

EIR supplement: Wisconsin wastewater discharge pipeline for the Crandon Project. Volume IIIa

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Crandon Mining Company

7 N. BROWN ST., 3RD FLOOR
RHINELANDER, WI 54501-3161

Jerome D. Goodrich, Jr.
PRESIDENT

November 21, 1995

Mr. Bill Tans
Wisconsin Department of Natural Resources
Bureau of Environmental Analysis and Review
P.O. Box 7921
Madison, WI 53707

Mr. David L. Ballman, Ecologist
U.S. Army Corps of Engineers
St. Paul District
190 Fifth Street East
St. Paul, MN 55101

DEC 06 1995

Dear Mr. Tans and Mr. Ballman:

Re: Crandon Project - *Environmental Impact Report*

Crandon Mining Company (CMC) is pleased to submit the enclosed update to Volume IIIa, Appendix 3-2, the *EIR Supplement: Wisconsin River Wastewater Discharge Pipeline*.

This update has been prepared on behalf of CMC by Foth & Van Dyke and Associates, Inc. As noted on the attached distribution list, CMC has distributed the information to appropriate state and federal agencies, to local officials, and to various interested parties. It is our understanding that the Wisconsin Department of Natural Resources (WDNR) and the U.S. Army Corps of Engineers (USCOE) will be responsible for distribution of the document to their appropriate staff members.

The page contained in this update needs to be inserted into EIR Volume IIIa, which was submitted to you in September, 1995, according to the attached reference list. The list has been prepared to not only facilitate insertion of the additional information, but also to serve as a log and reference identifying changes made to the EIR Supplement by CMC throughout the permitting process. If subsequent revisions are made, they will be added to the attached list in sequential order and the list will be forwarded with the changes.

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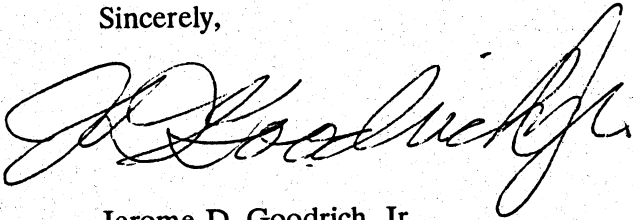
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Mr. Bill Tans/Mr. David L. Ballman
November 21, 1995
Page 2

If you or your staff have any questions regarding the EIR or EIR Supplement, please contact me at (715) 365-1450.

Sincerely,

A handwritten signature in cursive script, appearing to read "J. Goodrich, Jr.", written in dark ink.

Jerome D. Goodrich, Jr.
President
Crandon Mining Company

JDG:mld2



Crandon Mining Company

7 N. BROWN ST., 3RD FLOOR
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October 21, 1996

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Mr. David L. Ballman, Ecologist
U.S. Army Corps of Engineers
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190 Fifth Street East
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OCT 30 1996

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The pages contained in this update need to be inserted into Volume IIIa of the EIR according to Items 4 through 14 on the attached reference list. This list serves as a log and reference identifying changes made to the EIR by CMC throughout the permitting process. Items 1 through 3 on the list were previously submitted. If additional revisions are made, they will be added to the attached list in sequential order and the list will be forwarded with the changes.

Please note that through this update Comment 172 from the May 3, 1996, WDNR letter pertaining to CMC's EIR has been addressed.

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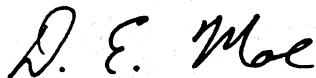


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Page 2

If you or your staff have any questions regarding the EIR, please contact me at (715) 365-1450.

Sincerely,

A handwritten signature in cursive script, reading "D. E. Moe".

Don Moe
Technical/Permitting Manager
Crandon Mining Company

DM:mld2

Crandon Project EIR Supplement: Wisconsin River Wastewater Discharge Pipeline Log of Updates and Additional Information

Entry Number	Date of Revision	Page(s)	Document Section Number	Description
1	11/21/95	3	Log of Updates	Addition (Place Behind Original Cover Letter)
2	11/21/95	4-10	Distribution List	Updated (Place Behind Log of Updates)
3	11/21/95	39	Table 4-1	Insert Updated Page
4	10/21/96	3	Log of Updates	Updated
5	10/21/96	4-9	Distribution List	Updated
6	10/21/96	v and vii	Table of Contents	Updated
7	10/21/96	15-16	Section 3.2	Updated to include work performed in 1996
8	10/21/96	25	Section 3.7	Added paragraph on 1996 aquatic threatened and endangered species surveys
9	10/21/96	30	Section 3.7.2.7	Added paragraph on 1996 aquatic threatened and endangered species surveys
10	10/21/96	36 and 36a	Section 4.2.1	Updated Section 4.2.1 to include work performed in 1996; Section 4.2.2 moved to new page
11	10/21/96	37	Section 4.2.6.1.1	Added new section subheading
12	10/21/96	39a	Section 4.2.6.1.2	Added new section
13	10/21/96	54-55	Section 5	Updated reference list
14	10/21/96	—	Appendix F	New Appendix

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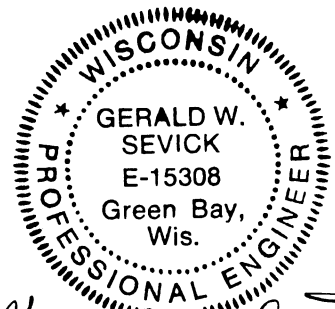
**EIR Supplement: Wisconsin River
Wastewater Discharge Pipeline
for the Crandon Project**

93C049

Prepared for
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Prepared by
Foth & Van Dyke and Associates Inc.

September 1995



Gerald W. Sevick
9/12/95



Donald E. Moe 9/12/95

Crandon Mining Company Environmental Impact Report Supplement Wisconsin River Discharge Pipeline

Executive Summary

Introduction

Crandon Mining Company (CMC) plans to discharge treated water from its Crandon mine into the Wisconsin River by way of an underground pipeline from the mine site to the Hat Rapids Dam, south of the City of Rhinelander. All water discharged will be treated to meet strict standards set by the Wisconsin Department of Natural Resources (WDNR). This document, a supplement to the project's Environmental Impact Report, shows that pipeline construction and the water discharge will not adversely affect the environment.

Description of the Project

The water pipeline will extend approximately 38.3 miles from the mine site to Hat Rapids Dam, following road rights-of-way. The fully sealed pipe will be buried a minimum of 4.5 feet underground, below the frost line. The pipeline route will run:

- From the project's wastewater treatment plant along the mine access road to Hwy. 55.
- Along the west side of Hwy. 55 north to Hwy. S.
- Along the west side of Hwy. S. to Hwy. 8.
- Along the north side of Hwy. 8 to Hwy. V, under the county snowmobile trail.
- Along the south side of Hwy. 8 from Hwy. V to the Rhinelander beltline.
- Along the north side of the Rhinelander beltline to HWY 17.
- Along the west side of Hwy. 17 to Hat Rapids Road.
- Along the south side of Hat Rapids Road to the Wisconsin River.
- Along the east side of the river to Hat Rapids Dam under land owned by Wisconsin Public Service Corporation.

The normal flow through the pipeline will be approximately 460 gallons per minute (gpm), but the pipeline will have a capacity of 1,200 gpm. The water will discharge directly into the turbine intakes of the dam, where it will mix with river water.

Environmental Impacts

Wisconsin River water discharge. The treated water will not have any adverse effect on water quality in the Wisconsin River. Excess water from the mine will be treated in a wastewater treatment plant built according to plans approved by the WDNR. The plant will use a lime/sulfide treatment process that has been tested under WDNR supervision to prove its effectiveness. The discharge must meet strict WDNR water quality standards designed to protect public health and welfare, protect the use of waters for public and private water supplies, and protect fish and wildlife. CMC studies show that the discharge will consistently meet WDNR limits for all substances. Comprehensive controls at the treatment plant will ensure that water is released through the pipeline only if it meets WDNR standards. Even during seasonal low-flow periods, the discharge rate of 460 gpm represents only 0.3 percent of the river's flow at the Hat Rapids Dam, and 0.08 percent of the river's flow 45 miles downstream at Merrill.

Interbasin water transfer. Piping water from the mine to Hat Rapids Dam will move water from the Wolf River drainage basin and into the Wisconsin River drainage basin. However, this will have no measurable effects on the environment because the amount of water transferred will be very small in relation to the sizes of the two river systems.

Pipeline construction. The environmental effects of pipeline construction will be small and temporary. The rights-of-way in which the pipeline will be built pass mainly through second-growth northern hardwood forests, wetlands, and farm and residential land. Because these lands are already disturbed by road construction and maintenance, they provide only limited wildlife habitat. When construction is completed, the land will be restored.

Where the pipeline crosses streams, CMC will use proven directional drilling methods to place the pipe several feet below the stream bed without disturbing the stream. At a minimum, the pipeline will be installed beneath the Wolf River, Gliske Creek, Mud Creek, Monico Creek, Venus Creek, Neptune Creek, the Pelican and North Branch Pelican Rivers, George Creek, and one unnamed creek.

The pipeline will temporarily disturb at most 13.1 acres of wetlands on or next to highway rights-of-way and along the snowmobile trail. After construction, the lands will be restored, and the wetlands will recover fully within one or two years.

CMC studies show that leaks in the pipeline are highly unlikely during the entire life of the mine. Even if a leak did occur, its effects would be negligible because of the high quality of the treated water. Nonetheless, systems will be in place to detect leaks, and procedures will be in place to shut down the system and make prompt repairs.

EIR Supplement: Wisconsin River Wastewater Discharge Pipeline Crandon Mining Company Crandon Project

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Appendix B	Oneida County Soil Survey Data Sheets
Appendix C	Forest County and Oneida County Soil Association Maps
Appendix D	Wisconsin Department of Natural Resources Correspondence
Appendix E	Habitat Characterization Field Data Forms
Appendix F	Addendum 1 - Supplement: Wisconsin River Discharge Pipeline for the Crandon Project

1 Introduction

Crandon Mining Company's (CMC) proposed mine/mill process will be a net consumer of water. However, even during a drought year, the total amount of mine drainage due to groundwater inflow will likely exceed the demand for makeup water in the mine process water system. Therefore, dewatering of the mine will result in a surplus of water which must be discharged from the site. CMC proposes to treat this water on-site to meet applicable effluent standards for ultimate discharge to the Wisconsin River approximately 38.3 miles west of the facility. The proposed route is shown on Figure 1-1.

This document provides a description of the proposed action and the existing environment the pipeline traverses, an assessment of the potential environmental impacts, and an alternatives evaluation. The document addresses the pipeline corridor from the intersection of the proposed plant site access road and State Trunk Highway (STH) 55 to the Wisconsin River. The portion of the pipeline extending from the plant site along the proposed access road to STH 55 is addressed separately in the main body of the project's 1995 Environmental Impact Report (EIR) (Foth & Van Dyke, 1995a).

2 Project Description

2.1 Location

As shown on Figure 1-1, beginning at the intersection of the site access road and STH 55, the pipeline is proposed to be routed along and buried within the right-of-way (ROW) of federal, state, county and locally designated public roads with the exception of a short segment along the Wisconsin River, where the pipeline will parallel the river on Wisconsin Public Service Corporation (WPSC) property from Hat Rapids Road north to the Hat Rapids Dam.

The proposed pipeline route begins at the CMC project site wastewater treatment facility and follows the proposed plant site access road to STH 55. The route then follows STH 55 north to County Trunk Highway (CTH) S, continuing north to United States Route (USR) 8. The proposed route will follow USR 8 to Rhinelander where it will head south along STH 17 to Hat Rapids Road. The route will follow Hat Rapids Road to the Wisconsin River, turn north and proceed to the Hat Rapids Dam. The total length of the proposed pipeline is approximately 38.3 miles. The Hat Rapids Dam is owned and operated by WPSC.

Table 2-1 provides specific information regarding the location of the proposed pipeline. As shown in Table 2-1, the pipeline will be routed on the west side of STH 55 and CTH S; to the north of USR 8 from CTH S to CTH V along an existing snowmobile trail; to the south of USR 8 between CTH V and River Bend Road; to the north of the Rhinelander Beltline; to the west of STH 17; and to the south of Hat Rapids Road. Per discussions with the Wisconsin Department of Transportation (WisDOT), the pipeline will be placed 25 feet from the edge of pavement along STH 55, STH 17 and all of USR 8, with the exception of the portion along the snowmobile trail. The pipeline will be installed down the centerline of the snowmobile trail. At the recommendation of the Forest County Highway Commission, the pipeline will be installed along the west top-of-ditch line (this varies but averages approximately 25 feet from the edge of pavement) on CTH S. Due to the narrow ROW, the pipeline will be installed at the edge of pavement on Hat Rapids Road. At the Wisconsin River, the pipeline will parallel the river on the east bank north to the Hat Rapids Dam on property owned by WPSC.

Table 2-1
Pipeline Location Data¹

Segment	Length (miles)	ROW Ownership	ROW Width ² (feet)	Side of Road	Distance from Edge of Pavement (feet)
STH 55	2.5	WisDOT	33-125	West	25
CTH S	2.0	Forest Co.	40-85	West	≈25
Snowmobile Trail	9.6	WisDOT	125-200	North	NA ³
USR 8 from CTH V to River Bend Road	9.4	WisDOT	41-230	South	25
Rhineland Beltline	5.8	WisDOT	100-150	North	25
STH 17	4.2	WisDOT	100-150	West	25
Hat Rapids Road	1.7	Crescent Township	66 ⁴	South	0

¹Does not include the 3.1 mile portion of the pipeline corridor along the CMC site access road.

²Width of ROW on indicated side of road. Width is from roadway centerline.

³The pipeline will be placed down the centerline of the snowmobile trail.

⁴Total ROW width on both sides of roadway.

Prepared by: RFS

Checked by: JWS

Figures 2-1 through 2-7 are typical cross-sections showing the location of the pipeline in reference to public roadway centerlines at a minimum depth of cover over the pipeline of 4.5 feet. Where the pipeline crosses or is embedded below roadways, the depth of cover over the pipeline will be a minimum seven feet. Where the pipeline distance is farther than the slope-intercept distance (i.e., the intersection of roadway sideslopes with undisturbed ground), the pipeline would be in undisturbed ROW. For the most part, as shown in Table 2-2 the pipeline will be within the roadway slope-intercept and therefore within disturbed ROW.

Table 2-2

Horizontal Pipeline Placement Within Public Right-of-Way¹

STH 55 CMC Entrance Rd. - CTH S					
Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to West	C.L. to West	C.L. to West	C.L. to West
262+00	266+45	60'- 90'	42'	50'- 72'	40'
266+45	270+75	90'- 55'	42'	46'- 72'	40'
270+75	271+09	55'- 70'	42'	45'- 46'	40'
271+09	271+58	70'- 100'	42'	44'- 45'	40'
271+58	272+00	100'- 88'	42'	44'- 45'	40'
272+00	273+00	88'- 60'	42'	45'- 49'	40'
273+00	279+49	60'- 100'	42'	34'- 49'	40'
279+49	275+00	100'	42'	34'- 45'	40'
275+00	276+00	100'- 70'	42'	34'- 52'	40'
276+00	278+00	70'	42'	45'- 59'	40'
278+00	279+00	70'- 60'	42'	44'- 47'	40'
279+00	292+00	60'	42'	44'- 47'	40'
292+00	295+00	60'- 70'	42'	49'- 60'	40'
295+00	298+33	70'- 60'	42'	36'- 62'	40'
298+33	310+00	60'	42'	41'- 47'	40'
310+00	303+50	60'- 110'	42'	39'- 41'	40'
303+50	304+71	110'- 77'	42'	33'- 80'	40'
304+71	307+00	77'- 94'	42'	37'- 44'	40'
307+00	311+07	94'- 50'	42'	32'- 34'	40'
311+07	314+00	50'- 60'	42'	34'- 46'	40'
314+00	324+00	60'	42'	33'- 52'	40'
324+00	325+00	60'- 70'	42'	43'- 66'	40'
325+00	329+00	70'	42'	50'- 66'	40'
329+00	332+00	70'- 50'	42'	44'- 52'	40'
332+00	334+50	50'	42'	39'- 44'	40'
334+50	336+00	40'- 50'	42'	29'- 39'	40'-35'
336+00	338+00	40'- 70'	42'	36'- 41'	35'
338+00	343+00	70'- 33'	42'	28'- 51'	35'-30'
343+00	345+00	33'- 44'	42'	28'- 30'	30'-35'
345+00	349+00	40'	42'	30'- 37'	35'
349+00	353+00	40'- 60'	42'	37'- 46'	35'
353+00	363+57	60'	42'	44'- 51'	35'-40'
363+57	365+00	60'- 50'	42'	41'- 45'	40'

Table 2-2 (Continued)

Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to West	C.L. to West	C.L. to West	C.L. to West
365+00	366+00	50'- 45'	42'	37'- 41'	40'
366+00	368+50	45'	42'	34'- 41'	40'
368+50	371+00	45'- 50'	42'	34'- 51'	40'
371+00	374+00	60'	42'	43'- 50'	40'
374+00	377+00	60'- 75'	42'	48'- 58'	40'
377+00	382+00	75'	42'	40'- 63'	40'
382+00	386+97	75'- 100'	42'	63'- 81'	40'
386+97	391+53	100'- 125'	42'	67'- 101'	40'
391+53	393+30	125'- 80'	42'	38'- 92'	40'

CTH S
STH 55 - USR 8

Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to West	C.L. to West	C.L. to West	C.L. to West
393+30	397+74	40'- 45'	32'	19'- 33'	37'
397+74	399+74	45'- 65'	32'	33'- 59'	37'
399+74	401+74	65'	32'	59'- 65'	37'
401+74	402+74	65'- 45'	32'	27'- 65'	37'
402+74	416+74	45'	32'	27'- 44'	37'
416+74	418+74	45'- 50'	32'	27'- 47'	37'
418+74	420+74	50'- 60'	32'	43'- 57'	37'
420+74	421+99	60'- 85'	32'	57'- 91'	37'
421+99	423+74	85'- 60'	32'	52'- 91'	37'
423+74	430+74	60'	32'	47'- 59'	37'
430+74	431+74	60'- 55'	32'	37'- 49'	37'
431+74	438+74	55'	32'	37'- 53'	37'
438+74	439+74	55'- 80'	32'	48'- 49'	37'
439+74	440+74	80'	32'	48'- 55'	37'
440+74	441+74	80'- 40'	32'	36'- 55'	37'
441+74	443+74	40'- 55'	32'	36'- 48'	37'
443+74	444+74	55'	32'	45'- 48'	37'
444+74	446+74	55'	32'	45'- 51'	37'
446+74	447+74	55'- 45'	32'	41'- 49'	37'
447+74	470+74	45'	32'	33'- 50'	37'
470+74	474+74	45'- 75'	32'	33'- 74'	37'
474+74	475+74	75'- 60'	32'	38'- 64'	37'
475+74	482+74	60'	32'	38'- 57'	37'

Table 2-2 (Continued)

Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to West	C.L. to West	C.L. to West	C.L. to West
482+74	489+74	40'	32'	33'- 37'	37'
489+74	490+74	40'- 50'	32'	37'- 49'	37'
490+74	497+74	50'	32'	33'- 50'	37'
497+74	498+74	50'- 70'	32'	39'- 43'	37'

USR 8 (Snowmobile Trail)
CTH S - CTH V

Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to North	C.L. to North	C.L. to North	C.L. to North
498+74	550+13	125'-220'	50'	N.A.	40'-170'
550+13	554+88	200'	50'	N.A.	170'-145'
554+88	561+88	200'-185'	50'	N.A.	145'-135'
561+88	537+88	185'-175'	50'	N.A.	135'-115'
537+88	579+49	175'-160'	50'	N.A.	115'-105'
579+49	601+88	160'-145'	50'	N.A.	105'-100'
601+88	606+03	145'	50'	N.A.	100'
606+03	631+73	145'-150'	50'	N.A.	100'-90'
631+73	654+88	150'	50'	N.A.	90'
654+88	660+33	150'	50'	N.A.	90'
660+33	675+06	200'	50'	N.A.	90'-105'
675+06	683+98	150'-160'	50'	N.A.	105'-115'
683+98	688+98	160'-165'	50'	N.A.	115'-120'
688+98	712+88	165'-155'	50'	N.A.	120'-125'
712+88	756+88	155'-190'	50'	N.A.	125'
756+88	780+21	190'-150'	50'	N.A.	125'-110'
780+21	806+21	150'	50'	N.A.	110'
806+21	811+21	150'	50'	N.A.	110'
811+21	819+21	150'-162'	50'	N.A.	110'
819+21	841+94	162'-145'	50'	N.A.	110'
841+94	855+21	145'-142'	50'	N.A.	110'-95'
855+21	925+85	110'-205'	50'	N.A.	70'-110'
925+85	937+21	157'-120'	50'	N.A.	110'-80'
937+21	967+21	120'	50'	N.A.	80'
967+21	975+21	120'	50'	N.A.	80'
975+21	996+21	120'-110'	50'	N.A.	80'-40'
996+21	1004+21	118'	50'	N.A.	40'

Table 2-2 (Continued)

USR 8 Monico - Lake George (≈ CTH V to River Bend Road)					
Pipe Station ⁴		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to South	C.L. to South	C.L. to South	C.L. to South
1080+76	1093+23	60'	50'	26'-38'	40'
1093+23	1096+90	41'-60'	50'	37'-38'	40'
1096+90	1098+90	91'-41'	50'	35'-37'	40'
1098+90	1113+42	91'	50'	35'	40'
1113+42	1120+20	100'	50'	35'-41'	40'
1120+20	1120+34	116'-110'	50'	40'-41'	40'
1120+34	1153+09	116'	50'	40'-80'	40'
1153+09	1343+97	100'	50'	29'-80'	40'
1343+97	1357+97	140'-100'	50'	40'-68'	40'
1357+97	1360+97	140'-200'	50'	60'-70'	40'
1360+97	1374+97	380'-200'	50'	42'-75'	40'
1374+97	1379+97	230'	50'	42'-80'	40'
1379+97	1387+97	230'	50'	48'-71'	40'
1384+97	1389+97	230'	50'	40'-80'	40'
1389+97	1394+97	230'	50'	55'-80'	40'
1394+97	1399+97	230'	50'	52'-100'	40'
1399+97	1402+97	230'	50'	92'-100'	40'
1402+97	1406+97	230'	50'	74'-92'	40'
1406+97	1411+97	230'	50'	52'-90'	40'
1411+97	1416+97	230'	50'	50'-106'	40'
1416+97	1421+97	230'	50'	45'-106'	40'
1421+97	1426+97	230'	50'	43'-52'	40'
1426+97	1431+97	230'	50'	49'-58'	40'
1431+97	1436+97	230'	50'	50'-66'	40'
1436+97	1441+97	230'	50'	48'-60'	40'
1441+97	1446+97	230'	50'	47'-49'	40'
1446+97	1451+97	230'	50'	42'-58'	40'
1451+97	1456+97	230'	50'	48'-55'	40'
1456+97	1461+97	230'	50'	42'-58'	40'
1461+97	1466+97	230'	50'	38'-44'	40'
1466+97	1471+97	230'	50'	44'-74'	40'
1471+97	1476+97	230'	50'	42'-88'	40'
1476+97	1481+97	230'	50'	61'-100'	40'
1481+97	1486+97	230'	50'	40'-100'	40'
1486+97	1493+97	230'	50'	50'-59'	40'

Table 2-2 (Continued)

Pipe Station ⁴		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to South	C.L. to South	C.L. to South	C.L. to South
1493+97	1498+97	60'-200'	50'	54'-125'	40'
1498+97	1503+97	60'-200'	50'	55'-108'	40'

USR 8 (Rhineland Beltline)
Lake George - STH 17

Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to North	C.L. to North	C.L. to North	C.L. to North
1503+97	1508+97	150'	50'	42'-96'	40'
1508+97	1513+97	150'	50'	46'-72'	40'
1513+97	1518+97	150'	50'	45'-60'	40'
1518+97	1523+97	150'	50'	50'-100'	40'
1523+97	1528+97	150'	50'	52'-100'	40'
1528+97	1533+97	150'	50'	40'-52'	40'
1533+97	1538+97	150'	50'	40'-65'	40'
1538+97	1543+97	150'	50'	66'-89'	40'
1543+97	1548+97	150'	50'	45'-125'	40'
1548+97	1553+97	150'	50'	104'-125'	40'
1553+97	1558+97	150'	50'	45'-104'	40'
1558+97	1563+97	150'	50'	49'-85'	40'
1563+97	1568+97	150'	50'	46'-81'	40'
1568+97	1573+97	150'	50'	44'-90'	40'
1573+97	1578+97	150'	50'	90'-124'	40'
1578+97	1583+97	150'	50'	108'-136'	40'
1583+97	1588+97	150'	50'	41'-132'	40'
1588+97	1593+97	150'	50'	36'-72'	40'
1593+97	1675+97	150'	50'	34'-92'	40'
1675+97	1691+97	150'	50'	38'-66'	40'
1691+97	1695+97	150'	50'	38'-58'	40'
1695+97	1710+97	150'	50'	38'-146'	40'
1710+97	1728+97	150'	50'	40'-146'	40'
1728+97	1734+97	100'	50'	41'-106'	40'
1734+97	1738+97	150'	50'	41'-64'	40'
1738+97	1754+97	150'	50'	32'-102'	40'
1754+97	1759+97	150'	50'	44'-102'	40'
1759+97	1768+97	100'	50'	36'-58'	40'
1768+97	1779+97	150'	50'	37'-98'	40'
1179+97	1809+97	150'	50'	37'-132'	40'

Table 2-2 (Continued)

STH 17
USR 8 - Hat Rapids Road

Pipe Station		ROW	Clear Zone ²	Slope Intercept ³	Pipe
From:	To:	C.L. to South	C.L. to South	C.L. to South	C.L. to South
1809+97	1914+89	150'	32'	14'-42'	39'
1914+89	1920+74	100'-150'	32'	35'-65'	39'
1920+74	1960+74	100'	32'	33'-70'	39'
1960+74	1969+59	120'-100'	32'	33'-65'	39'
1969+59	1976+74	113'-120'	32'	40'-70'	39'
1976+74	1989+94	117'-113'	32'	30'-70'	39'
1989+94	1990+74	100'-117'	32'	60'-70'	39'
1990+74	2029+74	100'	32'	33'-70'	39'

¹ The pipeline segment within the Town of Crescent is not included in this table since the pipeline in that segment will be located on the edge of the road pavement.

² Clear zone is defined as a roadside border free from obstructions located adjacent to the edge of the roadway and designated available for safe use by errant vehicles.

³ Slope intercept is the intersection of roadway sideslopes with undisturbed ground.

⁴ From the pipe station 1004+21 to 1080+76 WisDOT information regarding ROW, clear zone and slope intercept is not currently available.

Prepared by: SCH
Checked by: PMP1

2.2 Pipe Material, Pumping Facilities and Appurtenances

The total length of the proposed pipeline route from the CMC wastewater treatment facility to the Wisconsin River at the Hat Rapids Dam is approximately 202,400 feet or 38.3 miles. The highest point along the route is approximately at elevation 1810 feet located along USR 8 between CTH S and the Forest/Oneida County line. The lowest elevation of 1521 feet is at the Pelican River crossing along USR 8. The maximum elevation difference is 289 feet.

2.2.1 Pipeline and Pumping Facilities

A 1200 gpm design discharge flow rate has been established for the discharge pipeline as part of the project's wastewater engineering evaluations. This flow rate was considered as the basis for the pipeline engineering design. The average discharge flow rate is estimated to be approximately 460 gpm.

The pipeline material will consist of either polyvinyl chloride (PVC) with solvent welded joints, high density polyethylene (HDPE) with butt fusion joints, or epoxy-coated steel with welded joints. The discharge system will consist of discharge pumps located at the plant site, with the potential of one or more booster stations located along the pipeline route.

Table 2-3 provides a summary of velocity headlosses at the design maximum 1200 gpm flow rate for various standard nominal pipe sizes for PVC, HDPE, and steel pipe material. It is desirable to maintain a minimum velocity of two feet per second (fps) in the pipeline to maintain a reasonable self-cleaning velocity. The upper limit velocity should be approximately five fps to minimize the amount of velocity change at startup and shutdown of the pumps, and therefore, minimize the amount of pressure surge in the pipeline as well as reduce velocity headloss in the pipeline.

To provide flexibility, the pumping system will be designed to pump at either 600 gpm or at a maximum of 1200 gpm. To provide reliability, two pumps are proposed with each providing a flow rate of 600 gpm, with a third pump available for installation in case of pump failure. One pump would be used for a 600 gpm discharge rate, while two would be used for a 1200 gpm rate. The discharge piping on the pumps will be equipped with rate-of-flow control valves to maintain constant flow rates as well as surge control to protect the piping on start-up and shutdown of the pumps. The control valves would maintain constant backpressure so that the proper flow rate from the pumps can be maintained when two 600 gpm pumps are used to provide the 1200 gpm maximum flow rate.

Table 2-3

Summary of Pipe Velocity and Headloss¹

Nominal Size (Inches)	Type of Pipe	Pipe O.D. (Inches)	Wall Thk (Inches)	Pipe I.D. (Inches)	H-W Coef.	Velocity (Feet/Sec.)	Headloss (Ft/1000 Ft)
10	PVC 1120 ASTM D 2241 SDR 17, PC 250	10.75	0.63	9.49	130	5.44	11.14
12	PVC 1120 ASTM D 2241 SDR 17, PC 250	12.75	0.75	11.25	130	3.87	4.86
14	PVC 1120 ASTM D 2241 SDR 17, PC 250	14.00	0.82	12.35	130	3.21	3.08
16	PVC 1120 ASTM D 2241 SDR 17, PC 250	16.00	0.94	14.12	130	2.46	1.61
10	PVC 1120 ASTM D 2241 SDR 21, PC 200	10.75	0.51	9.73	130	5.18	9.88
12	PVC 1120 ASTM D 2241 SDR 21, PC 200	12.75	0.61	11.54	130	3.68	4.30
14	PVC 1120 ASTM D 2241 SDR 21, PC 200	14.00	0.67	12.67	130	3.05	2.72
16	PVC 1120 ASTM D 2241 SDR 21, PC 200	16.00	0.76	14.48	130	2.34	1.43
14	HDPE 3408 ASTM D 3035 DR 9, PC 200	14.00	1.56	10.89	140	4.13	4.96
16	HDPE 3408 ASTM D 3035 DR 9, PC 200	16.00	1.78	12.44	140	3.17	2.60
18	HDPE 3408 ASTM D 3035 DR 9, PC 200	18.00	2.00	14.00	140	2.50	1.46
20	HDPE 3408 ASTM D 3035 DR 9, PC 200	20.00	2.22	15.56	140	2.02	0.87
10	STEEL AWWA C-200, 21,000 psi Stress	10.00	0.18	9.64	120	5.28	12.00
10.75	STEEL AWWA C-200, 21,000 psi Stress	10.75	0.18	10.39	120	4.54	8.31
12	STEEL AWWA C-200, 21,000 psi Stress	12.00	0.18	11.64	120	3.62	4.79

¹Design Maximum Flow Rate (GPM) = 1,200

Prepared by: GEV
Checked by: PMP1

2.2.2 Pipeline Appurtenances

The pipeline will have over 80 high points where an air pocket could build up causing a capacity reducing restriction. Also, at high points and sharp changes in gradient there is the possibility of a vacuum being created as well as secondary pressure surges. Therefore, air release and vacuum relief valves will be installed at high points in the pipeline. Figure 2-8 shows a typical installation of the manhole and valve arrangement.

Rate-of-flow measurement and total flow measurement will be included at each pumping facility. Rate-of-flow measurement and totalizers will also be provided at the discharge to the Wisconsin River. These features will provide information needed to adjust the pump control valves on the pump discharge and will assist in the verification that the pipeline is not leaking.

Discharge to the Wisconsin River is proposed to be accomplished by diffusers discharging on the upstream side of the dam into the turbine intakes. Valving would be installed to direct the discharge to the operational turbine(s).

2.2.3 Leak Prevention and Monitoring Equipment

The pipeline is designed as a sealed system with completely sealed, welded joints. Once installed and prior to backfilling, the pipeline will be pressure and leak tested using either air or water to verify that all joints and connections are properly sealed and there are no leaks. If water is used, it will either be treated water from the project's wastewater treatment plant or water from a potable source. Water used for testing will be left in the pipe.

During operation, pipeline flow rates will be monitored at the discharge from the treatment plant, at an intermediate location near Monico and at the discharge point at the Hat Rapids Dam. Flow rate and volume will be monitored continuously at these locations. Pumping times will also be monitored so that total flows can be calculated and compared with the metered flows. This data will be telemetered back to the plant control room for continuous monitoring. This will provide for leak detection at a level comparable to the accuracy of the flow meters (i.e., $\pm 1.5\%$). If a leak is identified the system will be shut down and the leak repaired. A leak in the discharge pipeline is highly unlikely during the duration of the project. The probability of a leak, its significance if one occurs, and contingency measures are addressed in Section 4.13 Risk Assessment of the Crandon Project Mine Permit Application (Foth & Van Dyke, 1995b).

Additionally, special precautions will be taken at the locations where the pipeline will cross under Swamp Creek, the Wolf River and Mud Creek. As discussed in Section 2.3 below, the pipeline will be double encased at these locations as a further protection against leaks.

2.2.4 Closure

At the end of the Crandon Project, the wastewater treatment facilities will be decommissioned in accordance with the project's reclamation plan (Foth & Van Dyke, 1995b). Upon the termination of discharge to the Wisconsin River, closure of the pipeline system will begin. Closure will involve the removal of booster stations, if included in the system, pumping equipment, manholes and air relief structures. The pipeline itself will be left in place.

2.3 Construction Methods

The proposed pipeline will be placed in an open-cut trench and backfilled with native material for most of the route. There are areas along the proposed route where open trench construction is not feasible or practical. These include crossing County and State roads and crossing streams. At County and State road crossings, the construction method will consist of boring or jacking of casing pipe a minimum of seven feet under the roadbed and then placing the pipeline within the casing pipe. These construction techniques are common and proven methods of construction. Streams designated by the Wisconsin Department of Natural Resources (WDNR) as Outstanding Resource Waters will also be crossed by boring or jacking a steel casing in-place a minimum of three feet under the streambed and installing the pipe through the casing. The annular space between the pipeline and the steel casing for both road and stream crossings will be grouted at both ends to provide a seal. Other streams will be crossed using directional boring under the streambed. Figures 2-9 and 2-10 show a cross-section of typical road and stream crossings.

Wetland excavation will be encountered along the pipeline route. It is anticipated that over excavation will be required and that granular material will be used for the pipe bedding to stabilize the pipe from settlement. Trench dewatering will also likely be required as part of wetland excavation. Figure 2-11 shows a typical cross-section for wetland excavation and pipe bedding design.

Clearing and grubbing of existing trees and brush will be required as part of this project. Assuming a 20 foot wide corridor of disturbance during construction, it is estimated that approximately 31.3 acres of clearing and grubbing will be required along the pipeline route. This includes acreage of northern hardwoods, conifer swamp, deciduous swamp, and shrub swamp. Merchantable trees with a diameter at breast height greater than three inches will be salvaged. The remainder of the trees and shrubs will be chipped and mulched. An additional 4.2 acres of lands within the ROW consisting of driveways, parking areas, the edges of lawns or agricultural fields, etc., will also be disturbed. The restoration required for disturbed areas is to replace in kind. That is, if the trench disturbs a grassed area or wooded area, then the disturbed area will be reseeded with local native grass, or if the trench crosses a paved driveway, then the drive will be replaced with similar pavement. If trees are cut down within the ROW of USR 8, STH 55 and STH 17, they do not need to be replaced per direction of WisDOT District 7. Similar procedures would also apply to CTH S. Tree replacement along Hat Rapids Road is not anticipated since the pipeline will be along the south edge of the roadbed.

Bedrock outcroppings exist at Monico and approximately 3.5 miles west of Monico along USR 8. It is anticipated that the depth to bedrock varies in the area and that bedrock may be encountered during construction. If encountered, it may be necessary to blast the bedrock for removal.

A detailed erosion control plan for the project is included in Section 4.10 of the project's Mine Permit Application (Foth & Van Dyke, 1995b). Pipeline specific erosion control facilities will be put in place prior to construction and continuously monitored and maintained throughout construction and until permanent vegetation is established. The purpose of the facilities will be to prevent sediments from entering waterways. As a general practice, straw bales and/or silt fence will be installed along the downslope side of the trench to prevent off-site migration of sediment. The installation will occur in segments as the trench is excavated, backfilled, topsoiled using native soils and seeded immediately upon completion of the pipeline installation. Along

the majority of the pipeline, no excess soil requiring disposal will be generated. Excavated soils will be backfilled into the trench and leveled. Methods employed for soil stabilization, seeding and mulching are dependent upon the site specific characteristics encountered along the pipeline route. Methods available for use and the site conditions they apply to are included in Section 4.10 of the Mine Permit Application (Foth & Van Dyke, 1995b).

Areas with high groundwater levels where the trench may fill with water will be avoided to the extent possible in the final design phase of the project. If these areas cannot be avoided, dewatering systems will be installed based on site specific characteristics. Typically these systems will consist of a series of dewatering wells connected to a header pipe. Extracted water will be discharged to natural drainage ways. In the event that extracted water contains sediments, it will first be clarified in an on site settling basin or tank prior to discharge.

It is anticipated that over-excavation will be required in some wetland areas with granular material placed into the trench to support the pipe. These areas will be backfilled to grade using the excavated topsoil containing the various wetland vegetation parts (e.g., roots, seeds, etc.) necessary for rapid revegetation of these areas. Excess soil material as a result of pipeline construction in wetland areas will be disposed of off-site.

3 Description of Environmental Setting

The purpose of this section is to present a description of the physical, chemical, biological, cultural, and socioeconomic environment associated with the proposed Crandon Project wastewater discharge pipeline corridor. The information provided in this section will facilitate the assessment of the potential project-related environmental impacts discussed in Section 4. Further, the data gathered were incorporated into decisions made during project design and site selection to avoid, minimize and mitigate potential environmental effects.

3.1 Regional and Local Setting

The proposed 38.3 mile discharge pipeline will begin at the Crandon Project plant site and run west where it will discharge into the Wisconsin River just south of Rhinelander, as shown in Figure 1-1. The proposed route will follow existing road corridors through Nashville and Crandon townships in Forest County, and Monico, Pelican, and Crescent townships in Oneida County. The pipeline corridor passes through a generally undeveloped rural setting, with the exception of the unincorporated town of Monico.

The region in which the pipeline will be located is drained by the Fox-Wolf and Upper Wisconsin River drainage basins. The Wolf River drains the eastern one-third of the pipeline corridor, while the western two-thirds are drained by the Wisconsin River. In total nine named streams are crossed along the pipeline corridor. Venus Lake is immediately adjacent to the north side of USR 8 at Monico.

The area surrounding the proposed corridor is generally comprised of three topographical regions. In the eastern portion, from the Crandon Project site to just east of the Forest County line, the topography tends to be hummocky. This is the result of till in drumlins clustered on upland areas and pitted outwash in lowland areas which were deposited on a streamlined, subglacially molded landscape (Simpkins, et al., 1987). The central portion of the pipeline corridor contains a more subdued rolling topography. This area is comprised of outwash plains, water-worked moraines and pitted outwash. There are also large wetland floodplains associated with the streams and rivers which traverse the area. The western portion of the pipeline corridor is slightly more hummocky than the central portion. This is the result of the existence of pitted outwash and morainal material near Rhinelander.

3.2 Historical and Archaeological

Investigations of historical and archaeological resources in the vicinity of the proposed pipeline route have been completed and are discussed below. A review of traditional cultural properties as related to the pipeline route is discussed in Sections 3 and 4 of the project's EIR (Foth & Van Dyke, 1995a).

In mid-1995, Great Lakes Archaeological Research Center, Inc (GLARC) completed a reconnaissance and literature review of the proposed discharge pipeline route. Their report (Richards, 1995) is reproduced in Appendix A. Subsequently, a Phase I archaeological and geoarchaeological study for the proposed discharge pipeline route was also completed by GLARC (Richards and Kolb, 1996). An August 1996 report titled *Archaeological and Geoarchaeological Investigations of the Proposed Route of a Waste Water Discharge Corridor, Forest and Oneida Counties, Wisconsin*, describing this work was submitted by CMC to the U.S. Army Corps of Engineers, Wisconsin Department of Natural Resources, and others in September 1996.

The results of both studies indicate that no previously reported archaeological sites or cemeteries are located within or adjacent to the proposed alignment. A single archaeological site associated with the structural remains of a former dam keeper's residence was encountered at the western terminus of the proposed route. However, the former residence has been moved from its original location to a new, nearby site. Shovel test data suggests that the original archaeological context has likely been disturbed by activities associated with moving the structure and with the recent construction of the adjacent Hat Rapids Road bridge over the Wisconsin River. Geoarchaeological data suggests that the project route is almost entirely restricted to extensively disturbed locales associated with former or existing highway and utility corridor right of way. In addition, soils along the proposed route are predominantly truncated, buried beneath massive fill deposits, or hydric in character. Finally, subsurface sampling of targeted locales failed to provide evidence of buried archaeological deposits or buried soils potentially capable of harboring in situ archaeological deposits anywhere along the proposed alignment.

3.3 Transportation and Utilities

The transportation and utilities section was compiled using information gathered from WisDOT District 7, the Forest County Highway Commission, the WPSC, and the Rhinelander Telephone Company.

3.3.1 Transportation

The main pipeline and alternative routes are located along the following roadway ROW: USR 8, STH 55 and STH 17; CTH S in Forest County and CTH G in Oneida County. In Oneida County, alternative pipeline routes to the Wisconsin River are located along the local roads of River Bend, Germond, and Lassig all in the Town of Pelican and Lassig and Hat Rapids roads in the Town of Crescent. All of the roads are two-lane and hard surfaced, such as bituminous or concrete.

Annual average daily traffic (AADT) counts for 1991 as provided by the WisDOT (1994) are shown in Figure 3-1. As shown in the figure, the highest AADT (4,190 vehicles) in 1991 was recorded on USR 8, just to the east of Rhinelander. The lowest AADT (240 vehicles) in 1991 was recorded on Hat Rapids Road.

The pipeline route does not include any rail crossings.

3.3.2 Existing Utilities Along Proposed Pipeline Route

Utilities located along the proposed pipeline route include the following: electric transmission and distribution; natural gas distribution; natural gas transmission; and telephone. A discussion of each follows. As described in Section 4 there will be no conflicts and only short-term interruptions with existing utilities as a result of pipeline installation.

3.3.2.1 Wisconsin Public Service Corporation Natural Gas Distribution System

Wisconsin Public Service Corporation underground natural gas distribution lines are first encountered along the pipeline route at Monico with a gas line crossing USR 8. There is also a WPSC gas line paralleling USR 8 in Monico, located on the north side of the roadway. Gas lines also cross USR 8 at Pelican Ranch Road, River Bend Road, CTH G and STH 17. At the intersection of USR 8 and STH 17 an existing gas line parallels the roadway along the south side of USR 8 and approximately 1,000 feet along the west side of STH 17 near the ROW line.

3.3.2.2 Wisconsin Public Service Corporation Electric Transmission and Distribution Lines

Wisconsin Public Service Corporation has overhead electric transmission and distribution lines paralleling most of the pipeline route. Along STH 55, the lines are located on the east side except for approximately 2,300 feet from CTH B south where it is located on the west side. Along CTH S, the location of the line varies from side to side over the entire length of highway from STH 55 to USR 8.

Along USR 8, the lines are located on the north side of the highway from CTH S to Monico. The line is located on the north side of USR 8, west of Monico for approximately one mile west of USR 45 South, then the line crosses the roadway to the south side of USR 8. From here to STH 17, the lines typically follow the old USR 8 route crossing the roadway at several locations. When the lines follow the current USR 8 route, they are located primarily on the south side of the road.

Along STH 17, the lines are located along the east side from USR 8 south to Boyce Road. At Boyce Road, the lines change to the west side of STH 17 to Hat Rapids Road. The lines are located along the north side of Hat Rapids Road from STH 17 to the Hat Rapids Dam on the Wisconsin River.

3.3.2.3 ANR Natural Gas Transmission Pipeline

An underground ANR natural gas transmission pipeline is first encountered approximately two miles west of Monico, along USR 8. The pipeline crosses USR 8 at that location from the north to the south, then heads westerly. The pipeline crosses USR 8 back to the north side approximately six miles west of Monico, and then crosses back to the south side in less than one mile. ANR pipeline mapping does not show the USR 8 beltline. However, referring to other available mapping, it appears the gas pipeline crosses USR 8 approximately three more times in that area. The ANR gas pipeline also crosses STH 17 approximately one-half mile south of USR 8.

3.3.2.4 Rhinelander Telephone

Rhinelander Telephone has buried cable for local service along the entire proposed pipeline route except along USR 8 between CTH G and STH 17 in Oneida County. There is also fiber optic cable buried along STH 55, USR 8, and STH 17. In general, the telephone lines are located near the ROW line.

Telephone cable is first encountered along STH 55. Fiber optic and local service cables are located on the east side of STH 55. There are some individual service cables on the west side of STH 55. Along CTH S, the telephone cable is located on the east side of the roadway with service cables crossing to the west side.

Along USR 8 there are between one and five telephone cables buried along the south side of the highway from CTH S in Forest County to CTH G in Oneida County. One cable crosses USR 8 to the north along the east side of CTH G and the other cables follow CTH G to the south.

Fiber optic and regular telephone cable service crosses the roadway at the intersection of USR 8 and STH 17. Telephone service cables are located along the east side of STH 17. There are some service cables along the west side of STH 17.

At Hat Rapids Road, the telephone cable is along the north side of the roadway from STH 17 to Washatka Road. The cable then crosses to the south side of Hat Rapids Road from Washatka Road to approximately 1,000 feet east of the Wisconsin River, where it crosses back to the north side of the roadway.

3.4 Climatology, Meteorology and Air Quality

The climate of the region is continental, modified slightly by Lake Michigan, to the east, and Lake Superior, to the north. The region has moderately warm summers with prevailing westerly winds and long cold winters. The historical average annual precipitation, at North Pelican Lake, is 30.36 inches. Snow fall in the region averages between 40 and 60 inches per year. A complete description of local and regional meteorological data is presented in Section 3.4 of the Crandon Project's EIR (Foth & Van Dyke, 1995a).

3.5 Geology and Soils

The geology and soils section was compiled using information including maps, reports, surveys and inventories from the Wisconsin Geologic and Natural History Survey, United States Geologic Survey and United States Department of Agriculture - Soil Conservation Service.

3.5.1 Geology

The pipeline corridor is located in the Northern Highlands physiographic province (Paull and Paull, 1985). The corridor is underlain by igneous and metamorphic Precambrian crystalline rocks, generally of Early Proterozoic Age. The Precambrian bedrock surface is generally overlain by Pleistocene glacial deposits and thin deposits of recent alluvial sediments, lacustrine sediments and peat.

The Early Proterozoic Age crystalline rocks consist mainly of mafic, intermediate and felsic metavolcanic rocks with subordinate metasedimentary units (Greenberg and Brown, 1984). These assemblages are very similar to calcalkaline island-arc volcanic sequences. Within the metavolcanic underlying the pipeline corridor, mainly near Rhinelander, are dioritic intrusive rocks. These dioritic intrusive rocks range from granodiorites to more common quartz diorites and hornblende diorites (Greenberg and Brown, 1984). These intrusive rocks are massive to foliated and commonly intruded by granite dikes.

The overlying unconsolidated Pleistocene sediments consist of a number of stratigraphic units. These include sediments of Pre- or Early Wisconsinan and Wisconsinan Age. Each of these generally consists of at least one till member and in many cases associated undifferential ice-marginal, outwash and lacustrine deposits.

The unconsolidated Pre-Wisconsinan deposits of the Forest-Oneida County area include the undifferentiated sediments of the Marathon Formation. Pleistocene units younger than the Marathon Formation include the Pre- or Early Wisconsinan Lincoln Formation, the Wisconsinan Mapview Member of the Horicon Formation, and the Nashville Member of the Copper Falls

Formation (Michelson et al., 1984). The Mapleview Member and the Nashville Member are considered stratigraphically equivalent (Simpkins, et al., 1987). In the easternmost portion of the pipeline corridor, the Mapleview Member is truncated and overlain by the Nashville Member. The Horicon Formation is present only in the extreme eastern portions of the pipeline corridor as it was deposited during the westward advance of the Green Bay Lobe.

The Marathon Formation is discontinuous along the pipeline corridor. Little is known about its thickness and extent in northern Wisconsin (Mickelson, et al., 1984). The Marathon Formation consists of a pebbly loam to clay loam till, which is generally less than 33 feet thick, and associated outwash (Michelson et al., 1984). This unit is found directly overlying bedrock, grussified bedrock or saprolitic bedrock-weathering residuum (Mickelson et al., 1984).

Overlying the Marathon Formation are discontinuous sediments belonging to the Lincoln Formation. In the Forest-Oneida County area, these sediments are undifferentiated. The Pre- or Early Wisconsinan Lincoln Formation includes a red-brown sandy loam till and associated sand and gravel outwash (Mickelson, et al., 1984). The Lincoln Formation may directly overlie bedrock in areas.

The Mapleview Member of the Horicon Formation is found only in the eastern portion of the study area. The Mapleview Member was deposited by ice from the Green Bay Lobe in Late Wisconsinan time around 15,000 to 14,000 B.P. (Mickelson, et al., 1984). This unit consists mainly of calcareous, cobbly, pebbly, silt sand till with boulders and associated outwash deposits. According to Mickelson and others (1984), the Mapleview Member is at least partly contemporaneous with the Nashville Member of the Copper Falls Formation deposited by ice of the Langlade Lobe. In the eastern portion of the study area the Mapleview Member is truncated and overlain by the Nashville member.

The majority of the surficial sediments in the Forest-Oneida County region belong to the Nashville Member of the Copper Falls Formation. The Nashville Member consists of a non-calcareous pebbly, cobbly, sandy loam till with numerous sand lenses and associated sand and gravel outwash (Mickelson, et al., 1984). Till of the Nashville Member is generally exposed at the surface in drumlins clustered on upland areas (Simpkins, et al., 1984). The associated outwash sands and gravels filled in low areas around the uplands and exists in the form of pitted and unpitted outwash plains.

Post-Pleistocene sediments have formed or been deposited on the Nashville Member surface. These include alluvial, lacustrine, wind-blown and peat deposits.

3.5.2 Soils

The soils in the vicinity of the pipeline corridor have been mapped and described by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS). Information used to prepare this section was obtained from the draft version of the USDA-SCS-WI Section IIA Technical Guide, Forest County, dated June 13, 1994 (USDA-SCS, 1994), and USDA-SCS-WI Soil Survey of Oneida County dated February, 1993 (USDS-SCS, 1993). The Forest County document is not finalized. As such, some soil series names are new and do not match the series names on the specific soil data sheets which are contained in Appendix 3.5-30, Volume V of the project's EIR (Foth & Van Dyke, 1995a).

The general soil associations the pipeline corridor traverses are presented in Table 3-1. Their extent is portrayed on Figure 3-2. The individual soil series data sheets for Oneida County soils are presented in Appendix B. The extent of the individual series for both Forest and Oneida counties are displayed in Appendix C on reproductions of the USDA-SCS map sheets the pipeline corridor traverses.

Table 3-1

Forest-Oneida County Soil Associations

Map Unit No.	Soil Association	County	General Description
F-1	Wabeno-Goodwit-Mudlake	Forest	Moderately deep and very deep, nearly level to sloping, moderately well drained and somewhat poorly drained, silty soils on drumlins and moraines.
F-2	Wabeno-Goodwit-Padus	Forest	Moderately deep and very deep, nearly level to steep, moderately well drained and well drained, silty soils on drumlins and moraines.
F-3	Laona-Sarona-Argonne	Forest	Moderately deep and very deep, nearly level to steep, well drained and moderately well drained, loamy soils on drumlins and moraines.
F-4	Lupton-Loxley	Forest	Very deep, nearly level, very poorly drained, mucky and peaty soils on outwash plains, moraines, and glacial lake plains.
F-5	Padus-Stambaugh-Pence	Forest	Very deep, nearly level to steep, well drained, loamy and silty soils on outwash plains, stream terraces, eskers and kames.
O-1	Magnor-Greenwood-Cable	Oneida	Nearly level and gently sloping, somewhat poorly drained to very poorly drained, silty, peaty, and mucky soils on moraines.
O-2	Goodman-Monico-Cable	Oneida	Nearly level to moderately steep, well drained to very poorly drained, silty, loamy, and muck soils on drumlins and moraines.
O-3	Greenwood-Dawson-Carbondale	Oneida	Nearly level, very poorly drained, peaty and mucky soils on outwash plains and moraines.
O-4	Padus-Goodman	Oneida	Nearly level to steep, well drained and moderately well drained, loamy and silty soils on drumlins, moraines, and outwash plains, and in areas of pitted outwash.
O-5	Au Gres-Croswell-Kinross	Oneida	Nearly level and gently sloping, moderately well drained to poorly drained, sandy and mucky soils on outwash plains.

Table 3-1 (Continued)

Map Unit No.	Soil Association	County	General Description
O-6	Sayner-Vilas	Oneida	Nearly level to steep, excessively drained, sandy soils on outwash plains and in areas of pitted outwash.
O-7	Padus-Pence	Oneida	Nearly level to steep, well drained and moderately well drained, loamy soils on outwash plains and in areas of pitted outwash.
O-8	Keweenaw-Vilas	Oneida	Nearly level to steep, moderately well drained, well drained, and excessively drained, loamy and sandy soils on drumlins, water-worked moraines, and outwash plains and in areas of pitted outwash.
O-9	Goodman-Keweenaw	Oneida	Nearly level to steep, moderately well drained and well drained, silty and loamy soils on drumlins and water-worked moraines.

Note: The O-1 and F-3 Soil Associations are peripheral to the pipeline route.

Prepared by: EAS
Checked by: BDH

The pipeline corridor originates at the Crandon Project plant site. The soil association in this area is the Wabeno-Goodwit-Padus (F-2). This association is dominated by nearly level to steep, moderately well-drained and well-drained, silty solids on drumlins and moraines. This association contains mainly soils of the Wabeno, Goodwit, Goodman, Argonne, Laona, Sarona, Padus, Pence and Vilas series.

The pipeline corridor traverses north along STH 55 and CTH S through the Padus-Stambaugh-Pence Soil Association (F-5). This association is dominated by nearly level to steep, well-drained, loamy and silty soils on outwash plains, stream terraces, eskers and kames. The Padus, Pence, Stambaugh, Mudlake, Lupton, Cathro and Markey series soils dominate this association.

The pipeline corridor then turns west along USR 8 and traverses through the Wabeno-Goodwit-Mudlake Soil Association (F-1). This association is dominated by nearly level to sloping, moderately well-drained and somewhat poorly drained, silty soils on drumlins and moraines. The Wabeno-Goodwit-Mudlake Soil Association in this area contains mainly the Wabeno, Goodwit, Mudlake, Soperton, Goodman, Loxley, Beseman, and Dawson Series soils.

As the pipeline corridor traverses west on USR 8 in Forest County it passes through the Padus-Stambaugh-Pence Soil Association again and into the Lupton-Loxley Soil Association (F-4). This association is dominated by very poorly drained, mucky and peaty soils on outwash plains, moraines and glacial lake plains. The Lupton-Loxley Soil Association in this area contains mainly Lupton, Loxley, Cathro, Markey, Kinross, Flink, Croswell, and Gaastra series soils.

The pipeline corridor then crosses into Oneida County and passes through the Greenwood-Dawson-Carbondale Soil Association (O-3). Similar to the Lupton-Loxley Soil Association in adjacent Forest County, the Greenwood-Dawson-Carbondale Soil Association (O-3) is dominated by nearly level, very poorly drained peaty and mucky soils on outwash plains and moraines. This association contains mainly soils of the Carbondale, Lupton, Markey, Pence, Padus, Goodman and Worchester series.

As the pipeline travels west it crosses through a small area of the Padus-Pence Soil Association (O-7). This association is dominated by nearly level to steep, well-drained and moderately well-drained loamy soils on outwash plains and areas of pitted outwash. The Padus-Pence Soil Association contains mainly soils of the Padus, Pence, Goodman, Keweenaw and Vilas series in this area.

The pipeline corridor then traverses the Goodman-Monico-Cable Soil Association (O-2). This association is dominated by nearly level to moderately steep, well-drained to very poorly-drained, silty, loamy and mucky soils on drumlins and moraines. Goodman, Monico, Cable, Carbondale, Lupton and Markey Series soils are the main components of the Goodman-Monico-Cable Soil Association in this area.

As the pipeline nears Monico it traverses the Au Gres-Croswell-Kinross Soil Association (O-5) dominated by nearly level and gently sloping, moderately well-drained to poorly-drained sandy and mucky soils on outwash plains. This association contains mainly Croswell and Cable series soils and Udorthents along the pipeline corridor. The pipeline corridor then passes back into an area of the Goodman-Monico-Cable Association (O-2) described previously.

After passing the aforementioned association the pipeline corridor traverses through a large area of the Keweenaw-Vilas Soil Association (O-8). This association is dominated by nearly level to steep moderately well-drained, well-drained and excessively-drained, loamy and sandy soils on drumlins, water-worked moraines and outwash plains and in areas of pitted outwash. The Keweenaw-Vilas contains mainly soils of the Keweenaw, Vilas, Cable, Monico, Goodman, Pequaming and Croswell Series in this area.

The corridor then travels west along USR 8 through the Padus-Pence Soil Association (O-7) described previously and into the Padus-Goodman Association (O-4). The Padus-Goodman Association (O-4) is dominated by nearly level to steep, well-drained and moderately well-drained, loamy and silty soils on drumlins, moraines and outwash plains and in areas of pitted outwash. This association contains mainly soils of the Padus, Goodman, Keweenaw, Vilas and Alcona series. The pipeline corridor turns south off USR 8 on STH 17 to Hat Rapids Road where it turns west and runs to the Wisconsin River. Through this entire course the corridor traverses the previously described Padus-Pence (O-7) and Padus-Goodman (O-4) Associations.

3.6 Groundwater

The pipeline corridor is located in the Northern Drift - Precambrian Hydrogeologic District as defined by Zaporozec and Cotter (1985). The pipeline corridor is located in the Fox-Wolf River, and Upper Wisconsin River Hydrologic Basins (Oakes and Cotter, 1975 and Olcott, 1968). The hydrogeologic setting of the area generally consists of thick, productive water-bearing Pleistocene deposits underlain by a complex of generally non-productive Precambrian igneous and metamorphic rocks (Zaporozec and Cotter, 1985).

The pipeline corridor passes through areas underlain by metavolcanic/metasediment complexes with lesser amounts of dioritic intrusives. These rocks are locally fractured and show some secondary permeability features, but typically they yield only small amounts of water.

The glacial aquifer consists of saturated deposits of glacial till and outwash. This may include any of the stratigraphic units described in Section 3.5.1 depending on location. Typically, the till units have relatively low permeabilities and are generally not used as an aquifer except where they interfinger outwash sands and gravels or contain sand and gravel lenses. Outwash deposits are relatively extensive and capable of yielding significant quantities of water. These sand and gravel deposits serve as the primary aquifer for domestic and municipal water supplies for the region.

The depth to groundwater is quite variable within the glacial deposits. This is mainly due to the considerable topographic relief in the area. Near groundwater discharge points (e.g., lakes, streams and wetlands) the depth to groundwater is on the order of several feet. The depth to groundwater can be more than 100 feet in recharge areas and on topographic highs (Foth & Van Dyke, 1995a). However, most groundwater flow systems are relatively small and shallow with discharges to local lakes and streams. There is a general trend for groundwater to flow southerly toward the Wolf or the Upper Wisconsin River. This can vary greatly on a local scale depending on the location of surface water bodies.

The hydrologic basin divide between the Wolf and Wisconsin Rivers occurs west of Crandon and the Forest-Oneida County line along the pipeline corridor. This divide is located between the headwaters of the Wolf River and Monico Creek located in the Wisconsin River Basin.

The groundwater quality within the glacial deposits is good with dissolved solids generally ranging from 100 to 300 mg/L. However, concentrations of dissolved solids can vary greatly on a local scale and high iron and manganese contents can be a problem. Groundwater in the area is typically hard and of the calcium-magnesium bicarbonate type (Oakes and Cotter, 1975 and Olcott, 1968).

3.7 Surface Water and Aquatic Biology

Studies were conducted to provide background surface water and aquatic biology data for selected streams that are crossed by the proposed discharge pipeline route. These studies included a review of the available literature and field reconnaissance completed on May 24 and 25, 1995. The 11 sites that were studied along the proposed pipeline route and their respective water bodies are shown in Table 3-2. The specific locations of all road crossing stream observation sites are shown on Figure 3-3.

The proposed pipeline corridor passes through two surface water drainage basins: the Fox-Wolf River Basin and the Upper Wisconsin River Basin (USGS, N.D.). The majority of the lotic systems located along the pipeline route can be characterized as small warm water streams. Site reconnaissance within these streams qualitatively evaluated stream morphology, dimensions, flow rates and floodplain characteristics, as well as the aquatic vegetation and benthic substrate present.

In addition to the above, detailed aquatic threatened and endangered species surveys were conducted in 1996 on the Wisconsin River over an area from the Hat Rapids Dam, which is approximately 6 miles downstream of the City of Rhineland, Wisconsin, to Menard Island located approximately 7 to 8 miles downstream of Hat Rapids Dam. These studies focused on benthic macroinvertebrates, Odonata (dragonfly and damselfly), mussels, aquatic plants, and fish. The results of this work are discussed in Section 3.7.2.7 which addresses the Wisconsin River.

Table 3-2
Stream Crossing Observation Site Locations

Stream	Drainage Basin	Site ID	Site Location (Section, Township, Range)	Road Crossing
Gliske Creek	Fox - Wolf	GK-01	14, 35N, 12E	STH 55
Wolf River	Fox - Wolf	WR-08	29, 36N, 12E	USR 8
Mud Creek	Fox - Wolf	MD-01	29, 36N, 12E	USR 8
Monico Creek	Upper Wisconsin	MC-01	29, 36N, 11E	USR 8
Venus Creek (Venus Lake Outlet)	Upper Wisconsin	VN-01	30, 36N, 11E	USR 8
Neptune Creek	Upper Wisconsin	NC-01	27, 36N, 10E	USR 8
North Branch Pelican River	Upper Wisconsin	PR-NB	19, 36N, 9E	USR 8
George Creek (George Lake Outlet)	Upper Wisconsin	GO-01	24, 36N, 9E	USR 8
Pelican River	Upper Wisconsin	PR-02	15, 36N, 9E	USR 8
Wisconsin River	Upper Wisconsin	WR-HR	27, 36N, 8E	Hat Rapids Road
Unnamed Creek 1	Upper Wisconsin	UC-01	26, 36N, 8E	Hat Rapids Road

Source: USGS Drainage Area Data, unpublished.

Prepared by: JJA
Checked by: BDH

3.7.1 Fox-Wolf River Basin

The Fox-Wolf River Basin incorporates a drainage area of 6,330 square miles that includes portions of 17 counties (USGS, N.D.) Specific water bodies evaluated as part of this study are located in Forest County and include Gliske Creek, the Wolf River, and Mud Creek. The three sites that were studied within this basin are discussed in the following section.

3.7.1.1 Gliske Creek

Gliske Creek is a small, hard water stream that originates in Section 11 of T35N, R12E and flows a total of 3.2 miles through an undeveloped wooded watershed before entering the north end of Rice Lake, a 208-acre hard water drainage lake in Forest County (USGS, 1973). As a Class I trout stream, Gliske Creek supports a fishery including brook trout and four species of forage fish (Steuck and Andrews, 1976). Throughout its length, its slightly alkaline, clear water is banked by shrub and coniferous wetlands and shrub uplands.

Gliske Creek is crossed by STH 55 in Section 14 of T35N, R12E at station GK-01 (Figure 3-3). Here the creek has an approximate average width of four feet, an approximate average depth of

0.5 feet and a moderate flow. The creek channel at this location flows through a floodplain of sedge grass and tag alder swamp. The mixed silt/sand/gravel substrate at site GK-01 supports a moderate density of submergent and emergent aquatic macrophytes including water cress.

3.7.1.2 Wolf River

The Wolf River is a large lotic system that originates from Hiles Mill Pond in Forest County and flows a distance of approximately 223 miles (through a watershed that is ninety-five percent wooded) to Lake Poygan in Winnebago County (Foth & Van Dyke, 1995a). Major tributaries to the Wolf located upstream of the town of Langlade include Swamp Creek, Pickerel Creek, Nine-Mile Creek and the Hunting and Lily Rivers.

The reach of the Wolf River located in Forest County is characteristically medium hard, neutral pH and light brown (Andrews and Threinen, 1966). The type of fishery inhabiting the Wolf River is also a function of stream reach. In Forest County the system is dominated by warm water species including northern pike, largemouth bass, and various species of panfish and forage fish (Andrews and Threinen, 1966).

The Wolf River is crossed by USR 8 in Section 29 of T36N, R12E at station WR-08 (Figure 3-3). The river at this location has an approximate average width of 25 feet, and approximate average depth of two feet, with a moderate flow. The river channel here is lined with sedge grass and tag alders and meanders through mixed northern hardwoods and agricultural land. The predominantly silt/sand substrate that is present supports a moderate density of both submergent and emergent aquatic macrophytes as well as patchy periphyton growth.

3.7.1.3 Mud Creek

Mud Creek is a small tributary to the Wolf River that flows a total of 7.0 miles through a watershed that is primarily wooded and wild (USGS, 1965). Near the Wolf River confluence (Section 31, T36N, R12E) the water in Mud Creek is characterized as hard, slightly acidic and clear (Steuck and Andrews, 1976). Further upstream in Section 24 of T36N, R11E the creek is characteristically soft, dark brown, and acidic (Steuck and Andrews, 1976). Mud Creek is known to support a fishery dominated by warm water forage species.

Mud Creek crosses USR 8 in Section 29 of T36N, R12E at station MD-01 (Figure 3-3). Here the stream flows at a moderate rate through a sedge meadow floodplain that extends to a conifer swamp. The river at this location averages approximately 15 feet wide and one foot deep, is banked by sedge grass, and contains a sand/silt substrate bottom with minor constituents of gravel.

3.7.2 Upper Wisconsin River Basin

The Upper Wisconsin River Basin incorporates a drainage area of 2,760 square miles that includes portions of eight counties (USGS, N.D.). Specific water bodies included in the wastewater discharge study area are located in Oneida County and include the Wisconsin, Pelican and North Branch Pelican Rivers as well as Carlson, Cuenin, George, Neptune, Venus and Monico Creeks and one small unnamed creek. The eight sites studied within these systems are described in the following section.

3.7.2.1 Monico Creek

Monico Creek is a small medium hard water stream that originates in Atkins Lake, a soft water drainage lake, and flows a total of 16.2 miles through a predominantly wooded watershed to its confluence with the Pelican River in Section 34 of T36N, R10E (USGS, 1965). Monico Creek contains slightly acid medium brown water that supports a warm water fishery (Andrews and Threinen, 1966).

Monico Creek is crossed by USR 8 in Section 29 of T36N, R11E at station MC-01 (Figure 3-3). Here the stream has an approximate average width of 10-15 feet and a depth that varies from approximately one to four feet. The banks within this reach of Monico Creek, which flows through a shrub sedge meadow, are steep and edged with sedge. The silt/sand substrate observed at site MC-01 supports a low density population of submergent aquatic macrophytes.

3.7.2.2 Venus Creek (Venus Lake Outlet)

Venus Creek is a small soft water tributary to Monico Creek that originates from Venus Lake, a 64.6 acre drainage lake located in Section 30 of T36N, R11E (USGS, 1965). The stream flows a total of 0.7 miles through a wooded and undeveloped watershed and contains water that is classified as highly alkaline and medium brown in color (Andrews and Threinen, 1966). Only forage fish have been recorded to inhabit Venus Creek, although it is likely that portions of the warm water fisheries present in Venus Lake and Monico Creek frequent the system.

Venus Creek is crossed by USR 8 in Section 30 of T36N, R11E at station VN-01 near the town of Monico, Wisconsin (Figure 3-3). This portion of the creek is the immediate outlet of Venus Lake where the stream flows through a sedge/shrub swamp wetland. The silt/sand substrate within this reach supports moderate densities of both submergent and emergent aquatic macrophytes. Ditriral organic substrate is also present.

3.7.2.3 Neptune Creek

Neptune Creek is a small, very soft water stream that originates in Neptune Lake, a drainage lake, and flows a total of 5.0 miles before entering the Pelican River to which it is a tributary (USGS, 1965). Neptune Creek contains acidic, medium brown stained water that flows through a watershed that is entirely wooded and wild (Andrews and Threinen, 1966). Warm water forage fish primarily inhabit Neptune Creek (Andrews and Threinen, 1966).

Neptune Creek is crossed by USR 8 in Section 27 of T36N, R10E at station NC-01 (Figure 3-3). The stream at this location has an approximate average width of 15 feet, an average depth of two to three feet, and a moderate flow rate. The creek channel near the USR 8 crossing has steep and undercut banks and flows through a shrub/sedge/conifer swamp. Bottom substrate at the site is dominated by sand, gravel and wood. A small riffle section exists approximately 100 feet downstream of the USR 8 crossing.

3.7.2.4 North Branch of the Pelican River

The North Branch of the Pelican River is a soft water stream that flows from its origins in the Moen chain of lakes to its confluence with the main branch of the Pelican River in Section 19 of T36N, R9E (USGS, 1982, 1965). The stream contains slightly acidic medium brown water that

flows through a wooded and agricultural watershed and supports a warm water fishery (Andrews and Threinen, 1966). Five Wisconsin special concern freshwater mussel species are known to exist in the North Branch of the Pelican River (WDNR, 1995).

The North Branch of the Pelican River is crossed by USR 8 in Section 19 of T36N, R9E at station PR-NB (Figure 3-3). At this location the river flows at a slow rate through a lowland hardwood/scrub swamp floodplain. The predominantly silt/sand substrate at the site supports a low population of rooted aquatic macrophytes.

3.7.2.5 George Creek (George Lake Outlet)

George Creek is a small, soft water stream that originates from Lake Thompson and flows 3.2 miles through George Lake, a 434.5 acre soft water drainage lake, before reaching its confluence with the Pelican River in Section 24 of T36N R9E (USGS, 1982). The creek contains acidic light brown water that flows through a watershed that is 99 percent wooded and undeveloped (Andrews and Threinen, 1966). Like the Pelican River to which it is a tributary, George Creek supports a warm water fishery including northern pike, muskellunge, walleye, bass, panfish and various species of minnows.

George Creek is crossed by USR 8 in Section 24 of T36, R9E at station GC-01 (Figure 3-3). The stream at this location averages approximately 25 feet wide and one to three feet deep as it flows at a low to moderate rate through a floodplain of sedge meadow, shrub brush and wetland. Evidence of beaver activity is apparent upstream of the USR 8 crossing. River substrate in this reach is predominantly of silt, sand and organic composition.

3.7.2.6 Pelican River

The Pelican River is a soft, slightly acid medium brown water stream that flows a total of 28.9 miles through a wooded watershed from its origin in Pelican Lake to the point where it joins the Wisconsin River to which it is a tributary (Andrews and Threinen, 1966). Primary named tributaries to the Pelican River are the Monico, Beaver, Cuenin and Slaughterhouse Creeks, as well as the George Lake outlet and the North Branch of the Pelican River (USGS, 1982, 1965). The Pelican River contains a warm water fishery that, according to the Wisconsin DNR, includes two "relatively uncommon fish species not on the special concern list" (WDNR, 1995). In addition to this, five state special concern freshwater mussel species are known to exist in the North Branch of the Pelican River. According to WDNR correspondence dated June 13, 1995 (Appendix D), these special concern mussel species likely also inhabit the Pelican River itself.

The Pelican River crosses USR 8 in Section 15 of T36N, R9E at station PR-02 (Figure 3-3). Here the river flows at a moderate rate through a deep (>3 feet) wide channel, with an approximate average width of 200 feet, that meanders through a northern lowland hardwood/sedge floodplain. Silt, sand and wood substrate support a low density of rooted aquatic macrophytes in this portion of the river, which has steep and undercut banks.

3.7.2.7 Wisconsin River

The Wisconsin River is a large warm water stream that originates from Lac Vieux Desert in Vilas County. A tributary to the Mississippi, the river flows nearly the entire length of the state

of Wisconsin through developed and undeveloped land before reaching its confluent at the Crawford County line approximately two miles south of Prairie du Chien.

Downstream of Rhinelander, the river ecology has been altered by industrial and municipal discharge (Andrews and Threinen, 1966). Here the characteristically soft, alkaline water supports warm water fish species including: northern pike, largemouth bass, bullheads, and various panfish and forage fish species (Andrews and Threinen, 1966).

The Wisconsin River is crossed by Hat Rapids Road in Section 26 of T36N, R8E (Figure 3-3) at station WR-HR. Approximately 0.1 mile upstream of this crossing, the river flow is impounded by a dam, creating the Hat Rapids flowage. Downstream of the dam, the river contains water of moderate velocity that flows over a mixed boulder/cobble/gravel substrate that supports a low to moderate density of submergent aquatic macrophytes and patches of periphyton. At this location the river is approximately 300 feet wide, and has steep banks that rise to stands of northern hardwood forest and agricultural land.

Detailed aquatic surveys focusing on threatened, endangered, and special concern species were conducted between June and August 1996 on the Wisconsin River from Hat Rapids Dam to Menard Island located approximately 7 to 8 miles downstream. These studies focus on benthic macroinvertebrates, Odonata (dragonfly and damselfly), mussels, aquatic plants, and fish. A detailed report describing field methods, results of the work, and the ecological significance of the findings is contained in Appendix F.

3.7.2.8 Unnamed Creeks

An unnamed creek is crossed by Hat Rapids Road in Section 26 of T36N, R8E at station UC-01 (Figure 3-3). USGS topographic maps of the area indicate that this stream is a small tributary to the Wisconsin River that flows a total distance of approximately 0.4 miles through a low relief floodplain (USGS, 1982). The reach of stream immediately adjacent to Hat Rapids Road flows at a slow to moderate rate through a conifer swamp. Here the stream's steep and undercut banks are edged with sedge grass and alders, and are shaded by a conifer canopy. Average stream width and depth at this location were estimated at eight feet and one foot, respectively. The silt/sand substrate here supports a low density of submergent rooted aquatic macrophytes.

3.8 Terrestrial Biology

This section provides a description of the terrestrial habitats present along the proposed pipeline route. The majority of the proposed route is confined to areas of prior disturbance within the highway ROW. As such, the focus is on the area within and immediately adjacent to the highway ROW coincident with the pipeline route.

The ROW corridors are variable in width and degree of disturbance. High quality native plant communities are not common in the ROW due to earlier road construction activities, routine maintenance (i.e., mowing or cutting approximately once per year) and stresses imposed by highway stormwater runoff and application of salt for deicing. These areas have typically been planted with non-native grasses or other cover crops to control erosion, and contain a high proportion of exotic weedy species. Due to the disturbed nature of the vegetative communities within the ROW and activity associated with the highways within these corridors, these areas provide only limited wildlife habitat.

The areas on either side of the prior disturbed areas within the ROW more closely resemble the natural habitats and vegetative communities common in the region. The pipeline corridor traverses an area ecologically similar to the study area described in Section 3.9 of the Crandon Project's EIR (Foth & Van Dyke, 1995a). The area is generally characterized by northern hardwood forests and wetlands with minor amounts of agriculture and residential land uses. As evidenced by a visual survey of the corridor, no old-growth northern hardwood forest exists along

the proposed route. All of the forests have been cut at least once in the past. The younger forests are typified by nearly monotypical stands of quaking aspen while the older forests are generally composed of maple, birch and basswood. Conifer swamp is the most common wetland habitat type followed by shrub swamp, deciduous forested wetlands, emergent marsh/sedge meadow, and bog. Agriculture is limited along the proposed corridor, generally consisting of pasture lands and is primarily confined to areas along STH 55, CTH S and Hat Rapids Road.

These habitats would be expected to support a composition of wildlife similar to that described for the study area surrounding the proposed mine site (Foth & Van Dyke, 1995a). Unlike much of the study area surrounding the proposed mine site, however, the existing roadway and ROW have truncated or traversed these habitat types which may favor those species preferring edge habitat. Although a number of state endangered, threatened and special concern species of terrestrial wildlife have been recorded in the area (Foth & Van Dyke, 1995a), it is unlikely, for the reasons identified above, that these species frequent the habitats provided in or immediately adjacent to the existing ROW.

Habitat characterization of the proposed pipeline route and alternatives was completed in the field by Foth & Van Dyke. Field forms with specific observations are reproduced in Appendix E. For the purpose of this survey the route was divided into seven segments. An overview of the habitats existing along and adjacent to each of these segments is given below.

3.8.1 STH 55

The STH 55 segment is just over two miles long. The prior disturbed ROW ranges from twenty to thirty feet from the edge of pavement. Outside of the disturbed ROW the terrestrial community is generally comprised of northern hardwoods with a small amount of conifer swamp. There are also residential, commercial and some agricultural lands outside of the ROW.

3.8.2 CTH S

The CTH S segment is approximately two miles long. The disturbed ROW is 20 feet from the edge of pavement. Much like STH 55, the area outside of the ROW along this segment is dominated by northern hardwoods. Some residential and agricultural land also exists.

3.8.3 Snowmobile Trail

This segment begins on the snowmobile trail on the north side of USR 8 at CTH S and runs for just less than 10 miles to CTH V. The trail is located within the old USR 8 roadbed. Wisconsin Public Service Corporation has overhead powerlines which run parallel to the north side of the trail. This powerline corridor is regularly maintained, creating a 20 to 40-foot area of disturbance between the trail and the native vegetation. The area north of the powerline corridor is generally comprised of northern hardwoods with a lesser amount of deciduous, conifer, and shrub swamps. There are also approximately twenty areas where one or more single family dwellings, or commercial buildings are located to the north of the ROW.

USR 8 parallels the snowmobile trail to the south. In areas where the trail is within the WisDOT maintained ROW there is little to no woody vegetation. Areas which are not cleared by the WisDOT are generally comprised of young northern hardwoods in upland areas and lowland hardwoods or shrub swamp in lowlands.

3.8.4 USR 8 from CTH V to River Bend Road

The USR 8 segment starts at CTH V and runs west for just less than 10 miles to River Bend Road. This segment starts in the unincorporated town of Monico where the commercial and residential dwellings are close to the road. Because of this the WisDOT cleared ROW is between eight and twenty feet from the edge of pavement.

After leaving the Town of Monico the cleared corridor associated with the highway extends out to an average width of 25 feet from the edge of pavement. Along this portion of the segment northern hardwoods and conifer swamps dominate the landscape outside the disturbed ROW. There is also a lesser component of shrub swamp, shallow marsh, sedge meadow, and bog.

3.8.5 Rhinelander Beltline (USR 8 from River Bend Road to STH 17)

This segment runs along the Rhinelander Beltline west from River Bend Road for approximately five miles to STH 17. The width of the WisDOT prior disturbed ROW ranges from 10 to 100 feet from the edge of pavement. The landscape outside of the disturbed ROW is dominated by northern hardwoods in the uplands with a smaller element of shrub, conifer, and deciduous swamps in the lowland.

3.8.6 STH 17

STH 17 runs south from USR 8 for just over two miles to Hat Rapids Road. The width of the previously disturbed ROW ranges from 10 to 15 feet from the edge of pavement. The landscape outside of the disturbed portion of the ROW is dominated by northern hardwoods in the uplands and conifer swamp with a lesser amount of shrub swamp in the lowlands. Several small areas of residential/agricultural land uses also exist.

3.8.7 Hat Rapids Road

Hat Rapids Road runs west from STH 17 just less than two miles to the Wisconsin River. The width of the previously disturbed ROW ranges from five to ten feet from the edge of the pavement. Outside of the disturbed ROW, this corridor is dominated by residential/agricultural land and coniferous swamp. There is also a lesser element of northern hardwoods and shrub swamp.

3.9 Wetlands

The wetland characteristics along the proposed pipeline corridor were extrapolated from the Department of Natural Resources Wisconsin Wetland Inventory maps (1983, 1984a, 1984b, 1984c, 1984d, 1985). This work was verified in the field by Foth & Van Dyke in the spring of 1995.

Table 3-3 presents a breakdown of the type and acreage of wetlands that occur within 500 feet of the pipeline route. The data presented in Table 3-3 includes only those wetlands existing on the sides of the roadway in which the pipeline will be routed. The specific wetland types mapped by the WDNR, as shown in Figure 3-4, were grouped in Table 3-3 into four general categories; shallow marsh, shrub swamp, deciduous swamp, and coniferous swamp. These wetlands are

generally associated with the many named, and unnamed waterways traversed by the road corridor.

Table 3-3

Wetland Acreage Within 500 Feet of Roadway Centerlines

	Side of Road	Shallow Marsh	Shrub Swamp	Deciduous Swamp	Coniferous Swamp	Total Area
STH 55	West	0	0	1.4	6.5	7.9
CTH S	West	0	0	0	0	0
Snowmobile Trail	North	0	23.03	15.00	79.25	117.28
USR 8 CTH V to River Bend Road	South	2.67	89.24	66.5	55.43	213.84
Rhinelanders Beltline	North	0	0	50.24	3.5	53.74
STH 17	West	0	2.5	0	6.5	9
Hat Rapids Road	South	0	0	0	22	22

Source: WDNR Wetland Inventory Maps.

Prepared by: BDH
Checked by: RFS

3.10 Ambient Noise/Vibration

Existing noise levels in the vicinity of the Crandon Project site are described in Section 3.11 of the Crandon Project's EIR (Foth & Van Dyke, 1995a). Existing ambient noise levels were measured along STH 55 in an area representing residential backyards adjacent to this roadway. Based on these measurements, the day/night noise level at this location was determined to range from 45 to 55 dBA (Foth & Van Dyke, 1995a). This range should be typical for similar areas along the majority of the proposed pipeline route.

3.11 Land Use and Zoning

In general, the land use adjacent to the ROW along the pipeline corridor is mostly undeveloped and wooded. There are, however, small concentrations of residential, commercial, and agricultural land. The most concentrated of these is the unincorporated town of Monico, in Oneida County. Here, there are several homes, a bar, and a church, all of which are relatively close to USR 8.

There is no industrial development along the route. There is, however, a public snowmobile trail which crosses USR 8 at Vieth Road, west of Monico. Types of development along each of the road segments are presented in Table 3-4.

In addition to the environmental reviews completed by WDNR and the U.S. Army Corps of Engineers, WisDOT will have approval authority over the construction and operation of the pipeline within the ROW of STH 55, USR 8, and STH 17. Forest County will have approval authority over the construction and operation of the pipeline within the ROW of CTH S. The Town of Crescent will have approval authority over the construction and operation of the pipeline within the ROW of Hat Rapids Road. See Wis. Stats § 86.16(1). In addition, Oneida County will have zoning authority over the portion of the pipeline located within county shorelands that lie outside of the Hat Rapids Road ROW. CMC is presently discussing the necessary approvals with the WisDOT, Forest County, Oneida County, and the Town of Crescent.

Table 3-4
Types of Development Along the Proposed Pipeline Corridor

Development Type	STH 55	CTH S	USR 8 (CTH S to Monico)	USR 8 (Monico)	USR 8 (Monico to River Bend Road)	Rhinelanders Beltline/STH 17/Hat Rapids Road
Private Residence	9	10	5	3	31	34
Commercial Property	—	—	3	1	—	—
Churches	—	—	1	—	—	—
Wayside	—	—	—	—	1	—

Prepared by: GMS
Checked by: RFS

3.12 Aesthetics

The discharge pipeline will primarily follow existing road corridor from the proposed Crandon Project site access road to the Wisconsin River. The view when traveling this corridor is typical of northern Wisconsin: generally rural, mostly forested, with many lakes and streams. The aesthetic view along the pipeline corridor road segments are described in the following paragraphs.

STH 55 is comprised of mostly agricultural and commercial land, and has little topographic variation. Because of the relatively flat topography and the agricultural openings the view of the area tends to be fixed on the commercial buildings and residences.

Continuing on CTH S there is a distinct rise in topography and the northern hardwood forest restricts the view. Traveling on, the topography flattens and there is some agricultural and commercial land. Because of this, the view is widened as USR 8 is approached.

USR 8 is the longest segment of the corridor. The first several miles are dominated by rolling hills with northern hardwoods in the uplands, and swamp conifers in the lowlands. After this, the topography tends to flatten causing the swamp conifer element to become more prevalent in the scenery. The entire corridor is in a forested rural setting with occasional commercial buildings, agricultural land or residences. For the most part, the roadside vegetation constricts the view which causes the road ahead to be the main focal point. The largest concentration of residential and commercial property along USR 8 is the unincorporated town of Monico. Here the view is dominated by residential and commercial buildings, and ultimately Venus Lake which is immediately adjacent to north side of the highway.

STH 17 is generally flat with some residential and agricultural areas. For the most part however, the view along the road is limited by vegetation.

Hat Rapids Road is a typical secondary road characterized by a small surface area and vegetation crowding the road. There are some private residences and agriculture which open the view but, for the most part the view is dominated by northern hardwood in the upland areas and swamp conifer in the low lying areas, which create a more closed range of vision.

3.13 Socioeconomics

The following evaluation provides a brief description of socioeconomic conditions for the area in which the pipeline corridor is to be located. For more information on socioeconomic conditions within Forest, Langlade, and Oneida counties including the area potentially affected by the mine project and pipeline corridor, refer to Section 3.14 of the Crandon Project's EIR (Foth & Van Dyke, 1995a).

In summary, the area is characterized as sparsely populated, with a significant amount of seasonal and secondary dwelling units. Much of the land is undeveloped. The economic base within Forest and Oneida counties is less industrialized and the residents are less affluent than Wisconsin as a whole. Per capita personal income is lower than statewide per capita income and the unemployment rates have historically been higher. Services are the most significant employment sector for both Forest and Oneida counties.

Housing stock in both Forest and Oneida counties includes a significant number of seasonal housing units. Most residential parcels have limited public services such as sewer and water.

4 Environmental Impacts

4.1 No-Action Alternative

The no action alternative would result in no discharge of wastewater from the Crandon Project facility. In addition to wastewaters which will be generated due to operations at the mine, mill, and ancillary facilities, two sources of wastewater will be generated at the facility which are independent of facility operations: groundwater inflow to the mine and net precipitation on the surface facilities. Groundwater inflow to the mine will occur continuously, and will have to be pumped from the mine as mine drainage in order to operate the mine. Net precipitation occurs because the annual amount of precipitation at the site exceeds the annual amount of evaporation from the site over a typical year. The volume of water generated by the net precipitation must be discharged.

The mill process is a net consumer of water, so some of the mine drainage and net precipitation can be reused as makeup water for the mill process water system. However, even during a drought year, the total amount of mine drainage due to groundwater inflow is likely to exceed the demand for makeup water in the mine process water system. Under all conditions, dewatering the mine will result in a surplus of water which must be discharged from the site. Therefore, the no discharge alternative is not technically feasible.

4.2 Preferred Alternative

As described in Section 2, the preferred alternative involves a pipeline from the Crandon Project site primarily along highway ROW to the Wisconsin River at the Hat Rapids Dam. The total length of the preferred route is approximately 38.3 miles.

4.2.1 Historical and Archaeological

A report prepared by GLARC (Richards and Kolb, 1996) detailing the results of archaeological and geoarchaeological investigations conducted along the proposed pipeline route was submitted to the U.S. Army Corps of Engineers and the Wisconsin Department of Natural Resources in September 1996. Investigations included literature and archival review of existing cultural resource related data, compilation of a geoarchaeological assessment based on existing geomorphic and land use history data, and field investigations that combined conventional pedestrian survey with geoarchaeological sampling of subsurface deposits.

Results indicate that: 1) approximately 30 percent of the route has been subjected to previous archaeological survey and determined to be devoid of archaeological sites; 2) 19 percent of the route is coincident with massively cut highway right-of-way in which no archaeological deposits are preserved; 3) 34 percent of the route traverses areas of hydric soil or locales characterized as unlikely to harbor archaeological deposits; 4) approximately 17 percent of the route is coincident with areas potentially capable of harboring archaeological deposits. However, archaeological and geoarchaeological testing within these areas indicates that no subsurface archaeological deposits are present within the proposed pipeline right-of-way. A single early 20th Century Euroamerican habitation site was identified near Hat Rapids Dam at the western terminus of the route. Shovel test data indicates that site deposits are disturbed and thinly scattered; consequently, the site is unlikely to be eligible for listing on the National Register of Historic Places. Planned construction has been designed to avoid any archaeological deposits associated with this site. Thus, project development should have no affect on the Hat Rapids Dam site.

Results of the historical and archaeological investigations indicate that no archaeological sites are present within the planned pipeline route. In the unlikely event that unidentified archaeological sites are encountered during construction, procedures outlined on page 23 of Appendix A will be implemented.

4.2.2 Transportation and Utilities

The proposed construction activities will not result in any long-term traffic/transportation impacts. County, state, and federal highway crossings will be directionally bored. The only impacts may involve temporary reduced speed limits and minor delays while equipment is moved into place. Short-term road closings may be required when construction activities trench across local roads. These closings will likely be for a time period of less than one day.

Other utilities (e.g., phone lines, natural gas, etc.) may be crossed resulting in potential temporary short-term (i.e., a matter of hours) losses of service within limited local areas. These impacts are expected to be very minor and result only in temporary inconveniences.

4.2.3 Air Quality

The proposed pipeline will not generate air emissions when operating and is not subject to regulation under Wisconsin air quality rules.

Particulate emissions may be present during the construction of the pipeline from cutting trees and earth moving, however, these impacts will be temporary and are expected to be negligible.

4.2.4 Geology and Soils

The proposed pipeline will be installed in an open-cut trench and backfilled with native material for the majority of the route. Areas of bedrock may be encountered that would require blasting. At county and state roads and stream crossings, the installation will require boring or jacking under these features. The pipeline will be buried to a minimum depth of 4.5 feet (seven feet under roadways).

Impacts to geology and soils will be temporary in nature. The cut trenches will be backfilled as soon as the pipe is installed and tested and the ground surface will be returned to existing grades. The proper use of sediment and erosion control will minimize the potential for impacts. Blasting, if needed, will be accomplished by qualified blasting contractors in accordance with applicable state codes.

The potential exists to encounter previously contaminated soils during the trenching process. A Phase I Environmental Assessment will be conducted prior to construction to specifically identify these areas, if they exist. Encountered contaminated soils will be disposed of, or treated in accordance with applicable Wisconsin Statutes.

4.2.5 Groundwater

The pipeline will be designed and constructed so that leakage will be less than that which is allowable according to the *Standards and Specifications for Sewer and Water Construction in Wisconsin* Fifth Edition - March 1, 1988 (PWIP, 1988). Leak testing will be performed in accordance with the standards and specifications applicable to the pipe material used. Since the pipeline will be sealed, it will not act as a sink or source of waters to encountered groundwater. In addition, the system will be monitored for potential leaks. Given the nominal diameter of the pipeline (i.e., 14 or 16 inches), it will not act as a barrier to groundwater flow.

4.2.6 Surface Water and Aquatic Biology

4.2.6.1 Wisconsin River

4.2.6.1.1 Flow and Water Quality

During the operational phase of the mine, wastewater will be generated from the inflow of groundwater to the mine, mine backfilling activities, contact stormwater and excess process water, as allowed under current regulations. This water will be treated in a wastewater treatment plant built according to a facilities design approved by the WDNR and using a lime/sulfide treatment

process that has been tested to demonstrate its effectiveness. The discharge from the treatment system will be routed via the proposed pipeline into the inlet piping of the turbines at the WPSC Hat Rapids Dam. This will provide instantaneous mixing and diffusion of the treated wastewater with the river water. Comprehensive controls will be in place at the treatment plant so that water is released through the pipeline only if it meets WDNR standards. In addition, the treated water must meet toxicity tests so that it will not harm the most sensitive organism in the river at the point of discharge. Complete information about the wastewater treatment plant and the treatment process can be found in the project's Preliminary Engineering Report for Wastewater Treatment Facilities which was forwarded to the WDNR, U.S. Army Corps of Engineers and others in September, 1995.

Maximum discharge to the Wisconsin River is estimated at 2.67 cubic feet per second (cfs) or 1,200 gpm. This represents approximately 0.9 percent of the river's $Q_{7,10}$ flow rate at Rhinelander, which is upstream of the proposed discharge point. The $Q_{7,10}$ flow rate is a historic low-flow rate defined as the seven day, ten year low flow level.

The treated water discharged to the Wisconsin River will be required to meet stringent effluent limits set by WDNR. These effluent limits are established to protect public health and welfare, protect the present and prospective use of all surface waters for public and private water supplies, and protect the propagation of fish and aquatic life and wild and domestic animal life (Wisconsin Administrative Code Chapters NR 105, NR 106 and NR 207). These water quality standards were developed to protect the most sensitive species and often go beyond protecting the organisms occurring naturally in a stream.

The quality of treatment plant effluent has been estimated based on treatability studies conducted by Foth & Van Dyke. This quality was then compared against the expected WDNR effluent limits for the Wisconsin River. The results, shown in Table 4-1, show that the discharge to the Wisconsin River is expected to be within the estimated WDNR limits for all substances. Therefore, no adverse water quality impacts to the river are anticipated.

During the operation of the mine the discharge of treated wastewater will be monitored to assure there will be no adverse impacts to the Wisconsin River. The discharge will be monitored for chemical specific parameters and whole effluent toxicity (e.g., both chronic and acute bioassays).

In calculating the expected WDNR effluent limits for the Wisconsin River, a conservative margin of safety consisting of one-third of the river's assimilative capacity was used. The expected daily, weekly and monthly effluent limits were calculated. The daily maximum effluent limits were conservatively calculated assuming 25 percent of the Wisconsin River $Q_{7,10}$ flow for dilution. Table 4-1 lists only the most stringent of the three limits for each substance. The effluent limits were calculated based on the peak effluent discharge of 2.67 cfs (1,200 gpm), and based on the following Wisconsin River flow rates at Rhinelander:

$Q_{7,10}$ (historic 7-day, 10-year low-flow rate)	304 cfs (136,400 gpm)
$Q_{7,2}$ (recent 7-day, 2-year low-flow rate)	443 cfs (198,800 gpm)
Average flow	752 cfs (337,500 gpm)

The discharge will contain a negligible concentration (10 mg/L or less) of BOD_5 . The quantity of BOD_5 will be very small in comparison to other point source and non-point source discharges in

this area of the river and will have no significant adverse impact on the assimilative capacity of the Wisconsin River.

Table 4-1
Estimated Treated Wastewater Quality

Substance	Units	Estimated Effluent Quality ¹	Estimated Water Quality Based Effluent Limits ²
Total Antimony	mg/L	< 0.05	734
Total Arsenic	mg/L	< 0.004	4.70
Total Beryllium	mg/L	< 0.005	0.019
Total Recoverable Cadmium	mg/L	0.0015	0.0048
Total Recoverable Chromium (+3)	mg/L	< 0.005	0.787
Total Recoverable Chromium (+6)	mg/L	< 0.005	0.358
Total Recoverable Copper	mg/L	0.010	0.090
Cyanide, Free	mg/L	0.09	0.190
Total Recoverable Lead	mg/L	< 0.003	0.080
Total Mercury	mg/L	N.D. ³	0.000014
Total Recoverable Nickel	mg/L	< 0.02	0.755
Total Recoverable Selenium (+4)	mg/L	0.09	0.270
Total Recoverable Silver	mg/L	< 0.001	0.015
Total Thallium	mg/L	< 0.010	1.03
Total Recoverable Zinc	mg/L	0.02	0.563
pH	S.U.	8.0	6-9

¹ Average When Treating Mine Drainage Water.

² Limits based on maximum flow rate of 1,200 gpm.

³ N.D. = Not Detectable. The accepted detection level for mercury is 0.0002 mg/L. Crandon Project effluent when tested is estimated to show a no detect. In computing the monthly average mercury content in the effluent a value of zero is used for no detect test results.

Prepared by: HJA
Checked by: RJC1

4.2.6.1.2 Aquatic Biology

As discussed in Section 4.2.6.1.1 above, treated wastewater will be routed via a pipeline from the mine site and discharged to the Wisconsin River. The pipeline will terminate at the Hat Rapids Dam with discharge into the turbines. This will result in complete and immediate mixing of the treated wastewater with the river. Because the pipeline will discharge directly to the turbine structure, there will be no impact to aquatic or terrestrial communities associated with the shoreline of the river.

Field studies conducted by CMC during 1996, and review of existing agency and other studies were used to identify any sensitive aquatic organisms within the study area that may have special status. In total, 15 species, which are currently listed on the Wisconsin Natural Heritage Inventory, were either observed during the 1996 study or have been published in historical records. These species include: one endangered and seven special concern dragonflies; two endangered, one threatened and three special concern mussels; and one threatened fish.

The WDNR currently regulates discharges to water bodies to protect the most sensitive organisms. Chapter NR 106 of the Wisconsin Administrative Code, Procedures for Calculating Water Quality Based Effluent Limitations for Toxic and Organoleptic Substances Discharged to Surface Waters, states that, "water quality based effluent limitations for toxic and organoleptic substances are needed to assure attainment and maintenance of surface water quality standards as established in accordance with s. 144.025 (2) (b), Stats., and as set forth in chs. NR 102 to 105." In addition Chapter NR 207, Water Quality Antidegradation, ". . . sets procedures applicable to proposed new or increased discharges to outstanding resource waters, exceptional resource waters, Great lakes waters, [and] fish and aquatic life waters . . .". Knowing this, the wastewater discharge to the Wisconsin River will be regulated to protect the most sensitive species or community. Therefore, it is anticipated that there will be no impact to aquatic communities within the Wisconsin River as a result of the proposed project.

4.2.6.2 Interbasin Transfer

The discharge of treated wastewater from the project site to the Wisconsin River will be an interbasin transfer of water from the Wolf River to the Wisconsin River. On a larger scale, this is a transfer from the Great Lakes Basin to the Mississippi River Basin. Wisconsin Administrative Code NR 142 regulates such transfers. Transfers greater than 100,000 but less than two million gallons per day require registration per NR 142.03. Transfers greater than two million gallons per day require approval per NR 142.06.

Under peak design flow conditions the Crandon Project discharge pipeline will be capable of transporting 1,200 gpm of water from the Crandon Project plant site to the Wisconsin River. This is equivalent to approximately 1.7 million gallons per day or 2.67 cfs. On an average annual basis the flow rate will be approximately 460 gpm, which is equivalent to 1.02 cfs or 0.66 million gallons per day. Based on these volumes, the transfer of water from the Great Lakes system to the Mississippi River system will require registration with the WDNR. As discussed below, interbasin transfer of water from the Wolf River basin to the Wisconsin River basin will be insignificant when compared to current flow conditions in the two systems.

The Wolf River's closest USGS monitoring station downstream from the project site is station 04074950 at Langlade, WI. The Wolf River, at this station, has a mean annual flow of 455 cfs (USGS, 1993a). The lowest recorded flow from 1966 through 1993 was 326 cfs (USGS, 1993a). Under annual average pipeline flow conditions a total of 1.02 cfs will be transferred from the Wolf River basin to the Wisconsin River basin. This will be equivalent to 0.2 percent of Wolf River mean average annual flow or 0.3 percent of the lowest recorded flow from 1966 to 1993. This change in flow will be negligible to the Wolf River System. Even under peak discharge flow rates (2.67 cfs) which will not occur on an annual average basis, only a 0.6 percent and 0.8 percent change in Wolf River flow at Langlade would occur for the mean annual flow and low flow conditions, respectively. Perceptible impacts on the biological communities in the Wolf River and adjacent terrestrial ecosystems are not anticipated as a result of interbasin transfers. A more detailed discussion of the potential impacts of mine dewatering relating to tributaries to the Wolf River system near the project site is contained in Section 4 of the project's EIR.

To evaluate the transfer of water to the Wisconsin River, three points on the river have been studied. The change in flow at the discharge point will be less than 0.9 percent under low flow conditions. The Wisconsin River at Rhinelander has a $Q_{7,10}$ of 304 cfs. With a peak flow of 2.67 cfs from the discharge, the change in water flow will be insignificant even under low flow conditions. Under normal or peak flow conditions for the Wisconsin River, the percent change in flow will be considerable less.

The use of the gaging data from Rhinelander is conservative. Additional tributaries, such as the Pelican River, enter the Wisconsin River below Rhinelander, yet above the proposed discharge location at the Hat Rapids Dam. In actuality, the change in flow attributable to the discharge is less than the estimated 0.9 percent discussed above.

The impact of the Wisconsin River under peak flow conditions is best discussed at the nearest down stream gaging station. The USGS monitoring station 05395000 at Merrill, WI is the closest down stream USGS monitoring station with significant historical data. The Wisconsin River at this station has a mean annual flow of 2,664 cfs, with the lowest recorded flow from 1903 through 1993 being 1,348 cfs (USGS, 1993b). Under average pipeline discharge rates an increase

in base flow of 1.02 cfs will equal less than a 0.08 percent increase during the lowest recorded year. For an average year this is equivalent to a 0.04 percent increase. This increase in flow will not be measurable at the Merrill, WI gaging station. The 100 year flood flow at Merrill is 30,500 cfs (USGS, 1992). Under average pipeline discharge rates the Crandon Project discharge will change the 100 year flood flow by 0.003 percent. Therefore, the change in flow will not measurably impact flood flow. The increase in flow on the Wisconsin River from the Crandon Project will therefore be negligible.

On a more regional scope, changes in flow to the entire Wisconsin River Drainage basin become even more insignificant. The Wisconsin river flow at the USGS monitoring station 05407000 at Muscoda, WI has a mean annual flow of 8,746 cfs, with the lowest recorded flow from 1914 through 1993 being 4,145 cfs (USGS, 1993b). The 100 year flood flow is 74,200 cfs (USGS, 1992). The Muscoda, WI station is near the confluence of the Wisconsin River and the Mississippi River. For either the mean annual flow or the low flow condition, the changes in flow due to the Crandon Project discharge will be negligible. Under either the mean annual or the low flow conditions the increase in flow will be less than 0.02 percent. Under 100 year flood and mean annual discharge conditions the change in flow on the Wisconsin River due to a Crandon Project discharge would be less than 0.002 percent. The change in flow will not measurably impact flood flow or low flow conditions. Because of this, perceptible impacts on the biological communities in the Wisconsin River, Mississippi River or the adjacent terrestrial ecosystems are not anticipated.

4.2.6.3 Other Surface Waters

As shown in Table 3-2, the proposed pipeline route crosses nine named streams and one significant unnamed stream. A number of additional small, unnamed, intermittent streams and drainage ways will also be crossed. No disturbance is proposed for any stream with a defined bed and banks. The pipeline will be routed under such streams through directional boring. With the use of proper sediment and erosion control measures, no impacts to these streams are anticipated. Intermittent drainages without a defined bed and bank will be traversed with an open cut trench which will be backfilled as soon as the pipe is installed. These areas will be seeded and restored as soon as construction is complete. Potential downstream impacts from soil losses will be prevented through the use of proper sediment and erosion controls during construction.

4.2.7 Terrestrial Biology

Because the pipeline is proposed to be located within or directly adjacent to previously disturbed highway ROW and along an existing maintained snowmobile trail, the overall impacts to the terrestrial ecosystem are expected to be minimal and temporary in nature.

With the exception of approximately 35.5 acres along the 38.3 mile corridor, the pipeline will be installed entirely within previously disturbed ROW. The estimated project disturbance by habitat type within undisturbed ROW is listed in Table 4-2. The temporary loss of habitat listed in Table 4-2 will be the result of clearing narrow strips ranging from approximately 5 to 20 feet in width adjacent to existing disturbed ROW. Temporary habitat loss will result from approximately 31.3 acres of clearing and grubbing in northern hardwoods, shrub swamp, conifer swamp, and deciduous swamp; and 4.2 acres of surface disturbance in bog, shallow marsh, residential, commercial and industrial areas. The type of disturbance depicted in Table 4-2 will

have little impact on the habitats in which it occurs, since areas will be reclaimed immediately after pipeline installation. It is anticipated that the disturbed areas will return to their original state as part of natural vegetation succession within one to two years.

Although endangered, threatened and rare species are known to occur in the region through which the proposed pipeline will pass, their use of the marginal disturbed habitat in which the pipeline will be installed is likely minimal. No impacts to these species are anticipated.

Table 4-2

Estimated Temporary Habitat Disturbance Within Undisturbed ROW

Estimated Temporary Disturbance Within Undisturbed ROW by Habitat Type in Acres										
Corridor Segment	Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Shallow Marsh	Residential	Commercial	Agricultural	Total
STH 55 ¹	0.84	0	0.36	0	0	0	0.21	0.06	0.03	1.5
CTH S ¹	2.42	0	0	0	0	0	0.09	0	0.54	3.05
Snowmobile Trail ²	0	3.8	0.1	0	0	0	0	0	0	3.9
USR 8 from CTH V to River Bend Road ¹	5.12	1.44	4.78	0.12	0.12	0.28	1.35	0.71	0	13.92
Rhinelanders Beltline ¹	0.87	0	0.3	0.48	0	0	0.18	0	0	1.83
STH 17 ¹	9.27	1.21	0.15	0	0	0	0	0.15	0.48	11.26
Hat Rapids Road ³	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	18.52	6.45	5.69	0.60	0.12	0.28	1.83	0.92	1.05	35.46

¹ Area of temporary disturbance based on placing the pipeline 25 feet from the edge of pavement, a 20 foot wide area of disturbance, and widths of maintained ROW from Appendix E.

² Area of temporary disturbance based on placing the pipeline in the center of the existing snowmobile trail. Disturbance of natural vegetation is minimal due to the regular maintenance by WPSC to the north, and WisDOT to the south of the trail.

³ Area of temporary disturbance based on placing the pipeline on the edge of pavement.

Prepared by: RFS
Checked by: JWS

4.2.8 Wetlands

The location of wetlands along the proposed pipeline route is shown on Figure 3-4. Table 4-3 presents a summary of the wetland impacts based on a review of the Wisconsin Wetland Inventory Maps (WDNR, 1983, 1984a, 1984b, 1984c, 1984d, 1985) for the corridor as well as on a visual survey conducted along the route. Although wetland conditions may persist in a degraded state within the previously disturbed ROW, the quantities reported in Table 4-3 represent the area of estimated temporary wetland disturbance by the portion of the approximate 20 foot wide construction corridor located outside of the disturbed ROW. The Wisconsin Wetland Inventory Maps indicate a total temporary disturbance of approximately 8.1 acres of wetland, while the field verification indicates that the total temporary disturbance may approach approximately 13.1 acres.

As with the impacts to terrestrial biology, wetland impacts will be minimal and temporary due to the pipeline's location within or directly adjacent to previously disturbed highway ROW and along the existing snowmobile trail. Trenching through these wetlands should have minimal long-term impact and the wetland functions currently provided by these wetlands should recover within one to two years.

Table 4-3

Estimated Temporary Wetland Disturbance Within Undisturbed ROW

Estimated Temporary Wetland Disturbance Within Undisturbed ROW by Habitat Type in Acres										
Corridor Segment	Shrub Swamp		Conifer Swamp		Deciduous Swamp		Bog		Shallow Marsh	
	Field Data	WWIM	Field Data	WWIM	Field Data	WWIM	Field Data	WWIM	Field Data	WWIM
STH 55 ¹	0	0	0.36	0.22	0	0	0	0	0	0
CTH S ¹	0	0	0	0	0	0	0	0	0	0
Snowmobile Trail ²	3.8	1.1	0.1	1.76	0	0	0	0	0	0
USR 8 from CTH V to River Bend Road ¹	1.44	2.83	4.78	1.43	0.12	0.16	0.12	0	0.28	0.2
Rhineland Beltline ¹	0	0	0.3	0.23	0.48	0	0	0	0	0
STH 17 ¹	1.21	0	0.15	0	0	0.2	0	0	0	0
Hat Rapids Road ³	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Totals	6.45	3.93	5.69	3.64	0.60	0.36	0.12	0	0.28	0.2

¹ Area of temporary disturbance based on placing the pipeline 25 feet from the edge of pavement, a 20 foot wide area of disturbance, and widths of maintained ROW from Appendix E.

² Area of temporary disturbance based on placing the pipeline in the center of the existing snowmobile trail. Disturbance of natural vegetation is minimal due to the regular maintenance by WPSC to the north, and WisDOT to the south of the trail.

³ Area of temporary disturbance based on placing the pipeline on the edge of pavement.

WWIM = Wisconsin Wetland Inventory Maps.

Prepared by: RFS

Checked by: JWS

4.2.9 Ambient Noise/Vibration

The only potential impacts from noise and vibration would be temporary and would occur during pipeline installation. The majority of this route traverses rural and wooded areas with very few residences. Some areas may experience increased noise for short periods of time during the actual construction, similar to a highway improvement or repair project. The equipment used and the proposed construction methods should not result in any noticeable vibration impacts. Since any booster stations located along the pipeline route will be constructed below ground, noise will not be heard by the public.

4.2.10 Land Use and Zoning

Permanent land use impacts are not anticipated as a result of the project. The entire pipeline will be installed within existing ROW and restored to pre-existing conditions once construction is complete. The portion of the pipeline to be installed in the snowmobile trail will not be installed during the winter and will be resurfaced with a material compatible with snowmobile use. As discussed in Section 3.11, CMC is presently seeking approvals to construct and operate the pipeline from WisDOT, Forest County, Oneida County, and the Town of Crescent.

4.2.11 Aesthetics

For the majority of the pipeline route, potential visual impacts will be minimal and will only occur during the construction phase of the project. Pipeline installation will create an approximate 20 foot wide disturbance corridor in which most of the vegetation will be cleared and the soil will be temporarily exposed. With the exception of the portion of the route along the snowmobile trail, this will be visible from the roadways paralleling the route. This visual effect will be lessened immediately upon completion of construction when the disturbed corridor is restored to existing grades and revegetated. Within one to two years it will not be possible to distinguish this corridor from the adjacent maintained highway ROW.

As currently proposed, the proposed action will also involve at least one pump station and a number of air relief valves along the route. These features will be installed below grade. The only visible portions of these features will be similar to standard manhole covers and a short vent pipe. These are not expected to have any aesthetic impact.

4.2.12 Socioeconomics

Socioeconomic impacts to the six communities encompassing the proposed route of the pipeline corridor are outlined as follows. Impacts to population, employment, housing, government structure and public finance, public facilities and services, and human, health, and social services were considered. Only construction related impacts are addressed. Pipeline operations and maintenance manpower is included in the operations manpower estimates presented in Section 4.2.13 of the project's EIR. Therefore impacts associated with pipeline operation and maintenance are also addressed in that section of the EIR.

4.2.12.1 Population

While construction of the pipeline will temporarily increase employment, no long-term impacts to population are anticipated. The general contractor and related subcontractors responsible for

pipeline construction will hire employees from within and outside the project area. It is anticipated that these employees will not change their place of residence as a result of the project, therefore no population impacts are anticipated.

4.2.12.2 Employment

Temporary employment for construction related workers will be generated during the installation of the pipeline and related restoration. Employment is estimated to be approximately 60 full time equivalent jobs over a six month period. The impact of pipeline construction employment is negligible in the overall context of total employment within Forest, Langlade and Oneida counties which is estimated to be over 22,000 people (Foth & Van Dyke, 1995a).

4.2.12.3 Housing

Pipeline construction is not anticipated to affect permanent housing because of its temporary duration. During the construction phase, some workers may use temporary housing during the work week as opposed to commuting from their permanent homes. This will impact the demand for motels, hotels, and other temporary lodging units by 48 total units during the six month construction period. This assumes 80 percent of the construction workers are from outside the local study area and do not commute. This impact is considered to be negligible in relation to the over 2,500 lodging units in the Forest, Langlade and Oneida county area (Foth & Van Dyke, 1995a).

4.2.12.4 Government Structure and Public Finance

Pipeline construction is anticipated to have a negligible impact on revenue generation or expenditures for the six affected communities. Since the pipeline will not generate tax revenue nor require public expenditure by any taxing authority it is not anticipated to create government structure or public finance impacts.

4.2.12.5 Public Facilities and Services

Because pipeline construction will not generate population impacts, and the pipeline will not be available for public facility use, it is anticipated that no significant public facility or service impacts will be generated.

4.2.12.6 Human, Health and Social Services

Because pipeline construction will not generate population impacts, it is not anticipated to generate human, health and social service impacts.

4.3 Alternatives to the Proposed Action

Potential alternatives to the proposed action include no-action, discharge to another surface water body, or the use of seepage cells. As described in Section 4.1, the no action alternative is not feasible. A discussion of the remaining alternatives and the reasons they are no longer being considered is provided in the following paragraphs.

4.3.1 Other Surface Water Discharge Locations

Other surface water bodies were considered in this alternatives analysis. The 1980's Crandon Project permitting documents identified Swamp Creek as the primary location for the discharge of treated project effluent. Other surface waters that were considered include: Little Sand Lake, Lake Metonga, Oconto River, Peshtigo River, Neptune Creek, Haymeadow Creek, Monico Creek, and Pelican River. A discussion of each of these locations follows.

4.3.1.1 Discharge to Swamp Creek

As with the preferred alternative, discharge to Swamp Creek would involve the construction of a pipeline from the plant site to the discharge point on Swamp Creek, a distance of approximately 6.1 miles. A feasible corridor would traverse mostly forested land, requiring the clearing of trees. As presented in the project's 1986 WDNR Final Environmental Impact Statement (FEIS) (WDNR, 1986), this pipeline would result in a temporary impact to approximately seven acres of wetland, 25 acres of northern hardwoods, and five acres of open agricultural lands. Impacts to both wetlands and the terrestrial ecosystem are similar in quantity to the preferred alternative and also would be temporary in nature. However, unlike the preferred alternative which follows existing disturbed ROW, much of this corridor would cross relatively undisturbed lands.

Unlike the preferred alternative, Swamp Creek is tributary to the Wolf River which has been designated as an Outstanding Water Resource (ORW). An advanced treatment process would be required to comply with the Wolf River's ORW status. In addition, the advanced treatment process would be costly and would result in the generation and disposal of additional solids removed during treatment. This alternative was dropped from further consideration for these reasons.

4.3.1.2 Little Sand Lake

Little Sand Lake is less than one mile south of the project site and thus offers a potentially convenient surface water body for discharge. The lake discharges to a small stream, Creek 12-9, which is a part of the Wolf River watershed. The effluent limits for a Little Sand Lake discharge would require advanced treatment of the water similar to that described for Swamp Creek. Thus, Little Sand Lake was eliminated as a potential receiving water for the full discharge from the Crandon Project wastewater treatment process for the same reasons a discharge to Swamp Creek was eliminated.

4.3.1.3 Lake Metonga

Lake Metonga falls into the same category as Little Sand Lake. Located approximately 2½ miles north, it is convenient to the site, but it also discharges to the Wolf River watershed. Given this fact, Lake Metonga was eliminated as a potential receiving water for the full discharge from the Crandon Project wastewater treatment process.

4.3.1.4 Oconto River, Peshtigo River, Neptune Creek, Haymeadow Creek, Monico Creek and Pelican River

As compared to the Wisconsin River, these streams are closer to the project site. The Oconto and Peshtigo Rivers are in the Great Lakes watershed. Neptune, Haymeadow, and Monico Creeks as well as the Pelican River are within the Mississippi River watershed. Each of these waters have very low background flow levels. The Pelican River, which is the largest of the four streams, has a ten year, seven day low flow ($Q_{7,10}$) of 10 cfs. None of these water bodies have sufficient volume to support the proposed discharge.

4.3.2 Seepage Cells

Seepage cells were considered as a discharge alternative. Preliminary evaluations of five seepage cell sites in the vicinity of the plant site were completed. Two of the sites had preliminary indications that the soil types would be suitable for construction of seepage cells. For one of these locations, extensive excavation of upper soil strata would be required to expose underlying soils which possess the potential hydraulic characteristics required for a seepage cell system. It is uncertain whether seepage cells constructed on these two sites would have sufficient capacity to dispose of the treated effluent at the maximum expected rate of 1,200 gpm. If seepage cells were pursued, the area needed to accept the volume of generated wastewater would be between 80 to 150 acres or more. This would result in considerably greater impacts to the terrestrial ecosystem than the preferred alternative (i.e., the temporary disturbance of less than 36 acres for the preferred alternative compared to 80 to 150 acres or more for a seepage system). The likely lack of an area of sufficient size and the greater amount of surface disturbance associated with the seepage cell concept were the primary reasons this alternative was not pursued further.

4.3.3 Comparison of Discharge Alternatives

Potentially feasible alternatives include discharge to other water bodies and discharge to seepage cells. Of the surface water bodies evaluated, only Swamp Creek, Little Sand Lake and Lake Metonga have sufficient water volumes to possibly support the discharge. It would be impractical to discharge to the lakes due to the difficulty in achieving adequate mixing. Impacts associated with Swamp Creek are similar to those associated with the preferred alternative, however, unlike the preferred alternative much of the pipeline corridor to Swamp Creek traverses undisturbed habitat. Further, Swamp Creek and both lakes are tributary to the Wolf River, an Outstanding Resource Water. When compared to the preferred alternative, seepage cells would result in a two to three times greater impact to the terrestrial ecosystem.

4.3.4 Pipeline Routing Alternative

An analysis of alternative routes for a discharge pipeline to the Wisconsin River was conducted. As a result of this analysis, three potential primary routes were identified: 1) WisDOT highway ROW, 2) Wisconsin Central Limited Railroad property and 3) the ANR pipeline corridor. After a preliminary investigation, the ANR corridor was eliminated from consideration because ANR does not own the land through which its pipeline traverses and therefore could not provide land for CMC use.

A description of the Wisconsin Central Limited Railroad and USR 8 routes is presented below. As shown on Figure 3-5, both routes commence at the plant site, and terminate at a common

point at the intersection of USR 8 and River Bend Road, southeast of Rhinelander. From this point, three supplemental routes were evaluated to bring the pipeline from USR 8 to Hat Rapids Road. Hat Rapids Road crosses the Wisconsin River just a few hundred feet downstream of Hat Rapids Dam. These three supplemental routes are common to both the railroad route and the highway route alternatives.

4.3.4.1 Wisconsin Central Limited Railroad Route

As shown on Figure 3-5, the Wisconsin Central Limited Railroad route begins at the Crandon Project site and follows the proposed railroad spur route toward the northeast to the mainline track approximately one-quarter mile south of Keith's Siding Road. The pipeline would then follow the mainline track north through Crandon, to a point approximately 1½ miles directly west of Argonne; then follow the railroad as it turns west entering Oneida County north of Atkins Lake and approximately 3¾ miles east of USR 45. The route continues west along the railroad through Starks to Lake Shore Drive. At this point the pipeline route leaves the railroad ROW and follows Lake Shore Drive south to CTH C, then southerly and southeast along CTH C to River Bend Road, then southwest on River Bend Road to USR 8.

4.3.4.2 USR 8 Route

The highway route begins (Figure 3-5) at the Crandon Project site, follows the proposed site access road toward the northwest to STH 55 approximately one-half mile south of Airport Road, then north on STH 55 to CTH S, then north on CTH S to USR 8, then west on USR 8 to River Bend Road, southeast of Rhinelander.

4.3.4.3 Alternative Routes from USR 8 to Wisconsin River

Route 1

Route 1 begins (Figure 3-5) at the intersection of USR 8 and River Bend Road and follows River Bend Road south and west to CTH G. The route continues on CTH G northwest to Lassig Road, then south and west on Lassig Road to Hat Rapids Road at the intersection with STH 17, then west on Hat Rapids Road to the Wisconsin River where the pipeline discharges at the Hat Rapids Dam.

Route 2

Route 2 begins (Figure 3-5) at the intersection of USR 8 and River Bend Road, then follows USR 8 west to CTH G, then follows south on CTH G to Lassig Road, then south and west on Lassig Road to Hat Rapids Road at the intersection with STH 17, and finally west on Hat Rapids Road to the Wisconsin River where the pipeline discharges at the Hat Rapids Dam.

Route 3

Route 3 begins (Figure 3-5) at the intersection of USR 8 and River Bend Road and follows USR 8 west to STH 17, then south on STH 17 to Hat Rapids Road, and west on Hat Rapids Road to the Wisconsin River where the pipeline discharges at the Hat Rapids Dam.

4.3.4.4 Evaluation Criteria

Available collected information was reviewed and a visual site survey of each potential pipeline route was performed to verify and determine existing conditions. Based on available information

and the visual site survey, data were generated about each potential pipeline route. These data are summarized in Table 4-4. The information is grouped by a series of evaluation criteria. The criteria relate to permitting requirements and/or to specific conditions relating to project impacts. A brief explanation of the evaluation criteria is presented below:

- **Route distances** are broken down by jurisdiction (e.g., railroad, U.S. and state highway, etc.) to provide an indication of what agency/owner has jurisdiction for each segment of the potential route, and for the length of the segment. A total distance for the two main routes and each of the three alternative routes is provided.
- **Construction/maintenance access** provides a general assessment of the ease of access. Ease of access will affect project impacts and project costs.
- **Wetlands** in the vicinity of the routes were identified based on a review of Wisconsin Wetland Inventory Maps, USGS maps and aerial photography.
- **Rock outcrops and forested areas** in the vicinity of the pipeline corridor were identified through a review of available maps, soil surveys, aerial photographs and observations made during the visual site survey.
- The **number of waterway crossings** were identified through a review of available maps and the visual site survey.
- The **number of road crossings** were identified from available maps and the site survey.
- **Potential utility conflicts and residential areas** were subjective determinations based on increased population or development density as compared to other areas of the potential routes. In both cases, increased care would be required during construction.
- **Distance in national forest** identifies the miles each respective route passes through the Nicolet National Forest.

Table 4-4

Summary of Data Collected for Potential Pipeline Routes

Evaluation Criteria	Railroad Route	Highway Route	Alternative Route 1	Alternative Route 2	Alternative Route 3
Distance - railroads	32.3 miles	0 miles	0 miles	0 miles	0 miles
Distance - U.S. & State highways	2.8 miles	21.7 miles	0 miles	3.0 miles	8.6 miles
Distance - County Trunk highways	2.7 miles	3.4 miles	.5 miles	2.0 miles	0 miles
Distance - Local roads	1.4 miles	0 miles	7.9 miles	6.2 miles	1.6 miles
Distance - Mine Site access road	3.0 miles	3.0 miles	0 miles	0 miles	0 miles
Total distance	42.2 miles	28.1 miles	8.4 miles	11.2 miles	10.2 miles
Construction/Maintenance access	Poor along railroad	Good along entire road	Good to fair	Good to fair	Good along entire road
Wetlands	13.2 miles	5.8 miles	0.8 miles	0.8 miles	1.2 miles
Rock outcrop	None observed	None observed	None observed	None observed	None observed
Forested Areas (Requires clearing)	18.8 miles	2.9 miles	3.2 miles	2.8 miles	1.4 miles
Number of waterway crossings	16	8	5	4	2
Number of Road Crossings	20	19	7	7	5
Potential utility conflicts	Crandon & CTH "C"	Monico	Minimal	Minimal	Minimal
Residential Areas	Crandon & CTH "C" & Lake Shore	Minimal	Minimal	Minimal	Minimal
Distance in Nicolet National Forest	3.4 miles	0 miles	0 miles	0 miles	0 miles

Prepared by: GEV
Checked by: JWS

4.3.4.5 Primary Route Alternative Evaluation

Table 4-4 shows that the distance of the railroad route is 14.1 miles longer than the highway route (42.2 miles versus 28.1 miles). Construction and maintenance access is better along the highway route than the railroad route. Wetland areas along the highway route are almost 2.3 times less (5.8 miles versus 13.2 miles for the railroad route). There are more than twice as many waterway crossings (16 versus 8) for the railroad. Additionally, more utilities would be encountered along the railroad route. The comparison shows that the highway route is the best choice for the discharge pipeline corridor from the plant site access road to USR 8 at River Bend Road.

4.3.4.6 Alternative Route Evaluation

To complete a comparative evaluation of alternative Routes 1, 2 and 3, a list of the major items from Table 4-4 was prepared with the three alternative routes ranked against each other for each item. The ranked alternative routes were assigned values of 1, 2 or 3, where 1 is the most desirable, and 3 is the least desirable. Each evaluation item was weighted equally during the comparison. The comparison is illustrated in Table 4-5.

Table 4-5
Alternative Route Evaluation

	Alternate Route 1	Alternate Route 2	Alternate Route 3
Shortest Distance	1	3	2
WisDOT ROW	3	2	1
Best Construction/Maintenance Access	2	2	1
Least Amount of Wetlands	1	1	2
Least Amount of Site Clearing	3	2	1
Least Number of Waterway Crossings	3	2	1
Least Number of Road Crossings	2	2	1
Least Potential for Utility/Residential Area Conflict	<u>1</u>	<u>1</u>	<u>1</u>
Total Score	16	15	10

Prepared by: GEV
Checked by: JWS

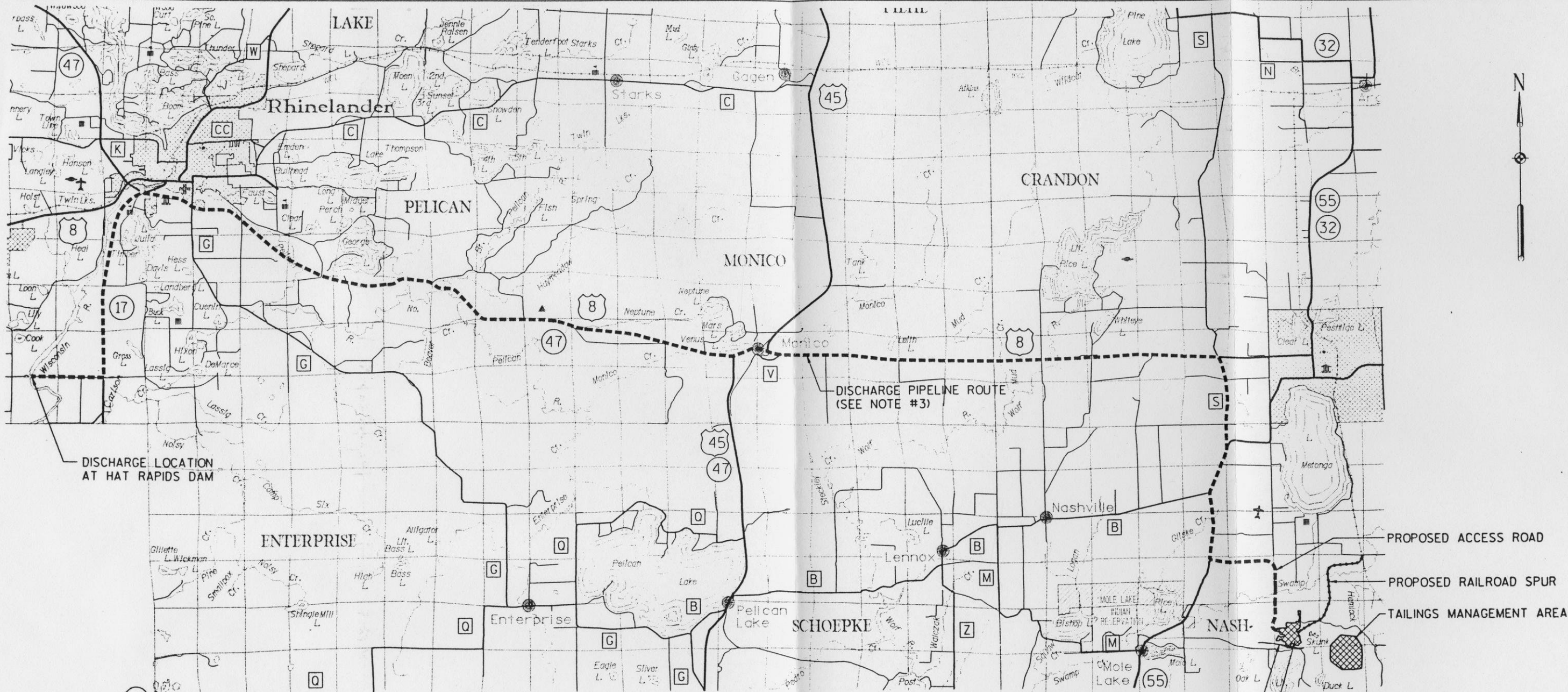
The above scoring system indicates that, based on the evaluation criteria listed in Table 4-4, Alternative Route 3 is the best alternative route for the discharge pipeline corridor from USR 8 to the Hat Rapids Dam.

5 References

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FIGURES FOR EIR SUPPLEMENT: WISCONSIN RIVER WASTEWATER DISCHARGE PIPELINE



LEGEND

- LAKES
- U.S. OR STATE HWY
- COUNTY TRUNK ROAD
- TOWN ROAD
- SECTION LINE
- CORPORATE LIMITS
- U.S. HWY NO.
- STATE HWY NO.
- COUNTY HIGHWAY LETTER
- PROPOSED WASTEWATER PIPELINE

NOTES:

- BASE MAP DERIVED FROM COUNTY MAPS PREPARED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION.
- ORE BODY OUTLINE IS REPRESENTATIVE OF THE SUBCROP AT THE BASE OF THE OVERBURDEN.
- THE DISCHARGE PIPELINE ROUTE BEGINS AT THE CRANDON PROJECT SITE, FOLLOWS THE PROPOSED PLANT SITE ACCESS ROAD TOWARD THE NORTHWEST TO STATE TRUNK HIGHWAY (STH) 55, APPROXIMATELY 1/2 MILE SOUTH OF AIRPORT ROAD, THEN NORTH ON STH 55 TO COUNTY TRUNK HIGHWAY (CTH) S, THEN NORTH ON CTH S TO U.S. ROUTE (USR) 8, THEN WEST ON USR 8 TO STH 17. FROM THE INTERSECTION OF USR 8 AND STH 17, THE ROUTE FOLLOWS STH 17 SOUTH TO HAT RAPIDS ROAD AND THEN WEST ON HAT RAPIDS ROAD TO THE HAT RAPIDS DAM.

TYPICAL REPRESENTATION:
REFINEMENTS MAY BE MADE
PRIOR TO CONSTRUCTION.

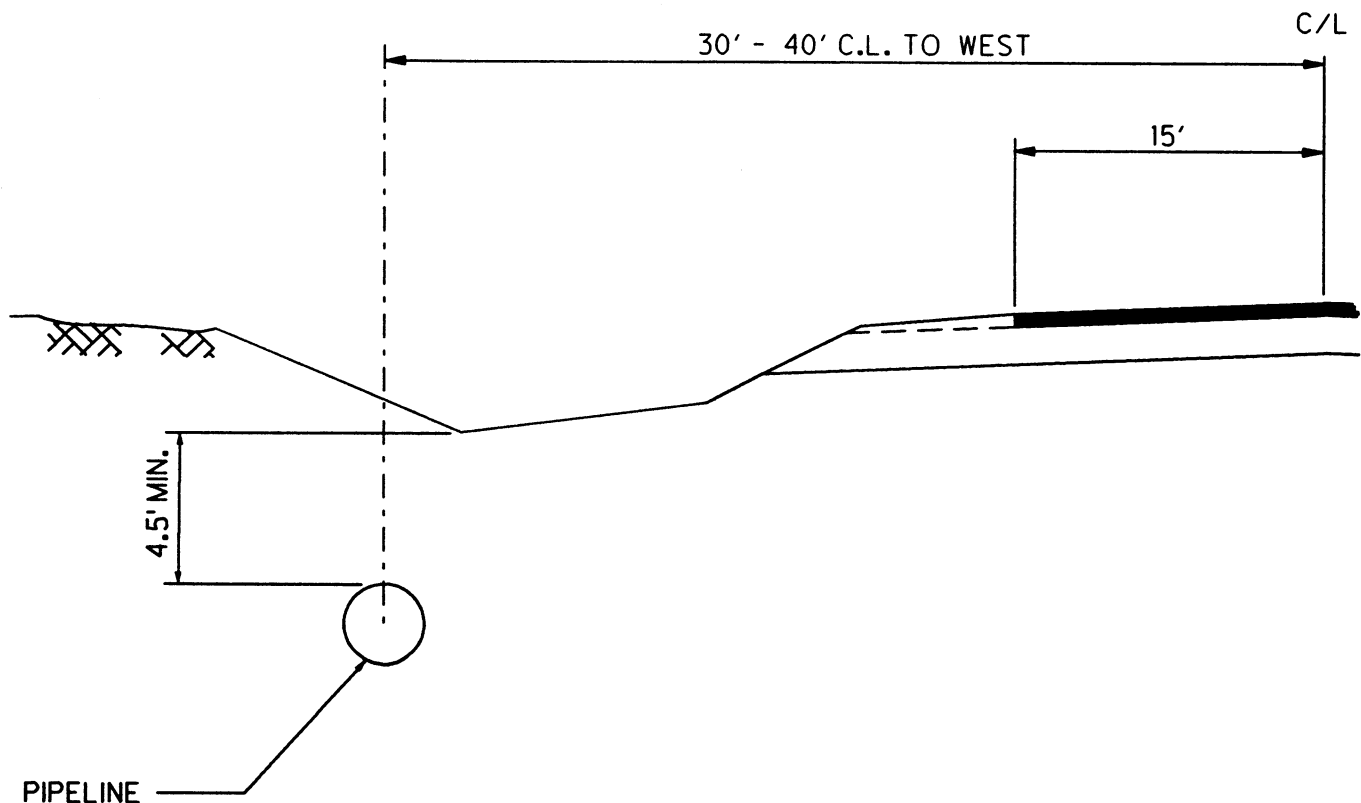
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CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		JBH	DATE: AUG.'95
APPROVED BY:		PAE	DATE: AUG.'95

Crandon Mining Company

FIGURE 1-1
PROPOSED PIPELINE ROUTE FOR
WISCONSIN RIVER DISCHARGE

Scale: 0 6000' 12,000' Date: MAY, 1995

Prepared By: Foth & Van Dyke By: GAM



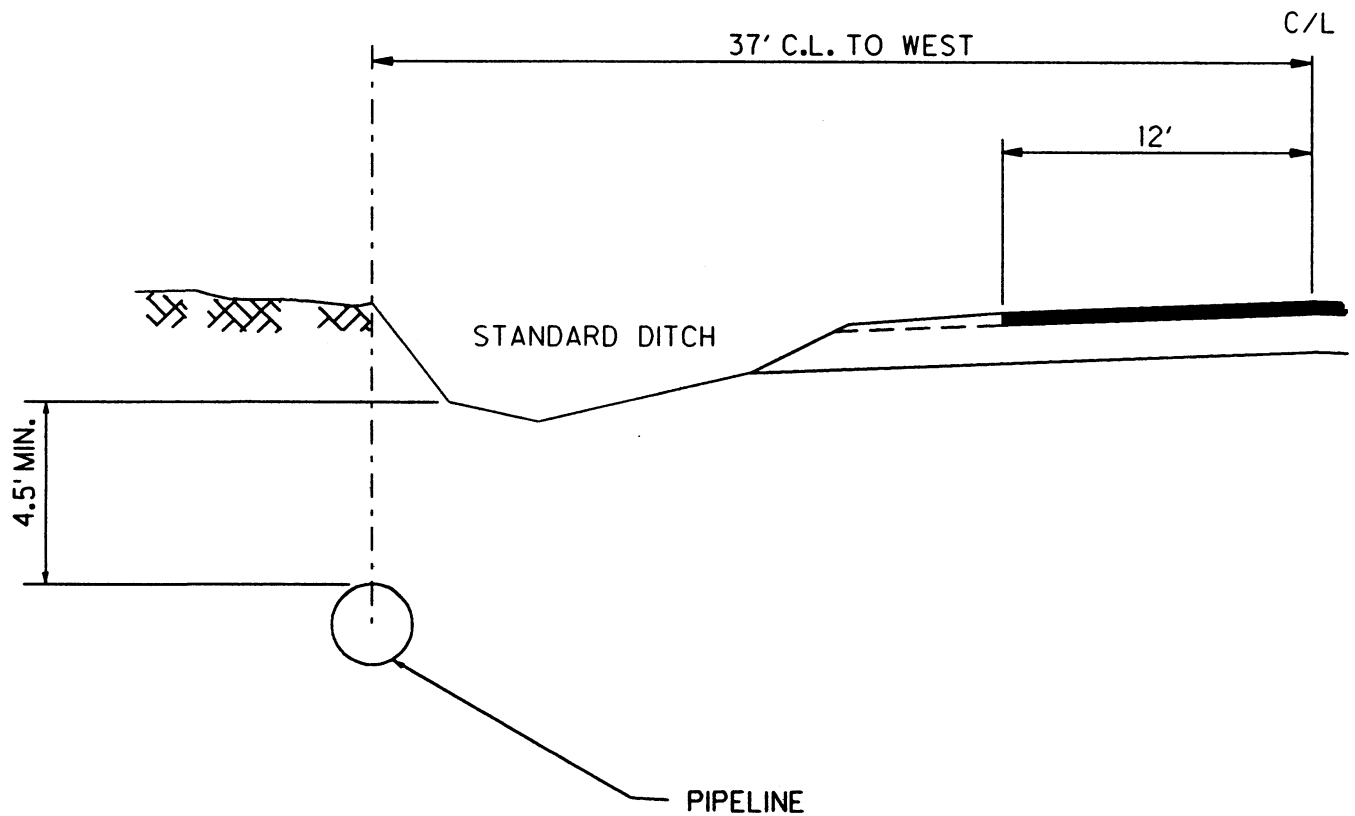
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CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE 2-1
TYPICAL SECTION FOR STH 55
MOLE LAKE TO CTH S

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMMI



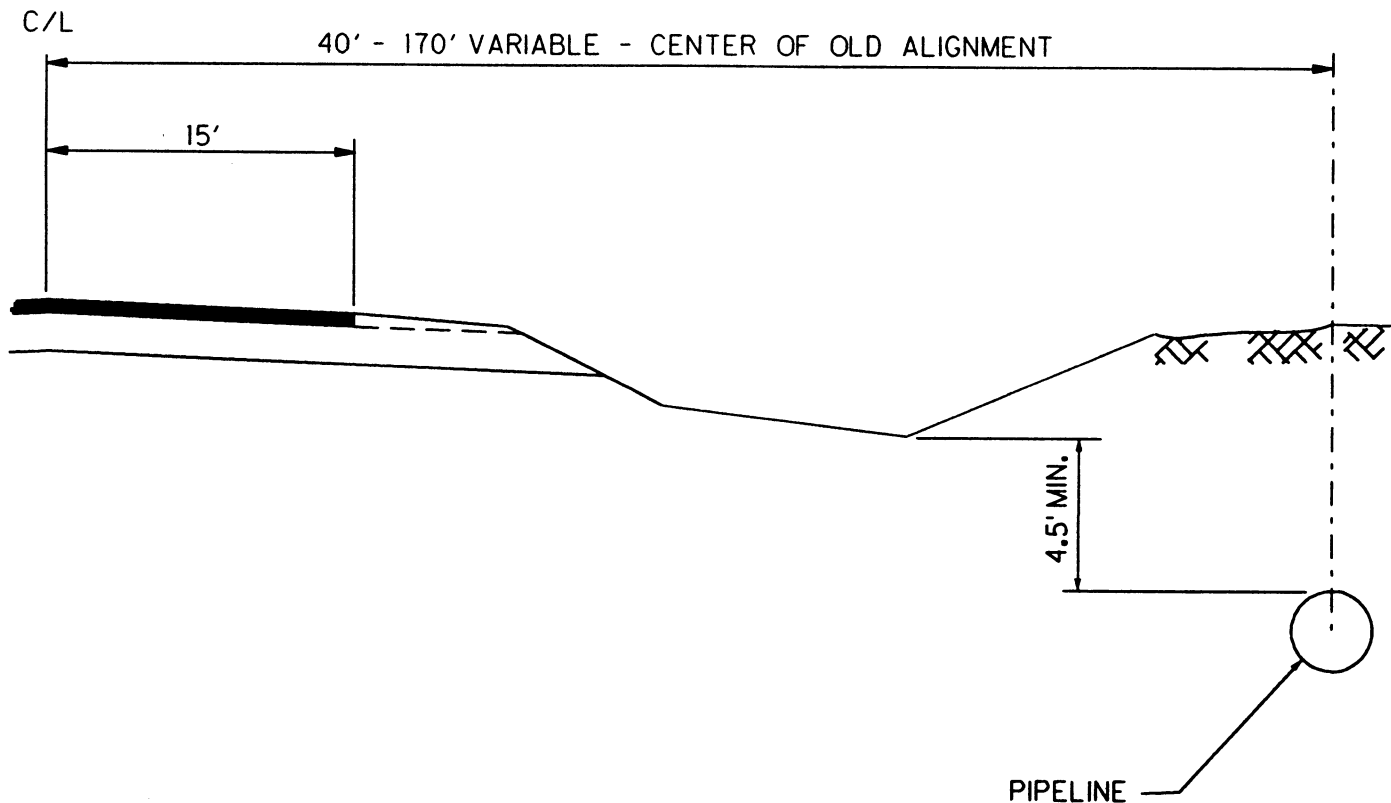
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CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE 2-2
TYPICAL SECTION FOR CTH S
STH 55 TO USR 8

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMMI



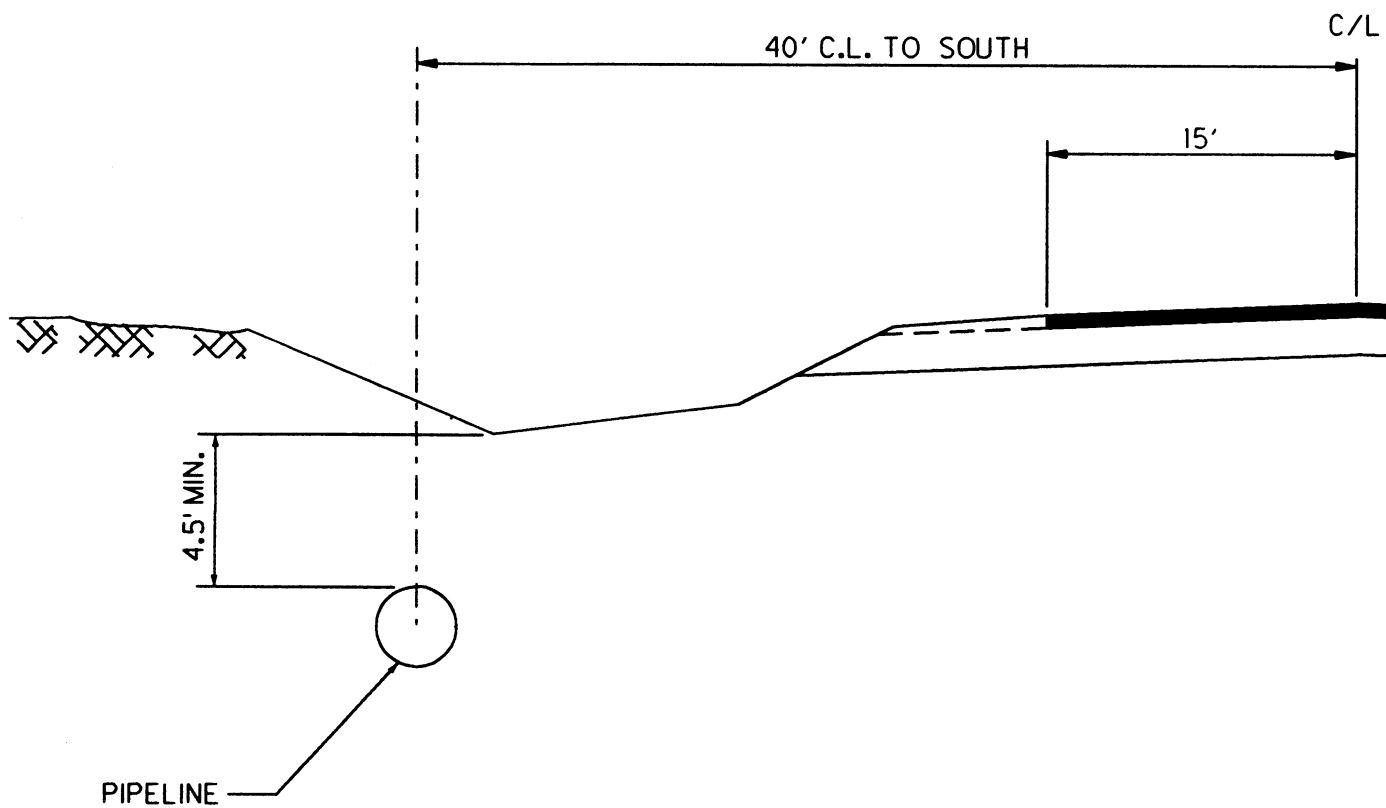
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CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE 2-3
TYPICAL SECTION FOR USR 8
CTH S TO CTH V

Scale: NOT TO SCALE	Date: AUGUST, 1995
Prepared By: Foth & Van Dyke	By: SMMI



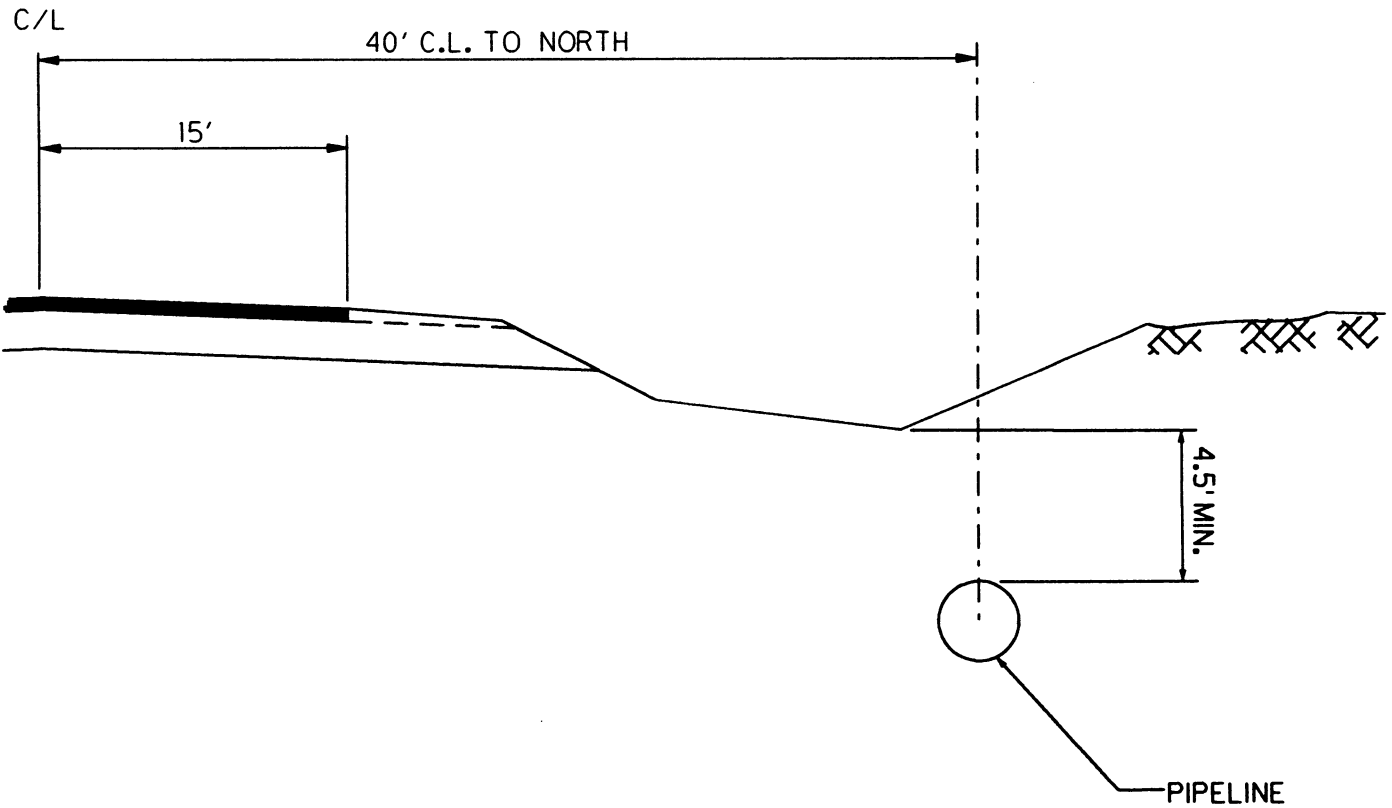
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REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG. '95
APPROVED BY:		GEV	DATE: AUG. '95
APPROVED BY:		GWS	DATE: AUG. '95



Crandon Mining Company

FIGURE 2-4
TYPICAL SECTION FOR USR 8
MONICO TO LAKE GEORGE

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMMI



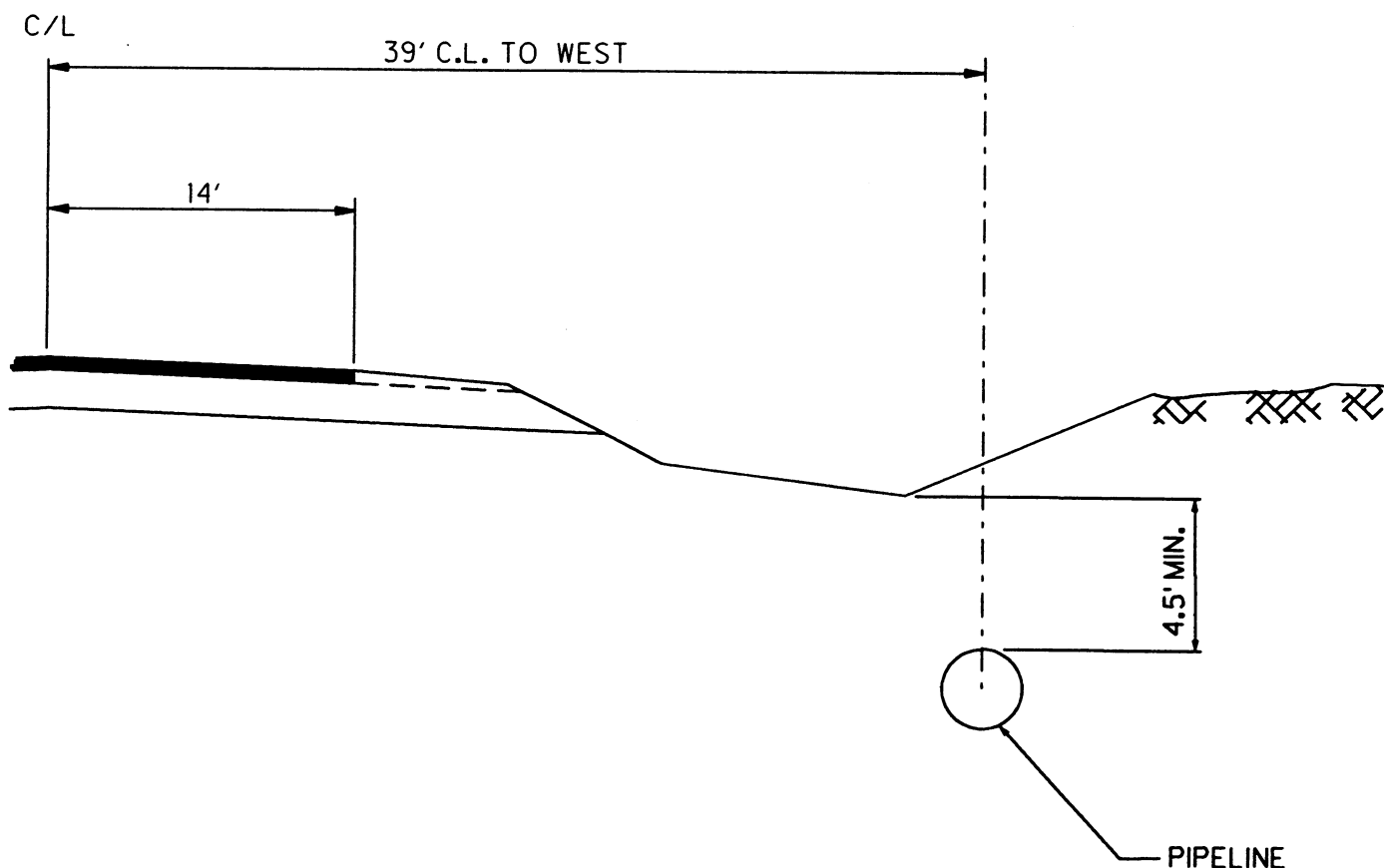
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CHECKED BY:		PMP1	DATE: AUG. '95
APPROVED BY:		GEV	DATE: AUG. '95
APPROVED BY:		GWS	DATE: AUG. '95



Crandon Mining Company

FIGURE 2-5
TYPICAL SECTION FOR USR 8
LAKE GEORGE TO STH 17

Scale:	NOT TO SCALE	Date:	AUGUST, 1995
Prepared By:	Foth & Van Dyke	By:	SMMI



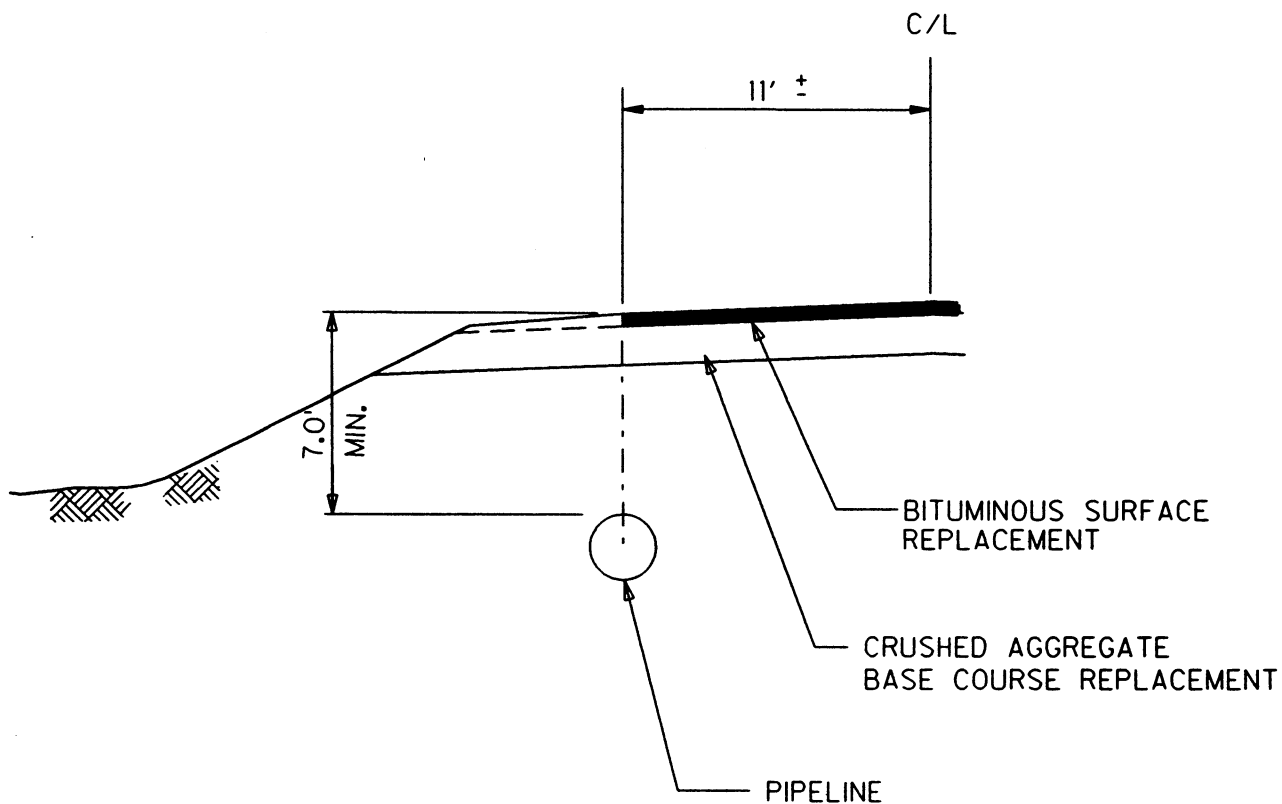
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REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG.' 95
APPROVED BY:		GEV	DATE: AUG.' 95
APPROVED BY:		GWS	DATE: AUG.' 95



Crandon Mining Company

FIGURE 2-6
TYPICAL SECTION FOR STH 17
USR 8 TO HAT RAPIDS ROAD

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMMI



Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG. '95
APPROVED BY:		GEV	DATE: AUG. '95
APPROVED BY:		GWS	DATE: AUG. '95

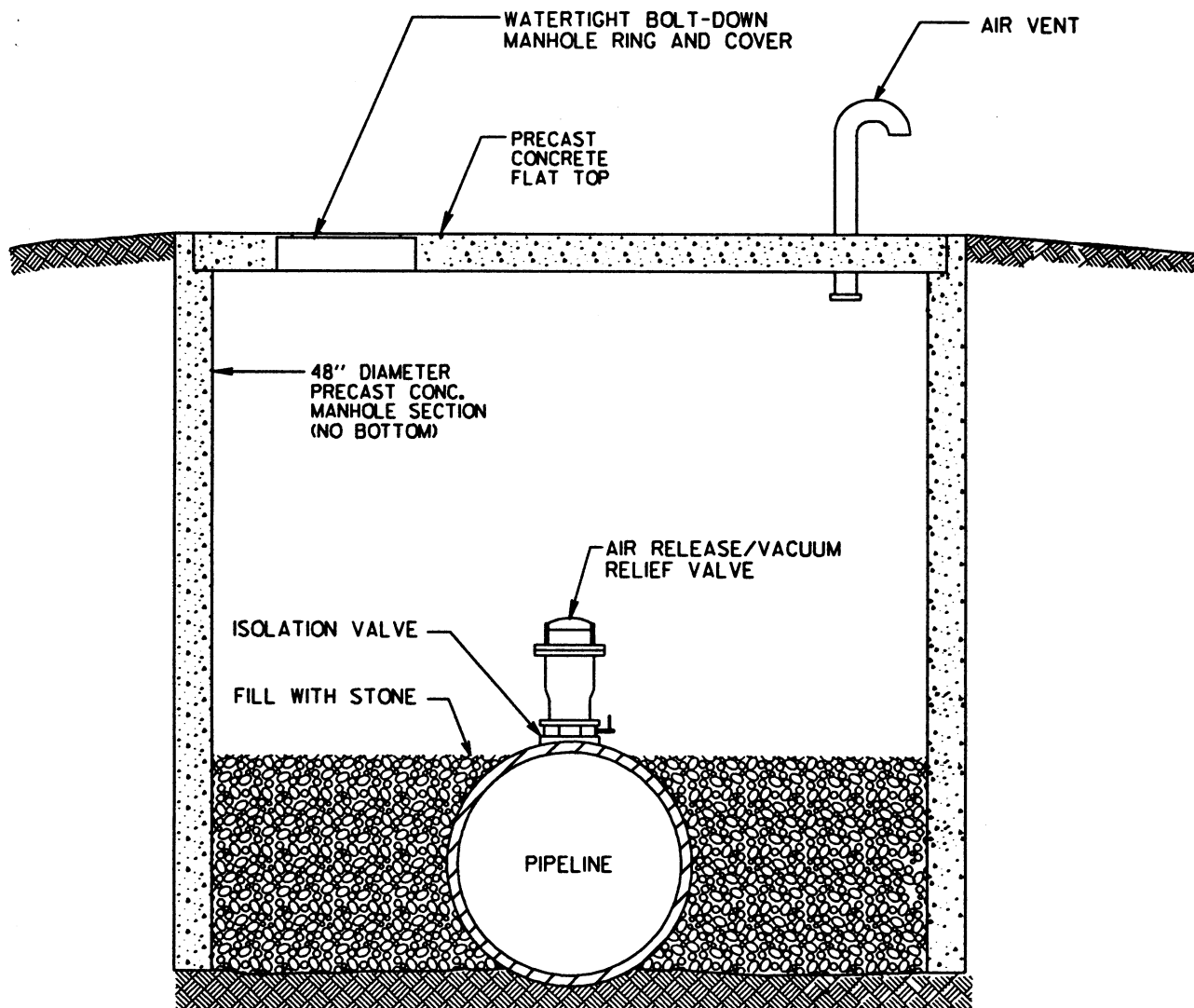


Crandon Mining Company

FIGURE 2-7

TYPICAL SECTION FOR HAT RAPIDS ROAD
STH 17 TO WISCONSIN RIVER

Scale: NOT TO SCALE	Date: AUGUST, 1995
Prepared By: Foth & Van Dyke	By: SMMI



Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
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Crandon Mining Company

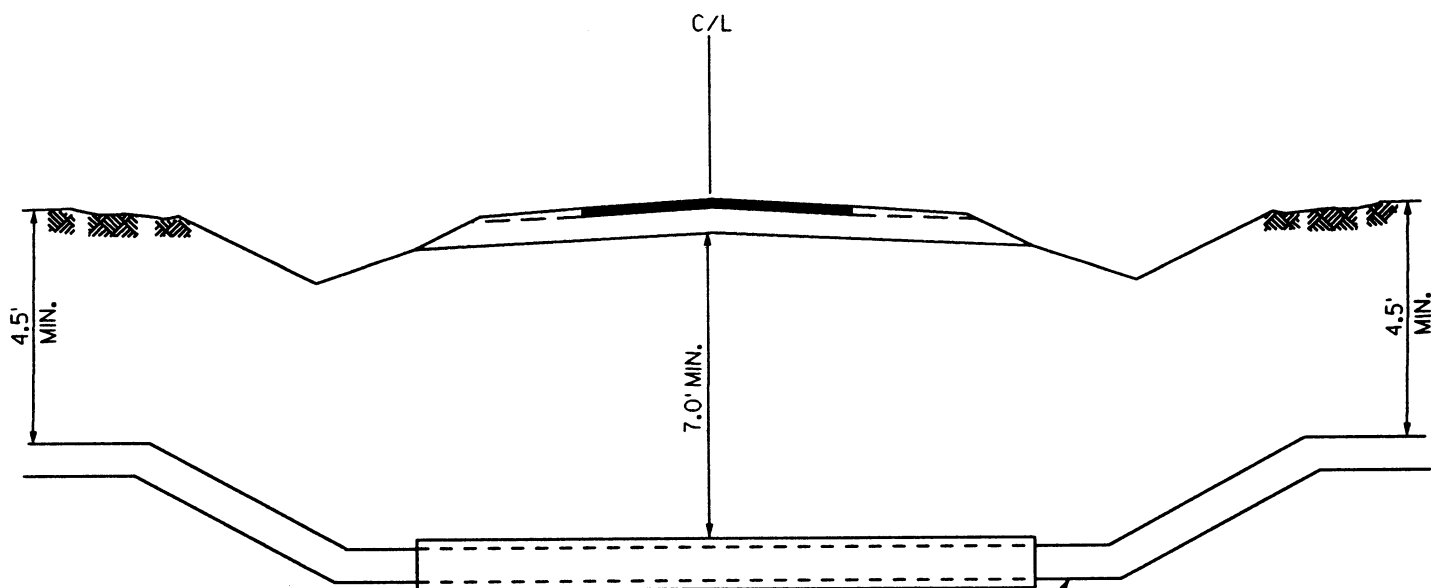
FIGURE 2-8

AIR RELEASE AND VACUUM RELIEF MANHOLE

Scale: NOT TO SCALE Date: AUGUST, 1995

Prepared By: Foth & Van Dyke

By: SMMI



STEEL CASING PIPE
JACKED OR BORED IN PLACE
CASING TO EXTEND TO TOE OF SLOPE
OR DITCH LINE, OR 20 FEET FROM EDGE
OF PAVEMENT, WHICHEVER IS LESS.

DISCHARGE PIPE

NOTE: THIS DETAIL PERTAINS TO STATE, COUNTY AND TOWN ROADS.

Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95

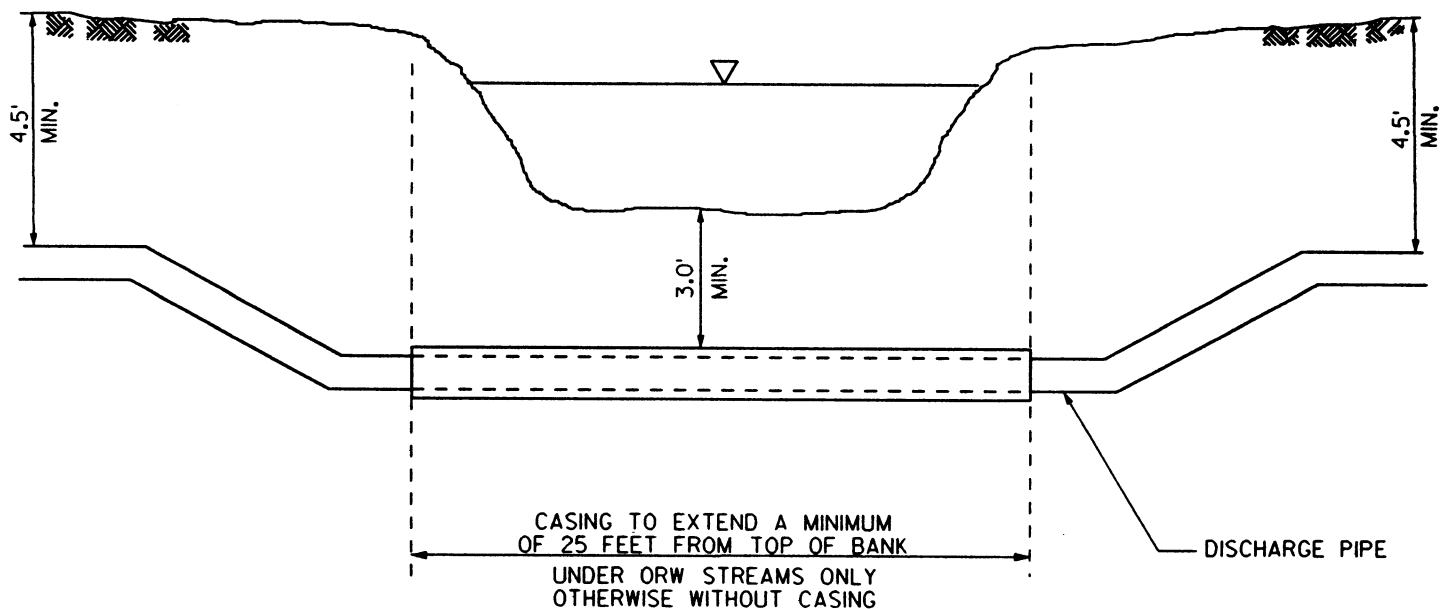


Crandon Mining Company

FIGURE 2-9

TYPICAL SIDE ROAD BORING & JACK

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMM1



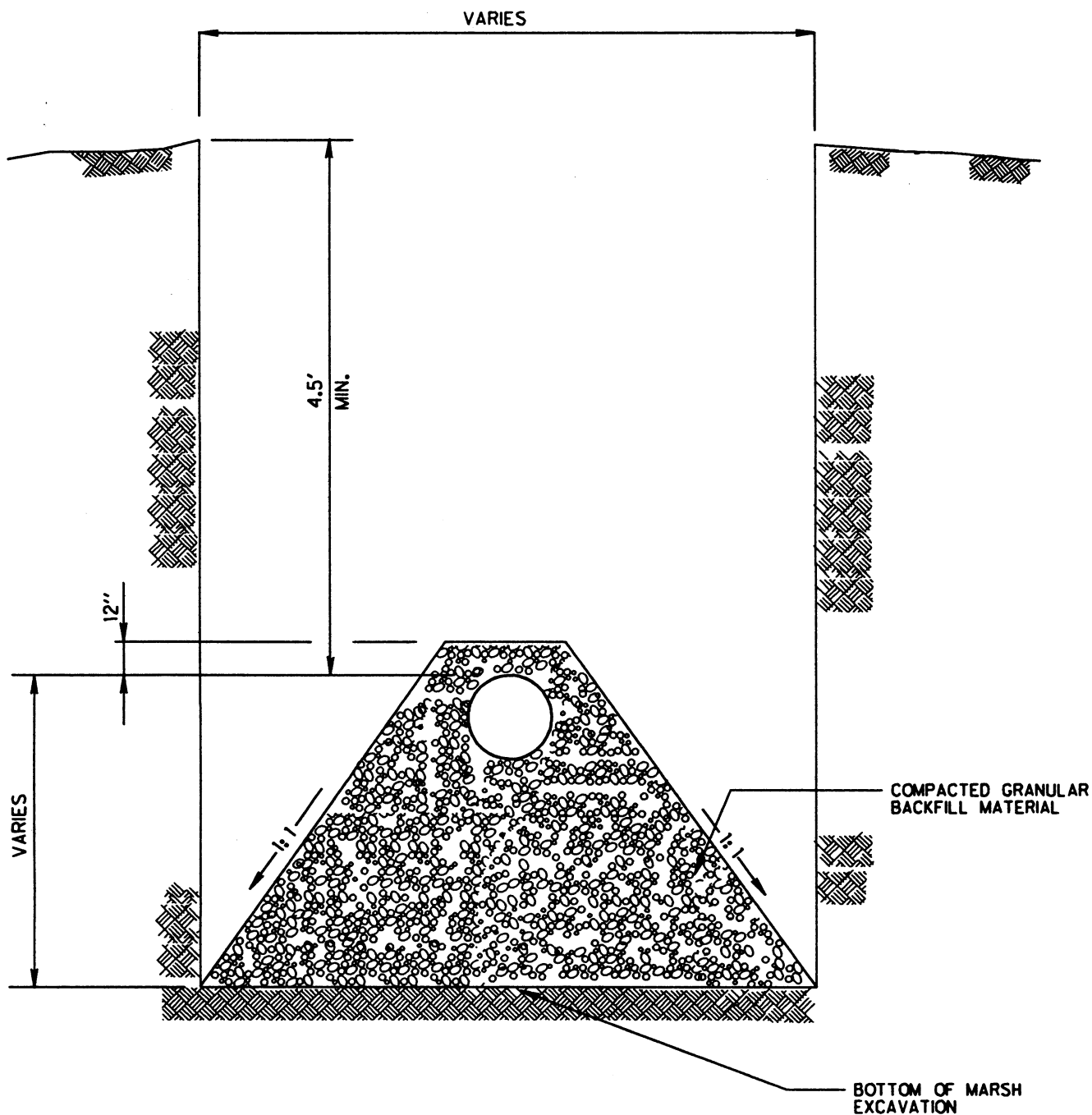
Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE 2-10
TYPICAL RIVER/STREAM CROSSING

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMM1



NOTE:
TRENCH TO BE BACKFILLED WITH NATIVE MATERIALS.

Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		PMP1	DATE: AUG.'95
APPROVED BY:		GEV	DATE: AUG.'95
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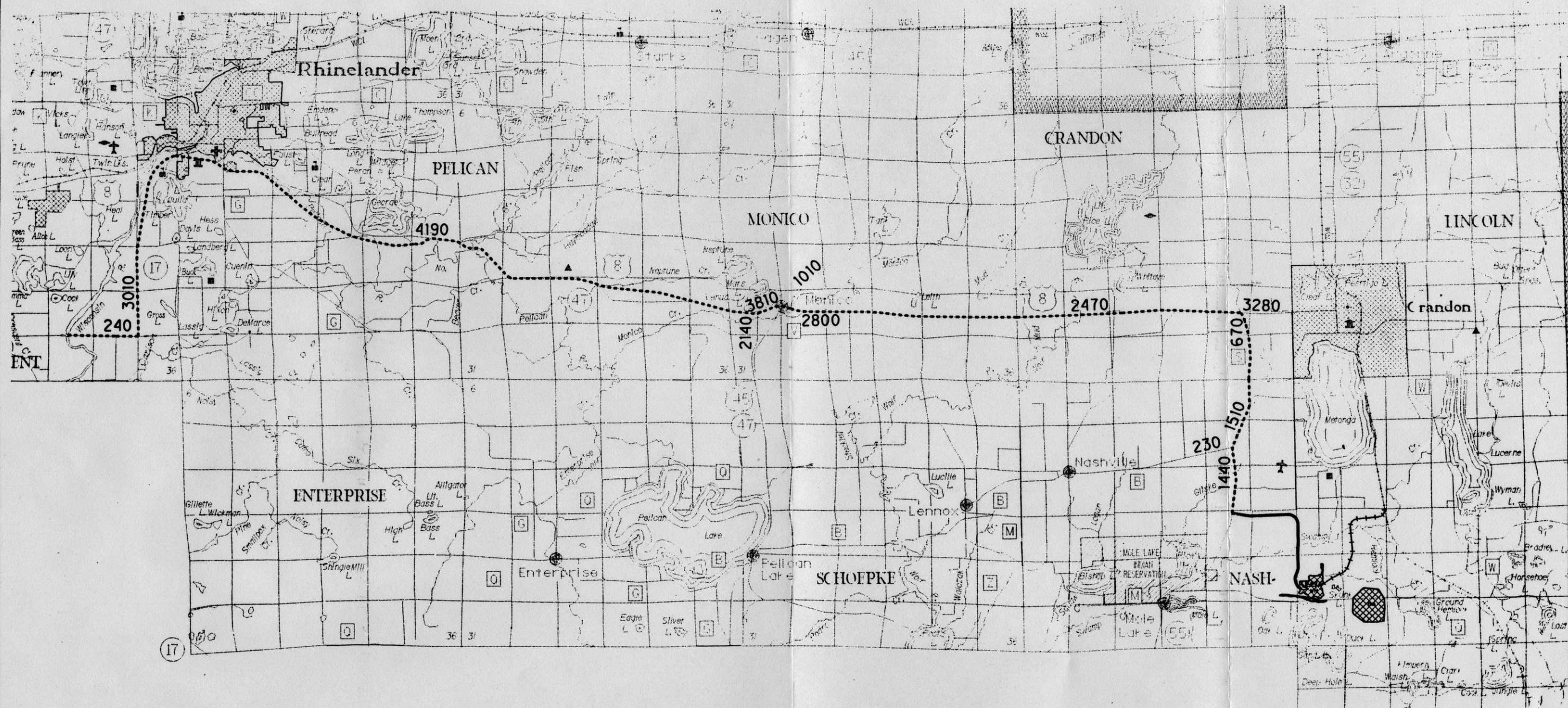


Crandon Mining Company

FIGURE 2-11

TYPICAL SECTION - WETLANDS EXCAVATION

Scale: NOT TO SCALE Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: SMM1



LEGEND

- | | | | |
|--|-----------------------|--|------------------------------|
| | U.S. OR STATE HWY | | CORPORATE LIMITS |
| | COUNTY TRUNK ROAD | | UNINCORPORATED VILLAGE |
| | TOWN ROAD | | ORE BODY |
| | COUNTY BOUNDARY | | PROPOSED ACCESS ROAD |
| | CIVIL TOWN BOUNDARY | | PROPOSED RAILROAD SPUR |
| | SECTION LINE | | PROPOSED FACILITIES |
| | U.S. HWY NO. | | PROPOSED WASTEWATER PIPELINE |
| | STATE HWY NO. | | AVERAGE DAILY TRAFFIC VOLUME |
| | COUNTY HIGHWAY LETTER | | |

NOTES:

1. BASE MAP DERIVED FROM COUNTY MAPS PREPARED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION.
2. ORE BODY OUTLINE IS REPRESENTATIVE OF THE SUBCROP AT THE BASE OF THE OVERBURDEN.

TYPICAL REPRESENTATION:
REFINEMENTS MAY BE MADE
PRIOR TO CONSTRUCTION.

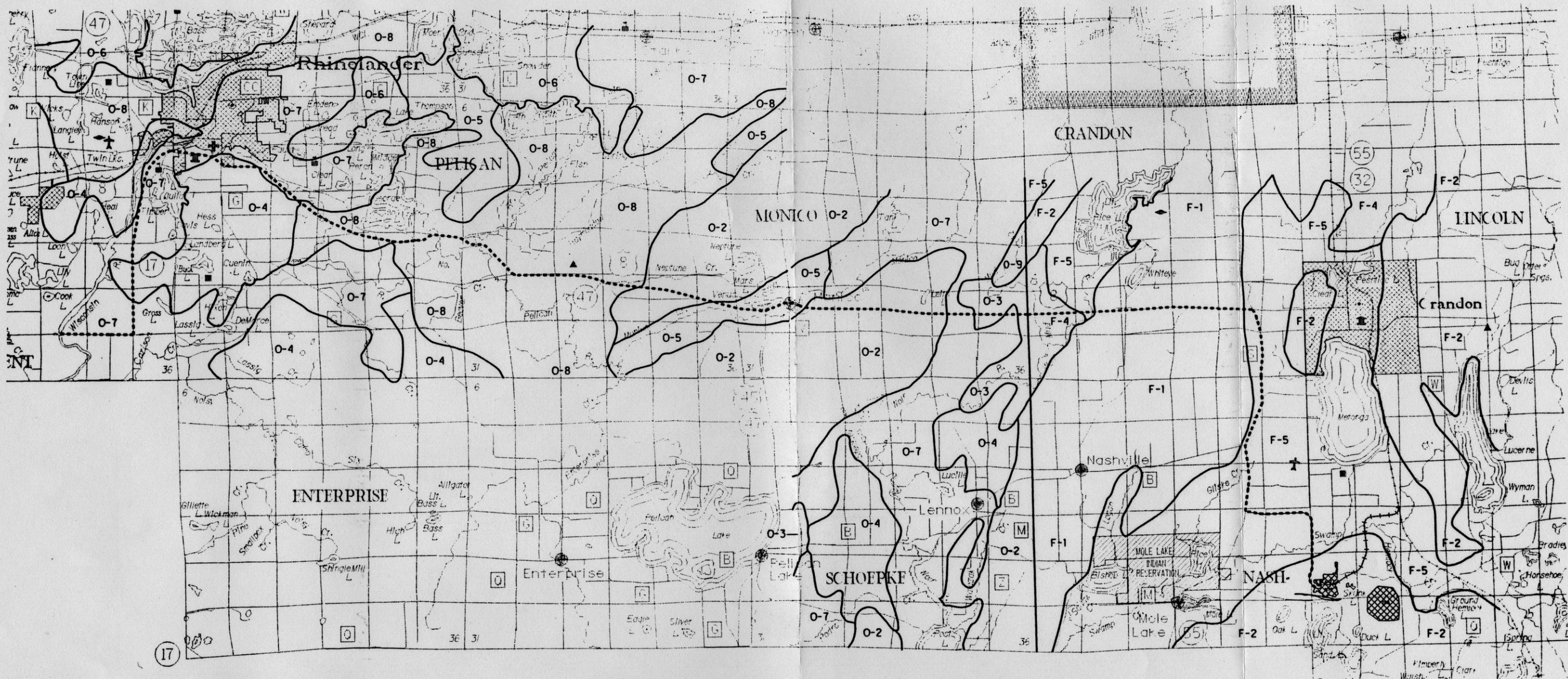
Foth & Van Dyke

REVISED	DATE	BY	DESCRIPTION
CHECKED BY: JKS1			DATE: AUG.'95
APPROVED BY: RFS			DATE: AUG.'95
APPROVED BY: GWS			DATE: AUG.'95

Crandon Mining Company

FIGURE 3-1
AVERAGE DAILY
TRAFFIC VOLUMES

Scale: 0 6000' 12,000' Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: JOW



LEGEND

- | | |
|-----------------------|------------------------------------|
| — U.S. OR STATE HWY | W COUNTY HIGHWAY LETTER |
| — COUNTY TRUNK ROAD | ■ CORPORATE LIMITS |
| — TOWN ROAD | ● UNINCORPORATED VILLAGE |
| — COUNTY BOUNDARY | — ORE BODY |
| — CIVIL TOWN BOUNDARY | — PROPOSED ACCESS ROAD |
| — SECTION LINE | — PROPOSED RAILROAD SPUR |
| 8 U.S. HWY NO. | ■ PROPOSED FACILITIES |
| 47 STATE HWY NO. | ----- PROPOSED WASTEWATER PIPELINE |

ONIEDA COUNTY, WS. SOIL LEGEND

- | | |
|-----|---|
| O-1 | MAGNOR-GREENWOOD-CABLE ASSOCIATION |
| O-2 | GOODMAN-MONICO-CABLE ASSOCIATION |
| O-3 | GREENWOOD-DAWSON-CARBONDALE ASSOCIATION |
| O-4 | PADUS-GOODMAN ASSOCIATION |
| O-5 | AU GRESS-CROSWELL-KINROSS ASSOCIATION |
| O-6 | SAYNER-VILAS ASSOCIATION |
| O-7 | PADUS-PENCE ASSOCIATION |
| O-8 | KEWEENAW-VILAS ASSOCIATION |
| O-9 | GOODMAN-KEWEENAW ASSOCIATION |

NOTE:
O-1 AND F-3 SOIL ASSOCIATIONS ARE PERIPHERAL TO THE PIPELINE ROUTE AND THEREFORE ARE NOT SHOWN ON THE DRAWING.

FOREST COUNTY, WS. SOIL LEGEND

- | | |
|-----|------------------------------------|
| F-1 | WABENO-GOODWIT-MUDLAKE ASSOCIATION |
| F-2 | WABENO-GOODWIT-PADUS ASSOCIATION |
| F-3 | LAONA-SARONA-ARGONNE ASSOCIATION |
| F-4 | LUPTON-LOXLEY ASSOCIATION |
| F-5 | PADUS-STAMBAUGH-PENCE ASSOCIATION |

NOTES:

1. BASE MAP DERIVED FROM COUNTY MAPS PREPARED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION.
2. ORE BODY OUTLINE IS REPRESENTATIVE OF THE SUBCROP AT THE BASE OF THE OVERBURDEN.

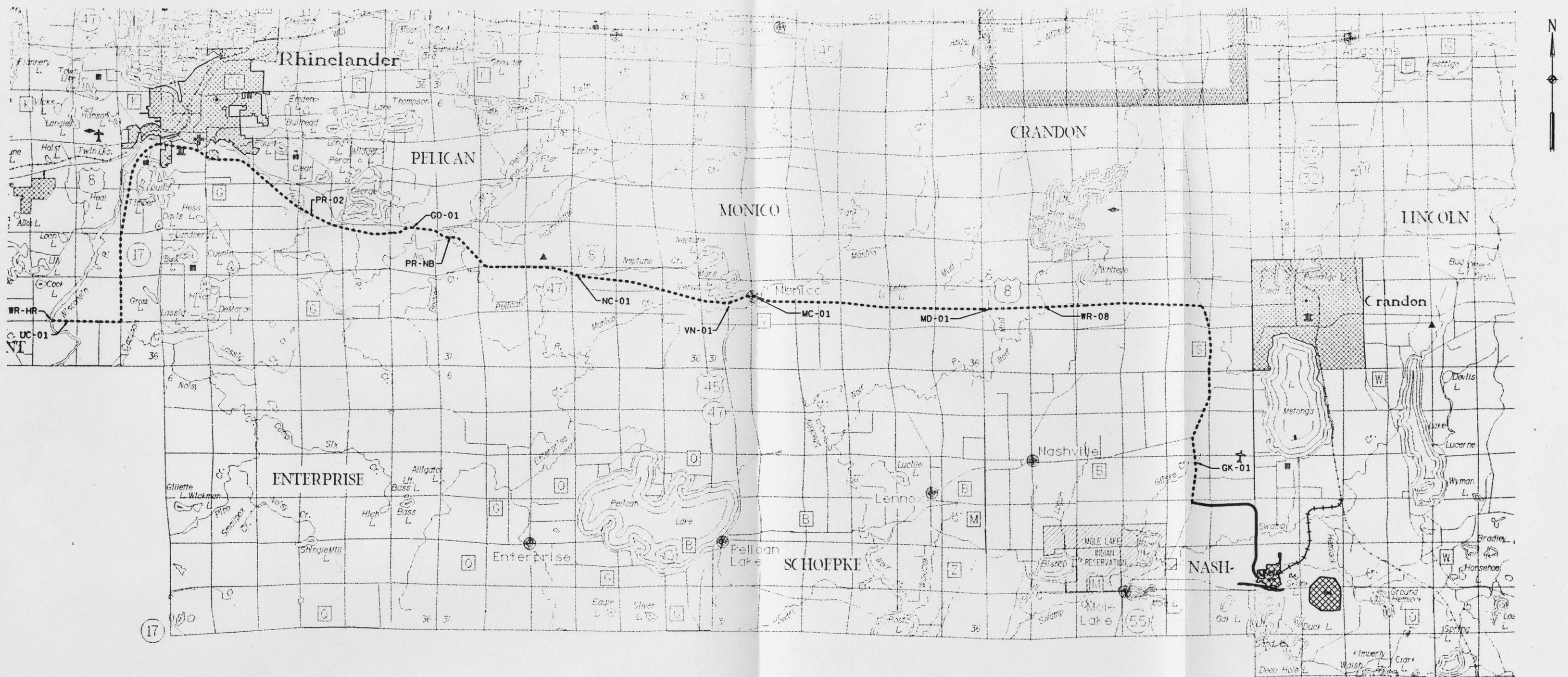
TYPICAL REPRESENTATION:
REFINEMENTS MAY BE MADE
PRIOR TO CONSTRUCTION.

Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95

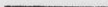
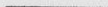
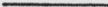
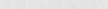
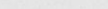
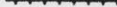
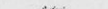
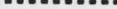
Crandon Mining Company

FIGURE 3-2
SOIL ASSOCIATION MAP

Scale: 0 6000' 12,000' Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: JOW



LEGEND

- | | | | |
|---|-----------------------|---|------------------------------------|
|  | U.S. OR STATE HWY |  | CORPORATE LIMITS |
|  | COUNTY TRUNK ROAD |  | UNINCORPORATED VILLAGE |
|  | TOWN ROAD |  | ORE BODY |
|  | COUNTY BOUNDARY |  | PROPOSED ACCESS ROAD |
|  | CIVIL TOWN BOUNDARY |  | PROPOSED RAILROAD SPUR |
|  | SECTION LINE |  | PROPOSED FACILITIES |
|  | U.S. HWY NO. |  | PROPOSED WASTEWATER PIPELINE |
|  | STATE HWY NO. |  | STREAM CROSSING OBSERVATION POINTS |
|  | COUNTY HIGHWAY LETTER | | |

NOTES:

1. BASE MAP DERIVED FROM COUNTY MAPS PREPARED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION.
2. ORE BODY OUTLINE IS REPRESENTATIVE OF THE SUBCROP AT THE BASE OF THE OVERBURDEN.

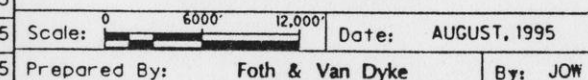
TYPICAL REPRESENTATION:
REFINEMENTS MAY BE MADE
PRIOR TO CONSTRUCTION.

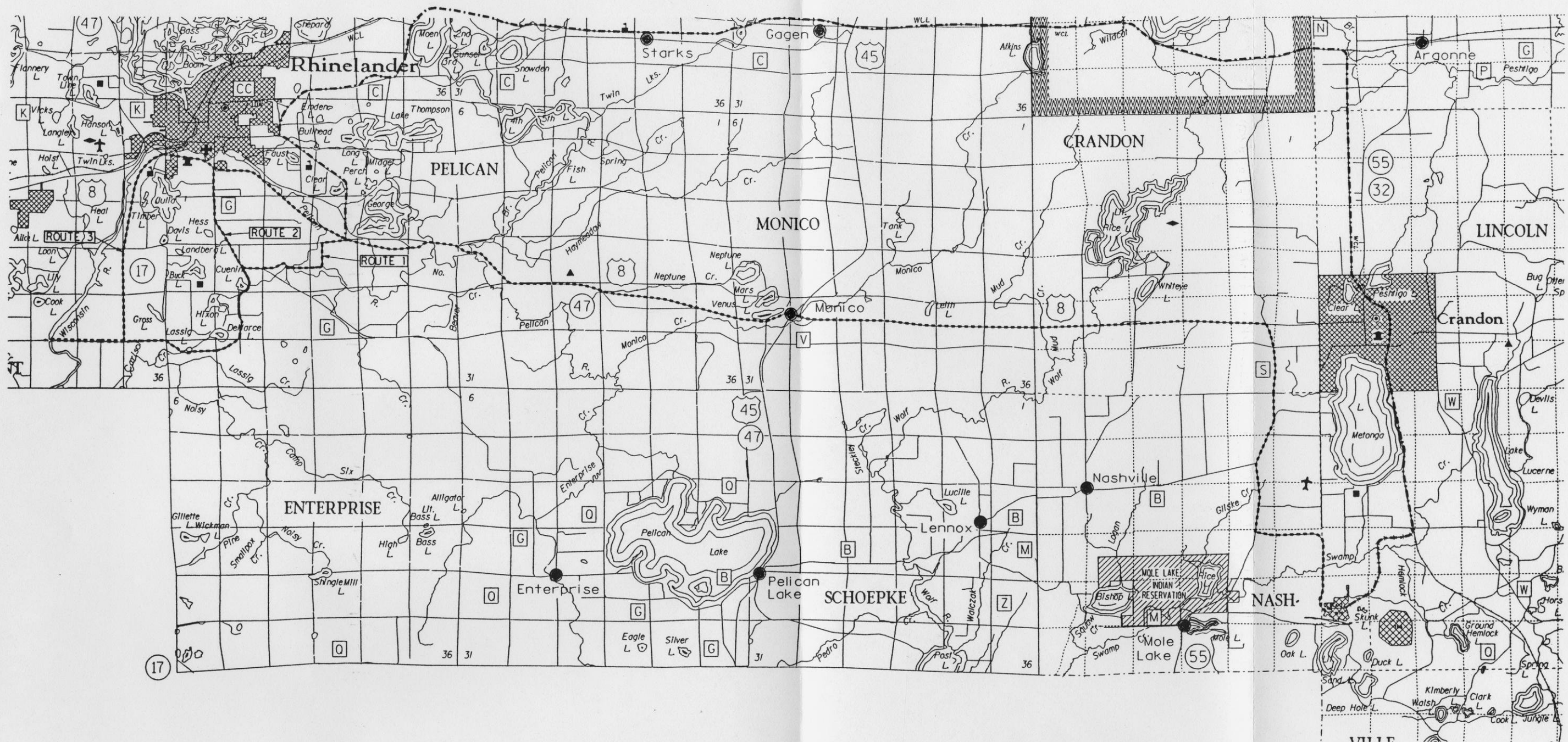
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REVISED	DATE	BY	DESCRIPTION
CHECKED BY: JKS1			DATE: AUG.'95
APPROVED BY: RFS			DATE: AUG.'95
APPROVED BY: GWS			DATE: AUG.'95



Crandon Mining Company

FIGURE 3-3
STREAM CROSSING
OBSERVATION POINTS





LEGEND

- | | | | |
|--|-----------------------|--|------------------------------------|
| | U.S. OR STATE HWY | | UNINCORPORATED VILLAGE |
| | COUNTY TRUNK ROAD | | ORE BODY |
| | TOWN ROAD | | PROPOSED ACCESS ROAD |
| | COUNTY BOUNDARY | | PROPOSED RAILROAD SPUR |
| | CIVIL TOWN BOUNDARY | | PROPOSED FACILITIES |
| | SECTION LINE | | DISCHARGE PIPELINE-HIGHWAY R.O.W. |
| | U.S. HWY NO. | | DISCHARGE PIPELINE-RAILROAD R.O.W. |
| | STATE HWY NO. | | |
| | COUNTY HIGHWAY LETTER | | |
| | CORPORATE LIMITS | | |

NOTES:

1. BASE MAP DERIVED FROM COUNTY MAPS PREPARED BY THE WISCONSIN DEPARTMENT OF TRANSPORTATION.
2. ORE BODY OUTLINE IS REPRESENTATIVE OF THE SUBCROP AT THE BASE OF THE OVERBURDEN.

TYPICAL REPRESENTATION:
REFINEMENTS MAY BE MADE
PRIOR TO CONSTRUCTION.

Foth & Van Dyke

REVISED	DATE	BY	DESCRIPTION
CHECKED BY: JKS1			DATE: AUG.'95
APPROVED BY: RFS			DATE: AUG.'95
APPROVED BY: GWS			DATE: AUG.'95

Crandon Mining Company	
FIGURE 3-5 ALTERNATIVE DISCHARGE PIPELINE CORRIDORS	
Scale: 0 6000' 12,000'	Date: AUGUST, 1995
Prepared By: Foth & Van Dyke	By: JOW

Appendix A

Historical/Archaeological Reconnaissance and Literature Review of the Wisconsin River Wastewater Discharge Pipeline Corridor Alternative, Forest and Oneida Counties, Wisconsin

GREAT LAKES ARCHAEOLOGICAL RESEARCH CENTER

TECHNICAL MEMORANDUM

DATE: 28 July 1995

TO: Jerry Sevick, Foth & Van Dyke

CC: Don Moe, Crandon Mining Company

FR: John D. Richards, Great Lakes Archaeological Research Center

RE: Crandon Project: Reconnaissance and Literature Review of the Wisconsin River Wastewater Discharge Pipeline Corridor Alternative, Forest and Oneida Counties, Wisconsin

1.0 Introduction

Great Lakes Archaeological Research Center, Inc. (GLARC) was asked by Foth and Van Dyke to conduct an archival and literature search in conjunction with a visual reconnaissance of the route of a proposed discharge pipeline extending to the Wisconsin River from the wastewater treatment facility at the Crandon Project site. The proposed alignment is restricted to existing highway and/or snowmobile trail right-of-way. The proposed route alignment is shown in figure 1.

The proposed construction easement is currently designed to coincide with: (1) the previously surveyed right-of-way of the Crandon Project's site access road (2) various existing state and county highway right-of-way; and (3) existing right-of-way coincident with the alignment of a snowmobile trail which parallels the northern half of the existing USH 8 right-of-way from CTH S to CTH V.

The route originates at the Crandon Project site in Forest County and follows the previously surveyed right-of-way of the North Access Road to the intersection of the North Access Road and STH 55. At this point, the proposed route follows the STH 55 right-of-way north to the intersection of STH 55 and CTH S. The route continues north along the CTH S right-of-way to the CTH S and USH 8

intersection. From this point, the project route follows the existing right-of-way of a snowmobile trail which is wholly coincident with portions of the USH 8 right-of-way west to the intersection of USH 8 and CTH V. At this intersection, the route continues west within the USH 8 right-of-way to the city of Rhinelander in Oneida County, Wisconsin. From Rhinelander, three alternate routes extend south and east coincident with existing highway right-of-way to intersect with the Wisconsin River and discharge below the Hat Rapids Dam. Accordingly, GLARC implemented a visual inspection of all affected highway and snowmobile trail right-of-ways in order to determine: (1) the degree of ground alteration; and (2) the potential of each to harbor archaeological deposits. A literature search was also completed in order to inventory previously reported burial sites and archaeological sites within one mile of the project route.

2.0 Summary of Available Information

Previous cultural resource investigations pertinent to the proposed route include surveys of intermittent sections of STH 55 (SHPO Compliance No. 88-1328), the USH 8 Rhinelander Bypass, and adjacent areas (Salzer and Birmingham 1977; Overstreet and Brazeau 1982; and Overstreet 1983a and 1983b). Also cogent is an overview by Richards (1994). Additional archival sources reviewed are listed in Appendix A.

3.0 Description of Project Area(s)

3.1 Project Route

The total length of the proposed USH 8 pipeline route is approximately 38 miles. The total length of the surveyed area is about 47 miles. The project area is located in Forest and Oneida counties which lie within the physiographic province known as the Northern Highlands as described by Martin (1965). The local terrain is dominated by glacial deposits. These deposits occur in the form of drumlinized ground moraine in the eastern portion of the project area within the Wolf River drainage basin, and pitted outwash plains which are more prominent in the

western project area within the Wisconsin River drainage basin. The relative youth of the landscape is evident in numerous swamps and lakes which reflect a poorly developed drainage system. Original vegetation as mapped by Finley (1976) was a mixed coniferous-hardwood forest with varying dominant tree species occurring in discrete communities. The route traverses four such communities: (1) hemlock, yellow birch, white pine, and red pine forest (2) white pine and red pine forest, (3) aspen, white birch, and pine forest, and (4) swamp conifer forests with white cedar, black spruce, tamarack, and hemlock. Minor areas of sedge meadow also occur in open lowland settings. The components of these original forest communities have been greatly altered by logging activities.

4.0 Methodology

4.1 Archival and Literature Search

Great Lakes Archaeological Research Center, Inc.'s pre-field research entailed a comprehensive review of the data housed at Great Lakes Archaeological Research Center, Inc. and at Madison, Wisconsin. Archives and serial file systems were also searched for site-specific information. Published literature sources consulted include: *The Wisconsin Archeologist*, a quarterly journal published since 1901; *The Wisconsin Magazine of History*, the journal of the State Historical Society of Wisconsin; *The Wisconsin Historical Collections* consisting of 20 volumes published between the years 1903 and 1920; and the *Bulletin of the Public Museum of the City of Milwaukee*, several of which detail archaeological investigations conducted in various Wisconsin localities.

Unpublished sources subjected to scrutiny are represented by four different formats: 1) serial entry files; 2) map files; 3) manuscript files; and 4) archaeological survey reports. Two serial file systems were consulted. The first of these is the Wisconsin Archaeological Site Inventory Files, housed at the Historic Preservation Division, State Historical Society of Wisconsin. This file consists of an inventory of previously reported archaeological sites from both historic and prehistoric times and provides information relating to site locations, cultural affiliation, artifacts, and literature sources. The second file consulted is the

Great Lakes Archaeological Research Center, Inc.

Historic Preservation Division inventory file also housed at the Historic Preservation Division, State Historical Society of Wisconsin. This file includes both archaeological sites and standing structures that have been identified as possessing architectural and/or historical significance.

Several map files were reviewed. They include: 1) The Charles E. Brown Archaeological Atlas; 2) the Government Land Office survey records; 3) the Trygg map files; and 4) local plat and deed maps. The Charles E. Brown Archaeological Atlas provides the locations of sites on county plat maps. The prehistoric and historic sites include camps, villages, mounds, springs, rock art, workshops, quarries, cemeteries, trails and various other types of archaeological manifestations reported to Brown during his long tenure as Secretary of the Wisconsin Archeological Society and as an employee of the State Historical Society of Wisconsin. The Government Land Office records consist of plats and survey notes that may provide information regarding presettlement vegetation, topography, and aquatic features, all important variables in determining potential site locations. In addition, dependent on the interests of individual land surveyors, cultural information such as the locations of Indian trails, camps and villages, maple sugar processing stations ("sugar bushes"), pioneer settlements, and early industrial improvements such as mills, roads, and early homes and farmsteads are frequently noted on these maps. Both map files are housed at the Archives Division, State Historical Society of Wisconsin and the latter is available on microfilm at various repositories.

The Trygg map file is a privately published composite of the GLO land survey records. While the Trygg maps are less detailed in scale than the GLO plats, the file is an important source for understanding the chronology and magnitude of regional development during the late historic period (ca. 1850). Finally, early plats and topographic maps were reviewed to assess historical settlement and development of the project environs.

Manuscript files investigated include the Charles E. Brown manuscript files and the State Archaeologist's county files. The former are housed at the Archives

Division and the latter at the Museum Division, State Historical Society of Wisconsin. The Brown manuscripts consist of 50 years of notes, correspondence, sketches, maps, and other data relating to historic and prehistoric archaeological sites. The county files include reports (unpublished), photographs, sketch maps, letters, and information derived from the Museum's highway archaeology program.

4.2 Field Investigations

Archaeological survey methods employed during the present reconnaissance of the proposed Wisconsin River wastewater discharge pipeline route were restricted to simple visual inspection. This technique is commonly employed to provide an initial assessment of a project area. Attempts are made to identify those portions of the project area not surveyable by conventional means.

In the present instance the entire route was subjected to visual inspection. A drive-by reconnaissance was conducted noting topography, ground cover, and the degree of alteration of existing highway right-of-way. The route was divided into 21 survey segments beginning at STH 55 one half mile south of Airport Road in Forest County and ending at Hat Rapids Road at the Wisconsin River in Oneida County (figure 2). The portion of the proposed route which extends from the Crandon Project Plant site to intersect with STH 55 (CTH S) was not subjected to visual reconnaissance. This segment is coincident with previously surveyed right-of-way associated with the proposed North Access Road (Overstreet 1983a).

5.0 Survey Results

5.1 Archival and Literature Research

Background information pertinent to the proposed Wisconsin River wastewater discharge pipeline route indicates that no previously reported prehistoric or historic period archaeological sites are coincident with the route. In addition, no reported burial sites are within the project right-of-way. Previously reported sites within one mile of the proposed route include 15 archaeological sites and six burial sites. These sites are inventoried in tables 1 and 2. Site locations are plotted in figure 2.

TABLE 1
PREVIOUSLY REPORTED ARCHAEOLOGICAL SITES
WITHIN ONE MILE OF THE PROJECT AREA.

Site #	Site Name	Description	Location
Fr-0152	Sokaogon Chippewa Housing Authority I	Late Woodland/Middle Woodland campsite/village	T35N,R12E SE,SW,SW,SW,SW Sec. 23 Mole Lake Quad
Fr-0271	Locus # 4856	Historic Euro-American/near logging road remnant	T35N,R12E SE,NE,NE Sec. 25 Mole Lake Quad
Fr-0119	Titus	Unknown prehistoric campsite/village, cemetery/burial	T35N,R12E SE,NW,NW & SW,NE,NW Sec. 26 Mole Lake Quad
Fr-0144	Skunk Lake Structure and Midden	Unknown Historic cabin/homestead	T35N,R13E SE,SE,NW,SE Sec. 30 Mole Lake Quad
Fr-0150	Plant Site Midden and Structure	Unknown Historic cabin/homestead	T35N,R13E SW,NW,SW Sec. 30 Mole Lake Quad
Fr-0658	Locus 5854	Historic Euro-American sugar bush	T35N,R13E SW,SE,SW,SW Sec. 30 Mole Lake Quad

TABLE 1 (CONCLUDED)

Site #	Site Name	Description	Location
Fr-0185	Schallock	Historic Euro-American cabin/ homestead	T36N,R12E SE,SE,SE,NE Sec. 36 Crandon Quad
On-0237	McDermott Site	Historic Euro-American cabin/ homestead	T36N,R8E SE,NE,NE Sec. 11 Rhineland Quad
On-0249	Denny Nordquist Site	Historic Indian/Woodland campsite/village	T36N,R8E SW,NE,NW,NW Sec. 26 Lake Julia Quad
On-0030	Pelican River	Unknown Campsite/Village	T36N,R9E S1/2,SW,SE,SW,SW Sec. 6 N1/2,NE,NW,NW Sec. 7 Rhineland Quad
On-0031	Koszarek	Late Woodland campsite/village	T36N,R9E NW,NE,SE Sec. 14 George Lake Quad
On-0247	St. Germain Homestead and Cemetery	Historic Indian cabin/ homestead, cemetery	T36N,R9E NE,SE,NE & NW,SE,NE Sec. 18 Lake Julia Quad
On-0032	Harris	Unknown campsite/village	T36N,R9E SE,NE Sec. 24 George Lake Quad
On-0095	Pelican Lake Foundation	Recent Historic Euro- American cabin/homestead	T36N,R10E SE,SE,SE Sec. 18 George Lake Quad
On-0057	Hubbard	Unknown cache/pit/hearth	T36N,R9E SE,SW,SW Sec. 5 Rhineland Quad

TABLE 2

PREVIOUSLY REPORTED BURIAL SITES WITHIN ONE MILE OF THE PROJECT AREA.

Site #	Site Name	Description	Location
BFr-0026	Titus Burial Site	unknown	T35N,R12E SE,NW,NW & SW,NE,NW Sec. 26 Mole Lake Quad
BFr-0006	Crandon Cemetery	unknown	T36N,R12E SE,NE,NE Sec. 35 Crandon Quad
BOn-0009	St. Mary's Cemetery	unknown	T36N,R9E SW,NW,SW & NW,SW,SW Sec. 4 Rhinelander Quad
BOn-0037	St. Germain Homestead and Cemetery	Chippewa/Ojibwa family cemetery	T36N,R9E NE,SE,NE & NW,SE,NE Sec. 18 Lake Julia Quad
BOn-0036	St. Germain Homestead and Cemetery	Chippewa/Ojibwa family cemetery	T36N,R9E NE,SE,NE & NW,SE,NE Sec. 18 Lake Julia Quad
BOn-0042	Forest Home Cemetery	unknown	T36N,R9E SE,SW & W,SW,SW,SE Sec. 5 & NW,NW,NE Sec. 8 Rhinelander Quad

Prehistoric archaeological sites within a one mile radius of the project route include Woodland period campsites (Fr-152, On-249, On-31), unknown prehistoric campsites (Fr-119, On-30, On-32), and a cache of prehistoric copper implements (On-57). Historic period sites include Euro-American, Historic Indian, or unknown historic homesteads (Fr-271, Fr-144, Fr-150, FR-185, On-237, On-247, On-95), in addition to Fr-658, a sugar bush, a documented locus for tapping sugar maple trees.

Burial sites include the Titus Burial site (BFr-26), the Crandon Cemetery (BFr-6), St. Mary's Cemetery (BOn-9), Forest Home Cemetery (BOn-42), and the St. Germain Homestead and Cemetery (On-247/BOn-36/BOn-37). The St. Germain Homestead and Cemetery site is the site of a nineteenth century Chippewa family homestead and cemetery situated approximately 150 m west of the proposed pipeline route. The family name was St. Germain. No descriptions are available for the remaining cemeteries.

5.2 Survey Segment Descriptions

5.2.1 Segment 1 (Plant site to STH 55)

Segment 1 is 3.5 miles in length originating at the Crandon Mining Company plant site. It continues cross country for three miles before joining STH 55 south of Airport Road in the Town of Nashville. The route continues north along STH 55. Segment 1 terminates at the Airport Road intersection. The route traverses an undulating pitted outwash plain with elevations ranging from 1,560 feet above mean sea level (famsl) to 1,620 famsl. The area is comprised of open fields to the east and second growth forest to the west along STH 55. The previously surveyed portion of the route is coincident with the alignment of the proposed North Access Road. This portion of the pipeline route crosses Swamp Creek north of the plant site, continues north, then turns due west within and adjacent to the Swamp Creek lowlands to intersect with STH 55.

No previously reported sites are present within or adjacent to the proposed route; however, the probability is high that prehistoric sites are present in the immediate area of the route given the proximity to waterways and adjacent lowlands. Nonetheless, the highway right-of-way is altered and the slope intercept is coincident with the highway right of way. No additional survey is recommended as long as the proposed pipeline construction is restricted to the existing right-of-way, and to the previously surveyed corridor of the off-road portion, from the plant site to STH 55.

5.2.2 Segment 2 (STH 55)

Continuing north on STH-55, Segment 2 is one mile in length, commencing at the Airport Road intersection and ending at the CTH B intersection at Sherman Corners. With the exception of a narrow conifer swamp drained by Gliske Creek, the terrain is an undulating upland, with elevations ranging from 1,600 to 1,650 famsl, supporting a second growth forest of poplar, birch, and conifers.

No previously reported sites are present within or adjacent to the route although it is possible that sites are present given the proximity of the route to the headwaters of Gliske Creek. In any event, a previous archaeological survey of the Gliske Creek crossing (SHPO Compliance No. 88-1328) and another separate archaeological survey at Sherman Corners (SHPO Compliance No. 88-1328) did not encounter archaeological sites. The STH 55 right-of-way is altered and the slope intercept is coincident with the highway right-of-way. No additional survey is recommended if construction is restricted to the existing highway right-of-way.

5.2.3 Segment 3 (STH 55)

Segment 3 follows STH 55 from CTH B north to the CTH S intersection, a linear distance of one mile. The terrain is an undulating upland with elevations ranging from 1,650 to 1,680 famsl. Fallow agricultural land, some of which is planted in spruce, is characteristic of the southern portion. Land use in the north portion of

the segment is characterized by second growth maple forest with a sparse hemlock understory.

A previous archaeological survey of the northern portion of Segment 3 (SHPO Compliance No. 88-1328) did not locate any archaeological sites. Furthermore, no previously reported sites are present within or adjacent to the route. The potential for encountering sites in Segment 3 is moderate due to the proximity to Lake Metonga. Nonetheless, the STH 55 right-of-way is altered and the slope intercept is coincident with the highway right-of-way. Therefore no additional survey is recommended if construction is restricted to the existing highway right-of-way.

5.2.3 Segment 4 (CTH S)

Continuing north on CTH S from the STH 55 intersection, Segment 4 terminates at USH 8, a linear distance of two miles. The terrain is an undulating upland with elevations ranging from 1,660 to 1,720 famsl and with small knolls along the south portion. Second growth forest abuts both sides of the right-of-way along the south portion with a new growth of poplar on the west side, and more diverse second growth on the east side. Approximately 0.6 miles north of Sherman Corners the route leaves Nashville Township to enter the Town of Crandon. The second growth forest gives way to fallow agricultural land interspersed with woodlots.

While no prehistoric sites have been reported adjacent to Segment 4, The Crandon Cemetery (BFR-0006) is situated directly west of the highway right-of-way. The potential for unreported archaeological sites in Segment 4 is high given the proximity to the headwaters of an unnamed stream draining into Lake Metonga. However, if construction is limited to the existing highway right-of-way no additional survey is recommended since the slope intercept is coincident with the right-of-way.

5.2.5 Segment 5 (USH 8/Snowmobile Trail)

Segment 5 originates at the intersection of CTH S and USH 8. The route is in the northern portion of the USH 8 right-of-way and extends due west a distance of 3.5 miles. This segment is restricted to a snowmobile trail which follows the abandoned route of Old USH 8. Segment 5 terminates within the Wolf River lowlands 0.1 mile east of the Wolf River channel. The route traverses a drumlinized upland landscape supporting a second growth forest of poplar, birch, and sparse hemlock on northeast-southwest trending elevations. Willow, red osier, sedges, and grasses occupy the interlying lowlands. Surface elevations range from 1,680 to 1,750 famsl. This portion of the route follows the right-of-way of a snowmobile trail coincident with the abandoned alignment of Old USH 8. Remnants of abandoned asphalt roadway are still visible in portions of this alignment. Much of the original USH 8 alignment appears to have been built on cut grades rather than filled roadbed. In addition, the northern boundary of the right-of-way is coincident with the right-of-way of an electric transmission line corridor.

No previously reported sites are present within 1.5 miles of the proposed route. This lacunae is likely due to a lack of formal survey, since the potential for prehistoric sites in the general area is extremely high due to the extensive lowlands and adjacent terrace settings at the outlet of Little Rice Lake. However, the snowmobile right-of-way has been heavily disturbed by use as a former highway alignment and current utilities corridor. No additional archaeological investigations are warranted as long as construction is confined to the snowmobile trail/Old USH 8 right-of-way

5.2.6 Segment 6 (USH 8/Snowmobile Trail)

Segment 6 is 0.2 miles in length commencing 0.1 mile east of the Wolf River. The segment ends 0.1 mile west of the Wolf River. Here, the snowmobile trail

alignment traverses a willow lowland (with elevations of 1,620 famsl) which rises west of the river to open agricultural land on an elevated terrace.

No previously reported sites are present, but, as with Segment 5, this is probably due to a lack of formal survey. The likelihood of either near surface, or deeply buried archaeological deposits within the general area is high considering the local depositional setting. Nonetheless, the snowmobile trail route is coincident with the heavily disturbed alignment of former USH 8 and no additional survey is recommended if construction is restricted to the snowmobile trail/Old USH 8 right-of-way.

5.2.7 Segment 7 (USH 8/Snowmobile Trail)

This segment is coincident with an elevated terrace west of the Wolf River (approximately 1,620 famsl) traversed by the proposed route for a distance of 0.3 mile. The west terminus of the segment is at the Cole Road/USH 8 intersection, east of a conifer swamp. The route is flanked by existing USH 8 right-of-way to the south and existing utility corridor to the north.

No previously reported sites are present, although the terrace setting suggests that archaeological sites may be present in the general area. However, no additional survey is recommended if construction is restricted to the heavily disturbed and altered snowmobile trail/Old USH 8 right-of-way.

5.2.8 Segment 8 (USH 8/Snowmobile Trail)

Segment 8 continues due west following the snowmobile trail right-of-way and traversing the Wolf River-Mud Creek lowlands (at an elevation of approximately 1,610 famsl). This segment, one mile in length, originates at the Cole Road intersection and terminates at the Forest County line coincident with the east side of an elevated peninsula (ca. 1,620 famsl) which juts out into a black spruce lowland drained by Mud Creek. Open areas are populated by red osier and sedges.

The route is flanked by existing USH 8 right-of-way to the south and existing utility corridor to the north.

No previously reported sites are present; again, this is probably due to a lack of formal survey since the elevations flanking the lowland are suited for prehistoric habitation. Similarly, the lowlands should not be arbitrarily disregarded as unsuitable for habitation, since these settings may have been used as locations of seasonal extraction activities. Nonetheless, no additional survey is recommended if construction is restricted to the heavily disturbed and altered snowmobile trail/Old USH 8 right-of-way.

5.2.9 Segment 9 (USH 8/Snowmobile Trail)

Continuing due west on USH 8 for 5.0 miles, Segment 9 commences at the Forest-Oneida County line, enters the Town of Monico, and terminates at the intersection of USH 8 and CTH V east of Monico Creek. The route traverses a drumlinized landscape of northeast-southwest trending elevations and interlying swamplands. Vegetation is primarily black spruce, poplar, birch, and sedges in the lowlands and second growth poplar and conifers in the upland forest. Campbell's Training Center at the intersection of Slizenski Road occupies an area of open agricultural land. The route is flanked by existing USH 8 right-of-way to the south and existing utility corridor to the north.

No previously reported sites are present adjacent to Segment 9. The general area is considered to harbor potential for prehistoric site locations due to the presence of numerous swamps. However, no additional survey is recommended if construction is restricted to the heavily disturbed and altered snowmobile trail/Old USH 8 right-of-way.

5.2.10 Segment 10 (USH 8)

Continuing westward on USH 8, Segment 10 originates at the intersection of USH 8 and CTH V east of Monico, crosses Monico Creek, passes through Monico on the south side of Venus Lake, and terminates at the USH 8 and USH 45 intersection west of town. This is a distance of 1 mile. The road grade rises high above the Monico Creek floodplain before descending to grade in residential portions of Monico. Ditched roadsides are characteristic of this portion of Segment 10. Surface elevation on the floodplain is less than 1,600 ft. rising to 1,610 famsl in Monico as the route skirts the prominent south bank of Venus Lake. Lowland vegetation consists of willow, sedges, and Labrador tea.

While no previously reported sites are present, this absence is due to a lack of formal survey of the Venus Lake area. The potential is very high for prehistoric site locations in this area. However, the slope intercept is coincident with the highway right-of-way and unless construction should occur outside of the altered right-of-way, no additional survey is recommended. Due to the potential archaeological sensitivity of Segment 10 detailed project design sheets should be reviewed to determine the precise location of the construction easement in relation to the existing highway right-of-way.

5.2.11 Segment 11 (USH 8)

Segment 11 begins at the USH 8/USH 45 intersection west of Monico and continues west on USH 8 approximately seven miles. The segment terminates at the North Branch of the Pelican River. This segment originates in a residential area on the high south bank of Venus Lake. Westward the landscape is drumlinized ground moraine with northeast-southwest trending elevations supporting a maturing second growth, along with new growth forest consisting of hardwoods and conifers. The lowlands support black spruce (at an elevation ranging from 1,590 to

1,620 famsl). West of the Neptune Creek crossing in the Town of Pelican, the route traverses an outwash plain which is also supports second growth forest.

No previously reported sites are present within or adjacent to the existing USH 8 right-of-way. This is likely due to a lack of formal survey since the potential is high for prehistoric site locations. Locales which may be characterized as archaeologically sensitive include the area south of Venus Lake, the area adjacent to Neptune Creek, the North Branch of the Pelican River at its confluence with the Pelican River, and areas adjacent to local lowlands. South of Venus Lake the right-of-way is minimally altered by a shallow roadside ditch sometimes only 50 cm in depth. Archaeological deposits, if present, are likely preserved in this area. West of Venus Lake alteration of the right-of-way is complete; the slope intercept is coincident with the right-of-way. As stated in the summary of Segment 10, a detailed project design sheet of the Venus Lake area should be reviewed prior to planned construction.

5.2.12 Segment 12 (USH 8)

Continuing westward on USH 8, Segment 12 extends for a distance of six miles. This segment originates at the North Branch of the Pelican River, skirts the south side of George Lake, and terminates at the USH 8 /CTH G intersection. The route traverses a pitted outwash plain (with elevations ranging from 1,550 to 1,620 famsl) supporting a second growth forest of poplar, birch, and conifers on the upland areas, and black spruce in lowland areas. An unnamed outlet of George Lake crosses the USH 8 alignment approximately 0.7 miles west of the North Branch of the Pelican River. The Pelican River crossing is 3.2 miles west of the North Branch. Here, the 800 m wide Pelican River valley floor lies about 15 m below the upland plain.

Four previously reported sites are located within the Segment 12 literature search corridor, but well outside of the existing USH 8 right-of-way. Two Euro-American burial sites, including St. Mary's Cemetery (BOn-9) located 1.8 km north of Segment 12, and Forest Home Cemetery (BOn-42) located 1.2 km north of Segment

12. The third reported site, the Koszarek site (On-31), is a Late Woodland campsite situated on the east shore of George Lake. The fourth archaeological site is the Hubbard site (On-57), the reported location of a cache of prehistoric copper artifacts recovered from a garden on the east bank of the Pelican River.

The probability that archaeological sites are present is high for sites on lands adjacent to Segment 12. However, the slope intercept is coincident with the existing highway right-of-way, and no additional survey is recommended if construction is restricted to the altered right-of-way. If staging areas for boring operations associated with tunneling beneath waterways are located outside of the altered right-of-way, these areas should be subjected to archaeological survey.

5.2.13 Segment 13 (USH 8)

Continuing northwest on USH 8 for 1.3 miles, Segment 13 originates at the USH 8 /CTH G intersection and terminates at the intersection of USH 8 /STH 17 in the Town of Crescent. The route traverses a pitted outwash plain (with elevations ranging from 1,550 to 1,600 famsl) which supports a second growth forest south of the Pelican River-Wisconsin River confluence.

One prehistoric archaeological site (On-30) is located 500 m north of the Segment 13 right-of-way. There is little doubt that Segment 13 is an archaeologically sensitive area. However, a previous survey (Salzer 1977) of this portion the USH 8 alignment failed to identify any unreported site locations. In any case, the slope intercept is coincident with the existing highway right-of-way; and no additional survey is recommended if construction is restricted to the existing right-of-way.

5.2.14 Segment 14 (Route 3)

This segment originates at the USH 8 /STH 17 intersection and continues 4.35 miles southward along the STH 17 alignment parallel to the Wisconsin River. Segment 14 terminates at the intersection of Hat Rapids Road and STH 17. The

terrain is pitted outwash with knolls, swales, and river terraces supporting a mix of second growth poplar and spruce. Areas of Jack pine and black spruce are present in wet swales. Surface elevations range from 1,550 to 1,650 famsl. Minor areas of cleared land are present as well.

No previously reported archaeological sites are present within or adjacent to the existing STH 17 right-of-way. The nearest reported archaeological site, the Denny Nordquist site (On-249), inventoried as a Woodland and Historic Indian campsite is situated 1.4 km west of the proposed route on the southeast bank of the Wisconsin River. Nonetheless, the potential for the presence of unreported archaeological sites is very high in the surrounding area along the Wisconsin River. Within the project right-of-way, however, the slope intercept is coincident with the highway right-of-way and no additional survey is recommended if construction is restricted to the altered right-of-way.

5.2.15 Segment 15 (Route 3)

At the Hat Rapids Road/STH 17 intersection the proposed route follows Hat Rapids Road 1.8 miles due west to the planned discharge station at the Wisconsin River. Segment 15 terminates on the summit of the west terrace of the Wisconsin River. The terrain is pitted outwash plain with knolls and swales and river terraces. The land supports a second growth forest of white pine and Jack pine on upland areas, and black spruce in the lowlands. Surface elevations range from less than 1,520 to 1,610 famsl. Forested land is interspersed with open agricultural land in upland areas.

No previously reported sites have been inventoried adjacent to Segment 15 even though the Wisconsin River crossing was subjected to formal survey in the past (Salzer 1977). The potential is nonetheless quite high for unreported prehistoric sites to be present on lands adjacent to Hat Rapids Road. However, the slope intercept is coincident with the highway right-of-way and no additional survey is recommended if construction is restricted to the altered right-of-way.

5.2.16 Segment 16 (Route 2)

Originating at the intersection of Lassig Road and STH 17, Segment 16 follows Lassig Road for 0.95 miles east to the intersection of Range Line Road. The terrain is a pitted outwash plain consisting of knolls and swales (with elevations ranging from 1,590 to 1,610 famsl) supporting new growth poplar and sparse white pine.

No previously reported sites occur near the route although the potential is high for unreported sites to be present in the immediate area. The slope intercept extends approximately four meters on either side of the road. If construction is restricted to the existing altered right-of-way, no additional archaeology survey is recommended.

5.2.17 Segment 17 (Route 2)

Continuing eastward along Lassig Road in the Town of Pelican, the 1.8 mile segment traverses a pitted outwash plain, crosses Carlson Creek, and leaves a new growth forest of poplar and white spruce to enter open agricultural land. A tamarack swamp borders Lassig Lake. Open land is present north of the road, and forest borders the south side of the road east of Sugar Bush Road. Surface elevations range from 1,560 to 1,610 famsl. Segment 17 terminates at the Lassig Road /CTH EZ Road intersection.

No previously reported sites are present although the potential for unreported archaeological sites to be present is high due to the numerous kettle lakes and streams characteristic of this portion of the project area. The existing slope intercept is coincident with the highway right-of-way. Therefore, no additional survey is recommended if construction is restricted to the altered right-of-way.

5.2.18 Segment 18 (Route 2)

Continuing north along Lassig Road from the Lassig Road /CTH EZ intersection, the route traverses an outwash plain (with elevations ranging from 1,555 to 1,580 famsl) for a distance of 1.6 miles. Segment 18 terminates at the Lassig Road /CTH G intersection. The route skirts the southeast side of Cuennin Lake and crosses Cuennin Creek approaching the north terminus. A second growth forest of poplar, red pine, and birch is interspersed with open agricultural land.

No previously reported sites are present within or adjacent to the existing right-of-way; however the potential is high for unreported archaeological sites to be present in this area of lakes, swamps, and connecting streams. The existing slope intercept is coincident with the right-of-way, extending for approximately four meters on either side of the highway. Therefore, no additional survey is recommended if construction is restricted to the altered right-of-way.

5.2.19 Segment 19 (Route 1)

Segment 19 continues east along CTH G and terminates 0.45 miles eastward at the CTH G and Germond Road intersection. The terrain is a pitted outwash plain (with elevations ranging from 1,580 to 1,620 famsl) supporting a second growth forest of white pine, birch, and poplar.

No previously reported sites are present within or adjacent to the existing highway right-of-way although the potential for unreported archaeological sites to be present in the immediate vicinity is high given the close proximity to swamps, kettle lakes, and streams. However, the slope intercept is coincident with the right-of-way. Therefore, no additional survey is recommended if construction is restricted to the altered right-of-way.

5.2.20 Segment 20 (Route 1)

From the CTH G and Germond Road intersection, the route follows Germond Road a short distance to River Bend Road. Segment 20 then follows River Bend Road eastward to USH 8, a distance of 2.5 miles. The terrain is pitted outwash plain (with elevations ranging from 1,550 to 1,580 famsl) supporting a second growth forest. Open areas are interspersed along the way. Cuennin Creek and the Pelican River are both crossed by Segment 20. River Bend Road also skirts the west edge of a swampland.

No previously reported sites are present within or adjacent to the existing highway right-of-way although the potential for unreported archaeological sites to be present is high due to the close proximity to the Pelican River, small streams, and local lowlands. However, the slope intercept is coincident with the existing right-of-way. Therefore, no additional survey is recommended if construction is restricted to the altered right-of-way.

5.2.21 Segment 21 (Route 2)

Commencing at the Lassig Road /CTH G intersection, Segment 21 traverses a pitted outwash plain (with elevations ranging from 1,580 to 1,630 famsl) northward to USH 8, a distance of two miles. Second growth forest of poplar, birch, and red pine is interspersed with fallow agricultural land and other open areas occupied by private residences and commercial buildings.

No previously reported archaeological sites are present within or directly adjacent to the existing CTH G right-of-way. The St. Germain Homestead and Cemetery site (On-247/BOn-37) is situated approximately 150 m west of the proposed route. Other unreported sites are likely given the close proximity to the Pelican and Wisconsin rivers and the interlying lowlands. However, the existing slope intercept is coincident with the highway right-of-way. Therefore, no additional survey is recommended if construction is restricted to the altered right-of-way.

6.0 Conclusions

Archival research indicates 15 previously reported archaeological sites and six burial sites are located within one mile of either side of the proposed wastewater discharge corridor. No reported site locations are coincident with the proposed right-of-way. However, portions of the project route are characterized by a generally elevated potential to harbor unreported archaeological sites. Alteration of highway right-of-way coincident with the proposed route is typically severe throughout the project area. A visual reconnaissance of the route suggests that the existing slope intercept is generally coincident with the limits of the existing highway right-of-way. An exception is the Venus Lake area at Monico within survey Segment 11, where USH 8 right-of-way alteration is minimal west of USH 45.

7.0 Recommendations

If the construction easement associated with development of the proposed wastewater discharge corridor is restricted to that portion of the existing right-of-way between the pavement and the limits of the existing slope intercept project development should have no effect on project area cultural resources. However, additional archaeological investigations may be warranted in any of the following three instances. Scenarios in which additional archaeological investigations may be warranted include: (1) construction easements extending beyond the existing slope intercept, (2) staging areas for underground borings at road intersections and waterways located beyond the existing slope intercept, and (3) pipeline excavation which penetrates below the existing slope intercept deposits.

Investigation is recommended at two locations since alteration of the existing right-of-way appears to be less severe than is typical of other portions of the proposed route. Hence, it is possible that undisturbed archaeological sites are present within the existing highway right-of-way in these locales. Locales where additional archaeological investigations may be warranted include the Mud Creek lowlands within Segment 8 and the eastern portion of Segment 10 west of

the USH 8/USH 45 intersection south of Venus Lake. These areas should be further investigated in order to determine the degree of prior disturbance since truncated archaeological deposits have been encountered within shallow roadside ditches elsewhere in Wisconsin (Richards and Overstreet 1990).

Current conventional archaeological survey techniques are inadequate to determine the presence of deeply buried archaeological or paleontological deposits. In the event that archaeological or paleontological materials are encountered during the course of the project, all construction should be halted.

If archaeological or paleontological materials are encountered immediate consultation to insure compliance with (1) 36 CFR 800.11, The Regulations of the Advisory Council on Historic Preservation Governing the 106 Process; or (2) S. 44.40, *Wis Stats*, may be obtained by contacting:

The Compliance Section
Historic Preservation Division
State Historical Society of Wisconsin
Phone #: 608-262-2970

If human remains are encountered immediate consultation to insure compliance with S. 157.70, *Wis Stats* may be obtained by contacting:

The Burial Sites Preservation Office
Historic Preservation Division
State Historical Society of Wisconsin
Phone #: 800-342-7834

8.0 References Cited

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1965 *The Physical Geography of Wisconsin. Third Edition. University of Wisconsin Press, Madison.*

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Overstreet, David F., and Linda A. Brazeau

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Richards, John D.

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Richards, John D., and David F. Overstreet

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Salzer, Robert J. and Robert Birmingham

1977 An Archaeological Survey of Two Highway Projects in Oneida County,
Wisconsin. *Beloit College*.

APPENDIX A

ARCHIVAL SOURCES CONSULTED

Bernsteen, Robert T.

1969 Atlas of the Eight Counties of Forest, Florence, Iron, Langlade, Lincoln, Oneida, Price, Vilas. *State Historical Society of Wisconsin, Archives Division Call Number: D/GX902/B53/1969.*

Brown, Charles E.

1906 *A Record of Wisconsin Antiquities.* The Wisconsin Archeologist os 5(3-4): 289-429.

1908 *Additions to the Record of Wisconsin Antiquities II.* The Wisconsin Archeologist os 7(1): 1-33.

1909 *Additions to the Record of Wisconsin Antiquities III.* The Wisconsin Archeologist os 8(4): 113-138.

1912 *Fourth Addition to the Record of Wisconsin Antiquities.* The Wisconsin Archeologist os 10(4): 176

1925 *Additions to the Record of Wisconsin Antiquities.* The Wisconsin Archeologist ns 4(1): 9-143.

Papers - Archaeology - Forest and Oneida Counties. State Historical Society of Wisconsin, Archives Division, Call Number: WIS/Mss/HB

n.d. *Atlas*

Forest County Map Company

1900 Map of Forest County, Wisconsin. *Published by the Forest County Map Company, Crandon, WI. State Historical Society of Wisconsin, Microforms Collections No. 92-1173.*

Government Land Office

Federal Land Survey Plat Book, Township 35N surveyed 1857 by Alfred MillaRoad *State Historical Society of Wisconsin, Archives Division Call Number: Series 698*

Federal Land Survey Plat Book, Township 36N Surveyed in 1839 and 1859 by H. C. Fellows and Wm E. Daugherty. *State Historical Society of Wisconsin, Archives Division Call Number: Series 698*

Hixson Map Company

1924 Plat Book of Forest County. *W.W. Hixson and Company, Rockford, IL.*

1925? Plat Book of Oneida County. *W.W. Hixson and Company, Rockford, IL.*

McGinley, B.

1919 Map of Forest County, Wisconsin, Map No. 2 Keith and Hiles Lumber Company. *B. McGinley, Crandon, WI. State Historical Society of Wisconsin, Archives Division Call Number: GX9028/F71/1919/M*

Moody, F. B.

1910 Field Plat Book of the Northern Highlands of Wisconsin. *Forest Management, Wisconsin Conservation Comm. State Historical Society of Wisconsin,, Archives Division Call Number: S/GZ902/1910.*

Rand McNally

1896 Map of Lincoln, Oneida, Villas and Parts of Iron, Price and Langlade Counties, Wisconsin. *Rand McNally & Co., Chicago. State Historical Society of Wisconsin, Archives Division Call Number: GX9028/L73/1896/R*

Ritter, I. R.

1920 Map of Forest County, Wisconsin. *I.R. Ritter, County Surveyor, Crandon, Wisconsin. State Historical Society of Wisconsin, Archives Division Call Number: GX9028/F71/1920/R*

Rockford Map Publishers

1958 Forest County Wisconsin Plat Book. *Rockford Map Publishers, Rockford, IL.*

Shepard, E.S.

1908 Map of Forest County, WI. *E.S. Shepard State Historical Society of Wisconsin, Archives Division Call Number: H/GX9028/F71/1908/S*

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State Historical Society of Wisconsin, Archives Division Call No.
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Trygg, W. J.

nd Composite Map of U.S. Land Surveyors Original Plat & Field Notes.
Wisconsin Sheets. *State Historical Society of Wisconsin, Archives Division*
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Unknown

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Historical Society of Wisconsin, Archives Division Call Number:
H/GX9028/O5/1890.

1908 Map of Oneida County, Wisconsin. *State Historical Society of*
Wisconsin, Archives Division Call Number: GX9028/O5/1908/O

Wisconsin State Planning Board

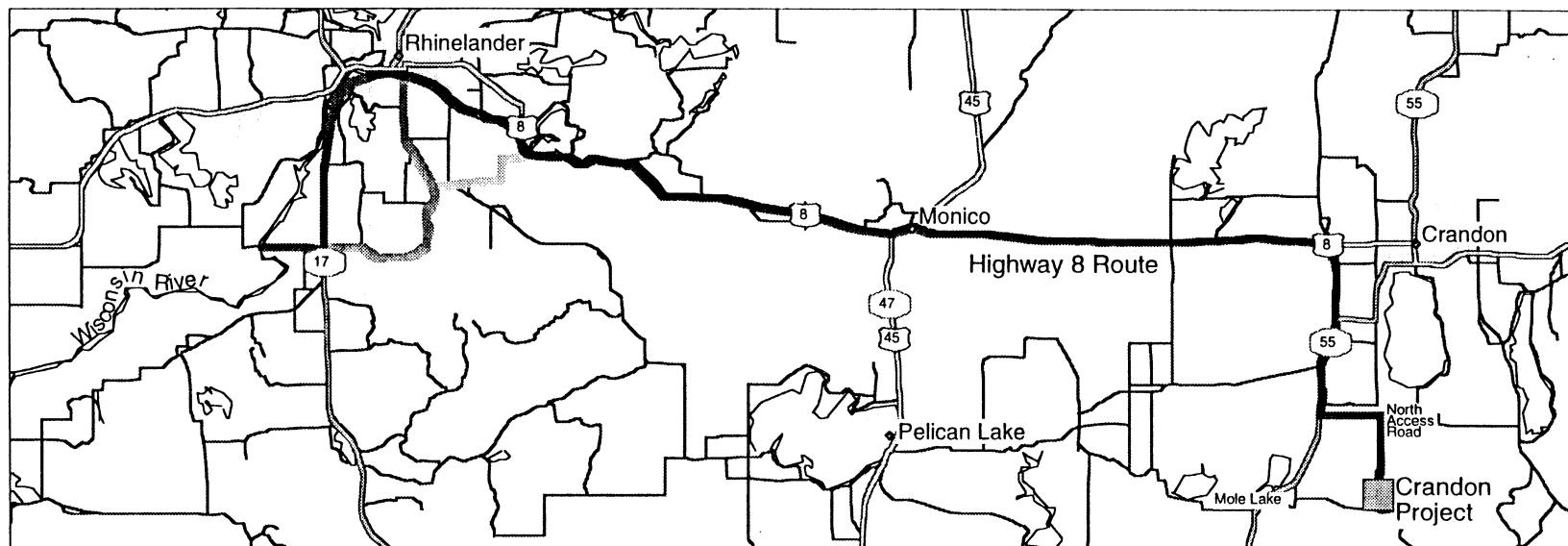
nd Wisconsin Land Economic Inventory, Forest and Oneida Counties,
Wisconsin. Box 2. *State Historical Society of Wisconsin, Archives Division*
Call Number: Series 1958, 1959.

APPENDIX B

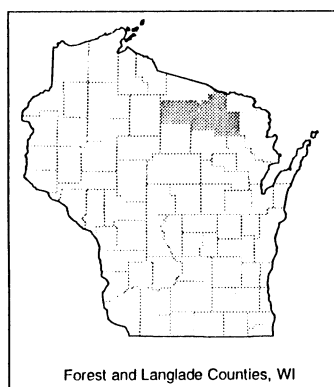
MAPS

PROJECT LOCATION

SURVEY SEGMENTS AND SITE LOCATIONS



Proposed Wisconsin River Wastewater Discharge Corridor



Crandon Project

Forest and Oneida Counties, Wisconsin

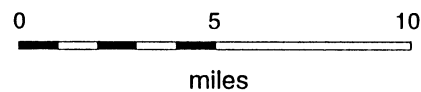


Figure 1

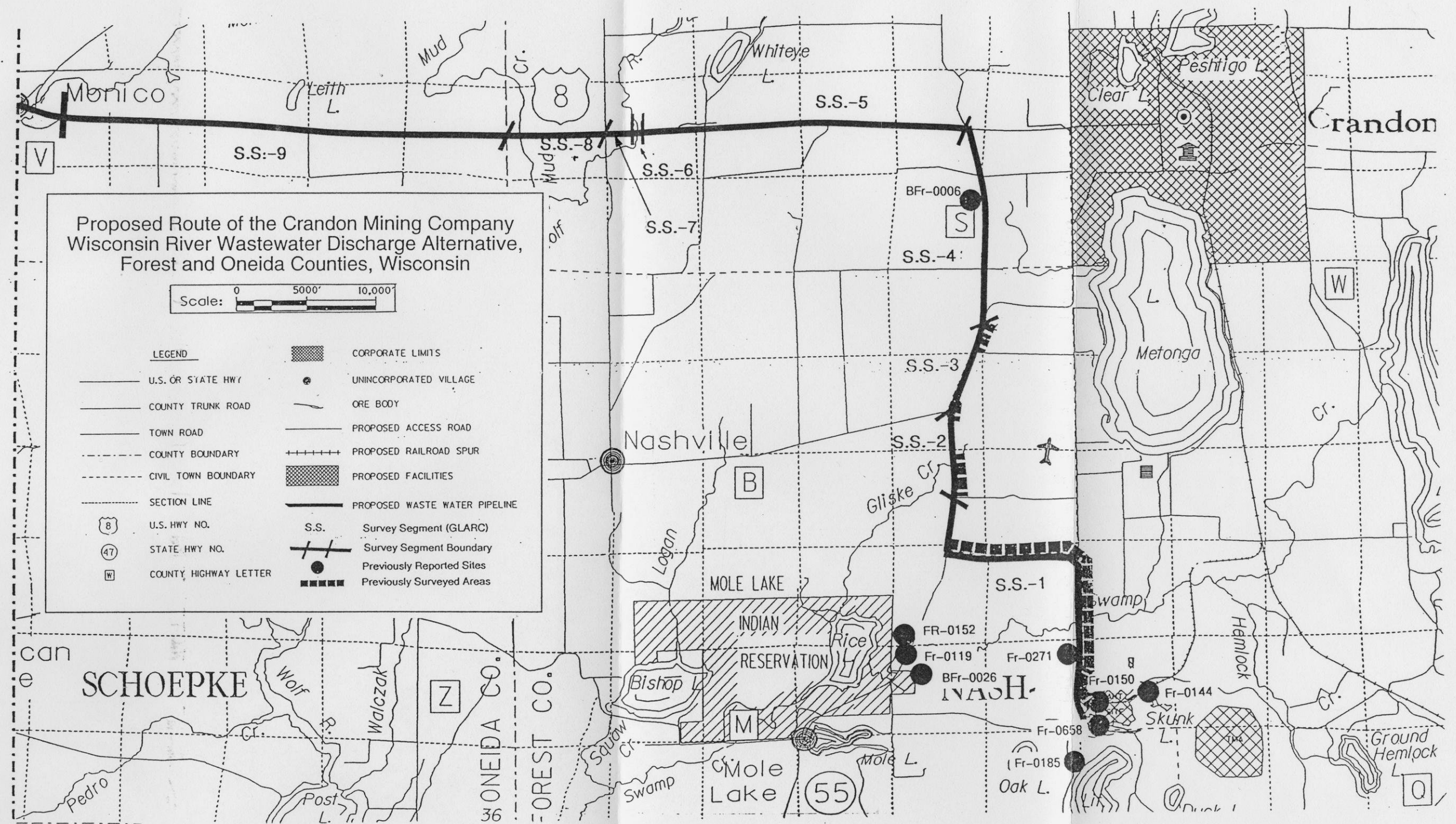


Figure 2

Appendix B

**Oneida County
Soil Survey Data Sheets**

SECTION II-B
SOIL DESCRIPTION REPORT
ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description
AcB	ALCONA FINE SANDY LOAM, 0 TO 6 PERCENT SLOPES Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy lacustrine deposits. This map unit is not highly erodible. The land capability classification is 2E. This map unit is prime farmland.
AcC	ALCONA FINE SANDY LOAM, 6 TO 15 PERCENT SLOPES Sloping, moderately well drained soil formed in sandy and loamy lacustrine deposits. This map unit is potentially highly erodible. The land capability classification is 3E.
Au	AU GRES LOAMY SAND, 0 TO 2 PERCENT SLOPES Nearly level, somewhat poorly drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 4W. This map unit may have hydric inclusions.
CaA	CABLE MUCK, 0 TO 3 PERCENT SLOPES, STONY Nearly level and gently sloping, poorly drained and very poorly drained soil formed in thin organic material overlying loamy deposits underlain by sandy loam glacial till. This map unit is not highly erodible. The land capacity classification is 6W. This map unit is hydric.
Cb	CARBONDALE, LUPTON, AND MARKEY MUCKS, 0 TO 1 PERCENT SLOPES Nearly level, very poorly drained soils formed in organic material more than 51 inches thick or underlain by sandy glacial outwash at depth of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.
CrA	CROSWELL SAND, 0 TO 3 PERCENT SLOPES Nearly level and gently sloping, moderately well drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 4S.
CsA	CROSWELL LOAMY SAND, LOAMY SUBSTRATUM, 0 TO 3 PERCENT SLOPES Nearly level and gently sloping, moderately well drained soil formed in sandy glacial outwash over silty and sandy lacustrine deposits. This map unit is not highly erodible. The land capability classification is 4S.

SECTION II-B
SOIL DESCRIPTION REPORT
ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description
EmE	EMMERT VERY GRAVELLY SAND, 20 TO 45 PERCENT SLOPES Moderately steep and steep, excessively drained soil formed in very gravelly sand glacial outwash. This map unit is highly erodible. The land capability classification is 7S.
Fh	FORDUM MUCKY VERY FINE SANDY LOAM, 0 TO 2 PERCENT SLOPES Nearly level, frequently flooded, poorly drained and very poorly drained soil formed in loamy and sandy alluvium. This map unit is not highly erodible. The land capability classification is 6W. This map unit is hydric.
GoB	GOODMAN SILT LOAM, 1 TO 6 PERCENT SLOPES, STONY Nearly level and gently sloping, moderately well-drained soil formed in silty deposits underlain by gravelly loamy sandy glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.
GoC	GOODMAN SILT LOAM, 6 TO 15 PERCENT SLOPES, STONY Sloping, moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.
GoD	GOODMAN SILT LOAM, 15 TO 25 PERCENT SLOPES, STONY Moderately steep, well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is highly erodible. The land capability classification is 7S in stony areas.
Gr	GREENWOOD, LOXLEY, AND DAWSON PEATS, 0 TO 1 PERCENT SLOPES Nearly level, very poorly drained soil formed in acid organic material more than 51 inches thick or underlain by sandy glacial outwash at depths of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.
KaB	KARLIN LOAMY FINE SAND, 0 TO 6 PERCENT SLOPES Nearly level and gently sloping, somewhat excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 3S.

SECTION II-B
SOIL DESCRIPTION REPORT
ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description
KeB	KEWEENAW SANDY LOAM, 1 TO 6 PERCENT SLOPES, STONY Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift. This map unit is not highly erodible. The land capability classification is 6S in stony areas.
KeC	KEWEENAW SANDY LOAM, 6 TO 15 PERCENT SLOPES, STONY Sloping, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.
KeD	KEWEENAW SANDY LOAM, 15 TO 25 PERCENT SLOPES, STONY Moderately steep, well drained soil formed in sandy and loamy deposits over gravelly, loamy sand glacial drift. This map unit is potentially highly erodible. The land capability classification is 7S in stony areas.
KnB	KEWEENAW-VILAS COMPLEX, 1 TO 6 PERCENT SLOPES, STONY Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and nearly level, and gently sloping, excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 6S in stony areas.
KnC	KEWEENAW-VILAS COMPLEX, 6 TO 15 PERCENT SLOPES, STONY Sloping, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and sloping, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.
KrD	KEWEENAW-SAYNER COMPLEX, 15 TO 30 PERCENT SLOPES, STONY Moderately steep and steep, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and moderately steep and steep, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel. This map unit is highly erodible. The land capability classification is 7S in stony areas.

SECTION II-B
SOIL DESCRIPTION REPORT
ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description

Ks	KINROSS MUCK, 0 TO 2 PERCENT SLOPES Nearly level, poorly drained soil formed in thin organic material overlying sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 6W. This map unit is hydric.
MaB	MAGNOR SILT LOAM, 1 TO 6 PERCENT SLOPES, STONY Nearly level and gently sloping, somewhat poorly drained soil formed in silty deposits underlain by sandy loam glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.
Mc	MINOCQUA SILT LOAM, 0 TO 2 PERCENT SLOPES Nearly level, poorly drained and very poorly drained soil formed in silty and loamy deposits underlain by gravelly coarse sand glacial outwash. This map unit is not highly erodible. The land capability classification is 6W. This map unit is hydric.
MoB	MONICO LOAM, 1 TO 6 PERCENT SLOPES, STONY Nearly level and gently sloping, somewhat poorly drained soil formed in silty and loamy deposits underlain by sandy loam glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.
PaB	PADUS LOAM, 0 TO 6 PERCENT SLOPES Nearly level and gently sloping, moderately well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 2E. This map unit is prime farmland.
PaC	PADUS LOAM, 6 TO 15 PERCENT SLOPES Sloping, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 3E.
PaD	PADUS LOAM, 15 TO 25 PERCENT SLOPES Moderately steep, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash. This map unit is highly erodible. The land capability classification is 6E.

SECTION II-B
SOIL DESCRIPTION REPORT
ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description
PbB	PADUS-GOODMAN COMPLEX, 1 TO 6 PERCENT SLOPES, STONY Nearly level and gently sloping, moderately well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash, and nearly level and gently sloping moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.
PbC	PADUS-GOODMAN COMPLEX, 6 TO 15 PERCENT SLOPES, STONY Sloping, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash and moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.
PbD	PADUS-GOODMAN COMPLEX, 15 TO 25 PERCENT SLOPES, STONY Moderately steep, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash and moderately steep, well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is highly erodible. The land capability classification is 7S in stony areas. This map unit may have hydric inclusions.
PeB	PADUS-PENCE SANDY LOAMS, 1 TO 6 PERCENT SLOPES Nearly level and gently sloping, well drained soils formed in loamy deposits underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is potentially highly erodible. The land capability classification is 3E.
PeC	PADUS-PENCE SANDY LOAMS, 6 TO 15 PERCENT SLOPES Sloping, well drained soils formed in loamy deposits underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is potentially highly erodible. The land capability classification is 4E.
PeD	PADUS-PENCE SANDY LOAMS, 15 TO 45 PERCENT SLOPES Moderately steep and steep, well drained loamy soils underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is highly erodible. The land capability classification is 7E.

SECTION II-B
SOIL DESCRIPTION REPORT
ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description
PrB	PEQUAMING LOAMY SAND, 1 TO 3 PERCENT SLOPES, STONY Nearly level and gently sloping, somewhat poorly drained soil formed mainly in sandy deposits over sandy and loamy glacial drift. This map unit is not highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.
Pt	PITS, GRAVEL Pits, sand or gravel
PvA	PLOVER FINE SANDY LOAM, 0 TO 3 PERCENT SLOPES Nearly level and gently sloping, somewhat poorly drained soil formed in sandy, loamy, and silty lacustrine deposits. This map unit is not highly erodible. The land capability classification is 2W. This map unit is prime farmland where drained. This map unit may have hydric inclusions.
RsB	ROUSSEAU LOAMY FINE SAND, 0 TO 6 PERCENT SLOPES Nearly level and gently sloping, well drained soil formed in sandy, glacial outwash and lacustrine deposits. This map unit is not highly erodible. The land capability classification is 3S.
RsC	ROUSSEAU LOAMY FINE SAND, 6 TO 15 PERCENT SLOPES Sloping, well drained soil formed in sandy glacial outwash and lacustrine deposits. This map unit is potentially highly erodible. The land capability classification is 3E.
SaB	SAYNER LOAMY SAND, 0 TO 6 PERCENT SLOPES Nearly level and gently sloping, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 4S.
SaC	SAYNER LOAMY SAND, 6 TO 15 PERCENT SLOPES Sloping, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S.
SaD	SAYNER LOAMY SAND, 15 TO 45 PERCENT SLOPES Moderately steep and steep, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel glacial outwash. This map unit is highly erodible. The land capability classification is 7S.

SECTION II-B

SOIL DESCRIPTION REPORT

ONEIDA COUNTY, WI

Map Unit Symbol	Map unit name / Description
VsB	VILAS LOAMY SAND, 0 TO 6 PERCENT SLOPES Nearly level and gently sloping, excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 4S.
VsC	VILAS LOAMY SAND, 6 TO 15 PERCENT SLOPES Sloping, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S.
VsD	VILAS LOAMY SAND, 15 TO 25 PERCENT SLOPES Moderately steep, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 7S.
WoA	WORCESTER SANDY LOAM, 0 TO 3 PERCENT SLOPES Nearly level and gently sloping, somewhat poorly drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash. This map unit is not highly erodible. The land capability classification is 2W. This map unit is prime farmland where drained. This map unit may have hydric inclusions.

Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy lacustrine deposits. This map unit is not highly erodible. The land capability classification is 2E. This map unit is prime farmland.

Component Name: ALCONA

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Classification												>10	3-10	Percent < 3 in. passing sieve				Clay %				
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm									
0- 9	FSL		SM SM-SC ML CL-ML		A-4 A-2-4		-	0-8	95-100	90-100	55- 95	25- 65	5-15									
9-16	LFS VFSL GR-SL		SM ML SC CL		A-4 A-2-4		-	0-8	85-100	70-100	55- 95	15- 65	5-20									
16-29	SL VFSL L		SC SM-SC CL CL-ML		A-2-4 A-4		-	0-8	95-100	90-100	55- 85	25- 70	10-20									
29-60	SR- FS SIL		SM ML		A-4 A-2-4		-	0-8	95-100	90-100	60- 95	25- 85	5-18									
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K											
0- 9	<25	NP-7	1.1-1.6	0.6-6.	0.12-0.18	4.5-7.3	-	-	1.- 3.	LOW	0.24											
9-16	<30	NP-10	1.3-1.7	0.6-6.	0.1-0.17	4.5-7.3	-	-	-	LOW	0.17											
16-29	20-30	4-10	1.4-1.7	0.6-2.	0.13- 0.2	5.1-7.8	-	-	-	LOW	0.24											
29-60	<30	NP-7	1.5-1.7	0.6-2.	0.08- 0.2	5.1-7.8	-	-	-	LOW	0.24											
												Wind	Risk of Corrosion		Potential							
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost												
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel	Concrete	Action										
NONE	-	-	2.5-6.0	PERCHED	SEP-MAY	>60	B	5	86	MODERATE	LOW	MODERATE										

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		POOR	Too Sandy	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		MODERATE	Wetness	
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		MODERATE	Frost Action	
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Too Sandy	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		MODERATE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Slope	Cutbanks Cave
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Droughty	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SLIGHT	
Picnic Areas	SLIGHT	
Playgrounds	MODERATE	Slope
Paths and Trails	SLIGHT	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				75	4.2	3.3	5.3	3.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE		red maple sugar maple yellow birch American beech white ash northern red oak American basswood red pine eastern white pine white spruce	E E E E E E E EP EP P	0 61 0 0 0 0 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur privet	11	arrowwood	14	eastern white pine	30
imperial Carolina poplar	70	lilac	11	nannyberry viburnum	14	Norway spruce	28
red pine	29	Siberian crabapple	13	silky dogwood	10	white spruce	22

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, moderately well drained soil formed in sandy and loamy lacustrine deposits. This map unit is potentially highly erodible. The land capability classification is 3E.

Component Name: ALCONA

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 9	FSL	SM	SM-SC	ML	CL-ML	A-4	A-2-4	-	0-8	95-100	90-100	55- 95	25- 65	5-15
9-16	LFS VFSL GR-SL	SM	ML	SC	CL	A-4	A-2-4	-	0-8	85-100	70-100	55- 95	15- 65	5-20
16-29	SL VFSL L	SC	SM-SC	CL	CL-ML	A-2-4	A-4	-	0-8	95-100	90-100	55- 85	25- 70	10-20
29-60	SR- FS SIL	SM	ML			A-4	A-2-4	-	0-8	95-100	90-100	60- 95	25- 85	5-18

	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K
0- 9	<25	NP-7	1.1-1.6	0.6-6.	0.12-0.18	4.5-7.3	-	-	1.- 3.	LOW	0.24
9-16	<30	NP-10	1.3-1.7	0.6-6.	0.1-0.17	4.5-7.3	-	-	-	LOW	0.17
16-29	20-30	4-10	1.4-1.7	0.6-2.	0.13- 0.2	5.1-7.8	-	-	-	LOW	0.24
29-60	<30	NP-7	1.5-1.7	0.6-2.	0.08- 0.2	5.1-7.8	-	-	-	LOW	0.24

								Wind	Risk of Corrosion		Potential		
----- Flooding-----			---- Water Table-(feet) ---			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action
-----			-----			-----			-----			-----	
NONE	-	-	2.5-6.0	PERCHED	SEP-MAY	>60		B	5	86	MODERATE	LOW	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		POOR	Too Sandy	

BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Wetness	Slope
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	Frost Action
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty

CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Too Sandy	

WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Slope	
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Slope	Cutbanks Cave
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Slope	Wetness
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SLIGHT	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				65	3.5	2.5	5.1	3.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE		red maple sugar maple yellow birch American beech white ash northern red oak American basswood red pine eastern white pine white spruce	E E E E E E E EP EP P	0 61 0 0 0 0 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur privet	11	arrowwood	14	eastern white pine	30
imperial Carolina poplar	70	lilac	11	nannyberry viburnum	14	Norway spruce	28
red pine	29	Siberian crabapple	13	silky dogwood	10	white spruce	22

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

03/12/91

AU AU GRES LOAMY SAND, 0 TO 2 PERCENT SLOPES

Nearly level, somewhat poorly drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 4W.

Component Name: AU GRES

Classification: ENTIC HAPLAQUODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Unified	Classification	AASHTO	>10 In.	3-10 Inches	Percent < 3 in. passing sieve	Clay %
							No. 4 No.10 No.40 No.200	<.002 mm
0-3	LS	SM SP-SM SM-SC	A-2-4 A-1-B	-	0		95-100 85-100 40- 75 10- 30	10-15
3-25	S LS	SP-SM SM SM-SC	A-2-4 A-3 A-1-B	-	0		95-100 85-100 40- 75 5- 30	1-15
25-60	S	SP-SM SM	A-3 A-2-4 A-1-B	-	0		95-100 85-100 40- 60 5- 15	0- 8

Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-3	<25	NP-7	1.3-1.5	6.-20.	0.07-0.09	3.6-7.3	-	-	0.5- 8.	LOW	0.17
3-25	<25	NP-7	1.5-1.7	6.-20.	0.06-0.09	4.5-7.3	-	-	-	LOW	0.15
25-60	-	NP	1.5-1.7	6.-20.	0.05-0.07	5.1-7.3	-	-	-	LOW	0.15

Frequency	Flooding Duration	Months	Water Table-(feet) Depth	Kind	Months	Bedrock-(in) Depth	Hard.	HYD T	Erod.	Uncoated Steel	Risk of Corrosion Concrete	Potential Frost Action
NONE	-	-	0.5-1.5	APPARENT	NOV-MAY	>60		B	5	134	LOW MODERATE	MODERATE

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)
Septic Tank Absorption Fields	SEVERE	Wetness
Daily Cover for Landfill	POOR	Seepage

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Shallow Excavations	SEVERE	Cutbanks Cave
Dwellings Without Basements	SEVERE	Wetness
Dwellings With Basements	SEVERE	Wetness
Small Commercial Buildings	SEVERE	Wetness
Local Streets and Roads	SEVERE	Wetness
Lawns, Landscaping, and Golf Fairways	SEVERE	Wetness

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)
Roadfill	POOR	Wetness
Sand	PROBABLE	
Gravel	IMPROBABLE	Too Sandy
Topsoil	POOR	Too Sandy

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)
Pond Reservoir Area	SEVERE	Seepage
Embankments, Dikes and Levees	SEVERE	Seepage
Drainage	LIMITATION	Cutbanks Cave
Irrigation	LIMITATION	Wetness
Terraces and Diversions	LIMITATION	Wetness
Grassed Waterways	LIMITATION	Wetness

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Wetness
Picnic Areas	SEVERE	Wetness
Playgrounds	SEVERE	Wetness
Paths and Trails	SEVERE	Wetness

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
				45	2.2	1.7	4.6	1.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
6W	SLIGHT	SEVERE	MODERATE	SEVERE	SEVERE		balsam fir red maple yellow birch paper birch bigtooth aspen quaking aspen northern whitecedar eastern hemlock eastern white pine Norway spruce white spruce red pine	E E E E E E E E EP P P P	0 0 0 0 0 70 0 0 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	9	Amur maple	15	common ninebark	8	eastern white pine	28
green ash	30	imperial Carolina poplar	60	jack pine	28	Manchurian crabapple	19
nannyberry viburnum	14	Norway spruce	28	silky dogwood	10	white spruce	24

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, poorly drained and very poorly drained soil formed in thin organic material overlying loamy deposits underlain by sandy loam glacial till. This map unit is not highly erodible. The land capacity classification is 6W. This map unit is hydric.

Component Name: CABLE

Classification: TYPIC HAPLAQUEPTS, COARSE-LOAMY, MIXED, NONACID, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No. 4	No.10	No.40	No.200	
0-3	SP	PT	A-8	-	25-50	-	-	-	-	0-
3-31	SIL L FSL	SM SC ML CL	A-2 A-4	-	0-25	75-100	75-100	50-100	30- 90	8-18
31-34	L SL GR-SL	SM SC ML CL	A-2 A-4 A-1	-	0-25	65-100	60-100	35- 95	20- 75	8-16
34-60	SL GR-SL	SM GM ML CL-ML	A-2 A-1 A-4	-	0-25	65-100	60-100	40- 90	20- 70	5-10

Depth (In)	Liquid Limit Index	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-3	-	-	0.1-0.3	2.-6.	0.35-0.45	4.5-7.3	-	-	60.-90.	LOW	0.1
3-31	<33	NP-10	1.4-1.5	0.2-2.	0.1-0.22	4.5-7.3	-	-	-	LOW	0.37
31-34	<27	NP-8	1.4-1.9	0.2-2.	0.03-0.18	4.5-7.3	-	-	-	LOW	0.37
34-60	<23	NP-6	1.7-1.9	0.2-0.6	0.03-0.13	5.1-7.8	-	-	-	LOW	0.28

Flooding			Water Table-(feet)			Bedrock-(in)		Wind		Risk of Corrosion		Potential	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	HYD	T	Erod.	Uncoated	Frost	
								GRP	Fact.	Index	Steel	Concrete	
NONE	-	-	+1-1.0 APPARENT YEAR-ROUND			>60		B/D	5	0	HIGH	HIGH	HIGH

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields	SEVERE	Ponding	Perchs Slowly
Daily Cover for Landfill	POOR	Small Stones	Ponding

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations	SEVERE	Ponding	
Dwellings Without Basements	SEVERE	Ponding	
Dwellings With Basements	SEVERE	Ponding	
Small Commercial Buildings	SEVERE	Ponding	
Local Streets and Roads	SEVERE	Ponding	Frost Action
Lawns, Landscaping, and Golf Fairways	SEVERE	Large Stones	Ponding Excess Humus

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)	
Roadfill	POOR	Wetness	
Sand	IMPROBABLE	Excess Fines	
Gravel	IMPROBABLE	Excess Fines	
Topsoil	POOR	Area Reclaim	Small Stones Wetness

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area	MODERATE	Seepage	
Embankments, Dikes and Levees	SEVERE	Piping	Ponding
Drainage	LIMITATION	Ponding	Frost Action
Irrigation	LIMITATION	Large Stones	Ponding
Terraces and Diversions	LIMITATION	Large Stones	Erodes Easily Ponding
Grassed Waterways	LIMITATION	Large Stones	Wetness Erodes Easily

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	SEVERE	Ponding	Excess Humus	
Picnic Areas	SEVERE	Ponding	Excess Humus	
Playgrounds	SEVERE	Ponding		
Paths and Trails	SEVERE	Ponding	Excess Humus	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
2X	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE		white ash black ash quaking aspen balsam fir red maple white spruce black spruce	E E E EP EP EP EP	48 2

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, very poorly drained soils formed in organic material more than 51 inches thick or underlain by sandy glacial outwash at depth of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.

Component Name: CARBONDALE

This map unit has 3 components and 3 interpretation sheets.

Classification: HEMIC BOROSAPRISTS, EUIC

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay %	
		Unified	AASHTO			No. 4	No. 10	No. 40	No. 200	<.002 mm	
0-35	SP	PT	A-8	-	0	-	-	-	-	0-	
35-60	HM	PT	A-8	-	0	-	-	-	-	0-	
Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-35	-	-	0.3-0.4	0.2-6.	0.35-0.45	5.6-7.8	-	-	40.-65.		0.1
35-60	-	-	0.1-0.2	0.6-6.	0.45-0.55	5.6-7.8	-	-	-		
							Wind	Risk of Corrosion		Potential	
Flooding-----								Uncoated		Frost	
Frequency Duration Months							HYD T	Erod.		Action	
							GRP Fact.	Index			
NONE							A/D	5 134		HIGH MODERATE	
										HIGH	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Subsides	Ponding	Perchs Slowly
Daily Cover for Landfill		POOR	Ponding	Excess Humus	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Excess Humus	Ponding	
Dwellings Without Basements		SEVERE	Subsides	Ponding	Low Strength
Dwellings With Basements		SEVERE	Subsides	Ponding	Low Strength
Small Commercial Buildings		SEVERE	Subsides	Ponding	Low Strength
Local Streets and Roads		SEVERE	Subsides	Ponding	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Excess Humus	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		POOR	Wetness		
Sand		IMPROBABLE	Excess Humus		
Gravel		IMPROBABLE	Excess Humus		
Topsoil		POOR	Excess Humus	Wetness	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage		
Embankments, Dikes and Levees		SEVERE	Excess Humus	Ponding	
Drainage -		LIMITATION	Ponding	Subsides	Frost Action
Irrigation		LIMITATION	Ponding	Soil Blowing	
Terraces and Diversions		LIMITATION	Ponding	Soil Blowing	
Grassed Waterways		LIMITATION	Wetness		

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SEVERE	Ponding	Excess Humus
Picnic Areas	SEVERE	Ponding	Excess Humus
Playgrounds	SEVERE	Excess Humus	Ponding
Paths and Trails	SEVERE	Ponding	Excess Humus

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
5W	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE		balsam fir silver maple paper birch tamarack black spruce northern whitecedar	E E E E E E	5 2 15 2

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, very poorly drained soils formed in organic material more than 51 inches thick or underlain by sandy glacial outwash at depth of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.

Component Name: LUPTON

This map unit has 3 components and 3 interpretation sheets.

Classification: TYPIC BOROSAPRISTS, EUIC

ESTIMATED SOIL PROPERTIES

Classification												>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm					
0-12	SP		PT		A-8		-	0	-	-	-	-	-	-				
12-60	SP		PT		A-8		-	0	-	-	-	-	-	-				
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K							
0-12	-	-	0.1-0.3	0.2-6.	0.35-0.45	5.6-7.8	-	-	70.-90.		0.1							
12-60	-	-	0.1-0.3	0.2-6.	0.35-0.45	5.6-7.8	-	-	-									
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Wind Erod.	Risk of Corrosion		Potential Frost							
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Uncoated Steel	Concrete	Action							
NONE	-	-	+1-1.0 APPARENT YEAR-ROUND			>60	4/D	5 134	HIGH	LOW	HIGH							

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Subsides	Ponding
Daily Cover for Landfill		POOR	Ponding	Excess Humus
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Excess Humus	Ponding
Dwellings Without Basements		SEVERE	Subsides	Ponding
Dwellings With Basements		SEVERE	Subsides	Ponding
Small Commercial Buildings		SEVERE	Subsides	Ponding
Local Streets and Roads		SEVERE	Ponding	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Excess Humus
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Wetness	Low Strength
Sand		IMPROBABLE	Excess Humus	
Gravel		IMPROBABLE	Excess Humus	
Topsoil		POOR	Excess Humus	Wetness
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Excess Humus	Ponding
Drainage		LIMITATION	Ponding	Subsides
Irrigation		LIMITATION	Ponding	Soil Blowing
Terraces and Diversions		LIMITATION	Ponding	Soil Blowing
Grassed Waterways		LIMITATION	Wetness	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SEVERE	Ponding	Excess Humus
Picnic Areas	SEVERE	Ponding	Excess Humus
Playgrounds	SEVERE	Excess Humus	Ponding
Paths and Trails	SEVERE	Ponding	Excess Humus

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
ZW	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE		balsam fir red maple paper birch black ash tamarack white spruce black spruce quaking aspen northern whitecedar	E E E E E E E E E	46 20 6

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, very poorly drained soils formed in organic material more than 51 inches thick or underlain by sandy glacial outwash at depth of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.

Component Name: MARKEY

This map unit has 3 components and 3 interpretation sheets.

Classification: TERRIC BOROSAPRISTS, SANDY OR SANDY-SKELETAL, MIXED, EUIC

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0-26	SP	PT		A-8		-	-	-	-	-	-	0-
26-60	S LS FS	SP SM SP-SM		A-2 A-3 A-1		-	0	95-100	75-100	35- 75	0- 30	0-10
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	
0-26	-	-	0.2-0.4	0.2-6.	0.35-0.45	5.6-7.8	-	-	55.-85.			0.1
26-60	-	NP	1.4-1.6	6.-20.	0.03-0.08	5.6-8.4	-	-	-	LOW		
----- Flooding-----			---- Water Table-(feet) ---			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE	-	-	+1-1.0 APPARENT YEAR-ROUND			>60	A/D	4 134	HIGH	LOW	HIGH	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Subsides	Ponding	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy	Ponding
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave	Excess Humus	Ponding
Dwellings Without Basements		SEVERE	Subsides	Ponding	Low Strength
Dwellings With Basements		SEVERE	Subsides	Ponding	
Small Commercial Buildings		SEVERE	Subsides	Ponding	Low Strength
Local Streets and Roads		SEVERE	Ponding	Frost Action	Subsides
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Excess Humus	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		POOR	Wetness		
Sand		PROBABLE			
Gravel		IMPROBABLE	Too Sandy		
Topsoil		POOR	Excess Humus	Wetness	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage		
Embankments, Dikes and Levees		SEVERE	Seepage	Piping	Ponding
Drainage		LIMITATION	Ponding	Subsides	Frost Action
Irrigation		LIMITATION	Ponding	Soil Blowing	
Terraces and Diversions		LIMITATION	Ponding	Too Sandy	Soil Blowing
Grassed Waterways		LIMITATION	Wetness		

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SEVERE	Ponding	Excess Humus
Picnic Areas	SEVERE	Ponding	Excess Humus
Playgrounds	SEVERE	Excess Humus	Ponding
Paths and Trails	SEVERE	Ponding	Excess Humus

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
ZW	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE		balsam fir red maple paper birch black ash tamarack white spruce black spruce quaking aspen northern whitecedar	E E E E E E E E E E	45 2

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 4S.

Component Name: CROSWELL

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 4 S		SP-SM	SM	A-3 A-2-4 A-1-B	-	0	90-100	85-100	40- 70	5- 15	0-10
4-38 S LS		SP-SM	SM SP	A-3 A-2-4 A-1-B	-	0	90-100	85-100	40- 75	3- 30	0-10
38-60 S		SP-SM	SM SP	A-3 A-2-4 A-1-B	-	0	90-100	85-100	40- 70	3- 15	0-10
	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 4	-	NP	1.3-1.5	6.-20.	0.06-0.09	3.6-6.5	-	-	0.5- 2.	LOW	0.15
4-38	-	NP	1.4-1.6	6.-20.	0.06- 0.1	4.5-7.3	-	-	-	LOW	0.15
38-60	-	NP	1.5-1.6	6.-20.	0.05-0.07	5.1-8.4	-	-	-	LOW	0.15
							Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)		Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE	-	-	2.0-4.0	APPARENT	NOV-MAY	>60	A 5	250	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		MODERATE	Wetness	
Dwellings With Basements		SEVERE	Wetness	
Small Commercial Buildings		MODERATE	Wetness	
Local Streets and Roads		MODERATE	Wetness	
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	Too Sandy
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Cutbanks Cave	
Irrigation		LIMITATION	Wetness	Droughty
Terraces and Diversions		LIMITATION	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Droughty	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Too Sandy
Picnic Areas	SEVERE	Too Sandy
Playgrounds	SEVERE	Too Sandy
Paths and Trails	SEVERE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanent Pasture
bu/a	tons/a	bu/a	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM
				40	2.5	2.	4.3	1.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
5S	SLIGHT	MODERATE	MODERATE	MODERATE	MODERATE		red maple	E 0	0
							jack pine	E 53	5
							bigtooth aspen	E 0	0
							quaking aspen	E 68	5
							black cherry	E 0	0
							northern red oak	E 0	0
							red pine	EP 55	6
							eastern white pine	EP 0	0
							white spruce	P 0	0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
Amur maple	10	Amur privet	10	eastern redcedar	16	eastern white pine	28
imperial Carolina poplar	65	lilac	10	manyflower cotoneaster	6	Norway spruce	30
red pine	28	Siberian crabapple	20	silky dogwood	9	white spruce	26

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in sandy glacial outwash over silty and sandy lacustrine deposits. This map unit is not highly erodible. The land capability classification is 4S.

Component Name: CROSWELL

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Unified	Classification AASHTO	>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
						No 4	No.10	No.40	No.200	
0-8	LS	SM	A-2 A-1	-	0	90-100	85-100	40- 75	15- 30	0-10
8-24	S LS	SP-SM SM SP	A-3 A-2 A-1	-	0	90-100	85-100	40- 75	0- 30	0-10
24-54	S	SP-SM SM SP	A-3 A-2 A-1	-	0	90-100	85-100	40- 70	0- 25	0- 5
54-60	SR- FS SIL	CL SC SM-SC CL-ML	A-6 A-4 A-2	-	0	100-100	90-100	65- 95	20- 90	10-25

Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-8	<20	NP-4	1.2-1.6	6.-20.	0.09-0.12	4.5- 6.	-	-	0.5- 1.	LOW	0.17
8-24	<20	NP-4	1.4-1.8	6.-20.	0.06- 0.1	5.1-6.5	-	-	-	LOW	0.15
24-54	-	NP	1.5-1.7	6.-20.	0.04-0.06	5.1-6.5	-	-	-	LOW	0.15
54-60	20-35	4-15	1.3-1.9	0.2-0.6	0.05-0.21	5.1-7.8	-	-	-	LOW	0.24

Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Uncoated Steel	Concrete	Potential Frost Action
NONE	-	-	2.5-5.0	PERCHED	NOV-MAY	>60		A	5 134	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	Percs Slowly
Daily Cover for Landfill		POOR	Seepage	Too Sandy

BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		MODERATE	Wetness	
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		SLIGHT		
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	

CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Thin Layer	
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	

WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Cutbanks Cave	
Irrigation		LIMITATION	Wetness	Droughty
Terraces and Diversions		LIMITATION	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Droughty	Soil Blowing

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Too Sandy
Picnic Areas	MODERATE	Too Sandy
Playgrounds	MODERATE	Small Stones Too Sandy
Paths and Trails	MODERATE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				50	2.5	2.	4.3	1.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
7A	SLIGHT	SLIGHT	SLIGHT	SLIGHT	MODERATE		red maple paper birch bigtooth aspen quaking aspen northern pin oak northern red oak American basswood jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 E 0 E 0 E 0 EP 0 EP 60 EP 0	0 0 0 0 0 0 0 0 7 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
eastern redcedar	15	eastern white pine	28	green ash	30	imperial Carolina poplar	60
jack pine	28	lilac	12	Manchurian crabapple	25	nannyberry viburnum	8
Norway spruce	26	red pine	28	Siberian peashrub	10	white spruce	22

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Moderately steep and steep, excessively drained soil formed in very gravelly sand glacial outwash. This map unit is highly erodible. The land capability classification is 7S.

Component Name: EMMERT

Classification: TYPIC UDORTHENTS, SANDY-SKELETAL, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture	Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 2	GRV-S	SM	SP	GW	GP	A-1	-	0-10	45- 90	40- 75	10- 50	0- 20	1- 5
2-60	GRV-COS GRV-S	GW	GP	SP	SW	A-1	-	0-30	20- 60	10- 45	5- 25	0- 5	1- 3
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion		
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor		
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K		
0- 2	15-25	NP	1.5-1.6	>20.	0.06- 0.1	5.1-6.5	-	-	0.5- 1.	LOW	0.1		
2-60	-	NP	1.5-1.6	>20.	0.02-0.04	5.1-7.3	-	-	-	LOW	0.1		
							Wind	Risk of Corrosion		Potential			
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost			
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action		
NONE	-	-	>6.0	-	-	>60	A	2 0	LOW	MODERATE	LOW		

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields	SEVERE	Poor Filter	Slope	
Daily Cover for Landfill	POOR	Seepage	Too Sandy	Small Stones

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations	SEVERE	Cutbanks Cave	Slope	
Dwellings Without Basements	SEVERE	Slope		
Dwellings With Basements	SEVERE	Slope		
Small Commercial Buildings	SEVERE	Slope		
Local Streets and Roads	SEVERE	Slope		
Lawns, Landscaping, and Golf Fairways	SEVERE	Small Stones	Droughty	

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)		
Roadfill	POOR	Slope		
Sand	PROBABLE			
Gravel	PROBABLE			
Topsoil	POOR	Too Sandy	Small Stones	Area Reclaim

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area	SEVERE	Seepage	Slope	
Embankments, Dikes and Levees	SEVERE	Seepage		
Drainage	LIMITATION	Deep To Water		
Irrigation	LIMITATION	Slope	Large Stones	Droughty
Terraces and Diversions	LIMITATION	Slope	Large Stones	Too Sandy
Grassed Waterways	LIMITATION	Large Stones	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope Small Stones
Paths and Trails	SEVERE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
6R	MODERATE	MODERATE	SEVERE	SLIGHT	SLIGHT		white spruce	E 55	7
							jack pine	EP 60	6
							red pine	EP 52	6
							eastern white pine	EP 50	6

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, frequently flooded, poorly drained and very poorly drained soil formed in loamy and sandy alluvium. This map unit is not highly erodible. The land capability classification is 6W. This map unit is hydric.

Component Name: FORDUM

Classification: MOLLIC FLUVAQUENTS, COARSE-LOAMY, MIXED, NONACID, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification					>10	3-10	Percent < 3 in. passing sieve				Clay %			
Depth	USDA Texture	Unified		AASHTO			In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		

0- 7	MK-VFSL	SM	SM-SC	ML	CL-ML	A-4	A-2	A-1	-	0-15	80-100	75-100	45- 95	20- 65	8-15
7-39	SIL FSL L	SM	SC	ML	CL	A-2	A-4	A-1	-	0-15	80-100	75-100	45-100	20- 90	8-18
39-60	S FS LFS	SP	SM			A-3	A-2	A-1	-	0-15	80-100	75-100	35- 80	2- 35	2- 5

	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion				
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor				
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K				

0- 7	15-25	3-7	1.4-1.5	0.6-6.	0.11-0.18	5.6-8.4	-	-	3.-12.	LOW	0.2				
7-39	15-30	3-10	1.4-1.5	0.6-6.	0.1-0.22	5.6-8.4	-	-	-	LOW	0.43				
39-60	-	NP	1.5-1.7	6.-20.	0.04- 0.1	5.6-8.4	-	-	-	LOW	0.15				

Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Wind	Risk of Corrosion		Potential			
Frequency		Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Erod.	Uncoated	Frost			
									Fact.	Index	Steel	Concrete	Action		

FREQUENT	LONG	MAR-JUN	+1-1.0	APPARENT	YEAR-ROUND	>60		D	4	0	HIGH	HIGH	HIGH		

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Flooding	Ponding	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy	Ponding
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave	Ponding	
Dwellings Without Basements		SEVERE	Flooding	Ponding	
Dwellings With Basements		SEVERE	Flooding	Ponding	
Small Commercial Buildings		SEVERE	Flooding	Ponding	
Local Streets and Roads		SEVERE	Ponding	Flooding	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Flooding	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		POOR	Wetness		
Sand		PROBABLE			
Gravel		IMPROBABLE	Too Sandy		
Topsoil		POOR	Small Stones	Wetness	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage		
Embankments, Dikes and Levees		SEVERE	Seepage	Piping	Ponding
Drainage		LIMITATION	Ponding	Flooding	Frost Action
Irrigation		LIMITATION	Ponding	Flooding	
Terraces and Diversions		LIMITATION	Ponding	Too Sandy	
Grassed Waterways		LIMITATION	Wetness		

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	SEVERE	Flooding	Ponding	
Picnic Areas	SEVERE	Ponding		
Playgrounds	SEVERE	Ponding	Flooding	
Paths and Trails	SEVERE	Ponding		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
ZW	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE		balsam fir tamarack white spruce black spruce northern whitecedar red maple silver maple white ash	E 0 E 0 E 0 E 0 E 0 EP 0 EP 80 EP 0	0 0 0 0 0 0 2 0

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well-drained soil formed in silty deposits underlain by gravelly loamy sandy glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.

Component Name: GOODMAN

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 3	SIL	ML	CL-ML	A-4		-	25-50	90-100	90-100	80-100	55- 90	5-12
3-23	SIL	ML	CL-ML	A-4		-	0-15	95-100	90-100	85-100	55- 90	8-14
23-38	FSL SL L	ML	CL-ML SM SM-SC	A-2 A-1 A-4		-	25-50	65-100	60- 95	30- 90	13- 70	2-12
38-60	SL GR-SL LS	SM	SM-SC	A-2 A-1		-	0-15	65-100	60- 95	30- 80	13- 35	2-12
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	
0- 3	<23	NP-6	1.4-1.5	0.6-2.	0.11- 0.2	3.6-6.5	-	-	3.- 7.	LOW	0.37	
3-23	<25	NP-7	1.5-1.6	0.6-2.	0.17-0.22	3.6-6.5	-	-	-	LOW	0.37	
23-38	<23	NP-6	1.5-1.6	0.6-2.	0.04-0.16	3.6-6.5	-	-	-	LOW	0.24	
38-60	<23	NP-6	1.5-1.8	0.6-2.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.24	
								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency		Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE			-	-	1.5-3.0	PERCHED	NOV-MAY	>60	B	5	0	LOW HIGH MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		FAIR	Wetness	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		MODERATE	Wetness	
Dwellings With Basements		SEVERE	Wetness	
Small Commercial Buildings		MODERATE	Wetness	
Local Streets and Roads		MODERATE	Wetness	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Large Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		MODERATE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Slope	
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Large Stones	Erodes Easily
Grassed Waterways		LIMITATION	Erodes Easily	Large Stones

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	MODERATE	Wetness		
Picnic Areas	MODERATE	Wetness		
Playgrounds	MODERATE	Large Stones	Slope	Wetness
Paths and Trails	MODERATE	Large Stones	Wetness	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							6.6	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	MODERATE	SEVERE		sugar maple yellow birch paper birch bigtooth aspen quaking aspen American basswood white spruce red pine eastern white pine	E E E E E E P P P	69 68 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.

Component Name: GOODMAN

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Classification												>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm					
0- 3	SIL		ML CL-ML		A-4		-	25-50	90-100	90-100	80-100	55- 90	5-12					
3-23	SIL		ML CL-ML		A-4		-	0-15	95-100	90-100	85-100	55- 90	8-14					
23-38	FSL SL L		ML CL-ML SM SM-SC		A-2 A-1 A-4		-	25-50	65-100	60- 95	30- 90	13- 70	2-12					
38-60	SL GR-SL LS		SM SM-SC		A-2 A-1		-	0-15	65-100	60- 95	30- 80	13- 35	2-12					
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K							
0- 3	<23	NP-6	1.4-1.5	0.6-2.	0.11- 0.2	3.6-6.5	-	-	3.- 7.	LOW	0.37							
3-23	<25	NP-7	1.5-1.6	0.6-2.	0.17-0.22	3.6-6.5	-	-	-	LOW	0.37							
23-38	<23	NP-6	1.5-1.6	0.6-2.	0.04-0.16	3.6-6.5	-	-	-	LOW	0.24							
38-60	<23	NP-6	1.5-1.8	0.6-2.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.24							
								Wind	Risk of Corrosion		Potential							
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost								
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action							
NONE	-	-	1.5-3.0	PERCHED	NOV-MAY	>60	B	5	0	LOW	HIGH	MODERATE						

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		FAIR	Slope	Wetness
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		MODERATE	Wetness	Slope
Dwellings With Basements		SEVERE	Wetness	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Wetness	Slope
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	Frost Action
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Large Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Slope	
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Slope	
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Slope	Large Stones
Grassed Waterways		LIMITATION	Slope	Erodes Easily

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope Wetness
Picnic Areas	MODERATE	Slope Wetness
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Large Stones Wetness

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							6.4	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	MODERATE	SEVERE		sugar maple yellow birch paper birch bigtooth aspen quaking aspen American basswood white spruce red pine eastern white pine	E 69 E E E E E 68 P P P	3 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Moderately steep, well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is highly erodible. The land capability classification is 7S in stony areas.

Component Name: GOODMAN

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No. 4	No.10	No.40	No.200	
0-3	SIL	ML CL-ML	A-4	-	25-50	90-100	90-100	80-100	55- 90	5-12
3-23	SIL	ML CL-ML	A-4	-	0-10	95-100	90-100	85-100	55- 90	8-14
23-38	FSL SL L	ML CL-ML SM SM-SC	A-2 A-1 A-4	-	0-10	65-100	60- 95	30- 90	13- 70	2-12
38-60	SL GR-SL LS	SM SM-SC	A-2 A-1	-	0-10	65-100	60- 95	30- 80	13- 35	2-12

Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-3	<23	NP-6	1.4-1.5	0.6-2.	0.11- 0.2	3.6-6.5	-	-	3.- 7.	LOW	0.37
3-23	<25	NP-7	1.5-1.6	0.6-2.	0.17-0.22	3.6-6.5	-	-	-	LOW	0.37
23-38	<25	NP-7	1.5-1.6	0.6-2.	0.04-0.16	3.6-6.5	-	-	-	LOW	0.24
38-60	<23	NP-6	1.5-1.8	0.6-2.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.24

Flooding			Water Table-(feet)			Bedrock-(in)		HYD	T	Erod.	Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Uncoated Steel	Concrete	Frost Action
NONE	-	-	>6.0	-	-	>60		B	5	0	LOW	HIGH	MODERATE

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields	SEVERE	Slope	
Daily Cover for Landfill	POOR	Slope	

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations	SEVERE	Cutbanks Cave	Slope
Dwellings Without Basements	SEVERE	Slope	
Dwellings With Basements	SEVERE	Slope	
Small Commercial Buildings	SEVERE	Slope	
Local Streets and Roads	SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways	SEVERE	Large Stones	Slope

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)	
Roadfill	FAIR	Slope	
Sand	IMPROBABLE	Excess Fines	
Gravel	IMPROBABLE	Excess Fines	
Topsoil	POOR	Large Stones	Slope

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area	SEVERE	Slope	
Embankments, Dikes and Levees	SEVERE	Piping	
Drainage	LIMITATION	Deep To Water	
Irrigation	LIMITATION	Slope	
Terraces and Diversions	LIMITATION	Slope	Erodes Easily
Grassed Waterways	LIMITATION	Slope	Erodes Easily

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Large Stones Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							6.	2.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3R	SLIGHT	MODERATE	SLIGHT	SLIGHT	SEVERE	NORTH	sugar maple yellow birch paper birch bigtooth aspen quaking aspen American basswood white spruce red pine eastern white pine	E E E E E E P P P	69 68 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, very poorly drained soil formed in acid organic material more than 51 inches thick or underlain by sandy glacial outwash at depths of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.

Component Name: GREENWOOD

This map unit has 3 components and 3 interpretation sheets.

Classification: TYPIC BOROHEMISTS, DYSIC

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 9	FB	PT		A-8		-	0	-	-	-	-	-		
9-60	HM	PT		A-8		-	0	-	-	-	-	-		
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion			
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor			
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K			
0- 9	-	-	0.3-0.4	6.-20.	0.55-0.65	3.6-4.4	-	-	55.-75.		0.1			
9-60	-	-	0.1-0.3	0.6-6.	0.45-0.55	3.6-4.4	-	-	-					
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Wind	Risk of Corrosion		Potential		
Frequency		Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Erod.	Uncoated	Frost		
									Fact.	Index	Steel	Concrete	Action	
NONE		-	-	+1-1.0 APPARENT YEAR-ROUND			>60		A/D	5	38	HIGH	HIGH	HIGH

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Subsides	Ponding
Daily Cover for Landfill		POOR	Ponding	Excess Humus
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Excess Humus	Ponding
Dwellings Without Basements		SEVERE	Subsides	Ponding
Dwellings With Basements		SEVERE	Subsides	Ponding
Small Commercial Buildings		SEVERE	Subsides	Ponding
Local Streets and Roads		SEVERE	Ponding	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Excess Humus
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Wetness	Low Strength
Sand		IMPROBABLE	Excess Humus	
Gravel		IMPROBABLE	Excess Humus	
Topsoil		POOR	Excess Humus	Wetness
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Excess Humus	Ponding
Drainage		LIMITATION	Ponding	Frost Action
Irrigation		LIMITATION	Ponding	
Terraces and Diversions		LIMITATION	Ponding	
Grassed Waterways		LIMITATION	Wetness	

RECREATIONAL DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Camp Areas		SEVERE	Ponding	Excess Humus
Picnic Areas		SEVERE	Ponding	Excess Humus
Playgrounds		SEVERE	Excess Humus	Ponding
Paths and Trails		SEVERE	Ponding	Excess Humus

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
ZW	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	NORTH	balsam fir tamarack black spruce	E 39 E E 15	5 2

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

05/28/92

Nearly level, very poorly drained soil formed in acid organic material more than 51 inches thick or underlain by sandy glacial outwash at depths of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.

Component Name: LOXLEY

This map unit has 3 components and 3 interpretation sheets.

Classification: TYPIC BOROSAPRISTS, DYSIC

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 4	FB		PT	A-8	-	0	-	-	-	-	-
4-60	SP		PT	A-8	-	0	-	-	-	-	-
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K
0- 4	-	-	0.3-0.4	6.-20.	0.35-0.65	3.6-4.5	-	-	70.-90.		0.1
4-60	-	-	0.1-0.3	0.2-6.	0.35-0.45	3.6-4.5	-	-	-		
							Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)		Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Action
NONE	-	-	+1-1.0 APPARENT YEAR-ROUND			>60	A/D	5	38	HIGH	HIGH
									Steel	Concrete	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Subsides	Ponding
Daily Cover for Landfill		POOR	Ponding	Excess Humus
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Excess Humus	Ponding
Dwellings Without Basements		SEVERE	Subsides	Ponding
Dwellings With Basements		SEVERE	Subsides	Ponding
Small Commercial Buildings		SEVERE	Subsides	Ponding
Local Streets and Roads		SEVERE	Subsides	Ponding
Lawns, Landscaping, and Golf Fairways		SEVERE	Too Acid	Ponding
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Wetness	Low Strength
Sand		IMPROBABLE	Excess Humus	
Gravel		IMPROBABLE	Excess Humus	
Topsoil		POOR	Excess Humus	Wetness
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Excess Humus	Ponding
Drainage		LIMITATION	Ponding	Subsides
Irrigation		LIMITATION	Ponding	Too Acid
Terraces and Diversions		LIMITATION	Ponding	
Grassed Waterways		LIMITATION	Wetness	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	SEVERE	Ponding	Excess Humus	Too Acid
Picnic Areas	SEVERE	Ponding	Excess Humus	Too Acid
Playgrounds	SEVERE	Excess Humus	Ponding	Too Acid
Paths and Trails	SEVERE	Ponding	Excess Humus	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
ZW	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	NORTH	balsam fir tamarack black spruce	E E E 15	2

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
common ninebark	8	eastern white pine	28	green ash	28	nannyberry viburnum	8
northern whitecedar	16	Siberian crabapple	30	silky dogwood	9	-	-

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, very poorly drained soil formed in acid organic material more than 51 inches thick or underlain by sandy glacial outwash at depths of 16 to 50 inches. This map unit is not highly erodible unless drained. The land capability classification is 6W. This map unit is hydric.

Component Name: DAWSON

This map unit has 3 components and 3 interpretation sheets.

Classification: TERRIC BOROSAPRISTS, SANDY OR SANDY-SKELETAL, MIXED, DYSIC

ESTIMATED SOIL PROPERTIES

	Classification					>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm

0- 4	FB		PT		A-8	-	0	-	-	-	-	0-
4-35	SP		PT		A-8	-	0	-	-	-	-	0-
35-60	S GR-S GRV-VFS		SM-SC SM SC SP-SM		A-2 A-3 A-1 A-4	-	0	45-100	35-100	15- 90	0- 45	0-10

	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	

0- 4	-	-	0.2-0.3	6.-20.	0.55-0.65	3.6-4.4	-	-	65.-85.		0.1	
4-35	-	-	0.2-0.4	0.2-6.	0.35-0.45	3.6-4.4	-	-	-			
35-60	<20	NP-10	1.5-1.8	6.-20.	0.03- 0.1	4.5-6.5	-	-	-	LOW		
-----								Wind	Risk of Corrosion		Potential	
----- Flooding-----			---- Water Table-(feet) ---			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	

NONE	-	-	+1-1.0 APPARENT YEAR-ROUND			>60	A/D	4	38	HIGH	HIGH	HIGH

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Subsides	Ponding	Percs Slowly
Daily Cover for Landfill		POOR	Ponding	Excess Humus	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave	Excess Humus	Ponding
Dwellings Without Basements		SEVERE	Subsides	Ponding	Low Strength
Dwellings With Basements		SEVERE	Subsides	Ponding	
Small Commercial Buildings		SEVERE	Subsides	Ponding	Low Strength
Local Streets and Roads		SEVERE	Subsides	Ponding	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Excess Humus	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		POOR	Wetness		
Sand		PROBABLE			
Gravel		PROBABLE			
Topsoil		POOR	Excess Humus	Wetness	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage		
Embankments, Dikes and Levees		SEVERE	Excess Humus	Ponding	
Drainage		LIMITATION	Ponding	Subsides	Frost Action
Irrigation		LIMITATION	Ponding	Rooting Depth	
Terraces and Diversions		LIMITATION	Ponding		
Grassed Waterways		LIMITATION	Wetness	Rooting Depth	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SEVERE	Ponding	Excess Humus
Picnic Areas	SEVERE	Ponding	Excess Humus
Playgrounds	SEVERE	Excess Humus	Ponding
Paths and Trails	SEVERE	Ponding	Excess Humus

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
2W	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	NORTH	tamarack black spruce	E E 15	2

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

03/12/91

KaB KARLIN LOAMY FINE SAND, 0 TO 6 PERCENT SLOPES

Nearly level and gently sloping, somewhat excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 3S.

Component Name: KARLIN

Classification: ENTIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification		>10	3-10	Percent < 3 in. passing sieve				Clay %	
Depth	USDA Texture	Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm	
0- 4	LFS	SM SP-SM	A-2 A-4	-	0	90-100	75-100	60-100	10- 45	0-12	
4-32	LFS LS SL	SP-SM SM ML	A-2 A-4	-	0	90-100	75-100	60-100	10- 55	2-15	
32-60	S	SP SP-SM SM	A-2 A-3 A-1	-	0	80-100	75-100	35- 70	0- 15	0-10	
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 4	<	NP-4	1.4-1.6	2.-6.	0.08-0.12	3.6-6.5	-	-	0.5- 2.	LOW	0.17
4-32	<20	NP-4	1.4-1.6	2.-6.	0.08-0.16	3.6-6.5	-	-	-	LOW	0.17
32-60	-	NP	1.4-1.7	6.-20.	0.03-0.04	5.6-7.3	-	-	-	LOW	0.15
							Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)		Bedrock-(in)	HYD T	Erod.	Uncoated		Frost	
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE	-	-	>6.0	-	-	>60	A	4 134	LOW	HIGH	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		SLIGHT		
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		SLIGHT		
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		FAIR	Too Sandy	Small Stones
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Too Sandy	Soil Blowing
Grassed Waterways		LIMITATION	Droughty	Fast Intake

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SLIGHT		
Picnic Areas	SLIGHT		
Playgrounds	MODERATE	Slope	Small Stones
Paths and Trails	SLIGHT		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
				55	3.	2.3	4.6	1.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
3A	SLIGHT	SLIGHT	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple yellow birch bigtooth aspen northern red oak American basswood red pine eastern white pine	E E E E E EP EP	61 0 0 0 0 0 0 3 0 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
Amur maple	10	Amur privet	11	arrowwood	14	eastern redcedar	18
eastern white pine	29	imperial Carolina poplar	70	lilac	11	manyflower cotoneaster	6
Norway spruce	32	red pine	29	Siberian crabapple	10	Siberian peashrub	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift. This map unit is not highly erodible. The land capability classification is 6S in stony areas.

Component Name: KEWEENAW

Classification: ALFIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 5	SL	SM	SC	SM-SC	A-2 A-4 A-1-B	-	25-50	90-100	75-100	45- 75	15- 40	2-15
5-23	LFS GR-LS S	SM	SC	SM-SC SP-SM	A-2 A-1-B A-4 A-3	-	0-25	85-100	60-100	30- 85	5- 45	2-15
23-55	FSL S GR-LS	SM	SC	SP-SM ML	A-2 A-3 A-1-B A-4	-	0-25	85-100	60-100	30- 85	5- 55	0-15
55-60	LS GR-LS	SM	SC	SM-SC SP-SM	A-2 A-1-B	-	0-25	85-100	60-100	30- 75	10- 30	2-15

Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 5	<20	NP-10	1.4-1.7	0.6-2.	0.13-0.15	4.5-6.5	-	-	1.- 2.	LOW	0.24	
5-23	<20	NP-10	1.5-1.8	2.-6.	0.08-0.11	4.5-6.5	-	-	-	LOW	0.17	
23-55	<30	NP-10	1.5-1.8	0.6-6.	0.06-0.14	4.5-6.5	-	-	-	LOW	0.17	
55-60	<20	NP-10	1.5-1.7	2.-6.	0.04- 0.1	5.1-6.5	-	-	-	LOW	0.17	
-----								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
-----								-----				-----
NONE	-	-	2.5-6.0	APPARENT	NOV-MAY	>60	A	5	0	LOW	MODERATE LOW	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		POOR	Seepage	Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Large Stones	
Dwellings With Basements		MODERATE	Wetness	Large Stones
Small Commercial Buildings		MODERATE	Large Stones	
Local Streets and Roads		MODERATE	Large Stones	
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Large Stones	Wetness
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Slope	Cutbanks Cave
Irrigation		LIMITATION	Slope	Large Stones Wetness
Terraces and Diversions		LIMITATION	Large Stones	Wetness
Grassed Waterways		LIMITATION	Large Stones	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	SLIGHT			
Picnic Areas	SLIGHT			
Playgrounds	MODERATE	Large Stones	Slope	Small Stones
Paths and Trails	MODERATE	Large Stones		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							4.6	2.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP. ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir E red maple E sugar maple E 61 3 yellow birch E paper birch E quaking aspen E black cherry E northern red oak E eastern hemlock E eastern white pine EP red pine P		

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.

Component Name: KEWEENAW

Classification: ALFIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 5	SL	SM	SC	SM-SC	A-2 A-4 A-1-B	-	25-50	90-100	75-100	40- 70	15- 40	2-15
5-23	LFS GR-LS S	SM	SC	SM-SC SP-SM	A-2 A-1-B A-4 A-3	-	0-25	85-100	60-100	30- 85	5- 45	2-15
23-55	FSL S GR-LS	SM	SC	SP-SM ML	A-2 A-3 A-1-B A-4	-	0-25	85-100	60-100	30- 85	5- 55	0-15
55-60	LS GR-LS	SM	SC	SM-SC SP-SM	A-2 A-1-B	-	0-25	85-100	60-100	30- 75	10- 30	2-15
Depth	Liquid Limit	Plas- ticity	Moist Bulk Density	Perme- ability	Available Water Capacity	Soil Reaction	CEC (me/ 100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
(In)		Index	g/cc	In/hr	(In./in)	(pH)						
0- 5	<20	NP-10	1.4-1.7	0.6-2.	0.13-0.15	4.5-6.5	-	-	1.- 2.	LOW	0.24	
5-23	<20	NP-10	1.5-1.8	2.-6.	0.08-0.11	4.5-6.5	-	-	-	LOW	0.17	
23-55	<30	NP-10	1.5-1.8	0.6-6.	0.06-0.14	4.5-6.5	-	-	-	LOW	0.17	
55-60	<20	NP-10	1.5-1.7	2.-6.	0.04- 0.1	5.1-6.5	-	-	-	LOW	0.17	
								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE	-	-	>6.0	-	-	>60	A 5	0	LOW	MODERATE	LOW	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		MODERATE	Percs Slowly	Slope Large Stones
Daily Cover for Landfill		POOR	Seepage	Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	Large Stones
Dwellings With Basements		MODERATE	Slope	Large Stones
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	Large Stones
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Large Stones	
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Large Stones Droughty
Terraces and Diversions		LIMITATION	Slope	Large Stones Too Sandy
Grassed Waterways		LIMITATION	Large Stones	Slope Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Large Stones

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							4.4	2.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir red maple sugar maple yellow birch paper birch quaking aspen black cherry northern red oak eastern hemlock eastern white pine red pine	E E E 61 E E E E E EP P	3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

05/28/92

Ked KEWEENAW SANDY LOAM, 15 TO 25 PERCENT SLOPES, STONY

Moderately steep, well drained soil formed in sandy and loamy deposits over gravelly, loamy sand glacial drift. This map unit is potentially highly erodible. The land capability classification is 7S in stony areas.

Component Name: KEWEENAW

Classification: ALFIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 5	SL	SM SC	SM-SC	A-2	A-4 A-1-B	-	25-50	90-100	75-100	40- 70	15- 40	2-15
5-23	LFS GR-LS S	SM SC	SM-SC SP-SM	A-2	A-1-B A-4	-	0-25	85-100	60-100	30- 85	5- 45	2-15
				A-3								
23-55	FSL S GR-LS	SM SC	SP-SM ML	A-2	A-3 A-1-B	-	0-25	85-100	60-100	30- 85	5- 55	0-15
				A-4								
55-60	LS GR-LS	SM SC	SM-SC SP-SM	A-2	A-1-B	-	0-25	85-100	60-100	30- 75	10- 30	2-15
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 5	<20	NP-10	1.4-1.7	0.6-2.	0.13-0.15	4.5-6.5	-	-	1.- 2.	LOW	0.24	
5-23	<20	NP-10	1.5-1.8	2.-6.	0.08-0.11	4.5-6.5	-	-	-	LOW	0.17	
23-55	<30	NP-10	1.5-1.8	0.6-6.	0.06-0.14	4.5-6.5	-	-	-	LOW	0.17	
55-60	<20	NP-10	1.5-1.7	2.-6.	0.04- 0.1	5.1-6.5	-	-	-	LOW	0.17	
								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE	-	-	>6.0	-	-	>60	A	5	0	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Slope	
Daily Cover for Landfill		POOR	Seepage	Small Stones Slope
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Slope
Dwellings Without Basements		SEVERE	Slope	
Dwellings With Basements		SEVERE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Large Stones	Slope
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Small Stones	Area Reclaim Slope
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Large Stones Droughty
Terraces and Diversions		LIMITATION	Slope	Large Stones Too Sandy
Grassed Waterways		LIMITATION	Large Stones	Slope Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Large Stones Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanent Pasture
bu/a	tons/a	bu/a	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM
								1.6

WOODLAND INTERPRETATIONS

WOODLAND	EROSION	EQUIPMENT	SEEDLING	WIND TH.	PLANT	INTERP	COMMONLY EXISTING TREES (E)	WOODLAND
ORD. SYB.	HAZARD	LIMITATION	MORTALITY	HAZARD	COMPETITION	ASPECT	and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX
3R	MODERATE	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH		
							balsam fir	E
							red maple	E
							sugar maple	E 61 3
							yellow birch	E
							paper birch	E
							quaking aspen	E
							black cherry	E
							northern red oak	E
							eastern hemlock	E
							eastern white pine	EP
							red pine	P

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and nearly level, and gently sloping, excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 6S in stony areas.

Component Name: KEWEENAW

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Classification												>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm					
0-5	SL		SM SC	SM-SC	A-2	A-4 A-1-B	-	25-50	90-100	75-100	45- 75	15- 40	2-15					
5-23	LFS GR-LS S		SM SC	SM-SC SP-SM	A-2	A-1-B A-4	-	0-25	85-100	60-100	30- 85	5- 45	2-15					
					A-3													
23-55	FSL S GR-LS		SM SC	SP-SM ML	A-2	A-3 A-1-B	-	0-25	85-100	60-100	30- 85	5- 55	0-15					
					A-4													
55-60	LS GR-LS		SM SC	SM-SC SP-SM	A-2	A-1-B	-	0-25	85-100	60-100	30- 75	10- 30	2-15					
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion							
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor							
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K							
0-5	<20	NP-10	1.4-1.7	0.6-2.	0.13-0.15	4.5-6.5	-	-	1.- 2.	LOW	0.24							
5-23	<20	NP-10	1.5-1.8	2.-6.	0.08-0.11	4.5-6.5	-	-	-	LOW	0.17							
23-55	<30	NP-10	1.5-1.8	0.6-6.	0.06-0.14	4.5-6.5	-	-	-	LOW	0.17							
55-60	<20	NP-10	1.5-1.7	2.-6.	0.04- 0.1	5.1-6.5	-	-	-	LOW	0.17							
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Wind	Risk of Corrosion		Potential						
Frequency Duration Months			Depth	Kind	Months	Depth	Hard.	GRP	Erod.	Uncoated	Concrete	Frost						
									Index	Steel		Action						
NONE			-	-	2.5-6.0 APPARENT	NOV-MAY	>60	A	5	0	LOW MODERATE	LOW						

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)
Septic Tank Absorption Fields	SEVERE	Wetness
Daily Cover for Landfill	POOR	Seepage
		Small Stones

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Shallow Excavations	SEVERE	Cutbanks Cave
Dwellings Without Basements	MODERATE	Large Stones
Dwellings With Basements	MODERATE	Wetness
Small Commercial Buildings	MODERATE	Large Stones
Local Streets and Roads	MODERATE	Large Stones
Lawns, Landscaping, and Golf Fairways	SEVERE	Large Stones

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)
Roadfill	FAIR	Large Stones
Sand	PROBABLE	Wetness
Gravel	IMPROBABLE	Too Sandy
Topsoil	POOR	Small Stones
		Area Reclaim

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)
Pond Reservoir Area	SEVERE	Seepage
Embankments, Dikes and Levees	SEVERE	Seepage
Drainage	LIMITATION	Slope
Irrigation	LIMITATION	Slope
Terraces and Diversions	LIMITATION	Large Stones
Grassed Waterways	LIMITATION	Large Stones
		Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	SLIGHT			
Picnic Areas	SLIGHT			
Playgrounds	MODERATE	Large Stones	Slope	Small Stones
Paths and Trails	MODERATE	Large Stones		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							4.6	2.
							4.	1.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir red maple sugar maple yellow birch paper birch quaking aspen black cherry northern red oak eastern hemlock eastern white pine red pine	E E E 61 E E E E E EP P	3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and nearly level, and gently sloping, excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 6S in stony areas.

Component Name: VILAS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification		>10	3-10	Percent < 3 in. passing sieve				Clay %	
Depth	USDA Texture	Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm	
0- 3	LS	SM SP-SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6	
3-19	LS	SP-SM SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6	
19-30	S	SM SP-SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	5- 20	1- 3	
30-60	S	SP SP-SM SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	1- 20	0- 3	
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 3	-	NP	1.4-1.6	6.-20.	0.09-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17
3-19	-	NP	1.5-1.6	6.-20.	0.07-0.12	4.5-6.5	-	-	-	LOW	0.17
19-30	-	NP	1.5-1.7	6.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.17
30-60	-	NP	1.5-1.7	6.-20.	0.04-0.07	5.1-6.5	-	-	-	LOW	0.17
							Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)		Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency Duration		Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE		-	>6.0	-	-	>60	A	5 134	LOW	HIGH	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		SLIGHT		
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		SLIGHT		
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Too Sandy	Soil Blowing
Grassed Waterways		LIMITATION	Droughty	Fast Intake

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	MODERATE	Too Sandy		
Picnic Areas	MODERATE	Too Sandy		
Playgrounds	MODERATE	Slope	Small Stones	Too Sandy
Paths and Trails	MODERATE	Too Sandy		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							4.6	2.
							4.	1.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
6S	SLIGHT	SLIGHT	MODERATE	SLIGHT	SLIGHT	NORTH	balsam fir red maple paper birch quaking aspen northern pin oak northern red oak jack pine red pine eastern white pine	E E E E E E EP 65 EP 57 EP 56	7 6 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and sloping, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.

Component Name: KEWEENAW
Classification: ALFIC HAPLORHODS, SANDY, MIXED, FRIGID

This map unit has 2 components, and 2 interpretation sheet.

ESTIMATED SOIL PROPERTIES

ESTIMATED SOIL PROPERTIES												
		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 5	SL	SM SC	SM-SC	A-2 A-4	A-1-B	-	25-50	90-100	75-100	40- 70	15- 40	2-15
5-23	LFS GR-LS S	SM SC	SM-SC SP-SM	A-2 A-1-B	A-4	-	0-25	85-100	60-100	30- 85	5- 45	2-15
				A-3								
23-55	FSL S GR-LS	SM SC	SP-SM ML	A-2 A-3	A-1-B	-	0-25	85-100	60-100	30- 85	5- 55	0-15
				A-4								
55-60	LS GR-LS	SM SC	SM-SC SP-SM	A-2 A-1-B		-	0-25	85-100	60-100	30- 75	10- 30	2-15
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 5	<20	NP-10	1.4-1.7	0.6-2.	0.13-0.15	4.5-6.5	-	-	1.- 2.	LOW	0.24	
5-23	<20	NP-10	1.5-1.8	2.-6.	0.08-0.11	4.5-6.5	-	-	-	LOW	0.17	
23-55	<30	NP-10	1.5-1.8	0.6-6.	0.06-0.14	4.5-6.5	-	-	-	LOW	0.17	
55-60	<20	NP-10	1.5-1.7	2.-6.	0.04- 0.1	5.1-6.5	-	-	-	LOW	0.17	
								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE	-	-	>6.0	-	-	>60	A	5	0	LOW MODERATE	LOW	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		MODERATE	Percs Slowly	Slope Large Stones
Daily Cover for Landfill		POOR	Seepage	Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	Large Stones
Dwellings With Basements		MODERATE	Slope	Large Stones
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	Large Stones
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Large Stones	
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Large Stones Droughty
Terraces and Diversions		LIMITATION	Slope	Large Stones Too Sandy
Grassed Waterways		LIMITATION	Large Stones	Slope Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Large Stones

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							4.4	1.7
							3.8	1.2

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir red maple sugar maple yellow birch paper birch quaking aspen black cherry northern red oak eastern hemlock eastern white pine red pine	E E E 61 E E E E E EP P	3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
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Sloping, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and sloping, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas.

Component Name: VILAS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No 4	No.10	No.40	No.200	
0- 3	LS	SM SP-SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6
3-19	LS	SP-SM SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6
19-30	S	SM SP-SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	5- 20	1- 3
30-60	S	SP SP-SM SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	1- 20	0- 3

Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 3	-	NP	1.4-1.6	6.-20.	0.09-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17
3-19	-	NP	1.5-1.6	6.-20.	0.07-0.12	4.5-6.5	-	-	-	LOW	0.17
19-30	-	NP	1.5-1.7	6.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.17
30-60	-	NP	1.5-1.7	6.-20.	0.04-0.07	5.1-6.5	-	-	-	LOW	0.17

Flooding-----			Water Table-(feet) ---			Bedrock-(in)		Wind		Risk of Corrosion		Potential	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	HYD T	Erod.	Uncoated	Steel	Frost	
								GRP	Fact.	Index		Action	
NONE	-	-	>6.0	-	-	>60		A	5	134	LOW	HIGH	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy

BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	Slope

CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	

WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope Too Sandy
Picnic Areas	MODERATE	Slope Too Sandy
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							4.4	1.7
							3.8	1.2

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	WOODLAND SITE INDEX	PRODUCT- IVITY
6S	SLIGHT	SLIGHT	MODERATE	SLIGHT	SLIGHT	NORTH	balsam fir red maple paper birch quaking aspen northern pin oak northern red oak jack pine red pine eastern white pine	E E E E E E EP 65 EP 57 EP 56	7 6 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
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Moderately steep and steep, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and moderately steep and steep, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel. This map unit is highly erodible. The land capability classification is 7S in stony areas.

Component Name: KEWEENAW

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification					>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
0- 5	SL	SM SC	SM-SC	A-2	A-4 A-1-B	-	25-50	90-100	75-100	40- 70	15- 40	2-15
5-23	LFS GR-LS S	SM SC	SM-SC SP-SM	A-2	A-1-B A-4	-	0-25	85-100	60-100	30- 85	5- 45	2-15
				A-3								
23-55	FSL S GR-LS	SM SC	SP-SM ML	A-2	A-3 A-1-B	-	0-25	85-100	60-100	30- 85	5- 55	0-15
				A-4								
55-60	LS GR-LS	SM SC	SM-SC SP-SM	A-2	A-1-B	-	0-25	85-100	60-100	30- 75	10- 30	2-15

	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
0- 5	<20	NP-10	1.4-1.7	0.6-2.	0.13-0.15	4.5-6.5	-	-	1.- 2.	LOW	0.24	
5-23	<20	NP-10	1.5-1.8	2.-6.	0.08-0.11	4.5-6.5	-	-	-	LOW	0.17	
23-55	<30	NP-10	1.5-1.8	0.6-6.	0.06-0.14	4.5-6.5	-	-	-	LOW	0.17	
55-60	<20	NP-10	1.5-1.7	2.-6.	0.04- 0.1	5.1-6.5	-	-	-	LOW	0.17	

								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Action	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
NONE	-	-	>6.0	-	-	>60	A	5	0	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Slope	
Daily Cover for Landfill		POOR	Seepage	Small Stones Slope
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Slope
Dwellings Without Basements		SEVERE	Slope	
Dwellings With Basements		SEVERE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Large Stones	Slope
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Small Stones	Area Reclaim Slope
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Large Stones Droughty
Terraces and Diversions		LIMITATION	Slope	Large Stones Too Sandy
Grassed Waterways		LIMITATION	Large Stones	Slope Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Large Stones Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
								1.4
								1.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
3R	MODERATE	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir red maple sugar maple yellow birch paper birch quaking aspen black cherry northern red oak eastern hemlock eastern white pine red pine	E E E 61 E E E E E EP P	3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Moderately steep and steep, well drained soil formed in sandy and loamy deposits over gravelly loamy sand glacial drift and moderately steep and steep, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel. This map unit is highly erodible. The land capability classification is 7S in stony areas.

Component Name: SAYNER

This map unit has 2 components, and 2 interpretation sheet.

Classification: ENTIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay %	
		Unified	AASHTO			No. 4	No. 10	No. 40	No. 200	<.002 mm	
0-4	LS	SM SP-SM	A-1 A-2	-	0-15	80-100	75-100	35- 75	10- 30	1- 5	
4-22	LS S GR-S	SP SM GP GM	A-1 A-3 A-2	-	0-15	50-100	50-100	20- 75	0- 30	1- 5	
22-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-3 A-2	-	0-15	50- 90	40- 85	0- 55	0- 10	0- 3	
Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-4	-	NP	1.3-1.4	2.-6.	0.08-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17
4-22	-	NP	1.4-1.5	2.-6.	0.03-0.12	4.5-6.5	-	-	-	LOW	0.17
22-60	-	NP	1.5-1.8	6.-20.	0.02-0.04	5.1-6.5	-	-	-	LOW	0.1
----- Flooding-----											
Frequency Duration			Water Table-(feet)			Bedrock-(in)	HYD T	Wind	Risk of Corrosion		Potential
			Depth	Kind	Months	Depth Hard.	GRP Fact.	Erod. Index	Uncoated Steel	Concrete	Frost Action
NONE			>6.0	-	-	>60	A 4	134	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	Slope
Daily Cover for Landfill		POOR	Seepage	Too Sandy
				Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Slope
Dwellings Without Basements		SEVERE	Slope	
Dwellings With Basements		SEVERE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Droughty	Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Slope	
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Too Sandy	Small Stones
				Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty
				Fast Intake
				Soil Blowing

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Slope Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
								1.4
								1.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
7R	MODERATE	MODERATE	MODERATE	SLIGHT	SLIGHT	NORTH	red maple paper birch quaking aspen northern red oak jack pine red pine eastern white pine	E E E E EP EP 59 EP 57	7 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, poorly drained soil formed in thin organic material overlying sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 6W. This map unit is hydric.

Component Name: KINROSS

Classification: TYPIC HAPLAQUODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay %	
		Unified	AASHTO			No. 4	No. 10	No. 40	No. 200	<.002 mm	
0-5	SP	PT	A-8	-	0	-	-	-	-	0-	
5-29	S FS LS	SP-SM SM	A-3 A-2-4	-	0	100-100	100-100	50- 80	5- 30	0-10	
29-60	S FS	SP-SM SM	A-3 A-2-4	-	0	100-100	100-100	50- 80	5- 30	0-10	
Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-5	-	NP	0.1-0.3	2.-6.	0.35-0.45	3.6- 5.	-	-	50.-99.		
5-29	-	NP	1.4-1.7	6.-20.	0.04-0.09	3.6- 6.	-	-	-	LOW	0.15
29-60	-	NP	1.4-1.7	6.-20.	0.04-0.06	4.5-6.5	-	-	-	LOW	0.15
----- Flooding-----						Wind		Risk of Corrosion		Potential	
Frequency		Duration	Months	Water Table-(feet)		Depth	Kind	Months	Depth	Hard.	
NONE		-	-	+1-1.0 APPARENT YEAR-ROUND		>60			A/D	5	134
									HYD	T	Erod.
									GRP	Fact.	Index
									Uncoated		Frost
									Steel	Concrete	Action
									HIGH	MODERATE	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Ponding	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy
				Ponding
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Ponding
Dwellings Without Basements		SEVERE	Ponding	
Dwellings With Basements		SEVERE	Ponding	
Small Commercial Buildings		SEVERE	Ponding	
Local Streets and Roads		SEVERE	Ponding	
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	Excess Humus
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Wetness	
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	Wetness
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Ponding	Cutbanks Cave
Irrigation		LIMITATION	Ponding	
Terraces and Diversions		LIMITATION	Ponding	Too Sandy
Grassed Waterways		LIMITATION	Wetness	Soil Blowing

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Ponding
Picnic Areas	SEVERE	Ponding
Playgrounds	SEVERE	Ponding
Paths and Trails	SEVERE	Ponding

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
2W	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	NORTH	balsam fir red maple tamarack black spruce quaking aspen northern whitecedar	E E E E E E	0 0 0 0 45 0

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, somewhat poorly drained soil formed in silty deposits underlain by sandy loam glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: MAGNOR

Classification: AQUIC GLOSSOBORALFS, COARSE-LOAMY, MIXED

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture	Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 4	SIL	CL CL-ML ML	A-4	-	15-25	95-100	90-100	85-100	65-100	5-18			
4-29	SIL SI	CL CL-ML ML	A-4	-	0-15	95-100	90-100	85-100	65-100	5-18			
29-35	L SL GR-SL	ML CL-ML SM SM-SC	A-2 A-4 A-1	-	0-15	75-100	70- 95	40- 90	20- 70	3-12			
35-60	SL L GR-SL	ML CL-ML SM SM-SC	A-2 A-4 A-1	-	0-15	75-100	70- 95	40- 90	20- 70	3-12			
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion		
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor		
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K		
0- 4	15-28	2-10	1.4-1.5	0.6-2.	0.12-0.21	4.5- 6.	-	-	3.- 7.	LOW	0.37		
4-29	<35	NP-10	1.6-1.7	0.6-2.	0.17-0.22	4.5- 6.	-	-	-	LOW	0.37		
29-35	<25	NP-7	1.4-1.7	0.2-2.	0.08-0.18	4.5- 6.	-	-	-	LOW	0.37		
35-60	<25	NP-6	1.8- 2.	<0.06	0.- 0.	4.5-6.5	-	-	-	LOW	0.24		
								Wind	Risk of Corrosion		Potential		
Flooding-----			Water Table-(feet) ---			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action
NONE	-	-	0.5-3.0-PERCHED		NOV-JUN	>60	C	4	0	LOW	MODERATE		HIGH

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	Percs Slowly
Daily Cover for Landfill		POOR	Wetness	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Wetness	
Dwellings Without Basements		SEVERE	Wetness	
Dwellings With Basements		SEVERE	Wetness	
Small Commercial Buildings		SEVERE	Wetness	
Local Streets and Roads		SEVERE	Wetness	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Wetness	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Small Stones	Wetness
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		MODERATE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Piping	Wetness
Drainage		LIMITATION	Percs Slowly	Frost Action
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Large Stones	Erodes Easily
Grassed Waterways		LIMITATION	Large Stones	Wetness

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Wetness
Picnic Areas	SEVERE	Wetness
Playgrounds	SEVERE	Wetness
Paths and Trails	SEVERE	Wetness

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							6.6	3.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	SEVERE	MODERATE	SEVERE	SEVERE	NORTH	red maple sugar maple yellow birch white ash bigtooth aspen quaking aspen northern red oak American basswood white spruce red pine eastern white pine	E E E E E E E E P P P	65 61 65 68 67 67 3 3 3 4 4 4

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level, poorly drained and very poorly drained soil formed in silty and loamy deposits underlain by gravelly coarse sand glacial outwash. This map unit is not highly erodible. The land capability classification is 6W. This map unit is hydric.

Component Name: MINOCQUA

Classification: TYPIC HAPLAQUEPTS, COARSE-LOAMY OVER SANDY OR SANDY-SKELETAL, MIXED, NONACID, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 8	SIL	CL ML SC SM	A-4	-	0-7	80-100	75-100	60-100	45- 90	8-12	
8-21	SIL L SL	SC SM CL ML	A-2 A-4 A-6	-	0-7	80-100	75-100	45-100	25- 90	10-18	
21-24	LCOS GR-LS GR-SL	SM GM GP SP	A-2 A-1 A-3 A-4	-	0-7	50-100	45-100	5- 70	2- 40	3-10	
24-60	GR-COS S GR-S	SP SM GP GM	A-1 A-3 A-2	-	0-7	35-100	30-100	5- 70	0- 30	0- 3	
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K
0- 8	<30	NP-10	1.2-1.5	0.6-2.	0.19-0.24	4.5-7.8	-	-	4.-10.	LOW	0.37
8-21	<35	NP-13	1.5-1.6	0.6-2.	0.11-0.19	4.5-7.8	-	-	-	LOW	0.37
21-24	<20	NP-4	1.6-1.8	2.-6.	0.06-0.13	4.5-7.8	-	-	-	LOW	0.1
24-60	-	NP	1.8-1.9	6.-20.	0.02-0.04	4.5-7.8	-	-	-	LOW	0.1
								Wind	Risk of Corrosion		Potential
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated		Frost
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE	-	-	+1-1.0 APPARENT YEAR-ROUND			>60.	B/D	4 56	HIGH	HIGH	HIGH

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Ponding	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Ponding
Dwellings Without Basements		SEVERE	Ponding	
Dwellings With Basements		SEVERE	Ponding	
Small Commercial Buildings		SEVERE	Ponding	
Local Streets and Roads		SEVERE	Ponding	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Ponding	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Wetness	
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping Ponding
Drainage		LIMITATION	Ponding	Frost Action Cutbanks Cave
Irrigation		LIMITATION	Ponding	Droughty
Terraces and Diversions		LIMITATION	Erodes Easily	Ponding Too Sandy
Grassed Waterways		LIMITATION	Wetness	Erodes Easily Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Ponding
Picnic Areas	SEVERE	Ponding
Playgrounds	SEVERE	Ponding
Paths and Trails	SEVERE	Ponding

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
7W	SLIGHT	SEVERE	SEVERE	SEVERE	SEVERE	NORTH	balsam fir black ash tamarack quaking aspen northern whitecedar red maple white ash white spruce black spruce	E 54 E 0 E 55 E 0 E 0 EP 55 EP 0 P 0 P 0	7 0 4 0 0 2 0 0 0

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, somewhat poorly drained soil formed in silty and loamy deposits underlain by sandy loam glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: MONICO

Classification: ENTIC HAPLAQUODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 3-10		Percent < 3 in. passing sieve				Clay %
		Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	
0-3	L	ML CL-ML SM SM-SC	A-4	-	25-50	75-100	70-100	60-100	40- 90	8-15
3-23	FSL GR-L SIL	SM SC ML CL	A-3 A-4	-	0-25	65-100	60-100	50- 95	30- 85	3-18
23-29	SL GR-SL LS	SM SP-SM GM GM-GC	A-2 A-1	-	0-25	60-100	60-100	30- 85	13- 35	2- 8
29-60	GR-LS LS GR-SL	SM SP-SM GM GM-GC	A-2 A-1	-	0-25	60-100	60-100	30- 85	13- 35	2- 8

Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-3	<35	NP-7	1.1-1.4	0.6-2.	0.09- 0.2	4.5-6.5	-	-	3.- 7.	LOW	0.32
3-23	<35	NP-10	1.6-1.8	0.6-2.	0.06-0.19	4.5-6.5	-	-	-	LOW	0.24
23-29	<20	NP-4	1.7-1.8	0.6-2.	0.04-0.12	5.1-7.3	-	-	-	LOW	0.17
29-60	<20	NP-4	1.7-1.8	0.6-2.	0.04-0.12	5.1-7.3	-	-	-	LOW	0.1

Flooding		Water Table-(feet)		Bedrock-(in)		HYD	T	Erod.	Wind	Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Uncoated Steel	Concrete	Frost Action
NONE	-	-	1.0-3.0	PERCHED	NOV-MAY	>60		C	5	0	MODERATE HIGH	HIGH

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields	SEVERE	Wetness	
Daily Cover for Landfill	POOR	Seepage	Small Stones Wetness

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations	SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements	SEVERE	Wetness	
Dwellings With Basements	SEVERE	Wetness	
Small Commercial Buildings	SEVERE	Wetness	
Local Streets and Roads	SEVERE	Frost Action	
Lawns, Landscaping, and Golf Fairways	SEVERE	Large Stones	

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)	
Roadfill	FAIR	Large Stones	Wetness
Sand	PROBABLE		
Gravel	PROBABLE		
Topsoil	POOR	Small Stones	Area Reclaim

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area	MODERATE	Seepage	Slope
Embankments, Dikes and Levees	SEVERE	Seepage	Piping
Drainage	LIMITATION	Frost Action	Slope Cutbanks Cave
Irrigation	LIMITATION	Slope	Large Stones Wetness
Terraces and Diversions	LIMITATION	Large Stones	Wetness Too Sandy
Grassed Waterways	LIMITATION	Large Stones	Wetness Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SEVERE	Wetness	
Picnic Areas	MODERATE	Wetness	Small Stones
Playgrounds	SEVERE	Small Stones	Wetness
Paths and Trails	MODERATE	Large Stones	Wetness

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							5.	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	MODERATE	MODERATE	NORTH	sugar maple yellow birch American basswood red maple white ash white spruce black spruce eastern white pine	E E E EP EP P P P	63 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 2E. This map unit is prime farmland.

Component Name: PADUS

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Unified	Classification AASHTO	>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
						No. 4	No.10	No.40	No.200	
0- 5	L	ML CL-ML CL	A-4	-	0-7	80-100	75-100	65-100	50- 90	6-15
5-33	FSL SL L	SM SC ML CL	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18
33-35	GR-LS S GR-SL	SM SP GP GM	A-2 A-4 A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10
35-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-2 A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3

Depth (In)	Liquid Limit Index	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 5	<30	NP-10	1.4-1.5	0.6-6.	0.17-0.24	4.5-6.5	-	-	2.- 4.	LOW	0.32
5-33	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24
33-35	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1
35-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1

										Wind	Risk of Corrosion		Potential
Flooding			Water Table-(feet)			Bedrock-(in)		HYD	T	Erod.	Uncoated		Frost
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action
NONE	-	-	2.5-4.0	PERCHED	NOV-MAY	>60		B	4	56	LOW	HIGH	MODERATE

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields	SEVERE	Wetness	Poor Filter	
Daily Cover for Landfill	POOR	Seepage	Too Sandy	Small Stones

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations	SEVERE	Cutbanks Cave		
Dwellings Without Basements	SLIGHT			
Dwellings With Basements	MODERATE	Wetness		
Small Commercial Buildings	SLIGHT			
Local Streets and Roads	MODERATE	Frost Action		
Lawns, Landscaping, and Golf Fairways	MODERATE	Large Stones	Droughty	

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)		
Roadfill	FAIR	Wetness		
Sand	PROBABLE			
Gravel	PROBABLE			
Topsoil	POOR	Small Stones	Area Reclaim	

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area	SEVERE	Seepage		
Embankments, Dikes and Levees	SEVERE	Seepage	Piping	
Drainage	LIMITATION	Slope	Cutbanks Cave	
Irrigation	LIMITATION	Slope	Wetness	Droughty
Terraces and Diversions	LIMITATION	Wetness	Too Sandy	
Grassed Waterways	LIMITATION	Droughty	Rooting Depth	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SLIGHT		
Picnic Areas	SLIGHT		
Playgrounds	MODERATE	Slope	Small Stones
Paths and Trails	SLIGHT		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanent Pasture
bu/a	tons/a	bu/a	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM
				75	4.	3.	6.	3.

WOODLAND INTERPRETATIONS

WOODLAND	EROSION	EQUIPMENT	SEEDLING	WIND TH.	PLANT	INTERP	COMMONLY EXISTING TREES (E)		WOODLAND
ORD. SYB.	HAZARD	LIMITATION	MORTALITY	HAZARD	COMPETITION	ASPECT	and/or	SITE	PRODUCT-
							TREES RECOMMENDED TO PLANT (P)	INDEX	IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple	E 67	3
							white ash	E 0	0
							bigtooth aspen	E 78	6
							northern red oak	E 70	4
							American basswood	E 0	0
							red pine	EP 0	0
							white spruce	P 0	0
							eastern white pine	P 0	0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

03/13/91

PaC PADUS LOAM, 6 TO 15 PERCENT SLOPES

Sloping, well drained soil formed in loam deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 3E.

Component Name: PADUS

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No. 4	No.10	No.40	No.200	<.002 mm
0- 5	L		ML CL-ML CL		A-4		-	0-7	80-100	75-100	65-100	50- 90	6-15
5-33	FSL SL L		SM SC ML CL		A-2 A-4 A-1-B		-	0-7	80-100	75-100	45- 95	20- 90	5-18
33-35	GR-LS S GR-SL		SM SP GP GM		A-2 A-4 A-1 A-3		-	0-7	50-100	45-100	25- 75	2- 40	2-10
35-60	SR- S G		SP SP-SM GP GP-GM		A-1 A-2 A-3		-	0-7	30-100	25-100	10- 70	1- 12	0- 3
	Liquid Limit	Plasticity	Moist Bulk Density	Permeability	Available Water Capacity	Soil Reaction	CEC	CaCO3	Organic Matter	Shrink Swell	Erosion Factor		
Depth (In)		Index	g/cc	In/hr	(In./in)	(pH)	(me/100g)	Pct	Pct	Potential	K		
0- 5	<30	NP-10	1.4-1.5	0.6-6.	0.17-0.24	4.5-6.5	-	-	2.- 4.	LOW	0.32		
5-33	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24		
33-35	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1		
35-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1		
									Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action
NONE	-	-	>6.0	-	-	>60	B	4	56	LOW	HIGH	MODERATE	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	Frost Action
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SLIGHT	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				70	3.5	2.5	5.8	2.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E E E EP P P	67 0 78 70 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Moderately steep, well drained soil formed in loamy deposit underlain by stratified sand and gravel glacial outwash. This map unit is highly erodible. The land capability classification is 6E.

Component Name: PADUS

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No. 4	No.10	No.40	No.200	
0-5	L	ML CL-ML CL	A-4	-	0-7	80-100	75-100	65-100	50- 90	6-15
5-33	FSL SL L	SM SC ML CL	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18
33-35	GR-LS S GR-SL	SM SP GP GM	A-2 A-4 A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10
35-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-2 A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3

Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-5	<30	NP-10	1.4-1.5	0.6-6.	0.17-0.24	4.5-6.5	-	-	2.- 4.	LOW	0.32
5-33	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24
33-35	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1
35-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1

Flooding		Water Table-(feet)			Bedrock-(in)		HYD T		Wind Erod.		Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Uncoated Steel	Concrete	Frost Action
NONE	-	-	>6.0	-	-	>60		B	4	56	LOW	HIGH	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	Slope
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Slope
Dwellings Without Basements		SEVERE	Slope	
Dwellings With Basements		SEVERE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Slope	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Slope	
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim Slope
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanent Pasture
bu/a	tons/a	bu/a	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM
							5.4	2.

WOODLAND INTERPRETATIONS

WOODLAND	EROSION	EQUIPMENT	SEEDLING	WIND TH.	PLANT	INTERP	COMMONLY EXISTING TREES (E)	WOODLAND
ORD. SYB.	HAZARD	LIMITATION	MORTALITY	HAZARD	COMPETITION	ASPECT	and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX
3R	MODERATE	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	67 0 78 70 0 0 0 0
								3 0 6 4 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash, and nearly level and gently sloping moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: PADUS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %	
Depth	USDA Texture	Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm	
0- 3	L	ML CL-ML CL	A-4	-	0-7	80-100	75-100	65-100	50- 90	6-15		
3-28	FSL SL L	SM SC ML CL	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18		
28-33	GR-LS S GR-SL	SM SP GP GM	A-2 A-4 A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10		
33-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-2 A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3		
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	
0- 3	<30	NP-10	1.4-1.5	0.6-6.	0.17-0.24	4.5-6.5	-	-	2.- 4.	LOW	0.32	
3-28	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24	
28-33	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1	
33-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1	
							Wind	Risk of Corrosion		Potential		
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Action	
NONE	-	-	2.5-4.0	PERCHED	NOV-MAY	>60	B	4	56	LOW	HIGH	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		MODERATE	Wetness	
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		MODERATE	Frost Action	
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Slope	Cutbanks Cave
Irrigation		LIMITATION	Slope	Wetness Droughty
Terraces and Diversions		LIMITATION	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Droughty	Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SLIGHT		
Picnic Areas	SLIGHT		
Playgrounds	MODERATE	Slope	Small Stones
Paths and Trails	SLIGHT		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							6.	3.
							6.6	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E 78 E 70 E EP P P	3 6 4

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, moderately well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash, and nearly level and gently sloping moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: GOODMAN

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

EXHIBIT D-1												
Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm		
		Unified	AASHTO			No 4	No.10	No.40	No.200			
0- 3	SIL	ML CL-ML	A-4	-	25-50	90-100	90-100	80-100	55- 90	5-12		
3-23	SIL	ML CL-ML	A-4	-	0-15	95-100	90-100	85-100	55- 90	8-14		
23-38	FSL SL L	ML CL-ML SM SM-SC	A-2 A-1 A-4	-	25-50	65-100	60- 95	30- 90	13- 70	2-12		
38-60	SL GR-SL LS	SM SM-SC	A-2 A-1	-	0-15	65-100	60- 95	30- 80	13- 35	2-12		
Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 3	<23	NP-6	1.4-1.5	0.6-2.	0.11- 0.2	3.6-6.5	-	-	3.- 7.	LOW	0.37	
3-23	<25	NP-7	1.5-1.6	0.6-2.	0.17-0.22	3.6-6.5	-	-	-	LOW	0.37	
23-38	<23	NP-6	1.5-1.6	0.6-2.	0.04-0.16	3.6-6.5	-	-	-	LOW	0.24	
38-60	<23	NP-6	1.5-1.8	0.6-2.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.24	
							Wind	Risk of Corrosion		Potential		
Flooding			Water Table-(feet)		Bedrock-(in)	HYD T	Erod.	Uncoated		Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE	-	-	1.5-3.0	PERCHED	NOV-MAY	>60	B	5	0	LOW	HIGH	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		FAIR	Wetness	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		MODERATE	Wetness	
Dwellings With Basements		SEVERE	Wetness	
Small Commercial Buildings		MODERATE	Wetness	
Local Streets and Roads		MODERATE	Wetness	Frost Action
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Large Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		MODERATE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Slope	
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Large Stones	Erodes Easily
Grassed Waterways		LIMITATION	Erodes Easily	Large Stones

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	MODERATE	Wetness		
Picnic Areas	MODERATE	Wetness		
Playgrounds	MODERATE	Large Stones	Slope	Wetness
Paths and Trails	MODERATE	Large Stones	Wetness	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							6.	3.
							6.6	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES and/or TREES RECOMENDED TO PLANT (P)	(E)	SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	MODERATE	SEVERE	NORTH	sugar maple yellow birch paper birch bigtooth aspen quaking aspen American basswood white spruce red pine eastern white pine	E E E E E E P P P	69 68	3 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash and moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: PADUS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 3	L	ML	CL-ML	CL	A-4	-	0-7	80-100	75-100	65-100	50- 90	6-15
3-28	FSL SL L	SM	SC	ML CL	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18
28-33	GR-LS S GR-SL	SM	SP	GP GM	A-2 A-4 A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10
33-60	SR- S G	SP	SP-SM	GP GP-GM	A-1 A-2 A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3

Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 3	<30	NP-10	1.4-1.5	0.6-6.	0.17-0.24	4.5-6.5	-	-	2- 4.	LOW	0.32
3-28	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24
28-33	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1
33-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1

Flooding		Water Table-(feet)			Bedrock-(in)	HYD	T	Erod.	Risk of Corrosion		Potential		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Frost Action
NONE	-	-	>6.0	-	-	>60	B	4	56	LOW	HIGH		MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones

BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	Frost Action
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty Slope

CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim

WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SLIGHT	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							5.8	3.
							6.4	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E E E EP P P	67 78 70 4

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

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sloping, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash and moderately well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is potentially highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: GOODMAN

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 3	SIL	ML	CL-ML	A-4		-	25-50	90-100	90-100	80-100	55- 90	5-12
3-23	SIL	ML	CL-ML	A-4		-	0-15	95-100	90-100	85-100	55- 90	8-14
23-38	FSL SL L	ML	CL-ML SM SM-SC	A-2 A-1 A-4		-	25-50	65-100	60- 95	30- 90	13- 70	2-12
38-60	SL GR-SL LS	SM	SM-SC	A-2 A-1		-	0-15	65-100	60- 95	30- 80	13- 35	2-12
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	
0- 3	<23	NP-6	1.4-1.5	0.6-2.	0.11- 0.2	3.6-6.5	-	-	3.- 7.	LOW	0.37	
3-23	<25	NP-7	1.5-1.6	0.6-2.	0.17-0.22	3.6-6.5	-	-	-	LOW	0.37	
23-38	<23	NP-6	1.5-1.6	0.6-2.	0.04-0.16	3.6-6.5	-	-	-	LOW	0.24	
38-60	<23	NP-6	1.5-1.8	0.6-2.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.24	
								Wind	Risk of Corrosion		Potential	
Flooding-----			Water Table-(feet) ---			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE	-	-	1.5-3.0	PERCHED	NOV-MAY	>60	B	5	0	LOW	HIGH	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		FAIR	Slope	Wetness
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		MODERATE	Wetness	Slope
Dwellings With Basements		SEVERE	Wetness	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Wetness	Slope
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	Frost Action
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Large Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Slope	
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Slope	
Irrigation		LIMITATION	Slope	Wetness
Terraces and Diversions		LIMITATION	Slope	Large Stones
Grassed Waterways		LIMITATION	Slope	Erodes Easily

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Camp Areas	MODERATE	Slope	Wetness	
Picnic Areas	MODERATE	Slope	Wetness	
Playgrounds	SEVERE	Slope		
Paths and Trails	MODERATE	Large Stones	Wetness	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							5.8	3.
							6.4	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
3X	SLIGHT	MODERATE	SLIGHT	MODERATE	SEVERE	NORTH	sugar maple yellow birch paper birch bigtooth aspen quaking aspen American basswood white spruce red pine eastern white pine	E E E E E E P P P	69 68 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
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Moderately steep, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash and moderately steep, well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is highly erodible. The land capability classification is 7S in stony areas. This map unit may have hydric inclusions.

Component Name: PADUS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

ESTIMATED SOIL PROPERTIES												
		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 3	L	ML	CL-ML	CL	A-4	-	0-7	80-100	75-100	65-100	50- 90	6-15
3-28	FSL SL L	SM	SC	ML CL	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18
28-33	GR-LS S GR-SL	SM	SP	GP GM	A-2 A-4 A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10
33-60	SR- S G	SP	SP-SM	GP GP-GM	A-1 A-2 A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 3	<30	NP-10	1.4-1.5	0.6-6.	0.17-0.24	4.5-6.5	-	-	2.- 4.	LOW	0.32	
3-28	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24	
28-33	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1	
33-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1	
								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency Duration		Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE			-	-	>6.0	-	>60	B	4	56	LOW HIGH MODERATE	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Poor Filter	Slope	
Daily Cover for Landfill		POOR	Seepage	Too Sandy	Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave	Slope	
Dwellings Without Basements		SEVERE	Slope		
Dwellings With Basements		SEVERE	Slope		
Small Commercial Buildings		SEVERE	Slope		
Local Streets and Roads		SEVERE	Slope		
Lawns, Landscaping, and Golf Fairways		SEVERE	Slope		
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		FAIR	Slope		
Sand		PROBABLE			
Gravel		PROBABLE			
Topsoil		POOR	Small Stones	Area Reclaim	Slope
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage	Slope	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping	
Drainage		LIMITATION	Deep To Water		
Irrigation		LIMITATION	Slope	Droughty	
Terraces and Diversions		LIMITATION	Slope	Too Sandy	
Grassed Waterways		LIMITATION	Slope	Droughty	Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							5.4	2.2
							6.	2.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3R	MODERATE	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E E E EP P P	67 78 70 4 3

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
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gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

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Moderately steep, well drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash and moderately steep, well drained soil formed in silty deposits underlain by gravelly loamy sand glacial till. This map unit is highly erodible. The land capability classification is 7S in stony areas. This map unit may have hydric inclusions.

Component Name: GOODMAN

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification		>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture	Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 3	SIL	ML CL-ML	A-4	-	25-50	90-100	90-100	80-100	55- 90	5-12		
3-23	SIL	ML CL-ML	A-4	-	0-10	95-100	90-100	85-100	55- 90	8-14		
23-38	FSL SL L	ML CL-ML SM SM-SC	A-2 A-1 A-4	-	0-10	65-100	60- 95	30- 90	13- 70	2-12		
38-60	SL GR-SL LS	SM SM-SC	A-2 A-1	-	0-10	65-100	60- 95	30- 80	13- 35	2-12		
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 3	<23	NP-6	1.4-1.5	0.6-2.	0.11- 0.2	3.6-6.5	-	-	3.- 7.	LOW	0.37	
3-23	<25	NP-7	1.5-1.6	0.6-2.	0.17-0.22	3.6-6.5	-	-	-	LOW	0.37	
23-38	<25	NP-7	1.5-1.6	0.6-2.	0.04-0.16	3.6-6.5	-	-	-	LOW	0.24	
38-60	<23	NP-6	1.5-1.8	0.6-2.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.24	
								Wind	Risk of Corrosion		Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE	-	-	>6.0	-	-	>60.	B	5	0	LOW	HIGH	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Slope	
Daily Cover for Landfill		POOR	Slope	
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave Slope	
Dwellings Without Basements		SEVERE	Slope	
Dwellings With Basements		SEVERE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones Slope	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Slope	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		POOR	Large Stones Slope	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Slope	
Embankments, Dikes and Levees		SEVERE	Piping	
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	
Terraces and Diversions		LIMITATION	Slope Erodes Easily	
Grassed Waterways		LIMITATION	Slope Erodes Easily	

RECREATIONAL DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Camp Areas		SEVERE	Slope	
Picnic Areas		SEVERE	Slope	
Playgrounds		SEVERE	Slope	
Paths and Trails		MODERATE	Large Stones	Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							5.4	2.2
							6.	2.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
3R	SLIGHT	MODERATE	SLIGHT	SLIGHT	SEVERE	NORTH	sugar maple yellow birch paper birch bigtooth aspen quaking aspen American basswood white spruce red pine eastern white pine	E E E E E E P P P	69 68 3

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

PeB PADUS-PENCE SANDY LOAMS, 1 TO 6 PERCENT SLOPES

Nearly level and gently sloping, well drained soils formed in loamy deposits underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is potentially highly erodible. The land capability classification is 3E.

Component Name: PADUS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 5	SL	SM	A-2 A-4 A-1-B		-	0-7	80-100	75-100	45- 85	20- 50	3-10	
5-33	FSL SL L	SM SC ML CL	A-2 A-4 A-1-B		-	0-7	80-100	75-100	45- 95	20- 90	5-18	
33-35	GR-LS S GR-SL	SM SP GP GM	A-2 A-4 A-1 A-3		-	0-7	50-100	45-100	25- 75	2- 40	2-10	
35-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-2 A-3		-	0-7	30-100	25-100	10- 70	1- 12	0- 3	
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 5	<25	NP-4	1.4-1.7	0.6-6.	0.1-0.15	4.5-6.5	-	-	0.5- 2.	LOW	0.24	
5-33	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24	
33-35	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1	
35-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1	
							Wind	Risk of Corrosion		Potential		
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency Duration		Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE			-	-	>6.0	-	>60	B 4 86	LOW	HIGH	MODERATE	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		SLIGHT		
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		MODERATE	Frost Action	
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty Soil Blowing
Terraces and Diversions		LIMITATION	Too Sandy	Soil Blowing
Grassed Waterways		LIMITATION	Droughty	Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SLIGHT		
Picnic Areas	SLIGHT		
Playgrounds	MODERATE	Slope	Small Stones
Paths and Trails	SLIGHT		

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				65	3.5	2.8	6.	2.5
				55	3.5	2.5	5.	2.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E E E EP P P	67 0 78 70 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, well drained soils formed in loamy deposits underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is potentially highly erodible. The land capability classification is 3E.

Component Name: PENCE

This map unit has 2 components, and 2 interpretation sheet.

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Unified	Classification	AASHTO	>10 In.	3-10 Inches	Percent < 3 in. passing sieve	Clay %
							No 4 No.10 No.40 No.200	<.002 mm
0- 8	SL	SM ML	A-4 A-2 A-1	-	0-7	85-100	75-100 45- 85 20- 55	3-11
8-15	SL L GR-SL	SM ML CL-ML SM-SC	A-4 A-2 A-1	-	0-7	55-100	50-100 30- 95 15- 75	2-12
15-21	GR-COS LS S	SM SP-SM GM GP-GM	A-2 A-1 A-3	-	0-8	55-100	50-100 25- 75 2- 30	2-10
21-60	GR-COS S SG	SP SP-SM GP GP-GM	A-1 A-3 A-2	-	0-15	30-100	25-100 10- 70 1- 12	0- 4

Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 8	<21	NP-4	1.2-1.6	2.-6.	0.1-0.18	4.5-6.5	-	-	1.- 3.	LOW	0.24
8-15	<25	NP-7	1.4-1.5	2.-6.	0.1-0.15	4.5- 6.	-	-	-	LOW	0.24
15-21	-	NP	1.6-1.8	2.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.1
21-60	-	NP	1.4-1.8	6.-20.	0.02-0.05	5.1-6.5	-	-	-	LOW	0.1

Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	HYD GRP	T Fact.	Erod. Index	Uncoated Steel	Risk of Corrosion Concrete	Potential Frost Action
NONE	-	-	>6.0	-	-	>60		B	3	86	LOW	MODERATE	LOW

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)
Septic Tank Absorption Fields	SEVERE	Poor Filter
Daily Cover for Landfill	POOR	Seepage
		Too Sandy
		Small Stones

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Shallow Excavations	SEVERE	Cutbanks Cave
Dwellings Without Basements	SLIGHT	
Dwellings With Basements	SLIGHT	
Small Commercial Buildings	SLIGHT	
Local Streets and Roads	SLIGHT	
Lawns, Landscaping, and Golf Fairways	MODERATE	Large Stones
		Droughty

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)
Roadfill	GOOD	
Sand	PROBABLE	
Gravel	PROBABLE	
Topsoil	POOR	Small Stones
		Area Reclaim

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)
Pond Reservoir Area	SEVERE	Seepage
Embankments, Dikes and Levees	SEVERE	Seepage
Drainage	LIMITATION	Deep To Water
Irrigation	LIMITATION	Droughty
Terraces and Diversions	LIMITATION	Too Sandy
Grassed Waterways	LIMITATION	Droughty
		Soil Blowing
		Slope

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SLIGHT	
Picnic Areas	SLIGHT	
Playgrounds	MODERATE	Slope
Paths and Trails	SLIGHT	Small Stones

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
				65	3.5	2.8	6.	2.5
				55	3.5	2.5	5.	2.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3S	SLIGHT	MODERATE	SLIGHT	SLIGHT	SLIGHT	NORTH	balsam fir sugar maple yellow birch paper birch quaking aspen American basswood red pine eastern white pine jack pine	E E E E E E EP EP P	0 59 0 0 0 0 59 57 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, well drained soils formed in loamy deposits underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is potentially highly erodible. The land capability classification is 4E.

Component Name: PADUS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Classification												>10	3-10	Percent < 3 in. passing sieve				Clay %				
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm									
0- 5	SL		SM		A-2	A-4	A-1-B	-	0-7	80-100	75-100	45- 85	20- 50	3-10								
5-33	FSL	SL L	SM	SC ML CL	A-2	A-4	A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18								
33-35	GR-LS	S GR-SL	SM	SP GP GM	A-2	A-4	A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10								
35-60	SR-	S G	SP	SP-SM GP GP-GM	A-1	A-2	A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3								
	Liquid	Plas-	Moist	Perme-	Available		Soil	CEC	CaCO3	Organic	Shrink	Erosion										
Depth	Limit	ticity	Bulk Density	ability	Water Capacity		Reaction	(me/		Matter	Swell	Factor										
(In)		Index	g/cc	In/hr	(In./in)		(pH)	100g)	Pct	Pct	Potential	K										
0- 5	<25	NP-4	1.4-1.7	0.6-6.	0.1-0.15		4.5-6.5	-	-	0.5- 2.	LOW	0.24										
5-33	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22		4.5-6.5	-	-	-	LOW	0.24										
33-35	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14		4.5-6.5	-	-	-	LOW	0.1										
35-60	-	NP	1.5-1.8	6.-20.	0.02-0.06		5.1-6.5	-	-	-	LOW	0.1										
												Wind	Risk of Corrosion		Potential							
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost											
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action									
NONE	-	-	>6.0	-	-	>60	B	4	86	LOW	HIGH	MODERATE										

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	Frost Action
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond, Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty Soil Blowing
Terraces and Diversions		LIMITATION	Slope	Too Sandy Soil Blowing
Grassed Waterways		LIMITATION	Slope	Droughty Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SLIGHT	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				55	3.	2.3	5.8	2.
				50	3.	2.3	4.8	2.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3L	SLIGHT	MODERATE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E E E EP P P	67 0 78 70 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, well drained soils formed in loamy deposits underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is potentially highly erodible. The land capability classification is 4E.

Component Name: PENCE

This map unit has 2 components, and 2 interpretation sheet.

Classification: ENTIC HAPLOTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Classification												>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm					
0- 8	SL		SM ML		A-4	A-2	A-1	-	0-7	85-100	75-100	45- 85	20- 55	3-11				
8-15	SL L	GR-SL	SM ML	CL-ML	SM-SC	A-4	A-2	A-1	-	0-7	55-100	50-100	30- 95	15- 75	2-12			
15-21	GR-COS	LS S	SM	SP-SM	GM GP-GM	A-2	A-1	A-3	-	0-8	55-100	50-100	25- 75	2- 30	2-10			
21-60	GR-COS	S SG	SP	SP-SM	GP GP-GM	A-1	A-3	A-2	-	0-15	30-100	25-100	10- 70	1- 12	0- 4			
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion							
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor							
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K							
0- 8	<21	NP-4	1.2-1.6	2.-6.	0.1-0.18	4.5-6.5	-	-	1.- 3.	LOW	0.24							
8-15	<25	NP-7	1.4-1.5	2.-6.	0.1-0.15	4.5- 6.	-	-	-	LOW	0.24							
15-21	-	NP	1.6-1.8	2.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.1							
21-60	-	NP	1.4-1.8	6.-20.	0.02-0.05	5.1-6.5	-	-	-	LOW	0.1							
									Wind	Risk of Corrosion		Potential						
Flooding			Water Table-(feet)			Bedrock-(in)		HYD	T	Erod.	Uncoated	Frost						
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action					
NONE	-	-	>6.0	-	-	>60	B	3	86	LOW	MODERATE	LOW						

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Droughty Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Droughty	Soil Blowing Slope
Terraces and Diversions		LIMITATION	Slope	Too Sandy Soil Blowing
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope
Picnic Areas	MODERATE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SLIGHT	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
				55	3.	2.3	5.8	2.
				50	3.	2.3	4.8	2.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3S	SLIGHT	MODERATE	SLIGHT	SLIGHT	SLIGHT	NORTH	balsam fir sugar maple yellow birch paper birch quaking aspen American basswood red pine eastern white pine jack pine	E 0 E 59 E 0 E 0 E 0 E 0 EP 59 EP 57 P 0	0 3 0 0 0 0 7 8 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Moderately steep and steep, well drained loamy soils underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is highly erodible. The land capability classification is 7E.

Component Name: PADUS

This map unit has 2 components, and 2 interpretation sheet.

Classification: ALFIC HAPLORHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No. 4	No.10	No.40	No.200	
0- 5	SL	SM	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 85	20- 50	3-10
5-33	FSL SL L	SM SC ML CL	A-2 A-4 A-1-B	-	0-7	80-100	75-100	45- 95	20- 90	5-18
33-35	GR-LS S GR-SL	SM SP GP GM	A-2 A-4 A-1 A-3	-	0-7	50-100	45-100	25- 75	2- 40	2-10
35-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-2 A-3	-	0-7	30-100	25-100	10- 70	1- 12	0- 3

Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 5	<25	NP-4	1.4-1.7	0.6-6.	0.1-0.15	4.5-6.5	-	-	0.5- 2.	LOW	0.24
5-33	<30	NP-10	1.4-1.6	0.6-6.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.24
33-35	<25	NP-4	1.4-1.6	0.6-6.	0.05-0.14	4.5-6.5	-	-	-	LOW	0.1
35-60	-	NP	1.5-1.8	6.-20.	0.02-0.06	5.1-6.5	-	-	-	LOW	0.1

Flooding		Water Table-(feet)		Bedrock-(in)		HYD T		Wind	Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Erod. Index	Uncoated Steel	Frost Action
NONE	-	-	>6.0	-	-	>60		B	4	86	LOW HIGH MODERATE

SANITARY FACILITIES	RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields	SEVERE	Poor Filter	Slope	
Daily Cover for Landfill	POOR	Seepage	Too Sandy	Small Stones

BUILDING SITE DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations	SEVERE	Cutbanks Cave	Slope	
Dwellings Without Basements	SEVERE	Slope		
Dwellings With Basements	SEVERE	Slope		
Small Commercial Buildings	SEVERE	Slope		
Local Streets and Roads	SEVERE	Slope		
Lawns, Landscaping, and Golf Fairways	SEVERE	Slope		

CONSTRUCTION MATERIAL	RATING	RESTRICTIVE FEATURE(S)		
Roadfill	POOR	Slope		
Sand	PROBABLE			
Gravel	PROBABLE			
Topsoil	POOR	Small Stones	Area Reclaim	Slope

WATER MANAGEMENT	RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area	SEVERE	Seepage	Slope	
Embankments, Dikes and Levees	SEVERE	Seepage	Piping	
Drainage	LIMITATION	Deep To Water		
Irrigation	LIMITATION	Slope	Droughty	Soil Blowing
Terraces and Diversions	LIMITATION	Slope	Too Sandy	Soil Blowing
Grassed Waterways	LIMITATION	Slope	Droughty	Rooting Depth

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SEVERE	Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							5.4	1.5
							4.4	1.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3R	SEVERE	SEVERE	SLIGHT	SLIGHT	MODERATE	NORTH	sugar maple white ash bigtooth aspen northern red oak American basswood red pine white spruce eastern white pine	E E E E E EP P P	67 0 78 70 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

PeD PADUS-PENCE SANDY LOAMS, 15 TO 45 PERCENT SLOPES

Moderately steep and steep, well drained loamy soils underlain by stratified sand and gravel and gravelly coarse sand glacial outwash. This map unit is highly erodible. The land capability classification is 7E.

Component Name: PENCE

This map unit has 2 components, and 2 interpretation sheet.

Classification: ENTIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 8	SL	SM ML		A-4 A-2 A-1	-	0-7	85-100	75-100	45- 85	20- 55		3-11
8-15	SL L GR-SL	SM ML CL-ML SM-SC		A-4 A-2 A-1	-	0-7	55-100	50-100	30- 95	15- 75		2-12
15-21	GR-COS LS S	SM SP-SM GM GP-GM		A-2 A-1 A-3	-	0-8	55-100	50-100	25- 75	2- 30		2-10
21-60	GR-COS S SG	SP SP-SM GP GP-GM		A-1 A-3 A-2	-	0-15	30-100	25-100	10- 70	1- 12		0- 4
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	
0- 8	<21	NP-4	1.2-1.6	2.-6.	0.1-0.18	4.5-6.5	-	-	1.- 3.	LOW	0.24	
8-15	<25	NP-7	1.4-1.5	2.-6.	0.1-0.15	4.5- 6.	-	-	-	LOW	0.24	
15-21	-	NP	1.6-1.8	2.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.1	
21-60	-	NP	1.4-1.8	6.-20.	0.02-0.05	5.1-6.5	-	-	-	LOW	0.1	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Wind	Risk of Corrosion		Potential	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	Erod.	Uncoated		Frost	
								Index	Steel	Concrete	Action	
NONE	-	-	>6.0	-	-	>60	B	3 86	LOW	MODERATE	LOW	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	Slope
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Slope
Dwellings Without Basements		SEVERE	Slope	
Dwellings With Basements		SEVERE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		SEVERE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Slope	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		POOR	Slope	
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim Slope
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Droughty	Soil Blowing Slope
Terraces and Diversions		LIMITATION	Slope	Too Sandy Soil Blowing
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SEVERE	Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							5.4	1.5
							4.4	1.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
3R	SEVERE	SEVERE	SLIGHT	SLIGHT	SLIGHT	NORTH	balsam fir sugar maple yellow birch paper birch quaking aspen American basswood red pine eastern white pine jack pine	E E E E E E EP EP P	0 59 0 0 0 0 59 57 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, somewhat poorly drained soil formed mainly in sandy deposits over sandy and loamy glacial drift. This map unit is not highly erodible. The land capability classification is 6S in stony areas. This map unit may have hydric inclusions.

Component Name: PEQUAMING

Classification: ALFIC HAPLAQUODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

CLASSIFICATION													
		Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %	
Depth	USDA Texture	Unified		AASHTO		In.	Inches	No. 4	No.10	No.40	No.200	<.002 mm	
0- 3	LS	SM	SC	SM-SC	SP-SM	A-2-4	A-1-B	-	25-50	95-100	90-100	40- 70 10- 30	0-12
3-24	LS S	SM	SM-SC	SC	SP-SM	A-2-4	A-3 A-1-B	-	0-25	95-100	90-100	40- 75 5- 30	0-15
24-32	LS SL	SM	SC	SM-SC		A-2	A-1 A-4 A-6	-	0-25	95-100	90-100	45- 75 15- 40	2-18
32-60	LS S GR-SL	SM	SM-SC	SC	SP-SM	A-1-B	A-3 A-2	-	0-25	80-100	60-100	30- 75 5- 30	0-12
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion		
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor		
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K		
0- 3	<20	NP-10	1.3-1.5	2.-20.	0.09-0.12	4.5- 6.	-	-	1.- 4.	LOW	0.17		
3-24	<20	NP-10	1.4-1.7	2.-20.	0.05-0.11	4.5- 6.	-	-	-	LOW	0.17		
24-32	<40	NP-25	1.5-1.8	2.-20.	0.08-0.14	4.5- 6.	-	-	-	LOW	0.17		
32-60	<25	NP-10	1.5-1.8	2.-20.	0.04-0.12	5.1-6.5	-	-	-	LOW	0.17		
								Wind	Risk of Corrosion		Potential		
Flooding				Water Table-(feet)		Bedrock-(in)	HYD ?	Erod.	Uncoated	Frost			
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel	Concrete	Action	
NONE	-	-	0.5-1.5	APPARENT	NOV-MAY	>60	A	5	0	LOW	HIGH	MODERATE	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Wetness	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy	Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness	
Dwellings Without Basements		SEVERE	Wetness		
Dwellings With Basements		SEVERE	Wetness		
Small Commercial Buildings		SEVERE	Wetness		
Local Streets and Roads		SEVERE	Wetness		
Lawns, Landscaping, and Golf Fairways		SEVERE	Large Stones	Wetness	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		POOR	Wetness		
Sand		PROBABLE			
Gravel		IMPROBABLE	Too Sandy		
Topsoil		POOR	Large Stones	Area Reclaim	Wetness
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage		
Embankments, Dikes and Levees		SEVERE	Seepage	Piping	Wetness
Drainage		LIMITATION	Cutbanks Cave		
Irrigation		LIMITATION	Large Stones	Wetness	
Terraces and Diversions		LIMITATION	Large Stones	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Large Stones	Wetness	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Wetness
Picnic Areas	SEVERE	Wetness
Playgrounds	SEVERE	Wetness
Paths and Trails	SEVERE	Wetness

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
							4.6	1.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
4X	SLIGHT	SEVERE	MODERATE	SEVERE	SEVERE	NORTH	balsam fir red maple sugar maple quaking aspen white spruce northern whitecedar Norway spruce black spruce eastern white pine	E E E E EP EP P P P	53 56 53 60 53 33

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Pt PITS, GRAVEL

ONEIDA COUNTY, WISCONSIN
03/13/91

Pits, sand or gravel

Component Name: PITS

Classification:

----- Wind						Risk of Corrosion	Potential
----- Flooding-----			--- Water Table-(feet) ---			HYD T Erod.	Frost
Frequency	Duration	Months	Depth	Kind	Months	Depth Hard.	Action
-----			-----			-----	-----
-	-	-	NA	-	-	NA	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanemt Pasture
bu/a	tons/a	bu/a	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM
-----					-----		-----	-----

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, somewhat poorly drained soil formed in sandy, loamy, and silty lacustrine deposits. This map unit is not highly erodible. The land capability classification is 2W. This map unit is prime farmland where drained.

Component Name: PLOVER

Classification: AQUIC GLOSSOBORALFS, COARSE-LOAMY, MIXED

ESTIMATED SOIL PROPERTIES

	Classification					>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture		Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm

0- 5	FSL		ML SM		A-2 A-4	-	0	100-100	100-100	60- 95	30- 55	3- 8
5-23	FSL VFSL L		SM ML SM-SC CL-ML		A-4	-	0	100-100	100-100	70-100	40- 75	5-18
23-29	FSL SL		SM ML CL-ML SM-SC		A-4	-	0	100-100	100-100	70-100	40- 70	10-18
29-60	SR- SI FS		SM ML CL-ML SM-SC		A-4	-	0	100-100	100-100	65-100	40- 75	1-12

	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion	
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor	
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K	

0- 5	<20	NP-4	1.4-1.6	0.6-2.	0.13-0.18	4.5-7.3	-	-	2.- 3.	LOW	0.24	
5-23	<20	NP-5	1.4-1.7	0.6-2.	0.15-0.19	4.5-7.3	-	-	-	LOW	0.24	
23-29	<25	NP-7	1.5-1.7	0.6-2.	0.12-0.17	4.5-7.3	-	-	-	LOW	0.24	
29-60	<25	NP-7	1.5-1.7	0.6-2.	0.11-0.22	5.6-7.3	-	-	-	LOW	0.24	
-----								Wind	Risk of Corrosion		Potential	
----- Flooding-----			----- Water Table-(feet) ---			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Action	

RARE	-	-	1.0-3.0	APPARENT	NOV-MAY	>60	C	5	86	MODERATE	HIGH	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	
Daily Cover for Landfill		POOR	Too Sandy	Wetness
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		SEVERE	Flooding	Wetness
Dwellings With Basements		SEVERE	Flooding	Wetness
Small Commercial Buildings		SEVERE	Flooding	Wetness
Local Streets and Roads		SEVERE	Frost Action	
Lawns, Landscaping, and Golf Fairways		MODERATE	Wetness	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		IMPROBABLE	Excess Fines	
Gravel		IMPROBABLE	Excess Fines	
Topsoil		FAIR	Thin Layer	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		MODERATE	Seepage	
Embankments, Dikes and Levees		SEVERE	Piping	Wetness
Drainage		LIMITATION	Frost Action	Cutbanks Cave
Irrigation		LIMITATION	Wetness	Soil Blowing
Terraces and Diversions		LIMITATION	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Wetness	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Flooding Wetness
Picnic Areas	MODERATE	Wetness
Playgrounds	SEVERE	Wetness
Paths and Trails	MODERATE	Wetness

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				70	3.5	3.	5.8	2.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES and/or TREES RECOMMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
3W	SLIGHT	SEVERE	SLIGHT	MODERATE	SEVERE	NORTH	red maple yellow birch American basswood American elm white spruce black spruce eastern white pine	E E E E P P P	65 0 0 0 0 0 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	eastern white pine	30	lilac	10	nannyberry viburnum	8
northern whitecedar	15	red maple	30	red pine	30	redosier dogwood	8
silky dogwood	10	silver maple	30	white ash	30	white spruce	20

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, well drained soil formed in sandy, glacial outwash and lacustrine deposits. This map unit is not highly erodible. The land capability classification is 3S.

Component Name: ROUSSEAU

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture		Unified	AASHTO	In.	Inches	No. 4	No.10	No.40	No.200	<.002 mm		
0- 6	LFS		SM	A-2-4 A-4	-	0	100-100	100-100	75- 95	25- 45	2-12		
6-21	FS		SM	A-2-4	-	0	100-100	100-100	65-100	20- 35	0-10		
21-60	FS S		SP-SM SM	A-2-4 A-3	-	0	100-100	100-100	50-100	5- 35	0-10		
	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K		
0- 6	-	NP	1.3-1.5	2.-6.	0.1-0.12	4.5- 6.	-	-	1.- 2.	LOW	0.17		
6-21	-	NP	1.3-1.6	6.-20.	0.06-0.08	4.5-6.5	-	-	-	LOW	0.15		
21-60	-	NP	1.5-1.6	6.-20.	0.05-0.07	5.1-6.5	-	-	-	LOW	0.15		
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Wind Erod.	Risk of Corrosion	Potential Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action
NONE	-	-	>6.0	-	-	>60		A	5	134	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy

BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		SLIGHT		
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		SLIGHT		
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	

CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	

WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Too Sandy	Fast Intake
Grassed Waterways		LIMITATION	Droughty	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Too Sandy
Picnic Areas	MODERATE	Too Sandy
Playgrounds	MODERATE	Slope Too Sandy
Paths and Trails	MODERATE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				55	2.5	2.	4.6	1.6

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
5A	SLIGHT	SLIGHT	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir E 0 0 red maple E 0 0 sugar maple E 60 3 yellow birch E 0 0 paper birch E 65 5 quaking aspen E 65 5 northern red oak E 0 0 eastern hemlock E 0 0 jack pine EP 62 6 red pine EP 0 0		

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
Amur privet	11	eastern redcedar	18	eastern white pine	29	imperial Carolina poplar	70
jack pine	26	manyflower cotoneaster	6	Norway spruce	28	red pine	26
Siberian crabapple	13	silky dogwood	10	Vanhoutte spirea	6	white spruce	22

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

RsC ROUSSEAU LOAMY FINE SAND, 6 TO 15 PERCENT SLOPES

Sloping, well drained soil formed in sandy glacial outwash and lacustrine deposits. This map unit is potentially highly erodible. The land capability classification is 3E.

Component Name: ROUSSEAU

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

				Classification		>10	3-10	Percent < 3 in. passing sieve				Clay %
Depth	USDA Texture			Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm
0- 6	LFS		SM		A-2-4 A-4	-	0	100-100	100-100	75- 95	25- 45	2-12
6-21	FS		SM		A-2-4	-	0	100-100	100-100	65-100	20- 35	0-10
21-60	FS S		SP-SM SM		A-2-4 A-3	-	0	100-100	100-100	50-100	5- 35	0-10
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K	
0- 6	-	NP	1.3-1.5	2.-6.	0.1-0.12	4.5- 6.	-	-	1.- 2.	LOW	0.17	
6-21	-	NP	1.3-1.6	6.-20.	0.06-0.08	4.5-6.5	-	-	-	LOW	0.15	
21-60	-	NP	1.5-1.6	6.-20.	0.05-0.07	5.1-6.5	-	-	-	LOW	0.15	
							Wind	Risk of Corrosion		Potential		
Flooding-----			Water Table-(feet) ---			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost		
Frequency Duration		Months	Depth	Kind	Months	Depth Hard.	GRP	Fact.	Index	Steel	Concrete	Action
NONE		-	>6.0	-	-	>60	A	5	134	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope Too Sandy
Picnic Areas	MODERATE	Slope Too Sandy
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				45	2.3	1.8	4.4	1.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
5A	SLIGHT	SLIGHT	SLIGHT	SLIGHT	MODERATE	NORTH	balsam fir red maple sugar maple yellow birch paper birch quaking aspen northern red oak eastern hemlock jack pine red pine	E 0 E 0 E 60 E 0 E 65 E 65 E 0 E 0 EP 62 EP 0	0 0 3 0 5 5 0 0 6 0

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
Amur privet	11	eastern redcedar	18	eastern white pine	29	imperial Carolina poplar	70
jack pine	26	manyflower cotoneaster	6	Norway spruce	28	red pine	26
Siberian crabapple	13	silky dogwood	10	Vanhoutte spirea	6	white spruce	22

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 4S.

Component Name: SAYNER

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay %	
		Unified	AASHTO			No 4	No.10	No.40	No.200	<.002 mm	
0- 4	LS	SM SP-SM	A-1 A-2	-	0-15	80-100	75-100	35- 75	10- 30	1- 5	
4-22	LS S GR-S	SP SM GP GM	A-1 A-3 A-2	-	0-15	50-100	50-100	20- 75	0- 30	1- 5	
22-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-3 A-2	-	0-15	50- 90	40- 85	0- 55	0- 10	0- 3	
Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 4	-	NP	1.3-1.4	2.-6.	0.08-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17
4-22	-	NP	1.4-1.5	2.-6.	0.03-0.12	4.5-6.5	-	-	-	LOW	0.17
22-60	-	NP	1.5-1.8	6.-20.	0.02-0.04	5.1-6.5	-	-	-	LOW	0.1
----- Flooding-----						Wind	Risk of Corrosion		Potential		
----- Water Table-(feet) -----						Bedrock-(in)	HYD T	Erod.	Uncoated	Frost	
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel	Concrete
NONE	-	-	>6.0	-	-	>60	A	4	134	LOW	MODERATE

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Poor Filter		
Daily Cover for Landfill		POOR	Seepage	Too Sandy	Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave		
Dwellings Without Basements		SLIGHT			
Dwellings With Basements		SLIGHT			
Small Commercial Buildings		SLIGHT			
Local Streets and Roads		SLIGHT			
Lawns, Landscaping, and Golf Fairways		SEVERE	Droughty		
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		GOOD			
Sand		PROBABLE			
Gravel		PROBABLE			
Topsoil		POOR	Too Sandy	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage		
Embankments, Dikes and Levees		SEVERE	Seepage		
Drainage		LIMITATION	Deep To Water		
Irrigation		LIMITATION	Slope	Droughty	Fast Intake
Terraces and Diversions		LIMITATION	Too Sandy	Soil Blowing	
Grassed Waterways		LIMITATION	Droughty		

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	MODERATE	Too Sandy	
Picnic Areas	MODERATE	Too Sandy	
Playgrounds	MODERATE	Slope	Small Stones Too Sandy
Paths and Trails	MODERATE	Too Sandy	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				40	2.3	1.8	3.3	1.4

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
7S	SLIGHT	MODERATE	MODERATE	SLIGHT	SLIGHT	NORTH	red maple paper birch quaking aspen northern red oak jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 EP 0 EP 59 EP 57	0 0 0 0 0 7 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S.

Component Name: SAYNER

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture		Unified	AASHTO	ln.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 4	LS		SM SP-SM	A-1 A-2	-	0-15	80-100	75-100	35- 75	10- 30	1- 5		
4-22	LS S GR-S		SP SM GP GM	A-1 A-3 A-2	-	0-15	50-100	50-100	20- 75	0- 30	1- 5		
22-60	SR- S G		SP SP-SM GP GP-GM	A-1 A-3 A-2	-	0-15	50- 90	40- 85	0- 55	0- 10	0- 3		
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion		
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor		
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K		
0- 4	-	NP	1.3-1.4	2.-6.	0.08-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17		
4-22	-	NP	1.4-1.5	2.-6.	0.03-0.12	4.5-6.5	-	-	-	LOW	0.17		
22-60	-	NP	1.5-1.8	6.-20.	0.02-0.04	5.1-6.5	-	-	-	LOW	0.1		
								Wind	Risk of Corrosion		Potential		
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost			
Frequency		Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel Concrete	Action	
NONE		-	-	>6.0	-	-	>60	A	4	134	LOW	MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	
Lawns, Landscaping, and Golf Fairways		SEVERE	Droughty	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Too Sandy	Small Stones Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty Fast Intake
Terraces and Diversions		LIMITATION	Slope	Too Sandy Soil Blowing
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	MODERATE	Slope	Too Sandy
Picnic Areas	MODERATE	Slope	Too Sandy
Playgrounds	SEVERE	Slope	
Paths and Trails	MODERATE	Too Sandy	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							3.	1.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
7S	SLIGHT	MODERATE	MODERATE	SLIGHT	SLIGHT	NORTH	red maple paper birch quaking aspen northern red oak jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 EP 0 EP 59 EP 57	0 0 0 0 0 7 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Moderately steep and steep, excessively drained soil formed in sandy deposits underlain by stratified sand and gravel glacial outwash. This map unit is highly erodible. The land capability classification is 7S.

Component Name: SAYNER

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No. 4	No. 10	No. 40	No. 200	
0-4	LS	SM SP-SM	A-1 A-2	-	0-15	80-100	75-100	35-75	10-30	1-5
4-22	LS S GR-S	SP SM GP GM	A-1 A-3 A-2	-	0-15	50-100	50-100	20-75	0-30	1-5
22-60	SR- S G	SP SP-SM GP GP-GM	A-1 A-3 A-2	-	0-15	50-90	40-85	0-55	0-10	0-3

Depth (In)	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0-4	-	NP	1.3-1.4	2.-6.	0.08-0.12	4.5-6.5	-	-	0.5-1.	LOW	0.17
4-22	-	NP	1.4-1.5	2.-6.	0.03-0.12	4.5-6.5	-	-	-	LOW	0.17
22-60	-	NP	1.5-1.8	6.-20.	0.02-0.04	5.1-6.5	-	-	-	LOW	0.1

Flooding		Water Table-(feet)			Bedrock-(in)		HYD	T	Erod.	Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Uncoated Steel	Frost Action
NONE	-	-	>6.0	-	-	>60		A	4	134	LOW MODERATE	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)		
Septic Tank Absorption Fields		SEVERE	Poor Filter	Slope	
Daily Cover for Landfill		POOR	Seepage	Too Sandy	Small Stones

BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)		
Shallow Excavations		SEVERE	Cutbanks Cave	Slope	
Dwellings Without Basements		SEVERE	Slope		
Dwellings With Basements		SEVERE	Slope		
Small Commercial Buildings		SEVERE	Slope		
Local Streets and Roads		SEVERE	Slope		
Lawns, Landscaping, and Golf Fairways		SEVERE	Droughty	Slope	

CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)		
Roadfill		POOR	Slope		
Sand		PROBABLE			
Gravel		PROBABLE			
Topsoil		POOR	Too Sandy	Small Stones	Area Reclaim

WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)		
Pond Reservoir Area		SEVERE	Seepage	Slope	
Embankments, Dikes and Levees		SEVERE	Seepage		
Drainage		LIMITATION	Deep To Water		
Irrigation		LIMITATION	Slope	Droughty	Fast Intake
Terraces and Diversions		LIMITATION	Slope	Too Sandy	Soil Blowing
Grassed Waterways		LIMITATION	Slope	Droughty	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	SEVERE	Slope

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tols/acre	Improved Pasture AUM	Permanemt Pasture AUM
								0.8

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
7R	SEVERE	SEVERE	SEVERE	SLIGHT	SLIGHT	NORTH	red maple paper birch quaking aspen northern red oak jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 EP 0 EP 59 EP 57	0 0 0 0 0 7 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Component Name: UDORTHENTS
 Classification:

Flooding-----			Water Table-(feet) ---			Bedrock-(in)		HYD T Erod.		Wind		Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index		Uncoated		Frost
												Steel	Concrete	Action
	-	-	NA	-	-	NA								

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanemt Pasture
bu/a	tons/a	bu/e	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, excessively drained soil formed in sandy glacial outwash. This map unit is not highly erodible. The land capability classification is 4S.

Component Name: VILAS

Classification: ENTIC HAPLORTHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Classification		>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay % <.002 mm
		Unified	AASHTO			No. 4	No.10	No.40	No.200	
0- 3	LS	SM SP-SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6
3-19	LS	SP-SM SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6
19-30	S	SM SP-SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	5- 20	1- 3
30-60	S	SP SP-SM SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	1- 20	0- 3

Depth (In)	Liquid Limit	Plas- ticity Index	Moist Bulk Density g/cc	Perme- ability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/ 100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 3	-	NP	1.4-1.6	6.-20.	0.09-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17
3-19	-	NP	1.5-1.6	6.-20.	0.07-0.12	4.5-6.5	-	-	-	LOW	0.17
19-30	-	NP	1.5-1.7	6.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.17
30-60	-	NP	1.5-1.7	6.-20.	0.04-0.07	5.1-6.5	-	-	-	LOW	0.17

Flooding			Water Table-(feet)			Bedrock-(in)		HYD	T	Wind	Risk of Corrosion		Potential
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Erod.	Uncoated	Steel	Frost
													Action
NONE	-	-	>6.0	-	-	>60		A	5	134	LOW	HIGH	LOW

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		SLIGHT		
Dwellings With Basements		SLIGHT		
Small Commercial Buildings		SLIGHT		
Local Streets and Roads		SLIGHT		
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Too Sandy	Fast Intake
Grassed Waterways		LIMITATION	Droughty	

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	MODERATE	Too Sandy	
Picnic Areas	MODERATE	Too Sandy	
Playgrounds	MODERATE	Slope	Small Stones
Paths and Trails	MODERATE	Too Sandy	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
				45	2.3	1.8	4.	1.5

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
6S	SLIGHT	MODERATE	MODERATE	SLIGHT	SLIGHT	NORTH	balsam fir red maple paper birch quaking aspen northern pin oak northern red oak jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 E 0 E 0 EP 65 EP 57 EP 56	0 0 0 0 0 0 7 6 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Sloping, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 6S.

Component Name: VILAS

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

	Classification				>10	3-10	Percent < 3 in. passing sieve				Clay %		
Depth	USDA Texture	Unified		AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm		
0- 3	LS	SM	SP-SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6		
3-19	LS	SP-SM	SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6		
19-30	S	SM	SP-SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	5- 20	1- 3		
30-60	S	SP	SP-SM SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	1- 20	0- 3		
	Liquid	Plas-	Moist	Perme-	Available	Soil	CEC	CaCO3	Organic	Shrink	Erosion		
Depth	Limit	ticity	Bulk Density	ability	Water Capacity	Reaction	(me/		Matter	Swell	Factor		
(In)		Index	g/cc	In/hr	(In./in)	(pH)	100g)	Pct	Pct	Potential	K		
0- 3	-	NP	1.4-1.6	6.-20.	0.09-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17		
3-19	-	NP	1.5-1.6	6.-20.	0.07-0.12	4.5-6.5	-	-	-	LOW	0.17		
19-30	-	NP	1.5-1.7	6.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.17		
30-60	-	NP	1.5-1.7	6.-20.	0.04-0.07	5.1-6.5	-	-	-	LOW	0.17		
								Wind	Risk of Corrosion		Potential		
Flooding			Water Table-(feet)			Bedrock-(in)	HYD	T	Erod.	Uncoated	Frost		
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP	Fact.	Index	Steel	Concrete	Action
NONE	-	-	>6.0	-	-	>60	A	5	134	LOW	HIGH	LOW	

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Poor Filter	
Daily Cover for Landfill		POOR	Seepage	Too Sandy
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	
Dwellings Without Basements		MODERATE	Slope	
Dwellings With Basements		MODERATE	Slope	
Small Commercial Buildings		SEVERE	Slope	
Local Streets and Roads		MODERATE	Slope	
Lawns, Landscaping, and Golf Fairways		MODERATE	Droughty	Slope
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		GOOD		
Sand		PROBABLE		
Gravel		IMPROBABLE	Too Sandy	
Topsoil		POOR	Too Sandy	
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	Slope
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Deep To Water	
Irrigation		LIMITATION	Slope	Droughty
Terraces and Diversions		LIMITATION	Slope	Too Sandy
Grassed Waterways		LIMITATION	Slope	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	MODERATE	Slope Too Sandy
Picnic Areas	MODERATE	Slope Too Sandy
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanent Pasture AUM
							3.8	1.2

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
6S	SLIGHT	MODERATE	MODERATE	SLIGHT	SLIGHT	NORTH	balsam fir red maple paper birch quaking aspen northern pin oak northern red oak jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 E 0 E 0 EP 65 EP 57 EP 56	0 0 0 0 0 0 7 6 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

VsD VILAS LOAMY SAND, 15 TO 25 PERCENT SLOPES

Moderately steep, excessively drained soil formed in sandy glacial outwash. This map unit is potentially highly erodible. The land capability classification is 7S.

Component Name: VILAS

Classification: ENTIC HAPLORHODS, SANDY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

		Classification		>10	3-10	Percent < 3 in. passing sieve				Clay %	
Depth	USDA Texture	Unified	AASHTO	In.	Inches	No 4	No.10	No.40	No.200	<.002 mm	
0- 3	LS	SM SP-SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6	
3-19	LS	SP-SM SM	A-1 A-2	-	0	80-100	75-100	35- 90	12- 30	2- 6	
19-30	S	SM SP-SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	5- 20	1- 3	
30-60	S	SP SP-SM SM	A-1 A-2 A-3	-	0	80-100	75-100	35- 90	1- 20	0- 3	
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 3	-	NP	1.4-1.6	6.-20.	0.09-0.12	4.5-6.5	-	-	0.5- 1.	LOW	0.17
3-19	-	NP	1.5-1.6	6.-20.	0.07-0.12	4.5-6.5	-	-	-	LOW	0.17
19-30	-	NP	1.5-1.7	6.-20.	0.05-0.08	4.5-6.5	-	-	-	LOW	0.17
30-60	-	NP	1.5-1.7	6.-20.	0.04-0.07	5.1-6.5	-	-	-	LOW	0.17
								Wind	Risk of Corrosion	Potential	
Flooding			Water Table-(feet)			Bedrock-(in)	HYD T	Erod.	Uncoated	Frost	
Frequency Duration		Months	Depth	Kind	Months	Depth Hard.	GRP Fact.	Index	Steel	Concrete	Action
NONE		-	>6.0	-	-	>60	A	5 134	LOW	HIGH	LOW
SANITARY FACILITIES				RATING		RESTRICTIVE FEATURE(S)					
Septic Tank Absorption Fields				SEVERE		Poor Filter		Slope			
Daily Cover for Landfill				POOR		Seepage		Too Sandy		Slope	
BUILDING SITE DEVELOPMENT				RATING		RESTRICTIVE FEATURE(S)					
Shallow Excavations				SEVERE		Cutbanks Cave		Slope			
Dwellings Without Basements				SEVERE		Slope					
Dwellings With Basements				SEVERE		Slope					
Small Commercial Buildings				SEVERE		Slope					
Local Streets and Roads				SEVERE		Slope					
Lawns, Landscaping, and Golf Fairways				SEVERE		Slope					
CONSTRUCTION MATERIAL				RATING		RESTRICTIVE FEATURE(S)					
Roadfill				FAIR		Slope					
Sand				PROBABLE							
Gravel				IMPROBABLE		Too Sandy					
Topsoil				POOR		Too Sandy		Slope			
WATER MANAGEMENT				RATING		RESTRICTIVE FEATURE(S)					
Pond Reservoir Area				SEVERE		Seepage		Slope			
Embankments, Dikes and Levees				SEVERE		Seepage		Piping			
Drainage				LIMITATION		Deep To Water					
Irrigation				LIMITATION		Slope		Droughty		Fast Intake	
Terraces and Diversions				LIMITATION		Slope		Too Sandy		Soil Blowing	
Grassed Waterways				LIMITATION		Slope		Droughty			

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)
Camp Areas	SEVERE	Slope
Picnic Areas	SEVERE	Slope
Playgrounds	SEVERE	Slope
Paths and Trails	MODERATE	Slope Too Sandy

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain	Corn Silage	Soybeans	Wheat	Oats	Alfalfa Hay	Red Clover Hay	Improved Pasture	Permanemt Pasture
bu/a	tons/a	bu/a	bu/a	bu/a	tons/acre	tons/acre	AUM	AUM
								1.

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	(E) SITE INDEX	WOODLAND PRODUCT- IVITY
6R	MODERATE	MODERATE	MODERATE	SLIGHT	SLIGHT	NORTH	balsam fir red maple paper birch quaking aspen northern pin oak northern red oak jack pine red pine eastern white pine	E 0 E 0 E 0 E 0 E 0 E 0 EP 65 EP 57 EP 56	0 0 0 0 0 0 7 6 8

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	Amur maple	10	eastern redcedar	15	eastern white pine	30
gray dogwood	8	jack pine	30	lilac	10	manyflower cotoneaster	6
Norway spruce	20	red pine	30	Siberian peashrub	8	silky dogwood	8

For more information contact: Area Resource Soil Scientist, Soil Conservation Service

Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Nearly level and gently sloping, somewhat poorly drained soil formed in loamy deposits underlain by stratified sand and gravel glacial outwash. This map unit is not highly erodible. The land capability classification is 2W. This map unit is prime farmland where drained. This map unit may have hydric inclusions.

Component Name: WORCESTER

Classification: AQUALFIC HAPLORTHODS, COARSE-LOAMY, MIXED, FRIGID

ESTIMATED SOIL PROPERTIES

Depth	USDA Texture	Unified	Classification	AASHTO	>10 In.	3-10 Inches	Percent < 3 in. passing sieve				Clay %
							No 4	No.10	No.40	No.200	<.002 mm
0- 3	SL	SM SM-SC	A-2 A-4		-	0-7	80-100	75-100	45- 85	25- 50	5-15
3-14	L SL SIL	SM SM-SC ML CL-ML	A-2 A-4		-	0-7	80-100	75-100	35- 95	12- 80	8-18
14-26	L SL GR-SL	SM SC ML CL	A-2 A-4 A-1		-	0-7	50-100	45-100	25- 95	10- 80	8-18
26-60	S GR-S GRV-S	SP SP-SM GP GP-GM	A-1 A-2 A-3		-	0-7	30-100	25-100	10- 70	1- 12	0- 3
Depth	Liquid Limit	Plasticity Index	Moist Bulk Density g/cc	Permeability In/hr	Available Water Capacity (In./in)	Soil Reaction (pH)	CEC (me/100g)	CaCO3 Pct	Organic Matter Pct	Shrink Swell Potential	Erosion Factor K
0- 3	15-20	2-7	1.4-1.5	0.6-2.	0.1-0.18	4.5-6.5	-	-	1.- 3.	LOW	0.24
3-14	15-20	2-7	1.4-1.7	0.6-2.	0.09-0.22	4.5-6.5	-	-	-	LOW	0.32
14-26	15-25	3-10	1.4-1.7	0.6-2.	0.06-0.19	4.5-6.5	-	-	-	LOW	0.32
26-60	-	NP	1.3- 2.	6.-20.	0.02-0.07	5.1-6.5	-	-	-	LOW	0.15
Wind Risk of Corrosion Potential											
----- Flooding----- --- Water Table-(feet) --- Bedrock-(in) HYD T Erod. Uncoated Frost											
Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard.	GRP Fact.	Index	Steel	Concrete
RARE	-	-	1.0-3.0	APPARENT	NOV-MAY	>60		C	4	86	HIGH

SANITARY FACILITIES		RATING	RESTRICTIVE FEATURE(S)	
Septic Tank Absorption Fields		SEVERE	Wetness	Poor Filter
Daily Cover for Landfill		POOR	Seepage	Too Sandy
				Small Stones
BUILDING SITE DEVELOPMENT		RATING	RESTRICTIVE FEATURE(S)	
Shallow Excavations		SEVERE	Cutbanks Cave	Wetness
Dwellings Without Basements		SEVERE	Flooding	Wetness
Dwellings With Basements		SEVERE	Flooding	Wetness
Small Commercial Buildings		SEVERE	Flooding	Wetness
Local Streets and Roads		SEVERE	Frost Action	
Lawns, Landscaping, and Golf Fairways		MODERATE	Large Stones	Wetness
				Droughty
CONSTRUCTION MATERIAL		RATING	RESTRICTIVE FEATURE(S)	
Roadfill		FAIR	Wetness	
Sand		PROBABLE		
Gravel		PROBABLE		
Topsoil		POOR	Small Stones	Area Reclaim
WATER MANAGEMENT		RATING	RESTRICTIVE FEATURE(S)	
Pond Reservoir Area		SEVERE	Seepage	
Embankments, Dikes and Levees		SEVERE	Seepage	Piping
Drainage		LIMITATION	Frost Action	Cutbanks Cave
Irrigation		LIMITATION	Wetness	Droughty
Terraces and Diversions		LIMITATION	Wetness	Too Sandy
Grassed Waterways		LIMITATION	Wetness	Droughty

RECREATIONAL DEVELOPMENT	RATING	RESTRICTIVE FEATURE(S)	
Camp Areas	SEVERE	Flooding	Wetness
Picnic Areas	MODERATE	Wetness	
Playgrounds	SEVERE	Wetness	
Paths and Trails	MODERATE	Wetness	

CROPS AND PASTURE YIELDS

Crop yields in this table are averages for high level management where the crop is commonly grown on the map unit.

Corn Grain bu/a	Corn Silage tons/a	Soybeans bu/a	Wheat bu/a	Oats bu/a	Alfalfa Hay tons/acre	Red Clover Hay tons/acre	Improved Pasture AUM	Permanemt Pasture AUM
				75	4.	3.	6.3	3.3

WOODLAND INTERPRETATIONS

WOODLAND ORD. SYB.	EROSION HAZARD	EQUIPMENT LIMITATION	SEEDLING MORTALITY	WIND TH. HAZARD	PLANT COMPETITION	INTERP ASPECT	COMMONLY EXISTING TREES (E) and/or TREES RECOMENDED TO PLANT (P)	SITE INDEX	WOODLAND PRODUCT- IVITY
ZW	SLIGHT	SEVERE	SLIGHT	MODERATE	MODERATE	NORTH	balsam fir sugar maple yellow birch red maple white spruce eastern white pine	E E E EP EP P	55 2

RECOMMENDED WINDBREAK SPECIES AND EXPECTED HEIGHT AT 20 YEARS

Plant Name	Height	Plant Name	Height	Plant Name	Height	Plant Name	Height
American cranberrybush	10	common ninebark	8	eastern white pine	30	lilac	10
nannyberry viburnum	8	northern whitecedar	15	red maple	30	redosier dogwood	8
silky dogwood	10	silver maple	30	white ash	30	white spruce	20

For more information contact: Area Resource Soil Scientist, Soil Conservation Service, Hwy 70 E. and Timberland Road,
Route 2, Box 2355, Spooner, WI 54801-1403, Phone: 715-635-3505

Appendix C

Forest County and Oneida County Soil Association Maps

(For Forest County Soil Series Properties see Appendix 3.5-30, Volume V of the Crandon Project's EIR. For Oneida County Soil Series Properties see Appendix B of the EIR Supplement: Wisconsin River Discharge Pipeline.)



LEGEND:

■■■■■ PIPELINE CORRIDOR

SOURCE: FOREST COUNTY
SOIL SURVEY, DRAFT 1994

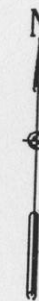
Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE C-1
FOREST COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667	Date: AUGUST, 1995
Prepared By: Foth & Van Dyke	By: KMP



LEGEND:

— — — — PIPELINE CORRIDOR

SOURCE: FOREST COUNTY
SOIL SURVEY, DRAFT 1994

Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE C-2
FOREST COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667 Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: KMP



LEGEND:

■■■■ PIPELINE CORRIDOR



SOURCE: FOREST COUNTY
SOIL SURVEY, DRAFT 1994

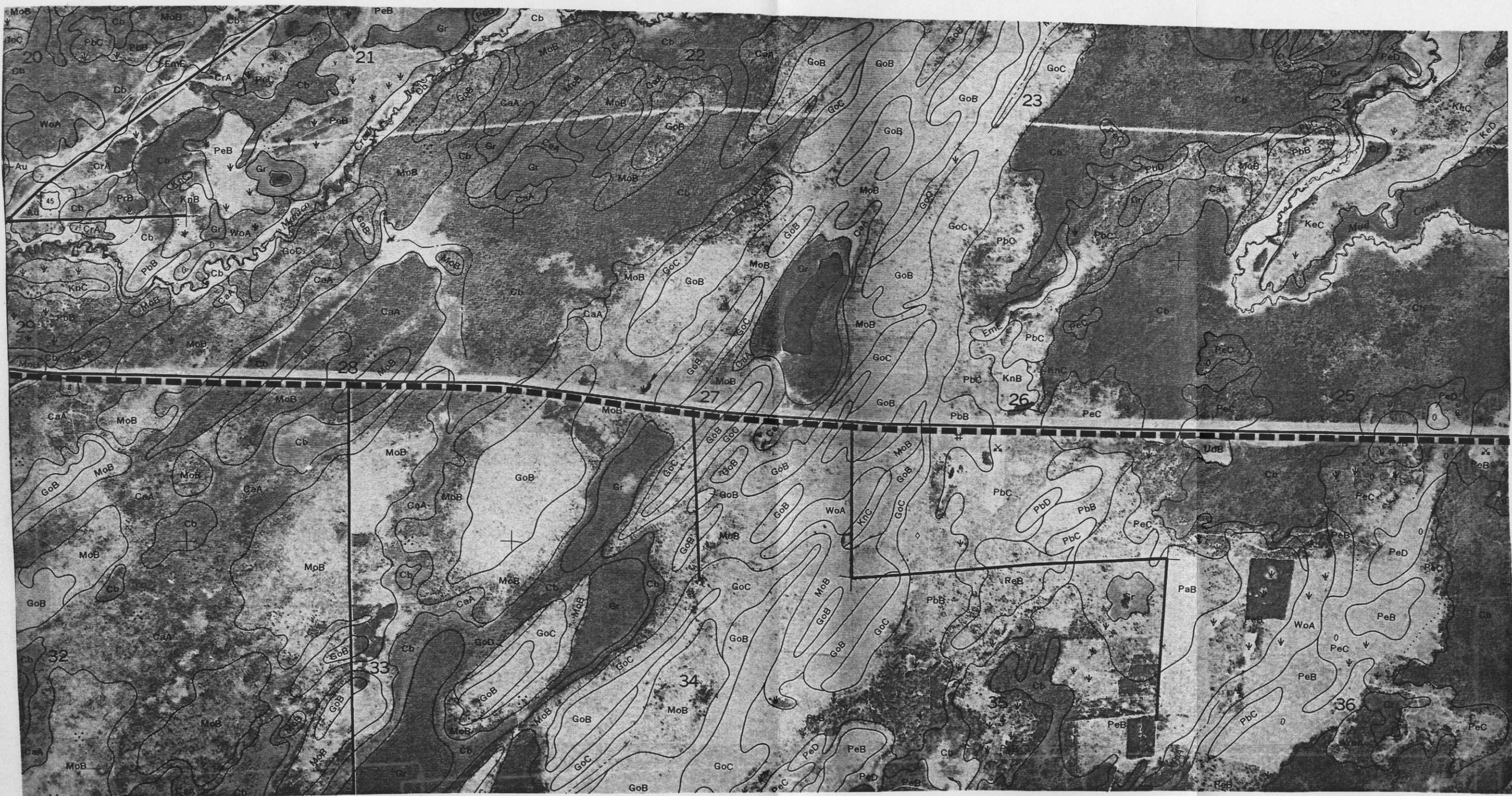
Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE C-4
FOREST COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667 Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: KMP



LEGEND:

— — — — PIPELINE CORRIDOR

SOURCE: ONEIDA COUNTY
SOIL SURVEY 1993

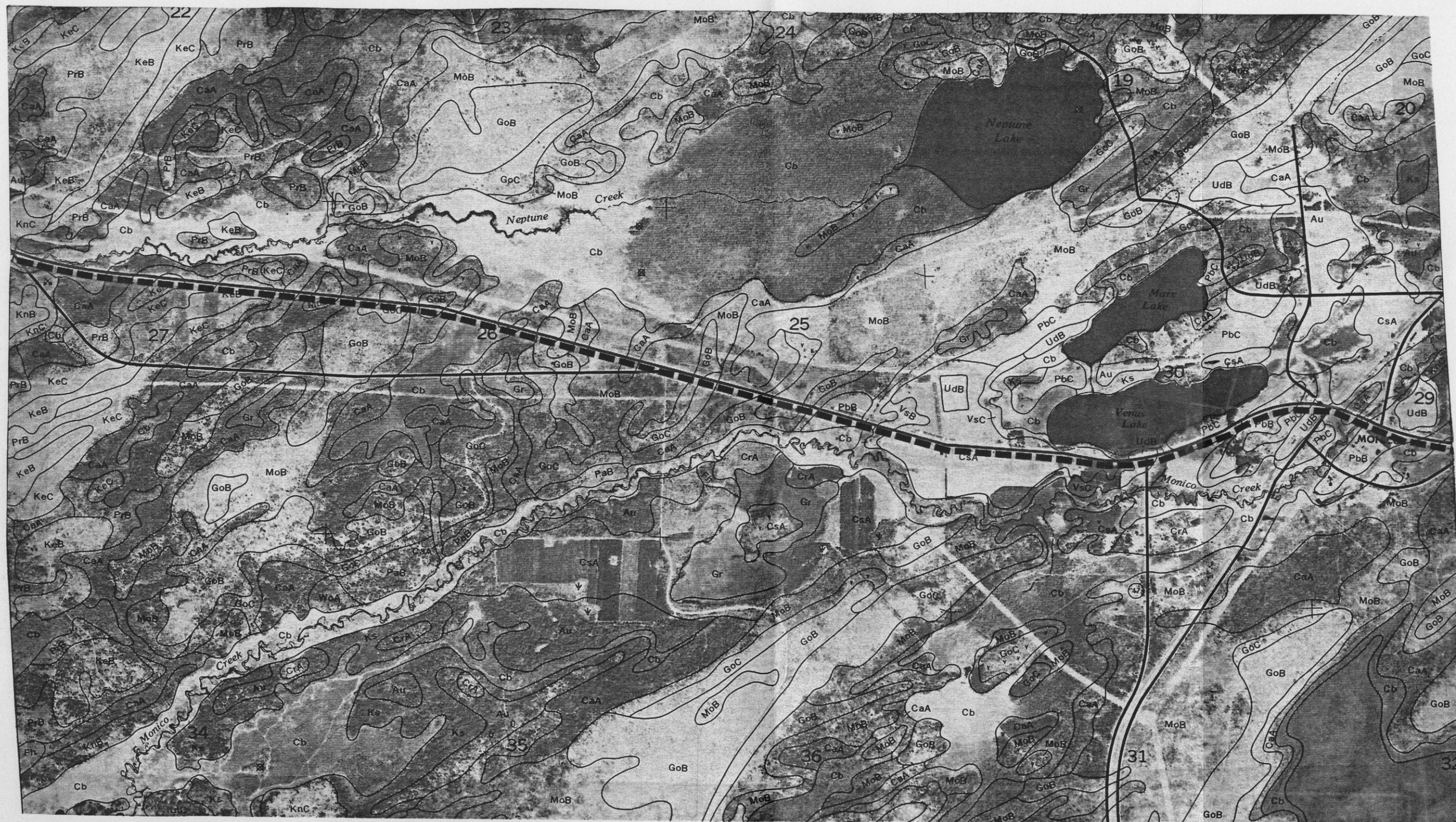
Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE C-5
ONEIDA COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667 Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: KMP



LEGEND:

■■■■ PIPELINE CORRIDOR

SOURCE: ONEIDA COUNTY
SOIL SURVEY 1993

Foth & Van Dyke				
REVISED	DATE	BY	DESCRIPTION	
CHECKED BY:		JKS1	DATE: AUG.'95	
APPROVED BY:		RFS	DATE: AUG.'95	
APPROVED BY:		GWS	DATE: AUG.'95	



Crandon Mining Company

FIGURE C-6
ONEIDA COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667 Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: KMP



LEGEND:

— — — — PIPELINE CORRIDOR

SOURCE: ONEIDA COUNTY
SOIL SURVEY 1993

Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE C-7
ONEIDA COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667	Date: AUGUST, 1995
Prepared By: Foth & Van Dyke	By: KMP



LEGEND:

■■■■■ PIPELINE CORRIDOR

SOURCE: ONEIDA COUNTY
SOIL SURVEY 1993

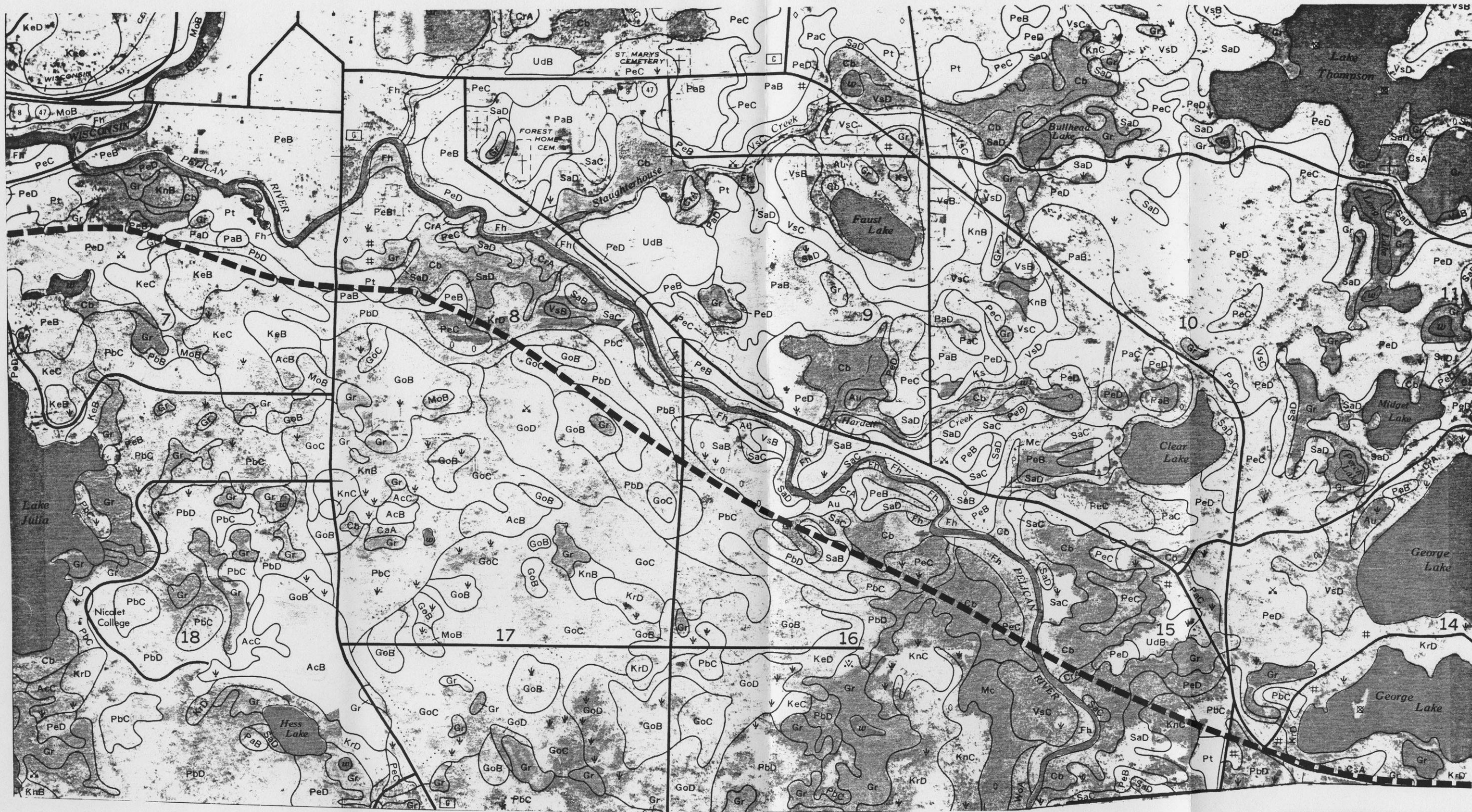
Foth & Van Dyke				
REVISED	DATE	BY	DESCRIPTION	
CHECKED BY:		JKS1	DATE:	AUG. '95
APPROVED BY:		RFS	DATE:	AUG. '95
APPROVED BY:		GWS	DATE:	AUG. '95



Crandon Mining Company

FIGURE C-8
ONEIDA COUNTY
SOIL MAP SHEET

Scale: APPROX. 1"=1667 Date: AUGUST, 1995
Prepared By: Foth & Van Dyke By: KMP



LEGEND:
 ■■■■■ PIPELINE CORRIDOR

SOURCE: ONEIDA COUNTY
 SOIL SURVEY 1993

Foth & Van Dyke			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS1	DATE: AUG.'95
APPROVED BY:		RFS	DATE: AUG.'95
APPROVED BY:		GWS	DATE: AUG.'95



Crandon Mining Company

FIGURE C-9
 ONEIDA COUNTY
 SOIL MAP SHEET

Scale: APPROX. 1"=1667	Date: AUGUST, 1995
Prepared By: Foth & Van Dyke	By: KMP



LEGEND:
 — — — — PIPELINE CORRIDOR

SOURCE: ONEIDA COUNTY
 SOIL SURVEY 1993

Foth & Van Dyke

REVISED	DATE	BY	DESCRIPTION
CHECKED BY:	JKSI	DATE:	AUG.'95
APPROVED BY:	RFS	DATE:	AUG.'95
APPROVED BY:	GWS	DATE:	AUG.'95



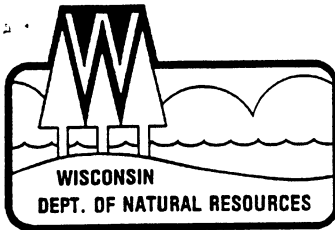
Crandon Mining Company

FIGURE C-10
 ONEIDA COUNTY
 SOIL MAP SHEET

Scale: APPROX. 1"=1667 Date: AUGUST, 1995
 Prepared By: Foth & Van Dyke By: KMP

Appendix D

Wisconsin Department of Natural Resources Correspondence



George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

North Central District Headquarters

Box 818

Rhineland, Wisconsin 54501

TELEPHONE 715-365-8900

TELEFAX 715-365-8932

RECEIVED
JUN 14 1995
FOTH & VAN DYKE

June 13, 1995

Mr. Ronald F. Steg
Foth & Van Dyke
P. O. Box 19012
Green Bay, Wisconsin 54307-9012

Dear Mr. Steg:

The Department has reviewed Crandon Mining Company's (CMC) proposed wastewater discharge pipeline corridor from the mine site to the Wisconsin River. This review is for the pipeline corridor itself and does not include evaluating the environmental impact of the wastewater discharge to the Wisconsin River. That analysis will come after specific wastewater quality and quantity characteristics are provided to the Department. Therefore, conclusions on the acceptability of discharging the wastewater to the Wisconsin River should not be based solely on this report.

At your suggestion, we did not evaluate a northern alternative route considered by CMC which would have proceeded northerly from the mine mill site along the Soo Line Railroad then westerly from the Argonne area through the Starks area. According to your telephone information, this alternative is not considered feasible.

Based on your telephone conversation, the CMC proposal is for a buried pipe between 8 and 14 inches in diameter, probably thermal plastic, averaging 4½ feet deep, and 7 feet under roads.

1. Department Statutory Authorities and Approvals

- a. Section 30.20, Wisconsin Statutes. If the proposed directional boring under the bed of any waterway proves infeasible, a Chapter 30.20, Wis. Stat., permit will be required to trench across. This is applicable to both navigable and non-navigable streams. Even the small and/or intermittent streams with discernable beds and banks would require the permits. If such permits are required, delays could be expected for processing. No Chapter 30 permits would be needed to directional bore several feet below the beds of the streams.
- b. Dredging across wetlands would require a Section 404 permit (Federal Clean Water Act) from the U.S. Army Corps of Engineers. The Section 401 Water Quality Certification portion of this permit would come from Wisconsin DNR. CMC should contact the Corps.

- c. NR 216, Wis. Administrative Code - I understand that Mr. Bob Chiesa of Foth & Van Dyke has contacted Mr. Paul Luebcke of our Central Office Bureau of Wastewater Management regarding the NR 216 permit needed for "land disturbing construction activities including clearing, grading and excavation activities which will result in the disturbance of five or more acres." Mr. Jim Bertolacini, Storm Water Specialist with DNR's Bureau of Wastewater Management (phone 608-266-7078), will provide further guidance to Foth & Van Dyke regarding the specific party(ies) responsible for obtaining this permit. It appears there would be at least four jurisdictions involved: the Town of Crescent, Wisconsin Department of Transportation, Forest County and CMC. As part of this permit, an erosion control plan, and practices consistent with the "Wisconsin Construction Site Best Management Practice Handbook" will be necessary.

Construction times of year should be considered from both environmental and construction advantages and disadvantages. There can be some advantages to constructing through wetlands during the frozen winter months, to reduce damage to the wetland itself. However, erosion control can be a problem at spring breakup. If winter construction occurs, erosion control measures need to be implemented in the fall to minimize or prevent such problems in the spring.

I am providing some recommendations on erosion control to Mr. Bertolacini, and he will be your primary contact person for this aspect.

- d. NR 812, Wis. Administrative Code - The well construction and pump installation administrative code requires a well not be placed within 50 feet of a wastewater treatment plant effluent pipe or a pressurized sewer, or within 100 feet of a lift station [NR 812.08(4)(c), and NR 812.08(4)(d)]. The CMC pipeline proposal does not identify the location of any well which may be within these distances. The identification of any well within 50 feet of the pipeline and 100 feet of any lift station will be necessary, and description of the well construction, depth, drilled/driven, etc. Since many wells are not recorded, field surveys by CMC will be necessary.
- e. Chapter 130, Wisconsin Statutes, and associated NR 140, Wisconsin Administrative Code - The importance of leaks and/or spills in the pipeline will depend on the wastewater quality, not only in regard to the wastewater quality standards, but also for health advisory levels specified under Chapter 160 of the Wisconsin Statutes and the associated NR 140 groundwater standards, and the maximum contaminant levels (mcl's) specified under the Federal Safe Drinking Water Act. The wastewater should be characterized and regularly monitored for these parameters to assist in the evaluation of potential releases from the pipeline.
- f. NR 718, Wisconsin Administrative Code - This code deals with the handling of excavated, contaminated soils. More information on the possibility of encountering contaminated soils along the proposed pipeline route is provided under #3 "Site Specific Comments and Recommendations" later in this report.

2. General Comments and Recommendations

There are numerous wetlands along the proposed pipeline route that would be crossed. Trenching through these areas should have minimal long term impacts if erosion control measures are effective. We would expect such areas to return to their existing wetland functions in a relatively short time. CMC should summarize the amount and locations of wetland intrusion.

We have examined DNR and Department of Industry, Labor and Human Relations (DIHLR) lists of existing underground storage tanks and suggest you seek an update of this information before final engineering plans are completed. We have also examined the Leaking Underground Storage Tanks (LUST) and Spill Sites information and address this issue under #3, later in this report.

According to your telephone call, the alternative of discharging to the Pelican River was eliminated because of its low flow characteristics.

Because the pipeline is proposed on or directly adjacent to previously disturbed highway right-of-ways, the overall adverse impact to wildlife is expected to be minimal.

Several bald eagle and osprey nests are located within $\frac{1}{4}$ to 1 mile of the route. However, we do not believe the installation of a pipe in the road right-of-way will impact these species.

Several rare species of mussels and fish, including some listed on the state "special concern" list are mentioned in Section #3 of this report ("Site Specific Comments and Recommendations"). For discretionary seasons, the exact locations and species are not included in this letter. Should directional boring prove infeasible under any of the waters with such species, or if you choose to conduct biological surveys (for these species) in advance of the contingency of possibly needing a Section 30.20, Wis. Stats., dredging permit, you may contact Mr. John Pohlman of DNR's Bureau of Endangered Resources, phone number (608)264-6263, for more details.

CMC should find out where all buried and overhead utilities along the corridor before completing final engineering plans.

There are several snowmobile trails in the area. Some of these are publicly funded. CMC should contact both the Forest County and Oneida County Snowmobile Trail Coordinators to investigate potential conflicts.

There are several spill sites (primarily of petroleum products from accidental truck overturns, etc.) on both Highway 8 and Highway 55 that have been cleaned up and are, therefore, not listed here.

It would be useful to provide a joint review of detailed engineering construction and erosion control plans with DNR, DOT and the Forest County Highway Department.

3. Site Specific Comments and Recommendations

- a. Hat Rapids Road - In the NE $\frac{1}{4}$ NW $\frac{1}{4}$, Section 34, T36N, R8E, there is a former solid waste disposal facility. It was used some years ago to dispose of paper fiber and sludge from the St. Regis Mill that was skimmed and dredged from the Hat Rapids Flowage. The site has been abandoned for a number of years but DNR's Solid Waste program should be consulted if the pipeline would be more than 600 feet south of Hat Rapids Road in this location. There is an unnamed stream channel next to the north side of Hat Rapids Road about one-half mile east of the Wisconsin River in SE SE, Section 27, T36N, R8E. There are also two small ponds north of the road in the SW SW of Section 26, T36N, R8E. These small ponds are shown on the current USGS quadrangle topographic map. The pipeline should avoid the shorelines of these ponds and the unnamed stream channel, unless directionally bored beneath. If boring is not feasible in this area, consideration should be given to routing the pipeline along the south side of Hat Rapids Road, or at least as close as possible to the north shoulder of the road.
- b. Highway 17 - There are several small streams and some wetlands along this route. Care should be taken in crossing all of these.
- c. Lassig Road - The shoreline areas of Lassig Lake and Cuenin Lake should be avoided. These lakes have wildlife and recreational values. Cuenin Lake has wild rice and its east shore touches Lassig Road, leaving no room on the west side of Lassig Road for pipeline installation. Lassig Road also crosses Carlson Creek and Cuenin Creek (the outlet of Cuenin Lake). If this route were chosen, it would be preferable to locate the pipeline east of Lassig Road in the area near Cuenin Lake and south of Lassig Road in the area near Lassig Lake.
- d. County Highway G (Route 2) - There are some wetlands along CTH "G".

There are two leaking underground storage tank sites west of County "G" near Pine Crest Road. If further information is needed on these LUST sites, please contact Connie Antonuk of the Rhinelander DNR Office. Her phone number is (715)365-8986.

- e. River Bend Road (Route 1) - There is a leaking underground storage tank site north of River Bend Road, east of Germond Road. For further information on this site, you may contact Connie Antonuk.

Cuenin Creek's channel is a steep rapids close to the north side of River Bend Road in the S $\frac{1}{2}$, Section 21, T36N, R9E, between Winquist Road and the Pelican River. If Route 1 were selected, the pipeline should go on the south side of River Bend Road to avoid this part of Cuenin Creek.

This route crosses the Pelican River which has a warm water gamefish population and is used for recreational canoeing, etc. The Pelican River also has two relatively uncommon fish species not on the "Special Concern" list. Any trenching in the Pelican River should avoid the May/June spawning times of these fish. The

Pelican River also likely contains the same five state "special concern" fresh water mussel species that the North Branch of the Pelican River (a tributary to the Pelican River) has. If directional boring beneath the Pelican River is not possible, we recommend surveys in the crossing area to ascertain the presence and locations of such mussels.

- f. Highway 8 - The small unnamed natural lake and its shoreline area, in the NW $\frac{1}{4}$ NW $\frac{1}{4}$, Section 7, T36N, R9E, south of Highway 8 should be avoided by pipeline construction. Also, across Highway 8 to the north of this unnamed natural lake, a small artificially created wetland in a former gravel pit area should also be avoided. There should be room enough for the pipeline on either side of the existing highway; however, consideration should be given to future addition of two more Highway 8 lanes southward. The Holmboe Forest Natural Area is north of the artificial wetland; it is not expected to be affected.

The Highway 8 Rhinelander bypass corridor also crosses the Pelican River (same fish and mussel concerns as previously mentioned).

Extreme care should be taken in crossing the Lake George outlet and the floodplain wetlands that are attached to its confluence with the Pelican River. This area is prone to floods, which could present construction problems during high water.

The North Branch of the Pelican River has five state special concern mussels. It will be extremely important to prevent sedimentation to the North Branch of the Pelican River. If directional boring is not possible, we recommend local mussel surveys to determine if seasonal or locational restrictions are needed to protect these mussels. This is also a flood-prone area and the channels and backwaters of the North Branch of the Pelican River are close to both sides of the highway. Construction other than directional boring would need to stay very close to the toe of the highway's slope intercept, whether on the north or south side of the highway.

There also are numerous small drainages and intermittent streams that cross Highway 8.

Neptune Creek is a warm water forage fish stream. Several hundred feet east of Highway 8's crossing of Neptune Creek, the stream's channel is very close to the north slope intercept of Highway 8. If the pipeline is installed on the north side of Highway 8 in this location, directional boring may be needed to pass beneath the channel in this area. Staying on the south side of Highway 8 in this area would avoid this.

At Venus Lake, the southwest shore is immediately adjacent to the north slope intercept of Highway 8. The area north of the Highway 45/47 intersection with Highway 8 has rock gabions along the north slope intercept of Highway 8, immediately adjacent to

the south shoreline of Venus Lake. There is not room for construction of a pipeline between Highway 8 and Venus Lake; therefore, the pipeline would need to be located south of Highway 8 in these areas. There are some bedrock outcroppings in this vicinity which may present some construction problems.

Highway 8 crosses the outlet of Venus Lake and also Monico Creek. Extreme care should be taken to prevent disruption of these streams.

There are contamination sites located on the north and south sides of Highway 8 in the Monico area. These sites are from leaking underground storage tanks-petroleum products that are not yet cleaned up. CMC would need to handle soils in those areas in compliance with NR 718, Wis. Adm. Code. For further information on these sites, you may contact Connie Antonuk.

The Wisconsin Department of Transportation is considering rebuilding the intersection of Highway 45/47 and Highway 8 in the future. It will be important to coordinate pipeline installation plans in that area with them.

The Wolf River and Mud Creek, a tributary to the Wolf River, should be treated with extreme care. The Mud Creek is a warm water forage fish stream with wildlife values. The Wolf River has high fish, wildlife, ecological, aesthetic and recreational canoeing values. There is a small spring pond several hundred feet east of the Wolf River on the south side of Highway 8, which drains into the Wolf River. Care should be taken to avoid intrusion into this spring pond or its wetland fringe at the toe of the south slope of Highway 8, unless directional boring can pass beneath the wetland fringe or toe of the highway fill slope. Construction on the north side of Highway 8 in this vicinity appears preferable from environmental and construction aspects.

- g. Forest County Highway "S" - If the pipeline is constructed in the right-of-way of Highway "S", we anticipate no problems with streams or wetlands. If the pipeline were constructed east of the Highway "S" right-of-way, wetland crossings and a possible old landfill site could be involved.
- h. Highway 55 from "S" to Mine Access Road - The most environmentally sensitive area along this segment is Gliske Creek, a Class I brook trout stream. There are also some wetlands along the route, mainly adjacent to Gliske Creek. Extreme care should be taken to minimize any disruption or siltation to Gliske Creek. Downstream from Highway 55 it has a brook trout spawning area. A short distance downstream from its Highway 55 culverts, Gliske Creek turns southward and parallels Highway 55. It appears there may be room between the stream channel and Highway 55 to construct the pipeline, if this can be done without disrupting the creek banks. Although there are more wetlands on the east side of Highway 55 in the vicinity of Gliske Creek, the east side can also be considered. If directional boring is not possible under Gliske Creek, active construction in and near the creek must be avoided from September 15 to May 1 of any year to avoid the fall spawning and winter incubation periods for trout eggs.

- i. Mine Access Road from Highway 55 to Mine/Mill Site - Depending on specific locations, this segment would cross three or four intermittent unnamed streams that become trout waters further downstream. Each of these should be directionally bored if possible.

Swamp Creek, a brook trout stream, is crossed by this route and extreme care should be taken. If directional boring is not feasible at Swamp Creek, the alternative of attaching the pipe to the proposed bridge should be carefully considered versus dredging the stream bottom in the rocky riffles area. Swamp Creek is also a tributary to Rice Lake, which has exceptional ecological, wild rice and wildlife values. Two state "special concern" mussel species, and five species of "special concern" dragonflies and one species of (state) endangered dragonfly occur in Swamp Creek. If directional boring is not possible, we would need surveys of the mussel and dragonfly populations before a decision on any proposed Section 30.20 dredging permit for burial of the pipeline in the bed of Swamp Creek.

If directional boring is not feasible under Swamp Creek or any of its tributaries along the access road, no instream construction will be permitted from September 15 to May 1 of any year to protect trout eggs.

Until we receive more detailed information on the placement of piping from the proposed treatment plant site to the access road, and all pertinent environmental CMC surveys (particularly vegetation) of that area, our analysis of the southern-most end of the pipeline is considered incomplete.

4. Summary

Of Routes #1, #2 and #3, #3 is preferable from an environmental standpoint.

Although there are no records in our National Heritage Inventory database of endangered resources occurring within highway rights-of-way along the proposed route, comprehensive endangered resource surveys have not been completed for these rights-of-way. As a result, our data files may be incomplete. With the possible exception of rivers or streams where directional boring may prove infeasible, we do not believe that further surveys are warranted, given the site's specific impacts associated with installing a pipe, the disturbed nature of these rights-of-way and the low probability of rare species utilizing these rights-of-way. We have not yet reviewed CMC's Environmental Impact Report. If there are more rare species of plants and animals found by CMC's consultants along the southerly pipeline corridor, we may need to update or revise this letter.

As further consideration of this proposal evolves, please keep us informed. If you should deviate from the locations for pipeline installation proposed in your letter and maps of April 24, 1995, please contact us for further investigation and input.

5. Additional Information Needed from CMC

It would be helpful if you documented the following details when they become available:

- a. The specific location(s) and size(s) of pump/lift stations.
- b. If the pipeline is pressure tested with water, the proposed source and discharge points of the water. Discharge water from such a test may need a Wisconsin Pollution Discharge Elimination System (WPDES) permit.
- c. A description of the proposed monitoring and alarm system for leaks, and shut-down process, and a spill plan.
- d. The desirability of using double walled, insulated pipes attached to bridges over the Pelican River, Wolf River, and Swamp Creek.
- e. Proposed intentions for the pipeline after mine closure. (Where pipe would be left in the ground, and if some is removed, repairs of disturbed areas.)

Thanks for the opportunity to review this proposal.

Sincerely,

Terry McKnight

Terrence C. McKnight
Environmental Impact Coordinator

TCM:da

cc: M. Stokstad/D. Urso, Rhinelander

A. Wilson, Rhinelander

C. Antonuk, Rhinelander

B. Tans, EA/6

J. Bertolacini, WW/2

P. Luebcke, WW/2

District Staff

Area Staff

C. Pils, ER/4

Mike Hess, Dept. of Transportation, 777 Hanson Lake Rd., Rhinelander, WI 54501

Crandon Mining Company, 7 N. Brown St., 3rd Floor, Rhinelander, WI 54501-3161

Appendix E

Habitat Characterization Field Data Forms

Table E-1

Dominant Habitat Types Along West Side of STH 55 from CTH S to Access Road

Corridor Segment: WEST side of STH 55					Beginning at: CTH S to Access Road						
Subsegment ¹ (miles)	Average Width of Maintained ROW ²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
0.0 - 0.4	30	✓									
0.4 - 0.5	30									✓	✓
0.5 - 1.2	30	✓							✓		
1.2 - 1.5	30	✓									
1.5 - 1.7	20			✓							
1.8 - 1.9	30	✓								✓	
1.9 - 2.2	30	✓									

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained right-of-way contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.

Prepared by: AWZ
Checked by: BDH

Table E-2

Dominant Habitat Types Along West Side of CTH S from USR 8 to STH 55

Corridor Segment: WEST side of CTH S					Beginning at: USR 8 to STH 55						
Subsegment ¹ (miles)	Average Width of Maintained ROW ²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
0.0 - 0.4	20	✓									
0.4 - 0.7	20										✓
0.7 - 0.8	20	✓							✓		
0.8 - 1.0	20										✓
1.0 - 1.9	20	✓									

E-2 ¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained right-of-way contains little native vegetation and is routinely mowed or otherwise maintained by the County.

Prepared by: AWZ
Checked by: BDH

Table E-3

Dominant Habitat Types Along North Side of the Snowmobile Trail from CTH S to Whiteye Lane

Corridor Segment: NORTH Side of Snowmobile Trail						Beginning at: CTH S to Whiteye Lane						
Subsegment ¹ (miles)	Approx. Width of Snowmobile Trail	Average Width of Maintained Area ²										
			Northern Hardwood	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Ag.
0.0 - 0.1	6'	20'									Construction	
0.1 - 0.4	6'	30'	✓									
0.4	6'	30'								✓		
0.5 - 0.6 ³	6'	30'	✓									
0.6	6'	30'								✓		
0.6 - 0.8	6'	30'	✓									
0.8 - 0.9	6'	30'				✓						
0.9 - 1.0	6'	30'		✓								
1.0 - 1.1	6'	30'	✓									
1.1	6'	30'								✓		
1.2 - 1.4	6'	30'	✓									
1.4	6'	30'								✓		
1.4 - 1.7	6'	30'	✓									
1.7	6'	30'								✓		
1.7 - 1.8	6'	30'	✓									
1.8 - 2.1	6'	30'				✓						
2.1 - 2.4	6'	30'	✓									
2.4 - 2.6	6'	30'								✓		

E-3

Table E-3 (Continued)

Corridor Segment: NORTH Side of Snowmobile Trail							Beginning at: CTH S to Whiteye Lane						
Subsegment ¹ (miles)	Approx. Width of Snowmobile Trail	Average Width of Maintained Area ²											
			Northern Hardwood	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Ag.	
2.6 - 2.9	6'	30'	✓										

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained power line corridor contains little native vegetation and is routinely maintained by the Wisconsin Public Service Corporation.

³ *Salix* spp. in North Ditch.

Prepared by: AWZ
Checked by: BDH

Table E-4

Dominant Habitat Types Along North Side of the Snowmobile Trail from Whiteye Lane to CTH V

Corridor Segment: NORTH Side of Snowmobile Trail						Beginning at: Whiteye Lane to CTH V						
Subsegment¹ (miles)	Approx. Width of Snowmobile Trail	Average Width of Maintained Area²										
			Northern Hardwood	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Ag.
0.0	6'	30'	✓									
0.1 - 0.5	10'	30'								✓		
0.5 - 0.7	6'	15'				✓						
0.7 - 1.1	10'	15'								✓	✓	
1.1 - 1.2	6'	10'		✓								
1.2	6'	10'			✓							
1.4 - 1.7	6'	10'								✓		
1.7 - 2.0	6'	10'		✓	✓							
2.0 - 2.1	6'	30'			✓							
2.1 - 2.2	6'	10'	✓									
2.2 - 2.3	6'	30'			✓							
2.3 - 2.7	6'	30'	✓									
2.7 - 2.8	6'	10'				✓						
2.8 - 3.0	6'	10'			✓							
3.0 - 3.1	6'	10'	✓									
3.1	6'	10'								✓		
3.1 - 3.4	6'	10'			✓							
3.4 - 3.7	6'	30'	✓									

E-5

Table E-4 (Continued)

Corridor Segment: NORTH Side of Snowmobile Trail						Beginning at: Whiteye Lane to CTH V						
Subsegment ¹ (miles)	Approx. Width of Snowmobile Trail	Average Width of Maintained Area ²										
			Northern Hardwood	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Ag.
3.5	6'	30'								✓		
3.7 - 3.8	6'	30'								✓		
3.8 - 4.3	6'	30'	✓							✓		
4.3	6'	30'								✓		
4.4	6'	30'	✓									
4.5	6'	30'			✓							
4.6 - 5.2	6'	30'								✓	✓	
5.2 - 5.4	6'	30'	✓									
5.4 - 5.8	6'	5'			✓							
5.8 - 6.2	6'	15'	✓									
6.2 - 6.4	6'	15'		✓								
6.4 - 6.8 ³	6'	15'	✓ recent cut	✓								
6.8 - 7.0 ³	6'	6'	✓	✓								
End at V												

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained power line corridor contains little native vegetation and is routinely maintained by the Wisconsin Public Service Corporation.

³ Trail is in disturbed wetland - ground is wet *salix* spp. & *alnus* spp. present.

Prepared by: AWZ
Checked by: BDH

Table E-5

Dominant Habitat Types Along South Side of the Snowmobile Trail from CTH S to Whiteye Lane

Corridor Segment: SOUTH Side of Snowmobile Trail						Beginning at: CTH S to Whiteye Lane						
Subsegment ¹ (miles)	Approx. Width of Snowmobile Trail	Average Width of Maintained Area ²										
			Northern Hardwood	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Ag.
0.0 - 0.4	6'	40 ³										
0.4 - 0.7	6'	40'	✓									
0.7 - 0.8	6'	10'	✓									
0.8 - 0.9	6'	10'				✓						
0.9 - 1.0	6'	10'		✓								
1.0 - 1.4	6'	10'	✓									
1.4 - 2.9	6'	40 ³										

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained power line corridor contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.

³ Maintained right-of-way consisting of mowed grass between the snowmobile trail and USR 8.

Prepared by: AWZ
Checked by: BDH

Table E-6

Dominant Habitat Types Along South Side of the Snowmobile Trail from Whiteye Lane to CTH V

Corridor Segment: SOUTH Side of Snowmobile Trail						Beginning at: Whiteye Lane to CTH V						
Subsegment ¹ (miles)	Approx. Width of Snowmobile Trail	Average Width of Maintained Area ²	Northern Hardwood	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Ag.
0.0 - 0.5	6'	50'	✓ ⁴									
0.5 - 0.7	6'	50'	✓ ⁶									
0.7 - 1.0	6'	10'	✓									
1.0 - 1.1	6'	50 ³										
1.1 - 1.2	6'	0 ⁵		✓								
1.2 - 1.9	6'	50'	✓	✓ close to USR 8								
1.9 - 2.7	6'	50'	✓ ⁶									
2.7 - 3.2	6'	0 ⁵		✓								
3.2 - 3.8	6'	10'	✓									
3.8 - 4.0	6'	50'	✓ ⁶									
4.0 - 4.4	6'	50 ³	✓									
4.4 - 5.4	6'	50'	✓ ⁶									
5.4 - 5.8	6'	0		✓								
5.8 - 6.4	6'	50'	✓ ⁶									
6.4 - 6.8	6'	0 ⁵		✓								
6.8 - 7.0	6'	0		✓ ⁵								
End at V												

E-8

Table E-6 (Continued)

- ¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.
- ² Maintained power line corridor contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.
- ³ Maintained right-of-way consisting of mowed grass between the snowmobile trail and USR 8.
- ⁴ Trees planted for barrier.
- ⁵ Vegetation to edge of trail.
- ⁶ Sparse woody vegetation.

Prepared by: AWZ
Checked by: BDH

Table E-7

Dominant Habitat Types Along South Side of USR 8 from River Bend Road to CTH V

Corridor Segment: SOUTH side of USR 8					Beginning at: River Bend Road to CTH V						
Subsegment¹ (miles)	Average Width of Maintained ROW²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
0.0 - 0.1	25							✓			
0.1 - 0.2	25			✓							
0.2 - 0.4	90	✓									
0.4 - 0.5	25					✓					
0.5 - 0.7	25	✓									
0.7 - 1.3	25			✓							
1.3 - 1.6	25	✓									
1.4	25		✓								
1.6 - 1.8	25			✓							
1.8 - 2.1	25		✓								
2.1 - 2.6	25			✓							
2.6 - 2.8	25		✓		✓						
2.8 - 3.2	25	✓									
2.9	25		✓								
3.2 - 3.3	25		✓								
3.3 - 4.0	25			✓							
4.0 - 4.2	25	✓									
4.2 - 4.5	25			✓							

E-10

Table E-7 (Continued)

Corridor Segment: SOUTH side of USR 8					Beginning at: River Bend Road to CTH V						
Subsegment ¹ (miles)	Average Width of Maintained ROW ²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
4.5 - 5.1	25	✓									
5.0	25						✓				
5.1 - 5.5	25			✓							
5.5 - 5.6	25	✓									
5.6 - 6.1	25			✓							
6.1 - 6.5	25	✓									
6.5 - 6.8	25			✓							
6.8 - 7.1	25	✓									
7.1 - 7.4	25		✓	✓							
7.4 - 7.5	25	✓									
7.5 - 7.7	25			✓							
7.7 - 8.2	25	✓									
8.2 - 8.4	20								✓		
8.4 - 8.5	20		✓								
8.5 - 8.7	20	✓							✓		
8.7 - 9.3	20	✓									
9.3 - 9.5	8		✓					✓	✓	✓	
9.5 - 9.9	8	✓							✓		
9.9 - 10.0	8		✓								

E-11

Table E-7 (Continued)

- ¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.
- ² Maintained right-of-way contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.

Prepared by: AWZ
Checked by: BDH

Table E-8

Dominant Habitat Types Along North Side of the USR 8 Bypass from River Bend Road to STH 17

Corridor Segment: NORTH Side of USR 8 Bypass					Beginning at: River Bend Road to STH 17						
Subsegment¹ (miles)	Average Width of Maintained ROW²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
0.0 - 0.3	100	✓									
0.3 - 0.5	10			✓	✓						
0.5 - 1.4	30	✓									
1.4 - 1.5	100	✓									
1.5 - 1.55	30	✓									
1.55 - 1.65	100								✓		
1.65 - 3.0	50	✓									
3.0 - 3.2	20	✓							✓		
3.2 - 3.5	40	✓									
3.5 - 3.6	20				✓						
3.6 - 3.8	30	✓									
3.8 - 3.9	40							✓			
3.9 - 4.1	40	✓									
4.1 - 4.2	40						✓				
4.2 - 4.3	50	✓									
4.3 - 4.4	100										
4.4 - 4.5	100	✓								✓	

E-13

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

Table E-8 (Continued)

² Maintained right-of-way contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.

Prepared by: AWZ
Checked by: BDH

E-14

Table E-9

Dominant Habitat Types Along West Side of STH 17 from USR 8 to Hat Rapids Road

Corridor Segment: WEST side of STH 17					Beginning at: USR 8 to Hat Rapids Road						
Subsegment ¹ (miles)	Average Width of Maintained ROW ²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
0.0 - 0.1	10			✓						✓	
0.1 - 2.2	10	✓									
0.9	15		✓								
2.2 - 2.7	15		✓								
2.7 - 3.6	15	✓									
3.6 - 3.8	15										
3.8 - 4.1	15	✓									✓

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained right-of-way contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.

Prepared by: AWZ
Checked by: BDH

Table E-10

Dominant Habitat Types Along South Side of Hat Rapids Road

Corridor Segment: SOUTH side of Hat Rapids Road					Beginning at: STH 17 to Wisconsin River						
Subsegment ¹ (miles)	Average Width of Maintained ROW ²	Dominant Habitat Type Adjacent to Maintained ROW									
		Northern Hardwoods	Shrub Swamp	Conifer Swamp	Deciduous Swamp	Bog	Sedge Meadow	Shallow Marsh	Residential	Commercial	Agri.
0.0 - 0.3	5	✓							✓		
0.3 - 0.6	5										✓
0.6 - 1.2	5			✓							
1.2 - 1.3	5										✓
1.3 - 1.4	5			✓							
1.4 - 1.45	5		✓								
1.45 - 1.5	5										✓

¹ A linear portion of the corridor beginning and ending at the indicated distance from the beginning point of the segment. Distances are approximate as measured by vehicle odometer.

² Maintained right-of-way contains little native vegetation and is routinely mowed or otherwise maintained by the WisDOT.

Prepared by: AWZ

Checked by: BDH

E-16



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Appendix F

Addendum 1 - Supplement: Wisconsin River Discharge Pipeline for the Crandon Project

Addendum 1 - Supplement: Wisconsin River Discharge Pipeline for the Crandon Project

93C049

Prepared for
Crandon Mining Company
7 North Brown Street, 3rd Floor
Rhinelander, Wisconsin 54501-3161

Prepared by
Foth & Van Dyke and Associates Inc.

October 1996

Foth & Van Dyke 1996

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Crandon Mining Company

Addendum 1 - EIR Supplement: Wisconsin River Discharge Pipeline for the Crandon Project

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Appendices

Appendix A	Regulatory Agency Correspondence
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1 Introduction

Crandon Mining Company (CMC) is proposing to develop a zinc/copper mine in an area south of Crandon, Wisconsin. Environmental studies to support the construction, operation and closure of the project have been conducted from the late 1970s into the mid-1990s. One such study, the September 1995 *EIR Supplement: Wisconsin River Wastewater Discharge Pipeline for the Crandon Project* (Foth & Van Dyke, 1995a), provided a description of the existing environment, an assessment of potential environmental impacts, and an alternatives analysis related to the proposed Wisconsin River wastewater discharge system. That report was submitted to the Wisconsin Department of Natural Resources (WDNR) and the U.S. Army Corps of Engineers (USCOE). In a May 3, 1996 letter, the WDNR requested that CMC complete aquatic surveys for mussels and macroinvertebrates downstream of the Wisconsin River from the proposed discharge point at Hat Rapids Dam similar in scope and detail to that provided for the Wolf River system as documented in the project's *Environmental Impact Report* (Foth & Van Dyke, 1995b). A work plan for this work was subsequently prepared and submitted to the WDNR on May 28, 1996, (CMC, 1996a). A copy of the work plan is included in Appendix A.

The May 28th work plan outlined investigations to assess the distribution of aquatic organisms in the following functional groups: benthic macroinvertebrates, Odonata (dragonfly and damselfly), mussels, and aquatic plants. In addition to general population investigations, the field work was to include activities which targeted species which are classified by the Wisconsin Natural Heritage Inventory as threatened, endangered, or of special concern.

In late spring of 1996, representatives of Foth & Van Dyke and Environmental Compliance Consultants, Inc., (ECCI) met with the WDNR to define the area of the Wisconsin River where the field investigation would be conducted. The proposed discharge location for the treated water from the project site is at the Hat Rapids Dam, approximately six miles downstream of the City of Rhinelander. The area of biological investigation began at the tailrace of the dam downstream to Menard Island (approximately 7 miles). The actual discharge is to be on the upstream side of the dam, in an intake structure, which will result in complete mixing of the mine discharge water at that point.

In the summer of 1996, CMC, after discussions with representatives of the WDNR, determined that it would be desirable to complete an intensive targeted fish survey on selected portions of the Wisconsin River downstream of the Hat Rapids Dam to supplement WDNR's on-going fish inventory program. An August 5, 1996 letter from Don Moe, CMC, to Bill Tans, WDNR, outlining the proposed work is contained in Appendix A (CMC, 1996b).

The following report contains a summary of the aquatic investigations that were conducted. Section 2 of the report addresses fauna, while Section 3 addresses flora. Aquatic fauna studies were primarily completed by William West of ECCI, Dr. Ken Tennessen of Florence, Alabama, Mr. Don Helms of Helms & Associates, Inc., Dr. Brian Armitage of the Ohio Biological Survey, Gregory Seegert of EA Engineering, Science, and Technology, and staff of Foth & Van Dyke. Aquatic flora studies were completed by Gary Fewless of the University of Wisconsin-Green Bay and staff of Foth & Van Dyke. Tim Weyenberg of Foth & Van Dyke led the development of the work plans and coordinated with the various experts working on the project. All of these parties contributed either data or narrative for this report.

2 Fauna

Aquatic biology fauna studies on the Wisconsin River were undertaken from the beginning of June 1996 into August 1996. The study area for these investigations includes those areas of the Wisconsin River from the Hat Rapids Dam downstream to Menard Island, a distance of about 7 miles. The study area is presented in Figure 2-1. The primary objective of the investigations was to provide field data on federal or state listed threatened, endangered, or special concern species, i.e., species "listed" by the Wisconsin Natural Heritage Inventory. Target species were identified prior to initiation of the 1996 field season through a review of historical records to identify known or suspected occurrences in the area. Sampling locations and time windows were selected to coincide with the life cycle and habitats of the target species. As related to fish and mussels, the historical review included areas above Hat Rapids Dam and below Menard Island downstream to Kings Dam in Tomahawk, Wisconsin, to provide additional information regarding the presence or absence of threatened, endangered, or special concern species.

2.1 Field Methods

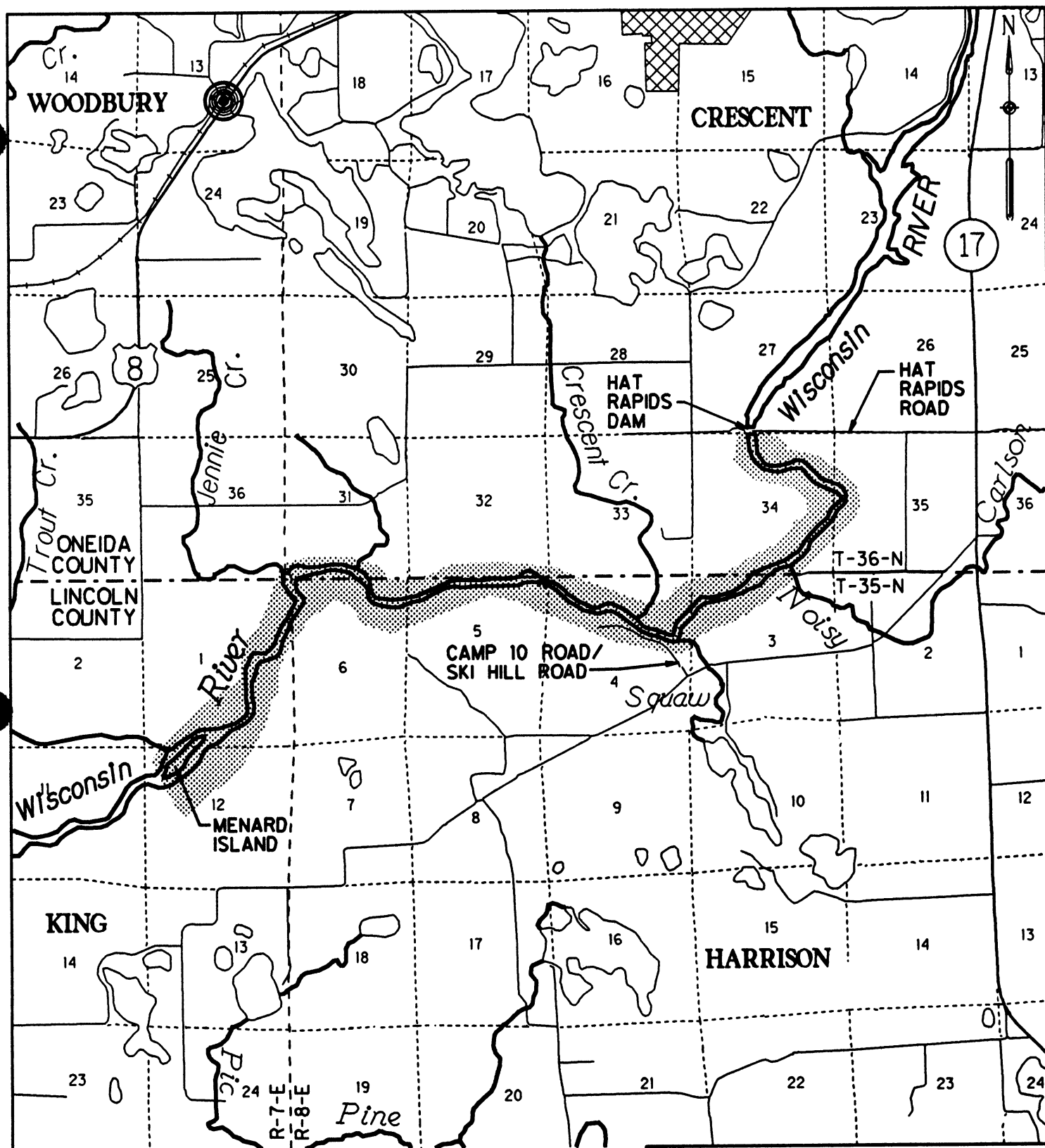
A discussion of sampling locations, field methods for the investigation, and quality control features follows.

2.1.1 Sampling Locations

The area of the investigation on the Wisconsin River, bounded by the Hat Rapids Dam and Menard Island, is a true riverine environment. Below Menard Island the river tends to broaden and become somewhat slower and more indicative of a lentic environment. Substrates above Menard Island typically range from cobble to boulder with pockets of gravel and finely washed sand. Sedimentation is not prevalent above Menard Island with the exception of isolated pockets in sheltered areas.

Benthic macroinvertebrates, odonata, and mussels investigation sampling stations selected for monitoring are shown on Figure 2-2. The locations were established based on review of project objectives and completion of a site reconnaissance with the WDNR in May 1996. A list and description of the sampling stations is provided in Table 2-1. Fish were sampled continuously along a 5-mile stretch of the river from Hat Rapids Dam to Crescent Creek (approximately 100 yards below Camp Ten Road) and a 1-mile stretch in the vicinity of Menard Island.

Based on the site reconnaissance in May 1996, three major site locations were established for the biological field collections (CMC-WWI-301, 310, and 320). Most activities were completed within these three major site locations, however, mussels collections extended beyond the general site locations described. Two other sampling locations (CMC-WWI-315 and 319) were added for Odonata exuviae where riffle habitat suggested a potential existed for locating riffle species. Another sampling area (CMC-TCI-300) was selected in the field along Trout Creek for Odonata study. Finally, a separate sampling location (CMC-WWI-300) was selected for mussel collections and adult Odonata surveys. Sampling dates for individual groups of specimens, excluding fish, are shown on Table 2-2. Fish sampling was conducted on August 24, 1996.



LEGEND

 STUDY AREA

Foth & Van Dyke

REVISED	DATE	BY	DESCRIPTION
CHECKED BY: JKS			DATE: SEPT.'96
APPROVED BY: BDH			DATE: SEPT.'96
APPROVED BY: GWS			DATE: SEPT.'96

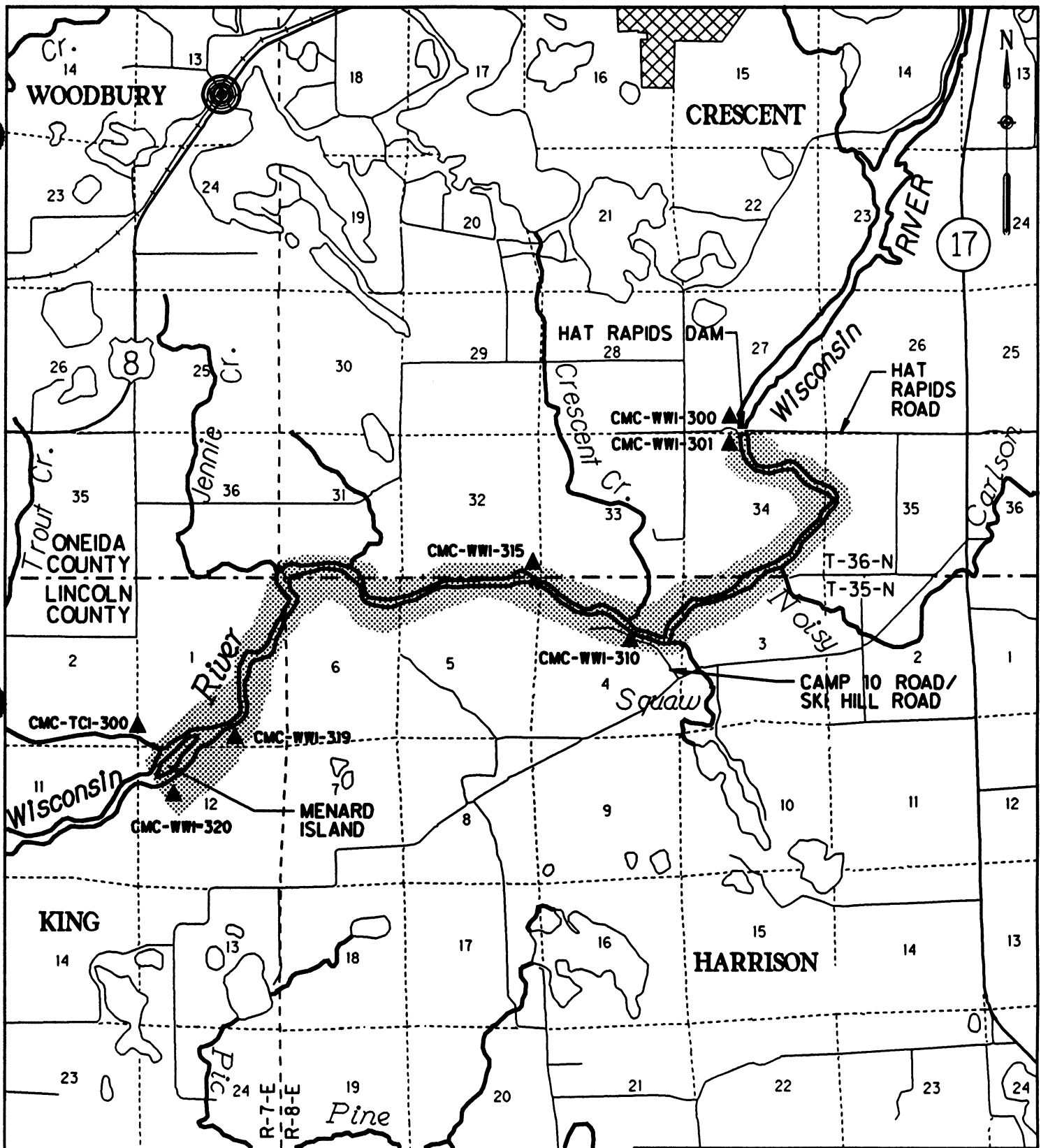


Crandon Mining Company

FIGURE 2-1

WISCONSIN RIVER THREATENED AND ENDANGERED SPECIES INVESTIGATION STUDY AREA

Scale: 	Date: SEPTEMBER, 1996
Prepared By: Foth & Van Dyke	By: JOW



LEGEND



APPROXIMATE
SAMPLING
LOCATIONS



STUDY AREA

Foth & Van Dyke

REVISED	DATE	BY	DESCRIPTION
CHECKED BY:		JKS	DATE: SEPT.'96
APPROVED BY:		BDH	DATE: SEPT.'96
APPROVED BY:		GWS	DATE: SEPT.'96



Crandon Mining Company

FIGURE 2-2

BENTHIC MACRO-INVERTEBRATES, ODONATA
AND/OR MUSSEL SAMPLING LOCATIONS

Scale: 0 2,500' 5,000'	Date: SEPTEMBER, 1996
Prepared By: Foth & Van Dyke	By: JOW

Table 2-1
Sampling Site Locations and Descriptions
Wisconsin River Below Rhinelander, Wisconsin

Site ID	Location	Description
CMC-WWI-300	Oneida County Section 27 T36N R8E	Wisconsin River immediately below Hat Rapids Dam downstream to the bridge on Hat Rapids Road. Covers the tailrace of the dam. Search for mussels and adult Odonata was conducted here. Habitat is comprised of boulders, rocks, and cobble with washed gravel in interstices; some debris below dam in tailrace.
CMC-WWI-301 ¹	Oneida County Section 34 T36N R8E	Wisconsin River immediately below the bridge on Hat Rapids Road to a point approximately 100 yards downstream. Collections consisted of benthic macroinvertebrates, Odonata adults and exuviae, and light trapping for insects. Habitat is comprised of few boulders, mostly rock and cobble with washed gravel; shoreline with some silt along erodible banks (left bank facing downstream).
CMC-WWI-310 ¹	Lincoln County Section 4 T35N R8E	Wisconsin River at Camp 10 landing. Area of study approximately 100 yards upstream and downstream of landing. Collections included benthic macroinvertebrates, Odonata adults and exuviae, light trapping for insects, and mussels. Mainstream with boulders and rocks, protected shore with gravel, cobble, and rock; silt along shore.
CMC-WWI-315	Oneida County Section 32 T36N R8E	Wisconsin River immediately upstream of Whirlpool Rapids. Collections included Odonata adults and exuviae. Habitat mostly boulders, rocks, and cobble along right bank where collections occurred.
CMC-WWI-319	Lincoln County Section 1 T35N R7E	Wisconsin River immediately upstream of Menard Island (approximately 100 yards upstream) where riffle exists. Collections included Odonata adults and exuviae. Both banks of boulder, rock, and cobble with gravel in interstices, a well-washed riffle area; very little silt except in slack water areas.
CMC-WWI-320 ¹	Lincoln County Section 1 & 12 T35N R7E	Wisconsin River immediately adjacent to Menard Island, approximately 200 yards from head of island toward toe. Collections included benthic macroinvertebrates, Odonata adults and exuviae, and mussels. Some gravel and rocks, mostly silt and soft sediment along right bank, left bank with more rock and cobble further downstream but turning to all soft sediments by downstream end of Menard Island.

Table 2-1 (Continued)

Site ID	Location	Description
CMC-TCI-300	Lincoln County Section 1 & 2 T35N R7E	Trout Creek approximately 1/8 mile west of Menard Island. Beaver pond with flooded meadow, discharge east to Wisconsin River. Sediments: washed sand and gravel turning to muck near Wisconsin River confluence. Collections included adult Odonata. Sediments include washed sand and gravel turning to muck near Wisconsin River confluence; muck bottom near beaver pond, center of Trout Creek washed gravel with edges of soft sediment and silt deposit and undercut bank common.

¹Designates sample site where the majority of field investigations were conducted.

Prepared by: WMW
Checked by: BDH

Table 2-2

1996 Aquatic Species Sampling Effort

Date	CMC-WWI-300	CMC-WWI-301	CMC-WWI-310	CMC-WWI-315	CMC-WWI-319	CMC-WWI-320	CMC-TCI-300
06-05-96		B,L	B,L			B	
06-12-96		E	E			E	A
06-18-96						E	
06-19-96		L	E,A,L			A	A
06-20-96			A		E,A		
06-21-96	A	E,A					
06-22-96			A	E,A			
07-31-96			M,E,A				
08-01-96	M		A			M,E,A	
08-02-96	M,A						

A = adult Odonata
 B = benthos
 E = exuviae
 L = Light trapping
 M = mussel

Prepared by: WMW
 Checked by: JWS

2.1.2 General Benthic Macroinvertebrates

Aquatic macroinvertebrate collections were conducted on June 5, 1996 at the three primary sites on the Wisconsin River. In general, three collection techniques were used for aquatic macroinvertebrates, including kick seining with an 8 x 18 inch rectangular net (800 to 900 micron mesh), surber sampler, and Ekman dredge. The rectangular net was used in all habitats to search bottom substrate, undercut banks, and sweep aquatic vegetation. The rectangular net was supplemented in riffle areas with the surber sampler and in soft bottom habitat with the Ekman dredge. Where the surber sampler and Ekman dredge were used, triplicate samples were collected, washed in a 600 to 800 micron filter, and preserved in formalin. Each microhabitat was sampled by one biologist for a minimum of two hours or until a five minute period produced no new species, whichever was the longer period.

Some organisms, such as the nymphs of Ephemeroptera and Plecoptera and larvae of Trichoptera and Coleoptera are difficult to identify to species. Therefore, light trapping for the adults of these groups was conducted in the summer of 1996. Light trapping was conducted on June 5 at Hat Rapids Dam and at the Camp Ten Road boat landing and again on June 19 at the same two locations. For light trapping efforts, common camping type lanterns were used. Each lantern contained two ultraviolet lights powered by eight size D batteries. Batteries were fully charged each night of sampling. Trapping efforts included the first two hours after sunset.

All macroinvertebrate samples were preserved on site with 10 percent formalin. Preserved samples were shipped to Dr. Ken Tennessen in Florence, Alabama, for identification. General macroinvertebrate specimens were identified by Dr. Tennessen. For light trapping collections, Trichoptera were identified by Dr. Brian Armitage of the Ohio Biological Survey. Voucher specimens of all threatened, endangered, or special concern species were sent to William Smith, WDNR for documentation, when required. Otherwise, voucher specimens were prepared for storage at the Richter Museum, University of Wisconsin-Green Bay, Green Bay, Wisconsin.

2.1.3 Odonata

Collection efforts for Odonata (dragonflies and damselflies) included searches for nymphs (aquatic), adults (terrestrial), and exuviae (casings left after emergence of nymphs from aquatic environment). Nymphs were collected during the general macroinvertebrate collection time period on June 5, 1996. Exuviae collections were conducted from shoreline locations in June with the greatest level of effort being expended from June 12 through June 22. Additional sampling was conducted in July and August in conjunction with the mussel survey work, however, no additional exuviae were collected during the later time window. Adult Odonata were collected or identified on the wing from late June into August, 1996. Collection methods and locations of Odonata nymph sampling are described above in Sections 2.1.2 and 2.1.1, respectively.

At each site, exuviae were collected over an approximate 100-meter distance along the shoreline within a minimum 3-foot strip from the water's edge landward. At each site except Whirlpool Rapids, both sides of the river were searched. During enumeration and identification, samples collected from each side of the river were kept separate. The sampling width increased if flat shoreline allowed emerging Odonata to penetrate further. Likewise, where steep banks occurred, the search area was more vertical than horizontal. All samples were placed in plastic containers

and preserved in 70 percent alcohol. Identifications were completed by Dr. Ken Tennessen, with assistance from William West of ECCI.

For some species of Odonata, nymph and exuviae collection techniques are not sufficient to document their presence or absence. Therefore, to provide a more complete collection effort, adults were sampled during the week of June 19, 1996. Dr. Tennessen, accompanied by William West, collected adult Odonata specimens from the three primary locations as well as CMC-WWI-315 and CMC-TCI-300. In general, all adult collections required the use of long handled (4 to 6 feet) sweep nets. Most specimens could be readily collected on the wing. Common species were collected, identified, the sex identified, recorded, and released. Special concern species were collected, identified, sexed, recorded and saved in plastic envelopes in the field. These specimens were placed in acetone in the laboratory.

Dr. Tennessen identified some adult Odonata specimens on the wing which were either common or which were out of reach, and therefore unable to be collected. Tentative identifications of visual observations were compared with other collection data (nymph and exuviae collections).

Additional adult Odonata collections were conducted by William West in conjunction with the mussel collection activities in late July and early August. These specimens were placed in plastic envelopes, preserved in acetone, and sent to Dr. Tennessen for identification.

2.1.4 Mussels

Mussels were collected primarily by diving. The divers were directed to search a variety of habitats at each of the three locations (CMC-WWI-300, 310, and 320). In addition to visually searching, substrates were examined by passing the hands through the surface layers of sediment to feel for buried mussels. Rocks were moved to examine for mussels beneath them, and substrates beneath large boulders were examined by reaching under and sweeping material from beneath them. The latter technique was particularly important in searching for the salamander mussel (*Simpsonaias ambigua*) which is generally found beneath large rocks frequented by its salamander host.

In addition, diving was supplemented with wading and visually searching from the surface with or without glass bottomed buckets. This latter technique is often effective in shallow riffle and shoal areas.

As outlined in the May 28, 1996 work plan (CMC, 1996a), captured mussels were accumulated and retained in mesh bags until processed. The original intent was to accumulate them in lots of 20 for enumeration by species. Since sufficient numbers of mussels could not be collected to accomplish this goal, searching was discontinued after four hours of effort was expended. This sampling strategy is consistent with methodology for the surveys conducted in 1994 at other sites near Crandon (Helms and Associates, 1994).

Processing of mussels commenced soon after specimens were captured and proceeded quickly to reduce exposure time (Waller, et al., 1993). Mussels were kept submersed in ambient water to prevent thermal shock and/or desiccation while being identified and counted. Following processing, they were handplaced back into the substrate in their approximate original position in the river. Mr. David Heath of the WDNR assisted in identification. Keys used included Stern (1990) and Burch (1975). Nomenclature followed Turgeon, et al. (1988). Voucher specimens

were retained for each species identified for submittal to the WDNR. Water temperature and substrate type as well as other pertinent observations were recorded for each sample collection.

2.1.5 Fish

Fish sampling was conducted on August 24, 1996. The objective was to determine the current status of the greater redhorse, *Moxostoma valenciennese*, and black redhorse, *Moxostoma duquesnei*, in the Wisconsin River between Hat Rapids Dam and Menard Island. However, all species of fish observed were recorded. Electrofishing was conducted in two areas: a 5-mile section from the base of Hat Rapids Dam to Crescent Creek and a 1-mile section in the vicinity of Menard Island. Equipment used during the sampling event included a 16 ft boat rigged with "Wisconsin" rings as the anode, and a Model VVP15 Coffelt electrofisher, used to control the output, which was typically between 400-450 volts pulsed DC and 4-6 amps. Sampling was conducted in a downstream direction. Actual shock time was three hours. Because of the habitat preference of the target species, the greatest portion of the sampling effort was aimed at swift water with rock substrates. Knowing this, lentic species (i.e., rock bass, bluegill, pumpkinseed, etc.) were potentially underestimated.

The survey was conducted by Greg Seegert and Joseph Vondruska of EA Engineering, Science, and Technology, with assistance from Brad Helmandollar of Foth & Van Dyke. Because of the large number of redhorse that were observed, it was not possible to net every specimen. However, all stunned redhorse were observed, and any that could possibly represent either of the target species were netted for closer examination, then released.

2.1.6 Quality Control

Field and laboratory quality control procedures were utilized during the aquatic biology studies such that the work was completed according to currently accepted standards of practice. Team leaders with senior level experience in the discipline in each field activity were assigned for each field task. Significant finds were documented in the field. Voucher specimens for all threatened, endangered, and special concern species were forwarded to WDNR. Voucher specimens for general species collections will be maintained for species verification at the University of Wisconsin-Green Bay Richter Museum.

A daily log of field activities was maintained by the field team leader who signed and dated the entries. A separate data sheet was used by Helms & Associates and Dave Heath (WDNR) to record the results of mussel field investigations.

2.2 Results

2.2.1 General Benthic Macroinvertebrates

A general list of aquatic macroinvertebrate specimens collected by site location is provided in Table 2-3. Only immature (larvae of nymphs) specimens which were in families containing a threatened, endangered, or special concern species were keyed to genus and, where possible, species. Table 2-4 provides the data summary for adult Trichoptera which were captured during light trapping collection efforts in June. With the exception of some Odonata, no threatened, endangered, or special concern species were collected from the study area. Odonata is discussed in Section 2.2.2.

Table 2-3

Benthic Aquatic Macroinvertebrates Collected June 1996

Site ID	Order	Family	Genus/species	Number found
CMC-WWI-301	Ephemeroptera	Baetidae	<i>Acerpenna sp.1</i>	4
			<i>Acerpenna sp.2</i>	3
		Ephemerellidae	<i>Eurylophella sp.</i>	3
			<i>Ephemerella sp.</i>	3
		Heptageniidae	<i>Stenacron sp.</i>	8
			<i>Stenonema sp.</i>	12
	Plecoptera	Perlodidae	<i>Isoperla sp.</i>	7
		Chloroperlidae	<i>Haploperla sp.</i>	1
	Trichoptera	Philopotamidae	<i>Chimarra sp.</i>	7
		Hydropsychidae	<i>Ceratopsyche sp.</i>	31
			<i>Cheumatophyche sp.</i>	46
			<i>Hydrophyche sp.</i>	1
	Coleoptera	Elmidae	<i>Stenelmis</i>	2 adults
			<i>Stenelmis sp.</i>	10 larvae
	Diptera	Chironomidae	Tanypodinae	6
			Orthoclaadiinae	10
		Tabanidae	<i>Chrysops sp.</i>	1
		Tipulidae	<i>Antocha sp.</i>	2
	Isopoda			6
	Amphipoda			3
	Decapoda			2
	Oligochaeta			5
	Hirudinea			2
	Snails			5
	Clams		<i>Corbicula</i>	1
CMC-WWI-310	Ephemeroptera	Baetidae	<i>Acerpenna sp.1</i>	21

Table 2-3 (Continued)

Site ID	Order	Family	Genus/species	Number found
			<i>Acerpenna sp.2</i>	6
		Ephemerellidae	<i>Eurylophella sp.</i>	1
			<i>Ephemerella sp.</i>	50
		Heptageniidae	<i>Stenacron sp.</i>	2
			<i>Stenonema sp.</i>	10
		Leptophlebiidae	<i>Paraleptophlebia sp.</i>	3
		Baetiscidae	<i>Baetisca sp.</i>	1
	Odonata	Gomphidae	<i>Gomphus fraternus</i>	1
			<i>Gonphus lividus</i>	1
			<i>Hagenius brevistylus</i>	1
			<i>Ophiogomphus rupinsulensis</i>	4
		Calopterygidae	<i>Calopteryx sp.</i>	1
	Plecoptera	Perlodidae	<i>Isoperla sp.</i>	4
		Chloroperlidae	<i>Haploperla sp.</i>	7
		Perlidae	<i>Phasgonophora sp.</i>	3
	Hemiptera	Corixidae	genus unidentified	2
	Trichoptera	Philopotamidae	<i>Chimarra sp.</i>	5
		Hydropsychidae	<i>Ceratopsyche sp.</i>	33
			<i>Cheumatopsyche sp.</i>	87
			<i>Macrostemum sp.</i>	2
		Polycentropidae	<i>Cynellus sp.</i>	1
			<i>Neureclipsis sp.</i>	1
			<i>Polycentropus sp.</i>	1
		Leptoceridae	<i>Oecetis sp.</i>	1

Table 2-3 (Continued)

Site ID	Order	Family	Genus/species	Number found
CMC-WWI-320	Coleoptera	Limnephilidae	<i>Limnephilus sp.</i>	20
		Elmidae	<i>Stenelmis</i>	3 adults
			<i>Stenelmis sp.</i>	6 larvae
		Halipidae	<i>Peltodytes sp.</i>	1 adult
			<i>Peltodytes sp.</i>	2 larvae
	Diptera	Chironomidae	Tanypodinae	1
			Orthoclaudiinae	9
		Tipulidae	<i>Antocha sp.</i>	1
		Diptera pupae	genera unidentified	2
	Amphipoda			8
	Decapoda			2
	Oligochaeta			2
	Snails			2
	Ephemeroptera	Baetidae	<i>Acerpenna sp. 1</i>	3
		Ephemerellidae	<i>Eurylophella sp.</i>	2
			<i>Ephemerella sp.</i>	5
		Heptageniidae	<i>Stenacron sp.</i>	4
			<i>Stenonema sp.</i>	34
		Isonychiidae	<i>Isonychia sp.</i>	2
		Baetiscidae	<i>Baetisca sp.</i>	1
		Caenidae	<i>Caenis sp.</i>	1
	Odonata	Aeshnidae	<i>Basiaeschna janata</i>	1
		Gomphidae	<i>Ophiogomphus rupinsulensis</i>	1
		Calopterygidae	<i>Calopteryx aequabilis</i>	3
			<i>Calopteryx maculata</i>	1
		Coenagrionidae	<i>Argia moesta</i>	1

Table 2-3 (Continued)

Site ID	Order	Family	Genus/species	Number found
			<i>Ischnura verticalis</i>	3
	Plecoptera	Perlodidae	<i>Isoperla sp.</i>	3
		Chloroperlidae	<i>Haploperla sp.</i>	12
		Perlidae	<i>Phasgonophora sp.</i>	4
	Trichoptera	Philopotamidae	<i>Chimarra sp.</i>	1
		Hydropsychidae	<i>Cheumatopsyche sp.</i>	19
		Helicopsychidae	<i>Helicopsyche sp.</i>	1
		Limnephilidae	<i>Limnephilus sp.</i>	11
	Coleoptera	Elmidae	<i>Stenelmis</i>	2 adults
			<i>Stenelmis sp.</i>	1 larvae
	Diptera	Chironomidae	Tanypodinae ¹	1
			Orthocladiinae ¹	6
		Tabanidae	<i>Chrysops sp.</i>	1
	Isopoda			13
	Amphipoda			12
	Decapoda			2
	Oligochaeta			2
	Snails			3
	Clams		<i>Corbicula</i>	8

¹Subfamily of chironomidae.

Prepared by: WMW
Checked by: BDH

Table 2-4

**Tricoptera Captured During Light Trapping
Wisconsin River, June 12 and 19, 1996**

Species	Site ID: CMC-WWI-301		Site ID: CMC-WWI-310	
	June 12	June 19	June 12	June 19
Glossosomatidae				
<i>Protoptila</i> sp.				f
Goeridae				
<i>Goera stylata</i>				f
Helicopsychidae				
<i>Helicopsyche borealis</i>		m		
Hydropsychidae				
<i>Ceratopsyche altemans</i>			m	
<i>Ceratopsyche morosa</i> ¹	f	m,f	m,f	m,f
<i>Cheumatopsyche cypyla</i>		f	f	f
<i>Cheumatopsyche pettiti</i> ¹	f	m,f	f	f
Hydroptilidae				
<i>Hydroptila grandiosa</i> ¹	f	m,f	f	f
<i>Hydroptila</i> nr. <i>scolops</i>				m,f
<i>Oxyethira forcipata</i>		m		m
<i>Stactobiella palmata</i>		m,f		m,f
Lepidostomatidae				
<i>Lepidostoma</i> sp.				f
Leptoceridae				
<i>Ceraclea ancylus</i>		f		m,f
<i>Ceraclea resurgens</i>		m		f
<i>Ceraclea</i> sp.				f
<i>Oecetis cinerascens</i>		m		
<i>Oecetis inconspicua</i>		m		
<i>Triaenodes tardus</i>		f		

Table 2-4 (Continued)

Species	Site ID: CMC-WWI-301		Site ID: CMC-WWI-310	
	June 12	June 19	June 12	June 19
Limnephilidae				
<i>Hydatophylax argus</i>				f
Philopotamidae				
<i>Chimarra obscura</i>		m,f		m,f (dominant)
Polycentropodidae				
<i>Neureclipsis validus</i>		m		
<i>Nyctiophylax</i> sp.				f
<i>Phylocentropus placidus</i>		m		m
<i>Polycentropus cinereus</i>		m		
Psychomyiidae				
<i>Psychomyia flavida</i> ¹	f	f	f	f

¹common in all samples

m = male

f = female

Prepared by: BA

Checked by: WMW

2.2.2 Odonata

Collection efforts for Odonata (dragonflies and damselflies) included searches for nymphs (aquatic), adults (terrestrial), and exuviae (casings left after emergence of nymphs from aquatic environment). Nymphs were collected during the general macroinvertebrate collection time period on June 5, 1996. Exuviae were collected from shoreline locations during mid to late June. Adult Odonata were collected or identified on the wing from late June into August, 1996. Collection methods and locations of Odonata nymph sampling are described above in Section 2.1.

Comprehensive collections of each of the life forms of Odonata species, i.e., nymph, final instar exuviae, and adult from the study area revealed, in general, members of the Odonata are widely distributed throughout the study area. One species, *Ophiogomphus howei*, which is ranked as endangered by the Wisconsin Natural Heritage Inventory, was collected at a single location (CMC-WWI-310) in the study area. Seven special concern species were collected and/or observed at several locations in the study area. These special concern species include the following: *Gomphus lineatifrons*, *G. quadricolor*, *G. ventricosus*, *G. viridifrons*, *Nasiaeschna pentacantha*, *Somatochlora kennedyi*, and *S. franklini*. Results of the Odonata collection activities are provided in Table 2-5.

2.2.3 Mussels

2.2.3.1 Abundance and Diversity

Mussels observed in the study area during collections were too sparse to allow the use of the technique of grouping the catch in lots of 20 for processing. Therefore, a minimum of four hours of effort were expended searching for mussels at each location. Total catch for the three locations combined was 123 individuals. Mussel abundance increased with increased distance downstream of Hat Rapids Dam as shown in Table 2-6. Twenty-three individuals were collected at Site CMC-WWI-300 while 34 and 66 specimens were collected at Sites CMC-WWI-310 and CMC-WWI-320, respectively. Similarly, species diversity appeared to increase progressively in a downstream direction from the dam as five, six, and eight species were encountered in each location respectively. Species diversity in these samples, however, may be a function of sample size as one would expect to increase the number of species collected with larger numbers of individuals.

2.2.3.2 Species Composition

Nine taxa were collected from the Wisconsin River in the area of the survey. One species is classified as special concern in the Wisconsin Natural Heritage Inventory. No threatened or endangered species were encountered. *Anodonta grandis* was the most common species, comprising 23 percent of the overall catch. The next most common species were *Lasmigona complanata* (21%), *Lampsilis siliquioidea* (20%), *Lampsilis cardium* (17%), and *Fusconia flava* (11%). *Lasmigona compressa*, the species of special concern was moderately common at 4 percent of the total catch and was found at two of the three locations. Two specimens of *Actinonaias carinata* (2%) were collected below the Hat Rapids Dam and a single specimen each of *Lasmigona costata* and *Strophitus undulata* (1%) were collected at the furthest downstream location.

Table 2-5

Odonata Collected in June and August 1996

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
<i>Amphiagrion saucium</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
<i>Argia moesta</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-5-96	N	N	1
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	A	N	
<i>Basiaeschna janata</i>	CMC-WWI-301R	Oneida	34	36N8E	6-12-96	E	N	1
	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-5-96	N	N	1
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	N	1
<i>Calopteryx sp.</i>	CMC-WWI-310	Lincoln	4	35N8E	6-5-96	N	N	1
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	N	1
<i>Calopteryx aequabilis</i>	CMC-WWI-310	Lincoln	4	35N8E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-5-96	N	N	3
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	1
	CMC-WWI-301L	Oneida	34	36N8E	6-12-96	E	N	1
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	N	1
	CMC-WWI-320L	Lincoln	1 & 12	35N7E	6-20-96	E	N	1
<i>Calopteryx maculata</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-5-96	N	N	1
	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	

Table 2-5 (Continued)

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
<i>Cordulegaster maculata</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	8-1-96	A	N	
<i>Coenagrion resolutum</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
<i>Cordulia shurtleffi</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
<i>Didymops transversa</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-301L	Oneida	34	36N8E	6-21-96	E	N	3
<i>Dorocordulia libera</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	N	
<i>Dromogomphus spinosus</i>	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	N	1
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	N	2
	CMC-WWI-320	Lincoln	1 & 12	35N7E	8-1-96	A	N	
<i>Epitheca (Tetragoneuria) canis</i>	CMC-WWI-310	Lincoln	4	35N8E	6-19-96	A	N	
	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-12-96	A	N	
<i>Epitheca (Tetragoneuria) cynosura</i>	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	N	
<i>Epitheca (Tetragoneuria) spinigera</i>	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	N	
<i>Enallagma boreale</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
<i>Gomphus adelphus</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	5
	CMC-WWI-319L	Lincoln	1	35N7E	6-20-96	E	N	1

Table 2-5 (Continued)

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
<i>G. exilis</i>	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	1
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	1
<i>G. fraternus</i>	CMC-WWI-310	Lincoln	4	35N8E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	N	
	CMC-WWI-310	Lincoln	4	35N8E	6-5-96	N	N	1
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	25
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	N	1
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	N	4
	CMC-WWI-319L	Lincoln	1	35N7E	6-20-96	E	N	1
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	N	2
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	N	3
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	23
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-12-96	E	N	4
<i>G. lineatifrons</i>	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	SC	1
	CMC-WWI-301R	Oneida	34	36N8E	6-21-96	E	SC	4
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	SC	6
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	SC	4
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
<i>G. lividus</i>	CMC-WWI-310	Lincoln	4	35N8E	6-5-96	N	N	1
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	2

Table 2-5 (Continued)

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
<i>G. quadricolor</i>	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	N	1
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	N	1
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	1
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-19-96	A	SC	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	SC	
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	SC	13
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	SC	5
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	SC	2
	CMC-WWI-320L	Lincoln	1 & 12	35N7E	6-20-96	E	SC	1
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	SC	1
<i>G. vastus</i>	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-12-96	E	SC	20
	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	166
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	N	19
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	N	23
	CMC-WWI-319L	Lincoln	1	35N7E	6-20-96	E	N	10
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	N	21
	CMC-WWI-301L	Oneida	34	36N8E	6-21-96	E	N	7
	CMC-WWI-301R	Oneida	34	36N8E	6-21-96	E	N	14
	CMC-WWI-320L	Lincoln	1 & 12	35N7E	6-20-96	E	N	6
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	N	65
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	84
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-12-96	E	N	6

Table 2-5 (Continued)

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
<i>G. ventricosus</i>	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	SC	
<i>G. viridifrons</i>	CMC-WWI-301R	Oneida	34	36N8E	6-12-96	A	SC	
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	A	SC	
	CMC-WWI-301R	Oneida	34	36N8E	6-12-96	E	SC	1
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	SC	6
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	SC	2
	CMC-WWI-319L	Lincoln	1	35N7E	6-20-96	E	SC	1
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	SC	2
	CMC-WWI-320L	Lincoln	1 & 12	35N7E	6-20-96	E	SC	2
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	SC	3
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	SC	3
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-12-96	E	SC	7
<i>G. spicatus</i>	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
<i>Hagenius brevistylus</i>	CMC-WWI-310	Lincoln	4	35N8E	6-5-96	N	N	1
	CMC-WWI-301L	Oneida	34	36N8E	6-21-96	E	N	1
<i>Ischnura verticalis</i>	CMC-WWI-310	Lincoln	4	35N8E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-5-96	N	N	3
<i>Ladona julia</i>	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
<i>Lestes dryas</i>	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
<i>Leucorrhinia frigida</i>	CMC-WWI-310	Lincoln	4	35N8E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
<i>L. intacta</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	

Table 2-5 (Continued)

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
<i>L. proxima</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
<i>L. hudsonica</i>	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
<i>Libellula lydia</i>	CMC-WWI-315	Oneida	32	36N8E	6-22-96	A	N	
<i>L. quadrimaculata</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-20-96	A	N	
	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-12-96	A	N	
<i>Macromia illinoiensis</i>	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	N	
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	2
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	N	1
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	N	4
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	2
<i>Nasiaeschna pentacantha</i>	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	SC	1
<i>Nehalennia irene</i>	CMC-TCI-300	Lincoln	1 & 2	35N7E	6-19-96	A	N	
<i>Ophiogomphus colubrinus</i>	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	N	3
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-12-96	E	N	1
<i>O. howei</i>	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	END	1
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	END	1
<i>O. rupinsulensis</i>	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	N	
	CMC-WWI-310	Lincoln	4	35N8E	6-5-96	N	N	4
	CMC-WWI-320	Lincoln	1 & 12	35N7E	6-5-96	N	N	1
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-18-96	E	N	178
	CMC-WWI-301L	Oneida	34	36N8E	6-12-96	E	N	3
	CMC-WWI-310L	Lincoln	4	35N8E	6-12-96	E	N	188

Table 2-5 (Continued)

Species	Site ID	County	Section	T/R	Date	Form	Rank	Number ¹
	CMC-WWI-315R	Oneida	32	36N8E	6-22-96	E	N	19
	CMC-WWI-319L	Lincoln	1	35N7E	6-20-96	E	N	84
	CMC-WWI-319R	Lincoln	1	35N7E	6-20-96	E	N	59
	CMC-WWI-301L	Oneida	34	36N8E	6-21-96	E	N	3
	CMC-WWI-301R	Oneida	34	36N8E	6-21-96	E	N	2
	CMC-WWI-320L	Lincoln	1 & 12	35N7E	6-20-96	E	N	5
	CMC-WWI-310R	Lincoln	4	35N8E	6-19-96	E	N	201
	CMC-WWI-310L	Lincoln	4	35N8E	6-19-96	E	N	69
	CMC-WWI-320R	Lincoln	1 & 12	35N7E	6-12-96	E	N	240
	CMC-WWI-320	Lincoln	1 & 12	35N7E	8-1-96	A	N	
<i>Somatochlora kennedyi</i>	CMC-WWI-310	Lincoln	4	35N8E	6-20-96	A	SC	
<i>S. franklini</i>	CMC-WWI-310	Lincoln	4	35N8E	6-22-96	A	SC	

Site ID: R = Right bank facing downstream.
L = Left bank facing downstream.

Form: A = Adult Rank: N = None
N = Nymph SC = Special Concern
E = Exuviae END = Endangered

Number = Total number found of that particular form.

¹Numbers only appear in this column for the forms nymph and exuviae.

Prepared by: WMW
Checked by: BDH

Table 2-6

Mussels Collected July 31 - August 2, 1996

Species	Location			Total #	Percent	Status
	CMC-WWI-300	CMC-WWI-310	CMC-WWI-320			
<i>Anodonta grandis</i>	4	6	18	28	23	None
<i>Lasmigona complanata</i>	0	4	22	26	21	None
<i>Lampsilis siliquoidea</i>	10	9	6	25	20	None
<i>Lampsilis cardium</i>	4	1	16	21	17	None
<i>Fusconia flava</i>	3	10	1	14	11	None
<i>Lasmigona compressa</i>	0	4	1	5	4	Special Concern
<i>Actinonaias carinata</i>	2	0	0	2	2	None
<i>Lasmigona costata</i>	0	0	1	1	<1	None
<i>Strophitus undulatus</i>	0	0	1	1	<1	None
Totals	23	34	66	123	100.0	
No. of species	5	6	8	9		

Prepared by: WMW/DRH
 Checked by: BDH

This species list was compared with a data set (Table 2-7) provided by David Heath of the WDNR in 1996 (Heath, 1996) for pertinent mussel records in the area. The Heath information is a compilation of data from 1992 through 1995. Data from available records for the reach of the Wisconsin River between Hat Rapids Dam and Kings Dam (16.2 miles) show total collection of 242 live individuals of seven species and 512 dead individuals of 14 species. Included in the WDNR data set for live individuals are two species not collected in the CMC survey. These included one individual of *Anodonta imbecillis* and three individuals of *Anodontoides ferussacianus*. It is unclear where these specimens were collected, but since both species are commonly found associated with softer substrates, it is possible they were collected further downstream where ponding effects of the reservoir made habitat more conducive to their existence. The CMC survey produced four living individuals of species not reported from previous surveys. These included: *L. cardium*, *A. carinata*, *L. costata*, and *S. undulatus*. *L. compressa*, a species of special concern, was represented in both data sets.

Five additional species which were found dead are included in the WDNR data set (Table 2-7). Since it is unclear how long these individuals had been dead before their discovery, some of them may no longer be present in the community. They have at least been present in the past.

Additional historical listings for the area are provided from an archaeological dig (Beard, et al., 1993) in the Kings Dam vicinity. That study reported the composition of shell middens presumably created by pearl hunters dating around the early 1900s.

In all, 19 species have been reported from this area from the three investigations. As presented in Table 2-7, six species found during the three surveys (i.e., Helms, 1996; WDNR, 1993; and Beard, et al., 1993) are included on the Wisconsin Natural Heritage Inventory. Two, *Cyclonaias tuberculata* and *Plethobasus cyphus* are endangered, and one, *Quadrula metanevra* is threatened. Three others, *Alasmidonta marginata*, *Lasmigona compressa* and *Pleurobema sintoxia*, are on the special concern list.

2.2.4 Fish

During the 1996 survey, 23 species of fish were documented (Table 2-8). Neither of the target species (greater redhorse and black redhorse) were observed. No species currently listed on the Wisconsin Natural Heritage Inventory were documented. Shorthead redhorse was clearly the most abundant species with approximately 1000 observations. Silver redhorse and northern hog sucker were also abundant. Although redhorse species were found throughout the study area, they were noticeably more common in the high gradient areas near Hat Rapids Dam, near the Camp 10 road access point, and adjacent to and upstream of Menard Island.

Except for logperch, forage fish (i.e., minnows and darters) were rare to uncommon. Smallmouth bass was the most common game fish observed, with small numbers of walleye, musky, northern pike, and largemouth bass also noted.

Fish sampling was done on the Wisconsin River by WDNR in August 1995 (Theis, 1996) from the Hat Rapids Dam downstream for 2 miles. Techniques used consisted of fyke nets and electrofishing. During the sampling, 24 species were recorded as shown in Table 2-8.

Table 2-7

**Summary of CMC 1996 and Historical Mussel Collection Data
Wisconsin River Between Hat Rapids Dam and Kings Dam**

Species	Helms CMC Survey 1996		WDNR Survey Data 1993 ¹				Archeological Dig 1993 ²		Status
	Total #	Percent	No. Live		No. Dead		47-Li-88		
<i>Actinonaias carinata</i>	2	2%	0	0	15	3%	407	23%	None
<i>Alasmidonta marginata</i>	0	0	0	0	5	1%	21	1%	Special Concern
<i>Amblema plicata</i>	0	0	0	0	4	<1%	12	<1%	None
<i>Anodontoides ferussacianus</i>	0	0	3	1%	0	0	0	0	None
<i>Anodonta grandis</i>	28	23%	178	74%	198	39%	0	0	None
<i>A. imbicillis</i>	0	0	1	<1%	2	<1%	0	0	None
<i>Cyclonaias tuberculata</i>	0	0	0	0	0	0	3	<1%	Endangered
<i>Elliptio dilatata</i>	0	0	0	0	4	<1%	22	1%	None
<i>Fusconia flava</i>	14	11%	14	6%	142	28%	0	0	None
<i>Lampsilis cardium</i>	21	17%	0	0	16	3%	842	48%	None
<i>L. siliquoidea</i>	25	20%	15	6%	91	18%	23	1%	None
<i>Lasmigona complanata</i>	26	21%	27	11%	7	1%	1	<1%	None
<i>L. compressa</i>	5	4%	4	2%	8	2%	0	0	Special Concern
<i>L. costata</i>	1	<1%	0	0	10	2%	241	14%	None
<i>Legumia recta</i>	0	0	0	0	9	2%	162	9%	None
<i>Plethobasus cyphus</i>	0	0	0	0	1	<1%	0	0	Endangered
<i>Pleurobema sintoxia</i>	0	0	0	0	0	0	2	<1%	Special Concern

Table 2-7 (Continued)

Species	Helms CMC Survey 1996		WDNR Survey Data 1993 ¹				Archeological Dig 1993 ²		Status
	Total #	Percent	No. Live		No. Dead		47-Li-88		
<i>Qaudrula metanevra</i>	0	0	0	0	0	0	3	<1%	Threatened
<i>Strophitus undulatus</i>	1	<1%	0	0	0	0	2	<1%	None
Totals	123	100.0%	242	100.0%	512	100.0%	1741	100.0%	
No. of Species	9		7		14		13		

¹Heath, 1996.

²Beard, et al., 1993.

Prepared by: WMW/DRH

Checked by: BDH

Table 2-8

Fish Species Recorded in the Wisconsin River Downstream of Hat Rapids Dam

Common Name	Scientific Name	Number Captured on August 24, 1996	Observed by WDNR in August 1993 ¹
Common shiner	<i>Luxilus cornutus</i>	15	X
Hornyhead chub	<i>Nicomis biguttatus</i>	10	X
Blacknose shiner	<i>Notropis heterolepis</i>	1 ²	
Bluntnose minnow	<i>Pimephales notatus</i>	5	X
Longnose dace	<i>Rhinichthys cataractae</i>	2	X
White sucker	<i>Catostomus commersoni</i>	25	X
Silver redhorse	<i>Moxostoma anisurum</i>	~200	
Golden redhorse	<i>Moxostoma erythrurum</i>	5	X
Shorthead redhorse	<i>Moxostoma macrolepidotum</i>	~1,000	X
Northern hog sucker	<i>Hypentelium nigricans</i>	~300	X
Muskellunge	<i>Exos masquinongy</i>	11	X
Northern pike	<i>Exos lucius</i>	3	X
Yellow bullhead	<i>Ameiurus natalis</i>	1 ²	X
Black crappie	<i>Pomoxis nigromaculatus</i>	1 ²	X
Rock bass	<i>Ambloplites rupestris</i>	2	X
Bluegill	<i>Lepomis macrochirus</i>	1	X
Smallmouth bass	<i>Micropterus dolomieu</i>	~50	X
Largemouth bass	<i>Micropterus salmoides</i>	2	
Yellow perch	<i>Perca flavescens</i>	7 ²	X
Walleye	<i>Stizostedion vitreum</i>	15	X
Johnny darter	<i>Etheostoma nigrum</i>	2	X
Logperch	<i>Percina caprodes</i>	~75	X
Slenderhead darter	<i>Percina phoxocephala</i>	2	X
Black bullhead	<i>Ictalurus melas</i>		X
Greater redhorse	<i>Moxostoma valenciennese</i>		X
Pumpkinseed	<i>Lepomis gibbosus</i>		X
Rosyface shiner	<i>Notropis ruvellus</i>		X

¹Total accumulated fish counts were not kept by WDNR.

²Collected only in the pooled portion of the river, downstream of Menard Island.

Prepared by: GS
Checked by: BDH

Comparing WDNR's results to CMC's 1996 results shows that 20 species were found common to both surveys. The CMC survey found three species not found by WDNR, while four species were found by WDNR that were not found during the CMC survey. Included in the WDNR survey was one greater redhorse, which is a state threatened species.

2.3 Ecological Significance of Findings

2.3.1 General Benthic Macroinvertebrates

Most of the aquatic macroinvertebrate collections were instream life stages, such as annelids, leeches, insects, crustaceans and mollusks. However, to help identify some specimens to species, some groups were collected in the adult stages. Adult insect collections were conducted using light trapping techniques. Groups targeted for light trapping included members of the orders Ephemeroptera, Trichoptera, Coleoptera, and Plecoptera.

With the exception of Odonata, no threatened, endangered, or special concern species of aquatic macroinvertebrates were collected from the study area.

2.3.2 Odonata

In contrast to fish and mussels, dragonflies represent a group of insects which are extremely mobile and have the ability to colonize suitable habitat fairly rapidly, i.e., they do not depend on other organisms or continuous aquatic habitat with which to disperse upstream or downstream. The Odonata are also very opportunistic. It would not be unreasonable to find populations of individual species in marginal habitat for short periods of time, and for this study, based on other similar work throughout northern Wisconsin, one would expect to find some state-listed species.

A total of 43 species of Odonata were identified from the study area. A breakdown of the findings shows that of the total species collected and/or observed, 86 percent were observed in the adult form, with 51 percent observed only in the adult form. Forty-two percent of the species were collected in the exuviae form, with 12 percent collected only as exuviae. Nymph forms were present in 21 percent of the total species encountered. However, for each species found as a nymph, an adult or exuviae form of the same species was also found resulting in positive identification and verification of the species. It is interesting to note that three of eight of the state-listed species recorded were found in the exuviae form only, highlighting the importance of varying collection methodologies when studying and inventorying dragonflies.

Several gomphids were collected from the study area, four of which are special concern species while one is an endangered species. These include *Ophiogomphus howei* (endangered), *Gomphus lineatifrons*, *G. ventricosus*, *G. viridifrons* and *G. quadricolor*.

G. lineatifrons is a listed species, but is fairly common in northern Wisconsin where suitable stream habitat exists. This species has a preference for medium-sized streams (15 to 20 feet wide), and was found as exuviae in low numbers at all stations within the study area.

G. lineatifrons nymphs can tolerate some degree of silt and muck in the substrate, but need a mix of sand and gravel. This microhabitat is common along the Wisconsin River above Menard Island. *G. viridifrons* requires much the same habitat as *G. lineatifrons* and the two species often occur together, although *G. viridifrons* appears to prefer slightly larger streams (Tennessen, 1994). *G. viridifrons* exuviae were found at all stations within the study area.

G. quadricolor prefers medium-sized to small streams with sand/gravel substrate and a series of pools and riffles. This species is indicative of good to excellent water quality. Larvae inhabit sandy gravel areas where flow is slow. *G. ventricosus* prefers medium-sized streams with silt/sand/gravel substrates and good to excellent water quality. Larvae inhabit slower flowing areas where silt and sand accumulate.

Three species of *Ophiogomphus* were collected from the study area, including *O. rupinsulensis*, *O. colubrinus*, and *O. howei*, the latter being an endangered species. *O. howei* was only collected in the exuviae form and only at the Camp 10 Landing (Site CMC-WII-310). Based on an assessment of habitat, this species may also occur downstream of the Camp 10 site to the Menard Island location as additional preferred habitat exists throughout this stretch of the river.

Nasiaeschna pentacantha, a species of special concern, prefers slow areas of woodland streams and lakes formed by slow streams. It also inhabits woodland ponds in the southern part of its range. Larvae cling to submerged logs and sticks, either in quiet water or along the edge of slow current where the bottom is muddy. The single specimen of *N. pentacantha*, an exuviae, was found in a reach of water sheltered from the main current and along a wooded bank containing numerous submerged logs.

Two species of *Somatochlora* were collected as adults in the study area. Both species, *S. kennedyi* and *S. franklini* are special concern species, however, because their habitat requirements during their pre-adult stages are not riverine in nature, there is no particular significance associated with these findings.

In general, habitat for state-listed species of Odonata appears to be abundant between Hat Rapids Dam and Menard Island. Although similar habitat occurs throughout the entire reach, species diversity and abundance is significantly greater from Camp 10 Landing to Menard Island. The reason for this apparent distribution pattern is unknown.

2.3.3 Mussels

Nine species of mussels were collected from three locations within the study area. The number of species encountered increased the further the distance downstream from the Hat Rapids Dam. This is not typical of impounded rivers relative to mussel collections where higher numbers of specimens in the vicinity of a dam would be expected.

No threatened or endangered species were encountered during the three day search. One special concern species, *Lasmigona compressa*, was collected at the two downstream sites but not at the site immediately downstream of Hat Rapids Dam. Previous records for this reach of the Wisconsin River indicate that threatened and endangered species may have occurred here including *Cyclonaias tuberculata* and *Plethobasus cyphus* (endangered) and *Quadrula metanevra* (threatened). These previous records do not include live specimens.

There are a number of factors which influence the presence and distribution of mussels. These factors may include sedimentation, presence or absence of host fish species, water temperature, scouring potential of the river, and relative amount of free flowing stream.

In the reach of the river where the study was conducted, some of these factors may influence the presence and distribution of mussels. Severe scouring was noted in the area immediately downstream of Hat Rapids Dam. This causes corrosion and pitting of mussel shells.

The mussel population is somewhat isolated from the rest of the Wisconsin River by the presence of two dams (Hat Rapids and Kings). The factors favoring isolationism restricts the free movement of host species, in particular, the movement of host species upstream into the area of study. An increase in sedimentation below Menard Island was noted during the study. The accumulation of sediment has been known to be detrimental to mussel populations.

Those factors which currently influence the presence and distribution of mussels in the Wisconsin River below Hat Rapids Dam should be neither enhanced nor reduced with the addition of the proposed mine discharge. It is unlikely that any parameter in the Crandon Project discharge will be deleterious to mussel populations in the Wisconsin River. There should be a negligible increase in base flow for the system. The single special concern species of mussel observed in the Wisconsin River in the study area should not be impacted by the discharge even if the mussel was found closer to the immediate area of the discharge.

2.3.4 Fish

The fishery of the Wisconsin River below Hat Rapids Dam is a moderately diverse and healthy community. Data collected by the WDNR and through the investigation by EA Engineering, Science, and Technology and Foth & Van Dyke uncovered 27 species of fish within the study area. These species are typically found in northern Wisconsin rivers that have been developed for the purpose of generating hydroelectric power.

Records provided by the WDNR (Theis, 1996) indicated that one greater redhorse (threatened) was identified within the study area. During CMC's field survey which concentrated mainly on areas of swift water with rock substrates (i.e., redhorse habitat), neither of the target species, greater redhorse or black redhorse, were observed. Despite the sampling results and very limited historical records of occurrence, the greater redhorse may occur in very low numbers in this stretch of the Wisconsin River. However, the black redhorse was not documented during either the WDNR or CMC's fish surveys.

Assuming that the greater redhorse does exist in low numbers within the study area, the proposed mine discharge is not expected to affect its life cycle or to affect the overall fish community in any adverse manner. The pipeline will discharge directly into the dam so that mixing will be complete and immediate. There will be a negligible increase in flow, and the discharge water will meet WDNR standards selected to protect the most sensitive species.

3 Flora

3.1 Field Methods

The survey for rare vascular plants along the Wisconsin River was conducted on June 29, 30, and 31, and August 14, 15, and 16, 1996. The survey included the general study area (Figure 2-1) from the Hat Rapids Dam to Menard Island and to lesser extent, downstream of Menard Island to County Trunk Highway (CTH) A. The survey was conducted by Gary Fewless of the University of Wisconsin-Green Bay (UWGB), and Bradley Helmandollar of Foth & Van Dyke.

Research conducted before field work was initiated showed that no endangered or threatened vascular plant species are known to exist within the area of the study. The Wisconsin Department of Natural Resources reported one special concern species, *Epilobium palustre* (marsh willow-herb) from within the area of T36N R8E, which is within the study area. This species is typically found in bogs or boggy swamps.

The state list of endangered, threatened and special concern species was examined for other plants which might be expected on this site. Initial examination of the site suggested that the habitat was not favorable for most of the Wisconsin rare species, but a few were considered possible. *Armoracia lacustris* has been found in an unexpected riverine site in recent years and was considered possible here. *Callitriche heterophylla*, *C. hermaphrodita*, *Equisetum palustre*, and *Poa paludigena* were also considered possible and *Ranunculus gmelinii* might have been present in cold springs feeding the river. All fully aquatic species were very carefully considered during the survey and the standard practice was to identify any unknown species such that unexpected rare species were not overlooked.

The river is not easily accessible along its shoreline within the area studied except for the portion immediately below the Hat Rapids Dam. Therefore the survey was conducted largely by canoe, with periodic stops to wade along the shoreline and to check adjacent wetlands and several small streams entering the river. A list was kept of aquatic species encountered and vouchers were collected and returned to the laboratory for identification if immature or otherwise unknown plants were found which could conceivably represent rare species.

It is likely that any effects of the discharge, if any, would be most pronounced in the area near the discharge point. Therefore, the greatest effort was applied to the area from the Hat Rapids Dam downstream to the sharp turn of the river in the NE ¼ of Section 4, T35N, R8E, a distance of roughly 2.5 miles. A walking survey was conducted along both shorelines and in the adjacent shallow water in the area between the dam and Hat Rapids Road. The area from approximately 2.5 miles downstream to the Highway A bridge in Section 21, T35N, R7E in Lincoln County was searched less intently, but with the same methodology.

3.1.1 Quality Control

Field and laboratory quality control procedures were utilized during the botany studies such that the work was completed according to currently accepted standards of practice. Team leaders with senior level experience in the discipline in which the field activities involved were assigned for each task. Significant finds were documented in the field. Voucher specimens were collected where appropriate, and will be maintained for species verification at the University of Wisconsin, Green Bay Herbarium.

A daily log of observed specimens was maintained by the field team leader. A voucher specimen was collected for any unique species or any specimen that could not be definitively identified in the field.

3.2 Results

A large proportion of the shoreline within the study area rises quickly to terrestrial communities which appear to be little affected by the river. Often the vegetation is small diameter mixed hardwoods or more uniform stands of young *Populus tremuloides* or plantations of *Pinus resinosa* or *P. banksiana*. Vascular plants likely to be directly affected by the river are aquatic macrophytes growing within the standing water of the river, or in narrow bands of emergent and wet soil species along the shoreline, or small areas of mostly open deciduous swamp or shrub carr adjacent to the river. A complete list of aquatic and wet soil species noted in this study is presented in Table 3-1.

3.2.1 Aquatic Macrophytes

Aquatic vegetation within the river is generally sparse in the upstream portion of the study area. The current is moderate in this area, the bottom is often rocky and the water is somewhat turbid. The most conspicuous vegetation noted in this area is an emergent bur-reed (*Sparganium*) which forms local populations in shallow water along the edges and sometimes produces large stands extending far out into the river. These plants are uniformly sterile in most cases and cannot be identified with a high degree of certainty, although the physical characteristics and the habitat are consistent with *S. americanum* and *S. chlorocarpum*. In a few calmer, shallower places a limited number of fertile *S. americanum* were found, and it is likely that most or all sterile populations of *Sparganium* were also *S. americanum*.

The only other regularly occurring aquatic species within the upper portion of the river is *Potamogeton epihydrus* which occurs in two forms. One form is the typical condition in which both oval floating leaves and long, linear submersed leaves are produced on the same plant. The second form, usually found in deeper and faster water, consists of only the long submersed leaves. A few other submersed species were found in the upper portion of the river, including *Vallisneria americana* and *Potamogeton richardsonii*, but they were uncommon.

Farther downstream the number of species increases and, beginning in the area of Menard Island, the current diminishes and there is a dramatic increase in the diversity and density of submersed and floating aquatic vegetation. *Potamogeton epihydrus* is present here along with *P. natans*, *P. richardsonii*, *P. zosteriformis*, *Ceratophyllum demersum*, *Elodea canadensis*, *Najas flexilis*, *Polygonum natans*, *Utricularia vulgaris*, *Nymphaea odorata*, *Nuphar variegatum* and others.

As the river approaches the Highway A bridge it widens, flow is almost imperceptible and conditions are more similar to a lake than to a stream. Both width and slow current of this portion of the river are probably due, at least in part, to the dam downstream. There are abundant submergent plants in this area and *Zizania aquatica* (wild rice) and *Pontederia cordata* (pickerel weed) are conspicuous. The high productivity and the appearance of a filamentous algae in this area suggests relatively high nutrient availability, perhaps enhanced by the activities associated with the cabins and homes along the river banks.

Table 3-1

**Aquatic Macrophytes and Shoreland Vegetation
Noted During June and August 1996**

Scientific Name	Common Name
<i>Abies balsamea</i>	Balsam fir
<i>Acer negundo</i>	Box elder
<i>Acer rubrum</i>	Red maple
<i>Acer saccharinum</i>	Silver maple
<i>Acer spicatum</i>	Mountain maple
<i>Acorus calamus</i>	Sweetflag
<i>Agrostis gigantea</i>	Red top
<i>Agrostis hyemalis</i>	Ticklegrass
<i>Agrostis tenuis</i>	Colonial bent
<i>Alisma plantago-aquatica</i>	Water plantain
<i>Alnus rugosa</i>	Speckled alder
<i>Alopecurus aequalis</i>	grass
<i>Amelanchier sp.</i>	Juneberry
<i>Amphicarpa bracteata</i>	Hog-peanut
<i>Anemone canadensis</i>	Canada anemone
<i>Aralia nudicaulis</i>	Wild sarsaparilla
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit
<i>Asclepias incarnata</i>	Swamp milkweed
<i>Aster lateriflorus</i>	Calico aster
<i>Aster simplex</i>	Panicked aster
<i>Aster umbellatus</i>	Flat-topped white aster
<i>Athyrium filix-femina</i>	Lady fern
<i>Betula alleghaniensis</i>	Yellow birch
<i>Betula papyrifera</i>	Paper birch
<i>Bidens discoidea</i>	Sticktight
<i>Bidens sp.</i>	Sticktight

Table 3-1 (Continued)

Scientific Name	Common Name
<i>Boehmeria cylindrica</i>	False nettle
<i>Botrychium virginianum</i>	Rattlesnake fern
<i>Bromus ciliatus</i>	Fringed brome
<i>Calamagrostis canadensis</i>	Bluejoint grass
<i>Calla palustris</i>	Wild calla
<i>Callitriche verna</i>	Water starwort
<i>Caltha palustris</i>	Marsh marigold
<i>Campanula aparinoides</i>	Bedstraw bellflower
<i>Cardamine pennsylvanica</i>	Bitter Cress
<i>Carex comosa</i>	sedge
<i>Carex crinita</i>	sedge
<i>Carex hystericina</i>	sedge
<i>Carex lacustris</i>	sedge
<i>Carex normalis</i>	sedge
<i>Carex projecta</i>	sedge
<i>Carex retrorsa</i>	sedge
<i>Carex scabrata</i>	sedge
<i>Carex spp.</i>	sedge
<i>Carex stricta</i>	Tussock sedge
<i>Carex tenera</i>	sedge
<i>Carex vesicaria</i>	sedge
<i>Ceratophyllum demersum</i>	Coontail
<i>Chelone glabra</i>	Turtlehead
<i>Chrysosplenium americanum</i>	Golden saxifrage
<i>Cicuta bulbifera</i>	Water hemlock
<i>Cicuta maculata</i>	Water hemlock
<i>Circaea alpina</i>	Small enchanters nightshade
<i>Cirsium muticum</i>	Swamp thistle
<i>Coptis trifolia</i>	Goldthread

Table 3-1 (Continued)

Scientific Name	Common Name
<i>Dryopteris cristata</i>	Crested fern
<i>Dulichium arundinacea</i>	Three-way sedge
<i>Echinocystis lobata</i>	Wild cucumber
<i>Eleocharis acicularis</i>	spikerush
<i>Eleocharis erythropoda</i>	spikerush
<i>Eleocharis obtusa</i>	spikerush
<i>Eleocharis smallii</i>	spikerush
<i>Elodea canadensis</i>	Waterweed
<i>Elymus virginicus</i>	Wild-rye
<i>Epilobium ciliatum</i>	Willow-herb
<i>Epilobium leptophyllum</i>	Willow-herb
<i>Equisetum arvense</i>	Field horsetail
<i>Equisetum fluviatile</i>	Water horsetail
<i>Equisetum sylvaticum</i>	Woodland horsetail
<i>Eupatorium maculatum</i>	Joe pye weed
<i>Eupatorium perfoliatum</i>	Boneset
<i>Fraxinus nigra</i>	Black ash
<i>Fraxinus pennsylvanica</i>	Green ash
<i>Galium asprellum</i>	Rough bedstraw
<i>Galium obtusum</i>	Bedstraw
<i>Galium trifidum</i>	Bedstraw
<i>Glyceria canadensis</i>	Manna grass
<i>Glyceria grandis</i>	Manna grass
<i>Glyceria striata</i>	Manna grass
<i>Gnaphalium uliginosum</i>	Low cudweed
<i>Gymnocarpium dryopteris</i>	Oak fern
<i>Helenium autumnale</i>	Sneezeweed
<i>Hieracium canadense</i>	Canada hawkweed
<i>Hydrophyllum virginianum</i>	Virginia waterleaf

Table 3-1 (Continued)

Scientific Name	Common Name
<i>Ilex verticillata</i>	Common winterberry holly
<i>Impatiens biflora</i>	Jewelweed
<i>Iris versicolor</i>	Blue flag
<i>Juncus brevicaudatus</i>	rush
<i>Juncus effusus</i>	rush
<i>Juncus filiformis</i>	rush
<i>Juncus sp.</i>	rush
<i>Lactuca biennis</i>	Tall blue lettuce
<i>Laportea canadensis</i>	Wood nettle
<i>Leersia oryzoides</i>	Rice cut-grass
<i>Lemna minor</i>	Duckweed
<i>Lemna trisulca</i>	Star duckweed
<i>Lilium superbum</i>	Turk's cap lily
<i>Lycopus uniflorus</i>	Water horehound
<i>Lysimachia ciliata</i>	Fringed loosestrife
<i>Lysimachia terrestris</i>	Yellow loosestrife
<i>Lysimachia thyrsiflora</i>	Tufted loosestrife
<i>Lythrum salicaria</i>	Purple loosestrife
<i>Maianthemum canadense</i>	Wild lily-of-the-valley
<i>Matteuccia struthiopteris</i>	Ostrich fern
<i>Mentha arvensis</i>	Wild mint
<i>Mimulus ringens</i>	Monkey flower
<i>Mitella nuda</i>	Naked miterwort
<i>Myosotis sp.</i>	Forget-me-not
<i>Myrica gale</i>	Sweet gale
<i>Najas flexilis</i>	Water-nymph
<i>Nuphar variegatum</i>	Bullhead-lily
<i>Nymphaea odorata</i>	Water lily
<i>Oenothera biennis</i>	Evening primrose

Table 3-1 (Continued)

Scientific Name	Common Name
<i>Onoclea sensibilis</i>	Sensitive fern
<i>Osmunda cinnamomea</i>	Cinnamon fern
<i>Osmunda claytoniana</i>	Interrupted fern
<i>Osmunda regalis</i>	Royal fern
<i>Oxalis acetosella</i>	Wood-sorrel
<i>Oxalis stricta</i>	Yellow wood-sorrel
<i>Parthenocissus vitacea</i>	Virginia creeper
<i>Penthorum sedoides</i>	Ditch stonecrop
<i>Phalaris arundinacea</i>	Reed canary grass
<i>Picea glauca</i>	White spruce
<i>Pilea fontana</i>	Clearweed
<i>Platanthera psychodes</i>	Purple fringed orchid
<i>Poa palustris</i>	Fowl meadow grass
<i>Polygonum hydropiper</i>	Smartweed
<i>Polygonum lapathifolium</i>	Pale smartweed
<i>Polygonum natans</i>	Water smartweed
<i>Polygonum pennsylvanicum</i>	Smartweed
<i>Polygonum persicaria</i>	Lady's thumb
<i>Polygonum punctatum</i>	Smartweed
<i>Polygonum sagittatum</i>	Smartweed
<i>Pontederia cordata</i>	Pickrel weed
<i>Populus balsamifera</i>	Balsam poplar
<i>Potamogeton amplifolius</i>	Pondweed
<i>Potamogeton epihydrus</i>	Pondweed
<i>Potamogeton natans</i>	Pondweed
<i>Potamogeton nodosus</i>	Pondweed
<i>Potamogeton richardsonii</i>	Pondweed
<i>Potamogeton spirillus</i>	Pondweed
<i>Potamogeton zosteriformis</i>	Pondweed

Table 3-1 (Continued)

Scientific Name	Common Name
<i>Potentilla palustris</i>	Marsh cinquefoil
<i>Prunus virginiana</i>	Choke cherry
<i>Pyrola asarifolia</i>	Pink pyrola
<i>Ranunculus longirostris</i>	White water crowfoot
<i>Ranunculus pensylvanicus</i>	Bristly crowfoot
<i>Ranunculus recurvatus</i>	Hooked buttercup
<i>Rorippa islandica</i>	Yellow cress
<i>Rubus pubescens</i>	Dwarf red blackberry
<i>Rubus strigosus</i>	Raspberry
<i>Rudbeckia laciniata</i>	Green-headed coneflower
<i>Rumex obtusifolius</i>	Bitter dock
<i>Sagittaria latifolia</i>	Arrowhead
<i>Sagittaria rigida</i>	Arrowhead
<i>Salix bebbiana</i>	Bebb's willow
<i>Salix discolor</i>	Pussy willow
<i>Salix fragilis</i>	Crack willow
<i>Salix lucida</i>	Shining willow
<i>Sambucus canadensis</i>	Common elderberry
<i>Scirpus cyperinus</i>	Wool grass
<i>Scirpus validus</i>	Soft stem bulrush
<i>Scutellaria galericulata</i>	Skullcap
<i>Scutellaria lateriflora</i>	Mad-dog skullcap
<i>Sium suave</i>	Water-parsnip
<i>Smilax tamnoides</i>	Bristly greenbrier
<i>Sparganium americanum</i>	Bur-reed
<i>Sparganium angustifolium</i>	Bur-reed
<i>Sparganium chlorocarpum</i>	Bur-reed
<i>Sparganium eurycarpum</i>	Bur-reed
<i>Sparganium fluctuans</i>	Bur-reed

Table 3-1 (Continued)

Scientific Name	Common Name
<i>Sparganium sp (emergent)</i>	Bur-reed
<i>Spiraea alba</i>	Meadowsweet
<i>Spirodela polyrhiza</i>	Greater duckweed
<i>Stachys palustris</i>	Hedge-nettle
<i>Thalictrum dasycarpum</i>	Purple meadow-rue
<i>Thelypteris palustris</i>	Marsh fern
<i>Thuja occidentalis</i>	Northern white cedar
<i>Toxicodendron radicans</i>	Poison ivy
<i>Triadenum fraseri</i>	Bog St. John's-wort
<i>Trientalis borealis</i>	Star flower
<i>Typha latifolia</i>	Broad-leaved cattail
<i>Ulmus americana</i>	American elm
<i>Urtica dioica</i>	Stinging nettle
<i>Utricularia vulgaris</i>	Greater bladderwort
<i>Verbena hastata</i>	Blue vervain
<i>Viburnum lentago</i>	Nannyberry
<i>Viburnum opulus</i>	Highbush cranberry
<i>Viola spp.</i>	Violet
<i>Zizania aquatica</i>	Wild rice

Prepared by: GF
Checked by: BDH

3.2.2 Shoreline Vegetation

The zone of emergent vegetation in the shallow water at the edge of the river was very narrow in the upper area near the dam. Occasional small stands of *Scirpus validus* were noted as well as scattered small populations of *Juncus effusus*, *Sagittaria latifolia* and *Sparganium eurycarpum*. Farther downstream, beginning at about Menard Island, stands of these species were also noted on sand bars and shoals within the river. *Scirpus validus* and *Leersia oryzoides* were especially prominent there, sometimes with *Pontederia cordata* and *Sagittaria rigida*.

Muddy edges just out of the water supported small populations of common wetland species including *Bidens* spp., *Callitriche verna*, *Cardamine pennsylvanica*, *Eleocharis erythropoda*, *Eleocharis obtusa*, and *Polygonum* spp. Some similar muddy wet areas are found along small springs which drain into the river, often associated with adjacent wet forests. These sites are often on dark, mucky soil and typical species include *Impatiens biflora*, *Lycopus uniflorus*, *Scutellaria lateriflora*, *S. galericulata*, *Polygonum sagittatum*, *Mimulus ringens*, *Glyceria striata*, and *Epilobium ciliatum*.

In the broad, slow portion of the river near Highway A there is a wide marshy area along the shoreline which has some boggy characteristics including a more or less floating mat near its outer edge and some additional species such as *Triadenum fraseri*, *Calla palustris*, *Dulichium arundinacea* and *Dryopteris cristata*.

Any wetland vegetation beyond the immediate edge of the river is usually in the form of a mixed, open forest of trees and shrubs with frequent openings in the canopy and underlain by robust herbaceous species. Common trees and shrubs include *Alnus rugosa*, *Acer saccharinum*, *Betula papyrifera*, *Fraxinus pennsylvanica*, *Ilex verticillata*, *Ulmus americana*, and *Salix* spp. Less common species include *Betula alleghaniensis*, *Acer rubrum*, *Fraxinus nigra*, *Viburnum lentago*, *Acer spicatum*, *Sambucus canadensis*, *Viburnum opulus*, and rarely *Abies balsamea* and *Populus balsamifera*. In a few places there are small stands of *Thuja occidentalis*. They were often at least several feet above the current river water level and were obviously fed by springs emerging from adjacent slopes. *Acer negundo* was prominent only near the Hat Rapids Dam. *Cornus stolonifera*, often a prominent wetland species, was relatively rare in this study area.

Grasses and sedges are often prominent in the ground layer of these swamps with *Calamagrostis canadensis* the most prominent species. Other species include the sedges *Carex stricta*, *Carex lacustris*, *Carex crinita* and *Scirpus cyperinus*, robust forbs including *Eupatorium maculatum*, *Asclepias incarnata*, *Rumex obtusifolius*, *Thalictrum dasycarpum*, *Urtica dioica* and *Helenium autumnale* and Pteridophytes such as *Equisetum arvense*, *Osmunda regalis* and *Matteuccia struthiopteris*.

3.3 Ecological Significance of Findings

No endangered or threatened vascular plant species were previously known to exist within the area of the study, and none were found during the study. The special concern species, *Epilobium palustre* (marsh willow-herb) had been reported from within the area of T36N R8E, but was not encountered in this survey, although the similar *E. leptophyllum* was found in the boggy marsh near Highway A.

Concerns for rare plants might focus on two types of changes in the river, water volume (as it affects depth or current) and physical changes in the water. Because the proposed discharge will not significantly affect the volume of water within the Wisconsin River, the effects on rare plant species could involve changes in quality of the river water. The wetlands immediately adjacent to the river are generally small and appear to depend primarily on water from springs and surface runoff. Therefore the exchange of water is likely to be primarily from the wetlands to the river and it is very unlikely that any potential changes in river water composition would have an effect on the plants in most of the adjacent wetlands. Aquatic species within the river water would, of course, be susceptible to any changes in the water composition, but no rare species were found within the river. No unique or remarkable habitats were encountered which are likely to harbor rare species, although the possibility of unexpected occurrences cannot be ruled out.

4 References

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Appendix A

Regulatory Agency Correspondence

- **May 28, 1996 Work Plan for Wisconsin River Discharge Aquatic Investigation**
- **August 5, 1996 Letter from Don Moe, CMC to Bill Tans, WDNR, Re: Crandon Project - Threatened & Endangered Species Investigation, Wisconsin River Below Hat Rapids Dam, Supplementary Work Plan**



Crandon Mining Company

7 N. BROWN ST., 3RD FLOOR
RHINELANDER, WI 54501-3161

May 28, 1996

Mr. Bill Tans
Wisconsin Department of Natural Resources
101 South Webster Street
P.O. Box 7921
Madison, WI 53707-7921

Dear Mr. Tans:

Re: Crandon Project - Threatened and Endangered Species Investigation
Wisconsin River Below Hat Rapids Dam

Enclosed is the work plan for an investigation of the Wisconsin River below the Hat Rapids Dam. It is submitted to the Wisconsin Department of Natural Resources (WDNR) in response to Comment 172, page 8 of the WDNR's May 3, 1996 EIR comment letter.

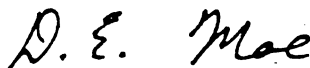
The work plan has been developed based on the following:

1. The proposed discharge will be secured to the existing dam structure and will not disturb the stream bed above or below the dam. Therefore, sampling above the dam is not required.
2. The proposed discharge will have effluent limitations selected specifically for the Wisconsin River at the Hat Rapids Dam to protect the most sensitive species.
3. The purpose of conducting this survey is specifically related to determining the presence of aquatic species of mussels and macroinvertebrates below Hat Rapids Dam that may have threatened or endangered status in Wisconsin or are listed as being of Special Concern by the WDNR.
4. Previous fish inventories of the area, according to WDNR personnel, are sufficient for purposes of environmental review and for permitting activities.

Schedule is very import because spring sampling should begin in early June this year. Crandon Mining Company is prepared to start this work immediately upon approval of the WDNR. Therefore, we ask you to respond as quickly as possible so the information you requested can be provided in a timeframe consistent with your schedule to produce a draft EIS.

If you have any questions regarding this submittal, please call me at (715) 365-1450.

Sincerely,



Don Moe
Technical/Permitting Manager
Crandon Mining Company



Mr. Bill Tans
Wisconsin Department of Natural Resources
May 28, 1996
Page 2

Enclosure

cc: Mr. Archie Wilson, Wisconsin Department of Natural Resources
Mr. Larry Lynch, Wisconsin Department of Natural Resources
Mr. Dave Heath, Wisconsin Department of Natural Resources
Mr. Bill Smith, Wisconsin Department of Natural Resources
Mr. John Pohlman, Wisconsin Department of Natural Resources
Mr. Robert Jaeger, U.S. Department of the Interior
Mr. Philip Shopodock, Forest County Potawatomi
Mr. Arlyn Ackley, Sokaogon Chippewa Community
Mr. John Teller, Menominee Indian Tribe of Wisconsin
Ms. M. Catherine Condon, Greene, Meyer & McElroy
Mr. Dan Cozza, U.S. Environmental Protection Agency
Mr. Dave Ballman, U.S. Army Corps of Engineers
Mr. Jerry Sevvick, Foth & Van Dyke
Mr. Tim Weyenberg, Foth & Van Dyke
Mr. Bill West, Environmental Compliance Consultants, Inc.

Crandon Project Work Plan for Wisconsin River Discharge Aquatic Investigations

1 Introduction

Beginning in 1993 and continuing in 1994, Crandon Project aquatic investigations included a search for threatened, endangered, or listed species. These investigations targeted species which, based on habitat availability, past records, or National Heritage Inventory lists were possible candidates to be located in the project area. A discussion of findings relating to these species, and the potential impacts to these species was included in the May 1995 Crandon Project Environmental Impact Report (EIR).

In 1995 the focus of the discharge point for treated waters from the Crandon Project was changed from a Swamp Creek discharge to the Wisconsin River. The proposed discharge point on the Wisconsin River is at the Hat Rapids Dam some three to four miles downstream of the City of Rhineland.

The Wisconsin Department of Natural Resources (WDNR) has reviewed certain aspects of the EIR relative to the aquatic investigations that were conducted for the Swamp Creek discharge. It has been suggested that a similar investigation be conducted for the Wisconsin River discharge. Specifically, as part of its May 3, 1996 letter the WDNR has that requested additional information relative to mussels and aquatic macroinvertebrates be collected for the proposed Wisconsin River discharge.

On May 20, 1996 Tim Weyenberg (Foth & Van Dyke) and Bill West [Environmental Compliance Consultants, Inc., (ECCI)], met with Dave Heath and Bill Smith (WDNR) to discuss the proposed Wisconsin River discharge location and conduct a site reconnaissance of the river. During the meeting, target areas for the aquatic investigations were discussed. In general, the area of investigation was identified as a section of the Wisconsin River below the Hat Rapids Dam downstream to and including the Menard Island environs (Figure 1). Menard Island is at the location of the confluence of Trout Creek with the Wisconsin River.

The following work plan has been developed to address the concerns of the WDNR with respect to the flora and fauna of the Wisconsin River. The proposed aquatic investigations are to focus on mussels and macroinvertebrates including Odonata. Other investigations which may be conducted include a single aquatic plant collection effort during low flow. Table 1 identifies times when collections are likely to occur.

2 Macroinvertebrates

2.1 Objective and Species List

The objective of the macroinvertebrate work is to determine the presence and/or status of macroinvertebrate species listed on the Wisconsin Heritage Inventory List of threatened and endangered species. Dragonflies (Odonata) are separated from the other invertebrate species in this work plan because distinct methods are proposed for this group.

Table 2 contains a target species working list organized by the preferred general collection technique. However, any of the techniques are suitable for the collection of each of the listed species. Species which may be collected equally well by more than one technique are listed within several of the categories listed in the table. During the general macroinvertebrate collection time periods, it is assumed that resident Odonata specimens will also be collected.

2.2 Methods for Odonata Collection

The field investigators will employ three techniques for collecting Odonata, including collection of exuviae from shoreline habitats, observation and collection of adult specimens, and instream sampling. Depending on the species of Odonata, one collection technique may be more suited than the other for obtaining information on potential species. For instance, the gomphid dragonflies will be most easily sampled by the collection of exuviae. The exuviae is a casing of a dragonfly which is left behind when the dragonfly emerges as an adult. Exuviae can be found along the banks of streams and lakes and on vegetation or other objects immediately after adults have emerged from the water body. Because of their relative size, members of the genus *Somatochlora* are best surveyed as adults.

In general, all larval Odonata may be collected using instream sampling techniques in either the fall or early spring while most species are in the late instars or at pre-emergence stages. It should be noted that instream sampling techniques may underestimate the numbers of organisms present and may miss some populations altogether. The collection of exuviae is a good technique for obtaining specimens which are uncommon or rare in an area and for determining relative species abundance.

Sites for sampling will be located on the Wisconsin River in the following areas; the tailrace of the Hat Rapids Dam, an access point in the vicinity of what is known as Camp Ten, and in the vicinity of Menard Island. All sites are downstream of the Hat Rapids Dam, the location of the proposed discharge site. Refer to Figure 1 for locations of sampling sites.

It is proposed to collect exuviae in the spring/early summer when adults have recently emerged. A field reconnaissance may be required to determine the specific timing of the emergence. Typically in northern Wisconsin, emergence will occur in late May or the first two weeks of June for the gomphids, although one gomphid (*Stylurus scudderi*) does not emerge until the second week of July. Because of the prolonged winter (1995/1996) and the late ice out period, the emergence window may be extended longer into June. Depending on exuviae abundance, 150 to

300 foot segments of river will be searched intensely. Both sides of the river will be searched. All specimens observed within a collection area will be included in the collection.

The reporting of exuviae will be qualitative. Where practical, attempts will be made to quantify species. Collections will be directed by Bill West with species verification completed by Dr. Ken Tennessen of the Tennessee Valley Authority (TVA), Florence, Alabama.

Dragonfly nymphs will be collected using instream techniques in the spring of the year (1996) prior to emergence. Kick seine sampling techniques will be used for collection of nymphs. Surber samplers, drift nets, and sweep nets may also be used if it is deemed that the site conditions suggest that these techniques are appropriate.

2.3 General Macroinvertebrate Collections

Aquatic macroinvertebrates other than Odonata included on the target list (Table 2) may be encountered in the project area. A search for these species will be conducted in spring 1996. Areas which will be targeted for field investigation include the area immediately downstream of the Hat Rapids Dam, the area in the vicinity of Camp Ten, and the area of Menard Island. These areas are identified on Figure 1. Qualitative instream sampling efforts will include the use of dip nets to hand pick a section of river selected from the general areas depicted on Figure 1 to represent a cross section of all available microhabitats in the river (i.e., pools, riffles, detrital masses in slackwater, cut banks with overhanging cover, snags, and various bottom types). Each micro-habitat will be sampled by a biologist hand picking for no less than one hour, or until a five minute period produces no new species, whichever is the longest. Some organisms such as the nymphs of Ephemeroptera and Plecoptera as well as the larvae of Trichoptera and Coleoptera generally cannot be identified to species. Therefore, sampling for adults using UV light traps and sweep netting will be conducted during the specific known flight seasons of the target species.

In addition, a riffle area in each site will be sampled using a surber sampler. Triplicate samples will be taken at each site. Pools with soft bottom substrates will be sampled using an Ekman dredge for collection of infaunal forms. Triplicate samples will be taken at each location. Samples will be washed through a surber net (mesh size 600 -800) and preserved in formalin. Sampling locations for the general macroinvertebrate collections and Odonata nymphs will be the same as those described for the exuviae collections. Dr. Tennessen will provide specimen verification.

2.4 Disposition of Specimens

Nymphs, larvae, or adults (live specimens) of listed species will be identified in the field, recorded, and released. Only voucher specimens will be retained for documentation. Voucher specimens of live organisms as well as exuviae of Odonata will be identified by Dr. Ken Tennessen and saved and deposited per requirements of the WDNR scientific collector's permit. All work to be conducted under this work plan will be authorized by a current threatened and

endangered species collectors permit issued by the WDNR. Disposition of specimens will be carried out as directed by the permit.

2.5 Personnel

The Odonata exuviae and general macroinvertebrate work will be led by Bill West. Adult Odonata field collection and general macroinvertebrate, Odonata exuviae and adult identification will be conducted by Dr. Ken Tennessen with assistance by Bill West.

2.6 Quality Assurance

Following preliminary taxonomic identification, vouchers will be provided to the WDNR for verification. Specific collection schedules will be provided to the WDNR as early as possible prior to the proposed initiation of an individual work plan. The WDNR is encouraged to allow their representatives to participate in the sampling effort as their time permits.

3 Mussels

3.1 Objective and Species List

The objective of the mussel work is to determine the occurrence or non-occurrence and status of listed threatened and endangered mussels or those listed as special concern species on the Wisconsin Heritage Inventory. Specific species targeted in the proposed study are listed in Table 3. This list represents the best and current information available at the time this plan was prepared.

3.2 Methods for Mussel Collection

Collection efforts will concentrate on the Wisconsin River below the Hat Rapids Dam. The proposed discharge is to be located at the upstream side of the dam at the turbine intake. Therefore, any potential impacts from the discharge may only be observed on the downstream side of the dam. It is anticipated that the investigation for mussels will include three specific locations representative of the riverine habitat below Hat Rapids Dam (Figure 1). At each location one bed of mussels will be located and sampled. More beds may be added if specific habitat is identified which may accommodate a listed species or if the specific habitat of a listed species falls outside of the target area.

In shallow waters, the search team will use snorkel equipment to locate mussels. This method may be aided with a water telescope. If deeper water is encountered such as pools, divers will be required. A site reconnaissance prior to completion of the work plan, with WDNR personnel, was completed to discuss target species, locate possible collection sites, identify previous work which may have been completed in this section of the river, and to determine the need for a diving crew.

As noted above, a minimum of three beds of mussels will be evaluated. A "bed" of mussels may consist of an area of several feet in length or, depending on substrate and other conditions, 300 feet or more in length. If defined beds are located, collectors will randomly pick 20 mussels and place them in a mesh bag or several mesh bags. The mesh bags will be brought to shore, remaining submerged, where a taxonomist will identify the mussels. Collectors will repeat this procedure picking 20 mussels at a time until no new species are found for six replicate picking efforts. If insufficient mussels are encountered within a bed to accomplish this protocol, then the collectors will continue to search for four hours in lieu of completing the six replicate collections.

The search for the salamander mussel will involve looking under large, flat rocks including those greater than 12 inches in diameter where such stream conditions occur.

In addition to general reconnaissance and hand picking techniques described above, bank searches will also be conducted. Field technicians will walk designated sections of the river looking for shells which may lie in the shallows or which other animals may have left along the bank. Shells may also be found during other aquatic investigations. These findings will be documented and will supplement the instream picking technique.

3.3 Disposition of Specimens

Live specimens of mussels which have been identified will be returned to the approximate location of their finding and replaced with proper alignment to substrate and flow. Voucher specimens will be retained per requirements of a Wisconsin Department of Natural Resources collector's permit.

3.4 Personnel

The mussel investigation will be carried out by Don Helms of Helms & Associates, Bellevue, Iowa. He will be assisted when required by a team of divers or by aquatic field technicians. Taxonomic identification and field reports will be provided by Don Helms. Mussel collection will be conducted in the summer of 1996 pending approval of this work plan.

3.5 Quality Assurance

Following preliminary taxonomic identification, species verification will be completed by the WDNR. Specific collection schedules will be provided to the WDNR one month prior to the proposed initiation of an individual work plan.

4 Plant Identification

A single day float trip will be conducted in the area of the Wisconsin River from the Hat Rapids Dam to Menard Island. The purpose of the trip will be to identify plant species which may appear on the list of target species. The float trip will be scheduled during the low flow period of July or August. The aquatic plant search team will be led by Brad Helmandollar of Foth & Van Dyke with assistance by an aquatic botanist. Voucher specimens of listed species will be provided to the WDNR for verification.

Table 1
Proposed Aquatic Investigation Schedule
Wisconsin River Discharge 1996

Activity				
Macroinvertebrate				
Odonata exuviae				
Adult Odonata				
Light Trap				
Mussels				
Plants				
	May	June	July	August

Prepared by: WMW
Checked by: TJW

Table 2
Targeted Macroinvertebrate Species

Target Species	Common Name	Wisconsin Status
A. Exuviae Collection Technique		
<i>Gomphus graslinellus</i>	Pronghorned clubtail	Special Concern
<i>Gomphus lineatifrons</i>	Splendid clubtail	Special Concern
<i>Gomphus quadricolor</i>	Rapids clubtail	Special Concern
<i>Gomphus ventricosus</i>	Skillet clubtail	Special Concern
<i>Gomphus viridifrons</i>	Green-faced clubtail	Special Concern
<i>Ophiogomphus aspersus</i>	Brook snaketail	Special Concern
<i>Ophiogomphus carolus</i>	Rifle snaketail	Special Concern
<i>Ophiogomphus anomalus</i>	Extra-striped snaketail	Endangered
<i>Ophiogomphus howei</i>	Pygmy snaketail	Endangered
<i>Stylurus amnicola</i>	Riverine clubtail	Special Concern
<i>Stylurus scudderi</i>	Zebra clubtail	Special Concern
B. Observation of Adult Odonata Specimens		
<i>Aeshna clepsydra</i>	Mottled darner	Special Concern
<i>Aeshna eremita</i>	Lake darner	Special Concern
<i>Aeshna tuberculifera</i>	Black-tipped darner	Special Concern
<i>Aeshna verticalis</i>	Green-striped darner	Special Concern
<i>Coenagrion interrogatum</i>	Subarctic bluet	Special Concern
<i>Cordulegaster obliqua</i>	Arrowhead spiketail	Special Concern
<i>Gomphaeschna fucillata</i>	Harlequin darner	Special Concern
<i>Libellula incesta</i>	Slaty skimmer	Special Concern
<i>Nannothemis bella</i>	Elfin skimmer	Special Concern
<i>Nasiaeschna pentacantha</i>	Cyrano darner	Special Concern

Table 2 (Continued)

Target Species	Common Name	Wisconsin Status
<i>Somatochlora forcipata</i>	Forcipate emerald	Special Concern
<i>Somatochlora franklini</i>	Delicate emerald	Special Concern
<i>Somatochlora incurvata</i>	Warpaint emerald	Special Concern
<i>Somatochlora kennedyi</i>	Kennedy's emerald	Special Concern
<i>Somatochlora tenebrosa</i>	Clamp-tipped emerald	Special Concern
<i>Sympetrum danae</i>	Black meadowhawk	Special Concern
<i>Williamsonia fletcheri</i>	Ebony bog hunter	Special Concern
C. Instream Sampling for Odonata Nymphs		
<i>Cordulegaster diastatops</i>	Delta-spotted spiketail	Special Concern
<i>Cordulegaster obliqua</i>	Arrowhead spiketail	Special Concern
<i>Naiaeschna pentacantha</i>	Cyrano darner	Special Concern
<i>Neurocodulia yamaskanensis</i>	Stygian shadowfly	Special Concern
<i>Ophiohomphus aspersus</i>	Brook snaketail	Special Concern
<i>Stylogomphus albistylus</i>	Least clubtail	Special Concern
D. Instream Collection of Non-Odonata Macroinvertebrates		
<i>Acanthametropus pecatonica</i>	Pecatonica river mayfly	Endangered
<i>Anepeorus simplex</i>	A flat-headed mayfly	Endangered
<i>Attaneuria ruralis</i>	A stonefly	Special Concern
<i>Dolania americana</i>	American sand burying mayfly	Special Concern
<i>Homoeoneuria ammophila</i>	A mayfly	Special Concern
<i>Hydroperla crosbyi</i>	A stonefly	Special Concern
<i>Lepidostoma libum</i>	A bizarre caddisfly	Special Concern
<i>Lepidostoma vernale</i>	A bizarre caddisfly	Special Concern

Table 2 (Continued)

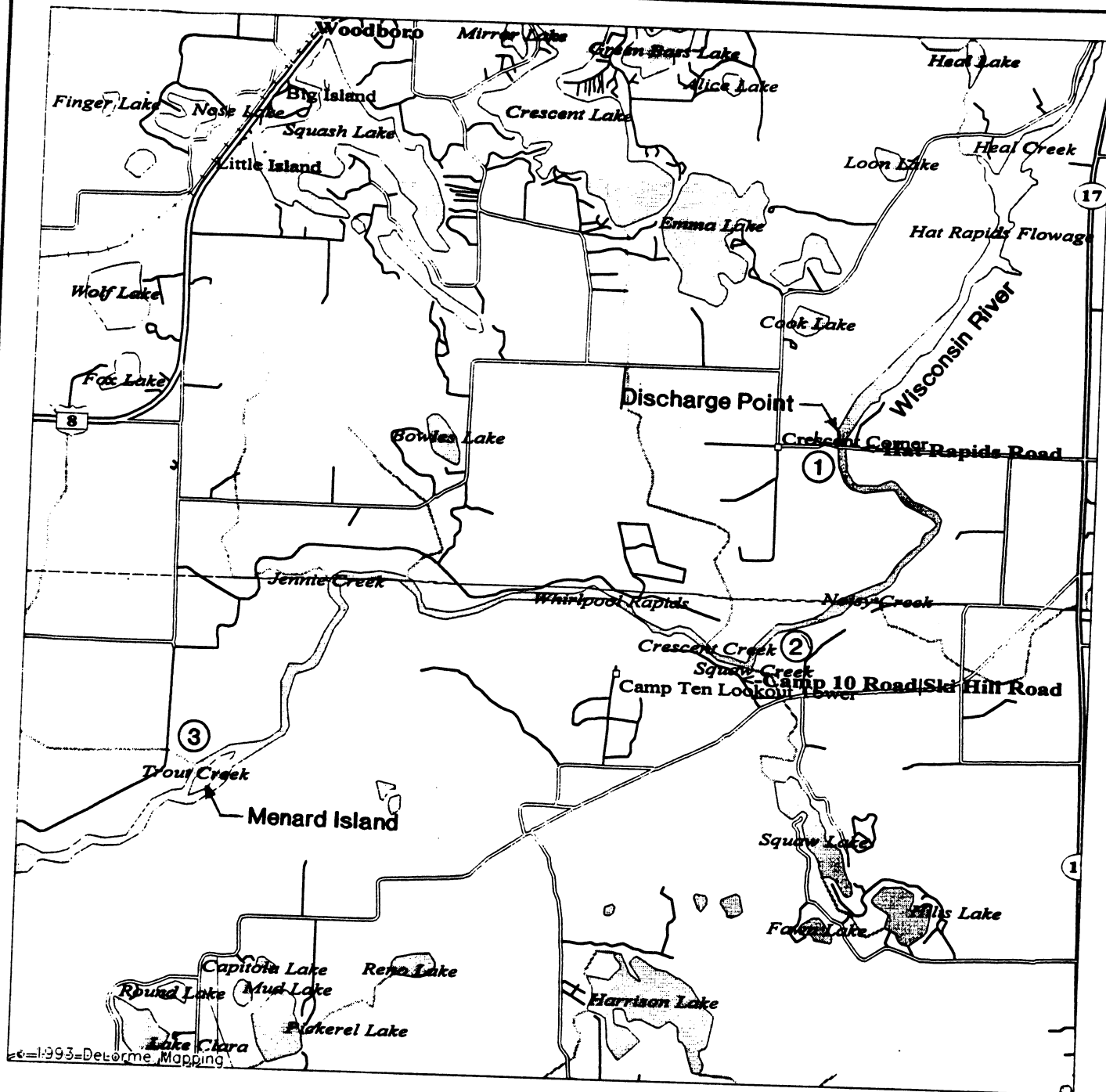
Target Species	Common Name	Wisconsin Status
<i>Macdunnoa persimplex</i>	A mayfly	Special Concern
<i>Paracloeodes minutus</i>	A small mayfly	Special Concern
<i>Soyedina vallicularia</i>	A stonefly	Special Concern
<i>Stenelmus douglasensis</i>	Douglas riffle beetle	Special Concern
<i>Stenelmus knobeli</i>	Knobel's riffle beetle	Endangered
<i>Triaenodes dipsius</i>	A long-horned casemaker caddisfly	Special Concern
<i>Zealeuctra narfi</i>	A rolled-winged winter stonefly	Special Concern

Prepared by: WMW
Checked by: TJW

Table 3
Targeted Mussel Species

Target Species	Common Name	Wisconsin Status
<i>Alasmidonta marginata</i>	Elktoe	Special Concern
<i>Alasmidonta viridis</i>	Slippershell	Threatened
<i>Anodonta cataracta cataracta</i>	Eastern floater	Special Concern
<i>Cyclonaias tuberculata</i>	Purple wartyback	Endangered
<i>Elliptio complanata</i>	Atlantic elliptio	Special Concern
<i>Epioblasma triquetra</i>	Snuffbox	Endangered
<i>Lasmigona compressa</i>	Creek heelsplitter	Special Concern
<i>Leptodea leptodon</i>	Scaleshell	Special Concern
<i>Plethobasus cyphus</i>	Bullhead	Endangered
<i>Pleurobema sintoxia</i>	Round pigtoe	Special Concern
<i>Quadrula fragosa</i>	Winged mapleleaf	Endangered
<i>Quadrula metanerva</i>	Monkeyface	Threatened
<i>Simpsonaias ambigua</i>	Salamander mussel	Threatened
<i>Tritogonia verrucosa</i>	Buckhorn	Threatened
<i>Venustaconcha ellipsiformis</i>	Ellipse	Threatened

Prepared by: WMW
Checked by: TJW



LEGEND

- Geo Feature
- County Boundary
- Street, Road
- == Major Street/Road
- == US Highway
- +++ Railroad
- River
- Open Water
- Utility (powerline)
- ① Sampling Location

Foth & Van Dyke				
REVISED	DATE	BY	DESCRIPTION	
CHECKED BY:		JKS	DATE:	MAY '96
APPROVED BY:		TJW	DATE:	MAY '96
APPROVED BY:		GWS	DATE:	MAY '96

 Crandon Mining Company	
FIGURE 1 WISCONSIN RIVER AQUATIC SAMPLING LOCATIONS	
Scale: 0 0.5 1.0 MILE	Date: MAY, 1996
Prepared By: Foth & Van Dyke	By: JOW



Crandon Mining Company

7 N. BROWN ST., 3RD FLOOR
RHINELANDER, WI 54501-3161

August 5, 1996

Mr. Bill Tans
Wisconsin Department of Natural Resources
Bureau of Environmental Analysis and Review
101 South Webster Street
P.O. Box 7921
Madison, WI 53707-7921

Dear Mr. Tans:

Re: Crandon Project - Threatened & Endangered Species Investigation
Wisconsin River Below Hat Rapids Dam
Supplementary Work Plan

Based on an evaluation of the available biological information for the Wisconsin River below Hat Rapids Dam, Crandon Mining Company (CMC) is aware that the Wisconsin Department of Natural Resources (WDNR) has an on-going fish inventory program for this section of the river. The WDNR's survey is focused on developing information on the status of the fish community from Hat Rapids Dam to Menard Isle, with most of the effort dealing with larger game and forage species.

CMC is proposing to supplement the WDNR's on-going program by conducting an intensive survey (up to 10 hours of field time) using shocking and seining techniques to provide additional data on the occurrence of species listed on the Wisconsin Heritage Inventory List that may not have a high likelihood of being encountered using the WDNR's sampling methods. This work will be accomplished in late summer of this year (1996) to coincide with the annual summer low flow period. Sampling will be accomplished in locations of this stretch of the river best representing habitat associated with the target species. E.A. Engineering Associates, Inc. will be the lead investigator for this study effort. CMC believes this work to be sufficient for purposes of environmental review as stated in a letter to you dated May 28, 1996, for these groups of fish.

The purpose of this letter is to inform the WDNR of the supplemental sampling and to request your acceptance of this addition to CMC's approved work plan.

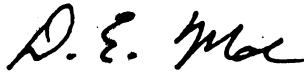
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Mr. Bill Tans
Wisconsin Department of Natural Resources
August 5, 1996
Page 2

If you have any questions, please call me at (715) 365-1450.

Sincerely,



Don Moe
Technical/Permitting Manager
Crandon Mining Company

DM:mld2

cc: Mr. Archie Wilson, Wisconsin Department of Natural Resources
Mr. Larry Lynch, Wisconsin Department of Natural Resources
Mr. Robert Jaeger, U.S. Department of the Interior
Mr. Philip Shopodock, Forest County Potawatomi
Mr. Arlyn Ackley, Sokaogon Chippewa Community
Mr. John Teller, Menominee Indian Tribe of Wisconsin
Ms. M. Catherine Condon, Greene, Meyer & McElroy
Mr. Dan Cozza, U.S. Environmental Protection Agency
Mr. Dave Ballman, U.S. Army Corps of Engineers
Mr. Jerry Seveck, Foth & Van Dyke
Mr. Tim Weyenberg, Foth & Van Dyke

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