Foth & Van Dyke

REPORT

Mining Permit Application for the Flambeau Project

Scope I.D.: 87K10

Volume I - Report Narrative

Flambeau Mining Company
Ladysmith, Wisconsin

Revised December 1989

EXHIBIT
11
Vol. 1 of 2

Kennecott Minerals Company
1515 Mineral Square
P.O. Box 11248
Salt Lake City, Utah 84147
Telephone (801) 322-8460
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December 29, 1989

Kennecott

87K102

Gordon H. Reinke, Chief
Mine Reclamation Section
Bureau of Solid Waste Management
Wisconsin Department of Natural Resources
101 S. Webster St., GEF II
P.O. Box 7921
Madison, WI 53707

Dear Mr. Reinke:

RE: Flambeau Project
Mining Permit Application

Flambeau Mining Company (Flambeau) a wholly owned subsidiary of Kennecott Corporation is pleased to provide the Wisconsin Department of Natural Resources (WDNR) with 45 copies of the revised report and appendices titled Mining Permit Application for the Flambeau Project prepared by Foth & Van Dyke and Associates Inc. and others. The application has been prepared in conformance with Wisconsin Administrative Codes NR 132 and pertinent sections of NR 182. A check in the amount of $19,000 to cover the estimated cost of evaluating the application has been previously submitted to the Department. The fee represents a total of those amounts specified in NR 132.06(3) (a) and NR 182.05(1), Table No. 1.

The application includes a mining plan; a reclamation plan; a proposed monitoring plan; and other key features as outlined in NR 132 and NR 182. Also included is NR 182 feasibility study and plan of operation information for the proposed storage piles and for backfilling the pit. Information relating to the environmental characterization of the site, project alternatives and potential project impacts are addressed in an Environmental Impact Report that has been previously forwarded to the WDNR. The Mining Permit Application has been revised to incorporate comments and requests for additional information from the Department, and the results of numerous meetings and discussions between the Department and Flambeau representatives since the original application was submitted in April of 1989.

Numerous additional permit applications have also been submitted to the WDNR in support of the development of the project. Information in these documents is frequently referenced in this application in order to avoid unnecessary duplication.

Flambeau is requesting that the WDNR review this application and the other permit applications in an expeditious manner such that permitting activities associated with the project can continue in a timely manner. In reviewing the document, please note that the title blocks for the figures have not been changed to reflect the name of Flambeau Mining Company. Since this document is filed by the Flambeau Mining Company, the fact that this change has not been made is immaterial.

As per an agreement developed with the WDNR, it is our understanding that the WDNR will distribute this application to all appropriate state and federal agencies. Flambeau will distribute the document to appropriate local public officials.

If you have any questions or comments as you review this applications, please contact us at your convenience.

Sincerely,

FLAMBEAU MINING COMPANY

Lawrence E. Mercando

Lawrence E. Mercando
Vice President

LEM:wjm

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MINING PERMIT APPLICATION
FOR THE
FLAMBEAU PROJECT

Prepared for:

FLAMBEAU MINING COMPANY

Prepared by:

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REVISED DECEMBER 1989

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1.0 INTRODUCTION

Flambeau Mining Company (Flambeau) a wholly owned subsidiary of Kennecott Corporation is proposing to develop a copper mine near Ladysmith, Wisconsin. As part of the development numerous federal, state and local environmental, construction, building and safety permits, and approvals will need to be obtained. One step in the permitting process is the issuance of a Mining Permit by the Wisconsin Department of Natural Resources (WDNR) under Wisconsin Administrative Code ch. NR 132. The Mining Permit will be applicable to the storage, handling, processing, transportation and disposal of materials resulting from the proposed mining operation.

In addition to the Mining Permit under NR 132, NR 182 requires that an operating license be obtained from the WDNR prior to the construction and operation of waste sites associated with a mine. Under NR 182.04(54) where a surface mine is backfilled with mining waste, the mine pit and land or appurtenances used for the storage of mining waste are considered a single site. Flambeau is proposing to backfill its surface mine and will be constructing two temporary storage areas for waste materials before they are returned to the open pit as part of project reclamation.

Although the backfilling of the proposed surface mine with mining waste is subject to the provisions of NR 182, certain exemptions apply. Chapters NR 182.08(2) and NR 182.09(1) provide that the Feasibility Study and Plan of Operation requirements of NR 182 may be satisfied by including the substantive requirements of NR 182 in the NR 132 Mining Permit Application.

This Mining Permit Application has been prepared to meet the requirements of both NR 132 and NR 182. Pursuant to NR 182.06(3), reference is also made to the Environmental Impact Report and other documents to avoid unnecessary duplication. A summary reference key for the NR 182 Feasibility Study and Plan of Operation is contained in Table Nos. 2-1 and 2-2.

This revised Mining Permit Application is organized into eleven sections. The first section is the introduction. The second contains the completed WDNR "Mining Permit Application" form. In addition, this section also includes or refers to the various attachments required on the application form. Section 3.0 addresses Flambeau's preferred method for providing financial responsibility. The fourth section contains detailed information concerning the design, construction and operation of the proposed facilities. Section 5.0 addresses the proposed reclamation procedures which involve backfilling the pit with excavated materials temporarily stored on site. Sections 6.0, 7.0, 8.0, 9.0, 10.0, and 11.0 address preliminary water budget, construction and operation phase monitoring, contingency plans, emergency notification procedures, long-term care and maintenance plans, and references, respectively.

Two scenarios exist as to how actual operation of the mine would take place. The first would involve owner operation and the second contractor operation. For either scenario Flambeau would remain as the owner, with the mine manager being a Flambeau employee. A final decision on the method of operation will be made prior to the commencement of construction.

Within this document there are references to the "project area" and the "mine site." These two terms have specific meanings, as follows:

- Project Area - This is defined as the area east of the Flambeau River, west of STH 27, north of the south line of Section 9, and south of Blackberry Lane. Also included is a typical 36-foot wide corridor east of STH 27 on which the railroad spur line is to be constructed.

- Mine Site - This is defined as an area within the project area which will be primarily enclosed by a security fence and encompasses the proposed open pit, major stockpile sites, plant area, and other ancillary surface facilities. Also included in the mine site are an approximate one acre area adjacent to the fenced area that is part of the project's wetland mitigation plan; a typically 36-foot wide corridor east of the security fence on which the railroad spur is to be constructed; and other miscellaneous peripheral features outside the security fence such as the temporary nursery, the access roads to the mine site, visitor observation platform and parking area, and outfalls from the wastewater treatment plant and settling ponds.

Figure No. 1-1 is a United States Geological Survey (USGS) topographic quadrangle map delineating the "project area". The "mine site area" is shown on Figure No. 1-2. The mine site area is approximately 181 acres in size.

Numerous documents and permit applications in addition to this revised "Mining Permit Application" have been prepared and submitted to the WDNR in support of the Flambeau Project permitting process. A list of these documents and permit applications is contained below.

- Environmental Impact Report

- Air Pollution Control Permit Application

- Revised Wisconsin Pollution Discharge Elimination System Permit Application

- Preliminary Engineering Report for Wastewater Treatment Facilities
- Final Engineering Report for Wastewater Treatment Facilities
- Revised Permit Applications pursuant to Wis. Stat. ch. 30
- Revised Groundwater Withdrawal Permit Application
- One Time Disposal Site Design Report/Operations Manual
- A Feasibility Report and Plan of Operation for mining waste storage and disposal facilities (the substance of these two documents has been incorporated into the Environmental Impact Report and the revised Mining Permit Application).

A conscientious attempt has been made during the preparation of these documents to avoid duplication. Therefore, this permit application refers to information provided in the above documents whenever appropriate.

Numerous parties have contributed to the preparation of the document. The firm of Pincock, Allen & Holt, Inc. Denver, Colorado completed design work for the open-pit and mine related facilities. The firm of Ford, Bacon and Davis Utah, Inc., formerly Ford, Bacon and Davis, Inc., Salt Lake City, Utah, completed design work for all surface facilities including the Type I and Type II stockpiles and wastewater treatment plant. Geotechnical and mining engineers from Flambeau's parent company (Kennecott Corporation) contributed to the design of mining and surface facilities. Foth & Van Dyke and Associates Inc., Green Bay, Wisconsin was responsible for assembling the application and completing the risk assessment and monitoring, contingency action, and long-term care and maintenance plans. Mr. Edwarde May of James Askew Associates, Inc. assisted in the exploration program, provided input into the geologic interpretation and assisted Foth & Van Dyke in assembling the application. A list of other contributors can be found at the front of the document.

2.0 COMPLETED APPLICATION FORM WITH ATTACHMENTS

A completed and signed mining permit application form for the Flambeau Project is located on the following two pages.

The various attachments or information that are requested on the application are addressed below. Also included on Table Nos. 2-1 and 2-2 are keys to the location of typical NR 182 Feasibility Study and Plan of Operation requirements. The key identifies pertinent sections of the administrative code and provides the document(s) and appropriate location(s) within the document(s) where the information can be found.

2.1 Legal Description (Item 7.)

The center of the Flambeau deposit is located 1.6 miles south of Ladysmith and 0.3 miles west of Highway 27 in the Town of Grant, Rusk County, Wisconsin.

The project area and the adjoining property is owned by Flambeau. The specific project area will be all that part of Section 9, Township 34 North, Range 6 West, Rusk County, Wisconsin, lying east of the Flambeau River and south of Blackberry Lane; and the area required for an approximate one-mile long railroad spur located in part of Section 10, Township 34 North, Range 6 West, Rusk County, Wisconsin, lying west of the mainline of the Wisconsin Central Ltd., as generally shown in Figure No. 1-1. A copy of the deed and legal description for property owned by Flambeau on which NR 182 facilities will be located are contained in Appendix A. The property in question is also insured by a title insurance policy issued to Flambeau's parent company.

Figure No. 1-2 illustrates the limits of the proposed mine site in relation to the site grid system. Since the site grid system is tied to the state plane coordinate system, the limits depicted on Figure No. 1-2 fix the location of the mine site.

2.2 Owner Information (Item 8.)

All the land within the project area is owned by Flambeau Mining Company. Specific Owner information such as corporate name and address is contained in Items 1 through 6 of the attached Mining Permit Application.

Flambeau Mining Company holds no prospecting permits or other mining permits in the State of Wisconsin.

2.3 Approvals and Exemption Requests (Item 9.)

The project site is located in Rusk County, with portions lying in either the Town of Grant or the City of Ladysmith. Flambeau, through its predecessor, has entered into a Local Agreement with

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
MINE RECLAMATION SECTION
BOX 7921
MADISON, WISCONSIN 53707

MINING PERMIT APPLICATION

(SECTIONS 144.80-144.94, WIS. STATS., AND CHAPTER NR 132, WIS. ADMIN. CODE)
FORM 2700-4 REV. 4-82

Instructions:
Please submit 25 copies of this application and other necessary documents in reproducible form to the above address. Assistance in completing this application and other associated work is available from the Mine Reclamation Section, Department of Natural Resources, Madison, Wisconsin.

SECTION A — GENERAL INFORMATION

1. Name of Applicant
FLAMBEAU MINING COMPANY

2. Street or Route
10 EAST SOUTH TEMPLE

City, State, Zip Code
SALT LAKE CITY, UT 84147

3. Applicant is (✓ one)
☐ Individual
☐ Sole Proprietorship
☐ Partnership
☒ Corporation
☐ Other (Explain)

4. Is Applicant a ☐ Division or ☒ Subsidiary of Another Corporation?
☒ Yes (If Yes, State Name and Address of Parent Corporation.)
☐ No

KENNECOTT CORPORATION
10 EAST SOUTH TEMPLE
SALT LAKE CITY, UT 84147

5. If Applicant is a Corporation, is it Incorporated Under Wisconsin Law?
☐ Yes ☒ No

6. If Applicant is Incorporated Outside Wisconsin, Does it Hold a Valid Certificate of Authority to do Business in Wisconsin Issued by the Secretary of State?
☒ Yes ☐ No

7. Attach a legal description of the mining site and delineate the area on a United States geological survey topographic quadrangle map(s). The map(s) shall be at a scale of 1:24,000 wherever available and at a scale of 1:62,500 elsewhere.
8. Attach a list of names and addresses of each owner of land within the mining site and each person known by the applicant to hold any option or lease on land within the mining site and all prospecting and mining permits in this state held by the applicant.
9. Provide evidence that the applicant has applied for necessary approvals and permits under all applicable zoning ordinances and that the applicant has applied for all necessary approvals, licenses or permits required by the Department.
10. Attach information as to whether the applicant, its parent, its principal shareholders, subsidiaries or affiliates in which it owns more than a 40% interest, has forfeited any mining bonds in other states within the past 20 years, and the dates and locations, if any.
11. Attach information relating to whether unsuitability may exist for surface mining to the extent not fully considered in s. 144.84, Wis. Stats.
12. Attach an itemized statement showing the estimation of the cost to the state of reclamation.
13. Attach descriptions of land contiguous to the proposed mining site which the applicant owns, leases or has an option to purchase or lease.
14. Attach information related to the minimization of disturbance to wetlands in accordance with Section NR 132.06(4), Wis. Admin. Code.
15. Attach a proposed monitoring and quality assurance plan consistent with the requirements of Chapters NR 132 and NR 182, Wis. Admin. Code, and s. 1.11, Wis. Stats.

The Department may require the submission of additional information if it feels that such information is necessary to complete the Mining Permit Application.

SECTION B — FINANCIAL RESPONSIBILITY

1. Attach one copy each of the applicant's and parent company's (where applicable) most recent annual report and most recent Form 10-K as filed with the Securities and Exchange Commission. If these are not available, attach a report of the applicant's current assets and liabilities and other necessary data to establish that the applicant is competent to conduct mining in a manner consistent with the requirements and purpose of ss. 144.80-144.94, Wis. Stats.
2. Attach an explanation and supporting documentation of how the applicant will comply with the financial responsibility provisions of Section NR 132.09, Wis. Admin. Code.

SECTION C — FEE

Enclose a fee of $10,000.00 to cover the estimated costs of evaluating the operator's mining permit application. Upon completion of its evaluation, the Department shall adjust this fee to reflect the actual cost of evaluation less any fees paid for the same services to satisfy other requirements.

SECTION D — MINING AND RECLAMATION PLANS

1. Attach a mining plan prepared in accordance with s. 144.85(3)(a), Wis. Stats, and Section NR 132.07, Wis. Admin. Code.
2. Attach a reclamation plan and timetable prepared in accordance with s. 144.834, Wis. Stats., and Section NR 132.08, Wis. Admin. Code.

SECTION E — CERTIFICATION

I hereby certify that the information contained in this application is true and correct to the best of my knowledge, and belief. I agree to furnish such further information as may be required by the Department of Natural Resources to complete this application.

Dated Green Bay (City) Wisconsin (State), this 29th day of December, 19 89.

Lawrence S. Mercando
(Signature of Responsible Official)

Vice President
(Title)

TABLE NO. 2-1

Key for NR 182 Feasibility Study
This Table is a Reference Guide and Not a Comprehensive Listing

Item	Location of Information
182.08(2)(a) General facility information	
- project title	MPA 2.0
- name, address, phone number of primary contact for departmental correspondence	MPA 2.0
- owner of proposed facility	MPA 2.2
- site location	MPA 2.1
- proposed licensed acreage	MPA 4.2, 4.7.3.2.8, 4.7.3.2.9
- proposed facility life and range of disposal capacity	MPA 5.0, 4.7.3.2.8, 4.7.3.2.9
- estimated waste type and quantities to be contained	MPA 5.0, 4.7.3.2.8, 4.7.3.2.9
(b) Waste characterization and analysis	EIR 3.5.6
2. Identification of waste characteristics	EIR 3.5.6.1
3. Testing	
a. classification of waste types, estimate of generation rates and volumes	EIR 3.5.6.1; 3.5.6.3.7; MPA 4.7.3.2.8, 4.7.3.2.9
b. Chemical, radiologic, and mineralogic analysis	EIR 3.5.6.3
c. Particle size analysis	EIR 3.5.6.2; 3.5.6.3.2, 3.5 App. N
d. Chemical and physical characteristic testing	EIR 3.5.6.3
1. Acid producing characteristics	EIR 3.5.6.3.2
2. Leaching potential	EIR 3.5.6.3.3
3. Evaluation of physical, radiologic, and chemical properties	
e. Description of testing and Chain-Of-Custody methods	EIR 3.5.6.2
f. Field testing program	NA
g. Discussion of alternative methods of disposal of waste materials	EIR 2.3.3, 2.4.2, 2.4.3, 4.4.1, 4.4.2, 4.4.3, MPA 5.7.4
4. Summary of waste characteristics relative to handling, storage, and disposal	EIR 3.5.6.4

TABLE NO. 2-1 (Cont.)

Item	Location of Information
5. Evaluation of waste characteristics and site and regional information to determine location, design, construction, operation, monitoring and long term care for each type of waste	EIR 3.5.6.4, MPA 4.7.3.2.8, 4.7.3.2.9, 4.7.3.3.11, 4.7.3.3.12, 7.0, 10.0
(c) Regional Information (five mile radius)	
1. Topography	EIR 3.5.2.1, 3.5.3.1
2. Hydrology	EIR 3.7.2 , 3.6.2
3. Geology	EIR 3.5.2.2, 3.5.2.3
4. Hydrogeology	EIR 3.6.2
5. Groundwater and surface water quality, and precipitation chemistry	EIR 3.6.2.6, 3.7.1.2, 3.7.3.5
6. Climatology	EIR 3.4
7. Identification of adjacent landowners	EIR 3.11.3.3
8. Zoning	EIR 3.11.2.3, 3.11.3
9. Present land uses	EIR 3.11.2, 3.11.3
10. Present or proposed access roads and weight restrictions	EIR 3.13.6.8, 4.3.11.5.9, MPA 4.7.4.1
11. Locational criteria	NA
12. Identification of aquatic and terrestrial ecosystems	EIR 3.8, 3.9
(d) Site Specific Information	
1. Existing conditions plan sheet	MPA Figure Nos. 2-2, 2-3 and 4-1
2. Boring locations	EIR 3.5.1.1
3. Boring logs	EIR 3.5 App. A-K
4. Soil testing	EIR 3.5.1.7, 3.5.3.2, 3.5.3.3
5. Hydraulic conductivity (in situ and laboratory)	EIR 3.5.3.3, 3.6.3.1.1
6. Water table observation wells	EIR 3.6.1, 3.6.3

TABLE NO. 2-1 (Cont.)

Item	Location of Information
7a. Geologic cross sections	EIR 3.5, Figure Nos. 3.5-3 to 3.5-9. 3.5-12 to 3.5-14, 3.5-22 to 3.5-24
b. Water table maps	EIR 3.6.3.2, Figure Nos. 3.6-4, 3.6-5
c. Groundwater flow nets	EIR 3.6.3.2, Figure Nos. 3.6-8, 3.6-9
8a. Environment characterization of potentially impacted ecosystems	EIR 3.8, 3.9, 4.3.6, 4.3.7
b. Baseline monitoring, physical-chemical and biological monitoring	EIR 3.4, 3.5, 3.6, 3.7, 3.8, 3.9
c. Land use map	EIR 3.11, Figure Nos. 3.11-3, 3.11-4, EIR 3.3, 3.8.6, 3.9.1.4
d. Baseline groundwater monitoring	EIR 3.6.1, 3.6.4
e. Table of water quality for potentially affected surface water	EIR 3.7.3.5, Table No. 3.7-6
f. Local climatological data	EIR 3.4
(e) Proposed Facility Design	
1. Existing conditions map with design features	MPA Figure Nos. 4-1, 4-10, 4-11, 4-17
2. Cross sections showing present topography, proposed Base grades, ginal grades, using geologic sections as a base	MPA Figure Nos. 4-14B, 4-20, 4-21, 5-2, 5-7, 5-8, EIR Figure Nos. 3.5-14 to 16D, 3.5-23 to 3.5-25
3. Preliminary earth work balance calculations	MPA 4.7.3.3.3, 4.7.4.1 to 4.7.4.4, 5.4
4. Proposed methods of leachate control	MPA 4.7.3.2,
5. Proposed operating procedures	MPA 4.7.2, 4.7.3.3, 4.7.4.1 to 4.7.4.5, 4.7.4.12, 4.8
6. Material balances	
a. At the end of a typical year of production	MPA 4.7.3.3

TABLE NO. 2-1 (Cont.)

Item	Location of Information
b. Before and after signficant change in operating practice	NA
c. At the end of operations	MPA 4.7.3.3
d. At the end of reclamation	MPA 5.4
7. Discussion of reasoning and logic behind design of major features of the site	MPA 4.7
8. Monitoring program	MPA 7.0
9. Groundwater Quality beyond outer perimeter of waste site	MPA 4.7.3.2.8, 5.7.1.1, 5.7.1.2
10. Site expansion report.	NA
(f) Water budget for dry, wet, and average conditions	MPA 6.0
(g) Aesthetics	MPA 4.7.2, EIR 4.3.10
(h) Dam safety factors (tailing pond embankments)	NA
(i) Contingency plan	MPA 8.0
(j) Closure and long-term care	MPA 10.0
(k) Alternative design, location, and operation submittal	EIR 2.4.2, 2.4.3, 4.4.1, 4.4.2, 4.4.3, 2.3.3, MPA 5.7.4
(l) Appendix	
1. Boring logs, soil tests, well construction data and water level measurements	EIR 3.5 Appendix A-K, EIR 3.5, 3.6
2. Methods and equations used in analysis	EIR/MPA Appendices
3. References	Sec. 6.0 EIR, Sec. 11.0 MPA

TABLE NO. 2-2

Key for NR 182 Plan of Operation
This Table is a Reference Guide and not a Comprehensive Listing

Item	Location of Information
182.09(2) Plans of Operations for Waste Sites	
(a) Engineering Plans	Plan Sheets
1. Title sheet	Full Size Plan Sheets
2. Existing site conditions plan sheet	MPA Figure Nos. 2-2, 2-3, 4-1
3. Base grade plan sheet	MPA Figure Nos. 4-11, 4-18, 4-24
4. Engineering modification plan sheet	MPA Figure Nos. 4-14B, 4-19, 4-22, 4-25, 4-26
5. Final site topography plan sheet (at closing)	MPA Figure No. 5-3
6. Series of phasing plan sheets	MPA Figure Nos. 4-14A, 4-17, 4-24, 4-27, 5-5, 5-6, 5-3
7. Site monitoring plan sheet	MPA Figure Nos. 7-1, 7-7
8. Long term care plans sheet	MPA Figure No. 10-1
10. Site cross sections perpendicular and parallel to site baseline at 500 feet spacings	MPA Figure Nos. 4-14B, 4-15, 4-20, 4-21, 5-2, 5-7, 5-8, EIR 3.5-14 to 3.5-16D, 3.5-23 to 25
11. Detailed drawings and typical sections	MPA Figure Nos. 4-8, 4-9, 4-13, 4-15 4-23, 4-38 to 40, 4-42, 4-43, 4-45 to 47, 4-49 to 62, 7-2 to 7-6, 10-2 to 10-5
(b) Operations Manual Information	
1. General	MPA 1.0, 2.0, 4.1 to 4.7, 5.7.2
2. Specifications for Site Construction and Operation	
a. Initial site preparations specifications	MPA 4.7
b. Certification plan for initial site preparations	MPA 4.7
c. Typical daily operation	MPA 4.7, 4.8, 5.7.2, 5.9, 5.10, 7.0, 8.0, 10.0
d. Development of subsequent phases	MPA 4.7, 4.8, 5.7.2, 5.10, 7.0, 8.0, 10.0
e. Site closing information	MPA 5.0, 10.0
f. Long-term care information	MPA 10.0
g. Economic analysis for closing, long term care	MPA 5.12, 10.2
(c) Design report	
1. Design discussion - reasoning and logic behind design of major features of site	MPA 4.7.1 to 4.7.3.2, 4.7.4, 5.5 to 5.7.1

TABLE NO. 2-2 (Cont.)

Item	Location of Information
2. Financial responsibility analysis for closure and long term care	MPA 3.0, 10.3
(d) Contingency plan for	
1a. Spill prevention, control and counter measures plan of clean water act	MPA 8.0
b. Monitoring programs	MPA 8.1 to 8.4
c. Provision for more monitoring	MPA 8.1 to 8.4
d. Accidential or emergency discharges and corrective actions	MPA 4.10
e. Identify time necessary for completion of identified actions.	MPA 4.10, 8.0 to 8.4
(e) Appendix - any additional data not previously presented	EIR/MPA Appendices

these three entities. Among other things, this Local Agreement provides that these entities will "take all action necessary to assure that the Applicant (Flambeau) is able to obtain all approvals, permits, licenses, and moratorium removals which may be necessary to assure that the mine can be constructed and is able to commence operations." (See paragraph 31 of the Local Agreement). A Conditional Use Permit was also issued for the mine. Copies of the Local Agreement and the Conditional Use Permit are attached hereto in Appendices B, C, and D. No other local approvals are required. Therefore, Flambeau has received all local approvals necessary under NR 132 and ch. 144 of the Wisconsin Statutes.

In addition, section 1.0 of this application contains a listing of other permits and approvals which Flambeau is seeking from the WDNR. No other permits, licenses or approvals are required from the WDNR.

Table No. 2-3 contains a list of exemptions that are being requested by Flambeau under sections NR 132.19 and NR 182.19 of the Wisconsin Administrative Code. A brief discussion justifying the need for each exemption follows. In reviewing the table and discussion, it should be noted that many of the features for which exemptions are sought are being constructed to enhance environmental protection.

<u>Location of Pit and Other Facilities Within 300 Feet of a Navigable Stream</u>

The proposed project plan includes facilities that are located or will be constructed within 300 feet of the Flambeau River and intermittent Stream C. These facilities generally include the open pit, fencing, a flood control dike, access roads and parking area, a slurry wall, power lines, two wastewater outfalls, a weir and riprapped reconstructed intermittent Stream B channel, a wetland with pond, surge pond, Type II stockpile and railroad spur line. An exemption for these facilities under NR 132.19 is justified because the nature and location of the deposit is fixed. As concluded in section 2.0 "Alternatives" in the Environmental Impact Report (EIR), surface mining is the most feasible and prudent means to recover the ore. In addition, design and construction activities have been planned to minimize any adverse environmental effects. For a further discussion of pit location and surface facilities and reclamation construction, the reader is referred to sections 4.7 and 5.0 of this report.

It should be noted that a determination of the navigability of intermittent Stream C has not yet been made in the area for which exemptions are requested due to the occurrence to two exceptionally dry springs. The above exemption request relating to facilities within 300 feet of this stream is made in the event it is determined at a later date that the stretch of the stream in question is navibable.

TABLE NO. 2-3

List of Requested Exemptions

Exemption Requested*	Code Reference
Locate pit and other facilities within 300 feet of a navigable river or stream	NR 132.18(1)(c)
Construct flood control dike and other structures in a floodplain	NR 132.18(1)(d)
Locate project facilities within 1,000 feet of the nearest edge of State Trunk Highway 27	NR 132.18(1)(e)
Locate project facilities within wetlands, except pursuant to NR 132.06(4)	NR 132.18(f)
Monitoring for certain baseline water quality parameters	NR 182.075(1)(d)5

* The Flambeau Project has been designed such that the selection of sites for project facilities will result in the least overall adverse environmental impact to wetlands as defined in NR 132.06(4). This conclusion is supported by the alternatives analysis and detailed wetlands assessment completed as part of the preparation of the project EIR. In the unlikely event it is determined at a later date that the project has not complied with the provisions of NR 132.06(4) an exemption is being requested.

Construction of Flood Control and Other Facilities in a Floodplain

A flood control dike will be constructed to prevent water from flowing into the pit in the event a 100-year flood occurs on the Flambeau River. This structure will be partially placed in the Flambeau River floodplain. As detailed in Appendix 3.7-A of the EIR, the portion of the floodplain affected by the dike is a "finger" of the floodplain, and is therefore considered to be a flood fringe. The storage capability of this flood fringe "finger" has been determined to be insignificant. Therefore, the dike will have no significant affect regarding floodwaters.

The flood control dike will be only four feet above the intermittent stream elevation and will tie into natural topography within 30 and 12 feet to the north and south, respectively. The dike will be topsoiled and seeded immediately after construction to promote stabilization and vegetative growth. The slurry wall will be buried and, other than during the period of construction, will not be visible. Construction will be done in such a way to minimize disturbance to the surrounding landscape. The construction area will also be restored and vegetated immediately after installation activities are completed. The pit itself will be located below ground and, except for a short period of time during preproduction stripping and at the close of reclamation, mining equipment will not be operating near the ground surface.

In addition to the flood control dike, two outfall structures and their associated pipelines and drainage channels will be located in the floodplain and within 300 feet of the Flambeau River, since there is no practical alternative to these features. Additionally, the railroad spur line, the access road, and a small portion of the Type II stockpile and surge pond will be located in the floodplain of intermittent Stream C. The features will not materially affect navigation and will not be detrimental to the public interest. A separate permit under Wis. Stat. ch. 30 and ch. 147 addressing these features has been submitted to the WDNR.

Structures Near STH 27

A number of physical facilities associated with the project are proposed to be located within 1,000 feet of the nearest edge of the right-of-way of State Trunk Highway (STH) 27. These facilities, as shown on Figure No. 2-1, consist of the topsoil stockpile; the visitor's access driveway and parking area; the septic drain field; the laboratory; the administration building and parking area; the surge pond; the site access road; the potable well; parts of the site security fence, Type I and II stockpiles, open pit, ore haul road, railroad spur line site drainage system, and appurtenances. Also included within the 1,000-foot area, but not shown or called out on Figure No. 2-1, are the wetland test plot and temporary nursery. The placement of these facilities as proposed is justified for the following reasons.

The relative location of the open pit and STH 27 are fixed by the easterly extent of the deposit. In planning the project, every attempt was made to locate project facilities in as compact an area as possible to minimize the size of the project area and to minimize the impact on wetlands and the environment.

Alternative locations as shown for siting project facilities were evaluated in sections 2.0 and 4.0 of the project EIR. The proposed locations as shown on Figure No. 2-1 were determined to be the best when all factors were considered as described in sections 2.0 and 4.0 of the EIR. In addition, the mine plan includes provisions for the use of natural screening and the installation of new plantings to make the area as aesthetically pleasing and as inconspicuous as is feasible. Figure No. 2-2 shows site topography and existing site conditions. Figure No. 2-3 illustrates site topography, existing conditions and boring and well locations.

Other Exemptions

In its November 1, 1989 letter proposing compliance boundaries, the WDNR suggested that Flambeau request an exemption for NR 182.075(1)(d)5 for monitoring certain parameters to determine baseline water quality. The parameters involved the primary organic, turbidity and radioactivity MCL's. Flambeau does not believe such an exemption is necessary because, among other things, it was not appropriate to monitor these parameters and the WDNR itself agreed that there was no need to monitor them.

It must be noted that the fact these parameters would not be monitored in the baseline sampling program was clearly indicated in the October 1987 Scope of Study - Kennecott Flambeau Project (SOS) document. A list of Primary and Secondary Drinking Water parameters not to be included in the baseline monitoring program is included on page 26 of the SOS. The rationale presented was: "These parameters are not commonly related to mining operations. Also, they are not routinely required parameters for groundwater monitoring at other types of waste sites in Wisconsin." The subject of monitoring was reviewed by the public -- including the holding of a public hearing in the City of Ladysmith. The final monitoring program was approved by the WDNR after taking all public comment into account. Nonetheless, because of the WDNR's suggestion, Flambeau hereby requests an exemption for NR 182.075(1)(d)5. If an exemption is in fact necessary, it should be provided. Information supporting the exemption request follows.

Organic compounds were not tested because there is no reason to believe, based on past land use, that any organic contamination is present on the site. Furthermore, there is no reason to believe that the mining operation will lead to any organics contamination. Therefore, there was no need to characterize the background groundwater quality with respect to organics.

Turbidity was not monitored because it is a meaningless parameter with respect to groundwater. Groundwater, unlike surface water, has no inherent turbidity. The velocities at which groundwater moves are too slow to provide the energy needed to keep small particles in suspension. Any turbidity which shows up on groundwater samples is an artifact of the well development process, and has nothing to do with turbidity in the groundwater itself. Therefore, turbidity is never tested in programs that are aimed at characterizing groundwater quality.

Radioactive compounds (radium, gross alpha, gross beta) were not tested because there is no historical evidence of radioactivity quality problems, either in the groundwater at the site specifically, or in the Ladysmith area groundwater in general. More importantly, no mining activity will take place which would conceivably cause radioactive contamination of groundwater to occur. Therefore, there was no need to characterize the background groundwater with respective to radioactivity. It should be noted that due to stated concerns from local residents, several rounds of samples were analyzed for uranium, as a metal. The results confirmed previous studies which showed that there was no evidence of uranium above normal background levels.

2.4 Information Pertaining to Mining Bonds in Other States (Item 10.)

Appendix E contains a letter from Robert B. Kennedy, Director of Treasurey Services, Kennecott Corporation, stipulating that neither Flambeau, its parent, its principal shareholder nor subsidiaries in which it owns more than 40 percent interest, have forfeited any mining bonds in other states within the past 20 years. Flambeau has no ownership interest in any affiliates.

2.5 Surface Mining Suitability (Item 11.)

The proposed Flambeau Project is suitable for surface mining because the surface mining activity will not, per NR 132.03(25) destroy or irreparably damage:

a) Habitat required for the survival of species of vegetation or wildlife as designated in NR 27, when such endangered species cannot be firmly re-established elsewhere.

b) Unique features of land as listed in NR 132.03(25)(b) which cannot have their unique characteristic preserved by relocation or replacement elsewhere.

The project area contains no endangered species or unique land features.

2.6 Reclamation Costs (Item 12.)

An itemization of the estimated cost of site reclamation is included in section 5.12 of this application.

2.7 Description of Contiguous Land (Item 13.)

Figure No. 2-4 shows the location of land contiguous to the proposed mining site, which is owned by Flambeau. A legal description of the land owned by Flambeau is contained in Appendix A. The location of existing zoning districts within and in the vicinity of the project area are shown on Figure No. 2-5. Project area land use is shown on Figure No. 2-6. A detailed discussion of land use and zoning, relating to the project area and surrounding land, can be found in section 3.11 of the EIR.

2.8 Minimization of Disturbance to Wetlands (Item 14.)

Mining activities for the Flambeau Project have been carefully planned and designed to result in the least overall adverse environmental impact as described in section 2.0 of the EIR. In this process, wetlands of the study area were given high priority and, as discussed in detail in section 4.0 of the Wetland Inventory and Assessment (Appendix 3.8-C of the EIR), the project was designed and will be operated to assure that adverse effects on wetlands will be minimized.

2.9 Monitoring and Quality Assurance Plan (Item 15.)

Monitoring for the Flambeau project as presented in this report is to consist of three elements.

The first element involves monitoring during the construction and operation phase of the project. The operation phase of the project is deemed to be complete at the time that work related to the initial revegetation is complete. This point in time is equivalent to the completion of site closure for typical NR 182 or NR 500 facilities. This monitoring element is discussed in section 7.0 of this report.

The second element involves monitoring associated with the determination of the success of reclamation. The third and final element involves post construction and operation monitoring. A discussion of the provisions of the second and third monitoring elements is presented in sections 5.0 and 10.0 of this report, respectively.

The proposed monitoring plans for the project have been prepared in accordance with Wisconsin Administrative Code, chapters NR 132 and NR 182. The methods of ground or surface water sample collection, preservation and analysis will be in accordance with the Methods for Chemical Analysis of Water and Wastewater, USEPA 1983 and with WDNR PUBL WR-153-87, Groundwater Sampling Procedures Guidelines. In accordance with NR 182.135, applicable laboratory test results submitted to the WDNR for this project shall be performed by a laboratory certified or registered under Ch. NR 149.

Following the receipt of necessary project permits, Flambeau will select a contractor(s) to conduct monitoring in accordance with the approved monitoring plan. This contractor(s) will assist Flambeau in the development of an updated laboratory quality assurance plan for the project. This updated plan will be forwarded to the WDNR prior to commencement of on-site construction activities. On-site monitoring activities conducted between the time this application is submitted and the submission of the updated laboratory quality assurance plan will be accomplished using quality assurance procedures outlined in the October 1987 Scope of Study which have been previously accepted by the WDNR.

3.0 FINANCIAL RESPONSIBILITY

Appendix F contains financial information which establishes that the applicant is competent to conduct mining in a manner consistent with the requirements and purposes of Wis. Stats. ss. 144.80 - 144.94.

Financial responsibility for reclamation activities will be provided through a bond as per applicable provisions of Wis. Admin. Code NR 132.09. The net worth test will be used to establish financial responsibility with respect to long-term care (Wis. Admin. Codes, NR 182.17(2)(f)).

4.0 MINING PLAN

4.1 Introduction

The following Mining Plan is a detailed description of the design, construction, and operation of the Flambeau Mine. The plan consists of several major sections, including General Description of the Proposed Action (4.6), Facility Information (4.7), Erosion Control (4.8), Environmental Protection (4.9), Risk Assessment (4.10), and a Preblast Survey Plan (4.11).

The Facility Information section (4.7) is where most of the project data is presented. This section has been subdivided into three parts to facilitate description of the project's key design features, construction, and operation. The key design subsection, 4.7.3.2, discusses design features of the major project components consisting of the open pit, haul road, crusher, ore stockpile, topsoil, Type I stockpile and settling pond, and the Type II stockpile. The construction and operation of these major project components are described in subsection 4.7.3.3. Finally, subsection 4.7.4 discusses the design, construction, and operations of the various ancillary facilities. The site plot plan which is shown in Figure No. 4-1 illustrates the general arrangement of the project components.

Duplication has been avoided whenever possible by referencing various other permits and plans that have been submitted to the WDNR under separate cover. For example, the discussion of Regional and Local Setting (4.3); the General Description of Geological/Geotechnical Investigations, Project Area Geology, and Waste Materials Characterization Studies (4.4), and Overview of Environmental Setting (4.5) are cross referenced to pertinent EIR sections. In a similar fashion, the description of the wastewater treatment plant is referenced to the Flambeau Project Final Engineering Report (FER) for Wastewater Treatment Facilities (December 1989).

4.2 General Project Overview

The Flambeau copper deposit was discovered using airborne geophysical techniques in 1968. The size and quality of the narrow, steeply dipping tabular-shaped sulfide deposit was determined by over 100 core holes drilled from the surface. The upper enriched portion of the deposit will be mined from a small open pit using conventional truck and shovel equipment. The 32-acre open pit will be approximately 550 feet wide, 2,600 feet long and 225 feet deep. Ore will be produced at a rate of approximately 320,000 tons per year.

Major components of the project, other than the open pit, are: waste rock, overburden, topsoil and ore stockpiles; a crusher; wastewater treatment plant; railroad spur; and various auxiliary support buildings. Ore produced at a rate of approximately

1,300 tons per day will be crushed and shipped via rail to an existing out-of-state processing plant. Overburden and waste rock containing less than one percent sulfur will be stored on an unlined 40-acre, 60-foot high Type I stockpile north of the pit because waste characterization studies indicate that the area does not need to be lined (EIR 3.5.6). Waste rock containing greater than one percent sulfur will be stored on a lined 27-acre, 70-foot high stockpile located south of the open pit. Runoff water from this area and open pit inflow water which comes into contact with Type II material will be treated in a wastewater treatment plant which is located south of the Type II stockpile. This plant has been designed to handle a maximum of 800 gallons per minute of wastewater, with the open pit serving as a major storm emergency sump. A total of approximately 181 acres will be physically disturbed by the project.

Most of the mining will take place over an approximate six-year period, with an additional one year for construction, and one to two years for reclamation. Approximately 55 to 61 persons will be employed during the operating phase of the project. Seventy-five percent of these employees will reside in or within ten miles of the Rusk County border.

Reclamation of the project area will return the site to a use compatible with the surrounding land use. The final use as called for by the reclamation plan will result in a non-consumptive, passive recreational area which provides wildlife habitat. This means backfilling, grading, and vegetating of the open pit site will be undertaken after mining has been completed.

4.3 Regional and Local Setting

The Regional and Local Setting is described in detail in section 3.2 of the EIR.

4.4 Geological/Geotechnical and Waste Materials Characterization Investigations

A comprehensive discussion of completed geological and geotechnical investigations and their results is presented in section 3.5 of the EIR. The section discusses field and laboratory methods, regional geology, geology of the project area, seismology, and waste characterization.

Geologic and geotechnical investigations planned to be performed during mining operations will consist of detailed geologic mapping of the open pit, geotechnical investigations of the river pillar and drilling for grade control. Details regarding these two programs are presented in section 4.7.3.3.6 of this application.

4.5 Overview of Environmental Setting

The overview of the Environmental Setting has been discussed in detail in section 3.0 of the EIR. Within this section the reader will find Regional and Local Setting (3.2), Historical and Archaeological Studies (3.3), Climate, Meteorology and Air Quality (3.4), Geology (3.5), Groundwater (3.6), Surface Water and Bottom Sediments of the Flambeau River (3.7), Aquatic Biology (3.8), Terrestrial Biology (3.9), Ambient Noise (3.10), Land Use (3.11), Aesthetics (3.12) and Socioeconomics (3.13).

4.6 General Description of the Proposed Action

4.6.1 General Project Overview

This section deals predominantly with project location, land ownership, scheduling, and general project facilities.

4.6.2 Location

The project area is shown on Figure No. 4-2. A description of the project area is discussed in section 2.1 above.

The proposed project area can be reached by traveling south on STH 27 from its junction with U.S. Highway 8 (USH 8), in the City of Ladysmith, a distance of 1.6 miles. Ladysmith, the county seat of Rusk County, is located in northwestern Wisconsin.

The Flambeau deposit lies in a northeast direction and will be mined from a small open pit aligned parallel to the long axis of the deposit. The west edge of the open pit is approximately 140 feet from the east bank of the Flambeau River and the east edge is approximately 600 feet west of STH 27.

4.6.3 Land Ownership and Use

Flambeau owns over 2,500 acres in the Town of Grant including most of the land in Section 9. The Flambeau deposit is located within this section. The approximately 181-acre mine site is owned by Flambeau including both the surface and mineral rights. The same is true in Section 10 between STH 27 and the mainline track where a railroad spur will connect with the Wisconsin Central Ltd. main railroad line. Figure 4-3 shows property ownership within and surrounding Section 9.

Natural land buffer zones north and west of the project area include the Flambeau River and adjoining vegetation. Other existing buffers to the east include the City of Ladysmith Industrial Park and a forested area east of STH 27. In addition, a large forested area immediately south of the project area also acts as a buffer zone.

The largest land use category of the project area is upland mixed forest, which accounts for 90 acres (30 percent). Pasture/old fields is the second-largest land use category, accounting for 82 acres (27 percent) of the project area. Only 44 acres (15 percent) of the project area is considered developed. Other miscellaneous uses make up the remainder of the project area.

The entire project area is zoned I-1 Industrial. For a further discussion of Land Use and Zoning, the reader is referred to EIR section 3.11 and section 2.7 of this report.

4.6.4 Project Schedule

Commencement of the proposed operation is wholly dependent upon the receipt of necessary federal and state approvals and permits. The proposed schedule projects that the mine permit approvals will be granted in late summer 1990. Engineering will then commence thereafter with construction commencing in April of 1991. A simplified construction schedule is shown on Figure No. 4-4. A more detailed schedule is shown in Figure No. 4-5.

The approximate six-month construction period will take the project into the fourth quarter of 1991. During the last four-months of construction the first phase of the open pit will be stripped and made ready for full production. A small amount of ore will be produced during this preproduction period. This ore will be left in the pit until the crusher and loadout facilities are ready for production.

Mining operations are scheduled to take place in two phases over approximately six years ending in late 1996 or early 1997.

In the first phase of the mine operation, the southwest end of the pit will be developed. The northeast end of the pit will be developed during the second phase of the mining operation. Immediately thereafter, backfilling of the pit and other reclamation activities will occur for approximately 19 months. Therefore, by the middle of 1999, upon completion of site grading and revegetation, activity at the project site will cease.

4.6.5 Project Facilities

Project facilities will consist of five major components plus ancillary facilities. The major components are the open pit, haul road, crusher, Type I stockpile, and Type II stockpile. Each of these facilities are briefly described below and in more detail in section 4.7 of this report. Table No. 4-1 contains a listing of project facilities and the respective acreage they occupy.

TABLE NO. 4-1

Acreage of Facilities
Within The Mine Site

Facility	Acres
Open Pit	32
Type I Stockpile (60 ft. high)	40
Type II Stockpile (70 ft. high)	27
Plant Area	8
Crusher Plus Loadout	3
Haul, Service, and Access Roads	9
Settling Ponds	6
Topsoil Stockpile	8
Railroad Spur Within Fenced Area	2
Wetland Test Plot	1
Railroad Spur East of Fenced Area	4
Observation Point, Parking and Mine Site Access	1.5
Topsoil Stockpile (Hydric Soils)	1
Miscellaneous Outfalls	0.5
Temporary Nursery	3
Other	35
Total Mine Site Area	181

The 32-acre open pit is approximately 2,600 feet long, 550 feet wide, and will be excavated to a maximum depth of 225 feet. Bench heights will be a maximum of 20 feet during mining, but will be left at 60-foot vertical intervals in the final pit wall. Using a 69-degree face angle in conjunction with a 50-degree interramp slope will allow for a 27-foot wide catch bench at the base of the 60-foot vertical benches. A much shallower 36-degree slope will be used in the unconsolidated overburden and poorly cemented sandstone. Sumps at the bottom of the open pit will collect and direct inflow water to the wastewater treatment plant.

A 60-foot wide haul road will exit the northeast corner of the open pit at a maximum grade of ten percent. This design width allows for safe passage of 35- and 50-ton trucks while passing in and out of the open pit. A three-foot high safety berm will be constructed on the outside of the haul road. Throughout its operation, the haul road will be sprayed with water to suppress fugitive dust on an as-needed basis.

A crusher will be installed south of the open pit and west of the Type II stockpile. The crusher with grizzly, rock breaker, and feed conveyor will reduce the ore to minus 12 inches in size. This fine ore will be belt stacked to a pile of approximate 6,000-ton capacity. From this ore stockpile, a front end loader will load 100-ton railroad cars. The crusher, loadout area, runoff pond, and surge pond will be lined.

There will be sufficient area above the crusher to allow for storage of coarse ore from the open pit and also allow for unobstructed operating area for the haulage trucks.

An approximate 40-acre unlined overburden and Type I waste rock stockpile will be located immediately north of the open pit. Eventually this stockpile will reach a nominal height of 60 feet. The outside faces of the stockpile will be at the angle of repose of the dumped materials or about 35 degrees. Surrounding the stockpile will be a small berm designed to collect and direct runoff from the stockpile to the settling ponds. Some site clearing and grubbing will be required prior to placement of the Type I overburden and waste rock. The total proposed capacity of the Type I stockpile will be approximately 2,790,000 cubic yards of material. Incorporated into the design of this stockpile will be the settling ponds.

South of the open pit will be the approximately 27-acre Type II lined stockpile. This stockpile, because it is confined by wetlands, STH 27, plant facilities, and the open pit, will reach a height of 70 feet. A total of approximately 2,185,000 cubic yards of Type II rock and material will be stored at this site. A 60-mil HDPE liner will collect precipitation at the bottom of the stockpile and direct it to a system of drain pipes for transport to the wastewater treatment plant.

Surrounding the Type II stockpile will be a 20-foot top width berm with a maintenance access road. Precipitation falling on the Type II stockpile will be collected and directed to the wastewater treatment plant. The outside of the berms of stockpiles I and II will be vegetated.

Ancillary facilities will consist of the wastewater treatment plant, maintenance shop, fuel tank area, administration building, septic or holding tank drain field, an eight-acre topsoil stockpile, nine acres of haul and access roads, and a two-track railroad spur located south of the crusher, ore loadout, and Type II stockpile areas. Approximately 171 acres of the mine site area will be enclosed in a security fence. The only facilities outside the fence will be outfalls, access roads and parking areas, the railroad spur, the temporary nursery and the hydric soil stockpile.

4.6.6 Requirements for Governmental Services

The only governmental services required by the Flambeau Project will be fire protection and emergency medical services from the City of Ladysmith. Some assistance may be required from time to time from the police or sheriff's department, otherwise the project will essentially be self sufficient. As described in the Socioeconomic section of the EIR (3.13), the local infrastructure is more than adequate for this project.

4.6.7 Reclamation Plan

The open pit will be reclaimed from materials that have been temporarily stockpiled on the surface during the six-year life of the mining operation and from minor amounts of imported construction material. During the actual backfilling operation, the Type II waste materials will be initially placed into the open pit and sloped to accumulate pit inflow water. Sump pumps will collect this water for surface treatment prior to discharge. Type I rock followed by a saprolite material will then be placed into the pit. Placement of sandstone, overburden, and topsoil in that order will complete the backfilling operation, followed by revegetation and stabilization of the site soils. A detailed description of the reclamation plan can be found in section 5.0 of this report.

A long-term care and maintenance plan will be implemented following site closure. This plan can be found in section 10.0 of this report.

4.7 Facility Information

4.7.1 Introduction

Section 4.7 of this report describes in detail the various facilities that make up the Flambeau Project. In particular, this section focuses on key design parameters pertinent to the final facility arrangement for the open pit, haul road, crusher plant, Type I and Type II stockpiles. These key design parameters are presented in subsection 4.7.3.2. An operations manual for the Type I and II stockpiles is incorporated in subsection 4.7.3.3.

Finally, the key design criteria, construction, and operating procedures for ancillary facilities are discussed together under subsection 4.7.4.

4.7.2 Aesthetics and Landscaping

During planning of the project area, considerations were given to achieving the aesthetic standards described in NR 132.17 and 132.18(1)(e). The project area contains most of the visual attributes that are common to the northern Wisconsin landscape. The project facilities will impact the aesthetic character of the project site to a limited degree. Visually, the most prominent features of the project area will be the stockpiles, which would be visible only from late stages of mining just prior to reclamation. The impact of the stockpiles will be temporary since the stockpiled material will be removed and used for reclamation of the pit at the end of the mining operation.

Landscaping of the project area with trees, shrubs and grasses will moderate the appearance of the facility site area and buildings. Areas already screened by natural or planted trees will be fenced to protect the areas during construction. In the 1970s, approximately 5,000 pine trees were planted by Flambeau's predecessor. These trees have grown to a height of over 15 feet and selected trees will be moved by a mechanical tree spade and replanted in areas designated for screening.

An approximate 150-foot wide strip of land west of STH 27 will not be impacted by the mining operation other than existing or proposed road and railroad spur access. This corridor will be planted with trees taken from the mine site to serve as a visual screen. Most of these trees will be removed from the active mine construction areas. Other trees will be placed into temporary nursery along the south side of Blackberry Lane and other suitable project site areas.

4.7.3 Open Pit, Haul Road, Crusher and Stockpiles

4.7.3.1 Introduction

Open pit mining will be conducted using standard shovel and truck mining methods, consisting of drilling, blasting, ripping, loading and hauling in order to extract the enriched portion of the deposit. The pit bottoms at the 900-foot elevation above sea level, for a maximum depth of 225 feet. Waste materials will be hauled to surface stockpiles for storage and eventual sequential return to the pit as backfill. For surface storage, waste materials will be classified, by sulfur content, into two categories. Material containing one percent or more sulfur will be deposited in the Type II stockpile, which is a lined storage site. Material containing less than one percent sulfur will be transported to the unlined Type I stockpile. Ore grade material will be hauled to a small crushing facility, crushed to minus 12-inch size, and loaded into rail cars for shipment.

One of several keys to successful mining is to minimize dilution of ore with subeconomic waste material. Achieving this objective requires the use of selective mining methods, and relatively small size mining equipment. In addition, most of the mining will be carried out in daylight hours which permits some visual ore control.

The production schedule is based on rail shipping of approximately 320,000 dry short tons per year of crushed ore to a processing facility located outside of the State of Wisconsin. Mining will normally take place five days per week (250 days per year) requiring an average daily ore mining rate of approximately 1,300 tons. Total average amount of material moved per day, including ore, will be about 6,000 tons.

4.7.3.2 Key Design Features

4.7.3.2.1 Open Pit

Open Pit Design Objectives

The Flambeau open pit has been designed to meet the following objectives:

- Comply with all applicable regulations.
- Minimize size of the open pit.
- Expose and maintain a continuous ore supply without stripping peaks, which would result in costly short-term increases in equipment and manpower requirements.
- Provide at least two ore faces to meet metallurgical blending requirements.
- Maintain efficient access to working benches.
- Conduct the mining operation in a safe and sound manner so that no unacceptable impacts to project site neighbors occur.

A discussion of the key design features for the open pit that will allow the above objectives to be met follows.

Distance to Flambeau River

Minimum separation distance for the west wall of the pit from the Flambeau River is governed by State regulations. The current pit design requires an exemption from NR 132.18(1)(c) since the proposed minimum separation distance of 140 feet is less than the state setback of 300 feet.

The decision to advance the west wall to a distance of 140 feet from the river was based on information that:

1. Grade of copper mineralization improves dramatically west towards the river but drops significantly before reaching the river.

2. Rock conditions within the river pillar area are geotechnically suitable for safe mine operations.

3. Deposit widths are widest on the west end of the deposit but narrow considerably within the pillar before reaching the river.

Pit Wall Stability and Slope Angle Selection

Pit slope angles are a function of rock strength, geologic structure, groundwater conditions, wall height, wall orientation, mining practice and time. Slope engineering studies were performed to achieve optimum development of the Flambeau deposit. Oriented core holes were drilled and logged in detail. Rock structure and strength were investigated along with groundwater conditions and overburden material properties. Bench, interramp and overall slope stability analyses were performed. Favorable rock structure coupled with acceptable rock and overburden material strengths allowed for relatively steep slopes for the shallow Flambeau open pit.

Slopes used in the current pit design include 36 degrees for the glacial till and poorly consolidated material above bedrock. Near the bedrock contact, a ten-foot horizontal bench will be maintained. Below the bedrock surface, a 50-degree interramp slope will be used in intervals above and below ramps.

Bench Widths

Bench configuration is a function of bench height, width, and face angle. The bench height is primarily a function of mining equipment size. The bench width is a function of bench height and safety considerations. Finally, the bench face angle is controlled by the orientation of the geologic structures and by excavation methods, particularly blasting.

For safety considerations, horizontal catch benches will be left at 60-foot vertical intervals on the final pit walls below the bedrock contact. Using a 69-degree face angle in conjunction with the 50-degree interramp slope allows a 27-foot wide catch bench at the 60-foot vertical intervals. The catch benches will include safety berms to control rockfall. The safety berms will be five feet high, 13 feet wide at the base and have slopes of 1.3:1. In order to achieve this geometry, the mining benches (20-foot height in waste) must be combined (triple benching) at the 69-degree face angle, which is an accepted mining practice. These design criteria are illustrated on Figure No. 4-6.

Access Parameters

The geometry of the deposit dictates the location of the access ramp system. A dropcut will be driven in waste on the hanging wall side of the ore zone and waste mining will progress southeast toward the ore. On reaching the ore hanging wall, waste will be carefully peeled off to minimize dilution. Waste mining will then progress to the northeast and/or southwest direction, leaving a clean ore face behind. After ore excavation, the footwall waste will be mined to design limits. For this operating sequence to be effective, the access ramp must be located on the hanging wall (northwest) side of the pit.

The ramp system has a design width of 60 feet. This design width includes eight feet along the outside edge for a three-foot high safety berm, a seven-foot wide ditch along the inside of the ramp, and a 45-foot wide running surface. A ten percent ramp gradient will be used and will be easily negotiated by the small mechanical drive trucks.

By definition, the ramp is located behind the 50-degree interramp slope. When the ramp intercepts a catch bench, the apparent ramp width is the design width of 60 feet plus the catch bench width of 27 feet. In order to provide dozer access to the catch benches, the pit walls have been pushed out slightly in areas where the catch benches and ramp intersect, resulting in an apparent ramp width, at the catch bench elevations, of nearly 115 feet. Although requiring additional waste stripping, this is a deliberate safety feature and will allow the catch benches to be cleaned with a dozer on a routine basis.

Water Control

During excavation of overburden and mining of waste rock and ore, it will be necessary to manage water entering the open pit. Runoff from direct precipitation will originate from a small drainage area located between the pit and the Type II stockpile and from the ore haul road. During excavation of overburden in both Phases I and II , this water will be collected in sumps and pumped to the Type I stockpile settling ponds. Once stripping has been completed and mining of ore and waste rock commences, this water will be pumped to the wastewater treatment plant. A description of the water sources and estimates of the volumes that will be generated from precipitation and runoff are contained in the FER.

Groundwater modeling was completed for the project to estimate pit inflows. The work was summarized in a report titled *Groundwater Model for the Kennecott Flambeau Project,* by Thomas A. Prickett & Associates, Inc., *et al.* July 1989. The report concluded that the maximum "best engineering judgement" inflow is estimated to be 296 gpm, and will occur during the very early stages of overburden excavation, well before mining of waste rock and ore commences. The estimated maximum inflow will occur as water from storage is depleted. Once the maximum rate is reached, inflow will decrease until steady state conditions are reached at the end of mining activities. The modeling report estimates that the "best engineering judgement" steady state average annual inflow will be 113 gpm at the end of mining. Both the maximum and steady state inflow rates assume that the planned slurry wall as discussed below is constructed.

It is estimated that without the planned slurry wall which will be located between the river and the northwest corner of the pit an additional 71 gpm of water would seep into the pit due to a permeable zone of sand and gravel located in this area (Appendix 4.3-A of the EIR). To minimize the contribution of this source to the inflow rate, an approximate 400-foot long slurry wall will be constructed to cut off this source. The location of the slurry wall is shown on Figure No. 4-7.

The slurry wall will be four feet wide and extend from the ground surface down to the top of the Precambrian bedrock as shown on Figure No. 4-8. The depth of the slurry wall will range from 12 to 46 feet depending upon the surface of the Precambrian bedrock. A simple system of grading and ditching within the pit to a series of sumps will act to capture and control the expected inflow. A detail of the planned sump arrangement is shown on Figure No. 4-9.

Detailed geologic and geotechnical mapping will be routinely conducted during mining and any areas of significant water inflow will be identified and flow rates monitored. In the unlikely event that flow rates do not show the expected rapid decrease as the cone of depression is developed, then one of several possible control measures will be employed. Such measures generally incorporate dewatering wells, horizontal drains and possible grouting from drill holes.

In order to verify the wall stability in the vicinity of the river pillar, mining of the last 100 to 200 horizontal feet of the west end of any given bench will be deferred for a short time. It is anticipated that this last increment of a bench can be deferred for one to two months without unduly hindering mine development. This time frame is adequate to map in detail the mined-out benches in the river pillar area for geotechnical and hydrologic investigations and evaluation of this data. These efforts will be undertaken as a fail-safe measure to assure predicted stability is attained. Mining will only be continued provided the conclusions from these investigations confirm that the river pillar structure provides a safe operation. Blasting in this area will be specifically designed at each stage based on results of investigations.

Slurry Wall

A four-foot wide slurry wall has been designed to impede the flow of groundwater from the Flambeau River east into the open pit. It is expected that most of this flow would be restricted to a narrow zone immediately above bedrock located approximately 12 to 16 feet below the surface and from a buried stream channel located in the northwest corner of the open pit. The slurry wall will reach its greatest depth of about 46 feet when crossing this channel.

Flood Control Dike

A flood control dike is required to prevent a 100-year flood from backing up in the Flambeau River Valley and overflowing into the pit. The lowest point between the open pit and the river valley is the intermittent Stream B channel. The flood control dike has been designed to block this channel and to act as an accessway around the west end of the open pit.

Blasting Program

The available data suggests that the upper approximately ten to 60 feet of the Precambrian bedrock will be saprolite which should be easily ripped using a dozer. The upper portion of the Type I & II waste rock and some portions of ore could also likely be ripped rather than drilled and blasted.

Due to the small scale of operations and the necessity for selective mining to minimize ore dilution, ore blasts will be relatively small. It is anticipated that blasting will occur three times per week, on the average. When working within the ore, one ore blast per week should suffice. Where the ore is interfingered with waste zones, blasts must be smaller in order to minimize dilution, and, consequently, more frequent shots may be necessary. In areas of waste rock away from the ore zone, a single blast is possible to provide broken material for one week's mining. Ore and waste blasting will be done concurrently to minimize disruptions to production scheduling. Blasting will be scheduled during day light hours only.

The Wisconsin Department of Industry, Labor and Human Relations establishes uniform limits on permissible levels of blasting resultants (noise, vibration, and flyrock) in ILHR 7. These provisions assure that blasting resultants do not cause injury, damage or unreasonable annoyance to persons or property outside any controlled blasting site area. Studies by two independent blasting experts have concluded that blasting practices to be employed in the open pit will meet ILHR requirements. Reports developed by these experts addressing blasting plan design and impacts can be found in Appendix 3.10-A of the EIR.

Initial blasting in the west end of the open pit will likely consist of a small number of short holes since much of the waste rock can be ripped by a dozer. Small blasts will be required to break the sulfide mineralization. The ore will be mined from ten-foot benches, thus requiring short, four-inch holes and smaller charges per hole. These small and infrequent blasts will be ideal for testing the blasting plan design. An occasional waste blast employing 20-foot, five-inch diameter holes, and larger charges will also be shot during this period.

The above blasting program will monitor the effectiveness of key blast parameters such as drill hole spacing, millisecond delays, number of holes per delay, stemming of holes, and charge size. The program will also include detailed monitoring to confirm anticipated vibration levels.

A pre-blast survey of structures will be completed as discussed in section 4.11. This survey discusses the existing condition of structures prior to the start of blasting.

During blasting, flyrock, ground vibration and noise impacts will be kept to a minimum by applying the following practices:

- Rip as much of the weathered bedrock as possible.
- Ensure all holes are carefully loaded and stemmed.
- Use of a high quality initiating system to ensure accurate sequencing.
- Fire blasts to open or free faces.
- Shoot as many blasts as possible perpendicular to the foliation; i.e., towards the northwest.
- Sink to the next lower bench using a "burn-cut" design when possible.
- Use millisecond delays between groups of holes to minimize ground vibration.
- Monitor blasts with a few permanent recorders in strategic locations for the duration of mining operations.

It is currently proposed to use a packaged slurry-type blasting agent due to the expected wet conditions for an estimated 50 percent of the holes. Dry blast holes will use a prilled ammonium nitrate-fuel oil mixture (ANFO) whenever conditions warrant. A blast hole dewatering system with plastic hole liners for ANFO may also be a viable alternative.

Since ore will be mined on ten-foot benches, controlled blasting will be required to minimize dilution. In order to peel the hanging wall waste from the ore and to separate internal waste from the ore, inclined blast holes will be used in selected locations. The ten-foot bench height will require small diameter (four-inch) holes on a tight pattern in order to properly fragment the ore. Waste immediately adjacent to the ore zone will also be drilled and blasted on ten-foot benches.

Waste not adjacent to the ore zone will be mined on 20-foot benches. This height will allow the use of a larger hole diameter and a wider spaced drill hole pattern. In order to minimize damage to final pit walls, cushion blasting techniques will be used in these areas. This will include a tighter hole spacing and minimal subgrade drilling in the final row and a single hole per delay detonation.

Hydraulic drills have been selected in order to cover the anticipated wide range of drilling requirements. These units are capable of drilling holes at nearly any orientation and can be used for inclined blast holes, horizontal holes for ore control sampling, and oriented holes should pressure grouting be necessary for water control. These units also have a reputation for being significantly quieter than equivalent size pneumatic drills.

In the event primary blasting produces material too large to be handled by the mining equipment or crusher, secondary breakage may be required. This could involve the use of hydraulic splitters or other methods, and if necessary, secondary blasting. The requirement for secondary breakage should reduce over time as experience is gained with blasting of the rock types.

Mine Planning

The Flambeau pit has been subdivided into two mining phases. The southwest half of the deposit will be mined to the 970-foot elevation in the initial phase. The open pit design at the end of phase one is illustrated in Figure No. 4-10. In the second phase the balance of the pit will be mined to final limits and the pit bottom will be extended to the 900-foot elevation. Final pit design is illustrated in Figure No. 4-11.

Approximately 1,900,000 tons of ore will have been removed from the open pit when the final pit configuration, as shown in

Figure No. 4-11, is reached. Total non-ore material that will have been removed is approximately 7,768,000 tons. Table No. 4-2 contains an itemization by phase and bench of the non-ore material to be removed. The table also describes where the excavated material will be stored.

Due to the high variation of grades within the deposit, it is necessary to have at least two ore mining faces available at all times. The capability to blend ore from the mining faces and in the crushed ore stockpile is necessary to avoid large swings in ore metallurgy that could impact concentrator performance.

An additional mine planning requirement is to ensure that sufficient waste is mined to provide operational flexibility. The next lower bench is developed as soon as working room becomes available. This allows construction of a sump of sufficient size to adequately handle the in-pit water flows and to provide a drop cut for emergency storage in case of significant precipitation over a short time period.

4.7.3.2.2 River Pillar

Slope engineering studies and geologic exploration work have determined that rock conditions within the river pillar are geotechnically suitable for safe mining conditions. No adverse structures have been identified to preclude overall wall stability. Stability analyses indicate acceptable safety factors, employing conservative pore pressure rock mass, and rock strength assumptions.

Pit water inflow is anticipated along the prominent northeast-southwest foliation planes. Seepage analyses indicate that inflow quantities are manageable.

As part of the pillar wall control program, detailed geotechnical and hydrogeological pit mapping will be carried out on a routine basis. Slope displacement and water level monitoring will be conducted. Should potentially adverse structures, wall displacements, or water inflows be identified, remedial action will be promptly implemented. This could include dewatering, slope reinforcement grouting and mine plan modification.

4.7.3.2.3 Haul Road

The ore haul road is designed to safely and efficiently haul ore from the open pit to the crusher facility. In addition, the road will take the waste rock and other materials to the various stockpile sites.

The 60-foot width of the planned haul road will accommodate both 35- and 50-ton trucks, both of which are currently under consideration for use at the site. This design width includes

TABLE NO. 4-2

Phase I and II Excavation Schedule

Phase I Bench	Type I Stockpile: Till* ktons	SS** ktons	SAP ktons	WR I ktons	Total ktons	Type II Stockpile: SAP ktons	WR II ktons	Total ktons	Total Waste ktons
1140	0	0	0	0	0	0	0	0	0
1130	48	0	0	0	48	0	0	0	48
1120	115	0	0	0	115	0	0	0	115
1110	235	0	0	0	235	0	0	0	235
1100	245	71	0	0	316	0	0	0	316
1090	104	118	36	0	258	72	0	72	330
1080	27	34	134	0	195	116	2	118	313
1070	4	0	127	0	131	66	38	104	235
1060	0	0	117	3	120	50	51	101	221
1050	0	0	55	59	114	34	71	105	219
1040	0	0	25	80	105	19	90	109	214
1030	0	0	12	78	90	4	106	110	200
1020	0	0	2	74	76	1	114	115	191
1010	0	0	0	34	34	0	87	87	121
1000	0	0	0	23	23	0	82	82	105
990	0	0	0	13	13	0	78	78	91
980	0	0	0	11	11	0	54	54	65
970	0	0	0	8	8	0	46	46	54
	778	223	508	383	1,892	362	819	1,181	3,071
Phase II Bench									
1140	6	0	0	0	6	0	0	0	6
1130	289	0	0	0	289	0	0	0	289
1120	348	0	0	0	348	0	0	0	348
1110	329	0	0	0	329	0	0	0	329
1100	150	182	0	0	332	0	0	0	332
1090	49	277	7	0	333	3	0	3	336
1080	23	136	59	0	218	80	2	82	300

TABLE NO. 4-2 (Cont.)

Phase II Bench	Type I Stockpile					Type II Stockpile			Total Waste
	Till* ktons	SS** ktons	SAP ktons	WR I ktons	Total ktons	SAP ktons	WR II ktons	Total ktons	ktons
1070	7	9	82	1	99	114	22	136	235
1060	0	2	72	19	93	77	64	141	234
1050	0	0	30	61	91	31	116	147	238
1040	0	0	1	88	89	3	146	149	238
1030	0	0	0	85	85	0	149	149	234
1020	0	0	0	80	80	0	146	146	226
1010	0	0	0	54	54	0	120	120	174
1000	0	0	0	55	55	0	112	112	167
990	0	0	0	61	61	0	111	111	172
980	0	0	0	53	53	0	112	112	165
970	0	0	0	49	49	0	110	110	159
960	0	0	0	49	49	0	140	140	189
950	0	0	0	17	17	0	79	79	96
940	0	0	0	12	12	0	65	65	77
930	0	0	0	8	8	0	54	54	62
920	0	0	0	4	4	0	42	42	46
910	0	0	0	0	0	0	14	14	14
900	0	0	0	0	0	0	14	14	14
Sub-total	1,201	606	251	696	2,754	308	1,633	1,941	4,695
TOTAL	1,979	829	759	1,079	4,646	670	2,452	3,122	7,768

*Includes 82,000 tons of topsoil, which will go to the topsoil stockpile.
**Approximately 223,000 tons of sandstone and 75,000 tons of till will be placed in the Type II stockpile for select fill purposes.

SS = Sandstone
SAP = Saprolite
WR I = Type I Waste Rock
WR II = Type II Waste Rock

TABLE NO. 4-2 (Cont.)

Tonnage Factors (cu ft/ton)

Till	17.0	Type I	13.5
Sandstone	14.0	Type II	12.8
Saprolite	16.0		

Rock Type	Swell Factor	Compaction Factor
Till	1.2	0.9
Sandstone	1.2	0.9
Saprolite	1.2	0.9
Type I	1.3	0.9
Type II	1.3	0.9

eight feet along the outside edge for a safety berm, a seven-foot wide ditch along the inside of the road and a 45-foot wide running surface. A ten percent road gradient has been designed for easy negotiation by the mine vehicles. The road bed design consists of a maximum of 54 inches of crushed and sorted material placed over on-site till and bedrock which has been graded and contoured to meet design grades.

A berm built along the perimeter of the Type II stockpile and adjacent to the haul road serves two purposes. First the berm acts as a drainage barrier to direct runoff water along the outside edge of the haul road and into the runoff collection system. Second, the berm is used to elevate and key in the northwest edge of the HDPE liner as further described in subsection 4.7.3.3.7. Infiltration water from the haul road will be collected and piped to the wastewater treatment plant.

4.7.3.2.4 Crusher

The crushing facility has been designed to crush coarse ore from nominally minus 24 inches to minus 12 inches in size. The crusher facility will be located on the southwest side of the Type II waste rock stockpile as shown on Figure No. 4-12. The crusher facility will be constructed above ground level as shown on Figure No. 4-13. An ore haul road will be constructed in the Type II waste rock stockpile area to provide access to the crusher feed hopper. A retaining wall will be constructed to separate the crusher from the Type II stockpile and to retain the Type II waste rock and saprolite in the area. Ore will be delivered to the feed hopper by mine haul trucks. A vibrating feeder with a scalping grizzly will feed ore greater than 12 inches to the 30-inch by 42-inch jaw crusher. The grizzly section of the feeder will direct ore less than 12 inches to the crushed ore stockpile conveyor, thereby bypassing the crusher.

A haul truck turnaround area is provided at the top of the crushing facilities. This area not only provides sufficient maneuverability room for the safe operation of truck traffic but also supplies ample room for the storage of several thousands of tons of coarse ore from the pit. Stockpiling on this temporary coarse ore stockpile could be required from time to time due to major downtime for the crusher or for other nonroutine mining operation activities. The crushing facility has been designed such that haul trucks can dump ore from a point inside the Type II stockpile. The retaining wall is also designed to assist in directing runoff water from the stockpile to the ditch surrounding the stockpile. The 60-mil HDPE stockpile liner will be attached to the retaining wall to insure a continuous liner in the retaining wall area. The retaining wall will be approximately 30 feet high and will be backfilled with approximately 28.5 feet of sandstone dressed with 12 to 18 inches of crushed gravel.

The crushing facility and the crushed ore stockpile will be underlain by a 60-mil HDPE liner to direct runoff to the runoff catch pond for processing by the wastewater treatment plant. Twelve inches of granular material will be placed over the liner as a drainage blanket, followed by 48 inches of selected Type II material.

The capacity of the crusher has been designed so that all crushing operations can be scheduled during daylight hours. The crusher has also been oriented such that noise generated by the crushing operation will be directed in a southwest direction away from populated areas and the City of Ladysmith.

Dust suppression spray systems have also been included in the design of the crusher to reduce dust emissions from the crushing and stocking operations.

4.7.3.2.5 <u>Stockpiles - General</u>

A total of four primary temporary stockpiles will be used during the operation to store topsoil, ore, Type I and Type II waste materials. In addition a second topsoil stockpile one-acre in size will be used to store hydric soils for use during site reclamation activities. A detailed discussion of the management of wetland soils is contained in Section 5.11 of this report.

Waste materials to be removed through the life of the mine have been identified as till, sandstone, saprolite, ore, Type I waste rock and Type II waste rock. Material identified as Type II waste rock and saprolite containing one percent or more total sulfur will be removed from the open pit and stockpiled in the area designated as the Type II stockpile. All other material, except topsoil and ore, will be transported by mine truck to the area designated as the Type I stockpile. Ore will be transported to the crushing facility for processing prior to storage in the crushed ore stockpile. In addition, coarse ore can be stored above the crusher in case of the need to perform crusher maintenance.

4.7.3.2.6 <u>Ore Stockpiles</u>

During preproduction, approximately 38,000 tons of gossan ore and 2,000 tons of sulfide ore will be mined. This ore will be crushed and shipped or will be placed in a temporary stockpile located in the open pit until the surface facilities are operational.

During production, coarse ore will be hauled from the mine and dumped directly into the crusher feed hopper. Provision will be made for temporary stockpiling of coarse ore in close proximity to the crusher in the event that the crusher is not operational. When operations resume, a front end loader will transport the ore from the coarse ore stockpile to the crusher.

Crushed ore will be transferred by conveyor to the 6,000-ton crushed ore stockpile area that will be located as outlined on Figure No. 4-12. The area will be dressed with gravel and lined to direct surface infiltration water drainage to the runoff catch pond. The road base will be designed for operation of a front end loader. Crushed ore will be reclaimed by the front end loader and loaded into railroad cars for transportation to a processing facility located out-of-state.

4.7.3.2.7 Topsoil Stockpile

Topsoil will be removed from disturbed portions of the mine area. Stripped topsoils will be used to dress berms and other project features that will be vegetated as part of site construction activities or used to build a visitor's overlook located to the northeast of the pit as shown on Figure No. 4-1. Approximately 220,000 cubic yards of topsoil will be used to construct this project feature.

As part of the Local Agreement between Rusk County, the Town of Grant, the City of Ladysmith and Flambeau, Flambeau agreed to provide an area to allow visitors to park and observe the mining operations. This observation area has always been envisioned as a platform on the topsoil stockpile because it would provide elevation to allow observation of more of the operation and is next to STH 27 for easy access. Current plans are to provide a pathway to the top of the stockpile where a gazebo-type structure will be located. The observation area and pathway to it will have limited access so the main portion of the stockpile will not have pedestrian traffic.

The north and west slopes of the topsoil stockpile will be built at 3:1 sideslopes. The east and south slopes will be built to 5:1 sideslopes. The stockpile will be built in two phases. The first phase will involve construction of the north portion of the pile to grade during initial preproduction construction. The second phase will involve completion of the southern portion of the stockpile to grade using topsoil stripped during construction of Phase II of the Type II stockpile area.

4.7.3.2.8 Type I Stockpile and Settling Ponds

The Type I stockpile will be constructed to store till, sandstone, saprolite, and Type I waste rock. Based on the results of the waste characterization studies for each of these materials; the results of soil sorption studies completed on soils in the Type I stockpile area (EIR section 3.5.6); the results of a July 1989 study titled *Prediction of Chromium, Copper, and Iron Concentrations In Vadose Zone Water Reaching the Water Table Beneath the Unlined Type I Stockpile for the Kennecott Flambeau Project* (Appendix G), it was concluded that the temporary stockpiling of the till, sandstone, saprolite, and waste rock containing less than two percent total sulfur can be safely accomplished on an unlined site. Flambeau has elected to limit the material which will be placed on an unlined site to till, sandstone, saprolite and waste rock which contain less than one percent total sulfur. The July study also recommended the order in which the various materials should be placed in the stockpile. A collection system has been designed to contain interior runoff from the stockpile and direct it to settling ponds prior to discharge to the river.

Design

The stockpile will consist of the following components:

- An unlined storage area approximately 40 acres in size.
- A system of exterior berms with an interior drainage system to contain the stockpiled material and to collect and channel runoff from the pile.
- A runoff collection system draining to two settling ponds located in series that will be used to clarify the water.
- An exterior drainage system to be used to channel run-on away from the site.
- A haul road that will be used to provide access to and from the site.

The Type I stockpile area, Figure No. 4-14, is designed to be constructed at the existing grades within its perimeter. Other than clearing and grubbing and topsoil removal, no grading or special preparation of the base of the site will be conducted.

Type I materials will be generated in two phases. The first phase, Phase I, will consist of materials removed from the upper portions of the western half of the open pit. Phase II materials will be subsequently removed from the upper portions of the eastern half of the open pit and from the entire lower portion of the pit. Phase I will consist of a preproduction and a production stage, relative to ore recovery. The preproduction stage of the first phase is expected to last four months. During this time period the till removed from the mine area will be used to make a "till blanket" of uniform thickness at the base of the 40-acre stockpile site. The till blanket will be approximately nine feet thick. As topography allows, the blanket will be dimpled in its central portion in order to minimize run-off from the blanket and to maximize percolation of leachate through it. The purpose of the blanket is to provide additional till material to sorb or retain metals that will be released from the overlying stockpiled materials. The July 1989 transport modeling study concluded that this design technique will result in no impact on groundwater from the Type I stockpile.

The remaining till, sandstone, saprolite and a portion of the Type I waste rock will be stockpiled on top of the till blanket in segregated areas. A final lift of Type I waste rock approximately eight feet thick will be placed over the entire top of the stockpile. The sizes of the segregated areas were determined by calculating the volumetric proportion that each waste type would require to be stored on top of the till blanket so that a final uniform height of all of the adjacent units would be obtained before the final lift of Type I waste rock was placed. It is estimated that the stockpiled till will occupy approximately the western 45 percent of the surface of the till blanket. Sandstone will then occupy the northeastern corner of the blanket surface (approximately 15 percent of the total area). Saprolite will occupy the east central part of the blanket surface (approximately 20 percent of the total surface area). Waste rock will occupy both the southeastern portion of the blanket surface (15 percent of the total surface area) and the area within an approximate eight foot lift on top of the stockpile. This stockpiling configuration was chosen in order to facilitate the backfilling of the open pit during reclamation activities. A plan view of the stockpile configuration is shown in Figure No. 4-14A. A north-south and an east-west section through the stockpile are shown in Figure No. 4-14B.

The interior and exterior drainage systems associated with the stockpile will be formed by a perimeter berm that will be approximately five feet high. The berm will be 20 feet wide and slope from outside to inside at two degrees. A shallow drainage swale will be constructed on the outside of the perimeter berm to collect runoff from the exterior of the berm and run-on from areas surrounding the stockpile. This runoff will be routed to drain into the natural drainage system northwest of the stockpile. A typical detail for the berm and the interior and exterior drainage swales is shown on Figure No. 4-15.

The stockpile has been designed to have a surface elevation of 1,203 feet. The maximum height of the pile will be approximately 60 feet above existing grades. Final grades are shown on Figure No. 4-14.

Access to the pile will be provided by a haul road located in the southeast corner of the stockpile. The stockpile's design volume is 2,790,000 cubic yards, which includes the estimated volume of each material to be sent to the stockpile plus a three percent contingency factor and a ten-foot lift to the top of the pile should additional space be required. Table No. 4-3 shows the relative volume of each of the Type I materials that will be placed in the stockpile.

The volumes in Table No. 4-3 differ somewhat from the volumes used to complete the July 1989 transport modeling work. both sets of volumes were calculated using the excavation schedule in Table No. 4-2. The differences are three fold. First, the 0.9

TABLE NO. 4-3

Estimated Volume of Type I Stockpile Materials

Type of Material		Type I Volumes (Cubic Yards)
Till		1,239,000
Sandstone		339,400
Saprolite		485,800
Waste Rock		631,200
	Total Volume	2,695,400

compaction factor from page three of Table No. 4-2 was not applied. Secondly, the till volume for the modeling work was not reduced by the 82,000 tons of topsoil that will go to the topsoil stockpile. Thirdly, the modeled till and sandstone volumes were not reduced by the 75,000 tons of till and 223,000 tons of sandstone that, while considered Type I material, will be used in the Type II stockpile as construction materials. The differences in the two volumes have no material effect on the transport modeling results.

The Type I stockpile will be operational for a period of approximately 7.25 years. This includes 5.75 years where material will move from the pit to the stockpile for storage, followed by 1.5 years where the reverse will happen during the reclamation process.

Water collected in the interior drainage swale will flow by gravity to the southwest portion of the stockpile (Figure No. 4-14) where the water will pass through a 30-inch diameter corrugated metal pipe (CMP) into the Type I settling ponds. The ponds will be used to remove sediment prior to the discharge of the water to the Flambeau River or to an adjacent wetland. The location and configuration of the settling ponds is shown on Figure No. 4-1. A section through the ponds is shown on Figure No. 4-15. A detailed discussion of the design, performance, and operation of the settling ponds can be found in the FER. As discussed in the FER, the settling ponds will be unlined structures. Their primary purpose is for water clarification prior to discharge. Since they will be unlined some leakage will occur. A discussion of the projected leaked rate follows.

Based on the way the settling ponds will be operated, one of the basins, on average, will likely not have water in it. The other pond will be full only very infrequently. Based on anticipated rainfaill events, it will likely be full 15 days per year. On the other 350 days per year, it will have one-foot of water in it. Using these parameters, the basin will allow seepage to groundwater at the rate of about 5-6,000 gallons per day, or approximately 4 gallons per minute. This amounts to about 11 percent of the average inflow to the basin which, according to information in Appendix N will be no less than 20,500,000 gallons per year, or 56,400 gallons per day.

4.7.3.2.9 Type II Stockpile

The following discussion addresses the proposed engineering design for the Type II stockpile. The design concepts are based on the analysis of subsoil and groundwater conditions at the site as presented in the project EIR. The design includes a minimum cut into the existing grade which is needed to achieve the design base grade configuration. A one foot compacted select fill liner, and a 60-mil HDPE liner will be installed. A leachate collection system will be installed on top of the HDPE liner to collect and remove leachate for on site treatment. Design concepts are presented below.

Anticipated Waste Quantities and Site Life

An estimated 2,185,000 cubic yards of material consisting of Type II waste rock, Type II saprolite, till and sandstone used for road base construction, will be placed in the Type II stockpile area. The estimate includes the volume of each material planned for storage at the site with an eight percent contingency added and a five-foot lift if additional room is required. Table No. 4-4 contains an estimated breakdown of the Type II material that will be placed in this stockpile. This waste will be used for reclamation when mining operations cease.

The operating life of the Type II stockpile is approximately seven years. This includes a period of six years where material will be moving to the pile for storage, followed by approximately one year where material will be moved from the stockpile to the pit, during reclamation.

Site Access and Traffic Routing

Access to the mine site will be at a controlled entrance. On-site movement of materials will be restricted to designated haul roads. All roads are designed to achieve efficient vehicular movement. Access roads and haul roads include roadway ditches and swales for surface water runoff from the roads. Haul roads will have a 54-inch road base.

Screening and Perimeter Fencing

Site screening and aesthetics have been discussed in section 4.7.2 of this application. Security and fencing of the stockpile will be part of the total mine site security and fencing plan. Details of this plan are outlined in section 4.7.4.5 of the Mine Permit Application.

Surface Water Drainage

Surface water will be controlled by a system of berms, ditches, and swales. The site design minimizes the amount of water coming in contact with the waste material. Noncontact surface water will be directed via swales located outside the site perimeter berm to existing on site drainage systems. Contact runoff water from the Type II stockpile will require on-site treatment and will be collected via swales located inside the site perimeter berm and directed to a 36-inch diameter HDPE pipe to a surge pond and be treated on-site prior to discharge to the Flambeau River. The surface water drainage plan for the site is shown in Figure No. 4-7. A plant site grading plan is shown in Figure No. 4-12, while the site underground piping plan is shown in Figure No. 4-16.

TABLE NO. 4-4

Estimated Volumes of Type II Stockpile Materials

Type of Material	Type II Volumes (Cubic Yards)
Till*	51,000
Sandstone*	125,000
Precipitate from Wastewater Treatment Plant	46,000
Saprolite	428,800
Waste Rock	1,360,000
Total Volume	2,010,800

*Material for road base construction.

Site Sequencing

To minimize the quantity of leachate generated, the stockpile and drainage system will be built in two phases. Phase I will consist of the construction and operation of the western portion of the area as shown on Figure No. 4-17. The Phase I area will be used for storage of material for the first 2.5 to 3 years of operations. The eastern portion of the stockpile will remain in its natural state until its development in year two of the project. Runoff from this area will follow the natural course of surface drainage.

Design

The Type II stockpile is designed to collect all rainwater which either infiltrates or runs off the stockpile. The site drainage system has been designed based on a 25-year, 24-hour storm event.

Figure Nos. 4-18 and 4-19 illustrate subbase and base grades for Phase I. The figures show the limits of excavation and berm construction. Also shown is the phase definition berm located between Phases I and II. The liner system for the site will consist of a 60-mil HDPE liner placed over a one-foot recompacted soil base. On site till will be used for this recompacted base. The recompacted base will be compacted to 90 percent of the maximum modified Proctor density (ASTM D 1557) in lifts of six to eight inches over the entire surface and on the berm slopes prior to installation of the HDPE liner. Base grade contours have been designed in a herringbone pattern to shorten the collection system pipe spacing and expedite drainage along the base to the collection system.

The base grades will slope at two percent towards the collection pipes. The HDPE liner will be installed on the base and sideslopes as outlined on Figure Nos. 4-20 and 4-21.

HDPE Liner

A HDPE liner has been selected as the liner material due to its low permeability and its use in highly successful applications throughout the mining industry. The liner material will be supplied and installed by experienced installers that have been approved by the National Sanitation Foundation as meeting all the requirements for manufacturing and installing HDPE liners. Specifications for the HDPE liner are included in Table No. 4-5.

The HDPE liner will be installed on the base and on the inside of the berms that encircle the Type II stockpile area. The liner will be anchored in the berms using standard anchoring techniques as shown on Figure No. 4-15. Berms will be constructed with a 3:1 slope for a smooth transition from the base to the berms.

TABLE NO. 4-5

HDPE Liner Specifications

Characteristics	Value
Material Thickness	60 mil
Density	0.94
Permeability (9K)	2.7×10^{-13} cm/sec
Hydrostatic Resistance	490 lbs/in^2
Puncture Resistance	270 lbs
Tensile Strength	240 lbs/in width

Leachate Collection System

The base grades will be constructed in a herringbone pattern and covered by the HDPE liner which will contain any rainwater infiltration and direct it to the leachate collection system. The drainage system will consist of a series of collection pipes located at the base along the valleys of the herringbone configuration as shown on Figure Nos. 4-20 and 4-22. The leachate collection pipes will consist of six-inch Schedule 80 perforated PVC pipe bedded in 18 inches of 1-1/2-inch by 3/4-inch screened and washed stone. Appendix H contains calculations verifying the suitability of the Schedule 80 pipe to withstand the pressure from overburden and live loading. The HDPE liner will be covered by a one-foot granular blanket having a permeability of 10^{-3} cm/sec or better as shown on Figure No. 4-23. The leachate collection pipe washed stone will be covered with filter fabric and then the one foot granular blanket (Figure No. 4-20) to minimize the possibility of fines migration into the stone.

Water collected by the perforated collection pipes will be transported to a Schedule 80 PVC header pipe which will be connected via a HDPE discharge pipe to the wastewater treatment surge pond for storage until processing.

The leachate collection system is designed to provide efficient collection while providing for ease of maintenance. Cleanout risers, which are designed to permit cleaning of the collection system by mechanical means or by high pressure water flow are included in the collection system as shown on Figure No. 4-20.

Phase II

Subbase and base grades for Phase II are shown on Figure Nos. 4-24 and 4-25. Figure No. 4-26 illustrates the leachate collection system for Phase II showing collection pipe, headers, and cleanouts. The same design parameters used for Phase I have been used in designing the Phase II area.

Liner Efficiency and Leachate Heads

Appendix I contains calculations that have been performed to determine the efficiency of the HDPE liner and leachate collection system. The appendix also includes estimates of leachate head build-up.

Liner drainage efficiency calculations were performed for each of the various base grade slopes in both Phases I and II using approximate drainage distances. Efficiencies ranged from 96.6 to 99.7 percent. Over 60 percent of the site will have an efficiency of greater than 98.8 percent.

Both maximum leachate head and the time it would take to reach that head were also calculated for each base grade slope. Using the relative size of each base grade slope, a weighted average for the leachate head for the site was calculated to be approximately 8.9 feet. Given the fact that the storage site will be in existence for a short duration and considering the high liner efficiencies and low maximum average leachate heads within the site, the liner and leachate collection system will provide protection to the environment during their life.

Final Grades

The configuration of the stockpile at the end of Phase I and Phase II filling is shown on Figure No. 4-27. The stockpile sideslopes have been designed to match the natural angle of repose of the stored material which is approximately 1.5 to 1. The top of the pile will be at a final elevation of 1,213 feet, which is 70 feet above the surrounding topography. Site reclamation will commence immediately after the Type II stockpile reaches final grade; therefore, the grading configuration shown in Figure No. 4-27 will exist for only a short period of time.

4.7.3.3 Construction and Operation

4.7.3.3.1 Introduction

This section opens with a discussion of the construction schedule, followed by a discussion of construction materials and balances required to bring the project into production. Temporary facilities needed during initial construction and clearing and grubbing of vegetation are also described. The remainder of this section focuses on the construction and operating procedures for the open pit, haul road, crusher, ore stockpiles, topsoil stockpile, Type I and Type II stockpiles. Some of the more routine actions such as haul road construction, the crusher, ore stockpiles, and stockpiling of topsoil are described under the single heading of construction and operation. The other actions of open pit mining, and the Type I and Type II stockpiles are each discussed in two subsections. These are construction, followed by operation.

Construction sequencing, equipment, and techniques will be optimized during final engineering. Construction of the open pit and surface facilities do not require new or improved technology. The necessary craft skills and construction procedures in the open pit and surface facilities are well established and readily quantifiable. The construction and operation plan for the Flambeau Project is described in detail in the following subsections.

4.7.3.3.2 Construction Schedule

The construction schedule was prepared to support mine development and crusher facility installation and sequenced to assure availability of all environmental protection systems well in advance of the needed date.

Mobilization in the field is scheduled for April of 1991 with clearing, grubbing, and earthwork excavation being the first activities to be commenced. Site preparation with the exception of the open pit will be completed in 1991. Figure No. 4-4 shows the Flambeau construction schedule in column format. A more detailed schedule which includes engineering activities is shown on Figure No. 4-5.

4.7.3.3.3 Construction Materials and Balances

Most of the earth and soil material needed for construction will be generated during preproduction stripping of the open pit and site preparation of surface facilities. However, approximately 128,000 cubic yards of construction materials may need to be purchased from off-site sources. The nature and volume of these materials are shown in Table No. 4-6. Most of the imported material will be crushed gravel (123,560 cubic yards) with minor amounts of concrete (2,490 cubic yards), asphalt (570 cubic yards), riprap (500 cubic yards), and clay and bentonite (1,060 cubic yards).

A summary of earthwork for the mine site, excluding the open pit is found on Table No. 4-7. The summary shows a balance between cut and fill requirements. The Type II stockpile and plant facilities are the two areas requiring the bulk of the cut and fill work.

4.7.3.3.4 Temporary Facilities

Some temporary structures will be required during initial site construction activities. These facilities will consist of construction offices for Flambeau's and the construction contractor's employees. Also, storage and workshop buildings for the contractor's equipment, potable water supply, electric power, and sanitary facilities will be required at the site until the construction of buildings required for the regular operations is completed.

A temporary parking area will be located in the general plant site area for vehicles used by construction personnel. Temporary areas for the storage of building materials and equipment will be provided on the site adjacent to structures under construction.

Fire protection for all temporary construction buildings will be provided by the water truck stationed on-site and nearby

TABLE NO. 4-6

Imported Materials

Area	Crushed Rock (cu.yd.)	Asphalt (cu.yd.)	Concrete (cu.yd.)	Clay (cu.yd)
Spur line ballast	14,930			
Roads and parking		570		
Riprap	500			
Concrete			2,490	
Access road	1,255			
Parking lot	725			
Slurry Wall (clay)				990
Slurry Wall (bentonite)				70
Granular material Type II				
Phase 1	37,700			
Phase 2	25,700			
Cr. Ore Loadout Area	6,900			
Haul roads	19,510			
Shipping ore stockpile	5,800			
Crusher	600			
Magazine	3,940			
Maintenance/wastewater treatment plant yard	6,500			
TOTALS	124,060	570	2,490	1,060
GRAND TOTAL (cu.yd.)				128,180

TABLE 4-7

Earthwork Summary

Location	Cut (cu. yd.)	Fill (cu. yd.)
Plant area	76,350	43,700
Railroad spur in fenced area	33,350	10,800
Railroad spur east of STH 27	1,850	12,550
Type II stockpile		
Phase 1	129,800	63,300
Phase 2	24,050	78,400
Type I stockpile and settling ponds	17,700	65,150
Access road	1,050	9,400
Visitor parking	0	1,050
TOTALS	284,150	284,350

municipal fire fighting system if needed. In addition, hand-operated fire extinguishers will be strategically located. Construction water will be provided by an existing on-site well. It is proposed that a new well located to the southeast of the plant site will be the primary potable water supply during the mine operating period.

Temporary on-site power will be furnished from the existing utility company or by use of on-site generators until the planned power substation is completed.

Chemical toilets for construction personnel will be provided on-site, and wastewater disposed off-site by a contractor. When the sanitary disposal system is completed, sanitary wastes will be disposed at this facility. The use of chemical toilets will continue throughout the construction period because some work locations will not be conveniently located near the permanent washroom facilities.

Temporary fences within the construction site will be installed by Flambeau or the contractor for protection of equipment, supplies, and those trees which will act as screens during the mining operation.

4.7.3.3.5 Clearing and Grubbing of Vegetation

Clearing and grubbing of the access road from STH 27, the topsoil stockpile, the hydric soil stockpile, and the Type I stockpile and settling ponds will be the first construction activities undertaken at the site. Clearing and grubbing for other site facilities such as roadways, Type II stockpile, open pit site, plant facilities area, and the railroad right-of-way will be conducted as the overall construction process proceeds. All clearing and grubbing activities will be preceded by or accomplished concurrently with the implementation of temporary erosion and runoff control practices.

During the clearing process, marketable trees will be salvaged and sold. Other trees will be chipped, with the chips saved for future soil stabilization use. Flambeau prefers to salvage wood from site grubbing operations as much as possible to minimize burning and to provide mulch materials. At this time, it is unknown how much usable chipped wood can be salvaged. It is anticipated that whenever, and wherever, wood chips can be salvaged during grubbing, they will be accumulated as close to the grubbing site as possible, outside of project facility areas and drainageways. Several small, accessible piles of wood chips will, therefore, be accumulated during clearing of the site for ultimate use during operations or during reclamation.

Remaining trees, wood, and brush will be burned on-site in areas designated for these activities. The areas shall be sufficiently removed from other vegetation so as to minimize the possibility of the spread of fire. As per Wis. Admin. Code NR 429.04 (1)(i), burning of such material is an acceptable practice.

4.7.3.3.6 Open Pit Construction and Operations

Section 4.7.3.3.6 discusses the construction and operation of the proposed open pit. As used here, construction of the open pit refers to the construction of the proposed slurry wall, placement of the planned flood control dike, and preproduction stripping. It should also be noted that the construction of the open pit is not a stand-alone process, but requires close coordination with construction of various ancillary facilities. For instance, open pit construction cannot commence until the Type I settling pond facility is in place. At that time, the open pit dewatering system can be installed, groundwater directed to the newly emplaced settling ponds, and open pit stripping initiated. Likewise, the Type II stockpile surge pond and wastewater treatment plant need to be complete and operational before sulfide mineralization is exposed and removed from the open pit. The construction and timing of the facilities that support the open pit are described in later sections.

Operation of the open pit as used in this report refers to the period in which ore and waste rock are removed from the pit. This period commences at the end of preproduction stripping and terminates when final pit limits are achieved. The backfilling portion of reclamation commences at the end of mining. Mining and operation of the pit are used synonymously in this section of the application.

Slurry Wall

The slurry wall will be constructed at the west end of the open pit and across the intermittent Stream B channel. Site preparation will entail the removal of trees, shrubs and vegetation, and grubbing of roots. Topsoil will be trucked to the stockpile located near STH 27. The site will be cleared wide enough to allow backhoe and truck equipment easy access. As part of the clearing process, a site corridor will be established with the western limit placed to minimize disturbance of existing vegetation. All construction activities will take place east of that line. The corridor will be graded to provide a slightly sloping (two percent to four percent) work area with all drainage being directed toward the pit area. From within the pit, this water will be collected in temporary dewatering sumps and pumped to the settling ponds. A low berm will be established along the corridor edge next to the river to prevent any drainage from migrating in that direction.

The four-foot wide slurry wall will be constructed for a length of approximately 400 feet using a backhoe. The backhoe will excavate to the bedrock contact and will remove enough of the weathered bedrock surface to establish a solid keyed contact along with the trench bottom. The depth to bedrock on the south end of the wall is approximately 12 feet, and deepens to the north to a maximum depth of about 46 feet. At the far north end of the slurry wall the bedrock rises to approximately 16 feet from the surface. The total volume of the trench is approximately 1,600 cubic yards. Some of the excavated material will be used for the flood control dike, some for the slurry wall construction itself, and the rest hauled to the Type I stockpile area. Figure Nos. 4-7 and 4.8 show the slurry wall design in plan and section during construction. Figure No. 4-49 is a sketch showing details of the slurry wall construction process.

During trench excavation, a mixture of five percent bentonite and 95 percent water will be mixed in a mixer located within the site corridor and pumped into the trench as material is excavated. Water will be obtained from the Flambeau River or the open pit. No water storage pond or slurry mixing/storage pond will be required. This mixture of five percent bentonite acts as a form of "drilling mud" and effectively keeps the trench from caving-in during excavation. The excavated material will be placed on the work pad east of the trench for removal to the Type I stockpile or for re-use as backfill in the finished slurry wall. Drainage will be directed away from the river and into the pit.

As soon as the trench has been excavated to bedrock and is of sufficient length, backfilling will commence. Backfill material will consist of a mixture of approximately 30 percent select on-site material, 67 percent imported clay and 3 percent bentonite. On-site material used in the backfill can be any gravelly sand or till free of material greater than 3.0 inches in diameter. Imported clay will be obtained from a local source with approximately 50 percent of the clay and silt particles passing 200 mesh. The bentonite will be API-13A certified bentonite from either Wyoming or Montana.

The dry backfill will be spread in a rectangular configuration within the corridor and adjacent to the slurry wall trench. The width and length of this pile will vary depending on the amount of the backfill required at the time. The height of the pile will be one to two feet. The bentonite will be mixed with water in the mixer and sprayed on the backfill. A bulldozer will use its tracks to pivot and churn on the pile to mix the backfill to a consistency having a 4- to 6-inch slump. Quality control monitoring will be provided by the owner to assure proper mixing and placement of the backfill. During trench excavation, the slurry will be mixed on-site and pumped into the trench. As the trench progresses, some of the excavated till will be returned to the trench and mixed with the slurry. The mixed backfill will be placed in the excavated trench at a rate compatible with the excavation rate so that the thin slurry supporting the trench walls does not overflow from the trench. The backfill material will fall to the bottom of the trench and form an angle of repose of between 5H:1V to 10H:1V. This process will continue until the trench has been completely backfilled. During the final stage of backfilling, slurry from the trench will overflow to a temporary ditch, and be directed to the sediment sumps within the pit perimeter. This sump will be constructed east of the trench and any excess slurry from the trench will be directed away from the river and into the pit. Excess slurry collected within this sump will be hauled to the Type I stockpile area.

Upon completion of the slurry wall, approximately 24 inches of clean till will be placed into the top of the trench.

<u>Flood Control Dike</u>

The flood control dike will be constructed on top of the slurry (Figure No. 4-8) wall. The dike is required to prevent a 100-year flood from backing up into intermittent Stream B channel and into the open pit. Maximum height of the dike will be 48 inches, to a top elevation of 1,097.5 feet or about 24 inches above the predicted 100-year flood elevation. The dike will be extended a distance of 30 feet to the north, and about 12 feet to the south of the stream bed. The top of the dike over the center line of Stream B will gradually taper down in both directions to the land surface.

Material for construction of the flood control dike will be taken from carefully selected materials (not uniform sands or gravels) excavated from the slurry wall or other project excavations. The selection and placement of fill material within the dike will be subject to approval by a Flambeau representative. The fill for the flood control dike will be constructed so that the distribution of the materials will be essentially free from lenses, pockets, streaks, or layers of materials differing substantially in texture or gradation from the surrounding material. The fill will be placed in approximately horizontal lifts extending the entire width of the embankment. The thickness of each lift will be no more than 12 inches. Each lift will be compacted to 90 percent of its modified Proctor density (ASTM D1557) with a moisture content within $\pm$ 2 percent optimum.

Once in place, the dike slope facing the river and the balance of the disturbed area outside the pit perimeter will be topsoiled and revegetated with appropriate ground cover. Erosion and runoff control measures such as temporary diversion ditches, sediment traps, silt fences and straw bales will be employed both during and following construction.

Preproduction Stripping

The preproduction mining plan has been developed in order to meet the following design and schedule criteria:

- Complete preproduction mining within a four-month period. Figure No. 4-28 illustrates the open pit upon completion of preproduction.
- Preproduction equipment fleet size should be compatible with that required for routine mine operations.
- Excavate as much waste and overburden material required for site construction as possible from the preproduction pit area in order to minimize getting this material from off the project area.
- Provide access to the ore so that sufficient ore can be mined to meet ore shipping required when operation begins.
- Haul the sandstone to the Type II stockpile for use as subbase for the haul road to the crusher.
- Operate the preproduction period on three, eight-hour shifts per day, seven days per week, in order to achieve the above tasks.

The topsoil will be removed from the entire open pit area and hauled to the stockpile for use during and after the mine operation. The quantity of material scheduled for removal during the pre-production period is based on developing an ore exposure such that future waste mining requirements are not excessive over short-term peaks. The current preproduction stripping consists of approximately 1,500,000 tons of material including 2,000 tons of enriched sulfide ore and 38,000 tons of gossan. The crushing, shipping and wastewater treatment facilities are scheduled for completion so that when enriched sulfide ore is exposed, these facilities will be in operation. If these facilities are not operational, the ore will be temporarily stockpiled in the pit or on the Type II stockpile. In either case, sufficient capacity will exist in each facility to store runoff until the wastewater treatment facility becomes operational.

Material removed during preproduction will consist of approximately 563,000 tons of till, 216,000 tons of topsoil, 223,000 tons of sandstone, 225,000 tons of saprolite, 233,000 tons of Type II material, 2,000 tons of ore, and 38,000 tons of gossan. The till will be hauled to the Type I stockpile. Most of the sandstone will be hauled to the Type II stockpile for select haul road fill purposes. Because of the proximity to the sulfide zone, approximately 217,000 tons of saprolite will be included in 233,000 tons of Type II material. Grab samples and blast hole drill cuttings will be used to sample material in the proximity of the deposit in order to determine sulfur content and destination of the waste materials.

Mining during preproduction will consist of dozing unconsolidated materials and ripping and dozing poorly consolidated materials into piles of suitable height for loading into haul trucks with hydraulic shovels. It is likely that blasting will not be required during this period, although some cherty zones could be encountered toward the end of prestripping. If these zones are encountered, some minor blasting would be necessary. Drilling and trenching will be required for sampling purposes, particularly when gossan ore is encountered.

The design slope in the overburden is 36 degrees, which has been determined to be stable employing limiting equilibrium analyses. Benching will not be implemented on final walls in this material. A smooth slope at the 36-degree angle will be maintained from the ground surface to the Precambrian bedrock contact with dozers. At the bedrock contact, which varies in elevation around the pit, a ten-foot flat area will be maintained as a catch bench. Normal benching will be implemented below the overburden and bedrock contact.

As the excavation approaches the water table, a series of in-pit dewatering sumps and trenches will be installed. These water collection points are designed to intercept overburden groundwater only and to lower the water table within the preproduction pit area. This will be accomplished by excavating a series of narrow trenches parallel to the length of the deposit using backhoe equipment. Water will drain freely through the trenches or through lined pipe trenches, in case of excavation collapse, to several water collection sumps equipped with pumps. Dewatering will facilitate movement of equipment during site preparation and remove groundwater away from the site during preproduction stripping. Water will be pumped to the settling ponds for clarification before discharge.

Major mining equipment requirements for the preproduction period consist of:

1 - dozer for ripping poorly consolidated material and for pit maintenance

1 - hydraulic drill

2 - hydraulic front shovels

5 - haul trucks

1 - dozer for waste storage area maintenance

1 - road grader for road maintenance and snow removal

1 - water wagon for road maintenance and dust control

The above equipment list is a reasonable example of the approximate amounts and kinds of machinery that could be required to operate an open pit mine at the proposed tonnage rates. However, it is possible that the type and amount of equipment could change depending upon what equipment is available at the time permits are granted and who conducts the mining i.e., Flambeau or a mining contractor. These conditions are true for both preproduction stripping and mining.

Mining Operating Schedule

Mining is expected to achieve full production by the end of 1991 and will be concluded approximately six years later during the early part of 1997. During this period of operation, the project will produce ore at an annual rate of approximately 320,000 tons, except for the start-up year when the annual production rate will be approximately 240,000 tons. Figure Nos. 4-29 through 4-37 illustrate the sequence of open pit development from the end of the first quarter, year one to end of third quarter, year six, final pit design.

In accordance with the Local Agreement, blasting, crushing, and rail shipping operations will be conducted during daylight hours, Monday through Saturday only. As per the Agreement, all other mining operations are allowable during three eight-hour shifts, 365 days per year as necessary to meet production requirements. However, mining is currently planned to occur during a one-shift-per-day, five-day-per-week operation.

Open Pit Operations

After the preproduction period, mining operations will initially consist of mining ore and waste from Phase I and stripping waste from Phase II. The Phase II waste stripping rate is defined by the requirement that Phase II ore must be exposed by the time Phase I ore is exhausted. Based on an annual ore production rate of 320,000 dry tons, the mine life is five years and eight months. Open pit operation is defined as that period beginning after preproduction and before backfilling. Operating on a one-shift-per-day, five-days-per-week basis over 250 days per year requires an average daily total material movement of 7,200 tons (1,280 tons ore plus 5,920 tons waste) for the first 3.5 years. After that time, total material requirements gradually decline to 6,400 tpd from the balance of the third year and all of year four, to an average of 3,450 tpd in year five, and an average of 2,150 tpd during the last year.

Because shipping costs for transporting ore to a processing facility are expensive, a primary objective in mining the deposit will be to minimize the dilution of ore with sub-economic material. Achieving this objective will require the use of selective mining methods, which necessitate the use of relatively small mining equipment. Two equipment items, the hydraulic drills and the hydraulic shovels, have been selected because of their applicability to selective mining. The hydraulic drills are suitable for drilling inclined blast holes and for drilling horizontal holes for grade control. The hydraulic shovels are well suited for selective digging and for a fast cycle time. Additional equipment will consist of haul trucks, a dozer for ripping and pit maintenance, a dozer for leveling the Type II stockpile area and for road maintenance, a road grader for road and dump maintenance, a water wagon for road maintenance and dust control, a rubber-tired front end loader for shovel backup and road maintenance and a dump truck for general maintenance. Estimated equipment requirements by year are summarized as follows:

	PP	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6*
Dozer	1	1	1	1	1	1	1
Hydraulic drill	1	2	2	2	2	2	2
Hydraulic shovels	2	2	2	2	2	2	2
Haul trucks	5	6	6	7	7	6	3
Loader	0	1	1	1	1	1	1
Dozer	1	1	1	1	1	1	1
Grader	1	1	1	1	1	1	1
Water wagon	1	1	1	1	1	1	1
Dump truck	0	1	1	1	1	1	1

*For first three quarters. Backfilling begins at end of third quarter. Required equipment for backfilling is not shown here.

Mining operations for any ore bench will begin with a dropcut in the hanging wall portion of the pit. Upon reaching grade, a flat area of sufficient width for a truck to access the ramp and for the development of a waste mining face will be left. The dropcut will continue down, and a water collection sump will be established below the grade of the bench under development. Sumps will normally be from ten to 15 feet deep. Pumps will be barge-mounted as shown in Figure No. 4-9. Water from the sump will be directed to the wastewater treatment plant. Waste mining will progress from the flat area at the toe of the ramp in a southeast direction to the deposit. Waste will be carefully peeled off the sharp north ore-waste contact and the waste mining will be turned to follow this contact both to the northeast and to the southwest. Ore mining will follow behind the hanging wall waste mining in both directions. After the ore is removed, the footwall waste or south side of the deposit will be mined to design pit limits.

When the major portion of ore from Phase I has been mined, mining in Phase II will begin. As in the preproduction period, the till, sandstone, and saprolite material in the Phase II area will be ripped with the large dozer and pushed into piles of sufficient height to be efficiently mined with the hydraulic shovels. The volumes of each of these materials of Type I and II waste rock are shown in Table No. 4-2.

Drilling and blasting will probably be required in the sulfide ore and ripping with drilling and blasting in Type I and Type II waste rock. In order to minimize dilution, the ore and adjacent waste rock will be mined in ten-foot benches. Waste rock will be mined toward the north contact of the deposit and will be excavated before the ore is blasted. Since the hanging wall waste ore contact is generally quite sharp, considerable care must be taken in positioning the last row of waste holes so as not to overmine or undermine the waste.

To take advantage of the naturally occurring planes of schistosity, inclined blast holes will be drilled parallel to the schistosity, which dip at approximately 71 degrees, with a range of 49 to 88 degrees. Inclined holes, oriented parallel to the steeply dipping mineralization, will be used in waste at the hanging wall ore contact to aid in peeling the waste off the ore. Inclined holes will also be used inside the ore zone to minimize the inclusion of internal waste. Four-inch diameter blast holes will be used in ore drilling to ensure that there is sufficient powder rise to properly fragment the rock for efficient loading by the shovels.

Waste material not adjacent to the ore zone will be mined in 20-foot benches. The increased bench height will allow the use of a larger hole diameter and a wider drilling pattern. Vertical holes will be used for most of the waste drilling. In order to minimize damage to final pit walls and to assure the integrity of the catch benches, carefully controlled blasting techniques will be used. This will include a tighter hole spacing in the final row of holes, lighter charging, and single-hole-per delay detonation.

The test blasting program described in section 4.7.3.2.1 will be used to define the best combination of hole diameter, burden spacing, and powder factor that will yield the best fragmentation and ore/waste separation. Hydraulic drills have been selected in order to cover the potentially wide range of drilling requirements. These units are capable of drilling holes at nearly any orientation, have a high penetration rate and are significantly quieter than equivalent pneumatic drills.

Prior to open pit blasting, the pit foreman and powder crew will patrol the mine site to determine that it is safe and secured. These employees will be equipped with two-way radios to report back to the blasting foreman that the blast can proceed. A siren will be sounded immediately before detonation to alert people in the vicinity of the pending blast. Blasting will commence in the west end of the pit, near the Flambeau River. As an extra precaution, flagmen will be stationed on the river bank for initial blasting required in the west end of the open pit. Likely sites would be where the Section 9 south boundary line intersects the east bank and north of intermittent Stream A, near a Flambeau home. These patrol station distances are approximately 600 and 1,300 feet south and north of the pit perimeter, respectively. Six hundred feet south of the pit should be of sufficient distance from the blast since blasting will be directed in a northwest direction.

The first blasting will probably occur in ore in the 1080 bench, which is the first full bench below original surface topography. The steep dip of the ore and host rocks to the northwest will tend to direct any fly rock in that direction and away from STH 27. Precautions will also be taken on the Flambeau River when blasting in the extreme west end of the pit. As an extra safety precaution, under certain circumstances, traffic may be halted on the highway during blasting.

Grade control will consist of detailed mapping, trenching and drill hole sampling. The mapping will entail keeping a detailed record of geologic data on each bench by mapping the mining face and final wall. These records will be projected to the bench below in order to supplement data available from delineation diamond core drilling for ore and waste blast hole location planning. In addition, sources of water inflow, flow rates, and records of structural data will be continuously compiled and assessed to assist in pit wall slope design.

Trenching or channel sampling will be required in certain areas of the deposit, particularly in the footwall and gossan. Trenching will be conducted by lowering a ripper tooth into the deposit and producing a shallow trench at right angles to the mineralization. In areas containing elevated levels of chert mineralization, other measures such as masonry saws may have to be considered. Trenching will be done in the softer footwall rock to supplement data from blast hole drilling.

Vertical or inclined blast hole samples will not be representative of the material in the blast due to the steeply dipping nature of the ore. To provide more reliable samples, hydraulic drills will be used to drill horizontal holes at the mid-bench elevation. These holes will be oriented perpendicular to the strike of the ore, will be drilled from the hanging wall side, and will be sampled on five-foot intervals. These horizontal holes will be blocked to reduce the potential for air blasts and premature energy dissipation.

Waste drill holes will be sampled and analyzed for sulfur in order to classify the material as either Type I or Type II for correct surface storage. Much of the upper portions of Type I and Type II waste material can be ripped and dozed into piles for haulage to the surface storage areas. Drilling and blasting of waste rock material will commence when the waste rock becomes unrippable. Segregation of the Type I and Type II waste materials will be conducted on a visual basis, backed up by blast hole drilling and grab samples for sulfide analyses.

The mine geologist or lead sampler will be responsible for making the determination whether the waste rock is Type I or Type II. There are several criteria that will be employed in making the visual inspection of the waste rock. Fortunately, pyrite mineralization at Flambeau is extremely easy to recognize based upon:

- Shape, which is usually cubic;
- Luster, which is generally metallic (shiny); and
- Color, which is brassy. Also, oxidized non-sulfide bearing rock is brown in color whereas sulfide bearing rock is usually gray.

Geologists, by training, are able to visually estimate various mineral percentages when examining rock samples. This is a normal and routine part of conducting mineral exploration and mine geology investigations. There are two ways to assist and verify visual estimates which are:

- Comparison charts to assist the geologist in making a visual estimate; and
- Analytical procedures for verification.

There are several government and geologic society comparison charts published to assist the geologist with the visual estimation process. One such chart is available from the American Geological Institute. This chart, or others will be used during detailed pit mapping during which time the waste rock will be classified into Type I and Type II material.

Criteria for determining when and how many sulfur analyses will be required depend upon what mining equipment is being employed to break-up waste rock. Waste rock will be broken by using bulldozers having a single tooth ripper or by drilling and blasting.

Directing the ripped waste rock to the correct surface storage pile will be determined by detailed geologic mapping, visual estimation and grab sampling. The amount of grab sampling will be reduced from several samples per day to an infrequent basis as the geologist gains experience and confidence in distinguishing Type I and Type II material. In general, there will be little difficulty recognizing the two waste rock types. Sulfur analysis from grab samples will be required in the gradational contact zones between Type I and Type II material, in zones of question, and in areas of complex interfingering of sulfide and non-sulfide bearing rock.

Waste rock drill holes will be sampled and analyzed for sulfur on a regular basis in order to classify the material as either Type I or Type II. Random grab samples of ripped or blasted rock will be taken to either assist in making the correct classification or verifying estimates before the rock is loaded and transported to the surface.

Blasted material will be flagged in the field to provide the loading equipment operator with the material classification. Flagging consists of outlining the block of material with colored ribbons tied to stakes to denote material type. The color of the ribbons would denote the material classification as per the following example:

<u>Color</u>	<u>Material Classification</u>
Red	- Ore
Blue	- Type I waste
Green	- Type II waste
Yellow	- Saprolite to be placed in the Type I stockpile

This method allows the loading equipment operator to readily distinguish material types when loading trucks for hauling the material to the appropriate disposal location.

Blasted material will be loaded by hydraulic front shovels. These units are well suited to selective mining because of their superior break-out force and fast cycle time.

The ore will be truck hauled to the crusher and dumped onto the vibrating grizzly. Oversized ore blocks will be reduced by a rockbreaker. A temporary coarse ore storage area will be constructed next to the crusher for emergency use during crusher downtime.

Waste material will be truck hauled to either the Type I or the Type II stockpiles, depending on sulfur content. Type II waste will be dumped on the operating surface of the dump and a dozer will then spread the material over the bedded liner. Rock types will be segregated in both stockpiles so that they may be backfilled in the required sequence at the end of the mine life.

In order to assess the wall stability in the vicinity of the river pillar, mining of the last 100 to 200 horizontal feet of the west end of any given bench will be deferred for a short time. It is anticipated that this last increment of a bench can be deferred for one to two months without unduly hindering mine development. This time frame is judged adequate to map in detail the mined-out benches in the river pillar area for geotechnical and hydrologic investigations and evaluation of this data. Mining will be continued when these investigations confirm that the river rock structure provides for safe operation.

Dust control will be provided by a 4,000-gallon water truck cycling as necessary over the haul roads and stockpile areas.

4.7.3.3.7 **Haul Road**

A gravel surface haul road will be constructed from the open pit entrance to the Type I and Type II stockpiles (Figure No. 4-1). Construction of the haul road from the open pit to the entrance of the Type I and Type II stockpiles will use a combination of on-site and imported materials. The type and volume of these materials was presented in Table Nos. 4-6 and 4-7. Construction of the road within the perimeter berms of the two stockpiles will be accomplished using open pit materials designated for the specific location.

An extension of the haul road will connect the open pit and crusher area to the equipment fueling and maintenance areas. The haul road northwest of the Type II stockpile will be lined for a distance of approximately 1,250 feet to the crusher turnoff. The site will be graded and prepared to receive twelve inches of selected open pit till and compacted to 90 percent of its maximum modified Proctor density (ASTM D 1557). The 60-mil HDPE liner will be laid on the compacted till and the liner joints carefully welded and inspected. The liner will be placed up and onto a berm constructed on the outside edge of the haul road as shown on Figure No. 4-21. The road bed will be built up using an 18-inch layer of granular drainage material, followed by sandstone and till materials up to thicknesses of approximately 30 feet. In this position the haul road will be constructed to have optimum grade out of the pit.

The sandstone and till used to construct that portion of the haul road lying within the perimeter of the Type II stockpile is classified as a Type I waste material. It will be placed on the Type II stockpile only to provide a base for the haul road leading to the crusher area. The sandstone and till are scheduled to be placed on the Type II stockpile during the 30-day period preceding the start-up and operation of the waste water treatment facilities. Runoff from the sandstone will either be held within the lined area of the Type II pile for subsequent treatment through the wastewater treatment system or, pumped to the settling ponds if no Type II material has yet been placed in the stockpile area.

The width of the haul road will be approximately 60 feet. The road will be carefully crowned and drained so that stormwater runoff is directed into the open pit. An aggregate base of up to a maximum of 54 inches will be placed and compacted to specified engineering standards. The road grade will generally range between four to eight percent with a maximum grade of ten percent.

Construction methods employed in building the haul road will be similar to those used in construction of the mining facilities access road, as described in section 4.7.4.1 of this application. A safety berm will be installed as required by mine safety regulations.

Haul trucks operating out of the open pit will transport ore from the pit to the crusher located on the southwest corner of the Type II stockpile. Based on normal mine operations, approximately 220 round trips will be made daily on the ore haul road either to or from the crushing facility or the stockpiles. Additional traffic will consist of other operations vehicles for maintenance, supervision, and transporting of employees to mining equipment. The slopes, contours and general condition of the ore haul road will be maintained to ensure a safe operating condition. Watering will be done as required to control the dust generated by the traffic on the ore haul road.

4.7.3.3.8 <u>Crusher</u>

The crushing facilities as shown on Figure No. 4-12 is located at the southwest edge of the Type II stockpile. The construction of the crushing facilities will consist of a foundation base mat and retaining wall with a wingwall extension on each side and a 60-mil HDPE underliner. Steel erection and equipment installation will commence after the retaining wall has been constructed.

Upon completion of the retaining wall, berm construction, and site preparation in the Type II stockpile area, a 60-mil HDPE liner will be installed as an underliner for the Type II stockpile. The HDPE liner will be tied into and sealed up against the back side of the retaining wall. In this fashion, precipitation infiltration at the crusher truck dump and haul road will be collected onto the Type II liner and directed to the wastewater treatment plant. Select fill (sandstone and till from the pit) will be placed along the Type II stockpile side of the retaining wall to an elevation of approximately 1,186 feet as shown on Figure No. 4-12. Approximately 3,940 cubic yards of crushed gravel will then be placed on the select fill to complete the construction of the haul road and turn-around area on the northeast side of the crusher area.

A coarse ore stockpile area will be located on a broad flat area northeast of the crusher (Figure No. 4-7). This area, which will be underlain by a 60-mil HDPE liner, has sufficient capacity to store several thousands of tons of coarse ore without impeding truck flow to and from the crusher feeder hopper.

The crusher will be operated during daylight hours five to six days per week. Because it has a design capacity of 280 tons per hour, it will only be necessary to operate the crusher 68 percent of the time in order to crush approximately 6,100 tons per week of ore. A crusher operator will be on duty to ensure a smooth flow of coarse ore feed from the hopper to the crusher. In addition, the operator will be responsible for activating the water sprays located at the crusher and conveyor belt discharge as required to suppress dust. Occasionally, an oversized piece of ore will require the operator to use the hydraulic rock breaker to reduce the ore to a manageable size for crushing.

If the crushing system should need major repairs requiring a prolonged shutdown, mining could continue at its normal production rate by stockpiling the ore in the flat area on the Type II stockpile immediately adjacent to the crusher. When repairs are completed, this ore would be reclaimed by a front-end loader at a rate compatible with the crushing system capacity.

Crushed Ore Loadout Area

Crushed ore will be removed from the crusher and transported by a discharge conveyor belt to a conical-shaped crushed ore stockpile. A small 100-foot diameter stockpile will be located within the crushed ore loadout area. The crushed ore loadout area will be lined with a 60-mil HDPE liner extending three feet under the toe of slope of the haul road fill and the Type II stockpile berm adjacent to the pad. The liner will be placed over a one-foot thick recompacted base of on-site till. The recompacted base will be constructed to 90 percent of its maximum modified Proctor density (ASTM D 1557). Subsequent construction of the loadout area will be as follows. A 24-inch thick layer of clean sand will be placed over the 60-mil HDPE liner. The clean sand will then be covered with 18 inches of select gravel material from the open pit. This gravel will be dressed with 12 inches of crushed gravel. The lined stockpile and loadout area will be sloped and contoured to channel runoff to the lined runoff pond (Figure No. 4-12). The loadout area will require approximately 2,170 cubic yards of off-site crushed gravel.

The rail sidings that extend into the loadout area will be constructed on a reinforced concrete pad, with ties supporting the rails and concrete fill between rails to establish a smooth crossing which will allow controlled migration of runoff water to the runoff pond. A plan view of the rail car loading area is shown on Figure No. 4-12. Detailed sections are shown on Figure

No. 4-23. A profile showing the Type II stockpile, crusher and crushed ore load out area is contained on Figure No. 4-62.

An average of ten to 12 railroad cars per day will require loading by a front end loader. Due to the high density of the sulfide ore, the railcars will be approximately half full volume-wise when receiving their full weight load commitment.

4.7.3.3.9 Stockpiles-General

Four primary material stockpiles will be in use throughout the life of the mining operation. These are the eight-acre topsoil stockpile; the 40-acre Type I material stockpile; the 27-acre lined Type II material stockpile; and temporary pre- and post-crusher stockpile in the loadout area. In addition, a small hydric soil stockpile will be developed in the remnant of Wetland No. 2. A discussion of this stockpile and the management of wetland soils is contained in Section 5.11 of this report. A discussion of the pre- and post-crusher stockpiles was presented above. The construction and operation of the remaining three stockpile sites is discussed below.

Waste material to be removed and stockpiled during operations will be designated for storage in one of the stockpile areas. Visual observation or analytical testing of material from the open pit will be used to assist in categorizing the various waste materials.

4.7.3.3.10 Topsoil

At the on-set of site construction activities, the area for the topsoil stockpile will be cleared, grubbed, and graded to establish drainage. The stockpile will be constructed in two phases. Phase I will be constructed during initial construction activities and will receive soil from the entire open pit, the west half of Type II stockpile, the base of the Type I stockpile, and from the plant facility and ancillary sites. Phase II will be constructed during year three when Phase II of the Type II stockpile is constructed.

Topsoil will be removed, handled and stockpiled northeast of the open pit. Equipment used to handle the topsoil will stockpile the material with a minimum amount of traffic activity upon the pile to minimize soil compaction. Final slopes and grades will be established using the track mounted dozers or backhoes to minimize ground pressure and compaction.

The entire topsoil stockpile will be reseeded and revegetated with a grass seed mix native to the area after the pile reaches its final design grade. The slopes will be slightly furrowed perpendicular to the slope to resist erosion and enhance revegetation. Silt fences and straw will be used to prevent erosion both during construction and revegetation. Any significant erosion will be immediately repaired and revegetated with additional erosion control measures implemented in the affected areas.

Construction of the visitor's observation area will first consist of grading for the visitor's parking area (Figure No. 4-14). This area will have the capacity to park up to 20 cars and one bus. The parking area will be constructed of crushed stone placed on a subbase of sand and gravels. Access to the parking area will be off STH 27. The access will be constructed according to appropriate Wisconsin Department of Transportation (WDOT) codes and regulations.

The observation area will be constructed at the top of the topsoil stockpile at elevation 1,190.0 feet. Access to the area will be provided by a trail extending from the visitor's parking area. The visitors observation platform will be a small, skid mounted structure and will not require a foundation or a compacted base. The trail and observation area will be secured by fencing. A locked gate will be installed at the entrance. Visiting hours will be from 9:00 a.m. to 4:00 p.m. all week long during the winter, and 9:00 a.m. to 9:00 p.m. during the summer season, with the exception that the area would be closed during blasting.

4.7.3.3.11 Type I Stockpile and Settling Ponds

Construction

The Type I stockpile (Figure No. 4-14) will cover 40 acres, and is located on the north side of the open pit. This stockpile will segregate and store overburden, sandstone, and Type I waste rock and saprolite. Associated with the stockpile will be the construction of two settling ponds to be used to clarify runoff from the Type I stockpile prior to discharge to the Flambeau River.

Construction of the two settling ponds will consist of excavating the ponds to grade. Overexcavation of subsoils is not planned. The excavation process will be followed by the placement of a 16-inch diameter corrugated metal pipe (CMP) outlet conduit connecting the ponds to the discharge drainage swale located to the southwest. This conduit will be connected on the upstream end to a 36-inch vertical inlet structure in each of the two ponds. Each inlet structure will have slide gates to allow draining of the ponds after an appropriate settling period. The conduit will be fitted with anti-seep collars at strategic locations to minimize the chance of piping. After the conduit is in place, the settling pond berms and spillways will be constructed. On-site till material, placed and compacted in shallow lifts, will be used for this purpose. After the berms are constructed, they will be bladed, mulched and the area seeded. At the time the discharge conduit and vertical inlet structures are being placed, a 30-inch diameter CMP inlet conduit will be placed in the northeast corner of the first settling pond. The conduit will transfer runoff from the internal Type I drainage system to the settling ponds.

The final construction activity associated with the settling ponds relates to the drainage swales from the ponds to the Flambeau River and to Wetland No. 1. The swales (Figure Nos. 4-7 and 4-20) will be constructed to design grades and topsoiled and seeded. At the time the swales are constructed, the diversion structure used to divert runoff to Wetland No. 1 or the Flambeau River will be constructed. The discharge point at the Flambeau River will be protected with riprap to prevent erosion. Construction of the swales will be accomplished while minimizing disturbance to surrounding areas. Details regarding the construction of this outfall are contained in section 4.7.4.13 of this application and the Wisconsin State Statutes Chapter 30 Permit Application for the Flambeau Project. Further details regarding the design, construction, and operation of the settling ponds can be found in section 4.7.4.12 of this application and in the FER.

At the on-set of site construction activities, the area for the Type I stockpile will be cleared and grubbed. Topsoil will be removed and placed in the topsoil stockpile. Temporary drainage control consisting of interim berms and swales will be used during the initial clearing and grubbing operation to channel drainage and control erosion.

Once clearing and grubbing is completed, the exterior berms will be constructed to design grades in compacted lifts. Concurrently, the development of the final drainage control system will take place. Once the berms are constructed, three inches of topsoil will be placed on the outward slopes of the Type I berms. Vegetating will then take place.

Material for construction of the Type I stockpile and settling pond berms will be obtained from overburden (not uniform sand or gravel) materials excavated from the open pit. The selection and placement of the material will be subject to approval by a Flambeau representative. The berms will be constructed so that the distribution of materials will be essentially free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material. The fill will be placed in approximately horizontal lifts extending the entire width of the embankment. The thickness of each lift will be no more than 12 inches. Each lift will be compacted to 90 percent of its modified Proctor density (ASTM D1557) with a moisture content within $\pm$ 2 percent optimum.

Operation

Till, sandstone, and Type I saprolite and waste rock will be hauled by truck to the Type I stockpile area. During mining operations, hauling will be done during one eight-hour shift. However, during preproduction, hauling will take place during three eight-hour shifts. Material delivered to the stockpile will be dumped and spread by dozer in shallow lifts. Some compaction of the material will take place as a result of operating equipment. During the operation of the Type I stockpile, a dozer or front end loader will be used to assist in grading loads and to provide a flat stable working area. A water truck will be used to control dust. The sequencing of material placement is discussed in section 4.7.3.2.8 of this application.

The sequence of construction of the Type I stockpile will result in substantial volumes of the till, sandstone and saprolite being in place by the end of the third year of operation. Those portions of the stockpiled till, sandstone and saprolite outboard slopes that are at grade after three years of operation will be seeded. The seeding procedure specified in section 4.8.4 will be used for this application.

Certification Plan

The certification plan for the Type I stockpile and settling ponds will consist of the collection of survey data to define site base grades and berm and drainage system construction. Survey data will also be collected to define the top of the "till blanket" following its construction.

Following the removal of topsoil and prior to the placement of the "till blanket", the base grade of the Type I stockpile will be mapped by a soils geologist. The purpose of the survey will be to qualitatively map the subsoils in the Type I stockpile area.

The data collected from the above work will be used to prepare drawings showing site base grades, top of till and a drawing illustrating the types of subsoils in the Type I stockpile area.

In addition to the above, photographs of the construction as it progresses will be taken. Photographs will also be taken by the geologist to provide visual reference material regarding subsoils composition.

The field data, drawings and photographs will be maintained by Flambeau in archives for future reference purposes. Included in the archived files will be an opinion by a registered professional engineer as to whether the site was constructed in substantial conformance with the plan.

4.7.3.3.12 **Type II Stockpile**

Construction and Development Timetable

The Type II waste stockpile will be used as a temporary storage for approximately 2.2 million cubic yards of waste material. The total site life from initial development to final reclamation will be approximately seven years. The stockpile area will be developed in two phases to minimize the amount of water to be handled and treated. Phase I will consist of the development of the west portion of the stockpile which contains the ore haul road as shown on Figure No. 4-18. Phase II construction will begin in the latter part of year two, with the area operational by the end of that year. Phase I is designed to store approximately 1,100,000 cubic yards of Type II material. Phase II will store an additional 1,100,000 cubic yards. During the initial filling within the stockpile, sandstone from the open pit will be placed along the west and northwest perimeter to provide a base for the main haul road and crusher turn-around area.

Initial site preparation for Phase I will include topsoil stripping and the construction of the ore haul road, drainage swales, surge pond, perimeter berms, subbase grade excavation, liner and collection system placement. The construction of the ore haul road and surge pond are addressed in other areas of this application. A discussion of the construction of the remaining Type II stockpile features is presented below.

Construction will commence with clearing, grubbing, and stripping of topsoil within the area required for Phase I construction. Removed topsoil will be stockpiled in the areas designated in Figure No. 4-1. Preparation of the Phase I subbase area as shown on Figure No. 4-18 will follow. Material excavated during this process will be used for fill where needed and for berm construction. The grain size incorporated into the fill for berm construction and the subbase for the Type II stockpile shall not exceed six inches. The prepared subgrade in contact with the membrane liner shall be free of rocks, stones, sticks, sharp objects and debris. The fill shall be constructed so that the distribution of materials will essentially be homogeneous and free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from the surrounding material. No fill shall be placed upon a frozen surface, nor shall snow, ice or frozen material be incorporated into the fill. Soil used for such fill purposes will be placed in one-foot lifts and compacted to a minimum of 90 percent of its maximum modified Proctor density (ASTM D 1557).

An interior phase definition berm separating Phase I and II will be constructed as shown on Figure No. 4-18. The berm will be used to contain the placement of Type II material within Phase I and to prevent runoff from the stockpiled material in the Phase

I area from coming into contact with noncontact runoff from the designated Phase II area. Phase I runoff will be directed to the wastewater treatment plant. Runoff from the Phase II area will be directed to the existing natural drainage system surrounding the site. During subbase grade preparation, temporary drainage control consisting of interim berms and swales will be used during topsoil stripping, excavation, and berm construction to channel drainage and control erosion.

As berm construction progresses, the exterior drainage system will be constructed. The north and southwestern portions of this system will be constructed as the ore haul road, crusher, and ore loadout areas are constructed. The construction of these facilities was addressed previously. The northeastern and southern portions of the system will be constructed to channel noncontact runoff away from the stockpile. The drainage structure to be constructed as part of Phase I construction will be the drainage swale to be located on the eastern edge of the Phase II area. This will be a permanent swale which directs water to intermittent Stream C. Therefore, it will be vegetated following contouring activities. At this point in the construction process, outboard slopes of permanent berms will be vegetated.

Following completion of the above activities, site till will be cut and filled to bring the area under the HDPE liner to base grade. The top one foot of all cut areas will be scarified and recompacted during the preparation of the base grade. Flambeau's representative shall provide visual inspection to insure that the base grade is free of rocks, stones, sticks, sharp objects and debris. It is not anticipated that any screening or processing of base grade material will be necessary. The soil in both the cut and fill areas will be compacted to a minimum of 90 percent of its maximum modified Proctor density (ASTM D 1557). The fill material shall be dried or moistened uniformly as necessary to bring the moisture content to $\pm$ 2 percent of optimum at the time of placement. The excavation contractor shall furnish and operate the types and kinds of equipment necessary to compact the fill materials to the specified density. The compaction equipment shall traverse the entire surface of each layer of material the number of times required to accomplish the specified compaction. All areas to receive the HDPE liner will be graded to provide a smooth, firm surface on which to place the liner. The ground surface will be inspected by Flambeau's representatives to ensure that the integrity and function of the liner will be maintained after placement and loading.

The HDPE liner will be installed on top of the one-foot recompacted till layer by a reputable contractor experienced in geomembrane liner construction. This contractor will be selected once project permits are obtained. After the selection is made, a detailed QA/QC plan for liner installation will be prepared by Flambeau and submitted to the WDNR for review. As part of the installation of the HDPE liner in Phase I, liner construction will extend to the eastern limit of the top of the phase definition berm for future splicing purposes. The liner on top of this berm will be covered with one foot of on-site soil to protect it from the elements.

A key trench having dimensions of one foot wide by two feet deep, as shown on Figure No. 4-15, will be constructed at the top of the berm to anchor the HDPE liner. The liner edge will be placed in the trench and turned up approximately one foot. The trench will then be backfilled.

As part of HDPE liner and berm construction, the HDPE piping required to connect the Type II runoff collection system and leachate collection system (Figure 4-16) to the surge pond will be installed. The piping will be placed on a one-foot bed of compacted on-site soil and will be backfilled with on-site soils. Where the piping is located in the berm, backfill will be compacted to meet berm compaction specifications.

The construction of the leachate collection system and placement of the granular blanket will occur as the HDPE liner is placed in order to minimize traffic on the liner. As part of the HDPE liner construction process, no trucks will be allowed to travel over the in-place liner either before or after granular blanket placement until an additional cover of Type II material has been placed and spread over the granular blanket. A discussion of the construction of the leachate collection system and granular blanket placement follows.

The HDPE liner will be placed in panels. When a sufficient width of panels has been placed, anchored, and welded, the installation of the granular blanket and leachate collection system will begin on the liner that is in place. The granular blanket will either be screened on-site material or imported material nominally minus 3/4-inch gradation, having a permeability of 10^{-3} or better, and having no more than 5 percent passing 200 mesh. A temporary ramp will be constructed over the berm to provide access to the liner. Granular blanket material will be dumped on the ramp, outside the perimeter of the liner, and dozed by a lightweight dozer onto the liner. Measurements will be taken to insure that a minimum of a one foot layer of granular material is placed on the liner. The granular material will be dozed in a manner that will minimize any sliding or skidding of the material along the surface of the liner and insure that equipment does not come into contact with the liner. Spotters will be used to insure that the material is placed in accordance with approved procedures and to the proper thickness.

The initial placement of granular material will be along an alignment of sufficient width to provide an access corridor for the trucks hauling the blanket material. Concurrently, a layer of gravely sand, obtained from preproduction stripping of the pit, will be placed over the granular blanket material in the same manner, i.e., by dozing a two to four foot layer over the blanket material to support truck traffic and dumping without damaging the liner or the leachate collection pipes. Truck traffic will be confined to the corridor areas covered with the additional layer of gravely sand.

The access corridor will be constructed with several branches criss-crossing the liner so that the granular blanket material can be placed throughout the entire lined area in a manner that will optimize the dozing distances. As the granular blanket is placed, the leachate collection system will be installed ahead of it with the blanket being used as a cushion for a lightweight front end loader that will be used to transport and place the screened and washed filter gravel used to bed the collection system. The filter gravel will be placed in an 18-inch thickness around the perforated PVC collection pipes and will consist of washed 1-1/2x 3/4-inch subangular, non-calcareous gravel as shown on Figure No. 4-20.

Prior to placement of the initial layer of waste material over the granular drainage material, the drainage blanket will be visually inspected to insure that no damage has occurred to the blanket or the liner. If any damage is detected, the drainage blanket will be removed from the affected area, repairs made and the drainage blanket replaced over the repaired area.

The leachate collection system will be installed above the HDPE liner as detailed on Figure Nos. 4-20 and 4-22. The leachate collection piping will be 6-inch diameter schedule 80 PVC pipe with an outside diameter of 6.625 inches and a minimum wall thickness of 0.432 inches. All of the pipe except the fittings, the cleanout risers and the leachate collection header extension will be perforated every five inches with two 1/2-inch diameter holes separated 120 degrees apart.

The leachate collection header extension will be a solid length of 6-inch diameter PVC pipe that will penetrate the Phase I liner on the east side, extend through the berm and will have a solvent welded cap placed over the end. This extension will later be connected to the collection header for Phase II of the Type II stockpile. The perforated pipe will be placed directly on the surface of the HDPE liner and bedded with 18-inches of 1-1/2 x 3/4-inch filter gravel on the sides and top. The schedule 80 perforated PVC pipe has sufficient strength to withstand crushing from both the weight of the stockpiled materials and the mobile equipment used to place material on the stockpile as shown by the calculations in Appendix H. It therefore will not be necessary to bed the pipe in a "V-trench" depression. The perforations will be placed toward the bottom, at 60 degrees either side of the vertical axis, to facilitate collection of the leachate.

Pipe joints and fittings will be solvent welded using a bonding adhesive in accordance with the PVC manufacturer's recommendations. All welded connections will be clean and free of moisture, dust, dirt and debris of any kind. Flanged connections will be made up where the PVC collection header connects to the HDPE leachate discharge structure.

The collection system is designed such that the penetration of the liner will occur at the point where leachate will be transferred from the lined area to the surge pond and where the collection system header pipe will be installed beyond the phase definition berm and capped for future extension into the Phase II area. The leachate discharge structure, Figure Nos. 4-50, 4-51, 4-52 and 4-53 will be a 48-inch diameter HDPE pipe with a factory welded one-inch cap on the bottom. The pipe will have 1/2-inch diameter perforations on 12-inch spacings both vertically and horizontally. A two foot thick layer of 3- x 1-inch gravel will surround the pipe from top to bottom to serve as a "French drain". The top of the discharge structure will extend two feet above the bottom of the inside perimeter drainage ditch to provide for energy dissipation and act as a sediment trap for runoff from the Type II pile. Sediments that accumulate below the top of the outlet structure will be periodically cleaned out so as to maintain the two foot clearance.

The 48-inch HDPE inlet structure will have three butt fused six-inch diameter HDPE tees and one butt fused 36-inch diameter tee installed at the factory. Each tee will be located on a 90 degree spacing approximately nine-inches above the bottom of the pipe. The tees will extend approximately twelve inches outside the outlet structure and each will have a butt fused flange adapter at the end. Matching flange adaptors will be made up on the six-inch PVC pipe and the 36-inch discharge pipe so that these pipes can be connected to the tees by metal back-up flanges with gaskets. Both the leachate collected from the liner and the runoff from the stockpile will flow through the 36-inch HDPE discharge pipe from the discharge structure to the surge pond.

Phase II Construction

Construction activities for Phase II will consist of clearing and grubbing, removal of topsoil, and the excavation of the Phase II area to the grades shown on Figure No. 4-24; the construction of exterior berms to the east and south; the placement of the recompacted base, HDPE liner, granular blanket, and leachate collection system. Construction techniques will be the same as those discussed for Phase I.

Certification Plan

Documentation of various construction activities will include the use of field and laboratory verification tests, survey information and photography. Collected data will be summarized in report form and maintained by Flambeau in archives for future reference purposes. The report will address both phases of site construction. The report will include documentation of berm and base grade construction; HDPE liner installation; and drainage blanket and leachate collection system construction. Also to be included will be an opinion by a registered professional engineer as to whether the site was constructed in substantial conformance with the Plan of Operation. Procedures to be followed in completing the documentation efforts are listed below.

Surveys

Surveys will be performed to document the location of berms and drainage swales; finished subbase and base grades; and leachate collection system piping.

Subgrade Soils

The following testing program will be performed on the fill used to bring the site to base grades and to construct berms.

- One field density test shall be conducted on each one-foot lift of fill at 100-foot horizontal intervals. Natural soil moisture at the time of placement shall also be determined at these locations.
- Grain size distribution curves shall be conducted on all fill materials including subgrade soils, at a frequency of one test per every 1,000 cubic yards of material placed.
- A modified Proctor curve shall be developed for every 10,000 cubic yards (in-place) of fill placed.

HDPE Liner

The following testing program shall be performed on the HDPE liner material and installation.

Material testing will be conducted and certified by the manufacturer for each roll of material and will include:

- Molecular weight of the material quantified using the melt index (ASTM D 1238).
- Tensile and elongation properties measured in accordance with ASTM D 638 and must meet manufacturers' specifications.

- Material thickness tested in accordance with ASTM D 1593.

- Environmental stress cracking resistance measured according to ASTM 1693.

- Visual inspection made to insure that liner is free of pores, pinholes or other detrimental defects.

Field quality control of the HDPE liner placement will be directed primarily towards the integrity and water tightness of the seams. Testing will include:

- Shear testing and peel testing of seams in accordance with ASTM D 638 conducted twice during each shift for each welding machine to determine joint structural integrity.

- Vacuum testing of the joint conducted using soap and a glass-faced suction box. If holes are located, they will be marked, repaired, and retested.

- A visual inspection done by the contractor's supervisor and repairs made if necessary.

- Photographs taken of the liner construction.

Additional HDPE supply and installation specifications are contained in Appendix J.

<u>Drainage Layers and Collection Pipe Bedding</u>

The following testing program shall be performed on the material used for the drainage layers.

- For each 2,500 in-place cubic yards of material placed, samples shall be collected for grain size analysis through P200 content.

- For each 2,500 in-place cubic yards of material placed, samples shall be collected for laboratory vertical permeability testing. Samples shall be tested at the anticipated field density of the material. Moisture content and density of each sample shall also be determined.

The following testing program shall be performed on the washed stone used for construction of the drainage collection system.

- One sample shall be collected for grain size analysis through the P200 content for each 1,000 lineal feet of trench. A minimum of three tests shall be performed.

Drainage Collection System

The following documentation program shall be performed on the drainage collection system:

- Collection pipe and cleanout riser locations and elevations will be surveyed and documented.

- Photo documentation of the placement of the drainage collection system, granular fill, and connection of collection lines to the wastewater treatment surge reservoir.

- Following construction, all collection lines will be cleaned using a water jet cleaning system. The cleaning operation shall be documented in the report.

Operation

Information such as hours of operation, traffic routing, and personnel are outlined in the other sections of the mine permit application.

Initial Type II Material Placement

A temporary access road will be constructed using Type II material from the west side of Phase I for access to the active fill area. The temporary road will be bedded on the drainage blanket material and shall be a minimum of four feet thick. Maximum grade on the road will be ten percent. The road will be constructed by pushing Type II material from the berm using a dozer. The dozer will only operate on material pushed in front of it. A culvert will be placed in the internal drainage swale so as not to impede internal drainage. An initial four-foot lift of Type II waste rock will then be placed over the granular blanket on the base area to protect the liner and collection system from damage from haul vehicles and other equipment. The saprolite material in the Type II pile will be placed at the extreme northern sector of the pile to limit the area affected by the lower permeability of this material, and thus to promote maximum drainage and collection.

Leachate Line Cleaning

Leachate collection lines will be jetted following completion of construction, just prior to the placement of waste material. Wherever possible, jetting will be accomplished from the low end of the line to the higher end. For the lines that are greater than 1,200 feet long, jetting will be performed in the same manner. If jetting of these lengths cannot be accomplished in one direction, they will be jetted from both ends. Using this approach, the jetting process will traverse 800 feet in both directions, thereby providing an overlap of 400 feet.

Given the short life of the stockpile as a whole and the fact that the two longest leachate collection lines are located in the eastern portion of Phase I and in Phase II, which means they will be active for a shorter period than the stockpile as a whole; the proposed cleaning frequency and procedures are sufficient for this project.

Record Keeping

The mine operator will have the responsibility of maintaining records to properly manage operations of the Type II stockpile. Records will be retained to monitor operation, maintenance activities, and waste quantities placed in the stockpile.

Typical Daily Operations

- Stockpile area is to be open for handling of material during normal day-shift mine operations except during preproduction when the haul road and crusher ramp material will be delivered on a three-shift basis.

- The destination of the materials to be removed from the pit will be determined on a daily basis.

- Material is to be placed in shallow lifts. A dozer will be used to spread the material and shape the stockpile.

- The amount of time the dozer works on the stockpile will be based on the amount of material delivered.

- Watering of the ore haul road and stockpile area will be done on an as-needed basis to control dust.

- Placement of Type II material is to be accomplished such that the internal swale and runoff collection system are maintained in accordance with the design as outlined on Figure Nos. 4-20 and 4-21. All swales will be maintained such that they are free and clear of obstructions that would disrupt collection and flow of runoff water to the wastewater treatment system.

Inclement Weather Operation

The main difficulty during cold weather operations is adequate site access. A snowplow or dozer will be used to clear roads.

Properly designed, constructed and maintained drainage swales and access roads will minimize operation disruptions due to periods of wet weather. Roads leading to the active storage area are to be passable during all weather conditions. Should the access road become impassable, a dumping area closer to the phase entrance will be used for the duration of the wet weather. An area in each phase will be reserved for such operations.

Every effort will be made to minimize the effect that windy conditions can have upon stockpile operation. This can be accomplished by taking advantage of prevailing wind directions and orienting operations to minimize the exposure of material to the winds when exceptionally high wind velocities are experienced.

Dust Control

Dust may be generated at the stockpile from operations of vehicular travel on access roads. Dust control will be accomplished by watering access roads and the deposited material at the active storage area, as necessary.

Inspections

Qualified personnel will inspect the site once per week. During each inspection, the following items will be observed. The berms shall be inspected for evidence of erosion, differential settlement, and vegetation stability. Internal and external drainage swales shall be inspected for erosion or blockage. Maintenance of problem areas shall be conducted as the need arises.

4.7.4 Ancillary Facilities - Design Construction and Operations

Introduction

The general arrangement of the plant facilities is illustrated on Figure No. 4-12. During construction, the entire eight-acre plant facility site will be stripped of topsoil and the area contoured for construction. A series of silt fences and a temporary water control sump will be located in the southeast corner. Runoff water from the site will be directed to the sump from which water will be pumped in a temporary pipeline to the settling ponds.

It is estimated that 76,350 cubic yards of cut will be required to prepare the plant site for construction. Of this amount, approximately 43,700 cubic yards of till can be used in other parts of the site to bring low areas up to grade. Excess cut material will be used elsewhere on the mine site such as on the Type I and II stockpile berms.

4.7.4.1 Access Road

A plant site paved access road will connect the site with STH 27 (Figure No. 4-1). The road will proceed approximately 750 feet west from STH 27 at a point directly opposite Jansen Road. The road will terminate at the plant entrance. The road will consist of two 12-foot wide lanes and three-foot wide shoulders. A culvert has been incorporated into the road design to maintain the current drainage of areas north and east of the access road. Figure No. 4-38 contains a cross section of the access road.

The right-of-way corridor for construction of the new access road will be cleared and grubbed of trees and shrubs prior to rough grading.

Based on preliminary engineering for the access road, approximately 0.8 acre of right-of-way will be cleared and grubbed.

The roadway will be built using both crushed aggregate and select sand and gravel from off-site. A base of well-graded material will then be placed and compacted to a depth of approximately 26 inches to provide adequate strength and drainage to resist damage from frost. Table No. 4-7 presented an estimate of the volume of on-site material needed for road construction. Final construction of the access road includes vegetating all disturbed areas along the right-of-way.

4.7.4.2 Parking and Gatehouse

An employee and visitor parking lot with a capacity of 60 vehicles will be located east of the administrative building as shown on Figure No. 4-12. The parking area will have asphalt paving. Drainage will be directed to the natural drainage system located east of the surge pond.

Topsoil in the parking area will be stripped and saved. The subbase will be graded, contoured, compacted, and a base layer of aggregate added to the site. Approximately 725 cubic yards of crushed gravel will be required to dress the parking lot. Finally, the lot will be paved using approximately 570 cubic yards of asphalt, and the surrounding areas topsoiled, mulched, and vegetated.

The gatehouse will be constructed as an extension to the main office directly adjacent to the entrance gate leading to the shop and yard area. The gatehouse will be manned at all times during the life of the mine to control access to the plant. During operations, the parking lot will be maintained by plant equipment.

4.7.4.3 Administrative and Maintenance Buildings

The administrative and maintenance buildings have been positioned for ease of traffic flow and employees' availability. The buildings are located within an area of approximately 250 feet by 350 feet (Figure No. 4-12) near the center of the plant site. The administrative building will be located on the west side of the employee parking lot. Figure No. 4-39 contains a plan view and elevations for this building. The design, construction, and use of this building will be in accordance with applicable federal, state, and local codes and to Flambeau's requirements.

A pre-engineered steel maintenance building will be constructed east of the wastewater treatment building. This building, as shown on Figure No. 4-40, will be constructed for equipment maintenance, and the storage of tools and spare parts. Heating will be provided to the maintenance bays and enclosed storage areas. Lubricants, paints, cleaning materials and bottled gas will be stored in an approximate nine-foot by 40-foot storage structure adjacent to the east side of the building. A two-hour firewall will be constructed between the supply storage area and the maintenance building. There will be no long-term storage of materials in the storage area. The maintenance building floor will be constructed of concrete. The building contents will be inspected regularly and any spills will be cleaned. The design, construction and use of the building will be in accordance with applicable federal, state and local codes.

Water collected in the truck maintenance shop will receive treatment prior to discharge to the influent structures of the wastewater treatment facilities. A gravity oil and grease separator will be used to remove the oil and grease from this water. The removed oil and grease will be disposed of off site.

During operations, the administrative and maintenance building will be staffed during each normal production shift. Off-hour use will be limited to maintenance activities.

4.7.4.4 Railroad Spur Line

The railroad spur line has been designed to provide as short and straight a track as possible between the plant facilities and mainline track while avoiding as much of the wetlands in Section 10 as possible. The spur corridor was also designed to minimize cut and fill and to maintain as level a grade as possible throughout its length. The railroad spur location and grade profile is shown on Figure No. 4-41.

The railroad spur will be used to transport crushed ore to an out-of-state processing facility. The spur, which will be routed from a main trunk line east of the mine site, will consist of a single track approximately 5,750 feet long and will include two 1,600-foot sidings located in the plant area as shown on Figure No. 4-1. Two road crossings and several culverts will be constructed as part of the spur line. Automatic warning signals will be installed on STH 27. Warning signs for the Meadowbrook Road crossing will be erected. Two switches will be installed on the plant area sidings for shunting of cars during loading operations. Figure No. 4-38 provides preliminary engineering details for railroad spur alignment and grade, the railroad subbase, bed cross section, the highway crossing, and the culverts to be installed.

Culverts will be installed to maintain the natural drainage pattern on either side of the spur line. A culvert will be installed at station 3+50 to maintain drainage along the west side of the mainline track; two culverts will be installed at approximately station 17+00 on either side of Meadowbrook Road; a culvert will be installed at station 33+75; a culvert will be installed at approximately station 48+15 along the east side of STH 27; and, two culverts will be installed at station 51+00 where Stream "C" crosses the spur line.

Spur line construction activities consist of clearing and grubbing three acres within the narrow spur line corridor extending from the main line of the Wisconsin Central Limited to the plant site. The construction corridor will vary from 35 feet to 60 feet in width, and reaches its widest point for a short distance where the spur line connects with the main line. Topsoil throughout the cleared area will stripped and pushed off to the side of the construction corridor. The topsoil will be pushed back during the completion of railroad spur construction for reclaiming disturbed areas such as embankments or cut slopes. Any excess topsoil will be relocated to the topsoil stockpile.

Temporary diversion dikes, ditches, and settling basins will be built prior to and during construction to collect disturbed area runoff water. Temporary siltation fences will be used in drainageways to control erosion until permanent vegetation has been established.

The spur line earthwork balance indicates approximately 14,930 cubic yards of select borrow material will be required to construct the railroad bed. This material will be provided by excess borrow available from development of the open pit and plant facilities or purchased from off-site. Cut and fill volumes for spur line subbase construction are approximately 35,200 cubic yards and 23,350 cubic yards, respectively. Most of the cut work is on the west end of the track in the plant area. Till is about evenly divided between the plant area and east of STH 27.

4.7.4.5 Fencing and Security

A six-foot high chain link fence with three strands of barbed wire on top will be installed for security purposes as shown on Figure No. 4-1. Access to the plant during construction will be restricted through the main gate located on the south side of the office building. Three additional gates will be installed. The first will be where the railroad line enters the site; the second at the existing access road to the existing shop building, and the third at the entrance to the observation platform. Figure No. 4-42 contains details of the fence and access gate construction.

During operations, the primary access to the site will be through the main gate located next to the gatehouse. A security guard will be stationed at the gatehouse at all times. The railroad spur and existing access road gates will be locked at all times. The locomotive operator will have keys to enable entry of locomotive and rail cars. The access road to the existing shop building will only be used for special delivery requirements. The gate to the observation platform will be locked except during normal working hours.

4.7.4.6 Laboratory

The laboratory will accommodate sample preparation, analysis, and support for the mining operation. Chemical analyses will be conducted on a daily basis for gold, silver, copper, oxide copper, sulfur, and some environmental analytical work. The building will include an area to receive and prepare samples, and a general laboratory area for wet process analysis of the samples. The laboratory has been designed to prepare and process about 90 samples per day and will be manned by employees on two shifts.

The underground utilities and foundations for these structures will be installed by the construction contractor. The laboratory will be a pre-engineered modular building, fabricated, delivered, and installed by the supplier or his subcontractor. The general layout of the building is shown on Figure No. 4-39.

During mining, the laboratory will operate two shifts per day, five days per week for analyses monitoring and accounting of the ore. Samples will be collected and delivered on a routine basis during normal operating hours with analytical work performed during both shifts.

4.7.4.7 Power Supply

An overhead power transmission line constructed to Northern States Power Company's (NSP) standards is planned for the project. The overhead line will terminate inside the plant site and a buried transmission line will continue to the main substation (Figure No. 4-12). The secondary circuit breaker in turn will feed the appropriate motor control centers located in the process areas. The outdoor substation will be mounted on a concrete pad which will be fenced as required by code.

The transmission line to the mine site will be constructed by NSP from an existing line, about 7,000 feet north of the mine facilities main substation.

Because of the permitting process and transmission line construction time, permanent power may not be available at the mine and plant facilities for approximately two months at the beginning of initial construction. During this period, power will be supplied by on-site generators.

During operations electrical power will be used to operate all process equipment, ancillary facilities, wastewater treatment facilities and for general lighting and miscellaneous use. Electrical power will be provided by NSP from their power network serving the general area of the mine. A summary of the average electrical power demand is shown below:

Operation		Average Demand Kw
Mine		145
Crusher area		209
Wastewater treatment		426
Office and labs		180
Miscellaneous loads		200
	TOTAL	1,160

With an allowance of approximately ten percent contingency, the projected average demand has been set at 1,275 Kw.

4.7.4.8 Fuel Storage and Distribution

Fuels and lubricants for the construction equipment will be hauled to the site by trucks. To assist in the need for on-site storage during construction, fuels will be obtained from a commercial source and temporarily stored in a tanker trailer.

A 15,000-gallon above ground diesel fuel storage tank will be constructed near the shop facility to supply fuel for the mining operation (Figure No. 4-12). These facilities have been located approximately 1,000 feet from the mine. No impacts are expected from blasting activities. The fuel tank will be constructed on a concrete ring foundation and will be completely surrounded by an earthen containment berm of sufficient height to contain the entire contents of the fuel tank, should a leak occur. The area within the berm will be lined with 60-mil HDPE and covered with sand to prevent any leaked fuel from seeping into the subsoil. A 1,000-gallon above ground gasoline tank will be constructed in a similar fashion on-site adjacent to the diesel facility. Figure Nos. 4-58, 4-59 and 4-60 contain a plan view and details pertaining to the construction of the fuel storage area.

During operations diesel fuel will be used for all of the mobile mining equipment. Diesel fuel will be delivered to the mine site by truck to the storage tank. The diesel fuel will be dispensed from the storage tank through an adjacent fuel pump. Fuel for the mining and haulage equipment will be transferred to an on-site fuel truck which will fuel the equipment during the beginning and end of shifts and during break times.

4.7.4.9 Magazines

Two portable magazines, each sized to store 15 tons of explosives, will be located in a remote area northwest of the Type I stockpile settling ponds as shown on Figure No. 4-1. A blasting cap storage building will also be located in the area. Each storage magazine will be arranged and bermed 15 feet high for safety and for protection of the storage areas as shown on Figure Nos. 4-14 and 4-43.

The magazine facility will be designed in accordance with the DIHLR and Department of Alcohol, Tobacco, and Firearms (ATF) standards to minimize damage from any accidental detonation. Separation distance of the magazines and their locations with respect to inhabited buildings, highways and railroads will comply with ATF requirements.

Access to the magazines will be by a gravel access road constructed to accept delivery and supply vehicles. The magazines will be locked and conspicuously marked in compliance with ATF regulations.

Mining operations will require explosives to be drawn from the magazines about one to five times per week. The explosives will be withdrawn and transported directly to the blasting area in vehicles that are clearly marked and identified. Before detonation of explosives in the open pit, a siren will be sounded to alert employees.

4.7.4.10 Water Supply

A new well will be constructed approximately 300 feet east of the surge pond to supply a reliable source of potable water in close proximity to the various buildings.

An existing potable water well, located near the intersection of the plant site access road and STH 27 will be used to furnish both potable and construction water to the mine/facilities until the new well is constructed.

Additionally, water from the settling ponds will be used to supply water for construction and dust suppression purposes in the project area. Effluent from the wastewater treatment plant may also be used for this purpose.

The new potable well will be constructed in accordance with the provisions of Wis. Admin. Code NR 112. Expected annual average usage from this well is approximately five gallons per minute.

4.7.4.11 Wastewater Treatment

The planned wastewater handling and treatment system consists of a water collection system and wastewater treatment plant.

The wastewater treatment plant, located on the west side of the plant facility area as shown on Figure No. 4-12, will treat contact water from three sources: open pit; Type II stockpile runoff and leachate; and site runoff from the crushing and ore loadout facilities and other ancillary facilities. Water from these sources is estimated to average 296 gallons per minute on an annual basis. A detailed discussion of the sources and volumes of anticipated water is presented in the FER. That document also includes a detailed discussion of the proposed design and operation of the wastewater treatment plant. Such a discussion will not be repeated here. Rather, this discussion focuses on the water collection system associated with the proposed wastewater treatment plant, followed by an overview of the wastewater treatment plant.

Water Collection System

A uniform feed to the wastewater treatment plant is desirable for optimum performance, therefore, provisions have been made for water storage both in a lined runoff pond and a lined surge pond (Figure No. 4-12). In addition the open pit will be used for emergency water storage. This storage system has capacity to store water for sufficient time to allow major maintenance work of the wastewater treatment plant, should it be necessary. A schematic showing wastewater generation points and ultimate disposition is shown on Figure No. 4-44.

Runoff from the Type II stockpile will flow by gravity to the surge pond via 36-inch HDPE piping as shown on Figure No. 4-16. Water from the open pit will be pumped to the surge pond using pumps mounted on a floating barge. Runoff from the crushing and plant site facilities will flow to the runoff pond.

The water treatment surge reservoir will provide a storage capacity of approximately 1.77 million gallons. The surge pond will be a totally excavated structure with less than 12-inches of fill required along the southeast and eastern edges of the pond berm. A drainage diversion berm will be constructed along the west and north sides of the surge pond. This will prevent non-contact runoff from the parking lot and the yard area north of the parking lot from draining into the surge pond. This runoff will be directed to Stream "C". The pond area will be overexcavated one foot and a one foot recompacted base constructed using on-site till (not uniform sand or gravel). The till will be compacted to a minimum of 90 percent of its maximum modified Proctor density (ASTM D1557). The same quality control and inspection procedures used in preparing the base of the Type II stockpile will be followed in preparing the base for the surge and runoff ponds.

The berms will be constructed so that the distribution of materials will be essentially free from lenses, pockets, streaks or layers of materials differing substantially in texture or gradation from the surrounding material. The selection and deposition of till material within the berms will be subject to approval by a Flambeau representative. The thickness of each lift of fill will be compacted to 90 percent of its maximum modified Proctor density (ASTM D1557) with a moisture content within ± 2 percent optimum. A 60-mil HDPE liner will be installed in the reservoir to contain the stored water. Typical design details are shown on Figure No. 4-8.

A minimum of an eight-inch layer of select on-site sandy material will be placed on the HDPE liner in both the surge and the runoff ponds. The maximum aggregate size within the sandy material shall not exceed three-inches. The sandy material will cover the bottom, side slopes and top of the berms. The sandy material will be placed by dozing a ramp to the bottom of each pond. Sand would then be dozed down the ramp and the bottom covered. Additional material would then be placed on the bottom and dozed up each of the side slopes in a uniform layer. A spotter would direct this work to insure that the liner was not damaged and that the sandy material was placed to the desired thickness. The sandy material placed on the side slopes will abut and be keyed to the sandy material covering the bottom. The angle of friction of the material on an HDPE liner is approximately 25 degrees. The 3H:1V side slopes are at an angle of 18.4 degrees which provides a 35 percent safety factor for the sandy material to resist sliding on the liner. Any material eroded or washed away from the liner due to wave action or runoff, will be replaced as required by manual shoveling or by using the original construction methods.

Riprap will be installed below the discharge of all inlet pipes to the ponds. The riprap will extend from below the discharge pipe to the bottom of the pond.

The runoff pond will be drained during the cold weather months and will be inactive except following a thaw. Following a thaw, runoff water will be immediately pumped into the wastewater treatment plant for treatment and elimination. Should water freeze in either pond, the sand blanket will protect the liner from contact with the ice.

Water from the reservoir will flow by gravity to an intermediate sump pump through a 12-inch diameter pipe. Wastewater will be pumped from the intermediate sump to the wastewater treatment plant. Provisions in the design have been included to discharge any overflow conditions to the open pit. A 32-inch diameter HDPE pipe will be installed from the reservoir to the pit for this purpose. Overflow from the intermediate sump will also flow by gravity to the pit via this same pipe.

The runoff pond having a capacity of 643,000 gallons and located to the west of the wastewater treatment plant is also shown on Figure No. 4-12. This pond has been designed to handle site runoff from the crusher area and ancillary facilities located south of the Type II stockpile. The runoff pond will also be an excavated structure. It will be constructed in the same manner as the surge pond but will have a safety berm completely surrounding it to prevent mining equipment from encroaching onto the lined area. Runoff will be collected around the outside perimeter of the safety berm and directed into the pond through one or more HDPE culvert pipes. The pond will be lined with a 60-mil HDPE liner. Waste will flow from the runoff pond to a pumping sump located in the wastewater treatment building through a 12-inch diameter HDPE pipe. Wastewater will be pumped from the sump to the wastewater treatment plant or to the surge pond. Overflow from the pond and the sump will flow through a 32-inch diameter HDPE pipe to the open pit.

Figure Nos. 4-54, 4-55, 4-56, 4-57 and 4-61 contain plan views and details pertaining to surge and runoff pond construction.

Water will flow from the runoff pond to a pumping sump located in the wastewater treatment building through a 12-inch diameter HDPE pipe. Wastewater will be pumped from the sump to the wastewater treatment plant or to the surge pond. Overflow from the pond and the sump will flow through an approximate 30-inch diameter HDPE pipe to the open pit.

The liner systems for both ponds will be installed in a manner similar to that used for the Type II stockpile and the crusher/loadout area. HDPE piping will be butt-fused and placed in shallow trenches and backfilled with excavated materials.

During the warm weather months, both the runoff and surge ponds will be used, while during cold weather months only the surge pond will be used. The surge pond intake pipe will be outfitted with agitators to minimize icing conditions during periods of freezing temperatures.

Wastewater Treatment Plant

The wastewater treatment plant is designed to process wastewater for acid neutralization and metal removal in accordance with WDNR standards. The plant consists of a three-stage treatment process as shown in Figure No. 4-45. Figure Nos. 4-46 and 4-47 contain a general plan view and an elevation view for the plant. The major elements of the proposed plant include lime treatment for acid neutralization and initial metals removal, followed by sulfide precipitation and then mixed media filtration.

Precipitate handling and treated water disposal make up the final components of the wastewater treatment system. Some of the treated water will be recycled for plant operations, makeup water, washdowns, and dust control, with the balance discharged to the Flambeau River or an adjacent wetland.

Treated wastewater will be recycled for plant operations as makeup water, washdowns, and dust control. Two pumps will be used to distribute the treated water.

The wastewater treatment plant will be operated continuously over the life of the mining operation. It will also be in operation at the end of the preproduction period and into the reclamation period as long as contact water is produced.

A staff of one will be required to operate the plant consisting of a certified wastewater treatment plant operator. In addition, on-site maintenance for the plant will be performed by the maintenance department. Trained personnel will be stationed at the plant at all times. The operating efficiency of the plant and effluent quality will be monitored by Flambeau on a routine basis. Reagents such as lime, sodium sulfite, polymer, and sulfuric acid will be unloaded from delivery trucks to storage bins and tanks located within the plant. Details regarding the storage features and their operation are contained on Figure No. 4-46. Feed rates for the reagents and plant staffing levels are discussed in the FER.

Precipitate from the clarifier at 25 percent solids by weight will be stored in an 8,000-gallon tank and be periodically pumped to a 4,000-gallon tank truck. The truck will deliver the precipatates to the Type II stockpile where they will be stored with the Type II waste rock. Based on the design criteria for the wastewater treatment plant (e.g. flow of 800 gpm), the maximum precipitate production will be 124 tons per day or 63,000 pounds of dry precipitates per day.

Bench test work completed as part of the FER has shown that precipitate production will vary with the length of exposure of Type II material to wetting and drying cycles. Precipate production during the study ranged from 9,000 pounds of dry precipitate per million gallons of wastewater to 60,000 pounds per million gallons. The higher figure corresponds to the initial wetting of the Type II material, while the lower value represented the third wetting. The second wetting produced an estimated production rate of 30,000 dry pounds per million gallons.

Given the bench test results, it is projected that the actual rate of precipitate production at the maximum plant capacity of 800 gpm will be closer to 35,000 dry pounds per day. At the estimated average flow rate of 296 gallons per minute, precipitate production is expected to be equivalent to approximately 13,000 dry pounds per day. Disposal alternatives for the precipitate include on-site and off-site options. An evaluation of these alternatives are as follows.

On-Site Disposal

The preferred alternative, which will minimize the handling and transport of the precipitate is to store it within the lined Type II material storage pile and to place it in the open pit during the backfilling sequence that has been identified for the Type II material.

Additional environmental advantages to this option are related to the chemical characteristics of the precipitate. Because of the large amount of lime used in the treatment process, the precipitate will help to neutralize the Type II material that comes in contact with it.

In addition, the secondary minerals formed in the wastewater treatment precipitate, and in the Type II stockpile areas that come in contact with the precipitate will provide a decrease in the overall solubility of the precipitate and the Type II materials it contacts. These conditions will reduce the potential for release of many metals found in the Type II materials under conditions that are expected for the reclaimed pit.

A second on-site alternative is segregating the precipitate from the other solids and placing it in a separate fill somewhere on the mine site. The option presents no apparent environmental advantage over placing it in the open pit with the Type II material where it will have important chemical benefits.

If a separate on-site location is selected, it will require the long-term care and management of a second separate facility. It will also significantly restrict the potential long-term use of the separate closed precipitate disposal site more so than the reclaimed pit under the preferred alternative. Therefore, the long-term impacts of a separate site on land use are adverse.

Off-Site Disposal

If the precipitate must be removed from the site for disposal, additional costs for handling and transport will be incurred. Hauling the material off site will increase the potential for spills on the roadways used, result in increased air emmissions from transport vehicles and result in the use of energy in the form of fuel.

The precipitate will contain 25 percent solids and, therefore, will present a special handling problem if trucked any distance from the site. Many Wisconsin landfills are restricted from accepting materials with less than 40 percent solids and a suitable landfill may not be available. If one is found, the high moisture characteristics of the precipitate will probably increase the tipping fees over and above the typical disposal costs. Otherwise, Flambeau will be required to install additional dewatering equipment at the WWTP to reduce the moisture content to allow handling and disposal at a licensed landfill in Wisconsin. If a Wisconsin site cannot be found that will take the precipitate under any condition, trucking it to an out-of-state landfill would be the only remaining option.

Other Information

The wastewater treatment plant, except for the clarifier, will be housed in a heated metal building. The plant will be constructed concurrently with the other support facilities in the area. The planned completion will coincide with the need to treat water from the mine pit, the Type II stockpile, and the holding pond adjacent to the wastewater treatment plant.

Wastewater treatment plant effluent will be pumped from the plant to the Flambeau River via a six-inch diameter Schedule 40 PVC discharge line along the route shown on Figure No. 4-1. Discharge will be from an outfall structure as shown on Figure No. 4-43. Riprap will be placed from the outfall to the river to prevent erosion. Details regarding the outfall structure are discussed in section 4.7.4.13 of this application and in the Wisconsin State Statutes Chapter 30 Permit Application for the Flambeau Project.

4.7.4.12 Storm Water Control

Storm water runoff control will be provided for all facilities including the Type I stockpile, Type II stockpile, mine site facilities, and undisturbed ground. The design of the storm water control facilities is based on the 25-year, 24-hour storm event for the Ladysmith area which is equivalent to 4.6 inches of rainfall. The use of the 25-year storm is believed to be conservative in light of the short duration of the project.

Type I Stockpile

The Type I stockpile runoff will collect at the base of the pile in a bermed drainage swale. The swale will collect and direct the runoff to two settling ponds located to the southwest of the pile. The swales and the ponds have been designed for a maximum peak flow rate of 21 cfs based on a 25-year storm event. The settling ponds are an integral part of the Type I stockpile storm water control system and, therefore, they are an integral part of the Type I stockpile.

Under normal conditions the ponds are designed to operate as settling ponds. The first pond in the series will act to remove larger suspended materials and provide initial settling of colloids if and when they are present. The second pond will allow final settling to occur. Water will normally be allowed to flow from the first to the second pond via an overflow spillway. The clear water from the second pond will flow via effluent structures into the Flambeau River or adjacent wetland.

The settling ponds have a design capacity to store up to 6,927,000 gallons of water. The volume of runoff expected from a 25-year, 24-hour duration storm (4.6 inches) totals 4,996,000 gallons, which will take only 72 percent of the pond storage capacity, leaving a 1.39 factor of safety. This is a very conservative design because no inflow reduction has been incorporated for infiltration into the stockpile soils. The pond is sized so that even if full, a detention time of approximately 34 hours can be expected from the 25-year storm event average inflow of 7.6 cfs. The ponds can be operated as either a detention or retention basin, since both spillway overflows and gate-controlled bottom discharge will be provided. The bottom discharge will consist of a 16-inch diameter corrugated metal pipe with manually operated gates on the outlet structures that can be opened to allow stored water to be removed.

Type II Stockpile

The Type II storm water collection system is designed to collect runoff water from the Type II stockpile at the base of the stockpile in a bermed swale. The bermed swale will be constructed with a 60-mil HDPE liner which is an extension of the stockpile liner. The swale will be constructed to direct the flow of runoff to a discharge point located along the southern boundary of the stockpile as shown on Figure No. 4-16. A HDPE discharge pipe will direct the flow to the surge pond.

Based on the size of the Type II stockpile (27 acres), and the 25-year storm event, the 24 hour average runoff flow rate is projected to be 265 gpm. The peak runoff rate is projected to be 7,769 gpm. The Type II stockpile storm water collection system is designed to handle these projected amounts of water and to direct the water to the surge pond. The average annual runoff flow to the surge pond is projected to be 47 gpm.

Plant Area

Runoff from the plant facilities comprised of the crushing and loadout area, wastewater treatment plant, maintenance building, and mine equipment parking area shown on Figure No. 4-12 will be directed to the runoff pond by contouring of the area and drainage ditches. Based on the size of the area and a projected 25-year rainfall, the 24-hour average runoff flow rate from the plant area is projected to be 830 gpm. The peak runoff rate is projected to be 2,434 gpm. The average annual runoff flow to the runoff pond from the plant area is projected to be 19 gpm.

Four storm runoff storage basins will be constructed on-site to handle storm events. These basins are the two settling ponds and the runoff and surge ponds. In addition during severe storms, water would be temporarily left in the open pit, or even directed to the open pit thus reducing the flow to the settling ponds, runoff and surge ponds or the wastewater treatment plant.

The settling ponds will be constructed to accept runoff water from the Type I stockpile and water from the open pit during preproduction stripping. Two ponds will be constructed, each having a surface area of 1.4 acres and being 17.5 feet deep. Materials to construct these ponds will come from the stripping of the open pit site.

A drainage swale will be constructed to transport the clarified and treated water from the settling ponds around the edge of the open pit for discharge into the Flambeau River or an adjacent wetland. A second storm water ditch will direct runoff water that may collect in a remnant of the intermittent Stream B channel on the north central side of the open pit. A small flood control dike will be placed across the upper end of this channel to prevent storm water flow from reversing into the pit at this point (Figure No. 4-7).

The runoff and surge ponds are a part of the wastewater treatment plant. These lined ponds will be constructed to handle runoff flow surges from open pit seepage and rainfall, the Type II stockpile and runoff from the ore haul road, crushing and loadout areas, and plant site facilities.

The runoff and surge ponds have a design capacity of 643,000 and 1,770,000 gallons, respectively. Water can be taken from these ponds and treated at the wastewater treatment plant at a rate of 800 gpm. The plant site has been graded to slope west from the administration building, elevation 1,153 feet to the runoff pond, elevation 1,141 feet. Eleven perimeter drainage pipes penetrate the runoff pond berm to allow runoff water from the plant site to enter the pond as shown on Figure No. 4-12.

The third storm water control facility is the open pit, which can be used on an emergency basis to store storm water. The runoff and surge ponds will be constructed with an overflow pipe to discharge water to the open pit if and when the ponds become full. The pit has significant amounts of capacity to store storm runoff water for processing later at the wastewater treatment plant.

Several culverts will be installed throughout the mine site (Table No. 4-8). Two culverts will be required under the ore haul road; one off the southwest corner of the topsoil stockpile, and another to the north of the Type II stockpile. Several culverts will be installed when constructing the railroad spur at the mainline track, crossing Meadowbrook Lane, one in Section 10, crossing STH 27, and intermittent Stream C. Finally, additional culverts will be installed where the plant

TABLE NO. 4-8

Drainage Culverts Within Project Area

Location	Size
Railroad Spur Line	48" x 50'
	18" x 50'
	18" x 50'
	24" x 50'
	18" x 60'
	18" x 60'
	2 - 57" x 38" x 50'
Entrance Road at STH 27	18" x 60'
Entrance Road at Stream	36" x 80'
Visitors Parking Lot	18" x 60'
STH 27 to H&H Building	18" x 60'
Type II Stockpile	24" x 180'
	36" x 180'
	18" x 60'
Type I Stockpile	36" x 100'

NOTE:

- All installed culverts are corrugated metal pipe (CMP)
- Existing culvert across STH 27 just north of plant entrance road is 36" RCP
- Existing culvert across access road at STH 27 is 18" CMP
- Existing culvert across STH 27 north of proposed observation parking is 30" RCP
- 57" x 38" culvert is a corrugated metal pipe arch culvert

access road crosses Stream C and where it joins STH 27. Of these culverts, only two will involve a stream, i.e., intermittent Stream C. Permits under Wis. Stat. ch. 30 have been requested for these two culverts.

During construction, storm water runoff will be controlled by temporary siltation basins and hay or straw bale ditch retention checks. The development of the control ponds and the wastewater treatment facility will precede the placement of Type II material in the Type II stockpile, thus preventing uncontrolled release of wastewater to natural drainageways. The construction of the settling ponds prior to the use of the Type I stockpile will provide clarification prior to discharge of runoff water.

The storm water control system will be in operation continuously throughout the life of the mine. Inspections of the control system will be made on a regular basis by personnel patrolling the site drainage system. These inspection trips are essential and need to be conducted on a more frequent basis during spring breakup or during stormy periods.

Periodically, solids from the settling ponds, the surge reservoir, and the runoff pond may require removal. The ponds will be cleaned as needed to maintain storage capacity and proper functioning. Cleaning of the settling ponds will be done using on-site mining equipment. Cleaning of the runoff and surge ponds will be done using a slurry vacuum pump. Material from the settling ponds will be transported to the Type I stockpile, and materials from the other two ponds will go to the Type II site.

4.7.4.13 <u>Water Discharge</u>

Treated water will be discharged at two points along the Flambeau River as shown on Figure No. 4-7. The outfall points are designed (Figure No. 4-43) to discharge clarified and treated water from the mine site into the Flambeau River without erosion to the river bank or impediment to the river flow.

The wastewater treatment plant outfall structure will consist of a concrete structure that will discharge water to a riprapped drainage swale that will transport the water to the Flambeau River. The second outfall will be a drainage swale from the settling ponds. Any areas where the slope of this swale exceeds two percent will be riprapped. Riprap will be placed in the river below each outfall to prevent erosion. During construction, topsoil will be removed to one side of the outfall site and saved. Silt fences will be put in place and riprap added downstream. The topsoil will be replaced and revegetated.

The annual average and peak discharges of water from the Type I stockpile settling ponds will be approximately 168 and 8,100 gpm, respectively. Peak discharge is based on the 25-year storm event. Water discharge will follow the rain and snow melt patterns in the area of the mine.

Water discharge from the water treatment plant will vary based on the water influent to the pit and the weather conditions in the area. Average and peak discharge flow rates are projected to be 296 and 800 gpm, respectively.

It is possible that the mine will interrupt the flow of water to a wetland near the proposed open pit. To mitigate this impact, up to 20 gallons per minute of the water from either or both of the discharge sources may be directed to this wetland as an alternative water supply. This would be a useful and beneficial use of the discharge waters.

Routine sampling of the effluent discharge will be done from the sampling points in the discharge line. Regular inspections will be made of the two outfall discharge points by the mine foreman. These structures will be inspected for any obstructions that could impede the flow of discharged water and that erosion is not occurring.

4.7.4.14 Sanitary Wastewater

Sanitary wastewater will be generated from the administration building. The total average daily flow rate of sanitary wastewater is estimated to be 1.9 gpm.

The 1.9 gpm estimate was developed based on the maximum operations work force of 61 people and estimated visitors of 15 per day. A total per-day per-person sanitary sewage waste generation rate of 45 gallons was used. This rate includes consideration for showers. Using these criteria, the total daily sanitary sewage flow is estimated to be 2,745 gallons or 1.9 gallons per minute.

The generated sanitary waste will be transported to a holding tank via a buried pipe system. The waste will be pumped to a septic tank and an above-ground mound leach field that will be located to the north side of the employee parking area. A mound leach field will be used due to the high ground water level. If a mound system is not applicable to the project area, a holding tank will be used.

Portable toilets will be used throughout the mine site from initial construction until sewer lines and permanent restrooms are constructed. A licensed septic tank pumping contractor will be used to service the portable toilets and the holding tank as necessary. Prior to installation of the permanent sanitary septic system, the licensed contractor will haul the sewage off-site for disposal.

Portable toilets will generate approximately four gallons of sewage per person per week. With a restroom/shower trailer approximately 35 gallons of sewage will be generated per person per day. During the first six months of construction, assuming a peak work force of 161 people over a short period of time with 25 having access to a restroom/shower trailer, approximately 875 gallons of sewage will be generated per day.

The sanitary wastewater system will be continuously in operation over the life of the mine and into reclamation. Routine maintenance and servicing will be conducted by outside contractors to ensure the system is working at peak performance.

4.7.4.15 Refuse Handling

Grit from the lime slaking operation will be transported by a screw conveyor to a location adjacent to the wastewater treatment building, where a front end loader will be used to load the grit into a truck. The grit will be hauled to the Type II stockpile where it will be disposed of with the waste rock. The maximum grit production to be handled will be 2,400 pounds per day.

Refuse from construction activities will be hauled off-site to an approved disposal area. The refuse normally generated by mine operations will consist of metal, rubber, wood, and lubricants as well as the daily trash and garbage typical of an industrial work force. Refuse will be accumulated in waste containers or areas for weekly disposal. Wood refuse generated during the construction and grubbing of the mine site will be chipped and/or burnt in accordance with approved burning permits.

The scrap metal waste will consist mostly of worn parts from process or production related equipment. Typically, this material will be collected in a specific location and periodically it will be sorted and sold to a scrap metal contractor. Small scrap metal pieces will be collected in bins. Larger pieces will be stored in a suitable outside area.

The bulk of the scrap rubber will result from mobile equipment tires and process related equipment such as conveyor belting and air and water hoses. Used tires will be returned to vendors. During operation of the mine, waste oils will be produced from mobile mining equipment and process equipment during the normal course of preventive equipment maintenance. This will include mobile equipment engine oil, hydraulic fluids, process equipment, lubricating oil, and special lubricants. The waste oils, fluids, and oil recovered in oil/water separators will be collected in special containers as it is removed from equipment, and will be returned to the supplier or special contractor for reprocessing or disposal off-site.

The scrap wood materials and the trash and garbage will be collected and temporarily stored in containers located throughout the facilities. This waste material will be periodically collected and removed from the mine site and disposed off-site by a licensed contractor.

The total volume of unsalvageable waste during operation is estimated to be approximately 2.5 tons per year per employee. Assuming an average employment of 55 people, the estimated annual waste generated will be approximately 138 tons.

4.7.4.16 Dust Control

During March of 1989 Flambeau submitted an Air Pollution Control Permit Application to the WDNR. That application identified two project sources that require permitting for air emissions. These sources involve the emission of particulate matter. Calculations of particulate emissions for the project indicate that such emissions will be no more than 46 tons per year, which is significantly less than the 250 ton per year minimum value to TSP that defines a "major new source" under Prevention of Significant Deterioration (PSD) Regulations (40 CFR 51.24). Therefore, the Flambeau Mine is not considered a major new source.

In addition to the above, the Flambeau Mine will include several sources which are exempt from permit requirements. These sources include space heaters, a laboratory fume hood, exhaust emissions from equipment, and the diesel fuel tank. A further discussion of emission sources from the project can be found in the project's Air Pollution Control Permit Application (March 1989). Discussed below are dust control procedures to be implemented for the project.

The key design criteria for dust control is the minimization of dust from leaving the project area. This can be accomplished by the use of water trucks in the mine, sprays on dust-generating equipment, and with dust collection equipment. While the primary means of controlling dust on the site will be through the use of water sprays, it may be necessary to use supplemental dust suppressants at times.

Due to the wet nature of the ore, no dust control provisions will be required from the open pit to the feed hopper at the crushing facility. Water sprays will be utilized in the crushing operation and conveyor belt discharge to the fine ore stockpile to control any fugitive dust generated by these operations.

Dust emissions which will be produced by operation of support equipment on facility roads will be controlled by watering. Emissions from mobile equipment will be maintained at low levels by proper maintenance.

To suppress dust from the stockpiles, selected active areas of the waste rock stockpiles will be watered as required.

Once final surface grades have been established on exposed soil, vegetation will be planted for prompt soil stabilization and dust control.

Dust is not expected to be a problem on the mine site during construction since the materials excavated from the open pit will be wet. In addition, the climate of Wisconsin is such that rainfall normally falls throughout the season without significant dry periods.

As a precaution to dust escaping the site, a 4,000-gallon tank truck will be available during construction and operation to wet down haul and access roads, and working areas where machinery is active.

4.8 Erosion Control

4.8.1 Introduction

This section discusses the erosion control procedures to be used during construction and operation of the proposed mine. Erosion control during reclamation is discussed in the reclamation plan (section 5.0 of the Mine Permit Application).

Exposed soil surfaces will require some type of cover to reduce erosion. To establish vegetation successfully on soil, it is important that the slopes are mechanically stable, the area is protected from runoff water, and surface erosion is temporarily minimized with a mulch, alone or in combination with a chemical soil stabilizer. On long slopes it may be necessary to reduce the segments of decreasing elevation with a system of diversion berms or bench terraces.

Erosion control is a pre-requisite for successful plant growth. Design criteria for soil erosion and sediment control applicable to construction and mining sites have been described by the USDA-Soil Conservation Service (1972), U.S. Highway Research Board (1973), U.S. Environmental Protection Agency (1975, 1976 a,b), and State of Wisconsin (1981).

Erosion control procedures should provide for the following:

a. Temporary control of sediment until more permanent structures and/or vegetation are established.

b. Detention of storm waters on the construction site and the release of these waters at non-erosive velocities.

c. Diversion of water from the construction site through the use of diversion terraces.

d. Establishment of cut-and-fill slopes as flat as feasible and consistent with the strengths of soil involved and overall project economics. Slope stability depends on length and steepness, soil strength, moisture content, density, and other factors.

Soil erosion and sediment control measures may be temporary or permanent, and will include installation of one or more of the following: (1) sedimentation traps or basins, (2) berms, (3) slope drains, (4) toe-slope ditches, and (5) diversion channels.

4.8.2 General Engineering Techniques for Erosion Control

Various techniques can be used for soil erosion control during the construction phase, and will be employed during development of the open pit and surface facilities, settling ponds, surge pond, waste rock stockpiles, railroad spur and access road. These techniques include diversion dikes, filter fabric, sediment traps, straw bale barriers, silt fences, sediment ponds, slope benches, and riprap.

Following are the general erosion control procedures that will be employed at the site.

Open Pit

- There will be no discharge from the pit itself.
- Runoff on the southeast side will enter the pit via the haul road.
- Runoff between the pit and the Type II stockpile will enter the pit directly.
- Runoff on the north side will be directed around the pit via a runoff trench.
- Part of the natural drainage into the pit along the north central part of the pit will be diverted by a berm.
- A sump in the bottom of the pit will collect noncontact water for pumping into the settling ponds before any sulfide material is exposed. This will be directed to the wastewater treatment plant after sulfide rock is exposed.

Stockpiles

- The sites will be graded to channel runoff away from the area.

- Runoff drainage swales between the berm and stockpile will be established to channel runoff to either the Type I settling ponds or the wastewater treatment plant surge pond.

- Runoff on the outside of the berm will be directed away from the facility via an engineered drainage system.

- Disturbed areas outside the perimeter berm will be vegetated.

Ore Haul Road

- The road will be ditched on the sides and water directed into the open pit or the Type II collection swale.

Crusher/Loadout Area

- The site will be graded to direct surface runoff into the runoff pond.

- Runoff water containment berms will be established.

- Runoff will be underlain with an HDPE liner to collect infiltration water and drain it to the runoff pond.

- Disturbed areas outside the limits of the crusher/loadout area will be vegetated.

4.8.3 Erosion Control Procedures for the Open Pit Stockpiles and Plant Facility Sites

Site Preparation Erosion Control

Site preparation will be performed in two stages:

a. Initially, the open pit, stockpiles and plant facility sites will be cleared of shrubs and trees and then rough-graded.

b. Following clearing, grubbing and rough grading, disturbed areas not required in the early phases of development will be seeded and silt fences will be placed to control erosion and runoff.

Erosion control during rough grading will consist of construction of surface drainage ditches to channel runoff. Where portions of the storm drainage system are not installed concurrently with the rough grading, separate provisions for runoff and erosion control will be made. These provisions will consist of temporary ditches, or straw bale barriers.

Graded areas not scheduled for immediate development will be mulched and revegetated with a temporary ground cover immediately 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 will be installed before beginning other construction. At that point, runoff would be controlled by the permanent system, although some straw bale barriers and silt fences may still be used to prevent downstream siltation. Development of the site in this manner will reduce the need for short-term temporary erosion control measures. To the extent possible, temporary erosion control measures will preceed the start of site preparation and construction.

Long-term erosion control will be provided through the final surface water drainage system. Through application of these procedures the major effects of construction activity will be contained within the construction area boundaries. These control measures will remain in effect and be maintained on a regular basis until final reclamation is achieved.

Railroad Spur

Clearing, grubbing, and material disposal for the railroad spur will be performed in the same manner as that planned for the mine facilities site preparation. Earthwork operations will follow as closely behind the clearing and grubbing operation as is practical. Temporary erosion and runoff control techniques, will be used with permanent culverts and a system of retention basins built into swale bottoms to prevent the unrestricted flow of runoff. Riprap, filter fabric, and hay matting in conjunction with the engineered drainage system will eliminate sediment flow into adjacent wetlands or other areas.

The soils in the wetland areas may not be suitable for roadbed construction. If this is the case, these soils will be over-excavated by an additional two feet and replaced with select material from the on-site excavation. The over excavation is currently estimated to be less than 3000 cubic yards. This material will be placed with the till on the Type I stockpile or spread adjacent to the railroad spur and covered with topsoil and seeded. Placement of subballast and ballast on the subgrade will complete the railroad bed before ties and rails are installed.

During the operation of the railroad spur, standard erosion control and vegetation maintenance procedures will be used. These procedures will include fertilization, mowing, brush control, and reseeding of areas disturbed during railroad spur line maintenance.

Herbicides or physical removal will be used to selectively treat undesirable woody plant species that encroach within the railroad spur right-of- way. Only EPA approved herbicides will be applied. Selective applications of herbicides will be completed by a private contractor in accordance with standard railroad maintenance practices.

Haul Road and Water Pipeline Corridor

Typical temporary erosion control techniques will be used during construction and until the new vegetation has been established. Specific details and locations of the temporary erosion control measures used during construction (straw bale barriers, filter fabric fences or similar measures) will be determined during the final engineering phase.

Following construction, the route will be seeded to provide erosion control. During the operation of the mine, landscape maintenance practices will be used to minimize invasion of shrubs and trees which would interrupt normal operating and line maintenance/ repair procedures.

Pipelines and Water Discharge Structure Construction

During construction of pipelines, exposed areas with potential for runoff of sediments will be controlled with straw bale barriers. Seeding and reestablishment of vegetation will follow after trench backfilling.

Areas disturbed during construction of the discharge structures near the Flambeau River and in nearby wetlands will be minimal. Lightweight equipment, swamp mats and other appropriate precautions will be taken to lessen working difficulties and disturbance in the wetlands and areas adjacent to the discharge structure.

In the construction zone for the discharge structure, straw bale barriers or geotextile materials will be used to trap silt and minimize sediment runoff to the Flambeau River. The same methods will be used in the wetlands and every effort will be made to minimize the extent of the disturbed area and keep the construction corridor as small as possible. These measures will be continued after completion of construction until the soils have stabilized and vegetation has been established.

Flood Control Dike and Slurry Wall

Run-off from the area disturbed during construction of the flood control dike and the slurry wall will be directed to a temporary sump within the perimeter of the open pit. Silt fences and straw bales will be used to control erosion from the dike slope adjacent to the river.

Waste Rock Stockpiles, Settling Ponds and Surge Ponds

Construction of the waste rock stockpiles, settling pond, and surge pond will be scheduled so that completion of each of the ponds occur at the time at which it is needed. The limited construction season in the area requires the concentration of construction effort during May through November.

During construction, control of surface water runoff will be accomplished by constructing a series of ditches, dikes, and retention ponds, and the use of temporary vegetation, soil stabilizers and mulches. Surface water runoff with the potential for high suspended solids content will be diverted through temporary sedimentation ponds with overflow weirs before being discharged into the drainage system of the surrounding area. These sedimentation ponds will allow for settling of the suspended solids. As each construction phase is completed, temporary and final vegetative cover will be established where appropriate.

Minor surface water diversion will be required in the mine and waste rock stockpile areas. However, minimal disruption will be made to the natural drainage of the area.

4.8.4 Vegetation Techniques for Erosion Control

Topsoil Removal and Preservation

Wisconsin NR 132.08(2)(f) states that "All topsoil from surface areas disturbed by the mining operations be removed and stored in an environmentally acceptable manner for use in reclamation." The major soil series present in the project area are described in section 3.5 of the EIR and are characterized generally as having "poor" topsoil characteristics. A generally accepted description of poor topsoils is as follows: Soils rated as poor are very sandy soils, very firm clayey soils, soils with suitable layers less than eight inches thick, soils having large amounts of gravel, stones or soluble salt, steep soils, and poorly drained soils.

The construction plan that has been developed assumes topsoil will be stripped to a depth of about ten to 12 inches. This material will be stored and reused during reclamation. Peat humus will form a valuable material for the generation and sustenance of plant growth. Therefore, where applicable, peat humus will be salvaged during construction activities and used during reclamation. Where applicable, the standards for removal, storage and use of topsoil and peat humus will be comparable to those of the Wisconsin Department of Transportation (WDOT).

Fertilizer Use

Successful establishment of forage type plant species for purposes of erosion control will likely require some type of fertilizer application. As major project facilities are constructed and the areas associated with, or adjacent to, these facilities are graded and ready for establishment of vegetative cover, soil samples will be taken and analyzed to determine the most appropriate fertilizer application.

The proposed seed mixtures that will be most commonly used for temporary erosion control are also composed of species tolerant of moderate soil fertility. Fertilizer requirements for non-herbaceous vegetation, whether planted directly into subsoils or into topsoil applied over subsoil, will follow the general practice by the WDOT for such projects.

Seed Selection

The seed mixture selected for best meeting the erosion control requirements of this site and which has proven effective in the State of Wisconsin is WDOT seed mix No. 3. This seed mix is described in Section 630 of the Standard Highway Road and Bridge Specification, pages 518 to 522.

Construction areas having exposed soils that will not be disturbed from October to May will be stabilized in late summer or early autumn with grass-based seed mixtures. These seed mixtures will be supplemented with mulch and/or soil surface stabilizers to ensure establishment of vegetative cover prior to the non-growing season. Vegetative cover will be established as early as possible on these areas so that the soils are stabilized and erosion potential is minimized. Otherwise, seeding and mulching will take place during the late spring or early summer planting period.

Methods of Seeding

During the construction phases of the project, seeding will be undertaken using both hydroseeding and mechanical methods. Specific site characteristics, but primarily slope, will determine which method is selected.

Time of Seeding

The optimum seeding period for the seed mixtures is May to June, or August and September. Where completion of construction of various facilities does not permit an optimum seeding time, temporary erosion control methods will be utilized.

Mulches and Soil Surface Stabilizers

Numerous types of mulches and soil surface stabilizers can be used when hydroseeding. Selection of a specific type will be dependent upon the recommendation of a contractor specializing in the field, cost, and availability.

4.9 Environmental Protection

Final development of the proposed mine plan has been accomplished to maximize protection of the physical and human environment of the local area and the region. The proposed mining plan is the culmination of over 15 years of careful planning.

The results and recommendations of extensive studies were incorporated into the site design, layout, and the development of the operation and reclamation plans. This section summaries the various environmental protection measures that have been adopted by Flambeau to assure that the project minimizes adverse effects on the environment. Details of the environmental protection measures incorporated into the project are provided in this Mining Plan Application, the EIR and various other permit applications submitted for the project.

4.9.1 Air Resources

The construction, operation and reclamation phases of the project will be accomplished so as to assure maintenance of the ambient air quality in the areas that surround the project. Careful and compact site layout minimizes the overall area affected and reduces emissions.

Haul roads will be watered and the ore crushing operation controlled by spray bars thereby effectively controlling dust. This has been shown to be 90 percent efficient in typical mining operations. Because there are no ore processing facilities proposed for this project, there will be no regulated emissions other than particulates.

4.9.2 Surface Water

Considerable study and design has been successful in developing a wastewater treatment systems for all wastewater from the open pit and other project features. The systems will prevent adverse impacts on the waters and aquatic communities of the Flambeau River. These projects are described in detail in the FER and WPDES Permit Applications.

All phases of the project have surface water control measures that will minimize erosion and releases of sediments from disturbed construction and/or mining areas. These measures include soil stabilization features that will control soil erosion from the site. Section 4.8 and Chapter 30 permit applications further discuss surface water protection.

4.9.3 Groundwater

Groundwater quality in the region is not expected to be adversely affected. Waste rock materials that produce contact water requiring treatment will be managed so as to collect, contain, and treat the water prior to releasing it to the environment. Although the temporary drawdown of groundwater is expected to affect the area immediately surrounding the pit, original groundwater regimes should reestablish after the pit is reclaimed. The extent of the temporary drawdown will not affect private wells in the vicinity of the site.

Reclamation of the pit includes a backfilling sequence that reflects the original stratigraphy and close to the original topography. In order to prevent significant changes to groundwater quality in the pit during and after backfilling, lime will be added with the Type II material to control pH. Therefore, after reclamation, groundwater quality is expected to return to preproject conditions.

4.9.4 Land Resources

Confining the project facilities to as small an area as practicable reduces overall surface disruption to a minimum. Terrestrial habitats will be reclaimed. The project area will be returned to land uses that are of an equal or higher quality than premining uses as a result of reclamation after a seven-year construction and operational period.

Special management techniques, such as the replenishment of surface water to adjacent wetlands will be employed as necessary during open pit mining to maintain the biological functions of these areas.

4.9.5 Public Safety

The major components of the mine site will be enclosed by a security fence. A guard will be present during the construction, operational, and reclamation phases of the project. The railroad spur across STH 27 will be appropriately signalled to provided protection to traffic. The railroad spur crossing at Meadowbrook Lane will be signed as required for public safety. Blasting will be conducted in accordance to all appropriate rules and regulations.

4.9.6 Monitoring and Contingency Plans

Environmental monitoring during and after the project is discussed in sections 5.0, 7.0 and 10.0 of this report. Contingency plans prepared to address potential deviations from expected operations that may affect the environment are presented in section 8.0 of this report.

4.10 Risk Assessment

4.10.1 Introduction

The risk assessment reported herein has been prepared to be responsive to the Wisconsin Administrative Code NR 132.08(i). That portion of the code states:

> "The applicant shall prepare a risk assessment of possible accidental health and other environmental hazards potentially associated with the mine operation. Contingency measures with respect to these risks and hazards, and the assumptions in this assessment, shall be explicitly stated."

The risk assessment evaluates the potential risks associated with all phases of the project, including construction, operation, and reclamation. The assessment was structured to evaluate several situations not expected to occur during the normal operation and/or lifetime of the facility. Potential environmental consequences of normal operation for the project are discussed in the EIR.

Assessment of risk under preliminary design conditions has been based on engineering judgment of experienced technical personnel, historical data from related, relevant fields, and semi-quantitative techniques.

The risk assessment was conducted in parallel with the development of the EIR and other studies integral to the Mining Plan. Where pollution control systems and equipment or administrative controls will be used in the project under normal operating conditions, the performance of these control measures was considered in the risk assessment.

For this assessment, the probability of various risk scenarios has been combined in a semi-quantitative manner to cover both the probability of occurrence and the probability of realizing the consequence discussed.

4.10.2 Chemical Use and Storage

Three chemical substances will be used in the wastewater treatment plant: sodium sulfide, sulfuric acid, and quicklime (calcium oxide). These chemicals are required solely for the purposes of treating water to meet environmental regulations.

Approximately 8,500 pounds of sodium sulfide will be used annually. It will be delivered by truck in bags on pallets, and will be stored inside the maintenance building in an enclosed storage area. A few bags will be kept on a pallet in the wastewater treatment plant for use in the sulfide precipitation process.

Approximately 16,500 pounds of sulfuric acid will be used annually. It will be delivered to the plant in bulk by tanker truck, and will be stored in a 1,200-gallon holding tank in the plant will be enclosed in a spill containment barrier.

Approximately 1,500 tons of quicklime will be used annually. It will be delivered to the plant in bulk by truck, and stored in a 46-ton silo next to the treatment plant. The silo will be covered and sealed, and will have a dust collection system to prevent particulate quicklime from entering the atmosphere.

4.10.2.1 Assessment of Risk

Sodium sulfide is flammable and can pose a fire and explosion risk if improperly handled. It is a strong irritant to skin and tissue, and liberates toxic hydrogen sulfide on contact with acids. It is harmful to aquatic life in very low concentrations. Sulfuric acid is strongly corrosive, very reactive and dissolves most metals. It is a strong irritant to skin and tissue and is harmful to aquatic life in very low concentrations. The threshhold limit value (TLV) is 1 mg/m^3 of air. Quicklime (slaked lime) is a strong irritant to skin and tissue and is harmful to aquatic life in very low concentrations. The TLV is 2 mg/m^3 of air.

Because chemical use and storage poses a potential hazard, the chemical storage and delivery systems have been designed to prevent leaks and spills. So designed, the potential risk to human health and the environment is considered to be low. Sodium sulfide will be stored inside the treatment plant and in the maintenance building in designated areas. Sulfuric acid will be stored in a tank with secondary containment to prevent leaks from escaping to the environment. Quicklime will be stored in a sealed silo with an efficient dust collection system.

Employees will be educated regarding potential hazards and trained in the use and handling of chemical substances. An emergency shower, eye wash station, and first aid equipment will be located in the wastewater treatment plant.

The occurrence of spills during transport of hazardous materials is a low probability event. Information for truck transport (Chemical and Engineering News, September, 1984) indicates that the probability of spills in 1983 was 2.7 by 10^{-5} per truck shipment. Professional judgment would indicate even lower probabilities for truck transport accidents within the project boundary because of the low truck speeds, low traffic densities and high quality of the roads. In addition, the U.S. Department of Transportation determined that approximately 80 percent of the spills reported in 1983 were not of a serious nature.

All chemical spills or releases will be contained and cleaned up immediately. Absorbent material that will be available on a permanent basis near the sulfuric acid storage tank can be used to wipe up acid spills that may occur during filling operations. If sodium sulfide is spilled at the mixing tanks, it will be swept up immediately and returned to the tank. If quicklime is spilled while the silo is being filled, it will be immediately swept up and used in the wastewater treatment plant. Records of recorded spills will be kept at the mine site and be made available for inspection by WDNR staff.

Contingency plans will be provided for the use of each chemical. These plans will be developed prior to operation and will be used as training guides for the operators in the wastewater treatment plant.

In conclusion, the risk of accidental chemical spills during routine project operation and during transportation of chemicals on the site will be a low probability event because of properly designed chemical handling and storage systems and properly designed and maintained roads. Consequences of small spills during chemical use will be mitigated by the containment and proper handling of each spill. Because these spills would be minor, discrete, short-term, reversible events, the consequences would not be severe. Since small on-site accidental spills would be localized, no threat to public health and safety or the environment will arise. The probability of a major on-site spill is low and actions would be taken to mitigate any impacts.

4.10.2.2 <u>Contingency Measures</u>

Although a remote possibility, if a major chemical spill occurs on-site, the following contingency actions will be initiated. The spill will be reported to the person responsible for compliance and to security personnel. In the event such a spill occurs when the person responsible for environmental compliance is not on duty, security personnel will be contacted initially and then the person responsible for environmental compliance and general manager at home, if necessary. The following information will be provided:

<u>Observer Reporting</u>

1. Identification of anyone injured or in immediate danger as a result of the spill.

2. Identity of the chemical spilled.

3. Location of the spill.

4. Estimated amount of material spilled.

5. Time the spill occurred.

All responsible personnel will receive training to assure the following actions are taken:

Action

1. Stay clear of the area.

2. Assist in preventing entry to the area by unauthorized personnel.

3. Do not leave the vicinity (i.e., in an assured safety zone) until someone arrives to assume the duty of isolating the area and commencing mitigative procedures.

4. Where appropriate, the general manager or his designee will notify the proper authorities.

The responsible staff will initiate recovery and isolation of the spill consistent with the concerns for public safety and environmental protection. Actions will include the following (not in order of performance):

Spill Recovery and Isolation

1. Secure the spill site to prevent entry to the area by unauthorized personnel.

2. Use only those personnel specifically trained and protected for handling such an emergency.

3. Contain the spilled material to prevent further spread.

4. Begin immediate recovery steps to assure maximum retention and isolation of the spilled material so that public exposure and environmental impact are minimized.

5. Provide for the proper storage and/or treatment of the recovered material.

6. Begin disposal of the unusable material and aids (i.e., rags, containers) at a predesignated site approved for receipt of this material.

7. Begin an investigation to determine cause of the spill and to the maximum extent possible prevent future occurrences.

All substances possessing toxic properties will be handled in accordance with state and federal regulations.

4.10.3 Storage and Transportation of Explosives

Blasting will be required for some minor mine development and for operation. Explosive storage will be maintained on the surface in a secure area, southwest of the Type I stockpile. In this location, explosives will be stored in three separate magazines. Two will be for 15 tons of explosives, and a third magazine for the caps, primers, and detonating cord. Explosive materials will be transferred by a clearly marked and flagged truck to the mine.

4.10.3.1 Assessment of Risk

The risk involved in the storage of explosives on-site is accidental detonation. This might occur as a result of impact, shock, fire, or an electrical charge. Historical data from the mining industry indicate accidental detonation of surface stored explosives would constitute an extremely rare event.

Potential effects of an accidental detonation are related to the environment and to public health and safety. With respect to on-site effects, the magazine will be designed in accordance with applicable codes, standards, and regulations. This will assure that debris generated by the detonation, and the associated shock wave, will present a minimal hazard to on-site personnel and the surrounding buildings and structures. The risk of an accidental detonation is also of concern in the open pit during transportation of explosives. Clearly marked transportation vehicles and stringent on-the-job safety training will help reduce the risk.

Design features, which are required for the surface storage of explosives, are well documented in federal and state regulations, MSHA, and the Wisconsin Department of Industry, Labor and Human Relations (DILHR). These features will be included in the final design of the facility. Some of these features include:

1. Storage areas will be located at required distances from inhabited buildings, public highways, and passenger roads.

2. Barricades (berms) constructed around the area will be in compliance with federal and state regulations (Bureau of Alcohol, Tobacco, and Firearms, and Wisconsin Administrative Code DILHR.

3. Storage buildings or shelters will be designed to be bullet-resistant, fire-resistant, weather-resistant, theft-resistant, and adequately ventilated. The interior of the magazines will be lined with non-sparking material.

4. Only battery-activated safety lights will be used in a magazine.

5. Doors will be designed so that hinges and hasps cannot be removed when the door is closed. Two locks, or the equivalent, will be installed.

6. Smoking or the carrying of matches or lighters will not be permitted in a magazine.

7. The area within 25 feet of the storage magazine will be kept clear of all combustible materials including vegetation.

8. Access to explosive storage will be restricted to authorized personnel.

In conclusion, with required design features and the enforcement of all appropriate federal and state regulations, the probability of an accidental detonation of stored explosives is considered to be very low. Safety standards have been built into the storage area design to reduce the potential risk of accidental detonation and to mitigate consequences, should an unlikely detonation occur.

4.10.3.2 Contingency Measures

Other than the design features noted above, no contingency plans for explosives are required. Standard procedures for handling and storage as set forth by the Institute of Makers of Explosives (IME) will be followed throughout the duration of the project.

Should any emergency services be needed, the fire department or ambulance services will be contacted in Ladysmith. In addition, a community hospital is located approximately one mile from the mine site.

4.10.4 Fuel Storage and Distribution

Diesel fuel and gasoline will be required during the construction, operation, and reclamation phases of the project. During the construction phase, diesel fuel will be required for earth moving equipment and will be dispensed from the tanker truck used for delivery. Gasoline will be used by other vehicles and equipment. Local petroleum distributors will supply gasoline to the project.

During the operation phase, an above ground 15,000-gallon tank will provide storage for diesel fuel. The annual quantity of fuel to be used is estimated to average 200,000 gallons, with a maximum of 360,000 gallons. This fuel will be used primarily for the fueling of mining equipment and mine trucks. Gasoline will be stored in a 1,000-gallon tank located next to the diesel fuel tank.

Diesel fuel and gasoline requirements during reclamation will be provided by existing facilities. When permanent storage is removed, diesel fuel and gasoline will be provided in the same manner as during the construction phase.

4.10.4.1 Assessment of Risk

The risk associated with storage of fuel and fueling of vehicles and equipment, regardless of project phase, comes from accidental fuel spills. Fuel spills could occur from leaking pipes and hoses or careless handling. This could occur during transfer of bulk fuel to the storage tanks or fueling of equipment. This assessment focuses on small quantity spills from handling rather than the rupture of the storage tanks. Handling of fuel presents the greatest opportunity for human error to occur in the fuel storage and handling system.

During the construction phase, before construction of a permanent fuel storage tanks and berm, fuel spills will be contained in a temporary berm. Spills absorbed in the soil will hinder the migration of fuel off-site. Because of the discrete nature of a spill, and the absorptive properties of the soil, these accidental spills can be easily contained and cleaned up. The only short-term effects will be highly localized contamination of soil and volatile emissions of the fuel vapor. There will be no long-term or irreversible effects because the contaminated soil will be removed following a spill.

During operation, diesel fuel and gasoline will be supplied only from a fuel station. This station will consist of an above ground 15,000-gallon diesel fuel storage tank and a 1,000-gallon gasoline storage tank. The diesel tank will be constructed on a concrete ring foundation. Both tanks will be completely surrounded by an earthen contaminant berm of sufficient height to contain the entire contents of either tank should a leak or rupture occur. The area within the berm will be lined with 60-mil HDPE and covered with sand to prevent any leaked fuel from seeping into the subsoil.

Diesel fuel will be dispensed to a tanker truck which will fuel equipment during the beginning and end of shifts and during break times. The fuel will be dispensed through a fuel pump located next to the storage tank. Gasoline will be dispensed via gravity feed at the fuel station. Small accidental spills will be cleaned up with absorptive materials. The only short-term effect of a fuel spill will be the emission of fuel vapor. There will be no long-term or irreversible effects from the storage or handling of fuel during the operation phase.

The effects of spills during reclamation will be similar to those discussed during construction and operation. As in those phases, there will be no short- or long-term irreversible effects.

Records of recorded spills will be kept at the mine site and be made available for inspection by WDNR staff.

In conclusion, with the system design and mitigating factors discussed, fuel spills will be a low probability event with minor short-term consequences. Spills which do occur will have no effect outside the operating area.

4.10.4.2 Contingency Measures

Contingency measures are required under the Federal SPCC regulations. Development of these plans will commence prior to the start of construction and will be incorporated into personnel training. The fuel storage tanks will be inspected daily for signs of leakage.

If a fuel tank ruptures or a major leak develops at the tank or fuel lines, all of the fuel will be contained within the HDPE-lined berm. The fuel will be immediately removed from within the berm by pump and stored in a portable tank. Absorbant material will be used to contain any spillage outside of the berm.

Absorbant material will be stored at the fuel storage area to contain accidental spillage during off-loading and fueling operations. The saturated absorbant material will be stored in 55-gallon drums and disposed according to current regulations. Contaminated soils will be immediately removed and disposed of according to current regulations.

The SPCC plan that will be prepared for the project will identify contingency measures that will be employed in the event of a major fuel spill from a tanker truck accident on site to prevent the fuel from reaching a surface water body. These measures could include emergency contaminent structures on drainage ways and other measures to isolate a spill.

4.10.5 Fires

The potential for accidental fires to occur always exists.

4.10.5.1 Assessment of Risk

Although combustible materials will be used on the mine site, fires which do occur on-site will have short duration and be localized. Fire protection for all temporary construction buildings will be provided by a water truck stationed on site. Hand-operated fire extinguishers will be provided by the various contractors. In addition, the Ladysmith Volunteer Fire Department is located minutes away from the project.

During operation, the administrative building and laboratory will be equipped with fire extinguishers to control any fires. The water treatment plant will be equipped with fire extinguishers in the control room area. A water line connected to a pump with a 10,000-gallon above ground storage tank will supply hose stations at the water treatment building and maintenance shop to control any fires which occur in the area of the buildings. Safety procedures will be outlined and enforced for handling of combustible fuels and explosives to reduce the potential of even a localized fire.

The occurrence of accidental fires within the project boundary must be considered during the construction, operation, and early reclamation phases of the project. Based upon data on surface fires at underground mines published by the Bureau of Mines in "An Annotated Bibliography of Metal and Nonmetal Mine Fire Reports", December 5, 1980, the probability of an accidental surface fire would be less than one fire during the life of the project. The duration of this postulated fire based on the same report would be less than four hours. Because of the fire prevention standards and detection systems that will be employed at the project, the probability of occurrence of an accidental fire and its duration should be less than that presented here. Therefore, on-site fires represent a low probability risk.

The potential for an on-site fire causing an off-site forest fire will be minimized by incorporating a large cleared area around the mine site which will serve as a fire break. During the construction phase of the project, controlled burning may be used to eliminate waste wood from clearing and grubbing activities. If this is done, a WDNR burning permit will be obtained. Measures specified on the permit will be followed to prevent forest fires. In all cases, the amount of cleared land around the structures will tend to eliminate the possibility of an on-site fire spreading to the surrounding environment. Trained personnel will be on-site at all times.

The potential of electrical fires starting along the powerline corridor will be very low. Following preparation of the corridor for the powerline, it will be maintained in a vegetative cover or herbaceous plants and low growing shrubs. Growth of undesirable woody plant species in the corridor will be controlled through cutting or the use of EPA-approved herbicides. The edges of the corridor will be maintained by periodically trimming the limbs that may extend into the right-of-way. The powerline corridor and adjacent access road will serve as a fire break for any local fires that may occur in areas bordering these project-related facilities.

The ballast section of the railroad spur will be kept entirely free of vegetation through cutting or the use of EPA-approved herbicides to assist in preventing forest fires. Undesirable weeds and woody plants within the right-of-way also will be controlled by mowing or through the use of EPA-approved herbicides. During project operation the railroad spur will receive limited use (approximately three or four round trips per week). These conditions will minimize the potential for fires along the railroad spur. The railroad spur also will provide a fire break which will help to control spreading of local fires originating in forest land along either side of the corridor. The design of the railroad spur and the operations on it will be very similar to other industrial rail spur tracks.

In conclusion, certain on-site activities create the potential for accidental fires to occur. Careful design, thorough work safety procedures, good housekeeping, and the firefighting force provide assurance that if small accidental fires occur, they will be quickly contained.

4.10.5.2 Contingency Measures

When necessary, in the event of an on-site fire, the Ladysmith Volunteer Fire Department will be immediately contacted and the on-site fire control system will be engaged. The Ranger Station located on State Highway 8 will also be contacted when appropriate.

4.10.6 Wastewater Treatment System Failure

The wastewater treatment plant is designed to treat stormwater and groundwater that comes into contact with sulfide mineralization. Several fail-safe systems are designed into the plant. Potential risk to the environment only exists if all systems fail.

4.10.6.1 Assessment of Risk

An advanced system has been proposed to treat wastewater prior to discharge and for reuse within the mine. However, equipment will be shut down periodically for maintenance, and unplanned events could cause operation to be interrupted. Table No. 4-9 shows the frequency, duration, and reason for equipment shutdowns for the wastewater treatment plant. Although a number of unplanned occurrences are shown, it is anticipated that the probability of occurrence of any event will be low over the short duration of the project. In addition, shutdown of the water treatment facilities can be tolerated without risk to the quality of the discharged water because water fed to the facility can be held in the open pit.

There will be a preventive maintenance program for the wastewater treatment plant designed to keep unplanned equipment failures to a minimum. This is represented in Table No. 4-9 by the normal shutdowns for general inspection, cleanout and filter sand replacement. Sufficient redundancy (spares, both installed and available standbys) will prevent long shutdowns of the treatment plant.

Most reagent feeding systems will have backup capability. Other reagent feeding systems have backup metering pumps available.

TABLE NO. 4-9

Lime/Sulfide Precipitation Treatment of Contaminated Mine Water
Equipment Shutdown and Maintenance Data

Unit Operation	Reason For Shutdown	Frequency	Duration Of Shutdown
Neutralization	Lime Addition Valve Plug Failure	Unplanned	1 to 3 days
	Sodium Sulfide or Acid Pump Failure	Unplanned	1 to 3 days
	Agitator Motor Failure	Unplanned	1 to 3 days
	pH Control System Failure	Unplanned	1 to 3 days
Clarification	Rake Drive Motor Failure	Unplanned	1 to 3 days
	Lime or Polymer Feed Pump Failure	Unplanned	1 to 3 days
	Sludge Pump or Valve Failure	Unplanned	1 to 3 days
	Shutdown for Normal Cleanout	Once every year	1 to 3 days
Filtering	Sand Replacement	Once every year	1 day
	Feed or Outlet Valve Failure	Unplanned	1 to 3 days

There is little probability of failure of the surface water discharge pipeline. The pipeline will not be exposed to corrosive materials nor extremes in internal or external pressures which could result in pipe failure. The water discharge pipeline is expected to be constructed of six-inch diameter high density polyethylene (HDPE) pipe and buried below ground beneath the frostline.

In conclusion, because of the tested design of the wastewater treatment plant, a strong preventive maintenance program, and sufficient redundancy built into the operation, the probability of a failure of the wastewater treatment plant is projected to be low. In addition, shutdown of the water treatment facilities can be tolerated without risk to the quality of the discharged water because water fed to the facility can be held in the open pit.

4.10.6.2 Contingency Measures

Should the wastewater treatment plant malfunction to the point where the water will not meet the criteria for discharge or reuse, it will be diverted to the runoff pond. The treatment system will be repaired and the water retreated prior to discharge or reuse. Because of the size of the surge pond, several days of water treatment plant outage can be tolerated while performing maintenance. In the event that the capacity of the pond is exceeded, an overflow system has been provided to direct the flow to the open pit for storage until treatment operations are restored.

During partial or complete shutdown of the wastewater treatment systems, all water can be held within the storage capacity of the facilities (i.e., surge pond, runoff pond, and open pit) until full operating conditions are restored.

4.10.7 Settling Pond Embankment Failure

A system of small-sized interconnected ponds are designed to collect and store stormwater and infiltrated groundwater during preproduction mining only. Failure of a pond embankment could result in a relatively minor and reversible effect on areas of land adjacent to the ponds.

4.10.7.1 Assessment of Risk

Embankments will be designed and constructed to accommodate a number of severe, abnormal conditions. The settling ponds have been designed to contain the 25-year, 24-hour storm. The embankment slopes will be designed for stability to cover the coincident conditions of a saturated embankment and a seismic event, even though no seismic events are on record for Rusk County. Because of the manner in which the embankments will be designed and the manner in which the ponds will be operated and embankments inspected, failure of the embankments will be extremely unlikely, based on engineering judgment.

4.10.7.2 Contingency Measures

Although partial or complete sectional failures of the embankments are not expected, immediate response would be implemented to provide public safety. After than, appropriate reclamation and restoration of the affected areas would be initiated in conjunction with a thorough evaluation of the resulting consequences. Additional evaluation would occur to enable necessary remedial actions to prevent another failure.

In the unlikely event that embankment leakage would occur, immediate repair of any such location will be implemented. Immediately following these activities, further evaluation of the cause of any leakage would occur, and necessary design or construction improvements would be implemented as an additional preventative mechanism.

4.10.8 Air Emissions

Ore handling and crushing, fires, vehicles, fuel transfer and storage, and chemical use, transfer and storage constitute air emission sources from facility operations.

4.10.8.1 Assessment of Risk

All potential air emission sources will have reliable and effective controls where appropriate and necessary. A complete listing of operation activities, component emissions, control methods, and emissions rates are presented in the air permit application.

Due to the wet nature of the ore from the mining operation, no dust control provisions will be required from the mine to the feed hopper at the crushing facility. Sprays will be utilized in the crushing operation and at the conveyor belt discharge point to contain any fugitive dust generation.

Dust emissions will be produced by operation of mining equipment on facility roads. Dust from unpaved roads will be controlled by watering and/or chemical stabilization. Some exhaust emissions will occur from combustion of gasoline and diesel fuel. Emissions from these equipment sources will be maintained at low levels by proper maintenance. The storage piles at active working areas for equipment will be watered as required to reduce dust emissions.

Once surface grades have been established on exposed soil, vegetation will be planted for soil stabilization, aesthetics, and dust control. For example, the flood control dike and drainage control ditches will be vegetated upon completion.

Transfer and storage of fuels will occur primarily at the 15,000-gallon bulk fuel storage tank located at the southern boundary of the plant. A vapor balance system will be used during storage tank loading to minimize hydrocarbon emissions. A dust collection baghouse will be mounted on the lime storage silo to collect any dust generated during the loading of the lime storage silo by pneumatic truck.

A sulfide precipitation stage is incorporated into the wastewater treatment facility. This removes copper, zinc, and mercury from the aqueous effluent streams produced during mine operation. The sulfide precipitation system consists of agitated tanks, a sulfuric acid dilution and addition system, a sodium sulfide dilution and addition system, and a sulfide precipitate filter station.

The sulfide treatment requires a pH of between 5 and 6. The system is designed with a three-tier failure protection mechanism to maintain the desired pH level. However, in the unlikely event that pH drops substantially, hydrogen sulfide (H_2S) could be produced.

Assuming a worst case scenario where all the reactants in the tank undergo complete conversion, 0.35 pounds of H_2S could be formed. This is highly unlikely as the pH of the tank will rise as the reaction proceeds to a steady state equilibrium where no additional H_2S would be formed. The mixing tanks are covered and vented through the building ventilation; any H_2S generated would be released and immediately diluted.

Stationary H_2S monitors will be incorporated in the mixing tank area to detect and alarm operations personnel in the very unlikely event that H_2S is generated during unbalanced conditions. These monitors are sufficiently sensitive to alert personnel of the presence of H_2S long before it reaches toxic levels within the plant. Even if the maximum amount (0.35 lbs.) of H_2S were discharged to the atmosphere, it would not cause any public health hazard.

In conclusion, although some air emissions will be generated during the construction, operation, and reclamation phases of the project, they will be controlled to the extent that they will represent a nearly nonexistent risk to human health and the environment.

4.10.8.2 <u>Contingency Measures</u>

With the exception of the unlikely potential to generate H_2S all air emissions are well defined and constitute a relatively continuous event. Therefore, specific contingency measures related to an unplanned event are not required. Engineered controls on point sources of air emissions and operational procedures to control dust generation will minimize human health and environmental impact. With respect to H_2S if the stationary monitors detect the gas in the mixing tank area and sound an alarm, personnel will evacuate the treatment plant building immediately and will not return until the reaction has reached equilibrium and H_2S generation ceases. There is no risk to health or environment due to H_2S generation outside the wastewater treatment plant building. The cause of the problem will then be corrected.

4.10.9 Crushed Ore Spill

Crushed sulfide ore will be produced at the mine site. A crushing facility will crush coarse ore to minus 12 inches. On an average basis, the project will produce approximately 1,300 short tons per day of crushed ore. The crushed ore will be handled using conventional conveyor and front-end loader technology. The crushed ore will be loaded from the fine ore stockpile into railroad cars for off-site transportation.

4.10.9.1 Assessment of Risk

To represent a potential risk to the environment, crushed ore would have to be released from the rail cars and allowed to be left in place for an extended period of precipitation. Since the spilled ore would be immediately cleaned up, the risk would be nonexistent.

Spills of crushed ore off-site could occur by derailment of a railcar; however, the probability of a train accident is low. In a systematic study of transportation accidents (R. K. Clarke, et al., 1976), it was determined that the probability is 1.5×10^{-6} car accidents per car mile. This was based on nationwide data for transportation of all types of commodities (rather than passengers) and for all types of operating conditions for the trains. The report noted that 83 percent of all train accidents evaluated involved derailments.

The probability of a train accident resulting in a cargo being spilled into a water body is even more remote than for a train accident resulting in a spill onto land (R. K. Clarke, et al., 1976). In part, this is due to the small fraction of the rail system that is built on bridges, and the typically low operating speeds for trains when on bridges. In addition, most bridges are equipped with a protective guard rail to further minimize the risk of derailment. In part, it is also due to the buffer zone of land that normally is present when a rail track is adjacent to a stream, lake, river, or other water body. It was concluded that the conditional probability of a train accident occurring on a bridge over water is 9×10^{-5}. This probability must be combined with the probability of 1.5×10^{-6} car accidents per car mile to give a net probability of 1.4×10^{-10} car accidents per car mile on a bridge. While the accuracy of these probabilities is subject to uncertainty, they are clearly low probability events.

If such a low probability incident did occur, the impact would be short-term, localized, reversible, and primarily a mechanical disturbance of the environment. Because the crushed ore is immobile, remedial measures would occur in a timely manner to recover the spilled material.

4.10.9.2 Contingency Measures

If a release of crushed ore to the environment occurs, Flambeau would work closely with the rail carrier to implement corrective action. Because of potential environmental impacts and the economic value of the crushed ore, recovery operations would occur immediately. Specific techniques used to recover spilled crushed ore will depend on the nature, magnitude, and location of the spill. However, the crushed ore will be recovered to the maximum extent practicable.

4.10.10 Blasting

Blasting will be required in the sulfide ore and Type I and II materials. Uncontrolled blasting represents a potential risk to human health and the environment.

4.10.10.1 Assessment of Risk

The initial surface excavation will uncover glacial till, followed by sandstone and saprolite material. All of this material will be ripped in lieu of blasting. The first blasting will occur in ore on the 1080 bench, which is the first full bench below original surface topography. The steep dip of the ore and host rocks to the northwest will tend to direct any fly rock in that direction and away from STH 27. However, as an extra safety precaution, under certain circumstances, traffic may be halted on the highway during blasting. Precautions will also be taken on the Flambeau River when blasting in the extreme west end of the pit.

Ground vibration, air impact and noise impact will be minimized by the use of millisecond delays between holes so that the holes are exploded in sequence, rather than simultaneously. Due to the small size of the operation, the relatively small blasts, and distance away from the nearest neighbors, the risk to human health and the environment is considered to be very low.

4.10.10.2 Contingency Measures

To prevent an accidental detonation of explosives during handling, all applicable State and Federal regulations for the storage and handling of explosives, including but not limited to

Wis. Admin. Code ILHR 7.20 to 7.23, will be strictly adhered to. This includes, but is not limited to:

- Only carefully trained, authorized personnel will handle explosives.

- All holes will be carefully loaded and stemmed.

- No blasting or loading of holes will be performed during electrical or anticipated electrical storms.

- Signs will be posted along STH 27 requesting vehicle electrical transmitters be turned off.

- Connection of the blast initiating device, usually an electric blasting cap, to the blast pattern will not occur until personnel and machinery are safely located outside the blasting area.

- Blasting or loading of holes will not be done at night.

The best means of accident prevention is education and training; all employees working with and around explosives will be thoroughly versed in safe operating procedures prior to being assigned to this area.

Strict adherence to applicable regulations and standard industry practice in handling of explosives will minimize the risk of blasting causing injury to humans, property damage, or adverse environmental impact.

4.10.11 <u>Wastewater Collection System Failure</u>

The wastewater collection systems consists of the bermed, lined and drained Type II stockpile, the lined surge pond, the lined runoff pond, the wastewater treatment plant, and the piping connecting these facilities. Potential risk to the environment could exist if the wastewater collection system fails during operation and results in discharge of contaminated water.

4.10.11.1 <u>Assessment of Risk</u>

Potential avenues of risk related to the wastewater collection system include the following:

- Failure of the wastewater treatment system
- Failure of the pond embankments
- Leaks in the pipelines
- Leaks in the liners
- Blockage of the drainage system

The risk associated with failure of the wastewater treatment system is discussed in section 4.10.6. Failure of the pond embankments is discussed in section 4.10.7. With respect to the pipeline, runoff storm water will flow through a properly sized HDPE pipe to the wastewater treatment plant. The pipes will be buried five feet below ground and below the frost line. Constructed to specification, the pipelines offer little risk to the environment from leaks.

A high-density polyethylene liner has been selected because of its extremely low permeability and its use in highly successful in other industrial applications. Section 4.7.3.3.12 discusses in greater detail the construction of the HDPE liner system.

If the HPDE liner is constructed to specification under a rigorous quality assurance/quality control program, the potential for leaks developing that would allow wastewater to enter the groundwater will be low. Any leaks that might develop over the duration of the project will have minimal impact on the environment since they would normally occur at a seam and be relatively small, and because wastewater under normal operating procedures will not be allowed to accumulate in the Type II stockpile impoundment, surge pond, and runoff pond for extended periods (i.e., water will accumulate during rain events and then be treated expeditiously). In addition, any water which could possibly leak from the liner would flow to the open pit where it would be collected before being pumped to the wastewater treatment facility.

A potential risk could exist if the drainage system at the base of the Type II stockpile fails and results in an accumulation of wastewater within the stockpile berms.

4.10.11.2 Contingency Measures

Contingency measures related to wastewater treatment system failure and failure of the pond embankments are discussed in section 4.10.6 and 4.10.7, respectively. No contingency measures are planned for the pipelines and liners because the potential for significant leakage to the environment is viewed to be a very low probability event.

4.10.12 Severe Natural Phenomena

Severe natural phenomena that could pose a risk to the project include seismic activity, tornadoes, and flooding.

4.10.12.1 Assessment of Risk

The mine site exists in a region of very low seismic risk (Algermissen, 1976). The appropriate seismic levels have been incorporated into the design of surface and subsurface facilities, as discussed in the EIR. Therefore, no unusual seismic risk exists for the facility.

While not as frequent as in other areas of the Midwest, relatively small tornadoes have been known to occur in northern Wisconsin (Thom, 1963). The probability of such events is rare. Damage at the project site is assumed to be slight under these conditions because of the safety margins incorporated into the structures for other extreme loads.

Unexpected significant flooding could occur due to the following:

- Catastrophic flood on the Flambeau River
- Torrential precipitation

The flood control dike situated between the mine and the Flambeau River is designed to contain a 100-year, 24-hour event. However, a significant rise in the Flambeau River above the 100-year prediction mark, a very low probability event, would overtop the flood control dike and flood the mine. The probability of overflowing the flood control dike is further reduced because the flood control dike will, in reality, be at a level above this mark and the project is of relatively short duration.

A torrential rain event has the potential to overtop the four ponds in the water collection/wastewater treatment system. The release of contaminated water could have a serious, although reversible, effect on the environment. However, the Type I stockpile setting ponds are designed to contain a 25-year, 24-hour storm event, the wastewater treatment surge pond a 25-year, 24-hour storm event, and the runoff pond a 25-year, 24-hour storm event.

Since the Type I stockpile settling ponds discharge by gravity flow to the Flambeau River, overtopping of the ponds does not represent a risk. The settling ponds are designed to retain stormwater for a period of 24 hours so that suspended solids will settle out and free iron will oxidize. If the 25-year, 24-hour design storm is exceeded, a very low probability event, unsettled water may discharge to the river. This would be an event of limited duration, and impact on aquatic life would be minimal.

The surge pond and runoff pond discharge to the wastewater treatment plant. If a major storm threatens to overtop the two ponds, the water will overflow into the mine via an emergency overflow pipe, thereby reducing the risk of overtopping of the ponds to a low probability event.

4.10.12.2 Contingency Measures

If overtopping of the flood control dike occurs and the mine floods, the open pit would be evacuated. Mining operations would not recommence until the water had been pumped out of the excavation and disposed of either in the settling ponds if the water quality is deemed appropriate, or through the wastewater treatment plant.

If a major storm event threatens to exceed the design capacity of the surge pond and runoff pond, the water will be diverted to the mine. When the event passes, the water will be collected and appropriately sent to the wastewater treatment plant for treatment.

4.10.13 Sabotage

Sabotage is a potential risk at any industrial project site.

4.10.13.1 Assessment of Risk

The mine site will be fenced and all gates will be either secured or manned during both operating hours and off-hours to control access to the mine site. During operation, a security officer or supervisors will monitor activities at the mine site to insure that operating procedures are being followed and that opportunities for sabotage are minimized. Based on the type of operation involved and the security to be provided, the risk of sabotage will be very low.

4.10.13.2 Contingency Measures

In the event an act of sabotage occurs, the damage will be repaired and the situation evaluated so that security measures can be improved to prevent a reoccurrence of the act.

4.10.14 Pit Wall Failure

Failure of a pit wall prior to or during mining in the area could result in human injury and lost production.

4.10.14.1 Assessment of Risk

Slope engineering studies were performed to achieve optimum slope design for the open pit. Oriented coreholes were drilled and logged in detail. Rock structure and strength were investigated along with groundwater condition and overburden material properties. Bench, interramp and overall slope stability analyses were performed.

Favorable rock structure coupled with acceptable rock and overburden material strength, allow for relatively steep slopes for the shallow open pit.

A potential risk to the stability of the pit walls exists from a inflow of groundwater to the open pit. Hydrologic studies indicate that most of the water inflowing into the pit will come from the bedrock/overburden contact. These studies also indicate that a simple system of grading and ditching to a series of sumps will be sufficient to capture and control most of the expected modest inflow rates.

To minimize water inflow from the river, a slurry wall will be constructed between the pit and the river from the surface to the bedrock contact. When mining progresses below the overburden and into bedrock, sumps will continue to be utilized as the primary collection device. Slopes used in the current pit design include 36° for the glacial till and poorly consolidated material above bedrock. At the bedrock contact, a ten-foot horizontal bench will be maintained. Below the bedrock surface, a 50° interramp slope will be maintained in intervals above and below ramps.

Bench configuration is a function of bench height, width, and face angle. The bench height is primarily a function of mining equipment; the bench width is a function of bench height and safety considerations; and the bench face angle is controlled by the orientation of the geologic structures and by excavation techniques, particularly blasting. The benches will be monitored by the mine engineer for stability and adjustments made as appropriate.

For safety considerations, horizontal catch benches will be left at 60-foot vertical intervals on the final pit walls below the bedrock contact. Using a 69° face angle in conjunction with a 50° interramp slope allows a 27-foot wide catch bench at the 60-foot vertical interval. The catch benches will include safety berms to control rockfall. The safety berms will be five feet high, 13 feet wide at the base, and have slopes of 1.3:1. In order to achieve this configuration, the mining benches (20-foot height in waste) must be combined (triple benching) at the 69° face angle, which is an accepted mining practice.

4.10.15 Power Disruption

Disruption of electrical power to the mine site would result in a shutdown of the wastewater treatment plant. For the duration of the power outage, water requiring treatment would be collected until power was resumed.

4.10.15.1 Assessment of Risk

Power outages, especially during thunderstorms and severe winter weather are not uncommon events. However, most outages are of relatively short duration and rarely exceed one hour. In the event of a power disruption, the wastewater treatment plant will shut down. This will not present a problem because both the surge pond and runoff pond have overflow drains which are connected to a storm overflow line going back to the pit. This system is designed to accommodate the 25-year storm as shown on Figure No. 4-16. During a power outage, water will accumulate in the ponds. If the ponds fill, the water will drain by gravity into the open pit. When power returns, the untreated water in the open pit will be pumped back to the wastewater treatment plant.

4.10.15.2 Contingency Measures

Since disruption of power and shutdown of the wastewater treatment plant will not result in release of contact storm water to the environment, a contingency plan is not required. During the power outage, the flow of contact water to the treatment plant will be stopped. When the power returns, the flow will be resumed such that stored wastewater can be treated.

4.10.16 Summary and Conclusions

The potential risk associated with operation of the Flambeau Project have been assessed. Without exception, the probability of occurrence of the potential hazards identified in this risk assessment has been determined to be low. Although it is possible for accidents to occur during the life of the project, the potential for this to happen has been minimized through conservative design features, safety-minded operating procedures, and employee training programs. Should an accident occur, sufficient contingency measures and remediation plans have been designed into the Mining Plan to assure that potential adverse effects to human health or the environment are minimal and/or of short duration. No potential hazard has been determined to be irreversible.

4.11 Preblast Survey Plan

The Wisconsin Administrative Code, Industry, Labor and Human Relations (ILHR) Subchapter VII establishes uniform limits on permissible levels of blasting resultants to reasonably assure that these resultants do not cause injury, damage or unreasonable annoyance to persons or property outside any controlled blasting site area. In particular, Section ILHR 7.61 Preblasting Notification states:

> "At least 24 hours before initiation of blasting, the operator shall notify all residents or owners of affected dwellings or other structures on how to request a preblasting survey. Affected dwellings or other structures shall be determined based on the scaled-distance equation."

This equation is D_S = D (W) 1/2 where D is the distance in which residences are to be notified, D_S is the scaled distance from the blast and W is the weight per delay of explosives to be used. This distance has been calculated at 1,732 feet and does not include any privately owned residences. Nevertheless, Flambeau will notify residents living in the company-owned homes as well as private residents who live north of the pit and south of the Flambeau River, south of Jansen Road and the administrative staff of Mount Senario College and Rusk County Nursing Home. The notification will establish communications between the operator and local residents and provides the operator the opportunity to explain the need for blasting and how it is likely to be conducted.

In addition to the above notification, Flambeau will conduct a preblast survey of residences and commercial buildings generally between the Flambeau River to the north and Meadowbrook Creek to the south and the Flambeau River and the Wisconsin Central Ltd railroad to the west and east, respectively. The location of these structures is shown on Figure No. 4-48.

The preblast survey will be conducted to document settling cracks, cracked plaster, windows, etc. that exist prior to blasting. Photographs of the residences and the buildings will be taken. Each home or commercial building owner will receive a copy of the survey results for his property.

5.0 RECLAMATION PLAN

5.1 Introduction

The existing project area is made up of open field and hardwood forests. It is typical of most of the land in rural northern Wisconsin and contains the following features as shown on Figure No. 2-6.

1. Abandoned, old farmstead with associated out buildings, scheduled for removal on the southeast corner of the area.

2. Several fields with different crop rotations, on the east side of the area.

3. An abandoned gravel pit on the northwest corner of the area.

4. Various wind and visual (spruce and pine) screen plantings near the farmstead, along the east border of the site, and 0along the east bank of the Flambeau River.

5. A large wooded area on the west side of the project area, and east of the Flambeau River, containing upland and lowland mesic hardwood forests, and a varied topography.

6. A large fallow farm field (early successional grassland) on the north side of the project area, to the east and south east of the gravel pit.

Generally, the existing project area does not have any unique features or visual qualities. For further discussion of site aesthetics, the reader is referred to sections 3.12 and 4.3.10 of the EIR.

Reclamation of the mine site will be accomplished following the completion of the mining operation. The reclaimed mine site will provide for a non-consumptive, passive recreational area with wildlife habitat. The reclamation plan will provide an environmentally stable site with desireable features until such time, if ever, the site is put to other use. In this regard, it should be recalled that deeper potential deposits remain on site which could be a valuable resource to the community if mining of the mineralization becomes economical in future years. Similiarly, the Local Agreement provides that the local community may wish to develop this site as an industrial park.

5.2 General Overview of Reclamation Procedures and Conformance with Standards

The reclamation procedures for the Flambeau project generally include removal of surface facilities, backfilling the pit, and returning the site to topography that closely resembles its original condition. The open pit will be backfilled and the entire area will be replanted to create the landforms and plant communities associated with a grassland/wooded savannah copse revegetation concept. Included in this revegetation plan is the development of new wetlands to mitigate the impact of the project on existing wetlands. This approach to reclamation complies with the intent of NR 132 in that it will return the project area to a state that provides long-term environmental stability.

Wisconsin Administrative Code NR 132.08 (2) establishes criteria relating to preparation of the reclamation plan for a mining site. As discussed below the proposed design, construction and operation as presented in the mining permit application for the Flambeau Project meets or exceeds these criteria.

> NR 132.08(2)(a). *All toxic and hazardous wastes, refuse, tailings and other solid waste shall be disposed of in conformance with applicable state and federal statutes or regulations.*
>
> The mine will not generate any tailings or toxic and hazardous waste. Refuse and solid waste are to be disposed of in an approved manner. The information presented in this document and the EIR generally meets or exceeds the requirements of NR 182 regarding the storage and disposal of mining wastes. Section 5.3 of this report addresses the disposal of demolition waste in accordance with NR 502. Section 4.7.4.3 and 4.7.4.15 address the proper disposal of separated oil and grease from the truck maintenance shop and general refuse.
>
> NR 132.08(2)(b). *All tunnels, shafts or other underground openings shall be sealed in a manner which will prevent seepage of water in amounts which may be expected to create a safety, health or environmental hazard, unless the applicant can demonstrate alternative uses which do not endanger public health and safety and which conform to applicable environmental protection and mine safety laws and rules.*
>
> The mine will not have any tunnels, shafts or underground openings. Thus, this section does not apply to open pit mines.
>
> NR 132.08(2)(c). *All underground and surface runoff waters from mining sites shall be managed, impounded or treated so as to prevent soil erosion to the extent practicable, flooding, damage to agricultural lands or livestock, damage to wild animals, pollution of ground or surface waters, damage to public health or threats to public safety.*

The management and treatment of surface water runoff is extensively addressed in the FER and sections 4.7.3, 4.7.4, 4.8, 5.4, 5.5, 5.7, 5.8, 5.9, 5.10 and 5.11.2 of this report. The extensive studies completed for this project and documented in the EIR, Water Regulatory Permit Applications, Groundwater Withdrawal Permit Application, WPDES Permit Application, Air Pollution Control Permit Application and the flow and transport modeling reports have shown that the project will not cause flooding, damage to agricultural lands or livestock, damage to wild animals, pollution to ground or surface waters, damage to public health or threats to public safety.

NR 132.08(2)(d). All surface structures constructed as a part of the mining activities shall be removed, unless they are converted to an acceptable alternate use.

As addressed in section 5.0 of this report all surface structures, with the exception of the flood control dike located at the west end of the open pit, will be removed as part of the project's reclamation activities. The dike will be used to assist in the creation of a wetland in the west end of the backfilled open pit. This is an acceptable alternate use, since the wetland will replace lower quality wetlands taken by the project.

It should be noted that certain ancillary facilities such as the plant access road, parking lot, railroad spur, various buildings and other ancillary facilities could be left in place. These actions are dependent upon possible future negotiations between Flambeau and local governments for use of the project area as an industrial park.

NR 132.08(2)(e). Adequate measures shall be taken to prevent significant surface subsidence, but if such subsidence does occur, the affected area shall be reclaimed.

Since the project does not involve underground mining, no subsidence will occur. Further as discussed in section 5.7.2.3 of this report settling of the backfilled pit is expected to be minimal. A discussion of backfilling techniques that will result in minimal settling is presented in sections 5.4 and 5.7 of this report.

NR 132.08(2)(f). All topsoil from surface areas disturbed by the mining operation shall be removed and stored in an environmentally acceptable manner for use in reclamation.

Sections 4.7.3, 4.8, 5.10 and 5.11 extensively address the removal, storage, reuse and minimization of erosion as related to handling topsoil in an environmentally acceptable manner.

NR 132.08(2)(g). All disturbed surface areas shall be revegetated as soon as practicable after the disturbance to stabilize slopes and prevent air and water pollution, with the objective of reestablishing a variety of plants, and animals indigenous to the area immediately prior to mining, unless such reestablishment is inconsistent with the provisions of s.144.81 (15), Stats. Plant species not indigenous to the area may be used if necessary to provide rapid stabilization of slopes and prevention of erosion, if such species are acceptable to the department, but the ultimate goal of reestablishment of indigenous species shall be maintained.

Sections 4.7.3 and 4.8 of this report address the revegetation of disturbed areas during the construction and operation phase of the project. Sections 5.10 and 5.11 address revegetation during reclamation. Section 5.11.3.1 specifically addresses the fact that locally indigenous plant species have been selected to revegetate disturbed portions of the mine site.

5.3 Reclamation Sequence and Schedule

As described in the EIR, section 3.5.6 (waste characterization), all waste material removed from the pit will be temporarily stored in either the Type I or the Type II stockpiles. Upon completion of the mining operation, the pit will be sequentially backfilled with the stockpiled waste materials.

Concurrent and subsequent to the backfilling of the open pit, other reclamation activities will take place. These will consist of the dismantling of the crusher and on-site buildings, the removal of the railroad spur, the dismantling of the wastewater treatment facilities, etc. During this process, the buildings, equipment and some spur line materials will be salvaged while a minor amount of demolition waste will be generated. The demolition waste will be disposed of in an on-site, one-time demolition waste disposal facility to be located in the eastern settling pond. This facility will be regulated under NR 502. A design and operations manual prepared as per the provisions of NR 502.12 for this proposed facility is contained in Appendix K. As part of this Mining Permit Application, Flambeau is requesting that the WDNR approve the development and use of the proposed one-time demolition waste facility for the Flambeau Project.

Revegetation of the project area will begin at the initial phase of construction and operation, in the form preserving certain resources for reuse and through the construction of a wetland test plot. Selected natural trees and those planted earlier by Flambeau will be relocated from within the project area to a temporary "nursery". This nursery will be used later in the process of reclamation or directly to screen project facilities. Topsoil will be segregated from other excavated materials for use in final cover of the reclaimed site. Screen plantings will mature, and eventually become a part of the reclaimed site. Finally, hydric soils will be salvaged and stockpiled for reuse. Upon cessation of the operation, the entire site will be covered with topsoil, stockpiled in the initial phases of the project, and planted using vegetation from the temporary nursery and from commercial sources. Finally, monitoring, maintenance, and management of the revegetated site will begin after the operation ceases and replanting has occurred. The reclamation schedule is shown in Figure No. 5-1.

5.4 Reclamation Materials and Earthwork Balances

The open pit will be developed through an orderly removal of waste material and ore. At the completion of mining operation the pit will have the approximate configuration shown in Figure No. 4-11 of section 4.0. The projected amounts of Type I and II material that will be placed back in the pit are presented in Table No. 5-1. In addition, approximately 123,500 cubic yards of imported construction material (crushed rock) and 600 cubic yards of cut-up HDPE liner and PVC piping will be placed in the backfilled pit. Also approximately 7.5 acres of HDPE liner from the site will be used to line a portion of the proposed wetland area to be constructed on the west end of the backfilled pit. If a suitable buyer can be found, the remaining HDPE liner and PVC piping will be recycled.

The sequence of backfilling will begin with the placement of Type II material with lime. This will be followed by the placement of Type I waste rock and then saprolite from the Type I stockpile. Sandstone and then till will be placed over the saprolite from the Type I stockpile and the area topsoiled and vegetated.

TABLE NO. 5-1

Projected Waste Backfilling Amounts

Bench	WR II ktons	WR I ktons	SAP ktons	SS ktons	Till ktons	TOTAL ktons	Cum. Backfill ktons
900	34	0	0	0	0	34	34
910	52	0	0	0	0	52	86
920	69	0	0	0	0	69	155
930	85	0	0	0	0	85	240
940	108	0	0	0	0	108	348
950	128	0	0	0	0	128	476
960	220	0	0	0	0	220	696
970	243	0	0	0	0	243	939
980	265	0	0	0	0	265	1,204
990	297	0	0	0	0	297	1,501
1000	314	0	0	0	0	314	1,815
1010	335	0	0	0	0	335	2,150
1020	302	0	0	143	0	445	2,595
1030	0	0	334	80	0	414	3,009
1040	113	245	0	70	0	428	3,437
1050	0	477	0	0	0	477	3,914
1060	0	357	139	0	0	496	4,410
1070	0	0	473	0	0	473	4,883
1080	0	0	147	469	0	616	5,499
1090	0	0	0	290	295	585	6,084
1100	0	0	0	0	516	516	6,600
1110	0	0	0	0	482	482	7,082
1120	0	0	0	0	396	396	7,478
1130	0	0	0	0	288	288	7,766
1140	0	0	0	0	2	2	7,768
GRAND TOTAL	3,122	1,079	759	829	1,979	7,768	

ktons = Thousand tons
SS = Sandstone
SAP = Saprolite
WR I = Type I waste rock
WR II = Type II waste material

During the actual backfilling operation, the Type II materials will be sloped towards the east and west ends of the pit. This will enhance the accumulation of precipitation and groundwater in two areas where sump pumps will be temporarily installed. When the backfilling reaches the 1,040-foot bench, the backfilled benches will be adjusted so that by the time the saprolite from the Type I stockpile is returned to the pit it will not be significantly above or below the elevation of the top of bedrock (Figure No. 5-2). As also shown in the figure, the final elevation of the saprolite layer along the centerline of the pit will be slightly higher (three to six feet) than it will be at the edges. This will be done to compensate for settling. If insufficient Type I and II material are available to provide this feature, till from the Type I stockpile will be used to make up the difference.

Given the volume of material removed from the pit and stored on-site, and the volume of material imported for construction purposes, it is estimated that an excess of material, as discussed below, will be available for backfilling the pit.

As shown in Table No. 4-6, approximately 123,600 cubic yards of crushed rock will be imported from off-site to be used as road base and as a drainage blanket for the Type II stockpile liner. This material will be placed in the open pit as backfilling progresses. Those materials that have come into contact with Type II material or leachate will be backfilled with Type II material. Those that have not will be backfilled with Type I material.

The schedule and sequence of the materials removed from the pit to be used in backfilling is presented in Table No. 4-2. The expected volume of stored waste material will nearly equal the total volume of waste and ore that was removed from the pit. This is due to the net result of two changes that will take place in the waste materials as they are handled. The first, known as the swell factor, results from the increase in porosity due to the physical disturbance of the materials. The swell factor is actually the increase in volume that takes place when solid material is excavated and handled and because of its increase in surface area cannot be returned to its original volume. The second change, known as the compaction factor, results from the decrease in swell porosity during the compaction associated with backfilling activities. Since the swell factors are greater than the compaction factor, a net increase in the volume of the waste is achieved. The swell and compaction factors for the different waste materials are included in Table No. 5-2. These swell and compaction factors represent the best engineering judgement for the material types based on information in the literature, experiences at other mining operations and geologic data collected at the site.

TABLE NO. 5-2

Swell and Compaction Factors

Rock Type	Swell Factor	Compaction Factor
Type II	1.3	0.9
Type I	1.3	0.9
ML (Saprolite)	1.2	0.9
Sandstone	1.2	0.9
Till	1.2	0.9

By applying the swell and compaction factors in Table No. 5-2 to the non-ore material removed from the pit, it has been determined that the backfilled material would occupy all but approximately 2,000 cubic yards of the volume created by the excavation of the pit. Adding this negative volume to the 123,600 cubic yards of off-site material to be backfilled with Type II material indicates an excess of 121,600 cubic yards would be available for backfilling the pit if the pit were backfilled to close to its original contours.

5.5 Final Site Grading Plan

Following removal of project facilities and backfilling of the open pit, the mine site, with the exception of the backfilled pit, will be graded to its approximate original contours. With the exception of the western 800 feet, the open pit area will be backfilled to slightly above (± six feet) original grade to compensate for anticipated settlement. The western 800 feet of the open pit will be backfilled to new contours to support the development of a seven and one-half acre wetland.

The 7.5 acre wetland restoration area will be lined with saprolite from the Type I stockpile and recycled HDPE liner material to restrict infiltration and to impound surface water. The wetland grading plan and liner design are further discussed in detail in section 5.11 of this report.

Figure No. 5-3 illustrates the final proposed contours for the site. After grading has been completed, stockpiled topsoil will be evenly distributed over the disturbed areas to prepare for revegetation.

The soil balance for the final grading plan as illustrated in Figure No. 3 contains an excess of approximately 60,000 cubic yards of fill material. This excess provides additional pit backfill material if it is needed. If this material is not needed for this purpose, it will be distributed over the reclaimed site in such a manner that it will not substantially modify site final grades.

The proposed grading plan involves reconstructing intermittent Stream B and that portion of intermittent Stream A that was located in the Type I stockpile area. The intermittent Stream B channel will be recreated within the open pit perimeter and will connect to its historic outlet west of the dike located on the west end of the open pit. The reconstructed portion of intermittent Stream A will connect the discharge point from the wetland test plot located to the east of the Type I stockpile to the natural stream course located west of the stockpile.

5.6 Final Land Use

Final land use of the mine site following the mining operation will be as a non-consumptive, passive recreational area which will provide wildlife habitat. The reclaimed land should attract and support wildlife. The site could eventually be converted by others into a park, or it could be developed for other uses.

Figure No. 5-4 illustrates the final land use of the mine site as it relates to surrounding use. A review of the figure shows that the final land use is consistant with existing land use in the area.

5.7 Open Pit Reclamation

A detailed environmental characterization of the site is presented in section 3.0 of the EIR. Based on this work and waste characterization studies on mining wastes, a design for backfilling the open pit has been prepared. This design consists of an engineered sequential backfilling process which includes the addition of lime during the backfilling of Type II material for pH control and the selected placement of saprolite to impede groundwater movement between the placed waste rock and overburden. A discussion of the proposed design follows.

5.7.1 Design Report

Backfilling of the pit will commence at the completion of mining. As per Figure No. 5-1, this is scheduled to occur after the planned ore removal is completed. Since the excavated pit will receive the backfill, no special site preparation other than provisions for the control of surface drainage and pit inflow water during backfilling operation will be required.

The sequential backfilling will begin with the Type II material. The Type II material will be covered successively by the waste rock and the saprolite from the Type I stockpile which will be placed to approximately an even thickness over the entire Type I waste rock. The saprolite will be moistened, as required and compacted in order to reduce its permeability. This compacted saprolite will minimize the mixing of water collected in the bottom of the filled pit with that in the overlying sediments. The saprolite layer will be located in the same relative stratagraphic position it was located in prior to mining (Figure No. 5-2). Since the saprolite material contains abundant fines, upon its placement back in the pit it will form a less permeable "layer" over the Type I waste rock and Type II materials. The sandstone will be placed on top of the saprolite and the remaining pit volume will be filled with till and covered with the stockpiled topsoil. The sequence of backfilling the open pit is shown on Figure Nos. 5-5 and 5-6.

Type II material and the Type I waste rock will be placed and compacted into approximately three-foot high lifts within the pit. This backfilling technique will result in higher densities than could be achieved through conventional mining backfilling techniques, thus resulting in smaller surface settlment. The saprolite from the Type I stockpile will be spread and compacted in approximately one foot lifts.

5.7.1.1 Control of Acid Production in the Pit

Possible parameter concentrations in the backfilled contact water have been calculated for five key parameters which are pH, sulfate, iron, copper, and manganese. These concentrations were calculated from the data derived from two waste characterization studies: the acid neutralization and the rock chip leach column testing. The column leaching studies were conducted under alternating wet/dry conditions over an 80-day period on Flambeau sulfide-bearing waste rock samples. The results of the acid neutralization studies determined that when contact water within the backfilled pit is maintained at a pH of approximately 6.5, leaching of the Type II materials can be controlled.

Leach column testing has generated a set of time/leaching relationships for the Type II materials. These relationships are listed in section 3.5.6 of the EIR. In addition, the Type II materials will be stored on the surface for an average of four years. During this period of time the stockpiled material will be subjected to approximately four to six intense leachings per year. A suite of secondary minerals will be formed within or on the outside of the stockpile as part of this process. These minerals will include various metal hydroxides, carbonates, and hydrous sulfates. Solubilities of these secondary minerals have been extensively studied and reported in the literature (Larsen, 1973 and Krauskopt, 1967).

The estimated quantity of lime (CaO) needed to bring the contact water within the backfilled open pit to a pH of 6.5 is 2.5 pounds per ton of Type II material. The composition of the open pit contact water has been estimated using the parameter reductions calculated from the wet/dry leach column testing of all of the parameters, and the reduction of copper, iron, and manganese due to lime addition. These calculations show that the expected concentrations will be as follows:

Parameter	Concentration
Sulfate	11.6 - 23.6 mg/l
Iron	25.6 - 60.2 ug/l
Copper	266 - 555 ug/l
Manganese	30.7 - 61.4 ug/l

These predicted concentrations are in agreement with theoretical and actual measured concentrations for lime treated water that has been in contact with sulfide-bearing waste rock as reported in the literature (Larsen, 1973). The concentrations of all four parameters are below the drinking water standards. The average groundwater concentrations of iron and manganese at the site, 220 and 350 ug/L, respectively, are greater than those predicted in the pit contact water. Therefore, it is expected that the iron and manganese concentrations in the pit contact water would be similar to those in the groundwater. The concentration in the groundwater leaving the backfilled pit will be below drinking water standards by the time the groundwater reaches the compliance boundary.

The above calculations are considered to be conservative since they do not consider the pit water effect. In addition, some water will be removed and directed to the wastewater treatment plant through the use of sumps during the backfilling process. The removal of this water will assist in pH control by removing some runoff which will consist primarily of unbuffered rainwater.

In conclusion, it is therefore predicted that pH in the contact water of the backfilled pit can be controlled on a short-term basis by the addition of lime during the placement of Type II material. The proposed adjusted pH is 6.5, which is typical of northern Wisconsin groundwater. The ultimate pH control will be the groundwater indigenous to the site which is buffered with carbonate and has a pH of approximately 6.5. It has been determined that by the use of a pH control mechanism with Type II material, metal and anion concentrations for iron, copper, manganese, and sulfate will not have an adverse effect on the groundwater. This topic is discussed further in the next section.

5.7.1.2 Potential Impacts on Water Quality Resulting from Backfilling Type II Material Into the Pit

The potential impacts on ground and surface water quality resulting from the backfilling of the pit with Type II material have been evaluated in the report *Prediction of Groundwater Quality Downgradient of the Reclaimed Pit for the Kennecott Flambeau Project,* Revised December 1989 (Appendix L). The results of this evaluation indicate that the concentrations of sulfate, manganese, iron and copper will be controlled by the solubility of the wastewater treatment precipitate which will be backfilled in the pit with the Type II materials. The study estimates that the concentrations of the above four parameters in the pit contact and groundwater will be as follows.

Parameter	Concentration
Sulfate	1,360 mg/L
Manganese	550 ug/L
Iron	320 ug/L
Copper	14 ug/L

While sulfate and manganese are both above the background concentrations and standards, this is not a problem since neither parameter will exceed the MCL at the proposed compliance boundary for the site, which is located at a distance of 1,200 feet. The reason for this conclusion is that the Flambeau River will serve as a very effective hydraulic boundary and that the river pillar acts as sink for groundwater.

The water flow of the Flambeau River at low flow is approximately 107,000 times greater than that of the groundwater entering the river from the backfilled pit. The difference in flow between the groundwater and river, results in the following projected incremental increases in average Flambeau River concentrations.

Parameter	Average River Concentrations (mg/l)	Projected Incremental Increases (mg/l)
Sulfate	10	0.0033
Manganese	<0.05	0.0000013
Iron	0.40	0.00000078
Copper	<0.005	0.000000034

A comparison of the projected incremental increases in Flambeau River concentrations to average Flambeau River concentrations shows that the projected incremental increases are so low, that they would not even be detectable in river water by today's sophisticated analytical laboratory techniques. It is, therefore, concluded that groundwater eminating from the Type II wastes in the reclaimed pit will not adversely impact either the surface or groundwater at the site.

5.7.2 <u>Operations Manual</u>

The following discussion addresses operations during backfilling. Topics addressed are specifications for site construction and operation; detailed instructions to the site operator relating to the backfilling process; a certification plan to document the placement of backfilled material; and a discussion of phasing and typical daily operations.

5.7.2.1 <u>Backfilling Operations</u>

The backfilling operation is scheduled for three eight-hour shifts per day, five days per week, for 250 days per year. The production rate is governed by the capacity of the equipment fleet on hand at the end of the pit excavation which is planned to be two shovels and seven haul trucks. As shown in Figure No. 5-1, backfilling will require approximately 19 months for completion. Backfilling could be accelerated by using additional equipment. Backfilling will be performed by the following mine equipment:

- 1 Dozer for leveling, spreading and compacting truck dumped material
- 1 Dozer for stockpile maintenance
- 2 Hydraulic front shovels
- 7 Haul trucks
- 1 Grader for road maintenance and spreading backfilled material
- 1 Water wagon for road maintenance and dust control
- 1 Rubber-tired front-end loader for shovel backup and road maintenance
- 1 Dump truck for general maintenance

A sequential discussion of the backfilling process for the pit follows and is shown on Figure Nos. 5-5 and 5-6. Figure Nos. 5-7 and 5-8 show cross sections of the pit at different stages of backfilling. The figures also show the relative position of backfilled material at each stage of backfilling.

5.7.2.1.1 <u>Type II Material</u>

From the Type II stockpile, the rock will be loaded into haul trucks by hydraulic shovels. The rock will be hauled to the bottom of the pit and placed on the floor of the working bench. The material will be placed such that the lifts gently slope towards the ends of the pit. This will facilitate the collection of pit inflow and precipitation, should these waters accumulate faster than the material is backfilled. Waters collected by the sump pumps installed at the ends of the pit will be considered contact water and will be pumped to the wastewater treatment facility.

In addition, lime slurry will be added to the daily accumulation of Type II materials in sufficient quantity to raise the pH of the discharge water to at least 6.5 (see section 5.7.1.1 of this report and section 3.5.6 of the EIR for a discussion of the quantity of lime that will be required). Liming will limit the release of substances from the backfilled Type II materials when these materials are saturated with incoming waters. Lime will most likely be added by discharging a slurry from a tank truck that will travel over the previously deposited Type II materials.

During the backfilling of the Type II materials, the slurried precipitate from the wastewater treatment facility will also be added to the materials in the pit rather than added to the remaining stockpile. Since the pH of the pit water will be 6.5 or greater, pH sensitive components in the precipitate will be more stable in the pit than on the stockpile where the pHs will range from 3 to 4. This is important for the stability of the copper, iron and manganese compounds. It will have little or no effect upon the solubility of gypsum, the main source of soluble sulfate.

During the removal of the Type II stockpile, rainwater collection systems will remain operational. It is expected that all backfill materials will be wet when they are returned to the pit and that a dust problem will not occur. Dusting will be controlled by adding water to the backfilled waste materials via the water truck to assist in the compaction efforts.

In order to achieve a reasonable degree of compaction, backfilled Type II material will be placed in small vertical lifts, approximately three feet in height. The operating procedure will be for the trucks to dump onto sloping benches. The load will then be spread with a dozer and compacted by dozer traffic and by traffic from loaded haul trucks delivering the backfill materials to the pit. Loaded truck traffic patterns will be established in the pit to promote compaction. Control of the backfilling process will be accomplished through field performance monitoring to maintain acceptable lift thickness. Field performance monitoring will be conducted by the mine engineer. The use of techniques, such as density testing, for control during rock backfilling are not considered practical for this or similar projects. It is believed that the planned lift thickness, dozer spreading and compaction with loaded, properly routed trucks will result in the acceptable settlement rates estimated in this report.

Following removal of the material from the Type II stockpile area, the drainage system consisting of the PVC pipe, the granular drainage blanket, and the HDPE liner will be removed. Approximately 7.5 acres of liner will be used to line that portion of the proposed 7.5 acre wetland to be constructed on the west end of the backfilled open pit that is located within the perimeter of the open pit. The remaining liner will be cut into pieces and disposed of in the pit with the Type II waste material. If a suitable buyer can be found, the remaining liner and/or PVC piping will be recycled. As the liner and drainage system are removed, a temporary berm will be constructed to control runoff water and direct contact water to the wastewater treatment facilities.

5.7.2.1.2 <u>Crushing and Loadout Facilities, Catchment Pond, and Ore Haul Road</u>

Following crushing of the last ore, the crushing facility will be dismantled in an orderly sequence. All equipment and structural steel will be removed from the site.

The crusher area retaining wall will be left intact until the final stages of the Type II stockpile removal. At that time, the retaining wall and its foundation will be removed. The removed material will be disposed of on-site in the one-time demolition waste disposal facility. The HDPE liner and blanket material in the crusher area will be removed and transported to the pit for disposal with the Type II material.

As part of the removal of the crushing facilities, the railroad spur in the ore loadout area and runoff pond will be removed. The HDPE liner under the ore crushing area and the overlying materials will be placed in the pit with the Type II material. At this point all that remains to be placed in the pit with the Type II material is the ore haul road base. Base material from the ore haul road will be excavated to a depth sufficient to remove material that has come into contact with sulfide mineralization. Removal will commence at the maintenance shop and move towards the pit in a fashion such that areas that have been excavated will not be further traversed by excavation equipment and haul vehicles. Removal of the haul road will continue into the pit until the working level has been reached.

5.7.2.1.3 <u>Type I Materials</u>

When the above activities are accomplished, the loading equipment will be moved to the Type I stockpile and the Type I waste rock will be loaded, hauled to the pit, and spread on top of the Type II material. Placement and compaction of the Type I waste rock will be accomplished in a fashion similar to that described for the Type II material. Lime will not be added to the Type I material since it is non-acid producing.

At the onset of this process, a small amount of gravel from an off-site source will be used to construct a temporary access road from the Type I stockpile to the currently existing building located south of the topsoil stockpile. This building will be used to perform maintenance on mining equipment during the final phase of pit backfilling. Additional minor amounts of gravel may also be needed to dress the lower sections of the haul road in the pit itself.

After all Type I waste rock is returned to the open pit, a continuous uniformly thick layer of saprolite from the Type I stockpile will be spread and compacted, in approximate one-foot lifts on top of the backfilled waste rock. This will provide an approximate seven to eight-foot thick lower permeability layer between the Type I waste rock and Type II material below, and the sandstone and till that will be placed above. The backfilled saprolite will be compacted by repeated dozer passes and loaded trucks.

The placement technique for the saprolite will result in a layer of material that has a lower permeability than the underlying rock and the river pillar. The results of the groundwater model completed for the project predicted that the very low post reclamation flows will be downward into the backfilled pit. The placement of the saprolite at an elevation at the bedrock surface will minimize this flow.

Sandstone will be placed on top of the saprolite layer, followed by till. Compaction techniques for both materials will be the same as described for the Type II material. When backfilling approaches the approximate final grades, truckloads will be spotted and dumped for final contouring. Surface contouring will begin as soon as possible. Overburden material will be mounded over all but the western 800 feet of the pit as described in section No. 5.5. The wetland area near the west end of the pit will be constructed. Topsoil will be replaced to the approximate ten to 12-inch depth existing prior to mining in those areas to be topsoiled. Section 5.11 discusses revegetation of the site.

5.7.2.2 <u>Water Control During Backfilling</u>

Water from three sources will accumulate in the pit. The first will be due to direct precipitation. The second will be due to runoff entering the pit from a small drainage area between the pit and the Type II stockpile. The third source will be inflow of groundwater. To keep the working areas free of this water, sumps will be located within the open pit. Water collected in the sumps will be pumped to the wastewater treatment plant during placement of Type II material. During the placement of subsequent material, the sump discharge will be monitored and, at such time as water quality allows, the discharge will be redirected to the settling ponds. At this time the wastewater treatment plant will be dismantled.

5.7.2.3 Settling

Settling within the backfilled pit is expected to be minimal due to the following:

1. In general the waste rock is significantly to moderately clay altered through supergene enrichment processes. This will result in the rock breaking down more readily than unaltered rock. Such breakdown will result in finer grained rock particles with smaller void area.

2. Ripping and blasting of the waste rock and repeated handling during its initial loading, hauling, and dumping, and its repeated handling will all assist in further breakdown of the rock fragments.

3. During storage of the Type II material, for periods up to six years, the rock is further decomposed through chemical action upon exposure to the elements.

4. All backfilled material will be placed in the pit in shallow lifts to minimize size gradation during the backfilling process.

5. Such shallow lifts will be more readily compacted by repeated passes of the heavy mine equipment.

It is estimated that settling will be less than five percent. For this reason the majority of the open pit site will be mounded to compensate for the anticipated amounts of minor settling.

5.7.2.4 Slurry Wall and Flood Control Dike

The slurry wall and flood control dike will be left in place. The flood control dike will actually assist in the development of the planned wetland on the west end of the pit. During the final stages of backfilling and during the initial stage of revegetation, the flood control dike will restrict the movement of sediments from the site to the Flambeau River.

5.7.2.5 Operations Under Varying Weather Conditions

Due to the nature of the backfilling operation, backfilling will continue under all weather conditions with the exception of major rainstorms where precipitation and runoff would exceed the pumping rates of the sump pumps. Under these conditions, backfilling will temporarily cease until sufficient water has been removed to allow operations to continue.

5.7.2.6 <u>Certification Plan</u>

To document the top of the Type II material, Type I waste rock and Type I saprolite, field elevations will be obtained through on-site surveys. The elevations will be taken on an approximate 150-foot grid pattern over the open pit area. In addition, following the topsoiling of the reclaimed open pit, a final survey on an approximate 150-foot grid system will also be completed to document final site contours.

In addition to the above, as part of normal mining operations rock types, mineralization, fractures, faults, and any areas of significant water inflow encountered will be noted in the field and recorded on detailed mine maps.

Finally, photographs will be taken of the backfilling process to illustrate the procedures used and conditions encountered.

The above information will be assembled and maintained by Flambeau in archives for future reference purposes as a normal course of conducting its business. The archived file will also include an opinion by a registered professional engineer as to whether the site was constructed in substantial conformance with the Plan of Operation.

5.7.3 <u>Engineering Drawings</u>

Plan of Operation drawings for the backfilling process are found in the project EIR and in sections 4.0, 5.0, 7.0, and 10.0 of this report. Figure No. 2-2 of this report shows an existing site condition plan sheet for the project area prior to any construction activities. Figure No. 4-11 of this report illustrates base grades (final pit design) of the open pit prior to backfilling. Since site engineering modifications are not part of the backfilling operation, an engineering modification plan sheet has not been prepared. Final site contours, including a final site topography plan sheet, are addressed in section 5.5 of this report.

Figure Nos. 5-5 and 5-6 show the phasing of the backfilling process. Figure No. 5-5 shows the extent of backfilling at the end of the first three months of the reclamation. Figure No. 5-6 shows the contours of the backfilled pit at the end of 15 months of the 19-month reclamation process. Figure Nos. 5-2, 5-7, and 5-8 are sections through the backfilled pit at various stages of the backfilling process.

Site monitoring and long-term care are addressed in sections 7.0 and 10.0, respectively of this report. Site geologic cross sections are found in section 3.5 of the EIR. The cross sections illustrate the location of the pit in relation to site geology, water table elevations, permeability data, haul roads, etc. Finally, typical sections for features such as haul roads and the pump barge are contained on detail sheets referred to in section 4.0 of this report.

5.7.4 Alternative Design, Location, and Operation

Alternatives to reclamation of the open pit and to the stockpile locations are discussed in detail in section 2.0 of the EIR.

As noted above, waste rock and overburden materials will be used during reclamation to backfill the open pit. Most other materials generated during the reclamation process will be salvaged for reuse. Other than pit backfill materials, only approximately 3,000 to 4,000 cubic yards of demolition waste will need to be disposed of as a result of the project.

There are no merchantible bi-products which can be obtained from the waste rock or overburden material. The reuse, sale, recovery or processing of waste rock or overburden for purposes other than backfilling the open pit are not practicable. The best reuse of these materials is through the backfilling of the open pit.

5.8 Final Grading of Crusher and Stockpile Areas

Following removal of stored material and liner and drain field material from the stockpile areas, and from the crusher loadout and ore haul road area, the areas will be graded to final design grades. To accomplish this, berms will initially be leveled after topsoil has been removed. Excess material in one area will be used to meet fill needs in other areas. Once final grades have been reached, topsoil will be placed and the area revegetated as outlined in section 5.11.

The berms and drainage systems for both the Type I and II stockpiles will be maintained until the final stages of reclamation of the stockpile. As required, temporary ditches or berms will be constructed to insure that runoff water is directed to the appropriate wastewater treatment facility.

The settling ponds associated with the Type I stockpile will be kept operational until the Type I stockpile reclamation and revegetation has been completed. The settling ponds and associated berms will be graded and the area returned to its approximate final contour after their use is terminated.

5.9 Ancillary Facilities

Flambeau's proposed plan is to reclaim the project area to a use compatible with surrounding land use. However, certain ancillary facilities such as the plant access road, parking lot, railroad spur, various buildings and other ancillary facilities could be left in place. These actions are dependent upon possible future negotiations between the company and local governments for use of the project area as an industrial park.

In the absence of such activities and in accordance with the proposed reclamation plan, all ancillary facilities are to be dismantled and/or removed from the project area. During the removal of ancillary facilities, materials such as wood, metal, etc. will be generated by the reclamation activities. These materials will be disposed of in the one-time demolition waste landfill. Following the removal of ancillary facilities, the project area is then to be returned to its final design grades. In accomplishing this action, all reclaimed areas will be graded, topsoiled, and revegetated as outlined in section 5.10. A discussion of the reclamation of each of the ancillary facilities follows.

5.9.1 Access Road

The access road will remain open until final reclamation at the facility is complete. The asphalt surface will be removed for disposal in the one-time demolition waste landfill. The roadbed material will remain in place and be scarified and then covered by topsoil and revegetated.

5.9.2 Parking Lot and Guardhouse

The parking lot and guardhouse will remain until activities at the site have been completed. The parking lot and guardhouse will be removed in conjunction with the access road. Asphalt will be disposed of in the one-time demolition waste landfill. The road bed area in the parking lot will remain in place, topsoiled, and revegetated.

5.9.3 Administrative Office, Maintenance Shop, Wastewater Treatment Plant, and Explosive Magazines

The administrative and maintenance buildings will be removed following reclamation of the project area. The wastewater treatment plant will be removed during backfilling of the open pit at such times as water quality will allow discharge to the settling ponds. The explosive magazines will be removed during reclamation.

All chemical reagents and equipment will be removed in an orderly sequence prior to dismantling the wastewater treatment building. All equipment and salvageable items will be hauled off-site and sold or otherwise recycled as appropriate. All masonry structures and concrete will be removed and placed into the one-time demolition waste landfill.

During dismantling of the wastewater treatment plant, the surge pond will also be removed. The HDPE liner for the pond will be placed in the backfilled pit. All underground piping associated with the wastewater treatment plant will be left in place.

5.9.4 Railroad Spur Line

The railroad corridor will be reclaimed to a natural state and will have minimal reclamation consisting mainly of removing the rails, ties, ballast, and base materials. The rails and ties will be removed and sold for salvage except the section imbedded in concrete in the load-out zone. This section, including the concrete, will be removed and disposed of in the one-time demolition waste disposal site. The ballast and base materials in the load-out zone will be disposed of in the pit. The balance of the ballast and base materials will be used in grading the area to its final grades. Topsoil replacement, regrading, and revegetation will complete the reclamation.

5.9.5 Fencing and Security

Fencing and security will be maintained at the facility until completion of reclamation activities. During this period, a security guard will be stationed at the main access gate adjacent to the administrative building. The fence will be removed as part of the last step in the reclamation of the area.

5.9.6 Power Supply

During dismantling of the wastewater treatment plant, a temporary transformer and power supply panel will be installed to replace the transformer and switch gear located in the wastewater treatment building. Power required for use in the maintenance and administrative buildings will be supplied from the temporary power panel.

The underground conduit and wiring from the power pole located on the south side of the plant and the wastewater treatment plant will be removed and sold or recycled off-site at the termination of the reclamation process.

5.9.7 Fuel Storage and Distribution

The fuel storage tanks will be used until the final stages of reclamation of the project area. After the pit and most of the other project areas have been reclaimed, the fuel tanks will be emptied and removed from the site. The sand fill over the liner will be tested for contamination and then will, if uncontaminated, be disposed of either in the settling pond as backfill or, if contaminated, taken to an approved disposal facility. After the tanks have been removed, fuel will be supplied from the contractor's fuel truck. Following removal of the fuel tanks and liner material, the area will be regraded to final contours, the topsoil replaced and revegetated.

5.9.8 Storm Water Control

The storm water control features installed during the construction and operation of the mine will be used during the reclamation of the stockpiles. As part of final site reclamation, all stormwater control features will be regraded and the areas returned to its final grades. Included will be the dismantling or removal of permanent structures such as culverts on an as needed basis.

5.9.9 Water Discharge

The water discharge pipes from the wastewater treatment plant will be operational until dismantling of the facility. At that time the ends of the discharge pipeline will be plugged and the pipeline left in place.

Outfall discharge structures adjacent to the Flambeau River will be removed and the areas returned to their approximate original state.

5.9.10 Sanitary Wastewater

The sanitary waste system will be removed at the time of the removal of the administration building and replaced by portable facilities from a licensed contractor. The septic or holding tank will be pumped clean. The drain field, if installed, and septic or holding tank will be removed and disposed of in the one-time demolition waste landfill.

5.9.11 Refuse Handling

Refuse such as garbage, and general waste will be accumulated and picked up by a licensed waste disposal contractor who will dispose of the material off site.

5.9.12 Monitoring Well Abandonment

Any existing groundwater monitoring wells or exploration drill holes not previously abandoned or not needed for post construction and operation monitoring will be properly abandoned in accordance with WDNR administrative rules.

5.10 Erosion Control During Reclamation

Erosion control during construction and operation is discussed in section 4.8 of this report. Since both site construction and reclamation are basically earthworks projects, the same erosion control techniques and procedures applied to the construction phase of the project will be applied during reclamation.

Generally, runoff control will be accomplished by removing perimeter drainage swales as part of the last reclamation activity for each reclaimed site feature. During this process straw bale barriers and silt fences will be used to control siltation. Temporary drainage features such as swales, diversion berms, and settling ponds will also be installed to control erosion and siltation.

Areas of the site reaching final grade will be topsoiled and seeded as soon as possible according to the site revegetation plan. Temporary overwinter seeding of disturbed areas will be completed, if needed. Seed mixtures and application techniques will be as described in section 4.8 of this report.

5.11 Revegetation

5.11.1 Introduction

Revegetation of the project area will actually start prior to or during pre-production activities. Prior to and during construction of the project facilities, some existing site trees will be identified and relocated to other sections of the area using a tree spade. Some of these trees will be relocated to screen parts of the project facilities, while other trees will be relocated to a temporary project nursery (Figure No. 2-1). These trees will then be available for use as needed during operations or final reclamation. After the project area is topsoiled, the trees will be transplanted into the project area as a part of the reclamation process. Most of the existing site trees that will be used for screen plantings and reclamation were planted by Flambeau's predessor in the early 1970s, in anticipation of the need for revegetation.

Revegetation will consist of savannah copses and grassland planting. Figure No. 5-9 contains a master plan for revegetation of the site.

An integral part of the reclamation plan will be the establishment of a wetland over the west end of the backfilled pit. This would be approximately seven and one-half acres in size. Measures, as discussed later in this section, will be taken to provide adequate drainage of the reclaimed open pit site.

5.11.2 Wetland Replacement

Approximately 8.3 acres of low, moderate and high quality wetlands will be taken by the project. To replace these acres, two new wetlands will be developed. Seven and one-half acres of moderate to high quality wetlands will be constructed on the western 800 feet of the open pit and will impound the flow of recreated intermittent Stream B in a fashion similar to the pre-project hydrologic function of Wetland No. 2. In addition, a 1.0 acre wetland will be developed as part of a test plot program in the area of Wetland No. 5. This wetland will also consist of open water and littoral areas.

The test plot (Figure No. 5-3) is included in the wetland mitigation plan to obtain information in order to refine the methods and procedures for constructing and revegetating the 7.5-acre wetland mitigation area. Information from the test plot will also be used to provide the benchmark to evaluate the success of the larger wetland area.

The wetlands that will be removed from the mine site are described in the Wetland Inventory and Assessment for the Flambeau Project. This assessment is located in Appendix 3.8-C of the EIR. Table No. 5-3 summarizes the functions of these wetlands. As described in the wetland assessment, Wetland Nos. 3a, 3b, 4a, 4b, 4c, 5a, 5b, and 6b, which comprise 1.7 acres of the total 8.3 acres that will be removed, are low quality wetlands with very minor functional value to the wetland ecosystems of the mine site.

Wetland No. 5c, which comprises 4.1 acres of the total to be taken by the project, has a portion with low biological function value which will be taken by the Type II stockpile. The higher value section of Wetland No. 5c will remain unaffected by the proposed facilities. Therefore, of the total 8.3 acres that will be affected by the project, 5.8 (70 percent) is of low quality.

Wetland No. 2 comprises the remainder of the 8.3 acres. It has high quality biological functions.

The proposed replacement wetlands include 8.5 acres of moderate to high quality wetland. The new wetland areas will provide open water, littoral habitat, and wet mesic forest that is more suitable for waterfowl and wildlife than the existing wetlands because these habitats and the transitional zones between them will be provided in the same wetland unit. On the existing site, the low quality wetlands are comprised of many small pockets of marginal habitat with no transitional zones that could be used for cover, nesting, and feeding. Therefore, the biological functions of the wetlands to be removed will be replaced by higher quality wetlands relative to their biological functions.

Watershed functions of the wetlands to be removed are very limited. In two cases (Wetland Nos. 2 and 5) the wetlands serve a hydrologic function in stormwater storage. These functions are of minor importance in their respective watersheds. The replacement watershed will provide the identical functions in the reclaimed intermittent Stream B watershed. The watershed function of Wetland No. 5c will not be significantly affected because the protion of the wetland adjacent to the partially

TABLE NO. 5-3

Flambeau Project
Summary of Wetland Functions

Function	Wetland No.				
	2	3	4	5	6
Geological Functions	H	L	L	M/L	M
Watershed Functions					
Hydrologic	M	L	L	M/L	M
Groundwater	L	L	L	L	L
Storm/Flood Water	L	L	L	L	L
Shoreline Protection	NA	NA	NA	NA	NA
Other	L	L	L	L	L
Recreational, etc.	Na	NA	NA	L	L
Quality	L	L	L	L	L
Study Area, Sanctuary, etc.	L	L	L	L	L
Regional Values	L	L	L	L	L

Qualitative Value High - H
Moderate - M
Low - L
NA - Not Applicable

developed channel that is tributary to intermittent Stream C will not be removed by the project.

Other potential functions of wetlands presented on Table No. 5-3 for the wetlands to be removed were all low quality. These functions will be provided in an equal or better manner by the proposed replacement wetlands.

5.11.2.1 Location/Design

The proposed seven and one-half acre wetland reconstruction will be located over the western most 800-foot section of the open pit. Specifically, it will consist of a three and one-half acre pond, three acres of sedge meadow, and about one acre of wooded wetland. The upland areas adjacent to the wetland will be planted with grassland vegetation that thrives on moist or poorly drained soils.

The proposed wetland reclamation area is depicted on the general site plan on Figure No. 5-3. The proposed 7.5-acre wetland will include the hydric soil storage area and a portion of the west end of the reclaimed pit. The pond is designed to attract wildlife and provide forage and nesting spots for various types of waterfowl. The pond edge is curvalinear which provides a number of secluded coves for nesting. The bed of the pond slopes away from the bank at a 2.0 percent, and then a 3 to 1 slope. This results in a maximum depth of the pond of about six feet. Most of the shallow areas of the pond will contain emergent vegetation, while the deeper sections of the pond nearer to the center will have open water.

The proposed one acre wetland test plot will be located east of the Type I stockpile near the northeast corner of the project area. This rectangular wetland will be created by stripping the existing topsoil, regrading the subsoil and covering the new subbase with about one foot of soil salvaged from wetlands that will be disturbed inside the mine site. Surface water from the area will be impounded by constructing a two foot earth berm on the west and north sides of the wetland. This impounded surface water will keep the hydric soils wet and will promote the growth of hydrophytic vegetation.

The wetlands will be vegetated according to the procedures outlined in section 5.11.3. Plant materials will be selected from the list of native wetland vegetation outlined in section No. 5.11.3.2. These wetland plant materials will be installed according to the typical planting plans presented in section No. 5.11.3.3 and the two installation procedures specified in section No. 5.11.4.4.

5.11.2.2 Hydrology

The 7.5-acre wetland area will be created by impounding water in recreated intermittent Stream B through a combination of the existing flood control dike and a weir. To achieve the desired wetland characteristics, the dike elevation will be raised 2.5 feet to 1,100.0 feet. Construction techniques for raising the dike will be the same as those outlined in Section 4.7.3.3.6.

The weir will be installed in order to be able to compensate for possible minor settlement of those areas of the wetland located over the reclaimed pit. The weir will provide flexibility for water level management in the new wetland. As shown on Figure No. 5-10, the weir's initial elevation will be set at 1,098 feet. Riprap will be placed on the discharge side of the dike and ten feet beyond the western toe of the dike to control erosion. The weir and discharge point will coincide with the historic location of intermittent Stream B such that surface water discharges to the Flambeau River from the stream will occur at the same location they currently do. The post reclamation drainage basin for the stream will be comparable in size to its premining condition.

The wetland test plot will be created by impounding water within the realigned intermittent Stream A (Figure No. 5-3). The source of water for intermittent Stream A upstream of the test plot is primarily Wetland No. 10. The discharge point for Wetland No. 10 is just west of STH 27. The discharge from the test plot will be transported by the continuation of the realigned intermittent Stream A channel to the west, where the channel will tie into the undisturbed western portion of the stream.

5.11.2.3 Liner Design

To minimize exfiltration through the base of the wetland pond a liner system will be installed under those areas of the pond located within the perimeter of the open pit. A liner will not be installed within the remnant of Wetland No. 2, since this area will not be excavated as part of site construction or reclamation.

A liner will not be installed in the test plot due to the fact that the soil characteristics in that area are known and the fact the water depth will be significantly lower than in the pond.

Figure No. 5-10 contains a northeast-southwest section through the proposed 7.5-acre wetland illustrating the slopes within the wetland, water depth, dike, weir, and liner system. The area to be lined will be the entire base of the wetland within the pit perimeter. The lined area will either extend to the pit perimeter or to ten feet beyond the limits of the wetland, whichever is less.

The liner system will generally consist of two feet of compacted saprolite from the Type I stockpile. Those areas of the wetland that extend to the pit perimeter will be underlain by four feet of compacted saprolite over a 100-foot distance from the pit perimeter toward the center of the wetland. The additional thickness of saprolite will be provided to compensate for the minor differential settlement that may occur in the wetland. The saprolite will be placed in one-foot lifts and be compacted using loaded mine haul vehicles.

Following placement of the saprolite, HDPE salvaged from other lined areas on the site will be placed over the saprolite. The HDPE panels for this application will be overlapped a minimum of four inches, but will not be welded. The HDPE will be free of major rips, tears, or missing pieces.

To provide sufficient depth for rooting of woody species, a 4.5-foot thickness of soil will be placed over the HDPE. Under the pond, this soil will be on-site till. For those areas of the wetland on the perimeter of the pond, two-thirds of a foot will be hydric soils from the hydric soil stockpile, with the lower four plus feet consisting of on-site till. The on-site till will be selectively chosen from the Type I stockpile and will not consist of clean sand or gravels.

The liner system will significantly reduce exfiltration from the pond, thereby contributing to the overall success of the reclamation plan.

5.11.2.4 <u>Wetland Soil Management Plan</u>

Hydric soils salvaged from wetlands disturbed in the project area will be stockpiled and used in the construction of the one acre wetland test plot and the reconstruction of the seven and one-half acre wetland. These salvaged hydric soils will be combined with other salvaged topsoil and placed over the subgrade of the proposed wetland areas. The hydric soil will be salvaged, stockpiled, and reused in the following manner:

a. A temporary hydric soil storage area will be located over the north remnant of Wetland No. 2. Woody vegetation will be removed and a small two-foot berm constructed around the area. Topsoil from the rest of Wetland No. 2 and other wetlands that can be salvaged will be placed over this one-acre area. The location of the hydric soil stockpile is shown on Figure No. 1-2.

   It is estimated that about 5.0 acres of existing wetlands have topsoils that will be useful in wetland restoration.

b. Suitable hydric soils from other wetlands to be affected by the project area will be identified and salvaged. Woody vegetation will be removed and the hydric soils will be carefully placed in the prepared storage area. The hydric soil will be minimally graded so as to reduce compaction.

c. The hydric soil will be kept wet during the period of mining operation using the same methods that will keep Wetland No. 1 moist (Section 4.7.4.13 of this report). During this time, no attempt will be made to restrict hydrophytic vegetation growth in the stockpile area.

d. During reclamation, the stored hydric soils will be pushed into stockpiles for use on the restored wetlands over the open pit. This hydric soil, along with other salvaged topsoil, will be transferred to the wetland area where it will be carefully placed and spread to a thickness of about two-thirds of a foot. The pond in the restoration area will not be retopsoiled.

e. The topsoiled wetland area will be revegetated immediately using methods outlined in sections 5.11.4.3 and 5.11.4.4 according to the typical planting plans presented in section 5.11.3.3.

5.11.3 Planting Plans

5.11.3.1 General Site Revegetation Plan

Figure No. 5-9 depicts the overall site layout for the revegetation of the mine site. The plan identifies the location and sizes of the various elements for the proposed revegetation. Specifically, the site layout includes the following elements:

Item	Size
Wetland (including 3.5 acre pond)	7.5 Acres
Wetland Test Plot	1.0 Acre
Wooded Savannah Copses	32.5 Acres
Grassland	140.0 Acres
Total Revegetation	181.0 Acres

Note: These acreages include a hydric soil storage area which will be reclaimed as part of the wetland restoration and the three acre temporary nursery which will be reclaimed as part of the grassland/wooded savannah copse's revegetation.

This general site plan supports the intent of the final land use described in section No. 5.6 and fulfills the wetland reconstruction requirements of the mining permit application. The seven and one-half acre wetland reconstruction over the western end of the open pit and the one acre wetland test plot will replace the 8.3 acres of wetland taken by the project. The savannah copse/grassland planting plan, along with the seven and one-half acre wetland will provide wildlife habitat and could provide passive recreation opportunities.

The overall intent of revegetation is to provide nesting and feeding opportunities for wildlife, and to provide non-consumptive passive recreation opportunities. The grassland/wetland/savannah copse planting concept was selected because it provides a wide variety of feeding and nesting opportunities for wildlife. The layout of the savannah copses provide an extensive plant community "edge" area that is ideal for wildlife feeding, while the secluded wetland areas with ponds provide excellent nesting opportunities for waterfowl. Furthermore, the grassland areas around and between the savannah copses will provide good opportunities for hiking, nature study and bird watching while providing a sense of security to the wildlife population.

Finally, locally indigenous plant species were selected to revegetate disturbed portions of the mine site. These plants will provide forage for wildlife, will promote natural plant community development and will provide a good demonstration area for this type of revegetation project.

5.11.3.2 Species Selection

The plant species selected for the proposed reclamation plan reflect the ultimate goal of creating self sustaining natural plant communities on appropriate land forms. Three major plant community types have been identified for the project area as follows: savannah copses, grassland and wetlands. Each of the three plant communities are represented on the final planting plan.

The plant lists in Table Nos. 5-4 to 5-6 contain a variety of plant materials typical to each community and are grouped into standard categories of trees, shrubs, grasses and understory. These trees, shrubs, grasses, and understory plants are native to Wisconsin and indigenous to the area.

Plant lists for each plant community were selected using the following sources:

1. John T. Curtis, 1959 The Vegetation of Wisconsin: University of Wisconsin Press. 657p.

TABLE NO. 5-4

Savannah Plant List

Trees	Shrubs	Understory
Trembling Aspen	Witchhazel	Jack-in-the Pulpit
Red Maple	Smooth Sumac	Buttercup
Paper Birch	American Cranberry Bush	Sweet White Violet
Basswood	Viburnum	Big Leaved Astec
Sugar Maple	Grey Dogwood	Bunchberry
White Ash	Beaked Hazelnut	Rice Grass
Butternut Hickory	Blueberry	Twisted Stalk
Red Oak		
Yellow Birch		
Silver Maple		
Hemlock		
White Pine		
Black Walnut		
Balsam Fir		
Ironwood		
Bur Oak		
Total Plants per Acre (excluding understory)		400

TABLE NO. 5-5

Wetland Plant List

Trees	Shrubs	Understory
Tag Alder Red Maple Black Ash Balsam Fir Hemlock	Red Twig Dogwood	Bulrush Bur Reed Wild Rice Lake Sedge Blue Flag Yellow Pond Lily Water Lily Pickeral Weed Arrowhead Sago Pondweed Wild Celery Sweet Flag
Total Plants per Acre (excluding understory)		400

TABLE NO. 5-6

Grassland Plant List

Shrubs

Sumac

Understory

WET SOILS SEED MIX

Canada Anemone
New England Aster
White False Indigo
Turtlehead
Canada Tick-Trefoil
Shooting Star
Joe Pye Weed
Bottle Gentian
Alum Rood
Wild Iris
Prairie Blazingstar
Turk's Cap Lily
Great Blue Lobelia
Bergamot
Yellow Coneflower
Sweet Black-Eyed Susan
Cupplant
Spiderwort
Ironweed
Culver's Root
Prairie Cordgrass
Spotted Joe Pye Weed
American Black Currant
Meadowsweet

DRY-MESIC SOILS SEED MIX

Leadplant
Thimbleweed
Common Milkweed
Butterflyweed
Sky Blue Aster
Heath Aster
New England Aster
Canada Milk Vetch
Cream False Indigo
New Jersey Tea
Stiff Coreopsis
Canada Tick-Trefoil
Shootingstar
Pale Purple Coneflower
Flowering Spurge
Western Sunflower
Alum Root
Ox-Eye Sunflower
Pearly Everlasting
Prairie Brome
Canada Wild Rye
Needlegrass
Rough Blazingstar
Prairie Blazingstar
Bergamot
Smooth Penstemon
Smooth Aster
Yellow Coneflower
Black-Eyed Susan
White False Indigo
Sweet Black-Eyed Susan
Stiff Goldenrod
Spiderwort
Culver's Root
Big Bluestem
Little Bluestem
Switchgrass
Indiangrass
Prairie Dropseed
Roundheaded Bushclover
Sweetfern
Brackenfern
June Grass

GRASSLAND SEEDING RATE = 125 lbs./acre

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2. Forest inventory as presented in the EIR (Appendix 3.9.-B).

3. Robert Matson's 1974 research
Flora & Plant Communities of an Area in Rusk County
Designated for a Copper Mine:
University of Wisconsin, Eau Claire.

The plant list also contains a summary of the number of plants per acre for each plant community type. Prior to installing the trees and shrubs, the disturbed area will be topsoiled, fine graded, seeded, fertilized and mulched according to the specifications contained in Appendix M. Additionally, the subsoil area in the savannah copse areas will be tilled or otherwise ripped to loosen any compaction caused by mining or reclamation operations.

After the grassland and understory has been seeded and the cover crop has been established, the trees and shrubs will be planted. Over a period of years, other native vegetation will reestablish in the mine site and further enhance the development of the plant communities.

5.11.3.3 <u>Typical Planting Plans and Sections</u>

Typical plans for the savannah copse's plant communities and wetland plant communities have been prepared (Figure Nos. 5-11 through 5-16). Typical plans have been prepared for initial planting, years three and 10 of revegetation. These planting plans include individual plant names (for initial planting only), locations, typical spacing and relative crown size for a 100-foot x 100-foot typical plant community area. Typical elevations have been prepared for each planting plan (Figure Nos. 5-17 through 5-22). Additionally, typical planting plans and elevations have been prepared for three other conditions (Figure Nos. 5-23 through 5-28) to depict various edge conditions.

A. Savannah Copse/Existing Woodland Edge

B. Savannah Copse/Grassland Edge

C. Wetland/Grassland Edge

These plans represent a typical distribution of woody plant species. Grassland species and seeded understory species are not depicted on the typical plans. Actual plant distribution on the site will depend on site conditions such as slope, aspect, soil moisture, micro climate, etc. Individual plant species will be located in areas that they are best suited to micro conditions, e.g. Paper Birch will be located in poorly drained, cool soils; while Red Oak will be located in well-drained uplands).

5.11.4 Implementation Plans

5.11.4.1 Temporary Nursery

An approximate three-acre temporary nursery will be constructed on the north end of the project area (Figure No. 1-2). Suitable existing site trees within the project area will be identified and relocated to this temporary nursery with a tree spade prior to the beginning of mining operations. These relocated site trees will be used for mitigation and revegetation.

5.11.4.2 Wetland Test Plot

A one acre wetland test plot will be constructed in the northwest corner of the project area prior to mining operations (Figure No. 5-3). Section 5.11.2.1 describes the method of constructing this wetland test plot.

This test plot is included in the wetland mitigation plan and will help to obtain information in order to refine the methods and procedures for constructing and revegetating the seven and one-half acre wetland mitigation area over the open pit. Information from the test plot will also be used to provide the benchmark to evaluate the success of the larger wetland area.

5.11.4.3 Seedbed and Plant Area Preparation

Seedbed and plant area preparation will primarily consist of the grading and topsoiling of the project area, and the analysis, augmentation, and stabilization of that topsoil layer. After the open pit has been backfilled and the project area has been rough graded, the subsoil in the savannah copse areas will be tilled with a harrow disc or ripped to break up compaction caused by mining operations. The seven and one-half acre wetland (less the open water area) will be topsoiled with the hydric soil stockpiled in the hydric soil storage area. Other topsoil stored on the site will be added to this hydric soil as needed so as to provide a uniform six- to eight-inch topsoil layer over the non pond wetland area. The remaining topsoil stockpile will be spread uniformly over the rest of the project area. All topsoil will be loaded and placed as appropriate, using rubber tire loaders to reduce soil compaction. After the project area has been topsoiled, one sample per ten acres will be extracted and analyzed for fertility and nutrients. Based on this analysis, the topsoil layer will be fertilized and stabilized to facilitate adequate growth of the appropriate plant community in that area. Also, immediately after topsoiling, the entire project area will be planted with the appropriate ground layer vegetation and nurse crop and mulched to reduce the chance of erosion during woody vegetation planting operations.

5.11.4.4 <u>Seeding and Planting Methods</u>

The installation of plant materials will be performed in accordance with professionally accepted standards. Specifically, the range of methods of installation for the appropriate vegetation includes:

1. Trees (deciduous and evergreen)

    a. Tree spade (relocate from project nursery)
    b. Bare root

2. Shrubs (deciduous and evergreen)

    a. Bare root
    b. Potted

3. Groundcover (Native and nurse crop grasses and selected understory vegetation)

    a. Mechanical seeding
    b. Hydro seeding
    c. Broadcast seeding

Typical standard planting details and specifications as presented in "American Standard for Nursery Stock" and landscape construction specifications 02480 (turf establishment) and 02490 (plant establishment) in Appendix M will be followed in the installation of all vegetation. Additionally, seeding rates for the grassland plantings will be as follows:

Native Grasses	125 lbs/Acre
Nurse Crop	110 lbs/Acre

5.11.4.5 <u>Mulching and Fertilizing</u>

Mulching and fertilizing of vegetation will be performed to specification as outlined in Landscape Construction Specification 02480 in Appendix M. Specifically, the range of methods include:

1. Mulching
    a. Hydro mulching

        (1) Material (paper mache)
        (2) Tack coat

    b. Mechanical

        (1) Material (straw)
        (2) Tack coat

2. Fertilizing

   a. Trees and shrubs
      (1) Material (granular or time release pockets) as required for each plant type according to the soil analysis.
      (2) Application (manual)

   (b) Ground cover and grasses
      (1) Material as required for each plant type according to the soils analysis.

         (a) Liquid
         (b) Granular

      (2) Application

         (a) Spray (liquid)
         (b) Rotary spreader (granular)

5.11.4.6 Short-Term Maintenance

Individual plants and grassland areas will be maintained on an as needed basis up to the notice of completion of reclamation to ensure that the plant materials remain healthy and viable components of the overall plant community. These maintenance procedures as listed below include relatively common techniques and will generally occur over the first year after planting in the revegetated areas.

- Remove and replace dead trees and shrubs.
- Replace subsoil and topsoil, overseed, and mulch washed out grassland areas to reduce erosion and maintain stable vegetative growth.
- Overseed grass areas as necessary to ensure a viable turf stand.
- Diagnose and treat diseases and pest infestations as necessary.
- Water trees, shrubs and other plants as necessary during the first growing season after planting.
- Fertilize and mulch all plant materials as necessary during the first growing season after planting.

5.11.4.7 Completion of Reclamation

The revegetation portion of reclamation will be considered complete at the end of the short-term maintenance period and when monitoring indicates that the revegetation is successful.

5.11.4.8 Monitoring

Vegetative monitoring will occur annually, beginning prior to submittal of the notice of completion of reclamation, and ending at certification of completion. Vegetative monitoring will consist of the following measurements.

Percent Cover

Acceptable cover will constitute no less than 70 percent cover averaged over the site at 90 percent statistical confidence during interim revegetation periods for purposes of site stabilization and for final reclamation at the notice of completion of reclamation and for certificate of completion. Cover will be determined as total cover as measured by the coverage of the canopy (vertical projection of plant parts) and will be recorded by species. Cover will be measured annually during any and all reclamation over the entire revegetated site at no less than 160 randomly placed one square meter quadrats. The timing for measurement will approximate peak biomass during the period from mid-August to early September. These measurements should correlate with the aerial color infrared photography. Sampling will be designed so as to accomodate different community types (i.e. along moisture gradients). The actual number of sample units per community type will be determined at the time of sampling based on mean/variance tests and may be fewer than 160 quadrats.

Biomass

Total above ground herbaceous biomass will be determined once for the notice of completion and once at the certificate of completion as a relative measure of temporal productivity. Biomass will be harvested at no less than 25 randomly placed quadrats of one square meter in size. The biomass at the certificate of completion should be no less than 80 percent of the biomass during the notice of completion at 90 percent statistical confidence. Burning of grassland will be planned so as not to interfere with biomass measurements.

Diversity

The frequency of occurrence by species will be reflective of its relative ratio in the seed mix or planting schedule. The similarity of the standing crop should be no less than 80 percent of the original mixture at 90 percent statistical confidence with a minimum of 15 planted species per community type.

Survivorship of Woody Plant Stock

A representative population sample of woody species will occur at the time of the notification of completion of reclamation and again at the time of the certificate of completion. No less than 80 percent of the initially planted species must survive in a similar proportion to the initial planting and show signs of vigor and health.

Wetland Vegetation

Vegetation measurements will consist of frequency of occurrence and density. The similarity of the standing crop will be no less than 80 percent of the initial planting at 90 percent statistical confidence with a minimum of 12 planted species.

Wildlife Habitat

Beginning two years after revegetation has commenced, and once a year for three years thereafter, a habitat evaluation (i.e., HEP analysis, U.S. Fish and Wildlife Services) will be conducted on the wetland and terrestrial areas that have been reclaimed.

5.11.4.9 Long-Term Management

Restored native plant communities will be maintained on an as needed basis to ensure that they develop in a manner consistent with naturally occurring plant communities. Volunteer native species will be encouraged wherever possible. Grassland vegetation will be managed by controlled burning every three to five years as necessary, beginning four years after initial planting, for a ten- year period.

If during the annual monitoring of the project area, it is determined that the plant community is under stress, Flambeau will add additional plant materials, or any other action it deems necessary to correct the condition.

5.11.5 Summary

The revegetation and land use portions of the reclamation plan are designed to fully reclaim the mine site in accordance with Wis. Stat. s144.85 and NR 132. This plan represents an alternative to the revegetation and land use plans originally proposed in the Mining Permit Application submitted on April 6, 1989, and was prepared in response to comments from WDNR and the public. It is now being proposed as the preferred option because it not only provides for environmental stability, but reclaims the site to a condition that improves overall wildlife habitat as well.

5.12 Reclamation Costs

Table No. 5-7 contains an itemized estimate of the cost of all reclamation activities associated with the project. The estimate is organized in three major categories as follows:

TABLE NO. 5-7

Reclamation Cost Estimate

	QTY.		COST	TOTAL
A. OPEN PIT BACKFILLING (LOAD, HAUL, SPREAD & COMPACT)				
Backfill Imported Crushed Rock	48767	CY	$ 1.13	$ 55,100
Backfill Type II Waste Rock & Sandstone	1673000	CY	1.23	2,057,790
Backfill Type II Drainage Blanket	70300	CY	1.23	86,300
Lime Addition to Backfill	4181	T	100.00	418,100
Backfill Saprolite[1]	915000	CY	1.23	1,123,240
Backfill Type I Waste Rock & Sandstone	1044300	CY	1.23	1,284,490
Backfill Till	1610000	CY	1.23	1,980,300
Remove Mine Pump Barge & Related Equipment	16500	LB	0.10	1,650
Rough Grade To Approximate Contours	20000	SY	0.72	14,400
Replace Topsoil & Final Contouring	60000	CY	1.80	108,000
Backfill Haul Roads	150000	CY	1.13	169,500
Remove Railroad Ballast & Sub-Base	28800	CY	1.80	51,840
Total Open Pit Backfilling				7,350,710
B. PROJECT SITE FACILITIES OTHER THAN OPEN PIT				
1. Type II Stockpile Area				
Remove HDPE Liner	1350200	SF	0.10	135,020
Remove Drain Pipes	17000	LF	0.15	2,550
Remove Culverts	410	LF	2.00	820
Rough Grade to Approximate Contours	15000	SY	0.72	10,800
Replace Topsoil & Final Contouring	45000	CY	1.80	81,000
Subtotal				230,190

TABLE NO. 5-7 (Cont.)

	QTY.		COST	TOTAL
2. Explosives Magazines & Settling Pond Area				
Remove Explosives Magazines	496	SF	1.00	500
Remove Culverts	200	LF	2.00	400
Remove Settling Pond Inlet Structure	5	CY	90.00	450
Remove Settling Pond Outlet Structure	28000	LB	0.09	2,520
Rough Grade to Approximate Contours	3500	SY	0.72	2,520
Replace Topsoil & Final Structures	10500	CY	1.80	18,900
	Subtotal			25,290
3. Type I Stockpile Area				
Remove Culverts	120	LF	2.00	240
Rough Grade to Approximate Contours	20000	SY	0.72	14,400
Replace Topsoil & Final Contouring	60000	CY	1.80	108,000
	Subtotal			122,640
4. Railroad Spur				
Remove Track & Ties	8000	LF	11.00	88,000
Remove Culverts	1050	LF	2.00	2,100
Remove Warning Signs & Signals	1	LT	500.00	500
Rough Grade to Approximate Contours	4500	SY	0.72	3,240
Replace Topsoil & Final Contouring	13500	CY	1.80	24,300
	Subtotal			118,140

TABLE NO. 5-7 (Cont.)

	QTY.		COST	TOTAL
5. Topsoil Stockpile Area				
Remove Visitors Viewpoint Platform	1	LT	200.00	200
Remove Visitors Parking Lot	200	CY	1.80	360
Remove Culverts	30	LF	2.00	60
Rough Grade to Approximate Contours	5000	SY	0.72	3,600
Replace Topsoil & Final Contouring	15000	CY	1.80	27,000
	Subtotal			31,220
6. Surface Facilities Area				
Remove Buildings	123220	SF	1.52	187,300
Remove Crusher & Structural Steel	196000	LB	0.09	17,640
Remove Concrete Retaining Wall & Foundation	1606	CY	90.00	144,540
Remove HDPE Drain Pipe	600	LF	2.00	1,200
Remove HDPE Liner-Ponds & Loadout Area	125400	SF	0.10	12,540
Remove Concrete Block Masonry	560	SF	0.25	140
Remove Process Equipment	1	LT	50000.00	50,000
Remove Asphalt-Access Road & Parking Lot	570	CY	10.00	5,700
Remove Septic System	1	LT	1000.00	1,000
Remove Road Signs	1	LT	400.00	400
Rough Grade to Approximate Contours	6500	SY	0.72	4,680
Replace Topsoil & Final Contouring	19500	CY	1.80	35,100
	Subtotal			460,240
7. Water Discharge Systems				
Remove Discharge Structure	2.2	CY	90.00	200
Remove Wetlands Diversion Structure	4.4	CY	90.00	400
Remove Discharge Pipe	600	LF	1.00	600
Remove Riprap	500	CY	1.80	900
Rough Grade to Approximate Contours	500	SY	0.72	360
Replace Topsoil & Final Contouring	1500	CY	1.80	2,700
	Subtotal			5,160

TABLE NO. 5-7 (Cont.)

	QTY.		COST	TOTAL
8. General Site Areas				
Remove Fencing	12600	LF	1.00	12,600
Remove Powerline	3500	LF	3.00	10,500
Remove Gas Line	1000	LF	4.00	4,000
Well Abandonment	1	LT	500.00	500
	Subtotal			27,600
	Total - Other Facilities			1,020,480
C. REVEGETATION				
1. Grassland				
Shrubs - 10 Shrubs/AE @ $4 ea.	140	AC	40/AC	5,600
Understory (Native Grasses & Nurse Crop)	136	AC	1,500/AC	210,000
	Subtotal			215,600
2. Savannah Copses				
Trees - 200 Plants/AC @ $7.50 ea.	32.5	AC	1,500/AC	48,750
Shrubs - 200 Plants/AC @ $5 ea.	32.5	AC	1,000/AC	32,500
Understory (Grasses, Ferns, Wildflowers, etc.)	32.5	AC	1,000/AC	32,500
	Subtotal			113,750

TABLE NO. 5-7 (Cont.)

	QTY.		COST	TOTAL
3. Wetland				
Trees - 200 Plants/AC @ $7.50 ea.	1.0	AC	1,500/AC	1,500
Shrubs - 200 Plants/AC @ $5 ea.	3.0	AC	1,000/AC	3,000
Understory (Grasses, Sedges, etc.)	4.0	AC	1,500/AC	6,000
Subtotal				10,500
Total Revegetation				$339,850
D. TOTAL PROJECT RECLAMATION				$8,711,040

[1]Includes placement of saprolite for 7.5 acre wetland in west end of the open pit.

- Open Pit Backfilling
- Project Site Facilities Other Than the Open Pit
- Revegetation

Each category is further subdivided into the various activities that will be conducted. As shown in the table, the total estimated cost of site reclamation is approximately $8,711,040.

Table No. 5-8 presents a summary of the anticipated reclamation cost obligation for the project for each year of operation. The table shows what the reclamation costs would be, if reclamation were to commence at the end of any year during the project's life. Categories of costs are divided into backfilling material removed from the open pit during mining; lime addition; backfilling other fill type materials such as the drainage blanket, railroad spur ballast, etc.; and remaining reclamation costs such as dismantling of ancillary facilities and revegetation. The table assumes that most of the surface facility construction will be completed at the time preproduction starts. Given this assumption, the cost of reclamation associated with these features would be the same for any year of operation after mining commences.

The table provides useful information regarding establishment of financial assurance for the project. The table shows that the cost of reclamation changes annually as mining takes place. Therefore, it is logical to establish financial assurance provisions that change in a similar fashion.

TABLE NO. 5-8

Anticipated Backfilling Costs by Year[1]

Date	Backfill K Tons Required[1]	Backfill Dollars	Lime Costs Dollars	Additional Backfill Material Dollars	Remaining Reclamation[2] Dollars	Total Costs Dollars	Time to Complete (Months)[3]
Construction Start[4]	0	$0	$0	$0	$0	$0	0
Preproduction Start[5]	0	0	0	486,790	1,360,330	1,847,120	0
12/31/91	1,580	1,311,100	36,660	486,790	1,360,330	3,194,880	4
12/31/92	3,060	2,539,160	98,520	486,790	1,360,330	4,484,800	7
12/31/93	4,530	3,758,960	143,050	486,790	1,360,330	5,749,130	11
12/31/94	5,900	4,895,770	242,500	486,740	1,360,330	6,985,390	14
12/31/95	7,120	5,908,120	349,900	486,790	1,360,330	8,105,140	17
12/31/96	7,640	6,339,610	402,510	486,790	1,360,330	8,589,240	18
End of Mining	7,768	6,445,820	418,100	486,790	1,360,330	8,711,040	19
12/31/97	4,968	4,122,400	0	486,790	1,360,330	5,969,520	12
12/31/98	768	637,280	0	486,790	1,360,330	2,484,400	2
12/31/99[6]	0	0	0	0	0	0	0

[1]Represents reclamation costs that would be incurred to reclaim the site if mining stopped and reclamation began at the end of the year indicated.

[2]Assumes all site work and surface facilities are installed at commencement of preproduction.

[3]Time to complete reclamation at the end of each given year.

[4]April 1991

[5]June 1991

[6]Reclamation completed in first quarter, 1999.

6.0 PRELIMINARY WATER BUDGET

6.1 Overview

A preliminary water budget has been prepared for the following project facilities: Type I stockpile; Type II stockpile and the open pit. The water budget addresses the preconstruction, the active operating, and the post reclamation periods. The water budget depicts dry, wet, and average precipitation-evaporation conditions.

The method used to prepare the water budget for the three areas is a combination of the Thornthwaite and Mather method and the U.S. EPA method. Climatological data used in the calculations covered the periods of 1960 through 1988 for Weyerhauser, Wisconsin which is located approximately 15 miles west of Ladysmith. A number of data bases were available for precipitation data. The Weyerhauser N.O.A.A. information was chosen since Weyerhaeuser is close to the project and since the precipitation data is conservative. The assumptions and calculations used for the analysis are contained in Appendix N of this report.

The results of the water budget are summarized in Table Nos. 6-1 to 6-6. The tables identify the average amount of infiltration, evapotranspiration, contact and non-contact runoff, leachate and pit inflow that will be generated by each facility in inches per year. These values were determined by first calculating the volume of water reporting to each category over the life of the facility and then converting this to inches per each year of the respective facilities' life.

6.2 Definitions

As used in the tables, infiltration means water that will percolate through the site subsoils and eventually reach the groundwater table. Evapotranspiration is water that either evaporates from exposed surfaces or is transpired to the atmosphere by vegetation. Non-contact runoff is runoff that will be directed to either existing natural drainways or to the settling ponds for clarification prior to discharge to the Flambeau River. Contact runoff is runoff that comes into contact with ore, Type II material or the process area and is collected and directed to the wastewater treatment plant for treatment prior to discharge. Collected leachate is infiltration that is intercepted by a hydraulic barrier and leachate collection system and is also directed to the wastewater treatment plant. Pit inflow is groundwater that is removed from the pit during mining and that is directed to either the settling ponds or the wastewater treatment plant.

TABLE NO. 6-1

Type I Stockpile - ~% and 4% Slopes[1]
Pre and Post Construction Water Budgets[2]

	Wet Conditions	Dry Conditions	Average Conditions
Infiltration (in/yr)	14.8	7.8	11.0
Evaporation (in/yr)	20.7	5.2	16.0
Runoff (in/yr)	10.1	5.0	7.0
Precipitation (in/yr)	45.6	18.0	34.0

Notes: in/yr reflects volume of water reporting to each category per year during the operating life of the facility. Operating life of stockpile for this analysis is = 7.5 years. Size of stockpile is 40 acres.

[1]Used a weighted average of the two slopes.
[2]Based on water budget calculations located in the report appendix.

TABLE NO. 6-2

Type I Stockpile
During Construction Water Budget[1]

	Wet Conditions	Dry Conditions	Average Conditions
Infiltration (in/yr)	11.4	4.5	8.5
Evaporation (in/yr)	11.4	4.5	8.5
Runoff (in/yr)	22.8	9.0	17.0
Precipitation (in/yr)	45.6	18.0	34.0

Notes: in/yr reflects volume of water reporting to each category per year during the operating life of the facility.
Operating life of stockpile for this analysis is= 7.5 years.
Size of stockpile is 40 acres.

[1]Based on water budget calculations located in the report appendix.

TABLE NO. 6-3

Type II Stockpile - 2% Slope
Pre and Post Construction Water Budgets[1]

	Wet Conditions	Dry Conditions	Average Conditions
Infiltration (in/yr)	16.3	7.9	10.9
Evaporation (in/yr)	21.2	5.4	16.7
Runoff (in/yr)	8.1	4.7	6.4
Precipitation (in/yr)	45.6	18.0	34.0

Notes: in/yr reflects volume of water reporting to each category per year during the operating life of the facility.
Operating life of stockpile for this analysis is= 6.8 years.
Size of stockpile is 27 acres.

[1]Based on water budget calculations located in the report appendix.

TABLE NO. 6-4

Type II Stockpile
During Construction Water Budget[1]

	Wet Conditions	Dry Conditions	Average Conditions
Infiltration (in/yr)	3.9	1.5	2.9
Evaporation (in/yr)	11.4	4.5	8.5
Runoff (in/yr) Non-Contact	7.8	3.0	5.8
Runoff, Contact (in/yr)	15.0	6.0	11.2
Leachate (in/yr)	7.5	3.0	5.6
Precipitation	45.6	18.0	34.0

Notes: in/yr reflects volume of water reporting to each category per year during the operating life of the facility. Operating life of stockpile for this analysis is= 6.8 years.
Size of stockpile is 27 acres.

[1]Based on water budget calculations located in the report appendix.

TABLE NO. 6-5

Mine Pit - 2%, 4% and 8% Slopes[1]
Pre and Post Construction Water Budgets[2]

	Wet Conditions	Dry Conditions	Average Conditions
Infiltration	14.8	7.8	11.0
Evaporation (in/yr)	20.7	5.2	15.9
Runoff (in/yr)	10.1	5.0	7.1
Precipitation (in/yr)	45.6	18.0	34.0

Notes: in/yr reflect volume of water reporting to each category per year during the operating life of the facility. Total life of open pit from preproduction through reclamation is 7.9 years.
Size of open pit is 32 acres.

[1]Used a weighted average of the slopes.
[2]Based on water budget calculations located in the report appendix.

TABLE NO. 6-6

Mine Pit
During Construction Water Budget[1]

	Wet Conditions	Dry Conditions	Average Conditions
Infiltration (in/yr))	2.3	0.9	1.7
Evaporation (in/yr)	11.4	4.5	8.5
Runoff (in/yr) Non-Contact	3.7	1.4	2.8
Runoff (in/yr) Contact	28.2	11.2	21.0
Precipitation (in/yr)	45.6	18.0	34.0
Operating Life Dewatering (in/yr)	89.7	89.7	89.7

Notes: in/yr reflect volume of water reporting to each category per year during the operating life of the facility. Total life of open pit from preproduction through reclamation is 7.9 years.
Size of open pit is 32 acres.

[1]Used a weighted average of the slopes.
[2]Based on water budget calculations located in the report appendix.

6.3 Description of Water Origins

Infiltration, non-contact runoff and evapotranspiration will occur for each site during both preconstruction and post reclamation. Since each site will be reclaimed to its approximate original contours, the preconstruction and post reclamation water budgets will be approximately the same.

During construction, infiltration, runoff and evaporation will occur at the Type I stockpile. There will be no collected leachate. Contact runoff will not occur since Type II material will not be stored in the site.

For the Type II stockpile all of the various categories except pit inflow will occur. Infiltration and non-contact runoff will occur during initial construction and during the period over which the Phase II area is not constructed. Evaporation will occur throughout the life of the site. Both contact runoff from the interior perimeter drainage system and collected leachate will be generated as soon as Type II material is placed in the site.

Evaporation will occur from the open pit. Non-contact runoff will be generated during preproduction stripping and stripping in Phase II of the pit area. Contact runoff will be generated during mining of ore and Type II waste rock. Dewatering during stripping and mining operations will generate water that will go to either the settling ponds or the wastewater treatment plant. This water will ultimately be discharged to the Flambeau River or an adjacent wetland. During backfilling, contact and non-contact runoff will be produced and infiltration will take place. Also during backfilling the voids within the backfilled material will fill with water until the water table stabilizes.

6.4 Discussion of Results

Comparing pre and post construction water budgets to the water budgets during construction in Table Nos. 6-1 and 6-2 for the Type I stockpile indicates that there is a general decrease in infiltration and evapotranspiration and an increase in non-contact runoff. This is due to the decrease in vegetation on the site during as a result of construction.

For the Type II stockpile non-contact runoff decreases because a portion of the total runoff becomes contact runoff and is directed to the wastewater treatment plant. Infiltration decreases as a result of an increase in total runoff and due to leachate being collected on the base liner. Evaporation decreases due to reduced evapotranspiration.

Infiltration decreases because there is no significant infiltration during mining. Total runoff increases primarily due to the decrease in infiltration. Evaporation decreased due to reduced evapotranspiration. During stripping and mining, groundwater will flow into the pit and be pumped out. This water will be discharged to surface waters after passing through the settling ponds or being treated at the wastewater treatment plant.

The quality of the non-contact runoff water discharged to either natural drainage ways or the Flambeau River will be controlled through the use of engineered erosion control techniques as described in section 4.8 of this application and through the routing of some runoff waters through the settling ponds for clarification prior to discharge.

Contact runoff and contact pit water will be treated at the proposed wastewater treatment plant and, therefore will meet acceptable discharge limits.

Water infiltrating in open areas during construction should be of nearly the same quality as that infiltrating during preconstruction. As discussed in section 3.5.6 of the EIR and in section 4.7.3.2.8 of this report, the quality of water infiltrating through the Type I stockpile is not expected to adversely affect the groundwater. Finally, as discussed in section 5.7.1.2 of this document water in the backfilled pit is not expected to be deleterious to the surrounding environment.

7.0 CONSTRUCTION AND OPERATION PHASE MONITORING PLAN

7.1 Introduction

This monitoring and quality assurance plan has been developed for the construction and operation phase of the Flambeau Project in response to NR 132.06(3)(d), NR 182.08(2)(e)8 and NR 182.09(2)(a)7. This monitoring will cease, and the long-term care and maintenance program discussed in section 10.0 of this report will begin, when site closure has been completed. Closure is deemed to be completed when final site grading and initial revegetation of the site is complete.

Construction and operation phase monitoring includes individual programs for groundwater, Type I stockpile exfiltrate, surface water, terrestrial ecology, meteorology, and pit inflows. Each of these programs is discussed below in sections 7.2 through 7.7, respectively. An item not discussed in this section is the monitoring requirement for effluent discharges to surface water. This requirement will be prescribed at a later date pursuant to the discharge permit issued for the project and applicable administrative code provisions.

7.2 Groundwater Monitoring During Construction and Operation

Under NR 132.11 and NR 182.13 groundwater monitoring during construction and operation may be required. A discussion of proposed monitoring locations, frequency, and parameters follows.

7.2.1 Monitoring Locations

Four of the baseline monitoring well nests will be sampled throughout construction and operation. These wells are shown on Figure No. 7-1. Well nests MW-1000 and MW-1004 are located downgradient of the pit, MW-1002 is located downgradient of the Type I stockpile, and MW-1005 is located upgradient of the site. Groundwater flow from the area of the Type II stockpile will be intercepted by the pit and would eventually be intercepted by either the MW-1000 nest or the MW-1004 nest.

One additional monitoring well, designated as MW-1010P, will be installed prior to the commencement of mining operations in bedrock unit 2A in the area between the river and the pit, for the purpose of measuring water levels and groundwater quality. The location indicated on Figure No. 7-1 will place the bottom of the well in the center of Unit 2A, approximately 100 feet below the present water table. Details regarding the design of this monitoring well are shown in Figure No. 7-2.

Two additional water table piezometers, designated as PZ-1011 and 1012 (Figure No. 7-1), will be installed prior to the commencement of mining operations for the purpose of measuring water levels. One will be located approximately 1,100 feet east of piezometer PZ-1007, and the other approximately 1,100 feet west of PZ-1007. These wells will be used to assess the extent of groundwater drawdown to the north and northeast of the pit. Details regarding the design of these two wells are shown in Figure Nos. 7-3 and 7-4.

Water levels in selected on-site wells will also be monitored to document the drawdown due to mine excavation. The location of wells included in the monitoring program for water level information are shown on Figure No. 7-1.

7.2.2 Monitoring Frequency, Parameters and Methods

NR 182.13(2) requires quarterly (March, June, September, and December) analysis of groundwater samples for water levels, specific conductance (field), pH (field and laboratory), total dissolved solids (TDS), and other parameters based on the results of the waste characterization studies. In addition, NR 182.13(2) also requires annual testing of "other contaminants which would reasonably be expected to occur in leachate from the facility." The waste characterization and in-pit transport modeling studies completed for the project have identified iron, manganese, copper, and sulfate as principal constituents that may be generated at the site. These four parameters will be included in the monitoring plan. Total alkalinity and total hardness as indicators of overall water quality will also be quarterly parameters.

Quarterly measurements of groundwater levels will be conducted for the wells shown in Table No. 7-1. The table lists wells, screened intervals, sampling frequency and parameters for the construction and operation period of the Flambeau Project.

In addition to the above, background data will be collected for new groundwater monitoring well MW-1010P. This program will consist of testing the first eight quarterly samples from this well for the parameters on the regular quarterly program plus the following metals.

Arsenic	Lead
Barium	Mercury
Cadmium	Selenium
Total Chromium	Silver
	Zinc

These metals were selected either because they are the primary drinking water standard metals or because they may occur in the leachate from the Type II waste.

TABLE NO. 7-1

Measuring and Sampling Points
for Groundwater Levels and Water Quality
(Construction and Operation Program)

Collection Lysimeter/ Well/Piezometer Number	Elevation of Screened Interval (ft. msl)	Geologic Unit	Parameter*
MW-1000	1091-1081	Precambrian,Till	1, 2
MW-1000P	1049-1044	Precambrian	1, 2
MW-1001	1118-1108	Till	1
MW-1001G	1095-1090	Till, Sandstone	1
MW-1001P	1051-1046	Precambrian	1
MW-1002	1096-1086	Sand & Gravel	1, 2
MW-1002G	1055-1050	Sand & Gravel	1, 2
MW-1003	1113-1103	Sandstone	1
MW-1003P	1062-1057	Precambrian	1
MW-1004	1112-1102	Sand & Gravel	1, 2
MW-1004S	1093-1088	Sandstone	1, 2
MW-1004P	1042-1037	Precambrian	1, 2
MW-1005	1134-1124	Till	1, 2
MW-1005S	1097-1092	Sandstone	1, 2
MW-1005P	1056-1051	Precambrian	1, 2
PZ-1006	1143-1138	Till	1
PZ-1006G	1119-1114	Till	1
PZ-1006S	1101-1096	Sandstone	1
PZ-1007S	1110-1105	Sandstone	1
PZ-1008	1138-1128	Till	1
PZ-1008G	1096-1091	Sand & Gravel	1
PZ-1009	1144-1134	Till	1
PZ-1009G	1107-1102	Till	1
MW-1010P	995- 990	Precambrian	1, 2
PZ-1011	1114-1104	Till	1
PZ-1012	1111-1101	Till	1
PZ-R1	901- 881	Precambrian	1
PZ-S1	1067-1062	Precambrian	1
PZ-S3	1100-1095	Sandstone	1
Sandpoint	1084-1082	Sand & Gravel	1
ST-9-23	1106-1101	Sandstone	1
ST-9-23A	1125-1120	Sand & Gravel	1
ST-9-26	1106-1101	Till	1
PZ-1A	1099-1097	Sand & Gravel	1
PZ-1B	1103-1101	Sand & Gravel	1
OW-7	1088-1078	Till	1
OW-10	1069-1059	Till	1
OW-39	1107-1073	Till	1
OW-42	1090-1058	Sand & Gravel	1
OW-43	1090-1022	Sand & Gravel	1
CL-1	n.a.	n.a.	3

*1 Groundwater elevation (quarterly).

*2 Specific conductivity (field), pH (field and lab), TDS, iron, manganese, sulfate, copper, total alkalinity, total hardness (all quarterly).

*3 pH (field and lab), specific conductance (field), total chromium, copper, iron, manganese, sulfate, total dissolved solids, total alkalinity, total hardness, volume of liquid removed (all quarterly).

Since groundwater gradients will be towards the pit during the construction and operation phase of the project, a comprehensive analysis program as referenced in NR 182.13(2)(e)2 is not warranted during this phase of groundwater monitoring. A comprehensive program is proposed as part of the long-term care and maintenance monitoring program as described in section 10.0 of this report.

Monitoring wells will be sampled on a quarterly basis. Sampling procedures will be consistent with WDNR PUBL WR-153-87, "Groundwater Sampling Procedures Guidelines".

Prior to sample collection, each well will be purged by removing four times the static volume of water in the monitoring well or until the well is dewatered, whichever occurs first. The wells will be purged with a dedicated PVC bailer. In the non-water table wells, water will be drawn from above the screen in the uppermost part of the water column such that fresh water from the screen moves upward.

Subsequent to purging, samples will be withdrawn with the dedicated bailers used for purging. Water samples will be poured from the bailer into containers specifically prepared for the given parameter(s). Metal sample aliquots will be filtered in the field through a 0.45 micron membrane prior to acidification. Conductance, pH, and temperature readings will be performed at the well head. Field observations of color, odor, and turbidity will also be noted. A field log sheet will be maintained by the sampler and used to record items such as dates, times, personnel, water levels, purged volumes, field pH, and field specific conductance.

Table No. 7-2 lists the proposed chemical parameters, preservatives, sample volume requirements, holding times, and detection limits for the program. These criteria, too, will be similar to those that were in place during the baseline monitoring program.

7.2.3 Reporting

The results of water elevation measurements and sampling will be submitted to the WDNR within 60 days of sampling. The data will be submitted on forms provided by the WDNR.

7.2.4 System Maintenance

Flambeau will immediately notify the WDNR if for any reason a monitoring well or device is destroyed or fails to function properly. Unless notified otherwise in writing by WDNR, Flambeau will restore, or properly abandon and replace, destroyed or failed monitoring devices within 60 days of the written notification referred to above.

TABLE NO. 7-2

Groundwater Monitoring Analytical Parameters

Parameter	Sample Volume (ml)	Preser-vative	Holding Time	MDL (mg/l)	Test Method
pH	100 (P)	N/A	24 Hours	N/A	150.1
Spec Cond	200 (P)	4°C	28 Days	1 umho/cm	120.1
Sulfate	200 (P)	4°C	28 Days	10	375.4
Total Alkalinity	100 (P)	4°C	14 Days	10	310.1
TDS	200 (P)	4°C	48 Hours	20	160.1
Total Hardness	100 (P)	4°C	Six Months	5	130.2
Arsenic	1000 (P)	HNO_3	Six Months	0.005	206.2
Barium	1000 (P)	HNO_3	Six Months	0.5	208.2
Cadmium	1000 (P)	HNO_3	Six Months	0.001	213.2
Total Chromium	1000 (P)	HNO_3	Six Months	0.005	218.2
Lead	1000 (P)	HNO_3	Six Months	0.005	239.2
Mercury	1000 (P)	HNO_3	Six Months	0.0005	245.1
Selenium	1000 (P)	HNO_3	Six Months	0.005	270.2
Silver	1000 (P)	HNO_3	Six Months	0.001	272.2
Zinc	1000 (P)	HNO_3	Six Months	0.05	289.2
Copper	1000 (P)	HNO_3	Six Months	0.01	220.1
Iron	1000 (P)	HNO_3	Six Months	0.1	236.1
Manganese	1000 (P)	HNO_3	Six Months	0.05	243.1

(P) Plastic

Method Reference = Methods for Chemical Analysis of Water and Wastes, 3rd Edition, March, 1983

7.3 Type I Stockpile Exfiltrate

The Type I stockpile will be equipped with a collection lysimeter at the location shown on Figure Nos. 4-14 and 7-1. The collection lysimeter will be used to determine the characteristics of the exfiltrate from the Type I stockpile.

7.3.1 Design and Construction

The collection lysimeter will be located beneath that portion of the Type I stockpile designated for the storage of sandstone, since waste characterization studies have shown that this material is the most leachable of those to be stored in the Type I stockpile.

Details depicting the design of the collection lysimeter are shown in Figure Nos. 7-5 and 7-6. The till blanket and the upper portion of the till underlying the stored materials is predicted to react with the exfiltrate to remove constituents from the stored materials. Therefore, the collection lysimeter will be placed three feet below the till blanket. During construction, soil placed over the collection lysimeter will be compacted to a density approximately equivalent to undisturbed in-place soil.

7.3.2 Monitoring Frequency, Parameters and Methods

The collection lysimeter will be sampled on a quarterly basis. Samples will be collected from the sampling riser. If the lysimeter is generating a large quantity of liquid on a continuous basis during the quarterly monitoring period, the sampling riser and storage space in the manhole sump will be bailed or pumped dry approximately one to two weeks prior to the sampling date to provide a "fresh" sample for analysis. Samples collected from the lysimeter shall be analyzed for the parameters listed below. Where only small sample volumes are obtained, analyses shall be performed on as many parameters as feasible in the same order as the parameters occur on the list.

pH (field and lab)
Specific conductance (field)
Total Chromium
Copper
Iron
Manganese
Sulfate
Total dissolved solids
Total alkalinity
Total hardness

Samples will be withdrawn from the collection lysimeter riser with a dedicated bailer. Water samples will be poured from the bailer into containers specifically prepared for the given parameter(s). Metal sample aliquots will be filtered in the field through 0.2 micron membrane prior to acidification. A 0.2-micron membrane filter will be used to provide samples for analysis that will only consist of dissolved metals. Conductance, pH and temperature readings will be performed at the riser. Field observations of color, odor and turbidity will also be noted. Once the sample has been obtained, the remainder of the water in the lysimeter riser and storage resevoir will be removed and the volume recorded. A field log sheet will be maintained by the sampler and used to record items such as dates, times, personnel, water levels in the manhole, purged volumes, field pH and field specific conductivity. Table No. 7-2 contains information pertaining to preservatives, sample volume requirements, holding times and detection limits for the parameters on the program.

7.3.3 <u>Reporting</u>

The results of the collection lysimeter analytical tests will be submitted to the WDNR within 60 days of sampling. The total volume of liquid removed during each quarterly monitoring period will be reported to the WDNR with quarterly monitoring data.

7.4 Surface Water

Water-quality based effluent limitations are being proposed for the surface water discharges from the Flambeau Project. These limitations are designed to protect the sensitive components of the aquatic environment and they incorporate bioaccumulation and bioconcentration considerations in their development. The treatment technology to be installed for the Flambeau Project in order to meet these very strict effluent limitations is advanced and the best economically available system.

The purpose of the WPDES permit, therefore, is to protect the Flambeau River environment and the public health and welfare. Monitoring of the effluent for specific chemical parameters, together with bioassay tests provides the most direct and reliable measure of whether the effluent is within permit limits and whether it is toxic to aquatic life.

Monitoring of the Flambeau River in the vicinity of the discharge can also be undertaken to demonstrate the effectiveness of the effluent limits in protecting the environment. The Flambeau River, its sediments and aquatic life are influenced by a variety of factors not related to the mine site. It is estimated that the discharge will constitute approximately one percent of the low flow (1/4 of the 7Q10) of the river. As a result, should monitoring show changes in the chemical constituents in the Flambeau River, its sediments or aquatic life, they may not be directly related to the mine.

Flambeau recognizes WDNR's interest in a secondary surface water monitoring program and believes such a program can provide information on the Flambeau River apart from serving regulatory or enforcement purposes.

If at any time during which the construction and operation surface water monitoring program is in effect, data collected show that certain aspects of the plan do not warrant continuation, Flambeau will request to discontinue those parts of the program.

The surface water monitoring program will include sampling and analytical testing of the following: sediments, fish, macro-invertebrates, water quality, habitat characteristics, and wetland surface flows. Unless noted below, construction and operation surface water sampling and/or monitoring will commence the year before discharges from the wastewater treatment plant begin, and cease at the time the discharge ceases. A discussion of each program element follows.

7.4.1 Sediments

Sediments in the Flambeau River will be collected once annually at two locations (Figure No. 7-7). An upstream sampling station will be established at Blackberry Lane, and a downstream station will be located at the old Port Arthur dam site. At each of these locations, three sediment traps will be installed after the spring runoff period is over.

The traps will be suspended above the river bed in May of each year. Traps will be glass cylinders similar to a one-quart canning jar with an opening approximately 1/3 of the depth of the cylinder. Three traps will be deployed at each sampling location. Sediments will be collected from the traps when the quantity of sediment is sufficient for analytical purposes.

Sediment samples will be analyzed individually for the following parameters:

Particle Size
Percent Volatile Solids
Iron
Manganese
Aluminum
Arsenic
Silver
Nickel
Cadmium
Chromium
Copper
Lead
Mercury
Selenium
Zinc

Table No. 7-3 presents holding times, levels of detection and analytical procedures to be used for sediments. Samples that contain adequate quantities to allow for analysis by the WDNR will be split prior to laboratory analysis and a sample will be provided to the WDNR for their quality assurance work.

TABLE NO. 7-3

Sediment Monitoring Analytical Parameters

Parameter	Sample Volume (ml)	Preservative	Holding Time	MDL (mg/l)	Test Method
Aluminum	1000 (P)	None	Six Months	**	202.2
Arsenic	1000 (P)	None	Six Months	**	206.2
Cadmium	1000 (P)	None	Six Months	**	213.2
Chromium, Total	1000 (P)	None	Six Months	**	218.2
Copper	1000 (P)	None	Six Months	**	220.1
Iron	1000 (P)	None	Six Months	**	236.1
Lead	1000 (P)	None	Six Months	**	239.2
Manganese	1000 (P)	None	Six Months	**	243.1
Mercury	1000 (P)	None	Six Months	**	245.1
Silver	1000 (P)	None	Six Months	**	272.2
Selenium	1000 (P)	None	Six Months	**	270.2
Zinc	1000 (P)	None	Six Months	**	289.2
Nickel	1000 (P)	None	Six Months	**	249.2
Volatile Solids	200 (P)	4°C	Seven Days	0.1%	160.2/160.4
Particle Size	500 g	None	None	1.0%	D-1140,D-422*

(P) Plastic

Method Reference = Methods for Chemical Analysis of Water and Wastes, 3rd Edition, March, 1983

*ASTM Methodology
**MDL is matrix-dependent

7.4.2 **Fish**

Fish (walleye) will be collected once annually during the low flow period of the year from the Ladysmith Flowage upstream of the site and the Thornapple Flowage downstream of the site (Figure No. 7-7). Acceptable sampling methods will include hook and line, electroshocking and fyke nets. A reasonable effort will be made to collect walleyes from each location according to the following size ranges:

- Ten to 12 inches - one fish
- Twelve to 15 inches - two fish
- Fifteen to 18 inches - three fish
- Eighteen to 22 inches - two fish
- Greater than 22 inches - one fish

The WDNR will be notified of each sampling effort prior to mobilization so that their representative can be present.

The WDNR recognizes that, even after a reasonable effort is put forth, it is possible that individual fish to coincide with the prescribed size ranges may not be collected. Therefore, it is recognized that the sampling effort will cease after a reasonable effort is put forth. A reasonable effort is defined as an eight hour, nocturnal sampling period.

Fillets (with skin left on) will be tested for total mercury. The livers of the fish collected at each of the two sampling stations will be composited into one upstream and one downstream sample. Each will be analyzed for the metal parameters included on the list of analytical parameters for sediments. Each organism will be measured for total length, sexed, and the stomach contents noted. The age of each individual fish will be determined using commonly-accepted techniques. Table No. 7-4 and Appendix O include the analytical methods to be employed for fish tissue analysis.

7.4.3 **Macroinvertebrates**

Three sampling locations will be established for the collection of macroinvertebrates (Figure No. 7-7). An upstream station will be located at Blackberry Lane. Downstream stations will be located at the site immediately above the mouth of Meadowbrook Creek and at a site to coincide with the sediment sampling location near the old Port Arthur dam site. All macroinvertebrate collection stations will be restricted to within 50 yards of the eastern bank of the river.

Once per year an adequate sample size of crayfish (25 individuals or more) will be collected from each site using the best available methods. Whole body composites (including the exoskeleton) will be made of the organisms collected from each site. Each of the three composite samples will be analyzed for

TABLE NO. 7-4

Fish and Macroinvertebrate Tissue Monitoring
Analytical Procedures

Parameters	Detection Limit[1] (ug/g)	Analytical Method
Aluminum	0.5	See Appendix O
Arsenic	0.3	" " "
Cadmium	0.1	" " "
Chromium	0.5	" " "
Copper	0.5	" " "
Lead	0.9	" " "
Mercury	0.07	" " "
Zinc	1.0	" " "
Selenium	0.25	" " "
Nickel	0.3	" " "
Silver	0.5	" " "

[1]Depends on sample size.
As dry weight except Hg

the parameters on Table No. 7-4. If an adequate sample size is not available after a reasonable effort, the tests will be run on the sample that is available, if any.

At each of the three macroinvertebrate sampling stations, the macroinvertebrate fauna will be collected in the autumn of each year. Methods to be employed will include hand-picking of all available substrates at each location. (Refer to Appendix P for sorting procedures). These organisms will be identified to the lowest possible taxonomic level. The sampling and evaluation of the taxonomic data of these organisms will follow Hilsenhoff (1987), "An Improved Biotic Index of Organic Stream Pollution": The Great Lakes Entomologist, Vol. 20.

7.4.4 Water Quality

Although the mass balance and mixing ratios of treated discharge to the Flambeau River show there will be no detectable increases in concentrations of the discharge parameters in the river, sampling of surface water in the Flambeau will be undertaken quarterly (in March, June, September and December) from two locations (Figure No. 7-7) as long as the permitted discharge is occurring. Where ice conditions cause a safety problem during December and March samplings, water quality sampling will be postponed until the next quarterly effort. Parameters tested, methods and procedures will be those included in the WPDES Permit. A grab sample will be taken at each site. The upstream site will be located at the western end of Blackberry Lane and the downstream site will be located approximately one hundred yards below the wastewater treatment plant discharge at the point where a dye test conducted at the first sampling period demonstrates the sampling point is in the discharge plume.

Chemical parameters designated for testing in the program will be phased out of the monitoring program in a manner similar to that for the WPDES permit. Therefore, as substances included in the WPDES permit are eliminated from the discharge monitoring list because they are not found in the effluent, they will be eliminated from the surface water monitoring program at the same time.

7.4.5 Habitat Characteristics

The design and construction of the project features, including the discharge locations on the river bank, have been selected to minimize sedimentation. However, a physical evaluation of the river bottom habitats along the eastern bank of the Flambeau River from a point 100 yards upstream of the northern discharge location to a point 1,000 yards downstream of the southernmost discharge (Figure No. 7-7) will be done annually during the summer low-flow period. The evaluation will note the physical character of the bottom habitats (i.e., location of river sediment bars, percent of area that is sand or finer particle size, unusual biological growth). The evaluation procedure will occur prior to the construction of the discharge structures on the bank of the river and approximately two months after discharges begin to function. This analysis will be completed annually during the low flow period until the permitted surface water discharges from the site cease.

During the field investigation to monitor changes in habitat characteristics, the river bank and near shore habitats will be documented using a series of panoramic photographs taken from the river. The purpose of these photos will be to document visible changes, if any, that may occur downstream of the project.

7.4.6 Wetland Surface Flows

Water level gauges will be installed at the outflow locations of Wetland Nos. 1, 5c, 7 and 10a. A gauge will also be installed in Wetland 6c at a point that is representative of its water level. The locations of the various water level gauges are shown on Figure Nos. 7-1 and 7-7. Water levels will be read and recorded monthly from March to December of each year. The staff gauges will be installed and read beginning two months (or as soon as practical depending on the season) after project permits are granted in order to obtain preconstruction water levels. At the time the pit is backfilled, the data will be compared to preconstruction levels and the recent precipitation history for the region. If water levels indicate there has been no significant drawdown effects on these wetlands attributable to the project, readings will cease.

7.4.7. Reporting

In March of each year following the collection of monitoring data for the previous year, an annual surface water monitoring report will be prepared and submitted to the WDNR. The report will include data from the previous year and present a map of the bottom types in the area where habitat characterization was completed.

7.5 Terrestrial Ecology

Aerial and color infrared photography will be used during the construction and operation monitoring period to monitor the impact of the project on vegetation in and around the project area. The photography will be completed once prior to the start of construction and during the third and sixth year of site operations. The area to be photographed will consist of the entire project area, less the railroad spur line corridor east of STH 27, as defined on Figure No. 4-2 and the area within and 500 feet beyond the maximum extent of drawdown as defined by Figure 12 of 19 of the July 1989 Groundwater Modeling Report completed for the project.

Photography work completed during site operation will be conducted in the late summer period. If at all possible, the preconstruction photography will be completed in the late summer also. If permitting and construction schedules preclude this from occurring, photography will be completed as close to late summer as possible. Copies of the aerial photos will be forwarded to the WDNR with the annual surface water monitoring report for the years in which photos are taken.

7.6 Meteorology

Meteorological data will be collected in the vicinity of the mining site through the use of wind sensors and a precipitation gauge.

The wind sensors will be mounted approximately 35 feet off the ground where they will be free of air turbulence caused by ground level obstructions such as buildings and trees. Obstructions close enough to cause turbulence will be removed from the vicinity of the sensors. The sensors will be used to continuously record wind speed and direction on an analog strip chart recorder.

A tipping bucket precipitation gauge will be used to gather data regarding precipitation occurring at the site. Precipitation amounts will be recorded on an externally-mounted digital strip chart recorder.

The meteorological instruments will be operated continuously from the commencement of construction until initial reclamation seeding has been completed. The equipment to be used will be the same or similar to that used during baseline monitoring activities. Quality assurance procedures will be the same as those detailed in the May 1988 Revised Quality Assurance Plan for the project.

Before a final decision is made on the location for the monitoring site, a site inspection will be organized by Flambeau such that representatives of Flambeau and WDNR can verify the suitability of the location. Meteorological data will be maintained by Flambeau at the project site.

7.7 Pit Inflows

Estimates of groundwater inflow into the open pit during stripping of overburden and mining will be calculated using the following procedures.

The total estimated amount of water pumped from the open pit will be recorded through the use of either flow measurement equipment or by calculating flow using recorded pump running time and the specific discharge rate-versus-head relationship for the pumps used to remove water from the pit. Groundwater inflow will be calculated by subtracting precipitation recorded using the precipitation gauge, less evaporation, from the volume of water pumped. In addition, adjustments to the calculation will be made to reflect the volume of runoff that flows into the pit from the area immediately surrounding the pit and from the pit access road, and to reflect overflows from the runoff pond back into the pit. Given the adjustments that are required, it should be recognized that the calculated inflow rate will be a reasonable estimate of the actual rate.

Inflow will be calculated in the above fashion on a monthly basis. Average monthly inflow rates will be reported to the WDNR on an annual basis along with the surface water monitoring report.

8.0 CONTINGENCY PLAN

Pursuant to NR 182.09(2)(d), a detailed Contingency Plan has been developed "to prevent or minimize human health or environmental damage in the event of an accidental or emergency discharge or other condition not anticipated in the Feasibility Report or Plan of Operation which does not comply with license conditions or other applicable standards." This plan has addressed two potential general occurrences:

- Accidental or emergency discharges or other unplanned events.

- Environmental problems detected by the monitoring program.

Since accidental or emergency discharges or other unplanned events are addressed in the Risk Assessment (section 4.10 of the Mining Plan), they will not be covered herein. Per agreement with the WDNR, the spill prevention, control, and countermeasures plan pursuant to the Clean Water Act will be available prior to the commencement of site operations. This Contingency Plan will, therefore, only address environmental problems that could theoretically be detected by the monitoring program.

Section 7.0 of this report includes a program for monitoring during the construction and operation phases of the project. Long-term care and maintenance is discussed in section 10.0. The purpose of the monitoring programs are to provide appropriate data to be used to evaluate the performance of environmental protection facilities and operations.

The Contingency Plan will define the contingency measures to be implemented should a significant increase in a monitoring parameter occur.

8.1 Groundwater

Various parameters will be analyzed as part of the groundwater monitoring program. The results of the analyses will be subjected to statistical analysis (multiple analysis of variance) to test for significant changes in the measured levels. If a statistically significant increase is detected, the contingency measures listed below will be implemented.

It should be noted that if groundwater quality is determined to be statistically significantly different from background, Flambeau will notify the WDNR within 45 days of making the determination. Any alteration of the approved monitoring program, investigation of the suspected contamination or selection and implementation of remedial actions will be conducted in consultation with the WDNR.

Step No. 1: Review all sampling, sample handling, and analytical procedures used during the monitoring period to determine if the proper procedures were used when the samples were taken.

Step No. 2: Determine what the elevated parameters represent by:

- Determining what the regional variations in groundwater quality are for individual parameters based on published information.

- Determining what the historical site-specific variations in groundwater quality are based on monitoring data.

- Determining if all monitoring wells are showing elevated levels or if the occurrence is localized.

Step No. 3: Resample to verify the analytical results that are in question.

Step No. 4: If similar results occur from the resampling, then determine the significance of the elevated parameter(s) and its potential impact on the environment.

Step No. 5: Based on the relative significance of the elevated parameter(s), determine if immediate action is required or if continued monitoring is sufficient.

Step No. 6: Determine, if possible, what the source of the occurrence is.

During the initial evaluation period, groundwater monitoring will continue according to the normal schedule. Once the evaluation is complete and if it has been concluded that a problem may exist, the next level of investigation will be to determine the extent of the problem. This could require the installation of additional groundwater monitoring wells in the affected area to determine the vertical and horizontal extent of the concern. This exercise could also consist of the use of a contaminant transport computer model analysis to determine the impact of the elevated parameters, and to assist in determining what can be done to correct the situation. The information gathered during this period of investigation will be submitted to the WDNR.

The results of the investigation will determine the remedial action needed to correct the problem. Remedial actions could consist of:

- Additional groundwater monitoring of all aquifer systems located downgradient from the problem area. This would include monitoring on a more frequent basis, but with a limited number of key indicator parameters. It might also include the use of specialized groundwater monitoring wells.

- Repair of the source of the problem.
- Construction of slurry cutoff walls.
- Installation of a series of flow barrier-type groundwater pumping wells.

8.1.2 Private Wells

The Local Agreement provides several measures which will be taken to monitor and protect private wells in the vicinity of the project. Flambeau sampled these wells to document their current condition and characteristics. The sampling included water quality analyses, water level measurements, and documentation of well construction characteristics. Specific provisions which pertain to this program are found in paragraphs 13 and 14 of the Local Agreement (Appendix B).

8.2 Surface Water Discharges

Discharge standards and contingency plans related to the wastewater discharges from the Type I stockpile and wastewater treatment plant are covered under the WPDES permit process. The baseline surface water quality data collected prior to mine operation will be used by the WDNR to set effluent discharge standards. Any exceedance of the discharge permit limits will be addressed pursuant to applicable permit conditions and administrative code provisions under Wis. Stat. ch. 147.

8.3 Surface Water

Various monitoring of sediments, fish, macroinvertebrates, surface water quality and habitat will be conducted along the eastern bank of the Flambeau River. If an adverse impact is noted, the contingency measures listed below will be implemented.

It should be noted that if surface water monitoring indicates an adverse impact on the Flambeau River is occuring, Flambeau will notify the WDNR within 45 days of making the determination. Any alteration of the approved monitoring program, investigation of suspected contamination or selection and implementation of remedial actions will be conducted in consultation with the WDNR.

Step No. 1: Review all sampling, sample handling, and analytical procedures used during the monitoring period to determine if the proper procedures were used when the samples were taken.

Step No. 2: Determine what the elevated parameters represent by:

- Determining what the regional variations in surface water characeteristics are for individual parameters based on published information.

- Determining what the historical site-specific variations in groundwater quality characteristics are based on monitoring data.

- Determining if all monitoring locations are impacted similarly or if the occurrence is localized.

Step No. 3: Resample or remonitor to verify the results that are in question.

Step No. 4: If similar results occur from the resampling or remonitoring, determine the significance of the results and their potential impact on the environment.

Step No. 5: Based on the relative significance determined in Step No. 4, determine if immediate action is required or if continued monitoring is sufficient.

Step No. 6: Determine, if possible, what the source of the occurrence is.

During the initial evaluation period, surface water monitoring will continue according to the normal schedule. Once the evaluation is complete and if it has been concluded that a problem may exist, the next level of investigation will be to determine the extent of the problem. This could require an increase in monitoring in the affected area to determine the extent of the concern. This could also include the completion of a risk assessment to determine the potential effect on human health and welfare. The information gathered during this period of investigation will be submitted to the WDNR.

The results of the investigation will determine the remedial action needed to correct the problem. Remedial actions could consist of:

- Additional monitoring of the Flambeau River, its sediments and/or its aquatic life. This would include monitoring on a more frequent basis, but with a limited number of key indicator parameters. It might also include the use of specialized monitoring equipment or techniques.

- Repair of the source of the problem.

- Construction of additional erosion control features.

8.4 Wetland Surface Flows

Staff guages will be used to monitor water levels in selected wetlands in the site vicinity. If a reduction in water levels are noted that are not the result of normal seasonal variations, the contingency measures listed below will be implemented. The same WDNR notification and approval provisions discussed under section 8.3 will also apply under this section.

Step No. 1: Verify that the water levels reading procedures and reporting are correct and in accordance with the approved monitoring plan.

Step No. 2: Determine what the collected data represent by:

- Determining what the regional variations in wetland flows and levels are based on a survey of area wetlands.
- Determining if the occurance is due to abnormal climatic conditions such as drought.
- Determining what the extent of the cone of depression is in relation to the wetland.

Step No. 3: If the results do not indicate a cause for the occurrence other than the project, determine the significance of the occurrence and its potential impact on the environment.

Step No. 4: Based on the relative significance of the occurrence, determine if immediate action is required or if continued monitoring is sufficient.

Step No. 5: Determine if possible what the source of the occurrence is.

During the initial evaluation period, wetland monitoring will continue according to the normal schedule. Once the evaluation is complete and if it has been concluded that a problem may exist, the next level of investigation will be to determine the extent of the problem. This could include the installation of groundwater piezometers in the affected area to determine the groundwater level in the vicinity of the wetland. The information gathered during this period of investigation will be submitted to the WDNR.

The results of the investigation will determine the remedial action needed to correct the problem. Remedial actions could consist of:

- Providing a supplemental source of water to the wetland.
- Increasing the size of the wetlands to be constructed as part of site reclamation activities to offset the area of wetland adversely impacted.

9.0 EMERGENCY NOTIFICATION PROCEDURES

In the event of an emergency, accident or other unplanned event, the following Flambeau personnel, listed in order of authority and responsibility, will contact the appropriate federal, state and/or local agencies, entities or authorities:

- General Manager
- Mine Superintendent
- Mine Shift Foreman

The following are potential emergencies, accidents, and unplanned events that were addressed in the Risk Assessment (section 4.10 of the Mining Plan). Listed below each are the agencies, entities, and/or authorities which may be contacted when appropriate.

Major Chemical Release to the Environment

- U.S. EPA, Region V - Permits and Technical Support Branch
  312/353-2000

- WDNR
  Spill Team Coordinator - Area Warden
  (H) 715/762-4443
  (W) 715/762-3204

- Wisconsin Division of Emergency Government
  608/266-3232

- National Response Center
  800/424-8802

- Ladysmith Volunteer Fire Department
  911

- Rusk County Zoning Administrator
  532-2156

- Rusk County Sheriff
  911

Accidental Detonation of Explosives

- MSHA (Duluth District Office)

  218/720-5448
  218/722-6547 (after 5:00 p.m.)
  218/727-6319 (after 5:00 p.m.)

- Rusk County Sheriff
  911

- Rusk County Zoning Administrator
  532-2156

- DILHR
  608/266-1340

<u>Major Fuel Spill</u>

- WDNR
  Spill Team Coordinator - Area Warden
  (H) 715/762-4443
  (W) 715/762-3204

- Wisconsin Division of Emergency Government
  608/266-3232 (24-hour Hotline)

- Rusk County Zoning Administrator
  532-2156

- Ladysmith Volunteer Fire Department
  911

- Rusk County Sheriff
  911

<u>Fire</u>

- Ladysmith Volunteer Fire Department
  911

- U.S. Forest Service (Ladysmith Ranger Station)
  532-3911 or 532-2200
  532-3737 or 532-2200 (after 5:00 p.m.)

- Rusk County Zoning Administrator
  532-2156

<u>Sabotage/Vandalism</u>

- Rusk County Sheriff
  911

- If explosives are stolen
  Federal Alcohol, Tobacco & Firearms Bureau
  312/353-3834

- FBI (Eau Claire)
  1-835-3761

10.0 LONG-TERM CARE AND MAINTENANCE

Long-term care for the site will commence at the completion of site closure. This will be the point in time when final site grading and initial site revegetation, as defined in the site reclamation plan, have been completed.

The following discussion addresses specific long-term care and maintenance requirements as per NR 132.08, NR 182.09, NR 182.16, and NR 182.19. These requirements relate to the procedures to be used, the estimated costs and financial responsibility for the 40-year long-term care period.

10.1 Procedures

Long-term care and maintenance for the project will relate to inspections of the site; maintenance of landforms, vegetation and monitoring devices; and monitoring groundwater, surface water, vegetation and terrestrial ecology. Each of these topics is discussed in the succeeding paragraphs.

10.1.1 Inspections

Flambeau will inspect the reclaimed site semi-annually for the first four years during the long-term care and maintenance period, and once per year thereafter. The semi-annual inspections will occur in the spring and fall. The annual inspection will occur in the late summer. The inspections will be performed by a person qualified to evaluate conditions associated with erosion, vegetation growth, settling and monitoring device integrity.

10.1.2 Maintenance

Maintenance activities will consist of landform, vegetative and monitoring device maintenance.

10.1.2.1 Landform

The method of backfilling the pit and the nature of the backfilled material will result in only a slight amount of settling. In the eastern portion of the pit a mounding will be provided to compensate for anticipated settling. It is calculated that an approximate six-foot mound will allow for the final grade over the pit to be near the original grade following settlement. In the west end of the pit, a few feet of settling will augment the formation of the proposed wetland located in that area. Current plans are to revegetate the open pit site and allow the land to settle to a final form. No additional grading of the pit or project area will be done except for erosion control or vegetation maintenance after reclamation is completed. Erosion control will consist of regrading and revegetating eroded areas.

10.1.2.2 Vegetation

After reclamation has been certified as complete, additional revegetation of eroded areas will be completed. Revegetation techniques will be those specified in section 5.11 for revegetation of the site as a whole.

10.1.2.3 Monitoring Devices

Flambeau will immediately notify the WDNR if for any reason a groundwater monitoring well or device is destroyed or fails to function properly. Unless otherwise notified in writing by WDNR, Flambeau will restore or properly abandon and replace destroyed or failed monitoring devices within 60 days of the written notification referred to above.

10.1.3 Groundwater Monitoring

Groundwater monitoring will include water level measurements and water quality data collection in monitoring wells located both in the backfilled pit and outside the pit. In addition, water level measurements will be made in selected piezometers outside the pit.

10.1.3.1 Groundwater Quality Monitoring Outside the Backfilled Pit

Water quality monitoring and water level measurements outside the pit perimeter will include four well nests (MW-1000, MW-1002, MW-1004, and MW-1005) and monitoring well MW-1010P (Figure No. 10-1). Well nests MW-1000 and MW-1004 and well MW-1010P are included in the program since they are located downgradient of the backfilled pit. Well nest MW-1002 is included since it is downgradient of the Type I stockpile. Well nest MW-1005 is included as the upgradient well nest for background water quality data purposes.

Sampling will be performed quarterly (March, June, September and December) during the long-term care and maintenance period. Analyses will be performed for the following parameters.

Specific Conductance (field)	Iron
pH (Field and Lab)	Manganese
Total Dissolved Solids	Copper
Total Alkalinity	Sulfate
Total Hardness	

Once per year, during the June monitoring round, each of the above monitoring wells will also be monitored for the following metals:

Arsenic	Mercury
Barium	Selenium
Cadmium	Silver
Total Chromium	Zinc
Lead	

10.1.3.2 Groundwater Quality Monitoring Inside the Backfilled Pit

As shown on Figure No. 10-1, two monitoring well nests will be placed in the backfilled pit following the completion of reclamation construction activities. Each nest will consist of two wells. In each nest, the deeper wells, MW-1013P and MW-1014P, will be bottomed in Type II waste rock material approximately thirty feet above the bottom of the backfilled pit. The shallower wells, MW-1013G and MW-1014G, will be bottomed in backfilled till and/or outwash on top of the backfilled saprolite layer. The specific planned well construction details for each of the four wells are shown on Figure Nos. 10-2 through 10-5.

After installation and upon the water level in the backfilled pit reaching each well, *in situ* permeability tests will be conducted and then monitoring of the wells for water quality will commence. Each well will be monitored quarterly (March, June, September and December) for two years for the parameters listed below.

Specific Conductance (Field)	Iron
pH (Field and Lab)	Manganese
Total Dissolved Solids	Copper
Total Alkalinity	Sulfate
Total Hardness	

During each June sampling round during the two-year period, the following metals will be added to the parameter list.

Arsenic	Mercury
Barium	Selenium
Cadmium	Silver
Total Chromium	Zinc
Lead	

Following the completion of eight consecutive rounds of water quality monitoring for each well in the two nests, the monitoring frequency will be reduced to annually, with the samples being collected in June. Annual sampling will be continued until the water levels in MW-1013P and MW-1014P indicate that the water table surface in the backfilled pit has risen to the bottom of the saprolite layer atop the waste rock. At that time, the sampling frequency will be reduced to one every five years. Collected samples will be analyzed for the following parameters.

Specific Conductivity (Field)	Arsenic
pH (Field and Lab)	Barium
Total Dissolved Solids	Cadmium
Total Alkalinity	Total Chromium
Total Hardness	Lead
Iron	Mercury
Manganese	Selenium
Copper	Silver
Sulfate	Zinc

The proposed reduction in sampling frequency after two years (eight quarters) is justified based on the following. The results of waste characterization tests have indicated that under conditions where Type II waste is exposed to water, reaction times for the release of metals tend to be relatively short. The sequence of backfilling material and the addition of lime to the Type II waste will govern the release of metals from this material. The equilibrium concentrations of the metals plus sulfate will be a function of the solubilities of the wastewater treatment precipitates placed in the pit with Type II wastes (Appendix L). It is expected that the equilibria between the precipitates and the groundwater will be extremely short. Therefore, it is anticipated that equilibria between the groundwater and the backfilled materials in the pit will be reached well within two years. In addition, two years of quarterly monitoring will produce eight sets of data, a number of data sets that is considered sufficient in other regulatory groundwater monitoring programs (e.g., NR 500).

Sampling, analytical and reporting procedures under the above program will be the same as those described in section 7.2.

The purpose of the in-pit groundwater quality monitoring will be to check the veracity of the groundwater modeling results submitted by Flambeau. Those results show that groundwater quality impacts will not occur. If the monitoring data continue to confirm this prediction at the time the water levels in the project area stabilize, then the need for groundwater monitoring in the pit will no longer exist, and the monitoring will cease.

10.1.3.3 Water Level Measurements in Selected Wells

Quarterly water level measurements at all wells used for this purpose during construction and operations monitoring (Table No. 7-1) shall be continued into the long-term care and maintenance period, until water levels are stabilized. At this point, water level measurements will only be taken at wells for which water quality sampling is performed.

10.1.4 Surface Water

The objective of the post-operational monitoring of surface waters is to confirm the findings of the monitoring during operations. In the unlikely event that operational monitoring results link increases in certain metals to the site, the proposed surface water monitoring program proposed in this section may need to be revised.

At the time at which the groundwater conditions in the reclaimed pit have rebounded so that there is a groundwater flow toward the Flambeau River, the groundwater data will be evaluated. If the conditions predicted by groundwater flow and water quality modeling are met, the post-operational surface water monitoring program will be deemed complete and no additional monitoring will be required.

Following is a discussion of the targeted long-term care and maintenance surface water monitoring program.

10.1.4.1 Sediments, Macroinvertebrates and Fish

After discharges from the wastewater treatment facilities have ceased, sediments, crayfish and fish will be collected once each year for two years at the same locations shown on Figure No. 7-7.

During the third year after the cessation of wastewater discharges and for each year thereafter, until the notice of completion of reclamation is issued by Flambeau, crayfish will be sampled and analyzed according to methods discussed in section 7.4.3. Fish will be sampled during the year that the certificate of completion is issued according to methods discussed in section 7.4.2.

10.1.4.2 Water Quality

During the two years following the cessation of the wastewater discharge, three surface water samplings will be made at the locations shown on Figure No. 7-7. Two of these samplings will occur at the time of spring runoff during each of these years. One additional sample will be taken during a stormwater runoff event so that the downstream sample taken in the Flambeau River includes runoff from the mine site. All surface water sampling will be terminated two years after the cessation of the wastewater discharge.

10.1.4.3 Wetland Surface Flows

If water level measurements collected during the construction and operation monitoring program indicate significant drawdown effects on a monitored wetland which is attributable to the project, then wetland surface flows will be monitored at that location during the long-term care and maintenance period three times per year (spring, summer and autumn) until water levels in monitored groundwater monitoring wells stabilize. At this point in time, monitoring will cease.

10.1.4.4 Sampling, Analytical and Reporting Frequencies

Sampling, analytical and reporting procedures under this program will be the same as those described in section 7.4.

10.1.5 Vegetation and Wildlife

Monitoring of vegetation will occur between the time planting has been completed and the certificate of completion of reclamation has been issued by the WDNR. The procedures to be followed during the vegetation and wildlife monitoring program are described in section 5.11 of this report. Maintenance of vegetation is discussed in section 10.1.2.2 of this report.

10.1.6 Terrestrial Ecology

Aerial and color infrared photography will be completed in the later summer for four consecutive years following completion of closure and every five years thereafter throughout the long-term care and maintenance period to monitor the success of revegetation.

The area to be surveyed will be the same as described in section No. 7.5. Copies of the photographs will be provided to WDNR with the surface water monitoring report until surface water monitoring is completed. At that time, the photographs will be forwarded to WDNR within 60 days of their receipt by Flambeau from the aerial contractor.

10.2 Long-term Care and Maintenance Costs

Table Nos. 10-1 and 10-2 contain itemized estimates of long-term care and maintenance costs for the project. Table No. 10-1 contains an itemization of the estimated annual costs for the first six years of long-term care and maintenance. Table No. 10-2 contains an itemization of these costs for years 7 through 40 of the long-term care and maintenance period.

Table No. 10-1 reflects the greater incidence of long-term care and maintenance activities during the earlier years of the period. The six-year period was selected since it represents the projected point after closure at which a certificate of completion of reclamation would be issued by WDNR for the project. The six-year period includes two years to monitor the revegetated site after closure, and the four years in which Flambeau's notice of the completion of reclamation is processed by WDNR.

TABLE NO. 10-1

Annual Long-Term Care and Maintenance Costs
Years 1 through 6

Item Description	Basis of Costs	Units	Estimated Quantity	Unit Cost	Cost
Site Inspections	Site Inspection and Report	Inspections per Year	1.67 (Ave)[1]	$ 500	$ 840
Maintenance					
·Landform Erosion Damage Repair	Repair Erosion Loss at 0.0625 Tons/Yr./Acre	Cubic Yards	9.2	$ 282	$ 2,600
·Vegetation and Soil Amendments	Replace Plantings, Seed, Fertilize, and Mulch	Acres	2.5 (Ave.)[2]	$4,520	$11,300
·Monitoring Device Replacement[3]	Replace and Abandon Wells, Documentation, Service Other Wells	Lump Sum			$ 750
Groundwater Monitoring[4]					
·Outside Backfilled Pit	Sample Collection and Lab Test	Samplings per Year	44 Samples	$ 234	$10,300
·Inside Backfilled Pit New Wells	Sample Collection and Lab Tests	Sampling per Year	40 (Ave.)[1]	$ 187	$ 7,500
Surface Water					
·Sediments, Macro-invertebrates and Fish Sampling	Collection, Prep and Analysis Yearly Ave.	Lump Sum			$ 4,530
·Water Quality	Collection and Lab Analysis	Sampling per Year	.5 (Ave.)[1]	$1,060	$ 530
·Wetland Surface Flows	Staff Gauge Reading	Per Reading	3	$ 100	$ 300

TABLE NO. 10-1 (Cont.)

Item Description	Basis of Costs	Units	Estimated Quantity	Unit Cost	Cost
Vegetation and Wildlife Monitoring	Biomass, Cover Diversity, HEP	Monitoring per Year	0.5 (Ave.)[1]	$ 5,600	$ 2,800
Terrestrial Ecology	Aerial Photo Documentation	Per Flight	.67 (Ave.)[1]	2,000	$ 1,340
				Subtotal	$42,790
Administration/Reporting	General Estimate	Lump Sum	10 Percent		$ 4,280
				Total	$47,070

[1]These figures are used to average the cost of a particular task so that a yearly average can be estimated.

[2]Average prorated as follows: Year 1 = 5 acres; Year 2 = 4 acres; Year 3 = 3 acres; Year 4 = 2 acres; Year 5 = 1 acre; Year 6 = 0 acres.

[3]Assumes one well is abandoned and replaced every five years and other wells are serviced annually.

[4]Includes water level measurement.

TABLE NO. 10-2

Annual Long Term Care and Maintenance Costs
Years 7 through 40

Item Description	Basis of Costs	Units	Estimated Quantity	Unit Cost	Cost
Site Inspections	Site Inspection and Report	One Inspection per Year	One/Year	$ 500	$ 500
Maintenance					
•Landform Erosion Damage Repair	Repair Erosion Loss at 0.0625 T/A/YR	Cubic Yards	9.2	$ 282	$ 2,600
•Vegetation and Soil Amendments	None Required After 6th Year				
•Monitoring Devices	Replace and Abandon Wells, Documentation, Service Other Wells	Lump Sum			$ 750
Groundwater Monitoring					
•Outside Backfilled Pit	Sample Collection and Lab Testing	Samplings Per Year	44 Samples	$ 234	$10,300
•Inside Backfilled Pit (Variable Schedule)	Sample Collection and Lab Testing	Samplings Every 5 Years	0.9 Samples	$ 265	$ 240
Wetland Surface Flow	Staff Gauge Reading	Readings Per Year	1 (Ave.)[1]	$ 300	$ 300
Terrestrial Ecology	Aerial Photo Documentation	Per Flight Every 5 Years	.2 (Ave.)[1]	$2,000	$ 400
				Subtotal	$15,090
Administration/Reporting	General Estimate	Lump Sum	5 Percent		$ 750
					$15,840

[1]These figures are used to average the cost of a particular task so that a yearly average can be estimated.

10.3 Financial Responsibility

The Flambeau Mining Company intends to use the net worth test to establish financial responsibility for long-term care as per the provisions of Wisconsin Administration Code NR 182.17(2) (f).

10.4 Responsible Party

The name of the person legally and operationally responsible for long-term maintenance is given below.

Lawrence E. Mercando, Vice President
Flambeau Mining Company
10 East South Temple
Salt Lake City, Utah 84147
(801) 322-8460

11.0 REFERENCES

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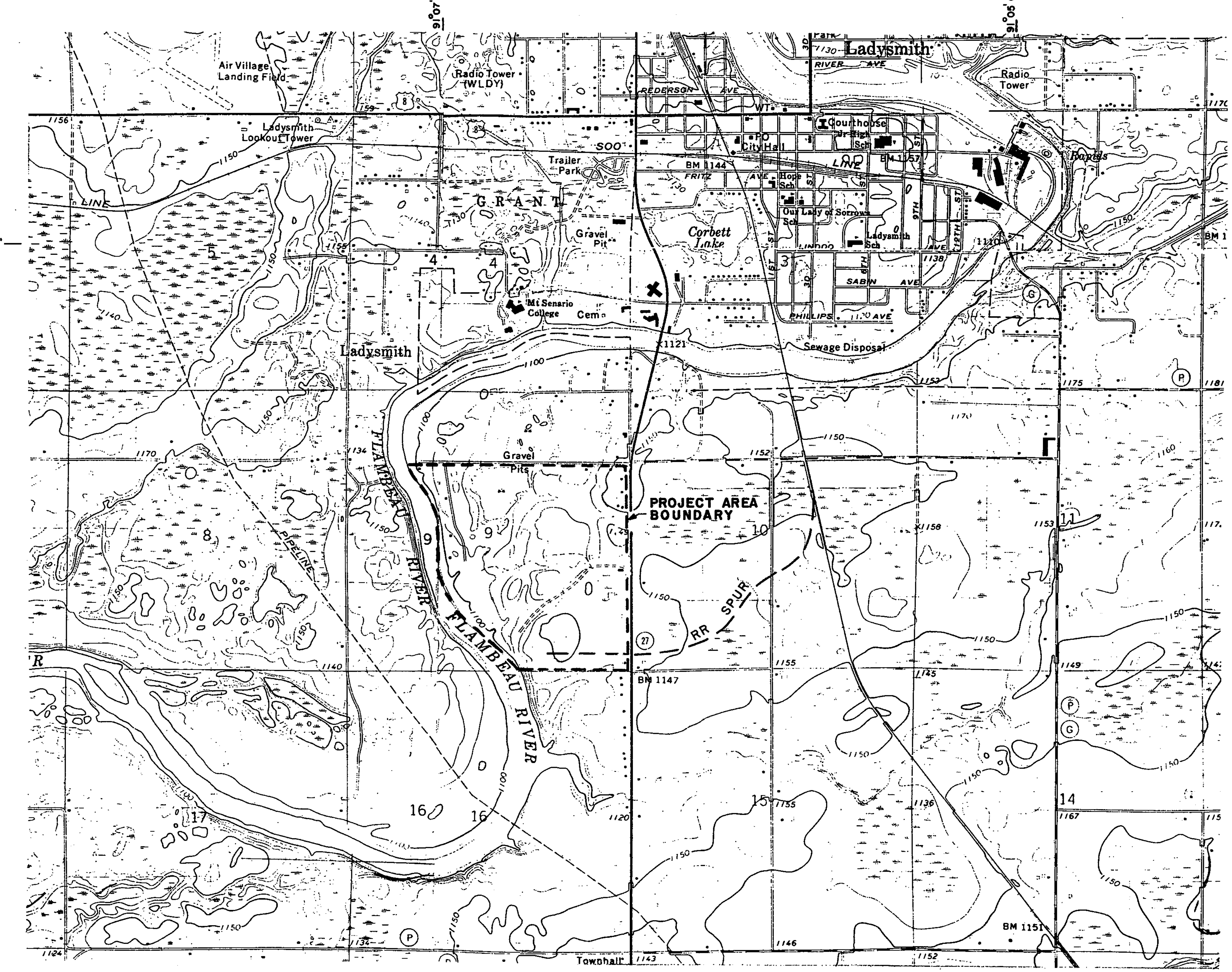
FIGURES FOR MINING PERMIT APPLICATION



NOTE: BASE MAP PREPARED FROM U.S.G.S. MAPS 7.5 MINUTE SERIES, LADYSMITH AND THORNAPPLE WISCONSIN QUADRANGLES

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

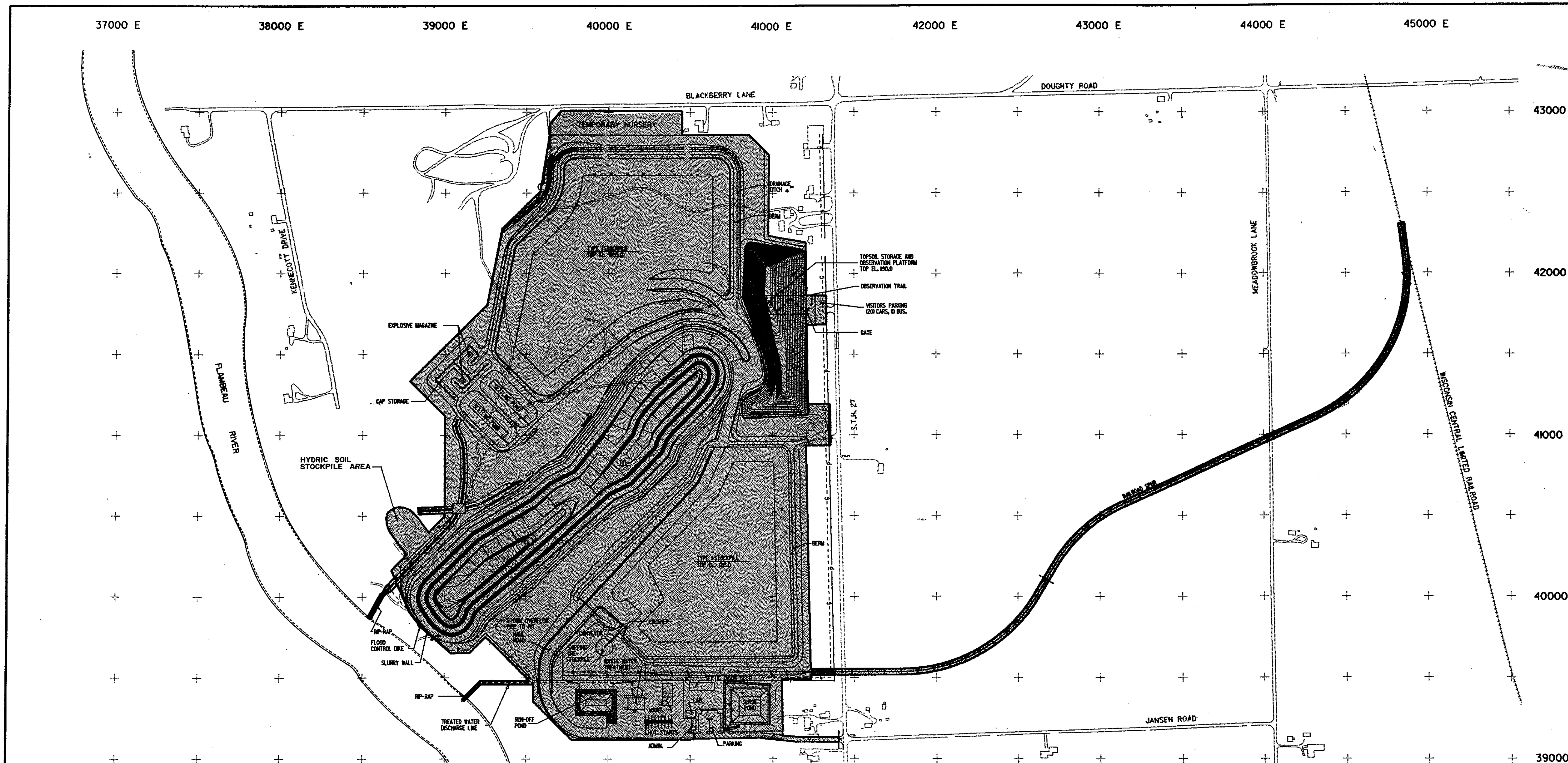
DESIGN	BY	DATE
DRAWN	S.J.L.	2/89
CHK'D	G.W.S.	3/89
DES. ENG'R		
SECT. ENG'R		

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. I-1
USGS. TOPOGRAPHIC MAP WITH PROJECT AREA

SCALE 1" = 2000'



NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970. ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATON, MINNEAPOLIS, MINNESOTA. DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

5. MINE FACILITIES DESIGN BY FORD, BACON & DAVIS, INCORPORATED, SALT LAKE CITY, UTAH AND PINCOCK, ALLEN & HOLT, INCORPORATED, LAKEWOOD, COLORADO.

LEGEND

- 1100 — EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- F-1 CONTROL MONUMENT
- MINE SITE

N

0 300' 600'
SCALE

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

FIGURE NO. I-2
MINE SITE LOCATION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.
	12/89	UPDATED SITE PLAN	M.J.O.	J.W.S.		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	M.J.O.	12/89
CHK'D	J.W.S.	12/89
DES. ENG'R		
SECT. ENG'R		

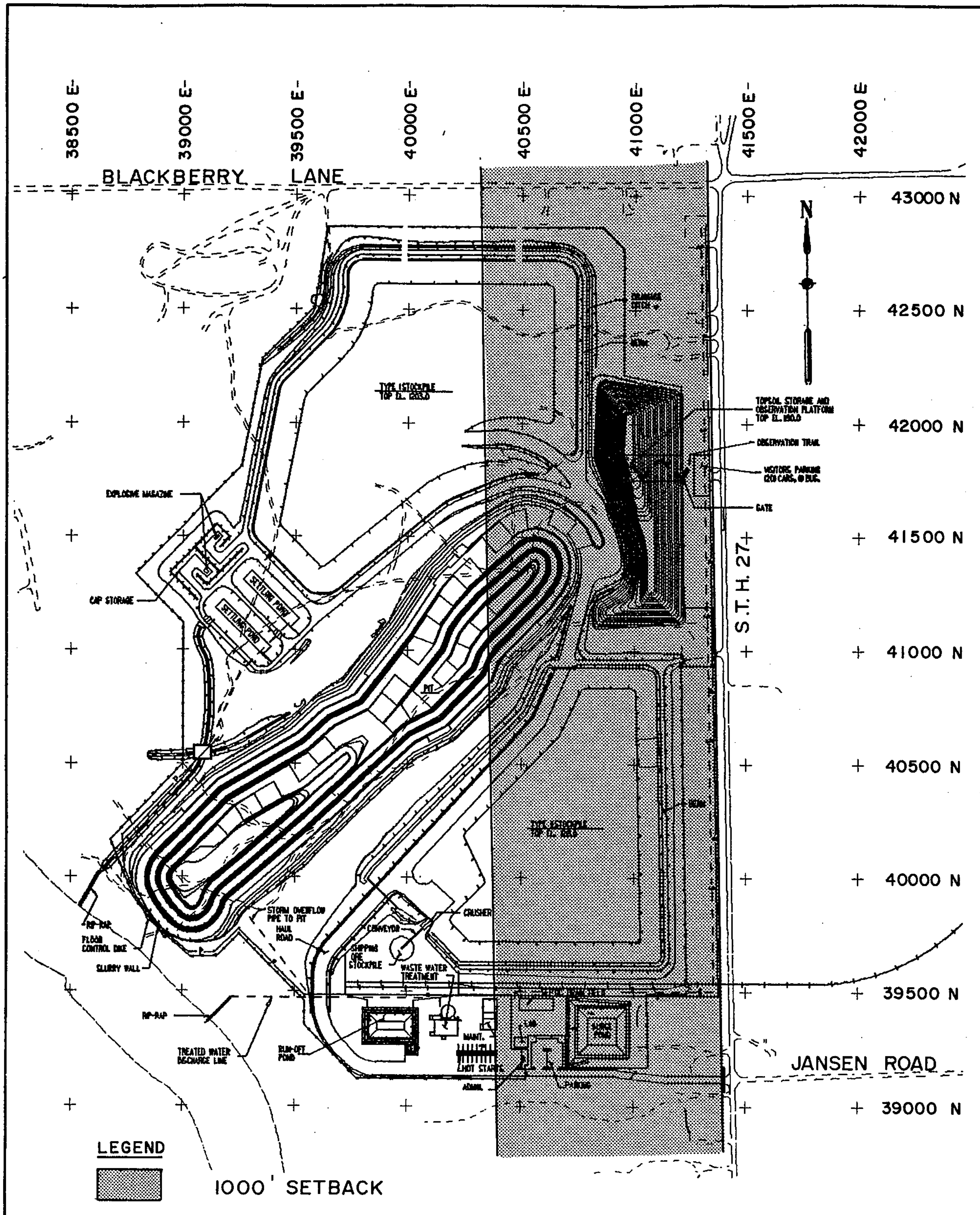
REFERENCES	DWG. NO.	DESCRIPTION

MICROFILM | JOB

DRAWING NO. | REV.

DIVISION DRAWING NO.

SCALE SEE BAR SCALE



FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	SJL	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 600'	

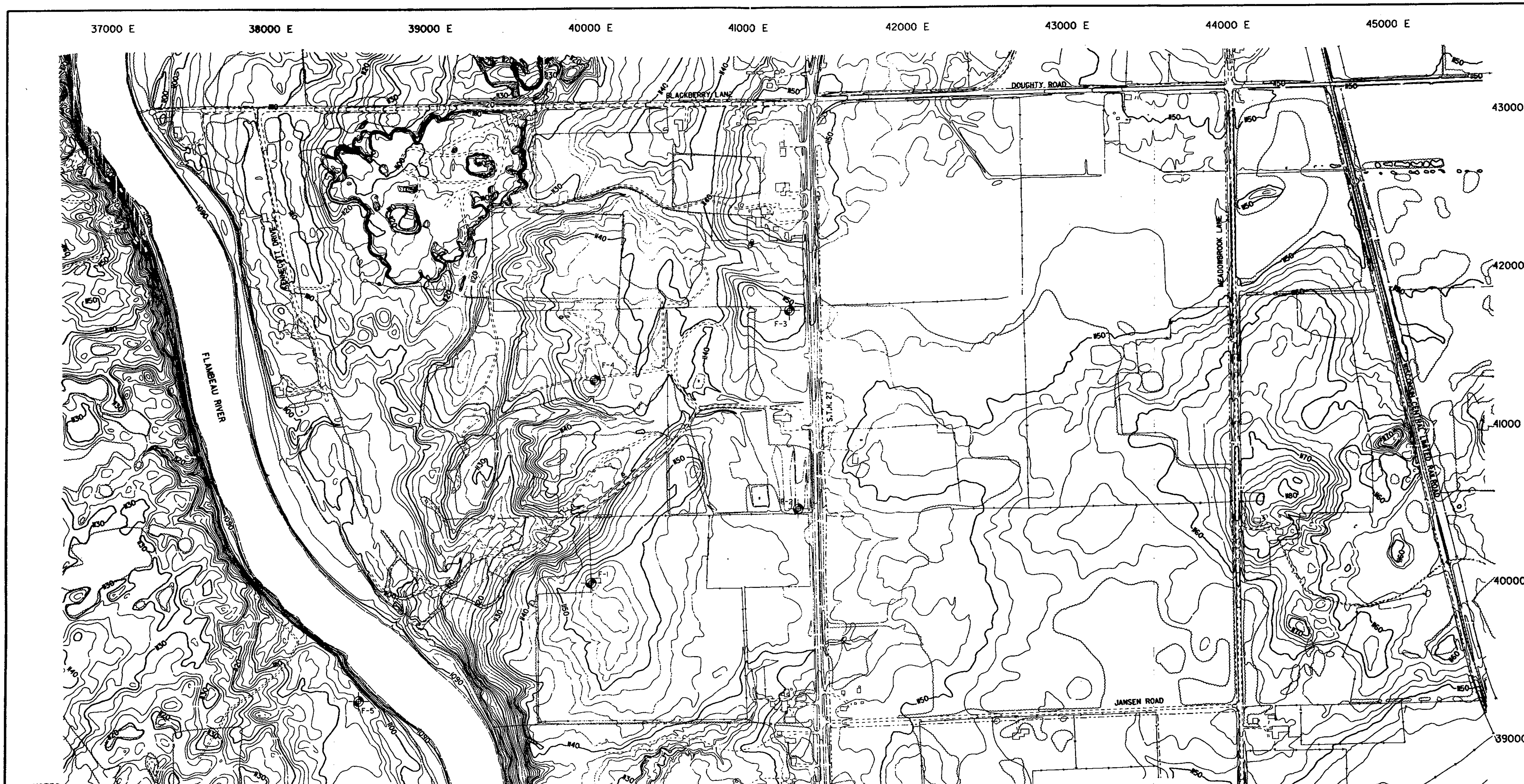
KENNECOTT MINERALS COMPANY

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 2-1

S. T. H. 27 SETBACK

Job No	Dwg No	REV



NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970.
   ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATON, MINNEAPOLIS, MINNESOTA.
   DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM.
   CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

LEGEND

- 1140 — EXISTING GROUND CONTOUR
- DEPRESSION
- TREES AND/OR BRUSH
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- EXISTING FENCE
- F-2 CONTROL MONUMENT
- ELECTRICAL LINE

N

0 300' 600'
SCALE

MONUMENTS	COORDINATES NORTH	COORDINATES EAST	ELEVATION TOP OF MONUMENT
F-1	40000.0000	40000.0000	1155.59
F-2	40471.1975	41301.7678	1143.65
F-3	41733.8779	41248.5930	1151.73
F-4	41293.0707	40025.5063	1148.43
F-5	39257.1140	38551.5944	1106.47

REFERENCES DWG. NO.	DESCRIPTION	REFERENCES DWG. NO.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR. PROCESS ENG'R			DRAWN	MJO	12/89
ENG'R MGR.			CHK'D	GWS	12/89
			DES. ENG'R		
			SECT ENG'R		

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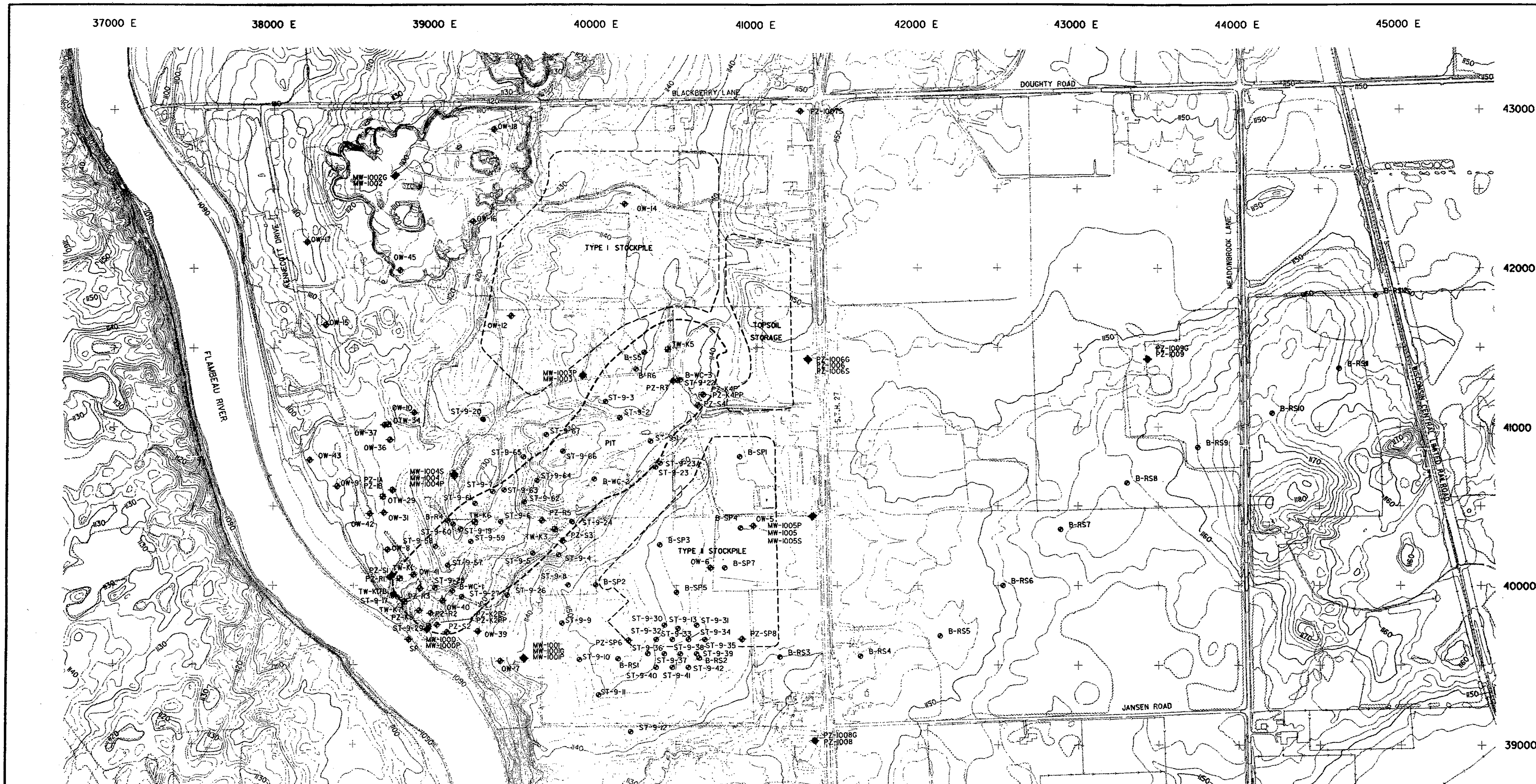
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

FIGURE NO. 2-2
SITE TOPOGRAPHY
AND EXISTING CONDITIONS

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE | SEE BAR SCALE



NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970. ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATON, MINNEAPOLIS, MINNESOTA. DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES' CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587, 357. 8087 N
40000 E =	1, 713, 516. 1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

LEGEND

- 1100 EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- F-1 CONTROL MONUMENT
- MW-1004 GROUNDWATER MONITORING WELL LOCATION AND NUMBER
- PZ-R5 OW-39 PIEZOMETER LOCATION AND NUMBER
- SP SANDPOINT LOCATION AND NUMBER
- B-SP2 ST-9-29 SOIL BORING LOCATION AND NUMBER
- TW-K6 OWT-34 TEST WELL LOCATION AND NUMBER

N

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GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 2-3
SITE TOPOGRAPHY, EXISTING CONDITIONS, AND BORING AND WELL LOCATIONS

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

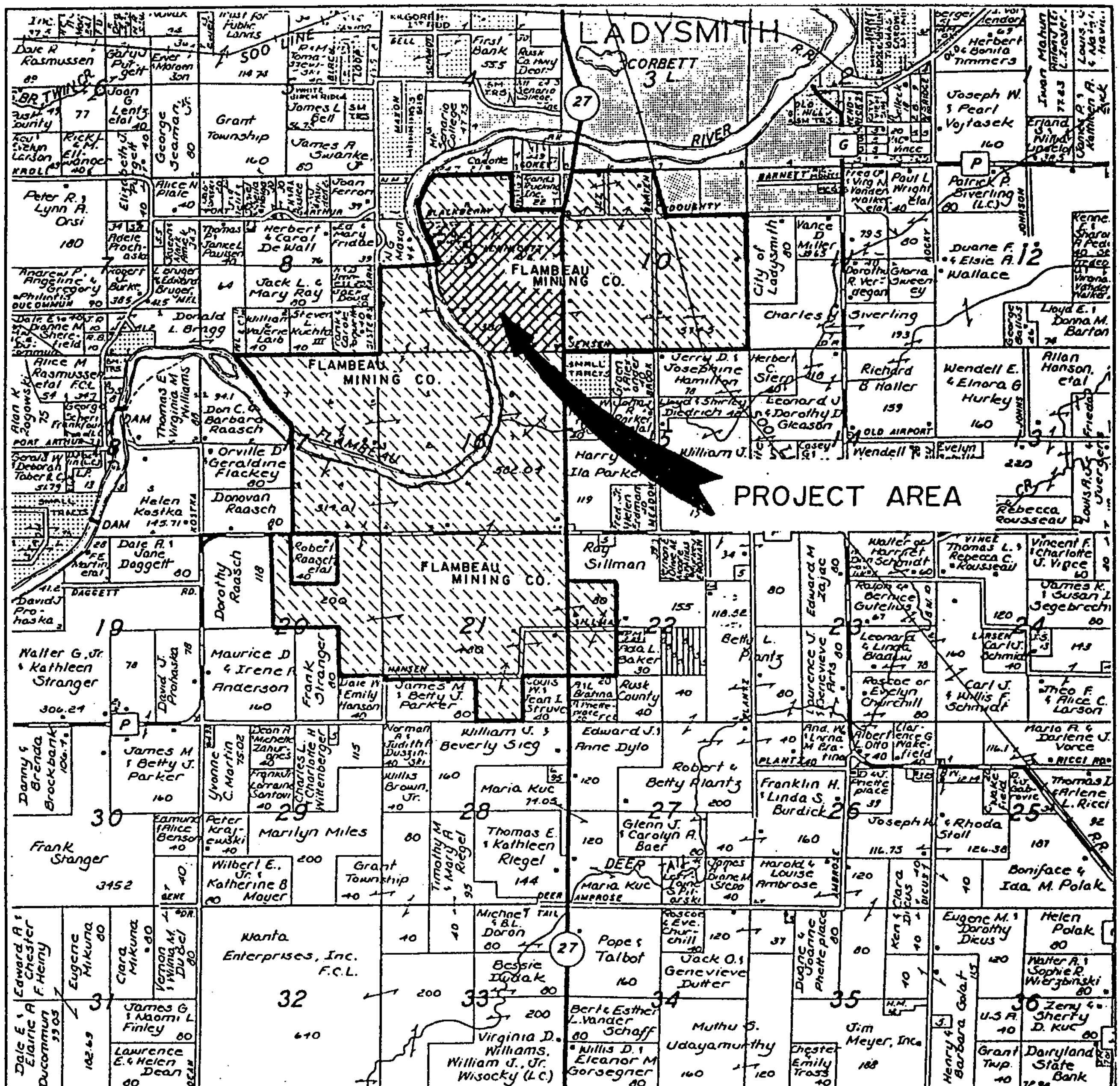
NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.
	12/89	UPDATED SITE PLAN	MJD	GWS		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	MRS	3/89
CHK'D	GWS	3/89
DES. ENG'R		
SECT. ENG'R		

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	SEE BAR SCALE



LEGEND

FLAMBEAU PROPERTIES

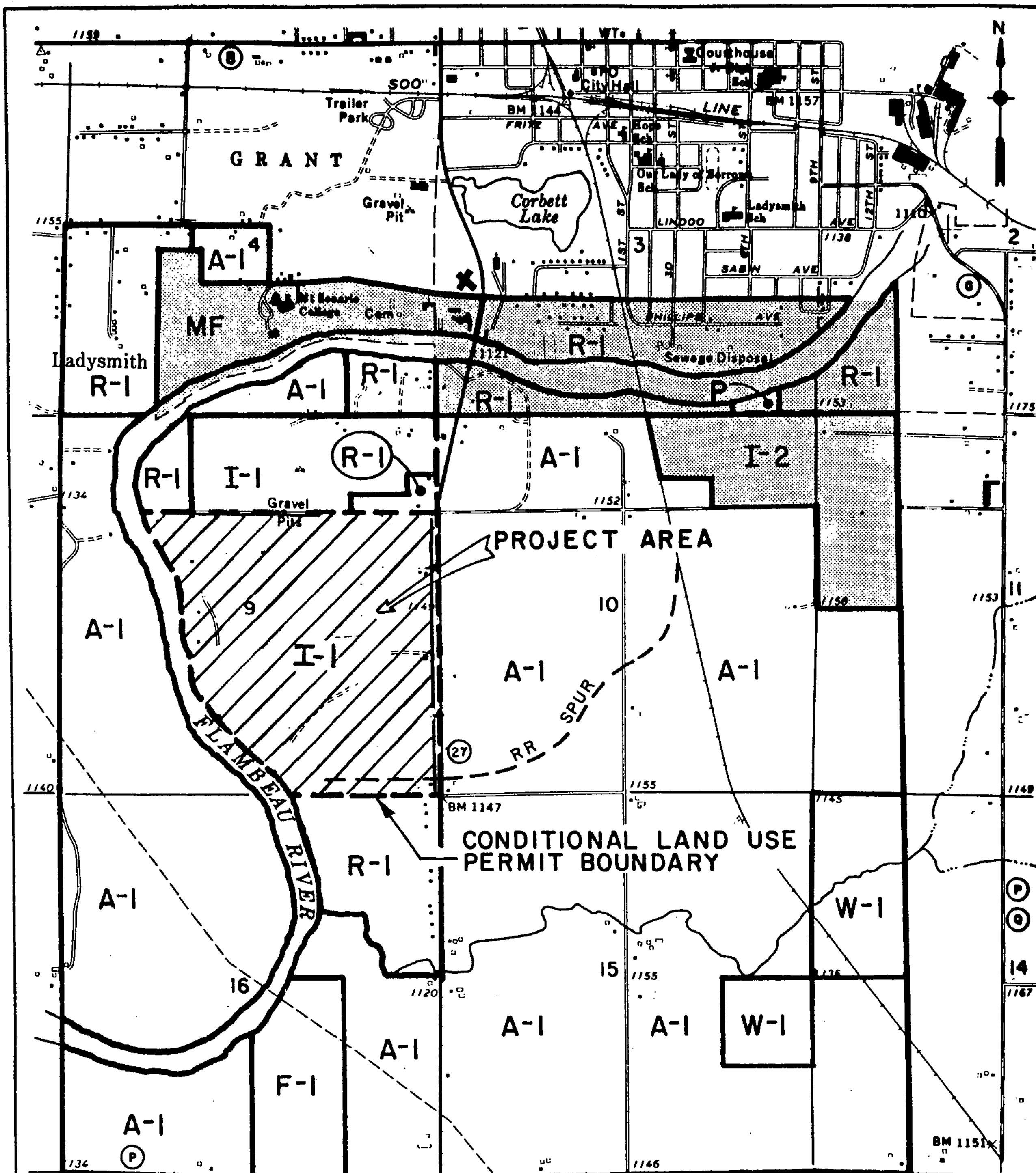
CITY OF LADYSMITH

NOTES:

PROJECT AREA INCLUDES A 36 FOOT WIDE CORRIDOR ALONG RAILROAD SPURLINE EAST OF STH 27.

BASE MAP PREPARED FROM LAND ATLAS AND PLAT BOOK RUSK COUNTY, WISCONSIN.

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 2-4 PROPERTY OWNERSHIP
	DESIGNED BY		
	DRAWN BY DHS	5/89	
	CHECKED BY MJO	6/89	
	APPROVED BY		
	CAD No. / SCALE NONE		Job No / Dwg No / REV



NOTE: RR SPUR RIGHT OF WAY IS ZONED I-1

LEGEND

(shaded)	CITY OF LADYSMITH	C-1	COMMERCIAL	W-1	RESOURCE CONSERVATION
R-1	SINGLE FAMILY RESIDENTIAL	I-1	INDUSTRIAL	MF	MULTI-FAMILY RESIDENTIAL
A-1	AGRICULTURAL	F-1	FORESTRY	P	PUBLIC & CONSERVANCY

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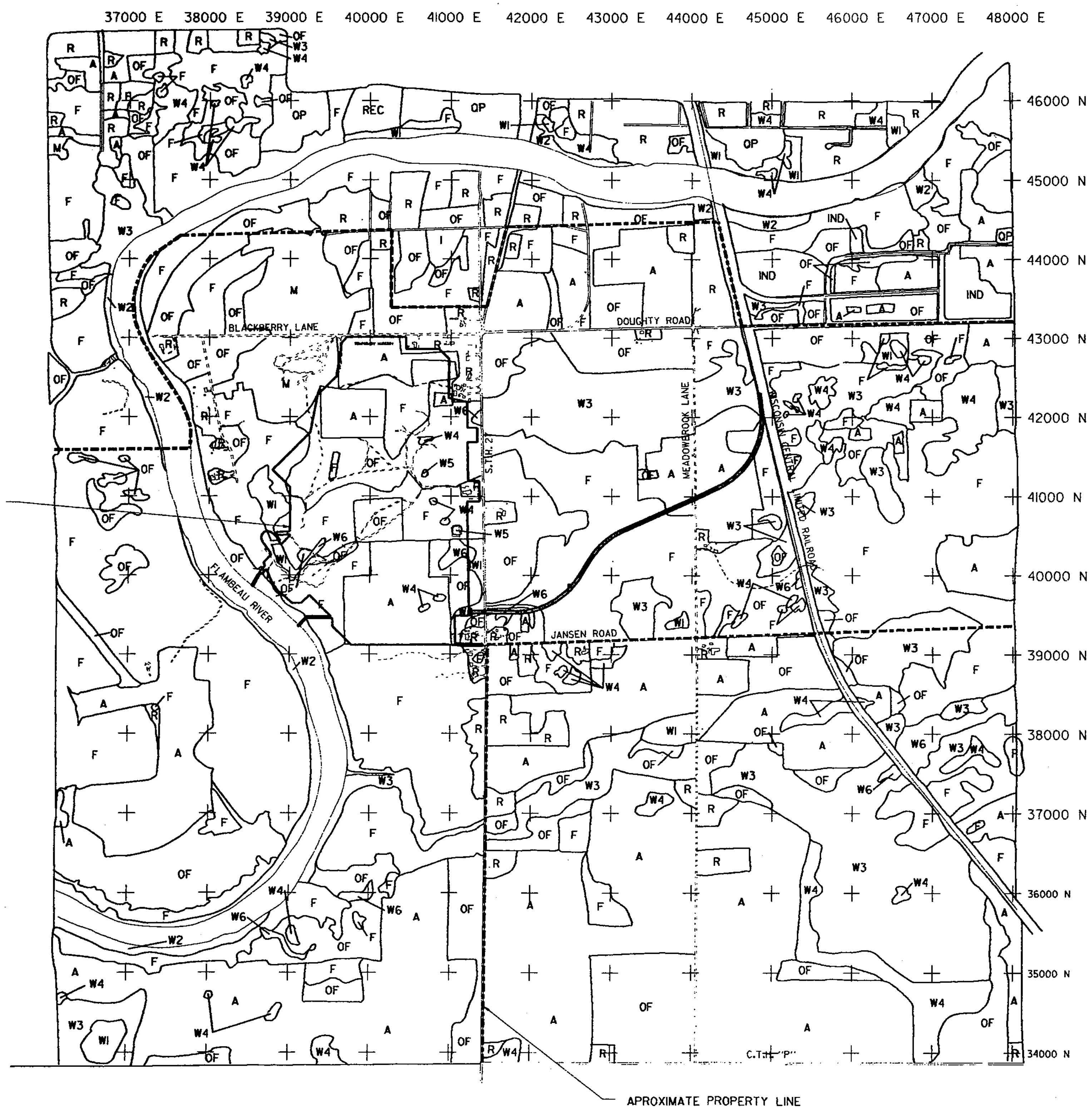
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 2-5
ZONING MAP

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	MWB	1/89
	CHECKED BY	KAJ	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	

Job No	Dwg No	REV



LAND USE STUDY AREA
ACREAGE TOTALS

	LAND USE CLASSIFICATION	ACRES
A	AGRICULTURE	754.3
F	UPLAND MIXED FOREST	924.8
OF	PASTURE / OLD FIELD / MEADOW	585.3
R	RESIDENTIAL / DISTURBED	183.1
W	WETLANDS	545.5
	W1 NORTHERN WET MESIC FOREST	34.1
	W2 RIVERINE FLOODPLAIN MEADOW	59.4
	W3 ALDER THICKET; BOG	336.7
	W4 NORTHERN SEDGE MEADOW, ALDER THICKETT	93.1
	W5 DUG PONDS	0.4
	W6 NORTHERN SEDGE MEADOW	21.8
REC	RECREATION	8.3
QP	QUASI PUBLIC	37.4
IND	INDUSTRIAL	25.7
M	GRAVEL PIT	59.5
	TRANSPORTATION (HWY'S,ROADS,RR)	60.0
	FLAMBEAU RIVER	169.8
	TOTAL	3353.7

NOTES:
1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

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LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

FIGURE NO. 2-6
PROJECT AREA LAND USE
WITH PROPERTY BOUNDARIES
AND MINE SITE DELINEATED

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.
	12/89	UPDATED SITE PLAN	MJO	GWS		

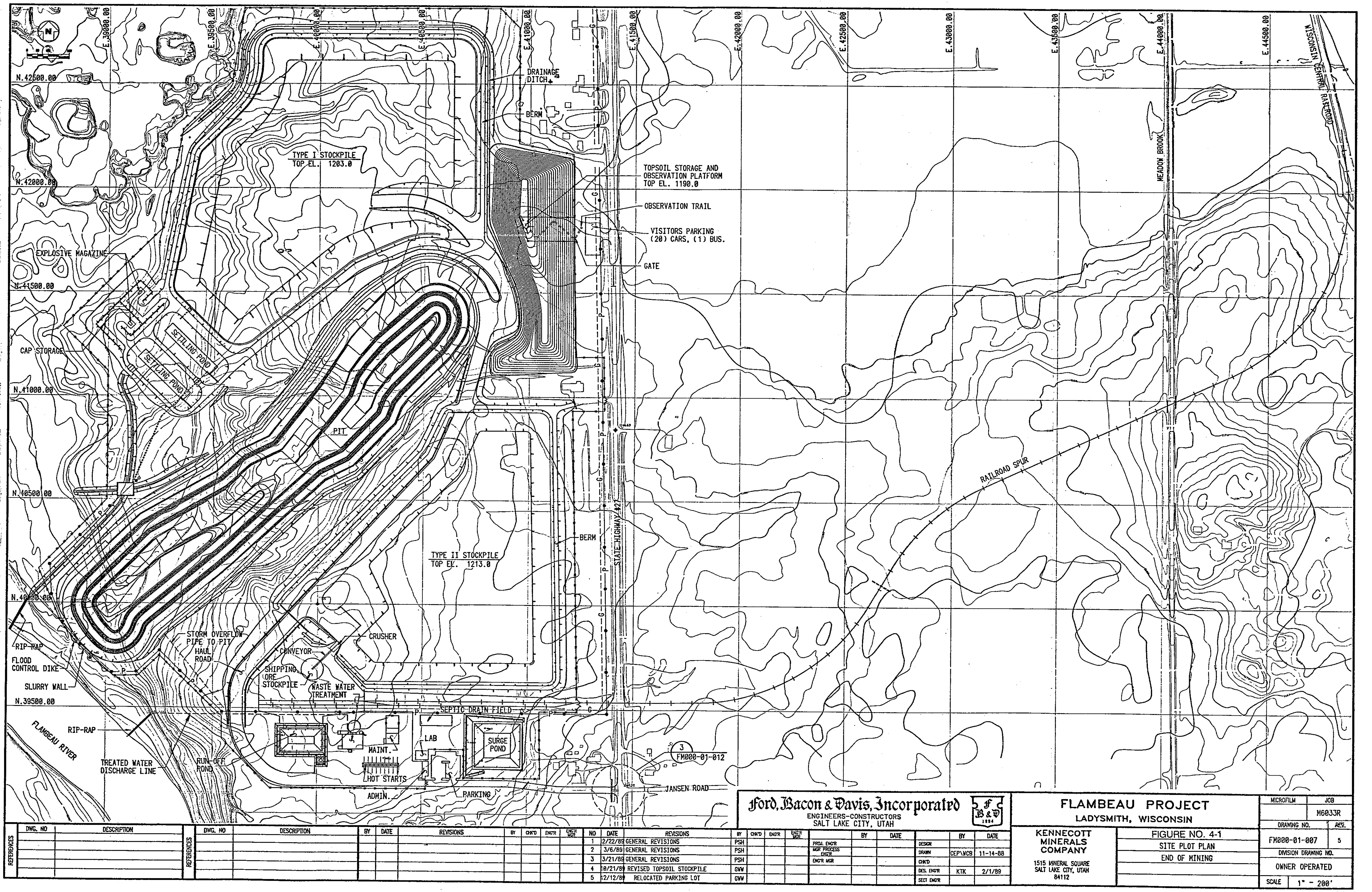
	BY	DATE
DESIGN		
DRAWN	SAG	6/89
CHK'D	GWS	6/89
DES. ENG'R		
SECT. ENG'R		

PROJ. ENG'R
MGR. PROCESS ENG'R
ENG'R MGR.

MICROFILM JOB
DRAWING NO. REV.
DIVISION DRAWING NO.
SCALE SEE BAR SCALE

REFERENCES
DWG. NO.	DESCRIPTION

REFERENCES
DWG. NO.	DESCRIPTION



WISCONSIN CENTRAL RAILROAD
MEADOW BROOK
RAILROAD SPUR
STATE HIGHWAY 27
JANSEN ROAD
FLAMBEAU RIVER
E.39000.00
E.39500.00
E.40000.00
E.40500.00
E.41000.00
E.41500.00
E.42000.00
E.42500.00
E.43000.00
E.43500.00
E.44000.00
E.44500.00
N.42500.00
N.42000.00
N.41500.00
N.41000.00
N.40500.00
N.40000.00
N.39500.00
DRAINAGE DITCH
BERM
TYPE I STOCKPILE
TOP EL. 1203.0
TOPSOIL STORAGE AND
OBSERVATION PLATFORM
TOP EL. 1190.0
OBSERVATION TRAIL
VISITORS PARKING
(20) CARS, (1) BUS.
GATE
EXPLOSIVE MAGAZINE
CAP STORAGE
SETTLING POND
SETTLING POND
PIT
TYPE II STOCKPILE
TOP EL. 1213.0
RIP-RAP
FLOOD CONTROL DIKE
SLURRY WALL
STORM OVERFLOW PIPE TO PIT
HAUL ROAD
CONVEYOR
CRUSHER
SHIPPING ORE STOCKPILE
WASTE WATER TREATMENT
SEPTIC DRAIN FIELD
LAB
SURGE POND
MAINT.
HOT STARTS
ADMIN.
PARKING
RUN-OFF POND
TREATED WATER DISCHARGE LINE
3
FM000-01-012
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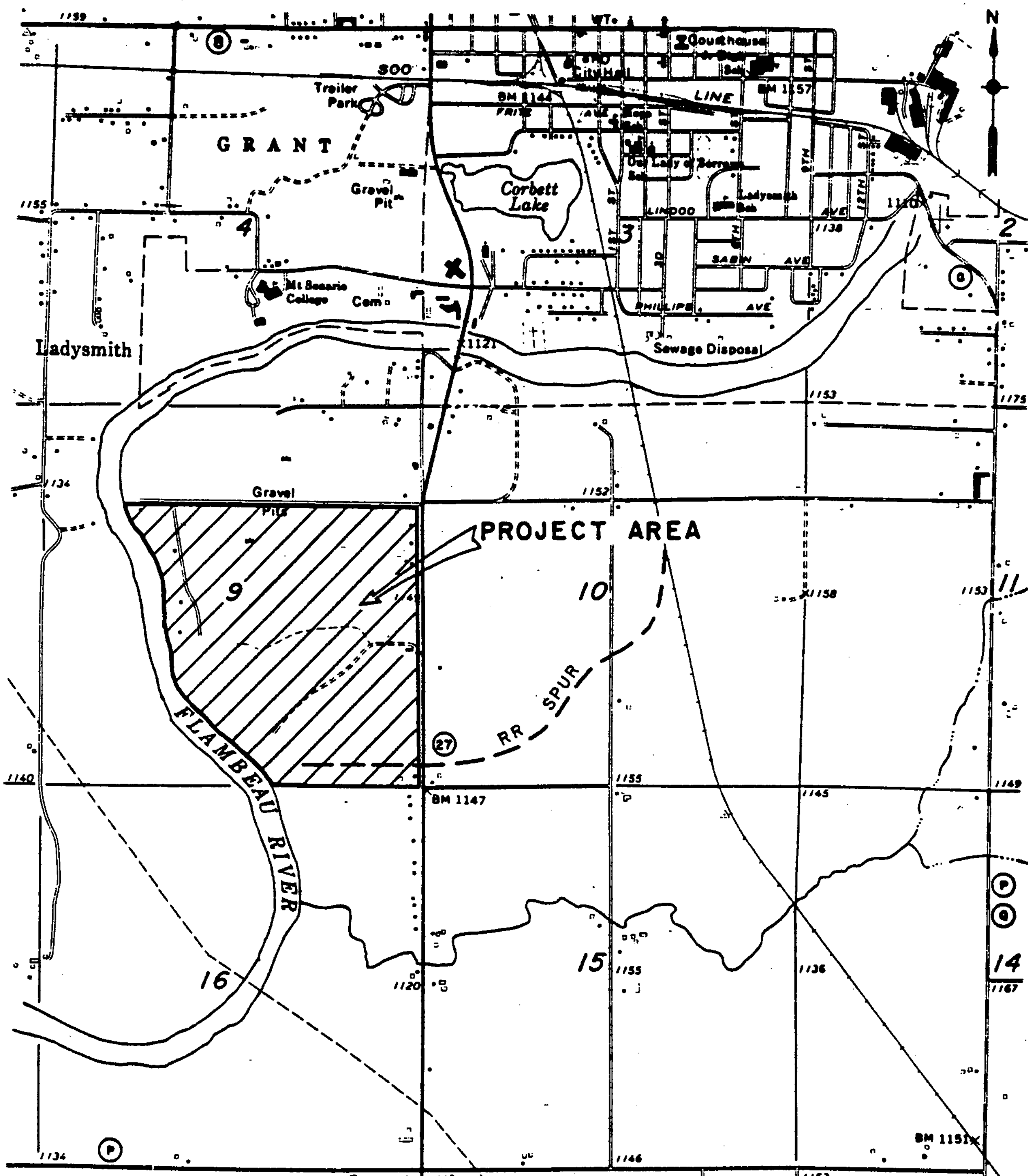
SALT LAKE CITY, UTAH
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN
KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112
FIGURE NO. 4-1
SITE PLOT PLAN
END OF MINING
MICROFILM
JOB M6033R
DRAWING NO. FM000-01-007
REV. 5
DIVISION DRAWING NO.
OWNER OPERATED
SCALE 1" - 200'
REFERENCES
DWG. NO
DESCRIPTION
REVISIONS
1 2/22/89 GENERAL REVISIONS PSH
2 3/6/89 GENERAL REVISIONS PSH
3 3/21/89 GENERAL REVISIONS PSH
4 10/21/89 REVISED TOPSOIL STOCKPILE GVW
5 12/12/89 RELOCATED PARKING LOT GVW
DRAWN CEP\WCB 11-14-88
DES. ENG'R KTK 2/1/89
MK756N



NOTES:

PROJECT AREA INCLUDES A 36 FOOT WIDE CORRIDOR ALONG RAILROAD SPURLINE EAST OF STH 27.

BASE MAP PREPARED FROM U.S.G.S MAPS 7.5 MINUTE SERIES, LADYSMITH AND THORNAPPLE WI. QUADRANGLES

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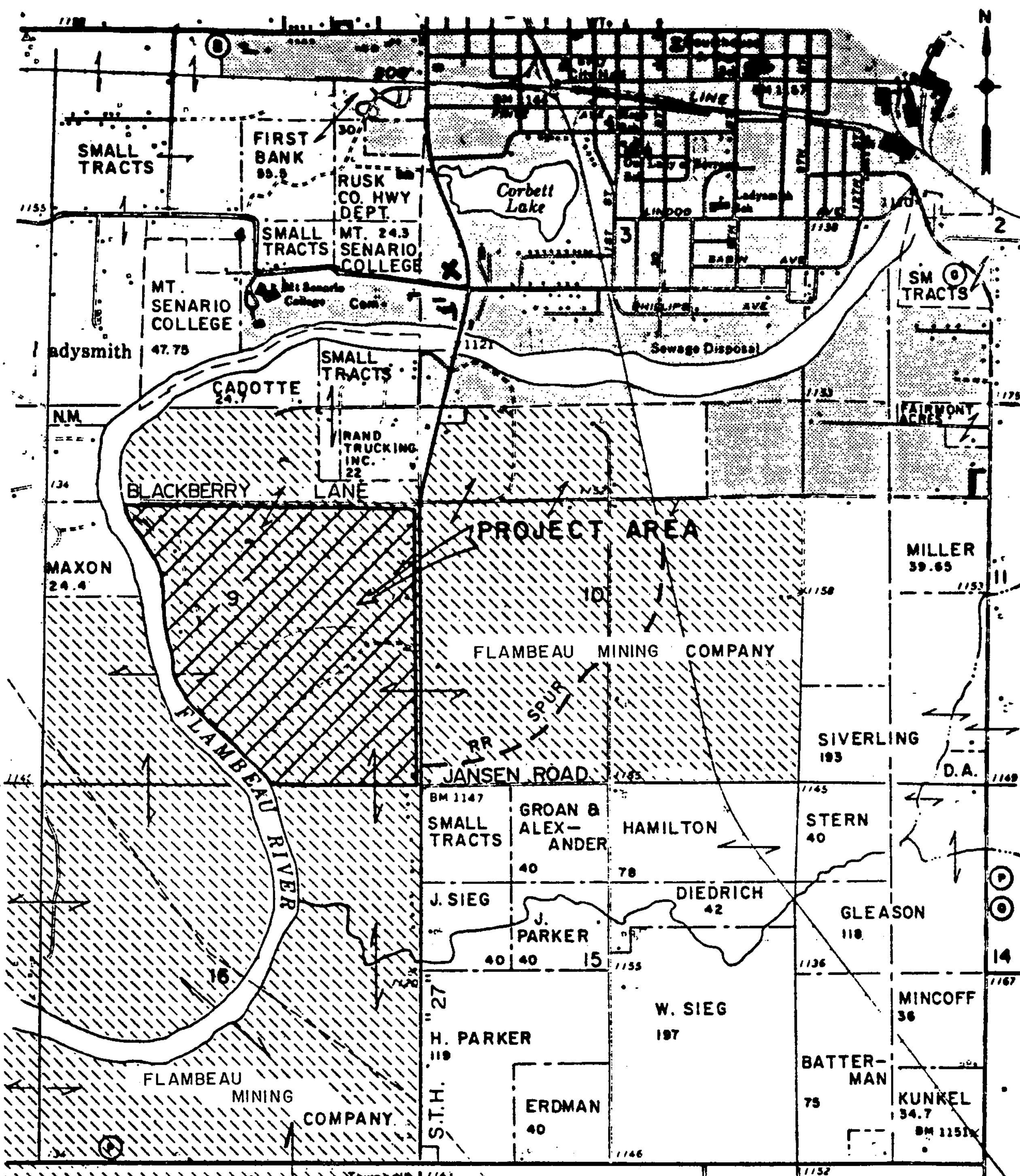
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	SJL	2/89
	CHECKED BY	GWS	3/89
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	

FIGURE NO. 4-2
PROJECT AREA LOCATION

Job No	Dwg No	REV



NOTES:

PROJECT AREA INCLUDES A 36 FOOT WIDE CORRIDOR ALONG RAILROAD SPURLINE EAST OF STH 27.

BASE MAP PREPARED FROM U.S.G.S MAPS 7.5 MINUTE SERIES, LADYSMITH AND THORNAPPLE WI. QUADRANGLES

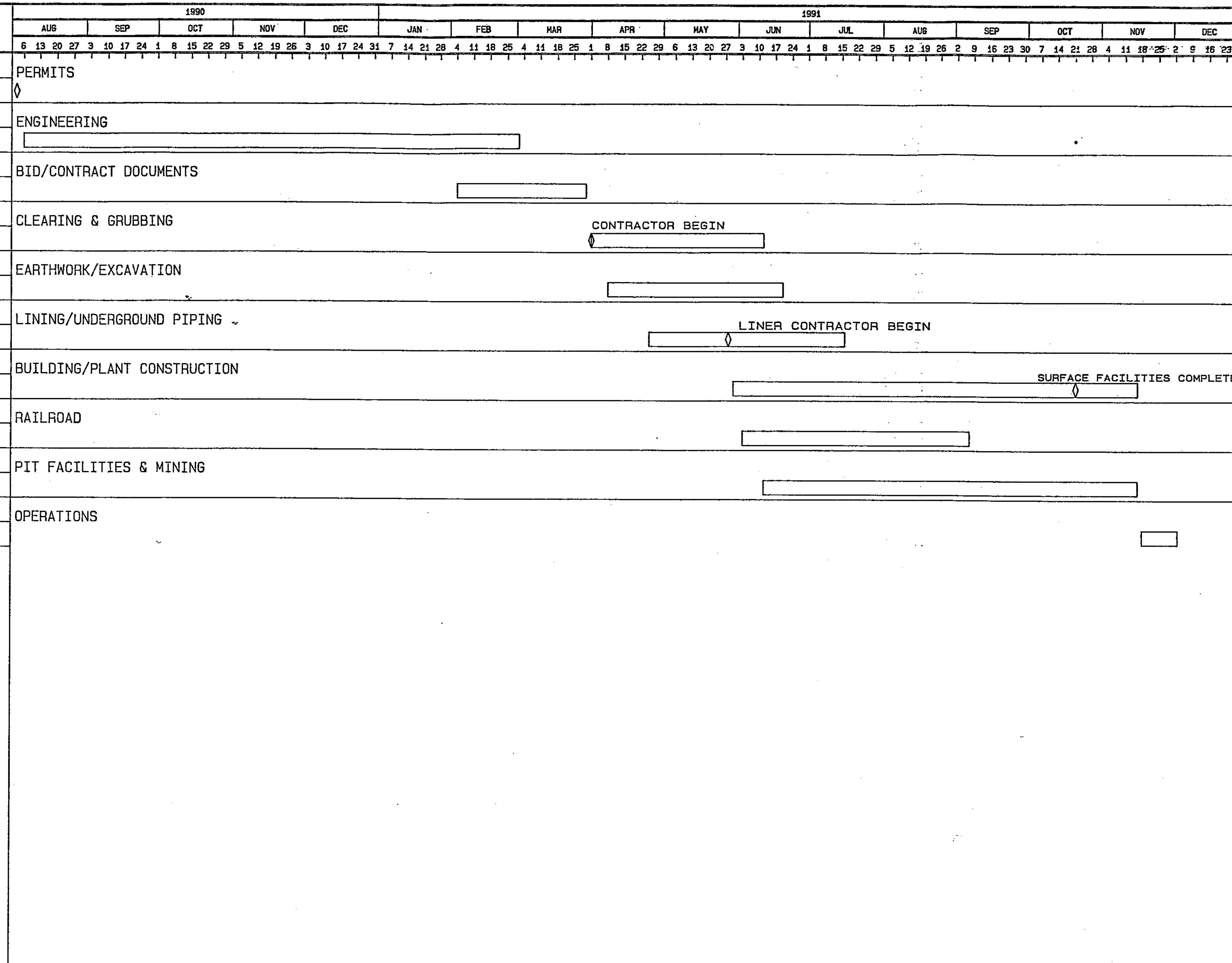
LEGEND

FLAMBEAU PROPERTIES

CITY OF LADYSMITH

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 4-3 PROPERTY OWNERSHIP
	DESIGNED BY		
	DRAWN BY SJL	2/89	
	CHECKED BY GWS	3/89	
	APPROVED BY		
	CAD No.	SCALE 1" = 2000'	Job No / Dwg No / REV

ACTIVITY	EARLY START	EARLY FINISH
PERMITS	3AUG90	2AUG90
ENGINEERING	6AUG90	1MAR91
BID/CONTRACT DOCUMENTS	4FEB91	29MAR91
CLEARING & GRUBBING	1APR91	11JUN91
EARTHWORK/EXCAVATION	8APR91	19JUN91
LINING/UNDERGROUND PIPING	25APR91	15JUL91
BUILDING/PLANT CONSTRUCTION	30MAY91	15NOV91
RAILROAD	3JUN91	6SEP91
PIT FACILITIES & MINING	12JUN91	15NOV91
OPERATIONS	18NOV91	2DEC91



Summary Bar/ Early Dates
Critical Designator
Progress Bar

Primavera Systems, Inc. 1984-1989

Project Start : 1MAR89
Project Finish: 2DEC91

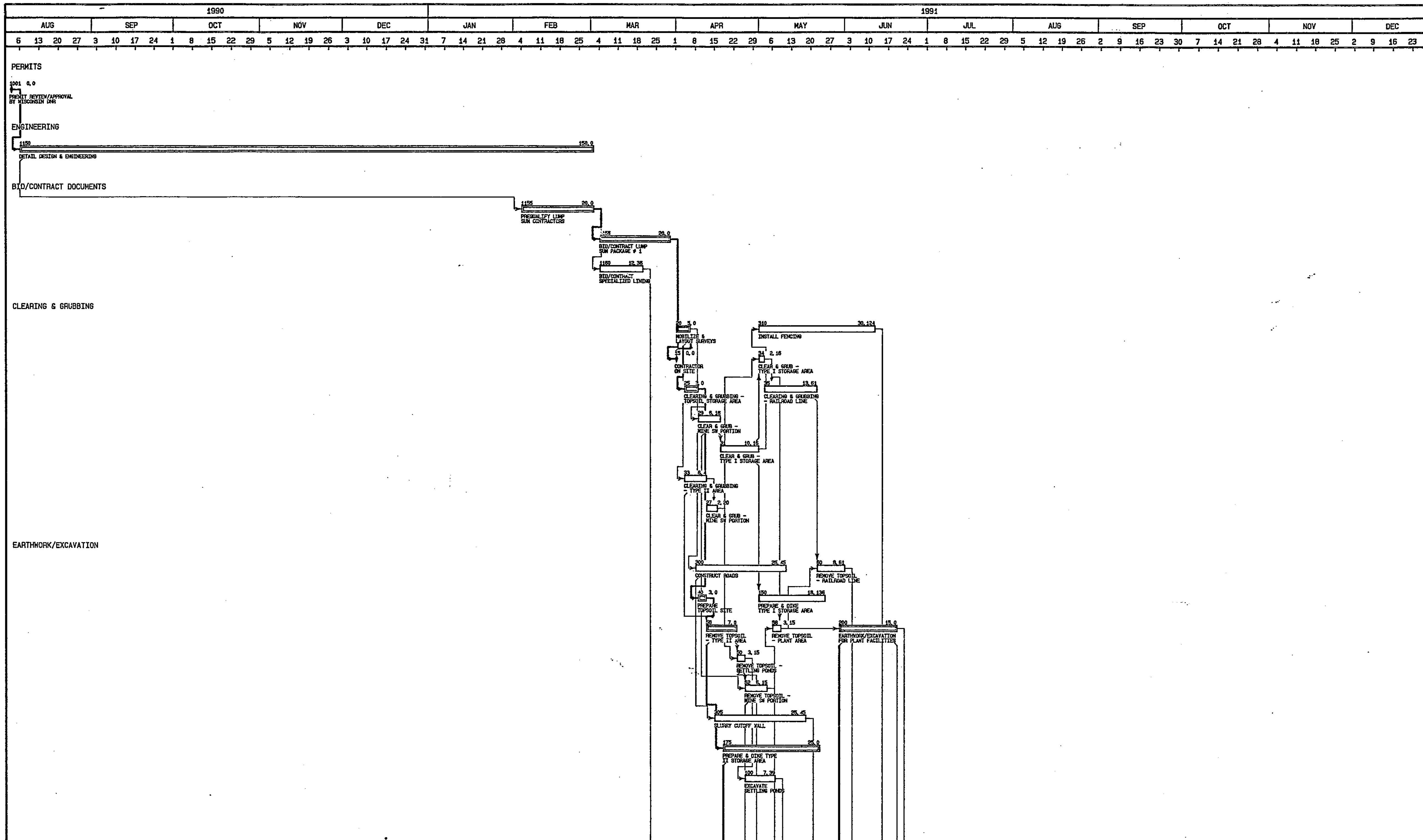
KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
CONSTRUCTION SCHEDULE

Sheet 1 of 1

Data Date: 1AUG90
Plot Date: 27DEC89

FIGURE NO. 4-4

Date	Revision	Checked	Approved



act id rd tf
description

Activity Bar/Early Dates
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1989

Project Start : 1MAR89
Project Finish: 2DEC91

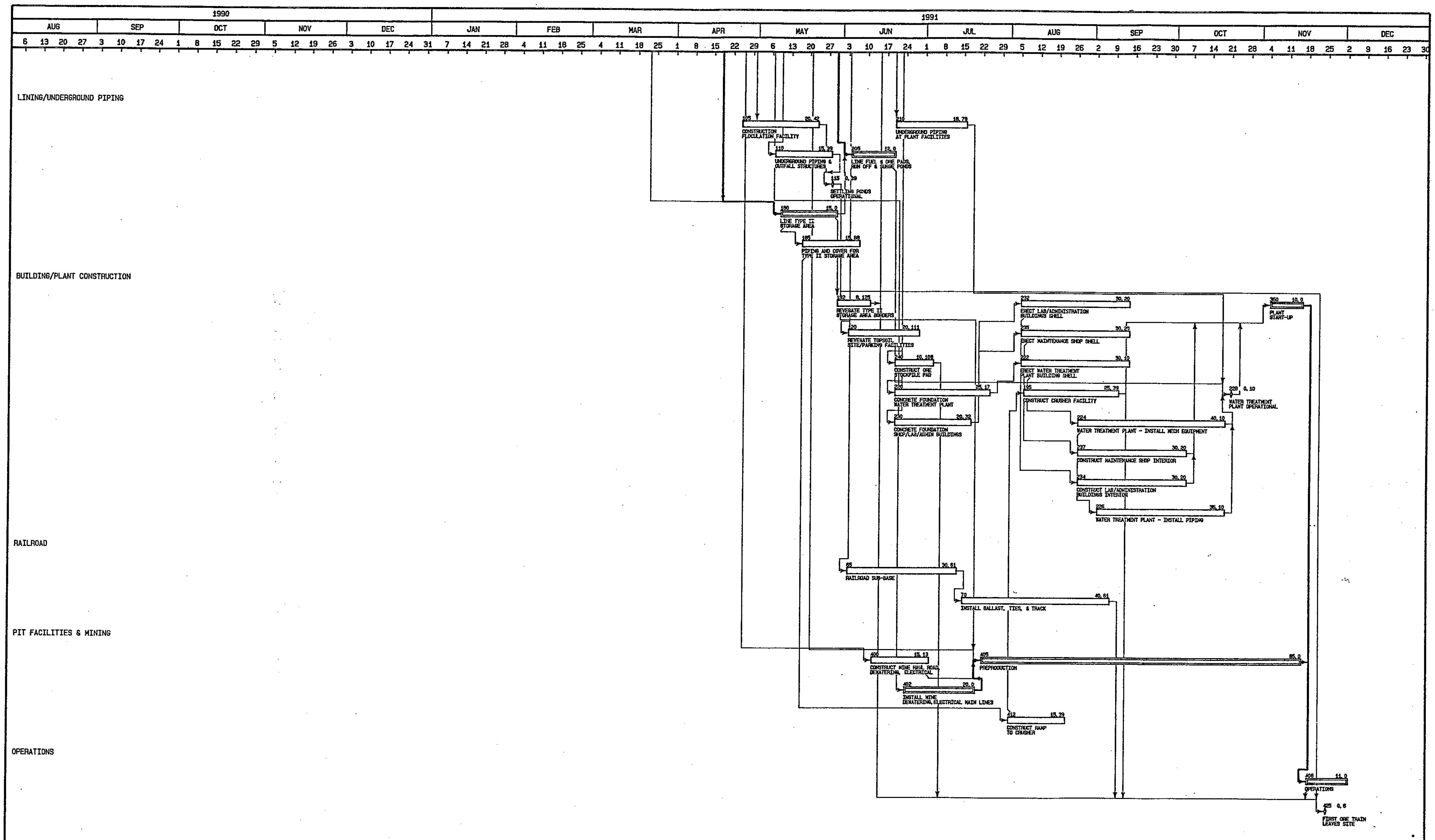
KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
ENGINEERING/CONSTRUCTION SCHEDULE

Sheet 1 of 2

Data Date: 1AUG90
Plot Date: 26DEC89

FIGURE NO. 4-5

Date	Revision	Checked	Approved



act id rd tf
description — Activity Bar/Early Dates
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1989

Project Start : 1MAR89
Project Finish: 2DEC91

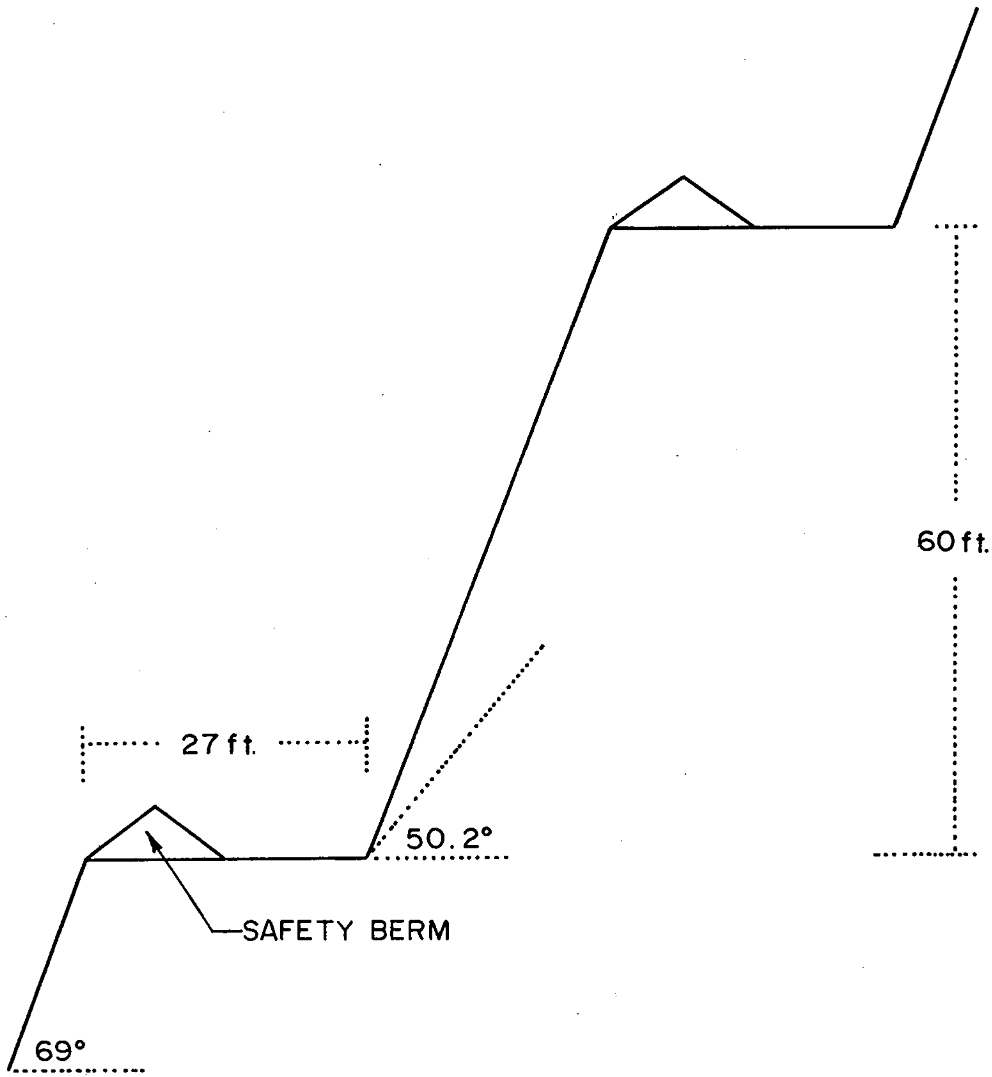
KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
ENGINEERING/CONSTRUCTION SCHEDULE

Sheet 2 of 2

Data Date: 1AUG90
Plot Date: 26DEC89

FIGURE NO. 4-5

Date	Revision	Checked	Approved



MINING HEIGHT	20 ft.
CATCH BENCH INCREMENT	3 @ 20 ft.
BENCH HEIGHT	60 ft.
CATCH BENGTH WIDTH	27 ft.
BERM HEIGHT	5 ft.
BERM WIDTH	13 ft.
FACE ANGLE	69.0°
BENCH FACE ANGLE	69.0°
INTERRAMP ANGLE	50.2°

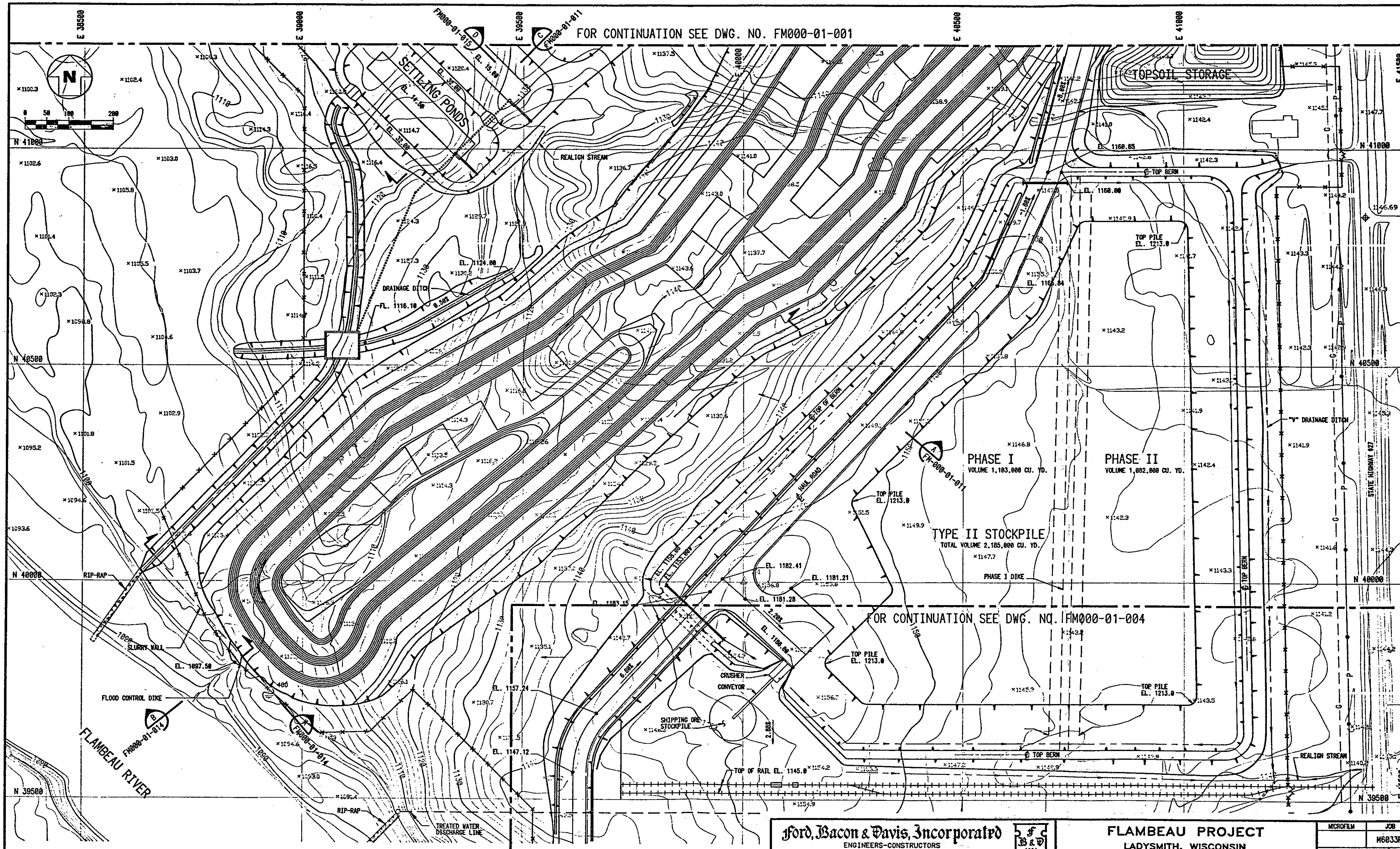
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	R.M.H.	3/89
	CHECKED BY	G.W.S.	3/89
	APPROVED BY		
	CAD No.	SCALE NTS	

FIGURE NO. 4-6
TYPICAL ROCK CATCH BENCH GEOMETRY

Job No	Dwg No	REV



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FLAMBEAU PROJECT
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SALT LAKE CITY, UTAH
84112

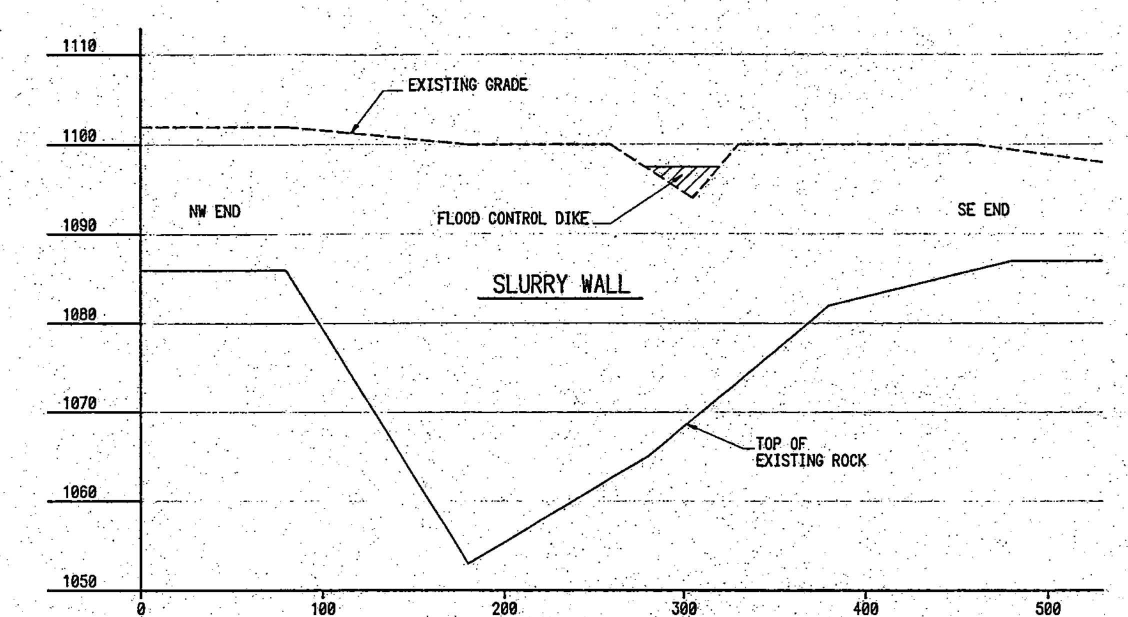
FIGURE NO. 4-7
SITE GRADING & DRAINAGE PLAN - SOUTH

NO	DATE	REVISIONS	BY
1	2/23/89	GENERAL REVISIONS	PSH
2	3/7/89	GENERAL REVISIONS	PSH
3	3/28/89	GENERAL REVISIONS	PSH

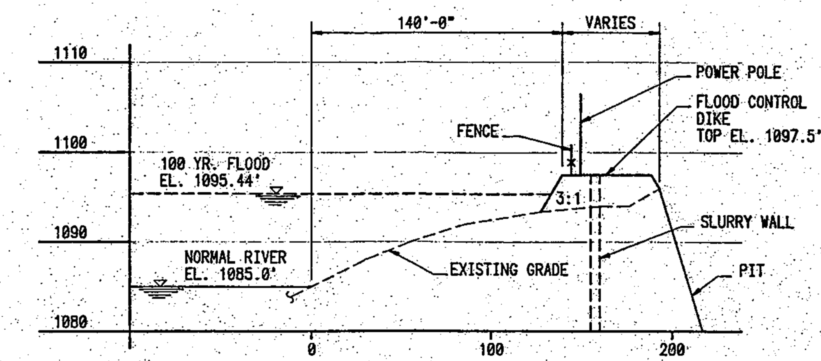
	BY	DATE
DRAWN	CEP\WCB	10/21/88
DES. ENG'R	KTK	2/1/89

JOB: M6033R
DRAWING NO.: FM000-01-002
REV.: 3
OWNER OPERATED
SCALE: 1"=100'

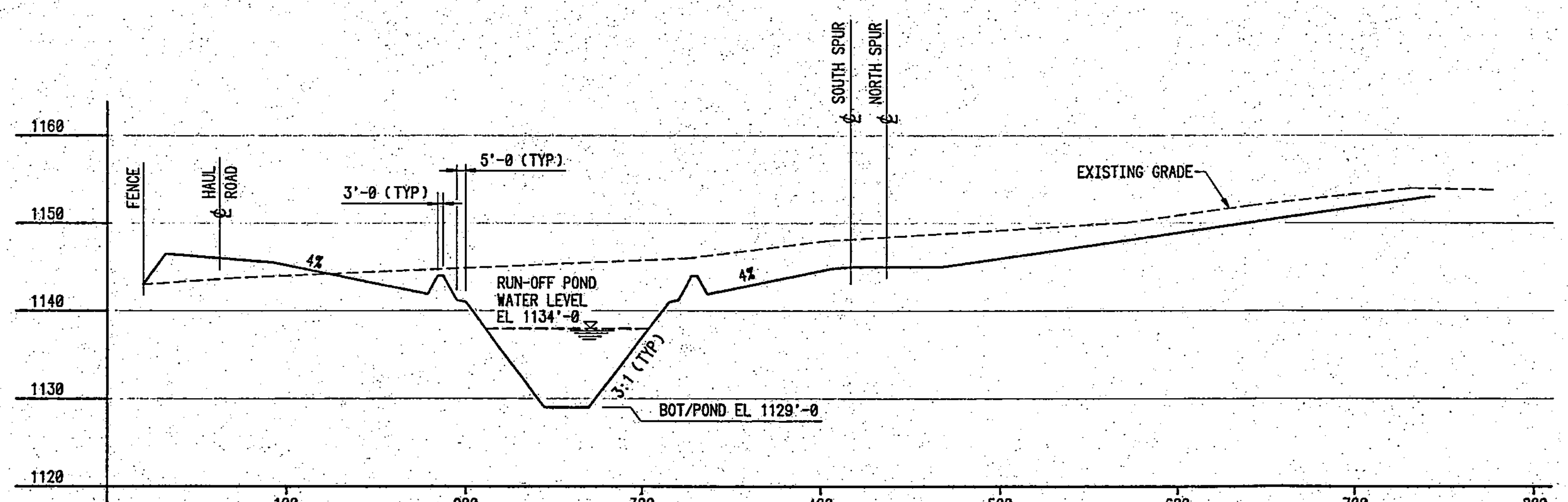
MK758L



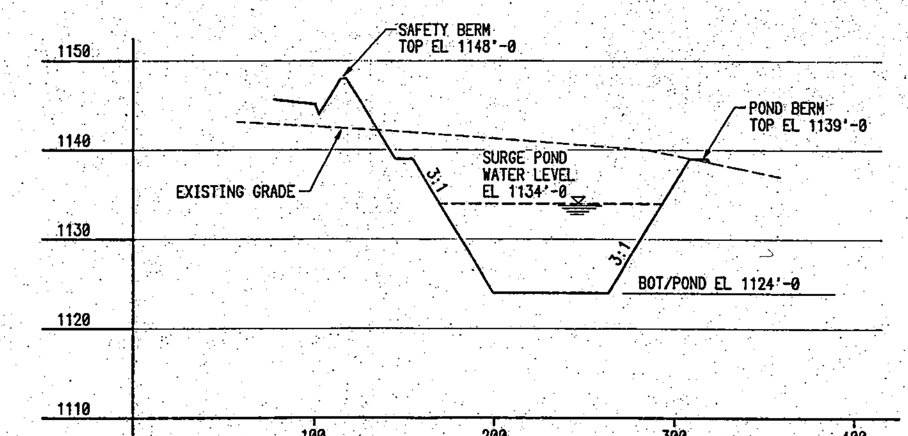
SECTION A FM000-01-002
H 1"=50'
V 1"=10'



SECTION B FM000-01-002
H 1"=50'
V 1"=10'



SECTION C FM000-01-004
H 1"= 50'
V 1"=10'



SECTION D FM000-01-004
H 1"=50'
V 1"=10'

REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

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SALT LAKE CITY, UTAH

	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR PROCESS ENG'R			DRAWN	GB	12-14-88
ENG'R MGR			CHK'D		
			DES. ENG'R		
			SECT ENG'R		

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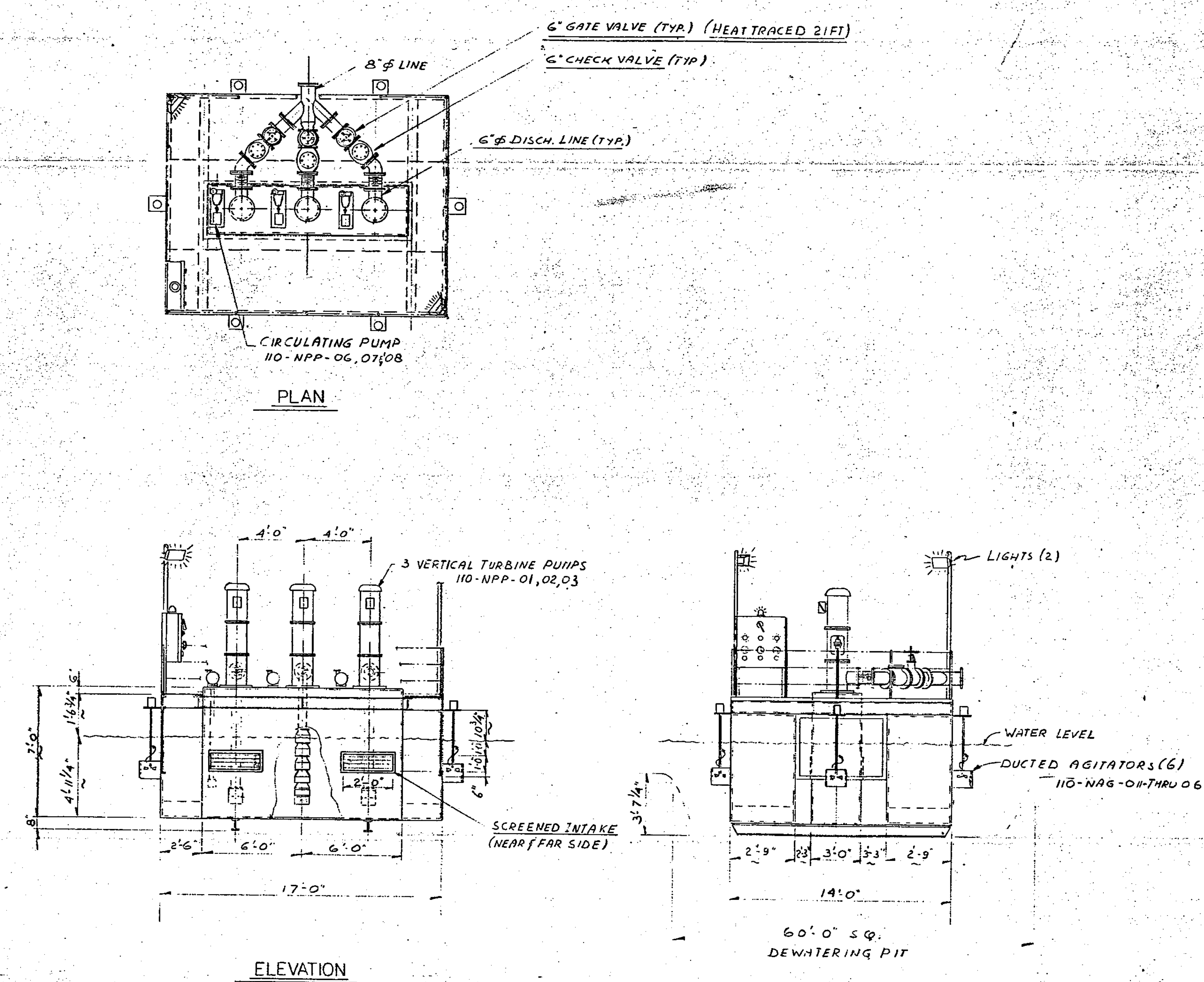
FIGURE NO. 4-8
SITE GRADING
MISC. SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-014	B
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NOTED

SL242B



0 1' 5' 10'

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ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

	BY	DATE
DESIGN	RJD	10/5/80
DRAWN	RJD	12/26/88
CHK'D		2-1-89
DES ENG'R		2-1-89
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		2-1-89
MGR PROCESS ENG'R		
ENG'R MGR		

REFERENCES DWG. NO	DESCRIPTION	REFERENCES DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS
	-												

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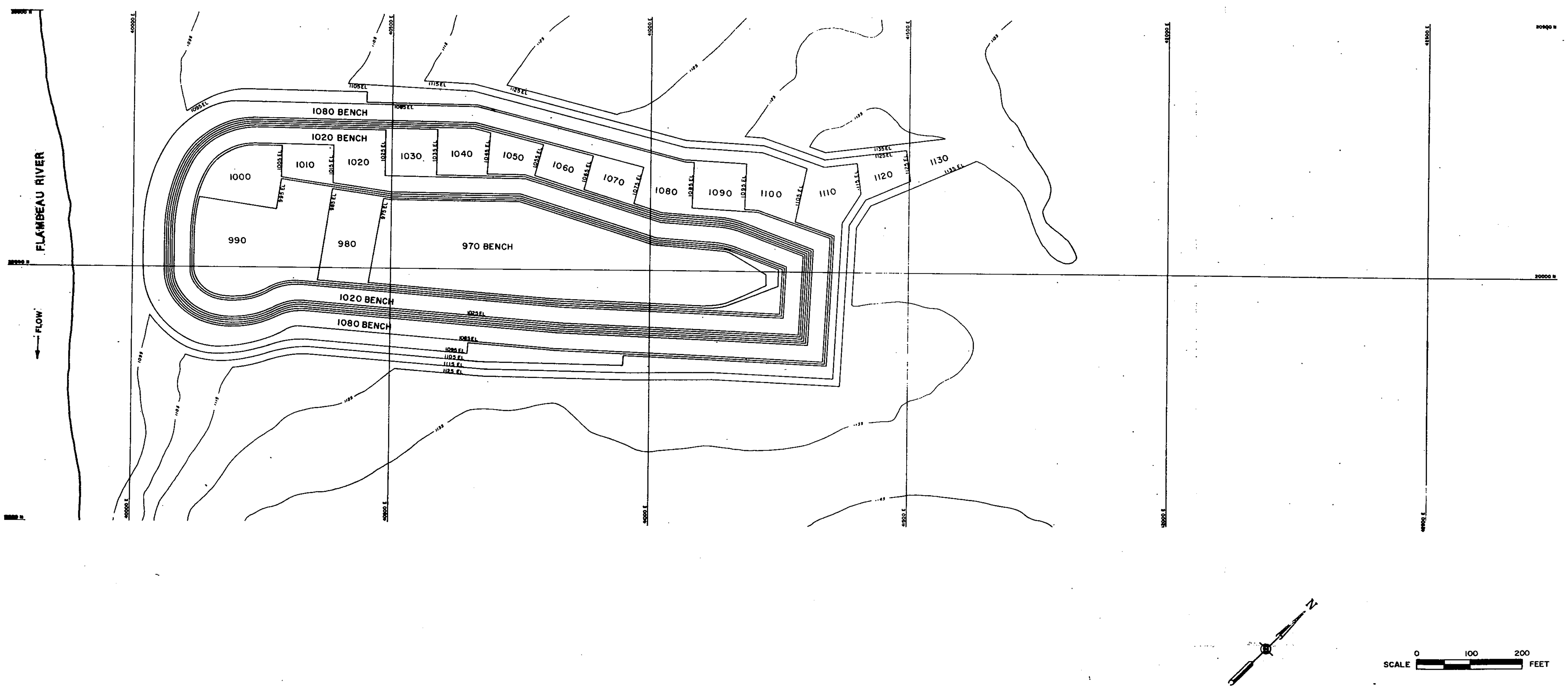
FIGURE NO. 4-9
MECHANICAL DETAILS
PUMP BARGE

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-026	0
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1/4" = 1'-0"



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
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84112

FIGURE NO. 4-10
PHASE I PIT DESIGN

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

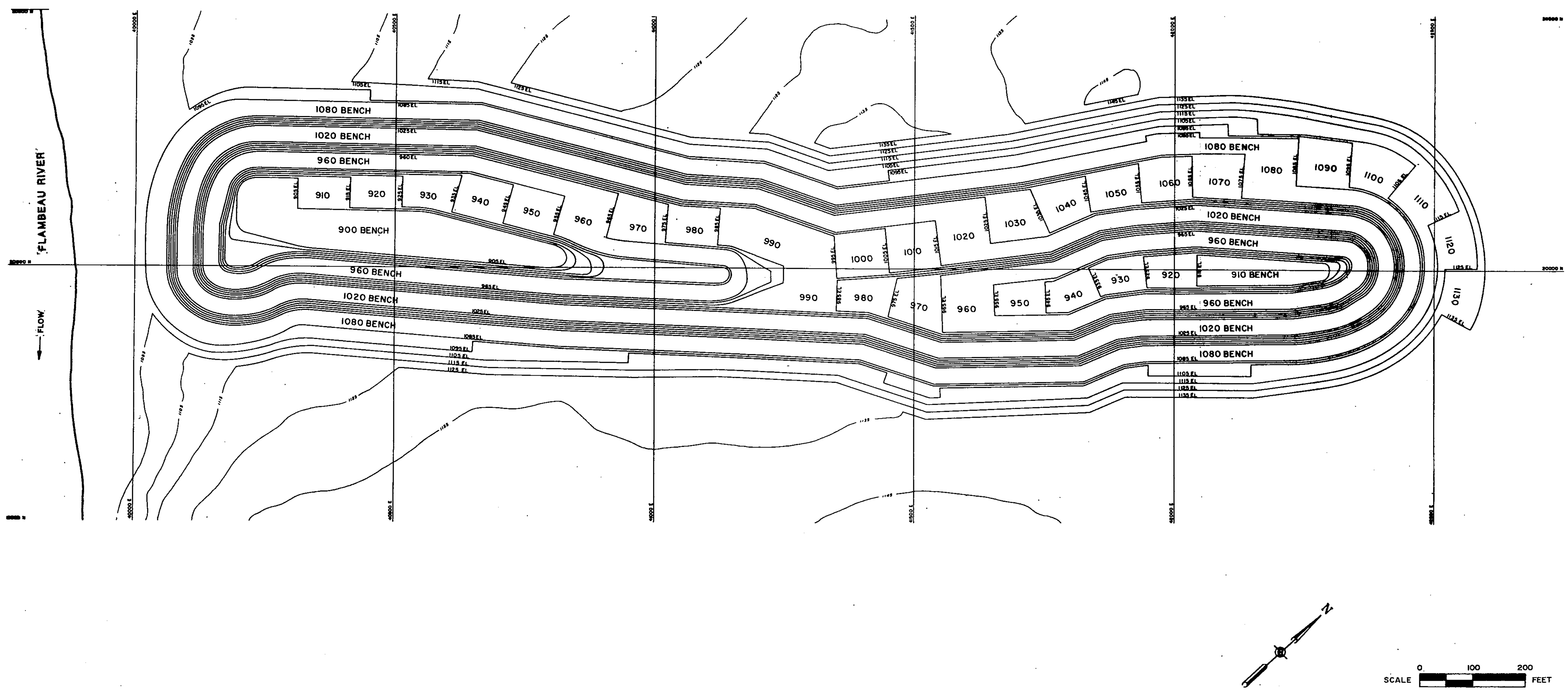
DWG. NO.	DESCRIPTION

MICROFILM | JOB

DRAWING NO. | REV.

DIVISION DRAWING NO.

SCALE



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LAKEWOOD, COLORADO

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84112

FIGURE NO. 4-11
FINAL PIT DESIGN

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

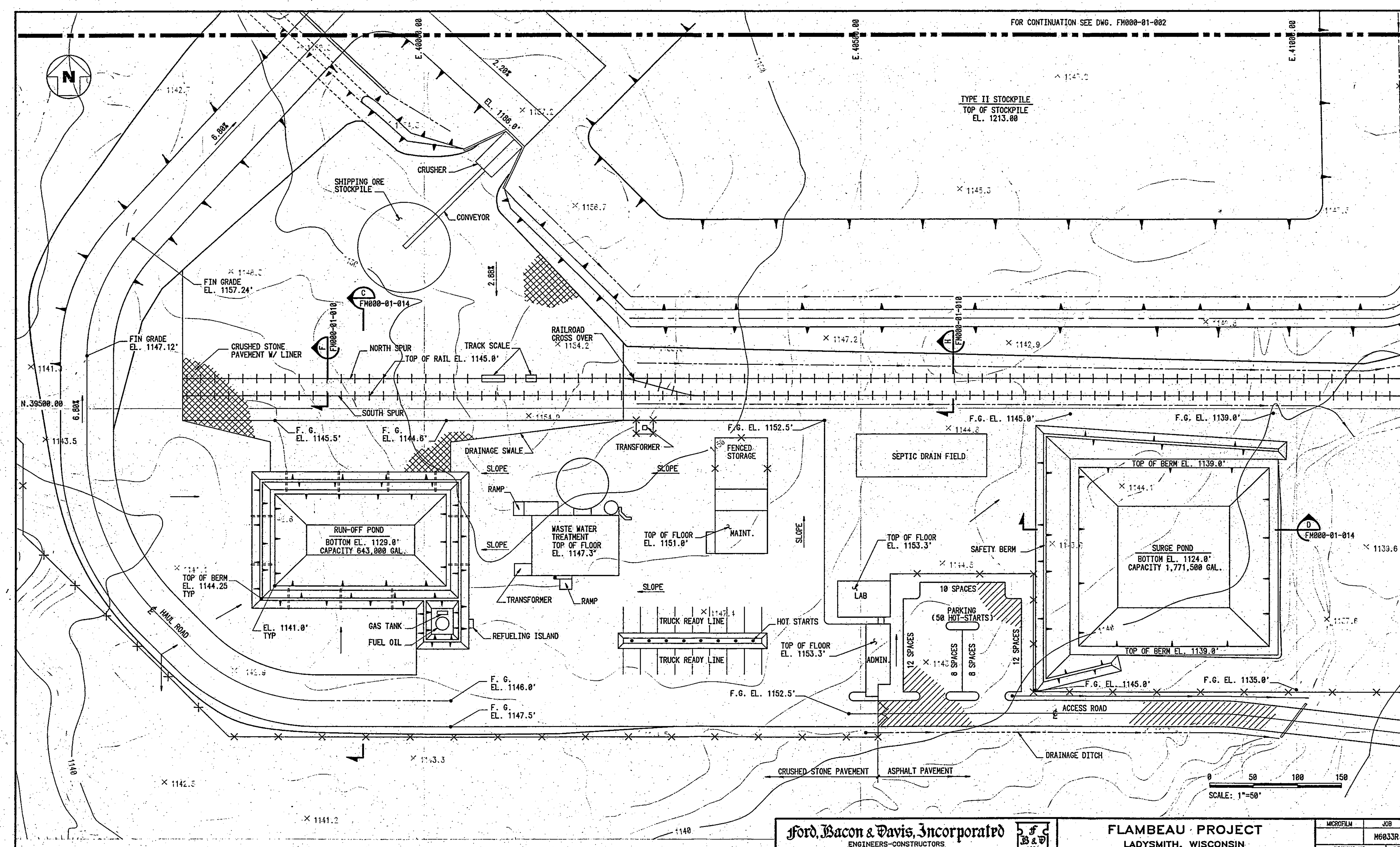
NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION



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SALT LAKE CITY, UTAH
84112

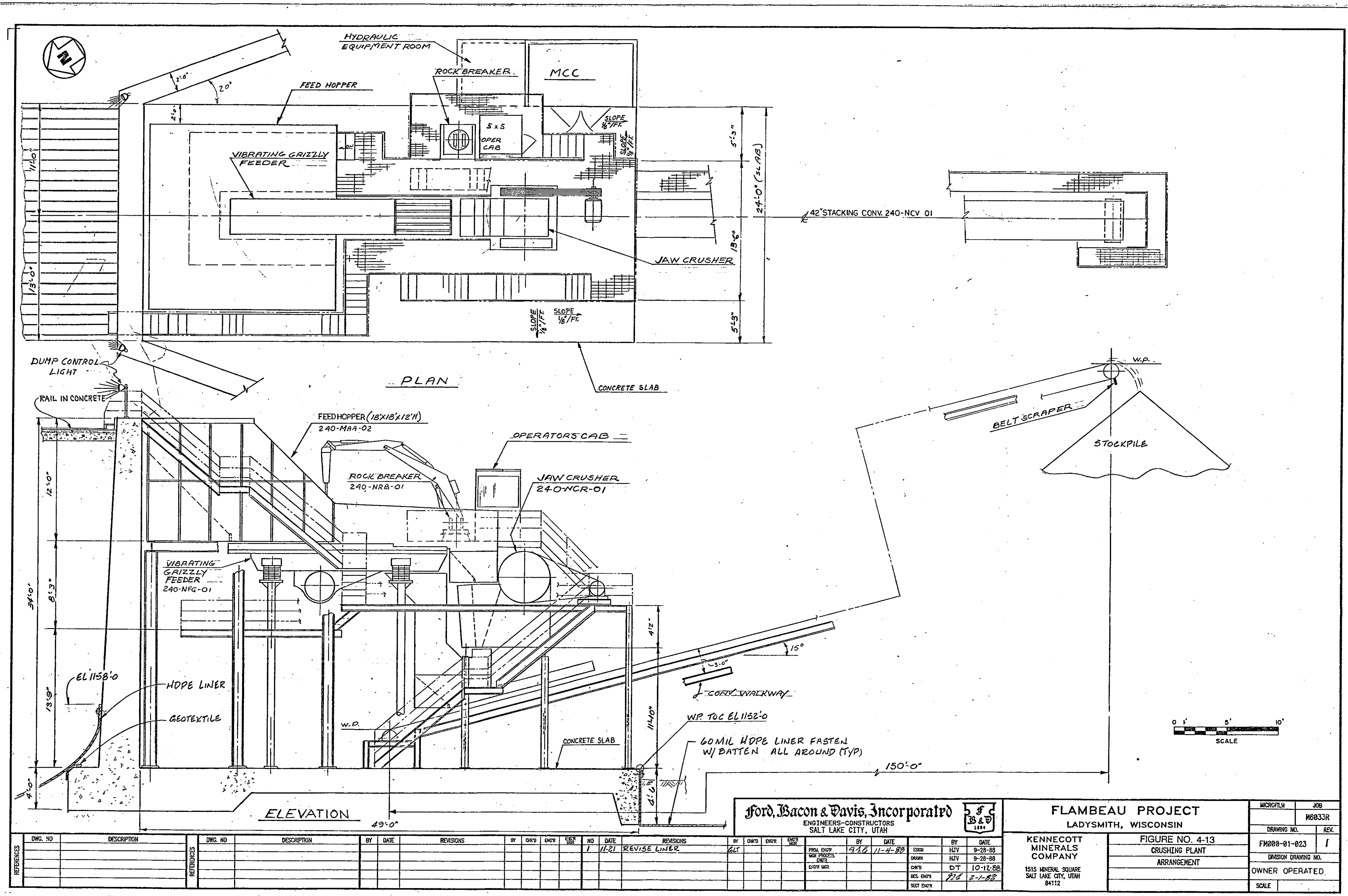
FIGURE NO. 4-12
GRADING & DRAINAGE
PLAN

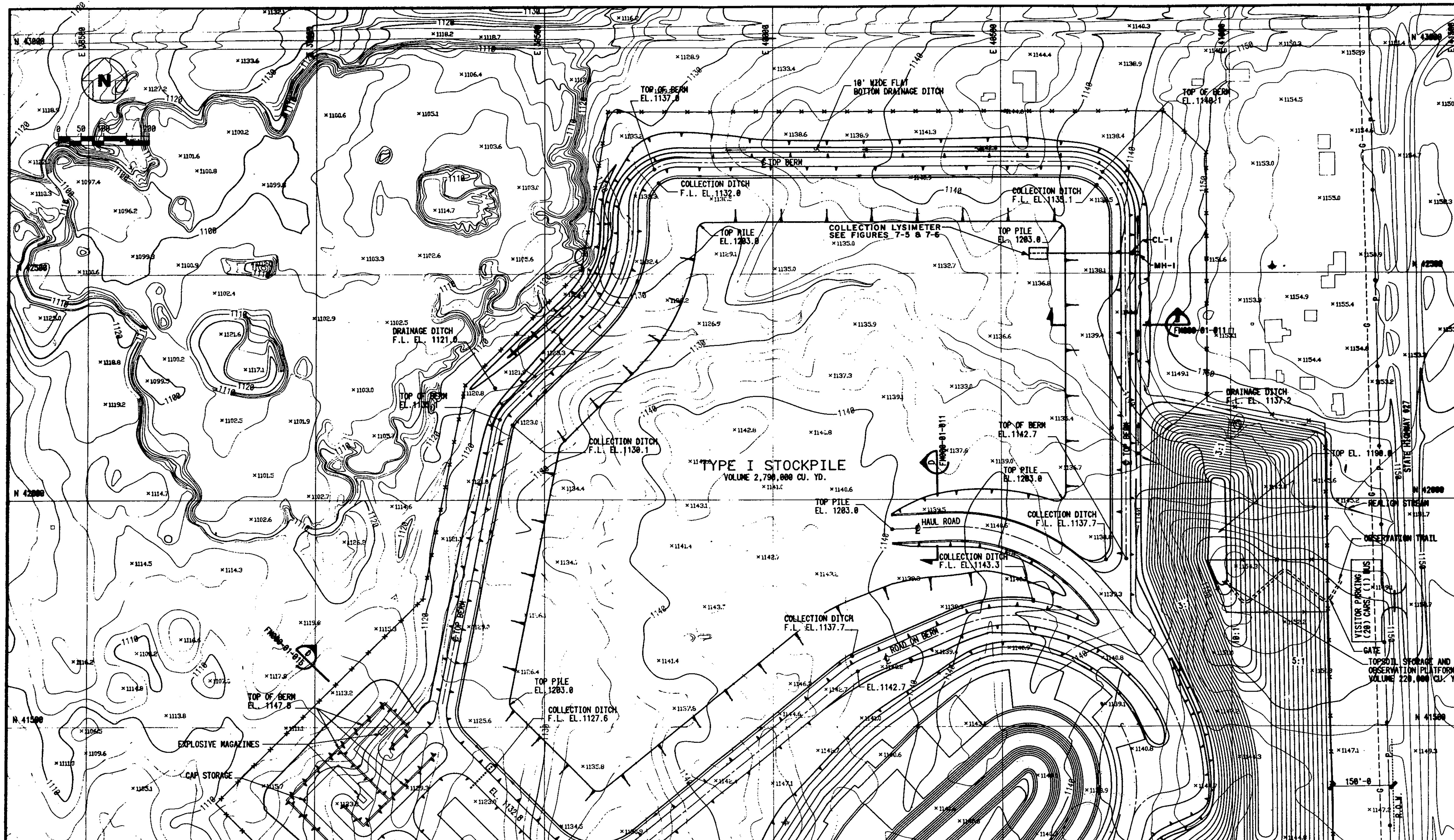
MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-004	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1"=50'

NO	DATE	REVISIONS	BY
1	2/23/89	GENERAL REVISIONS	PSH

	BY	DATE
DESIGN	CEP	10/25/88
DRAWN	WCB/CEP	10/25/88
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

MK7584


HYDRAULIC EQUIPMENT ROOM
ROCK BREAKER
MCC
FEED HOPPER
5 x 5 OPER CAB
SLOPE 1/8"/FT.
VIBRATING GRIZZLY FEEDER
JAW CRUSHER
5'-3"
24'-0" (SLAB)
13'-6"
42" STACKING CONV. 240-NCV 01
11'-0"
13'-0"
2'-0"
20°
CONCRETE SLAB
PLAN
DUMP CONTROL LIGHT
RAIL IN CONCRETE
FEED HOPPER (18'x18'x12'H) 240-MAA-02
OPERATORS CAB
ROCK BREAKER 240-NRB-01
JAW CRUSHER 240-NCR-01
VIBRATING GRIZZLY FEEDER 240-NFG-01
W.P.
BELT SCRAPER
STOCKPILE
12'-0"
8'-3"
13'-9"
34'-0"
4'-0"
EL 1158'-0
HDPE LINER
GEOTEXTILE
4'-2"
11'-10"
15°
3'-0"
CONV. WALKWAY
WP. TOC EL 1152'-0
60 MIL HDPE LINER FASTEN W/ BATTEN ALL AROUND (TYP)
CONCRETE SLAB
150'-0"
ELEVATION
49'-0"
0 1' 5' 10'
SCALE
Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN
KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112
FIGURE NO. 4-13
CRUSHING PLANT
ARRANGEMENT
MICROFILM
JOB M6033R
DRAWING NO. FM000-01-023
REV. 1
DIVISION DRAWING NO.
OWNER OPERATED
SCALE
REFERENCES
DWG. NO
DESCRIPTION
BY
DATE
REVISIONS
CHK'D
ENG'R
NO 1 11-21 REVISE LINER GLT
DESIGN HJV 9-28-88
DRAWN HJV 9-28-88
CHK'D DT 10-12-88
PROJ. ENG'R 11-4-88
DES. ENG'R 2-1-88



FOR CONT. SEE DWG NO. FM000-01-002

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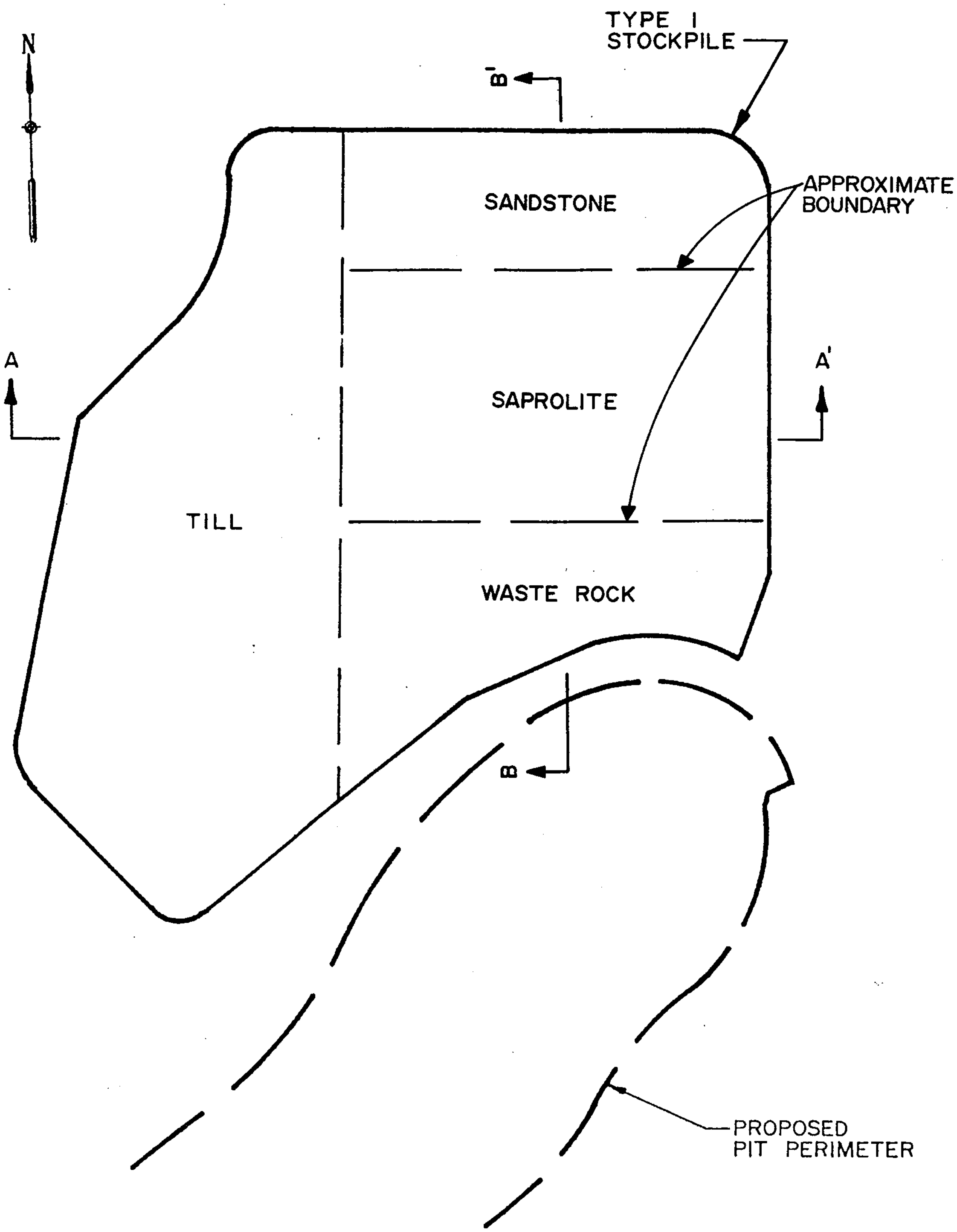
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-14
SITE GRADING & DRAINAGE PLAN - NORTH

NO	DATE	REVISIONS	BY
1	2/23/89	GENERAL REVISIONS	PSH
2	3/1/89	GENERAL REVISIONS	PSH
3	8/26/89	REVISED TOPSOIL STOCKPILE	GWW
4	12/14/89	RELOCATED PARKING LOT	GWW

	BY	DATE
DES'CN	CEP	10/21/88
DRAWN	CEP\WCB	10/21/88
CHK'D		
DES. ENG'R	KTK	2/1/88
DES'T ENG'R		

MICROFILM	
JOB	M6833R
DRAWING NO.	FM000-01-001
REV.	4
DIVISION DRAWING NO.	OWNER OPERATED
SCALE	1"=100'



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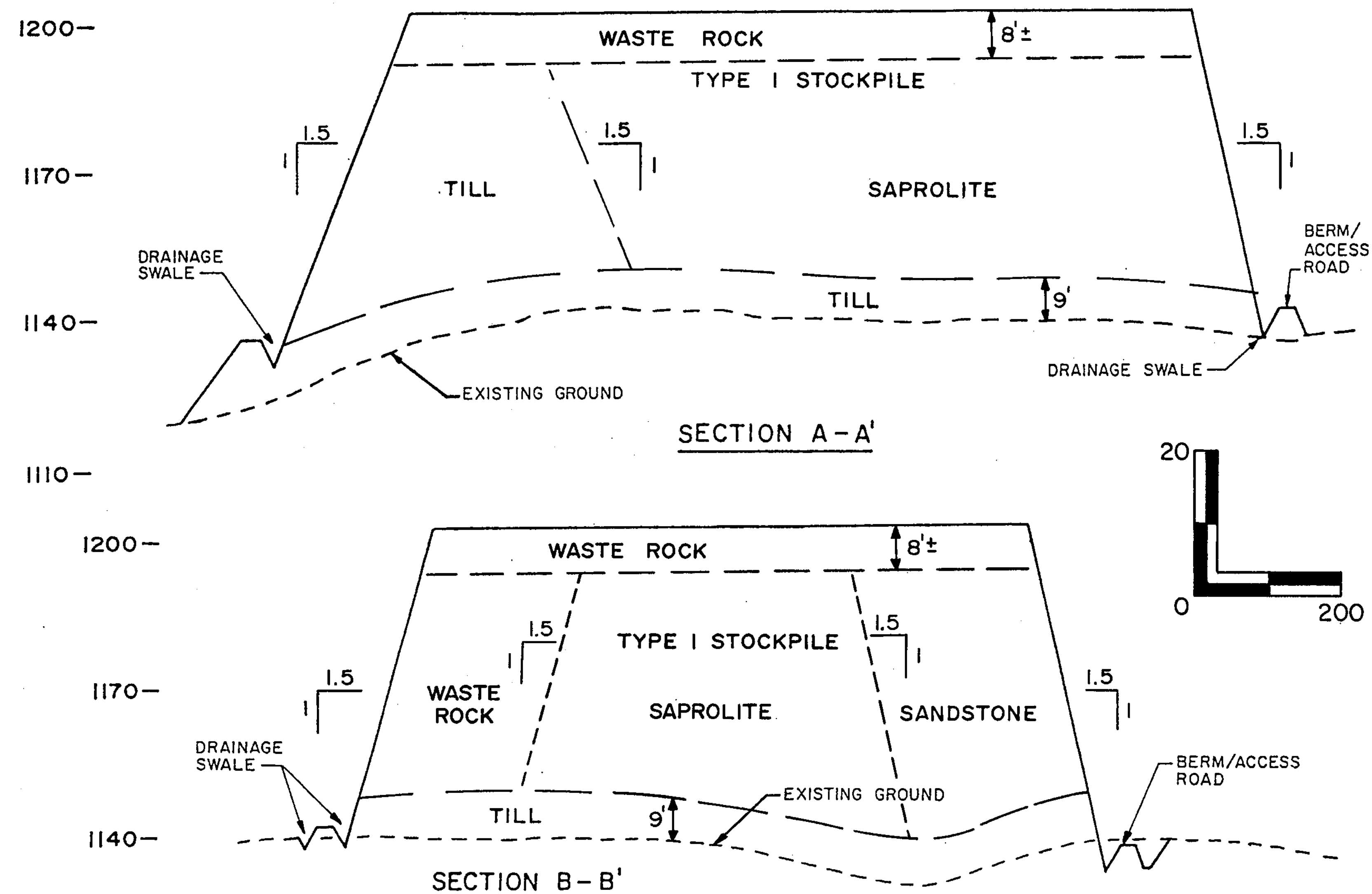
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	DHS	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 300'	

FIGURE NO. 4-14A
TYPE I STOCKPILE
MATERIAL DISTRIBUTION

Job No	Dwg No	REV



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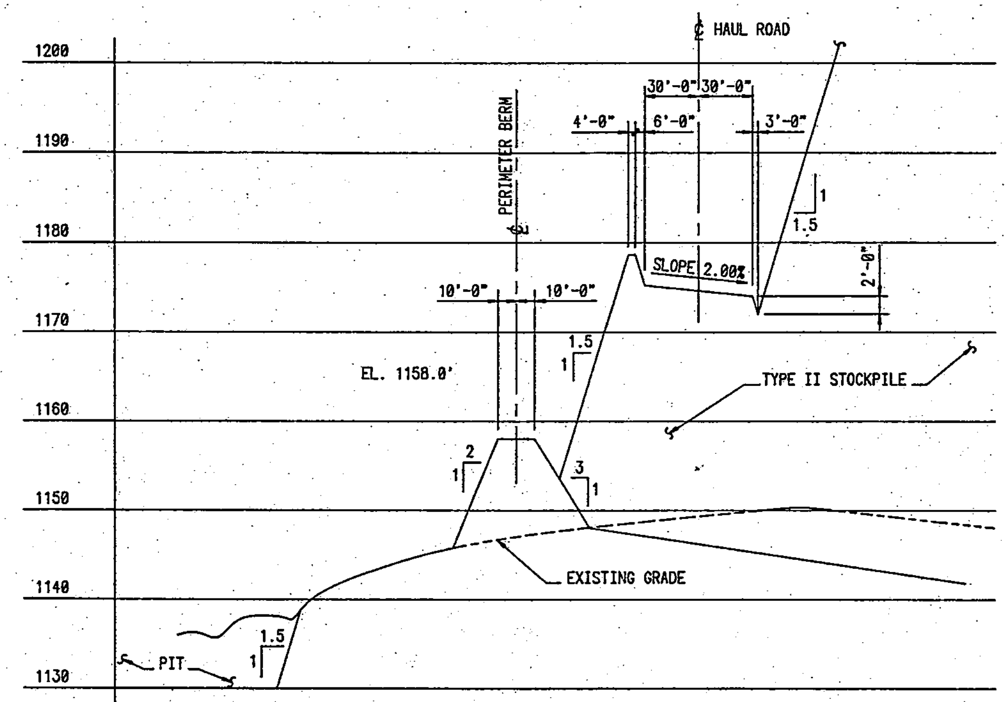
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

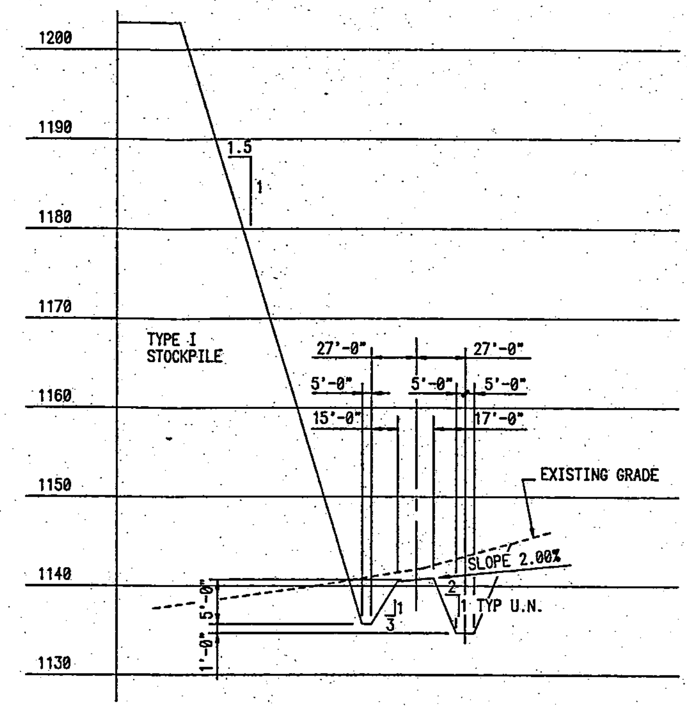
No	REVISIONS	NOTES	APPROVAL		DATE
△			DESIGNED BY		
△			DRAWN BY	DHS	12/89
△			CHECKED BY	GWS	12/89
△			APPROVED BY		
△			CAD No.	SCALE AS SHOWN	

FIGURE NO. 4—14B
TYPE I STOCKPILE
SECTIONS

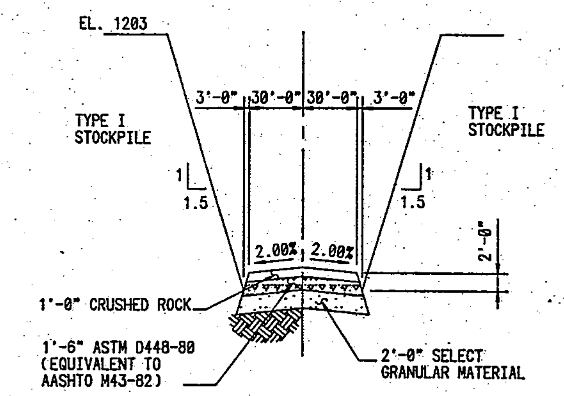
Job No	Dwg No	REV



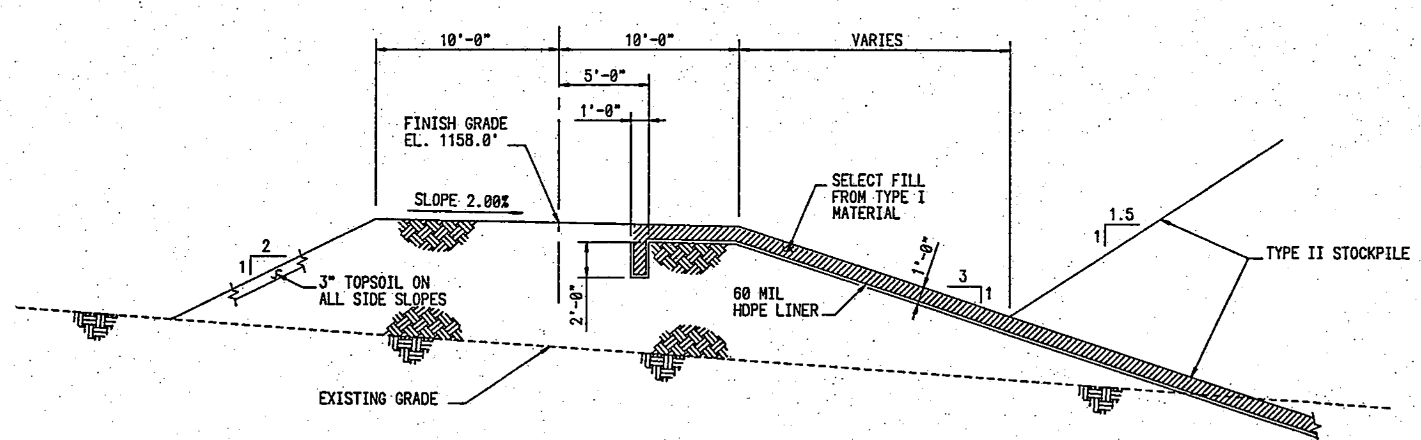
SECTION (A / FM000-01-002)
H. 1"=50'
V. 1"=10'



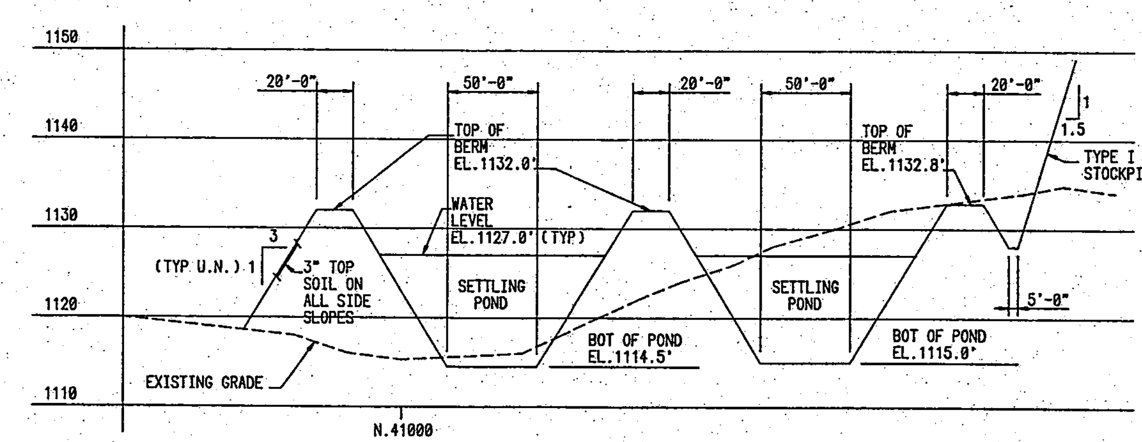
SECTION (B / FM000-01-001)
H. 1"=50'
V. 1"=10'



SECTION (D / FM000-01-001)
H. 1"=50'
V. 1"=10'



TYPICAL PERIMETER BERM TYPE II SECTION
SCALE: 1"=5'-0"



SECTION (C / FM000-01-002)
H. 1"=50'
V. 1"=10'

REFERENCES DWG. NO	DESCRIPTION	REFERENCES DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

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	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR PROCESS ENG'R			DRAWN	GB	11-9-88
ENG'R MGR			CHK'D		
			DES. ENG'R		
			SECT ENG'R		

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FIGURE NO. 4-15
SITE GRADING
STOCKPILE SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-011	8
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NOTED

SK932G

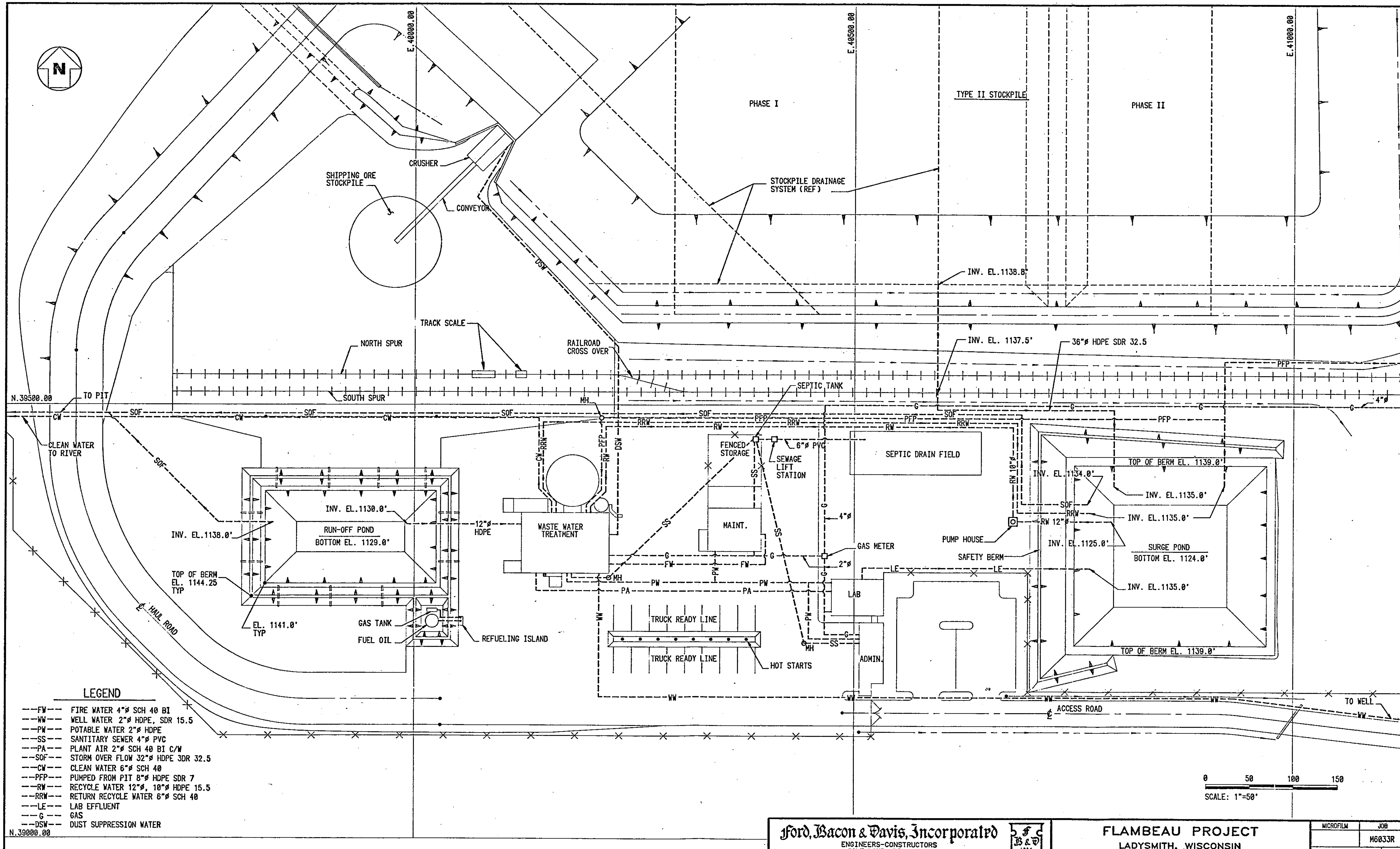

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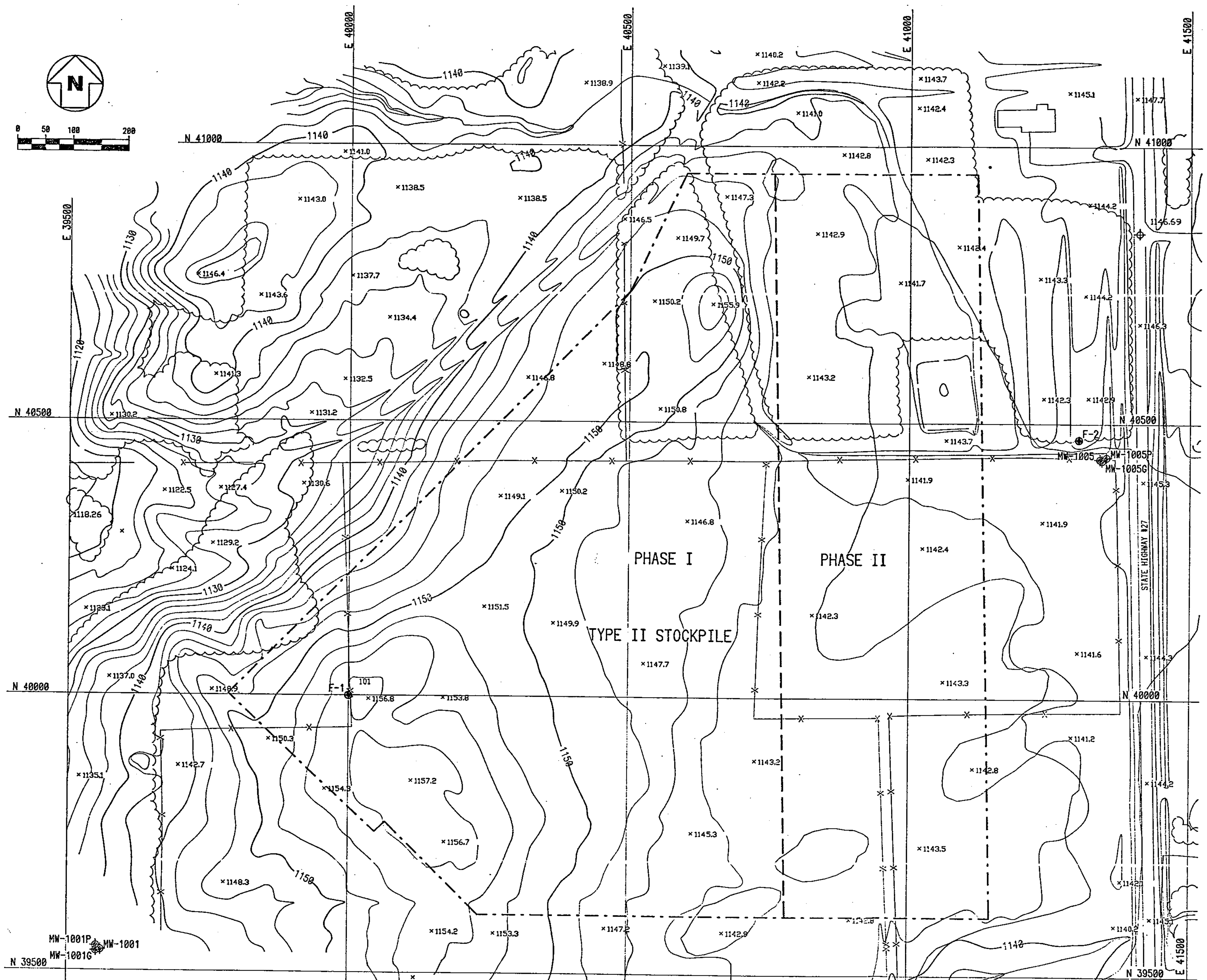
FIGURE NO. 4-16
UNDERGROUND PIPING
PLAN

NO	DATE	REVISIONS	BY
1	2/23/89	GENERAL REVISION	PSH
2	3/21/89	GENERAL REVISION	PSH
3	11/30/89	REVISED DRAIN LINE ROUTE	GWW

	BY	DATE
DESIGN		
DRAWN	GB	12-15-88
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-005	3
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1"=50'

SL246H



SITE PREPARATION

PHASE	AREA (ACRES)	EXCAVATION CUT	(C.Y.) FILL	H.D.P.E. LINER (SQ. FT.)	GRANULAR BLANKET (C.Y.)
I	17.8	130,000	63,000	780,000	37,700 CU. YD.
II	12.2	24,000	78,000	535,000	25,700 CU. YD.
TOTAL	30.0	154,000	141,000	1,315,000	63,400 CU. YD.

SITE OPERATION

PHASE	ESTIMATED PHASE LIFE (YEARS)	NET AIR SPACE (C.Y.)
I	2.8	1,103,000
II	2.9	1,082,000
TOTAL	5.7	2,185,000

LEGEND:

- —1000— EXISTING GROUND CONTOUR
- x 1000 EXISTING SPOT ELEVATIONS
- TREES AND/OR BRUSH
- —X—X— EXISTING FENCE
- EXISTING BUILDINGS
- MW-1000 GROUNDWATER MONITORING WELL LOCATION AND NUMBER
- F-1 CONTROL MONUMENTS
- — · — · — PROPOSED LIMITS OF WASTE PLACEMENT
- — — — PHASE LIMITS

NO	DATE	REVISIONS	BY
B	2/2/89	CHANGED QUANTITIES	DS

	BY	DATE
DESIGN		—
DRAWN	PSH	12/27/86
CHK'D		
DES. ENG'R		
SECT ENG'R		

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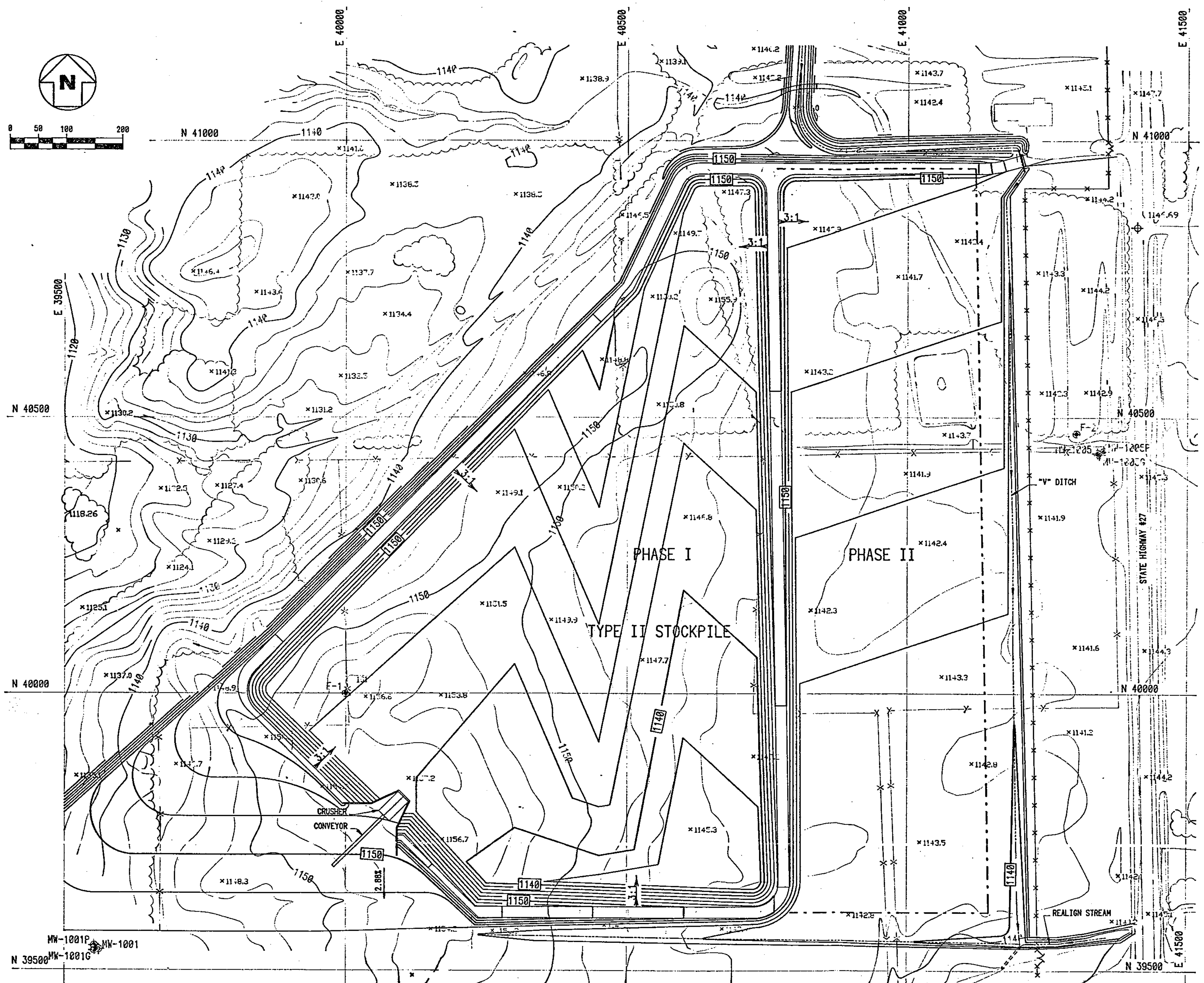
FIGURE NO. 4-17
CONTAMINATED WATER
COLLECTION SYSTEM
SITE SEQUENCING

MICROFILM | JOB M6033R
DRAWING NO. FM000-01-060 | REV. B
DIVISION DRAWING NO.
SCALE 1"=100'



LEGEND:

- -1000- EXISTING GROUND CONTOUR
- x 1002 EXISTING SPOT ELEVATIONS
- TREES AND/OR BRUSH
- -x-x- EXISTING FENCE
- EXISTING BUILDINGS
- MW-1200 GROUNDWATER MONITORING WELL LOCATION AND NUMBER
- F-1 CONTROL MONUMENTS
- PROPOSED LIMITS OF WASTE PLACEMENT
- PHASE LIMITS
- 1140 PROPOSED CONTOUR
- 2.5% PROPOSED SLOPE
- 3:1 PROPOSED SLOPE RATIO
- PROPOSED CULVERT
- DITCH OR STREAM FLOW LINE
- -x-x- PROPOSED FENCE

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FIGURE NO. 4-18

TYPE II STOCKPILE
PHASE I SUB BASE GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-061	A
DIVISION DRAWING NO.	
SCALE	1"=100'

	BY	DATE
DESIGN		
DRAWN	PSH	12/30/88
CHK'D		
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

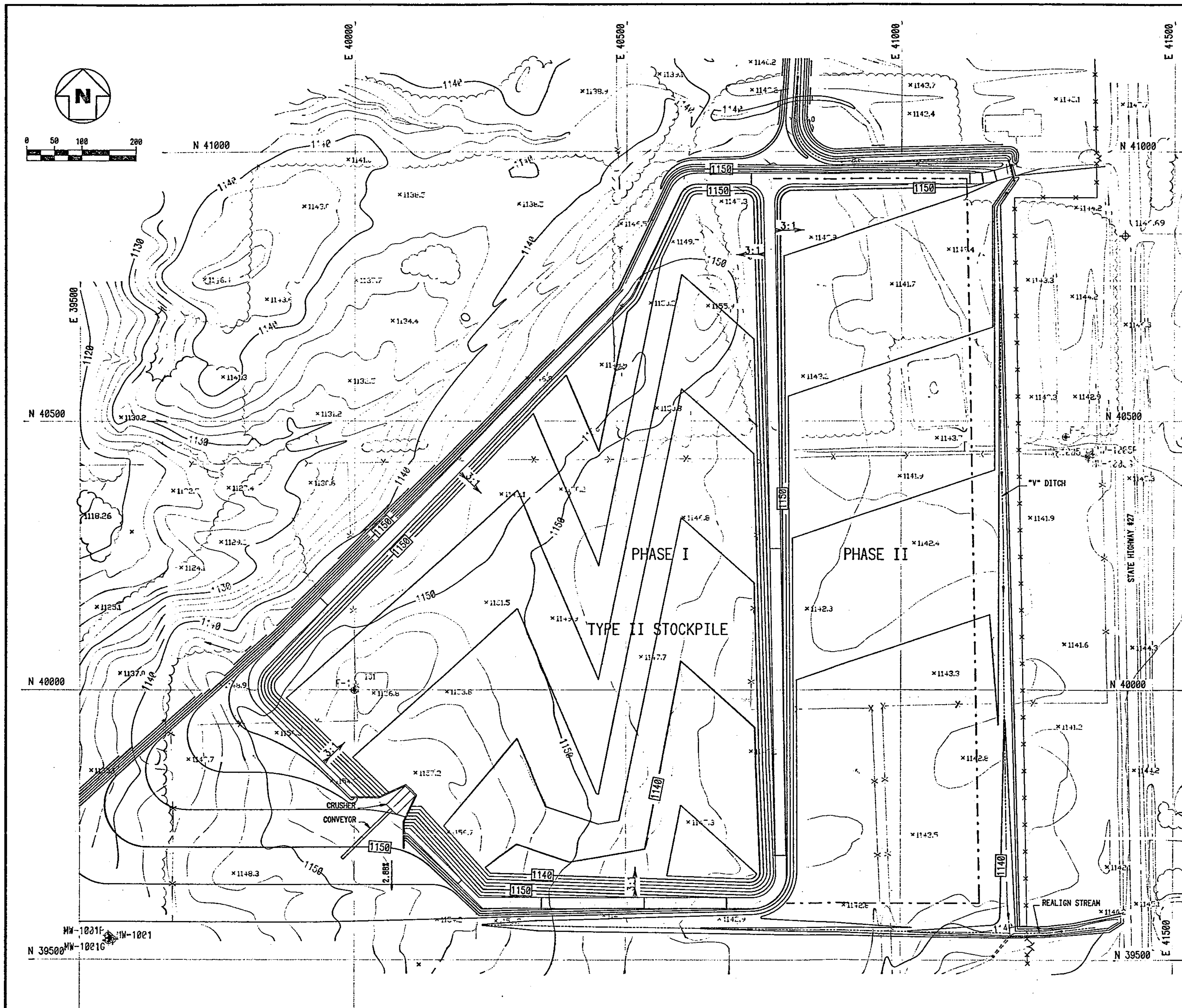
REFERENCES

DWG. NO	DESCRIPTION

REFERENCES

DWG. NO	DESCRIPTION

SL2739



LEGEND:

- EXISTING GROUND CONTOUR
- EXISTING SPOT ELEVATIONS
- TREES AND/OR BRUSH
- EXISTING FENCE
- EXISTING BUILDINGS
- GROUNDWATER MONITORING WELL LOCATION AND NUMBER
- F-1 CONTROL MONUMENTS
- PROPOSED LIMITS OF WASTE PLACEMENT
- PHASE LIMITS
- 1140 PROPOSED CONTOUR
- 2.5% PROPOSED SLOPE
- 3:1 PROPOSED SLOPE RATIO
- PROPOSED CULVERT
- DITCH OR STREAM FLOW LINE
- PROPOSED FENCE

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DWG. NO	DESCRIPTION	DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR
REFERENCES		REFERENCES															

	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR PROCESS ENG'R			DRAWN	PSH	1/14/89
ENG'R MGR			CHK'D		
			DES. ENG'R		
			SECT ENG'R		

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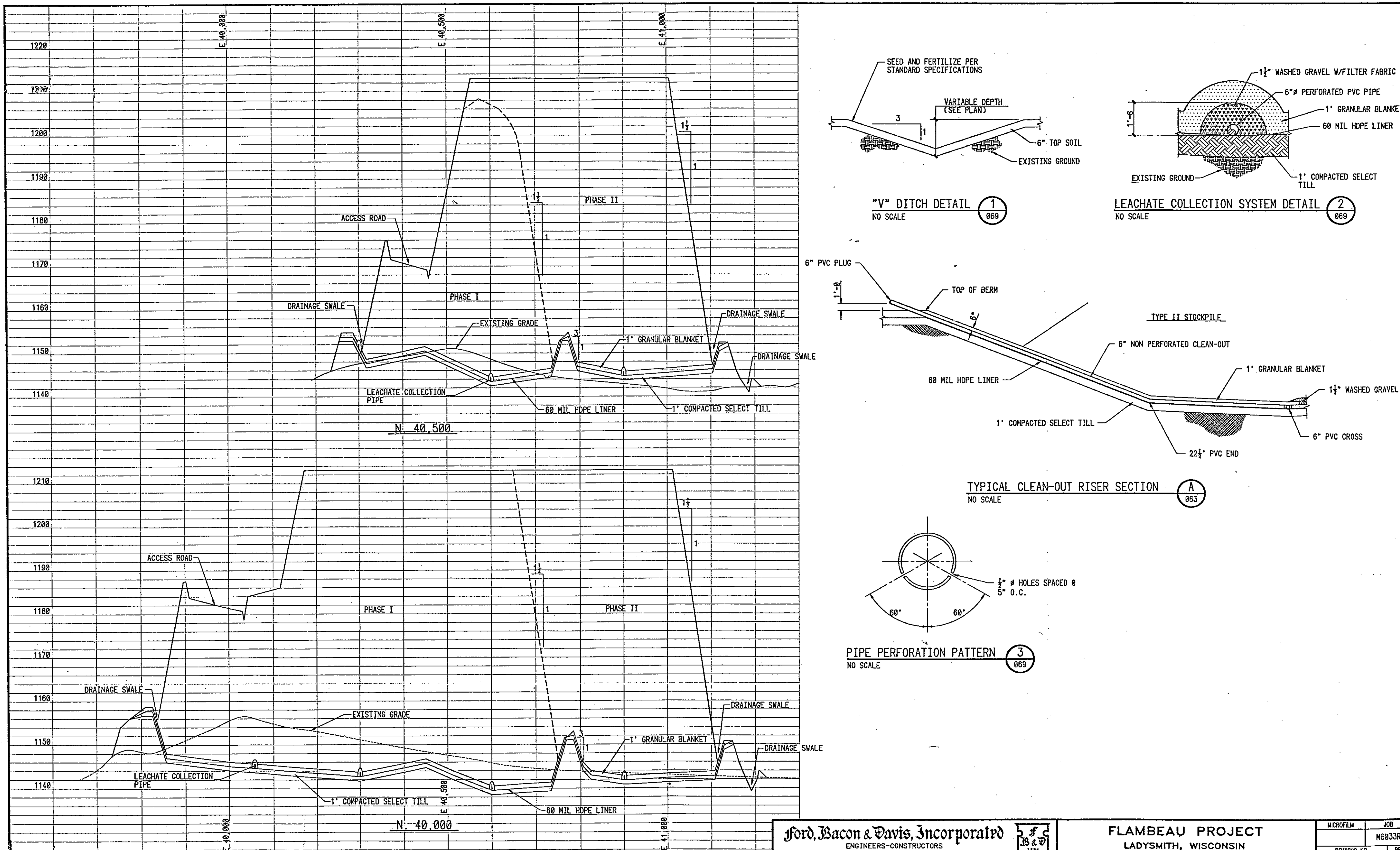
FIGURE NO. 4-19
TYPE II STOCKPILE
PHASE I BASE GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM001-01-062	A
DIVISION DRAWING NO.	
SCALE	1"=100'

SL390A



REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION

BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR
0	12/15/89	GENERAL REVISION	GWW			

	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR PROCESS ENG'R			DRAWN	PSH	2/16/89
ENG'R MGR			CHK'D		
			DES. ENG'R		
			SECT ENG'R		

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FIGURE NO. 4-20
CONTAMINATED WATER
COLLECTION SYSTEM
ENGINEERING CROSS SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-069	0
DIVISION DRAWING NO.	
SCALE	AS NOTED

SL610B

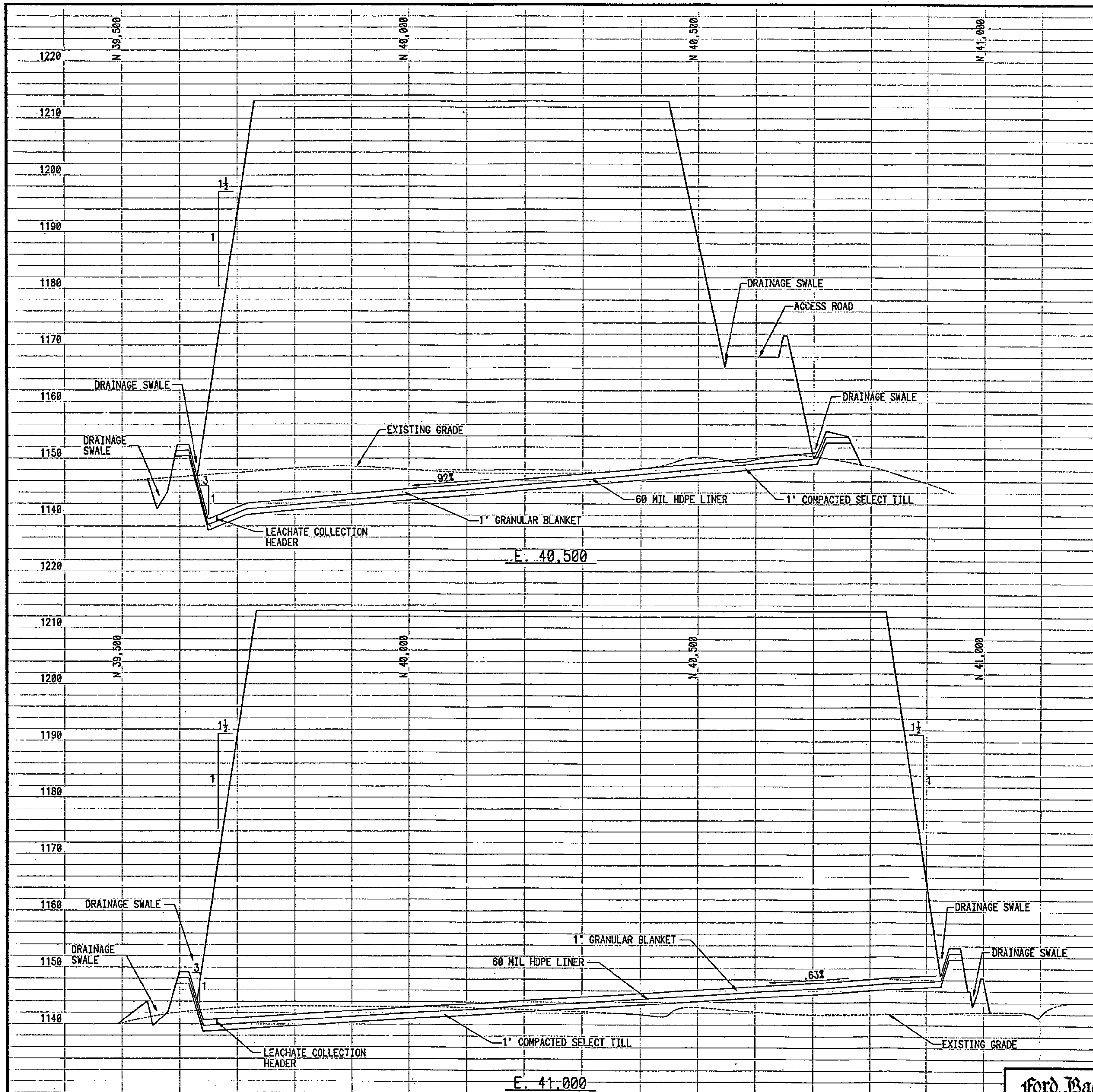

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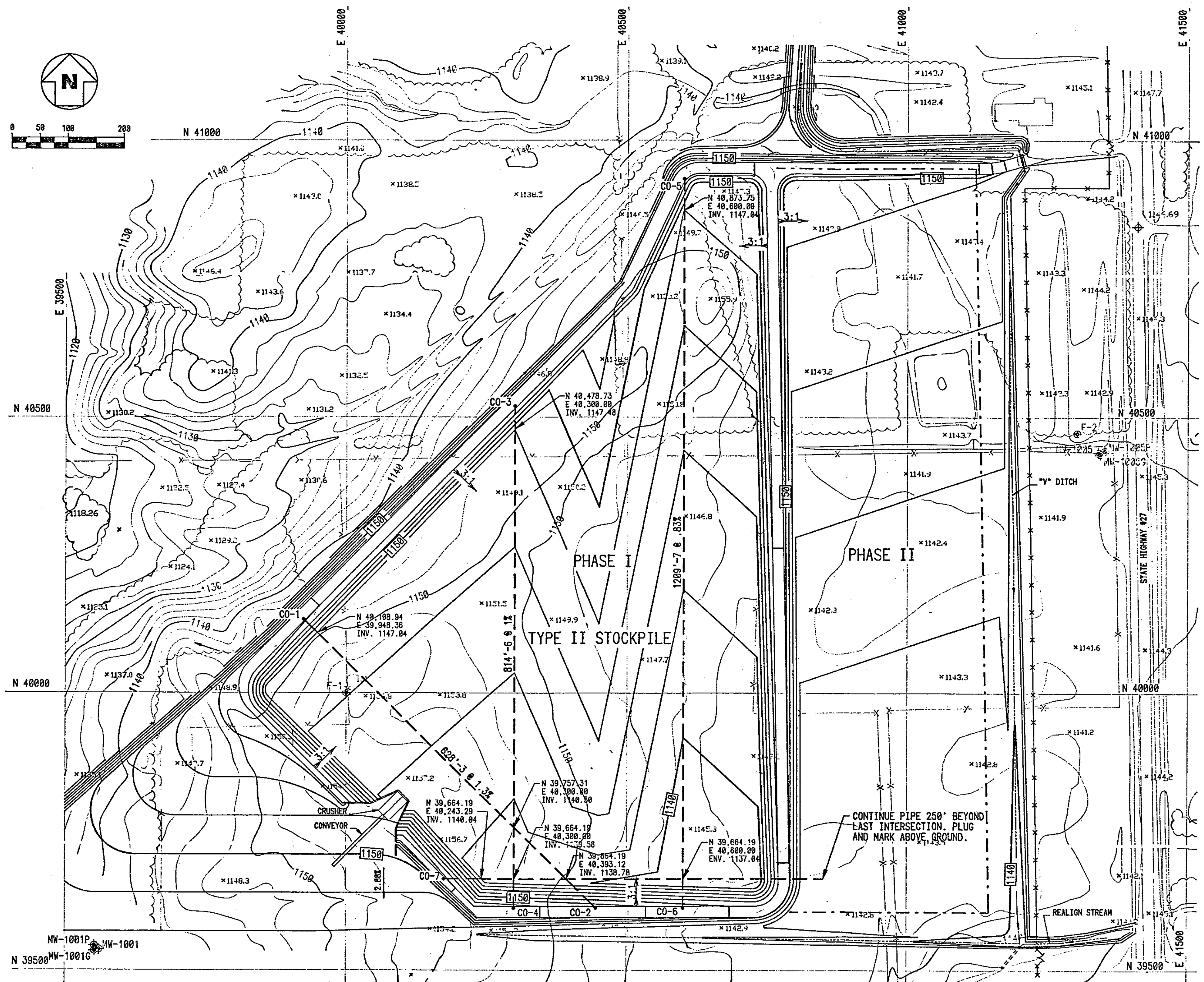
FIGURE NO. 4-21
CONTAMINATED WATER
COLLECTION SYSTEM
ENGINEERING CROSS SECTIONS

DRAWN: PSH 2/20/89

MICROFILM — JOB: M6033R
DRAWING NO.: FM000-01-070 — REV.: A
DIVISION DRAWING NO.
SCALE: AS NOTED

SL616A



CLEANOUT LOCATION SCHEDULE			
CLEANOUT	LOCATION		SURFACE ELEVATION
	NORTH	EAST	
CO-1	40,133.21	39,924.10	1156.15
CO-2	39,612.01	40,445.29	1153.00
CO-3	40,520.08	40,300.00	1155.00
CO-4	39,612.01	40,300.00	1154.50
CO-5	40,930.39	40,600.00	1154.25
CO-6	39,612.01	40,600.00	1151.00
CO-7	39,664.19	40,176.74	1156.50

LEGEND:

- —1000— EXISTING GROUND CONTOUR
- x 1000 EXISTING SPOT ELEVATIONS
- TREES AND/OR BRUSH
- EXISTING FENCE
- EXISTING BUILDINGS
- MW-1000 GROUNDWATER MONITORING WELL LOCATION AND NUMBER
- F-1 CONTROL MONUMENTS
- PROPOSED LIMITS OF WASTE PLACEMENT
- PHASE LIMITS
- 1140 PROPOSED CONTOUR
- 2.5% PROPOSED SLOPE
- 3:1 PROPOSED SLOPE RATIO
- PROPOSED CULVERT
- DITCH OR STREAM FLOW LINE
- PROPOSED FENCE

REFERENCES DWG. NO	DESCRIPTION	REFERENCES DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

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	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR PROCESS ENG'R			DRAWN	PSH	1/17/89
ENG'R MGR			CHK'D		
			DES. ENG'R		
			SECT ENG'R		

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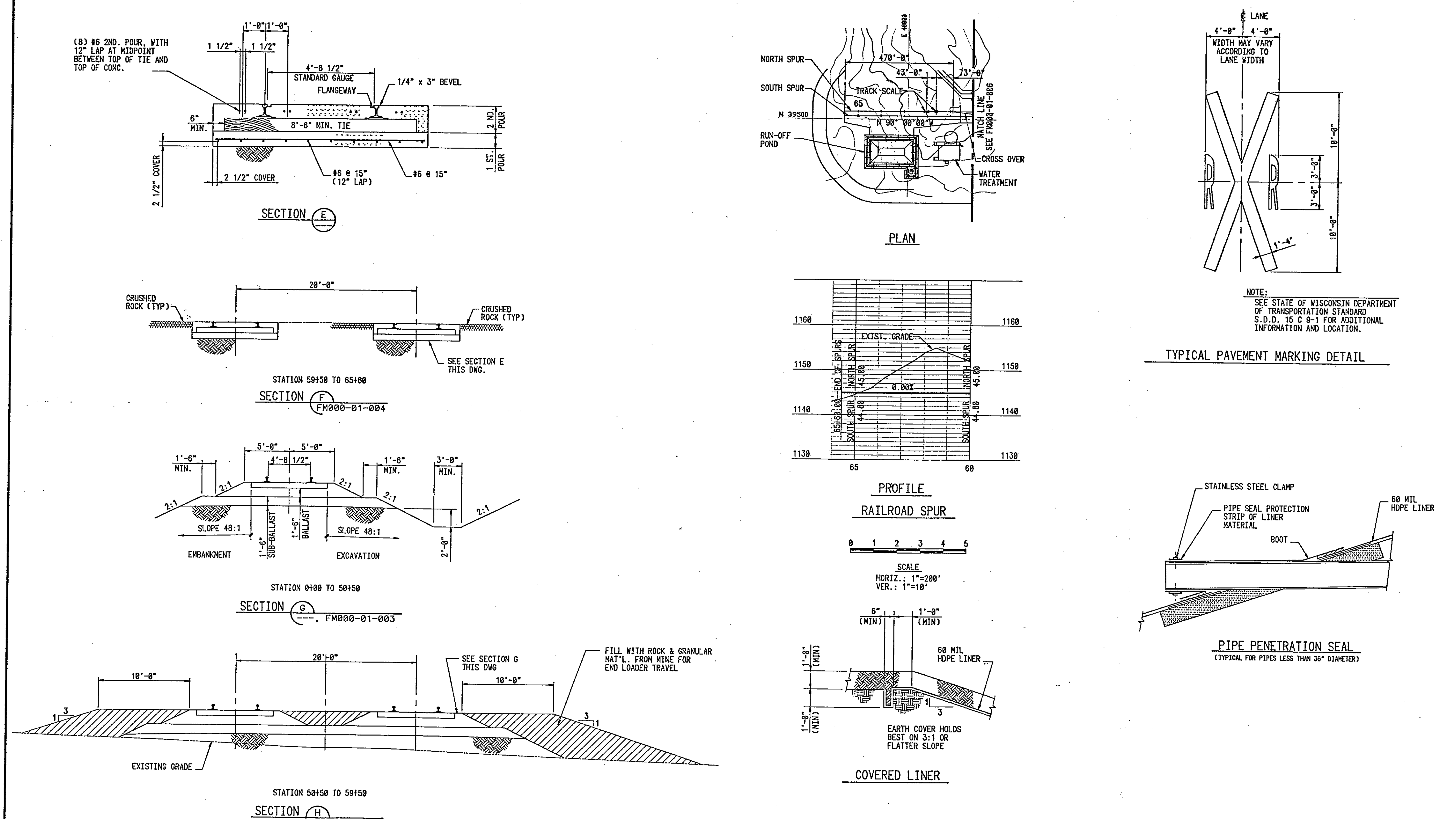
FIGURE NO. 4-22
TYPE II STOCKPILE
LEACHATE COLLECTION SYSTEM PHASE I

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-063	A
DIVISION DRAWING NO.	
SCALE	1"=100'

SL391A



REFERENCES					
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NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR
1	1-30-89	REVISED PIPE PENETRATION TITLE	GWW			

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	BY	DATE
DESIGN		
DRAWN	GB	11-8-88
CHK'D		
DES. ENG'R	KTK	2/3/89
SECT ENG'R		

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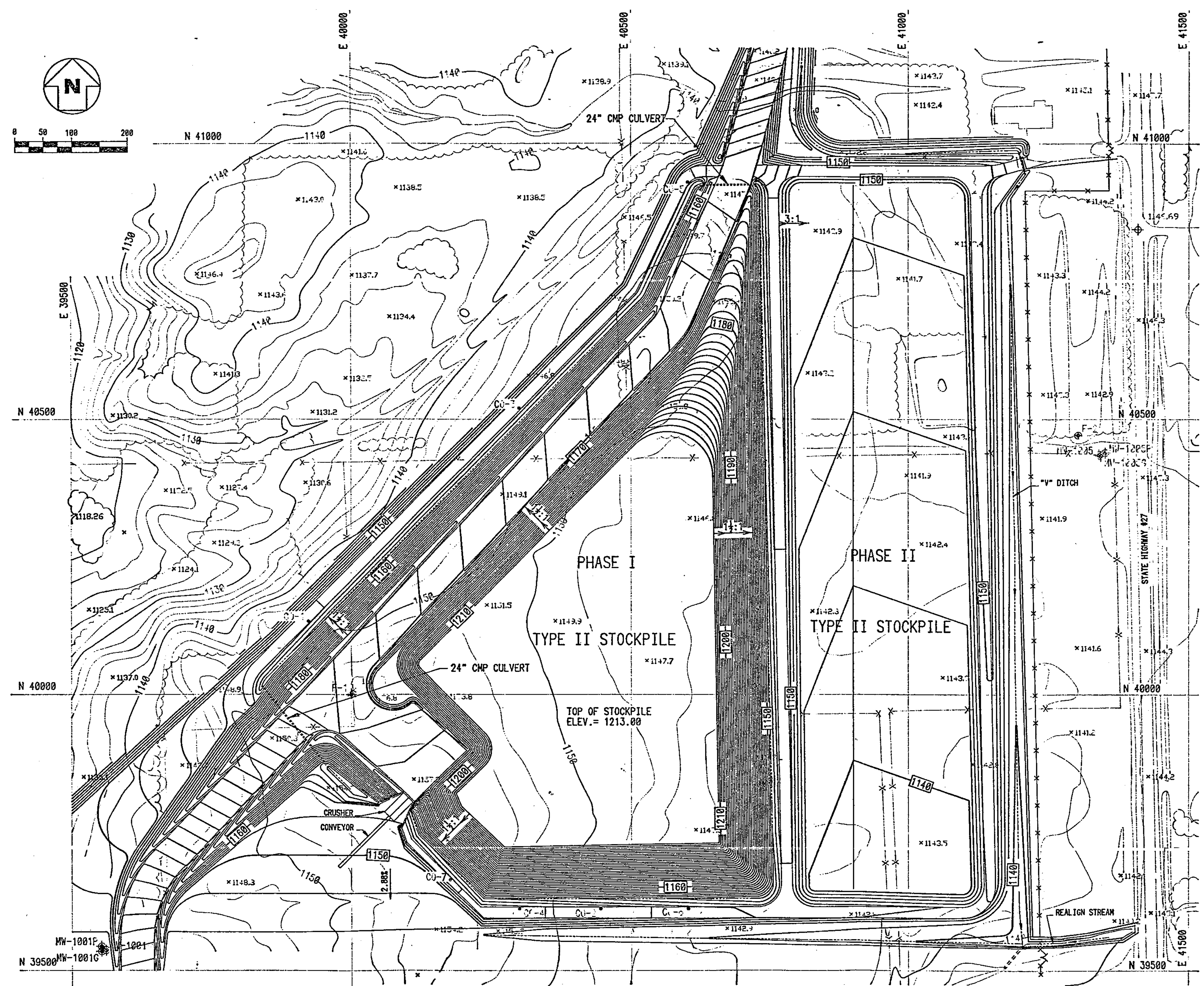
FIGURE NO. 4-23
SITE GRADING
RAILROAD SECTIONS AND DETAILS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-010	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NOTED

SK923H



LEGEND:

1200	EXISTING GROUND CONTOUR
x 1200	EXISTING SPOT ELEVATIONS
	TREES AND/OR BRUSH
—x—x—	EXISTING FENCE
	EXISTING BUILDINGS
MW-1000	GROUNDWATER MONITORING WELL LOCATION AND NUMBER
F-1	CONTROL MONUMENTS
	PROPOSED LIMITS OF WASTE PLACEMENT
	PHASE LIMITS
1140	PROPOSED CONTOUR
2.5%	PROPOSED SLOPE
3:1	PROPOSED SLOPE RATIO
	PROPOSED CULVERT
	DITCH OR STREAM FLOW LINE
—x—x—	PROPOSED FENCE

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FIGURE NO. 4-24
TYPE II STOCKPILE
PHASE I FINAL GRADES AND
PHASE II SUB-BASE

MICROFILM	JOB	M6033R
DRAWING NO.	FM000-01-065	REV. A
DIVISION DRAWING NO.		
SCALE	1"=100'	

	BY	DATE
DESIGN		
DRAWN	PSH	2/09/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

PROJ. ENG'R
MGR PROCESS ENG'R
ENG'R MGR

DWG. NO	DESCRIPTION

REFERENCES

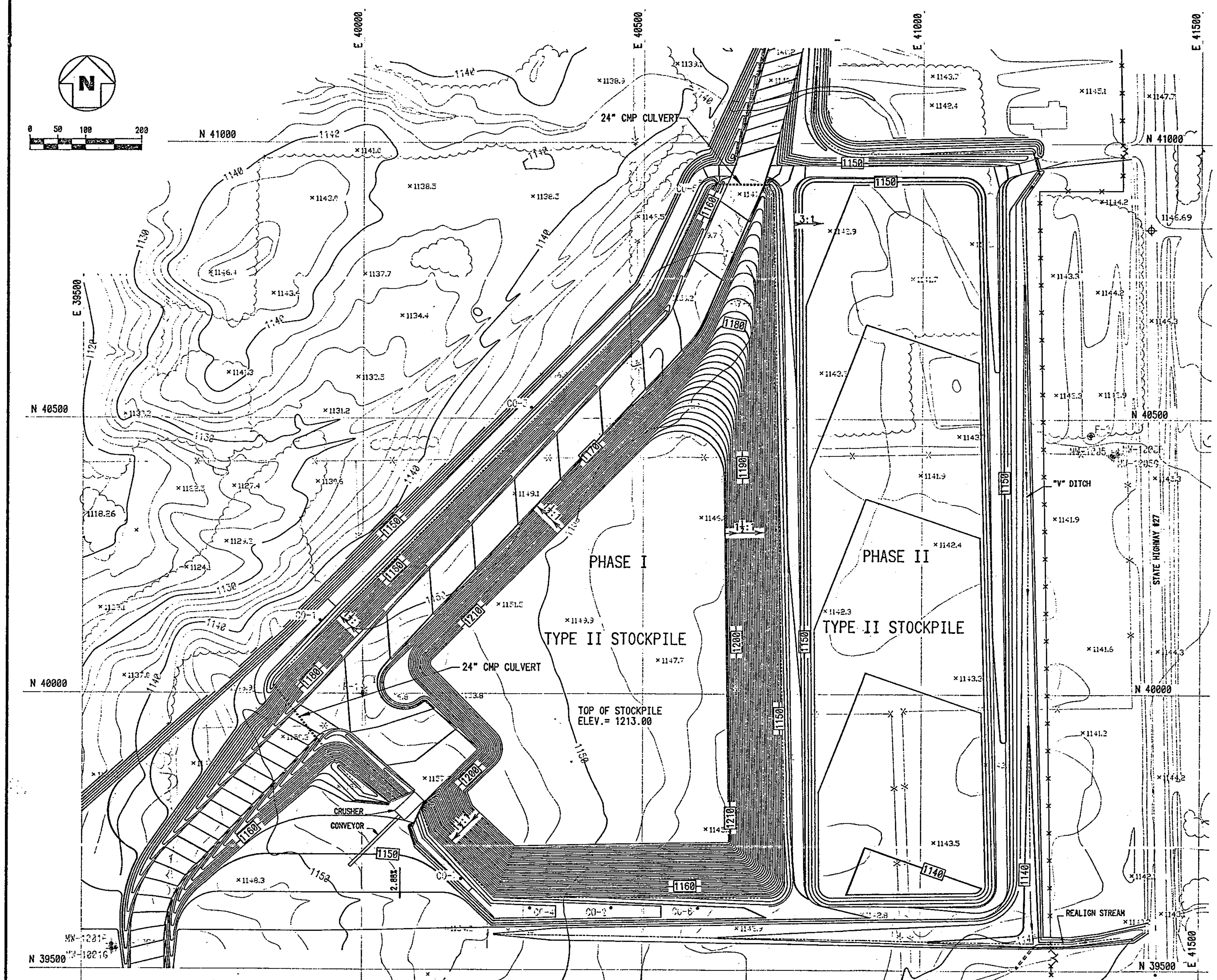
DWG. NO	DESCRIPTION

REFERENCES

BY	DATE	REVISIONS	BY	CHK'D	ENG'R	SUP'V MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

SL549A



LEGEND:

—1200—	EXISTING GROUND CONTOUR
x 1000	EXISTING SPOT ELEVATIONS
	TREES AND/OR BRUSH
—x—x—	EXISTING FENCE
	EXISTING BUILDINGS
MW-1202	GROUNDWATER MONITORING WELL LOCATION AND NUMBER
F-1	CONTROL MONUMENTS
— · — · —	PROPOSED LIMITS OF WASTE PLACEMENT
— — —	PHASE LIMITS
—1140—	PROPOSED CONTOUR
2.5%	PROPOSED SLOPE
3:1	PROPOSED SLOPE RATIO
	PROPOSED CULVERT
	DITCH OR STREAM FLOW LINE
—x—x—	PROPOSED FENCE

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REFERENCES DWG. NO	DESCRIPTION	REFERENCES DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR PROCESS ENG'R			DRAWN	PSH	2/13/89
ENG'R MGR			CHK'D		
			DES. ENG'R		
			SECT ENG'R		

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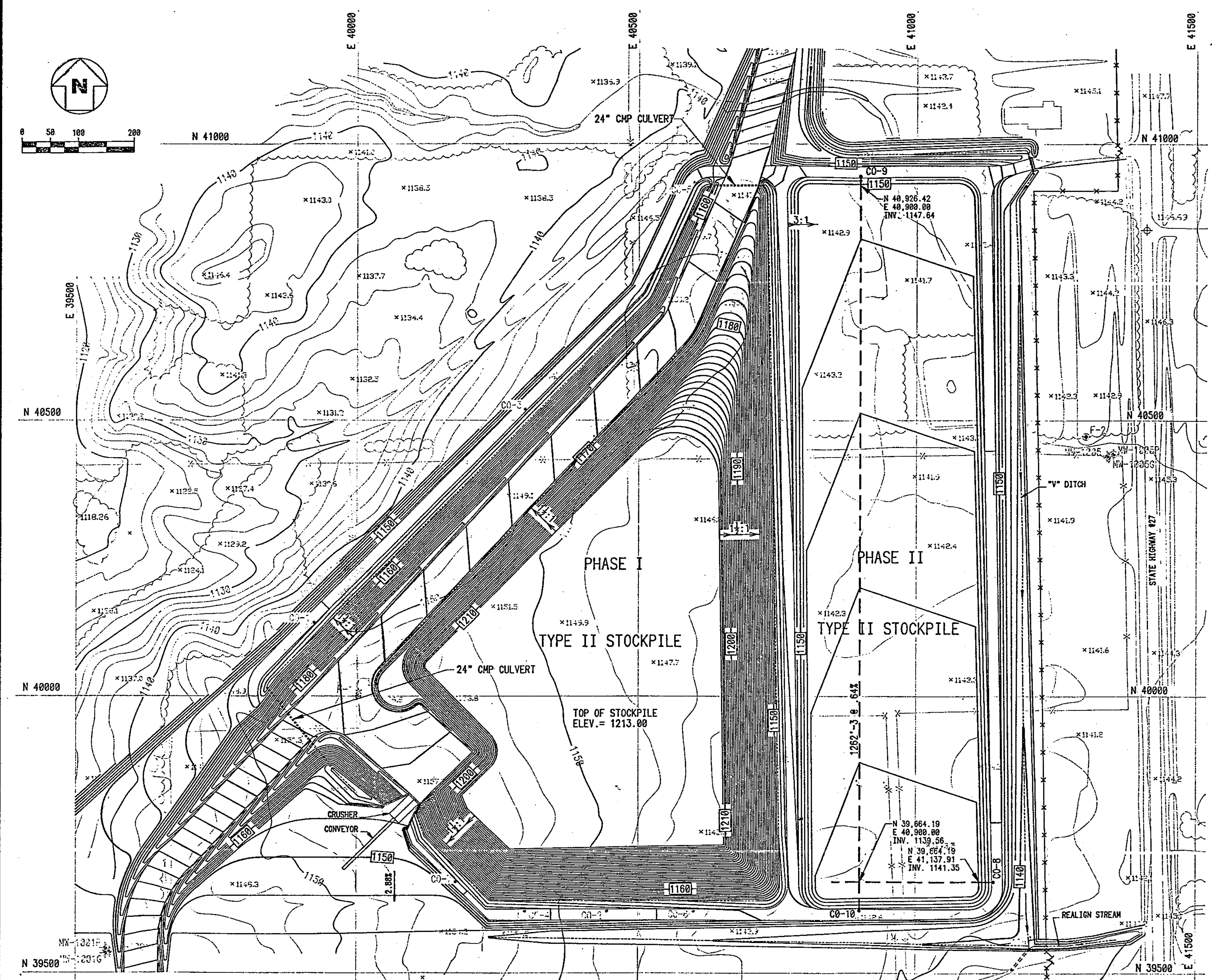
84112

FIGURE NO. 4-25

TYPE II STOCKPILE
PHASE II BASE GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-066	A
DIVISION DRAWING NO.	
SCALE	1"=100'

SL558A



CLEANOUT LOCATION SCHEDULE			
CLEANOUT	LOCATION		SURFACE ELEVATION
	NORTH	EAST	
CO-8	39,664.19	41,112.91	1149.50
CO-9	40,942.67	40,900.00	1152.67
CO-10	39,612.01	40,900.00	1150.00

LEGEND:

- —1000— EXISTING GROUND CONTOUR
- x 1000 EXISTING SPOT ELEVATIONS
- TREES AND/OR BRUSH
- EXISTING FENCE
- EXISTING BUILDINGS
- MW-1000 GROUNDWATER MONITORING WELL LOCATION AND NUMBER
- F-1 CONTROL MONUMENTS
- PROPOSED LIMITS OF WASTE PLACEMENT
- PHASE LIMITS
- 1140 PROPOSED CONTOUR
- 2.5% PROPOSED SLOPE
- 3:1 PROPOSED SLOPE RATIO
- PROPOSED CULVERT
- DITCH OR STREAM FLOW LINE
- PROPOSED FENCE

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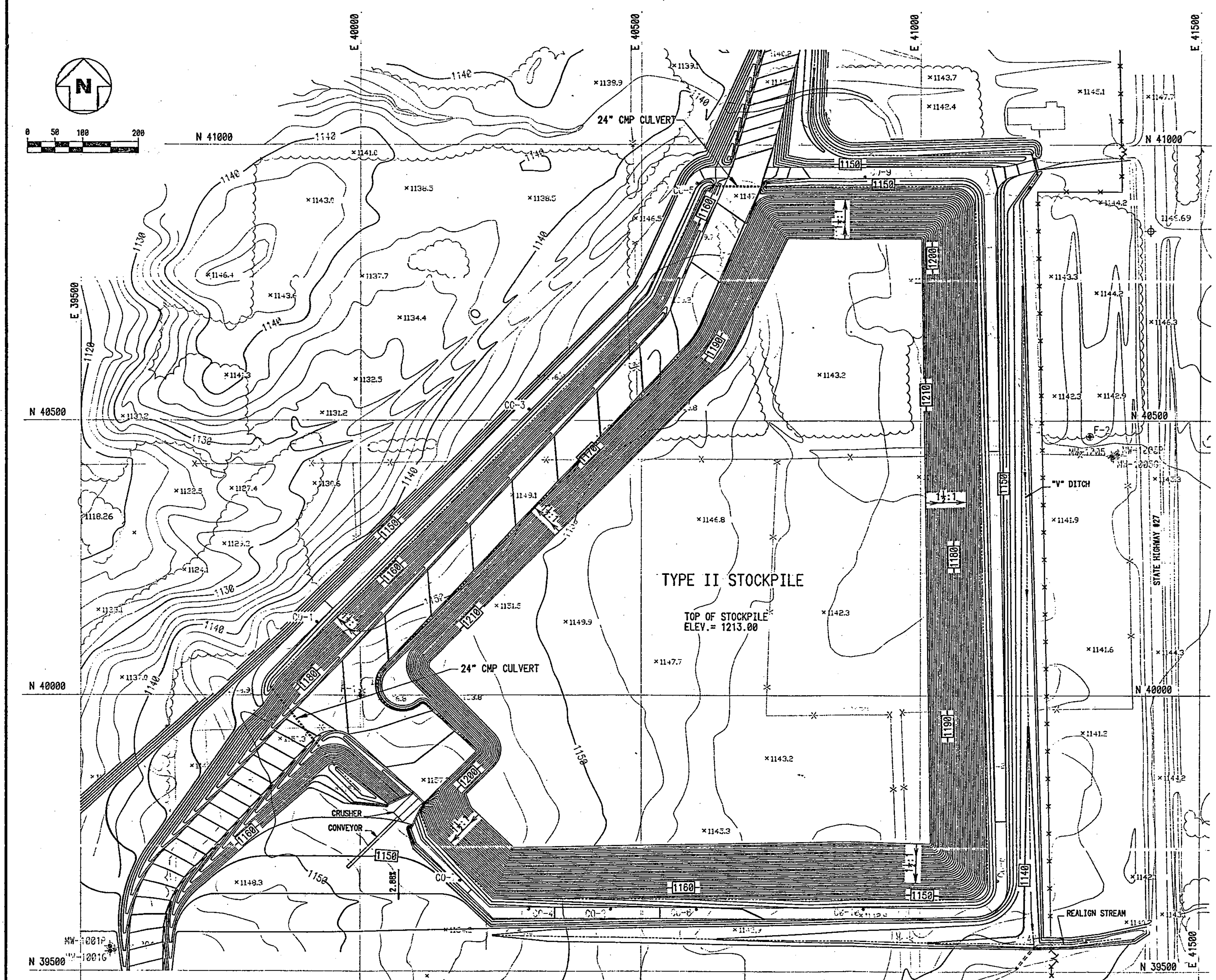
FIGURE NO. 4-26
TYPE II STOCKPILE
PHASE I FINAL GRADES AND
PHASE II LEACHATE COLLECTION SYSTEM

DRAWN: PSH 2/14/89

MICROFILM | JOB: M6033R
DRAWING NO.: FM000-01-067 | REV.: A
DIVISION DRAWING NO.
SCALE: 1"=100'

SL564A



LEGEND:

—1000—	EXISTING GROUND CONTOUR
x 1000	EXISTING SPOT ELEVATIONS
	TREES AND/OR BRUSH
—x—x—	EXISTING FENCE
	EXISTING BUILDINGS
MW-1000	GROUNDWATER MONITORING WELL LOCATION AND NUMBER
F-1	CONTROL MONUMENTS
— · — · —	PROPOSED LIMITS OF WASTE PLACEMENT
— — —	PHASE LIMITS
—1140—	PROPOSED CONTOUR
2.5%	PROPOSED SLOPE
3:1	PROPOSED SLOPE RATIO
	PROPOSED CULVERT
	DITCH OR STREAM FLOW LINE
—x—x—	PROPOSED FENCE

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH
FB&D 1894

	BY	DATE
DESIGN		
DRAWN	PSH	2/15/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

PROJ. ENG'R / MGR PROCESS ENG'R / ENG'R MGR

REFERENCES: DWG. NO | DESCRIPTION

REVISIONS: NO | DATE | REVISIONS | BY | CHK'D | ENG'R | ENG'R MGR

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
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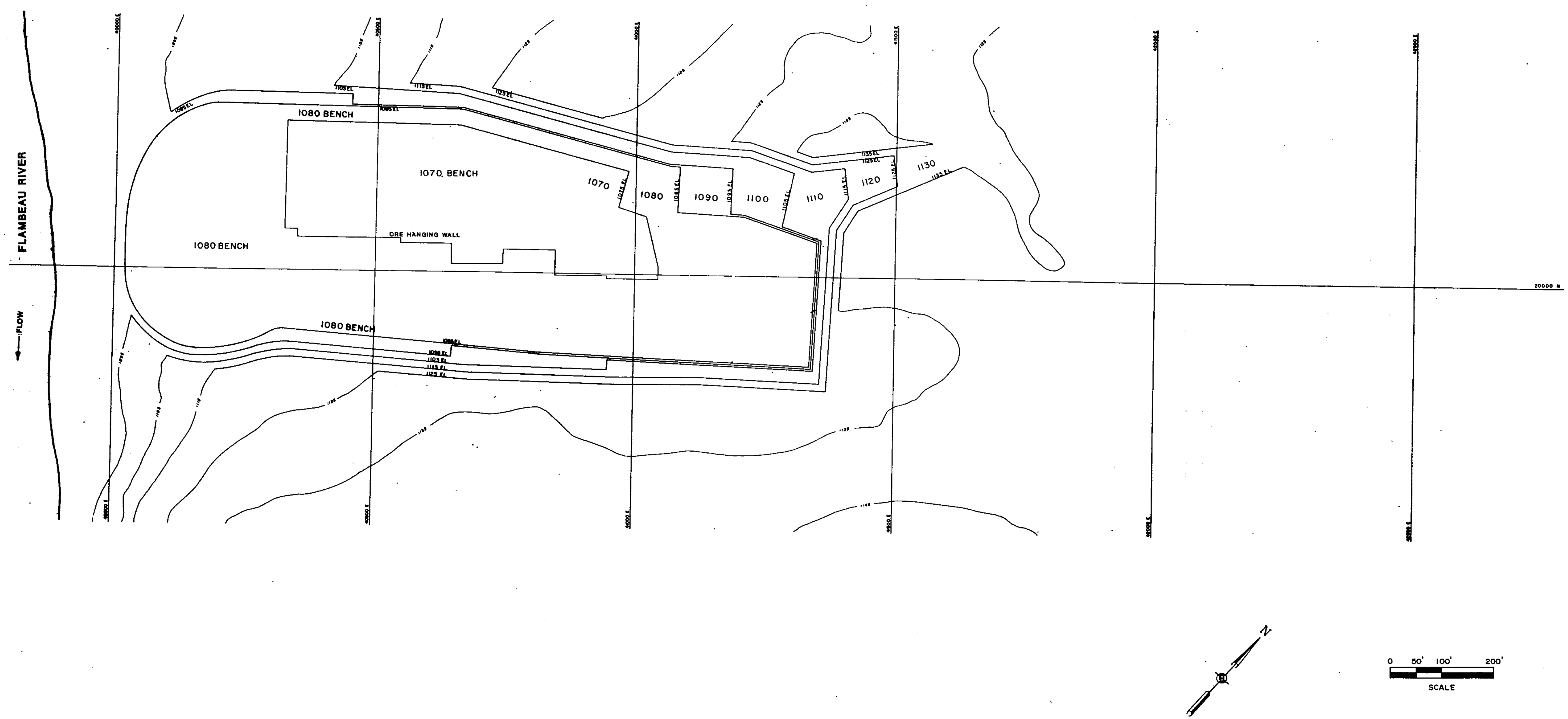
FIGURE NO. 4-27

TYPE II STOCKPILE
FINAL GRADES

MICROFILM | JOB M6033R
DRAWING NO. FM000-01-068 | REV. A
DIVISION DRAWING NO.
SCALE 1"=100'

SL593A



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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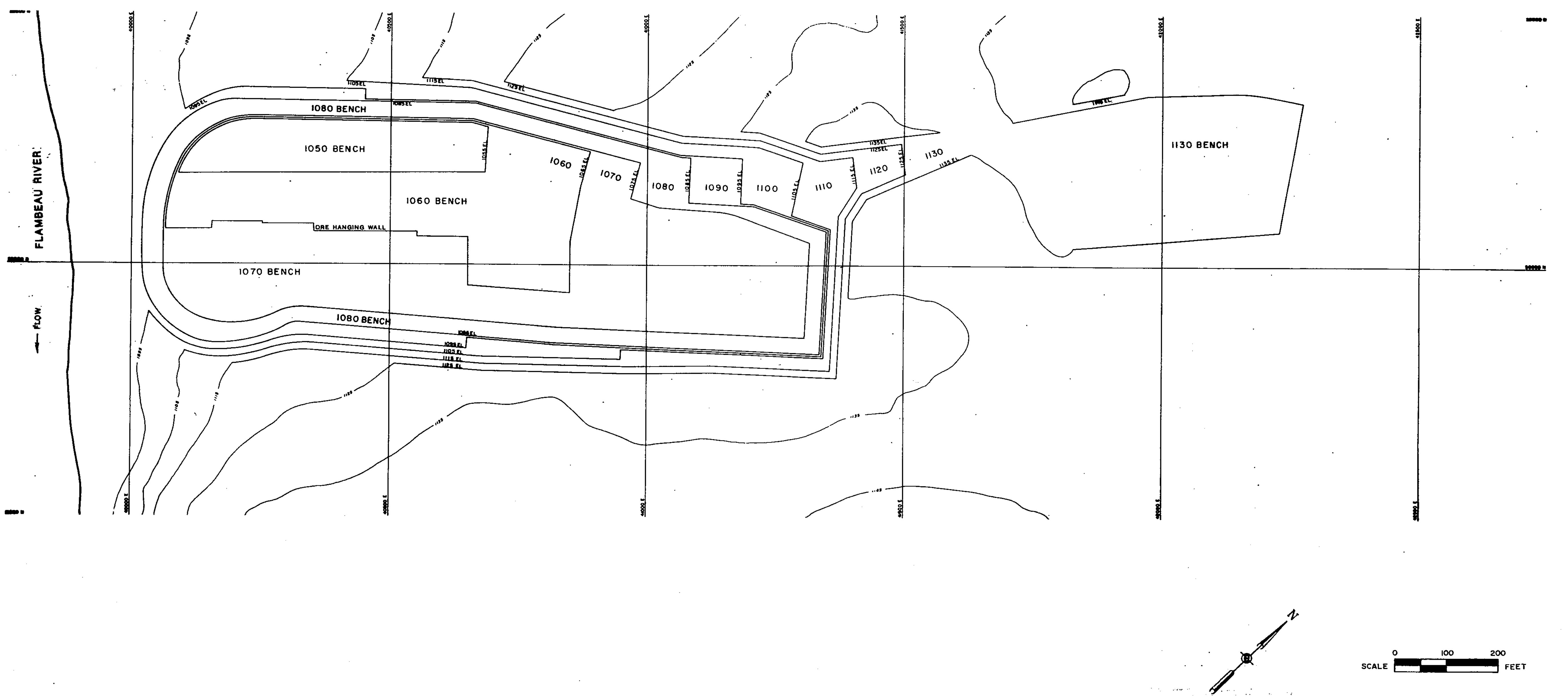
FIGURE NO. 4-28
END OF PREPRODUCTION

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	

REFERENCES DWG. NO.	DESCRIPTION	REFERENCES DWG. NO.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

	BY	DATE		BY	DATE
PROJ. ENG'R			DESIGN		
MGR. PROCESS ENG'R			DRAWN		
ENG'R MGR.			CHK'D		
			DES. ENG'R		
			SECT ENG'R		



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
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FIGURE NO. 4-29
END OF 1ST QUARTER
YEAR 1

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

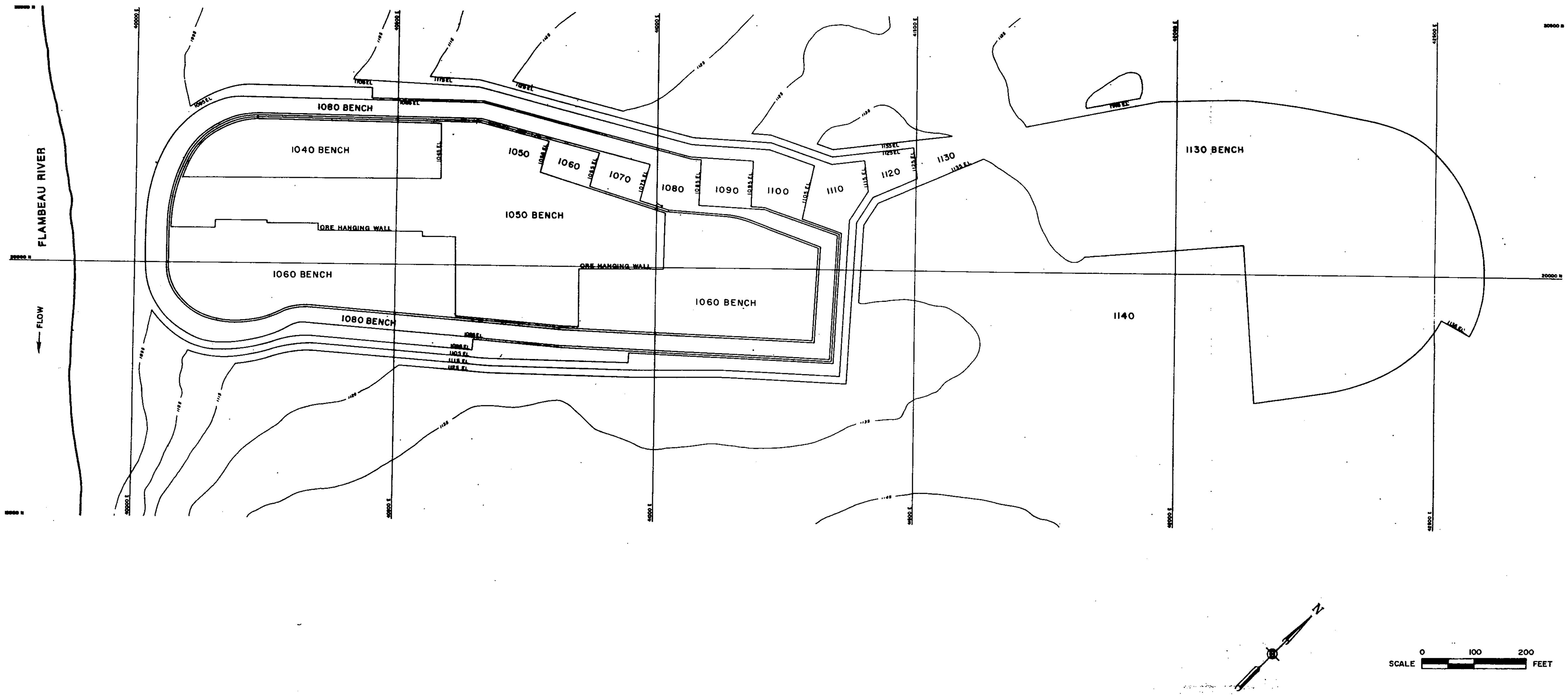

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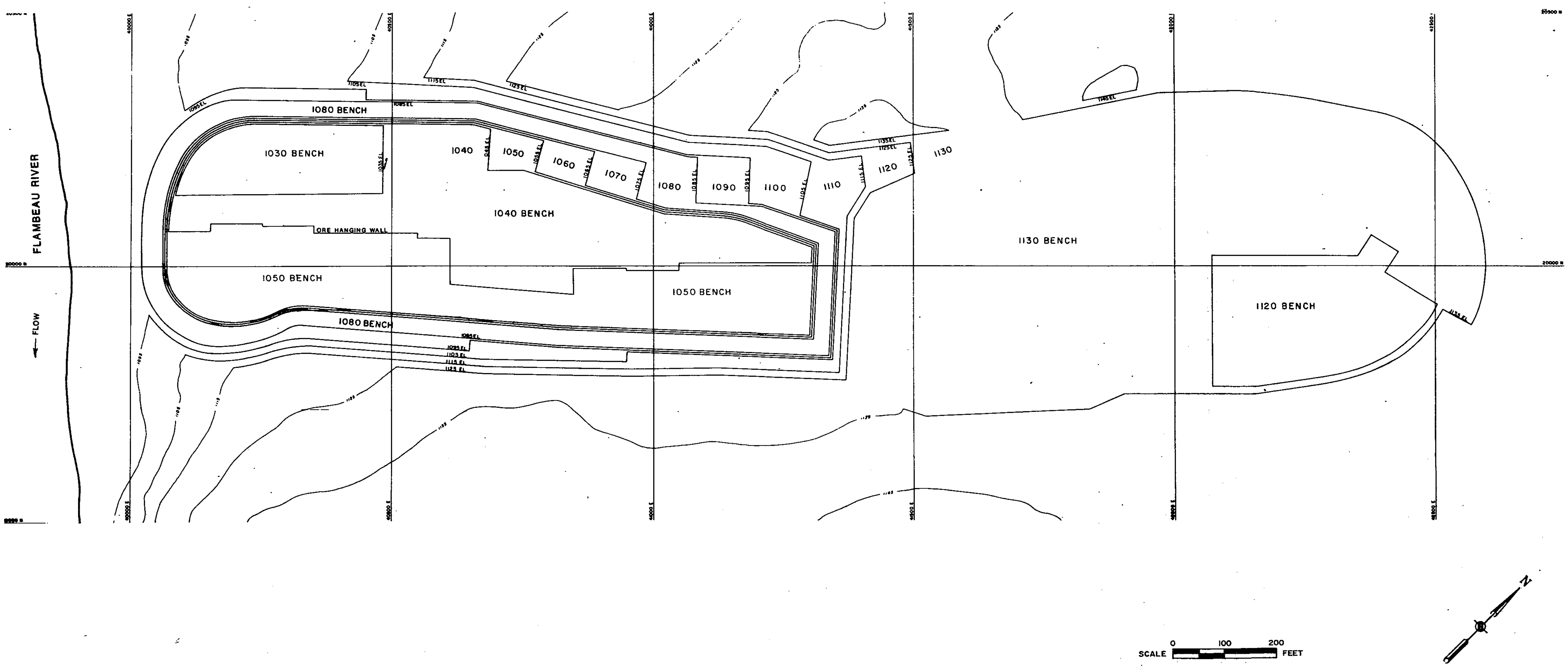
FIGURE NO. 4-30
END OF 2ND QUARTER
YEAR 1

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES: DWG. NO. | DESCRIPTION
REVISIONS: NO. | DATE | REVISIONS | BY | CHK'D | ENG'R | ENG'R MGR
PROJ. ENG'R | MGR. PROCESS ENG'R | ENG'R MGR | BY | DATE



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LADYSMITH, WISCONSIN

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FIGURE NO. 4-31
END OF 3RD QUARTER
YEAR 1

	BY	DATE
DESIGN		
DRAWN	D.H.S	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

PROJ. ENG'R	BY	DATE
MGR. PROCESS ENG'R		
ENG'R MGR		

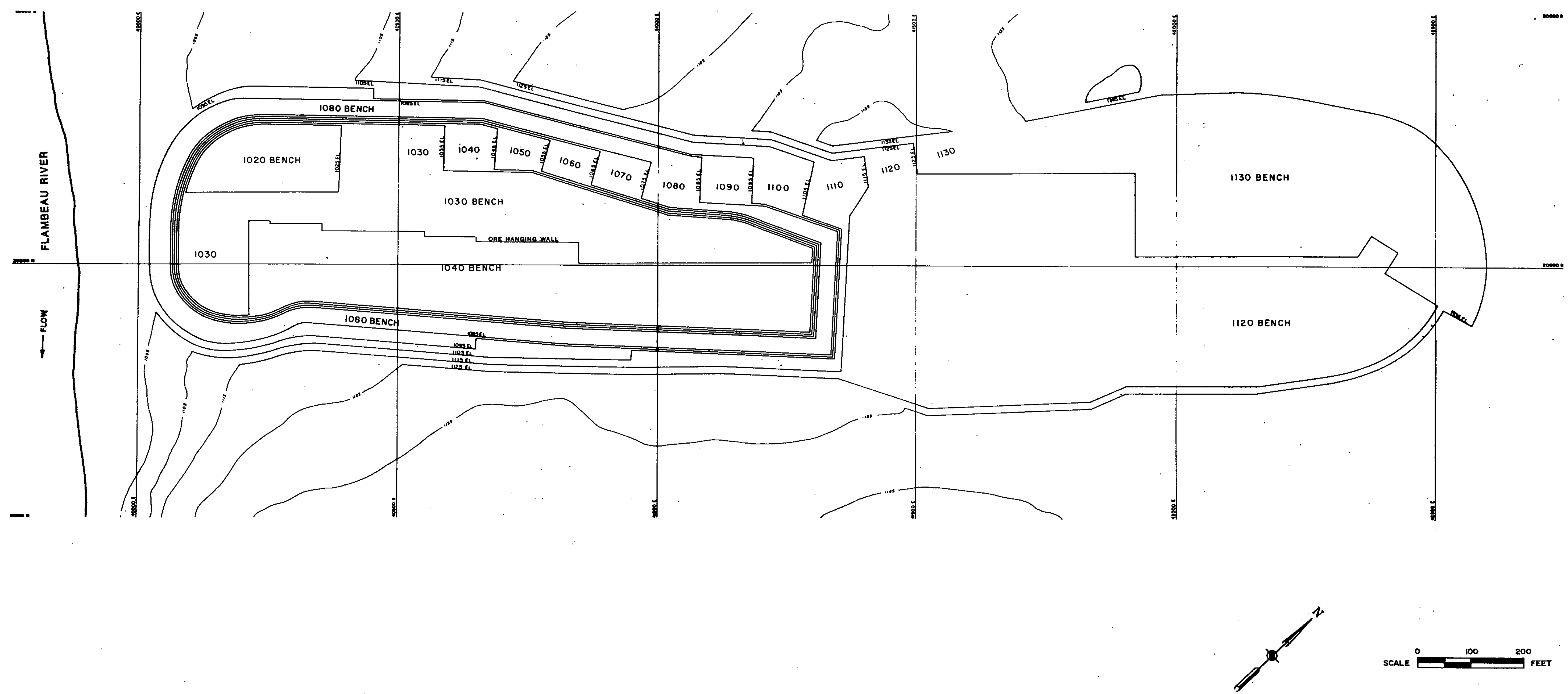
REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	



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LAKEWOOD, COLORADO

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LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
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SALT LAKE CITY, UTAH
84112

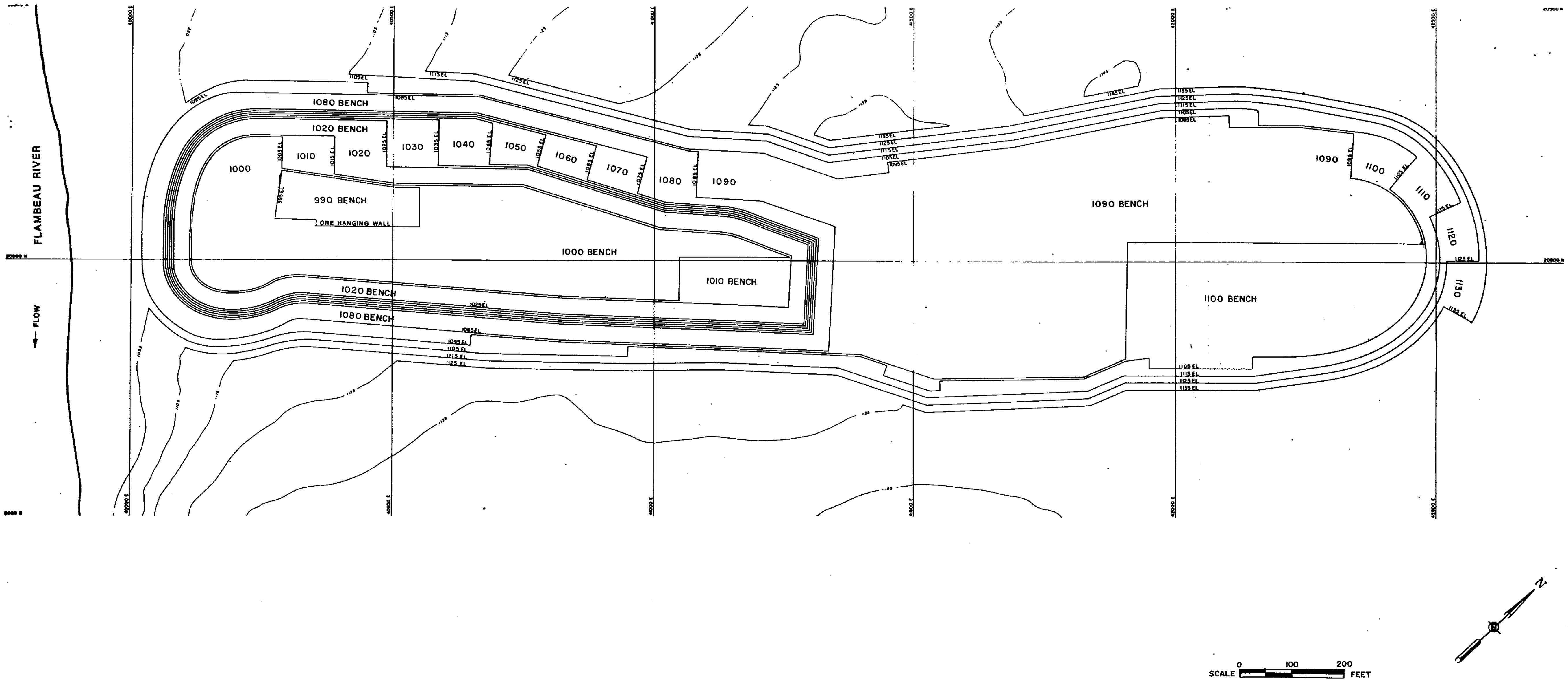
FIGURE NO. 4-32
END OF YEAR I

	BY	DATE
DESIGN		
DRAWN	D.H.S	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

PROJ. ENG'R
MGR. PROCESS ENG'R
ENG'R MGR.

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES: DWG. NO. | DESCRIPTION
REVISIONS: NO. | DATE | REVISIONS | BY | CHK'D | ENG'R | ENG'R MGR.



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LADYSMITH, WISCONSIN

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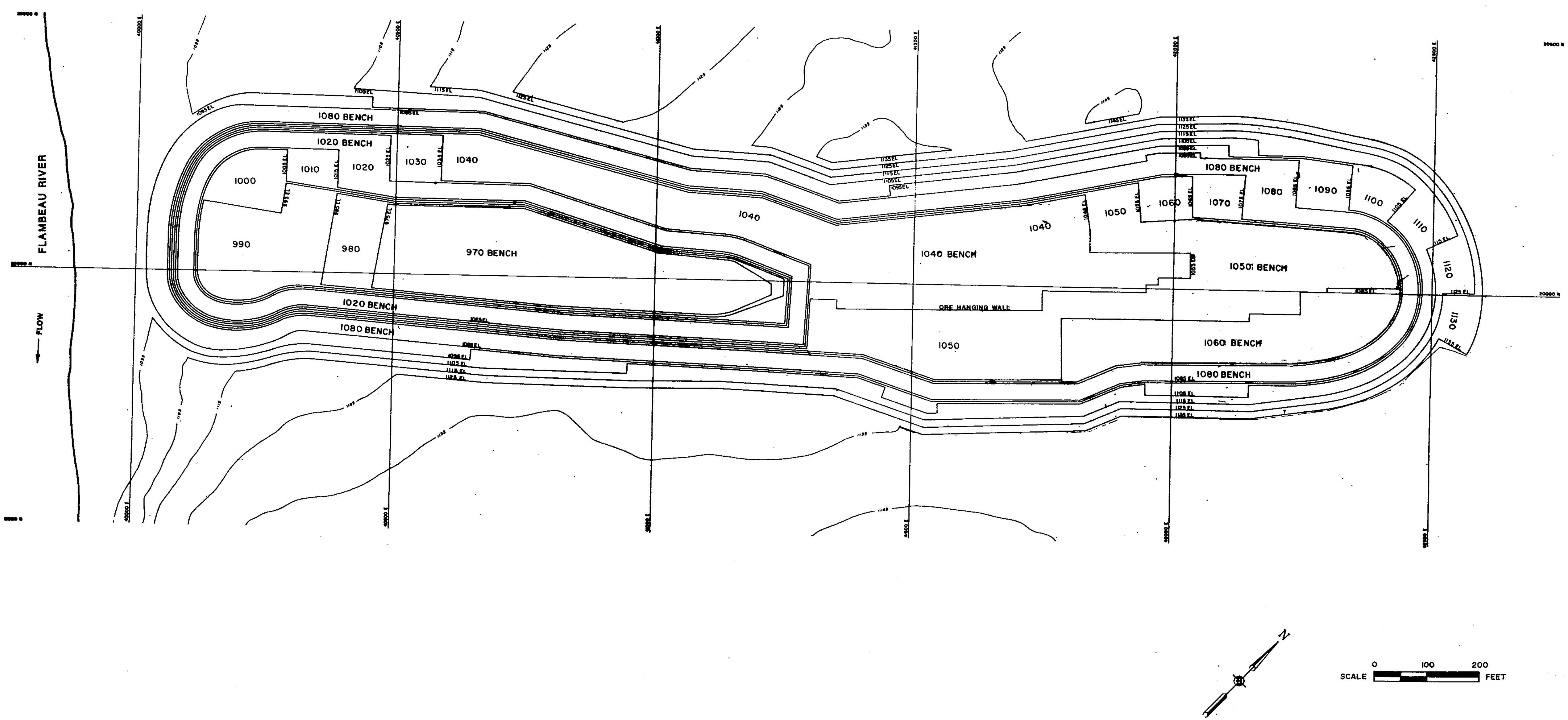
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-33
END OF YEAR 2

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		



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FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
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84112

FIGURE NO. 4-34
END OF YEAR 3

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
RES. ENG'R		
SECT ENG'R		

MICROFILM JOB
DRAWING NO. REV.
DIVISION DRAWING NO.
SCALE

DWG. NO.	DESCRIPTION

REFERENCES

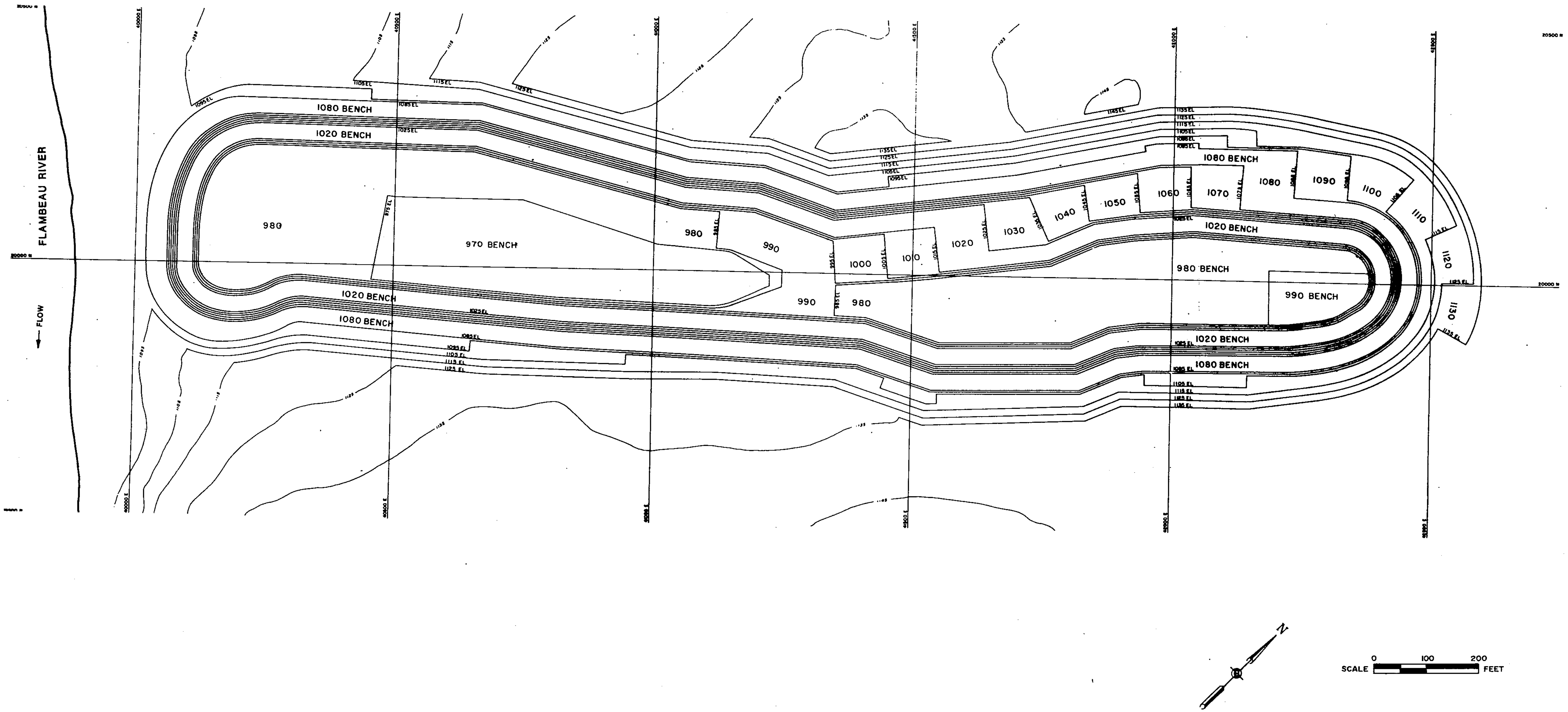
DWG. NO.	DESCRIPTION

REFERENCES

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		



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LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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84112

FIGURE NO. 4-35
END OF YEAR 4

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'G MGR.		

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'G MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'G MGR.

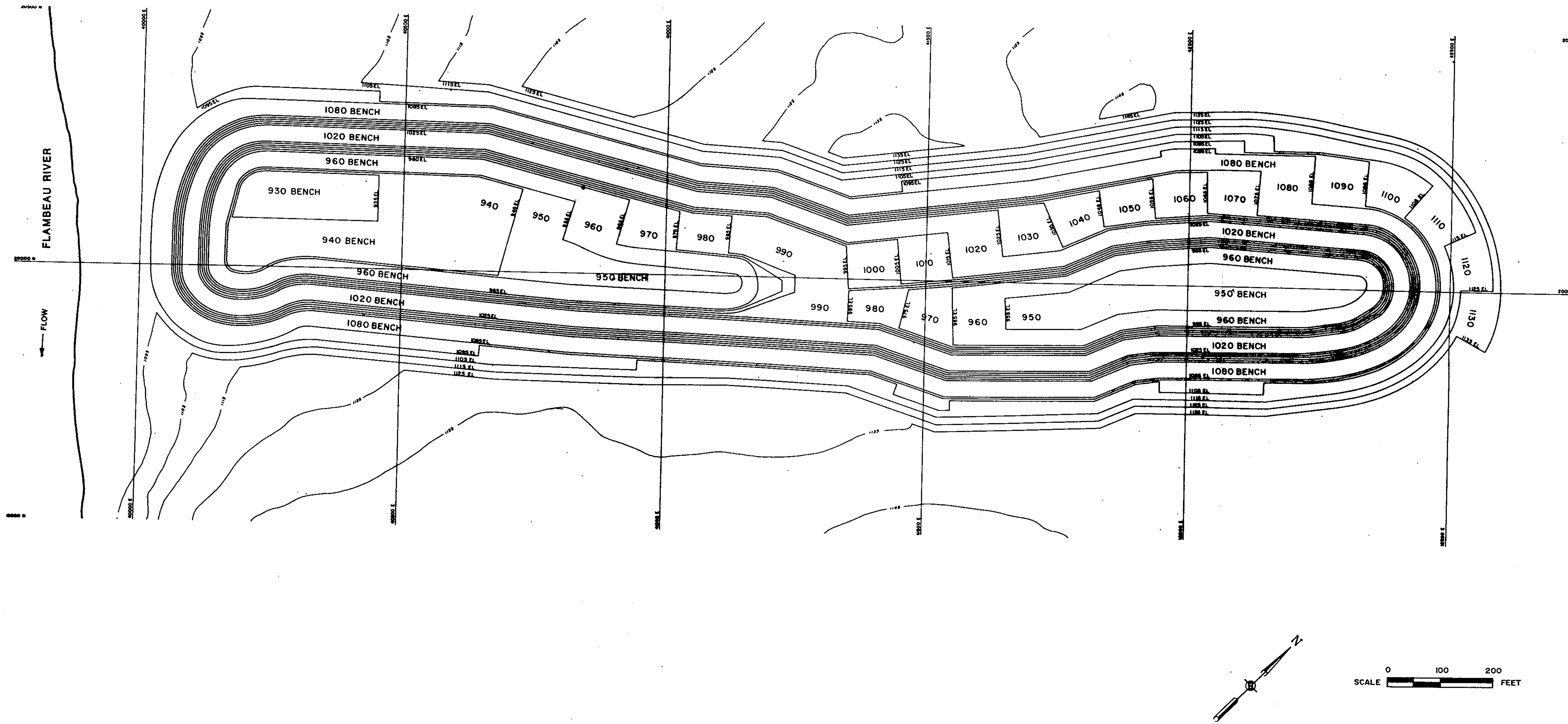
REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE



PINCOCK, ALLEN & HOLT, INC.	FLAMBEAU PROJECT
LAKEWOOD, COLORADO	LADYSMITH, WISCONSIN

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
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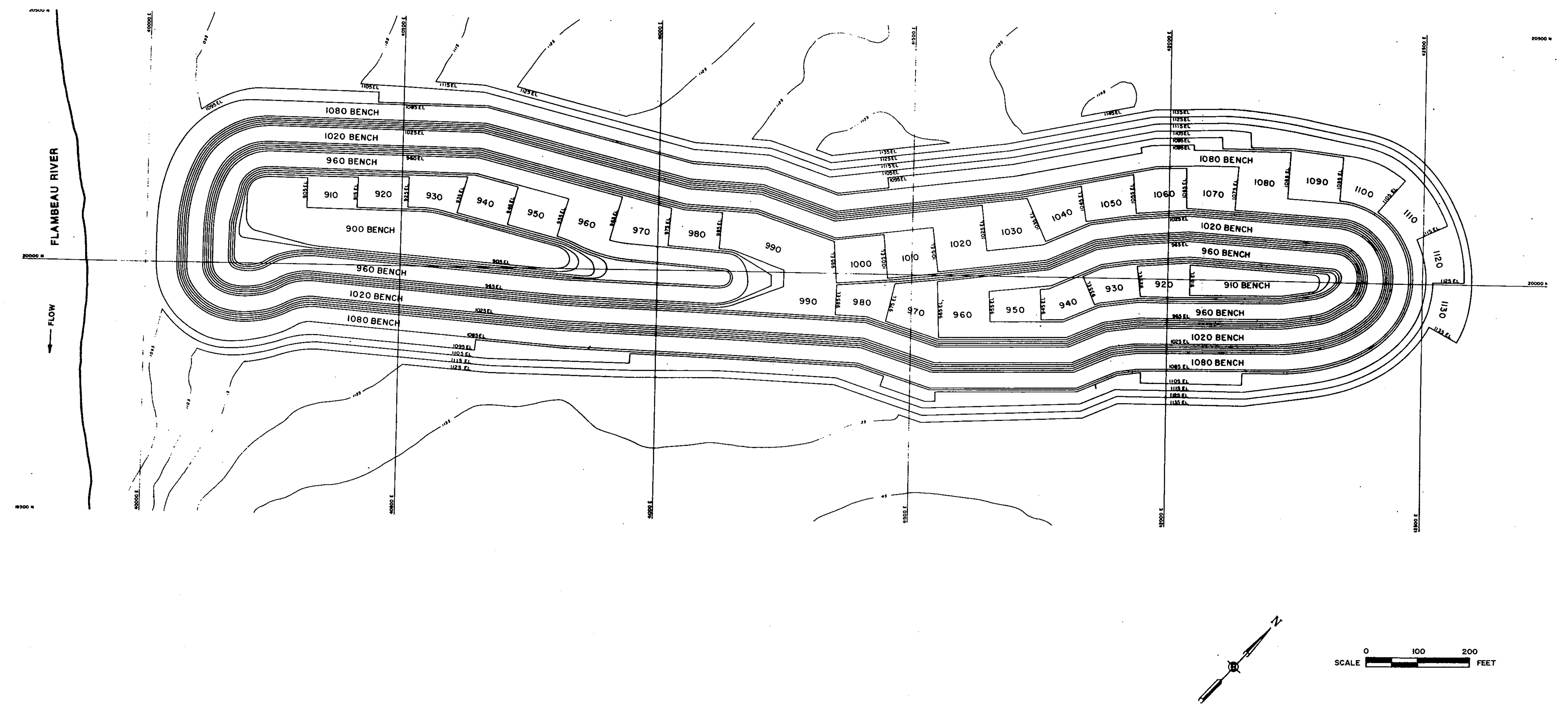
FIGURE NO. 4-36
END OF YEAR 5

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	

REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-37
END OF 3RD QUARTER
YEAR 6
FINAL PIT DESIGN

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

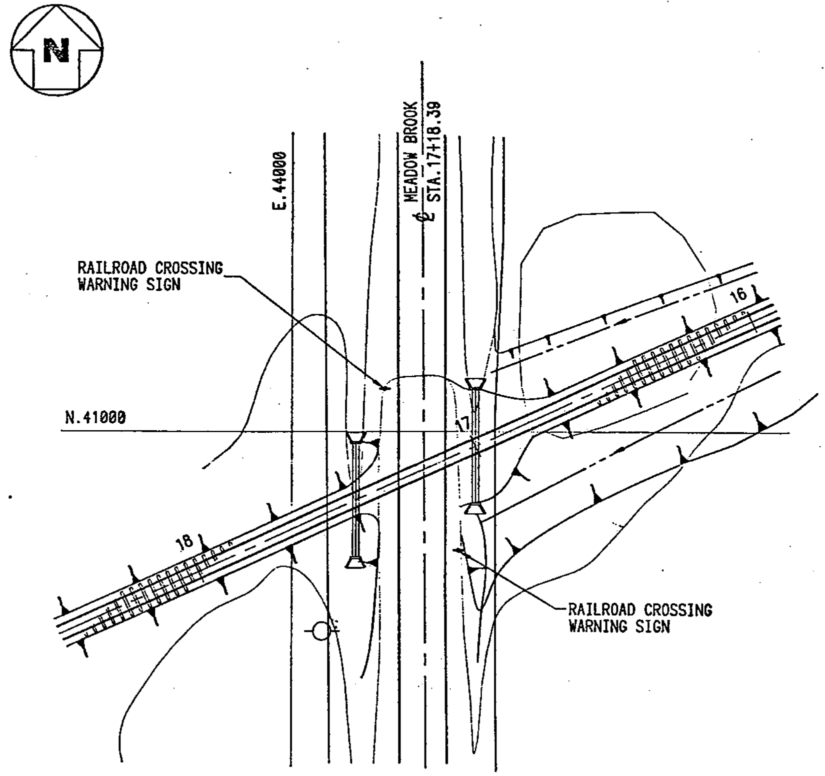
REFERENCES

DWG. NO.	DESCRIPTION

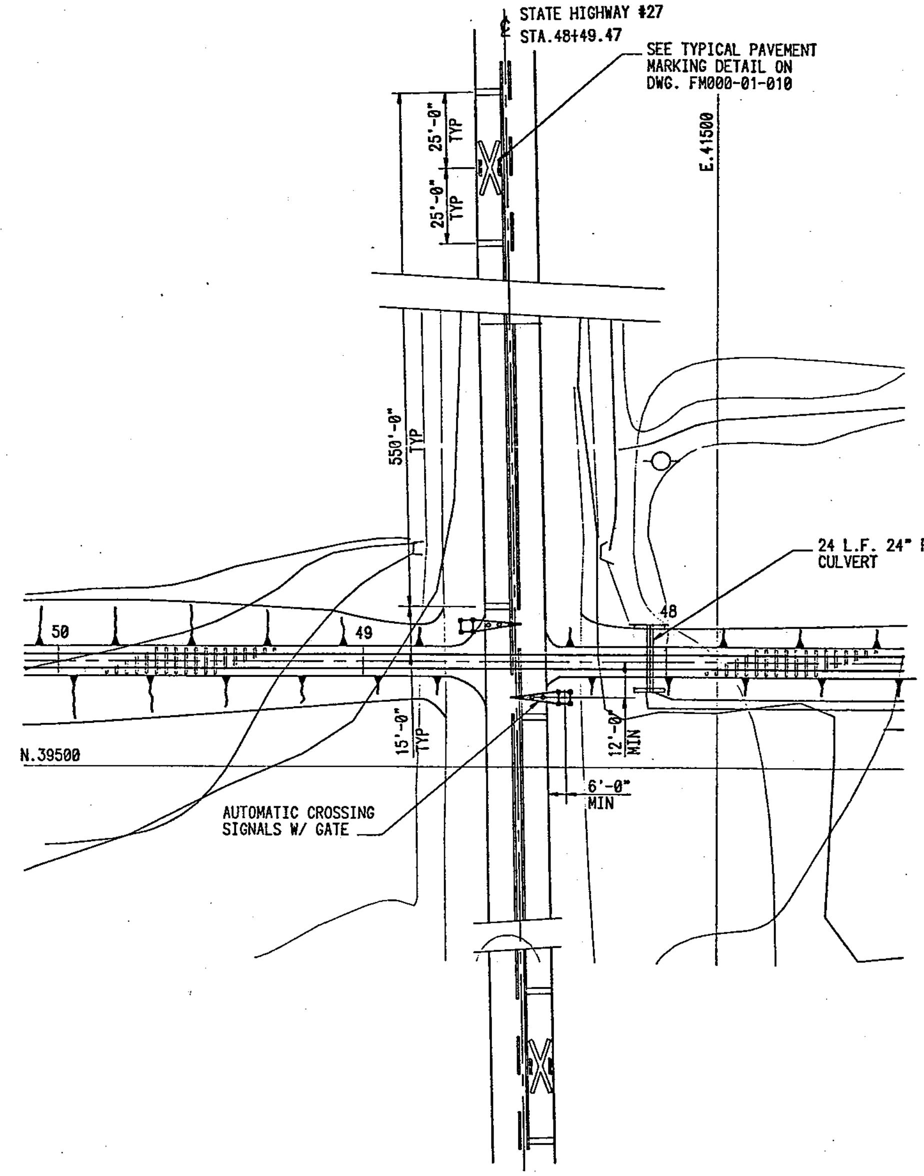
REFERENCES

DWG. NO.	DESCRIPTION

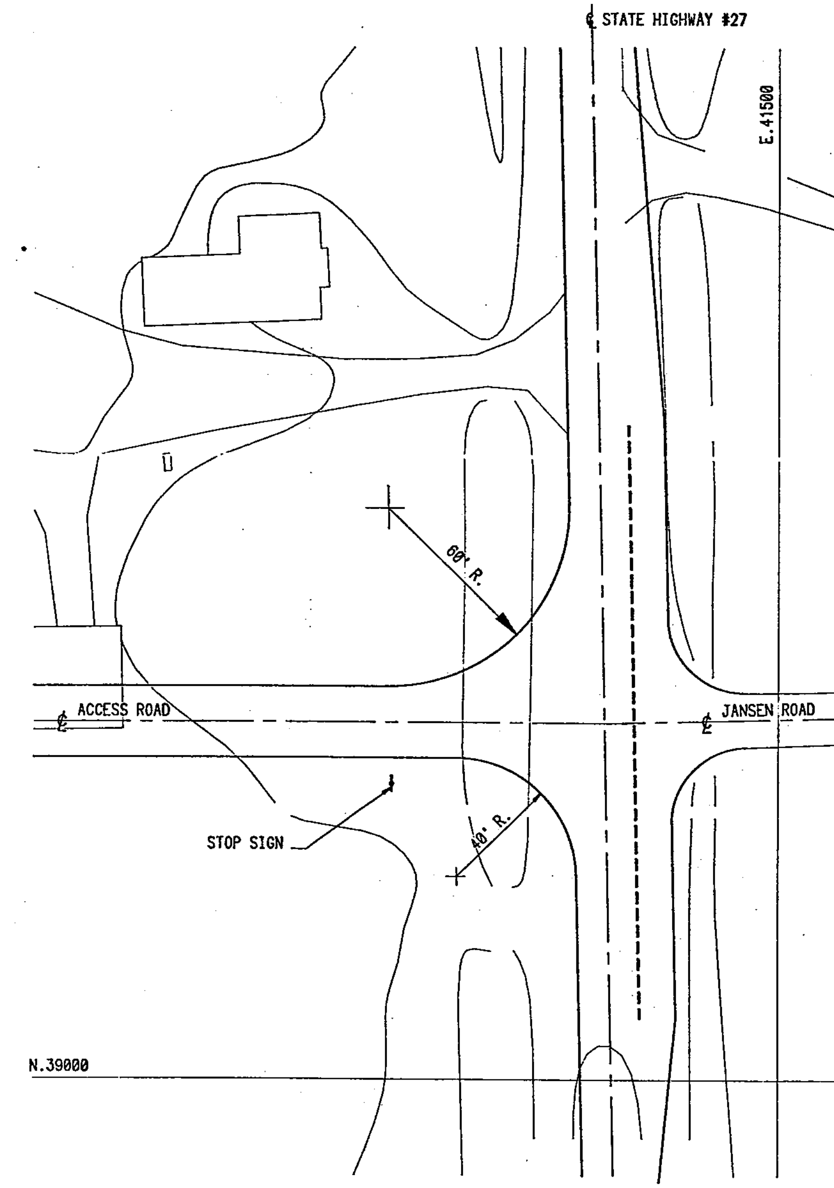
MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	



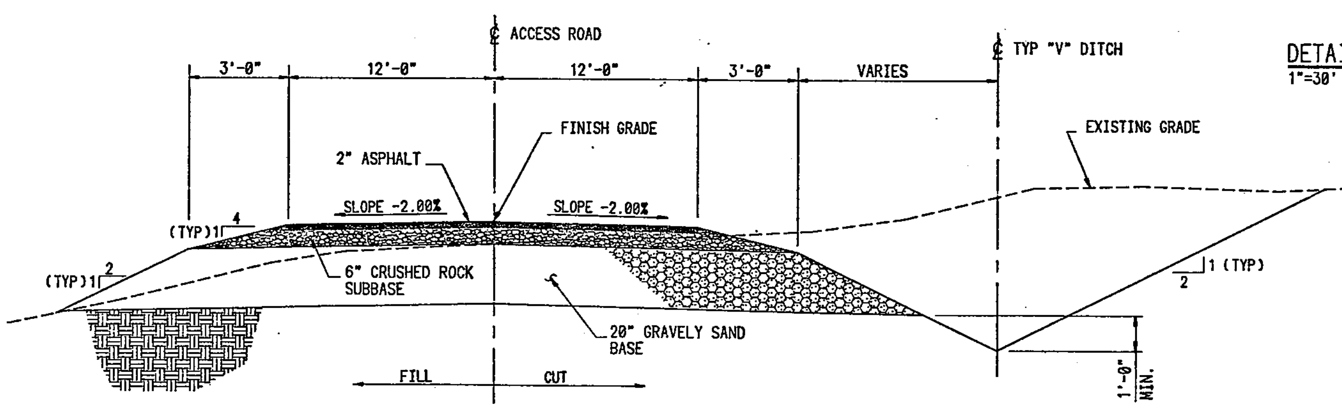
DETAIL 1
1"=30'
FM000-01-003



DETAIL 2
1"=30'
FM000-01-003



DETAIL 3
1"=30'
FM000-01-003



TYPICAL ROAD TANGENT CROSS-SECTION
NTS

REFERENCES DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R
0	12-13-89	GENERAL REVISION	GWW		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

	BY	DATE
DESIGN	CEP	11-11-88
DRAWN	CEP	11-11-88
CHK'D		
DES. ENG'R		
SECT ENG'R		

KENNECOTT MINERALS COMPANY
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SALT LAKE CITY, UTAH
84112

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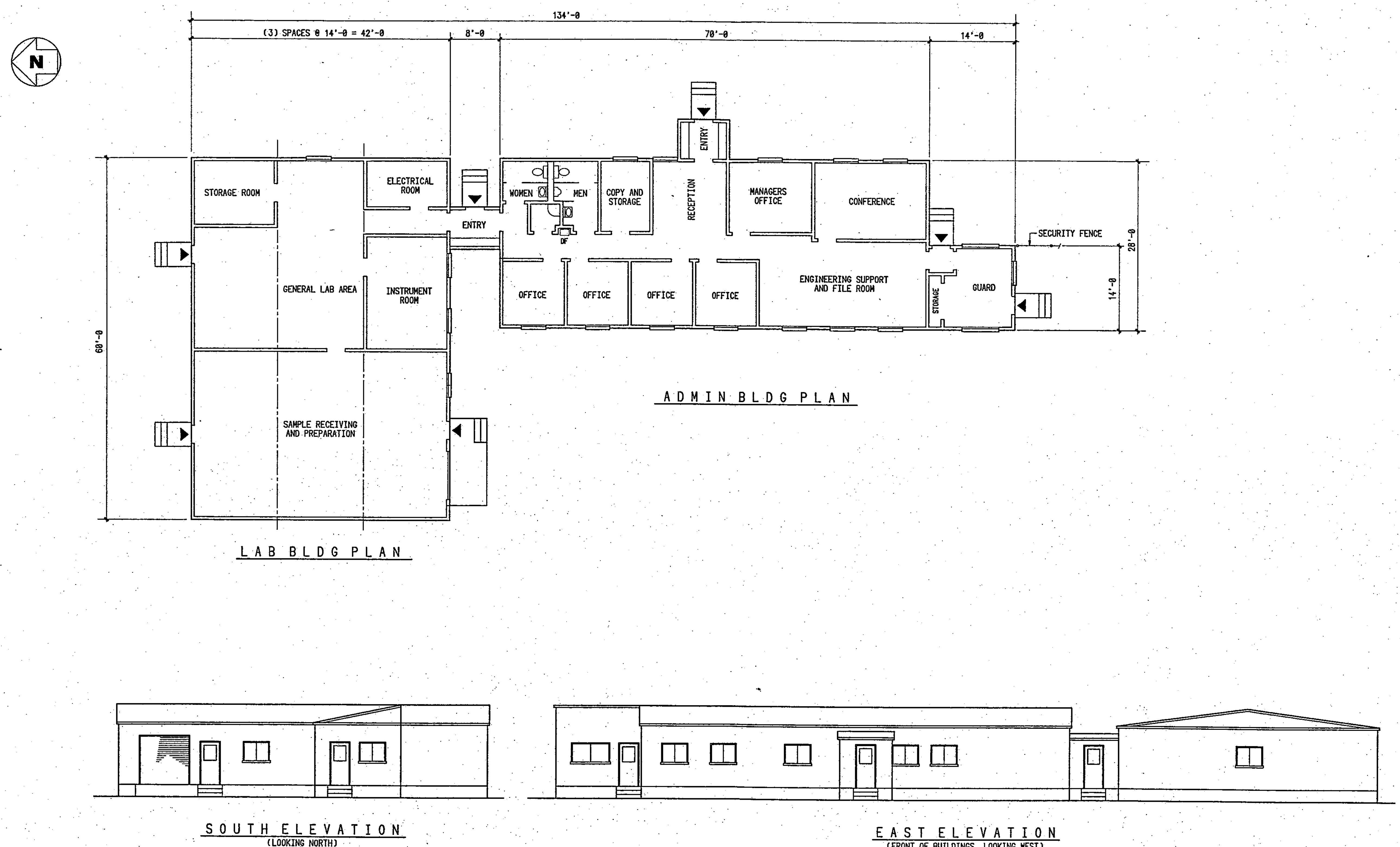
LADYSMITH, WISCONSIN

FIGURE NO. 4-38
RAILROAD SPUR
CROSSING PLANS &
ROAD SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-012	0
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1"=30'

SK942H



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ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

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FIGURE NO. 4-39
ADMINISTRATION BUILDING
LAB BUILDING
PLANS AND ELEVATIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-008	D
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1/8"=1'-0

	BY	DATE
DESIGN		
DRAWN	BTT	12-13-88
CHK'D		
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

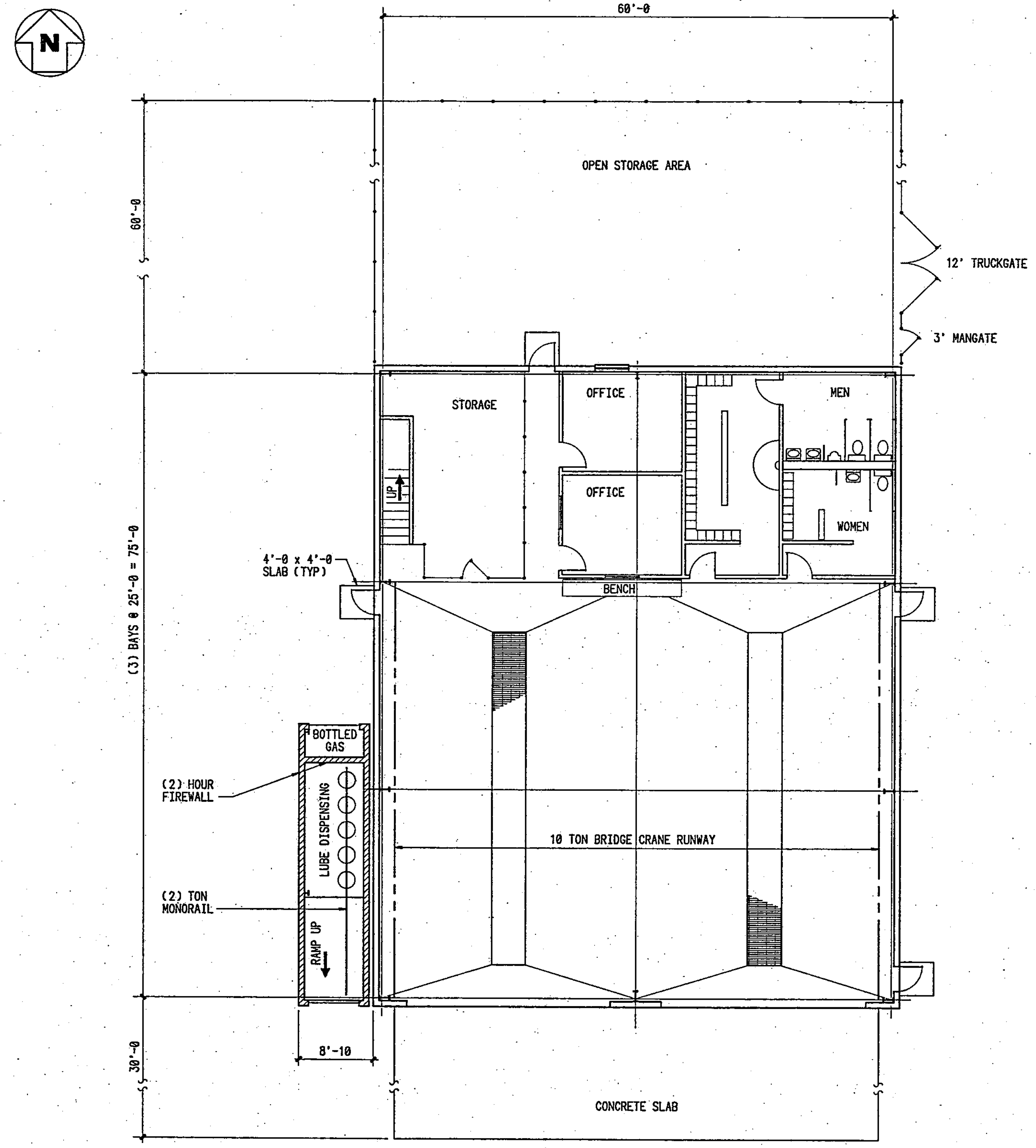
DWG. NO	DESCRIPTION	BY	DATE

DWG. NO	DESCRIPTION

REFERENCES

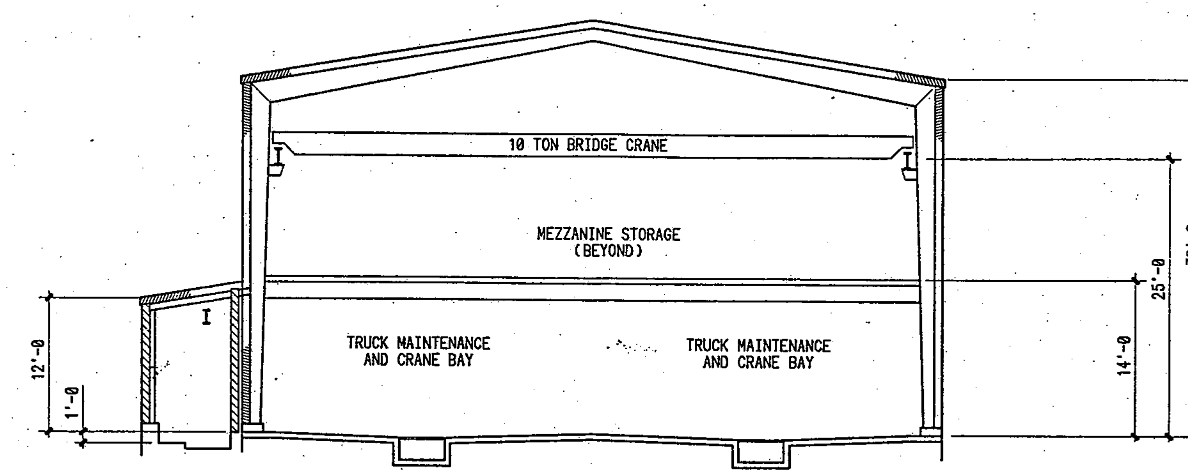
REFERENCES

SL239

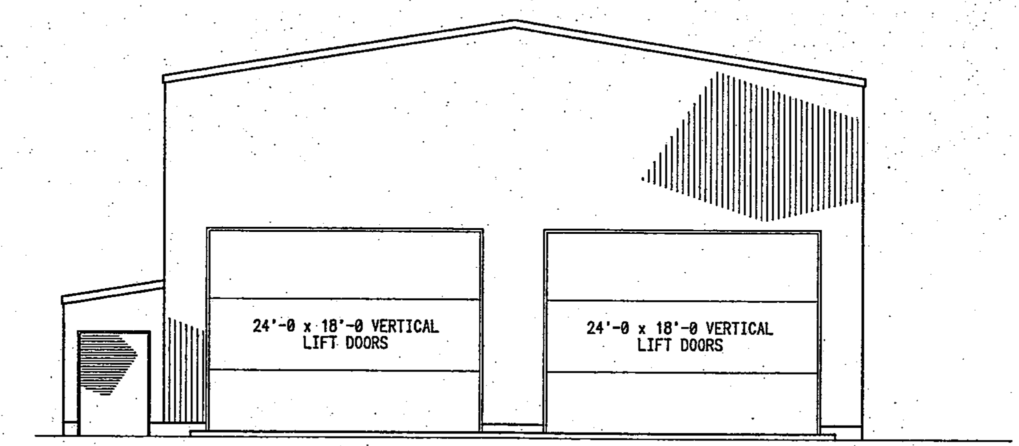


FLOOR PLAN

UBC - TYPE IIN CONSTRUCTION, H4 OCCUPANCY



SECTION



SOUTH ELEVATION

(LOOKING NORTH)

1'0 5' 10'

SCALE 1/8"=1'-0"

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FLAMBEAU PROJECT
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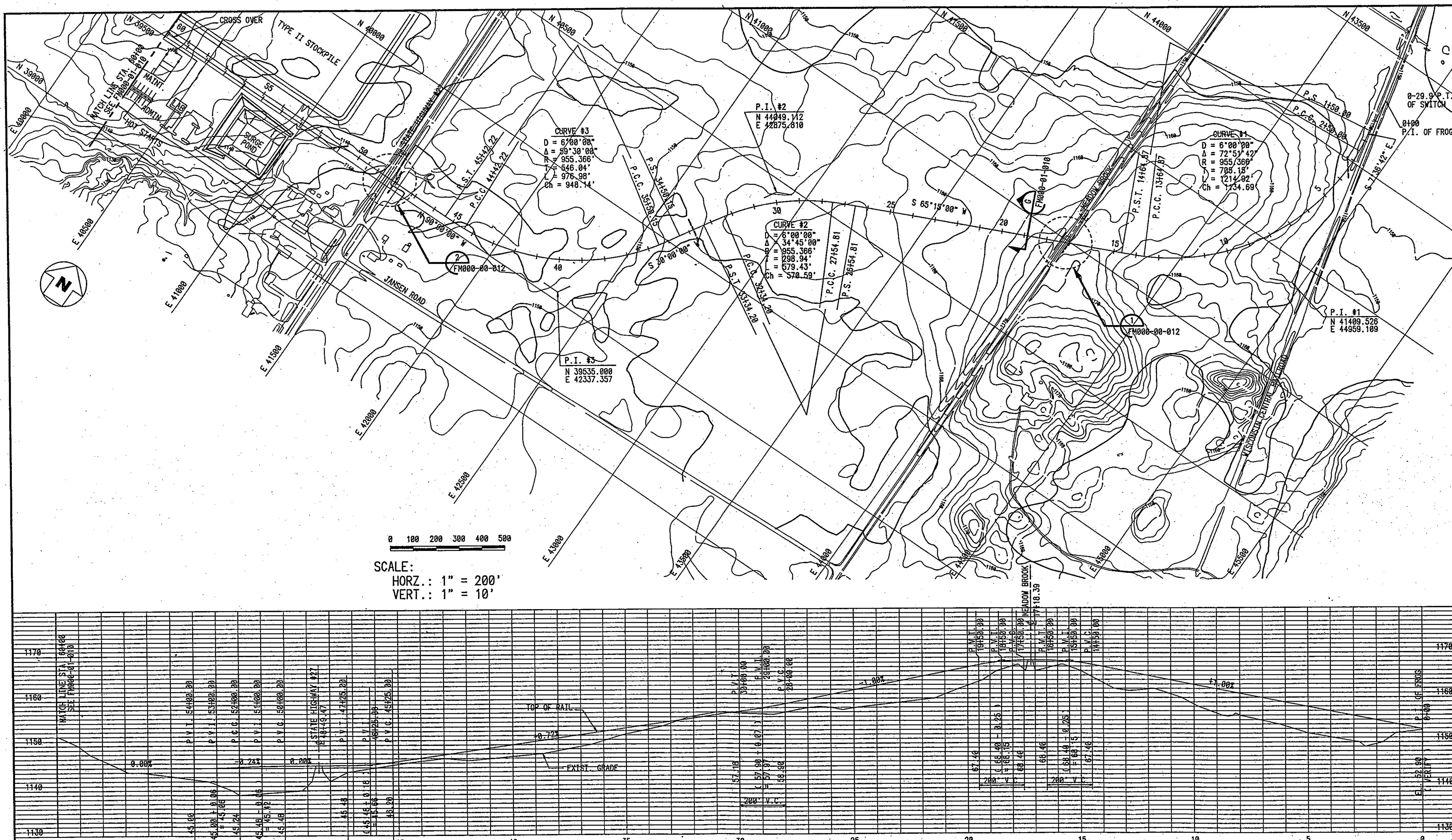
KENNECOTT
MINERALS
COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-40
MAINTENANCE BUILDING
FLOOR PLAN
SECTION AND ELEVATION

	BY	DATE
DESIGN		
DRAWN	BTT	12-12-88
CHK'D		
DES. ENG'R		
SECT ENG'R		

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-009	C
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1/8"=1'-0

SL235E



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KENNECOTT MINERALS COMPANY
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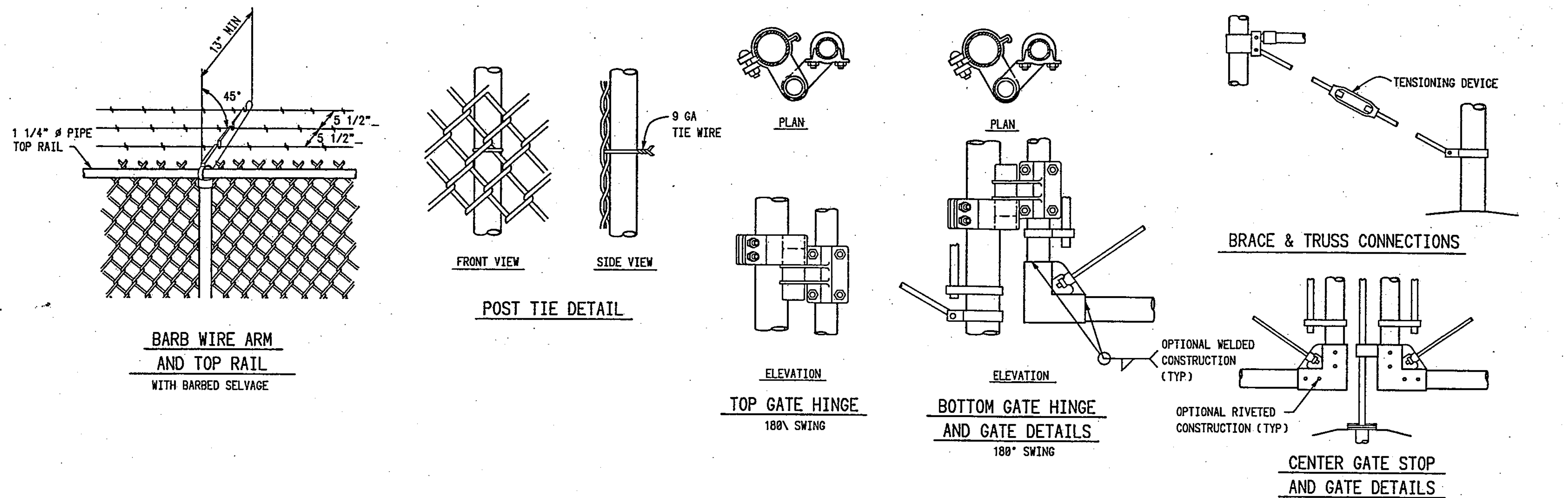
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-41
RAILROAD SPUR

	BY	DATE
DESIGN	CEP	11-09-88
DRAWN	CEP/WCB	11-09-88
CHK'D		
DES. ENG'R		
SECT ENG'R		

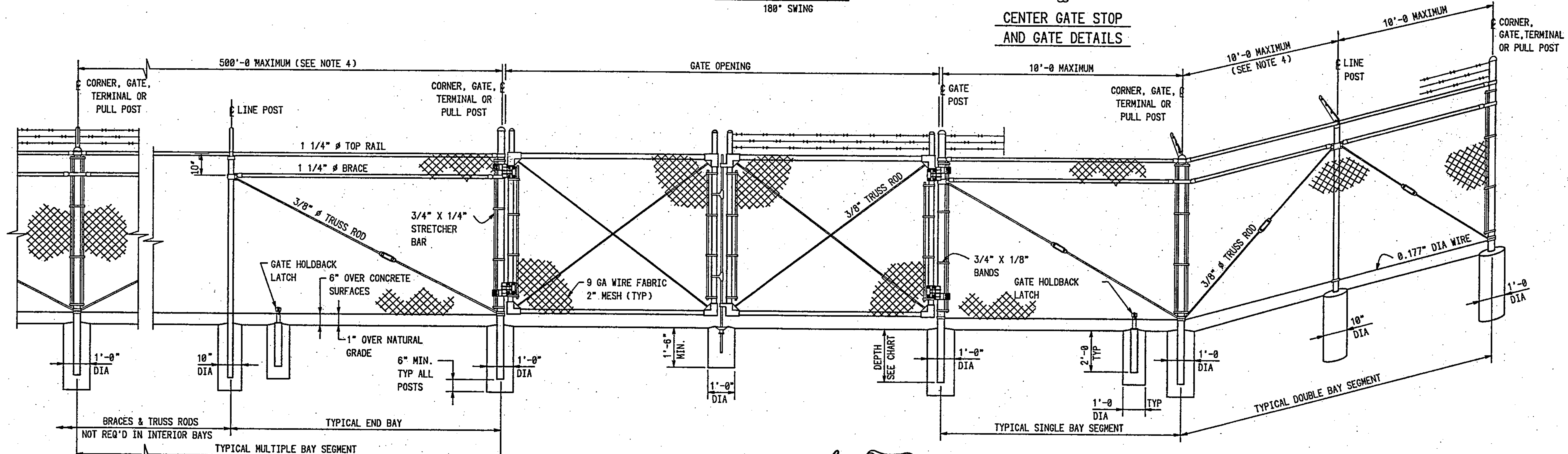
MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-003	F
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	1" = 200'

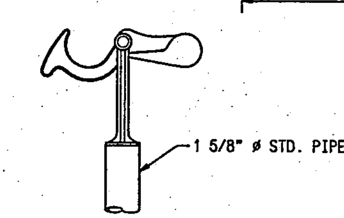
NK5971



NOTES

1. MATERIALS, CONSTRUCTION AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH PROJECT SPECIFICATIONS.
2. ALL STEEL PIPE MEMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM DESIGNATION A-120, SCHEDULE 40, HOT DIPPED ZINC COATED STEEL PIPE.
3. LINE POSTS SHALL BE LOCATED AT EQUAL SPACINGS FOR EACH SEGMENT WITH MAXIMUM SPACING AS FOLLOWS:
   - A. TANGENT SECTIONS TO 500 FEET RADIUS - NOT MORE THAN 10 FEET.
   - B. UNDER 500 FEET RADIUS TO 200 FEET RADIUS - NOT MORE THAN 8 FEET.
   - C. UNDER 200 FEET RADIUS TO 100 FEET RADIUS - NOT MORE THAN 6 FEET.
   - D. UNDER 100 FEET RADIUS - NOT MORE THAN 5 FEET.
4. PULL POST SHALL BE PROVIDED AT NOT MORE THAN 500 FEET MAXIMUM INTERVALS.





GATE HOLDBACK LATCH
SIDE VIEW

HEIGHT OF FABRIC	DEPTH OF POSTS	LENGTH OF END, CORNER OR PULL POSTS	LENGTH OF LINE POSTS	SIZE OF POSTS: CORNER, END & PULL	LINE POSTS (MIN)	GATE POSTS
7'	3'	10'	9'-8	2 1/2"	2"	SEE GATE POST TABLE
6'	3'	9'	8'-8	2 1/2"	2"	
5'	3'	8'	7'-8	2"	1 1/2"	
4'	2'	6'	5'-8	2"	1 1/2"	
3'	2'	5'	4'-8	2"	1 1/2"	

GATES
GATE POSTS AND GATE FRAMES

HEIGHT	GATE OPENING	GATE POST	GATE FRAME
UNDER 6 FEET	SINGLE TO 6' OR DOUBLE TO 12'	2"	1"
	SINGLE OVER 6' TO 8' OR DOUBLE OVER 12' TO 16'	2 1/2"	1 1/2"
	SINGLE OVER 8' TO 12' OR DOUBLE 16' TO 24'	3 1/2"	
6 FEET AND OVER	SINGLE TO 6' OR DOUBLE TO 12'	2 1/2"	1 1/2"
	SINGLE OVER 6' TO 13' OR DOUBLE OVER 12' TO 24'	3 1/2"	
	SINGLE OVER 13' TO 18' OR DOUBLE OVER 24' TO 36'	6"	
	SINGLE OVER 18' OR DOUBLE OVER 36'	8"	

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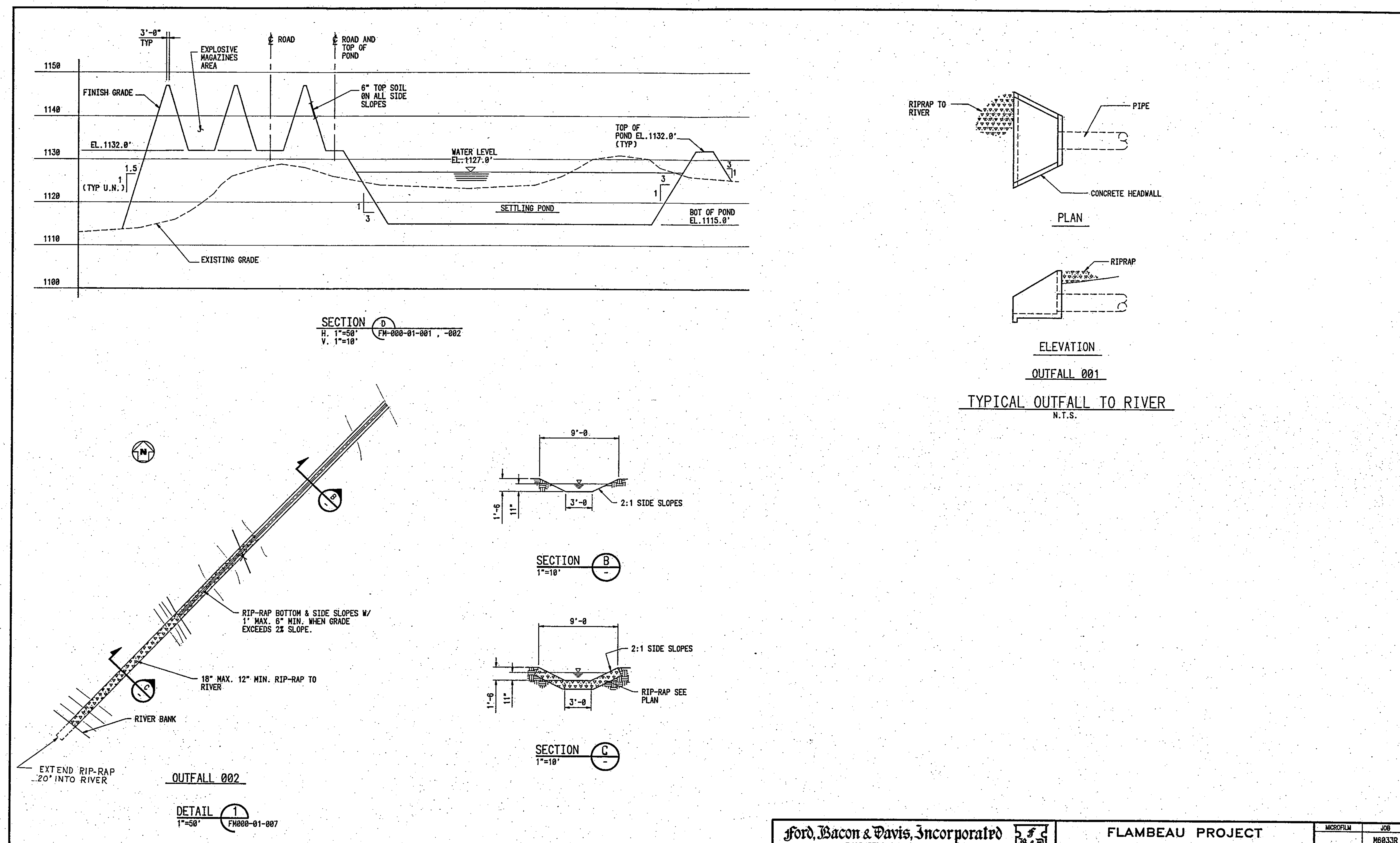
SALT LAKE CITY, UTAH 84112

FIGURE NO. 4-42
FENCING DETAILS

DRAWN	WCB 11-1-88
MICROFILM	
JOB	W6033R
DRAWING NO.	FM000-01-006
REV.	C
DIVISION DRAWING NO.	OWNER OPERATED
SCALE	NOTED

REFERENCES: DWG. NO — DESCRIPTION
REVISIONS: NO — DATE — BY — CHK'D — ENG'R



REFERENCES DWG. NO	DESCRIPTION	DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R
					1/2/90	Extend rip-rap into river	DJK		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

	BY	DATE
DESIGN		
DRAWN	GB	1-5-89
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

PROJ. ENG'R
MGR PROCESS ENG'R
ENG'R MGR

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
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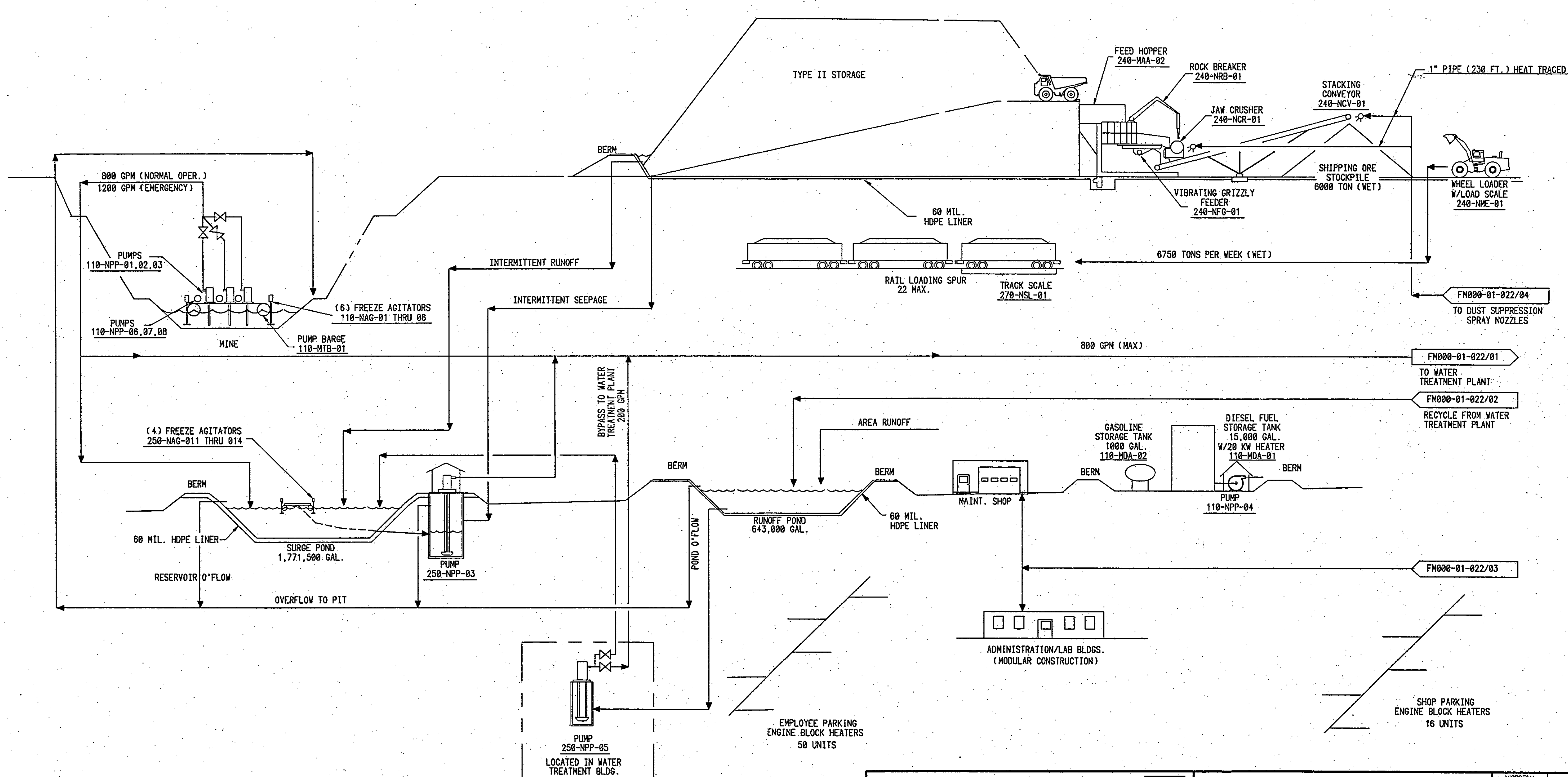
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4-43
SITE GRADING
MISC. SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM-000-01-015	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NOTED

SL318E



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FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-44
FLOW SHEET
MINE FACILITY

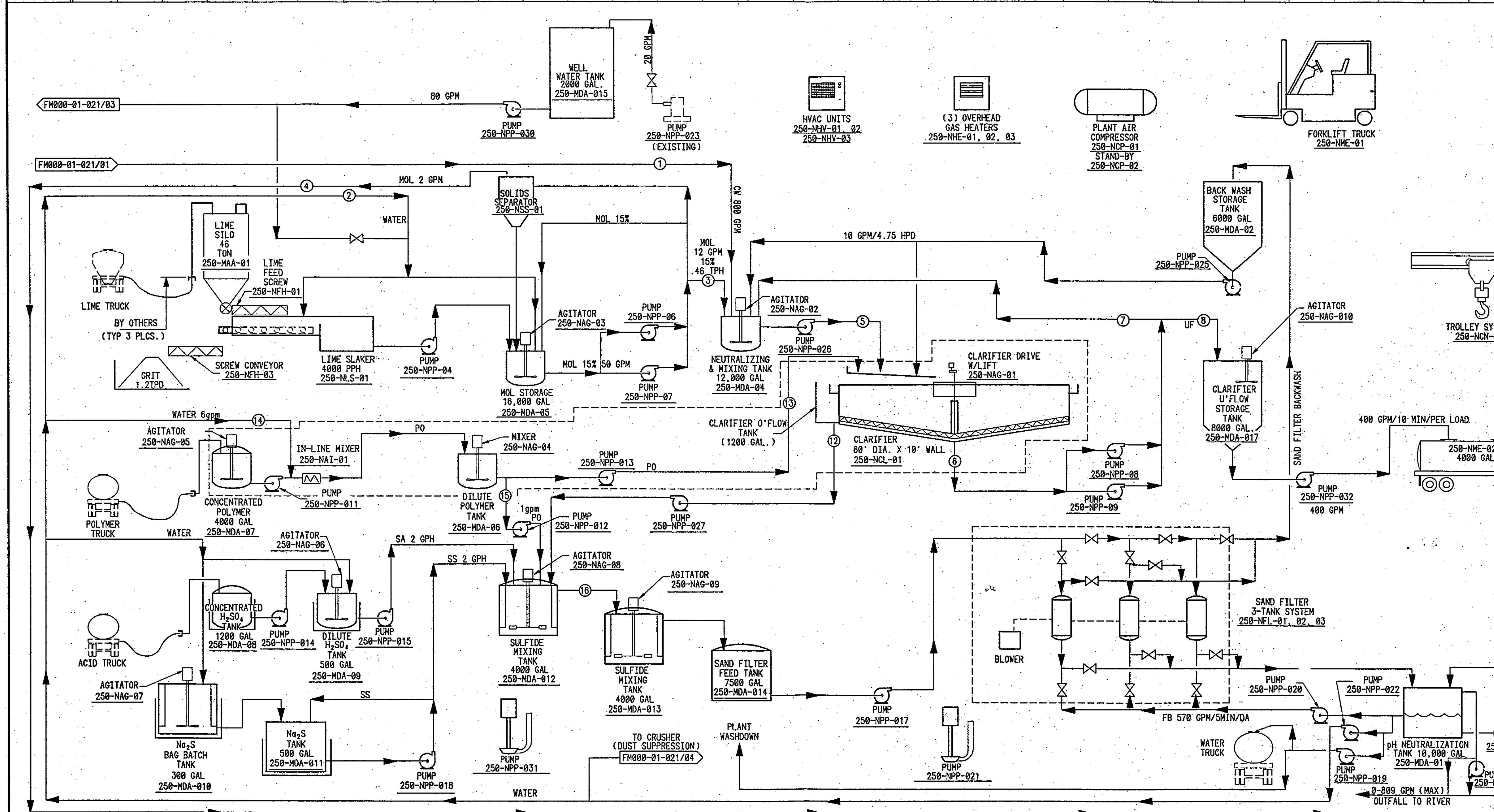
NO	DATE	REVISIONS	BY
1	3/8/89	GENERAL REVISION	PSH

	BY	DATE
PROJ. ENG'R	JLC	11/4/88
DESIGN	DK	9/20/88
DRAWN	TEQ	10/21/88
CHK'D	HJV	11/3/88
DES. ENG'R	JLC	2/1/89

MICROFILM | JOB M6033R
DRAWING NO. FM000-01-021 | REV. 1
DIVISION DRAWING NO.
OWNER OPERATED
SCALE NONE

HK697C

PROCESS PORT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
GPM	800	58.7	12	2	1197	396.3	375	21.3				795.7	5	6	1	796.7													
#/MIN (SOLID)	6.7	0	15.3	0	991.5	991.5	938.3	53.2				0	0	0	0	0													
SG (SLURRY)	1.00	1.00	1.09	1.01	1.06	1.2	1.2	1.2				0	1.0	1.0	1.0	1.0													
ph	3.5	7.0	12	12	8.5	8.5	8.5	8.5				8.5	7.0	7.0	7.0	6.0													
% SUSPENDED SOLIDS	0.1	0	15	0	8.1	25	25	25				0	0	0	0	0													



LEGEND:

CW	CONTAMINATED WATER
MOL	MILK OF LIME
TF	CLARIFIER FEED
OF	CLARIFIER OVERFLOW
UF	CLARIFIER UNDERFLOW
PO	POLYMER
SA	SULFURIC ACID (H_2SO_4)
SS	SODIUM SULFIDE (Na_2S)
FF	FILTER FEED
FB	FILTER BACKWASH
FI	FILTRATE
GPM	GALLONS PER MINUTE
GPH	GALLONS PER HOUR
TPH	TONS PER HOUR (DRY)
%	PERCENT SOLIDS
TPD	TONS PER DAY
DA	24 HOURS
MIN	MINUTES
PPH	POUNDS PER HOUR
HPD	HOURS PER DAY

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FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-45
WATER TREATMENT
PLANT
FLOW SHEET

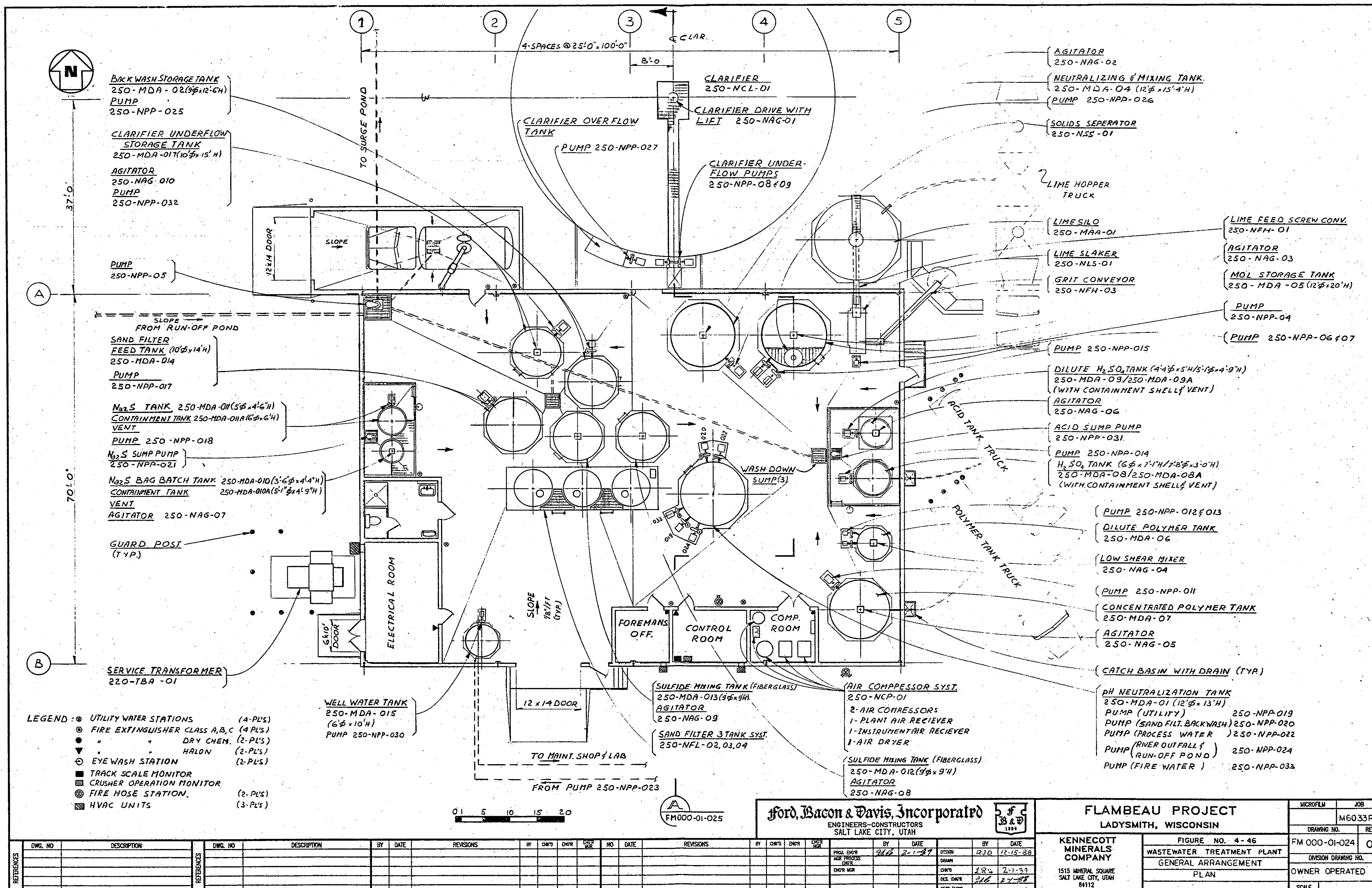
MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM0001-01-022	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NONE

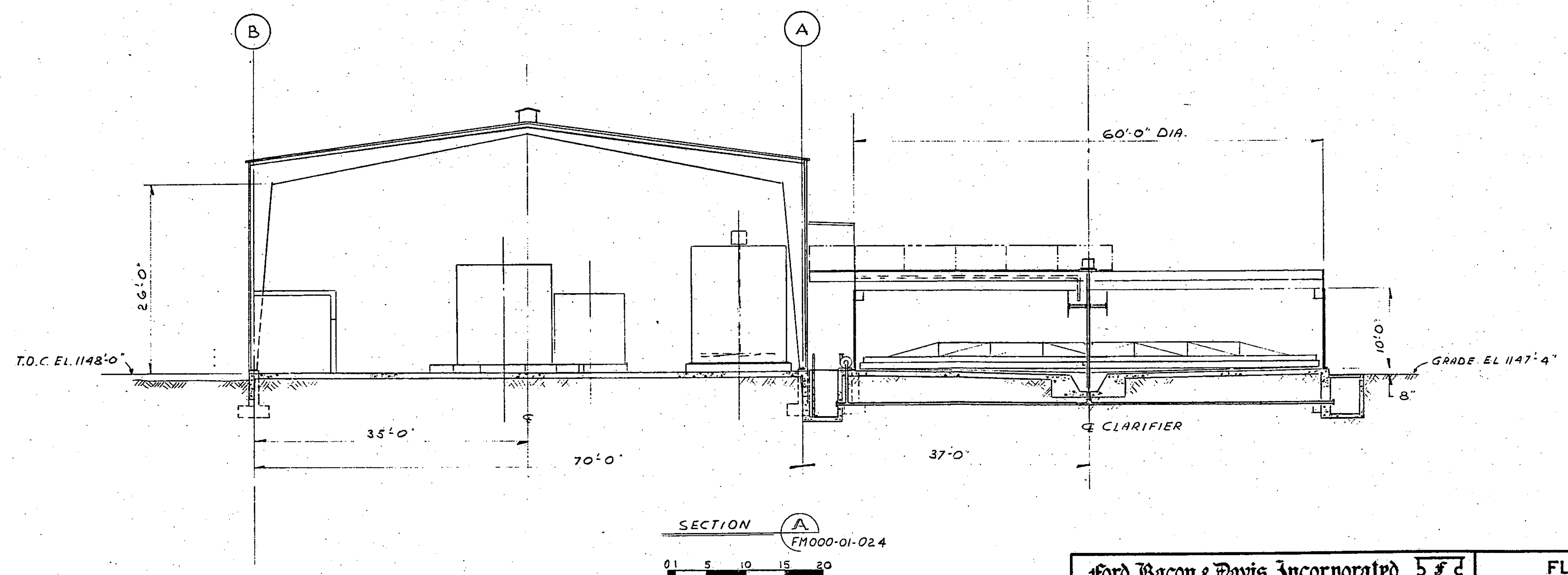
NO	DATE	REVISIONS	BY	CHK'D	ENG'R	
0	2/1	ISSUED FOR CLIENT REVIEW	TEQ	LRH	JLC	DK
1	2/9	MISC. REVISIONS	TEQ	LRH	JLC	DK

	BY	DATE
PROJ. ENG'R	JLC	11-4-88
DESIGN	TB	4-22-88
DRAWN	WCB	4-27-88
CHK'D	HJV	11-4-88

REFERENCES: DWG. NO | DESCRIPTION

MJ492D


BACK WASH STORAGE TANK
250-MDA-02(9'Ø x 12'-6"H)
PUMP
250-NPP-025
CLARIFIER UNDERFLOW STORAGE TANK
250-MDA-017(10'Ø x 15'H)
AGITATOR
250-NAG-010
PUMP
250-NPP-032
PUMP
250-NPP-05
SLOPE FROM RUN-OFF POND
SAND FILTER FEED TANK (10'Ø x 14'H)
250-MDA-014
PUMP
250-NPP-017
Na_2S TANK 250-MDA-011(5'Ø x 4'-6"H)
CONTAINMENT TANK 250-MDA-011A(6'Ø x 6'H)
VENT
PUMP 250-NPP-018
Na_2S SUMP PUMP
250-NPP-021
Na_2S BAG BATCH TANK 250-MDA-010(3'-6"Ø x 4'-4"H)
CONTAINMENT TANK 250-MDA-010A(5'-1"Ø x 4'-9"H)
VENT
AGITATOR 250-NAG-07
GUARD POST (TYP.)
SERVICE TRANSFORMER
220-TBA-01
TO SURGE POND
12x14 DOOR
SLOPE
4-SPACES @ 25'-0" = 100'-0"
8'-0
CL CLAR.
37'-0"
70'-0"
CLARIFIER
250-NCL-01
CLARIFIER DRIVE WITH LIFT 250-NAG-01
CLARIFIER OVER FLOW TANK
PUMP 250-NPP-027
CLARIFIER UNDER-FLOW PUMPS
250-NPP-08 & 09
ELECTRICAL ROOM
6'x10' DOOR
SLOPE 1/8"/FT (TYP.)
12 x 14 DOOR
FOREMANS OFF.
CONTROL ROOM
COMP. ROOM
WASH DOWN SUMP(3)
WELL WATER TANK
250-MDA-015
(6'Ø x 10'H)
PUMP 250-NPP-030
TO MAINT. SHOP & LAB
FROM PUMP 250-NPP-023
SULFIDE MIXING TANK (FIBERGLASS)
250-MDA-013(9'Ø x 9'H)
AGITATOR
250-NAG-09
SAND FILTER 3 TANK SYST.
250-NFL-02,03,04
AIR COMPRESSOR SYST.
250-NCP-01
2-AIR COMPRESSORS
1-PLANT AIR RECIEVER
1-INSTRUMENT AIR RECIEVER
1-AIR DRYER
SULFIDE MIXING TANK (FIBERGLASS)
250-MDA-012(9'Ø x 9'H)
AGITATOR
250-NAG-08
AGITATOR
250-NAG-02
NEUTRALIZING & MIXING TANK.
250-MDA-04 (12'Ø x 15'-4"H)
PUMP 250-NPP-026
SOLIDS SEPERATOR
250-NSS-01
LIME HOPPER TRUCK
LIME SILO
250-MAA-01
LIME SLAKER
250-NLS-01
GRIT CONVEYOR
250-NFH-03
LIME FEED SCREW CONV.
250-NFH-01
AGITATOR
250-NAG-03
MOL STORAGE TANK
250-MDA-05 (12'Ø x 20'H)
PUMP
250-NPP-04
PUMP 250-NPP-06 & 07
PUMP 250-NPP-015
DILUTE H_2SO_4 TANK (4'-4"Ø x 5'H/5'-1"Ø x 4'-9"H)
250-MDA-09/250-MDA-09A
(WITH CONTAINMENT SHELL & VENT)
AGITATOR
250-NAG-06
ACID SUMP PUMP
250-NPP-031
PUMP 250-NPP-014
H_2SO_4 TANK (6'Ø x 7'-1"H/7'-8"Ø x 3'-0"H)
250-MDA-08/250-MDA-08A
(WITH CONTAINMENT SHELL & VENT)
ACID TANK TRUCK
POLYMER TANK TRUCK
PUMP 250-NPP-012 & 013
DILUTE POLYMER TANK
250-MDA-06
LOW SHEAR MIXER
250-NAG-04
PUMP 250-NPP-011
CONCENTRATED POLYMER TANK
250-MDA-07
AGITATOR
250-NAG-05
CATCH BASIN WITH DRAIN (TYP.)
pH NEUTRALIZATION TANK
250-MDA-01 (12'Ø x 13'H)
PUMP (UTILITY) 250-NPP-019
PUMP (SAND FILT. BACKWASH) 250-NPP-020
PUMP (PROCESS WATER) 250-NPP-022
PUMP (RIVER OUTFALL & RUN-OFF POND) 250-NPP-024
PUMP (FIRE WATER) 250-NPP-033
LEGEND:
UTILITY WATER STATIONS (4-PL'S)
FIRE EXTINGUISHER CLASS A,B,C (4 PL'S)
" " DRY CHEM. (2-PL'S)
" " HALON (2-PL'S)
EYE WASH STATION (2-PL'S)
TRACK SCALE MONITOR
CRUSHER OPERATION MONITOR
FIRE HOSE STATION. (2-PL'S)
HVAC UNITS (3-PL'S)
0 5 10 15 20
A
FM000-01-025
Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH
FB&D 1894
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN
KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112
FIGURE NO. 4-46
WASTEWATER TREATMENT PLANT
GENERAL ARRANGEMENT
PLAN
MICROFILM
JOB
M6033R
DRAWING NO.
REV.
FM 000-01-024
0
DIVISION DRAWING NO.
OWNER OPERATED
SCALE
REFERENCES
DWG. NO
DESCRIPTION
BY
DATE
REVISIONS
CHK'D
ENG'R
ENG'R MGR
NO
PROJ. ENG'R
MGR PROCESS ENG'R
ENG'R MGR
DESIGN
RJD 12-15-88
DRAWN
CHK'D
DES. ENG'R
SECT. ENG'R



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FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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84112

FIGURE NO. 4-47
WASTEWATER
TREATMENT PLANT ELEVATION

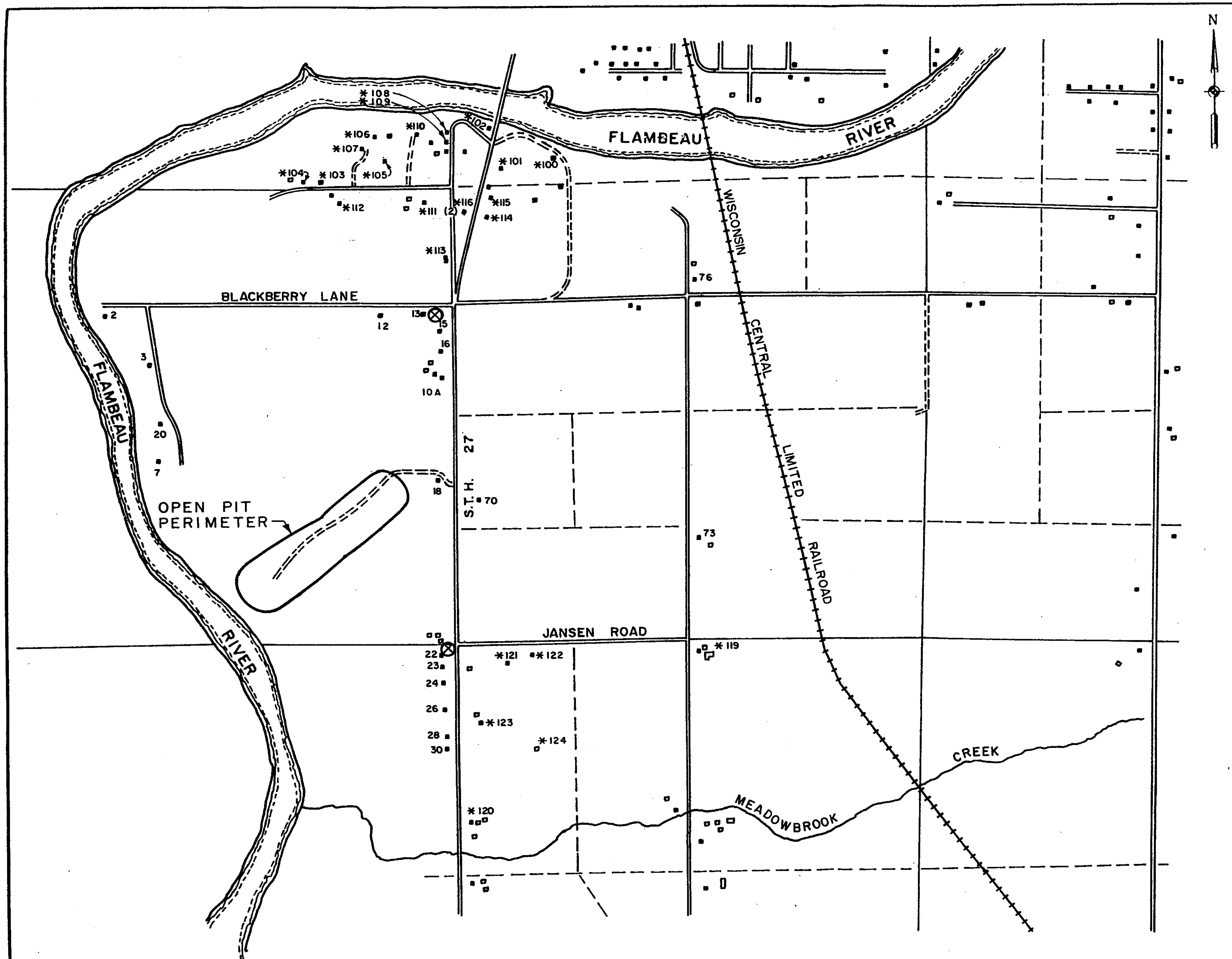
MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-025	O
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

	BY	DATE
PROJ. ENG'R	JLB	2-1-89
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	RJD	12-17-88
DRAWN		
CHK'D	JQG	2-1-89
DES. ENG'R	[illegible]	2-1-89
SECT ENG'R		

DWG. NO	DESCRIPTION	DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

REFERENCES
REFERENCES



LEGEND

2 FLAMBEAU — OWNED BUILDINGS TO BE INCLUDED IN THE PREBLAST SURVEY

100 * NON FLAMBEAU OWNED BUILDINGS TO BE INCLUDED IN THE PREBLAST SURVEY

⊗ BLAST MONITOR SITE

▪ NON FLAMBEAU OWNED BUILDINGS

PRODUCED FROM USGS LADYSMITH AND THORNAPPLE 7.5 MINUTE SERIES TOPOGRAPHIC MAPS

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-48
PREBLAST SURVEY PLAN

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R
	12/89	NAME AND SCALE	MJO	GWS	

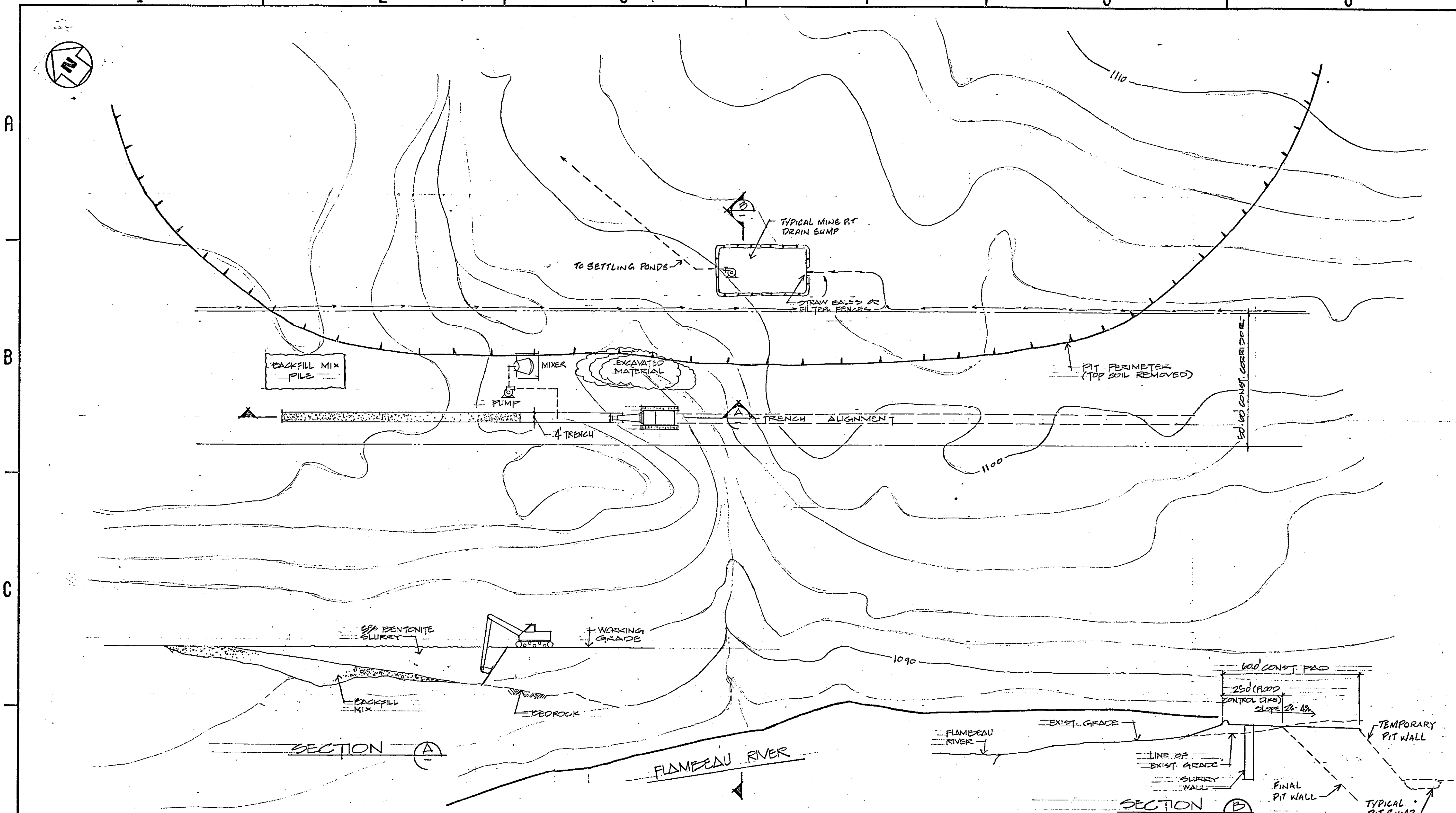
	BY	DATE
DESIGN		
DRAWN	R.M.H.	3/89
CHK'D	G.W.S.	3/89
DES. ENG'R		
SECT. ENG'R		

MICROFILM | JOB

DRAWING NO. | REV.

DIVISION DRAWING NO.

SCALE SEE BAR SCALE



REVISIONS

NO	DESCRIPTION	DATE	BY	CHK	APP
	REVISED MINE SUMP & DISCHARGE	12/19/89	GT		

REFERENCE DRAWINGS — DRAWING NO / TITLE

ISSUE RECORD — DATE / ISS / REV / TO / FOR

ENGR RECORD

	BY	DATE
DRAWN	SWW	5-1-89
CHECKED		
ELEC CHECK		
INST CHECK		
MECH CHECK		
PIPING CHECK		
STRUCT CHECK		
SQUAD LEADER		
CHIEF ENG/DES		
PROJECT ENG		
APPROVED		
APPROVED		

CURRENT DRAWING STATUS

	BY	DATE
PRELIMINARY OR PLANNING		
APPROVED FOR FINAL DESIGN		
IN FINAL DESIGN		
APPROVED FOR QUOTE/PURCH		
APPROVED FOR CONSTRUCTION		

Ford, Bacon & Davis, Incorporated
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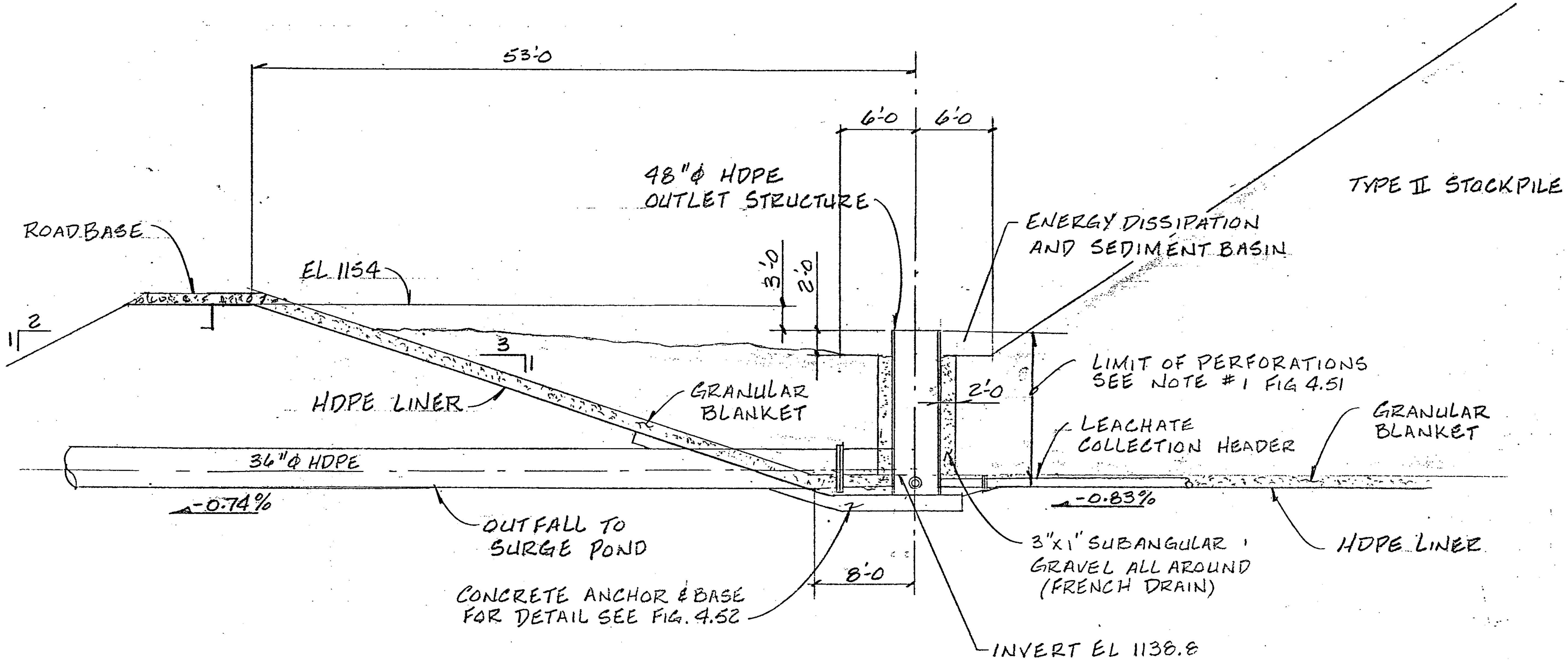
UTAH DIVISION SALT LAKE CITY, UTAH

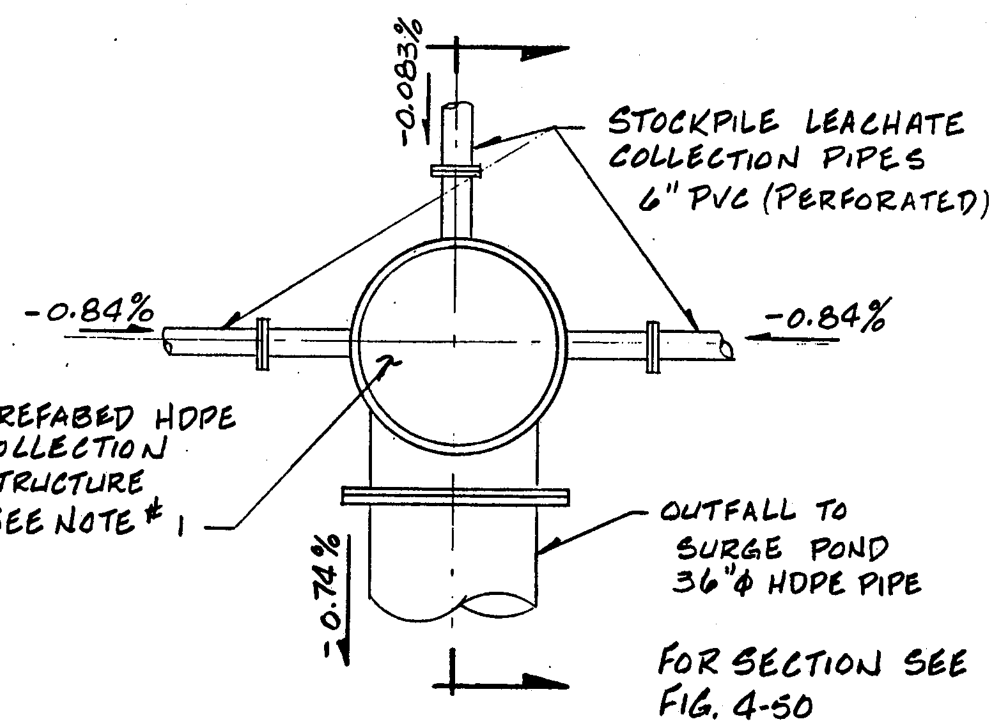
TITLE
FIGURE NO. 4-49
FLAMBEAU PROJECT
SLURRY WALL
PLAN AND SECTIONS

FOR KENNECOTT MINERALS COMPANY

SCALE | JOB NO | FB&D DWG NO | OWNERS DWG NO FM000-01-017 | REV 0



Ford, Bacon & Davis Utah, Inc. ENGINEERS – CONSTRUCTORS P.O. BOX 58009 – SALT LAKE CITY, UTAH 84158-0009			
FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY GLT	DATE 11-89
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO: 4-50	SKETCH NO.	REV. A
	TYPE II STOCKPILE		
	DRAINAGE DETAILS		
		SCALE	



PLAN

NOTES:

1- COLLECTION STRUCTURE TO BE 48"φ HDPE SDR 13.5 WITH 1/2"φ PERFORATIONS ALL AROUND @ 12" O.C. STAGGER PERFORATIONS IN THE VERTICAL DIRECTION BETWEEN THE LIMITS SHOWN ON FIG. 4.50

2- ALL PIPE STUBOUTS, HDPE PLATES AND CONNECTIONS TO BE SHOP FABRICATED JOINTS.

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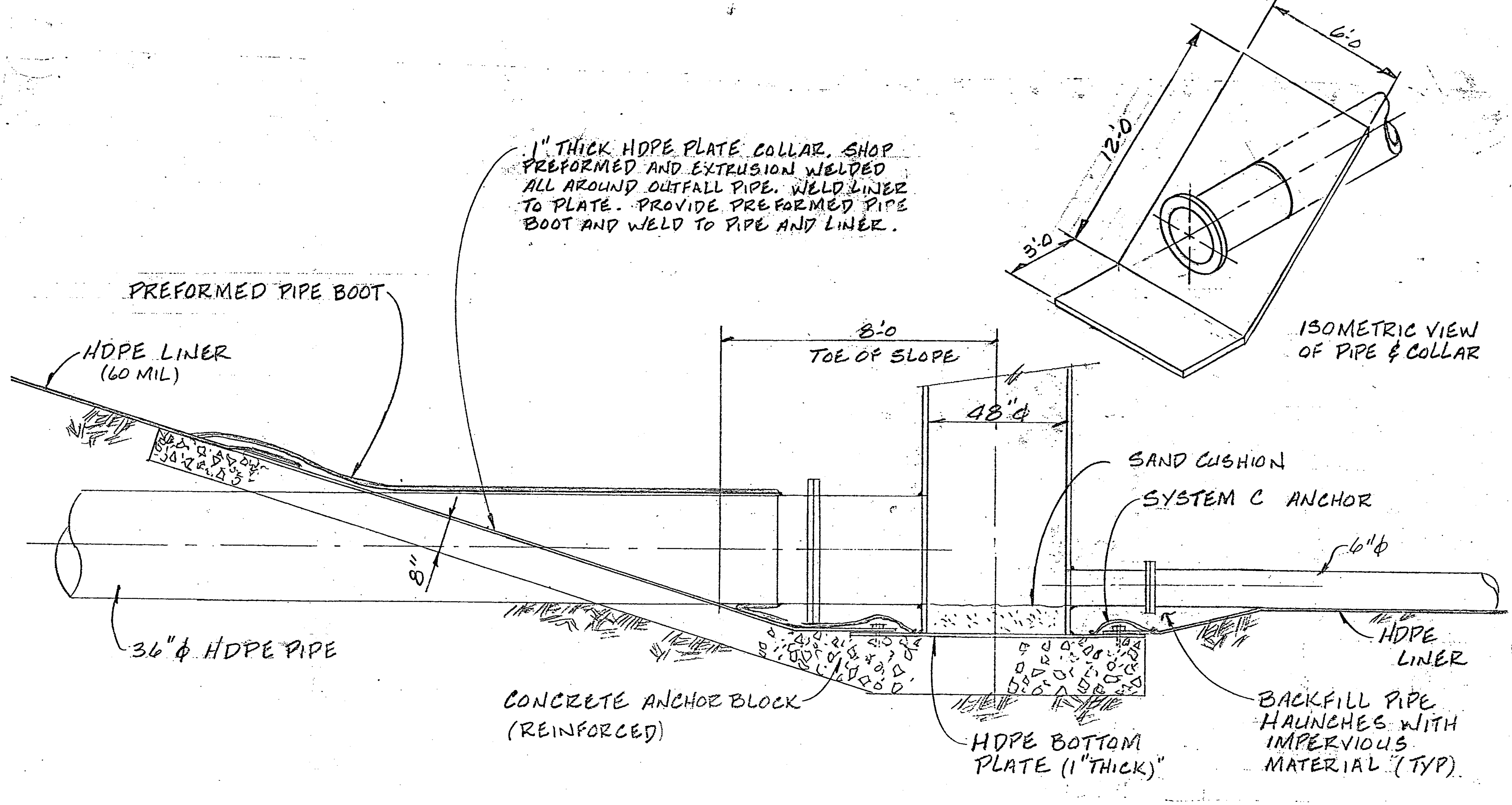
FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY GLT / DATE 11-89 / SKETCH NO. / REV. B
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO. 4-51 TYPE II STOCKPILE DISCHARGE STRUCTURE RUNOFF—LEACHATE	SCALE NONE



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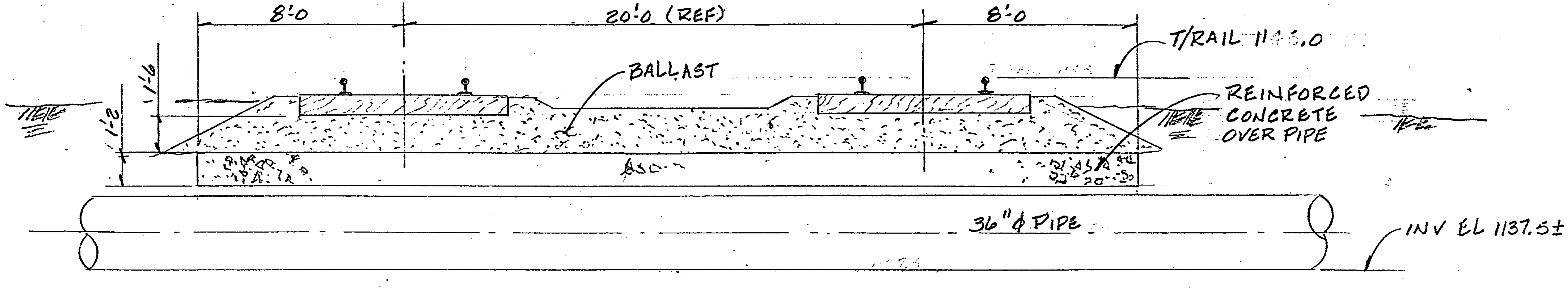
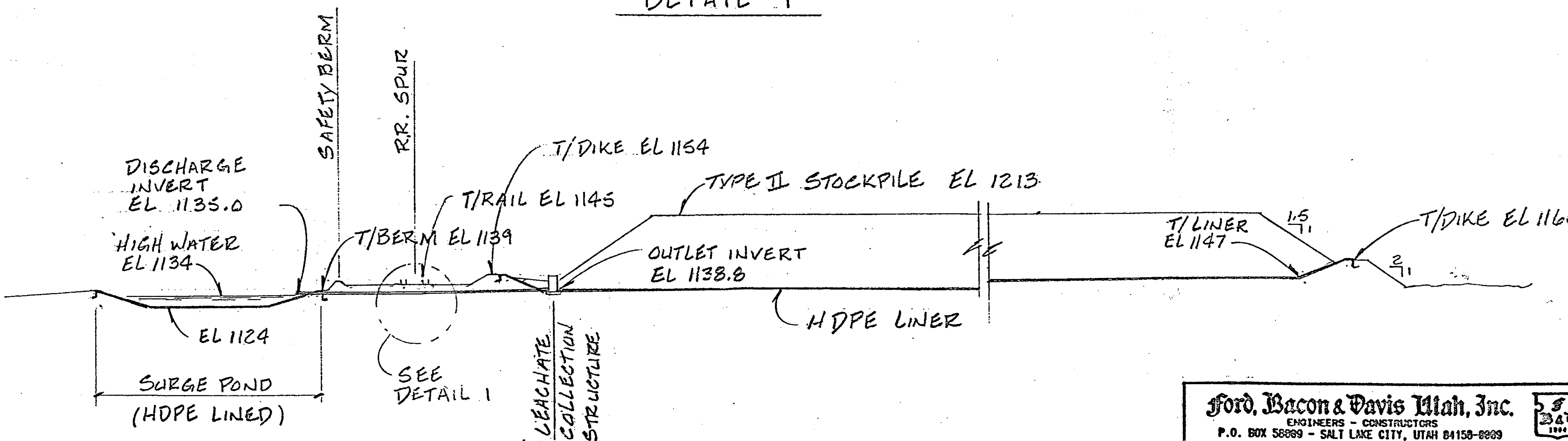
ENGINEERS – CONSTRUCTORS
P.O. BOX 58889 – SALT LAKE CITY, UTAH 84158-8889

FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY: GLT	DATE: 11-89
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO. 4-52 TYPE II STOCKPILE OUTLET STRUCTURE PIPE PENETRATION DETAILS	SKETCH NO.	REV. B
		SCALE	NONE



DETAIL 1



SECTION THRU TYPE II STOCKPILE & SURGE POND

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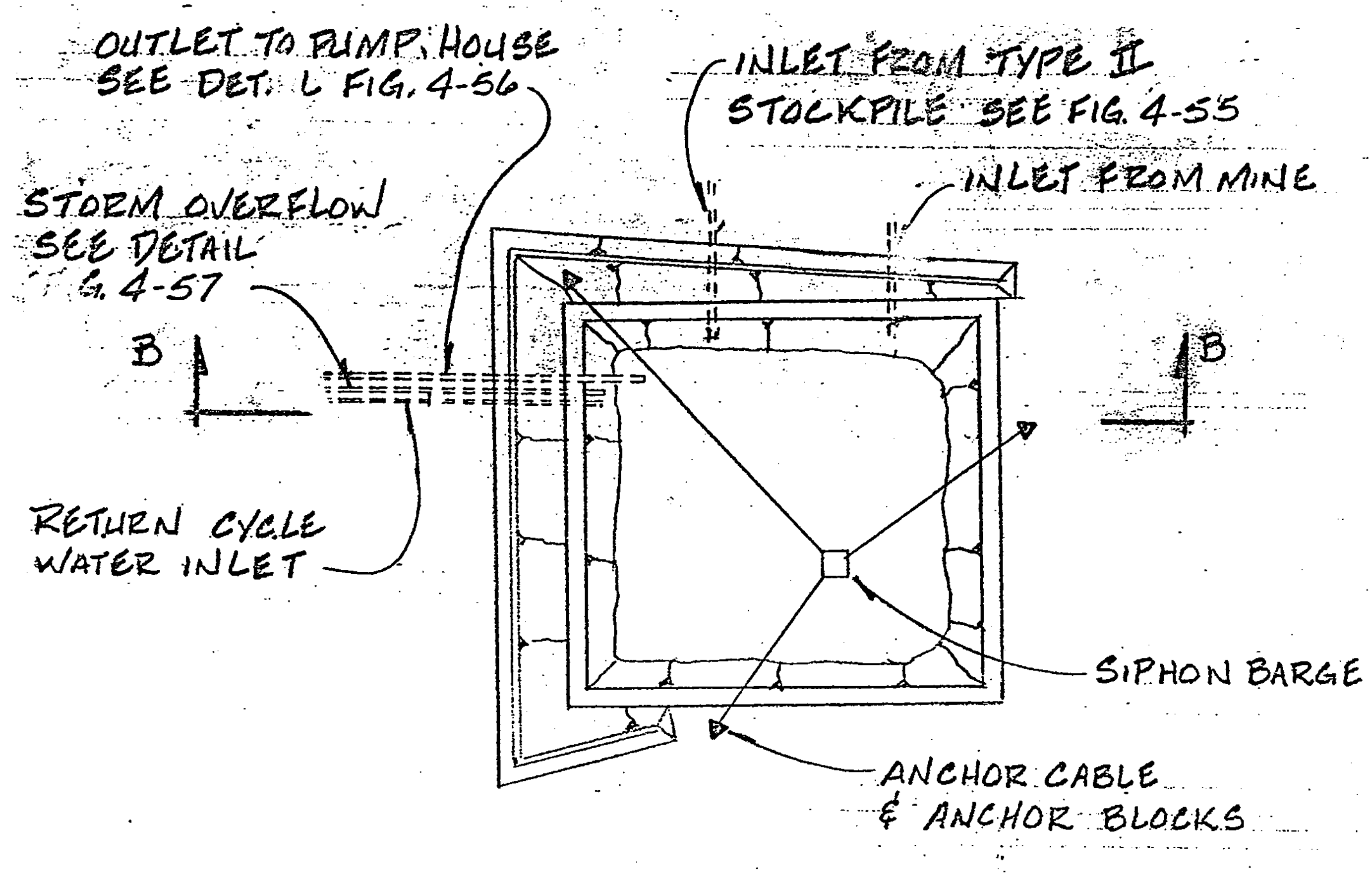
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

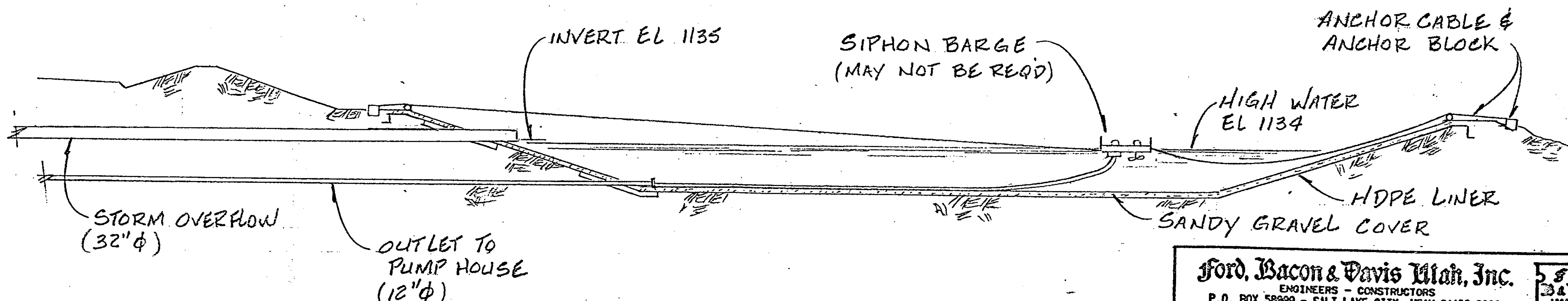
KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH 84112

FIGURE NO: 4-53
TYPE II STOCKPILE
DISCHARGE PIPE
SECTION AT R.R. CROSSING
DETAILS

DRAWN BY	DATE
GLT	11-89
SKETCH NO.	REV.
	B
SCALE	NONE

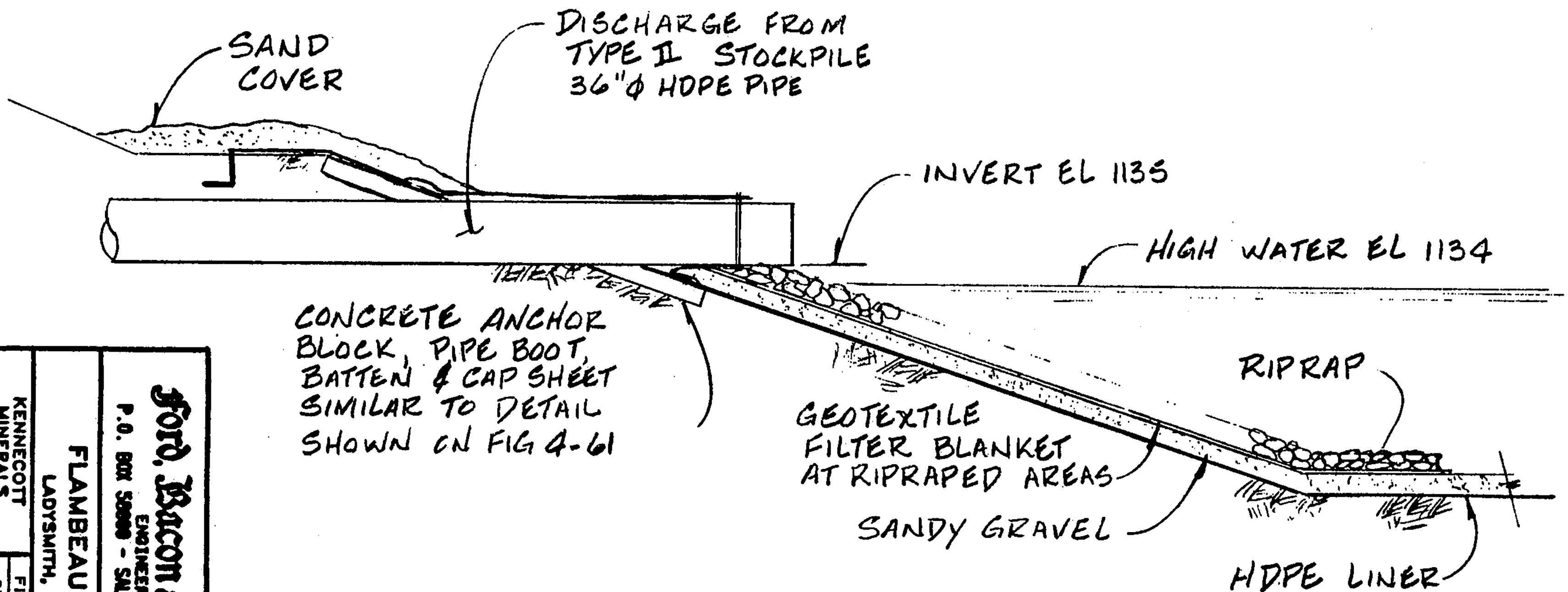


SURGE POND PLAN



SECTION B-B

Ford, Bacon & Davis Utah, Inc. ENGINEERS - CONSTRUCTORS P.O. BOX 58009 - SALT LAKE CITY, UTAH 84158-0009	FB&D 1880
FLAMBEAU PROJECT LADYSMITH, WISCONSIN	DRAWN BY GLT / DATE 11-89
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO. 4-54 / SURGE POND / PLAN AND SECTION
SKETCH NO.	REV. B
SCALE	NONE



SURGE POND

INLET FROM TYPE II STOCKPILE

(ALL PIPE INLET PENETRATIONS SIMILAR)

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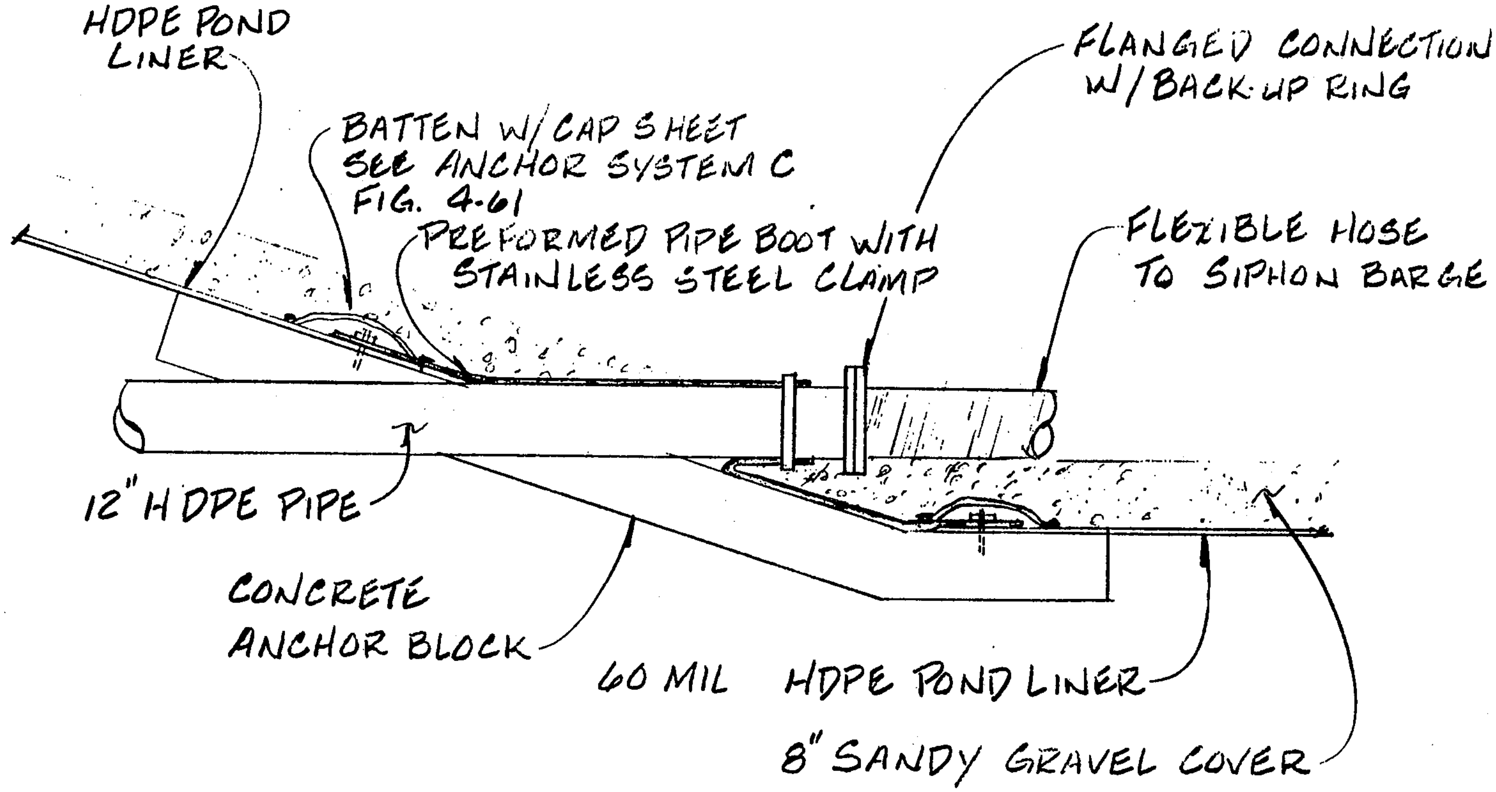
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

DRAWN BY	DATE	
GLT	11-89	
SKETCH NO.		REV.
		B
SCALE	NONE	

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO 4-55
SURGE POND INLET
SECTIONS AND DETAILS



SURGE POND OUTLET

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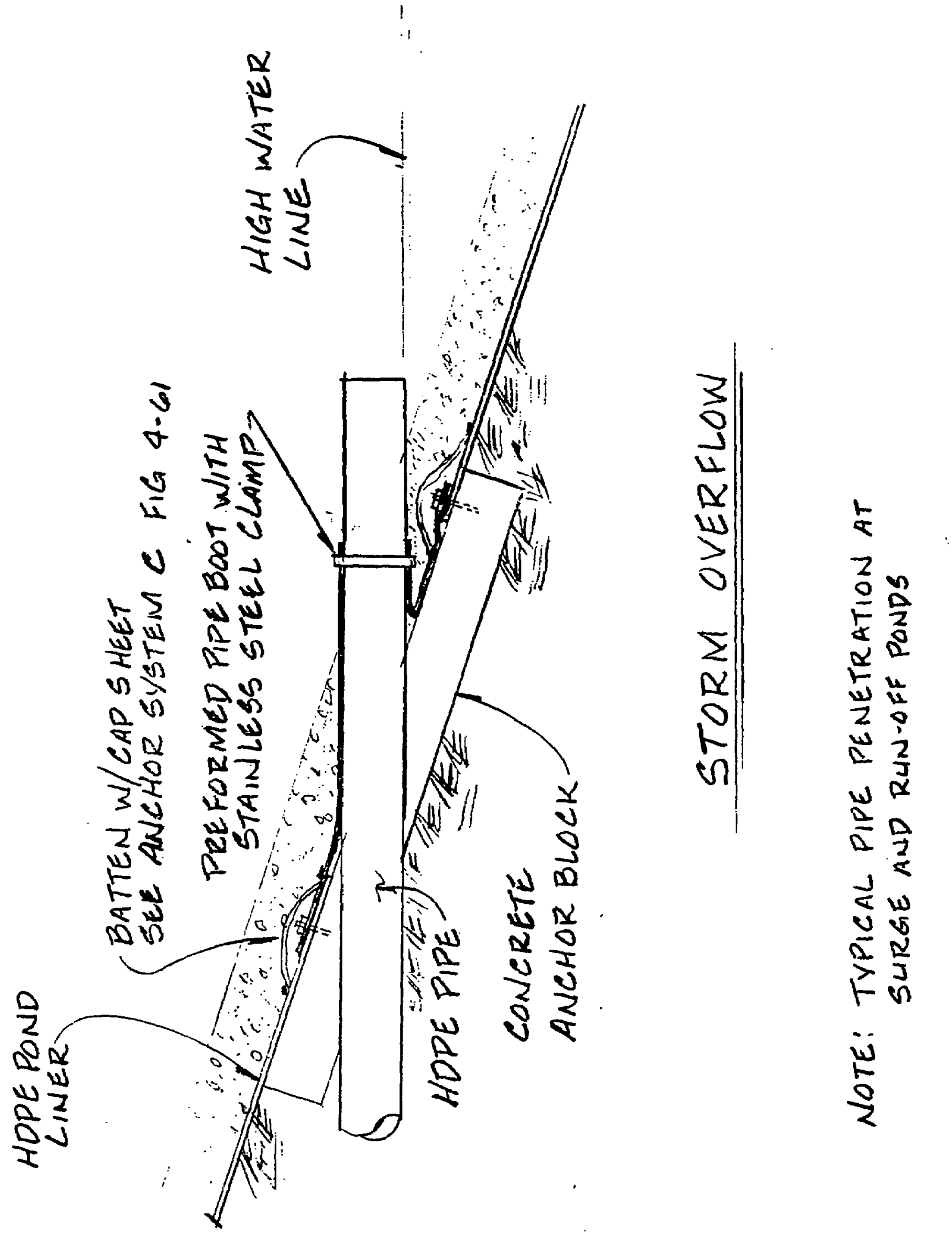
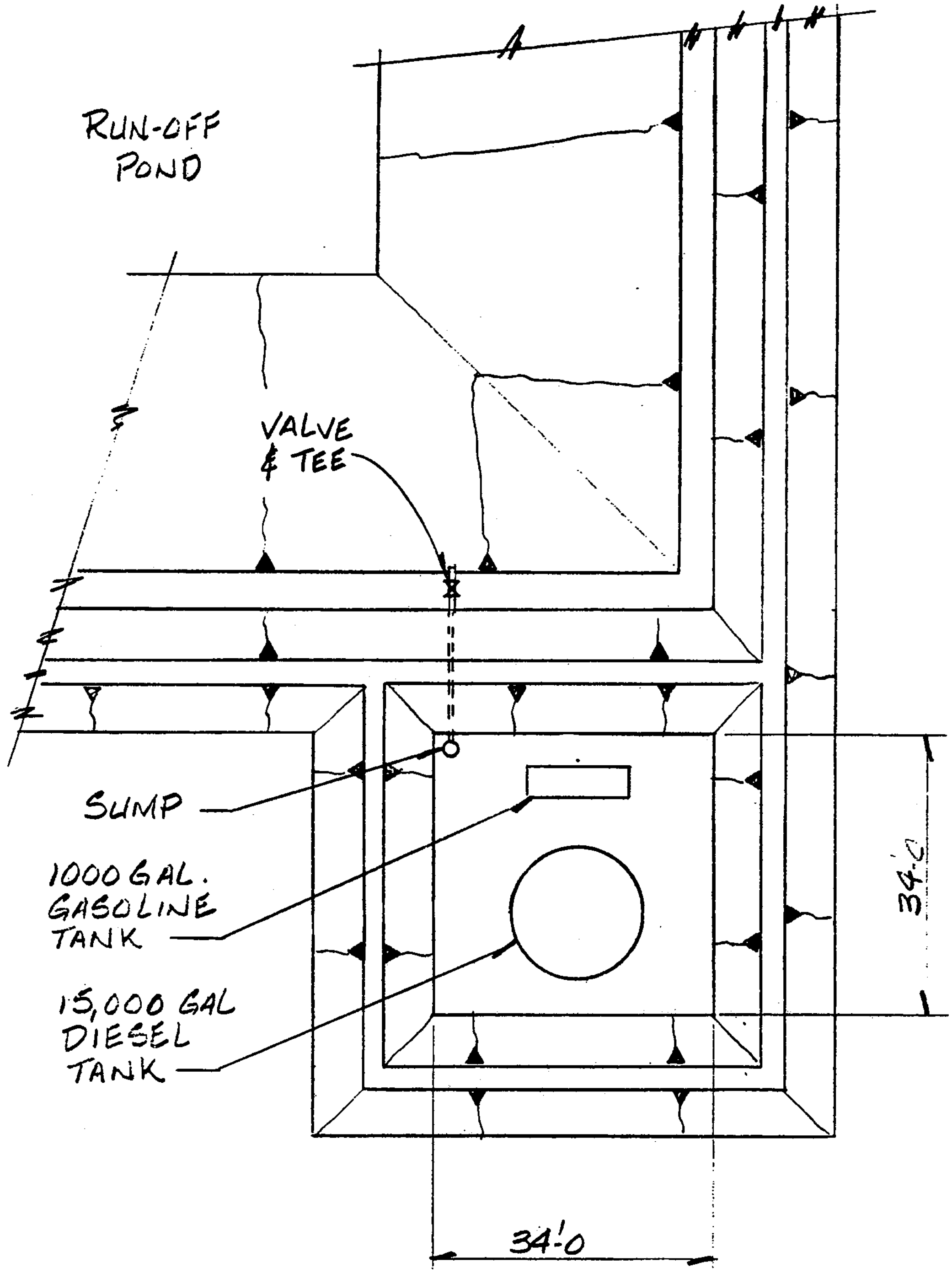
P.O. BOX 58009 - SALT LAKE CITY, UTAH 84158-0009

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO 4-56 SURGE POND OUTLET SECTIONS AND DETAILS	DRAWN BY: GLT SKETCH NO. SCALE: NONE	DATE: 11-89 REV. A



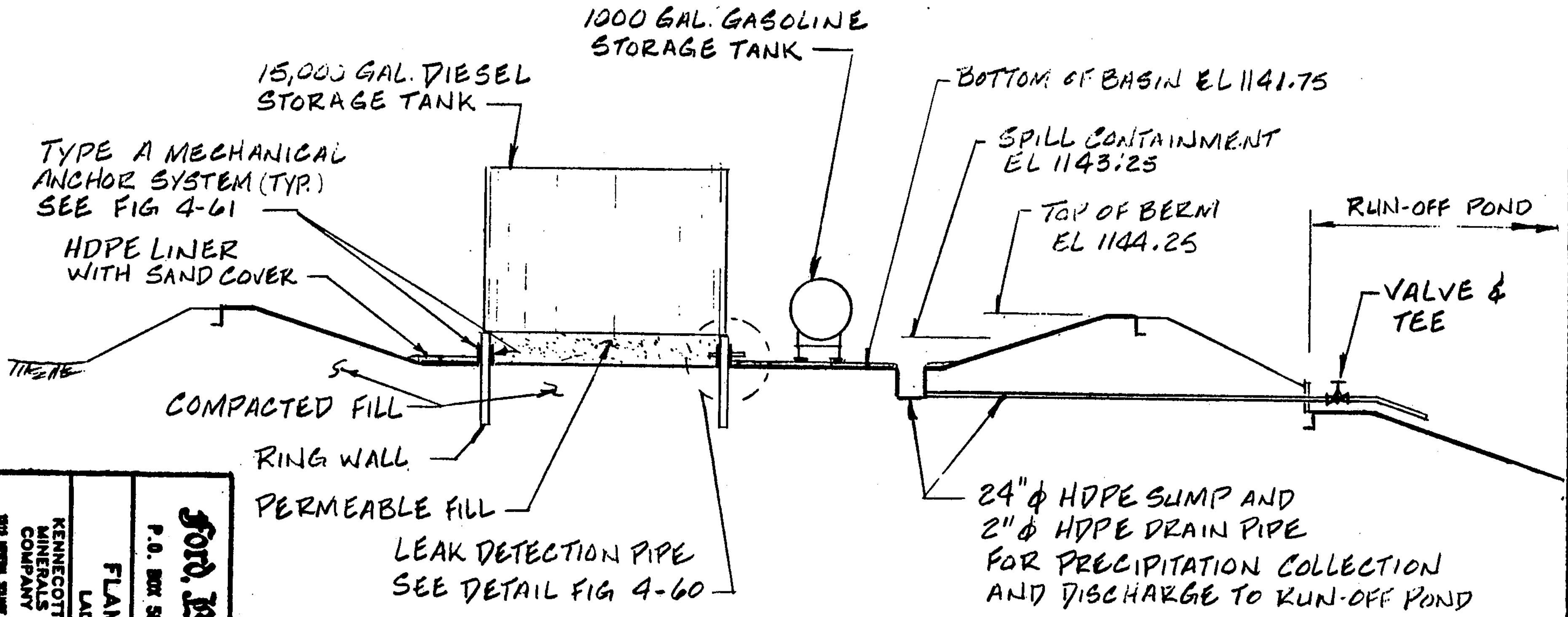
Ford, Bacon & Davis Utah, Inc. ENGINEERS - CONSTRUCTORS P.O. BOX 58009 - SALT LAKE CITY, UTAH 84158-0009		
FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY: GLT DATE: 11-89
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO 4-57 SURGE AND RUN-OFF PONDS STORM OVERFLOW PIPE DETAILS	SKETCH NO. REV. A SCALE NONE



FUEL CONTAINMENT PLAN

Ford, Bacon & Davis Utah, Inc.
ENGINEERS - CONSTRUCTORS
P.O. BOX 58009 - SALT LAKE CITY, UTAH 84158-0009

FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY: GLT	DATE: 1-89
		SKETCH NO.	REV. B
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO 4-58 FUEL STORAGE AREA PLAN		
		SCALE	NONE



SECTION THRU FUEL STORAGE AND SPILL CONTAINMENT

NOTE: SEE FIG 4-58 FOR PLAN
AND FIG 4-60 FOR DETAILS

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ENGINEERS - CONSTRUCTORS
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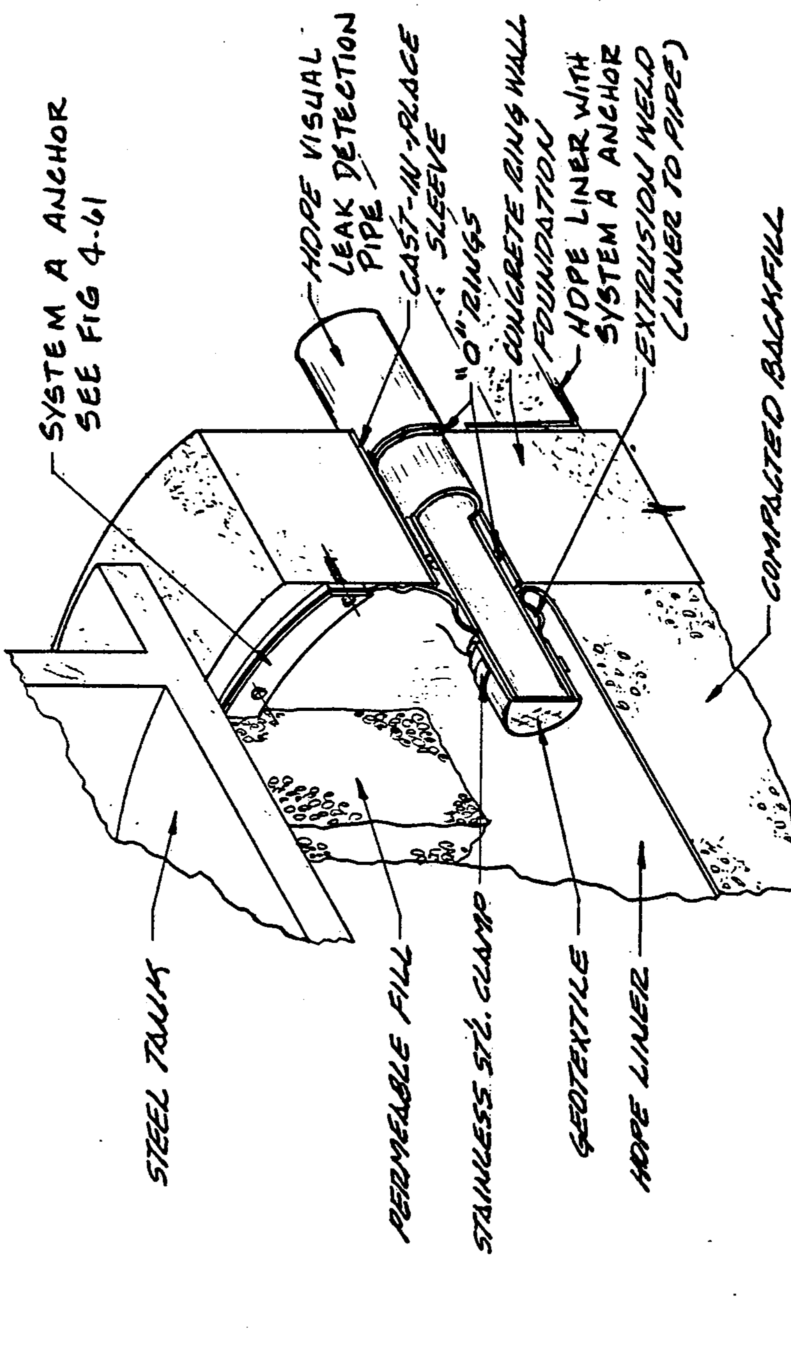
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

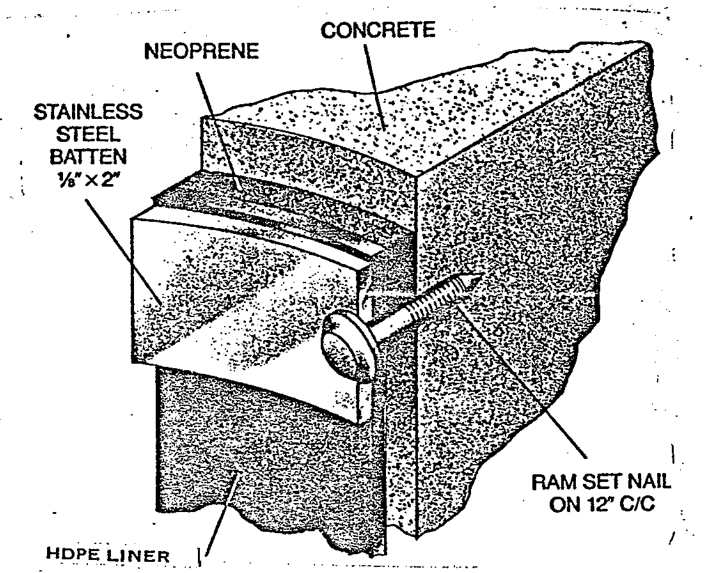
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO 4-59 FUEL STORAGE AREA SECTION AND DETAILS	DRAWN BY: GLT	DATE: 11-89
		SKETCH NO.	REV. B
		SCALE	



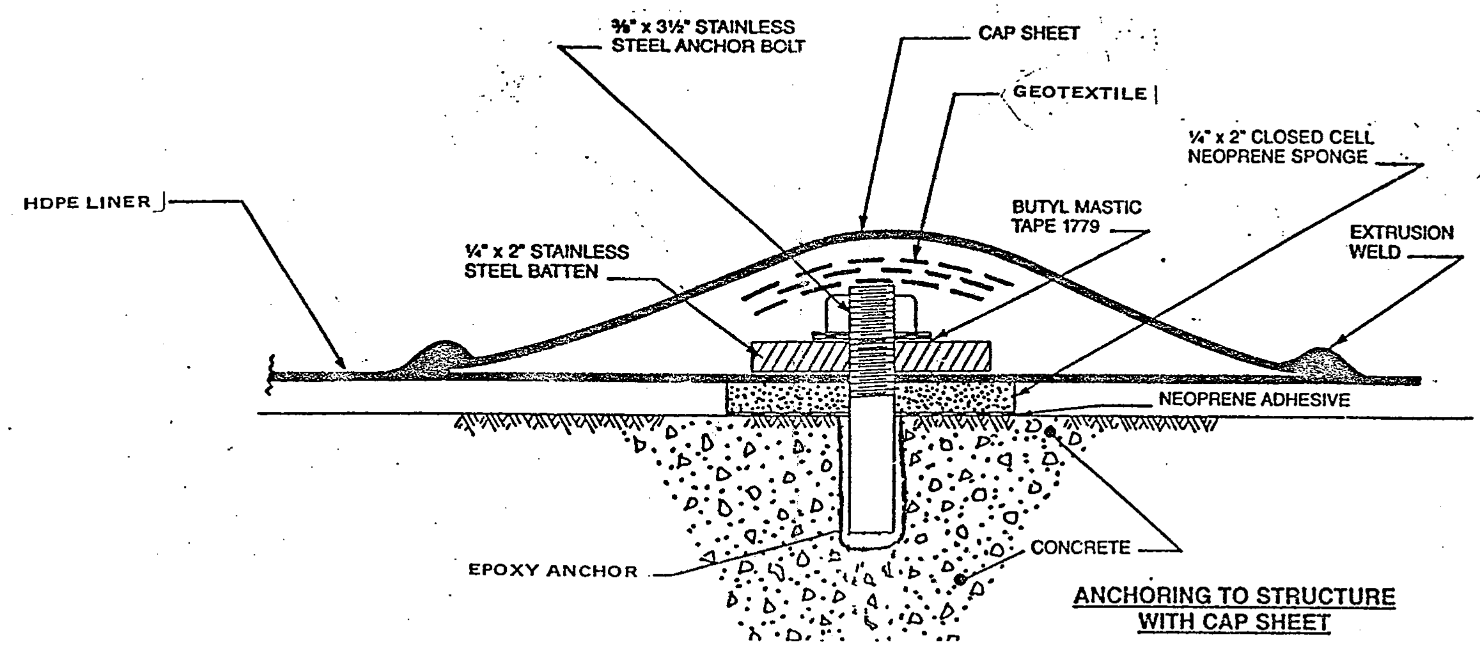
TANK LEAK DETECTION-LINER & PIPING DETAIL

15,000 GAL. DIESEL OIL STORAGE TANK

Ford, Bacon & Davis Utah, Inc. ENGINEERS - CONSTRUCTORS P.O. BOX 58000 - SALT LAKE CITY, UTAH 84158-0000			
FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY: GLT	DATE: 11-89
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO 4-60	SKETCH NO.	REV. B
	FUEL STORAGE AREA		
	LEAK DETECTION DETAILS		
		SCALE	NONE

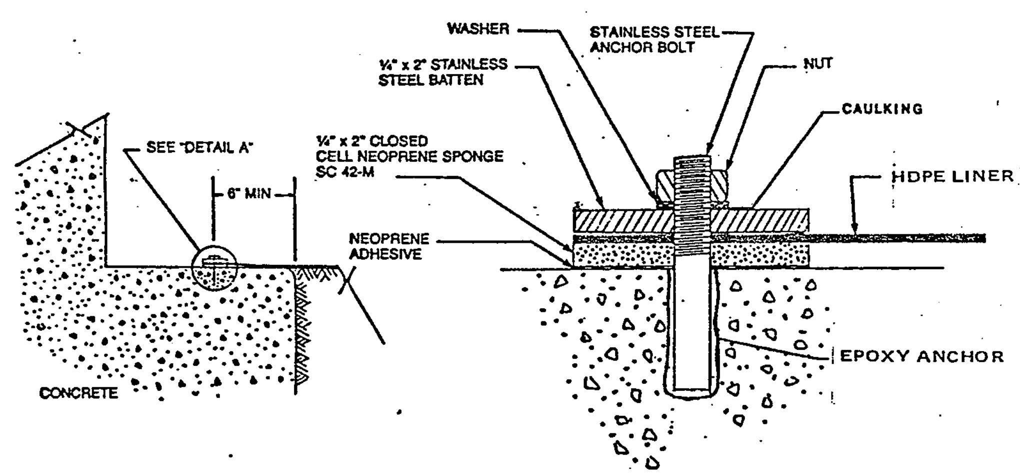


SYSTEM A
(NON–SUBMERSED)



ANCHORING TO STRUCTURE WITH CAP SHEET

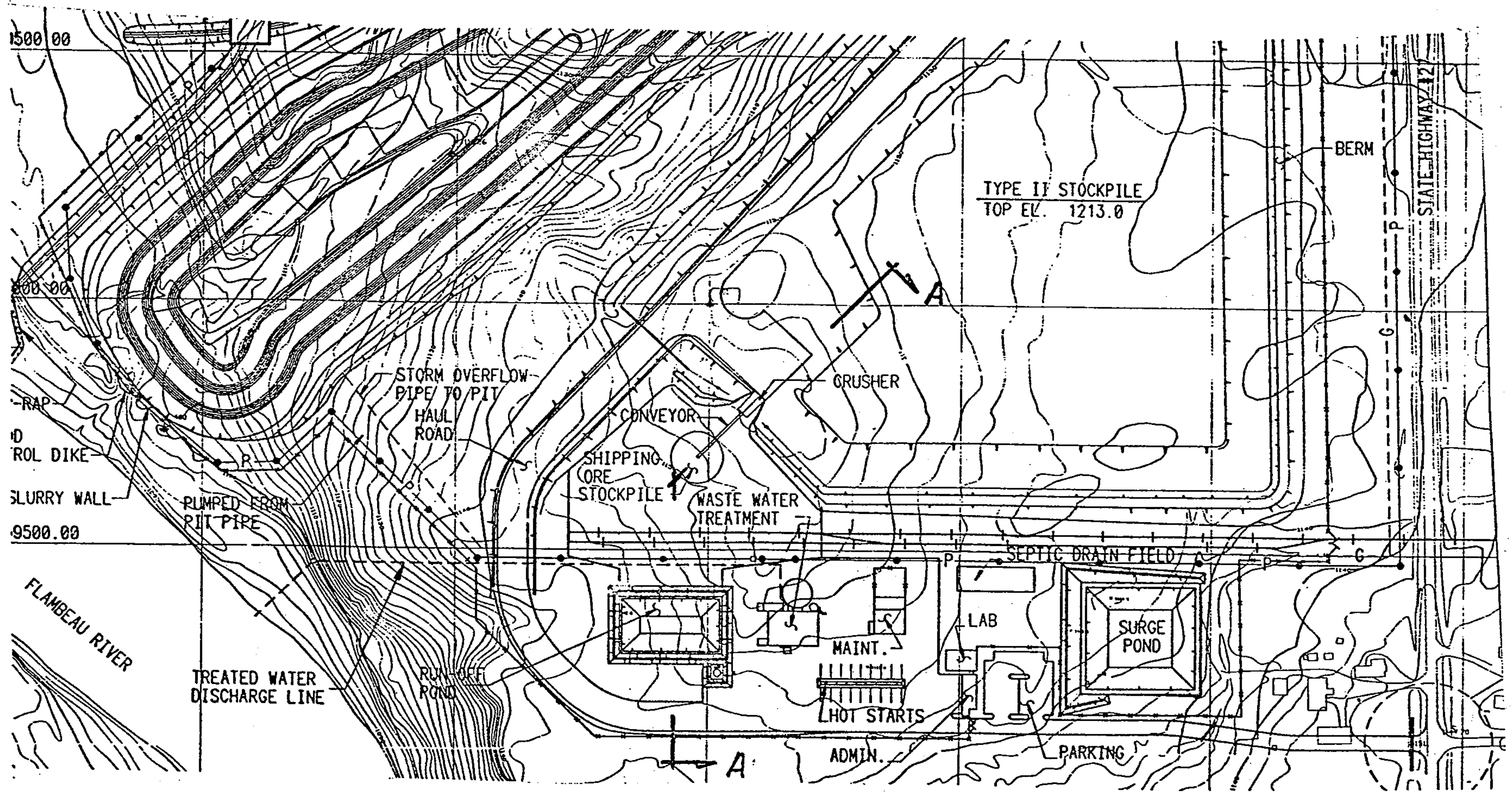
SYSTEM C
(SUBMERSED)



SYSTEM B
(NON–SUBMERSED)

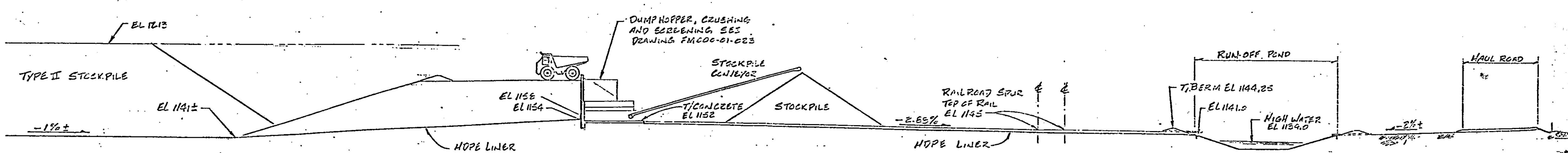
MECHANICAL ANCHORING SYSTEMS

Ford, Bacon & Davis Utah, Inc. ENGINEERS – CONSTRUCTORS P.O. BOX 58009 – SALT LAKE CITY, UTAH 84158-0009			
FLAMBEAU PROJECT LADYSMITH, WISCONSIN		DRAWN BY GLT	DATE 11-89
KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO 4-61 HDPE LINER; MECHANICAL ANCHORING SYSTEMS	SKETCH NO.	REV. A
		SCALE	NONE



PARTIAL PLAN

SEE DWG FM000-01-007



SECTION A-A

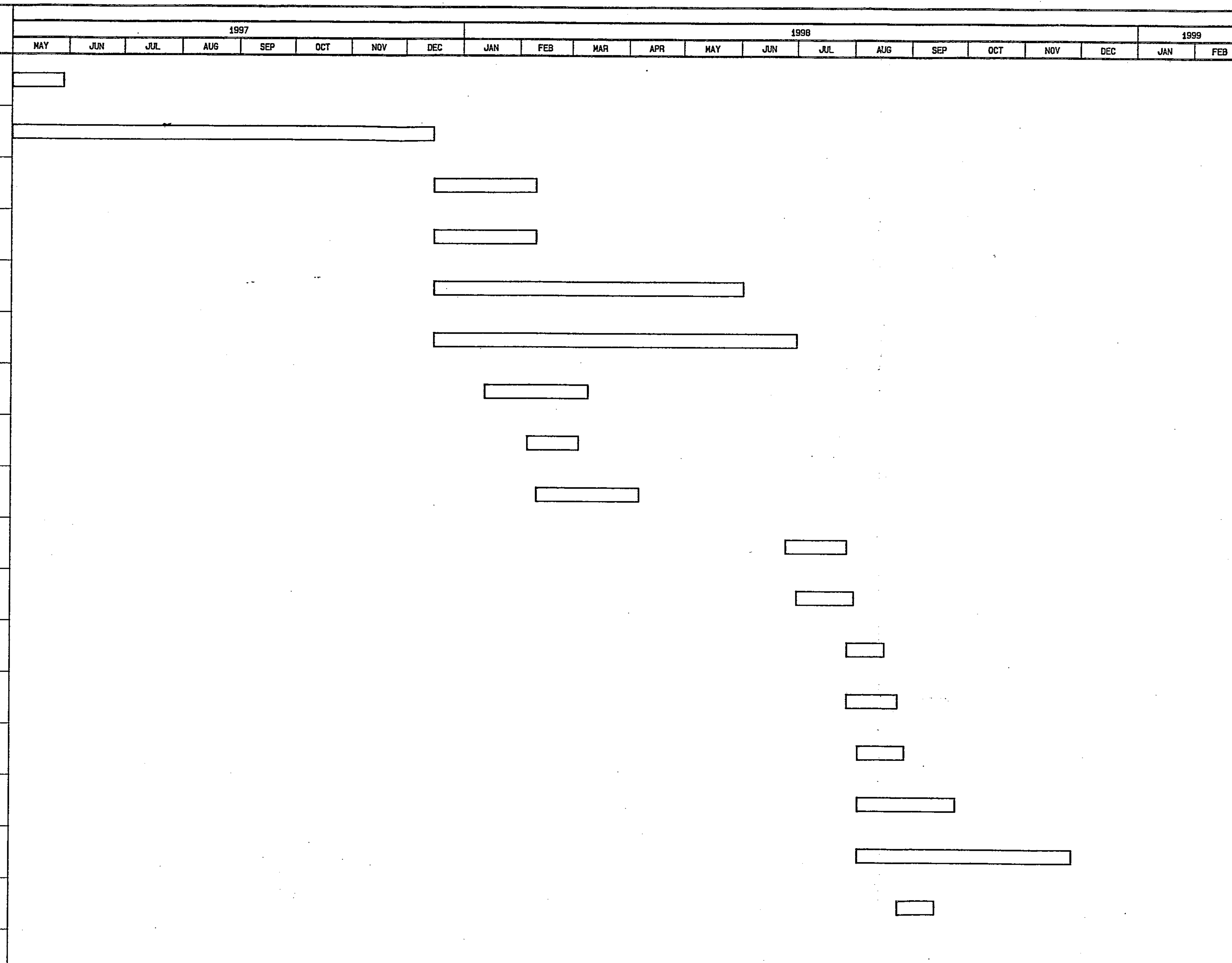
Ford, Bacon & Davis Utah, Inc.
ENGINEERS - CONSTRUCTORS
P.O. BOX 58009 - SALT LAKE CITY, UTAH 84158-0009

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY 1515 MINERAL SQUARE SALT LAKE CITY, UTAH 84112	FIGURE NO. 4-62 TYPE II STOCKPILE LOADING AREA AND RUN-OFF POND PLAN AND SECTION	DRAWN BY: GLT SKETCH NO. SCALE: NONE	DATE: 11-89 REV. A

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
RECLAMATION SCHEDULE

Activity	OD	ES	EF
CRUSHER-REMOVE EQUIPMENT AND STRUCTURE	20	1MAY97	28MAY97
TYPE II-REMOVE WASTEROCK	163	1MAY97	15DEC97
TYPE II-REMOVE SAPROLITE MATERIAL	40	16DEC97	9FEB98
TYPE II-REMOVE DRAINAGE SYSTEM AND LINER	40	16DEC97	9FEB98
SITE FAC-REMOVE ORE HAUL ROAD	120	16DEC97	1JUN98
TYPE I-REMOVE WASTEROCK	141	16DEC97	30JUN98
TYPE II-RECLAIM TO FINAL CONTOURS	40	13JAN98	9MAR98
CRUSHER-REMOVE CONCRETE RETENTION WALL	20	5FEB98	4MAR98
TYPE II-REPLACE TOPSOIL AND REVEGETATE	40	10FEB98	6APR98
CRUSHED ORE STOCKPILE-REMOVE SUB-BASE MATERIAL	23	25JUN98	27JUL98
TYPE I-REMOVE SAPROLITE & SANDSTONE MATERIAL	23	1JUL98	31JUL98
PONDS RUN-OFF & SURGE PONDS TO FINAL CONTOURS	15	28JUL98	17AUG98
CRUSHER-RECLAIM AREA TO FINAL CONTOURS	20	28JUL98	24AUG98
SITE FAC-REMOVE EXPLOSIVE MAGAZINES	20	3AUG98	28AUG98
SITE FAC-REMOVE WATER TREATMENT PLANT	40	3AUG98	25SEP98
TYPE I-REMOVE TILL MATERIAL	85	3AUG98	27NOV98
CRUSHER-REPLACE TOPSOIL AND REVEGETATE	15	25AUG98	14SEP98



Activity Bar/Early Dates
Critical Activity
Progress Bar

Project Start : 1MAY97
Project Finish: 5FEB99

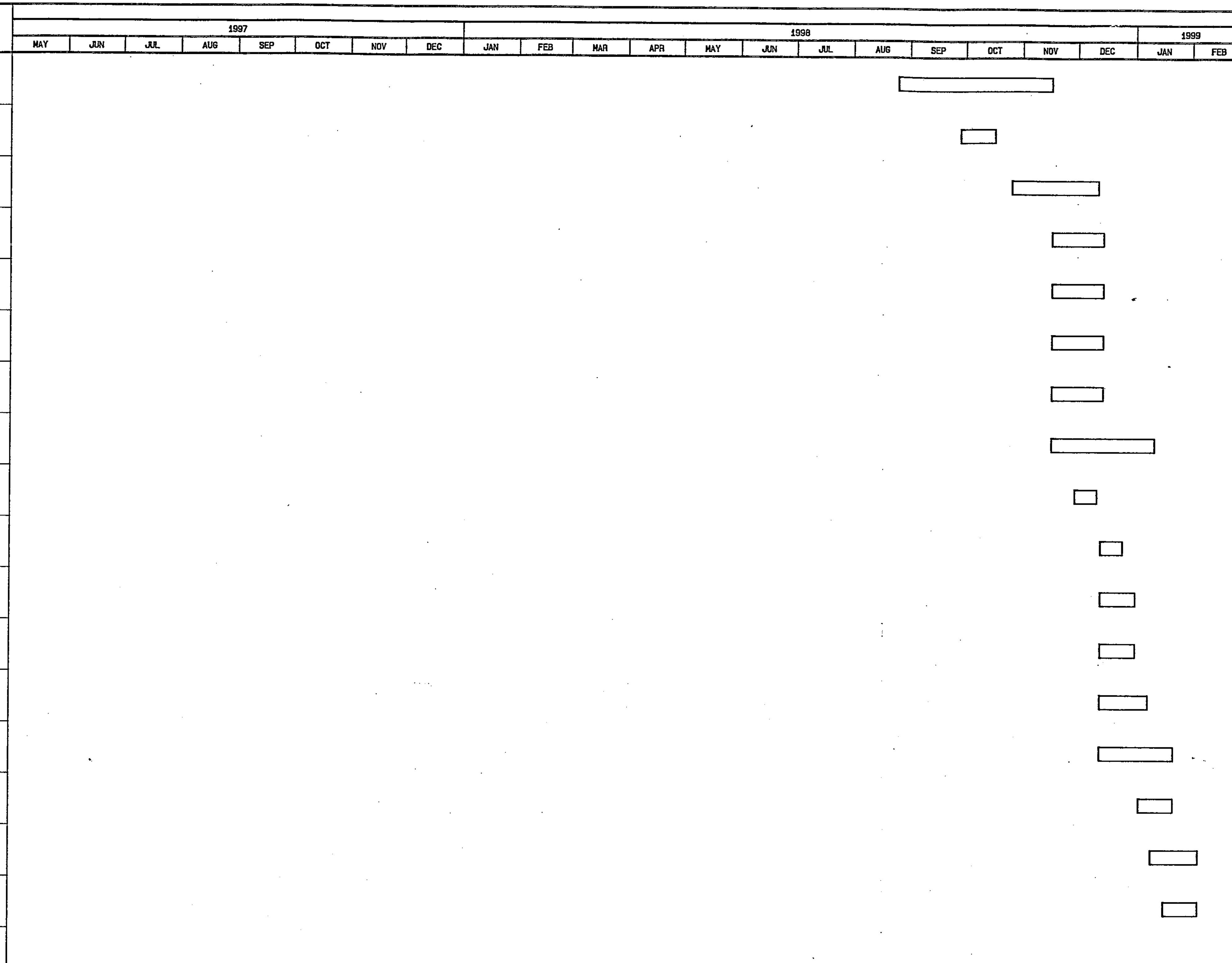
Sheet 1 of 2

Data Date: 1MAY97
Plot Date: 26DEC89

FIGURE NO. 5-1

Date	Revision	Checked	Approved

Activity	OD	ES	EF
SITE FAC-REMOVE RAILROAD SPUR	60	25AUG98	16NOV98
SITE FAC-REMOVE LABORATORY BUILDING	15	28SEP98	16OCT98
TYPE I-RECLAIM TO FINAL CONTOURS	35	26OCT98	11DEC98
SITE FAC-REMOVE FUEL STORAGE TANK	20	17NOV98	14DEC98
SITE FAC-DISPOSE SANITARY WASTE LEACH FIELD	20	17NOV98	14DEC98
SITE FAC-REMOVE PARKING LOT AND ACCESS ROAD	20	17NOV98	14DEC98
SITE FAC-CAP DISCHARGE PIPES AND RECLAIM OUTFALL	20	17NOV98	14DEC98
SITE FAC-RECLAIM R.R. SPUR CORRIDOR	40	17NOV98	11JAN99
PIT-RECLAIM TO FINAL CONTOURS	10	30NOV98	11DEC98
PIT-REPLACE TOPSOIL AND REVEGETATE	10	14DEC98	25DEC98
SITE FAC-REMOVE MAINTENANCE BUILDING	15	14DEC98	1JAN99
SITE FAC-REMOVE OFFICE AND ADMIN BUILDING	15	14DEC98	1JAN99
PONDS-RECLAIM SETTLING PONDS TO FINAL CONTOURS	20	14DEC98	8JAN99
TYPE I-CULTIVATE AND REVEGETATE	30	14DEC98	22JAN99
SITE FAC-RE-ESTABLISH FINAL CONTOURS	15	4JAN99	22JAN99
PONDS-REPLACE TOPSOIL AND REVEGETATE	20	11JAN99	5FEB99
SITE FAC-REPLACE TOPSOIL AND REVEGETATE	15	18JAN99	5FEB99



Activity Bar/Early Dates
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1989

Project Start : 1MAY97
Project Finish: 5FEB99

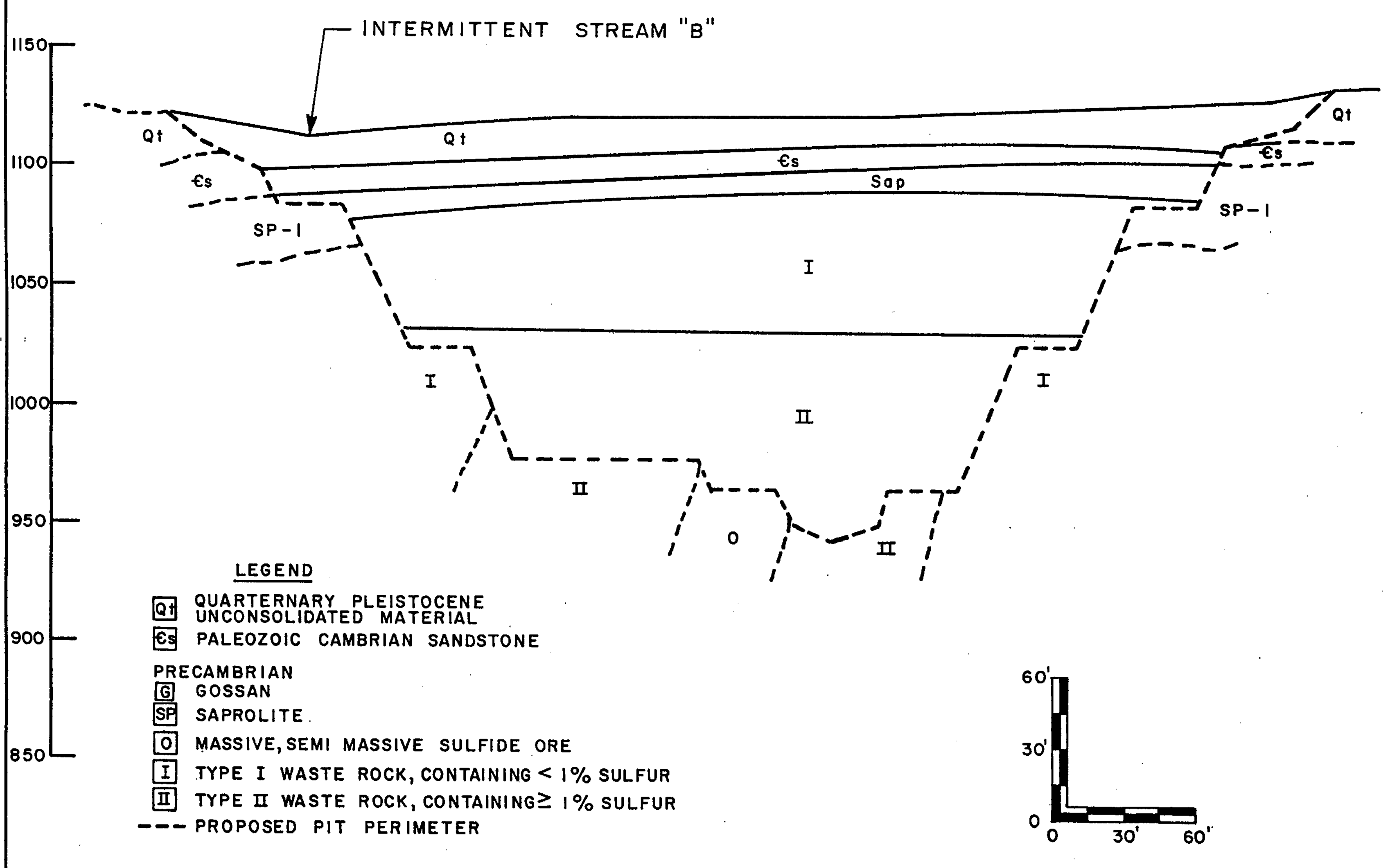
KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
RECLAMATION SCHEDULE

Sheet 2 of 2

Data Date: 1MAY97
Plot Date: 26DEC89

FIGURE NO. 5-1

Date	Revision	Checked	Approved



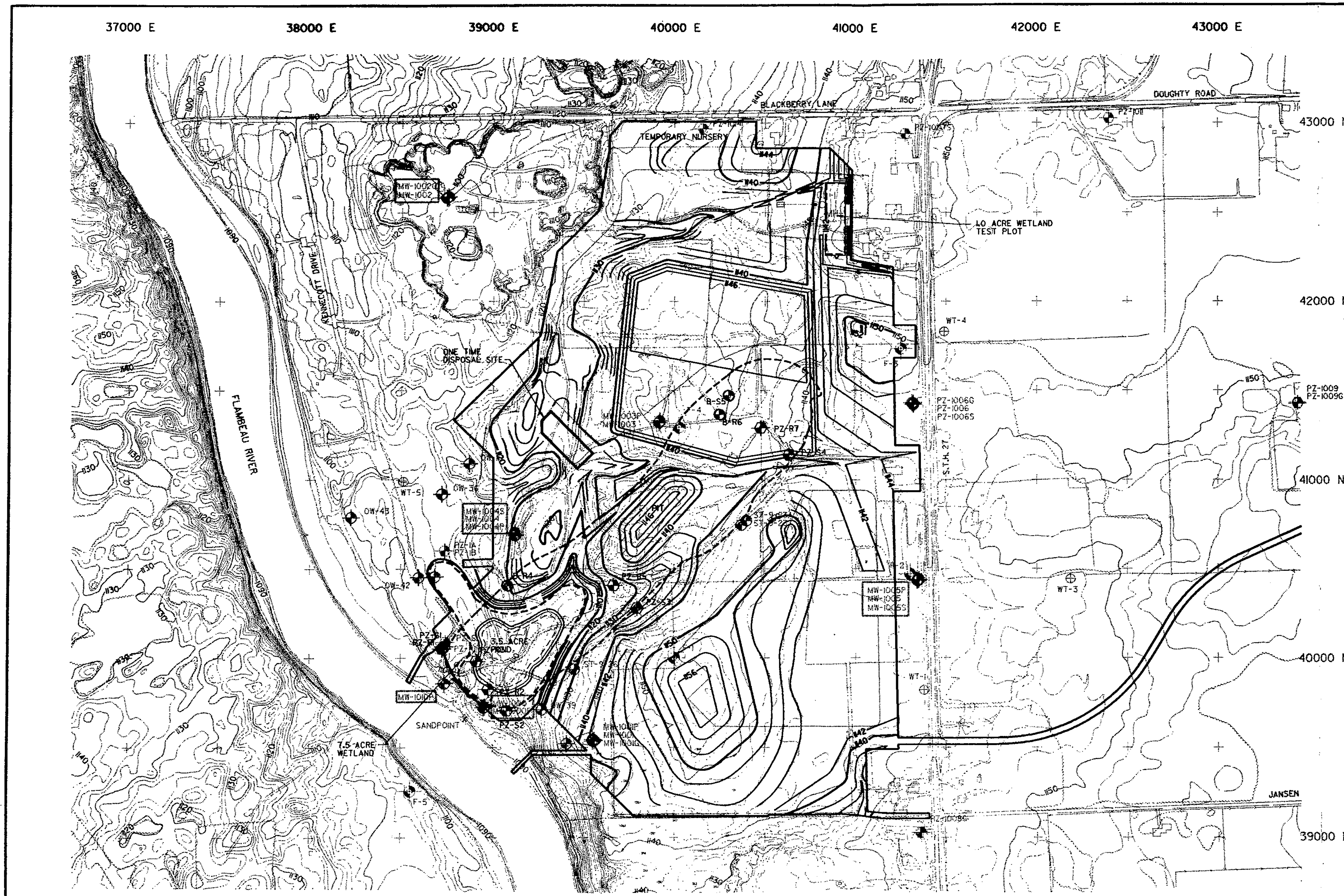
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

No	REVISIONS	NOTES	APPROVAL		DATE
△			DESIGNED BY		
△			DRAWN BY	SJL	12/89
△			CHECKED BY	GWS	12/89
△			APPROVED BY		
△			CAD No.	SCALE	

FIGURE NO. 5-2
SECTION THROUGH OPEN PIT AFTER COMPLETION OF BACKFILLING

Job No | Dwg No | REV



N

LEGEND

- 1100 — EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- F-1 CONTROL MONUMENT
- MINE SITE

NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970. ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATON, MINNEAPOLIS, MINNESOTA. DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

5. RAILROAD SPUR LINE CORRIDOR EAST OF STH 27 TO BE GRADED TO ITS APPROXIMATE ORIGINAL CONTOUR AS PART OF THIS GRADING PLAN.

0 300' 600'
SCALE

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

FIGURE NO. 5-3
RECLAIMED SITE FINAL
GRADING PLAN

	BY	DATE
DESIGN		
DRAWN	MJO	12/89
CHK'D	GWS	12/89
DES. ENG'R		
SECT. ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

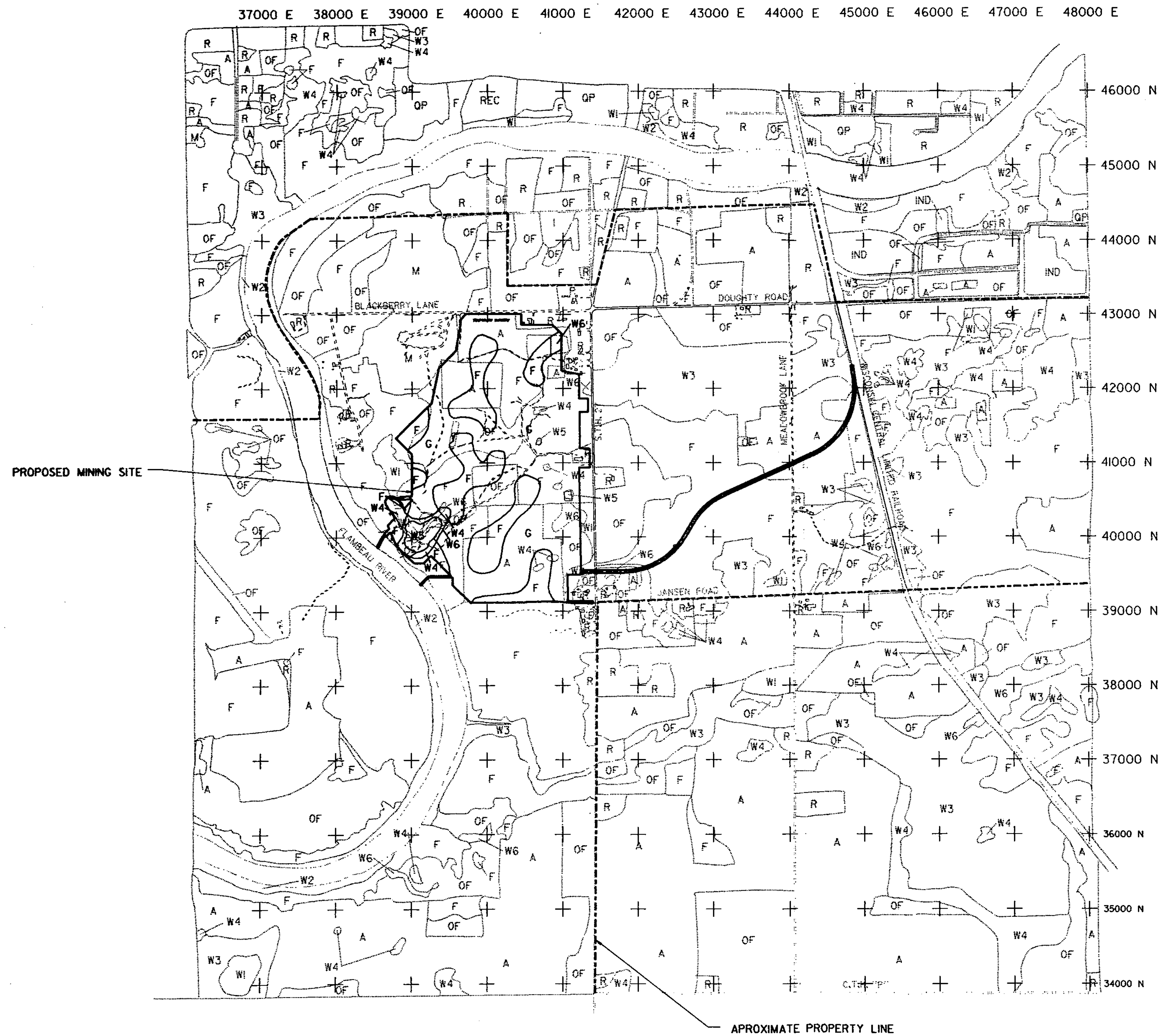
REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	SEE BAR SCALE



LAND USE STUDY AREA
ACREAGE TOTALS

LAND USE CLASSIFICATION		ACRES PREMINING	ACRES POSTMINING
A	AGRICULTURE	754.3	695.5
F	UPLAND MIXED FOREST	924.8	898.5
OF (G)	PASTURE / OLD FIELD / MEADOW / GRASSLAND	585.3	672.3
R	RESIDENTIAL / DISTURBED	183.1	181.3
W	WETLANDS	545.5	545.7
	W1 NORTHERN WET MESIC FOREST	34.1	34.1
	W2 RIVERINE FLOODPLAIN MEADOW	59.4	59.4
	W3 ALDER THICKET; BOG	336.7	336.7
	W4 NORTHERN SEDGE MEADOW, ALDER THICKETT	93.1	91.0
	W5 DUG PONDS	0.4	3.5
	W6 NORTHERN SEDGE MEADOW	21.8	21.0
REC	RECREATION	8.3	8.3
QP	QUASI PUBLIC	37.4	37.4
IND	INDUSTRIAL	25.7	25.7
M	GRAVEL PIT	59.5	59.2
	TRANSPORTATION (HWY'S,ROADS,RR)	60.0	60.0
	FLAMBEAU RIVER	169.8	169.8
	TOTAL	3353.7	3353.7

NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

0 800' 1600'
SCALE

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

FIGURE NO. 5-4
LAND USE OF RECLAIMED MINE SITE

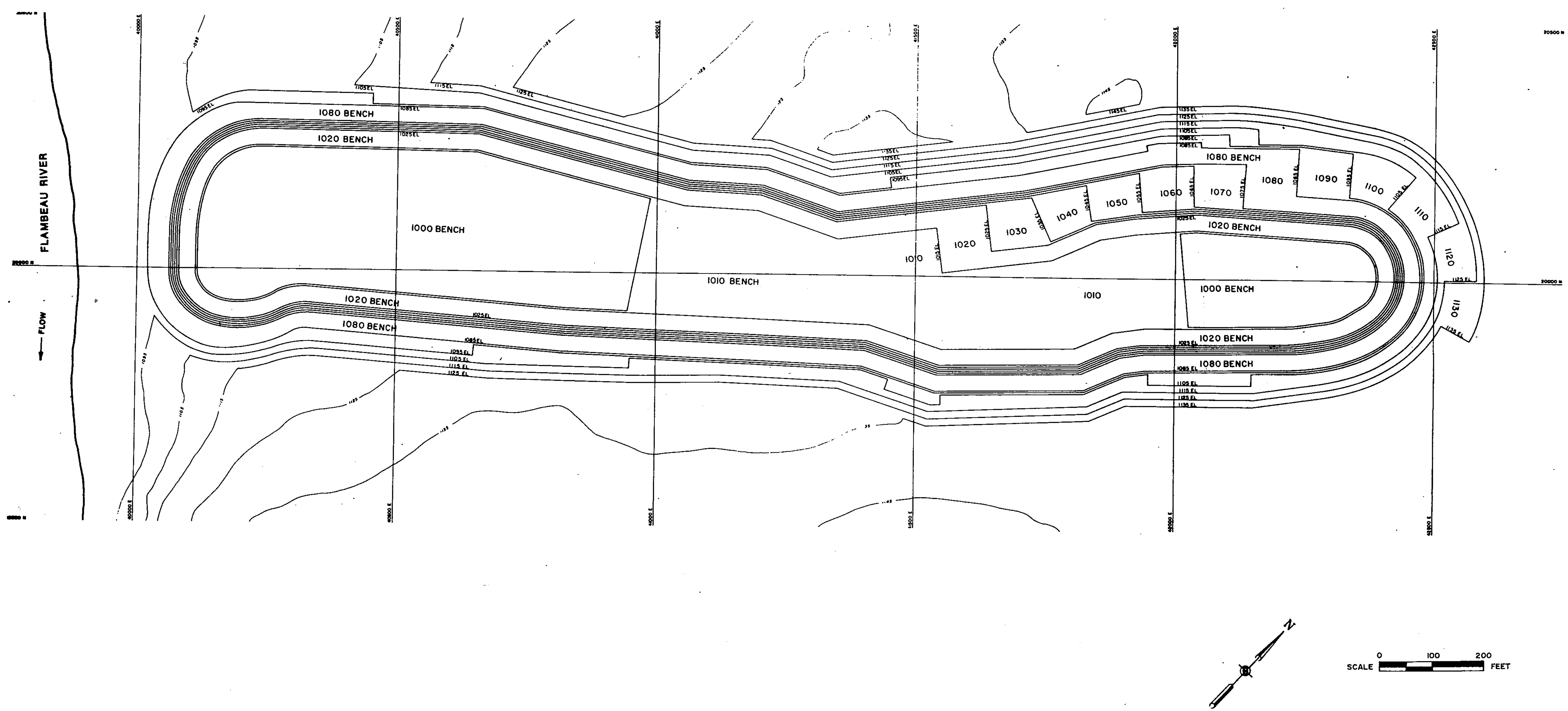
NO.	DATE	REVISIONS	BY	CHK'D
	12/89	UPDATE SITE PLAN	MJO	GWS

	BY	DATE
DESIGN		
DRAWN	SAG	6/89
CHK'D	GWS	6/89
DES. ENG'R		
SECT. ENG'R		

PROJ. ENG'R
MGR. PROCESS ENG'G
ENG'R MGR.

REFERENCES — DWG. NO. — DESCRIPTION

MICROFILM — JOB
DRAWING NO. — REV.
DIVISION DRAWING NO.
SCALE — SEE BAR SCALE



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 5-5
END OF 3 MONTHS
OF BACKFILLING

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

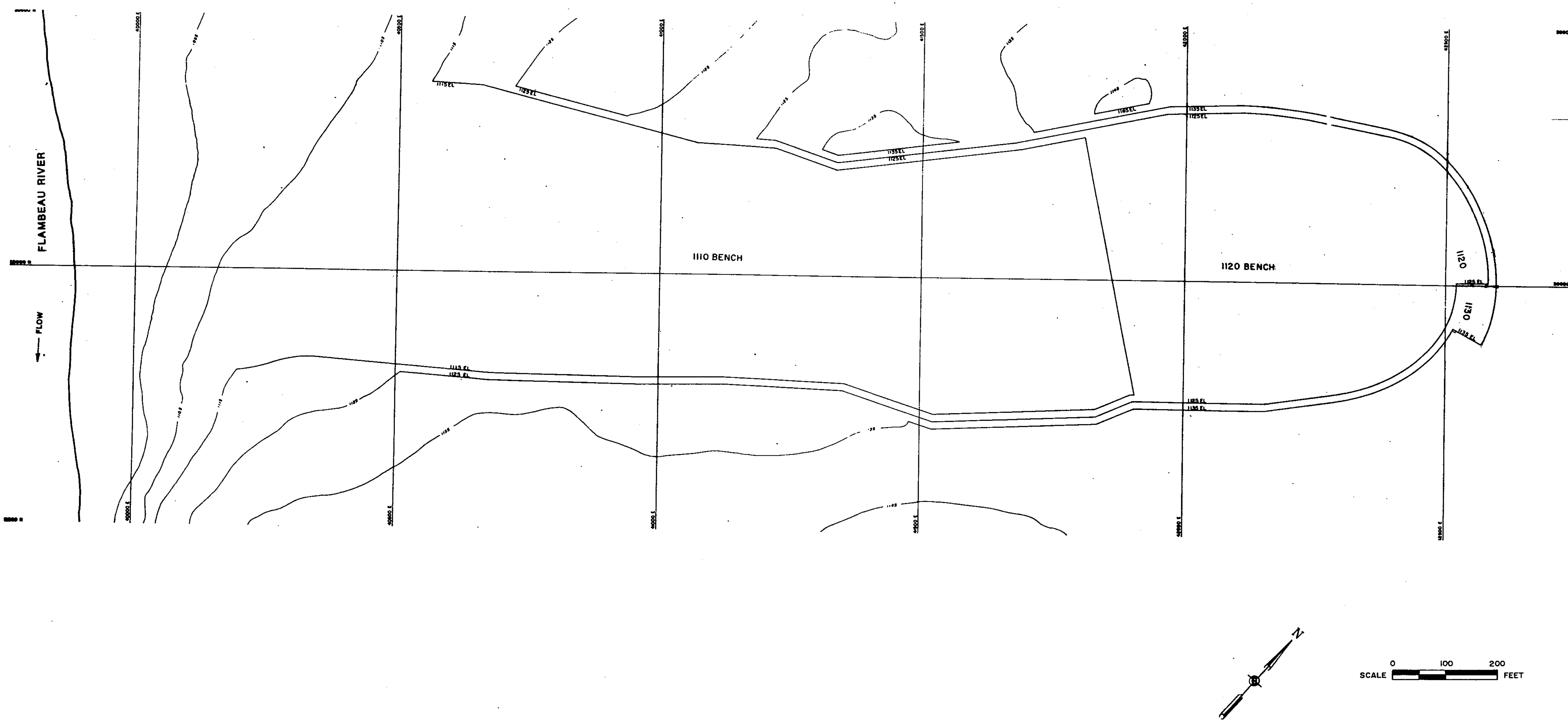
NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 5-6
END OF 15 MONTHS
OF BACKFILLING

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENGR		

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

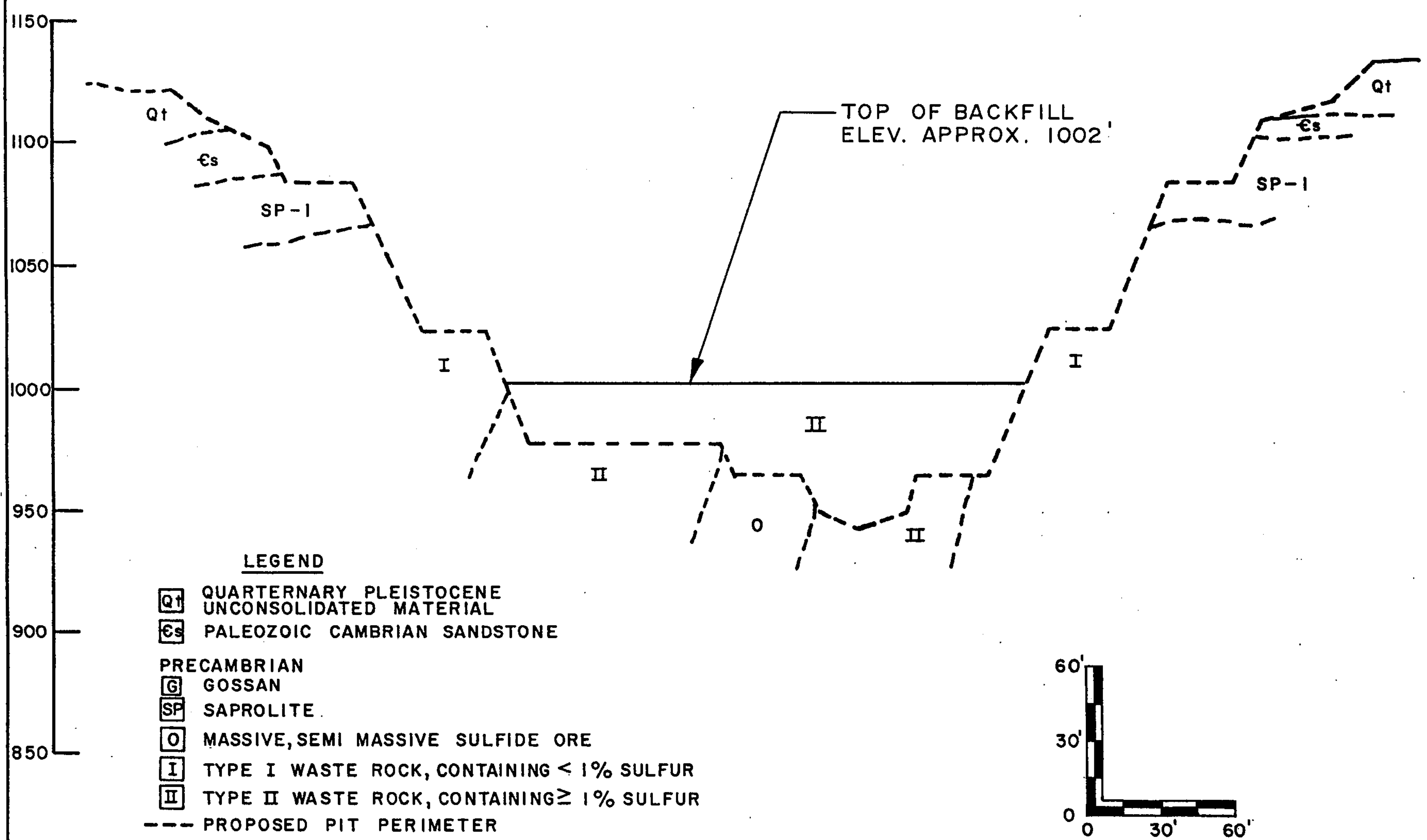
NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION



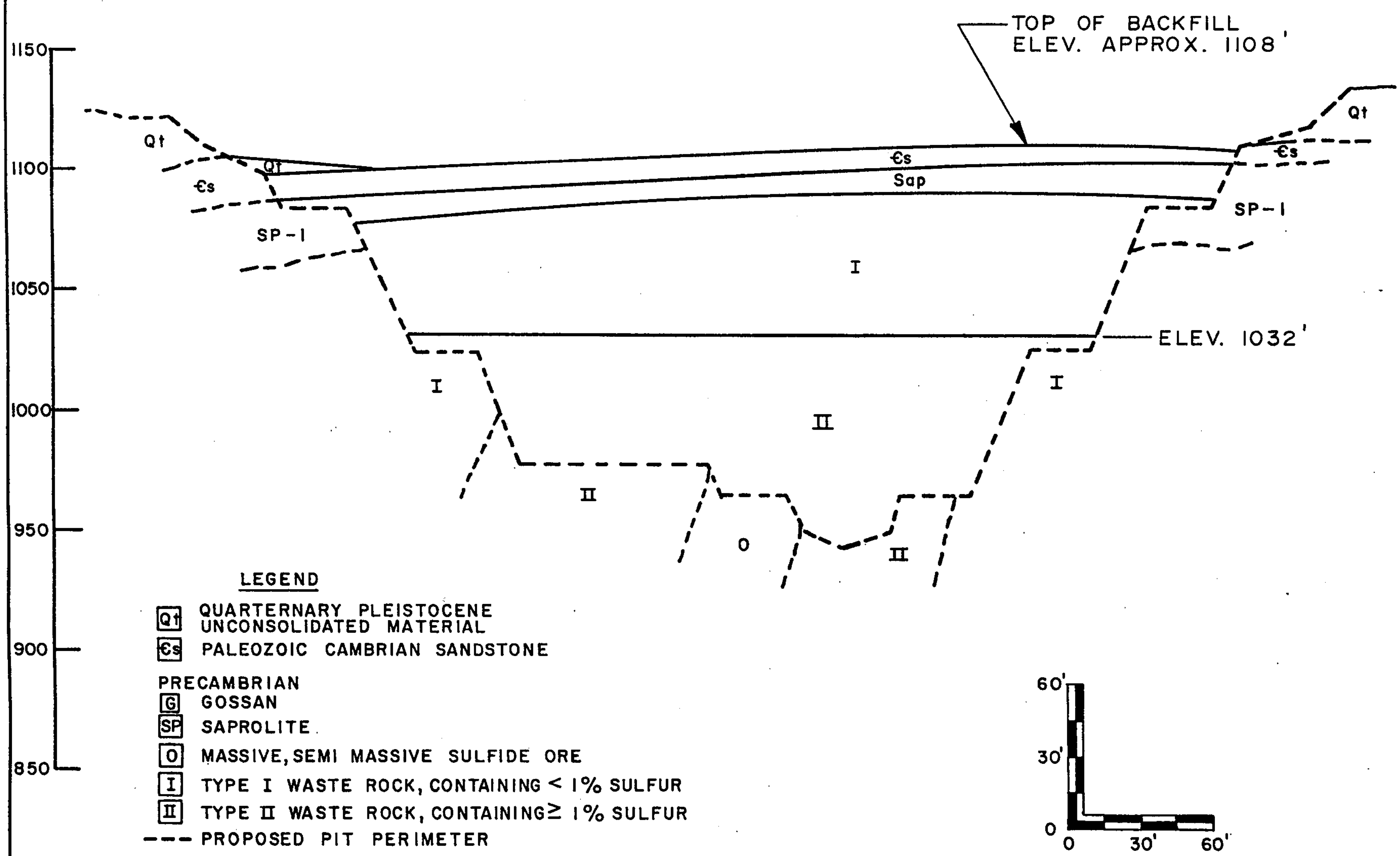
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

No	REVISIONS	NOTES	APPROVAL		DATE
△			DESIGNED BY		
△			DRAWN BY	SJL	12/89
△			CHECKED BY	GWS	12/89
△			APPROVED BY		
△			CAD No.	SCALE	

FIGURE NO. 5-7
SECTION THROUGH OPEN PIT AFTER 3 MONTHS OF BACKFILLING

Job No | Dwg No | REV



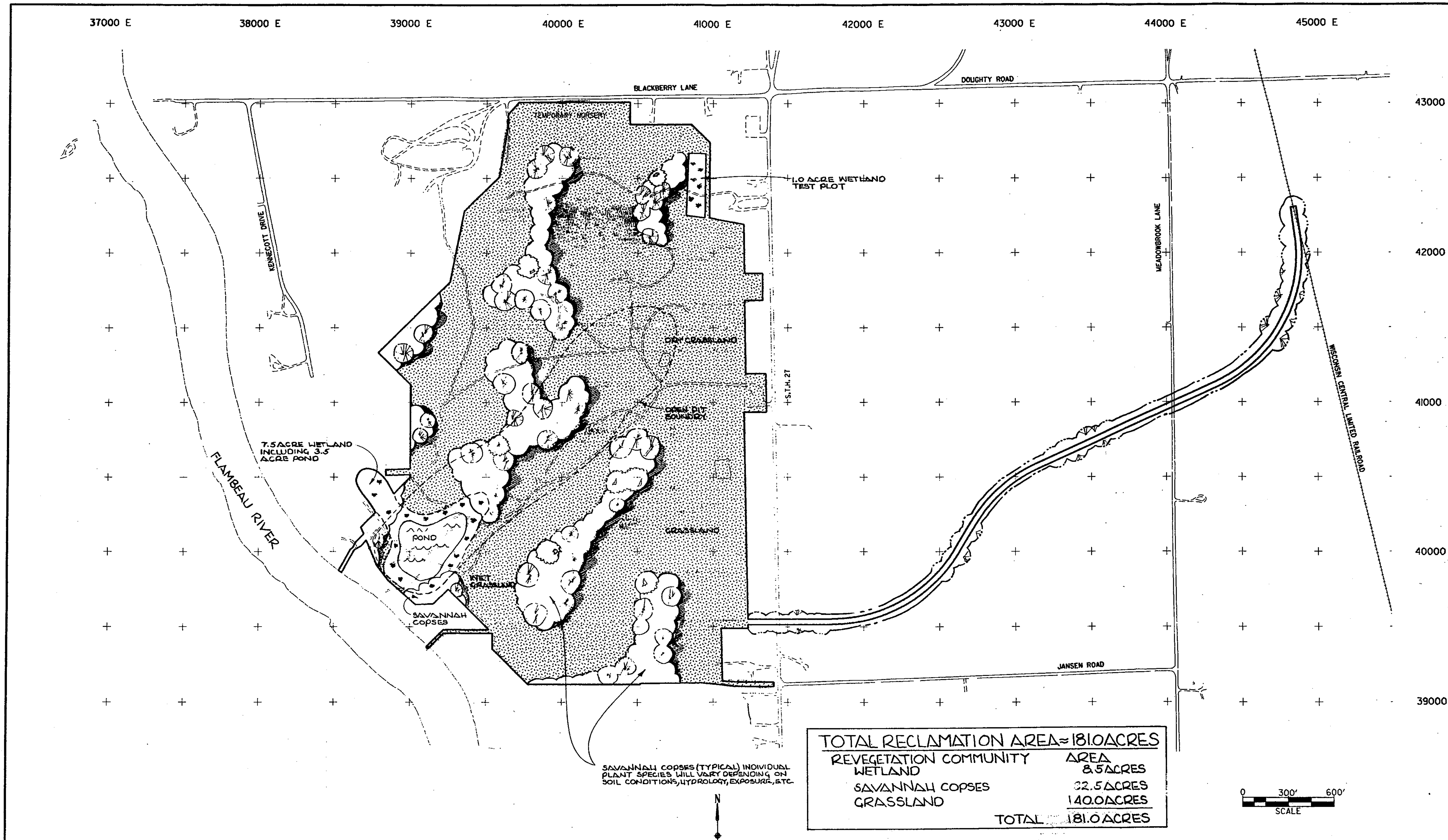
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

No	REVISIONS	NOTES	APPROVAL		DATE
			DESIGNED BY		
			DRAWN BY	SJL	12/89
			CHECKED BY	GWS	12/89
			APPROVED BY		
			CAD No.	SCALE	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 5-8
SECTION THROUGH OPEN PIT
AFTER 15 MONTHS OF BACKFILLING

Job No | Dwg No | REV



TOTAL RECLAMATION AREA ≈ 181.0 ACRES

REVEGETATION COMMUNITY	AREA
WETLAND	8.5 ACRES
SAVANNAH COPSES	32.5 ACRES
GRASSLAND	140.0 ACRES
TOTAL	181.0 ACRES

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

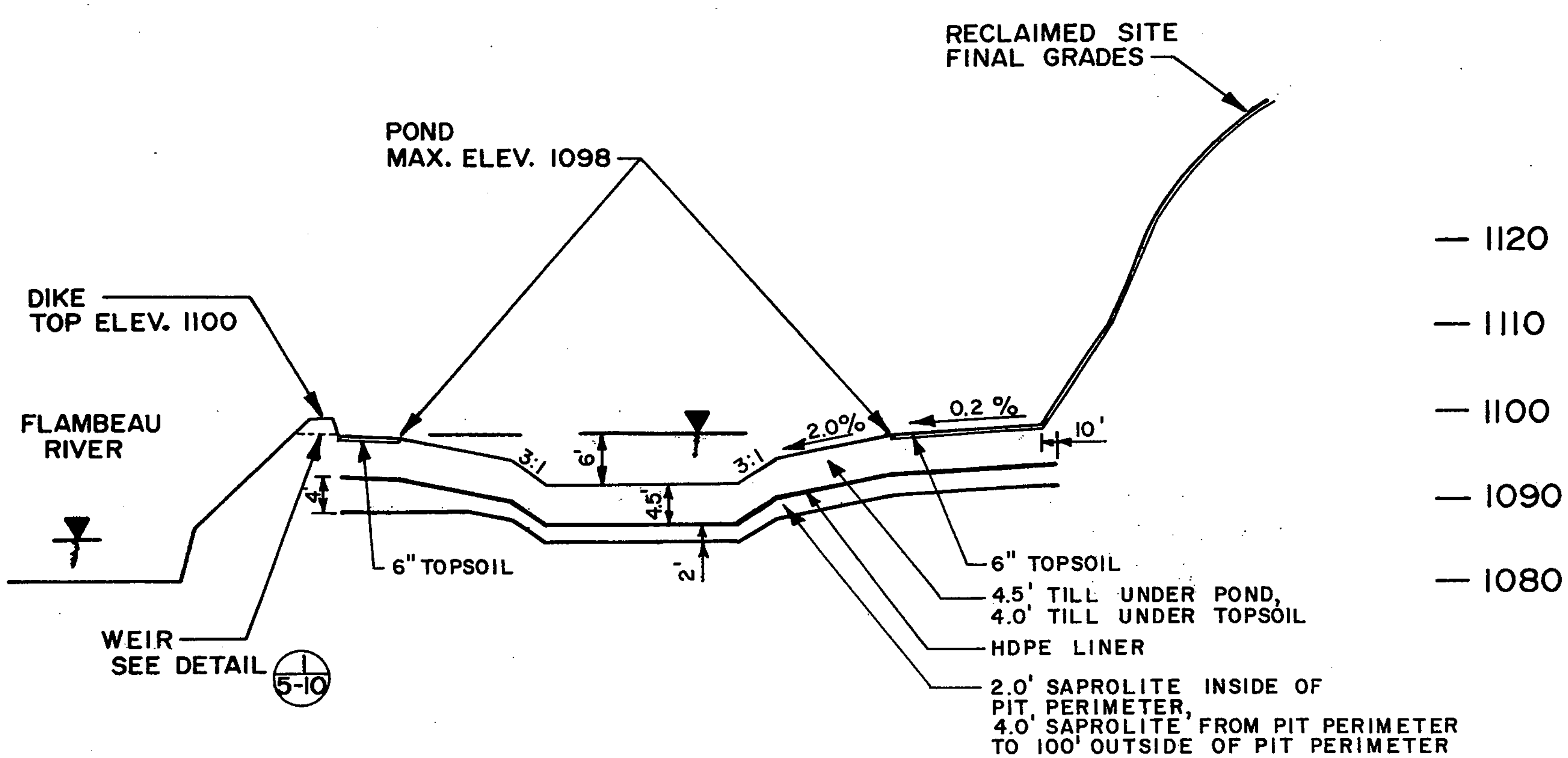
FIGURE NO. 5-9
REVEGETATION MASTER PLAN

	BY	DATE
DESIGN		
DRAWN	T.D.H.	12/89
CHK'D	J.W.S.	12/89
DES. ENG'R		
SECT. ENG'R		

PROJ. ENG'R
MGR. PROCESS ENG'R
ENG'R MGR.

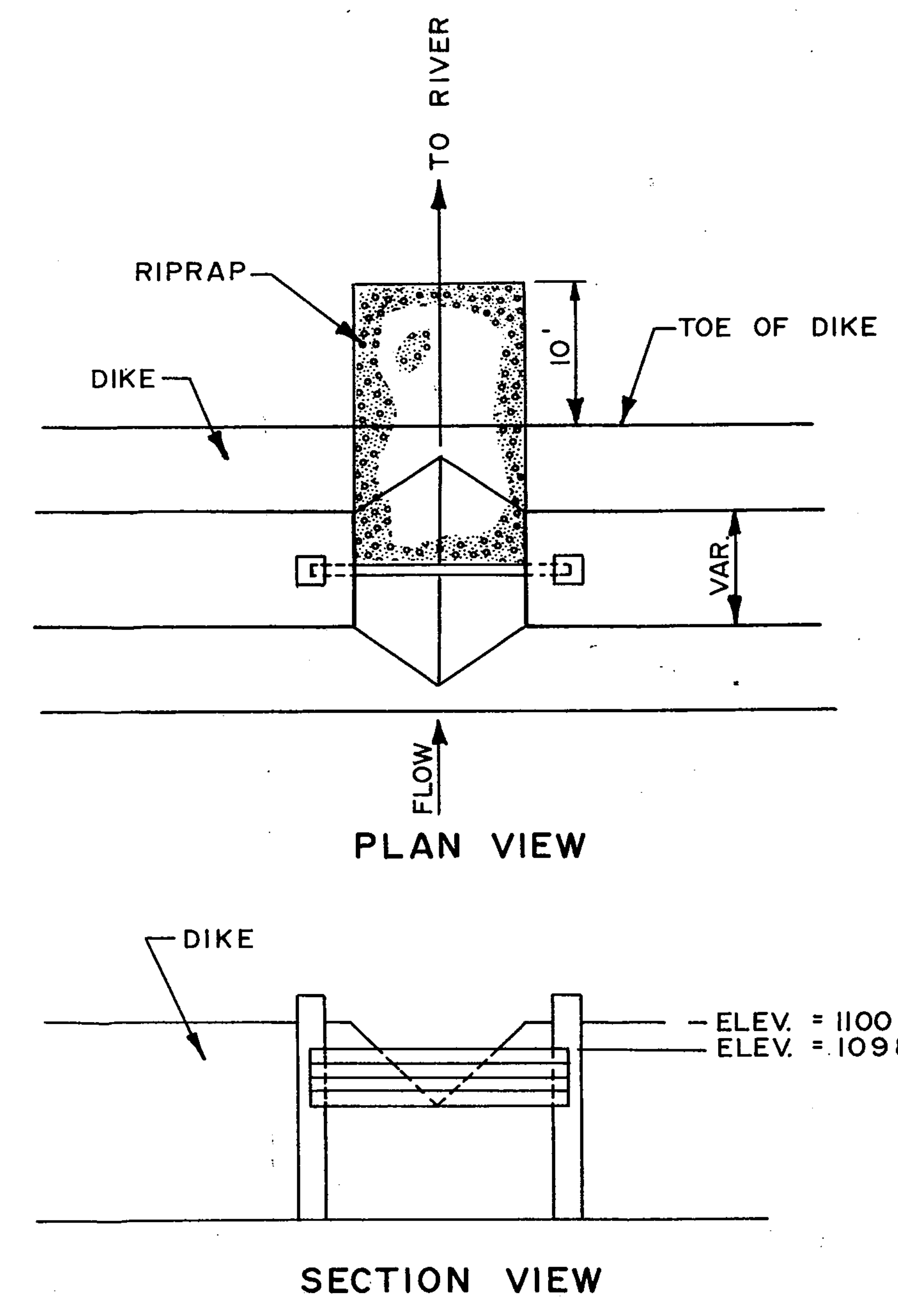
MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE | SEE BAR SCALE

REFERENCES: DWG. NO. | DESCRIPTION
REVISIONS: NO. | DATE | REVISIONS | BY | CHK'D | ENG'R | ENG'R MGR.



SCALE: HORIZ. 1" = 200'
VERT. 1" = 20'

NOTE: SAPROLITE AND HDPE TO BE PLACED ONLY IN AREA OF WETLAND WITHIN PIT PERIMETER.



1/5-10 WEIR DETAIL
NOT TO SCALE

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

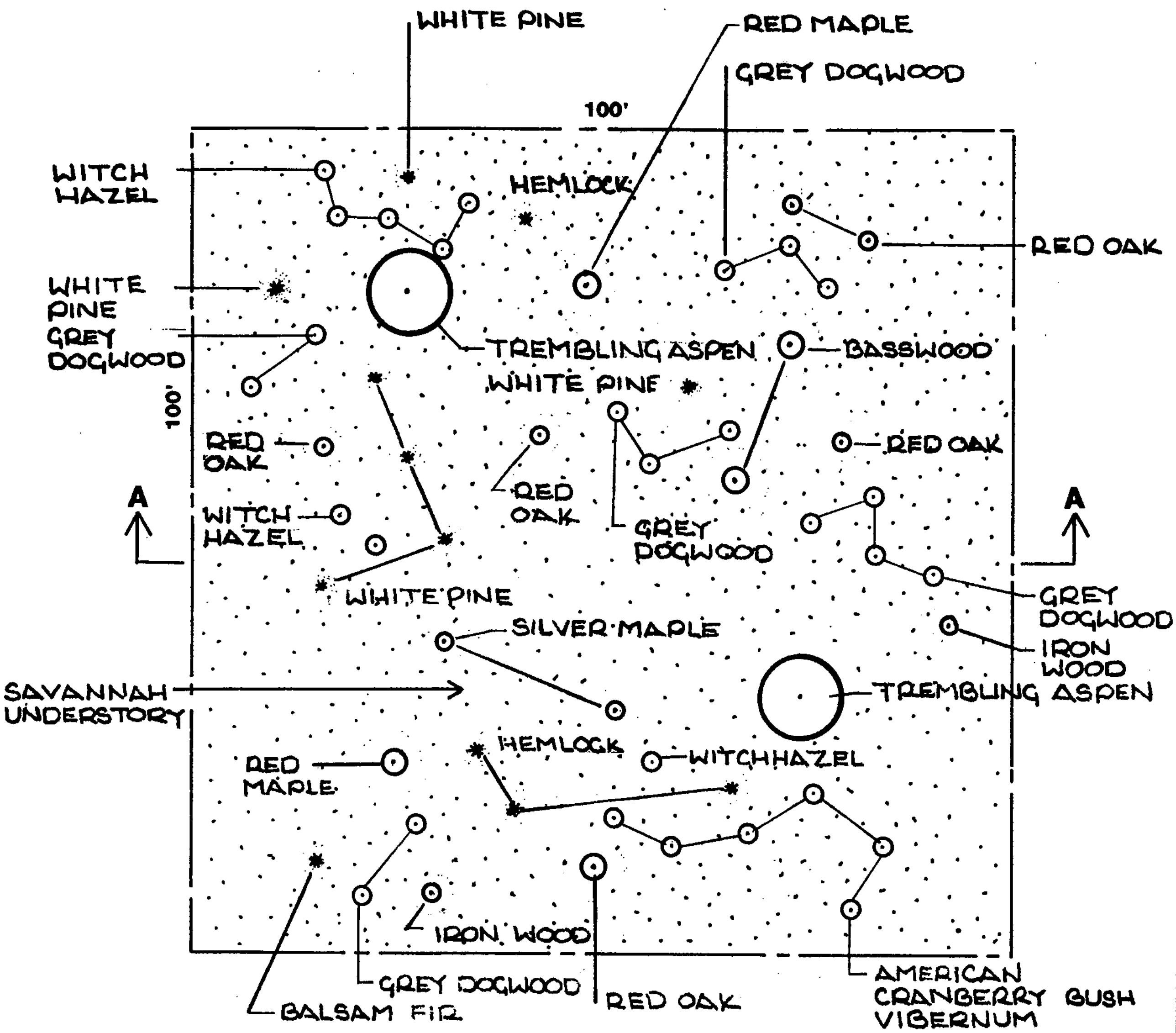
FIGURE NO. 5-10

WETLAND CROSS SECTION AND DETAILS

	BY	DATE
DESIGN		
DRAWN	SJL	12/89
CHK'D	GWS	12/89
DES. ENG'R		
SECT ENG'R		

MICROFILM | JOB | DRAWING NO. | REV. | DIVISION DRAWING NO. | SCALE

REFERENCES	DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR



Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT INITIAL PLANTING

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

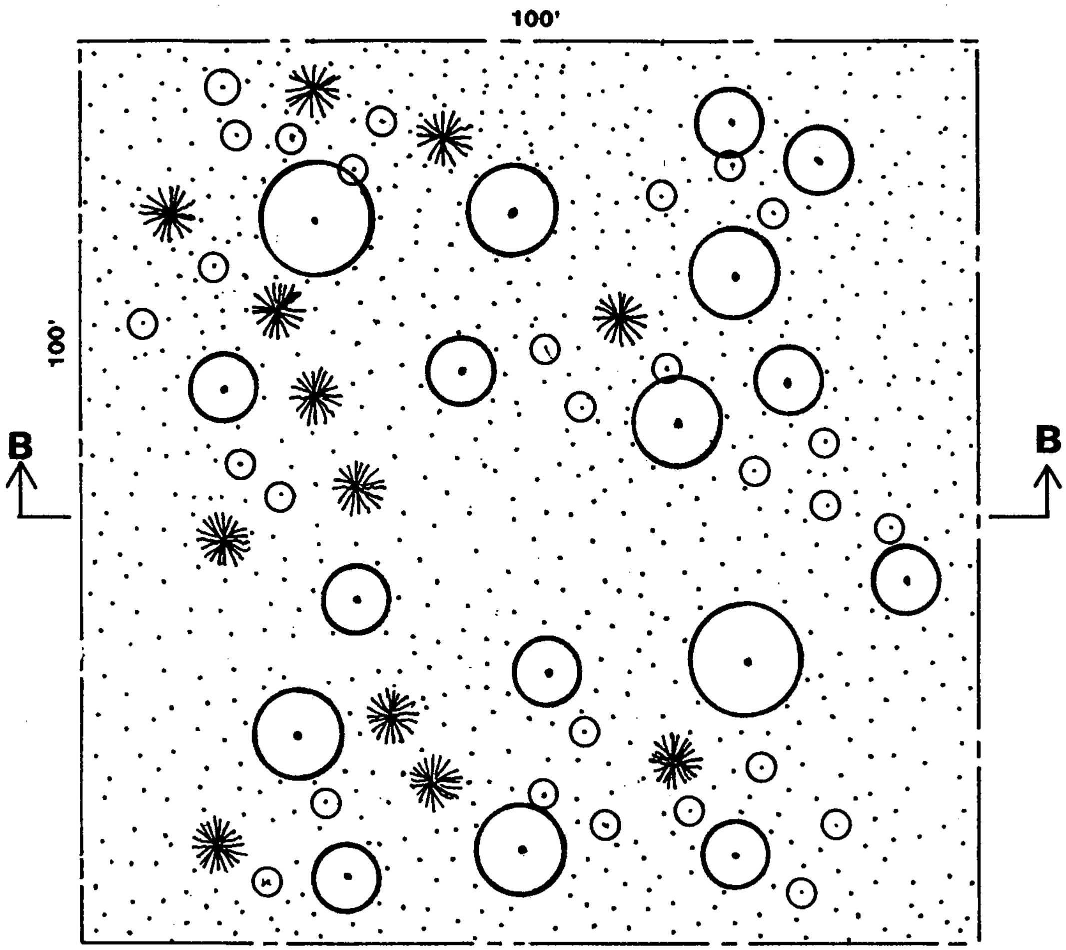
KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	JWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

FIGURE NO. 5-11

TYPICAL PLAN VIEW OF SAVANNAH COPSE VEGETATION PLANTINGS

Job No | Dwg No | REV



Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT YEAR 3 OF RECLAMATION

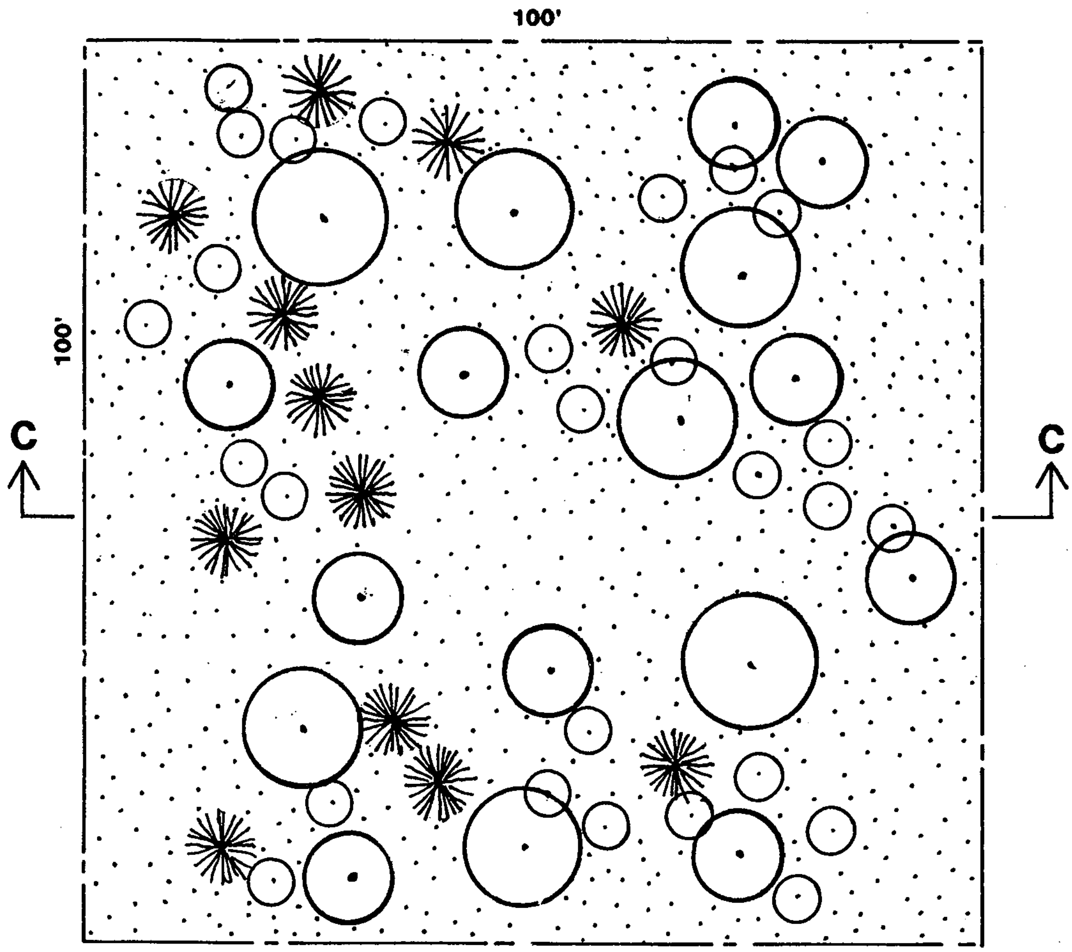
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	JWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 5-12
TYPICAL PLAN VIEW OF SAVANNAH COPSE VEGETATION PLANTINGS

Job No 87K10	Dwg No	REV



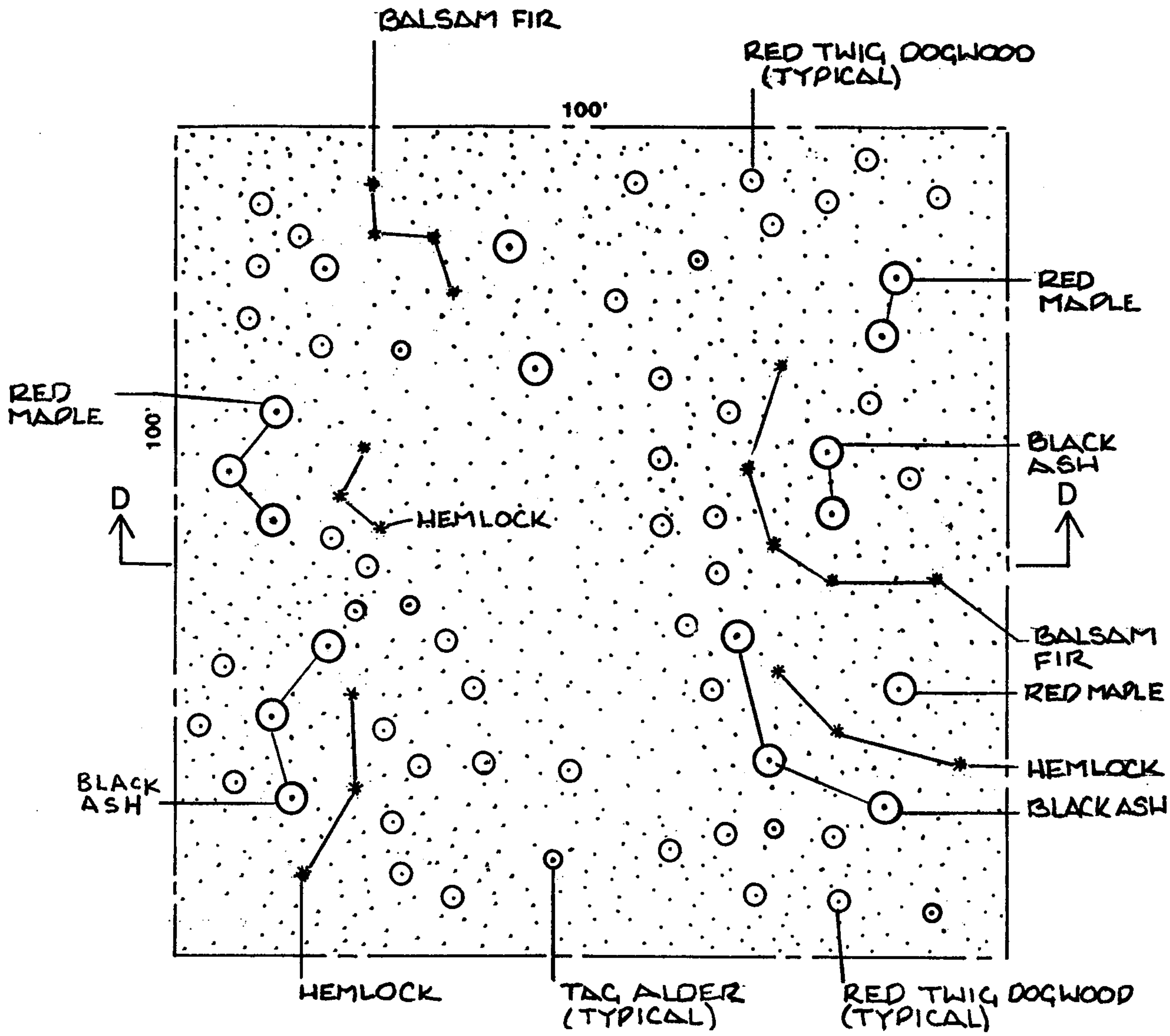
Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT YEAR 10 OF RECLAMATION

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN				KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL		DATE	FIGURE NO. 5-13 TYPICAL PLAN VIEW OF SAVANNAH COPSES VEGETATION PLANTINGS
	DESIGNED BY			
	DRAWN BY	PES	12/89	
	CHECKED BY	JWS	12/89	
	APPROVED BY			
	CAD No.	SCALE 1" = 20"		Job No 87K10 / Dwg No / REV



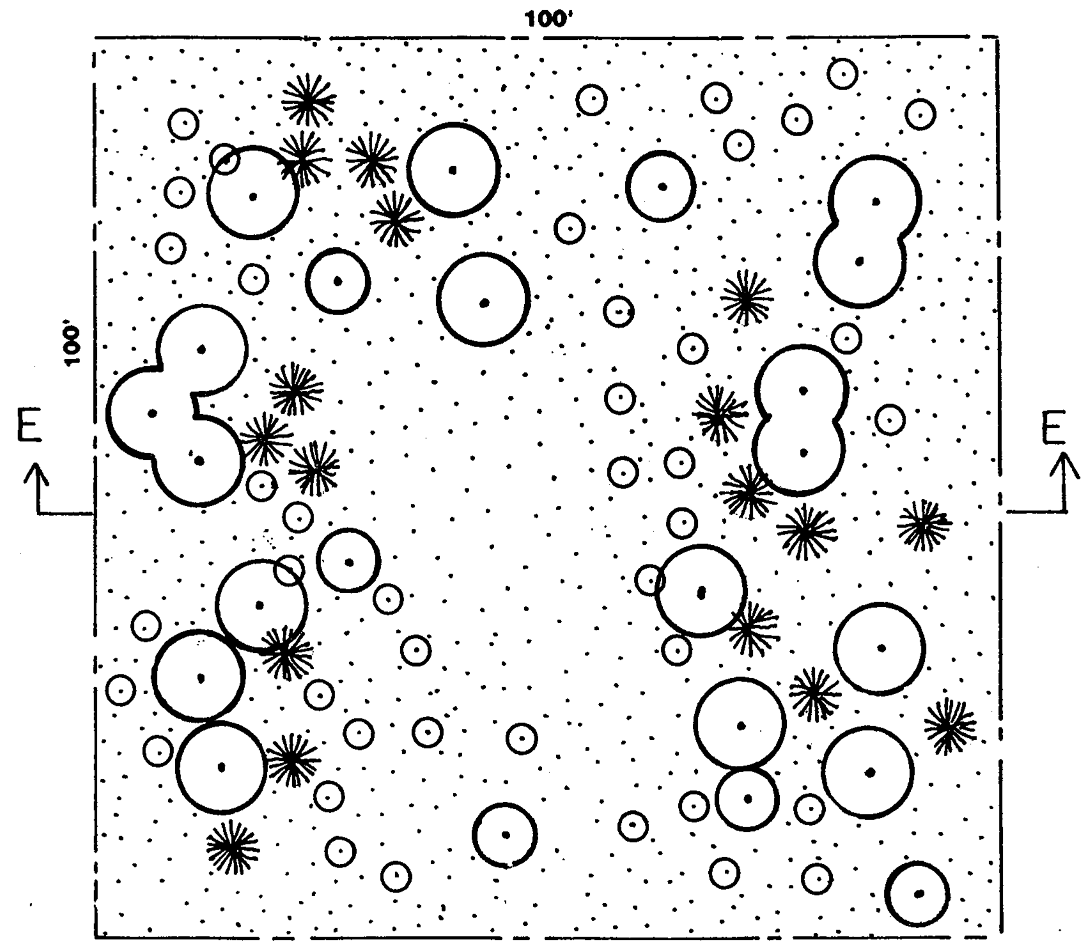
Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT INITIAL PLANTING

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 5-14 TYPICAL PLAN VIEW OF WETLAND VEGETATION PLANTINGS
	DESIGNED BY		
	DRAWN BY PES	12/89	
	CHECKED BY JWS	12/89	
	APPROVED BY		
	CAD No.	SCALE 1"= 20'	Job No 87K10 / Dwg No / REV



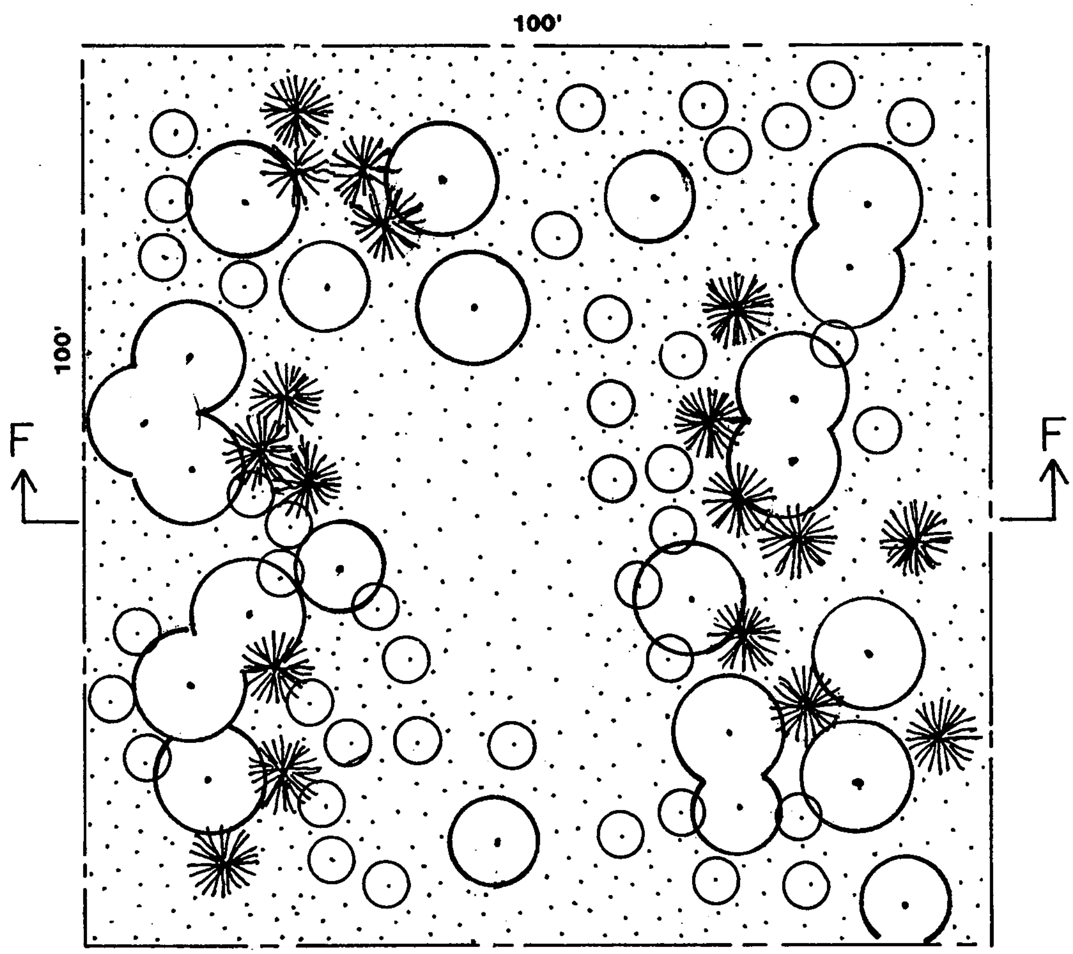
Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT YEAR 3 OF RECLAMATION

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN				KENNECOTT MINERALS COMPANY **FLAMBEAU PROJECT** LADYSMITH, WISCONSIN		
NOTES	APPROVAL		DATE	FIGURE NO. 5-15 TYPICAL PLAN VIEW OF WETLAND VEGETATION PLANTINGS		
	DESIGNED BY					
	DRAWN BY	PE S	12/89			
	CHECKED BY	JWS	12/89			
	APPROVED BY					
	CAD No.	SCALE 1" = 20'		Job No 87K10	Dwg No	REV



Note:

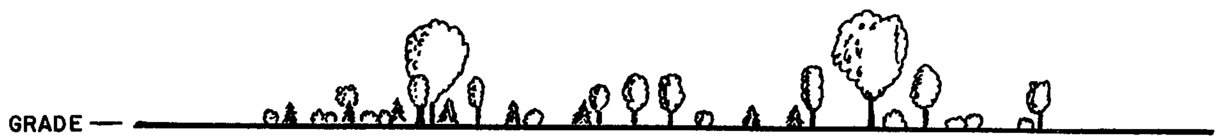
1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT YEAR 10 OF RECLAMATION

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN				KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL		DATE	FIGURE NO. 5-16 TYPICAL PLAN VIEW OF WETLAND VEGETATION PLANTINGS
	DESIGNED BY			
	DRAWN BY	PES	12/89	
	CHECKED BY	JWS	12/89	
	APPROVED BY			
	CAD No.	SCALE 1" = 20'		

Job No 87K10	Dwg No	REV



SECTION 'A – A'

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT INITIAL PLANTING

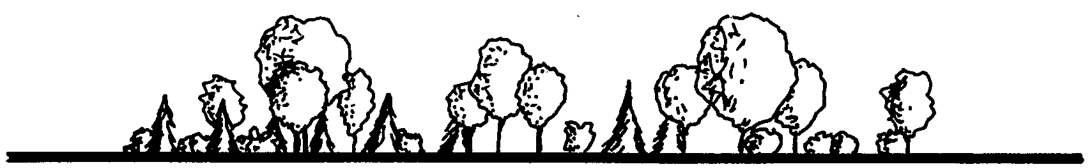
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	JWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 5-17
TYPICAL SECTION OF SAVANNAH COPSE VEGETATION PLANTINGS

Job No	Dwg No	REV



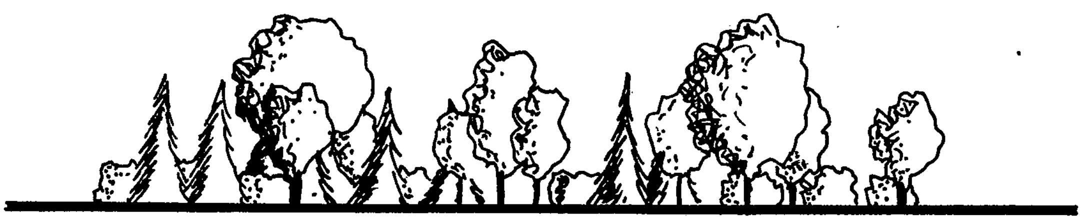
SECTION 'B – B'

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT YEAR 3 OF RECLAMATION

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN				KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL		DATE	FIGURE NO. 5-18 TYPICAL SECTION OF SAVANNAH COPSE VEGETATION PLANTINGS
	DESIGNED BY			
	DRAWN BY	PES	12/89	
	CHECKED BY	JWS	12/89	
	APPROVED BY			
	CAD No.	SCALE 1" = 20'		Job No 87K10 Dwg No REV



SECTION 'C – C'

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT YEAR 10 OF RECLAMATION

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 5-19 TYPICAL SECTION OF SAVANNAH COPSE VEGETATION PLANTINGS
	DESIGNED BY		
	DRAWN BY PES	12/89	
	CHECKED BY JWS	12/89	
	APPROVED BY		
	CAD No. / SCALE 1" = 20'		Job No 87K10 / Dwg No / REV

SECTION D-D

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT INITIAL PLANTING

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

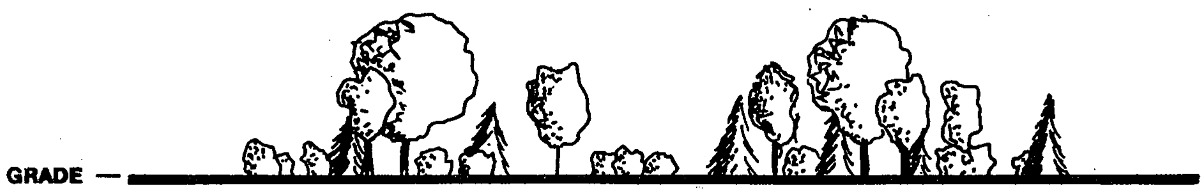
NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	JWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 5-20

TYPICAL SECTION OF WETLAND VEGETATION PLANTINGS

Job No 87K10	Dwg No	REV



SECTION E-E

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT YEAR 3 OF RECLAMATION

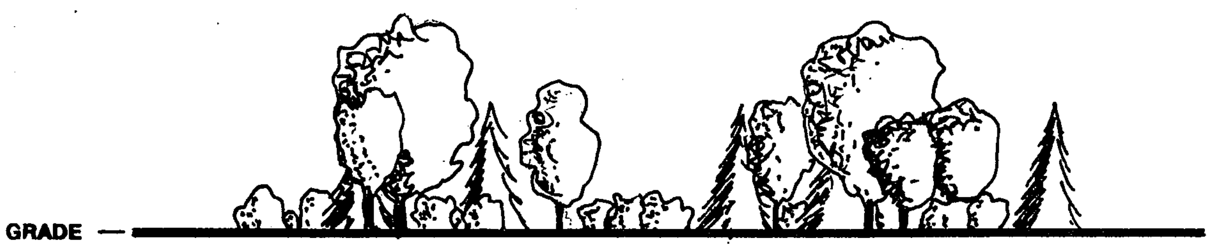
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	JWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

FIGURE NO. 5-21
TYPICAL SECTION OF
WETLAND VEGETATION PLANTINGS

Job No 87K10 | Dwg No | REV



SECTION F-F

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT YEAR 10 OF RECLAMATION

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

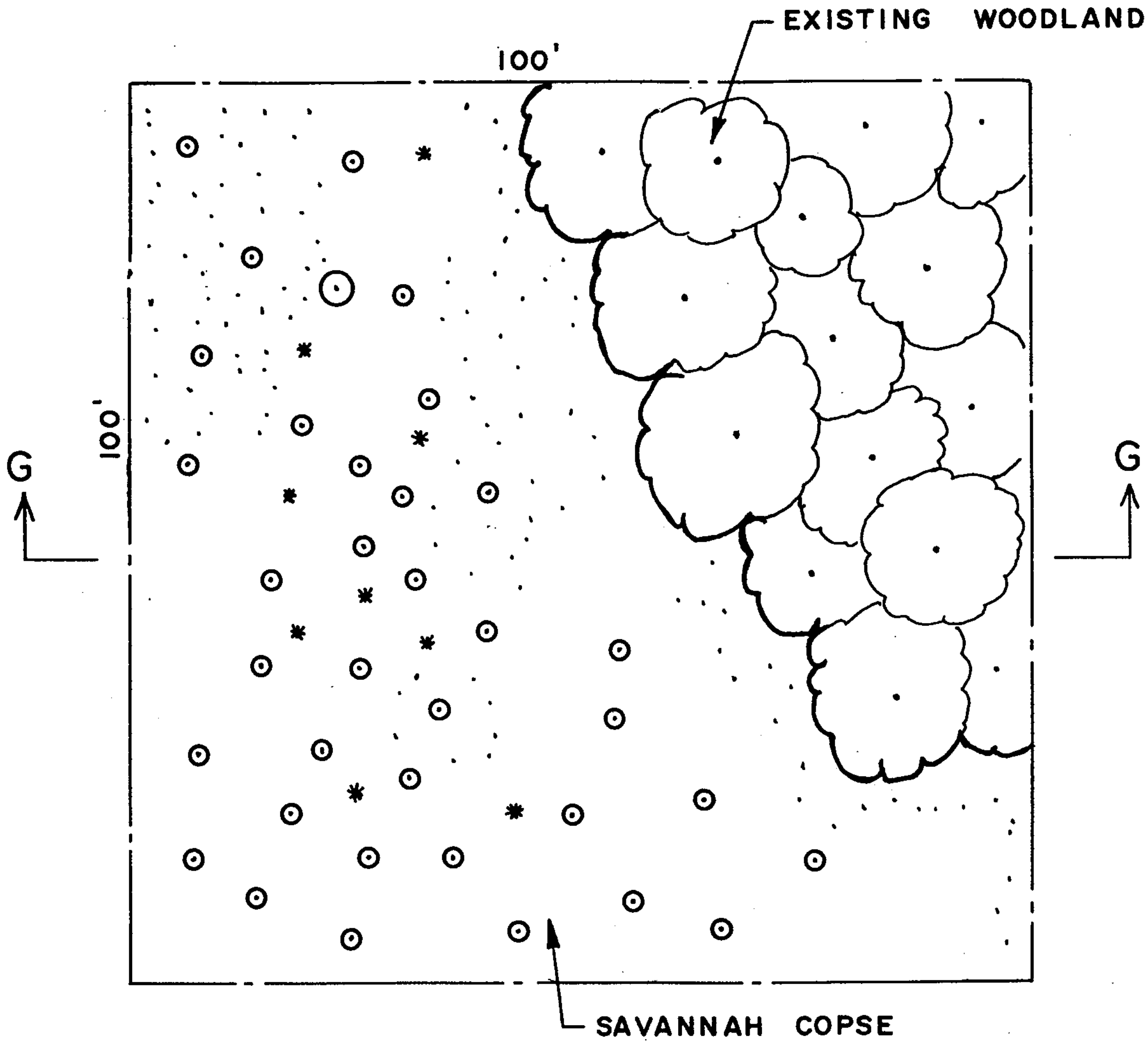
NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	JWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 5-22

TYPICAL SECTION OF WETLAND VEGETATION PLANTINGS

Job No 87K10	Dwg No	REV



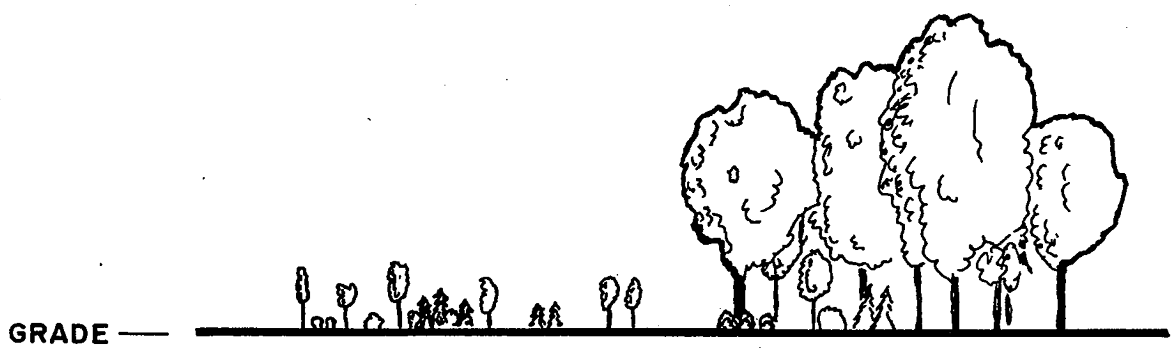
Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT INITIAL PLANTING

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 5-23
	DESIGNED BY		TYPICAL PLAN VIEW OF SAVANNAH COPSE/EXISTING WOODLAND EDGE
	DRAWN BY PES	12/89	
	CHECKED BY GWS	12/89	
	APPROVED BY		
	CAD No. SCALE 1" = 20'		Job No Dwg No REV



SECTION G - G

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT INITIAL PLANTING

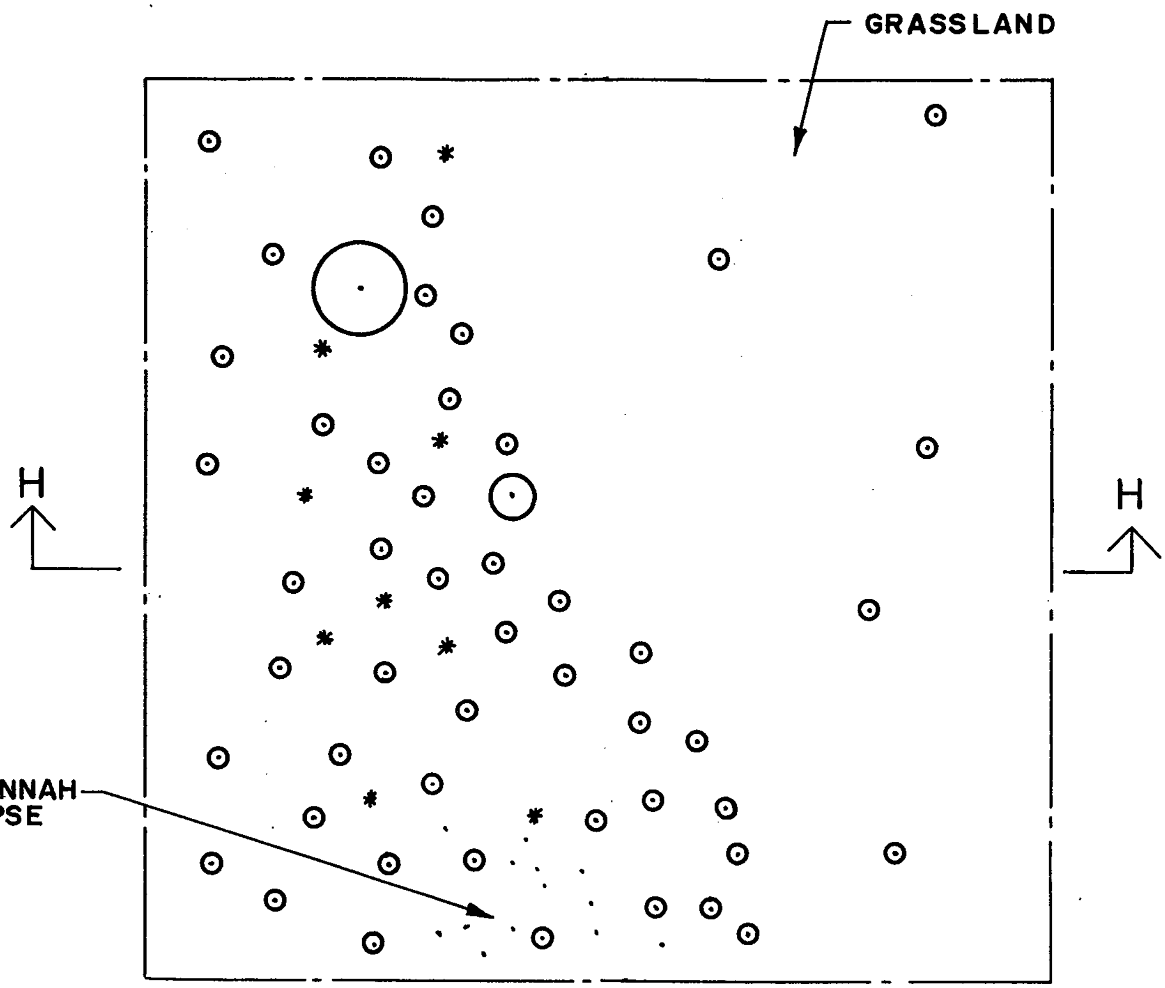
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

FIGURE NO. 5-24
TYPICAL SECTION OF SAVANNAH COPSE
EXISTING WOODLAND EDGE

Job No	Dwg No	REV



Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT INITIAL PLANTING

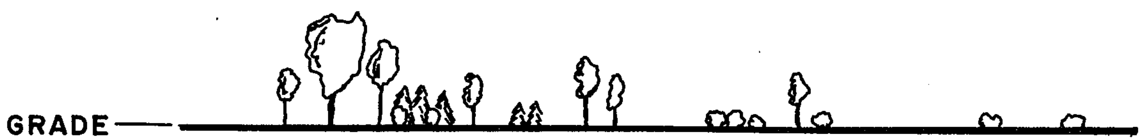
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

FIGURE NO. 5-25
TYPICAL PLAN VIEW OF SAVANNAH COPSE / GRASSLAND EDGE

Job No	Dwg No	REV



SECTION H-H

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT INITIAL PLANTING

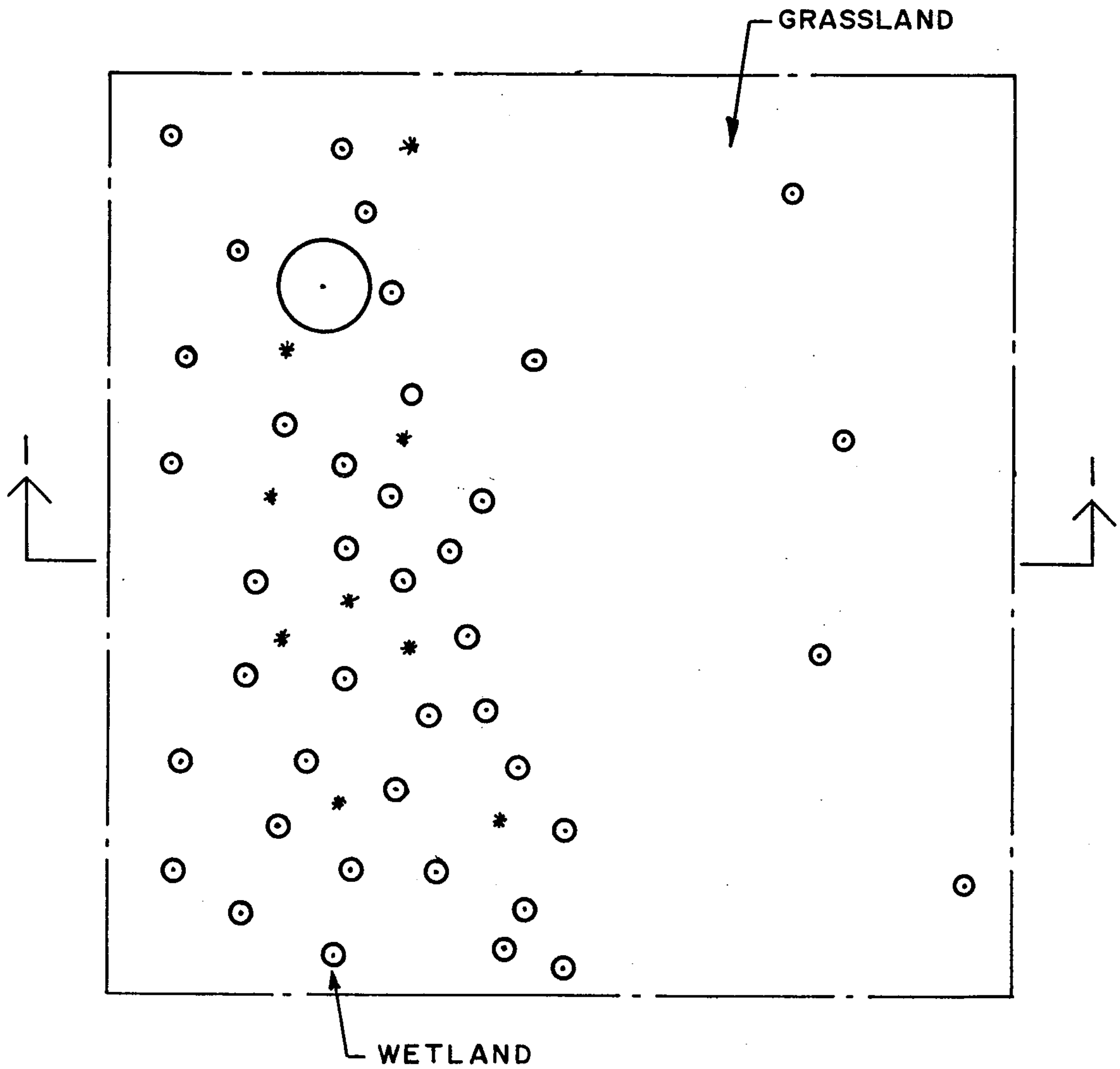
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

FIGURE NO. 5-26
TYPICAL SECTION OF SAVANNAH COPSE GRASSLAND EDGE

Job No	Dwg No	REV



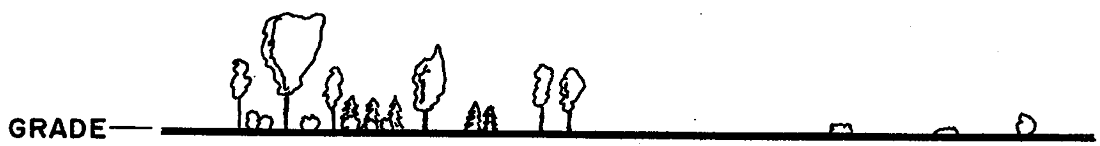
Note:

1) This figure represents a typical distribution of plant species. Actual distribution may vary.

2) In addition to this initial distribution, other indigenous plant species will invade and establish themselves randomly throughout the site.

RELATIVE CROWN SIZE AT INITIAL PLANTING

FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 5-27 TYPICAL PLAN VIEW OF WETLAND/GRASSLAND EDGE
	DESIGNED BY		
	DRAWN BY PES	12/89	
	CHECKED BY GWS	12/89	
	APPROVED BY		
	CAD No. / SCALE 1" = 20'		Job No / Dwg No / REV



SECTION 1-1

1" = 20'

Note: This elevation drawing represents an artist's estimation of the height and crown size of the illustrated vegetation at the time specified below. The actual height and crown density may vary depending on the age, specie and maturity of individual plants.

RELATIVE CROWN SIZE AT INITIAL PLANTING

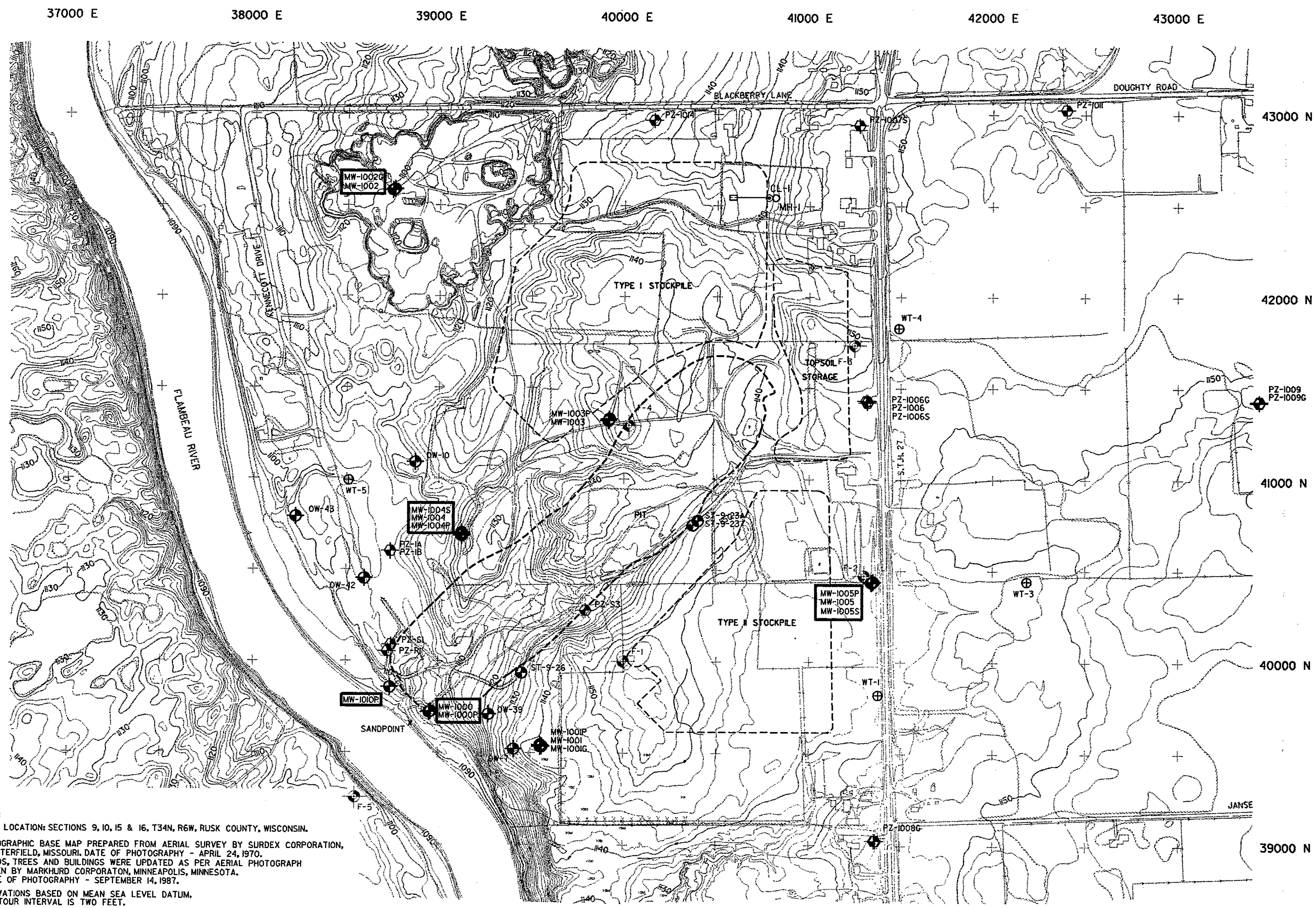
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY		
	DRAWN BY	PES	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE 1" = 20'	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 5-28
TYPICAL SECTION OF WETLAND/GRASSLAND EDGE

Job No	Dwg No	REV



NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970. ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATON, MINNEAPOLIS, MINNESOTA. DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

5. SEE FIGURE NO.'S 7-1 AND 7-7 FOR THE LOCATION OF WETLAND STAFF GAUGE WT-2 AND FOR SURFACE WATER MONITORING LOCATIONS.

LEGEND

- 1100 EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- FENCE
- F-1 CONTROL MONUMENT
- MW-1005 MONITORING WELL
- PZ-R3 PIEZOMETER
- MW-1005 WELL ON THE WATER QUALITY MONITORING PROGRAM
- WT-5 WETLAND STAFF GAUGE

N

0 300' 600'
SCALE

GROUNDWATER AND COLLECTION LYSIMETER
CONSTRUCTION AND OPERATION MONITORING PROGRAM

COLLECTION LYSIMETER/ WELL/PIEZOMETER NUMBER	ELEVATION OF SCREENED INTERVAL (FT. MSL)	GEOLOGIC UNIT	PARAMETER*
MW-1000	1091-1081	PRECAMBRIAN, TILL	1, 2
MW-1000P	1049-1044	PRECAMBRIAN	1, 2
MW-1001	1118-1108	TILL	1
MW-1001G	1095-1090	TILL, SANDSTONE	1
MW-1001P	1051-1046	PRECAMBRIAN	1
MW-1002	1096-1086	SAND & GRAVEL	1, 2
MW-1002G	1055-1050	SAND & GRAVEL	1, 2
MW-1003	1113-1103	SANDSTONE	1
MW-1003P	1062-1057	PRECAMBRIAN	1
MW-1004	1112-1102	SAND & GRAVEL	1, 2
MW-1004S	1093-1088	SANDSTONE	1, 2
MW-1004P	1042-1037	PRECAMBRIAN	1, 2
MW-1005	1134-1124	TILL	1, 2
MW-1005S	1097-1092	SANDSTONE	1, 2
MW-1005P	1056-1051	PRECAMBRIAN	1, 2
PZ-1006	1143-1138	TILL	1
PZ-1006G	1119-1114	TILL	1
PZ-1006S	1101-1096	SANDSTONE	1
PZ-1007S	1110-1105	SANDSTONE	1
PZ-1008	1138-1128	TILL	1
PZ-1008G	1096-1091	SAND & GRAVEL	1
PZ-1009	1144-1134	TILL	1
PZ-1009G	1107-1102	TILL	1
MW-1010P	995- 990	PRECAMBRIAN	1, 2
PZ-1011	1114-1104	TILL	1
PZ-1012	1111-1101	TILL	1
PZ-R1	901- 881	PRECAMBRIAN	1
PZ-S1	1067-1062	PRECAMBRIAN	1
PZ-S3	1100-1095	SANDSTONE	1
SANDPOINT	1084-1082	SAND & GRAVEL	1
ST-9-23	1106-1101	SANDSTONE	1
ST-9-23A	1125-1120	SAND & GRAVEL	1
ST-9-26	1106-1101	TILL	1
PZ-1A	1099-1097	SAND & GRAVEL	1
PZ-1B	1103-1101	SAND & GRAVEL	1
OW-7	1088-1078	TILL	1
OW-10	1069-1059	TILL	1
OW-39	1107-1073	TILL	1
OW-42	1090-1058	SAND & GRAVEL	1
OW-43	1090-1022	SAND & GRAVEL	1
CL-1	N.A.	N.A.	3

*1 GROUNDWATER ELEVATION (QUARTERLY).

*2 SPECIFIC CONDUCTIVITY (FIELD), PH (FIELD AND LAB), TDS, IRON, MANGANESE, SULFATE, COPPER, TOTAL ALKALINITY, TOTAL HARDNESS (ALL QUARTERLY).

*3 PH (FIELD AND LAB), SPECIFIC CONDUCTANCE (FIELD), TOTAL CHROMIUM, COPPER, IRON, MANGANESE, SULFATE, TOTAL DISSOLVED SOLIDS, TOTAL ALKALINITY, TOTAL HARDNESS, VOLUME OF LIQUID REMOVED (ALL QUARTERLY).

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
8412

FIGURE NO. 7-1
CONSTRUCTION AND OPERATION
GROUNDWATER AND COLLECTION
LYSIMETER MONITORING PROGRAM

	BY	DATE
DESIGN		
DRAWN	DHS	12/89
CHK'D	GWS	12/89
DES. ENG'R		
SECT ENG'R		

PROJ. ENG'R
MGR. PROCESS ENG'R
ENG'R MGR.

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE: SEE BAR SCALE

REFERENCES: DWG. NO. | DESCRIPTION
REVISIONS: NO. | DATE | REVISIONS | BY | CHK'D | ENG'R | ENG'R MGR.

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: --　　**Well No.:** MW-1010P

Drilling Method: Tricone and mud through Quaternary, Air Rotary into bedrock　　**Date Installed:** --

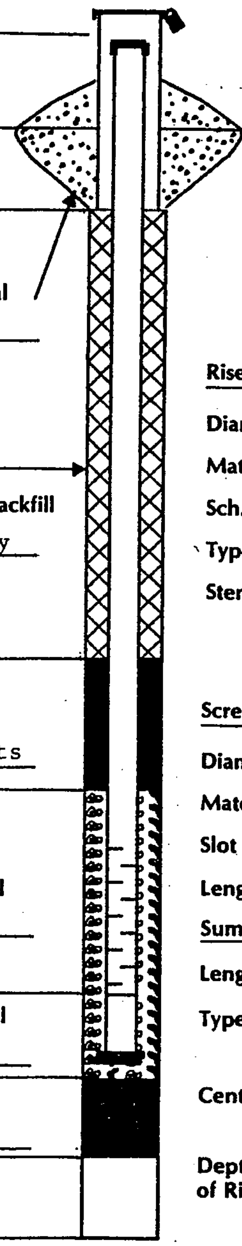
Coordinates: (see Figure No. 7-1)

Protector Pipe:

Size: 6"

Material: steel

Lock No.: --



Elevation

Stick-up: 3'

Ground Elev. ~1100'

1'

Surface Seal Material: Concrete

Drill Hole Diameter: 6"

Type of Annular Space Backfill: Bentonite slurry — ~98'

Ground Surface to Tip of Well Screen: ~110'

Type of Seal: Bentonite pellets — 3'

Type of Filter Material: #30 Sand — 8'

Type of Filter Material: N/A — N/A

Type of Seal: N/A — N/A

Type of Backfill: N/A — N/A

Riser:

Diameter: 2" ID

Material: PVC

Sch.: 80

Type of Joints: Flush threaded

Stenciled? No

Screen:

Diameter: 2" ID

Material: PVC

Slot Size: 0.010"

Length: 5'

Sump:

Length: N/A

Type of Cap: PVC

Centralizer: Used ☐ Not Used ☑

Depth to Water From Top of Riser at Completion: ~15'

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY	BNP	11-26-89
	DRAWN BY	JRB	11-30-89
	CHECKED BY	JWS	12-1-89
	APPROVED BY		
	CAD No.	SCALE NONE	

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 7-2
PROPOSED WELL MW-1010P
CONSTRUCTION DETAIL

Job No	Dwg No	REV

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: -

Well No.: PZ-1011

Drilling Method: HSA

Date Installed: -

Coordinates: (See Figure No. 7-1)

Protector Pipe:

Size: 4"

Material: Steel

Lock No.: -

Elevation

Stick-up: 3'

Ground Elev. ~1151'

1'

Surface Seal Material: Concrete

Drill Hole Diameter: 8"

Type of Annular Space Backfill: Bentonite Slurry — ~30'

Ground Surface to Tip of Well Screen: ~47'

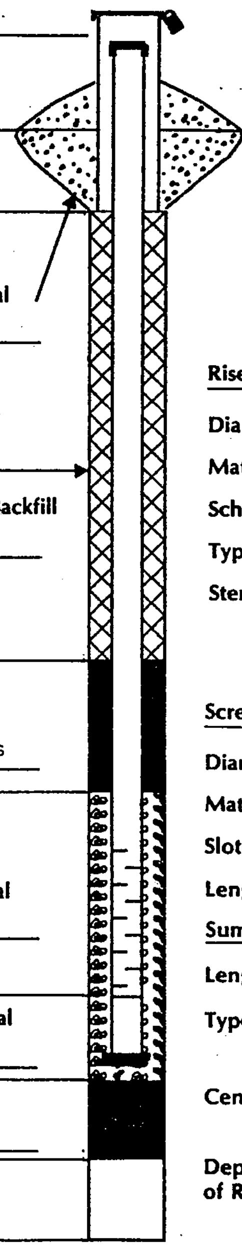
Type of Seal: Bentonite Pellets — 3'

Type of Filter Material: #30 Sand — 13'

Type of Filter Material: N/A — N/A

Type of Seal: N/A — N/A

Type of Backfill: N/A — N/A



Riser:

Diameter: 2" I.D.

Material: PVC

Sch.: 80

Type of Joints: Flush Threaded

Stenciled? No

Screen:

Diameter: 2" I.D.

Material: PVC

Slot Size: 0.010"

Length: 10'

Sump:

Length: N/A

Type of Cap: PVC

Centralizer: Used ☐ Not Used ☒

Depth to Water From Top of Riser at Completion: ~39'

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

NOTES	APPROVAL		DATE
	DESIGNED BY	BNP	11-26-89
	DRAWN BY	JRB	11-30-89
	CHECKED BY	JWS	12-1-89
	APPROVED BY		
	CAD No.	SCALE NONE	

FIGURE NO. 7-3
PROPOSED WELL PZ-1011
CONSTRUCTION DETAIL

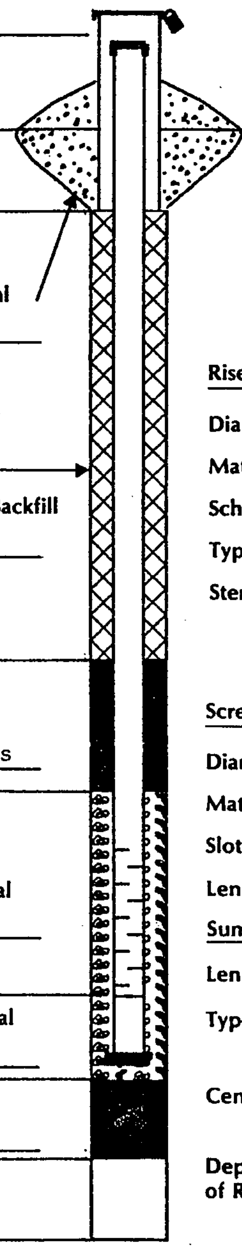
Job No | Dwg No | REV

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: –
Well No.: PZ-1012
Drilling Method: HSA
Date Installed: –

Coordinates: (See Figure No. 7-1)

Protector Pipe:
Size: 4"
Material: Steel
Lock No.: –



	3'	Elevation / Stick-up
Ground Elev. ~1136'	1'	Surface Seal Material: Concrete
~35' (Ground Surface to Tip of Well Screen)	~18'	Drill Hole Diameter: 8"; Type of Annular Space Backfill: Bentonite Slurry
	3'	Type of Seal: Bentonite Pellets
	13'	Type of Filter Material: #30 Sand
	N/A	Type of Filter Material: N/A
	N/A	Type of Seal: N/A
	N/A	Type of Backfill: N/A

Riser:
Diameter: 2" I.D.
Material: PVC
Sch.: 80
Type of Joints: Flush Threaded
Stenciled? No

Screen:
Diameter: 2" I.D.
Material: PVC
Slot Size: 0.010"
Length: 10'

Sump:
Length: N/A
Type of Cap: PVC

Centralizer: Used ☐
Not Used ☒

Depth to Water From Top of Riser at Completion: ~31'

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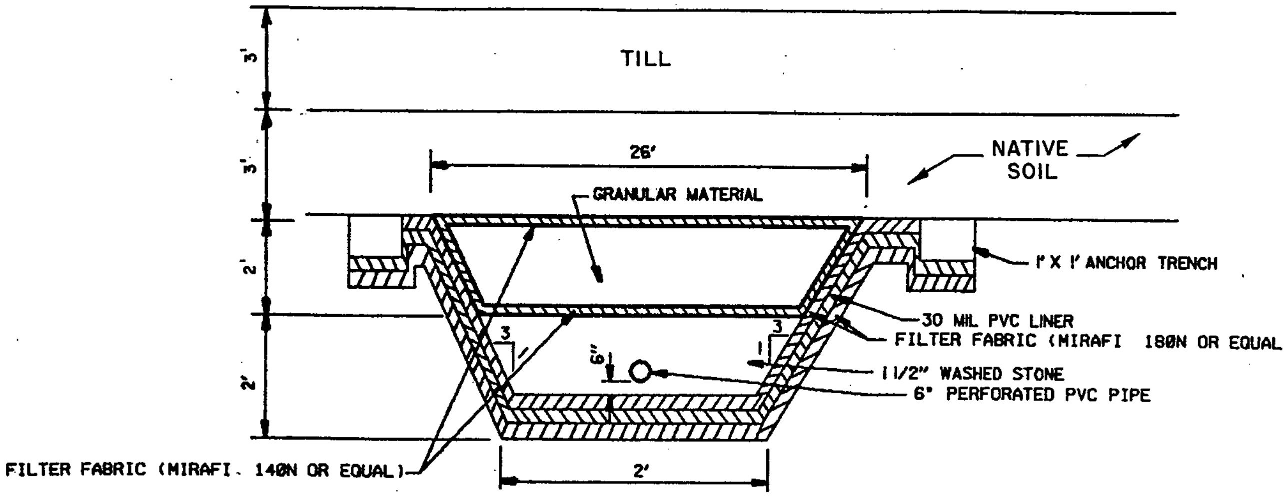
	DRAWN BY	JRB	11-30-89
	CHECKED BY	JWS	12-1-89
	APPROVED BY		
	CAD No.	SCALE NONE	

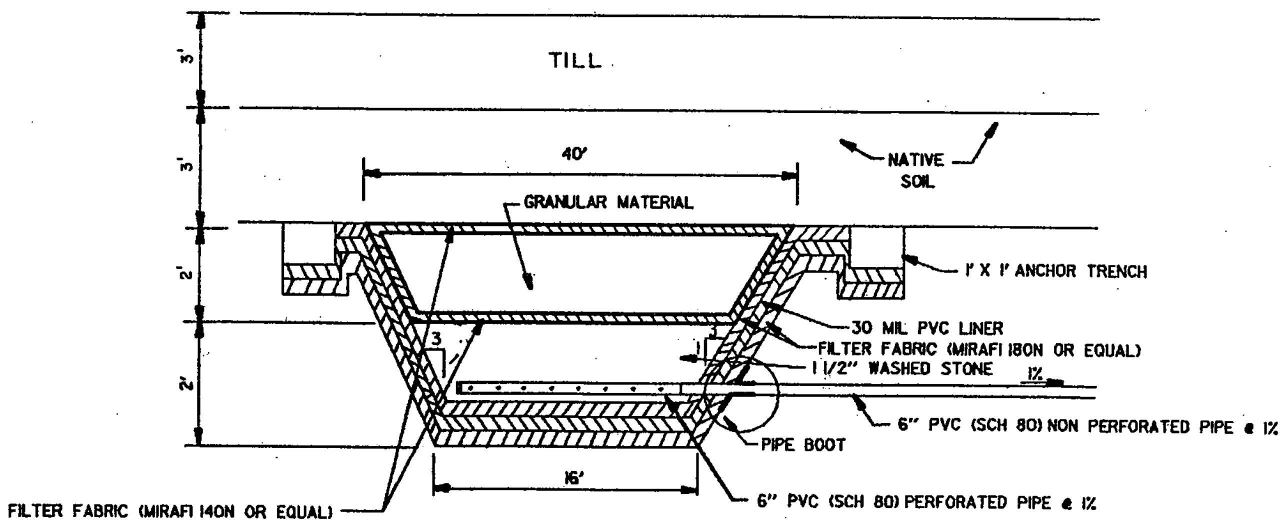
FIGURE NO. 7-4
PROPOSED WELL PZ-1012
CONSTRUCTION DETAIL

Job No | Dwg No | REV



TYPICAL SECTION PERPENDICULAR TO COLLECTION LYSIMETER PIPING

NOT TO SCALE



TYPICAL SECTION THRU COLLECTION LYSIMETER PIPING

NOT TO SCALE

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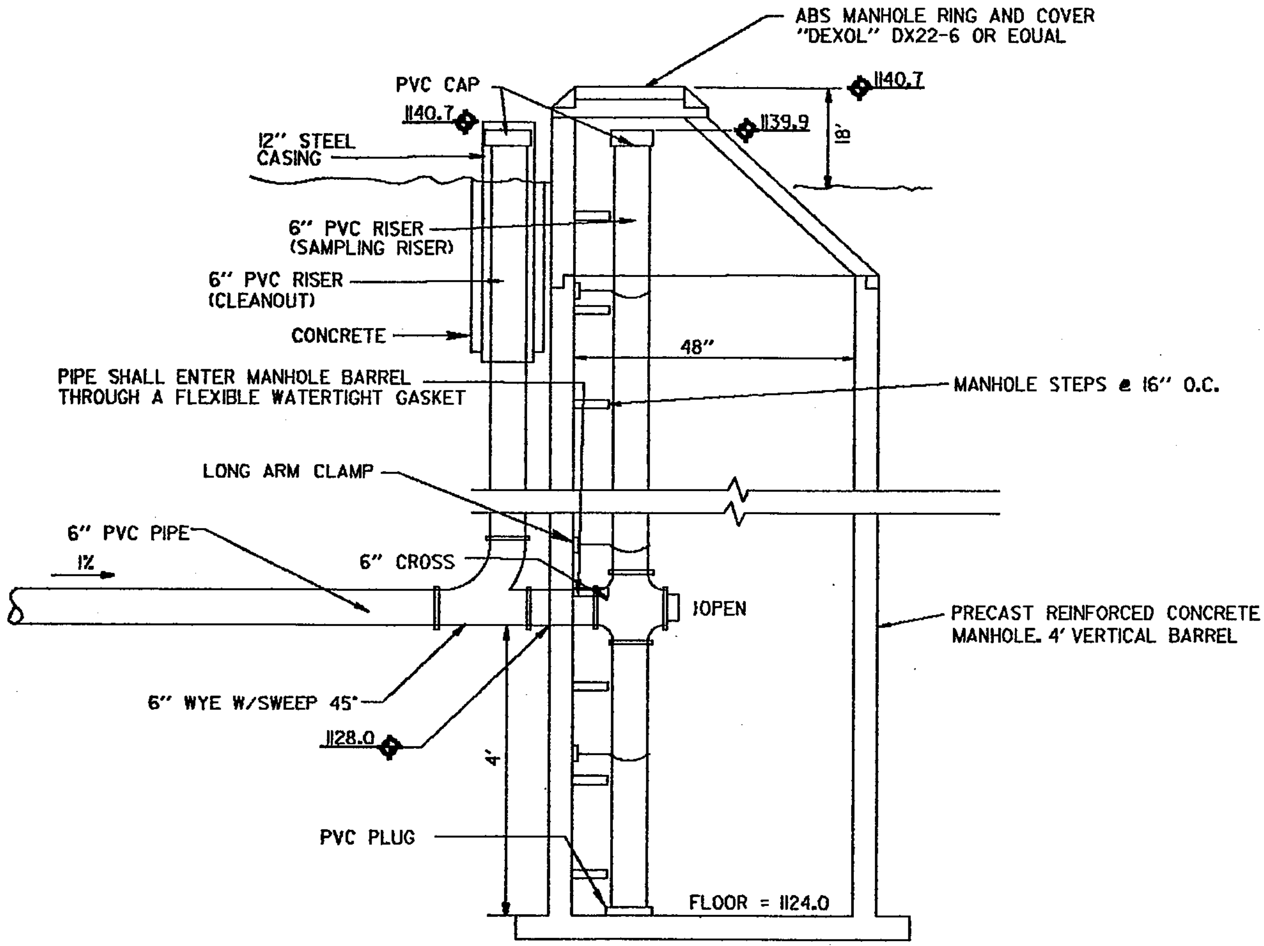
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE	

FIGURE NO. 7-5
COLLECTION LYSIMETER SECTIONS

Job No	Dwg No	REV



COLLECTION LYSIMETER

STORAGE, SAMPLING & CLEANOUT RISER

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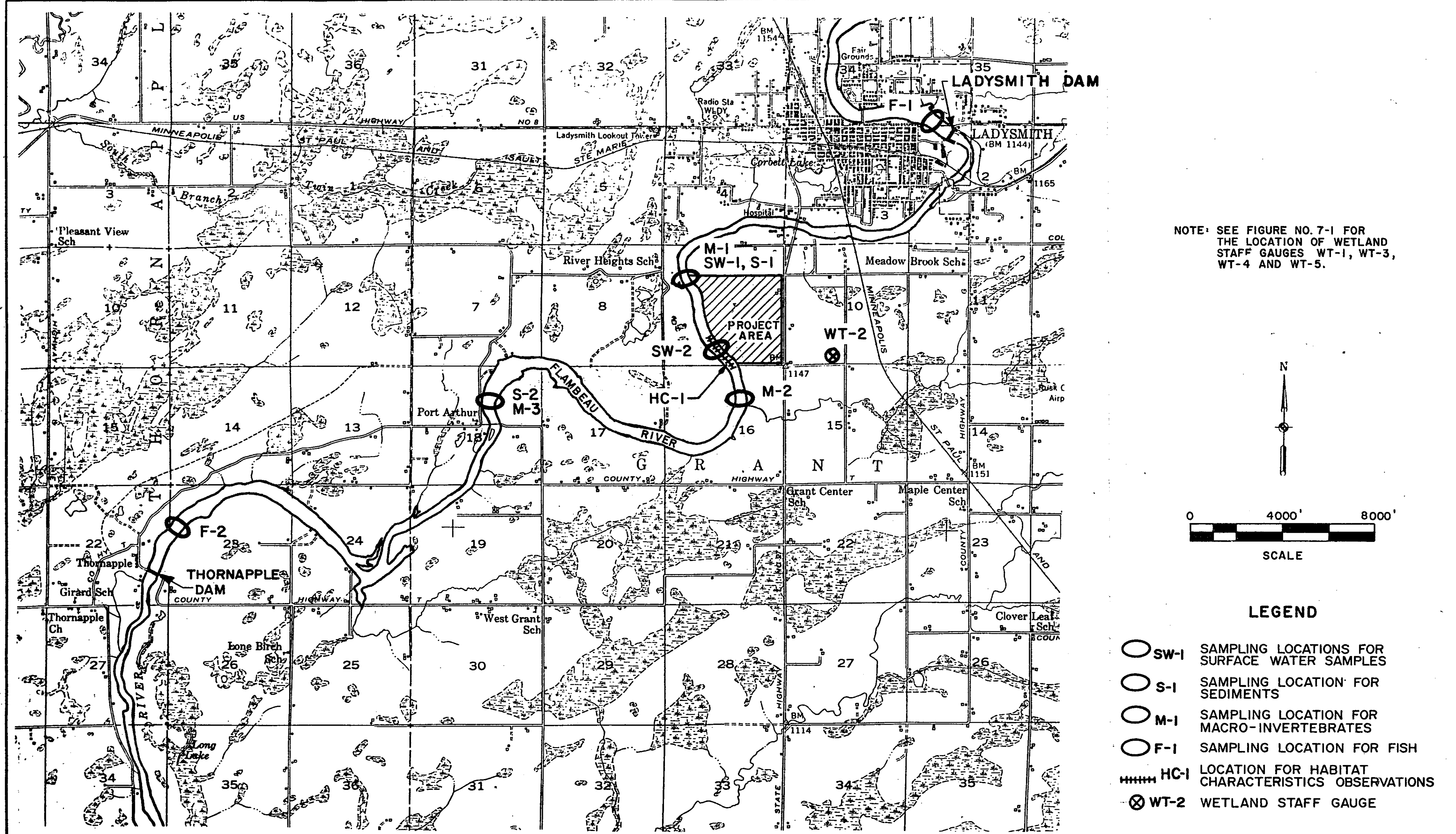
	DESIGNED BY		
	DRAWN BY	DHS	12/89
	CHECKED BY	GWS	12/89
	APPROVED BY		
	CAD No.	SCALE NONE	

FIGURE NO. 7-6
COLLECTION LYSIMETER RISER AND SUMP DETAIL

Job No	Dwg No	REV



MAP SOURCE: U.S.G.S. LADYSMITH, WI. 15 MINUTE QUADRANGLE

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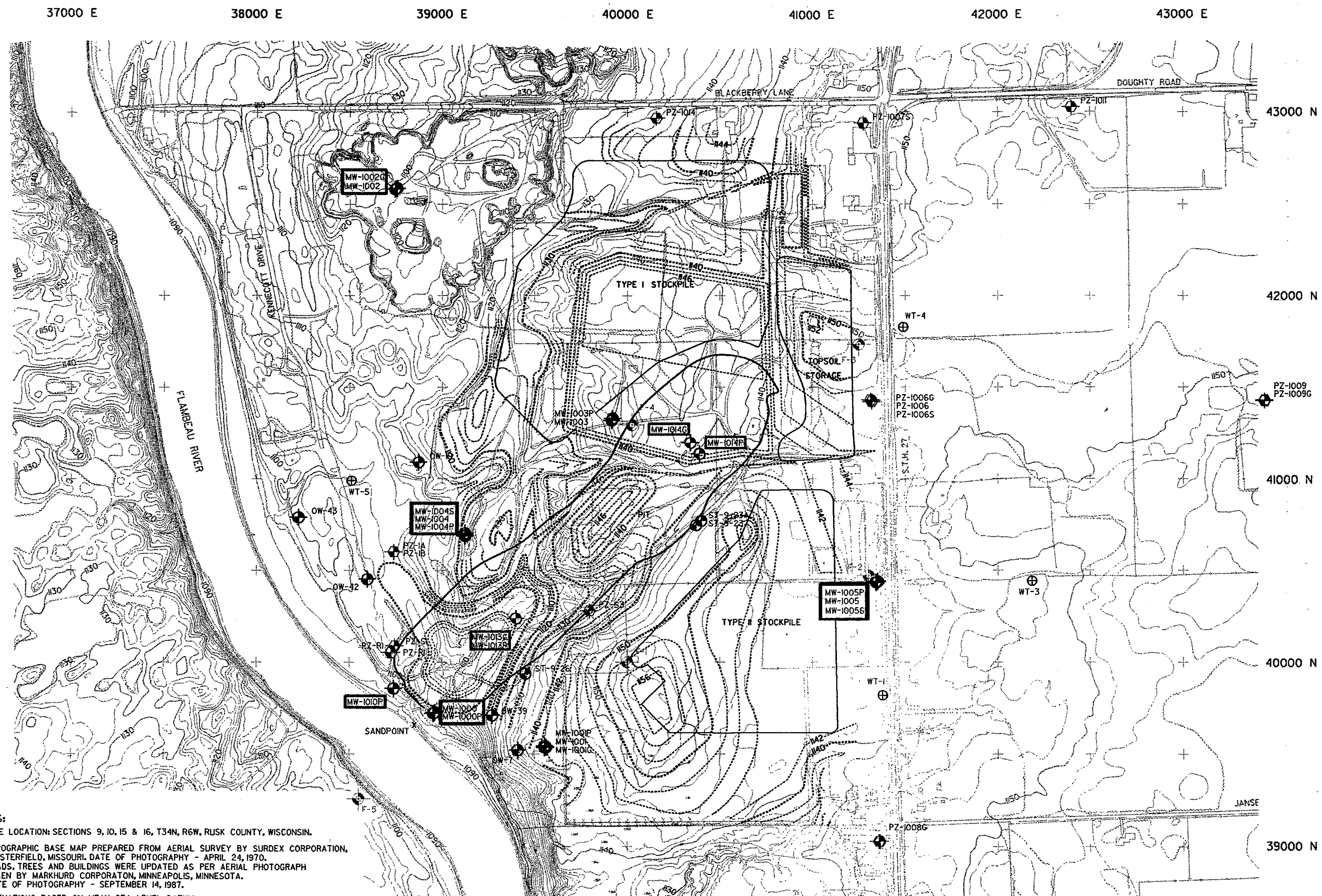
84112

FIGURE NO. 7-7
CONSTRUCTION AND OPERATION
SURFACE WATER MONITORING
SITE LOCATIONS

DRAWN: DHS 12/89



40 YEAR LONG TERM CARE AND MAINTENANCE PLAN

	TIMES PER YEAR	DURATION
1. INSPECTIONS INSPECT RECLAIMED SITE FOR EROSION, VEGETATION GROWTH, SETTLING, AND MONITORING DEVICE INTEGRITY		
PHASE I	SPRING & FALL	4 YEARS
PHASE II	LATE SUMMER	36 YEARS
2. MAINTENANCE		
A. LANDFORM	AS NEEDED	40 YEARS
B. VEGETATION	AS NEEDED	40 YEARS
C. MONITORING DEVICE	AS NEEDED	40 YEARS
3. GROUNDWATER MONITORING		
A. OUTSIDE BACKFILLED PIT WELL NESTS-MW-1000, 1002, 1004, 1005 WELL-MW-1010P	QUARTERLY[1], ANNUALLY[2]	40 YEARS
B. INSIDE BACKFILLED PIT WELL NESTS - 1013&1014		
PHASE I	QUARTERLY[1], ANNUALLY[2]	2 YEARS
PHASE II	ANNUALLY (JUNE)[1&2]	SEE FOOTNOTE 3
PHASE III	EVERY FIFTH YEAR (JUNE)[1&2]	REMAINDER OF PERIOD
C. WATER LEVELS		
PHASE I	QUARTERLY[4]	UNTIL WATER LEVELS STABILIZE
PHASE II	QUARTERLY[5]	REMAINDER OF PERIOD
4. SURFACE WATER[6]		
A. SEDIMENTS, MACROINVERTEBRATES & FISH		
PHASE I	ANNUALLY	2 YEARS
PHASE II (CRAY FISH ONLY)	ANNUALLY	UNTIL ISSUANCE OF NOTICE OF COMPLETION
PHASE III (FISH ONLY)	ONCE	IN YEAR CERTIFICATE OF COMPLETION IS ISSUED
B. WATER QUALITY	THREE IN TWO YEAR PERIOD	2 YEARS
C. WETLAND SURFACE FLOWS[7]	SPRING, SUMMER & AUTUMN	UNTIL WATER LEVELS STABILIZE
5. VEGETATION & WILDLIFE		
A. PERCENT COVER	SEE FOOTNOTE 8	UNTIL ISSUANCE OF CERTIFICATE OF COMPLETION
B. BIOMASS	SEE FOOTNOTE 8	UNTIL ISSUANCE OF CERTIFICATE OF COMPLETION
C. DIVERSITY	SEE FOOTNOTE 8	UNTIL ISSUANCE OF CERTIFICATE OF COMPLETION
D. SURVIVORSHIP OF WOODY PLANT STOCK	SEE FOOTNOTE 8	UNTIL ISSUANCE OF CERTIFICATE OF COMPLETION
E. WETLAND VEGETATION	SEE FOOTNOTE 8	UNTIL ISSUANCE OF CERTIFICATE OF COMPLETION
F. HABITAT EVALUATION	SEE FOOTNOTE 8	UNTIL ISSUANCE CERTIFICATE OF COMPLETION
6. TERRESTRIAL ECOLOGY		
PHASE I	ANNUALLY (LATE SUMMER)[9]	4 YEARS
PHASE II	EVERY FIVE YEARS (LATE SUMMER)[9]	35 YEARS

1 PARAMETERS: SPECIFIC CONDUCTANCE (FIELD), PH (FIELD AND LAB), TOTAL DISSOLVED SOLIDS, TOTAL ALKALINITY, TOTAL HARDNESS, IRON, MANGANESE, COPPER, SULFATE.

2 PARAMETERS: ARSENIC, BARIUM, CADMIUM, TOTAL CHROMIUM, LEAD, MERCURY, SELENIUM, SILVER, ZINC (JUNE QUARTERLY ROUND).

3 ANNUAL SAMPLING WILL CONTINUE UNTIL WATER LEVELS IN MW-1013P AND 1014P INDICATE THAT WATER LEVELS HAVE RISEN TO BOTTOM OF SAPROLITE LAYER IN THE BACKFILLED PIT.

4 LOCATIONS: SEE TABLE NO. 7-1 OF REPORT.

5 LOCATIONS: WELL NESTS MW-1000, 1002, 1004 AND 1005. WELL MW-1010P.

6 SEE SECTION 7.4 OF REPORT FOR SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS.

7 MONITORING TO BE CONDUCTED ONLY IF WATER LEVEL MEASUREMENTS DURING THE CONSTRUCTION AND OPERATION MONITORING PROGRAM INDICATE A SIGNIFICANT DRAWDOWN EFFECT ON A MONITORED WETLAND WHICH IS ATTRIBUTABLE TO THE PROJECT.

8 AT DISCRETION OF APPLICANT TO DEMONSTRATE THAT MINIMUM STANDARDS HAVE BEEN MET BEFORE ISSUANCE OF NOTICE OF COMPLETION OF RECLAMATION BY THE APPLICANT AND ISSUANCE OF CERTIFICATE OF COMPLETION OF RECLAMATION BY WDNR. SEE SECTION 5.11 OF REPORT FOR MINIMUM STANDARDS AND MONITORING PROCEDURES.

9 AERIAL AND COLOR INFRARED PHOTOGRAPHY.

NOTES:

1. SITE LOCATION: SECTIONS 9, 10, 15 & 16, T34N, R6W, RUSK COUNTY, WISCONSIN.
2. TOPOGRAPHIC BASE MAP PREPARED FROM AERIAL SURVEY BY SURDEX CORPORATION, CHESTERFIELD, MISSOURI. DATE OF PHOTOGRAPHY - APRIL 24, 1970. ROADS, TREES AND BUILDINGS WERE UPDATED AS PER AERIAL PHOTOGRAPH TAKEN BY MARKHURD CORPORATON, MINNEAPOLIS, MINNESOTA. DATE OF PHOTOGRAPHY - SEPTEMBER 14, 1987.
3. ELEVATIONS BASED ON MEAN SEA LEVEL DATUM. CONTOUR INTERVAL IS TWO FEET.
4. HORIZONTAL DATUM BASED ON PROJECT SITE GRID SYSTEM. SITE GRID COORDINATES CORRELATION TO STATE PLANE COORDINATES DERIVED AS FOLLOWS:

SITE GRID COORDINATES CONTROL MONUMENT F-1	STATE PLANE COORDINATES
40000 N =	587,357.8087 N
40000 E =	1,713,516.1229 E

THE ANGULAR ROTATION FROM STATE PLANE BEARINGS TO SITE GRID BEARINGS IS 359°-13'-23" RIGHT WITH CONTROL POINT F-1 AS THE BASE POINT.

5. SEE FIGURE NO.'S 7-1 AND 7-7 FOR THE LOCATION OF WETLAND STAFF GAUGE WT-2 AND FOR SURFACE WATER MONITORING LOCATIONS.

LEGEND

—1100— EXISTING CONTOUR
EXISTING PAVED ROADWAY
EXISTING TRAIL/GRAVEL SURFACE
TREES AND/OR BRUSH
FENCE
F-1 CONTROL MONUMENT

MW-1005 MONITORING WELL
PZ-R3 PIEZOMETER
MW-1005 WELL ON THE WATER QUALITY MONITORING PROGRAM
WT-5 WETLAND STAFF GAUGE

N

0 300' 600'
SCALE

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8412

FIGURE NO. 10-1
LONG TERM CARE
AND MAINTENANCE PLAN

	BY	DATE
DESIGN		
DRAWN	DHS	12/89
CHK'D	GWS	12/89
DES. ENG'R		
SECT ENG'R		

PROJ. ENG'R
MGR. PROCESS ENG'R
ENG'R MGR.

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE | SEE BAR SCALE

DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

REFERENCES

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

MONITORING WELL CONSTRUCTION DIAGRAM

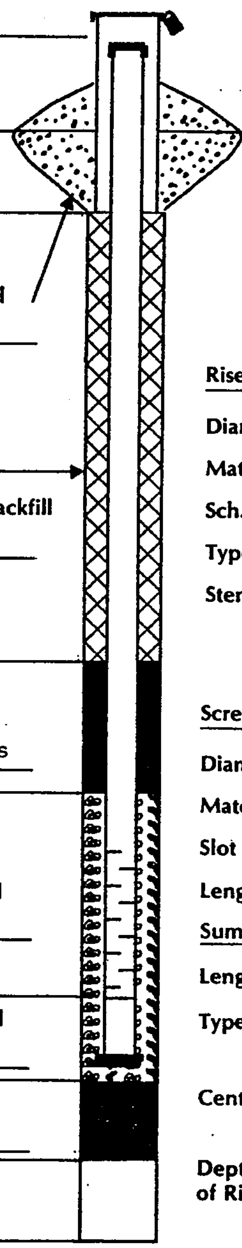
Driller: –

Well No.: MW-1013G

Drilling Method: HSA

Date Installed: –

Coordinates: (See Figure 10-1)



Elevation

Stick-up: 3'

Ground Elev. ~1100'

1'

Surface Seal Material: Concrete

Drill Hole Diameter: 8"

Type of Annular Space Backfill: N/A — ~6'

Ground Surface to Tip of Well Screen: ~20'

Type of Seal: Bentonite Pellets — 4"

Type of Filter Material: #30 Sand — 13'

Type of Filter Material: N/A — N/A

Type of Seal: N/A — N/A

Type of Backfill: N/A — N/A

Protector Pipe:

Size: 4"

Material: Steel

Lock No.:

Riser:

Diameter: 2" I.D.

Material: PVC

Sch.: 80

Type of Joints: Flush Threaded

Stenciled? No

Screen:

Diameter: 2" I.D.

Material: PVC

Slot Size: 0.010"

Length: 10'

Sump:

Length: N/A

Type of Cap: PVC

Centralizer: Used ☐ Not Used ☒

Depth to Water From Top of Riser at Completion: (dry)

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	CHECKED BY	JWS	12-1-89
	APPROVED BY		
	CAD No.	SCALE NONE	

FIGURE NO. 10-2
PROPOSED WELL MW-1013G
CONSTRUCTION DETAIL

Job No	Dwg No	REV

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: --

Well No.: MW-1013P

Drilling Method: Tricone & mud through soil backfill; air rotary through backfilled waste rock

Date Installed: -

Coordinates: (See Figure No. 10-1)

Protector Pipe:

Size: 6"

Material: Steel

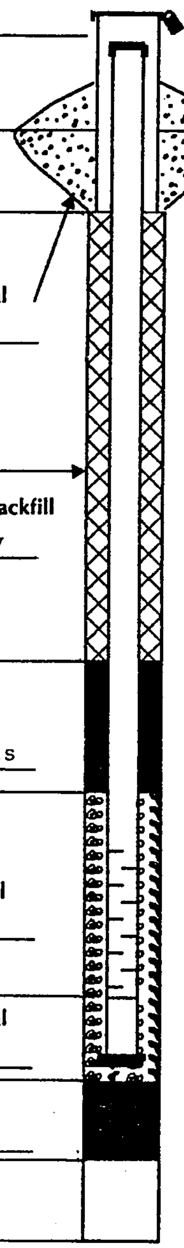
Lock No.: -

Elevation

3' Stick-up

Ground Elev. ~1100'

1'



Surface Seal Material: Concrete

Drill Hole Diameter: 6"

Type of Annular Space Backfill: Bentonite Slurry

~170' Ground Surface to Tip of Well Screen

~158'

3' Type of Seal: Bentonite Pellets

8' Type of Filter Material: #30 Sand

N/A Type of Filter Material: N/A

N/A Type of Seal: N/A

N/A Type of Backfill: N/A

Riser:

Diameter: 2" I.D.

Material: PVC

Sch.: 80

Type of Joints: Flush Threaded

Stenciled? --

Screen:

Diameter: 2" I.D.

Material: PVC

Slot Size: 0.010"

Length: 5'

Sump:

Length: N/A

Type of Cap: PVC

Centralizer: Used ☐ Not Used ☒

Depth to Water From Top of Riser at Completion: (Unknown)

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	APPROVED BY		
	CAD No.	SCALE NONE	

FIGURE NO. 10-3

PROPOSED WELL MW-1013P CONSTRUCTION DETAIL

Job No	Dwg No	REV

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: --

Well No.: MW-1014G

Drilling Method: HSA

Date Installed: --

Coordinates: (See Figure No. 10-1)

Protector Pipe:

Size: 4"

Material: Steel

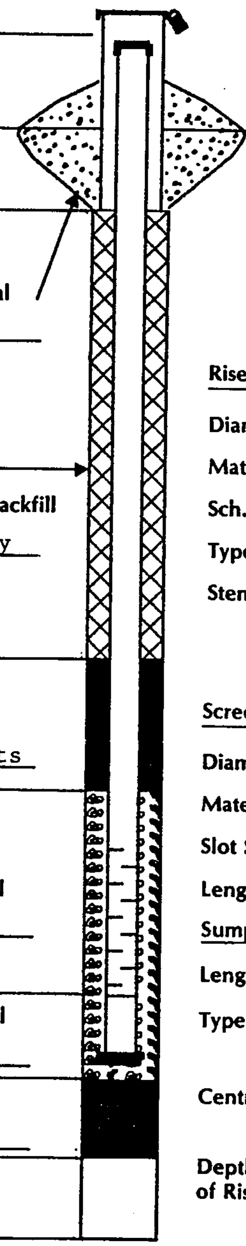
Lock No.:

Elevation

3' Stick-up

Ground Elev. ~ 1146'

1'



Surface Seal Material: Concrete

Drill Hole Diameter: 8"

Type of Annular Space Backfill: Bentonite Slurry

~50' Ground Surface to Tip of Well Screen

~33'

3' Type of Seal: Bentonite Pellets

13' Type of Filter Material: #30 Sand

N/A Type of Filter Material: N/A

N/A Type of Seal: N/A

N/A Type of Backfill: N/A

Riser:

Diameter: 2" I.D.

Material: PVC

Sch.: 80

Type of Joints: Flush Threaded

Stenciled? No

Screen:

Diameter: 2"

Material: PVC

Slot Size: 0.010"

Length: 10'

Sump:

Length: N/A

Type of Cap: PVC

Centralizer: Used ☐ Not Used ☒

Depth to Water From Top of Riser at Completion: (dry)

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	DRAWN BY	JRB	11-30-89
	CHECKED BY	JWS	12-1-89
	APPROVED BY		
	CAD No.	SCALE NONE	

FIGURE NO. 10-4

PROPOSED WELL MW-1014G
CONSTRUCTION DETAIL

Job No	Dwg No	REV

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: –

Well No.: MW-1014P

Drilling Method: Tricone and mud through soil backfill; air rotary through backfilled waste rock

Date Installed:

Coordinates: (See Figure No. 10-1)

Protector Pipe:

Size: 6"

Material: Steel

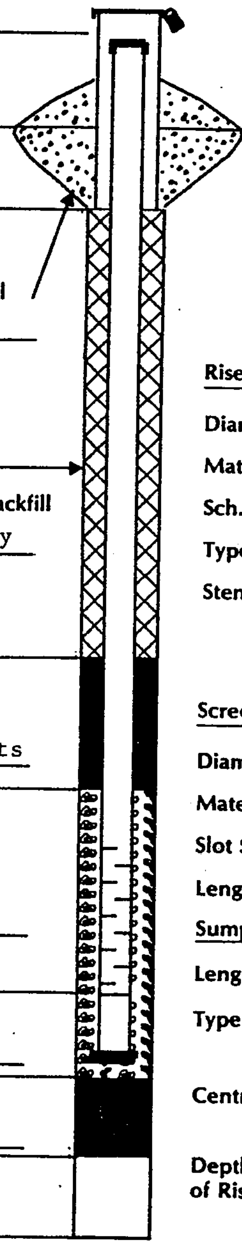
Lock No.:

Elevation

3' Stick-up

Ground Elev. ~1146'

1'



Surface Seal Material: Concrete

Drill Hole Diameter: 6"

Type of Annular Space Backfill: Bentonite Slurry

~206' Ground Surface to Tip of Well Screen

~194'

3' Type of Seal: Bentonite Pellets

8' Type of Filter Material: #30 Sand

N/A Type of Filter Material: N/A

N/A Type of Seal: N/A

N/A Type of Backfill: N/A

Riser:

Diameter: 2" I.D.

Material: PVC

Sch.: 80

Type of Joints: Flushed Threaded

Stenciled? --

Screen:

Diameter: 2" I.D.

Material: PVC

Slot Size: 0.010"

Length: 5'

Sump:

Length: N/A

Type of Cap: PVC

Centralizer: Used ☐ Not Used ☒

Depth to Water From Top of Riser at Completion: (Unknown)

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GREEN BAY, WISCONSIN

NOTES	APPROVAL		DATE
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	DRAWN BY	JRB	11-30-89
	CHECKED BY	JWS	12-1-89
	APPROVED BY		
	CAD No.	SCALE NONE	

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FIGURE NO. 10-5

PROPOSED WELL MW-1014P CONSTRUCTION DETAIL

Job No	Dwg No	REV