LIBRARIES
UNIVERSITY OF WISCONSIN–MADISON

Mining permit application for the Kennecott Flambeau Project. 1989

[s.l.]: Foth and Van Dyke, 1989

https://digital.library.wisc.edu/1711.dl/ND65NLQNCOZ6H8N

http://rightsstatements.org/vocab/InC/1.0/

For information on re-use see:
http://digital.library.wisc.edu/1711.dl/Copyright

The libraries provide public access to a wide range of material, including online exhibits, digitized collections, archival finding aids, our catalog, online articles, and a growing range of materials in many media.

When possible, we provide rights information in catalog records, finding aids, and other metadata that accompanies collections or items. However, it is always the user's obligation to evaluate copyright and rights issues in light of their own use.

728 State Street | Madison, Wisconsin 53706 | library.wisc.edu

Foth & Van Dyke

REPORT

Mining Permit Application for the Kennecott Flambeau Project

Scope I.D.: 87K10

Kennecott Minerals Company
Ladysmith, Wisconsin

April 1989

Kennecott Minerals Company
1515 Mineral Square
P.O. Box 11248
Salt Lake City, Utah 84147
Telephone (801) 322-8460
FAX (801) 583-3129

UNIVERSITY LIBRARY
UW-STEVENS POINT

TD
194.66
.W62
F62
1989a
v.1

April 1, 1989

Kennecott

87K10-57

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: Kennecott Flambeau Project
Mining Permit Application

Kennecott Minerals Company (Kennecott) is pleased to provide the Wisconsin Department of Natural Resources (WDNR) with 40 copies of the report and appendices titled *Mining Permit Application for the Kennecott 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 section(s) of NR 182. Also enclosed is a check in the amount of $19,000 to cover the estimated cost of evaluating the application. 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 feasiblity 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 forwarded to the WDNR. 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.

Kennecott 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. 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. Kennecott will distribute the document to appropriate local public officials.

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

Sincerely,

KENNECOTT

Lawrence E. Mercando

Lawrence E. Mercando
Director, Process Development

LEM:psl

DISTRIBUTION LIST

No. of Copies	Sent To
40	Gordon Reinke, Chief Mine Reclamation Section Bureau of Solid Waste Management Wisconsin Department of Natural Resources 101 S. Webster St., GEF II Madison, WI 53707
7	Lawrence E. Mercando, Director Process Development Kennecott Minerals Company 1515 Mineral Square Salt Lake City, UT 84112
1	Edwarde R. May Principal Geological Engineer James Askew Associates, Inc. 5600 S. Quebec Street Suite 312A Englewood, CO 80111
1	Kennecott Minerals Company Ladysmith Office P. O. Box 166 Ladysmith, WI 54848
3	Henry J. Handzel DeWitt, Porter, *et al.* 121 S. Pinckney Street Madison, WI 53703
1	John Kaiser, Chairman Rusk County Board 114 W. Miner Avenue Ladysmith, WI 54848
1	Robert Plantz, Chairman Town of Grant N3356 Plantz Road Ladysmith, WI 54848
1	Martin Reynolds, Mayor City of Ladysmith c/o City Hall 120 W. Miner Avenue Ladysmith, WI 54848

KMINE

DISTRIBUTION LIST (Cont.)

No. of Copies	Sent To
1	Norm Arndt Rusk County Zoning Administrator 311 E. Miner Avenue Ladysmith, WI 54848
1	William G. Thiel Jordan, Herrell and Thiel 2600 Stein Boulevard Eau Claire, WI 54701
1	Master File

LIST OF CONTRIBUTORS

Following is a list of companies and individuals which have contributed in a significant way to the Flambeau Project Mining Permit Application.

BP Minerals America, Inc.
P.O. Box 11248
Salt Lake City, UT 84147
(801) 322-8460
Mr. Lawrence E. Mercando
Director, Process Development

Call & Nicholas, Inc.
3625 E. 42nd Stravenue
Tucson, AZ 85713
Mr. Richard D. Call
President

Ford, Bacon, and Davis, Inc.
Engineers - Constructors
375 Chipeta Way
P.O. Box 8009
Salt Lake City, Utah 84108-8009
(801) 584-7558
Mr. David J. Krohn
Project Manager

Foth & Van Dyke and Associates Inc.
2737 S. Ridge Road
P.O. Box 19012
Green Bay, WI 54307-9012
(414) 497-2500
Mr. Gerald W. Sevick, P.E.
Division General Manager
Geosciences and Environmental Management

Globo De Plomo Enterprises
P.O. Box 872
Douglas, AZ 85607
Mr. Sidney A. Williams
Geologist

Golder Associates (Western Canada), Ltd.
Consulting Geotechnical and Mining Engineers
224 West 8th Avenue
Vancouver, British Columbia
Canada V5Y IN5
(604) 879-9266
Mr. P.F. Stacey, P. Eng.
Principal

Mr. David A. Lee
Consulting Forester
1217 River Avenue, E.
Ladysmith, WI 54848
(715) 532-3453

James Askew Associates, Inc.
5600 S. Quebec Street, Suite 312 A
Englewood, CO 80111
(303) 290-0103
Mr. Edwarde R. May
Principal Geological Engineer

Midwest Engineers
3149 Venard Road
Downers Grove, IL 60515
(312) 969-4307
Mr. V. Rajaram, P.E.

ORTEK
Oneida Environmental Technology Center
2496 West Mason Street
P. O. Box 12435
Green Bay, WI 54307-2435
(414) 498-2222
Dr. David E. Turriff, Ph.D.
Director

Pincock, Allen & Holt, Inc.
12345 W. Alemeda Parkway
Lakewood, CO 80228
(303) 986-6950
Mr. Ernest L. Bohnet, P.E.
President

Rusk Surveying
115 West Second Street, South
Ladysmith, WI 54848
(715) 532-5757
Mr. Larry F. Gotham, R.L.S.
President

Swanson Environmental Inc.
3490 N. 127th Street
Brookfield, WI 53005
(414) 783-6111
Mr. George C. Kandler, Jr.
Field Services Manager
Mr. Timothy Young
Environmental Specialist

Thomas A. Prickett & Associates
6 G.H. Baker Drive
Urbana, IL 61801
(217) 384-0518
Mr. Thomas A. Prickett
President

Thresher & Son, Inc.
2828 Regent Street, Jr.
Madison, WI 53705
(608) 233-2097
Mr. John E. Thresher, Jr.
Soil Chemist

Uniplan Associates
2826 Viking Drive, Apt. 20
P. O. Box 2816
Green Bay, WI 54304
(414) 494-7073
Mr. Steve R. Milquet, P.E., A.I.C.P.

Winnebago Archaeological Surveys
810 Paynes Point Beach Road
Neenah, WI 54956
(414) 722-2255
Dr. Margie L. Staab, Ph.D.
Archaeologist

Yanko Environmental Services, Inc.
3303 Paine Avenue
Sheboygan, WI 53081
(414) 459-2500
Mr. James C. Bird
Vice President

VOLUME 1
MINING PERMIT APPLICATION
FOR THE
KENNEOCTT FLAMBEAU PROJECT

Prepared for:

KENNECOTT MINERALS COMPANY

Prepared by:

FOTH & VAN DYKE and Associates Inc.
and Contributors
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012

APRIL 1989

Engineering contributions by Foth & Van Dyke and Associates Inc. Prepared under the direct supervison of:



Engineering contributions by Ford, Bacon & Davis Utah, Inc. Prepared under the direct supervision of



Engineering contributions by Pincock, Allen & Holt, Inc. Prepared under the direct supervision of:



Foth & Van Dyke
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

TABLE OF CONTENTS

		PAGE
1.0	INTRODUCTION	1
2.0	COMPLETED APPLICATION FORM WITH ATTACHMENTS	4
2.1	Legal Description (Item 7.)	4
2.2	Owner Information (Item 8.)	4
2.3	Approvals and Exemption Requests (Item 9.)	4
2.4	Information Pertaining to Mining Bonds in Other 13 States (Item 10.)	13
2.5	Surface Mining Suitability (Item 11.)	13
2.6	Reclamation Costs (Item 12.)	14
2.7	Description of Contiguous Land (Item 13.)	14
2.8	Minimization of Disturbance to Wetlands (Item 14.)	14
2.9	Monitoring and Quality Assurance Plan (Item 15.)	14
3.0	FINANCIAL RESPONSIBILITY	15
4.0	MINING PLAN	16
4.1	Introduction	16
4.2	General Project Overview	16
4.3	Regional and Local Setting	17
4.4	Geological and Geotechnical Investigations	17
4.5	Overview of Environmental Setting	17
4.6	General Description of the Proposed Action	18
4.6.1	General Project Overview	18
4.6.2	Location	18
4.6.3	Land Ownership and Use	18
4.6.4	Project Scheduling	19
4.6.5	Project Facilities	19
4.6.6	Requirements for Governmental Services	22
4.6.7	Reclamation Plan	22
4.7	Facility Information	22
4.7.1	Introduction	22
4.7.2	Aesthetics and Landscaping	23
4.7.3	Open Pit, Haul Road, Crusher and Stockpiles	23
4.7.3.1	Introduction	23
4.7.3.2	Key Design Features	24
4.7.3.2.1	Open Pit	24
4.7.3.2.2	Berm Between Pit and River	34
4.7.3.2.3	Haul Road	34
4.7.3.2.4	Crusher	35
4.7.3.2.5	Stockpiles - General	36
4.7.3.2.6	Ore Stockpiles	36

TABLE OF CONTENTS (Cont.)

PAGE

4.7.3.2.7 Topsoil Stockpile .. 37
4.7.3.2.8 Type I Stockpile and Settling Ponds . 37
4.7.3.2.9 Type II Stockpile .. 40
4.7.3.3 Construction and Operation 45
4.7.3.3.1 Introduction 45
4.7.3.3.2 Construction Schedule 46
4.7.3.3.3 Construction Materials and Balances 46
4.7.3.3.4 Temporary Facilities 46
4.7.3.3.5 Clearing and Grubbing of Vegetation 49
4.7.3.3.6 Open Pit Construction and Operations 49
4.7.3.3.7 Haul Road 58
4.7.3.3.8 Crusher 59
4.7.3.3.9 Stockpiles-General . 60
4.7.3.3.10 Topsoil 61
4.7.3.3.11 Type I Stockpile and Settling Ponds . 61
4.7.3.3.12 Type II Stockpile .. 63
4.7.4 Ancillary Facilities - Design Construction and Operations 70
4.7.4.1 Access Road 70
4.7.4.2 Parking and Gatehouse 71
4.7.4.3 Administrative and Maintenance Buildings 71
4.7.4.4 Railroad Spur Line 72
4.7.4.5 Fencing and Security 73
4.7.4.6 Laboratory 73
4.7.4.7 Power Supply 74
4.7.4.8 Fuel Storage and Distribution . 75
4.7.4.9 Magazines 75
4.7.4.10 Water Supply 76
4.7.4.11 Wastewater Treatment 76
4.7.4.12 Storm Water Control 79
4.7.4.13 Water Discharge 83
4.7.4.14 Sanitary Wastewater 83
4.7.4.15 Refuse Handling 84
4.7.4.16 Dust Control 85
4.8 Erosion Control 86
4.8.1 Introduction 86
4.8.2 General Engineering Techniques for Erosion Control 87

TABLE OF CONTENTS (Cont.)

PAGE

4.8.3 Erosion Control Procedures for the Open Pit Stockpiles and Plant Facility Sites 89
4.8.4 Vegetation Techniques for Erosion Control 91
4.9 Environmental Protection 93
4.9.1 Air Resources 93
4.9.2 Surface Water 93
4.9.3 Groundwater 94
4.9.4 Land Resources 94
4.9.5 Public Safety 94
4.9.6 Monitoring and Contingency Plans 94
4.10 Risk Assessment 95
4.10.1 Introduction 95
4.10.2 Chemical Use and Storage 95
4.10.2.1 Assessment of Risk 96
4.10.2.2 Contingency Measures 97
4.10.3 Storage and Transportation of Explosives 99
4.10.3.1 Assessment of Risk 99
4.10.3.2 Contingency Measures 100
4.10.4 Fuel Storage and Distribution 100
4.10.4.1 Assessment of Risk 101
4.10.4.2 Contingency Measures 102
4.10.5 Fires 102
4.10.5.1 Assessment of Risk 102
4.10.5.2 Contingency Measures 104
4.10.6 Wastewater Treatment System Failure 104
4.10.6.1 Assessment of Risk 104
4.10.6.2 Contingency Measures 106
4.10.7 Settling Pond Embankment Failure 106
4.10.7.1 Assessment of Risk 106
4.10.7.2 Contingency Measures 106
4.10.8 Air Emissions 107
4.10.8.1 Assessment of Risk 107
4.10.8.2 Contingency Measures 108
4.10.9 Crushed Ore Spill 109
4.10.9.1 Assessment of Risk 109
4.10.9.2 Contingency Measures 110
4.10.10 Blasting 110
4.10.10.1 Assessment of Risk 110
4.10.10.2 Contingency Measures 110
4.10.11 Wastewater Collection System Failure .. 111
4.10.11.1 Assessment of Risk..... 111
4.10.11.2 Contingency Measures 112
4.10.12 Severe Natural Phenomena 112
4.10.12.1 Assessment of Risk 112
4.10.12.2 Contingency Measures 113

TABLE OF CONTENTS (Cont.)

PAGE

4.10.13 Sabotage 114
4.10.13.1 Assessment of Risk 114
4.10.13.2 Contingency Measures 114
4.10.14 Pit Wall Failure 114
4.10.14.1 Assessment of Risk 114
4.10.15 Power Disruption 115
4.10.15.1 Assessment of Risk 115
4.10.15.2 Contingency Measures 116
4.10.16 Summary and Conclusions 116
4.11 Preblast Survey Plan 116

5.0 RECLAMATION PLAN 118

5.1 Reclamation Plan Introduction 118
5.2 Reclamation Procedures 118
5.3 Reclamation Sequence and Schedule 119
5.4 Reclamation Materials and Earthwork Balances .. 119
5.5 Open Pit Reclamation 123
5.5.1 Design Report 123
5.5.1.1 Control of Acid Production in the Pit 124
5.5.2 Operations Manual 125
5.5.2.1 Backfilling Operations 125
5.5.2.1.1 Type II Material ... 126
5.5.2.1.2 Crushing and Loadout Facilities, Catchment Pond, and Ore Haul Road .. 126
5.5.2.1.3 Type I Materials ... 127
5.5.2.2 Water Control During Backfilling 128
5.5.2.3 Settling 128
5.5.2.4 Slurry Wall and Flood Control Dike 129
5.5.2.5 Operations Under Varying Weather Conditions 129
5.5.2.6 Certification Plan 129
5.5.3 Engineering Drawings 129
5.5.4 Alternative Design, Location, and Operation 130
5.6 Final Grading of Crusher and Stockpile Areas .. 130
5.7 Ancillary Facilities 131
5.7.1 Access Road 131
5.7.2 Parking Lot and Guardhouse 131
5.7.3 Administrative Office, Maintenance Shop, Wastewater Treatment Plant, and Explosive Magazines 131
5.7.4 Railroad Spur Line 132
5.7.5 Fencing and Security 132

TABLE OF CONTENTS (Cont.)

PAGE

5.7.6 Power Supply 132
5.7.7 Fuel Storage and Distribution 132
5.7.8 Storm Water Control 133
5.7.9 Water Discharge 133
5.7.10 Sanitary Wastewater 133
5.7.11 Refuse Handling 133
5.8 Revegetation 133
5.8.1 Introduction 133
5.8.2 Site Final Topography 134
5.8.3 Species Selection 134
5.8.4 Seedbed and Plant Area Preparation 140
5.8.5 Seeding and Planting Methods 140
5.8.6 Mulching and Fertilizing 141
5.8.7 Summary 141
5.9 Aesthetics 142
5.10 Maintenance Plan 142
5.11 Backfilling Costs 142

6.0 PRELIMINARY WATER BUDGET 143

6.1 Overview 143
6.2 Definitions 143
6.3 Description of Water Origins 150
6.4 Discussion of Results 150

7.0 MONITORING PLAN 152

7.1 Groundwater 152
7.2 Interim Groundwater Monitoring 152
7.3 Monitoring During Construction and Operation .. 153
7.3.1 Monitoring Locations 153
7.3.2 Monitoring Frequency and Parameters 153
7.3.3 Reporting 155

8.0 CONTINGENCY PLAN 156

8.1 Groundwater 156
8.1.2 Private Wells 158
8.2 Surface Water 158

9.0 EMERGENCY NOTIFICATION PROCEDURES 159

10.0 LONG-TERM CARE AND MAINTENANCE 161

10.1 Procedures 161
10.1.1 Inspections 161
10.1.2 Maintenance 161

TABLE OF CONTENTS (Cont.)

PAGE

10.1.2.1 Landform Maintenance 161
10.1.2.2 Vegetation Maintenance 161
10.1.2.2.1 Short-Term Requirements ... 162
10.1.2.2.2 Long-Term Requirements ... 162
10.1.3 Groundwater Monitoring 162
10.2 Long-Term Care Costs 163
10.3 Financial Responsibility 163
10.4 Responsible Party 163

11.0 REFERENCES 165

LIST OF TABLES

TABLE NO. 2-1 Key for NR 182 Feasibility Study This Table is a Reference Guide and Not a Comprehensive Listing..... 5
TABLE NO. 2-2 Key for NR 182 Plan of Operation (This Table is a Reference Guide and not a Comprehensive Listing)..... 9
TABLE NO. 2-3 List of Requested Exemptions..... 12
TABLE NO. 4-1 Approximate Disturbed and Undisturbed Acreages Within Project Area..... 20
TABLE NO. 4-2 Phase I and II Excavation Schedule..... 31
TABLE NO. 4-3 Volumes of Type I Stockpile Material..... 39
TABLE NO. 4-4 Estimated Volumes of Type II Stockpile Materials..... 41
TABLE NO. 4-5 HDPE Liner Specifications..... 44
TABLE NO. 4-6 Imported Materials..... 47
TABLE NO. 4-7 Earthwork Summary..... 48
TABLE NO. 4-8 Drainage Culverts Within Project Area.... 82
TABLE NO. 4-9 Lime/Sulfide Precipitation Treatment of Contaminated Mine Water Equipment Shutdown and Maintenance Data..... 105
TABLE NO. 5-1 Projected Waste Backfilling Amounts and Destinations..... 120
TABLE NO. 5-2 Swell and Compaction Factors..... 122
TABLE NO. 5-3 Reclamation Land Acreage..... 135
TABLE NO. 5-4 Plant List - Upland Mesic Hardwood..... 136
TABLE NO. 5-5 Plant List - Lowland Mesic Hardwood..... 137
TABLE NO. 5-6 Plant List - Wetlands..... 138
TABLE NO. 5-7 Seed Mixture* - Open Meadow and Project Area Cover Crop..... 139
TABLE NO. 5-8 Anticipated Backfilling Costs by Year.... 142a
TABLE NO. 6-1 Type I Stockpile - 2% and 4% Slope[1] Pre and Post Construction Water Budgets[2]. 144

TABLE OF CONTENTS (Cont.)

TABLE NO. 6-2	Type I Stockpile During Construction Water Budget[1].....	145
TABLE NO. 6-3	Type II Stockpile - 2% Slope..... Pre and Post Construction Water Budgets[1]	146
TABLE NO. 6-4	Type II Stockpile During Construction Water Budget[1].....	147
TABLE NO. 6-5	Mine Pit - 2%, 4% and 8% Slopes[1] Pre and Post Construction Water Budgets[2].	148
TABLE NO. 6-6	Mine Pit During Construction Water Budget[1]	149
TABLE NO. 7-1	Measuring Points for Groundwater Levels and Water Quality Sampling Points (Construction and Operation Program).....	154
TABLE NO. 10-1	Long Term Care Costs.....	164

LIST OF FIGURES

		Following Page
FIGURE NO. 1-1	USGS Topographic Map with Mining Site	
FIGURE NO. 2-1	STH 27 Setback	
FIGURE NO. 2-2	Existing Site Conditions	
FIGURE NO. 4-1	Site Plot Plan	
FIGURE NO. 4-2	Project Area Location	
FIGURE NO. 4-3	Property Ownership	
FIGURE NO. 4-4	Flambeau Construction Schedule	
FIGURE NO. 4-5	Engineering/Construction Schedule	
FIGURE NO. 4-6	Typical Rock Catch Bench Geometry	
FIGURE NO. 4-7	Site Grading and Drainage Plan - South	
FIGURE NO. 4-8	Miscellaneous Site Grading Sections	
FIGURE NO. 4-9	Pump Barge Mechanical Details	
FIGURE NO. 4-10	Phase I Pit Design	
FIGURE NO. 4-11	Final Pit Design	
FIGURE NO. 4-12	Plant Site Grading and Drainage Plan	
FIGURE NO. 4-13	Crushing Plant Arrangement	
FIGURE NO. 4-14	Site Grading and Drainage Plan - North	
FIGURE NO. 4-15	Stockpile Sections	
FIGURE NO. 4-16	Underground Piping Plan	
FIGURE NO. 4-17	Type II Stockpile Phasing Plan	
FIGURE NO. 4-18	Type II Stockpile Phase I Sub-Base Grades	
FIGURE NO. 4-19	Type II Stockpile Phase I Base Grades	
FIGURE NO. 4-20	Type II Stockpile Engineering Cross Sections and Typical Details	
FIGURE NO. 4-21	Type II Stockpile Engineering Cross Sections	

TABLE OF CONTENTS (Cont.)

FIGURE NO. 4-22 Type II Stockpile Phase I Leachate Collection System
FIGURE NO. 4-23 Site Grading Railroad Sections and Details
FIGURE NO. 4-24 Type II Stockpile Phase I Final Grades and Phase II Sub-Base Grades
FIGURE NO. 4-25 Type II Stockpile Phase I Final Grades and Phase II Base Grades
FIGURE NO. 4-26 Type II Stockpile Phase I Final Grades and Phase II Leachate Collection System
FIGURE NO. 4-27 Type II Stockpile Final Grades
FIGURE NO. 4-28 End of Construction
FIGURE NO. 4-29 End of First Quarter Year1
FIGURE NO. 4-30 End of Second Quarter Year 1
FIGURE NO. 4-31 End of Third Quarter Year 1
FIGURE NO. 4-32 End of Year 1
FIGURE NO. 4-33 End of Year 2
FIGURE NO. 4-34 End of Year 3
FIGURE NO. 4-35 End of Year 4
FIGURE NO. 4-36 End of Year 5
FIGURE NO. 4-37 End of Third Quarter Year 6 Final Pit Design
FIGURE NO. 4-38 Railroad Spur Crossing Plans and Road Sections
FIGURE NO. 4-39 Administration Building Lab Building Plans and Elevations
FIGURE NO. 4-40 Maintenance Building Floor Plan Section and Elevation
FIGURE NO. 4-41 Railroad Spur
FIGURE NO. 4-42 Fencing Details
FIGURE NO. 4-43 Site Grading Misc. Sections
FIGURE NO. 4-44 Flow Sheet Mine Facility
FIGURE NO. 4-45 Wastewater Treatment Plant Flow Sheet
FIGURE NO. 4-46 Wastewater Treatment Plant General Arrangement Plan
FIGURE NO. 4-47 Wastewater Treatment Plant Elevation
FIGURE NO. 4-48 Preblast Survey Plan
FIGURE NO. 5-1 Reclamation Schedule
FIGURE NO. 5-2 End of 3 Months of Backfilling
FIGURE NO. 5-3 End of 15 Months of Backfilling
FIGURE NO. 5-4 Final Topography of Reclaimed Pit
FIGURE NO. 5-5 Revegetation Plan
FIGURE NO. 7-1 Monitoring Plan
FIGURE NO. 10-1 Long Term Care Plan

LIST OF APPENDICES

APPENDIX A Property Deeds
APPENDIX B Information Pertaining to Mining Bonds In Other States
APPENDIX C Description of Contiguous Lands

TABLE OF CONTENTS (Cont.)

APPENDIX D	Annual Reports
APPENDIX E	Liner Efficiency and Leachate Head Calculations
APPENDIX F	Local Agreement
APPENDIX G	Conditional Land Use Permit
APPENDIX H	Conditional Land Use Certification
APPENIDX I	Reference Standards Applicable to Specie Selection, Seedbed Preparation, Planting Methods, Mulching, and Fertilizing Methods
APPENDIX J	Water Budget Calculations

1.0 INTRODUCTION

Kennecott Minerals Company (Kennecott) 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. Kennecott 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 Mining Permit Application is organized into eight sections. The first section is the introduction. The second contains the completed WDNR "Mine Permit Application" form. In addition, this section also includes or refers to the various attachments required on the application form. Section 3.0 addresses Kennecott'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 proposed water balance, monitoring, contingency action, emergency notification procedures, long-term care 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 Kennecott would remain as the owner, with the mine manager being a Kennecott 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 24 to 36-foot wide corridor east of the 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 enclosed by a security fence and which encompasses the proposed open pit, stockpile sites, plant area, and other ancillary surface facilities.

Figure No. 1-1 is a United States Geological Survey (USGS) topographic quadrangle map delineating both the "project area" and "mine site area."

Numerous documents and permit applications in addition to this "Mine 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

- Wisconsin Pollution Discharge Elimination System Permit Application

- Preliminary Engineering Report for Wastewater Treatment Facilities

- Permits pursuant to Wis. Stat. ch. 30

- Groundwater withdrawal approval

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, Salt Lake City, Utah, completed design work for all surface facilities including the Type I and Type II stockpiles and wastewater treatment plant. Kennecott's geotechnical and mining engineers 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 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 Kennecott Flambeau Project is located on the following two pages.

The various attachments or information that is 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 Kennecott. 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. Copy of deeds for property owned by Kennecott on which NR 182 facilities will be located are contained in Appendix A.

2.2 Owner Information (Item 8.)

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

Kennecott Minerals 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. Kennecott entered into a Local Agreement with these three entities. Among other things, this Local Agreement provided that these entities would "take all action necessary to assure that the Applicant (Kennecott) 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). Kennecott was also issued a Conditional Use Permit for the mine. Copies of the

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
KENNECOTT MINERALS COMPANY

2. Street or Route
1515 MINERAL SQUARE

City, State, Zip Code
SALT LAKE CITY, UT 84112

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

4. Is Applicant a ☐ Division or ☒ Subsidiary of Another Corporation?
☒ Yes (If Yes, State Name and Address of Parent Corporation.)
BP AMERICA INC.
200 PUBLIC SQUARE
CLEVELAND, OHIO 44114-2375
☐ No

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 First day of April, 19 89.

Lawrence B Mercando
(Signature of Responsible Official)

Director, Process Development
(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 55.4
4. Summary of waste characteristics relative to handling, storage, and disposal	EIR 3.5.6.4

KMINE

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, MPA, 4.7.3.2.9, MPA 4.7.3.3.11, MPA 4.7.3.3.12
(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, 4-1 and 4-10
2. Boring locations	EIR 3.5.1.1
3. Boring logs	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 EIR 3.6.1, 3.6.3

TABLE NO. 2-1 (Cont.)

Item	Location of Information
6. Water table observation wells	
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. 2-2, 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. 4-22, 4-23, EIR Figure Nos. 3.5-3 to 3.5-9, 3.5-12 to 14, 3.5-22 to 3.5-24
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 4.7.3.2.8, 4.7.3.2.9
5. Proposed operating procedures	MPA 4.7.3.3, 4.7.4.1 to 4.7.4.4, 4.7.4.5, 4.7.4.12, 4.8, 4.7.2
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 4.7.1 to 4.7.3.2, 4.7.4
8. Monitoring program	MPA 7.0
(f) Water budget for dry, wet, and average conditions	MPA 6.0
(g) Aesthetics	MPA 4.7.2, 5.9
(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
(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	
2. Existing site conditions plan sheet	MPA Figure Nos. 4-7 and 4-12
3. Base grade plan sheet	MPA Figure Nos. 4-1, 4-5, 4-10, 4-11, 4-15, 4-18, 4-25, 4-40, 4-41, 4-42, 4-43, 4-49
4. Engineering modification plan sheet	
5. Final site topography plan sheet (at closing)	MPA Figure Nos. 4-20, 4-21- 4-24, 4-26, 4-27, 4-28, 4-29
6. Series of phasing plan sheets	
7. Site monitoring plan sheet	
8. Long term care plans sheet	
9. Site cross sections perpendicular and parallel to site baseline at 500 feet spacings	MPA Figure Nos. 4-5, 4-15, 4-22, 4-23, 4-25, 4-40, 4-43
10. Detailed drawings and typical sections	MPA Figure Nos. 4-9, 4-10, 4-11 4-13, 4-25, 4-40, 4-41, 4-42, 4-44, 4-46, 4-47, 4-48, 4-49
(b) Operations Manual Information	MPA 1.0, 2.0, 4.1 to 4.7
1. General	
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 4.7.3.3
d. Development of subsequent phases	MPA 4.7, 4.8, 5.0
e. Site closing information	MPA 5.0
f. Long-term care information	MPA 10.0
g. Economic analysis for closing, long term care	MPA 5.11, 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, 5.5.1
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

KMINE

TABLE NO. 2-2 (Cont.)

	Item	Location of Information
	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	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

Local Agreement and the Conditional Use Permit are attached hereto in Appendices B, C, and D. This information indicates Kennecott has received all local approvals necessary under NR 132 and subchapter V g, section 144 of the Wisconsin Statutes.

In addition, page 3g of this application contains a listing of other permits and approvals which Kennecott is seeking from the WDNR. Kennecott is not aware of any other permits, licenses or approvals required for the WDNR.

Table No. 2-3 contains a list of exemptions that are being requested by Kennecott under Sections NR 132.19 and NR 182.19 of the Wisconsin Administrative Code. A brief discussion justifying the need for each exemption follows.

Location of Pit

The proposed project plan includes facilities that are located or will be constructed within 300 feet of the Flambeau River. These facilities are the open pit, fencing in the vicinity of the open pit, a flood control dike, an access road, a slurry wall, and a power 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, the reader is referred to subsection 4.7.3.2.1, Key Design Features - Open Pit.

Other Facilities Near Navigable Waters

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 needed 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 twelve 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,

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 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)

* 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 request.

KMINE

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 within 300 feet of the Flambeau River. Since there is no practical alternative to these features. These structures will also be separately permitted under Wis. Stat. ch. 30 and ch. 147.

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. 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 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 the existing site conditions.

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

Appendix E contains a letter from Thomas E. Tetlak, BP America, Inc., Corporate Risk Manager, stipulating that Kennecott, its parent, its principal shareholder, subsidiaries or affiliates in which it owns more than 40 percent interest, have not forfeited any mining bonds in other states within the past 20 years.

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 5.10 of this application.

2.7 Description of Contiguous Land (Item 13.)

A description of land contiguous to the proposed mining site, which is owned by Kennecott, is provided in Appendix F.

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.)

A proposed monitoring plan for the project prepared in accordance with Wisconsin Administrative Code, chapters NR 132 and NR 182, is contained in Section 6.0 of this application. Following the receipt of necessary project permits, Kennecott will select a contractor(s) to conduct monitoring in accordance with the approved monitoring plan. This contractor(s) will assist Kennecott in the development of the quality assurance plan for the project. This 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 quality assurance plan will be accomplished using quality assurance procedures outlined in the October 1987 Scope of Study.

3.0 FINANCIAL RESPONSIBILITY

Copies of Kennecott's parent company's most recent annual reports as described below have been forwarded to the WDNR under separate cover. Copies of the cover pages from each report are included in Appendix G. the reports establish 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. These reports are:

- BP America Annual Report, 1987
- British Petroleum Company p.l.C. Annual Report, 1987
- British Petroleum Company p.l.S. Form 20-F (UK equivalent of Form 10K)

Kennecott intends to provide financial responsibility for reclamation activities through a bond as per applicable provisions of Wis. Admin. Code NR 132.09. Kennecott intends to use the net worth test 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 Pre-Blasting 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 operation 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), Geological and Geotechnical Investigations (4.4), Overview of Environmental Setting (4.5), and the General Description of Geological/Geotechnical Investigations, Project area Geology, and Waste Materials Characterization Studies (4.6.1) are cross referenced to pertinent EIR sections. In a similar fashion, the description of the wastewater treatment plant is referenced to the Kennecott Flambeau Project Preliminary Engineering Report (PER) for Wastewater Treatment Facilities (March 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 140 acres will be physically disturbed by the entire 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 its approximate original contours and use immediately prior to the operation. 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 and Geotechnical Investigations

For a comprehensive discussion of geological and geotechnical investigations, the reader is referred to Section 3.5 of the EIR. This section discusses field and laboratory methods, regional geology, geology of the project area, seismology, and waste characterization.

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), Archaeological Studies (3.3), Climate 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

Kennecott owns over 2,500 acres in the Town of Grant including most of the land in Section 9 that contains the Flambeau deposit. The approximately 175 acres required for the operation is completely owned by Kennecott 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 89.8 acres (29 percent). Pasture/old fields is the second-largest land use category, accounting for 82 acres (26.4 percent) of the project area. Only 45 acres (14.4 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.

4.6.4 Project Scheduling

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 spring 1990, with construction commencing shortly thereafter. A simplified construction schedule is shown on Figure No. 4-4. A more detailed schedule is shown in Figure No. 4-5.

The ten-month design construction period will take the project into the first or second quarter of 1991. Towards the end of this time frame there is a four-month period during which 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 1998, upon completion of site grading and revegetation, activity at the project site will cease. The Flambeau reclamation plan is described in Section 5.0 of this report. Terms of a Local Agreement require Kennecott to continue monitoring the project area and surrounding environment for a period of 30 years.

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.

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

TABLE NO. 4-1

Approximate Disturbed and Undisturbed Acreages
Within Project Area

Facility	Acres
Total Project Area	300
Total Disturbed Area Within Mine Site	
Open pit size	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	7
Railroad spur within fenced area	2
Total	134
Total Undistrubed Area Within Mine Site	36
Railroad Spur East Of Fenced Area	3
Observation Parking And Access	1.5

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, a seven-acre topsoil stockpile, nine acres of haul and access roads, and a security fence to enclose and secure the 170-acre mine site. A two-track railroad spur is located south of the crusher, ore loadout, and Type II stockpile. The mine site will incorporate all the above major and ancillary facilities with the exclusion of the three-acre spur line located east of STH 27.

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 clay-rich 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 monitoring and long-term care plan will be implemented to assure and document that the reclamation has been completed to the satisfaction of regulatory agencies. These plans are found in sections 6.0 and 9.0, respectively.

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 4.7.3.4.

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 Kennecott planted trees will be fenced to protect the areas during construction. In the 1970s, approximately 5,000 pine trees were planted by Kennecott. 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 rescued from the active mine construction areas. Other trees will be placed into temporary nurseries 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 1,280 tons. Total average amount of material moved per day, including ore, will be about 6,000 tons per day.

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 has been utilized 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 has been 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 will originate from a small drainage area located between the pit and the Type II stockpile and from the ore haul road, from direct precipitation, and from groundwater inflow. 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 PER.

Appendix 4.3-A of the EIR contains a report addressing pit inflow projections. The report concludes that the maximum inflow, estimated to be 588 gpm, will occur during the 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 pit inflow report estimates that the steady state inflow will be 294 gpm. Both the maximum and steady state inflow rates assume that the planned slurry wall as discussed below is constructed.

Of the steady state inflow, it is estimated that 95 percent (280 gpm) will originate from the Precambrian rock, with the rest originating from the sandstone and glacial sediments of the rock inflow, about one-half will originate from the river pillar.

The pit inflow report also estimated that a permeable zone of sand and gravel between the river and the northwest corner of the pit could allow an additional 71 gpm of water to seep into the pit. 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 rock structure provides a safe operation indicated by ongoing 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, electric 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 blasting may be required. The requirement for secondary blasting 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

TABLE NO. 4-2

Phase I and II Excavation Schedule

Phase I Bench	Type I Stockpile					Type II Stockpile			Total Waste ktons
	Till* ktons	SS** ktons	SAP ktons	WR I ktons	Total ktons	SAP ktons	WR II ktons	Total 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
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 I Bench	Type I Stockpile					Type II Stockpile			Total Waste ktons
	Till* ktons	SS** ktons	SAP ktons	WR I ktons	Total ktons	SAP ktons	WR II ktons	Total 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 70,000 tons of sandstone 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	1.2	0.9
Type II	1.2	0.9

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 Berm Between Pit and River

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 haul road planned will accommodate both 35- and 50-ton trucks which are currently under consideration. This design width includes 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 Stockpiles - General

A total of four temporary stockpiles will be used during the operation to store topsoil, ore, Type I and Type II waste materials. 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, sandstone and saprolite containing more than 1 percent sulfur will be removed from the open pit and stockpiled in the area designated as the Type II stockpile. All other material except 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 Ore Stockpiles

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 160,000 cubic yards of topsoil will be used to construct this project feature.

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 and the results of soil sorption studies completed on soils in the Type I stockpile area (EIR Section 3.5.6), it was concluded that the temporary stockpiling of the till, sandstone, saprolite, and waste rock can be safely accomplished on an unlined site. The study also recommended the order in which the various materials should be placed in the stockpile. A collection system has been designed to contain 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 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, no grading or special preparation of the base of the site will be conducted. Topsoil will be left in place to take advantage of its sorptive capacity.

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 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.

The sequence of placement of the Type I materials will be as follows. Till will be placed at the base of the pile to provide the maximum soil available for sorption purposes. Sandstone and saprolite will then be placed on the till in segregated areas. Type I waste rock will then be placed on top of the sandstone and till.

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 36-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 PER.

TABLE NO. 4-3

Volumes of Type I Stockpile Material

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

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 Type II material (Type II waste rock and saprolite and sandstone from the west end of the pit) will be temporarily stored in the Type II stockpile area. The estimate includes the volume of each material planned for storage at the site with a six 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

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
Sludge from Wastewater Treatment Plant	83,000
Saprolite	428,800
Waste Rock	1,360,000
Total Volume	2,047,000

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.

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 698) 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 a two percent grade 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.

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. 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.

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 H 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

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

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 August of 1990 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 1990. 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 160,000 cubic yards of construction materials will 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 (158,250 cubic yards) with minor amounts of concrete (1,630 cubic yards) and asphalt (570 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 Kennecott'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 municipal fire fighting system if needed. In addition, hand-operated fire extinguishers will be strategically located.

TABLE NO. 4-6

Imported Materials

Area	Crushed Rock (cu.yd.)	Asphalt (cu.yd.)	Concrete (cu.yd.)
Spur line ballast	14,930		
Roads and parking		570	
Concrete			1,630
Access road	1,255		
Parking lot	725		
Granular material Type II			
Phase 1	62,600		
Phase 2	42,680		
Haul roads	19,510		
Shipping ore stockpile	2,170		
Crusher	3,940		
Magazine	3,940		
Maintenance/wastewater treatment plant	6,500	___	___
TOTALS	158,250	570	1,630
GRAND TOTAL			160,450

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

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 Kennecott 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, 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.

During the clearing process, marketable trees will be salvaged and sold. Other trees will be chipped, with the chips saved for soil stabilization use during construction and operation. 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. A temporary silt collection sump and silt fences will be installed downstream of the construction area.

The four-foot wide slurry wall will be constructed for a length of approximately 400 feet using a backhoe. 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 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 in plan and section, respectively.

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. Upon completion of the slurry wall, approximately 24 inches of clean till will be placed into the top of the trench. A slurry collection 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. This excess slurry will be hauled to the Type I stockpile area.

Flood Control Dike

The flood control dike will be constructed on top of the slurry wall. The dike is required to prevent a 100-year flood from backing up 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 excavated from the slurry wall. This material will be placed in shallow lifts and compacted to 90 percent of its modified Proctor density (ASTM D 698). Once in place, a stormwater collection system will be developed in the open pit to capture and direct water to the completed settling ponds.

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. The crushing and shipping 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.

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 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., Kennecott or a mining contractor. These conditions are true for both preproduction stripping and mining.

Mining Operating Schedule

Mining is expected to achieve full production during the second quarter of 1991 and will be concluded approximately six years later during the fourth quarter of 1996. 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 subeconomic 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. For this reason, flagmen will be stationed on the river bank above and below 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 Kennecott 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 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.

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. Sulfide samples will be taken in the gradation contact areas between the Type I and Type II waste rocks, in questionable areas, and in areas of complex interfingering of sulfide and nonsulfide rock.

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:

Color	Material Classification
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 698). 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 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 Crusher

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.

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 698). 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 total 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.

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 half full volume-wise when receiving their full weight load commitment.

4.7.3.3.9 Stockpiles-General

Four material stockpiles will be in use throughout the life of the mining operation. These are the seven-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 and loadout area. 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, 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 placed on the pile and spread in lifts using a dozer or grader. Compaction will be accomplished as both haul and earthmoving equipment traverse the pile. Upon reaching grade, the pile will be seeded with a grass seed mix native to the area and vegetation established.

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 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, followed by the placement of 16-inch diameter corrugated metal pipe (CMP) conduit connecting the ponds to the diversion structure located to the southwest. This conduit will be connected 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 dressed with three inches of topsoil and the area seeded. At the time the discharge conduit and vertical inlet structures are being placed, a 36-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 rip rap 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 PER.

At the on-set of site construction activities, the area for the Type I stockpile will be cleared and grubbed. Topsoil will be left in place. 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.

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.

Certification Plan

The certification plan for the Type I stockpile will consist of the collection of survey data to define the horizontal limits of Type I material placement. This data will be used to prepare a drawing illustrating these limits. This drawing will be maintained by Kennecott 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 of 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 and will be 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 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. 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 698).

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, one foot of compacted on-site till will be cut and filled to bring the area to base grade. The soil will be compacted to a minimum of 90 percent of its maximum modified Proctor density (ASTM D 698). Large stones, sticks, and other debris will be removed from the soil to prevent puncturing of the HDPE. 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 the liner contractor 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 Kennecott 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. Pipe penetration through the HDPE liner shall be done in accordance with the liner manufacturer's 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 will be placed in panels. When a sufficient width of panels has been placed, anchored, and welded, the installation of additional panels will be temporarily halted until the granular blanket and leachate collection system are installed on the liner that is in place. Granular blanket material will be dumped at the downslope edge of the liner and spread upslope using light grading equipment. Spreading will be accomplished such that any traffic on the liner will only take place on the previously spread granular blanket. As the granular blanket is placed, the leachate collection system will be installed with the blanket being used as a cushion for a light front end loader that will be used to transport the screened and washed filler gravel used to bed the collection system.

The leachate collection system will be installed above the HDPE liner as detailed on Figure Nos. 4-20 and 4-22. All leachate piping (i.e., perforated lines, headers, and cleanout risers) within the lined area of the site will be bedded in one and one-half feet of washed gravel. 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.

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 Kennecott in archives for future reference purposes. The report will address both phases of site construction. The report will include documentation of soil liner 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 and 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 will be quantified using the melt index (ASTM D 1238).
- Tensile and elongation properties will be measured in accordance with ASTM D 638 and must meet manufacturers' specifications.
- Material thickness will be tested in accordance with ASTM D 1593.
- Environmental stress cracking resistance will be measured according to ASTM 1693.
- Visual inspection will be 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 will be conducted twice during each shift for each welding machine to determine joint structural integrity.
- Vacuum testing of the joint will be conducted using soap and a glass-faced suction box. If holes are located, they will be marked, repaired, and retested.
- A visual inspection will also be done by the contractor's supervisor and repairs made if necessary.
- Photographs will be taken of the liner construction.

Drainage Layers and Collection Pipe Bedding

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 5,000 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 five 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 material 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.

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 of 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 Kennecott'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.

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 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.

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. 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 during construction to collect disturbed area runoff

water. Temporary siltation fences will be used in drainageways when weather conditions or construction delays preclude immediate establishment of permanent vegetation.

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 till 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 around the entire site 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 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). 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.

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 617 gallons per minute on an annual basis. A detailed discussion of the sources and volumes of anticipated water is presented in the PER. 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. 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. 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 pond will be lined with a 60-mil HDPE liner. 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. Liner penetrations will be constructed as shown in the pipe penetration detail on Figure No. 4-23.

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.

Sludge 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 Kennecott 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 PER.

Sludge 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 sludge to the Type II stockpile where it will be mixed with the Type II waste rock. Based on the design criteria for the wastewater treatment plant, the maximum sludge production will be 124 tons per day.

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

No. 4-43. Rip rap 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 4,909,000 gallons, which will take only 71 percent of the pond storage capacity, leaving a 1.4 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 maximum runoff flow rate is projected to be 93 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.

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 maximum 24-hour runoff to be treated will be 37 gpm which will be held in the runoff pond or overflowed to the mine pit.

Three storm runoff storage basins will be constructed on-site to handle significant storm events. These basins are the settling ponds, runoff and surge ponds, and the open pit. During abnormally severe storms, water could be temporarily left in the open pit, thus reducing the flow to the settling ponds or wastewater treatment plant depending upon the stage of the operation.

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 ground 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).

Storm water runoff from the Type II construction site and plant site construction will be handled by one or more of the techniques described in Section 4.8.2.

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 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 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 release of water to the natural drainage.

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

TABLE NO. 4-8

Drainage Culverts Within Project Area

Location	Size
Railroad Spur Line	36" x 80'
	18" x 50'
	18" x 50'
	24" x 50'
	18" x 60'
	18" x 60'
	36" x 80'
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 100'
	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 culverts across access road STH 27 are 18" CMP
- Existing culverts across STH 27 north of proposed observation parking is 30" RCP

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 Water Discharge

Treated water will be discharged at two points along the Flambeau River as shown on Figure No. 4-7. The outfall points are designed 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.

Two water discharge points will be constructed as shown on Figure No. 4-43. One outfall structure will be constructed of concrete and located on the east bank of the Flambeau River; the second will be a dug, rip rapped drainage. Rip rap will be placed below each outfall to prevent soil erosion. During construction, topsoil will be removed to one side of the outfall site and saved. Silt fences will be put in place and rip rap 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 271 and 8,078 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 617 and 800 gpm, respectively.

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 1.8 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 and 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 each year for 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 Kennecott 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.

Due to the wet nature of the ore, no 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 rip rap.

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 area 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

- 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 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.

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. Rip rap, filter fabric, and hay matting in conjunction with the engineered drainage system will eliminate sediment flow into adjacent wetlands or other areas.

Soils not suitable for spur line roadbed construction will be excavated and replaced with select material from the on-site excavation. 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 on the Flambeau River will be minimal. Lightweight equipment, swamp mats and other appropriate precautions will be taken to lessen working difficulties and disturbance in 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. These measures will be continued after completion of construction until the soils have stabilized and vegetation has been established.

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 Kennecott 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, 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 PER 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 permits 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 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 nor is it expected to affect wetlands in the vicinity of the mine site.

Reclamation of the pit includes a backfilling sequence that reflects the original stratigraphy and 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. Preproject land uses will be returned to their approximate premining use 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 project area will be enclosed by a security fence. A guard will be present during the construction, operational, and reclamation phases. The railroad spur across STH 27 will be appropriately signalled to provided protection to traffic. The railroad spur crossing at Meadowbrook Lane will also 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 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 19,000 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 38,000 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 3,400 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 will 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.

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 Contingency Measures

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 environmental compliance staff and to the security personnel. In the event such a spill occurs when the environmental staff is not on duty, security personnel will be contacted initially and then environmental staff and general manager at home, if necessary. The following information will be provided:

Observer Reporting

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.

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.

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.

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.

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

KMINE

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 hydrogen sulfide 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 hydrogen sulfide 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 Contingency Measures

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, Kennecott 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 Wastewater Collection System Failure

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 Assessment of Risk

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 Kennecott Flambeau 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 Flambeau mine. 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 Flambeau pit.

A potential risk to the stability of the pit walls exists from a inflow of groundwater to the open mine. 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 Kennecott 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 $D = D_S (W) 1/2$ 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, Kennecott 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, Kennecott 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 Reclamation Plan 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. 3.11-3 of the EIR.

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 along 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 aesthetics, the reader is referred to Sections 3.12 and 4.3.10 of the EIR.

5.2 Reclamation Procedures

These include removal of surface facilities, backfilling the pit, and returning the site to approximately its original topography. Mine reclamation relies mostly on the technical data and performance information. The open pit will be backfilled and the entire area will be planted to create the landforms and plant communities associated with upland mesic hardwood forests, lowland mesic hardwood forests, wetlands, early successional grasslands, and fallow farm fields.

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. For further discussion of the regional and project area information, the reader is referred to Section 3.0 of the EIR, and for general facility information, to the mining permit.

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 (less than one percent sulfur) or the Type II (greater than one percent sulfur) stockpiles. Upon completion of the mining operation, the pit will be sequentially backfilled with the stockpiled waste materials.

Reclamation of the project area will begin at the initial phase of construction and operation, in the form preserving certain resources for reuse. Selected natural trees and those planted earlier by the company 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. Also, several ground cover test plots will be established on the berms surrounding the stockpiles to help determine the most effective seed mixture to be used for reclamation. In addition, 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. 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 following an orderly removal of waste material and ore. The projected waste backfilling amounts are presented in Table No. 5-1 for the open pit reclamation activities.

At the completion of mining operations the pit will have the approximate configuration shown in Figure No. 4-11 of Section 4.0. The open pit will be reclaimed from the materials that have been temporarily stockpiled on the surface and from imported construction materials.

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.

During the actual backfilling operation, the Type II waste 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

TABLE NO. 5-1

Projected Waste Backfilling Amounts and Destinations

Back-filled Bench	Till ktons	SS ktons	SAP ktons	WR I ktons	WR II ktons	Total ktons
900	0	0	0	0	34	34
910	0	0	0	0	52	52
920	0	0	0	0	69	69
930	0	0	0	0	85	85
940	0	0	0	0	108	108
950	0	0	0	0	128	128
960	0	0	0	0	220	220
970	0	0	0	0	243	243
980	0	0	0	0	265	265
990	0	0	0	0	297	297
1000	0	0	0	0	314	314
1010	0	0	0	0	335	335
1020	0	143	0	0	302	445
1030	0	80	334	0	0	414
1040	0	0	336	92	0	428
1050	0	0	0	477	0	477
1060	0	0	0	496	0	496
1070	0	0	459	14	0	473
1080	0	316	300	0	0	616
1090	295	290	0	0	0	585
1100	516	0	0	0	0	516
1110	482	0	0	0	0	482
1120	396	0	0	0	0	396
1130	288	0	0	0	0	288
1140	2	0	0	0	0	2
GRAND TOTAL	1979	829	1429	1079	2452	7768

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

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 be in its approximate pre-mining position.

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 160,000 cubic yards of construction material will be imported from off-site to be used primarily as road base and as a drainage blanket for the Type II stockpile liner. Of this 160,000 cubic yards, approximately 130,000 cubic yards will need to be backfilled with the Type II material. This will be done since this material will have come into contact with water requiring treatment at the wastewater treatment plant. The remaining material can be placed in the upper portion of the open pit, distributed elsewhere on the site.

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.

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 160,000 cubic yards of off-site material to be backfilled with Type II material indicates an excess of 158,000 cubic yards available for backfilling the pit to grade. Any excess material can be distributed over the site or used to recontour the project area.

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

5.5 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.

5.5.1 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 in a uniform layer over the 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 top of the saprolite layer will be no greater in elevation than the top of the Precambrian rock in the pit walls. Since the saprolite material contains abundant clays, upon its placement back in the pit it will form a less permeable "layer" over the Type I rock and Type II materials, reducing potential upflow of water from the pit bottom to the more permeable overburden.

As the Precambrian rock also has lower permeability than the overlying glacial materials, the materials placed back into the pit will be surrounded on all sides by relatively low permeability material. 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. 5-2 and 5-3.

Type II material and the Type I waste rock will be placed and compacted into three-foot high lifts within the pit. The Type I saprolite will then be placed and compacted in three-foot lifts on top of the Type I waste rock. Previous studies have determined that the permeability of compacted saprolite collected from the open pit area ranges from 1×10^{-6} to 1×10^{-8} cm/sec (see NOI data file Ken-40). The mean permeability is 3.3×10^{-6} cm/sec.

5.5.1.1 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 rock. 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

The concentrations of copper, iron, and sulfate will be below the drinking water standards. The concentration of manganese will be near the standard. 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. It should also be

noted that these predicted concentrations are in agreement with theoretical and actual measured concentrations for lime treated water that has come into contact with waste rock as previously reported in the literature (Larsen, 1973).

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.

5.5.2 Operations Manual

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.

5.5.2.1 Backfilling Operations

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. 5-2 and 5-3.

5.5.2.1.1 Type II Material

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. As discussed in the previous section, lime will be spread on the floor of each bench prior to the emplacement of each Type II waste material lift. During the removal of the stockpile, the 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. If, however, dust will be created, it will be controlled by adding water to the backfilled waste materials via the water truck.

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 the normal operating traffic.

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. The liner will be cut into pieces and disposed of along with the other materials in the pit with the Type II waste material. 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.

5.5.2.1.2 Crushing and Loadout Facilities, Catchment Pond, and Ore Haul Road

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 will be removed to 1.5 feet below the final proposed grades. All deeper foundation material will be left in place. The removed material will be disposed of on-site with

the Type II waste material in the reclamation of the pit area. The HDPE liner and blanket material in the crusher area will be removed and also 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 run off 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.

5.5.2.1.3 Type I Materials

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 in the Type I stockpile will be placed in shallow lifts on top of the backfilled waste rock. This will provide an approximate eight-foot impervious 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 carefully placed to eliminate potential water channels and will be compacted by repeated dozer passes.

Sandstone will then be placed on top of the saprolite layer, followed by till. When backfilling approaches the approximate original contours, truckloads will be spotted and dumped for final contouring effort. Surface contouring will begin as soon

as possible. Overburden material will be mounded over all but the western 500 feet of the pit as described in Section 5.8.2. Topsoil will be replaced to the approximate ten to 12-inch depth existing prior to mining.

5.5.2.2 Water Control During Backfilling

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.

5.5.2.3 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.

5.5.2.4 Slurry Wall and Flood Control Dike

The slurry wall and flood control dike will be left in place. 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.

5.5.2.5 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.

5.5.2.6 Certification Plan

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 Kennecott 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.

5.5.3 Engineering Drawings

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 5.8.2 of this report.

Figure Nos. 5-2 and 5-3 show the phasing of the backfilling process. Figure No. 5-2 shows the extent of backfilling at the end of the first three months of the reclamation. Figure No. 5-3 shows the contours of the backfilled pit at the end of 15 months of the 19-month reclamation process.

The site monitoring plan and long-term care plan are addressed in Sections 7.0 and 10.0, respectively in 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.

5.5.4 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.

5.6 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 approximate original contours. To accomplish this, berms will initially be leveled after topsoil has been removed. Excess material in one area will be used to meet shortfalls in other areas. Any total excess will either be used as backfill to the open pit. Any shortfall of material will be provided from till stored in the Type I stockpile. Once final grades have been reached, topsoil will be placed and the area revegetated as outlined in Section 5.8.

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.

5.7 Ancillary Facilities

Kennecott's proposed plan is to reclaim the project area to its approximate immediate pre-mining condition and 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, 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 open pit. Following the removal of ancillary facilities, the project area is then to be returned to its approximate original contour. In accomplishing this action, all reclaimed areas will be graded, topsoiled, and revegetated as outlined in Section 5.8. A discussion of the reclamation of each of the ancillary facilities follows below.

5.7.1 Access Road

The access road will remain open until final reclamation at the facility is complete. The asphalt surface will be removed for disposal of on-site or transported to an off-site landfill. The roadbed material will remain in place and be scarified and then covered by topsoil and revegetated.

5.7.2 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 at an approved off-site facility. The road bed area in the parking lot will remain in place, topsoiled, and revegetated.

5.7.3 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 to approximately 1.5 feet below final proposed grades will be removed and placed into the open pit. Deeper concrete and masonry will be left in place except for slabs which will be broken up before covering to permit normal infiltration of precipitation.

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.

5.7.4 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. Topsoil replacement, regrading, and revegetation will complete the reclamation. The railroad spur materials may be sold as salvage.

5.7.5 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.

5.7.6 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.

5.7.7 Fuel Storage and Distribution

The fuel storage tanks will be utilized until the final stages of reclamation of the project area. After reclamation has been completed, the fuel tank will be emptied and removed from the site.

5.7.8 Storm Water Control

The storm water control features installed during the construction and operation of the mine will be utilized during the reclamation of the stockpiles. As part of final site reclamation, all stormwater control features will be regraded and the areas returned to the approximate original contours. Included will be the dismantling or removal of permanent structures such as culverts on an as needed basis.

5.7.9 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.

5.7.10 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 open pit.

5.7.11 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.

5.8 Revegetation

5.8.1 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. 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 Kennecott in the early 1970s, in anticipation of the need for revegetation.

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 five acres in size. Measures will be taken to provide adequate drainage of the reclaimed open pit site.

5.8.2 Site Final Topography

Following removal of project facilities and backfilling of the open pit, the site area, with the exception of the backfilled pit, will be graded to approximate original contours. With the exception of the western 500 feet, the open pit area will be backfilled to slightly above original grade to compensate for anticipated settlement. The western 500 feet of the open pit will be backfilled to its approximate original grades to allow settlement to assist in the development of a planned wetland area.

Figure No. 5-4 illustrates the final proposed contours for the backfilled pit. The proposed approximate contours for the remaining site area are illustrated on Figure No. 2-2. After grading has been completed, stockpiled topsoil will be evenly distributed over the disturbed areas to prepare for revegetation.

5.8.3 Species Selection

The plant species selected for the proposed reclamation plan reflect the ultimate goal of creating self sustaining natural plant communities in appropriate land forms. Four major plant community types have been identified for the project area as follows: upland mesic hardwood, lowland mesic hardwood, open meadow, and wetlands. Each of the four plant communities are represented on the final planting plan. In addition to the four major plant community types previously listed, that portion of the project area that was devoted to agricultural crop rotations previous to the mining operation, including the site north of the proposed open pit which now contains some temporary tree plantings, will be returned to a condition suitable for use in farming. Specifically, the amount of land devoted to each cover type is summarized in Table No. 5-3.

The plant list in Table Nos. 5-4 to 5-7 contains a variety of plant materials typical to each community, grouped into standard categories of tree, shrub, and evergreen. These trees, shrubs, and evergreens are those normally used by the Wisconsin Department of Transportation and approved by the State DNR for

TABLE NO. 5-3

Reclamation Land Acreage

Cover Type	Approximate Acreage
Upland Mesic Hardwood	40
Lowland Mesic Hardwood	3
Open Meadow	42
Wetlands	5
Farm Cropland	50
Total	140

TABLE NO. 5-4

Plant List - Upland Mesic Hardwood

Quantity Per Acre	Botanical Name	Common Name	Size	Root
	Trees			
5	Acer Rubrum	Red Maple	4"	Tree Spade
5	Populus Tremuldous	Quaking Aspen	4"	DSS
20	Acer Saccarum	Silver Maple	1-1/2"	BR
15	Tillia Americana	Basswood	1"	BR
25	Fraxinus Americana	White Ash	1"	BR
	Shrubs			
60	Viburnum Trilobum	American Cranberry Bush	15"	BR
60	Viburnum Dentatum	Arrowood Viburnum	15"	BR
60	Ribes Alpinum	Alpine Currant	12"	BR
	Evergreen			
25	Picea Abies	White Spruce	2'-3'	BB
25	Pinus Strobus	White Pine	2'-3'	BB
300	Total Plants Per Acre			

TABLE NO. 5-5

Plant List - Lowland Mesic Hardwood

Quantity Per Acre	Botanical Name	Common Name	Size	Root
	Trees			
10	Populus Tremuldous	Quaking Aspen	4"	Tree Spade
50	Betula Paperifera	Paper Birch	8'	BR
20	Betula Nigra	River Birch	8'	BR
	Shrubs			
100	Ainus sp.	Alder (Tag & Specked)	18"	BR
50	Cornus Stolenifera	Red Twig Dogwood	12"	BR
20	Cornus Lutea	Yellow Twig Dogwood	12"	BR
	Evergreens			
30	Tsuga Canabensis	Hemlock	3'	BB
20	Picea Abies	White Spruce	2'	BB
300	Total Plants Per Acre			

TABLE NO. 5-6

Plant List - Wetlands

Quantity Per Acre	Botanical Name	Common Name	Size	Root
	Trees			
50	Betula Paperifera	White Birch	1"	BR
25	Betula Nigra	River Birch	1"	BR
25	Salix Alba	White Willow	8"	BR
	Shrubs			
60	Comus Lutea	Yellow Twig Dogwood	12"	BR
60	Alnus sp.	Alder sp. (Tag and Dogwood)	18"	BR
60	Cornus Stolenifera	Red twig dogwood	12"	BR
	Evergreens			
50	Larix Larcinia	Tamarack	8'	BR
30	Thuja Occidentalis	Arborvitae	2'	BB
300	Total shrubs per acre			

TABLE NO. 5-7

Seed Mixture* - Open Meadow and Project Area Cover Crop

% Composition By Weight	Seed Type
65%	Kentucky 31 Fescue
15%	Kentucky Bluegrass
15%	Creeping Red Fescue
5%	Perennial Rye Grass
100%	Seed Mix No. 3

Suggested seeding rate = 130 pounds per acre

* Seed mix to be used will be the Wisconsin Department of Transportation Seedmix #3 as described in Section 630 of the Standard Highway Road and Bridge Specifications, pages 518-522.

other reclamation projects. The plant list also contains a summary of the number of plants per acre for each plant community type. Prior to installing the trees, shrubs, and evergreens, the disturbed area will be topsoiled, fine graded, seeded, fertilized, and mulched according to the attached specifications. The seed mixture, which is approved for highway by the state Department of Transportation, is a highly effective cover crop that will germinate and grow rapidly, and proven to inhibit erosion. After this cover crop has been established, the trees, shrubs, and evergreens will be planted and maintained. Over a period of years other native vegetation will reestablish itself in the project area, and further enhance the development of the native plant communities.

A test plot for the seed mixtures will be installed on the stockpile berms during the operational phase of the project to determine their viability and hardiness for eventual use as a final cover crop for the reclaimed project area.

5.8.4 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 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 a nurse crop and mulched to reduce the chance of erosion during planting operations. The general arrangement for the mine site reclamation plan is shown on Figure No. 5-5.

5.8.5 Seeding and Planting Methods

The installation of plant materials will be performed in accordance with professionally accepted standards. Specifically, the range of methods of installation includes:

1. Trees (deciduous and evergreen)

    a. Tree spade (relocate materials from project nursery)
    b. Balled and burlapped
    c. Bare root

2. Shrubs (deciduous and evergreen)

    a. Balled and burlapped
    b. Bare root

3. Groundcover

    a. Seed

4. Grasses (Native and maintained turf)

    a. Mechanical seeding
    b. Hydro seeding
    c. Broadcast seeding

5.8.6 Mulching and Fertilizing

Mulching and fertilizing will be performed in accordance with professionally accepted standards. Specifically, the range of methods include:

1. Mulching

    a. Hydro mulching

        (1) Material (papiermache)
        (2) Tack coat (Terra Tack)

    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)

5.8.7 Summary

Appendix I contains a summary of the appropriate reference standards applicable to the specie selection, seedbed

preparation, planting methods, and mulching and fertilizing methods. The execution of this portion of the reclamation plan will be performed by a competent landscape contractor.

5.9 Aesthetics

The character of the project area will be dynamic. This means that at the completion of the operation phase of the project a metamorphosis will occur. The open pit mine will gradually be filled with the Type I and II materials stored on site. Once that has been accomplished, the topsoil will be spread over the site, and the appropriate vegetation will be planted according to the planting plan. Finally, over about a ten-year period, the vegetation on the site will reach a point of ecological stability.

5.10 Maintenance Plan

A site maintenance plan consisting of both landform and vegetation maintenance is discussed in Section 10.0, Long-term Care.

5.11 Backfilling Costs

The projected costs of reclamation at the completion of each year of operation to termination of the project is shown in Table No. 5-8.

TABLE NO. 5-8

Anticipated Backfilling Costs by Year,
Flambeau Project, Ladysmith, Wisconsin

Date	Backfill K Tons Required[1]	Cost $[1]	Time to Complete (Mos.)[2]
Construction Start	0	0	0
12/31/90	2,200	1,716,000	6
12/31/91	3,680	2,370,000	8
12/31/92	5,160	4,025,000	11
12/31/93	6,440	5,023,000	14
12/31/94	7,490	5,842,000	17
12/31/95	7,745	6,041,000	18
End of Mining	7,768	6,016,746	19
12/31/96	3,571	2,522,101	7
12/31/97	0	0	0

[1] Backfill and cost required if reclamation started at that date.
[2] Time to complete reclamation of that portion of the project completed as of the date given.

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 post reclamation and the active operating period. 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 J 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 and its 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 - 2% 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 in Appendix J.

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 in Appendix J.

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 in Appendix J.

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 in Appendix J.

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 in Appendix J.

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)	206.5	206.5	206.5

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 in Appendix J.

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 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 the quality of water infiltrating through the Type I stockpile is not expected to adversely affect the groundwater. Finally, as discussed in Section 5.5.1 of this document water in the backfilled pit is not expected to be deleterious to the surrounding environment.

7.0 MONITORING PLAN

This monitoring and quality assurance plan has been developed for the Flambeau Project in response to NR 132.06(3)(d), NR 182.08(2)(e)8 and NR 182.09(2)(a)7.

The Flambeau Project monitoring plan includes a program for groundwater monitoring during the construction and operation phases of the project. Monitoring requirements for discharges to surface water will be prescribed pursuant to the discharge permit and applicable administrative code provisions and will not be described in this section. See PER and WPDES Permit applications. Monitoring of the physical features on the site will be presented as part of the long-term care provisions. This is further described in Section 10.0 of the mining permit. The purpose of the monitoring program is to provide appropriate data to be used to evaluate the performance of environmental facilities and operations. Effects of project activities at the open pit mine, the Type I and Type II stockpiles, and the backfilled pit will be monitored.

Quality assurance and quality control (QA/QC) procedures will be followed for all programs of the monitoring plan. Following the receipt of necessary project permits, Kennecott will conduct monitoring in accordance with the approved monitoring plan. Kennecott will develop a quality assurance plan for the project. This 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 quality assurance plan will be accomplished using quality assurance procedures outlined in the October 1987 Scope of Study.

7.1 Groundwater

Background baseline groundwater monitoring was conducted for the site in 1987 and 1988 and is discussed in Section 3.6 of the EIR. Interim monitoring is currently on-going and will continue until construction begins, after which construction and operations monitoring will be conducted. Monitoring of groundwater during the post reclamation period is discussed in Section 10.0.

7.2 Interim Groundwater Monitoring

In the time period between the completion of the baseline groundwater monitoring program and the beginning of construction, an interim monitoring program will be conducted. Well nests numbered MW-1004 and MW-1005 (Figure No. 7-1) have been and will continue to be sampled quarterly for the parameters listed below. Groundwater levels in the on-site wells will also be measured quarterly until construction begins. Sampling and QA/QC procedures will be followed in the same manner as for the baseline sampling program.

pH (field)	Iron
Specific conductivity (field)	Zinc
Alkalinity	Copper
Hardness	
Cadmium	

7.3 Monitoring During Construction and Operation

Under NR 132.11 and NR 183.13 groundwater monitoring during construction and operation maybe required. A discussion of proposed monitoring locations, frequency, and parameters follows.

7.3.1 Monitoring Locations

Four of the baseline monitoring well nests will be sampled throughout construction and operation. 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.

Water levels in selected on-site wells will be monitored to document the drawdown due to the mine excavation. After the pit is backfilled, water levels will be monitored until groundwater levels stabilize.

7.3.2 Monitoring Frequency and Parameters

NR 182.13(2) requires quarterly (March, June, September, and December) analysis of groundwater samples for water levels, specific conductivity (field), pH (field and laboratory), 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 studies completed for the project have identified iron, manganese, and copper as principal constituents that may be generated at the site. These three parameters will be included in the monitoring plan. Total alkalinity and hardness as indicators of overall water quality will also be quarterly parameters.

Quarterly measurements of groundwater levels will be continued for the wells shown in Table No. 7-1. The table lists wells, screened intervals, and sampling parameters for the construction and operation period of the Flambeau Project. Figure No. 7-1 shows the locations of these wells.

TABLE NO. 7-1

Measuring Points for Groundwater Levels
and Water Quality Sampling Points
(Construction and Operation Program)

Well/Piezometer Number	Elevation of Screened Interval (ft. msl)	Geologic Unit	Parameter *
MW-1000	1091-1081	PC,Till	1, 2
MW-1000P	1049-1044	PC	1, 2
MW-1001	1118-1108	Till	1
MW-1001G	1095-1090	Till, Sandstone	1
MW-1001P	1051-1046	PC	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	PC	1
MW-1004	1112-1102	Sand & Gravel	1, 2
MW-1004S	1093-1088	Sandstone	1, 2
MW-1004P	1042-1037	PC	1, 2
MW-1005	1134-1124	Till	1, 2
MW-1005S	1097-1092	Sandstone	1, 2
MW-1005P	1056-1051	PC	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
PZ-S1	1067-1062	PC	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-42	1092-1060	Sand & Gravel	1
OW-43	1092-1030	Sand & Gravel	1

*
1- groundwater elevation (quarterly).
2- specific conductivity (field), ph (field and lab), tds, iron, manganese, copper, total alkalinity, hardness (quarterly).

7.3.3 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.

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 only address environmental problems that could theoretically be detected by the monitoring program.

The Monitoring Plan for the Flambeau Project (Section 7.0 of the Mining Plan) includes a program for groundwater monitoring during the construction and operation phases of the project. References to monitoring for surface water and post-reclamation monitoring are also listed in Section 7.0. The purpose of the monitoring program is 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 following contingency measures will be implemented.

Step No. 1: Review all sampling, sample handling, and analytical procedures used during the monitoring period to assure that 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, 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. All potential sources should be examined.

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. Kennecott 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. (See Appendix F.)

8.2 Surface Water

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.

9.0 EMERGENCY NOTIFICATION PROCEDURES

In the event of an emergency, accident or other unplanned event, the following Kennecott 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

Major Fuel Spill

- 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

Fire

- 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

Sabotage/Vandalism

- 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

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 30-year long-term care period. Figure No. 10-1 illustrates the long-term care plan for the mine site.

10.1 Procedures

Since the project area will be returned to its approximate original contours and revegetated as discussed in Section 5.0 of this application, long-term care will relate only to site inspections, surface and vegetation maintenance, and groundwater monitoring.

10.1.1 Inspections

Kennecott will inspect the reclaimed site twice per year for the first four years after reclamation is complete 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 during long-term care will consist of landform and vegetative maintenance.

10.1.2.1 Landform Maintenance

The method of backfilling the pit, and the nature of the backfilled material will result in only a slight amount of settling. In the east end of the pit a mounding has been provided to compensate for anticipated settling. It is calculated that an approximate three-foot mound will allow for the final grade over the pit to be near the original grade. In the west end of the pit, the backfill will be purposely allowed to subside a few feet in order to create a lowland suitable for formation of a wetland. 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 seeding and planting has been completed. Erosion control will consist of regrading and revegetating eroded areas.

10.1.2.2 Vegetation Maintenance

After the project area has been graded and planted according to the final site topography and planting plan, vegetation will be monitored and maintained as required.

10.1.2.2.1 Short-Term Requirements

Individual plants and turf areas will be maintained on an as needed basis 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.

- Remove and replace dead trees and shrubs.
- 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 year after planting.
- Fertilize and mulch all plant materials as necessary during the first year after planting.

10.1.2.2.2 Long-Term Requirements

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.

If during the annual monitoring of the project area, it is determined that the plant community is under stress, Kennecott will add additional plant materials, or other action as deemed necessary.

10.1.3 Groundwater Monitoring

Groundwater monitoring during the long-term care period will include three well nests (MW-1000, MW-1004, and MW-1005). Well nests MW-1000 and MW-1004 are included in the program since they are located downgradient of the backfilled pit. 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). Analyses or measurements will be performed for the following parameters.

Water levels
Specific conductance (field)
pH (field)
Total dissolved solids
Alkalinity
Hardness
Iron
Manganese
Copper

Reporting procedures under this program will be the same as that described in Section 7.3.3.

10.2 Long-Term Care Costs

Table No. 10-1 contains an itemized estimate of long term care costs based on the procedures outlined above.

10.3 Financial Responsibility

Kennecott intends to use the net worth test to establish financial responsibility for long-term care as per the provisions of Wisconsin Adminstration 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
Director, Process Development
On Behalf of Kennecott Minerals Company
1515 Mineral Square
Salt Lake City, Utah 84112
(801) 322-8460

TABLE NO. 10-1

Long Term Care Costs

Item Description Site Long Term Care	Basis of Cost	Units	Estimated Quantity	Unit Cost	Cost
Site Inspections First 4 Years Next 26 Years	Incl: Site Inspection & Sum Report	Inspect/Year	1.133[1] (ave.)	$ 500	$ 570
Landform Maintenance Erosion Damage Repair	Assume Erosion Loss 0.0625/T/Y/Acre	Cubic Yards	9.2	$ 282	$ 2,600
Vegetation and Soil Amendments	Assumes a Prorated Average[2]	Acre	0.5 (ave.)	$4,520	$ 2,260
Environmental Monitoring Groundwater Monitoring	Incl: Sample Collection & Lab Test	Sample/YR	32	$ 155 (ave.)	$ 4,960
Administration	General Estimate	Lump Sum	5%		$ 520
Total Cost Per Year (Annual Cost)					$10,910

[1]Average based on two times per year first four years and once per year for the remaining 26 years.
[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; and years 6 to 30 = 0 acre.

KMINE

11.0 REFERENCES

Breeman, N. van. 1973a. Soil Forming Processes in Acid Sulfate Soils, Acid Sulfate Soils, H. Dost, ed. vol. 1. ILRI. Wageningen, the Netherlands. pp. 66-130.

Breeman, N. van. 1973b Dissolved Aluminum in Acid Sulfate Soils and in Acid Mine Waters. *Soil Science Society of America Proceedings,* vol. 37. pp. 694-697.

Dent, D. 1986. *Acid Sulfate Soils: a Baseline for Research Development.* ILRI. Wageningen, the Netherlands. pp. 74-93.

Garrels, R. M. and C. L. Christ. 1965. *Solutions, Minerals, and Equilibria.* Harper & Row, NY.

Kelly, M. 1988. *Mining and the Freshwater Environment.* Elsevier, NY. pp. 33-42.

Kern, R. and A. Weisbrod. 1967. *Thermodynamics for Geologists.* Freeman, San Francisco. pp. 278-284.

Krauskopf, K.B. 1967. *Introduction to Geochemistry.* McGraw-Hill, NY.

Lanoutte, K. H. 1977. Heavy Metals Removal. *Chemical Engineering,* Deskbook Issue, October 17, 1977. pp. 73-80.

Larsen, H. P., J. K. Shou and L. W. Ross. 1973. Chemical Treatment of Metal-Bearing Mine Drainage. *J. Water Pollution Control Federation,* vol. 45. pp. 1682-1695.

Nordstrom, D. K. 1982. Aqueous Pyrite Oxidation and the Consequent Formation of Secondary Iron Minerals. *Acid Sulfate Weathering.* SSSA Spec. Publ. No. 10. Soil Science Society of America. Madison, WI. pp. 37-56.

Palache, C., H. Berman and C. Frondel. 1951. The System of Mineralogy, vol. II. Wiley, NY. pp. 395-634.

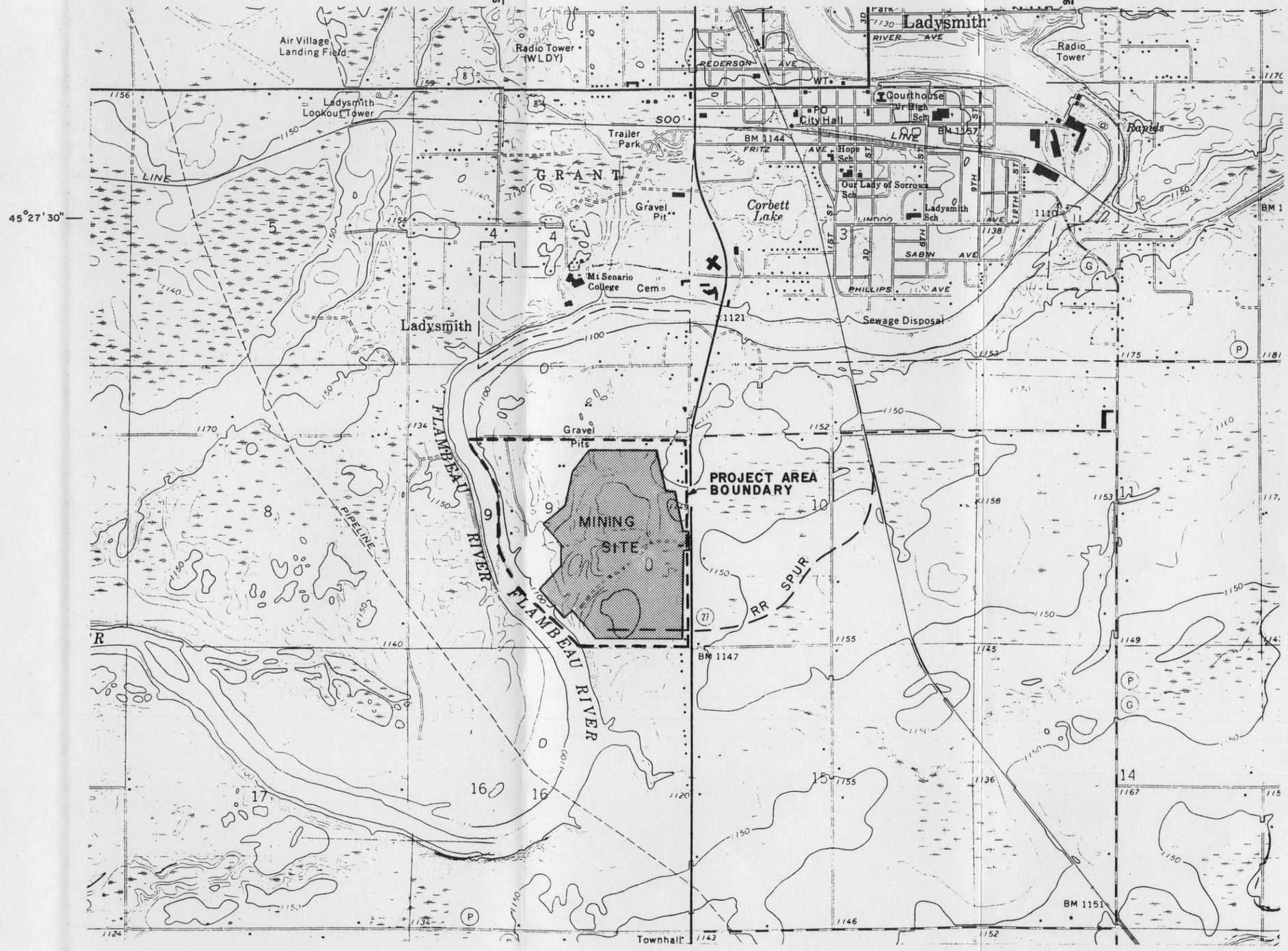
Schwertmann, U. 1985. The Effect of Pedogenic Environments on Iron Oxide Minerals. Advances in Soil Science, B. A. Stewart, ed., vol. 1. Springer-Verlag, NY. pp. 171-200.

REFERENCES (Cont.)

Stevenson, F. J. 1985. *Cycles of Soils.* Wiley, NY. pp. 309-317.

Whiting, D. L. 1985. Surface and Groundwater Pollution Potential. *Design of Non-Impounding Mine Waste Dumps,* M. K. McCarter, ed. AIME. pp. 90-98.

FIGURES FOR MINING PLAN



NOTE: BASE MAP PREPARED FROM U.S.G.S. MAPS 7.5 MINUTE SERIES, LADYSMITH AND THORNAPPLE WISCONSIN QUADRANGLES

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR.

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	S.J.L.	2/89
CH'K'D	G.W.S.	3/89
DES. ENG'R		
SECT ENG'R		

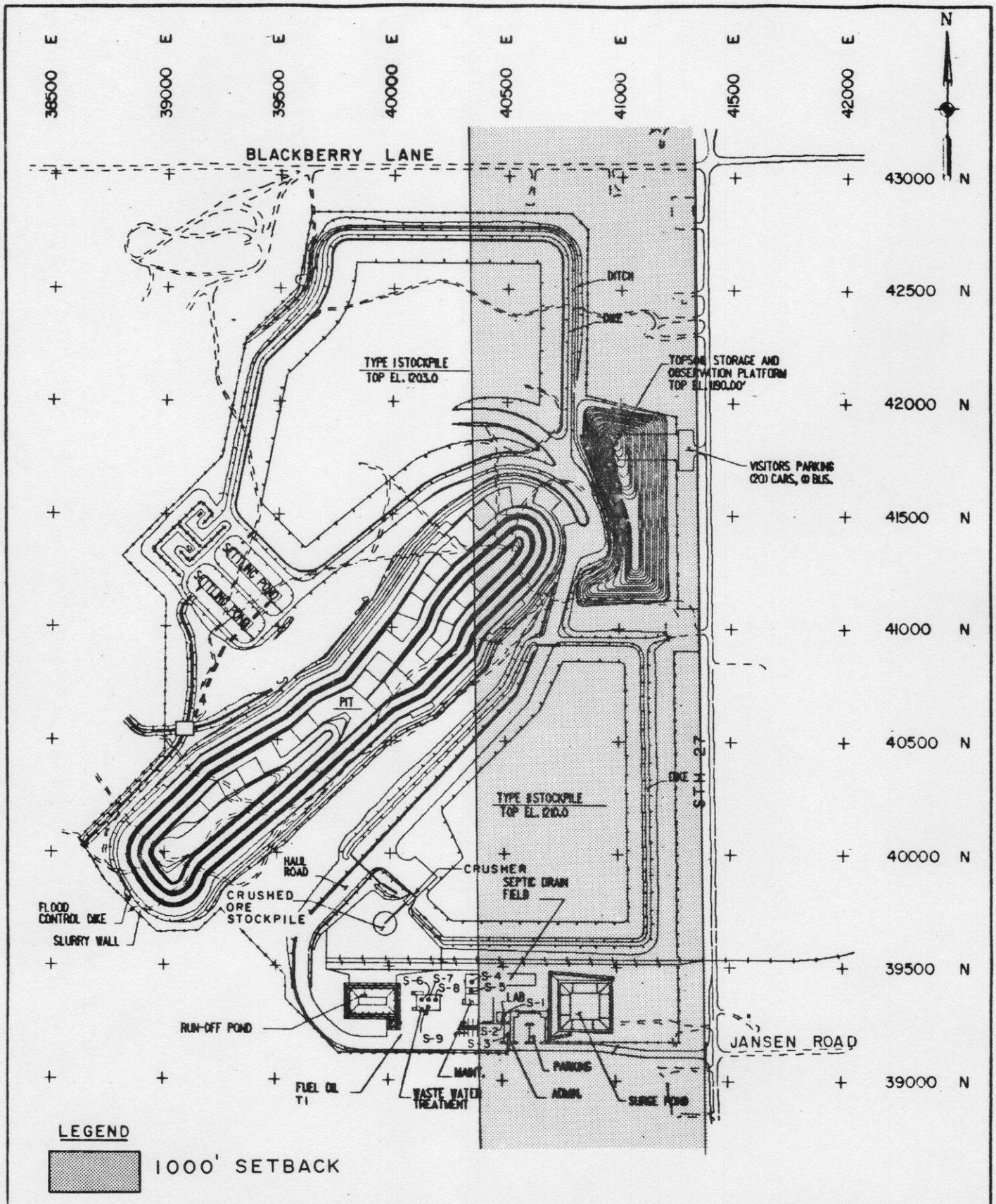
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 1-1
USGS TOPOGRAPHIC MAP
WITH MINING SITE

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	1" = 2000'



FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 2-1 STH 27 SETBACK
	DESIGNED BY		
	DRAWN BY SJL	2/89	
	CHECKED BY GWS	3/89	
	APPROVED BY		
	CAD No. SCALE 1" = 600'		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

- —1100— EXISTING CONTOUR
- EXISTING PAVED ROADWAY
- EXISTING TRAIL/GRAVEL SURFACE
- TREES AND/OR BRUSH
- F-1 FENCE
- 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

0 300' 600'
SCALE

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
55 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 2-2
EXISTING SITE CONDITIONS

REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

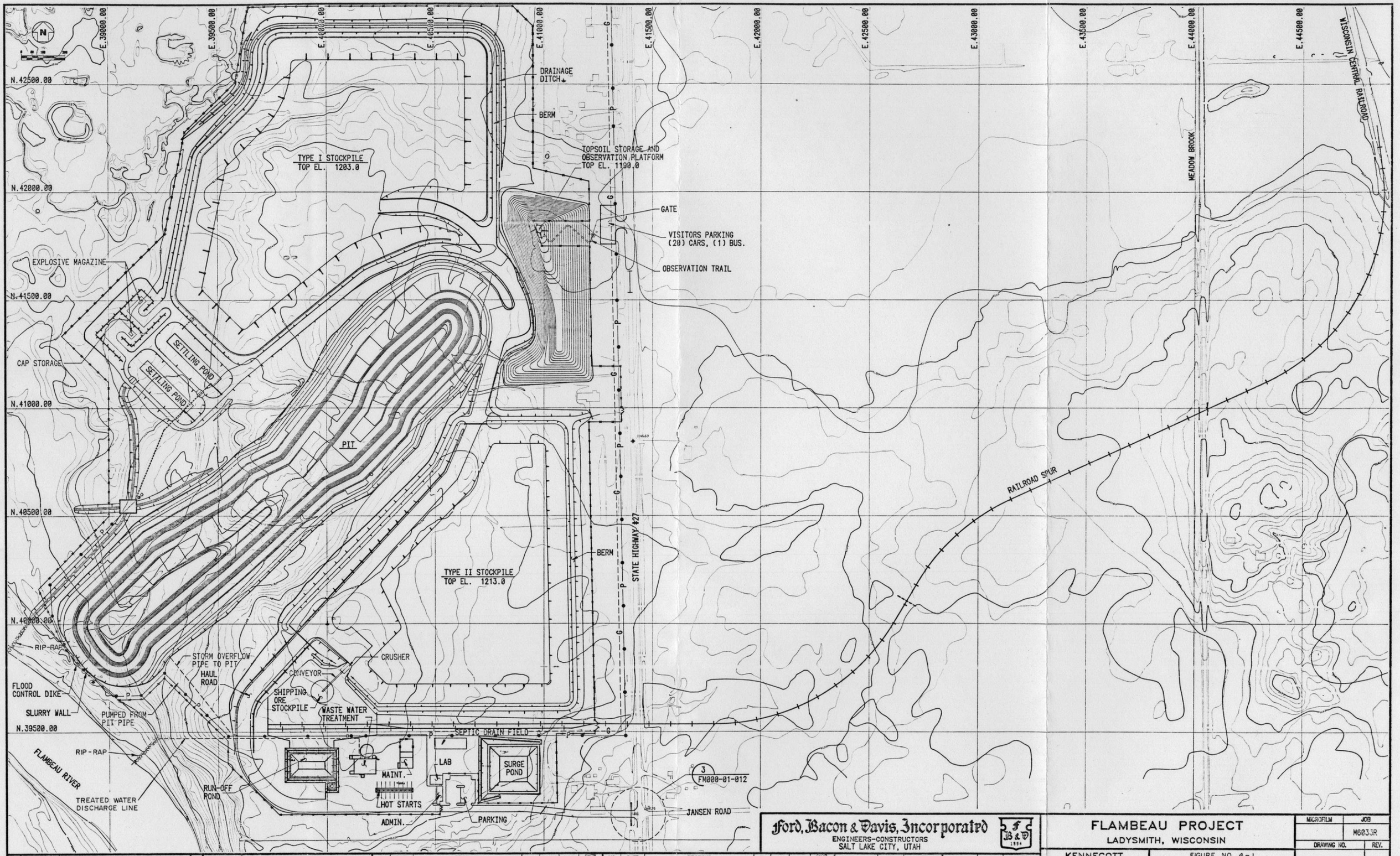
NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

	BY	DATE
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



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
1	2/22/89	GENERAL REVISIONS	PSH			
2	3/6/89	GENERAL REVISIONS	PSH			

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'G		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	CEP\WC9	11-14-88
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

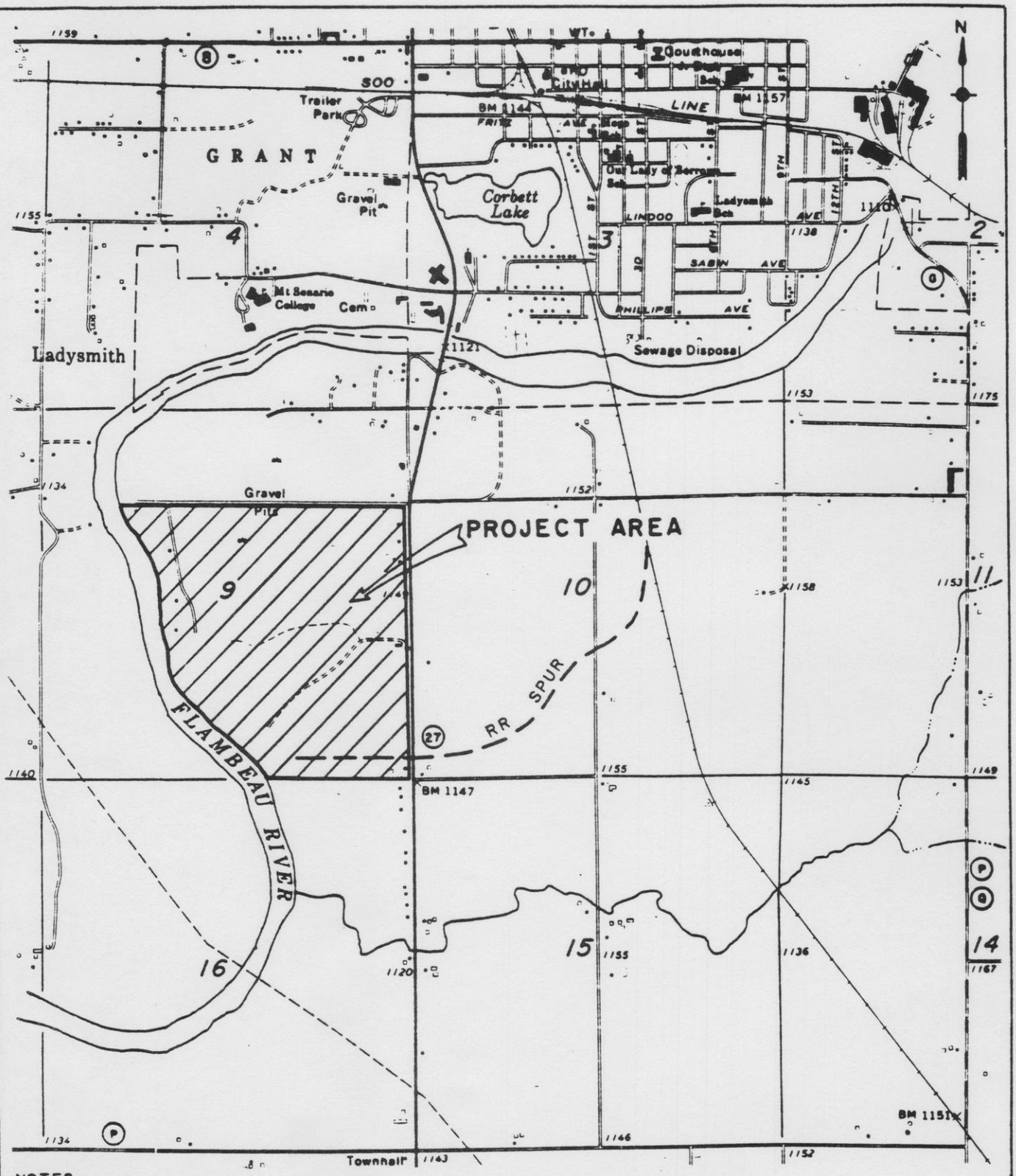
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-1
SITE PLOT PLAN

MICROFILM	JOB
	M603JR
DRAWING NO.	REV.
FM000-01-007	2
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

MK756K



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

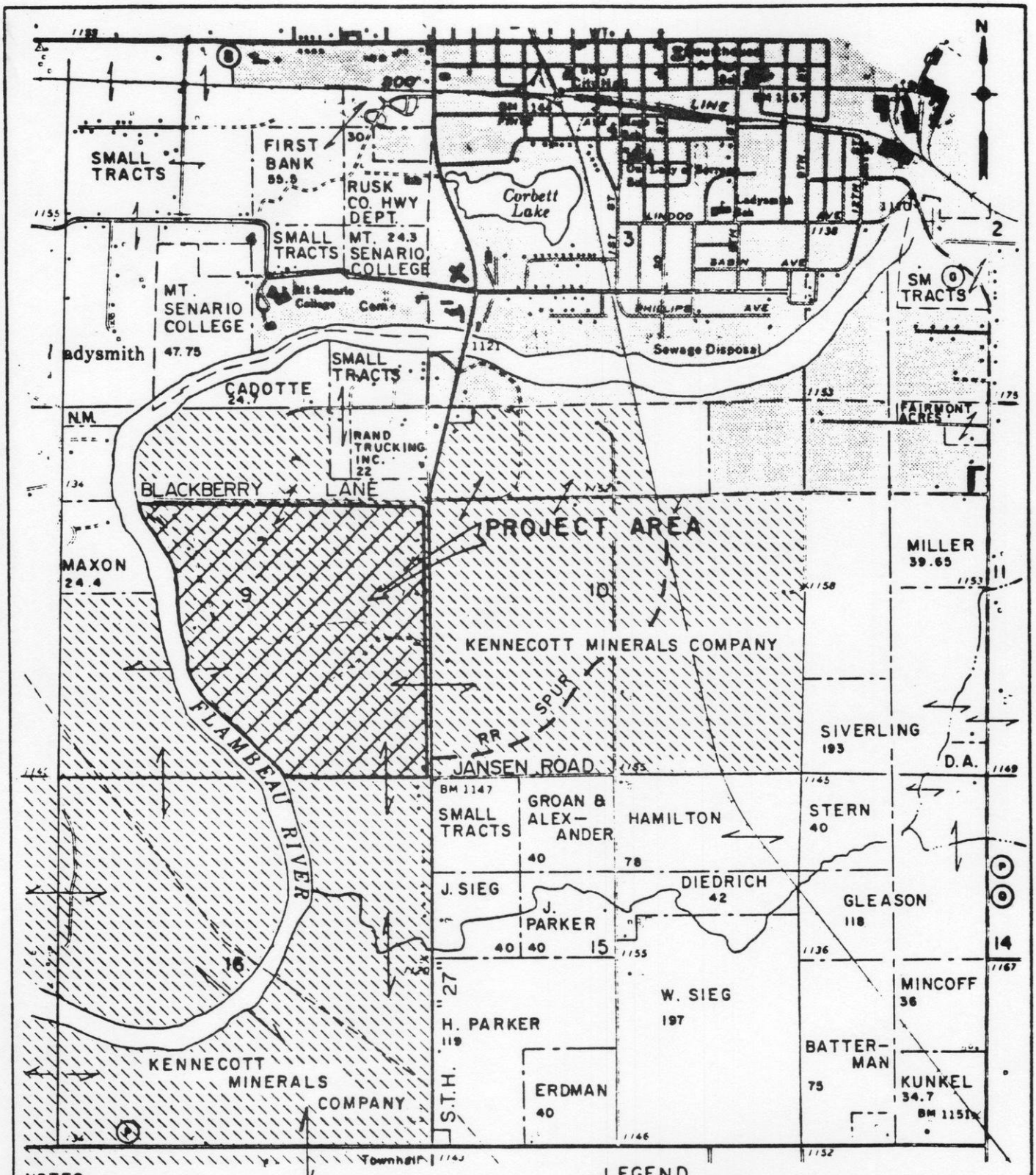
FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

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

KENNECOTT PROPERTIES

CITY OF LADYSMITH

FOTH & VAN DYKE

GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

KENNECOTT MINERALS COMPANY

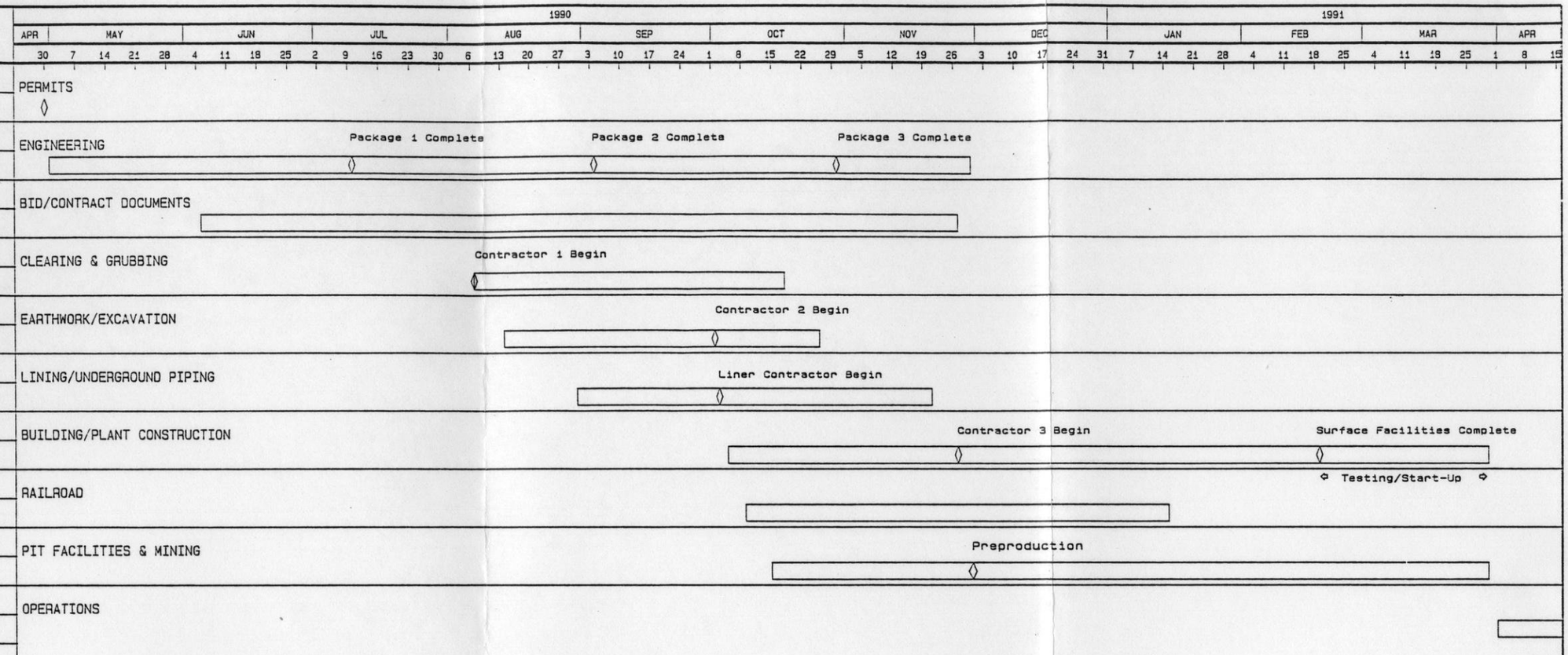
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4-3
PROPERTY OWNERSHIP

NOTES	APPROVAL		DATE
	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	30APR90	27APR90
ENGINEERING	1MAY90	29NOV90
BID/CONTRACT DOCUMENTS	5JUN90	26NOV90
CLEARING & GRUBBING	7AUG90	17OCT90
EARTHWORK/EXCAVATION	14AUG90	25OCT90
LINING/UNDERGROUND PIPING	31AUG90	20NOV90
BUILDING/PLANT CONSTRUCTION	5OCT90	29MAR91
RAILROAD	9OCT90	14JAN91
PIT FACILITIES & MINING	15OCT90	29MAR91
OPERATIONS	1APR91	15APR91



Summary Bar/ Early Dates
Critical Designator

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
FLAMBEAU CONSTRUCTION SCHEDULE

Sheet 1 of 1

Data Date: 1MAR89
Plot Date: 9MAR89

FIGURE NO. 4-4

Date	Revision	Checked	Approved

1990 | 1991

APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR

23 30 7 14 21 28 4 11 18 25 2 9 16 23 30 6 13 20 27 3 10 17 24 1 8 15 22 29 5 12 19 26 3 10 17 24 31 7 14 21 28 4 11 18 25 4 11 18 25 1 8 15

ENGINEERING

BID/CONTRACT DOCUMENTS

CLEARING & GRUBBING

EARTHWORK/EXCAVATION

LINING/UNDERGROUND PIPING

BUILDING/PLANT CONSTRUCTION

RAILROAD

PIT FACILITIES & MINING

OPERATIONS

1150 153.0 DETAIL DESIGN & ENGINEERING

1151 0,0 DESIGN TYPES I & II AREA, SETTLING POND COMPLETE

1152 0,0 DESIGN RAILROAD, EARTH, CONCRETE, BLDGS COMPLETE

1153 0,19 DESIGN EQUIPMENT, MECHANICAL, PIPING COMPLETE

1155 20.5 PREQUALIFY LUMP SUM CONTRACTORS

1156 20.0 BID/CONTRACT LUMP SUM PACKAGE # 1

1160 12.36 BID/CONTRACT SPECIALIZED LINING

1161 20.0 BID/CONTRACT LUMP SUM PACKAGE #2

1163 20.19 BID/CONTRACT LUMP SUM PACKAGE #3

20 5.0 MOBILIZE & LAYOUT SURVEYS

34 2.16 CLEAR & GRUB - TYPE I STORAGE AREA

15 0.0 CONTRACTOR #1 ON SITE

31 10.16 CLEAR & GRUB - TYPE I STORAGE AREA

32 3.0 CLEARING & GRUBBING - TOPSOIL STORAGE AREA

35 13.65 CLEARING & GRUBBING - RAILROAD LINE

29 6.16 CLEAR & GRUB - MINE SW PORTION

310 30.128 INSTALL FENCING

33 6.4 CLEARING & GRUBBING - TYPE II AREA

27 2.20 CLEAR & GRUB - MINE SW PORTION

300 25.49 CONSTRUCT ROADS

50 8.65 REMOVE TOPSOIL - RAILROAD LINE

40 3.0 PREPARE TOPSOIL SITE

52 6.15 REMOVE TOPSOIL - MINE SW PORTION

199 5.0 CONTRACTOR #2 MOBILIZE & LAYOUT

56 7.0 REMOVE TOPSOIL - TYPE II AREA

58 3.15 REMOVE TOPSOIL - PLANT AREA

196 0.0 CONTRACTOR #2 ON SITE

59 3.15 REMOVE TOPSOIL - SETTLING PONDS

200 15.0 EARTHWORK/EXCAVATION FOR PLANT FACILITIES

305 25.49 SLURRY CUTOFF WALL

175 25.0 PREPARE & DIKE TYPE II STORAGE AREA

100 7.43 EXCAVATE SETTLING PONDS

150 18.140 PREPARE & DIKE TYPE I STORAGE AREA

105 20.46 CONSTRUCTION FLOCULATION FACILITY

115 0.43 SETTLING PONDS OPERATIONAL

110 14.43 UNDERGROUND PIPING & OUTFALL STRUCTURES

210 18.83 UNDERGROUND PIPING AT PLANT FACILITIES

180 15.0 LINE TYPE II STORAGE AREA

205 12.0 LINE FUEL & ORE PADS, RUN OFF & SURGE PONDS

185 15.92 PIPING AND COVER FOR TYPE II STORAGE AREA

192 8.129 REVEGATE TYPE II STORAGE AREA BORDERS

215 0,19 CONTRACTOR #3 ON SITE

234 30.29 CONSTRUCT LAB/ADMINISTRATION BUILDINGS INTERIOR

228 0,19 WATER TREATMENT PLANT OPERATIONAL

120 20.115 REVEGATE TOPSOIL SITE/PARKING FACILITIES

215 5.19 CONTRACTOR #3 ON SITE

224 40.19 WATER TREATMENT PLANT - INSTALL MECH EQUIPMENT

220 25.21 CONCRETE FOUNDATION WATER TREATMENT PLANT

195 25.47 CONSTRUCT CRUSHER FACILITY

350 10.0 PLANT START-UP

240 10.112 CONSTRUCT ORE STOCKPILE PAD

222 30.19 ERECT WATER TREATMENT PLANT BUILDING SHELL

230 20.36 CONCRETE FOUNDATION SHOP/LAB/ADMIN BUILDINGS

235 30.29 ERECT MAINTENANCE SHOP SHELL

232 30.29 ERECT LAB/ADMINISTRATION BUILDINGS SHELL

237 30.29 CONSTRUCT MAINTENANCE SHOP INTERIOR

226 35.19 WATER TREATMENT PLANT - INSTALL PIPING

65 30.65 RAILROAD SUB-BASE

70 40.65 INSTALL BALLAST, TIES, & TRACK

400 15.28 CONSTRUCT MINE HAUL ROAD, DEWATERING, ELECTRICAL

412 15.47 CONSTRUCT RAMP TO CRUSHER

402 20.0 INSTALL MINE DEWATERING, ELECTRICAL MAIN LINES

405 85.0 PREPRODUCTION

409 11.0 OPERATIONS

425 6 FIRST ORE TRAIN LEAVES SITE

act id rd tf
description
Activity Bar/Early Dates
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1989

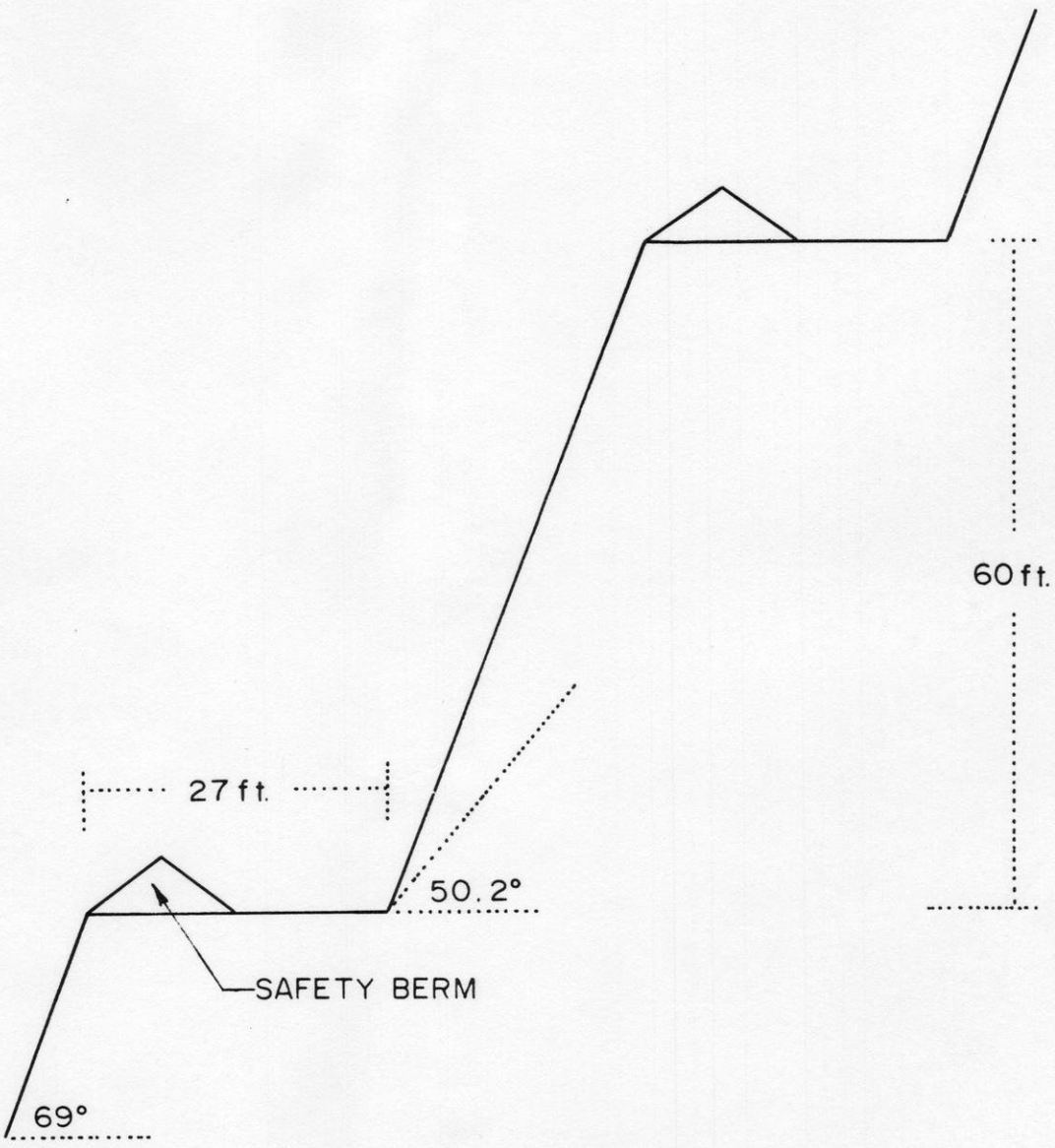
Project Start : 1MAR89
Project Finish: 15APR91

KENNECOTT MINERALS COMPANY
FLAMBEAU PROJECT
ENGINEERING/CONSTRUCTION SCHEDULE

Data Date: 1MAR89
Plot Date: 29MAR89

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

FOR CONTINUATION SEE DWG. NO. FM000-01-001

E 38500 E 39000 E 39500 E 40000 E 40500 E 41000 E 41500

N 41000 N 40500 N 40000 N 39500

FM000-01-015 D EL. 15.00 EL. 32.00 C FM000-01-011

SETTLING PONDS EL. 14.50 EL. 32.00

REALIGN STREAM

DRAINAGE DITCH FL. 1116.10 0.50% 1124.00

TOPSOIL STORAGE EL. 1160.65 EL. 1160.00 ℄ TOP BERM

TOP PILE EL. 1213.0 EL. 1155.9 EL. 1165.84 7.60%

"V" DRAINAGE DITCH

STATE HIGHWAY #27

PHASE I VOLUME 1,103,000 CU. YD.

PHASE II VOLUME 1,082,000 CU. YD.

A FM-000-01-011

℄ HAUL ROAD ℄ TOP OF BERM

TOP PILE EL. 1213.0

TYPE II STOCKPILE TOTAL VOLUME 2,185,000 CU. YD.

PHASE I DIKE

EL. 1158.00 EL. 1157.00 EL. 1182.41 EL. 1181.21 EL. 1181.28 EL. 1183.15

2.20% EL. 1186.00 8.80%

CRUSHER CONVEYOR

SHIPPING ORE STOCKPILE 2.88%

EL. 1157.24 EL. 1147.12 TOP OF RAIL EL. 1145.0

FOR CONTINUATION SEE DWG. NO. FM000-01-004

RIP -RAP SLURRY WALL EL. 1097.50 FLOOD CONTROL DIKE

B FM000-01-014 FM000-01-014

FLAMBEAU RIVER

TREATED WATER DISCHARGE LINE RIP -RAP

0 50 100 200

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
1	2/23/89	GENERAL REVISIONS	PSH			
2	3/7/89	GENERAL REVISIONS	PSH			

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	CEP\WCB	10/21/88
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

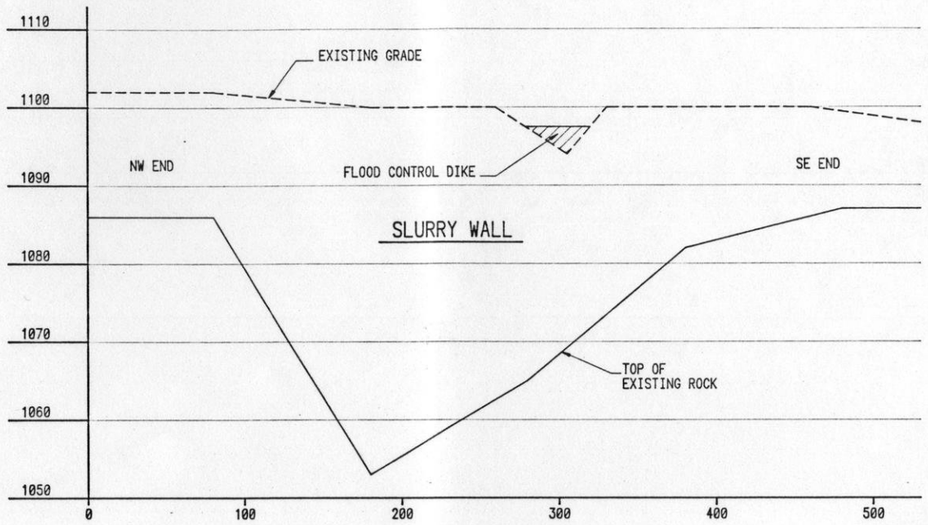
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

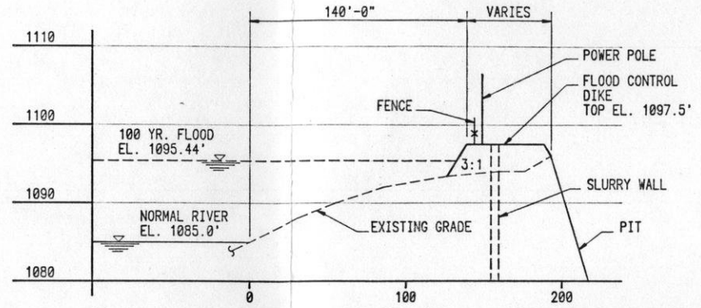
FIGURE NO. 4-7
SITE GRADING AND DRAINAGE PLAN - SOUTH

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-002	2
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

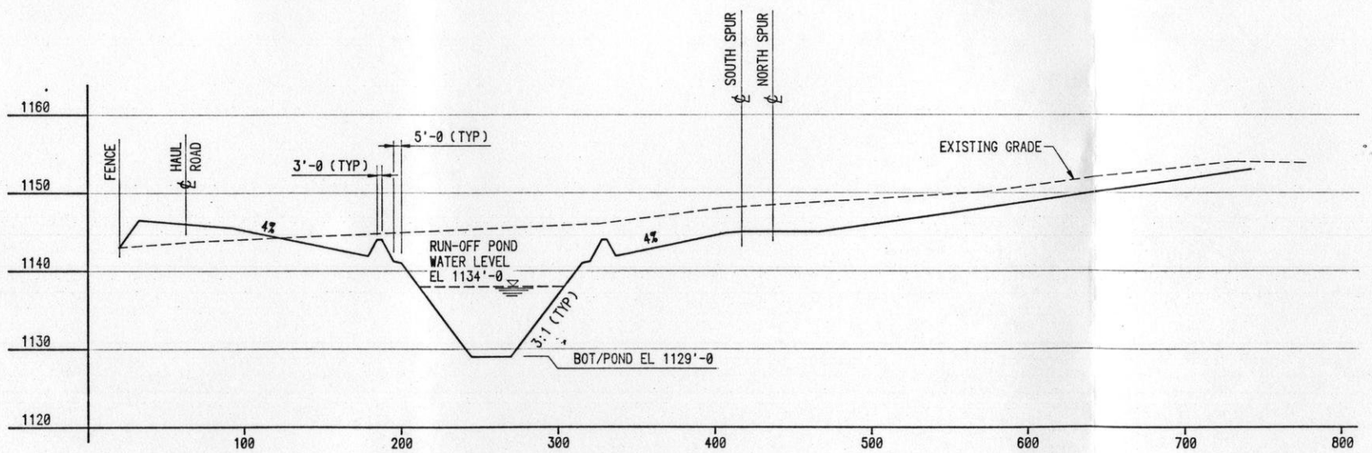
MK758K



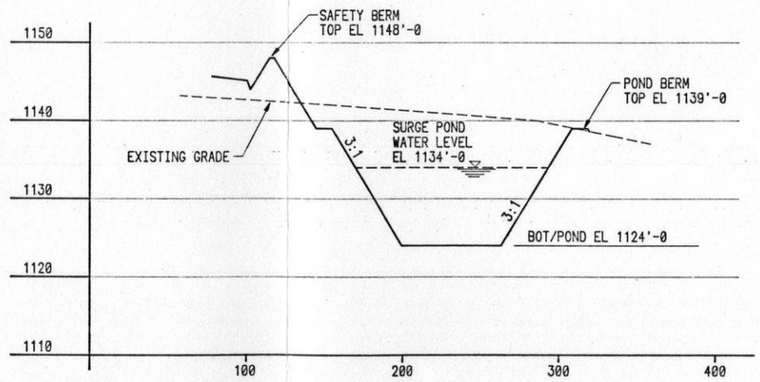
SECTION A
H 1"=50'
V 1"=10'
FM000-01-002



SECTION B
H 1"=50'
V 1"=10'
FM000-01-002



SECTION C
H 1"= 50'
V 1"=10'
FM000-01-004



SECTION D
H 1"=50'
V 1"=10'
FM000-01-004

REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	CONST MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	CONST MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	GB	12-14-88
CHK'D		
DES. ENG'R	[illegible]	2-1-89
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

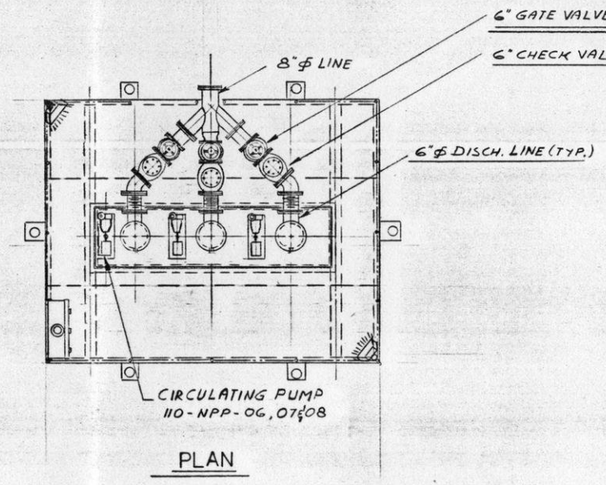
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

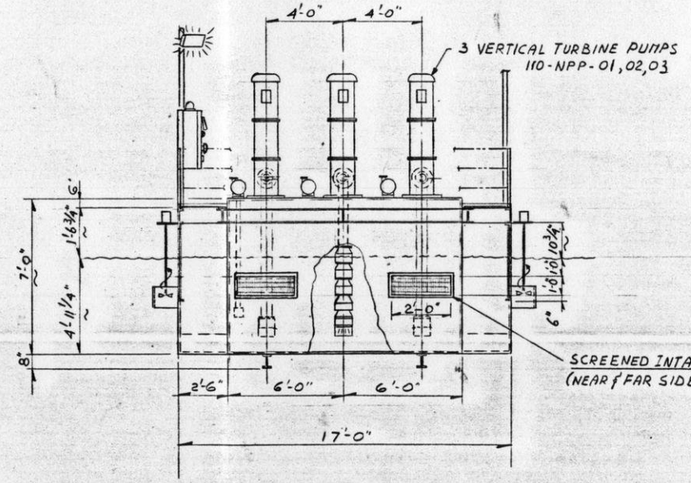
FIGURE NO. 4-8
MISC. SITE GRADING SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-014	B
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

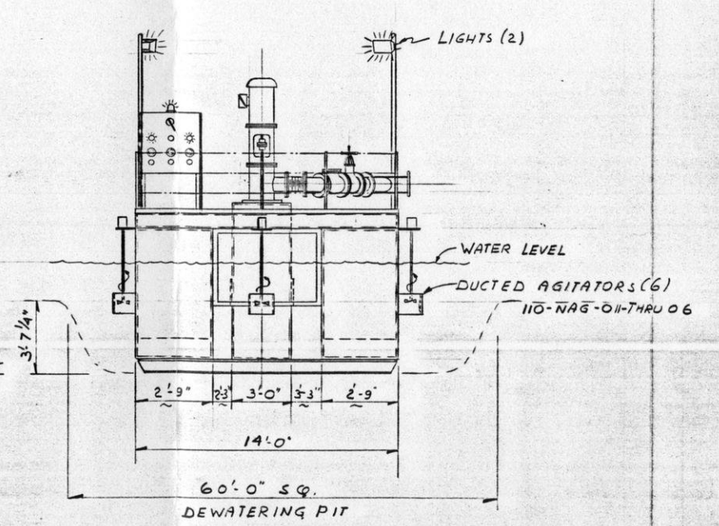
SL2428



PLAN



ELEVATION



1' 0 1' 5' 10'

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

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
PROJ. ENG'R	JHS	2-1-89
MGR PROCESS ENG'G		
ENG'R MGR		

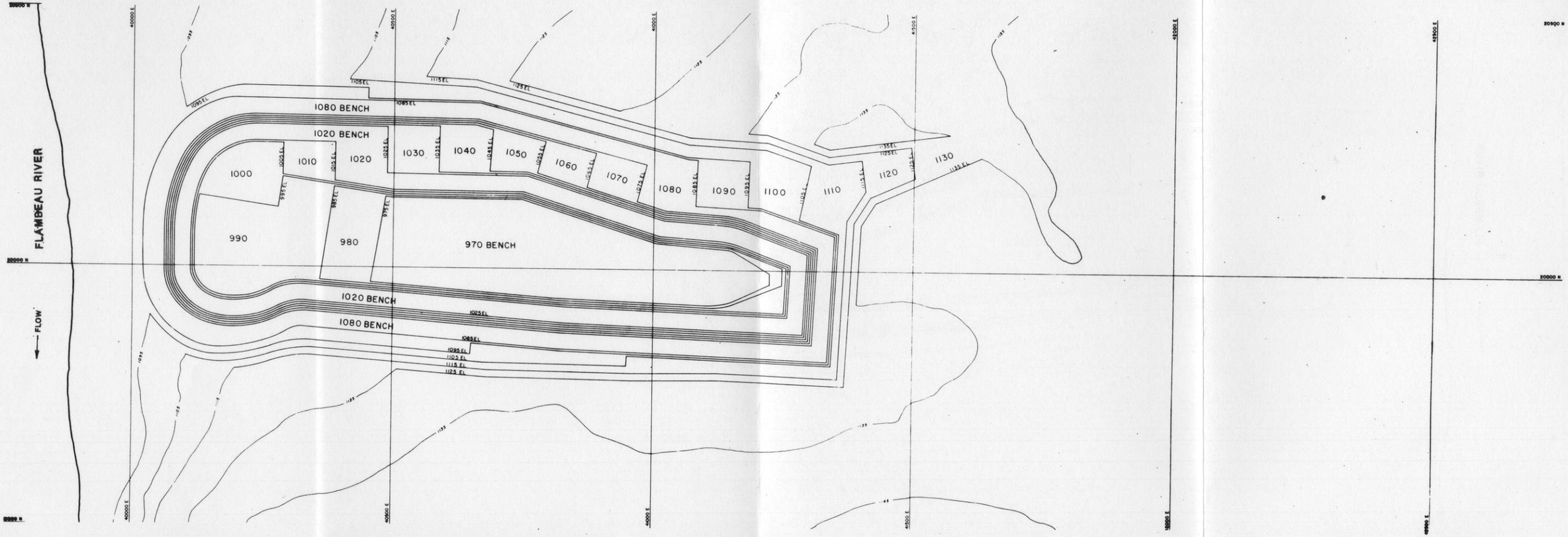
	BY	DATE
DESIGN	RJD	10/5/88
DRAWN	RJD	12/28/88
CHK'D	ZRH	2-1-89
DES. ENG'R	JHS	2-1-89
SECT ENG'R		

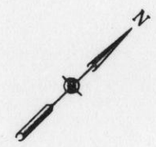
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-9
PUMP BARGE MECHANICAL DETAILS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-026	0
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	





SCALE 0 100 200 FEET

PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-10
PHASE I PIT DESIGN

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES	DWG. NO.	DESCRIPTION

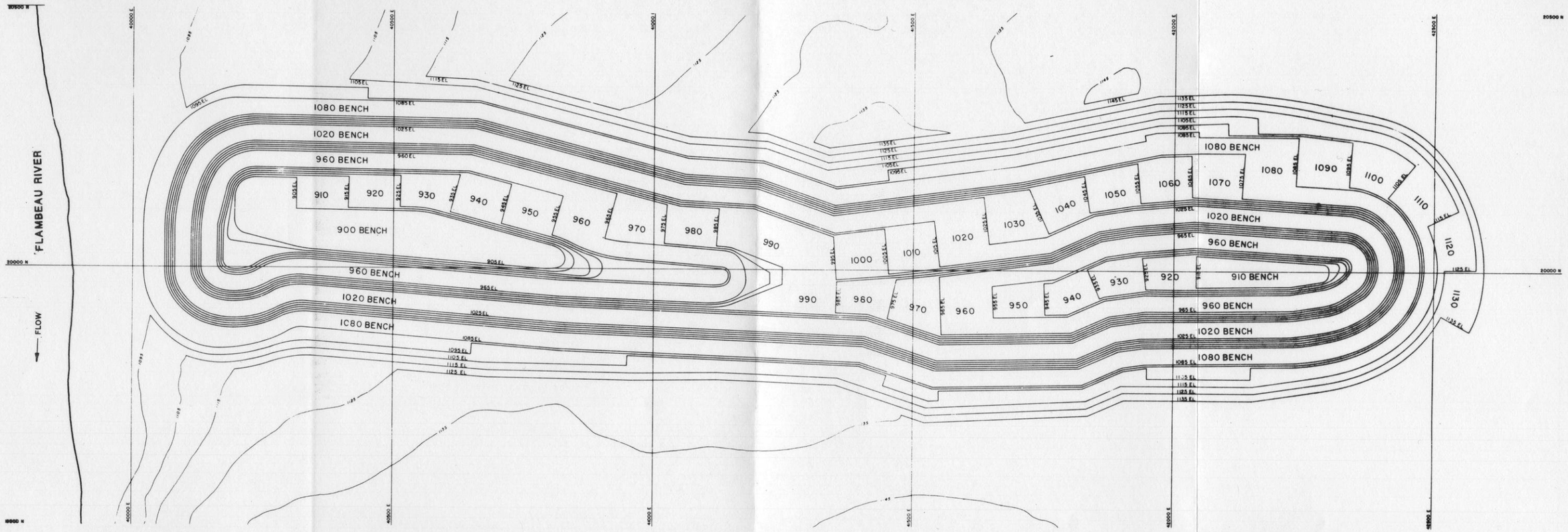
REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		



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
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT. ENG'R		

PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-11
FINAL PIT DESIGN

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	

FOR CONTINUATION SEE DWG. FM000-01-002

N

E. 40000.00

E. 40500.00

E. 41000.00

N.39500.00

TYPE II STOCKPILE
TOP OF STOCKPILE
EL. 1213.00

SHIPPING ORE STOCKPILE

CRUSHER

CONVEYOR

2.20%

EL. 1186.0'

6.80%

2.86%

FIN GRADE
EL. 1157.24'

C
FM000-01-014

F
FM000-01-010

H
FM000-01-010

FIN GRADE
EL. 1147.12'

CRUSHED STONE
PAVEMENT W/ LINER

NORTH SPUR

TOP OF RAIL EL. 1145.0'

TRACK SCALE

RAILROAD
CROSS OVER

SOUTH SPUR

F. G.
EL. 1145.5'

F. G.
EL. 1144.6'

DRAINAGE SWALE

SLOPE

RAMP

SLOPE

RUN-OFF POND
BOTTOM EL. 1129.0'
CAPACITY 643,000 GAL.

WASTE WATER
TREATMENT
TOP OF FLOOR
EL. 1147.3'

TRANSFORMER

RAMP

TRANSFORMER

SLOPE

TOP OF FLOOR
EL. 1151.0'

MAINT.

FENCED
STORAGE

F.G. EL. 1152.5'

SLOPE

SEPTIC DRAIN FIELD

F.G. EL. 1145.0'

F.G. EL. 1139.0'

TOP OF BERM EL. 1139.0'

SURGE POND
BOTTOM EL. 1124.0'
CAPACITY 1,771,500 GAL.

D
FM000-01-014

TOP OF BERM
EL. 1144.25
TYP

EL. 1141.0'
TYP

GAS TANK

FUEL OIL

REFUELING ISLAND

HAUL ROAD

TRUCK READY LINE

HOT STARTS

TRUCK READY LINE

SLOPE

TOP OF FLOOR
EL. 1153.3'

LAB

10 SPACES

PARKING
(50 HOT-STARTS)

TOP OF FLOOR
EL. 1153.3'

ADMIN.

12 SPACES

8 SPACES

8 SPACES

12 SPACES

SAFETY BERM

TOP OF BERM EL. 1139.0'

F.G. EL. 1145.0'

F.G. EL. 1135.0'

F.G. EL. 1152.5'

ACCESS ROAD

F. G.
EL. 1146.0'

F. G.
EL. 1147.5'

DRAINAGE DITCH

CRUSHED STONE PAVEMENT

ASPHALT PAVEMENT

0 50 100 150

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
1	2/23/89	GENERAL REVISIONS	PSH			

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	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		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

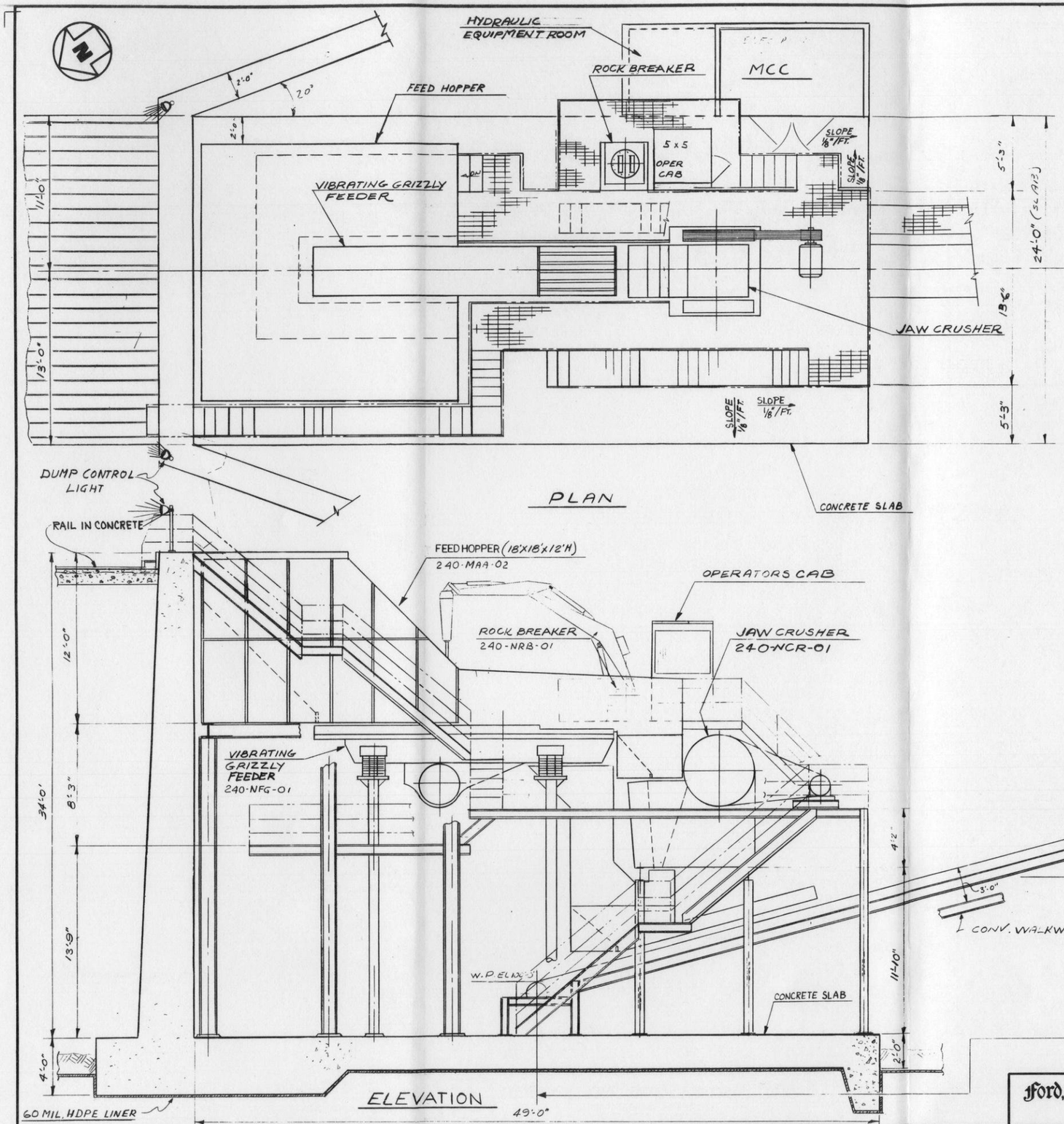
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-12
PLANT SITE GRADING
AND DRAINAGE PLAN

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-004	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

MK759K



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
PROJ. ENG'R	316	11-4-88
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	HJV	9-28-88
DRAWN	HJV	9-28-88
CHK'D	DT	10-12-88
DES. ENG'R	316	2-1-89
SECT ENG'R		

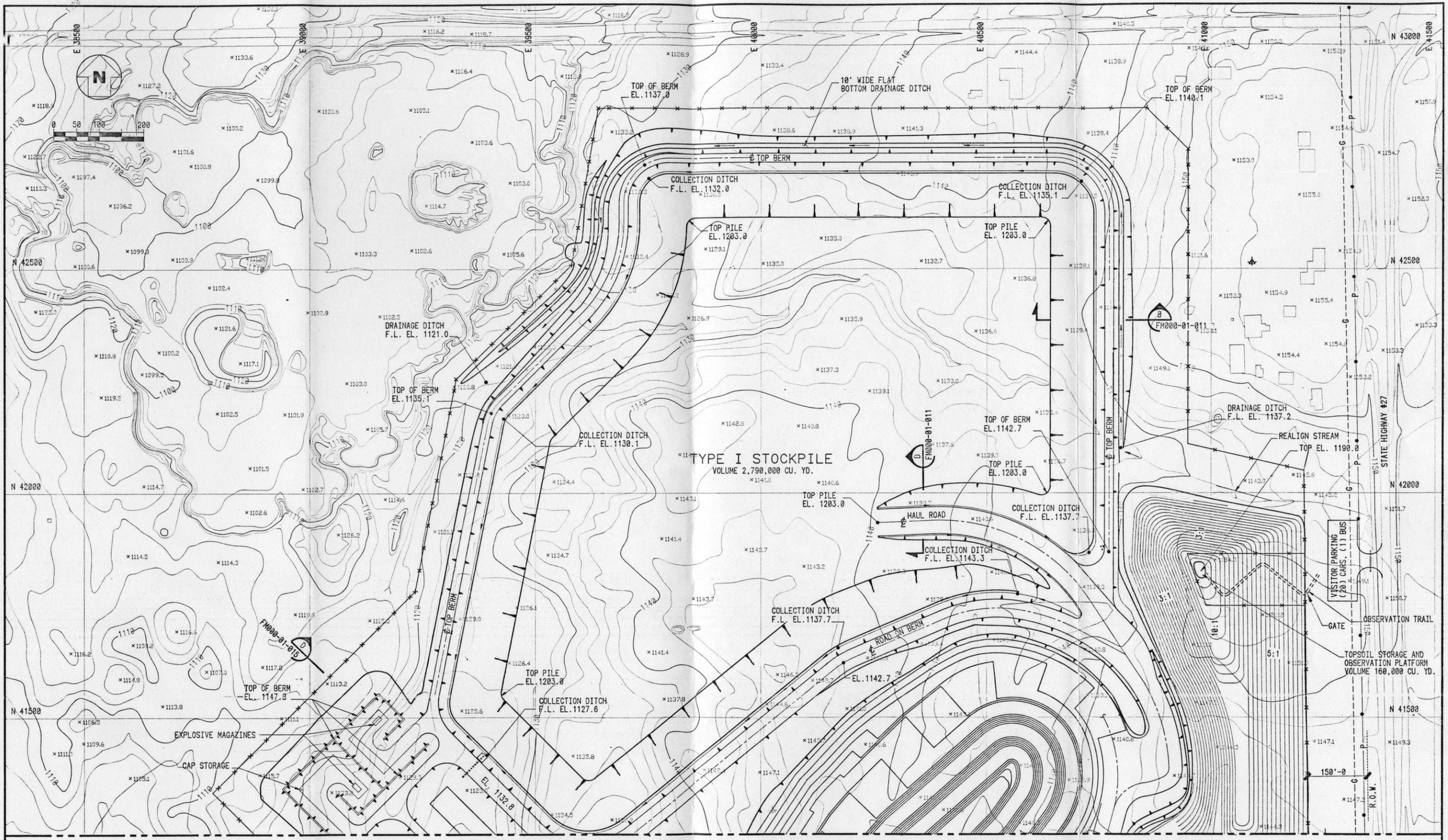
Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4.13
CRUSHING PLANT
ARRANGEMENT

MICROFILM	JOB
	M6833R
DRAWING NO.	REV.
FMC88-01-023	0
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	



FOR CONT. SEE DWG NO. FM000-01-002

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 - 14
SITE GRADING AND DRAINAGE PLAN - NORTH

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-001	2
DMSION DRAWING NO.	
OWNER OPERATED	
SCALE	

REFERENCES

DWG. NO	DESCRIPTION

REFERENCES

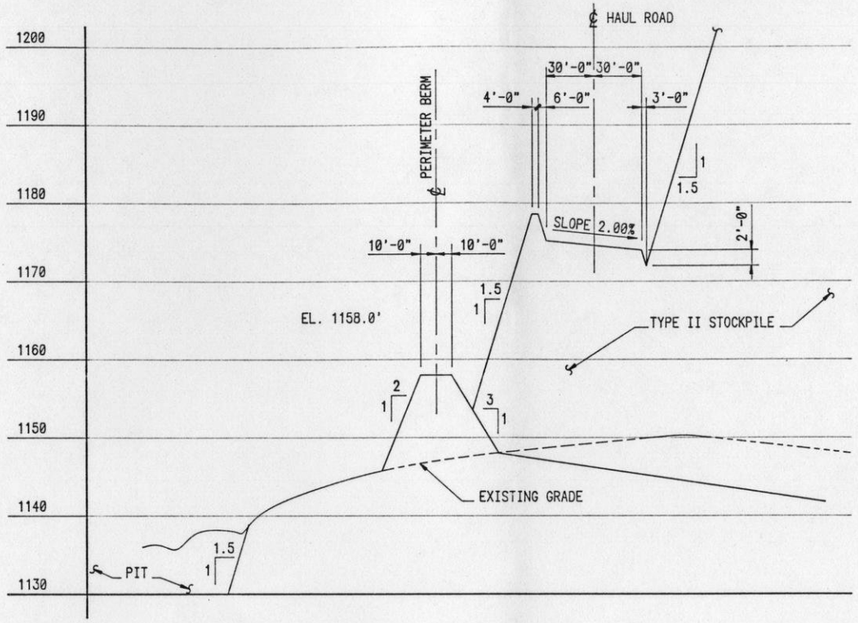
DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR
1	2/23/89	GENERAL REVISIONS	PSH			
2	3/1/89	GENERAL REVISIONS	PSH			

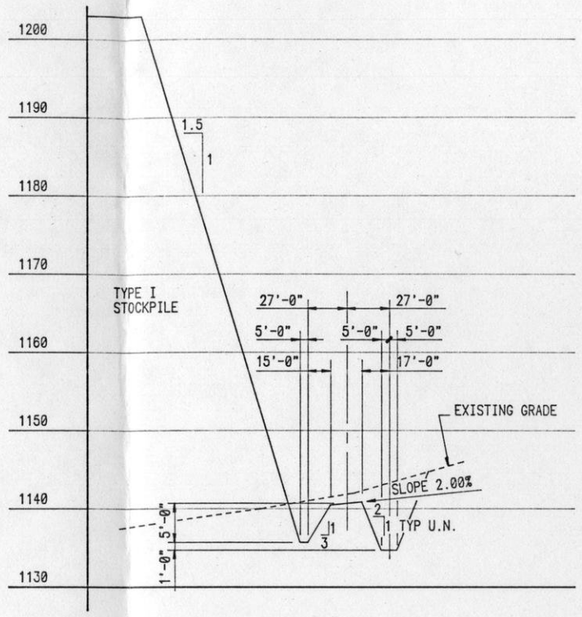
	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	CEP	10/21/88
DRAWN	CEP\WCB	10/21/88
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

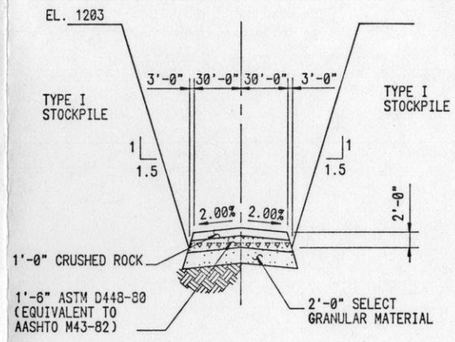
MK757K



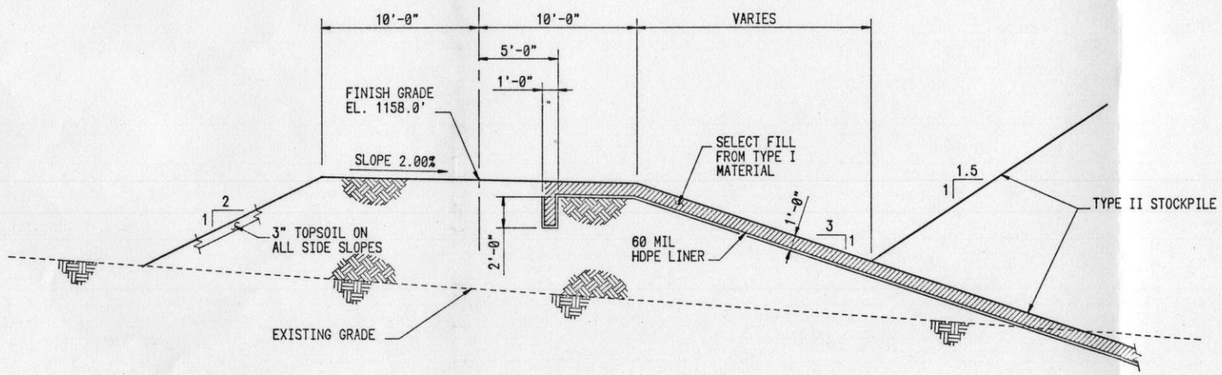
SECTION A
H. 1"=50'
V. 1"=10'
FM000-01-002



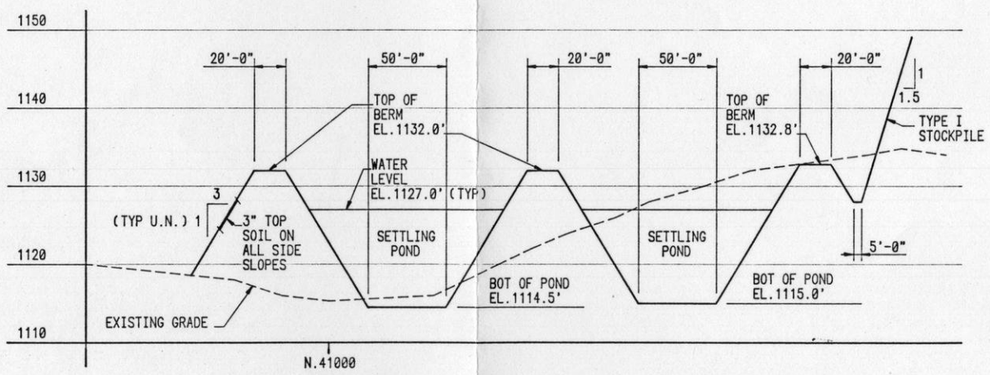
SECTION B
H. 1"=50'
V. 1"=10'
FM000-01-001



SECTION D
H. 1"=50'
V. 1"=10'
FM000-01-001



TYPICAL PERIMETER BERM TYPE II SECTION
SCALE: 1"=5'-0"



SECTION C
H. 1"=50'
V. 1"=10'
FM000-01-002

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. 4-15
STOCKPILE SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-011	B
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

	BY	DATE
DESIGN		
DRAWN	GB	11-9-88
CHK'D		
DES. ENG'R	JCH	2-1-89
SECT ENG'R		
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

REFERENCES

DWG. NO	DESCRIPTION

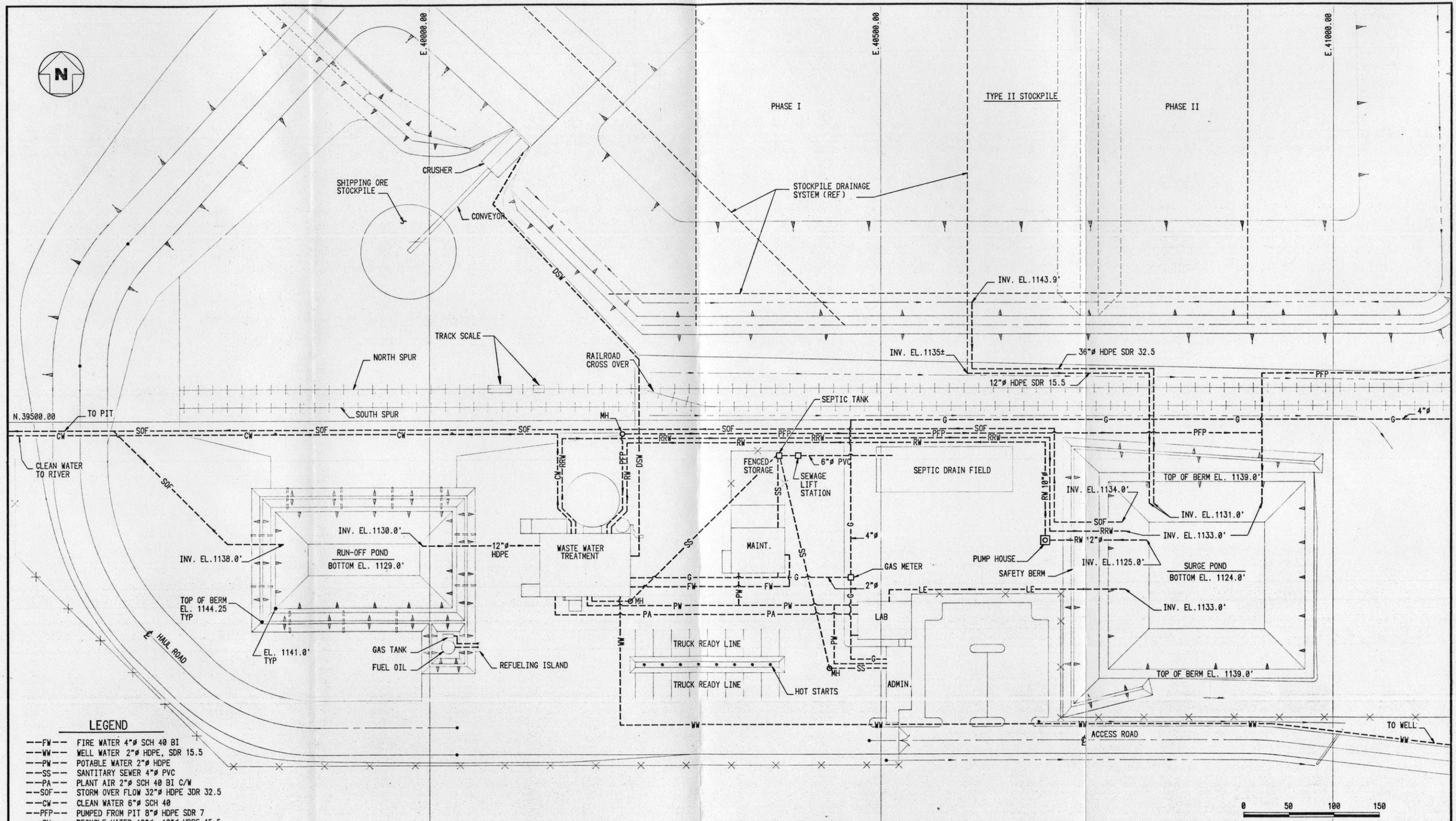
REFERENCES

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

SK932G



LEGEND

--FW--	FIRE WATER 4"ø SCH 40 BI
--WW--	WELL WATER 2"ø HDPE, SDR 15.5
--PW--	POTABLE WATER 2"ø HDPE
--SS--	SANTITARY SEWER 4"ø PVC
--PA--	PLANT AIR 2"ø SCH 40 BI C/W
--SOF--	STORM OVER FLOW 32"ø HDPE 3DR 32.5
--CW--	CLEAN WATER 6"ø SCH 40
--PFP--	PUMPED FROM PIT 8"ø HDPE SDR 7
--RW--	RECYCLE WATER 12"ø, 10"ø HDPE 15.5
--RRW--	RETURN RECYCLE WATER 6"ø SCH 40
--LE--	LAB EFFLUENT
--G--	GAS
--DSW--	DUST SUPPRESSION WATER

N.39000.00

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. 4-16
UNDERGROUND PIPING PLAN

MICROFILM | JOB: M6033R
DRAWING NO.: FM000-01-005 | REV.: 1
DIVISION DRAWING NO.: OWNER OPERATED
SCALE:

REFERENCES

DWG. NO	DESCRIPTION

REFERENCES

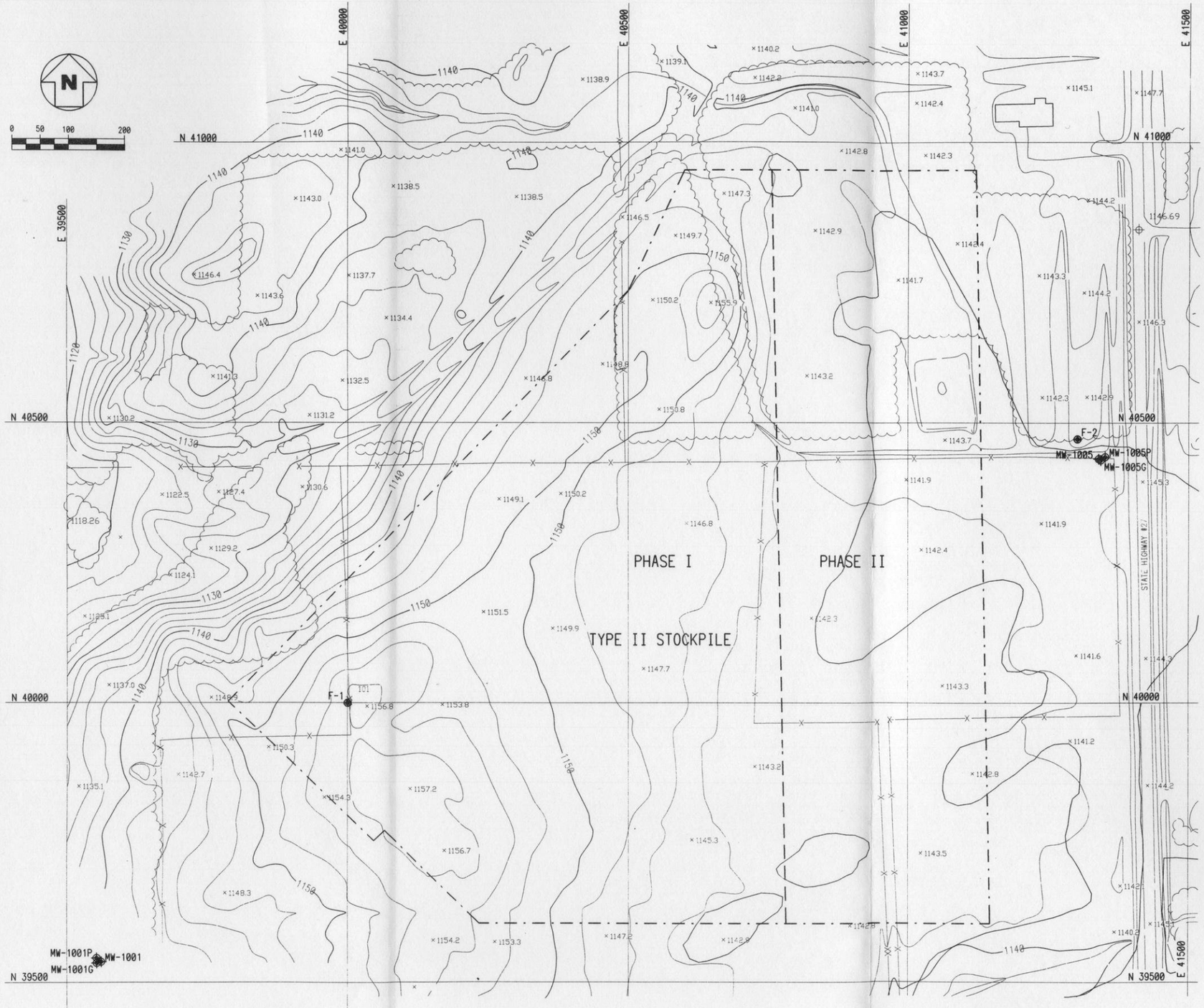
DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR
1	2/23/89	GENERAL REVISION	PSH			

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	GB	12-15-88
CHK'D		
DES. ENG'R	KTK	2/1/89
SECT ENG'R		

SL246F



SITE PREPARATION

PHASE	AREA (ACRES)	EXCAVATION CUT	(C.Y.) FILL	H.D.P.E. LINER (SQ. FT.)	GRANULAR BLANKET (C.Y.)
I	17.8	194,000	52,000	850,000	62,600 CU. YD.
II	12.2	36,000	64,000	580,000	42,700 CU. YD.
TOTAL	30.0	230,000	116,000	1,430,000	105,300 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

REFERENCES

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

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	12/27/88
CHK'D		
DES. ENG'R		
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

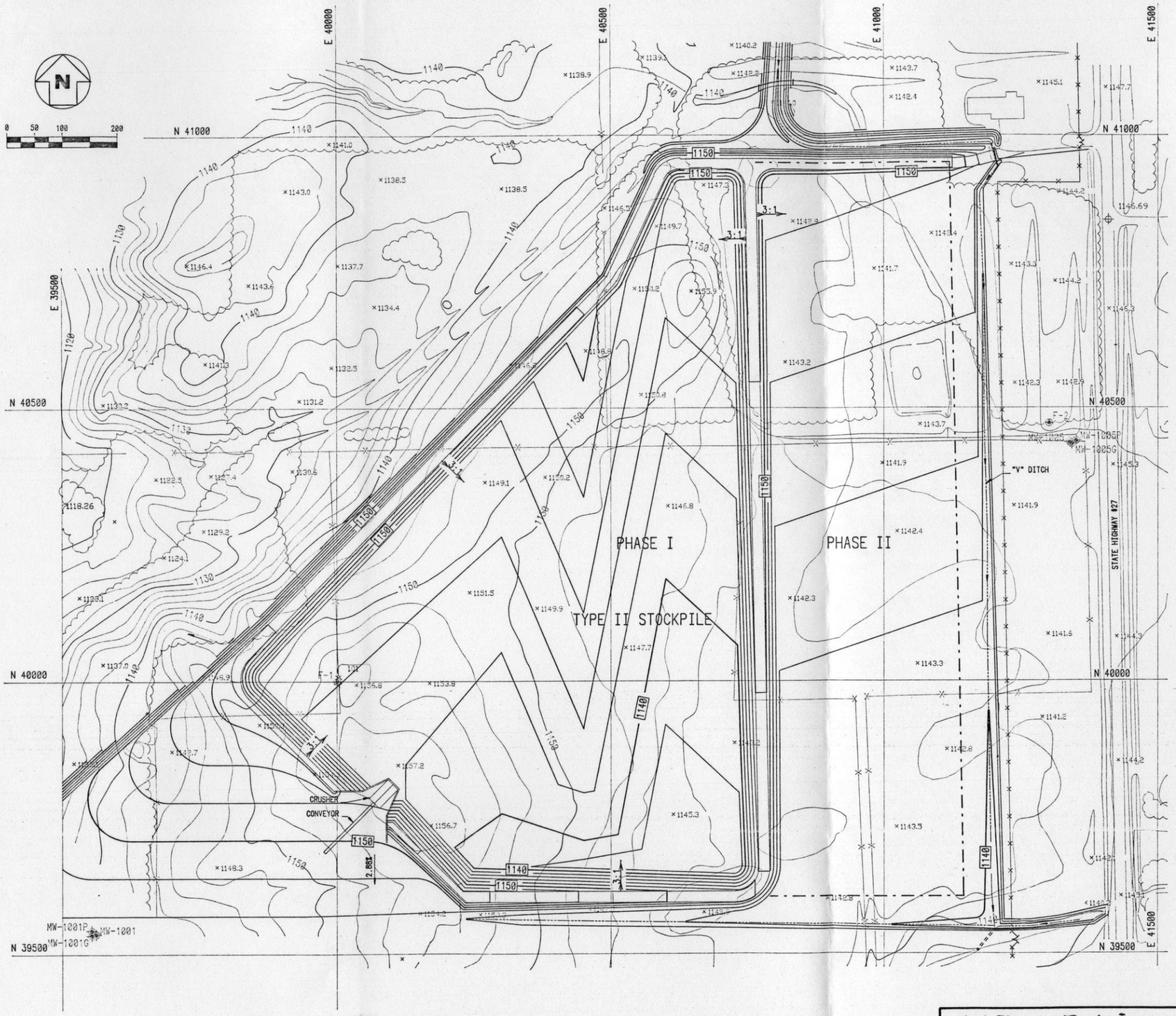
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-17
TYPE II STOCKPILE
PHASING PLAN

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-060	A
DIVISION DRAWING NO.	
SCALE	

SL263A



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

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'G		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	12/30/88
CHK'D		
DES. ENG'R		
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

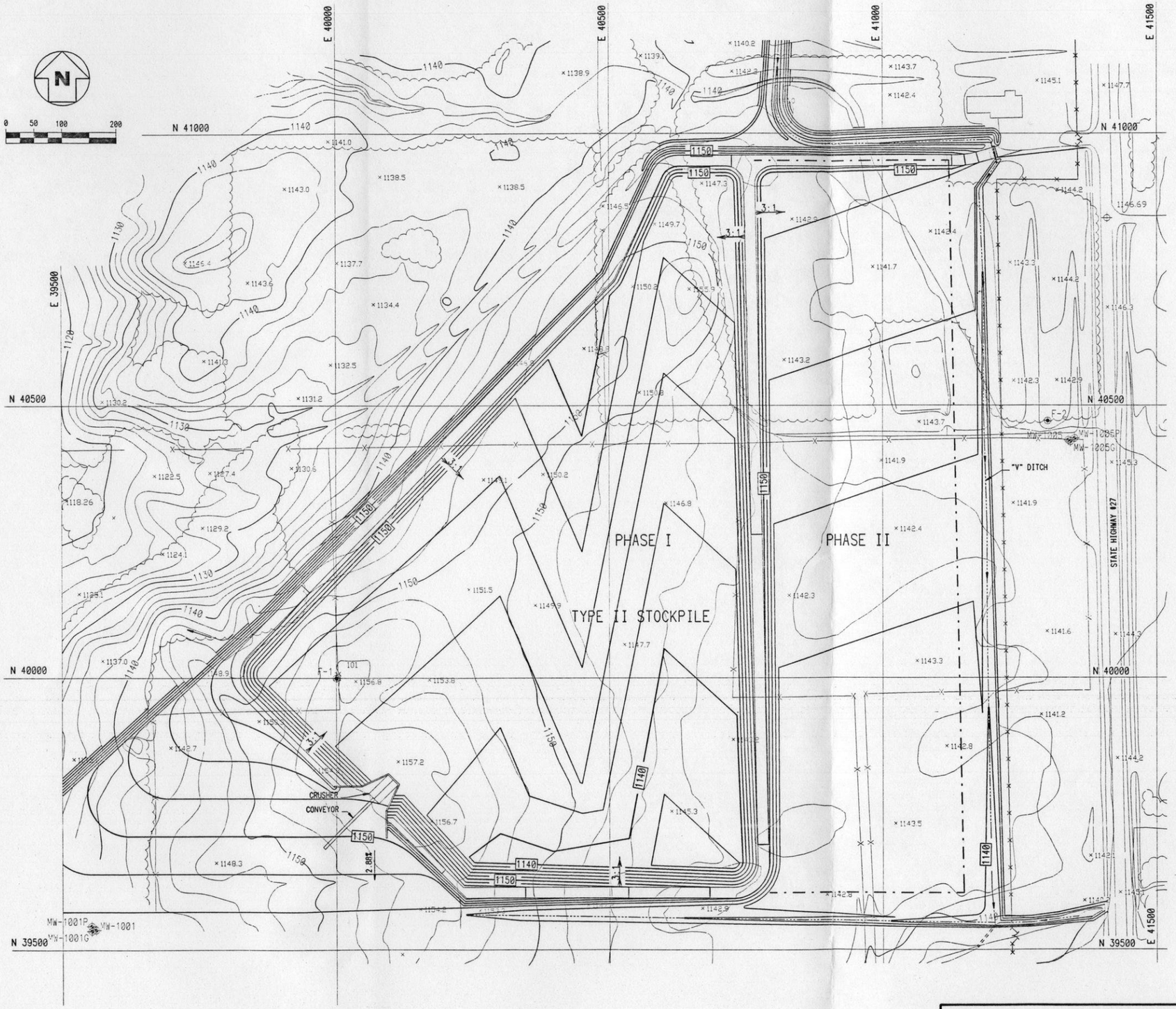
KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

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	

SL2738



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

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. 4-19
TYPE II STOCKPILE
PHASE I BASE GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM001-01-062	B
DIVISION DRAWING NO.	
SCALE	

REFERENCES	DWG. NO	DESCRIPTION

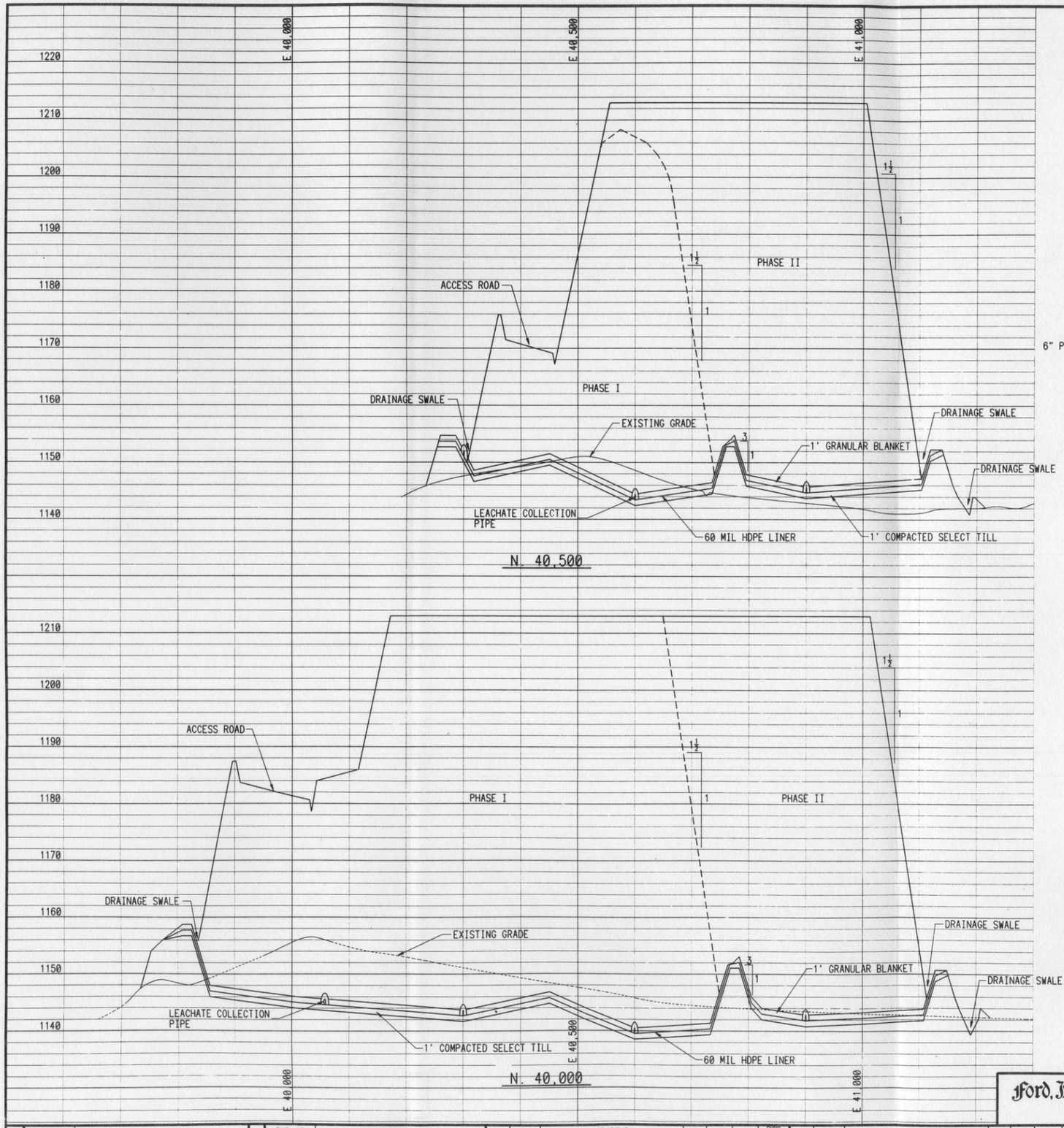
REFERENCES	DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

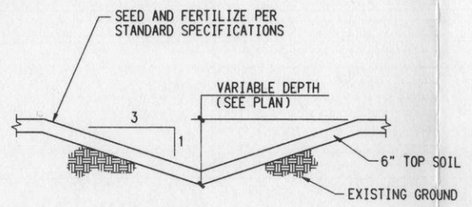
NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

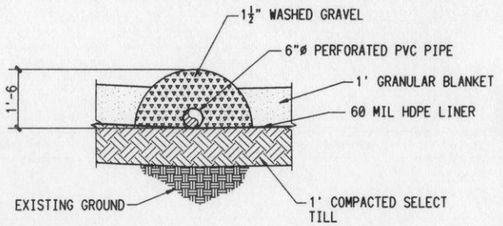
	BY	DATE
DESIGN		
DRAWN	PSH	1/14/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

SL390C

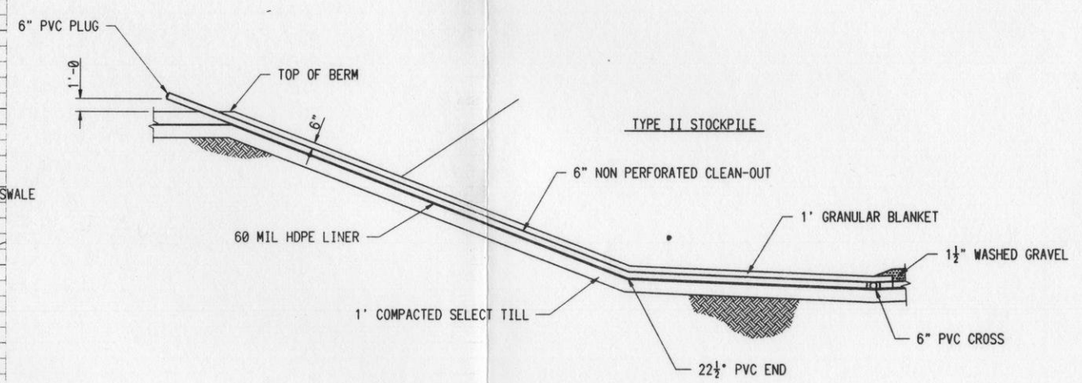




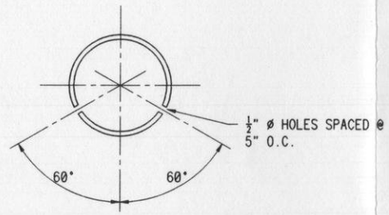
"V" DITCH DETAIL 1/069
NO SCALE



LEACHATE COLLECTION SYSTEM DETAIL 2/069
NO SCALE



TYPICAL CLEAN-OUT RISER SECTION A/063
NO SCALE



PIPE PERFORATION PATTERN 3/069
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
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	2/16/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

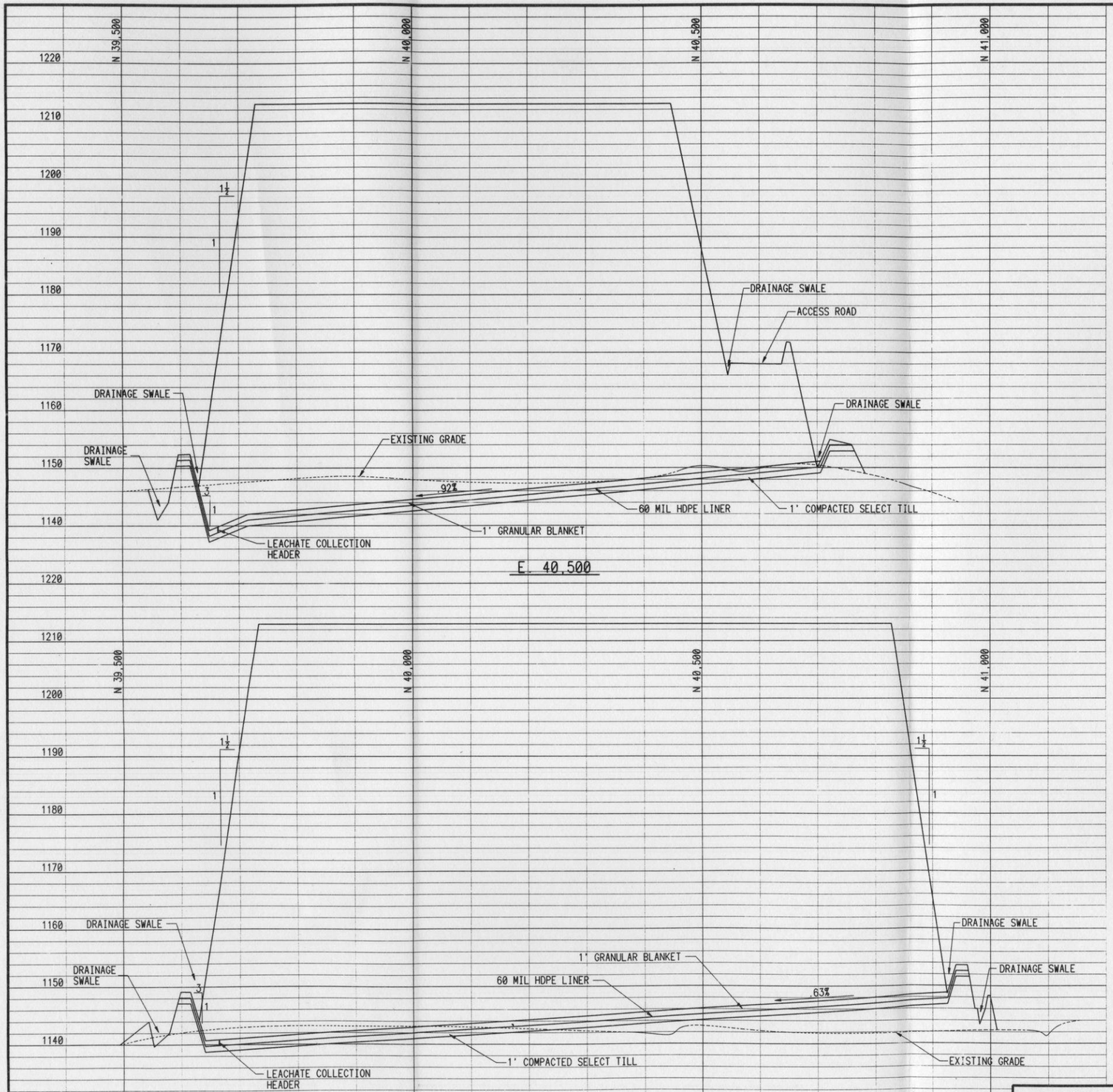
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-20
TYPE II STOCKPILE
ENGINEERING CROSS SECTIONS
AND TYPICAL DETAILS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV
FM000-01-069	A
DIVISION DRAWING NO.	
SCALE	AS NOTED

SL610A



REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION

REVISIONS	BY	DATE

REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	2/20/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

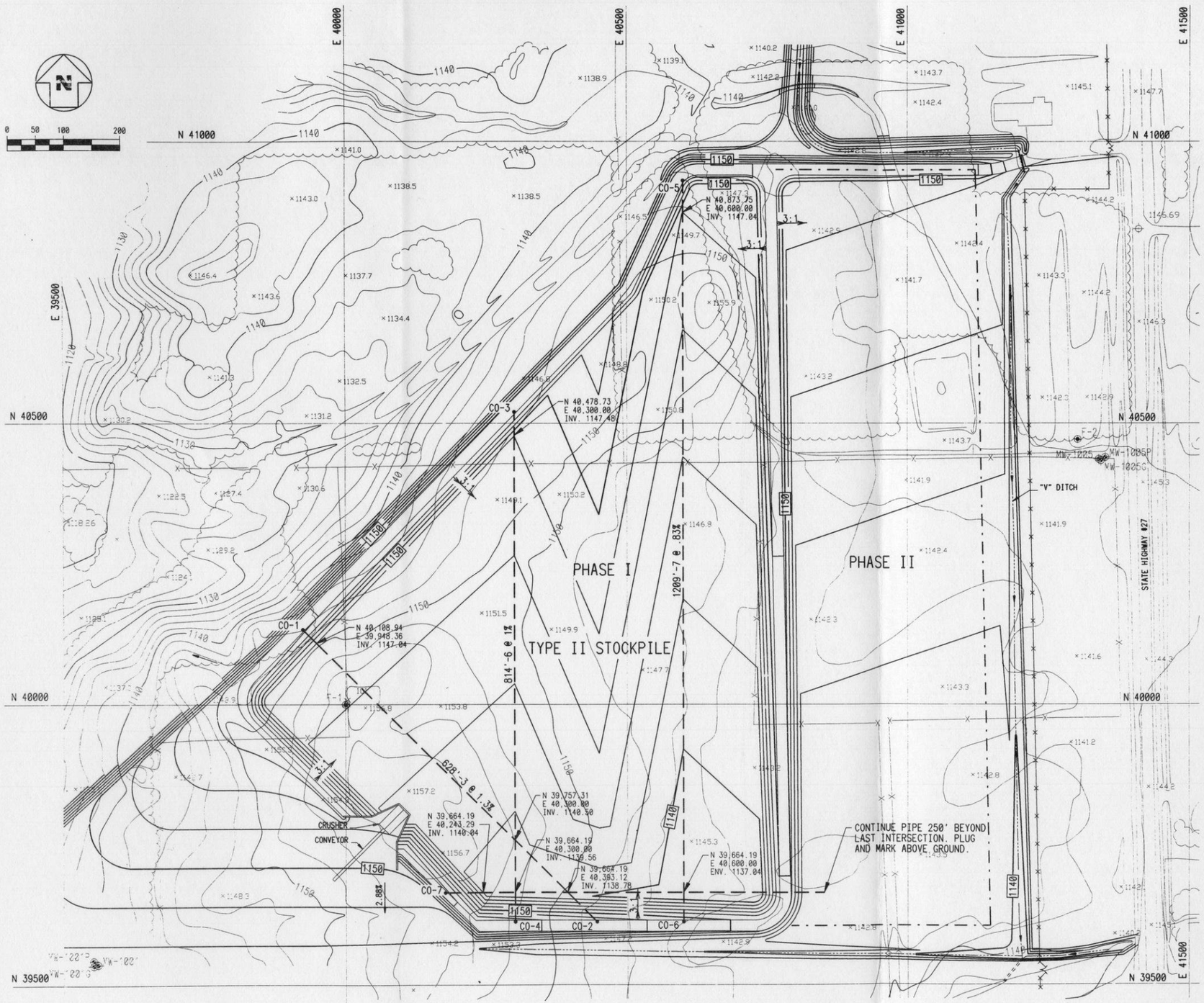
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-21
TYPE II STOCKPILE
ENGINEERING CROSS SECTIONS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-070	A
DIVISION DRAWING NO.	
SCALE	

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

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. 4-22
TYPE II STOCKPILE
PHASE I
LEACHATE COLLECTION SYSTEM

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-063	A
DIVISION DRAWING NO.	
SCALE	

	BY	DATE
DESIGN		
DRAWN	PSH	1/17/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

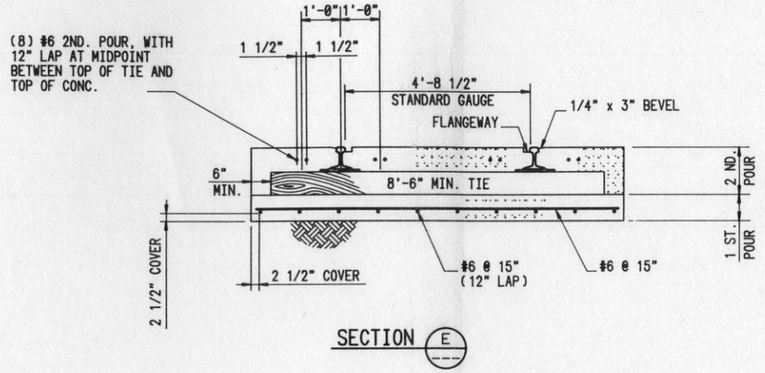
PROJ. ENG'R
MGR PROCESS ENG'R
ENG'R MGR

REFERENCES

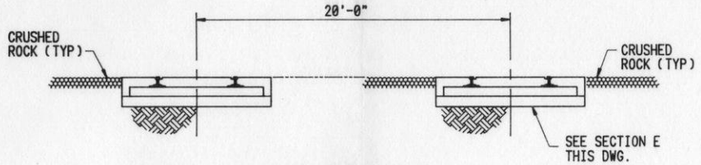
DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

SL391A

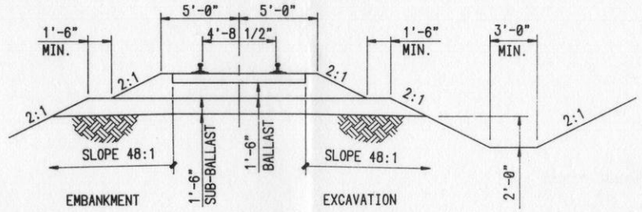


SECTION (E)



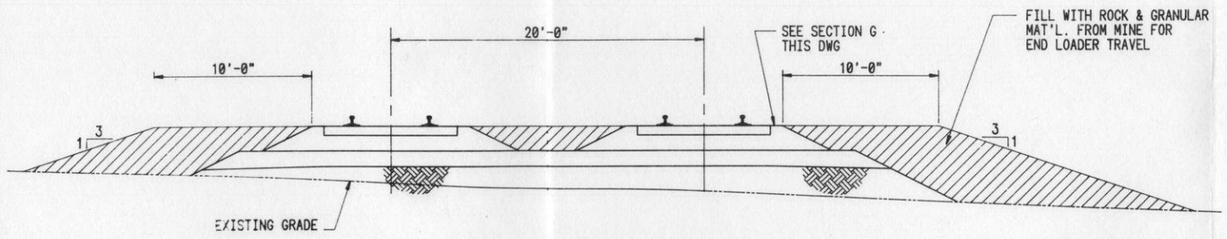
STATION 59+50 TO 65+60

SECTION (F) FM000-01-004



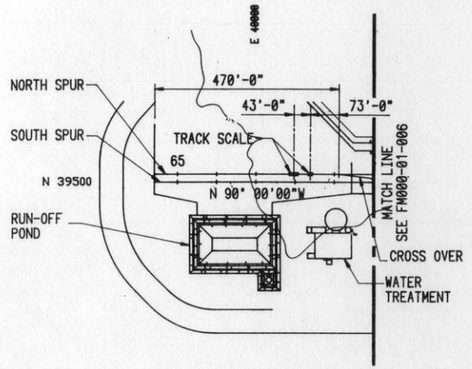
STATION 0+00 TO 50+50

SECTION (G) ---, FM000-01-003

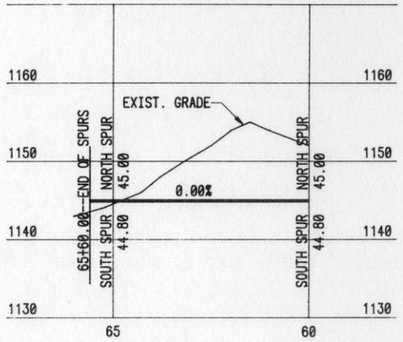


STATION 50+50 TO 59+50

SECTION (H) FM000-01-004

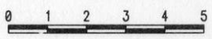


PLAN

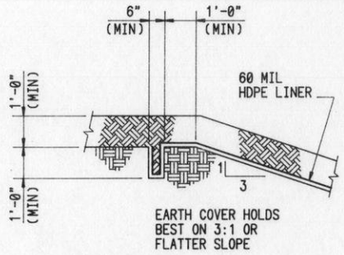


PROFILE

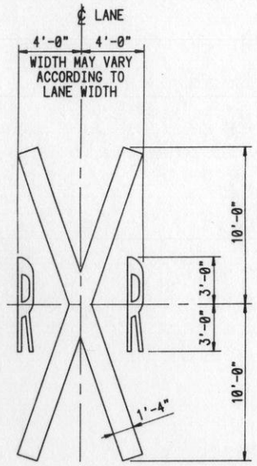
RAILROAD SPUR



SCALE
HORIZ.: 1"=200'
VER.: 1"=10'

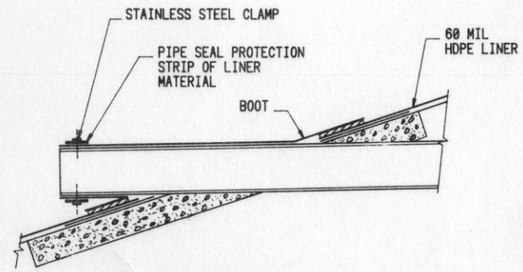


COVERED LINER



NOTE:
SEE STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION STANDARD S.D.D. 15 C 9-1 FOR ADDITIONAL INFORMATION AND LOCATION.

TYPICAL PAVEMENT MARKING DETAIL



PIPE PENTRATION SEAL

REFERENCES	DWG. NO	DESCRIPTION

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		

	BY	DATE
DESIGN		
DRAWN	GB	11-8-88
CHK'D		
DES. ENG'R	KTK	2-3-89
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

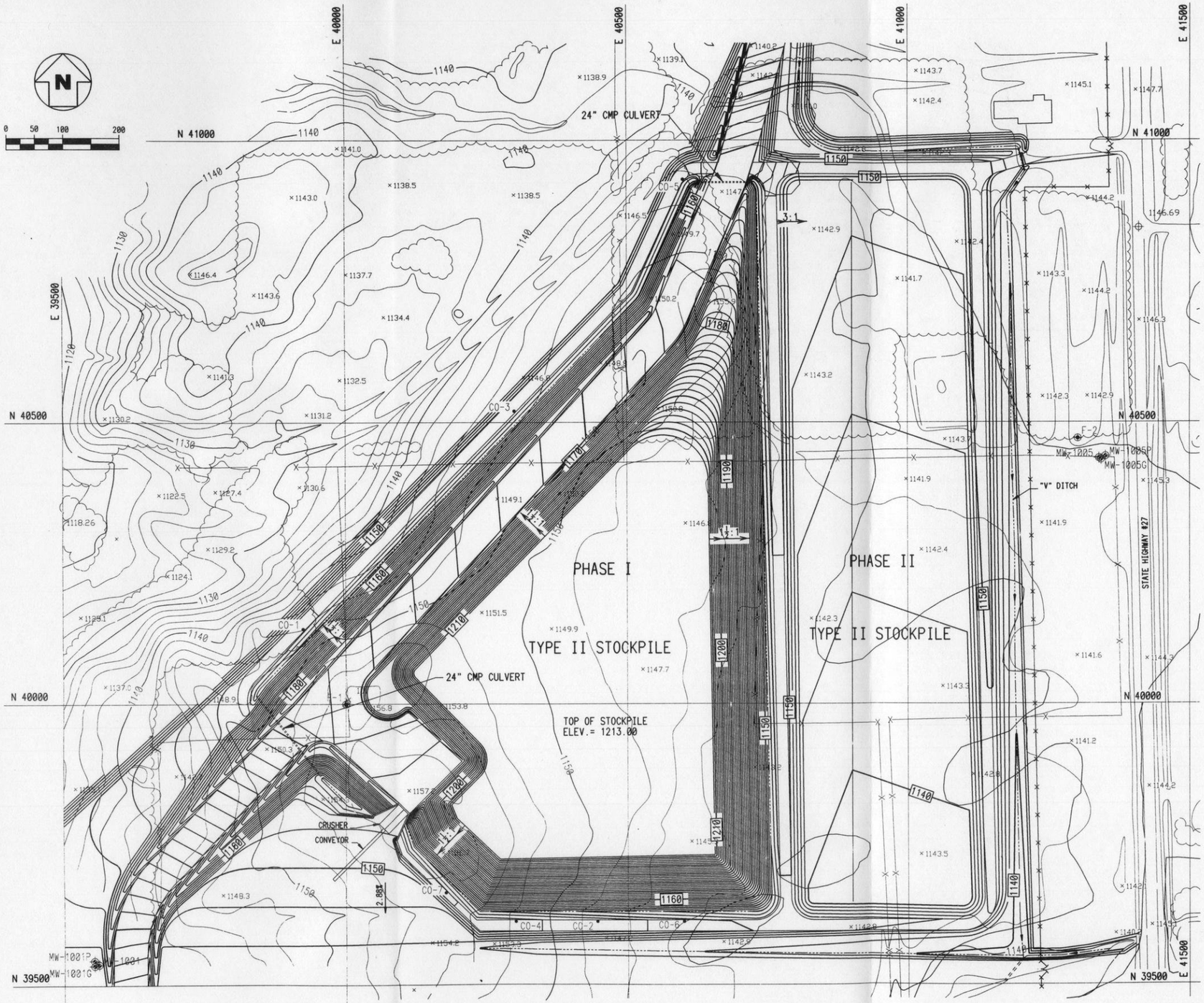
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-23
SITE GRADING
RAILROAD SECTIONS AND DETAILS

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-010	E
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NOTED

SK923F



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

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-24
TYPE II STOCKPILE
PHASE I FINAL GRADES AND
PHASE II SUB-BASE GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-065	A
DIVISION DRAWING NO.	
SCALE	

REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION	BY	DATE

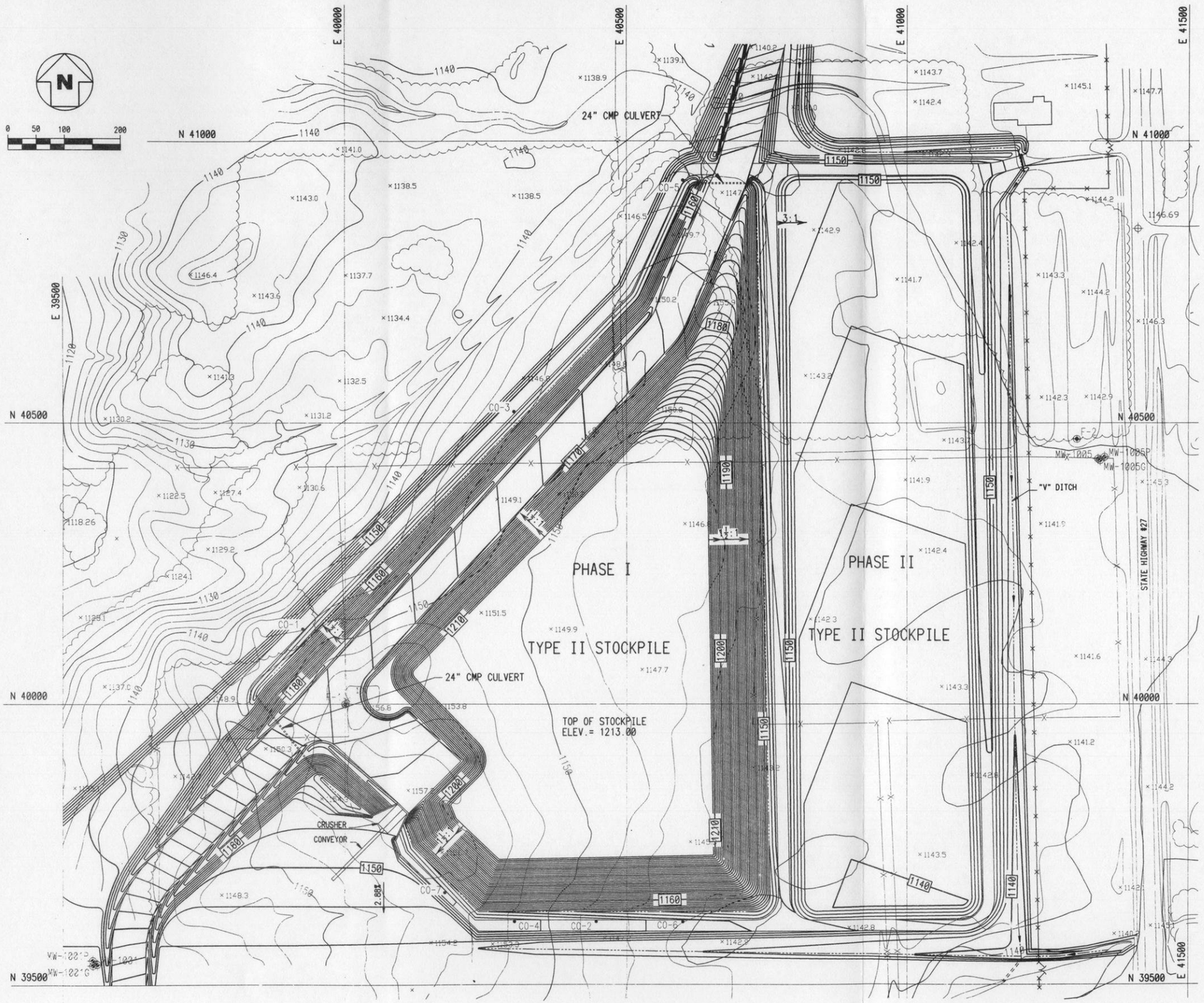
REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR

NO	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	2/09/89
CH'K'D		
DES. ENG'R		
SECT ENG'R		

SL549A



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

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. 4-25
TYPE II STOCKPILE
PHASE I FINAL GRADES AND
PHASE II BASE GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-066	A
DIVISION DRAWING NO.	
SCALE	

REFERENCES

DWG. NO	DESCRIPTION

REFERENCES

DWG. NO	DESCRIPTION

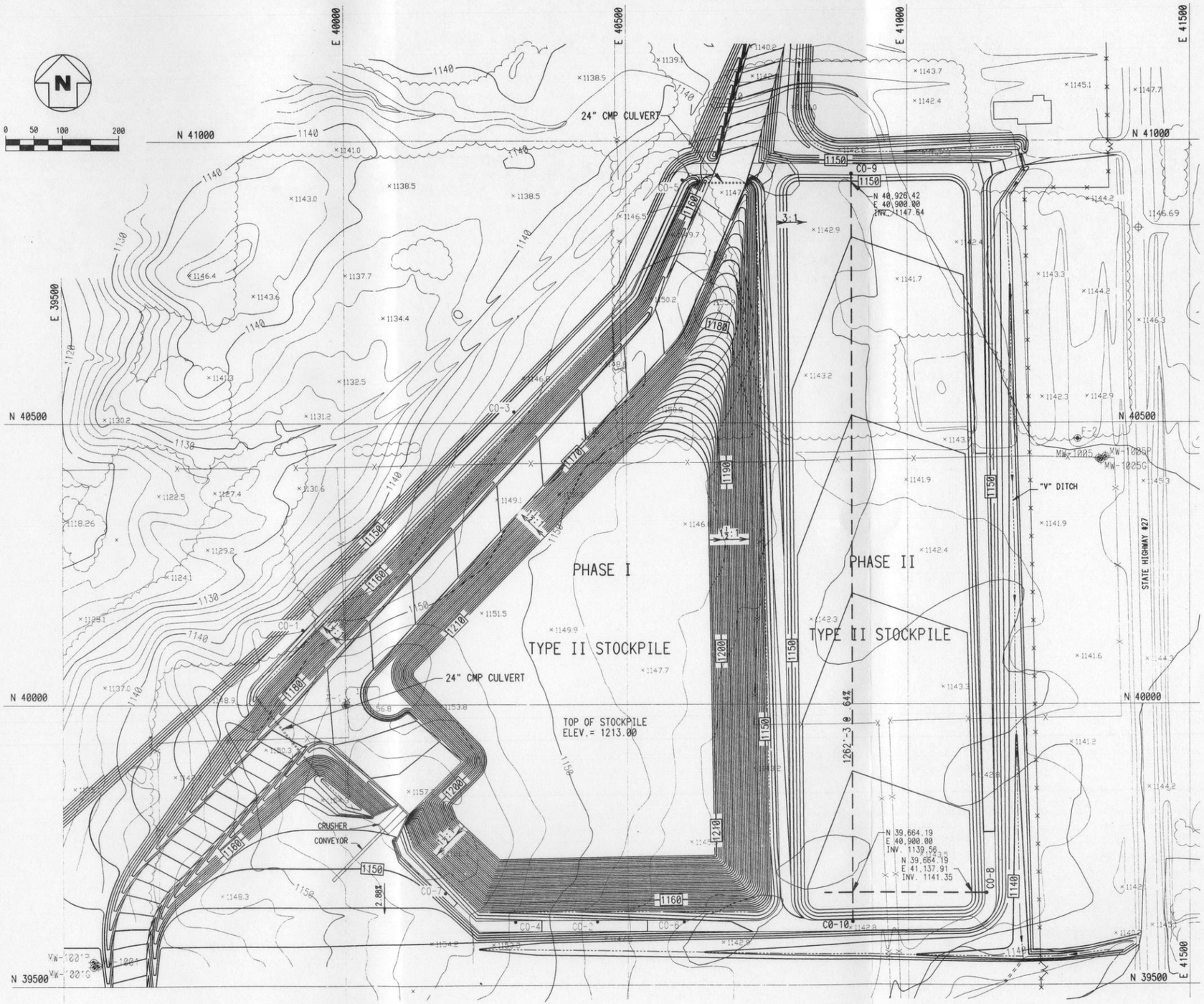
NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	2/13/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

SL558A



CLEANOUT LOCATION SCHEDULE			
CLEANOUT	LOCATION		SURFACE ELEVATION
	NORTH	EAST	
C0-8	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
- —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

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-26
TYPE II STOCKPILE
PHASE I FINAL GRADES AND
PHASE II LEACHATE COLLECTION SYSTEM

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-067	A
DIVISION DRAWING NO.	
SCALE	

REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION

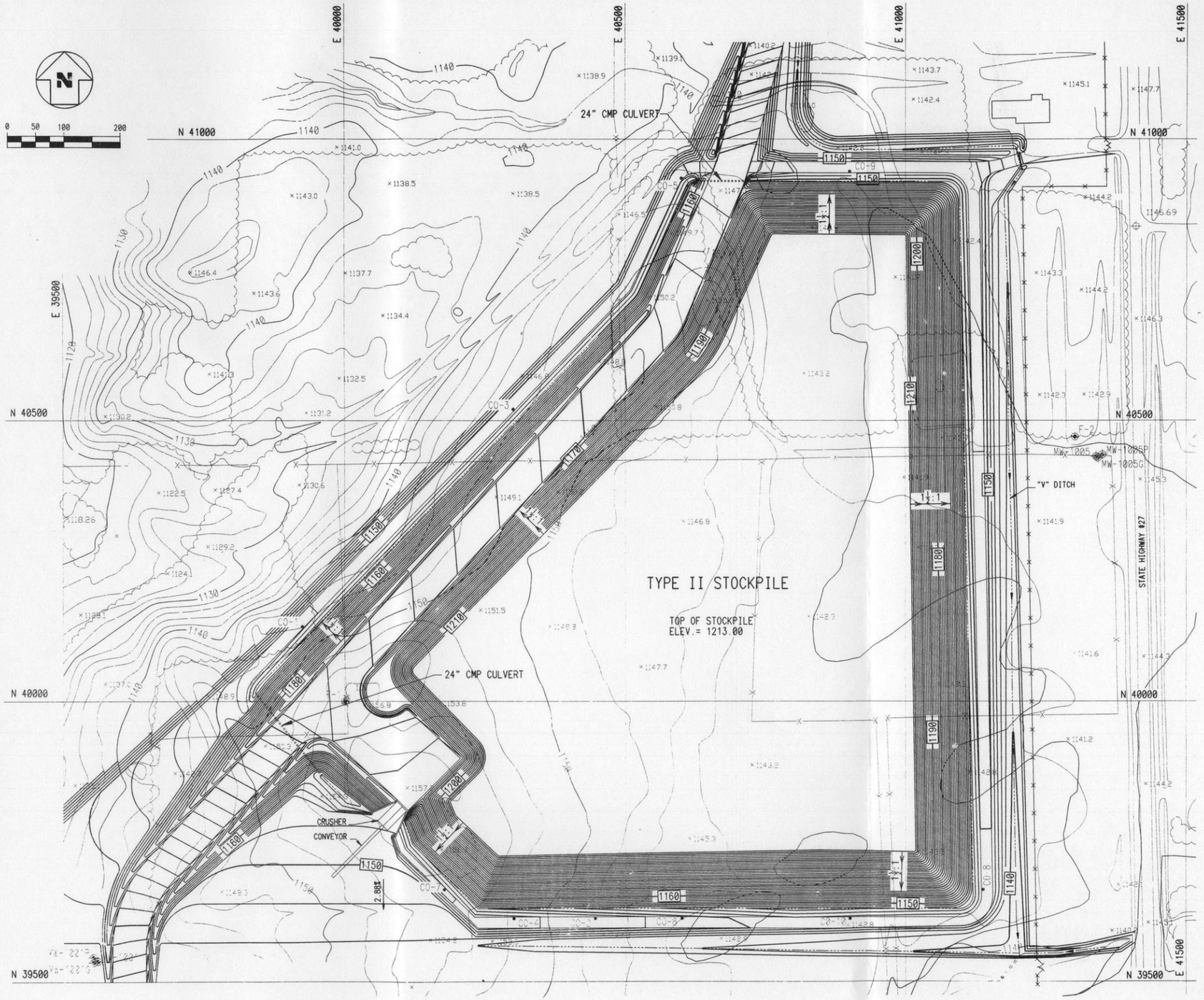
NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	2/14/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

SL564A



LEGEND:

- 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

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. 4-27
TYPE II STOCKPILE
FINAL GRADES

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-068	A
DIVISION DRAWING NO.	
SCALE	

REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION

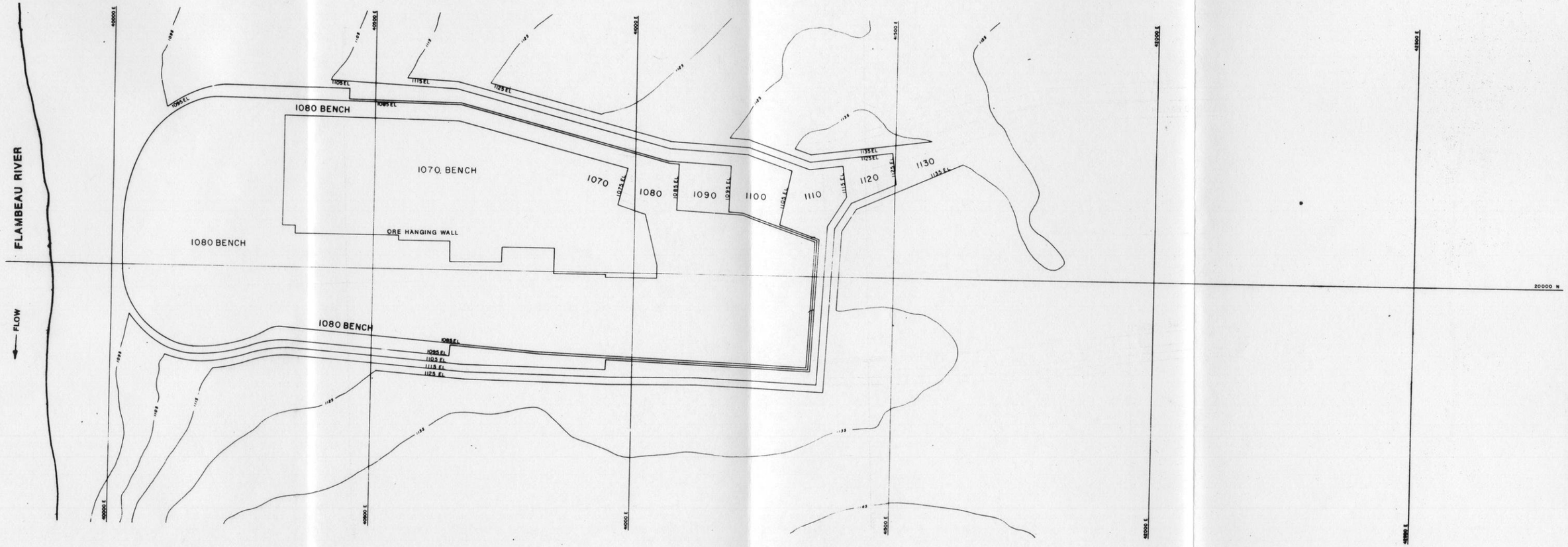
NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	PSH	2/15/89
CHK'D		
DES. ENG'R		
SECT ENG'R		

SL593A



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
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN		
CHK'D		
DES. ENG'R		
SECT. ENG'R		

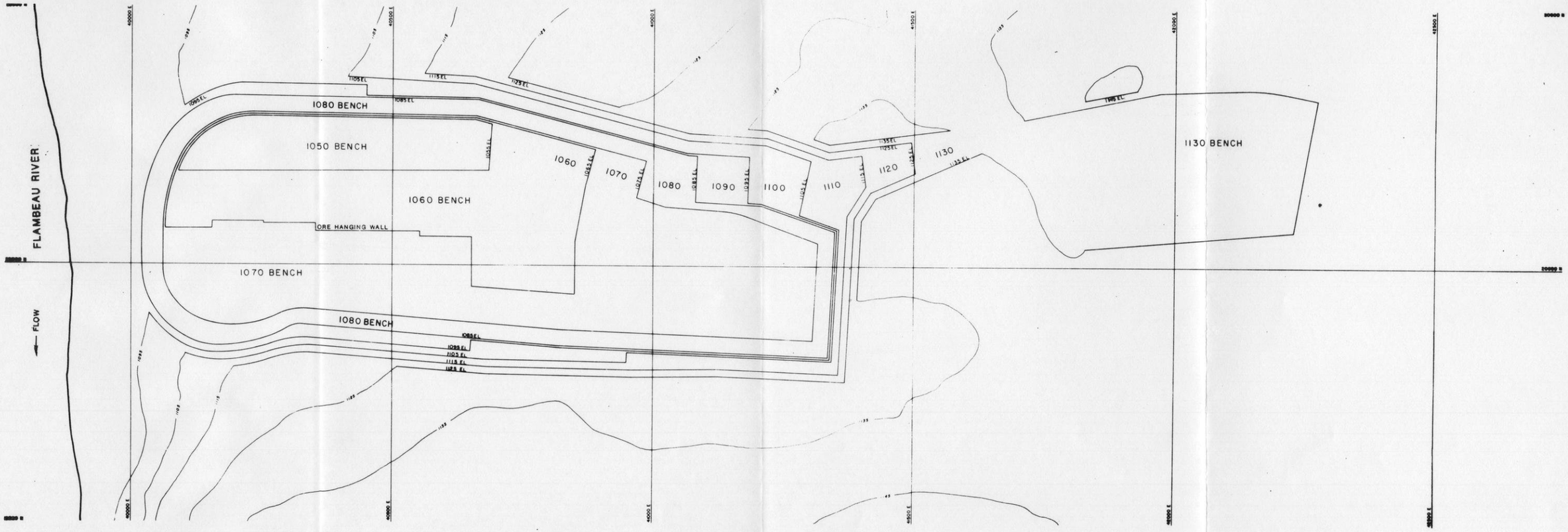
PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

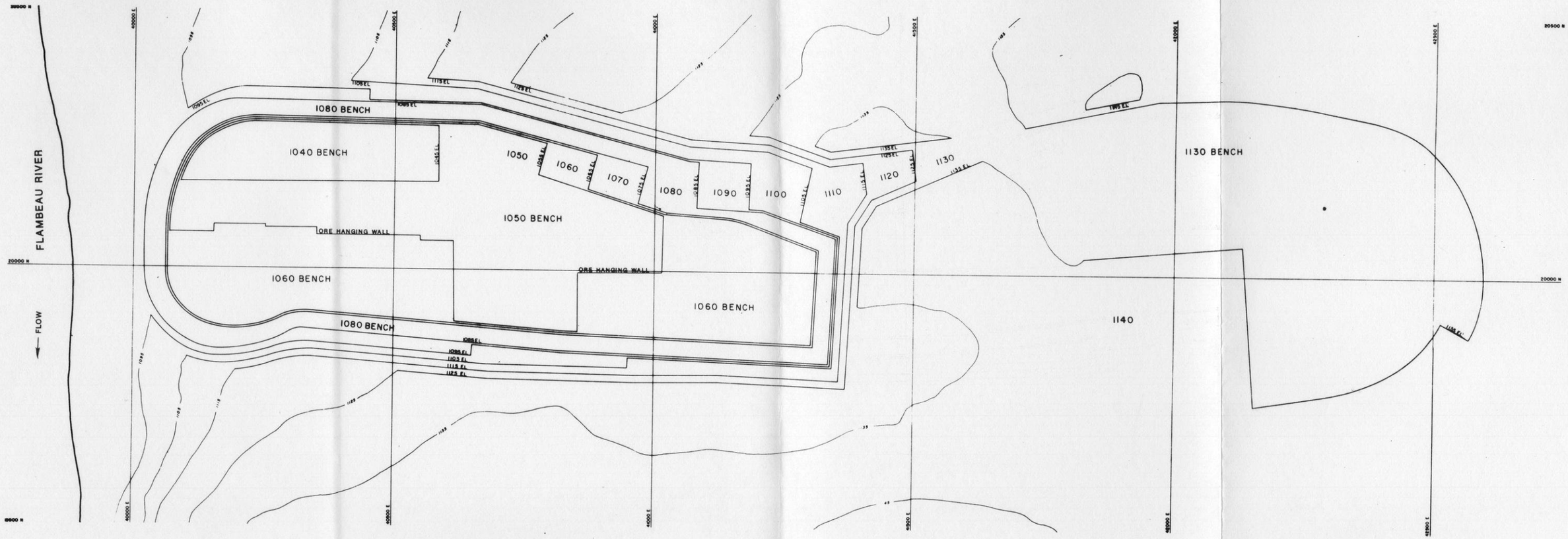
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-28
END OF PREPRODUCTION

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	


FLAMBEAU RIVER
FLOW
1080 BENCH
1050 BENCH
1060 BENCH
ORE HANGING WALL
1070 BENCH
1080 BENCH
1060
1070
1080
1090
1100
1110
1120
1130
1130 BENCH
45000 E
45500 E
46000 E
46500 E
47000 E
47500 E
48000 E
48500 E
49000 E
49500 E
50000 E
50500 E
51000 E
51500 E
52000 E
52500 E
53000 E
53500 E
54000 E
54500 E



N

SCALE 0 100 200 FEET

PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-30
END OF 2ND QUARTER
YEAR 1

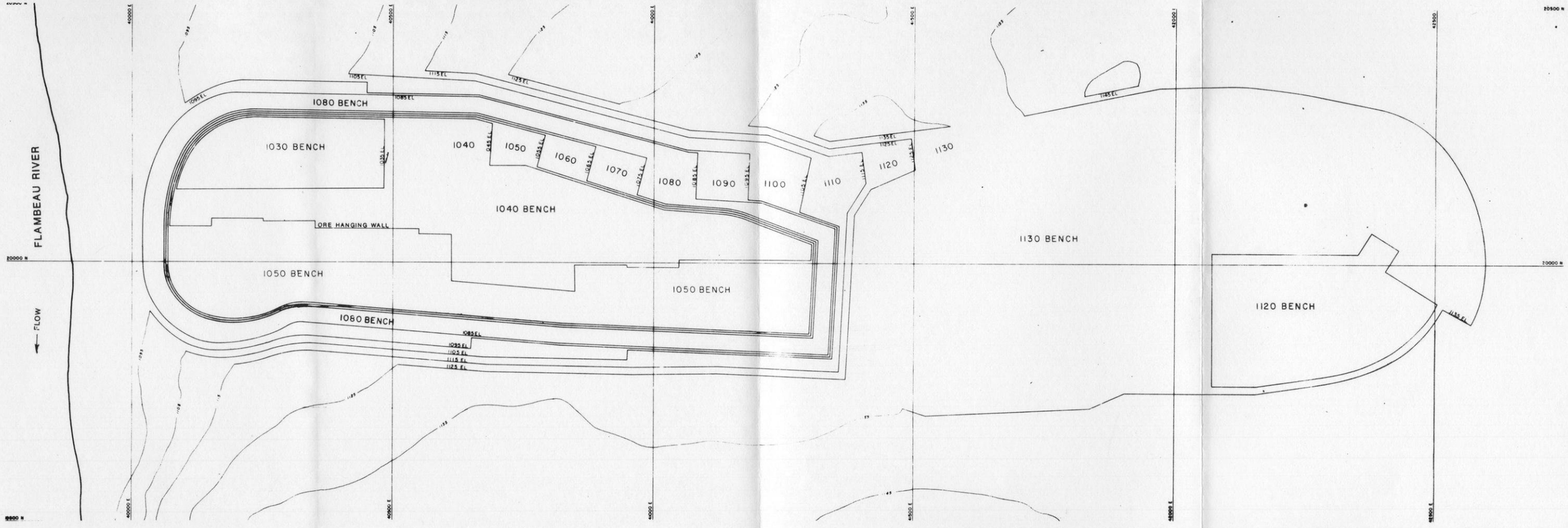
	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENGR		
SECT ENGR		

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES

DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENGR	ENGR MGR.



SCALE 0 100 200 FEET

N

PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-31
END OF 3RD QUARTER
YEAR 1

	BY	DATE
PROJ. ENGR		
MGR. PROCESS ENG'G		
ENGR MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S	3/89
CHK'D	M.J.O.	3/89
DFS. ENGR		
SECT ENGR		

MICROFILM JOB
DRAWING NO. REV.
DIVISION DRAWING NO.
SCALE

REFERENCES

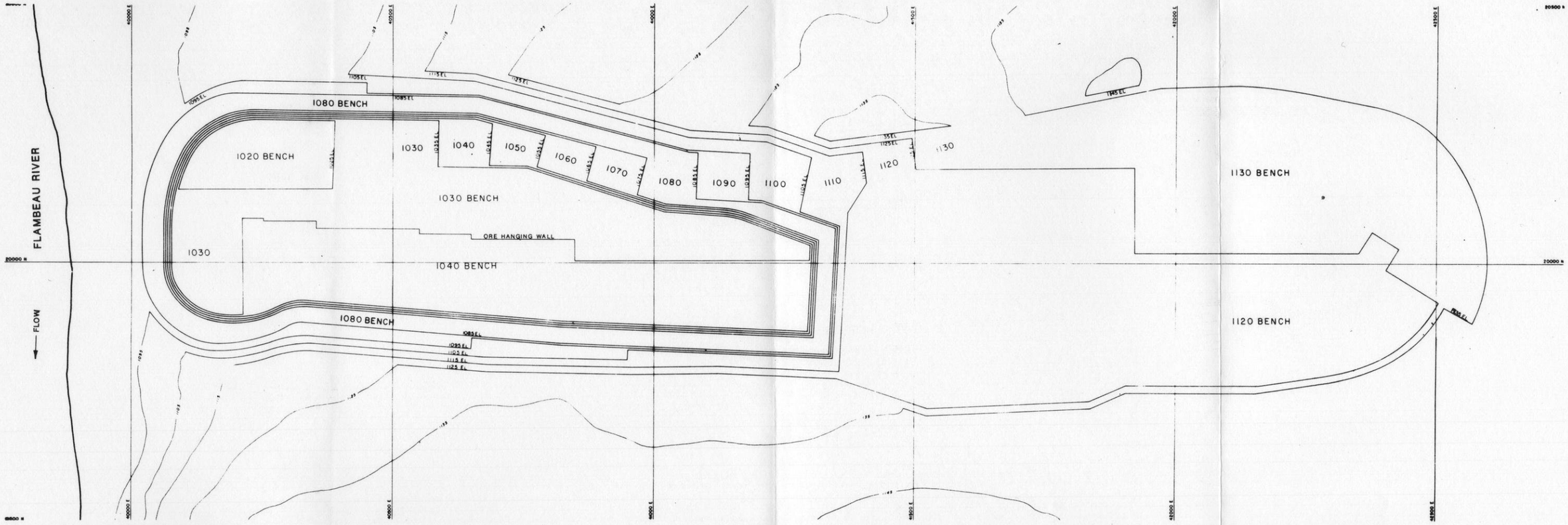
DWG. NO.	DESCRIPTION

REFERENCES

DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENGR MGR.

NO	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENGR 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.

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	D.H.S	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

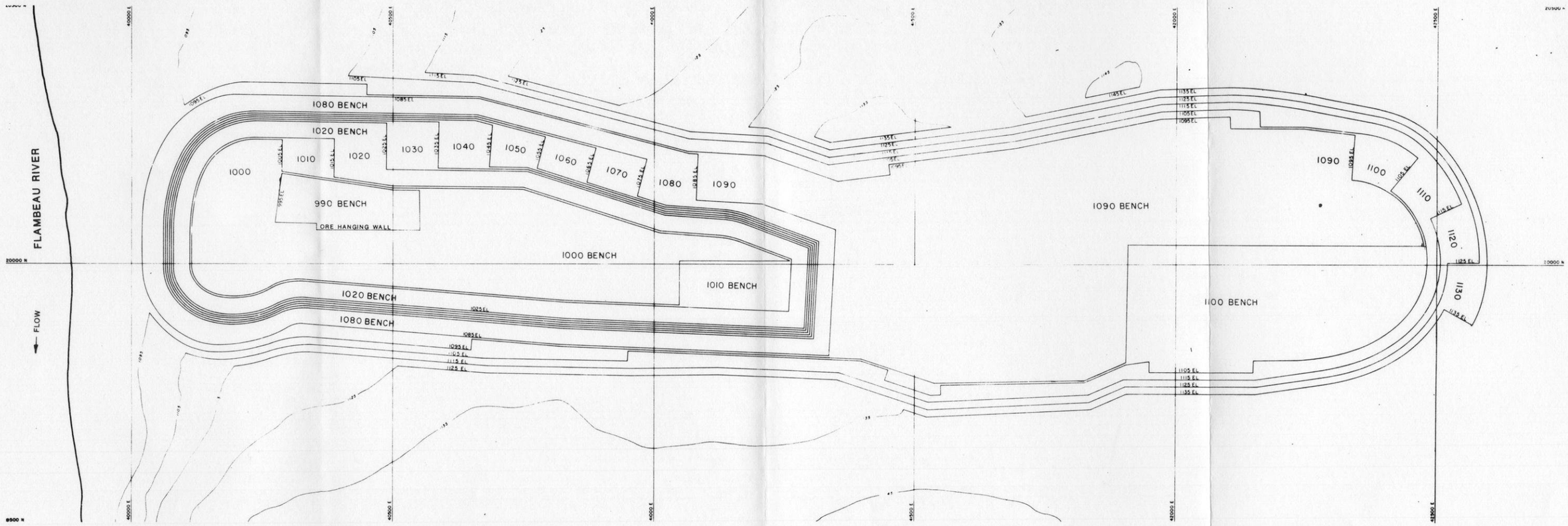
PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4-32
END OF YEAR 1

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
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT. ENG'R		

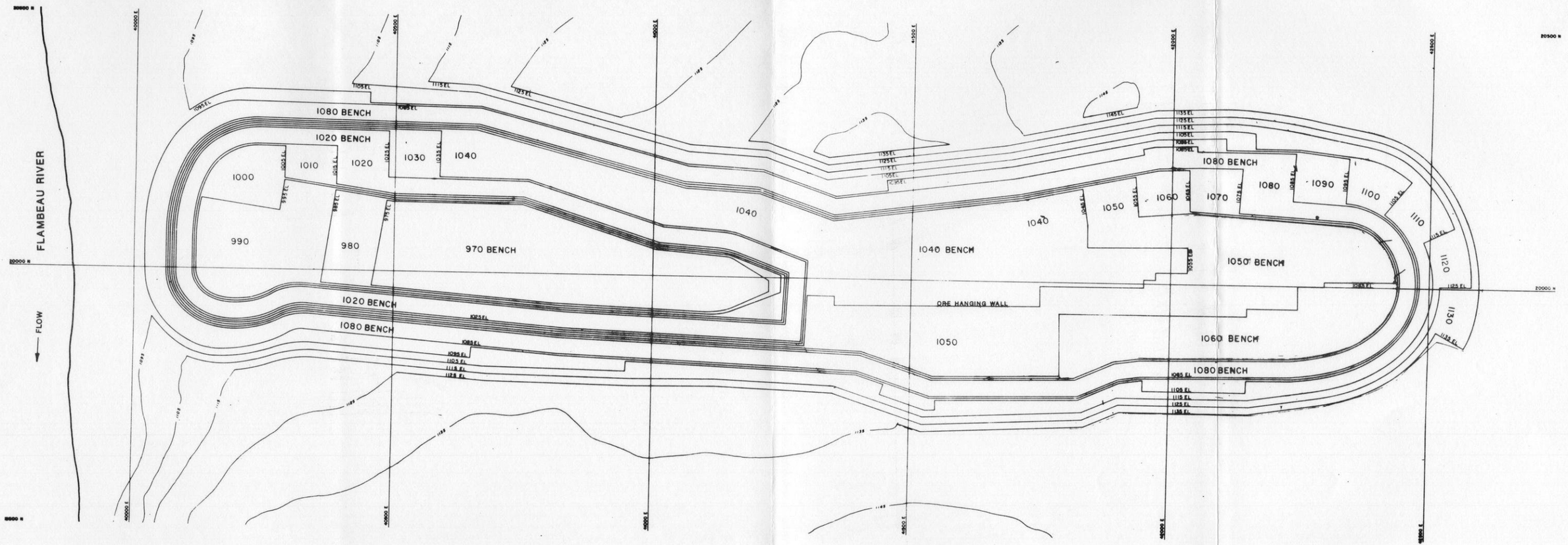
PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-33
END OF YEAR 2

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	PROJ. MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	PROJ. MGR.

	BY	DATE
PROJ. ENG'R		
MGR. PROJECTS ENG'G		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
DES. ENG'R		
SECT. ENG'R		

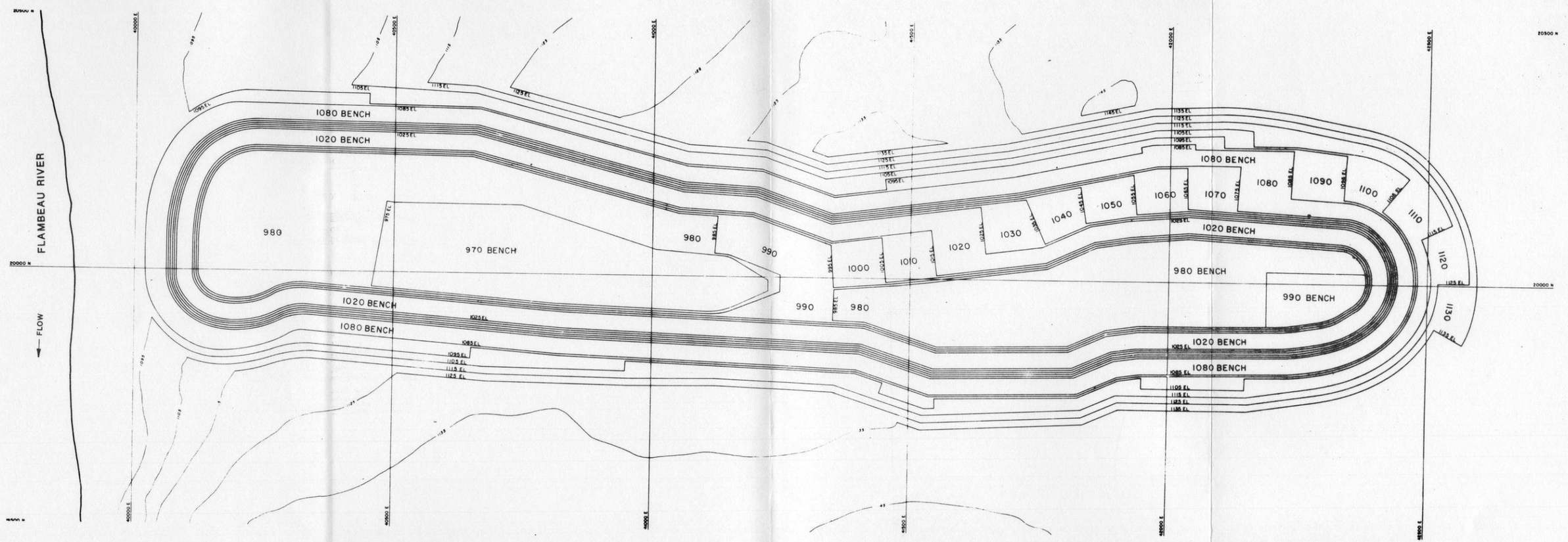
PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-34
END OF YEAR 3

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	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. 4-35
END OF YEAR 4

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES

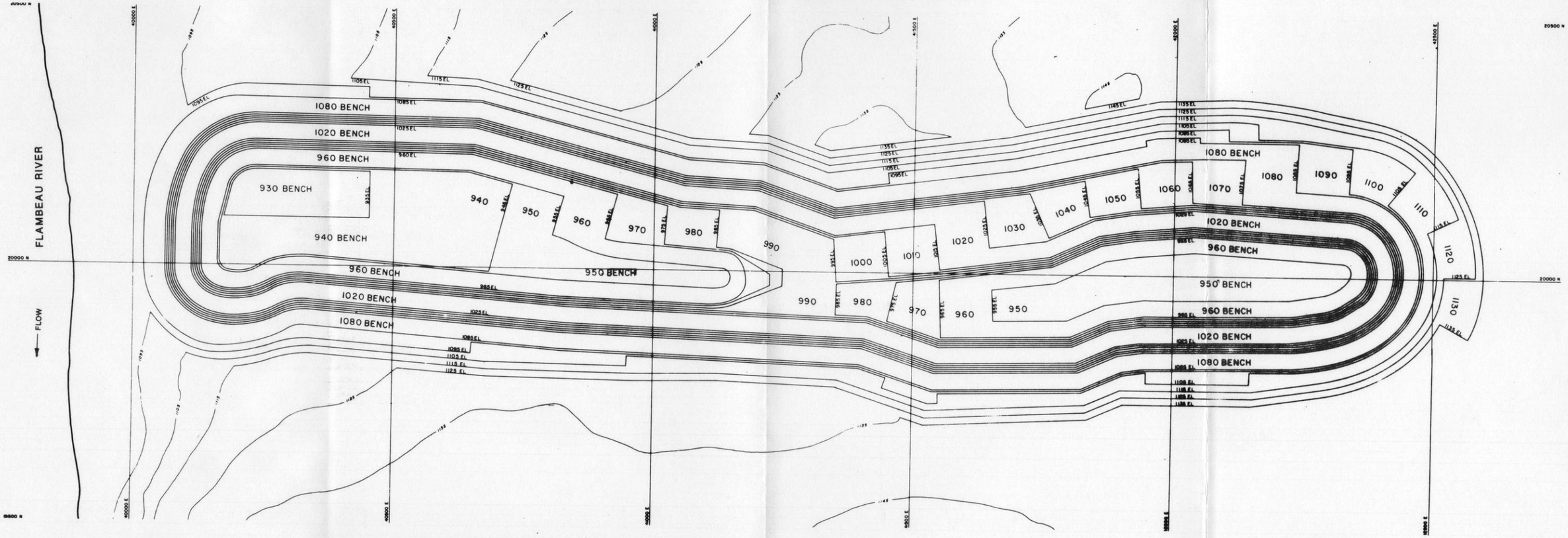
DWG. NO.	DESCRIPTION

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.



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-36
END OF YEAR 5

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	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

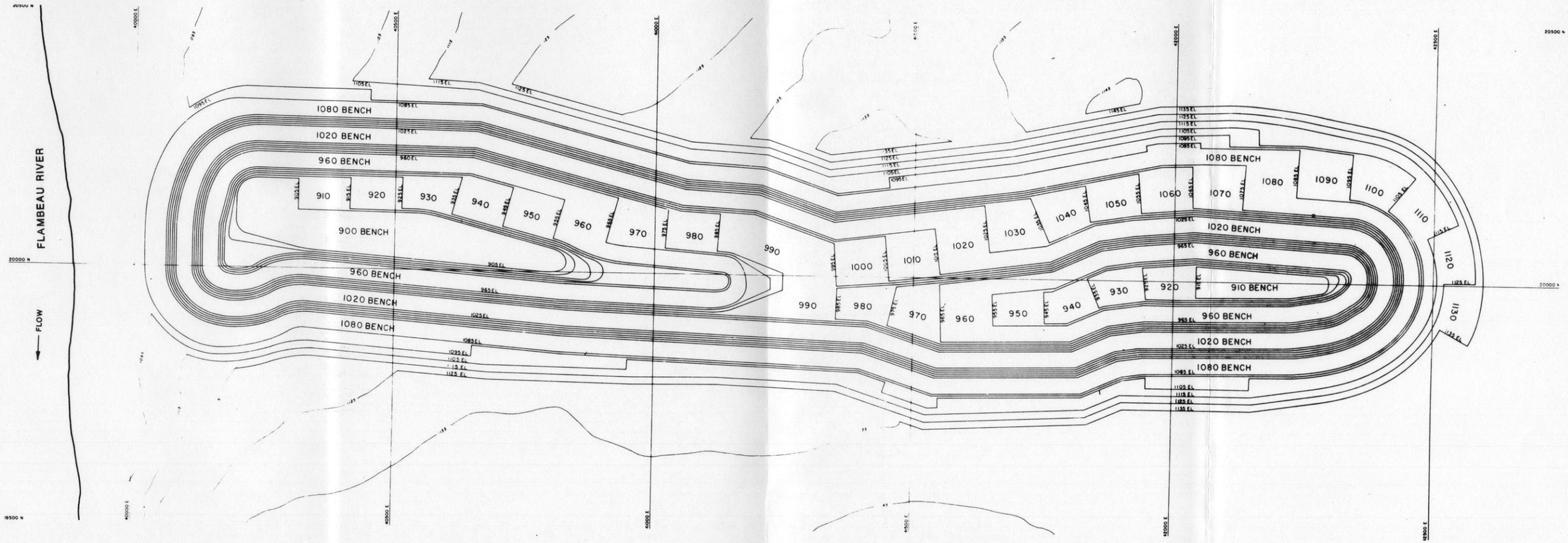
DWG. NO.	DESCRIPTION

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.



REFERENCES	DWG. NO.	DESCRIPTION

REFERENCES	DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CH'KD	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CH'KD	ENG'R	ENG'R MGR.

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CH'KD	M.J.O.	3/89
DES. ENG'R		
SECT. ENG'R		

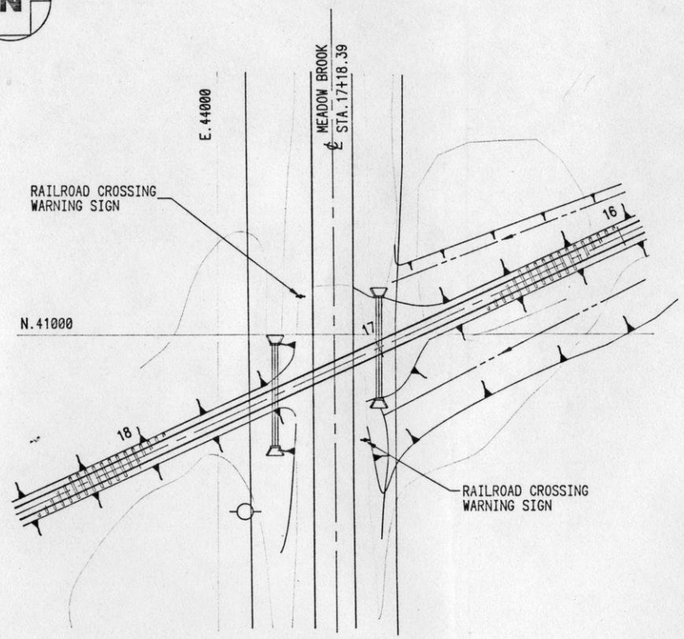
PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

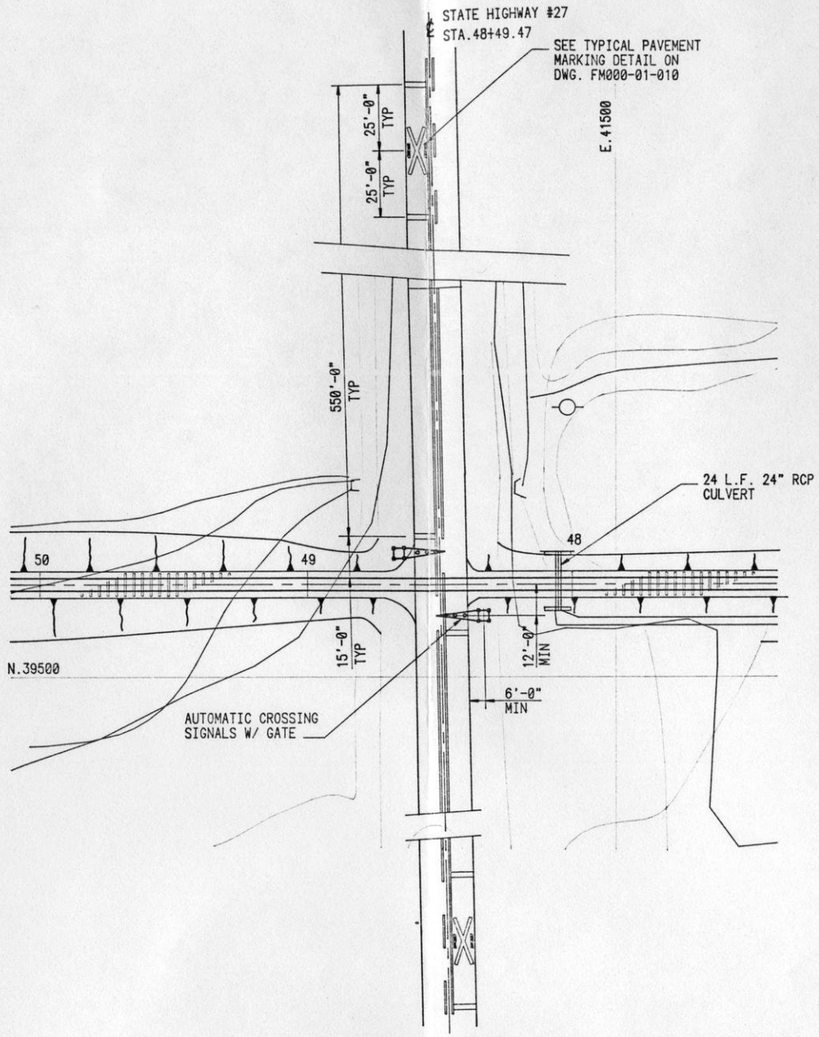
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

FIGURE NO. 4-37
END OF 3RD QUARTER
YEAR 6
FINAL PIT DESIGN

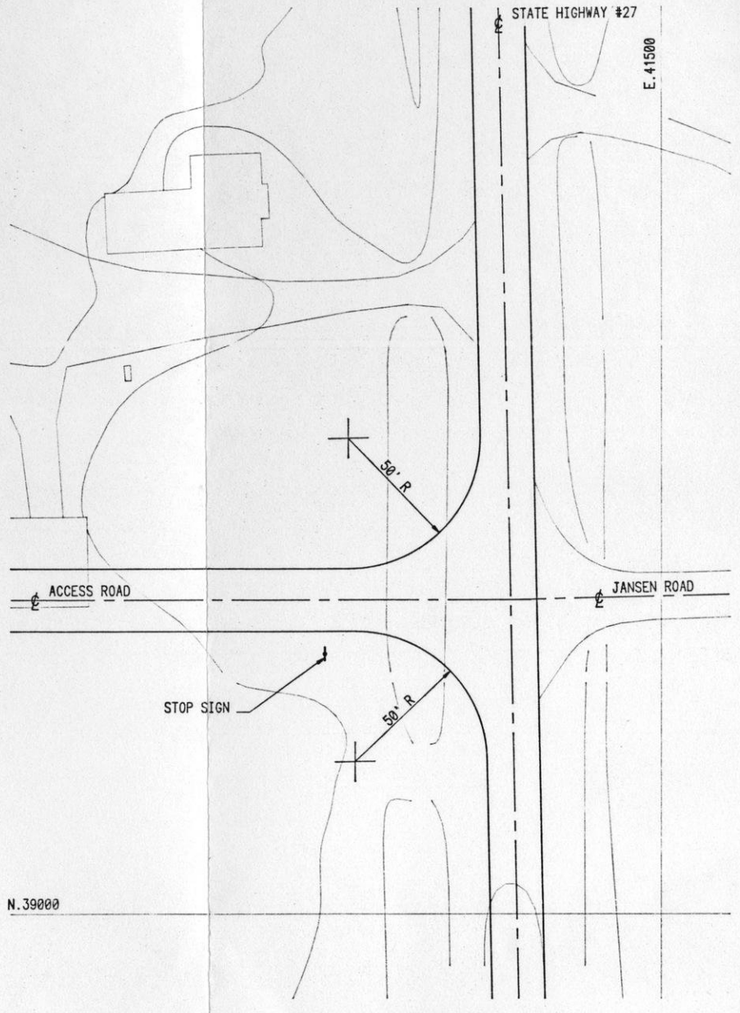
MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	



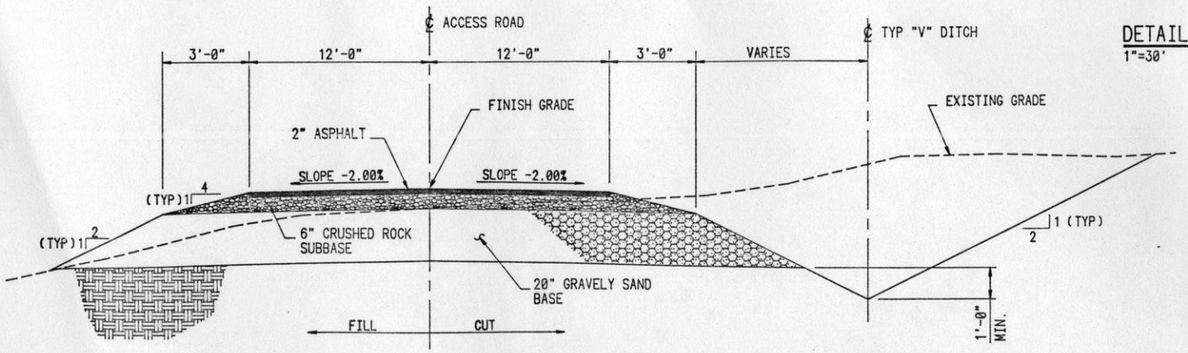
DETAIL 1
1"=30' FM000-01-003



DETAIL 2
1"=30' FM000-01-003



DETAIL 3
1"=30' FM000-01-003



TYPICAL ROAD TANGENT CROSS-SECTION
NTS

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

REFERENCES	DWG. NO	DESCRIPTION

REFERENCES	DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	LNG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	CEP	11-11-88
DRAWN	CEP	11-11-88
CHK'D		
DES. ENG'R		
SECT. ENG'R		

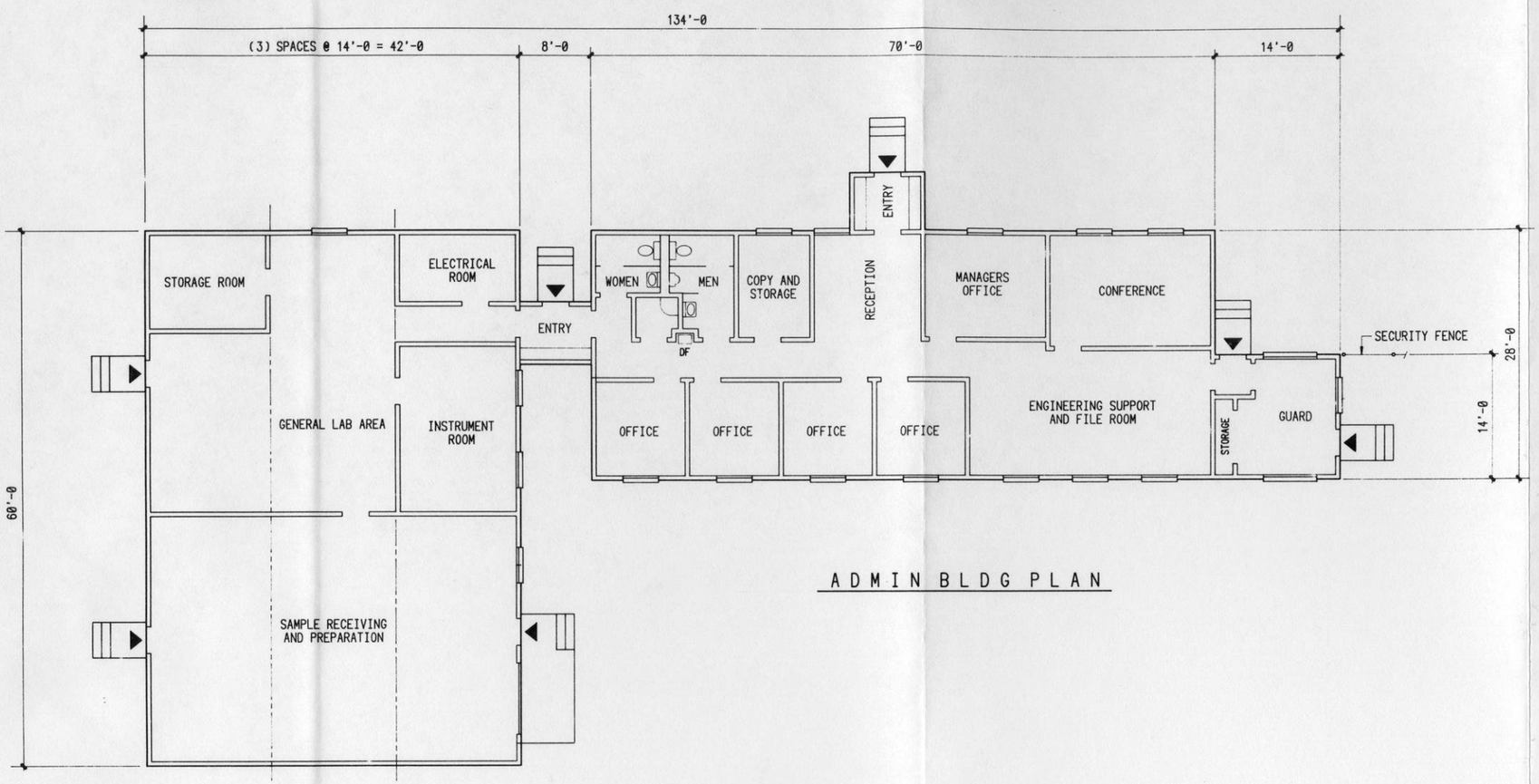
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-38
RAILROAD SPUR
CROSSING PLANS &
ROAD SECTIONS

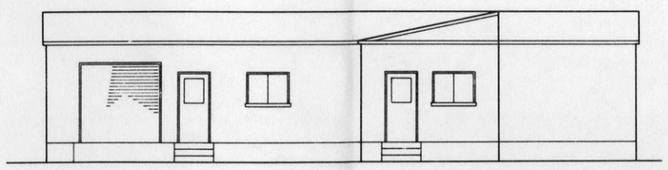
MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-012	D
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

SK942G

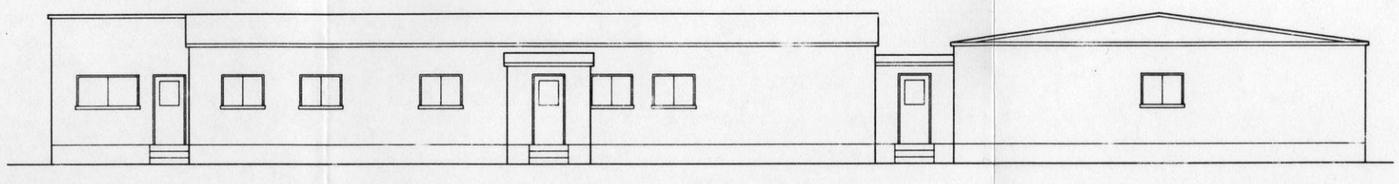


LAB BLDG PLAN

ADMIN BLDG PLAN



SOUTH ELEVATION
(LOOKING NORTH)



EAST ELEVATION
(FRONT OF BUILDINGS, LOOKING WEST)

0' 5' 10'

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
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	BTT	12-13-88
CHK'D		
DES. ENG'R	[illegible]	2-1-89
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS–CONSTRUCTORS
SALT LAKE CITY, UTAH

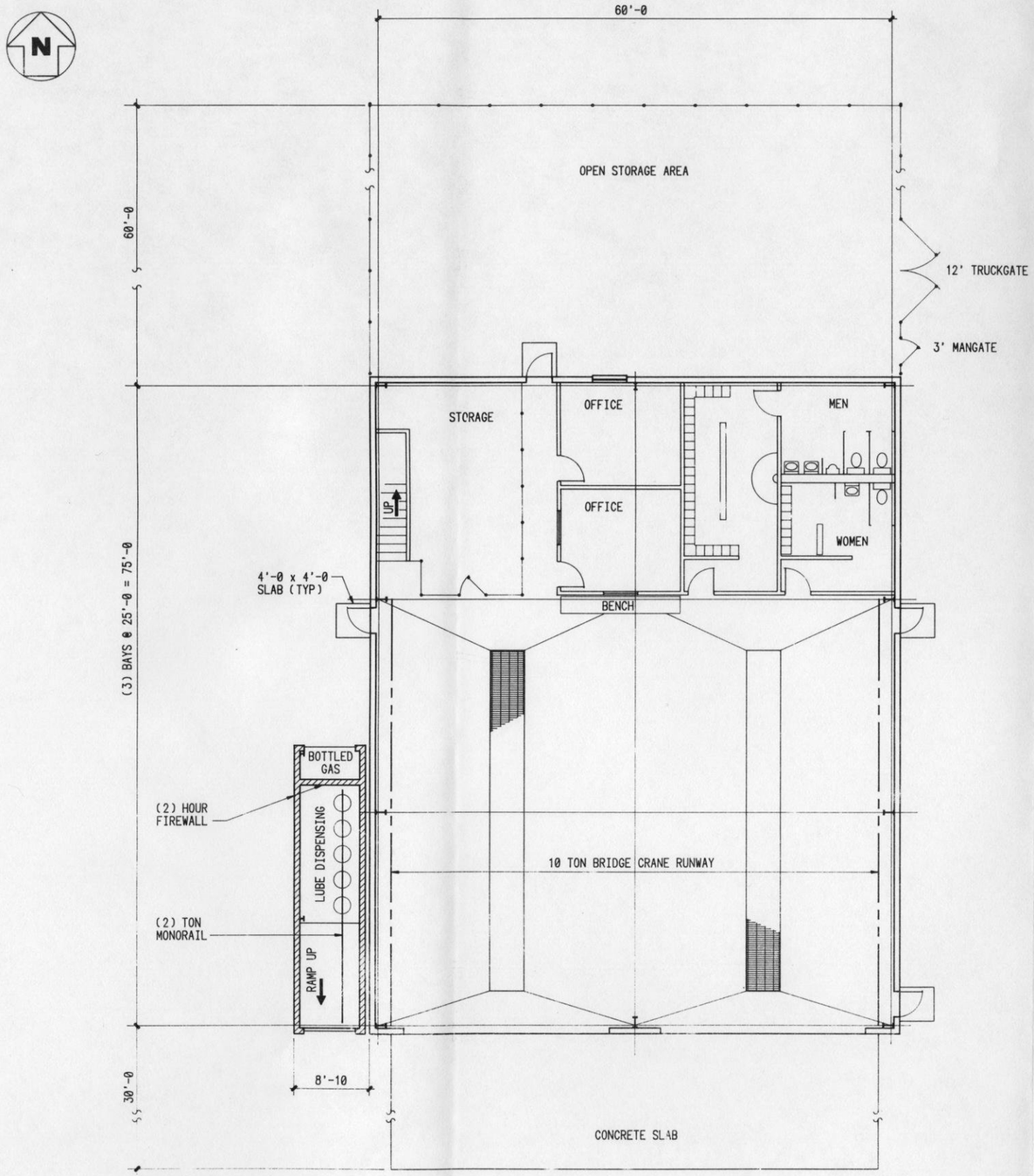
F B&D 1884

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

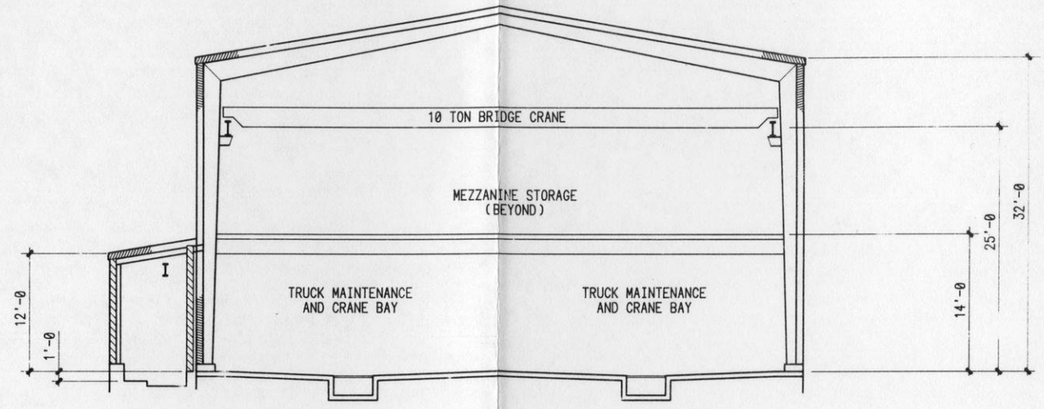
FIGURE NO. 4-39
ADMINISTRATION BUILDING
LAB BUILDING
PLANS AND ELEVATIONS

MICROFILM	JOB
	M033R
DRAWING NO.	REV.
FM000-01-008	D
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

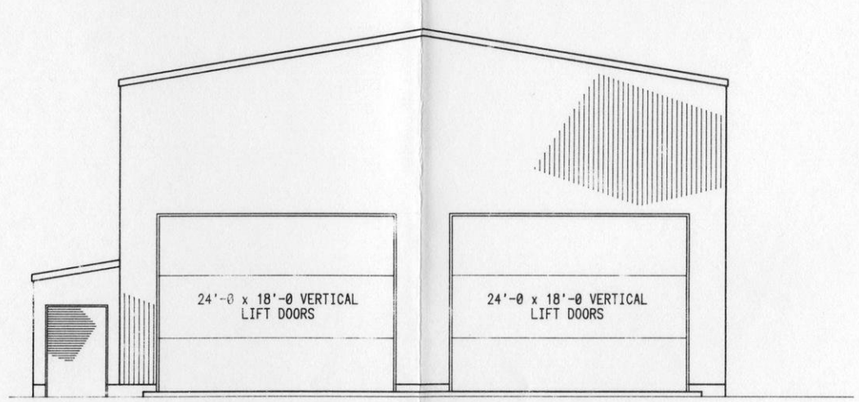


FLOOR PLAN

UBC - TYPE IIN CONSTRUCTION, H4 OCCUPANCY



SECTION



SOUTH ELEVATION

(LOOKING NORTH)

1' 0 5' 10'

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

REFERENCES	DWG. NO	DESCRIPTION

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		

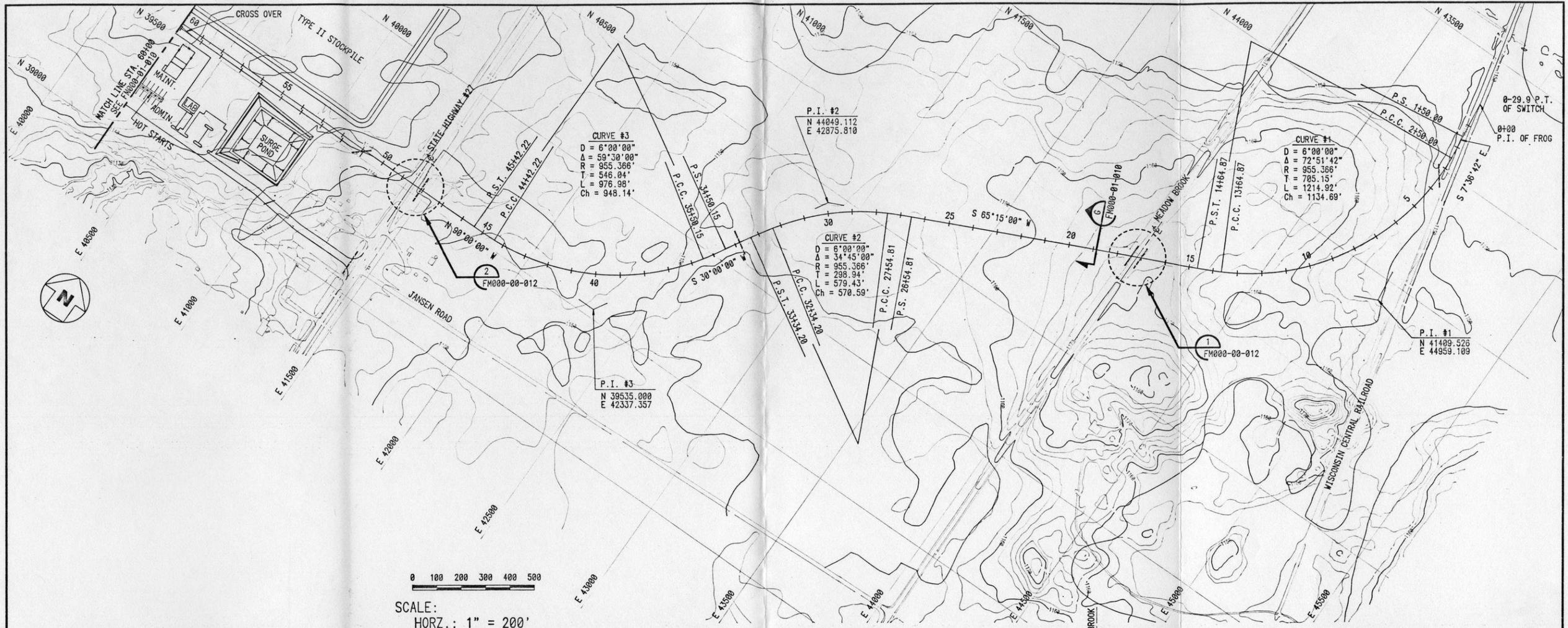
	BY	DATE
DESIGN		
DRAWN	BTT	12-12-88
CHK'D		
DES. ENG'R	RTA	2-1-89
SECT ENG'R		

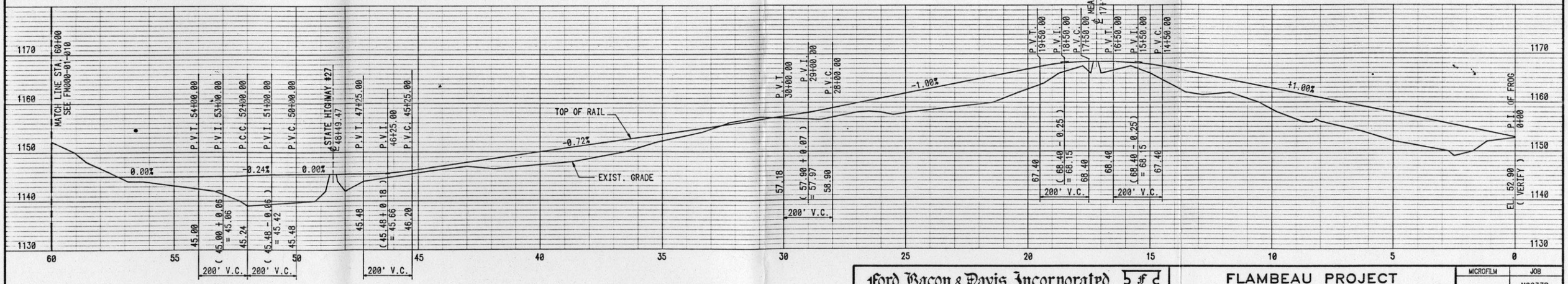
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-40
MAINTENANCE BUILDING
FLOOR PLAN
SECTION AND ELEVATION

MICROFILM	JOP
	M0033R
DRAWING NO.	REV.
FM000-01-009	C
DIVISION DRAWING NO.	
OWNER OPERATED	
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. 4-41
RAILROAD SPUR

MICROFILM	JOB
	M60J3R
DRAWING NO.	REV.
FM000-01-003	F
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

REFERENCES

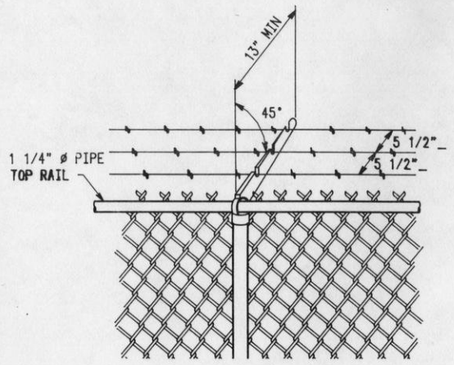
DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR

	BY	DATE
PROJ. ENG'R		
MGR PROCESS ENG'R		
ENG'R MGR		

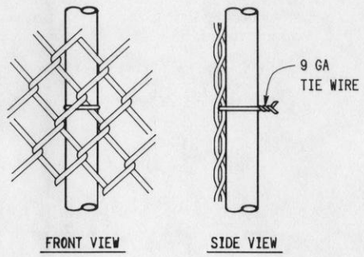
	BY	DATE
DESIGN	CEP	11-09-88
DRAWN	CEP/MCB	11-09-88
CHK'D		
DES. ENG'R		
SECT ENG'R		

MK597I



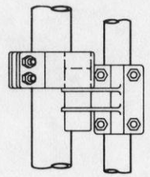
BARB WIRE ARM AND TOP RAIL

WITH BARBED SELVAGE



POST TIE DETAIL

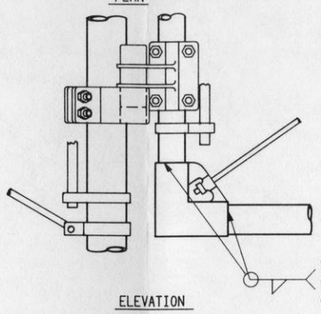




TOP GATE HINGE

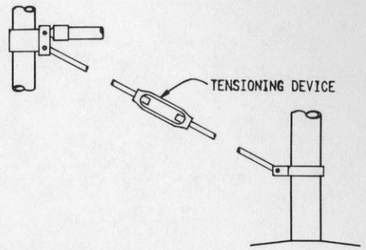
180\ SWING



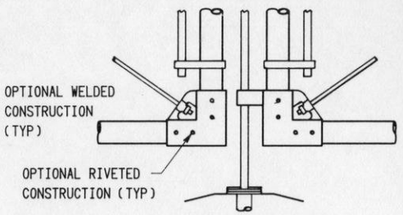


BOTTOM GATE HINGE AND GATE DETAILS

180° SWING



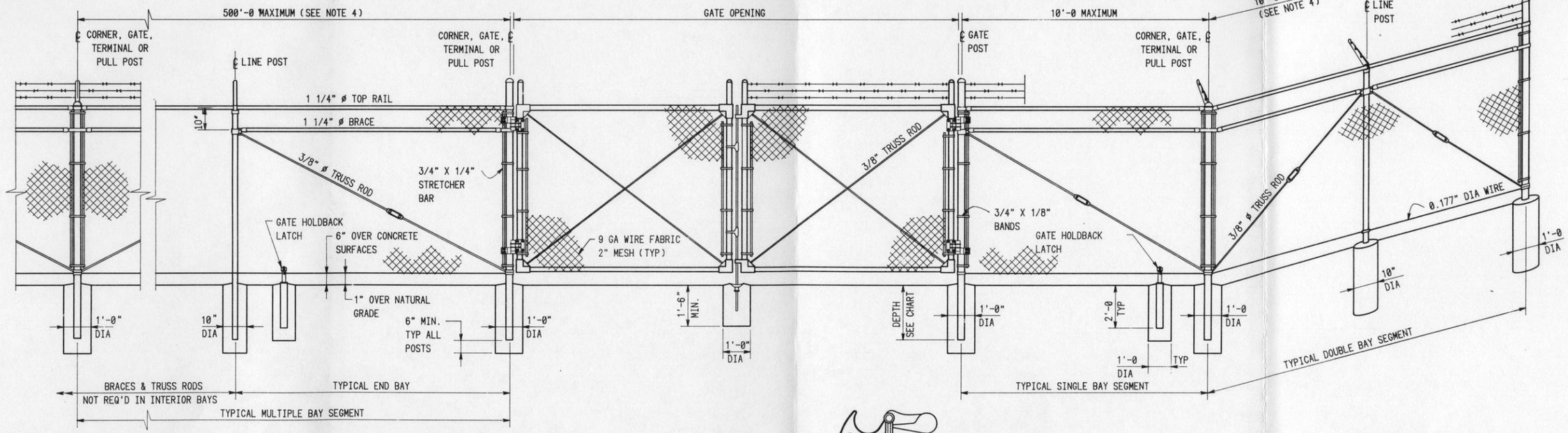
BRACE & TRUSS CONNECTIONS



CENTER GATE STOP AND GATE DETAILS

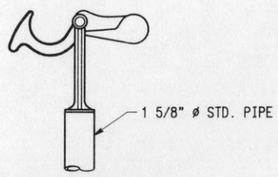
NOTES

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.



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"	



GATE HOLDBACK LATCH

SIDE VIEW

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. 4-42

FENCING DETAILS

MICROFILM	JOB
	WE033R
DRAWING NO.	REV.
FM000-01-006	C
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

REFERENCES	DWG. NO	DESCRIPTION

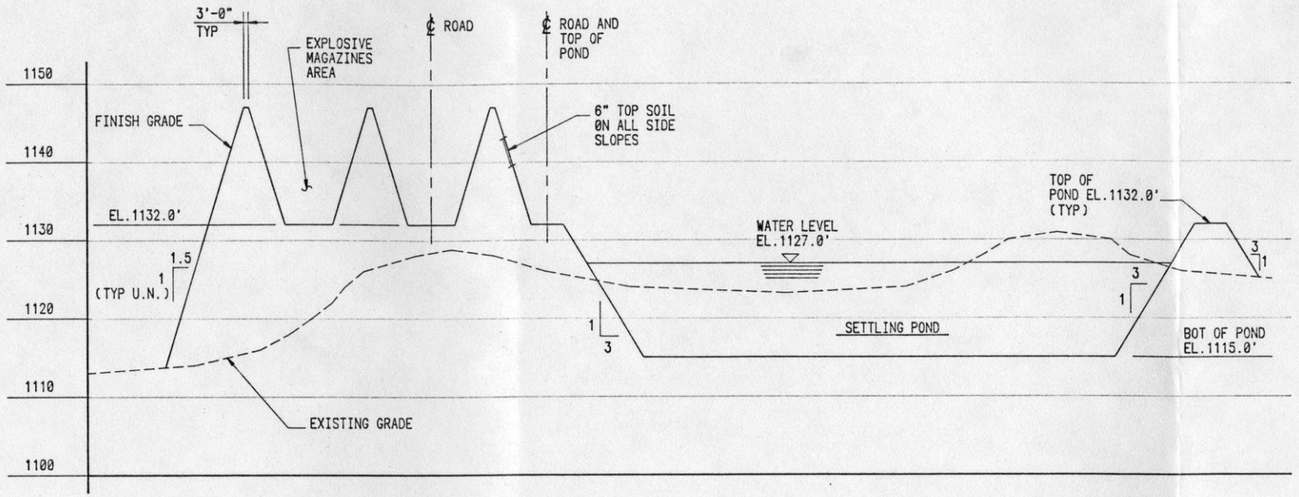
REFERENCES	DWG. NO	DESCRIPTION	BY	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

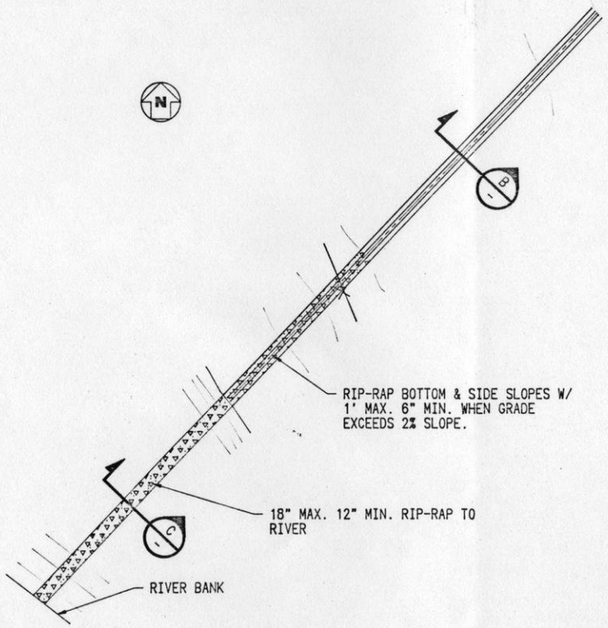
	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	WCB	11-1-88
CHK'D		
DES. ENG'R		
SECT ENG'R		

MK-880



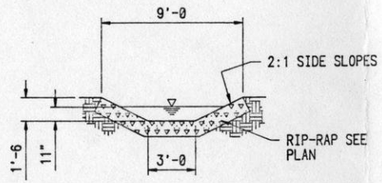
SECTION D
H. 1"=50'
V. 1"=10'
FM-000-01-001 , -002



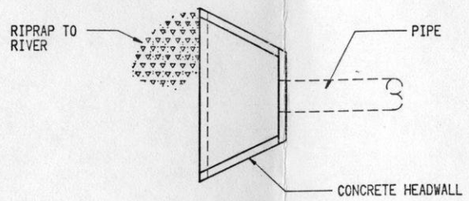
OUTFALL 002

DETAIL 1
1"=50'
FM000-01-007

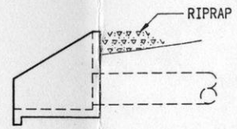
SECTION B
1"=10'



SECTION B
1"=10'



PLAN



ELEVATION

OUTFALL 001

TYPICAL OUTFALL TO RIVER
N.T.S.

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
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN		
DRAWN	GB	1-5-89
CHK'D		
RES. ENG'R	KTK	2/1/89
SECT. ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH

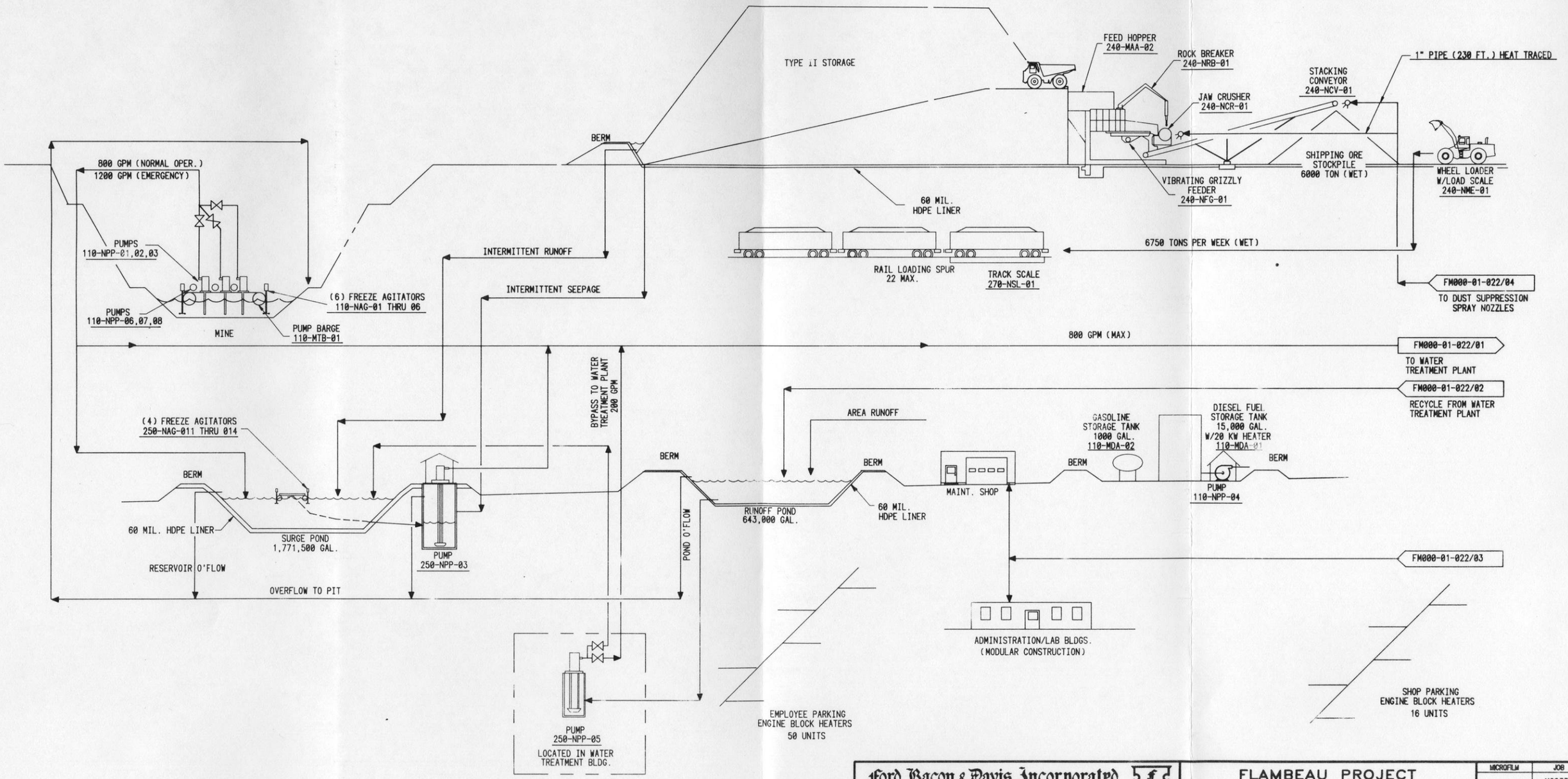
KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

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

SL310E



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.
1	3/9/89	GENERAL REVISION	PSH			

	BY	DATE
PROJ. ENG'R	JLC	11/4/88
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	DK	9/28/88
DRAWN	TEQ	10/21/88
CHK'D	HJV	11/3/88
DES. ENG'R	JLC	2/1/89
SECT ENG'R		

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. 4-44
FLOW SHEET
MINE FACILITY

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-021	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NONE

MK697C

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

FM000-01-021/03
80 GPM
PUMP 250-NPP-030
WELL WATER TANK 2000 GAL. 250-MDA-015
20 GPM
PUMP 250-NPP-023 (EXISTING)
HVAC UNITS 250-NHV-01, 02 250-NHV-03
(3) OVERHEAD GAS HEATERS 250-NHE-01, 02, 03
PLANT AIR COMPRESSOR 250-NCP-01 STAND-BY 250-NCP-02
FORKLIFT TRUCK 250-NME-01
FM000-01-021/01
MOL 2 GPM
WATER
SOLIDS SEPARATOR 250-NSS-01
CW 800 GPM
MOL 15%
MOL 12 GPM 15% .46 TPH
10 GPM/4.75 HPD
BACK WASH STORAGE TANK 6000 GAL 250-MDA-02
PUMP 250-NPP-025
LIME SILO 46 TON 250-MAA-01
LIME FEED SCREW 250-NFH-01
LIME TRUCK
BY OTHERS (TYP 3 PLCS.)
GRIT 1.2TPD
SCREW CONVEYOR 250-NFH-03
LIME SLAKER 4000 PPH 250-NLS-01
PUMP 250-NPP-04
AGITATOR 250-NAG-03
PUMP 250-NPP-06
MOL STORAGE 16,000 GAL 250-MDA-05
MOL 15% 50 GPM
PUMP 250-NPP-07
AGITATOR 250-NAG-02
NEUTRALIZING & MIXING TANK 12,000 GAL 250-MDA-04
PUMP 250-NPP-026
CLARIFIER DRIVE W/LIFT 250-NAG-01
CLARIFIER 60' DIA. X 10' WALL 250-NCL-01
CLARIFIER O'FLOW TANK (1200 GAL.)
UF
CLARIFIER U'FLOW STORAGE TANK 8000 GAL. 250-MDA-017
AGITATOR 250-NAG-010
TROLLEY SYSTEM 250-NCN-02
SAND FILTER BACKWASH
400 GPM/10 MIN/PER LOAD
250-NME-02 4000 GAL.
TO TYPE II STOCKPILE
PUMP 250-NPP-032 400 GPM
PUMP 250-NPP-08
PUMP 250-NPP-09
WATER 6gpm
AGITATOR 250-NAG-05
IN-LINE MIXER 250-NAI-01
PUMP 250-NPP-011
CONCENTRATED POLYMER 4000 GAL 250-MDA-07
POLYMER TRUCK
MIXER 250-NAG-04
DILUTE POLYMER TANK 250-MDA-06
PUMP 250-NPP-013
PO
1gpm
PUMP 250-NPP-012
PUMP 250-NPP-027
WATER
AGITATOR 250-NAG-06
SA 2 GPH
SS 2 GPH
AGITATOR 250-NAG-08
AGITATOR 250-NAG-09
CONCENTRATED H_2SO_4 TANK 1200 GAL 250-MDA-08
PUMP 250-NPP-014
DILUTE H_2SO_4 TANK 500 GAL 250-MDA-09
PUMP 250-NPP-015
ACID TRUCK
SULFIDE MIXING TANK 4000 GAL 250-MDA-012
SULFIDE MIXING TANK 4000 GAL 250-MDA-013
SAND FILTER FEED TANK 7500 GAL 250-MDA-014
SAND FILTER 3-TANK SYSTEM 250-NFL-01, 02, 03
BLOWER
TO TRUCK SHOP & WTP BUILDING FIRE TRUCK FILL STATION
AGITATOR 250-NAG-07
SS
Na_2S BAG BATCH TANK 300 GAL 250-MDA-010
Na_2S TANK 500 GAL 250-MDA-011
PUMP 250-NPP-018
PUMP 250-NPP-031
WATER
TO CRUSHER (DUST SUPPRESSION) FM000-01-021/04
PLANT WASHDOWN
PUMP 250-NPP-017
PUMP 250-NPP-021
FB 570 GPM/5MIN/DA
PUMP 250-NPP-020
PUMP 250-NPP-022
WATER TRUCK
pH NEUTRALIZATION TANK 10,000 GAL 250-MDA-01
PUMP 250-NPP-033
PUMP 250-NPP-019
PUMP 250-NPP-024
0-809 GPM (MAX) OUTFALL TO RIVER
FM000-01-021/02

REFERENCES

DWG. NO	DESCRIPTION

NO	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR
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
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	TB	4-22-88
DRAWN	WCB	4-27-88
CHK'D	HJV	11-4-88
DES. ENG'R		
SECT ENG'R		

Ford, Bacon & Davis, Incorporated
ENGINEERS-CONSTRUCTORS
SALT LAKE CITY, UTAH
B&V 1864

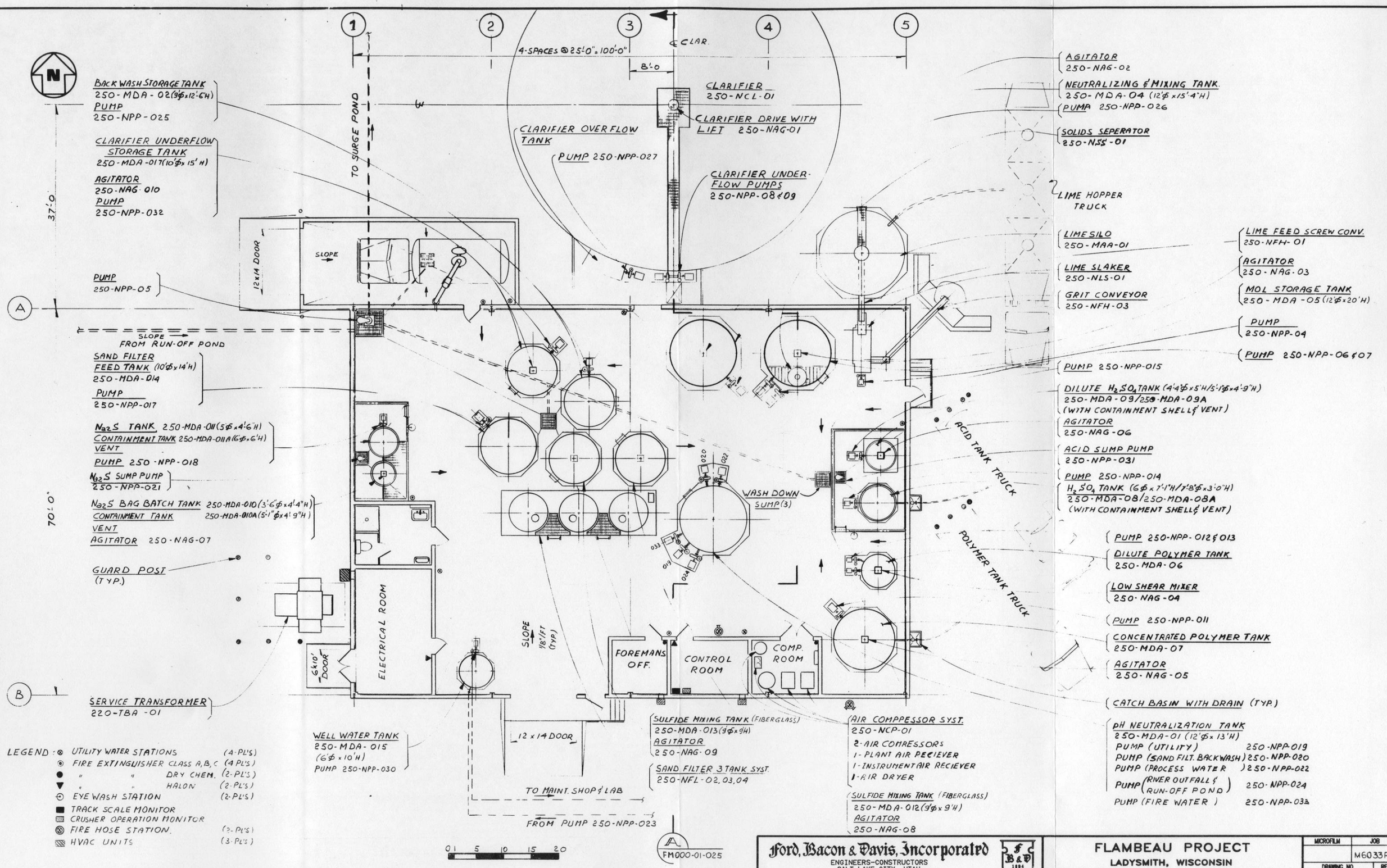
FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-45
WASTEWATER
TREATMENT PLANT
FLOW SHEET

MICROFILM	JOB
	M6833R
DRAWING NO.	REV.
FM0001-01-022	1
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	NONE

MJ4020



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. 4-46
WASTEWATER TREATMENT PLANT
GENERAL ARRANGEMENT
PLAN

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM 000-01-024	0
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

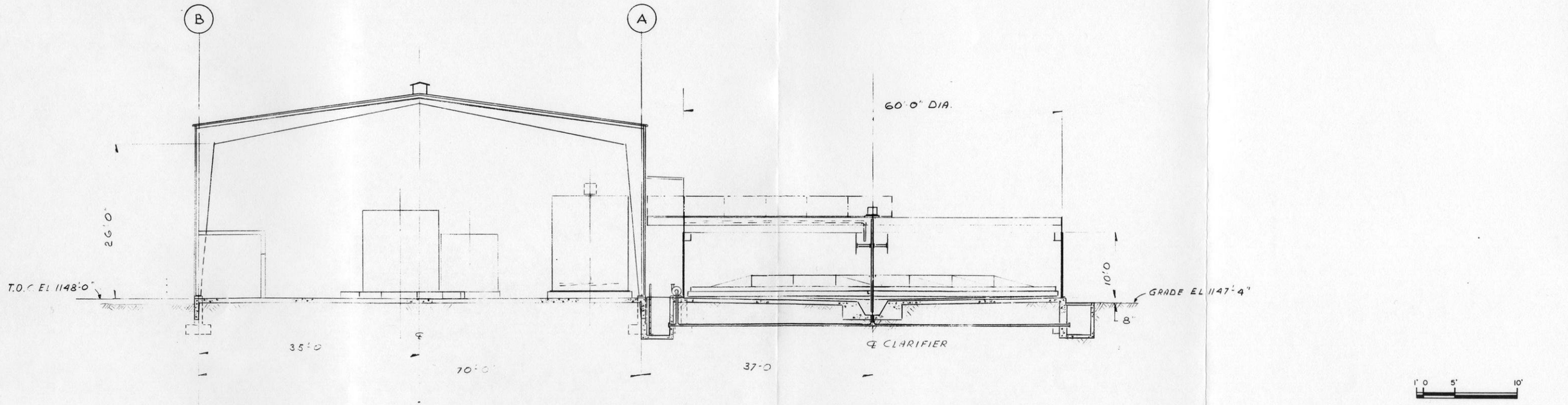
REFERENCES	DWG. NO	DESCRIPTION

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
PROJ. ENG'R	[illegible]	2-1-89
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	RJD	12-15-88
DRAWN		
CHK'D	[illegible]	2-1-89
DES. ENG'R	[illegible]	2-1-89
SECT ENG'R		



SECTION (A) FM000-01-024

0 1 5 10 15 20

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 - 47
WASTEWATER
TREATMENT PLANT ELEVATION

MICROFILM	JOB
	M6033R
DRAWING NO.	REV.
FM000-01-025	O
DIVISION DRAWING NO.	
OWNER OPERATED	
SCALE	

REFERENCES

DWG. NO	DESCRIPTION

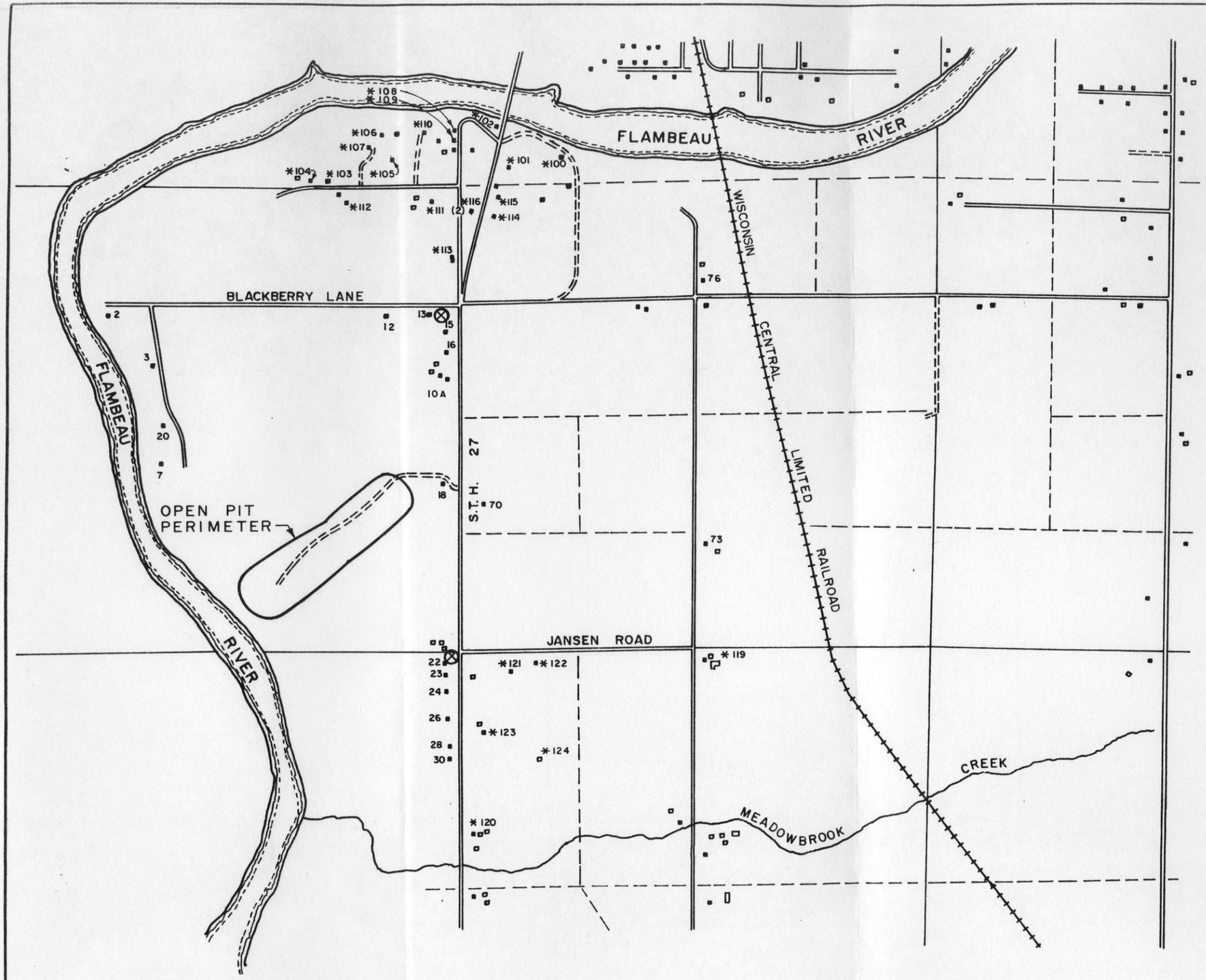
REFERENCES

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
PROJ. ENG'R	RJO	2-1-89
MGR PROCESS ENG'R		
ENG'R MGR		

	BY	DATE
DESIGN	RJO	12-17-88
DRAWN		
CHK'D	RJO	2-1-89
DES. ENG'R	RJO	2-1-89
SECT ENG'R		



LEGEND

- ▪2 KENNECOTT - OWNED BUILDINGS TO BE INCLUDED IN THE PREBLAST SURVEY
- 100 * NON KENNECOTT OWNED BUILDINGS TO BE INCLUDED IN THE PREBLAST SURVEY
- ⊗ BLAST MONITOR SITE
- ▪ NON KENNECOTT OWNED BUILDINGS

PRODUCED FROM USGS
LADYSMITH AND THORNAPPLE 7.5
MINUTE SERIES TOPOGRAPHIC MAPS

0' 500' 1000'

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1315 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 4-48
PREBLAST SURVEY PLAN

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R.		
ENG'R MGR.		
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

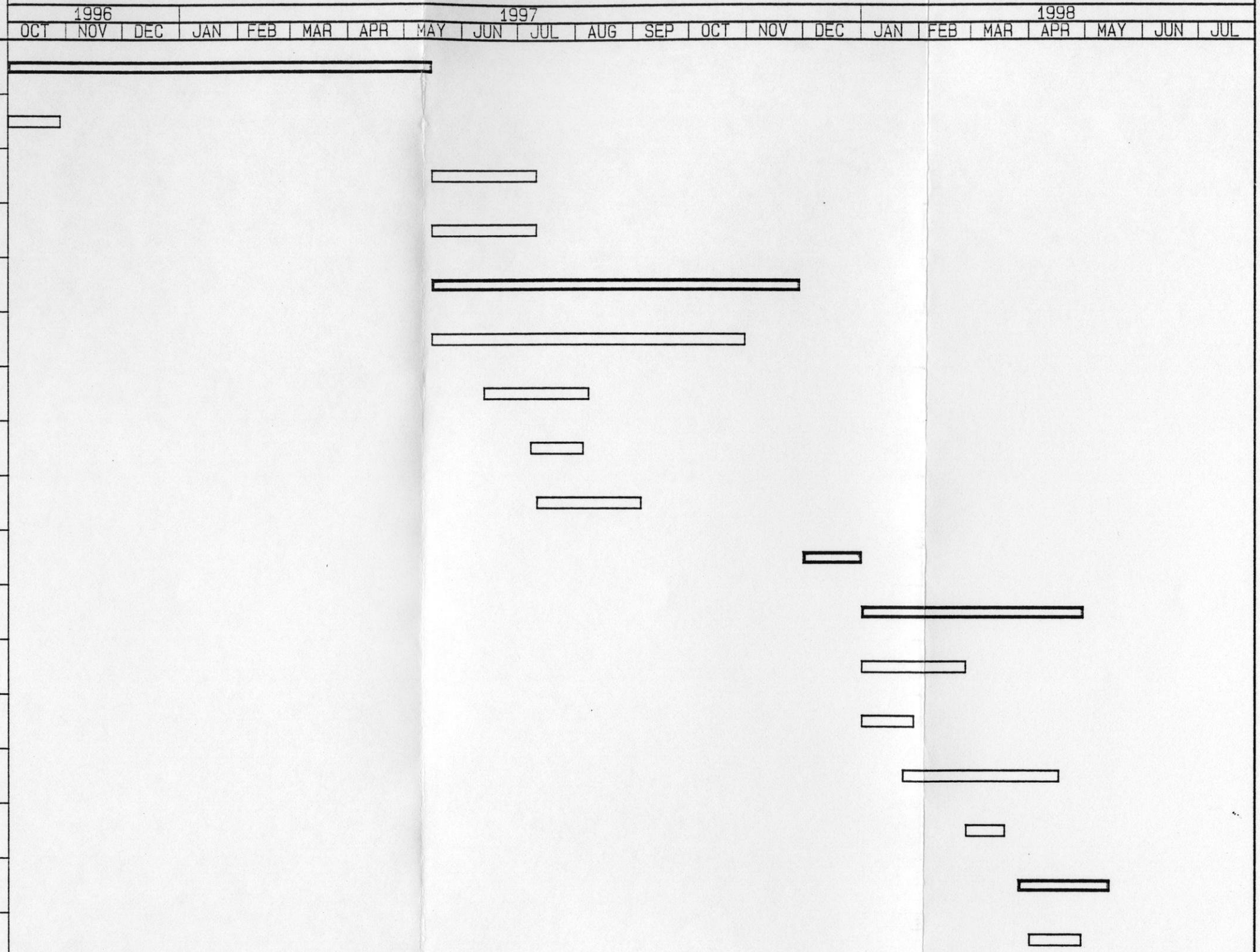
REFERENCES

DWG. NO.	DESCRIPTION

REVISIONS

DWG. NO.	DESCRIPTION	NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

TYPE II-REMOVE WASTEROCK 10 ES 10CT96 EF 15MAY97	
CRUSHER-REMOVE EQUIPMENT AND STRUCTURE 130 ES 10CT96 EF 28OCT96	
TYPE II-REMOVE SAPROLITE MATERIAL 20 ES 16MAY97 EF 10JUL97	
TYPE II-REMOVE DRAINAGE SYSTEM 30 ES 16MAY97 EF 10JUL97	
TYPE I-REMOVE WASTEROCK 60 ES 16MAY97 EF 28NOV97	
SITE FAC-REMOVE ORE HAUL ROAD 270 ES 16MAY97 EF 30OCT97	
TYPE II-RECLAIM TO ORIGINAL CONTOURS 40 ES 13JUN97 EF 7AUG97	
CRUSHER-REMOVE CONCRETE RETENTION WALL 140 ES 8JUL97 EF 4AUG97	
TYPE II-REPLACE TOPSOIL AND REVEGETATE 50 ES 11JUL97 EF 4SEP97	
TYPE I-REMOVE SAPROLITE & SANDSTONE MATERIAL 70 ES 1DEC97 EF 31DEC97	
TYPE I-REMOVE TILL MATERIAL 80 ES 1JAN98 EF 29APR98	
SITE FAC-REMOVE WATER TREATMENT PLANT 190 ES 1JAN98 EF 25FEB98	
SITE FAC-REMOVE EXPLOSIVE MAGAZINES 240 ES 1JAN98 EF 28JAN98	
SITE FAC-REMOVE RAILROAD SPUR 290 ES 23JAN98 EF 16APR98	
SITE FAC-REMOVE LABORATORY BUILDING 180 ES 26FEB98 EF 18MAR98	
TYPE I-RECLAIM TO ORGINAL CONTOURS 90 ES 26MAR98 EF 13MAY98	
CRUSHER-REMOVE ASPHALT AND SUB-BASE MATERIAL 150 ES 1APR98 EF 28APR98	



Activity Bar/Early Dates
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1989

KENNECOTT MINERALS
KENNECOTT MINERALS-FLAMBEAU PROJECT
FLAMBEAU RECLAMATION PROJECT

Project Start : 10CT96
Project Finish: 15JUL98

Sheet 1 of 2

Data Date: 10CT96
Plot Date: 29MAR89

FIGURE NO. 5-1

Date	Revision	Checked	Approved

	1996			1997												1998						
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
SITE FAC-RECLAIM R.R. SPUR CORRIDOR 300 ES 17APR98 EF 11JUN98																						
CRUSHER-RECLAIM AREA TO ORIGINAL CONTOURS 160 ES 29APR98 EF 26MAY98																						
PIT-RECLAIM TO ORGINAL CONTOURS 320 ES 30APR98 EF 13MAY98																						
TYPE I-CULTIVATE AND REVEGETATE 100 ES 14MAY98 EF 24JUN98																						
PONDS-RECLAIM SETTLING PONDS TO ORIG. CONTOURS 110 ES 14MAY98 EF 10JUN98																						
SITE FAC-REMOVE MAINTENANCE BUILDING 200 ES 14MAY98 EF 3JUN98																						
SITE FAC-REMOVE OFFICE AND ADMIN BUILDING 210 ES 14MAY98 EF 3JUN98																						
SITE FAC-REMOVE FUEL STORAGE TANK 250 ES 14MAY98 EF 10JUN98																						
SITE FAC-DISPOSE SANITARY WASTE LEACH FIELD 260 ES 14MAY98 EF 10JUN98																						
PIT-REPLACE TOPSOIL AND REVEGETATE 330 ES 14MAY98 EF 27MAY98																						
CRUSHER-REPLACE TOPSOIL AND REVEGETATE 170 ES 27MAY98 EF 16JUN98																						
SITE FAC-REMOVE PARKING LOT AND ACCESS ROAD 280 ES 4JUN98 EF 1JUL98																						
SITE FAC-CAP DISCHARGE PIPES AND RECLAIM OUTFALL 310 ES 4JUN98 EF 1JUL98																						
PONDS-REPLACE TOPSOIL AND REVEGETATE 120 ES 11JUN98 EF 8JUL98																						
SITE FAC-RE-ESTABLISH ORIGINAL CONTOURS 220 ES 11JUN98 EF 1JUL98																						
SITE FAC-REPLACE TOPSOIL AND REVEGETATE 230 ES 25JUN98 EF 15JUL98																						

Activity Bar/Early Dates
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1989

Project Start : 10CT96
Project Finish: 15JUL98

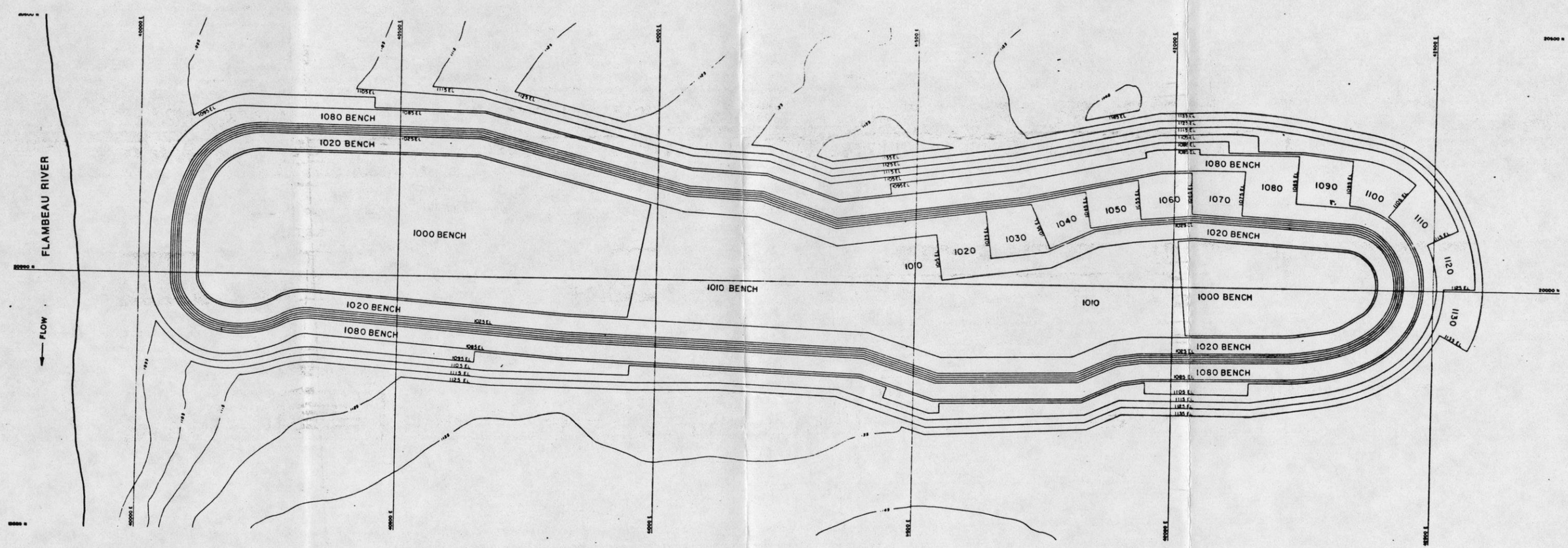
KENNECOTT MINERALS
KENNECOTT MINERALS-FLAMBEAU PROJECT
FLAMBEAU RECLAMATION PROJECT

Sheet 2 of 2

Data Date: 10CT96
Plot Date: 29MAR89

FIGURE NO. 5-1

Date	Revision	Checked	Approved



PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 5-2
END OF 3 MONTHS
OF BACKFILLING

MICROFILM	JOB
DRAWING NO.	REV.
DIVISION DRAWING NO.	
SCALE	

REFERENCES	DWG. NO.	DESCRIPTION

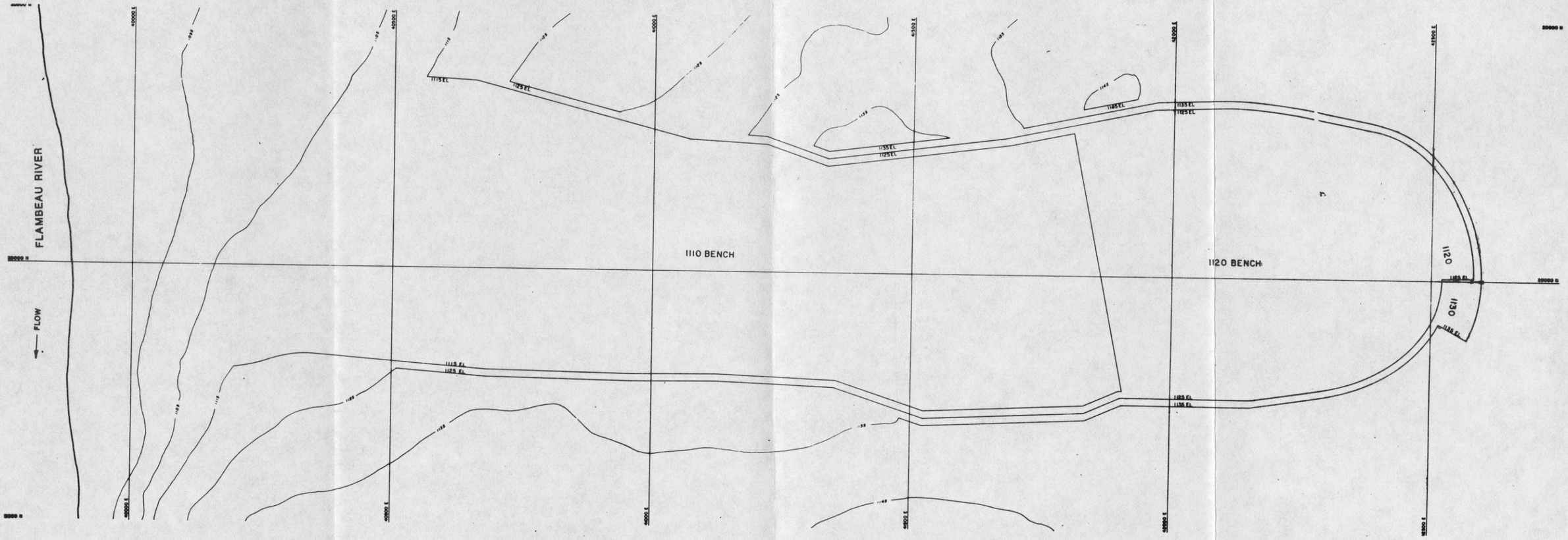
REFERENCES	DWG. NO.	DESCRIPTION

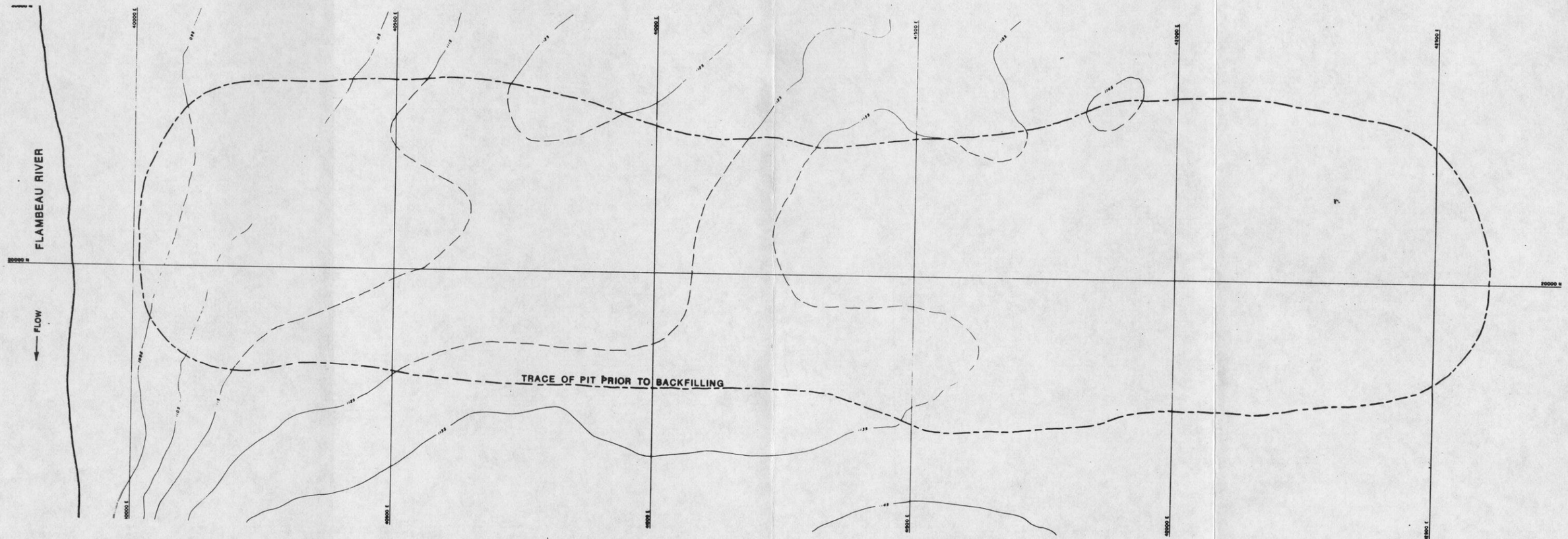
NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

	BY	DATE
PROJ. ENG'R		
MGR. PROJECTS DEPT.		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CHK'D	M.J.O.	3/89
QCS ENG'R		
SECT ENG'R		


FLAMBEAU RIVER
FLOW
1110 BENCH
1120 BENCH
1130
1115 EL
1125 EL
1135 EL
1145 EL
1155 EL
1165 EL
1175 EL
1185 EL
1195 EL
1205 EL
1215 EL
1225 EL
1235 EL
1245 EL
1255 EL
1265 EL
1275 EL
1285 EL
1295 EL
1305 EL



NOTE: FINAL CONTOURS ARE APPROXIMATE.

N

SCALE 0 100 200 FEET

PINCOCK, ALLEN & HOLT, INC.
LAKEWOOD, COLORADO

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
1515 MINERAL SQUARE
SALT LAKE CITY, UTAH
84112

FIGURE NO. 5-4
FINAL TOPOGRAPHY
OF RECLAIMED PIT

	BY	DATE
PROJ. ENG'R		
MGR. PROCESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	D.H.S.	3/89
CH'K'D	M.J.O.	3/89
DES. ENG'R		
SECT ENG'R		

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE

REFERENCES

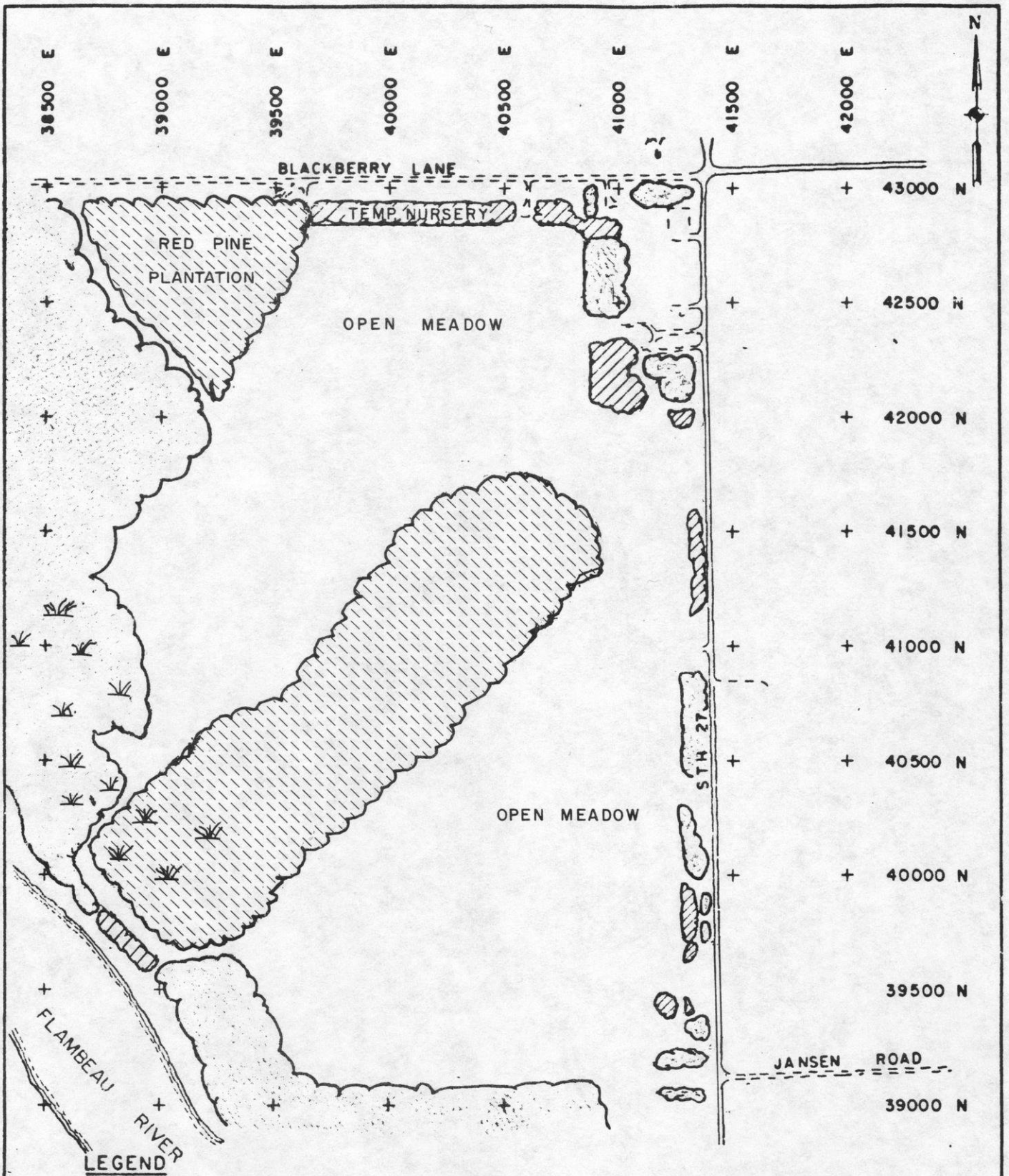
DWG. NO.	DESCRIPTION

REFERENCES

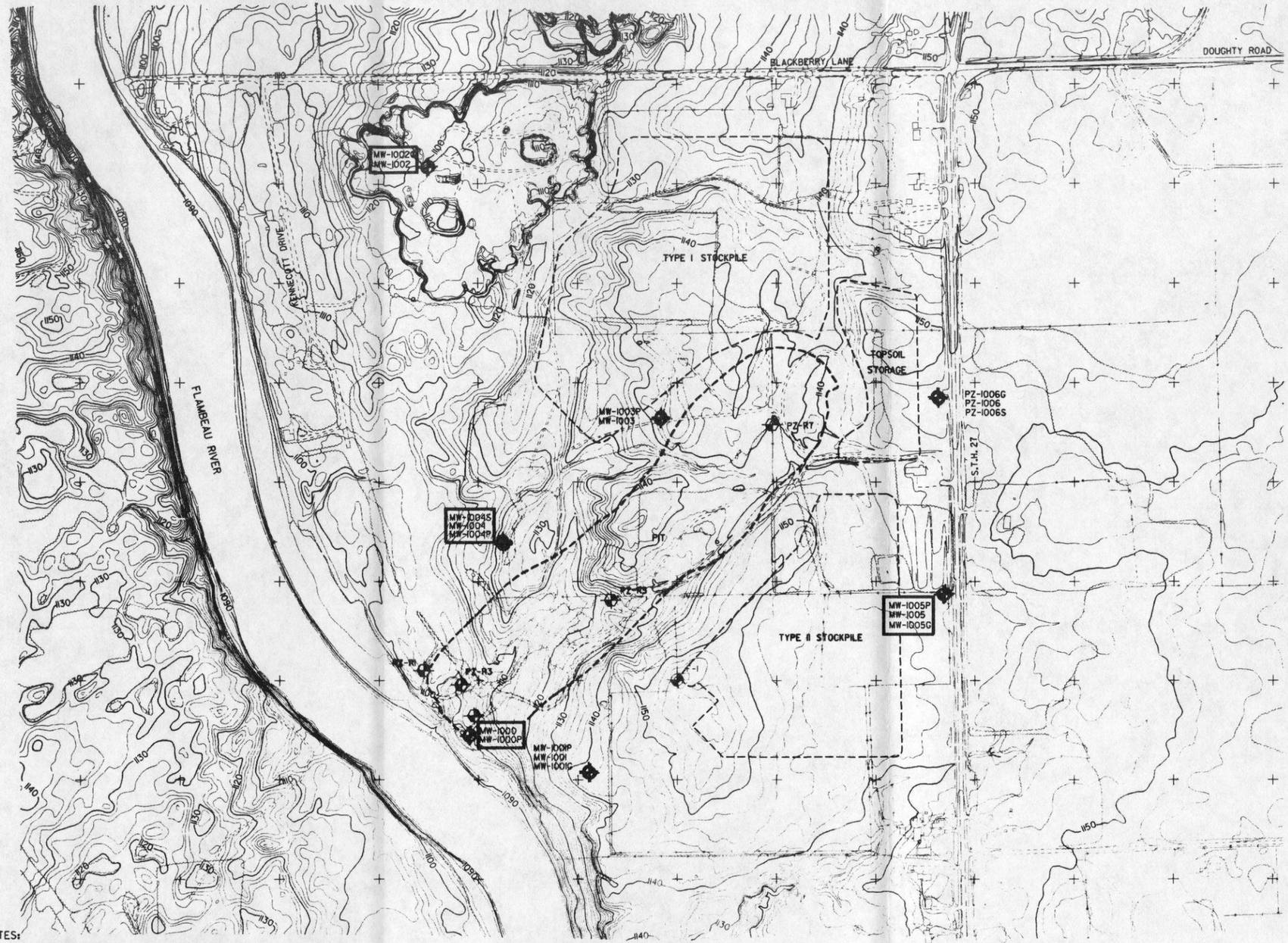
DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR.

NO.	DATE	REVISIONS	BY	CH'K'D	ENG'R	ENG'R MGR.



FOTH & VAN DYKE GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION GREEN BAY, WISCONSIN			KENNECOTT MINERALS COMPANY FLAMBEAU PROJECT LADYSMITH, WISCONSIN
NOTES	APPROVAL	DATE	FIGURE NO. 5-5 REVEGETATION PLAN
	DESIGNED BY		
	DRAWN BY R.M.H.	2/89	
	CHECKED BY G.W.S.	3/89	
	APPROVED BY		
	CAD No. SCALE 1" = 600'		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

- 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 WELLS ON THE MONITORING PROGRAM

0 300' 600'
SCALE

GROUNDWATER CONSTRUCTION AND OPERATION MONITORING PROGRAM

MEASURING POINTS FOR GROUNDWATER LEVELS AND WATER QUALITY SAMPLING POINTS

WELL/PIEZOMETER NUMBER	ELEVATION OF SCREENED INTERVAL (FT. MSL)	GEOLOGIC UNIT	PARAMETER •
MW-1000	1091-1081	PC, TILL	1, 2
MW-1000P	1049-1044	PC	1, 2
MW-1001	1118-1108	TILL	1
MW-1001G	1095-1090	TILL, SANDSTONE	1
MW-1001P	1051-1046	PC	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	PC	1
MW-1004	1112-1102	SAND & GRAVEL	1, 2
MW-1004S	1093-1088	SANDSTONE	1, 2
MW-1004P	1042-1037	PC	1, 2
MW-1005	1134-1124	TILL	1, 2
MW-1005S	1097-1092	SANDSTONE	1, 2
MW-1005P	1056-1051	PC	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
PZ-S1	1067-1062	PC	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-42	1092-1060	SAND & GRAVEL	1
OW-43	1092-1030	SAND & GRAVEL	1

•
1- GROUNDWATER ELEVATION (QUARTERLY).
2- SPECIFIC CONDUCTIVITY (FIELD), PH (FIELD AND LAB), TDS, IRON, MANGANESE, COPPER, TOTAL ALKALINITY, HARDNESS (QUARTERLY).

REFERENCES

DWG. NO.	DESCRIPTION

NO.	DATE	REVISIONS	BY	CHK'D	ENG'R	ENG'R MGR.

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

	BY	DATE
PROJ. ENG'R		
MGR. PROGRESS ENG'R		
ENG'R MGR.		

	BY	DATE
DESIGN		
DRAWN	MRS	3/89
CHK'D	GWS	3/89
DES. ENG'R		
SECT ENG'R		

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
155 MINERAL SQUARE
SALT LAKE CITY, UTAH
8402

FIGURE NO. 7-1
MONITORING PLAN

MICROFILM | JOB
DRAWING NO. | REV.
DIVISION DRAWING NO.
SCALE | SEE BAR SCALE



30 YEAR LONG TERM CARE PLAN		
	TIMES PER YEAR	DURATION
1. INSPECTIONS INSPECT RECLAIMED SITE FOR EROSION, VEGETATION GROWTH, SETTLING, AND MONITORING DEVICE INTEGRITY		
FIRST FOUR YEARS	SPRING & FALL	4 YEARS
NEXT 26 YEARS	LATE SUMMER	26 YEARS
2. LAND FORM MAINTENANCE EROSION CONTROL	AS NEEDED	30 YEARS
3. VEGETATION MAINTENANCE	AS NEEDED	30 YEARS
4. GROUNDWATER MONITORING	QUARTERLY	30 YEARS
A. WELL NESTS MW-1000, 1004, & 1005		
B. PARAMETERS		
WATER LEVELS		
SPECIFIC CONDUCTANCE (FIELD)		
PH (FIELD AND LAB)		
TOTAL DISSOLVED SOLIDS		
ALKALINITY, TOTAL		
HARDNESS		
IRON		
MANGANESE		
COPPER		

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-1005 MONITORING WELL
- PZ-R3 PIEZOMETER
- MW-1005 WELLS ON THE MONITORING PROGRAM

0 300' 600'
SCALE

FOTH & VAN DYKE
GEOSCIENCES & ENVIRONMENTAL MANAGEMENT DIVISION
GREEN BAY, WISCONSIN

FLAMBEAU PROJECT
LADYSMITH, WISCONSIN

KENNECOTT MINERALS COMPANY
55 MINERAL SQUARE
SALT LAKE CITY, UTAH 84112

FIGURE NO. 10-1
LONG TERM CARE PLAN

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.		

	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

APPENDIX A

Property Deeds

Deeds for the mine site property will be forwarded under separate cover to the WDNR.

APPENDIX B

Local Agreement

LOCAL AGREEMENT

BETWEEN RUSK COUNTY, THE TOWN OF GRANT,

THE CITY OF LADYSMITH

AND

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD.

FOR

DEVELOPMENT OF THE

KENNECOTT FLAMBEAU MINE

LOCAL AGREEMENT

INDEX

Definitions			Page
Section	1	DNR PERMITS/PERFORMANCE BOND	5
"	2	MINING PERMIT	5
"	3	PROJECT OVERVIEW	6
"	4	SETBACKS	8
"	5	GATES AND VISITORS OBSERVATION TOWER	9
"	6	SECURITY FENCING	9
"	7	CONSTRUCTION SUPERVISION/INSPECTION	9
"	8	HOURS OF OPERATION	9
"	9	ACCEPTABLE WASTE TYPES	9
"	10	OFF-SITE ACCESS ROADS	10
"	11	TRUCKING RESTRICTIONS	11
"	12	HIRING OF EMPLOYEES	12
"	13	GROUNDWATER MONITORING WELLS	13
"	14	TESTING/GUARANTEE OF PRIVATE OFF-SITE WELLS	13
"	15	COMPENSATION FROM LOSS IN PROPERTY VALUE DUE TO PROXIMITY OF MINE	15
"	16	LOCAL MINING IMPACT COMMITTEE	18
"	17	LEACHATE STORAGE AND TREATMENT	20
"	18	EMERGENCY EQUIPMENT AND PLAN	21
"	19	SUCCESSION OF AGREEMENT	22
"	20	CLOSING PLAN	23
"	21	MUNICIPAL NEGOTIATION AND RELATED PROFESSIONAL EXPENSES	28
"	22	MUNICIPAL LIABILITY	28
"	23	OPERATOR RESPONSIBILITY DURING OPERATION AND AFTER CLOSURE OF THE MINE	29
"	24	RENEGOTIATION	30
"	25	GRIEVANCES	33
"	26	ADDITIONAL INFORMATION	33
"	27	CONDITIONAL USE PERMIT	34

Definitions			Page
"	28	LIMITATIONS ON OTHER CONTRACTS	35
"	29	ENFORCEABILITY OF THIS AGREEMENT IN THE EVENT THAT THE MINE IS NOT LICENSED	36
"	30	RUSK COUNTY MINING IMPACT FUND	36
"	31	LOCAL GOVERNMENTS WILL NOT OPPOSE THE MINE	46
"	32	INAPPLICABILITY OF RUSK COUNTY MINERAL MINING CODE	47
"	33	DEFAULTS	48
"	34	ABILITY OF PARTICIPATING LOCAL GOVERNMENTS TO PARTICIPATE IN NR132 HEARING PROCESS	48
"	35	DISPUTES	49
"	36	INVALIDATION	49
"	37	LAW	50
"	38	NOTICES	50
"	39	MODIFICATIONS	51
"	40	TITLES ARE ILLUSTRATIVE OF CONTENT ONLY	51
"	41	LEGAL AUTHORITY	51
"	42	DATE	51

EXHIBITS

A. Plot Plan showing the Active Mine Area

B. Legal description of the land where the Mine is located

C. Map showing location of groundwater monitoring wells

D. Map showing Area covered by Well Guarantee

E. Map showing Area covered by Property Guarantee

F. Premises Used as Basis For Agreement

G. Waivers and Variances approved by Local Impact Committee

H. Conditional Use Permit

I. Letter dated July 13, 1988 from L.E. Mercando to W.G. Thiel with attached Kennecott letter dated July 12, 1988 regarding Two Tier Testing

AGREEMENT BETWEEN RUSK COUNTY, THE TOWN OF GRANT,

THE CITY OF LADYSMITH

AND

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD.

WHEREAS, the County of Rusk, the Town of Grant and the City of Ladysmith have formed a Local Impact Committee for, among other things, the purpose of representing local governments to protect local interests while developing workable rules under which the mining project proposed by Kennecott Explorations (Australia) Ltd. (Kennecott) can proceed in Rusk County;

WHEREAS, portions of Sections 9, 10, 16, 17, 20 and 21, T-34N, R6W Rusk County in the Town of Grant have been identified as a site with a mineral deposit;

WHEREAS, Kennecott owns the mineral deposit and is interested in developing such deposit into an Open Pit copper mine;

WHEREAS, Rusk County, the Town of Grant and the City of Ladysmith have exercised the authority granted in section 144.838 and 144.839, Wisconsin Statutes, by establishing a Local Impact Committee to negotiate with Kennecott relative to the proposed copper Mine;

WHEREAS, Rusk County, the Town of Grant and the City of Ladysmith have exercised the authority granted in section 144.838 of the Wisconsin Statutes by appointing two members each to the Local Impact Committee; and

WHEREAS, the Town of Grant, Rusk County, City of Ladysmith, and Kennecott are desirous of completing these negotiations in a timely and equitable fashion.

NOW, THEREFORE IT IS AGREED, by and between the Town of Grant, Rusk County, the City of Ladysmith and Kennecott that the following definitions shall be used to interpret the meaning of items contained within this Agreement.

"Active Mine Area" shall mean the operations area of the Operator's land including the Open Pit, itself, as well as the water treatment facility, crushing and loadout facility, runoff catchment, administration center, stockpiled material for backfill, overburden, topsoil and settling ponds, as identified with reference to Exhibit A, but excluding the railroad spur and utility lines.

"Active Mining" shall mean and include all phases of construction and operation of the Mine.

"Baseline Monitoring Program" shall mean that period of time and that phase of the proposed mining operation during which baseline data, as defined in Sec. NR132.03(2) is being collected and analyzed.

"DNR" shall mean the Wisconsin Department of Natural Resources.

"Downgradient Wells" shall mean all wells located west and northwest of the Open Pit, between the Pit and the Flambeau River and as far north as Blackberry Lane.

"Earthen construction" shall mean the berm which the Operator shall construct in the Active Mine Area to contain wastes and wastewater treatment ponds.

"Emergency" shall mean, for the purposes of section 10, only those times when due to strikes, acts of God, accidents or force majeure, the railway line serving the Mine cannot transport Ore away from the Mine.

"EPA" shall mean the United States Environmental Protection Agency.

"Gossan" shall mean gold bearing ore.

"Hazardous Waste" shall have the meaning set forth at Sec. 144.43(2), Wisconsin Statutes.

"Leachate" shall have the meaning at Sec. NR182.04(26).

"Local Impact Committee" shall mean the committee designated by the Town of Grant, Rusk County and the City of Ladysmith to negotiate, subject to each of the parent municipality's satisfaction, this Agreement, and any successor committees hereto, whether designated pursuant to Secs. 144.438 or 66.30, Wisconsin Statutes, or under other statutory authority.

"Metallic Mineral" shall have the meaning at Sec. NR132.03(9).

"Mine" shall mean all of the operations associated with the Open Pit mine sought to be developed under this Agreement by Kennecott.

"Mine Operation" shall mean that phase of the mining project which shall begin after the necessary DNR permits have been granted and after construction has been concluded, to consist of the process, over several years of time, of the extraction and of the shipping of Ore. It shall end with the conclusion of the Ore extraction process, shipping of the Ore and the commencement of the closure.

"Mineral Deposits" shall mean the body of Ore from which Kennecott proposes to extract copper and gold.

"Mining" shall have the meaning at Sec. NR132.03(11).

"Mining Operation" shall mean and include all phases of construction, operation and closure of the Mine.

"Open Pit" shall mean that area on the surface of Operator's land which the Operator intends to excavate and from which Ore will be extracted.

"Operator" shall mean and include the following: The person applying for (Applicant) all necessary local, state and/or federal permits with which to operate the Mine subject to this Agreement, the Owner of the land on which the Mining Operation will take place and the Owner of the Ore extracted therefrom.

"Operator's Rentals" shall mean those houses, business buildings, other structures, and real estate owned by the Operator, but rented or leased by it to third parties for their use and occupation.

"Ore" shall have that meaning set forth at Sec. NR132.03(17).

"Owner," "Applicant" or "Operator" shall mean Kennecott.

"Participating Local Governments" shall mean the Town of Grant, the County of Rusk and the City of Ladysmith, all of which are located in the State of Wisconsin.

"Pollution" shall have the meaning set forth at Sec. 144.01(10), Wisconsin Statutes.

"Secured Area" shall mean all of the Operator's land situated inside of the Security Fence.

"Security Fences" shall mean a fence capable of preventing human beings from intruding into the Active Mine Area, to consist generally of a six (6) foot high chain link fence with three strands of wire on the top.

"Temporary Closure" shall mean an unanticipated cessation of Active Mining operations not to exceed six (6) months whether caused by a strike or strikes, force majeure or other reasons.

"Test Materials" shall mean the equipment, supplies, chemicals and/or other items necessary to take and test water samples.

"Ton" shall mean 2000 American pounds.

"Town Board" shall mean the Board of the Town of Grant, Rusk County, Wisconsin, and where the circumstances dictate, it shall refer to the City Council of the City of Ladysmith.

"Town Officials" means any person legally holding the elective offices of Town Chairman, Town Supervisor, Town Clerk, Town Treasurer and Town Assessor. For purposes of this Agreement, said term shall also include officials of the City of Ladysmith occupying the same or similar positions, whether elected or appointed, under circumstances wherein such interpretation should be given to the term.

"Well Cluster" shall mean 2 or more wells installed within 10 feet of each other at the ground surface and constructed to varying depths.

IT IS FURTHER AGREED THAT:

1. DNR PERMITS/PERFORMANCE BOND

   The Owner or Operator of the Mine will secure all necessary licenses and permits from the DNR. The Operator will furnish a copy of the performance bond or other approved security set by the DNR to the Local Impact Committee

2. MINING PERMIT

   Operation of the Mine shall comply with all DNR regulations in NR 132 applicable to the Mine and associated facilities except as to exemptions from such regulations as may be granted to the Operator by the DNR in accordance with NR 132.19, Wis.Adm. Code, in which cases the Operator shall comply with such alternative regulations, if any, as are imposed by the DNR. The Local Impact Committee will be provided copies of all pertinent documents which Kennecott provides to the DNR pertaining to any

request for an exemption. A copy of the mining permit and plan of operation, and any modifications thereto, if any, submitted to and approved by the DNR as a requirement for licensing will be made a part of this Agreement.

The Operator shall take preventative measures to minimize surface water runoff or erosion and to accomplish that purpose will finish grading and will seed completed areas of the Mine in accordance with the closing plan made a part of this Agreement.

3. PROJECT OVERVIEW

Project Scope and Limitations:

a. The Mine, inclusive of appurtenant structures and facilities, but excluding the railroad spur, access roads, and utility feed lines, shall be situated on land whose legal description is as set forth in Exhibit B. It shall consist of an Open Pit, from which the Operator intends to extract topsoil, overburden waste rock and Ore, the purpose of which Open Pit shall be to remove Ore containing copper, silver and gold. The topsoil, waste rock and overburden shall be stored for use in restoration of the Open Pit during the Mine's closure phase.

b. Dimensions of the Open Pit and Active Mine Area: the Open Pit shall be no greater than 40 acres, more or less, in size and shall be excavated to a depth of no more than 225 feet, more or less, below the grade existing on the site as of January 1, 1988.

c. Limitations: The Mine herein described shall be subject to the following limitations:

(1) There shall be no conversion from an Open Pit to deep shaft mineral mining.

(2) There shall be no smelting, concentrating or refining of Ore on the Operator's land or in Rusk County.

(3) There shall be no material expansion of the Mine without first reopening this Agreement and any zoning land use permits granted in accord herewith. "Material expansion" shall mean any substantial increase or variation in the size, scope or intent of the Operator as to the instant Mining Operation which varies with the description of the project as herein contained and as correspondingly established in the DNR permit process. "Substantial increase or variation in the size, scope or intent of the Operator" shall be further defined as any such increase or variation in the size, scope or intent as to the instant Mining Operation which shall exceed in excess of ten (10) percent (%), the parameters for the project as set forth in paragraph 3 b. of this Agreement. It shall not include minor variations on either the size in acres or depth of the Open Pit as evidenced by the approximate dimensional criteria set forth at b. above, nor shall it include variations in annual activity during the Mine Operation phase of the project due to production fluctuations. Material expansion shall not pertain to amounts of Ore shipped in any year nor over the life of the project.

(4) The Active Mine Area shall, at all times during the construction, operations and closure phases of the project, be enclosed by the Security Fence, entry through which shall be via secured gates.

(5) The Operator shall install, maintain and utilize surface water containment systems and a water treatment plant to protect the groundwater and surface

water of Rusk County in accordance with DNR specifications.

(6) The topsoil, waste rock and overburden removed from the Open Pit shall be stock piled for use in site restoration during the Mine closure phase.

(7) Except as otherwise allowed in this Agreement, all transportation of Ore away from the site shall be via railroad.

(8) Such other and further limitations as are expressed in this Agreement or by the DNR shall also apply to the proposed Mine.

(9) The restrictions herein enumerated as to hours and days of operation.

(10) 300,000 Tons of ore per year shall be the approximate projected amount of ore to be shipped from the Mine each year.

d. The Mine and operations related thereto shall consist of three (3) phases, those being: (1) Construction; (2) Mine Operation; and (3) Closure.

4. SETBACKS

Structures in the Active Mine area shall be kept at least 250 feet from adjacent property owned by others except for the distance from the Flambeau River and other streams within the Active Mining Area and from roads and shall at no time exceed 225 acres. The total Open Pit area shall not exceed 40 acres. The 250 foot buffer to adjacent property shall be maintained in existing natural vegetation to act as an aesthetic, visual barrier. The Open Pit contemplated herein shall be excavated no

deeper than approximately 225 feet below the grades existing at the Active Mine Area on January 1, 1988.

5. GATES AND VISITORS OBSERVATION AREA

The Operator shall construct and maintain gates of sufficient strength to control access to the Mine. The gates shall be closed and kept locked by the Operator except during the hours of operation.

The Operator will provide an area to allow visitors to park and observe the Mining Operation.

6. SECURITY FENCING

Security Fences shall be used to surround the Active Mine Area to prevent unauthorized entry. These Security Fences shall be in place prior to operation, and maintained and used during the life of the Mine. Commencing with construction start up and continuing through closure of the Mine, the Operator shall repair the Security Fences as needed.

7. CONSTRUCTION SUPERVISION/INSPECTION

All earthen construction of the Mine, its storage areas and wastewater treatment ponds shall be under direct supervision/-inspection of a registered professional engineer.

8. HOURS OF OPERATION

Blasting, crushing and rail shipping operations shall be conducted during daylight hours, Monday through Saturday only.

9. ACCEPTABLE WASTE TYPES

The only non-hazardous wastes to be stored at the Mine are those wastes as defined by DNR and generated by the operations. The Operator shall not accept, receive, store or dispose of any Metallic Mineral from any other mine without Local Impact Committee approval, except those materials necessary for operation of the Mine and facilities. No Hazardous Waste, as

currently defined by the DNR according to NR 181.12, regardless of quantity, shall be accepted, received, stored, disposed of or transported to the Mine and Operator agrees that it shall not, at any time, apply to the DNR for a Hazardous Waste permit to store, or to dispose of any material currently defined as Hazardous Waste, at the Mine, or at any location in Rusk County.

This section does not preclude on-site storage of fuels, lab chemicals and blasting materials, provided they are contained in secured areas. This section also shall not apply to any precipitate resulting from water treatment activities.

10. OFF-SITE ACCESS ROADS

During the life of the Mine, Operator, its employees and agents transporting Ore to and from the Mine by truck shall be limited to access, to and from the Mine, from State Highway 27 via Blackberry Lane, a town road as of the time of execution of this Agreement, unless a new access road is constructed entirely at the expense of the Operator. Use of Jensen Road, Meadowbrook Road and Doughty Road, lying to the east of State Highway 27, for Ore hauling purposes, shall be limited to those emergency situations when the rail spur serving the Mine is impassible or inoperable and only for the purpose of gaining access to and from the main railway line to which said spur line is connected. The Operator shall construct, maintain and repair, to Town Road Standards as established by the Wisconsin Department of Transportation, and as amended or revised from time to time, those portions of the designated access road which are under Town jurisdiction and which are used by trucks for transporting Ore to or from the Mine to the extent that they remain as public roads. The Operator may contract with the Town, any other municipality or private firms for said maintenance and repair, including such graveling, grading and snow plowing as is necessary. Said maintenance and repair responsibilities shall continue throughout the period of active Mining. Notwithstanding the language above, the primary means of transporting Ore to

and from the Mine shall be by rail. The use of trucks for transporting Ore to and from the site shall be limited to emergency situations, or for special shipments of Ore containing significant amounts of gold bearing Gossan if required for special shipments. The use of trucks to transport to and from the Mine during the closure phase shall be negotiated separately prior to the end of the active Mining phase.

Emergency situations, as that term is used herein, shall not include the closure of the rail line or lines over which the Ore is intended to be transported for periods of time in excess of one month whether due to employee strikes, weather or other conditions, either within or outside of the control of the said rail line or rail lines, nor shall such conditions exist if the railroad, currently the Wisconsin Central, Ltd., or its successor in interest, to which the Mine spur line would be connected, abandons its line to which the spur is connected. Under any of the circumstances herein described, the Operator agrees to confer with the Local Impact Committee as to alternative means of transportation and their environmental, social and governmental effects and means of minimizing the same.

The restriction in sections 10 and 11 to the effect that conditions are imposed upon the use of trucks for the hauling of Ore to and from the Mine shall not apply with respect to sample shipments for testing purposes or other small shipments which are capable of being transported in trucks whose gross loaded weight does not exceed 10,000 pounds.

11. TRUCKING RESTRICTIONS

In the event that trucks are used as referred to under section 10, such use shall be subject to the following restrictions:

(a) No trucks shall transport Ore on Town roads during any other than daylight hours.

(b) This section and section 10 shall also apply to any Town roads which are ultimately annexed by the City of Ladysmith.

(c) The Operator shall clean all truck tires before such trucks exit on to any hard surfaced public road.

(d) The Town Board may set speed restrictions on any Town Roads or Town roads which are ultimately annexed by the City used for transporting Ore, pursuant to s. 349.11, Wisconsin Statutes.

(e) Any trucks transporting Ore on public roads shall be maintained to minimize leaks and shall be covered.

(f) All internal haul roads at the Mine site shall be restricted to prevent any public access.

It is agreed that the primary means of transporting Ore from the Mine to off-site facilities for smelting, processing and refining shall be via railway. To this effect, the Operator agrees that it shall, before Mining and extraction begin, take the necessary steps to have constructed and place into operation a spur line connecting the Mine with the main line of what is presently the Wisconsin Central, Ltd., east of the Mine.

12. HIRING OF EMPLOYEES

Over the life of the operation, Kennecott shall, in accordance with applicable law, assure that after the start of Ore shipments, an average of 75% of the mine workers shall be persons who have resided in or within 10 miles of Rusk County for a period of at least one year prior to hiring, whether hired directly by Kennecott or by any contractor/subcontractor hired by Kennecott. Contracts awarded by Kennecott shall contain local hiring goals for this purpose.

13. GROUNDWATER MONITORING WELLS

Not less than 6 groundwater monitoring Well Clusters shall be constructed within the Active Mine Area as indicated in Exhibit C. These wells are to be tested on at least a quarterly basis during the Baseline Monitoring Program, construction, and operation. In the event that a background of ground water contamination or content of minerals or other substances is ascertained which exceeds any applicable state or federal health standards, which discovery is made during base line testing, the well owner or owners shall be notified. Monitoring after closure shall be in accordance with the DNR approved reclamation plan. If testing of Downgradient Wells indicates that water quality does not meet primary and secondary drinking standards and if water quality indicates a significant deterioration from the background testing required herein, written notice shall be immediately sent by the Operator to all existing Downgradient Well owners within the area indicated on Exhibit D, attached hereto, informing them of the results and requesting permission to test their wells within 48 hours.

14. TESTING/GUARANTEE OF PRIVATE OFF-SITE WELLS

In addition to monitoring wells on the Mine site and surrounding the Mine site in accordance with this Agreement and DNR regulations, the Operator will also pay for and be responsible for the following:

a. The Operator shall test all existing active wells with respect to both quality and quantity, to establish background data, including those serving the Operator's rentals, within the area indicated on the map attached hereto as Exhibit D, at least twice prior to construction of the Mine and provided the owners not party to this Agreement give permission.

b. If, after commencement of mining, any well tests within the area indicated on Exhibit D indicate contamination or

Pollution, or if recommendations are issued by DNR not to use such well or wells for human consumption, Operator shall immediately following such discovery and also at least once a year thereafter test all active wells within the area indicated on Exhibit D and continue such testing for 20 years thereafter, unless it is proven that the contamination or Pollution is not caused by the Mine, or such condition is corrected, in which case such further testing shall no longer be required, or such requirement is waived, in writing, by the Local Impact Committee provided for herein. Such waiver shall not be unreasonably withheld.

c. Appropriate records shall be maintained and kept during this time period. The results of all tests on and off site shall be filed with the Town Clerk and Local Impact Committee.

d. The parameters to be tested are: field ph, field conductivity, acidity, chemical oxygen demand, iron, hardness, alkalinity and chlorides. Tests are to be conducted in accord with standard EPA or DNR approved methods. If the tests indicate a significant adverse change in any of the parameters from the baseline data the Operator will perform additional tests for other elements such as sulfates, arsenic, cadmium, chromium, lead, mercury and zinc to determine the cause of the change.

Test materials shall be furnished by the Operator, who shall be responsible for taking samples.

If during the period commencing with the start of the Mining Operation and ending 20 years after the Mine ceases to operate any well within the area indicated on the map attached as Exhibit D has evidence of contamination, Pollution or has written recommendations by the DNR not to be used for human

consumption, it shall be presumed that failure of the well has occurred and that failure was caused by the Mine, unless Operator, at it own expense, proves otherwise. Owners who do not grant the Operator permission to test their wells as indicated in a., above, shall not be eligible for relief granted hereunder.

Where well failure is presumed, as indicated above, the Operator shall, upon notice by the Town Board, provide an alternate and adequate source of water for domestic consumption, and for livestock consumption where applicable. In addition, the Operator shall assume all municipal responsibility under Sec. 144.855 (4) Wis. Stats., for any damage to those owners' water supplies, until such time as responsibility is proven otherwise. As used in this sub-section, "municipal" shall include the Town of Grant as well as the City of Ladysmith.

If the Operator undertakes the municipal responsibilities under Sec. 144.855 (4) Wis. Stats., and provides an alternate source of water and it is later determined by the DNR or a court that the Mine is not the cause of damage to a private water supply, the Operator may elect to be reimbursed for all the costs of supplying water, during a period not exceeding one year, under this Agreement by the third party to whom such water was supplied. The Operator shall have no responsibility to furnish compensation or an alternative supply of water under these provisions unless the party to whom compensation is provided or to whom the water is supplied signs an agreement with the Operator acknowledging the Operator's right to reimbursement.

15. COMPENSATION FROM LOSS IN PROPERTY VALUE DUE TO PROXIMITY OF MINE

During the period commencing with the start of the Mining Operation and ending 20 years after the Mining Operation ceases, any private land owner or tenant, or his or her successor in interest utilizing a well or wells located within the area set

forth in Exhibit E, who feels they have suffered a tangible, monetary loss as a direct result of their proximity to the Mine, may appear at any regularly scheduled meetings of the Local Impact Committee to present any claims of loss in property value due to their proximity to the Mine and which loss exceeds any other prevailing losses to similar property values in the County. The Local Impact Committee will hear all testimony relative to the compensation claim. An investigation may also be made of the facts in the claim independently by the Local Impact Committee.

Prior to construction of the Mine, and with the cooperation of landowners within the above-mentioned area, the Operator, at his own cost, shall have all properties in the subject area and three comparable properties outside the subject area, but in Rusk County, appraised by an independent appraiser to establish base information. Any property owner or his or her successor in interest refusing to cooperate by allowing their property to be appraised shall not be eligible to seek relief under this section at a later date. If the Local Impact Committee does not agree with the appraisals, the Local Impact Committee shall obtain an independent appraisal. The cost of the appraisal shall be paid for in equal shares by the Participating Governments and reimbursed from the payment required in Section 21 herein. If two appraisals are not within 10% of one another, the Operator or the Local Impact Committee can request a third appraisal be made by a mutually acceptable appraiser. The average of the third appraisal and the closest appraisal will be used as the basis and the party whose appraisal is not used will pay for the third appraisal.

If any such claim cannot be settled through a meeting between the claimant, the Operator and the Local Impact Committee, claimants must supply a new appraisal from a licensed appraiser substantiating, in writing, the reasons for such loss in property values. The Operator, at its expense, shall also have a new

appraisal prepared by a licensed appraiser again substantiating, in writing, reasons for any loss or in dispute of any loss in value of the subject property. The Local Impact Committee shall then have a review appraisal made of these two appraisals to determine whether there has been any decrease in value of the subject property solely due to its proximity to the Mine and to determine just compensation for any such loss in value substantiated by the Reviewer. The Local Impact Committee shall hire the review appraiser. These appraisals and reviews shall be conducted in accordance with DNR appraisal and review appraisal guidelines in effect at the time such reviews or appraisals are done or some other appropriate guidelines as agreed to by the parties.

If, based upon the review appraisal, the Local Impact Committee determines that the decrease in the value of the subject property was solely due to the proximity of the subject property to the Mine and the claim is justified, the Local Impact Committee shall determine that the amount of compensation representing the difference between the property without proximity and with proximity to the Mine shall be paid to the claimant. If a compensation award is made to the claimant, the Operator shall reimburse the claimant for appraisal costs in the manner indicated below. If no compensation is awarded, the claimant shall not be reimbursed for appraisal costs and shall reimburse the Operator for the Operator's appraisal costs. The Local Impact Committee shall have the power to assess Local Impact Committee costs and fees for conducting any investigation, in addition to compensation awarded.

The affected property owners shall have the right to elect to receive monetary damages if the property is sold in an arms length transaction, for the subject property's reduced market value due to the proximity to the Mine substantiated by the respective appraisals, unless the Operator, at its option, purchases the affected property from the claimant at its

equalized valuation in the year preceding any determination of Loss. The equalized valuation for such purposes shall be calculated by the Town Assessor in the usual manner and shall not reflect any loss in value due to proximity to the Mine.

16. LOCAL MINING IMPACT COMMITTEE

Within ten days after the date of this Agreement, the County, Town and City shall establish a successor Rusk County Mining Impact Committee (Committee or Local Impact Committee) consisting of the chief elected official of the Town, County and City or their designee(s) who possess no conflict of interest relative to the Mine. For purposes of this Agreement,"conflict of interest" shall be defined as meaning that no member shall own real estate within one mile of the Mine, nor shall he or she be married to or related by blood to any person with a fee simple interest in real estate situated within one mile of the Mine or employed at the Mine. Any two members shall establish a quorum. Said Committee may hold such public meetings noticed pursuant to the Open Meeting Law as it deems to be appropriate. One or more of said meetings each year shall include a public forum to discuss concerns or problems with the operation of the Mine. This reference to public meetings shall not be construed as prohibiting the Committee from transacting business in closed session, where deemed appropriate and necessary by it, in accord with Sec. 19.85, Wis. Stats.

To assist the Local Impact Committee in its monitoring efforts and in order for the Local Impact Committee to maintain familiarity with the ongoing status of the mining operation, the following information will be provided by the Operator on an annual basis, if generated no more than one (1) time per year, or on a semi-annual basis, if generated more frequently than on an annual basis:

a. Verifiable information as to the amounts and types of Ore removed on an annual basis.

b. Copies of reports between the Operator and the DNR.

c. Copies of complaints that are received by the Operator from citizens, neighbors, local law enforcement officers, and the DNR.

d. Notice of any significant change in operational plans for the proposed site.

e. Copies of insurance certificates pertaining to the proposed site.

f. Such information as is necessary to update the Participating Local Governments officials as to any substantial changes in organizational structure of the Operator and the impact of such organizational changes on the Mining Operation.

The Local Impact Committee, at its discretion, shall also review, discuss, and inspect the site during reasonable time and with reasonable notice, hold public meetings and report findings to the Participating Local Governments on the following:

a. Any complaints or complaints received by the Operator or Committee from citizens relative to the Mine and this Agreement.

b. Specific compliance by the Mine Operator with this Agreement and DNR regulations.

c. Potential dangers, imminent hazards or public nuisances and recommended actions to mitigate them.

d. All other items that are pertinent to the Mine including transportation to and from, construction, operation, maintenance, closure and long-term care of the site.

Copies of the official minutes of all such meetings shall be provided to the Operator within 10 days of meetings. This requirement shall not apply to the minutes of closed sessions, if any are held by the Committee, which shall be subject to release to the Operator in accord with Sec. 19.35 (1) (a), Wis. Stats., or when the need to maintain confidentiality no longer exists.

The expenses of the Local Impact Committee shall be paid by the Operator and per diem for each member shall be $20.00 per meeting, plus verifiable travel expenses. Such reimbursement of Local Impact Committee costs by the Operator shall not exceed a $750.00 cap, annually. The per diem fee and reimbursement cap shall be increased annually by four percent (4%) commencing the year after the Mine begins operations, for not more than 20 years after the Mine ceases operations.

The Operator agrees to on-site inspection of the Mine by the Local Impact Committee and/or the Grant Town Board upon reasonable notice and a representative of the Operator will accompany the inspector at all times.

17. LEACHATE STORAGE AND TREATMENT

During the life of the Active Mining operation and during any period of Temporary Closure, the Operator shall continue to collect, pump to its wastewater treatment facility, and treat all waters which come into contact with sulfide mineralization which is of such characteristics so as to warrant treatment pursuant to NR 102. The Operator shall not dispose of, store or treat outside the Mine site any Leachate that has been removed from the Mine except Leachate treated pursuant to a WPDES/NPDES permit, nor shall the Operator accept, receive, store or treat at this Mine site any Leachate from any other mine. Any drippings resulting from spraying Ore in rail cars to control dust shall not be classified as Leachate for purposes of this section. Ice, snow and water from precipitation which may

accumulate in rail cars during the course of loading and/or shipping, shall also be exempt from classification as Leachate.

To facilitate collection and treatment of water which comes in contact with potential sulfide mineralization and can produce a leachate that does not meet State standards the Operator agrees that it shall store the waste rock, which is removed from the Open Pit and contains sufficient sulfides that when leached by rain water will produce a discharge which is greater than the State standards will allow, on sites within the active mine areas specifically prepared for such storage. Said sites shall be lined to prevent seepage into the water table from occurring and shall be equipped with water collection pipes and equipment into which the water shall be channeled for treatment through the waste water treatment facility.

18. EMERGENCY EQUIPMENT AND PLAN

The Operator shall maintain a reliable communication system at the Mine using radio and/or telephone, so that contact can be made with the providers of emergency services, should the need arise.

The Operator will provide an emergency/security lighting system at the Active Mine Area during the hours of darkness.

The Operator shall prepare and issue to the Local Impact Committee an Emergency Preparedness Plan prior to filing a mining permit application with the DNR. Comments from the Local Impact Committee will be reviewed and incorporated if mutually agreed upon.

The plan submitted shall identify hazards peculiar to this Mine, such as steep slopes, blasting and heavy equipment use and, additionally, shall provide information to emergency responders as to chemicals or other materials stored on premises which may present particular fire fighting hazards. In addition, the plan

shall detail how emergencies associated with hazards associated with the Mine shall be dealt with by the Operator and shall include special instructions to any local governments responsible for administration of emergency responses. With respect to the emergency plan to be developed by the Operator, reasonable recommendations of the Participating Local Governments shall be incorporated into the plan.

19. SUCCESSION OF AGREEMENT

This Agreement shall be binding on all parties, their heirs, successors or assigns until its termination by mutual consent of the parties or at the expiration of the mining permit granted to the Operator by the DNR pursuant to NR 132, Wis. Adm. Code, whichever first occurs. This Agreement shall run with the land and a short form of this Agreement giving notice of this Agreement shall be recorded in the appropriate tract in the office of the Register of Deeds. All sections of this Agreement relating to closure, long-term care, insurance, sale or lease of the Mine or its operation, escrow funds, renegotiation, liability, guarantees, and related matters shall survive the termination of this Agreement for the period of years set forth therein. If at the termination of this Agreement the Operator seeks to continue Mining at this location, the Operator shall, in addition to all other requirements imposed by law, regulation and ordinance, agree to enter in negotiations on a new agreement with the Participating Local Governments. Owner may assign this Agreement, without the consent of the Participating Local Governments to a related company of Operator. A related company shall be a subsidiary or parent company of Operator or a sister company of Operator having the same ultimate parent company as Operator's parent company. The Operator may also assign this Agreement to a third party, other than a related company, subject only to submission to the Participating Local Governments of proof of the proposed assignee's financial capacity to assume all of the Operator's obligations hereunder. At a minimum, the assignee shall demonstrate compliance with Sec. 144.87 (2) (e), Wis.

Stats. Upon presentation of proof of financial capability, the Participating Local Governments shall not unreasonably withhold consent to assignment.

20. CLOSING PLAN

The Operator of the Mine, prior to commencing operation, shall file with the Local Impact Committee a copy of a closing plan for the Mine. The plan, at a minimum, shall contain a detailed finish grade plan and a landscape planting plan with types of vegetation indicated. In addition, the Operator shall provide a plan for future disposition of the land. These plans may be the same as those submitted to DNR.

After completion of the present planned Mine Operation, Kennecott will consider several options for disposition of Kennecott-owned property and facilities in Rusk County such as, continuing to maintain ownership, leasing portions to the Participating Local Governments for use as an Industrial Park, or selling the property and facilities. Prior to the sale to third parties of any property owned by Kennecott in Rusk County at this time, or the sale to third parties of any Kennecott-owned facilities or structures required for the Mine Operation, the Participating Local Governments will be given the first right of refusal based on the highest bid received. This excludes the internal transfer or assignment of property or facilities to a related company of Kennecott, which related company shall include a parent company, subsidiary company of Kennecott or parent or a company having a common parent with Kennecott. In the event of an internal transfer, the assignee will assume the obligations of the assignor.

The Participating Local Governments either jointly or individually will be given the first option or right of first refusal to match a bonafide offer to purchase the industrial site situated in the Active Mine Area, provided that in the Operator's sole opinion the separate sale of any portion thereof does

not adversely affect the sale or value of other property owned by the Operator. Said individual site shall include, but not be limited by reference thereto, the following:

(1) An area of land whose approximate dimensions are: Commencing at the Northwest corner of the intersection of Jensen Road and S.T.H. 27, thence Northerly 1000 feet; thence Westerly 1500 feet; thence Southerly 1000 feet; thence Easterly 1500 feet to the point of beginning, including the Operator's water treatment facility, crushing and ore loading facilities and administration center, among other structures but not including any portion of the Open Pit Mine or waste rock storage area.

(2) The building formerly known as the "H & H Hauler's Building" plus adjacent land, five hundred (500) feet to its North, South and West and East to the right-of-way of S.T.H. 27.

(3) The building formerly known as the "Grow Cheese Factory," plus adjacent land of the Operator, sufficient in the area to meet minimal requirements for industrial use under the Rusk County Zoning Code.

In addition, the industrial site shall also include the railway Spur Line connecting the Active Mine Area with the main line of the Wisconsin Central, Ltd.

Prior to the sale or dismantling of any equipment or facilities on the mine site the Participating Local Governments either jointly or individually will be given the first option or right of first refusal to match a bonafide offer to purchase any or all of the equipment and facilities, provided that in

Kennecott's sole opinion the separate sale of a specific item does not adversely affect the sale or value of other items. The equipment and facilities include such items as the fencing, pumps, water treatment facilities, crushing equipment, electrical equipment, piping, building (temporary and permanent), the rail spur, and the railroad right of way east of S.T.H. 27.

In the event Kennecott sells any property, equipment, or facilities to another mining company Kennecott will transfer the Participating Local Governments' option or right of first refusal as part of the sale. If the property is not to be used again for mining, Kennecott will use reasonable efforts to help the Participating Local Governments in finding a purchaser for the property.

Prior to the sale of the industrial site at the N.W. corner of the intersection of S.T.H. 27 and Jensen Road, if extended westerly to the Flambeau River, or the sale or dismantling of any equipment or facilities identified above, the Participating Local Governments either jointly or individually shall be given the first option or right of refusal to lease the industrial site and some or all of the equipment and facilities. The lease agreement will state that the users of the property will not resist, delay or interfere with any future mining operation on property presently owned by Kennecott in Rusk County, will not file any complaints against Kennecott or successors who may buy the property with respect to development or operation of any mine facility on Kennecott's property, will vacate the premises, upon ninety (90) days written notice to be exercised at the Operator's sole discretion whether at or before the end of an express term of occupancy and that its operations on premises shall be such that it is capable of physically vacating the premises within such period, and will carry full liability insurance in an amount sufficient to satisfy Kennecott. If Kennecott elects to sell the industrial site along with other

property owned by Kennecott, Kennecott will use its best efforts to provide the Participating Local Government or Governments who are leasing the property and/or equipment an opportunity to meet with the potential buyers to discuss for a period not exceeding 30 days any arrangement between the potential buyer and the Participating Local Government or Governments which would not affect the sale but could be satisfactory to the Government or Governments.

The Operator agrees to donate to the Participating Local Governments, subsequent to the reclamation of the site of the Mining Operation controlled by this Agreement, that parcel which it owns East of the main line of the Wisconsin Central, Ltd., South of Doughty Road and North of Jensen Road provided the Participating Local Governments agree that the users of the property will not resist or delay further development of the Flambeau Ore deposit and will not file any complaints against Kennecott or subsequent mining companies with respect to development or operation of a mining project because of the proximity, use or impact of the further development to the said parcel.

The Operator further agrees to lease to the Participating Local Governments the following parcels which it owns for $1.00 and other consideration.

(1) A parcel on the North side of the former "Sisters Farm," lying West of the Flambeau River, for use and development as an outdoor recreation area;

(2) River Frontage adjacent to the end of Blackberry Lane at the Flambeau River for park purposes.

The lease agreement will include the provisions identified above for the leasing of the industrial site.

The Operator, although recognizing the positive economic and social impacts which its Mine will make upon the community and the citizens

represented by the Participating Local Governments, agrees to duly consider the potential of donating other real estate from its holdings adjacent to the Active Mine Area to one or more of the Participating Local Governments or, in other ways, of benefiting the community. The Operator, in its sole discretion, agrees to contemplate these potentials, for the purpose of promoting, after cessation of Mining Operations, the interests of the community in which the contemplated mine will be situated.

Except as provided in this Agreement, any party, their successors and assigns, who acquires all or a portion of the Kennecott property and facilities located in Rusk County, shall not be permitted to use the property and facilities in a manner inconsistent with Kennecott's obligations pursuant to this Agreement and all applicable Federal, State and local laws, and such party will not oppose Kennecott's sale of remaining properties and facilities, and such party shall assume responsibility for the following obligations: (a) environmental, (b) all obligations resulting from the use of the property and facilities subsequent to the transfer of the property and facilities from Kennecott to such third parties, and (c) damage or injury to Kennecott caused by such third parties who have acquired the property and facilities in the event such third parties interfere with or adversely affect Kennecott's closing plan facilities. Such acquiring parties will permit Kennecott, upon reasonable notice, to have full access to the property and facilities to facilitate Kennecott's compliance with its obligations pursuant to this Agreement and all applicable Federal, State and local law.

It is further understood that the reference in the paragraph immediately above to environmental responsibility shall be limited to the liability of a successor in interest for environmental damage which occurs from and after the date of its assumption of ownership and use as a result of said successor's use of a specified portion of the Operator's property. It shall

not be interpreted as transferring or assigning to such transferee any of the Operator's environmental obligations under this Agreement or under Federal or State laws or regulations pertaining to the Operator's Mining Operation, closure of the mine or reclamation of the Active Mining Area.

21. MUNICIPAL NEGOTIATION AND RELATED PROFESSIONAL EXPENSES

The Operator shall reimburse the Participating Local Governments for municipal costs and expenses incurred by them during negotiations or as a result of the Operator's intent to locate a Mine in the Town regardless of whether the Mine actually is constructed or operated. While these funds may be used to hire professionals to assist in the negotiation process, the funds shall not be used to encourage, devise, initiate, continue or otherwise pursue legislation, rulemaking or litigation to prohibit the project. The costs and expenses to be defrayed shall be limited to the sum of $60,000.00 to cover such legal, engineering, per diem and related expenses as have already been incurred as of the date of this Agreement or are anticipated to be incurred by the municipalities. The Applicant shall provide this sum in equal portions to the Participating Local Governments within thirty (30) days of the date of executing of this Agreement by all parties.

22. MUNICIPAL LIABILITY

The Operator agrees to indemnify and hold harmless the Participating Local Governments, their officers, agents or employees from any and all liability, loss or damage the Participating Local Governments or their officers, agents or employees may suffer as a result of any claims, demands, costs or judgments against them arising in any way from negotiation of this Agreement, or from actions brought against the Participating Local Governments from persons suffering injury or property damage as a result of the transportation to the Active Mine Area and from the Active Mine Area by the Owner or Operator or the agents or contractors of either, construction, operation, maintenance,

closure and long-term care of the Mine, provided, however, such liability, loss or damage was not caused by the negligent or willful or wanton misconduct of the Participating Local Governments or their Town Officials or agents or employees. This Agreement to indemnify shall be for a period of 25 years. The Operator also agrees to support, defend and/or reimburse the Participating Local Governments for seventy-five percent (75%) of their respective reasonable legal expenses with regard to the above mentioned actions provided, however, such proceeding is not brought by any person or group of which any Participating Local Governments, Town Official or Member of the Local Impact Committee, or person negotiating this Agreement on behalf of the City, Town or County is a member or has given financial or legislative support of any kind to such person or group.

23. OPERATOR RESPONSIBILITY DURING OPERATION AND AFTER CLOSURE OF THE MINE

To evidence its commitment to long-term care of the Mine, as required under the Wisconsin Administrative Code, including subsequent amendments thereto, the Operator shall provide the Participating Local Governments with the following documentation:

a. After issuance of the mining permit by the DNR, but prior to commencing mining, a certification to the Participating Local Governments that a bond payable to the DNR in the amount required under NR 132 or other appropriate security as required by NR 132 has been secured.

b. Thereafter, the Operator shall annually certify to the Participating Local Governments that it is in compliance with NR 132, including any amendments thereto.

The Operator further agrees not to seek an exemption from NR 132.13(3) or (4) and to maintain the bond or other security in accordance with NR 132.13-(3) and (4) for thirty (30) years after closure which period shall commence 90 days after completion of the backfilling of the Mine, unless the Committee

receives a copy of the request to be exempted and concurs in writing, with a DNR conclusion to grant exemption. Such concurrence shall not be unreasonably withheld.

24. RENEGOTIATION

At any time, after the DNR grants of a mining permit under NR132 Wis. Adm. Code to the Operator, the Participating Local Governments or Kennecott may cause this Agreement to be opened for renegotiation by serving a petition upon the other party alleging the existence of one of the following conditions, provided that said petition or petitions are based upon findings made by or statements contained within correspondence to or from persons possessing the professional expertise to make such findings or statements, including but not limited to attorneys, engineers and hydrogeologists.

a. A feasibility study or any engineering or financial report disclosing any significant adverse environmental or economic impact not contemplated at the time of negotiation of this Agreement which has the potential to cause significant damages to the environment and/or expand significantly the financial burdens of any of the Participating Local Governments.

b. Expansion of more than ten percent (10%) of the area disturbed by the Operation in the Active Mine Area by the Operator, or the intention by the Operator to expand the site beyond the particular design described herein or the acquisition whether by purchase or gift, by the Operator, of a significant amount of additional real property or interest in additional real property adjoining the real property acknowledged by the parties to be the site of the Mine at the time of execution of the Agreement.

c. The Participating Local Governments reserve the further right, not to be limited by or to be construed as falling

under subparagraph a., above, to invoke their rights under NR 132 Wis. Adm. Code and Sec. 144.836, Wis. Stats., to provide comments or evidence to the DNR in any hearing or hearings on a mining permit application in the event all of the following conditions occur:

- There is a substantial change in any of the environmental or financial premises listed in Exhibit F, upon which the Agreement is based.

- The change will have a significant adverse effect on the Participating Local Governments or their residents or reduce the Operator's requirement to protect the environment below the requirements of federal and state statutes and regulations.

- The change is made between the time of execution of this Agreement and the DNR grant to the Operator of a mining permit under NR 132 Wis. Adm. Code.

If the above conditions all occur, the Participating Local Governments will also have the right to reopen specific affected provisions of this Agreement, with the exception of Paragraphs 27 and 31, for purposes of addressing such significant adverse effects. This right to reopen specific affected provisions of this Agreement, with the exception of Paragraphs 27 and 31 may also be invoked by the Participating Local Governments in the event that subsequent to execution, the Operator seeks to procure a waiver from or variance from any Wisconsin Administrative Code provision other than those identified in Exhibit G, which variance requests are acknowledged by these Participating Local Governments as having been made known to them prior to execution of this Agreement and as to which they have no objection. This right is reserved relative to variances pertaining to construction, operation and closure of the

Mine and only if such waiver or variance has an adverse effect on the local community or reduce the Operator's requirement to protect the environment. As is set forth with respect to renegotiation of the Agreement under sub-paragraph a., above, the Agreement reopening process shall be based solely upon findings made by or statements contained within correspondence to or from persons possessing the professional expertise to make such findings or statements, including but not limited to attorneys, engineers and hydrogeologists. In the event that the Participating Local Governments seek to invoke the rights set forth herein, prior written notice of the specific provision(s) as to which Agreement reopening is demanded or, alternatively, with respect to additional variance or waiver requests beyond those specified in Exhibit G, upon notice thereof from the Operator, prior notice as to the refusal to agree to said further waivers or variances beyond those expressed in Exhibit G and/or to the amount and time period of the performance bond shall be communicated to the Operator. In the event that reopening is demanded, it shall be with reference to specific clauses of the Agreement only. All rights, obligations and responsibilities of the Operator and Participating Local Governments not affected by said clauses shall continue in full force and effect.

d. If at any time the Mine ceases operations for longer than six months which cessation is not caused by a labor dispute, economic shutdown or force majeure.

e. In the event that uranium or thorium, or either of them, are discovered within the Mine site at levels above natural background which would render them to be merchantable and subject to possible mining by the Operator.

For the purposes of implementing this sub-paragraph, the Operator shall notify the Participating Local Governments upon its acquisition of information or formulation of an intent, either of which falls within the categories at a to e above.

Within thirty (30) days of receiving documented invoices, after entering into renegotiation of this Agreement, the Operator shall reimburse the Participating Local Governments for seventy--five (75%) percent of justifiable municipal costs and expenses incurred as a result of such renegotiations. Said costs and expenses may include but are not limited to: (1) attorney and consulting fees, (2) per diem costs of municipal officials and employees and (3) per diem costs of the Committee. Such reimbursements shall not exceed the cap of $5,000.00 unless another amount is specified within any renegotiated agreement. During any renegotiation proceedings initiated under sub-section a., above, and until the same are concluded, any item of the Agreement which qualifies under sub-section a., above is subject to renegotiation.

25. GRIEVANCES

The Operator shall respond, in writing, within thirty (30) days to any written grievance filed by Participating Local Governments' officials, relative to the operation, including during the initial construction phase.

26. ADDITIONAL INFORMATION

Before any operational plans for the proposed Mine are filed with the DNR, the Applicant shall provide the Local Participating Governments with the following information, which may be the same as that provided DNR:

a. The names, business addresses and telephone numbers of the corporation and its corporate officers, including the name of its parent corporation.

b. The names, addresses and telephone numbers of the legal agents for the corporations in a. above.

c. The business address and telephone number of the corporate office most directly involved with this proposed Mine.

d. Description of proposed site ownership.

e. Status of any other Rusk County mine sites under construction by the Applicant and locational information about them.

f. Reference from corporate bond counsel, if available.

g. Description of any civil criminal violations the Applicant has had within this State, with DNR or other state or local agencies or government.

h. Name of the responsible corporate officer for this proposed site, and names of attorneys and negotiators for the Operator, including their business addresses and telephone numbers.

i. Types of Ores which will be removed from the proposed Mine.

j. Estimated amount of Ore in tonnage.

27. CONDITIONAL USE PERMIT

This Agreement is contingent upon, and the parties obligations hereunder will not commence until, the occurrence of the acts or events set forth in a., b., and f., below, and is further subject to the understandings set forth in c., d., and e. below:

a. The issuance of a conditional use permit for the Mine as provided in Attachment H.

b. All Participating Local Governments providing adequate proof to the DNR in the form necessary to satisfy the Wisconsin Statutes and Administrative Regulations that the proposed Mine has all necessary local approvals from the Participating Local Governments.

c. That portion of the Comprehensive Zoning Code known as the Rusk County Mineral Mining Code, Secs. 6.3 to 6.11, inclusive, shall not be applicable to the Active Mine Area, Mine, Mine Operation and Railway Spur Line.

d. The County Shoreland-Wetland overlay zoning district is not applicable to the Active Mine Area, Mine, Mine Operation and Railway Spur Line.

e. The zoning of the Active Mine Area and Railway Spur Line shall be under the I-1 industrial classification in the County Comprehensive Zoning Code.

f. A representation shall be made by counsel for the Town of Grant that, in his opinion, a certain moratorium against mining adopted at the annual town meeting held on April 13, 1982, and that certain moratorium against mining adopted at the annual town meeting on April 12, 1988, as pertaining to the Mine which is the subject of this Agreement are void and unenforceable.

The above activities shall be provided in accordance and consistent with all applicable statutory provisions.

28. LIMITATIONS ON OTHER CONTRACTS MADE BY THE APPLICANT/OPERATOR

To minimize concerns of Participating Local Governments about future operational or organizational changes, the Applicant/-Operator agrees that:

a. This Agreement may not be assumed by a third party unless such third party is financially capable and assumes all of the obligations of Owner hereunder.

b. The Owner may not transfer responsibility of ownership, possession or operation of the Mine to a third party unless the third party is financially capable and assumes all of the obligations of Owner hereunder.

29. ENFORCEABILITY OF THIS AGREEMENT IN THE EVENT THAT THE MINE IS NOT LICENSED

If, for whatever reason, a license is not granted by DNR to the Operator, its successors, or assigns to operate the proposed Mine, sections 21. and 22. only shall be enforceable against the Operator, and all other items shall become null and void.

30. RUSK COUNTY MINING IMPACT FUND

a. Each of the Participating Local Governments shall in each year the Mine is in operation apply for and retain all amounts to which each is entitled under Sec. 70.395, Wis. Stats.

b. Annually, beginning with the year in which Mine Operation commences and continuing during each calendar year of the Mine Operation, the Operator shall pay to each of the Participating Local Governments, whether each actually receives net proceeds first dollar tax shares under Sec. 70.395 (2) (d) 1. and 2., Wis. Stats., or not, the difference if the amount each Participating Local Government is entitled to receive for their use under Secs. 70.395 (2) (d) 1. and 2., Wis. Stats. is less than $100,000 (adjusted for inflation under Sec. 70.375(6) Wis.Stats.) in proportion to the number of tons of Ore shipped in the calendar year in question versus 300,000 tons. In the event, however, that the Operator ships more or less than 300,000 tons in the calendar year in question, it shall pay to the

Participating Local Governments $100,000, plus the inflation factor under Sec. 70.375[6], Wis. Stats., multiplied times a ratio whose numerator shall be the number of tons actually shipped and whose denominator shall be 300,000, less their first dollar payment entitlement, plus inflation factor for that calendar year. This annualized payment shall be subject to the minimum operations gross payment required under c., below. However, the Operator will not pay any portion of the difference which results from tax credits the Operator receives from payment of any new pre-operations tax payments which are required by new tax laws. For the purpose of this paragraph, it is assumed that the Operator will invoke its right to annex at least 15% of the mineable Ore body to the City of Ladysmith, thus making the City eligible for receipt of first dollar payments under Sec. 70.395 (2) (d) 2., Wis. Stats.

c. It is the Operator's intention to provide to the Participating Local Governments a minimum gross payment which shall consist of the first dollar payments, adjusted for inflation under Sec. 70.375 (6), Wis. Stats., which each is actually entitled to receive pursuant to Sec. 70.395 (2) (d) 1. and 2., Wis. Stats., to the extent that tax monies are actually generated from the net proceeds tax, in sufficient amounts so as to cause the specified first dollar payments or portions thereof to be made to the Participating Local Governments, and additional payments, to be provided directly by the Operator to them, resulting in a minimum gross payment by the Operator to the Participating Local Governments over the operating life of the Mine in the amount of $1,500,000.00, adjusted for inflation in accord with Sec. 70.375 (6), Wis. Stats. (1985-86) provided no actions are taken by the State of Wisconsin or the Participating Local Governments which prevent the Operator from Mining the Ore Body. This cumulative payment shall be in addition to and not in lieu of any other tax

shares which each of or any one of the Participating Local Governments may receive pursuant to Sec. 70.395 (2) (d) 1m., or 5. or (g), or (h), Wis. Stats, except as otherwise provided herein at d., below. This cumulative payment over the operating life of the Mine shall constitute a minimum guarantee of first dollar payments only under Sec. 70.395 (2) (d) 1. and 2., Wis. Stats. In addition, said cumulative payment shall be made by the Operator to the Participating Local Governments whether or not one or more of them is ineligible to receive first dollar payments under Secs. 70.375 to 70.395, Wis. Stats., and whether or not said statutory sections and the Wisconsin net proceeds tax on mineral extraction, whether in its present form or as amended, remain law throughout the operating life of this Mine.

d. Commencing with the first full calendar year of Mine Operation and continuing for not less than four (4) years or until the last full calendar year of Mine Operation, whichever is later, the Operator shall guarantee to Rusk County payment of up to its maximum entitlement to tax proceeds under Sec. 70.395(2)(d)1m., Wis. Stats., should the actual tax proceeds entitled by the County from the State of Wisconsin thereunder be less than the maximum entitlement of the County in any or all of those years. This guarantee shall be conditioned upon and subject to the following qualifications:

(1) For each calendar year subject hereto, the guarantee payment shall be based upon the average yearly Comex price of copper for the year in question. In accord with the following chart, depending upon the average Comex copper price, should the County be entitled from the State an amount less than its maximum entitlement of $250,000.00, the Operator shall guarantee payment to the County in the

amount of $250,000.00 multiplied by the percentage listed opposite the copper price in question, as modified by the terms of (2), (3) and (4) below.

(2) The annual guarantee, as conditioned under (1) above shall be subject to the following multiplier: the sum arrived at under (1) shall be multiplied times a ratio whose numerator shall be the actual number of tons of Ore shipped from the Mine in the calendar year in question and whose denominator shall be 300,000 tons or Ore.

(3) From the net sum arrived at upon application of (1) and (2) above, there shall be deducted the actual amount of tax collections the County is entitled to receive from the State of Wisconsin under Sec. 70.395(2)(d)1m., Wis. Stats., for the calendar year in question. The resulting sum, subject to (4), shall be paid directly from the Operator to the County.

(4) The guaranteed payments determined under this paragraph shall be further adjusted for inflation in accord with Sec. 70.375(6), Wis. Stats.

COMEX COPPER PRICE

Cents per pound of copper	Percentage
Less than 65	0
65 but less than 70	20
70 but less than 75	40
75 but less than 80	60
80 but less than 85	80
85 or greater	100

The Operator further agrees that pursuant to Sec. 70.395(2)(d)5c, Wis. Stats., the Operator will make a one-time only construction period payment, and pursuant to Sec. 70.395(2)(dg), Wis. Stats., the Operator will deduct the gross amount of said construction period payment from its tax liability under Sec. 70.395, Wis. Stats., for other than the maximum amount of first dollar payments. The Operator will use its best efforts to distribute such tax credits to minimize the impact on the taxes the County is entitled to receive under 70.395(2)(d)1m., Wis. Stats.

e. The Operator, in its capacity as owner of the real property, in which the Mine is situated, shall exercise the right granted at Sec. 66.021, Wis. Stats., to petition to annex the following described property to the City of Ladysmith:

A parcel of land located in Sections 9 and 10, Township 34 North, Range 6 West, Rusk County, Wisconsin, described as follows:

Commencing at the northeast corner of the Southeast Quarter of the Northeast Quarter (SE¼-NE¼) of said Section 10, also being the point of beginning of this description; thence westerly along the sixteenth line to the West right-of-way line of the Wisconsin Central Railroad Ltd.; thence southerly along said west right-of-way line to a point approximately 1250 feet North of the south line of said Section 10, said point also being North 40,500 feet as based upon the Flambeau Mining Corp. mine coordinate system; thence West, assumed bearing, 900 feet along the mine grid line of North 40,500 feet; thence South 300 feet; thence West 400 feet; thence North 300 feet to the mine grid line of North 40,500 feet; thence West to a point approximately 1380 feet North of the south line of said Section 9 and 1300 feet West of the east line of said

Section 9, said point being more particularly described as North 40,500 feet and East 40,100 feet, mine coordinates; thence South 45° West approximately 980 feet to Section 404 of the Flambeau Mining Corp. Baseline; thence approximately North 45° West 860 feet along Section 404 of said Baseline; thence South 45° West 600 feet to the center of the Flambeau River; thence South 45° East approximately 800 feet to a point, said point being more particularly defined as North 39,500 feet and East 39,000 feet, mine coordinates; thence East approximately 500 feet to a point, said point being more particularly defined as North 39,500 feet and East 39,500 feet, mine coordinates; thence approximately North 45° East 425 feet to a point, said point being more particularly described as North 39,800 feet and East 39,800 feet, mine coordinates; thence East 625 feet to a point, said point being more particularly described as North 39,800 feet and East 40,425 feet, mine coordinates; thence South 300 feet to a point approximately 380 feet north of the south line of said Section 9 and approximately 1050 feet West of the east line of said Section 9, said point being more particularly described as North 39,500 feet and East 40,425 feet, mine coordinates; thence East to the east line of said Section 10, said course being more particularly described as East along grid line North 39,500 feet, mine coordinates; thence North along the east line of said Section 10 to the point of beginning.

The purpose of this requirement shall be to enable the City of Ladysmith to be deemed eligible for first dollar payments under Sec. 70.395 (2) (d) 2., Wis. Stats. said property description is presumed to contain at least fifteen (15) percent (%) of the mineable Ore body which is the subject of this Agreement. Should the description not contain 15% of the mineable Ore body, it shall be the sole

responsibility of the Operator to prepare a legal description of real estate which contains that minimum % for purposes of annexation to the City.

f. For the purpose of applying c., above as concerning the attribution of the inflation factor against the minimum gross payment due to the Participating Local Governments, the following shall control. In a given calendar year, the base payment, defined as $100,000 multiplied by the number of local governments who are considered Local Participating Governments with respect to paragraphs a, b, and c of this section 30 in proportion to the number of tons of Ore shipped in the calendar year in question versus 300,000 tons (hereinafter "base payment"), shall have added to it the indexed amount calculated under Sec. 70.375 (6), Wis. Stats. For each calendar year in which a base payment is made, the appropriate indexed amount shall be added thereto. When the base payments made equal $1,500,000.00, the Operator shall have satisfied its obligation hereunder.

g. In addition to the above described payments from the Operator to the Participating Local Governments, in the event that the Operator fails to exercise its right at all or prior to the commencement of Ore extraction, as to annexation of land to the City of Ladysmith, for the purposes of application of paragraphs a., b., c. and f., the City of Ladysmith shall be considered to be a Participating Local Government and the minimum gross payment called for at Paragraph b. shall not be reduced due to the City's ineligibility to receive first dollar payments under Sec. 70.395 (2) (d) 2., Wis. Stats. However, the City of Ladysmith shall not be considered a Participating Local Government with respect to paragraphs a, b, c and f, of this Section 30 if the City does not approve an annexation requested by the Operator which includes at least 15% of the Mineral Ore Body. If the City of Ladysmith is not

considered a Participating Local Government with respect to paragraphs a, b, c and f of this section 30, the minimum gross payment of $1,500,000 referred to in paragraphs c, f and o will be reduced to $1,000,000.00.

h. The Participating Local Governments may, at their sole discretion, waive all or any portion of the payments to such Participating Local Governments, which payments are required hereunder, if they determine that presently unanticipated benefits of mining will provide offsetting long-term benefits to their respective Participating Local Governments.

i. Funds received under this paragraph 30. shall not be used to devise, initiate, continue or otherwise pursue legislation, rulemaking or litigation to suspend Mining Operations.

j. It is further understood and agreed upon that as to payments called for under this Agreement which are in addition to and beyond those payments received by the Participating Local Governments through and under the net proceeds tax under Secs. 70.375 to 70.395, Wis. Stats., the said additional payments may be used by each Participating Local Government Unit in any governmental or proprietary manner which it may legislate and shall not be limited to Mining related purposes.

k. The Operator will use all reasonable efforts to support the Participating Local Governments to cause a change to Sec. 70.395 (2) (d) 1m. and Sec. No. 70.396 (1) Wis. Stats. to eliminate the requirement that the County use amounts received from the Net Proceeds Taxes for Mine related purposes or enable it and/or the City or Town to develop sinking funds from which to meet unanticipated local costs associated with the operation and closure of the Mine. In

addition, the Operator will use all reasonable efforts to support the Participating Local Government's efforts to receive the full share of the net proceeds first dollar taxes which they are entitled to under Sec. 70.395(2)(d) 1 and 2 Wis. Stats., and will contribute 50% of the reasonable legal fees associated with such an effort up to a maximum of $25,000.00.

l. In the event that during the Mine Operation phase the Operator, for reasons unrelated to this Agreement, avails itself of its ability to submit a petition for annexation or if its land is subject to a petition of a third party for annexation to the City of Ladysmith, which petition is adopted by the said City and as a result of which annexation less than 15% of the mineable Ore body remains in the Town of Grant, the Operator, despite said Town's ineligibility to continue receipt of first dollar payments under Sec. 70.395 (2) (d) 2., Wis. Stats., shall continue to treat the Town as a Participating Local Government and the annual payment and minimum gross payment called for at paragraph b. and c. shall not be reduced due to the Town's ineligibility to receive first dollar tax proceeds.

m. The guarantees expressed in this section shall be binding against the Operator; provided, however, that no actions shall be taken by the State of Wisconsin or the Participating Local Governments which will prevent the Operator from mining the Ore body and shipping Ore from it. In the event of such action, during the pendency of the halt to the Mining and shipping of Ore, if it is temporary in nature or, if permanent from and after its inception, the guarantees shall be ineffective and not binding upon the Operator. As to Ore shipments made before and/or after such a halt, all responsibilities of the Operator under this section shall be met by it.

n. (1) Wherever, in b., c. and d., above, the words "entitled" or "entitlement" are used with reference to a conditioning of the Operator's guarantee of first-dollar payments, it is understood and agreed upon between the parties hereto that said words refer solely to circumstances in which either the State of Wisconsin or its local impact board refuse, in a given year, to appropriate to one or more of the Participating Local Governments all or part of their first-dollar payment entitlements under Sec. 70.395(1)(a)(2)(d)1. and 2. and (e) Wis. Stats., for failure of the local government in question to have used past first-dollar payments in a manner consistent with law or where Participating Local Governments have been required to return previously appropriated first-dollar payments to the State of Wisconsin. Only under these express circumstances shall the Operator's minimum gross payment guarantee be reduced and then only to the extent of the deficiency in entitled first-dollar payments received or retained in accord with Sec. 70.395(1)(a)(2)(d)1. and 2. and (e), Wis. Stats., which deficiency is caused by the non-appropriation of or return to the State of first-dollar payments by the Participating Local Governments in question.

(2) It is the further understanding and agreement of the parties hereto that Sec. 70.395(1), Wis. Stats., calls for the payment of net revenue taxes collected by the Department of Administration to the extent of the first-dollar payments or 60 percent of the total tax collected, whichever is greater, into the investment and local impact fund, from which, in turn, the Department of Administration, upon certification of eligibility, shall distribute first-dollar payment monies to the Participating Local Governments under Sec. 70.395(2)(d)1. and 2., Wis. Stats., adjusted for inflation under Sec. 70.395(1)(c), Wis. Stats., as modified

by Sec. 70.395(2)(e), Wis. Stats. Thus, should the Operator pay, in any given year of operation, less than the amount required to fully fund the maximum legal levels of participation by each of the Participating Local Governments in first-dollar payments, as determined with reference to Sec. 70.395(1)(a), Wis. Stats., the minimum gross payment over the operating life of the Mine shall not be reduced.

o. If upon the conclusion of the shipping of Ore from the Mine, the total of the annual base payments are less than $1,500,000.00, which is the required minimum gross payment under c., above, the Operator shall, within three (3) months next following the final yearly base payment, which consist of the underlying first-dollar payment and the Operator's guarantee payment, pay to the Participating Local Governments the difference between $1,500,000.00 and the total of the annual base payments made. Added to this payment shall be the inflation factor in accord with Sec. 70.375(6), Wis. Stats.

31. LOCAL GOVERNMENTS WILL NOT OPPOSE THE MINE

Except as provided herein, the Participating Local Governments and parties negotiating this Agreement agree not to oppose the Mine or to take any action which would serve to unreasonably delay the construction of the Mine. The Participating Local Governments also agree to take all action necessary to assure that the Applicant 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 operation.

The local permits, approvals and licenses herein above referred to are expressly identified as follows: (a) The conditional land use permit to be issued by Rusk County pursuant to its authority under Sec. 59.97, Wis. Stats. (b) Building permits

consistent with applicable state and local regulations as may be required for the erection for structures. (c) Sanitary permits under state and local regulations as may be required. (d) Ratification by the Town of Grant in accord with Sec. 59.97 (5) (e) 6., Wis. Stats., of that change in zoning district boundaries incorporated by reference in the conditional use permit set forth at (a) above. (e) In the event of annexation of a part of the real properties subject to this Agreement to the City of Ladysmith, ratification by the said City of the terms of the conditional use permit as governing its zoning control of the Operator's land use thereupon.

The moratoriums are certain moratoriums against Mining adopted at the annual town meetings held on April 13, 1982 and April 12, 1988 as pertaining to the Mine which is the subject of this Agreement. Counsel for the Town of Grant represents that it is not necessary to remove these moratoriums as these certain moratoriums are void and unenforceable.

As to the permits which may be required under sub-clause (b) and (c) above, upon compliance of the Operator with state and local regulations, both of a procedural and substantive nature, the requisite permits shall be granted by the Participating Local Government in control of the same.

This affirmation shall include any and all local permits, approvals, licenses and moratoriums necessary for operation of the Mine, but shall not include any state or federal permits required to be obtained by the Operator in connection with the Mine. It shall be the Operator's sole responsibility to ascertain the need for and to apply for and procure any such permits.

32. INAPPLICABILITY OF RUSK COUNTY MINERAL MINING CODE

a. That portion of the Comprehensive Zoning Code known as the "Rusk County Mineral Mining Code," which consists of

Sections 6.3 to 6.11 inclusive of the Comprehensive Zoning Code shall not be applicable to the Active Mine Area, Mine, Mine Operation, and railroad spur.

b. The County Shoreland-Wetland overlay zoning district is not applicable to the Active Mining Area, Mine, Mine Operation, and railroad spur.

c. Zoning of the Active Mine area and areas encompassing the railroad spur shall be I-1.

33. DEFAULTS

In the event either party is in default in the observance or performance of any of the covenants or obligations contained in this Agreement, the nondefaulting party may give the defaulting party written notice of the default specifying the details of the same. The defaulting party shall have two weeks to remedy any default in payment of monies or a reasonable time of not less than two months within which to remedy any other default described herein or to commence action in good faith to remedy such default. Unless the defaulting party shall so comply the nondefaulting party may pursue any remedy it may have in equity or at law. If the nondefaulting party obtains a judicial determination that this Agreement should otherwise be terminated because of such default, the defaulting party shall have a reasonable time of not less than two months after such determination within which to remedy such default or to commence action in good faith to remedy such default before any such termination may be declared.

34. ABILITY OF PARTICIPATING LOCAL GOVERNMENTS TO PARTICIPATE IN NR132 HEARING PROCESS

Nothing in this Agreement shall be interpreted as restricting or prohibiting the Participating Local Governments from participating in the DNR permit granting process, with respect to this

proposal to mine, providing, in the course of such participation, input or evidence to be considered by the DNR in its review and permitting process under NR132 Wis. Adm. Code. The sole restriction imposed hereunder upon the Participating Local Governments, should they chose to so participate, is that they shall not, in the course thereof, renounce, repudiate, or reopen this Agreement or any other permits and local approvals granted by them hereunder, except as such right or option may be made available to them under Section 24.

35. DISPUTES

The parties will use their best efforts to resolve disputes arising over the interpretation of this Agreement. In the event of such disputes, the party noting the dispute shall give the other party written notice of such dispute. Upon receipt of such written notice, the party receiving the notice shall have thirty (30) days to respond in writing to the original party. Thereafter, the parties shall meet together in good faith and use their best efforts to resolve the dispute in question. Either party may, at its sole expense, invite third parties, including technical consultants and others, to comment upon the dispute and the other party shall give due consideration to such comments. If the parties have not resolved the dispute within ninety (90) days of the date of the first written notice of the dispute, or by a later date, if agreed upon by the parties, either party may pursue any remedy it may have in equity or in law.

36. INVALIDATION

Invalidation of any item of this Agreement by a court, except paragraphs 27, 31 and 32, shall not invalidate the remainder of this Agreement. Invalidation of either paragraphs 27, 31 or 32 shall invalidate the entire Agreement except paragraphs 21 and 22.

37. LAW

This Agreement shall be interpreted under the laws of the State of Wisconsin.

38. NOTICES

Unless otherwise dictated within this Agreement, either expressly or by reasonable implication, and unless otherwise dictated pursuant to state or federal laws, rules or regulations governing the instant Mining Project, notices required or deemed appropriate under the terms of this Agreement shall be provided in writing and served personally or by mail upon the following designated representatives of the parties hereto:

(1) Upon Kennecott Explorations (Australia) Ltd., at 1515 Mineral Square, Salt Lake City, Utah 84112, Attention: Project Manager - Flambeau.

With a copy to:

Kennecott, 10 East South Temple Street, Salt Lake City, Utah 84133, Attention: Assistant Chief Counsel.

(2) Upon Local Impact Committee, to the Chairman thereof.

(3) Upon Rusk County to the Chairman of the Board of Supervisors at the Rusk County Court House, Ladysmith, Wisconsin 54848.

(4) Upon the Town of Grant, to the Chairman of the Town Board.

(5) Upon the City of Ladysmith, to the Clerk-Administrator at Ladysmith City Hall, Ladysmith, Wisconsin 54848.

It shall be the responsibility of each of the Participating Local Governments to promptly advise the Operator of the names and addresses of their designated representatives, as changes in

said positions occur, from time to time. Prompt notice of a change in its designated representative or representatives shall be given by the Operator to each of the Participating Local Governments and the Local Impact Committee, as well.

39. MODIFICATIONS

There shall be no modifications to this Agreement, except those which are mutually agreed to by all of the parties hereto in which are reduced to writing and executed with the same formality as this Agreement.

40. TITLES ARE ILLUSTRATIVE OF CONTENT ONLY

Titles to sections, paragraphs and/or other subdivisions within this Agreement are for illustrative purposes only and shall not be construed as limiting or expanding the intent of the substantive language set forth thereunder.

41. LEGAL AUTHORITY

This Agreement is entered into by the Participating Local Governments in accord with the authority granted to each such unit pursuant to Secs. 59.07, 59.97, 60.22, 62.11, 66.30, 144.838, 144.839 (laws of 1987-88, Wis. Stats).

42. DATE

This Agreement is dated as of the 1st day of August, 1988.

RUSK COUNTY

By John P. Kaiser

Melanie Meyer

TOWN OF GRANT

By

CITY OF LADYSMITH

By _____

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD.

By _____

MASTER-jl

EXHIBITS

A. Plot Plan showing the Active Mine Area

B. Legal description of the land where the Mine is located

C. Map showing location of groundwater monitoring wells

D. Map showing Area covered by Well Guarantee

E. Map showing Area covered by Property Guarantee

F. Premises Used as Basis For Agreement

G. Waivers and Variances approved by Local Impact Committee

H. Conditional Use Permit

I. Letter dated July 13, 1988 from L.E. Mercando to W.G. Thiel With attached Kennecott letter dated July 12, 1988 regarding Two Tier Testing

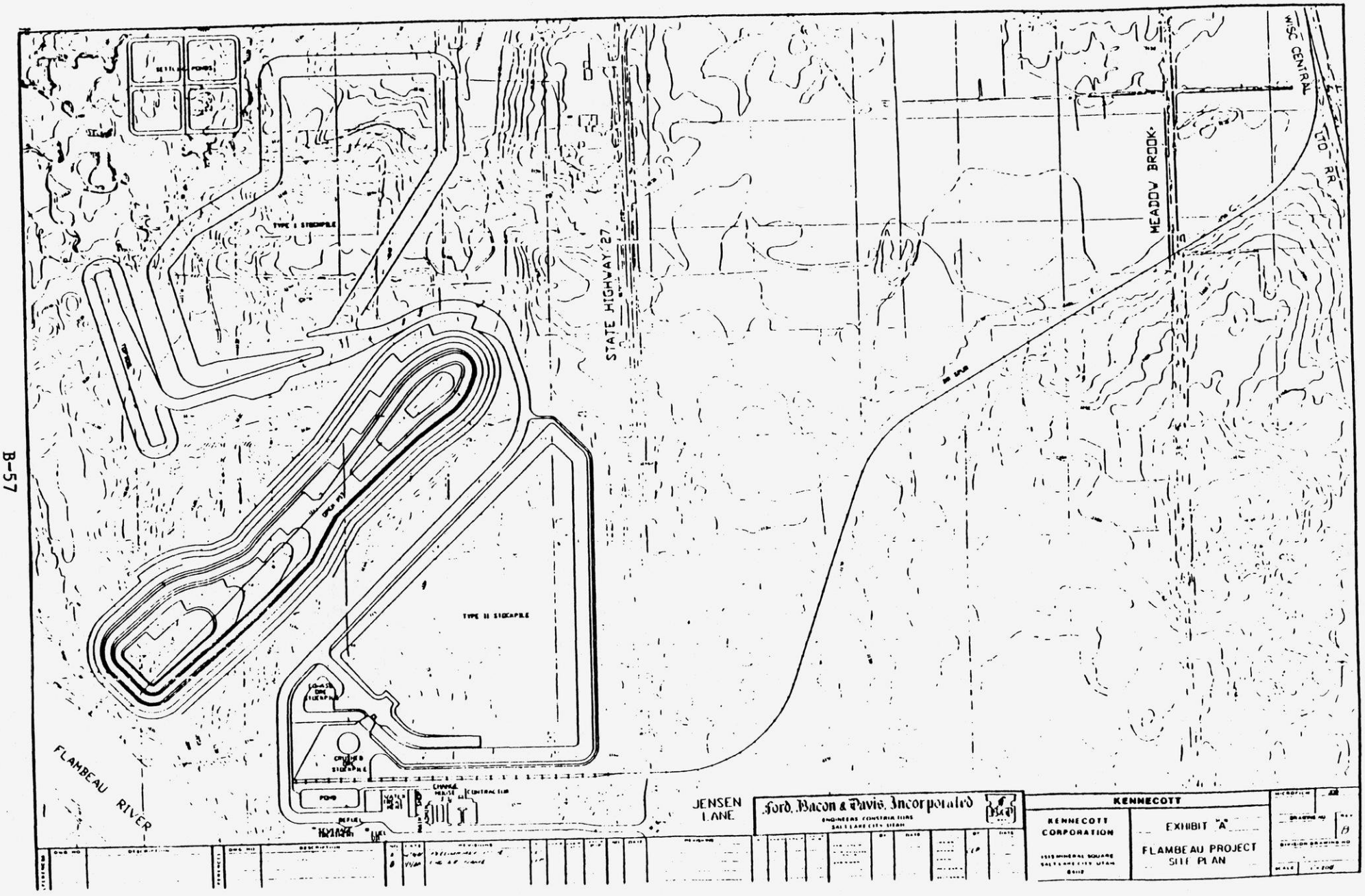

WISC CENTRAL LTD RR.
MEADOW BROOK
STATE HIGHWAY 27
TYPE I STOCKPILE
TYPE II STOCKPILE
FLAMBEAU RIVER
JENSEN LANE
Ford, Bacon & Davis, Incorporated
KENNECOTT
KENNECOTT CORPORATION
EXHIBIT "A"
FLAMBEAU PROJECT
SITE PLAN

EXHIBIT B

LEGAL DESCRIPTION OF THE LAND WHERE MINE IS LOCATED

FACILITIES ON LAND: Mine, appurtenant structures and facilities, but excluding the railroad spur, access roads, and utility feed lines.

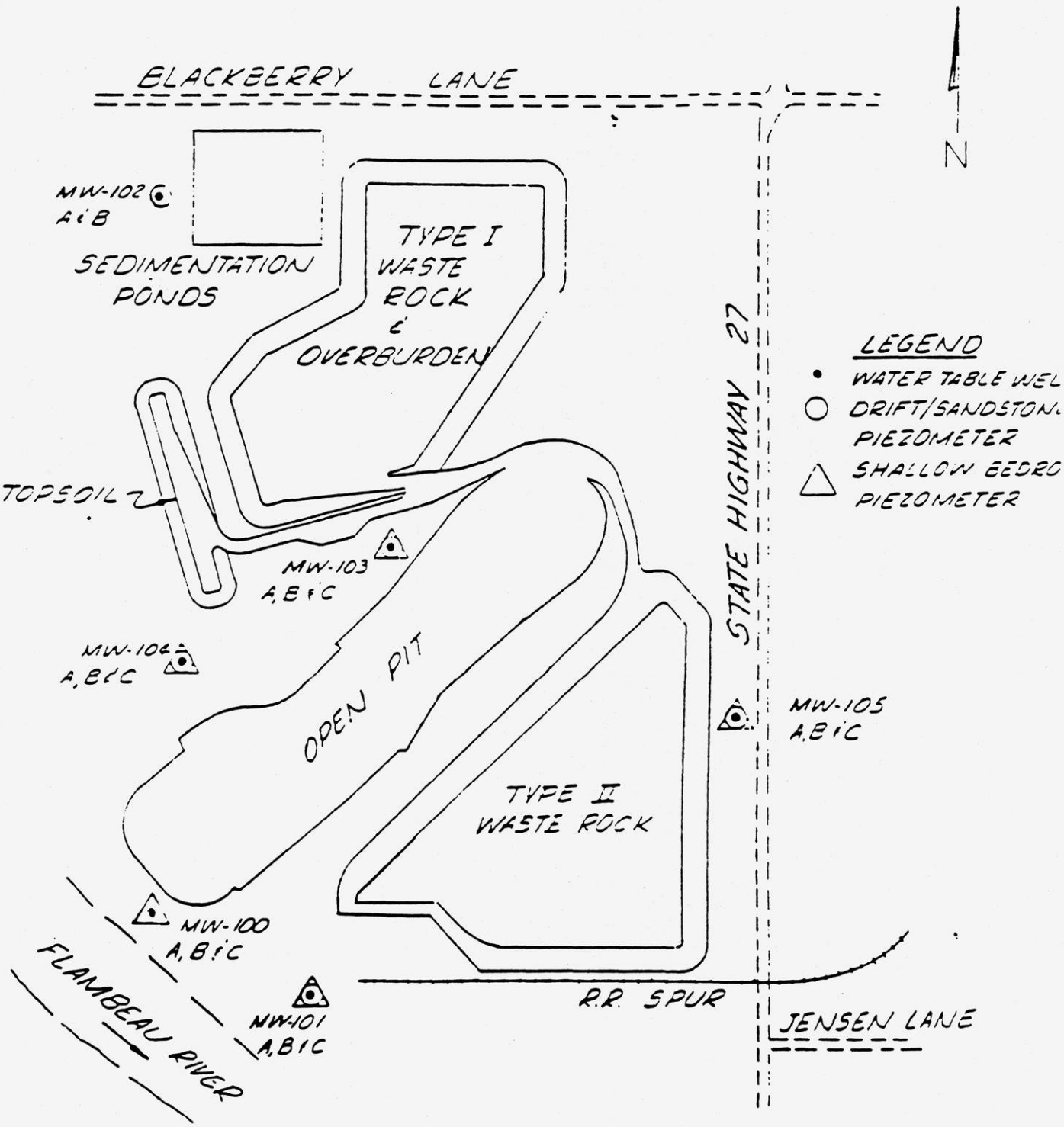
LEGAL DESCRIPTION: All that part of Section 9, Township 34 North, Range 6 West, Rusk County, Wisconsin, lying East of the Flambeau River and South of Blackberry Lane.

LEGAL DESCRIPTION OF THE RAILROAD SPUR

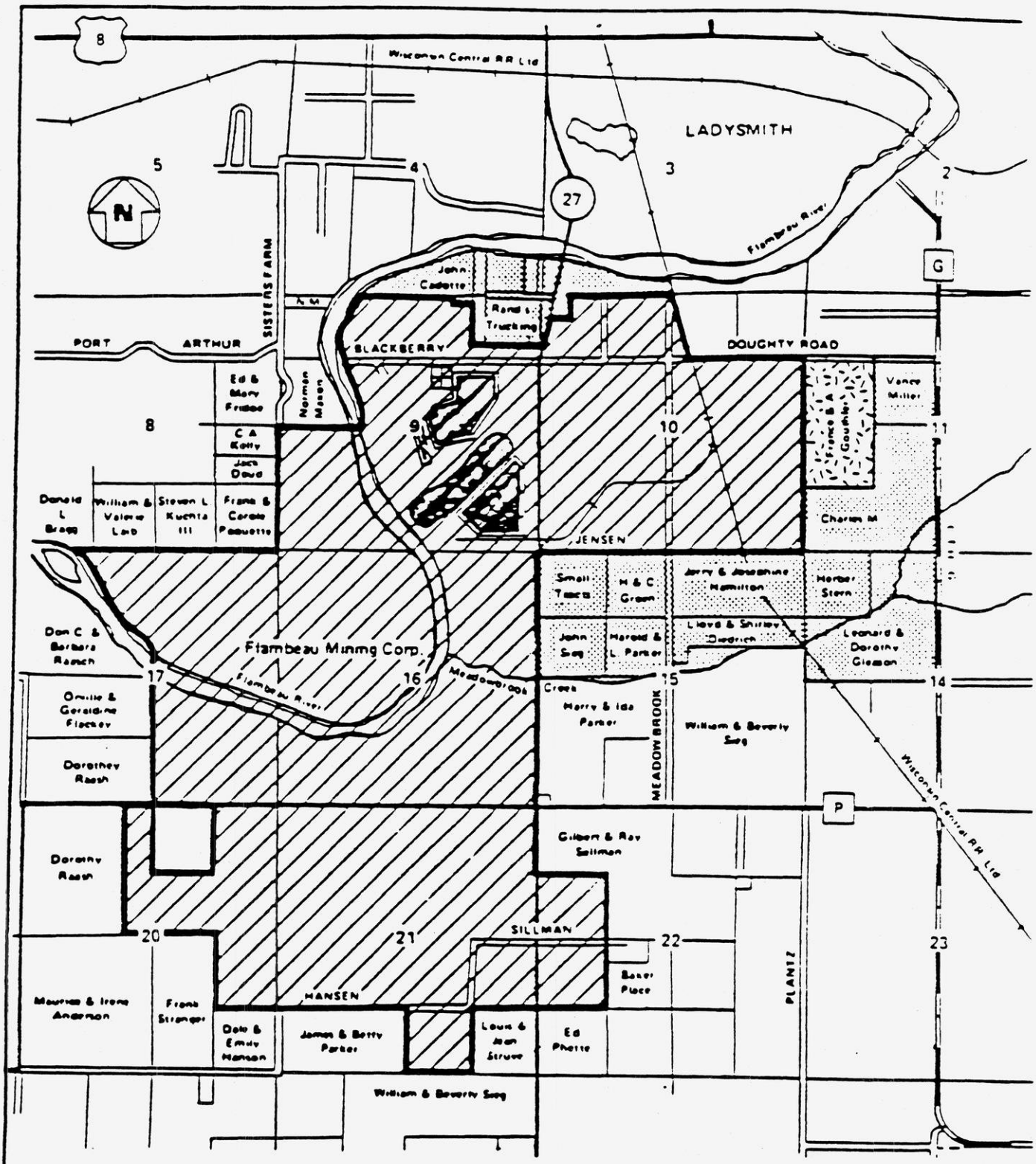
This permit also authorizes construction and operation of an approximately one mile long railroad spur to be located in part of Section 10, Township 34 North, Range 6 West, Rusk County, Wisconsin, lying west of the main line of the Wisconsin Central Railroad Ltd. as generally shown in the scale map of the site plan, Exhibit A.

It is understood by the County that until the DNR issues to the permit holder its NR132 permit, the legal description of the railroad spur line will be tentative only. It is possible that the DNR may approve of an alternate right-of-way, in which instance, without the need for further approval from the Zoning Committee, the official County zoning map shall be change to reflect the relocated railway right-of-way and its zoning district designated under Section (5) of this permit.

Kennecott is the legal and equitable owner of all of the above mentioned land.



KENNECOTT FLAMBEAU PROJECT	
EXHIBIT C GROUNDWATER MONITORING WELL LOCATIONS	
SCALE NONE	DATE 6-23-82
PREPARED BY FORD BACON & DAVIS INC.	



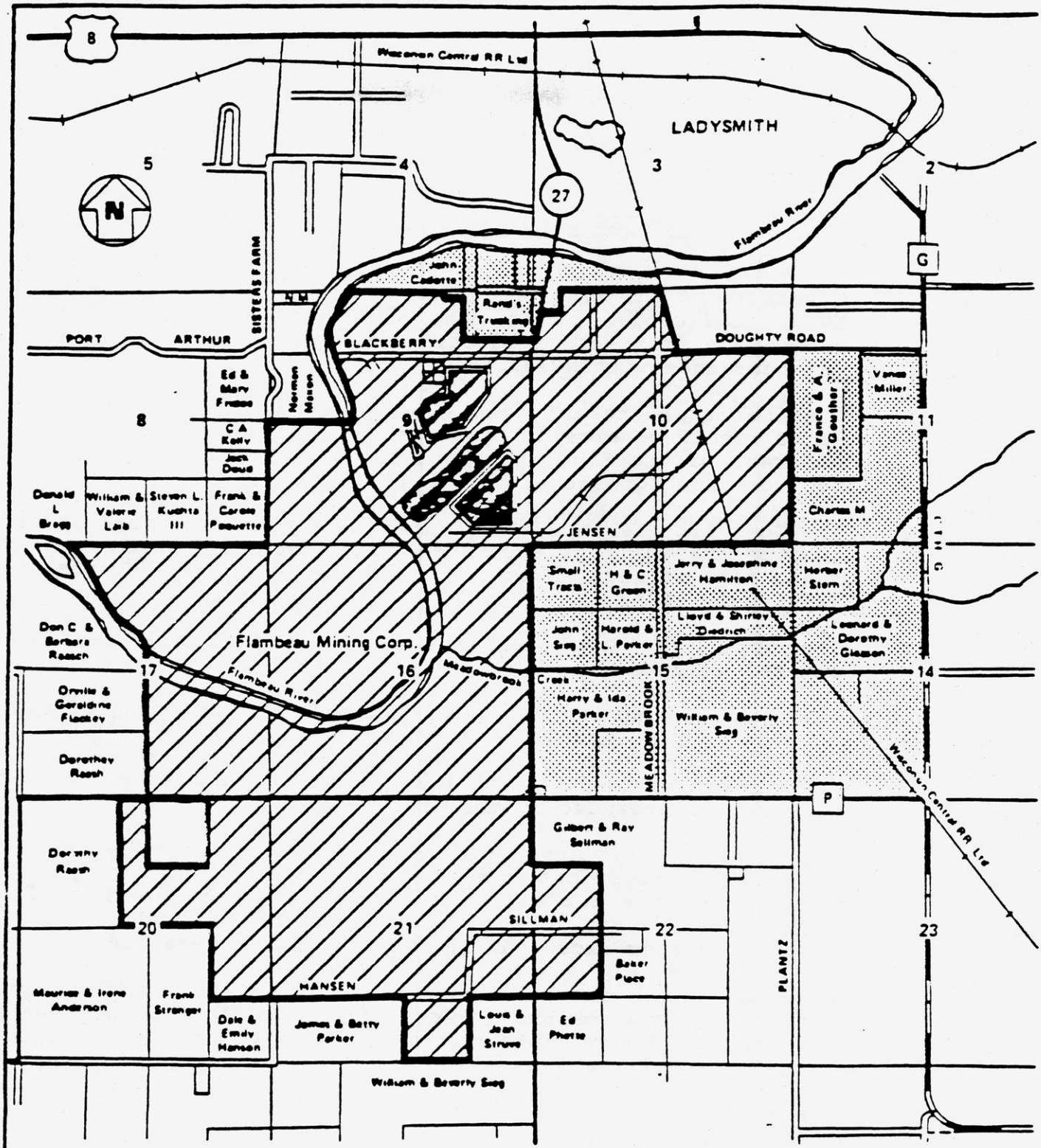
LEGEND

- Kennecott Owned Property
- City Water can be Provided
- Areas to be Covered by Well Guarantee

EXHIBIT D

WELL GUARANTEE – LOCATION MAP

FLAMBEAU MINING COMPANY



LEGEND

Kennecott Owned Property

Areas to be Covered by Property Value Guarantee

EXHIBIT E

LOCATION MAP

PROPERTY VALUE GUARANTEE

FLAMBEAU MINING COMPANY

EXHIBIT F

PREMISES USED AS BASIS FOR AGREEMENT

1. Operation of the Mine shall comply with all DNR regulations in NR132 applicable to the Mine site and facilities except as exemptions from such regulations may be procured by Kennecott in accordance with NR132.19.

2. Operator shall take preventative measures to minimize surface water runoff or erosion by finish grading and seeding completed areas of the Mine in accordance with the closing plan made part of this Agreement.

3. The Open Pit shall be not greater than 40 acres, more or less, in size and shall be excavated to a depth of no more than 225 feet, more or less, below the grade existing on the site as of January 1, 1988.

4. The Open Pit Mine shall not be converted to a deep shaft mineral mine.

5. There will be no smelting, concentrating or refining of Ore on the Operator's land or in Rusk County.

6. The area disturbed by the operation in the Active Mine Area will not be expanded by more than 10%.

7. The Active Mine Area shall at all times during the construction, operations and closure phases of the project, be enclosed by the Security Fence, entry through which shall be via secured gates. The gates shall be closed and kept locked by the Operator except during the hours of operation.

8. Operator shall install, maintain and utilize surface water containment systems and a water treatment plant to protect the groundwater and surface water of Rusk County in accordance with DNR specifications.

9. The topsoil, waste rock and overburden removed from the Open Pit shall be stockpiled for use in site restoration during the Mine closure phase.

10. Primary means for transportation of Ore away from the site shall be via railroad and except as otherwise allowed in this Agreement, all transportation of Ore away from the site shall be via railroad.

11. Blasting, crushing and rail shipping operations shall be conducted during daylight hours, Monday through Saturday only.

12. The only non-hazardous wastes to be stored at the Mine are those mine wastes as defined by DNR and generated by the operations, except those materials necessary for operation of the Mine and facilities.

13. No Hazardous Waste, as currently defined by the DNR according to NR180.04(27) shall be accepted, received, stored, or disposed of or transported to the Mine. On-site storage of fuels, lab chemicals and blasting materials will be allowed provided they are contained in secured areas.

14. No less than six groundwater monitoring Well Clusters shall be constructed within the Active Mine Area. These wells are to be tested on at least a quarterly basis during the Baseline Monitoring Program, construction, and operation. Monitoring after closure shall be in accordance with the DNR approved reclamation plan.

15. During the life of the Active Mining operation and during any period of Temporary Closure, the Operator shall continued to collect, pump to its waste water treatment facility, and treat all waters which come into contact with sulfide mineralization which is of such characteristics so as to warrant treatment pursuant to NR132.

16. After issuance of the mining permit by the DNR, but prior to commencing mining a certification to the Participating Local Governments that a bond payable to the DNR in the amount required under NR132 or other appropriate security as required by NR132 has been secured.

17. The Operator agrees to maintain a reclamation bond or other security in accordance with NR132.13-(3) and (4) for thirty (30) years after closure which is 90 days after completion of the backfilling of the Mine unless the Committee receives a copy of the request to be exempted and concurs in writing with the DNR conclusion to grant exemption.

18. Environmental Premises.
    a. Operator will abide by all applicable federal and state laws, rules and regulations as to control, containment, elimination of or limitation of air, water, ground and noise pollution or contamination.

b. In accordance with the applicable federal and state laws, rules and regulations, it is the Opreator's intent to (i) protect ground and surface water resources from contamination which may arise in the course of the Mining Operation, that could result from contact by water with sulfide bearing rock formations associated with the mineral ore body to be mined, which protection shall take the form of collecting and treating surface, ground and precipitation water which may potentially be so contaminated before discharging the same onto the surface of the ground, into surface waters or into the ground; (ii) conduct its operations in all three (3) phases of the project in such a manner as to minimize adverse physical impact on land owners in the Town of Grant and City of Ladysmith; (iii) upon completion of mining, restore the site of the open pit, as nearly as possible, to its original grade by re-depositing, in the reverse of the order in which each such layer was removed, the waste rock, overburden and topsoil removed from the pit during the mining process and to re-vegetate the surface of the mine site; (iv) conduct blasting work in such a fashion as to minimize impact upon adjoining properties and improvements situated thereupon; (v) minimize dispersal of dust and/or other pollutants into the air in the course of Mining Operations and transportation of ore from the mine site; and (vi) retain fiscal and general management responsibility for site restoration, reclamation and environmental protection for a period of thirty (30) years next following the actual closure of the Mine.

EXHIBIT G

WAIVERS AND VARIANCES APPROVED BY LOCAL IMPACT COMMITTEE

NR132.18(1)(c)	-	The setback from the river will be 140 feet compared to 300 feet specified in the regulations. In addition, variances may also be required with respect to unnamed tributaries A, B and C in the Active Mine Area.
NR132.18(1)(d)	-	The proposed plan will require the construction of a dike which will partially be in the flood plain. The dike will provide additional protection against flooding of the mine during a 100 year storm.
NR132.18(1)(e)	-	The setback from the highway will be 150 feet compared to the 1,000 feet specified in the regulations.
NR132.18(1)(f)	-	A variance may be required with respect to the disturbance of several small wetland areas in the vicinity of the orebody.

APPENDIX C

Conditional Land Use Permit

CONDITIONAL LAND USE PERMIT

(1) GENERAL CONDITIONS.

Rusk County, a quasi-municipal corporation, duly organized under the laws of Wisconsin, hereby grants to Kennecott Explorations (Australia), Ltd., a Delaware corporation, the following Conditional Land Use Permit. Said permit is granted pursuant to the powers vested in Rusk County under Secs. 59.025, 59.07, 59.97 and 144.839, Stats., and constitutes an exercise of said county's authority to plan for and zone as to land uses within its corporate limits under the general auspices of its police powers. Said powers have been exercised in accord with Secs. 59.97, 66.30 and 144.839, Stats., and under the Rusk County Comprehensive Zoning Code, adopted April 20, 1971, as amended, from time to time thereafter, to and through the date of this permit. In addition, the Town of Grant, a civil town organized under the laws of Wisconsin, having, through its Town Board, elected to participate in County Comprehensive Zoning on or about June 14, 1982, and having elected to participate in the Local Agreement under Sec. 144.839, Wis. Stats., said Comprehensive Zoning Code and the exercise of County Zoning Powers as to the instant land use which is situated, either as a whole or in part, in the Town of Grant as of the date of issuance of this permit, is deemed to be effective under Wisconsin law.

This permit shall be interpreted and applied as a Conditional Use Permit, in accord with the definition of the term "conditional use" at Secs. 2.1(6) and 7.1 (Preamble) of the Rusk

County Comprehensive Zoning Code (hereinafter "Comprehensive Zoning Code"). As such, the Permit Holder shall strictly conform its activities and land uses to the terms of this permit.

Administration of this permit shall, at all times, be subject to the control of the Rusk County Zoning Committee, or its successor, a standing committee of the Rusk County Board of Supervisors, appointed pursuant to Sec. 59.06, Stats.

In accord with Sec. 59.97(1) and (11), and 144.839, Stats., the purpose of this permit grant shall be to promote the public health, safety and general welfare of the residents of the County, while at the same time allowing to the Permit Holder the right, subject to the limitations expressed herein, to engage in the described land use of property which it owns in Rusk County.

This permit implements a Local Agreement which was duly entered between Rusk County, the Town of Grant, the City of Ladysmith and Kennecott Explorations (Australia), Ltd., on August 1, 1988; and was duly approved of by the Rusk County Board on July 22, 1988, by the Ladysmith City Council on August 1, 1988, and by the Town Board of the Town of Grant on July 25, 1988.

(2) DEFINITIONS.

The following definitions, unless the context dictates otherwise, shall be used in interpretating and applying the provisions of this Conditional Use Permit:

(a) "Active Mine Area" shall refer to that real estate described at page 2 of the Local Agreement, whose legal description is as set forth at Sec. 3. of this permit.

(b) "Comprehensive Zoning Code" shall mean that code of ordinances duly adopted by the Rusk County Board of Supervisors pursuant to Sec. 59.97, Wis. Stats., et al., which generally governs, from a planning and zoning standpoint, the use of lands in unincorporated areas in said county in towns which have ratified said zoning code.

(c) "County" shall mean Rusk County, State of Wisconsin.

(d) "Disturbed Sites" shall mean any site which, during the course of construction, operation or closure shall have had its topography, surface grade and vegetation altered, removed, destroyed or disturbed, each of which site shall be within the Active Mine Area.

(e) "DNR" shall mean the Wisconsin Department of Natural Resources.

(f) "Local Agreement" shall mean that agreement entered into between Rusk County, the City of Ladysmith, the Town of Grant and the Permit Holder pursuant to Sec. 144.839, Wis. Stats.

(g) "Mining Activities" shall mean any and all land use activities engaged in under this permit related to a creation of, taking of ore from, and re-filling of the open pit to be situated on site and appurtenant activities and land uses associated therewith.

(h) "Mining Permit" shall mean the permit procured by the Permit Holder under Ch. NR132 Wis. Adm. Code.

(i) "Operator" shall mean the Permit Holder under this Conditional Use Permit.

(j) "Permit Holder" shall mean the individual or corporation or his or its assignee, transferee or conveyee

operating subject to this Conditional Use Permit.

(k) "Stats." or "Wis. Stats." shall mean the Wisconsin Statutes.

(l) "Type I Wasterock" shall refer to that wasterock generated in the course of mining activities and removed from the open pit which does not contain an incidence of sulfide mineralization requiring storage and treatment in the same manner as Type II Wasterock so as to prevent water contamination. Type I Wasterock shall be backfilled, subject to DNR approval, into the mine during the closure phase.

(m) "Type II Wasterock" shall refer to that wasterock to be generated in the course of the mining activities and removed from the open pit which contains an incidence of sulfide mineralization sufficient to cause a leachate which requires treatment pursuant to DNR regulations. Such wasterock shall be stored in accord with the terms of the Local Agreement and backfilled, subject to DNR approval, into the mine during the closure phase.

(n) "Wis. Adm. Code" shall refer to the Wisconsin Administrative Code.

(o) "Zoning Administrator" shall mean that administrative official or employee of Rusk County, duly designated by the county board to administer its zoning code.

(p) "Zoning Committee" shall mean that standing committee designated by the Rusk County Board of Supervisors, within its realm of delegated authority, to administer the Zoning Code on behalf of the Board of Supervisors.

(3) LEGAL DESCRIPTION OF PROPERTY SUBJECT TO THE INSTANT PERMIT

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.

This permit also authorizes construction and operation of a rail spur, approximately one mile in length, to be located in part of Section 10, Township 34 North, Range 6 West, Rusk County, Wisconsin, lying West of the main line of the Wisconsin Central, Ltd., as generally shown in the scale map of the site plan, Exhibit "A".

It is understood by the County that until the DNR issues to the Permit Holder its NR132 permit, the legal description of the Railway Spur Line as set forth above will be tentative only. It is possible that the DNR may approve of an alternate right-of-way, in which instance without the need for further approval from the Zoning Committee, the official County zoning map shall be changed to reflect the relocated railway right-of-way and its zoning district designation under Section (5) of this permit.

(4) PERMIT HOLDER.

The Permit Holder shall be Kennecott Explorations (Australia), Ltd., a Delaware corporation, or its successor in interest. The Permit Holder agrees and understands that the rights herein afforded to it are assignable or transferable only in accord with Sec. 19 of the Local Agreement. Upon any sale, transfer, lease or assignment of rights by the Permit Holder to a third party relative to the real estate subject hereto or of the transfer of rights or responsibilities relative to the commencement, continuation or closure of any operations maintained on

said real estate in accord with this permit, all rights set forth under this permit shall then and there cease and be deemed unenforceable by the said transferee, assignee or conveyee, unless full compliance with the terms and conditions of Sec. 19 of the Local Agreement is demonstrated. All the terms and conditions of this permit shall be enforced against transferees, assignees or conveyees. The granting of this permit is based upon the underlying assumption that the Permit Holder qualifies to hold a mining permit under Sec. 144.85, Stats., continues to hold a valid mining permit thereafter and that, in the event of a sale, transfer or conveyance of the mine, that the proposed transferee, assignee or conveyee shall be in full compliance with Sec. 144.87(2), Wis. Stats. Should the DNR notify the Zoning Committee of a violation of said statute, it shall constitute cause for potential revocation of or the imposition of additional conditions hereupon in the discretion of the said committee in accord with Sec. (16) of this permit.

(5) ZONING CLASSIFICATION.

In accord with the Comprehensive Zoning Code, the zoning classification for the property described at Sec. (3), above, shall be that of the I-1, Industrial District.

(6) SETBACK REQUIREMENTS.

The following express setback requirements shall apply and pertain to land uses and the erection of structures upon the property described at (1), above.

(a) Subject to Department of Natural Resources of the State of Wisconsin (hereinafter "DNR") approval of variances under

NR132, Wis. Adm. Code, the following specific setbacks shall apply:

1. Highway setbacks from State Highway 27: 150 feet.
2. Setback from the Flambeau River; the minimum shall be as shown for the open pit on the scale map of the Active Mine Area shown in the site plan, Exhibit "A", which is 140 feet from the bank of the river as it existed on June 1, 1988.

In the absence of approval of said variances, the setbacks required under NR132, Wis. Adm. Code, shall be the minimum requirements to be met relative to the specific setbacks set forth above. Additionally, such other setbacks set forth at NR132 or variances therefore approved by the DNR, shall also apply. In addition, the following setback requirements shall be met: Setback from Blackberry Lane 63 feet from the centerline or 30 feet from the right-of-way line, whichever is greater. Minor, readily removable structures, such as open fences or signs may be placed within the setback lines. Public utility equipment without permanent foundations is also permitted. When deemed necessary by the Zoning Committee in conjunction with development, such as highway improvement programs, the Permit Holder and public utilities may be required to remove, at their own expense and without right of compensation, any such structures erected within the setback lines.

(b) In each quadrant of every street or highway intersection, there shall be designated a visual clearance triangle bounded by the street centerlines and a line connecting them 300 feet from any intersection with State Highway 27, and 200 feet

from any intersection with Blackberry Lane. If two (2) highways of a different class intersect, the largest distance shall apply to both centerlines. Within this triangle, no object over 2 1/2 feet in height above the level of the streets shall be allowed if it obstructs the view across the triangle. Posts and open fences are excluded from this prohibition.

(c) Tree trunks shall be exempt from the visual clearance provisions set forth above when they are unbranched to a height of 10 feet and located a minimum of 30 feet apart.

(d) Where different from the setbacks identified at (a), above, as to the Active Mine Area, the setback from adjacent properties set forth at paragraph 4 of the Local Agreement shall control.

(e) With respect to both setbacks and site plan approval, the scale map of the Active Mine Area is incorporated herein by reference.

(f) In the event of any conflict between the setback requirements for purposes of procuring a mining permit, as imposed upon the Permit Holder by the DNR under NR132, Wis. Adm. Code, and those set forth herein, the more strict of said setback requirements shall be enforced, except in situations where the DNR has approved a variance.

(g) It shall be required of the Permit Holder that it shall, at its sole expense, survey, mark and delineate, by the placement of appropriate, permanent markers, each of the setback lines set forth above or incorporated herein by reference, with reference to highways, the Flambeau River and such other natural

or artificial boundaries of the parcel subject to this permit as are required in order to demonstrate compliance with the setback conditions herein established.

(h) The setback requirements herein expressed shall not apply to the Railway Spur Line serving the Active Mine Area.

(i) The setback requirements set forth herein shall not apply to what is commonly referred to as the "old H & H Building," it having been located on the site subject hereto prior to the granting of this permit; provided, however, that said structure is hereby designated as a non-conforming structure. Structural repairs or alterations of it shall not exceed 50 percent of its assessed valuation as of the time it became non-conforming in June, 1982. In the event that use of the structure ceases for one (1) or more years, after ore shipment starts, it shall be considered to be abandoned and all use of it shall be permanently discontinued.

(7) FENCING AND SECURITY PROVISION REQUIREMENTS.

The Permit Holder shall, at all times, from and after commencement of construction of its mine site and appurtenant facilities, provide fencing of the Active Mine Area and/or security measures, consistent with the definition of "security fences" and Section 3(c)(4), Section 5, Sections 6 and 11(f) of the Local Agreement, each of which are incorporated herein by reference. This requirement shall apply solely with respect to the Active Mine Area. The Railway Spur Line need not be fenced outside of that location.

The maintenance of such fencing and security provisions shall be a condition of this permit to be observed at all times

until the end of the reclamation period during the closure phase of operation by the Permit Holder.

(8) TRANSPORTATION RESTRICTIONS; ACCESS RESTRICTIONS.

The following restrictions, incorporated herein by reference from the Local Agreement, shall apply regarding transportation of ore from the Active Mine Area subject to this permit and, additionally, as to the means of access to and from the Active Mine Area.

(a) The primary means of transportation from the Active Mine Area shall be via railway, in accord with paragraph 10 of the Local Agreement.

(b) Emergency means of transportation: Availability of trucks for transportation purposes, to be limited by sections 10 and 11 of the Local Agreement.

(c) Access restrictions. The means of access to the Active Mine Area shall be limited as follows:

1. As set forth at sections 10 and 11 of the Local Agreement.

2. Construction of access driveways, streets or highways:

a. Shall be subject to town road standards as to construction, maintenance and repair.

b. Zoning Code Requirements Applicable. Access roads, streets or driveways constructed from the Active Mine Area to public highways abutting the land subject to this permit shall comply with the following requirements:

Highway:	Minimum Distance of Highway Frontage Between Access Roads:
State Highway 27	600 feet
Blackberry Lane	75 feet

The maximum number of access roads, driveways or streets connecting with each public highway abutting the Active Mine Area shall be two (2). This restriction, however, shall not prohibit the construction of an additional driveway from S.T.H. 27 to be used as access to a possible mine overlook for sightseers.

(9) PROHIBITION AS TO SMELTING, REFINING OR PROCESSING OF ORE.

There shall be no smelting, refining or processing of ore extracted from the subject mine, at any location within Rusk County, Wisconsin.

(10) PARKING AVAILABILITY.

As and for each building constructed under this permit, sufficient off-street parking spaces shall be provided for employee, agent and guest automobiles and trucks. Each parking space shall be at least 200 square feet in area. The actual number of spaces required shall be determined on the basis of projected office space and the number of anticipated employees and guests. Said determination shall be reviewed by the Zoning Administrator. In addition, the Permit Holder shall provide a sufficient area or areas within the Active Mine Area for storage of or parking of trucks, graders, earth moving equipment and other vehicles which may be used from time to time on the premises for purposes associated with the mining operation.

(11) LOCATION, HEIGHT, SIZE OF BUILDINGS AND OTHER STRUCTURES.

(a) To be limited to the approved site plan locations; subject, however, to the following understanding: the site plan incorporated herein by reference is preliminary in nature only. So long as both in number, size and location, structures which are ultimately built or constructed in the Active Mine Area do not substantially change the preliminary plan or substantially alter the scope of the project, changes as to structure locations shall be allowed without further approval of the committee. Any monitoring facilities mandated by the DNR are hereby approved and are not subject to these limitations.

(b) This permit shall include authorization to the Permit Holder to erect the following structures, each of which may exceed thirty-five (35) feet in height, but shall not exceed seventy-five (75) feet in height: Crushing facilities, stacker, ambient air monitors, storage piles, radio tower, water treatment facility and other structures as may be agreed upon by the Permit Holder and the County.

(12) INCORPORATION BY REFERENCE OF ALL APPLICABLE STATE AND FEDERAL REGULATIONS AS TO COMPLIANCE THEREWITH, SUBJECT TO EXPRESS VARIANCES, IF GRANTED, BY PERMIT AUTHORITIES.

The use of the Active Mine Area shall, in addition to being subject to the express terms hereof, be subject at all times to the application of all relevant state and federal regulations and strict compliance by the Permit Holder therewith, subject only to the exception of such express variances, if any, which are granted by the enforcement authorities. In the event the Permit Holder seeks a variance from any such regulation, it shall

provide written notice to the Zoning Committee. In turn, the participating local governments could provide comments to or present evidence to the granting authority as to the appropriateness of the variance or variances requested. Variances which have been identified thus far are as follows:

(a) A variance from NR132.18(1)(d), Wis. Adm. Code as to the construction of a dike which would partially exist in the flood plain to provide additional protection against flooding of the mine during a 100-year storm.

(b) A variance from NR132.18(1)(f), Wis. Adm. Code as to the disturbance of several small wetland areas in the vicinity of the ore body.

(c) With reference to (6), above, as to setbacks, those specific variances sought under NR132.18(1)(e), and NR132.18(1)(c), as to setbacks from State Highway 27 and the Flambeau River and unnamed streams A, B and C.

This permit is further subject to strict compliance by the Permit Holder with all permit requirements imposed under NR132 and NR182, Wis. Adm. Code, as deemed to be applicable by the DNR and such other state and federal regulations and statutes governing mining, in general, and environmental controls of the state and federal governments as are incorporated therein by the State of Wisconsin by statute or Administrative Code provision or variances thereto.

(13) MINE WATER TREATMENT PLANT.

A mine water treatment plant, whose purpose shall be to treat ground and surface water and precipitation which comes in contact with sulfide mineralization sufficient to produce a

leachate which does not meet with state discharge standards, during the course of operation subject to this permit, shall be constructed, maintained and operated by the Permit Holder, pursuant to and in accord with DNR regulations and requirements.

(14) BLASTING LIMITATIONS.

The following conditions and limitations shall apply to blasting and the use of explosives:

(a) Explosives shall be stored in strict compliance with all applicable state and federal laws and regulations, including but not limited to ILHR 7.20 to 7.23, Wis. Adm. code.

(b) No explosions shall be detonated except between 8:00 a.m. and 6:00 p.m., or between sunrise and sunset, whenever sunrise is later than or whenever sunset is earlier than the above designated times, Monday thru Saturday only.

(c) No explosions shall be detonated on the surface of the ground at the mine site, surface being described as the elevation of the ground as it existed on January 1, 1988.

(d) All explosions shall be detonated in such a manner as to control noise, particle displacement and ground vibration, and subject, specifically, to strict compliance with ILHR 7.64, Wis. Adm. code.

(e) Seismographic monitoring shall be required to be maintained in accord with ILHR 7.64 (4) (b) 3. and (d) 2., Wis. Adm. Code.

(f) No explosion shall be detonated which will result in a maximum peak particle velocity of the ground motion in any direction in excess of the standards at ILHR 7.64 (b) 1., Wis. Adm.

Code.

(g) In blasting, the Permit Holder shall at all times, comply with all applicable state and federal laws and regulations or variances therefrom.

(h) In accord with ILHR 7.37, Wis. Adm. code, the Permit Holder shall keep accurate records of times and locations of all explosions set off by it in the area covered by the permit as well as of the type and amount of explosive used for each hole, the size of the charge and the delay between charges. Said records shall be furnished to the Zoning Administrator upon request.

(i) For purposes of implementing this Conditinal Use Permit, the County hereby adopts by reference all other applicable provisions of ILHR 7, Wis. Adm. code, not expressly set forth herein, to the effect that ILHR 7 shall, in accord with ILHR 7.35 (2), Wis. Adm. Code, constitute a local regulation to be complied with by the Permit Holder. In accord with ILHR 7.35 (3), Wis. Adm. code, the site of the proposed blasting shall be considered to be in a "community", as defined at ILHR 7.04 (10), Wis. Adm. code, for purpose of requiring and implementing the notification provisions therein set forth.

(j) It is the further understanding of the Zoning Committee that the Permit Holder will be using a fertilizer base explosive consisting of ammonium nitrate and fuel-oil and/or dynamite and that use of the term "explosive" or any form thereof in this permit shall refer expressly thereto. Should the Permit Holder, at any time during the life of this permit, seek to change the type of explosives to be utilized, it shall first

advise the Zoning Committee which shall not unreasonably withhold consent if compliance with all criteria of this portion of the permit shall, with such change, still be maintained.

(15) INSPECTION POWERS OF ZONING ADMINISTRATOR.

The County Zoning Administrator (hereinafter "Zoning Administrator") and his or her duly authorized agents shall have inspection powers and authority for the purposes of ascertaining compliance with the terms of this permit, which powers shall include but not be limited to the following:

(a) Access to any and all portions of the subject premises and any structure situated thereupon in order to perform his duties under the Comprehensive Zoning Code and this permit. The Permit Holder hereby consents to said entry between the hours of 8:00 a.m. and 6:00 p.m., Monday through Saturday, with the exception of legal holidays. At all other times prior arrangements shall be made with the Permit Holder by the Zoning Administrator for entry. In the event that the Permit Holder shall refuse a reasonable request for the right of entry, after reasonable notice, for any or no reason whatsoever, excluding reasons related to hazards, and for any or all of the purposes germane to and allowable under Sec. 66.122, Stats., the County and the Zoning Administrator may avail themselves of the right to obtain a special inspection warrant or warrants for inspection purposes.

(16) ENFORCEMENT OF ALLEGED VIOLATIONS.

(a) Included within this general category shall be:

1. Violations of the terms of this permit.

2. Violation of the terms of any state or federal

permit granted with respect to the mine.

3. Violation of any provision of the Comprehensive Zoning Code except that portion thereof designated as the "Rusk County Mineral Mining Code", Sections 6.3 through 6.11 inclusive of the Comprehensive Zoning Code, and any such other provisions of the Comprehensive Zoning Code which are inapplicable under the Local Agreement or are expressly or impliedly waived herein, if any.

4. Public nuisances constituting real and imminent dangers to public health, safety, and welfare created by operations maintained under this permit.

5. The building of, moving or substantial alteration of any structure (excluding removal) in the Active Mine Area which is not in substantial conformity with the approved of preliminary site plan incorporated by reference in this permit. This is subject, however, to the following understanding: The site plan incorporated herein by reference is preliminary in nature only. So long as, in number, size, location and degree of alteration, structures which are ultimately built or constructed during one of the three phases subject to this permit do not substantially change the preliminary plan or substantially alter the scope of the project, changes as to structure locations, construction or alteration shall be allowed without further approval of the committee and, hence, shall not constitute violations of this permit.

6. The use of any portion of the Active Mine Area which is not in substantial conformity with the approved site plan incorporated by reference under this permit.

(b) Remedies in the event of violations: Remedies may include, but not be limited to the following:

1. Temporary and permanent injunctive relief;

2. Damages, if any, sustained by Rusk County;

3. Imposition of a forfeiture in accord with (c), below;

4. Such other and further relief available to the County under Wisconsin law;

5. Revocation of this permit; or

6. The imposition of additional conditions not included in the original permit.

7. Relief with respect to items 1 - 4, above, may be obtained only through Court action.

(c) Forfeitures. Each violation of this permit and of the Comprehensive Zoning Code and of federal or state permits granted with respect to the contemplated mining operation shall be subject to the imposition upon the Permit Holder of a forfeiture in the amount of from $200.00 to $1,000.00 for each day that the violation continues, plus reasonable costs of prosecution should the County prevail. The period of time during which forfeitures may be assessable shall commence running with the first day after the end of the compliance period alloted to the Permit Holder pursuant to (d) of this section in the event that the Permit Holder fails to conform its land use activities to the directions of the County. In the event of a default in payment of any such forfeiture as assessed by a Court, unless a stay of payment is provided, the instant Conditional Use Permit shall be subject to termination at the discretion of the Zoning Committee. Each day

a violation continues to exist shall constitute a separate violation. Resort to this remedy shall not be construed as limiting the County from resorting to any other remedies set forth at (b), above.

(d) Notices; Hearings; Right To Cure Performance.

1. Prior to instituting legal action, except as to public nuisances under (a)4., above, which are causing a real and imminent danger to public health, safety and welfare, the Zoning Administrator shall serve a written notice on the Permit Holder's designated representative of the nature of the alleged violations. The Permit Holder shall have 20 days to respond, either acknowledging the existence of the violations and setting forth its proposal to cure the same or expressly denying the allegations. In the event that the Permit Holder fails to respond or if its response is insufficient to cure the alleged violations, the Zoning Committee may authorize pursuit of a remedy or remedies under (b), above. Under no circumstances, however, shall the permit be revoked without the holding of a due process hearing. In the event that the Permit Holder's response to the notice is satisfactory, it shall be given a reasonable period of time by the committee in which to conform its land use activities to the terms of this permit. Should it fail to do so, the County may resort to the remedies at (b) above.

(17) PERMIT COVERAGE.

This permit shall cover the following phases of operation:

(a) Construction;

(b) Mine operation;

(c) Mine closure.

Subject to reopening in accord with (29), of this permit, this permit shall be valid for that period of time, commencing with the date of issuance hereof, defined further as that date no later than forty (40) days after ratification of this permit by the Rusk County Board of Supervisors or the date upon which the Town Board of the Town of Grant approves of the herein contained zoning district boundary change, whichever occurs first, in accord with Sec. 59.97 (5) (e) 6., Wis. Stats., and continuing for the duration of the three phases of operation as set forth above for a period not to exceed forty (40) years. The construction phase shall be first and its approximate duration shall be ten (10) months. Then shall follow the mine operation phase during which ore may be extracted and shipped and reclamation may begin and its approximate duration shall be five (5) years. Finally, the mine closure phase shall take place during which all reclamation and site restoration activities shall be completed, and, during which, environmental monitoring shall take place. In accord with the reclamation plan filed with and approved of by the DNR, during and immediately after the mine operation phase, the Permit Holder shall take the necessary steps to refill the open pit to the approximate grade which existed on June 1, 1988. The Permit Holder shall be required to complete its construction, mine operation and open pit refilling and site restoration activities within the first fifteen (15) years after the DNR has granted to it its NR132 permit. Should it be unable to do so, it shall be required to petition the County for an extension. Permission to so extend shall not unreasonably be withheld by the

Zoning Committee. Subsequent to the said fifteen (15) year period, or completion of pit refilling and site restoration, whichever occurs first, environmental monitoring shall continue for the remainder of the permit life or until concluded, whichever occurs first. Unless an extension of the permit life is requested as a permit modification under Sec. (29) of this permit, for mine closure purposes only, all special uses and entitlements under this permit shall cease at the conclusion of environmental monitoring or the passage of forty (40) years, whichever occurs first. Subject to the fifteen (15) and forty (40) year limitations, which shall be enforced, the time periods expressed herein for each phase shall be deemed to be approximations only. Nonetheless, once the shipping of ore during the mine operation phase has been concluded, the Permit Holder shall not be entitled to recommence the extraction and shipping of ore unless and until a renegotiated Local Agreement and modified Conditional Use Permit has been granted. The effective date, as expressed herein, shall be controlled by and subject to the provisions of (32), below.

(18) SIZE AND SCOPE LIMITATIONS.

This permit is conditioned upon the mine remaining within and not exceeding the limitations expressed at paragraphs 3.b. and c. and 24. of the Local Agreement.

(19) LIAISON TO THE COMMITTEE; REPORTS.

(a) The Permit Holder shall designate a qualified representative, familiar with all aspects of the mine, to act as a liaison to the Zoning Committee. His or her function shall be

to respond to requests for information and to advise both the Committee and Zoning Administrator as to the status of the mining operation, from time to time. Said representative shall also be designated by the Permit Holder to receive written notices of alleged violations of this permit under Sec. (16) above.

(b) The Permit Holder shall provide to the Zoning Committee a copy of each report which it generates and provides to the Impact Committee under Section 16 of the Local Agreement.

(20) SITE PLAN.

Incorporated by reference in this permit is the Site Plan, Exhibit "A", of this permit and any monitoring facilities mandated by the DNR which are hereby approved of by the Zoning Committee. If, at any time during the life of this permit, the Permit Holder desires to substantially alter its site plan or erect additional structures beyond those identified on the site plan, incorporated herein by reference, which structures substantially vary in size, scope, height, number or use from those identified on the site plan, it shall first obtain approval of the Committee. In either granting or rejecting such alterations, the Committee shall be guided by Sec. 7.1 of the Comprehensive Zoning Code.

(21) PERMITTED USE.

This Conditional Use Permit grants to the holder the right to engage in mining activities in, upon and under the surface of the Active Mine Area, a special use. This permit also approves of the construction and operation of the Railway Spur, utility lines and access roads to serve the Active Mine Area. No other or further use of the real estate subject to this permit, not

generally allowed as a permitted use under Sec. 14.5(a)(b), of the Comprehensive Zoning Code, shall be allowed.

(22) INAPPLICABILITY OF RUSK COUNTY SHORELAND-WETLAND ZONING PROVISIONS TO ACTIVE MINE AREA.

None of the property affected by this permit is within a shoreland-wetland district under the official Rusk County Shoreland-Wetland Maps as of the date of this permit. The Shoreland-Wetland overlay zoning district is not applicable to the Active Mine Area and land uses contemplated to be made of it under this permit. In accord with Sec. 14.8.3.C.2 of the Comprehensive Zoning Code, this permit shall control use of that portion of the Active Mine Area subject to the Shoreland Overlay Zoning District.

(23) INAPPLICABILITY OF RUSK COUNTY MINERAL MINING CODE.

Pursuant to the Local Agreement, Sections 6.3 through 6.11 inclusive of the Comprehensive Zoning Code, known as the "Rusk County Mineral Mining Code" shall not be applicable to the Permit Holder, nor to its land uses granted by this permit.

(24) REVEGETATION OF ACTIVE MINE AREA.

It shall be a condition of this permit that during the closure phase the Permit Holder shall re-vegetate all disturbed sites in the Active Mine Area. To facilitate such revegetation, the Permit Holder shall, prior to the construction phase, take an inventory of the existing vegetation. In revegetating disturbed sites the Permit Holder shall use said inventory as a guide and shall plant the same or similar grasses, shrubs, trees and other vegetation. Subsequent to said revegetation, the Permit Holder shall remain responsible for and shall insure viability of what

it has planted for a period of 20 years, during which time it shall replant vegetation which fails to take hold and/or which dies.

(25) MODIFICATION OF PERMIT PROCEDURE.

In the event that subsequent to the issuance of this permit the Permit Holder desires modifications of the terms and conditions hereof including, but not limited to structural alterations, expansion of permitted uses or site plan amendments, the Permit Holder shall make an application to the Zoning Committee. In accord with Secs. 7.1 and 7.2(1), (3), (4) and (5) of the Comprehensive Zoning Code, the Zoning Committee shall issue its determination. In making such a decision, it shall not be bound by the Mineral Code, Sec. 6.3 through 6.11 inclusive, because those sections have been deemed inapplicable pursuant to the Local Agreement.

(26) FEES.

A. Upon ratification of this permit by the Rusk County Board of Supervisors, the Permit Holder shall pay a fee of $5,000.00, which fee shall be non-refundable and the purpose of which shall be to defray the costs of the permit granting process.

B. As a further condition of the permit, the Permit Holder shall make a contribution to Rusk County for the expenses to it of permit compliance monitoring and enforcement by the Zoning Administrator. Said contribution shall be in the amount of $750 per year. This requirement shall apply for each calendar year of construction and of mine operation. Said payment shall be made

on or before December 31 of each calendar year of construction and of mine operation.

C. Upon application for modification of this permit, the Permit Holder shall pay a non-refundable fee of $500.00 and, additionally, shall pay all costs associated with the holding of the public hearing(s) and Zoning Committee meetings including, but not limited to per diems, costs of publication, expert witness and/or advisor fees.

D. The Permit Holder shall pay such other fees, charges and costs as are called for in this permit.

(27) PRECIPITATE DISPOSAL.

Precipitate, defined as any solid generated in the course of waste water treatment under Sec. (13) of this permit and further defined as the residue remaining after ground and surface water and precipitation which have come in contact with sulfide mineralization have been treated in accord with state water discharge standards, shall be disposed of as follows: The Operator shall store said precipitate in such a manner as to comply with Sec. (17) of the Local Agreement and shall, during or prior to the closure phase under this permit, re-deposit the said precipitate in the open pit, in conjunction with that portion of the Type II wasterock which has the highest incidence of sulfide mineralization, at the bottom of the said open pit, provided this method is approved of by the DNR.

(28) RAIL CAR AND TRUCK; ACCESS ROADS--DUST CONTROL.

The Permit Holder shall use appropriate means, consistent with Wisconsin law and regulations, to control dust from ore being transported by rail car or truck or from the passage of

trucks over unpaved access roads.

(29) REOPENING OF PERMIT.

In the event that the Permit Holder desires to reopen and extend the life of this permit, it shall make application for the same to the Zoning Committee, in writing, at least two (2) years prior to the end of the term hereof. Reopening may be granted by the Committee solely for reasons related to site reclamation. In the event that the Permit Holder desires to expand or extend the project scope, whether during or after the mine operation phase, it shall be required to apply for a new permit in accord with Secs. 7.1 and 7.2(1), (3), (4) and (5), of the Comprehensive Zoning Code, or their successors.

(30) CLOSURE PHASE: MINE SITE RECLAMATION RESPONSIBILITY OF PERMIT HOLDER.

The Permit Holder shall remain financially responsible and shall, as such, maintain its reclamation bond or other security pursuant to NR132, WIs. Adm. Code covering the mine in question for a period of not less than thirty (30) years commencing 90 days next following the date and year of actual mine closure, unless the committee receives a copy of a request to be exempted and concurs in writing with the DNR conclusion to grant said exemption, such concurrence shall not be unreasonably withheld.

(31) SCREENING OF ACTIVE MINE AREA.

To the extent possible, consistent with the Permit Holder's use and erection of structures within and surrounding the Active Mine Area and the setback requirements herein set forth, in order to minimize traffic hazards along and upon S.T.H. 27, as it passes to the east of the Active Mine Area, caused by travelers

upon said highway who wish to observe the Active Mine Area and, additionally, as an aesthetic component, the Permit Holder shall make reasonable efforts to retain the trees growing on its property adjacent to the west line of S.T.H. 27.

(32) AUTHORIZATION FOR CONDITIONAL LAND USE PERMIT.

The granting of this Conditional Land Use Permit to the Permit Holder by Rusk County, is authorized pursuant to Secs. 59.97 and 144.839, Wis. Stats., adopted in Act 399, Laws of 1987-88. It shall not be deemed to be effective, nor shall the Permit Holder consider it as conferring upon it any rights, entitlements or privileges until a public hearing has been held by each participating local government, as defined in the agreement incorporating this permit by reference, nor until each said unit of local government shall have, in open session, ratified entry into said Local agreement, nor until Rusk County, through its Board of Supervisors shall have ratified, in its capacity as the zoning authority, the granting of this permit. Only upon the occurance of the last of these events shall this permit be deemed to be effective.

(33) ADOPTION OF THE INSTANT PERMIT BY THE CITY OF LADYSMITH.

In the event that, in accord with the agreement incorporating this permit by reference, the Permit Holder annexes a portion of the property described at (1), above, to the City of Ladysmith, the said City hereby agrees, pursuant to the power vested in it at Secs. 62.23 (7) and 144.839, Wis. Stats., to adopt and implement the terms and conditions of this permit as its zoning regulation of the Permit Holder's mine.

(34) AMENDMENT OF TERMS AND CONDITIONS IMPOSED UNDER THIS PERMIT.

In the event that, during the period of time covered by this permit, the Permit Holder shall apply for variances from applicable federal or state laws or regulations, other than those identified at Sec. (12) above, which variances act to substantially change or have the potential to substantially change the nature of or scope or extent of the mining operations to take place in the Active Mine Area subject hereto, such as the development of a shaft underground mine or the installation of more or larger equipment so as to increase the yearly ore shipping rate in excess of 125 percent of the level expressed in Sec. 3.c. (10) of the Local Agreement or expanding beyond the limits of Sec. 24.b. of the Local Agreement, or in the event that cause exists, for either the Permit Holder or Rusk County to renegotiate all or a specific provision or provisions of this Local Agreement, in accord with Sec. 24 a., thereof, Rusk County reserves the right, in deference to the interest of the public health, safety and welfare and its authority at Sec. 59.97, Wis. Stats., to modify or impose additional or different conditions upon the Permit Holder's special use activity--mining. The process of considering and establishing or rejecting such additional or different conditions shall be governed by Sec. 7.1 and 7.2(1), (3), (4) and (5) of the Comprehensive Zoning Code or their successors.

(35) BACK FILLING OF OPEN PIT.

Upon the conclusion of its mining under this permit and under the Operator's NR132 permit, the Operator shall, in accord

with and subject to applicable provisions of NR132 and NR182, back fill the open pit created in the course of its mining operations. The present plan, subject to DNR approval, is that it shall use the soil, overburden wasterock and precipitate generated from wastewater treatment in the back filling of the mine and shall deposit in the layer furthest below the grade level of the land that wasterock with the highest incidence of sulfide mineralization as well as the precipitate. It shall also, if acceptable to the DNR, and subject to engineering specifications approved of by the DNR, place at an appropriate level below the soil and overburden, a layer composed of a clay-like, possibly saprolitic rock formation, referred to otherwise as "ML material", to help assure that the permeability of the Type II Wasterock filled below the Type I Wasterock will be less than the permeability of the Type I Wasterock and earth fill at the top of the pit.

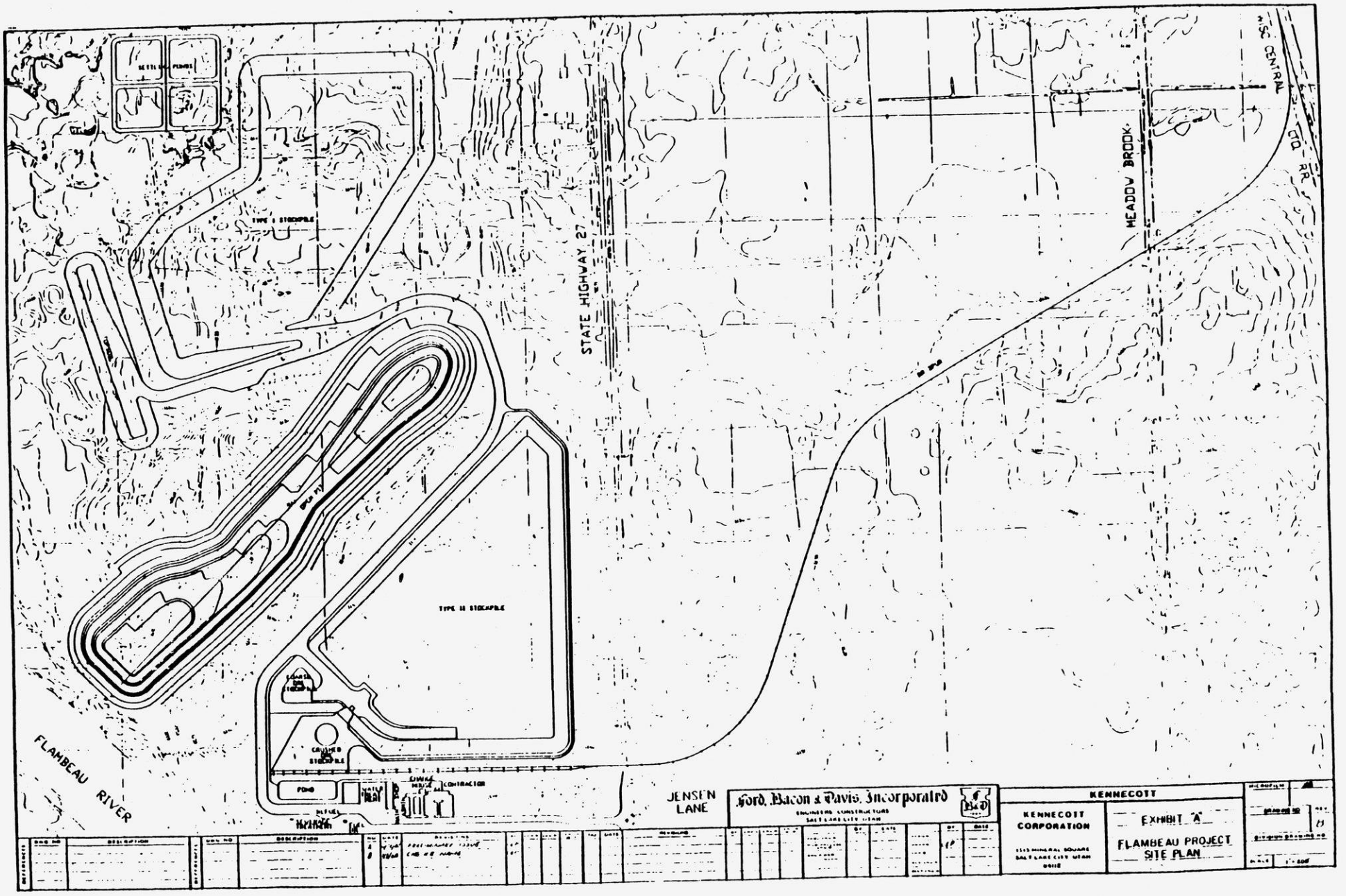
This Conditional Use Permit is hereby granted to the Permit Holder under authority vested in the Rusk County Board of Supervisors.

Rusk County,
A QuasiMunicipal Corporation of
The State of Wisconsin.

BY:

Norman Arndt

Norman Arndt
Zoning Administrator


STATE HIGHWAY 27
HEADDY BROOK
MSC CENTRAL
GTO RR
FLAMBEAU RIVER
JENSEN LANE
TYPE II STOCKPILE
CRUSHED STOCKPILE
POND
CONTRACTOR
Ford, Bacon & Davis, Incorporated
KENNECOTT
KENNECOTT CORPORATION
EXHIBIT "A"
FLAMBEAU PROJECT
SITE PLAN

APPENDIX D

Conditional Land Use Permit Certificate

RUSK COUNTY ZONING ADMINISTRATOR
COURTHOUSE
LADYSMITH, WISCONSIN 54848
TELEPHONE 532-2156

Permit No. 34
Date Issued 8-1-88

THIS CERTIFIES THAT A

LAND USE PERMIT

Has been issued to Kennecott Explorations (Australia) LTD.

for Development of the Kennecott Flambeau Mine (Type and use of building) in — (Metes and bounds or Lot, block and subdivision)

As described in (3) of the Conditional Land Use Permit

in — ¼ of — ¼ of Section 9 in Township 34N Range 6W

on Hwy. "27" Highway Rusk County

Town of Grant

Norman Arndt
(Zoning Administrator)

Post on Premises in Plain View

This permit also authorizes construction and operation of a rail spur, approximately one mile in length, to be located in part of section 10, township 34 north, Range 6 west. As per (3) Conditional Use Permit

D-1

APPENDIX E

Information Pertaining to Mining Bonds in Other States

BP America Inc.
200 Public Square
Cleveland, Ohio 44114-2375
216-586-4141

BP AMERICA

December 6, 1988

The State of Wisconsin
Department of Natural Resources
Madison, Wisconsin

To Whom It May Concern:

Please be advised that I am currently the Corporate Risk Manager for BP America Inc. I have been in this position for the past five years and prior to that had served in the position of Assistant Risk Manager for seven years. It is the responsibility of our Department to provide all Surety Bonds on behalf of BP America Inc. and its subsidiary organizations. During the time that I have been involved with this organization, BP America Inc. has not forfeited on any bond instrument that we have issued. In addition, I have checked with the prior management of this Department and can confidently say that over the past twenty years BP America Inc. has never forfeited on a bond document.

For your information, over this timeframe, BP America Inc. and its predecessor Company, The Standard Oil Company (Ohio), have had three major bond insurers. These companies have been the Aetna Casualty and Surety Company, The Insurance Company of North America and Safeco Insurance Company. During this timeframe, our bonding broker has consistently been Johnson & Higgins of Ohio, Inc. Each of these firm's can verify that we have never forfeited on a bond instrument issued by this Company.

This information is being provided to you in support of Kennecott Minerals Company application for a mining permit for its Flambeau mining project. Kennecott Minerals Company is a subsidiary of BP Minerals America which is a wholly owned subsidiary of BP America Inc. As a subsidiary, we would provide Kennecott with all of its bonding requirements.

If additional information is needed on this matter, please don't hesitate to contact me.

Very truly yours,

Thomas E. Tetlak
Corporate Risk Manager

TET:aml
12-5.doc

APPENDIX F

Description of Contiguous Land

Legal Description of Land and Mineral Rights Owned by Kennecott

FLAMBEAU PROJECT

Ladysmith, Rusk County, Wisconsin

A. Mineral rights only in Government Lot Two (2) of Section Four (4); all of Section Nine (9) excepting the NE¼-NE¼, excepting Government Lots One (1) and Two (2), and excepting surface rights only on a two (2) acre tract in the NE corner of the NW¼-NE¼; all of Section Ten (10) lying East of State Highway 27 excepting three (3) tracts of land described as:

1. NE¼-NE¼

2. Commencing at the intersection of the South right-of-way line of Gokey Road with the East right-of-way line of State Highway 27, thence Southerly along said East right-of-way line, 175 feet, to the point of beginning of the land to be herein described; thence Southerly along the East line of highway 208.7 feet, thence Easterly at right angles, 208.7 feet, thence Northerly at right angles and parallel to said East right-of-way line, 208.7 feet; thence Westerly at right angles, 208.7 feet to the point of beginning; and

3. Commencing at the intersection of the South right-of-way line of Gokey Road with the East right-of-way line of State Highway 27; thence Southerly along said East right-of-way line 175 feet, thence Easterly at right angles, 150 feet, thence Northerly at right angles and parallel to said East right-of-way line, 215 feet to the South line of Town Road, thence Westerly along Town Road 156 feet, to the point of beginning;

B. All of Section Sixteen (16); the E½ of Government Lots Six (6) and Seven (7) of Section Seventeen (17); the E½-E½-NW¼, the NE¼-SE¼, and the NE¼ excepting the NW¼-NE¼ of Section Twenty (20); the N½, the N½-S½, and the SW¼-SE¼ of Section Twenty-one (21); and the SW¼-NW¼ and the NW¼-SW¼ of Section Twenty-two (22);

all in Township Thirty-four (34) North, Range Six (6) West, subject to State, County and Town rights-of-way, small tracts owned by Lakehead Pipe Line Company in Section Sixteen (16) and their easement in Sections Nine (9) and Sixteen (16), railroad right-of-way in Sections Three (3) and Ten (10) and reservation of 50% of the mineral rights by Cornell University in the NW¼ of Section Twenty-one (21).

C. The South One-half of the South One-half of the Northeast Quarter of the Northeast Quarter (S½-S½-NE¼-NE¼) of Section Nine (9), Township Thirty-four (34) North, Range Six (6) West except:

A parcel of land located in the Northeast Quarter of the Northeast Quarter (NE¼-NE¼) of Section Nine (9), Township Thirty-four (34) North, Range Six (6) West and more particularly described as follows:

"Commencing at the Northeast corner of the said Northeast Quarter of the Northeast Quarter (NE¼-NE¼) and running thence due South, along the East boundary of said Northeast Quarter of Northeast Quarter (NE¼-NE¼) 1162.23 feet to the point of beginning of the land to be described; thence, at right angles, due West, 25.00 feet to a 1" iron pipe; thence continuing due West 128.39 feet to a 1" iron pipe; thence at right angles, due North, 25.00 feet to a 1" iron pipe; thence N. 89° 46.5' W, 311.95 feet to a 1" iron pipe; thence due North, parallel to the East boundary of said Northeast Quarter of the Northeast Quarter (NE¼-NE¼) 136 feet, more or less, to the North boundary of the South 330 feet of the said Northeast Quarter of the Northeast Quarter (NE¼-NE¼); thence Easterly along the North boundary of the South 330 feet of the said Northeast Quarter of the Northeast Quarter (NE¼-NE¼) 465.95 feet to the East boundary of said Northeast Quarter

of the Northeast Quarter (NE¼-NE¼); thence due South along the East boundary of said Northeast Quarter of the Northeast Quarter (NE¼-NE¼), 171.31 feet to the point of beginning.

D. Government Lot Seven (7), Section Three (3), Township Thirty-four (34) North, Range Six (6) West except the following described parcel to which Kennecott has retained the rights to all minerals of every description, including the oil and gas, deposited under said tract of land with the full right to, at any and all times, to mine or bore for and remove said mineral deposits of every description, including gas and oil:

All that part of Government Lot Seven (7), Section Three (3) and all that part of the Northwest Quarter of the Northeast Quarter (NW¼-NE¼) of Section Ten (10), Township Thirty-four (34) North, Range Six (6) West lying East of the Easterly right-of-way line of the soo Line Railroad and North of the existing spur line track easement running across the said Northwest Quarter of the Northeast Quarter (NW¼-NE¼) which said easement is described as follows:

Commencing at the Northeast corner of said Section Ten (10) thence S 00°54'46"E 1286.46 feet; thence S 88° 27' 28" W 1329.39 feet; thence N 00° 48' 04" W 325.03 feet to the point of beginning of the centerline of the above described 50 foot strip of land; thence S 88° 27' 28" W 401.37 feet; thence along the arc of a curve concave northerly, having a radius of 477.47 feet, whose chord bears N 71° 23' 24" W 328.99 feet to the easterly right-of-way of the Soo Line Railroad and there terminating, the sides of said strip of land shall extend and contract as required to insure continuity.

APPENDIX G

Annual Reports

BP America
Annual Report
1987

Introducing BP AMERICA

Highlights

		1987	1986
Financial	Revenues	$15,448	$13,938
Millions of dollars	Income (loss) before interest, income taxes, minority interest and extraordinary item	2,257	(242)*
	Minority interest	(143)	138
	Income (loss) before extraordinary item	564	(158)
	Net income (loss)	564	(188)
	Cash provided from operations	3,017	2,301
	Capital expenditures	1,549	1,993
	Purchase of minority shareholding in Standard Oil	7,825	—
	Other acquisitions	251	590
	Total assets	23,287	20,169
Operating and Other	Crude oil and natural gas liquids produced (net)–barrels per day	853,600	802,600
	Average sales price per barrel	$17.04	$13.72
	Produced natural gas sold (net)–thousands of cubic feet per day	240,900	194,400
	Average sales price per thousand cubic feet	$1.44	$1.54
	Refinery runs–barrels per day	622,500	622,800
	Petroleum products sold–barrels per day	844,000	1,003,000
	Produced copper sold–thousands of tons	129	181
	Gold produced–thousands of troy ounces	74	59
	Acrylonitrile produced–millions of pounds	930	840
	Ilmenite ore shipped–thousands of tons	3,000	3,000
	Animal feed produced–thousands of tons	4,430	1,190
	Employees	48,000	48,200

*Includes charges for unusual items of $1,133.

Corporate Profile

BP America is one of the largest industrial companies in the United States, with revenues of $15.4 billion in 1987. The company's primary business is petroleum. It is the country's leading domestic producer of crude oil, in addition to holding substantial oil and gas reserves. The company is a significant refiner and marketer, with an established retail network throughout most of the eastern United States.

More than a petroleum company, BP America has significant interests in chemicals, minerals, and animal nutrition. The company licenses the manufacturing process for over 90 percent of worldwide acrylonitrile capacity. It is modernizing its Bingham Canyon mine to become the lowest-cost producer of copper in North America. And, it owns Purina Mills, the country's largest animal feed supplier.

BP America also operates businesses in coal, ceramic- and resin-based materials, titanium dioxide slag, advanced composites, gas flare systems, and copper and brass products. The company is a wholly owned subsidiary of The British Petroleum Company p.l.c.

ANNUAL REPORT AND ACCOUNTS 1987

BP 87

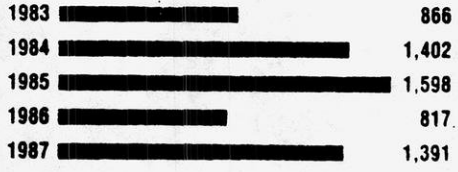
FINANCIAL HIGHLIGHTS

		1987	1986
Profit (after tax but before extraordinary items)			
Historical cost	£m	1,391	817
Replacement cost	£m	1,308	1,779
Extraordinary charges	£m	—	318
Earnings (historical cost)			
per ordinary share	pence	24.9	14.9
per American depositary receipt*	$	4.92	2.62
Dividends per ordinary share*	pence	12.50	11.67
Return on average shareholders' interest†	%	13.4	8.2
Capital expenditure and acquisitions	£m	3,556	3,787

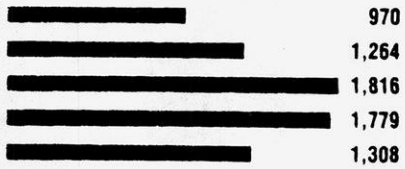
*ADR holders should also refer to pages 59 and 60
†Described on page 55

FIVE-YEAR TRENDS

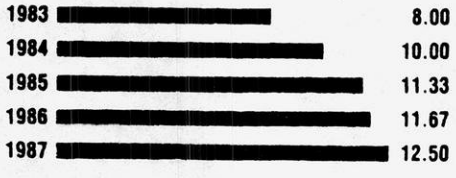
Historical cost profit (£m)



Replacement cost profit (£m)



Dividends per share (pence)



Funds generated from operations (£m)





BP 20-F

SECURITIES AND EXCHANGE COMMISSION

(Mark One) **FORM 20-F**

[ ] **REGISTRATION STATEMENT PURSUANT TO SECTION 12(b) OR (g) OF THE SECURITIES EXCHANGE ACT OF 1934**

OR

[✓] **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

for the fiscal year ended: December 31, 1987

Commission file number: 1-6262

THE BRITISH PETROLEUM COMPANY p.l.c.

(Exact name of Registrant as specified in its charter)

ENGLAND

(Jurisdiction of incorporation or organization)

BRITANNIC HOUSE, MOOR LANE, LONDON EC2Y 9BU, ENGLAND

(Address of principal executive offices)

Securities registered or to be registered pursuant to Section 12(b) of the Act.

Title of each class	Name of each exchange on which registered
Ordinary Shares of 25p each	New York Stock Exchange*

*Not for trading, but only in connection with the registration of American Depositary Shares, pursuant to the requirements of the Securities and Exchange Commission.

Securities registered or to be registered pursuant to Section 12(g) of the Act.

None

Securities for which there is a reporting obligation pursuant to Section 15(d) of the Act.

None

Indicate the number of outstanding shares of each of the issuer's classes of capital or common stock as of the close of the period covered by the annual report.

Ordinary Shares of 25p each	5,962,298,449
Cumulative First Preference Shares of £1 each	7,232,838
Cumulative Second Preference Shares of £1 each	5,473,414

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days.

Yes ✓ No ___

Indicate by check mark which financial statement item the registrant has elected to follow.

Item 17 ___ Item 18 ✓

APPENDIX H

Liner Efficiency and Leachate Head Calculations

Prepared by: JKS Date: March 27, 1989
Checked by: JWS Date: March 29, 1989

TABLE NO. 1

Liner Efficiency and Leachate Head Calculations

Approximate Slope (%)	Approximate Drain. Dist. L.F.	Approximate Base Area (%)	Efficiency (%)	Leachate Head (feet)	*T3
Phase I:					
1.18	396**	16.0	96.65	23.22	9.73
2.40	150	13.0	99.36	6.40	1.81
4.65	150	10.1	99.67	4.43	0.94
4.00	120	5.9	99.69	4.43	0.87
1.08	130	15.9	98.78	10.02	3.49
Phase II:					
1.74	110	13.9	99.36	6.42	1.83
0.67	200	25.2	97.01	20.97	8.66

* T3 is the time required to achieve steady state leachate head levels.

** Drain. Dist. of 396 feet is an average based on the shape and area (ft^2) of the Phase I area @ 1.18 percent slope.

NOTE: 1. Efficiency percentage, leachate head (feet), and T3 derived from Wong Equation. Refer to attached calculations.

2. Refer to Table No. 2 for annual infiltration (in.) utilized in the Wong Equation.

3. The liner permeability of 1×10^{-11} used in the Wong Equation is a conservative estimate based on information presented at the Eleventh Annual Madison Waste Conference (September 13-14, 1988), as follows: "Water vapor transmission through a 40-mil HDPE liner has been measured according to ASTM E96 to be 0.04 $g/m^2/day$ (Matrecon Laboratory, 1983). This transmission rate is equivalent to 2.7×10^{-13} cm/sec."

4. Other assumptions utilized in the Wong equation are as follows:
   - Blanket permeability (cm/sec) .001
   - Liner permeability (cm/sec) 1×10^{-11}
   - Blanket porosity 0.3
   - Liner thickness (60 mil) 0.0049'
   - Base slopes Vary

TABLE NO. 2

Monthly Precipitation (Inches)
(1987)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Rice Lake**	0.89	0.81	1.67	2.70	3.59	4.77	4.11	4.66	3.64	2.16	-	1.09	
Weyerhaeuser**	1.06	0.83	1.78	2.77	3.81	4.52	4.37	4.48	3.95	2.35	1.57	-	
Jump River 3E**	0.86	0.67	-	2.62	3.67	4.35	4.02	4.39	3.88	2.33	1.63	1.13	Total
Averages	0.94	0.77	1.73*	2.70	3.69	4.55	4.17	4.51	3.82	2.28	1.60*	1.11*	31.87

H-2

*Where no precipitation data is indicated, the monthly average is based on the remaining two quantities.

**Refer to attached state map for locations.

NOTE: 1. Quantities shown represent precipitation (inches), i.e., total recorded precipitation plus or minus departure from normal. Normal = 1951-1980. Source: Climatological Data - Wisconsin (1987), Volume 92.

2. For annual infiltration (inches) in Wong Equation calculations use 50% of total (average).
31.87 inches x 50 percent = 15.93 inches.

KMINE

TABLE NO. 3

Leachate Head (Feet)-Weighted Average

Weighted Average = Percent Area of Stockpile Base X Predicted Leachate Head at Given Percent Base Slope

Area Base (%)	Predicted Leachate Head (Feet)	
16	16.11*	2.58
13	6.40	0.83
10.1	4.43	0.45
5.9	4.43	0.26
15.9	10.02	1.59
13.9	6.42	0.89
25.2	9.08*	2.29
Weighted Average Leachate Head (Feet)		8.89

*Prorated for the actual life of the stockpile in these areas.

FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.0067

DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
160.0000	97.602	17.2517	6.92	%1160.33	160.0	6.92
170.0000	97.454	18.2522	7.36	%1168.34	170.0	7.36
180.0000	97.307	19.1215	7.79	%1174.95	180.0	7.79
190.0000	97.161	20.0851	8.22	%1181.93	190.0	8.22
200.0000	97.014	20.9743	8.66	%1188.09	200.0	8.66
210.0000	96.868	21.9111	9.09	%1194.29	210.0	9.09
220.0000	96.722	22.8142	9.52	%1200.03	220.0	9.52
230.0000	96.577	23.6388	9.95	%1205.07	230.0	9.95
240.0000	96.431	24.6439	10.39	%1210.99	240.0	10.39
250.0000	96.286	25.4834	10.82	%1215.75	250.0	10.82

NOTE:
1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.

FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.0174

DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
80.0000	99.532	5.5235	1.33	998.73	80.0	1.33
90.0000	99.474	5.8896	1.50	%1007.84	90.0	1.50
100.0000	99.415	6.1826	1.67	%1014.74	100.0	1.67
110.0000	99.357	6.4222	1.83	%1020.14	110.0	1.83
120.0000	99.299	6.6220	2.00	%1024.48	120.0	2.00
130.0000	99.241	7.1242	2.17	%1034.87	130.0	2.17
140.0000	99.183	7.5546	2.33	%1043.20	140.0	2.33
150.0000	99.125	7.9277	2.50	%1050.04	150.0	2.50
160.0000	99.067	8.2542	2.67	%1055.77	160.0	2.67

NOTE:

1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.

FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.0108

DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
100.0000	99.061	8.2875	2.68	%1056.25	100.0	2.68
110.0000	98.967	8.7296	2.95	%1063.63	110.0	2.95
120.0000	98.874	9.4019	3.22	%1074.16	120.0	3.22
130.0000	98.781	10.0188	3.49	%1083.19	130.0	3.49
140.0000	98.688	10.5475	3.76	%1090.49	140.0	3.76
150.0000	98.595	11.0575	4.03	%1097.20	150.0	4.03
160.0000	98.503	11.7184	4.30	%1105.44	160.0	4.30
170.0000	98.410	12.3015	4.56	%1112.34	170.0	4.56
180.0000	98.318	12.8198	4.83	%1118.20	180.0	4.83
190.0000	98.225	13.4023	5.10	%1124.51	190.0	5.10
200.0000	98.133	14.0212	5.37	%1130.92	200.0	5.37

NOTE:
1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.

FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.04

DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
80.0000	99.796	4.4250	0.58	967.88	80.0	0.58
90.0000	99.771	4.4250	0.65	967.88	90.0	0.65
100.0000	99.745	4.4250	0.73	967.88	100.0	0.73
110.0000	99.720	4.4250	0.80	967.88	110.0	0.80
120.0000	99.694	4.4250	0.87	967.88	120.0	0.87
130.0000	99.669	4.4250	0.94	967.88	130.0	0.94
140.0000	99.643	4.4927	1.02	970.04	140.0	1.02
150.0000	99.618	4.7811	1.09	978.88	150.0	1.09
160.0000	99.593	5.0335	1.16	986.18	160.0	1.16

NOTE:
1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.

FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.0465

DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
100.0000	99.781	4.4250	0.62	968.15	100.0	0.62
110.0000	99.759	4.4250	0.69	968.15	110.0	0.69
120.0000	99.737	4.4250	0.75	968.15	120.0	0.75
130.0000	99.715	4.4250	0.81	968.15	130.0	0.81
140.0000	99.693	4.4250	0.87	968.15	140.0	0.87
150.0000	99.671	4.4250	0.94	968.15	150.0	0.94
160.0000	99.649	4.4250	1.00	968.15	160.0	1.00
170.0000	99.627	4.6784	1.06	976.06	170.0	1.06
180.0000	99.606	4.9084	1.12	982.88	180.0	1.12
190.0000	99.584	5.1142	1.19	988.72	190.0	1.19
200.0000	99.562	5.2995	1.25	993.78	200.0	1.25

NOTE:

1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.

FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.024

DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
100.0000	99.576	5.1831	1.21	989.84	100.0	1.21
110.0000	99.533	5.5136	1.33	998.61	110.0	1.33
120.0000	99.491	5.7890	1.45	%1005.54	120.0	1.45
130.0000	99.449	6.0221	1.57	%1011.14	130.0	1.57
140.0000	99.407	6.2219	1.69	%1015.78	140.0	1.69
150.0000	99.364	6.3950	1.81	%1019.67	150.0	1.81
160.0000	99.322	6.5465	1.93	%1023.00	160.0	1.93
170.0000	99.280	6.7950	2.05	%1028.29	170.0	2.05
180.0000	99.238	7.1481	2.18	%1035.48	180.0	2.18
190.0000	99.196	7.4640	2.30	%1041.63	190.0	2.30
200.0000	99.154	7.7484	2.42	%1046.94	200.0	2.42

NOTE:
1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.

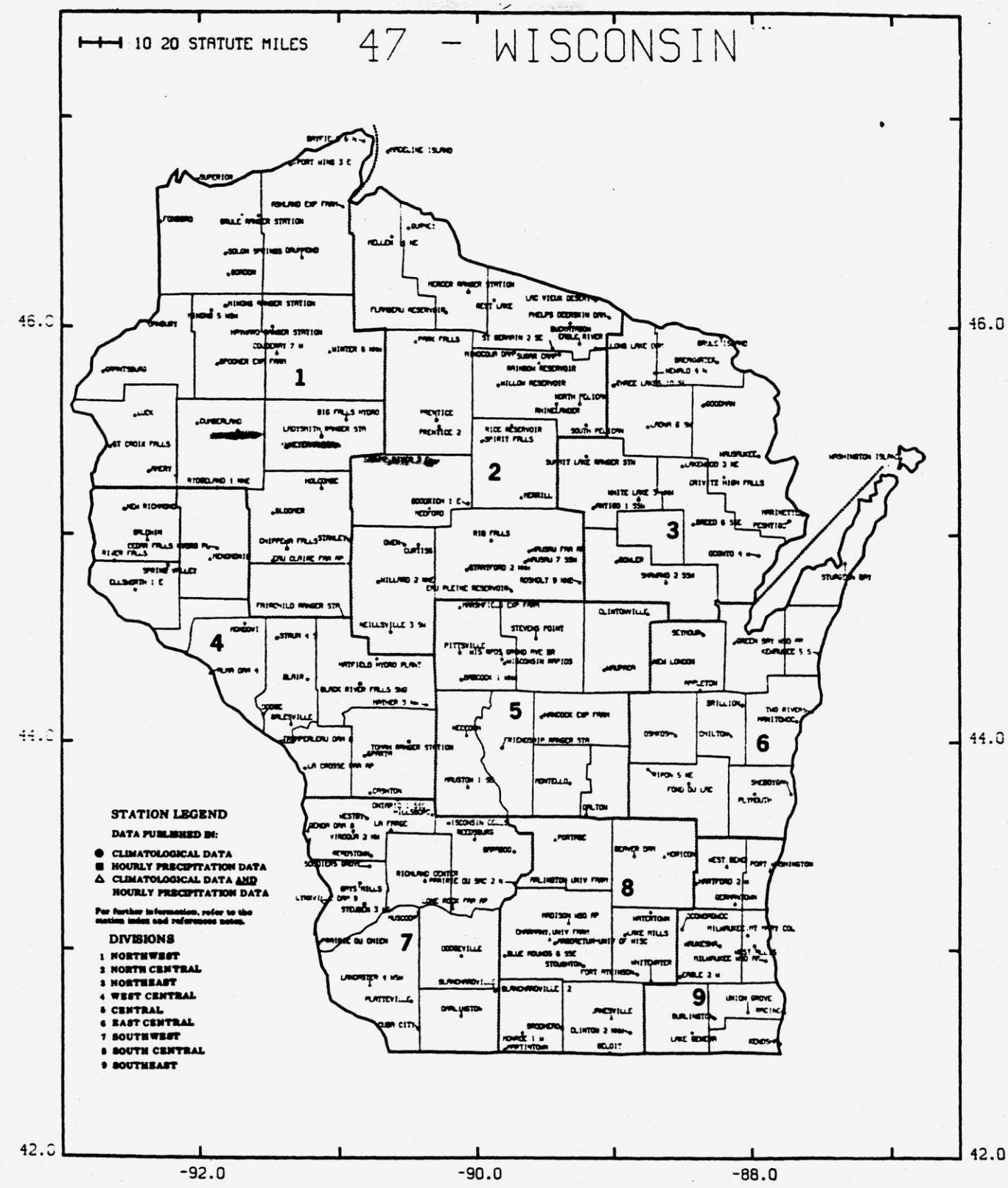
FOTH & VAN DYKE and ASSOCIATES / Waste Energy Division
LINER EFFICIENCY CALCULATIONS
ANNUAL ADDITIVE HEAD RECHARGE METHOD

FOR: kennecott

ANNUAL INFILTRATION (INCHES)	15.93
BLANKET PERMEABILITY (CM/SEC)	.001
LINER PERMEABILITY (CM/SEC)	1E-11
BLANKET POROSITY	.3
LINER THICKNESS (FEET)	.0049
BASE SLOPE (FEET/FOOT)	.0118

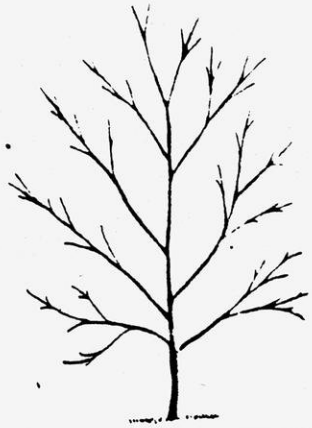
DRAINAGE DISTANCE (FEET) (VARIABLE)	EFFICIENCY (%)	LEACHATE HEAD (FEET)	T1 (YEARS)	T2 (YEARS)	COLL DIST (FEET)	T3 (YEARS)
390.0000	96.701	22.9385	9.58	%1200.86	390.0	9.58
392.0000	96.685	23.0346	9.63	%1201.45	392.0	9.63
394.0000	96.668	23.1298	9.68	%1202.04	394.0	9.68
396.0000	96.652	23.2240	9.73	%1202.62	396.0	9.73
398.0000	96.635	23.3172	9.78	%1203.19	398.0	9.78
400.0000	96.618	23.4095	9.83	%1203.75	400.0	9.83
402.0000	96.602	23.5009	9.88	%1204.30	402.0	9.88
404.0000	96.585	23.5914	9.93	%1204.85	404.0	9.93
406.0000	96.569	23.6810	9.98	%1205.39	406.0	9.98

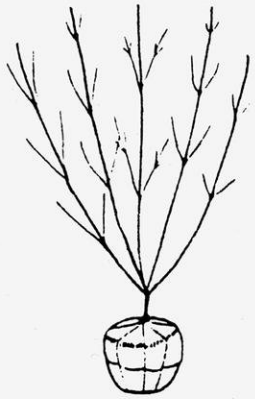
NOTE:
1) T1 IS THE TIME FOR ONE COMPLETE COLLECTION CYCLE TO OCCUR.
1) T2 IS THE TIME FOR THE AVERAGE LEACHATE HEAD AT STEADY STATE CONDITIONS TO LEAK INTO THE LINER
3) THE COLLECTION DISTANCE NOTED IS THE MAXIMUM DISTANCE FROM THE LEACHATE COLLECTION LINE THAT THE STEADY STATE LEACHATE HEAD MAY BE EXPECTED TO FLOW INTO THE COLLECTION LINE BEFORE INFILTRATING THE LINER.
4) T3 IS THE TIME REQUIRED TO ACHIEVE STEADY STATE LEACHATE HEAD LEVELS.
5) Liner efficiencies calculated using a computer program based on an original program developed by the State of Wisconsin, Bureau of Solid Waste Management and presented at the Eight Annual Madison Waste Conference, September 18-19, 1985.


10 20 STATUTE MILES
47 - WISCONSIN
46.0
44.0
42.0
-92.0
-90.0
-88.0
STATION LEGEND
DATA PUBLISHED IN:
CLIMATOLOGICAL DATA
HOURLY PRECIPITATION DATA
CLIMATOLOGICAL DATA AND HOURLY PRECIPITATION DATA
For further information, refer to the station index and references notes.
DIVISIONS
1 NORTHWEST
2 NORTH CENTRAL
3 NORTHEAST
4 WEST CENTRAL
5 CENTRAL
6 EAST CENTRAL
7 SOUTHWEST
8 SOUTH CENTRAL
9 SOUTHEAST

APPENDIX I

Reference Standards Applicable to Specie Selection, Seedbed Preparation, Planting Methods, and Mulching and Fertilizing Methods









Z60.1-1973

AMERICAN STANDARD FOR NURSERY STOCK

American Association of Nurserymen
230 Southern Building, Washington, D.C. 20005

FOREWORD

One of the early activities of the American Association of Nurserymen, Inc. was the development of a standardized system of sizing and describing plants to facilitate the trade in nursery stock. Since 1921 the Association has maintained an active committee on standards. Its first edition of "Horticultural Standards" was published in 1923. From time to time, these standards were revised and expanded to meet the needs of the industry.

After World War II the Association elected to make the standards a national standard by adhering to the standards procedures of the American Standards Association. The first edition published under the procedures of the Americsn Standards Association (forerunner of the current American National Standards Institute) was published on June 22, 1949.

The revisions included in the 1973 edition were developed by the Association's Horticultural Standards Committee since January 1969. The proposed revisions were submitted to interested national and regional societies, associations and governmental agencies for their review and endorsement.

STANDARDIZED PLANT NAMES

The nomenclature used in this issue of "American Standard for Nursery Stock" conforms to that of Standardized Plant Names, Second Edition, American Joint Committee on Horticultural Nomenclature, 1942. Publisher J. Horace McFarland Company, Harrisburg, Pennsylvania.

HORTICULTURAL STANDARDS COMMITTEE

Ralph Shugert, Chairman, Spring Hill Nurseries Company, Tipp City, Ohio
Larry Bachman, Bachman's, Inc., Minneapolis, Minnesota
Edward B. Ballard, Annandale, Virginia (Representing American Society of Landscape Architects)
Lester Begick, Bay City, Michigan (Representing National Landscape Association)
Bruce A. Briggs, Briggs Nursery, Olympia, Washington
Jack Brownell, Rhode Island Nurseries, Inc., Newport, Rhode Island
George Cultra, Morning Star Nursery, Inc., Rives, Tennessee
Robert Denney, Stark Bro's Nurseries & Orchards Co., Louisiana, Missouri
Homer Greenwood, Mount Arbor Nurseries, Shenandoah, Iowa
William Kreutzfeld, D. Hill Nursery Company, Dundee, Illinois
Michael V. Michael, Michael's Nursery, Boynton Beach, Florida
Gary Moller, Moller's Nursery, Inc., Gresham, Oregon
Harold Nickel, Greenleaf Nursery Company, Park Hill, Oklahoma
John J. Ryan, Albany, New York (Representing New York State Department of Transportation)
William G. Thornton, Cincinnati, Ohio (Representing Associated Landscape Contractors of America)
William Tomlinson, Select Nurseries, Inc., Brea, California
Martin W. Usrey, Monrovia Nursery Company, Azusa, California
Dale E. Wild, The Sarcoxie Nurseries, Sarcoxie, Missouri
Hewitt Wilson, C.E. Wilson Nurseries, Inc., Jacksonville, Texas
Phillip Worth, Kankakee Nursery Company, Aroma Park, Illinois

American Association of Nurserymen, Inc.
230 Southern Building
Washington, D.C. 20005

TABLE OF CONTENTS

Page

1 DECIDUOUS SHADE AND FLOWERING TREES 1
1.1 General Specifications
1.1.1 Caliper and Height Measurement
1.1.2 Height of Branching-Street Trees
1.1.3 Height Relationship to Caliper by Types
1.1.4 Deciduous Trees for Other Uses
1.2 Bare Root Specifications
1.2.1 Nursery Grown-Spread of Roots
1.2.2 Collected-Spread of Roots
1.3 Balling and Burlapping Specifications
1.3.1 Nursery Grown
1.3.2 Collected
1.3.3 Plantation Grown
1.3.4 Ball Depths
1.4 Container Grown Specifications
1.5 Balled and Potted

2 DECIDUOUS SHRUBS 5
2.1 General Specifications
2.1.1 Height Measurement
2.1.2 Quality Definitions
2.1.3 Grading Tolerance
2.1.4 Recommended Grades
2.1.5 Types of Shrubs
2.2 Bare Root Specifications
2.2.1 Nursery Grown-Spread of Roots
2.2.2 Collected-Spread of Roots
2.3 Balling and Burlapping Specifications
2.3.1 Nursery Grown
2.3.2 Collected
2.3.3 Plantation Grown
2.3.4 Ball Depths
2.4 Container Grown Specifications
2.5 Balled and Potted

3 CONIFEROUS EVERGREENS 9
3.1 General Specifications
3.1.1 Quality Definitions
3.1.2 Types of Conifers
3.2 Balling and Burlapping Specifications
3.2.1 Nursery Grown
3.2.2 Collected
3.2.3 Plantation Grown
3.2.4 Ball Depths
3.3 Container Grown Specifications
3.4 Balled and Potted

4 BROADLEAF EVERGREENS 14
4.1 General Specifications
4.1.1 Quality Definitions
4.1.2 Grading Tolerance
4.1.3 Types and Measurement Designation

Page

4.2 Balling and Burlapping Specifications
4.2.1 Nursery Grown
4.2.2 Collected
4.2.3 Plantation Grown
4.2.4 Ball Depths
4.3 Container Grown Specifications
4.4 Balled and Potted

5 ROSE GRADES 18
5.1 General
5.2 Hybrid Tea, Tea, Grandiflora, Hybrid Perpetual, Moss and Miscellaneous Bush Roses
5.3 Floribunda Roses
5.4 Polyantha, Dwarf and Light Growing Floribunda Roses
5.5 Climbing Roses
5.6 Container Grown Roses

6 VINES & GROUND COVERS 20
6.1 Type 1 — Fast Growing Vines
6.2 Type 2 — Medium Growing Vines
6.3 Type 3 — Clump Type
6.4 Type 4 — Ground Covers
6.5 Type 5 — Ground Cover—Crownvetch
6.6 Vines in Pots or Containers

7 FRUIT TREE GRADES 21
7.1 Deciduous
7.1.1 General
7.1.2 One Year Standard
7.1.3 Seedlings
7.2 Citrus

8 SMALL FRUITS 22
8.1 Raspberries
8.2 Dewberries, Blackberries, Boysenberries, Youngberries
8.3 Currants
8.4 Blueberries
8.5 Gooseberries
8.6 Grape Vines
8.7 Strawberry Plants
8.8 Asparagus Crowns

9 LINING OUT STOCK 23
9.1 General
9.2 Designation
9.3 Size Designation
9.4 Recommendations—Evergreen Lining Out Stock

Page

10 SEEDLING TREES AND SHRUBS 24
10.1 General
10.2 Deciduous or Hardwoods
10.3 Conifers—Evergreens

11 BULBS, CORMS AND TUBERS 25
11.1 General
11.2 Tulips
11.3 Hyacinths
11.4 Grape Hyacinths
11.5 Crocus
11.6 Narcissus and Daffodils

Page

11.7 Narcissus—Paper White
11.8 Gladioli
11.9 Amaryllis
11.10 Lilies (Regal and Easter)
11.11 Caladium (Fancy Leaved)
11.12 Tuberous Begonias and Gloxinius
11.13 Tuberoses, Callas and other Miscellaneous Bulbs
11.14 Peonies and Bleeding Heart
11.15 Cannas
11.16 Dahlias

12 CHRISTMAS TREE STANDARDS 26

1 DECIDUOUS SHADE & FLOWERING TREES

1.1 GENERAL SPECIFICATIONS

1.1.1 CALIPER AND HEIGHT MEASUREMENT

In size grading B&B trees, caliper shall take precedence over height.

In size grading bare root trees, height shall take precedence to 8 ft., thereafter caliper takes precedence.

Caliper of the trunk shall be taken 6 inches above the ground level up to and including 4 inch caliper size and 12 inches above the ground level for larger sizes.

Where a minimum and maximum size, i.e. size range, is specified, the average of the lot should approximate the midpoint of the specified size range.

1.1.2 HEIGHT OF BRANCHING—STREET TREES

Unless otherwise specified trees are to be suitable for planting as street trees and are to be free of branches to a point about 50% of their height. Height of branching should bear a relationship to the size and kind of tree also so that the crown of the tree will be in good balance with the trunk as the tree grows.

Examples:

Acer platanoides, 2 to 2½ in. cal., 12 to 14 ft., branched 6 to 7 ft.

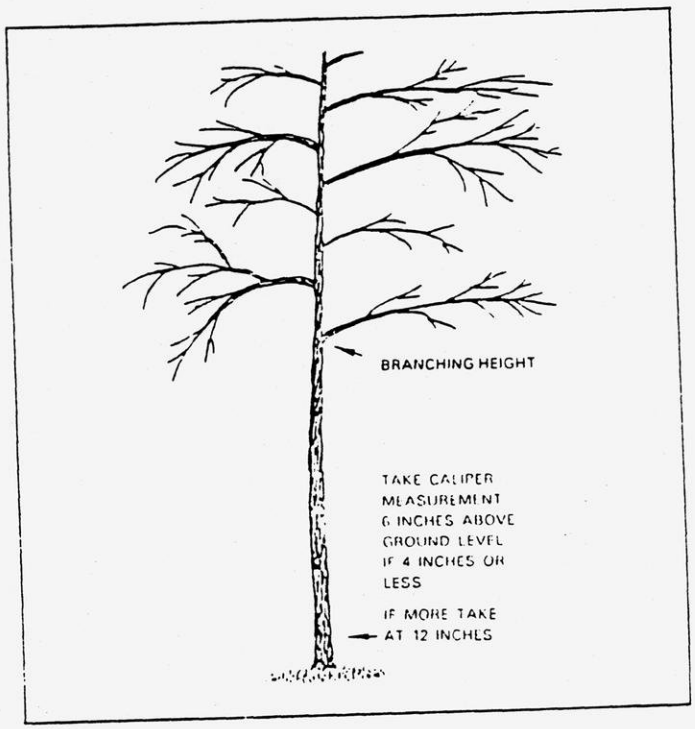
Quercus borealis 'Maxima' 3½ to 4 in. cal., 14 to 16 ft., branched 7 to 9 ft.

Trees with ascending branches (example — Ulmus americana and Tilia tomentosa) may be branched one foot or more below the standard height and still provide proper clearance which is the purpose of this specification.

1.1.3 HEIGHT RELATIONSHIP TO CALIPER BY TYPES

It is recognized that climatic conditions in different sections of the country produce trees of different caliper-height proportions. Trees from one region of the country may have less caliper in proportion to height while trees from another section may have greater caliper in proportion to height than shown in the following table.

The table in Type 1 shows the average height range and also maximum heights permitted. (See 1.1.3.1)



1.1.3.1 Type 1. Shade Trees

The height relationship to caliper will for most standard shade trees be as follows:

Caliper	Average Height Range	Maximum Heights
½ to ¾ in.	5 to 6 ft.	8 ft.
¾ to 1 in.	6 to 8 ft.	10 ft.
1 to 1¼ in.	8 to 10 ft.	11 ft.
1¼ to 1½ in.	8 to 10 ft.	12 ft.
1½ to 1¾ in.	10 to 12 ft.	14 ft.
1¾ to 2 in.	10 to 12 ft.	14 ft.
2 to 2½ in.	12 to 14 ft.	16 ft.
2½ to 3 in.	12 to 14 ft.	16 ft.
3 to 3½ in.	14 to 16 ft.	18 ft.
3½ to 4 in.	14 to 16 ft.	18 ft.
4 to 5 in.	16 to 18 ft.	22 ft.
5 to 6 in.	18 ft. and up	26 ft.

Sizes under one inch may be calipered if desired.

Examples:

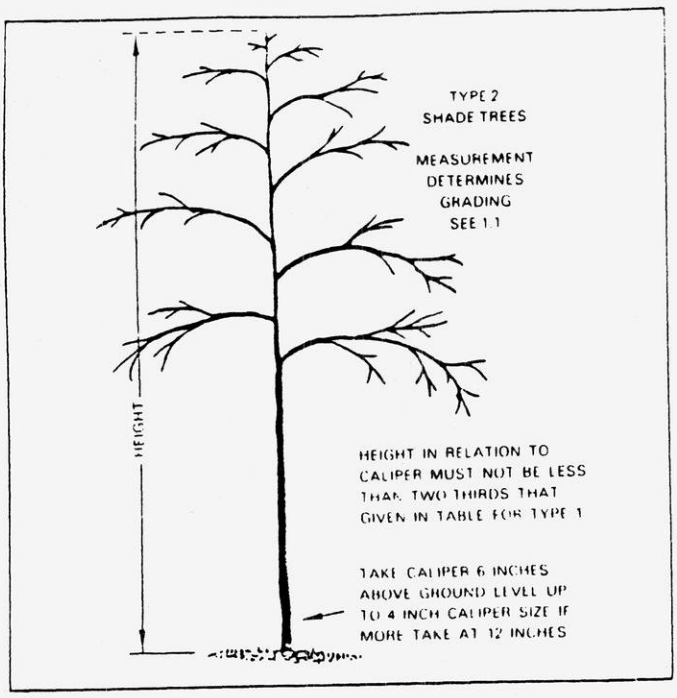
Acer rubrum, saccharinum
Betula
Fraxinus americana, pennsylvanica
Ginkgo
Gleditsia
Liriodendron
Platanus
Populus
Quercus borealis, macrocarpa, palustris, phellos
Salix
Tilia americana
Ulmus americana

1.1.3.2 Type 2. Shade Trees

Trees of slower growth which will not usually attain the height measurement in relation to caliper as in Type 1. The height should, however, be not less than two-thirds the height relationship given for Type 1. (See 1.1.3.1)

Examples:

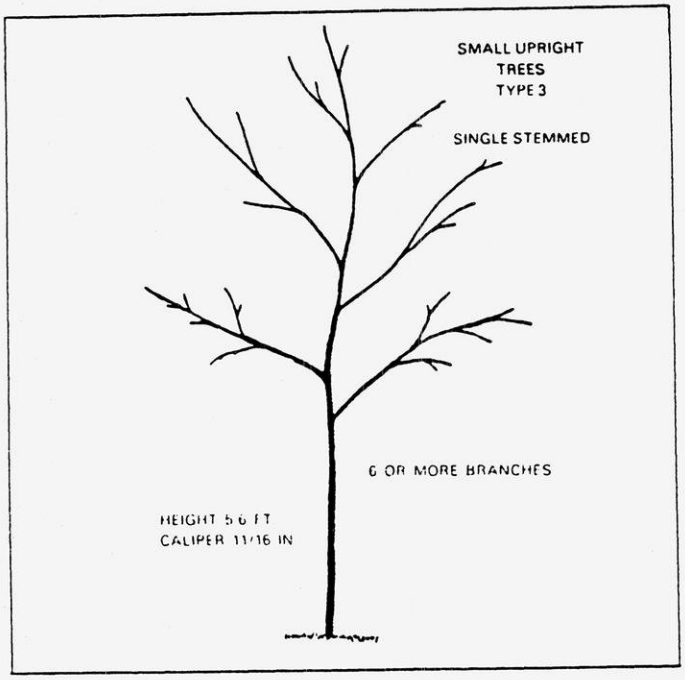
Aesculus
Celtis
Cladrastis lutea
Fagus sylvatica
Koelreuteria
Laburnum
Liquidambar
Nyssa
Quercus alba
Sorbus
Tilia cordata, euchlora



1.1.3.3 Type 3. Small Upright Trees

This is a broad group including small upright trees which may be grown as a clump or shrub. Height shall be the governing measurement. For single stem plants, the minimum relationship of caliper and branching will usually be as follows:

2 to 3 ft., 5/16 in. caliper, 3 or more branches
3 to 4 ft., 7/16 in. caliper, 4 or more branches
4 to 5 ft., 9/16 in. caliper, 5 or more branches
5 to 6 ft., 11/16 in. caliper, 6 or more branches
6 to 8 ft., 7/8 in. caliper, 7 or more branches



Examples:

Acer campestre, circinatum
Cercis
Crataegus
Halesia
Malus (most crabapples)
Prunus cerasifera 'Thundercloud'
Prunus serrulata, subhirtella
Styrax
Syringa amurensis 'Japonica' .

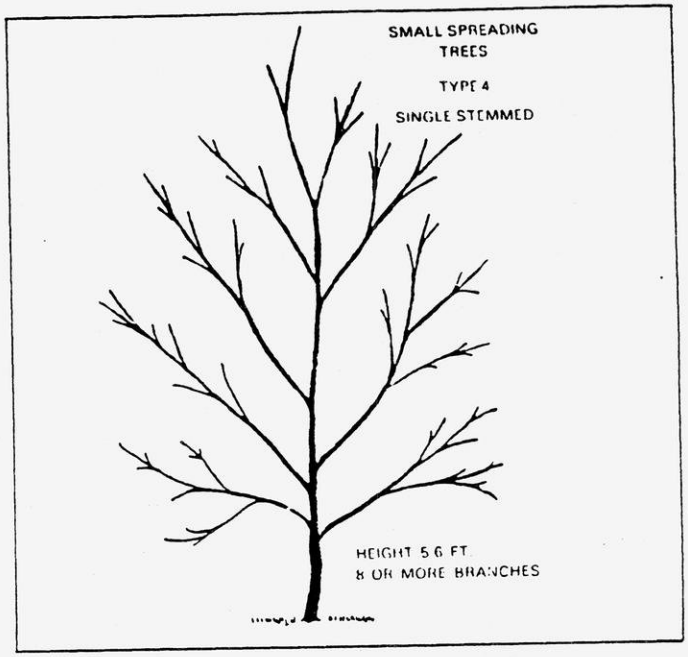
1.1.3.4 Type 4. Small Spreading Trees

This is a broad group including small spreading trees of dwarf habit of growth and certain large shrubs grown in tree or multi-stemmed form. Height shall be the governing measurement. For single stem plants, the minimum branching will be as follows:

2-3 ft. 4 or more branches
3-4 ft. 5 or more branches
4-5 ft. 7 or more branches
5-6 ft. 8 or more branches
6-8 ft. 8 or more branches

Examples:

Acer palmatum, griseum
Cornus
Lagerstromia indica
Magnolia, soulangeana, stellata
Malus sargentii
Viburnum prunifolium



1.1.4 DECIDUOUS TREES FOR OTHER USES

Trees for special uses should be branched or pruned naturally according to type. Where a form of growth is desired which is not in accordance with a natural growth habit, this form should be so specified.

Examples:

Bush form — trees which start to branch close to the ground in the manner of a shrub.

Clumps — trees with two or more main stems starting from the ground with the number of stems to be specified.

Cut back or Sheared—trees that have been pruned back so as to multiply the branching structure and to develop a more formal effect.

Topiary—Trees sheared or trimmed closely to a definite geometric pattern.

1.2 BARE ROOT SPECIFICATIONS

1.2.1 NURSERY GROWN—SPREAD OF ROOTS

All bare root trees shall have a well branched root system characteristic of the species. The following table represents the approved minimum root spread for nursery grown shade trees.

Caliper	Average Height Range	Minimum Root Spread
½ to ¾ in.	5 to 6 ft.	12 in.
¾ to 1 in.	6 to 8 ft.	16 in.
1 to 1¼ in.	8 to 10 ft.	18 in.
1¼ to 1½ in.	8 to 10 ft.	20 in.
1½ to 1¾ in.	10 to 12 ft.	22 in.
1¾ to 2 in.	10 to 12 ft.	24 in.
2 to 2½ in.	12 to 14 ft.	28 in.
2½ to 3 in.	12 to 14 ft.	32 in.
3 to 3½ in.	14 to 16 ft.	38 in.

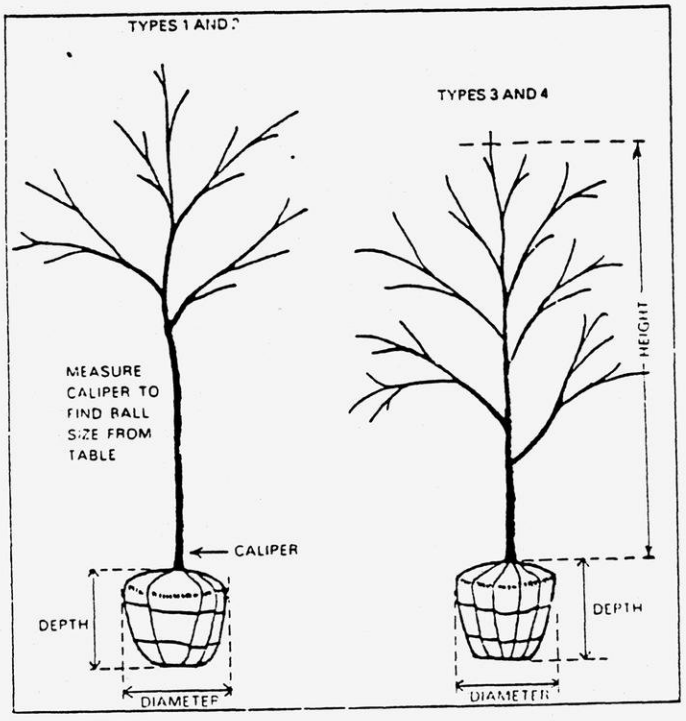
1.2.2 COLLECTED—SPREAD OF ROOTS

Trees collected from native stands or established plantings must be so designated. The spread of roots, bare root trees, shall be ⅓ greater than the spread of roots, bare root nursery grown, as tabulated above.

Trees collected from wild or native stands may be considered nursery grown when they have been successfully reestablished in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

1.3 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.



1.3.1 NURSERY GROWN

The following table represents the recommended minimum sizes of balls for trees which are being grown in the nursery under favorable growing conditions and which have received the proper cultural treatment to develop a well branched root system.

These specifications are for plants dug with the ball of earth in which they are growing.

Shade Trees Types 1 and 2		Trees Types 3 and 4	
Caliper	Minimum Diameter Ball	Height	Minimum Diameter Ball
Inches	Inches	Feet	Inches
½-¾	12		
¾-1	14	2-3	10
1-1¼	16	3-4	12
1¼-1½	18	4-5	14
1½-1¾	20	5-6	16
1¾-2	22	6-7	18
2-2½	24	7-8	20
2½-3	28	8-9	22
3-3½	32	9-10	24
3½-4	38	10-12	26
4-4½	42		
4½-5	48		
5-5½	54		

It is recognized that plants having a coarse or wide-spreading root system because of natural habit of growth, soil condition, infrequent transplanting practice, or that are moved out of season, would require a size of ball in excess of the recommended sizes.

1.3.2 COLLECTED

It is generally recognized that plants growing in their native state will sustain a much more severe shock when transplanted than the same kinds of plants when nursery grown. If collected material is moved, considerably larger ball than that recommended for transplanted nursery stock is required, because of the unrestricted root development and the varying conditions of soil in which such material is found.

The minimum ball sizes shall be equal to those specified in 1.3.1 for the next larger size nursery grown stock.

Trees collected from wild or native stands may be considered nursery grown when they have been successfully reestablished in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

1.3.3 PLANTATION GROWN STOCK

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where there has been a minimum of after-care.

The minimum ball sizes shall be equal to those specified in 1.3.1 for the next larger size nursery grown stock.

1.3.4 BALL DEPTHS

Under certain soil and regional conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly encompass the roots. Conversely in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.

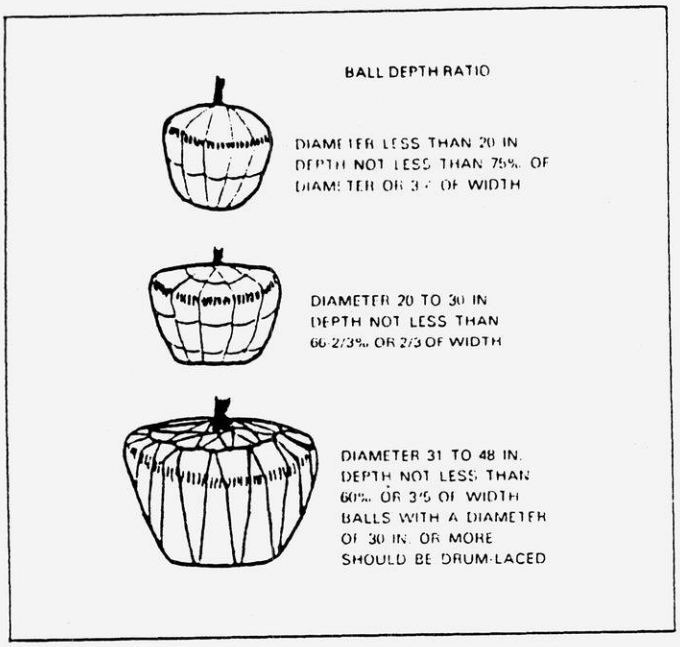
For the greater part of the country ball depths will carry the following ratios:

Balls with diameters less than 20 inches — Depth not less than 75% of diameter.

Balls with diameters of 20 inches to 30 inches incl. — Depth not less than 66⅔% of diameter.

Balls with diameters of 30 inches to 48 inches incl. — Depth not less than 60% of diameter.

Balls with diameters over 48 inches will have the depth scaled down proportionately.



1.4 CONTAINER GROWN SPECIFICATIONS

All container grown trees shall be healthy, vigorous, well-rooted and established in the container in which they are sold. They shall have tops which are of good quality and are in a healthy growing condition.

An established container grown tree shall be a tree transplanted into a container and grown in that container sufficiently long for the new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

The container shall be sufficiently rigid to hold the ball shape protecting the root mass during shipping.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given size container.

The following table gives tree sizes and acceptable container sizes:

Tree Height	Container Size
12 to 18 in. 18 to 24 in. 2 to 3 ft. 3 to 4 ft.	1 gal. (trade designation) Minimum of 5½ inches across top and height of 6 inches or equivalent volume
2 to 3 ft. 3 to 4 ft. 4 to 5 ft.	2 gal. (trade designation) Minimum of 7 inches across top and height of 7½ inches or equivalent volume
4 to 5 ft. 5 to 6 ft. 6 to 8 ft.	5 gal., egg can or square can (trade designation) Minimum of 9 inches across top and height of 10 inches or equivalent volume

1.5 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.

The minimum ball size specification for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 1.3.1)

2 DECIDUOUS SHRUBS

2.1 GENERAL SPECIFICATIONS

2.1.1 HEIGHT MEASUREMENT

2.1.1.1 Dwarf and Semi-dwarf Shrubs

State height in inches up to 24 inches, over 24 state in feet. Size grade in 3 inch series to 18 inches, six inches 18-24 inches, and over 24 inches in ½ foot series. Examples: 12-15 in.; 15-18 in.; 18-24 in.; 2-2½ ft.; 2½-3 ft.

2.1.1.2 Strong Growing Shrubs

Grade in 6-inch series up to 24 inches; example: 12-18 in.; over 24 inches by single feet up to 6 feet; then in double feet above 6 feet; example: 8-10 ft.

2.1.2 QUALITY DEFINITIONS

If a plant is well grown with single stem, well shaped and bushy and has sufficient well spaced side branches to give it weight and good bud qualities, it should be an acceptable plant.

A cane shall be considered a primary stem which starts from the ground or close to the ground at a point not higher than one-fourth the height of the plant.

2.1.3 GRADING TOLERANCE

The growing of plant material cannot be rigidly standardized because of varying conditions of growth and methods of handling preferred or necessitated by climate, soil, and other conditions beyond the control of the grower. Judgment should therefore be exercised and allowances made in the above definitions to agree with those which are recognized by the trade as typical of acceptable plants in that region.

2.1.4 RECOMMENDED GRADES

Lots or groups of plants of a given grade should have an approximate average height as in the following examples:

Grade of Plant	18-24 in.	2-3 ft.	3-4 ft.	4-5 ft.
Approximate Average of lot	21 in.	2½ ft.	3½ ft.	4½ ft.

The recommended grades apply to the height of plants grown under average soil and climatic conditions in nursery beds and fields, which have been transplanted, root pruned and trimmed according to regular nursery practice. Judgment must be exercised in interpreting and adapting these general classifications to any particular species or variety, and consideration given to the normal growth habit under conditions peculiar to the region. (For container grown shrubs, see 2.4)

2.1.5 TYPES OF SHRUBS

2.1.5.1 Type 0 — Shrubs Having a Tendency Not to Mature All Top Growth

It is an accepted nursery trade practice to prune the top growth of these shrubs back to live wood.

2.1.5.1.1 Type 0-1

6-9 in. shrubs should have no less than 2 canes, 6 in. and up of live top; 9 in. and up shrubs should have no less than 3 canes, 9 in. and up of live top.

Example: Hydrangea macrophylla

2.1.5.1.2 Type 0-2

9-12 in. shrubs should have no less than 2 canes, 9 in. and up of live top.

Examples: Caryopteris, Hypericum (shrubby types)

2.1.5.1.3 Type 0-3

12-18 in. shrubs should have not less than 2 canes, 12 in. and up of live top.

18 in. & up shrubs should have not less than 3 canes, 18 in. and up of live top.

Examples: Hydrangea arborseeens, Buddleia, Vitex

2.1.5.2 Type 1 — Shrubs: Dwarf and Semi-Dwarf

12-15 in. shrubs should have not less than 4 canes, 12 in. and up.

15-18 in. shrubs should have not less than 4 canes, 15 in. and up.

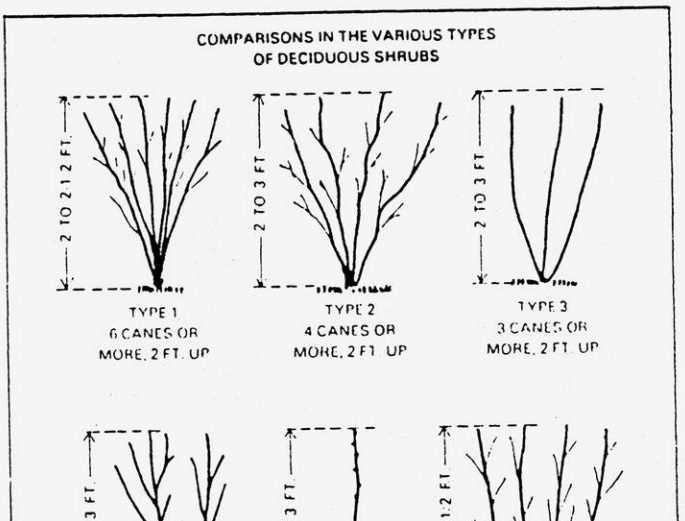
18-24 in. shrubs should have not less than 5 canes, 18 in. and up.

2-2½ ft. shrubs should have not less than 6 canes, 2 ft. and up.

2½-3 ft. shrubs should have not less than 7 canes, 2½ ft. and up.

Examples:

Berberis thunbergii atropurpurea, 'Crimson Pigmy'
Deutzia gracilis
Euonymus kiautschovica 'Jewell'
Potentilla fruticosa
Ribes alpinum
Spiraea bumalda 'Anthony Waterer'



2.1.5.3 Type 2

18-24 in. shrubs should have not less than 3 canes, 18 in. and up.

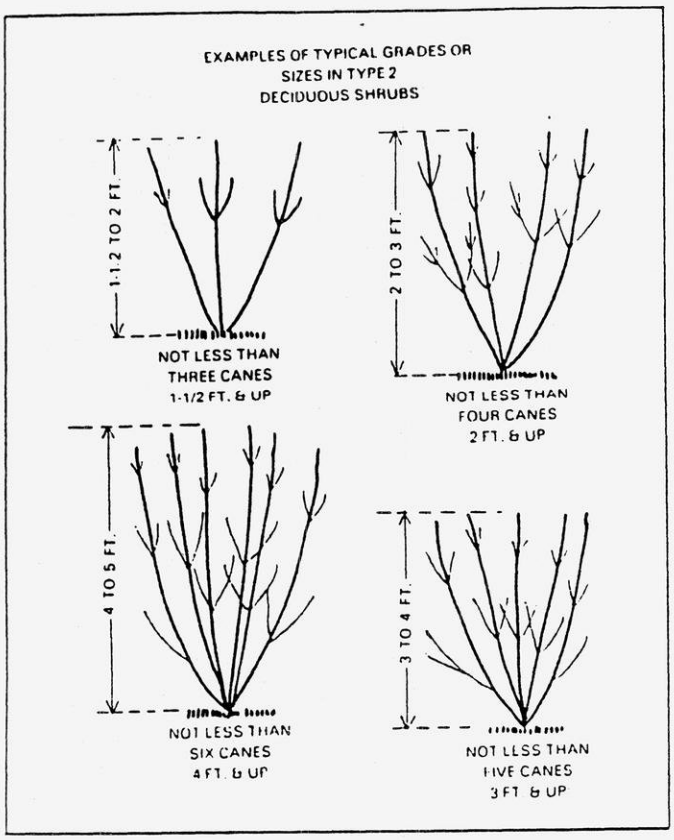
2-3 ft. shrubs should have not less than 4 canes, 2 ft. and up.

3-4 ft. shrubs should have not less than 5 canes, 3 ft. and up.

4-5 ft. shrubs should have not less than 6 canes, 4 ft. and up.

Examples:

Azalea (deciduous species)
Cephalanthus occidentalis
Cornus alba, sibirica, racemosa, stolonifera
Diervilla sessilifolia
Itea virginica
Kolkwitzia amabilis
Lespedeza thunbergi
Philadelphus lemoinei
Rhodotypos scandens
Rosa multiflora, setigera
Stephanandra incisa



2.1.5.4 Type 3

18-24 in. shrubs should have not less than 3 canes, 18 in. and up.

2-3 ft. shrubs should have not less than 3 canes, 2 ft. and up.

3-4 ft. shrubs should have not less than 4 canes, 3 ft. and up.

4-5 ft. shrubs should have not less than 5 canes, 4 ft. and up.

Examples:

Acanthopanax sieboldianus
Alnus rugosa
Amelanchier
Aronia arbutifolia, melanocarpa
Calycanthus floridus
Chaenomeles speciosa
Clethra alnifolia
Cornus amomum, sanguinea
Corylus americana, avellana
Cotoneaster acutifolia
Deutzia (tall growing species)
Euonymus americanus
Forsythia
Hamamelis
Hibiscus syriacu
Hydrangea paniculata grandiflora (Peegee H)
Ilex laevigata, verticillata
Kerria japonica (single and double)
Ligustrum obtusifolium regelianum
Lonicera (bush form)
Myrica pensylvanica
Philadelphus virginalis
Prunus amygdalus, cistena, serasifera, triloba (bush forms)
Rhus canadensis
Rosa blanda, rugosa
Sambucus canadensis, nigra (variegated forms)
Sorbaria aitchisoni, arborea, sorbifolia
Spiraea (tall growing varieties)
Symphoricarpos chenaulti, mollis, occidentalis, albus, orbiculatus
Syringa chinensis, amurensis japonica, josikaea, persica, villosa
Vaccinium corymbosum, stamineum
Viburnum cassinoides, dentatum, lantana, molle, opulus, plicatum, tomentosum, trilobum
Weigela floribunda, florida

2.1.5.5 Type 4

18-24 ft. shrubs should have not less than 2 canes, 18 in. and up.

2-3 ft. shrubs should have not less than 2 canes, 2 ft. and up.

3-4 ft. shrubs should have not less than 3 canes, 3 ft. and up.

4-5 ft. shrubs should have not less than 4 canes, 4 ft. and up.

Examples:

Amorpha fruticosa
Baccharis halimifolia
Caragana arborescens
Chionanthus virginica
Colutea arborescens
Cotinus americanus, coggygria
Cornus alternifolia, mas
Elaeagnus angustifolia, commutata, umbellata
Euonymus alatus, atropurpureus, bungeanus, europaeus, yedoenis
Exochorda racemosa
Halesia carolina
Lespedeza bicolor
Lindera benzoin
Rhamnus cathartica, frangula
Rubus odoratus
Sambucus pubens
Syringa vulgaris
Tamarix
Viburnum lentago, prunifolium

2.1.5.6 Type 5

18-24 in. shrubs with 1 or more canes 18 in. and up in height 5/16 in. cal.

2-3 ft. shrubs with 1 or more canes 2 ft. and up in height 3/8 in. cal.

3-4 ft. shrubs with 1 or more canes 3 ft. and up in height 1/2 in. cal.

4-5 ft. shrubs with 1 or more canes 4 ft. and up in height 5/8 in cal.

5-6 ft. shrubs with 1 or more canes 5 ft. and up in height 7/8 in. cal.

Examples:

Rhus copallina, glabra, typhina

2.1.5.7 Type 6 — Barberry

12-15 in. Berberis thunbergi, 3 canes or more, 12 in. and up.

15-18 in. Berberis thunbergi, 3 canes or more, 15 in. and up.

18-24 in. Berberis thungergi, 4 canes or more, 18 in. and up.

2-2½ ft. Berberis thunbergi, 4 canes or more, 2 ft. and up.

2½-3 ft. Berberis thunbergi, 5 canes or more, 2½ ft. and up.

3 ft. size Berberis thunbergi, 6 canes or more, 3 ft. and up.

2.1.5.8 Type 7 — Privet (Hedging)

18-24 in. Ligustrum in variety shall have 3 canes or more 18 in. and up

2-3 ft. Ligustrum in variety shall have 4 canes or more 2 ft. and up.

3-4 ft. Ligustrum in variety shall have 5 canes or more 3 ft. and up.

4-5 ft. Ligustrum in variety shall have 6 canes or more 4 ft. and up.

Note: For Ligustrum obtusifolium regalianum, see Type 3

2.2 BARE ROOT SPECIFICATIONS

2.2.1 NURSERY GROWN — SPREAD OF ROOTS

Roots of deciduous shrubs shall have a well-branched root system characteristic of the species. Bare root shrubs shall have minimum root spreads as follows:

Strong Growing Shrubs

Height of Plant	18-24 in.	2-3 ft.	3-4 ft.	4-5 ft.	5-6 ft.	6-8 ft.
Min. Root Spread	10 in.	11 in.	14 in.	16 in.	18 in.	20 in.

2.2.2 COLLECTED — SPREAD OF ROOTS

Shrubs collected from native stands or established plantings must be so designated. The spread of roots, bare root collected, shall be 1/3 greater than the spread of roots of nursery grown shrubs as tabulated above.

Shrubs collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

2.3 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.

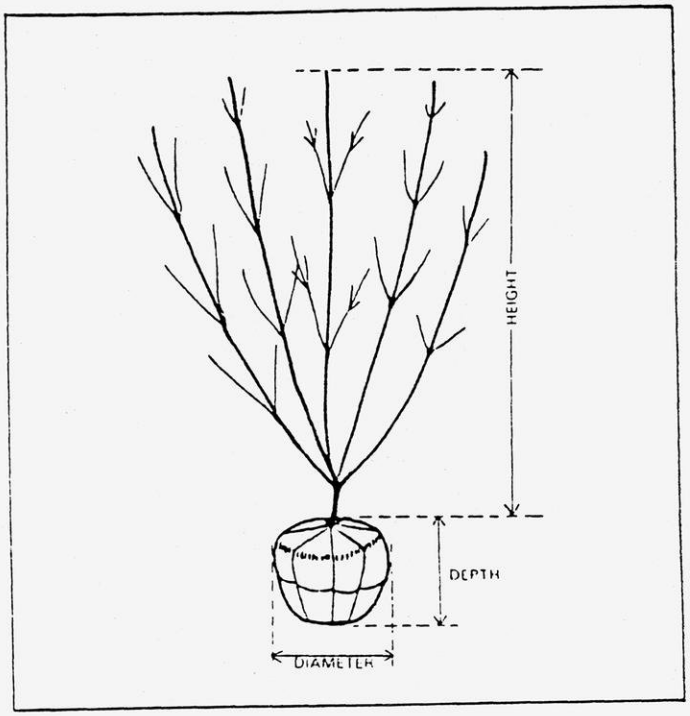
2.3.1 NURSERY GROWN

The following Table represents the recommended minimum sizes of balls for shrubs which are being grown under favorable growing conditions and which have received the proper cultural treatment to develop a well-branched root system.

These specifications are for plants dug with the ball of earth in which they are growing.

Deciduous Shrubs

Height	Minimum Diameter Ball Inches
12-18 in.	8
18-24 in.	9
2-3 ft.	10
3-4 ft.	12
4-5 ft.	14
5-6 ft.	16
6-7 ft.	18
7-8 ft.	20
8-9 ft.	22
9-10 ft.	24
10-12 ft.	26



2.3.2 COLLECTED

The minimum sizes of ball shall be equal to those specified in 2.3.1 for the next larger size nursery grown stock.

Shrubs collected from wild or native stands may be con-

sidered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

2.3.3 PLANTATION GROWN STOCK

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where there has been a minimum of after-care.

The minimum ball sizes shall be equal to that specified in 2.3.1 for the next larger size nursery grown stock.

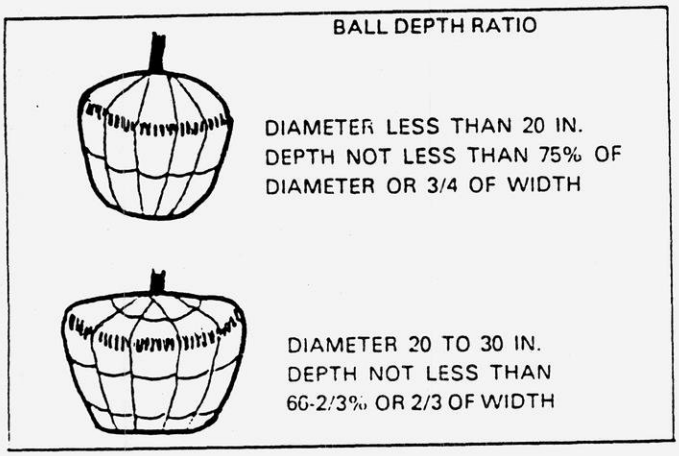
2.3.4 BALL DEPTHS

For the greater part of the country ball depths will carry the following ratios:

Balls with diameters less than 20 inches — Depth not less than 75% of diameter.

Balls with diameters of 20 inches to 30 inches incl. — Depth not less than 66⅔% of diameter.

Under certain soil and regional conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly encompass the roots. Conversely in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.



2.4 CONTAINER GROWN SPECIFICATIONS

All container grown deciduous shrubs shall be healthy, vigorous, well-rooted and established in the container in which they are sold. They shall have tops which are of good quality and are in a healthy growing condition.

An established container grown deciduous shrub shall be a deciduous shrub transplanted into a container and grown in that container sufficiently long for the new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

The container shall be sufficiently rigid to hold the ball shape protecting the root mass during shipping.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given size container.

The following table gives deciduous shrub sizes and acceptable container sizes:

Height	Container Size
6 to 9 in. 9 to 12 in. 12 to 15 in. 15 to 18 in. 18 to 24 in. 2 to 3 ft.	1 gal. (trade designation) Minimum of 5½ inches across top and height of 6 inches or equivalent volume
12 to 15 in. 15 to 18 in. 18 to 24 in. 2 to 3 ft.	2 gal. (trade designation) Minimum of 7 inches across top and height of 7½ inches or equivalent volume
18 to 24 in. 2 to 3 ft. 3 to 4 ft. 4 to 5 ft.	5 gal., egg can or square can (trade designation) Minimum of 9 inches across top and height of 10 inches or equivalent volume

2.5 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.

The minimum ball size specification for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 2.3.1)

3 CONIFEROUS EVERGREENS

3.1 GENERAL SPECIFICATIONS

3.1.1 QUALITY DEFINITIONS

The quality of evergreens offered is assumed to be normal for the species of variety unless otherwise designated as:

Specimen (Spec.) This designation may be used to indicate exceptionally heavy, well shaped plants and is usually applied to the larger commercial sizes and plants which have been cut back or trimmed to form a perfectly symmetrical, tightly knit plant. The letters "X," "XX," or "XXX" may be used to designate the degree of heavy grades in place of using the word "specimen" (spec.).

Collected. (Coll.) Natural seedling plants dug from native stands or forest plantings must be so designated.

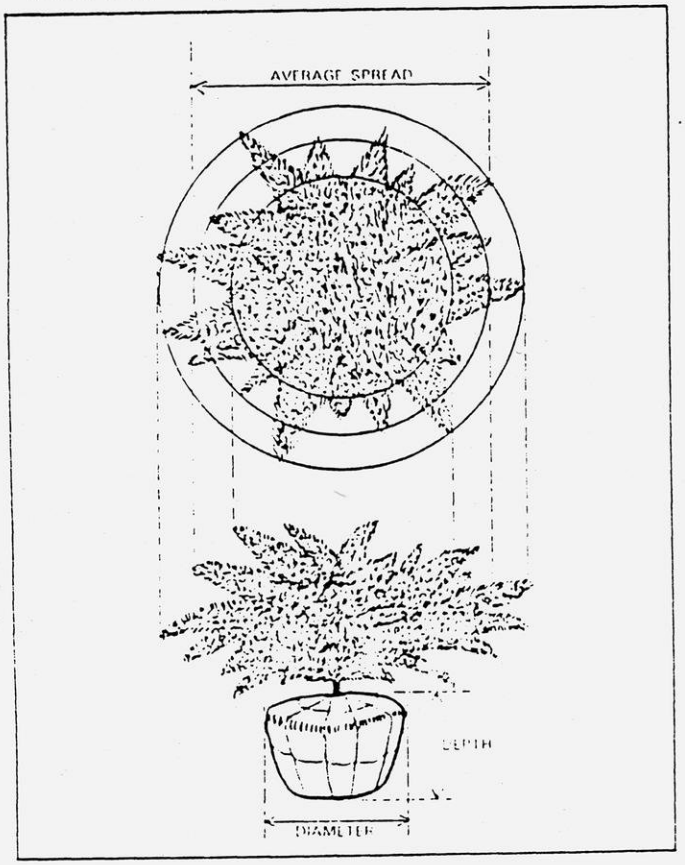
3.1.2 TYPES OF CONFIERS

3.1.2.1 Type 1. Creeping or Prostrate Type

Measurement designates spread (height not considered).
Use 3 inch intervals up to 18 inches
Use 6 inch intervals from 18 inches to 4 feet
Use 1 foot intervals from 4 feet up

Measurement should be average of plant and not the greatest diameter. Plants properly trimmed and transplanted should measure the same in any direction. If a plant is uneven, for example, 15 inches the widest way and nine the narrowest, it should be classified as 12" stock.

Examples:
Juniperus horizontalis cultivars
Juniperus procumbens
Pinus mugo mugi us



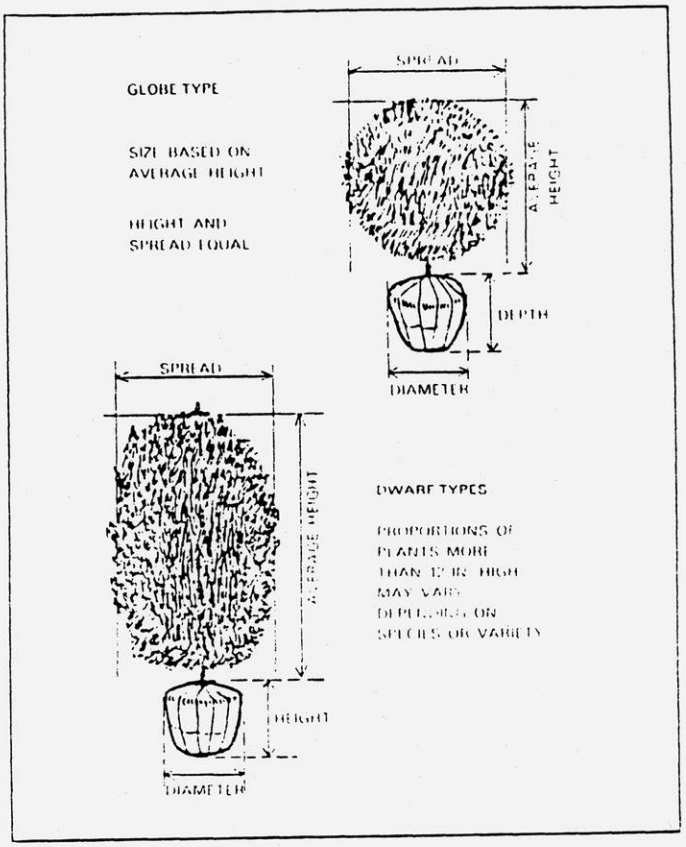
3.1.2.2 Type 2. Semi-Spreading Type

Measurement designates spread.
Use 3 inch intervals up to 18 inches
Use 6 inch intervals from 18 inches to 4 feet
Use 1 foot intervals from 4 feet up
Measurement should be average as in Type 1.

Height will be at least one half of the spread. Above 3 feet the height will be less than the spread, varying somewhat according to natural growth of the particular species and method of handling.

Spread	Height
6 to 9 in. up to 3 ft.	Same as spread
3 to 4 ft.	2½ to 3½ ft.
4 to 5 ft.	3 to 4 ft.

Examples:
Juniperus chinensis pfitzer, sabina
Taxus cuspidata, cuspidata 'Nana', media 'Densiformis'



3.1.2.3 Type 3. Broad Spreading, Globe and Upright Dwarf Types

Measurement designates height.
Use 3 inch intervals up to 18 inches
Use 6 inch intervals from 18 inches to 4 feet
Use 1 foot intervals from 4 feet up

Spread will usually be equal to height in well grown material up to twelve inches. From there on there will be a variation of spread to height depending on the variety.

Height	Spread
6 to 9 in.	min. spread, 6 in.
9 to 12 in.	min. spread, 9 in.
12 to 15 in.	min. spread, 10 in.
15 to 18 in.	min. spread, 12 in.
18 to 24 in.	min. spread, 15 in.
2 to 2½ ft.	min. spread, 18 in.
2½ to 3 ft.	min. spread, 21 in.
3 to 3½ ft.	min. spread, 24 in.

Many broad spreading and globe types included in this classification will usually have the same spread as height (or a greater spread) even in the larger sizes.

Examples:

Chamaecyparis obtusa 'Nana'; pisifera 'Plumosa Nana,' 'Squarrosa Nana'
Juniperus virginiana 'Globe'
Picea abies 'Nidiformis'
Taxus media 'Browni'
Thuja occidentalis 'Globe,' 'Little Gem'

Upright growing dwarf types may approach the minimum dimensions above.

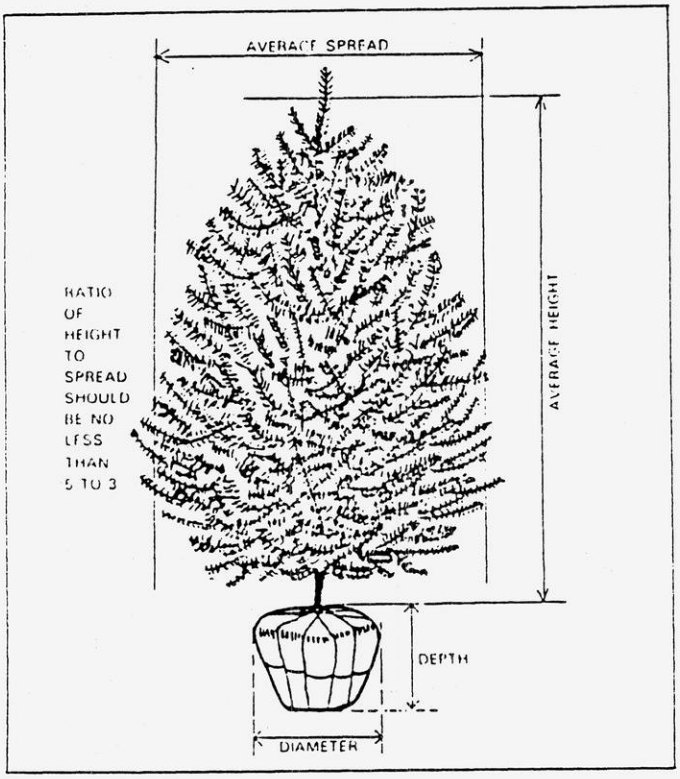
Examples:

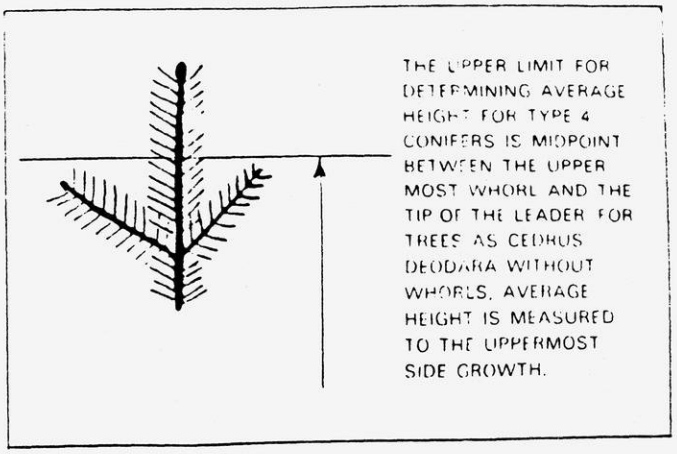
Chamaecyparis obtusa 'Gracilis'
Juniperus squamata 'Mayeri,' excelsa 'Stricta'
Thuja occidentalis 'Hovey,' 'Parsons,' 'Woodward;' orientalis 'Goldbush'

3.1.2.4 Type 4. Cone Type (Pyramidal)

Measurement designates height.
Use 3 inch intervals up to 18 inches
Use 6 inch intervals from 18 inches to 3 feet
Use 1 foot invervals from 3 feet to 10 feet
Use 2 feet intervals from 10 feet up

The ratio of height to spread of properly grown material should not be less than 5 to 3.





Height	Spread
12 to 15 inch	8 to 12 inches
15 to 18 inch	9 to 15 inches
18 to 24 inch	12 to 18 inches
2 to 2½ feet	15 to 21 inches
2½ to 3 feet	18 to 24 inches
3 to 4 feet	21 to 30 inches
4 to 5 feet	2½ to 3 feet
5 to 6 feet	3 to 4 feet

Examples:

Abies
Cedrus deodara
Chamaecyparis pisifera and varieties (except dwarf types)
Picea abies (conical types)
Pinus (except dwarf type)
Pseudotsuga menzeisi
Taxus cuspidata capitata
Thuja occidentalis, orientalis (conical types)
Tsuga canadensis, caroliniana

3.1.2.5 Type 5. Broad Upright Type

Measurement designates height.
Use 3 inch intervals up to 18 inches
Use 6 inch intervals from 18 inches to 3 feet
Use 1 foot intervals from 3 feet to 10 feet
Use 2 feet intervals from 10 feet up

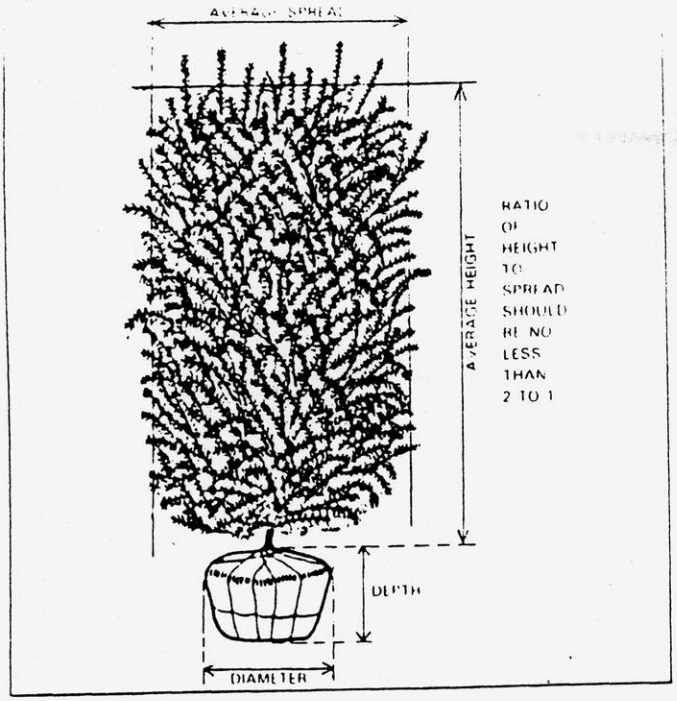
This group includes all the broader, upright growing evergreens which develop a straight sided form with many upright branches of "leaders."

The ratio of height to spread of properly grown material should not be less than 2 to 1.

Height	Spread
12 to 15 inches	8 to 12 inches
15 to 18 inches	9 to 15 inches
18 to 24 inches	12 to 18 inches
2 to 2½ feet	15 to 21 inches
2½ to 3 feet	18 to 24 inches
3 to 4 feet	21 to 30 inches
4 to 5 feet	2½ to 3 feet
5 to 6 feet	3 to 4 feet

Examples:

Chamaecyparis lawsoniana 'Allumii'
Juniperus chinensis 'Keteleeri,' scopulorum
Taxus baccata 'Irish'
Taxus media 'Hicks,' 'Hatfield'



3.1.2.6 Type 6. Columnar Type

Measurement designates height.
Use 3 inch intervals up to 18 inches
Use 6 inch intervals from 18 inches to 3 feet
Use 1 foot intervals from 3 feet to 10 feet
Use 2 feet intervals from 10 feet up

This group includes all the upright growing evergreens which naturally develop a straight sided form or one that tapers only slightly from the ground to a point more than half the height.

The broader types will usually have a ratio of height to spread of 4 to 1. Many forms, however, will not attain this ratio and even those of broad habit may be trimmed to advantage into a narrowed form. However, in most cases the ratio of height to spread should not be less than 5 to 1.

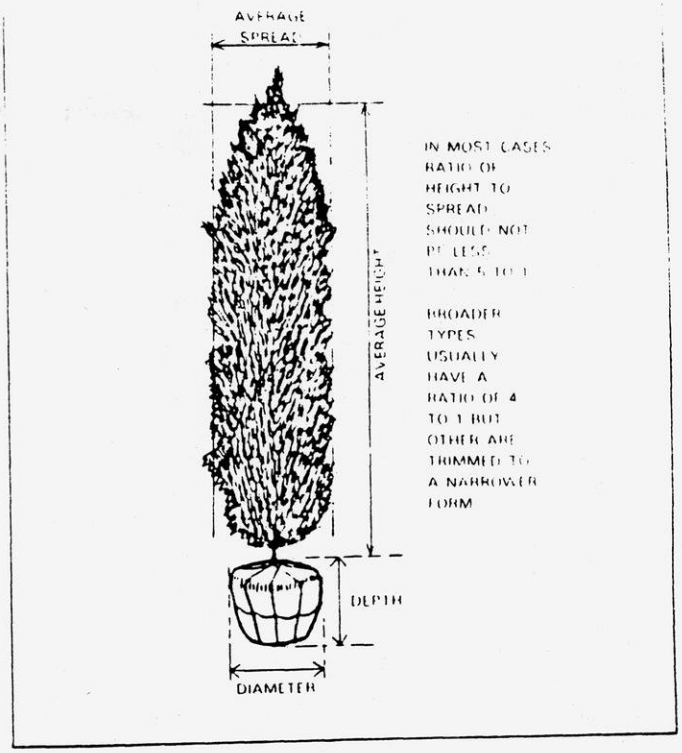
Height	Spread
12 to 15 inches	3 to 6 inches
15 to 18 inches	4 to 7 inches
18 to 24 inches	5 to 8 inches
2 to 2½ feet	6 to 9 inches
2½ to 3 feet	7 to 10 inches
3 to 4 feet	9 to 12 inches
4 to 5 feet	12 to 15 inches
5 to 6 feet	15 to 18 inches
6 to 7 feet	18 to 21 inches
7 to 8 feet	21 to 24 inches
8 to 10 feet	24 to 30 inches

Examples:

Cupressus sempervirens
Juniperus communis, virginiana (columnar type varieties)
Thuja occidentalis, orientalis (columnar type varieties)

3.2 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.



3.2.1 NURSERY GROWN

The following table represents the recommended minimum sizes of balls for conifers which are being grown in the nursery under favorable growing conditions and which have received the proper cultural treatment to develop a well branched root system.

These specifications are for plants dug with the ball of earth in which they are growing.

Spreading, Semi-Spreading and Globe or Dwarf Type Conifers Types 1, 2 & 3		Cone and Broad Upright Type Conifers Types 4 & 5	
Spread	Minimum Diameter Ball	Height	Minimum Diameter Ball
18-24 in.	10 in.	18-24 in.	10 in.
2-2½ ft.	12 in.	2-3 ft.	12 in.
2½-3 ft.	14 in.	3-4 ft.	14 in.
3-3½ ft.	16 in.	4-5 ft.	16 in.
3½-4 ft.	18 in.	5-6 ft.	20 in.
4-5 ft.	21 in.	6-7 ft.	22 in.
5-6 ft.	24 in.	7-8 ft.	24 in.
6-7 ft.	28 in.	8-9 ft.	27 in.
7-8 ft.	32 in.	9-10 ft.	30 in.
8-9 ft.	36 in.	10-12 ft.	34 in.
		12-14 ft.	38 in.
		14-16 ft.	42 in.
16-18 ft.	46 in.		
		18-20 ft.	50 in.

Columnar Conifers Type 6

Rgular growing kinds		Rapid growing kinds*	
Height	Minimum Diameter Ball	Height	Minimum Diameter Ball
18-24 in.	10 in.	18-24 in.	8 in.
2-3 ft.	12 in.	2-3 ft.	9 in.
3-4 ft.	13 in.	3-4 ft.	11 in.
4-5 ft.	14 in.	4-5 ft.	12 in.
5-6 ft.	16 in.	5-6 ft.	14 in.
6-7 ft.	18 in.		
7-8 ft.	20 in.		
8-9 ft.	22 in.		
9-10 ft.	24 in.		
10-12 ft.	27 in.		
12-14 ft.	30 in.		
14-16 ft.	33 in.		
16-18 ft.	36 in.		
18-20 ft.	40 in.		

*Rapid growing kinds as: Thuja orientalis (Oriental Arborvitae), Juniperus communis 'Strieta' (Irish Juniper).

It is recognized that plants having a coarse or wide-spreading root system because of natural habit of growth, soil condition, infrequent transplanting practice, or that are moved out of season, would require a size of ball in excess of the recommended sizes. It is also recognized that special handling of certain material, such as stock grown in pots or other containers, field plants recently planted out from containers or with smaller balls, or material which has been frequently transplanted or root pruned, constitute cases where the sizes recommended may be excessive.

3.2.2 COLLECTED

The minimum sizes of ball shall be equal to that specified in 3.2.1 for the next larger size nursery grown stock.

Plants collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing-seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

3.2.3 PLANTATION GROWN STOCK

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where there has been a minimum of after-care.

The minimum ball sizes shall be equal to that specified in 3.2.1 for the next larger size nursery grown stock.

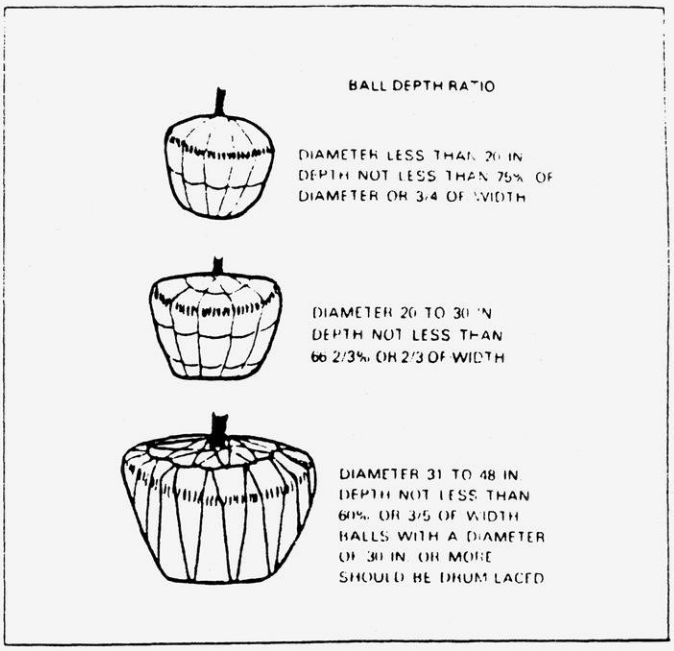
3.2.4 BALL DEPTHS

For the greater part of the country ball depths will carry the following ratios:

Balls with diameters less than 20 inches — Depth not less than 75% of diameter.

Balls with diameters of 20 inches to 30 inches incl. — Depth not less than 66⅔% of diameter.

Balls with diameters of 30 inches to 48 inches incl. — Depth not less than 60% of diameter.



Balls with diameters over 48 inches will have the depth scaled down proportionately.

Under certain soil and regional conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly encompass the roots. Conversely in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth than the size recommended.

3.3 CONTAINER GROWN SPECIFICATIONS

All container grown conifers shall be healthy, vigorous, well-rooted and established in the container in which they are sold. They shall have tops which are of good quality and are in a healthy growing condition.

An established container grown conifer shall be a conifer transplanted into a container and grown in that container sufficiently long for the new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

The container shall be sufficiently rigid to hold the ball shape protecting the root mass during shipping.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given size container.

The following table gives conifer sizes and acceptable container sizes:

3.3.1 TYPES 1, 2 AND 3

Spread (Type 1, Spreading and Type 2, Semi-Spreading Conifers)

Height (Type 3, Globe or Dwarf Conifers)

	Container Size
6 to 9 in.	1 gal. (trade designation) Minimum of 5½
9 to 12 in.	inches across top and height of 6 inches
12 to 15 in.	or equivalent volume
12 to 15 in.	2 gal. (trade designation) Minimum of 7
15 to 18 in.	inches across top and height of 7½ inches
	or equivalent volume

2½ to 4 ft.	5 gal. egg can or square can (trade designation) Minimum of 9 inches across top
2 to 2½ ft.	and height of 10 inches
2½ to 3 ft.	or equivalent volume

3.3.2 TYPES 4, 5 AND 6*

Height	Container Size
6 to 9 in. 9 to 12 in. 12 to 15 in. 15 to 18 in. 18 to 24 in.	1 gal. (trade designation) Minimum of 5½ inches across top and height of 6 inches or equivalent volume
12 to 15 in. 15 to 18 in. 18 to 24 in. 2 to 2½ ft.	2 gal. (trade designation) Minimum of 7 inches across top and height of 7½ inches or equivalent volume
18 to 24 in. 2 to 2½ ft. 2½ to 3 ft. 3 to 3½ ft. 3½ to 4 ft.	5 gal., egg can, or square can (trade designation) Minimum of 9 inches across top and height of 10 inches or equivalent volume

*Except for extreme columnar types as Cupressus sempervirens (Italian cypress) which is acceptable 1 or 2 sizes taller than standard for a given container.

3.4 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.

The minimum ball size specification for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 3.2.1)

4 BROADLEAF EVERGREENS

4.1 GENERAL SPECIFICATIONS

4.1.1 QUALITY DEFINITIONS

The quality of evergreens offered is assumed to be normal for the species or variety unless otherwise designated as:

Collected (Coll.) Natural seedling plants dug from native stands or forest plantings must be so designated.

4.1.2 GRADING TOLERANCE

The growing of plant material cannot be rigidly standardized because of varying conditions of growth and methods of handling preferred or necessitated by climate, soil, and other conditions beyond the control of the grower. Judgment should therefore be exercised and allowances made in the above definitions to agree with those which are recognized by the trade as typical of acceptable plants in that region.

Where a minimum and maximum size, i.e. size range is specified, the average of the lot shall approximate the midpoint of the specified size range. Plant lots of a given height shall have an approximate average as in the following examples:

Height of Plant	18-24 in.	2-3 ft.	3-4 ft.	4-5 ft., etc.
Average of Lot	21 in.	2½ ft.	3½ ft.	4½ ft.

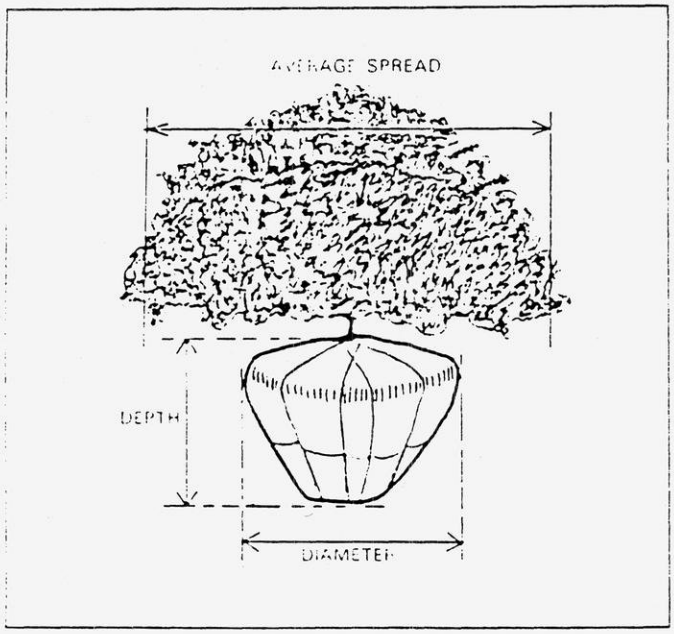
4.1.3 TYPES AND MEASUREMENT DESIGNATION

Measurement of height should begin at the ground line and should continue up to where the main part of the plant ends and not to the tip of a thin shoot.

Five general types or groups are considered separately as follows:

4.1.3.1 Type 1 Spreading Type

Measurement designates spread (height not considered).
Use 3 inch intervals up to 18 inches.
Use 6 inch intervals from 18 inches to 4 feet
Use 1 foot intervals over 4 feet.

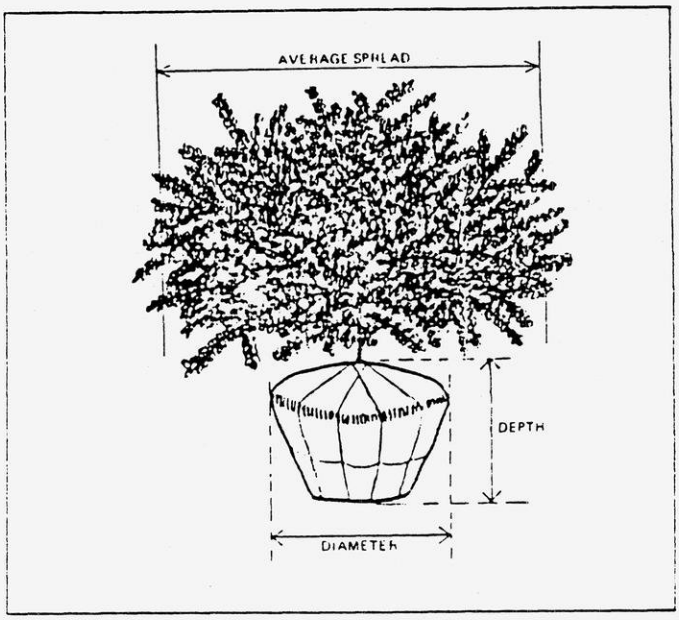


Examples:
Calluna vulgaris (and cultivars)
Carissa grandiflora 'Green Carpet'
Cotoneaster dammeri, horizontalis (and cultivars)
Cytisus 'Lydia'
Ilex crenata 'Helleri'
Mahonia nervosa, repens

4.1.3.2 Type 2 Semi-Spreading Type

Measurement designates spread (height not considered).
Use 3 inch intervals up to 18 inches.
Use 6 inch intervals up to 18 inches to 4 feet.
Use 1 foot intervals over 4 feet.

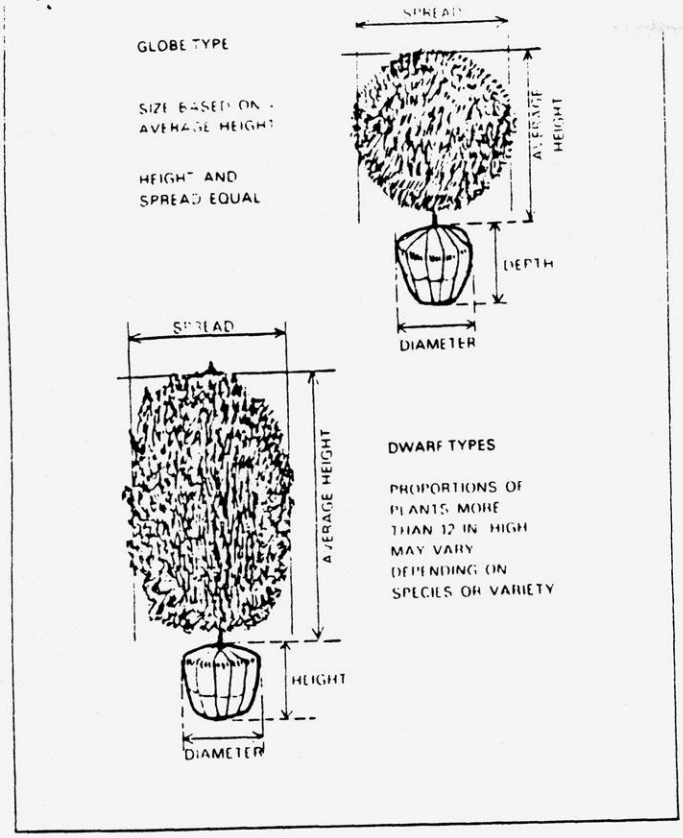
Examples:
Berberis verruculosa
Cotoneaster francheti, salicifolia
Daphne odora
Ilex crenata 'Convexa', 'Hetzi'
Leucothoe axillaria, catesbaei
Pieris floribunda
Raphiolepis umbellata
Rhododendron (Azalea) obtusum 'Amoenum,' Gumpo & Kurume types
Rhododendron impeditum



4.1.3.3 Type 3 Globe or Dwarf Type

Measurement designates height.
Use 3 inch intervals up to 18 inches.
Use 6 inch intervals from 18 inches to 4 feet.
Use 1 foot intervals from 4 feet up.

Spread will usually be equal to or only slightly less than the height up to 12 inches. From there on the spread may be less than the height but in no case will the ratio be more than 2 to 1 or height more than twice the spread. Both dimensions may be given, as it would be a good practice.



Height	Minimum Spread
6 to 9 inches	min. spread 5 inches
9 to 12 inches	min. spread 6 inches
12 to 15 inches	min. spread 7 inches
15 to 18 inches	min. spread 9 inches
18 to 24 inches	min. spread 10 inches
2 to 2½ feet	min. spread 14 inches

Examples:

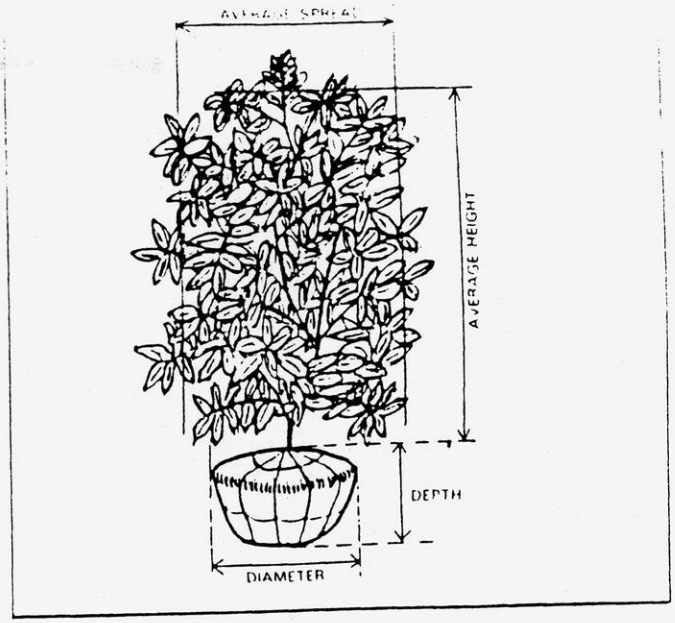
Buxus microphylla (dwarf cultivars), sempervirens 'Suffruticosa'
Ilex cornuta 'Rotunda,' vomitoria 'Nana'
Leiophyllum buxifolium

4.1.3.4 Type 4 Broad Upright Type

Measurement designates height.
Use 3 inch intervals up to 18 inches.
Use 6 inch intervals from 18 inches to 3 feet.
Use 1 foot intervals from 3 feet up.

This group includes all of the larger growing upright "broadleaves" which vary considerably in ratio of spread to height. Well grown material will in most cases have a height equal to if not greater than the spread. However, the spread should not be less than two-thirds of the height.

Height	Minimum Spread
12 to 15 inches	min. spread 8 inches
15 to 18 inches	min. spread 10 inches
18 to 24 inches	min. spread 12 inches
2 to 2½ feet	min. spread 16 inches
2½ to 3 feet	min. spread 20 inches
3 to 4 feet	min. spread 24 inches
4 to 5 feet	min. spread 28 inches



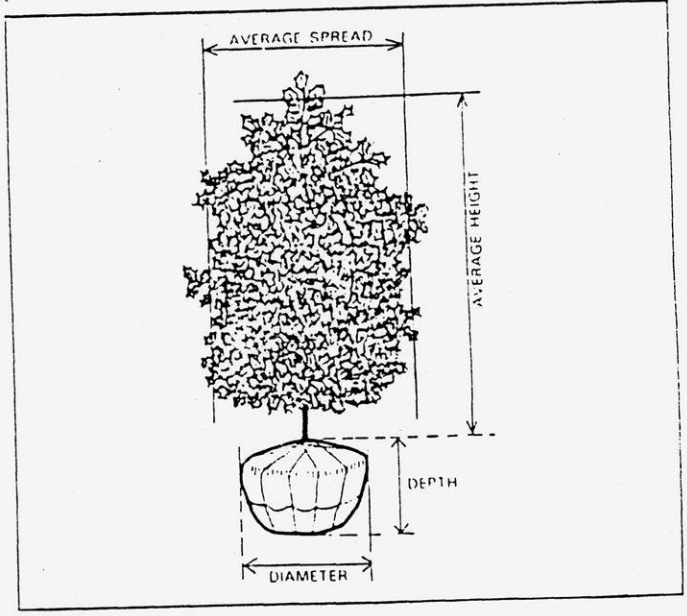
Examples:

Abelia grandiflora
Aucuba japonica (and cultivars)
Azalea 'Rosebud'
Berberis julianae
Cytisus 'Burkwoodi'
Elaeagnus pungens
Gardenia jasminoides
Ilex cornuta (and cultivars), crenata 'Rotundifolia'
Kalmia latifolia
Ligustrum lucidum, texanum
Mahonia aquifolium
Pieris japonica
Rhododendron (cultivars)
Viburnum rhytidophyllum, tinus

4.1.3.5 Type 5 Cone Type

Specifications identical to Type 4.

This type includes all upright growing broadleaf evergreens which naturally develop into a conical form. Well



grown material will have a ratio of height to spread of 3 to 2. However a greater spread is acceptable.

Examples:

Ilex aquifolium, opaca (and cultivars)
Ilex hybrids as 'Foster #2' and 'Nellis R. Stevens'
Camellia japonica, sasanqua
Illicium anisatum
Prunus caroliniana, laurocerasus, lusitanica

4.2 BALLING AND BURLAPPING SPECIFICATIONS

Ball sizes should always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.

4.2.1 NURSERY GROWN

The following table represents the recommended minimum sizes of balls for broadleaf evergreens which are being grown in the nursery under favorable growing conditions and which have received the proper cultural treatment to develop a well branched root system.

These specifications are for plants dug with the ball of earth in which they are growing.

Spreading, Semi-Spreading and Globe or Dwarf Broadleaf Evergreens Types 1, 2 & 3		Cone and Broad up-right Type Broadleaf Evergreens Types 4 & 5	
Spread	Minimum Diameter Ball	Height	Minimum Diameter Ball
18-24 in.	10 in.	18-24 in.	10 in.
2-2½ ft.	12 in.	2-3 ft.	12 in.
2½-3 ft.	14 in.	3-4 ft.	14 in.
3-3½ ft.	16 in.	4-5 ft.	16 in.
3½-4 ft.	18 in.	5-6 ft.	20 in.
4-5 ft.	21 in.	6-7 ft.	22 in.
		7-8 ft.	24 in.
		8-9 ft.	27 in.
		9-10 ft.	30 in.
		10-12 ft.	34 in.
		12-14 ft.	38 in.
		14-16 ft.	42 in.
		16-18 ft.	46 in.
		18-20 ft.	50 in.

It is recognized that plants having a coarse or wide-spreading root system because of natural habit of growth, soil condition, infrequent transplanting practice, or that are moved out of season, would require a size of ball in excess of the recommended sizes. It is also recognized that special handling of certain material, such as stock grown in pots or other containers, field plants recently planted out from containers or with smaller balls, or material which has been frequently transplanted or root pruned, constitute cases where the sizes recommended may be excessive.

4.2.2 COLLECTED

The minimum sizes of ball shall be equal to those specified in 4.2.1 for the next larger size nursery grown stock.

Plants collected from wild or native stands may be considered nursery grown when they have been successfully re-established in the nursery row and grown under regular nursery cultural practices for a minimum of two growing seasons and have attained adequate root and top growth to indicate full recovery from transplanting into the nursery row.

4.2.3 PLANTATION GROWN STOCK

Plants which have been systematically planted in fertile, friable soil which is relatively free of stones and foreign matter, but where there has been a minimum of after-care.

The minimum ball sizes shall be equal to that specified in 4.2.1 for the next larger size nursery grown stock.

4.2.4 BALL DEPTHS

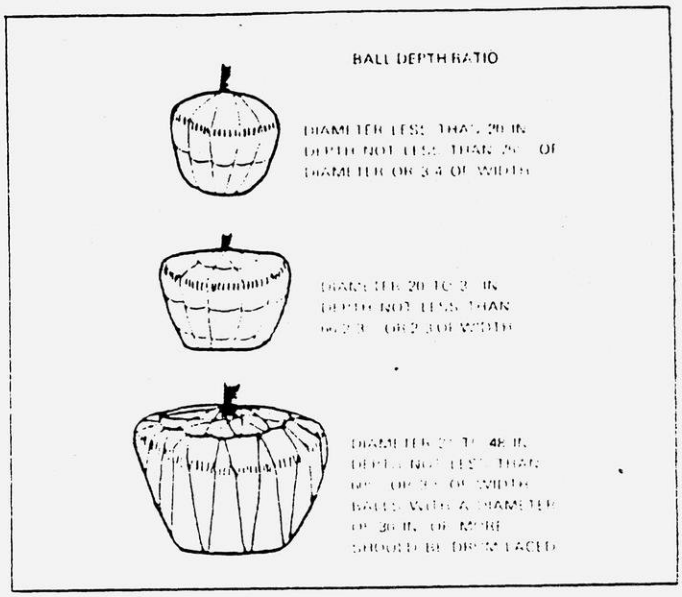
For the greater part of the country ball depths will carry the following ratios:

Balls with diameters less than 20 inches — Depth not less than 75% of diameter.

Balls with diameters of 20 inches to 30 inches incl. — Depth not less than 66⅔% of diameter.

Balls with diameters of 30 inches to 48 inches incl. — Depth not less than 60% of diameter.

Ball with diameters over 48 inches will have the depth scaled down proportionately.



Under certain soil and regional conditions, plants have root systems of proportionately less depth and greater diameter. These require a more shallow but wider ball to properly encompass the roots. Conversely in other soils and in certain regions roots develop greater depth and less spread, requiring an exceptionally deep ball which may be smaller in diameter and greater in depth that the size recommended.

4.3 CONTAINER GROWN SPECIFICATIONS

All container grown broadleaf evergreens shall be healthy, vigorous, well-rooted and established in the container in which they are sold. They shall have tops which are

of good quality and vigorous growing condition.

An established container grown broadleaf evergreen shall be a broadleaf evergreen transplanted into a container and grown in that container sufficiently long for the new fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

The container shall be sufficiently rigid to hold the ball shape protecting the root mass during shipping.

Dwarf and light growing varieties may be 1 or 2 sizes smaller than standard for a given container.

The following table gives broadleaf evergreen sizes and acceptable container sizes:

4.3.1 TYPES 1, 2 AND 3 BROADLEAF EVERGREENS

Spread (Type 1, Spreading and Type 2, Semi-Spreading)

Height (Type 3, Dwarf or Globe)

	Container Size
6 to 9 in. 9 to 12 in. 12 to 15 in.	1 gal. (trade designation) Minimum of 5½ inches across top and height of 6 inches or equivalent volume
12 to 15 in. 15 to 18 in.	2 gal. (trade designation) Minimum of 7 inches across top and height of 7½ inches or equivalent volume
18 to 24 in. 2 to 2½ ft. 2½ to 3 ft.	5 gal., egg can or square can (trade designation) Minimum of 9 inches across top and height of 10 inches or equivalent volume

4.3.2 TYPE 4, BROAD UPRIGHT TYPE AND TYPE 5, CONE TYPE* BROADLEAF EVERGREENS

Height	**Container Size**
6 to 9 in. 9 to 12 in. 12 to 15 in. 15 to 18 in. 18 to 24 in.	1 gal. (trade designation) Minimum of 5½ inches across top and height of 6 inches or equivalent volume
12 to 15 in. 15 to 18 in. 18 to 24 in. 2 to 2½ ft.	2 gal. (trade designation) Minimum of 7 inches across top and height of 7½ inches or equivalent volume
18 to 24 in. 2 to 2½ ft. 2½ to 3 ft. 3 to 3½ ft. 3½ to 4 ft.	5 gal., egg can, or square can (trade designation) Minimum of 9 inches across top and height of 10 inches or equivalent volume

*Except for extreme columnar types as Prunus laurocerasus (Cherry Laurel) and Ligustrum japonicum (Japanese Privet) which are acceptable 1 or 2 sizes taller than standard for a given container.

4.4 BALLED AND POTTED

Balled and potted plants are field-grown nursery plants, dug with a ball of earth still intact in which they are growing, and in lieu of burlapping, are placed in a container to retain the ball unbroken.

Ball sizes shall always be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant.

The minimum ball size specification for "balled and potted" plants shall be the same as for "balled and burlapped" plants. (See 4.2.1)

5 ROSE GRADES

5.1 GENERAL

The standards specified apply only to field grown two year Roses when sold either bare root or individually wrapped and packaged, or in cartons.

All grades of roses must have a well-developed root system and have proportionate weight and caliper according to grade and variety. Roses shall be graded by size, number and length of canes, and proper consideration should be given to weight and caliper of canes, depending upon grade and variety.

The specifications outlined for length of canes are applicable before pruning in preparation for sale.

Rose bushes that do not meet these standards for the individual grades are defined as CULLS.

5.2 HYBRID TEA, TEA, GRANDIFLORA, HYBRID PERPETUAL, MOSS AND MISCELLANEOUS BUSH ROSES

Grade No. 1

3 or more strong canes, two of which are to be 18 inches and up, with the exception of a few of the light growing sorts*, which are to have three or more canes, two of which are to be 16 inches and up, and one cane to be 18 inches and up, branched not higher than 3 inches above the bud union.

Grade No. 1½ or Medium

2 or more strong canes, to be 15 inches and up with the exception of a few of the light growing sorts*, which are to have 2 strong canes 13 inches and up, branched not higher than 3 inches above the bud union.

Grade No. 2

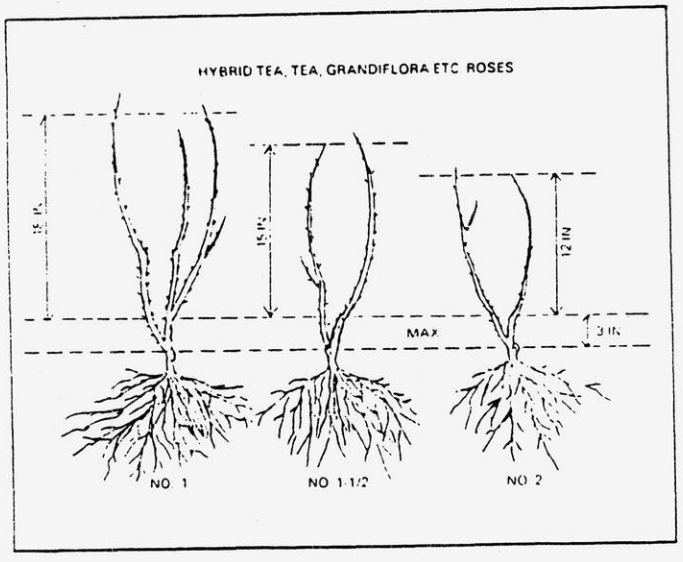
2 or more strong canes 12 inches and up, with the exception of a few light growing sorts*, which are to have 2 or more canes, 10 inches and up, branched not higher than 3 inches above the bud union.

*Many varieties of Hybrid Tea Roses express varying growth characteristics in different parts of the country. Some varieties may be generally known to be less vigorous in some regions than in others. The term used above, "light growing sorts" cannot therefore be used in a universal or rigid sense. Examples of varieties generally considered to be "light growing" are:

'President Hoover'
'Etoile de Holland'
'The Doctor'
'Mojave'

Other examples that are often considered in some areas as "light growing varieties" are:

'New Yorker'
'Charlotte Armstrong'
'Helen Traubel'



5.3 FLORIBUNDA ROSES

Grade No. 1

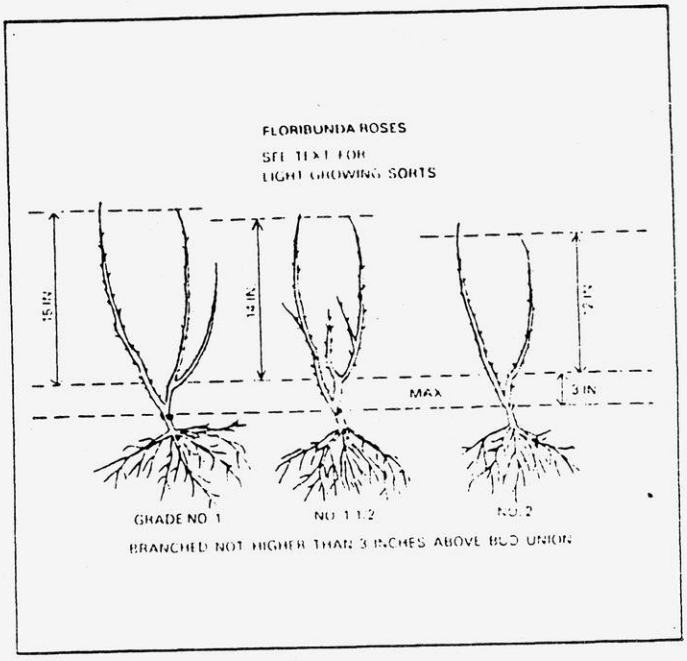
3 or more strong canes, 2 of which are to be 15 inches and up branched not higher than 3 inches above the bud union.

Grade No. 1½ or Medium

2 or more strong canes to be 14 inches and up, branched not higher than 3 inches above the bud union.

Grade No. 2

2 or more strong canes to be 12 inches and up branched not higher than 3 inches above the bud union.



5.4 POLYANTHA, DWARF AND LIGHT GROWING FLORIBUNDA ROSES

Grade No. 1

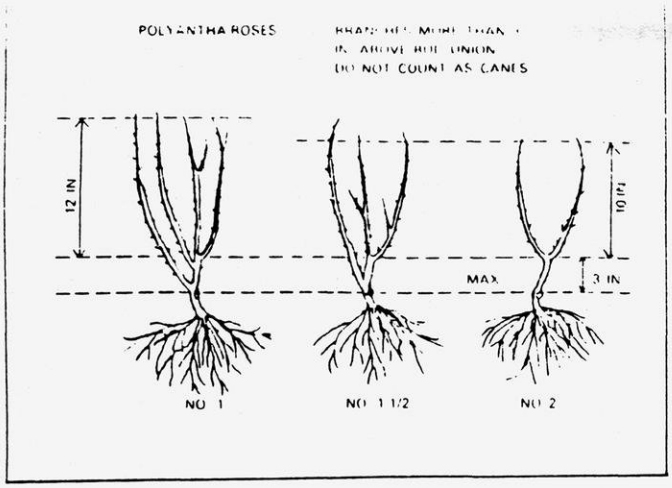
to have 4 or more canes, all to be 12 inches and up and branched not higher than 3 inches above the bud union.

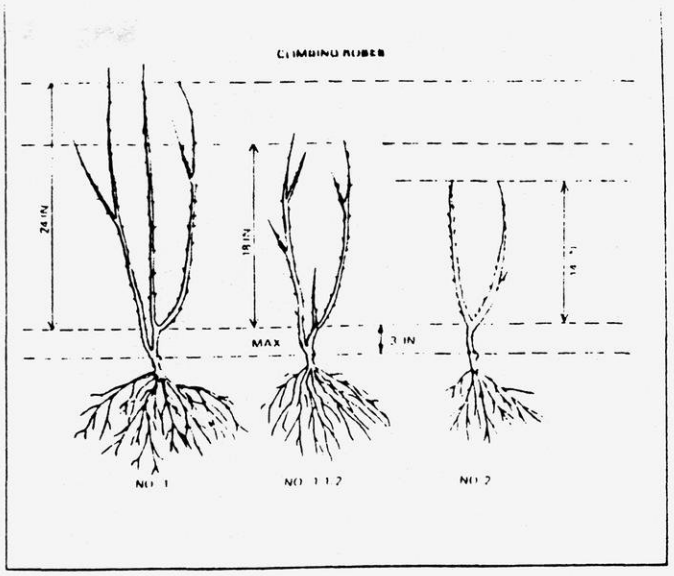
Grade No. 1½ or Medium

to have 3 or more canes, all to be 10 inches and up and branched not higher than 3 inches above the bud union.

Grade No. 2

2 or more strong canes, both to be 10 inches and up and branched not higher than 3 inches above the bud union.





5.5 CLIMBING ROSES

Grade No. 1

to have 3 or more strong canes, 24 inches and up, branched not higher than 3 inches above the bud union or crown.

Grade No. 1½ or Medium

to have 2 strong canes, each 18 inches and up, branched not higher than 3 inches above the bud union or crown.

Grade No. 2

To have 2 strong canes each 14 inches and up, branched not higher than 3 inches above the bud union or crown.

5.6 CONTAINER GROWN ROSES

All container grown roses shall have been growing in the container in which they are marketed for a minimum of one month of active growing season and for a maximum of two growing seasons. Roses may be cut back to a minimum of 4 inches above the bud union at the time they are potted, and still comply with the grades in which they were classified prior to pruning in preparation for potting.

Grade of Roses	Minimum Container Size
No. 1	2 gal. (trade designation) Minimum of 7 inches across top and height of 7½ inches or equivalent volume
No. 1½ and No. 2	1 gal. (trade designation) Minimum of 5½ inches across top and height of 6 inches or equivalent volume

6 VINES & GROUND COVERS

6.1 TYPE 1 — FAST GROWING VINES

The fast growing vines which normally produce a number of vigorous woody runners in one or two years shall be graded and designated as follows:

2 year, number 1 — shall have heavy well branched tops with not less than 3 runners 18 inches and up and vigorous well developed root system.

2 year, number 2 — lighter grade below number 1 standard but without serious defects, 3 runners 12 inches and up and a root system commensurate with the top.

Older vines should be designated according to age, heavy or light grade, length of runners, and other characteristics such as standard, grafted, potted, or tubbed.

Examples:

Celastrus orbiculata, scandens
Lonicera japonica, halliana, sempervirens
Parthenocissus quinquefolia, engelmanni
Rosa wichuraiana
Wisteria

6.2 TYPE 2 — MEDIUM GROWING VINES

Woody vines usually starting with a single cane or runner should be designated by age and grade — heavy and light.

2 year, number 1 — shall have a heavy well branched top and vigorous well developed root system.

2 year, medium — lighter grade than the above without serious defects, top not as well branched. However, root system must be in porportion to top.

Older vines should be designated according to age, heavy or light grades, length of runners, and other characteristics such as standard, grafted, potted, or tubbed.

Examples:

Actinidia
Aristolochia
Campsis (Bignonia) radicans
Parthenocissus tricuspidata veitchi
Vitis

6.3 TYPE 3 — CLUMP TYPE

Clump type shall be designated by age and heavy or light grade. Dormant plants may or may not have live runners. In this group a well developed root system and healthy well developed crown are the important considerations.

Examples:

Clematis
Pueraria (Kudzu)

6.4 TYPE 4 — GROUND COVERS

Dwarf vines and ground covers are to be designated or described by age, size of clump, length of vines or runners, and or other characteristics indicative of the species or cultivars listed.

Examples:

Arctostaphylos uva-ursi
Cornus canadensis
Cotoneaster dammeri
Hedera helix (and cultivars)
Euonymus fortunei (botanical varieties and cultivars)
Pachysandra terminalis
Vinca minor, major (and cultivars)

6.5 TYPE 5 — GROUND COVER — CROWNVETCH

Clump type shall be designated by age, runner length and container. Dormant plants may or may not have live runners. In this type a well developed root system and healthy, well developed crown are the important considerations.

Field grown crownvetch shall be whole crowns, at least one growing season old. The overall length of the plant shall be 6-9 in., including 2 in. of top growth and the root caliper 1 in. below the root collar shall measure no less than 1/8 in.

Crownvetch produced in pots or other media-holding containers will be grown in sizes adequate for the age and grade and will be acclimated to conditions befitting the planting season.

6.6 VINES IN POTS OR CONTAINERS

Ground covers supplied in pots or similar containers shall be thrifty, well-balanced plants, well established in the containers.

The following are suggested minimum specifications:

Variety	Size of Pot	Min. No. of Runners	Min. Length of Runners
Ajuga reptans and cultivars	2¼ in., 4 in., gal.	—	—
Euonymus fortunei and cultivars	2¼ in.	2	8 in.
"	3 in.	3	10 in.
"	4 in.	4	12 in.
"	gal.	6	12 in.
Hedera helix and cultivars	2¼ in.	1	8 in.
"	3 in.	2	10 in.
"	4 in.	3	10 in.
"	gal.	4	10 in.
Lonicera jap. halliana	2¼ in.	2	4 in.
"	3 in.	3	6 in.
"	4 in.	4	8 in.
Pachysandra terminalis	2¼ in., 3 in., 4 in.	—	—
Vinca minor, major and cultivars	2¼ in.	3 to 6	6 to 8 in.
"	3 in.	6 to 8	8 to 10
"	4 in.	10 to 12	8 to 10 in.

Collected (Coll.) — Plants collected from the wild must be so designated.

7 FRUIT TREE GRADES

7.1 DECIDUOUS

7.1.1 GENERAL

All trees should have reasonably straight bodies according to habit of growth.

All grades five-sixteenths and larger should be branched except one year Sweet Cherry, and well rooted. The nine-sixteenths and eleven-sixteenths should have three or more side branches. Caliper should be taken two inches above the collar or bud. Height shall be taken from the collar if grafted or from the union of the bud and stock if budded.

The caliper shall govern, height being intended to represent average height of most varieties. Slow growing kinds may fall short of height specified. Age should be given as one year, two years, etc.

Caliper (in inches)	Minimum Heights
APPLE—Standard, CHERRY—Sweet, PEACH, PEAR—Standard & PLUM (1 and 2 years)	
11/16 and up	4½ ft. and up
9/16 to 11/16	4 ft. and up
7/16 to 9/16	3 ft. and up
5/16 to 7/16	2 ft. and up
PEAR—Dwarf & QUINCE	
9/16 and up	3½ ft. and up
7/16 to 9/16	3 ft. and up
5/16 to 7/16	2 ft. and up
APPLE—Dwarf	
9/16 and up	3½ ft. and up
7/16 to 9/16	2½ ft. and up
5/16 to 7/16	2 ft. and up
APRICOT	
11/16 and up	4 ft. and up
9/16 to 11/16	3 ft. and up
7/16 to 9/16	2½ ft. and up
5/16 to 7/16	2 ft. and up
CHERRY—Sour	
11/16 to 1 in., 2 years	4 ft. and up
9/16 to 11/16, 2 years	3½ ft. and up
7/16 to 9/16, 2 years	3 ft. and up
5/16 to 7/16, 2 years	2 ft. and up
11/16 and up, 1 year	3½ ft. and up
9/16 to 11/16, 1 year	3 ft. and up
7/16 to 9/16, 1 year	2½ ft. and up
5/16 to 7/16, 1 year	2 ft. and up

7.1.2 ONE YEAR STANDARD

It is accepted practice in the three West Coast states, Washington, Oregon and California, to grade one year old standard fruit tree stock (apples, pears, cherries, plums, peaches, nectarines, apricot and quince) in intervals of 1/8 inch as follows:

1 yr. 3/4 inch and up
1 yr. 5/8 inch and up
1 yr. 1/2 inch to 5/8 inch
1 yr. 3/8 inch to 1/2 inch
1 yr. 1/4 inch to 3/8 inch

7.1.3 SEEDLINGS

7.1.3.1 Caliper Measurement

Caliper shall be taken at the collar or ground line and grade shall correspond to the following caliper:

3/8 in. — 3/8 in. to 7/16 in.
1/4 in. — 1/4 in. to 3/8 in.
No. 1 — 3/16 in. to 1/4 in.
No. 2 — 1/8 in. to 3/16 in.
No. 3 — 15/16 in. to 2/16 in.
No. 4 — 1/16 in. to 15/16 in.

Exception: Grade No. 1 "Straight" of Apple Seedlings shall be graded from 3/16" to 5/16" caliper.

7.1.3.2 Special Specifications:

In the case of seedlings with limbs there shall be at least two inches above the collar free of limbs for one-half the circumference of the seedling.

In case of Apple and Pear Seedlings where the root description is given as branched or straight, the following shall apply:

Branched Root — Not less than three root branches and point of branching shall be not more than four inches from the collar.

Straight Root — The root shall carry the caliper of the grade for not less than six inches from the collar.

In the case of "cutting" grown stock, the caliper shall be taken on the original "cutting," at the collar.

7.2 CITRUS

Citrus stocks are to be graded according to 1/8 inch series as follows: 3/8 to 1/2 inch; 1/2 inch to 5/8 inch; 5/8 inch to 3/4 inch; 3/4 inch to 1 inch; 1 inch to 1¼ inches.

Age in years is to be given; that is one or two years. Caliper is to be taken 1/2 inch above the bud union. Minimum size to be 3/8 inch except that tangerine, mandarin or lime trees may be sold in 5/16 to 3/8 inch caliper.

8 SMALL FRUITS

All small fruit plants must be well rooted. No injured, dwarfed or odd shape plants shall be included in any grade.

8.1 RASPBERRIES

8.1.1 SUCKER AND ROOT CUTTING PLANTS

GRADE NO. 1

Sucker and root cutting plants, also tip plants, should be graded 3/16 inch and up in caliper at collar; sucker plants should have 10 inches or more of live top; tip plants, 8 inches or more live tops; and well rooted.

GRADE NO. 2

Sucker and root cutting plants, also tip plants, 1/8 inch and up in caliper at collar; sucker and root cutting plants to have 8 inches or more of live top; tip plants, 6 inches or more of live tops, and all proportionately well rooted.

8.1.2 TRANSPLANTED RASPBERRIES

GRADE NO. 1

All transplanted raspberries should caliper 1/4 inch and up at collar and have 15 inches or more of live top, and be well rooted.

GRADE NO. 2

Number two must caliper 3/16 inch and up with 12 inches or more of live top, and be well rooted.

8.2 DEWBERRIES, BLACKBERRIES, BOYSENBERRIES, YOUNGBERRIES

8.2.1 ROOT CUTTINGS

GRADE NO. 1

Root cuttings should caliper 1/8 inch and sucker plants should caliper 3/16 inch and up at collar and have 12 inches or more of live top, and be well rooted.

GRADE NO. 2

Root cuttings should caliper 3/32 inch and up and sucker plants should caliper 1/8 inch and up at collar and have 8 inches or more of live top, and be proportionately well rooted.

8.2.2 TRANSPLANTED BLACKBERRIES

GRADE NO. 1

Should caliper 1/4 inch and up at collar and have 12 inches or more of live top, and be well rooted.

8.3 CURRANTS

GRADE 2 YR. NO. 1

Shall measure 12 inches and up in height, with two or more branches, and be well rooted.

GRADE 1 YR. NO. 1

Shall measure 9 inches and up in height; if single cane plants, to be 12 inches high, and be well rooted.

GRADE 2 YR. NO. 2

Same specifications as 1 Yr. No. 1.

8.4 BLUEBERRIES

All measurements to indicate overall height of plant from crown to tip of plants. All well rooted and well branched in proportion to height.

1 year Rooted Cuttings	3-6 in.
2 year No. 1	9-12 in.
2 year No. 2	6-9 in.
3 year No. 1	12-18 in.
4 year No. 1	18-24 in.

8.5 GOOSEBERRIES

GRADE 2 YR. NO. 1

Shall measure 12 inches and up in height, with three or more canes, or equivalent side branches, and be well rooted.

GRADE 1 YR. NO. 1

Shall measure 8 inches and up in height, with two or more branches, or equivalent side branches, and be well rooted.

GRADE 2 YR. NO. 2

Same specifications as 1 Yr. No. 1.

8.6 GRAPE VINES

Grading of Grape Vines is based mainly on root system.

GRADE 2 YR. NO. 1

The lightest growing varieties should have 12 inches or more of live top; stronger growing varieties should be proportionately larger and all well rooted.

GRADE 1 YR. NO. 1

Lightest growers should have 6 inches or more of live top; stronger growers should be proportionately larger and all be well rooted.

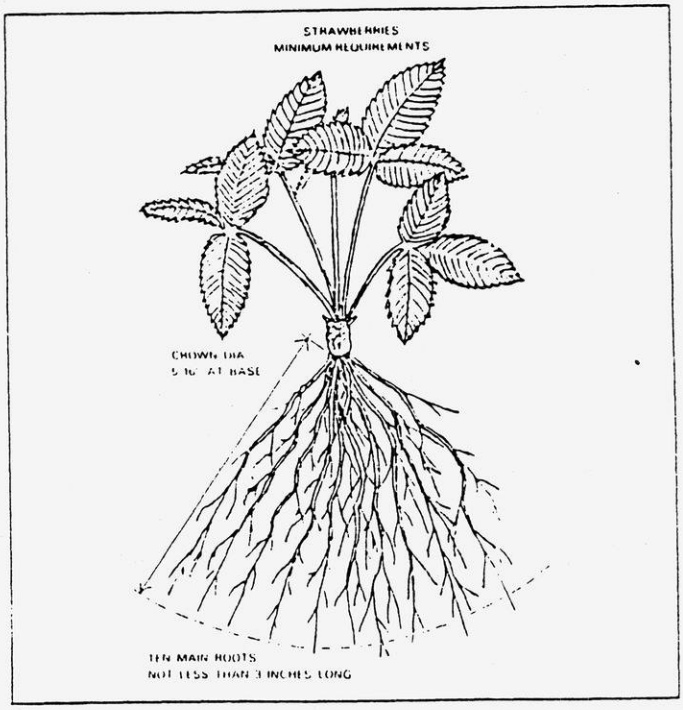
GRADE 2 YR. NO. 2

Same specifications as 1 Yr. No. 1.

8.7 STRAWBERRY PLANTS

MINIMUM GRADE

There shall be at least ten (10) main roots, not less than three (3) inches long, and a minimum crown diameter of 5/16 in. measured at the base.



8.8 ASPARAGUS CROWNS

1 YR. NO. 1

Shall not weigh less than sixty (60) pounds per thousand. Fifty (50%) per cent of the root system shall exceed five (5 in.) inches in length.

2 YR. NO. 1

Shall not weigh less than one hundred twenty (120) pounds per thousand plants. Fifty (50%) per cent of the root system shall exceed seven (7 in.) inches in length.

2 YR. NO. 2

Shall not weigh less than sixty (60) pounds per thousand. Fifty (50%) per cent of the root system shall exceed five (5 in.) inches in length.

3 AND 4 YR. NO. 1 — Super Size, Bearing Age.

Shall not weigh less than two hundred (200) pounds per thousand. Fifty (50%) per cent of the root system shall exceed ten (10 in.) inches in length.

9 LINING OUT STOCK

9.1 GENERAL

Lining out stock shall include all plant material coming from propagating houses, beds or frames and young material of suitable size to plant out in a nursery.

9.2 DESIGNATION

Age — Should be given by number of years since propagated or in the case of seedlings, since growth started.

Transplanted — The number of times transplanted to be represented by using for each transplanting the letter "T."

Seedling — Stock to be represented by the letter "S."

Cuttings — To be represented by the letter "C."

Grafted — Stock to be represented by the letter "G."

Size — Should be given in accordance with the intervals recommended for each plant class.

EXAMPLE: Koster Spruce G. 6-8 in., 4 yr. TT means Koster Spruce graft, 6 to 8 inches high, 4 years old and twice transplanted.

Pot Grown or Container Grown — Lining out stock supplied in pots or similar containers shall be thrifty, well-branched plants, well established in the containers.

9.3 SIZE DESIGNATION

In grading use 2 inch intervals up to 12 in.; 3 inch intervals up to 24 in.; 6 inch intervals for larger sizes.

9.4 RECOMMENDATIONS—EVERGREEN LINING OUT STOCK

Evergreens should be transplanted frequently enough to create a good root system, which will insure a minimum of transplanting loss, and to give the top room enough to start the branch framework properly, making a well-shaped specimen when placed in the nursery row.

In order to produce a fibrous root system we recommend that in species such as Firs, Pines and similar sorts, which normally make a few coarse roots, that they be transplanted every two or three years, and that species such as Arborvitae and Chamaecyparis be transplanted every three to four years as they naturally make better roots.

Broad leaved evergreen species such as Pyracantha lalandi, which normally make a few coarse roots, should be transplanted every year, while those producing a good system of fibrous roots may be transplanted every second year only.

Trimming is also necessary to insure a proper foundation for good shape in the finished plant, although frequent transplanting will usually avoid the necessity of severe trimming.

10 SEEDLING TREES AND SHRUBS

10.1 GENERAL

Forest, game refuge, erosion control, shelterbelt, or farm woodlot plantings, under natural conditions shall come under the following classifications. Actual conditions of soil, climate, and environment will necessarily govern the minimum size for a particular species that is required.

Tolerance of not more than 10% under grade should be accepted so long as it is not intentional and the ones under grade are close to the grade required.

10.2 DECIDUOUS OR HARDWOODS

When caliper is important measurements are taken at root collar or ground line.

Caliper in inches	Min. height in inches	Min. root length
1-4 in. and up	12 in.	10 in.
3/16-1/4 in.	10 in.	10 in.
1/8-3/16 in.	8 in.	8 in.
1/16-1/8 in. –	6 in.	8 in.

Tops or roots will not be trimmed unless specified by grower or requested by purchaser.

When height is important measurements are taken from root collar or ground line.

Height in inches	Min. caliper in inches	Min. root length
24-36 in.	1/4 in.	12 in.
18-24 in.	3/16 in.	10 in.
12-18 in.	1/8 in.	10 in.
6-12 in.	1/16 in.	8 in.

Suggested for commercial nurseries furnishing or purchasing stock for the retail trade, and still comply with demands for calipered stock.

It should be understood that when heights are to govern that caliper specification is minimum and when caliper is to govern, the height specification is minimum.

10.3 CONIFERS—EVERGREENS

Height in inches	Min. caliper in inches
12-15 in.	3/16 in.
9-12 in.	1/8 in.
6-9 in.	1/16 in.

Age is not important when height or caliper is specified; however it may be used in listings or demanded by purchaser.

KEY for use in indicating seedling, root pruned, or transplants:

S — for seedling

RP — for root pruned (should not be root pruned deeper than 6 inches when applying to conifers)

T — one T for each time transplanted.

General — All plants are to have well developed root systems, to be free of insects and diseases as well as mechanical injuries, and in all respects be suitable for field planting. All conifers must have dormant buds (except in the south) and secondary needles.

At the option of the purchaser other special restrictions may be specified.

11 BULBS, CORMS AND TUBERS

11.1 GENERAL

Bulbs and corms are generally sold under grade names such as forcing size, top-size, large, etc. In the case of Narcissus and Daffodils, the designations of "double nose" to indicate a split bulb with probably two flower buds and "rounds" are used.

With some groups, for example Hyacinths, the grade names indicate usage such as exhibition and forcing sizes and sizes more suitable for outdoor bedding purposes.

Some grade measurements have normally been given in centimeters of circumference, since this measurement allows closer grading. This system is in vogue and is generally accepted in the trade for the smaller sized bulbs such as Crocus and Grape Hyacinth, while for larger and particularly for the flat type corms, inches in diameter is the generally accepted measurement: for example, Gladioli, Tuberous Begonias and Caladiums.

For such items as Peonies and Bleeding Heart and Cannas, the number of "eyes" or buds on the tuber is designated.

The following grades conform in substance to generally accepted trade usage. Both grade names and sizes in inches or centimeters should be given; size in inches or centimeters must be designated.

Offers of bulbs, corms and tubers (except Peony divisions) which cannot reasonably be expected to bloom in the season after planting should not be made to the public. If they are, then they should be clearly indicated as "non-blooming" sizes for naturalization or other plantings for which "non-blooming" sizes might be acceptable.

11.2 TULIPS

Designated by centimeters or inches of circumference.

Top size (12 cm. and up) . . . . . 4-3/4" up in circumference
Large (11-12 cm.) . . . . . 4-3/8"—4-3/4" circumference
Medium (10-11 cm.) . . . . . 4"—4-3/8" circumference
Small (9-10 cm.) . . . . . 3-5/8"—4" circumference

Note: Some botanical and species Tulips are smaller than above-designated sizes. Bulbs of botanical and species tulips should be so identified and sizes given.

11.3 HYACINTHS

Designated by centimeters or inches of circumference.

Top Exhibition Forcing Size
(19 cm. and up) . . . . . 7-5/8" up in circumference
Large Exhibition Forcing Size
(18-19 cm.) . . . . . 7-1/4"—7-5/8" circumference
Medium Exhibition Forcing Size
(17-18 cm.) . . . . . 6-3/4"—7-1/4" circumference
Top Bedding or Garden Size
(16-17 cm.) . . . . . 6-3/8"—6-3/4" circumference
Large Bedding or Garden Size
(15-16 cm.) . . . . . 6"—6-3/8" circumference
Medium Bedding, Miniature,
or Garden Size (14-15 cm.) . . . 5-1/2"—6" circumference

11.4 GRAPE HYACINTHS

Designated by centimeters or inches of circumference.

Top Size . . . . . 9-11 cm. and up in circumference
Large Size . . . . . 8-9 cm. circumference
Medium Size . . . . . 7-8 cm. circumference

11.5 CROCUS

Designated by centimeters or inches of circumference.

Top Size (9 cm. and up) . . . . . 3-5/8" up in circumference
Large (8-9 cm.) . . . . . 3-1/8"—3-5/8" circumference
Medium (7-8 cm.) . . . . . 2-3/4"—3-1/8" circumference
Small (6-7 cm.) . . . . . 2"—2-3/4" circumference

11.6 NARCISSUS AND DAFFODILS

Designated by centimeters or inches of circumference.

Top Size Round Large Size Round Medium Size Round	"Round means single nosed bulbs which are fairly circular in cross-section and which show evidence of producing one flower. Slabs are not permitted in this grade.
Top Size Double Nose Large Size Double Nose Medium Size Double Nose	"Double Nose" means bulbs that show evidence of producing two or more flowers. Due to double character of bulb, circumference measurements are variable.

There are certain varieties that normally have smaller bulbs than others. Until size grades are established, name grade designations as indicated and accepted by the trade (as bulbs are purchased) should be used.

11.7 NARCISSUS — PAPER WHITE

Paper White. (A type of bulb that normally is a smaller bulb than other varieties and consequently is listed separately.)

Designated by centimeters or inches of circumference.

Top Size (16 cm. up) . . . . . 6-3/8" up in circumference
Large (15-16 cm.) . . . . . 6"—6-3/8" circumference
Medium (14-15 cm.) . . . . . 5-1/2"—6" circumference
Small (12-14 cm.) . . . . . 4-3/4"—5-1/2" circumference

11.8 GLADIOLI

Designated by inches in diameter according to Fair Trade Practice Rules adopted by Gladiolus Growers as follows:

Jumbo		Over 2" in diameter
Large	No. 1	1-1/2"—2" diameter
	No. 2	1-1/4"—1-1/2" diameter
Medium	No. 3	1"—1-1/4" diameter
	No. 4	3/4"—1" diameter
Small	No. 5	1/2"—3/4" diameter
	No. 6	3/8"—1/2" diameter
No grade name	No. 7	under 3/8" diameter

11.9 AMARYLLIS

Designated by inches in diameter

Fancy	3-1/2" up in diameter
Top Size	3-1/4"—3-1/2" diameter
Large	3"—3-1/4" diameter
Medium	2-3 4"—3" diameter
Small	2-1/4"—2-3/4" diameter

Under 2-1/4" not acceptable

11.10 LILIES

(Regal and Easter.)
Designated by inches of circumference.

Giant	10" up circumference
Fancy	9-10" circumference
Extra Large	8-9" circumference
Large	7-8" circumference
Standard	6-7" circumference
Medium	5-6" circumference

11.11 CALADIUM

(Fancy-leaved.)
Designated by inches in diameter.

Giant	3-1/2" up in diameter
Large	2-1/2"—3-1/2" diameter
Standard	2"—2-1/2" diameter
Medium	1-1/2"—2" diameter
Small	1"—1-1/2" diameter

11.12 TUBEROUS BEGONIAS AND GLOXINIAS

Designated by inches in diameter.

Giant Size	2-1/2" and up in diameter
Extra Large	2"—2-1/2" diameter
Large	1-1/2"—2" diameter
Medium	1-1/4"—1-1/2" diameter
Small	1"—1-1/4" diameter

11.13 TUBEROSES, CALLAS AND OTHER MISCELLANEOUS BULBS

Designated in centimeters or inches in diameter or circumference as generally accepted trade practice may dictate.

11.13.1 TUBEROSES

Top Size	4"—6" circumference
First Size	3"—4" circumference

11.13.2 CALLAS

Top Size	2-1/2" and up in diameter
Large	2"—2-1/2" diameter
Medium	1-1/2"—2" diameter
Small	1-1/4"—1-1/2" diameter

11.13.3 RANUNCULUS

Giant Size	1" and up in diameter
Extra Large	7/8"—1" diameter
Large	3/4"—7/8" diameter
Medium	5/8"—3/4" diameter
Small	1/2"—5/8" diameter

11.13.4 FREESIA

Extra Large	7/8" and up in diameter
Large	3/4"—7/8" diameter
Medium	5/8"—3/4" diameter
Small	1/2"—5/8" diameter

11.13.5 ANEMONES

Extra Large	7/8" and up in diameter
Large	3/4"—7/8" diameter
Medium	5/8"—3/4" diameter
Small	1/2"—5/8" diameter

11.14 PEONIES AND BLEEDING HEART

Number of "eyes" or "buds" per division to be indicated.

Select	5-7 "eye" divisions
Standard	3-5 "eye" divisions
Small	2-3 "eye" divisions

11.15 CANNAS

Number of "eyes" or "buds" per root to be indicated: for example 2-3 "eye" roots. Any root with less than 2 "eyes" not to be offered the public — suitable for growing on in nursery, or for potting or bedding purposes.

11.16 DAHLIAS

Due to nature of divisions from different varieties no size designations can be listed. Each division must have a portion of live crown and at least 1 "eye" or "bud."

12 CHRISTMAS TREE STANDARDS

The standard herewith shall conform to the standards promulgated by the United States Department of Agriculture, effective Jun 15, 1962, and as thereafter may be revised. These standards are based on the factors of density, taper, balance, foliage and deformities and are classified as U.S. Premium, U.S. No. 1 or U.S. Choice, U.S. No. 2 or U.S. Standard, and Culls. Copies of these standards are available from the Consumer and Marketing Service, U.S. Department of Agriculture, Washington, D.C. 20250.

APPENDIX J

Water Budget Calculations

Infiltration Calculations

Data Sources

Data	Source
Monthly Air Temperature	N.O.A.A. 1960 thru 1988, Weyerhaeuser, Wi
Monthly Precipitation	N.O.A.A. 1960 thru 1988, Weyerhaeuser, Wi
Conversion and Computation Tables	Thornthwaite and Mather, 1975
Runoff Coefficients	U.S. EPA, 1975 Soil Conservation, Hudson, N., 1971
Water Holding Capacity of Soil	U.S. EPA, 1975
Evaporation from Bare Soils	U.S. EPA, 1975

I. Type II Stockpile - Assumptions:

A. The 1977 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI were used to represent wet precipitation conditions.

B. The 1976 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI were used to represent dry precipitation conditions.

C. The average of the 1960 through 1988 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI was used to represent average precipitation conditions.

D. The Type II stockpile consists of 27 acres.

E. After removal of the stored material the stockpile area will be restored to approximate preconstruction conditions. Therefore, the preconstruction and post construction water budget conditions are the same. The existing ground slope is approximately 2%.

F. The Type II stockpile has a life of approximately 6.3 years. An additional 0.5 years was considered in the calculations to address the period of time over which site construction will be completed but no Type II material will be placed.

G. The stockpile will be filled in two phases.
-Entire stockpile area (27 acres) is open from October 1990 to April 1991 before filling with waste rock begins.

-Filling in Phase I begins April 1991.

-Filling in Phase II begins in January 1994.

-Site restoration is completed June 1997.

H. Runoff and evaporation from bare soils are approximately 75% of the total precipitation (U.S. EPA, 1975).

I. Flat slope was assumed for during construction calculations. Assumption is reasonable given the large ratio of flat area to steep area on the site.

II. Type II Stockpile - Infiltration Calculations

1. Preconstruction and Post Construction
2% slope

1a. Wet Conditions - Infiltration

$$27 \text{ Acres} \times \frac{16.27 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{11{,}927{,}800 \text{ gal}}{\text{yr}}$$

1b. Dry Conditions - Infiltration

$$27 \text{ Acres} \times \frac{7.9 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{5{,}791{,}600 \text{ gal}}{\text{yr}}$$

1c. Average Conditions - Infiltration

$$27 \text{ Acres} \times \frac{10.98 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{8{,}049{,}600 \text{ gal}}{\text{yr}}$$

2. During Construction Infiltration Calculation

2a. Wet Conditions
precip = $\frac{45.62 \text{ in}}{\text{yr}}$ Infiltration $\frac{45.6 \text{ in}}{\text{yr}}$ x 25% = $\frac{11.40 \text{ in}}{\text{yr}}$

Area Open Before Filling

$$.5 \text{ yr} \times 27 \text{ AC} \times \frac{11.40 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{4,178,800 \text{ gal}}$$

Phase I Filling of Waste Rock

$$2.75 \text{ yrs} \times 15.53 \text{ AC} \times \frac{11.40 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{13,219,600 \text{ gal}}$$

Phase II Open No Filling

$$2.75 \text{ yrs} \times 11.47 \text{ AC} \times \frac{11.40 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{9,763,600 \text{ gal}}$$

Phase I & II Filling and Removal of Waste Rock

$$3.55 \text{ yrs} \times 27 \text{ AC} \times \frac{11.40 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{29,669,200 \text{ gal}}$$

2b. Dry Conditions
precip = $\frac{18.06 \text{ in}}{\text{yr}}$ Infiltration $\frac{18.06 \text{ in}}{\text{yr}}$ x 25% = $\frac{4.51 \text{ in}}{\text{yr}}$

Area Open Before Filling

$$.5 \text{ yr} \times 27 \text{ AC} \times \frac{4.51 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ft}}{12 \text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{1,653,200 \text{ gal}}$$

Phase I Filling of Waste Rock

$$2.75\ \text{yrs} \times 15.53\ \text{AC} \times \frac{4.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{5{,}229{,}800\ \text{gal}}$$

Phase II Open No Filling

$$2.75\ \text{yrs} \times 11.47\ \text{AC} \times \frac{4.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{3{,}862{,}600\ \text{gal}}$$

Phase I & II Filling and Removal of Waste Rock

$$3.55\ \text{yrs} \times 27\ \text{AC} \times \frac{4.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{11{,}737{,}500\ \text{gal}}$$

2c. Average Conditions

precip = $\frac{34.03\ \text{in}}{\text{yr}}$ Infiltration $\frac{34.03\ \text{in}}{\text{yr}} \times 25\% = \frac{8.51\ \text{in}}{\text{yr}}$

Area Open Before Filling

$$.5\ \text{yr} \times 27\ \text{AC} \times \frac{8.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{3{,}119{,}400\ \text{gal}}$$

Phase I Filling of Waste Rock

$$2.75\ \text{yrs} \times 15.53\ \text{AC} \times \frac{8.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{9{,}868{,}300\ \text{gal}}$$

Phase II Open No Filling

$$2.75\ \text{yrs} \times 11.47\ \text{AC} \times \frac{8.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{7{,}288{,}400\ \text{gal}}$$

Phase I & II Filling and Removal of Waste Rock

$$3.55\ \text{yrs} \times 27\ \text{AC} \times \frac{8.51\ \text{in}}{\text{yr}} \times \frac{43560\ \text{ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48\ \text{gal}}{\text{ft}^3}$$

$$= \underline{22{,}147{,}800\ \text{gal}}$$

III. Type I Stockpile - Assumptions:

A. The 1977 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI were used to represent wet precipitation conditions.

B. The 1976 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI were used to represent dry precipitation conditions.

C. The average of the 1960 through 1988 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI was used to represent average precipitation conditions.

D. The Type I stockpile consists of 40 acres.

E. After removal of the stored material the stockpile area will be restored to approximate preconstruction conditions. Therefore, the preconstruction and post construction water budget conditions are the same. The existing ground slopes are approximately 2% and 4%.

F. The Type I stockpile has a life of approximately 7.5 years.

G. The stockpile will be filled in one phase. Therefore, it is assumed the total 40 acres is open for the site life.

H. Runoff and evaporation from bare soils is approximately 75% of the total precipitation (U.S. EPA, 1975).

I. Flat slope was assumed for during construction calculations. Assumption is reasonable given the large ratio of flat area to steep area on the site.

IV. Type I Stockpile - Infiltration Calculations

1. Preconstruction and Post Construction
2% and 4% slopes

1a. Wet Conditions - Infiltration

2% Slope (~10 AC)

$$10 \text{ Acres} \times \frac{16.27 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{4{,}417{,}700 \text{ gal}}{\text{yr}}$$

4% Slope (~30 AC)

$$30 \text{ AC} \times \frac{14.34 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{11{,}681{,}000 \text{ gal}}{\text{yr}}$$

$$\text{Total} = \frac{16{,}098{,}700 \text{ gal}}{\text{yr}}$$

1b. Dry Conditions - Infiltration

2% Slope (~10 AC)

$$10 \text{ AC} \times \frac{7.9 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{2{,}145{,}000 \text{ gal}}{\text{yr}}$$

4% Slope (~30 AC)

$$30 \text{ AC} \times \frac{7.76 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \frac{6{,}321{,}100 \text{ gal}}{\text{yr}}$$

$$\text{Total} = \frac{8{,}466{,}100 \text{ gal}}{\text{yr}}$$

1c. Average Conditions - Infiltration

2% Slope (~10 AC)

$$10\ AC \times \frac{10.98\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{2,981,300\ gal}{yr}$$

4% Slope (~30 AC)

$$30\ AC \times \frac{10.98\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{8,944,000\ gal}{yr}$$

$$\text{Total} = \frac{11,925,300\ gal}{yr}$$

2. During Construction Infiltration Calculation

2a. Wet Conditions precip = $\frac{45.62 \text{ in}}{\text{yr}}$ Infiltration $\frac{45.62 \text{ in}}{\text{yr}} \times 25\% = \frac{11.40 \text{ in}}{\text{yr}}$

$$7.5 \text{ yrs} \times 40 \text{ AC} \times \frac{11.40 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{92,860,800 \text{ gal}}$$

2b. Dry Conditions precip = $\frac{18.06 \text{ in}}{\text{yr}}$ Infiltration $\frac{18.06 \text{ in}}{\text{yr}} \times 25\% = \frac{4.52 \text{ in}}{\text{yr}}$

$$7.5 \text{ yrs} \times 40 \text{ AC} \times \frac{4.52 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{36,818,700 \text{ gal}}$$

2c. Average Conditions precip = $\frac{34.03 \text{ in}}{\text{yr}}$ Infiltration $\frac{34.03 \text{ in}}{\text{yr}} \times 25\% = \frac{8.51 \text{ in}}{\text{yr}}$

$$7.5 \text{ yrs} \times 40 \text{ AC} \times \frac{8.51 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{69,320,100 \text{ gal}}$$

V. Mine Pit - Assumptions:

A. The 1977 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI were used to represent wet precipitation conditions.

B. The 1976 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI were used to represent dry precipitation conditions.

C. The average of the 1960 through 1988 monthly temperature and precipitation N.O.A.A. data for Weyerhaeuser, WI was used to represent average precipitation conditions.

D. The mine pit consists of 32 acres.

E. After mining is complete, stored material will be put back into the pit. The pit will be restored to a few feet higher than preconstruction grades. Therefore, the construction and post construction water budget conditions are the same. The existing ground slopes are approximately 2%, 4%, and 8%.

F. The mine pit has a life of 7.9 years from preproduction through reclamation.

G. The pit will be mined in two phases. Phase I will be open the entire operating life of the pit. Phase II will be open beginning the fourth quarter of the first year and be open the remainder of the operating life of the pit.

H. Evaporation from bare soils is approximately 50% of the total precipitation (U.S. EPA, 1975).

I. There will be no infiltration in the pit during construction because the pit is being dewatered.

J. During backfilling 50% of runoff will be non-contact runoff and 50% will be contact runoff.

VI. Mine Pit Infiltration, Precipitation, and Runoff Calculations

1.) Preconstruction and Post Construction
2%, 4%, and 8% slopes.

1a. Wet Conditions - Infiltration

2% Slope

$$6\ AC \times \frac{16.27\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{2,650,600\ gal}{yr}$$

4% Slope

$$14\ AC \times \frac{14.34\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{5,451,100\ gal}{yr}$$

8% Slope

$$12\ AC \times \frac{13.04\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{4,248,800\ gal}{yr}$$

$$\text{Total} = \frac{12,350,500\ gal}{yr}$$

1b. Dry Conditions - Infiltration

2% Slope

$$6\ AC \times \frac{7.9\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{1,287,000\ gal}{yr}$$

4% Slope

$$14\ AC \times \frac{7.76\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{2,949,800\ gal}{yr}$$

8% Slope

$$12\ AC \times \frac{7.58\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{2,469,800\ gal}{yr}$$

$$\text{Total} = \frac{6,706,600\ gal}{yr}$$

1c. Average Conditions - Infiltration

2% Slope

$$6\ AC \times \frac{10.98\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{1,788,800\ gal}{yr}$$

4% Slope

$$14\ AC \times \frac{10.98\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \frac{4,173,900\ gal}{yr}$$

8% Slope

$$12\ AC \times \frac{10.95\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \quad \frac{7.48\ gal}{ft^3}$$

$$= \frac{3,567,800\ gal}{yr}$$

$$\text{Total} = \frac{9,530,500\ gal}{yr}$$

2. During Construction Precipitation and Runoff

2a. Wet Conditions

precip - $\frac{45.62 \text{ in}}{\text{yr}}$ Evaporation $\frac{45.62 \text{ in}}{\text{yr}} \times 50\% = \frac{22.81 \text{ in}}{\text{yr}}$

Precipitation and Runoff $\frac{45.62 \text{ in}}{\text{yr}} - \frac{22.81 \text{ in}}{\text{yr}} = \frac{22.81}{\text{yr}}$

Mine Pit - Preproduction

$$16 \text{ AC} \times .33 \text{ yr} \times \frac{22.81 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{3,270,100 \text{ gal}}$$

Mine Pit - Phase I Open

$$16 \text{ AC} \times .42 \text{ yr} \times \frac{22.81 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{4,162,000 \text{ gal}}$$

Total Pit Area Open

$$32 \text{ AC} \times 5.58 \text{ yr} \times \frac{22.81 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{110,590,000 \text{ gal}}$$

Mine Pit - Restoration

$$32 \text{ AC} \times 1.58 \text{ yr} \times \frac{22.81 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1\text{ft}}{12\text{in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{31,314,100 \text{ gal}}$$

2b. Dry Conditions

precip - $\frac{18.06 \text{ in}}{\text{yr}}$ Evaporation $\frac{18.06 \text{ in}}{\text{yr}} \times 50\% = \frac{9.03 \text{ in}}{\text{yr}}$

Precipitation and Runoff $\frac{18.06 \text{ in}}{\text{yr}} - \frac{9.03 \text{ in}}{\text{yr}} = \frac{9.03 \text{ in}}{\text{yr}}$

Mine Pit - Preproduction

$$16 \text{ AC} \times .33 \text{ yr} \times \frac{9.03 \text{ in}}{\text{yr}} \times \frac{43560 \text{ ft}^2}{\text{AC}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{7.48 \text{ gal}}{\text{ft}^3}$$

$$= \underline{1,294,600 \text{ gal}}$$

Mine Pit - Phase I Open

$$16\ AC \times .42\ yr \times \frac{9.03\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^3}$$

$$= \underline{1,647,600\ gal}$$

Total Pit Area Open

$$32\ AC \times 5.58\ yr \times \frac{9.03\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^2}$$

$$= \underline{43,780,400\ gal}$$

Mine Pit - Restoration

$$32\ AC \times 1.58\ yr \times \frac{9.03\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1\ ft}{12\ in} \times \frac{7.48\ gal}{ft^3}$$

$$= \underline{12,396,600\ gal}$$

2c. Average Conditions

precip - $\frac{34.03\ in}{yr}$ Evaporation $34.03 \times 50\% = \frac{17.02\ in}{yr}$

Precipitation and Runoff $\frac{34.03\ in}{yr} - \frac{17.02\ in}{yr} = \frac{17.01\ in}{yr}$

Mine Pit - Preproduction

$$16\ AC \times .33\ AC \times \frac{17.01\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1\ ft}{12\ in} \times \frac{7.48\ gal}{ft^2}$$

$$= \underline{2,438,600\ gal}$$

Mine Pit - Phase I Open

$$16\ AC \times .42\ yr \times \frac{17.01\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^2}$$

$$= \underline{3,103,700\ gal}$$

Total Pit Area Open

$$32\ AC \times 5.58\ yr \times \frac{17.01\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1ft}{12in} \times \frac{7.48\ gal}{ft^2}$$

$$= \underline{82,470,100\ gal}$$

Mine Pit - Restoration

$$32\ AC \times 1.58\ yrs \times \frac{17.01\ in}{yr} \times \frac{43560\ ft^2}{AC} \times \frac{1\ ft}{12\ in} \times \frac{7.48\ gal}{ft^2}$$

$$= \underline{23,351,800\ gal}$$

2d. Open Pit Dewatering

- Maximum inflow is estimated to be 588 gpm during production.
- Minimum inflow is estimated to be 294 gpm at the end of mining.
- Assume simple arithmetic average for inflow over pit life after Phase I. This is conservative since decrease in inflow is not a straight line function.
- Assume pit inflow during Phase I is equal to an average of 500 gpm.

$$\text{Average inflow} = \frac{294+588}{2} = 426 \text{ gpm}$$

$$426 \text{ gpm} \times \frac{60 \text{ min}}{\text{hr}} \times \frac{24 \text{ hr}}{\text{day}} \times \frac{365 \text{ days}}{\text{yr}}$$

$$= \frac{223{,}906{,}000 \text{ gal}}{\text{yr}}$$

$$223{,}906{,}000 \text{ gal/yr} \times \frac{\text{ft}^3}{7.48 \text{ gal}} \times \frac{1}{32 \text{ AC}} \times \frac{\text{AC}}{43560 \text{ ft}^2} \times \frac{12 \text{ in}}{1 \text{ ft}}$$

$$= \frac{257.70 \text{ in}}{\text{yr}}$$

Calculations Prepared By: JSK Date: 3/15/89

Calculations Checked By: JWS Date: 3/29/89

DURING CONSTRUCTION WATER BUDGET

TYPE I STOCKPILE

	RUNOFF	EVAP	INFIL	PRECIP
WET CONDITIONS				
gallons ($\times 10^6$)	185.722	92.861	92.861	371.444
inches/yr.	22.81	11.40	11.40	45.61
DRY CONDITIONS				
gallons ($\times 10^6$)	73.638	36.819	36.819	147.276
inches/yr.	9.04	4.51	4.51	18.06
AVERAGE CONDITIONS				
gallons ($\times 10^6$)	138.640	69.320	69.320	277.280
inches/yr.	17.02	8.51	8.51	34.04

DURING CONSTRUCTION WATER BUDGET

TYPE II STOCKPILE

	NONCONT. RUNOFF.[1]	CONT. RUNOFF[2]	EVAP	INFIL	LEACH.[3]	PRECIP
WET CONDITIONS						
AREA OPEN BEFORE FILLING						
gallons ($\times 10^6$)	8.358	0	4.179	4.179	0	16.716
inches/yr.	22.81	0	11.40	11.40	0	45.61
PHASE I FILLING						
gallons ($\times 10^6$)	0	26.440	13.220	0	13.220	52.88
inches/yr.	0	22.81	11.40	0	11.40	45.61
PHASE II OPEN NO FILLING						
gallons ($\times 10^6$)	19.528	0	9.764	9.764	0	39.052
inches/yr	22.81	0	11.40	11.40	0	45.61
PHASE I + II FILLING						
gallons ($\times 10^6$)	0	59.338	29.669	0	29.669	118.676
inches/yr.	0	22.81	11.40	0	11.40	45.61
Average over life of site (in/yr)	7.76	15.05	11.40	3.88	7.52	45.61

TYPE II STOCKPILE CONT'D

	NONCONT RUNOFF[1]	CONT. RUNOFF[2]	EVAP	INFIL	LEACH[3]	PRECIP
DRY CONDITIONS AREA OPEN BEFORE FILLING						
gallons ($\times 10^6$)	3.306	0	1.653	1.653	0	6.612
inches/yr.	9.02	0	4.51	4.51	0	18.04
PHASE I FILLING						
gallons ($\times 10^6$)	0	10.46	5.23	0	5.23	20.92
inches/yr	0	9.02	4.51	0	4.51	18.04
PHASE II OPEN NO FILLING						
gallons ($\times 10^6$)	7.726	0	3.863	3.863	0	15,452
inches/yr	9.02	0	4.51	4.51	0	18.04
PHASE I+II FILLING						
gallons ($\times 10^6$)	0	23.476	11.738	0	11.738	46.952
inches/yr.	0	9.02	4.51	0	4.51	18.04
Average over life of site (in/yr)	3.07	5.95	4.51	1.54	2.97	18.04

TYPE II STOCKPILE CONT'D

	NON CONT RUNOFF[1]	CONT. RUNOFF[2]	EVAP	INFIL	LEACH[3]	PRECIP
AVERAGE CONDITIONS						
AREA OPEN BEFORE FILLING						
gallons ($\times 10^6$)	6.238	0	3.119	3.119	0	12.476
inches/yr	17.02	0	8.51	8.51	0	34.04
PHASE I FILLING						
gallons ($\times 10^6$)	0	19.36	9.868	0	9.868	38.72
inches/yr	0	17.02	8.51	0	8.51	34.04
PHASE II OPEN NO FILLING						
gallons ($\times 10^6$)	14.576	0	7.288	7.288	0	29,152
inches/yr	17.02	0	8.51	8.51	0	34.04
PHASE I + II FILLING						
gallons ($\times 10^6$)	0	44.30	22.148	0	22.148	88.596
inches/yr	0	17.02	8.51	0	8.51	34.04
Average over site life (in/yr)	5.79	11.23	8.51	2.90	5.61	34.04

1 Noncontact runoff directed to natural drainage features.

2 Contact runoff directed to the wastewater treatment plant.

3 Leachate directed to the wastewater treatment plant.

Foth & Van Dyke

Client: Kennecott Scope I.D.: 87K10
Project: Permit Page: 5 of 7
Prepared by: JSK Date: 3-15-89
Checked by: JWS Date: 3/21/89

DURING CONSTRUCTION WATER BUDGET

MINE PIT

	NONCONTACT PRECIP/RUNOFF[1]	CONTACT PRECIP/RUNOFF[2]	EVAP	INFIL	PRECIP	OPER. LIFE[3] DEWATERING
WET CONDITIONS PREPROD.						
gallons ($\times 10^6$)	4.905	0	1.635	0	6.54	223.70
inches/yr	34.21	0	11.40	0	45.62	257.70
PHASE I MINING						
gallons ($\times 10^6$)	0	6.243	2.081	0	8.324	223.906
inches/yr	0	34.21	11.40	0	45.62	257.70
TOTAL PIT						
gallons ($\times 10^6$)	0	165.88	55.29	0	221.18	223.906
inches/yr	0	34.21	11.40	0	45.62	257.70
Restoration						
gallons ($\times 10^6$)	75.65	75.65	15.65	15.65	62.628	0
inches/yr	11.40	11.40	11.40	11.40	45.62	0
Average over life of site (in/yr)	3.70	28.26	11.40	2.28	45.62	206.48

MINE PIT CON'T

	NONCONTACT PRECIP/RUNOFF[1]	CONTACT PRECIP/RUNOFF[2]	EVAP	INFIL	PRECIP	OPER. LIFE DEWATERING
DRY CONDITIONS PREPROD						
gallons (x10⁶)	1.941	0	.647	0	2.588	223.70
inches/yr	13.54	0	4.51	0	18.06	257.70
PHASE I MINING						
gallons (x10⁶)	0	2.472	.824	0	3.296	223,706
inches/yr	0	13.54	4.51	0	18.06	257,70
TOTAL PIT						
gallons (x10⁶)	0	65.67	21.89	0	87,560	223,706
inches/yr	0	13.54	4.51	0	18.06	257,70
Restoration						
gallons (x10⁶)	6.20	6.20	6.20	6.20	24.794	0
inches/yr	4.52	4.52	4.52	4.52	18.06	0
Average over life of site (in/yr)	1.46	11.18	4.51	.90	18.06	206.48

MINE PIT CON'T

	NONCONTACT PRECIP/RUNOFF[1]	CONTACT PRECIP/RUNOFF[2]	EVAP.	INFIL	PRECIP	OPER. LIFE DEWATERIN
AVERAGE CONDITIONS PREPROD.						
gallons (x10⁶)	3.658	0	1.219	0	4.877	223.70
inches/yr	25.51	0	8.50	0	34.02	257.70
PHASE I MINING						
gallons (x10⁶)	0	4.656	1.552	0	6.208	223.70
inches/yr	0	25.51	8.50	0	34.02	257.70
TOTAL PIT						
gallons (x10⁶)	0	123.705	41.235	0	164.94	223.70
inches/yr	0	25.51	8.50	0	34.02	257.70
Restoration						
gallons (x10⁶)	11.68	11.68	11.68	11.68	46.704	0
inches/yr	8.50	8.50	8.50	8.50	34.02	0
Average over life of site (in/yr)	2.76	21.07	8.50	1.70	34.02	206.48

1 Non contact precipitation / runoff pumped to settling ponds.

2 Contact precipitation / runoff pumped to wastewater treatment plant.

3 This water is discharged to surface water either through the wastewater treatment plant or settling ponds.

CLIENT Kennecott

PROJECT

PROJECT NO. 87 K10

WATER BALANCE

2% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	0.6	19.2	36.7	51.3	64.0	62.0	71.2	62.1	57.3	45.2	31.2	14.8	43.0
I	0	0	0.37	3.18	6.82	6.19	9.27	6.22	4.77	1.78	0	0	38.60
UPET	0	0	0.01	0.07	0.11	0.11	0.14	0.11	0.09	0.04	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0.31	2.37	4.22	4.23	5.50	3.99	2.81	1.13	0	0	
P	0.91	1.06	5.75	3.83	3.62	5.22	5.6	6.78	5.85	3.18	1.46	2.36	45.62
C/o	-	0.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-	-	
RO	-	2.90	0.75	0.50	0.47	0.68	0.73	0.88	0.76	0.41	-	-	8.08
I	-	2.89	5.0	3.33	3.15	4.54	4.87	5.90	5.09	2.77	-	-	
I-PET	-	2.89	4.69	0.96	-1.07	0.31	-0.63	1.91	2.28	1.64	-	-	
ACC-WL				0	-1.07	-1.07	-1.7						
ST	12.0	12.0	12.0	12.0	10.97	10.97	10.41	12.0	12.0	12.0	12.0	12.0	
ΔST	0	0	0	0	1.03	0	0.56	-1.59	0	0	0	0	0
AET	0	0	0.31	2.37	2.12	4.23	4.31	3.99	2.81	1.13	0	0	21.27
PERC	0	2.89	4.69	0.96	0	0.31	0	3.50	2.28	1.64	0	0	16.27

= PERC + AET + ΔST + R/O

= 16.27 + 21.27 + 0 + 8.08

= 45.62

NOTES:

LAT = 45°26'

LONG = 91°25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Wet Year - 1977

OTHER: N.O.A.A Data - Weyerhauser, WI

BY JSK DATE 3-15-89

CHECKED BY DMR DATE 3-31-89

Foth & Van Dyke engineers architects

CLIENT Kennecott

PROJECT

PROJECT NO. 87 K10

WATER BALANCE

4% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	0.6	19.2	36.7	51.3	64.0	62.0	71.2	62.1	57.3	45.2	31.2	14.8	43.0
I	0	0	0.37	3.18	6.82	6.19	9.27	6.22	4.77	1.78	0	0	38.60
UPET	0	0	0.01	0.07	0.11	0.11	0.14	0.11	0.09	0.04	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0.31	2.37	4.22	4.23	5.50	3.99	2.81	1.13	0	0	
P	0.91	1.06	5.75	3.83	3.62	5.22	5.6	6.78	5.85	3.18	1.46	2.36	45.62
C/O	-	-	0.5	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	-	
RO	-	-	5.04	0.61	0.58	0.84	0.90	1.08	0.94	0.51	0.23	-	10.73
I	-	-	5.04	3.22	3.04	4.38	4.70	5.70	4.91	2.67	1.23	-	
I-PET	-	-	4.73	0.85	-1.18	0.15	-0.8	1.71	2.10	1.54	1.23	-	
ACC-WL					-1.18	-1.18	-2.03						
ST	12.0	12.0	12.0	12.0	10.87	11.02	10.12	11.83	12.0	12.0	12.0	12.0	
Δ ST	0	0	0	0	1.13	-0.15	0.9	-1.71	-0.17	0	0	0	0
AET	0	0	0.31	2.37	1.91	4.23	3.80	3.99	2.81	1.13	0	0	20.55
PERC	0	0	4.73	0.85	0	0.3	0	3.42	2.27	1.54	1.23	0	14.34

= PERC + AET + Δ ST + R/O

= 14.34 + 20.55 + 0 + 10.73

= 45.62

NOTES:

LAT = 45°26'

LONG = 91°25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Wet Year - 1977

OTHER: N.O.A.A Data - Weyerhauser, WI

BY JSK

DATE 3-15-89

CHECKED BY DMR

DATE 3-31-89

Foth & Van Dyke

engineers architects

CLIENT Kennecott

PROJECT

PROJECT NO. 87 K10

WATER BALANCE

8% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	0.6	19.2	36.7	51.3	64.0	62.0	71.2	62.1	57.3	45.2	31.2	14.8	43.0
I	0	0	0.37	3.18	6.82	6.19	9.27	6.22	4.77	1.78	0	0	38.60
UPET	0	0	0.01	0.07	0.11	0.11	0.14	0.11	0.09	0.04	0	0	
r	24	24.3	30.16	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0.31	2.37	4.22	4.23	5.50	3.99	2.81	1.13	0	0	
P	0.91	1.06	5.75	3.83	3.62	5.22	5.6	6.78	5.85	3.18	1.46	2.36	45.62
C/O	-	-	0.5	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	-	
RO	-	-	5.77	0.77	0.72	1.04	1.12	1.36	1.17	0.64	-	-	12.59
I	-	-	5.77	3.06	2.90	4.18	4.48	5.42	4.68	2.54	-	-	
I-PET	-	-	5.46	0.69	-1.32	-0.05	-1.02	1.43	1.87	1.41	-	-	
ACC-WL					-1.32	-1.37	-2.39						
ST	12.0	12.0	12.0	12.0	10.75	10.70	9.82	11.25	12.0	12.0	12.0	12.0	
Δ ST	0	0	0	0	1.25	0.05	0.88	-1.43	-0.75	0	0	0	0
AET	0	0	0.31	2.37	1.65	4.13	3.60	3.99	2.81	1.13	0	0	19.99
PERC	0	0	5.46	0.69	0	0	0	2.86	2.62	1.41	0	0	13.04

= PERC + AET + Δ ST + R/O

= 13.04 + 19.99 + 0 + 12.59

= 45.62

NOTES:

LAT = 45° 26'

LONG = 91° 25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Wet Year - 1977

OTHER: N.O.A.A Data - Weyerhauser, WI

BY JSK DATE 3-15-89

CHECKED BY DMB DATE 3-31-89

Foth & Van Dyke engineers architects

CLIENT Kennecott

PROJECT

PROJECT NO. 87K10

WATER BALANCE

2% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	8.96	15.0	28.23	43.61	55.29	63.23	67.93	65.39	56.71	45.64	30.79	14.78	41.35
I	0	0	0	1.47	4.22	6.57	8.13	7.28	4.60	1.88	0	0	34.15
UPET	0	0	0	0.04	0.09	0.11	0.13	0.12	0.09	0.05	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0	1.36	3.46	4.26	5.11	4.36	2.81	1.41	0	0	
P	1.14	0.88	1.92	2.62	3.44	4.17	4.33	4.07	4.61	2.76	2.76	1.33	34.03
Cr/o	-	-	0.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-	
RO	-	-	2.64	0.34	0.45	0.54	0.56	0.53	0.60	0.36	0.36	-	6.38
I	-	-	2.63	2.28	2.99	3.63	3.77	3.54	4.01	2.40	2.40	-	
I-PET	-	-	2.63	0.92	-0.47	-0.63	-1.34	-0.82	1.20	0.99	2.40	-	
ACC-WL					-0.47	-1.1	-2.44	-3.26					
ST	12.0	12.0	12.0	12.0	11.54	10.95	9.78	9.15	10.35	11.34	12.0	12.0	
Δ ST	0	0	0	0	0.46	0.59	1.17	0.63	-1.20	-0.99	-0.66	0	0
AET	0	0	0	1.36	2.53	3.04	2.60	2.91	2.81	1.41	0	0	16.66
PERC	0	0	2.63	0.92	0	0	0	0	2.4	1.98	3.05	0	10.98

= PERC + AET + Δ ST + R/O

= 10.98 + 16.66 + 0 + 6.38

= 34.02

NOTES:

LAT = 45°26'

LONG = 91°25'

AVAILABLE WATER IN FINAL COVER =

PRECIP. & TEMP. FROM: Average Monthly Precip & Temp. 1960-1988

OTHER: N.O.A.A. Data - Weyerhauser, Wi

BY JSK

DATE 3-14-89

CHECKED BY DMR

DATE 3-31-89

Foth & Van Dyke engineers architects

F. S. & D. 3-83

CLIENT Kennecott

PROJECT

PROJECT NO. 87K10

WATER BALANCE

4% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	8.96	15.0	28.23	43.61	55.29	63.23	67.93	65.39	56.71	45.64	30.79	14.78	41.35
I	0	0	0	1.47	4.22	6.57	8.13	7.28	4.60	1.88	0	0	34.15
UPET	0	0	0	0.04	0.09	0.11	0.13	0.12	0.09	0.05	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0	1.36	3.46	4.26	5.11	4.36	2.81	1.41	0	0	
P	1.14	0.88	1.92	2.62	3.44	4.17	4.33	4.07	4.61	2.76	2.76	1.33	34.03
Cr/o	-	-	0.5	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	-	
RO	-	-	2.64	0.42	0.55	0.67	0.69	0.65	0.74	0.44	0.44	-	7.24
I	-	-	2.63	2.20	2.89	3.50	3.64	3.42	3.87	2.32	2.32	-	
I-PET	-	-	2.63	0.84	-0.57	-0.76	-1.47	-0.94	1.06	0.91	2.32	-	
ACC-WL					-0.57	-1.33	-2.80	-3.74					
ST	12.0	12.0	12.0	12.0	11.44	10.74	9.50	8.78	9.84	10.75	12.0	12.0	
Δ ST	0	0	0	0	0.56	0.70	1.24	0.72	-1.06	-0.91	-1.25	0	0
AET	0	0	0	1.36	2.33	2.80	2.40	2.70	2.81	1.41	0	0	15.81
PERC	0	0	2.63	0.84	0	0	0	0	2.12	1.82	3.57	0	10.98

= PERC + AET + Δ ST + R/O

= 10.98 + 15.81 + 0 + 7.24

= 34.03

NOTES:

LAT = 45°26'

LONG = 91° 25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Average Monthly Precip & Temp. 1960-1988

OTHER: N.O.A.A. Data - Weyerhaeuser, Wi

BY JSK DATE 3-15-89

CHECKED BY DMR DATE 3-31-89

Foth & Van Dyke engineers architects

F & V D 3 83

CLIENT Kennecott

PROJECT

PROJECT NO. 87K10

WATER BALANCE

8% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	8.916	15.0	28.23	43.61	55.29	63.23	67.93	65.39	56.71	45.64	30.79	14.78	41.35
I	0	0	0	1.47	4.22	6.57	8.13	7.28	4.60	1.88	0	0	34.15
UPET	0	0	0	0.04	0.09	0.11	0.13	0.12	0.09	0.05	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0	1.36	3.46	4.26	5.11	4.36	2.81	1.41	0	0	
P	1.14	0.88	1.92	2.62	3.44	4.17	4.33	4.07	4.61	2.76	2.76	1.33	34.03
Cr/o	-	-	0.5	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	
RO	-	-	2.64	0.52	0.69	0.83	0.87	0.81	0.92	0.55	0.55	-	8.38
I	-	-	2.63	2.10	2.75	3.34	3.46	3.26	3.69	2.21	2.21	-	
I-PET	-	-	2.63	0.74	-0.71	-0.92	-1.65	-1.1	0.88	0.80	2.21	-	
ACC-WL					-0.71	-1.63	-3.28	-4.38					
ST	12.0	12.0	12.0	12.0	11.31	10.47	9.13	8.32	9.20	10.00	12.0	12.0	
Δ ST	0	0	0	0	0.69	0.84	1.34	0.81	-0.88	-0.80	2.00	0	0
AET	0	0	0	1.36	2.06	2.50	2.12	2.44	2.81	1.41	0	0	14.70
PERC	0	0	2.63	0.74	0	0	0	0	1.76	1.60	4.22	0	10.95

= PERC + AET + Δ ST + R/O

= 10.95 + 14.70 + 0 + 8.38

= 34.03

NOTES:

LAT = 45°26'

LONG = 91°25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Average Monthly Precip & Temp. 1960-1988

OTHER: N.O.A.A. Data - Weyerhaeuser, Wi

BY JSK DATE 3-15-89

CHECKED BY DMR DATE 3-31-89

Foth & Van Dyke engineers architects

F 9\ D 3 83

CLIENT Kennecott

PROJECT

PROJECT NO. 87K10

WATER BALANCE

2% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	6.0	21.0	25.1	44.7	53.6	67.3	70.6	68.2	57.1	42.7	25.2	6.7	40.7
I	0	0	0	1.68	3.76	7.92	9.06	8.23	4.72	1.30	0	0	36.67
UPET	0	0	0	0.04	0.07	0.13	0.14	0.13	0.09	0.04	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0	1.36	2.69	5.03	5.50	4.72	2.81	1.13	0	0	
P	2.05	0.92	3.22	2.35	1.41	2.13	2.42	1.40	1.24	0.57	0	0.35	18.06
C/O	-	-	0.5	0.13	0.13	0.13	0.13	0.13	0.13	0.13	-	-	
RO	-	-	3.27	0.31	0.18	0.28	0.31	0.18	0.16	0.07	-	-	4.76
I	-	-	3.27	2.04	1.23	1.85	2.11	1.22	1.08	0.50	-	-	
I-PET	-	-	3.27	0.68	-1.46	-3.18	-3.39	-3.50	-1.73	-0.63	-	-	
ACC-WL					-1.46	-4.64	-8.03	-11.53	-13.26	-13.89			
ST	3.76	3.76	7.03	7.71	10.62	8.15	6.14	4.58	3.97	3.76	3.76	3.76	
Δ ST	0	0	-3.27	-0.68	-2.91	2.47	2.01	1.56	0.61	0.21	0	0	0
AET	0	0	0	1.36	4.14	-0.62	0.10	-0.34	0.47	0.29	0	0	5.40
PERC	0	0	6.54	1.36	0	0	0	0	0	0	0	0	7.90

= PERC + AET + Δ ST + R/O

= 7.90 + 5.40 + 0 + 4.76

= 18.06

NOTES:

LAT = 45°26'

LONG = 91° 25'

AVAILABLE WATER IN FINAL COVER =

PRECIP. & TEMP. FROM: Dry Year - 1976

OTHER: N.O.A.A. Data - Weyerhauser, WI

BY JSK DATE 3-15-89

CHECKED BY DMR DATE 3-31-89

Foth & Van Dyke engineers architects

CLIENT Kennecott

PROJECT

PROJECT NO. 87K10

WATER BALANCE

4% Slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	6.0	21.0	25.1	44.7	53.6	67.3	70.6	68.2	57.1	42.7	25.2	6.7	40.7
I	0	0	0	1.68	3.76	7.92	9.06	8.23	4.72	1.30	0	0	36.67
UPET	0	0	0	0.04	0.07	0.13	0.14	0.13	0.09	0.04	0	0	
r	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0	1.36	2.69	5.03	5.50	4.72	2.81	1.13	0	0	
P	2.05	0.92	3.22	2.35	1.41	2.13	2.42	1.40	1.24	0.57	0	0.35	18.06
Cr/o	-	-	0.50	0.16	0.16	0.16	0.16	0.16	0.16	0.16	-	-	
RO	-	-	3.27	0.38	0.23	0.34	0.39	0.22	0.20	0.09	-	-	5.12
I	-	-	3.27	1.97	1.18	1.79	2.03	1.18	1.04	0.48	-	-	
I-PET	-	-	3.27	0.61	-1.51	-3.24	-3.47	-3.54	-1.77	-0.65	-	-	
ACC-WL					-1.51	-4.75	-8.22	-11.76	-13.53	-14.18			
ST	3.68	3.68	6.95	7.56	10.58	8.07	6.04	4.50	3.88	3.68	3.68	3.68	
Δ ST	0	0	-3.27	-0.61	-3.02	2.51	2.03	1.54	0.62	0.20	0	0	0
AET	0	0	0	1.36	4.20	-0.72	0	-0.36	0.42	0.28	0	0	5.18
PERC	0	0	6.54	1.22	0	0	0	0	0	0	0	0	7.76

= PERC + AET + Δ ST + R/O

= 7.76 + 5.18 + 0 + 5.12

= 18.06

NOTES:

LAT = 45°26'

LONG = 91° 25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Dry Year - 1976

OTHER: N.O.A.A. Data - Weyerhauser, WI

BY JSK

DATE 3-15-89

CHECKED BY DMR

DATE 3-31-89

Foth & Van Dyke

engineers architects

CLIENT Kennecott

PROJECT

PROJECT NO. 87K10

WATER BALANCE

8% slope

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	YEAR
T	6.0	21.0	25.1	44.7	53.6	67.3	70.6	68.2	57.1	42.7	25.2	6.7	40.7
I	0	0	0	1.68	3.76	7.92	9.06	8.23	4.72	1.30	0	0	36.67
UPET	0	0	0	0.04	0.07	0.13	0.14	0.13	0.09	0.04	0	0	
t	24	24.3	30.6	33.9	38.4	38.7	39.3	36.3	31.2	28.2	23.7	22.5	
PET	0	0	0	1.36	2.69	5.03	5.50	4.72	2.81	1.13	0	0	
P	2.05	0.92	3.22	2.35	1.41	2.13	2.42	1.40	1.24	0.57	0	0.35	18.06
C r/o	-	-	0.5	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	-	
RO	-	-	3.27	0.47	0.28	0.43	0.48	0.28	0.25	0.11	-	-	5.57
I	-	-	3.27	1.88	1.13	1.70	1.94	1.12	0.99	0.46	-	-	
I-PET	-	-	3.27	0.52	-1.56	-3.33	-3.56	-3.60	-1.82	-0.67	-	-	
ACC-WL					-1.56	-4.89	-8.45	-12.05	-13.87	-14.54			
ST	3.57	3.57	6.84	7.36	10.53	7.98	5.93	4.39	3.77	3.57	3.57	3.57	
Δ ST	0	0	-3.27	-0.52	-3.17	2.55	2.05	1.54	0.62	0.20	0	0	0
AET	0	0	0	1.36	4.30	.85	-0.11	-0.42	0.37	0.26	0	0	4.91
PERC	0	0	6.54	1.04	0	0	0	0	0	0	0	0	7.58

= PERC + AET + ΔST + R/O

= 7.58 + 4.91 + 0 + 5.57

= 18.06

NOTES:

LAT : 45°26'

LONG : 91° 25'

AVAILABLE WATER IN FINAL COVER = 12"

PRECIP. & TEMP. FROM: Dry Year - 1976

OTHER: N.O.A.A. Data - Weyerhauser, WI

BY JSK DATE 3-15-89

CHECKED BY DMR DATE 3-31-89

Foth & Van Dyke engineers architects

UW-STEVENS POINT
3 1775 677582 9