APPENDIX E-29 2021 Saxon Falls and Superior Falls Fisheries Study Report

Report

FOR

MONTREAL RIVER
Saxon Falls Hydroelectric Project (FERC Project No. 2610)
and
Superior Falls Hydroelectric Project (FERC Project No. 2587)

WORK SCOPE 4SS:
Fisheries Study

Prepared for:

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November 23, 2021

1.0 BACKGROUND

Northern States Power Company – Wisconsin (NSPW or Licensee), d/b/a Xcel Energy, currently holds licenses issued by the Federal Energy Regulatory Commission (FERC or Commission) to operate and maintain the Saxon Falls and Superior Falls Hydroelectric Projects (Project or Projects). The Projects are owned, operated, and maintained by the Licensee. The current licenses, which designate the Projects as FERC Nos. 2610 and 2587 respectively, expire on December 31, 2024. To obtain a new license, the Licensee must submit a final license application to FERC no later than December 31, 2022. The final license application, in part, must include an evaluation of the existing fishery associated with the Projects. On April 9, 2020, the Licensee held a Joint Agency Meeting to present information about the Projects. At the meeting, and during the 60-day comment period immediately following, the Licensee received comments and study requests from several entities. Michigan Department of Natural Resources (MDNR), River Alliance of Wisconsin (RAW), and Wisconsin Department of Natural Resources (WDNR) requested that fisheries studies be completed at each Project.

- MDNR requested that the Licensee document aquatic resources present in the reservoir and tailwaters, following standardized fisheries methods for stream fishery resources and impoundment fishery resources.

- WDNR requested that the Licensee conduct a fisheries study to define the diversity and abundance of the fish community within the Projects. WDNR requested that Seasonal Catch per unit effort (CPUE) surveys be conducted in the spring, summer, and fall to quantify fish population relative abundance and summary report to document the species available to recreational fishers and general fish community composition. The request included one night of shoreline electrofishing during each season along the entire shoreline of the reservoir.

- RAW recommended that fish community information be updated to include data on species composition and frequency of abundance.

2.0 STUDY AREA

2.1 Superior Falls Project

The Superior Falls Project Dam is located on the Montreal River approximately 0.4 miles upstream of its confluence with Lake Superior in the town of Saxon, Iron County, Wisconsin and Ironwood Township, Gogebic County, Michigan. The Project is located approximately 14 miles northwest of the neighboring cities of Hurley, Wisconsin and Ironwood, Michigan and roughly 23 miles east of the city of Ashland, Wisconsin.

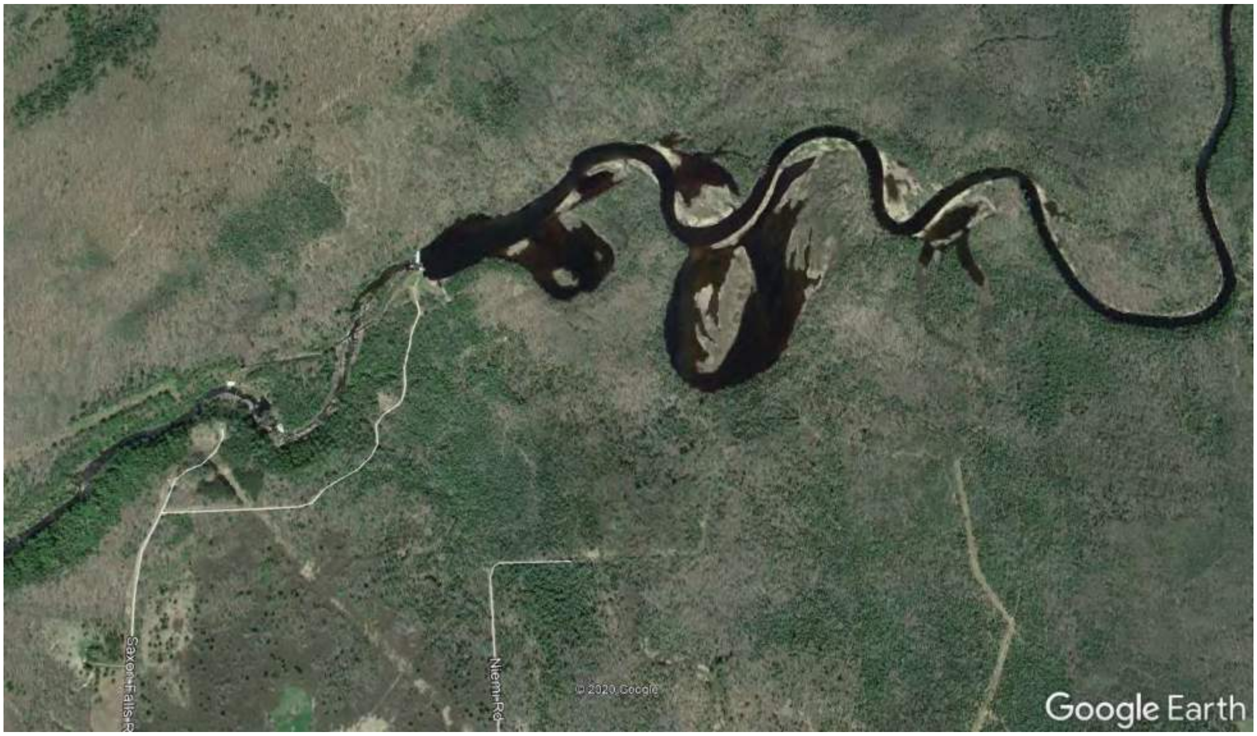
Figure 1. Superior Falls Study Area

Based on a 1991 survey, the Superior Falls Project reservoir encompasses approximately 16.9 acres with a storage capacity of 80.9 acre-feet at the maximum reservoir elevation of 740.0 feet. It has a maximum depth of 18 feet near the dam and an average depth of 4.8 feet (Northern States Power Company, 1991). The substrate consists of 55% sand, 22% gravel, 3% rock, and 20% muck (WDNR, 2019).

2.2 Saxon Falls Study Area

The Saxon Falls Project Dam is located on the Montreal River, 4.3 miles upstream of its confluence with Lake Superior in the town of Saxon, Iron County, Wisconsin and Ironwood Township, Gogebic County, Michigan. The Project is located 11 miles northwest of the neighboring cities of Hurley, Wisconsin and Ironwood, Michigan and roughly 25 miles east of the city of Ashland, Wisconsin.

Figure 2. Saxon Falls Study Area



The Saxon Falls Project reservoir encompasses approximately 69 acres with a storage capacity of about 550 acre-feet at the maximum reservoir elevation of 997.0 feet. It has a maximum depth of 12 feet and an estimated average depth of 8 feet. The substrate consists of 70% sand, 0% gravel, 0% rock, and 30% muck (WDNR, 2019).

3.0 Survey Methods

3.1 Electrofishing

Seasonal night time electrofishing surveys were conducted in spring (Late May), summer (late July), and fall (mid-October when water temperatures are between 55-70 F) at each Project reservoir. One night of shoreline electrofishing was conducted per season at each Project reservoir. Electrofishing was conducted via a 16-ft boat with a Pulsed DC-current set up. The electrofishing boat was controlled by a Smith-Root 5.0 GPP running to a boom-mounted shocking array and powered by a 5000-watt generator. Output was set at each site according to conditions but was generally at 60 pulses per second and power limited to produce 4-5 amps. Each Project location was sampled thoroughly. Time fished was recorded in seconds and distance of shoreline sampled was measured in meters for catch per unit effort (CPUE) calculation. CPUE is calculated as individuals captured per kilometer of shoreline.

3.2 Fish Processing

Collected fish were held in a live-well until the end of the transect when they were counted and identified to species. After enumeration fish were released approximately 300 meters upstream of capture to minimize the risk of recapture. When large fish were collected (muskellunge, northern pike, and walleye), sampling was suspended to reduce handling stress and mortality. The same procedure was followed when large numbers of white suckers and common shiners were captured. Fish were transported upstream 300 meters weighed, measured and released. Individual fish were measured to the nearest mm and weighed to the nearest gram. For small fish, individuals were batch weighed in order to register a valid weight on the scale.

4.0 Survey Results

The study area for fish sampling consisted of shoreline locations accessable by boat throughout each Project's reservoir. Due to lower water levels and increasing vegetation. The entire shoreline of each Project was not accessable by boat. Electrofishing was conducted along nearshore vegetation beds and accessable shoreline locations. Nearshore large woody debris was also targeted during the survey.

4.1 Fish Collection Superior Falls

GLEC field staff collected 1,954 individuals representing 20 species during the May, July, and October sampling events. Table 1 shows the total number of individuals relative abundance (%), and catch per unit effort (CPUE) of each species collected from the Superior Falls Project reservoir.

Table 1. Summary of Species Collected from the Superior Falls Hydroelectric Project (May, July, and October 2021).

Common Name	Scientific Name	Total Collected	Relative Abundance (%)[1]	CPUE Dist. (Km)
Muskellunge*	Esox masquinongy	1	0.05	0.17
Central Mudminnow	*Umbra limi*	15	0.77	2.55
Black Bullhead	*Ameiurus melas*	55	2.81	9.35
White Sucker	*Catostomus commersonii*	766	39.20	130.18
Longnose Dace	*Rhinichthys cataractae*	8	0.41	1.36
Western Blacknose Dace	*Rhinichthys obtusus*	10	0.51	1.70
Redside Dace	*Clinostomus elongatus*	3	0.15	0.51
Common Shiner	*Luxilus cornutus*	672	34.39	114.21
Blacknose Shiner	*Notropis heterolepis*	5	0.26	0.85
Creek Chub	*Semotilus atromaculatus*	71	3.63	12.07
Hornyhead Chub	*Nocomis biguttatus*	149	7.63	25.32
Rock Bass*	*Ambloplites rupestris*	97	4.96	16.49
Black Crappie*	*Pomoxis nigromaculatus*	4	0.20	0.68
Smallmouth Bass*	*Micropterus dolomieu*	4	0.20	0.68
Pumpkinseed*	*Lepomis gibbosus*	39	2.00	6.63
Yellow Perch*	*Perca flavescens*	10	0.51	1.70
Walleye*	*Sander vitreus*	1	0.05	0.17
Logperch	*Percina caprodes*	17	0.87	2.89
Johnny Darter	*Etheostoma nigrum*	24	1.23	4.08
Mottled Sculpin	*Cottus bairdii*	3	0.16	0.51
TOTAL NUMBER OF SPECIES		20		
TOTAL NUMBER OF INDIVIDUALS		1891		

1-Percent Total Fish Collected
*-Identified as Game Fish

White sucker (*Catostomus commersonii*) and common shiner (*Luxilus cornutus*) were the most abundant species collected and represent approximately 74% of all individuals captured at this project. Game fish potentially available to recreational anglers include Muskellunge (*Esox masquinongy*), rock bass (*Ambloplites rupestris*), black crappie (*Pomoxis nigromaculatus*), smallmouth bass (*Micropterus* dolomieu), pumpkinseed (*Lepomis gibbosus*), yellow perch (*Perca flavescens*), and walleye (*Sander vitreus*). Rockbass and pumpkinseed were the most abundant gamefish within the Superior Falls Project. Three redside dace (*Clinostomus elongatus*) individuals were collected upstream of the bridge crossing during the July sampling event. This area of the Superior Falls Project is more riverine with gravel riffles and gravel and clean sand runs. The Michigan Natural Features Inventory (MNFI) lists the redside dace as State Endangered. All three individuals were released successfully after recording the length and weights.

4.2 Fish Collection Saxon Falls

GLEC field staff collected 1,604 individuals representing 19 species during the May, July, and October sampling events. Table 1 shows the total number of individuals relative abundance (%), and catch per unit effort (CPUE) of each species collected from the Saxon Falls Project reservoir.

Table 2. Summary of Species Collected from the Saxon Falls Hydroelectric Project (May, July, and October 2021).

Common Name	Scientific Name	Total Collected	Relative Abundance (%)[1]	CPUE Dist. (Km)
Muskellunge*	*Esox masquinongy*	13	0.81	0.56
Northern Pike*	*Esox Lucius*	30	1.87	1.28
Central Mudminnow	*Umbra limi*	1	0.06	0.04
Brook Stickleback	*Culaea inconstans*	1	0.06	0.04
Black Bullhead	*Ameiurus melas*	403	25.12	17.24
White Sucker	*Catostomus commersonii*	156	9.73	6.67
Golden Shiner	*Notemigonus crysoleucas*	57	3.55	2.44
Common Shiner	*Luxilus cornutus*	153	9.54	6.55
Hornyhead Chub	*Nocomis biguttatus*	5	0.31	0.21
Rock Bass*	*Ambloplites rupestris*	74	4.61	3.17
Black Crappie*	*Pomoxis nigromaculatus*	62	3.87	2.65
Smallmouth Bass*	*Micropterus dolomieu*	3	0.19	0.13
Pumpkinseed*	*Lepomis gibbosus*	315	19.64	13.48
Bluegill*	*Lepomis macrochirus*	1	0.06	0.04
Yellow Perch*	*Perca flavecens*	282	17.58	12.07
Walleye*	*Sander vitreus*	22	1.37	0.94
Logperch	*Percina caprodes*	16	1.00	0.68
Johnny Darter	*Etheostoma nigrum*	9	0.56	0.39
Mottled Sculpin	*Cottus bairdii*	1	0.06	0.04
TOTAL NUMBER OF SPECIES		19		
TOTAL NUMBER OF INDIVIDUALS		1604		

1-Percent Total Fish Collected
*-Identified as Game Fish

Black bullhead (*Ameiurus melas*), pumpkinseed (*Lepomis gibbosus*), yellow perch (*Perca flavescens*), and white sucker (*Catostomus* commersonii) were the most abundant species collected and represent approximately 72% of all individuals captured at this project. Game fish potentially available to recreational anglers include Muskellunge (*Esox masquinongy*), northern pike (*Esox* lucius), rock bass (*Ambloplites rupestris*), black crappie (*Pomoxis nigromaculatus*), smallmouth bass (*Micropterus* dolomieu), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis* macrochirus), yellow perch (*Perca flavescens*), and walleye (*Sander vitreus*). Pumpkinseed, rockbass, and black crappie were the most abundant gamefish within the Saxon Falls Project. During the October sampling event, several muskellunge were collected with the largest measuring 1041 mm.

5.0 References

Wisconsin Department of Natural Resources. 2019. WDNR Fish Mapping Application. https://cida.usgs.gov/wdnr_fishmap/map/.

Michigan Natural Features Inventory. 2021. MNFI Species Descriptions. https://mnfi.anr.msu.edu/species/description/11307/clinostomus-elongatus .

Appendix A

Field Datasheets

FISH SURVEY RECORD

SUPERIOR FALLS

MPCA

Field Number: 1 → 2	Date (mm/dd/yy): 05/25/21
Stream Name:	County:
Location: SUPERIOR FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) **Right Bank** Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
550 m	1226	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKER	257-394	3740	10		
2. WHITE SUCKER	190-269	1020	8		
3. ROCK BASS	192	160	1		
4. ROCK BASS	85-145	172	6		
5. BLACK BULLHEAD	144/146	110	2		
6. PUMPKINSEED	77/82	25	2		
7. WHITE SUCKER	85-170	1250	76		
8. WESTERN BLACKNOSE DACE	76-80	20	3		
9. HORNY HEAD CHUB	160-60	335	21		
10. COMMON SHINER	57-116	108	35		
11. JOHNNY DARTER	45-55	10	3		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

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Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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FISH SURVEY RECORD

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Field Number: 3 → 4	Date (mm/dd/yy): 05/25/21
Stream Name:	County:
Location: SUPERIOR FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
510	1211	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKER	370-440	2020	3		
2. WHITE SUCKER	145-280	490	5		
3. WHITE SUCKER	94-122	370	26		
4. ~~WHITE SUCKER~~					
5. HORNY HEAD CHUB	93-126	110	7		
6. N. CREEK CHUB	50-173	145	9		
7. COMMON SHINER	50-155	175	15		
8. YELLOW PERCH	112	15	1		
9. HORNYHEAD CHUB	156	50	1		
10. BLACK BULLHEAD	146/168	160	2		
11. ROCK BASS	40-134	75	3		
12. MUDMINNOW	68-90	20	3		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

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Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

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FISH SURVEY RECORD

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Field Number: 5 → 6	Date (mm/dd/yy): 05/25/21
Stream Name:	County:
Location: SUPERIOR FALLS	Crew:

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m): 600	Time Fished (sec): 1353	Identified By: D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKER	260-450	4260	9		
2. WHITE SUCKER	187-221	420	4		
3. WHITESUCKER	45-66	1230	61		
4. COMMON SHINER	50-133	295	82		
5. HORNYHEAD CHUB	66-150	225	14		
6. N. CREEK CHUB	76-161	260	12		
7. ROCK BASS	88-148	195	6		
8. PUMPKINSEED	92/78	25	2		
9. MUDMINNOW	73-100	20	3		
10. LONGNOSED DACE	51-85	25	8		
11. BLACK BULLHEAD	86/95	30	2		
12. WESTERN BLACKNOSED DACE	45-64	5	5		
13. LOG PERCH	96	5	1		
14. JOHNNY DARTER	40-55	5	4		
15. BLACKNOSED SHINER	61/63	4	2		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

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Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

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FISH SURVEY RECORD

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Field Number: 7 → 8	Date (mm/dd/yy): 05/26/21
Stream Name:	County:
Location: SUPERIOR FALLS	Crew: D. JOHNS D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
400	870	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKER	410/432	1600	2		
2. WHITE SUCKER	95–150	260	24		
3. WHITE SUCKER	171–275	740	6		
4. JOHNNY DARTER	45/48	2	2		
5. N. CREEK CHUB	115/152	55	2		
6. HORNYHEAD CHUB	48–115	145	15		
7. ROCK BASS	45–144	185	9		
8. COMMON SHINER	57–116	120	45		
9. BLACKNOSED DACE	81/99	10	2		
10. HORNYHEAD CHUB	90	5	1		
11. COMMON SHINER	50/55	4	2		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

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Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

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FISH SURVEY RECORD

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Field Number: 9 → 10	Date (mm/dd/yy): 05/26/21
Stream Name:	County:
Location: SUPERIOR FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank START Mid-Channel CIRCLE Left Bank FINISH

Distance (m):	Time Fished (sec):	Identified By:
717	2171	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKER	322/300	770	2		
2. WHITE SUCKER	384/441	1770	2		
3. WHITE SUCKER	398/379	1420	2		
4. WHITE SUCKER	420	830	1		
5. WHITE SUCKER	325/380	1160	2		
6. WHITE SUCKER	60 - 160	640	38	(ONE SPECIMEN - SWAY BACK)	
7. COMMON SHINER	40 - 120	90	20		
8. BLACKNOSED SHINER	58-60	5	3		
9. N. CREEK CHUB	50 - 118	60	6		
10. ROCK BASS	75-146	130	5		
11. PUMPKINSEED	71-78	30	4		
12. LOG PERCH	89	5	1		
13. MUDMINNOW	57-81	30	8		
14. JOHNNY DARTER	36/45	3	2		
15. BLACK BULLHEAD	163-195	495	4		
16. HORNY HEAD CHUB	41-104	30	7		
17. WHITE SUCKER	200-283	1100	6		
18. WHITE SUCKER	201-286	1050	6		
19. WHITE SUCKER	179-210	380	4		
20. SMALLMOUTH BASS	225	210	1		
21. YELLOW PERCH	110	20	1		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

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Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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START 46.55496
-90.40977

END 46.55382
-90.41374

FISH SURVEY RECORD

MPCA

Field Number: #1 UST OF BRIDGE	Date (mm/dd/yy): 07/28/2021
Stream Name: MONTREAL RIVER	County:
Location: SA SUPERIOR FALLS	Crew:

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
880	2448	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKER	398	625	1		
2.	302	280	1		
3.	417	678	1		
4.	326	342	1		
5.	365	482	1		
6.	403	586	1		
7.	422	658	1		
8.	311	283	1		
9.	412	750	1		
10.	332	362	1		
11.	319	337	1		
12.	271	221	1		
13.	277	191	1		
14.	252	156	1		
15.	257	155	1		
16.	275	187	1		
17. WHITE SUCKER	258	167	1		
18. BLACK BULLHEAD	178	102	1		
19.	153	64	1		
20.	168	91	1		
21.	173	102	1		
22.	170	79	1		
23.	149	61	1		
24.	180	112	1		
25. BLACK BULLHEAD	154	60	1		
26. CENTRAL MUDMINNOW	76	10	1		
27. PUMPKINSEED SUNFISH	71	4	1		

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28. ROCK BASS	157	82	1		
29.	141	68	1		
30.	133	50	1		
31.	140	61	1		
32.	141	63	1		
33. ROCKBASS	142	62	1		
34.	~~12~~				
35.					
36.					
37.					

25/47, 71
100/140

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
✓ 1. REDSIDE DACE	62 - 91	12	3		
✓ 2. ~~SLIMY~~ SCULPIN, MOTTLED	30 - 41	2	2		
✓ 3. ROCKBASS	71 - 127	286	12		
✓ 4. BLACK BULLHEAD	81 - 91	83	7		
✓ 5. WHITE SUCKER	49 - 217	900	25		
6.		890	99		
7.		780			
8.		860			
9.		240			
✓ 10. COMMON SHINER	42 - 158	813	213		
11.		203			
12.		587			
13. HORNYHEAD CHUB	59 - 140	780	56		
14. CREEK CHUB	71 - 181	800	25		
15. LOG PERCH	41 - 111	87	10		
16. JOHNNY DARTER	33 - 57	7	9		
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(Revised Feb. 2009)

START/END AT 46.55724, -90.41456

IMPOUNDMENT SHALLOW
THICK AQUATIC VEGETATION
IN AREAS

FISH SURVEY RECORD

MPCA

Field Number: DST BRIDGE	Date (mm/dd/yy): 07/28/2021
Stream Name: MONTREAL RIVER	County:
Location: SUPERIOR FALLS	Crew:

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom
16' GPP5.0

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
607	2049	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. SMALLMOUTH BASS	278	403	1		
2. SMALLMOUTH BASS	259	312	1		
3. YELLOW PERCH	151	35	1		
4. SMALLMOUTH BASS	228	216	1		
5. YELLOW PERCH	172	63	1		
6. SMALLMOUTH BASS	238	272	1		
7. WHITE SUCKER	439	841	1		
8. YELLOW PERCH	146	32	1		
9. LOG PERCH	108	7	1		
10. WHITE SUCKER	271	239	1		
11. WHITE SUCKER	274	242	1		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
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30.					
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36.					
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. LOG PERCH	38 - 110	38	4		
2. JOHNNY DARTER	51 - 63	3	2		
3. WHITE SUCKER	51 - 225	870	68		
4.		860			
5.		455			
6. COMMON SHINER	49 - 142	875	173		
7.		492			
8. PUMPKINSEED SUNFISH	69 - 122	278	13		
9. ROCKBASS	69 - 121	~~281~~ 290	11 ~~10~~		
10. HORNYHEAD CHUB	54 - 109	219	22		
11. CREEK CHUB	41 - 118	82	8		
12. BLACK BULLHEAD	70 - 175	429	11		
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START 1 → END 1

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 10/6/2021
Stream Name: MONTREAL RIVER	County:
Location: SUPERIOR FALLS UST BRIDGE	Crew: J. STRICKO, C. JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m): 880	Time Fished (sec): 3397	Identified By: J. STRICKO

Species (common name)	Length Range ~~(mm)~~ Inches	Weight (g)	Number	Anomalies	Voucher
1. WHITE SUCKERS	11.1	200	1		
2.	16.1	700	1		
3.	15.2	600	1		
4.	16.6	750	1		
5.	14.5	500	1		
6.	18.3	850	1		
7.	15.3	525	1		
8.	17.6	900	1		
9.	18.2	1000	1		
10.	17.5	675	1		
11.	17.3	825	1		
12.	15.6	575	1		
13.	18.0	900	1		
14.	13.2	475	1		
15.	12.2	300	1		
16.	13.6	410	1		
17.	16.7	725	1		
18.	17.0	790	1		
19.	7.2	55	1		
20.	8.1	60	1		
21.	14.3	475	1		
22.	9.8	150	1		
23.	7.6	85	1		
24.	2.7 - 7.6	600	14		
25.	5.1 - 15	1300	15		
26.	4.2 - 11.3	900	15		
27. WHITE SUCKER	6.4 - 13.3	1325	20		

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

START 1 → END 1

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 10/6/2021
Stream Name: MONTREAL RIVER	County:
Location: UST BRIDGE	Crew: J. STRICKO, C. JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m): 880	Time Fished (sec): 3397	Identified By: J. STRICKO

Species (common name)	Length Range ~~(mm)~~ Inches	Weight (g)	Number	Anomalies	Voucher
1. White Suckers	16.8	975	1		
2. WHITE SUCKER	16.5	900	1		
3.	2.5 - 13.2	815	23		
4.	2.3 - 13.3	1950	25		
5.	17.3	905	1		
6.	12.8	310	1		
7.	14.4	325	1		
8.	16.9	810	1		
9.	17.8	1000	1		
10.	13.6	305	1		
11.	16.9	850	1		
12.	3.2 - 11.3	1100	20		
13. WHITE SUCKER	2.3 - 8.6	825	40		
14. Creek chubs	3.4 - 7.9	225	7		
15. Common Shiner	2.3 - 5.7	205	31		
16. Horny head chub	3.3 - 5.4	100	5		
17. Rock Bass	1.1 - 6.1	410	13		
18. Black Bullhead	6.5 - 8.5	1050	11		
19. Yellow Perch	8.1	160	1		
20. Pumpkin seed	4.2	20	1		
21. Johnny Darter	2.2	2	1		
22. JOHNNY DARTER	2.3	2	1	B	
23. Mottled Sculpin	1.7	1	1		
24.					
25.					
26.					
27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 10/7/2021
Stream Name: MONTREAL RIVER	County:
Location: SUPERIOR FALLS DST BRIDGE	Crew: J. STRICKO, C. JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank
ENTIRE SHORELINE

Distance (m):	Time Fished (sec):	Identified By:
740	2246	J. STRICKO

Species (common name)	Length Range ~~(mm)~~ Inches	Weight (g)	Number	Anomalies	Voucher
1. Muskellunge	20.8	975	1		
2. Walleye	18.5	925	1		
3. Common Shiner	2.9 - 6.3	675	58		
4. Rock Bass	1.0 - 6.6	1250	25		
5. Black Crappie	4.3 - 7.2	250	4		
6. Pumpkin seed	3.2 - 5.4	350	16		
7. Creek Chub	7.5 - 8.1	175	2		
8. White Suckers	2.7 - 12.2	1825	40		
9. ↓	2.5 - 13.2	2625	25		
10. WHITE SUCKER	2.9 - 14.3	2225	13		
11. Yellow Perch	4.1 - 7.2	160	4		
12. Johnny darter	1.0 - 2.3	2	2	B	
13. Black Bullhead	1.1 - 5.7	150	8		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
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36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
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RUN1

FISH SURVEY RECORD

MPCA

Field Number: 1→2	Date (mm/dd/yy): 05/24/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m): 1171	Time Fished (sec): 1630	Identified By: D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. YELLOW PERCH	255	245	1		
2. Y PERCH	101-140	95	3		
3. WALLEYE	152	35	1		
4. ROCK BASS	95	20	1		
5. BLACK CRAPPIE	138 & 151	92	2		
6. BROOK STICKLEBACK	58	1	1		
7. COMMON SHINER	36-79	20	12		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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RUN 2

FISH SURVEY RECORD

MPCA

Field Number: 3→4	Date (mm/dd/yy): 5/24/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
1250	1989	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. NORTHERN PIKE	375	360	1		
2. N. PIKE	315	215	1		
3. N. PIKE	377	370	1		
4. BLACK CRAPPIE	175	80	1		
5. ROCK BASS	108/135	95	2		
6. PUMPKINSEED	105	35	1		
7. WHITE SUCKER	135	30	1		
8. YELLOW PERCH	266	340	1		
9. YELLOW PERCH	101-210	270	5		
10. COMMON SHINER	92	5	1		
11. WHITE SUCKER	54	2	1		
12. COMMON SHINER	35-85	45	16		
13. WALLEYE	185	60	1		
14. WALLEYE	197	75	1		
15. JOHNNY DARTER	51/35	3	2		
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25.					
26.					
27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
31.					
32.					
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34.					
35.					
36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
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RUN 3

FISH SURVEY RECORD

MPCA

Field Number: 2 → 5	Date (mm/dd/yy): 05/24/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
1070	1755	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. NORTHERN PIKE	370	270	1	BLACKSPECKS - MANY	
2. NORTHERN PIKE	326	260	1	" - FEW	
3. WHITE SUCKER	353	510	1		
4. YELLOW PERCH	270	225	1		
5. YELLOW PERCH	171-82	190	5	FEW BLACK SPOTS	
6. WALLEYE	205	85	1		
7. BLACK CRAPPIE	185	110	1		
8. BLACK CRAPPIE	137/152	95	2		
9. ROCK BASS	187	155	1		
10. ROCK BASS	55/72/101	55	3		
11. BLACK CRAPPIE	150	50	1		
12. GOLDEN SHINER	116	16	1		
13. " "	125	19	1		
14. BLACK BULLHEAD	130	35	1		
15. PUMPKINSEED	76-89	40	3		
16. COMMON SHINER	58-82	30	10		
17. HORNYHEAD CHUB	50	4	1		
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26.					
27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
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34.					
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37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
2.					
3.					
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Run 4

FISH SURVEY RECORD

MPCA

Field Number: 4 → 6	Date (mm/dd/yy): 05/25/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m): 920	Time Fished (sec): 1743	Identified By: D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. NORTHERN PIKE	366	270	1	BLACK SPECS - MANY	
2. " "	405	395	1	"	"
3. " "	330	200	1	"	"
4. WHITE SUCKER	321	370	1		
5. " "	105	10	1		
6. YELLOW PERCH	172-220	540	6		
7. " "	93-146	195	8		
8. BLACK BULLHEAD	97-155	345	8		
9. YELLOW PERCH	76/86	7	2		
10. BLACK CRAPPIE	133-153	290	6		
11. ROCK BASS	196	175	1		
12. ROCK BASS	90-111	65	3		
13. PUMPKINSEED	86/112	65	2		
14. ROCK BASS	85	15	1		
15. JOHNNY DARTER	42-55	7	3		
16. PUMPKINSEED	81	10	1		
17. WHITE SUCKER	75	5	1		
18. GOLDEN SHINER	85	10	1		
19. COMMON SHINER	42-80	15	9		
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27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
31.					
32.					
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34.					
35.					
36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
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RUN 5

FISH SURVEY RECORD

MPCA

Field Number: 5 → 7	Date (mm/dd/yy): 5/25/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM
Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom *Type of Backpack: (circle one) Generator LR-24 Halltech	
Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank	

Distance (m):	Time Fished (sec):	Identified By:
1035	2299	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. NORTHERN PIKE	460	490	1		
2. " "	465	530	1		
3. WHITE SUCKER	295	300	1		
4. WALLEYE	325	490	1		
5. WHITE SUCKER	97-145	110	5		
6. YELLOW PERCH	240-253	1150	5		
7. " "	85-190	675	12		
8. " "	121-181	470	9		
9. BLACK BULLHEAD	106-172	510	12		
10. " "	48-61	20	5		
11. GOLDEN SHINER	80-145	125	16		
12. WALLEYE	185	60	1		
13. PUMPKINSEED	42-112	255	17		
14. BLACK CRAPPIE	138-196	350	5		
15. ROCK BASS	112	35	1		
16. COMMON SHINER	50-97	53	11		
17. ROCK BASS	95	25	1		
18. GOLDEN SHINER	100	10	1		
19. GOLDEN SHINER	75	6	1		
20. BLACK BULLHEAD	130	15	1		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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RUN 6

FISH SURVEY RECORD

MPCA

Field Number: 7 → 8	Date (mm/dd/yy): 05/25/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
1900	3004	D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. MUSKELLUNGE	582	1350	1		
2. " "	449	500	1		
3. WHITE SUCKER	203	50	1		
4. NORTHERN PIKE	467	595	1		
5. BLACK BULLHEAD	105-175	720	14		
6. " "	110-135	275	9		
7. " "	35-50	10	12		
8. BLACK CRAPPIE	260	265	1		
9. " "	126-165	170	4		
10. BLACK BULLHEAD	105-135	220	8		
11. YELLOW PERCH	120-185	605	12		
12. " "	195-266	1090	10		
13. PUMPKINSEED	131-175	340	18		
14. MUDMINNOW	100	8	1		
15. GOLDEN SHINER	75-144	115	11		
16. COMMON SHINER	47-122	95	19		
17. WHITE SUCKER	92	3	1		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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RUN 7

FISH SURVEY RECORD

MPCA

Field Number: 8 → 9	Date (mm/dd/yy): 5/25/21
Stream Name:	County:
Location: SAXON FALLS	Crew: D. JOHNS, D. BRIEM

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m): 1750	Time Fished (sec): 1726	Identified By: D. BRIEM

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. PUMPKINSEED	80-151	900	17		
2. BLUEGILL	165	112	1		
3. NORTHERN PIKE	370	389	1		
4. " "	231	242	1		
5. BLACK BULLHEAD	65-180	405	16		
6. YELLOW PERCH	195-260	950	6		
7. " "	85-185	455	11		
8. BLACK CRAPPIE	[illegible]-161	50	1		
9. PUMPKINSEED	80-131	50	2		
10. GOLDEN SHINER	70-135	30	5		
11. COMMON SHINER	60/75	5	2		
12. GOLDEN SHINER	95	5	1		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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START 46.54486 END 46.53697
#3 -90.34626 -90.35219

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 07/29/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS	Crew:

Gear Type: (circle one) Backpack* Stream-Shocker Boom-Shocker Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
1145	2123	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WALLEYE	357	441	1		
2. WALLEYE	401	572	1		
3. HORNYHEAD CHUB	66 - 98	21	2		
4. SMALLMOUTH BASS	74	3	1		
5. LOGPERCH	82 - 105	79 ~~58~~ 68	~~7~~ 11		
6. BLACK CRAPPIE	172	89	1		
7. BLACK CRAPPIE	58 - 109	27	2		
8. WHITE SUCKER	59 - 68	13	3		
9. YELLOW PERCH	119 - 169	312	9		
10. PUMPKINSEED SUNFISH	62 - 88	49	4		
11. ROCK BASS	81 - 135	242	7		
12. COMMON SHINER	58 - 96	71	11		
13. BLACK BULLHEAD	91 ~~98~~ - 98	69	4		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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#4 START 46.54486 -90.34655 END 46.53717 -90.35210

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 7/29/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS	Crew:

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) **Right Bank** Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
1,103	2368	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. MUSKELLUNGE	732	*	1		
2. MUSKELLUNGE	872	*	1		
3. NORTHERN PIKE	383	311	1		
4. WALLEYE	294	246	1		
5. COMMON SHINER	66 - 128	82	10		
6. SMALLMOUTH BASS	181	139	1		
7. SMALLMOUTH BASS	74	19	1		
8. ROCK BASS	76 - 148	~~14~~ 573	14		
9. HORNYHEAD CHUB	72 - 95	53	4		
10. BLACK CRAPPIE	225	206	1		
11. BLACK CRAPPIE	243	228	1		
12. BLACK CRAPPIE	203	133	1		
13. BLACK CRAPPIE	110 - 181	151	3		
14. PUMPKINSEED SUNFISH	74 - 128	263	13		
15. YELLOW PERCH	56 - 189	568	15		
16. GOLDEN SHINER	123	41	1		
17. WHITE SUCKER	212	120	1		
18. WHITE SUCKER	193	87	1		
19. MOTTLED ~~SLIMY~~ SCULPIN	79	18	1		
20. LOGPERCH	93 - 100	38	4		
21. BLACK BULLHEAD	81 - 147	642	31		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

* FISH TOO LARGE TO ACCURATELY WEIGH

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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END 4 - END 5

START 46.53717
-90.35210

END 46.54053
-90.36372

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 7/30/2021
Stream Name: MONTREAL RIVER	County:
Location: SAYON FALLS	Crew: STRICKO / JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) **Right Bank** Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
1415	3056	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. NORTHERN PIKE	434	550	1		
2. WALLEYE	446	923	1		
3. WALLEYE	404	698	1		
4. YELLOW PERCH	131 - 199	172	3		
5. BLACK CRAPPIE	193	52	1		
6. BLACK CRAPPIE	126	30	1		
7. COMMON SHINER	61 - 112	82	8		
8. ROCK BASS	73 - 161	172	4		
9. PUMPKINSEED SUNFISH	63 - 130	468	26		
10. BLACK CRAPPIE	69	2	1		
11. BLACK BULLHEAD	83 - 166	748	41		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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S 46.53697 END 46.54040
END 3 - END 6 -90.35219 -90.36345

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 07/30/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS	Crew: STRICKO / JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel **Left Bank**

Distance (m):	Time Fished (sec):	Identified By:
1,380	3035	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. NORTHERN PIKE	504	732	1		
2. ↓	403	263	1		
3.	424	423	1		
4. NORTHERN PIKE	420	415	1		
5. WALLEYE	281	163	1		
6. WHITE SUCKER	346	392	1		
7. YELLOW PERCH	56 - 227	423	6		
8. COMMON SHINER	44 - 121	81	12		
9. BLACK CRAPPIE	138	41	1		
10. PUMPKINSEED SUNFISH	37 - 122	363	41		
11. ROCKBASS	73 - 127	438	17		
12. BLACK BULLHEAD	85 - 147	705 + 261	47		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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Field Number:	Date (mm/dd/yy): 07/30/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS	Crew: STRICKO / JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel **Left Bank**

Distance (m): 2,442	Time Fished (sec): 4255	Identified By: J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WALLEYE	351	321	1		
2. NORTHERN PIKE	456	454	1		
3.	470	602	1		
4.	471	638	1		
5.	568	972	1		
6.	402	363	1		
7. NORTHERN PIKE	477	568	1		
8. BLACK CRAPPIE	269	273	1		
9. WHITE SUCKER	57 - 67	67	67		
10. PUMPKINSEED SUNFISH	33 - 142	923+6	55+3		
11. BLACK CRAPPIE	59 - 171	113	3		
12. ROCK BASS	88 - 139	202	5		
13. GOLDEN SHINER	70 - 193	104	8		
14. COMMON SHINER	81 - 121	178	18		
15. YELLOW PERCH	112 - 235	721 + 171	14		
16. BLACK BULLHEAD	72 - 151	900 + 347	51		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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START → E6
46.54238
~~46.54236~~ -90.34823
-90.~~54236~~ 34861

END
46.54040
-90.36345

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 10/7/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS	Crew: J. STRICKO

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) **Right Bank** Mid-Channel Left Bank

Distance (m): 2182 1381 + 801	Time Fished (sec): 4263	Identified By: J. STRICKO

Species (common name)	Length Range ~~(mm)~~ Inches	Weight (g)	Number	Anomalies	Voucher
1. Muskellunge	29.3	2300	1		
2. ↓	26.9	1400	1		
3.	35.5	NA	1	F,L	
4.	27.3	2050	1		
5. Walleye	12	175	1		
6. ↓	8.2	100	1	F,L	
7.	12.9	250	1		
8.	13.1	325	1		
9. Yellow Perch	2.6 – 8.4	610	20		
10. Black Crappie	2.3 – 7.0	110	4		
11. Rock Bass	1.8 – 5.9	200	9		
12. Black Bullhead	3.5 – 6.0	210	10		
13. Golden Shiner	4.2	~~3~~ 10	1		
14. Johnny Darter	2.3	~~+~~ 3	1		
15. Pumpkinseed	2.4	~~2~~ 4	1		
16. ↓	1.5	~~+~~ 2	1		
17.	1.8	~~+~~ 3	1		
18. White Sucker	2.5 – 10.9	830	33		
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Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
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END 6 – END ~~X~~ 5 START 46.54040 -90.36345 END 46.54053 -90.36372

FISH SURVEY RECORD

MPCA

Field Number:		Date (mm/dd/yy): 07/30/2021
Stream Name: MONTREAL RIVER		County:
Location: SAXON FALLS		Crew: STRICKO/JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) Right Bank Mid-Channel **Left Bank**

Distance (m):	Time Fished (sec):	Identified By:
2,442	4255	J. STRICKO

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1. WALLEYE	351	321	1		
2. NORTHERN PIKE	456	454	1		
3.	470	602	1		
4.	471	638	1		
5.	568	972	1		
6.	402	363	1		
7. NORTHERN PIKE	477	568	1		
8. BLACK CRAPPIE	269	273	1		
9. WHITE SUCKER	57 - 67	67	67		
10. PUMPKINSEED SUNFISH	33 - 142	923+6	55+3		
11. BLACK CRAPPIE	59 - 171	113	3		
12. ROCK BASS	88 - 139	202	5		
13. GOLDEN SHINER	70 - 193	104	8		
14. COMMON SHINER	81 - 121	178	18		
15. YELLOW PERCH	112 - 235	721 + 171	14		
16. BLACK BULLHEAD	72 - 151	900 + 347	51		
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
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10.					
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27.					
28.					
29.					

START → END5
46.54237 → 46.54053
-90.34860 → -90.36372

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 10/7/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS PROJECT	Crew: J. STRICKO, C. JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) **Right Bank** Mid-Channel Left Bank

Distance (m):	Time Fished (sec):	Identified By:
750+1415 = 2165	4640	J. STRICKO

Species (common name)	Length Range ~~(mm)~~ Inches	Weight (g)	Number	Anomalies	Voucher
1. Muskellunge	24.2	1615	1		
2.	33.5	2400	1		
3.	41.0	N/A	1		
4. Walleye	12.9	250	1		
5.	19.8	1500	1		
6. White Suckers	2.4-9.2	625	35		
7. Yellow perch	3.5-7.2	360	24		
8. Common Shiner	1.1-4.3	25	7		
9. Rock Bass	5.7	100	1		
10. Johnny Darter	2.6	2	1		
11. Pumpkin seed	2.8	2	1		
12.	1.5	1	1		
13. Black Crappie	2.9	2	1		
14. log Perch	2.3	2	1		
15. Yellow Perch	3.3	3	1		
16. white sucker	3.2	2	1		
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
2.					
3.					
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29.					

E5-E6

FISH SURVEY RECORD

MPCA

Field Number:	Date (mm/dd/yy): 10/8/2021
Stream Name: MONTREAL RIVER	County:
Location: SAXON FALLS	Crew: J. STRICKO, C. JOHNS

Gear Type: (circle one) Backpack* Stream-Shocker **Boom-Shocker** Mini-Boom

*Type of Backpack: (circle one) Generator LR-24 Halltech

Channel Position: (circle one if boom-shocking site) **Right Bank** Mid-Channel **Left Bank**

Distance (m):	Time Fished (sec):	Identified By:
2442	4409	J. STRICKO

Species (common name)	Length Range ~~(mm)~~ Inches	Weight (g)	Number	Anomalies	Voucher
1. Walleye	19.6	1625	1		
2. Muskellunge	25.4	1625	1		
3.	22.0	950	1		
4. Northern Pike	20.2	850	1		
5.	19.5	650	1		
6.	17.7	475	1	B	
7.	16.8	350	1	B	
8. Walleye	16.8	750	1		
9. Northern Pike	15.3	325	1	B	
10. Black Crappie	2.8 - 9.7	975	16		
11. Yellow Perch	3.0 - 8.8	1430	30		
12.	3.1 - 9.8	1550	50		
13.	2.8 - 5.5	175	18		
14. Pumpkin Seed	1.4 - 5.8	825	107		
15. Rock Bass	1.8 - 5.8	200	4		
16. Common shiners	1.6 - 4.3	10	7		
17. White sucker	2.9 - 9.2	505	29		
18.	13.1	325	1		
19. Walleye	7.7	50	1		
20. Golden Shiner	6.0	10	1		
21. Johnny Darter	2.7	3	1		
22.	1.5	1	1		
23.	2.0	1	1		
24. Black Bullhead	3.1 - 5.9	905	68		
25.					
26.					
27.					

Anomalies: A-anchor worm; B-black spot; C-leeches; D-deformities; E-eroded fins; F-fungus; G-yellow grub; L-lesions; N-blind; P=parasites; PL-parasite lesion; Y-popeye; S-emaciated; W-swirled scales; T-tumors; Z-other. (Heavy (H) or Light (L) code may be combined with above codes.)

(Cont.)

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
28.					
29.					
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.					

INDIVIDUAL OR BATCH MEASUREMENTS

Species (common name)	Length Range (mm)	Weight (g)	Number	Anomalies	Voucher
1.					
2.					
3.					
4.					
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6.					
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Appendix B

Summary Table

Summary table for species collected during each sampling event along with relative abundance(%) and CPUE (#/Km) calculations.

Common Name	Scientific Name	Superior May	Saxon May	Superior July	Saxon July	Superior October	Saxon October	Total Montreal River	Total Superior Falls	Superior Rel Abund (%)	CPUE Dist (Km)	Total Saxon Falls	Saxon Rel Abund (%)	CPUE Dist (Km)
Muskellunge	*Esox masquinongy*		2		2	1	9	14	1	0.05	0.17	13	0.81	0.56
Northern Pike	*Esox Lucius*		13		12		5	30	0			30	1.87	1.28
Central Mudminnow	*Umbra limi*	14	1	1				16	15	0.77	2.55	1	0.06	0.04
Brook Stickleback	*Culaea inconstans*		1					1	0			1	0.06	0.04
Black Bullhead	*Ameiurus melas*	10	86	26	239	19	78	458	55	2.81	9.35	403	25.12	17.24
White Sucker	*Catostomus commersonii*	297	14	187	13	282	129	922	766	39.20	130.18	156	9.73	6.67
Golden Shiner	*Notemigonus crysoleucas*		46		9		2	57	0	0.00		57	3.55	2.44
Longnose Dace	*Rhinichthys cataractae*	8						8	8	0.41	1.36	0	0.00	
Western Blacknose Dace	*Rhinichthys obtusus*	10						10	10	0.51	1.70	0	0.00	
Redside Dace	*Clinostomus elongatus*			3				3	3	0.15	0.51	0	0.00	
Common Shiner	*Luxilus cornutus*	197	80	386	59	89	14	825	672	34.39	114.21	153	9.54	6.55
Blacknose Shiner	*Notropis heterolepis*	5						5	5	0.26	0.85	0	0.00	
Creek Chub	*Semotilus atromaculatus*	29		33		9		71	71	3.63	12.07	0	0.00	
Hornyhead Chub	*Nocomis biguttatus*	66	1	78	4	5		154	149	7.63	25.32	5	0.31	0.21
Rock Bass	*Ambloplites rupestris*	30	14	29	47	38	13	171	97	4.96	16.49	74	4.61	3.17
Black Crappie	*Pomoxis nigromaculatus*		24		17	4	21	66	4	0.20	0.68	62	3.87	2.65
Smallmouth Bass	*Micropterus dolomieu*			4	3			7	4	0.20	0.68	3	0.19	0.13
Pumpkinseed	*Lepomis gibbosus*	8	61	14	142	17	112	354	39	2.00	6.63	315	19.64	13.48
Bluegill	*Lepomis macrochirus*		1					1	0			1	0.06	0.04
Yellow Perch	*Perca flavecens*	2	92	3	47	5	143	292	10	0.51	1.70	282	17.58	12.07
Walleye	*Sander vitreus*		6		7	1	9	23	1	0.05	0.17	22	1.37	0.94
Logperch	*Percina caprodes*	2		15	15		1	33	17	0.87	2.89	16	1.00	0.68
Johnny Darter	*Etheostoma nigrum*	9	5	11		4	4	33	24	1.23	4.08	9	0.56	0.39
Mottled Sculpin	*Cottus bairdii*			2	1	1		4	3	0.16	0.51	1	0.06	0.04
TOTAL NUMBER OF INDIVIDUALS		687	447	792	617	475	540	3558	1954	100.0		1604	100.0	

Total of all Individuals	3558
Total Saxon Falls	1604
Total Superior Falls	1954
Total Distance Fished Saxon Falls	23372
Total Distance Fished Superior Falls	5884
Total Time Fished Saxon Falls	42295
Total Time Fished Superior Falls	16971

APPENDIX E-30 Saxon Falls and Superior Falls Intake Velocity Calculations

Saxon Falls

Velocity Through Trashrack

Calc by: JAM Date: 4/24/2020

Hydraulic Capacity Estimate: Maximum

Checked by: NLH Date: 4/27/2020

Parameters:

Max Headwater EL =	997.0	ft	Top of trashrack is below, so fully submerged
Powerhouse Max Hydraulic Capacity, ***Q*** =	170	cfs	
Trashrack Height, ***H*** =	20.0	ft	Measured along incline of trashrack
Trashrack Width, ***W*** =	15.0	ft	
Bar Width, ***BW*** =	0.25	in	
Clear Space, ***CS*** =	1.0	in	

Computing Trashrack and Bar Geometry

$$Total\ Trashrack\ Area = \boldsymbol{H} * \boldsymbol{W}$$

Total Trashrack Area, ***A Trash*** = 300 sq. ft

Bar Width + Clear Space, ***BC*** = 1.25 in

$$Total\ \#\ Bars = \left(\frac{\boldsymbol{W}}{\boldsymbol{BC}}\right) - 1$$

Total # Bars = 143

$$Bar\ Surface\ Area = \boldsymbol{BW}\ * \boldsymbol{H}$$

Bar Surface Area, ***BA*** = 0.42 sq. ft

$$Total\ Bar\ Surface\ Area = \boldsymbol{Total\ \#\ Bars}\ * \boldsymbol{BA}$$

Total Bar Surface Area, ***BA Total*** = 59.58 sq. ft

Computing Velocity

$$Effective\ Flow\ Area = \boldsymbol{A\ Trash} - \boldsymbol{BA\ Total}$$

Effective Flow Area, **A** = 240.42 sq. ft

$$\boldsymbol{V} = \frac{\boldsymbol{Q}}{\boldsymbol{A}}$$

Velocity, V = 0.71 ft/s

Superior Falls

Velocity Through Trashrack

Calc by: JAM   Date: 4/24/2020

Hydraulic Capacity Estimate: Maximum

Checked by: NLH   Date: 4/27/2020

Parameters:

Max Headwater EL =	740.2	ft	Top of trashrack is below, so fully submerged
Powerhouse Max Hydraulic Capacity, ***Q*** =	220	cfs	
Trashrack Height, ***H*** =	22.0	ft	Measured along incline of trashrack
Trashrack Width, ***W*** =	15.0	ft	
Bar Width, ***BW*** =	0.25	in	
Clear Space, ***CS*** =	1.0	in	

Computing Trashrack and Bar Geometry

$$Total\ Trashrack\ Area = \boldsymbol{H} * \boldsymbol{W}$$

Total Trashrack Area, ***A Trash*** =	330	sq. ft
Bar Width + Clear Space, ***BC*** =	1.25	in

$$Total\ \#\ Bars = \left(\frac{\boldsymbol{W}}{\boldsymbol{BC}}\right) - 1$$

Total # Bars = 143

$$Bar\ Surface\ Area = \boldsymbol{BW} * \boldsymbol{H}$$

Bar Surface Area, ***BA*** = 0.46 sq. ft

$$Total\ Bar\ Surface\ Area = \boldsymbol{Total\ \#\ Bars} * \boldsymbol{BA}$$

Total Bar Surface Area, ***BA Total*** = 65.54 sq. ft

Computing Velocity

$$Effective\ Flow\ Area = \boldsymbol{A\ Trash} - \boldsymbol{BA\ Total}$$

Effective Flow Area, **A** = 264.46 sq. ft

$$\boldsymbol{V} = \frac{\boldsymbol{Q}}{\boldsymbol{A}}$$

Velocity, V =	**0.83**	**ft/s**

APPENDIX E-31 Chippewa River Fish Protection Study

CHIPPEWA RIVER FISH PROTECTION STUDY

FINAL REPORT

HOLCOMBE PROJECT (FERC NO. 1982)
CORNELL PROJECT (FERC NO. 2639)
JIM FALLS PROJECT (FERC NO. 2491)
WISSOTA PROJECT (FERC NO. 2567)
CHIPPEWA FALLS (FERC NO. 2440)
DELLS PROJECT (FERC NO. 2670)

Prepared for:

Xcel Energy
Eau Claire, Wisconsin

Prepared by:

Kleinschmidt

www.KleinschmidtGroup.com

November 2016

CHIPPEWA RIVER FISH PROTECTION STUDY

FINAL REPORT

HOLCOMBE PROJECT (FERC NO. 1982)
CORNELL PROJECT (FERC NO. 2639)
JIM FALLS PROJECT (FERC NO. 2491)
WISSOTA PROJECT (FERC NO. 2567)
CHIPPEWA FALLS (FERC NO. 2440)
DELLS PROJECT (FERC NO. 2670)

Prepared for:

Xcel Energy
Eau Claire, Wisconsin

Prepared by:

Kleinschmidt
www.KleinschmidtGroup.com

November 2016

CHIPPEWA RIVER FISH PROTECTION STUDY

FINAL REPORT

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EXECUTIVE SUMMARY

Operation of hydroelectric projects on the Chippewa River has the potential to entrain resident fish species through the intakes as water is diverted for clean, renewable hydropower generation. Small, common resident fish species (i.e., bluegill, yellow perch, and black crappie that are less than 3 inches long) are likely to be the most susceptible to entrainment (GLEC 2000). Lake sturgeon, a species of special management interest in the Chippewa River, also has the potential to be affected by operations of the Chippewa River hydroelectric projects.

Xcel Energy, the current owner and licensee of the Holcombe, Cornell, Jim Falls, Wissota, Chippewa Falls, and Dells hydroelectric projects on the lower Chippewa River, is an active participant in a comprehensive Settlement Agreement that was developed in the late 1990s during the licensing and license amendment process of the projects with the Federal Energy Regulatory Commission. Pursuant to the 2001 Lower Chippewa River Settlement Agreement, Xcel Energy established a fish protection fund dedicated to identifying measures to protect and enhance the Chippewa River fish community. Kleinschmidt, on behalf of Xcel Energy and the rest of the Chippewa River Settlement Implementation Team (Implementation Team),[1] developed this report to assess whether new, effective, and affordable technologies are available that would reduce the number of fish that may be entrained at hydroelectric projects on the Chippewa River.

Limited advancements in downstream fish passage and protection technologies have been made at hydropower projects in the past 10 to 20 years. Many of the available physical, behavioral, and operational alternatives are likely to be ineffective for protecting small resident fish, would require major structural changes, are cost-prohibitive, or are in various stages of development and testing. We reviewed 20 measures that have been used at water diversions throughout the

[1] A sub-group of the signatories to the Settlement Agreement.

United States for protecting fish at water intakes to determine if they would provide a feasible and cost-effective means to reduce the number of fish entrained at Xcel Energy's hydroelectric projects on the Lower Chippewa River. After our initial screening, we selected the following four measures for further review:

- replace the existing trashracks with new full-depth trashracks with narrowly spaced bars;
- install angled bar racks with full-depth trashracks with narrowly spaced bars;
- install inclined bar racks with full-depth, narrowly spaced trashracks; and
- deploy a floating barrier net system.

State and federal agencies routinely recommend these measures for hydropower facilities because they can physically exclude fish from water intakes. Our analysis focuses on screening measures that have 1-inch clear openings (i.e., trashrack bars, angled racks, and inclined screens), which is a standard design recommended by fisheries resource agencies for fish protection at hydropower intakes. Although narrower screens can be used, they are not likely to be biologically effective or cost effective because they will result in water velocities that may impinge fish, cause more head loss across the trashracks, and may significantly increase debris loading and maintenance. Furthermore, the licensee's fish entrainment study at the Wissota Project in the late 1990s demonstrated that 96 percent of entrained fish were less than 6 inches long (GLEC 2000); therefore, we did not consider fish protection measures with trashrack bars spaced wider than 1-inch because they would not prevent the entrainment of small, resident fish species.

For each selected alternative, we evaluated how these measures would affect head loss, energy production, and turbine operations and evaluated the expected biological effectiveness of these physical screening measures. We also prepared opinions of probable construction and maintenance costs for these alternatives. The opinions of probable construction costs range from approximately $1 million to $7 million each over the remainder of the license term (i.e., through 2033). Results of the energy modeling indicate that narrowly spaced intake trashracks with 1-inch openings would have some effect on generation, but the calculated reductions attributable to losses through the trashracks are minimal. Most of the hydroelectric projects appear to have adequate submergence for the reported operational flows, such that head loss associated with narrower racks would not negatively affect operation of the turbines. Decreased open rack area resulting from the accumulation of leaves, woody debris, ice, or other materials on the face of the trashracks (i.e., blinding) would have a greater effect on energy and submergence, and narrowly spaced racks can significantly increase the rate of accumulation of debris (or ice). The increased rate of blinding would require very frequent raking, and keeping the racks clean would be difficult even with good raking equipment.

Narrowly spaced trashracks and modified intake designs (i.e., angled- or inclined-bar racks) would result in continued entrainment of resident fish species because many juvenile fish would still be able to fit through them. Furthermore, the velocity of the water traveling through narrowly spaced trashracks is expected to increase substantially compared to existing conditions because of the decrease in open intake area; this would increase the potential for larger fish that are physically excluded to become impinged on the face of the trashracks. The predicted survival of fish that may still be entrained through narrower trashracks at these hydroelectric facilities ranges from 75.9 to 98.9 percent. Maximum survival of entrained fish tends to occur near peak turbine operating efficiency, and smaller fish tend to suffer the least mortality (EPRI 1992).

Based on our evaluation, it is our opinion that no new cost-effective technologies for protecting small, resident fishes at hydropower intakes have emerged in the last 20 years; therefore, it is our opinion that contributing funds toward fishery restoration measures in the Chippewa River, such as habitat protection, hatchery production, and other fisheries management projects in the region, is likely to be more effective and practical.

FINAL REPORT

1.0 INTRODUCTION

Xcel Energy owns and operates the Holcombe, Cornell, Jim Falls, Wissota, Chippewa Falls, and Dells hydroelectric projects, all of which are located on the lower Chippewa River in Wisconsin. Xcel Energy produces nearly 600,000 megawatt hours (MWh) of clean, renewable electricity annually at these facilities (Xcel Energy 2007), enough to provide power for nearly 55,000 residences.[2] In addition to providing a renewable energy source, the Chippewa River provides ample recreational opportunities for residents of the region, including open water and ice-fishing, swimming, boating, canoeing, picnicking, waterskiing, camping, hiking, waterfowl hunting, and snowmobiling (FERC 2002).

Northern States Power Company (now Xcel Energy) applied to the Federal Energy Regulatory Commission (FERC) for new licenses for the Holcombe, Wissota, and Dells projects on June 21, 1996, June 22, 1998, and August 24, 1998, respectively. The licensee also filed applications to amend the Cornell, Jim Falls, and Chippewa Falls licenses on February 1, 2001. As part of the license and amendment application process, Northern States Power Company, the city of Eau Claire, the Wisconsin Department of Natural Resources (WDNR), the U.S. Fish and Wildlife Service (USFWS), the National Park Service, the River Alliance of Wisconsin, the Wisconsin Conservation Congress, the Chippewa Rod and Gun Club, the Lake Holcombe Improvement Association, the Lake Wissota Improvement Association, and the Lower Chippewa Restoration Coalition, Inc. (Parties) developed the Lower Chippewa River Settlement (Settlement), which identified the principal environmental conditions that the Parties agreed should be incorporated into licenses issued by FERC for the six projects. The Parties identified, negotiated, and resolved 23 major environmental issues in the Settlement, several of which included measures related to fish protection at the six hydroelectric projects.

[2] Assuming an average annual energy consumption of 11 MWh (USEIA 2016)

Pursuant to Section 4.1.1 of the Settlement, the licensee established the Chippewa River Protection and Restoration Fund, which has two sub-accounts: (1) the Natural Resource Fund account ($500,000); and (2) the Fish Protection Fund (FPF) account ($3,250,000). The money in the sub-accounts is equal to the amount of money identified by the Parties for environmental protection, mitigation, or restoration activities and studies, including fish protection, in the lower Chippewa River Basin. The FPF is to be available at a future date when, and if, fish protection technology is shown to be biologically effective for preventing or substantially reducing the risk of mortality for fish that are entrained through the turbines. If a feasible protection measure is not developed after 20 years, the money may be used for habitat enhancement (FERC 2002).

Hydroelectric projects may entrain resident fish species through water intakes during turbine operation, which can lead to injury and mortality. Alternatively, fish can become impinged on or injured by project structures in areas where water moves at high velocity (e.g., trashracks, gates, and piers). In the late 1990s, Northern States Power Company studied entrainment at the Wissota Project using full-depth entrainment nets placed in the tailraces of Wissota Units 1 and 3 to estimate annual entrainment. The study demonstrated that:

- approximately 524,000 fish are entrained at the Wissota Project annually;
- bluegill (48.9 percent), yellow perch (16.7 percent), black crappie (13.9 percent), trout perch (10.4 percent), and emerald shiner (5.7 percent) are the most abundant species entrained;
- the vast majority of entrained fish are less than 75 millimeters (3 inches);
- very few of the entrained fish are larger than 125 millimeters (5 inches);
- immediate turbine mortality is 3.7 percent (about 20,000 fish);
- the overall annual loss (immediate and delayed mortality) is approximately 51,000 fish (9.7 percent);
- the highest entrainment rates are in the spring and summer, with peaks in late July and mid-September; and
- operation of the Wissota Project has limited effects on catchable game fish (e.g., smallmouth bass, and walleye).

Based on the study results, most stakeholders agreed that mitigation is warranted for the fish injury and mortality at the Wissota Project and for similar losses that may occur at Xcel Energy's other Chippewa River projects. The stakeholders agreed at the time that state-of-the-art fish protection technologies (e.g., angled racks with a bypass, louvers with a bypass, or fish friendly turbines) had not been perfected, nor could they provide reasonable assurances that the measure(s) would effectively guide fish to a bypass or otherwise reduce entrainment. The stakeholders also agreed that cost-effective, biologically proven protection measures that could minimize or eliminate turbine entrainment of fish may be perfected in the future.

On behalf of Xcel Energy and the rest of the Implementation Team, Kleinschmidt reviewed currently available alternatives to protect fish at hydroelectric intakes. The goal of the study was to determine whether new, effective, and affordable technologies have been developed that would reduce the number of fish entrained at Xcel Energy's Chippewa River hydroelectric projects. Our analysis focuses on walleye, yellow perch, muskellunge, smallmouth bass, black crappie, bluegill, and lake sturgeon, which are seven species of management interest in the watershed (personal communication, Jesse Waldrip, Fish Passage Team Leader, Kleinschmidt with Joseph Gerbyshak, Wisconsin Department of Natural Resources, February 10, 2016). This report provides:

- a description of the Chippewa River and its environmental resources (Section 2.0);
- a description of the existing intake configurations and normal operations of the Holcombe, Cornell, Jim Falls, Wissota, Chippewa Falls, and Dells projects (Section 3.0);
- a review of fish protection systems that have been used at water withdrawals (Section 4.0);
- a detailed evaluation of four fish protection alternatives and opinions of probable construction costs for the selected alternatives (Section 5.0);
- an evaluation of potential head loss (Section 6.0);
- an evaluation of the potential effects of head loss on turbine operations (Section 7.0);
- an evaluation of potential energy loss (Section 8.0); and
- an evaluation of whether the selected options are likely to improve conditions for resident fish species in the Chippewa River (Section 9.0).

2.0 DESCRIPTION OF THE CHIPPEWA RIVER

This section provides a brief overview of the Chippewa River and its fishery resources. The licenses, amendment applications, and FERC license orders contain additional information. The six hydroelectric projects are on the Chippewa River (Figure 1), which is the second largest river in Wisconsin. The Chippewa River flows approximately 185 miles through west-central and northwestern Wisconsin from the confluence of the East Fork Chippewa River and West Fork Chippewa River to its confluence with the Mississippi River (Figure 1). The hydroelectric projects are on the lowermost 121 miles of the Chippewa River, which drops approximately 380 feet in elevation before discharging into the Mississippi River.

The Chippewa River supports a quality cool water fishery with a diverse sport fish community including walleye, smallmouth bass, largemouth bass, northern pike, muskellunge, yellow perch, and several species of panfish, such as bluegill, black crappie, and rock bass. The river and flowages between dams contain numerous shallow bays, stump fields, undercut banks, and boulder-strewn areas that provide excellent fish habitat (FERC 2002). The lower Chippewa River also provides habitat for lake sturgeon, which is a species of special concern in the watershed. The shoreline along most of the 61 miles of the lower Chippewa River downstream from the Dells Hydro Project is generally steep, relatively undeveloped, and heavily forested. The lower Chippewa River, with its vast wetlands and riverine sloughs, is a corridor of outstanding value that connects to the Upper Mississippi River National Fish and Wildlife Refuge. Both the Chippewa River and Upper Mississippi River are important to sustaining habitat for federally listed threatened and endangered species, federal species of concern, waterfowl and waterbird populations, terrestrial migratory birds, and migratory riverine fishes (FERC 2002).

Source: XCEL Energy, Kleinschmidt, ESRI

FIGURE 1 LOCATION OF THE HOLCOMBE, CORNELL, JIM FALLS, WISSOTA, CHIPPEWA FALLS, AND DELLS HYDROELECTRIC PROJECTS

3.0 DESCRIPTION OF THE HYDROELECTRIC PROJECTS

3.1 HOLCOMBE PROJECT

The Holcombe Project powerhouse has three, vertical, fixed-blade, axial-flow turbines (propeller) with a total generating capacity of 34 megawatts (MW). The turbines each have a maximum hydraulic capacity of 4,000 cubic feet a second (cfs), for a total powerhouse capacity of 12,000 cfs. Xcel Energy operates the turbines at a best-efficiency gate setting, which results in a flow of 3,600 cfs for each unit. Xcel Energy's average annual generation at the Holcombe Project is 101,120 MWh. The intake is integral with the powerhouse, and each turbine bay has a central intake pier with two trashrack sections on either side (Photo 1). The trashracks are constructed of vertical, 3/8-inch-thick bars with 4.625-inch clear spacing between bars. Each rack section is 18.5 feet wide with an invert elevation of 997.5 feet, and a normal headpond elevation of 1,045.0 feet, for an effective height of 47.5 feet. With two racks in each bay, this results in a normal average approach velocity[3] of 2.05 feet per second (fps) at each of the units.

PHOTO 1 HOLCOMBE PROJECT INTAKE AREA

[3] The average approach velocity is calculated by dividing the normal operating (best gate) hydraulic capacity by the gross intake rack area for each turbine unit.

3.2 Cornell Project

The Cornell Project powerhouse contains three, horizontal, fixed-blade, axial-flow turbines and one, vertical, fixed-blade, axial-flow turbine that serves as a minimum flow unit, for a total installed capacity of 21 MW. Xcel Energy's average annual generation at the Cornell Project is approximately 89,000 MWh. The intakes for the three larger turbines are integral with the powerhouse; the minimum flow turbine bay is connected via a conduit (Photo 2). The primary bays have total widths between 42 and 45 feet; however, concrete piers and vertical support beams for trashracks reduce the open intake width of each bay to approximately 35 feet. The trashracks are constructed of vertical, 5/8-inch-thick bars with a clear spacing of 5 3/8 inches between the bars. With an invert elevation of 982.2 feet and a normal headpond elevation of 1002.0 feet, the racks have an effective height of 19.8 feet. Turbines are dispatched at best gate, which has a flow of 3,750 cfs, resulting in a calculated average approach velocity of 5.41 fps. The intake for the minimum flow unit is integral with the forebay retaining wall and is 9.83 feet wide. The intake racks are constructed of 5/8-inch-thick, vertical bars with a clear spacing of 2.375 inches. With an invert at elevation 977.5 feet and a flow of 400 cfs, the average approach velocity at the minimum flow unit is 1.80 fps.

Photo 2 Cornell Project Intake Area

3.3 JIM FALLS PROJECT

The Jim Falls Project has two powerhouses: the primary powerhouse contains two vertical Kaplan turbines, and the minimum flow powerhouse contains a single vertical Francis turbine. The Jim Falls project has a total generation capacity of 57.5 MW; Xcel Energy's average annual generation is approximately 142,000 MWh. The main powerhouse has two integral intake bays that are each 49 feet wide; concrete piers account for 6 feet of that width (Photo 3). The trashracks are constructed of ¾-inch-thick bars inclined 15 degrees from vertical with 5-inch clear spacing between the bars. The tops of the racks are at elevation 934.79 feet and are fully submerged at a normal headpond elevation of 953.2 feet; the bottoms of the racks are at 890.35 feet. Each turbine has an estimated best-gate operating flow of 6,750 cfs, which results in an average intake approach velocity of 3.41 fps. The minimum flow turbine has a penstock-and-siphon intake and consists of a three-sided rack structure with an invert elevation of 942.0 feet; the exact dimensions of the intake rack are unknown, but the combined width of the three sides is more than 30 feet. The intake racks are constructed of 3/8-inch-thick vertical bars with 1-inch clear spacing. The flow through the turbine is 240 cfs, which results in an average approach velocity of less than 1.0 fps at the normal head elevation of 953.2 feet.

PHOTO 3 JIM FALLS PROJECT INTAKE AREA

3.4 WISSOTA PROJECT

The Wissota Project powerhouse contains six, vertical, Francis turbines with a combined installed capacity of approximately 40 MW. Xcel Energy's average annual generation is approximately 144,400 MWh. Xcel Energy upgraded two of the six turbines in 2013 to a capacity of 8 MW; the four original turbines have a capacity of 6 MW. The intake structure is integral with the powerhouse, and each bay has an open width between piers of 26 feet (Photo 4). The trashracks are constructed of 5/16-inch-thick bars inclined 15 degrees from vertical with a clear spacing of 3.75 inches between the bars. The invert of the racks is at elevation 871.0 feet, and the tops of the wetted racks are at normal pond elevation, 898.0 feet. With a best-gate operating flow of 1,850 cfs, the two upgraded turbines have an average approach velocity of 2.56 fps. The other four turbines have a normal flow of 1,440 cfs and approach velocities of 1.98 fps.

PHOTO 4 WISSOTA PROJECT INTAKE AREA

3.5 CHIPPEWA FALLS

The Chippewa Falls Project consists of a gated concrete spillway impounding a 270-acre reservoir, and a six-unit powerhouse at the north end of the dam. Each turbine-generator is rated at 3.6 MW, for a total licensed capacity of 21.6 MW; the station's average annual generation is approximately 71,000 MWh. Two of the turbines are vertical Kaplan machines, and the other four are vertical, fixed-blade axial machines. The integral intake is separated into six 45-foot-wide bays with a clear opening of 39 feet. The invert of the intake is at elevation 810.5 feet, and the vertical racks extend above the normal pond elevation of 839 feet. At a best-gate flow of 1,650 cfs, the approach velocity of the fixed-blade turbines is 1.48 fps; the best-gate flow and approach velocity for the two Kaplan machines are 1,350 cfs and 1.21 fps, respectively. The racks are constructed of ½-inch-thick steel vertical bars with 4.5-inch clear spacing and have been retrofitted with ¾-inch-thick plastic intermediate bars to reduce clear spacing to 1 inch. Because the racks already have a clear spacing of 1 inch, no alternatives were evaluated for the Chippewa Falls Project.

PHOTO 5 CHIPPEWA FALLS PROJECT INTAKE AREA

3.6 DELLS PROJECT

The Dells Project powerhouse contains five units with a combined installed capacity of 11.8 MW. Xcel Energy's average annual generation is approximately 46,160 MWh. One turbine is a vertical Kaplan machine; the other four are horizontal, fixed-blade, axial-flow machines. The intake for the vertical Kaplan turbine is 50 feet wide, and piers account for 14 feet. The other four bays are 28 feet wide, and piers account for 4 feet of the width of each (Photo 6). The racks are constructed of 5/16-inch-thick bars inclined at 15 degrees from vertical with a clear spacing of 4.68 inches between bars. With a rack invert at elevation of 777.0 feet, a normal pond elevation of 795.0 feet, and a best-gate flow of 1,800 cfs, the vertical turbine bay has an average approach velocity of 2.68 fps. The other four units have a trashrack invert elevation of 774.75 feet. Three of those turbines have a best-gate flow of 1,425 cfs, and the other is 800 cfs, for average approach velocities of 2.83 fps and 1.59 fps, respectively.

PHOTO 6 DELLS PROJECT INTAKE AREA

4.0 INITIAL REVIEW OF FISH PROTECTION TECHNOLOGIES

Measures to protect fish at water intakes usually rely on physical barriers, mechanisms that affect fish behavior, or operational strategies. Physical barriers are designed to exclude fish from water intakes and diversions. Behavioral barriers elicit a negative (repulsive) response to keep fish from entering intakes and water diversions. Operational measures (e.g., fish-friendlier turbines or reductions in generation) can be employed strategically to use the biological and life-history requirements of fish to reduce the chances they will interact with the turbines (e.g., during specific time periods associated with downstream migration).

As an initial step, Kleinschmidt evaluated 20 measures that have been used to reduce entrainment of fish at various water diversions (e.g., cooling water intakes, irrigation diversions, and hydroelectric facilities) throughout the United States. During the initial review, Kleinschmidt eliminated options that (1) are not known to be biologically effective or are experimental, (2) may have prohibitive costs, (3) would require excessive maintenance, or (4) are based on criteria for design or resource protection that are not applicable to the Chippewa River (i.e., protection of diadromous fish species). Table 1 provides a summary of the options considered feasible or infeasible at Xcel Energy’s lower Chippewa River hydroelectric projects.

TABLE 1 SUMMARY OF FEASIBLE AND INFEASIBLE OPTIONS FOR FISH PROTECTION AT XCEL ENERGY'S LOWER CHIPPEWA RIVER HYDROELECTRIC PROJECTS

BARRIER TYPE	DESCRIPTION	FEASIBLE FOR HOLCOMBE?	FEASIBLE FOR CORNELL?	FEASIBLE FOR JIM FALLS?	FEASIBLE FOR DELLS?	FEASIBLE FOR WISSOTA?
Physical	**Drum Screens** - rotating mesh (woven wire) covered drums to exclude fish and debris from the intake area	No	No	No	No	No
	Coanda Screens - screening mechanism installed on a spillway or hydraulic drop	No	No	No	No	No
	Submerged Cylindrical Screens - submerged screens at the intake of diversion conduits	No	No	No	No	No
	Traveling Screens – Belt driven vertical or inclined intake screening system	No	No	No	No	No
	Eicher Screens - Closed conduit system developed for hydroelectric projects	No	No	No	No	No
	Inclined Trashrack or Screens - Sloped intake with narrow spaced bar racks	**Yes**	No	No	**Yes**	**Yes**
	Full-depth Narrow Spaced Trashracks - Replace existing trashracks with narrow spaced bar racks	**Yes**	**Yes**	**Yes**	**Yes**	No
	Partial-Depth Trashracks - Replace top 10 feet of existing trashracks with narrow spaced bar racks	No	No	No	No	No
	Angled Bar Rack System - Full depth angled bar rack structure with narrow spaced racks	No	**Yes**	**Yes**	No	No
	Full-depth or Partial Depth Floating Barrier Net - Heavy duty netting system	**Yes**	**Yes**	**Yes**	No	**Yes**
	Full or Partial Depth Seasonal Overlays - Temporary screening overlain on trash rack face	No	No	No	No	No
Behavioral	**Sound Deterrent System -** sound to deter fish from intake areas	No	No	No	No	No
	Light Deterrent System - lighting systems to deter fish from intake areas	No	No	No	No	No
	Air Bubbler System - air bubblers to deter fish from intake areas	No	No	No	No	No
	Louver System - induces turbulence along a rack system to guide fish away from the intake area	No	No	No	No	No
	Electrical Barrier - low voltage electrical system to deter fish from intake areas	No	No	No	No	No
Operational	**Unit Shutdowns** - employed strategically based on outmigration time frames of migratory fish	No	No	No	No	No
	Unit Turndowns - reduce flow through to reduce approach velocities	No	No	No	No	No
	Fish Friendlier Turbines – replace turbines with Alden or Kaplan minimum gap runner	No	No	No	No	No

Note: The Chippewa Falls Project intake is already retrofitted with 1-inch clear spacing between bars; therefore, that facility was excluded from the fish protection alternatives analysis.

4.1 PHYSICAL BARRIERS

Drum Screens – Drum screens consist of a series of screened cylinders placed at an angle to the flow, such that the axis of each cylinder is oriented horizontally. The cylinders (drums) rotate slowly, such that the anterior surface moves up and out of the flow while the trailing surface rotates down. The rotating drums carry debris up on the anterior surfaces, and it is washed off on the backside as the flow passes through the screen. Sweeping flows across the cylinders guide fish to a bypass around the diversion. Drum screens typically are used at in-canal diversions (e.g., at irrigation diversions). They are suitable for small volumes of water with stable water-surface elevations (USBR 2006). Capital and operation and maintenance costs are typically high. We consider drum screens to be infeasible for the Chippewa River hydroelectric projects because of their specific application for in-canal systems that process small volumes of water, expense, and operational and maintenance requirements.

Coanda Screens – Coanda screens are installed on the downstream face of concrete overflow weirs. Water passes over the weir, passing fish and debris across the downstream end of the screen. Given its specific weir-crest application, we consider this technique infeasible for the Chippewa River hydroelectric projects.

Submerged Cylindrical Screens – This design consists of a fully submerged screen module placed in a lake or river at the intake of pumped or gravity-fed diversions for irrigation water, process water, cooling water, or for small hydropower applications (USBR 2006). Submerged cylindrical screens are the most common design, although conical and inclined modules are used for fish protection where applicable. Given its design as a modular component of a conduit withdrawal system, we consider the submerged screen to be infeasible for the Chippewa River hydroelectric projects.

Traveling Screens – Traveling screens rely on a system of belt-driven screens rotating through the water column intermittently or continuously to clear debris. They can be installed vertically or on an incline. Traveling screens are common at intakes for process water and cooling water, where small volumes of flow are diverted (e.g., small diversions or at secondary dewatering structures in fish bypasses) (USBR 2006). Given their specific, low-volume application and large capital expense, we consider traveling screens to be infeasible for the Chippewa River hydroelectric projects.

Eicher Screens – Eicher screens are patented, passive, inclined screens that can be installed in a closed system (e.g., penstock) to divert fish from the turbines. The design includes a flat screen panel that is placed diagonally to flow and is supported by a pivot-beam at the mid-point of the conduit. Water passing through the screen guides fish over the screen to a fish bypass. Eicher screens may increase the potential for injuring fish because of the elevated water velocities across the screen. Substantial head loss is likely (up to 2.5 feet). Eicher screens are expensive, and their effectiveness is unproven (USBR 2006). We consider this technique to be infeasible for the Chippewa River hydroelectric projects because of its potential to injure fish, the lack of closed-conduit systems (i.e., penstocks) at the projects, uncertainty regarding effectiveness of the technology, expected head loss, and expense.

Inclined Screens – Inclined screens typically are placed at a shallow slope on the channel bed upstream of an intake. These screens are designed for bottom-oriented or migratory species that require a downstream bypass. Fish and debris are swept over the length of the screen towards a bypass located at the upper end of the screen. Inclined screens can also be used to increase the intake area, thereby reducing the water velocities and the chances for impingement or entrainment. Sedimentation, rack cleaning, and debris loading can be major issues with these screens; however, submerged inclined screens with narrowly spaced trashracks may be feasible at the Holcombe, Wissota, and Dells projects, as discussed in detail in Section 5.0.

Full-depth, Narrowly Spaced Trashracks – A common method to protect fish at intakes is to replace or install trashracks with full-depth, narrowly spaced vertical-bar racks. The USFWS often recommends clear spacing of 1-inch between trashrack bars for the protection of fish species in the Midwest. Although trashracks with narrowly spaced bars exclude large-bodied fish, they can cause increased water velocity that may impinge fish, increased formation of frazil ice, and increased maintenance. Nevertheless, this option may be feasible at the Holcombe, Cornell, Jim Falls, and Dells projects and is discussed in detail in Section 5.0.

Partial-depth, Narrowly Spaced Trashracks – Partial-depth trashracks have been used regularly in the Northeast to screen the upper portion of intakes at hydroelectric facilities. Typically, this application is designed to protect migratory fish (e.g., river herring or Atlantic salmon) that use the upper portion of the water column during their outmigration. In recent years, effectiveness testing (e.g., radio-telemetry studies) has demonstrated that these techniques may not prevent entrainment of all individuals because fish often sound to deeper sections where the racks are wider, allowing passage via the turbines. Given the ability of fish to sound below a partial-depth rack, and the potential presence of lake sturgeon (a bottom-oriented species), this technique is considered infeasible for the Chippewa River hydroelectric projects.

Angled Bar Racks – An angled, vertical-bar trashrack system typically is installed to guide downstream migrants to a bypass, or to increase the rack area in front of an intake to reduce water velocities and, therefore, reduce the chances for impingement or entrainment. These methods are used commonly at intakes where velocities are fairly high (e.g., 3 to 5 feet per second), which is the case at several of the Chippewa River projects. Angled intakes with narrowly spaced trashracks may be feasible at the Cornell and Jim Falls projects, as discussed in detail in Section 5.0.

Floating or Anchored Barriers (Partial-depth and Full-depth) – Partial-depth and full-depth floating or anchored barriers have been used to reduce fish entrainment at hydroelectric facilities with some regularity. Examples of floating or hanging barriers include mesh nets, Kevlar screens, and perforated metal plates. Most often, these measures are used to guide outmigrating diadromous fish (e.g., salmon and herring) to a downstream bypass. Floating or anchored barrier systems also have been used at hydroelectric facilities to protect resident fish from entrainment and impingement. Nets typically are designed with narrow openings (less than 1 inch). Although nets typically are coated with a material that prevents biofouling, debris loading and cleaning efforts can be considerable. Nets are either anchored to the bottom of the channel or canal bed or suspended from large floating booms. These types of barrier nets are generally applicable in areas of low water velocity. Depending on the type, size, frequency, volume, and timing of debris, full-depth nets may be practical at some locations. Partial-depth barriers are impractical for the Chippewa River projects because of the potential presence of lake sturgeon and the fact that fish can sound to depth. The feasibility of installing full-depth barrier nets at the Holcombe, Cornell, Jim Falls, and Wissota projects is discussed in Section 5.0.

Full-depth or Partial-depth Seasonal Overlays – Seasonal overlays have been used to minimize the entrainment of fish in the Northeast with some success. These temporary screen overlays are installed on top of an existing trashrack to reduce the open area. Overlays typically are constructed from perforated metal plates, vertical-bar racks, expanded wire mesh, or other applicable screening materials. Overlays are installed seasonally to target a specific life stage of outmigrating diadromous fish (e.g., Atlantic salmon smolts during the spring or river herring during the late summer and early fall). Overlays tend to be difficult to clean, and clogged screens periodically cause head loss. We consider this technique infeasible for the Chippewa River projects because of its use to target specific migratory periods and its maintenance requirements.

4.2 Behavioral Mechanisms

Sound, Light, Electricity, and Air Bubbler Systems – These types of deterrents are considered to be experimental technologies that elicit varying responses from fish (USBR 2006). The performance of these systems is not well documented, and they can be adversely affected by environmental conditions (e.g., water clarity) (USBR 2006, USBR 2009). These measures are not absolute barriers to fish, and exclusion rates tend to be lower than those for conventional screens (USBR 2009). Given their unproven effectiveness, we consider these techniques to be infeasible for the Chippewa River projects.

Louvers – A louver consists of an array of vertical bars installed at an angle to flow (e.g., 15 to 30 degrees). Louvers exclude fish by creating turbulence along the bar rack, which fish avoid (repulsive reaction). The vertical bars usually are oriented perpendicularly to the axis of flow. The resulting turbulence creates a transverse flow along the face of the louver array. Generally, fish follow the transverse flow to a downstream bypass at the end of the array. Louvers typically are installed in river systems in which diadromous fish species require downstream passage. Several studies have been conducted to evaluate louver efficiencies as a function of design parameters; however, uncertainty persists concerning whether a louver system is an effective means of protection for a specific fishery (USBR 2006). We consider this technology infeasible for the Chippewa River projects because louver systems are more appropriate for migratory fish species seeking a downstream bypass, because their effectiveness is unproven, and because installation is not cost-effective.

4.3 Operational Measures

4.3.1 Reduced Generation

Changes of operations may be appropriate at facilities on river systems that have actively migrating diadromous fish species (e.g., Atlantic salmon, American eel, and river herring) because the times during which these species move are well defined. Reducing flow through turbines beyond the design operating range can induce excessive vibration that can damage equipment. In addition, turbine efficiency decreases significantly when turbine flows are reduced below the optimal range of operation, which reduces energy generation. Deliberately reducing generation is not a viable option for protecting fish at the Chippewa River projects because no diadromous fish species are present in their vicinity and because of the potential to damage equipment.

4.3.2 Fish-Friendlier Turbines

Two turbine designs promoted as being “fish friendly” are the helical Alden turbine designed by Alden Research Laboratory, Inc., and the minimum gap runner (MGR), a type of Kaplan turbine designed by Voith. Alden turbines have been tested primarily using computational fluid dynamic models that have not been verified in the field. Studies of an MGR installed at Bonneville dam in Washington State demonstrated a 2 percent reduction in mortality (down from 4 percent for a standard Kaplan turbine) for fish near the blade tip. Fish along the mid-blade area sustained lower mortality (about 1 percent, down from 2 percent); however, at the hub of the turbine, fish mortality at the MGR was 0.5 percent greater than the mortality expected at a standard Kaplan turbine. A 2007 assessment of an MGR installed at Wanapum Dam (Washington State) demonstrated no statistical difference in blade strike, shear, or other types of injury compared to conventional Kaplan turbines (Dauble et al. 2007).

The helical Alden turbine was originally designed for use with net head between 75 feet and 100 feet, although design modifications are speculated to extend feasible use to a lower limit of 30 feet. The Chippewa Falls and Dells projects have just below 30 feet of gross head; the other four projects evaluated herein have gross heads ranging between 37 and 57 feet. The modified design with the extended range, therefore, could be applied to these projects, but doing so would constitute pilot tests of the Alden turbine outside of the current design range. The MGR turbines are custom-designed Kaplan machines with spherical hubs, and blades contoured to match a spherical discharge ring insert. The applicability to projects, therefore, is identical to that of Kaplan machines. Each of the Chippewa River projects has a gross head well within the range of the Kalpan turbine.

Cost estimates for the Alden turbine are indexed by 3 percent annually for a 2016 cost of $1,680 a kilowatt (EPRI 2011). This cost estimate includes the generator, which would have to be replaced at some projects to accommodate the slower rate of rotation associated with the Alden design, but does not include costly civil modification of the powerhouses that would be necessary at every project because of the different geometry of the Alden turbine. The total cost to install Alden turbines is estimated to range between $20 million and $94 million for each hydroelectric project.

The cost to install the MGR turbines was estimated using recent bids for Kaplan turbines, which average approximately $530 a kilowatt, resulting in an equipment cost ranging between $6 and $30 million. No actual MGR quotes were solicited for this effort, but equipment costs would be expected to exceed this indexed estimate due to custom-designed elements associated with the technology. Moreover, this indexed cost does not include equipment installation or civil modifications, the combination of which could easily match or surpass estimated equipment costs. The total cost of installing MGR turbines is estimated to range between $12 million and $60 million for each hydroelectric project.

Given the expense, the major structural upgrades required (similar in scale to completely redeveloping a site), and the uncertainty concerning the biological benefits, installing fish-friendlier turbines is not a viable alternative for protecting fish at the Chippewa River projects.

5.0 DETAILED EVALUATION OF SELECTED ALTERNATIVES

Limited advancements in downstream fish passage and protection technologies at hydropower projects have been made in the past 10 to 20 years. Many of the physical, behavioral, and operational alternatives described in Section 4.0 are likely to be ineffective for protecting small resident fish in the Chippewa River; would require major, costly changes that exceed the funds that Xcel Energy has dedicated to fish protection pursuant to the Settlement; or are in various stages of development. Newly constructed downstream fish protection systems at hydropower projects typically rely on existing, straight-forward technologies such as narrowly spaced trashrack systems, full-depth or partial-depth guidance devices leading to downstream fish bypasses, angled rack structures, or barrier nets; therefore, we reviewed the feasibility of these standard protection alternatives for resident fish species at the Holcombe, Cornell, Jim Falls, and Dells hydroelectric projects. Fish protection technologies at hydropower intakes have not changed significantly since Xcel Energy completed its fish protection study at the Wissota Project in 1997; therefore, we selected two options identified in the 1997 study and updated the opinion of probable construction costs to the current dollar value.

Our analysis focuses on screening measures (i.e., trashrack bars) that have 1-inch clear openings, which is a standard USFWS design recommendation for fish protection at hydropower intakes. Although narrower screens can be used, they are not likely to be biologically effective or cost-effective because they will result in water velocities that may impinge fish, cause more head loss across the trashracks, and significantly increase debris loading and maintenance. Based on the results of Xcel Energy's fish entrainment study at the Wissota Project in the late 1990s, which demonstrated that the majority of entrained fish were less than 3 inches long and 96% were less than 6 inches long (GLEC 2000), fish protection measures with trashrack bars spaced wider than 1-inch were excluded from this evaluation because they would not prevent the entrainment of small resident fish species. Table 2 provides a summary of the options that we considered for each site. The intake at the Jim Falls minimum flow powerhouse already has narrowly spaced bar racks with approach velocities less than 2.0 fps; therefore, we considered no additional alternatives for that unit. The Chippewa Falls Project intake is also retrofitted with 1-inch clear spacing between bars; therefore, that facility was excluded from the fish protection alternatives analysis.

TABLE 2 FISH PROTECTION ALTERNATIVES AT THE DELLS, JIM FALLS, CORNELL, AND HOLCOMBE HYDROELECTRIC PROJECTS

ALTERNATIVE DESCRIPTION	HOLCOMBE	CORNELL	JIM FALLS	WISSOTA	DELLS
Replace existing trashracks with narrowly spaced trashracks	x	x	x		x
Inclined bar rack structure with full-depth, narrowly spaced trashracks	x			x	x
Angled bar rack structure with full-depth, narrowly spaced trashracks		x	x		
Floating barrier net system	x	x	x	x	

Our analysis of these alternatives considered the following:

- engineering feasibility;
- material selection;
- civil/structural concerns with regard to location, concept configurations, and loads on system elements;
- operation and maintenance requirements;
- general acceptability of technology with resource agencies; and,
- biological effectiveness.

In addition, we prepared opinions of probable construction and maintenance costs, analyzed head loss and effects on energy generation, assessed the effects of the measures on turbine operations, and assessed the potential for entrainment and impingement of resident species of management interest, where applicable.

5.1 TRASHRACKS WITH NARROWLY SPACED BARS

This option involves replacing the existing trashracks at the Holcombe, Cornell, Jim Falls, and Dells projects with new trashracks that have narrowly spaced steel bars. Vertical trashrack bars would be 0.375-inch thick with horizontal tie-rods placed at 3-foot intervals to prevent spreading as a result of debris accumulation. Although a trashrack system with narrowly spaced bars would deter fish from swimming through the intakes volitionally and would reduce entrainment of large-bodied fish, through-rack velocities (i.e., the velocity of the water as it accelerates through the trashrack bars) would increase, potentially increasing the number of fish impinged on the racks. Appendix A provides calculations of through-rack velocity at each turbine intake resulting from the installation of narrowly spaced trashracks (i.e., 1-inch clear opening).

Table 3 summarizes our assessment of the operational requirements and maintenance requirements, engineering feasibility, and biological feasibility of this option. Table 4 provides our opinion of probable construction costs and the estimated annual operation and maintenance costs. This estimate does not include additional indirect costs associated with owner's administration, finance, insurance, outages associated with installation, or other non-capital costs. We expect Xcel Energy would not be able to use the existing debris raking systems, and replacement estimates are provided.

Additional cleaning and rack maintenance would be required, including semiannual underwater inspections to assess rack integrity and clear debris that becomes wedged between vertical bars. A system for monitoring head on both sides of the racks also would be necessary to detect head loss resulting from excessive debris loading. Narrowing the spacing between bars in trashracks may result in accumulation of frazil ice (i.e., super-cooled slush freezing to structures on contact) by intercepting more ice and providing more nucleation surface upon which ice can form, which would increase head loss and reduce generation. Frazil ice can accumulate rapidly and can completely cover a trashrack. For these reasons, a fully automated raking system would be required to keep racks clear.

TABLE 3 FEASIBILITY CONSIDERATIONS FOR TRASHRACKS WITH NARROWLY SPACED BARS

ENGINEERING FEASIBILITY?	FEASIBLE
Material selection	Steel bar-rack system
Construction methods/techniques	Replacement of existing trashracks (in the wet)
Civil/structural issues	Assumes the existing intake structure is capable of supporting the loads from the new racks
Operation and maintenance requirements	Additional cleaning and monitoring, increased debris load, will require modifications of the existing trash rake, potential frazil ice issues
Construction/installation concerns	Assumes the existing intake support structures are in good condition and will not require replacement
Acceptability of technology	Standard recommended by resource agencies
Biological considerations	1-inch spacing unlikely to prevent entrainment of juvenile resident fish species; increased through-rack velocities for trashracks less than or equal to 1-inch likely to increase number of fish impinged

TABLE 4 OPINION OF PROBABLE COSTS FOR TRASHRACKS WITH NARROWLY SPACED BARS

PROJECT	CONSTRUCTION COSTS	ANNUAL O & M COSTS*
Holcombe	$1,872,000	$41,000/yr.
Cornell	$1,207,000	$41,000/yr.
Jim Falls	$1,734,000	$41,000/yr.
Dells	$1,900,000	$41,000/yr.
TOTAL	**$6,713,000**	**$164,000/yr.**

*Assumes that two operators have to spend an average of one additional hour every other day to clean the racks.

5.2 Angled Bar Rack with Narrowly Spaced Bars

This option would involve installing new, full-depth, angled bar rack structures upstream of the intakes for the Cornell and Jim Falls projects. The angled bar rack structures would extend from the spillway side of each powerhouse upstream to the forebay wall at an angle of 15 to 45 degrees. The structures would have narrowly spaced, steel-bar racks with 0.375-inch-thick bars and horizontal tie-rods placed at 3-foot intervals to prevent spreading as a result of debris accumulation. The angle of the bar rack would be selected to provide enough rack area to limit approach velocities to 2.0 fps to reduce entrainment and impingement.

Figure 2 below shows an example of what an angled bar rack structure would look like at a generic hydroelectric site. Detailed sketches of the proposed layout of angled bar rack structures at the Cornell and Jim Falls Projects are included in Appendix F.

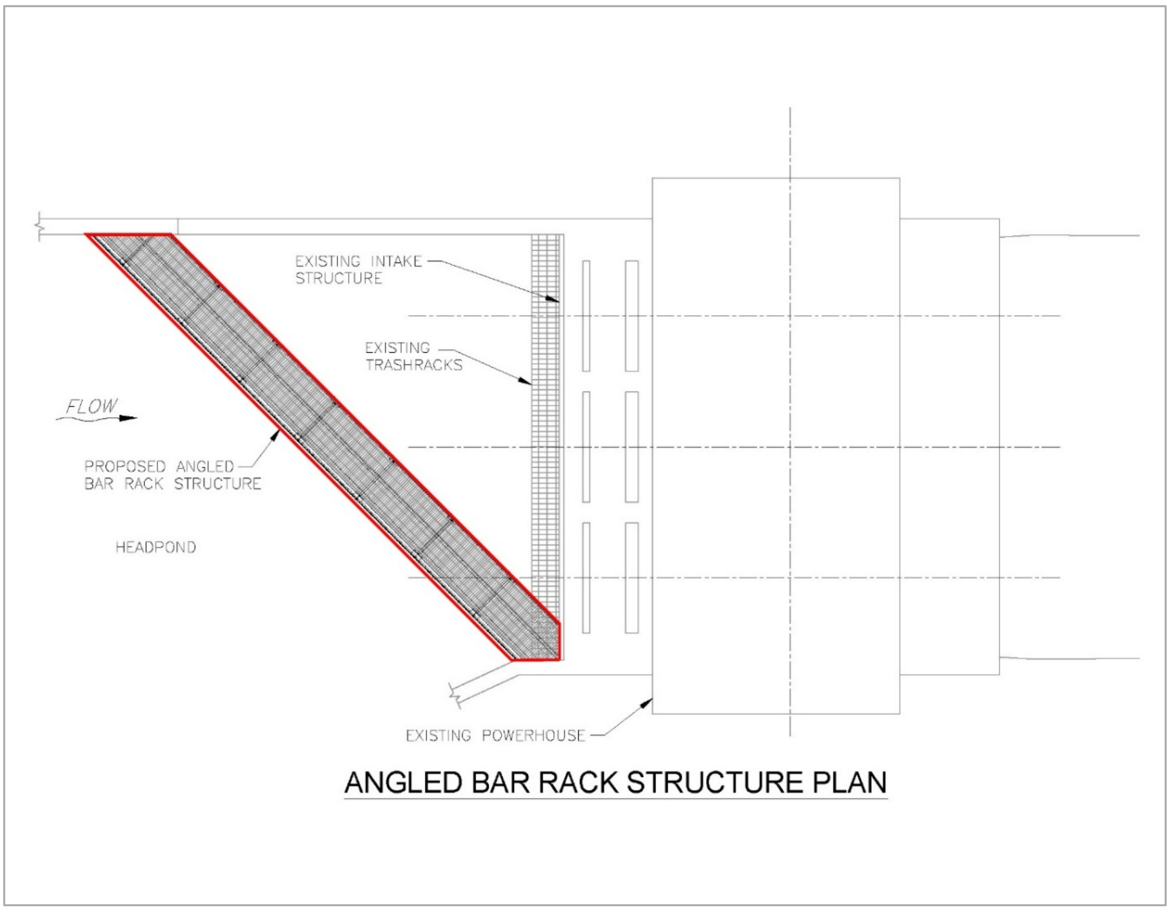

Figure 2 Angled Bar Rack Structure - Plan View

Table 5 summarizes our assessment of the operations and maintenance requirements, engineering feasibility, and biological feasibility of this option. Table 6 provides our opinion of probable construction costs and the estimated annual operation and maintenance costs. This estimate does not include additional indirect costs associated with owner's administration, finance, insurance, outages associated with installation, or other non-capital costs. Our cost estimate assumes that Xcel Energy would need to install new debris-cleaning rakes.

Additional cleaning and rack maintenance would be required, including semiannual underwater inspections to assess rack integrity and clear debris that becomes wedged between vertical bars. New fully automated mechanical trash rakes would be required for cleaning and maintaining the angle bar racks. A system for monitoring head on both sides of the racks also would be necessary to detect head loss resulting from excessive debris loading. Narrowing the rack bar spacing may result in increased accumulation of frazil ice (i.e., super-cooled slush freezing to structures on contact) by intercepting more ice and providing more nucleation surface upon which ice can form, which would increase head loss and reduce generation.

An angled bar rack is impractical at the Holcombe Project because of the high cost of construction and because the existing approach velocities are already very close to 2.0 fps.

TABLE 5 FEASIBILITY CONSIDERATIONS FOR ANGLED BAR RACK SYSTEM

ENGINEERING FEASIBILITY?	**FEASIBLE**
Material selection	Steel bar-rack system
Construction methods/techniques	New construction (in the wet)
Civil/structural issues	Assume bedrock is present for intake structure foundation; structural design for fully blinded racks due to increased potential for ice buildup
Operation and maintenance requirements	Additional cleaning and monitoring, increased debris load
Construction/installation concerns	Construction will likely need to be completed in the wet with a barge and divers
Acceptability of technology	Recommended by resource agencies on site-specific basis
Biological considerations	1-inch spacing unlikely to prevent entrainment of juvenile resident fish species

TABLE 6 OPINION OF PROBABLE COSTS FOR ANGLED BAR RACK SYSTEM

PROJECT	CONSTRUCTION COSTS	ANNUAL O & M COSTS*
Cornell	$6,984,000	$131,000/yr.
Jim Falls	$4,681,000	$111,000/yr.
TOTAL	**$11,665,000**	**$242,000/yr.**

* Assumes that two operators have to spend an average of two additional hours per day every other day to clean the racks.

5.3 INCLINED BAR RACK WITH NARROWLY SPACED BARS

This option would involve installing new, inclined trashracks at the Holcombe, Wissota, and Dells projects. The inclined trashracks would be positioned slightly upstream of the powerhouse intake area for each turbine; the angle of the racks would range from approximately 15 to 45 degrees. The structure would have narrowly spaced 0.375-inch-thick steel bars and horizontal tie-rods placed at 3-foot intervals to prevent spreading as a result of debris accumulation. The narrowly spaced bars would reduce the ability of fish to swim through volitionally or to be entrained through the intake. The inclination of the rack would be selected to provide enough rack area to limit approach velocities to 2.0 fps to reduce entrainment and impingement. This option was not considered at other intakes because the inclined racks would result in approach velocities greater than 2.0 fps.

Figure 3 and Figure 4 show an example of what an inclined trashrack structure would look like at a generic hydroelectric site. Detailed sketches of the proposed layout of inclined trashrack structures at the Holcombe, Wissota and Dells Projects are included in Appendix F.

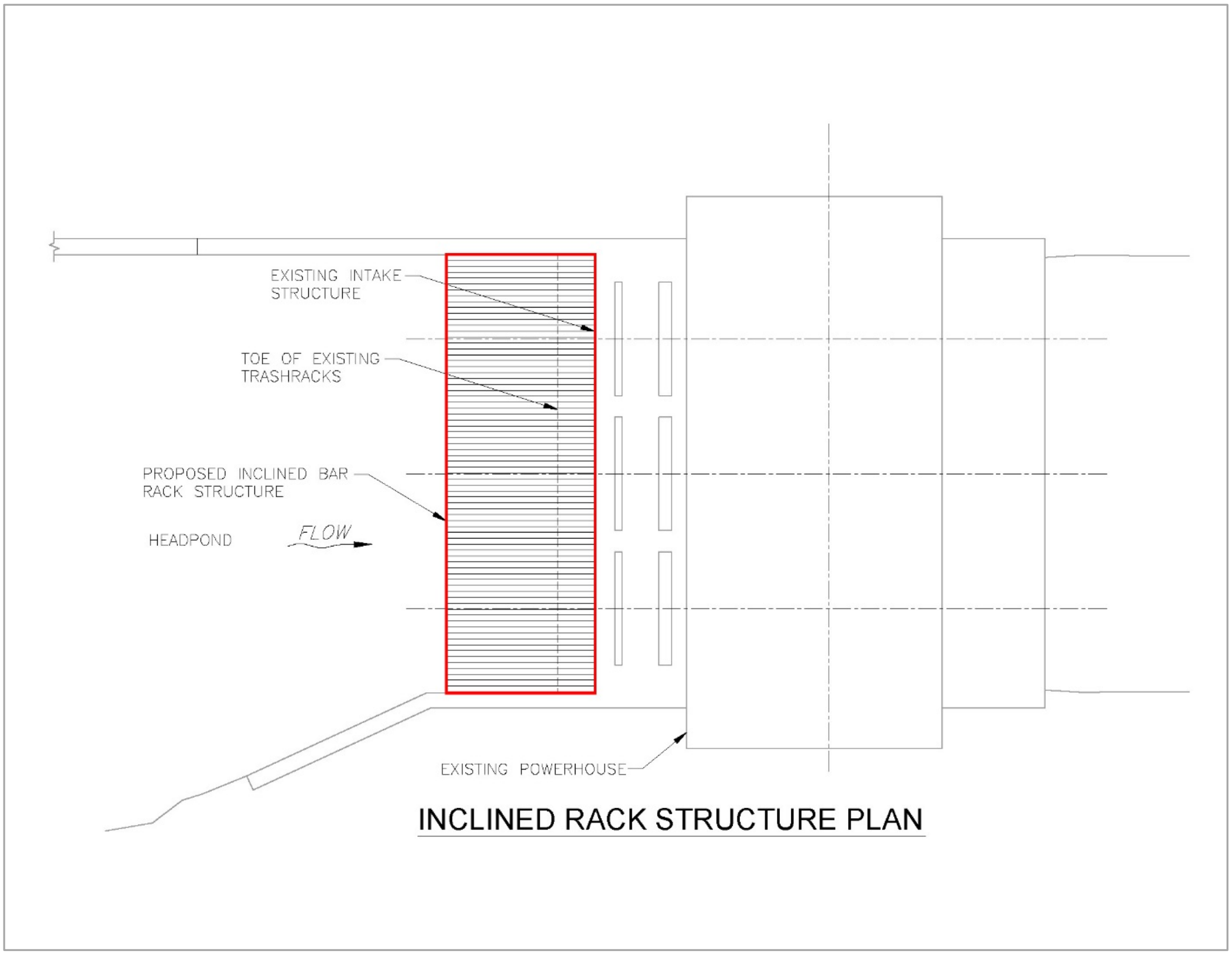

FIGURE 3 INCLINED TRASHRACK STRUCTURE - PLAN VIEW

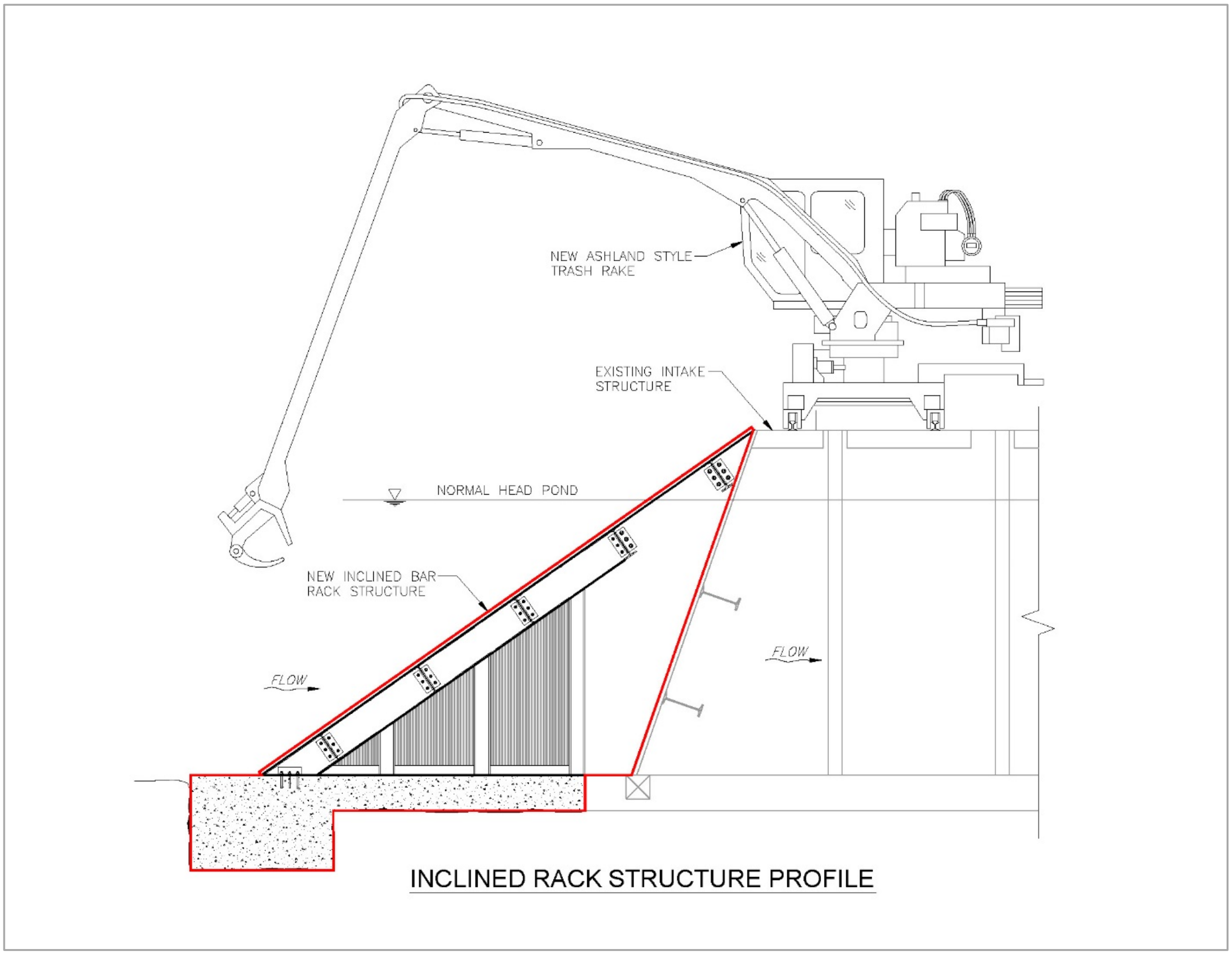

FIGURE 4 INCLINED TRASHRACK STRUCTURE - PROFILE VIEW

Table 7 summarizes our assessment of the operations and maintenance requirements, engineering feasibility, and biological feasibility of this option. Table 8 provides our opinion of probable construction costs and the estimated annual operation and maintenance costs. This estimate does not include additional indirect costs associated with owner's administration, finance, insurance, outages associated with installation, or other non-capital costs.

New fully automated mechanical trash rakes would be required for cleaning and maintaining the racks. Additional cleaning and rack maintenance would be required, including semiannual underwater inspections to assess rack integrity and clear debris that becomes wedged in between vertical bars. A system for monitoring head on both sides of the racks also would be necessary to detect head loss resulting from excessive debris loading. The inclined rack may result in increased accumulation of frazil ice by intercepting more ice and providing more nucleation surface upon which ice could form.

TABLE 7 FEASIBILITY CONSIDERATIONS FOR INCLINED RACK SYSTEM

ENGINEERING FEASIBILITY?	FEASIBLE
Material selection	Steel bar-rack system
Construction methods/techniques	New construction (in the wet)
Civil/structural issues	Assume bedrock is present for intake structure foundation; structural design for fully blinded racks due to increased potential for ice buildup
Operation and maintenance requirements	Additional cleaning and monitoring, increased debris load
Construction/installation concerns	Construction will likely need to be completed in the wet with a barge and divers
Acceptability of technology	Recommended by resource agencies
Biological considerations	1-inch spacing unlikely to prevent entrainment of juvenile resident fish species; increased through-rack velocities for trashracks less than or equal to 1-inch likely in increase number of fish impinged

TABLE 8 OPINION OF PROBABLE COSTS FOR INCLINED RACK SYSTEM

PROJECT	CONSTRUCTION COSTS	ANNUAL O & M COSTS*
Holcombe	$3,518,000	$66,000/yr.
Wissota	$5,851,000	$110,000/yr.
Dells	$3,680,000	$66,000/yr.
TOTAL	**$13,049,000**	**$242,000/yr.**

* Assumes that two operators have to spend an average of one additional hour per day every other day to clean the racks.

5.4 FLOATING BARRIER NET

This option involves installing a full-depth, heavy-duty netting system just upstream of the Holcombe, Cornell, Jim Falls and Wissota intakes. For these sites the barrier net would be L-shaped, extending from the spillway side of each powerhouse directly upstream to an anchor point in the existing forebay and then extending from the anchor point at a 90-degree angle over to the forebay wall or shoreline. The nets would be constructed of knotless, heavy-duty material (e.g., Dyneema)[4] with a small mesh opening (i.e., less than 1 inch). Although nets would be coated with a material that prevents bio-fouling, debris loading and cleaning could be considerable. Nets would be anchored to the bottom of the channel or canal bed and suspended from large floating booms. The nets probably would be installed seasonally during the period when freezing of the headpond was not a concern. Debris fouling could be a significant issue because the nets cannot be cleaned easily like trashracks. Xcel Energy would need to deploy divers regularly to clean the nets and annually to retrieve them to prevent damage due to ice or debris. The potential for the nets and anchoring system to fail under a heavy debris load may limit the feasibility of this option. The floating barrier net would reduce the ability of fish to swim through the intake volitionally or to be entrained. The layout of the net would be selected to provide enough area to limit approach velocities to be less than 1.0 fps to reduce entrainment and impingement. This option is infeasible at the Dells Project due to heavy debris loading in the impoundment.

Detailed sketches of the proposed layout of barrier nets at the Holcombe, Cornell, Jim Falls, and Wissota Projects are included in Appendix F. Table 9 summarizes our assessment of the operations and maintenance requirements, engineering feasibility, and biological feasibility of this option. Table 10 provides our opinion of probable construction costs and the estimated annual operation and maintenance costs. This estimate does not include additional indirect costs associated with owner's administration, finance, insurance, outages associated with installation, or other non-capital costs.

[4] Strong light fiber used in commercial fishing and aquaculture operations made from ultra-high molecular weight polyethylene.

TABLE 9 FEASIBILITY CONSIDERATIONS FOR FLOATING BARRIER NET

ENGINEERING FEASIBILITY?	FEASIBLE
Material selection	Dyneema or comparable netting, concrete anchors, floating booms
Operations and maintenance requirements/issues	Additional cleaning and debris loading; annual removal and installation to prevent damage from ice; dive inspections; replacement or mending of nets if damage from woody debris occurs
Construction methods/techniques	Cranes or boom-truck; divers required
Civil/structural issues	Loads on anchors for floating boom will be significant
Acceptability of technology	Has been used in the Mid-West in some situations
Biological considerations	Typically, effective for larger bodied fish, may cause impingement in nets, resulting in injury or mortality; may dissuade smaller fish from entering the intake areas

TABLE 10 OPINION OF PROBABLE COSTS FOR FLOATING BARRIER NET

PROJECT	CONSTRUCTION COSTS	ANNUAL O & M COSTS*
Holcombe	$1,072,000	$80,000/yr.
Cornell	$1,542,000	$90,000/yr.
Jim Falls	$1,158,000	$80,000/yr.
Wissota	$933,000	$60,000/yr.
TOTAL	**$4,705,000**	**$310,000/yr.**

* Assumes that a dive team will be on site for installation, removal, and cleaning twice per year (spring and fall).

5.5 WISSOTA FISH PROTECTION

No significant advances in downstream fish protection technology have been made since Xcel Energy completed the conceptual design study of fish protection alternatives at the Wissota Project in 1997. Therefore, we reviewed two options identified in the 1997 study (i.e., floating barrier net and an inclined intake structure with full-depth, narrowly spaced trashracks) and updated the costs to 2016 dollars. The cost for the floating barrier net was scaled using the historical cost index from RS Means. Since no cost was included in the 1997 study for a new inclined intake structure the cost was scaled from the angle bar rack structure for Jim Falls because the required length and incline were similar to what would be required for Wissota. Our opinion of probable construction costs and the estimated annual operation and maintenance costs for the floating barrier net and inclined intake structure are provided in Table 8 and Table 10.

6.0 HEAD LOSS ANALYSIS

Head loss values at each turbine were calculated for each project, except Chippewa Falls. As flow enters the turbine bays, the physical obstruction caused by the bars on the intake rack reduces the gross flow area, which results in increased water velocity through the rack (i.e., through-rack velocity). Greater velocities cause increased drag forces, represented as dynamic head losses. The primary obstruction for clean intake racks is due to the thickness of the vertical bars (typically 3/8 inch) and the clear spacing between them (varies); therefore, reducing the spacing between the vertical bars represents a direct increase (non-linear) in dynamic head loss. Debris that collects on the intake racks partially blocks the intake, effectively reducing the gross area. This "blinding" of the intake racks further increases water velocity through the remaining open areas, contributing to the dynamic head losses.

We examined head losses for the existing rack configurations and the alternatives selected for further review. Each site was analyzed for a range of trashrack blinding conditions as well as 1-inch bar spacing. Four percentages of trashrack blinding were examined: 0, 15, 25, and 50. Dimensions of the trashracks were obtained from historical project drawings and measurements taken during a site visit. Table 11 summarizes the alternatives analyzed for each site. Head loss is considered to be minimal for the floating barrier net alternatives.

TABLE 11 FISH PROTECTION ALTERNATIVES REVIEWED IN DETAIL

PROJECT	SELECTED ALTERNATIVES
Holcombe	- Replace existing trashracks with narrowly spaced bar racks - Inclined intake structure with full-depth narrowly spaced trashracks
Cornell	- Replace existing trashracks with narrowly spaced bar racks - Angled bar rack structure with full-depth narrowly spaced trashracks
Jim Falls	- Replace existing trashracks with narrowly spaced bar racks - Angled bar rack structure with full-depth narrowly spaced trashracks
Wissota	- Replace existing trashracks with narrowly spaced bar racks - Inclined intake structure with full-depth narrowly spaced trashracks
Dells	- Replace existing trashracks with narrowly spaced bar racks - Inclined intake structure with full-depth narrowly spaced trashracks

6.1 METHODS

For the inclined racks, the trashracks were assumed to be at an incline of approximately 15 to 45 degrees. The depth of rack in the water was increased to account for the incline in the bars. For the angled bar racks, the racks were assumed to have a slight incline of 15 degrees, so the depth of rack in the water was assumed to be equal to the difference between the headpond and invert elevations. Using the bar spacing, bar widths, and any supports attached to the bars, the total blocked area was calculated and subtracted from the gross area to obtain the net flow area through the trashracks.

The head losses through each rack were calculated using the formula $H_L = K*(V^2/2g)$, where:

H_L = head loss (feet)
K = loss coefficient
V = flow velocity through the rack (feet/second)
g = gravitational constant (feet/second squared)

The loss coefficient K was determined for each bar spacing option using the equation $K = 1.45 – 0.45R – R^2$ (Creager and Justin 1950), where R is the ratio of net rack flow area to gross rack area. The loss coefficient remains constant for all percentages of rack blinding because it represents the hydraulics associated with flow through the bars and their spacing in each rack.

Field observations at some of the intakes indicated a higher head loss than calculated. This may be attributed to partial blinding during the observation, hydraulic complexities such as cross-flow or end contractions, or higher flows through some units. Given these conditions, the observed head losses were assumed to be associated with the 15 percent blinded condition; incremental increases were added to those based on the calculated values. The incremental increase added to the projects was based on the reported observations and varied among the sites.

The through-rack velocity was calculated as part of the head loss calculations at each turbine intake. The through-rack velocities were then used in our analysis of the potential for impingement (Section 9.0). Table 12 summarizes the assumptions for the head loss calculations at each site, and the calculations are included in Appendix B.

Table 12 Assumptions for Head Loss Analysis

	Holocombe Units 1-3		Cornell EC and NSTR		Cornell Units 1-4	Jim Falls Units 1 and 2[b]		Wissota EC and NSTR		Wissota Units 1-6	Dells EC and NSTR			Dells Inclined Racks and NSTR
	EC & NSTR	Inclined Racks & NSTR	Units 1-3	Minimum Flow Unit 4	Angled Bar Rack & NSTR	EC & NSTR	Angled Bar Rack & NSTR	Units 1 & 4	Units 2, 3, 5, & 6	Inclined Racks & NSTR	Unit 1	Units 2-4	Unit 5	Units 1-5
Total Rack Length (ft)	111	140	105	9.08	365	86	116.33	52	104	90	36	73	24	162
Rack Invert Elevation (ft)	997.5	997	982.2	977.5	982[a]	890.35	890.35	871	871	871	777	774.75	774.75	774.75
Normal Headpond Elevation (ft)	1,045	1045	1002	1,002	1002	953.2	952.2	898	898	898	795	795	795	795
Depth of Trashrack in Flow (ft)	47.50	48.00	19.80	24.50	20.00	46.34	46.34	27.95	27.95	67	18.70	20.95	20.95	31.00
Gross Area (ft^2)	1,757.5	6,720.0	693.0	222.5	7,300.0	1,992.6	5,390.7	726.7	726.7	6030	635.6	502.8	502.8	5,022.0
Total Flow Capacity (cfs)	10,800	10,800	11,250	400	11,650	13,500	13,500	3,700	5,760	9460	1,800	4,275	800	6,875
Incremental Loss Factor (ft)	0	0	0.25	0	0.25	1.0	1.0	0.0	0.0	0.0	0.3	0.5	0.2	1.0

[a] Invert of trashrack assumed to be at same elevation as Units 1-3.

[b] Head loss calculations do not include the minimum flow unit for Jim Falls.

EC = Existing conditions

NSTR = Narrowly spaced trashrack

6.2 RESULTS

Table 13 summarizes the results of the analysis. Generally, head losses increase as the spacing between bars decreases because decreasing bar spacing results in decreased net flow area and increased flow velocities through the racks. The effect of blinding increases as the spacing between the bars decreases. For example, at Cornell, 25 percent blinding over the existing units would result in an incremental increase in head loss of 0.01 foot compared with clear racks. The same blinding comparison with 1.0-inch spacing results in an incremental increase in head loss of 0.4 foot.

Careful consideration of the increased rate of blinding that occurs with narrower rack spacing is warranted. Although the calculated head loss associated with reduced bar spacing is not significant, it results in smaller debris accumulating on the intake that would pass through under current conditions. The accumulation of smaller debris will increase the blinding rate quickly, which has a greater effect than the rack spacing. Narrower spacing has an identical effect on ice buildup. When blinding by debris or icing increases, increasing velocity through the racks increases end contractions, which effectively reduce the area of the racks through which flow passes. These compounding effects are difficult to account for with reasonable accuracy, and this analysis does not account for them specifically. Cleaning racks frequently is important to avoid rapidly increasing head losses with narrower bar spacing. Even with good raking equipment, blinding can require almost continuous cleaning of racks.

TABLE 13 CALCULATED HEAD LOSS (FEET)

	0% Blind	15% Blind	25% Blind	50% Blind
HOLCOMBE UNITS 1-3				
Existing conditions (5-inch bar spacing)	0.0	0.0	0.0	0.1
Replace existing trashracks with narrowly spaced racks	0.1	0.1	0.2	0.4
Inclined rack structure with full-depth, narrowly spaced racks	0.1	0.1	0.1	0.2
CORNELL UNITS 1-3				
Existing conditions (6-inch bar spacing)	0.4	0.4	0.4	0.7
Replace existing trashracks with narrowly spaced racks	0.9	1.1	1.3	2.7
CORNELL MINIMUM FLOW UNIT 4				
Existing conditions (3-inch bar spacing)	0.0	0.1	0.1	0.2
Replace existing trashracks with narrowly spaced racks	0.2	0.2	0.3	0.7
CORNELL UNITS 1-4				
Angled rack structure with full-depth, narrowly spaced racks	0.3	0.3	0.4	0.5
JIM FALLS UNITS 1 AND 2				
Existing conditions (5-inch bar spacing)	1.0	1.1	1.1	1.2
Replace existing trashracks with narrowly spaced racks	1.2	1.3	1.4	2.0
Angled rack structure with full-depth, narrowly spaced racks	1.1	1.1	1.1	1.2
WISSOTA UNITS 1 AND 4				
Existing conditions (3.75-inch bar spacing)	0.0	0.1	0.1	0.2
Replace existing trashracks with narrowly spaced racks	0.2	0.2	0.3	0.7
WISSOTA UNITS 2, 3, 5, AND 6				
Existing conditions (3.75-inch bar spacing)	0.0	0.0	0.0	0.1
Replace existing trashracks with narrowly spaced racks	0.1	0.1	0.2	0.4
WISSOTA UNITS 1-6				
Inclined rack structure with full-depth narrowly-spaced racks	0.1	0.1	0.1	0.2
DELLS UNIT 1				
Existing conditions (5-inch bar spacing)	0.3	0.3	0.3	0.4
Replace existing trashracks with narrowly spaced racks	0.4	0.4	0.5	0.7
DELLS UNITS 2-4				
Existing Conditions (5-inch bar spacing)	0.5	0.5	0.5	0.6
Replace existing trashracks with narrowly-spaced racks	0.6	0.7	0.7	1.0
DELLS UNIT 5				
Existing conditions (5-inch bar spacing)	0.2	0.2	0.2	0.2
Replace existing trashracks with narrowly spaced racks	0.2	0.2	0.3	0.3
DELLS UNITS 1-5				
Inclined rack structure with full-depth, narrowly spaced racks	1.0	1.0	1.0	1.1

7.0 POTENTIAL EFFECTS OF HEAD LOSS ON TURBINE OPERATIONS

Turbine water passages should provide adequate hydraulic capacity and steady-state flow paths under the full operating range, which is important for operating efficiently and ensuring that equipment remains in reliable condition. Flow accelerates 10-fold between the intake and the turbine, and adequate intake depth should be provided to prevent strong vortices from extending into the turbine. Vortices can cause excessive vibration that can damage equipment, and air entrained by strong vortices can reduce generating efficiency. Increases in head loss associated with narrower trashrack bar spacing or increased blinding can effectively reduce turbine submergence. A cursory review of turbine submergence at each project was performed to identify turbines susceptible to operational problems due to increased head loss.

7.1 METHODS

Where applicable, the predicted submergence requirement was calculated using an empirically derived equation, the Gordon formula (ASCE, 1995). This calculation of recommended minimum submergence is based on the depth of the intake, the velocity at the intake entrance, and a coefficient related to flow uniformity. The simplest application of the equation is for a well-defined horizontal intake, such as a penstock opening or an immediate transition from a vertical wall to a horizontal conveyance. A horizontal intake often is absent at hydro projects, especially those with intakes that are integral with powerhouses, like the Chippewa River projects; therefore, we considered multiple locations for each unique turbine and bay, particularly intake gate slots and places where intake geometry changes abruptly. This simplistic approach provides order-of-magnitude estimates. Where actual submergence is close to the calculated requirement, these estimates offer no assurance that exiting submergence is adequate to prevent problems.

Flows were reported by Xcel Energy personnel, and all dimensions and geometry information used in the analysis is as represented on drawings provided by Xcel Energy. The Chippewa Falls Hydro Project was excluded from this evaluation because its trashracks already have 1-inch clear spacing between the bars; the minimum flow unit at Jim Falls was excluded for the same reason.

7.2 RESULTS

Most turbines at most of the projects appear to have adequate submergence for the reported flows, such that head loss associated with installing racks with narrowly spaced bars would not be expected to affect turbine operation negatively. Submergence appears to be inadequate to accommodate significantly increased head loss at some units at the Cornell and Dells projects, as described in the following paragraphs.

The water passage for the three large units at Cornell appears to be defined by an inclined entrance directly below the radial gates; however, it is not clear whether the conveyance starts with a circular cross-section or a rectangular cross-section that transitions gradually to circular. Assuming a circular entrance produces a smaller entrance surface area than assuming a rectangular entrance and results in velocity such that the actual submergence (19.8 feet) is slightly below the calculated 21.4 feet of submergence recommended to accommodate the head loss expected with racks with narrowly spaced bars. This assumes a non-uniform flow, which would be expected with a sharp entrance that lacks a rounded or beveled edge. Given the potentially large head losses calculated for these units (i.e., 2.7 feet with 50-percent blinding; Table 14), the potential effects of reduced submergence are worthy of concern. When evaluated as a rectangular entrance with a gradual transition to round, the entrance velocity is much lower, flow is more uniform, and actual submergence appears to be adequate; nevertheless, the expected 2.7-foot head loss associated with 50 percent blinding of racks with narrowly spaced bars would account for more than half of the 5-foot margin between the calculated requirement and actual submergence.

TABLE 14 CALCULATED SUBMERGENCE REQUIREMENTS FOR CORNELL UNITS 1 – 3

ASSUMPTION OF ENTRANCE GEOMETRY	EXISTING SUBMERGENCE (ft)	CALCULATED SUBMERGENCE REQUIRED (ft)	CALCULATED SUBMERGENCE W/ NARROWLY SPACED RACKS, 50% BLINDED
Circular Entrance	19.8	21.4	17.1
Rectangular Entrance	19.8	14.1	17.1

The horizontal units at the Dells powerhouse have exposed gate cases in open flumes through which water is drawn when the wicket gates open. Such flumes are particularly susceptible to developing vortices and entraining air. Units 2, 3, and 4 were replaced within the past 10 years, but Unit 5 is original; all of the units have the same horizontal configuration. The newer, larger turbines were installed with increased hydraulic capacity and a higher shaft setting, resulting in slightly less submergence for these three units. Velocity through the gate casings at these three units is greater than at Unit 5, which results in an increased submergence requirement for the newer units. Although the submergence requirement for trashracks with narrowly spaced bars cannot be determined easily, comparing these conditions indicates that any issues with submergence would become apparent first with the three larger turbines. Assuming a potential 6-inch incremental increase in head loss with 50 percent blinding and the top of the gate case just 8 feet below the normal pond elevation, these turbines could be subject to submergence issues if racks with narrowly spaced bars were to be installed.

These findings do not indicate that the turbines at Cornell and Dells currently have, or will have, operational issues associated with inadequate submergence; however, this evaluation suggests the need for careful consideration of the potential for submergence issues before making any permanent changes at the intakes for these units. Hydraulic modeling is one means of evaluating the adequacy of these units' submergence more thoroughly, but it could be very costly. A less expensive alternative for evaluating the potential effects of blinding would be to monitor operations of these turbines under conditions where the racks are partially blinded, such as just prior to cleaning.

If any of these units currently have operational issues suspected to be associated with limited submergence, Kleinschmidt recommends carefully considering the potential effects of head loss of even a few inches associated with installing racks with narrowly spaced bars. The effect of blinding on head loss is greater than the effect of bar spacing, and the increased rate at which the racks with narrowly spaced bars would collect debris will result in rapidly worsening blinding; therefore, 50 percent blinding of trashracks with narrowly spaced bars should be considered in any decision-making process. Rack cleaning operations would need to increase in frequency to prevent excessive blinding and poor operational conditions.

8.0 ENERGY ANALYSIS

8.1 METHODS

Kleinschmidt uses a Microsoft Excel-based model to calculate the energy generated by a project daily. Flow data for use within the energy models for each project were obtained using gauge data from the upstream watershed. The three USGS gauges upstream of the Holcombe site (Gage No 05356500 – Chippewa River near Bruce, WI; Gage No 05360500 – Flambeau River near Bruce, WI; Gage No. 05362000 – Jump River at Sheldon, WI) were used to develop the modeled flows for Holcombe, Cornell, Jim Falls, and Wissota. The USGS gauge downstream of the Chippewa Falls dam and upstream of the Dells dam (Gage No. 05365500 – Chippewa River at Chippewa Falls, WI) was used to develop the modeled flows for the Dells Project. The mean daily flows from January 1996 through December 2015 were used for all the models. Using the flow data from the USGS gauge for each day of the noted period along with the number of turbines operated for each day, head losses through the machines and the peak efficiency for each type of turbine were used to compute the annual generation. Peak efficiency values were selected because Xcel Energy operates the turbines at best-gate settings, which maximizes generation. For projects with a minimum flow unit, the flow was allocated through that unit first, and then to the larger units.

8.2 RESULTS

8.2.1 BASE CASE – CALIBRATION

After developing the base model with the existing conditions, the results were compared with the historical monthly generation between 2009 and 2014. Generator efficiency was assumed to be static for each unit but ranged between 92 and 95 percent. The head loss through the turbine and draft tube was adjusted within a relatively narrow range to calibrate the modeled generation to match the historical values. Leakage through gates was assumed to occur at each site, depending on the number of gates. Each site’s generation was calibrated to historical generation using the existing rack spacing and assuming 15 percent blinding, which is a typical average condition. Calibration was assumed to be reached when the modeled generation was within 5 percent of the historical generation (2009 through 2014). When necessary, the models were calibrated by adjusting the leakage, turbine or generator efficiency, and overall head loss.

8.2.2 ENERGY ANALYSIS FOR SELECTED ALTERNATIVES

Scenarios were run to predict the effect of replacing the intake trashracks with the options discussed in Section 5.0. The assumptions for each model remained the same as those for the calibrated model, except for the head loss associated with the trashracks.

Table 15 summarizes the modeled percent change in annual energy generation for the different intake rack options based on the last 19 years of recorded continuous flow (1996 through 2014). A negative percentage indicates a decrease in generation. Annual and monthly results of the energy model evaluation are included in Appendix C.

TABLE 15 CHANGE IN ANNUAL ENERGY GENERATION ESTIMATED FOR ALTERNATIVE CONFIGURATIONS AT XCEL ENERGY'S CHIPPEWA RIVER PROJECTS

	0% BLIND	15% BLIND	25% BLIND	50% BLIND
HOLCOMBE				
Replace existing trashracks with narrowly spaced racks	-0.1%	-0.2%	-0.3%	-0.6%
Inclined rack structure with full-depth, narrowly spaced trashracks	0.0%	0.0%	0.0%	0.0%
CORNELL				
Replace existing trashracks with narrowly spaced racks	-1.0%	-1.3%	-1.7%	-3.8%
Angled rack structure with full-depth, narrowly spaced trashracks	0.5%	0.6%	0.6%	1.0%
JIM FALLS				
Replace existing trashracks with narrowly spaced racks	-0.2%	-0.3%	-0.4%	-0.8%
Angled rack structure with full-depth, narrowly spaced trashracks	0.5%	0.5%	0.5%	0.5%
WISSOTA				
Replace existing trashracks with narrowly spaced racks	-0.1%	-0.2%	-0.3%	-0.6%
Inclined rack structure with full-depth narrowly spaced trashracks	0.0%	0.1%	0.1%	0.2%
DELLS				
Replace existing trashracks with narrowly spaced racks	-0.3%	-0.4%	-0.6%	-1.3%
Inclined rack structure with full-depth, narrowly spaced trashracks	-0.1%	-0.1%	0.0%	0.0%

Results of the energy modeling indicate that replacing trashracks with narrowly spaced racks (i.e., 1-inch clear spacing between the bars) would have minimal effects on generation, assuming clear racks. Without blinding (0 percent), the annual generation would decrease between 0.15 and 1.0 percent at each site. Replacing the trashracks with the angled or inclined rack structures with narrowly spaced trashracks would increase generation at Cornell, Jim Falls, and Wisotta, assuming no blinding. No noticeable change in generation is predicted at Holcombe, and a very small decrease in generation is predicted at Dells.

Narrower bar spacing will result in more rapid blinding of the racks, and blinding has a more significant effect on energy generation than does bar spacing. The energy model does not account for the rate of blinding, but that factor should be considered before selecting narrower bar spacing. For example, although reducing bar spacing to 1 inch is predicted to decrease generation at Cornell by only 1 percent without blinding (i.e., the worst case among the modeled conditions across the projects), average blinding conditions of 25 percent are expected to cause a nearly 2 percent loss in generation, and 50 percent blinding would cause a nearly 4 percent loss. In addition to causing head losses that reduce generation, significant blinding can require units to be shutdown to prevent damage due to rough operation or just to facilitate cleaning the intake trashracks. The energy analysis does not account for the potential reduced generation if units are taken offline due to blinding, which could be several percent if blinding occurs rapidly.

9.0 ANALYSIS OF BLADE STRIKE, ENTRAINMENT, AND IMPINGEMENT

Installing traditional fish screening measures such as trashracks with narrowly spaced vertical bars (i.e., 1-inch clear openings) has the potential to entrain small fishes that can fit between the bars. The resulting increase in water velocity that occurs in front of and through racks with narrowly spaced bars also has the potential to impinge larger fish on the face of the trashracks. The number of fish entrained is related to a variety of physical factors near the dams and powerhouses including powerhouse flow, forebay configuration, intake depth, plant operating mode, intake approach velocities, trashrack spacing, and proximity to fish feeding and rearing habitats (EPRI 1992; FERC 1995). Other factors include head, turbine size and design, runner speed, wicket gate openings and overhangs, number of runner blades, angle of runner blades, gap sizes, and the amount and direction of water passing through the turbines (Cada 1990; Odeh 1999; Cada and Rinehart 2000; Cada 2001). Biotic factors that affect the level of entrainment include diurnal and seasonal patterns of fish migration and dispersal, fish size and swimming speed, fish behavior, life history requirements, and density-dependent influences (e.g., resource availability) of fish populations in upstream habitats (EPRI 1992; FERC 1995; Cada et al. 1997).

Fish that pass through hydroelectric turbines can be injured or killed as a result of striking or colliding with structures within the turbine system (e.g., moving runner blades, fixed guide and stay vanes, flow-straightening walls in the draft tube) or of being drawn through gaps between fixed and moving structures in the turbine passageway. Several other mechanisms can lead to mortality as fish pass through a turbine, including pressure changes, cavitation, turbulence, and shear stress (Cada 1990; Cada et al. 1997; Cada 2001; Odeh 1999). Entrained fish are most likely to survive when turbines are operating near their peak efficiency, and smaller fish tend to suffer the least mortality (EPRI 1992). Outside the peak range of operating efficiency, increased mortality appears to be related mainly to the effects of cavitation, pressure changes, shear stresses, turbulence, and narrow clearances between wicket gates at low gate settings (EPRI 1992; Cada 2001). The sizes of clearances between wicket gates, and between the trailing edges of the wicket gates and the turbine blades, are especially important for the passage of larger fish at high runner speeds (EPRI 1992).

9.1 BLADE STRIKE ASSESSMENT

9.1.1 METHODS

Our analysis of turbine-related injury focused on estimating the probability of blade strike following the installation of full-depth, narrowly spaced vertical trashracks, angled racks, or inclined racks. The predictive equations we used consider only fish size; they do not differentiate between species. Fish size has been shown to influence turbine survival more than species (Franke et al. 1997). Several models have been developed to predict the survival rate of fish passing through hydroelectric turbines. These models consider fish size, turbine specifications, and station hydraulics to estimate the theoretical probability of blade strike and of survival of fish of specific sizes for a particular turbine configuration. Direct effects of turbine passage can be predicted as a probability because the variables (e.g., turbine diameter, number of blades) and values for those variables can be defined precisely. These models allow the user to manipulate parameters such as fish size or turbine characteristics to determine the relative effect on turbine passage survival.

Blade strike probability and turbine passage survival at the Holcombe, Cornell, Jim Falls, Wissota, and Dells projects were calculated using the Advanced Hydro Turbine model developed by Franke and colleagues (1997). Franke and colleagues (1997) revised an earlier model (Bell 1981) to consider the effect of tangential projection of the fish length on blade strike probability because most turbine passage mortality at low-head dams (<100 feet) is caused by fish striking a turbine blade or some other turbine structure. Appendix D provides a summary of the methods used to determine the probability of blade strike survival.

Blade strike probability and turbine passage survival were estimated for the seven target species (i.e., muskellunge, smallmouth bass, walleye, bluegill, black crappie, yellow perch, and lake sturgeon) based on the size ranges expected to become entrained through trashrack bars spaced at 1 inch, clear spacing (Table 16). Survival estimates are based on the composite total of all fish that could physically fit through 1-inch trashracks (Table 16). Fish greater than 1 inch in at least two dimensions (i.e., length and body width) would be physically excluded but may be impinged as a result of increases in the velocity at which water moves through the trashracks. In general, body width appears to be the limiting factor with regard to physical exclusion by trashracks. Table 16 also can be used to understand which species may not be susceptible to entrainment but may be subject to impingement if narrowly spaced trashracks were installed.

TABLE 16 SIZE OF FISH THAT MAY BE ENTRAINED THROUGH A 1-INCH TRASHRACK

Fish Length (inches)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Muskellunge	0.09	0.18	0.29	0.37	0.46	0.55	0.64	0.74	0.83	0.92	1.01	1.11	1.20	1.29	1.38	1.47	1.57	1.66	1.75	1.84	1.93	2.03	2.12	2.21	2.30
Walleye	0.12	0.24	0.36	0.48	0.60	0.73	0.85	0.97	1.09	1.21	1.33	1.45	1.57	1.69	1.81	1.93	2.06	2.18	2.30	2.42	2.54	2.66	2.78	2.90	3.02
Smallmouth bass	0.18	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	1.97	2.15	2.32	2.50	2.68	2.86	3.04								
Bluegill	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.69	2.84	2.99	3.14				
Black crappie	0.15	0.30	0.44	0.59	0.74	0.89	1.04	1.18	1.33	1.48	1.63	1.78	1.92	2.07	2.22	2.37	2.51	2.66	2.81	2.96	3.11				
Yellow perch	0.19	0.38	0.57	0.76	0.95	1.14	1.33	1.52	1.71	1.90	2.09	2.29	2.48	2.67	2.86	3.05									
Lake sturgeon*	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18	1.30	1.42	1.53	1.65	1.77	1.89	2.01	2.13	2.24	2.36	2.48	2.60	2.72	2.83	2.95

Values within the table are fish widths corresponding to the fish lengths identified at the top of the column.

Cells shaded in blue represent fish less than 1" in width that could pass through a 1-inch trashrack (i.e., would be entrained).

* Critical body width per fish size (inches) as converted from ratio of body width to girth derived using regression analysis for lake sturgeon collected in the Grasse River, New York (Appendix E).

Body morphology varies by species; therefore, body width was estimated relative to body length based on morphological characteristics of the target species provided by Smith (1985). Body width for lake sturgeon was estimated based on morphometric information collected during a recent radio-telemetry study of lake sturgeon habitat use in the Grasse River[5] conducted by Kleinschmidt. In total, researchers collected 170 sturgeon with complete body morphology information. The final equation used in this analysis for lake sturgeon width given length is:

$$\textbf{width = length*0.12}$$

Appendix E provides the methodology used to calculate lake sturgeon body girth so that we could identify the size of fish likely to be entrained at intakes with trashrack bars with 1-inch clear openings.

9.1.2 RESULTS

Several dynamic parameters affect turbine survival estimates: turbine discharge (i.e., gate settings), turbine specifications (e.g., number of blades, RPM) operating head, the value of the correlation factor, and fish size. As such, there are many potential iterations of turbine survival estimates. The survival estimates provided in this section represent unweighted average values for the size groups representing target species. Although the model output is not species specific, data are presented by length ranges representing the sizes of the target fishes that would pass through a 1-inch trashrack. In general, survival rates are greater for small fish than for large fish; therefore, survival across all projects is expected to be greater for small species (e.g., bluegill, yellow perch, black crappie, and smallmouth bass) than for large species (e.g., walleye, muskellunge, and large sturgeon). In summary, the results of our analysis demonstrate that predicted average turbine passage survival of small resident fish species is greater than 90 percent for all seven species at the Holcombe, Cornell, Dells, Jim Falls, and Wissota hydroelectric projects (Table 17). Turbine passage survival for muskellunge and walleye is predicted to be the lowest at all projects; the lowest estimated turbine passage survival for muskellunge (75.9 percent) and for walleye (88 percent) is at the Cornell Project Unit 4 (Table 18). Average turbine passage survival for juvenile lake sturgeon ranged from 90.1 percent (Wissota Units 2, 3, 5, and 6) to 96.6 percent (Jim Falls Units 1 and 2) (Table 18).

[5] Tributary to the St. Lawrence River in eastern New York.

TABLE 17 SUMMARY OF PERCENT TURBINE PASSAGE SURVIVAL OF WALLEYE, MUSKELLUNGE, SMALLMOUTH BASS, BLUEGILL, YELLOW PERCH, BLACK CRAPPIE, AND LAKE STURGEON AT CHIPPEWA RIVER PROJECTS WITH NARROWLY SPACED TRASHRACKS

PROJECT AND UNIT(S)	MINIMUM SURVIVAL ESTIMATE (%)	MAXIMUM SURVIVAL ESTIMATE (%)	AVERAGE SURVIVAL ESTIMATE (%)
Holcombe Project (all units)	93.3	98.6	96.7
Cornell Project (Units 1, 2, and 3)	93.1	98.9	97.3
Cornell Project (Unit 4)	75.9	96.4	91.7
Dells Project (Unit 1)	91.7	98.6	96.6
Dells Project (Units 2, 3, and 4)	84.2	97.7	93.6
Dells Project (Unit 5)	84.9	97.7	93.6
Jim Falls Project (Unit 1 and 2)	94.1	99.9	97.4
Wissota Project (Unit 1 and 4)	89.2	96.9	94.0
Wissota Project (Units 2, 3, 5, 6)	84.3	95.8	91.8

Appendix D presents the model results for the numerous iterations for each target species based on 1-inch size increments for each of the different unit types at the Holcombe, Cornell, Jim Falls, Wissota, and Dells projects.

TABLE 18 PREDICTED TURBINE PASSAGE SURVIVAL FOR EACH TARGET FISH SPECIES AT XCEL ENERGY'S CHIPPEWA RIVER HYDROELECTRIC PROJECTS

	HOLCOMBE			CORNELL UNITS 1, 2 &3			CORNELL UNIT 4			DELLS UNIT 1			DELLS UNITS 2, 3, & 4			DELLS UNIT 5			JIM FALLS UNITS 1 & 2			WISSOTA UNITS 1 & 4			WISSOTA UNITS 2, 3, 5, & 6		
SPECIES	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**
Muskellunge	95.5	93.3	97.5	95.0	93.1	96.8	83.4	75.9	89.6	94.3	91.7	96.4	89.3	84.2	93.3	89.6	84.9	93.5	95.9	94.1	97.4	91.9	89.2	94.6	88.2	84.3	92.2
Walleye	96.3	94.4	97.9	97.5	96.5	98.4	91.7	88.0	94.8	95.7	93.8	97.3	92.0	88.1	95.0	92.2	88.7	95.1	96.4	94.8	97.7	93.3	91.0	95.5	91.0	87.9	94.0
Smallmouth Bass	97.4	96.1	98.6	98.3	97.6	98.9	94.2	91.6	96.4	97.9	97.1	98.6	96.2	94.5	97.7	96.4	94.7	97.7	98.4	97.7	99.0	95.3	93.7	96.9	93.7	91.6	95.8
Bluegill	97.0	95.5	98.4	98.0	97.2	98.7	93.4	90.4	95.8	97.7	96.7	98.6	95.7	93.7	97.3	95.9	93.9	97.4	98.2	97.7	99.9	94.6	92.8	96.4	92.8	90.4	95.2
Black Crappie	97.0	95.5	98.4	98.0	97.2	98.7	93.4	90.4	95.8	97.7	96.7	98.6	95.7	93.7	97.3	95.9	93.9	97.4	98.2	97.4	98.8	94.6	92.8	96.4	92.8	90.4	95.2
Yellow Perch	97.4	96.1	98.6	98.3	97.6	98.9	94.2	91.6	96.4	98.0	97.1	98.7	96.2	94.5	97.7	96.4	94.7	97.7	98.4	97.7	99.0	95.3	93.7	96.9	93.7	91.6	95.8
Lake Sturgeon	96.3	94.4	97.9	96.0	94.4	97.4	91.7	88.0	94.8	94.8	92.5	96.8	90.3	85.8	94.0	91.7	87.9	94.8	96.6	95.1	97.8	93.3	91.0	95.5	90.1	86.7	93.4

9.2 SWIM SPEED AND IMPINGEMENT ANALYSIS

The formula typically used to estimate the size at which fish would be expected to avoid certain water velocities is (USFWS 1989):

Critical Fish Length (ft) = Water velocity (fps) /Minimum sustained speed (3 to 7 body lengths/sec)

Sustained swimming speed is the velocity that a fish can be expected to sustain indefinitely; burst speed is a velocity that a fish could sustain briefly to ambush prey, escape predation, or maneuver in current (Bell 1990). Using the USFWS criteria, swimming at a rate of 3 body lengths a second, a 12-inch fish would be capable of a sustained speed of 3 fps. Using a higher burst speed of 6 body lengths a second, a 12-inch fish would yield a swimming speed of 6 fps. Table 19 describes the swimming performance for both sustained swimming speeds (3 to 5 body lengths) and burst swimming speeds (6 to 7 body lengths) for each length frequency group using this equation. Based on the sustained swim speed criteria, which is a gait or swim speed that can be maintained indefinitely (Beamish 1978), fish measuring 6 inches or larger potentially would be able to swim away or escape a target approach velocity of 2.0 fps in front of the intake structures.

TABLE 19 SWIMMING SPEEDS OF FISH FOR EACH LENGTH FREQUENCY GROUP

Swim Speed (Body Length/s)	1-inch	2-inch	3-inch	4-inch	5-inch	6-inch	7-inch	8-inch	9-inch	10-inch	11-inch	12-inch	13-inch	14-inch	15-inch	16-inch	17-inch	18-inch	19-inch	20-inch
	FISH LENGTH																			
Sustained Swim Speeds	SWIMMING SPEEDS (fps)																			
3	0.24	0.48	0.75	0.99	1.26	1.5	1.8	2.1	2.25	2.49	2.76	3.0	3.3	3.27	3.75	3.99	4.23	4.5	4.74	4.98
4	0.32	0.64	1.0	1.32	1.68	2.0	2.4	2.8	3	3.32	3.68	4.0	4.4	4.36	5	5.32	5.64	6.0	6.32	6.64
5	0.4	0.8	1.25	1.65	2.1	2.5	3.0	3.5	3.75	4.15	4.6	5.0	5.5	5.45	6.25	6.65	7.05	7.5	7.9	8.3
Burst Swim Speeds																				
6	0.48	0.96	1.5	1.98	2.52	3.0	3.6	4.2	4.5	4.98	5.52	6.0	6.6	6.54	7.5	7.98	8.46	9.0	9.48	9.96
7	0.56	1.12	1.75	2.31	2.94	3.5	4.2	4.9	5.25	5.81	6.44	7.0	7.7	7.63	8.75	9.31	9.87	10.5	11.06	11.62

Installing narrowly spaced trash racks (i.e., 1-inch clear opening) would increase through-rack velocities by 0.40 fps to 3.67 fps over existing conditions at the Holcombe, Cornell, Jim Falls, Wissota, and Dells projects depending on unit and intake configuration (Appendix A). Through-rack velocities under existing conditions at these 5 sites range from 1.69 fps to 11.82 fps at 0 percent to 50 percent blinding, respectively. With narrowly spaced trashracks, through-rack velocities would range from 2.09 fps to 15.49 fps at 0 percent to 50 percent blinding, respectively (Table 20). Many of these velocities exceed the swim speeds of juvenile and adult fish and, therefore, are likely to result in increased impingement of large-bodied fish and entrainment of fish smaller than 3 inches. The calculated through-rack velocities for the 1-inch trashracks installed at the Chippewa Falls range from 2.47 fps to 4.95 fps (Table 20). These velocities exceed the sustained swim speed of fish smaller than 3 inches and the burst swim speed of an 8-inch fish. Depending on the size and species of fish, fish that are not entrained may not be able to avoid being involuntarily impinged at each of the hydroelectric projects due to the increase in through-rack velocities.

TABLE 20 EXPECTED THROUGH-RACK VELOCITIES AT THE CHIPPEWA RIVER PROJECTS WITH NARROWLY SPACED TRASHRACKS (0 AND 50 PERCENT BLINDING)

PROJECT / INTAKE AREA	EXISTING CONDITIONS (NO BLINDING)	EXISTING CONDITIONS (50 % BLINDING)	EXPECTED WATER VELOCITY (NO BLINDING)	EXPECTED WATER VELOCITY (50 % BLINDING)
Cornell Project (Units 1-3)	5.91 fps	11.82 fps	7.75 fps	15.49 fps
Cornell Project (Unit 4)	2.36 fps	4.73 fps	3.46 fps	6.92 fps
Dells Project (Unit 1)	2.84 fps	5.68 fps	3.51 fps	7.02 fps
Dells Project (Units 2-4)	3.01 fps	6.02 fps	3.72 fps	7.44 fps
Dells Project (Unit 5)	1.69 fps	3.38 fps	2.09 fps	4.17
Holcombe (all units)	2.19 fps	4.38 fps	2.92 fps	5.84 fps
Jim Falls (all units)	3.70 fps	7.40 fps	4.81 fps	9.78 fps
Wissota (Units 1-4)	2.98 fps	5.96 fps	3.88 fps	7.75 fps
Wissota (Units 2-3, 5-6)	2.32 fps	4.64 fps	3.02 fps	6.03 fps
Chippewa Falls (all units)	2.47 fps	4.95 fps	NA*	

* The Chippewa Project already has 1-inch trashrack bars in front of the turbines intakes.

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APPENDIX A

CALCULATIONS OF THROUGH-RACK VELOCITIES

APPENDIX A CALCULATIONS OF THROUGH-RACK VELOCITIES

Chippewa River Fish Protection Study
Through Rack Velocity Summary Tables

Cornell

Units 1-3 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	5.91	6.95	7.88	11.82
Proposed 1" Spacing	7.75	9.11	10.33	15.49

Unit 4 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	2.36	2.78	3.15	4.73
Proposed 1" Spacing	3.46	4.07	4.61	6.92

Units 1-4 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Proposed Angled 1" Spacing	2.35	2.76	3.13	4.69

Dells

Unit 1 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	2.84	3.34	3.79	5.68
Proposed 1" Spacing	3.51	4.13	4.68	7.02

Units 2-4 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	3.01	3.54	4.01	6.02
Proposed 1" Spacing	3.72	4.37	4.96	7.44

Unit 5 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	1.69	1.99	2.25	3.38
Proposed 1" Spacing	2.09	2.46	2.78	4.17

Units 1-5 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Proposed Angled 1" Spacing	2.73	3.21	3.63	5.45
Proposed Inclined 1" Spacing	2.68	3.15	3.57	5.35

Holcombe

Units 1-3 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	2.24	2.63	2.98	4.47
Proposed 1" Spacing	3.01	3.54	4.01	6.01
Proposed Angled 1" Spacing	2.36	2.77	3.14	4.71

Jim Falls

Units 1-2 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	3.70	4.35	4.93	7.40
Proposed 1" Spacing	4.89	5.75	6.52	9.78
Proposed Inclined 1" Spacing	2.51	2.95	3.34	5.01

Wissota

Units 1 & 4 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	2.98	3.51	3.97	5.96
Proposed 1" Spacing	3.88	4.56	5.17	7.75

Units 2,3,5,6 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	2.32	2.73	3.09	4.64
Proposed 1" Spacing	3.02	3.55	4.02	6.03

Chippewa Falls

Units 1-6 Through Velocity Summary Table (Velocity in ft/s)

Scenario	0% Blind	15 % Blind	25% Blind	50% Blind
Existing Conditions	2.47	2.91	3.30	4.95

APPENDIX B

HEAD LOSS CALCULATIONS

TABLE B1 HOLCOMBE HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions			Trash Rack Base Dimensions		
Rack Total Length, L =	37	ft	Rack Total Length, L =	140	ft
Rack Invert Elevation =	997.5	ft	Rack Invert Elevation =	997	ft
Normal Headpond Elevation =	1045	ft	Normal Headpond Elevation =	1045	ft
Height of trash rack in flow =	47.50	ft	Height of trash rack in flow =	48.00	ft
			Slope of trash rack =	0.00	H:V
Gross Area, A_{gross} =	1757.50	ft^2	Gross Area, A_{gross} =	6720.00	ft^2
Flow Capacity, Q =	3600	cfs	Flow Capacity, Q =	10800	cfs
			Top of Rack =	1053	ft
5.0" Rack Spacing - Existing Conditions			**1.0" Rack Spacing - Angled rack**		
Vertical Bar Spacing =	5.0	in	Vertical Bar Spacing =	1.0	in
Vertical Bar Width, b_{bar} =	0.375	In	Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar Length in Flow, L_{bar} =	47.50	ft	Vert. Bar Length in Flow, L_{bar} =	48.00	ft
Number of Vertical Bars =	44		Number of Vertical Bars =	1221	
Horizontal Bar 1 Width =	0.75	in	Horizontal Bar 1 Width =	0.75	in
Horizontal Bar 1 Length =	35.8	ft	Horizontal Bar 1 Length =	140	ft
Number of Horizontal Bar 1 =	13		Number of Horizontal Bar 1 =	13	
Horizontal Bar 2 Width =	0.88	in	Horizontal Bar 2 Width =	0.88	in
Horizontal Bar 2 Length =	37.00	ft	Horizontal Bar 2 Length =	140.00	ft
Number of Horizontal Bar 2 =	8		Number of Horizontal Bar 2 =	8	
Horizontal Bar 3 Width =	0.75	in	Horizontal Bar 1 Width =	0.75	in
Horizontal Bar 3 Length =	37	ft	Horizontal Bar 1 Length =	140	ft
Number of Horizontal Bar 3 =	8		Number of Horizontal Bar 1 =	8	
Angle Bar Total Length =	12.1	ft	Angle Bar Total Length =	12.1	ft
Angle Bar width =	0.75	in	Angle Bar width =	0.75	in
Number of Angle bars in flow =	17.1		Number of Angle bars =	51.3	
Area of Bars, A_{bars} =	147.4	ft^2	Area of Bars, A_{bars} =	2135.7	ft^2
Net Open Area of Racks, A_{net} =	1610.1	ft^2	Net Open Area of Racks, A_{net} =	4584.3	ft^2
Ratio of Net to Gross Area, R =	0.92		Ratio of Net to Gross Area, R =	0.68	
Loss Coefficient, K =	0.198		Loss Coefficient, K =	0.678	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	1610.08	ft^2	Net Open Area of Racks =	4584.29	ft^2
Flow Velocity, V =	2.24	ft/s	Flow Velocity, V =	2.36	ft/s
Trash Rack Head Loss, H_L =	0.015	ft	Trash Rack Head Loss, H_L =	0.058	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	1368.57	ft^2	Net Open Area of Racks =	3896.64	ft^2
Flow Velocity, V =	2.63	ft/s	Flow Velocity, V =	2.77	ft/s
Trash Rack Head Loss, H_L =	0.021	ft	Trash Rack Head Loss, H_L =	0.081	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	1207.56	ft^2	Net Open Area of Racks =	3438.22	ft^2
Flow Velocity =	2.98	ft/s	Flow Velocity =	3.14	ft/s
Trash Rack Head Loss =	0.027	ft	Trash Rack Head Loss =	0.104	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	805.04	ft^2	Net Open Area of Racks =	2292.14	ft^2
Flow Velocity =	4.47	ft/s	Flow Velocity =	4.71	ft/s
Trash Rack Head Loss =	0.062	ft	Trash Rack Head Loss =	0.234	ft

TABLE B2 CORNELL HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions			Trash Rack Base Dimensions - Angled Rack		
Rack Total Length, L =	35	ft	Rack Total Length, L =	365	ft
Rack Invert Elevation =	982.2	ft	Rack Invert Elevation =	982	ft
Normal Headpond Elevation =	1002	ft	Normal Headpond Elevation =	1002	ft
Height of trash rack in flow =	19.80	ft	Height of trash rack in flow =	20.00	ft
Gross Area, A_{gross} =	693.00	ft^2	Gross Area, A_{gross} =	7300.00	ft^2
Flow Capacity, Q =	3750	cfs	Flow Capacity, Q =	11650	cfs
			Top of Rack =	1008	ft
Calibration Factor	0.25	ft			
6.0" Rack Spacing - Existing Conditions			**1.0" Rack Spacing - Angled Bar Rack**		
Vertical Bar Spacing =	6.0	in	Vertical Bar Spacing =	1	in
Vertical Bar 1 Width, b_{bar} =	0.5	In	Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar 1 Length in Flow, L_{bar} =	19.80	ft	Vert. Bar Length in Flow, L_{bar} =	20.00	ft
Number of Vertical Bar 1 =	2		Number of Vertical Bars =	3185	
Vertical Bar 2 Width, b_{bar} =	0.5	In			
Vert. Bar 2 Length in Flow, L_{bar} =	19.80	ft			
Number of Vertical Bar 2 =	2				
Vertical Bar 3 Width, b_{bar} =	0.625	In			
Vert. Bar 3 Length in Flow, L_{bar} =	19.80	ft			
Number of Vertical Bar 3 =	34				
Plate Area =	50	in^2			
Number of plates in flow =	6				
Horizontal Bar 1 Width =	0.625	in	Horizontal Bar 1 Width =	0.625	in
Horizontal Bar 1 Length =	19.08	ft	Horizontal Bar 1 Length =	365	ft
Number of Horiz. Bar 1 in flow =	3		Number of Horiz. Bar 1 in flow =	3	
Horizontal Bar 2 Width =	0.5	in	Horizontal Bar 2 Width =	0.5	in
Horizontal Bar 2 Length =	19.08	ft	Horizontal Bar 2 Length =	365	ft
Number of Horiz Bar 2 in flow =	7		Number of Horiz Bar 2 in flow =	7	
Horizontal Bar 3 Width =	3.00	in	Horizontal Bar 3 Width =	3.00	in
Horizontal Bar 3 Length =	19.08	ft	Horizontal Bar 3 Length =	365.00	ft
Number of Horiz Bar 3 in flow=	2		Number of Horiz Bar 3 in flow=	2	
Area of Bars, A_{bars} =	58.5	ft^2	Area of Bars, A_{bars} =	2336.6	ft^2
Net Open Area of Racks, A_{net} =	634.5	ft^2	Net Open Area of Racks, A_{net} =	4963.4	ft^2
Ratio of Net to Gross Area, R =	0.92		Ratio of Net to Gross Area, R =	0.68	
Loss Coefficient, K =	0.200		Loss Coefficient, K =	0.682	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	634.47	ft^2	Net Open Area of Racks =	4963.39	ft^2
Flow Velocity, V =	5.91	ft/s	Flow Velocity, V =	2.35	ft/s
Trash Rack Head Loss, H_L =	0.358	ft	Trash Rack Head Loss, H_L =	0.308	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	539.30	ft^2	Net Open Area of Racks =	4218.88	ft^2
Flow Velocity, V =	6.95	ft/s	Flow Velocity, V =	2.76	ft/s
Trash Rack Head Loss, H_L =	0.400	ft	Trash Rack Head Loss, H_L =	0.331	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	475.85	ft^2	Net Open Area of Racks =	3722.54	ft^2
Flow Velocity =	7.88	ft/s	Flow Velocity =	3.13	ft/s
Trash Rack Head Loss =	0.443	ft	Trash Rack Head Loss =	0.354	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	317.23	ft^2	Net Open Area of Racks =	2481.69	ft^2
Flow Velocity =	11.82	ft/s	Flow Velocity =	4.69	ft/s
Trash Rack Head Loss =	0.684	ft	Trash Rack Head Loss =	0.483	ft

TABLE B2 CORNELL HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	9.08	ft
Rack Invert Elevation =	977.5	ft
Normal Headpond Elevation =	1002	ft
Height of trash rack in flow =	24.50	ft
Gross Area, A_{gross} =	222.54	ft^2
Flow Capacity, Q =	400	cfs

3.0" Rack Spacing - Existing Conditions			1.0" Rack Spacing		
Vertical Bar Spacing =	3.0	in	Vertical Bar Spacing =	1	in
Vertical Bar 1 Width =	0.625	In	Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar 1 Length in Flow =	24.50	ft	Vert. Bar Length in Flow, L_{bar} =	24.50	ft
Number of Vertical Bar 1 =	33		Number of Vertical Bars =	79	
Vertical Bar 2 Width (MK2-2) =	0.5	In			
Vert. Bar 2 (MK2-2) Length in Flow, =	2.92	ft			
Number of Vertical Bar 2 (MK2-2) =	2				
Vertical Bar 3 Width (MK2-1) =	0.625	In			
Vert. Bar 3 Length in Flow (MK2-1) =	9.42	ft			
Number of Vertical Bar 3 (MK2-1) =	2				
Vertical Bar 3 Width (MK2-2) =	0.625	In			
Vert. Bar 3 Length in Flow (MK2-2) =	12.00	ft			
Number of Vertical Bar 3 (MK2-2) =	2				
Vertical Bar 4 Width (MK2-2) =	0.5	In			
Vert. Bar 4 Length in Flow (MK2-2) =	24.50	ft			
Number of Vertical Bar 4 (MK2-2) =	2				
Plate Area =	50	in^2	Plate Area =	50	in^2
Number of plates in flow =	6		Number of plates in flow =	6	
Horizontal Bar 1 Width =	0.625	in	Horizontal Bar 1 Width =	0.75	in
Horizontal Bar 1 Length =	9.5	ft	Horizontal Bar 1 Length =	19.33	ft
Number of Horizontal Bar 1 =	7		Number of Horizontal Bar 1 =	25	
Horizontal Bar 2 Width =	0.50	in	Horizontal Bar 2 Width =	0.88	in
Horizontal Bar 2 Length =	9.50	ft	Horizontal Bar 2 Length =	19.33	ft
Number of Horizontal Bar 2 =	3		Number of Horizontal Bar 2 =	10	
Area of Bars, A_{bars} =	53.4	ft^2	Area of Bars, A_{bars} =	106.9	ft^2
Net Open Area of Racks, A_{net} =	169.2	ft^2	Net Open Area of Racks, A_{net} =	115.7	ft^2
Ratio of Net to Gross Area, R =	0.76		Ratio of Net to Gross Area, R =	0.52	
Loss Coefficient, K =	0.530		Loss Coefficient, K =	0.946	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	169.18	ft^2	Net Open Area of Racks =	115.68	ft^2
Flow Velocity, V =	2.36	ft/s	Flow Velocity, V =	3.46	ft/s
Trash Rack Head Loss, H_L =	0.046	ft	Trash Rack Head Loss, H_L =	0.176	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	143.80	ft^2	Net Open Area of Racks =	98.32	ft^2
Flow Velocity, V =	2.78	ft/s	Flow Velocity, V =	4.07	ft/s
Trash Rack Head Loss, H_L =	0.064	ft	Trash Rack Head Loss, H_L =	0.243	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	126.89	ft^2	Net Open Area of Racks =	86.76	ft^2
Flow Velocity =	3.15	ft/s	Flow Velocity =	4.61	ft/s
Trash Rack Head Loss =	0.082	ft	Trash Rack Head Loss =	0.312	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	84.59	ft^2	Net Open Area of Racks =	57.84	ft^2
Flow Velocity =	4.73	ft/s	Flow Velocity =	6.92	ft/s
Trash Rack Head Loss =	0.184	ft	Trash Rack Head Loss =	0.703	ft

TABLE B3 JIM FALLS HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions			Trash Rack Base Dimensions - Angled Rack		
Rack Total Length, L =	43	ft	Rack Total Length, L =	150	ft
Rack Invert Elevation =	890.35	ft	Rack Invert Elevation =	890	ft
Normal Headpond Elevation =	953.2	ft	Normal Headpond Elevation =	952.2	ft
Height of trash rack in flow* =	46.34	ft	Height of trash rack in flow* =	50.00	ft
Gross Area, A_{gross} =	1992.62	ft^2	Gross Area, A_{gross} =	7500.00	ft^2
Flow Capacity, Q =	6750	cfs	Flow Capacity, Q =	13500	cfs
*Existing rack is angled					
Calibration Factor	1	ft			
5.0" Rack Spacing - Existing Conditions			**1.0" Rack Spacing**		
Vertical Bar Spacing =	5.0	in	Vertical Bar Spacing =	1.0	in
Vertical Bar 1 Width, b_{bar} =	0.75	In	Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar 1 Length in Flow, L_{bar} =	46.34	ft	Vert. Bar Length in Flow, L_{bar} =	50.00	ft
Number of Vertical Bar 1 =	42		Number of Vertical Bars =	1309	
Plate Area =	14	in^2	Plate Area =	14	in^2
Number of plates in flow =	96		Number of plates in flow =	96	
Horizontal Bar 1 Width =	0.75	in	Horizontal Bar 1 Width =	0.75	in
Horizontal Bar 1 Length =	2.85	ft	Horizontal Bar 1 Length =	19.33	ft
Number of Horizontal Bar 1 =	128		Number of Horizontal Bar 1 =	25	
Horizontal Bar 2 Width =	0.75	in	Horizontal Bar 1 Width =	0.75	in
Horizontal Bar 2 Length =	2.08	ft	Horizontal Bar 1 Length =	19.33	ft
Number of Horizontal Bar 1 =	112		Number of Horizontal Bar 1 =	25	
Area of Bars, A_{bars} =	168.2	ft^2	Area of Bars, A_{bars} =	2114.9	ft^2
Net Open Area of Racks, A_{net} =	1824.5	ft^2	Net Open Area of Racks, A_{net} =	5385.1	ft^2
Ratio of Net to Gross Area, R =	0.92		Ratio of Net to Gross Area, R =	0.72	
Loss Coefficient, K =	0.200		Loss Coefficient, K =	0.611	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	1824.45	ft^2	Net Open Area of Racks =	5385.11	ft^2
Flow Velocity, V =	3.70	ft/s	Flow Velocity, V =	2.51	ft/s
Trash Rack Head Loss, H_L =	1.042	ft	Trash Rack Head Loss, H_L =	1.060	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	1550.78	ft^2	Net Open Area of Racks =	4577.35	ft^2
Flow Velocity, V =	4.35	ft/s	Flow Velocity, V =	2.95	ft/s
Trash Rack Head Loss, H_L =	1.059	ft	Trash Rack Head Loss, H_L =	1.083	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	1368.34	ft^2	Net Open Area of Racks =	4038.84	ft^2
Flow Velocity =	4.93	ft/s	Flow Velocity =	3.34	ft/s
Trash Rack Head Loss =	1.075	ft	Trash Rack Head Loss =	1.106	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	912.23	ft^2	Net Open Area of Racks =	2692.56	ft^2
Flow Velocity =	7.40	ft/s	Flow Velocity =	5.01	ft/s
Trash Rack Head Loss =	1.170	ft	Trash Rack Head Loss =	1.239	ft

TABLE B4 WISSOTA HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	26	ft
Rack Invert Elevation =	871	ft
Normal Headpond Elevation =	898	ft
Height of trash rack in flow =	27.95	ft
Gross Area, A_{gross} =	726.70	ft^2
Flow Capacity, Q =	1440	cfs

3.75" Rack Spacing - Existing Conditions			1.0" Rack Spacing		
Vertical Bar Spacing =	3.8	in	Vertical Bar Spacing =	1.0	in
Vertical Bar Width, b_{bar} =	0.3125	In	Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar Length in Flow, L_{bar} =	27.95	ft	Vert. Bar Length in Flow, L_{bar} =	27.95	ft
Number of Vertical Bar =	74		Number of Vertical Bar =	226	
Horizontal Bar Width =	3	in	Horizontal Bar Width =	3	in
Horizontal Bar Length =	26	ft	Horizontal Bar Length =	26	ft
Number of Horizontal Bars =	8		Number of Horizontal Bars =	8	
Area of Bars, A_{bars} =	105.9	ft^2	Area of Bars, A_{bars} =	249.4	ft^2
Net Open Area of Racks, A_{net} =	620.8	ft^2	Net Open Area of Racks, A_{net} =	477.3	ft^2
Ratio of Net to Gross Area, R =	0.85		Ratio of Net to Gross Area, R =	0.66	
Loss Coefficient, K =	0.336		Loss Coefficient, K =	0.723	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	620.84	ft^2	Net Open Area of Racks =	477.30	ft^2
Flow Velocity, V =	2.32	ft/s	Flow Velocity, V =	3.02	ft/s
Trash Rack Head Loss, H_L =	0.028	ft	Trash Rack Head Loss, H_L =	0.102	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	527.71	ft^2	Net Open Area of Racks =	405.71	ft^2
Flow Velocity, V =	2.73	ft/s	Flow Velocity, V =	3.55	ft/s
Trash Rack Head Loss, H_L =	0.039	ft	Trash Rack Head Loss, H_L =	0.141	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	465.63	ft^2	Net Open Area of Racks =	357.98	ft^2
Flow Velocity =	3.09	ft/s	Flow Velocity =	4.02	ft/s
Trash Rack Head Loss =	0.050	ft	Trash Rack Head Loss =	0.182	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	310.42	ft^2	Net Open Area of Racks =	238.65	ft^2
Flow Velocity =	4.64	ft/s	Flow Velocity =	6.03	ft/s
Trash Rack Head Loss =	0.112	ft	Trash Rack Head Loss =	0.409	ft

TABLE B4 WISSOTA HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	26	ft
Rack Invert Elevation =	871	ft
Normal Headpond Elevation =	898	ft
Height of trash rack in flow =	27.95	ft
Gross Area, A_{gross} =	726.70	ft^2
Flow Capacity, Q =	1850	cfs

3.75" Rack Spacing - Existing Conditions			1.0" Rack Spacing		
Vertical Bar Spacing =	3.8	in	Vertical Bar Spacing =	1.0	in
Vertical Bar Width, b_{bar} =	0.3125	In	Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar Length in Flow, L_{bar} =	27.95	ft	Vert. Bar Length in Flow, L_{bar} =	27.95	ft
Number of Vertical Bar =	74		Number of Vertical Bar =	226	
Horizontal Bar Width =	3	in	Horizontal Bar Width =	3	in
Horizontal Bar Length =	26	ft	Horizontal Bar Length =	26	ft
Number of Horizontal Bars =	8		Number of Horizontal Bars =	8	
Area of Bars, A_{bars} =	105.9	ft^2	Area of Bars, A_{bars} =	249.4	ft^2
Net Open Area of Racks, A_{net} =	620.8	ft^2	Net Open Area of Racks, A_{net} =	477.3	ft^2
Ratio of Net to Gross Area, R =	0.85		Ratio of Net to Gross Area, R =	0.66	
Loss Coefficient, K =	0.336		Loss Coefficient, K =	0.723	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	620.84	ft^2	Net Open Area of Racks =	477.30	ft^2
Flow Velocity, V =	2.98	ft/s	Flow Velocity, V =	3.88	ft/s
Trash Rack Head Loss, H_L =	0.046	ft	Trash Rack Head Loss, H_L =	0.169	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	527.71	ft^2	Net Open Area of Racks =	405.71	ft^2
Flow Velocity, V =	3.51	ft/s	Flow Velocity, V =	4.56	ft/s
Trash Rack Head Loss, H_L =	0.064	ft	Trash Rack Head Loss, H_L =	0.233	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	465.63	ft^2	Net Open Area of Racks =	357.98	ft^2
Flow Velocity =	3.97	ft/s	Flow Velocity =	5.17	ft/s
Trash Rack Head Loss =	0.082	ft	Trash Rack Head Loss =	0.300	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	310.42	ft^2	Net Open Area of Racks =	238.65	ft^2
Flow Velocity =	5.96	ft/s	Flow Velocity =	7.75	ft/s
Trash Rack Head Loss =	0.185	ft	Trash Rack Head Loss =	0.675	ft

TABLE B4 WISSOTA HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	90	ft
Rack Invert Elevation =	871	ft
Normal Headpond Elevation =	898	ft
Height of trash rack in flow =	67.00	ft
Gross Area, A_{gross} =	6030.00	ft^2
Flow Capacity, Q =	9460	cfs
1.0" Rack Spacing - Inclined		
Vertical Bar Spacing =	1.0	in
Vertical Bar Width, b_{bar} =	0.375	In
Vert. Bar Length in Flow, L_{bar} =	67.00	ft
Number of Vertical Bar =	785	
Horizontal Bar Width =	3	in
Horizontal Bar Length =	90	ft
Number of Horizontal Bars =	8	
Area of Bars, A_{bars} =	1823.6	ft^2
Net Open Area of Racks, A_{net} =	4206.4	ft^2
Ratio of Net to Gross Area, R =	0.70	
Loss Coefficient, K =	0.649	
Gravitational Constant, g =	32.20	ft/s^2
0% Blinding		
Percent Blinding =	0%	
Net Open Area of Racks =	4206.41	ft^2
Flow Velocity, V =	2.25	ft/s
Trash Rack Head Loss, H_L =	0.051	ft
15% Blinding		
Percent Blinding =	15%	
Net Open Area of Racks =	3575.45	ft^2
Flow Velocity, V =	2.65	ft/s
Trash Rack Head Loss, H_L =	0.071	ft
25% Blinding		
Percent Blinding =	25%	
Net Open Area of Racks =	3154.80	ft^2
Flow Velocity =	3.00	ft/s
Trash Rack Head Loss =	0.091	ft
50% Blinding		
Percent Blinding =	50%	
Net Open Area of Racks =	2103.20	ft^2
Flow Velocity =	4.50	ft/s
Trash Rack Head Loss =	0.204	ft

TABLE B5 DELLS HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	36	ft
Rack Invert Elevation =	777	ft
Normal Headpond Elevation =	795	ft
Height of trash rack in flow* =	18.70	ft
Gross Area, A_{gross} =	673.20	ft^2
Flow Capacity, Q =	1800	cfs
*Angled rack measured from drawing		
Calibration Factor	0.3	ft

5" O.C. Rack Spacing - Existing Conditions			1.0" Rack Spacing		
Vertical Bar Spacing =	5.0	in	Vertical Bar Spacing =	1.0	in
Vertical Bar 1 Width, b_{bar} =	0.3125	In	Vertical Bar Width, b_{bar} =	0.3125	In
Vert. Bar 1 Length in Flow, L_{bar} =	18.70	ft	Vert. Bar Length in Flow, L_{bar} =	18.70	ft
Number of Vertical Bar =	81		Number of Vertical Bar =	329	
Area of Bars, A_{bars} =	39.4	ft^2	Area of Bars, A_{bars} =	160.2	ft^2
Net Open Area of Racks, A_{net} =	633.8	ft^2	Net Open Area of Racks, A_{net} =	513.0	ft^2
Ratio of Net to Gross Area, R =	0.94		Ratio of Net to Gross Area, R =	0.76	
Loss Coefficient, K =	0.140		Loss Coefficient, K =	0.526	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	633.75	ft^2	Net Open Area of Racks =	512.98	ft^2
Flow Velocity, V =	2.84	ft/s	Flow Velocity, V =	3.51	ft/s
Trash Rack Head Loss, H_L =	0.318	ft	Trash Rack Head Loss, H_L =	0.401	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	538.69	ft^2	Net Open Area of Racks =	436.04	ft^2
Flow Velocity, V =	3.34	ft/s	Flow Velocity, V =	4.13	ft/s
Trash Rack Head Loss, H_L =	0.324	ft	Trash Rack Head Loss, H_L =	0.439	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	475.32	ft^2	Net Open Area of Racks =	384.74	ft^2
Flow Velocity =	3.79	ft/s	Flow Velocity =	4.68	ft/s
Trash Rack Head Loss =	0.331	ft	Trash Rack Head Loss =	0.479	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	316.88	ft^2	Net Open Area of Racks =	256.49	ft^2
Flow Velocity =	5.68	ft/s	Flow Velocity =	7.02	ft/s
Trash Rack Head Loss =	0.370	ft	Trash Rack Head Loss =	0.703	ft

TABLE B5 DELLS HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	24	ft
Rack Invert Elevation =	774.75	ft
Normal Headpond Elevation =	795	ft
Height of trash rack in flow* =	20.95	ft
Gross Area, A_{gross} =	502.80	ft^2
Flow Capacity, Q =	1425	cfs
*Angled rack measured from drawing		
Calibration Factor (ft)	0.5	

5" O.C. Rack Spacing - Existing Conditions			1.0" Rack Spacing		
Vertical Bar Spacing =	5.0	in	Vertical Bar Spacing =	1.0	in
Vertical Bar 1 Width, b_{bar} =	0.3125	In	Vertical Bar Width, b_{bar} =	0.3125	In
Vert. Bar 1 Length in Flow, L_{bar} =	20.95	ft	Vert. Bar Length in Flow, L_{bar} =	20.95	ft
Number of Vertical Bar =	54		Number of Vertical Bar =	219	
Area of Bars, A_{bars} =	29.5	ft^2	Area of Bars, A_{bars} =	119.5	ft^2
Net Open Area of Racks, A_{net} =	473.3	ft^2	Net Open Area of Racks, A_{net} =	383.3	ft^2
Ratio of Net to Gross Area, R =	0.94		Ratio of Net to Gross Area, R =	0.76	
Loss Coefficient, K =	0.140		Loss Coefficient, K =	0.526	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	473.34	ft^2	Net Open Area of Racks =	383.32	ft^2
Flow Velocity, V =	3.01	ft/s	Flow Velocity, V =	3.72	ft/s
Trash Rack Head Loss, H_L =	0.520	ft	Trash Rack Head Loss, H_L =	0.613	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	402.34	ft^2	Net Open Area of Racks =	325.82	ft^2
Flow Velocity, V =	3.54	ft/s	Flow Velocity, V =	4.37	ft/s
Trash Rack Head Loss, H_L =	0.527	ft	Trash Rack Head Loss, H_L =	0.656	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	355.00	ft^2	Net Open Area of Racks =	287.49	ft^2
Flow Velocity =	4.01	ft/s	Flow Velocity =	4.96	ft/s
Trash Rack Head Loss =	0.535	ft	Trash Rack Head Loss =	0.701	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	236.67	ft^2	Net Open Area of Racks =	191.66	ft^2
Flow Velocity =	6.02	ft/s	Flow Velocity =	7.44	ft/s
Trash Rack Head Loss =	0.579	ft	Trash Rack Head Loss =	0.951	ft

TABLE B5 DELLS HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	24	ft
Rack Invert Elevation =	774.75	ft
Normal Headpond Elevation =	795	ft
Height of trash rack in flow* =	20.95	ft
Gross Area, A_{gross} =	502.80	ft^2
Flow Capacity, Q =	800	cfs

*Angled rack measured from drawing

Calibration Factor (ft) 0.2

5" O.C. Rack Spacing - Existing Conditions			1.0" Rack Spacing		
Vertical Bar Spacing =	5.0	in	Vertical Bar Spacing =	1.0	in
Vertical Bar 1 Width, b_{bar} =	0.3125	In	Vertical Bar Width, b_{bar} =	0.3125	In
Vert. Bar 1 Length in Flow, L_{bar} =	20.95	ft	Vert. Bar Length in Flow, L_{bar} =	20.95	ft
Number of Vertical Bar =	54		Number of Vertical Bar =	219	
Area of Bars, A_{bars} =	29.5	ft^2	Area of Bars, A_{bars} =	119.5	ft^2
Net Open Area of Racks, A_{net} =	473.3	ft^2	Net Open Area of Racks, A_{net} =	383.3	ft^2
Ratio of Net to Gross Area, R =	0.94		Ratio of Net to Gross Area, R =	0.76	
Loss Coefficient, K =	0.140		Loss Coefficient, K =	0.526	
Gravitational Constant, g =	32.20	ft/s^2	Gravitational Constant, g =	32.20	ft/s^2
0% Blinding			**0% Blinding**		
Percent Blinding =	0%		Percent Blinding =	0%	
Net Open Area of Racks =	473.34	ft^2	Net Open Area of Racks =	383.32	ft^2
Flow Velocity, V =	1.69	ft/s	Flow Velocity, V =	2.09	ft/s
Trash Rack Head Loss, H_L =	0.206	ft	Trash Rack Head Loss, H_L =	0.236	ft
15% Blinding			**15% Blinding**		
Percent Blinding =	15%		Percent Blinding =	15%	
Net Open Area of Racks =	402.34	ft^2	Net Open Area of Racks =	325.82	ft^2
Flow Velocity, V =	1.99	ft/s	Flow Velocity, V =	2.46	ft/s
Trash Rack Head Loss, H_L =	0.209	ft	Trash Rack Head Loss, H_L =	0.249	ft
25% Blinding			**25% Blinding**		
Percent Blinding =	25%		Percent Blinding =	25%	
Net Open Area of Racks =	355.00	ft^2	Net Open Area of Racks =	287.49	ft^2
Flow Velocity =	2.25	ft/s	Flow Velocity =	2.78	ft/s
Trash Rack Head Loss =	0.211	ft	Trash Rack Head Loss =	0.263	ft
50% Blinding			**50% Blinding**		
Percent Blinding =	50%		Percent Blinding =	50%	
Net Open Area of Racks =	236.67	ft^2	Net Open Area of Racks =	191.66	ft^2
Flow Velocity =	3.38	ft/s	Flow Velocity =	4.17	ft/s
Trash Rack Head Loss =	0.225	ft	Trash Rack Head Loss =	0.342	ft

TABLE B5 DELLS HEAD LOSS CALCULATIONS

Trash Rack Base Dimensions		
Rack Total Length, L =	162	ft
Rack Invert Elevation =	774.75	ft
Normal Headpond Elevation =	795	ft
Height of trash rack in flow =	31.00	ft
Gross Area, A_{gross} =	5022.00	ft^2
Flow Capacity, Q =	6875	cfs
Top of Rack =	802.5	ft
Caibration Factor	1	ft
1.0" Rack Spacing - Inclined rack		
Vertical Bar Spacing =	1.0	in
Vertical Bar 1 Width, b_{bar} =	0.3125	In
Vert. Bar 1 Length in Flow, L_{bar} =	31.00	ft
Number of Vertical Bar =	1481	
Area of Bars, A_{bars} =	1195.6	ft^2
Net Open Area of Racks, A_{net} =	3826.4	ft^2
Ratio of Net to Gross Area, R =	0.76	
Loss Coefficient, K =	0.527	
Gravitational Constant, g =	32.20	ft/s^2
0% Blinding		
Percent Blinding	0%	
Net Open Area of Racks =	3826.40	ft^2
Flow Velocity, V =	1.80	ft/s
Trash Rack Head Loss, H_L =	1.026	ft
15% Blinding		
Percent Blinding	15%	
Net Open Area of Racks =	3252.44	ft^2
Flow Velocity, V =	2.11	ft/s
Trash Rack Head Loss, H_L =	1.037	ft
25% Blinding		
Percent Blinding	25%	
Net Open Area of Racks =	2869.80	ft^2
Flow Velocity =	2.40	ft/s
Trash Rack Head Loss =	1.047	ft
50% Blinding		
Percent Blinding	50%	
Net Open Area of Racks =	1913.20	ft^2
Flow Velocity =	3.59	ft/s
Trash Rack Head Loss =	1.106	ft

APPENDIX C

MONTHLY RESULTS OF THE ENERGY MODEL EVALUATION

TABLE C1 MONTHLY GENERATION – HOLCOMBE EXISTING CONDITIONS

Existing	0% Blind	15% Blind	25% Blind	50% Blind
JAN	4,574.0	4,573.7	4,573.4	4,571.6
FEB	4,388.0	4,387.7	4,387.4	4,385.6
MAR	7,651.1	7,650.2	7,649.4	7,644.7
APR	14,041.7	14,039.8	14,037.9	14,027.0
MAY	12,201.5	12,200.0	12,198.4	12,189.5
JUN	9,379.1	9,378.0	9,376.8	9,370.4
JUL	6,511.6	6,510.9	6,510.3	6,506.7
AUG	5,884.8	5,884.3	5,883.8	5,880.7
SEP	5,394.3	5,393.8	5,393.4	5,390.6
OCT	6,920.9	6,920.3	6,919.5	6,915.5
NOV	6,537.2	6,536.6	6,535.9	6,532.3
DEC	5,465.5	5,465.0	5,464.6	5,461.9
ANN	88,949.7	88,940.3	88,930.7	88,876.5

TABLE C2 MONTHLY GENERATION – HOLCOMBE PROPOSED NARROWLY-SPACED RACKS CONDITIONS

1"	0% Blind	15% Blind	25% Blind	50% Blind
JAN	4,569.8	4,567.9	4,566.0	4,554.9
FEB	4,383.8	4,381.9	4,380.0	4,369.0
MAR	7,640.1	7,635.1	7,630.0	7,601.1
APR	14,016.3	14,004.6	13,992.6	13,925.2
MAY	12,180.7	12,171.1	12,161.4	12,106.1
JUN	9,364.1	9,357.3	9,350.3	9,310.7
JUL	6,503.1	6,499.2	6,495.2	6,472.8
AUG	5,877.6	5,874.3	5,870.9	5,851.8
SEP	5,387.9	5,385.0	5,381.9	5,364.9
OCT	6,911.6	6,907.3	6,902.9	6,878.0
NOV	6,528.7	6,524.8	6,520.7	6,498.1
DEC	5,459.4	5,456.6	5,453.7	5,437.6
ANN	88,823.1	88,765.1	88,705.6	88,370.0

TABLE C3 MONTHLY GENERATION – HOLCOMBE PROPOSED NARROWLY-SPACED INCLINED RACKS CONDITIONS

1"-Inclined	0% Blind	15% Blind	25% Blind	50% Blind
JAN	4,573.8	4,573.4	4,573.0	4,570.8
FEB	4,387.8	4,387.4	4,387.0	4,384.7
MAR	7,650.5	7,649.5	7,648.4	7,642.5
APR	14,040.4	14,038.0	14,035.6	14,021.8
MAY	12,200.5	12,198.5	12,196.5	12,185.2
JUN	9,378.3	9,376.9	9,375.5	9,367.4
JUL	6,511.1	6,510.3	6,509.5	6,504.9
AUG	5,884.5	5,883.8	5,883.1	5,879.2
SEP	5,394.0	5,393.4	5,392.8	5,389.3
OCT	6,920.5	6,919.6	6,918.7	6,913.6
NOV	6,536.8	6,536.0	6,535.2	6,530.5
DEC	5,465.2	5,464.6	5,464.0	5,460.7
ANN	88,943.3	88,931.4	88,919.3	88,850.8

TABLE C4 MONTHLY GENERATION – CORNELL EXISTING CONDITIONS

Existing	0% Blind	15% Blind	25% Blind	50% Blind
JAN	4,050.9	4,049.0	4,047.0	4,035.9
FEB	3,897.1	3,895.1	3,893.1	3,881.8
MAR	6,848.2	6,842.8	6,837.2	6,805.8
APR	12,826.4	12,812.6	12,798.4	12,718.4
MAY	11,037.1	11,025.9	11,014.4	10,949.9
JUN	8,390.1	8,382.4	8,374.5	8,329.7
JUL	5,791.7	5,787.5	5,783.1	5,758.8
AUG	5,241.6	5,238.0	5,234.4	5,213.6
SEP	4,806.9	4,803.5	4,800.1	4,780.9
OCT	6,163.0	6,158.1	6,153.1	6,124.9
NOV	5,821.9	5,817.6	5,813.2	5,788.6
DEC	4,849.0	4,846.0	4,842.9	4,825.3
ANN	79,723.9	79,658.5	79,591.6	79,213.5

TABLE C5 MONTHLY GENERATION – CORNELL PROPOSED NARROWLY-SPACED RACKS CONDITIONS

1"	0% Blind	15% Blind	25% Blind	50% Blind
JAN	4,029.5	4,019.4	4,009.0	3,950.4
FEB	3,875.1	3,864.7	3,854.0	3,793.8
MAR	6,785.0	6,755.3	6,724.8	6,552.8
APR	12,663.3	12,586.8	12,508.4	12,065.8
MAY	10,905.7	10,844.0	10,780.9	10,424.3
JUN	8,299.4	8,256.9	8,213.2	7,967.0
JUL	5,743.0	5,720.0	5,696.5	5,563.9
AUG	5,200.4	5,180.9	5,161.0	5,048.7
SEP	4,768.7	4,750.7	4,732.3	4,628.3
OCT	6,106.3	6,079.6	6,052.3	5,898.0
NOV	5,772.5	5,749.2	5,725.4	5,590.9
DEC	4,814.3	4,797.9	4,781.1	4,686.4
ANN	78,963.1	78,605.5	78,239.0	76,170.3

TABLE C6 MONTHLY GENERATION – HOLCOMBE PROPOSED NARROWLY-SPACED ANGLED RACKS CONDITIONS

1"-Angled	0% Blind	15% Blind	25% Blind	50% Blind
JAN	4,061.5	4,061.2	4,060.9	4,059.2
FEB	3,908.1	3,907.8	3,907.5	3,905.7
MAR	6,880.8	6,879.9	6,879.0	6,873.8
APR	12,911.3	12,909.0	12,906.5	12,892.9
MAY	11,105.3	11,103.4	11,101.4	11,090.5
JUN	8,437.1	8,435.8	8,434.4	8,426.9
JUL	5,816.6	5,815.9	5,815.2	5,811.2
AUG	5,262.6	5,262.1	5,261.5	5,258.1
SEP	4,826.3	4,825.8	4,825.2	4,822.1
OCT	6,192.1	6,191.3	6,190.5	6,185.8
NOV	5,847.2	5,846.5	5,845.8	5,841.7
DEC	4,866.7	4,866.2	4,865.7	4,862.9
ANN	80,115.6	80,104.8	80,093.6	80,030.8

TABLE C7 MONTHLY GENERATION – JIM FALLS EXISTING CONDITIONS

Existing	0% Blind	15% Blind	25% Blind	50% Blind
JAN	6,241.9	6,241.6	6,241.4	6,239.9
FEB	5,999.4	5,999.0	5,998.7	5,996.7
MAR	10,499.5	10,498.0	10,496.5	10,487.6
APR	19,730.1	19,724.9	19,719.6	19,689.5
MAY	16,926.1	16,922.2	16,918.3	16,895.9
JUN	12,789.1	12,786.7	12,784.3	12,770.7
JUL	8,883.3	8,882.2	8,881.1	8,875.1
AUG	8,045.4	8,044.5	8,043.5	8,038.2
SEP	7,375.2	7,374.2	7,373.2	7,367.7
OCT	9,415.3	9,413.9	9,412.4	9,404.1
NOV	8,918.5	8,917.4	8,916.2	8,909.7
DEC	7,454.1	7,453.4	7,452.7	7,448.7
ANN	122,277.9	122,258.2	122,237.9	122,123.8

TABLE C8 MONTHLY GENERATION – JIM FALLS PROPOSED NARROWLY-SPACED RACKS CONDITIONS

1"	0% Blind	15% Blind	25% Blind	50% Blind
JAN	6,238.7	6,237.2	6,235.7	6,227.0
FEB	5,995.2	5,993.3	5,991.3	5,980.0
MAR	10,480.6	10,471.8	10,462.8	10,411.9
APR	19,665.5	19,635.5	19,604.8	19,431.1
MAY	16,878.1	16,855.7	16,832.8	16,703.7
JUN	12,759.8	12,746.3	12,732.3	12,653.8
JUL	8,870.3	8,864.3	8,858.1	8,823.3
AUG	8,033.9	8,028.6	8,023.1	7,992.2
SEP	7,363.3	7,357.7	7,352.0	7,319.9
OCT	9,397.5	9,389.3	9,380.8	9,333.0
NOV	8,904.6	8,898.2	8,891.5	8,854.3
DEC	7,445.5	7,441.4	7,437.3	7,414.0
ANN	122,033.0	121,919.2	121,802.6	121,144.2

TABLE C9 MONTHLY GENERATION – JIM FALLS PROPOSED NARROWLY-SPACED ANGLED RACKS CONDITIONS

1"-Angled	0% Blind	15% Blind	25% Blind	50% Blind
JAN	**6,250.0**	**6,249.9**	**6,249.7**	**6,248.6**
FEB	**6,010.0**	**6,009.7**	**6,009.5**	**6,008.1**
MAR	**10,547.5**	**10,546.5**	**10,545.4**	**10,539.2**
APR	**19,893.8**	**19,890.2**	**19,886.4**	**19,865.3**
MAY	**17,047.9**	**17,045.2**	**17,042.4**	**17,026.6**
JUN	**12,863.1**	**12,861.4**	**12,859.7**	**12,850.2**
JUL	**8,916.0**	**8,915.3**	**8,914.6**	**8,910.3**
AUG	**8,074.5**	**8,073.9**	**8,073.2**	**8,069.4**
SEP	**7,405.5**	**7,404.8**	**7,404.1**	**7,400.2**
OCT	**9,460.4**	**9,459.4**	**9,458.4**	**9,452.6**
NOV	**8,953.6**	**8,952.8**	**8,952.0**	**8,947.5**
DEC	7,476.1	7,475.6	7,475.1	7,472.3
ANN	122,898.5	122,884.6	122,870.4	122,790.2

TABLE C10 MONTHLY GENERATION – WISSOTA EXISTING CONDITIONS

Existing	0% Blind	15% Blind	25% Blind	50% Blind
JAN	7,209.3	7,208.1	7,206.9	7,200.0
FEB	6,856.7	6,855.5	6,854.4	6,847.8
MAR	11,438.8	11,436.3	11,433.7	11,419.1
APR	18,672.6	18,668.0	18,663.3	18,636.9
MAY	16,980.7	16,976.7	16,972.5	16,949.3
JUN	13,778.0	13,774.8	13,771.6	13,753.4
JUL	9,969.4	9,967.4	9,965.3	9,953.5
AUG	8,906.0	8,904.3	8,902.5	8,892.7
SEP	8,085.4	8,084.0	8,082.5	8,074.2
OCT	10,408.9	10,406.8	10,404.7	10,392.8
NOV	10,000.3	9,998.3	9,996.2	9,984.6
DEC	8,475.0	8,473.5	8,472.0	8,463.2
ANN	130,781.0	130,753.7	130,725.7	130,567.6

TABLE C11 MONTHLY GENERATION – WISSOTA PROPOSED NARROWLY-SPACED RACKS CONDITIONS

1"	0% Blind	15% Blind	25% Blind	50% Blind
JAN	7,201.1	7,196.7	7,192.3	7,167.1
FEB	6,848.9	6,844.7	6,840.5	6,816.6
MAR	11,421.4	11,412.3	11,402.8	11,349.7
APR	18,641.1	18,624.5	18,607.4	18,511.1
MAY	16,953.0	16,938.4	16,923.4	16,838.8
JUN	13,756.3	13,744.8	13,733.1	13,666.7
JUL	9,955.4	9,948.0	9,940.4	9,897.5
AUG	8,894.2	8,888.0	8,881.6	8,845.7
SEP	8,075.5	8,070.3	8,065.0	8,034.8
OCT	10,394.7	10,387.2	10,379.6	10,336.2
NOV	9,986.5	9,979.2	9,971.7	9,929.5
DEC	8,464.6	8,459.1	8,453.5	8,421.6
ANN	130,592.9	130,493.3	130,391.3	129,815.1

TABLE C12 MONTHLY GENERATION – WISSOTA PROPOSED NARROWLY-SPACED INCLINED RACKS CONDITIONS

1"	0% Blind	15% Blind	25% Blind	50% Blind
JAN	7,211.7	7,211.4	7,211.1	7,209.5
FEB	6,858.9	6,858.6	6,858.3	6,856.7
MAR	11,443.5	11,442.8	11,442.0	11,437.8
APR	18,680.2	18,678.5	18,676.9	18,667.4
MAY	16,987.6	16,986.2	16,984.8	16,976.9
JUN	13,783.6	13,782.6	13,781.6	13,776.0
JUL	9,973.3	9,972.7	9,972.2	9,969.0
AUG	8,909.2	8,908.7	8,908.2	8,905.4
SEP	8,088.0	8,087.6	8,087.2	8,084.8
OCT	10,412.6	10,412.0	10,411.4	10,407.9
NOV	10,004.0	10,003.5	10,002.9	9,999.7
DEC	8,477.9	8,477.5	8,477.1	8,474.8
ANN	130,830.6	130,822.3	130,813.8	130,765.9

TABLE C13 MONTHLY GENERATION – DELLS EXISTING CONDITIONS

Existing	0% Blind	15% Blind	25% Blind	50% Blind
JAN	3,172.9	3,172.3	3,171.7	3,168.0
FEB	2,933.6	2,933.0	2,932.4	2,928.7
MAR	4,621.3	4,620.1	4,618.9	4,611.9
APR	5,704.0	5,702.2	5,700.3	5,689.6
MAY	5,608.8	5,607.2	5,605.5	5,596.0
JUN	5,120.9	5,119.5	5,118.1	5,110.0
JUL	4,061.9	4,061.0	4,060.0	4,054.6
AUG	3,504.3	3,503.6	3,502.7	3,498.2
SEP	3,197.6	3,196.9	3,196.1	3,191.8
OCT	3,946.4	3,945.4	3,944.4	3,938.7
NOV	4,079.8	4,078.8	4,077.8	4,072.2
DEC	3,516.3	3,515.5	3,514.7	3,510.1
ANN	49,468.0	49,455.4	49,442.5	49,369.6

TABLE C14 MONTHLY GENERATION – DELLS PROPOSED NARROWLY-SPACED RACKS CONDITIONS

Narrowly-Spaced	0% Blind	15% Blind	25% Blind	50% Blind
JAN	3,165.1	3,161.5	3,157.8	3,136.8
FEB	2,925.8	2,922.1	2,918.4	2,897.2
MAR	4,606.5	4,599.6	4,592.5	4,552.6
APR	5,681.3	5,670.7	5,659.8	5,598.6
MAY	5,588.6	5,579.2	5,569.6	5,515.3
JUN	5,103.7	5,095.7	5,087.6	5,041.3
JUL	4,050.3	4,044.9	4,039.4	4,008.1
AUG	3,494.7	3,490.2	3,485.6	3,459.6
SEP	3,188.4	3,184.1	3,179.8	3,155.1
OCT	3,934.3	3,928.7	3,922.9	3,890.3
NOV	4,067.8	4,062.2	4,056.4	4,024.0
DEC	3,506.5	3,501.9	3,497.2	3,470.8
ANN	49,313.0	49,240.9	49,166.9	48,749.6

TABLE C15 MONTHLY GENERATION – DELLS PROPOSED NARROWLY-SPACED INCLINED RACKS CONDITIONS

Inclined	0% Blind	15% Blind	25% Blind	50% Blind
JAN	3,175.3	3,175.0	3,174.7	3,173.0
FEB	2,935.0	2,934.6	2,934.3	2,932.5
MAR	4,617.0	4,616.3	4,615.6	4,611.3
APR	5,692.2	5,691.0	5,689.7	5,682.5
MAY	5,599.8	5,598.7	5,597.6	5,591.4
JUN	5,114.2	5,113.3	5,112.4	5,107.2
JUL	4,060.2	4,059.7	4,059.2	4,056.0
AUG	3,504.0	3,503.6	3,503.2	3,500.7
SEP	3,196.9	3,196.5	3,196.1	3,193.7
OCT	3,944.2	3,943.6	3,943.0	3,939.7
NOV	4,078.4	4,077.8	4,077.2	4,074.0
DEC	3,516.7	3,516.2	3,515.8	3,513.4
ANN	49,433.9	49,426.4	49,418.7	49,375.3

APPENDIX D

METHODS AND RESULTS OF PROBABILITY OF BLADE STRIKE SURVIVAL

Model iterations for the target species were prepared using three correlation factors for all units and three *r* values for the Kaplan units. The *r* value refers to the point along the runner radius where fish enter the turbine. The passage routes (i.e., *r* values) included the edge of hub, midpoint between the turbine hub and the discharge ring, and at the blade tip. The Advanced Hydro Turbine model uses a correlation factor to adjust the model results to correspond with empirical results from field studies because the contact of a fish with a turbine component does not always result in injury or mortality (Bell 1981; Cada 1998). The correlation factor is used to adjust predicted turbine strike results to more closely match empirical results. Based on a number of recent test results obtained from studies conducted with salmonids on the west coast, Franke and colleagues (1997) recommend setting the correlation factor between 0.10 and 0.20. In this study, we used correlation factors of 0.10, 0.15, and 0.20.

The probability of blade strike was calculated for each Kaplan and Francis turbine (including axial flow) using the following formulas:

$$P = \lambda \frac{N \cdot L}{D} \cdot \left[\frac{\cos \alpha_a}{8 \cdot Q_{wd}} + \frac{\sin \alpha_a}{\pi \cdot \frac{r}{R}} \right]$$

$$P = \lambda \frac{N \cdot L}{D} \cdot \left[\frac{\sin \alpha_t \left[\frac{B}{D_1} \right]}{2Q_{\omega d}} + \frac{\cos \alpha_t}{\pi} \right]$$

In each formula the input parameters are defined as:

P	=	Predicted strike probability
N	=	Number of turbine blades
L	=	Length of fish
D	=	Diameter of runner
D_1	=	Diameter of runner at inlet
B	=	Runner height at inlet

λ = Strike mortality correlation factor (lambda)

R = Radius of runner = (D/2)

r = Location along radius that a given fish enters the turbine (i.e., edge of hub, midpoint between the turbine hub and the discharge ring, and at the blade tip)

η = Turbine efficiency

$E_{\omega d}$ = Head Coefficient or energy coefficient

$$= \frac{gH}{(\omega D)^2}$$

α_a = Angle to axial of absolute flow upstream of runner

$$= \tan\alpha_a = \frac{\pi \cdot E_{wd} \cdot \eta}{2 \cdot Q_{wd} \cdot \frac{r}{R}}$$

g = Acceleration of gravity

H = Turbine net head

ω = Rotational speed

$$= RPM \cdot \frac{2\pi}{60}$$

RPM = Revolutions per minute

Q = Turbine discharge

Q_{opt} = Turbine discharge at best efficiency

$Q_{\omega d}$ = Discharge Coefficient

$$= \frac{Q}{\omega D^3}$$

$$\tan\beta = \frac{0.707 \cdot \frac{\pi}{8}}{\xi \cdot Q_{\omega d}\, opt \left(\frac{D_1}{D_2}\right)^3}$$

ξ = Ratio between Q with no exit swirl and Q_{opt}

Survival was calculated by subtracting the predicted strike estimate from 100.

TABLES D1.1 THROUGH D1.7

HOLCOMBE PROJECT – RESULTS OF BLADE STRIKE CALCULATIONS

TABLE D1.1 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
6	2.79%	4.18%	5.58%		**6**	2.51%	3.76%	5.01%		**6**	2.47%	3.71%	4.94%
7	3.25%	4.88%	6.51%		**7**	2.92%	4.38%	5.85%		**7**	2.88%	4.32%	5.77%
8	3.72%	5.58%	7.44%		**8**	3.34%	5.01%	6.68%		**8**	3.29%	4.94%	6.59%
9	4.18%	6.28%	8.37%		**9**	3.76%	5.64%	7.52%		**9**	3.71%	5.56%	7.41%
10	4.65%	6.97%	9.30%		**10**	4.18%	6.26%	8.35%		**10**	4.12%	6.18%	8.24%
Average	**2.8%**	**4.2%**	**5.6%**		**Average**	**2.5%**	**3.8%**	**5.0%**		**Average**	**2.5%**	**3.7%**	**4.9%**
	97.2%	95.8%	94.4%			97.5%	96.2%	95.0%			97.5%	96.3%	95.1%

TABLE D1.2: RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
6	2.79%	4.18%	5.58%		**6**	2.51%	3.76%	5.01%		**6**	2.47%	3.71%	4.94%
7	3.25%	4.88%	6.51%		**7**	2.92%	4.38%	5.85%		**7**	2.88%	4.32%	5.77%
8	3.72%	5.58%	7.44%		**8**	3.34%	5.01%	6.68%		**8**	3.29%	4.94%	6.59%
Average	**2.3%**	**3.5%**	**4.6%**		**Average**	**2.1%**	**3.1%**	**4.2%**		**Average**	**2.1%**	**3.1%**	**4.1%**
	97.7%	96.5%	95.4%			97.9%	96.9%	95.8%			97.9%	96.9%	95.9%

TABLE D1.3 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
Average	**1.6%**	**2.4%**	**3.3%**		**Average**	**1.5%**	**2.2%**	**2.9%**		**Average**	**1.4%**	**2.2%**	**2.9%**
	98.4%	97.6%	96.7%			98.5%	97.8%	97.1%			98.6%	97.8%	97.1%

TABLE D1.4 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – BLUEGILL.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
6	2.79%	4.18%	5.58%		**6**	2.51%	3.76%	5.01%		**6**	2.47%	3.71%	4.94%
Average	**1.9%**	**2.8%**	**3.7%**		**Average**	**1.7%**	**2.5%**	**3.3%**		**Average**	**1.6%**	**2.5%**	**3.3%**
	98.1%	97.2%	96.3%			98.3%	97.5%	96.7%			98.4%	97.5%	96.7%

TABLE D1.5 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
6	2.79%	4.18%	5.58%		**6**	2.51%	3.76%	5.01%		**6**	2.47%	3.71%	4.94%
Average	**1.9%**	**2.8%**	**3.7%**		**Average**	**1.7%**	**2.5%**	**3.3%**		**Average**	**1.6%**	**2.5%**	**3.3%**
	98.1%	97.2%	96.3%			98.3%	97.5%	96.7%			98.4%	97.5%	96.7%

TABLE D1.6 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – YELLOW PERCH.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
Average	**1.6%**	**2.4%**	**3.3%**		**Average**	**1.5%**	**2.2%**	**2.9%**		**Average**	**1.4%**	**2.2%**	**2.9%**
	98.4%	97.6%	96.7%			98.5%	97.8%	97.1%			98.6%	97.8%	97.1%

TABLE D1.7 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE HOLCOMBE PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.93%	1.39%	1.86%		**2**	0.84%	1.25%	1.67%		**2**	0.82%	1.24%	1.65%
3	1.39%	2.09%	2.79%		**3**	1.25%	1.88%	2.51%		**3**	1.24%	1.85%	2.47%
4	1.86%	2.79%	3.72%		**4**	1.67%	2.51%	3.34%		**4**	1.65%	2.47%	3.29%
5	2.32%	3.49%	4.65%		**5**	2.09%	3.13%	4.18%		**5**	2.06%	3.09%	4.12%
6	2.79%	4.18%	5.58%		**6**	2.51%	3.76%	5.01%		**6**	2.47%	3.71%	4.94%
7	3.25%	4.88%	6.51%		**7**	2.92%	4.38%	5.85%		**7**	2.88%	4.32%	5.77%
8	3.72%	5.58%	7.44%		**8**	3.34%	5.01%	6.68%		**8**	3.29%	4.94%	6.59%
Average	**2.3%**	**3.5%**	**4.6%**		**Average**	**2.1%**	**3.1%**	**4.2%**		**Average**	**2.1%**	**3.1%**	**4.1%**
	97.7%	96.5%	95.4%			97.9%	96.9%	95.8%			97.9%	96.9%	95.9%

TABLES D2.1 THROUGH D2.14

CORNELL PROJECT – RESULTS OF BLADE STRIKE CALCULATIONS

TABLE D2.1 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT - MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
6	2.08%	3.12%	4.16%		**6**	1.94%	2.91%	3.89%		**6**	1.93%	2.90%	3.87%
7	2.43%	3.64%	4.86%		**7**	2.27%	3.40%	4.53%		**7**	2.25%	3.38%	4.51%
8	2.78%	4.16%	5.55%		**8**	2.59%	3.89%	5.18%		**8**	2.58%	3.87%	5.15%
9	3.12%	4.69%	6.25%		**9**	2.91%	4.37%	5.83%		**9**	2.90%	4.35%	5.80%
10	3.47%	5.21%	6.94%		**10**	3.24%	4.86%	6.48%		**10**	3.22%	4.83%	6.44%
Average	**3.5%**	**5.2%**	**6.9%**		**Average**	**3.2%**	**4.9%**	**6.5%**		**Average**	**3.2%**	**4.8%**	**6.4%**
	96.5%	94.8%	93.1%			96.8%	95.1%	93.5%			96.8%	95.2%	93.6%

TABLE D2.2 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT - WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
6	2.08%	3.12%	4.16%		**6**	1.94%	2.91%	3.89%		**6**	1.93%	2.90%	3.87%
7	2.43%	3.64%	4.86%		**7**	2.27%	3.40%	4.53%		**7**	2.25%	3.38%	4.51%
8	2.78%	4.16%	5.55%		**8**	2.59%	3.89%	5.18%		**8**	2.58%	3.87%	5.15%
Average	**1.7%**	**2.6%**	**3.5%**		**Average**	**1.6%**	**2.4%**	**3.2%**		**Average**	**1.6%**	**2.4%**	**3.2%**
	98.3%	97.4%	96.5%			98.4%	97.6%	96.8%			98.4%	97.6%	96.8%

TABLE D2.3 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT – SMALLMOUTH BASS.

	Correlation Factor					Correlation Factor					Correlation Factor		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
Average	**1.2%**	**1.8%**	**2.4%**		**Average**	**1.1%**	**1.7%**	**2.3%**		**Average**	**1.1%**	**1.7%**	**2.3%**
	98.8%	98.2%	97.6%			98.9%	98.3%	97.7%			98.9%	98.3%	97.7%

TABLE D2.4 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT – BLUEGILL.

	Correlation Factor					Correlation Factor					Correlation Factor		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
6	2.08%	3.12%	4.16%		**6**	1.94%	2.91%	3.89%		**6**	1.93%	2.90%	3.87%
Average	**1.4%**	**2.1%**	**2.8%**		**Average**	**1.3%**	**1.9%**	**2.6%**		**Average**	**1.3%**	**1.9%**	**2.6%**
	98.6%	97.9%	97.2%			98.7%	98.1%	97.4%			98.7%	98.1%	97.4%

TABLE D2.5 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT – BLACK CRAPPIE.

	Correlation Factor					Correlation Factor					Correlation Factor		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
6	2.08%	3.12%	4.16%		**6**	1.94%	2.91%	3.89%		**6**	1.93%	2.90%	3.87%
Average	**1.4%**	**2.1%**	**2.8%**		**Average**	**1.3%**	**1.9%**	**2.6%**		**Average**	**1.3%**	**1.9%**	**2.6%**
	98.6%	97.9%	97.2%			98.7%	98.1%	97.4%			98.7%	98.1%	97.4%

TABLE D2.6 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT – YELLOW PERCH.

	Correlation Factor					Correlation Factor					Correlation Factor		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
Average	**1.2%**	**1.8%**	**2.4%**		**Average**	**1.1%**	**1.7%**	**2.3%**		**Average**	**1.1%**	**1.7%**	**2.3%**
	98.8%	98.2%	97.6%			98.9%	98.3%	97.7%			98.9%	98.3%	97.7%

TABLE D2.7 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1-3 AT THE CORNELL PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.69%	1.04%	1.39%		**2**	0.65%	0.97%	1.30%		**2**	0.64%	0.97%	1.29%
3	1.04%	1.56%	2.08%		**3**	0.97%	1.46%	1.94%		**3**	0.97%	1.45%	1.93%
4	1.39%	2.08%	2.78%		**4**	1.30%	1.94%	2.59%		**4**	1.29%	1.93%	2.58%
5	1.74%	2.60%	3.47%		**5**	1.62%	2.43%	3.24%		**5**	1.61%	2.42%	3.22%
6	2.08%	3.12%	4.16%		**6**	1.94%	2.91%	3.89%		**6**	1.93%	2.90%	3.87%
7	2.43%	3.64%	4.86%		**7**	2.27%	3.40%	4.53%		**7**	2.25%	3.38%	4.51%
8	2.78%	4.16%	5.55%		**8**	2.59%	3.89%	5.18%		**8**	2.58%	3.87%	5.15%
Average	**2.8%**	**4.2%**	**5.6%**		**Average**	**2.6%**	**3.9%**	**5.2%**		**Average**	**2.6%**	**3.9%**	**5.2%**
	97.2%	95.8%	94.4%			97.4%	96.1%	94.8%			97.4%	96.1%	94.8%

TABLE D2.8 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
6	7.23%	10.84%	14.45%		**6**	6.45%	9.67%	12.90%		**6**	6.24%	9.37%	12.49%
7	8.43%	12.65%	16.86%		**7**	7.52%	11.28%	15.05%		**7**	7.28%	10.93%	14.57%
8	9.63%	14.45%	19.27%		**8**	8.60%	12.90%	17.19%		**8**	8.32%	12.49%	16.65%
9	10.84%	16.26%	21.68%		**9**	9.67%	14.51%	19.34%		**9**	9.37%	14.05%	18.73%
10	12.04%	18.06%	24.09%		**10**	10.75%	16.12%	21.49%		**10**	10.41%	15.61%	20.81%
Average	**12.0%**	**18.1%**	**24.1%**		**Average**	**10.7%**	**16.1%**	**21.5%**		**Average**	**10.4%**	**15.6%**	**20.8%**
	88.0%	81.9%	75.9%			89.3%	83.9%	78.5%			89.6%	84.4%	79.2%

TABLE D2.9 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
6	7.23%	10.84%	14.45%		**6**	6.45%	9.67%	12.90%		**6**	6.24%	9.37%	12.49%
7	8.43%	12.65%	16.86%		**7**	7.52%	11.28%	15.05%		**7**	7.28%	10.93%	14.57%
8	9.63%	14.45%	19.27%		**8**	8.60%	12.90%	17.19%		**8**	8.32%	12.49%	16.65%
Average	**6.0%**	**9.0%**	**12.0%**		**Average**	**5.4%**	**8.1%**	**10.7%**		**Average**	**5.2%**	**7.8%**	**10.4%**
	94.0%	91.0%	88.0%			94.6%	91.9%	89.3%			94.8%	92.2%	89.6%

TABLE D2.10 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
Average	**4.2%**	**6.3%**	**8.4%**		**Average**	**3.8%**	**5.6%**	**7.5%**		**Average**	**3.6%**	**5.5%**	**7.3%**
	95.8%	93.7%	91.6%			96.2%	94.4%	92.5%			96.4%	94.5%	92.7%

TABLE D2.11 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – BLUEGILL.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
6	7.23%	10.84%	14.45%		**6**	6.45%	9.67%	12.90%		**6**	6.24%	9.37%	12.49%
Average	**4.8%**	**7.2%**	**9.6%**		**Average**	**4.3%**	**6.4%**	**8.6%**		**Average**	**4.2%**	**6.2%**	**8.3%**
	95.2%	92.8%	90.4%			95.7%	93.6%	91.4%			95.8%	93.8%	91.7%

TABLE D2.12 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
6	7.23%	10.84%	14.45%		**6**	6.45%	9.67%	12.90%		**6**	6.24%	9.37%	12.49%
Average	**4.8%**	**7.2%**	**9.6%**		**Average**	**4.3%**	**6.4%**	**8.6%**		**Average**	**4.2%**	**6.2%**	**8.3%**
	95.2%	92.8%	90.4%			95.7%	93.6%	91.4%			95.8%	93.8%	91.7%

TABLE D2.13 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – YELLOW PERCH.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
Average	**4.2%**	**6.3%**	**8.4%**		**Average**	**3.8%**	**5.6%**	**7.5%**		**Average**	**3.6%**	**5.5%**	**7.3%**
	95.8%	93.7%	91.6%			96.2%	94.4%	92.5%			96.4%	94.5%	92.7%

TABLE D2.14 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 4 AT THE CORNELL PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	2.41%	3.61%	4.82%		**2**	2.15%	3.22%	4.30%		**2**	2.08%	3.12%	4.16%
3	3.61%	5.42%	7.23%		**3**	3.22%	4.84%	6.45%		**3**	3.12%	4.68%	6.24%
4	4.82%	7.23%	9.63%		**4**	4.30%	6.45%	8.60%		**4**	4.16%	6.24%	8.32%
5	6.02%	9.03%	12.04%		**5**	5.37%	8.06%	10.75%		**5**	5.20%	7.80%	10.41%
6	7.23%	10.84%	14.45%		**6**	6.45%	9.67%	12.90%		**6**	6.24%	9.37%	12.49%
7	8.43%	12.65%	16.86%		**7**	7.52%	11.28%	15.05%		**7**	7.28%	10.93%	14.57%
8	9.63%	14.45%	19.27%		**8**	8.60%	12.90%	17.19%		**8**	8.32%	12.49%	16.65%
Average	**6.0%**	**9.0%**	**12.0%**		**Average**	**5.4%**	**8.1%**	**10.7%**		**Average**	**5.2%**	**7.8%**	**10.4%**
	94.0%	91.0%	88.0%			94.6%	91.9%	89.3%			94.8%	92.2%	89.6%

TABLES D3.1 THROUGH D3.21

DELLS PROJECT – RESULTS OF BLADE STRIKE CALCULATIONS

TABLE D3.1 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**5**	1.85%	2.78%	3.70%		**5**	1.80%	2.71%	3.61%
6	2.49%	3.73%	4.97%		**6**	2.22%	3.33%	4.44%		**6**	2.17%	3.25%	4.33%
7	2.90%	4.35%	5.80%		**7**	2.59%	3.89%	5.18%		**7**	2.53%	3.79%	5.05%
8	3.31%	4.97%	6.63%		**8**	2.96%	4.44%	5.93%		**8**	2.89%	4.33%	5.77%
9	3.73%	5.59%	7.46%		**9**	3.33%	5.00%	6.67%		**9**	3.25%	4.87%	6.50%
10	4.14%	6.21%	8.29%		**10**	3.70%	5.56%	7.41%		**10**	3.61%	5.41%	7.22%
Average	**4.1%**	**6.2%**	**8.3%**		**Average**	**3.7%**	**5.6%**	**7.4%**		**Average**	**3.6%**	**5.4%**	**7.2%**
	95.9%	93.8%	91.7%			96.3%	94.4%	92.6%			96.4%	94.6%	92.8%

TABLE D3.2 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**5**	1.85%	2.78%	3.70%		**5**	1.80%	2.71%	3.61%
6	2.49%	3.73%	4.97%		**6**	2.22%	3.33%	4.44%		**6**	2.17%	3.25%	4.33%
7	2.90%	4.35%	5.80%		**7**	2.59%	3.89%	5.18%		**7**	2.53%	3.79%	5.05%
8	3.31%	4.97%	6.63%		**8**	2.96%	4.44%	5.93%		**8**	2.89%	4.33%	5.77%
Average	**3.1%**	**4.7%**	**6.2%**		**Average**	**2.8%**	**4.2%**	**5.6%**		**Average**	**2.7%**	**4.1%**	**5.4%**
	96.9%	95.3%	93.8%			97.2%	95.8%	94.4%			97.3%	95.9%	94.6%

TABLE D3.3 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**6**	2.22%	3.33%	4.44%		**6**	2.17%	3.25%	4.33%
Average	**1.5%**	**2.2%**	**2.9%**		**Average**	**1.4%**	**2.1%**	**2.8%**		**Average**	**1.4%**	**2.0%**	**2.7%**
	98.5%	97.8%	97.1%			98.6%	97.9%	97.2%			98.6%	98.0%	97.3%

TABLE D3.4 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – BLUEGILL.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**5**	1.85%	2.78%	3.70%		**5**	1.80%	2.71%	3.61%
6	2.49%	3.73%	4.97%		**6**	2.22%	3.33%	4.44%		**6**	2.17%	3.25%	4.33%
Average	**1.7%**	**2.5%**	**3.3%**		**Average**	**1.5%**	**2.2%**	**3.0%**		**Average**	**1.4%**	**2.2%**	**2.9%**
	98.3%	97.5%	96.7%			98.5%	97.8%	97.0%			98.6%	97.8%	97.1%

TABLE D3.5 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**5**	1.85%	2.78%	3.70%		**5**	1.80%	2.71%	3.61%
6	2.49%	3.73%	4.97%		**6**	2.22%	3.33%	4.44%		**6**	2.17%	3.25%	4.33%
Average	**1.7%**	**2.5%**	**3.3%**		**Average**	**1.5%**	**2.2%**	**3.0%**		**Average**	**1.4%**	**2.2%**	**2.9%**
	98.3%	97.5%	96.7%			98.5%	97.8%	97.0%			98.6%	97.8%	97.1%

TABLE D3.6 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – YELLOW PERCH.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**5**	1.85%	2.78%	3.70%		**5**	1.80%	2.71%	3.61%
Average	**1.5%**	**2.2%**	**2.9%**		**Average**	**1.3%**	**1.9%**	**2.6%**		**Average**	**1.3%**	**1.9%**	**2.5%**
	98.5%	97.8%	97.1%			98.7%	98.1%	97.4%			98.7%	98.1%	97.5%

TABLE D3.7 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 1 AT THE DELLS PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.83%	1.24%	1.66%		**2**	0.74%	1.11%	1.48%		**2**	0.72%	1.08%	1.44%
3	1.24%	1.86%	2.49%		**3**	1.11%	1.67%	2.22%		**3**	1.08%	1.62%	2.17%
4	1.66%	2.49%	3.31%		**4**	1.48%	2.22%	2.96%		**4**	1.44%	2.17%	2.89%
5	2.07%	3.11%	4.14%		**5**	1.85%	2.78%	3.70%		**5**	1.80%	2.71%	3.61%
6	2.49%	3.73%	4.97%		**6**	2.22%	3.33%	4.44%		**6**	2.17%	3.25%	4.33%
7	2.90%	4.35%	5.80%		**7**	2.59%	3.89%	5.18%		**7**	2.53%	3.79%	5.05%
8	3.31%	4.97%	6.63%		**8**	2.96%	4.44%	5.93%		**8**	2.89%	4.33%	5.77%
9	3.73%	5.59%	7.46%		**9**	3.33%	5.00%	6.67%		**9**	3.25%	4.87%	6.50%
Average	**3.7%**	**5.6%**	**7.5%**		**Average**	**3.3%**	**5.0%**	**6.7%**		**Average**	**3.2%**	**4.9%**	**6.5%**
	96.3%	94.4%	92.5%			96.7%	95.0%	93.3%			96.8%	95.1%	93.5%

TABLE D3.8 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
6	4.74%	7.12%	9.49%		**6**	4.12%	6.18%	8.24%		**6**	4.00%	6.01%	8.01%
7	5.53%	8.30%	11.07%		**7**	4.81%	7.21%	9.62%		**7**	4.67%	7.01%	9.34%
8	6.33%	9.49%	12.65%		**8**	5.50%	8.24%	10.99%		**8**	5.34%	8.01%	10.68%
9	7.12%	10.67%	14.23%		**9**	6.18%	9.27%	12.36%		**9**	6.01%	9.01%	12.01%
10	7.91%	11.86%	15.81%		**10**	6.87%	10.30%	13.74%		**10**	6.67%	10.01%	13.35%
Average	**7.9%**	**11.9%**	**15.8%**		**Average**	**6.9%**	**10.3%**	**13.7%**		**Average**	**6.7%**	**10.0%**	**13.3%**
	92.1%	88.1%	84.2%			93.1%	89.7%	86.3%			93.3%	90.0%	86.7%

TABLE D3.9 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT –WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
6	4.74%	7.12%	9.49%		**6**	4.12%	6.18%	8.24%		**6**	4.00%	6.01%	8.01%
7	5.53%	8.30%	11.07%		**7**	4.81%	7.21%	9.62%		**7**	4.67%	7.01%	9.34%
8	6.33%	9.49%	12.65%		**8**	5.50%	8.24%	10.99%		**8**	5.34%	8.01%	10.68%
Average	**5.9%**	**8.9%**	**11.9%**		**Average**	**5.2%**	**7.7%**	**10.3%**		**Average**	**5.0%**	**7.5%**	**10.0%**
	94.1%	91.1%	88.1%			94.8%	92.3%	89.7%			95.0%	92.5%	90.0%

TABLE D3.10 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
Average	**2.8%**	**4.2%**	**5.5%**		**Average**	**2.4%**	**3.6%**	**4.8%**		**Average**	**2.3%**	**3.5%**	**4.7%**
	97.2%	95.8%	94.5%			97.6%	96.4%	95.2%			97.7%	96.5%	95.3%

TABLE D3.11 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT – BLUEGILL.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
6	4.74%	7.12%	9.49%		**6**	4.12%	6.18%	8.24%		**6**	4.00%	6.01%	8.01%
Average	**3.2%**	**4.7%**	**6.3%**		**Average**	**2.7%**	**4.1%**	**5.5%**		**Average**	**2.7%**	**4.0%**	**5.3%**
	96.8%	95.3%	93.7%			97.3%	95.9%	94.5%			97.3%	96.0%	94.7%

TABLE D3.12 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
6	4.74%	7.12%	9.49%		**6**	4.12%	6.18%	8.24%		**6**	4.00%	6.01%	8.01%
Average	**3.2%**	**4.7%**	**6.3%**		**Average**	**2.7%**	**4.1%**	**5.5%**		**Average**	**2.7%**	**4.0%**	**5.3%**
	96.8%	95.3%	93.7%			97.3%	95.9%	94.5%			97.3%	96.0%	94.7%

TABLE D3.13 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT –YELLOW PERCH.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
Average	**2.8%**	**4.2%**	**5.5%**		**Average**	**2.4%**	**3.6%**	**4.8%**		**Average**	**2.3%**	**3.5%**	**4.7%**
	97.2%	95.8%	94.5%			97.6%	96.4%	95.2%			97.7%	96.5%	95.3%

TABLE D3.14 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2-4 AT THE DELLS PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.58%	2.37%	3.16%		**2**	1.37%	2.06%	2.75%		**2**	1.33%	2.00%	2.67%
3	2.37%	3.56%	4.74%		**3**	2.06%	3.09%	4.12%		**3**	2.00%	3.00%	4.00%
4	3.16%	4.74%	6.33%		**4**	2.75%	4.12%	5.50%		**4**	2.67%	4.00%	5.34%
5	3.95%	5.93%	7.91%		**5**	3.43%	5.15%	6.87%		**5**	3.34%	5.01%	6.67%
6	4.74%	7.12%	9.49%		**6**	4.12%	6.18%	8.24%		**6**	4.00%	6.01%	8.01%
7	5.53%	8.30%	11.07%		**7**	4.81%	7.21%	9.62%		**7**	4.67%	7.01%	9.34%
8	6.33%	9.49%	12.65%		**8**	5.50%	8.24%	10.99%		**8**	5.34%	8.01%	10.68%
9	7.12%	10.67%	14.23%		**9**	6.18%	9.27%	12.36%		**9**	6.01%	9.01%	12.01%
Average	**7.1%**	**10.7%**	**14.2%**		**Average**	**6.2%**	**9.3%**	**12.4%**		**Average**	**6.0%**	**9.0%**	**12.0%**
	92.9%	89.3%	85.8%			93.8%	90.7%	87.6%			94.0%	91.0%	88.0%

TABLE D3.15 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
6	4.54%	6.81%	9.08%		**6**	3.99%	5.98%	7.97%		**6**	3.90%	5.86%	7.81%
7	5.30%	7.94%	10.59%		**7**	4.65%	6.98%	9.30%		**7**	4.56%	6.83%	9.11%
8	6.05%	9.08%	12.11%		**8**	5.32%	7.97%	10.63%		**8**	5.21%	7.81%	10.41%
9	6.81%	10.21%	13.62%		**9**	5.98%	8.97%	11.96%		**9**	5.86%	8.79%	11.71%
10	7.57%	11.35%	15.13%		**10**	6.65%	9.97%	13.29%		**10**	6.51%	9.76%	13.02%
Average	**7.6%**	**11.3%**	**15.1%**		**Average**	**6.6%**	**10.0%**	**13.3%**		**Average**	**6.5%**	**9.8%**	**13.0%**
	92.4%	88.7%	84.9%			93.4%	90.0%	86.7%			93.5%	90.2%	87.0%

TABLE D3.16 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
6	4.54%	6.81%	9.08%		**6**	3.99%	5.98%	7.97%		**6**	3.90%	5.86%	7.81%
7	5.30%	7.94%	10.59%		**7**	4.65%	6.98%	9.30%		**7**	4.56%	6.83%	9.11%
8	6.05%	9.08%	12.11%		**8**	5.32%	7.97%	10.63%		**8**	5.21%	7.81%	10.41%
Average	**5.7%**	**8.5%**	**11.3%**		**Average**	**5.0%**	**7.5%**	**10.0%**		**Average**	**4.9%**	**7.3%**	**9.8%**
	94.3%	91.5%	88.7%			95.0%	92.5%	90.0%			95.1%	92.7%	90.2%

TABLE D3.17 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
Average	**2.6%**	**4.0%**	**5.3%**		**Average**	**2.3%**	**3.5%**	**4.7%**		**Average**	**2.3%**	**3.4%**	**4.6%**
	97.4%	96.0%	94.7%			97.7%	96.5%	95.3%			97.7%	96.6%	95.4%

TABLE D3.18 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – BLUEGILL.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
6	4.54%	6.81%	9.08%		**6**	3.99%	5.98%	7.97%		**6**	3.90%	5.86%	7.81%
Average	**3.0%**	**4.5%**	**6.1%**		**Average**	**2.7%**	**4.0%**	**5.3%**		**Average**	**2.6%**	**3.9%**	**5.2%**
	97.0%	95.5%	93.9%			97.3%	96.0%	94.7%			97.4%	96.1%	94.8%

TABLE D3.19 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
6	4.54%	6.81%	9.08%		**6**	3.99%	5.98%	7.97%		**6**	3.90%	5.86%	7.81%
Average	**3.0%**	**4.5%**	**6.1%**		**Average**	**2.7%**	**4.0%**	**5.3%**		**Average**	**2.6%**	**3.9%**	**5.2%**
	97.0%	95.5%	93.9%			97.3%	96.0%	94.7%			97.4%	96.1%	94.8%

TABLE D3.20 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – YELLOW PERCH.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
Average	**2.6%**	**4.0%**	**5.3%**		**Average**	**2.3%**	**3.5%**	**4.7%**		**Average**	**2.3%**	**3.4%**	**4.6%**
	97.4%	96.0%	94.7%			97.7%	96.5%	95.3%			97.7%	96.6%	95.4%

TABLE D3.21 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNIT 5 AT THE DELLS PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	1.51%	2.27%	3.03%		**2**	1.33%	1.99%	2.66%		**2**	1.30%	1.95%	2.60%
3	2.27%	3.40%	4.54%		**3**	1.99%	2.99%	3.99%		**3**	1.95%	2.93%	3.90%
4	3.03%	4.54%	6.05%		**4**	2.66%	3.99%	5.32%		**4**	2.60%	3.90%	5.21%
5	3.78%	5.67%	7.57%		**5**	3.32%	4.98%	6.65%		**5**	3.25%	4.88%	6.51%
6	4.54%	6.81%	9.08%		**6**	3.99%	5.98%	7.97%		**6**	3.90%	5.86%	7.81%
7	5.30%	7.94%	10.59%		**7**	4.65%	6.98%	9.30%		**7**	4.56%	6.83%	9.11%
8	6.05%	9.08%	12.11%		**8**	5.32%	7.97%	10.63%		**8**	5.21%	7.81%	10.41%
Average	**6.1%**	**9.1%**	**12.1%**		**Average**	**5.3%**	**8.0%**	**10.6%**		**Average**	**5.2%**	**7.8%**	**10.4%**
	93.9%	90.9%	87.9%			94.7%	92.0%	89.4%			94.8%	92.2%	89.6%

TABLES D4.1 THROUGH D4.7

JIM FALLS PROJECT – RESULTS OF BLADE STRIKE CALCULATIONS

TABLE D4.1 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 2 AT THE JIM FALLS PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
6	1.95%	2.93%	3.90%		**6**	1.77%	2.66%	3.55%		**6**	1.74%	2.60%	3.47%
7	2.28%	3.41%	4.55%		**7**	2.07%	3.10%	4.14%		**7**	2.03%	3.04%	4.05%
8	2.60%	3.90%	5.20%		**8**	2.36%	3.55%	4.73%		**8**	2.32%	3.47%	4.63%
9	2.93%	4.39%	5.85%		**9**	2.66%	3.99%	5.32%		**9**	2.60%	3.91%	5.21%
10	3.25%	4.88%	6.50%		**10**	2.96%	4.43%	5.91%		**10**	2.89%	4.34%	5.79%
Average	**2.9%**	**4.4%**	**5.9%**		**Average**	**2.7%**	**4.0%**	**5.3%**		**Average**	**2.6%**	**3.9%**	**5.2%**
	97.1%	95.6%	94.1%			97.3%	96.0%	94.7%			97.4%	96.1%	94.8%

TABLE D4.2 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 2 AT THE JIM FALLS PROJECT –WALLEYE.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
6	1.95%	2.93%	3.90%		**6**	1.77%	2.66%	3.55%		**6**	1.74%	2.60%	3.47%
7	2.28%	3.41%	4.55%		**7**	2.07%	3.10%	4.14%		**7**	2.03%	3.04%	4.05%
8	2.60%	3.90%	5.20%		**8**	2.36%	3.55%	4.73%		**8**	2.32%	3.47%	4.63%
Average	**2.6%**	**3.9%**	**5.2%**		**Average**	**2.4%**	**3.5%**	**4.7%**		**Average**	**2.3%**	**3.5%**	**4.6%**
	97.4%	96.1%	94.8%			97.6%	96.5%	95.3%			97.7%	96.5%	95.4%

TABLE D4.3 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 2 AT THE JIM FALLS PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
Average	**1.1%**	**1.7%**	**2.3%**		**Average**	**1.0%**	**1.6%**	**2.1%**		**Average**	**1.0%**	**1.5%**	**2.0%**
	98.9%	98.3%	97.7%			99.0%	98.4%	97.9%			99.0%	98.5%	98.0%

TABLE D4.4 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 2 AT THE JIM FALLS PROJECT – BLUEGILL.

	CORRELATION FACTOR					**CORRELATION FACTOR**					**CORRELATION FACTOR**		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
6	1.95%	2.93%	3.90%		**6**	1.77%	2.66%	3.55%		**6**	1.74%	2.60%	3.47%
Average	**1.3%**	**2.0%**	**2.6%**		**Average**	**1.2%**	**1.8%**	**2.4%**		**Average**	**1.2%**	**1.7%**	**2.3%**
	98.7%	98.0%	97.4%			98.8%	98.2%	97.6%			98.8%	98.3%	97.7%

Table D4.5 Results of Blade Strike Calculations Based on the Formulas Provided in Franke et al (1997) for Units 1 & 2 at the Jim Falls Project – Black Crappie.

	Correlation Factor					Correlation Factor					Correlation Factor		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
6	1.95%	2.93%	3.90%		**6**	1.77%	2.66%	3.55%		**6**	1.74%	2.60%	3.47%
Average	**1.3%**	**2.0%**	**2.6%**		**Average**	**1.2%**	**1.8%**	**2.4%**		**Average**	**1.2%**	**1.7%**	**2.3%**
	98.7%	98.0%	97.4%			98.8%	98.2%	97.6%			98.8%	98.3%	97.7%

Table D4.6 Results of Blade Strike Calculations Based on the Formulas Provided in Franke et al (1997) for Units 1 & 2 at the Jim Falls Project – Yellow Perch.

	Correlation Factor					Correlation Factor					Correlation Factor		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
Average	**1.1%**	**1.7%**	**2.3%**		**Average**	**1.0%**	**1.6%**	**2.1%**		**Average**	**1.0%**	**1.5%**	**2.0%**
	98.9%	98.3%	97.7%			99.0%	98.4%	97.9%			99.0%	98.5%	98.0%

TABLE D4.7 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 2 AT THE JIM FALLS PROJECT – LAKE STURGEON.

	CORRELATION FACTOR					CORRELATION FACTOR					CORRELATION FACTOR		
	0.10	0.15	0.20			0.10	0.15	0.20			0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**		**L (in)**	**P (%)**	**P (%)**	**P (%)**
2	0.65%	0.98%	1.30%		**2**	0.59%	0.89%	1.18%		**2**	0.58%	0.87%	1.16%
3	0.98%	1.46%	1.95%		**3**	0.89%	1.33%	1.77%		**3**	0.87%	1.30%	1.74%
4	1.30%	1.95%	2.60%		**4**	1.18%	1.77%	2.36%		**4**	1.16%	1.74%	2.32%
5	1.63%	2.44%	3.25%		**5**	1.48%	2.22%	2.96%		**5**	1.45%	2.17%	2.89%
6	1.95%	2.93%	3.90%		**6**	1.77%	2.66%	3.55%		**6**	1.74%	2.60%	3.47%
7	2.28%	3.41%	4.55%		**7**	2.07%	3.10%	4.14%		**7**	2.03%	3.04%	4.05%
8	2.60%	3.90%	5.20%		**8**	2.36%	3.55%	4.73%		**8**	2.32%	3.47%	4.63%
Average	**2.4%**	**3.7%**	**4.9%**		**Average**	**2.2%**	**3.3%**	**4.4%**		**Average**	**2.2%**	**3.3%**	**4.3%**
	97.6%	96.3%	95.1%			97.8%	96.7%	95.6%			97.8%	96.7%	95.7%

TABLES D5.1 THROUGH D5.14

WISSOTA PROJECT – RESULTS OF BLADE STRIKE CALCULATIONS

TABLE D5.1 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
6	5.4%	8.1%	10.8%
7	6.3%	9.4%	12.6%
8	7.2%	10.8%	14.4%
9	8.1%	12.1%	16.2%
10	9.0%	13.5%	18.0%
Average	**5.4%**	**8.1%**	**10.8%**
	94.6%	91.9%	89.2%

TABLE D5.2 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT –WALLEYE.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
6	5.4%	8.1%	10.8%
7	6.3%	9.4%	12.6%
8	7.2%	10.8%	14.4%
Average	**4.5%**	**6.7%**	**9.0%**
	95.5%	93.3%	91.0%

TABLE D5.3 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
Average	**3.1%**	**4.7%**	**6.3%**
	96.9%	95.3%	93.7%

TABLE D5.4 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT – BLUEGILL.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
6	5.4%	8.1%	10.8%
Average	**3.6%**	**5.4%**	**7.2%**
	96.4%	94.6%	92.8%

TABLE D5.5 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
6	5.4%	8.1%	10.8%
Average	**3.6%**	**5.4%**	**7.2%**
	96.4%	94.6%	92.8%

TABLE D5.6 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT –YELLOW PERCH.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
Average	**3.1%**	**4.7%**	**6.3%**
	96.9%	95.3%	93.7%

TABLE D5.7 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 1 & 4 AT THE WISSOTA PROJECT – LAKE STURGEON.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	1.8%	2.7%	3.6%
3	2.7%	4.0%	5.4%
4	3.6%	5.4%	7.2%
5	4.5%	6.7%	9.0%
6	5.4%	8.1%	10.8%
7	6.3%	9.4%	12.6%
8	7.2%	10.8%	14.4%
Average	**4.5%**	**6.7%**	**9.0%**
	95.5%	93.3%	91.0%

TABLE D5.8 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT – MUSKELLUNGE.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
6	7.2%	10.9%	14.5%
7	8.4%	12.7%	16.9%
8	9.6%	14.5%	19.3%
9	10.9%	16.3%	21.7%
10	12.1%	18.1%	24.1%
Average	**7.8%**	**11.8%**	**15.7%**
	92.2%	88.2%	84.3%

TABLE D5.9 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT –WALLEYE.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
6	7.2%	10.9%	14.5%
7	8.4%	12.7%	16.9%
8	9.6%	14.5%	19.3%
Average	**6.0%**	**9.0%**	**12.1%**
	94.0%	91.0%	87.9%

TABLE D5.10 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT – SMALLMOUTH BASS.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
Average	**4.2%**	**6.3%**	**8.4%**

TABLE D5.11 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT – BLUEGILL.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
6	7.2%	10.9%	14.5%
Average	**4.8%**	**7.2%**	**9.6%**
	95.2%	92.8%	90.4%

TABLE D5.12 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT – BLACK CRAPPIE.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
6	7.2%	10.9%	14.5%
Average	**4.8%**	**7.2%**	**9.6%**
	95.2%	92.8%	90.4%

TABLE D5.13 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT – YELLOW PERCH.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
Average	**4.2%**	**6.3%**	**8.4%**
	95.8%	93.7%	91.6%

TABLE D5.14 RESULTS OF BLADE STRIKE CALCULATIONS BASED ON THE FORMULAS PROVIDED IN FRANKE ET AL (1997) FOR UNITS 2, 3, 5 & 6 AT THE WISSOTA PROJECT – LAKE STURGEON.

	CORRELATION FACTOR		
	0.10	0.15	0.20
L (in)	**P (%)**	**P (%)**	**P (%)**
2	2.4%	3.6%	4.8%
3	3.6%	5.4%	7.2%
4	4.8%	7.2%	9.6%
5	6.0%	9.0%	12.1%
6	7.2%	10.9%	14.5%
7	8.4%	12.7%	16.9%
8	9.6%	14.5%	19.3%
Average	**6.6%**	**9.9%**	**13.3%**
	93.4%	90.1%	86.7%

APPENDIX E

LAKE STURGEON MORPHOLOGY ANALYSIS

Morphometric information including measurements of length and girth was collected from more than 100 sturgeon. Although width was not measured specifically, a simplifying assumption regarding a sturgeon's body shape allowed us to estimate width from the available data. We assumed that a sturgeon's body is cylindrical and that girth was measured at the widest point (pectoral fins); therefore, width was estimated using the equation for the circumference of a circle (i.e. $C = \pi d$), where *C* is the circumference of a circle and is assumed to be equal to the girth of a fish, and *d* is the diameter and is assumed to be equal to the width of a fish.

To create an entrainment exclusion function for lake sturgeon, Kleinschmidt performed a simple linear ordinary least squares regression on the calculated widths given measured lengths using the data analysis extension within Microsoft Excel. In total, Kleinschmidt collected 170 sturgeon with complete information. An examination of the mean and median total length and calculated width show little skew (Table 1). Figures 1 and 2 are frequency distributions for length and width.

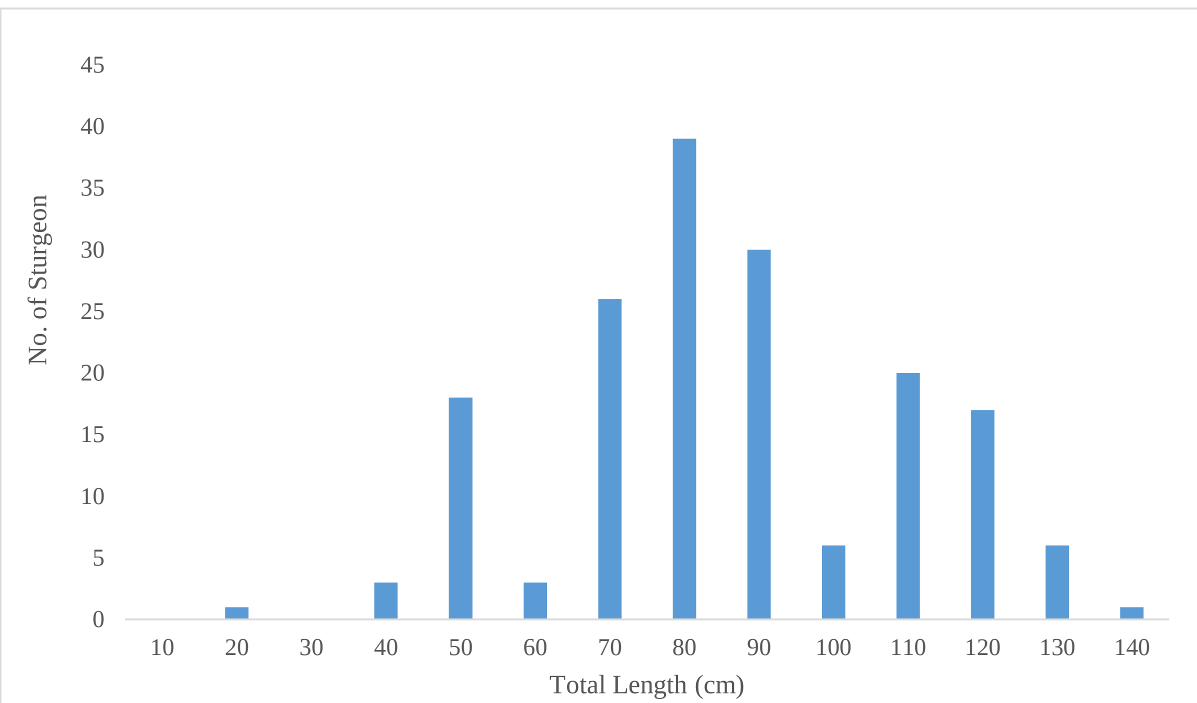


FIGURE 1 **LENGTH-FREQUENCY PLOT OF LAKE STURGEON TOTAL LENGTH, GRASSE RIVER, NEW YORK.**

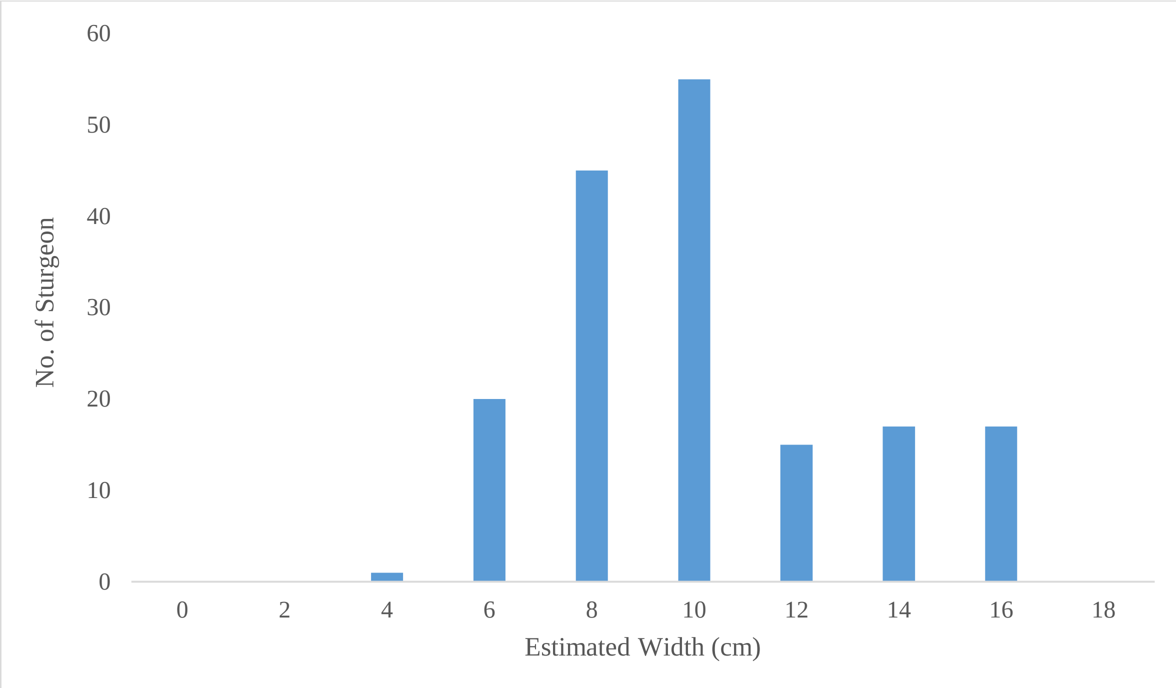


FIGURE 1 LENGTH-FREQUENCY PLOT OF LAKE STURGEON WIDTH, GRASSE RIVER, NEW YORK.

An examination of the mean and median total length and calculated width show little skew (Table 1).

TABLE 1 LAKE STURGEON LENGTH AND WEIGHT STATISTICS USED IN ANALYSIS

PARAMETER	MEAN	MEDIAN	ST DEV	MIN	MAX	N
Length (cm)	81.6	79.3	23	19	138	170
Width (cm)	9.2	8.4	2.8	3.7	15.9	170

The normal probability plot resulting from the ordinary least squares regression appears acceptable (Figure 3). One observation that appears to be influential was not removed from the analysis, and residual error increases with length (Figure 4). The regression was highly significant (F = 1609.065, p < 0.001, R^2 = 0.91), as was the slope (0.12 (+/- 0.0058), p < 0.001); however, the intercept was not (-0.42 (+/- 0.49), p = 0.10). Therefore, the final equation for lake sturgeon width given length is:

$$W = 0.12(L)$$

Where W is the width of a sturgeon and L is the total length of the sturgeon, both measured in centimeters (cm).

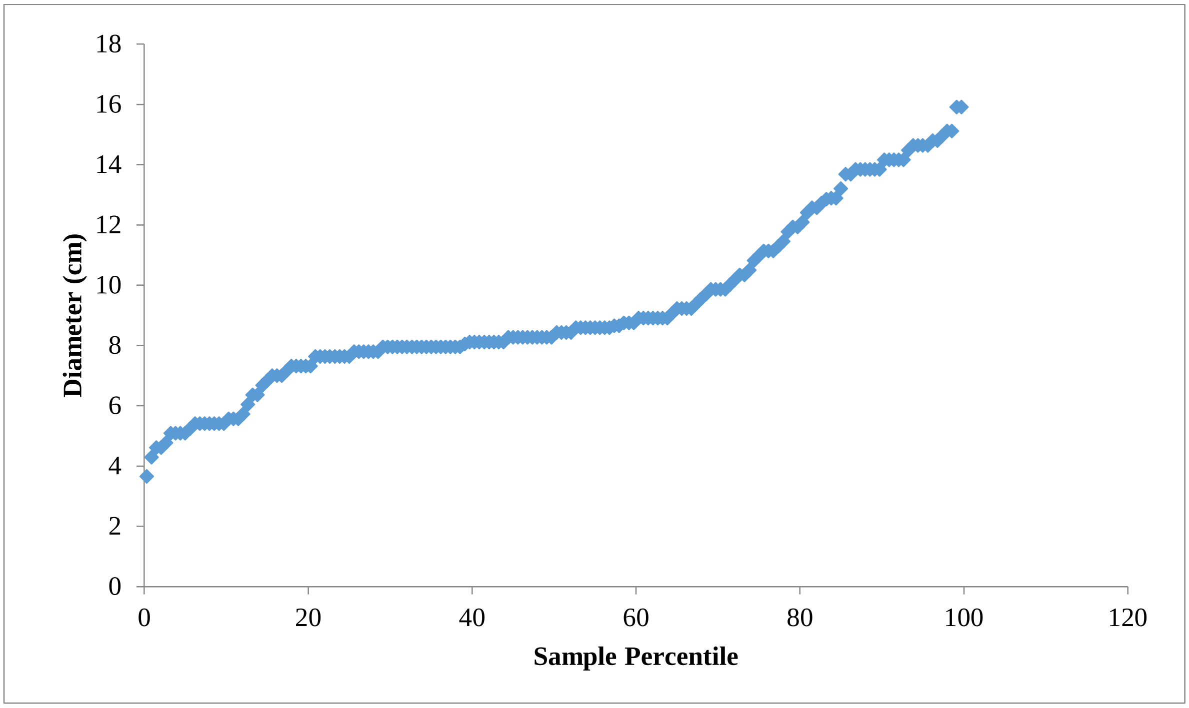


FIGURE 3 **NORMAL PROBABILITY PLOT OF LAKE STURGEON DIAMETER, GRASSE RIVER, NEW YORK**

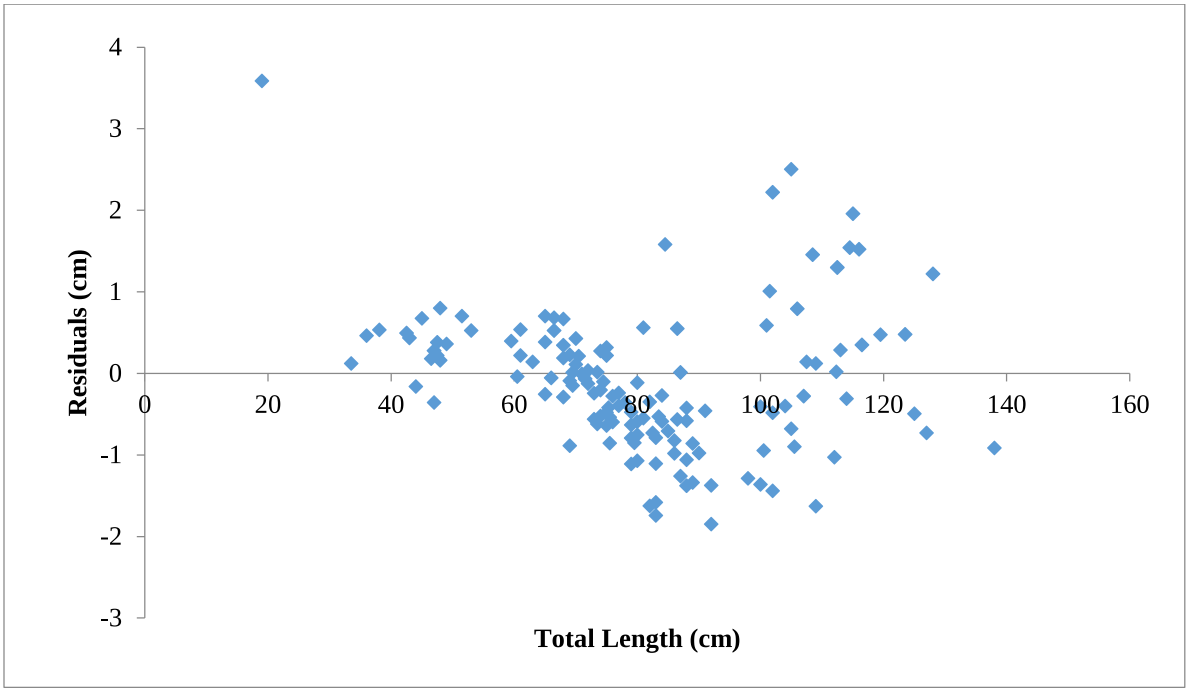


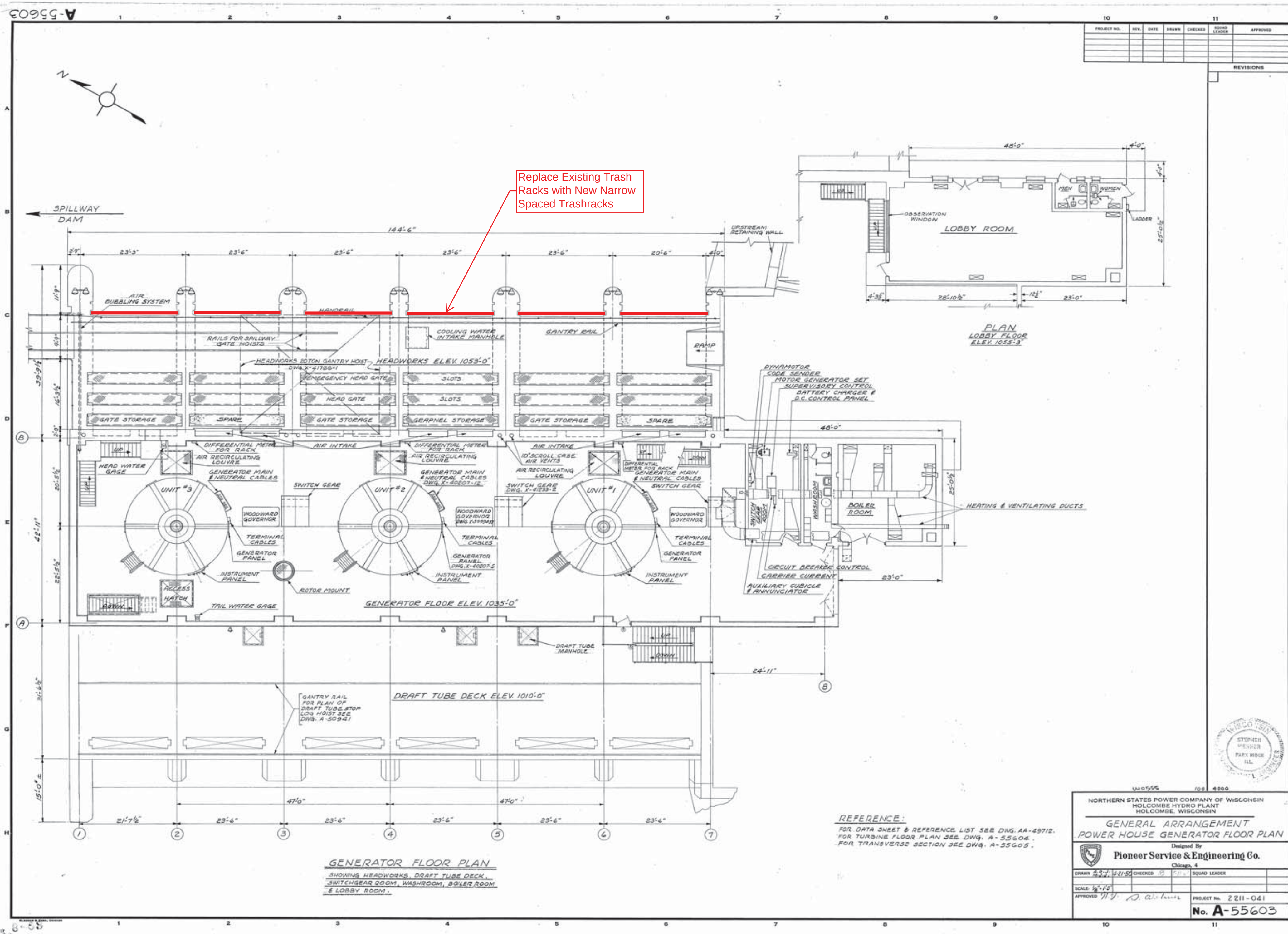
FIGURE 4 **REGRESSION RESIDUAL PLOT FOR LAKE STURGEON, GRASSE RIVER, NEW YORK**

APPENDIX F

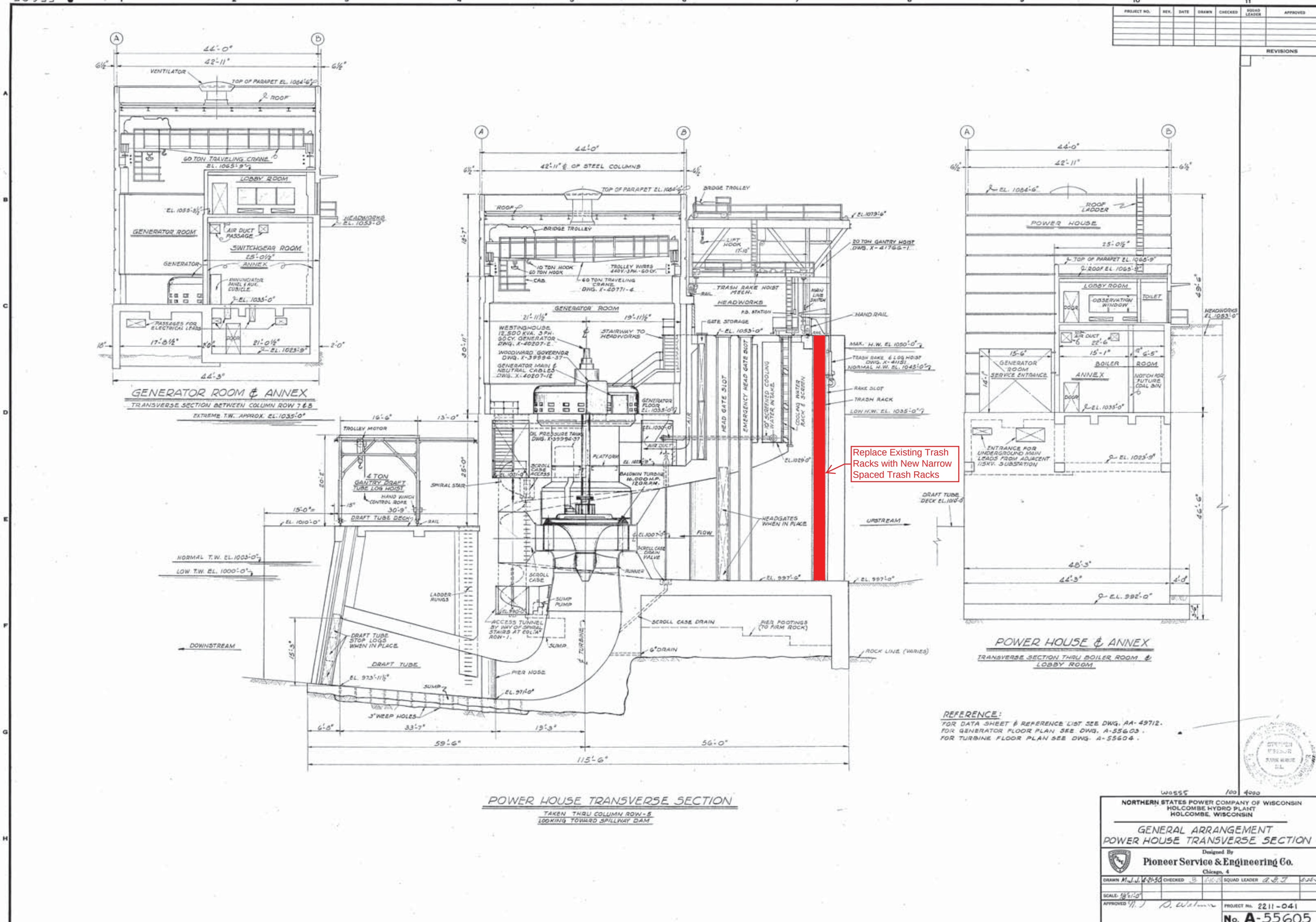
SKETCHES OF FISH PROTECTION ALTERNATIVES

HOLCOMBE

REPLACE EXISTING TRASHRACKS WITH NEW NARROWLY SPACED TRASHRACKS



A-55603
Replace Existing Trash Racks with New Narrow Spaced Trashracks
SPILLWAY DAM
144'-6"
AIR BUBBLING SYSTEM
HANDRAIL
RAILS FOR SPILLWAY GATE HOISTS
HEADWORKS 20 TON GANTRY HOIST DWG. X-41766-1
COOLING WATER INTAKE MANHOLE
GANTRY RAIL
HEADWORKS ELEV. 1053'-0"
RAMP
EMERGENCY HEAD GATE
SLOTS
HEAD GATE
GATE STORAGE
SPARE
GRAPNEL STORAGE
UPSTREAM RETAINING WALL
LOBBY ROOM
OBSERVATION WINDOW
MEN
WOMEN
LADDER
PLAN LOBBY FLOOR ELEV. 1055'-3"
DYNAMOTOR
CODE SENDER
MOTOR GENERATOR SET
SUPERVISORY CONTROL
BATTERY CHARGER & D.C. CONTROL PANEL
DIFFERENTIAL METER FOR RACK
AIR INTAKE
AIR RECIRCULATING LOUVRE
HEAD WATER GAGE
GENERATOR MAIN & NEUTRAL CABLES
SWITCH GEAR
UNIT #3
UNIT #2
UNIT #1
WOODWARD GOVERNOR
TERMINAL CABLES
GENERATOR PANEL
INSTRUMENT PANEL
ROTOR MOUNT
ACCESS HATCH
TAIL WATER GAGE
GENERATOR FLOOR ELEV. 1035'-0"
SWITCH GEAR ROOM
WASHROOM
BOILER ROOM
HEATING & VENTILATING DUCTS
CIRCUIT BREAKER CONTROL
CARRIER CURRENT
AUXILIARY CUBICLE & ANNUNCIATOR
DRAFT TUBE MANHOLE
GANTRY RAIL FOR PLAN OF DRAFT TUBE STOP LOG HOIST SEE DWG. A-50941
DRAFT TUBE DECK ELEV. 1010'-0"
REFERENCE:
FOR DATA SHEET & REFERENCE LIST SEE DWG. AA-49712.
FOR TURBINE FLOOR PLAN SEE DWG. A-55604.
FOR TRANSVERSE SECTION SEE DWG. A-55605.
GENERATOR FLOOR PLAN
SHOWING HEADWORKS, DRAFT TUBE DECK, SWITCHGEAR ROOM, WASHROOM, BOILER ROOM & LOBBY ROOM.
REVISIONS
NORTHERN STATES POWER COMPANY OF WISCONSIN
HOLCOMBE HYDRO PLANT
HOLCOMBE, WISCONSIN
GENERAL ARRANGEMENT
POWER HOUSE GENERATOR FLOOR PLAN
Designed By
Pioneer Service & Engineering Co.
Chicago, 4
PROJECT No. 2211-041
No. A-55603



REFERENCE:
FOR DATA SHEET & REFERENCE LIST SEE DWG. AA-49712.
FOR GENERATOR FLOOR PLAN SEE DWG. A-55603.
FOR TURBINE FLOOR PLAN SEE DWG. A-55604.

NORTHERN STATES POWER COMPANY OF WISCONSIN
HOLCOMBE HYDRO PLANT
HOLCOMBE, WISCONSIN

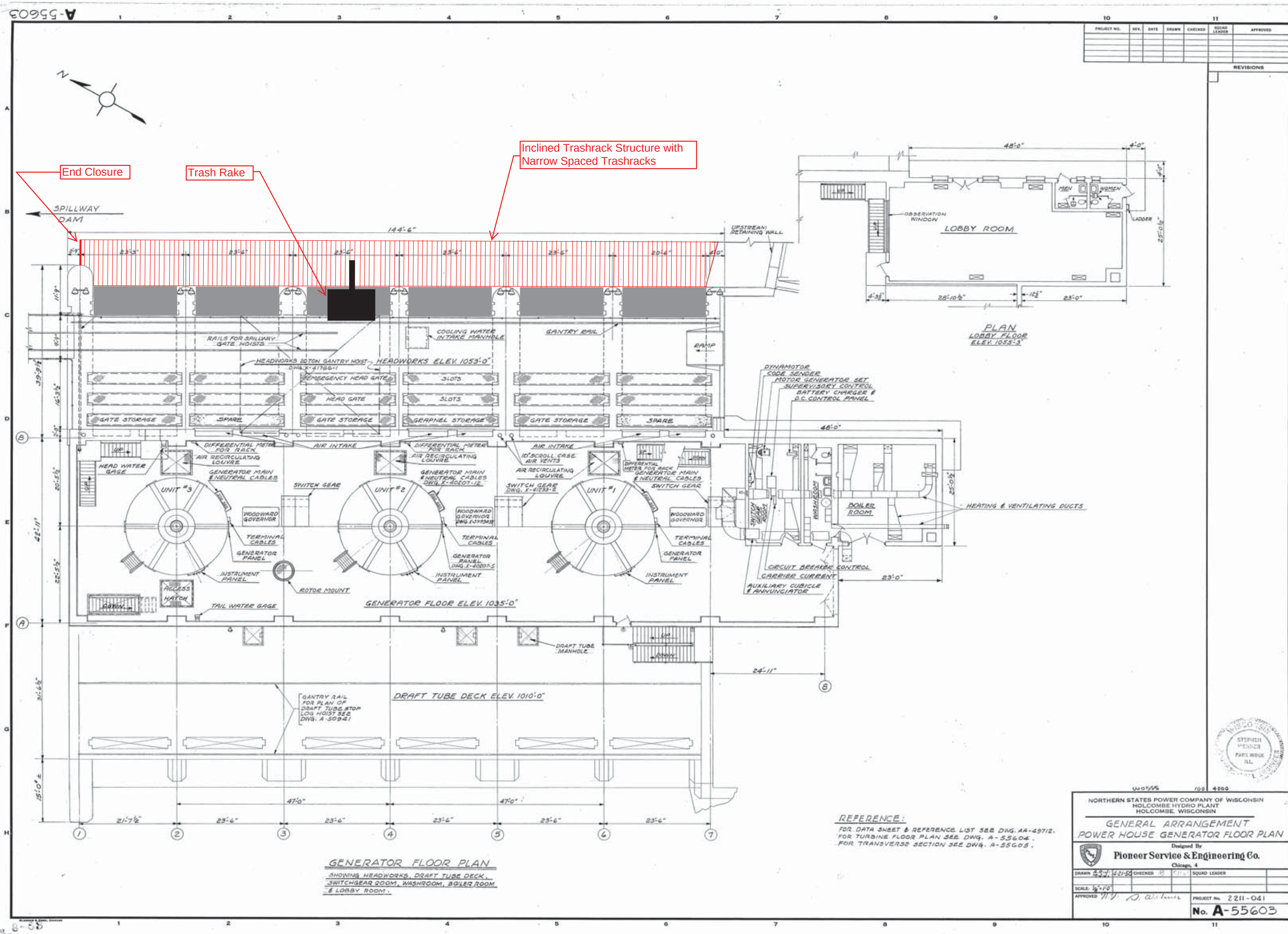
GENERAL ARRANGEMENT
POWER HOUSE TRANSVERSE SECTION

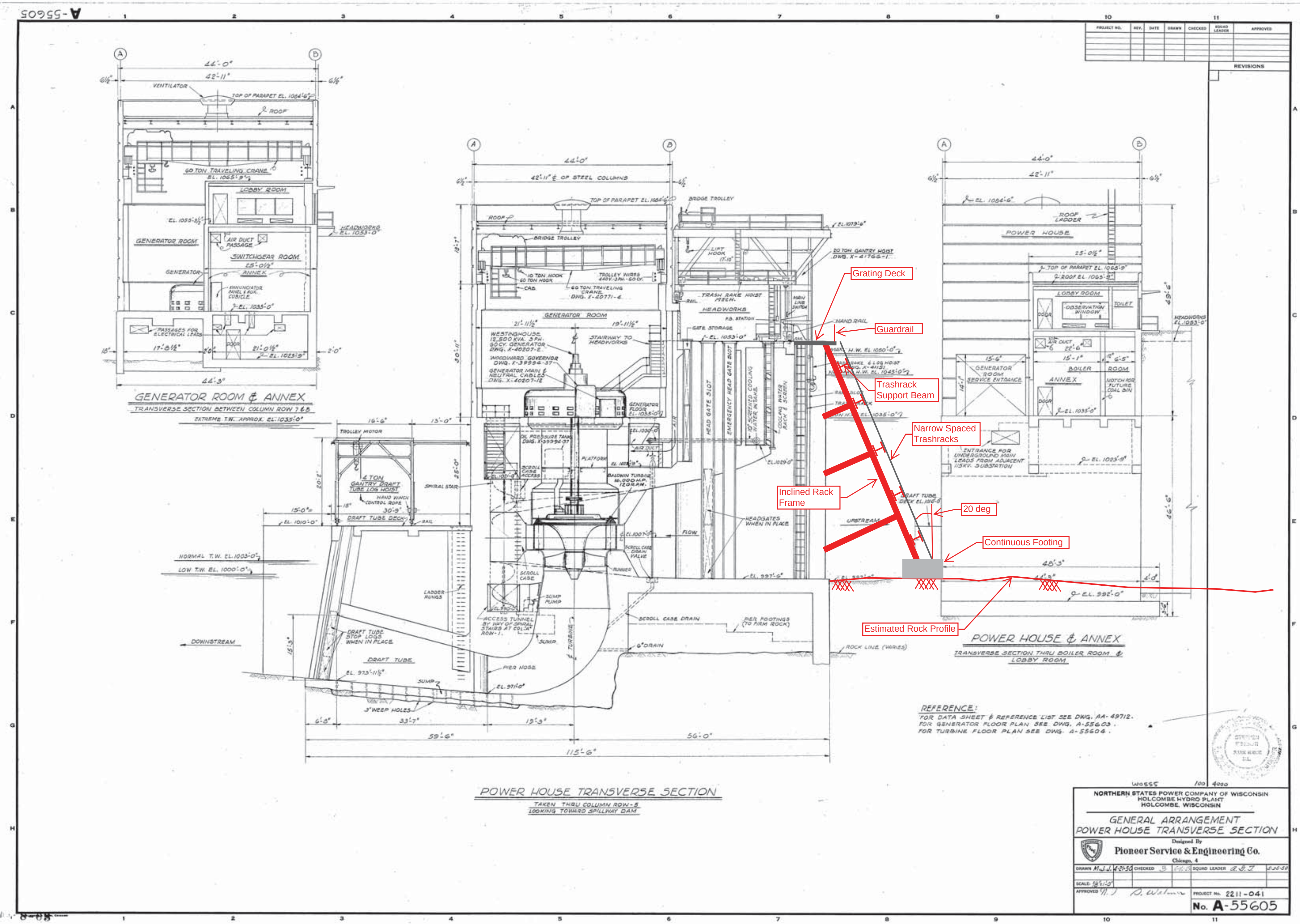
Designed By
Pioneer Service & Engineering Co.
Chicago, 4

PROJECT No. 2211-041
No. A-55605

HOLCOMBE

INCLINED BAR RACK WITH NARROWLY SPACED BARS

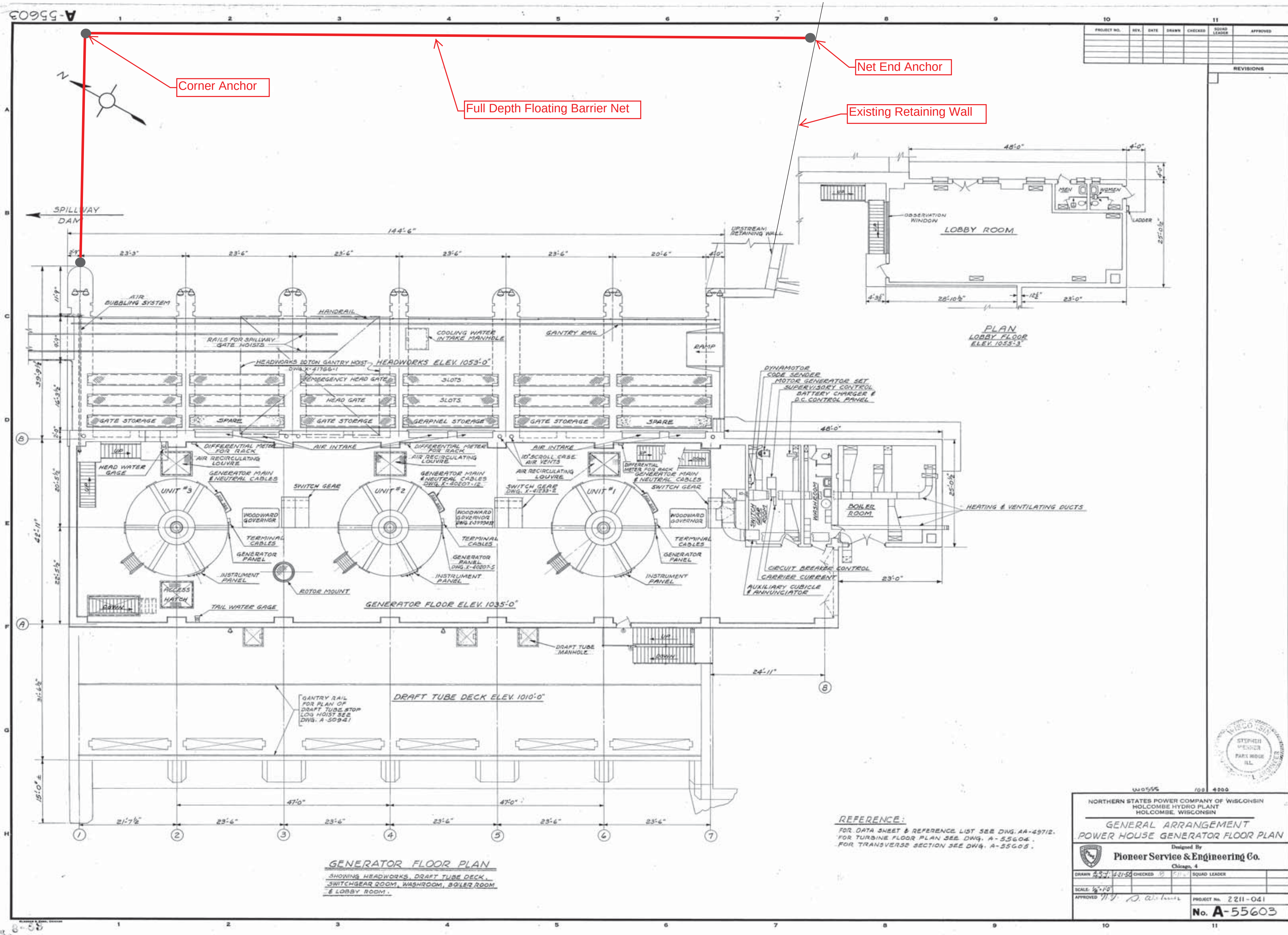

A-55603
End Closure
Trash Rake
Inclined Trashrack Structure with Narrow Spaced Trashracks
SPILLWAY DAM
144'-6"
UPSTREAM RETAINING WALL
RAILS FOR SPILLWAY GATE HOISTS
HEADWORKS 20 TON GANTRY HOIST DWG. X-41766-1
HEADWORKS ELEV. 1053'-0"
COOLING WATER INTAKE MANHOLE
GANTRY RAIL
RAMP
EMERGENCY HEAD GATE
HEAD GATE
SLOTS
GATE STORAGE
SPARE
GRAPNEL STORAGE
DIFFERENTIAL METER FOR RACK
AIR RECIRCULATING LOUVRE
AIR INTAKE
HEAD WATER GAGE
GENERATOR MAIN & NEUTRAL CABLES
SWITCH GEAR
UNIT #3
UNIT #2
UNIT #1
WOODWARD GOVERNOR
TERMINAL CABLES
GENERATOR PANEL
INSTRUMENT PANEL
ROTOR MOUNT
ACCESS HATCH
TAIL WATER GAGE
GENERATOR FLOOR ELEV. 1035'-0"
DRAFT TUBE MANHOLE
DYNAMOTOR
CODE SENDER
MOTOR GENERATOR SET
SUPERVISORY CONTROL
BATTERY CHARGER & D.C. CONTROL PANEL
SWITCH GEAR ROOM
WASHROOM
BOILER ROOM
HEATING & VENTILATING DUCTS
CIRCUIT BREAKER CONTROL
CARRIER CURRENT
AUXILIARY CUBICLE & ANNUNCIATOR
OBSERVATION WINDOW
LOBBY ROOM
MEN
WOMEN
LADDER
PLAN
LOBBY FLOOR
ELEV. 1055'-3"
GANTRY RAIL FOR PLAN OF DRAFT TUBE STOP LOG HOIST SEE DWG. A-50941
DRAFT TUBE DECK ELEV. 1010'-0"
REFERENCE:
FOR DATA SHEET & REFERENCE LIST SEE DWG. AA-49712.
FOR TURBINE FLOOR PLAN SEE DWG. A-55604.
FOR TRANSVERSE SECTION SEE DWG. A-55605.
GENERATOR FLOOR PLAN
SHOWING HEADWORKS, DRAFT TUBE DECK, SWITCHGEAR ROOM, WASHROOM, BOILER ROOM & LOBBY ROOM.
NORTHERN STATES POWER COMPANY OF WISCONSIN
HOLCOMBE HYDRO PLANT
HOLCOMBE, WISCONSIN
GENERAL ARRANGEMENT
POWER HOUSE GENERATOR FLOOR PLAN
Designed By
Pioneer Service & Engineering Co.
Chicago, 4
PROJECT No. 2211-041
No. A-55603
REVISIONS

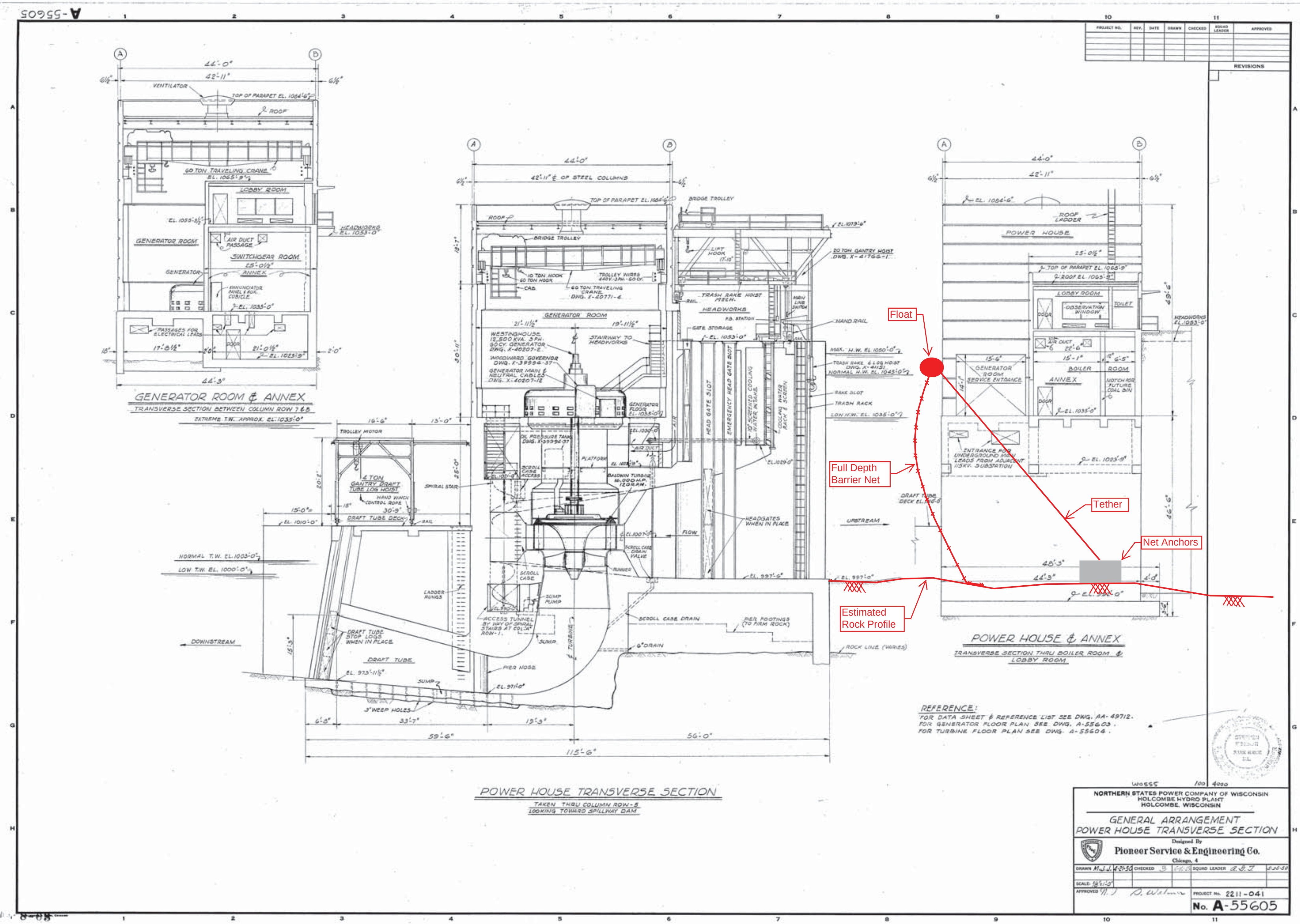


A-55605
GENERATOR ROOM & ANNEX
TRANSVERSE SECTION BETWEEN COLUMN ROW 7 & 8
EXTREME T.W. APPROX. EL. 1035'-0"
VENTILATOR
TOP OF PARAPET EL. 1084'-6"
ROOF
60 TON TRAVELING CRANE
LOBBY ROOM
GENERATOR ROOM
SWITCHGEAR ROOM
ANNEX
HEADWORKS EL. 1053'-0"
AIR DUCT PASSAGE
GENERATOR
PASSAGES FOR ELECTRICAL LEADS
POWER HOUSE TRANSVERSE SECTION
TAKEN THRU COLUMN ROW-5
LOOKING TOWARD SPILLWAY DAM
42'-11" ℄ OF STEEL COLUMNS
BRIDGE TROLLEY
10 TON HOOK
TROLLEY WIRES
60 TON TRAVELING CRANE DWG. X-40771-4
WESTINGHOUSE 12,500 KVA. 3 PH. 60 CY. GENERATOR DWG. X-40207-2
WOODWARD GOVERNOR DWG. X-39994-37
STAIRWAY TO HEADWORKS
BALDWIN TURBINE 16,000 H.P. 120 R.P.M.
SCROLL CASE
SCROLL CASE DRAIN
RUNNER
SUMP PUMP
ACCESS TUNNEL
DRAFT TUBE STOP LOGS WHEN IN PLACE
DRAFT TUBE
DRAFT TUBE DECK
4 TON GANTRY DRAFT TUBE LOG HOIST
TROLLEY MOTOR
SPIRAL STAIR
NORMAL T.W. EL. 1003'-0"
LOW T.W. EL. 1000'-0"
DOWNSTREAM
3" WEEP HOLES
PIER NOSE
PIER FOOTINGS (TO FIRM ROCK)
6" DRAIN
ROCK LINE (VARIES)
SCROLL CASE DRAIN
HEAD GATE SLOT
EMERGENCY HEAD GATE SLOT
HEADGATES WHEN IN PLACE
FLOW
UPSTREAM
TRASH RAKE HOIST MECH.
HEADWORKS
GATE STORAGE
20 TON GANTRY HOIST DWG. X-41766-1
LIFT HOOK
HAND RAIL
MAX. H.W. EL. 1050'-0"
59'-6"
56'-0"
115'-6"
POWER HOUSE & ANNEX
TRANSVERSE SECTION THRU BOILER ROOM & LOBBY ROOM
ROOF LADDER
POWER HOUSE
LOBBY ROOM
OBSERVATION WINDOW
TOILET
GENERATOR ROOM SERVICE ENTRANCE
BOILER ROOM
ANNEX
NOTCH FOR FUTURE COAL BIN
ENTRANCE FOR UNDERGROUND MAIN LEADS FROM ADJACENT 115KV. SUBSTATION
EL. 992'-0"
Grating Deck
Guardrail
Trashrack Support Beam
Narrow Spaced Trashracks
Inclined Rack Frame
20 deg
Continuous Footing
Estimated Rock Profile
REFERENCE:
FOR DATA SHEET & REFERENCE LIST SEE DWG. AA-49712.
FOR GENERATOR FLOOR PLAN SEE DWG. A-55603.
FOR TURBINE FLOOR PLAN SEE DWG. A-55604.
NORTHERN STATES POWER COMPANY OF WISCONSIN
HOLCOMBE HYDRO PLANT
HOLCOMBE, WISCONSIN
GENERAL ARRANGEMENT
POWER HOUSE TRANSVERSE SECTION
Designed By
Pioneer Service & Engineering Co.
Chicago, 4
PROJECT No. 2211-041
No. A-55605
REVISIONS

HOLCOMBE

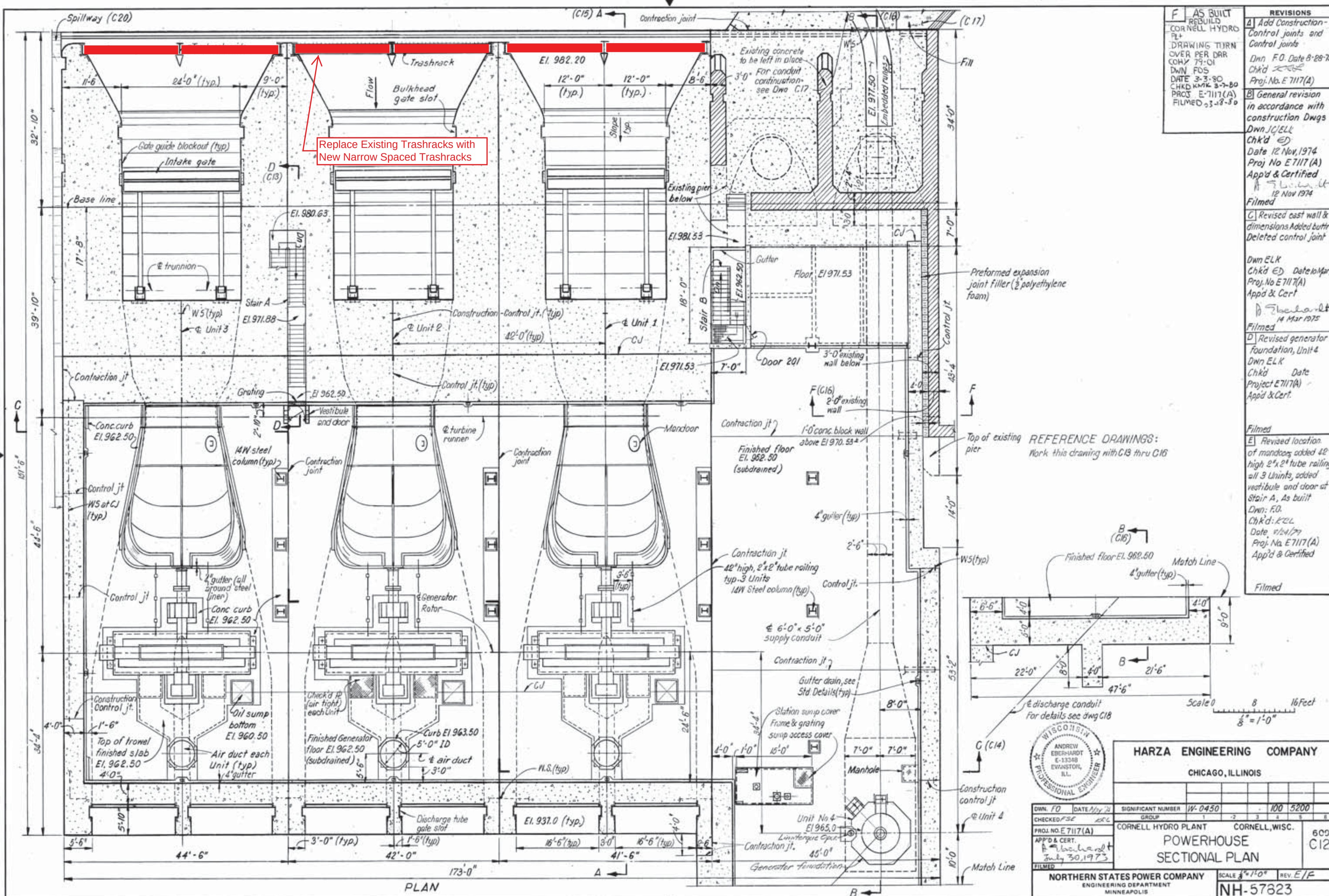
FLOATING BARRIER NET

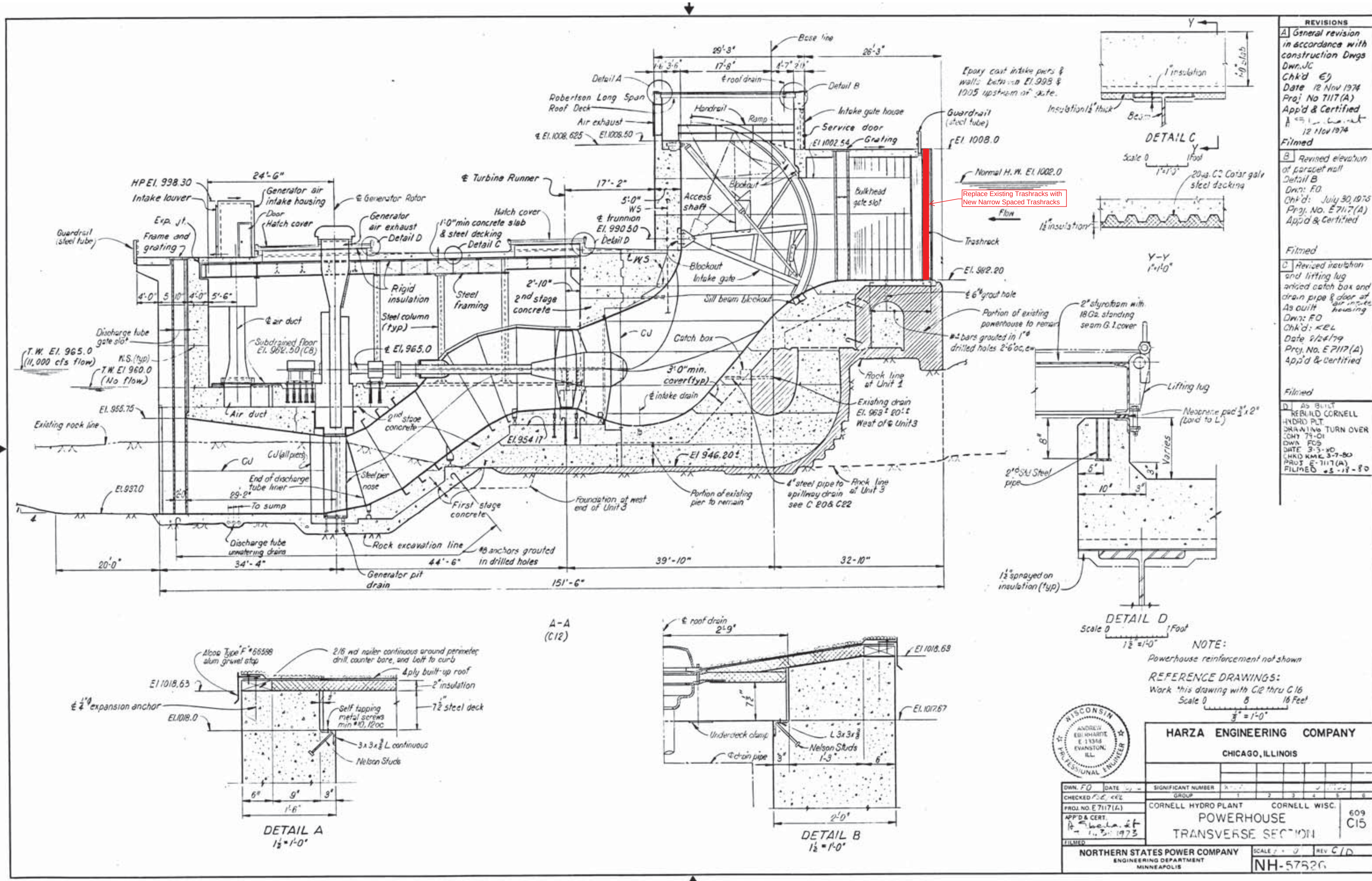

A-55603
Corner Anchor
Full Depth Floating Barrier Net
Net End Anchor
Existing Retaining Wall
N
SPILLWAY DAM
UPSTREAM RETAINING WALL
144'-6"
AIR BUBBLING SYSTEM
HANDRAIL
COOLING WATER INTAKE MANHOLE
GANTRY RAIL
RAILS FOR SPILLWAY GATE HOISTS
RAMP
HEADWORKS 20TON GANTRY HOIST DWG. X-41766-1
HEADWORKS ELEV. 1053'-0"
EMERGENCY HEAD GATE
SLOTS
HEAD GATE
GATE STORAGE
SPARE
GRAPNEL STORAGE
DIFFERENTIAL METER FOR RACK
AIR INTAKE
AIR RECIRCULATING LOUVRE
HEAD WATER GAGE
GENERATOR MAIN & NEUTRAL CABLES
SWITCH GEAR
UNIT #3
UNIT #2
UNIT #1
WOODWARD GOVERNOR
TERMINAL CABLES
GENERATOR PANEL
INSTRUMENT PANEL
ROTOR MOUNT
ACCESS HATCH
TAIL WATER GAGE
GENERATOR FLOOR ELEV. 1035'-0"
DRAFT TUBE MANHOLE
GANTRY RAIL FOR PLAN OF DRAFT TUBE STOP LOG HOIST SEE DWG. A-50941
DRAFT TUBE DECK ELEV. 1010'-0"
DYNAMOTOR
CODE SENDER
MOTOR GENERATOR SET
SUPERVISORY CONTROL
BATTERY CHARGER & D.C. CONTROL PANEL
SWITCH GEAR ROOM
WASHROOM
BOILER ROOM
HEATING & VENTILATING DUCTS
CIRCUIT BREAKER CONTROL
CARRIER CURRENT
AUXILIARY CUBICLE & ANNUNCIATOR
OBSERVATION WINDOW
LOBBY ROOM
MEN
WOMEN
LADDER
PLAN LOBBY FLOOR ELEV. 1055'-3"
REFERENCE:
FOR DATA SHEET & REFERENCE LIST SEE DWG. AA-49712.
FOR TURBINE FLOOR PLAN SEE DWG. A-55604.
FOR TRANSVERSE SECTION SEE DWG. A-55605.
GENERATOR FLOOR PLAN
SHOWING HEADWORKS, DRAFT TUBE DECK, SWITCHGEAR ROOM, WASHROOM, BOILER ROOM & LOBBY ROOM.
REVISIONS
NORTHERN STATES POWER COMPANY OF WISCONSIN
HOLCOMBE HYDRO PLANT
HOLCOMBE, WISCONSIN
GENERAL ARRANGEMENT
POWER HOUSE GENERATOR FLOOR PLAN
Designed By
Pioneer Service & Engineering Co.
Chicago, 4
PROJECT No. 2211-041
No. A-55603


A-55605
GENERATOR ROOM & ANNEX
TRANSVERSE SECTION BETWEEN COLUMN ROW 7 & 8
EXTREME T.W. APPROX. EL. 1035'-0"
POWER HOUSE TRANSVERSE SECTION
TAKEN THRU COLUMN ROW-5
LOOKING TOWARD SPILLWAY DAM
POWER HOUSE & ANNEX
TRANSVERSE SECTION THRU BOILER ROOM & LOBBY ROOM
Float
Full Depth Barrier Net
Tether
Net Anchors
Estimated Rock Profile
GENERATOR ROOM
SWITCHGEAR ROOM
LOBBY ROOM
60 TON TRAVELING CRANE
HEADWORKS
UPSTREAM
DOWNSTREAM
FLOW
DRAFT TUBE
TRASH RACK
HEAD GATE SLOT
EMERGENCY HEAD GATE SLOT
MAX. H.W. EL. 1050'-0"
NORMAL H.W. EL. 1045'-0"
LOW H.W. EL. 1035'-0"
NORMAL T.W. EL. 1003'-0"
LOW T.W. EL. 1000'-0"
ROCK LINE (VARIES)
115'-6"
59'-6"
56'-0"
REFERENCE:
FOR DATA SHEET & REFERENCE LIST SEE DWG. AA-49712.
FOR GENERATOR FLOOR PLAN SEE DWG. A-55603.
FOR TURBINE FLOOR PLAN SEE DWG. A-55604.
NORTHERN STATES POWER COMPANY OF WISCONSIN
HOLCOMBE HYDRO PLANT
HOLCOMBE, WISCONSIN
GENERAL ARRANGEMENT
POWER HOUSE TRANSVERSE SECTION
Designed By
Pioneer Service & Engineering Co.
Chicago, 4
PROJECT No. 2211-041
No. A-55605

CORNELL

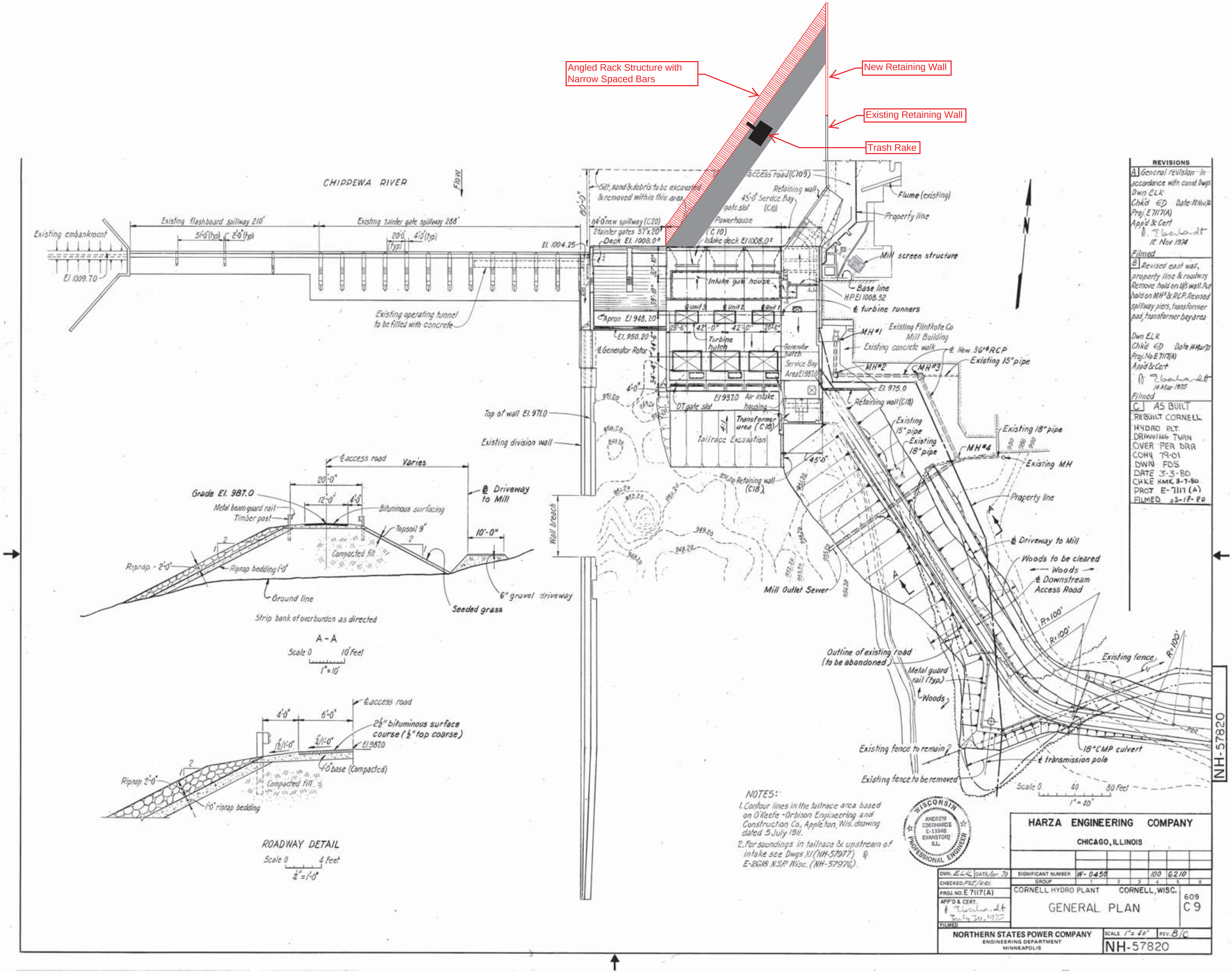
REPLACE EXISTING TRASHRACKS WITH NEW NARROWLY SPACED TRASHRACKS


Replace Existing Trashracks with New Narrow Spaced Trashracks
PLAN
Trashrack
El. 982.20
Bulkhead gate slot
Flow
Gate guide blockout (typ)
Intake gate
Base line
Spillway (C20)
Contraction joint
Existing concrete to be left in place
For conduit continuation see Dwg C17
Fill
Embedded rungs
Existing pier below
Gutter
Floor El 971.53
Preformed expansion joint filler (1/2" polyethylene foam)
Control jt
Stair A
Stair B
Construction-Control jt (typ)
℄ Unit 1
℄ Unit 2
℄ Unit 3
℄ trunnion
Door 201
3'-0" existing wall below
Grating
Vestibule and door
℄ turbine runner
Mandoor
Contraction joint
Conc. curb El. 962.50
14W steel column (typ)
Finished floor El. 962.50 (subdrained)
4" gutter (typ)
Top of existing pier
REFERENCE DRAWINGS:
Work this drawing with C13 thru C16
Contraction jt
42" high, 2"x2" tube railing typ-3 Units
14W Steel column (typ)
Generator Rotor
℄ 6'-0" x 5'-0" supply conduit
Gutter drain, see Std Details (typ)
Station sump cover Frame & grating sump access cover
Manhole
Oil sump bottom El. 960.50
Air duct each Unit (typ)
Top of trowel finished slab El. 962.50
Check'd ℄ (air tight) each Unit
Finished Generator floor El. 962.50 (subdrained)
Curb El 963.50
5'-0" ID
℄ air duct
Discharge tube gate slot
El. 937.0 (typ)
Unit No 4 El 965.0
Generator foundation
℄ discharge conduit For details see dwg C18
Construction control jt
℄ Unit 4
Match Line
Finished floor El. 962.50
Scale 1/8" = 1'-0"
173'-0"
44'-6"
42'-0"
41'-6"
F AS BUILT REBUILD CORNELL HYDRO PL+ DRAWING TURN OVER PER DRR COHY 79-01 DWN FDS DATE 3-3-80 CHKD KMK 3-7-80 PROJ E-7117(A) FILMED 03-18-80
REVISIONS
A Add Construction-Control joints and Control joints. Dwn F.O. Date 8-28-73 Proj. No. E 7117(A)
B General revision in accordance with construction Dwgs. Dwn JC/ELK Date 12 Nov, 1974 Proj No E7117(A) App'd & Certified 12 Nov 1974 Filmed
C Revised east wall & dimensions. Added buttress. Deleted control joint. Dwn ELK Date 10 Mar 75 Proj. No E7117(A) App'd & Cert 14 Mar 1975 Filmed
D Revised generator foundation, Unit 4. Dwn ELK Project E7117(A) App'd & Cert.
Filmed
E Revised location of mandoors, added 42" high 2"x2" tube railing all 3 Units, added vestibule and door at Stair A, As built. Dwn: F.O. Proj. No. E7117(A) App'd & Certified
Filmed
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
ANDREW EBERHARDT E-13348 EVANSTON, ILL. PROFESSIONAL ENGINEER
SIGNIFICANT NUMBER W-0450 100 5200
CORNELL HYDRO PLANT CORNELL, WISC.
POWERHOUSE SECTIONAL PLAN
609 C12
PROJ. NO. E7117(A)
NORTHERN STATES POWER COMPANY ENGINEERING DEPARTMENT MINNEAPOLIS
SCALE 1/8"=1'-0" REV. E/F
NH-57823

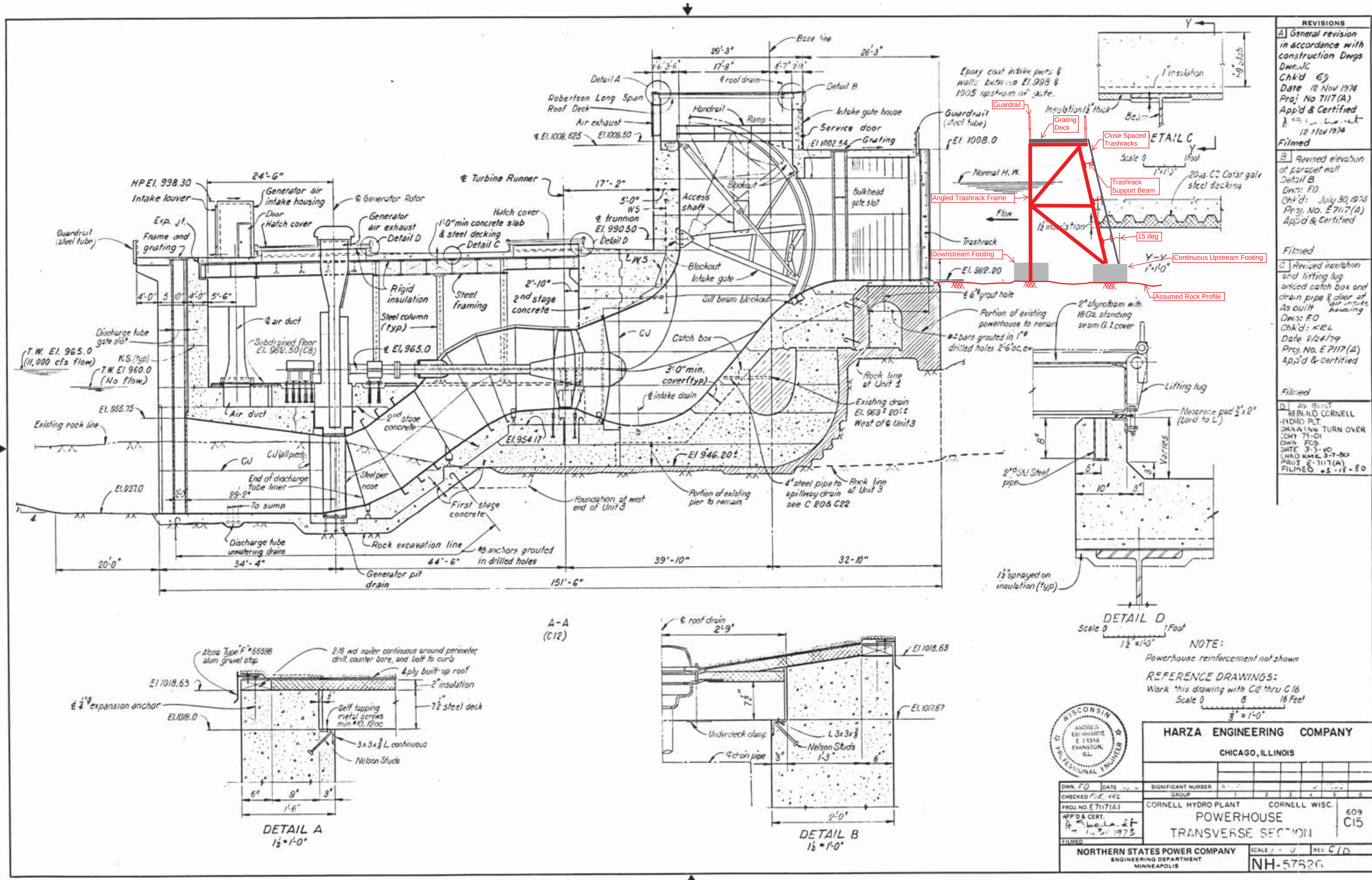

REVISIONS
A General revision in accordance with construction Dwgs
Dwn. JC
Date 12 Nov 1974
Proj No 7117(A)
App'd & Certified
12 Nov 1974
Filmed
B Revised elevation of parapet wall Detail B
Drn: FO
Date: July 30, 1975
Proj. No. E7117(A)
App'd & Certified
Filmed
C Revised insulation and lifting lug added catch box and drain pipe & door at air intake housing As built
Drn: FO
Chk'd: KEL
Date 8/24/79
Proj. No. E7117(A)
App'd & Certified
Filmed
Replace Existing Trashracks with New Narrow Spaced Trashracks
Base line
29'-3"
26'-3"
17'-8"
Detail A
Detail B
Robertson Long Span Roof Deck
Handrail
Ramp
Intake gate house
Service door
Grating
Guardrail (steel tube)
El. 1008.0
Air exhaust
℄ El. 1008.625
El. 1008.50
El. 1002.54
Epoxy coat intake piers & walls between El. 998 & 1005 upstream of gate.
Normal H.W. El. 1002.0
Flow
Trashrack
El. 982.20
℄ 6" grout hole
Portion of existing powerhouse to remain
#4 bars grouted in 1" drilled holes 2'-6" o.c.
Rock line at Unit 1
Existing drain El. 963± 20'± West of ℄ Unit 3
Rock line at Unit 3
4" steel pipe to spillway drain see C 20 & C22
Portion of existing pier to remain
Foundation at west end of Unit 3
El. 946.20±
Bulkhead gate slot
Access shaft
Blockout
Intake gate
Sill beam blockout
Catch box
3'-0" min. cover (typ)
℄ intake drain
HP El. 998.30
Intake louver
24'-6"
Generator air intake housing
Door
Hatch cover
℄ Generator Rotor
℄ Turbine Runner
17'-2"
5'-0" WS
℄ trunnion El. 990.50
Detail D
Generator air exhaust
Detail D
1'-0" min concrete slab & steel decking
Detail C
Hatch cover
Guardrail (steel tube)
Exp. jt.
Frame and grating
Rigid insulation
Steel framing
2nd stage concrete
2'-10"
Steel column (typ)
℄ air duct
Discharge tube gate slot
Subdrained floor El. 962.50 (C8)
W.S. (typ)
℄ El. 965.0
T.W. El. 965.0 (11,000 cfs flow)
T.W. El. 960.0 (No flow)
El. 955.75
Air duct
2nd stage concrete
El. 954.17
Existing rock line
CJ (all piers)
End of discharge tube liner
Steel pier nose
El. 937.0
To sump
First stage concrete
Discharge tube unwatering drains
Rock excavation line
#8 anchors grouted in drilled holes
Generator pit drain
20'-0"
34'-4"
44'-6"
39'-10"
32'-10"
151'-6"
A-A (C12)
DETAIL C
Scale 0 1 Foot
1"=1'-0"
1" insulation
Insulation 1 1/2" thick
Beam
1'-0" slab
20 ga. C.C. Cofar galv steel decking
1 1/2" insulation
Y-Y 1"=1'-0"
2" styrofoam with 18 Ga. standing seam G.I. cover
Lifting lug
Neoprene pad 3/8" x 2" (bond to L)
2" ⌀ Std Steel pipe
Varies
1 1/2" sprayed on insulation (typ)
DETAIL D
Scale 0 1 Foot
1 1/2"=1'-0"
Alcoa Type "F" #66588 alum gravel stop
2/6 wd nailer continuous around perimeter, drill, counter bore, and bolt to curb
4 ply built-up roof
2" insulation
1 1/2" steel deck
El 1018.63
℄ 1/4" ⌀ expansion anchor
El. 1018.0
Self tapping metal screws min #10, 12oc
3 x 3 x 3/8 L continuous
Nelson Studs
1'-6"
DETAIL A
1 1/2"=1'-0"
℄ roof drain
2'-9"
El 1018.63
El 1017.67
Underdeck clamp
L 3x3x3/8
Nelson Studs
℄ drain pipe
2'-0"
DETAIL B
1 1/2"=1'-0"
NOTE:
Powerhouse reinforcement not shown
REFERENCE DRAWINGS:
Work this drawing with C12 thru C16
Scale 0 8 16 Feet
3/32"=1'-0"
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
CORNELL HYDRO PLANT CORNELL WISC.
POWERHOUSE TRANSVERSE SECTION
609 C15
NORTHERN STATES POWER COMPANY
ENGINEERING DEPARTMENT
MINNEAPOLIS
NH-57526

CORNELL

ANGLED BAR RACK WITH NARROWLY SPACED BARS



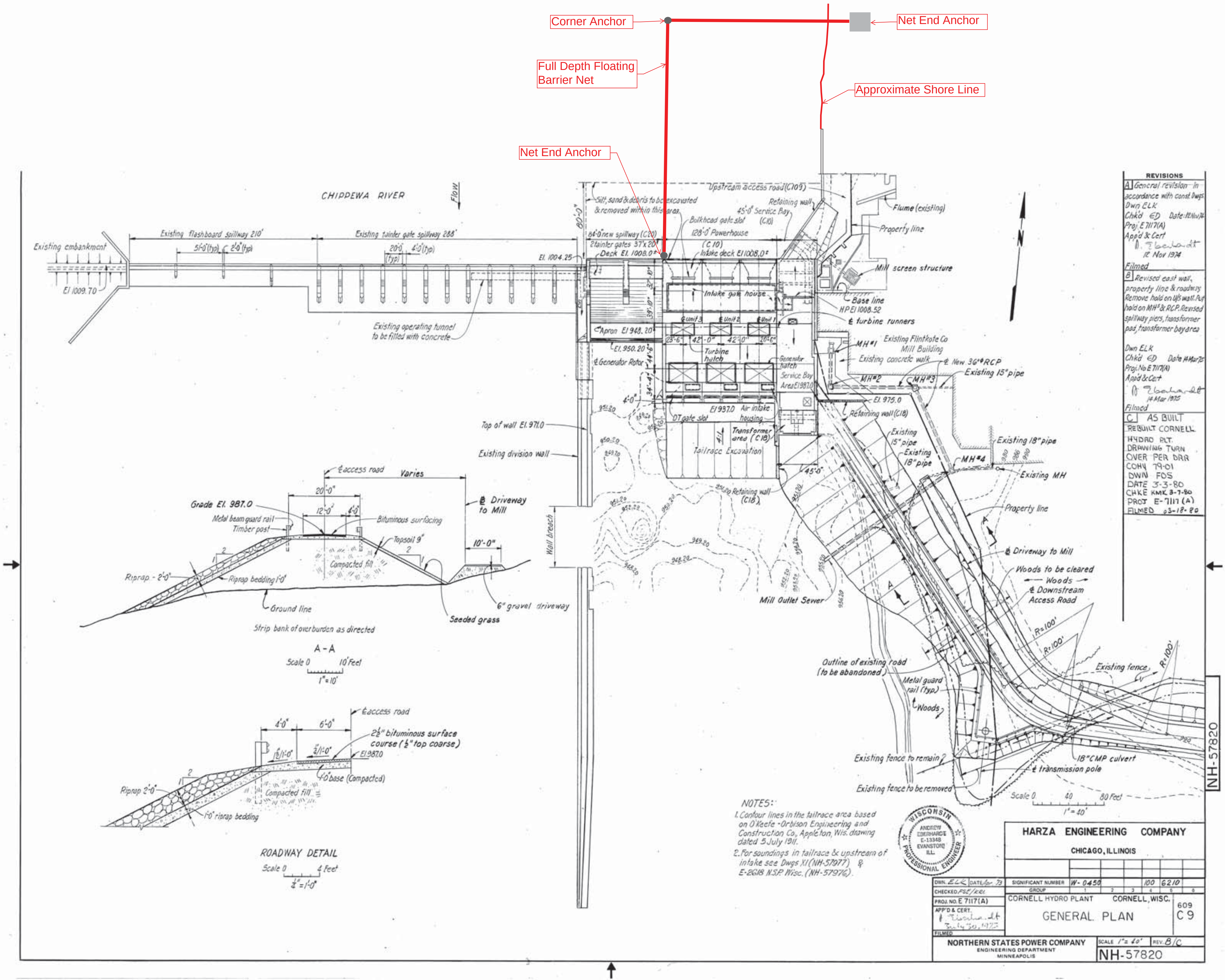
Angled Rack Structure with Narrow Spaced Bars
New Retaining Wall
Existing Retaining Wall
Trash Rake
CHIPPEWA RIVER
Flow
Existing embankment
El 1009.70
Existing flashboard spillway 210'
Existing tainter gate spillway 288'
El. 1004.25
Existing operating tunnel to be filled with concrete
Silt, sand & debris to be excavated & removed within this area
84'-0" new spillway (C20)
2 tainter gates 37'x 20'
Deck El. 1008.0±
Powerhouse (C10)
Intake deck El 1008.0±
Retaining wall
45'-0" Service Bay
access road (C109)
Flume (existing)
Property line
Mill screen structure
Intake gate house
Base line HP El 1008.52
℄ turbine runners
Apron El 948.20
El. 950.20
℄ Generator Rotor
Turbine hatch
Existing Flintkote Co Mill Building
Existing concrete walk
New 36" RCP
Existing 15" pipe
MH #1
MH #2
MH #3
MH #4
El. 975.0
Retaining wall (C18)
El 937.0 Air intake housing
DT gate slot
Transformer area (C18)
Tailrace Excavation
Top of wall El. 971.0
Existing division wall
Existing 15" pipe
Existing 18" pipe
Existing MH
Property line
Wall breach
Mill Outlet Sewer
℄ Driveway to Mill
Woods to be cleared
Woods
℄ Downstream Access Road
R=100'
Outline of existing road (to be abandoned)
Metal guard rail (typ)
Woods
Existing fence
Existing fence to remain
Existing fence to be removed
18" CMP culvert
℄ transmission pole
Scale 0 40 80 Feet
1" = 40'
℄ access road
Varies
Grade El. 987.0
Metal beam guard rail
Timber post
20'-0"
12'-0"
4'-0"
Bituminous surfacing
Topsoil 9"
Compacted fill
Riprap - 2'-0"
Riprap bedding 1'-0"
Ground line
Strip bank of overburden as directed
℄ Driveway to Mill
10'-0"
6" gravel driveway
Seeded grass
A-A
Scale 0 10 Feet
1" = 10'
℄ access road
4'-0"
6'-0"
2½" bituminous surface course (½" top coarse)
El 987.0
4" base (Compacted)
Riprap 2'-0"
Compacted fill
1'-0" riprap bedding
ROADWAY DETAIL
Scale 0 4 Feet
¾" = 1'-0"
NOTES:
1. Contour lines in the tailrace area based on O'Keefe-Orbison Engineering and Construction Co., Appleton, Wis. drawing dated 5 July 1911.
2. For soundings in tailrace & upstream of intake see Dwgs XI (NH-57977) & E-2618 N.S.P. Wisc. (NH-57976).
REVISIONS
A General revision in accordance with const. Dwgs
B Revised east wall, property line & roadway. Remove hold on U/S wall. Put hold on MH³ & RCP. Revised spillway piers, transformer pad, transformer bay area
C AS BUILT REBUILT CORNELL HYDRO PLT. DRAWING TURN OVER PER DRR
WISCONSIN PROFESSIONAL ENGINEER ANDREW EBERHARDT E-13348 EVANSTON ILL.
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
SIGNIFICANT NUMBER W-0450
CORNELL HYDRO PLANT
CORNELL, WISC.
GENERAL PLAN
609 C9
PROJ. NO. E 7117 (A)
NORTHERN STATES POWER COMPANY
ENGINEERING DEPARTMENT
MINNEAPOLIS
SCALE 1" = 40'
REV. B/C
NH-57820

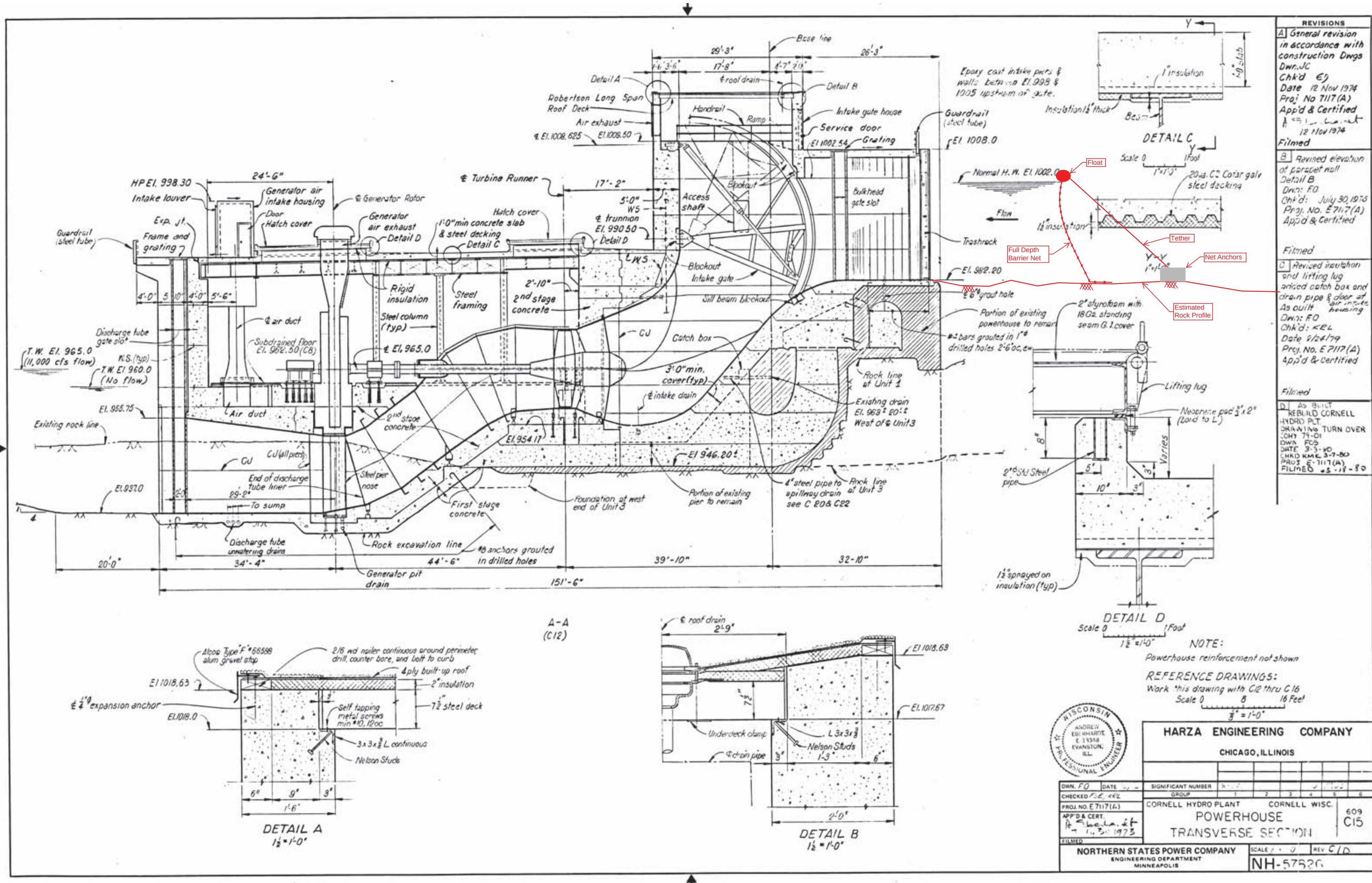


REVISIONS
A General revision in accordance with construction Dwgs Dwn. JC Chk'd Date 12 Nov 1974 Proj No 7117(A) App'd & Certified 12 Nov 1974 Filmed
B Revised elevation of parapet wall Detail B Dwn: FO Chk'd: July 30, 1975 Proj. No. E7117(A) App'd & Certified Filmed
C Revised insulation and lifting lug added catch box and drain pipe & door at air intake housing As built Dwn: FO Chk'd: KEL Date 5/24/79 Proj. No. E7117(A) App'd & Certified Filmed
D AS BUILT REBUILD CORNELL HYDRO PLT. DRAWING TURN OVER CONT 79-01
Base line
29'-3"
26'-3"
Detail A
Detail B
℄ roof drain
Robertson Long Span Roof Deck
Air exhaust
℄ El. 1008.625
El. 1009.50
Handrail
Ramp
Intake gate house
Service door
El. 1002.54
Grating
Guardrail (steel tube)
El. 1008.0
Epoxy coat intake piers & walls between El. 998 & 1005 upstream of gate.
Guardrail
Grating Deck
Close Spaced Trashracks
Trashrack Support Beam
Angled Trashrack Frame
15 deg
Downstream Footing
Continuous Upstream Footing
Assumed Rock Profile
DETAIL C
Normal H.W.
Flow
Trashrack
El. 982.20
℄ 6" grout hole
HP El. 998.30
Intake louver
24'-6"
Generator air intake housing
℄ Generator Rotor
℄ Turbine Runner
17'-2"
Door
Hatch cover
Generator air exhaust
Detail D
1'-0" min concrete slab & steel decking
Detail C
Hatch cover
℄ trunnion El. 990.50
Detail D
Access shaft
Blockout
Bulkhead gate slot
Blockout
Intake gate
Sill beam blockout
Exp. jt.
Frame and grating
Guardrail (steel tube)
Rigid insulation
Steel framing
2nd stage concrete
Steel column (typ)
℄ air duct
Discharge tube gate slot
Subdrained floor El. 962.50 (C8)
℄ El. 965.0
CJ
Catch box
T.W. El. 965.0 (11,000 cfs flow)
T.W. El. 960.0 (No flow)
El. 955.75
Existing rock line
Air duct
2nd stage concrete
El. 954.17
3'-0" min. cover (typ)
℄ intake drain
El. 946.20
Portion of existing powerhouse to remain
#4 bars grouted in 1" drilled holes 2'-6" o.c.
Rock line at Unit 1
Existing drain El. 963 ± 20' ± West of Unit 3
CJ (all piers)
End of discharge tube liner
To sump
Steel pier nose
First stage concrete
Foundation at west end of Unit 3
Portion of existing pier to remain
4" steel pipe to spillway drain see C20 & C22
Rock line at Unit 3
El. 937.0
Discharge tube unwatering drains
Rock excavation line
#8 anchors grouted in drilled holes
Generator pit drain
20'-0"
34'-4"
44'-6"
39'-10"
32-10"
151'-6"
A-A (C12)
2" styrofoam with 18 Ga. standing seam G.I. cover
Lifting lug
Neoprene pad
2"ø Std Steel pipe
Varies
1½" sprayed on insulation (typ)
DETAIL D
Scale 1½" = 1'-0"
NOTE: Powerhouse reinforcement not shown
REFERENCE DRAWINGS: Work this drawing with C12 thru C16
Alcoa Type "F" #66588 alum gravel stop
2/6 wd nailer continuous around perimeter drill, counter bore, and bolt to curb
4 ply built-up roof
2" insulation
7½" steel deck
El 1018.63
El 1018.0
℄ ¼"ø expansion anchor
Self tapping metal screws min #10, 12oc
3x3x⅜ L continuous
Nelson Studs
DETAIL A
1½" = 1'-0"
℄ roof drain
2'-9"
El 1018.63
El 1017.67
Underdeck clamp
L 3x3x⅜
Nelson Studs
℄ drain pipe
DETAIL B
1½" = 1'-0"
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
CORNELL HYDRO PLANT CORNELL WISC.
POWERHOUSE TRANSVERSE SECTION
609 C15
NORTHERN STATES POWER COMPANY ENGINEERING DEPARTMENT MINNEAPOLIS
NH-57826

CORNELL

FLOATING BARRIER NET


Corner Anchor
Net End Anchor
Full Depth Floating Barrier Net
Approximate Shore Line
Net End Anchor
CHIPPEWA RIVER
Flow
Existing embankment
Existing flashboard spillway 210'
Existing tainter gate spillway 288'
El 1009.70
El. 1004.25
84'-0" new spillway (C20)
2 tainter gates 37'x 20'
Deck El. 1008.0±
Upstream access road (C109)
Silt, sand & debris to be excavated & removed within this area
Bulkhead gate slot
128'-0" Powerhouse
Intake deck El 1008.0±
Retaining wall
45'-0" Service Bay
Flume (existing)
Property line
Mill screen structure
Intake gate house
Base line
HP El 1008.52
℄ turbine runners
Existing operating tunnel to be filled with concrete
Apron El 948.20
Unit 3
Unit 2
Unit 1
El. 950.20
℄ Generator Rotor
Turbine hatch
Generator hatch
Service Bay Area El 983.0
Existing Flintkote Co Mill Building
Existing concrete walk
MH#1
MH#2
MH#3
℄ New 36"φ RCP
Existing 15" pipe
El. 975.0
Retaining wall (C18)
El 937.0
Air intake housing
DT gate slot
Transformer area (C18)
Tailrace Excavation
Top of wall El. 971.0
Existing division wall
Existing 15" pipe
Existing 18" pipe
Existing 18" pipe
MH#4
Existing MH
Property line
Retaining wall (C18)
Wall breach
℄ access road
Varies
Grade El. 987.0
Metal beam guard rail
Timber post
Bituminous surfacing
Topsoil 9"
Compacted fill
Riprap - 2'-0"
Riprap bedding 1'-0"
Ground line
Strip bank of overburden as directed
℄ Driveway to Mill
10'-0"
6" gravel driveway
Seeded grass
A - A
Scale 0 10 Feet
1" = 10'
℄ Driveway to Mill
Woods to be cleared
Woods
℄ Downstream Access Road
Mill Outlet Sewer
R=100'
Outline of existing road (to be abandoned)
Metal guard rail (typ)
Woods
Existing fence
Existing fence to remain
18" CMP culvert
℄ transmission pole
Existing fence to be removed
Scale 0 40 80 Feet
1" = 40'
℄ access road
4'-0"
6'-0"
2½" bituminous surface course (½" top coarse)
El 987.0
4" base (Compacted)
Riprap 2'-0"
Compacted fill
1'-0" riprap bedding
ROADWAY DETAIL
Scale 0 4 Feet
¾" = 1'-0"
NOTES:
1. Contour lines in the tailrace area based on O'Keefe - Orbison Engineering and Construction Co., Appleton, Wis. drawing dated 5 July 1911.
2. For soundings in tailrace & upstream of intake see Dwgs XI (NH-57977) & E-2618 NSP Wisc. (NH-57976).
REVISIONS
A General revision in accordance with const. Dwgs
Dwn ELK
Chk'd ED
Proj E7117(A)
App'd & Cert
12 Nov 1974
Filmed
B Revised east wall, property line & roadway. Remove hold on U/S wall. Put hold on MH's & RCP. Revised spillway piers, transformer pad, transformer bay area
Dwn ELK
Chk'd ED
Proj. No E7117(A)
App'd & Cert
14 Mar 1975
Filmed
C AS BUILT REBUILT CORNELL HYDRO PLT. DRAWING TURN OVER PER DRR
COHY 79-01
DWN FOS
DATE 3-3-80
CHKE KMK 3-7-80
PROJ E-7117 (A)
FILMED 03-18-80
WISCONSIN ANDREW EBERHARDT E-13348 EVANSTON ILL. PROFESSIONAL ENGINEER
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
SIGNIFICANT NUMBER W-0450 100 6210
CORNELL HYDRO PLANT CORNELL, WISC.
GENERAL PLAN
609
C9
NORTHERN STATES POWER COMPANY
ENGINEERING DEPARTMENT
MINNEAPOLIS
SCALE 1" = 40'
REV. B/C
NH-57820



REVISIONS
A General revision in accordance with construction Dwgs
Date 12 Nov 1974
Proj No 7117(A)
App'd & Certified
Filmed
B Revised elevation of parapet wall Detail B
Date July 30, 1975
Proj. No. E7117(A)
App'd & Certified
Filmed
C Revised insulation and lifting lug added catch box and drain pipe & door at air intake housing As built
Date 9/24/79
Proj. No. E7117(A)
App'd & Certified
Filmed
D AS BUILT REBUILD CORNELL HYDRO PLT. DRAWING TURN OVER
Float
Full Depth Barrier Net
Tether
Net Anchors
Estimated Rock Profile
Normal H.W. El. 1002.0
Flow
Trashrack
Bulkhead gate slot
Intake gate house
Service door
Grating
Guardrail (steel tube)
El. 1008.0
El. 982.20
Detail A
Detail B
Detail C
Detail D
Robertson Long Span Roof Deck
Air exhaust
Handrail
Ramp
Access shaft
Blockout
Blockout Intake gate
Sill beam blockout
Catch box
3'-0" min. cover (typ)
℄ intake drain
℄ Turbine Runner
℄ Generator Rotor
Generator air intake housing
Door
Hatch cover
Generator air exhaust
1'-0" min concrete slab & steel decking
℄ trunnion El. 990.50
HP El. 998.30
Intake louver
Exp. jt.
Frame and grating
Guardrail (steel tube)
Rigid insulation
Steel framing
2nd stage concrete
Steel column (typ)
℄ air duct
℄ El. 965.0
Discharge tube gate slot
Subdrained floor El. 962.50 (C8)
T.W. El. 965.0 (11,000 cfs flow)
T.W. El. 960.0 (No flow)
El. 955.75
Existing rock line
Air duct
2nd stage concrete
El. 954.17
El. 946.20±
El. 937.0
End of discharge tube liner
To sump
Steel pier nose
First stage concrete
Discharge tube unwatering drains
Rock excavation line
#8 anchors grouted in drilled holes
Generator pit drain
Foundation at west end of Unit 3
Portion of existing pier to remain
4" steel pipe to spillway drain see C20 & C22
Rock line at Unit 3
Existing drain El. 963± 20'± West of Unit 3
Rock line at Unit 1
Portion of existing powerhouse to remain
#4 bars grouted in 1" drilled holes 2'-6" oc, ew
℄ 6" grout hole
2" styrofoam with 18 Ga. standing seam G.I. cover
Lifting lug
Neoprene pad
2" Std Steel pipe
1½" sprayed on insulation (typ)
151'-6"
A-A (C12)
DETAIL A 1½" = 1'-0"
DETAIL B 1½" = 1'-0"
DETAIL C
DETAIL D 1½" = 1'-0"
NOTE: Powerhouse reinforcement not shown
REFERENCE DRAWINGS: Work this drawing with C12 thru C16
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
CORNELL HYDRO PLANT
CORNELL WISC.
POWERHOUSE TRANSVERSE SECTION
609
C15
NORTHERN STATES POWER COMPANY
ENGINEERING DEPARTMENT
MINNEAPOLIS
NH-57826

JIM FALLS

REPLACE EXISTING TRASHRACKS WITH NEW NARROWLY SPACED TRASHRACKS

EQUIPMENT IDENTIFICATION LIST

REF NO.	ID NUMBER	EQUIPMENT FULL NAME	FOUNDATION DWG. NO.
12	GRWD-CPL-1	RIVER HORN WARNING CONTROL PANEL	
13	CFFK-CAB-1	PLANT EMS RTU CABINET 1	
14	CSCE-SFAN-1B	GENERATOR AIR SUPPLY FAN 1B	
15	CSCE-SFAN-2B	GENERATOR AIR SUPPLY FAN 2B	
16	CSCE-CPL-4	TEMPERATURE CONTROL PANEL 4	
17	CSCE-CHT-4	CABINET HEATER 4	
18	CSCE-EFAN-2	WORKSHOP EXHAUST FAN 2	

EQUIPMENT IDENTIFICATION LIST

REF NO.	ID NUMBER	EQUIPMENT FULL NAME	FOUNDATION DWG. NO.
1	1GTB – XF – 1	GENERATOR STEP-UP TRANSFORMER	
2	2GTB – XF – 1	GENERATOR STEP-UP TRANSFORMER	
3	1COF-CPL-3	UNIT 1 CONTROL PANEL	
4	CAPC-BX-4	PULLBOX 4	
5	2COF-CPL-3	UNIT 2 CONTROL PANEL	
6	CBSJ – ELV – 1	ELEVATOR 1	
7	1COF-CPL-1	UNIT 1 EXCITATION AND AVR PANEL	
8	1COF-CPL-2	UNIT 1 GOVERNOR ELECTRONIC PANEL	
9	2COF-CPL-1	UNIT 2 EXCITATION AND AVR PANEL	
10	2COF-CPL-2	UNIT 2 GOVERNOR ELECTRONIC PANEL	
11	CCOF-CPL-1	COMMON CONTROL PANEL	

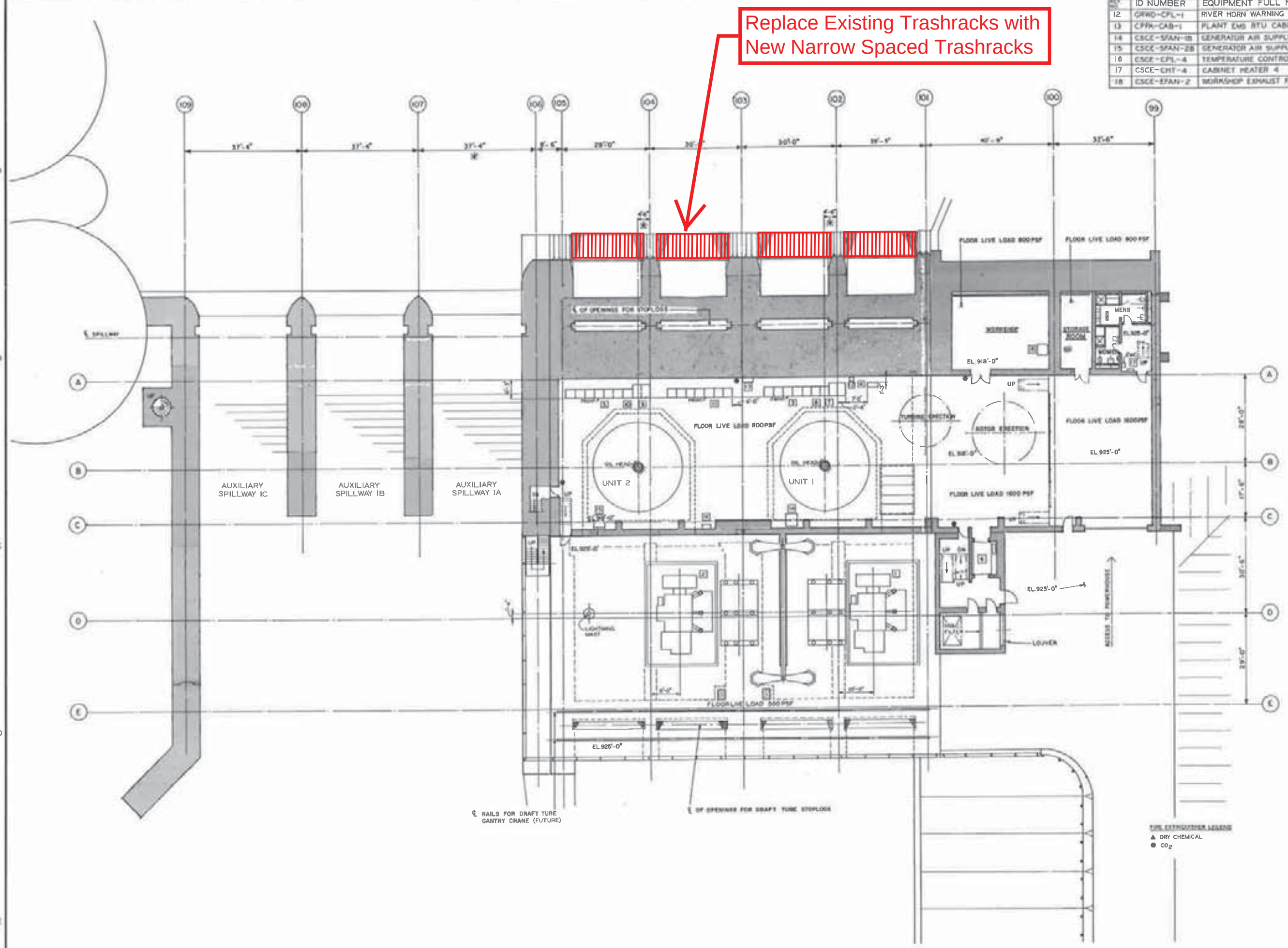


EXHIBIT F

DRAWING 3

NORTHERN STATES POWER CO. (WIS.)

EAU CLAIRE, WISCONSIN

JIM FALLS HYDRO

FERC PROJECT NO. 2491
CHIPPEWA COUNTY WISCONSIN

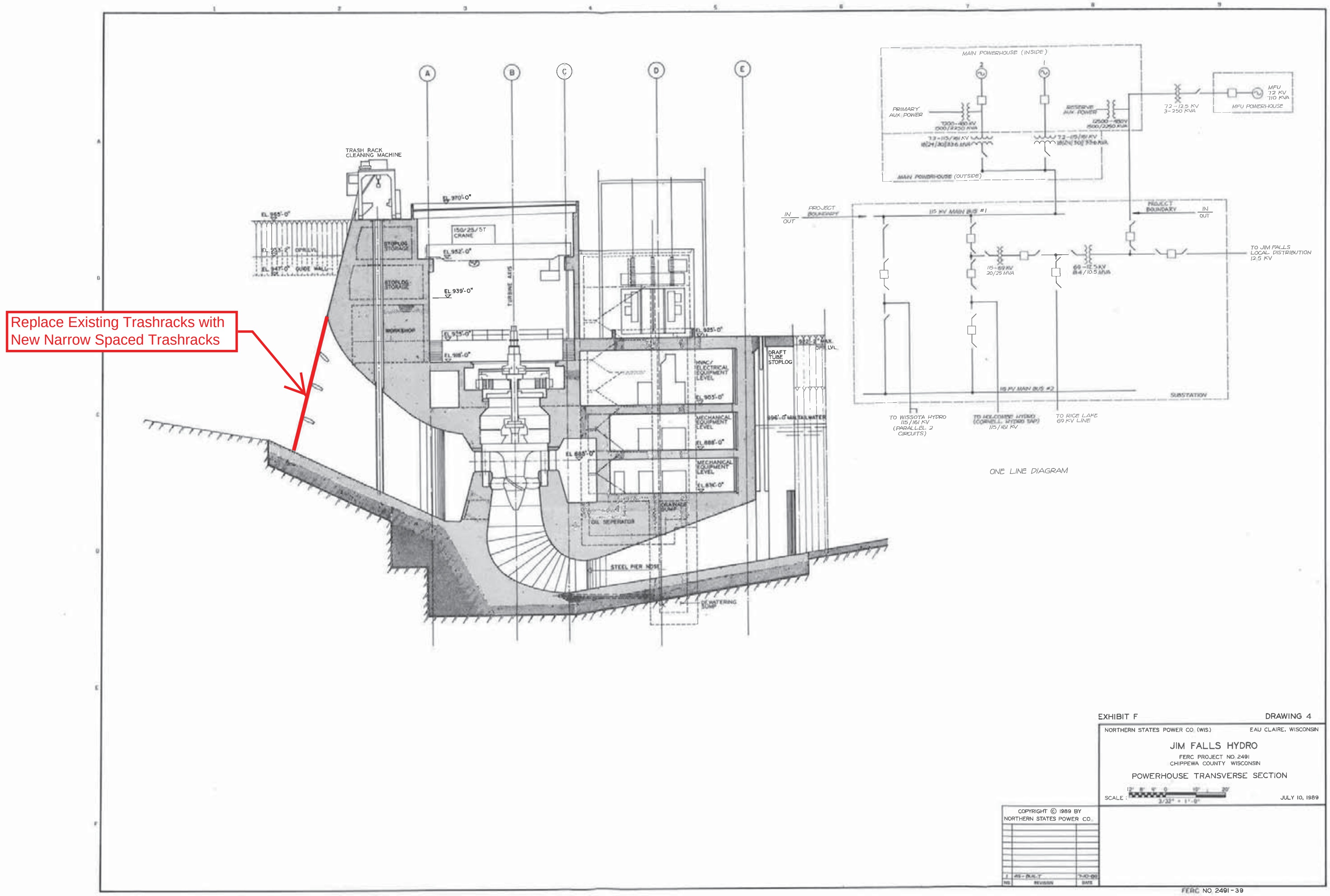
POWERHOUSE GENERATOR FLOOR PLAN
EL 918.0 & 925.0

SCALE: 3/32" = 1'-0"

JULY 10, 1989

NO.	REVISION	DATE
1	AS-BUILT	7-10-89

FERC NO. 2491-38



Replace Existing Trashracks with
New Narrow Spaced Trashracks
TRASH RACK CLEANING MACHINE
STOPLOG STORAGE
WORKSHOP
150/25/5T CRANE
TURBINE AXIS
HVAC/ ELECTRICAL EQUIPMENT LEVEL
MECHANICAL EQUIPMENT LEVEL
DRAFT TUBE STOPLOG
OIL SEPERATOR
DRAINAGE SUMP
STEEL PIER NOSE
DEWATERING SUMP
MAIN POWERHOUSE (INSIDE)
MAIN POWERHOUSE (OUTSIDE)
PRIMARY AUX. POWER
RESERVE AUX. POWER
MFU POWERHOUSE
PROJECT BOUNDARY
115 KV MAIN BUS #1
115 KV MAIN BUS #2
SUBSTATION
TO JIM FALLS LOCAL DISTRIBUTION 12.5 KV
TO WISSOTA HYDRO 115/161 KV (PARALLEL 2 CIRCUITS)
TO RICE LAKE 69 KV LINE
ONE LINE DIAGRAM
EXHIBIT F
DRAWING 4
NORTHERN STATES POWER CO. (WIS.)
EAU CLAIRE, WISCONSIN
JIM FALLS HYDRO
FERC PROJECT NO. 2491
CHIPPEWA COUNTY WISCONSIN
POWERHOUSE TRANSVERSE SECTION
SCALE: 3/32" = 1'-0"
JULY 10, 1989
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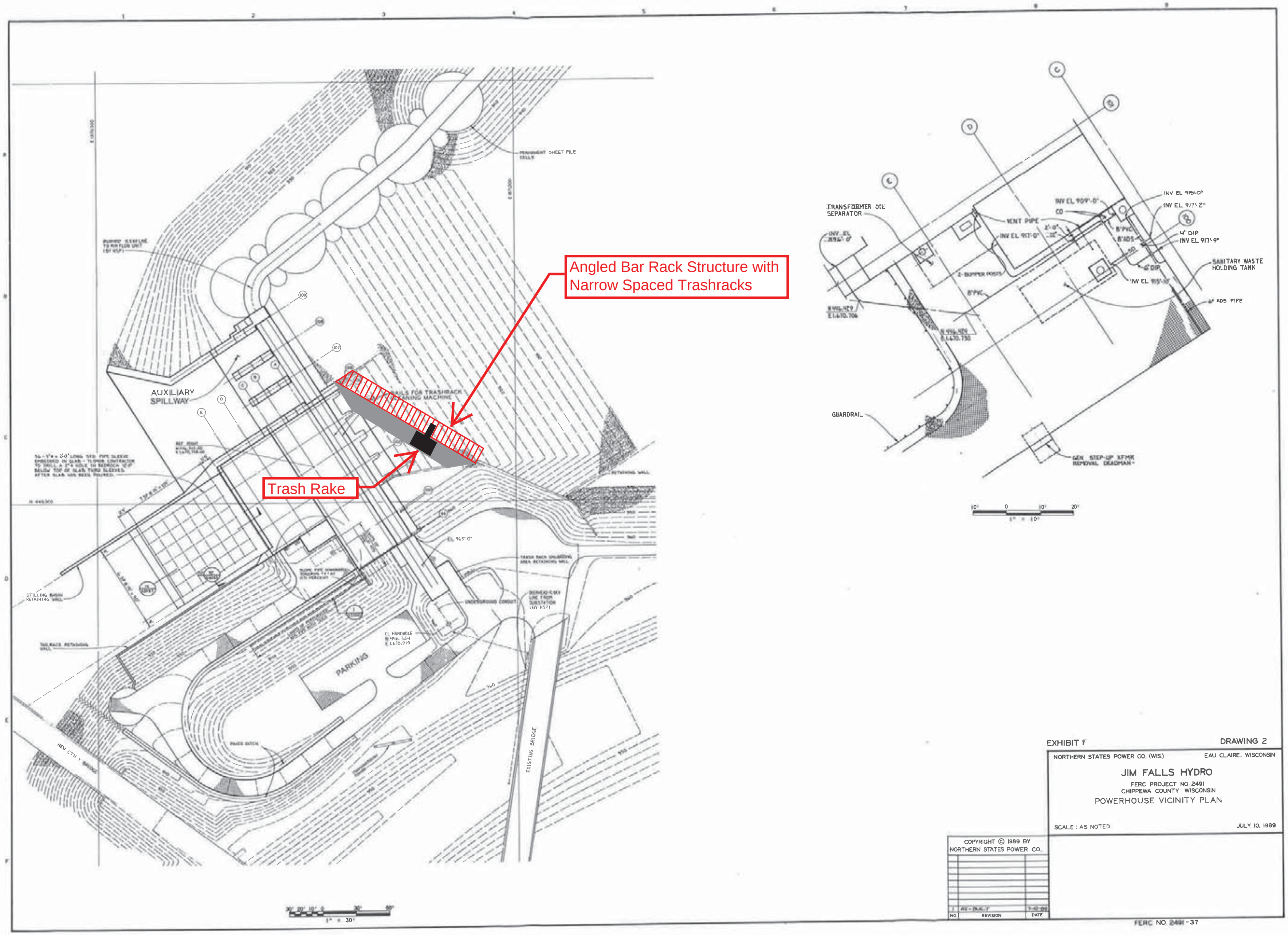
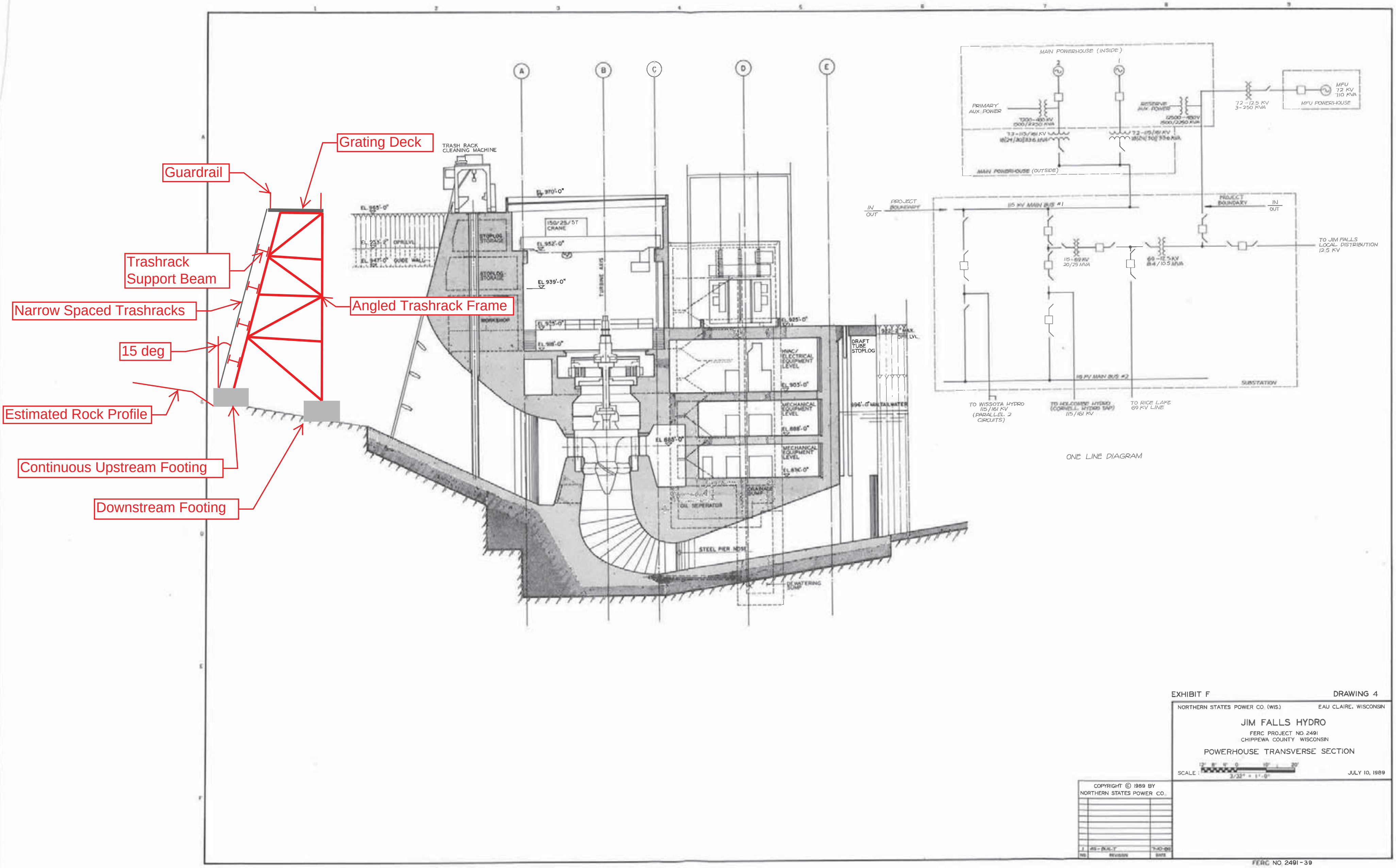
AS-BUILT
FERC NO. 2491-39

JIM FALLS

ANGLED BAR RACK WITH NARROWLY SPACED BARS



Angled Bar Rack Structure with Narrow Spaced Trashracks
Trash Rake
AUXILIARY SPILLWAY
PARKING
EXISTING BRIDGE
TRANSFORMER OIL SEPARATOR
VENT PIPE
SANITARY WASTE HOLDING TANK
GUARDRAIL
GEN. STEP-UP XFMR REMOVAL DEADMAN
EXHIBIT F
DRAWING 2
NORTHERN STATES POWER CO. (WIS.)
EAU CLAIRE, WISCONSIN
JIM FALLS HYDRO
FERC PROJECT NO. 2491
CHIPPEWA COUNTY WISCONSIN
POWERHOUSE VICINITY PLAN
SCALE : AS NOTED
JULY 10, 1989
COPYRIGHT © 1989 BY NORTHERN STATES POWER CO.
REVISION
DATE
FERC NO. 2491-37


Grating Deck
Guardrail
Trashrack
Support Beam
Narrow Spaced Trashracks
Angled Trashrack Frame
15 deg
Estimated Rock Profile
Continuous Upstream Footing
Downstream Footing
TRASH RACK CLEANING MACHINE
150/25/5T CRANE
TURBINE AXIS
STOPLOG STORAGE
WORKSHOP
HVAC/ELECTRICAL EQUIPMENT LEVEL
MECHANICAL EQUIPMENT LEVEL
DRAFT TUBE STOPLOG
OIL SEPERATOR
DRAINAGE SUMP
STEEL PIER NOSE
DEWATERING SUMP
MAIN POWERHOUSE (INSIDE)
MAIN POWERHOUSE (OUTSIDE)
PRIMARY AUX. POWER
RESERVE AUX. POWER
MFU POWERHOUSE
PROJECT BOUNDARY
115 KV MAIN BUS #1
115 KV MAIN BUS #2
SUBSTATION
TO JIM FALLS LOCAL DISTRIBUTION 12.5 KV
TO WISSOTA HYDRO 115/161 KV (PARALLEL 2 CIRCUITS)
TO RICE LAKE 69 KV LINE
ONE LINE DIAGRAM
EXHIBIT F
DRAWING 4
NORTHERN STATES POWER CO. (WIS.)
EAU CLAIRE, WISCONSIN
JIM FALLS HYDRO
FERC PROJECT NO. 2491
CHIPPEWA COUNTY WISCONSIN
POWERHOUSE TRANSVERSE SECTION
SCALE: 3/32" = 1'-0"
JULY 10, 1989
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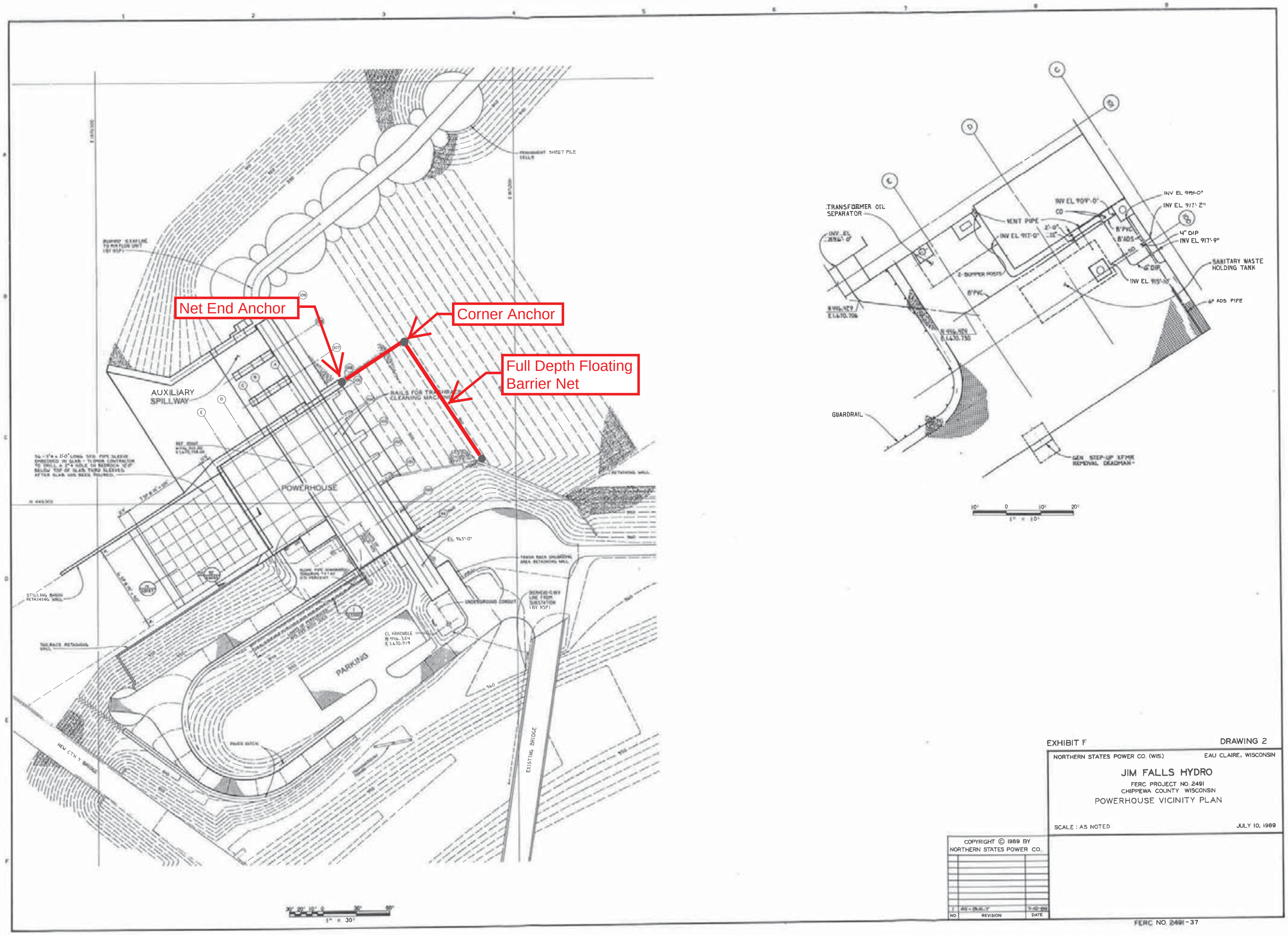
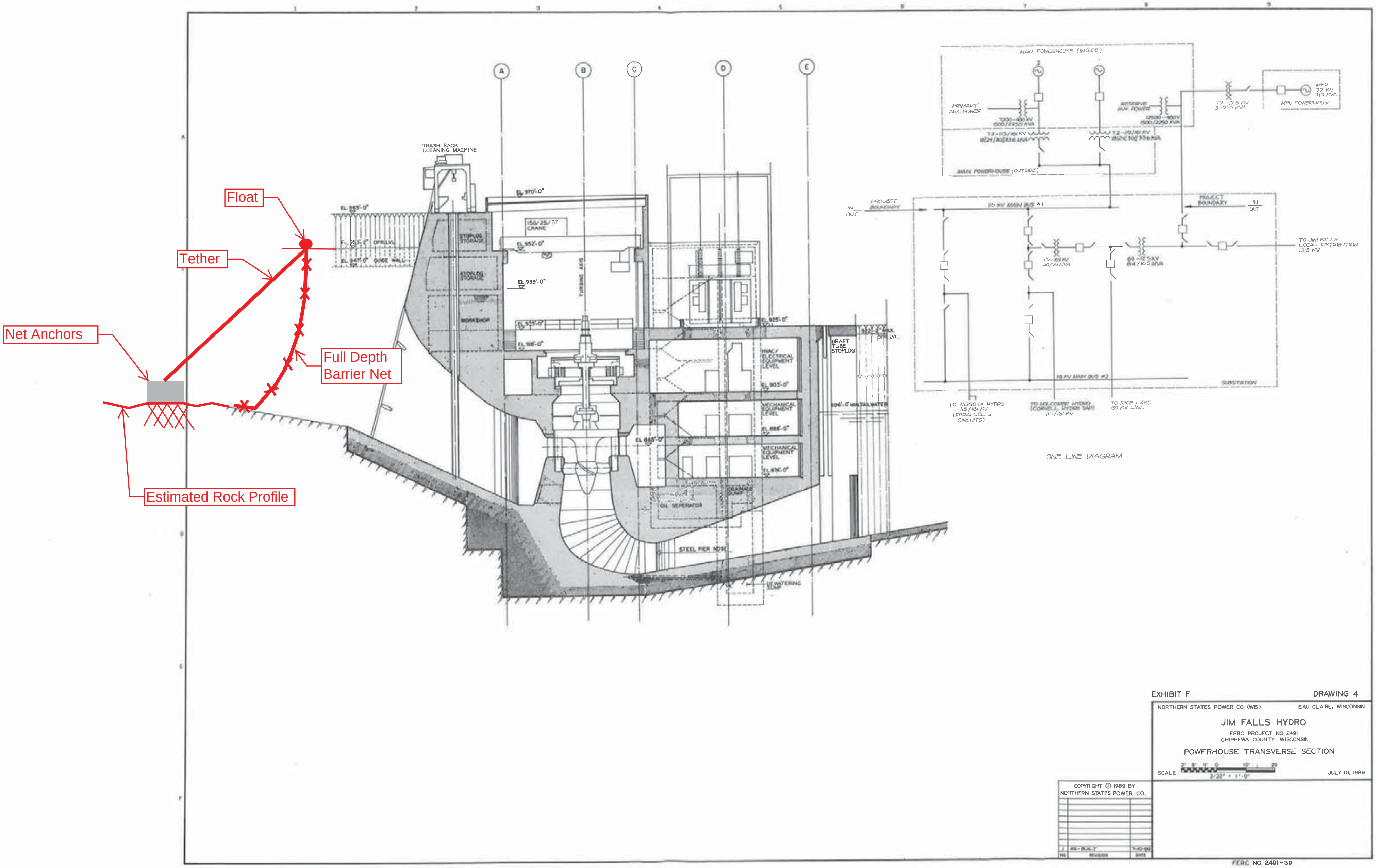
AS-BUILT
FERC NO. 2491-39

JIM FALLS

FLOATING BARRIER NET



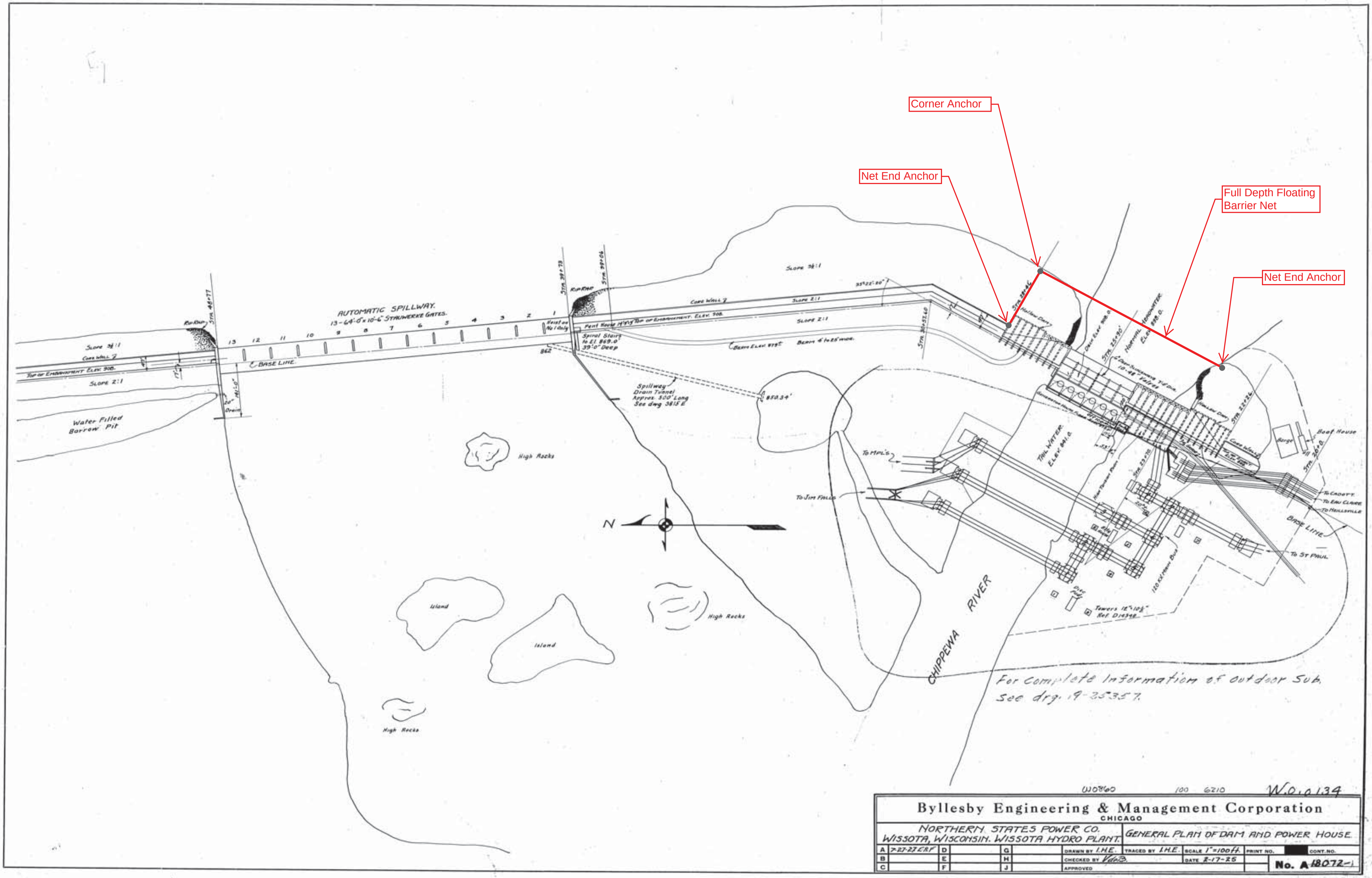
Net End Anchor
Corner Anchor
Full Depth Floating Barrier Net
AUXILIARY SPILLWAY
POWERHOUSE
RAILS FOR TRASHRACK CLEANING MACHINE
PARKING
EXISTING BRIDGE
NEW CTH 'Y' BRIDGE
TRANSFORMER OIL SEPARATOR
VENT PIPE
SANITARY WASTE HOLDING TANK
GUARDRAIL
GEN. STEP-UP XFMR REMOVAL DEADMAN
1" = 30'
1" = 10'
EXHIBIT F
DRAWING 2
NORTHERN STATES POWER CO. (WIS.)
EAU CLAIRE, WISCONSIN
JIM FALLS HYDRO
FERC PROJECT NO. 2491
CHIPPEWA COUNTY WISCONSIN
POWERHOUSE VICINITY PLAN
SCALE : AS NOTED
JULY 10, 1989
COPYRIGHT © 1989 BY NORTHERN STATES POWER CO.
NO
REVISION
DATE
FERC NO. 2491-37



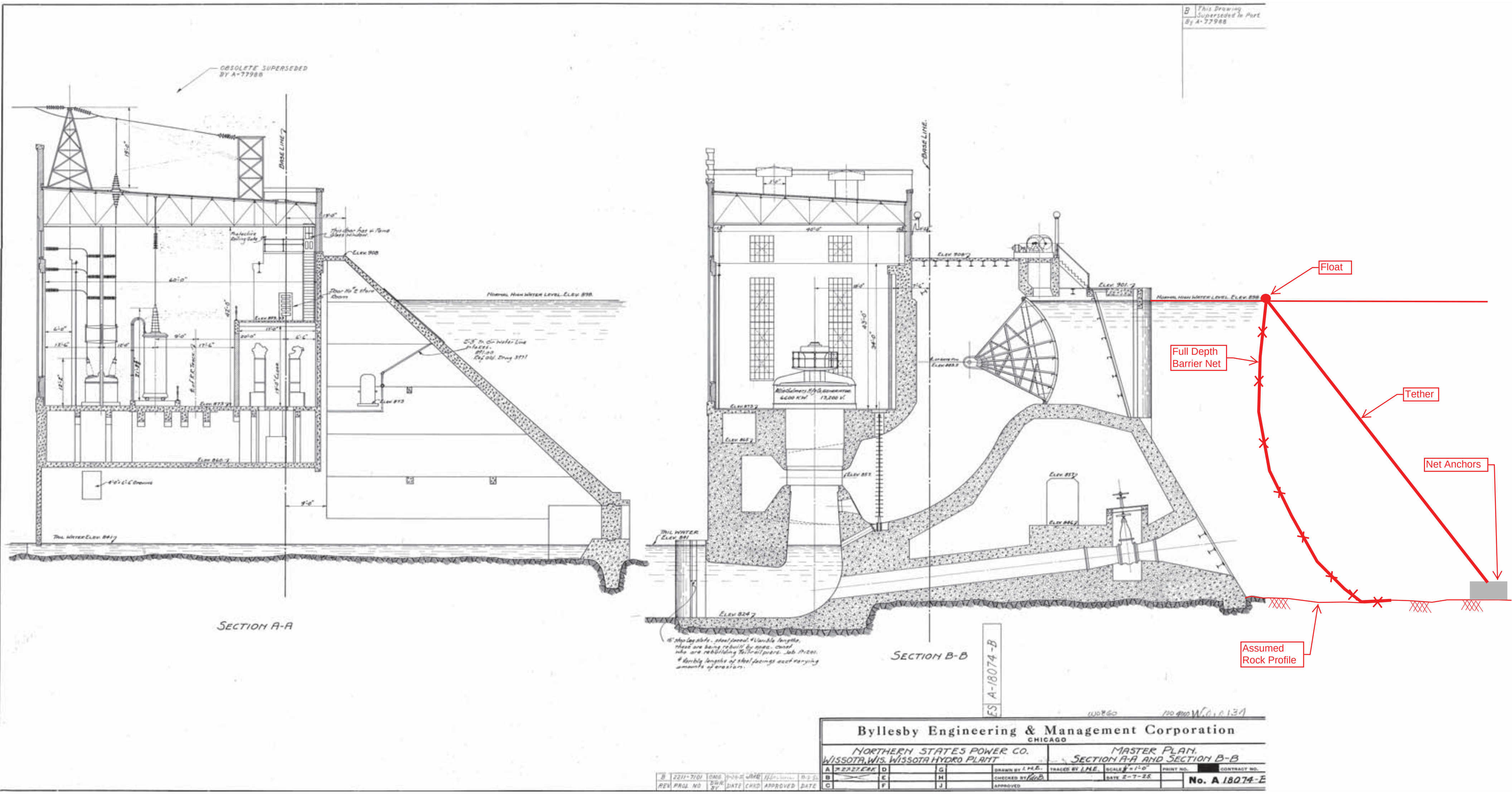
Float
Tether
Net Anchors
Full Depth Barrier Net
Estimated Rock Profile
TRASH RACK CLEANING MACHINE
150/25/5T CRANE
TURBINE AXIS
STOPLOG STORAGE
WORKSHOP
DRAFT TUBE STOPLOG
HVAC/ELECTRICAL EQUIPMENT LEVEL
MECHANICAL EQUIPMENT LEVEL
OIL SEPERATOR
DRAINAGE SUMP
STEEL PIER NOSE
DEWATERING SUMP
MAIN POWERHOUSE (INSIDE)
MAIN POWERHOUSE (OUTSIDE)
PRIMARY AUX. POWER
RESERVE AUX. POWER
MFU POWERHOUSE
PROJECT BOUNDARY
115 KV MAIN BUS #1
115 KV MAIN BUS #2
SUBSTATION
TO JIM FALLS LOCAL DISTRIBUTION 12.5 KV
TO WISSOTA HYDRO 115/161 KV (PARALLEL 2 CIRCUITS)
TO RICE LAKE 69 KV LINE
ONE LINE DIAGRAM
EXHIBIT F
DRAWING 4
NORTHERN STATES POWER CO. (WIS.)
EAU CLAIRE, WISCONSIN
JIM FALLS HYDRO
FERC PROJECT NO. 2491
CHIPPEWA COUNTY WISCONSIN
POWERHOUSE TRANSVERSE SECTION
SCALE: 3/32" = 1'-0"
JULY 10, 1989
COPYRIGHT © 1989 BY NORTHERN STATES POWER CO.
AS-BUILT
FERC NO. 2491-39

WISSOTA

FLOATING BARRIER NET



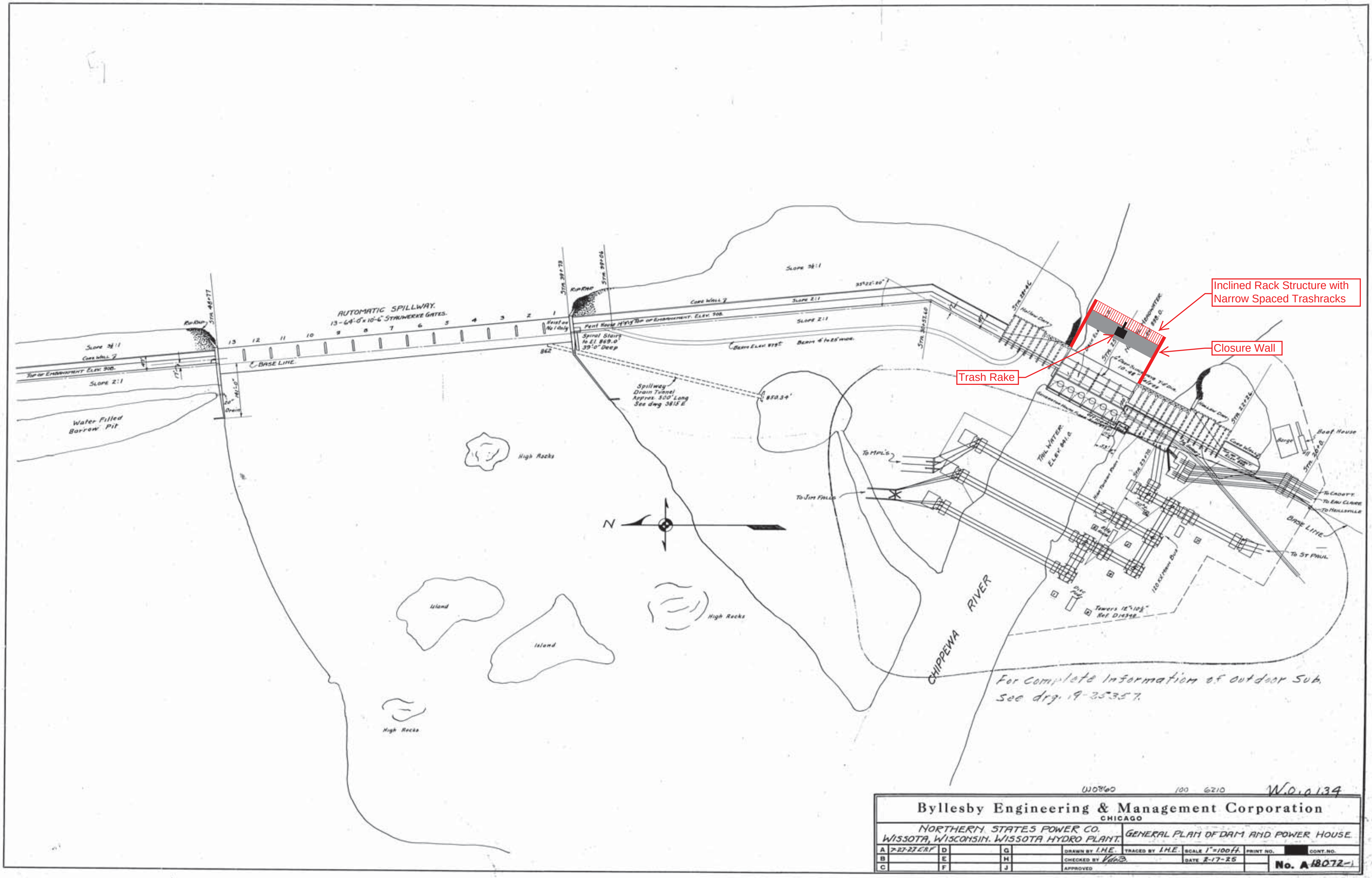
Corner Anchor
Net End Anchor
Full Depth Floating Barrier Net
Net End Anchor
AUTOMATIC SPILLWAY.
Slope 2:1
Water Filled Barrow Pit
High Rocks
Island
Island
High Rocks
High Rocks
N
CHIPPEWA RIVER
Tailwater Elev. 841.0
Boat House
Barge
To Cadott
To Eau Claire
To Neillsville
Base Line
To St Paul
To Mpls
To Jim Falls
For complete information of outdoor Sub. see drg. 19-25357.
W.O. 0134
Byllesby Engineering & Management Corporation
CHICAGO
NORTHERN STATES POWER CO.
WISSOTA, WISCONSIN. WISSOTA HYDRO PLANT.
GENERAL PLAN OF DAM AND POWER HOUSE.
SCALE 1"=100 ft.
DATE 2-17-25
No. A 18072-1



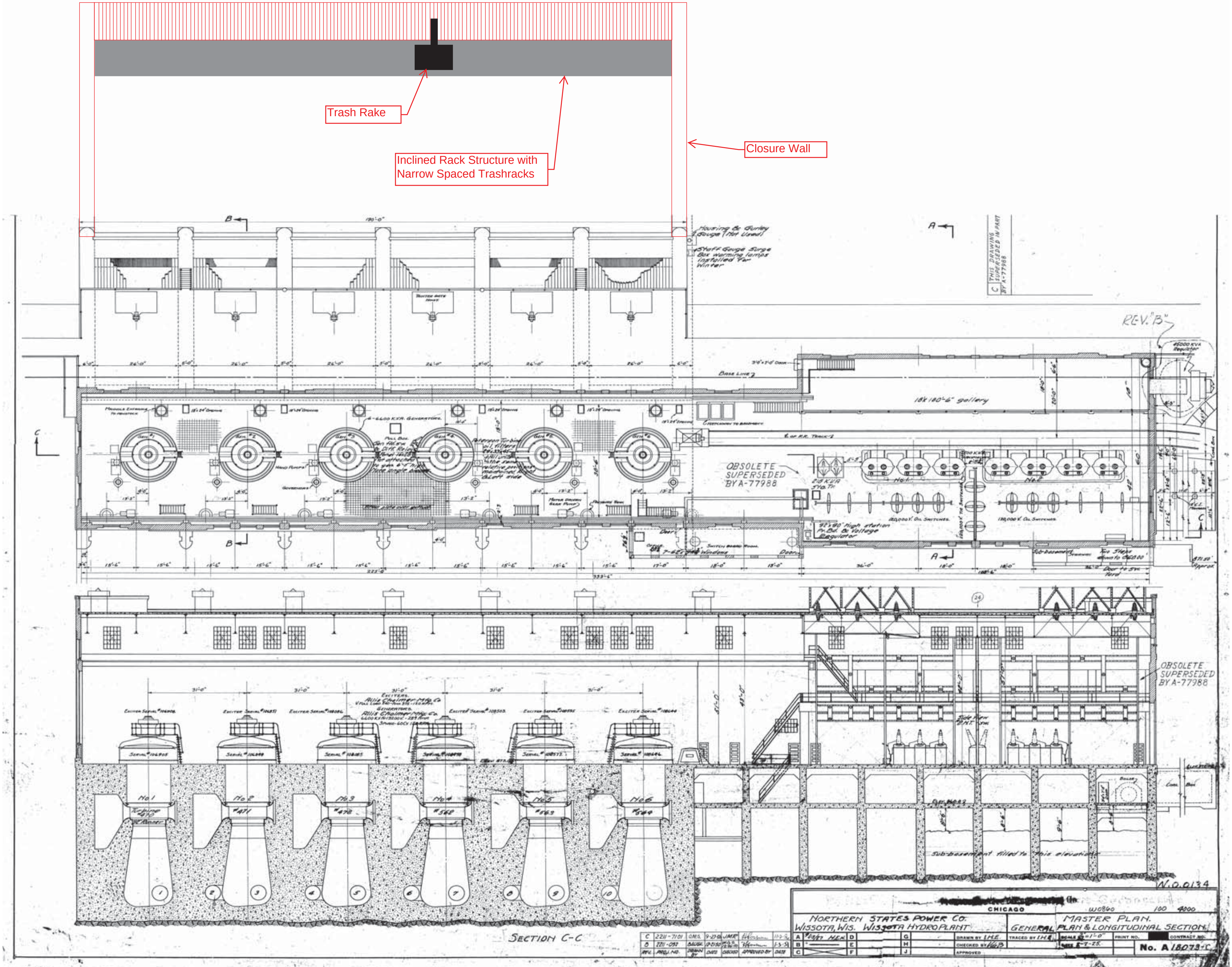
OBSOLETE SUPERSEDED BY A-77988
B This Drawing Superseded in Part By A-77988
SECTION A-A
SECTION B-B
NORMAL HIGH WATER LEVEL ELEV. 898
TAIL WATER ELEV. 841
BASE LINE
ELEV. 908
ELEV. 901
ELEV. 824
Allis Chalmers Hydro Generator 6600 KW 13,200 V.
Float
Full Depth
Barrier Net
Tether
Net Anchors
Assumed
Rock Profile
A-18074-B
Byllesby Engineering & Management Corporation
CHICAGO
NORTHERN STATES POWER CO.
WISSOTA, WIS. WISSOTA HYDRO PLANT
MASTER PLAN.
SECTION A-A AND SECTION B-B
DRAWN BY L.M.E.
TRACED BY L.M.E.
DATE 2-7-25
PRINT NO.
CONTRACT NO.
No. A 18074-B

WISSOTA

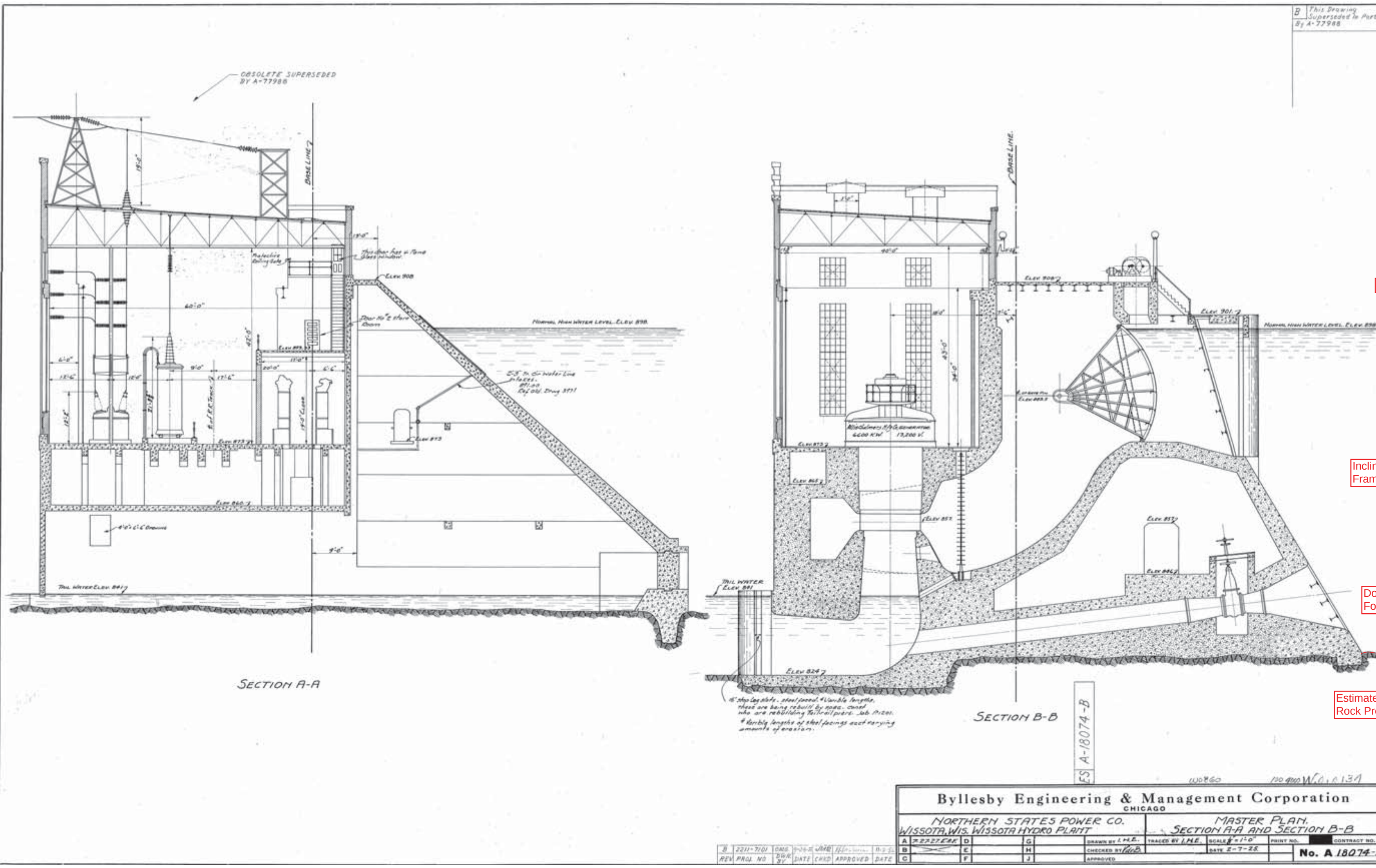
INCLINED BAR RACK WITH NARROWLY SPACED BARS



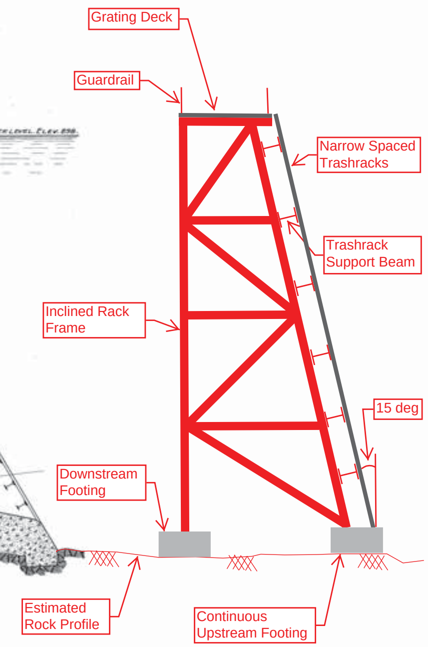
Inclined Rack Structure with Narrow Spaced Trashracks
Closure Wall
Trash Rake
AUTOMATIC SPILLWAY.
13 - 64'-0" x 10'-6" STRAUWERKE GATES.
BASE LINE.
Water Filled Barrow Pit
High Rocks
Island
Island
High Rocks
High Rocks
N
CHIPPEWA RIVER
TAILWATER ELEV. 841.0
To MPL's
To Jim Falls
To St Paul
Base Line
Boat House
Barge
Towers 12'-10½" Ref. D14348
For complete information of outdoor Sub. see drg. 19-25357.
W0860
100 6210
W.O. 0134
Byllesby Engineering & Management Corporation
CHICAGO
NORTHERN STATES POWER CO.
WISSOTA, WISCONSIN. WISSOTA HYDRO PLANT.
GENERAL PLAN OF DAM AND POWER HOUSE.
DRAWN BY I.H.E.
TRACED BY I.H.E.
SCALE 1"=100 ft.
PRINT NO.
CONT. NO.
CHECKED BY
DATE 2-17-25
APPROVED
No. A 18072-1



Trash Rake
Inclined Rack Structure with Narrow Spaced Trashracks
Closure Wall
18x180'-6" gallery
REV. "B"
OBSOLETE SUPERSEDED BY A-77988
OBSOLETE SUPERSEDED BY A-77988
SECTION C-C
CHICAGO
NORTHERN STATES POWER CO.
WISSOTA, WIS. WISSOTA HYDRO PLANT
MASTER PLAN.
GENERAL PLAN & LONGITUDINAL SECTION
No. A 18073-C



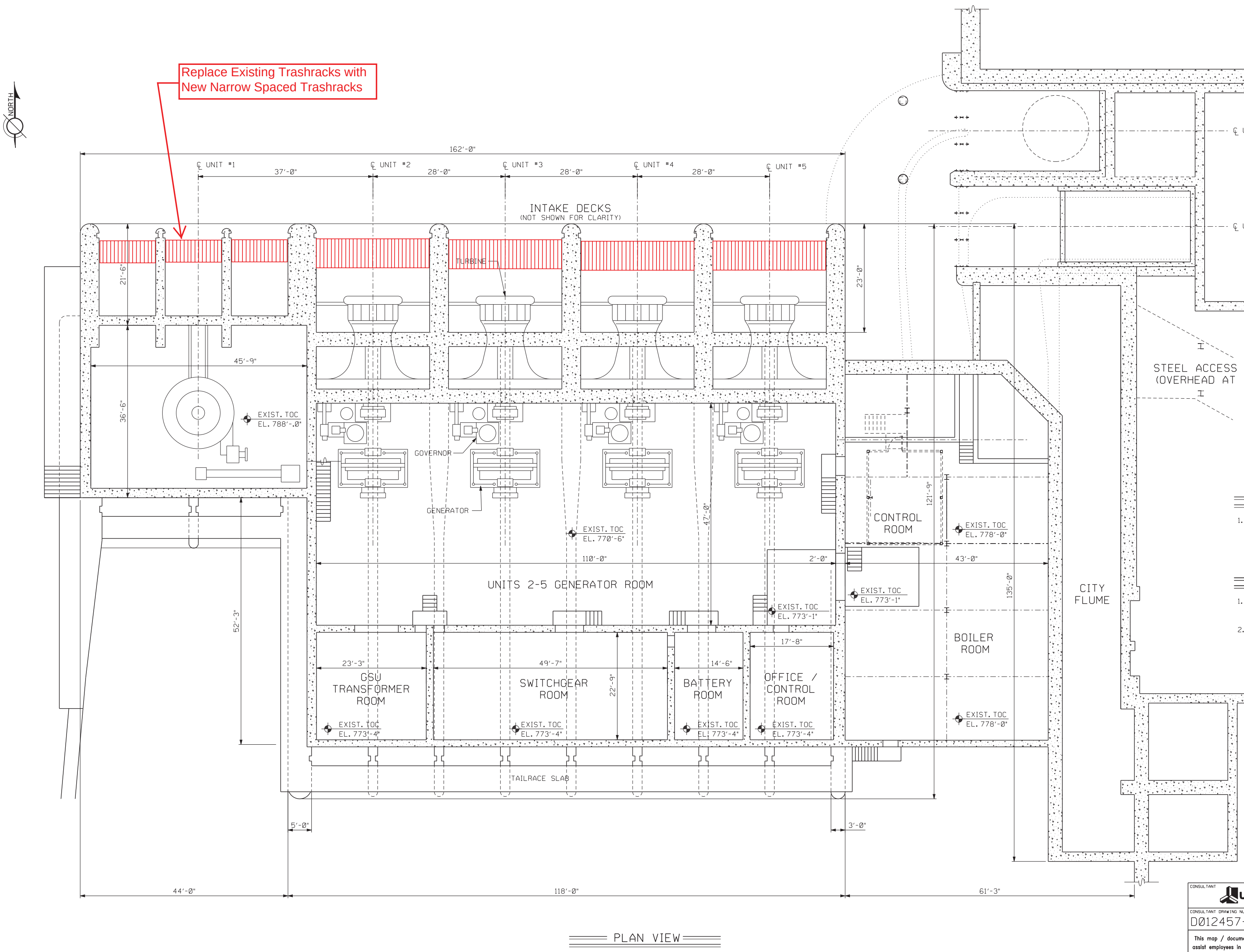
This Drawing Superseded in Part By A-77988
OBSOLETE SUPERSEDED BY A-77988
BASE LINE
ELEV. 908
NORMAL HIGH WATER LEVEL ELEV. 898
TAIL WATER ELEV. 841
SECTION A-A
TAIL WATER ELEV. 881
ELEV. 824
SECTION B-B
A-18074-B
Byllesby Engineering & Management Corporation
CHICAGO
NORTHERN STATES POWER CO.
WISSOTA, WIS. WISSOTA HYDRO PLANT
MASTER PLAN.
SECTION A-A AND SECTION B-B
DRAWN BY L.M.E.
TRACED BY L.M.E.
CHECKED BY
APPROVED
SCALE
DATE 2-7-25
PRINT NO.
CONTRACT NO.
No. A 18074-B



Grating Deck
Guardrail
Narrow Spaced Trashracks
Trashrack Support Beam
Inclined Rack Frame
15 deg
Downstream Footing
Estimated Rock Profile
Continuous Upstream Footing

DELLS

REPLACE EXISTING TRASHRACKS WITH NEW NARROWLY SPACED TRASHRACKS



PLAN VIEW

GENERAL NOTES

1. DIMENSIONS SHOWN ARE BASED UPON INFORMATION IN EXISTING PLANT DRAWINGS. CONTRACTOR IS RESPONSIBLE TO VERIFY ALL DIMENSIONS.

REFERENCE DRAWINGS

1. DELLS REPOWERING PROJECT: INDEX SHEET NH-211950 (D012457-LSIL10001, SHT 01)
2. DELLS REPOWERING PROJECT: GENERAL CONSTRUCTION NOTES NH-211951 (D012457-LSIL10002, SHT 01)

REVISIONS

0 ISSUED FOR CONSTRUCTION

DRAWN:
DESIGNED: (ENG'R)
CHECKED: (DES'R)
CHECKED: (ENG'R)
X (SIGNED)
APPROVED: (ENG'R)
X (SIGNED)
APPROVED: (PROJ MGR)
DATE:
REG. NO.:
UE PROJECT #: 012457

UTILITY ENGINEERING

WISCONSIN PROFESSIONAL ENGINEER PETERSON MICHAEL E-38169 MINNEAPOLIS, MINNESOTA

CONSULTANT: UTILITY ENGINEERING — HEADQUARTERS - DENVER, COLORADO; AMARILLO, TEXAS; MINNEAPOLIS, MINNESOTA; OMAHA, NEBRASKA

CONSULTANT DRAWING NUMBER: D012457-LSIL10003 | SHEET: 01 | REV: 0

This map / document is a tool to assist employees in the performance of their jobs. Your personal safety is provided for by using safety practices, procedures and equipment as described in safety training programs, manuals and SPAR's.

SIGNIFICANT NO.							
GROUP	1	2	3	4	5A	5B	6

UNITS 2-5 CIVIL & MECH CONSTRUCTION
POWERHOUSE GENERAL ARRANGEMENT
EXISTING PLAN

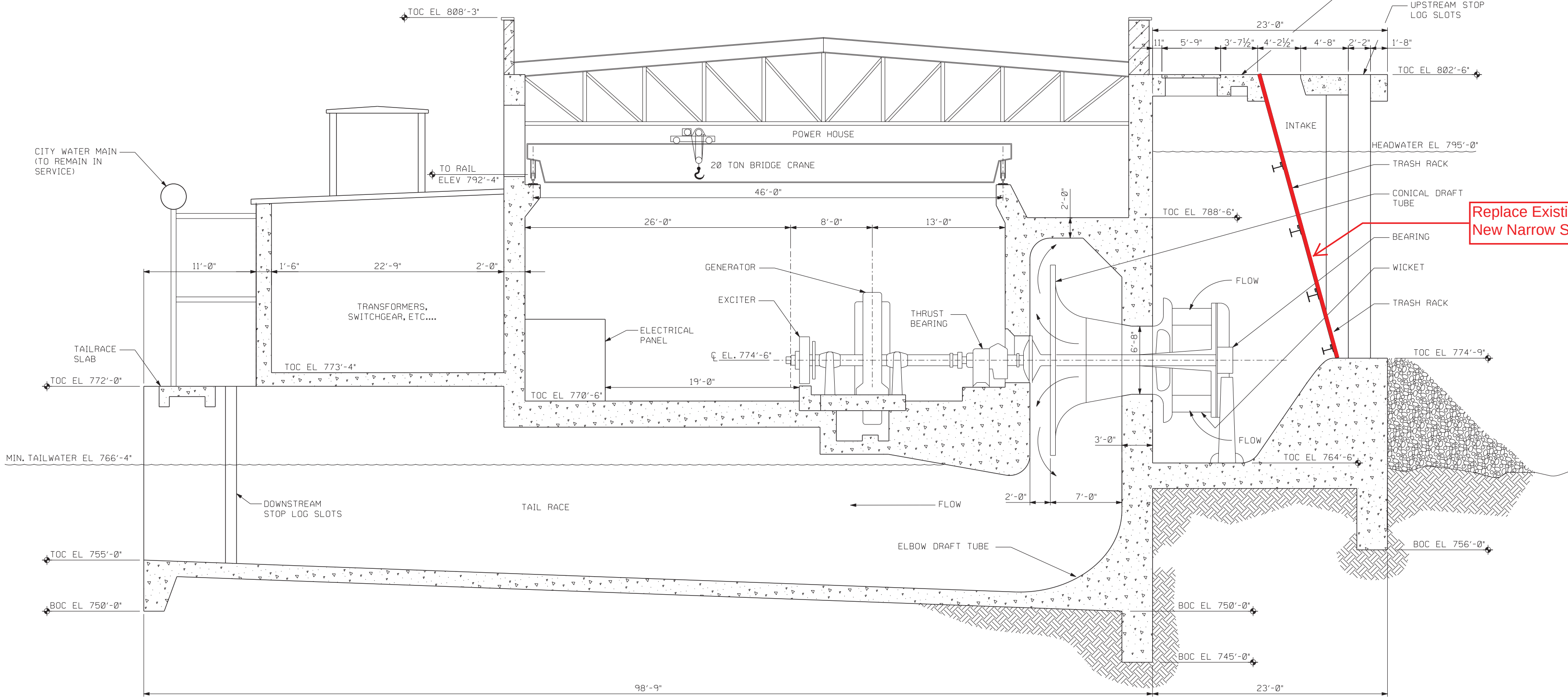
NORTHERN STATES POWER COMPANY
DELLS HYDRO GENERATING PLANT
EAU CLAIRE, WISCONSIN

Xcel Energy

SCALE | NH-211952 | REV

FILE NAME.DGN NSP GENERATION CAD

$$USERNAME$$
$$$$$$SYTIME$$$$$$ $$$$$$SYDATE$$$$$$
$$$$$$$$$DESIGNFIL$$$$$$$$$



SECTION (2)

LEGEND

- EXISTING CONCRETE
- UNDISTURBED BEDROCK
- ROCK FILL

REFERENCE DRAWINGS

1. DELLS REPOWERING PROJECT: INDEX SHEET NH-211950 (D012457-LSIL10001), SHT 01)
2. DELLS REPOWERING PROJECT: GENERAL CONSTRUCTION NOTES NH-211951 (D012457-LSIL10002), SHT 01)

REVISIONS

0 ISSUED FOR CONSTRUCTION

DRAWN:
DESIGNED: (ENG'R)
CHECKED: (DES'R)
CHECKED: (ENG'R)
X (SIGNED)
APPROVED: (ENG'R)
X (SIGNED)
APPROVED: (PROJ MGR)
DATE:
REG. NO.:
UE PROJECT #: 012457

UTILITY ENGINEERING

WISCONSIN PROFESSIONAL ENGINEER — PETERSON MICHAEL E-38169 MINNEAPOLIS, MINNESOTA

CONSULTANT: UTILITY ENGINEERING — HEADQUARTERS - DENVER, COLORADO; AMARILLO, TEXAS; MINNEAPOLIS, MINNESOTA; OMAHA, NEBRASKA

CONSULTANT DRAWING NUMBER: D012457-LSIL12001 SHEET 01 REV 0

This map / document is a tool to assist employees in the performance of their jobs. Your personal safety is provided for by using safety practices, procedures and equipment as described in safety training programs, manuals and SPAR's.

SIGNIFICANT NO.							
GROUP	1	2	3	4	5A	5B	6

UNITS 2-5 CIVIL & MECH CONSTRUCTION
EXISTING UNITS 2-5
SECTION

NORTHERN STATES POWER COMPANY
DELLS HYDRO GENERATING PLANT
EAU CLAIRE, WISCONSIN

Xcel Energy

SCALE
NH-211954
REV

FILE NAME.DGN NSP GENERATION CAD

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$$$$$$$$$DESIGNFIL$$$$$$$$$

Figure SDR-2 (b)

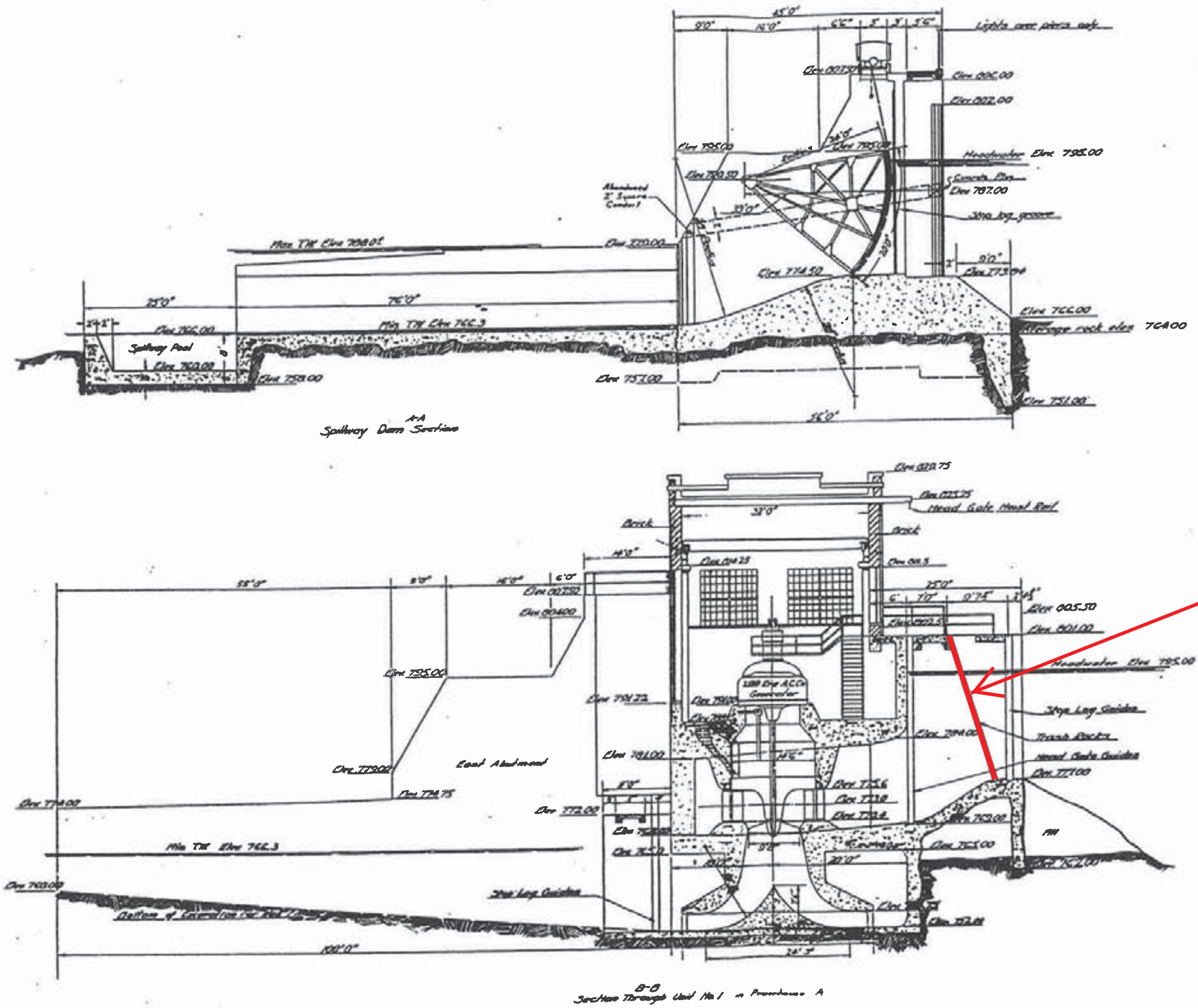


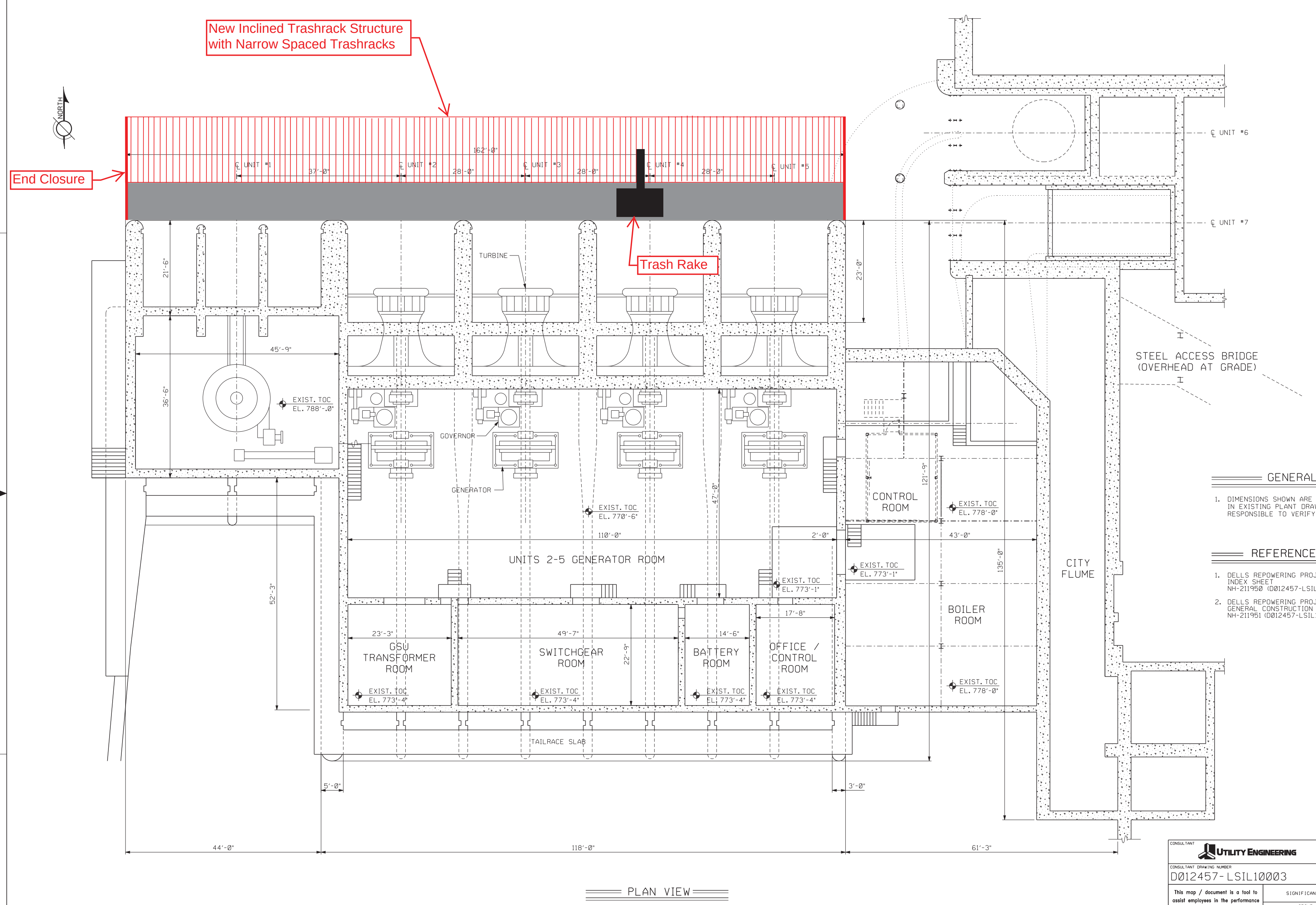
EXHIBIT F-2

THE CITY OF EAU CLAIRE, WISCONSIN AND NORTHERN STATES POWER COMPANY (WISCONSIN)
DELLS HYDRO
FERC PROJECT NO. 2670
SECTIONS OF SPILLWAY AND UNIT #1 IN POWERHOUSE A

3

DELLS

INCLINED BAR RACK WITH NARROWLY SPACED BARS



PLAN VIEW

GENERAL NOTES

1. DIMENSIONS SHOWN ARE BASED UPON INFORMATION IN EXISTING PLANT DRAWINGS. CONTRACTOR IS RESPONSIBLE TO VERIFY ALL DIMENSIONS.

REFERENCE DRAWINGS

1. DELLS REPOWERING PROJECT;
   INDEX SHEET
   NH-211950 (D012457-LSIL10001, SHT 01)
2. DELLS REPOWERING PROJECT;
   GENERAL CONSTRUCTION NOTES
   NH-211951 (D012457-LSIL10002, SHT 01)

REVISIONS

0

ISSUED FOR CONSTRUCTION

DRAWN:
DESIGNED: (ENG'R)
CHECKED: (DES'R)
CHECKED: (ENG'R)

X
(SIGNED)
APPROVED: (ENG'R)

X
(SIGNED)
APPROVED: (PROJ MGR)

DATE:
REG. NO.:
UE PROJECT #: 012457

UTILITY ENGINEERING

WISCONSIN PROFESSIONAL ENGINEER
PETERSON MICHAEL E-38169 MINNEAPOLIS, MINNESOTA

CONSULTANT
UTILITY ENGINEERING
HEADQUARTERS - DENVER, COLORADO
AMARILLO, TEXAS
MINNEAPOLIS, MINNESOTA
OMAHA, NEBRASKA

CONSULTANT DRAWING NUMBER: D012457-LSIL10003 | SHEET: 01 | REV: 0

This map / document is a tool to assist employees in the performance of their jobs. Your personal safety is provided for by using safety practices, procedures and equipment as described in safety training programs, manuals and SPAR's.

SIGNIFICANT NO.							
GROUP	1	2	3	4	5A	5B	6

UNITS 2-5 CIVIL & MECH CONSTRUCTION
POWERHOUSE GENERAL ARRANGEMENT
EXISTING PLAN

NORTHERN STATES POWER COMPANY
DELLS HYDRO GENERATING PLANT
EAU CLAIRE, WISCONSIN

Xcel Energy

SCALE | NH-211952 | REV

$$USERNAME$$
$$$$$$SYTIME$$$$$$ $$$$$$SYDATE$$$$$$
$$$$$$$$$DESIGNFIL$$$$$$$$$

FILE NAME.DGN NSP GENERATION CAD

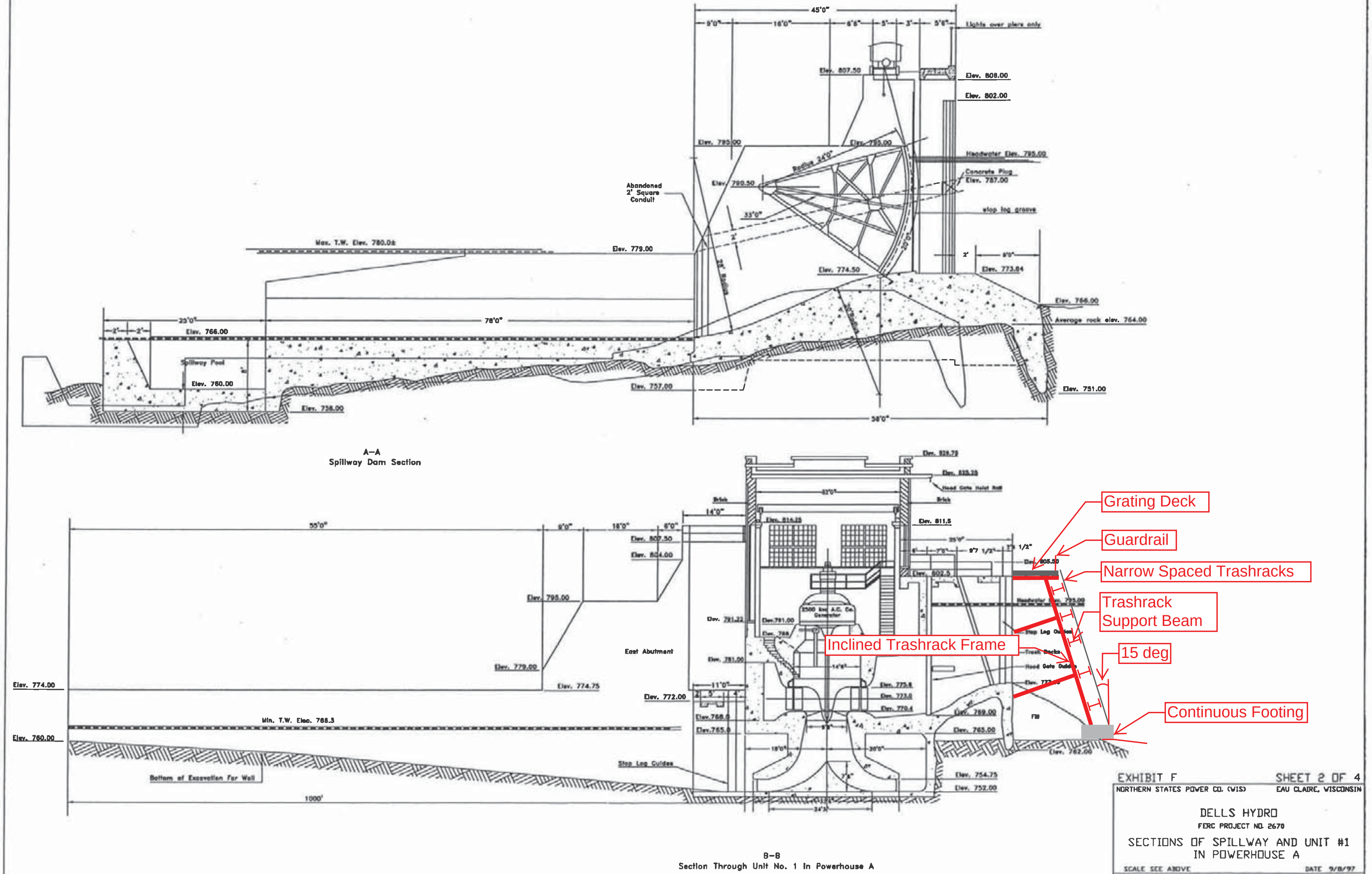


EXHIBIT F SHEET 2 OF 4

NORTHERN STATES POWER CO. (WIS) EAU CLAIRE, WISCONSIN

DELLS HYDRO

FERC PROJECT NO. 2670

SECTIONS OF SPILLWAY AND UNIT #1 IN POWERHOUSE A

SCALE SEE ABOVE DATE 9/8/97

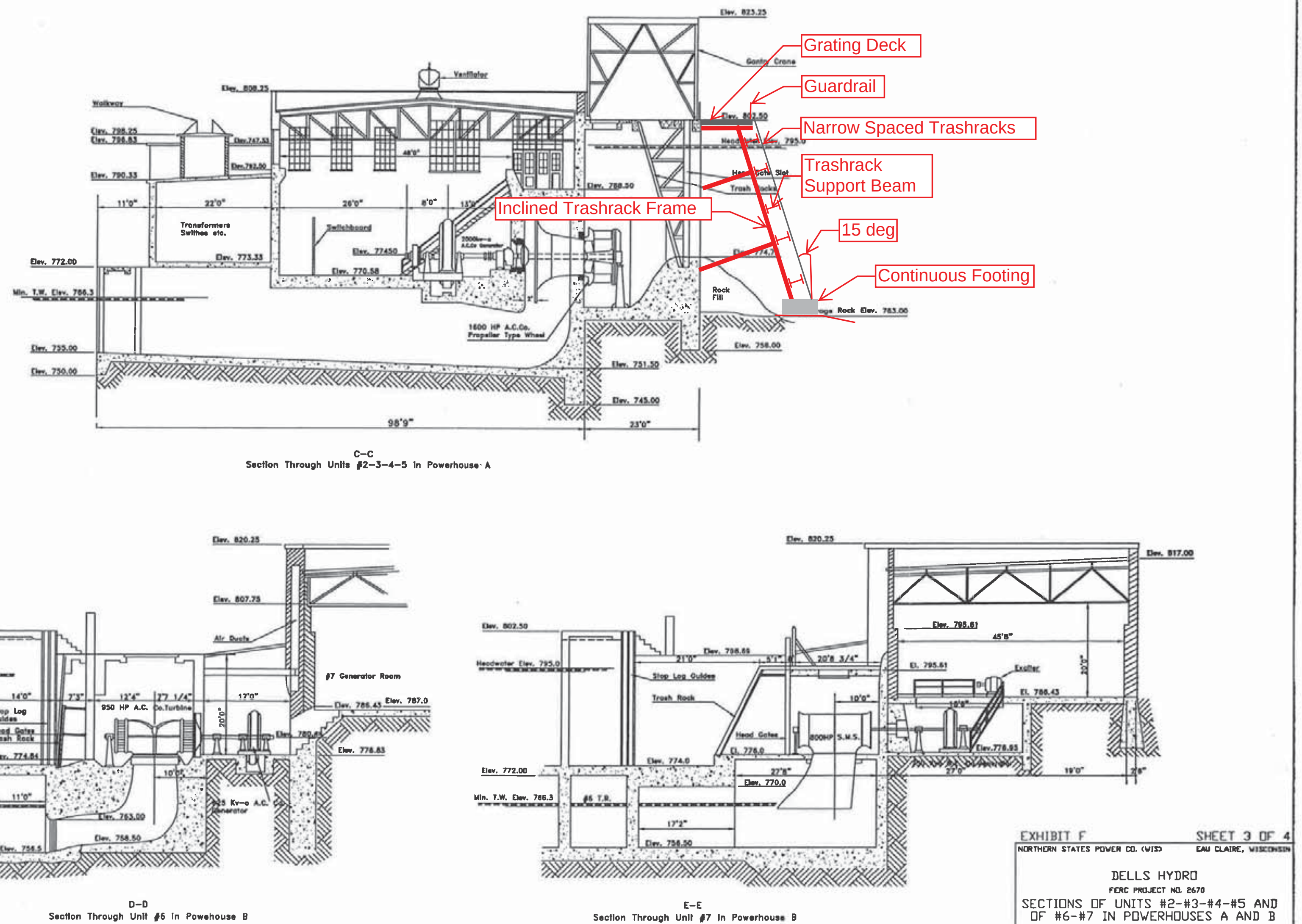


EXHIBIT F

SHEET 3 OF 4

NORTHERN STATES POWER CO. (WIS) EAU CLAIRE, WISCONSIN

DELLS HYDRO

FERC PROJECT NO. 2670

SECTIONS OF UNITS #2-#3-#4-#5 AND OF #6-#7 IN POWERHOUSES A AND B

SCALE SEE ABOVE DATE 9-8-97

APPENDIX G

OPINIONS OF PROBABLE CONSTRUCTION COST

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
HOLCOMB OPTION 1 - CLOSE SPACED BAR RACKS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 159,500
1	MOBILIZATION/DEMOBILIZATION		10%	$ 107,000	$ 107,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	0.25 MONTH	$ 50,000 /MONTH	$ 12,500	$ 12,500	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION						$ 281,000
6	REMOVE EXISTING TRASHRACKS	7800 SF	$ 10 /SF	$ 78,000	$ 78,000	
7	MODIFICATIONS TO HEADGATE GANTRY AND TRASH RAKE	1 LS	$ 200,000	$ 200,000	$ 200,000	
8	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
D. CIVIL						$ 7,950
9	REMOVE SEDIMENT AND DEBRIS AT BASE OF RACKS	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
10	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
11	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
E. CONCRETE (THIS SECTION NOT USED)						$ -
F. STRUCTURAL STEEL						$ 237,000
12	TRASHRACK PANELS	7800 SF	$ 30 /SF	$ 234,000	$ 234,000	
13	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
G. MECHANICAL						$ 300,000
14	TRASHRAKE	1 LS	$ 300,000	$ 300,000	$ 300,000	
H. ELECTRICAL						$ 188,600
15	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
16	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
17	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
18	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	
19	POWER DISTRIBUTION				$ 27,500	
	POWER CABLE & CONDUIT	1 LS	$ 20,000	$ 20,000		
	SAFETY SWITCH	1 LS	$ 4,000	$ 4,000		
	POWER PANEL AND BREAKERS	1 LS	$ 3,500	$ 3,500		
20	HOIST SERVICE & CONTROL				$ 23,100	
	HOIST & GATE ACTUATOR	1 LS	$ 18,600	$ 18,600		
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500	$ 4,500		
21	GROUNDING	1 LS	$ 10,000	$ 10,000	$ 10,000	
22	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000	$ 30,000	$ 30,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 1,174,000*	
	Contingency	25%			$ 294,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 1,468,000**	
G1	ENGINEERING & PERMITTING	12%			$ 176,000	
G2	CONSTRUCTION MONITORING	10%			$ 147,000	
	SUM OF INDIRECT COSTS				*$ 323,000*	
	Contingency	25%			$ 81,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 404,000**	
	TOTAL PROJECT COSTS				**$ 1,872,000**	
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 15,000	$ 15,000	$ 15,000	
	OPERATIONS COST (COST PER YEAR)	365 HR	$ 70 /HR	$ 25,550	$ 25,550	

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
HOLCOMB OPTION 2 - INCLINED BAR RACK STRUCTURE

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 391,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 201,000	$ 201,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	3 MONTHS	$ 50,000 /MONTH	$ 150,000	$ 150,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION						$ 281,000
6	REMOVE EXISTING TRASHRACKS	7800 SF	$ 10 /SF	$ 78,000	$ 78,000	
7	MODIFICATIONS TO HEADGATE GANTRY AND TRASH RAKE	1 LS	$ 200,000	$ 200,000	$ 200,000	
8	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
D. CIVIL						$ 10,950
9	SOIL EXCAVATION FOR UPSTREAM FOOTING	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
10	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
11	DIVERS	3 DAYS	$ 3,000 /DAY	$ 9,000	$ 9,000	
E. CONCRETE						$ 36,000
12	UPSTREAM FOOTING	40 CY	$ 600 /CY	$ 24,000	$ 24,000	
13	DIVERS	4 DAYS	$ 3,000 /DAY	$ 12,000	$ 12,000	
F. STRUCTURAL STEEL						$ 999,700
14	ANGLED SUPPORTS BEAMS (W16X50)	17800 LBS	$ 5 /LBS	$ 89,000	$ 89,000	
15	SUPPORTS BEAM BRACES (W10X30)	5400 LBS	$ 5 /LBS	$ 27,000	$ 27,000	
16	RACK SUPPORTS (W18X50)	39900 LBS	$ 5 /LBS	$ 199,500	$ 199,500	
17	BOTTOM RACK SUPPORT (L6X6X3/8)	2700 LBS	$ 5 /LBS	$ 13,500	$ 13,500	
18	TRASHRACK PANELS	7400 SF	$ 60 /SF	$ 444,000	$ 444,000	
19	END CLOSURE TRASHRACK PANELS	600 SF	$ 60 /SF	$ 36,000	$ 36,000	
20	GRATING SUPPORTS (W12X30)	9300 LBS	$ 5 /LBS	$ 46,500	$ 46,500	
21	GRATING	850 SF	$ 37 /SF	$ 31,450	$ 31,450	
22	GUARDRAIL	150 FT	$ 45 /FT	$ 6,750	$ 6,750	
23	TRASH RAKE SUPPORT RAILS	3200 LBS	$ 5 /LBS	$ 16,000	$ 16,000	
24	DIVERS	30 DAYS	$ 3,000 /DAY	$ 90,000	$ 90,000	
G. MECHANICAL						$ 300,000
25	TRASHRAKE	1 LS	$ 300,000	$ 300,000	$ 300,000	
H. ELECTRICAL						$ 188,600
26	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
27	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
28	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
28	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	
29	POWER DISTRIBUTION				$ 27,500	
	POWER CABLE & CONDUIT	1 LS	$ 20,000	$ 20,000		
	SAFETY SWITCH	1 LS	$ 4,000	$ 4,000		
	POWER PANEL AND BREAKERS	1 LS	$ 3,500	$ 3,500		
30	HOIST SERVICE & CONTROL				$ 23,100	
	HOIST & GATE ACTUATOR	1 LS	$ 18,600	$ 18,600		
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500	$ 4,500		
31	GROUNDING	1 LS	$ 10,000	$ 10,000	$ 10,000	

32	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000	$ 30,000	$ 30,000
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 2,207,000*
	Contingency	25%			$ 552,000
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 2,759,000**
G1	ENGINEERING & PERMITTING	12%			$ 331,000
G2	CONSTRUCTION MONITORING	10%			$ 276,000
	SUM OF INDIRECT COSTS				*$ 607,000*
	Contingency	25%			$ 152,000
	SUBTOTAL OF INDIRECT COSTS				**$ 759,000**
	TOTAL PROJECT COSTS				**$ 3,518,000**
OPERATIONS AND MAINTENANCE					
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 40,000	$ 40,000	$ 40,000
	OPERATIONS COST (COST PER YEAR)	365 HR	$ 70 /HR	$ 25,550	$ 25,550

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
HOLCOMB OPTION 3 - FULL DEPTH BARRIER NET

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 151,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 61,000	$ 61,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	1 MONTH	$ 50,000 /MONTH	$ 50,000	$ 50,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION (THIS SECTION NOT USED)						$ -
D. CIVIL						$ 7,950
6	RIVER BOTTOM PREP	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
7	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
8	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
E. CONCRETE						$ 48,000
9	PRECAST CONCRETE NET BOTTOM ANCHORS	25 CY	$ 600 /CY	$ 15,000	$ 15,000	
10	PRECAST CONCRETE NET CORNER ANCHOR	5 CY	$ 600 /CY	$ 3,000	$ 3,000	
11	DIVERS	10 DAYS	$ 3,000 /DAY	$ 30,000	$ 30,000	
F. STRUCTURAL STEEL						$ 8,000
12	NET END ANCHORS	1000 LBS	$ 5 /LBS	$ 5,000	$ 5,000	
13	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
G. BARRIER NET						$ 458,000
14	NET	11000 SF	$ 40 /SF	$ 440,000	$ 440,000	
15	DIVERS	6 DAYS	$ 3,000 /DAY	$ 18,000	$ 18,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 673,000*	
	Contingency	25%			$ 168,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 841,000**	
G1	ENGINEERING & PERMITTING	12%			$ 101,000	
G2	CONSTRUCTION MONITORING	10%			$ 84,000	
	SUM OF INDIRECT COSTS				*$ 185,000*	
	Contingency	25%			$ 46,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 231,000**	
	TOTAL PROJECT COSTS				**$ 1,072,000**	
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 50,000	$ 50,000	$ 50,000	
	OPERATIONS COST (DIVERS COST PER YEAR)	10 DAYS	$ 3,000 /DAY	$ 30,000	$ 30,000	

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
CORNELL OPTION 1 - CLOSE SPACED BAR RACKS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
	A. GENERAL					$ 121,500
1	MOBILIZATION/DEMOBILIZATION		10%	$ 69,000	$ 69,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	0.25 MONTH	$ 50,000 /MONTH	$ 12,500	$ 12,500	
	B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)					$ -
	C. DEMOLITION					$ 37,000
6	REMOVE EXISTING TRASHRACKS	3400 SF	$ 10 /SF	$ 34,000	$ 34,000	
7	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
	D. CIVIL					$ 7,950
8	REMOVE SEDIMENT AND DEBRIS AT BASE OF RACKS	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
9	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
10	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
	E. CONCRETE (THIS SECTION NOT USED)					$ -
	F. STRUCTURAL STEEL					$ 102,000
11	TRASHRACK PANELS	3300 SF	$ 30 /SF	$ 99,000	$ 99,000	
12	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
	G. MECHANICAL					$ 300,000
13	TRASH RAKE	1 LS	$ 300,000	$ 300,000	$ 300,000	
	H ELECTRICAL					$ 188,600
14	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
15	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
16	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
17	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	
18	POWER DISTRIBUTION				$ 27,500	
	POWER CABLE & CONDUIT	1 LS	$ 20,000	$ 20,000		
	SAFETY SWITCH	1 LS	$ 4,000	$ 4,000		
	POWER PANEL AND BREAKERS	1 LS	$ 3,500	$ 3,500		
19	HOIST SERVICE & CONTROL				$ 23,100	
	HOIST & GATE ACTUATOR	1 LS	$ 18,600	$ 18,600		
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500	$ 4,500		
20	GROUNDING	1 LS	$ 10,000	$ 10,000	$ 10,000	
21	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000	$ 30,000	$ 30,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 757,000*	
	Contingency	25%			$ 189,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 946,000**	
G1	ENGINEERING & PERMITTING	12%			$ 114,000	
G2	CONSTRUCTION MONITORING	10%			$ 95,000	
	SUM OF INDIRECT COSTS				*$ 209,000*	
	Contingency	25%			$ 52,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 261,000**	
	TOTAL PROJECT COSTS				**$ 1,207,000**	
	OPERATIONS AND MAINTENANCE					
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 15,000	$ 15,000	$ 15,000	
	OPERATIONS COST (COST PER YEAR)	365 HR	$ 70 /HR	$ 25,550	$ 25,550	

NOTES:

1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
CORNELL OPTION 2 - ANGLED BAR RACK STRUCTURE

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 923,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 398,000	$ 398,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 20,000	$ 20,000	$ 20,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	9 MONTHS	$ 50,000 /MONTH	$ 450,000	$ 450,000	
6	BARGE MOBILIZATION/DEMOBILIZATION	1 LS	$ 5,000	$ 5,000	$ 5,000	
7	BARGE	1 MONTH	$ 15,000 /MONTH	$ 15,000	$ 15,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION						$ 29,000
8	MODIFICATIONS TO THE EXISTING INTAKE STRUCTURE	1 LS	$ 20,000	$ 20,000	$ 20,000	
9	DIVERS	3 DAYS	$ 3,000 /DAY	$ 9,000	$ 9,000	
D. CIVIL						$ 99,300
10	SOIL EXCAVATION FOR RETAINING WALL EXTENSION	1500 CY	$ 26 /CY	$ 39,000	$ 39,000	
11	FILL BEHIND RETAINING WALL	400 CY	$ 5 /CY	$ 2,000	$ 2,000	
12	SOIL EXCAVATION FOR ANGLED BAR RACK UPSTREAM FOOTING	150 CY	$ 26 /CY	$ 3,900	$ 3,900	
13	SOIL EXCAVATION FOR ANGLED BAR RACK DOWNSTREAM FOOTING	150 CY	$ 26 /CY	$ 3,900	$ 3,900	
14	HAULING	2750 CY	$ 10 /CY	$ 27,500	$ 27,500	
15	GRADING AND SEEDING	1 LS	$ 5,000	$ 5,000	$ 5,000	
16	DIVERS	6 DAYS	$ 3,000 /DAY	$ 18,000	$ 18,000	
E. CONCRETE						$ 544,000
17	UPSTREAM ANGLED BAR RACK FOOTING	80 CY	$ 600 /CY	$ 48,000	$ 48,000	
18	DOWNSTREAM ANGLED BAR RACK FOOTINGS	70 CY	$ 600 /CY	$ 42,000	$ 42,000	
19	VERTICAL ROCK ANCHORS	60 EA	$ 600 /EA	$ 36,000	$ 36,000	
20	EXTEND EXISTING RETAINING WALL (STEM)	170 CY	$ 800 /CY	$ 136,000	$ 136,000	
21	EXTEND EXISTING RETAINING WALL (FOOTER)	170 CY	$ 600 /CY	$ 102,000	$ 102,000	
22	DIVERS	60 DAYS	$ 3,000 /DAY	$ 180,000	$ 180,000	
F. STRUCTURAL STEEL						$ 2,298,200
23	RACK PANEL GUIDES (W4X13)	26100 LBS	$ 5 /LBS	$ 130,500	$ 130,500	
24	SUPPORT COLUMNS (W16X50)	41300 LBS	$ 5 /LBS	$ 206,500	$ 206,500	
25	TRASH RAKE SUPPORT BEAMS (W24X68)	54600 LBS	$ 5 /LBS	$ 273,000	$ 273,000	
26	TRASH RACK SUPPORT BEAMS (W14X48)	57800 LBS	$ 5 /LBS	$ 289,000	$ 289,000	
27	CROSS BEAMS (W14X48)	11900 LBS	$ 5 /LBS	$ 59,500	$ 59,500	
28	CROSS BEAMS (W12X26)	31300 LBS	$ 5 /LBS	$ 156,500	$ 156,500	
29	CROSS BRACE (LL6X6X1/2)	23500 LBS	$ 5 /LBS	$ 117,500	$ 117,500	
30	TOP RACK PANEL GUIDE SUPPORT (L5X3-1/2X3/8)	4200 LBS	$ 5 /LBS	$ 21,000	$ 21,000	
31	BOTTOM RACK PANEL GUIDE SUPPORT (L6X6X3/8)	6000 LBS	$ 5 /LBS	$ 30,000	$ 30,000	
32	TRASHRACK PANELS	9200 SF	$ 60 /SF	$ 552,000	$ 552,000	
33	GRATING	5500 SF	$ 37 /SF	$ 203,500	$ 203,500	
34	GUARDRAIL	760 FT	$ 45 /FT	$ 34,200	$ 34,200	
35	DIVERS	75 DAYS	$ 3,000 /DAY	$ 225,000	$ 225,000	

G. MECHANICAL										$	300,000
36	TRASHRAKE	1 LS	$	300,000.00		$	300,000	$	300,000		
L. ELECTRICAL										$	188,600
37	TRASHRAKE ELECTRIC SUPPLY	1 LS	$	10,000		$	10,000	$	10,000		
38	CONTROL PANEL	1 LS	$	20,000		$	20,000	$	20,000		
39	TRANSFORMER	1 LS	$	8,000		$	8,000	$	8,000		
40	PLC	1 LS	$	60,000		$	60,000	$	60,000		
41	POWER DISTRIBUTION							$	27,500		
	POWER CABLE & CONDUIT	1 LS	$	20,000		$	20,000				
	SAFETY SWITCH	1 LS	$	4,000		$	4,000				
	POWER PANEL AND BREAKERS	1 LS	$	3,500		$	3,500				
42	HOIST SERVICE & CONTROL							$	23,100		
	HOIST & GATE ACTUATOR	1 LS	$	18,600		$	18,600				
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$	4,500		$	4,500				
43	GROUNDING	1 LS	$	10,000		$	10,000	$	10,000		
44	MISC CABINETS, CONDUITS AND WIRES	1 LS	$	30,000		$	30,000	$	30,000		
	SUM OF DIRECT CONSTRUCTION COSTS							*$*	*4,382,000*		
	Contingency	25%						$	1,096,000		
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS							**$**	**5,478,000**		
G1	ENGINEERING & PERMITTING	12%						$	657,000		
G2	CONSTRUCTION MONITORING	10%						$	548,000		
	SUM OF INDIRECT COSTS							*$*	*1,205,000*		
	Contingency	25%						$	301,000		
	SUBTOTAL OF INDIRECT COSTS							**$**	**1,506,000**		
	TOTAL PROJECT COSTS							**$**	**6,984,000**		
OPERATIONS AND MAINTENANCE											
	MAINTENANCE COST (COST PER YEAR)	1 LS	$	80,000		$	80,000	$	80,000		
	OPERATIONS COST (COST PER YEAR)	730 HR	$	70	/HR	$	51,100	$	51,100		

NOTES:

1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
CORNELL OPTION 3 - FULL DEPTH BARRIER NET

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 233,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 88,000	$ 88,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 10,000	$ 10,000	$ 10,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	2 MONTH	$ 50,000 /MONTH	$ 100,000	$ 100,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION (THIS SECTION NOT USED)						$ -
D. CIVIL						$ 19,675
6	RIVER BOTTOM PREP	100 CY	$ 26 /CY	$ 2,600	$ 2,600	
7	HAULING	125 CY	$ 10 /CY	$ 1,250	$ 1,250	
8	DIVERS	3 DAYS	$ 3,000 /DAY	$ 9,000	$ 9,000	
9	UPSTREAM NET END ANCHOR				$ 6,825	
	EXCAVATION	70 CY	$ 20 /CY	$ 1,400		
	BACKFILL	65 CY	$ 5 /CY	$ 325		
	HAULING	10 CY	$ 10 /CY	$ 100		
	GRADING AND SEEDING	1 LS	$ 5,000	$ 5,000		
E. CONCRETE						$ 102,000
10	PRECAST CONCRETE NET BOTTOM ANCHORS	60 CY	$ 600 /CY	$ 36,000	$ 36,000	
11	PRECAST CONCRETE NET CORNER ANCHOR	5 CY	$ 600 /CY	$ 3,000	$ 3,000	
12	DIVERS	20 DAY	$ 3,000 /DAY	$ 60,000	$ 60,000	
13	PRECAST CONCRETE NET END ANCHOR	5 CY	$ 600 /CY	$ 3,000	$ 3,000	
F. STRUCTURAL STEEL						$ 8,000
14	NET END ANCHOR	1000 LBS	$ 5.00 /LBS	$ 5,000	$ 5,000	
15	DIVERS	1 DAY	$ 3,000 /DAY	$ 3,000	$ 3,000	
G. BARRIER NET						$ 604,000
16	NET	14500 SF	$ 40 /SF	$ 580,000	$ 580,000	
17	DIVERS	8 DAYS	$ 3,000 /DAY	$ 24,000	$ 24,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 967,000*	
	Contingency	25%			$ 242,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 1,209,000**	
G1	ENGINEERING & PERMITTING	12%			$ 145,000	
G2	CONSTRUCTION MONITORING	10%			$ 121,000	
	SUM OF INDIRECT COSTS				*$ 266,000*	
	Contingency	25%			$ 67,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 333,000**	
	TOTAL PROJECT COSTS				**$ 1,542,000**	
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 60,000	$ 60,000	$ 60,000	
	OPERATIONS COST (DIVERS COST PER YEAR)	10 DAYS	$ 3,000 /DAY	$ 30,000	$ 30,000	

NOTES:

1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
JIM FALLS OPTION 1 - CLOSE SPACED BAR RACKS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 189,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 99,000	$ 99,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	1 MONTH	$ 50,000 /MONTH	$ 50,000	$ 50,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION						$ 138,000
6	REMOVE EXISTING TRASHRACKS	4200 SF	$ 30 /SF	$ 126,000	$ 126,000	
7	DIVERS	4 DAY	$ 3,000 /DAY	$ 12,000	$ 12,000	
D. CIVIL						$ 7,950
8	REMOVE SEDIMENT AND DEBRIS AT BASE OF RACKS	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
9	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
10	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
E. CONCRETE (THIS SECTION NOT USED)						$ -
F. STRUCTURAL STEEL						$ 264,000
11	TRASHRACK PANELS	4200 SF	$ 60 /SF	$ 252,000	$ 252,000	
12	DIVERS	4 DAYS	$ 3,000 /DAY	$ 12,000	$ 12,000	
G. MECHANICAL						$ 300,000
13	TRASH RAKE	1 LS	$ 300,000	$ 300,000	$ 300,000	
H. ELECTRICAL						$ 188,600
14	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
15	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
16	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
17	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	
18	POWER DISTRIBUTION				$ 27,500	
	POWER CABLE & CONDUIT	1 LS	$ 20,000	$ 20,000		
	SAFETY SWITCH	1 LS	$ 4,000	$ 4,000		
	POWER PANEL AND BREAKERS	1 LS	$ 3,500	$ 3,500		
19	HOIST SERVICE & CONTROL				$ 23,100	
	HOIST & GATE ACTUATOR	1 LS	$ 18,600	$ 18,600		
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500	$ 4,500		
20	GROUNDING	1 LS	$ 10,000	$ 10,000	$ 10,000	
21	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000	$ 30,000	$ 30,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 1,088,000*	
	Contingency	25%			$ 272,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 1,360,000**	
G1	ENGINEERING & PERMITTING	12%			$ 163,000	
G2	CONSTRUCTION MONITORING	10%			$ 136,000	
	SUM OF INDIRECT COSTS				*$ 299,000*	
	Contingency	25%			$ 75,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 374,000**	
	TOTAL PROJECT COSTS				**$ 1,734,000**	
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 15,000	$ 15,000	$ 15,000	
	OPERATIONS COST (COST PER YEAR)	365 HR	$ 70 /HR	$ 25,550	$ 25,550	

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
JIM FALLS OPTION 2 - ANGLED BAR RACK STRUCTURE

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 622,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 267,000	$ 267,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 20,000	$ 20,000	$ 20,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	6 MONTHS	$ 50,000 /MONTH	$ 300,000	$ 300,000	
6	BARGE MOBILIZATION/DEMOBILIZATION	1 LS	$ 5,000	$ 5,000	$ 5,000	
7	BARGE	1 MONTH	$ 15,000 /MONTH	$ 15,000	$ 15,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						
C. DEMOLITION						$ 19,000
8	MODIFICATIONS TO THE EXISTING INTAKE STRUCTURE	1 LS	$ 10,000	$ 10,000	$ 10,000	
9	DIVERS	3 DAY	$ 3,000 /DAY	$ 9,000	$ 9,000	
D. CIVIL						$ 9,850
10	SOIL EXCAVATION FOR ANGLED BAR RACK UPSTREAM FOOTING	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
11	SOIL EXCAVATION FOR ANGLED BAR RACK DOWNSTREAM FOOTING	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
12	HAULING	125 CY	$ 10 /CY	1250	$ 1,250	
13	DIVERS	2 DAY	$ 3,000 /DAY	$ 6,000	$ 6,000	
E. CONCRETE						$ 111,000
14	UPSTREAM ANGLED BAR RACK FOOTINGS	35 CY	$ 600 /CY	$ 21,000	$ 21,000	
15	DOWNSTREAM ANGLED BAR RACK FOOTINGS	25 CY	$ 600 /CY	$ 15,000	$ 15,000	
16	VERTICAL ROCK ANCHORS	25 EA	$ 600 /EA	$ 15,000	$ 15,000	
17	DIVERS	20 DAYS	$ 3,000 /DAY	$ 60,000	$ 60,000	
F. STRUCTURAL STEEL						$ 1,666,450
18	RACK PANEL GUIDES (W4X13)	27000 LBS	$ 5 /LBS	$ 135,000	$ 135,000	
19	SUPPORT COLUMNS (W16X50)	33000 LBS	$ 5 /LBS	$ 165,000	$ 165,000	
20	TRASH RAKE SUPPORT BEAMS (W24X68)	22500 LBS	$ 5 /LBS	$ 112,500	$ 112,500	
21	TRASH RACK SUPPORT BEAMS (W14X48)	31700 LBS	$ 5 /LBS	$ 158,500	$ 158,500	
22	CROSS BEAMS (W14X48)	19800 LBS	$ 5 /LBS	$ 99,000	$ 99,000	
23	CROSS BEAMS (W12X26)	12400 LBS	$ 5 /LBS	$ 62,000	$ 62,000	
24	CROSS BRACE (LL6X6X1/2)	25900 LBS	$ 5 /LBS	$ 129,500	$ 129,500	
25	TOP RACK PANEL GUIDE SUPPORT (L5X3-1/2X3/8)	1700 LBS	$ 5 /LBS	$ 8,500	$ 8,500	
26	BOTTOM RACK PANEL GUIDE SUPPORT (L6X6X3/8)	2500 LBS	$ 5 /LBS	$ 12,500	$ 12,500	
27	TRASHRACK PANELS	9900 SF	$ 60 /SF	$ 594,000	$ 594,000	
28	GRATING	2300 SF	$ 37 /SF	$ 85,100	$ 85,100	
29	GUARDRAIL	330 FT	$ 45 /FT	$ 14,850	$ 14,850	
30	DIVERS	30 DAYS	$ 3,000 /DAY	$ 90,000	$ 90,000	
G. MECHANICAL						$ 300,000
31	TRASHRAKE	1 LS	$ 300,000.00	$ 300,000	$ 300,000	
L. ELECTRICAL						$ 188,600
32	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
33	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
34	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
35	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	

36	POWER DISTRIBUTION					$ 27,500
	POWER CABLE & CONDUIT	1 LS	$ 20,000		$ 20,000	
	SAFETY SWITCH	1 LS	$ 4,000		$ 4,000	
	POWER PANEL AND BREAKERS	1 LS	$ 3,500		$ 3,500	
37	HOIST SERVICE & CONTROL					$ 23,100
	HOIST & GATE ACTUATOR	1 LS	$ 18,600		$ 18,600	
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500		$ 4,500	
38	GROUNDING	1 LS	$ 10,000		$ 10,000	$ 10,000
39	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000		$ 30,000	$ 30,000
	SUM OF DIRECT CONSTRUCTION COSTS					*$ 2,937,000*
	Contingency	25%				$ 734,000
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS					**$ 3,671,000**
G1	ENGINEERING & PERMITTING	12%				$ 441,000
G2	CONSTRUCTION MONITORING	10%				$ 367,000
	SUM OF INDIRECT COSTS					*$ 808,000*
	Contingency	25%				$ 202,000
	SUBTOTAL OF INDIRECT COSTS					**$ 1,010,000**
	TOTAL PROJECT COSTS					**$ 4,681,000**
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 60,000		$ 60,000	$ 60,000
	OPERATIONS COST (COST PER YEAR)	730 HR	$ 70	/HR	$ 51,100	$ 51,100

NOTES:

1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
JIM FALLS OPTION 3 - FULL DEPTH BARRIER NET

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 161,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 66,000	$ 66,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 10,000	$ 10,000	$ 10,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	1 MONTH	$ 50,000 /MONTH	$ 50,000	$ 50,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION (THIS SECTION NOT USED)						$ -
D. CIVIL						$ 7,950
6	RIVER BOTTOM PREP	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
7	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
8	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
E. CONCRETE						$ 48,000
9	PRECAST CONCRETE NET BOTTOM ANCHORS	25 CY	$ 600 /CY	$ 15,000	$ 15,000	
10	PRECAST CONCRETE NET CORNER ANCHOR	5 CY	$ 600 /CY	$ 3,000	$ 3,000	
11	DIVERS	10 DAYS	$ 3,000 /DAY	$ 30,000	$ 30,000	
F. STRUCTURAL STEEL						$ 11,000
12	NET END ANCHORS	1000 LBS	$ 5.00 /LBS	$ 5,000	$ 5,000	
13	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
G. BARRIER NET						$ 498,000
14	NET	12000 SF	$ 40 /SF	$ 480,000	$ 480,000	
15	DIVERS	6 DAYS	$ 3,000 /DAY	$ 18,000	$ 18,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 726,000*	
	Contingency	25%			$ 182,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 908,000**	
G1	ENGINEERING & PERMITTING	12%			$ 109,000	
G2	CONSTRUCTION MONITORING	10%			$ 91,000	
	SUM OF INDIRECT COSTS				*$ 200,000*	
	Contingency	25%			$ 50,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 250,000**	
	TOTAL PROJECT COSTS				**$ 1,158,000**	
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 50,000	$ 50,000	$ 50,000	
	OPERATIONS COST (DIVERS COST PER YEAR)	10 DAYS	$ 3,000 /DAY	$ 30,000	$ 30,000	

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
DELLS OPTION 1 - CLOSE SPACED BAR RACKS

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 198,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 108,000	$ 108,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	1 MONTH	$ 50,000 /MONTH	$ 50,000	$ 50,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION						$ 302,000
6	REMOVE EXISTING TRASHRACKS	3100 SF	$ 30 /SF	$ 93,000	$ 93,000	
7	MODIFICATIONS TO HEADGATE GANTRY	1 LS	$ 200,000	$ 200,000	$ 200,000	
8	DIVERS	3 DAYS	$ 3,000 /DAY	$ 9,000	$ 9,000	
D. CIVIL						$ 7,950
9	REMOVE SEDIMENT AND DEBRIS AT BASE OF RACKS	50 CY	$ 26 /CY	$ 1,300	$ 1,300	
10	HAULING	65 CY	$ 10 /CY	$ 650	$ 650	
11	DIVERS	2 DAYS	$ 3,000 /DAY	$ 6,000	$ 6,000	
E. CONCRETE (THIS SECTION NOT USED)						$ -
F. STRUCTURAL STEEL						$ 195,000
12	TRASHRACK PANELS	3100 SF	$ 60 /SF	$ 186,000	$ 186,000	
13	DIVERS	3 DAYS	$ 3,000 /DAY	$ 9,000	$ 9,000	
G. MECHANICAL						$ 300,000
14	TRASH RAKE	1 LS	$ 300,000	$ 300,000	$ 300,000	
H. ELECTRICAL						$ 188,600
15	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
16	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
17	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
18	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	
19	POWER DISTRIBUTION				$ 27,500	
	POWER CABLE & CONDUIT	1 LS	$ 20,000	$ 20,000		
	SAFETY SWITCH	1 LS	$ 4,000	$ 4,000		
	POWER PANEL AND BREAKERS	1 LS	$ 3,500	$ 3,500		
20	HOIST SERVICE & CONTROL				$ 23,100	
	HOIST & GATE ACTUATOR	1 LS	$ 18,600	$ 18,600		
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500	$ 4,500		
21	GROUNDING	1 LS	$ 10,000	$ 10,000	$ 10,000	
22	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000	$ 30,000	$ 30,000	
	SUM OF DIRECT CONSTRUCTION COSTS				*$ 1,192,000*	
	Contingency	25%			$ 298,000	
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS				**$ 1,490,000**	
G1	ENGINEERING & PERMITTING	12%			$ 179,000	
G2	CONSTRUCTION MONITORING	10%			$ 149,000	
	SUM OF INDIRECT COSTS				*$ 328,000*	
	Contingency	25%			$ 82,000	
	SUBTOTAL OF INDIRECT COSTS				**$ 410,000**	
	TOTAL PROJECT COSTS				**$ 1,900,000**	
OPERATIONS AND MAINTENANCE						
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 15,000	$ 15,000	$ 15,000	
	OPERATIONS COST (COST PER YEAR)	365 HR	$ 70 /HR	$ 25,550	$ 25,550	

NOTES:
1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

WISCONSIN PUBLIC SERVICE
CHIPPEWA RIVER FISH PROTECTION STUDY
DELLS OPTION 2 - INCLINED BAR RACK STRUCTURE

CONCEPTUAL LEVEL - OPINION OF PROBABLE CONSTRUCTION COST
(COST IN $2016)

ITEM#	ITEM DESCRIPTION	QUANTITY	UNIT PRICE ($)	UNIT TOTAL ($)	TOTAL ($)	
A. GENERAL						$ 400,000
1	MOBILIZATION/DEMOBILIZATION		10%	$ 210,000	$ 210,000	
2	ENVIRONMENTAL PROTECTION DEVICES	1 LS	$ 5,000	$ 5,000	$ 5,000	
3	GENERAL SITE ACCESS	1 LS	$ 25,000	$ 25,000	$ 25,000	
4	CRANE MOBILIZATION/DEMOBILIZATION	1 LS	$ 10,000	$ 10,000	$ 10,000	
5	CRANE	3 MONTHS	$ 50,000 /MONTH	$ 150,000	$ 150,000	
B. COFFERDAMS AND TEMPERARY SOIL RETENTION WALLS (THIS SECTION NOT USED)						$ -
C. DEMOLITION						$ 302,000
6	REMOVE EXISTING TRASHRACKS	3100 SF	$ 30 /SF	$ 93,000	$ 93,000	
7	MODIFICATIONS TO HEADGATE GANTRY	1 LS	$ 200,000	$ 200,000	$ 200,000	
8	DIVERS	3 DAYS	$ 3,000 /DAY	$ 9,000	$ 9,000	
D. CIVIL						$ 59,850
9	SOIL EXCAVATION FOR UPSTREAM FOOTING	775 CY	$ 26 /CY	$ 20,150	$ 20,150	
10	HAULING	970 CY	$ 10 /CY	$ 9,700	$ 9,700	
11	DIVERS	10 DAYS	$ 3,000 /DAY	$ 30,000	$ 30,000	
E. CONCRETE						$ 39,000
12	UPSTREAM FOOTING	45 CY	$ 600 /CY	$ 27,000	$ 27,000	
13	DIVERS	4 DAYS	$ 3,000 /DAY	$ 12,000	$ 12,000	
F. STRUCTURAL STEEL						$ 1,019,120
14	ANGLED SUPPORTS BEAMS (W16X50)	17200 LBS	$ 5 /LBS	$ 86,000	$ 86,000	
15	SUPPORTS BEAM BRACES (W10X30)	7900 LBS	$ 5 /LBS	$ 39,500	$ 39,500	
16	RACK SUPPORTS (W18X50)	44600 LBS	$ 5 /LBS	$ 223,000	$ 223,000	
17	BOTTOM RACK SUPPORT (BENT PLATE)	2500 LBS	$ 5 /LBS	$ 12,500	$ 12,500	
18	TRASHRACK PANELS (39FTx162FT)	6300 SF	$ 60 /SF	$ 378,000	$ 378,000	
19	END CLOSURE TRASHRACK PANELS	1100 SF	$ 60 /SF	$ 66,000	$ 66,000	
20	GRATING SUPPORTS (W12X30)	10700 LBS	$ 5 /LBS	$ 53,500	$ 53,500	
21	GRATING	810 SF	$ 37 /SF	$ 29,970	$ 29,970	
22	GUARDRAIL	170 FT	$ 45 /FT	$ 7,650	$ 7,650	
23	TRASH RAKE SUPPORT RAILS	3600 LBS	$ 5 /LBS	$ 18,000	$ 18,000	
24	DIVERS	35 DAYS	$ 3,000 /DAY	$ 105,000	$ 105,000	
G. MECHANICAL						$ 300,000
25	TRASHRAKE	1 LS	$ 300,000	$ 300,000	$ 300,000	
H. ELECTRICAL						$ 188,600
26	TRASHRAKE ELECTRIC SUPPLY	1 LS	$ 10,000	$ 10,000	$ 10,000	
27	CONTROL PANEL	1 LS	$ 20,000	$ 20,000	$ 20,000	
28	TRANSFORMER	1 LS	$ 8,000	$ 8,000	$ 8,000	
29	PLC	1 LS	$ 60,000	$ 60,000	$ 60,000	
30	POWER DISTRIBUTION				$ 27,500	
	POWER CABLE & CONDUIT	1 LS	$ 20,000	$ 20,000		
	SAFETY SWITCH	1 LS	$ 4,000	$ 4,000		
	POWER PANEL AND BREAKERS	1 LS	$ 3,500	$ 3,500		
31	HOIST SERVICE & CONTROL				$ 23,100	
	HOIST & GATE ACTUATOR	1 LS	$ 18,600	$ 18,600		
	LEVEL TRANSMITTER AND STILLING WELL	1 LS	$ 4,500	$ 4,500		
32	GROUNDING	1 LS	$ 10,000	$ 10,000	$ 10,000	
33	MISC CABINETS, CONDUITS AND WIRES	1 LS	$ 30,000	$ 30,000	$ 30,000	

	SUM OF DIRECT CONSTRUCTION COSTS					$	*2,309,000*
	Contingency	25%				$	577,000
	SUBTOTAL OF DIRECT CONSTRUCTION COSTS					**$**	**2,886,000**
G1	ENGINEERING & PERMITTING	12%				$	346,000
G2	CONSTRUCTION MONITORING	10%				$	289,000
	SUM OF INDIRECT COSTS					$	*635,000*
	Contingency	25%				$	159,000
	SUBTOTAL OF INDIRECT COSTS					**$**	**794,000**
	TOTAL PROJECT COSTS					**$**	**3,680,000**
OPERATIONS AND MAINTENANCE							
	MAINTENANCE COST (COST PER YEAR)	1 LS	$ 40,000	$	40,000	$	40,000
	OPERATIONS COST (COST PER YEAR)	365 HR	$ 70 /HR	$	25,550	$	25,550

NOTES:

1. OWNER ADMINISTRATION AND OVERHEAD COSTS ARE NOT INCLUDED.
2. COSTS FOR HYDRO UNIT DOWN TIME RESULTING FROM INSTALLATION ARE NOT INCLUDED.
3. COSTS ASSOCIATED WITH SALES TAX AND INSURANCE ARE NOT INCLUDED.

BY: KLEINSCHMIDT ASSOCIATES

APPENDIX E-32 Saxon Falls and Superior Falls Freshwater Mussel Survey Report

Saxon Falls and Superior Falls Freshwater Mussel Survey Report
Montreal River, Michigan and Wisconsin

FERC No. 2610 and FERC No. 2587

Prepared for:

Xcel Energy®

and

Mead&Hunt

October 5, 2021

Prepared by:

EDGE
ENGINEERING & SCIENCE
further insight.

Edge Engineering and Science, LLC
Cincinnati, Ohio

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LIST OF ACRONYMS

°C	Celsius
EDGE	Edge Engineering and Science, LLC
°F	Fahrenheit
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
Guidelines	2015 Wisconsin Department of Natural Resources Guidelines for Sampling Freshwater Mussel in Wadable Streams
m^2	Square meter
MDNR	Michigan Department of Natural Resources
min	Minute
Project	Saxon Falls and Superior Falls Hydroelectric Projects
RAW	River Alliance of Wisconsin
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources
Xcel	Xcel Energy

1.0 PROJECT BACKGROUND

Northern States Power Company-Wisconsin, d/b/a Xcel Energy, currently holds licenses issued by the Federal Energy Regulatory Commission (FERC) to operate and maintain the Saxon Falls (FERC No. 2610; Map 1) and Superior Falls (FERC No. 2587; Map 2) Hydroelectric Projects on the Montreal River along the border of Gogebic County, Michigan, and Iron County, Wisconsin (Projects). The current licenses expire on December 31, 2024, and Final License Applications (FLA) must be submitted prior to the end of December 2022. Submission of the FLAs must include an evaluation of the existing fish and wildlife resources and any potential impacts to these resources. As part of the relicensing process, the Wisconsin Department of Natural Resources (WDNR), River Alliance of Wisconsin (RAW), and Michigan Department of Natural Resources (MDNR) has requested that mussel surveys be completed.

Mussel survey records are relatively depauperate in the Montreal River and the WDNR statewide mussel database only identified two mussel species within the Montreal River including Cylindrical Papershell (*Anodontoides ferussacianus*) and Eastern Elliptio (*Elliptio complanata*). According to the Michigan Natural Features Inventory (https://mnfi.anr.msu.edu/resources/michigan-mussels[1]), the Montreal River is not known to support freshwater mussel resources, presumably due to lack of formal survey information. Similarly, review of iNaturalist.org[2], a citizen-scientist, species identification system and organism occurrence recording tool, did not exhibit any publicly available unionid mussel records from the Montreal River. Due to the lack of survey records, it is unknown if the Montreal River harbors extant freshwater mussel populations or supports the availability of suitable mussel habitats.

On behalf of Xcel Energy, Mead & Hunt contracted Edge Engineering and Science, LLC (EDGE) to conduct the requested mussel surveys within the Montreal River. The objective of the survey efforts was to provide baseline data on mussel species occurrence, diversity, and abundance within the Project area, to denote the presence/absence of rare and sensitive mussel species, and to characterize mussel habitats within the Project boundaries. This report details the methods and results of the freshwater mussel survey completed by EDGE.

2.0 METHODS

Mussel surveys were employed in accordance with a mussel survey study plan outlining survey methods derived from 2015 Wisconsin Department of Natural Resources (WDNR) Guidelines for Sampling Freshwater Mussels in Wadable Streams (Piette, 2015) and other standard survey methodologies (Guidelines). The Guidelines provide information on minimum survey efforts for wadable conditions and were modified for non-wadable conditions. The objective of the study is to adequately document and characterize the resident mussel assemblage in the Project boundaries. Mussel survey efforts were conducted within several Survey Reaches assigned to each hydroelectric project.

[1] Accessed September 3, 2021

[2] Accessed September 7, 2021

2.1 Saxon Falls

Three survey reaches (Map 3) were sampled in association with Saxon Falls:

+ Reach 1 was a 1,000-meter reach in a riverine portion of the Project reservoir that originated approximately 1,975 meters upstream of the Saxon Falls Dam
+ Reach 2 was a 1,000-meter reach beginning approximately 460 meters upstream of the Project dam and extended upstream for 1,000 meters
+ Reach 3 began at the Project powerhouse and extended approximately 200 meters downstream.

Reaches 1 and 2 occur upstream of Saxon Falls and surveys consisted of 5 randomly selected transects per Reach that extended bank to bank. Prior to surveys, 10 linear transects (numbered 1-10 from downstream to upstream) were systematically overlayed onto survey reaches via GIS desktop analyses, and a random number selector was utilized to select five transects for survey in each reach. In Reach 1 and Reach 2, transects were spaced 100 meters apart.

Reach 3 is located downstream of the Project powerhouse. The Reach was limited to 200 meters in length due to topography/geography. In this reach, surveys consisted of two transects spaced approximately 100 meters apart. Transects were located at least 25 meters downstream of the powerhouse and outside of the mixing zone.

2.2 Superior Falls

Three survey reaches (Map 4) were sampled in association with Superior Falls:

+ Reach 1 was a 1,000-meter reach in a riverine portion of the Project reservoir that originated approximately 1,125 meters upstream of the Superior Falls Dam
+ Reach 2 was an 800-meter reach beginning approximately 350 meters upstream of the Project dam and extended upstream for 800 meters
+ Reach 3 began at the Project powerhouse and extended approximately 200 meters downstream.

Reaches 1 and 2 occur upstream of Superior Falls and surveys consisted of 5 randomly selected transects per Reach that extended bank to bank. Prior to surveys, linear transects (numbered 1-10 or 1-8 from downstream to upstream) were systematically overlayed onto survey reaches via GIS desktop analyses, and a random number selector was utilized to select five transects for survey in each reach. The number of overlain transects varied according to the length the Reach. In Reach 1 and Reach 2, transects were spaced 100 meters.

Reach 3 is located downstream of the Project powerhouse. The reach was limited to 200 meters in length due to topography/geography. At Superior Falls, the powerhouse is located a short distance upstream of the Montreal River's confluence with Lake Superior. In these reaches, surveys consisted of two transects approximately 100 meters apart. Transects were located at least 25 meters downstream of the powerhouse and outside of the mixing zone.

2.3 Survey Efforts

In total, 12 linear transects were surveyed for mussels in association with the Saxon Falls Project (Map 3) and another 12 linear transects were surveyed for the Superior Falls Project (Map 4). Survey efforts involved searches along linear transects that extended from bank-to-bank within each Survey Reach 1 as outlined in the study plan. Transects were further subdivided into 10-meter intervals. Each 10-meter interval was searched for a minimum of 0.2 minute (min)/square meters (m^2) (2 min total) if no mussels were present. If mussels were located along a 10-meter interval, search effort increased to ≥1.0 min/m^2 (≥10 min total) for the interval. For each 10-meter interval, surveyors used visual and tactile methods to survey the river bottom collecting all mussels within 1 meter of the transect line. Surveyors used their hands and fingertips to fan the top level of substrate, rake loose sediments, and overturn cobble and boulders to increase mussel detection. Depth and substrate composition (e.g., Wentworth Scale) were also collected and recorded for each 10-meter interval.

2.4 Data and Mussel Handling

All mussels were identified to species, measured, sexed (i.e., sexually dimorphic species only), enumerated, photographed for vouchers (Appendix A), and returned to the area where they were collected. To minimize stress, all mussels are kept in the water in mesh bags in a shady area of the river to await processing. Mussels are not exposed to air longer than necessary (no more than 5 minutes) for identification, measurement, and photographic documentation. Any imperiled individuals (if encountered) are handled gently and returned to the area of collection, taking care to rebed them into the substrate in the posterior-up position. For shallow water areas (≤ 1 meter), mussels are handled and processed one at a time and placed back into the substrate from the location collected. For deeper water areas (>1 meter), mussels are submerged in water and kept in the shade while awaiting to be processed. Mussels are partially placed back into the substrate with their posterior side up. Should an individual appear gravid, care is taken to gently encourage the mussel to withdraw the lure and foot into the shell to prevent glochidial release before removal from the substrate. A representative photograph of each mussel species was taken for verification purposes. Deadshell were identified and categorized as either fresh dead (dead within the past year, nacre shiny, hinge flexible, valves attached, with or without tissue), weathered dead (dead many months to years, nacre chalky, hinge brittle, valves typically separated, periostracum intact), or subfossil (dead many years to decades, periostracum eroded, valves separate, very chalky). Mussel taxonomy followed the names presented by Williams et al., 2017.

If any living or dead federally or state-listed species were encountered, appropriate notifications were required to be made to the applicable agency(s). MDNR, WDNR, and U.S. Fish and Wildlife Service (USFWS) (i.e., federally listed species only) were to be notified per surveyor collection permit requirements. No live mussels were harmed nor taken during this Project. Any specimens of federally or state-listed species that are encountered were individually hand placed into their places of origin.

3.0 RESULTS

Survey efforts within the survey reaches were completed on August 25 and August 26, 2021. Survey efforts occurred during suitable survey conditions, with air temperatures averaging 23.9°C (75°F) and water temperature ranging between 18.3 and 19.4°C (65-67°F). Although the Montreal River is highly tannic, visibility was adequate and exceeded 0.5 meter throughout the duration of survey efforts. A stream monitoring station is not located on the Montreal River; however, the nearest U.S. Geological

Survey (USGS) stream gage is located approximately 23 Euclidean kilometers southeast of the Project on the Black River near Bessemer, Michigan and water levels remained relatively low (Figure 1).

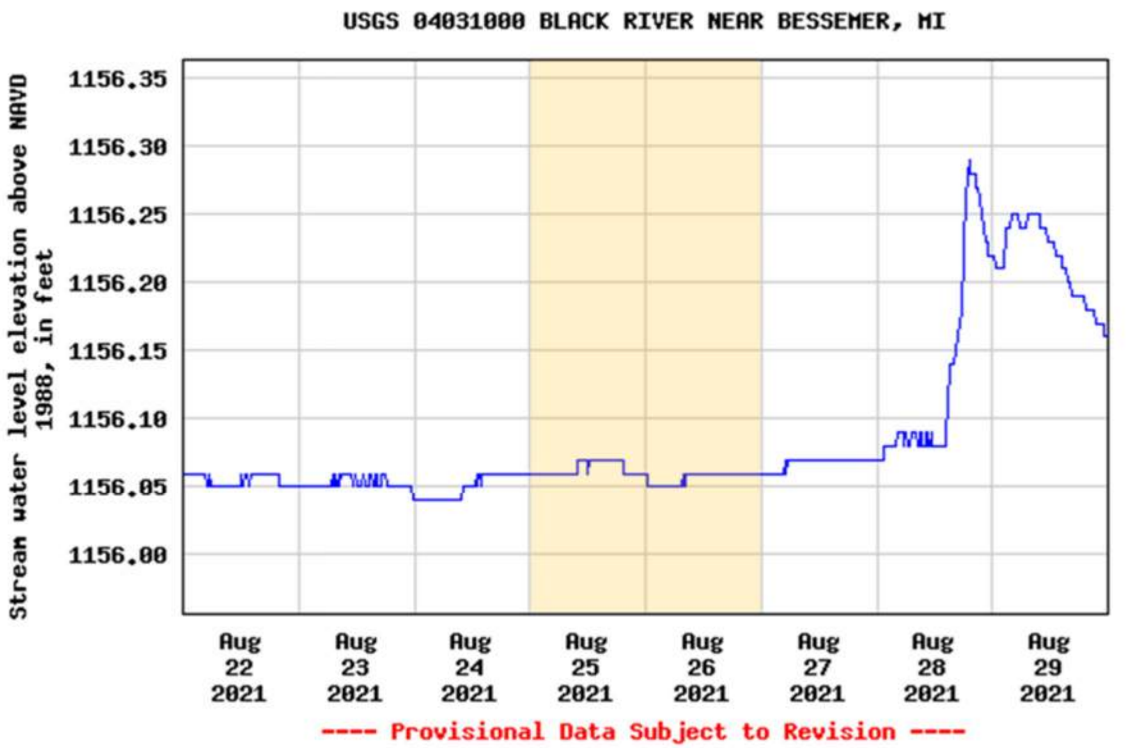


Figure 1. Representative Flows Shown at the Nearest USGS River Gage in Bessemer, Michigan.

3.1 Saxon Falls

Mussel survey efforts were completed at three survey reaches associated with Saxon Falls on August 26, 2021. A total of 1 hour and 48 minutes of search effort were expended to survey along 12 transects (Map 5) that totaled 360 linear meters and resulted in the collection of 2 live individuals of one species, Giant Floater (*Pyganodon grandis*; Table 1). Both individuals were collected in close proximity to the bank (<10 meters). The Giant Floater carries no federal or state protection designations. No additional species were recovered as deadshell. The live individuals were found in two reaches (i.e., R1 T03_0-10 and R2 T04 10-20); thereby representing an overall qualitative density of 0.006 mussels per m^2 that were exclusively found in the reaches upstream (i.e., reservoir) of Saxon Falls. Catch per unit effort (CPUE) in Survey Reach 1 averaged 0.02 mussels/min and ranged between 0 individuals and 0.09 individuals/min while CPUE in Survey Reach 2 averaged 0.02 mussels/min and ranged between 0 individuals and 0.08 individuals/min. No live mussels were encountered in Reach 3 (Table 1). Representative photographs are provided in Appendix A, and mussel data are provided in Appendix B. Survey results for each Survey Reach are provided below.

Table 1. Mussels Collected from Survey Reaches Adjacent the Saxon Falls Hydroelectric Facility within the Montreal River, Gogebic County, Michigan, and Iron County, Wisconsin, 2021.

Scientific Name	Common Name	State Status	Reach 1	Reach 2	Reach 3	Total
Pyganodon grandis	Giant Floater	-	1	1	-	2
		Total	**1**	**1**		**2**

3.1.1 Reach 1 – Reservoir

A total of 52.5-minutes was spent surveying 5 transects totaling 160 meters. Substrates were predominately fines and sand with areas of gravel, cobble, and boulder. A single live Giant Floater was encountered during survey efforts. The surveyed channel was dominated by pool habitat.

3.1.2 Reach 2 – Upper Reservoir

A total of 47.5-minutes was spent surveying 5 transects totaling 170 meters. Substrates were predominately fines and clay with areas of sand, cobble, and boulder. A single live Giant Floater was encountered during survey efforts The surveyed channel was dominated by pool habitat.

3.1.3 Reach 3 – Downstream of Powerhouse

A total of 8-minutes was spent surveying 2 transects totaling 30 meters. No live individuals were collected on the spillway transects. Substrates were dominated by bedrock with seams of unstable gravel, cobble, and boulder along the shores. Substrates were not suitable to support unionid populations. The surveyed channel was dominated by riffle and glide habitats.

3.2 Superior Falls

Mussel survey efforts were completed at three Survey Reaches associated with Superior Falls on August 25, 2021. A total of 2 hours and 43 minutes were expended to survey along 12 transects (Map 6) that totaled 390 linear meters and resulted in the collection of 36 live individuals of 6 species including Eastern Elliptio (*Elliptio complanata*, *n*= 55.6%), Fatmucket (*Lampsilis siliquoidea*, *n*= 25%), Flutedshell (*Lasmigona costata*, *n*= 2.8%), Black Sandshell (*Ligumia recta*, *n*= 5.6%), Giant Floater (*Pyganodon grandis*, *n*= 8.3%), and Creeper (*Strophitus undulatus*, *n*= 2.8%) (Table 2). No additional species were recovered as deadshell only. Black Sandshell is listed as state endangered in Michigan and was the only state listed mussel species encountered. One Black Sandshell individual was represented as a juvenile (23.7 mm length) and the other was an adult (109.9 mm length). The required notification to MDNR regarding the observation of a state listed mussel species was made on August 26, 2021.

All live mussels were encountered along the two transects within Survey Reach 3; located between the Superior Dam Powerhouse and Lake Superior. Twenty-six live mussels were encountered along Transect 01 and the remaining 9 individuals were found along Transect 02. A maximum of 19 live individuals were found along a single transect interval (i.e., R3 T01_0-10); thereby representing a qualitative density of 1.9 mussels per m^2. CPUE in Survey Reach 3 averaged 0.22 mussels/min and ranged between 0 individuals and 1.58 individuals/min. Representative photographs are provided in Appendix A and mussel data are provided in Appendix B.

Table 2. Mussels Collected from Survey Reaches Adjacent the Superior Falls Hydroelectric Facility within the Montreal River, Gogebic County, Michigan, and Iron County, Wisconsin, 2021.

Scientific Name	Common Name	State Status[a]	Reach 1	Reach 2	Reach 3	Total	Relative Abundance
Elliptio complanata	Eastern Elliptio	-	-	-	20	20	55.6%
Lampsilis siliquoidea	Fatmucket	-	-	-	9	9	25.0%
Lasmigona costata	Fluted Shell	-	-	-	1	1	2.8%
Ligumia recta	Black Sandshell	E	-	-	2	2	5.6%
Pyganodon grandis	Giant Floater	-	-	-	3	3	8.3%
Strophitus undulatus	Creeper	-	-	-	1	1	2.8%
		Total	**0**	**0**	**36**	**36**	

[a] E = Endangered in Michigan

3.2.1 Reach 1 – Reservoir

A total of 43-minutes was spent surveying 5 transects totaling 180 meters. Substrates were predominately cobble and gravel with areas of sand and boulder. No live or deadshell individuals were encountered during survey efforts. The surveyed channel was dominated by pool and glide habitats.

3.2.2 Reach 2 – Upper Reservoir

A total of 24-minutes was spent surveying 5 transects totaling 75 meters. Substrates were predominately cobble and gravel with areas of sand. Although substrates were suitable for occupation of mussels, no live or deadshell individuals were encountered during survey efforts. The surveyed channel was dominated by riffle and run habitats.

3.2.3 Reach 3 – Downstream of Powerhouse

A total of 96-minutes was spent surveying 2 transects totaling 135 meters. Thirty-six live mussels of six species were collected in the spillway pool. Substrates were dominated by cobble and gravel, with some boulders present. Substrate was suitable and supported diverse unionid populations.

4.0 DISCUSSION

Mussel survey efforts were conducted in six Survey Reaches during suitable survey conditions within the Project area in the Montreal River along the border of Gogebic County, Michigan, and Iron County, Wisconsin. A total of 24 bank-to-bank transects yielded 38 live individuals of 6 species including one Michigan state endangered species (Maps 5 and 6). No additional species were found only as dead shell material and no live federally listed species were collected. The majority (95%) of live mussels were located in a single survey reach, located downstream of Superior Falls. Two live Giant Floaters were recovered in the Saxon Falls Reservoir. A plethora of suitable, silty habitat with only a few mussels present may suggest that the Giant Floater is a recent addition to the riverine mussel community above Saxon and Superior Falls. The Giant Floater may also occur in the downstream portions of Superior Falls Reservoir but very little suitable habitats (i.e., slow, silty backwaters) were observed during transect surveys.

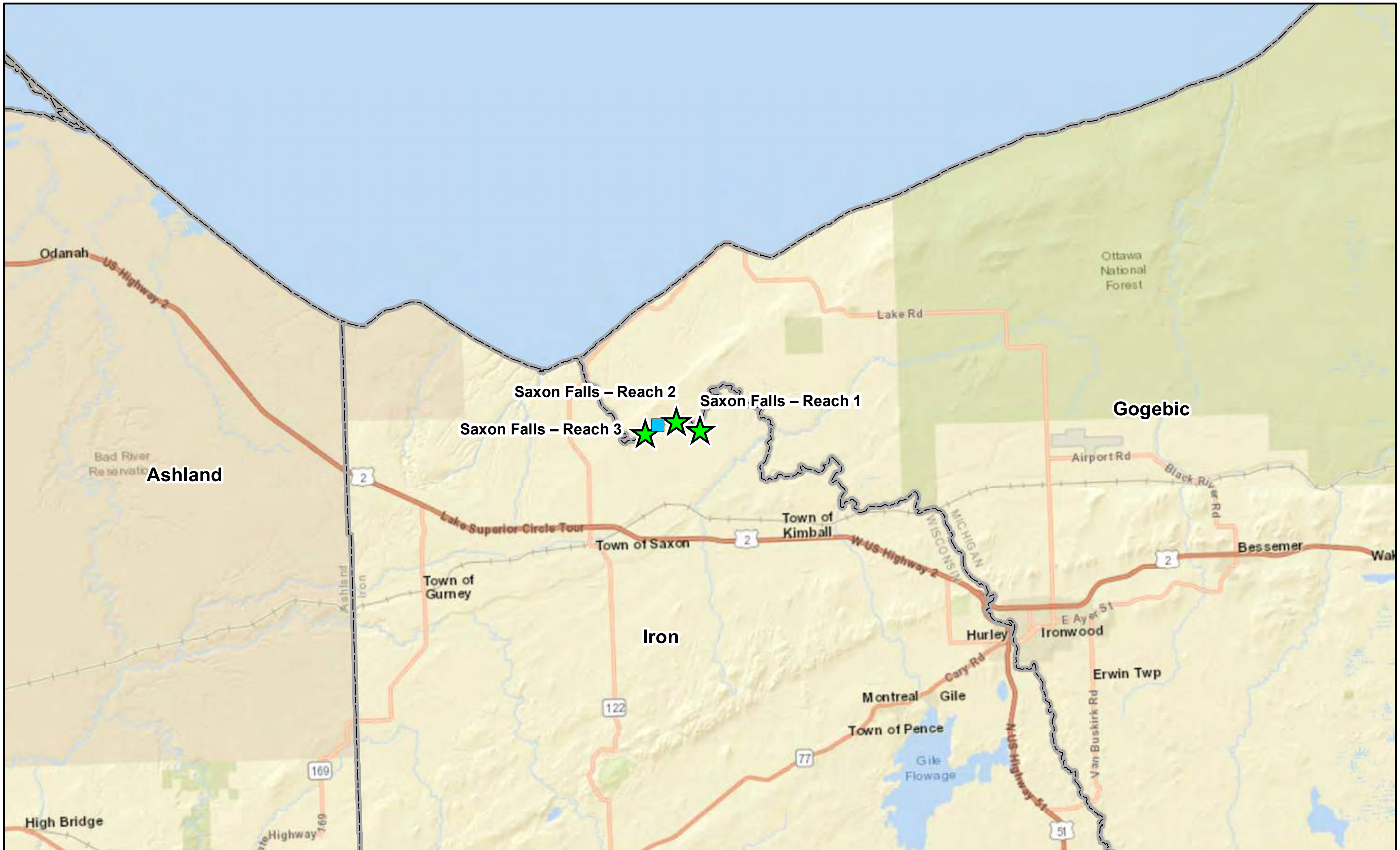
The Montreal River is nearly destitute of mussel survey records and these survey efforts provided valuable information regarding the extant mussel assemblage therein. Significant mussel resources were encountered below Superior Falls which serves as the first cataract of the Montreal River that impedes upstream fish migration. The Falls serve as a natural barrier for fish hosts and may inhibit the upstream colonization of mussels from a source population (i.e., Lake Superior). Presumably, fish hosts are capable of migrating into the lower section of the Montreal River, become infected with glochidia, and help promulgate resident mussel populations. The life cycles of several species are actively being completed for numerous mussel species. This portion of the Montreal River supports a relatively healthy freshwater mussel population, with at least 6 extant species. Survey efforts within this Reach only covered a fraction (3.75%) of the potentially available mussel habitat (i.e., >20,000 m^2) between Superior Falls and Lake Superior; therefore, represents only a small proportion of the mussel assemblage and population. Live mussels were represented by many different size classes and age structures. The presence of sub-adult mussels (e.g., <5 years old, <40 mm) in the Project area indicates successful recruitment for multiple species including Black Sandshell. Given the evidence of recruitment and the presence of state endangered species, a small portion of the Montreal River appears to remain relatively healthy for mussel populations.

5.0 LITERATURE CITED

Piette, R. R. 2015. Guidelines for sampling freshwater mussels in wadable streams. Wisconsin Department of Natural Resources. 50 pp.

Williams, J.D., A.E. Bogan, R.S. Butler, K.S. Cummings, J.T. Garner et al. 2017. A revised checklist of the freshwater mussels (Mollusca: Bivalvia: Unionida) of the United States and Canada. Freshwater Mollusk Biology and Conservation 20(2): 33-58.

Maps



Project Location

Dam Location

County Boundary

N

0 3 6

Kilometers

Scale: 1:236,220

Mead & Hunt

EDGE ENGINEERING & SCIENCE

Mead and Hunt
Superior/Saxon Freshwater Mussel Surveys

Map 1
Project Vicinity Map,
Saxon Falls Hydroelectric Dam FERC Relicensing Project,
Gogebic County Michigan and Iron County, Wisconsin.

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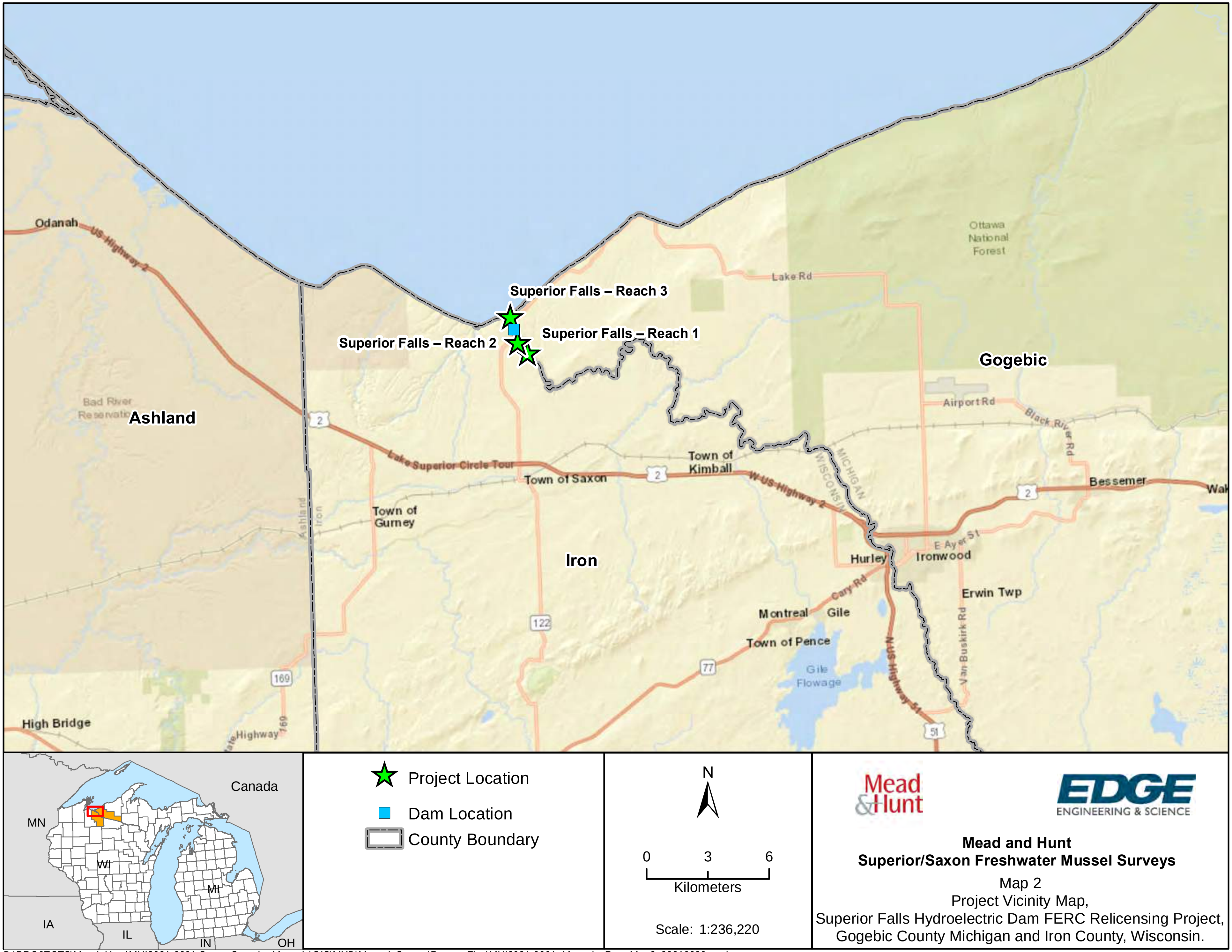
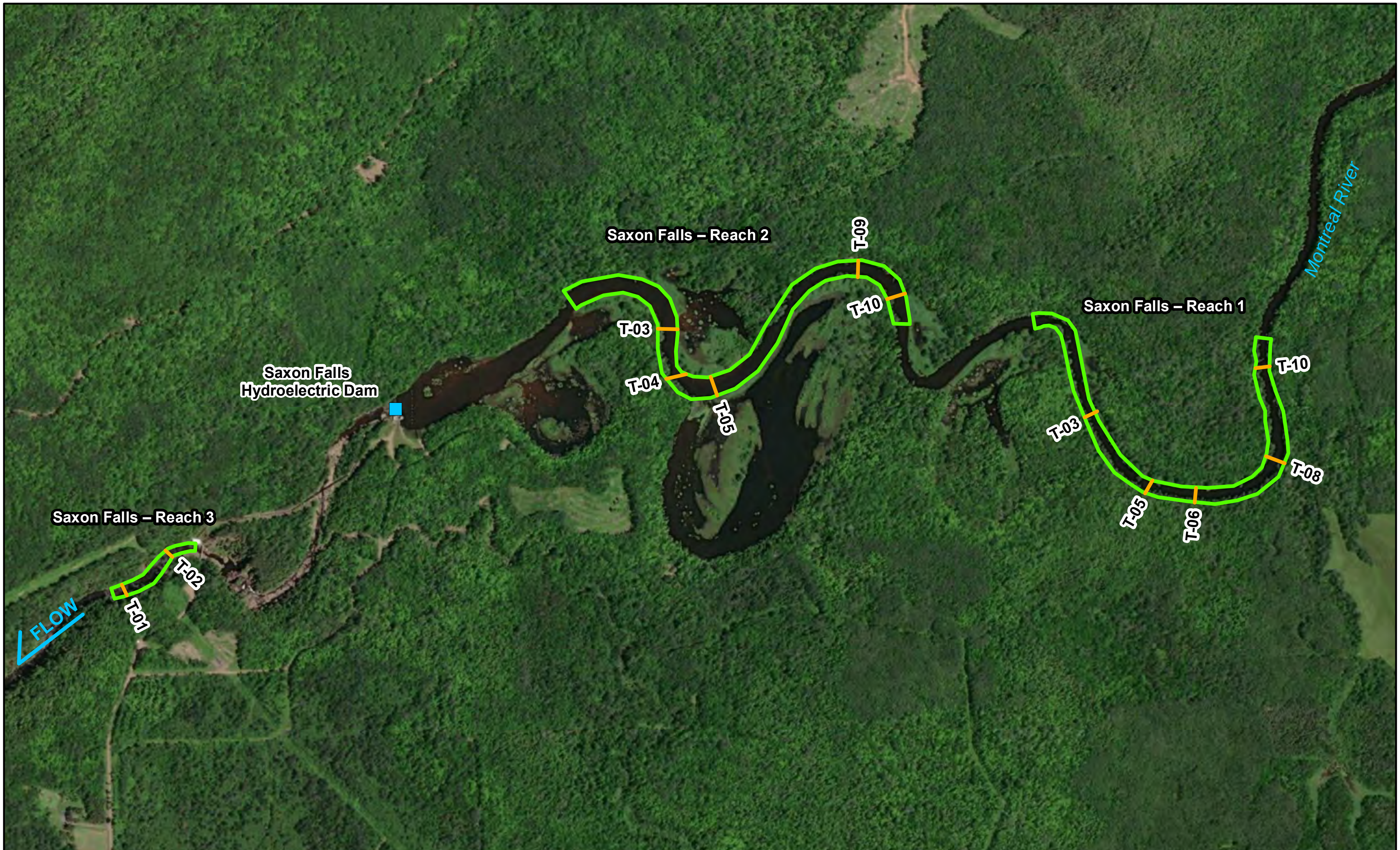


Mead and Hunt
Superior/Saxon Freshwater Mussel Surveys

Map 2
Project Vicinity Map,
Superior Falls Hydroelectric Dam FERC Relicensing Project,
Gogebic County Michigan and Iron County, Wisconsin.

D:\PROJECTS\Mead_Hunt\MHI2021-0001 Saxon Superior Mussels\GIS\MXD\Mussel_Survey\Report_Figs\MHI2021-0001_Mussels_Rprt_Map2_20210930.mxd



Dam Location
Survey Transect
Project Survey Area

N

0 150 300
Meters

Scale: 1:11,811

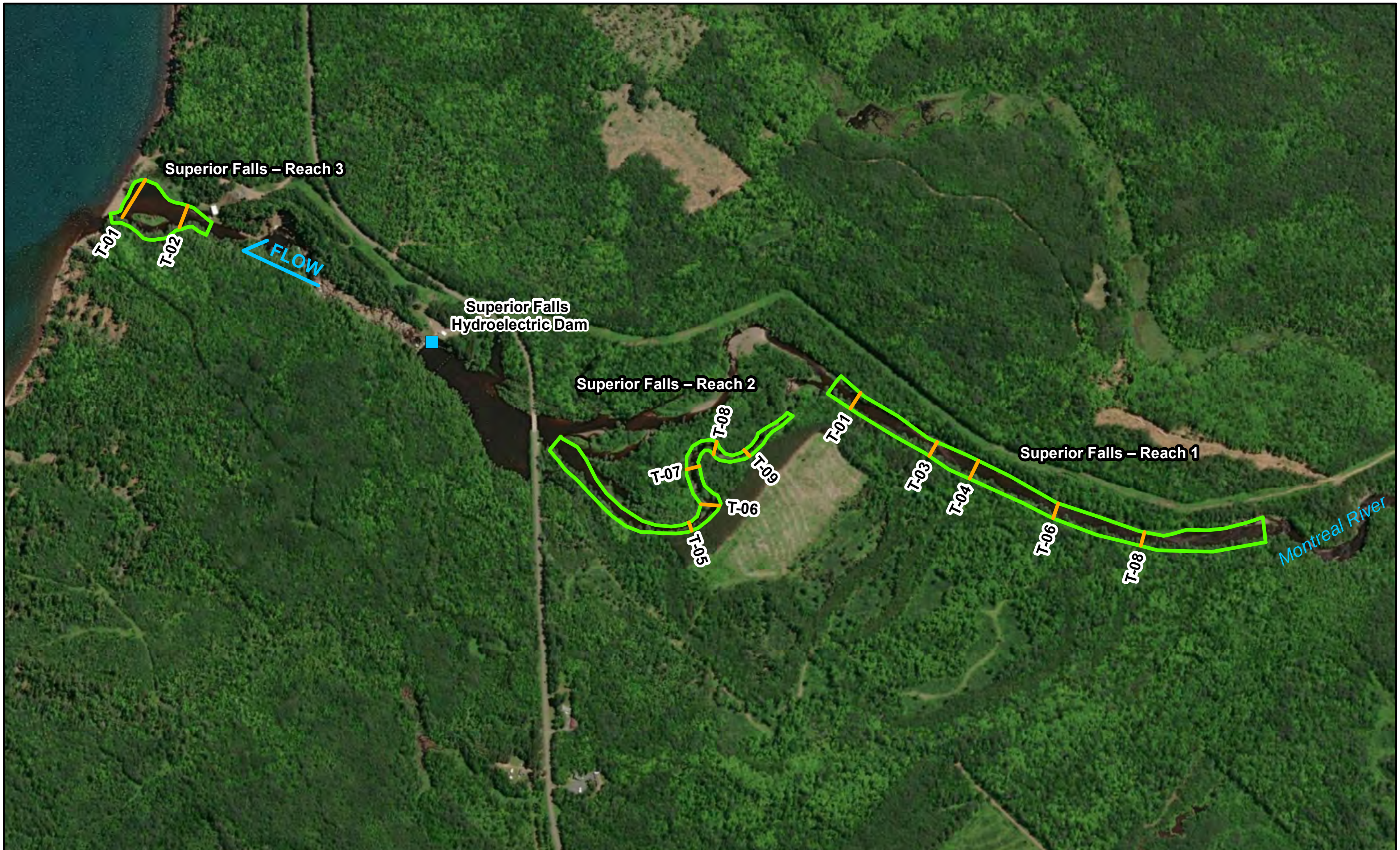
Mead & Hunt

EDGE ENGINEERING & SCIENCE

Mead and Hunt
Superior/Saxon Freshwater Mussel Surveys

Map 3
Freshwater Mussel Survey Extent in Montreal River for the Saxon Falls Hydroelectric Dam FERC Relicensing Project, Gogebic County Michigan and Iron County, Wisconsin.

D:\PROJECTS\Mead_Hunt\MHI2021-0001 Saxon Superior Mussels\GIS\MXD\Mussel_Survey\Report_Figs\MHI2021-0001_Mussels_Rprt_Map3_20210930.mxd



Dam Location
Survey Transect
Project Survey Area

N

0 150 300
Meters

Scale: 1:11,811

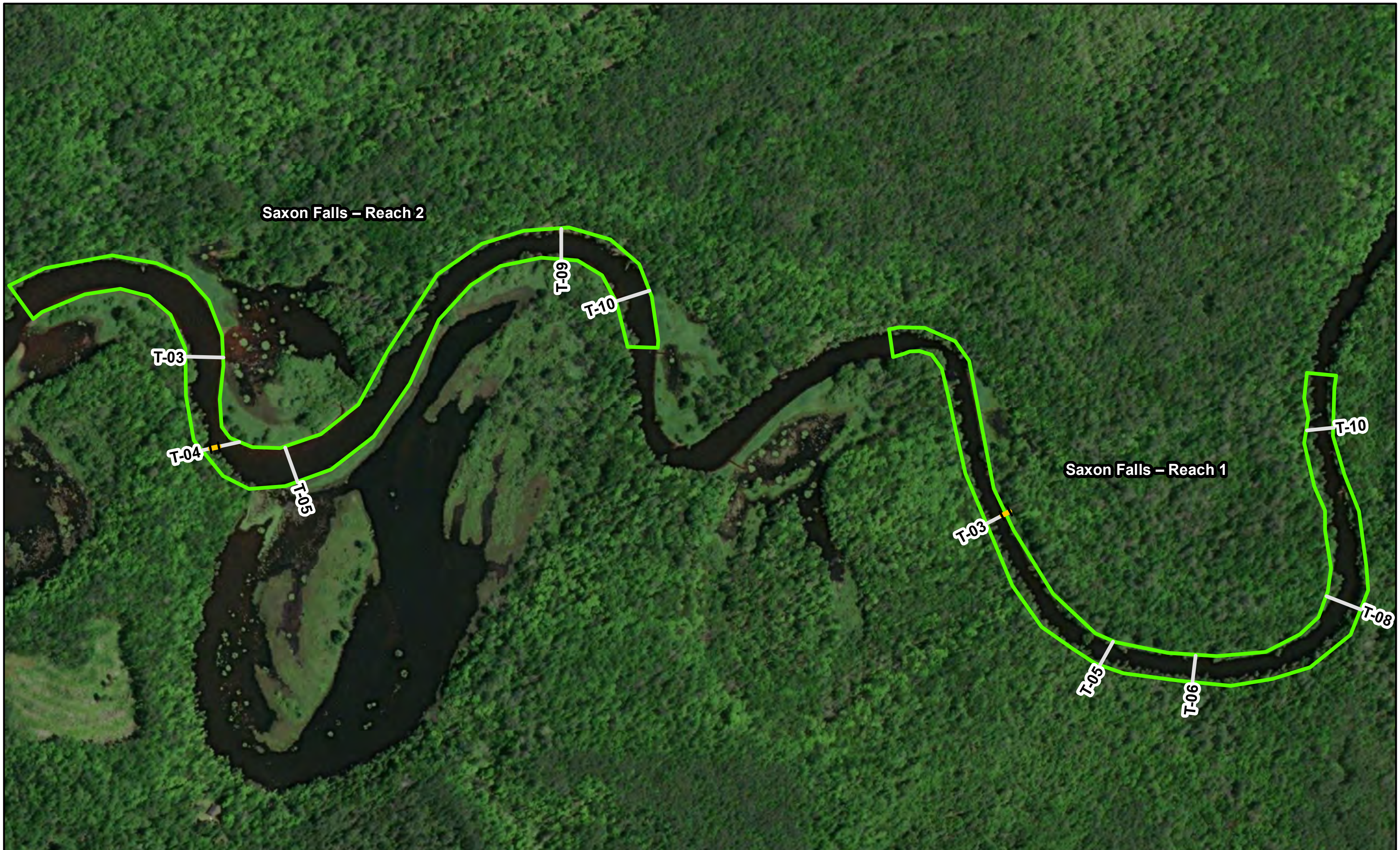
Mead & Hunt

EDGE ENGINEERING & SCIENCE

Mead and Hunt
Superior/Saxon Freshwater Mussel Surveys

Map 4
Freshwater Mussel Survey Extent in Montreal River for the Superior Falls Hydroelectric Dam FERC Relicensing Project, Gogebic County Michigan and Iron County, Wisconsin.

D:\PROJECTS\Mead_Hunt\MHI2021-0001 Saxon Superior Mussels\GIS\MXD\Mussel_Survey\Report_Figs\MHI2021-0001_Mussels_Rprt_Map4_20210930.mxd



Mussel Abundance

0

1

Project Survey Area

N

0 80 160

Meters

Scale: 1:6,299

Mead &Hunt

EDGE ENGINEERING & SCIENCE

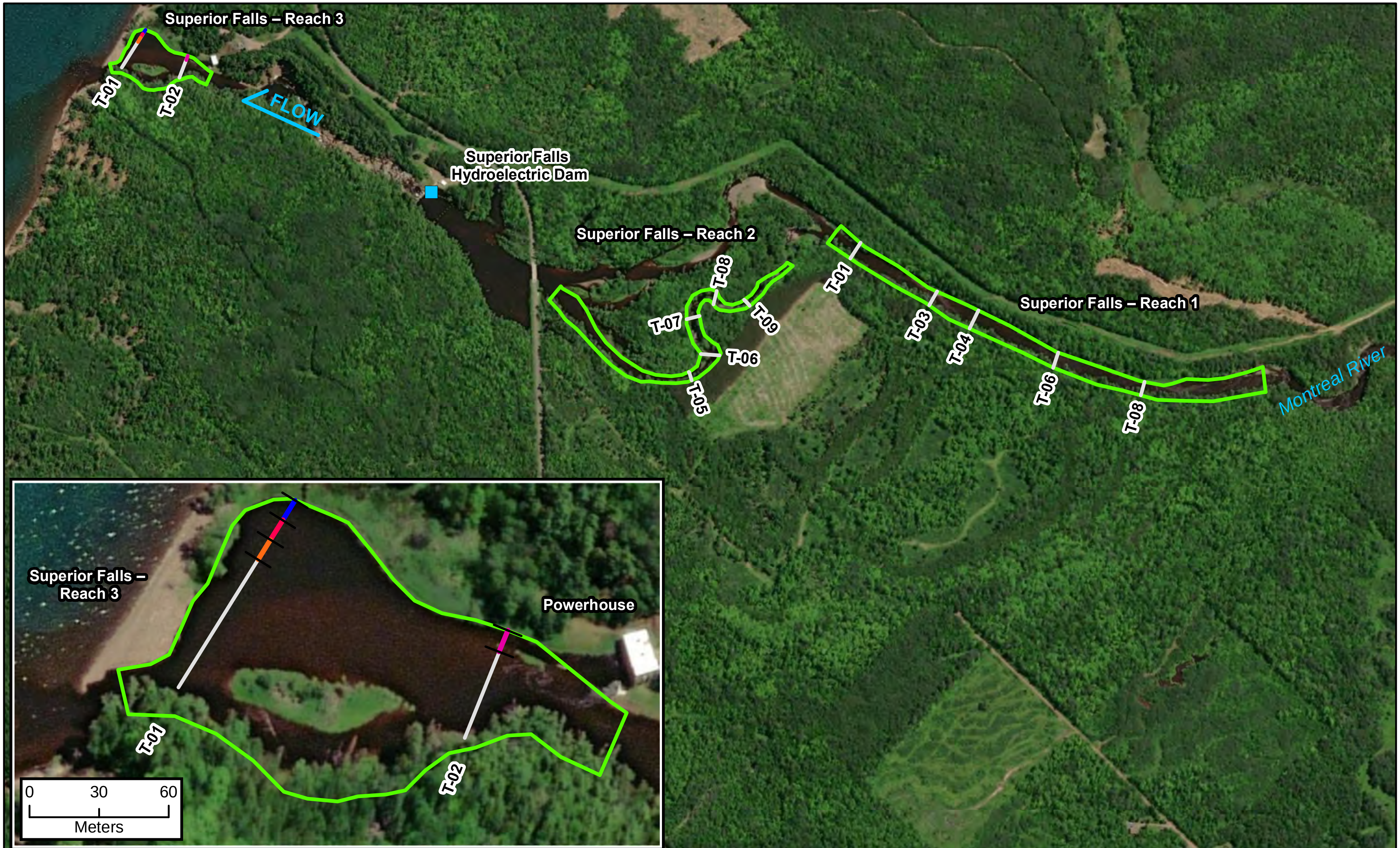
Mead and Hunt

Superior/Saxon Freshwater Mussel Surveys

Map 5

Mussel Abundance by Interval in the Survey Reaches on the Montreal River at Saxon Falls, Gogebic County Michigan and Iron County, Wisconsin.

D:\PROJECTS\Mead_Hunt\MHI2021-0001 Saxon Superior Mussels\GIS\MXD\Mussel_Survey\Report_Figs\MHI2021-0001_Mussels_Rprt_Map5_20210930.mxd



Dam Location

Mussel Abundance

- 0
- 3
- 5
- 9
- 19

Project Survey Area

N

0 150 300

Meters

Scale: 1:11,811

Mead & Hunt

EDGE ENGINEERING & SCIENCE

Mead and Hunt
Superior/Saxon Freshwater Mussel Surveys

Map 6

Mussel Abundance by Interval in the Survey Reaches on the Montreal River at Saxon Falls, Gogebic County Michigan and Iron County, Wisconsin.

D:\PROJECTS\Mead_Hunt\MHI2021-0001 Saxon Superior Mussels\GIS\MXD\Mussel_Survey\Report_Figs\MHI2021-0001_Mussels_Rprt_Map6_20210930.mxd

Appendix A

REPRESENTATIVE PHOTOGRAPHS

Superior Falls – Reach 1

Superior Falls – Reach 2

Superior Falls – Reach 3

Saxon Falls – Reach 1

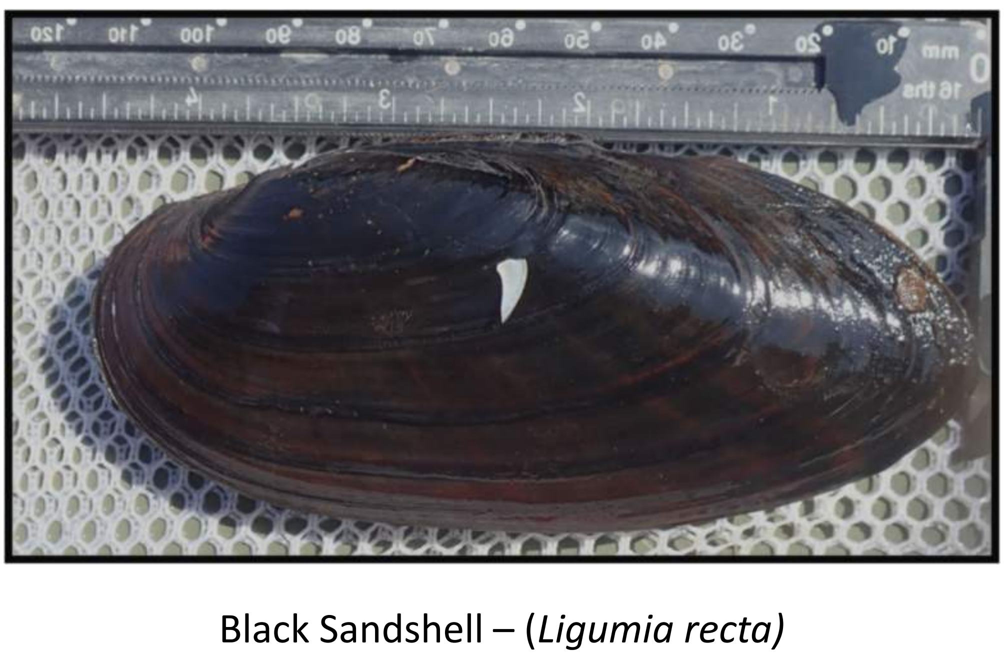
Saxon Falls – Reach 2

Saxon Falls – Reach 3

Eastern Elliptio – (*Elliptio complanata*)

Fatmucket – (*Lampsilis siliquoidea*)

Fluted Shell – (*Lasmigona costata*)



Black Sandshell – (*Ligumia recta)*

Giant Floater – (*Pyganodon grandis*)

Creeper – (*Strophitus undulatus*)

Freshwater Mussel *in situ* - Filtering

Freshwater Mussel *in situ* - Filtering

Black Sandshell – (*Ligumia recta)* - Adult and Juvenile

Representative live Unionids collected below Superior Falls

Appendix B

DATA

Appendix B. Morphometric Mussel Survey Results in the Montreal River for the Saxon Falls and Superior Falls Hydroelectric Relicensing Projects in Gogebic County Michigan and Iron County, Wisconsin.

Project_ID	Date	Reach	Transect	Interval	T_Int	Species name	Common Name	Length (mm)	M / J/ F[1]	No. Live	MI Status
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Ligumia recta*	Black Sandshell	109.9		1	Endangered
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Ligumia recta*	Black Sandshell	23.7	J	1	Endangered
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Strophitus undulatus*	Creeper	77.3		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Lampsilis siliquoidea*	Fatmucket	32.4	M	1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Pyganodon grandis*	Giant Floater	66.9		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Pyganodon grandis*	Giant Floater	92.2		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	82.7		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	76.9		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	84.0		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	85.8		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	83.6		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	75.3		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	69.4		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	66.6		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	84.5		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	78.6		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	58.8		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	54.7		1	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	*Elliptio complanata*	Eastern Elliptio	40.1		1	
Superior Falls	8/25/2021	Reach 3	T01	10-20	T01_10-20	*Elliptio complanata*	Eastern Elliptio	90.0		1	
Superior Falls	8/25/2021	Reach 3	T01	10-20	T01_10-20	*Elliptio complanata*	Eastern Elliptio	87.2		1	
Superior Falls	8/25/2021	Reach 3	T01	10-20	T01_10-20	*Elliptio complanata*	Eastern Elliptio	71.0		1	
Superior Falls	8/25/2021	Reach 3	T01	10-20	T01_10-20	*Elliptio complanata*	Eastern Elliptio	82.8		1	
Superior Falls	8/25/2021	Reach 3	T01	10-20	T01_10-20	*Elliptio complanata*	Eastern Elliptio	38.7		1	
Superior Falls	8/25/2021	Reach 3	T01	20-30	T01_20-30	*Elliptio complanata*	Eastern Elliptio	67.7		1	
Superior Falls	8/25/2021	Reach 3	T01	20-30	T01_20-30	*Elliptio complanata*	Eastern Elliptio	87.0		1	
Superior Falls	8/25/2021	Reach 3	T01	20-30	T01_20-30	*Lampsilis siliquoidea*	Fatmucket	79.1	M	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lasmigona costata*	Fluted Shell	56.8		1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Pyganodon grandis*	Giant Floater	44.6		1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	74.3	F	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	76.0	F	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	77.4	F	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	77.7	F	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	60.8	M	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	65.1	M	1	
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	*Lampsilis siliquoidea*	Fatmucket	66.7	M	1	
Saxon Falls	8/26/2021	Reach 1	T03	20-30	T03_20-30	*Pyganodon grandis*	Giant Floater	46.7		1	
Saxon Falls	8/26/2021	Reach 2	T04	10-20	T04_10-20	*Pyganodon grandis*	Giant Floater	41.8		1	

[1] M = Male, F = Female, J = Juvenile

Appendix B. Substrate Composition along Transects in the Montreal River for the Saxon Falls and Superior Falls Hydroelectric Relicensing Projects in Gogebic County Michigan and Iron County, Wisconsin.

						Substrate Composition (%)													
Project_ID	Date	Reach	Transect	Interval	T_Int	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Clay	Woody Debris	Other	Survey Time (min)	Avg. Depth (ft)	Avg. Depth (m)	Diver	Notes
Superior Falls	8/25/2021	Reach 1	T01	0-10	T01_0-10	10	30		60						2	3	0.91	Benshoff	
Superior Falls	8/25/2021	Reach 1	T01	10-20	T01_10-20	15	50		35						2	3	0.91	Benshoff	
Superior Falls	8/25/2021	Reach 1	T01	20-30	T01_20-30	15	50		35						2.5	4	1.22	Benshoff	
Superior Falls	8/25/2021	Reach 1	T01	30-40	T01_30-40	30	30		40						2	5	1.52	Benshoff	Silt/sand coating on substrates
Superior Falls	8/25/2021	Reach 1	T03	0-10	T03_0-10			60	40						3.5	0.5	0.15	Foltz	
Superior Falls	8/25/2021	Reach 1	T03	10-20	T03_10-20		10	30	60						2	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 1	T03	20-25	T03_20-25		10	30	60						2.5	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 1	T04	0-10	T04_0-10		15	40	40	5					2.5	1	0.30	Benshoff	
Superior Falls	8/25/2021	Reach 1	T04	10-20	T04_10-20		15	40	40	5					2	1	0.30	Benshoff	
Superior Falls	8/25/2021	Reach 1	T04	20-30	T04_20-30		15	40	40	5					2.5	1	0.30	Benshoff	
Superior Falls	8/25/2021	Reach 1	T04	30-40	T04_30-40		15	40	40	5					2	1	0.30	Benshoff	
Superior Falls	8/25/2021	Reach 1	T06	0-10	T06_0-10		10	30	50	10					2	0.5	0.15	Foltz	
Superior Falls	8/25/2021	Reach 1	T06	10-20	T06_10-20		10	30	50	10					2.5	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 1	T06	20-30	T06_20-30		10	30	50	10					2	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 1	T06	30-40	T06_30-40		10	30	50	10					2	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 1	T08	0-10	T08_0-10		10	40	40	10					2	1	0.30	Benshoff	
Superior Falls	8/25/2021	Reach 1	T08	10-20	T08_10-20		10	35	35	20					2	1	0.30	Benshoff	
Superior Falls	8/25/2021	Reach 1	T08	20-30	T08_20-30		5	20	65	10					2.5	0.5	0.15	Benshoff	
Superior Falls	8/25/2021	Reach 1	T08	30-35	T08_30-35		5	20	65	10					2.5	0.5	0.15	Benshoff	
Superior Falls	8/25/2021	Reach 2	T05	0-10	T05_0-10	5	15	40	40						2	2	0.61	Benshoff	
Superior Falls	8/25/2021	Reach 2	T05	10-15	T05_10-15								100		2	3	0.91	Benshoff	
Superior Falls	8/25/2021	Reach 2	T06	0-10	T06_0-10			60	40						2.5	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 2	T06	10-20	T06_10-20	15		20	65						2.5	1.5	0.46	Foltz	
Superior Falls	8/25/2021	Reach 2	T06	20-25	T06_20-25	50						50			2	1.5	0.46	Foltz	Backwater
Superior Falls	8/25/2021	Reach 2	T07	0-10	T07_0-10		20	40	40						2.5	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 2	T07	10-15	T07_10-15		20	40	40						2.5	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 2	T08	0-10	T08_0-10		25	40	35						5	1	0.30	Foltz	Foot of riffle
Superior Falls	8/25/2021	Reach 2	T09	0-10	T09_0-10		20	40	40						3	1	0.30	Foltz	
Superior Falls	8/25/2021	Reach 3	T01	0-10	T01_0-10	40	50	10							12	9	2.74	Kriege	
Superior Falls	8/25/2021	Reach 3	T01	10-20	T01_10-20	30	50	20							12	6	1.83	Kriege	
Superior Falls	8/25/2021	Reach 3	T01	20-30	T01_20-30	10	30	30	30						13	4	1.22	Kriege	
Superior Falls	8/25/2021	Reach 3	T01	30-40	T01_30-40	10	10	30	40	10					6	3	0.91	Kriege	Unconsolidated substrates
Superior Falls	8/25/2021	Reach 3	T01	40-50	T01_40-50		10	40	40	10					6	3	0.91	Kriege	Unconsolidated substrates
Superior Falls	8/25/2021	Reach 3	T01	50-60	T01_50-60		10	40	40	10					5	3	0.91	Kriege	Unconsolidated substrates
Superior Falls	8/25/2021	Reach 3	T01	60-70	T01_60-70		10	40	40	10					5	2	0.61	Kriege	Unconsolidated substrates
Superior Falls	8/25/2021	Reach 3	T01	70-80	T01_70-80	10	10	30	50						3	1.5	0.46	Kriege	Unconsolidated substrates
Superior Falls	8/25/2021	Reach 3	T01	80-90	T01_80-90	30	10	10	40			10			3	1	0.30	Kriege	Unconsolidated substrates
Superior Falls	8/25/2021	Reach 3	T02	0-10	T02_0-10	10	40	50							15	2	0.61	Foltz	Tight band of mussels in stable substrates
Superior Falls	8/25/2021	Reach 3	T02	10-20	T02_10-20		20	50	30						7	3	0.91	Foltz	
Superior Falls	8/25/2021	Reach 3	T02	20-30	T02_20-30			40	50	10					3	3	0.91	Foltz	
Superior Falls	8/25/2021	Reach 3	T02	30-40	T02_30-40			40	50	10					3	2	0.61	Foltz	
Superior Falls	8/25/2021	Reach 3	T02	40-45	T02_40-45	25		25	50						3	1	0.30	Foltz	
Saxon Falls	8/26/2021	Reach 1	T03	0-10	T03_0-10	25		50	25						4	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T03	10-20	T03_10-20	75	25								2	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T03	20-30	T03_20-30	50	50								11	N/A	N/A	Benshoff	Live mussel
Saxon Falls	8/26/2021	Reach 1	T03	30-40	T03_30-40	75								25	2	N/A	N/A	Benshoff	Loose detritus
Saxon Falls	8/26/2021	Reach 1	T05	0-10	T05_0-10	10		10	60	20					4	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T05	10-20	T05_10-20	40	60								2.5	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T05	20-30	T05_20-30	10								90	2	N/A	N/A	Benshoff	Loose detritus
Saxon Falls	8/26/2021	Reach 1	T06	0-10	T06_0-10	50			40	10					3	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T06	10-20	T06_10-20		20	30	30	20					4	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T06	20-30	T06_20-30	50	50								2	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T08	0-10	T08_0-10	50			50						2.5	N/A	N/A	Benshoff	

						Substrate Composition (%)													
Project_ID	Date	Reach	Transect	Interval	T_Int	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Clay	Woody Debris	Other	Survey Time (min)	Avg. Depth (ft)	Avg. Depth (m)	Diver	Notes
Superior Falls	8/25/2021	Reach 1	T01	0-10	T01_0-10	10	30		60						2	3	0.91	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T08	10-20	T08_10-20	10	10	20	40	20					3	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T08	20-30	T08_20-30	50	50								2	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T10	0-10	T10_0-10	30	50		20						2.5	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T10	10-20	T10_10-20		10	20	60	10					3	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 1	T10	20-30	T10_20-30	20		10	60	10					3	N/A	N/A	Benshoff	
Saxon Falls	8/26/2021	Reach 2	T03	0-10	T03_0-10	50						50			2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T03	10-20	T03_10-20	100									2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T03	20-30	T03_20-30	100									2.5	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T04	0-10	T04_0-10	25						75			3	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T04	10-20	T04_10-20	75			25						12	N/A	N/A	Kriege	Live mussel
Saxon Falls	8/26/2021	Reach 2	T04	20-30	T04_20-30	50								50	2	N/A	N/A	Kriege	Loose detritus
Saxon Falls	8/26/2021	Reach 2	T05	0-10	T05_0-10	75						25			2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T05	10-20	T05_10-20		75					25			2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T05	20-30	T05_20-30	75	25								2.5	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T05	30-40	T05_30-40	75						25			2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T09	0-10	T09_0-10	100									2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T09	10-20	T09_10-20	60	10	30							3	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T09	20-30	T09_20-30	70				10			20		2.5	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T10	0-10	T10_0-10	100									2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T10	10-20	T10_10-20	25	75								2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T10	20-30	T10_20-30	65	25			10					2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 2	T10	30-40	T10_30-40	100									2	N/A	N/A	Kriege	
Saxon Falls	8/26/2021	Reach 3	T01	0-10	T01_0-10					20	80				2	2.5	0.76	Foltz	Bedrock chutes
Saxon Falls	8/26/2021	Reach 3	T01	10-15	T01_10-15			5	5	5	85				2	1	0.30	Foltz	Bedrock chutes
Saxon Falls	8/26/2021	Reach 3	T02	0-10	T02_0-10			5	5	5	85				2	2.5	0.76	Foltz	
Saxon Falls	8/26/2021	Reach 3	T02	10-15	T02_10-15			5	5	5	85				2	1	0.30	Foltz	

APPENDIX E-33 Saxon Falls Macroinvertebrate Taxa Sampled and Relative Abundance

Table E-4 Macroinvertebrate Taxa Sampled and Relative Abundance at Three Stations in the Lower Montreal River During the 1987 Survey. A = Abundant, C = Common, P = Present.

Taxa	Station 1	Station 2	Station 4
Isopoda (sow bugs)	P		P
Decapoda (crayfish)			
Orconectes propinquus	P		C
Plecoptera (stoneflies)			
Perlidae			A
Ephemeroptera (mayflies)			
Heptageniidae			C
Tricorythidae			C
Ephemeridae, Ephemera spp.	P		C
Odonata - Anisoptera (dragonflies)			
Aeschnidae	P		P
Gomphidae	P	C	P
Hemiptera (bugs)			
Gerridae (water striders	C	C	P
Notonectidae (back swimmers)	C	C	C
Megaloptera (alderflies, fishflies)			
Corydalidae, Chauliodes spp.	C		C
Sialidae, Sialis spp.	C		C
Trichoptera (caddis flies)			
Brachycentridae	P		
Hydropsychidae			P
Limnephilidae			P
Coleoptera (beetles)			
Dytiscidae, Agabetes spp.			P
Elmidae			C
Diptera (flies, midges)			
Chironomidae	C	C	C
Rhagionidae			C
Gastropoda (snails)			
Planorbidae	P		P
Lymnaeidae	P		P
Pelecypoda (mussels, clams)			
Sphaeriidae (fingernail clams)			P
TOTAL NUMBER OF TAXA	13	4	21

APPENDIX E-34 WDNR Superior Falls Macroinvertebrate Sampling Data

Monitoring Station

Station ID 10031229
Station Name Montreal River below Superior Falls Flowage

Show specific parameter: <Show All>

Sample Results

Previous 1-25 of 84 Next

Project	Date/Time	DNR Parameter	Species	Result	Units	Present/Absent	Lab Comments
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA BAETIDAE		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA BAETIDAE ACERPENNA PYGMAEA		9			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA EPHEMERELLIDAE EPHEMERELLA INVARIA		2			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA HEPTAGENIIDAE LEUCROCUTA		8			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA LEPTOPHLEBIIDAE PARALEPTOPHLEBIA		50			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA LEPTOPHLEBIIDAE PARALEPTOPHLEBIA MOLLIS		2			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA LEPTOPHLEBIIDAE PARALEPTOPHLEBIA PRAEPEDITA		2			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	TRICHOPTERA HYDROPSYCHIDAE CHEUMATOPSYCHE		6			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	TRICHOPTERA HYDROPSYCHIDAE CERATOPSYCHE MOROSA MOROSA FORM SCHMUDE, HILSENHOFF 1986		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	COLEOPTERA ELMIDAE OPTIOSERVUS		8			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	COLEOPTERA ELMIDAE OPTIOSERVUS TRIVITTATUS		6			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	COLEOPTERA ELMIDAE STENELMIS		2			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	COLEOPTERA ELMIDAE STENELMIS CRENATA		2			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA EMPIDIDAE CLINOCERA		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA SIMULIIDAE SIMULIUM VENUSTUM "COMPLEX"		2			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA SIMULIIDAE SIMULIUM QUEBECENSE		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA SIMULIIDAE SIMULIUM -- PUPA		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA CHIRONOMIDAE		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA TANYPODINAE 0 CONCHAPELOPIA		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA ORTHOCLADIINAE 1 EUKIEFFERIELLA CLARIPENNIS GROUP CRANSTON ET AL. 1983		3			

NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA ORTHOCLADIINAE 1 ORTHOCLADIUS (ORTHOCLADIUS)	1
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA ORTHOCLADIINAE 1 PARAMETRIOCNEMUS	2
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA ORTHOCLADIINAE 1 TVETENIA BAVARICA GROUP BODE 1983	1
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA CHIRONOMINAE 4 MICROPSECTRA	1
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA CHIRONOMINAE 4 TANYTARSUS	4

Monitoring Station

Station ID 10031229
Station Name Montreal River below Superior Falls Flowage

Show specific parameter: <Show All>

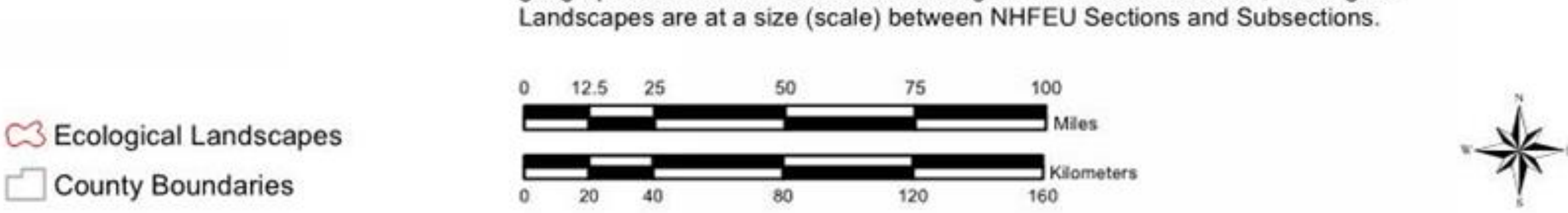
Sample Results

Project	Date/Time	DNR Parameter	Species	Result	Units	Present/Absent	Lab Comments
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA CHIRONOMINAE 4 MICROTENDIPES PEDELLUS GROUP PINDER, REISS 1983		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	AMPHIPODA HYALELLIDAE HYALELLA		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA ORTHOCLADIINAE 1 CRICOTOPUS (CRICOTOPUS) BICINCTUS		1			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	DIPTERA CHIRONOMINAE 4 POLYPEDILUM (URESIPEDILUM) FLAVUM		6			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	EPHEMEROPTERA HEPTAGENIIDAE MACCAFFERTIUM VICARIUM/LUTEUM DIMICK, UNPUBL.		4			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Index of Biological Integrity (IBI), Wadable		7.65169			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	HILSENHOFF'S BIOTIC INDEX (HBI)		2.764			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	FAMILY-LEVEL BIOTIC INDEX (FBI)		3.628			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	HBI Max 10		3.575			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	SPECIES RICHNESS		24			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	GENERA RICHNESS		22			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT EPT INDIVIDUALS		65			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT EPT GENERA		32			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT CHIRONOMIDAE INDIVIDUALS		17			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	SHANNON'S DIVERSITY INDEX		4.05			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT SCRAPERS		23			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT FILTERER		12			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT SHREDDERS		5			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	PERCENT GATHERERS		58			
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Family Rank 1		LEPTOPHLEBIIDAE			

NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Family Rank 2	CHIRONOMIDAE
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Family Rank 3	ELMIDAE
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Family Rank 4	HEPTAGENIIDAE
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Family Rank 5	BAETIDAE
NOR Watershed Rotation Sites (Non_LTT)	04/26/2010 12:00 AM	Macroinvertebrate Genus Rank 1	PARALEPTOPHLEBIA

APPENDIX E-35 Ecological Landscapes of Wisconsin Map

Wisconsin was divided into 16 ecoregions with similar ecology and management opportunities. Each of these ecoregions is called an Ecological Landscape. The Ecological Landscapes are based on the National Hierarchical Framework of Ecological Units (NHFEU; Cleland et al. 1997). There were too many NHFEU Subsections and too few NHFEU Sections to be useful for management purposes. Ecological Landscapes use the same boundaries as NHFEU Sections or Subsections. However, some NHFEU Subsections were combined to reduce the number of geographical units in the state to a manageable number. Therefore, Ecological Landscapes are at a size (scale) between NHFEU Sections and Subsections.



APPENDIX E-36 Superior Falls Timber Inventory Map

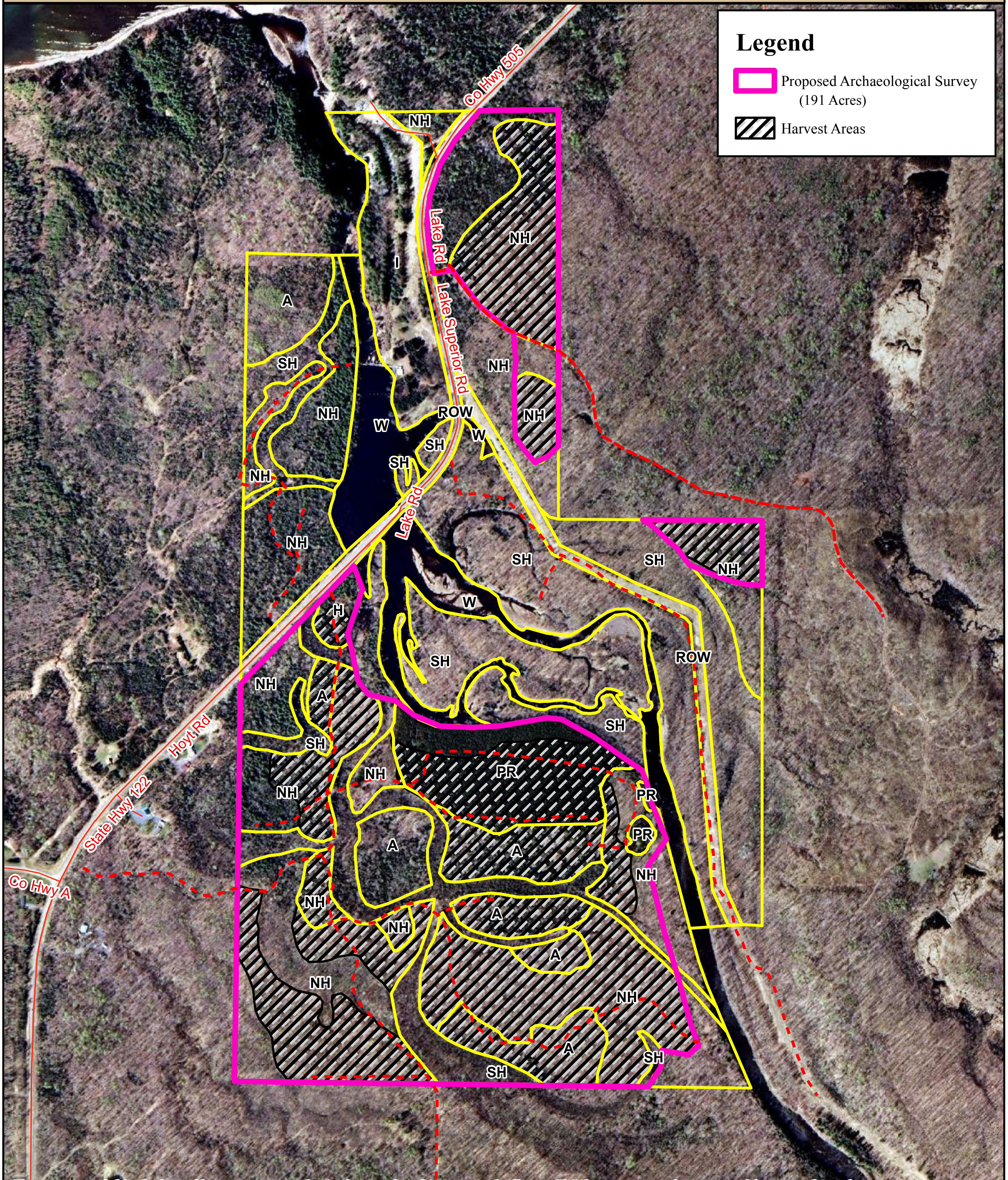
Compass Land Consultants

Superior Falls (Xcel Energy)
Section 7 & 18, T47N-R1E, Iron Co, WI
Section 15, T48N-R49W, Gogebic Co, MI

Backdrop: 2010 Aerial Photograph

0 250 500 Feet

1:10,000



This map is intended for display and location purposes only. On the ground conditions may and will vary. CLC does not warrant the accuracy of this map and provides it as is.

APPENDIX E-37 Saxon Falls IPaC Official Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Minnesota-Wisconsin Ecological Services Field Office
4101 American Blvd E
Bloomington, MN 55425-1665
Phone: (952) 252-0092 Fax: (952) 646-2873
http://www.fws.gov/midwest/Endangered/section7/s7process/step1.html

In Reply Refer To: April 07, 2022
Project Code: 2022-0010313
Project Name: Saxon Falls Project Boundary

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

This response has been generated by the Information, Planning, and Conservation (IPaC) system to provide information on natural resources that could be affected by your project. The U.S. Fish and Wildlife Service (Service) provides this response under the authority of the Endangered Species Act of 1973 (16 U.S.C. 1531-1543), the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d), the Migratory Bird Treaty Act (16 U.S.C. 703-712), and the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*.).

Threatened and Endangered Species

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and may be affected by your proposed project. The species list fulfills the requirement for obtaining a Technical Assistance Letter from the U.S. Fish and Wildlife Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS IPaC system by completing the same process used to receive the enclosed list.

Consultation Technical Assistance

Please refer to refer to our Section 7 website for guidance and technical assistance, including step-by-step instructions for making effects determinations for each species that might be present and for specific guidance on the following types of projects: projects in developed areas, HUD, CDBG, EDA, pipelines, buried utilities, telecommunications, and requests for a Conditional Letter of Map Revision (CLOMR) from FEMA.

Using the IPaC Official Species List to Make No Effect and May Affect Determinations for Listed Species

1. If IPaC returns a result of "There are no listed species found within the vicinity of the project," then project proponents can conclude the proposed activities will have **no effect** on any federally listed species under Service jurisdiction. Concurrence from the Service is not required for **no effect** determinations. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records.
2. If IPaC returns one or more federally listed, proposed, or candidate species as potentially present in the action area of the proposed project – other than bats (see below) – then project proponents must determine if proposed activities will have **no effect** on or **may affect** those species. For assistance in determining if suitable habitat for listed, candidate, or proposed species occurs within your project area or if species may be affected by project activities, you can obtain Life History Information for Listed and Candidate Species on our office website. If no impacts will occur to a species on the IPaC species list (e.g., there is no habitat present in the project area), the appropriate determination is **no effect**. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records.
3. Should you determine that project activities **may affect** any federally listed, please contact our office for further coordination. Letters with requests for consultation or correspondence about your project should include the Consultation Tracking Number in the header. Electronic submission is preferred.

Northern Long-Eared Bats
Northern long-eared bats occur throughout Minnesota and Wisconsin and the information below may help in determining if your project may affect these species.

This species hibernates in caves or mines only during the winter. In Minnesota and Wisconsin, the hibernation season is considered to be November 1 to March 31. During the active season (April 1 to October 31) they roost in forest and woodland habitats. Suitable summer habitat for northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥3 inches dbh for northern long-eared bat that have exfoliating bark, cracks, crevices, and/or hollows), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of forested/wooded habitat. Northern long-eared bats have also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat and evaluated for use by bats. If your project will impact caves or mines or will involve clearing forest or woodland habitat containing suitable roosting habitat, northern long-eared bats could be affected.

Examples of unsuitable habitat include:

- Individual trees that are greater than 1,000 feet from forested or wooded areas,
- Trees found in highly developed urban areas (e.g., street trees, downtown areas),
- A pure stand of less than 3-inch dbh trees that are not mixed with larger trees, and
- A stand of eastern red cedar shrubby vegetation with no potential roost trees.

If IPaC returns a result that northern long-eared bats are potentially present in the action area of the proposed project, project proponents can conclude the proposed activities **may affect** this species **IF** one or more of the following activities are proposed:

- Clearing or disturbing suitable roosting habitat, as defined above, at any time of year,
- Any activity in or near the entrance to a cave or mine,
- Mining, deep excavation, or underground work within 0.25 miles of a cave or mine,
- Construction of one or more wind turbines, or
- Demolition or reconstruction of human-made structures that are known to be used by bats based on observations of roosting bats, bats emerging at dusk, or guano deposits or stains.

If none of the above activities are proposed, project proponents can conclude the proposed activities will have **no effect** on the northern long-eared bat. Concurrence from the Service is not required for **No Effect** determinations. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records.

If any of the above activities are proposed, please use the northern long-eared bat determination key in IPaC. This tool streamlines consultation under the 2016 rangewide programmatic biological opinion for the 4(d) rule. The key helps to determine if prohibited take might occur and, if not, will generate an automated verification letter. No further review by us is necessary.

Whooping Crane

Whooping crane is designated as a non-essential experimental population in Wisconsin and consultation under Section 7(a)(2) of the Endangered Species Act is only required if project activities will occur within a National Wildlife Refuge or National Park. If project activities are proposed on lands outside of a National Wildlife Refuge or National Park, then you are not required to consult. For additional information on this designation and consultation requirements, please review "Establishment of a Nonessential Experimental Population of Whooping Cranes in the Eastern United States."

Other Trust Resources and Activities

Bald and Golden Eagles - Although the bald eagle has been removed from the endangered species list, this species and the golden eagle are protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act. Should bald or golden eagles occur within or near the project area please contact our office for further coordination. For communication and wind energy projects, please refer to additional guidelines below.

Migratory Birds - The Migratory Bird Treaty Act (MBTA) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Service. The Service has the responsibility under the MBTA to proactively prevent the mortality of migratory birds whenever possible and we encourage implementation of recommendations that minimize potential impacts to migratory birds. Such measures include clearing forested habitat outside the nesting season (generally March 1 to August 31) or conducting nest surveys prior to clearing to avoid injury to eggs or nestlings.

Communication Towers - Construction of new communications towers (including radio, television, cellular, and microwave) creates a potentially significant impact on migratory birds, especially some 350 species of night-migrating birds. However, the Service has developed voluntary guidelines for minimizing impacts.

Transmission Lines - Migratory birds, especially large species with long wingspans, heavy bodies, and poor maneuverability can also collide with power lines. In addition, mortality can occur when birds, particularly hawks, eagles, kites, falcons, and owls, attempt to perch on uninsulated or unguarded power poles. To minimize these risks, please refer to guidelines developed by the Avian Power Line Interaction Committee and the Service. Implementation of these measures is especially important along sections of lines adjacent to wetlands or other areas that support large numbers of raptors and migratory birds.

Wind Energy - To minimize impacts to migratory birds and bats, wind energy projects should follow the Service's Wind Energy Guidelines. In addition, please refer to the Service's Eagle Conservation Plan Guidance, which provides guidance for conserving bald and golden eagles in the course of siting, constructing, and operating wind energy facilities.

State Department of Natural Resources Coordination

While it is not required for your Federal section 7 consultation, please note that additional state endangered or threatened species may also have the potential to be impacted. Please contact the Minnesota or Wisconsin Department of Natural Resources for information on state listed species that may be present in your proposed project area.

Minnesota
Minnesota Department of Natural Resources - Endangered Resources Review Homepage
Email: Review.NHIS@state.mn.us

Wisconsin
Wisconsin Department of Natural Resources - Endangered Resources Review Homepage
Email: DNRERReview@wi.gov

We appreciate your concern for threatened and endangered species. Please feel free to contact our office with questions or for additional information.

Note: IPaC has provided all available attachments because this project is in multiple field office jurisdictions.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Minnesota-Wisconsin Ecological Services Field Office
4101 American Blvd E
Bloomington, MN 55425-1665
(952) 252-0092

This project's location is within the jurisdiction of multiple offices. However, only one species list document will be provided for all offices. The species and critical habitats in this document reflect the aggregation of those that fall in each of the affiliated office's jurisdiction. Other offices affiliated with the project:

Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
(517) 351-2555

Project Summary

Project Code: 2022-0010313
Event Code: None
Project Name: Saxon Falls Project Boundary
Project Type: Dam - Operations
Project Description: Saxon Falls dam in Gogebic, Michigan
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@46.538982399999995,-90.365130595649,14z

Counties: Michigan and Wisconsin

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened
Gray Wolf *Canis lupus* Population: U.S.A.: All of AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, and WV; and portions of AZ, NM, OR, UT, and WA. Mexico. There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/4488	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045 General project design guidelines: https://ipac.ecosphere.fws.gov/project/L44EDDQBAJCQPKKP6CBVRYFDIQ/documents/generated/5664.pdf	Threatened

Birds

NAME	STATUS
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Only actions that occur along coastal areas during the Red Knot migratory window of MAY 1 - SEPTEMBER 30. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Canada Warbler *Cardellina canadensis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Aug 10

NAME	BREEDING SEASON
Golden-winged Warbler *Vermivora chrysoptera* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8745	Breeds May 1 to Jul 20

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

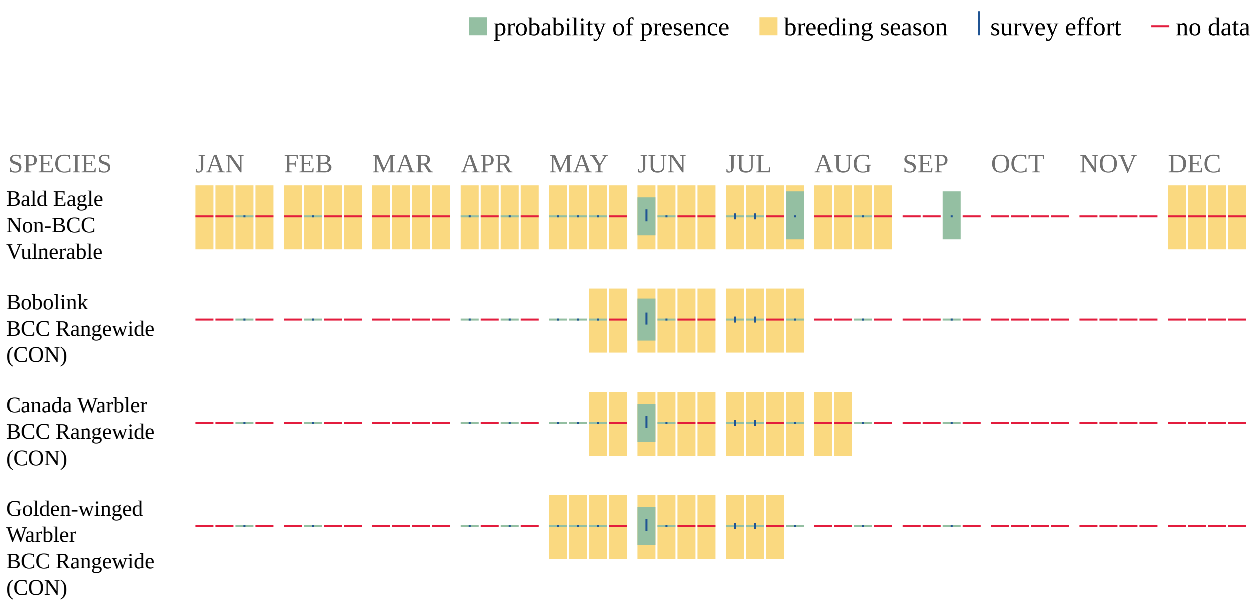
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of

certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

RIVERINE

- R2UBH
- R4SBC
- R5UBH

FRESHWATER FORESTED/SHRUB WETLAND

- PFO1/SS1A
- PSSF
- PSS1C
- PFO1/SS1C
- PSS1/EM1F

FRESHWATER EMERGENT WETLAND

- PEM1C
- PEM1F

LAKE

- L1UBH

IPaC User Contact Information

Agency: Mead and Hunt
Name: Arianna Bresnan
Address: 2440 Deming Way
City: Middleton
State: WI
Zip: 53562
Email arianna.bres@gmail.com
Phone: 6084430316

APPENDIX E-38 Superior Falls IPaC Official Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Minnesota-Wisconsin Ecological Services Field Office
4101 American Blvd E
Bloomington, MN 55425-1665
Phone: (952) 252-0092 Fax: (952) 646-2873
http://www.fws.gov/midwest/Endangered/section7/s7process/step1.html

In Reply Refer To: April 07, 2022
Project Code: 2022-0010398
Project Name: Superior Falls Project Boundary

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

This response has been generated by the Information, Planning, and Conservation (IPaC) system to provide information on natural resources that could be affected by your project. The U.S. Fish and Wildlife Service (Service) provides this response under the authority of the Endangered Species Act of 1973 (16 U.S.C. 1531-1543), the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d), the Migratory Bird Treaty Act (16 U.S.C. 703-712), and the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq*.).

Threatened and Endangered Species

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and may be affected by your proposed project. The species list fulfills the requirement for obtaining a Technical Assistance Letter from the U.S. Fish and Wildlife Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS IPaC system by completing the same process used to receive the enclosed list.

Consultation Technical Assistance

Please refer to refer to our Section 7 website for guidance and technical assistance, including step-by-step instructions for making effects determinations for each species that might be present and for specific guidance on the following types of projects: projects in developed areas, HUD, CDBG, EDA, pipelines, buried utilities, telecommunications, and requests for a Conditional Letter of Map Revision (CLOMR) from FEMA.

Using the IPaC Official Species List to Make No Effect and May Affect Determinations for Listed Species

1. If IPaC returns a result of “There are no listed species found within the vicinity of the project,” then project proponents can conclude the proposed activities will have **no effect** on any federally listed species under Service jurisdiction. Concurrence from the Service is not required for **no effect** determinations. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records.
2. If IPaC returns one or more federally listed, proposed, or candidate species as potentially present in the action area of the proposed project – other than bats (see below) – then project proponents must determine if proposed activities will have **no effect** on or **may affect** those species. For assistance in determining if suitable habitat for listed, candidate, or proposed species occurs within your project area or if species may be affected by project activities, you can obtain Life History Information for Listed and Candidate Species on our office website. If no impacts will occur to a species on the IPaC species list (e.g., there is no habitat present in the project area), the appropriate determination is **no effect**. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records.
3. Should you determine that project activities **may affect** any federally listed, please contact our office for further coordination. Letters with requests for consultation or correspondence about your project should include the Consultation Tracking Number in the header. Electronic submission is preferred.

Northern Long-Eared Bats
Northern long-eared bats occur throughout Minnesota and Wisconsin and the information below may help in determining if your project may affect these species.

This species hibernates in caves or mines only during the winter. In Minnesota and Wisconsin, the hibernation season is considered to be November 1 to March 31. During the active season (April 1 to October 31) they roost in forest and woodland habitats. Suitable summer habitat for northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and travel and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, old fields and pastures. This includes forests and woodlots containing potential roosts (i.e., live trees and/or snags ≥3 inches dbh for northern long-eared bat that have exfoliating bark, cracks, crevices, and/or hollows), as well as linear features such as fencerows, riparian forests, and other wooded corridors. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet (305 meters) of forested/wooded habitat. Northern long-eared bats have also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat and evaluated for use by bats. If your project will impact caves or mines or will involve clearing forest or woodland habitat containing suitable roosting habitat, northern long-eared bats could be affected.

Examples of unsuitable habitat include:

- Individual trees that are greater than 1,000 feet from forested or wooded areas,
- Trees found in highly developed urban areas (e.g., street trees, downtown areas),
- A pure stand of less than 3-inch dbh trees that are not mixed with larger trees, and
- A stand of eastern red cedar shrubby vegetation with no potential roost trees.

If IPaC returns a result that northern long-eared bats are potentially present in the action area of the proposed project, project proponents can conclude the proposed activities **may affect** this species **IF** one or more of the following activities are proposed:

- Clearing or disturbing suitable roosting habitat, as defined above, at any time of year,
- Any activity in or near the entrance to a cave or mine,
- Mining, deep excavation, or underground work within 0.25 miles of a cave or mine,
- Construction of one or more wind turbines, or
- Demolition or reconstruction of human-made structures that are known to be used by bats based on observations of roosting bats, bats emerging at dusk, or guano deposits or stains.

If none of the above activities are proposed, project proponents can conclude the proposed activities will have **no effect** on the northern long-eared bat. Concurrence from the Service is not required for **No Effect** determinations. No further consultation or coordination is required. Attach this letter to the dated IPaC species list report for your records.

If any of the above activities are proposed, please use the northern long-eared bat determination key in IPaC. This tool streamlines consultation under the 2016 rangewide programmatic biological opinion for the 4(d) rule. The key helps to determine if prohibited take might occur and, if not, will generate an automated verification letter. No further review by us is necessary.

Whooping Crane

Whooping crane is designated as a non-essential experimental population in Wisconsin and consultation under Section 7(a)(2) of the Endangered Species Act is only required if project activities will occur within a National Wildlife Refuge or National Park. If project activities are proposed on lands outside of a National Wildlife Refuge or National Park, then you are not required to consult. For additional information on this designation and consultation requirements, please review "Establishment of a Nonessential Experimental Population of Whooping Cranes in the Eastern United States."

Other Trust Resources and Activities

Bald and Golden Eagles - Although the bald eagle has been removed from the endangered species list, this species and the golden eagle are protected by the Bald and Golden Eagle Act and the Migratory Bird Treaty Act. Should bald or golden eagles occur within or near the project area please contact our office for further coordination. For communication and wind energy projects, please refer to additional guidelines below.

Migratory Birds - The Migratory Bird Treaty Act (MBTA) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Service. The Service has the responsibility under the MBTA to proactively prevent the mortality of migratory birds whenever possible and we encourage implementation of recommendations that minimize potential impacts to migratory birds. Such measures include clearing forested habitat outside the nesting season (generally March 1 to August 31) or conducting nest surveys prior to clearing to avoid injury to eggs or nestlings.

Communication Towers - Construction of new communications towers (including radio, television, cellular, and microwave) creates a potentially significant impact on migratory birds, especially some 350 species of night-migrating birds. However, the Service has developed voluntary guidelines for minimizing impacts.

Transmission Lines - Migratory birds, especially large species with long wingspans, heavy bodies, and poor maneuverability can also collide with power lines. In addition, mortality can occur when birds, particularly hawks, eagles, kites, falcons, and owls, attempt to perch on uninsulated or unguarded power poles. To minimize these risks, please refer to guidelines developed by the Avian Power Line Interaction Committee and the Service. Implementation of these measures is especially important along sections of lines adjacent to wetlands or other areas that support large numbers of raptors and migratory birds.

Wind Energy - To minimize impacts to migratory birds and bats, wind energy projects should follow the Service's Wind Energy Guidelines. In addition, please refer to the Service's Eagle Conservation Plan Guidance, which provides guidance for conserving bald and golden eagles in the course of siting, constructing, and operating wind energy facilities.

State Department of Natural Resources Coordination

While it is not required for your Federal section 7 consultation, please note that additional state endangered or threatened species may also have the potential to be impacted. Please contact the Minnesota or Wisconsin Department of Natural Resources for information on state listed species that may be present in your proposed project area.

Minnesota
Minnesota Department of Natural Resources - Endangered Resources Review Homepage
Email: Review.NHIS@state.mn.us

Wisconsin
Wisconsin Department of Natural Resources - Endangered Resources Review Homepage
Email: DNRERReview@wi.gov

We appreciate your concern for threatened and endangered species. Please feel free to contact our office with questions or for additional information.

Note: IPaC has provided all available attachments because this project is in multiple field office jurisdictions.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Minnesota-Wisconsin Ecological Services Field Office
4101 American Blvd E
Bloomington, MN 55425-1665
(952) 252-0092

This project's location is within the jurisdiction of multiple offices. However, only one species list document will be provided for all offices. The species and critical habitats in this document reflect the aggregation of those that fall in each of the affiliated office's jurisdiction. Other offices affiliated with the project:

Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
(517) 351-2555

Project Summary

Project Code: 2022-0010398
Event Code: None
Project Name: Superior Falls Project Boundary
Project Type: Dam - Operations
Project Description: Superior Falls IPAC list in Gogebic County, MI
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@46.55285475,-90.41129570421043,14z

Counties: Michigan and Wisconsin

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened
Gray Wolf *Canis lupus* Population: U.S.A.: All of AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, and WV; and portions of AZ, NM, OR, UT, and WA. Mexico. There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/4488	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045 General project design guidelines: https://ipac.ecosphere.fws.gov/project/V73WTBTKUJF7LMIGBU36T6DMP4/documents/generated/5664.pdf	Threatened

Birds

NAME	STATUS
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Black Tern *Chlidonias niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20

NAME	BREEDING SEASON
Bobolink *Dolichonyx oryzivorus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Eastern Whip-poor-will *Antrostomus vociferus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Aug 20
Golden-winged Warbler *Vermivora chrysoptera* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8745	Breeds May 1 to Jul 20

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

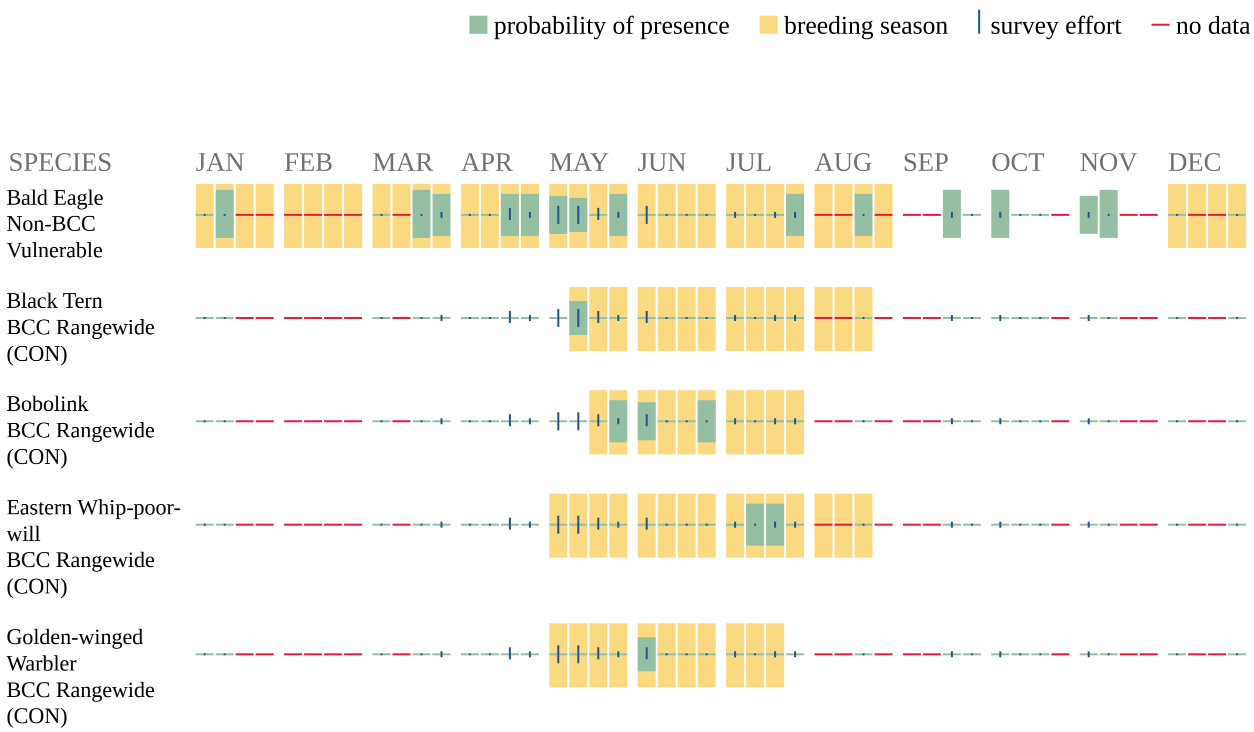
Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php

- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be

aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

FRESHWATER FORESTED/SHRUB WETLAND

- PFO1/4B
- PFO1/SS1C
- PFO2/SS3E
- PFO1C

FRESHWATER EMERGENT WETLAND

- PEM1C

RIVERINE

- R2UBH
- R5UBH
- R4SBC

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APPENDIX E-39 Saxon Falls NHI Review (Public)

This appendix has been e-filed separately as privileged information.

APPENDIX E-40 Superior Falls NHI Review (Public)

This appendix has been e-filed separately as privileged information.

APPENDIX E-41 BITP-BITA for Wisconsin Cave Bats

Broad Incidental Take Permit and Broad Incidental Take Authorization for Wisconsin Cave Bats

Conservation Plan - May 2020

During this COVID-19 pandemic, there is increasing concern that symptomatic or asymptomatic humans could inadvertently pass the virus that causes COVID-19 disease in humans to mammals, including bats, during handling. As a reminder, any handling of bats by a pest control operator requires an Endangered/Threatened (E/T) Species Permit (this is not required for a landowner). In addition, please be sure to continue following disinfection protocols for any equipment used during bat removals or exclusions (see Appendix 4).

The department has issued this broad incidental take authorization (used by state agencies) and broad incidental take permit (used by non-state agencies and individuals), as provided for under s. 29.604, Wis. Stats., to allow for the incidental taking of state listed cave bats in Wisconsin that may occur as a result of specific public health concerns, bat removals, building demolitions, tree cutting, bridge demolitions, miscellaneous building repairs and wind energy development projects.

This permit and authorization cover the above activities only if the associated minimization measures are followed and take is reported (where required). These measures must be followed when a bat is present or suspected to be present (e.g., evidence of bat presence, Endangered Resources Review). Please note that the northern long-eared bat is currently listed as threatened in Wisconsin and threatened with 4(d) rule at the federal level by the United States Fish and Wildlife Service (USFWS, http://www.fws.gov/Midwest/endangered/mammals/nleb/index.html). For the activities listed above, this Conservation Plan includes both state and federal requirements. The state cannot permit or authorize take of a federally listed species, however this Conservation Plan was written to incorporate both state and federal requirements.

For activities not listed above, contact the Wisconsin Department of Natural Resources' Endangered Resources Review Program (DNRERReview@wi.gov) for more information on state and federal requirements. Please note that building demolition, tree cutting, bridge projects, miscellaneous building projects and wind energy development typically require a full Endangered Resources Review http://dnr.wi.gov/topic/ERReview/Review.html to determine impacts to other wildlife species as well.

An incidental take permit or authorization is typically issued on a project-by-project basis, however a broad incidental take permit and broad incidental take authorization were created for this situation so that neither an application nor a permit fee are required. An individual following the minimization measures listed below is automatically covered by this broad incidental take permit/authorization. Take will be minimized by following specific minimization measures and the Department has concluded that the projects covered under this permit/authorization are not likely to jeopardize the continued existence and recovery of the state population of these bats or the whole plant-animal community of which they are a part; and has benefit to the public health, safety or welfare that justifies the action.

Project Location

Statewide

Project Information

This permit/authorization cover specific public health concerns, bat removals, building demolitions, forestry activities, bridge demolitions, miscellaneous building repairs and wind energy development projects as described in *Minimization Measures.*

Species Information

This permit/authorization cover all cave bats currently listed in Wisconsin (NR 27.07, Wis. Admin. Code):

- Big brown bat (*Eptesicus fuscus*) – State Threatened
  The big brown bat is a large insectivorous bat, weighing 15.0-26.0 grams. Fur color is russet to dark brown, and the muzzle is black and hairless. In summer, big brown bats commonly roost in artificial structures such as barns, but these bats will also use crevices in trees and rock faces. Big brown bats migrate short distances to caves and mines where they will hibernate for the winter.
- Eastern pipistrelle (*Perimyotis subflavus*) – State Threatened
  The eastern pipistrelle is Wisconsin's smallest bat weighing 4.0-8.0 grams. Fur color ranges from golden brown to reddish brown, and the wing membrane is black with red forearms. The eastern pipistrelle is an insectivorous bat. In summer, these bats commonly roost in the branches of deciduous trees disguised as a leaf. This species migrates short distances to caves and mines in the fall where they hibernate over the winter.
- Little brown bat (*Myotis lucifugus*) – State Threatened
  The little brown bat is a medium-sized member of the genus *Myotis*. This insectivorous bat weighs 5.0-12.5 grams, and has tan, reddish-brown or dark brown fur. This species commonly uses artificial structures such as attics and barns as summer roosting sites, but will also roost in crevices and cavities of trees. In fall, little brown bats make local long-distance migrations of up to 279 miles to caves and mines where they will hibernate for the winter.
- Northern long-eared bat (*Myotis septentrionalis*) – State Threatened and Federally Threatened
  The northern long-eared bat is dark brown with a gray belly, weighing 5.0-8.0 grams and is insectivorous. In summer this bat roosts in trees behind loose bark and in cracks/crevices/holes along the trunk of the tree. It rarely roosts in artificial structures. Unlike most of the state's bats, this species commonly forages in forest interior. In fall the northern long-eared bat migrates to caves and mines where they will hibernate for the winter.

Likely Impact to Species

Although minimization measures to protect the big brown bat, eastern pipistrelle, little brown bat and northern long-eared bat are incorporated into this broad incidental take permit/authorization, it is not possible to fully avoid incidental take of these species in all situations. Due to the nature of activities covered under this permit/authorization, it is difficult to determine the exact number of individuals that could be taken as a result of the project; however take will be minimized by following specific minimization measures. The Department has concluded that the take allowed for under this permit/authorization is not likely to jeopardize the continued existence and recovery of the state population of these bats or the whole plant-animal community of which they are a part.

Alternative Actions

The following alternatives were considered for this permit/authorization:

Alternative 1: Do not allow for any take of cave bats.

> This alternative was determined to not be feasible, due to the large number of affected activities, and is not an appropriate public health decision.

Alternative 2: Do not allow for any take of cave bats during the summer roosting period but allow for some take throughout the remainder of the year.

> This alternative was determined to not be feasible, due to the large number of affected activities that occur during the summer roosting period, and is not an appropriate public health decision.

Alternative 3: Allow for some take of cave bats, with minimization measures in place, during the summer roosting period and throughout the remainder of the year.

> This option was the preferred alternative because it addresses public health concerns; protects a large number of bats; and allows for most affected activities to continue as planned, or with minimal modifications.

Minimization Measures

This permit/authorization covers the activities listed below only if the associated minimization measures are followed and take is reported (where required). These measures must be followed when a bat is present or suspected to be present (e.g., evidence of bat presence, Endangered Resources Review). Please note that the northern long-eared bat is currently listed as threatened in Wisconsin and threatened with 4(d) rule at the federal level by the United States Fish and Wildlife Service (USFWS, http://www.fws.gov/Midwest/endangered/mammals/nleb/index.html). For the activities listed below, this Conservation Plan includes both state and federal requirements. The state cannot permit or authorize take of a federally listed species, however this Conservation Plan was written to incorporate both state and federal requirements.

For activities not listed below, contact the Wisconsin Department of Natural Resources' Endangered Resources Review Program (DNRERReview@wi.gov) for more information on state and federal requirements. Please note that building demolition, tree cutting, bridge projects, miscellaneous building projects and wind energy development typically require a full Endangered Resources Review http://dnr.wi.gov/topic/ERReview/Review.html to determine impacts to other wildlife species as well.

Note: Take covered under this permit/authorization must be reported within 5 working days (where required below). Take not reported within 5 working days is not legally covered and is in violation of the Wisconsin Endangered Species Law (s. 29.604, Wis. Stats.). Reports can be submitted via email (DNRBats@wi.gov), or by submitting a sick/dead bat report using the form: http://wiatri.net/Inventory/Bats/Report/BatForm.cfm. When using the form, state that you are reporting take in the "Additional Comments" section.

A. Health Exceptions

The landowner, rather than the DNR, is allowed to determine if they believe there is a health risk under this section (Section A).

Centers for Disease Control and Prevention (CDC) protocols should be followed for all situations where rabies or histoplasmosis is a possibility or may become a possibility if action is not taken (see Appendix 1).

Additionally, exclusions completed from June 1 through August 15 must be reported to the Department by submitting a Health Exemption Form in order to be covered under this permit or authorization. The landowner is responsible for completing and submitting the form, which is available online (http://dnr.wi.gov/topic/erreview/itbats.html). This form must be completed and submitted to the Department within **5 working days of start of work**.

If an activity qualifies as a health exception, it is exempt from timing minimization measures, and maximum take limits, but exclusions done during the non-exclusion period for human health reasons must still minimize take by following the approved exclusion protocols listed in Appendix 5. Exclusion practices used that are not described in Appendix 5 are in violation of this permit/authorization.

B. Bat Removals and Exclusions

Exclusion is defined as the process of allowing a colony of bats to leave the structure but not re-enter (i.e., use of one-way doors, see Appendices 2 and 5). Physically removing the colony of bats is not included in the definition of exclusion and is not covered under this section of the permit/authorization. Bats may be removed from the living space of a building at any time (see B.1. below).

Approved exclusion practices may be reviewed in Appendix 5. Exclusion practices used that are not described in Appendix 5 are in violation of this permit/authorization

If bats must be handled or transported for any reason during the exclusion process, the person conducting the exclusion must possess a valid Endangered/Threatened (E/T) Species Permit (http://dnr.wi.gov/topic/endangeredresources/permits.html). By obtaining the E/T Permit, the pest control operator can assure the landowner that practices used by the pest control company are in accordance with state law and no fines should incur while exclusion is completed. If bats must be handled during the exclusion, an E/T Permit holder (i.e. a rehabilitator or licensed pest control operator) may be contacted to handle the bats.

Practices that cause intentional take of the bats (i.e., sticky traps, sealing the entry/exit points to the roost with bats inside, large-hole netting that traps bats) are not considered exclusion methods, are not covered under this permit/authorization and are in violation of Wisconsin's Endangered Species Law (s. 29.604, Wis. Stats.).

1. Living Space or Place of Work

A living space is defined as a place of residence that is routinely and consistently inhabited. A living space does not include attics that are empty or used as storage.

If individual bats (5 or fewer) enter a living space or place of work, reasonable attempts must first be made to remove or exclude the bats alive and unharmed (see Appendix 2). If individual bats cannot realistically be removed unharmed, up to 5 bats may be killed for the purpose of removing them from a living space or place of work. No more than 5 bats may be killed within any 24 hour period and a maximum of 10 bats may be killed from June 1 – August 15 (**take report recommended – see "Note" above**).

Removals and exclusions from June 1 – August 15 are allowed in hospitals, medical clinics, day cares centers, nursing homes, assisted living facilities and restaurants.

2. Storage Areas, Attics, Barns, etc.

   Bats found in storage areas, attics, barns, etc., may be excluded from the area August 16 – May 31 (see Appendix 2). Exclusion may not occur from June 1 – August 15 unless a health exemption report form is filed (see Section A).

3. In an effort to help curb the spread of white-nose syndrome (WNS), bat exclusion professionals and pest control operators must follow these guidelines concerning cleaning equipment (NR 40, Wis. Admin. Code.):

   - Equipment used outside of Wisconsin should be thoroughly cleaned and disinfected before use in Wisconsin following the protocols in Appendix 4.
   - Equipment used at multiple sites within Wisconsin should be cleaned thoroughly and disinfected between uses following the protocols in Appendix 4. Materials that come in direct contact with bats such as bat cones or exclusion devices should not be used at multiple sites and should be discarded after use.

C. Building Demolition

Please note that timing restrictions in this section vary slightly from those listed for other activities. Bats typically leave summer roosts (in buildings or other locations) in late fall and begin to return in early spring. However, one bat species in Wisconsin is known to hibernate in buildings in winter. Bats are not actively flying during winter hibernation and can appear dead. As a result, traditional exclusion methods do not work.

1. For projects occurring where there is no evidence of bat presence (see Appendix 3), there are no restrictions.
2. For building demolition occurring from June 1 – August 15, where there is evidence of bat presence (see Appendix 3):
   - Building demolition and bat exclusions are generally not permitted during this time period in order to protect flightless pups in the roost. Exclusion and subsequent demolition may occur only if the bats are considered by the landowner to be a health risk. In these situations, a health exemption form must be completed within 5 days of starting work (see section A).
3. For building demolition occurring from August 16 – October 31 or March 16 – May 31, where there is evidence of bat presence (see Appendix 3):
   - Bats must be excluded from the building for at least 7 consecutive days immediately prior to demolition. Full exclusion is not required if the building is unsafe to enter, however reasonable attempts should still be made to exclude as many bats as possible while keeping all people safe. (Report required for unsafe buildings – see "Note" on Page 3.)
4. For building demolition occurring from November 1 – March 15, where there is evidence of bat presence (see Appendix 3):

- For any bats found prior to demolition work or encountered during the demolition phase, attempts must be made to transfer the bats to a wildlife rehabilitator for the remainder of the hibernation period OR the DNR's bat biologists must be consulted for additional options (Paul White, 608-267-0813 and john.white@wi.gov, or Heather Kaarakka, 608-266-2576 and heather.kaarakka@wi.gov).

D. Tree Cutting

Northern long-eared bats are federally protected in trees that are known maternity roosts (from June 1 – July 31) and in areas where known hibernacula could be impacted (including tree removal within 0.25 miles of a hibernacula entrance). If you will be cutting trees, please have an Endangered Resources Review http://dnr.wi.gov/topic/ERReview/Review.html conducted to determine if known northern long-eared bat maternity roosts or hibernacula exist near your project. If the Endangered Resources Review states that these areas do not exist near your project, there are no restrictions for tree cutting; however special consideration should be given to protecting snags or dying trees, particularly from June 1 – August 15.

E. Bridge Projects

The process for assessing transportation project impacts to listed species and the associated minimization measures will follow existing protocols.

1. Bridge repairs or demolition occurring from August 16 – May 31 do not have any restrictions. If bats are present, reasonable attempts should be made to prevent take by excluding the bats from the structure prior to demolition.
2. Emergency bridge repairs or demolition occurring from June 1 – August 15 are covered under this permit/authorization but must be reported within 5 working days (**report required – see "Note" above**).
3. Non-emergency bridge repairs or demolition may not occur from June 1 - August 15 unless bats are excluded prior to April 1 to prevent bats from using the bridge during the maternity period.

F. Miscellaneous Building Projects (e.g., roofing, painting, siding)

1. For projects occurring where there is no evidence of bat presence (see Appendix 3):
    - Full bat exclusions are not required.
    - If roofing, painting or siding and bats are found incidentally under shingles or roof vents, or behind shutters or siding, set the shutters or siding down and leave the area. Once the bats have left, continue with repairs. If bats do not leave, attempts should be made to transfer the bats to a wildlife rehabilitator OR the DNR's bat biologists should be consulted for additional options (Paul White, 608-267-0813 and john.white@wi.gov, or Heather Kaarakka, 608-266-2576 and heather.kaarakka@wi.gov).
2. For projects occurring from June 1 – August 15, where there is known bat presence (see Appendix 3):
    - Building projects with the potential to impact bats and bat exclusions are generally not permitted during this time period in order to protect flightless pups in the roost. Exclusion and subsequent building repairs may occur only if the bats are considered

by the landowner to be a health risk. In these situations, a health exemption form must be completed within 5 days of starting work (see section A).

- If roofing, painting or siding and bats are found incidentally under shingles or roof vents, or behind shutters or siding, set the shutters or siding down and leave the area. Once the bats have left, continue with repairs. If bats do not leave, attempts should be made to transfer the bats to a wildlife rehabilitator OR the DNR's bat biologists should be consulted for additional options (Paul White, 608-267-0813 and john.white@wi.gov, or Heather Kaarakka, 608-266-2576 and heather.kaarakka@wi.gov). Note that full bat exclusions are not required when bats are only incidentally found during miscellaneous building projects.

3. Projects occurring from August 16 – May 31 where there is known bat presence (see Appendix 3):

   - Take should be minimized during the course of the project by following applicable exclusion protocols listed in Appendix 5. Exclusion practices used that are not described in Appendix 5 are in violation of this permit/authorization.
   - If roofing, painting or siding and bats are found incidentally under shingles or roof vents, or behind shutters or siding, set the shutters or siding down and leave the area. Once the bats have left, continue with repairs. If bats do not leave, attempts should be made to transfer the bats to a wildlife rehabilitator OR the DNR's bat biologists should be consulted for additional options (Paul White, 608-267-0813 and john.white@wi.gov, or Heather Kaarakka, 608-266-2576 and heather.kaarakka@wi.gov). Note that full bat exclusions are not required when bats are only incidentally found during miscellaneous building projects.

G. Wind Energy Development

Wind energy projects typically affect tree bat species (not currently listed) and only impact cave bat species in certain situations (e.g., projects located near cave bat hibernacula may increase the occurrence of impacts to cave bats especially during fall migration in August and September). Further, there is not enough data at this time to determine the impact of potential mortality to local bat populations. Because of this uncertainty and the scope of impacts, no additional actions, above those currently requested by the Department, will be required of this industry at this time.

Mitigation

For every take of a cave bat that occurs, reasonable attempts must be made to prevent future take in the same area (e.g., exclusion of bats from the area, sealing of siding or eaves after bats are gone).

Responsible Parties

Landowners are responsible for all actions and costs incurred as a result of following this Broad Incidental Take Permit/Authorization.

Funding

Landowners are responsible for all costs incurred as a result of following this Broad Incidental Take Permit/Authorization.

Appendix 1: Health Information

Appendix 2: Removing and Excluding Bats

Appendix 3: Determining Bat Presence

Appendix 4. Cleaning and Disinfection Protocols for Bat Exclusion Professionals

Appendix 5. WDNR Exclusion Protocol

Appendix 1: Health Information

The following information was created by the Center for Disease Control and Prevention (CDC): http://www.cdc.gov/rabies/bats/contact/index.html. This information should be followed when handling or testing bats for rabies or histoplasmosis.

Recent data suggest that transmission of rabies virus can occur from minor, seemingly unimportant, or unrecognized bites from bats. Human and domestic animal contact with bats should be minimized, and bats should never be handled by untrained and unvaccinated persons or be kept as pets.

In all instances of potential human exposures involving bats, the bat in question should be safely collected, if possible, and submitted for rabies diagnosis. Rabies postexposure prophylaxis is recommended for all persons with bite, scratch, or mucous membrane exposure to a bat, unless the bat is available for testing and is negative for evidence of rabies.

Postexposure prophylaxis should be considered when direct contact between a human and a bat has occurred, unless the exposed person can be certain a bite, scratch, or mucous membrane exposure did not occur.

In instances in which a bat is found indoors and there is no history of bat-human contact, the likely effectiveness of postexposure prophylaxis must be balanced against the low risk such exposures appear to present. Postexposure prophylaxis can be considered for persons who were in the same room as a bat and who might be unaware that a bite or direct contact had occurred (e.g., a sleeping person awakens to find a bat in the room or an adult witnesses a bat in the room with a previously unattended child, mentally disabled person, or intoxicated person) and rabies cannot be ruled out by testing the bat. Postexposure prophylaxis would not be warranted for other household members.

If you woke up because a bat landed on you while you were sleeping or if you awakened and found a bat in your room, you should try to safely capture the bat and have it tested. The same precautions should be used if you see a bat in a room with an unattended child, or see a bat near a mentally impaired or intoxicated person.

The small teeth of the bat can make a bite difficult to find. Be safe and in these situations, try to safely capture the bat, have the bat tested, and seek medical advice.

Appendix 2: Removing and Excluding Bats

Bat Exclusion

Method used by The Wisconsin Bat Program

A PROVEN SOLUTION

Do you have bats that you would like to remove from your living space? The following description is the widely accepted, non-lethal approach for excluding bats from your home. Killing the bats you will find does not solve the root problem which involves locating and sealing the actual access point that the bats are using. The remaining bats and future bats will still find their way into your attic or similar roosting space until you locate and seal all access points. Bats are NOT rodents and therefore will NOT chew their way into your house if you close off the opening. They use only existing openings.

As you may already know, bats are extremely beneficial to have in your neighborhood and many property owners spend a lot of effort trying to attract bats to their area by providing artificial roosts for them. If you have bats in your home you are half-way to experiencing the benefits of these insect-eating mammals without having to share your living space. The first step is already done; you have the bats interested in your location. The second step involves providing these bats with alternative roosting options that allows them to remain on the property without having access to your home. Finally, after a successful exclusion, the bats you saved will have a good chance of staying nearby. Why should you care if they stay? A single bat can eat 1,000 or more mosquito-sized insects in one hour and the equivalent of the bat's own body weight per night. As that is just a single bat, you can imagine what a colony of 20 to 100 bats can eat in one night.

Bats will NOT attack you while you are enjoying an evening on your porch. Instead, they are enjoyable to view as they capture 100's and 1,000's of insect pests that would normally be interrupting your relaxing night outside. They conduct this service to you for free. You simply need to provide these bats with an alternative place to live that is not in your home. Like bird houses, a bat house is relatively easy to build yourself, inexpensive to purchase, and readily available from a variety of organizations.

Let's get started with the process.

First of all, timing is important when excluding bats from the home. Do not attempt to exclude bats during the summer months when the colony is established and the young are unable to fly. Bat exclusions should not be conducted from May 1st through August 31. Exclusions occurring during this time period will separate mothers from their pups, leaving the pups to die of starvation. Frantic mothers, searching for an opening to reach their pups, may enter your living space and be more difficult to deal with than what you started with. By trapping the flightless young inside, you may also have created another unexpected problem involving the smell of dead animals.

Step 1: OBSERVE
Where are the bats entering?

At sunset or just before sunrise, have one or more persons located around the house observe where the bats are exiting the building. Observers should be able to see the entire structure without turning their heads; bats can exit and take flight in a matter of seconds. Make observations

Bat Guano

for several nights. This will ensure that all or most exit-points are identified. Pay special attention to areas in which bats commonly find access to your home: corners, eaves, louvers, loose siding, window air conditioners, and loose or damaged screens. Search the building for other various structural defects needing maintenance as the bats may search for alternative openings to their former roosting site after exclusion. It may take a second year of observation to ensure you have located all possible entry points.

Visible signs such as staining and guano (bat droppings) will also help identify openings. The body oils of bats can cause

Bat guano in front of garage

staining on the main access areas of the building, though you will need to look carefully because it is not always obvious. One of the best ways to find an opening is somewhat counter-intuitive: looking down instead of up. Guano found on the ground indicates bat activity from their opening above. When you find a concentration of these small droppings on the ground next to the foundation, you will often have a better chance of finding the access point.

Step 2: INSTALL
Can we still keep the bats here in my yard by putting up a bat house?

YES. Want to provide bats with a home, just not your own? We recommend installing an alternative roost, commonly referred to as a “bat house”, in the general vicinity of the entry-points. If you exclude in the fall, installing the bat house a year before the exclusion or during the start of summer, provides the best chance for

Two types of bat houses

success. As bats come and go, they will become familiar with the structure. Upon exclusion, this familiarity will provide the best possible chance for the successful inhabitation of the bat house by the recently excluded bats. If you are interested in purchasing or building bat houses, contact the Wisconsin Bat Monitoring program. The program staff can help you decide on where to purchase the best bat house design with proven success. The Wisconsin Bat Monitoring program can also give you instructions for building your own bat house. Read our information pamphlet titled: "Building a Bat House" to learn how to build and locate your bat house. Location and design are critical pieces as bats are more difficult to attract to a bat house than birds are to a bird house.

Step 3: EXCLUDE

1. One-way doors 2. One-week wait, 3. Seal all of the holes.

After all openings have been discovered, install one-way exits. These exits will allow bats to leave, but will not allow them to re-enter. Keep in mind the time of year as you do not want to trap the flightless young inside. Avoid excluding bats between May 1st and August 31st.

One-way exclusion devices can be created using plastic netting with one-sixth inch (0.4 centimeter) or smaller mesh. Shape the plastic netting so that it covers the opening entirely and extends at least two feet below it. Using staples or duct tape, attach the top and side edges of the

Applying screen for one-way door

plastic netting to the building, leaving the bottom edge open. Be conscious of the netting's tautness; you should be able to slide your hand into the bottom opening though not so loose that the bats may easily crawl back up the opening. At sunset the following night, some of the bats will escape through the open, bottom portion. Leave the netting up for five to seven days; this will ensure that all bats have exited the building. After all bats have been excluded, you may then seal the openings permanently with appropriate construction materials.

Space on bottom for bats to escape

Remember that bats will not chew their way back inside your house. So, after you've found and sealed all of the access points you will have successfully excluded the bats from your living space.

Other materials can be used to create one-way exits, such as plastic sheeting or PVC pipe. Install the plastic sheeting in the exact manner as the plastic netting. A portion of PVC pipe, which should be similar in size to a tube of caulk, can be inserted into the opening. Seal the remaining portion of the opening that surrounds the outer rim of the pipe.

PVC one-way door

Clean-up

After the bats have been successfully excluded, most people will want to clean the guano out of the building. When cleaning enclosed spaces, there is one simple precaution you should take in protecting yourself from being exposed to a disease known as histoplasmosis. Histoplasmosis is a respiratory disease caused by a fungus that can grow on accumulations of bird and bat guano and may become airborne if disturbed during the cleaning process. The fungus is not necessarily present at your site; however it is best to approach any clean-up with some safety measures. Symptoms of histoplasmosis usually appear within 3 to 17 days after exposure, and may resemble a cold or chronic cough. The risk of histoplasmosis can be reduced and even prevented by wearing a face mask and gloves while working. Wash all clothes and equipment after cleaning out the previously occupied space. If you want nothing to do with a possible risk to your health there are professional cleaning services that can do this for you. Search online or in your phone directory for a local business. There are also a number of exclusion professionals that deal specifically with bat removal in the State of Wisconsin if you are not comfortable with the do-it-yourself method.

Summary

This is how you conduct widely accepted, non-lethal approach to excluding bats from your living space.

1. Observe your building around sunset or sunrise to detect all locations bats are using for access.
2. Install a bat house prior to conducting exclusion in order to maintain the beneficial insect-eating service of the bats in your back yard.
3. Install a one-way door over the opening(s) and wait a week until all of the bats have left.
4. Permanently seal the access points with appropriate materials.
5. Enjoy a night on your deck or patio and watch your relocated colony of bats eat 100's to 1,000's of mosquito-sized insects.
6. Let us know how it worked out as we would like to hear your success story about relocating bats from your attic to their own bat house.
7. For additional information on bats of Wisconsin check out our bat website.

Wisconsin Bat Monitoring Program
http://wiatri.net/inventory/bats

Bat Access points to your living space

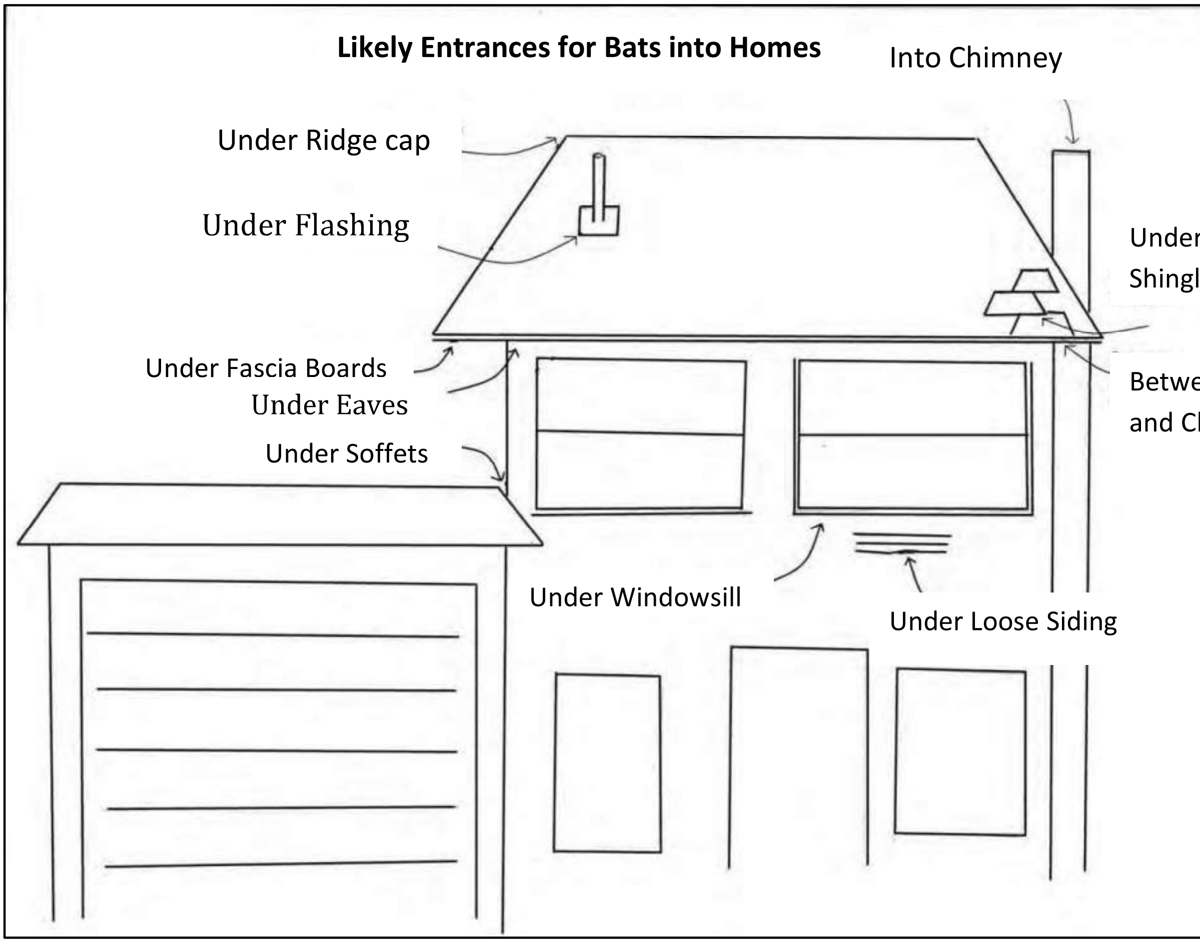

Figure 1: There are several common entry points for bats to find their way into your home. Check for guano piles and stains around these points first in locating the entry points.

Exit Only

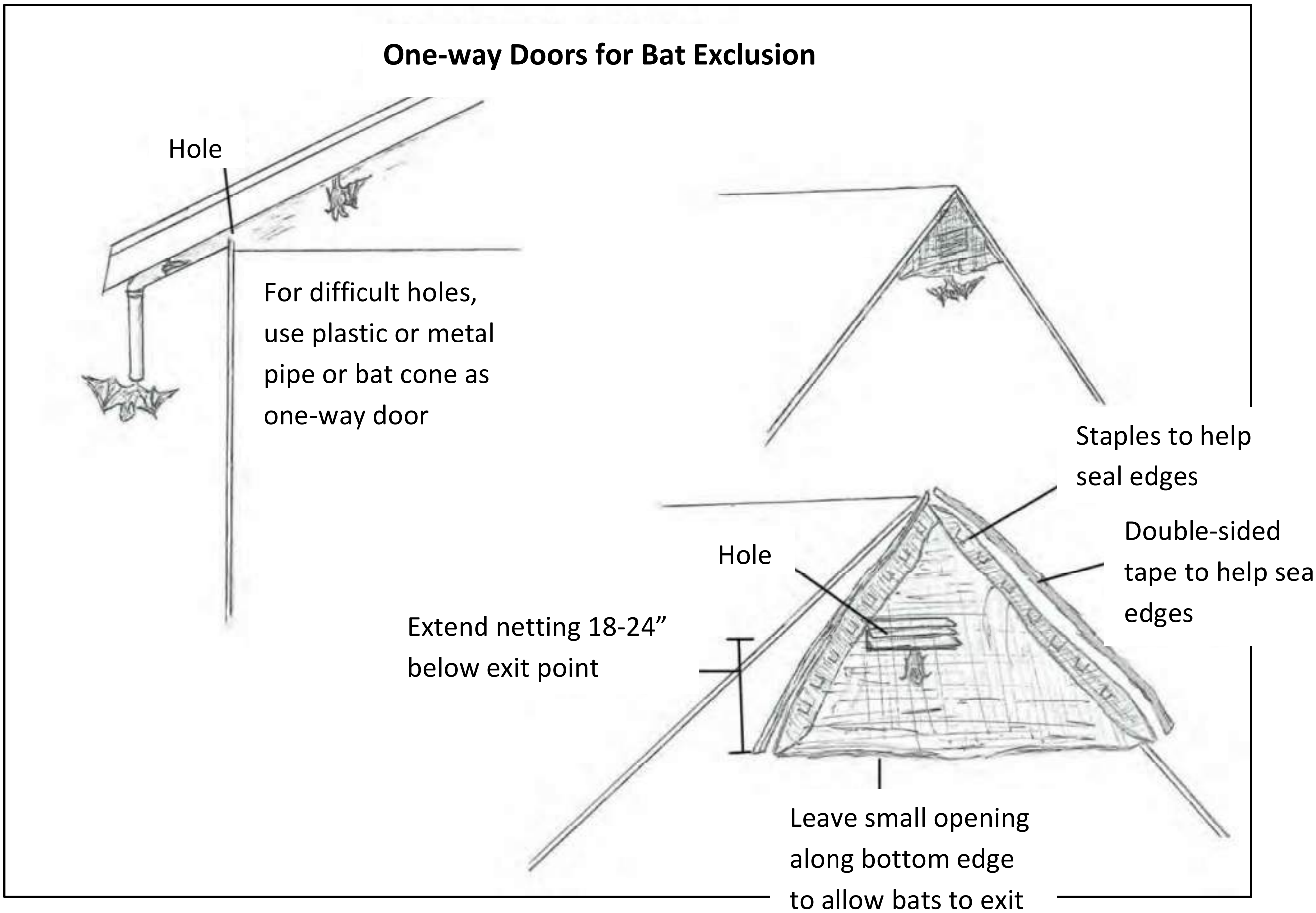

Figure 2: Two common one-way door designs: PVC tube for a small oddly-shaped hole, and netting or mesh for larger holes.

Appendix 3: Determining Bat Presence

1. Take note of places where bats are likely to enter your home. Bats can enter through holes smaller than a quarter in size. Places like fascia boards, where two buildings meet, between the building and a chimney, under loose shingles, under ridgecaps, under windows, through vents into attics, under flashing, under eaves and under loose siding are all common places for bats to enter.

2. Look for evidence on the ground. Bats will defecate while they roost, and piles of guano usually indicate where bats are roosting.

3. Look for evidence on the building itself. Places where bats enter and exit often have stains from urine and skin oils on the siding and holes. These can be good indications of where bats are entering.

4. Monitor in the evening. Even if no visible signs occur, bats may still be roosting in a building. Observe the building at dusk to see if any bats fly out of openings. Listening at this time can also alert the observer to the presence of bats. Bats will often become very vocal 5-10 minutes before they take flight to forage. Bats make an audible buzzing and clicking while they are roosting.

Appendix 4.

The WDNR is requiring cleaning of all equipment and clothing that comes in contact with cave bats and their habitat at any point during the year in an effort to control human transmission of white-nose syndrome. The fungus that causes white-nose syndrome, *Pseudogymnoascus destructans* was listed as prohibited invasive species in 2011 under NR. 40, and allow for the following control measures.

All equipment and clothing that is used outside of the state of Wisconsin and at multiple sites within the state during exclusion must be cleaned according to the protocols listed in appendix 4. Protocols are in accordance with U.S. Fish and Wildlife Service white-nose syndrome decontamination procedures: http://whitenosesyndrome.org.

Additionally, to minimize risk of possible transfer of the SARS-CoV-19 to North American bats, follow these guidelines for proper Personal Protective Equipment during work.

1. Per CDC guidelines for COVID-19, to block or minimize exchange of respiratory droplets wear a mask when doing work involving bats, including installation of one-way doors and cleaning of attics.
2. Use of disposable equipment and coverings (gloves, coveralls and booties) is highly recommended.
3. All equipment used during the exclusion process should be thoroughly scrubbed or brushed to remove all organic material.
4. Once scrubbed of organic material, clothing and equipment must be sealed in a plastic container or bag to be transported to a suitable site for cleaning. Anything that can be disposed of must be sealed in a plastic trash bag and discarded.
    a. All equipment and clothing that can be **completely submersed** must be washed with Woolite in wash cycle, rinsed, then
        i. submersed in hot water (>131 degrees F) for a minimum 20 minutes
        ii. soaked in 1:10 bleach solution for a minimum of 10 minutes,
        iii. soaked in 1:128 Lysol for a minimum of 10 minutes.
    b. All equipment that **cannot be completely submerged** in a solution or hot water or must be used immediately between sites must be scrubbed to remove all organic material and wiped with Lysol disinfecting wipes so that the entire surface is disinfected.
5. All equipment and clothing must air dry.
6. Prior to entering the vehicle, clean or remove clothing and footwear to avoid contaminating vehicles.

Appendix 5: WDNR Exclusion Protocol

Exclusion activities outside of the following protocol are not covered under the Broad Incidental Take Permit/Authorization and mortality may incur fines. The landowner and/or the pest control operator completing the work may be liable for fines.

Exclusion is the act of allowing bats to leave but not return to a building through the use of one-way doors. One-way doors may be comprised of the following materials and design:

1. **Tubing**- Tubes for exclusion may be plastic or metal and should hang down at least 10-15 inches from the opening. Netting may be installed at the end of the tube to prevent re-entry but the mesh must be plastic with holes smaller than 1/6th inch.
2. **Mesh or netting**- Netting may be installed over entry/exit points, but the netting must have holes 1/6th inch or smaller so as to not trap bats, and must extend at least two feet below the entry point. The mesh/netting must be open at the bottom to allow bats to exit under the screen.
    a. If it is found the netting used is tangling and trapping bats, the pest control operator must remove the bats and release them, and the netting must be replaced with smaller mesh or with a different type of one-way door.
3. **Plastic sheeting**- Plastic sheeting may be installed in a similar fashion to the mesh. There should be enough space behind the plastic to allow the bats to crawl out from behind the sheeting. It must be open at the bottom to allow the bats to exit.
4. **Changes to roosting environment**- changes can be made to the roosting habitat to discourage use by bats. These may include, but are not limited to, installation of windows to increase light in the roost, or installation of sheet metal on roosting surface to limit ability of bats to hang. Any changes to the roost environment must not cause take.

Exclusion devices must remain up for at least 5 days prior to sealing the openings, and there must not be bats in the roost when building is sealed.

APPENDIX E-42 Iron County Outdoor Recreation Plan

IRON COUNTY
OUTDOOR RECREATION PLAN 2016-2020










APRIL, 2016

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FIGURES

TABLES

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James Kichak
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Kelly Klein, Iron County Development Zone
Terry Daulton, Citizen
Tom Bergman, Zoning Administrator
Joe Olson, Representing snowmobile
Dave Traczyk, Representing ATV
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This plan was prepared by the Northwest Regional Planning Commission, under the guidance and direction of the Iron County Outdoor Recreation Planning Committee.

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Northwest Regional Planning Commission
NWRPC
keeping your future as our focus

PURPOSE

The purpose of this plan rewrite is to investigate Iron County's existing outdoor recreation resources, anticipate future demands and to identify recommendations for county-administered outdoor recreation facilities. Submission of this report to the Wisconsin Department of Natural Resources (WDNR) maintains eligibility for the County and local units of government for a variety of Federal and State Aids to purchase land and to add facilities to existing outdoor recreation lands. Preparation of this plan will be conducted in accordance with guidance found in Wisconsin Statute 23.30 Outdoor Recreation Program and the Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP).

PROCESS DOCUMENTATION

The Iron County Outdoor Recreation Plan was developed over a seven-month period from July of 2015 through January of 2016. During plan development, the Iron County Outdoor Recreation Planning Committee convened three times, on September 16th, October 28th and December 29th, 2015. Meeting Agendas and sign-in sheets are included in **Appendix A**. In order to solicit public feedback on recreation issues within Iron County, an online outdoor recreation survey was developed in July of 2015. The survey became active on August 8th, 2015 and remained active for a period of 30 days. Survey results are included in **Appendix B.**

COMPREHENSIVE PLAN INTEGRATION

At the time of the development of this Outdoor Recreation Plan, Iron County was engaged in a process to revise its long-range comprehensive plan. The Iron County *Asset Based Community Development Plan (ABCD)* will replace the 2008 Comprehensive Plan as the county's official framework for future growth, development and investment in Iron County. This plan will serve as an addendum to the ABCD plan and will also serve to inform and guide recreation-based strategies within the ABCD process.

VISIONING FRAMEWORK

Iron County prepared a number of goals and objectives to address the outdoor recreational needs of the residents. The goals and objectives are intended to assist the County Board and other community leaders in implementing actions deemed important and in the best interest of the County. It is imperative that the goals and objectives in this plan are implemented.

GOALS AND OBJECTIVES

GOAL
The Outdoor Recreation Plan shall serve to meet their varied recreation needs of Iron County residents and visitors while at the same time protecting, conserving, and enhancing the County's natural, historical, and cultural resources.

FACILITIES

OBJECTIVE 1.0:
Provide high quality recreation facilities for all users.

Policy 1.1
Improve and maintain existing facilities.

Policy 1.2
Develop new recreational facilities that will expand recreational opportunities for all residents and visitors.

Policy 1.3
Park and recreation facilities shall provide opportunities for all persons regardless of race, creed, age, sex, or economic status.

Policy 1.4
Develop, improve and maintain recreational facilities according to the Americans with Disabilities Act standard.

Policy 1.5
Encourage communities and local school districts to cooperate in the development of community recreational and playground facilities.

Policy 1.6
Measure the economic impacts provided by high quality recreation facilities in Iron County.

Policy 1.7
Include an educational component with recreational facilities, where appropriate.

OPPORTUNITES

OBJECTIVE 2.0:
Provide a network of parks and recreation areas that offer a diversity of high quality recreational opportunities.

Policy 2.1
Explore alternatives to expand recreational opportunities and programs throughout Iron County.

Policy 2.2
Expand recreational opportunities by proactively developing partnerships with public agencies and private entities.

Policy 2.3
Ensure balance of use, enjoyment and separation where appropriate between motorized and non-motorized modes of recreation.

Policy 2.4
Encourage/coordinate the multiple uses of recreational land, areas or facilities.

Policy 2.5
Measure the economic impacts of recreational opportunities and programs in Iron County

Policy 2.6
Include an educational component with outdoor recreational opportunities and programs, where appropriate.

RESOURCES

OBJECTIVE 3.0:
Protect, conserve and enhance natural, historical, and cultural resources.

Policy 3.1
Minimize recreational impacts to natural, scenic and historical resources.

Policy 3.2
Provide an appropriate level of access to publicly-owned areas unique in natural, historical or cultural resources.

Policy 3.3
Partner with communities, area school districts and other organizations to achieve a high level of educational benefits from the county's unique natural, historical and cultural resources.

Policy 3.4
Promote economic sustainability through natural, historical, and cultural resources protection.

PROMOTION

OBJECTIVE 4.0
Promote outdoor recreation in Iron County.

Policy 4.1
Improve funding opportunities for outdoor recreation

Policy 4.2

Focus on developing and maintaining partnerships to promote outdoor recreation in Iron County.

Action: *Partner with communities and school districts to promote outdoor recreation in Iron County.*

Policy 4.3
Improve public access to data and information about outdoor recreation in Iron County.

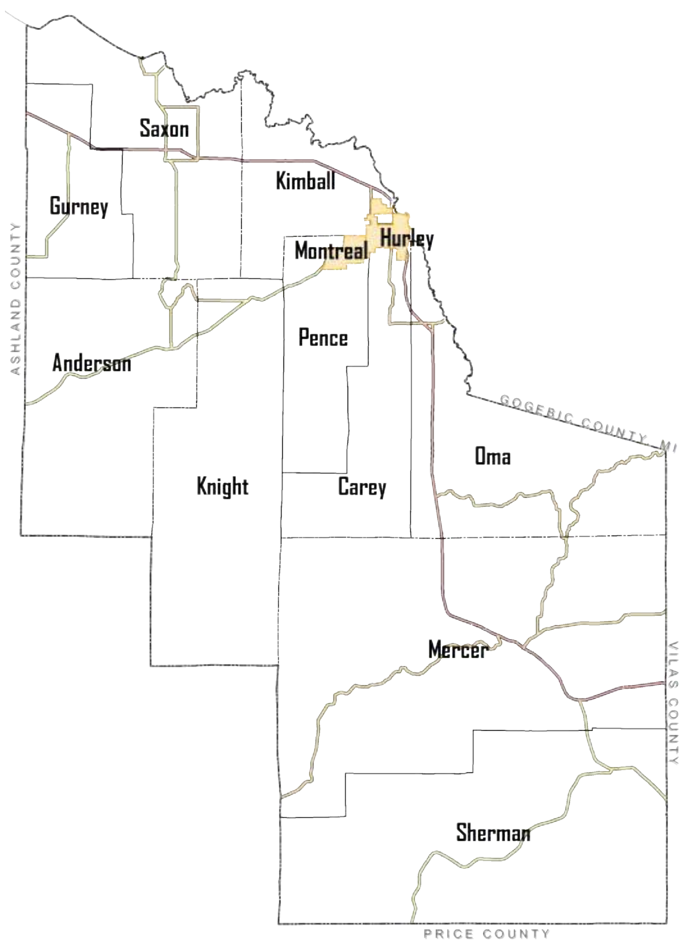
Policy 4.4
Promotional efforts should include an educational component, where appropriate.

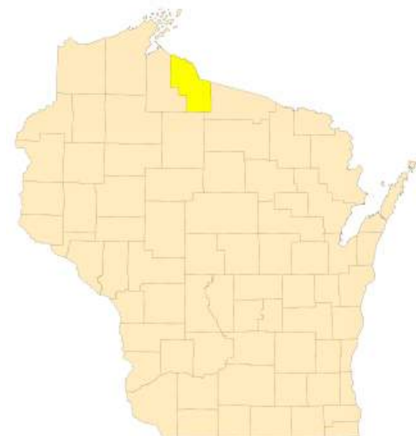
DESCRIPTION OF THE PLANNING REGION

SOCIAL CHARACTERISTICS

PHYSICAL SETTING

Iron County is located in northern Wisconsin and borders the south shore of Lake Superior and the Upper Peninsula of the State of Michigan. Iron County borders the counties of Ashland, Price, and Vilas in Wisconsin, and Gogebic County in Michigan. Iron County is 757.23 square miles in size and had a 2015 estimated population of 6,297. Local units of government within Iron County include ten civil towns and two cities. The City of Hurley is the largest municipality in the county and is the county seat.





2015 Population: 6,297

Median Age: 52.6 Years

Land Area: 757.23 mi^2

Water Area: 162.01mi^2

Percent Public: 52.6%

Percent Private: 47.4 %

County Forest: 174,159 Acres

State Land: 84,310 Acres

Private Lands Open to Public Recreation: 64,205 Acres

Public Land Per Capita: 37 Acres/person
(Statewide 1.2 Acres/Person)

Number of Lakes: 494

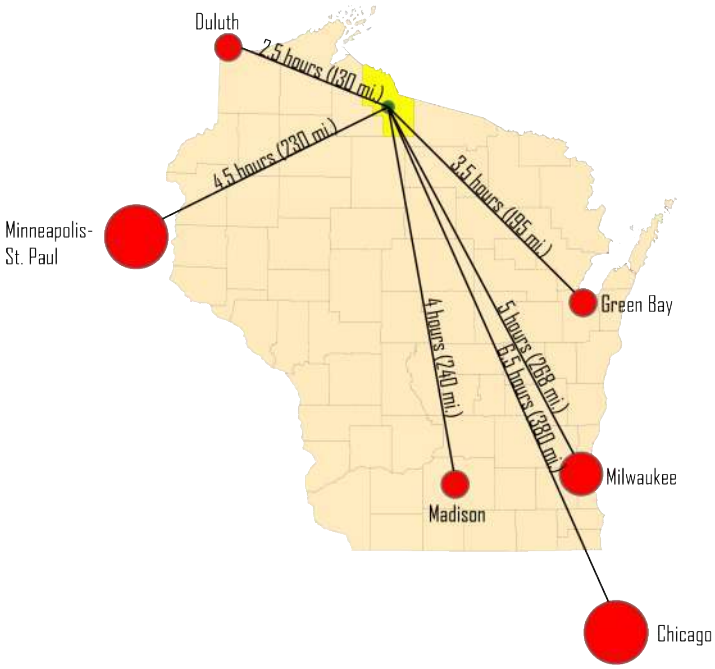
Miles of Shoreline: 740

Miles of Streams: 633

Miles of Trout Streams: 304

Direct Visitor Spending (2014):
$19 million (64th of 72 Counties)

Tourism Employment (2014):
264



Situated in the remote northern tier of Wisconsin, Iron County is one of the least densely populated counties in the state. Iron County is generally 4 or more hours, by vehicle, to major regional population centers.

POPULATION CHARACTERISTICS

Since the creation of Iron County from Ashland and Oneida Counties in 1893, the county's population has been quite erratic. The population increased the most in the ten years from 1910 to 1920, gaining 1,955 people, and sustained its greatest loss from 1940 to 1950, losing 1,335 residents. Recent data suggests the county's population has stabilized.

Figure 1: Iron County: Population 1990-2010

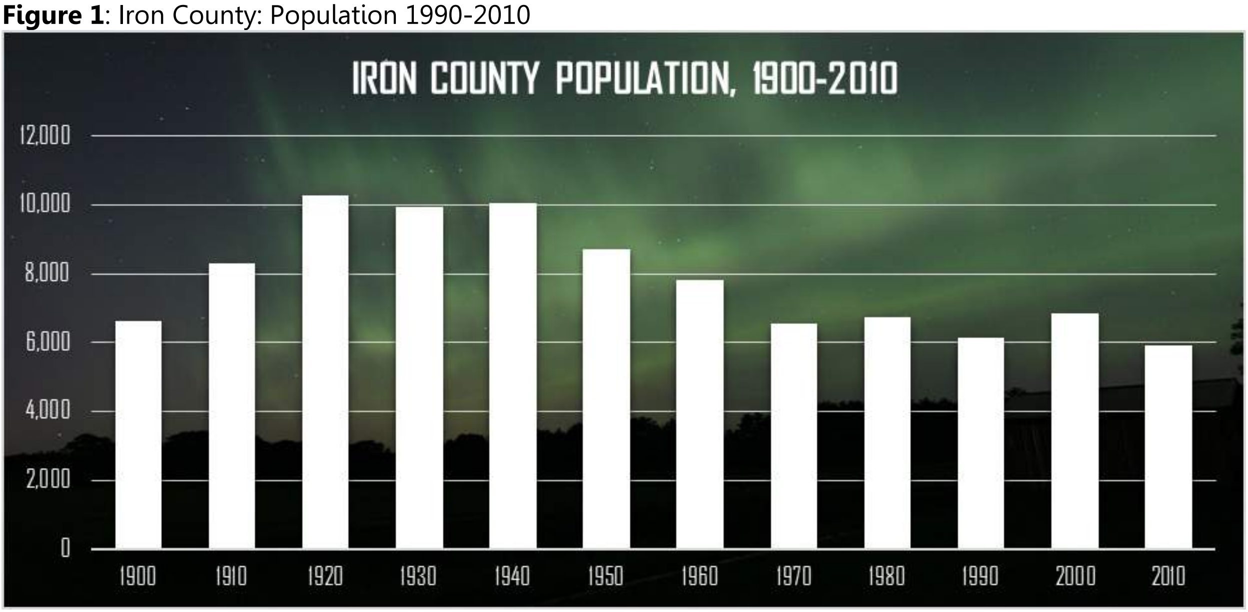
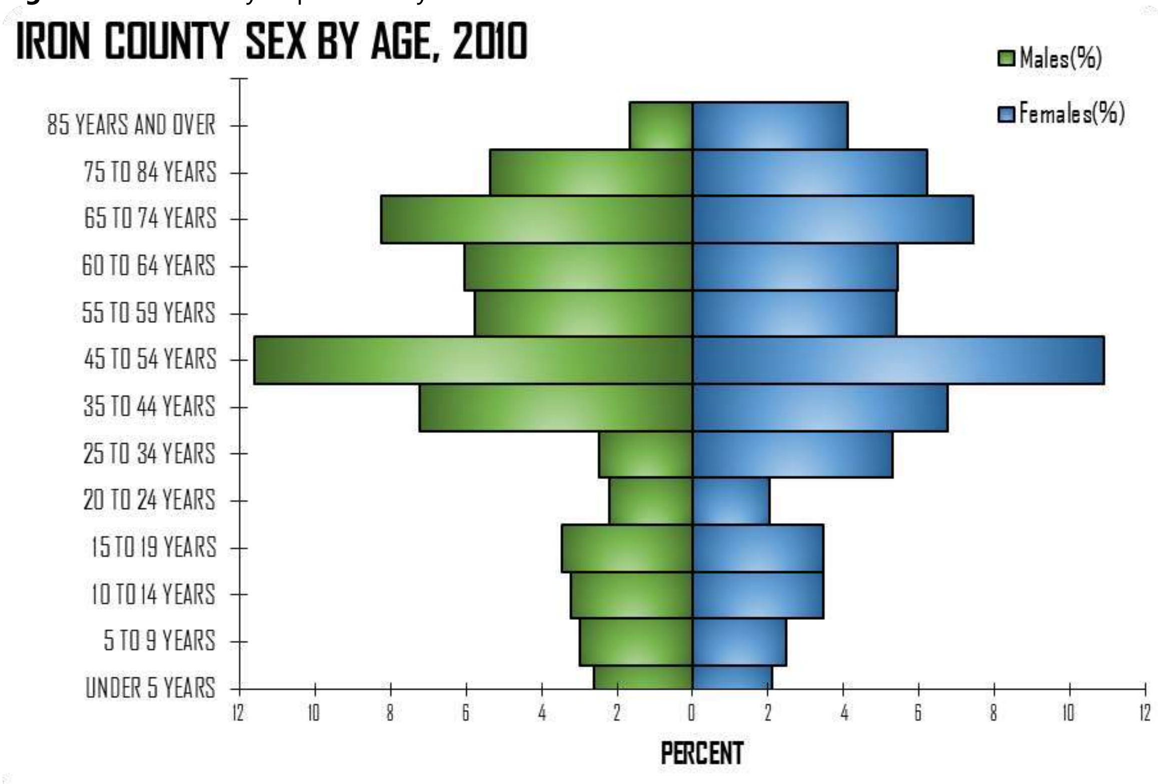


Figure 2: Iron County Population Pyramid



The population distribution of Iron County residents across age classes is reflective of many rural counties in northern Wisconsin. The graphical depiction of sex by age reveals a top-heavy structure, indicative of an aging population. A classic pyramidal shape is indicative of a young, rapidly growing population.

Table 1: Iron County Demographic Change, 2000-2010

Age Category	Absolute Change: 2000-2010	Percent Change: 2000-2010
Under 5	-61	-22.3%
5 to 14	-237	-30.1%
15 to 24	-171	-25.2%
25 to 34	-1241	-73.3%
35 to 44	-439	-40.8%
45 to 54	48	4.9%
55 to 64	170	19.8%
65 to 74	-92	-11.4%
75 to 84	-47	-8.2%
84 and over	50	23.5%

Source: U.S. Census Bureau, American FactFinder

The recreational needs of all Iron County age groups will be represented in this plan. Generally speaking, older residents are interested in more passive recreation, such as enjoying scenic views through the provision of seating and benches that allows for the enjoyment of nature trails and paths. Younger people tend to enjoy more active recreation, such as fishing and fitness trails and motorized recreation. Families often enjoy a broad range of activities such as camping and picnicking as well as motorized recreation.

POPULATION PROJECTIONS

Table 1.2 shows population projections for Iron County from 2010 to 2030. These projections are based on past and current population trends and are intended to be a baseline guide for county decision makers. The projections indicated that Iron County will experience a slow decline in population over the next 25 years. Although Iron County is "projected" to decline in population over the next 25 years, many feel that the county will actually increase in population like it has over the last decade.

Table 2: Population Projections

Year	Iron County
2020	5,680
2030	5,970
2040	5,420
Absolute Change 2010-2040	-496

Source: http://www.doa.state.wi.us/Divisions/Intergovernmental-Relations/Demographic-Services-Center/Wisconsin-Population-Projections/

RECREATION AND COUNTY ECONOMICS

In 2015, there were 1,945 jobs in Iron County (EMSI, 2015). A total of 648 (33.3%) jobs fall within the tourism and recreation-related categories of retail trade, accommodation and food services, real estate and rental/leasing, and arts entertainment and recreation. This means that one out of every three jobs in Iron County is either partially or wholly dependent upon tourism and recreation.

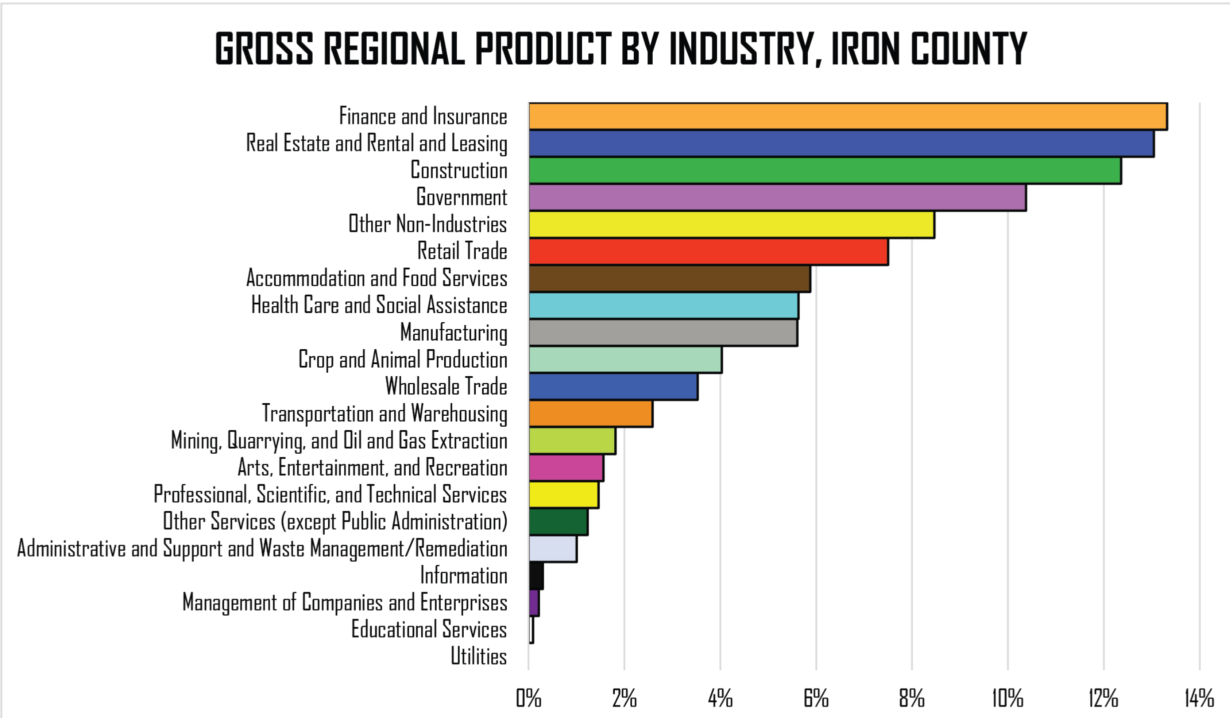
Table 3: Employment by Industry, 2015

Industry	2015 Jobs
Government	347
Retail Trade	**261**
Accommodation and Food Services	**245**
Health Care and Social Assistance	231
Construction	210
Manufacturing	183
Real Estate and Rental and Leasing	**90**
Wholesale Trade	60
Arts, Entertainment, and Recreation	**52**
Professional, Scientific, and Technical Services	50
Transportation and Warehousing	49
Other Services (except Public Administration)	42
Finance and Insurance	35
Administrative and Support/Waste Management and Remediation	33
Crop and Animal Production	20
Mining, Quarrying, and Oil and Gas Extraction	16
Information	11
Management of Companies and Enterprises	<10
Educational Services	<10

EMSI, 2015

Gross Regional Product (GRP) is a measurement of total economic output. GRP is defined as the market value of all final goods and services produced by all firms in a regional economy. In 2013, the total GRP for Iron County was $207.1 million, resulting in $129 million in earnings, $15.2 million in taxes on production and $63 million in property income. The total GRP for tourism-related categories was $58 million, or 28% of total county GRP.

Figure 3: Gross Regional Product by Industry



According to the Wisconsin Department of Tourism, direct visitor spending was $19 million in 2014. Total business sales related to recreation and tourism were $26.1 million, while the total labor income was $4.7 million. State and local tax revenue generated by tourism was $2.4 million.

In Iron County, forestry is the largest employer in the county, providing 15.4% of all jobs. Forestry and logging account for $3.3 million in output and $1.3 million in value-added economic impacts. Sawmills and wood products provide $77.7 million in total output and an additional $18.5 million in value added impacts.

County forests are essential to Wisconsin's forest products industry and economy. Each year, these lands generate anywhere from $25 to $30 million in timber revenues for counties and towns. Statewide, approximately 16,000 jobs and $4.6 billion in forest products production result from the timber harvested from county forests. County forests also provide many recreation and tourism opportunities.

In 2014, Iron County Forest and Parks generated $3.1 million in revenue. Most of this revenue (82%) was attributable to direct timber harvesting on County Forest lands (stumpage sales). Timber sale acreage on county forest lands has increased significantly over the past decade, from slight more than 1,000 acres in 2005 to over 4,000 acres in 2014.

Revenues from county forest lands is an important part of the county's annual budget portfolio. Under Wisconsin's Severance Tax Law, 10% of the gross revenue generated by timber sales on County Forest must be paid to towns. These individual payments are based on the acreage of county forest within each town.

ECONOMY

In addition to having one of the highest unemployment rates in the state, Iron County also has some of the lowest incomes in the state. As shown in Table 1.7, annual average wages earned by workers in Iron County in 2007 fell short of the statewide average for all industry sectors. Workers employed in the industry sectors of Manufacturing, Financial Activities, and Professional & Business Services received less than 60 percent of the State of Wisconsin average for workers in those same fields. Workers in the Construction industry sector earned the highest annual wage followed by the Public Administration industry.

Table 4: Annual Average Wages by Industry Division

	Iron County Average Annual Wage	State Average Annual Wage	Percent of State Average
All Industries	$26,162	$41,985	62.3%
Construction	$32,035	$51,670	62.0%
Education & Health Services	$33,379	$43,781	76.2%
Financial Activities	$21,827	$58,493	37.3%
Information	ND	$56,015	NA
Leisure & Hospitality	$12,868	$15,221	84.5%
Manufacturing	$27,968	$52,413	53.4%
Natural Resources	$57,579	$33,047	174.2%
Other Service	ND	$23,598	NA
Professional & Business Services	$26,668	$49,451	53.9%
Public Administration	$33,011	$42,198	78.2%
Trade, Transportation, Utilities	$23,361	$35,946	65.0%

Sources: Wisconsin Dept. of Workforce Development-Iron Co Workforce Profile 2012. ND = Non Disclosable—data do not meet BLS or State agency disclosure standards

PHYSICAL CHARACTERISTICS

TOPOGRAPHY

Iron County is divided by the Penokee-Gogebic Range, two parallel ridges running southwesterly from Hurley, that separate the Lake Superior lowlands to the north from the Northern Highland Peneplain to the south. This geologic feature is part of a large regional landscape that extends eastward to the Keweenaw Peninsula in the Upper Peninsula of Michigan. Ore deposits were mined extensively in these highlands from the 1880's through the 1960's. The northern third of Iron County slopes generally downward from the Penokee Range northward to Lake Superior, forming a large coastal plain. Numerous rivers and streams bisect this area. To the south of the range, the northern rim of the Northern Highland Peneplain begins its gradual rise. This region contains undulating gravely pitted outwash containing many lakes and wetlands.
The highest elevation found in Iron County is approximately 1,877 feet above sea level at the former Pleasant Lake Lookout in Section 34, T44N-R1E in the Town of Knight. The lowest elevation of 603 feet above sea level is found at the Lake Superior coast in the Town of Saxon. Information related to topography was obtained through the United States Geological Survey.

GLACIAL GEOLOGY & SOILS

With the exception of the outcrop areas, all of Iron County is covered with a variety of glacial deposits. Clay deposits cover most of the northern end of the county and ground and end moraine glacial till deposits cover most of the center of the county. Pitted outwash covers the southern part of the county, and outwash is found in narrow areas, primarily stream beds. The clayey deposits consist of mostly clayey till, covered by a thin layer of clayey lake deposits in a few areas. The ground and end moraine till deposits consist of a mixture of sand, gravel, boulders, silt and clay. Most of these deposits in the county have a high proportion of sand except for end moraine deposits in the far northern part of the county which are mostly clayey till.

Soil survey interpretations are provided for specific soil uses. Interpretations for each soil use are based on a set of interpretative soil properties. Soil suitability ratings are usually made on the basis of restrictive soil interpretative properties such as slope, occurrence of internal free water, and texture of surface horizons. A rating of "very limited" indicates that the soil has one or more features that are unfavorable for the specified use. A rating of "moderately limited" indicates that the soil has features that are moderately favorable for the specified use. These limitations can be sometimes be overcome through special designs or planning.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The ratings are based on the soil properties that affect the ease of developing camp areas and the performance of the areas after development. Slope, stoniness, and depth to bedrock are the main concerns affecting the development of camp areas.

In general, soil limitations for camping areas and trails in Iron County are primarily due to wetness and ponding (wetlands), slope, and sandiness.

BEDROCK GEOLOGY

Iron County is underlain by three general bedrock formations. Sedimentary rocks, which include sandstone, shale and conglomerate, are found under the extreme northwest corner of the county. Under the area along and to the north of the Gogebic Range are lava flows, formed mostly of basalt and crystalline rocks consisting of steeply dipping and complexly faulted layers of slate, iron formation and dolomitic marble. The remainder of the county is underlain by undifferentiated crystalline rocks. Numerous bedrock outcrop areas exist in the county, especially along streams, in the Hurley-Montreal area along the Gogebic Range, in the Saxon Harbor area and in an area west of Mercer. Depths to bedrock vary widely in the county from over 400 feet in the northwest corner to less than 50 feet in and around the Gogebic Range and other areas.

WATER RESOURCES

Water resources are an important component of the natural landscape. These dynamic resources provide many benefits to both humans and wildlife. Lakes, rivers, streams, waterfalls, wetlands and floodplains are part of a natural cycle and provide many outdoor recreational opportunities. These resources not only provide direct recreational opportunities, such as fishing and boating, but they also enhance wildlife habitat that offer wildlife hiking, viewing and hunting activities.

CLIMATE

The climate of Iron County is separated into two general classifications: a *lake modified continental* climate along the Lake Superior shoreline area and a continental climate throughout the rest of the county. The continental climate is generally characterized by hot summers and cold winters. This pattern is modified along the Lake Superior coast by the cold lake waters that serve to moderate summertime temperatures and increase wintertime temperatures. Average temperatures in Iron County range from 13° F in January to 67° F in July. Average temperatures along the lakeshore can be as much as 10-15° cooler in the summer and slightly warmer during the winter months.

Average annual precipitation varies from about 36 inches in the Penokee highlands of north central Iron County, to 32 inches along the lake and in the far southern part of the county. Average annual snowfall ranges from 160 inches at Hurley to 80 inches in the southwestern part of the county. Lake enhanced winter storms produce generally higher snowfalls across northern Iron County, particularly in areas of high elevation.

LAND OWNERSHIP

Land ownership has a significant impact on the natural resource base by influencing development patterns, land use, management, policy, and public use/access.

Table 5: Land Ownership

Total Area	513,169 acres
County*	174,159 acres
Federal	22 acres
State	63,136 acres
Total Public Land	234,092 acres
Total Private	230,582 acres
Surface Water	29,836 acres
Tribal Lands	18,658 acres

Sources: Wisconsin Stewardship GIS Data, *Iron County Forestry

SUPPLY

OUTDOOR RECREATION INVENTORY

Table 6: Inventory of Existing Recreational Facilities

	TABLE	TRASH CAN	GRILL	SHELTER	DOCK	LANDING	TOILET	PLAYGROUND	SHOWER	CAMPING	SWIMMING
COUNTY PARKS											
Lake of the Falls	✓	✓		✓		✓	✓		✓	32	✓
Schomberg Park	✓	✓		✓			✓		✓	14	
Weber Lake	✓	✓		✓	✓	✓	✓	✓		11	✓
Saxon Harbor	✓	✓		✓	✓	✓	✓	✓	✓	43	✓
Potato River Falls	✓	✓		✓			✓			7	
CITY PARKS											
Al Riccelli Park	✓			✓			✓	✓			
Veteran's Memorial Field		✓					✓				
Cary Road Park							✓	✓			
Albert C. Morzenti Sr. Memorial Park	✓	✓	✓					✓			
Slugger Baron Park	✓							✓			
Gile Park on Gile Flowage	✓			✓	✓	✓	✓	✓			✓
Dan Young Park								✓			
TOWN PARKS											
Carrow Community Park	✓			✓			✓	✓			✓
Upson Community Park	✓			✓			✓			✓	
Kimball Park	✓			✓			✓	✓		✓	
Kimball Town Baseball Field							✓				
Oma Town Park	✓			✓			✓	✓			✓
STATE CAMPGROUNDS											
Sandy Beach Campgrounds	✓					✓	✓			37	✓
Turtle Flambeau Flowage Islands	✓			✓			✓			✓	
PRIVATE CAMPGROUNDS											
Frontier Bar Campgrounds	✓						✓	✓		✓	
Loon Lagoon Campground										✓	

There are many recreational facilities owned and managed by the towns, county and state that are available to residents and visitors of Iron County. In addition to the maintained recreational facilities, county forests and bodies of water also provide countless recreational opportunities. In addition to the campgrounds, the public is allowed to set up and camp on the County Forest for up to two weeks in the same location.

COUNTY PARKS

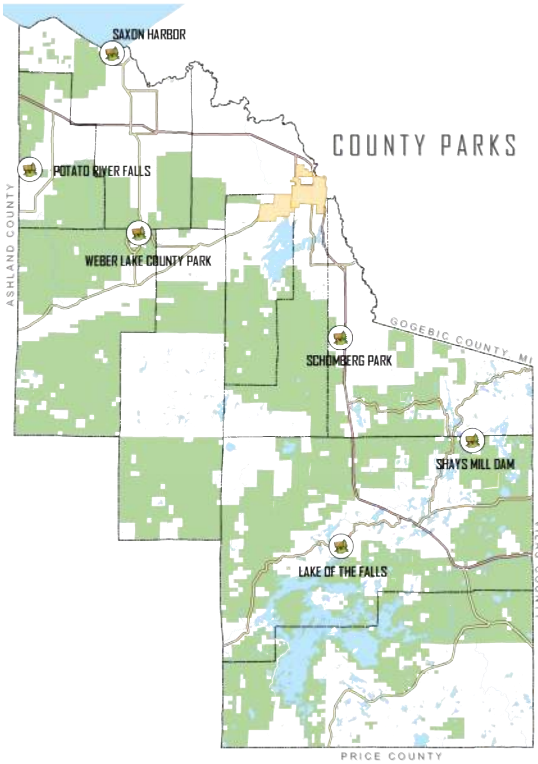


Figure 4: County Parks

Lake of the Falls

A 40-acre county park and campground (32 units) located at the beginning of the Turtle Flambeau Flowage, 6 miles west of Mercer on County Road FF. Facilities include picnic area, tables, fire rings, drinking water, restrooms, showers, swimming area, boat ramp, fishing, pavilion, electrical hookups, dumpstation, and a caretaker.

Schomberg Park

A 160-acre county park and campground (14 units) located off Highway 51 in the Town of Oma along Layman's Creek. Facilities include a restrooms and showers, pavilion and picnic area, tables, fire rings, electrical hookups, drinking water, dump station, ATV wash station, ATV trail access. Schomberg Park also has a 1.7 mile snowshoe trail loop with parking available in the winter.

Weber Lake

This County Park and campground (11 units) is located west of Hurley off County Road E in the Town of Anderson. The park consists of ten acres with a picnic area, tables, fire rings, drinking water, pavilion, restrooms, changing rooms, boat ramp, fishing, swimming area and electrical hookups.

Saxon Harbor

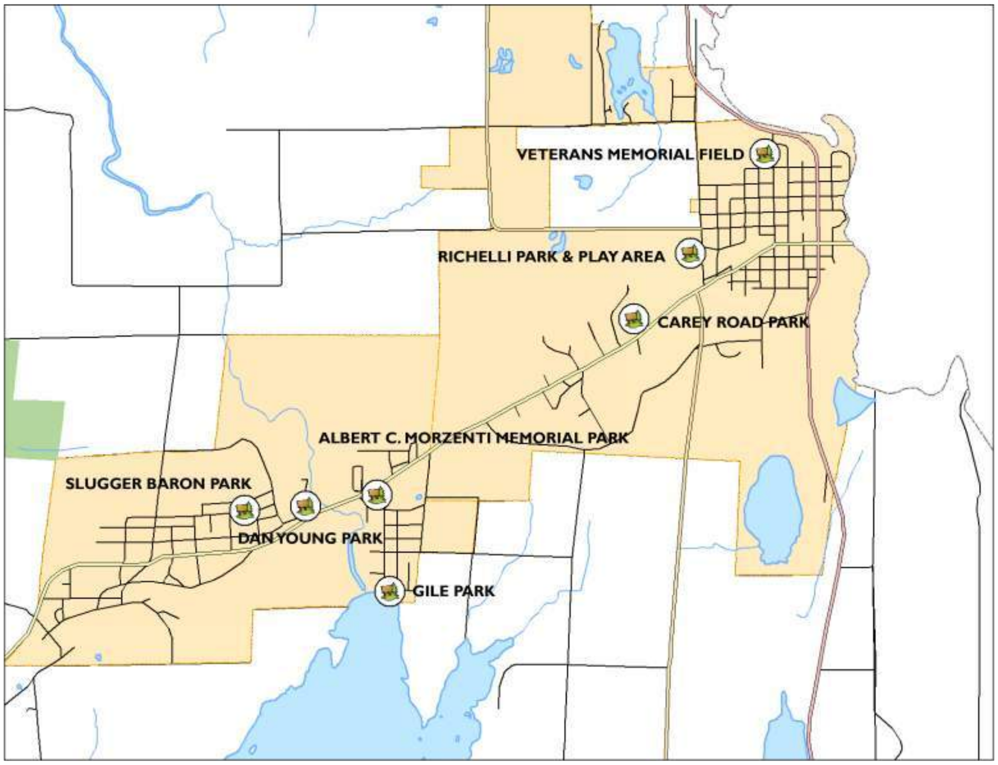
This County Park and campground (43 units) is at Lake Superior, north of U.S. 2 off Highway 122 and County Road A. The Harbor includes 91 slips for boats up to 40 feet long, 12 transient moorings, three boat launches, parking for 50 trailers, gas for sale, boat septic system pump out, water, boat-lift, restroom and shower facilities and dump station. Picnic tables, a pavilion, playground, fire rings, electrical hookup and swimming area are available. ATV trail access. In 2009 a bridge across Oronto Creek and 5 walk-in campsites were built. Each campsite contains a tent pad, fire ring and picnic table.

Potato River Falls

Located two miles west of Highway 169 in the town of Gurney, rustic campsites (7 units) and fire rings are available at Potato River Falls. Hiking/biking trails, restrooms, picnic tables and a pavilion surround the waterfalls and trout fishing possibilities.

CITY PARKS

Figure 5: City Parks



Al Riccelli Park

This five-acre community park is located at 805 Maple Street in the City of Hurley. Facilities include playground equipment, picnic tables, basketball court, pavilion and new restrooms constructed in 2009. Little League fields are located adjacent to Riccelli Park, which includes bleacher seating and a concession stand.

Veteran's Memorial Field

Located on Fifth Avenue in Hurley, Veteran's Memorial Field offers opportunity for various forms of recreation. A football field with two large sets of bleachers offers a location for home football games in the fall accompanied by concession stands, restrooms and locker room facilities. Also at Veteran's Memorial Field, there are newly sealed basketball and tennis courts for public use.

Cary Road Park

This park is located off Highway 77 in the City of Hurley. Facilities include a softball field, volleyball court, horseshoe pits, bocce ball court, playground equipment, combination concession stand/restrooms and a paved walking trail.

Albert C. Morzenti Sr. Memorial Park

This 10-acre park is located on Highway 77 in the City of Montreal. The west fork of the Montreal River flows along this park near the picnic area. Facilities include picnic tables, grills, swing set, trash containers, and a historical marker commemorating the site of the world's deepest iron mine. Montreal baseball fields are adjacent to this park.

Slugger Baron Park

Located on Ohio Avenue in the City of Montreal, this park consists of picnic tables and new playground equipment.

Gile Park of Gile Park Flowage

Gile Park is a park owned by the City of Montreal, located west of Hurley on Hwy 77, left into Gile to Flowage. The park has a picnic area, tables, fireplaces, drinking water, pavilion, restrooms, changing rooms, slide and swings, swimming, boat launching ramps and fishing.

Dan Young Park

Located in the City of Montreal. The park includes a local softball field, swing sets and other play equipment.

TOWN PARKS

Figure 6: Town Parks

Carrow Community Park

This town park is located on County Road J on Grand Portage Lake in Mercer. Facilities include a picnic area, tables, fireplaces, pavilion, and restrooms, swimming area, new playground equipment, bike racks, ball field and paved walking track.

Upson Community Park

This town park is maintained by the Town of Anderson, and is located on the Potato River west of Upson. Facilities include picnic area, tables, fireplaces, pavilion, restrooms, overnight camping, electrical hookups, waterfall and trout fishing.

Kimball Town Park

The Kimball Town Park west of Hurley and south on Park Road on the Montreal River offers a beautiful view of Kimball Falls. Other facilities include a picnic area, tables, fire rings, pavilion, restrooms, overnight camping, trout and walleye fishing, walking trails, and kayak options.

Kimball Town Baseball field

The Town of Kimball owns a baseball field situated on US Highway 2. This facility includes fences and an outhouse. This field has been neglected over the years and is in need of maintenance before any future use.

Oma Town Park

This town park located on County Road G is found on Pine Lake. Facilities include picnic area, tables, fireplaces, pavilion, restrooms, swimming and a playground.

PRIVATE CAMPGROUNDS

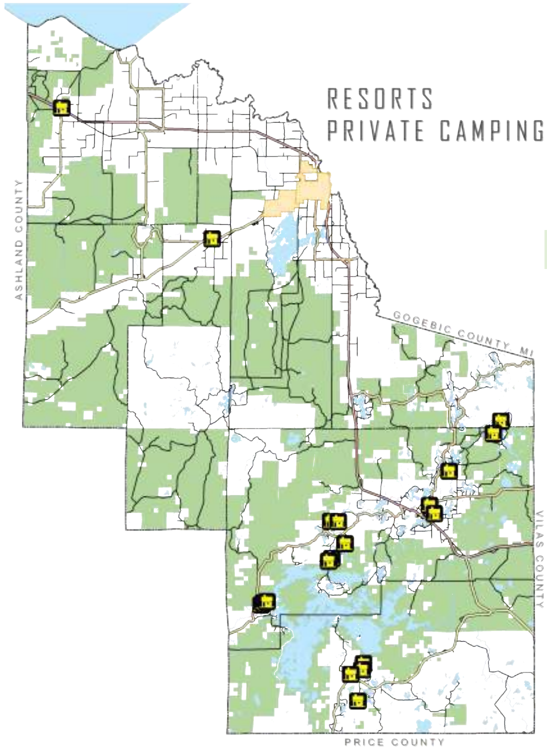


Figure 7: Private Campgrounds

Frontier Bar Campgrounds

Camping options can be found just behind the Frontier Bar in Cedar off Highway 2. Facilities include fireplaces, drinking water, restrooms, picnic area and tables. Sewer, electrical, water, Laundromat and pull thru sites are available to RVs. Easy access to ATV trail 2.

Loon Lagoon Campground

Located two blocks east of Highway 51 in Mercer, Wisconsin, on the outlet of Grand Portage Lake. It is an open, grassy park within walking distance of stores and restaurants. The grounds are centrally located for day trips and fishing in historic Iron County. Camping on Grand Portage Lake can be found at 2580 Margaret St., Mercer.

STATE CAMPGROUNDS

Figure 8: State Resources

Sandy Beach Campgrounds

This state campground is located on Powell Marsh Road in the northeastern corner of the Town of Sherman. Facilities include rustic campsites, toilets, tables, picnic area, fire rings, drinking water, swimming and a boat launch. Maps are available at the Mercer Ranger Station and the Mercer Area Chamber of Commerce or by visiting the DNR web site. (http://dnr.wi.gov/topic/lands/turtleflambeau/) Boat launches are available in several locations.

Turtle Flambeau Flowage Islands

The Turtle Flambeau Flowage offers excellent fishing, canoeing and kayaking opportunities. Six group sites on Big Island are available by reservation only. There is a fee for these sites. Reservations can be made by contacting Reserve America or the WDNR website.

WATERFALLS

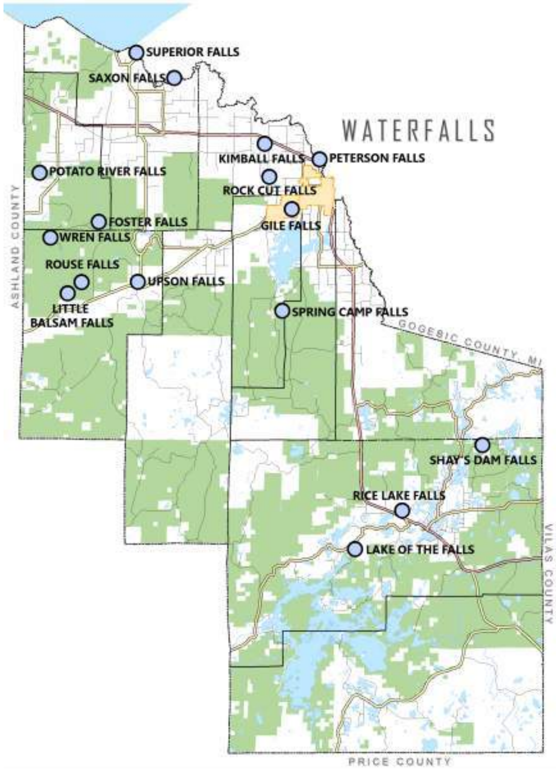


Figure 9: Waterfalls

Superior Falls - 90 feet
Montreal River (Lake Superior/Saxon Area)

Potato River Falls – 90 feet
Potato River (Gurney Area)

Peterson Falls – 35 feet
West Branch Montreal River (Gile Area)

Upson Falls – 18 feet
Potato River (Upson Area)

Gile Falls – 15 feet
West Branch Montreal River (Gile Area)

Shay's Dam Falls – 15 feet
Turtle River (Mercer Area)

Kimball Falls – 10 feet
West Branch Montreal River (Hurley Area)

Lake of the Falls – 10 feet
Turtle River (Flambeau Flowage Area)

Rock Cut Falls – 15 feet – (No Public Access)
West Branch Montreal River (Hurley Area

Spring Camp Falls – 20 feet
East Branch Montreal River (Hurley Area)

Wren Falls – 15 feet
Tyler Forks River (Gurney Area)

Foster Falls – 25 feet
Potato River (Gurney Area)

Rice Lake Falls – 10 feet
Turtle River (Mercer Area)

Rouse Falls – 15 feet
Rouse Creek (Upson Area)

Little Balsam Falls – 8 feet
Tyler Forks River (Upson Area)

Saxon Falls – 78 feet
Montreal River (Lake Superior/Saxon Area)

NON-MOTORIZED TRAILS

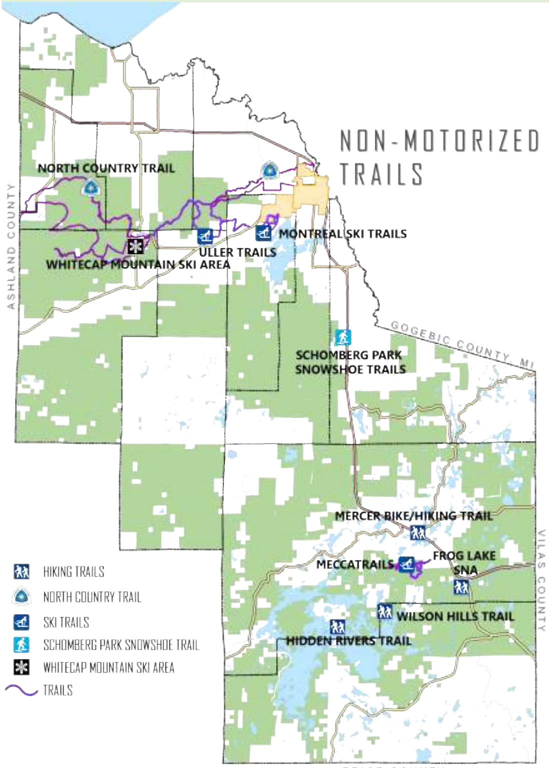


Figure 10: Non-Motorized Trails

Non-motorized recreational facilities in Iron County include scenic hiking and walking trails, off-road biking, cross country ski trails, and canoe routes. What follows is a listing and descriptions of current and proposed non-motorized trails in Iron County.

MECCA Trail

The MECCA (Mercer Cross-Country Association) Trail system is located in the Town of Mercer and consists of hiking, biking and cross-country ski trails. These trails also serve as hunter walking trails in the fall. MECCA grooms 20 km for skiing through the woods and around the Little Turtle Flowage. Most trails are on Iron County Forest and State lands. The club operates a log chalet at the main trailhead 2 miles off Hwy 51 on the south side of Mercer, via Beachway Street.

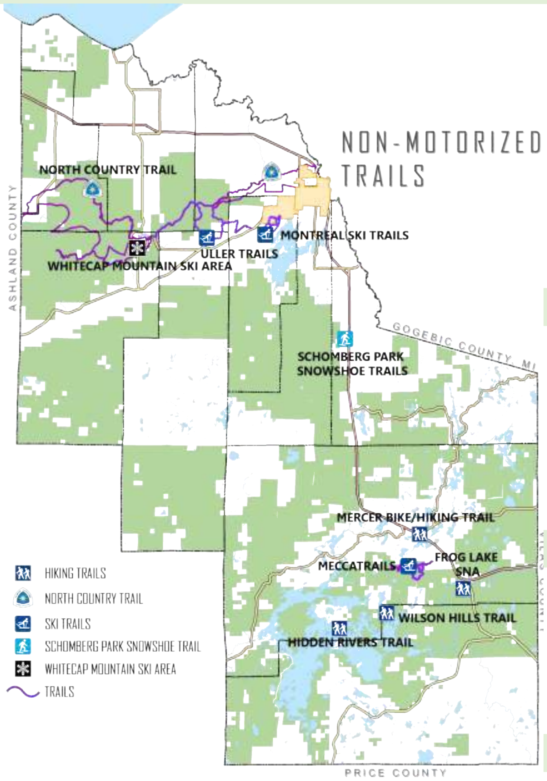
Flambeau Trail

The Flambeau Trail was the key transportation route for Native Americans long before European exploration. Later, the trail hosted voyagers, fur traders and settlers during their journeys throughout the region. The Flambeau Trail crossed the Continental Divide linking the Lake Superior and Mississippi watersheds. Today, the Flambeau Trail is used as an auto tour highlighting historic sites along the trail.

North Country Trail

The North Country National Scenic Trail is a premier footpath that stretches more than 4,000 miles to link communities and wilderness areas across seven northern states. Wisconsin has the smallest distance of any of the seven states the North Country Trail crosses, and the second smallest amount of trail developed to date. The trail crosses from Michigan on the US-2 Bridge from Ironwood into Hurley. A few miles west of Hurley, the Uller Trail, a 7-mile trail on Iron County Forest land is also used.

NON-MOTORIZED TRAILS CONT...



Montreal Nordic Ski Trails

This trail is located in and around the City of Montreal and includes just over nine miles of trails. Eight different sections, each with a very different class (easiest, more difficult, most difficult), meander in and around the city. Interpretive signing describes the mining activity in the area. Penokee Ranger volunteers groom trails.

Uller Trail

The Uller Trail is part of the Nordic Ski Trails system and is located along the Penokee Range from Pence and Iron Belt to Weber Lake. The trail's terrain is hilly and remote and is approximately 19 miles in length. Penokee Ranger volunteers groom the trail.

Pines and Mines Mountain Bike Trail System

This trail system offers 300 miles of marked and mapped mountain biking opportunities in the abundant public lands of Iron County and the nearby Ottawa National Forest.

Hidden Rivers Nature Trail

This interpretive trail is located at Fisherman's Landing on the Turtle Flambeau Flowage in the Town of Mercer. The trail is two miles long and includes signage describing the history and resources of the Flowage.

Downtown Mercer Biking/Walking Trail Project

A paved hiking/biking trail has been constructed along County Road J from Margaret Street to Scheels Road. The Town of Mercer continues working toward the development of pedestrian trails along portions of existing road right-of-ways and adjacent to a segment of abandoned railroad right-of-ways. The proposed trails would provide areas of the community with a safe, walking and biking route to the central business district and would enhance tourism by connecting to neighboring communities such as Manitowish Waters and Winchester.

NON-MOTORIZED TRAILS CONT…

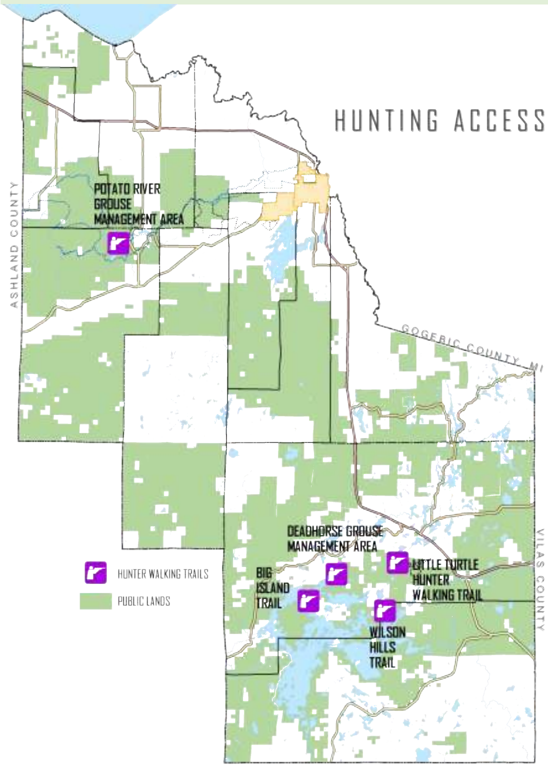


Figure 11: Hunting Access

Schomberg Park Snowshoe Trail

Two loops totaling 1.7 miles of snowshoe trail has been developed and marked in cooperation between the Iron County Forestry Department and the Iron County Economic Development Committee. Future plans include interpretive signing by the Iron County Land and Water Conservation Department and expansion of the trail. This trail may also be used as a hiking trail in the summer.

Hunter Walking Trails

The Iron County Forestry Department has received a grant from the Ruffed Grouse Society to map and print hunting trails throughout Iron County on the County Forest. This project began in 2009 and continues on.

Deadhorse Trail

This hunter walking trail is located off of Popko Circle West in the Town of Mercer. The trail includes interpretive and informational signs about grouse habitat management and a deer/hare exclosure. It is managed in cooperation with the Ruffed Grouse Society.

MOTORIZED TRAILS

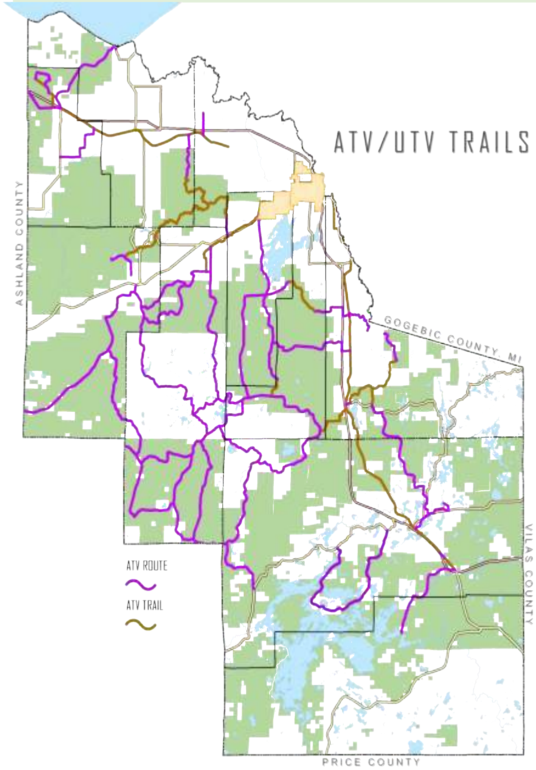


Figure 12: ATV/UTV Trails

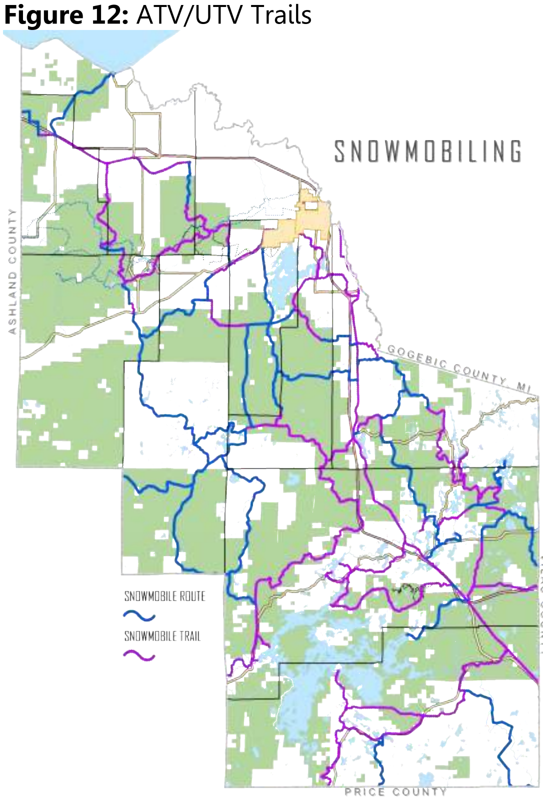


Figure 13: Snowmobile Trails

ATV Trails

Iron County boasts Wisconsin's largest ATV system starting in the Hurley area, with more than 250 miles of trails and routes to take riders deep into the heart of Iron County. Along the routes, motorists will find a variety of pit stops offering food, beverages, gas, lodging and scenic outlooks. For maps on Iron County's ATV trails, contact the Iron County Development Zone Council or the Hurley and Mercer Chamber of Commerce.

The Iron County Forestry Department, along with the Iron County ATV Association and Mercer Dusty Loons, maintains 118 miles of ATV trails throughout the County. The Forestry Department also contracts with the White Thunder Riders and Mercer SnoGoers to maintain 165 miles of winter ATV trails.

Snowmobile Trails

Over 300 miles of well-groomed, uncrowded snowmobile trails traverse Iron County. Unmatched beauty, with a unique microclimate, along with the most reliable snow in the Midwest guarantees Iron County snow even when other areas are without hence Governor Doyle's designation of Iron County as the Snow Capital of Wisconsin in 2009.

Iron County's snowmobile trails connect and incorporate many of the county's historic communities, transportation corridors, mining and lumbering sites, as well as plenty of forests and lakes. As with the ATV trail system, varieties of establishments offer food, beverages, gas and lodging along the journey. Experienced riders may visit scenic outlooks.

The Iron County Forestry Department contracts with the White Thunder Riders and the Mercer SnoGoers to maintain 303 miles of snowmobile trails throughout the County.

FISHING

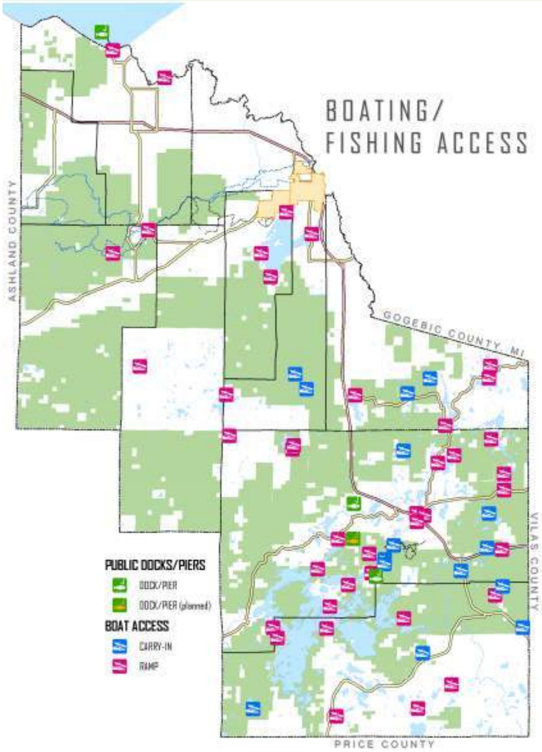


Figure 14: Boating/Fishing Access

Boat Landings

There are a number of boat landings found within Iron County. Many are county and state owned, offering access to spectacular lakes as large as Lake Superior and as small as Lake Obadash. The number of landings located at each lake is listed. Depending on the lake, landings may be paved or rustic and vary from powerboat use to canoe.

Table 7: Iron County Lakes with Public Boating Access

Lake	Lake	Lake
Bass Lake	Lake Obadash	Randall Lake
Bearskull Lake	Lake of the Falls	Sandy Beach Lake
Beaver Lake	Lake One	Saskatoon Lake
Brandis Lake	Lake Six	Saxon Falls
Cedar Lake	Little Moose	Saxon Harbor
Deer Lake	L. Turtle Flowage	Shay’s Dam
Deer Tail Lake	Long Lake	Shirley Lake
Du Page Lake	McDermott Lake	Spider Lake
Echo Lake	Mercer Lake	Tamarack Lake
Fisher Lake	Moose Lake	Trude Lake
Fox Lake	Mud Lake	Turtle Flambeau
Gile Flowage	North Bass Lake	Twin Lakes
Grand Portage Lake	One Man Lake	Upson Lake
Hewitt Lake	Owl Lake	Weber Lake
Island Lake	Pike Lake	Wilson Lake
Lake Evelyn	Pine Lake	
Lake O’Brien	Plunkett Lake	

Source: Wisconsin Department of Natural Resources, 2016. Statewide inventory of public boat access and fishing sites. *Note: Public access data may not be complete and additional access points may exist.*

BICYCLING

Bike Routes

The Wisconsin State Bike Map, published and distributed through the Bicycle Federation of Wisconsin, identifies and classifies state and county roads in terms of their bicycling conditions. The bicycle map for Iron County can be accessed on the WisDOT web site at http://wisconsindot.gov/Documents/travel/bike/bike-maps/county/iron.pdf

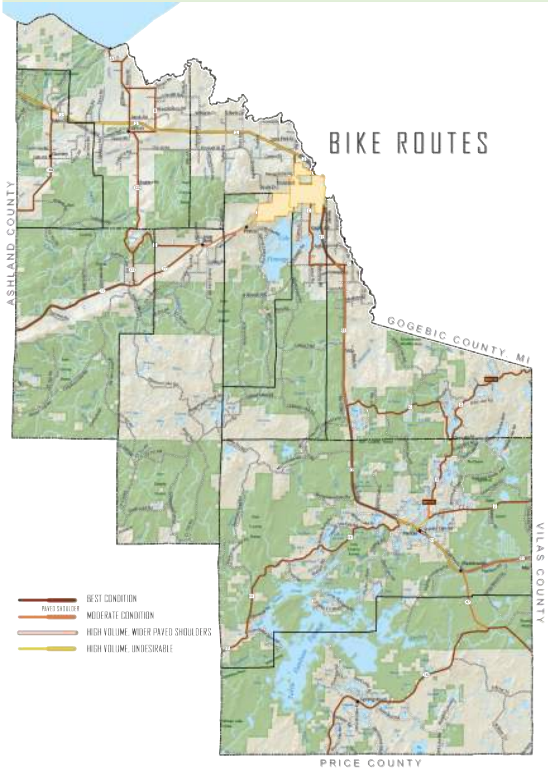


Figure 15: Bike Routes

GOLF

Eagle Bluff Golf Club

Public, 18-hole golf course located in Hurley. The course features 5,870 yards of golf from the longest tees for a par of 70.

Skye Golf Course

The 18-hole "Whitecap Skye" course at the Skye Golf in the Whitecap Mountains facility in Upson, features 5,320 yards of golf from the longest tees for a par of 70.

Tahoe Lynx Golf Course

This 9-hole public golf course in Mercer opened in 1994 and measures 2606 yards from the longest tees. The course features 3 sets of tees for different skill levels.

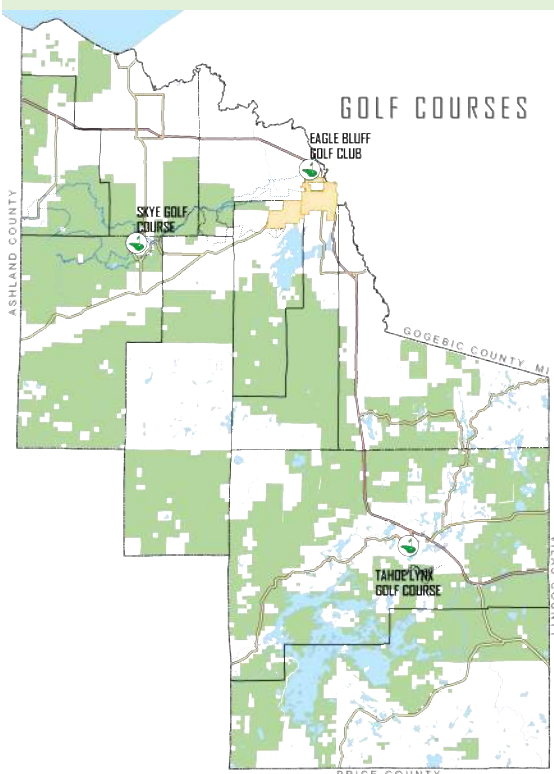


Figure 16: Golf Courses

SCENIC SITES/POINTS OF INTEREST

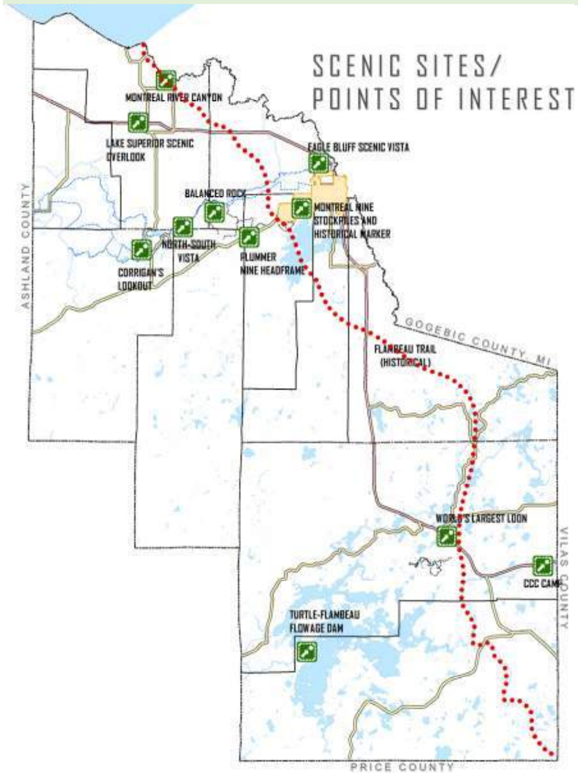
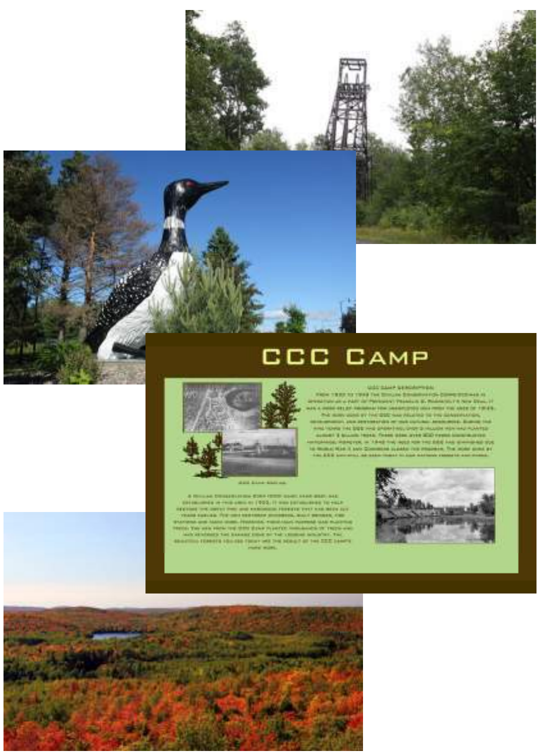


Figure 17: Scenic Sites/Points of Interest



Montreal River Canyon

Scenic and remote canyon on the Montreal River in northern Iron County. The canyon's contains high sheer rock walls straddle whitewater rapids (class II – class V) and boulder gardens which make this a destination for adventurous whitewater rafters. Located on private property.

Lake Superior Scenic Overlook

WisDOT overlook and rest area along US Highway 2.

Corrigan's Lookout

Rock outcrop overlooking Upson Lake and the Penokee Hills. Located on Iron County Forest lands, near Upson.

North-South Vista

Scenic views of the Penokee Hills landscape. ATV & snowmobile access via Trail 6.

Balanced Rock

Natural geologic feature located near the midpoint of the Uller Trail. ATV & snowmobile access via Trail 6.

Plummer Mine Headframe

The Plummer Mine Headframe is the last standing headframe in Wisconsin, and is listed on the National Register of Historic Places.

Eagle Bluff Scenic Vista

A spectacular vista of two states and Lake Superior. South of U.S. 2 on County D at the Eagle Bluff Golf Club, one mile west of Hurley.

Montreal Mine Stockpiles and Historical Marker

Neat white frame houses, gently curving streets, and gracious landscaping mark the City of Montreal—the only planned mining company town in Wisconsin.

World's Largest Loon

Statue of Claire d'Loon", the world's largest loon, in front of the Mercer Chamber of Commerce.

Turtle-Flambeau Dam

Dam constructed in 1926 on the Flambeau River which created the Turtle-Flambeau Flowage.

Flambeau Trail

Historical travel trade route trips from La Pointe, on Madeline Island, to Lac du Flambeau, 90 miles to the south.

CCC Camp (Mercer Trail)

Historical site of former Civilian Conservation Corp camp 660 established along the Manitowish River in the Town of Mercer.

PUBLIC ACCESS LANDS

Iron County Forest

Encompassing over 174,000 acres, the Iron County Forest is an actively managed, working forest that provides tremendous recreational opportunities, jobs and timber products.

State Forest

The State of Wisconsin owns and manages over 84,000 acres of public access lands in Iron County, including the 35,500 acre Turtle-Flambeau Scenic Waters Area.

Nature Conservancy Lands

The Bass Lake Preserve in southern Iron County contains a diversity of trees, including aspen, sugar and red maple, yellow and white birch. This area was designated as a State Natural Area in 1986.

Forest Tax Law

Approximately 64,000 acres of privately-owned lands enrolled in Wisconsin's Forest Tax Law programs are open to public access and recreation. These programs encourage sustainable forest management on private lands by providing a property tax incentive to landowners. Two different forest tax law programs currently exist: the Managed Forest Law (MFL) and the Forest Crop Law (FCL).

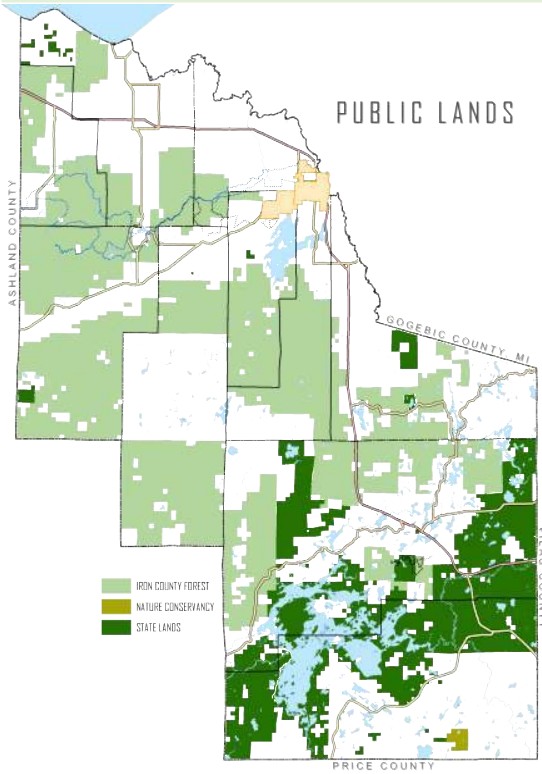


Figure 18: Public Lands

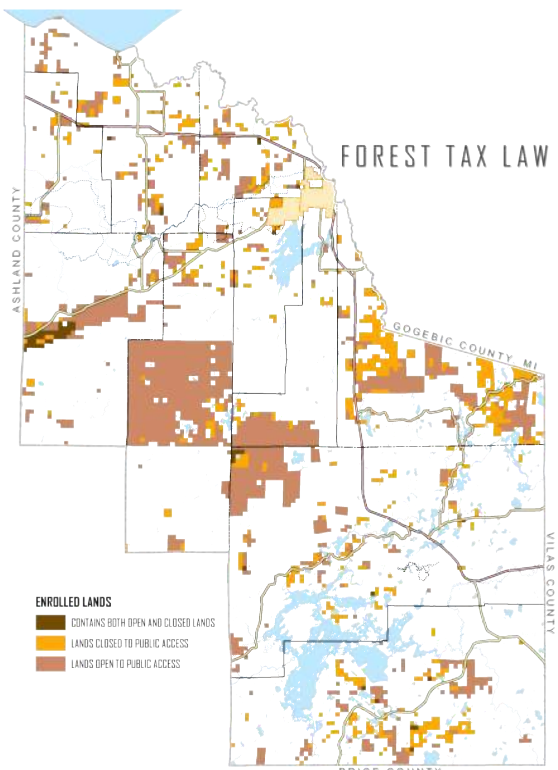


Figure 19: Forest Tax Law Lands

STATE OWNED AND MANAGED PROPERTIES

Underwood State Wildlife Area (SWA)
Located in the Town of Oma, the Underwood State Wildlife Area is a 1,600 acre state-owned tract managed primarily for wildlife species such as ruffed grouse, deer, woodcock, bears, and wolves. Habitat types found within this area include forested uplands and cedar swamps.

Hay Creek-Hoffman Lake Wildlife Area (SWA)
This SWA encompasses portions of Ashland and Iron Counties. Within Iron County, the Wildlife Area is found within the Town of Sherman and a small portion of the Town of Mercer. The total acreage of this SWA is 13,424 acres, with 7,412 acres in Iron County. This SWA provides habitat for a wide range of wildlife species including ruffed grouse, deer, woodcock, bears, loons, waterfowl, beavers, otters, fishers, coyotes, bobcat, muskrats, ospreys, eagles, and timber wolves.

Moose Lake State Natural Area (SNA)
The Moose Lake SNA encompasses 1,113 acres within the Town of Mercer. This area contains a high quality forest with several patches of old-growth hemlock forest. This SNA also contains rare plants and an important warbler breeding area. Frog Lake and Pines State Natural Area (SNA) This 192-acre SNA located in the Town of Mercer features an undisturbed wilderness lake surrounded by old-growth northern dry-mesic forest in a large lowland bordering the Manitowish River. This SNA is located entirely within the Northern Highland American Legion State Forest.

Bass Lake Preserve State Natural Area (SNA)
This 30-acre preserve is located within the Northern Highland American Legion State Forest in the Town of Sherman. This property features a wilderness type lake, conifer swamp and bog and northern hardwoods forest.

Lake Evelyn State Natural Area (SNA)
The Lake Evelyn State Natural Area encompasses 26 acres in Section 23, T44N R3E, in the Town of Oma. This SNA features an undeveloped soft-water seepage lake surrounded by wetlands and upland forest.

Caroline Lake State Natural Area (SNA)
The Caroline Lake SNA is located in T44N-R1W, Section 19, in the Town of Anderson. This SNA encompasses 518 total acres of northern hardwoods, conifer, wetland, and mixed forest. Caroline lake also forms the headwaters of the Bad River and contains unique plant communities and forested wetlands.

Springstead Muskeg State Natural Area (SNA)
The Springstead Muskeg SNA is a large peatland featuring an extensive undisturbed bog located at the headwaters area of the South Fork of the Flambeau River. This SNA encompasses 200 acres in Section 28 of the Town of Sherman.

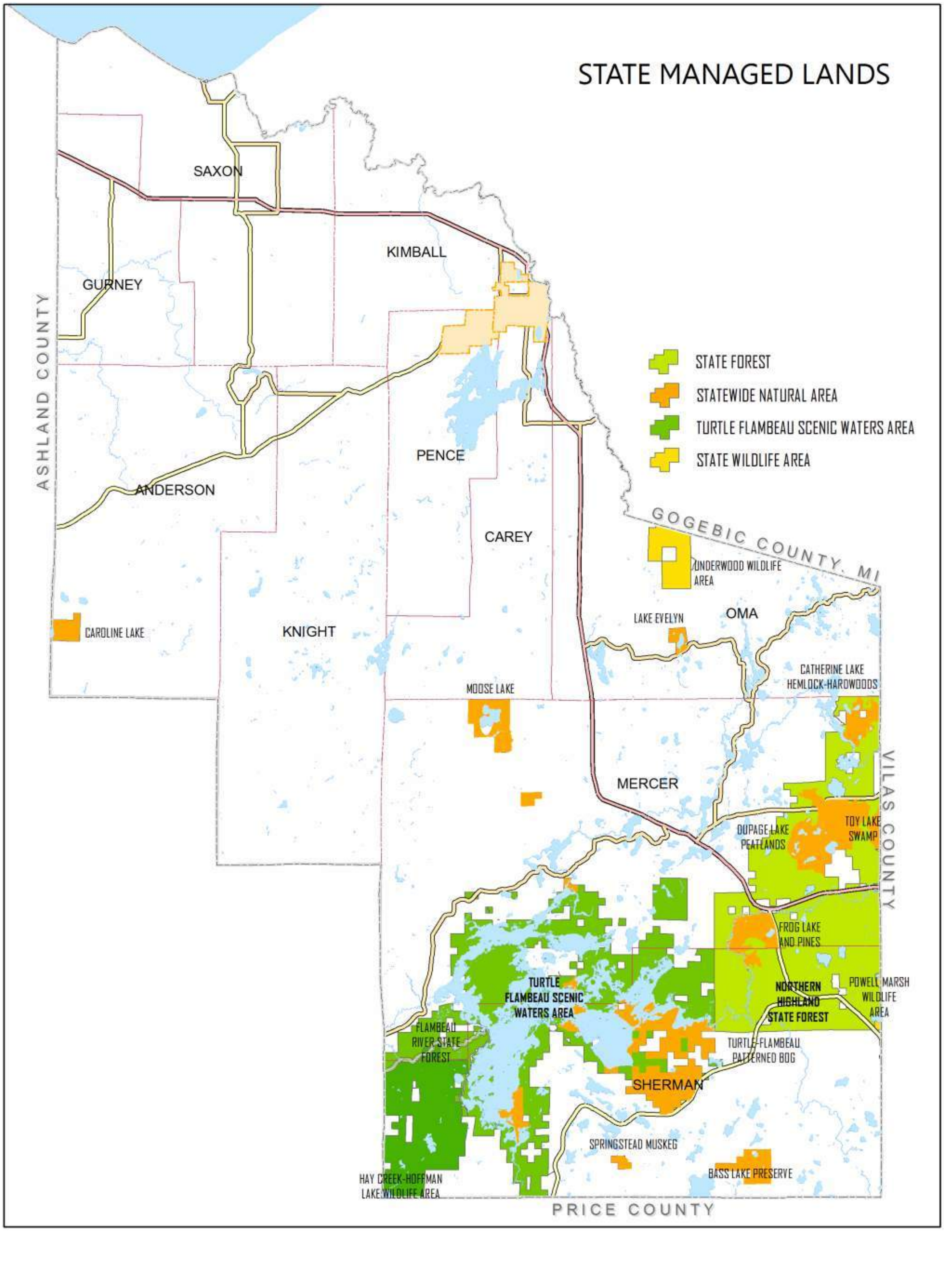
Powell Marsh Wildlife Area (SWA)
This SWA lies within the boundary of the Northern Highland American Legion State Forest on the western edge of the Town of Sherman. Since 1980, management activities in this SWA have focused on enhancing habitat for waterfowl and sharp-tailed grouse. Total acreage of this SWA within Iron County is approximately 105 acres.

Turtle-Flambeau Flowage State Natural Area (SNA)
This 3,145 SNA is found in the Towns of Mercer and Sherman in Iron County. The Flowage was created in 1926 by the inundation of lowland wetlands and contains numerous unique and varied plant and animal communities.

Turtle-Flambeau Scenic Waters Area
The Turtle-Flambeau Scenic Waters Area contains several thousand state-owned acres of water and miles of undeveloped shoreline. The Flowage itself is a 19,000-acre reservoir with 212 miles of predominantly wilderness shoreline. This area is a popular recreation destination for those seeking fishing and wilderness camping experiences. This area includes the once separate Boot Lake State Wildlife Area.

Northern Highland American Legion State Forest
This state forest was established in 1925 to protect the streamflow at the headwaters of the Wisconsin, Flambeau and Manitowish Rivers. The NHAL State Forest is the largest in Wisconsin, encompassing over 222,000 acres in Vilas, Oneida and Iron Counties. Within Iron County there are approximately 30,000 acres of land within the NHAL State Forest.

Flambeau River State Forest
The Flambeau River State Forest was established in 1930. This forest occupies a total of 90,000 acres of land surrounding the North and South Forks of the Flambeau River. Within Iron County, this forest occupies about 335 total acres.


STATE MANAGED LANDS
STATE FOREST
STATEWIDE NATURAL AREA
TURTLE FLAMBEAU SCENIC WATERS AREA
STATE WILDLIFE AREA
SAXON
KIMBALL
GURNEY
ASHLAND COUNTY
PENCE
ANDERSON
CAREY
GOGEBIC COUNTY, MI
UNDERWOOD WILDLIFE AREA
LAKE EVELYN
OMA
CAROLINE LAKE
KNIGHT
CATHERINE LAKE HEMLOCK-HARDWOODS
MOOSE LAKE
MERCER
VILAS COUNTY
DUPAGE LAKE PEATLANDS
TOY LAKE SWAMP
FROG LAKE AND PINES
TURTLE FLAMBEAU SCENIC WATERS AREA
NORTHERN HIGHLAND STATE FOREST
POWELL MARSH WILDLIFE AREA
FLAMBEAU RIVER STATE FOREST
TURTLE-FLAMBEAU PATTERNED BOG
SHERMAN
SPRINGSTEAD MUSKEG
BASS LAKE PRESERVE
HAY CREEK-HOFFMAN LAKE WILDLIFE AREA
PRICE COUNTY

WAYSIDES/PICNIC AREAS

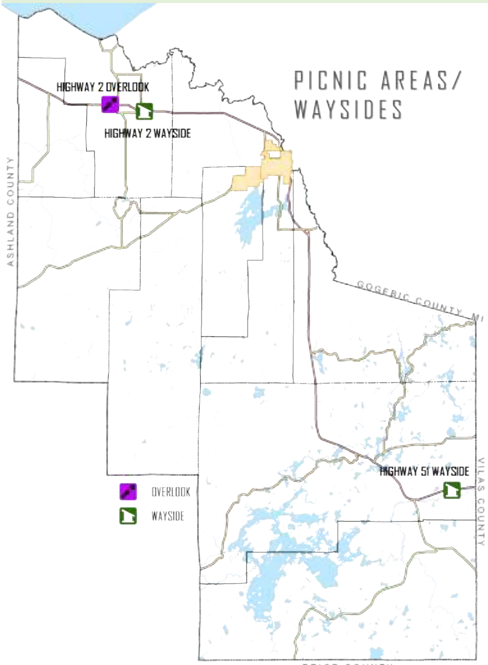


Figure 20: Picnic Areas/Waysides

Highway 2 Overlook (Apostle Islands)

WisDOT overlook along US Highway 2 in the Town of Saxon. No facilities.

Highway 2 Wayside

WisDOT wayside along US Highway 2 in the Town of Saxon. Interpretive signage and limited day-use facilities are present.

Highway 51 Wayside

WisDOT wayside along US Highway 51 in the Town of Mercer.

LOCAL EVENTS/FESTIVALS

Figure 21: Public Events

Iron County Fair

The Iron County Fair is one of the best small county fairs in Wisconsin. Located in the town of Saxon, the fair offers a multitude of activities for every age. Activities include, agricultural exhibits, animals, rides, food, entertainment, midway rides and games, and other fun.

Paavo Nurmi Marathon

Named for the Finnish winner of nine Olympic gold medals in the 1920s, this marathon draws about 300 participants annually. It starts in Upson, WI and finishes in downtown Hurley. It was established in 1969 and is considered to be the oldest running marathon in Wisconsin.

Loon Day

An annual art & craft show in Mercer with more than 250 exhibitors. Loon calling contest (trophies awarded), food, music, dancing, demonstrations, sidewalk and bake sales, face painting for kids and a flea market

Snowmobile Olympus (Ironwood, MI)

One of the premier snowmobile oval races in all of North America.

SISU Ski Fest (Ironwood, MI)

XC Ski races and snowshoe events, held annually.

Festivale Italiano

Annual family fun event held in Hurley celebrating Italian heritage.

Heritage Festival

Two weeks of events to celebrate Iron County's rich cultural heritage. Held annually.

Musky Fishing Challenge

A catch and release musky fishing tournament that allows the use of both artificial and live bait. Held annually in Mercer

Lupine Junefest

Annual festival held in Mercer, featuring bike/hike tours, live music, arts/crafts, silent auction, photography, informational booth and classic car show.

CanYak Fishing Tournament

Fishing, Trade Show, Demos, and Live Music. Held in Mercer

Saxon Harbor Fishing Tournament

Annual spring fishing tournament on Lake Superior.

SHOOTING RANGES

Figure 22: Shooting Ranges

Northwood’s Shooting Range

The Northwood’s Shooting Range is maintained by the Northwood’s Wildlife & Wetlands Club and is open to the public from April 1 to November 30. The range is located five miles south of Mercer, just off Hwy 51 on Range Road. The facility includes a 200-yard rifle and 100-yard pistol range and field course. Shooting events are held weekly throughout the summer.

The Knight Shooting Range

The Knight Shooting Range is a rifle only range. It is located on Snake Track Road, two miles southwest of Iron Belt. This range is open to the public, and shooting benches and target backstops are provided.

Pence Archery Range

The village of Pence now has an archery Range on the north side of Hwy77. Practice targets and a field range are provided.

PADDLESPORTS

Figure 23: Paddlesports

Inland Lakes and Streams

Iron County has 217 named inland lakes along with 277 smaller, unnamed lakes totaling 29,902 acres of surface water. The county also has 724 miles of perennial streams.

Turtle River Trail

The 27-mile Turtle River Trail connects 17 different lakes. There are many put-in and take-out possibilities on the Turtle River offering a wide variety of trips

Bear River

This trip is tranquil and unspoiled by development. Only one low hazard rapids, better described as a "riffle," will be encountered at the second bridge crossing. The usual put-in is below the outlet of Flambeau Lake. This makes for a 25-mile paddle to the Murray's landing take-out.

Manitowish River

This 20-mile route is a continuation of the popular Manitowish trip that begins at High Lake (Vilas County) at the river's origin on County Road B east of Presque Isle.

Gile Flowage

Gile Flowage, a 3,380-acre lake in northern Iron County, is the last large underdeveloped "Laurentian Shield" lake in Wisconsin. Most of the shoreline is ancient exposed bedrock and the flowage is dotted with bedrock islands reminiscent of the Boundary Waters and Quetico canoe- country region of northern Minnesota.

Turtle-Flambeau Scenic Waters Area

The Turtle-Flambeau Scenic Waters Area encompasses over 38,000 acres with its star attraction being the Turtle-Flambeau Flowage. A voluntary quiet area has been established on approximately the eastern one-fifth of the Flowage.

Montreal River – West Branch

Expert-only paddle route which includes high hazard Class V rapids, dams and inaccessible canyon-like areas.

Lake Superior Water Trail (LSWT)

The LSWT is a network of mapped access points and recreational resources along Wisconsin’s Lake Superior south shore. The water trail provides a framework for a wealth of environmental, historical, and cultural experiences accessible along the Lake Superior coastline.

RUSTIC ROADS

Figure 24: Rustic Roads

Rustic Road 100

A 13.5 mile designated Rustic Road extending from County Highway G from the Michigan/Wisconsin border, continuing south along County Highway H to Mercer. This route along part of the historic Flambeau Trail is Wisconsin's 100th designated Rustic Road.

OUTDOOR RECREATION NEEDS ASSESSMENT

To ensure that the needs of the public are served by this plan, a significant amount of time has been expressed gaining public input into the plan development. Gaining public input and support is a critical element to assessing the needs, development and implementation of this outdoor recreation plan.

RECREATION NEEDS STANDARDS

The National Recreation and Parks Association (NRPA) and Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP) identify standards for designing recreation facilities. The NRPA suggests that a park system, at a minimum, be composed of a "core" system of parklands, with a total of **6.25 to 10.5 acres** of developed open space per **1,000 population**. The size and amount of "adjunct" parklands will vary from community to community, but must be taken into account when considering a total, well-rounded system of parks and recreation areas.

While not classified as parks *per se*, public lands including county and state forestlands provide many of the same park functions in terms of providing open space for a wide range of outdoor activities. Using the NRFA definition, Iron County would need between 37.0 and 59.1 acres of parks to satisfy the demands of county residents. Considering that Iron County has more than 230,000 acres of public recreation land available, the resource is more than sufficient to meet current and projected demands for residents and visitors alike.

PUBLIC INPUT ASSESSMENT

An online survey was developed requesting information from the public regarding their personal interest in the development and maintenance of outdoor recreation in Iron County. On August 6th, 2015, a press release was also submitted and published in the Ironwood Daily Globe and Iron County Miner. Social media was also used to distribute the survey link and solicit comments. The online survey became active on August 8th, 2015 and remained active for a period of 30 days. A total of 654 unique responses were recorded. A letter was mailed to city and town elected officials on September 22nd, 2015, requesting community input in the recreation plan (see appendix). A similar letter of was sent to the following key recreation stakeholders, school districts and interest groups in Iron County.

- Bad River Tribal Council
- Eagle Bluff Golf Course
- Fat Tire Bike Club
- Friends of the Gile Flowage
- Frontier Campground
- Hurley Area Chamber of Commerce
- Hurley School District
- Iron County ATV Association
- Iron County Development Zone
- Iron County Outdoor Recreation Enthusiasts
- Iron County Recreation Council
- Iron County UW-Extension
- Lac Du Flambeau Tribal Council
- Loon Lagoon
- MECCA Ski Club
- Mercer Area Chamber of Commerce
- Mercer Dusty Loons
- Mercer School District

- Mercer SnoGoers
- North Country National Scenic Trail
- North Country Trail Association
- Northern Highland-American Legion State Forest
- Penokee Rangers
- Saxon Harbor Boating Club
- Turtle Flambeau Flowage Association
- White Thunder Riders
- WhiteCap Kayak
- Wisconsin Department of Natural Resources

PUBLIC INPUT SUMMARY

Recreation Uses

In terms of user participation, hiking, fishing, boating, kayaking and snowshoeing were among the most popular recreational activities identified by survey respondents. Summer sports participation rates exceeded winter participation rates by a margin of greater than 2:1.

1. Hiking (Top annual participation)
2. Fishing
3. Snowshoeing
4. Boating
5. Kayaking
6. Cross Country Skiing
7. Road Biking
8. Camping
9. ATVing/UTVing
10. Other water sports
11. Mountain Biking
12. Playgrounds
13. Other
14. Snowmobiling
15. Downhill Skiing
16. Horseback Riding (Lowest annual participation)

Key “other” identified recreational uses included hunting/nature activities, running, motorcycling, driving (touring), watersports (SUP, canoe, swimming) and organized sports**.**

Facilities Demand

In terms of county-owned and managed facilities, the most visited/used facilities identified in the survey include Saxon Harbor, boat landings, Lake of the Falls County Park and the Potato River Falls. Developed county parks also tended to receive much higher usage/visitation rates than minimally developed or primitive sites. The most popular boat landings included those on the Turtle-Flambeau Flowage, Gile Flowage and Lake of the Falls.

Local waterfalls, Montreal Trails, the Turtle-Flambeau Flowage and the Gile Flowage were the most popular non-county-owned or managed facilities or resources in Iron County.

Facilities Satisfaction

In terms of overall satisfaction with the condition of county-owned and managed facilities, 86 percent of survey respondents said they were either very or somewhat satisfied.

Public Water Access

More than 90 percent of survey respondents indicated that Iron County currently has adequate public water access. Less than 10 percent of respondents stated that there are additional needs for public water access in the county. When asked where additional public access was needed, respondents identified the following:

1. Turtle Flambeau Flowage and many smaller lakes
2. Saxon Harbor
3. Lake of the Falls
4. Rice Lake, Echo Lake
5. Fox Lake, Pike Lake
6. Boot lake, Springstead Lake
7. Sturgeon Bay
8. French Lake and Boot Lake
9. Gile Flowage
10. Tyler's Forks
11. Lake Superior
12. Build canoe and kayak accesses to Iron County rivers along roadsides.
13. Bad River
14. Turtle Flambeau Flowage
15. Island Lake. Crystal Lake (Oma)
16. Montreal River

When asked what improvements were needed at public boat landings and water access points, survey respondents indicated issues related to bathrooms, general maintenance, addition/repair or improvement of docks, piers and slips, concerns with the condition of the boat landing itself and parking.

Campgrounds

The majority of survey respondents (71.6%) felt that the number of campground facilities in Iron County was adequate. Nearly a quarter of respondents felt that improvements are needed to existing facilities. Improvements needed most frequently citied included improving/expanding facilities, providing more utilities such as electric and Internet access and general maintenance concerns. When asked where additional camping facilities are needed, respondents listed the following (in priority order):

1. Gile Flowage
2. Hurley Area
3. Remote
4. Saxon Harbor
5. Turtle-Flambeau Flowage
6. Mercer Area
7. Penokee Hills
8. Waterfalls
9. Lake Superior
10. Lake of the Falls

When asked what general concerns they had about county-owned campgrounds, survey respondents most often cited issues related to the camping experience (noise, privacy, visual), need for expanding opportunities (adding additional sites, backcountry opportunities, adding trails, etc.) and the condition of existing facilities (cleanliness, parking, restrooms).

Snowmobile Trails

Nearly 90 percent of survey respondents felt that Iron County has an adequate number of miles of snowmobile trails. A small proportion of respondents (15%) felt that specific improvements were needed to existing trails. The need for additional signage was the most frequently expressed concern, followed by trail maintenance, expanding trails into new areas and grooming.

ATV/UTV Trails

Nearly 80 percent of survey respondents felt that Iron County has an adequate number of ATV/UTV trail miles. Nearly 17 percent indicated that specific trail improvements are needed. The most frequently expressed improvements needed included better signage, trail maintenance (rock removal, widening) and a need for grading to fix rough trails. When asked to provide other concerns regarding ATV/UTV trails, respondents cited adding or expanding trails and allowing multi-use on exiting trails (motorcycles), among other concerns.

Ski Trails

Nearly 64 percent of survey respondents felt that Iron County has an adequate number of kilometers of cross-country ski trails. Nearly 10 percent of respondents indicated that improvements were needed to existing trails, while roughly one-third of respondents indicated more trails were needed. Cited improvements needed include better/more frequent grooming, better signage and general trail maintenance. When asked to provide other concerns regarding ski trails, respondents cited the need to expand trails and develop new trails, improve trail promotion and adding additional facilities, among the previously cited concerns.

Expanding Recreational Opportunities

Survey respondents were asked to identify recreational opportunities which the county should explore or investigate for possible future development. The most cited opportunity was the expansion of biking across the county, including the development new of trails for both mountain and road biking (paved). Another highly cited activity was the expansion of walking/hiking opportunities, including the development of new hiking/walking trails. Increasing opportunities for dual sport motorcycling was also highly cited. This activity involves motorcycles that are designed for both on and off-road use, which are currently not-permitted on the ATV/UTV trail system. A number of other recreational opportunities were identified including development and/or expansion of:

1. ATV/UTV
2. Other Recreation (swimming, dogsledding, jeep trails, etc.)
3. XC Skiing
4. Motorcycling
5. Horse Trails
6. Non-motorized Recreation
7. Nature/Birding
8. Disc Golf
9. Camping
10. Snowshoe
11. Shooting Range
12. Snowmobile
13. Zip line
14. Hunting
15. Canoe/Kayak
16. Boating
17. Improving Recreation Access

Biking/Walking

Most survey respondents (63.1 percent) indicated that they would bike/walk more frequently if there were biking/walking trails in Iron County. Slightly over 15 percent indicated that they would bike/walk the same as they currently do and 21.5 percent stated they would not use biking/walking trails.

COMMUNITY INPUT

TOWN & MUNICPAL PARKS AND RECREATION ASSETS (2010-2015 PLANNING SUMMARY)

MCD	PUBLIC RECREATION FACILITIES			
	NAME	**TYPE**	**AMENITIES AVAILABLE**	**IMPROVEMENTS MADE** (LAST 5 YEARS)
		TOWNS		
TOWN OF ANDERSON	Upson Town Park	Campground	Picnic Tables, Pit Toilets, Grills, Electric, Drinking Water	Picnic Tables, Added (1) Toilet, Painted
TOWN OF KIMBALL	Kimball Town Park	Park	Picnic Tables, Pit Toilets, Handicap Toilet, Grills, Fire Pits, Basketball Court, Playground Equipment, Handicap Fishing Deck, Pavilion, Electrical Power, Walk-in Accessible	
	Softball/Volley ball Field	Field Area		
TOWN OF MERCER	W.S. Carrow Park	Park	Basketball courts, Baseball diamond, beach, grills, picnic tables, volleyball area, pavilion with water and electricity, restrooms, snack shack, playground, tennis court, paved walking oval, paved ADA walking path to beach, beach shelter.	Second basketball court, native plantings on eroding hill, new pier at beach
	ATV & Snowmobile Trails	Trails	Cleared and maintained trails, mapping	Trail extensions and modifications
	Boat Landing	Other	Upgraded and maintained, Handicapped fishing deck on Mercer Lake	Add and upgrade, as needed

MCD	PUBLIC RECREATION FACILITIES			
	NAME	**TYPE**	**AMENITIES AVAILABLE**	**IMPROVEMENTS MADE** (LAST 5 YEARS)
TOWN OF OMA	Oma Town Park	Park, Boat Landing	Boat Landing on Pine Lake, swimming, Pier, Open space, Pavilion, Picnic Tables, Grills Playground, Paved Parking, Pit Toilets	New roofing on Pavilion, renovated pit toilets, new pier at boat landing, refurbished picnic tables
	Oma Community Forest	80 acres of undisturbed woodland recreation area	Unimproved road access adjacent to US Hwy 51	None
TOWN OF SAXON	Iron Horse Trail	Trail	None	None
TOWN OF SHERMAN	Snowmobile Trail	Trail	None	none
CITIES				
CITY OF MONTREAL	Gile Park/Gile Flowage	Park	Pavilion, Toilets, Picnic Tables, Playground, Beach, Boat Launch/Dock	None
	Slugger Baron Park	Park	Playground, Picnic Tables, Basketball Court	
	West End Ball Field	Ball Field/Park	Baseball Field, Basketball Court, Playground	
	City Hall Ball Field	Park/Playground	Baseball Field, Tennis Court	
CITY OF HURLEY	Riccelli Park	Park	Tables, Pavilion, Grills, Playground, Flushable Restrooms	Add swings, Repair merry-go-round, Remove dead trees
	Cary Road Ball Park	Park	Tables, Grills, Playground, Bocce Ball Courts, Volley Ball Courts, Walking Trail, Restrooms, Drinking Water	
	Eagle Bluff Golf Course	18 Hole Golf Course	Club House, Cart Rentals, Storage Sheds	

MCD	PUBLIC RECREATION FACILITIES			
	NAME	**TYPE**	**AMENITIES AVAILABLE**	**IMPROVEMENTS MADE** (LAST 5 YEARS)
	Little League Field	Ball Field/Park	2 Baseball Diamonds, Electronic Scoreboards, Concession Buildings, Restrooms	
	Range Trail	Non-Motorized Trail	Tables, Bike Rack, Information Board	

TOWN & MUNICPAL PARKS AND RECREATION ASSETS PLAN FOR IMPROVEMENTS 2016-2020

FUTURE OUTDOOR RECREATIONAL IMPROVEMENTS DESIRED FROM JANUARY 2016 TO DECEMBER 2020. (SUCH AS PLANNED TRAILS OR OTHER NEW RECREATION SITES).	
TOWNS	
TOWN OF ANDERSON	New construction of vault toilets in campground
TOWN OF KIMBALL	Interstate and Peterson Falls viewing area. Plan to provide a parking area and hiking trails.
TOWN OF MERCER	Trails: Install concrete walk/bike trail from school to Carow Park, Complete 7-mile non-motorized trail to Vilas County line, Install ballards into existing walk/bike trail along US Hwy 51, Initiate grant applications for funding for non-motorized trail with along County Hwy J from Carow Park to County line, or along, County Hwy H from County Hwy J to County Hwy G, or along County Hwy FF.
	Carow Park: Redoing the tennis courts, new posts for new cyclone fence, remove basketball casings and install new basketball equipment and supports, upgrade grills, Remodel bathroom facilities.
	With improved town road improvements, add additional property to Lake of the Falls Park
TOWN OF OMA	Residents of Oma have not communicated a desire for the Town to make significant expansions to the existing recreation sites beyond maintenance and general upkeep.
	The Oma Community Forest is an 80 acre parcel located 1.5 miles south of Schomberg Park along US Hwy 51. No established motorized trails are nearby. This area is a completely undisturbed upland forest that is available for recreation. Access is via a short unimproved road. No amenities are available. The timber is managed by the Iron County Forestry Department and due for logging in 2030. With grant funding and inter-governmental cooperation with Iron County Forestry and Parks Department, this area has potential to support quiet-outdoor recreation.
TOWN OF SAXON	Would like Iron Horse Trail to be paved between 122 & B.
TOWN OF SHERMAN	Biking/hiking/cross country ski trails. (Possibly various locations. Some residents have expressed significant interest in such a trail alongside the Flowage Road in Springstead). Possible outdoor skating rink in Winter.
CITIES	
CITY OF MONTREAL	Work with local groups to get walking/biking trail to Montreal's west end.
CITY OF HURLEY	We want to expand the non-motorized trail to meet Cary Road Park and someday to Montreal Wisconsin. Add another trail head park with all amenities.

TOWN & MUNICPAL INPUT ON COUNTYWIDE AND LOCAL RECREATIONAL PLANNING ISSUES

MCD	WHAT ARE THE TOP THREE RECREATIONAL ISSUES FACING IRON COUNTY?	HOW SHOULD THE COUNTY RECREATION ISSUES IDENTIFIED BE SATISFIED?	WHAT ARE THE TOP THREE RECREATIONAL ISSUES FACING YOUR COMMUNITY?	HOW SHOULD THE LOCAL ISSUES IDENTIFIED BE SATISFIED?
TOWN OF MERCER	Focus on improving all silent sport recreational opportunities along with improved PR and mapping Improved signage and mapping for outdoor recreational areas Funding for all trails: motorized and non-motorized	Grant awards, Use organizations and governmental entities to focus on improving all of the above.	Same as countywide	Again with governmental bodies and organizations working in union to address all of the above. Funding and participation are imperative.
TOWN OF OMA	Signage to existing trails, waterfalls, and hiking areas. Non-motorized winter recreation with maintained trails and available parking	Install better signage to existing recreation areas. Example: It is very difficult to find the trailhead at Saxon Falls. Many examples of this throughout the county. Iron County has numerous areas that can be used for quiet outdoor winter recreation. After a timber sale on county land the logging contractors build wonderful roads that could be maintained as non-motorized snowshoe trails, especially in select-cut timberlands. For minimal investment in trailhead parking areas (that are plowed in the winter), signage, and trail maps there could be miles of quiet outdoor recreation on county land.	The Town of Oma, being centrally located between Hurley and Mercer, does not have any identifiable recreational issues. The main concern for the community is the overall economic health of Iron County. Having a comprehensive county-wide balance between motorized and non-motorized recreational areas is key to the long term economic stability of the county.	

CITY OF MONTREAL	Maintenance of existing facilities/amenities and creation of new opportunities	Work with governing bodies, community and volunteers to maintain and create recreational facilities to the best that can be done		
CITY OF HURLEY	Expand trail system, both non-motorized and motorized. Showers and restrooms at Lake of the Falls Campground. Flushable toilets and showers at Weber Lake	Apply for grant money to cover costs	Non-Motorized trail access	Apply for any type of grant available
TOWN OF SHERMAN	Communication to outlying communities far from Hurley (e.g.: Springstead has postal service out of Park Falls, a different county, so residents don't receive information about iron County activities, including the Iron County Fair.) Size of county	Provide information to the Park Falls Miner…have mailings go to residents in Springstead/Town of Sherman, which much of it is out of Park Falls post office	Ability to pay for staff to maintain trails, parks, activity areas	County funding and reimbursement for staffing of and maintenance of new recreational spots
TOWN OF KIMBALL	Speed limit for both snowmobiles and ATVs Getting routes and trails off of roads			

CLUB/ORGANIZATIONAL INPUT

WHAT ARE THE TOP THREE RECREATIONAL ISSUES FACING IRON COUNTY?				
CLUB/ORG.	**ISSUE 1**	**ISSUE 2**	**ISSUE 3**	**HOW SHOULD RECREATION ISSUES BE STAISFIED?**
HURLEY CHAMBER OF COMMERCE	An alternate trail route, for recreational vehicles, needs to be determined from Hurley to Saxon through Kimball.	Lack of funding for Silent Sports to maintain trail use in winter. (Example: cross country trails)		Meeting with the town board members in Kimball to resolve trail route issues.
IRON COUNTY OUTDOOR RECREATION ENTHUSIASTS (ICORE)	Lack of non-motorized trails (hiking and biking), both regional trails connecting communities and trail systems/loops.	Poor non-motorized access to water bodies (lakes, rivers, waterfalls)	Poorly maintained non-motorized trails (signage, mapping, parking, grooming, plowing)	
LOONY PADDLERS	Lack of toilets at boat landings	Difficulty of finding description of hiking trails	Lack of scenic hiking trails	Portable toilets would help protect our likes and the landowners adjacent to the boat landings and rid us of unsightly toilet paper debris. The county could focus on the development of silent sport trails in the lake-rich southern third on public lands bordering streams and lakes. Volunteers might be recruited to help with clearing and maintaining walking trails. A silent sports trail map, similar to the Vilas County piece, could be developed, to include trails both on county, state and federal lands.

WHAT ARE THE TOP THREE RECREATIONAL ISSUES FACING IRON COUNTY?				
CLUB/ORG.	**ISSUE 1**	**ISSUE 2**	**ISSUE 3**	**HOW SHOULD RECREATION ISSUES BE STAISFIED?**
MERCER DUSTY LOONS	ATV/UTV Trails-Combo Trails.	Hunting - DNR problem/wolves.	Fishing - DNR problem/Regulation takes too long.	Need to help fight the state land now used by motorized vehicles. Get active on State Laws.
SCHOOL DISTRICT OF MERCER	ATV trails too narrow and bumpy.	People are not considerate on trails.	Speed limits on trails are too high.	Grade the trails every two years or less. Have someone check the trails and fix washboards. Lower speed limit especially at night. Enforce trails better. Have volunteer groups teach people about trail rules and being considerate.
WHITE THUNDER RIDERS	Shortage of funding to adequately maintain/rehab ATV trails.	Distance in/development of a long range strategic trail plan for the county.	Finding ways to promote Iron County as a year round "Destination" for recreation.	Pursue grants to leverage funds to supplement state funds and hire a consultant to assist with plan development.

CLUB/ORGANIZATIONAL RECREATIONAL IMPROVEMENTS

	DESIRED IMPROVEMENTS AT COUNTY MANAGED FACILITY OR TRAILS		NEW RECREATION FACILITIES OR TRAILS DESIRED AND FUNDING SOURCES	
CLUB/ORG.	**FACILITY OR TRAIL**	**IMPROVEMENT NEEDED**	**NEW FACILITIES OR TRAILS**	**FUNDING SOURCES**
HURLEY CHAMBER OF COMMERCE	ATV/UTV Snowmobile Trails	Improved Signage	Trails to Saxon Harbor providing better access for recreational vehicles	Grants, private funds, fundraisers, etc.
IRON COUNTY OUTDOOR RECREATION ENTHUSIASTS (ICORE)	Gateway Regional Trail Trails to Waterfalls ULLER	Extend from Hurley to Montreal. Signage, mapping, parking and plowing of trailheads. Improve trail maintenance, parking and grooming.	Create backcountry experiences, such as campgrounds and cabins along lakes and trails. Provide enhanced access to scenic views, provide parking, signage, maintenance and mapping. Connect Hurley and Mercer with non-motorized hiking and biking trails. Enhance non-motorized access to lakes and streams. Develop brochures for birding opportunities.	
MERCER DUSTY LOONS		Open up County Road FF for ATV/UTV use from Popko circle to Swamp Creek Rd. to make a loop to Hurley and Mercer	ATV/UTV in Mercer	Combo trails on some of our state land. Put our state land to better use by more than tree huggers. If we get to use state land we would build our own trails.
LOONY PADDLERS	Schomberg Park	Improve the snowshoe trail so that it is easier to negotiate in the non-snow season, too.	Walking/snowshoe trails along streams or lakeshores.	

	DESIRED IMPROVEMENTS AT COUNTY MANAGED FACILITY OR TRAILS		NEW RECREATION FACILITIES OR TRAILS DESIRED AND FUNDING SOURCES	
CLUB/ORG.	**FACILITY OR TRAIL**	**IMPROVEMENT NEEDED**	**NEW FACILITIES OR TRAILS**	**FUNDING SOURCES**
WHITE THUNDER RIDERS	Keep up with rehabilitation and maintenance of ATV trails as they get blown out. Better signage to points of interest (falls, overlooks, etc.) from snowmobile and ATV trails. Designate more sites/areas for dispersed camping opportunities. Especially near natural attractions.	Hurley to Ashland motorized trail. Outhouse at B-47 crash site memorial.	Finding ways to promote Iron County as a year round "destination" for recreation.	Grants, state funding, county recreation budget
SCHOOL DISTRICT OF MERCER	The Railroad Grade. Trail by Cranberry Inn. Trail from Mercer to Cramer Lake Rd. Lake of the Falls Walking Trail.	Grade it, add gravel, widen in spots. Rocky rough, riding sideways needs to be fixed. Roots sticking up in trail need removed. Has poison ivy everywhere around trail.	Mountain bike trails around Mercer	

PLAN IMPLEMENTATION

Findings from the surveys of Iron County citizens, recreation users and outdoor recreation interest groups clearly show a high level of interest in outdoor recreation in Iron County, as well as the need to invest in the development, improvement and maintenance of facilities.

With finite resources available for outdoor recreation, it is critical to prioritize needs across the county. However, funding alone is not the answer. Active partnerships are also essential to meeting the outdoor recreation needs of county residents and visitors. At the core of the county's parks and recreation system are local, state and nonprofit agencies and organizations which can provide the resources and support that will be necessary to continue to grow and maintain the recreation system.

The Iron County Outdoor Recreation Plan Steering Committee, with input from the county's outdoor recreation stakeholders and communities, has identified one overall goal and four supporting objectives which serve as the vision to guide the management and development of Iron County's outdoor recreation base over the next five years. The plan's goals and objectives are implemented through a series of related policies, which guide future decision-making, and specific programs and actions which identify the priorities and outcomes for the next 5-year planning cycle.

IRON COUNTY OUTDOOR RECREATION IMPLEMENTATION PLAN

The Iron County Forestry Department (ICF) will continue maintenance of existing facilities. Iron County Forestry will increase promotion of recreation opportunities on the Iron County Forest via website, social media, Chambers, maps & brochures. ICF will also explore opportunities to promote outdoor recreation through outreach with local schools. ICF will also continue to assess the need to offer WIFI at the campgrounds as it becomes available. Funding for these activities continue to come from user fees set and assessed by the Forestry Committee annually, grant opportunities when applicable and Iron County.

RESOURCE	ACTIVITY	COST	SOURCE
COUNTY PARKS			
Lake of the Falls	Install drain field for Side 3 restroom/shower building.	$20,000	County Park Budget
	Construct and install dock at boat landing on Side 1	$5,000	Grant Funding via WDNR Conservation Aids
	Explore new water supply and add electrical service to sites for Side 2. Install parking area for boaters and day use on Side 1	Est. $7,000	To Be Determined
	Assess the need for campground expansion and additional restroom/shower buildings, plan & build if needed.	To Be Determined	Grant funding from WDNR Recreational Boating, Stewardship, Xcel Energy or any other eligible opportunities.
Schomberg Park	Plant trees within campground	Est. $750	To Be Determined
Weber Lake	Continue to assess the need for flush toilet/showers. Work in partnership with an organized friends or interest group for additional upgrades within the park.	To Be Determined	To Be Determined
Saxon Harbor	Install floating docks and sidewalk to complete remaining south side of north basin	2016 - $165,000	2016 Saxon Harbor Budget
	Engineer, plan and install floating docks and sidewalk throughout the remainder of north basin. Engineer, plan and construct new parking lot on north side of north basin	Est. for north side of north basin & parking lot $500,000	WDNR Rec. Boating, Forestry/Saxon Harbor Budget
	Repair transient docking wall on east side.	To Be Determined	Seek grant funding through, USACE, Coastal Management, WDNR Recreational Boating, Conservation Aids, or Stewardship, or any other eligible opportunities. Seek matching funds contribution in cooperation with Saxon Harbor Boating Club.
	Overstory removal to open up campsites 39-43. Upgrade beach access. Continue improvements of Harbor and Campground in partnership from Saxon Harbor Boating Club.	To Be Determined	To Be Determined

RESOURCE	ACTIVITY	COST	SOURCE
Potato River Falls	Additional signage on Hwy 169 and trails within park. Tree and brush removal around viewing platforms.	Est. signing & brushing $3,000	Unknown
	Seek and construct better viewing areas and trails where needed.	Unknown	Unknown
Waterfalls	Continue maintenance of trails and viewing areas. Increase signage in cooperation with Iron Co Development.	Unknown	Unknown
NON-MOTORIZED TRAILS			
MECCA	Continue to work in cooperation with MECCA Ski Club in maintaining the MECCA trails by assisting in grant funding opportunities.	Unknown	Grant Funding Opportunities
	Explore mountain bike trail opportunities within the trail system, assist with development and funding opportunities.	Unknown	Grant Funding Opportunities
Uller Trail	Continue to work with Penokee Rangers in maintaining the Uller Trail by providing some labor and equipment and continue to seek grant funding opportunities.	Unknown	Grant Funding Opportunities
	Assist in installing bridges over small creeks.	$9,600	Funding already secured from WDNR-RTA funds
	Explore options for mountain bike, snowshoe and fat bike use in partnership with organized interest groups. Consider adding loops of trail so trail users can begin & end at the same point.	Unknown	Unknown
North Country Trail	Continued cooperation with the North Country Trail Association in expansion of certified portions of NCT. Assist in the development of a walking bridge over Tyler Forks at Wren Falls.	Unknown	Funding sources from North Country Trail.
Schomberg Park Snowshoe Trail	Continue maintenance. Install footbridges over drainages. Explore opportunities to utilize trails for Fat Bikes (winter use).	Unknown	Unknown

RESOURCE	ACTIVITY	COST	SOURCE
Hunter walking trails	Continue to maintain the Potato River Grouse Management Area in Saxon/Upson. Continue to improve and develop additional hunting opportunities in cooperation with Ruffed Grouse Society and other interest groups. These trails may also be an opportunity for winter Fat Bike and snowshoeing use.	Unknown	Unknown
Other Projects/Activities	Work with organized interest group to assess the need for mountain bike trails and fat tire bike trails (winter use). Help to plan and develop a trail system within Iron County Forest.	Unknown	Assist in seeking grant funding from WDNR and other sources
	Work with interested groups to continue expansion of Gateway Trail.	Unknown	Assist in seeking grant funding from WDNR, Coastal Management, WDOT and any other sources.
	Work with organized interest group to assess the need for horseback riding trails on County Forest. Help to plan and develop a trail system.	Unknown	Assist in seeking grant funding from WDNR and other sources.
	Promote wilderness/rustic camping on County Forest Land.	Unknown	Unknown
	Assess locations of scenic/historic sites throughout the County Forest, their accessibility, create and promote them as destinations for recreation enthusiasts.	Unknown	Unknown
	Cooperate with interest groups and Chambers on special events and races with the use of County Forest for resources and event locations.	Unknown	Unknown

RESOURCE	ACTIVITY	COST	SOURCE
MOTORIZED TRAILS			
ATV/UTV Trails	Continue maintenance of existing ATV trails in cooperation with the Iron County ATV Association, Mercer Dusty Loons, Mercer Sno-Goers and White Thunder Riders by providing grant administration, labor, equipment and supplies.	Unknown	Funding from WDNR ATV/UTV maintenance and development grants.
	Develop a plan and work to implement to provide improved signage throughout the system.	Unknown	Funding from WDNR ATV/UTV Maintenance grants.
	Provide trail location assistance, easement acquisition, engineering and development, construction, funding opportunities and administration of required ATV trail relocations with priority of placement on public lands where possible.	Unknown	Unknown
	Continue assessment of existing trails and bridges and assist clubs in engineering, construction, funding opportunities and administration of rehab projects needed on existing ATV trails.	Unknown	Unknown
	Assess the need and feasibility of additional ATV trails throughout the County with first priority of placement on public lands. Assist in grant opportunities through WDNR, construction and maintenance on any new trails due to expansion. Clubs will continue to seek feasible ATV trail opportunities considering economic need, soil conditions and social issues. Easements for new trails will be sought from private landowners by club members.	Unknown	Grant opportunities through WDNR, construction and maintenance on any new trails due to expansion.

RESOURCE	ACTIVITY	COST	SOURCE
ATV/UTV Trails	Assess the feasibility of corridor expansion to Ashland County into Mellen and Bad River and Vilas County to Lac Du Flambeau. Continue to cooperate with non-motorized groups to assess the feasibility of acquiring Canadian National railroad grade from Hurley to Mellen. Provide engineering and development where needed.	Unknown	Funding opportunities to be sought from WDNR, Coastal Management and other sources.
	Trail 15 relocation from Trail 77 to Cary Mine will be constructed in 2016.	$27,760	Funding secured by WDNR ATV & Snowmobile grants, total cost.
	New decking and railings to be constructed on Layman's Creek Bridge (Oma)	$8,696	Funding secured from WDNR Snowmobile & ATV Program.
	Arrowhead Bridge (Mercer)	$12,206 on Trail 17 in 2016	Funding secured from WDNR Snowmobile & ATV Program.
	Search for a trail location on County Forest Property for ATV and Snowmobile use to get riders from the Island Lake area to Ashland County trails with minimal use of road routes in cooperation with ATV and Snowmobile Clubs.	To be determined	WDNR ATV and Snowmobile Grant Funds
Snowmobile Trails	Continue maintenance of existing snowmobile trails in cooperation with the Mercer Sno-Goers and White Thunder Riders by providing grant administration, labor, equipment and supplies.	Unknown	Funding from WDNR Snowmobile grants.
	Develop a plan and work to implement to provide improved signage throughout the trail system.	Unknown	Funding from WDNR Snowmobile Maintenance grants.
	Provide trail location, engineering, development, construction, easement acquisition and funding opportunities and administration of required Snowmobile trail relocations with priority of placement on public lands where possible.	Unknown	Unknown

RESOURCE	ACTIVITY	COST	SOURCE
Snowmobile Trails	Continue to assessment of trails and bridges and assist clubs in engineering, construction, funding opportunities and administration of rehab projects, including trails and bridges, needed on existing Snowmobile trails.	Unknown	Unknown
	Assess the need and feasibility of additional Snowmobile trails throughout the County with first priority of placement on public lands. Assist in grant opportunities through WDNR, construction and maintenance on any new trails due to expansion or relocation. Clubs will continue to seek feasible Snowmobile trail opportunities considering economic need and social issues. Easements for new trails will be sought from private landowners by club members.	Unknown	Assist in grant opportunities through WDNR
	Assess the feasibility of corridor expansion to Ashland County into Mellen and Bad River. Continue to cooperate with non-motorized groups to assess the feasibility of acquiring Canadian National railroad grade from Hurley to Mellen. Provide engineering and development where needed.	Unknown	Funding opportunities from WDNR, Coastal Management and other sources.
	Trail 15 relocation from Trail 77 to Cary Mine will be constructed in 2016.	$27,760	Funding secured by WDNR ATV & Snowmobile grants
	New decking and railings to be constructed on Layman's Creek Bridge (Oma)	$8,696	Funding secured from WDNR Snowmobile & ATV Program.
	Arrowhead Bridge (Mercer)	$12,206 on Trail 17 in 2016	Funding secured from WDNR Snowmobile & ATV Program.
	Construction of 180' bridge over wetland on Trail 17 on NHAL property between Hwy 51 intersection and Sandy Beach.	Partial funding ($29,000) Total project estimate $84,000.	Partial funding received from WDNR Snowmobile grants and remaining funding will continue to be applied for through the WDNR Snowmobile program.

RESOURCE	ACTIVITY	COST	SOURCE
Snowmobile Trails	Search for a trail location on County Forest Property for ATV and Snowmobile use to get riders from the Island Lake area to Ashland County trails with minimal use of road routes in cooperation with ATV and Snowmobile Clubs.	To be determined	WDNR ATV and Snowmobile Grant Funds
BOAT LANDINGS			
Boat Landings	Continue to monitor, maintain and repair Iron County owned boat landings throughout the County.	Unknown	Seek funding through WDNR Recreational Boating and Conservation Aids or other sources when needed.
	Install dock at Lake of the Falls boat landing.	$5,000	Funding secured through WDNR Conservation Aids with local match
NON-COUNTY MANAGED FACILITIES			
Non-County Managed Facilities	Economic Development and Chambers will continue water route mapping for paddlers. Promote and make materials available.	Unknown	Unknown

APPENDIX A
PLANNING PROCESS DOCUMENTATION

Iron County Outdoor Recreation Plan Update Meeting
Forestry Conference Room, 607 3rd Ave N, Hurley, WI 54534.
Wednesday, September 16, 2015
6:00 PM

1. Call meeting to order
2. Discuss process, timeline, meeting schedule
3. Discuss outdoor recreation survey
4. Discuss community outdoor recreation plan questionnaire
5. Discuss data needs for plan update
6. Public comment
7. Adjourn

Iron County Outdoor Recreation Plan Update Meeting 2
Forestry Conference Room, 607 3rd Ave N, Hurley, WI 54534.
Wednesday, October 28th, 2015
4:00 PM

1. Call meeting to order
2. Outdoor recreation survey update. Review community and organizational questionnaires.
3. Set goals, objectives and policies for outdoor recreation.
4. Review recreational facilities and opportunities mapping.
5. Public comment
6. Adjourn

Individuals wishing to direct written comments may do so to the attention of Jason Laumann, Northwest Regional Planning Commission, 1400 S. River Street, Spooner WI 54801 or by email to jlaumann@nwrpc.com

Iron County Outdoor Recreation Plan Update Meeting 3
Forestry Conference Room, 607 3rd Ave N, Hurley, WI 54534.
Wednesday, December 9th, 2015
4:00 PM

1. Call meeting to order
2. Review community and organizational questionnaires/response summaries
3. Develop outdoor recreation implementation strategies
4. Public comment
5. Adjourn

Individuals wishing to direct written comments may do so to the attention of Jason Laumann, Northwest Regional Planning Commission, 1400 S. River Street, Spooner WI 54801 or by email to jlaumann@nwrpc.com

Iron County Outdoor Recreation Plan - September 16, 2015

Name	Affiliation	Phone	Email Address
ERIC PETERSON	IRON Co. FOREST ADMIN	715 561-2697	icfadmin@ironcountyforest.org
Tara Krall	Iron Co Forestry Dept	715-561-2697	tara@ironcountyforest.org
Kelly Klein	Iron Co Economic Development	715/561-2922	Kelly@ironcountywi.com
Terry Daulton	* citizen	715 476-3530	tdaulton@unac.com
Tom	Zoning		

Iron County Outdoor Recreation Plan - October 28, 2015

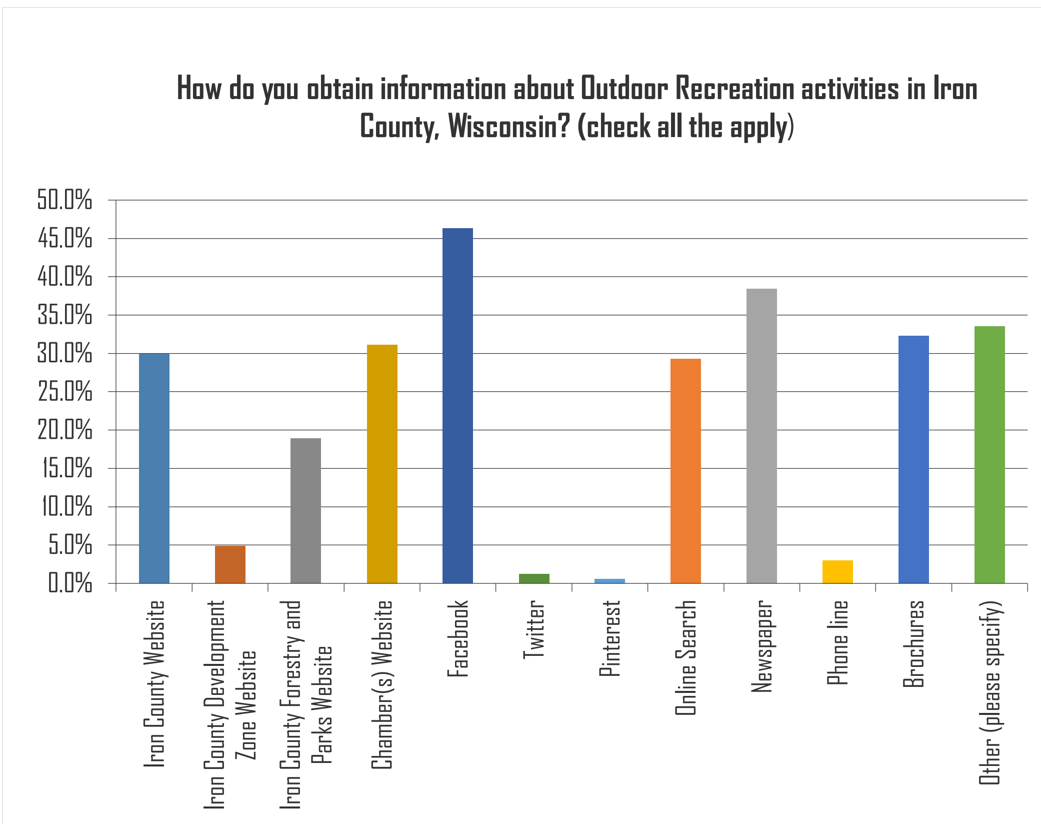
Name	Affiliation	Phone	Email Address
Kelly Klein	Iron Co. Econ Dev	715/561-2922	Kelly@ironcountywi.com
ERIC PETERSON	IRON Co Forest ADMIN	561-2697	icfadmin@ironcountyforest.org
Larry ERickson	IRON CO REC COUNCIL	561 4834	LDERickson@centurytel.net
Tara Krall	Iron Co Forestry	561-2697	tara@ironcountyforest.org
Tom Bergman	Iron Co Zoning	561-5414	zoningadmin@ironcountywi.org

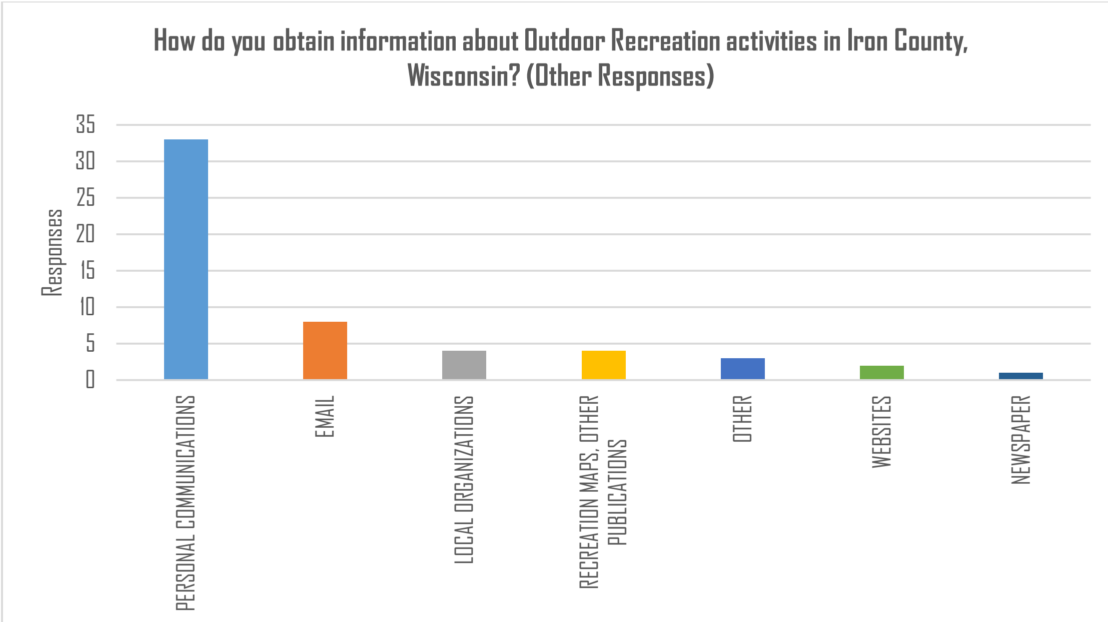
Iron County Outdoor Recreation Plan December 9, 2015

Name	Affiliation
Jason Laumann (CFAC)	NWRPC
Larry Erickson	IC Rec Council
Kelly Klein	Iron Co Econ Dev
Will Andresen	Iron County UW-Extension
Tara Krall	Iron County Forestry
Tom Bergman	Iron Cty Zoning
Terry Daulta	citizen
Pito Santini	Iron County ATV

APPENDIX B
RECREATION USER SURVEY RESULTS

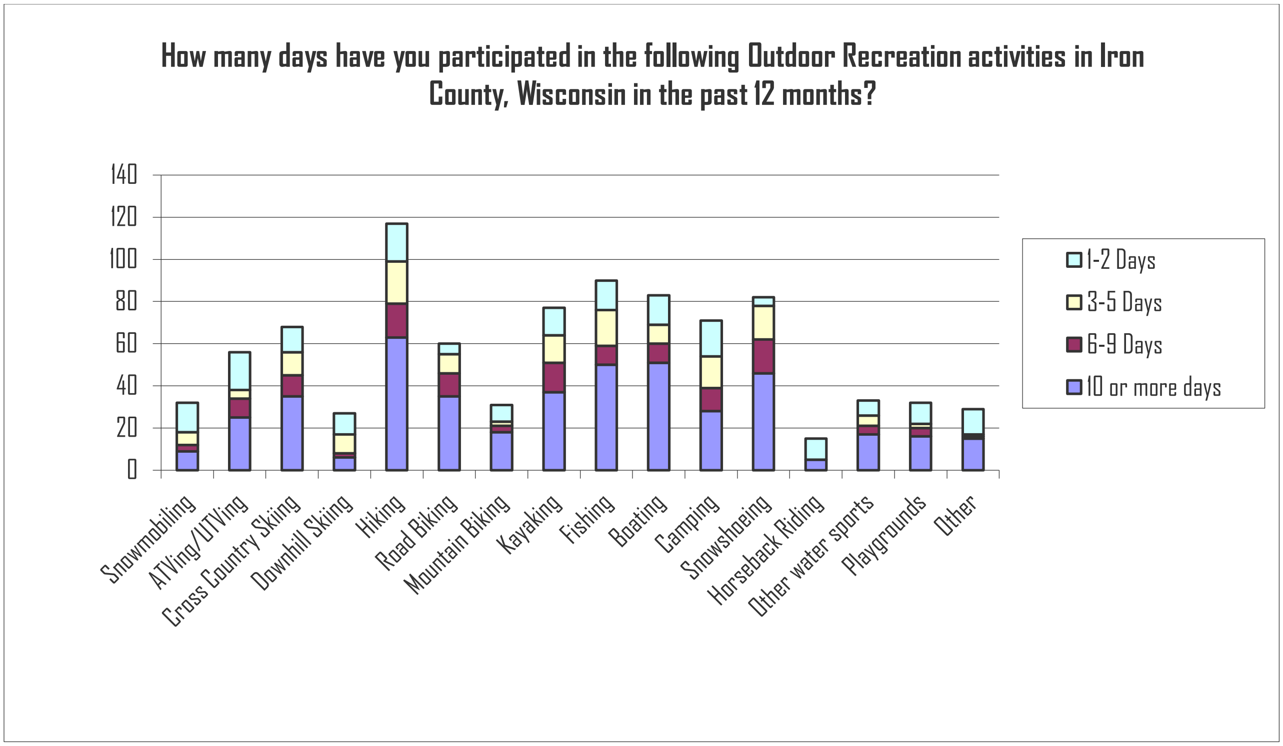
Q1. How do you obtain information about Outdoor Recreation activities in Iron County, Wisconsin? (check all the apply)		
Answer Options	**Response Percent**	**Response Count**
Iron County Website	29.9%	49
Iron County Development Zone Website	4.9%	8
Iron County Forestry and Parks Website	18.9%	31
Chamber(s) Website	31.1%	51
Facebook	46.3%	76
Twitter	1.2%	2
Pinterest	0.6%	1
Online Search	29.3%	48
Newspaper	38.4%	63
Phone line	3.0%	5
Brochures	32.3%	53
Other (please specify)	33.5%	55

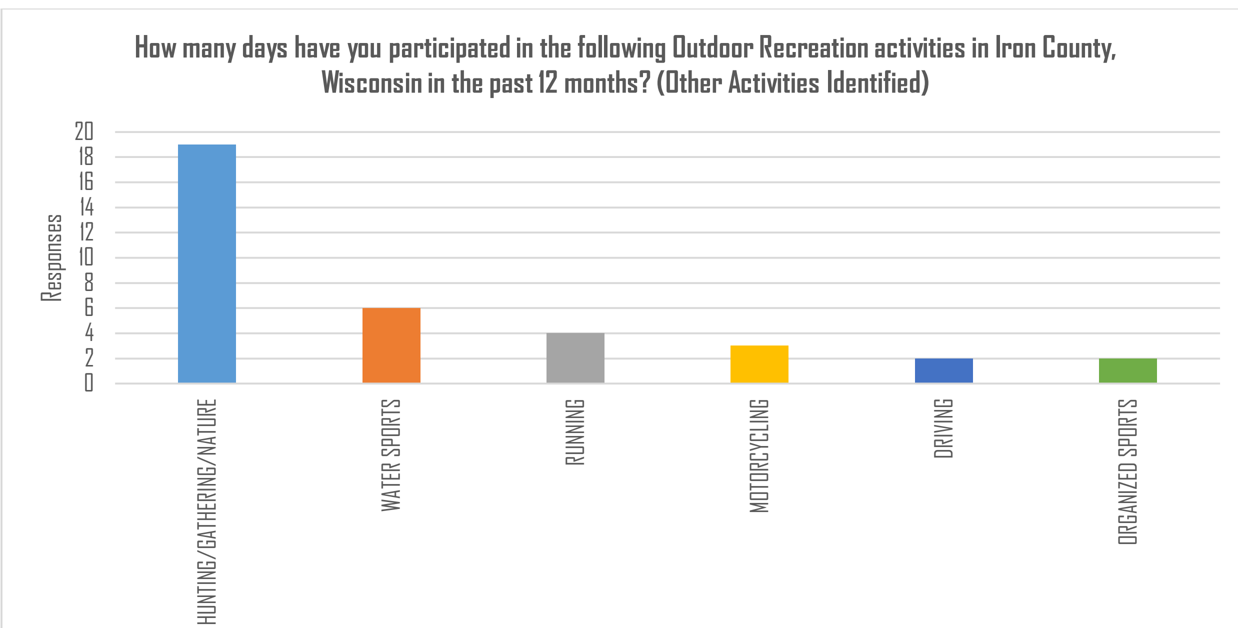




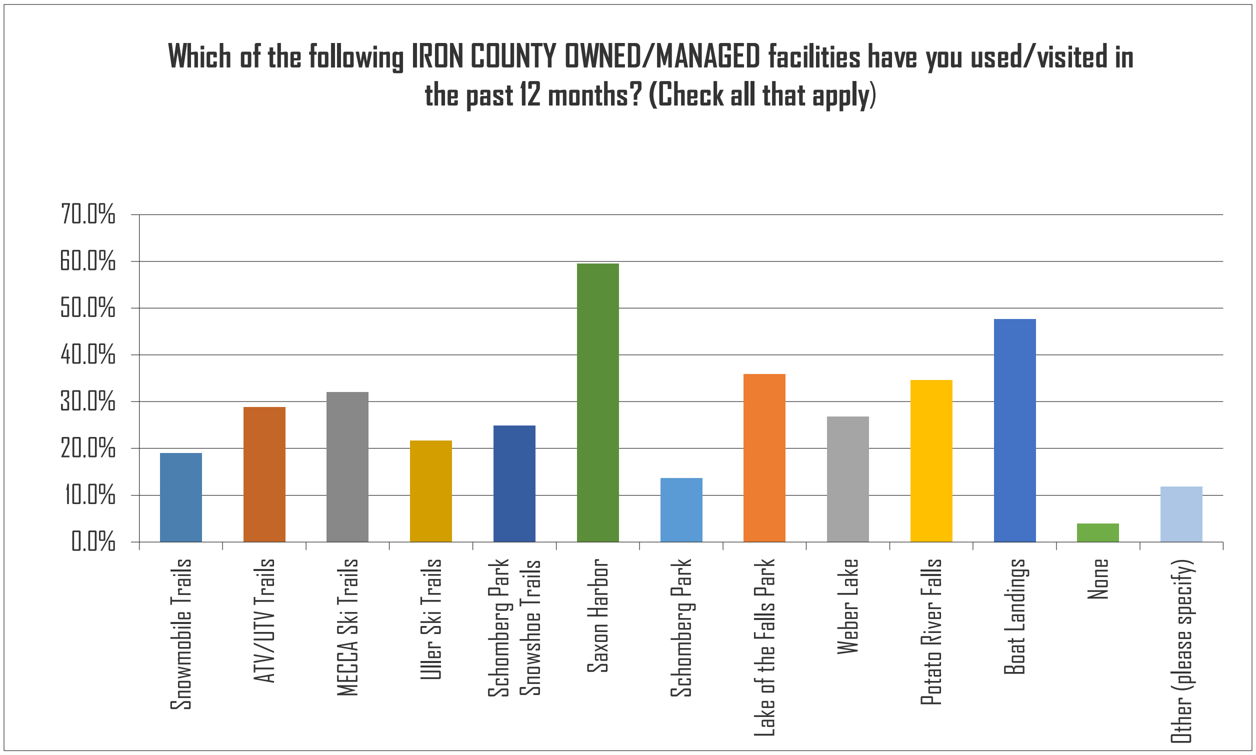
Q2. How many days have you participated in the following Outdoor Recreation activities in Iron County, Wisconsin in the past 12 months?

Answer Options	1-2 Days	3-5 Days	6-9 Days	10 or more days	Response Count
Snowmobiling	14	6	3	9	32
ATVing/UTVing	18	4	9	25	56
Cross Country Skiing	12	11	10	35	68
Downhill Skiing	10	9	2	6	27
Hiking	18	20	16	63	117
Road Biking	5	9	11	35	60
Mountain Biking	8	2	3	18	31
Kayaking	13	13	14	37	77
Fishing	14	17	9	50	90
Boating	14	9	9	51	83
Camping	17	15	11	28	71
Snowshoeing	4	16	16	46	82
Horseback Riding	10	0	0	5	15
Other water sports	7	5	4	17	33
Playgrounds	10	2	4	16	32
Other	12	1	1	15	29
Please Specify Other Activity					41


How many days have you participated in the following Outdoor Recreation activities in Iron County, Wisconsin in the past 12 months?
140
120
100
80
60
40
20
0
Snowmobiling
ATVing/UTVing
Cross Country Skiing
Downhill Skiing
Hiking
Road Biking
Mountain Biking
Kayaking
Fishing
Boating
Camping
Snowshoeing
Horseback Riding
Other water sports
Playgrounds
Other
1-2 Days
3-5 Days
6-9 Days
10 or more days


How many days have you participated in the following Outdoor Recreation activities in Iron County, Wisconsin in the past 12 months? (Other Activities Identified)
Responses
20
18
16
14
12
10
8
6
4
2
0
HUNTING/GATHERING/NATURE
WATER SPORTS
RUNNING
MOTORCYCLING
DRIVING
ORGANIZED SPORTS

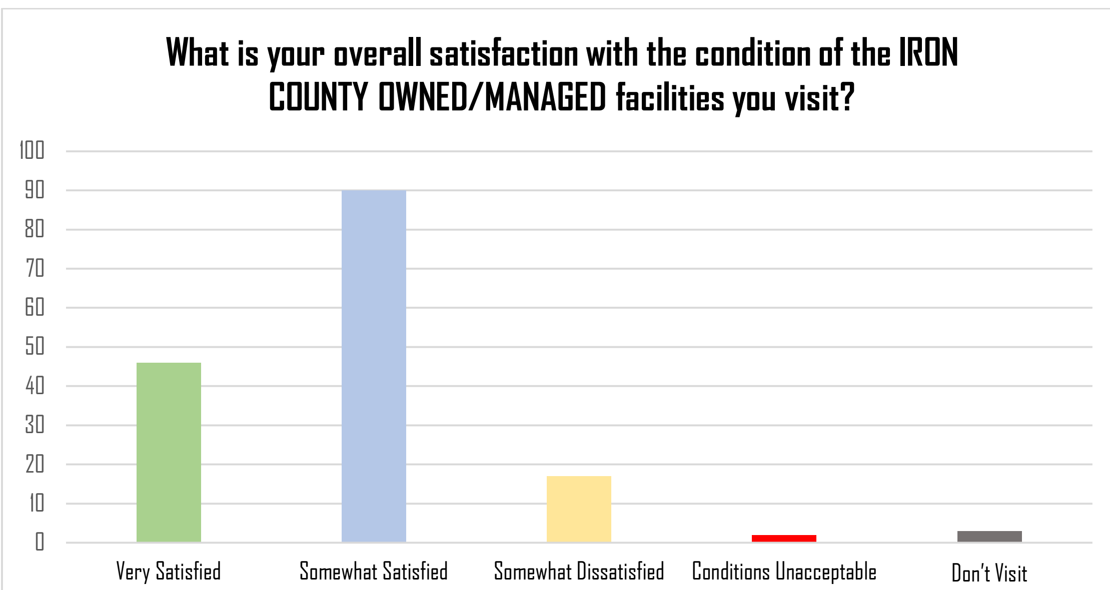
Q3. Which of the following IRON COUNTY OWNED/MANAGED facilities have you used/visited in the past 12 months? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Snowmobile Trails	19.0%	29
ATV/UTV Trails	28.8%	44
MECCA Ski Trails	32.0%	49
Uller Ski Trails	21.6%	33
Schomberg Park Snowshoe Trails	24.8%	38
Saxon Harbor	59.5%	91
Schomberg Park	13.7%	21
Lake of the Falls Park	35.9%	55
Weber Lake	26.8%	41
Potato River Falls	34.6%	53
Boat Landings	47.7%	73
None	3.9%	6
Other (please specify)	11.8%	18



- biking county roads
- Corrigan's lookout, other waterfalls, walking on woods roads away from motorized vehicles
- County land off Moore Park Road.
- Forest land
- Gold Mine, Wren Falls

- County Forest Trails.
- Iron County Forest - hunting
- Montreal Ski Trails
- Natural settings
- Penokee hills (2)
- Rouse Falls, Tyler Forks, Foster Falls, Wren Falls, OBrien Lake
- Several other falls
- Utilized ATV trails for biking and running
- Waterfall hikes, need better facilities at falls
- Waterfall tours; Corrigan's Look-out
- Wilderness areas
- Wren Falls, Foster Falls, gold Mine, Tyler Forks, Upson Park, Corrigans Lookout

Q4. What is your overall satisfaction with the condition of the IRON COUNTY OWNED/MANAGED facilities you visit?							
Answer Options	**Very Satisfied**	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Conditions Unacceptable**	**Don't Visit**	**Rating Average**	**Response Count**
	46	90	17	2	3	1.90	158
Comments							22



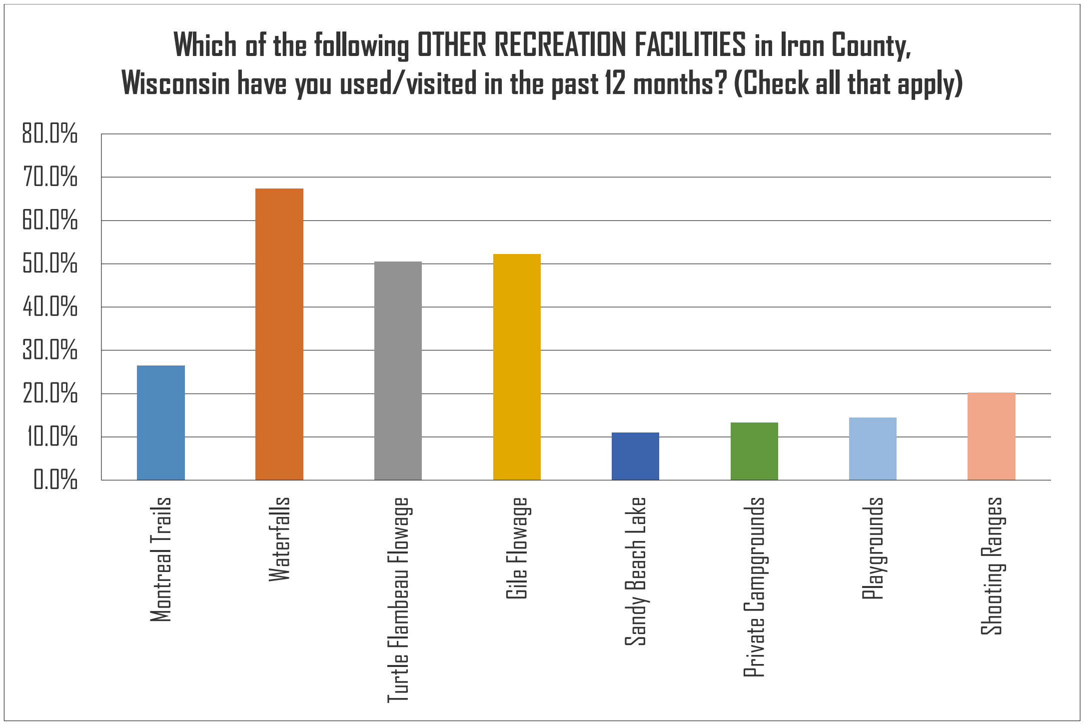
COMMENTS

- ATV's ruin the common snowmobile/ATV trails
- Beautiful natural setting. Great fishing.
- I think it would be wonderful to have more silent sports trails--i.e. for hiking, snowshoeing, skiing, etc.
- I ATV up there two years ago. I thought the trail system was poor. I ATV Jackson, Clark, Marinette, Forest, Florence and Landglade Counties every year. Iron County trail system is poor compared to them.
- I love the wilderness and the quiet places, the clear clean waters and lands. Tend to be out and about vs. visiting facilities so if Iron County manages by keeping the area wild, free of industry and polluters, I'll be very, very happy
- Many facilities need maintenance

- Silent sports trails could be better taken care of
- Some boat launch docks (where present) could be replaced, would be nice to have docks at more launches
- Some places not clearly marked, no info on sites at the sites
- Tend to be silent sports, family recreation with picnic, or stopping to eat in town
- The Saxon Harbor boating club is full of very friendly and helpful people I have ever met and the marina and camp grounds are number 1 in our books.
- There are many hiking trails in which ATV's have rutted them up so badly it's difficult to hike. It's really discouraging!
- Toilets at the Sportsman Boat Landing
- Too bad you trashed all the forests at the waterfalls. NO longer too inviting
- Too much focus on motorized vehicle users. If you created some shelters and even pit toilets for other users you would recognize how many visit the area and likely increase the number of visitors. Even improve some of the trails to the scenic views with walking access board walks across wet areas to Corrigan's and smaller water falls.
- Trails are too improved!
- Uller ski trails could use some work but very beautiful
- Very satisfied as long as Iron County leaves these areas as natural as possible.
- We need more options for a family to ride bikes on. Something like the trail in Ironwood that extends west through iron county (2).
- We need more toilet facilities at boat landings - Porta-potties or latrines.
- What we have is very well maintained...however we need additional facilities for parking etc. at waterfalls

Q5. Which of the following OTHER RECREATION FACILITIES in Iron County, Wisconsin have you used/visited in the past 12 months? (Check all that apply)

Answer Options	Response Percent	Response Count
Montreal Trails	26.5%	157
Waterfalls	67.4%	399
Turtle Flambeau Flowage	50.5%	299
Gile Flowage	52.2%	309
Sandy Beach Lake	11.0%	65
Private Campgrounds	13.3%	79
Playgrounds	14.4%	85
Shooting Ranges	20.3%	120

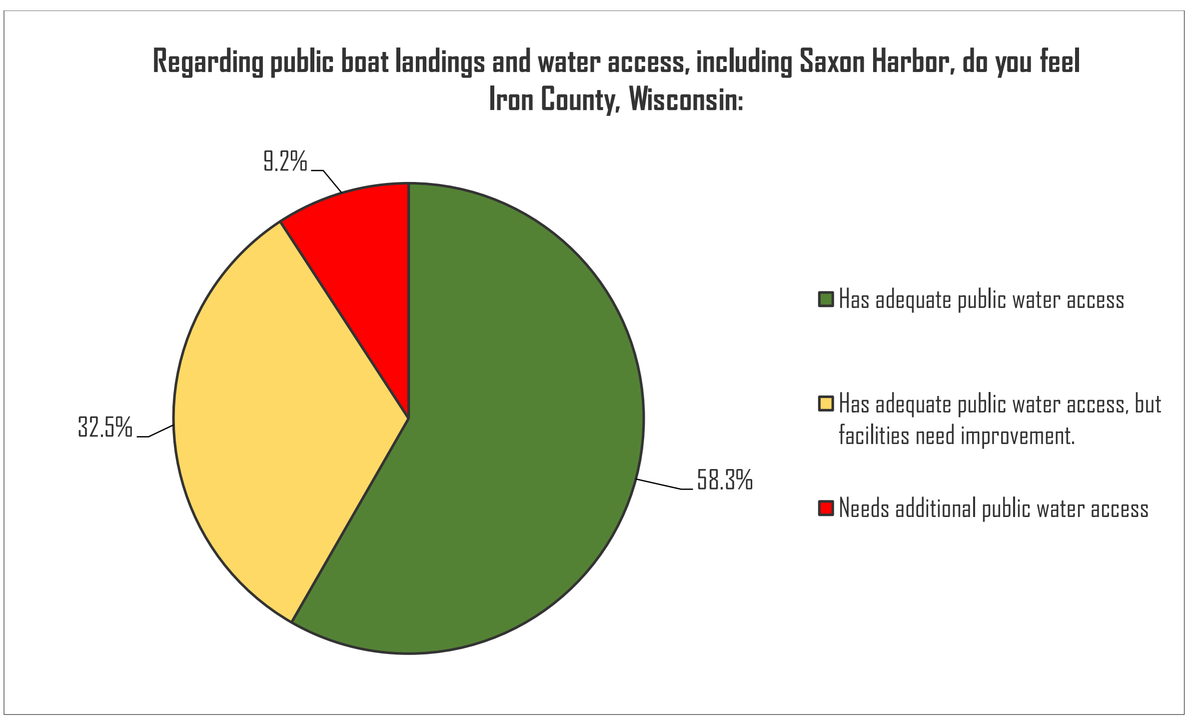


Q6. Which Iron County boat landings have you used in the past 12 months?	
Answer Options	**Response Count**
	365

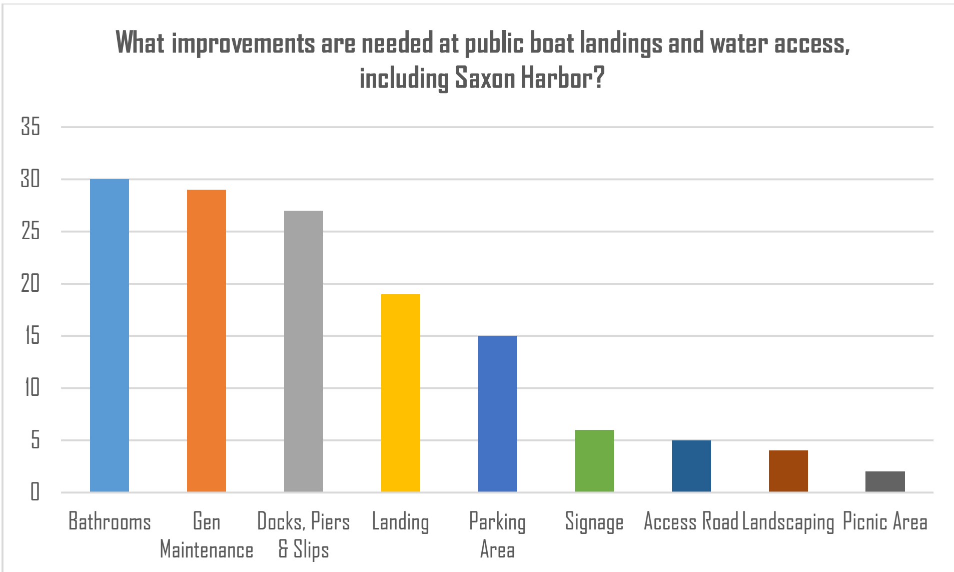
Turtle Flambeau Flowage	17	Long	2
Fisherman	16	Moose	2
Sportsman	14	Obadash	2
Gile Flowage	13	O'Brien,	2
Murray	10	Oma	2
Lake of the Falls	6	pence	2
Fischer	6	Pike	2
Robinson	6	PRIVATE	2
Turtle Flambeau Flowage	6	Springstead	2
CTH C	5	Spider	2
Manitowish	5	Sucker	2
Shay's	5	Upson	2
Springstead	5	Beaver	1
Bass	4	Brandt	1
Oxbo	4	Brant	1
Portage	4	Caroline	1
Saxon	4	Deer	1

Trude	4	Hewitt	1
Spring Camp	3	Pine	1
Cedar	3	Sturgeon	1
Echo	3	Lake of the Falls	1
Hole	3	Mcdermott	1
Turtle Flambeau Flowage	3	Mill	1
Mercer	3	Montreal	1
Owl	3	Pleasant	1
Pine	3	Plunkett	1
Ruggers	3	Randall	1
Sturgeon	3	Rapids	1
Turtle	3	Rice	1
Weber	3	Sandy	1
Bear	2	Sherman	1
Bearskull,	2	Spring	1
Evelyn	2	Tank	1
Island	2		

Q7. Regarding public boat landings and water access, including Saxon Harbor, do you feel Iron County, Wisconsin:		
Answer Options	**Response Percent**	**Response Count**
Has adequate public water access	58.3%	267
Has adequate public water access, but facilities need improvement.	32.5%	149
Needs additional public water access	9.2%	42



Q8. What improvements are needed at public boat landings and water access, including Saxon Harbor?	
Answer Options	**Response Count**
	110

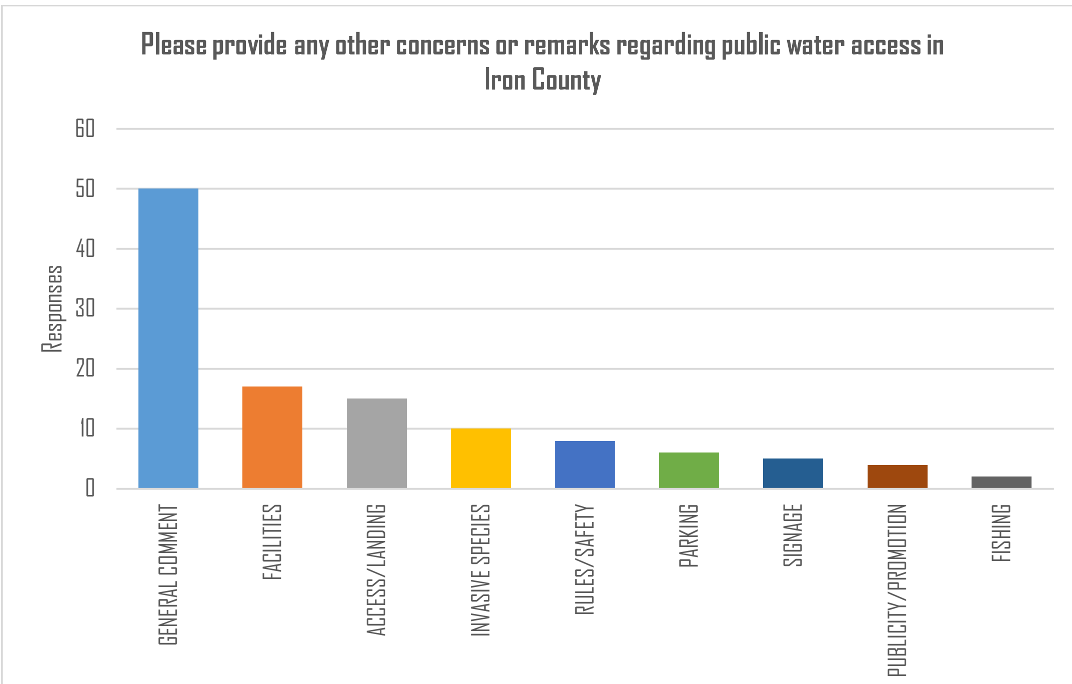


Q9. Where is additional public water access needed? (please list lakes and rivers)	
Answer Options	**Response Count**
	21

- Turtle Flambeau Flowage and many smaller lakes
- Saxon Harbor
- Lake of the Falls
- Rice Lake, Echo Lake
- Saxon Harbor
- Fox Lake, Pike Lake
- Boot lake, Springsteen Lake
- Sturgeon Bay
- French Lake and Boot Lake
- Gile Flowage
- Tyler's Forks
- Lake Superior

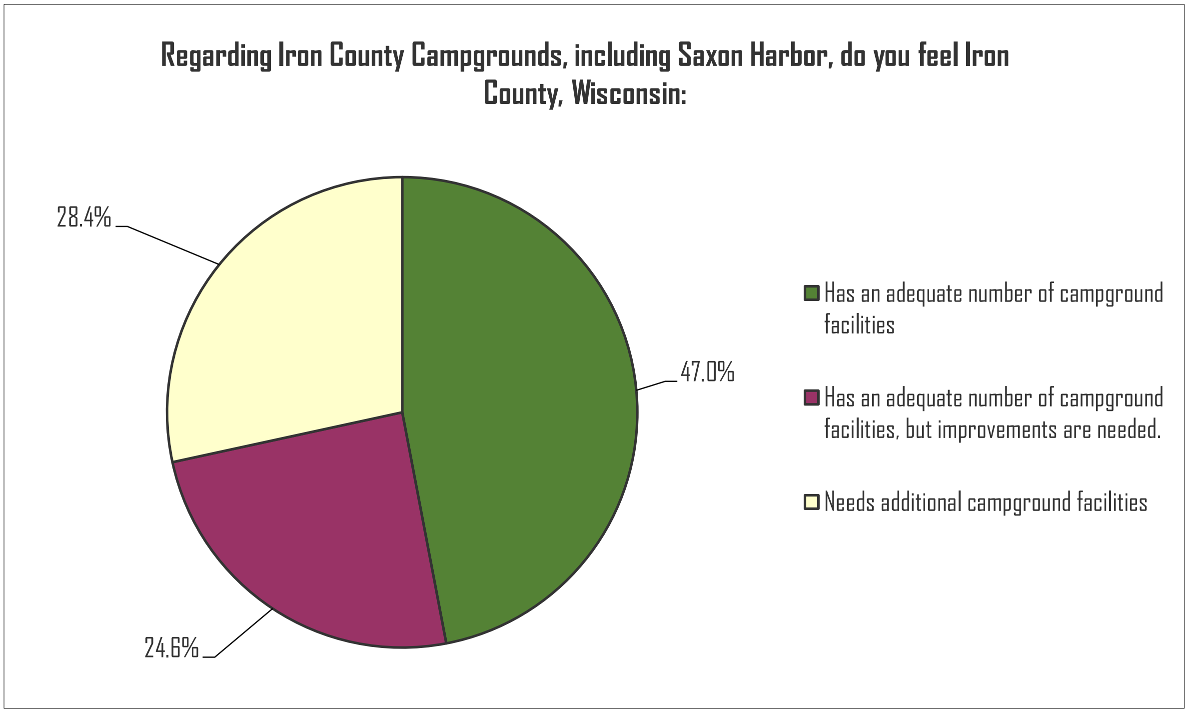
- Build canoe and kayak accesses to Iron County rivers along roadsides.
- Bad River
- Turtle Flambeau Flowage
- Island Lake. Crystal Lake.(Oma)
- Montreal River

Q10. Please provide any other concerns or remarks regarding public water access in Iron County.	
Answer Options	**Response Count**
	120

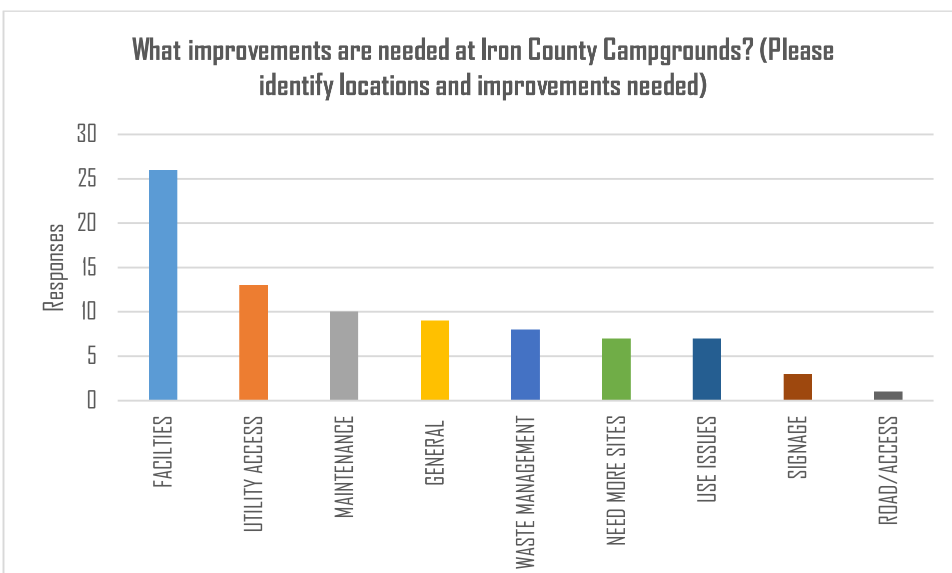


*25 location-specific comments

Q11. Regarding Iron County Campgrounds, including Saxon Harbor, do you feel Iron County, Wisconsin:		
Answer Options	**Response Percent**	**Response Count**
Has an adequate number of campground facilities	47.0%	218
Has an adequate number of campground facilities, but improvements are needed.	24.6%	114
Needs additional campground facilities	28.4%	132
	answered question	**464**
	skipped question	**193**

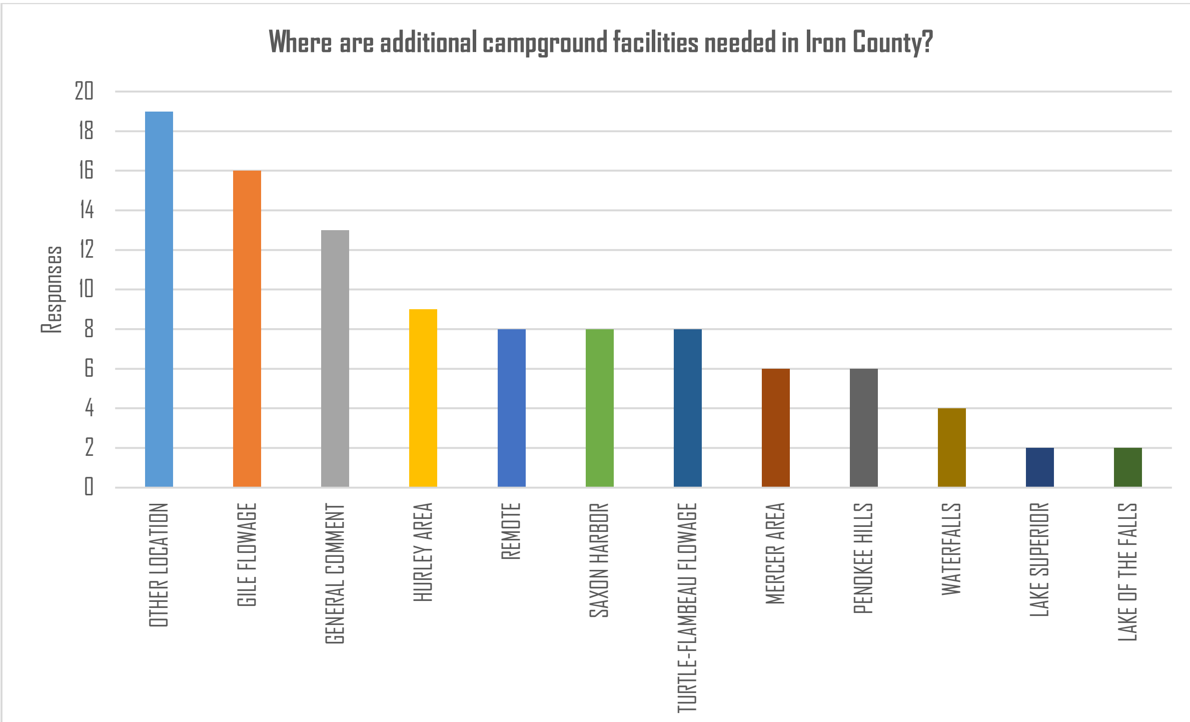


Q12. What improvements are needed at Iron County Campgrounds? (Please identify locations and improvements needed)	
Answer Options	**Response Count**
	72

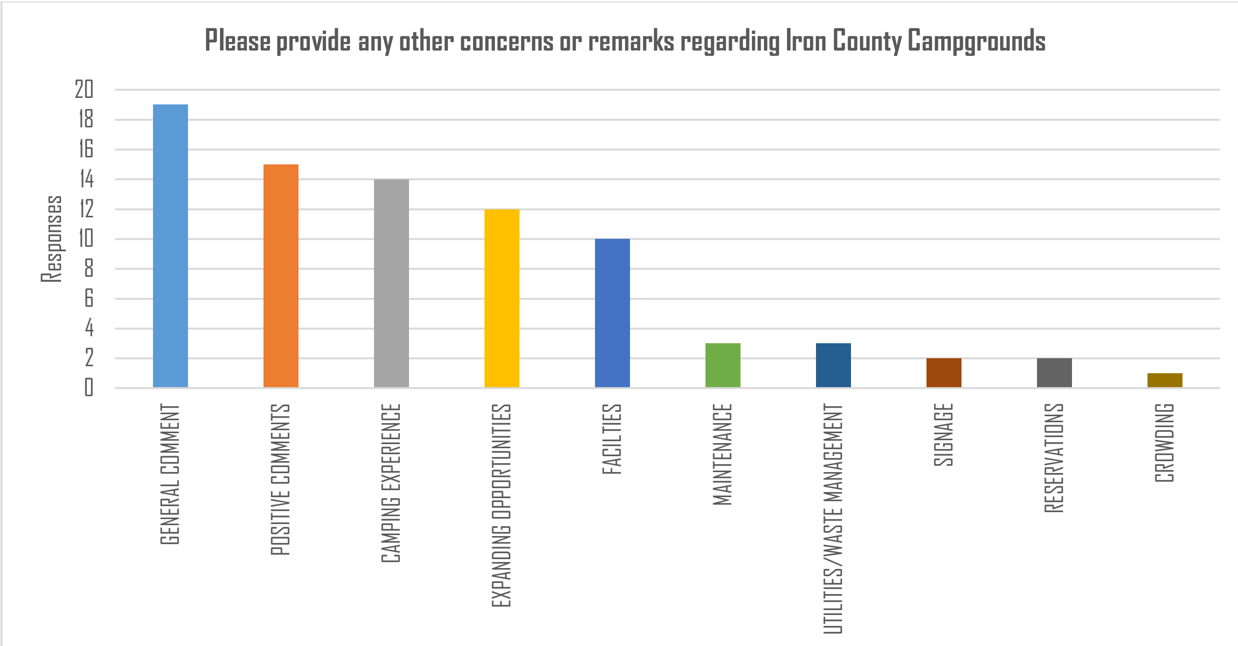


*23 location-specific comments

Q13. Where are additional campground facilities needed in Iron County?	
Answer Options	Response Count
	90

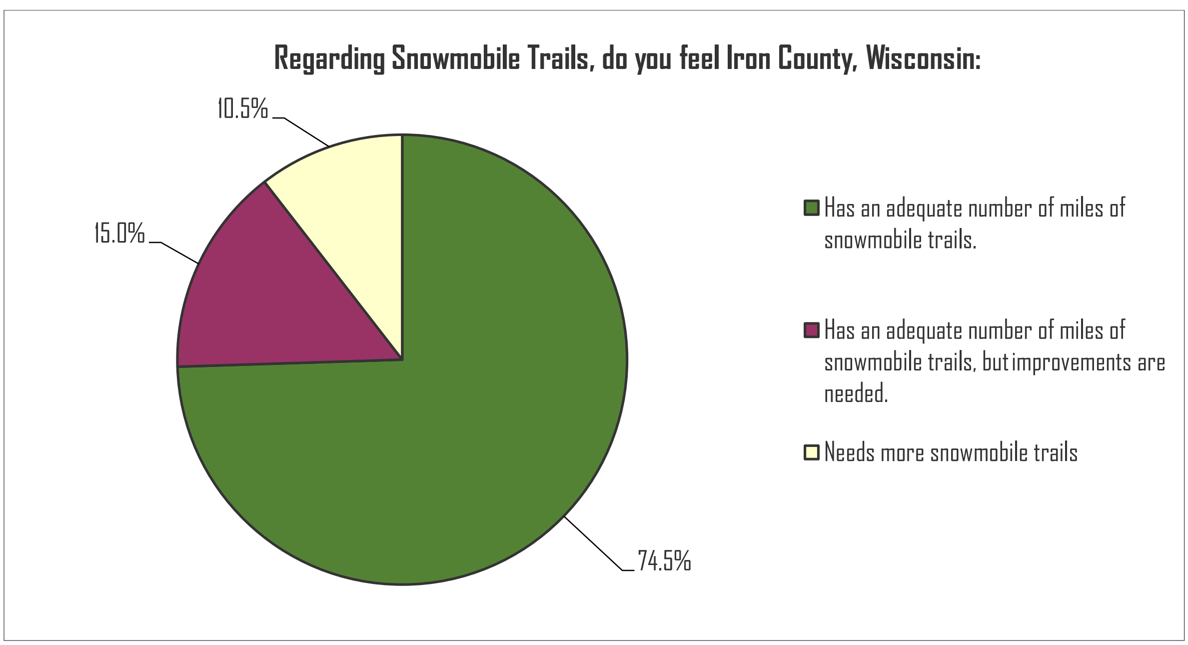


Q14. Please provide any other concerns or remarks regarding Iron County Campgrounds:	
Answer Options	Response Count
	102

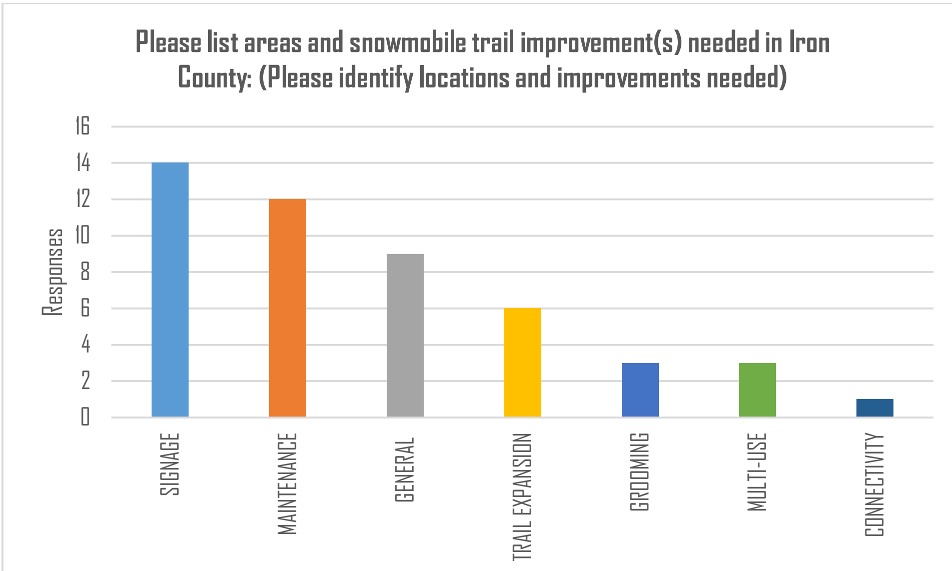


*24 location-specific comments

Q15. Regarding Snowmobile Trails, do you feel Iron County, Wisconsin:		
Answer Options	**Response Percent**	**Response Count**
Has an adequate number of miles of snowmobile trails.	74.5%	363
Has an adequate number of miles of snowmobile trails, but improvements are needed.	15.0%	73
Needs more snowmobile trails	10.5%	51

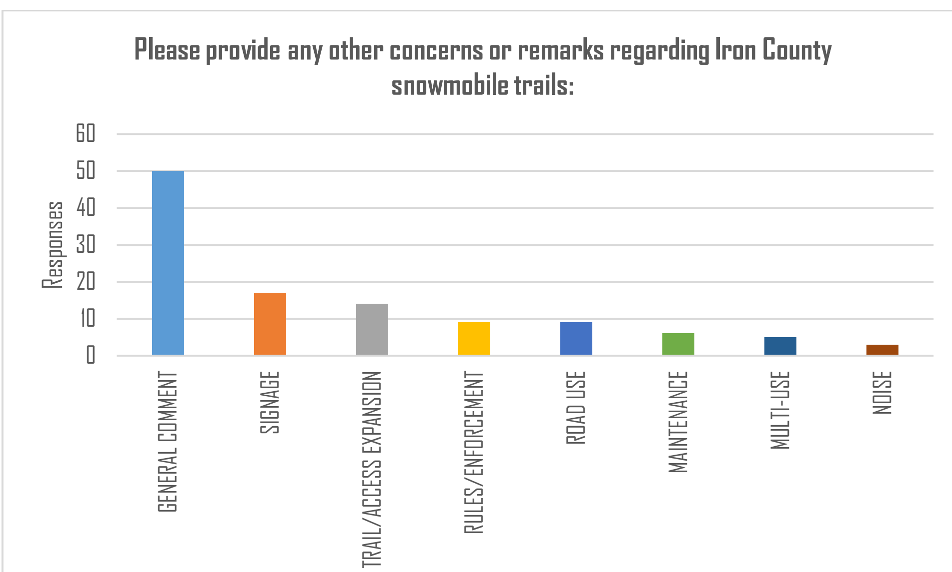


Q16. Please list areas and snowmobile trail improvement(s) needed in Iron County: (Please identify locations and improvements needed)	
Answer Options	**Response Count**
	53



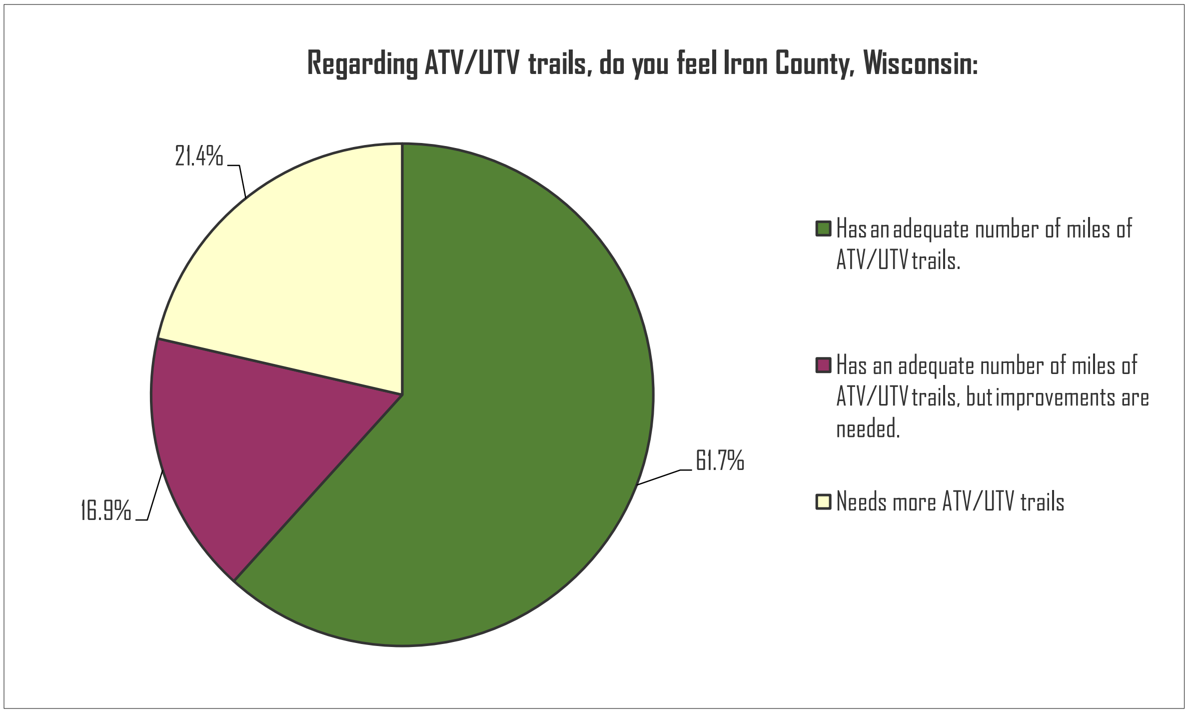
*14 location-specific comments

Q17. Please provide any other concerns or remarks regarding Iron County snowmobile trails:	
Answer Options	**Response Count**
	130

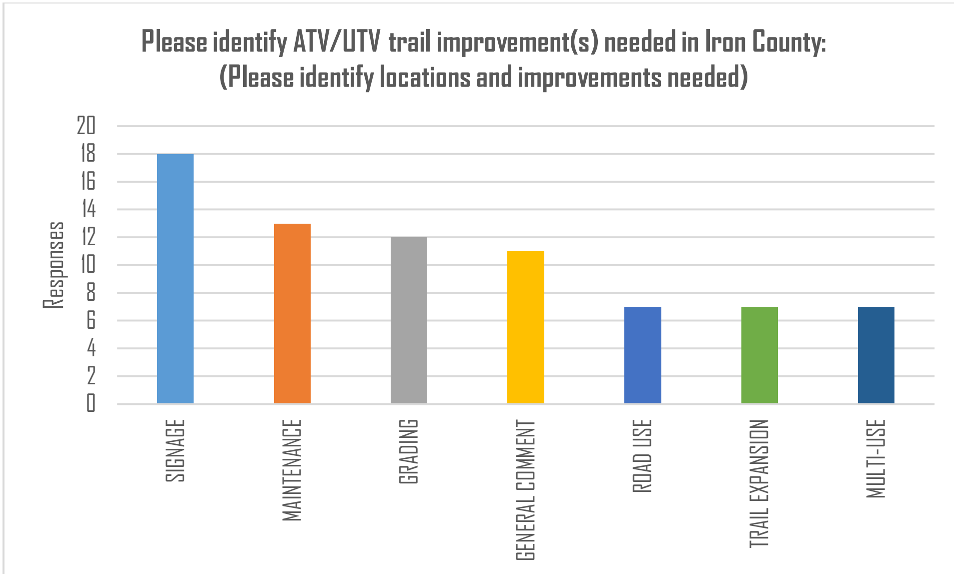


*3 location-specific comments

Q18. Regarding ATV/UTV trails, do you feel Iron County, Wisconsin:		
Answer Options	**Response Percent**	**Response Count**
Has an adequate number of miles of ATV/UTV trails.	61.7%	303
Has an adequate number of miles of ATV/UTV trails, but improvements are needed.	16.9%	83
Needs more ATV/UTV trails	21.4%	105

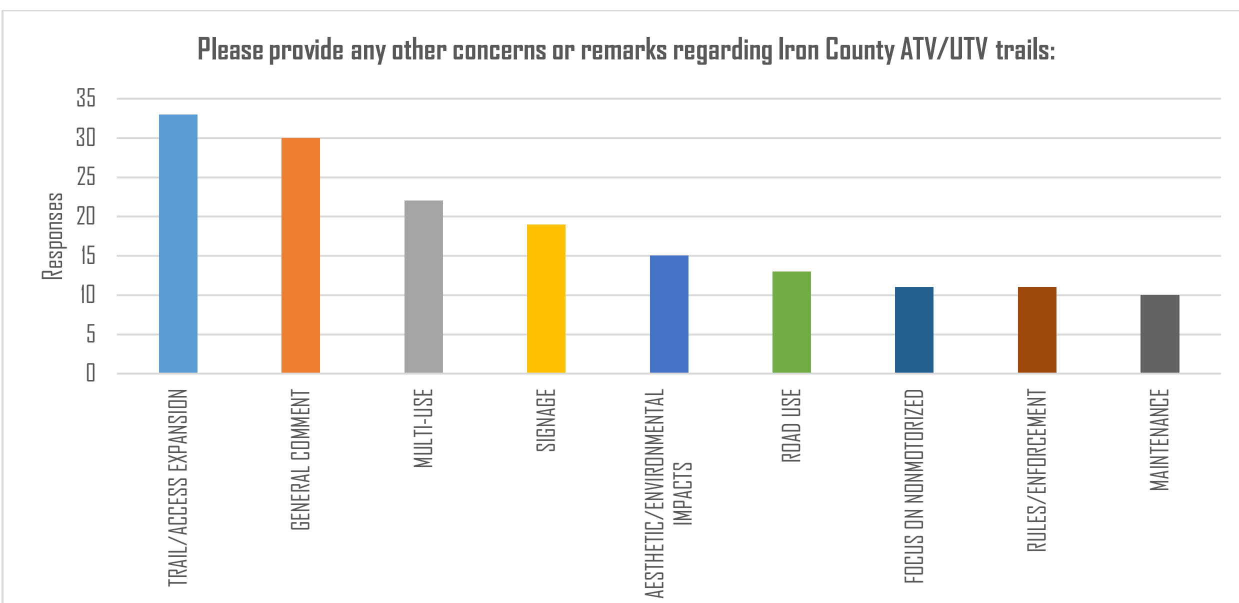


Q19. Please identify ATV/UTV trail improvement(s) needed in Iron County: (Please identify locations and improvements needed)	
Answer Options	**Response Count**
	70



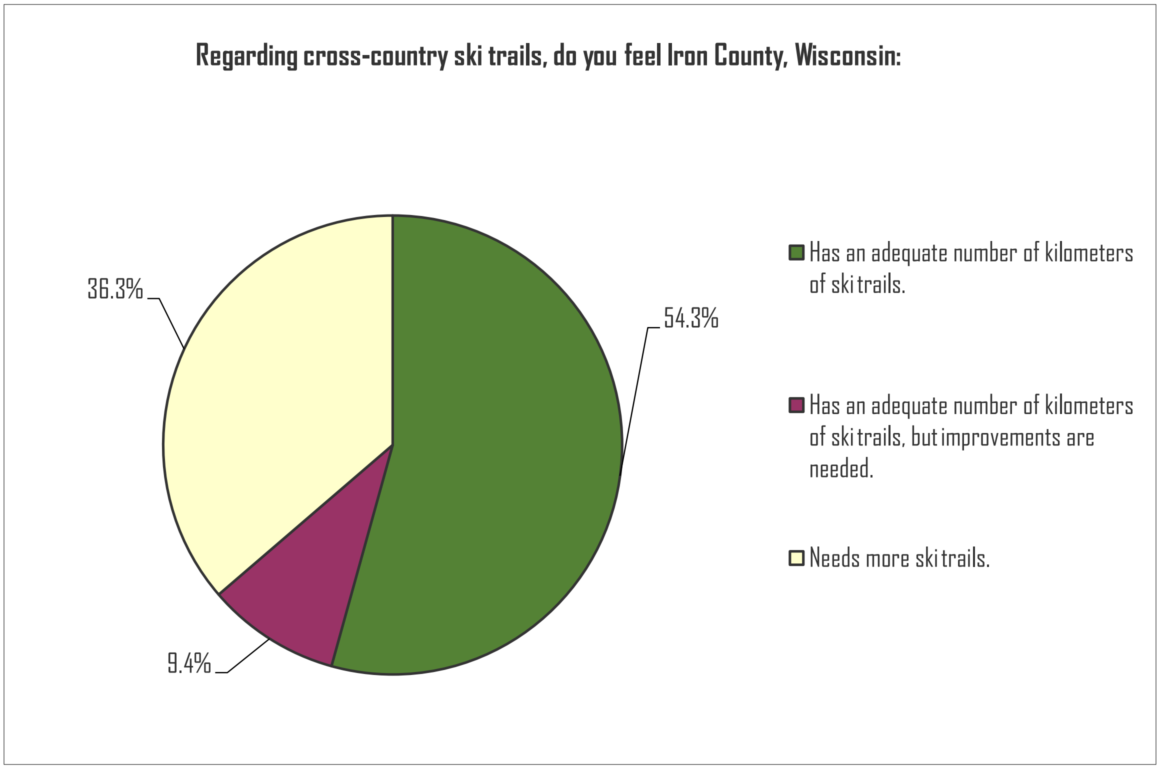
*20 location-specific comments

Q20. Please provide any other concerns or remarks regarding Iron County ATV/UTV trails:	
Answer Options	**Response Count**
	177

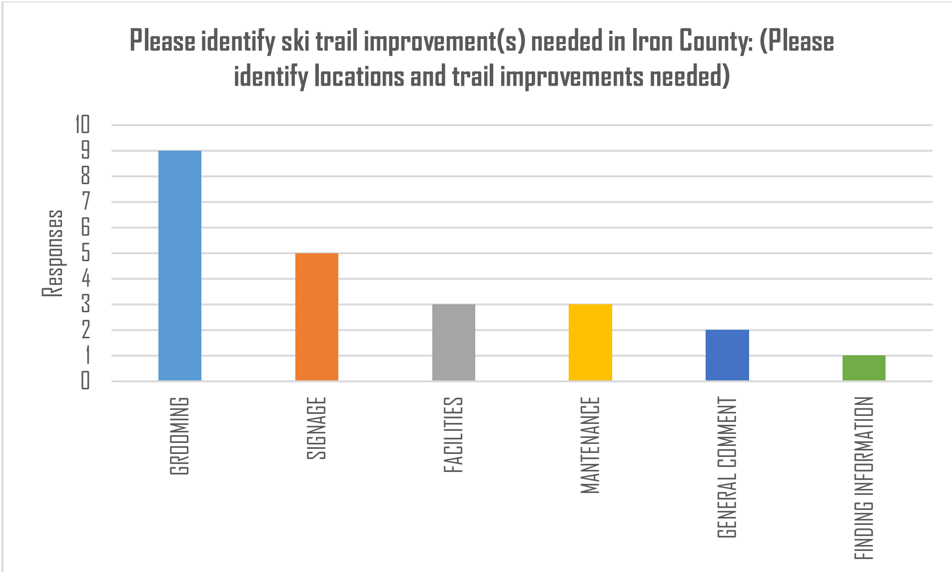


*14 location-specific comments

Q21. Regarding cross-country ski trails, do you feel Iron County, Wisconsin:		
Answer Options	**Response Percent**	**Response Count**
Has an adequate number of kilometers of ski trails.	54.3%	196
Has an adequate number of kilometers of ski trails, but improvements are needed.	9.4%	34
Needs more ski trails.	36.3%	131

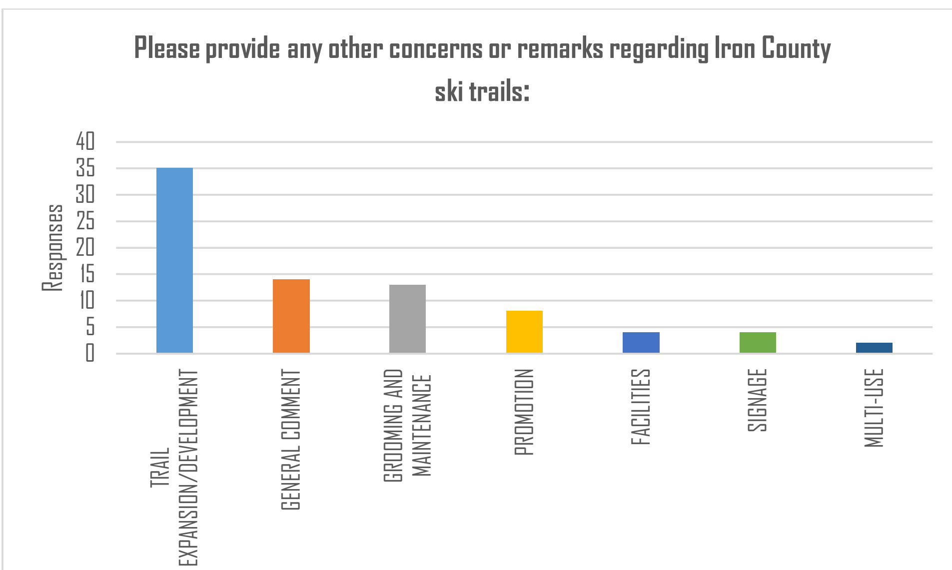


Q22. Please identify ski trail improvement(s) needed in Iron County: (Please identify locations and trail improvements needed)	
Answer Options	**Response Count**
	27



*8 location-specific comments

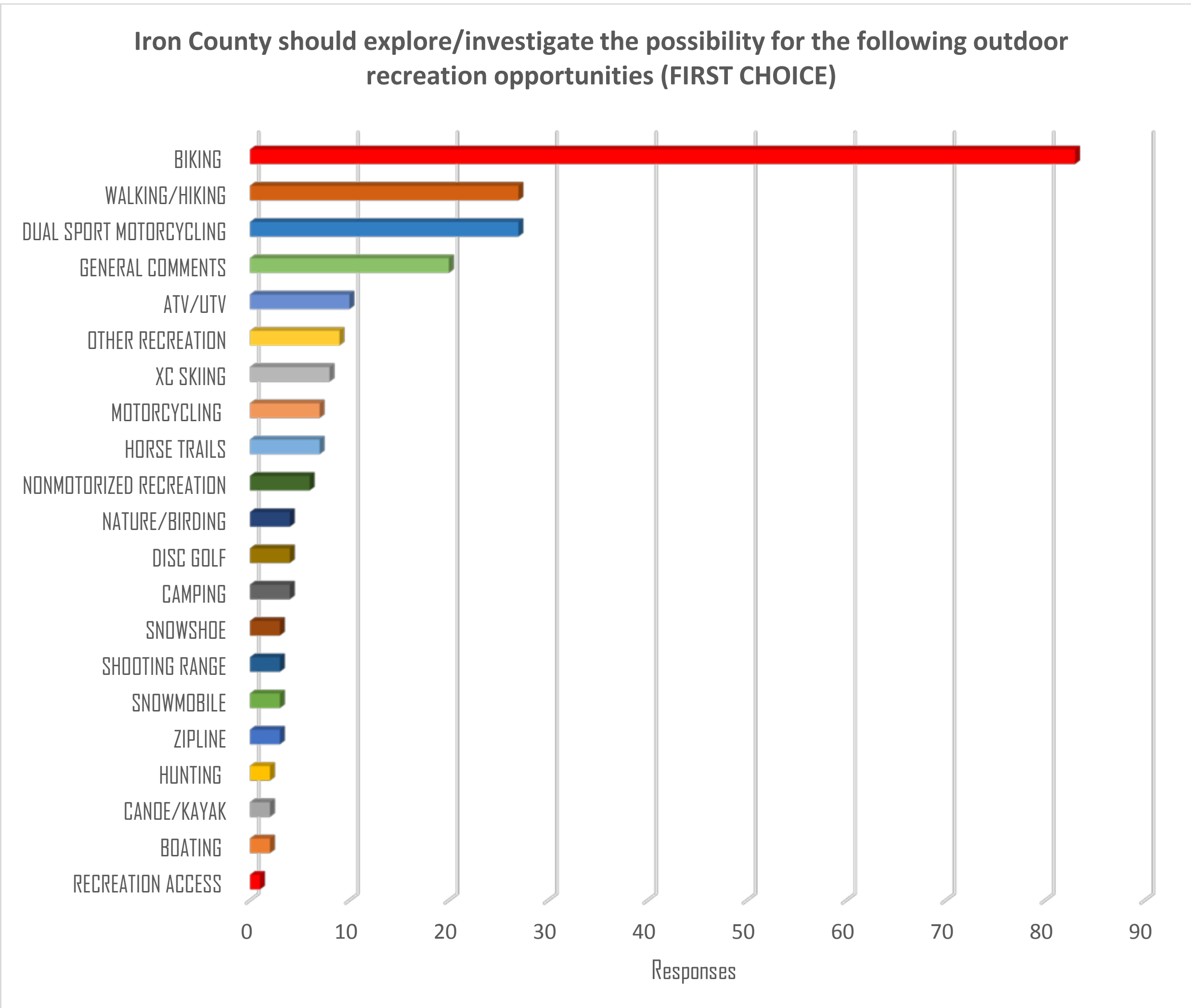
Q23. Please provide any other concerns or remarks regarding Iron County ski trails:	
Answer Options	**Response Count**
	89

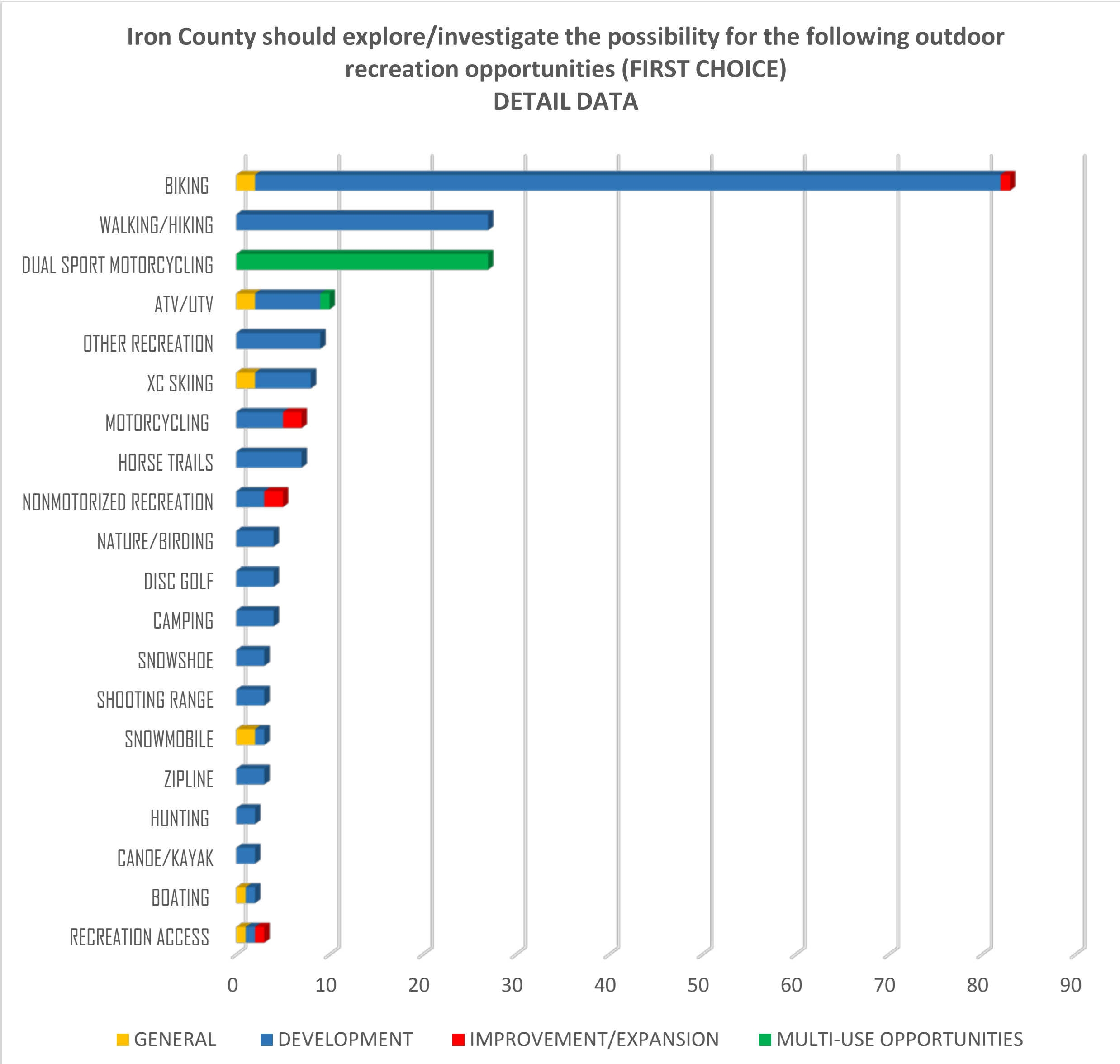


*20 location-specific comments

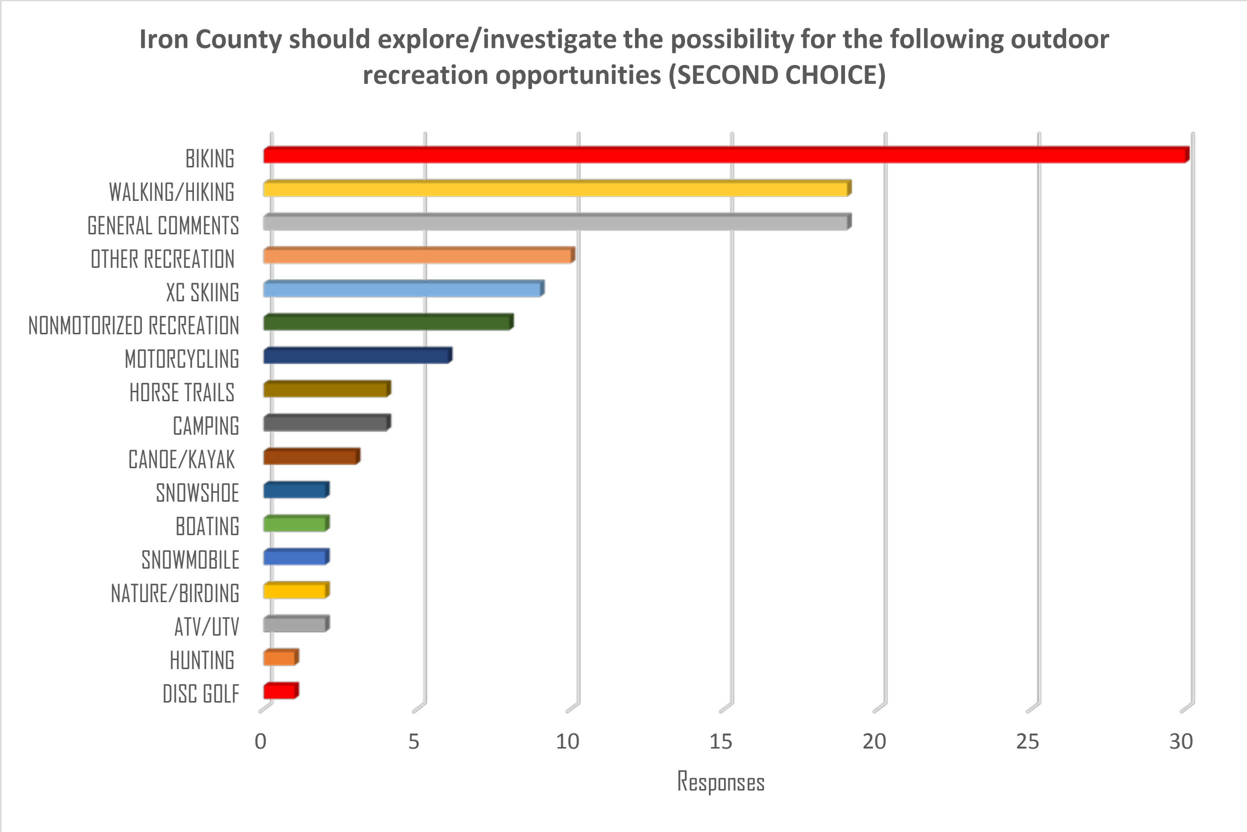
Q24. Iron County should explore/investigate the possibility for the following outdoor recreation opportunities. (please list and include location)		
Answer Options	Response Percent	Response Count
1.	100.0%	220
2.	53.2%	117
3.	31.8%	70
4.	16.4%	36
5.	9.1%	20

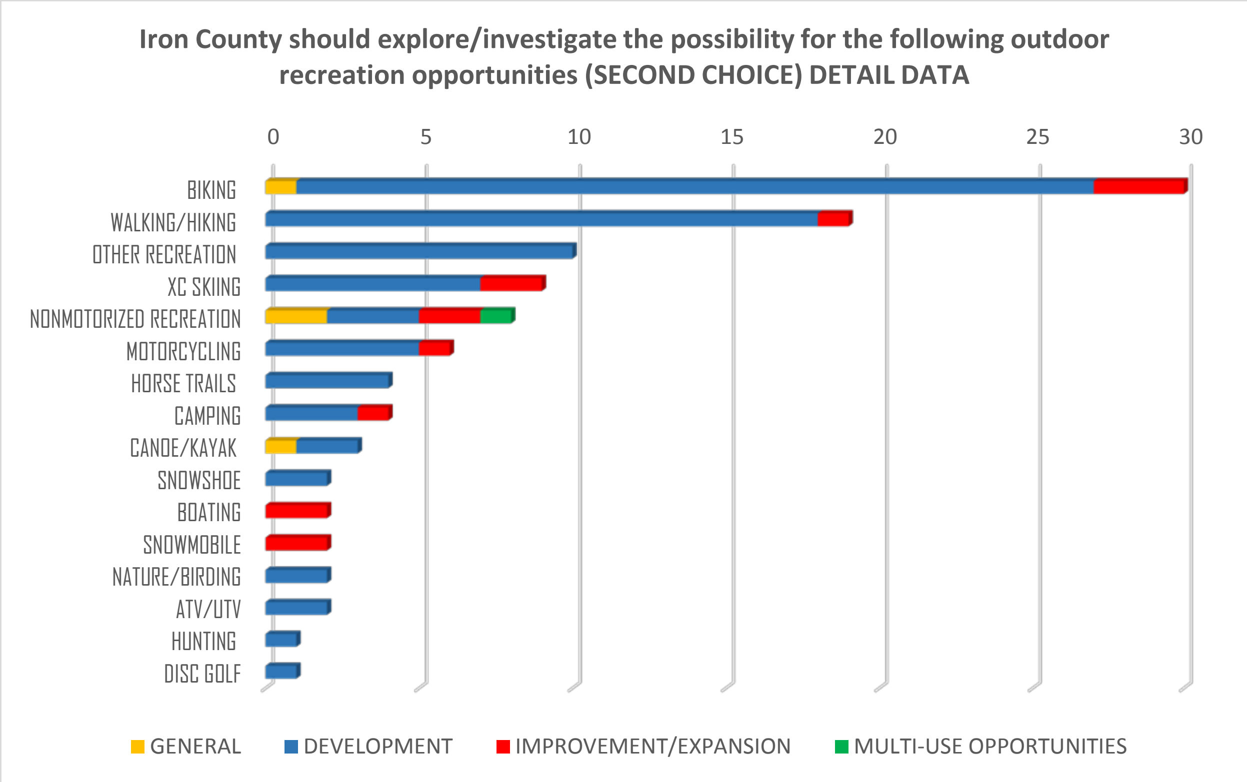
FIRST CHOICE



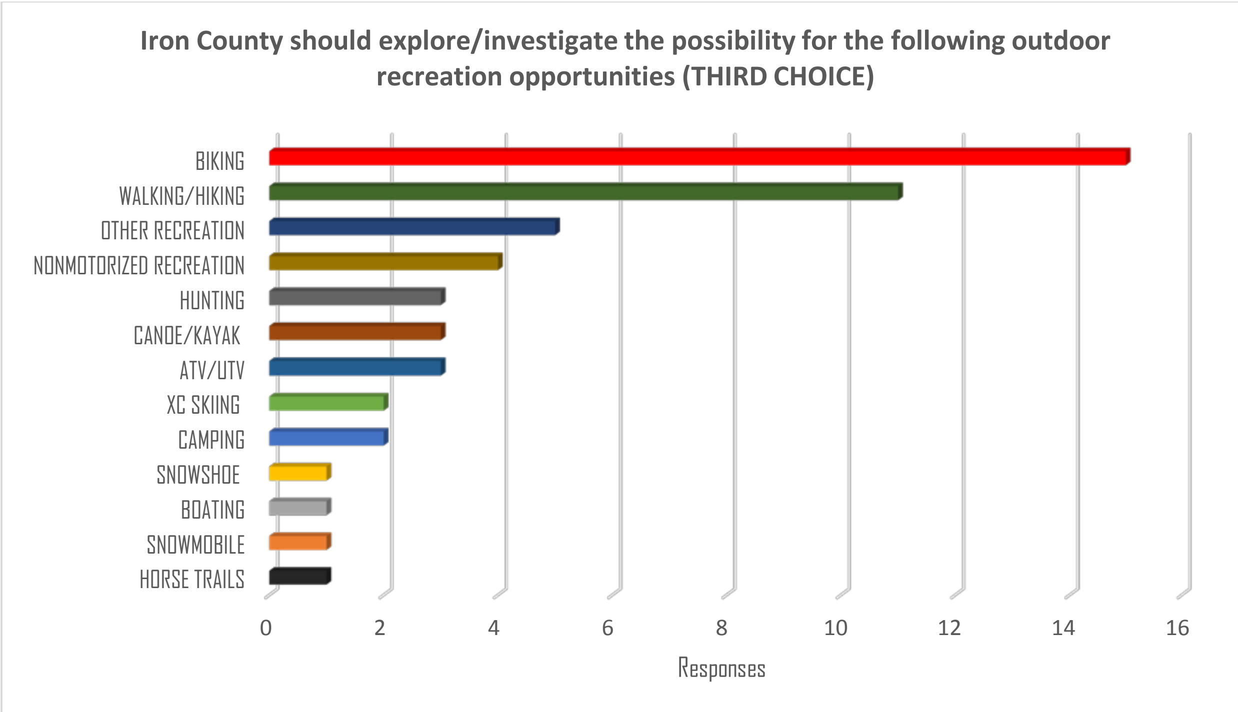

Iron County should explore/investigate the possibility for the following outdoor recreation opportunities (FIRST CHOICE)
DETAIL DATA
BIKING
WALKING/HIKING
DUAL SPORT MOTORCYCLING
ATV/UTV
OTHER RECREATION
XC SKIING
MOTORCYCLING
HORSE TRAILS
NONMOTORIZED RECREATION
NATURE/BIRDING
DISC GOLF
CAMPING
SNOWSHOE
SHOOTING RANGE
SNOWMOBILE
ZIPLINE
HUNTING
CANOE/KAYAK
BOATING
RECREATION ACCESS
0
10
20
30
40
50
60
70
80
90
GENERAL
DEVELOPMENT
IMPROVEMENT/EXPANSION
MULTI-USE OPPORTUNITIES

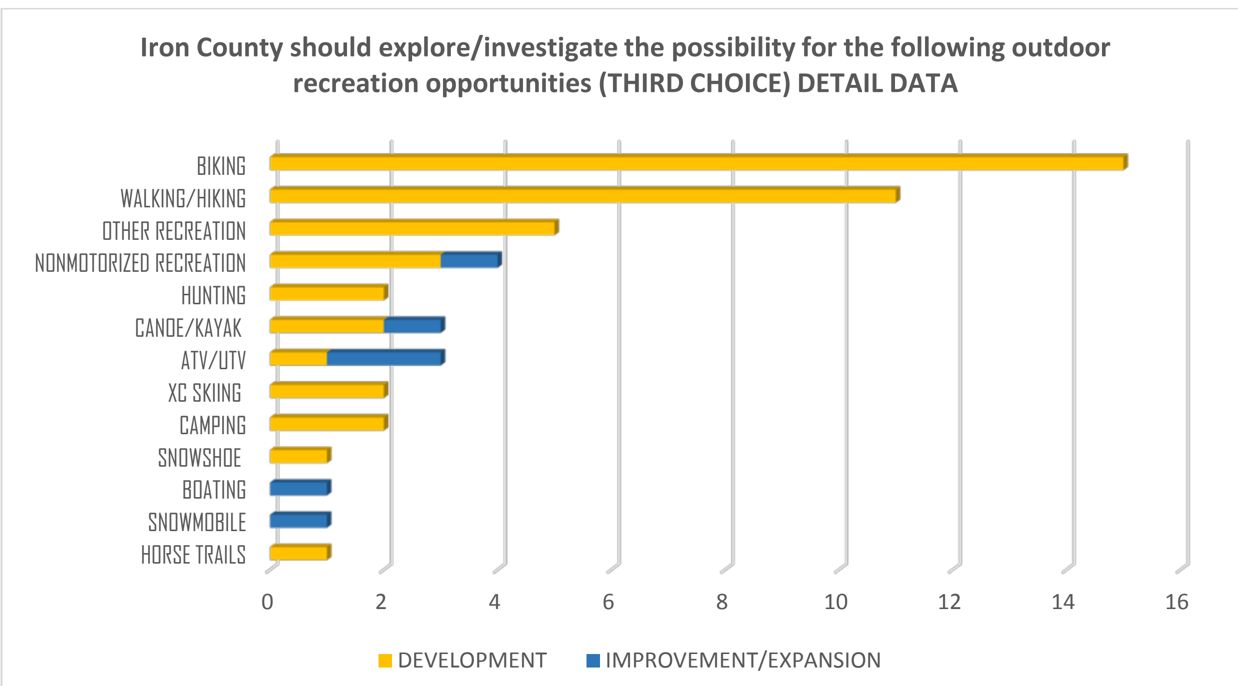
SECOND CHOICE



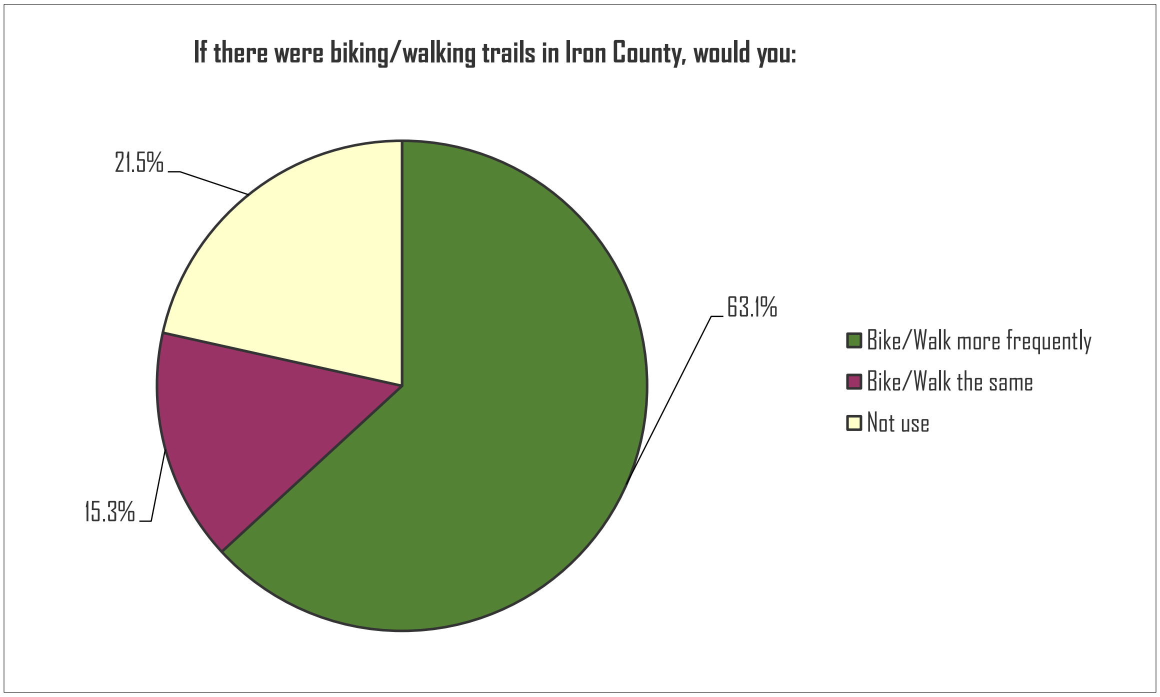


THIRD CHOICE





Q25. If there were biking/walking trails in Iron County, would you:		
Answer Options	**Response Percent**	**Response Count**
Bike/Walk more frequently	63.1%	317
Bike/Walk the same	15.3%	77
Not use	21.5%	108
Comments		57



Q26. Please provide any other comments to help us improve Outdoor Recreation opportunities in Iron County, Wisconsin.	
Answer Options	**Response Count**
	127
answered question	**127**
skipped question	**530**

RAW DATA

1. Keep up the good work
2. I have been snowmobiling there for 25 and ATVing for 15. My family has been going to Hurley since my mom was a little girl. My family spends 2 weeks a year there and I spend a couple more weeks than that myself. We have dumped 10s of thousands of dollars up there over the years. We are from Neenah. So with all that mine [redacted] we thought about looking to spend our money someplace else. Those operating engineer signs rubbed me the wrong way. It said we live here we are not on vacation. Well fine and dandy, but my money was fine over the last 25 years [redacted]. Also did not like seeing people not so concealed carrying in the bars. The atmosphere is not what it used to be. We have been spending more time in the UP, Ashland, and Bayfield because of it. Not so welcoming to tourists any more. I do know many local people and my mom had family that lived there until a few years ago. I am a public employee and those people know it. After all the Scott walker [redacted] telling everybody public employees are bad I had people up there tell how bad I was causing all their problems. So there is a motel I used to stay at when by myself that I won't go to anymore and a few bars and restaurants I stay away from. I love the area, but not so much the people anymore.
3. The county needs to work closer with the local communities, especially Mercer, as it has many different recreational opportunities to offer. There should be more cooperation between the county and towns. Maybe quarterly meetings with the county and town board and/or chamber of commerce would help?
4. Revamp the Mercer SnoGoers club.
5. As a whole Iron County is really behind on silent sports. Look at Duluth, Wausau, Marquette, Hayward, Woodruff. They are all thriving from silent sports not power sports. Iron County has the most important resource which is terrain. Use it to make more Mountain Biking trails and cross country ski trails. The payoff will come as this is what the younger generation that spends money looks for today not ATV AND SNOWMOBILE TRAILS.
6. More silent sport areas are needed that don't have to listen to ATV users
7. I am interested in helping with this planning, but Mercer is too far to drive for meetings. Thanks [redacted] for keeping me in the loop.
8. Tear down [redacted] and place a Paavo Nurmi Finish Line park. Complete with a stage for outdoor live music.
9. We have numerous trails in Iron County, we do not need to create more. I consider the people riding ATVs in summer and snowmobiles in winter on those trails more of a nuisance than a resource for the community. Please work with law enforcement to enforce the laws regarding the noise and speed violations these people commit when they ride their machines.
10. Good idea to do a survey to get ideas from people that actually recreate in the county that they live in
11. Continue public awareness of the facilities available, locations etc...I think if people aren't able to participate in outdoor activities they take pride knowing that there are opportunities available to others where they live. Happy that you are moving forward to provide continued improvements to the recreation here in Iron County. Working with Gogebic County recreation people will help coordinate interests.
12. [redacted] get serious about helping the deer herd to recover. [redacted]
13. [redacted] an excellent officer--- [redacted] very good at providing education and point people in the correct and safe manor. Thank you [redacted] for being out there on patrol!

14. It would also be nice to have one central location to get information about the trails and conditions, a website with updates and weather, bug conditions etc.
15. Advertise more, no one really knows what you all have to offer.
16. Better signage and access to our fabulous waterfalls
17. Can't people think of outdoor activities on their own without putting the burden of cost on the tax payers? [redacted] Get real jobs in this area that pay good wages with benefits and people will create their own activities without anyone's help!!
18. Your snowmobile, ATV, boating and fishing clubs are great.
19. Get rid of the wolves. That would greatly help the outdoor experience.
20. There is a lot of clean water and biological diversity in Iron County and these could be attractive to a lot of people. Ideally they would be done in a way that would not destroy what attracts people. What is going to happen to Whitecap? I never heard of it before 2013, and it is a beautiful area that could be upgraded and used for retreats for groups and some snowing/ski boarding in the winter. Public transportation from the south to northern Wisconsin needs to be improved.
21. I think Iron County does a great job in providing Outdoor Recreation opportunities!
22. Need to construct NCT Bridge near Wren Falls.
23. Very Nice Area...Will Return again
24. Let's make sure we include good publicity and out-reach and make use of every opportunity to include education (EE)
25. Build on the great work you have done so far
26. Do not accept grants or other funding that places restrictions on land use such as limiting use to "silent sports"
27. Please have more paved biking trails because a lot of county roads are used by loggers, trucks etc. too intimidated to ride on these at the same time.
28. We have most of the elements to offer a wide variety of vacation options, but vacationers are on their own to find what opportunities exist here. What we're missing is "destination" vacation options. E.g., we have hundreds of miles of hunter walking trails, but most people can't find most of the trails. We have lots of public land (county, town, MFL, etc.), but again there's no simple source saying, "So you're in Mercer...here's exactly how you get to woodlands or waters that are open to the public." We have the ability to create hundreds of miles of hiking/skiing/biking trails and I believe this should be a priority. Such trails can mostly be "rustic" in nature. If they existed, they would be used. The problem is really how to get them started.
29. Snowmobiling and ATV numbers continually are declining. The demographic it brings detracts from the natural beauty of the area. Very small minority will trailer up to ATV. A much larger demographic will and do travel up to bike, ski, hike, kayak/canoe and explore the history of the Penokee Range. The mining history of the Montreal and Cary along with the Ottawa are sites that should be developed fully to capitalize on Heritage Tourism. The Montreal Trails are an unbelievable industrial heritage site. The Keweenaw National Historic Park should be a template for developing the Penokee/ Gogebic Range. Making Hurley a hub for non-motorized would vastly improve the quality of life for residents both young and old. 10,000 visitors a day at the Apostle Islands ice caves many who drove through Hurley, but gentleman's clubs attract how many. How about crushed limestone to the Rock Cut. Home owners do not want ATV trails anywhere near their property even if they own an ATV/snowmobile. ATV trails decrease property value while a non-motorized trail increases property values. The geology, topography and history of Iron County is totally unique and rivals anywhere in the Midwest.
30. Dual sport and adventure motorcycle access to ATV/UTV trails would raise my visitation to the county for recreation.
31. Looking forward to the trail being expanded to tie into the Michigan trail system....
32. Love the county. Really would love to see dual-sport motorcycle trail access.
33. We have the best waterfalls, lakes, and wild areas in the state. People have no clue. Even locals. Start by appreciating our area. Way too much complaining about [redacted] people and [redacted] jobs [redacted] Drop it and start some positive discussions going.

34. Adventure motorcycle riding is a growing activity and connecting ATV trails between counties will bring tourism without adding cost. I ride dual sport motorcycles in other counties with my family (wife and 4 daughters) all of which prefer motorcycles but some are forced to ride ATV's due to regulations. We also look for single track riding which is scarce in Wisconsin but easy to build trails with minimal maintenance. We ride year round (ice race, snowmobile) so we travel almost every weekend and spend a lot of money in each place we ride!
35. Develop a plan for preserving and mapping the historic Flambeau trail. Develop a usage policy for the North Country Trail. Any bridges built across major rivers should be open to multi use. Other segments should be hiking only
36. Whatever improvements are made, if there are not rules that can be enforced, it will be hard to keep the County in its pristine condition.
37. The development of dockominiums and/or keyhole lots will reduce the quality of water sports in Iron County and should not be allowed.
38. Adding the growing sport of off-road and/or dual sport motorcycles will greatly increase tourism.
39. Would really like to see more opportunities for dual sport and adventure motorcycling that involve the existing ATV trail system.
40. Please keep the ATV's out of the TFF area. There are plenty of other areas for ATV'ers to go. Thank you.
41. Pedestrian/bike links to the regional trail system in Michigan, and to Mercer.
42. North Country Trail has some ambitious ideas and is nationally funded we might make mention of it more at the County level, who knows what people want to see, look what happened at the ice caves. We have limited Lake Superior shoreline and may want public access to as much as possible either through federal/state/county efforts. The Whitecap/Weber Lake location could become a key for the future, example Lutsen/GunFlint Trail/Grand Marais MN. Very similar to our situation at Saxon Harbor.
43. Maps showing old logging trails would be nice. Haven't found a site showing these. Since this is a snow belt, promote cross country skiing and snowshoeing, not just snowmobiling. Open more trails to back country skiing and hiking.
44. Advertise on the [redacted] Radio [redacted]
45. More newer hotel lodging
46. Get our hunting back in shape
47. I think Iron County is on the right track, but need to put more support into the Silent sports since there is an increasing number of people who are opting for these kind of sports. Most people doing these types of activities are looking for an area to enjoy year round, and Iron County has the area to expand on it.
48. More focus on biking trails and silent sports would be a great help to Iron County.
49. Waterfalls: perhaps better directions and labeling key. Some are hidden gems, but should they be so difficult to find? Better descriptions of the trails would be nice, too, so varied users can decide appropriate choices. Examples: how hard & long of a walk, wheelchair accessible viewing.
50. Let's get ATV access throughout the county
51. Recreation in Iron County is great, and with a few improvements, such as those that I listed above, the recreation can be amazing and attract more tourists!
52. More 5k running races
53. Promote southern Iron County more
54. Impeach [redacted]. Why do the Vilas County lakes on the chain get to manipulate the water levels at their discretion, leaving wildlife and Iron County taxpayers too high, or too low, below the dam on the Manitowish River?
55. Don't try to do something that is against the better judgement for the future or Iron County...stay strong
56. Maintain and upkeep what we currently have
57. More public information like Minocqua has but smaller scale. Loved their snowman and really cheerful during winter to find a way to embrace the cold and snow!!
58. Snowmobile sign and distance to towns or area need to be bigger and reflect for night riding and safety.
59. Please read my comments I didn't keep them in any order as this survey is just a little long. Thank you again please consider my comments as productive. I enjoy using and respecting all the work that is required for the subject of this survey. Thank you.

60. Non-Motorized recreation is the way of the future, and Iron County has virtually limitless opportunities to grow in this direction. 4 season recreation could really help improve the economy, and draw people from all over to enjoy the beautiful resource we have. This sustainable tourism can be realized for generations, and its value should not be underestimated. Now is the time. Act now!
61. I would encourage capitalizing on the trail system now coming in from Ironwood, and continue to increase miles of trails, connecting the trail from town to town and linking trails already in existence.
62. I understand more and better trails increases revenue, but it also invites trouble. If people want to have paved trails in abundance they should go to Minocqua. I like the serenity of Iron County. The world is running out of darkness. Please leave Iron County the way it is!! [redacted]
63. I feel that silent sport enthusiasts should pay a fee for trail usage in all of Wisconsin.
64. Improve the health outcomes by promoting activities other that riding motorized vehicles from bar to bar, especially an extensive bike trail.
65. Connect Mercer with a paved bike path to Manotowich Waters Trails
66. Primarily visit during winter months for snowmobiling.
67. I've been coming to Iron County for 15 years and it's getting old riding the same ATV trails again and again and again. Some new connector trails between routes would be nice. Additionally, trails like 6 and 8 offer a wide range of scenery and terrain that are very picturesque. More trails like this would enhance the riding experience of Iron County. While the county may not much influence with the local business establishments, I have noticed that local restaurant and bar owners seem much less enthused about tourism than in years past, which means we don't stay as long and don't spend as much as we once did...[redacted] is a notable exception which is always welcoming and friendly to ATV riders.
68. Please keep the ease of access simple and the cost to use low because timber harvesting and taxes are what the county makes money on. Tourism is what local businesses make money on and if we make it easy and cheap for the tourists to come and stay they will be more apt to spend their dollars at these businesses.
69. How about something for motor bikes?
70. Silent sport opportunities. Too much emphasis is placed on ATV and snowmobiling. I would like to ride my bike from one end of the country to the other on safe roads and trails. Something like the Bear skin trail in Minocqua. Or the trails in Sparta that connect to each other.
71. Biking, Birdwatching and other silent sports are on the rise. We need paths and campgrounds to accommodate them in the future. Don't let our southern counties steal these opportunities from us.
72. Your new registration system should be interesting
73. White Thunder Riders does an awesome job. Keep maps updated - provide trail updates more frequently via Facebook and chamber web so businesses can advise customers. Update data to digital map providers as future will go electronic - future idea not critical. Monitor signage at junctions what sign refers to what? People turn signs. Extend bike and running lanes. Gile Loop?
74. ATV trails could be marked better. In some locations the ATV trails are not really marked. Bayfield County is a good example of well-marked trails.
75. I'd like to make campground reservations online.
76. Advertise, make your county a destination...not a glimmer.
77. Fix up the Plummer Mine area. It's a mess, disgrace, and dangerous. I cannot believe that it is considered an "interpretive" park.
78. Non motorize trails for walking and biking
79. Update ATV map
80. A few more signage or something talking about the history of Iron County, along trails.
81. I think there is a missed opportunity in the county and actually the entire state of Wisconsin. Look at Minnesota state and county parks for horse trails and camping. They are all over, there is nothing like it in Wisconsin and Iron County could really draw a huge number of horse campers because of the beauty of the area and the wilderness. It's what horse people want and need in the state. Could be a great draw for the county and tourism.
82. Better signs on ATV trails

83. Limit the activities related to the "bar scene". Encourage healthy life choices. Close down the lower block strip clubs. Promote a positive image for Hurley.

84. More non-motorized trails, including hiking, mountain biking and skiing. This would be good for local residents and also for tourism, business development and job creation.

85. The entire county needs to be included. At the same time, all opportunities may not exist equally throughout the county. To a large degree it will be based on where the county owns land and who it fits with other local land use. Maybe the county could consider another small campground or two in the Town of Mercer (Deer Lk, Fisher Lk, Spider Lk) where they can't provide ATV trails.

86. More lifetime aerobic sports opportunities (biking, walking, Nordic skiing). Trails needed and the labor to maintain them.

87. I have been coming here for over 50 years. I love the quiet and the peace I have found here. Over the years this has changed and I understand that other needs for recreation have to be met, however, noise carries, ATV's can create havoc in the wetlands, public safety on the roads where ATV's can ride has become a worry, When do we say they have enough? When does my voice for quiet and wildlife count. I hope here. Thanks

88. Iron County has an adequate amount of motorized trails. Some areas of the County are not conducive to ATV use. Sometimes you have to go to the area where your type of recreation is allowed or permitted, not always out your back door.

89. There should be more resources spent on developing and promoting silent sport opportunities, because they are healthier for our kids and our environment. They are an often overlooked source of revenue, because participants don't "wear" their sport, ie. Helmets or dust, when they walk into a bar or restaurant.

90. It is very sad to live in such a beautiful area and not be able to bike or walk with children without worrying about the traffic. We have so much to offer with our waterfalls and beautiful area that we should have paved trails to be able to experience this area.

91. It's critical for county planners to think about the impacts of mountain biking and other biking in our community. Other communities around Iron County are proving the success of investment in mountain biking, and biking/walking trails that connect people to places. We need trails with a purpose. Iron County also has countless, unique outdoor assets in which could be built upon. For example, Whitecap is a gem in the rough. It has potential to be a mecca for outdoor enthusiasts and a great economic driver for our area. I encourage county leaders to think creatively and locally about developing a healthy, vibrant community for all ages.

92. Promote us as a destination for silent sports.

93. Change the focus from motorized to non-motorized sports

94. Get rid of the lower block strip clubs. Have less emphasis on alcohol related events.

95. Iron County could be a vibrant outdoor recreation area for families if it would understand and recognize the popularity of Silent Sports. This is where the future of outdoor recreation is going. Bicycling, kayaking x-country skiing, snowshoeing and paddle boarding is growing at phenomenal rates. We have already nicely accommodated those people who enjoy motor sports (ATV and snowmobiling). It is time for expanding the opportunities to include a very fast growing population who enjoy Silent Sports. Data supports the fact that the demographics for silent sports enthusiasts is above average wage earners who travel to find solitude and beauty to enjoy the outdoors. Let's attract them to Iron County! Thank you!

96. Keep the CAFO's and Iron mines OUT. Put moratoriums on BOTH until you can come up with a plan to make it so damn miserable for them to operate that they go away. Tax them. Make them clean the pollutants from the water they use...ie discharging only CLEAN TREATED WATER anywhere in Iron County with a full scale water treatment plant...just like the cities in the area have to. Regulate them to death. They are not needed. Tourism is a major industry. It must be protected as must all waters that flow into Lake Superior.

97. Natural settings are more preferable to developed sites

98. Help preserve the Penokee Hills in their current undisturbed by mining and other extraction industries practices.

99. Iron County is a gateway to connecting recreational opportunities with other counties and the UP of MI. Providing these "links", will bring tourists to our area which will help economically. This area has so much natural beauty that could be tapped into to make coming here more desirable.

100. Keep it wild and rugged. Pristine wilderness areas are the best thing you have.

101. When deciding on trails please keep in mind the welfare of our shorelines, wetlands, wildlife, and water.

102. We have such a large county for more expansion for recreation, I think with more effort we all can contribute ideas to increase activities and income for the area residents. The cost and risk of a Mine and Hog factory is much too high, let's keep the area as beautiful, pristine and welcoming as it has always been. As I have always said clean air and water starts HERE!

103. You need to start thinking about the impact of activities on the environment more. It is also necessary to fund enforcement of regulations, not just implementing a regulation. This means having more police presence!

104. I'd like to see a comprehensive guide to the silent sports activities in Iron County including accurate maps and signage. Also, continue to explore any and all opportunities to expand silent sports in Iron County. Boulder Junction is a perfect example of the economic advantages of bike trails and silent sports activities in a community or region. This is an exciting time for Iron County to take its place as an outdoor recreation haven for the Midwest. The county has great potential for becoming a silent sports mecca, and since silent sports are on the rise, we have a golden opportunity to take advantage of the social climate and our beautiful natural resources.

105. Keep it natural

106. Rare beauty and wildlife there, but we have had some bad experiences with people running their dogs while we are camping with ours, and with [redacted] partying. If you invested in oversight, people will come. Winter misleading availability would be a big deal too.

107. Trails to waterfalls, skiing and hiking trails need to be protected from destruction by logging.

108. Iron County needs more handicapped accessible cm ping, fishing piers, etc.

109. We bike, and always go into Vilas County, because nothing is here

110. We have a very active community and having more outdoor activities such as paved trails will allow people of this community to be more active and healthy. This will also increase tourism and bring money into our area.

111. Use Facebook to even let locals know of what we have or what is in the works. Look how successful and popular the Ironwood paved trail is.

112. Please do not allow open pit mines in Iron County it will ruin the beauty of the country side.

113. Silent sports are really making a comeback and if people have trails to use they will use them. A great example would be the walking trail in Ironwood. It continually has people on it steady running, walking, and biking. If it's there people will use it. We could even use more marked snowshoe trails it's a cheap thing to do and when the trail is marked like Schoenberg Park, it gets a lot of traffic in the winter. Also another great asset would be to have mountain bike trails. The ones in Michigan get used all the time and people from our area go over there to use there's because we don't have marked trails. Please start grooming the rest of the cross country ski trails in Montreal that are marked on the map.

114. Keep up the good work, keep the momentum rolling!

115. Unfortunately, the deer population has been decimated by a perfect storm of wolves, bears, cougars and [redacted] too many permits a few years ago. I have stopped hunting in Wisconsin and have bought a piece of land in Illinois, which is where I now hunt. My neighbor had been coming up for many years to hunt in Iron County, but he also purchased a piece of land in Illinois and will not be coming up here to deer hunt in the future. Most of my neighbors who hunt are very frustrated with the current situation. I am concerned that the decline in hunting opportunities will lead to a decline in the employment and lifestyle opportunities in Iron County. It is important that Iron County find ways to expand and diversify its recreational opportunities to help put its economy on a sustainable and growing footing. The loss of the mine and some other businesses in the county make it imperative that we focus on doing whatever is necessary to enhance recreational tourism.

116. Why has there been so much logging around the falls? Seems like we should keep these areas in older forests, which better protect water quality and are generally more attractive to visitors.

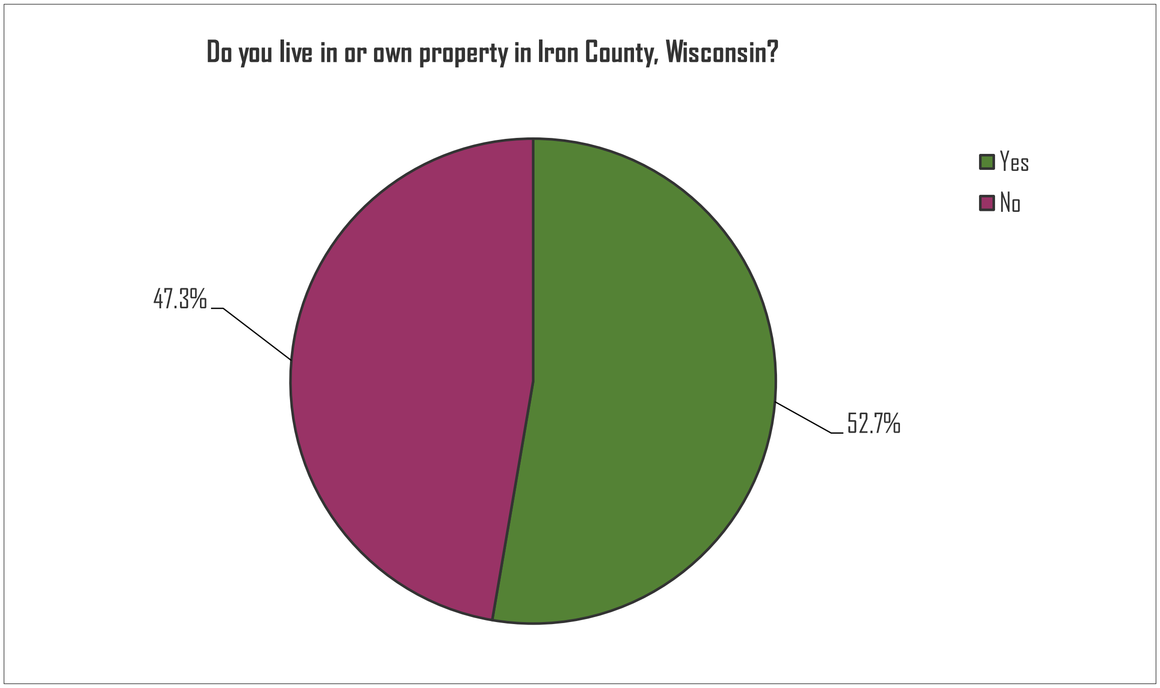
117. Silent sports are very popular in the county and across the country. Need to promote and provide more trails.

118. I am involved with the North Country Trail and was recently involved with building a new backpacking campsite near the Gold Mine. I believe the NCT in Iron County has a great potential to become one of the best backpacking corridors in the Midwest. I have hiked the whole Ice Age Trail in Wisconsin and most of the Superior Hiking Trail in Minnesota. The SHT is a very popular backpacking trail. There is no reason Iron County cannot be like that. The NCT already goes from Wren Falls

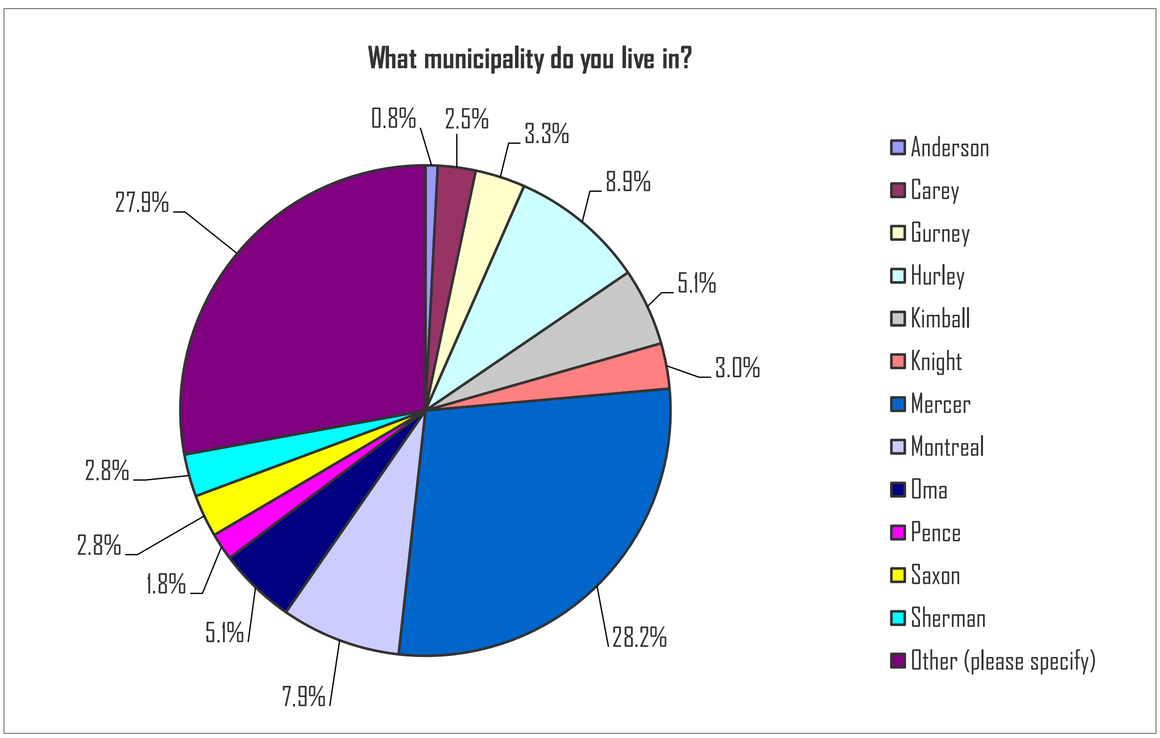
to Upson Lake. From there it is planned to go north past Foster Falls, Potato Falls and eventually Superior Falls. Plus, to the west it will connect from Wren Falls to Copper Falls State Park. When completed it will be the premiere hiking trail section in Wisconsin. Backpacking campsites are inexpensive to build and attracts people who are real outdoor enthusiasts. Right now, only Newport State Park is the only place in Wisconsin that is well known for backpacking campsites. I just checked their website. They have 13 backpacking campsite and they are 90% reserved for the next two weeks, including completely filled on the weekends.

119. Iron County would benefit from an expansion of their mindset as a motorized recreation area.
120. Outdoor recreation is what we are all about, an incredibly important aspect of our community which will help grow our economy. More events promoting these sports would help--gravel road bike races, kayak events, etc.
121. We have perhaps the most diverse landscapes in the Northwoods, from inland lakes and rivers to Lake Superior and the Penokees. We should work to promote this diversity and the wild country experiences folks can have. Imagine any other county where you could come for a week and see such a variety, from fishing the TFF to hiking the North Country Trail and visiting waterfalls, to Lake Superior's shores at Saxon Harbor. Not to mention paddling the Manitowish River, visiting very remote lakes like Moose Lake, paddling the Flambeau below the TFF Dam.
122. You're doing well. Money is tight. More landings and force foresters to make logging roads that are looped or connected to enhance upland hunting opportunities. We have the aspen. Let's use it.
123. The reputation of Hurley as a hard drinking, brawling, strip club place is a major turn off for respectable people and families.
124. I think it would be helpful for Iron County to look at the tourist and economic impact that the CAMBA Mountain Biking Trail system has had on Bayfield, Sawyer and Ashland Counties. There is a big opportunity for development in our area with all the public land.

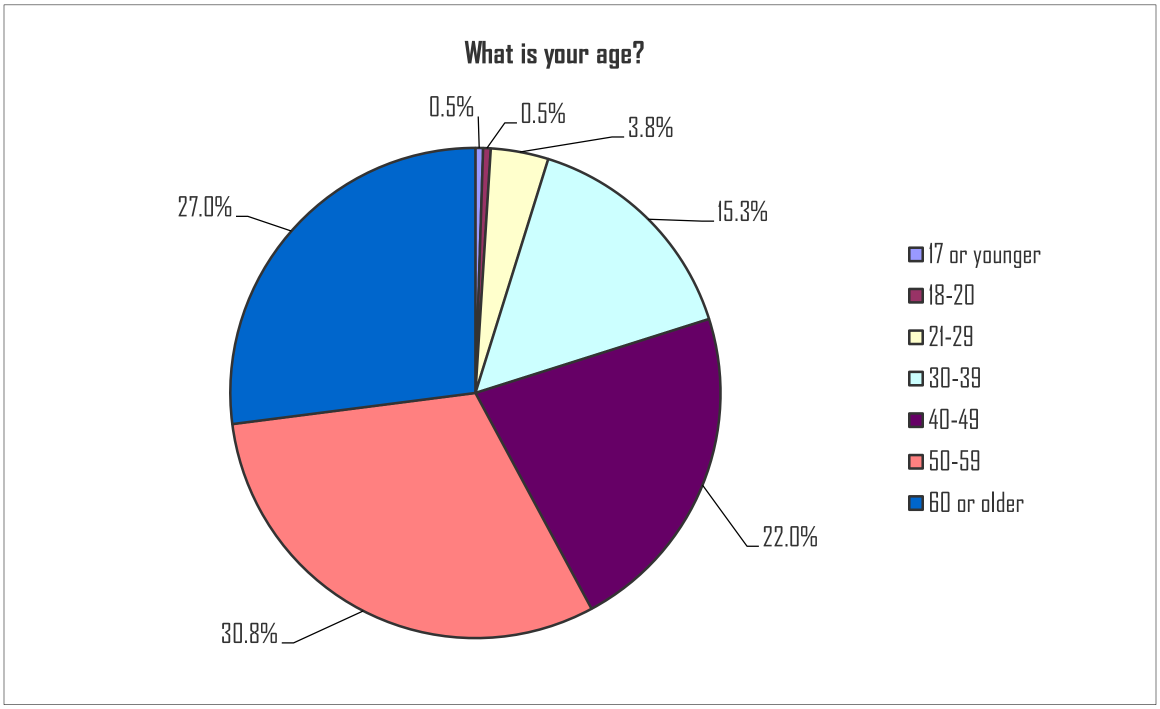
Q27. Do you live in or own property in Iron County, Wisconsin?		
Answer Options	Response Percent	Response Count
Yes	52.7%	294
No	47.3%	264



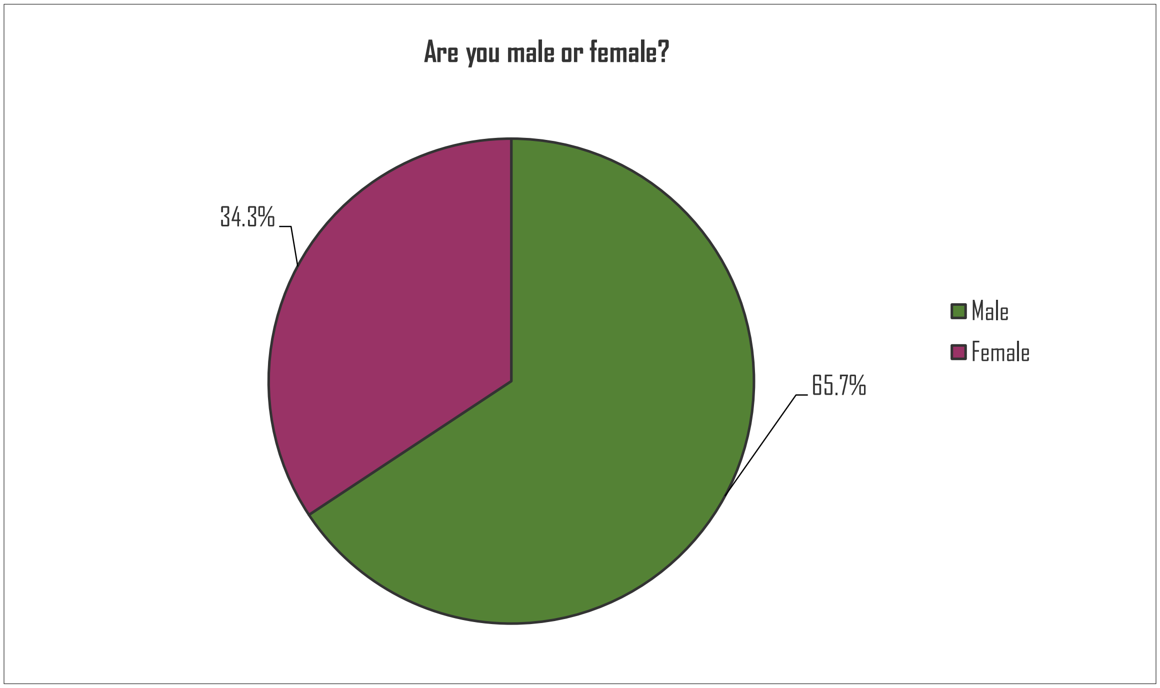
Q28. What municipality do you live in?		
Answer Options	**Response Percent**	**Response Count**
Anderson	0.8%	3
Carey	2.5%	10
Gurney	3.3%	13
Hurley	8.9%	35
Kimball	5.1%	20
Knight	3.0%	12
Mercer	28.2%	111
Montreal	7.9%	31
Oma	5.1%	20
Pence	1.8%	7
Saxon	2.8%	11
Sherman	2.8%	11
Other (please specify)	27.9%	110



Q29. What is your age?		
Answer Options	**Response Percent**	**Response Count**
17 or younger	0.5%	3
18-20	0.5%	3
21-29	3.8%	21
30-39	15.3%	85
40-49	22.0%	122
50-59	30.8%	171
60 or older	27.0%	150



Q30. Are you male or female?		
Answer Options	**Response Percent**	**Response Count**
Male	65.7%	364
Female	34.3%	190



If you would like more information about Iron County Outdoor Recreation opportunities, please provide your name and email or mailing address:		
Answer Options	**Response Percent**	**Response Count**
Name	93.1%	134
Address	79.9%	115
Email Address	94.4%	136

APPENDIX E-43 Gogebic County Recreation Plan

PUBLIC REVIEW DRAFT

1/3/2018

Gogebic County

2018-2022 Recreation Plan

Prepared for: Gogebic County Forestry and Parks Commission
200 N. Moore St., Bessemer, MI 49911

Prepared by: Western Upper Peninsula Planning and Development Region
P.O. Box 365, Houghton, MI 49931

WUPPDR
of Michigan

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Introduction

Recreational opportunities are an important aspect of the quality life in Gogebic County and are one of the primary reasons people choose to live and vacation here. For this reason, Gogebic County is committed to ensuring that quality recreational facilities are available to both residents and visitors. The 2018-2022 Gogebic County Recreation Plan has been written to guide future parks and recreation improvement activities for the County. The intent of this plan is to evaluate the county's existing recreation facilities, determine future needs, and establish a program of facility improvements to county-owned facilities.

The Gogebic County Forestry and Parks Commission has been responsible for planning, administration, and oversight of the County Parks and County Forest since 2001. Prior to that, the parks had been administered by the Gogebic County Road Commission. The parks, built in the 1920s and 1930s as federal Works Progress Administration and Civilian Conservation Corps projects, had fallen into a state of disrepair by 2001 due to budget limitations. The transfer of parks to the Forestry and Parks Commission, part of the County Government*, enabled the parks to become a self-sustaining enterprise. Ultimate responsibility for the parks remains with the Gogebic County Board of Commissioners.

By developing this plan, Gogebic County endeavors to create an affordable and achievable improvement program that will provide for current and future recreational needs. The Forestry and Parks Commission has been highly effective in its role: Over half of the capital improvement projects (35 of 66) included in recreation plans from 2001 to 2017 have reached completion, in addition to at least 5 projects not specifically identified in the plans. All projects completed under the Forestry and Parks Commission from 2001 to 2010, along with several other projects after that time, were paid for with County financial resources. Since then, DNR Trust Fund grants have improved Little Girl's Point, a county-owned site, and helped to create the Iron Belle trail segment in 2014 for which the County served as a pass-through grantee. These grants were awarded in 2010 and 2014 respectively.

* County when capitalized refers to the Gogebic County Government and when lowercase refers to Gogebic County generally.

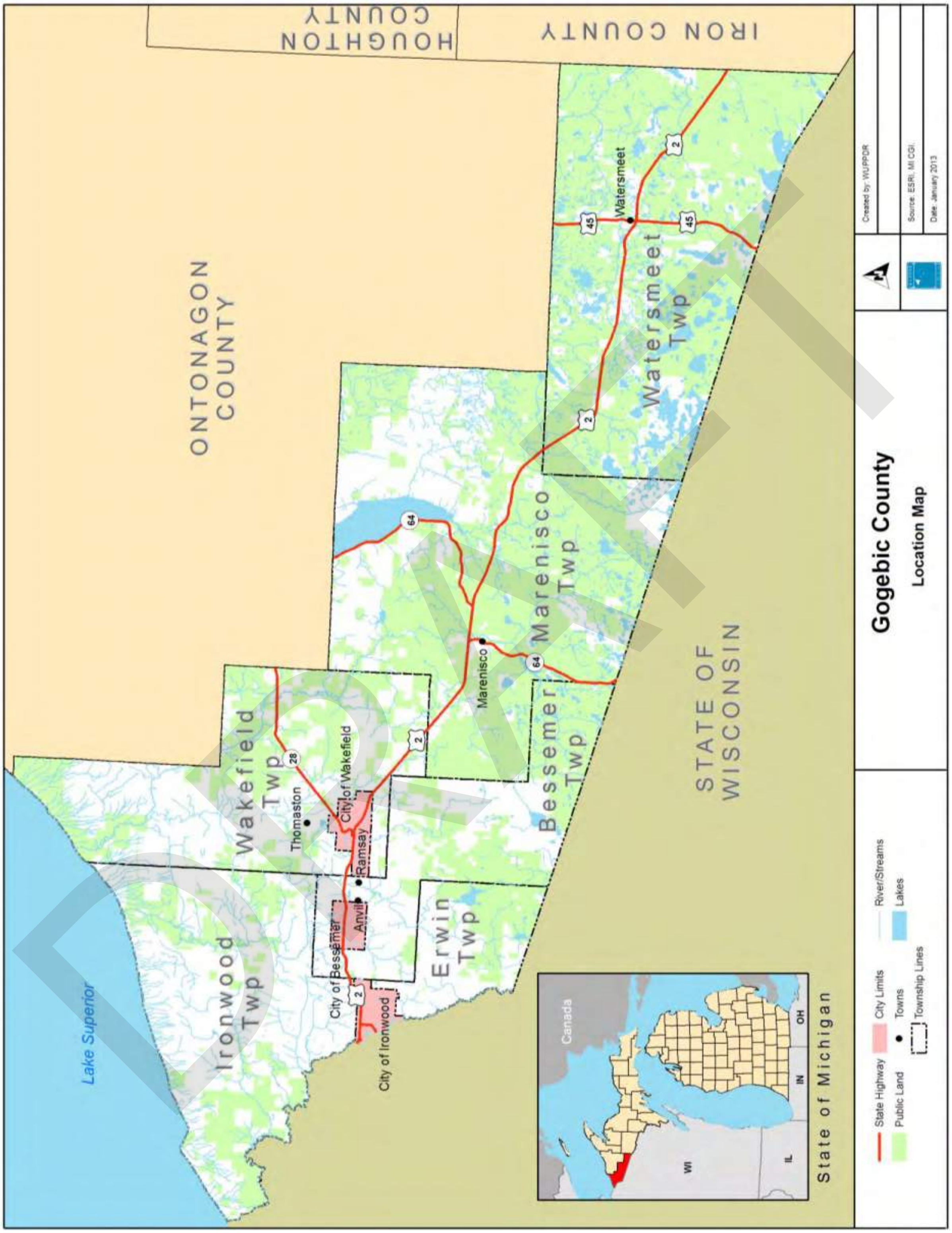
Community Description

Location

Gogebic County is located in the extreme western part of Michigan's Upper Peninsula (see **Map 1**). It is bordered by Ontonagon County and Lake Superior to the north, Iron County to the east, and the State of Wisconsin and the Montreal River to the south. The total land area of the county is 1,105 square miles. The greatest expanse of the county is northwest to southeast, a distance of nearly 80 miles. The county contains numerous lakes and streams, and over 90 percent of land is forested. Three percent of the total area (39 square miles) is surface water, in bodies of 40 acres or more. The largest inland lake in the county and Upper Peninsula is Lake Gogebic, with half located in Gogebic County and half in Ontonagon County.

Established as a county in 1887, Gogebic County contains three incorporated cities (Ironwood, Bessemer, and Wakefield) and six townships (Bessemer, Erwin, Ironwood [Charter], Marenisco, Wakefield, and Watersmeet). County operations are governed by a seven-member Board of Commissioners. The County Seat is the City of Bessemer.

Map 1. Gogebic County Location



Population, Housing, and Socio-Economic Characteristics

Based on the 2010 Decennial Census, 81 percent of Gogebic County's population is concentrated on the west end of the county in the cities of Bessemer, Ironwood, and Wakefield and the adjacent townships of Ironwood, Bessemer, Wakefield, and Erwin. The other 19 percent is found in Marenisco and Watersmeet Townships, including the unincorporated communities by those names in the south-central and southeast parts of the county, respectively. These townships make up close to half of the county's land area, and the majority of their land is within the Ottawa National Forest. The county's population declined by 5.4 percent from 2000 to 2010. See **Table 1** for details.

Table 1. Area Population Totals

Gogebic County (2010)	16,427	
Gogebic County (2000)	17,370	
Population Change (2000-2010)	-943 (-5.4%)	
Municipality	**Total Persons (2010)**	**Percent of Total**
Bessemer (City)	1,905	11.6%
Ironwood (City)	5,387	32.8%
Wakefield (City)	1,851	11.3%
Bessemer Township	1,176	7.1%
Erwin Township	326	2.0%
Ironwood Township	2,333	14.2%
Marenisco Township	1,727	10.5%
Wakefield Township	305	1.9%
Watersmeet Township	1,417	8.6%

Source: Decennial Census 2000 & 2010, U.S. Census Bureau

The County population is 91.7 percent White, with a significant (4.1 percent) African-American population in Marenisco Township and a notable (2.4 percent) American Indian population located primarily in Watersmeet Township on the Lac Vieux Desert Indian Reservation.

Based on 2015 American Community Survey Five-Year Estimates (ACS), 17.2 percent of Gogebic County's civilian noninstitutionalized population has a disability. This compares to 14.1 percent in the State of Michigan. Accessibility is taken into account in local recreation planning, and recreation facilities and sites are upgraded to meet universal design guidelines as improvements are made (see **Figure 1**).

Figure 1. Seven Principles of Universal Design

1. **Equitable Use:** The design is useful and marketable to any group of users.
2. **Flexibility in Use:** The design accommodates a wide range of individual preferences and abilities.
3. **Simple and Intuitive Use:** Use of the design is easy to understand.
4. **Perceptible Information:** The design communicates necessary information effectively to the user.
5. **Tolerance for Error:** The design minimizes hazards and the adverse consequences of accidental or unintentional actions.
6. **Low Physical Effort:** The design can be used efficiently and comfortably.
7. **Size and Space for Approach and Use:** Appropriate size and space is provided for approach and use

Special consideration should also be given to Gogebic County's population aged 65 and older, of which approximately one-third has a disability. Population projections from the Michigan Department of Transportation and University of Michigan in 2017 predict a considerable increase in the population age 65 and older from 2018 to 2025. The number of people in the county in this age range is projected to increase by 10.5 percent at the same time the total population falls by 3.5 percent. The population 15 years and younger, which requires much different recreation facilities, is projected to fall by 3.7 percent, which is approximately the same rate as the total population. As of 2015 (ACS) the county's median age is 48.3 years versus the state's 39.5. See **Table 2** for basic population characteristics as of 2015 (note that this is a different and more recent data source than used in Table 1).

Table 2. Gogebic County and State Population Characteristics

	County		State	
	Persons	% of Total	Persons	% of Total
Total	15,824		9,900,571	
Male	8,556	54.1%	4,861,973	49.1%
Female	7,268	45.9%	5,038,598	50.9%
Median Age (years)	48.3		39.5	
Under 5 Years	618	3.9%	575,786	5.8%
5 to 19 Years	2,205	13.9%	1,955,936	19.8%
20 to 44 Years	4484	28.3%	3,113,804	31.5%
45 to 64 Years	4,891	30.9%	2,772,180	28.0%
65 Years and over	3,626	22.9%	1,482,865	15.0%
White	14,382	90.9%	7,823,875	79.0%
Black or African American	723	4.6%	1,381,388	14.0%
American Indian and Alaska Native	377	2.4%	53,951	0.5%
Asian or Pacific Islander	89	0.6%	270,849	3.0%
Other single races	19	0.1%	109,184	1.1%
Two or more races	234	1.5%	261,324	2.6%

Source: 2011-2015 ACS Five-Year Estimates, U.S. Census Bureau

Economy

Based on Gogebic County's 2015 U.S. Census County Business Patterns, reporting on 4,219 paid employees by industry sector, the top industry sectors by employment are Accommodation and Food Services (773) and Retail Trade (743). These service industries are strongly associated with tourism. These sectors are closely followed by Manufacturing (729) and Healthcare and Social Assistance (701). Educational Services, though not reported, also employs a relatively large number. Agriculture, Forestry, Fishing and Hunting reports only 99 employees. This suggests a divergence from the historically predominant natural resource extractive industries.

The tourism industry is focused on the wealth of natural resources located within the county and focuses on the Ottawa National Forest, including its Sylvania Wilderness Area, with activities like hiking, camping, canoeing, and snowshoeing; the Gogebic County Forest; four alpine ski hills/resorts; and miles of ski, snowmobile, and mountain bike trails. Gogebic County is also home to the Black River National Forest Scenic Byway and the North Country Trail, a hiking route that extends 4,600 miles from New York to North Dakota.

In Watersmeet, at the east end of the county, the Lac Vieux Desert Band of Lake Superior Chippewa operates the Northern Waters Casino Resort. The resort includes a 200-acre golf course. A second casino location is being considered at Indianhead Resort in Wakefield.

Businesses are capitalizing on the great natural beauty of the county and its plentiful lakes, streams, forests, and snowfall to grow the tourist-based economy, but at the same time, efforts have been made to attract small, diversified industrial firms to the area. Industrial parks created as (temporarily) tax-free "Renaissance Zones" in the 1990s are now home to several diversified industrial firms. Gogebic Community College in Ironwood has grown rapidly in recent years, providing a diversity of career and education opportunities in the area, and is itself one of the county's largest employers.

Transportation

Gogebic County is served by three federal highways: U.S. Routes 2, 45, and 51. U.S. 51 joins with U.S. Route 2 in Hurley, Wisconsin less than one mile from Ironwood. Two major state highways also serve the county: M-28 and M-64. The Gogebic County Road Commission and municipalities maintain numerous local roads. Limited freight rail service exists. The Gogebic-Iron County Airport in Ironwood Township, co-operated with Iron County, Wisconsin, provides daily Essential Air Service flights to Minneapolis and Chicago via Air Choice One. Intercity bus service is provided by Indian Trails at several stops along U.S. 2, transporting passengers across the Upper Peninsula, into Wisconsin, and to Michigan's Lower Peninsula. Gogebic County

Transit Authority operates public transit "flex routes" between Ironwood and Wakefield and between Ironwood and Watersmeet, as well as localized demand-response transit service within the county.

Land Use and Zoning

Gogebic County land use is very diverse, ranging from concentrated industry to undeveloped forest. Most of the population and urbanized development is in the western end of the county around the cities of Ironwood, Bessemer, and Wakefield and in smaller pockets near Marenisco and Watersmeet. Zoning is in effect in all cities and townships, and long-established parks are recognized and protected within local ordinances. Gogebic County is relatively progressive in long-range planning, with most local governments having comprehensive plans recently adopted or in progress.

Federal, State, County, and privately owned forestlands, along with state parks, make up the majority of land cover in the county. These are tremendous assets for recreational development. Gogebic County is home to the only County Forest program in the State of Michigan, and the program is completely self-sustaining. Though the forest provides obvious recreation opportunities, another important purpose is to provide for timber sales which are the primary funding source of the forestry program. The majority of the forest cover is harvestable land dominated by northern hardwoods, aspen, and coniferous trees.

As of its 2016 Annual Report, the Gogebic County Forestry and Parks Commission administers 50,290 acres under its forest management program, with timber rights to another 374 acres. Approximately 80 percent of this land is considered productive or harvestable. In 2017 the Commission concluded the first phase of a multi-year process begun in 2013 to re-inventory the entire County Forest stock: timber volume and type, and major forest types. The first phase was northern hardwoods, the bulk of the forest content; the second phase, lowland hardwoods, was also initiated in 2017.

Topography

Gogebic County contains two belts of undulating terrain. The first of these is the Gogebic Range, which consists of igneous formations and contains iron ore bodies extending from the Montreal River to Lake Gogebic. The second belt, the Gogebic Highlands, consists of steep-sloped clay bluffs extending from Little Girl's Point to the Porcupine Mountains.

Geology and Soils

The various soil associations found in Gogebic County have been placed under six categories by the Natural Resources Conservation Service. They are upland areas dominated by 1) loamy soils, 2) loamy soils with associated rock outcrops, 3) loamy soils with associated sandy soils, 4) organic soils with associated wet loams, 5) heavy loamy soils, and 6) clayey, lacustrine soils. Within these categories, there are nine general soils associations. On-site inspection of soils, slope, and geology are essential when planning for development. For example, a particular site may have severe limitations for septic tank and drain field installation due to poorly drained soils, or bedrock near the surface may pose problems for construction of basements.

Lake Gogebic County Park and Little Girl's Point are both located in areas known to have moderate to severe limitations for recreational land use development. Therefore, a suitability analysis must be performed for each planned facility. Soils information, including slope, wetness, stoniness, and texture, helps to define the limitations imposed. Context-sensitive design concepts can help minimize the impact of facilities.

Climatic Conditions

The climate of Gogebic County is characterized by short, cool summers with long, cold winters. On average, the first date of temperature below 32 degrees Fahrenheit can take place anywhere from late August in the eastern part of the county to late September or early October in the western area along Lake Superior. The average date for the last freezing temperature in spring can take place from May in the western area along Lake Superior to early June in the eastern interior. **Table 3** provides climatic data for Ironwood in the west and Watersmeet in the east.

Table 3. Gogebic County Climate

Weather Characteristic	Ironwood	Watersmeet
Warmest Month	July	July
Avg. Maximum Temperature (° F)	76.1	78.0
Avg. Minimum Temperature (° F)	55.5	50.2 F
Coldest Month	January	January
Avg. Maximum Temperature (° F)	20.3	22.5
Avg. Minimum Temperature (° F)	2.9	0.7
Days Above 90° F	1.1	3.2
Days Below 0° F	38.0	45.2
Average Annual Precipitation (in.)	34.93	30.99
Average Annual Snowfall (in.)	188.2	Not Available

Source: NOAA Climate Normals, 1981-2010

Water Resources

Gogebic County is traversed by numerous rivers and streams and is dotted with inland lakes. Notable rivers include the Montreal, Black, Presque Isle, and Ontonagon. Notable lakes include Lake Gogebic, Lac Vieux Desert, Cisco Chain of Lakes, Presque Isle River Flowage, McDonald Lake, Black River Lake, Thousand Island Lake area, and numerous lakes of the Sylvania Wilderness in Watersmeet Township.

Groundwater availability varies greatly within the county, having the lowest capacity in clayey surface geology along the Lake Superior shoreline and highest capacity within glacial outwash in the eastern portion of the county. Wells in bedrock north to northwest of the Keweenaw Fault have problems such as low yields and large amounts of chloride (salt) infiltration due in part to improper well drilling practices, such as lack of grouting.

Vegetation and Wildlife

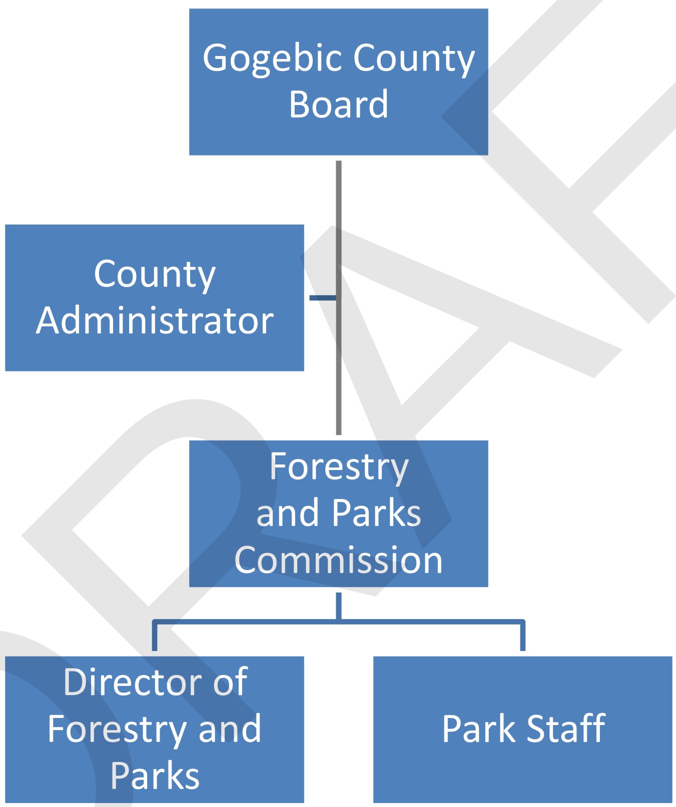
Fifty-five percent of Gogebic County's overall forestland is of the Northern Hardwoods type (dominated by maple and birch). The second most extensive type of forest cover in the County is aspen. The county is also interspersed with numerous conifer swamps, containing tamarack, cedar, balsam, and white and black spruce. As previously mentioned, the Gogebic County Forest is composed of this same mixture of hardwood and coniferous tree types. The Sylvania Wilderness has a notable stand of old-growth white pine.

Certain animal habitats in the county warrant special consideration. A deeryard, for example, is a gathering place for whitetail deer during the winter season when there is a shortage of food. The lures of a deeryard are reduced snow depth, which provides greater ability to find food, and the thermal cover given by the conifer canopy. Deeryards dwindle in number over the course of a winter, affecting the deer population accordingly. The county also contains Bald Eagle nesting areas which can also be utilized by osprey and great blue heron. There are scattered waterfowl nesting areas in Marenisco, Bessemer, and Watersmeet Townships, which are frequented by ducks, geese, cranes, and kingfishers. Other wildlife known to inhabit the county include black bear, coyote, gray wolf, fox, beaver, rabbit, muskrat, squirrel, chipmunk, and lynx.

Administrative Structure

Parks are administered by the Gogebic County Forestry and Parks Commission (appointed by the County Board of Commissioners) and the Forestry and Parks Director, who is responsible for day-to-day operations of the park system and the County Forest. (See **Figure 2**.) The Gogebic County Forestry and Parks Commission makes final decisions on the parks. The Forestry and Parks Commission meets the third Thursday of the month, and its meetings are open to the public.

Figure 2. Forestry and Parks Organizational Chart



The Forestry and Parks Commission and its operations are financially self-sustaining (with the exception of project-specific external grant funding). Revenues and expenditures in 2016 are shown in **Table 4**.

Table 4. Forestry and Parks Commission Finances, 2016

Component	Revenues	Expenditures	Net
Lake Gogebic County Park	$45,193	$43,435	$1,758
Little Girl's Point & Lodge	$50,375	$106,503	-$56,128
Other	$76,156		
TOTAL PARKS	$171,724	$149,937	$21,787
TOTAL FORESTRY	$596,367	$615,146	$-18,779
TOTAL COMMISSION	$768,092	$765,083	$3,008

Lake Gogebic County Park and Little Girl's Point both have seasonal park managers. Basic facilities maintenance is performed by staff, but major repairs are put out to bid. The primary source of income for the Parks operation of the Commission is camping fees. Timber sales, the major source of income on the Forestry side, provided an annual average of $701,811 in revenue from 2012 through 2016.

Little Girl's Point had an atypical financial year in 2016, with a significant deficit due to critical repair work and temporary closure resulting from severe shoreline flooding in summer. Also, finances were affected by a change in the County fiscal year in 2016.

In recent years the Commission has partnered with several organizations. In one example, in 2015 the Commission worked with Gogebic Conservation District, Michigan Department of Natural Resources (DNR), and the Ruffed Grouse Society to create five miles of hunter walking trails and three wildlife openings on County Forestland to be managed as a Grouse Enhanced Management Site (GEMS). In 2016 the Conservation District was awarded a Deer Habitat Improvement Grant from DNR for use at the GEMS. This involved creating a fourth wildlife opening and planting appropriate vegetation. Additional DHIG funding supported ongoing maintenance and additional vegetation planting in 2017. Some local businesses are also taking part in this partnership by offering a discount to hunters and visitors who show their pictures taken in front of the GEMS sign. Other groups the Commission has worked with include the United States Forest Service, Michigan State University Extension, Wisconsin County Forest Association, Gogebic Range Trail Authority, Boy Scouts, and private forest industry.

Recreation Inventory: County-Owned Sites

Gogebic County owns and operates two major parks with campgrounds: one on Little Girl's Point on Lake Superior and the other at the southwest end of Lake Gogebic. The County also owns a park with a rustic campground on the north end of McDonald Lake and oversees a trail network in Ironwood Township. Aside from developed sites, the County maintains a network of trails, the Powers Road Recreation Area, within the County Forest.

The County has played a role in funding for the Iron Belle Trail within the county, and the County is exploring possible avenues of involvement in the Copper Peak recreation complex, so these facilities are detailed after the current County-owned sites.

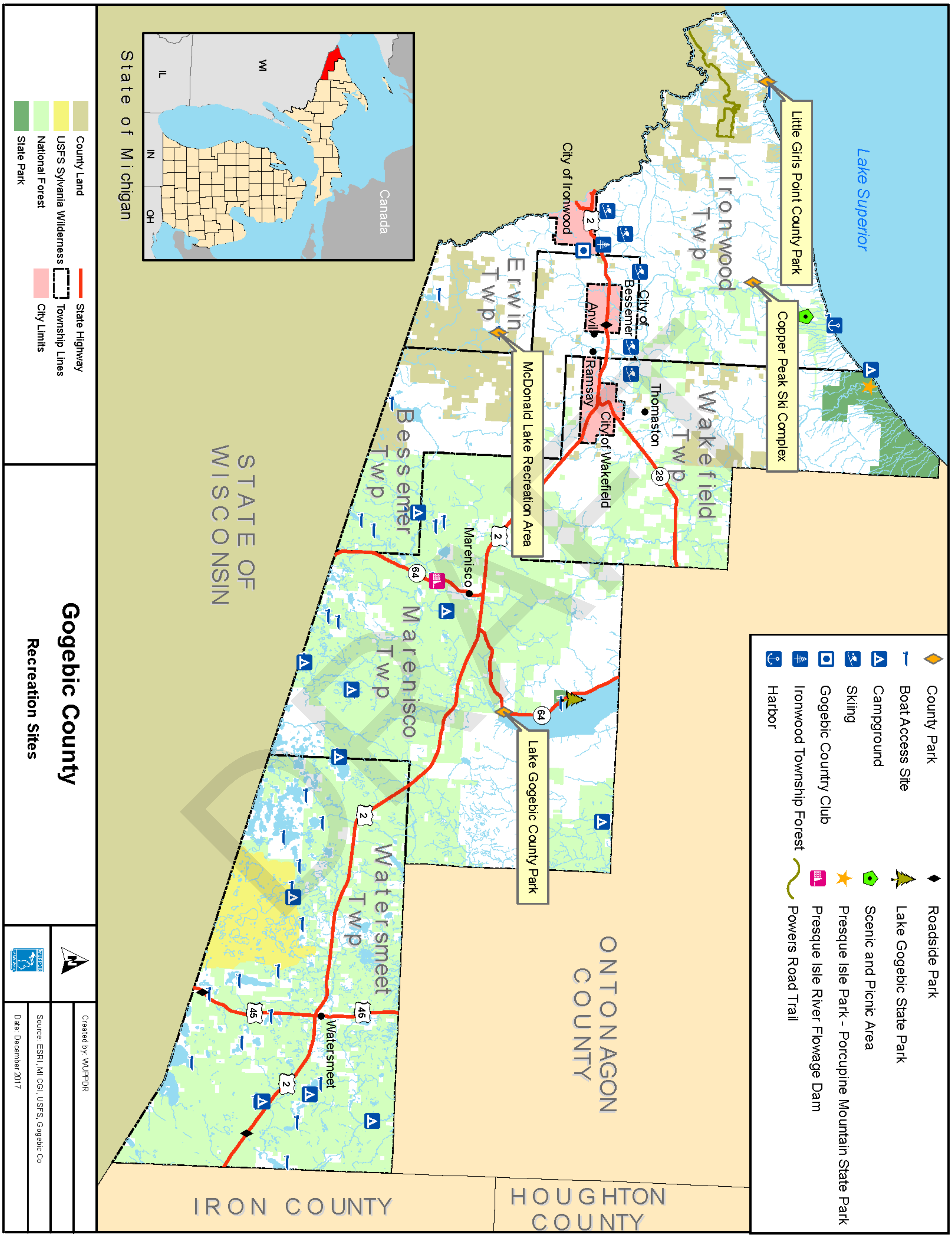
In addition to the sites under County purview, a preexisting inventory of all known sites in the county has been updated with input from local governments (**Appendix A**). **Map 2** shows the location of County-owned and other recreation sites, as well as land ownership.

Little Girl's Point County Park

Little Girl's Point is a 271-acre facility with 31 campsites, restrooms, changing rooms, playground equipment, picnic sites, access for swimming and fishing Lake Superior, and an adjacent DNR boat launch (Oman Creek Access Site, which the Commission has maintained and administered on behalf of DNR since 2016). The park is also home to "The Lodge" multi-purpose building (see below). Campground occupancy was 59 percent during the 2016 season (May 6 – October 2).

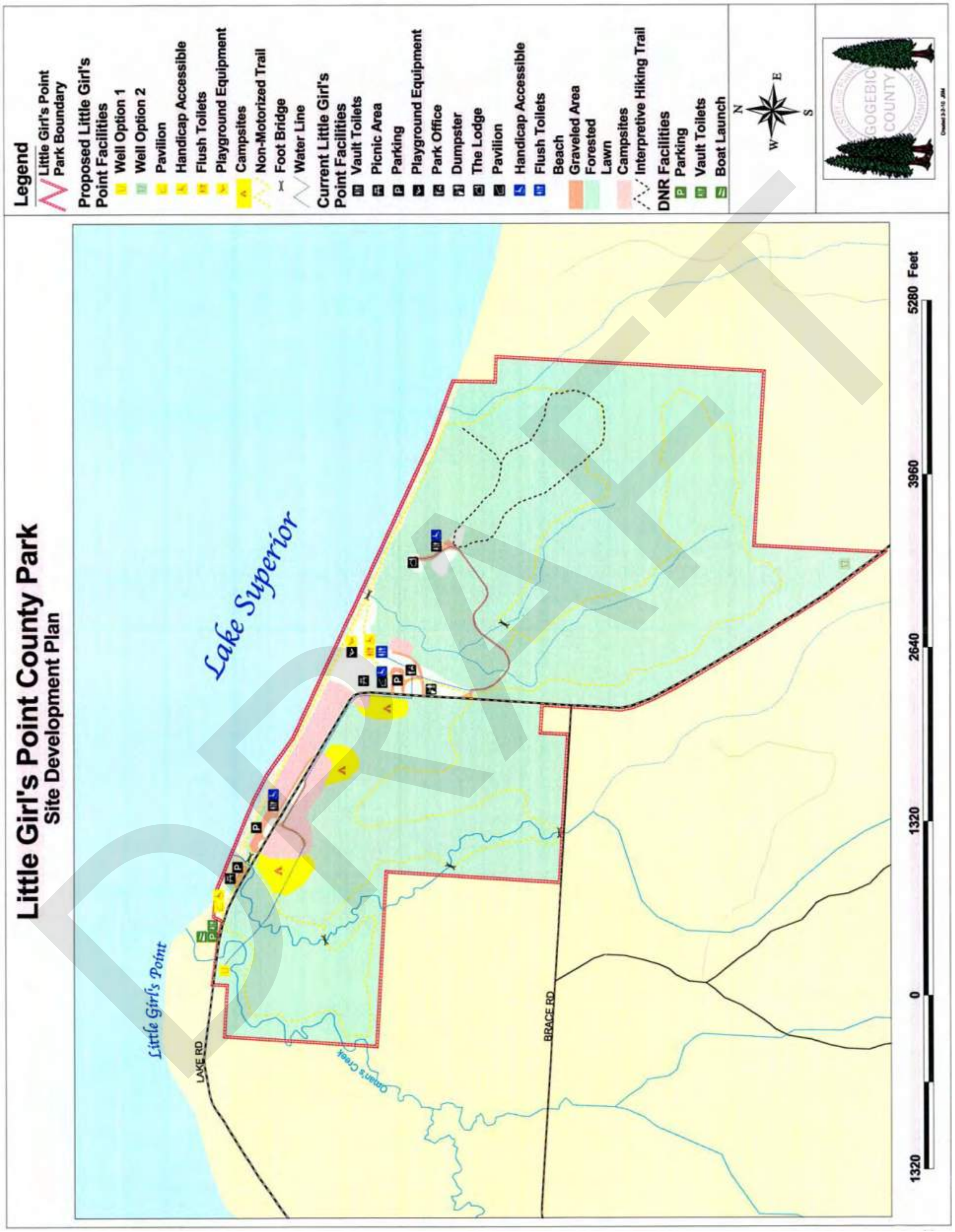
The park's desirability and diversity of use was increased as a result of a 2011 DNR grant, which funded playground equipment, a day use pavilion, upgraded restrooms, water system improvements, development of additional campsites, and a non-motorized trail system. **Map 3** is a basic map of the park, and **Map 4** is the park's site plan as prepared for its 2010 Trust Fund grant.

Map 2. Gogebic County Recreation Sites



Map 3. Little Girl's Point County Park Map

Map 4. Little Girl's Point County Park Site Plan Map (2010)



The Lodge

The Lodge at Little Girl's Point is the location of numerous educational, recreational and social activities and programs, such as school outings, family reunions, and picnics. The facility is available for private rental for a fee. The Lodge can sleep up to 40 overnight guests and provides a large kitchen with two stoves and refrigerators and a dining hall with fireplace. Outside is tent or trailer camping space, a campfire area, and beach access. The Lodge was estsablished in 1951 by the Gogebic County Cooperative Extension.

Lake Gogebic County Park

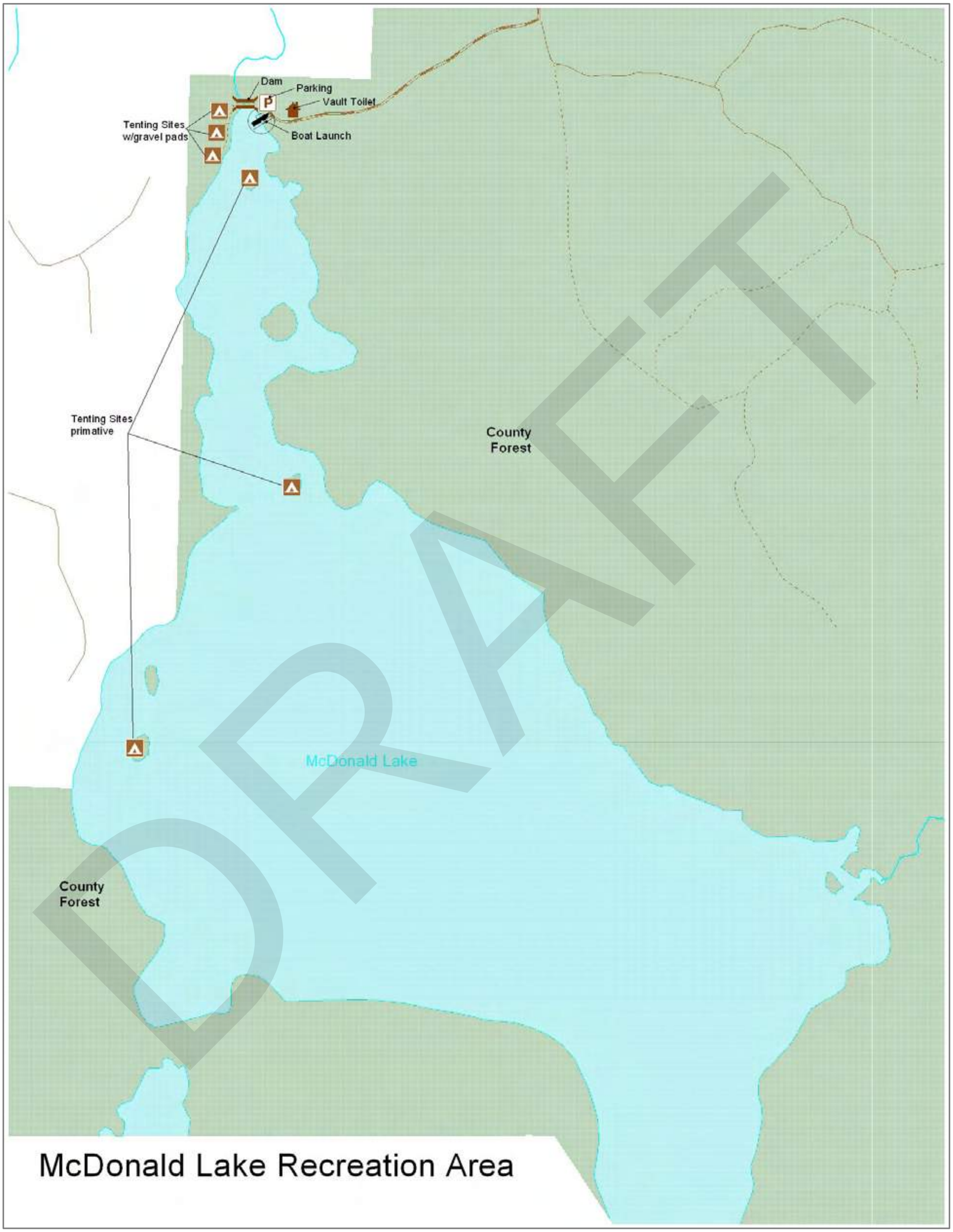
Lake Gogebic County Park is a 133-acre recreational facility providing access to one of Michigan's largest inland lakes. Recreation facilities include 53 camping sites, a boat launch, swimming beach, restrooms, play field, and playground area. Playground equipment includes a swing, slide, merry-go-round, and horseshoe pits. Approximately half of the campsites are rented seasonally, a dozen monthly, and the remaining sites weekly or daily. See **Map 5**.

McDonald Lake County Park

McDonald Lake County Park has a rustic campground, making it unique from the other two County-owned parks. The park has six campsites, half of which are located at the northern end of the lake, with the other half located on islands in the lake. There is no fee to camp, and the sites are rustic, designed for tent camping only. Each site has a picnic table. The three sites on the lakeshore have tent pads and fire rings, but the island sites do not. See **Map 6**.

Map 5. Lake Gogebic County Park

Map 6. McDonald Lake County Park



Powers Road Recreation Area

Located in the far northwestern part of Gogebic County, the Powers Road trail network, approximately 30 miles in total, was developed in cooperation with a local mountain biking group with the intention of connecting to regional trails in nearby parts of Upper Michigan and Northern Wisconsin. Area trail planning is conducted by the Gogebic Range Trail Authority. The trails allow multiple uses: non-motorized, ATV/ORV, and equestrian. Over five miles of trails are developed as hunter walking trails, and in connection with four wildlife openings created since 2015, deer and grouse hunting opportunities are abundant. See **Map 7**.

Accessibility Assessment

Gogebic County Forestry & Parks Commission evaluated the accessibility of each County-owned site based on knowledge gained during previous projects and maintenance and taking into account ADA National Network checklists.

Accessibility rankings were assigned as follows:

- **Little Girl's Point County Park** 2 – Some site elements meet standards
- **The Lodge** 3 – Most site elements meet standards
- **Lake Gogebic County Park** 2 – Some site elements meet standards
- **McDonald Dam Recreation Area** 2 – Some site elements meet standards
- **Powers Road Recreation Area** 1 – None of the site elements meet standards

Gogebic County will address ADA compliance by incorporating accessible elements as it upgrades facilities and undertakes new capital projects. Relatively simple upgrades include accessible campsites and picnic tables. Currently Little Girl's Point has one of each of these, and the same is planned for Lake Gogebic. Most restrooms and toilets at county sites are accessible, but increased accessibility for any new restrooms and upgraded buildings are a priority.

Previous DNR Recreation Grants

DNR recreation grants previously received by Gogebic County are as follows; all are in good condition unless otherwise noted:

Lake Superior Park Addition: #26-00178 of 1969, closed, in the amount of $10,000

- Acquisition of 101 acres of land (complete)

Lake Gogebic Dock Rehabilitation: #TF93-267 of 1993, closed, in the amount of $86,300

- Mobilization (complete)
- Removal of old dock (complete)
- Dock (steel pile type; *needs rehabilitation again*)
- Miscellaneous (lighting, erosion; remains in good repair)

Lake Superior Park: #BF95-194 of 1995, withdrawn, in the amount of $34,000

- Well
- Water lines to/from well

Lake Superior Observation Deck: #TF96-118 of 1996, withdrawn, in the amount of $57,750

- Observation deck
- Beach access
- Paving of parking area
- Toilets

Little Girl's Point Improvements: #TF10-094 of 2010, closed, in the amount of $235,500

All complete:

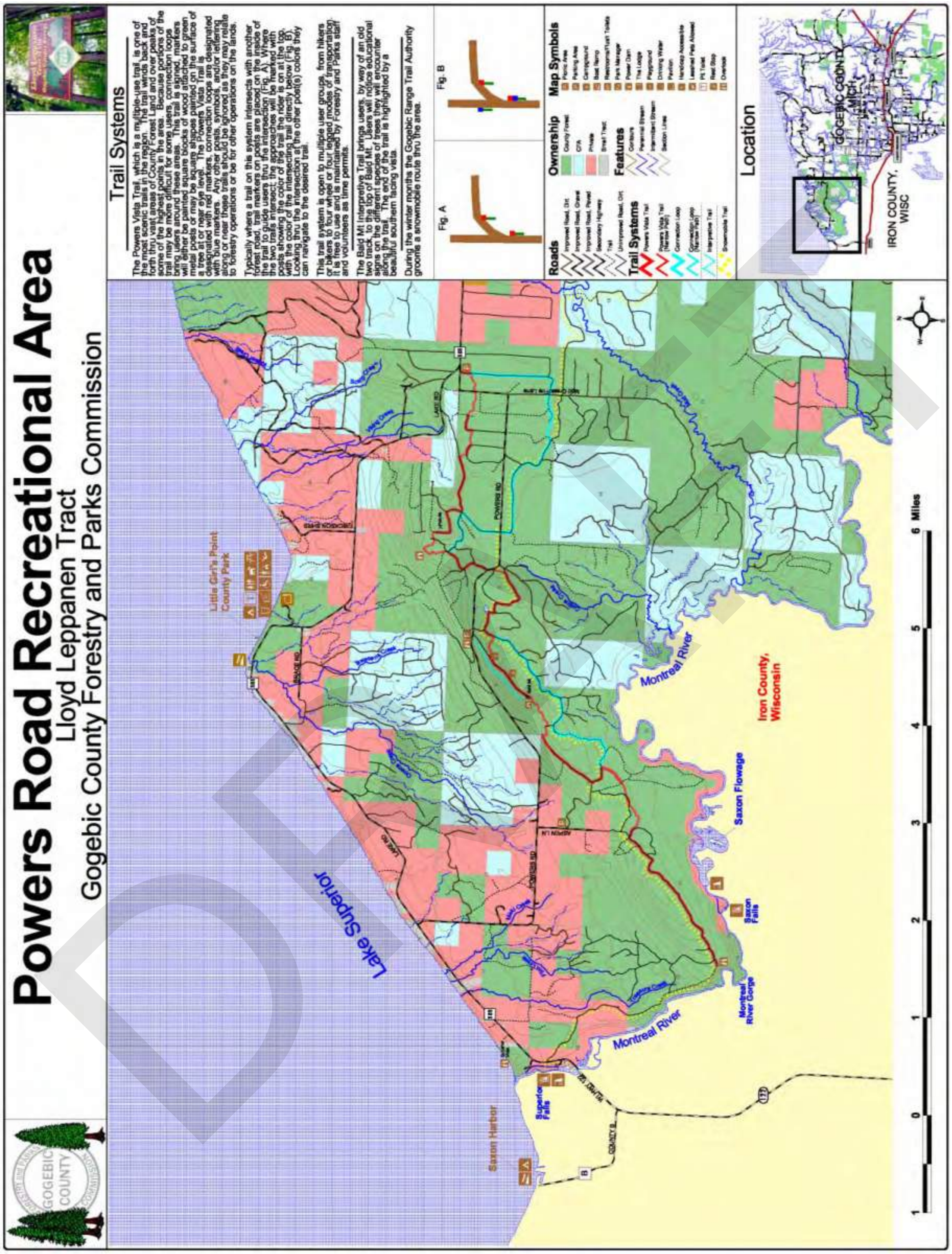
- Playground
- Pavilion
- Restroom improvements
- Utilities
- Campsite development *(damaged by flood in 2016; some already replaced)*
- Trail *(damaged by flood in 2016; will be rehabilitated)*

Ironwood to Bessemer Trail Project: TF14-0166 of 2014, active, in the amount of $295,000

PA executed and in progress:

- Bench
- Pedestrian bridge
- Recycle bins
- Signage
- Trail – 8' to 10'-wide
- Trash bins

Map 7. Powers Road Recreation Area



Recreation Inventory: Other Key Sites

Iron Belle Trail

The Iron Belle Trail Bicycle Route within Gogebic County runs east from the City of Ironwood, roughly following the U.S. Highway 41/M-28 corridor. Phase one of the trail, within Ironwood, was fully implemented by the City. Gogebic County served as pass-through applicant for a 2014 DNR Trust Fund grant for the second phase, a 4.2-mile, 10-foot-wide paved pathway between Ironwood and Bessemer. DNR is perpetually responsible for operations and maintenance of this segment, either itself or under contract with another entity (the first 20 years being with the Western Gateway Trail Authority). The County may apply for 2018 Natural Resources Trust Fund funding for the third phase of this trail, which will extend from Bessemer to Ramsay. No formal agreements are in place for a possible fourth phase from Ramsay to Wakefield, but this plan is generally supportive of the ongoing development.

Copper Peak Recreation Complex

In Ironwood Township north of the City of Bessemer, the Copper Peak recreation complex contains the largest ski jumping hill in North America along with accessory facilities such as chairlifts, a visitor center, restroom facilities, and parking. The ski jump is 26 stories in height, offering panoramic views of Lake Superior, the Porcupine Mountains, the Apostle Islands, and distances as far away as Minnesota. Copper Peak is one of the Western U.P.'s top tourist destinations; guests can ride a chairlift from the parking area and visitor center to the structure and then take an elevator ride to the top of the structure. For more active recreation, over 5.5 miles of single-track mountain bike trails have been established within the 300-acre property over the past several years.

Constructed in 1969, the Copper Peak ski jump hosted 10 ski flying events from 1970 until 1994. Since that time, Copper Peak, Inc., the nonprofit corporation that owns the facility, has maintained it and operated it as a tourist attraction in hopes of a return to ski events. In recent years progress toward this goal has accelerated. Provided the nonprofit is able to bring the facility up to specification, the International Ski Federation is prepared to authorize the facility to host international-level ski events including the Finale of the Summer Grand Prix of international ski jumping. Equipped with a plastic mat, the ski hill would have an internationally unique status as a summer practice facility. Although the hill's height does not meet today's international standards for the highest level of winter competition, the facility has potential to host certain winter ski events again.

Copper Peak, Inc. has a detailed redevelopment plan in place pending sufficient funding, and one component of this is development of a public event plaza at the base of the hill. Gogebic County holds Copper Peak's success as a high-priority and will consider roles it could play to help facilitate development of the facility.

Countywide Priorities and Trends

Recreation facilities in the county span a full spectrum of activities and uses: active and passive; athletic, natural resource-oriented, and casual; facility-based and land-based; and fixed and transient in location. Gogebic County's own Forestry and Parks Commission offers a variety of outdoor recreation opportunities with its abundance of public land and forested recreation sites. County-owned facilities include campgrounds, boat launches, and beaches. DNR and Ottawa National Forest offer many similar amenities on a much larger land base. Local governments in the county offer such facilities as baseball fields, basketball courts, and playgrounds. The county is also known for its abundance of recreational and competitive ski complexes and resorts. Three of these are owned and operated by the private sector, and Mount Zion is owned and operated by Gogebic Community College. Many of these complexes offer terrain parks and trails in the off-season, and potential exists for development of additional summer activities.

A variety of trail enthusiasts have discovered that the county and entire Western Upper Peninsula offer great opportunities for trail development. The most prominent of these has been the snowmobiling community, which has defined winter—and even year-round—tourism countywide for decades. More recently, all-terrain and off-road vehicle (ATV/ORV) enthusiasts have been brought into the motorized fold, including subsets such as dirt-bikers.

Meanwhile, in concurrence with national trends, non-motorized trail activities have become increasingly popular in recent years. Hiking, biking, and paddling are being promoted through such initiatives as the Iron Belle Trail (extending from Ironwood to Belle Isle, Michigan; the fruition of Michigan Governor Rick Snyder's vision to make Michigan the "Trail State"), Western U.P. Water Trail, and "The Wilds of Michigan." All of these promote the region as a four-season tourism destination rather than focusing on the traditionally predominant winter sports. Gogebic County's portion of the Iron Belle bicycle route is among the most quickly advancing in the Upper Peninsula, due in large part to formation of the Western Gateway Trail Authority, which includes officials from four local governments along the route. The county intends to support trail development wherever it has an appropriate role.

The Gogebic Range Trail Authority (GRTA), formed by local businesses, snowmobile clubs, all-terrain/off-road vehicle (ATV/ORV) users, cross-country skiers, and mountain biking enthusiasts in response to the growing demand for trail facilities and tourist accommodations, administers a trail system plan within the County. The system connects with existing regional trails and others planned or under development in Wisconsin and the western Upper Peninsula. Currently the primary function of GRTA is snowmobile trail grooming.

In the eastern part of the county, the Wilderness Lakes Trails network is a 37-mile, primarily non-motorized loop connecting Watersmeet with Land O' Lakes, Wisconsin and skirting part of the Sylvania Wilderness. The loop is composed of a combination of low-volume roads, widened road shoulders, and fine gravel paths. It traverses many different land ownerships, primarily the Ottawa National Forest. Development of the Wilderness Lakes Trails began in 2004 and as of 2017 is nearly complete.

Both motorized and non-motorized networks are growing and playing a meaningful role in the economy, but on the ground the coexistence is not always peaceful. Some trails are happily shared by both types of users, whereas others are hotly debated as to who should be able to travel where and when. Equestrian use is particularly controversial and often rejected by both motorized and other non-motorized interests. Thus, all parties must continually be engaged to keep an open dialogue to ensure equitable use of all lands and routes.

A longer-term, wide-ranging goal in trails is to undertake a study of the economic impacts of all types of trails in order to demonstrate the value of this asset in the Upper Peninsula.

Longstanding means of recreation, such as campgrounds, water accesses, and athletic venues will remain as important as ever, but trail activities and networks will continue to grow and diversify, contributing to existing lands and facilities to serve diverse user groups.

Planning Process

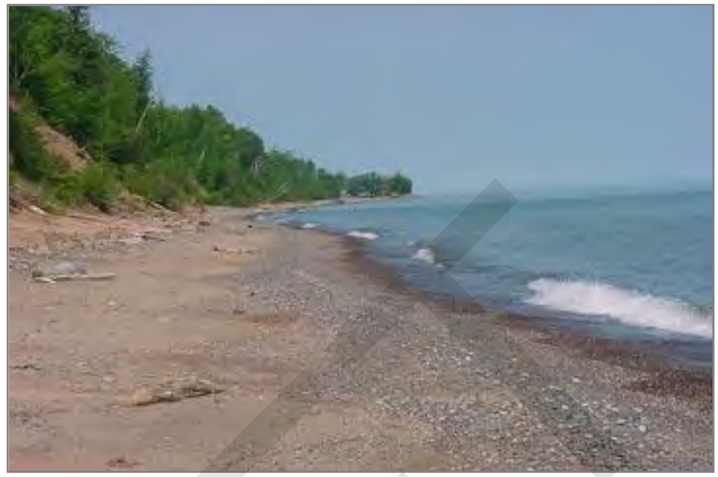
This Recreation Plan was developed with assistance from the Western Upper Peninsula Planning and Development Region (WUPPDR). Planning was initiated with a meeting of the Gogebic County Forestry and Parks Commission on August 9, 2017, at which members considered goals and objectives, reviewed the previous action plan and updated the status of its projects, and considered potential projects for the new Action Program (hereinafter referred to as Capital Improvements Plan or CIP). Based on this information, a survey (**Appendix B**) was developed, approved by the Forestry and Parks Director, and publicized through a press release (**Appendix C**) to local media on September 29. The survey, available online and in print, was also distributed to a network of trail groups, to the Gogebic Community College main campus, and in print at several locations throughout the county. The survey was open until mid-November. The survey received 147 responses (**Appendix D**), which were taken into account for this plan.

WUPPDR attended a second Forestry and Parks Commission meeting on November 21. Based on survey results and input from the commissioners, projects in the action plan were prioritized, and the discussion of goals and objectives was reviewed and updated. Follow-up on more formulaic parts of the plan, was made by WUPPDR with the Forestry and Parks Director, and Commission members provided final input to the plan draft. The draft became available for public review (online via www.wuppdr.org and in print at the Forestry and Parks Commission office) on January 5, 2018. A press release announcing this was issued on January 3 (**Appendix E**).

[Information about F&PC approval meeting & resolution {**Appendix F**}, notice & affidavit of public hearing {**Appendix G**}, etc.]

[Information about public hearing comments/minutes {**Appendix H**}, County Board adoption meeting & resolution {**Appendix I**}, etc.]

Goals and Objectives



The overarching goal of the Gogebic County Forestry and Parks Commission is to maintain a variety of both developed and undeveloped sites and opportunities for recreation for both residents and visitors. This can be accomplished through an affordable and achievable capital improvement program that will increase use and user satisfaction at County facilities. Though Gogebic County's recreation opportunities are offered by a diverse group of local governments and other providers, the County-owned facilities are the focus of this Recreation Plan.

The County-owned facilities are diverse and well-distributed geographically. They support a variety of different activities, both active and passive. The modern campgrounds in particular cater to all ages, and where disability standards are not being met the parks can be retrofitted to do so, so maintenance and continuing development of these sites is particularly important for the area's aging population. Little Girl's Point and Lake Gogebic offer great opportunities for family activities that span the full range of ages, such as swimming. Powers Road Trail Network satisfies the more active desires of trail users and hunters. Three of the four facilities are on the west end of the county where the majority of the population is located. However, as driving is the almost ubiquitous transportation mode, geographic location is not the primary factor in facility focus.

The Forestry and Parks Commission's effectiveness at carrying out planned projects to meet these objectives has been established over the course of three previous recreation plans since 2001 – but much work remains to be done. Although major upgrades at Little Girl's Point since 2011 increased user satisfaction, major flooding in 2016 hampered progress and will require additional intensive maintenance. At the same time, major upgrades are planned for other County facilities in 2018, beginning with the popular Powers Road Trail Network and McDonald Lake County Park, the latter of which has seen relatively few recent improvements. Major projects are planned at the other facilities beginning in 2019, with improved restrooms at Little Girl's Point at the top of the list. The Commission is making a concerted effort to improve facilities in accordance with use levels and user preferences, within financial constraints. See **Table 5** for the Capital Improvements Plan (CIP).

Regional trail connectivity remains a high priority, especially for Powers Road and for snowmobile trails along the Ironwood-to-Wakefield Highway M-28/U.S. 2 corridor. Land ownership and volatility of easements present a challenge for long-term trail reliability. Trail organizations and other stakeholders in the county, including private parties along with DNR and MDOT, have done well to increase opportunities and will continue to collaborate. Gogebic County also intends to help facilitate continuing development of the Iron Belle Trail, particularly where the County is uniquely positioned to act as the fiduciary for various funding sources, as was the case for Phase 2 and likely future phases. Since Iron Belle is not a County-owned facility it is not included in the CIP.

Copper Peak recreation complex offers additional trail and outdoor recreation opportunities. With its status as North America's largest ski jumping hill, it is regaining national and international interest. There is a need for many added and upgraded components to put the facility into service at this level. It is possible the County will be involved with land acquisition or serve in a fiduciary capacity for external funding of the project, but since the specifics of possible County involvement are uncertain at this time and the facility is currently not County-owned, Copper Peak is not included in the CIP.

The end result of trail improvements will be a better quality of life for residents and economic prosperity derived from utilization by outside visitors. By working in tandem with initiatives such as The Wilds of Michigan and organizations such as Copper Peak, Inc., the Forestry and Parks Commission can produce a recreational end product greater than the sum of its parts.

Of 16 projects identified for county facilities in the 2013-2017 Gogebic County Recreation Plan, 5 were completed, along with partial elements of some projects, and one major project (Powers Road habitat improvement) not in the plan. In 2016 and 2017, major financial resources of the Forestry and Parks Commission were diverted to repairs at Little Girl's Point County Park and The Lodge. The proceeding CIP carries over some uncompleted projects from the previous plan, deletes several that are no longer relevant or are not prioritized within the next five years, and identifies several new projects.

Action Program

Capital Improvements

Recreation priorities were identified according to the current and projected needs of Gogebic County and have been addressed in the five-year Capital Improvements Plan below. Other projects consistent with the goals and objectives of this plan will be considered as needs and opportunities arise.

Table 5. Capital Improvements Plan

	Project	Location	Est. Cost	Primary Funding
2018				
1	Improvements to Existing Trails	Powers Road	$5,000	Local
2	Trailhead Upgrade with Gravel	Powers Road	$2,500	Local
3	Access Road Improvements	McDonald Lake	$8,000	Local
4	Kayak Launch	McDonald Lake	$5,000	Local
2019				
1	New Restrooms with Flush Toilets	Little Girl's Point	$80,000	DNR
2	Major Maintenance of Dam	McDonald Lake	$15,000	DNR or DEQ
3	Additional Hunter Walking Trails	Powers Road	$7,500	Local
4	Tent Pad Improvements	McDonald Lake	$3,000	Local
2020				
1	Major Maintenance of Dock	Lake Gogebic	$10,000	Local
2	Day Use Pavilion(s) near beach	Lake Gogebic	$50,000	DNR
3	Upgraded Playground Equipment near beach	Lake Gogebic	$7,500	Local
2021				
1	Kayak Launch	Lake Gogebic	$5,000	Local
2022				
1	New Restrooms with Flush Toilets	Lake Gogebic	$80,000	DNR
2	New Vault Toilet	McDonald Lake	$12,000	DNR

Potential Funding Sources

A number of possible sources of public funding for recreation projects within Gogebic County are available, as shown in **Table 6**. Note that for many grant programs, projects that commit more than the minimum local match receive additional points in evaluation/scoring.

Table 6. Potential Funding Sources

Description	Minimum Local Match	Source
County/Local Funds	N/A	Local
Community Foundation/Other (local service organizations and businesses)	N/A	Local
Michigan Natural Resources Trust Fund (MNRTF) ($15,000-300,000 grant for development projects)	25%	DNR
Land & Water Conservation Fund (LWCF) ($30,000-$150,000 grant)	50%	DNR
Boating Infrastructure Grants (BIG)	25%	DNR
Waterways Program Grants	50%	DNR
Recreation Passport Grants (Up to $150,000 grant in 2017)	25%	DNR
Dam Management Grants	10%	DNR
Off-Road Vehicle Trail Improvement Program	N/A	DNR
Snowmobile Trail Improvement Program	N/A	DNR
Recreational Trails Program	N/A	DNR
Law Enforcement Grants (Marine Safety, ORV, Snowmobile)	N/A	DNR
Coastal Zone Management (CZM) ($10,000-$100,000 in FY2019)	50%	DEQ
Michigan Department of Transportation (MDOT)	Varies	MDOT
United States Department of Agriculture – Rural Development (USDA-RD)	Varies	USDA

Appendix

Appendix A: Countywide Recreation Inventory

Appendix B: Recreation Survey Form

Appendix C: Recreation Survey Press Release

Appendix D: Recreation Survey Results

Appendix E: Public Review Period Press Release and Column

Appendix F: Public Hearing Notice Affidavit

Appendix G: Forestry and Parks Commission Resolution

Appendix H: Public Hearing Meeting Minutes

Appendix I: County Board of Commissioners Resolution

Appendix A:

Countywide Recreation Inventory

Countywide Recreation Inventory

LOCATION	SIZE/ ACRE	OWNERSHIP	EXISTING FACILITIES
City of Bessemer			
A.D. Johnson High School Massie Field Complex	7	Bessemer School District	Football field, reg. ball diamond, track, tennis courts (2), gym (2 backboards)
Barber Field	4.6	City of Bessemer	Softball field
Bessemer City Hall	1	City of Bessemer	Gymnasium, stage
Bessemer Housing	4.6	Public-Housing Commission	Playground, basketball court
Bessemer VFW	<1	Private	Horseshoe pits
Bluff Valley Park	10.4	City of Bessemer	Pavilion, picnic area, playground, sand volleyball court, basketball & tennis courts, racetrack for remote controlled cars, ice rink
E.J. Oas Softball Field	5	City of Bessemer	Softball field
Ethnic Commons Park	0.3	City of Bessemer	Picnic tables, gazebos
Iron Belle Trail (part)	1.4 mi	Gogebic County Road Commission	Multi-use paved trail
St. Sebastian Catholic School	<1	Private-School	Playground
Steiger Little League Field	3	City of Bessemer	Little league baseball field
Washington Elementary School	4	Bessemer School District	Football field, basketball court, gym (2,400 sq. ft. 2 backboards), swimming pool
City of Ironwood			
All Saints Catholic Academy	1	Marquette Roman Catholic Diocese School	Multi-purpose gym
Cemetery Trails	2 mi	City of Ironwood	2 miles snowshoe, hiking, and single track mountain bike trails
Curry Park	9.25	City of Ironwood	Campsites (56; 9 full-hook-up, some electric), playground, picnic tables, grills, toilets, showers, laundry, dump station
Depot Recreation Park and Trailhead	---	City of Ironwood	Playground; pavilion; volleyball courts (2); walking path (0.2 miles); snowmobile, ATV, and non-motorized trail crossings; kiosk; toilet
Downtown Art Park	<1	City of Ironwood	Benches, art displays

Downtown Pocket Park	0.08	City of Ironwood	Garden, walkway, benches
Gogebic County Fairgrounds Oval Track	---	Gogebic County	Used for snowmobile races, etc.
Gogebic Country Club	160	Private	Club house, pro shop, golf course (9 holes)
Hiawatha Park	1.04	City of Ironwood	Playground, pavilion, picnic tables
Hiawatha Rotary Skateboard Park	1.2	City of Ironwood	Skateboard equipment, bicycle pump track
Iron Belle Trail (part)	2.5 mi	MDOT	Multi-use paved trail
Ironwood Travel Information Center	10	State, MDOT	Picnic area, restrooms
John Krznarich Little League Field	2.75	City of Ironwood	Baseball field, playground, toilets, concession stand
Kiwanis Tot Lot (Mansfield Street)	---	Private-Public Use	Playground
Kuitunen Park	0.5	City of Ironwood	Benches
Lake & Ayer Streets Park	<1	City of Ironwood	Playground, benches, basketball
L.L. Wright High School	14	Ironwood Area Schools	Playgrounds (2), gymnasiums (2), football field
Longyear Park	3	City of Ironwood	Playground, basketball court (lighted), walking track, picnic tables, band shell
Miners Memorial Heritage Park	---	City of Ironwood	Biking, hiking, skiing, and snowshoe trails including 4-kilometer groomed cross-country ski loop
Mount Zion Overlook Park	40	City of Ironwood	Benches, toilet, non-motorized trails including 1 mile single track mountain bike trail, frisbee golf
Mountain Man Disc Golf	---	Private	18 disc golf baskets
Municipal Memorial Building	---	City of Ironwood	Gym, auditorium
Newport Heights Historical Park	0.5	City of Ironwood	
Norrie Park	105	City of Ironwood	Playground, pavilion, swimming area, toilets, changing area, picnic tables, (2) tennis courts, horseshoe pits (2), volleyball, paved bike trail, walking paths, swimming area, accessible fishing platform, community gardens, grills
Patterson Tennis Courts	0.77	City of Ironwood	Tennis courts (2), playground
Playground (Sleight School)	2.8	Ironwood Area Schools	Playground (2 backboards), pickup ball diamond, gym (2 backboards)
Randa Field	---	City of Ironwood	Softball field (lights, concession stand)
City of Wakefield			

Gabby Brunelle/Halberg Fields	5	City of Wakefield	Softball fields, pavilion, restrooms
Indian Statue Deck	---	City of Wakefield	Little league baseball diamonds, tennis courts
Robert Burns Little League Field	---	City of Wakefield	Little league baseball diamond, tennis courts
Southwest Park	---	City of Wakefield	Restroom, boat launch, lighted walking trail
Sunday Lake Camper Park	8	City of Wakefield	Campsites (78), water, sewer & electric hook-up, dump station, restroom/shower, fire rings, and picnic tables
Sunday Lake Eddy Park	42	City of Wakefield	Picnic area, fire rings/grills, tennis courts (2), volleyball court, swimming beach, change house/ restrooms, boat launch and ramp, playground equipment, pavilions (2) with electric hook-up & lights, paved and wooded lighted walking trails
Wakefield-Marenisco School District	---	Wakefield Twp. Schools	Football field, gym, tennis court, baseball field off-site in Marenisco
Bessemer Township			
Blackjack Ski Resort	733	Private	Skiing, 32 km cross country skiing, snowboarding, terrain park
Chaney Lake	575*	MI DNR	Boat launch (large), toilets
Eel Lake	---	USFS	Boat launch (small)
Henry Lake	---	USFS	Boat launch (medium)
Iron Belle Trail (part)	1.8 mi	Gogebic County Road Commission	Multi-use paved trail
Memory Lane Roadside Park	---	State, MDOT	Picnic area, restrooms
Moraine Lake	---	USFS	Boat launch (small)
Ramsay Memorial Park	5	Bessemer Township	Playground, picnic tables, grills, keystone bridge, pavilion with kitchen facilities, fishing
Thrush Lake	---	USFS	Boat launch (medium)
Erwin Township			
ABR Ski Trails	---	Private	35 km skate and classic trails
Black River Lake	69	MI DNR	Boat launch (medium), toilets
McDonald Dam Park	380	Gogebic County Forest	Boat launch (small), dock, campsites (6), toilets
Ironwood Township			
Airport/Skyway Baseball Field	---	Ironwood Township	Baseball and football fields
Airport Soccer Park	---	Ironwood Township	Pavilion, walking trail, soccer fields
Big Powderhorn Mountain	403	Private	Skiing, sleigh rides, 30 km cross-country skiing, ice rink, terrain park

Black River Harbor Park	254	US Forest Service	Lake Superior boat launch (large), swimming, restrooms, campground (40 sites)
Copper Peak Ski Complex	---	Quasi-public	Ski flying/jumping, ski jumping, chalet, chair-lift rides
Curry Park (City Tourist)	9	City of Ironwood	Restrooms, laundry, showers, campground (56 sites), picnic tables, stoves, playground, spill station
Iron Belle Trail (part)	1.1 mi	Gogebic County Road Commission	Multi-use paved trail
Ironwood Township Community Building	---	Ironwood Township	Indoor gym, baseball field, basketball and tennis courts, playground equipment
Lost Lake Park	---	Ironwood Township	Day use, including picnic and fishing
Mount Zion	150	Gogebic Community College	Alpine skiing, snow tubing, snowboarding, cross country skiing, picnic area
Oman Creek	---	MI DNR	Lake Superior boat launch (large), toilets
Pat O'Donnell Civic Center	---	City of Ironwood	Skating, hockey, multipurpose center
Sunset Road Park	---	Ironwood Township	Playground; baseball, basketball, and tennis courts
Wolverine Ski Hill	---	Private	Ski jumping, cross-country skiing, mountain biking
Marenisco Township			
Bobcat Lake Campground	---	U.S. Forest Service	Boat launch (small), swimming, campground (12 sites), toilets
Community Center	---	Marenisco Township	
Dawn Lake	---	USFS	Boat launch (carry-down)
Don McKenzie Memorial Park	5	Marenisco Township	Tennis court, ice rink, skateboard area
Elbow Lake	---	USFS	Boat launch (medium)
Gaylord Lake	---	Private	Public access via private landing
Henry Lake Campground	20	U.S. Forest Service	Boat launch, toilets, campground (11 sites)
Kimberly Field	---	Private-Non-Profit	Softball Field, Playground
Lake Gogebic (East)	14,781*	MI DNR	Boat launch (large)
Lake Gogebic State Park	361	MI DNR	Restrooms, picnicking, hiking, playground, boat launch (large), cross-country skiing, camping (165 sites), swimming, fishing
Langford Lake Campground	10	U.S. Forest Service	Boat launch, fishing, day use,

			toilets, campground (11 sites)
Little Oxbow Lake	---	USFS	Boat launch (small to medium)
Moosehead Lake Campground	---	USFS	Boat launch (medium), toilets, campground (13 sites)
Ormes Lake	---	USFS	Boat launch (medium)
Pomeroy Lake Campground	40	USFS	Boat launch (medium), toilets, campground (13 sites)
Presque Isle River Flowage Dam	---	State, MDOT	Roadside park, picnic area, boat launch (medium), toilets
Redboat Lake	---	USFS	Boat launch (medium)
Shooting Range	---	Village of Marenisco	Firearm, archery activities
Wakefield Township			
Delmar's Campground	---	Private	Playground, recreation bldg., swimming, boat launch, fishing, campground (25 sites)
Indianhead Mountain Resort	363	Private	Tennis courts, sports court, horseback riding, downhill skiing, snowboarding, swimming pool, spa, terrain park
Porcupine Mt. State Park-Presque Isle River	10,560	DNR State Park Division	Backpacking, picnicking, hunting, restrooms, admin bldg., fishing, cross country skiing, campground (88 sites) on Lake Superior
Watersmeet Township			
Allen Lake	---	MI DNR	Boat launch (medium)
Bass Lake	---	Watersmeet Township	Boat launch
Beatons Lake (North)	---	USFS	Boat launch (small to medium)
Beatons Lake (South)	---	USFS	Boat launch (carry-down)
Bond Falls	---	Private/US Forest Service	Picnic sites (40), trail, fishing
Burned Dam Campground	40	US Forest Service	Campground (6 sites), Meximine Falls trail, fishing, toilet
Cisco Lake	506*	MI DNR	Boat launch (large), toilets, accessible
Clearwater Lake	---	MI DNR	Boat launch (medium), toilets
Dinner Lake	110*	MI DNR	Boat launch (medium), toilets
Duck Lake	616*	MI DNR	Boat launch (large), toilets
Grass Lake	---	USFS	Boat launch (carry-down)
Imp Lake Campground	20	US Forest Service	Boat launch, fishing, swimming, toilets, day use campground (22 sites), One-mile accessible trail
Lac Vieux Desert	4,260*	DNR Waterways Division	Boat launch (medium to large), toilets
Lac Vieux Desert Tribe	---		Indoor recreation and community

			center, multi-use event track
Lac Vieux Desert Resort	---		Casino, 18-hole golf course
Little Duck Lake	---	MI DNR	Boat launch (small to medium)
Marion Lake	---	USFS	Boat launch, fishing, day use, toilets, campground (39 sites), swimming
Middle Branch, Ontonagon River	40	DNR Waterways Division	Small boat & canoe launch, fishing
Moon Lake	---	MI DNR	Boat launch (large)
Robert Rigotti Roadside Park	---	State, MDOT	Picnic area, restrooms
Roy Greeman Roadside Park	---	State, MDOT	Picnic area, restrooms
Taylor Lake	---	USFS	Boat launch (small to medium), toilets
Thousand Island Lake	1,079	MI DNR	Boat launch (large), toilets
Township Ball Field	---	Watersmeet Township	Diamond, dugout, bleachers
Sylvania Visitor’s Center	---	U.S. Forest Service Center	Paved interpretive trail, information center, restrooms
Sylvania Wilderness & Recreation Area	18,327	US Forest Service	Boat launches, fishing, day use, toilets, campground (40 sites), backcountry campsites, 26 miles non-motorized trails
Watersmeet Township School District	2	Watersmeet Township	Playground, ball diamond, gym (6 backboards), weight and fitness center
Wilderness Lakes Trail	13 mi	Various; primarily US Forest Service	Multi-use trail between Watersmeet, MI and Land O'Lakes, WI
Wolf Mountain	---	US Forest Service	Trail, overlook

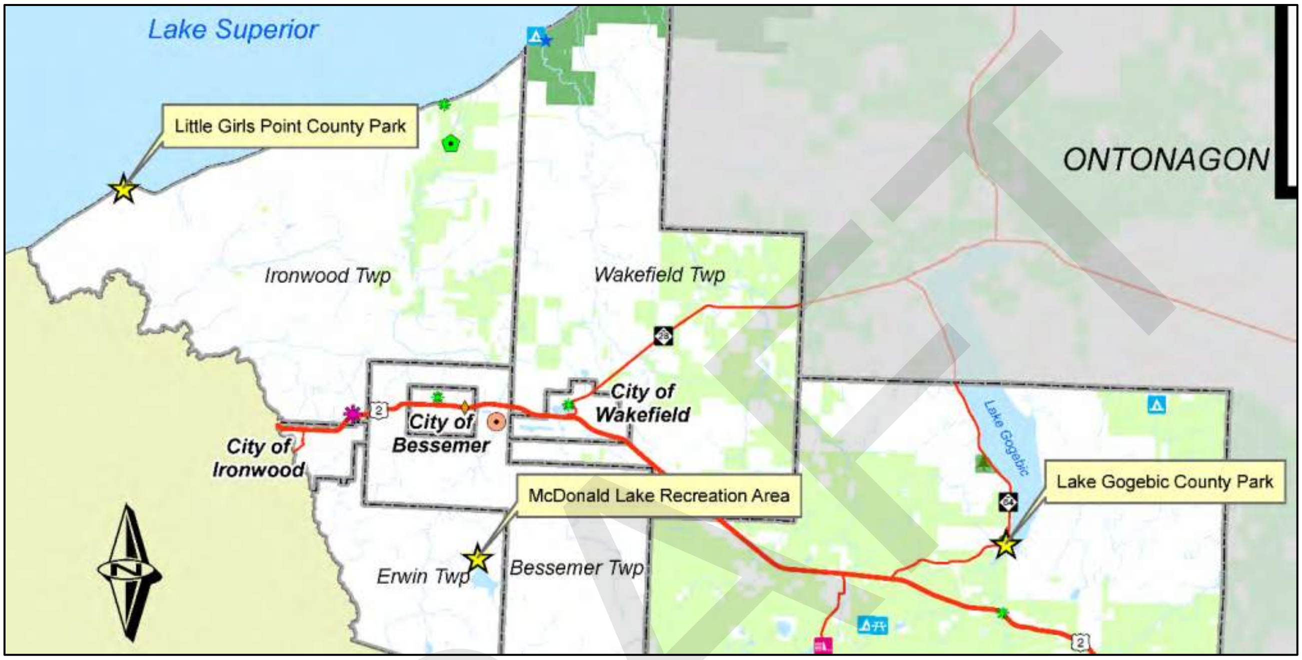
Appendix B:

Recreation Survey Form

Gogebic County Recreation Survey 2017

The Gogebic County Recreation Committee is seeking public input to help plan improvements to County recreation sites over the next five years. The survey can also be completed online **(preferred method)** at: https://www.surveymonkey.com/r/88T3DNV. If you choose to complete this paper version, return it by **October 29, 2017** to the location where you obtained it or to: **WUPPDR, P.O. Box 365, Houghton, MI 49931**

A number of survey questions refer to county-owned recreation sites. These are denoted with stars below:



1. Please indicate your residency status (check **one**):
   - ❍ I am a full-time resident of Gogebic County
   - ❍ I am a seasonal resident of Gogebic County (less than six months/year)
   - ❍ I am not a resident, but I do visit Gogebic County (if so, skip to question #3)
   - ❍ None of the above

2. If you are a resident of Gogebic County, where is your residence (check **one**)?

❍ City of Bessemer	❍ Bessemer Township	❍ Marenisco Township
❍ City of Ironwood	❍ Erwin Township	❍ Wakefield Township
❍ City of Wakefield	❍ Ironwood Township	❍ Watersmeet Township

3. How many persons in your household falls into each of the following age groups:
   ___ 0-5 years ___ 6-12 years ___ 13-19 years ___ 20-39 years ___ 40-64 years ___ 65+ years

4. Does anyone in your household, including you, have a disability or require specialized recreation? Specialized recreation refers to accommodations or modifications made to recreation facilities and equipment in order to remove barriers that prevent individuals with disabilities from using the facilities or equipment.
   ❍ Yes ❍ No (if not, skip to question #6)

5. **If you or someone else in your household has a disability or requires specialized recreation**, please explain:

____

____

6. Does anyone in your household use or take part in any of the following? (Check **ALL** that apply).
   - ❍ Archery
   - ❍ ATV/ORV trails
   - ❍ Backpacking
   - ❍ Baseball fields
   - ❍ Basketball courts
   - ❍ Bicycling (mountain)
   - ❍ Bicycling (path/road)
   - ❍ Boating/canoeing/kayaking
   - ❍ Campgrounds – RV hookups
   - ❍ Campgrounds – no hookups
   - ❍ Camping on isolated sites
   - ❍ Fishing – boat/canoe/kayak
   - ❍ Fishing – shore or wading
   - ❍ Golf
   - ❍ Hiking
   - ❍ Hockey
   - ❍ Horseshoes
   - ❍ Hunting
   - ❍ Ice skating
   - ❍ Picnicking
   - ❍ Playgrounds
   - ❍ Running/jogging
   - ❍ Shooting
   - ❍ Skiing – cross-country
   - ❍ Skiing – downhill
   - ❍ Skijoring
   - ❍ Sledding
   - ❍ Snowboarding
   - ❍ Snowmobiling
   - ❍ Snowshoeing
   - ❍ Soccer
   - ❍ Softball fields
   - ❍ Swimming
   - ❍ Tennis
   - ❍ Volleyball
   - ❍ Other; please specify: ____

7. The following are park improvement projects that may be undertaken by the County in the next five years. Please indicate each potential project's level of importance (to you) using the scale provided where <u>**1** is LEAST IMPORTANT</u> and <u>**5** is MOST IMPORTANT</u>. Leave blank if you have no opinion.

<u>LAKE GOGEBIC COUNTY PARK</u>
(Off Highway M-64 at southern tip of lake)

	Least ←	*Importance*		→	**Most**
Perform major maintenance or replacement of dock	1	2	3	4	5
Install upgraded playground equipment near beach	1	2	3	4	5
Construct new restrooms with flush toilets	1	2	3	4	5
Construct day use pavilion(s) near beach	1	2	3	4	5
Construct kayak launch	1	2	3	4	5
Other: ______________________________	1	2	3	4	5

<u>LITTLE GIRL'S POINT</u>
(On Lake Superior in Ironwood Township)

	Least ←	*Importance*		→	**Most**
Construct new restrooms with flush toilets	1	2	3	4	5
Other: ______________________________	1	2	3	4	5

<u>McDONALD DAM RECREATION AREA</u>
(Erwin Township south of Bessemer)

	Least ←	*Importance*		→	**Most**
Improve tent pads	1	2	3	4	5
Improve road to recreation area	1	2	3	4	5

McDONALD DAM RECREATION AREA (continued)

	Least ← *Importance* →			Most
Improve/perform major maintenance on dam	1	2	3	4	5
Construct kayak launch	1	2	3	4	5
Construct new vault toilet	1	2	3	4	5
Other: ____	1	2	3	4	5

(Note: repair of boat ramp and dock is budgeted for 2018)

POWERS ROAD RECREATION AREA
(Trails throughout western tip of county)

	Least ← *Importance* →			Most
Improve existing multi-use trails	1	2	3	4	5
Upgrade trailhead with gravel	1	2	3	4	5
Develop additional hunter walking trails	1	2	3	4	5
Other: ____	1	2	3	4	5

8. Within the last year, approximately how many days did you or someone from your household use each of the facilities?

	Less than 1	1 to 5	6 to 20	Over 20
Lake Gogebic County Park	❍	❍	❍	❍
Little Girl's Point	❍	❍	❍	❍
McDonald Dam Recreation Area	❍	❍	❍	❍
Powers Road Recreation Area	❍	❍	❍	❍

9. Gogebic County is considering the possibility of acquiring an area of land at the base of Copper Peak, the ski jumping/flying hill north of Bessemer off Black River Road. This would help make the county eligible for DNR grant funding to develop a public plaza. The plaza would be utilized for a variety of events including potential international-level ski flying competition. Do you have any opinion about this project?

____

____

10. Please use the space below to list additional recreation projects you would like to see in Gogebic County, or provide comments/suggestions you think will be for the Gogebic County Recreation Committee:

____

____

Thank you! Your input is important to help identify and prioritize recreation projects throughout the county. Survey results will be included in the draft 2018-2022 Gogebic County Recreation Plan, which will be available for public review in late 2017 or early 2018. Notice of the draft's availability will be publicized at the appropriate time.

Appendix C:

Recreation Survey Press Release

Western Upper Peninsula
Planning & Development Regional Commission

P.O. BOX 365, HOUGHTON, MICHIGAN 49931
906-482-7205 FAX 906-482-9032 ‧ E-MAIL: info@wuppdr.org

News Release

FOR IMMEDIATE RELEASE

Media Contact:
Jerry Wuorenmaa, Executive Director
906.482.7205, ext. 319
jwuorenmaa@wuppdr.org

September 29, 2017

Recreation Survey Available for Gogebic County

Gogebic County is working with the Western Upper Peninsula Planning and Development Region (WUPPDR) to update its five-year recreation plan. In addition to guiding improvements to the county's recreation facilities and sites, the plan will ensure the county is eligible for certain grants from the Michigan Department of Natural Resources (DNR).

Members of the public can have a voice in the planning effort by taking a short survey. ***Online responses are preferred*** and can be provided at https://www.surveymonkey.com/r/88T3DNV. Alternatively, paper copies can be obtained starting October 9 at the Gogebic County Courthouse and Forestry & Parks Department in Bessemer; public libraries in Marenisco, Bessemer, and Wakefield; and township offices of Watersmeet and Erwin.

The survey will be available through **October 29, 2017**. For further information, contact Jerry Wuorenmaa at jwuorenmaa@wuppdr.org or (906) 482-7205 ext. 319.

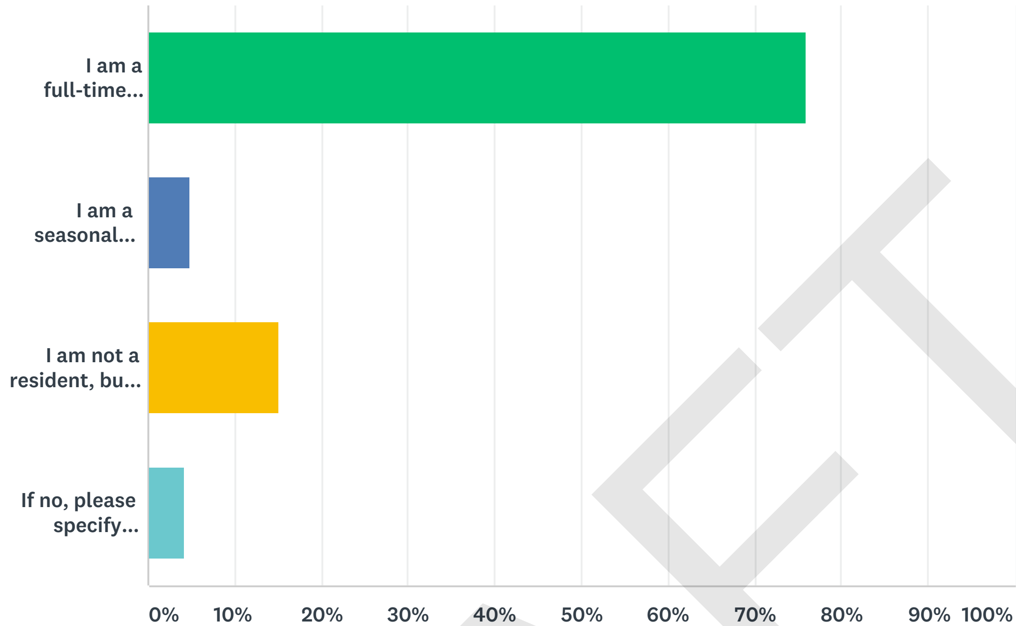
###

Appendix D:

Recreation Survey Results

Q1 Please indicate your residency status:

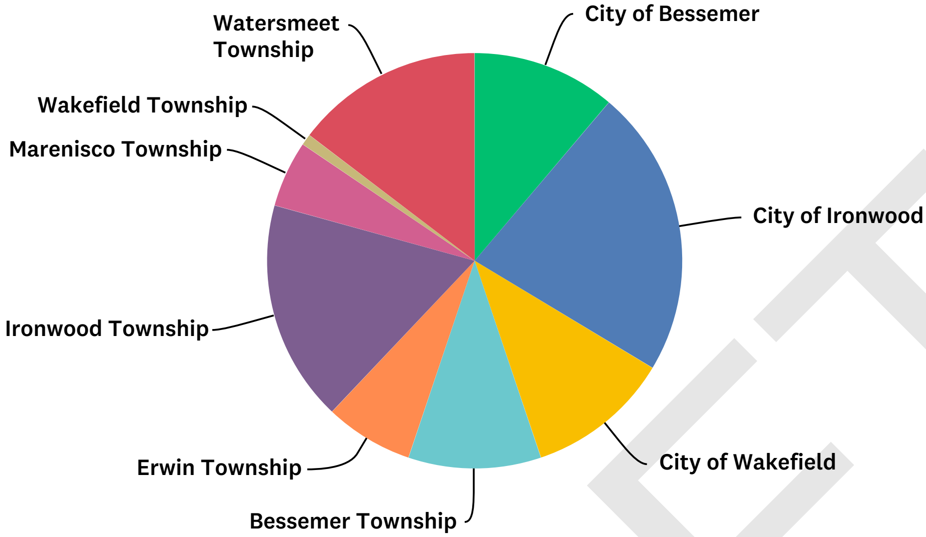
Answered: 146 Skipped: 0



ANSWER CHOICES	RESPONSES	
I am a full-time resident of Gogebic County	76.03%	111
I am a seasonal resident of Gogebic County (less than six months/year)	4.79%	7
I am not a resident, but I do visit Gogebic County (if so, skip to question #3)	15.07%	22
If no, please specify location of residence:	4.11%	6
TOTAL		146

Q2 If you are a resident of Gogebic County, where is your residence.

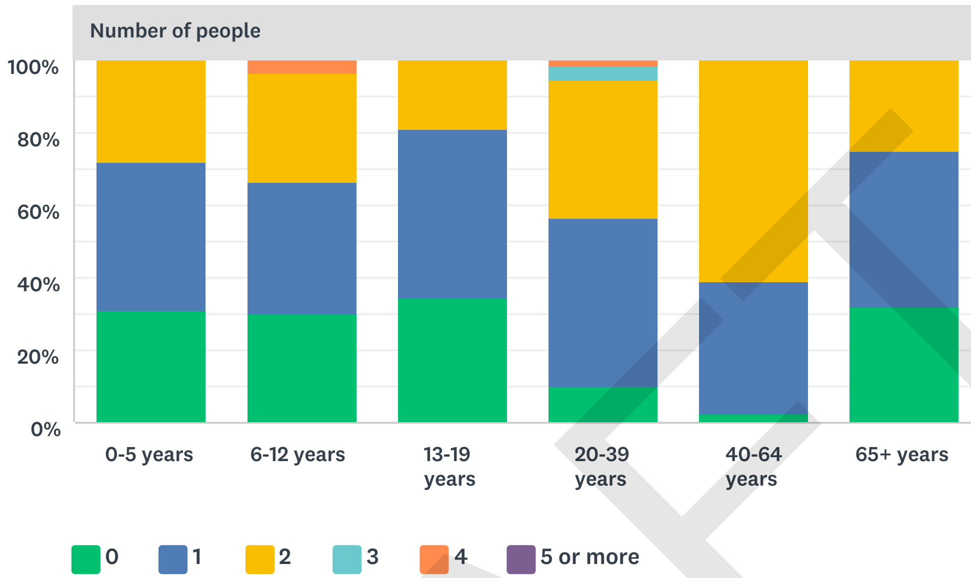
Answered: 116 Skipped: 30



ANSWER CHOICES	RESPONSES	
City of Bessemer	11.21%	13
City of Ironwood	22.41%	26
City of Wakefield	11.21%	13
Bessemer Township	10.34%	12
Erwin Township	6.90%	8
Ironwood Township	17.24%	20
Marenisco Township	5.17%	6
Wakefield Township	0.86%	1
Watersmeet Township	14.66%	17
TOTAL		116

Q3 How many persons in your household falls into each of the following age groups

Answered: 129 Skipped: 17

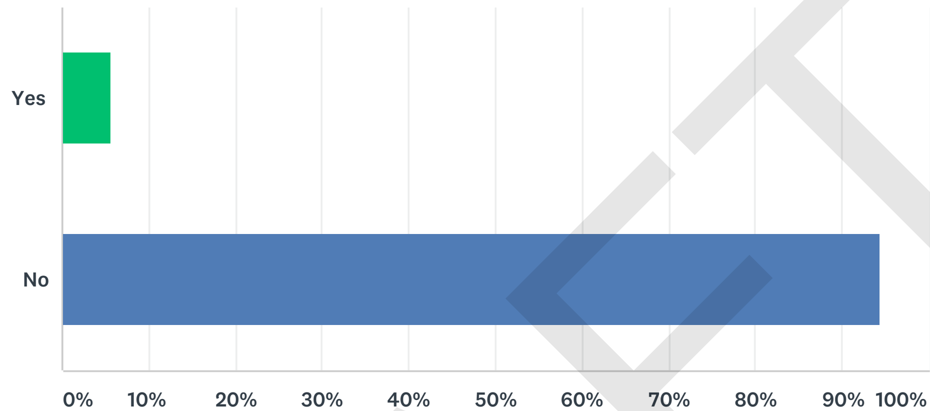


Number of people

	0	1	2	3	4	5 OR MORE	TOTAL
0-5 years	30.77% 12	41.03% 16	28.21% 11	0.00% 0	0.00% 0	0.00% 0	39
6-12 years	30.00% 9	36.67% 11	30.00% 9	0.00% 0	3.33% 1	0.00% 0	30
13-19 years	34.38% 11	46.88% 15	18.75% 6	0.00% 0	0.00% 0	0.00% 0	32
20-39 years	9.86% 7	46.48% 33	38.03% 27	4.23% 3	1.41% 1	0.00% 0	71
40-64 years	2.35% 2	36.47% 31	61.18% 52	0.00% 0	0.00% 0	0.00% 0	85
65+ years	32.14% 9	42.86% 12	25.00% 7	0.00% 0	0.00% 0	0.00% 0	28

Q4 Does anyone in your household, including you, have a disability or require specialized recreation? Specialized recreation refers to accommodations or modifications made to recreation facilities and equipment in order to remove barriers that prevent individuals with disabilities from using the facilities or equipment.

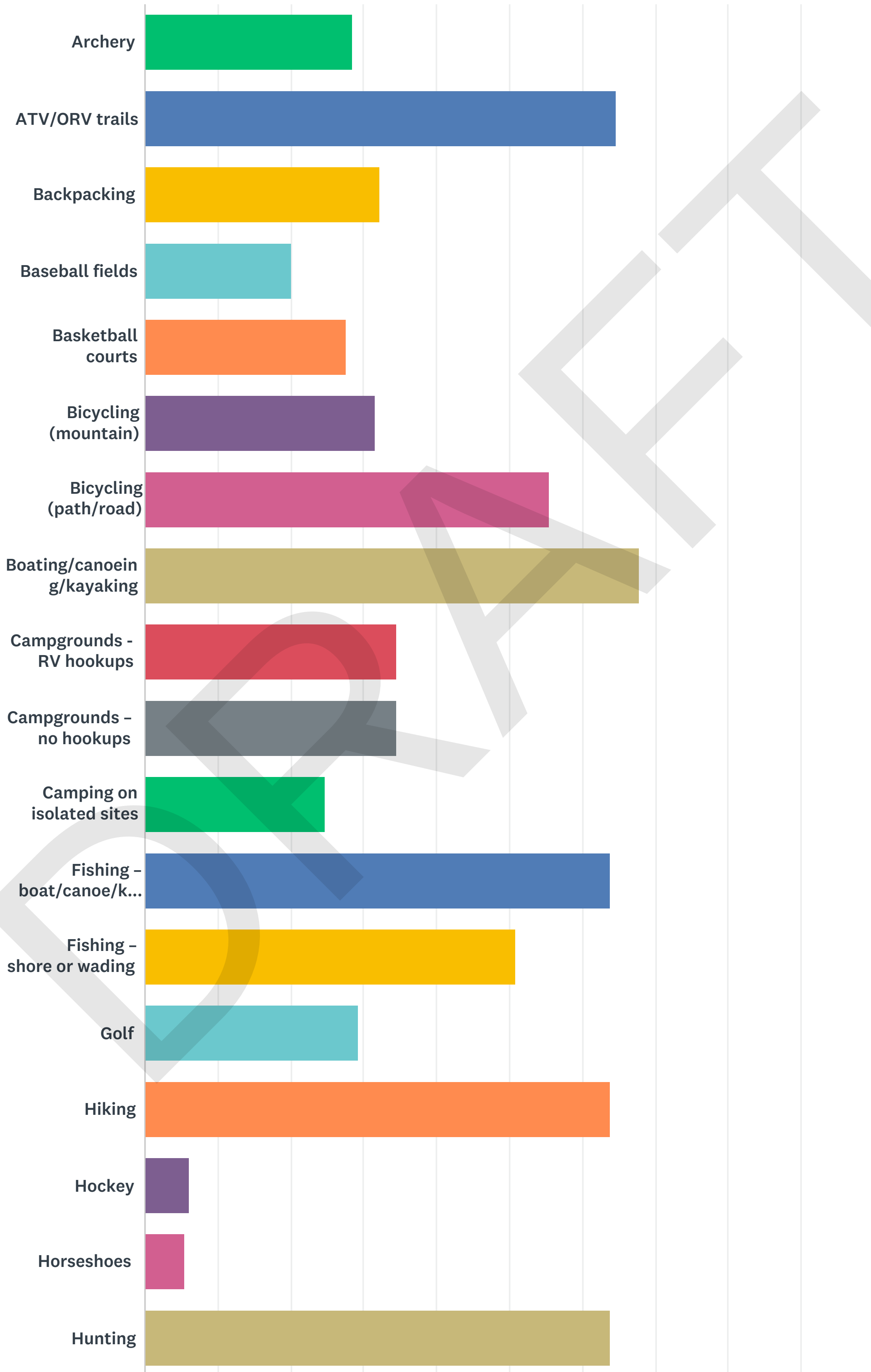
Answered: 142 Skipped: 4

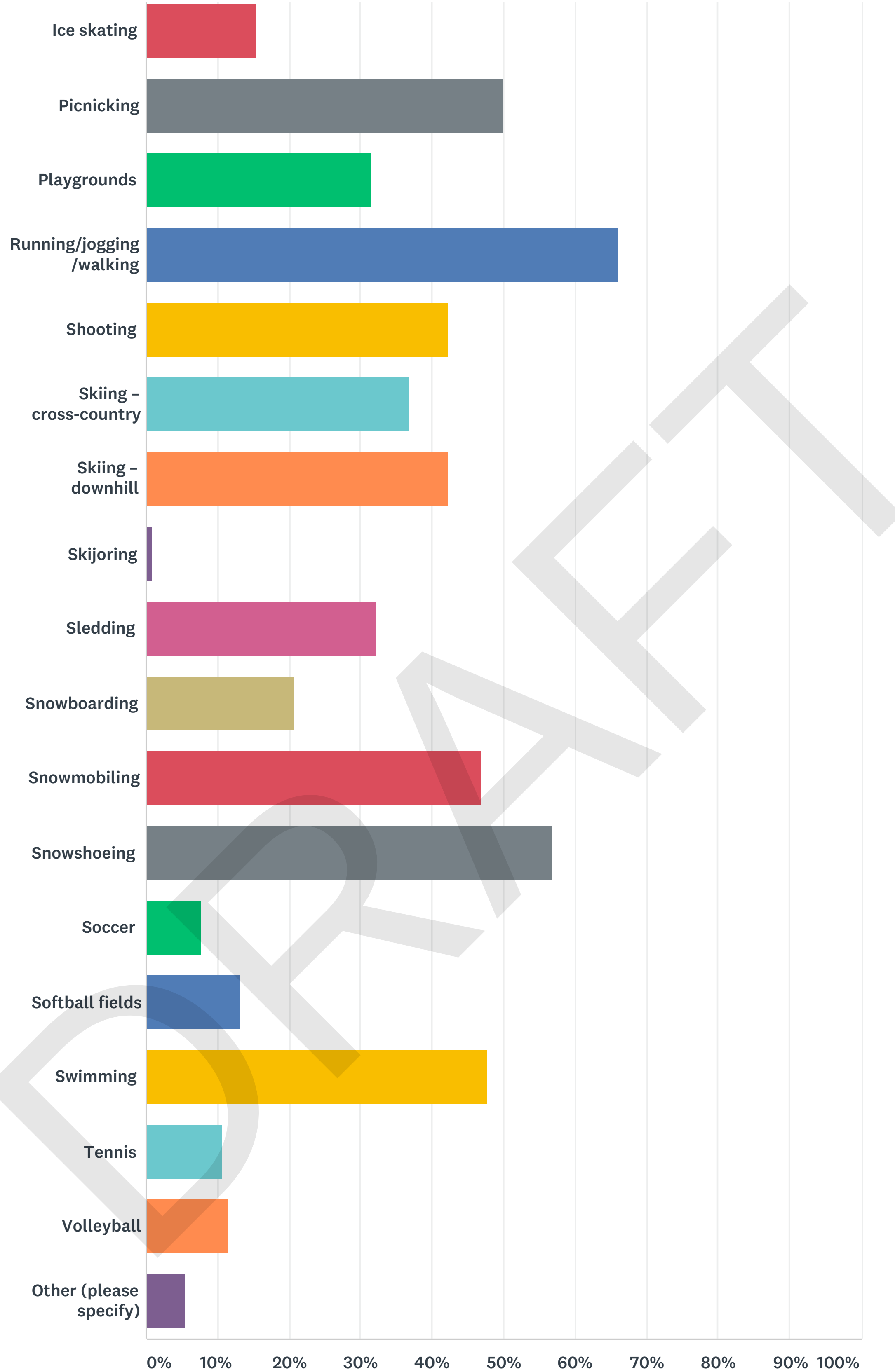


ANSWER CHOICES	RESPONSES	
Yes	5.63%	8
No	94.37%	134
TOTAL		142

Q6 Does anyone in your household use or take part in any of the following? (Check ALL that apply).

Answered: 130 Skipped: 16

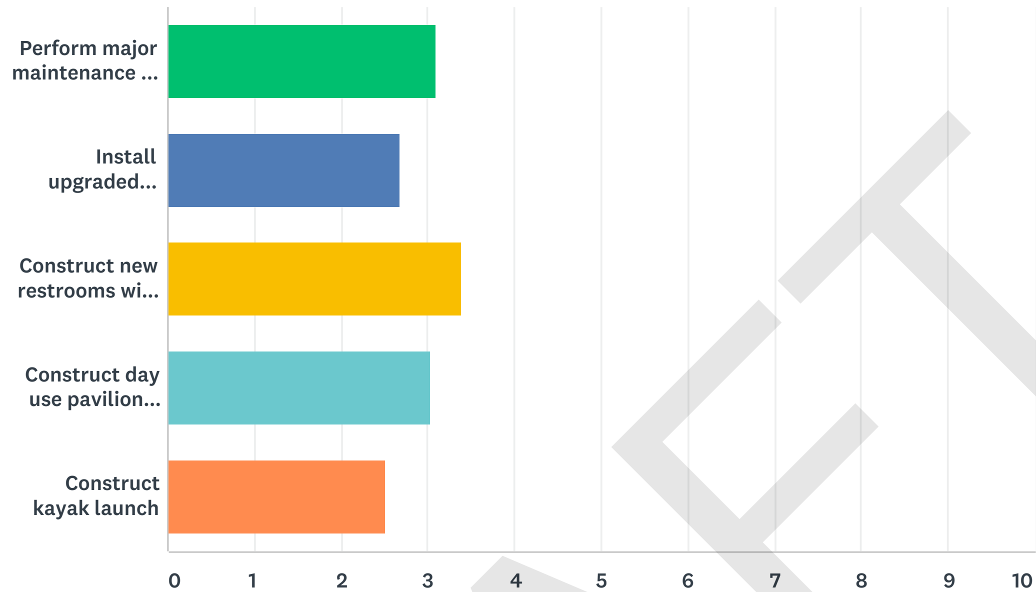




ANSWER CHOICES	RESPONSES	
Archery	28.46%	37
ATV/ORV trails	64.62%	84

Q7 LAKE GOGEBIC COUNTY PARK (off Highway M-64 at southern tip of lake)

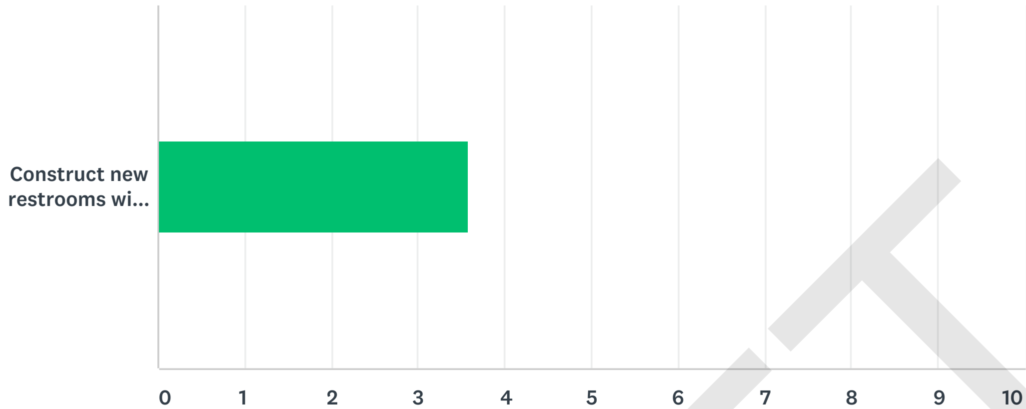
Answered: 125 Skipped: 21



	LEAST IMPORTANT1	2	3	4	MOST IMPORTANT5	TOTAL	WEIGHTED AVERAGE
Perform major maintenance or replacement of docks	16.67% 20	16.67% 20	26.67% 32	20.00% 24	20.00% 24	120	3.10
Install upgraded playground equipment near beach	30.51% 36	19.49% 23	16.95% 20	17.80% 21	15.25% 18	118	2.68
Construct new restrooms with flush toilets	10.74% 13	14.88% 18	23.14% 28	28.10% 34	23.14% 28	121	3.38
Construct day use pavilion(s) near beach	15.70% 19	18.18% 22	26.45% 32	25.62% 31	14.05% 17	121	3.04
Construct kayak launch	33.62% 39	19.83% 23	18.10% 21	18.97% 22	9.48% 11	116	2.51

Q8 LITTLE GIRL'S POINT (on Lake Superior in Ironwood Township)

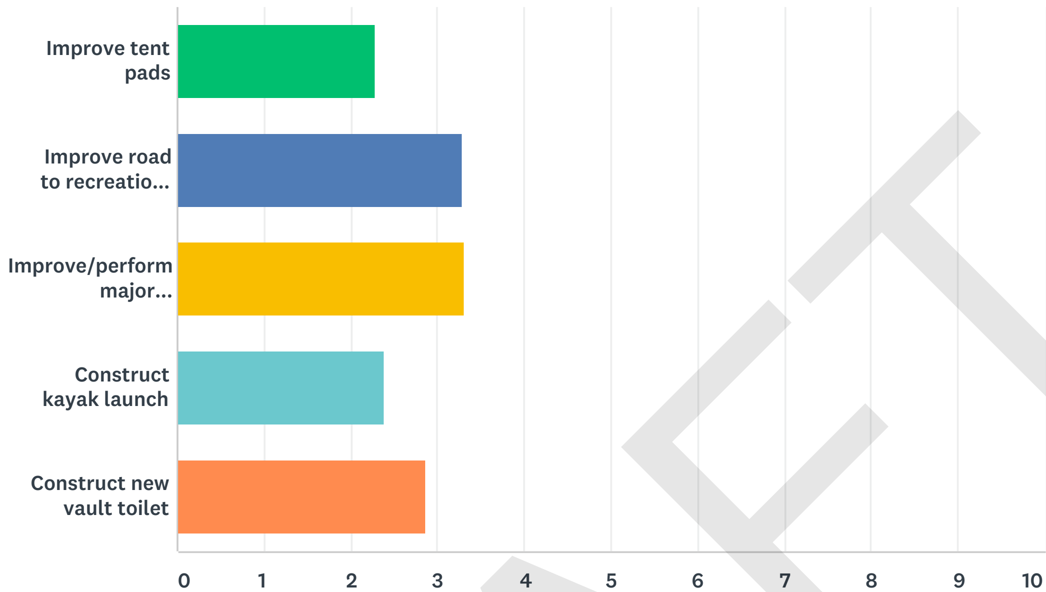
Answered: 128 Skipped: 18



	LEAST IMPORTANT1	2	3	4	MOST IMPORTANT5	TOTAL	WEIGHTED AVERAGE
Construct new restrooms with flush toilets	10.94% 14	11.72% 15	22.66% 29	17.97% 23	36.72% 47	128	3.58

Q9 McDONALD DAM RECREATION AREA (in Erwin Township south of Bessemer)

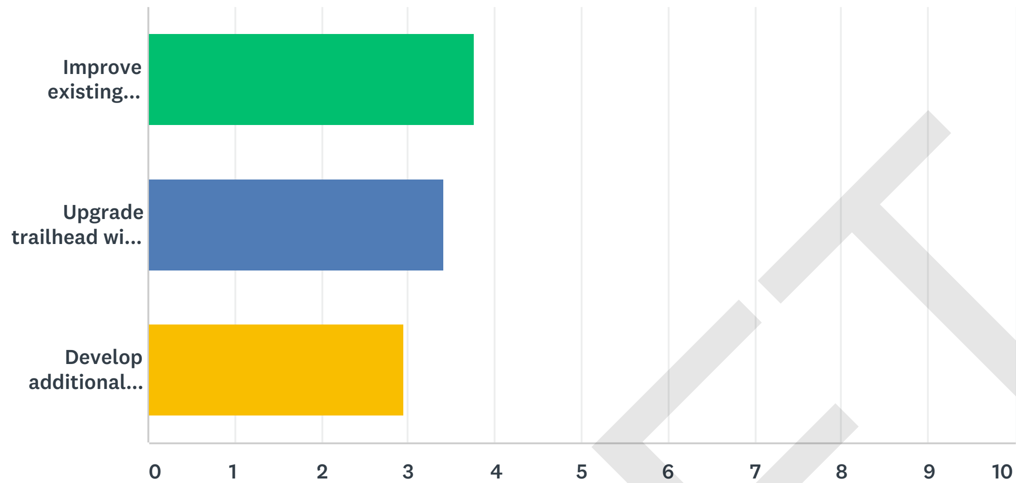
Answered: 124 Skipped: 22



	LEAST IMPORTANT1	2	3	4	MOST IMPORTANT5	TOTAL	WEIGHTED AVERAGE
Improve tent pads	32.14% 36	27.68% 31	23.21% 26	13.39% 15	3.57% 4	112	2.29
Improve road to recreation area	14.66% 17	10.34% 12	25.86% 30	29.31% 34	19.83% 23	116	3.29
Improve/perform major maintenance on dam	13.91% 16	10.43% 12	27.83% 32	26.09% 30	21.74% 25	115	3.31
Construct kayak launch	35.65% 41	18.26% 21	23.48% 27	16.52% 19	6.09% 7	115	2.39
Construct new vault toilet	18.18% 22	19.01% 23	31.40% 38	21.49% 26	9.92% 12	121	2.86

Q10 POWERS ROAD RECREATION AREA (trails throughout western tip of county)

Answered: 119 Skipped: 27



	LEAST IMPORTANT1	2	3	4	MOST IMPORTANT5	TOTAL	WEIGHTED AVERAGE
Improve existing multi-use trails	10.17% 12	4.24% 5	23.73% 28	22.88% 27	38.98% 46	118	3.76
Upgrade trailhead with gravel	10.17% 12	9.32% 11	34.75% 41	21.19% 25	24.58% 29	118	3.41
Develop additional hunter walking trails	20.87% 24	13.04% 15	30.43% 35	20.87% 24	14.78% 17	115	2.96

2017 Gogebic County Recreation Survey

Project Importance Ranking

1.	Powers Road	Improve Existing Trails	3.76
2.	LGP	Restrooms	3.58
3.	Powers Road	Improve Trailhead w/Gravel	3.41
4.	Lake Gogebic	Restrooms	3.38
5.	McDonald Dam	Dam Maintenance	3.31
6.	McDonald Dam	Improve Road	3.29
7.	Lake Gogebic	Dock Maintenance/Replacemt	3.10
8.	Lake Gogebic	Day Use Pavilions	3.04
9.	Powers Road	Addl. Hunter Walking Trails	2.96
10.	McDonald Dam	Vault Toilet	2.86
11.	Lake Gogebic	Playground Equipment	2.68
12.	Lake Gogebic	Kayak Launch	2.51
13.	McDonald Dam	Kayak Launch	2.39
14.	McDonald Dam	Improve Tent Pads	2.29

Project Comments

Lake Gogebic

- Allow horse camping in parks, with rules
- ATV/ORV campgrounds
- Increase seasonal camper rates
- Walking & biking trails

Little Girls Point

- Boat launch: maintain/redesign/keep open
- Equestrian: allow camping, add trails
- Expand parking lot
- More campsites
- Add shower
- Add water fountain

McDonald Dam

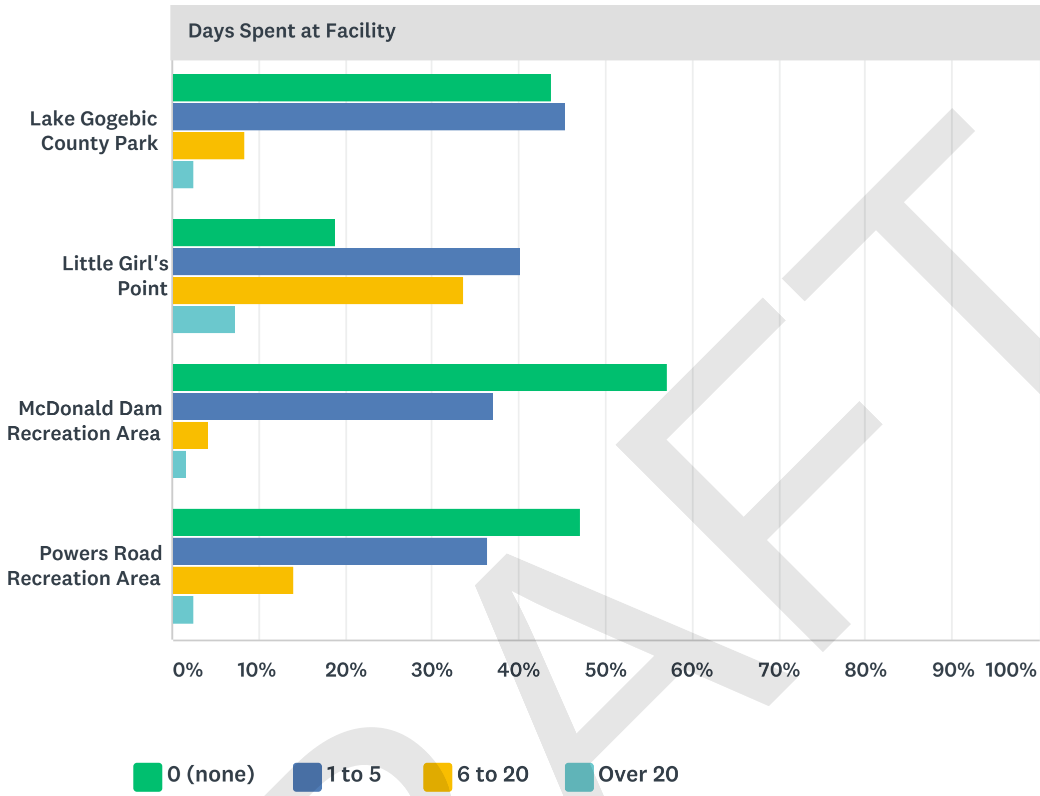
- Raise dam to increase water depth at boat ramp
- Equestrian: expand/create camping area; add trails
- Add trash cans
- New dock & boat launch

Powers Road

- ORV access, trail connections
- Equestrian: expand camping, add trails
- Add trail maps
- Improve non-motorized; add bike trails
- Add rustic campsites at Gorge & Bald Mtn lookouts: GRTA will approach county about helping

Q11 Within the last year, approximately how many days did you (or someone from your household) use each of the facilities?

Answered: 126 Skipped: 20



Days Spent at Facility	0 (NONE)	1 TO 5	6 TO 20	OVER 20	TOTAL
Lake Gogebic County Park	43.80% 53	45.45% 55	8.26% 10	2.48% 3	121
Little Girl's Point	18.85% 23	40.16% 49	33.61% 41	7.38% 9	122
McDonald Dam Recreation Area	57.14% 68	36.97% 44	4.20% 5	1.68% 2	119
Powers Road Recreation Area	47.11% 57	36.36% 44	14.05% 17	2.48% 3	121

Q12 Gogebic County is considering the possibility of acquiring an area of land at the base of Copper Peak, the ski jumping/flying hill north of Bessemer off Black River Road. This would help make the county eligible for DNR grant funding to develop a public plaza . The plaza would be utilized for a variety of events including potential international-level ski flying competition.Do you have any opinion about this project?

Q13 Please use the space below to list additional recreation projects you would like to see in Gogebic County or to provide comments/suggestions you think will be for the Gogebic County Recreation Committee:

Q12 Copper Peak Comments:

- 71 positive
- 24 negative
- 8 mixed, ambivalent, or not applicable

Appendix E:

Public Review Period Press Release

WUPPDR of Michigan

Western Upper Peninsula Planning & Development Regional Commission

P.O. BOX 365, HOUGHTON, MICHIGAN 49931
906-482-7205 FAX 906-482-9032 ' E-MAIL: info@wuppdr.org

News Release

FOR IMMEDIATE RELEASE

Media Contact:
Jerald Wuorenmaa, Executive Director
906.482.7205 ext. 319
jwuorenmaa@wuppdr.org

January 3, 2018

Gogebic County Recreation Plan Available for Review

Gogebic County has released for review and comment a draft of its 2018-2022 Recreation Plan.

The draft will become available Friday, January 5 for public review and comment. A final public hearing for the plan will be scheduled prior to adoption of the plan; noticed will be published accordingly.

The plan will be available for review online at http://www.wuppdr.org and in print at the Gogebic County Forestry and Parks Office, 500 N. Moore St., Bessemer, and at the Ironwood Carnegie Library, 235 E. Aurora St., Ironwood.

Written comments must be received by February 8 and may be e-mailed to Jerry Wuorenmaa at jwuorenmaa@wuppdr.org or mailed to WUPPDR, PO Box 365, Houghton, MI 49931. For more information on the plan or process contact Jerry Wuorenmaa at the addresses above or at (906) 482-7205 ext. 319.

###

Appendix F:

Public Hearing Notice Affidavit

Appendix G:

Forestry and Parks Commission Resolution

Appendix H:

Public Hearing Meeting Minutes

Appendix I:

County Board of Commissioners Resolution

APPENDIX E-44 Wisconsin SCORP

WISCONSIN STATEWIDE COMPREHENSIVE OUTDOOR RECREATION PLAN

(SCORP) 2019-2023

Did You Know?

Wisconsin has received

$81 million

from the federal
Land & Water
Conservation Fund

95% of Wisconsin residents **participate** in some form of **outdoor recreation**

County Forests

are the largest public land holding in Wisconsin

2.4 million acres

Consumer spending on outdoor recreation in Wisconsin totals

$17.9 billion

60% of Wisconsin residents rely on **public lands and waters** mostly or entirely when participating in their **favorite** outdoor activity

Wisconsin's **urban population** has more than tripled in the last 100 years

1910 = 1 million
2010 = 3.5 million

Participation in most nature-based activities declines as people reach middle age

The exception?

Bird and wildlife watching

which peaks around age 65

Wisconsin's **goals** for outdoor recreation:

Boost participation
Grow partnerships
Provide high-quality experiences
Improve data
Enhance funding and financial stability

Wisconsin residents' TOP 5

nature-based outdoor activities

Favorite

Walking, hiking
Fishing
Hunting
Bicycling
Camping

Most frequent participation

Bird/wildlife watching at home
Hiking/walking/running on trails
Picnicking/tailgating/cookout
Visit a beach/beach walking
Swimming in lakes/ponds/rivers

Most needed in their home county

Hiking, walking, or running trails
Bicycling trails
Public shore access to lakes, rivers and streams
Public campsites
Public shooting ranges

2019-2023

Wisconsin

Statewide Comprehensive Outdoor Recreation Plan

Prepared by:

Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921

This document and related appendices are prepared to comply with the Land and Water Conservation Fund Grants Manual produced by the National Park Service, Department of the Interior. The preparation of this plan was financed, in part, through a planning grant from the National Park Service, Department of the Interior, under provisions of the Land and Water Conservation Fund Act of 1965 (Public Law 88-578, as amended).

This publication is available in alternative format (large print, braille, audio tape, etc.) upon request.
Please call 1-888-936-7463 for more information.
You can also view this document on the Web at: **dnr.wi.gov**, keyword "SCORP."

March 2019

Suggested citation:
Wisconsin Department of Natural Resources. 2019. *Wisconsin Statewide Comprehensive Outdoor Recreation Plan 2019 – 2023*. Madison, WI.

ACKNOWLEDGEMENTS

SCORP Advisory Team

Angie Tornes – National Park Service Rivers, Trails and Conservation Assistance

Bridget Monahan - Fort HealthCare

Dave Cieslewicz - Wisconsin Bike Federation

Dave Larson - Wisconsin Conservation Congress

David Spiegelberg - Wisconsin Department of Tourism

Doug Johnson - Governor's State Trails Council

Gretchen Marshall - Wisconsin School Forest Program

Hilary Markin - Chequamegon-Nicolet National Forest

Jane Severt - Wisconsin County Forest Association

Laura Anderson McIntyre - UW-Stevens Point, College of Natural Resources

Mark LaBarbera - Outdoor Heritage Education Center

Michael John Jaeger - Wisconsin Society for Ornithology

Mike Carlson - Gathering Waters

Mike Wollmer - Ice Age Trail Alliance

Paul Heinen - The Nature Conservancy

Steve Brunner - Wisconsin Parks and Recreation Association

Department of Natural Resources

Guidance

Ben Bergey - Parks and Recreation

Terry Bay - Facilities and Lands

Staff

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Beth Norquist - Community Financial Assistance

Bob Holsman - Analysis Services

Brigit Brown - Parks and Recreation

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Jonathon Kult - Facilities and Lands

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Kathryn Gehrke - Parks and Recreation

Nick Zouski - Facilities and Lands

Paul Cunningham - Fisheries Management

Peter Bakken - Forestry

Sadie Derouin - Law Enforcement

Teague Prichard - Forestry

Thomas Meyer - Natural Heritage Conservation

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Layout/Design

Savannah Ernzen - Facilities and Lands

ACRONYMS

4WD	Four wheel drive
ATV	All terrain vehicle
BCPL	Board of Commissioners of Public Land
DNR	Department of Natural Resources
DOT	Department of Transportation
FWS	U.S. Fish & Wildlife Service
GOMESA	Gulf of Mexico Energy Security Act
LWCF	Land and Water Conservation Fund
NPS	National Park Service
OPSP	Open Project Selection Process
ROA	Recreation Opportunities Analysis
SCORP	Statewide Comprehensive Outdoor Recreation Plan
UTV	Utility task/terrain vehicle (aka, side-by-side)

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FOREWORD

Dear Fellow Wisconsinites:

I am pleased to present Wisconsin's 2019-2023 Statewide Comprehensive Outdoor Recreation Plan. This document will provide you with updated information on the status of Wisconsin's outdoor recreation. This plan also provides guidance for distributing money through the Land and Water Conservation Fund and other grant programs administered by the Department of Natural Resources that support outdoor recreation projects on state properties and in local communities throughout the state.

High-quality outdoor recreation experiences available in Wisconsin contribute to our exceptional quality of life, reflected in sustained economic growth and in outdoor recreation traditions passed down through generations. From city riverwalks to expansive public forests, public recreation lands and facilities enhance our lives, draw millions of visitors, and support businesses large and small. The economic, social, and health benefits of outdoor recreation in Wisconsin far exceed our investment.

Thanks to the vision, economic investments and dedication of earlier generations, the portfolio of outdoor recreation opportunities in our state is unrivaled. From the Brule River to Chiwaukee Prairie, we are blessed with beautiful places to enjoy the outdoors in a plethora of ways. Yet, there are many ways and many opportunities to continue enhancing the recreation offerings throughout Wisconsin and to grow our recreation-based economy.

I'd like to thank all those who answered a survey, attended a public meeting or sent in comments during the development of the plan. The information, ideas and suggestions you provided are integral to the success of this SCORP. I also want to extend my appreciation and recognition for the work, wisdom and counsel of the SCORP Advisory Team. Their collective passion for the outdoors and desire to enhance the recreation opportunities in Wisconsin weaves through these pages.

Many agencies and organizations are involved in shaping outdoor recreation in the state. City, village and county park programs, federal agencies, conservation groups and recreation clubs, chambers of commerce, foresters and biologists, health care providers and countless others all play a role. The Department of Natural Resources is committed to working with agencies, local governments, businesses, organizations, and private citizens to expand and modernize outdoor recreation programs and facilities to serve changing public outdoor recreation preferences.

My hope is that the information presented in this report encourages people and groups to continue cooperatively growing our recreation infrastructure and enhancing opportunities for all our residents – and generations to come – to enjoy Wisconsin's great outdoors.

Preston D. Cole
Secretary, Department of Natural Resources

Photo: Linda Freshwater Arndt

Priorities for **LWCF grants** in Wisconsin include projects that:

- Meet the needs of urban areas.
- Provide recreation opportunities that serve diverse populations.
- Develop facilities in areas with limited outdoor recreation opportunities.
- Provide multi-use facilities.
- Meet outdoor recreation needs identified by local communities.

5 This plan lays out **five** overarching goals for outdoor recreation.

1. Boost participation in outdoor recreation

2. Grow partnerships

3. Provide high-quality experiences

4. Improve data to enhance visitor experiences and benefits

5. Enhance funding and financial stability

EXECUTIVE SUMMARY

This document comprises the 2019-2023 iteration of the Wisconsin Statewide Comprehensive Outdoor Recreation Plan (SCORP). The plan provides recommendations to guide public outdoor recreation policy and planning decisions, the use of Land and Water Conservation Fund money that comes to Wisconsin, and other Department of Natural Resources (DNR) administered grant programs.

To support the development of SCORP, a statewide survey of Wisconsin residents was conducted regarding their outdoor recreation participation and frequency, as well as their opinions about future needs. In addition, the DNR undertook an assessment of recreation opportunities and needs in each region of the state. Together, these supporting documents (Appendix 6 and Appendix 8) provide the foundation of the SCORP.

Remarkably, although maybe unsurprisingly, an estimated 95% of Wisconsin adults participated in some type of outdoor recreation in the past year. Activities in which residents most frequently engaged tend to be those that require little preparation or travel time and can provide a high-quality experience in a limited amount of time. Examples include hiking and walking on trails, fishing, bicycling, dog walking, and bird/wildlife watching.

Although this SCORP provides some basic information on a wide variety of outdoor activities, the focus is on those activities that are related to natural resources and where experiences are enhanced with higher quality natural habitats. In this document, these are referred to as nature-based recreation activities.

Top priority needs include providing more places near urban centers to support a variety of nature-based recreation. Of particular note is the demand for more trails (both non-motorized and motorized) and water and shore access for fishing, boating and swimming.

Our effectiveness in meeting future recreation needs will be shaped by many factors including the shifting demographics of our population, the quality of habitats and the impacts from invasive species and changing climate conditions, our ability to improve the compatibility between and among recreation participants, and sustainable financial resources.

Parks and nature preserves, wildlife areas and refuges, and forests and trails connect people to the natural environment. These places, from small neighborhood parks to the large national, state and county forests, are the stages on which we enjoy the outdoors, improve our health, protect our air and water, and provide a large economic boost, particularly to our rural areas.

This document presents the "who, what, where, when, why, and how" of outdoor recreation in Wisconsin.

This SCORP is designed to both provide a broad overview of issues affecting nature-based recreation as well as include information, much of which is in the appendices, that the public and decision-makers can use in evaluating local and regional needs and opportunities.

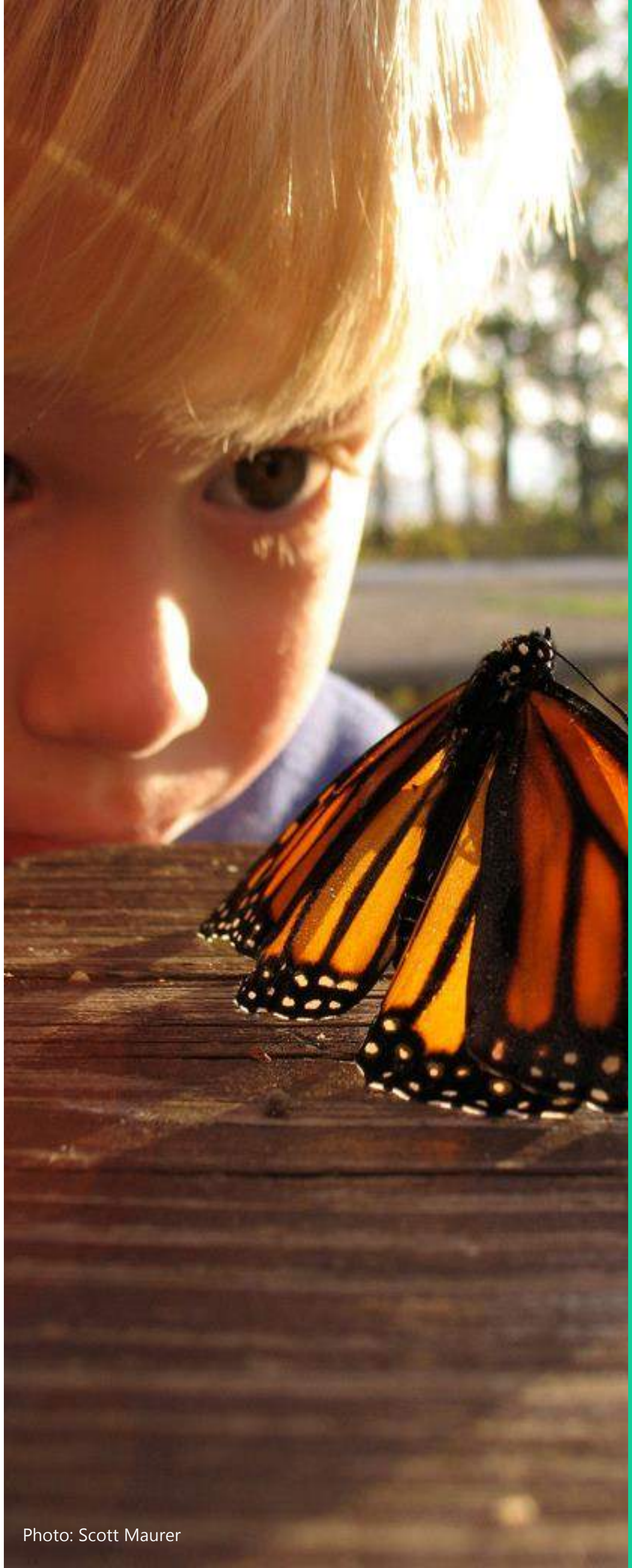
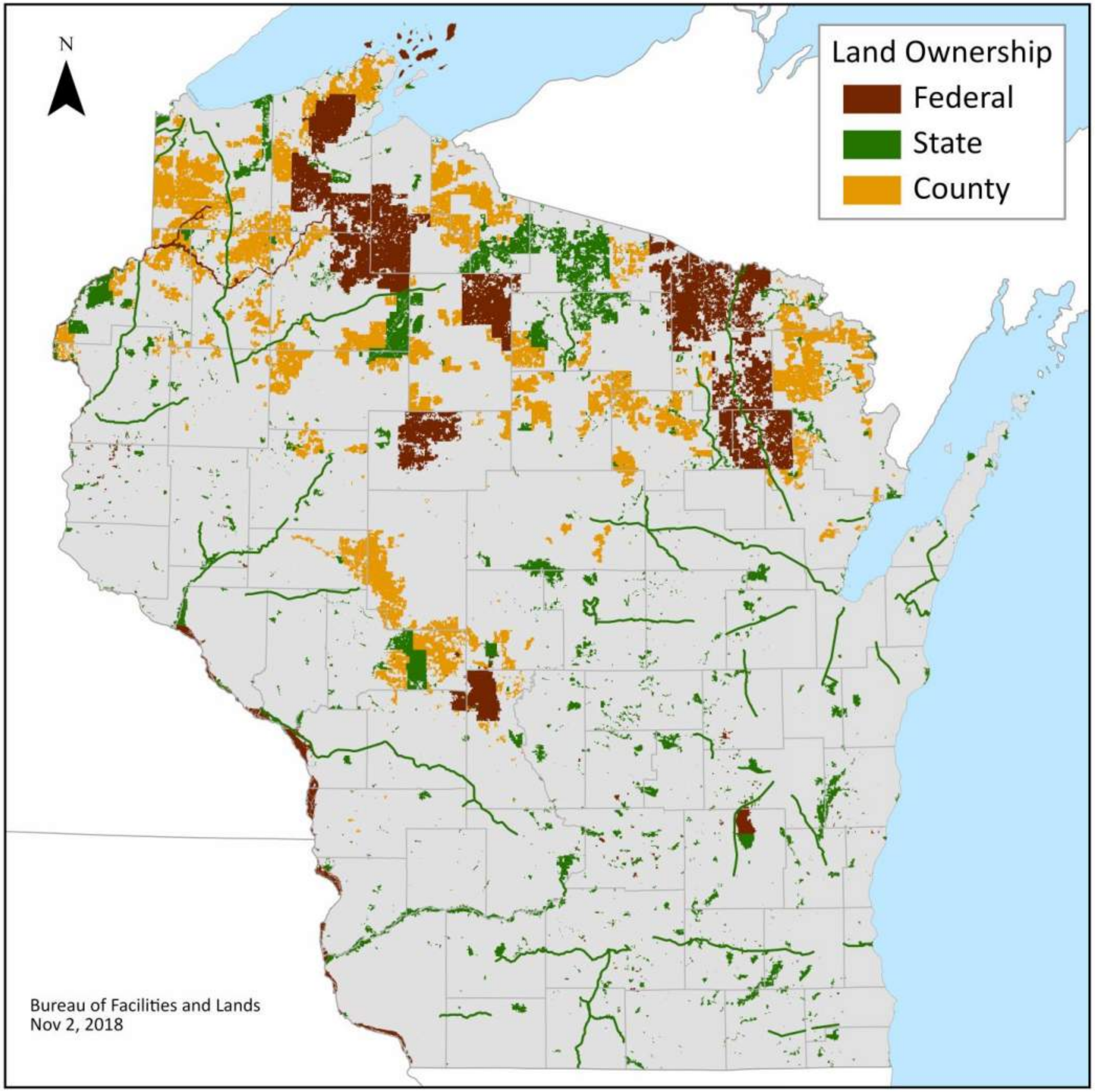
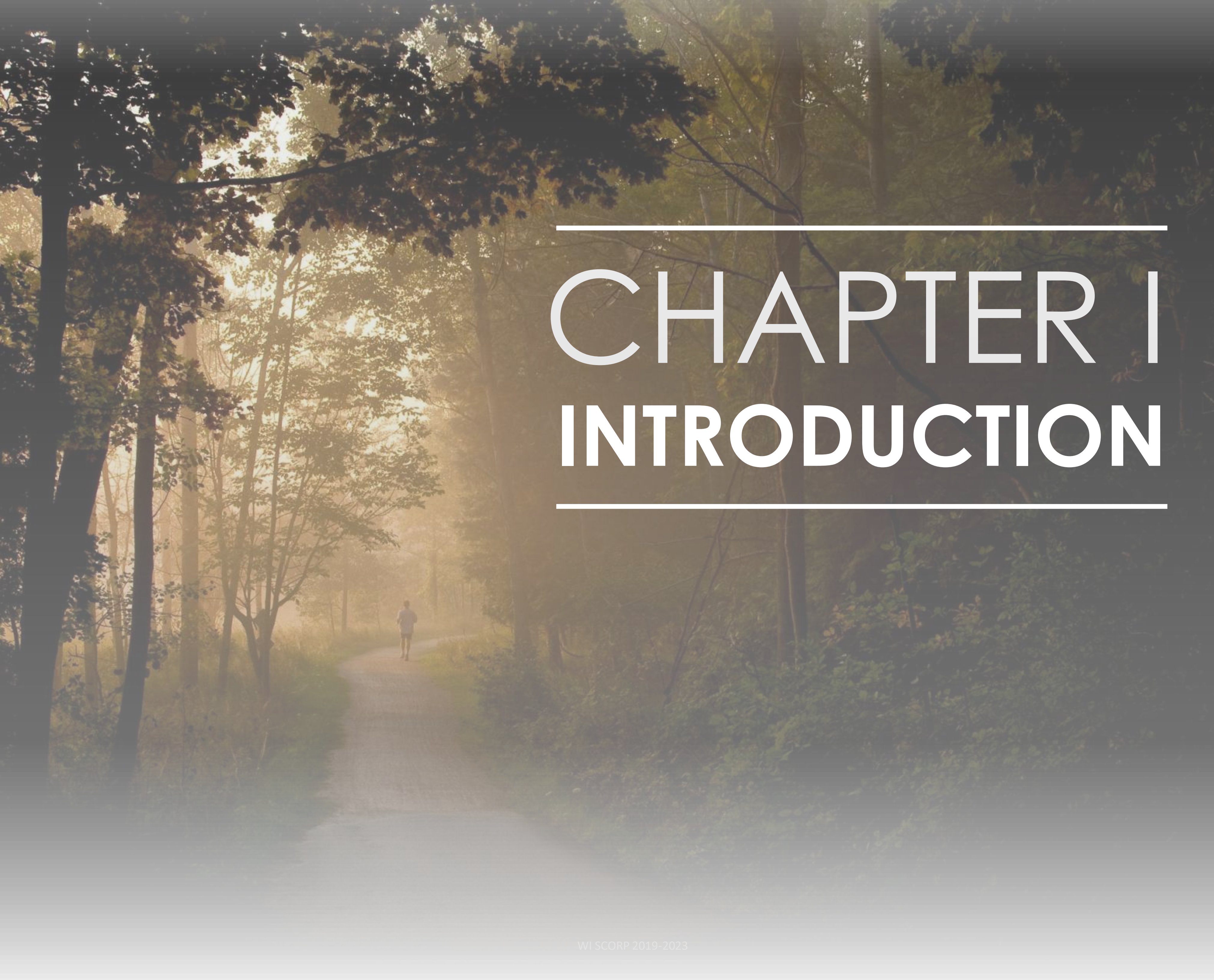


Photo: Scott Maurer

Figure 1: Public lands in Wisconsin



*See **Appendix 3** for maps of public lands by region*



CHAPTER I
INTRODUCTION


Photo: Tom Davenport


Photo: Liz Herzmann


Photo: Dixie Brumm


Photo: Greg Sanderson


Photo: Greg Sanderson

"Outdoor Recreation Activities"
include all 58 activities that were included in the survey of Wisconsin residents' recreation participation. See Appendix 6.

"Nature-Based Activities"
include a subset of 40 of these "outdoor recreation activities" that require or occur in natural habitats or settings. See Table 1.

BACKGROUND

Wisconsin's economy and the exceptional quality of life our residents enjoy are intertwined with our abundant and rich natural resource base. From deep forests to Great Lake shorelines, from urban trails to secluded campsites, Wisconsinites have unparalleled opportunities to enjoy the outdoors. Whether motivated by the desire to relax, exercise, or be with friends and families, Wisconsinites participate in outdoor recreation with an uncommon passion.

For many citizens, what makes our state special is directly tied to the good times we have at our favorite places to camp, hunt, walk, ride snowmobiles or ATVs, bike, fish, or simply enjoy the peace and quiet of a natural setting.

Public conservation lands in Wisconsin protect some of the state's most notable, scenic and cherished places. Although these places collectively meet many recreation demands, numerous other places – from school forests to land trust preserves to local parks – also play critical roles in providing high quality recreation opportunities to residents and out-of-state visitors.

On behalf of the State of Wisconsin, the Department of Natural Resources has developed this SCORP with the help of many partners and the public. This document brings together a variety of information on the outdoor recreation opportunities in Wisconsin and lays out goals and priorities for the future. What that future ultimately becomes will depend on the collective effort of elected officials, public agencies, private organizations and, most importantly, residents.

Some types of outdoor recreation, notably ball sports, occur on athletic fields and sport courts provided by local units of government. LWCF grants in Wisconsin fund a wide variety of outdoor facilities important to local communities, including athletic fields. Participation in many of these activities varies considerably across the state making their inclusion in a statewide plan difficult.

Other types of recreation take place outdoors but aren't related to natural resources (e.g., walking on sidewalks or roads, driving for pleasure, attending an outdoor music festival). Consistent with past SCORP efforts, many of these activities were included in the survey of state residents' participation in outdoor recreation.

Although this SCORP addresses all types of recreation that occur outdoors (as required by federal legislation), its focus is on "nature-based recreation" activities that are typically provided at larger public lands and require or occur in natural habitats or settings (see Table 1).

> ***NOTE:*** *the term "nature-based" is used in other policies, codes and laws. Its use here in SCORP* ***only applies to this document*** *and* *<u>does not influence or affect use of the term in other contexts</u>.*

Table 1: Nature-based activities for this SCORP

- Bicycling – rail-trails, mt. biking, fat-tire/snow biking
- Bird/wildlife watching - at home & away from home
- Camping – tent, RV/pop-up
- Canoeing/kayaking
- Cross-country skiing
- Downhill skiing/snowboarding
- Driving 4-WD vehicles on trails/routes
- Fishing – lake, stream, river
- Gathering berries, mushrooms, etc.
- Geocaching
- Hiking/walking/running on trails
- Horseback riding on trails
- Hunting – big & small game, turkey, migratory bird
- Ice skating
- Motor boating
- Nature photography
- Personal water craft riding
- Picnicking/tailgating/cookout
- Riding ATVs/UTVs on trails/routes
- Riding motorcycles on trails/routes
- Sailing
- Snowmobiling
- Snowshoeing
- Stand-up paddle boarding
- Swimming – lakes/rivers/ponds
- Target shooting – firearms, archery
- Trapping
- Visiting a nature center
- Visiting a beach/beach walking
- Visiting a dog park
- Walking/running dogs on trails
- Waterskiing/tubing/wakeboarding

PURPOSE OF SCORP

The SCORP provides data related to the supply and demand for outdoor recreation in Wisconsin that can help inform local and state-level recreation decision making.

The objectives of this SCORP are to:

- Provide an analysis of outdoor recreation supply and demand.
- Provide information and context that is useful to counties, local units of government, organizations, Native American Nations, and others as they develop plans and policies for recreation opportunities in their communities.
- Ensure Wisconsin's continued eligibility for National Park Service LWCF state-side grants.
- Establish priorities for LWCF grants and guidance for other applicable state and federal funds.

The DNR will use the SCORP to help guide decisions related to recreation, including land acquisition, property management and development of facilities.

States are required to complete SCORPs every five years to be eligible to participate in the Land and Water Conservation Fund (LWCF) State Assistance Program. SCORPs are intended to evaluate outdoor recreation trends and issues of statewide importance and set forth ideas about recreation's future role in the state. There are several required elements for SCORPs, including identifying priorities for use of LWCF grants. Of the many important issues related to outdoor recreation in Wisconsin, the SCORP highlights the areas of greatest need, thus providing a framework for evaluating LWCF grants.

Towns, villages, cities, counties, tribal governments, school districts and other state political subdivisions are eligible to apply for LWCF grants for acquisition or development of public outdoor recreation areas and facilities. Of course, these government entities best understand their citizens' needs, as well as the opportunities to leverage their local resources and assets. As such, the focus of this SCORP is on providing a range of information, at the county level where possible, to help the public and their elected officials place local conditions, needs, and opportunities into a broader framework.

While this SCORP brings together a range of information on outdoor recreation in Wisconsin, it is not intended to provide guidance at a site or project level, nor does it attempt to address all outdoor recreation issues. Rather, the SCORP identifies general outdoor recreation participation patterns, trends, issues and opportunities, and provides recommendations for future steps.

Collaborative planning at local and regional scales along with cooperative implementation of policies and programs by governments, businesses, health care providers, community organizations, and others will continue to be essential in achieving the priorities described in the SCORP.

SCORP REQUIREMENTS

The National Park Service identifies five components required in all Statewide Comprehensive Outdoor Recreation Plans. Table 2 lists where the required elements can be found in this SCORP.

Table 2: Required SCORP components and their location in the SCORP

Component	Requirement Description	Location
Process & Methodology	The plan must describe the process and methodology(s) used by the State to develop the SCORP and meet LWCF program guidelines.	Page 13
Public Participation	The planning process must include ample opportunity for public participation involving all segments of the state's population.	Page 13 Appendix 6 Appendix 8
Comprehensive Information	The plan must: 1) Identify outdoor recreation issues of statewide importance; 2) Evaluate public outdoor recreation demands; and 3) Evaluate available outdoor recreation resources.	Chapter 2 Appendix 6 Appendix 4 Appendix 8
Implementation Program	The plan must have an implementation program of sufficient detail for use in developing project selection criteria for the State's Open Project Selection Process (OPSP).	Page 56 Appendix 9 Appendix 10
Section 303 Compliance	The plan must contain a wetlands priority component consistent with Section 303 of the Emergency Wetlands Resources Act of 1986, including the following: 1) Be consistent with the National Wetlands Priority Conservation Plan, prepared by the U.S. Fish and Wildlife Service; 2) Provide evidence of consultation with the state agency responsible for fish and wildlife resources; 3) Contain a listing of those wetland types which should receive priority for acquisition; and 4) Consider outdoor recreation opportunities associated with its wetlands resources for meeting the State's public outdoor recreation needs.	Appendix 1

Photo: Judy Klippel

LAND AND WATER CONSERVATION FUND

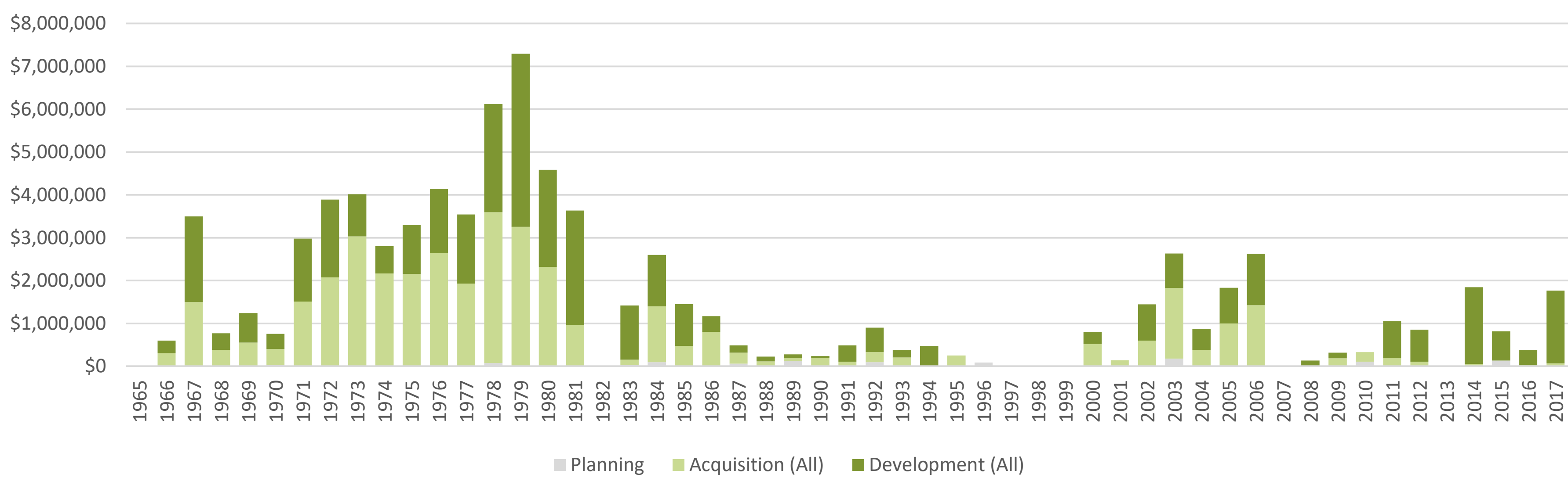
> ***Did You Know?***
>
> Since 1965, Wisconsin has received **$81 million** from the Land & Water Conservation Fund to support recreation projects throughout the state.

Background

The Land and Water Conservation Fund Act (LWCF) was enacted by Congress in 1965 "to strengthen the health and vitality of the citizens of the United States" through outdoor recreation. A portion of the LWCF supports development of outdoor recreation opportunities in national parks and other federal lands and a portion is passed to states for projects on state, tribal, and local properties. A related federal program is the Gulf of Mexico Energy Security Act (GOMESA), which was passed in 2006. States have flexibility to determine how to use these funds, either on state properties or as pass-through to eligible grant recipients (local governments, school districts, and Native American Nations).

The National Park Service (NPS) administers the program at the federal level. Each state designates an agency responsible for administering the program in partnership with NPS. In Wisconsin, the LWCF program is administered by DNR. In the associated figures presented here, the LWCF and GOMESA funds are combined.

Figure 2: LWCF grants to Wisconsin



Funding

The LWCF is funded through lease and production fees paid to the federal government by energy companies operating in federal waters. The total LWCF appropriation is set annually by Congress. Funds are allocated to all U.S. states and territories via a formula that incorporates population and proximity to leased lands in the Gulf of Mexico. Annual LWCF and GOMESA appropriations have varied dramatically over the years, largely due to fluctuations in oil and gas activity and competing Congressional priorities. Wisconsin's allocations from these funds have varied considerably over the years (Figure 2). In FY2019, Wisconsin received $2.9 million, a significant increase in funding that was due to a change in the GOMESA formula.

LWCF and GOMESA support a wide variety of public outdoor recreation projects. Grant recipients are required to provide a minimum of 50% non-federal matching funds. Projects proposed for LWCF grants must be selected through an open project selection process, which is designed to ensure that available funds are used to address priority outdoor recreation needs at the state and local level. Unique to Wisconsin, the LWCF also supports acquisition and development projects that expand the Ice Age National Scenic Trail and North Country National Scenic Trail.

LWCF Impact in Wisconsin

LWCF grants have touched communities in every one of Wisconsin's 72 counties (see Table 3 – pg. 12). Over 1,800 state and local projects have received LWCF support, leveraging more than $81 million in federal funds. Since the program began, 72% of LWCF projects in Wisconsin have been implemented by local communities, 27% by DNR, and the remaining 1% by the Wisconsin Department of Transportation and Tribal governments. In early years of the program (1960s and 1970s), LWCF grants were used about evenly between land acquisition and development projects (Figure 3). This balance has shifted over time in favor of development projects. In the past 10 years, nearly 90% of LWCF dollars spent in Wisconsin supported a development project in a state or local park.

LWCF grants have supported a wide diversity of recreation facilities including trails, picnic shelters, and athletic fields as well as facilities such as splash pads, dog parks and skateparks. LWCF is a key funding resource for local governments, as it is the only grant program administered by the DNR that funds development of active recreation facilities.

Figure 3: LWCF grant use in Wisconsin

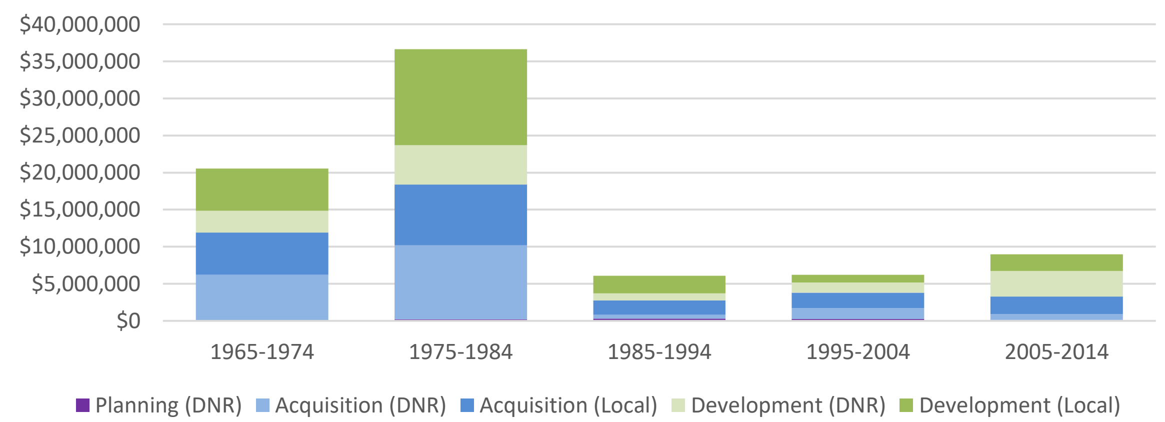


Table 3: LWCF grants by county, 1965 to 2017

County	Total Grant Awards	# Projects
ADAMS	$116,777	5
ASHLAND	$271,775	11
BARRON	$404,834	14
BAYFIELD	$378,527	21
BROWN	$2,473,758	59
BUFFALO	$142,871	20
BURNETT	$403,144	21
CALUMET	$617,628	25
CHIPPEWA	$2,648,342	42
CLARK	$285,242	12
COLUMBIA	$412,507	19
CRAWFORD	$1,261,435	10
DANE	$7,991,977	121
DODGE	$821,513	31
DOOR	$3,907,803	43
DOUGLAS	$691,357	24
DUNN	$429,381	20
EAU CLAIRE	$1,254,062	37
FLORENCE	$136,911	5
FOND DU LAC	$584,970	29
FOREST	$148,643	7
GRANT	$1,251,766	34
GREEN	$252,496	12
GREEN LAKE	$130,912	12
IOWA	$937,708	19
IRON	$354,284	9
JACKSON	$419,232	14
JEFFERSON	$230,296	18
JUNEAU	$953,072	22
KENOSHA	$3,289,116	23
KEWAUNEE	$282,454	11
LA CROSSE	$636,281	30
LAFAYETTE	$429,494	15
LANGLADE	$2,472,965	15
LINCOLN	$126,406	6
MANITOWOC	$1,199,544	47
MARATHON	$515,672	27
MARINETTE	$1,269,858	23
MARQUETTE	$283,834	9
MENOMINEE	$6,893	1
MILWAUKEE	$3,476,761	44
MONROE	$295,229	20
OCONTO	$158,013	9
ONEIDA	$921,486	26
OUTAGAMIE	$954,018	39
OZAUKEE	$395,554	15
PEPIN	$72,150	8
PIERCE	$1,034,941	21
POLK	$2,068,979	29
PORTAGE	$1,734,602	31
PRICE	$25,053	3
RACINE	$1,420,556	24
RICHLAND	$118,157	9
ROCK	$763,578	24
RUSK	$133,956	8
SAUK	$4,066,862	72
SAWYER	$471,893	17
SHAWANO	$766,796	31
SHEBOYGAN	$1,053,706	31
ST. CROIX	$1,993,784	38
TAYLOR	$184,632	7
TREMPEALEAU	$395,494	22
VERNON	$454,910	12
VILAS	$462,214	28
WALWORTH	$1,185,262	23
WASHBURN	$513,144	6
WASHINGTON	$1,443,211	37
WAUKESHA	$3,674,591	56
WAUPACA	$677,432	28
WAUSHARA	$147,150	15
WINNEBAGO	$1,824,796	43
WOOD	$537,189	24

PUBLIC PARTICIPATION AND SCORP DEVELOPMENT

Developing a plan for outdoor recreation requires understanding residents' participation patterns and their perspectives on the future. The DNR gathered public input several ways in developing this document. A 17-member SCORP Advisory Team – consisting of representatives from public agencies, conservation organizations, recreation groups, the University of Wisconsin, and the health care industry – provided invaluable assistance and guidance on a wide range of issues affecting outdoor recreation in the state.

As part of the Recreation Opportunities Analysis, which was undertaken to support the development of this SCORP, the DNR hosted meetings in each region of the state to gather public input on existing recreation opportunities and future needs. Hundreds of people attended these meetings and thousands of people submitted comments. In addition, county park directors and staff were asked to provide input on recreation opportunities, needs and trends at their properties.

Finally, the DNR surveyed a random sample of 6,400 residents to gather statistically-significant data on recreation participation, issues of concern, and future needs. A portion of the survey is shown in Figure 4. Following this data collection effort, the DNR provided the opportunity for the public to complete the same survey online; over 16,500 people did, which presented an additional set of perspectives.

This SCORP builds on the work of earlier iterations and uses the eight regions first delineated in the 2005-2010 SCORP to describe recreation uses, patterns and needs. In drafting this SCORP, the DNR combined the extensive public and Advisory Team input with staff expertise. Staff began their work in 2015 gathering background information and assembling the Advisory Team. Over the ensuing three years the Team provided advice, input and direction on plan's content and the goals, objectives, and desired action items.

In 2017 the DNR received an extension in the timeline from the National Park Service in order to devote considerable effort in developing the Recreation Opportunities Analysis to help inform the SCORP. This effort generated extensive information on existing opportunities and high priority needs for the future, including an assessment of DNR properties that may be well-suited to help meet these needs.

Figure 4: Portion of the SCORP recreation participation survey (Appendix 6)

3. Trail-related activities in Wisconsin

Activity	**How many <u>days</u> did you participate in this activity in the last 12 months?** 0	1-2	3-9	10-29	30+
Hiking/walking/running on trails	○	○	○	○	○
Walking/running dog on trails	○	○	○	○	○
Horseback riding on trails	○	○	○	○	○
Bicycling on rail trails/developed trails	○	○	○	○	○
Mountain biking on single-track trails	○	○	○	○	○
Riding ATVs/UTVs on trails/routes	○	○	○	○	○
Driving 4-WD vehicles on trails/routes	○	○	○	○	○
Riding motorcycles on trails/routes	○	○	○	○	○

4. Winter activities in Wisconsin

Activity	**How many <u>days</u> did you participate in this activity in the last 12 months?** 0	1-2	3-9	10-29	30+
Snowmobiling	○	○	○	○	○
Cross-country skiing	○	○	○	○	○
Downhill skiing/snowboarding	○	○	○	○	○
Snowshoeing	○	○	○	○	○
Ice fishing	○	○	○	○	○
Ice skating outdoors	○	○	○	○	○
Hockey outdoors	○	○	○	○	○
Fat tire biking/snow biking	○	○	○	○	○


Photo: Joseph Warren


Photo: Linda Freshwater Arndt


Photo: Wisconsin Bike Fed

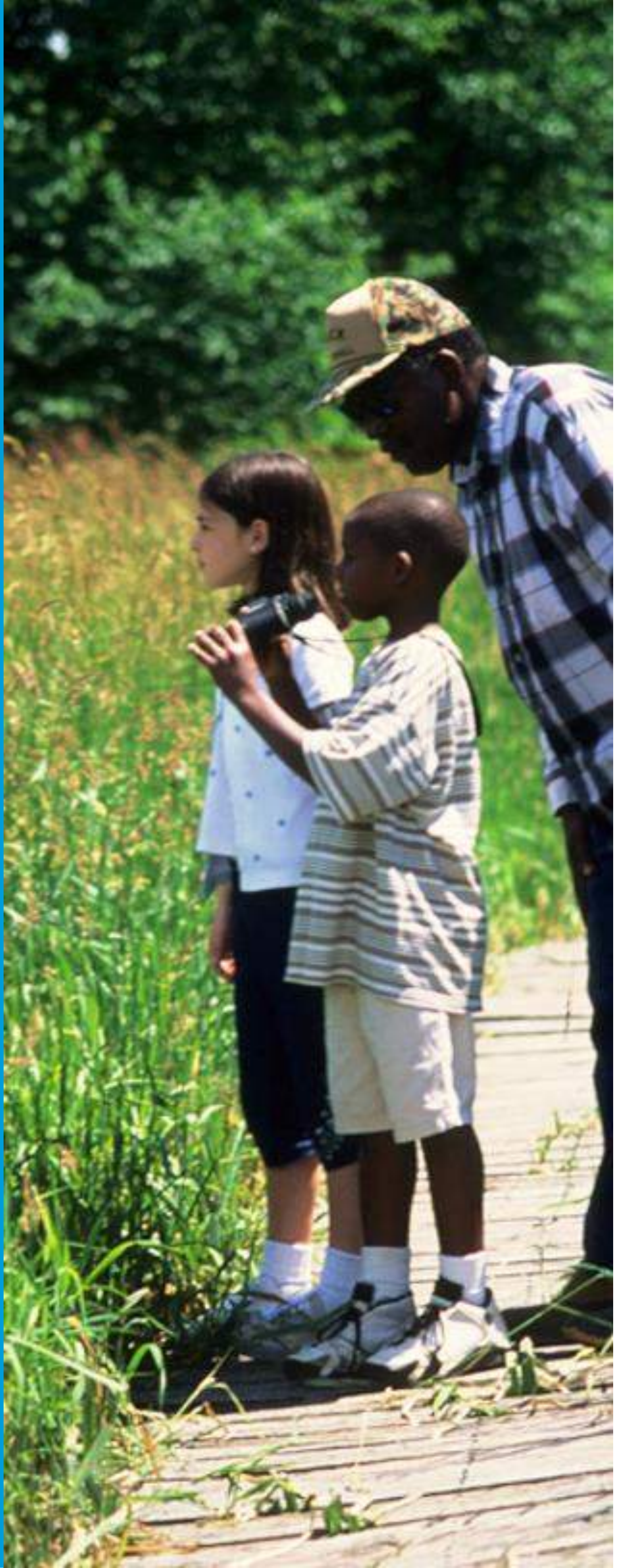

Photo: Angie Tornes


Photo: Savannah Ernzen


Photo: Gretchen Marshall

CHAPTER II
RECREATION IN WISCONSIN

Photo: Tim Sweet



OUTDOOR RECREATION: AT THE CROSSROADS OF OUR QUALITY OF LIFE

Outdoor recreation influences many aspects of our lives and the larger communities in which we live. For example, people that participate in outdoor recreation, especially from an early age, tend to have stronger connections to nature and conservation ethics.[1, 2] In turn, these connections often lead to stronger support for the protection of natural resources. Thus, **participation in nature-based activities is likely to be increasingly important in the public's level of support for protecting air and water quality, open spaces, and wildlife.**

As has been described in previous SCORPs and in many other studies, participation in outdoor recreation also plays a critical role in promoting health.[3, 4, 5] Whether walking their dog, canoeing, mountain biking, hunting, camping or engaging in countless other activities, the fresh air, exercise, natural settings and companionship with others helps people feel physically and mentally refreshed. Engaging in outdoor recreation activities is an effective way to aid in preventing and treating many chronic illnesses including obesity, diabetes and cardiovascular disease. In addition, participating in outdoor recreational activities is increasingly recognized for its benefits to people's mental health. A further description on the health benefits of outdoor recreation can be found on page 36.

People often participate in outdoor recreation as a group activity. The shared experiences among family and friends help create social bonds among participants. Participation in outdoor activities also creates social connections among people pursuing the same activities, even if they don't participate together. Interactions between people participating in different recreation activities can provide opportunities to learn about respective needs and desired experiences. A further description on the social benefits of outdoor recreation can be found on page 38.

Generating almost $18 billion in consumer spending, 168,000 jobs, $5.1 billion in wages and salaries, and $1.1 billion in state and local tax revenue, outdoor recreation is a financial engine in Wisconsin.[6] A further description on the economic benefits of outdoor recreation can be found on page 40.

Finally, lands and waters that provide the spaces for outdoor recreation often also have important environmental benefits, including habitats for rare and game species, flood control, carbon sequestration and groundwater replenishment. A further description on the environmental benefits that places for outdoor recreation provide can be found on page 41.

FACTORS AFFECTING RECREATION PARTICIPATION

Many factors influence participation in outdoor recreation. Some, such as the weather, vary daily and seasonally resulting in spur of the moment trips or skipped outings that had been planned well in advance. Other factors – including demographic characteristics, population distribution, and technological advances – evolve over extended periods. A summary of major issues affecting participation in outdoor recreation in Wisconsin follows.

Demographics

Population characteristics such as age and gender play important roles in determining participation levels in many types of recreation.

> *From childhood to early adulthood, participation in many outdoor activities generally increases.*

Younger age groups tend to participate in activities that are more physically demanding, rugged, faster-paced or motorized. Examples include team sports, running, tent camping, hunting, whitewater canoeing, snowmobiling, all terrain vehicle (ATV) riding, downhill skiing, and riding personal watercraft.

People's participation in outdoor activities changes over time. Older age groups tend towards less strenuous and slower-paced forms of recreation such as wildlife watching (in particular bird watching), golf, nature photography, walking, utility task vehicle (UTV) riding and camping with recreational vehicles.

Gender also plays a big role in participation. In general, males participate in more outdoor activities and more frequently than females. Hunting is one of the outdoor activities most skewed towards men; in Wisconsin, almost 75% of hunters are male. Women tend to participate in nature photography and dog-related activities more than men.

Access to Opportunities

Although many people travel to seek out unique recreation experiences, most people have limited time for leisure activities and tend to participate most frequently in activities for which opportunities are located nearby. As a result, urban residents participate in ball sports, bicycling, running, visiting dog parks and other similar activities at higher rates than rural residents. Conversely, rural residents participate in hunting, fishing, trapping, ATV/UTV and snowmobile riding at higher rates than urban residents.

Since many opportunities for nature-based recreation activities are in rural areas, as more and more of our residents move to cities their ease of access to places to pursue activities such as hunting, snowmobiling, ATV and UTV riding and horseback riding will decline. Places near the state's major urban areas that provide opportunities for these activities are often heavily used.

Another obstacle for some people is the cost of travelling to places for recreation or feasible transportation options. Residents with limited incomes can find it difficult to access opportunities to participate in outdoor activities, let alone afford necessary equipment. Although many underserved communities are located in urban settings, access to affordable opportunities also affects lower-income rural residents.

Another factor that influences access is knowledge about how to engage in activities successfully and exposure over time. Family experiences, traditions, and the transfer of know-how can play substantial roles in participation rates. [7, 8, 9, 10]

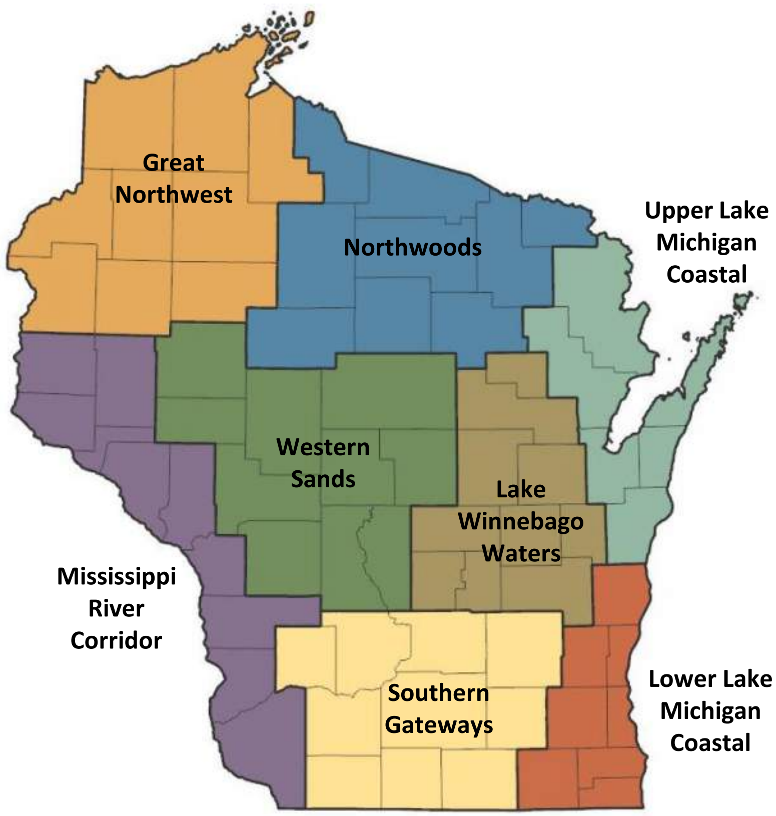
> *People are more likely to participate in activities in which their parents, other close family members or friends engage. This is most noticeable in activities, like hunting and trapping, that take considerable skill and experience to succeed.*

Health

People's health is often related to and influenced by their participation in outdoor recreation. The benefits of outdoor recreation on one's physical and mental health has been well documented recently.

REGIONS OF THE STATE AND THEIR RECREATIONAL OPPORTUNITIES

Figure 5: Recreation regions of Wisconsin



Previous SCORPs divided the state into eight regions based on similarities in their recreation attributes, visitation patterns, natural resources, and general features. This SCORP uses the same eight regions in describing recreational supply and demand.

Great Northwest

The Great Northwest Region has an abundance of natural resources such as Lake Superior, the Namekagon and St. Croix rivers, numerous inland lakes, and large forest blocks. Not surprisingly, tourism is a large and growing industry within the region. In addition to Wisconsin residents, visitors from the Twin Cities and surrounding suburban areas, utilize the region's recreational resources. Seasonal home development, particularly along rivers and lakes, has increased dramatically within the region.

Mississippi River Corridor

The Mississippi River Corridor Region includes the state's western border counties running along the "Mighty Mississippi." The river and its backwater sloughs and wetlands are used for a variety of water-based recreational activities. In addition to the Upper Mississippi River Wildlife and Fish Refuge, a number of popular state parks and natural areas occur along the corridor. A number of clear, cold trout waters are found in the region that draw anglers from throughout the Midwest.

Northwoods

The Northwoods Region has one of the largest concentrations of lakes in the country and has been a tourist and seasonal home destination for over a century. Increasingly, retirees are moving to the region and converting their vacation houses to permanent residences. With a number of popular public lands including the Northern Highland American Legion State Forest and the Chequamegon-Nicolet National Forest, tourism is an important business here. The construction of an extensive bicycle trail network along with a growing number of ATV/UTV routes and trails, has increased visitation.

Western Sands

The Western Sands Region has an abundance of public lands that draw visitors from Milwaukee, Chicago and the Twin Cities. From camping to ATV riding and hunting to bird watching, the county and state forests and the expansive wildlife areas here support a wide diversity of recreation. Although largely rural, easy highway access and relatively inexpensive land prices within the region have increasingly made it a popular location for seasonal home development.

Lake Winnebago Waters

The Lake Winnebago Waters Region is centered on the Lake Winnebago watershed which includes the lakes of Butte des Morts, Winneconne, and Poygan as well as the Fox and Wolf rivers. Together, these waters are the major recreational resource within the region and draw visitors from throughout the state and beyond for boating, fishing, hunting, bird watching and more. The region is home to the popular sturgeon fishing season. Urban and suburban development within the region continue to grow in the Fox River Valley.

Southern Gateways

The Southern Gateways Region contains a variety of environments - rolling hills in the south, the centrally-located Wisconsin River, and large marshes in the east - the combination of which provides a wide array of recreational opportunities. The region also has a number of important geologic features, including Devil's Lake, a craggy glacial lake surrounded by high cliffs and scenic overlooks that is one of Wisconsin's most popular recreation destinations. The rapid development around Madison has also increased demand for urban-based recreation opportunities such as dog parks, bicycle trails and developed sports facilities.

Upper Lake Michigan Coastal

The Upper Lake Michigan Coastal Region is heavily influenced by Lake Michigan. Although many residents and visitors to the region use Lake Michigan for their recreational needs, other water resources such as the Peshtigo, Menominee, and Manitowoc rivers also attract visitors with their abundant fishing and paddling opportunities. Door County contains over 250 miles of picturesque shoreline (more than any other county in the United States) and 10 historic lighthouses, features that attract many tourists and seasonal residents. Peninsula State Park, located along the shores of Green Bay, is one of the most popular state parks in Wisconsin.

Lower Lake Michigan Coastal

The Lower Lake Michigan Coastal Region is the most urban and populous of the eight regions. The urban influence of Milwaukee and its surrounding suburbs has led to an extensive network of trails and associated recreation facilities such as dog parks, athletic fields and sport courts. Despite this urban influence, some areas of the region offer opportunities for undeveloped outdoor recreation. The five units of the Kettle Moraine State Forest are easily accessible not only to the region's residents but also the greater Chicago metropolitan area and are some of the most heavily used public lands in the state.

Betty LaBarbera

My Story: Traditions

Betty LaBarbera

Betty LaBarbera, 91, has been buying a fishing license for as long as she can remember. Residents around Long Lake talk about the old plywood boat that she and her late husband, Joe, frequently rowed around the lake. Other boaters with modern, high-tech rigs slowed to no wake and gave a wide, respectful berth to the couple as they fished and enjoyed the scenery.

Nowadays, Betty's children and grandchildren pick her up for family fishing trips to the same Long Lake cabin that has been in the family since the turn of the last century. They still have the plywood rowboat that grandpa made, but they prefer to fish and swim from the multi-colored pontoon boat, "Grandma Betty's Barge."

The family fishing trips continue to follow a familiar pattern.

> *"First, we buy our license at Din's Market in Dundee," explains Betty, "and a dozen nightcrawlers. Joe is probably looking down from heaven and shaking his head; he'd always dig worms in the garden."*

After filling up on groceries and gas at Din's, Grandma Betty sometimes treats everyone to burgers and ice cream cones at the Hamburger Haus drive-in or a meal at Benson's on the north end. When she's done helping the local economy and reminiscing with old-timers from the Long Lake Fishing Club, it's time to go fishing.

Betty gives her annual lesson in how to put just the right size piece of nightcrawler on the bare hook. When the sun finally sets on another day on the lake, she says, "Whose gonna cook grandma's fish? Remember, we only keep 'em if we're gonna eat 'em."

After a fresh panfish supper, the LaBarbera tradition dictates that everyone in the family pitch in for the evening ritual. While some do the dishes, others start the campfire or prepare the s'mores. When the fire is lit, everyone gathers, and stories are told of memorable days gone by, fishing with friends and family.

The warmth lingers long after the last ember fades.

Mark LaBarbera
Outdoor Heritage Education Center

THE CURRENT STATE OF OUTDOOR RECREATION

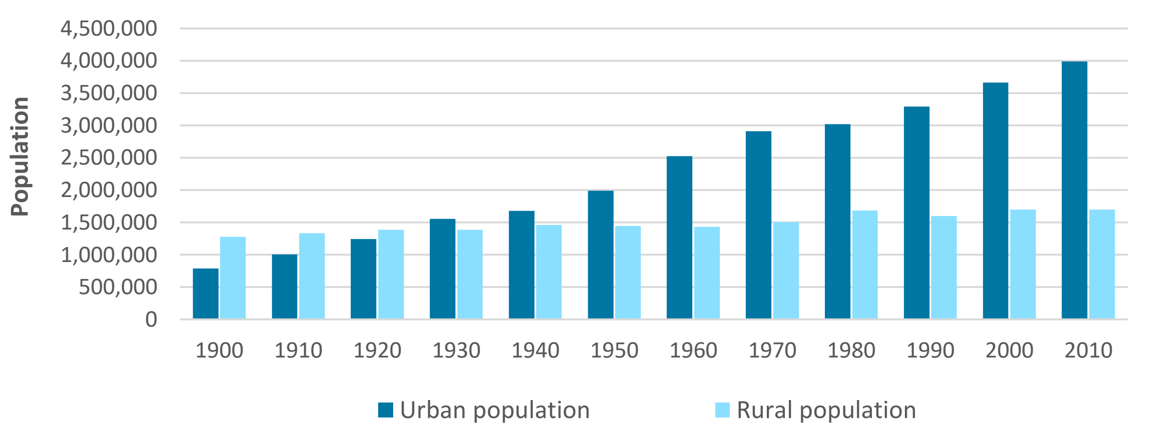
WISCONSINITES WHO WE ARE

Over the last 50 years, Wisconsin's population has increased at a rate of about 0.6%/year. The state's population is projected to grow from 5.8 million today to 6.5 million in 2040, an increase of about 0.5%/year (Table 4, Figure 7 – pg. 21).

The state's rural population has remained relatively stable over the last century (at about 1.5 million) while the urban population has more than tripled to over 3.5 million (Figure 6). While Wisconsin's urban population is growing considerably faster than the rural population, the state's rural population is relatively strong compared to nearby states that are dominated by very large urban centers.

Following national trends, our population is increasingly urban, more ethnically and culturally diverse, and older (Figure 8 – pg. 22).[11, 12] Although Wisconsin's population is less diverse than other states, populations of people of color continue to grow. The Hispanic population nearly doubled from 2000 to 2015 and now comprises 6.9% of the state's residents. Wisconsin's Black/African American population increased nearly 10% since 2000 and is now 6.7% of Wisconsin's population.[14] Wisconsin's Asian population has grown to be 2.9% of the population while people identifying as two or more races have increased to 1.9% of the state's population. The Native American population now numbers more than 60,000 in Wisconsin.

Figure 6: Wisconsin urban and rural population, 1900 Census - 2010 Census[13]



The increasing diversity of our population will continue. With over 44% identifying as people of color, the Millennial generation is more diverse than any preceding generation.[15] And the next younger age cohort, is even more diverse.

The distribution of Wisconsin's population is concentrated in several areas: the southeast metropolitan area centered on Milwaukee (Milwaukee, Racine, Kenosha, Waukesha, Washington, and Ozaukee counties), Madison and surrounding communities (Dane County), the Fox Valley (Brown, Outagamie, and Winnebago counties), La Crosse (La Crosse County) and the region near the Twin Cities (St. Croix County). Together, although these 12 counties comprise just 11% of the state's land area, they harbor 56% of the state's population (Figure 9 – pg. 22). Current and projected population numbers by county are shown in Appendix 2.

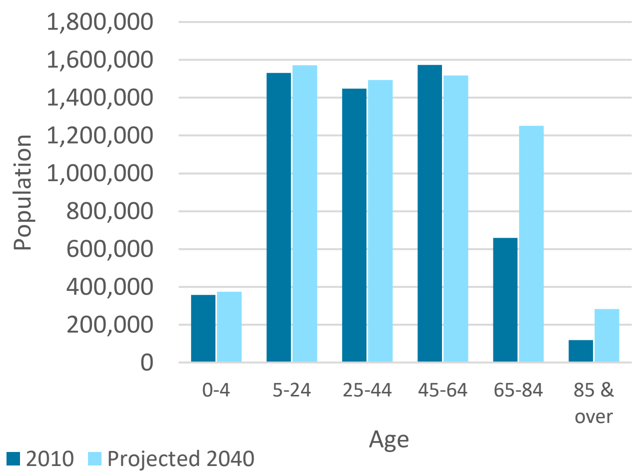
The number of Wisconsin residents living with disabilities continues to climb (Figures 10 and 11 – pg. 23). In part, this is due to the rise in our aging population and the increase in chronic diseases. Over 32% of Wisconsin residents over age 65 report living with one or more disabilities.[16] Many communities are building and upgrading facilities to meet the needs of people with different types of disabilities.

Participation in most outdoor activities declines after age 50; after 70, participation drops considerably (Figure 13 – pg. 25). Much of this decline in participation is likely due to health-related issues.

Table 4: Wisconsin population projected change, 2010 Census - 2040 projection, by age group[11]

Age Group	Numerical Change	Percent Change
0-4	15,497	**4.3%**
5-24	41,060	**2.7%**
25-44	46,235	**3.2%**
45-64	-56,194	**-3.6%**
65-84	592,956	**90.0%**
85 & over	165,095	**139.3%**
TOTAL	**804,649**	**14.1%**

Figure 7: Wisconsin population projected change by age group, 2010 Census – 2040 projection[11]



The Millennial Generation: the country's largest age group

Understanding the lifestyles and interests of younger generations can be helpful in anticipating the activities and experiences that may be popular in the future as these groups age. The Millennial generation (typically defined as those born from 1982 to 2000 and 18 to 36 years old today) is having a large impact on outdoor recreation. Not only are they the largest age group in the country (they surpassed the Baby Boomers in 2015) but they also spend more time and money on outdoor recreation than the average outdoor consumer.[17] This cohort, more than other age groups, generally has the following attributes related to outdoor pursuits:

Committed to health and wellness

More than previous generations, Millennials spend considerable time exercising and are the least obese age group.[18]

Seek experiences over material goods

More than three-quarters of Millennials would choose to spend money on a desirable experience or event over buying something desirable.[19] This may be linked to the sharing of experiences on social media, which may entice others to try similar or other experiences.

Participate in active outdoor pursuits

Younger people typically engage in more active forms of recreation (e.g., hiking, kayaking, and stand-up paddling) than their elders, a pattern that continues with Millennials. However, Millennial participation in newer, more strenuous activities (endurance races, trail running and mountain biking) is particularly notable. This is also linked to their desire to live healthy lives.

Are more likely to rent than own

This approach includes a range of items (e.g., cars, music and bicycles) and provides a greater degree of flexibility and mobility than traditional ownership.[20] Millennials tend to move more frequently than older generations did in when they were young adults and they continue the long-standing pattern of young adults moving from rural areas and small cities to large metropolitan areas (both in-state and out-of-state).

Use social media to share their experiences

Posting pictures, stories, reviews and endorsements on various internet-based platforms is likely to become an even more dominant way that participants communicate about their outings and influence others' participation.

Have pets

Nearly three-quarters of 30 to 39 year old's (the older Millennials) own dogs.[21]

Figure 8: Percent of Wisconsin population age 65 or older by county, 2015 estimate – 2040 projection[22]

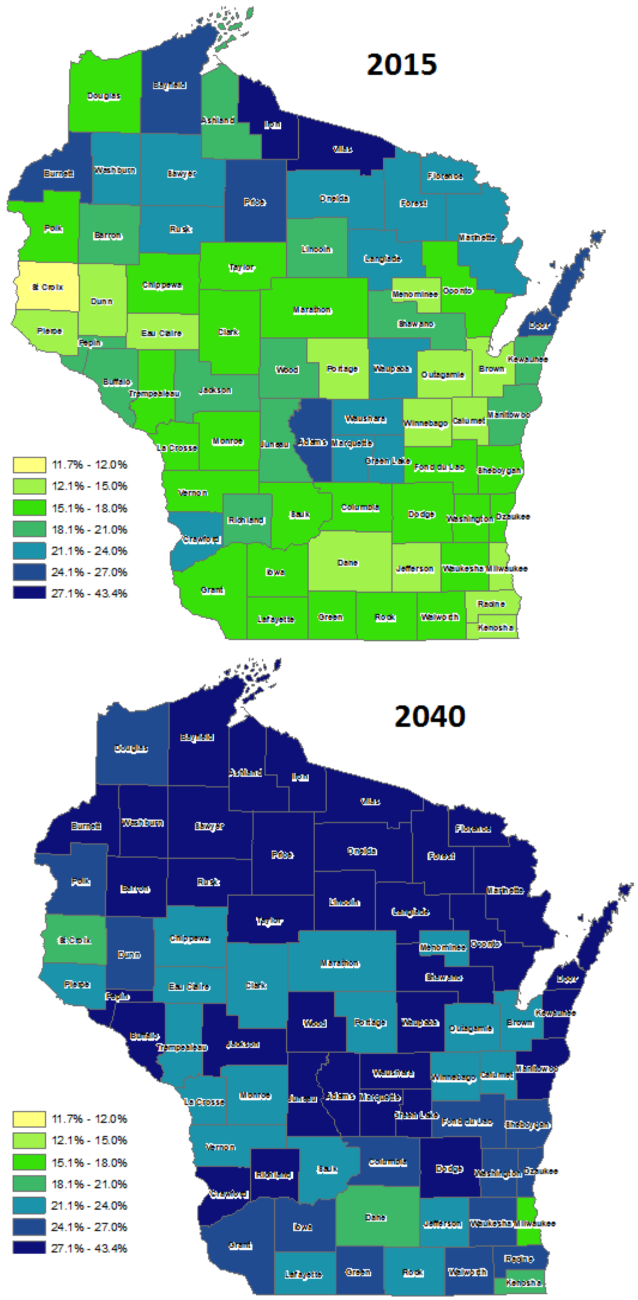


Figure 9: Population density by Census tract, 2010 Census[23]

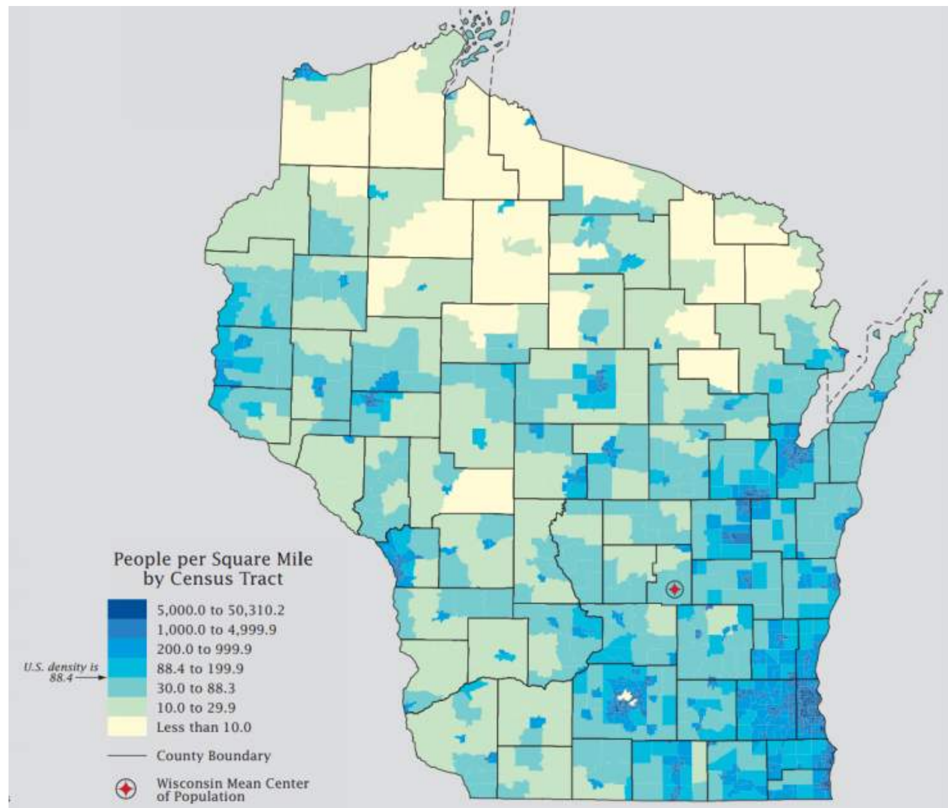


Figure 10: Number of Wisconsinites with a disability[24]

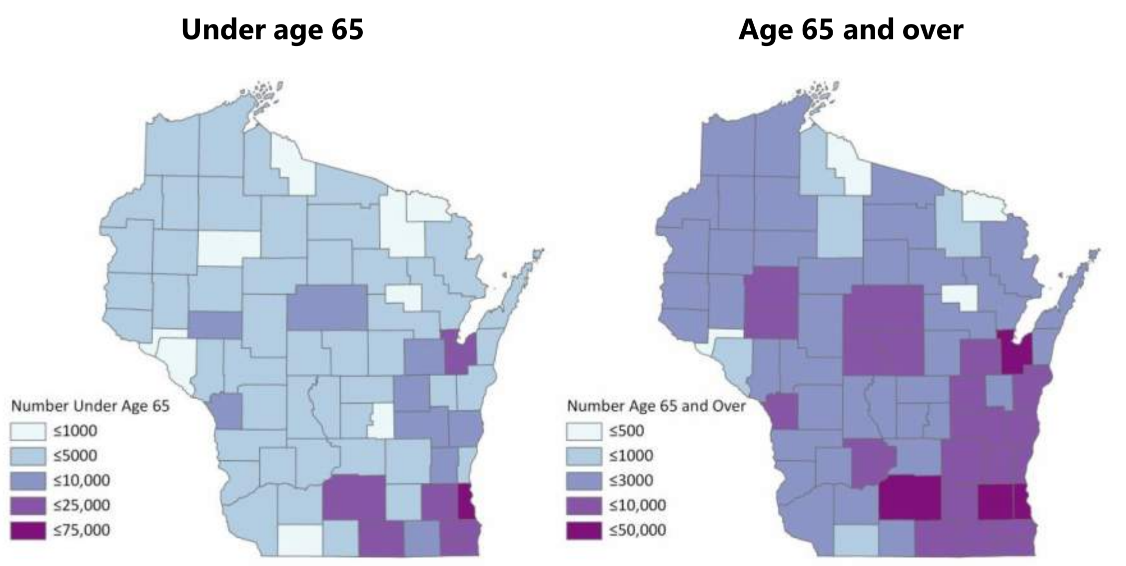


Figure 11: Percent of Wisconsin population with a disability[24]

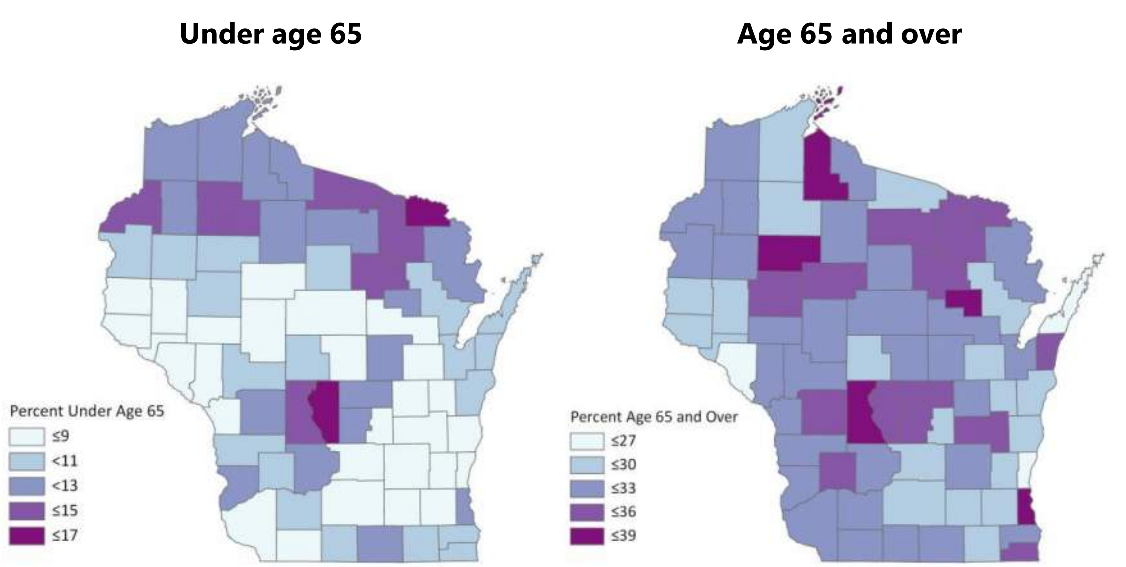


Photo: Skillet Creek Media

WISCONSINITES WHAT WE DO

Table 5: Wisconsin resident participation rates of *grouped* nature-based recreation activities[25]

Activity group	% of WI residents that participated at least once in last 12 months
Hiking	**68%**
Hiking/walking/running on trails	
Nature observation	**66%**
Bird/wildlife watching	
Nature photography	
Gathering berries, mushrooms, etc.	
Boating-related	**61%**
Motor boating	
Canoeing/kayaking	
Personal water craft (jet-ski)	
Sailing	
Stand-up paddle boarding	
Waterskiing	
Fishing	**49%**
Lake fishing	
Stream/river fishing	
Ice fishing	
Camping	**41%**
Tent camping	
RV/pop-up camping	
Dog-related activities	**38%**
Walking/running dog on trails	
Visiting a dog park	
Bicycling	**35%**
Bicycling on rail-trails or other developed trails	
Mountain biking	
Fat-tire biking/snow biking	
Hunting	**27%**
Big game hunting	
Turkey hunting	
Small game hunting	
Migratory bird hunting	
Motorized trail-based activities	**25%**
ATVs/UTVs on trails-routes	
Snowmobiling	
4-WD vehicles on trails-routes	
Motorcycles on trails-routes	

Participation Rates

Wisconsinites have historically participated in outdoor recreation at higher rates than the national average. This is likely largely attributable to our abundant natural resource base, the quantity and quality of public lands and waters, and cultural traditions that value the outdoors. It is estimated that more than 95% of state residents participated in some form of outdoor recreation in the past year.

Table 5 shows participation rates of Wisconsin residents for general groupings of nature-based recreation activities. For comparison, 46% of Wisconsin residents participated in ball sports (golf, tennis, basketball, softball, baseball, soccer, and handball).

A list of the 20 most popular specific nature-based activities is presented in Table 6. A full listing of participation rates for recreation activities is found in Appendix 6.

Most residents participate in many outdoor recreational activities. Of the activities that were included in the participation survey, over half of residents noted that they participated in at least 16 different activities in the last year (Figure 12).

Outdoor enthusiasts recreate in many different ways. One common thread is that people often participate in multiple activities on the same trip or outing. Canoeists watch wildlife while paddling down a river. Horseback riders take nature photographs. Motor boaters swim and fish; hunters ride ATVs and camp.

What differs, often dramatically, is the overall type of outdoor experience that people favor. Some prefer quiet, secluded settings where they can experience the sights, sounds, and smells of the natural world with few (if any) other nearby groups or distractions. Popular activities for these people include wildlife watching, fishing, canoeing, tent camping, hiking, hunting and horseback riding.

Others prefer more active, strenuous experiences such as cross-country skiing, trail running, mountain biking and geocaching. Still others prefer the thrill of faster, often motorized activities such as ATV riding, motor boating, personal watercraft riding and snowmobiling (see Appendix 6 for activity clusters).

Figure 12: Number of outdoor recreation activities in which Wisconsin residents participate[25]

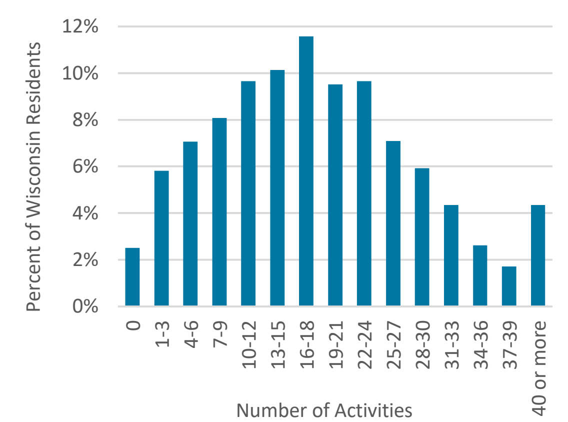
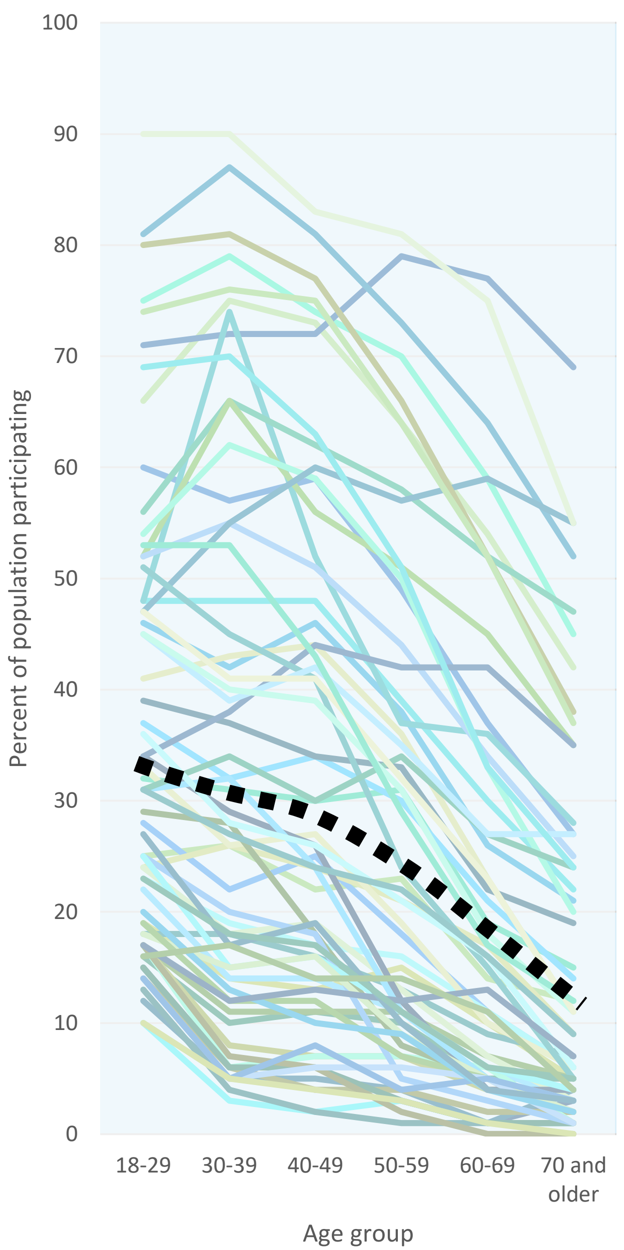


Figure 13: Wisconsin resident participation in outdoor recreation activities, by age group[25]



Age

As mentioned earlier, age plays an important role in participation rates. Although participation in most activities decreases with age, there is variation in the degree to which participation drops.

Figure 13 shows **participation rates by age group** (that is, the percentage of the state's population within each age group that participates). Each line depicts a different recreation activity and the average of all the activities is shown as a **dashed black line**.

It is likely that activities with relatively stable participation rates across age groups "pick up" participants in other activities as people age.

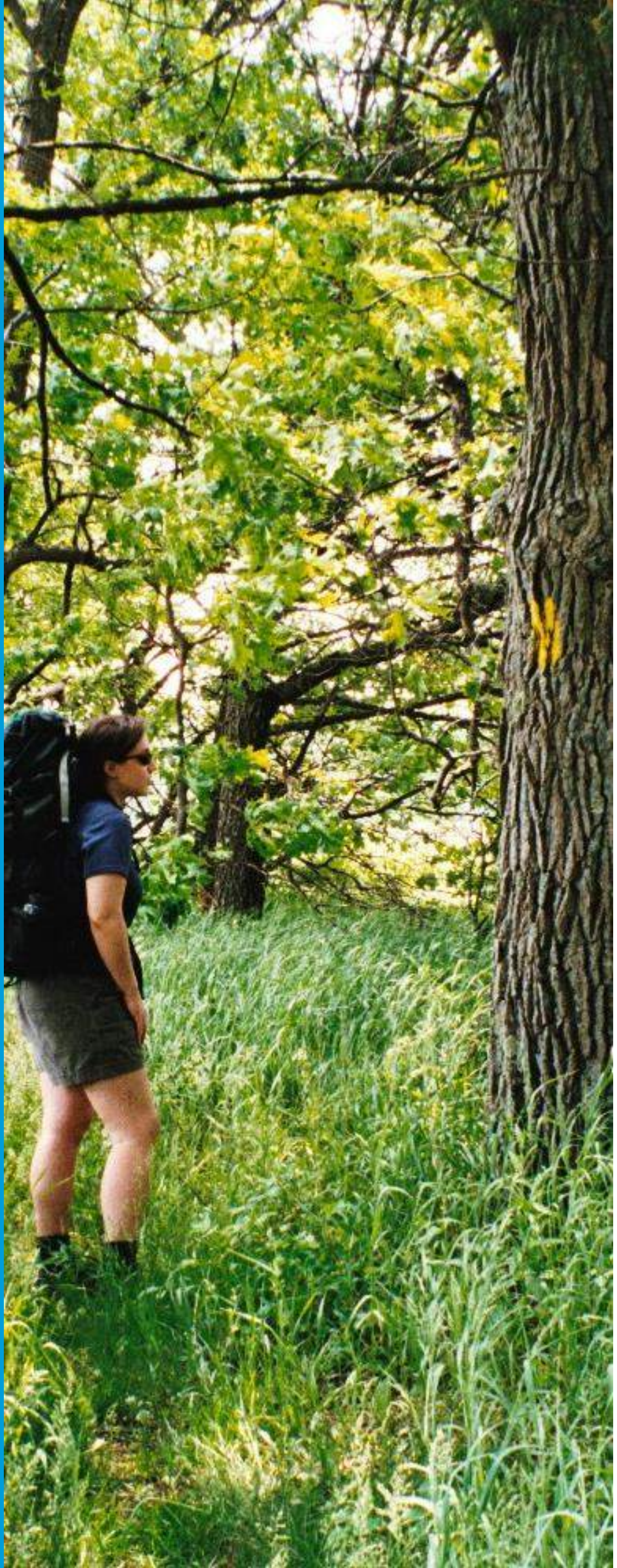
For example, it is likely that some people that downhill ski as young adults shift to cross-country skiing in later years (participation in downhill skiing drops from 27% of the population in the 18 to 29 age group to 4% for the 60 to 69 age group while cross-county skiing only declines from 17% to 13% for the same age groups).

Did You Know?

With over 200,000 registered snowmobiles and over 25,000 miles of trails, Wisconsin is the nation's snowmobiling champion.

Table 6: Wisconsin resident participation rates of the 25 most popular nature-based recreation activities.[25]

Participation Rate	Activity
74%	Picnicking/tailgating/cookout
68%	Hiking/walking/running on trails
65%	Visiting a beach/beach walking
55%	Bird/wildlife watching at home
54%	Swimming in lakes/ponds/rivers
52%	Visiting a nature center
45%	Motor boating
40%	Lake fishing from shore or a pier
39%	Bird/wildlife watching away from home
37%	Lake fishing from a boat/canoe/kayak
37%	Nature photography
34%	Bicycling on rail-trails/developed trails
34%	Canoeing/kayaking
32%	Tent camping
32%	Dog walking on trails
31%	Gathering berries, mushrooms, etc.
29%	Target firearm shooting
23%	Ice fishing
23%	Visiting a dog park
21%	Hunting big game on private land
21%	RV/pop-up camping
21%	Stream/river fishing from shore/wading
21%	Water skiing/tubing/wakeboarding
20%	River fishing from a boat/canoe/kayak
19%	Target archery outdoors



Participation Frequency

Understanding overall demand for recreation requires knowing both the number of people participating and how often they participate. Together, these provide a picture of the total "recreation days" in which residents engage.

As part of the survey on recreation participation, the department collected data on frequency of participation using the following categories: 0 days/year, 1-2 days/year, 3-9 days/year, 10-29 days/year, and 30+ days/year. Results are listed in Appendix 6.

As can be seen in Figure 14 (pg. 27), for some activities (e.g., canoeing/kayaking and tent camping) participants typically engaged in the activity less than 10 days in the last year. For other activities, most notably bird/wildlife watching at home, people that participate tend to participate often. Unsurprisingly, people tend to engage most frequently in activities that can occur near their homes, require little preparation or can provide a high-quality experience in a limited amount of time.

Although the frequency of participation is comparable across many activities, there are several factors to bear in mind. For example:

Hunting, fishing and trapping regulations
The harvest seasons for different game animals can limit participation. For example, most residents can only legally hunt turkeys in the spring during one of the six, one-week periods. Thus, someone who participated in turkey hunting 3-9 days in the last 12 months could have participated during the majority or entirety of their legally allowed days.

Seasonality
Some activities are dependent on conditions associated with seasons. For example, there may be a limited number of opportunities for people to participate in snow or ice-based activities, particularly in the southern part of the state, simply due to a lack of adequate conditions. Thus, although ice fishing, snowmobiling, cross-country skiing, and snowshoeing registered fewer days of average participation than activities such as nature photography or bird/wildlife watching, the people participating in winter activities may be participating in a higher percentage of the available days.

Value vs. Frequency
Activities in which people participate infrequently can still be very important to them. For example, someone may only go camping once per year, but it may be an annual family reunion that is their favorite outdoor activity of the year.

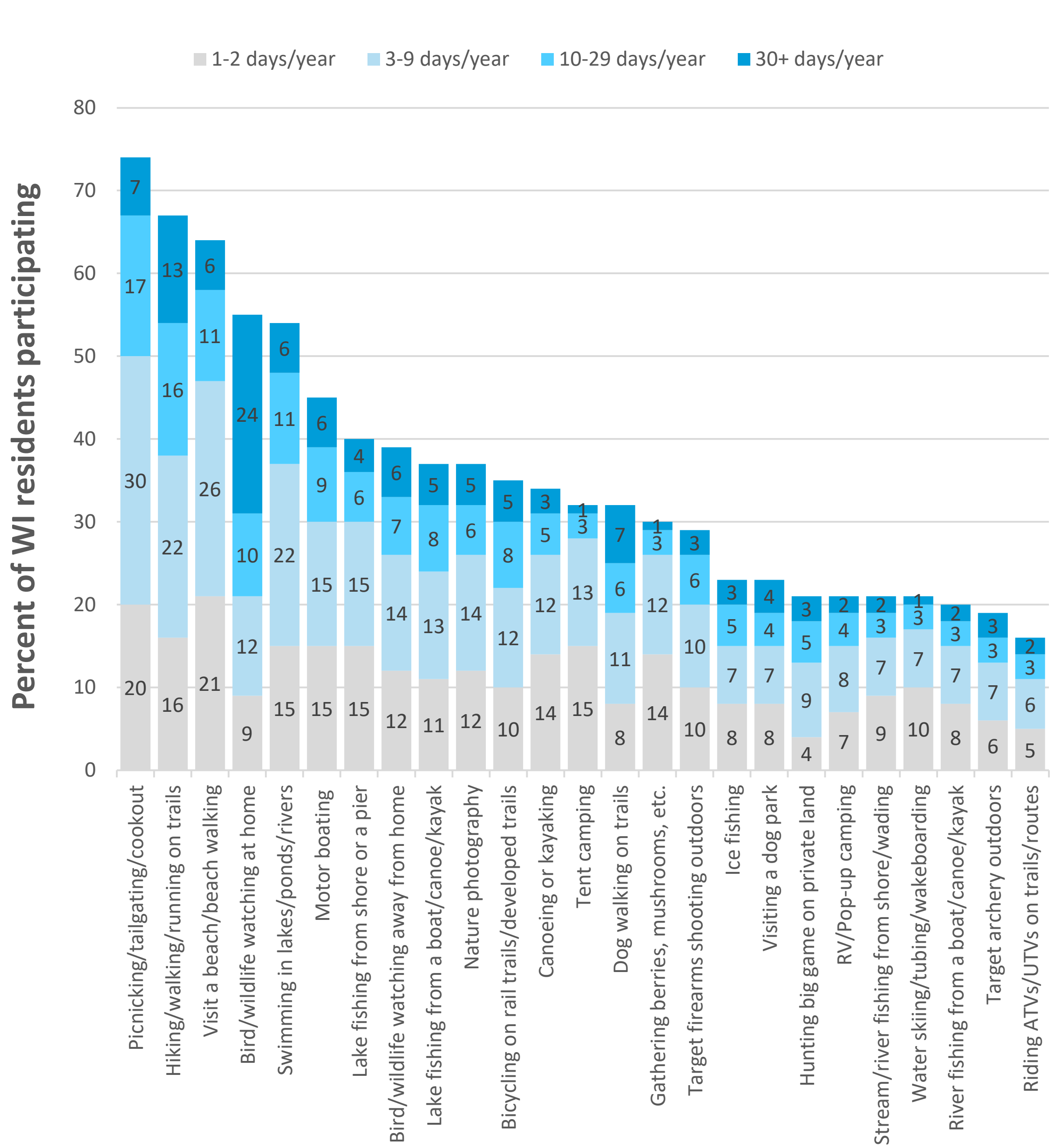
Favorite Outdoor Activities

Of course, frequency of participation can be independent of passion for an activity. That is, people's favorite outdoor activities are not necessarily those in which they participate most frequently.

When asked to name their favorite outdoor activity, the top five responses were:

1. **Walking, hiking**
2. **Fishing**
3. **Hunting**
4. **Bicycling**
5. **Camping**

Figure 14: Frequency of participation in the 25 most popular nature-based recreation activities[25]



My Story: Childhood Explorer

The Spaul Family

Hannah and her husband Mike love spending time outdoors and have taken their son, Oscar, along pretty much everywhere since he was born. Oscar was 3 months old on his first camping trip and was canoeing before he could walk; his mom would hold him while he paddled.

Unsurprisingly, Oscar wants to do everything his parents do so they make sure he has equipment, but in his size. His paddle, fishing pole and net, headlamp and walking stick fit him well. His parents also change things up to keep him interested.

> *"We might start a scavenger hunt while on a hike or stop for snacks by the lake. And we give him as much control over what he wants to do as we can. Instead of moving at our desired pace, we slow things down and let him appreciate that cool rock or shell he just found," says Hannah.*

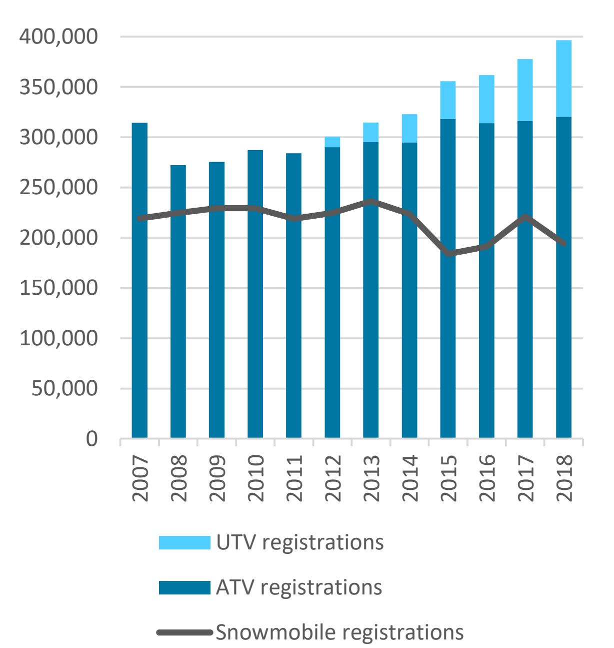
Most kids, unfortunately, don't get this type of exposure to the outdoors or the benefits. Surveys reveal children are not spending enough time outdoors. "I don't think it's just an issue for children. People are not spending much time outdoors, which means they're not taking their children outside either. Some children I know are afraid to go out in nature because they have no experience with it. But most children enjoy spending time outdoors when it's well-facilitated and they have the companions and the supplies they need to be comfortable," says Hannah.

Oscar's favorite place to visit is The Nature Conservancy's Lulu Lake Preserve in southeast Wisconsin. "When we take him canoeing there, he hops off the side of the canoe with his life jacket and his snorkel set. He'll swim around looking at fish until he's blue," reports Hannah.

Oscar is now ten and in fourth grade. He loves swimming, snorkeling, canoeing, fishing and taking short hikes. He digs in the dirt, collects rocks and loves bugs. When asked why she thinks it's important for Oscar to spend time in the outdoors, Hannah responds, "It's healthy, and it encourages independent learning and problem-solving. It's also a great way to unplug and spend time with other people - from family and friends to park rangers and naturalists. Nature adventures and discovery are a big part of our lives, and it's a gift we want to give to Oscar."

Paul Heinen
The Nature Conservancy

Figure 15: ATV, UTV, and snowmobile registrations in Wisconsin, 2007 - 2018[26]



Recreation Trend Example

Motorized recreation

While ATV use has been generally constant in Wisconsin over the last decade, UTV use has increased considerably. This growth is likely due both to the substantial number of Baby Boomers (older riders tend to prefer UTVs more than ATVs) and also because on-going upgrades in UTV features have expanded their appeal and utility.

Given the projected growth in older age groups, there is likely to be an increase in the number of people that will participate in UTV riding.

Participation Trends

Future participation levels will be affected by the size of our population and the rates at which residents engage in different activities. The state's population is projected to grow by about 700,000 additional residents by 2040 and as a result most activities will see increases in the number of participants, even if participation rates for many activities decline as our population ages.

Of course, participation rates in activities rise and fall as trends come and go.[27, 28] Newer forms of recreation provide users with more options for enjoying the outdoors, and in some cases supplement users' recreational experiences. For example, fat-tire bikes can extend biking opportunities into the winter months, kayaking can be another way to fish small streams, UTVs can be a way for groups to get to a favorite hunting spot, and drones can be a new way to photograph nature. As battery technology continues to improve, it is possible that many applications will affect outdoor recreation in the future.

Based on the number of residents that are projected to be in different age groups in 2040, if future participation rates for each age group are the same as today's rates, the largest increases in the number of participants in nature-based recreation are expected for bird watching, picnicking/tailgating/cookout, visiting a nature center, and hiking/walking/running on trails (Appendix 4, Table 17).

Because the methods to survey recreation participation in Wisconsin have changed over time, it is not possible to analyze current and past data to quantitatively identify trends in statewide participation rates or frequencies. To address this, qualitative input was gathered from county recreation providers on their perspectives of how recreation participation has changed over the past five years at their properties. The recreation opportunities in highest demand on county-managed properties are campsites, hiking/walking/ running on trails, mountain biking and recreational biking trails, motorized trails, and shore access to lakes, rivers and streams (Appendix 4, Table 16).

ATV and UTV - What's the difference?

ATV (all terrain vehicle): usually meant for a single rider that straddles a saddle and steers using a handlebar system.

UTV (utility task or terrain vehicle, sometimes referred to as side-by-side): can seat multiple people and riders sit in bench or bucket seats. Driver uses a steering wheel.

See State Statutes 340.01 and 23.33(1)(ng) for legal definitions.

Trends in participation at county parks, forests and trails

Activities with largest increases in participation over the last five years at county properties:

- Bicycling – winter/fat-tire biking
- Camping – RV/pop-up
- Bicycling – mountain biking
- Riding ATV/UTVs
- Canoeing/kayaking
- Bicycling – recreational/rail-trail biking
- Picnic areas/day use/beaches
- Paddle boarding
- Dog walking on trails
- Hiking/walking/running on trails
- Fishing

WISCONSINITES
WHERE WE PARTICIPATE

With 7.5 million acres of land open to the public, there are abundant opportunities for residents and visitors to enjoy outdoor recreation experiences in Wisconsin. Approximately half of this acreage is managed by state and federal agencies, including the Wisconsin Department of Natural Resources, U.S. Forest Service, U.S. Fish and Wildlife Service, and National Park Service. Local and tribal governments also manage a broad portfolio of places available to the public for outdoor recreation, including local parks, school forests and nearly 2.4 million acres of county forest land.

In addition, the public has access to private lands enrolled in some conservation programs and lands where agencies have acquired public access easements. Descriptions of the types of lands open to the public for nature-based recreation and acreages for each county are listed in Appendix 3. In addition, Table 14 in Appendix 4 provides an overview of the recreation opportunities at county-managed properties.

Although public conservation and recreation lands comprise only about 17% of the state (Table 7 – pg. 30), a sizable percentage of residents use public lands for outdoor recreation. When asked about their top two favorite outdoor activities, nearly two-thirds of residents said their participation was “entirely” or “mostly” on public lands or waters. However, 65% of respondents that listed hunting as their favorite outdoor activity used private lands “entirely” or “mostly.” This is not surprising since public lands – especially in the southern part of the state – are typically crowded during hunting seasons.

Given the distribution of our population as well as our public lands, it is logical that for some activities there are geographic patterns of visitation. The large public land holdings in central and northern Wisconsin draw visitors for multi-day outings, including camping, ATV/UTV and snowmobile riding, hunting and fishing. Public lands in the southern and eastern parts of the state, which tend to be smaller, are heavily used by people pursuing shorter outings (half-day or less) to hike, walk a dog, watch birds, ride a bike, picnic, fish, hunt, gather edibles and other similar activities.

Frog Bay Tribal National Park
Red Cliff Band of Lake Superior Chippewa


Photo: Michael Defoe

Frog Bay Tribal National Park is the **first tribal national park in the United States.** Established in 2012, the 300-acre conservation area includes a 170-acre park that is open to the public for hiking on several trails that lead to 4,000 feet of Lake Superior shoreline.

The property includes pristine sandy beaches, old-growth boreal forest, and a high-quality coastal estuary that provides critical habitat for many native species. The park provides views of the Apostle Islands including Oak, Basswood, Hermit, Raspberry and Stockton islands.

The Red Cliff Band of Lake Superior Chippewa also provides public camping and hiking opportunities at other properties it manages in Bayfield County.

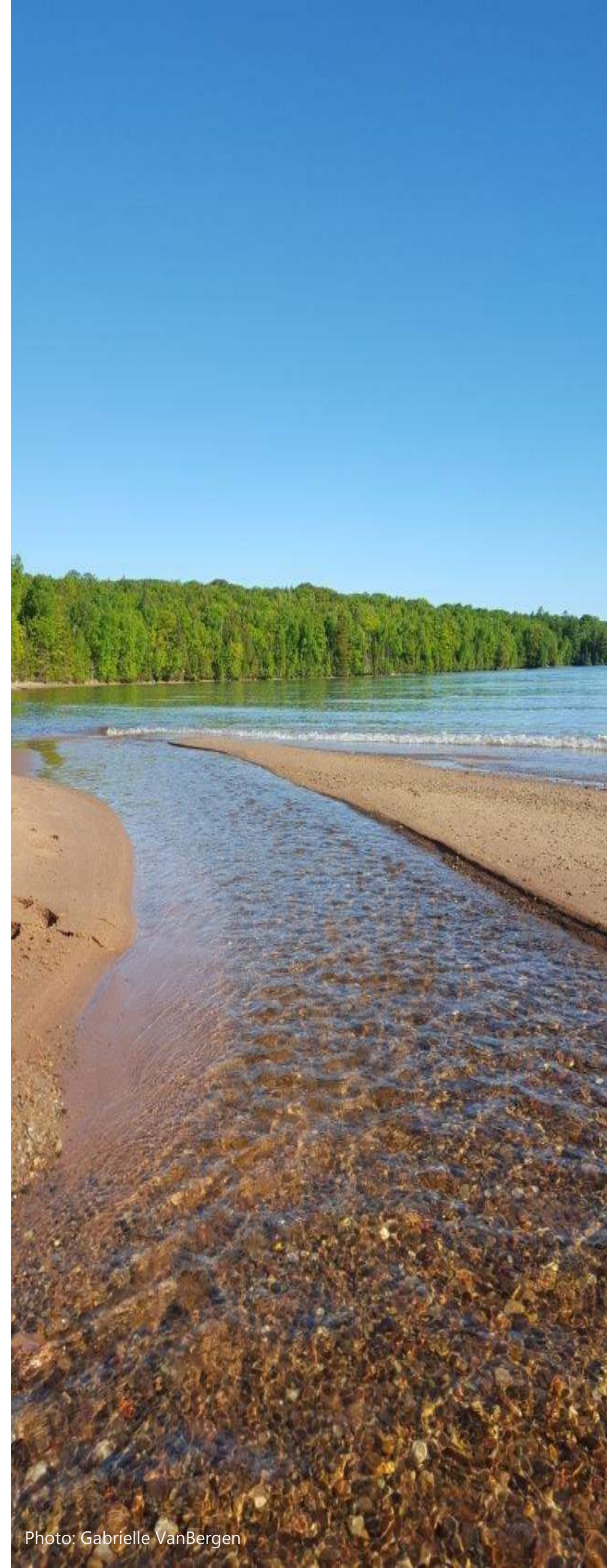
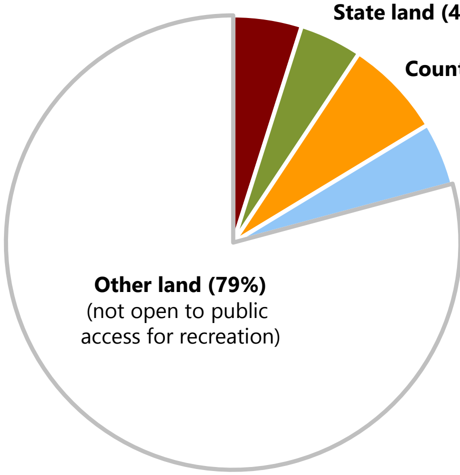


Photo: Gabrielle VanBergen

Figure 16: Lands in Wisconsin open to the public for recreation[29]



Ways to value land purchases for recreation

Governments acquire land for a variety of purposes. In determining where to purchase property for outdoor recreation, agencies must evaluate costs and benefits to determine the most effective and efficient use of public funds.

Lands that are least expensive to purchase often provide limited recreation opportunities, given their location and the type and quality of experiences the land can provide.

When viewed using metrics other than dollars/acre, higher-priced places near population centers may be a more effective use of public funds than less-expensive lands distant from cities. For example, applying metrics such as visitor-days or the economic returns accruing to nearby communities from these visitors' spending may show that recreation lands near urban areas provide a better return on investment than lower-priced lands in remote areas that are less frequently used.

Similarly, the benefits of improved health and quality-of-life will affect substantially more people when places are available near urban areas for outdoor recreation.

Table 7: Lands in Wisconsin open to the public for recreation[29]

	Public Ownership	Acres Owned	Percent of the State
Federal	U.S. Forest Service	1,524,500	4.2%
	National Park Service	67,500	0.2%
	U.S. Fish & Wildlife Service	149,500	0.4%
	U.S. Army Corps of Engineers	14,300	0.0%
	Total Federal	**1,755,800**	**4.9%**
State	Department of Natural Resources - Fee title	1,507,000	4.2%
	Board of Commissioners of Public Land	75,900	0.2%
	Total State	**1,582,900**	**4.5%**
County and Local	County Forests	2,395,400	6.7%
	County Parks (estimate)	70,000	0.2%
	City, Village, and Town recreation properties funded by Stewardship matching grants	15,000	0.0%
	City, Village, and Town recreation properties not funded by Stewardship matching grants (estimate)	50,000	0.1%
	School Forests	27,900	0.1%
	Total County and Local	**2,558,300**	**7.2%**
Total *public* lands open to public recreational access		**5,897,000**	**16.5%**

Table 7: Lands in Wisconsin open to the public for recreation (continued)

Private and Tribal Ownership	**Acres Open to the Public**	**Percent of the State**
Non-government organization lands funded by Stewardship matching grants	70,000	0.2%
Managed Forest Law land open to the public*	1,081,600	3.0%
Forest Crop Law land**	125,800	0.4%
Forest Legacy program easements	248,200	0.7%
Department of Natural Resources – easements on private lands	55,100	0.2%
Voluntary Public Access (VPA) lands	32,000	0.1%
Red Cliff Band of Lake Superior Chippewa	200	0.0%
Total *private and tribal* lands open to public recreational access	**1,612,900**	**4.5%**

* By statute, open for hunting, fishing, hiking, sight-seeing, and cross-country skiing.
** By statute, open for hunting and fishing.

Total: Land Open for Public Recreation	
State of Wisconsin (acres)	**35,640,000**
Land in the state open for public recreation (acres)	**7,509,900**
Percent of the State of Wisconsin open for public recreation	**21%**

See Appendix 3 for maps and a listing of public lands by county.

Photo: Gretchen Marshall

WISCONSINITES

WHEN WE PARTICIPATE

Wisconsin's four-season climate supports a wealth of opportunities for outdoor recreation throughout the year. The seasonal patterns of participation vary across activities; some are popular year-round while others are limited by conditions – like adequate snow or migration events – or by specific dates (for example hunting, fishing and trapping seasons). In addition to participation patterns related to the seasons, there are also ebbs and flows of participation across the days of the week and the times of the day.

Participation in outdoor activities varies from outings of an hour or two (often after work) to half-day or day-long trips (often on weekends) to multi-day vacations. Although people pursue the full gamut of activities in each of these types of getaways, activities differ in the length of time needed to provide a high-quality experience.

For example, participants in activities such as dog walking, trail running, or nature photography can have an excellent experience in as little as a half-hour. Other activities, such as horseback riding, hunting, fishing, canoeing and bicycling are often pursued for two to three hours or longer. Table 8 shows estimates of the frequency of the duration of people's participation in different recreation activities.

Where people go to participate in outdoor activities is, of course, a function of available time and locations of opportunities. One's willingness to travel different distances is often directly related to the time available to participate in an activity. Typically, people are willing to invest a total travel time (getting to and from the destination) no more than the same amount of time they will recreate. If the travel time is much beyond the recreation time, then most people conclude the enjoyment of participating in the outing isn't worth the cost or effort.

Combining travel time and the participation time needed for a high-quality experience provides an indication of what types of activities people typically engage at different distances from home. As an example, since most people walk their dog for 30 minutes to an hour at a time, they typically travel no more than 15 to 30 minutes to a place that would provide a high-quality experience. Thus, most dog walking happens close to home and a map showing where participation takes place would mimic our state's population map.

For other activities, a map of participation would be quite different. Participants in hunting and many motorized activities often spend four to six hours or more a day engaged in these activities; occasionally, participants spend several days in a row on trips. Participants are typically willing to spend four or more hours travelling to locations that provide first-rate experiences. And, of course, camping involves multi-day trips. For these types of activities, a map showing where participation occurs would be more influenced by the locations and characteristics of existing opportunities rather than where people live.

Table 8: Frequency of estimated hours per day participants typically engage in selected nature-based recreation activities*

Recreation Activity	Hours of participation within a day											Multi-day
	0.5	1	1.5	2	2.5	3	4	5	6	7	8+	
Water skiing/tubing/wakeboarding	Most common	Common	Occasional	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely
Swimming in lakes/ponds/rivers	Most common	Common	Occasional	Infrequent	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely
Dog walking on trails	Common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely	Rarely
Target firearm shooting	Common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely	Rarely
Target archery	Common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely	Rarely
Trapping	Occasional	Common	Most common	Common	Occasional	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely	Rarely
Hiking/walking/running on trails	Common	Most common	Most common	Common	Occasional	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Infrequent	Infrequent
Nature photography	Common	Most common	Most common	Common	Occasional	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Infrequent	Rarely
Mountain biking	Infrequent	Common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Rarely	Rarely	Rarely	Rarely
Gathering berries, mushrooms and other wild edibles	Common	Most common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Infrequent	Rarely
Visiting a beach/beach walking	Occasional	Most common	Most common	Most common	Common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Rarely
Cross-country skiing	Occasional	Common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Infrequent	Infrequent
Lake/river fishing from a boat/canoe/kayak	Occasional	Common	Most common	Most common	Most common	Common	Common	Occasional	Occasional	Infrequent	Infrequent	Rarely
Lake/river/stream fishing from shore/wading/pier	Occasional	Common	Most common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Rarely
Motor boating	Infrequent	Common	Most common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Rarely
Horseback riding	Occasional	Common	Most common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Rarely	Rarely	Occasional
Canoeing or kayaking	Infrequent	Common	Most common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent	Occasional
Bicycling on rail-trails or other developed trails	Infrequent	Common	Most common	Most common	Most common	Common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent
Bird/wildlife watching away from home	Infrequent	Common	Most common	Most common	Most common	Common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent
Hunting small game	Infrequent	Occasional	Common	Most common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent
Ice fishing	Infrequent	Occasional	Common	Common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Infrequent	Infrequent
Riding motorcycles on trails/routes	Rarely	Infrequent	Occasional	Common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Infrequent	Infrequent
Riding ATVs/UTVs on trails/routes	Rarely	Infrequent	Occasional	Common	Most common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Occasional
Snowmobiling	Rarely	Infrequent	Occasional	Common	Most common	Most common	Most common	Common	Occasional	Occasional	Infrequent	Occasional
Driving 4-WD vehicles on trails/routes	Rarely	Rarely	Infrequent	Occasional	Common	Most common	Most common	Common	Occasional	Infrequent	Infrequent	Common
Hunting big game	Infrequent	Infrequent	Infrequent	Occasional	Occasional	Common	Common	Most common	Most common	Common	Occasional	Common
RV/pop-up camping	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Most common
Tent camping	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Rarely	Most common

Estimated Frequency	
Rarely (less than 2% of trips) or not applicable	
Infrequent (3% to 9% of trips)	
Occasional (10% to 19% of trips)	
Common (20% to 39% of trips)	
Most common (40% or more of trips)	

**These estimates are based on department staff consultations with outdoor organizations and their professional judgement.*

My Story: Empowered

Sarah Lisiecki

The outdoors is a space for me. A space where there aren't expectations or "shoulds" and a space where I can go to be a happier, healthier, more creative version of the person I was when I went in. As a woman, I spend a lot of time being told how to behave, feel, act and believe.

> *The outdoors offers me a place to transcend those "shoulds" and focus on who I am at the core and who I want to be as my future self.*

Being outdoors – hiking, biking, climbing, kayaking, trail running, camping – allows me to be physically challenged and to confront fear and be brave. Here I feel empowered yet find a peacefulness that is unique to time spent without walls. It allows me to see my body for all it can accomplish and not what it can't. It allows my mind to be relaxed, yet focused.

In the outdoors I build my thoughts, find my peace, overcome and gain confidence. People in the outdoors foster a community; there is something special about these places that brings people together.

> *Being outdoors and void of distractions help me deepen friendships, family relationships and my relationship with myself.*

Maybe it's the struggle followed by the reward or maybe it's being reminded of what's essential and having the opportunity to relish beauty uninterrupted.

Sarah Lisiecki

WISCONSINITES

WHY WE PARTICIPATE

Table 9: Top ten reasons to get outside, US residents, Age 6+[33]

Reasons to get outside	% of respondents
Get exercise	64%
Be with family and friends	55%
Keep physically fit	50%
Observe scenic beauty	49%
Be close to nature	47%
Enjoy the sounds and smells of nature	47%
Get away from the usual demands	40%
Be with people who enjoy the same things I do	31%
Experience excitement and adventure	32%
Experience solitude	20%

Table 10: Top ten reasons to not get outside, US residents, Age 6+[33]

Reasons to *not* get outside	% of respondents
Too busy with family responsibilities	21%
Outdoor recreation equipment is too expensive	18%
Do not have anyone to participate with	17%
Do not have the skills or abilities	16%
Have a physical disability	14%
My health is poor	11%
Places for outdoor recreation cost too much	10%
Too busy with other recreation activities	10%
Places for outdoor recreation are too far away	10%
Do not have enough information	7%

Considerable research has been conducted by various organizations to understand what motivates people to participate in outdoor recreation and what obstacles exist. The results of these research efforts consistently identify social and health benefits as primary drivers of participation. At heart, many people spend time outdoors simply to have fun and get away from daily stresses.

In addition to the reasons that draw people to outdoor activities listed in Table 9, another motivation is the desire to eat locally-grown, sustainable, organic food. This has led some people to take up or increase their participation in hunting, fishing and gathering wild edibles – cultural traditions that have been practiced and maintained by Native Americans and settlers of the region since before Wisconsin achieved statehood.

Although many people understand the health and social benefits of ongoing experiences in nature and are interested in pursuing outdoor activities, there can be a substantial gap between "concept and reality."[30] Competing priorities for time, lack of easy access to places or people to go with, and cost of equipment are often cited as obstacles to participation. Although some types of equipment can be expensive, it should also be noted that the price of computers, phones, Internet and phone service, cable television and other technology can also be costly. For example, Americans spent $36 billion on video games in 2017.[31] This is more than the combined spending on all fishing and hunting equipment ($34 billion).[32]

Table 10 lists top reasons people identify for not getting outside.

Photo: TJ Brusoe

Photo: TravelWisconsin

Photo: Mark LaBarbera

Photo: Mark LaBarbera

My Story: AccessAbility

Monica Spaeni

As daylight faded and the northern Wisconsin forest darkened in the early evening, Monica saw 300 pounds of shadow move closer to her wheelchair. The hungry bruin moved through the trees slowly, pausing often.

Unlike most other hunters, she wasn't in the relative safety of an elevated tree stand. Seconds seemed like minutes and minutes seemed like hours as Monica sat still, her senses tingling with excitement. Monica was focused solely on the bear moving among the shadows. It stepped into an opening nearby. Monica's heart raced. She raised her .308 and shot, killing the bear and filling her freezer.

Her guide, Wayne, and friend, Steve, made it possible for her to hunt bear despite her spinal cord injury.

Monica was in a wheelchair because of a skiing accident when she was chaperoning her child's field trip. She resisted feelings of self-pity and did not settle for a sedentary life.

After the diagnosis that she would not walk again, Monica focused on how she and others could enjoy a life filled with accessible outdoor recreation activities.

It didn't take long for Monica to discover the Action TrackChair, a motorized all-terrain wheelchair that allows anyone to go afield where normal wheelchairs cannot. Soon, Monica was tracking through corn stubble on pheasant hunts, navigating rough trails to fish streams, and traversing wooded terrain in pursuit of whitetails. Dog park trails near home were easy for her motorized wheelchair as she exercised her dog.

She did not stop there. She wanted others to have access to the all-terrain chairs. With help from the local chapter of Pheasants Forever, AccessAbility was born and has grown into an independent, non-profit organization that is building a fleet of chairs throughout the state that can be used by anyone at no cost.

What started as a ski accident that threatened to limit her mobility and future recreation opportunities, has turned into a series of accomplishments that has improved opportunities and access for not just Monica, but so many others.

Mark LaBarbera
Outdoor Heritage Education Center

WISCONSINITES HOW WE BENEFIT

Chronic Diseases and Their Costs

Wisconsinites currently face chronic health issues related to society's increasingly sedate lifestyle.

Despite the growing awareness of the problem, the obesity rate for adults in our state has doubled since 1990.[34]

Maybe more troubling, 25% of adolescents are overweight or obese.

In addition, more than 350,000 Wisconsinites have been diagnosed with diabetes.[35] And in both Wisconsin and the United States, heart disease is a leading cause of death; one-third of all deaths in the state were due to cardiovascular disease.[36] A table of some health care indicators, by county, is presented in Appendix 2.

Chronic diseases exact a substantial cost on the state's economy. The direct costs of these diseases to just the Medicaid system are estimated to total $1.15 billion annually in Wisconsin; if costs to the private sector were included, the amount would be significantly higher.[37]

Health benefits

Most people participate in outdoor activities for enjoyment and because it helps them feel energized and revitalized. The fresh air, exercise, natural settings and companionship with others helps people feel physically and mentally refreshed. Participating in outdoor recreational activities, or simply being in peaceful natural settings, can have substantial benefits to one's mental health. Outdoor exercise has been shown to reduce stress, boost the immune system, diminish the risk of disease and increase life expectancy.

And from walleyes to ducks to mushrooms, "consumptive activities" can be a nutritious source of lean, organic, sustainable food. For many years the DNR has hosted a Learn to Hunt program that links novice hunters with experienced ones. The program is increasingly popular with young urban residents interested in connecting with the state's hunting heritage and harvesting locally-grown, healthy food.

As the physical and mental health benefits of spending time outdoors are better understood, the health care community is developing creative ways to encourage patients to get outside. In one of the better-known examples, some physicians are recommending "park prescriptions" to patients with various chronic diseases.[52]

The health care cost savings generated by participating in outdoor recreation, particularly more strenuous activities, is just beginning to be explored. Given the physical and mental health benefits of outdoor recreation, several programs in Wisconsin (along with many other states) have embarked on campaigns to draw people outside and become more active. Three of these efforts are highlighted on the adjacent page.

Did You Know?

OutWiGo is a statewide initiative encouraging people to improve their overall health and wellness by being active in the outdoors.

Since launching in May 2018, over 2,000 residents have pledged to be active in Wisconsin's Parks, Forests and Trails. OutWiGo aims to reach additional users through outreach, partnership events and social media marketing.

Learn more at:
https://dnr.wi.gov/topic/parks/outwigo.html

OutWiGo

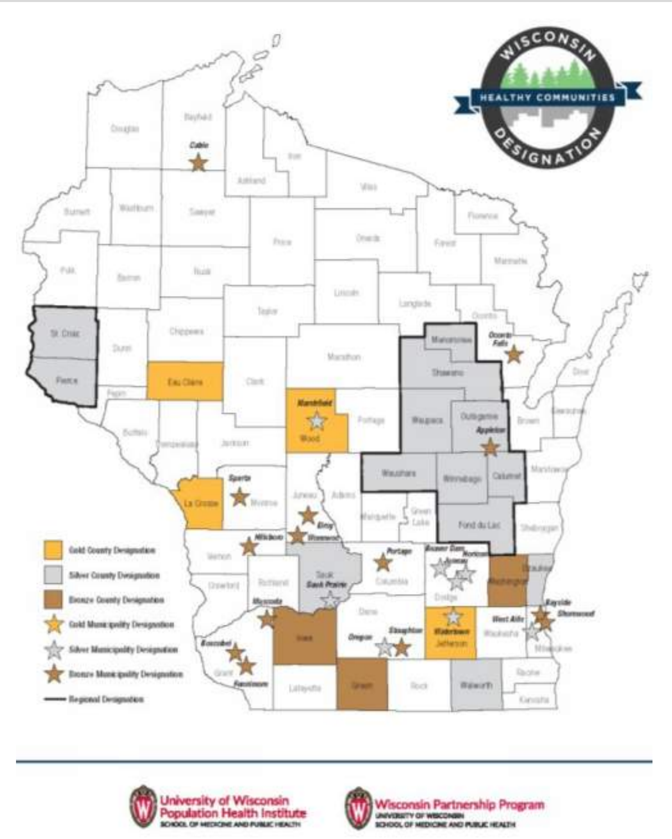
Wisconsin Healthy Communities Designation[38]

This new program encourages achievements in health improvement in Wisconsin by recognizing communities that focus multiple, connected efforts – including health behaviors, clinical care, social and economic factors, and the physical environment – to improve the health of their residents. The program's inaugural round of gold, silver or bronze designations was announced in September 2018 and included 31 communities (Figure 17).

One of only four gold designations went to Jefferson County, which was recognized for its efforts to reduce obesity rates through outdoor exercise strategies (among other programs geared to improving resident's health). The county's Parks Department has been a leader in providing natural-resource-oriented parks and trails that make it easy for residents to get outside, exercise, and enjoy the woods, prairies, and rural landscape. Examples include expanding the popular Glacial River Trail, constructing a new bicycle trail from Watertown to Oconomowoc, increasing recreational offerings in parks, and developing a series of water trails for paddlers.

These and other efforts appear to be paying off; the county's health ranking jumped from 33rd in the state in 2012 to 12th in 2018.

Figure 17: Healthy Communities Designations, 2018



Wisconsin Active Together[39]

Wisconsin Active Together is an initiative that provides recognition awards to community groups or coalitions that are making it easier for people to walk, bike and be active and meet basic criteria to demonstrate that commitment. The initiative was developed in 2017 by a diverse group of state-level and community-based partners that identified the need to support more local-level action on strategies that make physical activity easy, safe and fun in community settings.

Wisconsin Active Together focuses on coalitions and processes working on policies, systems and environments that build physical activity into routine daily life.

The first set of communities recognized were:

- Appleton
- Fond du Lac
- Fox Valley
- La Crosse Region
- New Holstein
- Watertown
- Wausau

Marathon County Strategic Plan

Marathon County recently adopted their 2018-2022 Strategic Plan with an overarching goal to be the healthiest, safest, and most prosperous county in Wisconsin. Their plan recognizes that:

> "Health is not merely restored at the doctor's office, but instead starts in our families, in our schools and workplaces, in our playgrounds and parks, and in the air we breathe and the water we drink. We recognize that health and well-being are lifelong pursuits and that our communities can support positive, healthy lifestyles."

Marathon County Parks, Recreation, and Forestry Department plays a key role in helping meet this goal. With 13 parks and over 30,000 acres of county forest, residents have abundant opportunities to enjoy outdoor recreation and stay active as part of efforts to improve their health. In addition, the lands managed by the Parks, Recreation, and Forestry Department improve air and water quality in the county.

Social benefits

Participation in many nature-based outdoor activities is often a group activity. Families and friends tend to camp, bicycle, ride snowmobiles, ATVs and UTVs, horseback ride, bird watch and hike in groups (see Table 9 - pg. 34: 55% of people stated that they participated in outdoor recreation to "be with family and friends").

The bonds that form through the collective outdoor experiences shared by groups are part of the "social glue" that brings people together. And the stories that accompany particularly memorable outings – whether because of a rare bird sighting, attempting an activity for the first time, reeling in a trophy fish, getting lost in the woods, or the inevitable mishaps that leave people laughing – often become family legends that are retold over and over.

Group activity: Rock climbing

Not only does rock climbing provide participants with sizeable physical and mental benefits, but by its very nature it is a communal and cooperative activity. Participants depend on each other for their personal safety and enjoyment of the experience. Climbers often form tight social bonds that span differences in age, gender, education, ethnicity and cultural backgrounds.

Wisconsin is home to some of the best outdoor climbing and bouldering opportunities in the Midwest. Devil's Lake, Governor Dodge, Interstate, and Willow River state parks draw thousands of participants annually.

Participation in climbing and bouldering has steadily increased both nationally and in Wisconsin. Climbing at Devil's Lake, by far the most popular location in the state, is estimated to have quadrupled over the last several decades. New opportunities are in demand throughout the state.

Outdoor recreation can also be an opportunity for people to meet and better understand each other's perspectives, needs, and motivations. Like sports, the arts, religion, social clubs and school, outdoor recreation can bring together diverse groups of people interested in a common pursuit and provide a forum to interact, learn new customs, and better understand each other. This in turn can strengthen community cohesion and connections to natural resources.

Recent research has indicated a connection between greenspace and the amount of time spent in nature with reduced crime and how people view their surroundings.[40] In Wisconsin, local park programs are increasingly customizing new outdoor recreation facilities to reflect the heritage and current ethnic diversity of the surrounding community. These city parks can serve two purposes – one as an outdoor recreation facility and also as a source of cultural education.

The link between physical activity and academic achievement in a range of school-age children has been the topic of ongoing research. Several studies have shown a positive connection between children's participation in physical pursuits, including nature-based outdoor activities, and improved educational outcomes.[41]

Outdoor recreation groups

Wisconsin has numerous clubs representing hunters, bicyclists, birders, horseback riders, and many other participants. These groups have been exceptionally key players in organizing events, volunteer work days, educational and outreach programs, and in advocating for policies and funding to support outdoor recreation. Participation in these groups is on the rise. For example, the number of snowmobile clubs has grown from 575 to 615 over the last ten years.

My Story: The Outdoors – from Passion to Occupation

Chase Cummings, Pepin County Land Conservation & Planning Director

The Tri-County School Forest is a 280-acre parcel in rural Waushara County that provides an excellent educational setting for students as well as recreational opportunities for the community. Area students from kindergarten through high school visit the property multiple times each year. The school forest is also open to the public to hunt, snowshoe, bicycle, cross-country ski, and picnic.

Rain or shine, Chase Cummings has always enjoyed being outside and connected with natural resources. For Chase, learning was easier in the woods or fields where he could see, hear, and feel his surroundings. It would be an understatement to say that he was very excited to visit the school forest each year.

When he reached high school, Chase became an Environmental Education (EE) Counselor at the forest. In his role, he coordinated field trips for the district's teachers and led a variety of lessons for other kids. Chase had to learn to identify different plants and animals, display leadership ability, and be a good communicator – skills that have benefited him in his career. The EE Counselor program helped give him the boost of confidence needed in more challenging experiences, such as public speaking, that are common elements of his career.

After high school, Chase pursued a degree in Soil and Waste Resources and now works as the Pepin County Land Conservation & Planning Director. Building on his experience at the school forest, in 2011 Chase started Conservation Field Days for 5th and 6th grades in Pepin County.

> *Students and teachers look forward to their twice-yearly trips out in the field learning about natural resources and their management; it has grown into a very successful program.*

As a kid growing up, Chase was fortunate to have opportunities to connect with the outdoors. With the Field Days program he created, he's passing that good fortune on to the next generation and planting the seeds for future conservationists.

Gretchen Marshall
Wisconsin School Forest Program


Photo: Gretchen Marshall


Photo: Gretchen Marshall


Photo: Gretchen Marshall


Photo: Jennifer Gihring

My Story: Small business success
Suzann and Montgomery "Mo" Mouw

How does outdoor recreation drive the tourism economy in Wisconsin? The story of ROAM Adventure Basecamp, located in Seely and offering a modern twist to trailside camping, shows how a couple's passion and love for outdoor recreation and the Northwoods led to a successful new business.

The Chequamegon Area Mountain Bike Association (CAMBA) develops, maintains and promotes over 300 miles of user-friendly biking, skiing and hiking trails in northwest Wisconsin. The extensive trail network was the primary reason Suzann and Mo Mouw have owned a trailside second home in the Hayward area since 2004.

After they acquired 96 acres of land on the American Birkebeiner ski trail in the heart of the CAMBA trail system, Suzann and Mo thought it would be nice to share their love of trailside living with others. Mo states, "though there are a number of campgrounds in the area, none catered specifically to bikers and skiers - thus, the idea of ROAM was hatched."

Started in 2017, the business provides both traditional tent camping sites and trendy, comfortable "tiny house" cabins with easy access to the trails. At the end of the day, guests can unwind in the campsites, eco-friendly cabins, or around a campfire with friends in a secluded natural setting.

The overwhelming feedback they receive from guests is their appreciation of being trailside with direct access to Wisconsin's premier Northwoods trail system. "No more loading gear every time they start an adventure."

The backbone of Wisconsin's tourism industry is small business owners and small family-run operations.

"On any given weekend we bring over a hundred plus people to the area that likely would have gone somewhere else if we did not offer our services," states Mo. Suzann and Mo's ROAM Adventure Basecamp is just one of many examples of how individuals turn their passion for the outdoors into a thriving business that generates travel, creates jobs, and drives economic impact in Wisconsin.

by David Spiegelberg
Wisconsin Department of Tourism

Economic benefits

From manufacturers of outdoor gear to resorts and restaurants, outdoor recreation is a financial powerhouse throughout Wisconsin. People's participation in outdoor recreation results in several types of economic activity. The most obvious is the travel-related spending that occurs on trips. These costs can include gas, meals, supplies (e.g., fuel for motors, bait, and shotgun shells), equipment rentals, overnight accommodations, entry fees, guide services, and various souvenirs. Of course, the amount of spending associated with travel varies considerably. Spending varies due to the distance participants travel, type of activity, personal preferences and other factors.

Typically, people engaged in many nature-based outdoor activities (e.g., bird watching, fishing, hunting, hiking, bicycling, horseback riding or cross-country skiing) spend about $20 to $50/party on day trips (see the sidebar on page 41 for citations).

People participating in motorized activities (snowmobiling and ATV/UTV riding in particular), and overnight trips tend to spend considerably more on a daily basis. It is not uncommon for these participants to spend more the $100/person each day on travel-related expenses.[56]

Another major form of economic activity associated with participation is the purchase and upkeep of outdoor gear. Although most of the supplies and equipment that residents purchase, including from local stores, are made in other states or countries, Wisconsin is home to many manufacturers of equipment used in nature-based recreation. Examples include fishing rods and lures, bicycles, motorboats and boat engines, canoes and kayaks, firearms and bows, and saddles.

In looking at the financial benefits that accrue to an area due to people's participation in outdoor recreation, it is important to highlight money that "moves into" an area from visitors.

In Wisconsin, estimates of overall economic activity related to outdoor recreation range considerably due to differences in the accuracy of data collected, recreation activities and expenditures included, how indirect and induced regional impacts are calculated, the geographic scale of analysis and other factors.

Importantly, outdoor recreation has long been one of the key mechanisms by which economic activity and wealth is transferred from urban areas (and out-of-state visitors) to the state's rural communities.

A tabulation, by county, of the broader tourism industry's economic impact in Wisconsin is provided in Appendix 5.

Did You Know?

Wisconsin hosts dozens of **manufacturers** of outdoor recreation equipment – from fishing rods to sailboats and canoes to bicycles.


Photo: Maggie Kailhofer

Not only does the state's economy benefit from the spending generated by people participating in outdoor recreation, but additional financial benefits are generated by the places that are protected to provide high-quality experiences for residents and visitors.

The property values of privately-owned lands near federal, state, county and local parks, trails, fish and wildlife areas, forests, natural areas and other protected places are typically higher and more stable than other private properties. A recent study for the U.S. Fish & Wildlife Service found that, all else being equal, homes within a half-mile of wildlife refuges are valued on average 3% to 9% higher than houses further away.[53] In Wisconsin, a study found that lots adjacent to the Mountain-Bay State Trail in Brown County sold for an average of 9% more than similar property not located next to the trail.[54.]

The places that provide outdoor recreation opportunities also contribute to nearby communities' quality-of-life, which in turn has a direct impact on their ability to attract businesses. The experiences available at parks, trails and other recreation lands and waters are key selling points that communities use to entice companies to locate and expand their operations.

In today's economy, high technology and service-sector industries are prime sources of wealth creation and growth; their workers are typically interested in a diverse range of outdoor activities. Communities that can tap into their natural resource base to provide opportunities for active experiences – from biking to rock climbing to kayaking – stand to benefit economically.[55]

Finally, providing opportunities for outdoor recreation complements other natural resource-based industries in the state, most notably the forest industry in the north. Similarly, several utility companies manage flowages throughout the state for power generation and flood control. They also provide the public with boat access sites and associated facilities on some of Wisconsin's most popular waterbodies.

Did you know?

Places open for public recreation also provide a wide range of high-quality habitats that support a diversity of native plants and animals. Indeed, some of the most ecologically important places in the state – Devil's Lake and Peninsula state parks, Kettle Moraine State Forest, the Apostle Islands and Horicon Marsh – are also among our most popular recreation destinations. It is estimated that over 75% of the Species of Greatest Conservation Need in Wisconsin are found on public lands in the state.[59]

In addition to their habitat values, places open for public recreation also provide a range of ecological services including: flood control, groundwater replenishment, water and air filtration, nutrient capture, refuges for insects that pollinate agricultural crops, carbon sequestration, and temperature moderation.[57]

A recent study found that the benefits generated from ecosystem services on lands acquired by the Minnesota DNR ranged from $19 to $154 per acre, annually.[58] It is likely that public lands in Wisconsin provide similar values.

Outdoor recreation: big business in Wisconsin!

Some examples of the economic impact of outdoor recreation in Wisconsin:

- Consumer spending on outdoor recreation in Wisconsin totaled **$17.9 billion** which resulted in 168,000 directly-related jobs, $5.1 billion in wages and salaries, and $1.1 billion in state and local tax revenue.[42]
- Properties in the Wisconsin State Park system draw an estimated 14 million visitor-days that generate more than **$1.0 billion in annual expenditures** in local communities.[43]
- **$19 million** in trip and equipment expenditures associated with waterfowl hunting in Wisconsin.[44]
- **$1.5 billion** in retail sales, 36,000 jobs and $235 million in state and local tax revenue generated by wildlife watchers in Wisconsin.[45]
- **$425 million** in output and personal incomes related to bicycle manufacturing in Wisconsin.[46]
- **$1.6 billion** annual total spending and economic impact generated by trout fishing in the Driftless Area (much of which is in Wisconsin).[47]
- **$1.4 billion** in sales generated by Wisconsin's horse industry.[48]
- Research conducted for the Wisconsin Department of Tourism indicates that day visitors to tourism events (which includes outdoor recreation trips) spend an average of **$64 per visitor** and overnight visitors spend **$144 per visitor**.[49]
- Wisconsin ATV riders spend on average **$164 per day** while out-of-state riders spend an average of **$573 per trip** to Wisconsin.[50] A more recent study found that ATV riders spent between $355 and $427 per trip while visiting the network of trails in Jackson County.[51]

Photo: Greg Sanderson

ISSUES, CONCERNS, AND FACTORS INFLUENCING THE FUTURE OF OUTDOOR RECREATION

This section summarizes key topics that are expected to affect the future demand for outdoor recreation opportunities, as well as the nature of experiences, in Wisconsin.

Demographic Changes

The continued evolution of our population's demographic characteristics will drive changes in recreation participation. As our population continues to age, urbanize and diversify, participation rates and frequencies in outdoor recreation will change. Existing data suggest that the increase in older residents will drive an increase in the popularity of activities such as hiking, dog walking, bicycling, UTV riding, nature photography and bird watching.

Condition of Recreation Facilities

Ongoing maintenance is key to protecting public investments in outdoor recreation and ensuring that existing facilities continue to provide satisfying experiences for the public. Although many recreation facilities are modest in design and scale, they require ongoing maintenance to remain safe, useable and enjoyable. The flip-side of a long history of outdoor recreation infrastructure in Wisconsin is a large portfolio of older infrastructure in need of upgrades to meet user expectations and heavier use (e.g., conversion of pit toilets to plumbed toilet/shower buildings). Adequate funding is key to adequate maintenance. For example, in 2017, all projects supported with LWCF grants on state properties involved repair or renovation of existing facilities.

Technology Advances

Technological advances affect all aspects of our lives, including outdoor recreation. From electric bikes to WiFi in campgrounds, technology is changing recreational experiences and providing new ways for people to engage in the outdoors. These changes require recreation providers to develop and implement new policies, manage an increasing number of uses (many of which can conflict with more traditional ones) and adapt to shifting conditions and demands. Adequate funding is also key to support modernization of outdoor recreation infrastructure to meet public expectations.

Social media provides a means to share experiences quickly and widely, which can help recreation providers attract a broader audience and better understand the features and attributes that drive demand. Attention and interest on social media can also result in visitation spikes.

Access to Public Lands

A longstanding issue complicating efforts to provide opportunities for several types of outdoor recreation in Wisconsin is the distribution of where many of the state's residents live and the locations of most public conservation and recreation lands. In large part driven by historical land use patterns and the economic fallout of the Great Depression in the 1920s and 1930s, over half of the lands open to the public (over 3.1 million acres) are located in just ten northern counties. Over half of the state's population resides in just nine counties, all in the southern or eastern part of Wisconsin.

This inverse distribution of public land and people means that for many residents wanting to participate in activities that require larger expanses of land they often must travel multiple hours. And as peoples' lives become busier and they have less time to devote to outdoor recreation (and the travel time required), the use of many public lands near urban centers – for example, Kettle Moraine State Forest, Devil's Lake, High Cliff and Kohler-Andrae state parks, and Richard Bong State Recreation Area – has grown significantly.


Photo: Susan Braun

Access to Private Lands

A generation or two ago, a higher percentage of our population lived in rural settings (see Figure 6 on page 20) and people who lived in cities were likely to have a relative or close friend that lived in the country. Consequently, many residents could get permission to hunt, fish, hike, pick berries or other activities on land owned by someone they knew. More and more residents now live in urban or suburban settings and no longer have direct contact with rural landowners.

In addition, there has been a loss of public access to industrial forest land in recent decades as paper companies, which historically owned over a million acres in the state and allowed public access, have sold most of their land holdings to timber investment management organizations or real estate investment trusts. These new owners typically have not re-enrolled their lands into programs that allow public access (Managed Forest Law).

Two programs administered by the DNR facilitate public access to private land for recreation purposes:

Managed Forest Law (MFL) Program

The program reduces property taxes for eligible landowners in return for implementing a certified forest management plan for their property. Landowners can choose to allow public access for hunting, fishing, hiking, sight-seeing, and cross-country skiing (for which they receive a greater financial benefit).

Voluntary Public Access (VPA) Program

Landowners who are willing to allow the public to hunt, fish, trap and watch wildlife on their property can enroll in this program and receive a modest payment. Recently, 32,000 acres had been enrolled.

Compatibility

The overwhelming majority of outdoor recreation occurs without significant conflicts between participants in the same or different activities. However, on occasion, conflicts emerge that can impact participant's satisfaction. Often, an underlying cause of recreation conflict is simply the density of use in an area. Even activities that are prone to conflict with one another (e.g., water skiing and fishing on the same lake) can co-exist if the number of interactions is minimal. Yet, as the number of participants in an area increases, overcrowding can easily emerge and result in conflicts and displacement of visitors. Many outdoor recreation providers increasingly must devote resources to address conflicts.

Aspects that can influence compatibility include:

- Expectations of participants about interactions with others.
- Skill and experience level of participants.
- Duration and intensity of interactions.
- Tolerance levels of participants, including social values and beliefs.

Techniques that can increase compatibility and decrease conflicts include:

- Education, outreach, and signage.
- Community engagement and self-policing by groups and clubs.
- Regulations and enforcement.
- Separation of participants in time and/or space.

Invasive Species and Habitat Quality

People have moved living things - sometimes purposefully, sometimes inadvertently - for millennia. Occasionally when non-native species are brought into a new area, they will spread rapidly and widely. When this happens, major impacts can occur to native wetland and upland ecosystems, farm and ranch lands, lakes and streams, and other settings. Invasive plants, animals, and pathogens can alter ecological relationships among native species and can affect ecosystem function, economic value of ecosystems, and human health.

Invasive plants and animals can significantly affect recreational experiences. Hunters, hikers and birdwatchers can find they are no longer able to walk in their favorite areas. Thorny multiflora rose, dense stands of buckthorn and other invaders can fill in the understory of once open native forests and grasslands. As habitats are modified by invasive plant species, wildlife that depend on native vegetation are affected. Invasive animals such as the mute swan can also change wildlife opportunities by chasing away waterfowl from the waterbodies they occupy.

Fishing outings can result in disappointment when aquatic invasive species modify lake and stream habitat. Eurasian water-milfoil clogs boat motors and invasive animals, such as the rusty crayfish, devour aquatic plants, reducing habitat for native fish at every stage of their life cycle.

Weather Patterns and Changing Climate

Weather patterns directly affect participation in outdoor recreation – a rainy weekend can result in cancelled camping or bicycling plans, while a very snowy winter in the north can attract lots of snowmobilers and skiers from Madison, Milwaukee and Chicago.

The changing patterns of our climate over extended periods of time may also affect the type and timing of participation. If, as predicted, spring arrives earlier and autumn later, opportunities for many types of outdoor recreation activities will be extended while others may be reduced. For example, reduced snow cover may lead some cross country skiers to shift to fat-tire biking, which doesn't require as much snow pack for an enjoyable experience.

Species' ranges and migration periods are projected to continue shifting as well.[60] This is likely to affect activities such as bird watching, hunting, and fishing over time.

Funding for Providing and Operating Places

Purchasing lands, developing and maintaining recreation facilities, managing habitats, enforcing regulations, and the other tasks associated with operating Wisconsin's recreation infrastructure is costly. Federal, state, and local agencies spend millions of dollars managing public lands each year.

Funds to maintain and operate conservation lands and recreation facilities come from a variety of sources, including hunting, fishing and trapping licenses and stamps, park entrance fees, trail passes, excise taxes on hunting and fishing equipment, grants and donations.

In addition to LWCF funds, over the last 25 years the DNR, local units of government, and non-profit conservation organizations have used funds from the Wisconsin Knowles-Nelson Stewardship program to help pay for many of the lands and facilities that provide recreation opportunities around the state.

The Stewardship funding is currently $33.25 million per year, allocated as follows:

- DNR land acquisition: $9.0 million (1/3rd for purchasing land, 2/3rd for purchasing easements)
- DNR property development: $3.75 million
- Grants to counties to acquire lands for county forests: $5.0 million
- Matching grants to local units of government (LUGs) for property development and land acquisition: $6.0 million
- Matching grants to non-profit conservation organizations for land acquisition: $7.0 million
- Recreational boating aids: $2.5 million

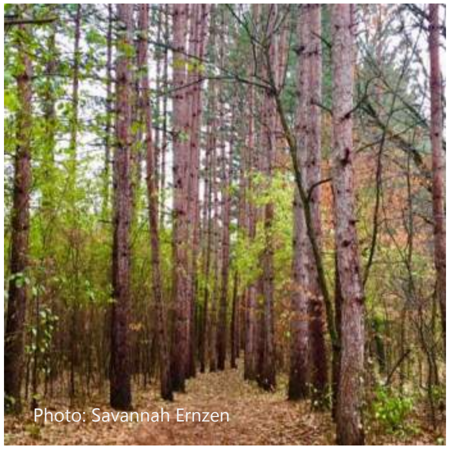


Photo: Savannah Ernzen


Photo: Dan Thoftne

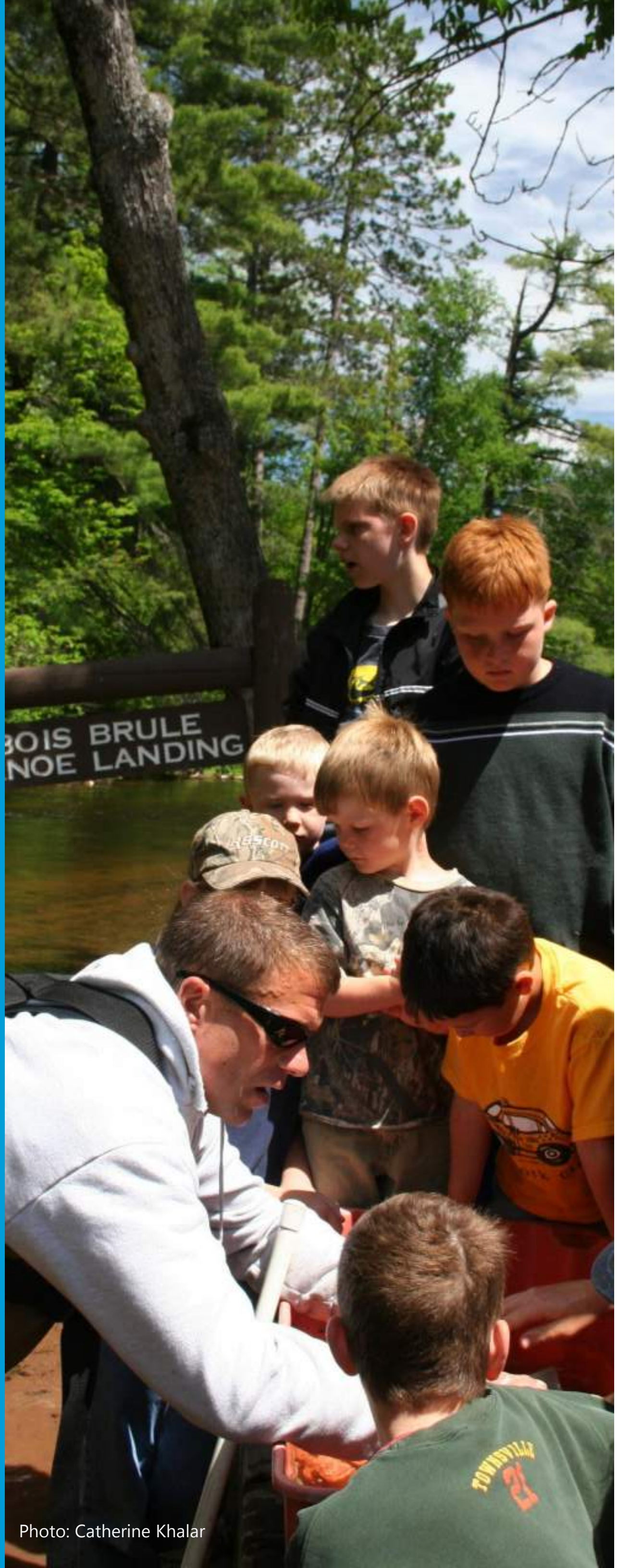


Photo: Catherine Khalar

GAPS AND NEEDS IN OUR EXISTING RECREATION OPPORTUNITIES

In developing the following statewide needs and gaps in our recreation opportunities, the department incorporated information from:

- The SCORP recreation participation survey question regarding needed recreation opportunities in residents' home county (Appendix 6).
- Recreation Opportunities Analysis, which identified recreation needs for each of the eight regions of the state (Appendix 8).
- The SCORP survey of county park directors, which asked about needs at the county level (Appendix 4).
- The SCORP Advisory Team and department staff.

Statewide Recreation Needs:

Places near population centers

Because of the inverse distribution of our population and public lands as well as the limited amount of time people have to participate, there is a very large need to provide more places for people to participate in outdoor recreation near where they live. In particular is the need to provide opportunities for residents to visit places after work or for a couple of hours on a weekend. Places that provide opportunities for hiking, all types of bicycle riding, dog walking, picnicking, and different water-related activities such as fishing, canoeing and kayaking are likely to be heavily used.

Trails

By nearly every measure, the largest need throughout the state is for more trails that enable people to experience natural settings, visit the vibrant downtowns of our cities and villages, commute to work, and access favorite sites. All types of trails are in demand – hiking, bicycling, horseback riding, snowmobiling, ATV/UTV and motorcycle riding, and 4WD vehicle trails.

Water access – shoreline and boat launches

Lakes, streams and rivers are a defining feature of Wisconsin. From the Great Lakes to the Mississippi River, from the thousands of inland lakes and the tens of thousands of miles of flowing water, residents and visitors have been drawn to the water's edge to fish, hunt, launch any manner of watercraft, bird watch and beach walk. Access to water remains a universal need throughout the state.

Camping opportunities

With a large cohort of retirees travelling in RVs combined with an adventurous younger generation, demand for camping has grown in recent years and is likely to remain popular for years to come. Given the divergence in desired experiences – some campers wanting access to hot showers and WiFi while others wanting neither – recreation providers will need to collaborate and coordinate on providing the camping experiences best suited to different public lands.

Statewide Recreation Needs: (cont.)

Dog parks and exercise areas

Taking care of a dog has many benefits, not the least of which is the exercise people get in walking their pets. With the steady rise in dog ownership (75% of people in their thirties own a dog) and an urbanizing population has come an increasing demand for places to walk, play with, socialize and train our canine friends. Many municipal and county dog parks are among their most visited properties.

Target shooting ranges

Many hunters and shooting sports participants live in rural areas or belong to gun clubs and practice their craft on their or the club's property. However, as our population continues to urbanize there is a growing need for places where people can practice gun and archery marksmanship and safety. By their nature, firearm ranges generate considerable sounds and siting new ranges has been a challenge in more populated areas of the state.

Statewide Policy Needs:

Better understand place-based recreation and associated outcomes

The survey conducted for this SCORP on recreation participation generated considerable data on which outdoor activities residents pursue and how often (see Appendix 6). What is not well known is where these "participation days" actually take place – that is, where, when, and why they occur at different places. Questions for which more detailed, property-specific, place-based data are needed include:

- How many people visit the place or property?
- When and what are the patterns of visitation?
- What recreation activities do they pursue?
- How far do visitors travel to reach the property and why did they visit the particular property (as opposed to other options)?
- What would improve their satisfaction?
- What are the economic, health, and social benefits associated with their visit?

With a more complete understanding of property use and the features and attributes that draw people, agencies can make more informed decisions about what types of recreation facilities to build and maintain at different places. And the public can better understand their "return on investment."

Better understand the nature-based recreation preferences of our diversifying population

Data are needed on the recreation preferences of our changing population. For a range of reasons, people of varying ages, residential settings, incomes, and social, racial, ethnic and cultural identities participate in different types of outdoor activities in different places. More information is needed on the types of activities and settings sought by the diversity of Wisconsin residents. In addition, data on how and where to most effectively provide quality experiences for people with varying backgrounds and cultures are needed.

Enhance and stabilize funding for outdoor recreation

Funding for conservation and recreation is derived from many sources and the overall total has fluctuated considerably from year to year. This has complicated efforts to plan, develop, and maintain recreation facilities. Some states have implemented funding sources that provide a more stable source of money for conservation and recreation projects. In addition to more consistent funding, there is a need to broaden the network of people and sources that help pay for the management of public lands in the state.

Expand collaborations among recreation providers

Each recreation provider has unique capabilities and their lands offer different types of experiences, features, facilities, and opportunities. There would be substantial benefit in continuing and expanding collaborations among federal, county and local governments. Focus should be placed on identifying ways to coordinate recreation experiences in each region of the state, minimizing duplicative efforts, and maximizing the benefits of recreation investments.

Together, providing well-planned, safe and enjoyable recreation opportunities that visitor's value will increase support for local communities and businesses, strengthen tourism, respond to evolving demographic and visitor needs, reduce user conflicts and improve natural settings.

Regional Recreation Needs (high needs identified in the **Recreation Opportunities Analysis** – see Appendix 8)

Great Northwest Region

ATV/UTV riding
Bicycling - bicycle touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping - developed and primitive
Canoeing or kayaking
Fishing
Four-wheel vehicle driving
Hiking, walking, trail running, backpacking
Hunting - big game
Motor boating (inc. waterski/tubing, personal watercraft)
Off-highway motorcycle riding
Swimming in lakes and rivers

Western Sands Region

Bicycling - bicycle touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping - developed and primitive
Canoeing or kayaking
Cross country skiing
Dog walking
Fishing
Hiking, walking, trail running, backpacking
Horseback riding
Hunting - big game
Picnicking
Snowshoeing
Swimming in lakes and rivers

Mississippi River Corridor Region

Bicycling - bicycle touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping - developed and primitive
Canoeing or kayaking
Cross country skiing
Dog walking
Fishing
Gather mushrooms, berries, etc.
Hiking, walking, trail running, backpacking
Hunting - big game
Nature photography
Participating in nature-based education programs
Picnicking
Snowshoeing
Visiting a beach, beach walking

Northwoods Region

ATV/UTV riding
Bicycling – bicycle touring/road riding and mountain biking/off-road biking
Camping – developed and primitive
Canoeing or kayaking
Fishing
Four-wheel vehicle driving
Hiking, walking, trail running, backpacking
Hunting – big game
Off-highway motorcycle riding
Participating in nature-based education programs
Snowmobiling

Southern Gateways Region

ATV/UTV riding
Bicycling – bicycle touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping – developed and primitive
Canoeing or kayaking
Fishing
Gather mushrooms, berries, etc.
Hiking, walking, trail running, backpacking
Motor boating (inc. waterski/tubing, personal watercraft)
Picnicking
Snowshoeing
Swimming in lakes and rivers

Upper Lake Michigan Coastal Region

Bicycling – bicycle touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping – developed and primitive
Canoeing or kayaking
Fishing – all types
Hiking, walking, trail running or backpacking
Horseback riding
Motor boating (inc. waterski/tubing, personal watercraft)
Visiting a beach, beach walking

Lake Winnebago Waters Region

Bicycling – bicycling touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping – developed and primitive
Canoeing or kayaking
Cross country skiing
Dog walking
Fishing
Hiking, walking, trail running, backpacking
Hunting – big game
Motor boating (inc. waterski/tubing, personal watercraft)
Nature photography
Participating in nature-based education programs
Picnicking
Swimming in lakes and rivers
Visiting a beach, beach walking

Lower Lake Michigan Coastal Region

Bicycling - bicycle touring/road riding and mountain biking/off-road biking
Bird or wildlife watching
Camping - primitive
Canoeing or kayaking
Cross country skiing
Fishing
Gather mushrooms, berries, etc.
Hiking, walking, trail running, backpacking
Motor boating (inc. waterski/tubing, personal watercraft)
Nature photography
Picnicking
Snowshoeing
Swimming in lakes and rivers

CHAPTER III
LOOKING AHEAD

Wisconsin has beautiful places, a four-season climate, healthy and diverse habitats, and citizens that care deeply about the environment and enthusiastically participate in a wide range of outdoor recreation activities.

Together, these provide the framework for identifying goals for the future.

Photo: Mike Grota

STATE OF WISCONSIN'S GOALS FOR OUTDOOR RECREATION

1. **Boost participation in outdoor recreation**
2. **Grow partnerships**
3. **Provide high-quality experiences**
4. **Improve data to enhance visitor experiences and benefits**
5. **Enhance funding and financial stability**

BOOST PARTICIPATION

Increase Wisconsin residents' participation and frequency of participation in outdoor recreation.

Objectives

- Increase the economic, social, and public health benefits resulting from residents' and out-of-state visitors' participation in outdoor recreation in Wisconsin.
- Enhance residents' overall quality of life.

Desired Actions

- Increase promotion and marketing of places that provide high-quality outdoor experiences.
- Continue improving the Public Access Lands maps and online mapping application.
- Continue upgrading and developing recreation facilities to meet demand.
- Evaluate visitor use at different types of public lands and waters.
- Identify and implement strategies to improve access, reduce barriers, and provide desired experiences, particularly for groups that have traditionally had lower participation rates or limited access.
- Expand efforts among federal, state, county, and local governments to coordinate and collaborate on providing recreation opportunities that leverage the unique features and facilities available at their lands and waters.
- Identify and implement programs to encourage more residents to participate in outdoor recreation, particularly as they age.

Photo: Joseph Warren

GOAL 2

GROW PARTNERSHIPS

Continue to strengthen connections and partnerships across the spectrum of agencies, organizations, and businesses with a vested interest in outdoor recreation.

Objectives

- Improve the effectiveness of public and private recreation providers in delivering high-quality experiences for residents and out-of-state visitors.
- Enhance the success of industries that manufacture outdoor recreation equipment and businesses that provide a range of facilities, retail opportunities and travel-related services associated with outdoor recreation.
- Facilitate support and advocacy for policies, programs and funding to enhance outdoor recreation opportunities.
- Integrate and coordinate SCORP, local outdoor recreation plans, and other agencies' and organizations' recreation plans.

Desired Actions

- Strengthen collaborations across public and private owners of land that provide recreation opportunities. Identify ways to provide more and enhanced participation opportunities across the collective portfolio of public and private lands.
- Continue building partnerships between outdoor recreation providers and the health care industry to improve residents' physical and mental health.
- Bring together manufacturers of outdoor gear & equipment with recreation providers to identify ways to market Wisconsin-made products and increase participation.
- Cultivate collaboration between outdoor recreation groups and non-traditional partners.
- Increase outdoor recreation opportunities by coordinating recreation interest groups, health care providers, recreation providers, elected officials and others to collaboratively develop outdoor recreation projects.

PROVIDE HIGH-QUALITY EXPERIENCES

Provide opportunities and settings – across the full range of public and private recreation lands – that, collectively, meet the state's recreational needs.

Objectives

- Encourage participation across all types of recreation.
- Provide recreation opportunities that properties are well-suited to provide.
- Seek to improve compatibility and lessen conflict among and between recreational uses.
- Maintain and enhance the ecological health of recreation properties and enrich people's connection with nature.
- Tailor recreation opportunities provided at places to match local conditions, needs, and requests.

Desired Actions

- Provide collections of recreation experiences that are matched to property conditions, needs and opportunities and that maximize compatibility.
- Identify and proactively address potential obstacles, conflicts and issues related to providing high-quality outdoor recreation experiences.
- Assess satisfaction of participants in a range of outdoor activities.

IMPROVE DATA TO ENHANCE VISITOR EXPERIENCES AND BENEFITS

On an ongoing basis, gather, analyze and distribute data on recreation participation in Wisconsin and associated economic, health and social benefits.

Objectives

- Improve the public's and elected officials' understanding of the economic, health and social benefits from public and private investments in outdoor recreation.
- Improve property managers' and administrators' understanding of both property-specific patterns of use and potential ways to improve visitor experiences.
- Improve public and private providers' understanding of regional recreational demands.
- Inform the next iteration of the Wisconsin SCORP.
- Better understand the recreation facilities and amenities that draw visitors to different types of properties.

Desired Actions

- Develop a standard protocol to assess visitation and satisfaction that can be applied to a wide variety of outdoor recreation properties.
- Gather data at an initial set of places on numbers of visitors, activities pursued, patterns of visitation, levels of satisfaction, travel-related spending and, as feasible, other information related to property use and management.
- Apply information related to property visitation to the DNR's property planning process for decisions related to individual properties and broader regional needs.
- In support of the development of the next iteration of the Wisconsin SCORP, assess overall outdoor recreation participation in Wisconsin and associated issues through a statewide survey.

ENHANCE FUNDING AND FINANCIAL STABILITY

Broaden and strengthen the funding sources for developing and managing outdoor recreation facilities and lands.

Objectives

- Provide a robust, long-term, and stable funding framework for outdoor recreation facilities and lands in Wisconsin.
- Identify ways for all participants in outdoor recreation to contribute equitably to the development and management of recreation opportunities.

Desired Actions

- Facilitate collaboration among federal, state, tribal, and local governments and other partners to fully utilize available LWCF and state funding to maintain, develop, and enhance outdoor recreation facilities.
- Develop and distribute materials that describe the economic, health and social values of outdoor recreation.
- Continue building and encouraging public property friends groups.
- Survey outdoor recreation participants to identify their support for different options to fund the development and operation of recreation facilities.
- Explore opportunities for public land management agencies to cooperatively develop creative funding solutions and efficiencies to meet recreation needs.

Photo: City of Madison

LAND & WATER CONSERVATION FUND PRIORITIES IN WISCONSIN OVER THE NEXT FIVE YEARS

As required by federal guidelines, Wisconsin has developed an Open Project Selection Process (OPSP) that provides criteria and standards for grant selection to distribute LWCF funds. The OPSP assures equal opportunity for eligible project applicants to participate in the benefits of the LWCF State Assistance Program.

Wisconsin has developed a project selection process that evaluates and selects projects based on quality and conformance with its priority rating system. Grants cover 50% of eligible project costs. The adjacent information provides guidance for how the State of Wisconsin will utilize LWCF monies to help achieve its recreation goals and objectives.

Wisconsin Open Project Selection Process (OPSP)

As described in Wisconsin Administrative Code (ch. NR 50.06), Wisconsin divides its LWCF allocation between state projects and pass-through grants to local governments, school districts, and Native American tribes. For state projects, LWCF project selection occurs via the DNR capital budget development and property planning process.

Proposed projects are evaluated and prioritized on three criteria: compatibility with the property master plan, compatibility with the six-year facility plan, and available matching funds.

Local projects are selected through a competitive grant process. Applications are accepted once per year. DNR grant staff score applications on a series of criteria that reflect statutory requirements, administrative code, and program policies. Projects are awarded funds in rank order until funds are fully utilized. Program application materials are reviewed and revised annually (Appendix 9). The DNR works closely with selected project sponsors to conduct final reviews and submit proposed grants to NPS for review. Each grant must be approved by the NPS.

LWCF Grants:

Eligible Applicants

- Towns, villages, cities, counties, tribal governments, and school districts are eligible.

Eligible Projects

- Land acquisition or development projects that will provide opportunities for public outdoor recreation.
- Property with frontage on rivers, streams, lakes, estuaries and reservoirs that will provide water-based outdoor recreation.
- Property that provides special recreation opportunities, such as floodplains, wetlands and areas adjacent to scenic highways.
- Natural areas and outstanding scenic areas, where the objective is to preserve the scenic or natural values, including wildlife areas and areas of physical or biological importance. These areas shall be open to the general public for outdoor recreation use to the extent that the natural attributes of the areas will not be seriously impaired or lost.
- Land or development within urban areas for day use picnic areas.
- Land or development of nature-based recreation trails.
- Development of basic outdoor recreation facilities.
- Renovation of existing outdoor recreation facilities which are in danger of being lost for public use.

Funding Priorities

- Meet the needs of urban areas.
- Provide recreation opportunities that serve diverse populations.
- Develop facilities in areas with limited outdoor recreation opportunities.
- Provide multi-use facilities.
- Meet outdoor recreation needs identified by local communities.

See **Appendix 9** for more information on grant guidance

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Since 1965, the following 532 entities have received grants from the
Land and Water Conservation Fund
to help fund recreation projects throughout Wisconsin.

Native American Nations

- Menominee Indian Tribe
- Oneida Indian Tribe

State agencies

- Department of Natural Resources
- Department of Transportation
- University of Wisconsin

Counties

- Adams
- Barron
- Bayfield
- Brown
- Burnett
- Calumet
- Chippewa
- Clark
- Columbia
- Dane
- Dodge
- Door
- Douglas
- Dunn
- Eau Claire
- Florence
- Fond du Lac
- Forest
- Green Lake
- Iron
- Jackson
- Jefferson
- Juneau
- Kenosha
- Kewaunee
- La Crosse
- Lafayette
- Langlade
- Lincoln
- Manitowoc
- Marathon
- Marinette
- Marquette
- Milwaukee
- Oconto
- Oneida
- Outagamie
- Ozaukee
- Pepin
- Pierce
- Polk
- Portage
- Price
- Racine
- Richland
- Rock
- Sauk
- Sawyer
- Shawano
- Sheboygan
- St. Croix
- Taylor
- Trempealeau
- Vernon
- Vilas
- Washburn
- Washington
- Waukesha
- Waupaca
- Waushara
- Winnebago
- Wood

Cities

- Abbotsford
- Adams
- Algoma
- Alma
- Altoona
- Antigo
- Appleton
- Arcadia
- Ashland
- Baraboo
- Barron
- Bayfield
- Beaver Dam
- Beloit
- Berlin
- Black River Falls
- Blair
- Bloomer
- Boscobel
- Brillion
- Brodhead
- Brookfield
- Buffalo
- Cashton
- Cedarburg
- Chilton
- Chippewa Falls
- Clintonville
- Cuba City
- Darlington
- De Pere
- Delafield
- Dodgeville
- Durand
- Eagle River
- Eau Claire
- Edgerton
- Fennimore
- Fond du Lac
- Fort Atkinson
- Galesville
- Glenwood City
- Grand Chute
- Green Bay
- Green Lake
- Hartford
- Hillsboro
- Hudson
- Hurley
- Independence
- Janesville
- Jefferson
- Juneau
- Kaukauna
- Kenosha
- Kewaunee
- Kiel
- La Crosse
- Ladysmith
- Lake Geneva
- Lake Mills
- Lancaster
- Lodi
- Madison
- Manawa
- Manitowoc
- Marinette
- Marion
- Marshfield
- Mauston
- Mayville
- Medford
- Menasha
- Menomonie
- Merrill
- Middleton
- Milwaukee
- Mineral Point
- Mondovi
- Monona
- Monroe
- Montello
- Mosinee
- Muskego
- Neenah
- New Berlin
- New Holstein
- New London
- New Richmond
- Oak Creek
- Oconomowoc
- Oconto
- Oconto Falls
- Omro
- Onalaska
- Oshkosh
- Osseo
- Park Falls
- Peshtigo
- Pewaukee
- Platteville
- Plymouth
- Port Washington
- Portage
- Princeton
- Racine
- Reedsburg
- Rhinelander
- Rice Lake
- Richland Center
- River Falls
- Seymour
- Shawano
- Sheboygan
- Sheboygan Falls
- Shell Lake
- Shullsburg
- Sparta
- Spooner
- Stanley
- Star Prairie
- Stevens Point
- Stoughton
- Sturgeon Bay
- Sun Prairie
- Superior
- Tomah
- Tomahawk
- Two Rivers
- Verona
- Viroqua
- Washburn
- Watertown
- Waukesha
- Waupaca
- Waupun
- Wausau
- Wautoma
- Wauwatosa
- West Bend
- Westby
- Weyauwega
- Whitehall
- Whitewater
- Wisconsin Dells
- Wisconsin Rapids

Villages

- Allouez
- Alma Center
- Aniwa
- Arena
- Argyle
- Arpin
- Ashwaubenon
- Athens
- Auburndale
- Baldwin
- Balsam Lake
- Bangor
- Barneveld
- Bay City
- Bear Creek
- Belmont
- Big Bend
- Birnamwood
- Black Creek
- Black Earth
- Bloomington
- Blue Mounds
- Bonduel
- Bowler
- Boyceville
- Brandon
- Brownsville
- Butler
- Cambria
- Camp Douglas
- Campbellsport
- Casco
- Cassville
- Cazenovia
- Cecil
- Cedar Grove
- Clayton
- Clear Lake
- Cleveland
- Cobb-Highland
- Cochrane
- Coleman
- Colfax
- Coloma
- Combined Locks
- Coon Valley
- Cross Plains
- Dane
- Darien
- De Soto
- Deerfield
- Deforest
- Dickeyville
- Dorchester
- Dresser
- East Troy
- Edgar
- Eleva
- Elk Mound
- Ellsworth
- Elmwood
- Endeavor
- Ephraim
- Ettrick
- Fall Creek
- Fall River
- Forestville
- Fox Lake
- Francis Creek
- Fredonia
- Friendship
- Friesland
- Gays Mills
- Germantown
- Gilman
- Glenbeulah
- Grafton
- Grantsburg
- Greendale
- Gresham
- Hammond
- Hancock
- Hatley
- Highland
- Hollandale
- Hortonville
- Howard
- Howards Grove
- Hustler
- Iola
- Iron Ridge
- Junction City
- Kellnersville
- Kendall
- Kewaskum
- Kimberly
- La Farge
- Lake Delton
- Little Chute
- Lomira
- Lone Rock
- Luxemburg
- Lyndon Station
- Maribel
- Mcfarland
- Melrose
- Mishicot
- Montfort
- Monticello
- Mount Horeb
- Mukwonago
- Muscoda
- Nashotah
- Nelsonville
- New Glarus
- Niagara
- North Hudson
- Norwalk
- Oakfield
- Oregon
- Orfordville
- Pardeeville
- Pepin
- Plainfield
- Plover
- Poplar
- Port Edwards
- Prentice
- Randolph
- Redgranite
- Rib Lake
- Roberts
- Rosendale
- Rothschild
- Rudolph
- Sauk City
- Saukville
- Scandinavia
- Sharon
- Sherwood
- Shorewood
- Sister Bay
- Slinger
- Soldiers Grove
- Somerset
- Spring Green
- Spring Valley
- St. Cloud
- St. Nazianz
- Stockbridge
- Stockholm
- Stoddard
- Strum
- Suring
- Taylor
- Theresa
- Tigerton
- Trempealeau
- Turtle Lake
- Twin Lakes
- Viola
- Warrens
- Waunakee
- West Salem
- Weston
- Westport
- Weyerhauser
- White Lake
- Whitelaw
- Whiting
- Wilton
- Winneconne
- Wittenberg
- Woodville

Towns

- Allouez
- Angelica
- Armstrong Creek
- Bass Lake
- Belle Plaine
- Bellevue
- Bellevue
- Bone Lake
- Brussels
- Caledonia
- Caledonia
- Clay Banks
- Clayton
- Clinton
- Cottage Grove
- Dunn
- Eagle Point
- Eau Pleine
- Fitchburg
- Florence
- Genesee
- Gilmanton
- Gordon
- Grant
- Green Lake
- Greenfield
- Greenville
- Harrison
- Holland
- Iron River
- Ixonia
- Jacobs
- Knight
- Kronenwetter
- Lafayette
- Lebanon
- Liberty Grove
- Liberty Grove
- Lima
- Menasha
- Merton
- Middleton
- Minocqua
- Mt. Pleasant
- Norway
- Oakdale
- Onalaska
- Oregon
- Oulu
- Pewaukee
- Pleasant Spring
- Richmond
- Shelby
- Sheldon
- St. Lawrence
- Suamico
- Sullivan
- Troy
- Wabeno
- Washington Island
- Waumandee
- Wescott
- Weston

Schools and park commissions

- Algoma School Dist.
- Arbor Vitae Woodruff Park Comm.
- Arkansaw Joint School Dist. No 1
- Bayfield School Dist.
- Beaver Dam Unified School Dist.
- Black River Falls School Dist.
- Bloomer School Dist.
- Bowler School Dist.
- Butternut School Dist.
- Cassville School Dist.
- Chilton School Dist.
- Chippewa Falls School Dist.
- Cornell School Dist.
- Cuba City School Dist.
- D.C. Everest School Dist.
- DeForest Area Schools
- Dodgeville School Dist.
- Durand School Dist.
- East Troy School Dist.
- Elk Mound Area School Dist.
- Elkhart Lake School Dist.
- Flambeau School Dist.
- Florence School Dist.
- Germantown Junction School Dist.
- Glidden School Dist.
- Greendale School Dist.
- Hazel Green School Dist.
- Holmen Public Schools
- Hudson School Dist.
- La Crosse School Dist.
- Ladysmith-Hawkins School Dist.
- Lake Holcombe School Dist.
- Lake Tomahawk Parks Committee
- Lodi School Dist.
- Luck School Dist.
- Markesan Joint School Dist.
- Marshall School Dist.
- McFarland School Dist.
- Menomonie School Dist.
- Monona Grove School Dist.
- Monroe School Dist.
- Montello School Dist.
- Mt. Horeb Joint School Dist. No 6
- Muskego-Norway School Dist.
- N. Fond Du Lac School Dist.
- Nekoosa School Dist.
- New Auburn School Dist.
- New Richmond School Dist.
- Northwood School Dist.
- Onalaska School Dist.
- Ondossagon School Dist.
- Oregon School Dist.
- Pepin School Dist.
- Phillips School Dist.
- Plum City School Dist.
- Portage School Dist.
- Potosi-Tennyson Park Commission
- Prentice School Dist.
- Princeton School Dist.
- Pulaski School Dist.
- Rib Lake School Dist.
- Ripon Public School District
- Seneca School Dist.
- Seymour School Dist.
- Shiocton School Dist.
- South Milwaukee School Dist.
- Southwestern WI Community Sch Dist.
- Sparta School Dist.
- St. Croix Falls School Dist.
- Stanley-Boyd Area Schools
- Sun Prairie School Dist.
- Thorp School Dist.
- Turtle Lake School Dist.
- Unity School Dist.
- Verona Area School Dist.
- Wabeno Joint School Dist. No 1
- Washburn School District
- Whitnall School Dist.
- Wild Rose School Dist.
- Wilmot Union High School Dist.
- Wisconsin Dells School Dist.
- Wrightstown Comm. School Dist.

2019-2023

Wisconsin

Statewide Comprehensive Outdoor Recreation Plan

WISCONSIN DEPT. OF NATURAL RESOURCES

LAND & WATER CONSERVATION FUND

DNR publication number: LF 114.2 (2019)

Photo: Ben Pierson