BRAINERD PUBLIC UTILITIES

8027 Highland Scenic Road • P.O. Box 373 • Brainerd, Minnesota 56401-0373

COMMISSION SECRETARY – Business Office 218.829.8726 – FAX 218.829.4703
SUPERINTENDENT OF UTILITIES – Repair Service Operations 218.829.2193 – FAX 218.829.2308
INTERNET WEB SITE – www.bpu.org

October 22, 2020

VIA E-FILING

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Re: Brainerd Hydroelectric Project, FERC Project No. 2533
Draft License Application (Public)

Dear Secretary Bose:

Brainerd Public Utilities (BPU) herein electronically files with the Federal Energy Regulatory Commission (FERC) this public version of the Draft License Application (DLA) for the relicensing of the Brainerd Hydroelectric Project (Project), FERC Project No. 2533 (Project). The Project is currently operating under a license that was issued by the FERC on February 28, 1993 and is set to expire on February 28, 2023. On February 28, 2018, BPU filed a Notice of Intent (NOI) with the FERC to file a license application for the new license for the Project under the Commission's Integrated Licensing Process (ILP).

BPU has opted to file a DLA in lieu of the less-comprehensive Preliminary Licensing Proposal in order to provide the most complete information to FERC and stakeholders to review. Due on-going work and continued consultation with stakeholders and interested parties, certain information within the DLA is still under development and will be included in the Final License Application (FLA) to be filed with the Commission on or before February 28, 2021. Proposals presented in this DLA are considered preliminary and subject to change. Comments on this draft License Application are welcome and encouraged. Comments on the DLA must be filed by **December 30, 2020** and must be filed with the Commission.

A copy of this letter is also being provided (via email) to all parties listed on the attached distribution list. All interested parties can access and download the DLA from BPU's public website: http://bpu.org/our-services/electric/hydro/ or the FERC website: https://www.ferc.gov/docs-filing/elibrary.asp. BPU looks forward to working with FERC and other interested parties on the Project relicensing. If you have questions regarding the PSP, you may contact Ms. Adéle Braun at 952-842-3703 or by email at abraun@barr.com or me at 218-825-3213 or by email at smagnuson@bpu.org.

Sincerely,

Scott Magnuson
Brainerd Public Utilities, Superintendent

Attachments:
Distribution List
Draft License Application

cc: Distribution List

Federal Agencies

Advisory Council on Historic Preservation
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U.S. Senator
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309 Hart Senate Office Building
Washington DC 20510
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U.S. Army Corps of Engineers, St. Paul District
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City of Baxter
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Crow Wing Soil & Water Conservation District
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Draft License Application

Brainerd Hydroelectric Project
FERC License No. 2533

Prepared for:
Brainerd Public Utilities
Brainerd, Minnesota

October 21, 2020

Available for Public Release

Draft License Application

Brainerd Hydroelectric Project
FERC License No. 2533

Prepared for:
Brainerd Public Utilities
Brainerd, Minnesota

October 21, 2020

Available for Public Release

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
Phone: 952.832.2600

Draft License Application
Brainerd Hydroelectric Project
October 21, 2020

Preface

Brainerd Public Utilities (BPU) is filing with the Federal Energy Regulatory Commission (FERC) this required Draft License Application (DLA) for renewal of its license to generate hydroelectric power. The existing Project license expires on February 28, 2023, and the Licensee must file for a new operating license with the FERC on or before February 28, 2021. As noted in BPU's Notice of Intent (NOI), submitted on February 28, 2018, BPU is following FERC's Integrated Licensing Process (ILP) as established in regulations issued by the FERC July 23, 2003 (Final Rule, Order No. 2002), and found in Title 18 of the U.S. Code of Federal Regulations (18 CFR), Part 5, during the relicensing process. As noted in these regulations, the ILP is the FERC's default process for relicensing.

This DLA follows the requirements of 18 CFR § 5.16(a), with minor changes in format to improve readability and formatted to be consistent with 18 CFR § 5.18, which requires general instructions, initial statement, Exhibits A, F, and G for major water projects 5 MW or less in accordance with 18 CFR § 5.18(a)(5)(i) in addition to Exhibit E in accordance with 18 CFR § 5.18(b) and Exhibit H in accordance with 18 CFR § 5.18(c).

Comments on this DLA from stakeholders are due December 30, 2020.

Contents

List of Appendices

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Abbreviations and Acronyms

BPU	Brainerd Public Utilities (Licensee)
BPUC	Brainerd Public Utilities Commission
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CSIR	Consultant's Safety Inspection Report
CUI	Controlled Unclassified Information
DLA	Draft License Application
DSSMP	Dam Safety Surveillance and Monitoring Plan
DSSMR	Dam Safety Surveillance and Monitoring Report
EA	Environmental Analysis
EAP	Emergency Action Plan
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FLA	Final License Application
FPA	Federal Power Act
hp	horsepower
ILP	Integrated Licensing Process
IPaC	Information, Planning, and Conservation System
ISR	Initial Study Report
kw	kilowatts
MBS	Minnesota Biological Survey
MDL	Minnesota Drifts and Lake Plains
MNDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MRBW	Mississippi River – Brainerd Watershed
NAD83	North American Datum 1983
NGO	Nongovernmental Organization
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum 1929
NHIS	Natural Heritage Inventory System
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRHP	National Register of Historic Places

NWI	National Wetland Inventory
ODSP	Owner's Dam Safety Program
PAD	Pre-Application Document
PFMA	Potential Failure Mode Analysis
PM&E	Protection, Mitigation, and Enhancement
Project	Brainerd Hydroelectric Project
PSP	Proposed Study Plan
PURPA	Public Utility Regulatory Policies Act of 1978
RSP	Revised Study Plan
RTE	Rare, Threatened, Endangered, and Special Status
SD1	Scoping Document 1
SD2	Scoping Document 2
SHPO	State Historical Preservation Office
STID	Supporting Technical Information Document
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USR	Updated Study Report
WMA	State Wildlife Management Areas
WPA	Waterfowl Production Areas

Definitions

Authorized installed capacity	The licensed turbine capacity at the Brainerd Hydroelectric Project (Project) is 3,542.5 kW
Installed capacity	The installed turbine capacity at the Project is currently 2,942.5 kW
Licensee	The license was issued to the city of Brainerd and its Brainerd Public Utilities Commission (BPUC). Brainerd Public Utilities (BPU) manages the Project.
Project	Brainerd Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2533 (Project)
Project Area	The area within the Project boundary consisting of "…lands necessary for the operation and maintenance of the Project and for other Project purposes…"
Project Boundary	The boundary line defined in the Project license issued by the FERC that surrounds the "…lands necessary for the operation and maintenance of the Project and for other Project purposes…" (1)
Relicensing	The process of acquiring a new FERC license for an existing hydropower project under expiration of the existing FERC license

Resource Affected Area	The geographic area in which a specific resource is potentially affected by the Project
Rare, Threatened, Endangered, and Special-Status Species	Rare, threatened, endangered, and special-status species, which for purposes of this Pre-Application Document (PAD) includes all species (plant and animal) listed, proposed for listing, or candidates for listing under the Federal and State Endangered Species Act and those listed by the U.S. Fish and Wildlife Service as sensitive, special status, or watch list
Study Plan Determination	A ruling from FERC that determines the studies conducted during relicensing

BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

DRAFT APPLICATION FOR LICENSE
FOR A MAJOR WATER POWER PROJECT – 5 MEGAWATTS OR LESS
EXISTING DAM

BRAINERD HYDROELECTRIC PROJECT
FERC PROJECT NO. 2533

Initial Statement

(Pursuant to 18 CFR §4.61)

1. Brainerd Public Utilities Commission (BPU) (hereinafter "Applicant" or "Licensee") applies to the Federal Energy Regulatory Commission (FERC) for a new license for the Brainerd Hydroelectric Project (FERC No. 2533) (Project), as described hereinafter.

2. The location of the project is:

   State or territory: Minnesota
   Counties: Crow Wing County
   Township or nearby town: City of Brainerd and the townships of Center, Irondale, Oak Lawn, and West Crow Wing.
   Stream or other body of water: Mississippi River

3. The exact name, address, and telephone number of the Applicant are:

   Brainerd Public Utilities Commission
   8027 Highland Scenic Road
   PO Box 373
   Brainerd, MN 56401
   (218) 825-3213

4. The exact name, address, and telephone number of each person authorized to act as agent for the applicant in this application are:

   Mr. Scott Magnuson
   Brainerd Public Utilities, Superintendent
   8027 Highland Scenic Road
   PO Box 373
   Brainerd, MN 56401

(218) 825-3213
smagnuson@bpu.org

5. The applicant is a municipality and is not claiming preference under section 7(a) of the Federal Power Act.

6. (i) The statutory or regulatory requirements of the state in which the project is located that affect the project as proposed, with respect to bed and banks and to the appropriation, division, and use of water for power purposes, and with respect to the right to engage in the business of developing, transmitting, and distributing power and any other business necessary to accomplish the purposes of the license under the Federal Power Act, are:

   a. Minnesota Statutes:

      - 103A.203 states that the Minnesota Legislature found the public health, safety, and welfare of the state are promoted by the use of state waters to produce hydroelectric power.

      - 103F.125 indicates that proper consideration should be given to the needs of an industry whose business requires that it be located within a floodplain.

      - 103G.127 delegates authority to the Commissioner of Natural Resources, with the concurrence of Board of Water and Soil Resources and the Commissioner of Agriculture to establish a program for regulating the discharge of material into waters of the state as necessary to obtain approval from the United States Environmental Protection Agency to administer the permit program under Section 404 of the Clean Water Act.

      - 103G.245 requires a state-issued permit to make changes in a reservoir, dam, waterway, or on a public water in any manner or diminish the course, current, or cross-section of public waters.

   b. Minnesota Regulations:

      - 6115.0190 requires permit authority to place fill into public waters.

      - 6115.0200 requires permit authority to excavate and remove materials in public waters.

      - 6115.0210 requires permit authority for construction of structures in public waters.

   (ii) The steps which the applicant has taken or plans to take to comply with each of the laws cited above and 33 USC §1341 (Section 401) of the Federal Clean Water Act are:

a. Pursuant to 18 CFR §5.18(b)(3)(i), applicants must file a request for a water quality certification, pursuant to Section 401 of the Federal Water Pollution Control Act, 33 S.C. S1341. The Project was issued a water quality certification during relicensing in 1993. When BPU applied for a non-capacity amendment in 2016, Minnesota Pollution Control Agency (MPCA) noted in a letter to BPU dated March 18, 2016, that the MPCA believed at that time that the original Section 401 Certification for the Project remained in effect because there were no significant structural changes, no change to the dam or reservoir, and no changes to the existing operation of the project. The applicant has been in coordination with the MPCA wand is applicant for the Water Quality Certificate pursuant to Section 401 of the Federal Clean Water Act and Minnesota Statue 103G.245.

b. There are no changes planned at the Project and therefore no changes that would diminish the course, current, or cross-section of public waters.

c. There is no current construction projects planned at the Project requiring permits under Minnesota Regulations.

7. Brief project description:

   The Project is an existing dam with an installed generating capacity of 2.94 megawatts (MW) operated as a run-of-river project on the Mississippi River. The Project is located on land owned by the Licensee.

   i. The installed generating capacity is 2.94 MW.

   ii. The Project is an existing dam.

8. Brainerd Public Utilities owns and operates the Project and there are no federal facilities or lands associated with the Project.

9. No construction is proposed.

Additional Information

(Pursuant to 18 CFR §5.18(a) and §4.32)

1. *Identify every person, citizen, associations of citizens, domestic corporation, municipality, or state that has or intends to obtain and will maintain any proprietary rights necessary to construct, operate, or maintain the project:*

   The Applicant presently holds and will continue to hold the proprietary rights necessary to operate and maintain the Project.

2. *Identify (providing names and addresses):*

   i. *Every county in which any part of the project, and any Federal facility that would be used by the project would be located:*

      Crow Wing County Government
      326 Laurel St., Suite 13
      Brainerd, MN 56401

      There are no Federal lands or facilities associated with the Project.

   ii. *Every city, town, or similar local political subdivision:*

      A. *In which any part of the project, and any Federal facilities that would be used by the project, would be located; or*

         City of Brainerd
         501 Laurel Street
         Brainerd, MN 56401

         Township of Center, Chairwoman
         22894 Antler Road
         Merrifield, MN 56465

         Township of Irondale
         19121 County Road 12
         Ironton, MN 56455

         Township of Oak Lawn, Supervisor
         P.O. Box 333
         Brainerd, MN 56401

         Township of West Crow Wing, Chairman

6930 Cuyuna Avenue
Brainerd, MN 56401

B. *That has a population of 5,000 or more people and is located within 15 miles of the project dam;*

City of Brainerd
501 Laurel Street
Brainerd, MN 56401

City of Baxter
13190 Memorywood Drive
Baxter, MN 56425

iii. *Every irrigation district, drainage district, or similar special purpose political subdivision*

A. *In which any part of the project, and any Federal facilities that would be used by the project would be located:*

There are no irrigation districts, drainage districts, or similar special purpose political subdivisions.

B. *That owns, operates, maintains, or uses any project facilities or any Federal facilities that would be used by the project:*

There are no irrigation districts, drainage districts, or similar special purpose political subdivisions. There are no Federal lands or facilities associated with the Project.

iv. *Every other political subdivision in the general area of the project that there is a reason to believe would likely be interested in, or affected by, the application:*

There are no other political subdivisions in the general area of the Project known to the Applicant that would be likely interested in, or affected by, the application.

v. *All Native American tribes that may be affected by the project:*

There are no Native American lands within the Project boundary or immediate project vicinity. BPU and the Commission consulted with the following Native American Tribes that may be affected by the Project throughout the relicensing process specifically in support of cultural resource studies.

Bois Forte Band of Chippewa
Bill Latady, Tribal Historic Preservation Officer
5344 Lakeshore Drive
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blatady@boisforte-nsn.gov

Cheyenne & Arapaho Tribes
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Kevin R. Dupuis, Chairman 1720
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Grand Portage Reservation Tribal Council
Norman Deschampe, Chairman
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Leech Lake Historic Preservation Office
Amy Burnette, Tribal Historic Preservation Officer
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Lower Sioux Indian Community of Minnesota
Cheyanne St. John,
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Mille Lacs Band of Ojibwe Indians
Natalie Weyaus, Tribal Historic
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Santee Sioux Tribal Nation
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Minnesota Chippewa Tribe
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Otoe-Missouria Tribal Council
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Ote-Missouria Tribe of Oklahoma
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jamie.arsenault@whiteearth.com

3. The Applicant has, in accordance with 18 CFR §4.32(a)(3), made a good-faith effort to notify, by certified mail, the following entities of the filing of this application: (to be completed in Final License Application)

    a. Every property owner of record of any interest within the bounds of the Project ;

    b. The entities listed in (2) above;

    c. Other governmental agencies that would likely be interested in or affected by the application.

Verification Statement

VERIFICATION

(To be signed in Final Application)

This Application for License for the Brainerd Hydroelectric Project, FERC No. 2533, is executed in the State of Minnesota, County of Crow Wing by __<name>____, President of the Brainerd Public Utilities Commission, 8027 Highland Scenic Road, PO Box 373, Brainerd, Minnesota, 54601, who, being duly sworn, deposes and says that the contents of this application are true to the best of his/her knowledge or belief. The undersigned Applicant has signed the application this ____ day of ______, 2021.

BRAINERD PUBLIC UTILITIES COMMISSION

BY: ____

Name
President
Brainerd Public Utilities Commission

NOTARY

(To be signed in Final Application)

Subscribed and sworn to before me, a Notary Public of the State of Minnesota this ____ day of _____, 2021.

____

(notary public)

My Commission Expires: _____________ /seal

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DRAFT APPLICATION FOR LICENSE
FOR A MAJOR WATER POWER PROJECT – 5 MEGAWATTS OR LESS
EXISTING DAM

BRAINERD HYDROELECTRIC PROJECT
FERC PROJECT NO. 2533

Exhibit A Project Description

(Pursuant to 18 CFR §4.61)

A.1 Applicability

Exhibit A is required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

A.2 Introduction

Brainerd Public Utilities Commission (BPU) owns and operates the Brainerd Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 2533. The Project is located in Crow Wing County, Minnesota, on the Mississippi River in the City of Brainerd, as shown in Figure A-1. The Project is located approximately 130 miles north of the Minneapolis – St. Paul metropolitan area.

Figure A-1 Project Location

A.3 License History

BPU is filing this Draft License Application (DLA) with the FERC for the relicensing of the Project. BPU's existing FERC license expires February 28, 2023. BPU has followed FERC's Integrated Licensing Process (ILP) as established in regulations issued by the FERC July 23, 2003 (Final Rule, Order No. 2002), and found in Title 18 of the U.S. Code of Federal Regulations (18 CFR), Part 5, during the relicensing process.

The original dam was authorized by an Act of Congress in 1886 (2). The dam was damaged by a flood in the spring of 1950 and the U.S. Army Corps of Engineers (USACE) approved reconstruction on May 18, 1951 (3). The FERC issued a license to the Northwest Paper Division of Potlatch Corporation on December 10, 1976, and the Project was relicensed for 30 years to Potlatch Corporation on March 2, 1993. License transfers to various entities were approved by FERC on the dates shown below (4):

- Missota Paper Company, LLC on April 8, 2003
- Wausau Paper of Minnesota, LLC on October 21, 2004
- Wausau Paper Printing and Writing, LLC on December 28, 2006
- Wausau Paper Mills, LLC on March 10, 2010
- City of Brainerd and its Public Utilities Commission on March 13, 2014

Transfer of the license officially occurred when BPU purchased the Project on June 13, 2014. At the time of the purchase, the Project boundaries were changed, removing the paper mill adjacent to the Project from within the Project boundaries.

On August 4, 2016, a non-capacity license amendment application was submitted to the FERC. The amendment was for the proposed permanent addition of a 600 kW turbine. On July 19, 2016, the FERC approved the amendment and changed the licensed installed capacity of the Project to 3,542.5 kW; however, the current installed capacity remains at 2,942.5 kW until the new turbine is installed.

A.3.1 Project Boundaries

Digital Project boundary maps including Project boundaries and the location of the dam are included in Figure A-1 of Appendix A. The Project Boundary is discussed further in Exhibit G.

A.3.2 Datum

Elevations herein are referenced to National Geodetic Vertical Datum 1929 (NGVD), in feet. All references to left and right assume an orientation looking downstream. Project features have historically been referenced to Memphis datum and/or NGVD. Memphis datum is 8.16 feet higher than NGVD (NGVD = Memphis – 8.16 feet). For reference, the top of the closed bascule gates in the vertical position is at elevation 1183.00 Memphis datum, or 1174.84 NGVD. GIS maps provided in the appendices of this report have been developed using North American Datum of 1983 (NAD83) Zone 15N coordinate system.

A.4 Description of Project and Proposed Mode of Operation – 18 CFR §4.61 (c)(1)

Pursuant to the Commission's regulations at 18 CFR §4.61(c)(1), the following sections describe the Project and mode of operation:

A.4.1 Generating Units – 18 CFR §4.61 (c)(1)(i) and (ii)

The Project is licensed for six generating units with a total installed capacity of 3,542.5 kilowatts (5). A summary of the generating unit information is provided in Table A-1 with detailed information on each unit in Table A-2. At present, five tandem horizontal turbines with direct connections to generators are installed. The license was amended in 2016 to allow for the additional capacity of a sixth turbine/generator unit which has not been installed yet. With the proposed turbine, the Project will have a combined rated capacity of 3,542.5 kW. The installed capacity is currently 2,942.5 kW.

Units 1, 2, and 3 have governors and synchronous generators. Units 4 and 5 have synchronous motors but no governors. Wicket gates for units 4 and 5 are manually controlled. Turbines 3, 4, and 5 were originally used for direct grinding of pulp and were converted to hydroelectric operation in 1956 (3).

Table A-1 Generating Unit Summary

Turbines and Generators		CFR Reference
Number of Authorized Units	6	18 CFR §4.61(c)(1)(i)
Number of Installed Unites	5	18 CFR §4.61(c)(1)(i)
Rated Capacity	Varies (see Table A-2)	18 CFR §4.61(c)(1)(i)
Provisions for Future Units	License was amended in 2016 to allow for a sixth turbine/generator unit, which has not been installed yet.	18 CFR §4.61(c)(1)(i)
Type of Hydraulic Turbines	Varies (see Table A-2)	18 CFR §4.61(c)(1)(ii)

Table A-2 Unit Summary

Unit No.	Year Generator / Turbine Installed	Authorized Installed Capacity (kW)	Generator Make and Type	Turbine Make and Type
1	1916	560[(1)]	Electric Machinery 700 kVA 2300V (560 kW)	2-S. Morgan Smith 45 inch Horizontal Frances 128.5 rpm Type N 610 hp (455 kW) at 665 cfs
2	1916	560[(1)]	Electric Machinery 700 kVA 2400V (560 kW)	2-S. Morgan Smith 45 inch Horizontal Frances 128.5 rpm Type N 610 hp (455 kW) at 665 cfs
3	1956/1916	480.3[(1)]	General Electric 600 kVA 2300V (480.3 kW)	2-S. Morgan Smith 32.5 inch Horizontal Frances 225 rpm Type S 520 hp (388 kW) at 493 cfs
4	1956/1916	671.1[(1)]	Electric Machinery 900 hp 2200V (671.1 kW)	2-S. Morgan Smith 32.5 inch Horizontal Frances 225 rpm Type S 520 hp (388 kW) at 493 cfs
5	1956/1916	671.1[(1)]	Electric Machinery 900 hp, 2200V (671.1 kW)	2-S. Morgan Smith 32.5 inch Horizontal Frances 225 rpm Type S 520 hp (388 kW) at 493 cfs
6	Planned 2021/2022	600[(2)] (assumed)	TBD	TBD

Unit No.	Year Generator / Turbine Installed	Authorized Installed Capacity (kW)	Generator Make and Type	Turbine Make and Type
Total		**2,942.5**		

(1) Based on BPU calculated capacity (6)
(2) ATS-63 Turbine/generator installation date TBD – (6)

A.4.2 Operations - 18 CFR §4.61 (c)(1)(iii) through 18 CFR §4.61 (c)(1)(vii)

A summary of operations data is provided in Table A-3 with supporting information included in Sections A.4.2.1 through A.4.2.6.

Table A-3 Operation Summary

Operation		CFR Reference
Plant Operations	Manual	18 CFR §4.61(c)(1)(iii)
Peaking	Not Used	18 CFR §4.61(c)(1)(iii)
Average Annual Generation	19,500,000 kWh	18 CFR §4.61(c)(1)(iv)
Average Head	20-feet	18 CFR §4.61(c)(1)(v)
Reservoir Surface Area	2,500 acres	18 CFR §4.61(c)(1)(vi)
Storage Capacity	13,000 acre-feet	18 CFR §4.61(c)(1)(vi)
Maximum Powerhouse Capacity (per installed unit)	2,773 cfs	18 CFR §4.61(c)(1)(vii)
Minimum Powerhouse Capacity (per installed unit)	295 cfs	18 CFR §4.61(c)(1)(vii)
Mean Annual Stream Flow	3,488 cfs	18 CFR §4.61(c)(1)(vii)

A.4.2.1 Operation - 18 CFR §4.61 (c)(1)(iii)

The Project is manually operated as a run-of-river project and maintains a target elevation of 1174.04 feet (NGVD) with fluctuations limited to 0.1 feet (6). The Project is not used for peaking. Run-of-river mode may be temporarily modified in the event of an emergency if the Minnesota Department of Natural Resources (MNDNR) agrees, but FERC must be notified as soon as possible following the event.

The addition of the sixth turbine involves no change to the dam or reservoir or to the existing operations of the present Project or its reservoir. The Project will remain run-of-river with inflow matching outflow. The only change is that instead of passing additional flow over the gated spillway section, the water will pass through the powerhouse, or the sixth turbine.

A.4.2.2 Average Annual Generation - 18 CFR §4.61 (c)(1)(iv)

Monthly net energy generation for the Project for 2013 to 2017 is provided in Table A-4. Based on generation records for 2013 to 2017, the average net generation is calculated as approximately 18,529 MWhs per year. The annual generation for this time period ranged from a high of 21,166 MWh in 2016 to a low of 16,511 MWh in 2013. The average annual generation will be updated with data through 2020 in the Final License Application.

Table A-4 Monthly Net Energy 2013–2017 (MWh)

Year	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Avg
2013	1,522	1,372	1,801	1,618	898	1,110	1,461	1,005	890	1,446	1,664	1,724	16,511	1,376
2014	1,854	1,664	1,845	1,449	887	1.039	1,673	2,006	1,619	2,029	1,972	1,876	19,913	1,659
2015	1,544	1,349	1,658	1,306	1,465	1,756	1,906	1,375	1,707	1,865	1,805	1,864	19,601	1,633
2016	1,955	1,639	1,709	1,561	1,806	1,914	1,370	1,875	1,892	1,954	1,929	1,562	21,166	1,764
2017	1,830	1,668	1,676	1,446	1,371	1,916	1,657	1,508	1,630	1,639	1,898	1,980	20,219	1,685
Avg	1,741	1,538	1,738	1,476	1,286	1,547	1,613	1,554	1,547	1,787	1,854	1,801	19,482	1,624

The annual average generation at the Project for the period 2013 to 2017 was 19,482,000 kWh. This represents approximately 10,600 tons of coal, 35,700 barrels of crude oil, 1,370,000 gallons of fuel oil, 1,490,000 gallons of diesel oil, or 197 million cubic feet of natural gas for power generation (7), (8), (9). The Project's installed capacity is 2,942.5 kW. A power factor of 0.756 was calculated based on the installed capacity and average generation between 2013 and 2017. The power factor is the Project's ability to convert water flow into generation (actual generation divided by installed capacity). The equation to calculate the power factor is (19,482 MWh/yr) / (2.9425 MW * 8760 hours/year) = 0.756

A.4.2.3 Average Head - 18 CFR §4.61 (c)(1)(v)

At normal pool, the estimated average head on the plant is 20-feet. The Project has a normal pool elevation of 1174.0 ± 0.1 feet (6). =The peak inflow design flood (IDF) for the Project was estimated to be 56,850 cubic feet per second (CFS) (10). The reservoir elevation during the peak IDF discharge was estimated to be elevation 1183.1 feet (NGVD).

A.4.2.4 Reservoir Data - 18 CFR §4.61 (c)(1)(vi)

At normal pool the reservoir has a surface area of about 2,500 acres and storage capacity of 13,000 acre-feet. The total contributing drainage area at the dam is approximately 7,320 square miles.

A.4.2.5 Plant Hydraulic Capacity - 18 CFR §4.61 (c)(1)(vii)

The hydraulic capacity range for each of the five existing turbines installed in flumes one through five is 295 to 2,773 cubic feet per second (cfs). If the flow is less than 295 cfs, (the hydraulic capacity of one unit) (6) flow is passed over the spillway and the powerhouse is shut down. Once flows reach 295 cfs, the powerhouse is used to regulate flow to maintain the reservoir level during normal flows. Once flows exceed the available powerhouse capacity (approximately 2,773 cfs) (6) the gates are operated to pass remaining flows. In this case, the outflow is equal to the flow through the turbines plus the flow over the spillway. Turbines continue to operate during high-flow conditions. The Project can maintain a constant pool elevation of 1174.0 up to an inflow of 13,000 cfs. For greater flows, the pool elevation starts to rise and flow is regulated by discharge capacity.

A.4.2.6 Average Flow Data - 18 CFR §4.61 (c)(1)(vii)

Historical flood data for this Project is gathered from the U.S. Geological Survey (USGS) gaging stations at Aitkin (52 miles upstream of Brainerd) and Royalton (48 miles downstream from Brainerd). A USGS gage was installed at Brainerd in 1987. Average monthly flow data from the Brainerd gage is shown for the last 10 years in Table A-5. The minimum, maximum, and average discharge for the above-listed gages are shown in Table A-6. The annual and monthly flow duration curves for the Project are included in Appendix A. The minimum, mean, and maximum average daily flows from the Brainerd gage for the period of record are 348 cfs, 3,488 cfs, and 17,900 cfs, respectively.

Table A-5 Average Monthly Flows for USGS Gauge 052452300 (2008-2017)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2008	1,791	1,491	1,228	4,902	8,598	6,069	2,838	1,002	801	1,938	2,758	1,670
2009	1,652	2,129	4,339	8,987	6,508	3,539	1,690	991	618	1,179	3,079	2,072
2010	2,212	2,050	3,013	1,656	2,501	1,652	2,167	2,769	2,503	3,735	6,925	3,714
2011	3,338	3,068	3,086	7,385	8,468	6,217	4,854	3,525	1,647	1,411	1,650	1,590
2012	1,400	1,338	1,839	2,970	6,209	12,540	11,590	3,535	1,170	885	1,195	2,044
2013	1,716	1,717	1,687	4,495	9,139	7,481	4,885	1,522	1,017	2,242	2,520	1,969
2014	2,116	2,120	2,264	7,093	10,900	10,010	5,952	3,685	3,506	3,018	2,619	2,020
2015	1,791	1,646	1,831	1,370	5,176	4,798	2,667	1,727	2,253	2,149	4,209	4,415
2016	3,669	3,196	5,252	5,795	4,462	3,477	8,002	4,047	3,522	3,436	3,215	4,864
2017	3,541	3,611	5,008	6,977	7,770	3,387	1,992	2,041	3,055	5,638	3,336	2,903
Monthly Mean (1)	2,475	2,290	2,739	5,677	6,014	4,727	4,234	2,382	2,166	2,983	3,350	2,851

Note:

1. Monthly mean based on data from May 1987 to December 2017

Table A-6 USGS Stream Gage Data

Gage	Drainage Area (mi²)	Period of Record	Maximum Discharge (cfs)	Minimum Discharge (cfs)	Average Discharge (cfs)
05227500 at Aitkin	6,140	1945 to 2017	19,900 (May 20, 1950)	153 (Sept. 1, 1961)	2,929
05242300 at Brainerd	7,320	1987 to 2017	17,900 (June 26, 2012)	348 (July 30, 1988)	3,488
05267000 near Royalton	11,600	1924 to 2017	38,200 (April 8, 1997)	254 (Nov. 25, 1937)	4,912

A.4.3 Developmental Resources – 18 CFR §4.61(c)(1)(viii)

Drawing G-06 in Appendix A includes a drawing showing the relative locations and physical interrelationships of the principal project features. Detailed descriptions for each of these features, including the composition and dimensions of each feature, are included below:

A.4.3.1 Dam

The dam structures include a short left embankment, a 256-foot-long powerhouse, a 78-foot-long slide gate section, a 207-foot-long bascule (crest) gate section, a single 20-foot-wide steel tainter gate, and a 200-foot-long right embankment, as shown in Figure A-2. An isometric view is presented in Figure A-3.

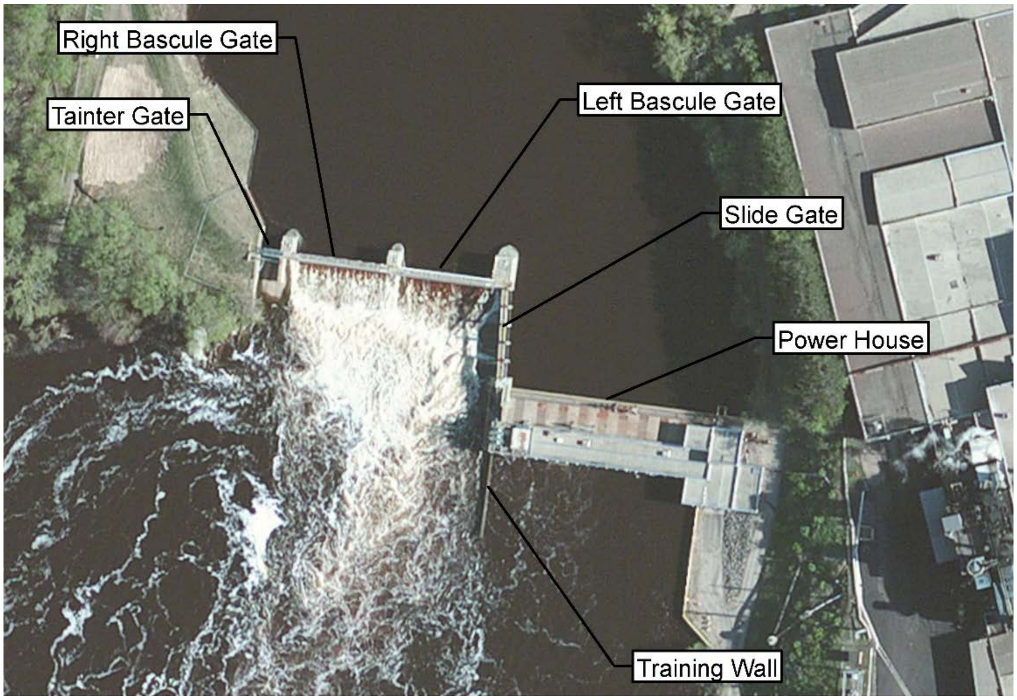


Figure A-2 Project Overview

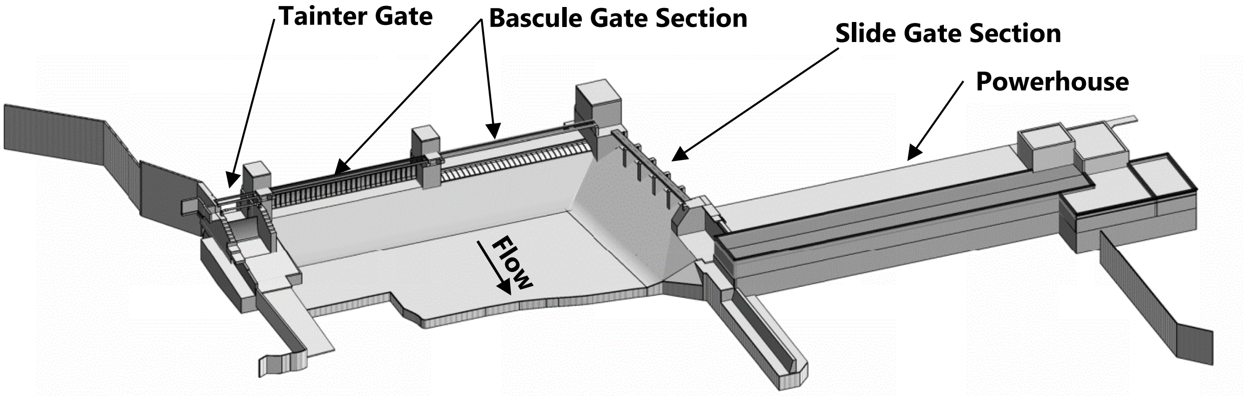


Figure A-3 Isometric View of Project

A.4.3.2 Left Embankment

The left embankment includes a steel sheetpile wall extending from the powerhouse wall to the left slope. The top of the sheetpile wall is at elevation 1183.8 feet NGVD. A 16-foot-wide opening allows for vehicular access along the road. Stoplogs are available at the site to close the opening as necessary.

A.4.3.3 Powerhouse

The 59-foot-wide by 256-foot-long powerhouse is a reinforced concrete structure founded on timber piling with a brick superstructure. The flumes are numbered one through 10 with number one being closest to the river and number 10 closest to the left embankment. Five of the original 10 flumes are currently used for power generation. Turbines are located in flumes one through five, a new turbine is planned in flume six, flumes seven through nine are sealed with concrete, and flume 10 is used for firewater.

A.4.3.4 Slide Gate Section

The slide gate section is 78 feet long measured between Pier 4, the pier adjacent to the powerhouse, and Pier 3, the pier connecting the bascule gate section and slide gate section. This section consists of five steel 13.6-foot-wide by 5-foot-high vertical steel gates, four intermediate piers, guide assemblies, and a spillway section. During reconstruction of the Project in the 1950s, a steel sheet pile was installed and grouted along the upstream side of the slide gate sections serving as a cofferdam; the rock-filled timber cribbing was consolidated, a reinforced-concrete spillway facing was installed over the consolidated timber cribbing serving as the spillway, and the gates (also referred to as stop logs) and guide assemblies were installed.

A.4.3.5 Bascule Gate Section

The bascule gate section is 207 feet long measured from the left side of Pier 3, the pier connecting the bascule gate section and the slide gate section, to the right side of Pier 1, adjacent to the tainter gate section. This section consists of the three primary concrete piers on the upstream side of the Project, two 85-foot-long by 7-foot 10-inch-high bascule gates, a concrete ogee section, and a spillway apron. During reconstruction of the Project in the 1950s, a cellular-steel-sheetpile system was installed and grouted upstream from the existing structure serving as a cofferdam; the rock-filled timber cribbing was consolidated, the piers were constructed, a reinforced-concrete ogee facing was installed over the consolidated timber cribbing serving as the spillway, and the gates were installed. In 2017, the spillway apron was overlaid to elevation 1153.17 feet NGVD by anchoring reinforced concrete into the existing apron. A vertical sheetpile extends across the Project on the downstream edge of the spillway apron.

A.4.3.6 Tainter Gate

The tainter gate section is 20 feet long by 11 feet high, measured from the right side of Pier 1, adjacent to the bascule section to the right abutment wall. A wooden tainter gate was replaced in 2000 with a steel tainter gate. In 2017, the spillway section downstream from the tainter gate was overlaid by anchoring reinforced concrete into the existing section.

A.4.3.7 Right Embankment

The 220-foot-long right embankment was constructed of earth-fill over rock-filled timber cribs with a 10-foot-wide embankment crest. The earthen embankment was raised to elevation 1184.84 feet NGVD by constructing a sheetpile wall on the upstream side of the embankment and filling in behind the sheetpile with earth. The sheetpile wall extends for 149 feet from its connection point with the tainter gate section and is anchored by concrete deadmen and steel tiebacks.

A.4.3.8 Tailrace Section

Ten flumes were originally constructed for power generation. Only five of the 10 flumes are currently used, with a sixth flume expected to be operational in the near future when the new turbine is installed. Below the draft tubes is a hard concrete floor. At the end of the concrete floor towards the downstream end of the tailrace, the floor transitions into timber planking.

A.4.3.9 Transmission Line

The Project transmission lines consist of a 236-foot-long 2.4-kilovolt (kV) overhead transmission line running from the powerhouse to a pad-mounted transformer located on the left embankment directly east of the powerhouse. Power is then transferred underground to the distribution grid. The transmission line length is shorter than stated in the existing license due to recent modifications. The 825-foot-long 34.5 kilovolt underground transmission line transfers power from the pad-mounted transformer (owned by BPU) to the distribution grid. The distribution grid is owned by BPU. Refer to Figure A-4 in Appendix B.

A.4.4 Estimated Cost of the Project – 18 CFR §4.61(c)(1)(ix)

The Project is an existing, licensed facility. The estimated average annual cost of the Project over the estimated licensing period will be provided in Table A-7 in the Final License Application.

Table A-7 Estimated Project Cost

Description	Cost
Cost of capital (equity and debt)	To be provided in the Final License Application
Local, state, and federal taxes	
Depreciation and amortization	
Operation and maintenance expenses, including interim replacements, insurance, administrative and general expenses, and contingencies	
Total	

A.4.5 Estimated Capital Costs and Estimated Annual Operation and Maintenance Costs of Proposed Environmental Measures – 18 CFR §4.61(c)(1)(x)

The estimated capital costs and estimated annual operation and maintenance costs of proposed environmental measures will be available in Table A-8 in the Final License Application.

Table A-8 Estimated Proposed Environmental Measures

Description	Cost
Total estimated current average annual cost	To be provided in the Final License Application
Estimated capital cost of proposed measure	
Estimated operations and maintenance cost of proposed measure	
Total estimated future average annual cost	

A.5 Purpose of the Project – 18 CFR §4.61(c)(2)

The primary purpose of the Project is hydropower generation.

A.6 Estimated Cost of Relicensing – 18 CFR §4.61 (c)(3)

The total estimated cost of relicensing for this Project, including consultation, studies, administrative and legal costs is estimated to be $400,000. This estimated will be updated in the Final License Application.

A.7 On-Peak and Off-Peak Project Power – 18 CFR §4.61 (c)(4)

The Project is operated a run-of-river Project; therefore, on-peak and off-peak power is not applicable for this application.

A.8 Estimated Change in Project Generation – 18 CFR §4.61 (c)(5)

No changes in project generation are proposed; therefore, an estimated change in project generation is not applicable for this application.

A.9 Undepreciated Net Investment – 18 CFR §4.61 (c)(6)

The remaining undepreciated net investment, or book value, of the Project will be included in the Final License Application.

A.10 Annual Operation and Maintenance – 18 CFR §4.61 (c)(7)

The annual operation and maintenance expense of the Project (based on historical data), including labor and overhead associated with operations and maintenance will be included in the Final License Application.

A.11 Single Line Electrical Diagram – 18 CFR §4.61 (c)(8)

A single-line diagram for the Project is included in Appendix B, which is filed as Critical Energy Infrastructure Information (CEII).

A.12 Safe Management – 18 CFR §4.61 (c)(9)

Measures taken to ensure safe management, operation, and maintenance of the Project are included in the Owner's Dam Safety Program (ODSP) for the Project, which includes the following:

- Consultant's Safety Inspection Reports (CSIR): A CSIR is the documentation of an inspection performed every five years in accordance with 18 CFR §12 Subpart D.
- Dam Safety Surveillance and Monitoring Plan (DSSMP) and Dam Safety Surveillance and Monitoring Report (DSSMR): A DSSMP summarizes the surveillance and instrumentation monitoring activities that are performed to track and evaluate dam performance. A DSSMR is submitted annually documenting the findings from surveillance and monitoring activities.
- Emergency Action Plan (EAP): An EAP documents a plan for actions to be taken in an emergency situation. The plan includes warnings for inhabitants, property owners, operators of water-related facilities, recreational users, and other persons in the vicinity who might be adversely affected by a sudden release of water at the dam. The EAP contains Notification Flowcharts to be used in the event of an emergency. Annual reviews and tests of the EAP are performed by BPU to maintain current information and maintain. BPU performs a Table top evaluation and functional exercise every five years to further test the EAP.
- Potential Failure Mode Analysis Report: A potential failure mode analysis (PFMA) was performed for the Brainerd Dam in 2008 and updated in 2018. A review of the PFMA is conducted as part of the Part 12D inspection. The purpose of the PFMA is to determine likely potential failure scenarios and identify potential risk-reduction measures to minimize the likelihood of occurrence of the consequences.
- Security Plan and Assessment: BPU maintains a security plan for the Brainerd Dam that documents the standard operating procedures related to all security concerns (physical, cyber, and procedural) at the dam. BPU updates the security plan annually to keep information current and maintain readiness.
- Supporting Technical Information Document: BPU maintains a current STID, which is a compilation of all relevant technical information for the dam in one central location. The STID is reviewed and updated regularly.
- Public Safety Plan: BPU maintains an updated public safety plan for the project outlining safety measures in place at the Project for the benefit of the public. These measures include water level indicators, boat barriers, signage, hand rails, lighting, and fencings.

Exhibit B Project Operation and Resource Utilization

(Pursuant to 18 CFR §5.18(a)(5)(i))

B.1 Applicability

Exhibit B is not required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

Exhibit C Proposed Construction Schedule

(Pursuant to 18 CFR §5.18(a)(5)(i))

C.1 Applicability

Exhibit C is not required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

Exhibit D Project Costs and Financing

(Pursuant to 18 CFR §5.18(a)(5)(i))

D.1 Applicability

Exhibit D is not required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

Exhibit E Environmental Report

(Pursuant to 18 CFR §5.18(b))

E.1 Applicability

Exhibit E is required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

E.2 Introduction

Brainerd Public Utilities Commission (BPU) owns and operates the Brainerd Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 2533. The Project is located in Crow Wing County, Minnesota, on the Mississippi River in the City of Brainerd, as shown in Figure E-1. The Project is located approximately 130 miles north of the Minneapolis – St. Paul metropolitan area.

Figure E-1 Project Location

E.2.1 License History

BPU is filing this Draft License Application (DLA) with the FERC for the relicensing of the Project. BPU's existing FERC license expires February 28, 2023. BPU has followed FERC's Integrated Licensing Process (ILP) as established in regulations issued by the FERC July 23, 2003 (Final Rule, Order No. 2002), and found in Title 18 of the U.S. Code of Federal Regulations (18 CFR), Part 5, during the relicensing process.

The original dam was authorized by an Act of Congress in 1886 (2). The dam was damaged by a flood in the spring of 1950 and the U.S. Army Corps of Engineers (USACE) approved reconstruction on May 18, 1951 (3). The FERC issued a license to the Northwest Paper Division of Potlatch Corporation on December 10, 1976, and the Project was relicensed for 30 years to Potlatch Corporation on March 2, 1993. License transfers to various entities were approved by FERC on the dates shown below (4):

- Missota Paper Company, LLC on April 8, 2003
- Wausau Paper of Minnesota, LLC on October 21, 2004
- Wausau Paper Printing and Writing, LLC on December 28, 2006
- Wausau Paper Mills, LLC on March 10, 2010
- City of Brainerd and its Public Utilities Commission on March 13, 2014

Transfer of the license officially occurred when BPU purchased the Project on June 13, 2014. At the time of the purchase, the Project boundaries were changed, removing the paper mill adjacent to the Project from within the Project boundaries.

On August 4, 2016, a non-capacity license amendment application was submitted to the FERC. The amendment was for the proposed permanent addition of a 600 kW turbine. On July 19, 2016, the FERC approved the amendment and changed the licensed installed capacity of the Project to 3,542.5 kW; however, the current installed capacity remains at 2,942.5 kW until the new turbine is installed.

E.2.2 Purpose of Action and Need for Power

The format of this Exhibit E, as defined by 18 Code of Federal Regulations (CFR) § 5.18 requires the exhibit to follow FERC's guidelines for preparing an Environmental Analysis (EA), and Pursuant to 18 CFR § 5.18(b)(5)(i)(B), must also, to the extent reasonably possible, describe the effects of preliminary terms and conditions filed with FERC by resource agencies. No specific terms and conditions had been filed at the time of this analysis.

FERC determines if a license will be issued to BPU for the continued operation of the Project and what conditions should be placed should a license be issued. In addition to the power and developmental purposes for which licenses are issued, FERC gives equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of fish and wildlife, the protection of recreational opportunities, and the preservation of other aspects of environmental quality. Issuing a new license for the Project would allow BPU to generate electricity at the Project for the term of a new license.

The Project is operated to produce hydroelectric power which is sold to the power provider.

E.3 General Description of the River Basin – 18 CFR § 5.18(b)(1)

E.3.1 Overview

The Mississippi River originates in an area of small lakes in northwestern Minnesota at Lake Itasca and empties into the Gulf of Mexico downstream from New Orleans, Louisiana. The Mississippi River is approximately 2,350 miles long with an elevation drop of approximately 1,475 feet. The Project is located at River Mile 1003.7 (11). Mississippi River State Water Trail maps showing the river system from Lake Itasca to its confluence with the Minnesota River near St. Paul, Minnesota near River Mile 844 are included Appendix C. The Project is located in the Upper Mississippi River basin, which is predominantly forest. The drainage area of the Upper Mississippi River Basin is approximately 7,320 square miles. The Project is located within the Mississippi River – Brainerd Watershed (MRBW), which is likewise heavily forested. The watershed is described as a glaciated region having gravelly and sandy outwash material (12).

E.3.1.1 Mississippi River-Brainerd Watershed

The MRBW covers 1,079,950 acres in the north-central part of the Upper Mississippi River Basin in central Minnesota. The watershed boundary begins in Aitkin County where the river flows through the cities of Aitkin, Brainerd, Baxter, and Little Falls. The primary ecosystem in the watershed is Northern Lakes and Forest (81-percent) & Norther Central Hardwood Forest (19-percent). An assessment for the MRBW (13) defined three management zones in the MRBW. The Project Area is primarily contained within the central management zone, which is the transition zone between the northern wetlands and forests to the southern prairies and wetlands, and has lake and stream water quality impairments but the overall water quality is good (13).

E.3.1.2 Project Drainage Area's Tributary Streams

Named tributaries to Mississippi River in the Project Boundary include the Rabbit River, Whiteley Creek, and Sand Creek.

E.3.1.3 Project Reservoir and Storage

The Project has a normal pool elevation of 1174.0 ± 0.1 feet (6). At normal pool the reservoir has a surface area of about 2,500 acres and storage capacity of 13,000 acre-feet.

E.3.1.1 Dams and Diversions along the River

In addition to the dam associated with the Project, there are seven dams located between the Headwaters of the Mississippi River and the Project location along the Mississippi River. There are an additional five dams located downstream from the Project prior to encountering the first lock and dam on the Mississippi in Minneapolis, Minnesota. Many of these dams were initially constructed for logging. Many of the remaining structures provide flood control and/or hydropower.

E.3.2 Climate

The Project region experiences mild, relatively humid summers and cold winters. Average July air temperatures in the project vicinity range from a daily average maximum of 80 degrees Fahrenheit to an average daily minimum of 57 degrees Fahrenheit. The daily average maximum air temperature for January is approximately 20 degrees Fahrenheit while the daily average minimum temperature is minus 4degrees Fahrenheit. The average total annual precipitation is 28.38 inches with average annual snowfall of 46.00 inches (14).

E.3.3 Major Water Uses

The Mississippi River is used for a variety of uses, including barge transportation well downstream of the Project, as well as power generation, water supply, and recreation in the more proximate vicinity of the Project. Power generation in the vicinity primarily consists of hydropower, while nearby communities pull water from the Mississippi River for municipal purposes. Recreational opportunities include fishing, swimming, canoeing, kayaking, tubing/floating, and hunting.

Source: MPCA WRAPS Report Summary (13)

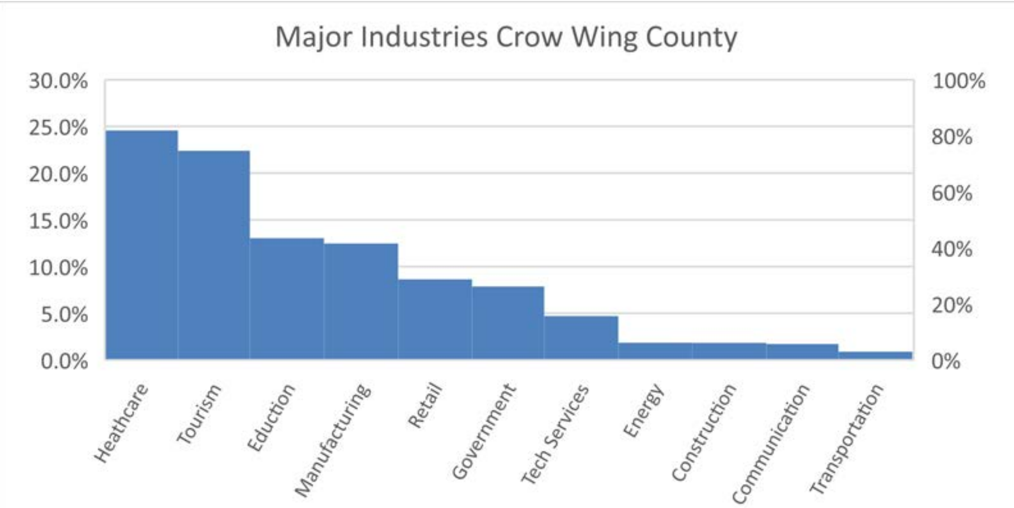
Figure E-2 Land Use Mississippi River- Brainerd

E.3.4 Major Land Uses

The Watershed Restoration and Protection Strategy summary report for the MRBW indicates that most of the land is wetland and forested with 36-percent forest, followed by row crop and grassland at 10-percent each, pasture at 8-percent, and open water and developed land at 6-percent each as shown in Figure E-2.

E.3.5 Economic Activities

The Project is located near the City of Brainerd, Minnesota in Crow Wing County. The largest employment industries in Crow Wing County are Heathcare (25-percent) and Tourism (22-pecent), accounting for nearly half of all employment in the county, followed by Education and Manufacturing at 13-percent each, Retail, Government, and Technical Services at 9-percent, 8-percent, and 5-percent respectively. The remaining major industries (energy, construction, communication, and transportation) are each less than 2-percent of the total from the major industries (15).



Source: Brainerd Lakes Area Economic Development Corporation (15)

Figure E-3 Major Industries in Crow Wing County

E.4 Cumulative Effects – 18 CFR § 5.18(b)(2)

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) 40 CFR § 1508.1(g)(3), An agency's analysis of effects shall be consistent with 40 CFR § 1508.1(g). Cumulative impact, defined in 40 CFR § 1508.7, has been repealed. 40 CFR § 1508.1(g) states:

> *Effects or impacts means changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives.*
>
>> *(1) Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic (such as the effects on employment), social, or health effects. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.*
>>
>> *(2) A "but for" causal relationship is insufficient to make an agency responsible for a particular effect under NEPA. Effects should generally not be considered if they are remote in time, geographically remote, or the product of a lengthy causal chain. Effects do not include those effects that the agency has no ability to prevent due to its limited statutory authority or would occur regardless of the proposed action.*

E.4.1 Cumulatively Effects Analysis

Through scoping, agency consultation, review of the Pre-Application Document (PAD), and Commission staff's preliminary analyses, the Commission noted in its Scoping Document 2 (SD2) (16) issued on August 10, 2018 that the Commission has not identified any resources that could be cumulatively affected by the proposed continued operation of the project.

E.4.1.1 Geographic Scope

The geographic scope of the analysis for cumulatively affected resources is defined by the physical limits or boundaries of (1) the proposed action's effect on the resource, and (2) contributing effects from other hydropower and non-hydropower activities within the Basin. Because the proposed action can affect resources differently, the geographic scope for each resource may vary. In the Revised Study Plan (RSP) (17), issued by BPU on December 10, 2018, the geographic scope for the studies included:

- immediately upstream and within 450-feet downstream of the Project for the dissolved oxygen and temperature study;
- within the Project Boundary for the cultural resources and recreation studies; and
- at the Project and potential effects on the health of the Upper Mississippi River fishery for the fish entrainment and impingement study.

E.4.1.2 Temporal Scope

The temporal scope of cumulative effects analysis in the exhibit addresses past, present and reasonably foreseeable future actions and their effects on each resources that may be cumulatively affected. Based on the potential terms of the new licenses, the temporal scope of this analysis would need to address reasonably foreseeable actions 30-50 years into the future.

E.5 Applicable Laws – 18 CFR § 5.18(b)(3)

E.5.1 Federal Power Act

Issuance of a new license for the Project is subject to requirements under the Federal Power Act (FPA) and other federal statutes.

E.5.1.1 Title 18 Fishway Prescriptions

Under Title 18 of the FPA, the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) have the authority to prescribe fishways at federally regulated hydropower projects. There are no upstream fish passage facilities in place. No preliminary prescriptions have been filed by either agency.

E.5.1.2 Section 4(e) Conditions

Section 4(e) of the FPA provides that any license issued by FERC for a project within a federal reservation shall be subject to and contain such conditions as the Secretary of the responsible federal land management agency deems necessary for the adequate protection and use of the reservation. This Project does not encompass any federal lands; therefore, these conditions do not apply.

E.5.1.3 Section 10(j) Recommendations

Under Section 10(j) of the FPA, FERC must consider recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation or enhancement of fish and wildlife resources affected by the Project prior to issuing the new license. FERC will include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. No preliminary 10(j) recommendations have been provided for inclusion in this application.

E.5.1.4 Section 401 of the Clean Water Act – 18 CFR § 5.18(b)(3)(i)

Section 401 of the Clean Water Act (CWA) requires BPU to obtain certification from the appropriate state pollution control agency verifying compliance with the CWA or to obtain a waiver of certification. The Minnesota Pollution Control Agency (MPCA) is the state agency responsible for water quality certifications for the Project. The Project was issued a water quality certification during relicensing in 1993. When BPU applied for a non-capacity amendment in 2016, MPCA noted in a letter to BPU dated March 18, 2016, that the MPCA believed at that time that the original Section 401 Certification for the Project remained in effect because there were no significant structural changes, no change to the dam or reservoir, and no changes to the existing operation of the project. This response from the MPCA was submitted to the FERC in a letter dated March 21, 2016 (Appendix C).

In August 2020, the MPCA stated that the aforementioned March 18, 2016, letter is the most current correspondence on the matter and confirmed that the original Section 401 water quality certification remains in effect. This determination was contingent on the fact that BPU is only relicensing its existing facilities, with no significant structural changes, no change to the dam or reservoir, and no changes to the existing operation of the project. Consultation with the MPCA will continue through the licensing process.

E.5.1.5 Endangered Species Act – 18 CFR § 5.18(b)(3)(ii)

Under provisions of Section 7(a)(2) of the Endangered Species Act (ESA), a federal agency that authorizes, permits, or carries out activities must consult with USFWS to ensure that its actions will not jeopardize the continued existence of any listed species. A federal agency is required to consult with the USFWS if an action "may affect" listed species or designated critical habitat, even if the effects are expected to be beneficial. A "may affect" determination includes actions that are "not likely to adversely affect," as well as "likely to adversely affect" listed species. If the action is "not likely to adversely affect" listed species (i.e., the effects are beneficial, insignificant, or discountable), and if the USFWS agrees with that determination and provides written concurrence thereof, then no further consultation is required. If the action is "likely to adversely affect" listed species, then the federal action agency must request initiation of formal consultation. This request is made in writing to the USFWS and must include a complete initiation package. Formal consultation concludes when the USFWS issues a biological opinion to the federal action agency. More detailed information regarding threatened and endangered species in the project area is provided in Section E.8.7.

E.5.1.6 Magnuson-Stevens Fishery Conservation and Management Act – 18 CFR § 5.18(b)(3)(iii)

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) section 305(b)(2) requires federal agencies to consult with National Oceanic and Atmospheric Administration (NOAA) Fisheries on all actions that may adversely affect Essential Fish Habitat (EFH). NOAA (18) lists no EFH for the Mississippi River.

E.5.1.7 Coastal Zone Management Act – 18 CFR § 5.18(b)(3)(iv)

Section 307(c)(3) of the Coastal Zone Management Act requires that all federally licensed and permitted activities be consistent with approved state Coastal Zone Management Programs. This Project is not located in a coastal zone management area; therefore, this section is not applicable.

E.5.1.8 National Historic Preservation Act – 18 CFR § 5.18(b)(3)(v)

Section 106 of the National Historic Preservation Act (NHPA) requires that every federal agency consider how each of its undertakings could affect historic properties. Historic properties are any prehistoric or historic districts, sites, buildings, structures, Traditional Cultural Properties (TCPs), and objects significant in American history, architecture, engineering, and culture that are eligible for inclusion in the National Register of Historic Places (NRHP). Sites within the Project Area are eligible for listing in the NRHP. BPU is filing a Historic Properties Management Plan will be included in the Cultural Resources Management Plan (see Section E.7.2)

E.5.1.9 Wild and Scenic Rivers and Wilderness Act – 18 CFR § 5.18(b)(3)(vii)

Section 7(a) of the Wild and Scenic Rivers Act requires federal agencies to make a determination as to whether the operation of a project under a new license would unreasonably diminish the scenic, recreational, and fish and wildlife values present in the designated area. The Mississippi River in the Project Area is not a designated Wild and Scenic River by the National Park Service (NPS) or the State of Minnesota (MDNR 2016a). The Wilderness Act of 1964 established a National Wilderness Preservation System. There are no designated Wilderness areas within or near the Project Area.

E.6 Project Facilities and Operation – 18 CFR § 5.18(b)(4)

E.6.1 Maps of Project Facilities within Project Boundaries – 18 CFR § 5.18(b)(4)(i)

The Project Boundary for the Project is shown on Figure E-1 in Appendix C.

E.6.2 Project Configuration – 18 CFR § 5.18(b)(4)(ii)

Drawing G-06 in Appendix C includes a drawing showing the relative locations and physical interrelationships of the principal project features. Detailed descriptions for each of these features, including the composition and dimensions of each feature, are included below:

E.6.2.1 Dam

The dam structures include a short left embankment, a 256-foot-long powerhouse, a 78-foot-long slide gate section, a 207-foot-long bascule (crest) gate section, a single 20-foot-wide steel tainter gate, and a 200-foot-long right embankment.

E.6.2.2 Left Embankment

The left embankment includes a steel sheetpile wall extending from the powerhouse wall to the left slope. The top of the sheetpile wall is at elevation 1183.8 feet NGVD. A 16-foot-wide opening allows for vehicular access along the road. Stoplogs are available at the site to close the opening as necessary.

E.6.2.3 Powerhouse

The 59-foot-wide by 256-foot-long powerhouse is a reinforced concrete structure founded on timber piling with a brick superstructure. The flumes are numbered one through 10 with number one being closest to the river and number 10 closest to the left embankment. Five of the original 10 flumes are currently used for power generation. Turbines are located in flumes one through five, the new turbine will be installed in flume six, flumes seven through nine are sealed with concrete, and flume 10 is used for firewater.

E.6.2.4 Slide Gate Section

The slide gate section is 78 feet long measured between Pier 4, the pier adjacent to the powerhouse, and Pier 3, the pier connecting the bascule gate section and slide gate section. This section consists of five steel 13.6-foot-wide by 5-foot-high vertical steel gates, four intermediate piers, guide assemblies, and a spillway section. During reconstruction of the Project in the 1950s, a steel sheet pile was installed and grouted along the upstream side of the slide gate sections serving as a cofferdam; the rock-filled timber cribbing was consolidated, a reinforced-concrete spillway facing was installed over the consolidated timber cribbing serving as the spillway, and the gates (also referred to as stop logs) and guide assemblies were installed.

E.6.2.5 Bascule Gate Section

The bascule gate section is 207 feet long measured from the left side of Pier 3, the pier connecting the bascule gate section and the slide gate section, to the right side of Pier 1, adjacent to the tainter gate section. This section consists of the three primary concrete piers on the upstream side of the Project, two 85-foot-long by 7-foot 10-inch-high bascule gates, a concrete ogee section, and a spillway apron. During reconstruction of the Project in the 1950s, a cellular-steel-sheetpile system was installed and grouted upstream from the existing structure serving as a cofferdam; the rock-filled timber cribbing was consolidated, the piers were constructed, a reinforced-concrete ogee facing was installed over the consolidated timber cribbing serving as the spillway, and the gates were installed. In 2017, the spillway apron was overlaid to elevation 1153.17 feet NGVD by anchoring reinforced concrete into the existing apron. A vertical sheetpile extends across the Project on the downstream edge of the spillway apron.

E.6.2.6 Tainter Gate

The tainter gate section is 20 feet long by 11 feet high, measured from the right side of Pier 1, adjacent to the bascule section to the right abutment wall. A wooden tainter gate was replaced in 2000 with a steel tainter gate. In 2017, the spillway section downstream from the tainter gate was overlaid by anchoring reinforced concrete into the existing section.

E.6.2.7 Right Embankment

The 220-foot-long right embankment was constructed of earth-fill over rock-filled timber cribs with a 10-foot-wide embankment crest. The earthen embankment was raised to elevation 1184.84 feet NGVD by constructing a sheetpile wall on the upstream side of the embankment and filling in behind the sheetpile with earth. The sheetpile wall extends for 149 feet from its connection point with the tainter gate section and is anchored by concrete deadmen and steel tiebacks.

E.6.2.8 Tailrace Section

Ten flumes were originally constructed for power generation. Only five of the 10 flumes are currently used, with a sixth flume expected to be operational in the near future when the new turbine is installed. Below the draft tubes is a hard concrete floor. At the end of the concrete floor towards the downstream end of the tailrace, the floor transitions into timber planking.

E.6.2.9 Transmission Line

The Project transmission lines consist of a 236-foot-long 2.4-kilovolt (kV) overhead transmission line running from the powerhouse to a pad-mounted transformer located on the left embankment directly east of the powerhouse. Power is then transferred underground to the distribution grid. The transmission line length is shorter than stated in the existing license due to recent modifications. The 825-foot-long

34.5 kilovolt underground transmission line transfers power from the pad-mounted transformer (owned by BPU) to the distribution grid. The distribution grid is owned by BPU. Refer to Figure A-4 in Appendix B.

E.6.3 Water Surface – 18 CFR § 5.18(b)(4)(iii)

The normal water surface area for the reservoir is 2,500 acres with a normal water surface elevation of 1174.0 ± 0.1 feet (NGVD). The storage capacity of the reservoir is 13,000 acre-feet.

E.6.4 Turbines and Generators – 18 CFR § 5.18(b)(4)(iv)

The Project is licensed for six generating units with a total installed capacity of 3,542.5 kilowatts (5). Detailed information on each unit in Table E-1. At present, five tandem horizontal turbines with direct connections to generators are installed. The license was amended in 2016 to allow for the additional capacity of a sixth turbine/generator unit which has not been installed yet. With the proposed turbine, the Project will have a combined rated capacity of 3,542.5 kW. The installed capacity is currently 2,942.5 kW. The minimum and maximum hydraulic capacity for the units is 295 and 2,773 cfs (per installed unit), respectively. The hydraulic capacity range of the new turbine is expected to be 310 to 925 cfs.

Table E-1 Unit Summary

Unit No.	Year Generator / Turbine Installed	Authorized Installed Capacity (kW)	Generator Make and Type	Turbine Make and Type
1	1916	560[1]	Electric Machinery 700 kVA 2300V (560 kW)	2-S. Morgan Smith 45 inch Horizontal Frances 128.5 rpm Type N 610 hp (455 kW) at 665 cfs
2	1916	560[1]	Electric Machinery 700 kVA 2400V (560 kW)	2-S. Morgan Smith 45 inch Horizontal Frances 128.5 rpm Type N 610 hp (455 kW) at 665 cfs
3	1956/1916	480.3[1]	General Electric 600 kVA 2300V (480.3 kW)	2-S. Morgan Smith 32.5 inch Horizontal Frances 225 rpm Type S 520 hp (388 kW) at 493 cfs
4	1956/1916	671.1[1]	Electric Machinery 900 hp 2200V (671.1 kW)	2-S. Morgan Smith 32.5 inch Horizontal Frances 225 rpm Type S 520 hp (388 kW) at 493 cfs
5	1956/1916	671.1[1]	Electric Machinery 900 hp, 2200V (671.1 kW)	2-S. Morgan Smith 32.5 inch Horizontal Frances 225 rpm Type S 520 hp (388 kW) at 493 cfs
6	Planned 2020/2021	600[2] (assumed)	TBD	TBD
Total		**2,942.5**		

(1) Based on BPU calculated capacity (6)
(2) ATS-63 Turbine/generator installation date TBD – (6)

E.6.5 Dependable Capacity – 18 CFR § 5.18(b)(4)(iv)

The dependable capacity and average energy production for the Project will be reported in the Final License Application.

E.6.6 Operation – 18 CFR § 5.18(b)(4)(v)

The Project is manually operated as a run-of-river project and maintains a target elevation of 1174.04 feet (NGVD) with fluctuations limited to 0.1 feet (6). The Project is not used for peaking, does not have ramping rates, flushing flows, or flood control operations. Run-of-river mode may be temporarily modified in the event of an emergency if the Minnesota Department of Natural Resources (MNDNR) agrees, but FERC must be notified as soon as possible following the event. The addition of the sixth turbine involves no change to the dam or reservoir or to the existing operations of the present Project or its reservoir. The Project will remain run-of-river with inflow matching outflow. The only change is that instead of passing additional flow over the gated spillway section, the water will pass through the powerhouse, or the sixth turbine. There are no changes to operation proposed for the Project.

E.7 Proposed Action and Alternatives – 18 CFR § 5.18(b)(5)

E.7.1 Summary of Existing Measures

BPU currently implements the following protection, mitigation, and enhancement (PM&E) measures for the protection of aquatic, water quality, geologic/soil, recreation, and cultural resources pursuant to the existing license for the Project:

- **Article 402** requires that the Licensee operate the Project in a run-of-river mode, maintain a target elevation of 1174.04 feet NGVD with fluctuations limited to 0.10 feet (12). Run of river may be temporarily modified in the event of an emergency if the MNDNR agrees, but the Commission must be notified as soon as possible following the event.

- **Article 403** requires the Licensee to file and implement a plan to monitor the Project's run-of-river operation.

- **Article 404** requires the Licensee to file and implement an operation plan which specifies how the Licensee coordinates with other plant operators on the Mississippi River and considers effects of flow adjustments on downstream fishery and other natural resources.

- **Article 405** requires the Licensee to file and implement a plan to annually monitor bald eagle nesting at the Project.

- **Article 406** requires the licensee to implement the Programmatic Agreement executed on January 11, 1993, to avoid and mitigate impacts to archeological and historic sites at the Project.

- **Article 407** requires the Licensee to consult with the State Historical Preservation Office (SHPO) before conducting any land-clearing or ground-disturbing activities within the Project boundaries or if a previously unidentified archaeological or historic property is discovered during the course of Project operation. In either instance, the Licensee must file the following with the Commission: a report containing a cultural resources survey, a cultural resource management plan completed by a qualified cultural resource specialist after consulting with the SHPO, and written comments of SHPO and Tribes. The Licensee shall implement the plan upon Commission approval.

- **Article 408** requires the Licensee to monitor recreation use of the Project area to determine if existing recreation facilities are meeting recreation needs. Monitoring studies shall occur annually and every 6 years the Licensee shall file a report with the Commission on the monitoring results. This report shall include annual recreation use figures, discussion of adequacy of facilities to meet recreation demand, a description of the methodology used to collect study data, if there is a need for additional recreation facilities in the Project area, documentation of agency consultation, and comments on the report and specific descriptions of how the agency's comments are accommodated.

E.7.2 Applicant's Proposal

The comprehensive studies, consultation, and evaluation of the Project during the previous licensing resulted in the development and implementation of multiple comprehensive PM&E measures; therefore, BPU is proposing measures consistent with the measures required by the existing license with some modifications. BPU anticipated further consultation with stakeholders regarding potential PM&E measures to be proposed by BPU in the Final License Application. BPU Proposes to:

- Maintain a target reservoir elevation of 1174.04 feet NGVD with fluctuations limited to 0.10 feet.
- Operate and maintain the current FERC-approved recreation facility owned by BPU.
- Develop a Recreation Management Plan to be filed with the Commission within 1 year of issuance date of the new license.
- Develop a Cultural Resources Management Plan (CRMP) to be filed with the Commission within 1 year of issuance date of the new license.

E.8 Environmental Analysis – 18 CFR § 5.18(b)(ii)

The effects of the Project on environmental resources is explained in this section utilizing the information filed in the PAD, information developed through implementation of the FERC-approved study plans, and additional information otherwise developed or obtained by the Licensee.

E.8.1 Geology and Soils

E.8.1.1 Affected Environment

E.8.1.1.1 Geology

The Project is located in the Mississippi River Valley near the headwaters of the Mississippi. In this region, the Mississippi River flows through ice-contact stratified materials and outwash sand deposited during the Wisconsin glaciation. Bedrock is Precambrian metamorphic rocks such as argillite (slate), greywacke, and ferruginous chert (see Figure E-2 in Appendix C). The bedrock surface is generally at a depth of less than 100 feet and occasionally outcrops near the surface. Soils in the area of the dam are predominantly outwash sands, ice-contact stratified materials, and Glacial Lake Brainerd deposits less than 100 feet deep (10) (see Figure E-3 in Appendix C). Sinkholes are generally associated with carbonate bedrock such as dolomite and limestone. Since the bedrock at the dam site is Precambrian metamorphic rock, sinkhole potential is negligible (10).

A northeast-trending thrust fault is located approximately ½ mile southeast of the dam (19). It should be noted that there is no history of significant earthquakes in this region. Minnesota is considered to be a low-risk seismic region as referenced in USACE publication ER 1110-2-1806 (20).

E.8.1.1.2 Soils

According to the Soil Survey of Crow Wing County (21), there are 24 soil map units found within the Project area. The most predominant soil map unit is water (84 percent of the Project area) due to the Project boundary primarily consisting of the reservoir upstream of the Brainerd Dam. Other soil map units that comprise more than 1 percent of the Project area include:

- Eutrudepts-Graycalm-Rollins complex, pitted, 20 to 45 percent slopes (5 percent of the Project area).
- Lougee-Totagatic-Bowstring complex, 0 to 1 percent slopes, frequently flooded (3 percent of the Project area).

All mapped soils in the Project area have a Kf[1] factor less than 0.37, making them less susceptible to sheet and rill erosion by water. Most of the soils in the Project area (88 percent) are mapped as not hydric, and none are classified as prime farmland. See Figure E-4 in Appendix C for a surficial soils map of the Project.

E.8.1.1.3 Topography

The topography in the vicinity of the Project is relatively level with some areas of strongly rolling hills. The highest ground elevation within 2 miles of the Project is about 165 feet above normal reservoir headwater elevation. From its upstream origin, the Mississippi River follows an extremely winding course which flows through a broad, flat highland covered with numerous lakes, swamps, and low hills. There is only a 70 foot vertical drop between the Blandin Dam (located in Grand Rapids) and the Project site in Brainerd. The Blandin Dam is the next upstream dam along the main stem of the Mississippi River, approximately 173 river miles away (12).

E.8.1.1.4 Reservoir Shoreline and Streambank Conditions

The shoreline surrounding the Project is forested. The streambanks are relatively stable. The Project is operated as run-of-river with a 0.1-foot variation. Sudden increases or decreases in reservoir elevation are due to weather conditions and not Project operations. Therefore, the Project is likely to have limited effect on erosion.

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[1] The Kf erosion factor indicates the erodibility of materials less than 2 millimeters in size. Values of K range from 0.02 to 0.69, with higher values indicating greater susceptibility.

E.8.1.2 Environmental Analysis

In SD2, the FERC did not identify geologic and soils resource issues. There were no studies proposed or completed during the relicensing regarding geology and soils. While project operations do not directly cause erosion, the dam will continue to serve as a physical barrier the traps sediment. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to geology, topography, and soils.

E.8.1.3 Proposed Environmental Measures

BPU proposes continued operation of the Project with PM&E measures consistent with those required by the existing license including limiting reservoir fluctuations to 0.10 feet.

E.8.1.4 Unavoidable Adverse Effects

Unavoidable adverse effects are those effects that may still occur after implementation of PM&E measures. Continued operation of the Project as a run-of-river facility is not expected to have unavoidable adverse impacts on geology or soil resources.

E.8.2 Water Resources

E.8.2.1 Affected Environment

E.8.2.1.1 Drainage Area

The Mississippi River arises in an area of small lakes in northwestern Minnesota and flows southeast across the state to its confluence with the Minnesota River near St. Paul, MN. The Project is part of the Upper Mississippi River basin, which is predominantly forest. The drainage area of the Upper Mississippi River Basin is approximately 7,320 square miles. The watershed is described as a glaciated region having gravelly and sandy outwash material (12).

E.8.2.1.2 Flows of Record

Historical flood data for this Project is gathered from the U.S. Geological Survey (USGS) gaging stations at Aitkin (52 miles upstream of Brainerd) and Royalton (48 miles downstream from Brainerd). A USGS gage was installed at Brainerd in 1987. Average monthly flow data from the Brainerd gage is shown for the last 10 years in Table E-2. The minimum, maximum, and average discharge for the above-listed gages are shown in Table E-3. The annual and monthly flow duration curves for the Project are included in Appendix A. The minimum, mean, and maximum average daily flows from the Brainerd gage for the period of record are 348 cfs, 3,488 cfs, and 17,900 cfs, respectively.

Table E-2 Average Monthly Flows for USGS Gauge 052452300 (2008-2017)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2008	1,791	1,491	1,228	4,902	8,598	6,069	2,838	1,002	801	1,938	2,758	1,670
2009	1,652	2,129	4,339	8,987	6,508	3,539	1,690	991	618	1,179	3,079	2,072
2010	2,212	2,050	3,013	1,656	2,501	1,652	2,167	2,769	2,503	3,735	6,925	3,714
2011	3,338	3,068	3,086	7,385	8,468	6,217	4,854	3,525	1,647	1,411	1,650	1,590

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2012	1,400	1,338	1,839	2,970	6,209	12,540	11,590	3,535	1,170	885	1,195	2,044
2013	1,716	1,717	1,687	4,495	9,139	7,481	4,885	1,522	1,017	2,242	2,520	1,969
2014	2,116	2,120	2,264	7,093	10,900	10,010	5,952	3,685	3,506	3,018	2,619	2,020
2015	1,791	1,646	1,831	1,370	5,176	4,798	2,667	1,727	2,253	2,149	4,209	4,415
2016	3,669	3,196	5,252	5,795	4,462	3,477	8,002	4,047	3,522	3,436	3,215	4,864
2017	3,541	3,611	5,008	6,977	7,770	3,387	1,992	2,041	3,055	5,638	3,336	2,903
Monthly Mean (1)	2,475	2,290	2,739	5,677	6,014	4,727	4,234	2,382	2,166	2,983	3,350	2,851

Note:

1. Monthly mean based on data from May 1987 to December 2017

Table E-3 USGS Stream Gage Data

Gage	Drainage Area (mi^2)	Period of Record	Maximum Discharge (cfs)	Minimum Discharge (cfs)	Average Discharge (cfs)
05227500 at Aitkin	6,140	1945 to 2017	19,900 (May 20, 1950)	153 (Sept. 1, 1961)	2,929
05242300 at Brainerd	7,320	1987 to 2017	17,900 (June 26, 2012)	348 (July 30, 1988)	3,488
05267000 near Royalton	11,600	1924 to 2017	38,200 (April 8, 1997)	254 (Nov. 25, 1937)	4,912

E.8.2.1.3 Water Uses and Upstream and Downstream Requirements

The primary purpose of the Project is electrical power generation. The Project is operated in a run-of-river mode year-round with Project discharges matching inflows. The reservoir elevation is maintained at 1174.0 is 1174.0+/- 0.1 feet (NGVD) for flows less than 13,000 cfs. When flows exceed 13,000 cfs, the Project no longer capable of regulating the reservoir elevation because all of the gates are fully open.

The applicant is not aware of any upstream water intakes within the boundary limits of the Project. BPU proposes to continue operating the Project in a run-of-river mode year-round, with discharges matching inflows. If there are existing water intakes located upstream from the Project, the Project is not anticipated to change impacts to those intakes because the Project will continue to regulate the reservoir at a minimum elevation of 1174.0 +/- 0.1 feet (NGVD).

Because the Project operates in a run-of-river mode year-round and BPU proposes to continue operating the Project in a run-of-river mode, the Project is not anticipated to change impacts to water elevations or flows downstream from the Project.

E.8.2.1.4 Existing Instream Flow Uses

The MNDNR and the Minnesota Pollution Control Agency (MPCA) regulate the use of surface waters within the state's boundaries. Primary water uses include recreation such as boating and fishing and hydroelectric power generation. Secondary uses include navigation and industrial process cooling water.

Because the Project operates in a run-of-river mode year-round and BPU proposes to continue operating the Project in a run-of-river mode, the Project is not anticipated to change impacts to instream flows from the Project.

E.8.2.1.5 Water Rights

The Project is located in Minnesota following eastern (Riparian) water law (22). Since the Project operates as a run-of river facility, no water use permit is required.

E.8.2.1.6 Relevant Federally Approved Water Quality Standards

Under Section 303(d) of the Clean Water Act (CWA), states are required to monitor and assess their waters to determine if they meet water quality standards supporting the beneficial uses they are intended to provide (33 U.S.C. 1313(d)). Waters that do not meet their designated uses due to water quality standard violations are listed as impaired. States are required to develop a list of impaired waters that require total maximum daily load (TMDL) studies and to submit an updated list of impaired waters to the Environmental Protection Agency (EPA) every 2 years. The MPCA monitors waters to determine if they meet water quality standards for designated uses and lists waters as impaired if they do not meet their designated uses because they exceed water quality standards.

Within the Project area, Rice Lake (ID 18-0145-00) and the reach of the Mississippi River from the Pine River to the Crow Wing River (ID 07010104-656), which extends both upstream and downstream of the Brainerd Dam, are listed as impaired. Rice Lake is impaired for mercury in fish tissue, with the affected designated use of aquatic consumption. Listed as impaired in 1998, a TMDL Plan for the Rice Lake mercury impairment was approved in 2008. Similar to Rice Lake, this reach of the Mississippi River was listed as impaired for mercury in fish tissue in 1998, with the affected designated use of aquatic consumption. A TMDL Plan for this impairment was approved in 2007. This reach of the Mississippi River was also listed as impaired for total suspended solids (TSS) in 2016, with the affected designated use being aquatic life. A TMDL Plan for the TSS impairment has not, yet, been completed, but is targeted for completion in 2021 (23).

Pursuant to 18 CFR §5.18(b)(3)(i), applicants must file a request for a water quality certification A water quality certification, pursuant to Section 401 of the Federal Water Pollution Control Act, 33 S.C. S1341. The Project was issued a water quality certification during relicensing in 1993. When BPU applied for a non-capacity amendment in 2016, MPCA noted in a letter to BPU dated March 18, 2016 that the MPCA believed at that time that the original Section 401 Certification for the Project remained in effect because there were no significant structural changes, no change to the dam or reservoir, and no changes to the existing operation of the project. This response from the MPCA was submitted to the FERC in a letter dated March 21, 2016 (Appendix C).

In August 2020, the MPCA stated that the aforementioned March 18, 2016, letter is the most current correspondence on the matter and confirmed that the original Section 401 water quality certification remains in effect. This determination was contingent on the fact that BPU is only relicensing its existing facilities, with no significant structural changes, no change to the dam or reservoir, and no changes to the existing operation of the project. Consultation with the MPCA will continue through the licensing process.

E.8.2.1.7 Project Effects on Seasonal Variation of Water Quality

The Project waters are subject to Minnesota Administrative Rule 7050, Waters of the State, Water Quality Standards for Protection of Waters of the State. Mississippi River water in the vicinity of the Project is in the water use group classifications 2B and 3B.

- Class 2B: Fisheries and recreation. The quality of this class of waters of the State shall be such as to permit the propagation and maintenance of a healthy community of cool or warm water aquatic biota and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing for which the waters may be usable.
- Class 3B: Industrial Consumption. The quality of this class of the waters of the State shall be such as to permit their use for general industrial purposes, except for food processing with only a moderate degree of treatment.

In addition, this reach of the river from Lake Itasca to Fort Ripley is designated as an outstanding resource value water. This means that these waters have special qualities which warrant stringent protection from pollution. The only established water quality monitoring station in this reach of the river is near Royalton, 48 miles below the Project. In 2017, the MPCA assessed water quality from the headwaters to the Twin Cities area. Although the portions of the river up and downstream of the project met recreation standards for water quality, the portion of the river upstream from Grand Rapids to Brainerd failed to meet river live standards due to sediment levels (24).

Each year the Minnesota Department of Health publishes a fish consumption advisory for Minnesota waterways for the presence of mercury, dioxin, and PCBs. The June 2016 publication (25) lists mercury advisories for a variety of fish species caught in the Mississippi River in the vicinity of the Project, both up and downstream.

The state of Minnesota has issued a Water Quality Certificate to the applicant which requires a minimum flow below the dam of 380 cfs, except when limited by reservoir inflow. This conforms to the EPA's recommendations on minimum flows for maintaining water quality below the dam.

E.8.2.1.8 Existing Reservoir Information

The reservoir elevation is 1174.0+/- 0.1 feet (NGVD). The reservoir has a normal surface area of about 2,500 acres or storage capacity of 13,000 acre-feet. A minimum outflow of 380 cfs is maintained at all times from the Project, except when the inflow is less than 380 cfs, in which case outflow equals inflow. The Project is a run-of-river facility.

E.8.2.2 Environmental Analysis

A dissolved oxygen and temperature study was conducted by BPU to evaluate the Dissolved Oxygen (DO) concentration and temperature of water entering the Project's powerhouse intakes within the reservoir, then discharged immediately downstream of the powerhouse into the Mississippi River during summer conditions. DO and water temperature were identified as the water quality monitoring variables of interest because these variables are effective indicators for overall health of the aquatic system, as fish and other organisms require DO and temperature within certain ranges. The report was summited to the FERC with the Initial Study Report (ISR) on January 22, 2020 and has been included in Appendix C of this DLA.

The objectives and summary results from the DO and Temperature Study (26) were:

- Objective: Identify the DO concentration and temperature of water entering the Project intakes.

  Results: DO concentration at the upstream monitoring location ranged from 5.22 to 8.90 mg/L, with a seasonal mean of 7.16 mg/L. Water temperature at the upstream monitoring location ranged from 13.8° to 26.1°C, with a seasonal mean of 21.0°C.

- Objective: Describe any temporal variations of DO concentration and temperature.

  Result: DO concentrations do not vary dramatically between upstream and downstream locations.

- Objective: Identify the DO and temperature profile within the Project reservoir in the vicinity of the intakes.

  Results: DO concentrations are highest in early summer and fall, and lowest mid-summer. Water temperature does not vary significantly throughout the reservoir in the summer season.

- Describe the changes of DO concentrations and temperature in the river downstream of the Project.

  Results: DO concentration and water temperature do not vary dramatically with water depth, either upstream or downstream.

Four monitoring locations were utilized for this study; one upstream and three downstream locations. The upstream location is located immediately upstream of the Project intake, at the intersection of the slide gates and the powerhouse within 33 feet of the intakes. The downstream locations are located 150 feet (Site 1), 300 feet (Site 2), and 450 feet (Site 3) downstream of the Project.

During data collection, information on water condition (odor, color, contents, etc.), hydrology, and Project operations (spillway and generator flow) was also collected. Although this Study was not designed to model the variables associated with DO and temperature, the inclusion of these supplemental variables may provide context to DO and water temperature results.

In addition to the target variables of DO and temperature, field staff also recorded qualitative observations on the condition and contents of water, such as surficial foam, algal blooms, fish kills, odors, color, organic sheen, etc. This information was collected to provide context to the dataset, and to potentially explain any low DO concentrations.

DO measurements were collected at each of the four monitoring locations as both concentrations (mg/L) and saturations (% Sat). Figure E-4 shows the average DO concentrations at each monitoring location over the course of the Study. Figure E-5 shows the average DO saturation at each monitoring location over the course of the Study. For both figures, average values were obtained by calculating the mean value for the profile data collected at each monitoring location. Figure E-6 shows the average water temperature at each monitoring location over the course of the Study. Average values were obtained by calculating the mean value for the profile at each monitoring location.

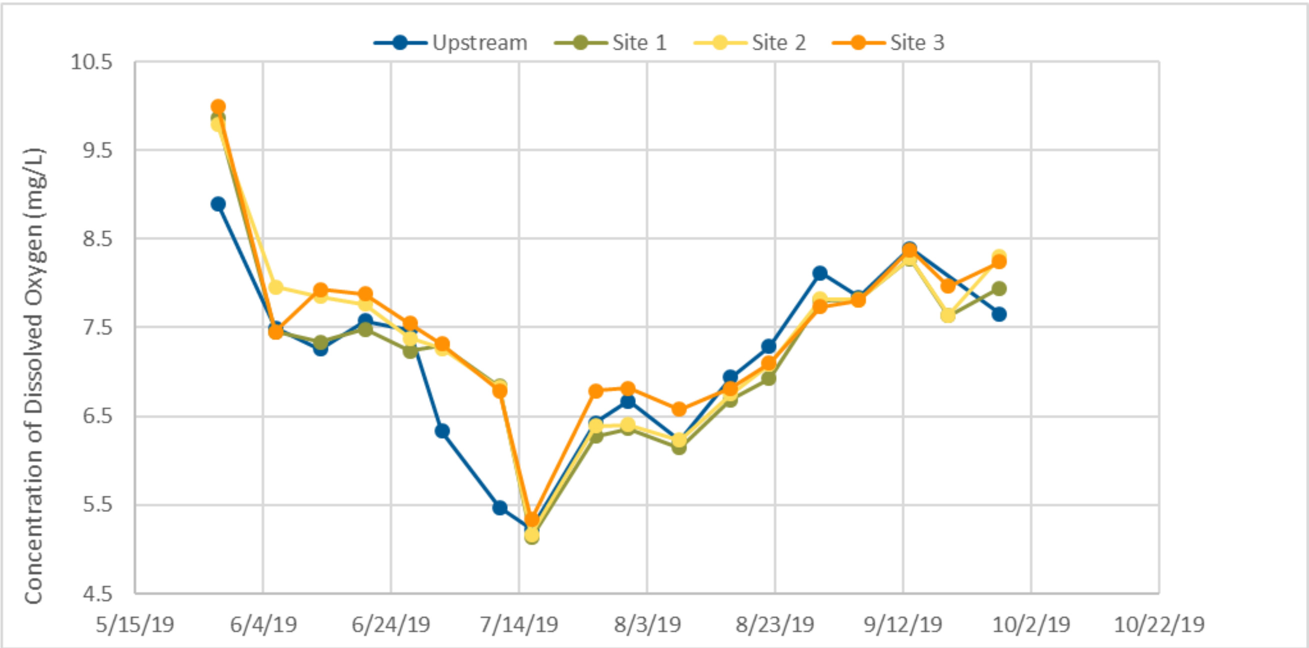

Figure E-4 **Average DO Concentrations**

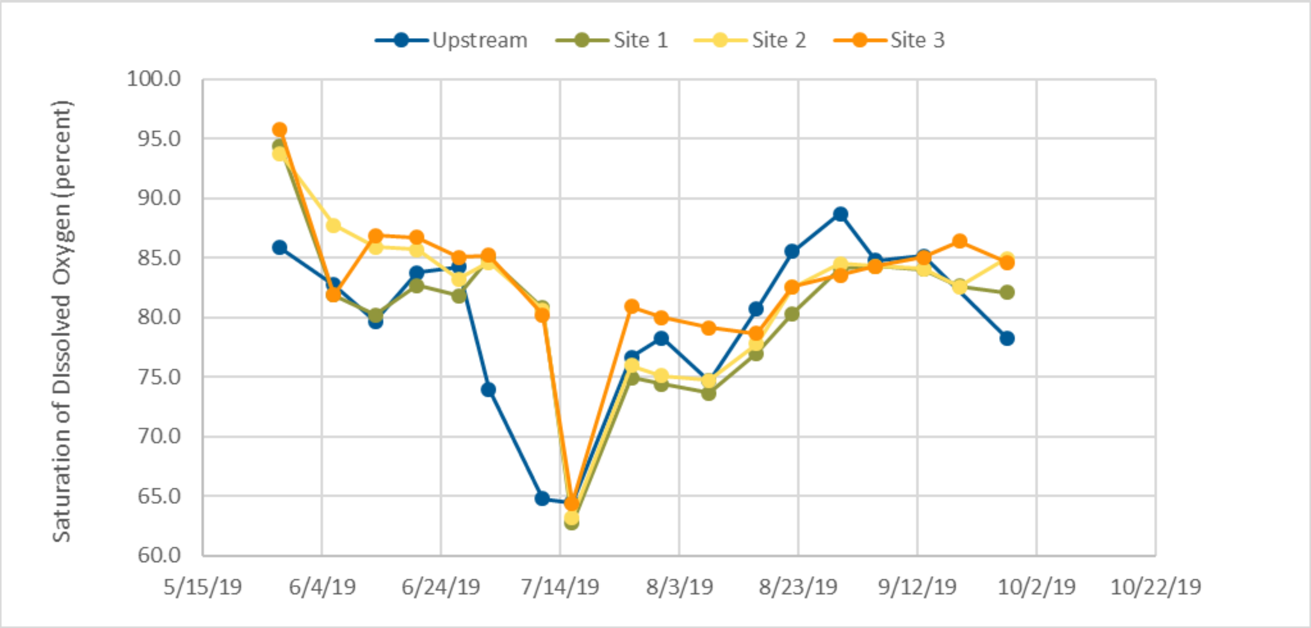

Figure E-5 Average DO Saturation

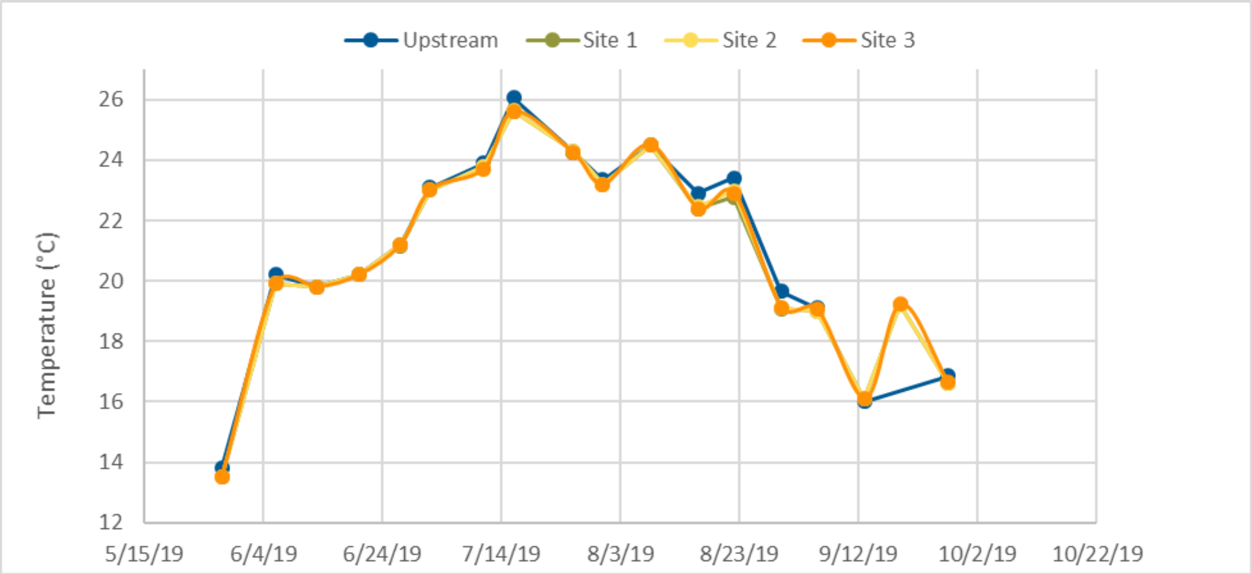

Figure E-6 Average Temperature

The monitoring data indicate the following about the water entering the Project intakes:

- DO concentration at the upstream monitoring location ranged from 5.22 to 8.90 mg/L, with a seasonal mean of 7.16 mg/L.
- DO saturation at the upstream monitoring location ranged from 64.3- to 88.9-percent saturation, with a seasonal mean of 79.6-percent saturation.

- Water temperature at the upstream monitoring location ranged from 13.8 to 26.1°C, with a seasonal mean of 21.0°C.

The monitoring data indicate the following about temporal variation in DO concentration and water temperature.

- DO concentrations recorded during the Study tended to be greatest in late May. DO concentrations generally decreased until mid-July, when DO values were lowest, then increased to early-season levels. DO saturation values also followed a very similar seasonal pattern, and vary inversely with water temperature.

- Water temperatures were lowest early in the growing season, peaked around mid-July, and then generally decreased for the rest of the season.

- Patterns of seasonal variability and the inverse relationship between DO and temperature were not unexpected. Microvariations from week to week were also not unexpected, because the monitoring was conducted on a weekly basis, instead of daily or hourly.

- The monitoring was completed on a weekly basis; therefore, this Study can only identify DO and temperature variations that occur on a corresponding weekly basis. Because more frequent monitoring was not conducted, this Study cannot show variations that occur on an hourly or daily basis.

- The monitoring was completed over an 18-week period between June 1 and September 30. Therefore, the Study cannot describe variations that occur outside of this time frame.

- Profile data from the upstream monitoring location suggests that DO and temperature in the reservoir do not vary dramatically with depth. The differences between the upper and lower measurements within the profile are less than 0.2 mg/L for DO concentration, less than 2% Sat for DO Saturation, and less than 0.5 °C for water temperature. These data suggest that the water in the reservoir is well-mixed immediately prior to entering the Project intakes for the duration of the summer season.

A comparison of surficial data between the downstream monitoring locations (Site 1, Site 2, and Site 3), suggest the following:

- DO concentrations in the water downstream of the Project generally increase with distance downriver, but only slightly. In general, the increase in DO concentration from Site 1 to Site 3 is less than 0.5 mg/L. This trend persisted with depth in the profile and was also present for the duration of the Study.

- DO saturation in the water downstream of the Project does not appear to vary consistently with distance downriver. In general, the variability of DO saturation from Site 1 to Site 3 is less than 10 % Sat. This trend persisted with depth in the profile and was also present for the duration of the Study.

- Temperature in the water downstream of the Project does not appear to vary consistently with distance downriver. In general, the variability of DO saturation from Site 1 to Site 3 is less than 1°C. This trend persisted with depth in the profile and was also present for the duration of the Study.

E.8.2.3 Proposed Environmental Measures

With the renewal of the license, no new impacts to water resources are expected. No changes to operations are proposed that would affect the availability or quantity of water in the project area for other water users, wildlife, landowners, or recreationists. There are no PM&E measures planned for this resource.

E.8.2.4 Unavoidable Adverse Effects

Unavoidable adverse effects are those effects that may still occur after implementation of PM&E measures. The DO and temperature data are very similar between upstream and downstream locations, which suggests that that the facility does not have any adverse effects on the reservoir water quality. Continued operation of the Project is not expected to cause new impacts to water resources.

E.8.3 Fish and Aquatic Resources

E.8.3.1 Affected Environment

E.8.3.1.1 Existing Environment

The Brainerd area provides premier fish habitat. In addition to the Mississippi River, the immediately upstream Rice Lake provides important fisheries habitat near the Project. Rice Lake is an impoundment of the Mississippi River created by the Brainerd Dam. As such, it contains both typical lake and riverine fish species (27).

The MNDNR surveyed the Rice Lake fishery in August 2014 and sampled 17 fish species, including black crappie, bluegill, bowfin (dogfish), brown bullhead, channel catfish, greater redhorse, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, shorthead redhorse, silver redhorse, smallmouth bass, walleye, yellow bullhead, and yellow perch (28). Although no muskellunge were sampled during the survey, there are reports of this fish species being caught in both Rice Lake and the adjoining reach of the Mississippi River as the MNDNR stocks this species in the Mississippi River. The MNDNR also stocks walleye in this region. Smallmouth bass is the primary management species of fish in Rice Lake, while walleye, northern pike, and muskellunge are secondary management species (27).

The MNDNR's Minnesota Statewide Mussel Survey indicates that the nearest mussel survey site is located approximately 6 miles upstream of the Project on the Mississippi River. The site (ID 2007059) was surveyed in June 2007, during which four species were identified: paper floater, fatmucket, giant floater, and plain pocketbook. According to the MNDNR, each of these is a common mussel species with a population that is presumed to be healthy.

BPU operates the Project in run-of-river mode for the protection of fish and wildlife resources in the Mississippi River, meaning that water is discharged at approximately the same rate as it enters the reservoir. The elevation of the upstream reservoir is held within 0.1 feet to the extent possible. Flows into the Project area are managed by USACE-controlled reservoirs upstream of the Project.

E.8.3.2 Environmental Analysis

A desktop fish entrainment and impingement study was completed to evaluate the potential for fish entrainment and impingement at the Project and its potential effects on the health of the upper Mississippi River fishery. The report was summited to the FERC with the Initial Study Report (ISR) on January 22, 2020 and has been included in Appendix C of this DLA.

Using a desktop analysis approach, the annual average number of fish less than 200 mm long expected to become entrained at the Project is approximately 290,000. Of that, approximately 36,000 will suffer mortality from entrainment. It was estimated that approximately 5,600 fish would become entrained with total lengths of 200 to 380 mm, and of those, approximately 1,200 suffering mortality. These estimations are based on species lists and relative composition data from the Mississippi River between Brainerd and the Grand Rapids Dam, entrainment data from the EPRI database, and the Project's operational specifications.

Physical exclusion is expected to occur for some larger fish of all species except Common Shiner, Mimic Shiner, Spotfin Shiner, Johnny Darter, Logperch, Trout-perch, and Central Mudminnow. Consequently, impingement on the trashrack is not expected to occur for any of the target species that reach a length at which they would be too large to pass through the 1.75-inch clear bar spacing.

Based on our evaluation and sampling by the MNDNR, population dynamics in the reach would remain as is and the status quo of Muskellunge and other game species, both above and below the Project, would be maintained. Black Crappie were estimated to have the highest entrainment and mortality rates for both size classes. The projected survival rate for all units combined at the Project is 82.6%.

E.8.3.3 Proposed Environmental Measures

Since the license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to fish and aquatic resources. There are no PM&E measures planned for this resource.

E.8.3.4 Unavoidable Adverse Effects

The desktop study demonstrated that project will likely impinge and entrain some fishes with associated mortality, however, no changes to the status quo of the fish populations above or below the project are anticipated.

E.8.4 Botanical Resources

E.8.4.1 Affected Environment

Publicly available data sources and available previous surveys in the vicinity of the Project were used to develop information related to wildlife and botanical resources and are shown on Figure E-5 in Appendix C.

E.8.4.2 Environmental Analysis

In response to questions posed during the licensing process a memorandum was developed describing the botanical resources in more detailed. This memorandum is included in Appendix C and the information summarized herein.

The Project is located within the Northern Minnesota Drift and Lake Plains (MDL) Section of Minnesota's Laurentian Mixed Forest Province (29). Vegetation patterns in the MDL reflect the area's history of patchy distribution of glacial deposits. Mesic forests typically consisting of sugar maple, basswood, paper birch, aspen, and northern red oak are widespread across the MDL. Historically, forests of jack pine and red pine were common. Sand and gravel deposits found atop moraines in the MDL provide suitable growing conditions for mixed forests of pine and boreal hardwood species such as quaking aspen and paper birch. The eastern portion of the MDL, where the Project is situated, contains former lake plains with expansive areas of peatland communities, such as black spruce, as well as both poor and rich swamp forests with white cedar and black ash. Sedge meadows and alder swamps occur in riparian areas along the Mississippi River and other smaller streams.

The Project is located in a hybrid urban/rural setting; as such, existing vegetation has become altered from native conditions in many locations. Much of the vegetation in the Project area has been converted to impervious surface, maintained open spaces (i.e., lawns, parks, etc.), or secondary growth forest. There are no MNDNR-identified native plant communities in the Project area. One Minnesota Biological Survey (MBS) site overlaps the majority of the Project boundary. This site, the Mississippi Moraine, is classified as a site of high biodiversity significance. MBS sites classified as high significance contain good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes. The MBS site classification for the Project area is shown on Figure E-5 in Appendix C.

E.8.4.3 Proposed Environmental Measures

Because the license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to botanical resources. There are no PM&E measures planned for this resource.

E.8.4.4 Unavoidable Adverse Effects

Continued operation of the Project is not expected to cause new impacts to botanical resources.

E.8.5 Wildlife Resources

E.8.5.1 Affected Environment

Publicly available data sources and available previous surveys in the vicinity of the Project were used to develop information related to wildlife and botanical resources and are shown on Figure E-5 in Appendix C.

The area surrounding the Project contains suitable habitat for a variety of wildlife, such as whitetail deer, wild turkey, coyote, red fox, rodents, rabbits, and raccoons. The Project is located in the Mississippi Flyway 5of North America (30). As such, migratory birds, including waterfowl, may use the surrounding area as resting grounds during spring and fall migrations, as well as breeding and nesting grounds throughout the summer.

Bald eagle surveys within the Project boundary have been ongoing since the 1993 License. Monitoring completed by the MNDNR in 2014 identified two bald eagle nests within the upper portion of the Project area—one active and one inactive. The active nest was located in the vicinity of a previously observed, known nest location. The inactive nest was located in a tree that had typically supported an active nest since bald eagle surveys were initiated in the early 1990s.

There are no Waterfowl Production Areas (WPA), State Wildlife Refuges, or State Wildlife Management Areas (WMA) within the Project boundaries. The nearest State Wildlife Refuge is the Camp Ripley Statutory Game Refuge, located approximately 10 miles southwest (downstream) of the Project area. The nearest WMA is the Loerch WMA, located approximately 1.6 miles southeast (downstream) of the Project area.

E.8.5.2 Environmental Analysis

In SD2, the FERC did not identify wildlife resource issues. There were no studies proposed or completed during the relicensing regarding wildlife resource issues. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to wildlife.

E.8.5.3 Proposed Environmental Measures

Because the license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to botanical resources. BPU proposes removing the bald eagle monitoring as a PM&E measure due to the change in status for bald eagles. There are no PM&E measures planned for this resource.

E.8.5.4 Unavoidable Adverse Effects

Continued operation of the Project is not expected to cause new impacts to wildlife resources.

E.8.6 Wetlands, Riparian, and Littoral Habitat

E.8.6.1 Affected Environment

Wetland, riparian, and littoral habitats within the Project area are primarily associated with margins and near-shore areas of the dam’s impoundment. According to the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI), the majority of the Project area is classified as lake (approximately 1,872 acres, comprising 93 percent of the Project area), which typically contains water depths too deep to support wetlands, see Figure E-6 in Appendix C. Of the 144 acres of NWI-identified wetland in the Project area, the predominant types are freshwater emergent (approximately 115 acres, comprising 80 percent of wetland in the Project area) and freshwater pond (approximately 19 acres, comprising 13 percent of wetland in the Project area), with lesser amounts (i.e., less than 10 percent) of freshwater forested/shrub and riverine wetland types (31).

Wetlands in Minnesota can be further categorized into types based on the Circular 39 system developed by the USFWS. Based on the Circular 39 system, wetlands in the Project area are primarily Type 3—shallow marsh, Type 4—deep marsh, Type 5—open water, and Type 8—bogs (32). Each of these wetland types is further characterized below:

- **Type 3—Shallow Marsh:** Soils of Type 3 wetlands are usually waterlogged in early spring and are often covered with 6 or more inches of water. Vegetation typically includes grasses, bulrushes, spikerushes, cattails, arrowheads, pickerelweed, and smartweed. Type 3 wetlands protect water quality and shoreland; retain floodwater; provide habitat for waterfowl, amphibians, and fish; and foster recreational opportunities, such as hunting, fishing, and canoeing.
- **Type 4—Deep Marsh:** Type 4 wetland soils are usually covered in 6 inches to 3 feet of water in spring and summer seasons. This type of wetland can completely fill shallow lake basins and depressions or may border littoral zones of open water areas. Vegetation of Type 4 wetland typically includes cattails, reeds, bulrushes, spikerushes, and occasionally wild rice. In open areas, pondweed, naiads, coontail, watermilfoils, waterweeds, duckweeds, waterlilies, or spatterdocks can be found. Type 4 wetlands provide water quality protection and floodwater detention while serving as habitat for wildlife and fisheries and providing recreational opportunities similar to those provided by Type 3 wetlands.
- **Type 5—Open Water:** Type 5 wetlands include shallow ponds and are littoral zones of reservoirs. Water in this type of wetland is typically less than 6 feet deep, fringed by a boarder of emergent vegetation. Benefits of Type 5 wetlands include floodwater detention, fish and wildlife habitat, and opportunities for hunting, fishing, and canoeing.
- **Type 8 – Bog:** Type 8 wetlands primarily occur in northern portions of the state. Soils are usually waterlogged and covered in spongy moss. Typical bog-type wetland plants include heath shrubs, sphagnum moss, sedge, leatherleaf, laborador-tea, cranberries, and cottongrass. Black spruce and tamarack can be found scattered throughout Type 8 wetlands, though their growth is often stunted by the conditions. Typical benefits of Type 8 wetlands include peat harvesting, water quality, low-flow augmentation, and shoreland protection.

E.8.6.2 Environmental Analysis

Further environmental analysis was not requested by the FERC in SD2 or from another agency. There were no studies proposed or completed during the relicensing regarding this resource. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to the resource

E.8.6.3 Proposed Environmental Measures

The Project is located in a forested landscape; as such, the majority of riparian areas surrounding lake and wetland areas consist of deciduous forest with smaller amounts of coniferous forest and pastureland. Because the license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to wetlands, riparian, and littoral resources, as the hydrologic regime of the reservoir would continue to be managed similar to present conditions.

E.8.6.4 Unavoidable Adverse Effects

Continued operation of the Project is not expected to cause new impacts to wetlands.

E.8.7 Rare, Threatened, and Endangered Species

E.8.7.1 Affected Environment

Federal and State of Minnesota laws establish designations for threatened, endangered, and special concern species of vegetation and wildlife. The limited terrestrial habitat within the Project boundary consists of a thin band of primarily deciduous riparian forest bordering the impoundment. Most of the upland habitat for terrestrial wildlife and vegetation species occurs outside the project boundary.

E.8.7.1.1 Federal Species Review

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended, federal agencies are required to ensure the following two criteria:

1. Any action funded or carried out by such agency must not be likely to jeopardize the continued existence of any federally listed endangered or threatened species or species proposed to be listed.

2. No such action can result in the destruction or adverse modification of habitat of such species that is determined to be critical by the Secretary.

In accordance with Section 7, the Project area was evaluated to determine the potential presence of federally listed species. Since the license was issued in 1993, the bald eagle was delisted from the Endangered Species Act, although it still enjoys protection under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. An official list of ESA-listed species in the Project area was initially requested through the USFWS online Information, Planning, and Conservation System (IPaC) program on February 14, 2018 (Appendix C). According to the IPaC results, there is no federally designated critical habitat in the Project area, but the following federally listed species may occur in the vicinity of the Project: gray wolf (*Canis lupus*—threatened) and northern long-eared bat (*Myotis septentrionalis*—threatened) (33).

The gray wolf occupies diverse habitats, including forests, prairies, and swamps. The non-reservoir portions of the Project area and immediate vicinity are largely undeveloped forested areas, which may provide suitable habitat for the gray wolf.

The northern long-eared bat roosts in living and dead trees greater than three inches in diameter that have loose or peeling bark, cavities, or crevices. During winter, the northern long-eared bat hibernates in caves and mines. The Project is located within the mapped white-nose syndrome zone for the species (34). White-nose syndrome is an emergent disease in hibernating bats that causes extreme sickness and death. According to the USFWS and MNDNR Natural Heritage Inventory System (NHIS), there are no documented records of northern long-eared bats, roost trees, or hibernacula in the vicinity of the Project. The nearest known location is approximately 26 miles southwest (downstream) of the Project.

E.8.7.1.2 State Species Review

State-listed species were reviewed using the MNDNR NHIS database (license agreement number LA-674, Barr Engineering Co.). One state-listed species was identified in the vicinity of the Project: Blanding's turtle (*Emydoidea blandingii*—threatened). In Minnesota, this species adapts to a variety of wetland and riverine habitats across the state. Its preferred habitat includes wetland complexes and adjacent sandy uplands suitable for nesting. Calm, shallow waters, including wetlands associated with rivers and streams with rich, aquatic vegetation are especially preferred. Wetlands in the Project area may contain suitable Blanding's turtle habitat.

E.8.7.2 Environmental Analysis

Further environmental analysis was not requested by the FERC in SD2 or from another agency. There were no studies proposed or completed during the relicensing regarding this resource. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to the resource

E.8.7.3 Proposed Environmental Measures

Given that license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to rare, threatened, endangered, and special status (RTE) species.

E.8.7.4 Unavoidable Adverse Effects

Continued operation of the Project is not expected to cause new impacts to RTE.

E.8.8 Recreation and Land Use

E.8.8.1 Affected Environment

Land use within the Project area is primarily the open water reservoir upstream of the Brainerd Dam, followed by wetland and deciduous forest land uses. Land use near the Project is shown on Figure E-7 in Appendix C. Lands and waters in the vicinity of the Project provide a variety of recreational opportunities to area residents and visitors, including a state water trail, boat launches, state hiking trails, snowmobile trails, and public recreation areas. Recreation opportunities are shown on Figure E-8 in Appendix C.

The Mississippi River's Headwaters River Trail begins at the river's source and flows 420 miles downstream, including through the Project, ending on the Minnesota/Iowa border. The River Trail is divided into 10 mapped segments, two of which overlap the Project: the Palisade-to-Brainerd segment and the Brainerd-to-Little Falls segment. Neither of these segments have major rapids requiring experienced paddling skills. These segments of the River Trail are accessible to users of all skill levels. Though a reach of the Mississippi River has been designated as Wild and Scenic River, it is located well downstream of the Project area (extending from St. Cloud to Anoka).

There are two trailer-accessible public boat ramps within the Project area, including one at Lum Park on Rice Lake and one at French Rapids on the Mississippi River. Carry-in boat access is available at Green's Point. Lum Park and Green's Point both provide users with fishing pier access, while Lum Park also hosts a picnic area and access to potable water. A canoe portage and restrooms are located at the Project over the right embankment.

The Paul Bunyan State Trail is a 115-mile-long hiking trail located approximately 1.2 miles west of the Project, at the nearest point. It is the longest of Minnesota's state trails and the longest continuously paved rails-to-trails pathway in the United States. The trail is used for hiking, biking, inline-skating, and winter snowmobiling. The Paul Bunyan State Trail was inducted into the Rail-Trail Hall of Fame in 2011 based on scenic value, trailside amenities, and excellence in management and maintenance (35). The French Rapids Trail is an approximately 5.9-mile long trail network that can be accessed from the French Rapids access. The trail is provides scenic views of the Mississippi River and in the winter is groomed for both classic and skate cross-country skiing. This trail is rated as an expert-level trail due to steep climbs and descents and is maintained by the Brainerd Nordic Ski Club for winter use. There is no lighting along the trail.

The Brainerd Snodeos, a local snowmobiling club, maintains 107 miles of groomed trails in the region, including the Harding Trail located south and east of the Project. The Merrifield Marathon snowmobile club maintains the Merrifield Trail located north of the Project. Though both of these snowmobile trails are in the vicinity of the Project, neither overlap the Project boundary.

The southern segment of the Cuyuna Country State Recreation Area (SRA) is located approximately 0.15 miles east of the upper portion of the Project area. Located atop an area of former mining pits and stockpiles, the Cuyuna Country SRA is one of Minnesota's newest SRAs. It consists of 5,000 acres of mostly undeveloped land and includes 25 miles of natural shoreline along small lakes (36). The Cuyuna Country SRA contains 29 drive-in camp sites, 4 walk-in sites, one group camping site, and three rental yurts. Other recreational amenities include campground showers and flush toilets, vault toilets, potable water sources, carry-in boat access points, shore fishing areas, and trails for hiking and mountain biking (37).

E.8.8.2 Environmental Analysis

A recreation use and inventory study was conducted by BPU to assess site use and the condition of recreation sites and facilities within the Project Boundary. The report was summited to the FERC with the Initial Study Report (ISR) on January 22, 2020 and has been included in Appendix C of this DLA.

The objectives and summary of the results are listed below:

- Identify the condition of all informal and formal recreation sites and facilities wholly or partially within the Project boundary.

  Results: Condition ratings were determined following condition assessments of each site. The resulting ratings ranged from 3-4 (Table E-4).

- Determine current and projected capacity at each recreation site/facility.

  Results: Surveyed users of the sites noted that three of the four sites were no very busy. Only Lum Park was noted as not very busy to moderately busy (Table E-4).

- Identify who owns, operates, and maintains each recreation site/facility.

  Results: The entity that owns, operates, and maintains each recreation site/facility is identified in (Table E-4).

- Conduct visitor surveys during the recreation season to determine the adequacy of Project recreation facilities and whether modifications or upgrades are needed to meet current or future recreation needs.

Table E-4 Summary of Results from Recreation Use and Inventory Planning Study

Recreation Site Name	Recreation Site Ownership/Maintenance	Condition Rating, 5-point Scale	Capacity	Recommendations
Canoe Portage	BPU	4 – Good	Not very busy	Routine maintenance
Lum Park	City of Brainerd	4 – Good	Not very busy to moderately busy	Routine maintenance
French Rapids Access	Crow Wing County	3 – Adequate	Not very busy	Maintain parking lot surface
Green's Point Access	MNDNR	3 – Adequate	Not very busy	Routine maintenance

E.8.8.3 Proposed Environmental Measures

Given that license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to recreational or land use. Maintaining water levels in the reservoir upstream from the Project helps maintain current recreational uses in Rice Lake and the Mississippi River. BPU will continue to operate and maintain the current FERC-approved recreation facility owned by BPU. BPU proposes to develop a recreation management plan to be filed with the Commission within 1 year of issuance date of the new license.

E.8.8.4 Unavoidable Adverse Effects

The Project provides a wide variety of recreation resources to the public that positively impact the region. No unavoidable adverse effects to recreation and land use have been identified.

E.8.9 Aesthetic Resources

E.8.9.1 Affected Environment

The Project is located within the Brainerd city limits and the reservoir extends north of the city through a primarily forested, rural residential setting. A variety of land uses, land covers, and terrain conditions along the Mississippi River provide a high level of landscape diversity, enhancing the aesthetics of the Project area. As a structure, the Brainerd Dam itself contributes to the aesthetics of the surrounding area.

E.8.9.2 Environmental Analysis

Further environmental analysis was not requested by the FERC in SD2 or from another agency. There were no studies proposed or completed during the relicensing regarding this resource. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to the resource

E.8.9.3 Proposed Environmental Measures

Given that license renewal essentially perpetuates current condition, the Project is not anticipated to result in any new impacts to aesthetic resources.

E.8.9.4 Unavoidable Adverse Effects

No unavoidable adverse effects to aesthetics have been identified.

E.8.10 Cultural Resources

E.8.10.1 Affected Environment

The Project is located in an area that was historically occupied by the Dakota (Sioux) Indians before the arrival of French explorers and fur trappers. Brainerd Township was founded in 1870 when the Northern Pacific survey determined that the Mississippi River should be crossed in this location. The city of Brainerd was organized in 1873 and grew rapidly with the development of water power at a dam (now the Brainerd Dam) constructed across the Mississippi River in 1898 (3)).

Cultural resources inventories were completed in support of the initial FERC license in 1991. Phase I inventories were completed in 1989 and 1991 and included a literature and records search, followed by a complete reconnaissance survey along the reservoir shoreline. Nearly 70 locations with definite or apparent cultural evidence were identified. A Phase II National Register of Historic Places (NRHP) evaluation for cultural resources identified in the Phase I effort was also completed in 1991. The Phase II evaluation included a more detailed assessment of Phase I-identified sites. A number of the sites were excluded from further study either due to their location (well outside of the reservoir impact zone) or being located in a highly disturbed setting with little potential for cultural significance. Upon conclusion of the Phase II effort, a total of 34 sites were considered eligible for NRHP listing, most of which were prehistoric archaeological sites (38).

The Brainerd Dam was also evaluated for NRHP eligibility in 1991. The dam itself was not eligible for the NRHP due to significant modifications to the original structure. The powerhouse was evaluated based on its original purpose, as a means to produce power for the paper mill. Two pocket grinders were found located in their original positions within the grinder room in the powerhouse. As a result, the grinder room was determined to be eligible for the NRHP under Criterion C (39).

A Cultural Resources Management Plan (CRMP) has been developed for the Project. This requires the Licensee to inspect previously identified cultural resources for evidence of site-altering activity and to file reports describing the implementation of the CRMP every 3 years. Based on the 2017 Cultural Resources Monitoring inspection, four sites were recommended to be evaluated for mitigation due to potential erosion impacts.

E.8.10.2 Environmental Analysis

A cultural resources study was conducted to determine the potential effects of Project operations on archaeological and historic resources within the area of potential effect (APE) that are included or eligible for listing on the National Register of Historic Places (NRHP). Phase II investigation activities completed include eight test pits and three formal test units within the APE. This information was provided in the ISR in correspondence with the appropriate resource agencies and Tribes. Consultation is on-going. An update on this consultation will be provided in the Final License Application.

E.8.10.3 Proposed Environmental Measures

Based on the location of several cultural resources sites in close proximity to the reservoir, continued operations of the Project may cause cultural resources impacts associated with erosion to be perpetuated. BPU proposes developing a Cultural Resources Management Plan (CRMP) to be filed with the Commission within 1 year of issuance date of the new license in coordination

E.8.10.4 Unavoidable Adverse Effects

Continued operation of the Project is not expected to cause new impacts to cultural resources.

E.8.11 Socio-Economic Resources

E.8.11.1 Affected Environment

The Project is primarily located in a rural setting of northern Minnesota, in the city of Brainerd. Demographic information for the Project area and surrounding vicinity is summarized in Table E-5. Based on 2010 census data, nearly half of the population of the city of Brainerd is employed. Primary employment industries include educational services and healthcare (22%), retail trade (18%), and entertainment/recreation (16%). Similarly, nearly half of the population of Crow Wing County is employed. Primary employment industries in Crow Wing County include educational services and healthcare (24%), retail trade (15%), and entertainment/recreation (12%). Within the Project area, 65% of the population is employed, presumably in industries similar to those that employ residents of the city of Brainerd.

Table E-5 Demographic Overview

Location	Population	Per-Capita Income	Population below Poverty Level	Minority Population	Predominant Race	Predominant Minority
Project Area[1]	2,443	$22,907	Not listed	5%	White (95%)	Hispanic (2%)
City of Brainerd	13,590	$18,948	21.8%	4%	White (96%)	American Indian (1%)
Crow Wing County	62,500	$27,936	11.3%	3%	White (97%)	American Indian (1%)
Statewide	5,303,924	$30,894	28%	12%	White (89%)	American Indian (5%)

(1) Analysis completed using the EPA's EJ Screen tool (40) and assessing a 0.25-mile buffer around the Project boundary.

E.8.11.2 Environmental Analysis

Further environmental analysis was not requested by the FERC in SD2 or from another agency. There were no studies proposed or completed during the relicensing regarding this resource. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to the resource

E.8.11.3 Proposed Environmental Measures

Given that license renewal essentially perpetuates current conditions, the Project is not anticipated to result in any new impacts to the socioeconomic conditions in the Project area and surrounding region.

E.8.11.4 Unavoidable Adverse Effects

No unavoidable adverse effects on socioeconomics were identified during the scoping process.

E.8.12 Tribal Resources

E.8.12.1 Affected Environment

In Minnesota, there are 11 recognized Native American tribes, including seven Chippewa (Ojibwe) communities and four Dakota (Sioux) communities. Chippewa (Ojibwe) communities in the state include Bois Forte, Fond du Lac, Grand Portage, Leech Lake, Mille Lacs, Red Lake, and White Earth. Dakota (Sioux) communities in the state include Prairie Island, Shakopee Mdewakanton, Lower Sioux, and Upper Sioux.

In addition to the eleven recognized Native American tribes in Minnesota, the FERC Initial Consultation Contact List for Minnesota identifies the following tribes that may also have an interest in licensing: Santee Sioux of Nebraska and Otoe-Missouria Tribe of Indians of Oklahoma (41).

FERC distributed "Consultation with Tribes for the Brainerd Hydroelectric Project" letters on October 11, 2017. This letter was distributed to additional tribes beyond those identified above that may have an interest in the relicensing process. They include the Red Cliff Band of Lake Superior Chippewa Indians of Wisconsin, the Sokaogon Chippewa Community (Wisconsin), the Bad River Band of Lake Superior Tribe of

Chippewa Indian (Wisconsin), the Lac du Flambeau Band of Lake Superior Indians of Wisconsin, the Menominee Indian Tribe of Wisconsin, the St. Croix Chippewa Indians of Wisconsin, the Iowa Tribe of Kansas and Nebraska (Iowa),the Keweenaw Bay Indian Community (Michigan), the Lac Vieux Desert Band of Lake Superior Chippewa Indians of Michigan, the Fort Belknap Indian Community of the Fort Belknap Reservation of Montana, the Apache Tribe of Oklahoma, and the Cheyenne and Arapaho Tribes of Oklahoma.

There are no reservation lands within the Project area, nor are there any known lands of ceremonial or religious significance or other traditional cultural properties within the Project area.

E.8.12.2 Environmental Analysis

Further environmental analysis was not requested by the FERC in SD2 or from any Tribe. There were no studies proposed or completed during the relicensing regarding this resource. Since the license renewal perpetuates current conditions, continued operation of the Project is not anticipated to result in any new impacts to the resource

E.8.12.3 Proposed Environmental Measures

Given that license renewal essentially perpetuates current condition, the Project is not anticipated to result in any new impacts to Tribal resources.

E.8.12.4 Unavoidable Adverse Effects

There are no reservation lands within the project boundary or known lands of ceremonial or religious significance associated with the Project, and therefore the Project would not result in any unavoidable adverse effects to tribal resources.

E.9 Economic Analysis – 18 CFR § 5.18(b)(5)(E)

BPU will provide the information required by 18 CFR § 5.18(b)(5)(E) in the Final License Application.

E.10 Consistency with Comprehensive Plans – 18 CFR § 5.18(b)(5)(F)

Section 10(a)(2) of the FPA, 16 U.S.C. section 803(a)(2)(A), requires the FERC to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by a project. Under 18 CFR § 5.18(b)(5)(F) each license application must identify relevant comprehensive plans and explain how and why the proposed project would, would not, or should not comply with such plans. In addition, the license application must include a description or any relevant resource agency or Native American Tribe determination regarding the consistency of the project with any such comprehensive plan.

E.10.1 FERC-Approved State of Minnesota Comprehensive Plans

Minnesota Department of Natural Resources. 1983. Statewide outstanding rivers inventory. St. Paul, Minnesota. March 1983.

Minnesota Department of Natural Resources. 2015. Minnesota State Parks and Trails System Plan. St. Paul, Minnesota. https://files.dnr.state.mn.us/input/mgmtplans/pat/system_plan/system_plan.pdf

Minnesota Department of Natural Resources. 2016. Minnesota's Wildlife Action Plan, 2015-2025. St. Paul, Minnesota. https://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/mnwap/wildlife-action-plan-2015-2025.pdf

Minnesota Department of Natural Resources. n.d. Canoe and boating route program. St. Paul, Minnesota. 39 pamphlets.

Minnesota Department of Natural Resources. n.d. Minnesota's State Comprehensive Outdoor Recreation Plan (SCORP): 2014-2018. St. Paul, Minnesota. https://files.dnr.state.mn.us/aboutdnr/reports/scorp_final_3308.pdf

Minnesota Department of Natural Resources. n.d. Strategic Conservation Agenda: The DNR's 10-year Strategic Plan, 2015-2025. St. Paul, Minnesota. https://files.dnr.state.mn.us/aboutdnr/reports/conservationagenda/ca-full.pdf

E.10.2 FERC-Approved Federal Comprehensive Plans

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E.11 Consultation Documentation – 18 CFR § 5.18(b)(5)(G)

A list containing the name and address of every Federal, state, and interstate resource agency, Tribe, or member of the public with which the applicant consulted in preparation of the Environmental Documentation is included in the Distribution List in Appendix C. Copies of letters received from agencies commenting on the application will be provided in the Final License Application.

E.12 Literature Cited – 18 CFR § 5.18(b)(5)(E)

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Exhibit F Project Operation and Resource Utilization

(Pursuant to 18 CFR §4.41(g))

F.1 Applicability

Exhibit F is required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

F.2 Exhibit F Drawings

The general drawings showing overall plan views, elevation views, and section of the major project structures in sufficient detail to provide a full understanding of the Project are listed below. The Exhibit F drawings are included in Appendix E.

F.3 Supporting Design Report

Pursuant to 18 CFR §4.41(g)(3) and (4), an applicant for a new license is required to file with the FERC two copies of a Supporting Design Report when the applicant files an application for a new license to demonstrate that the existing structures are safe and adequate to fulfill their stated functions.

As an existing Project, the Project is subject to the requirements of 18 CFR Part 12 – Safety of Water Power Projects and Project Works, Subpart D – Inspection by an Independent Consultant. In 2003, the FERC instituted a new program to be used on the context of the Part 12 Independent Consultant Safety Inspection Program entitled “Potential Failure Modes Analysis” (PFMA), which is a dam- and project-safety tool intended to broaden the scope of the safety evaluations to included potential failure scenarios that may have been overlooked in past investigations. In addition, the FERC initiative for the develoPM&Ent of Supporting Technical Information Document (STID) for Projects subject to Part 12D.

Given that the Project is subject to Part 12D, the Project has been inspected by an independent consultant within the past five years and an STID for each Project has been prepared and submitted to the FERC. Table F-1 provides the dates for which the most recent Part 12D Consultant Safety Inspection Report, PFMA Report, and STID were filled with the Chicago Regional Office. Based on these filings, a Supporting Design Report is not included with this application for this Project.

Table F-1 List of Dam Safety Documents and Filing Dates

Document Name	Date
Initial PFMA Report	September 2009, Updated 2018
Initial STID	June 2005
Most Recent STID Update	February 3, 2014, to be updated in 2020
Part 12D Consultant's Safety Inspection Report	November 30, 2018

DRAFT APPLICATION FOR LICENSE
FOR A MAJOR WATER POWER PROJECT – 5 MEGAWATTS OR LESS
EXISTING DAM

BRAINERD HYDROELECTRIC PROJECT
FERC PROJECT NO. 2533

Exhibit G Project Maps

(Pursuant to 18 CFR §4.41(h))

G.1 Applicability

Exhibit G is required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

G.2 Project Maps

The current Project Boundary Maps were prepared in 1991 and show the Project vicinity, location and boundary to provide an understanding of the of the Project's location. BPU is in the process of updating the Exhibit G drawings in consultation with the State Historic Preservation Office (SHPO). This update includes minor adjustments to the digitized Project Boundary for more accurate GIS images while maintaining the boundary as one that is two feet above the ordinary high water mark. A Project Boundary map showing the FERC-approved boundary is included in Appendix F. The updated Exhibit G drawings will be provided in the Final License Application.

Exhibit H Ability to Operate

(Pursuant to 18 CFR §5.18(c))

H.1 Applicability

Exhibit H is required for this application. 18 CFR §5.18(a)(5)(i) defines the contents of the application license for a major water project 5 MW or less includes the general instructions, initial statement and Exhibits A, F, and G in accordance with 18 CFR §4.61, Exhibit E in accordance with 18 CFR §5.18(b), and Exhibit H in accordance with 18 CFR §5.18(h).

H.2 Reliable Electrical Source – 18 CFR §5.18(c)(1)(i)(A)

BPU operates and maintains the Project in a manner that provides efficient and reliable electric service by performing routine inspections and performing regular maintenance of the generation equipment.

H.2.1 Increase Capacity or Generation

There are no changes proposed to capacity or generation at the Project.

H.2.2 Coordination with Other Projects

The Project is manually operated as a run-of-river project and maintains a target elevation of 1174.04 feet (NGVD) with fluctuations limited to 0.1 feet (6). During routine operation, coordination with other projects is not required for operation. BPU coordinates with projects upstream and downstream from the Project for emergency preparedness.

H.2.3 Coordination of Operation with Electrical Systems

Power generated by the Project is transmitted through an underground electric line to a connection point with the distribution grid all of which are owned and maintained by BPU.

H.3 Need for Project Power – 18 CFR §5.18(c)(1)(i)(B)

H.3.1 Cost and Availability of Alternative Sources of Power

The reasonable cots and reasonable availability of alternative sources of power that would be needed by the applicant or its customers if the applicant is not granted a license for the Project will be discussed in Final License Application.

H.3.2 Increase Cost to Replace Generation Power

The increase in fuel, capital, and other costs that would be incurred by the applicant or its customers to purchase or generate power necessary to replace the output of the license project, if the applicant is not granted a license for the Project will be discussed in Final License Application.

H.3.3 Effect of Alternative Source of Power

The effect of each alternative source of power on the applicant's customers, operating and load characteristics, and the communities served will be discussed in Final License Application.

H.4 Alternative Sources of Power – 18 CFR §5.18(c)(1)(i)(C)

H.4.1 Average Annual Cost of Power

The estimated average annual cost of power produced from the Project will be provided in Table H-1 in the Final License Application.

Table H-1 Estimated Project Cost

Description	Cost
Cost of capital (equity and debt)	To be provided in the Final License Application
Local, state, and federal taxes	
Depreciation and amortization	
Operation and maintenance expenses, including interim replacements, insurance, administrative and general expenses, and contingencies	
Total	

H.4.2 Required Resources

The projected resources required to meet the capacity and energy requirements over the short and long term will be provided in the Final License Application.

H.4.2.1 Energy and Capacity Resources

Energy and capacity resources, including the contributions from the applicant's generation, purchases, and load modification measures (such as conservation, if considered as a resource), as separate components of the total resources required will be provided in the Final License Application.

H.4.2.2 Resource Analysis

A resource analysis, including a statement of system reserve margins to be maintained for energy and capacity will be provided in the Final License Application.

H.4.2.3 Effects of Load Management Measures

If load management measures are not viewed as resources, the effects of load management measures on the projected capacity and energy requirements will be provided in the Final License Application.

H.4.2.4 Resources for Alternate Power Sources

The total annual cost of each alternative source of power to replace project power; the basis for the determination of projected annual cost; and a discussion of the relative merits of each alternative will be provided in the Final License Application.

H.5 Use of Power for Applicant-Owned Industrial Facility – 18 CFR §5.18(c)(1)(i)(D)

BPU does not use the power generated at the Project to supply its own industrial facilities; therefore, this section is not applicable.

H.6 Nate American Tribe as Applicant – 18 CFR §5.18(c)(1)(i)(E)

BPU is not a Native American tribe; therefore, this section is not applicable.

H.7 Impacts of License on Transmission System – 18 CFR §5.18(c)(1)(i)(F)

A comparison of the impact on the operations and planning of the applicant's transmission system of receiving or not receiving the project license will be provided in the Final License Application.

H.7.1 Power Redistribution

An analysis of the effects of any resulting redistribution of power flows on line loading (with respect to applicable thermal, voltage, or stability limits), line losses, and necessary new construction of transmission facilities or upgrading of existing facilities, together with the cost impact of these effects will be provided in the Final License Application.

H.7.2 Advantages of Transmission System

An analysis of the advantages that the applicant's transmission system would provide in the distribution of the project's power will be provided in the Final License Application.

H.7.3 Single-Line Diagrams

A single-line diagram is provided in Appendix B. In the Final Licenses Application the single-line diagram will be updated to include existing system facilities identified by name and circuit number, that show system transmission elements in relation to the project and other principal interconnected system elements. Power flow and loss data that represent system operating conditions may be appended if applicants believe such data would be useful to show that the operating impacts described would be beneficial

H.8 Modifications – 18 CFR §5.18(c)(1)(i)(G) and (H)

BPU does not have plans to modify the Project; therefore, these sections are not applicable.

H.9 Financial and Personnel Resources – 18 CFR §5.18(c)(1)(i)(I)

(I) A statement describing the applicant's financial and personnel resources to meet its obligations under a new license, including specific information to demonstrate that the applicant's personnel are adequate in number and training to operate and maintain the project in accordance with the provisions of the license.

H.9.1 Financial Resources

BPU is dedicated to operating the Project in a safe and reliable manner to provide clean renewable electric energy to the electricity grid. As demonstrated under the existing license, BPU has the financial resources to meet the operations, maintenance, and capital requirements of the Project.

H.9.2 Personnel Resources

Operations, maintenance, environmental and license compliance, modification, technical and administrative activities required for the Project are performed and supported by employees and contractors of BPU. BPU will provide additional details related to resources in the Final License Application.

H.10 Expansion of Lands – 18 CFR §5.18(c)(1)(i)(K)

BPU does not anticipate a proposed expansion of Project Boundaries at the Project; therefore, this section is not applicable.

H.11 Electricity Consumption Efficiency – 18 CFR §5.18(c)(1)(i)(K)

BPU's electricity consumption efficiency improvement program will be provided in the Final License Application.

H.12 Affected Indian Tribes – 18 CFR §5.18(c)(1)(i)(L)

The Project is not located on Native American lands. BPU and the Commission consulted with Native American tribes that may be affected by the Project throughout the relicensing process and in support of cultural resources studies. Contact information associated with each of these Native American Tribes is presented in the Initial Statement of this application and the associated distribution list in Appendix C

H.13 Project Safety – 18 CFR § 5.18(c)(1)(ii)(B)

H.13.1 Operation During Flood Conditions – 18 CFR § 5.18(c)(1)(ii)(B)(1)

The existing and planned operation of the project during flood conditions is provided in the Emergency Action Plan (EAP) for the Project, which is filed with the Commission. Specific actions that will be taken at the facility include in Table H-2.

Table H-2 High Flow Procedure

Action	Flow	Water Level (NGVD)
Install No. 2 Generator Pit Plug	5,100 cfs	TW 1163.5
Install all Pit Plugs	8,000 cfs	TW 1166.0
Install ballast at No. 1 & No. 2	13,400 cfs	TW 1169.5
Install flood door at lower door	13,400 cfs	TW 1169.5
Activate High Flow EAP	16,000 cfs	TW 1171.0
Install ballast at No. 3, No. 4, No. 5	16,000 cfs	TW 1171.0
Add ballast to No. 1 & No. 2	20,400 cfs	HW 1185.0
Sand bag door to raw water pumps	20,400 cfs	HW 1185.0
Install stop logs in roadway	20,400 cfs	HW 1185.0

H.13.2 Warning Devices – 18 CFR § 5.18(c)(1)(ii)(B)(2)

BPU maintains public safety measures at the Project for public safety upstream, in the vicinity of, and downstream of the Project pursuant to the Commission-approved Public Safety Plan. Warning devise for pulice safety include audible alarm, signage in multiple locations, seasonal upstream boat barriers, and additional measures consistent with the Public Safety Plan for the Project. The Public Safety Plan is filed with the FERC.

H.13.3 Emergency Action Plan – 18 CFR § 5.18(c)(1)(ii)(B)(3)

There are no changes proposed to the operation of the project or downstream development that might affect the existing Emergency Action Plan; therefore, this section is not applicable.

H.13.4 Surveillance and Monitoring – 18 CFR § 5.18(c)(1)(ii)(B)(4)

The Project is maintained by BPU in accordance with industry practices and monitored as described in the Dam Safety Surveillance and Monitoring Plan (DSSMP) that are maintained for the Project and is on file with the FERC Division of Dam Safety and Inspections – Chicago Office. As described in the DSSMP for the Project, surveillance and monitoring for the Projects consists of visual observation, settlement monitoring, alignment monitoring, crack monitoring, sounding surveys and dive inspections, and headwater and tailwater level monitoring.

H.13.5 Employee and Public Safety – 18 CFR § 5.18(c)(1)(ii)(B)(5)

BPU manages the Project consistent with its long-standing commitment to employee safety which is in compliance with applicable local regulations. BPU will provide any Lost Time or Recordable accidents that have occurred at the Project since taking Ownership in June 2014 through the end of 2020 with the Final License Application.

H.14 Current Operation – 18 CFR § 5.18(c)(1)(ii)(C)

The Project is manually operated as a run-of-river project and maintains a target elevation of 1174.04 feet (NGVD) with fluctuations limited to 0.1 feet consistent with the requirements of the current license (6). There are no constraints that affect the manner in which the Project is operated.

H.15 Project History – 18 CFR § 5.18(c)(1)(ii)(D)

As discussion of the history of the project and record of programs to upgrade the operations and maintenance of the Project is included in Table H-3.

Table H-3 Project History

Date	Summary
1888	The original rock-filled timber crib dam was constructed. It is also assumed that a powerhouse was constructed at this time, although no documentation exists to support this. (42)
1916-1917	The dam was reconstructed and the powerhouse replaced. The original turbines were installed along with generators for Unit No. 1 and No. 2 (42)
1936	Generator No. 3 and No. 4 were installed (42)
1940	Generator No. 5 was installed (42)
1950-1951	Dam reconstruction following failure of the wooden dam gates. The work generally included: • Constructing a sheetpile cofferdam system upstream from the existing concrete dam (43). • Consolidating timber sections that remained after the failure to elevations shown on B401-C-20 and filling the voids between timbers with Prepakt concrete. • Constructing new concrete piers and a new concrete spillway for the bascule and slide gate sections. • Installing new bascule and slide gates.
1996-1997	Repairs to the log sluice, Generator No. 2 forebay wall, and stop log gate repairs included: • Consolidation grouting at the downstream end of the east pier crib between the log sluice (now the tainter gate section) and the bascule gate. Grout bags were added at this time. • Grouting of two sinkholes in the right embankment. • Reinforcement of the east timber strut for the tainter gate • Concrete repairs to the west wall of the forebay and slide gate piers • Void filled on the upstream face of the slide gate section along the entire extents.
1997	Concrete repairs to the structural supports at the hydro plant
2000	Flood control upgrades and timber tainter gate replacement including: • Right embankment raised • Right abutment sheetpile wall with tiebacks • Wooden tainter gate replaced with a steel tainter gate • Stoplog closure added to left abutment • Steel walkway added over tainter gate section For record drawings, refer to the referenced final construction report.
2007	Remediation of tailwater seepage on right embankment

2010-2011	Subsidence along the powerhouse road downstream of the powerhouse and at the entry slab to the powerhouse were remediated.
2011	Three small sinkholes were discovered and were subsequently excavated and backfilled with pit-run sand. During excavation, quarry rock and small amounts of timber were excavated from the area of the sinkhole. There was no evidence of any void area observed during excavation nor sings of running water. The conclusion was that the sinkhole and subsidence was the settlement of the ground in void areas between the rocks along with void areas created by deteriorating timber.
2013	Riprap scour protection placed along the upstream slope of the right embankment and downstream from the spillway apron within the river. For record drawings, refer to the referenced final construction report.
2014-2015	Spillway apron modifications and interim repairs resulting in removal of concrete on the spillway apron, replacement of concrete on a section of the east spillway and placement of 7 chute blocks. For record drawings, refer to the referenced final construction report.
2015-2016	A physical model study was performed to improve understanding of the complex hydraulics of the Brainerd dam spillway, develop spillway design modifications that reduce long-term deterioration of the spillway apron, downstream score of the river channel, and evaluate the potential of undermining the downstream apron due to local scour.
2016	Performed concrete coring on the spillway apron to better understand seepage below the apron to inform the spillway apron overlay design.
2016-2019	Minor concrete work, installation of a sluice gate, and installation of the new turbine in Bay 6.
2017	Design report for the spillway apron overlay project. This report summarizes the results from the physical modeling, plan view seepage, and documents the spillway apron overlay design.
2017	Spillway apron overlay construction project resulting in a concrete overlay on the main spillway and tainter gate aprons as well as a concrete cap over the downstream sheetpile. During the project, concrete coring were taken documenting the condition of the material below the apron. For record drawings, refer to the referenced final construction report.
2020	Installation of sheetpile extension on left embankment

H.15.1 Lost Generation – 18 CFR § 5.18(c)(1)(ii)(E)

A summary of unscheduled outages for the Project over the past five years will be provided in the Final License Application in Table H-4.

Table H-4 Summary of Unscheduled Outages (2015 – 2020)

Unit	Outage Duration	Cause
To be provided in Final License Application		

H.15.2 Record of Compliance – 18 CFR § 5.18(c)(1)(ii)(F)

A discussion of the record of compliance with the terms and conditions of the existing license, including a list of all incidents of noncompliance, their disposition, and any documentation relating to each incident will be provided in the Final License Application.

H.15.3 Actions by Licensee – 18 CFR § 5.18(c)(1)(ii)(G)

BPU believes that actions by the Licensee are favorable to the public in that the Project provides clean, renewable electric energy as well as non-power benefits associated with the Project such as the canoe portage. In addition, the Project provides diversification for the residence helping to reduce utility costs. BPU believes that past actions and future actions related to the Project will not adversely affect the public.

H.15.4 Expenses due to License Transfer – 18 CFR § 5.18(c)(1)(ii)(H)

There is no proposal or application to transfer the Project license from the existing Licensee; therefore, this section is not applicable.

H.15.5 Fees Paid for use of Federal or Indian Lands – 18 CFR § 5.18(c)(1)(ii)(I)

There are no federal or Native American lands associated with the Project. BPU does not pay annual fees under Part 1 of the FPA; therefore, this section is not applicable.

H.16 Consistency with Comprehensive Plans – 18 CFR § 5.18(d)

Comprehensive plans are listed in Exhibit E, Section E.10 of this Application. An explanation of why the Project would, would not, or should not comply with any of the relevant comprehensive plans will be included in the Final License Application.

H.17 Response to Information Requests – 18 CFR § 5.18(e)

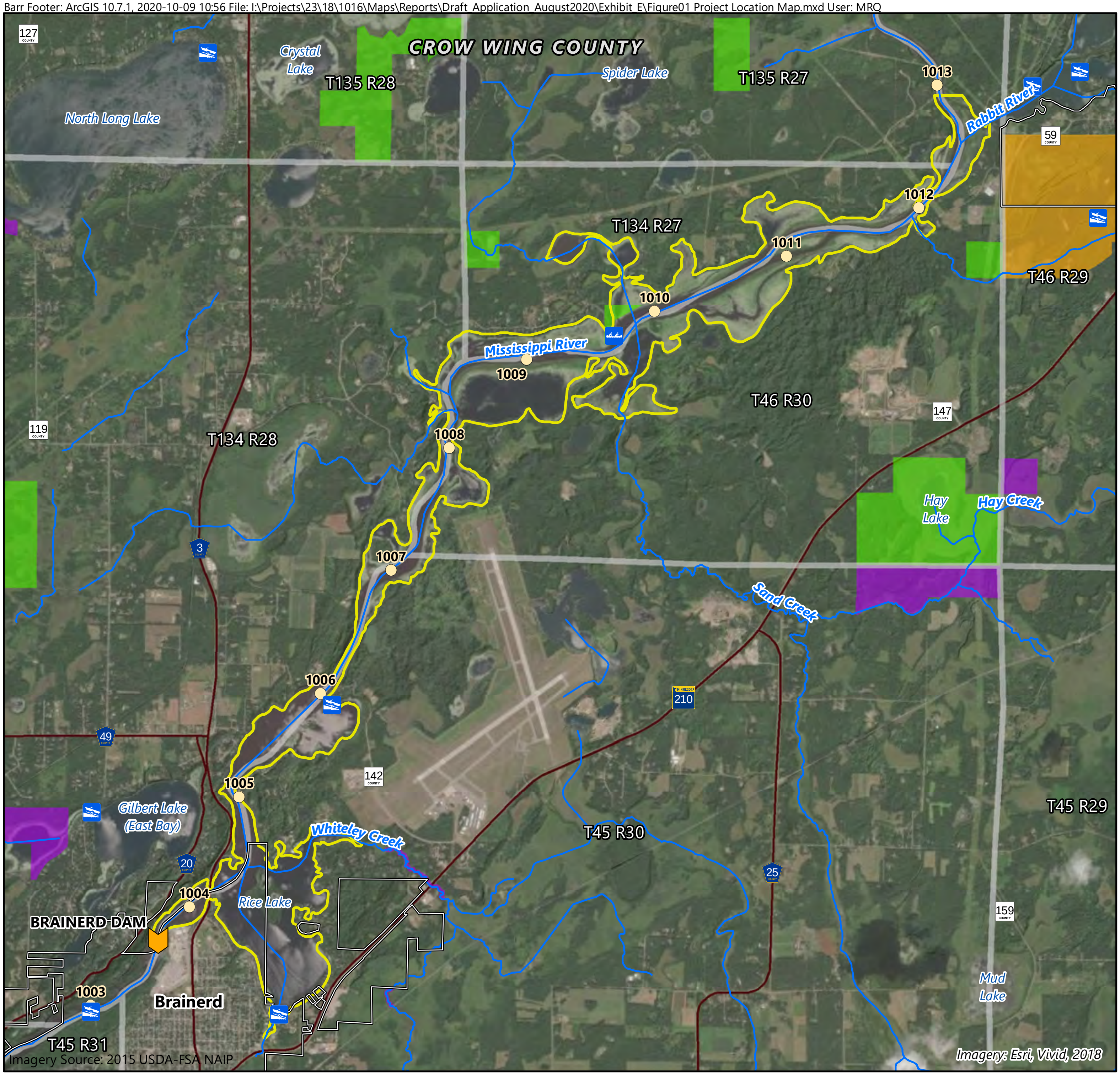
Responses to information requests have been provided throughout the relicensing process. A summary of the requests and responses, including those to the DLA, will be included in the Final License Application.

Appendix A

Exhibit A - Project Description Attachments (Public)

- **Project Map**
- **Flow Duration Curves**
- **Principal Project Features**

Barr Footer: ArcGIS 10.7.1, 2020-10-09 10:56 File: I:\Projects\23\18\1016\Maps\Reports\Draft_Application_August2020\Exhibit_E\Figure01 Project Location Map.mxd User: MRQ



Carry-in/Portage
Trailer Launch
River Mile Marker
Dam Location
Major Highway
Project Boundary
Corporate Limits
PLSS Township

Protected Areas

State Trust Land
State Fish and Wildlife
State Park and Recreation

N

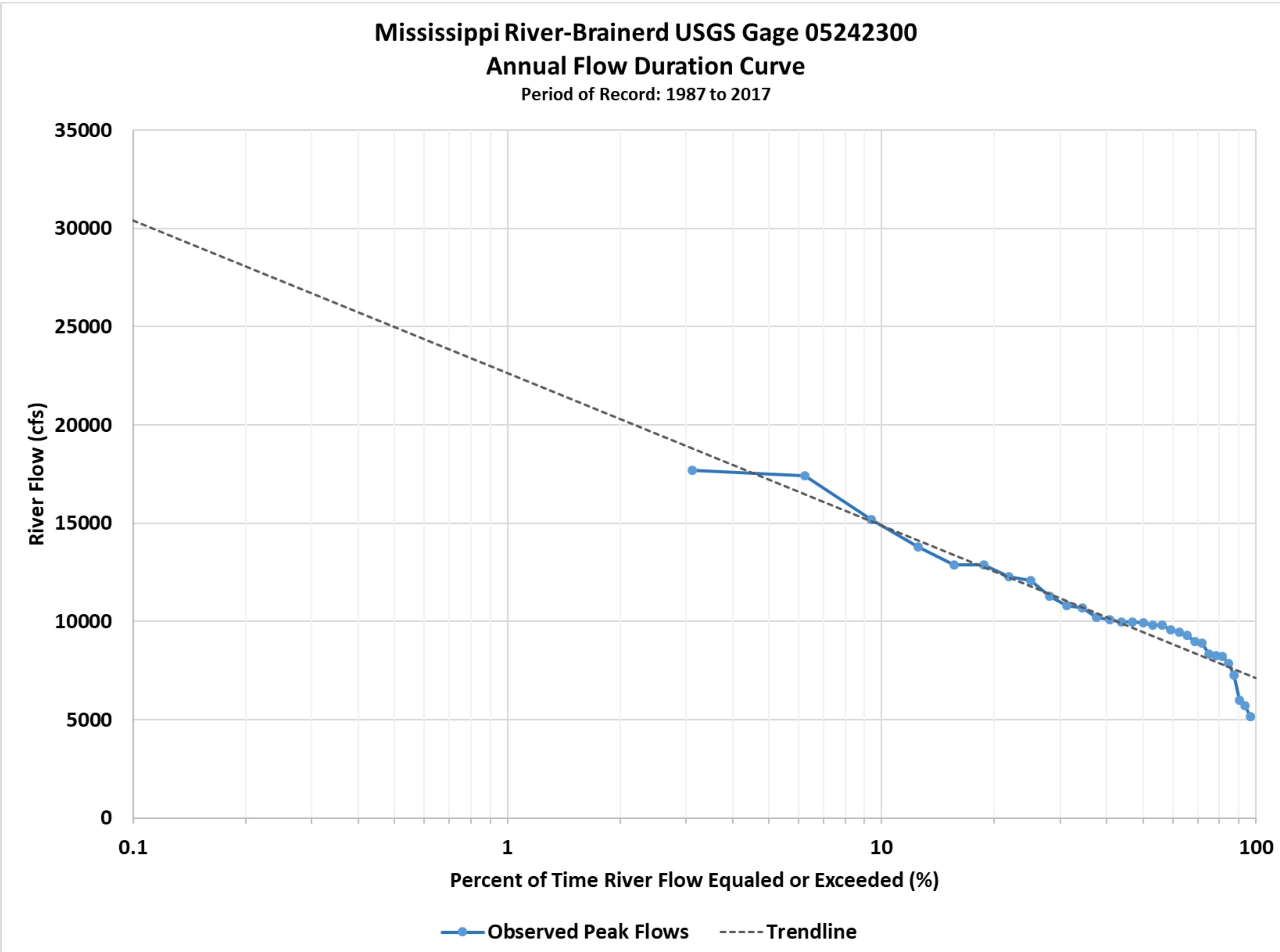
0 5,000

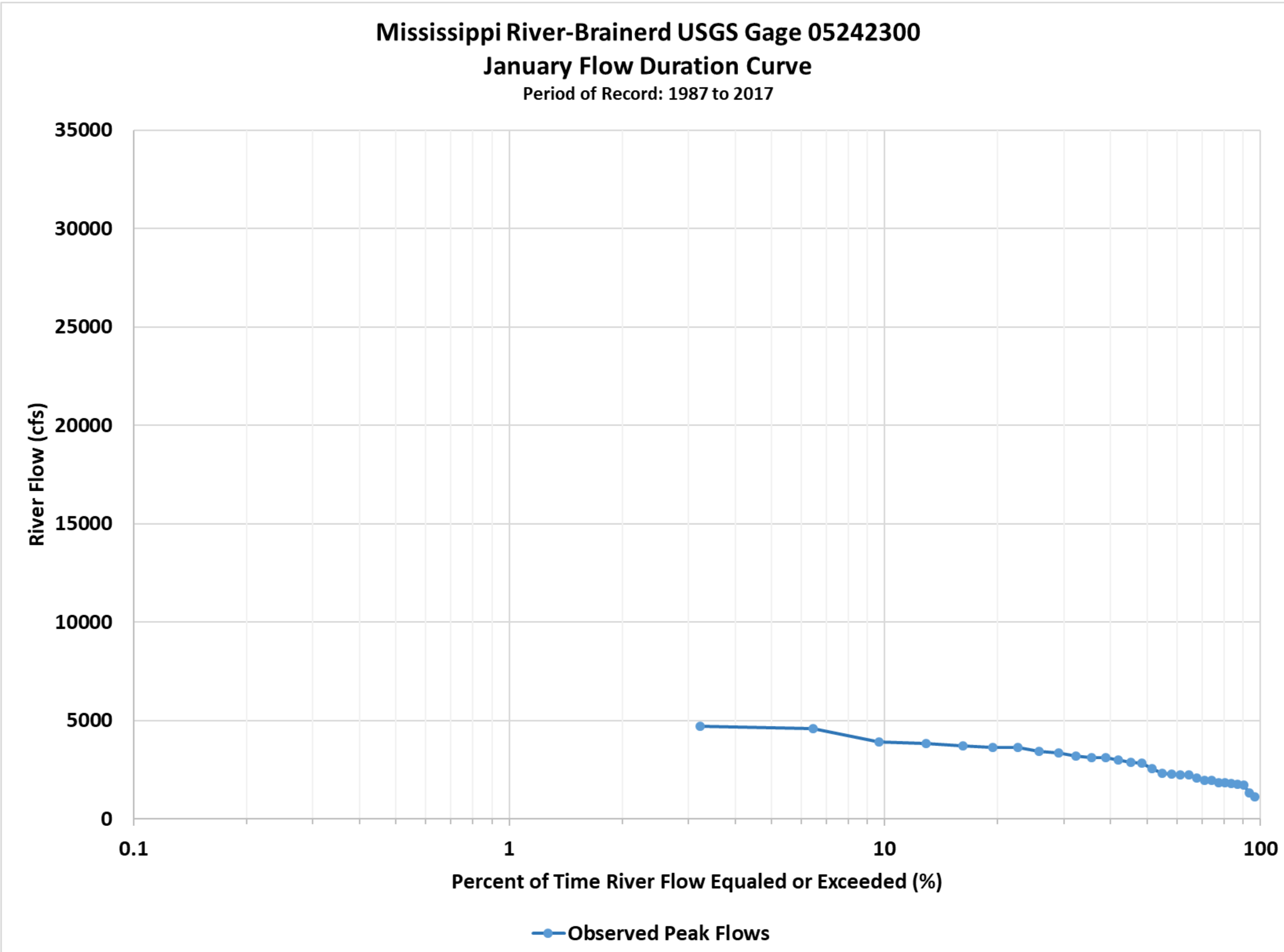
Feet

BARR

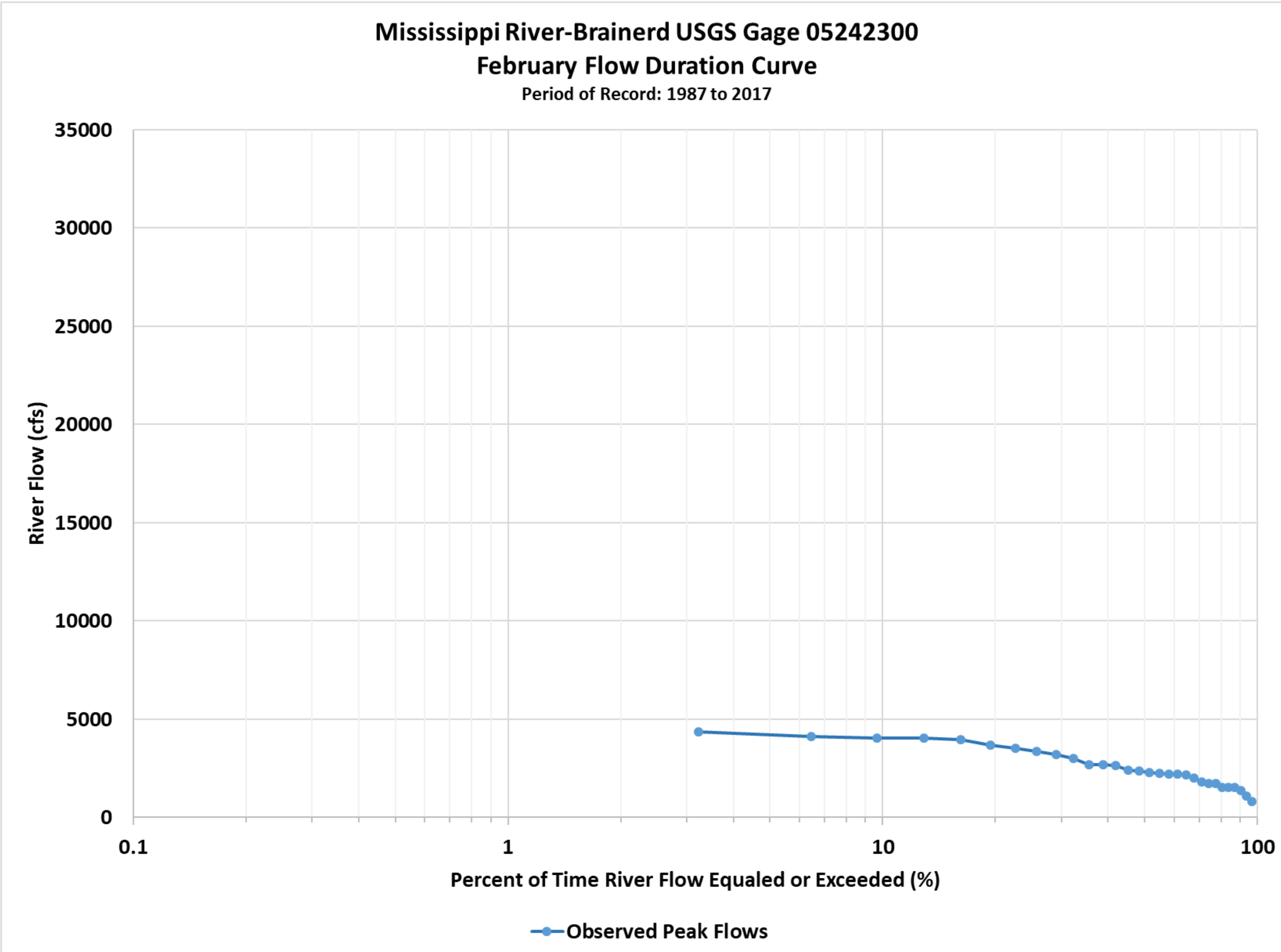
Figure A-1

PROJECT LOCATION
Brainerd Dam
Brainerd Public Utilities

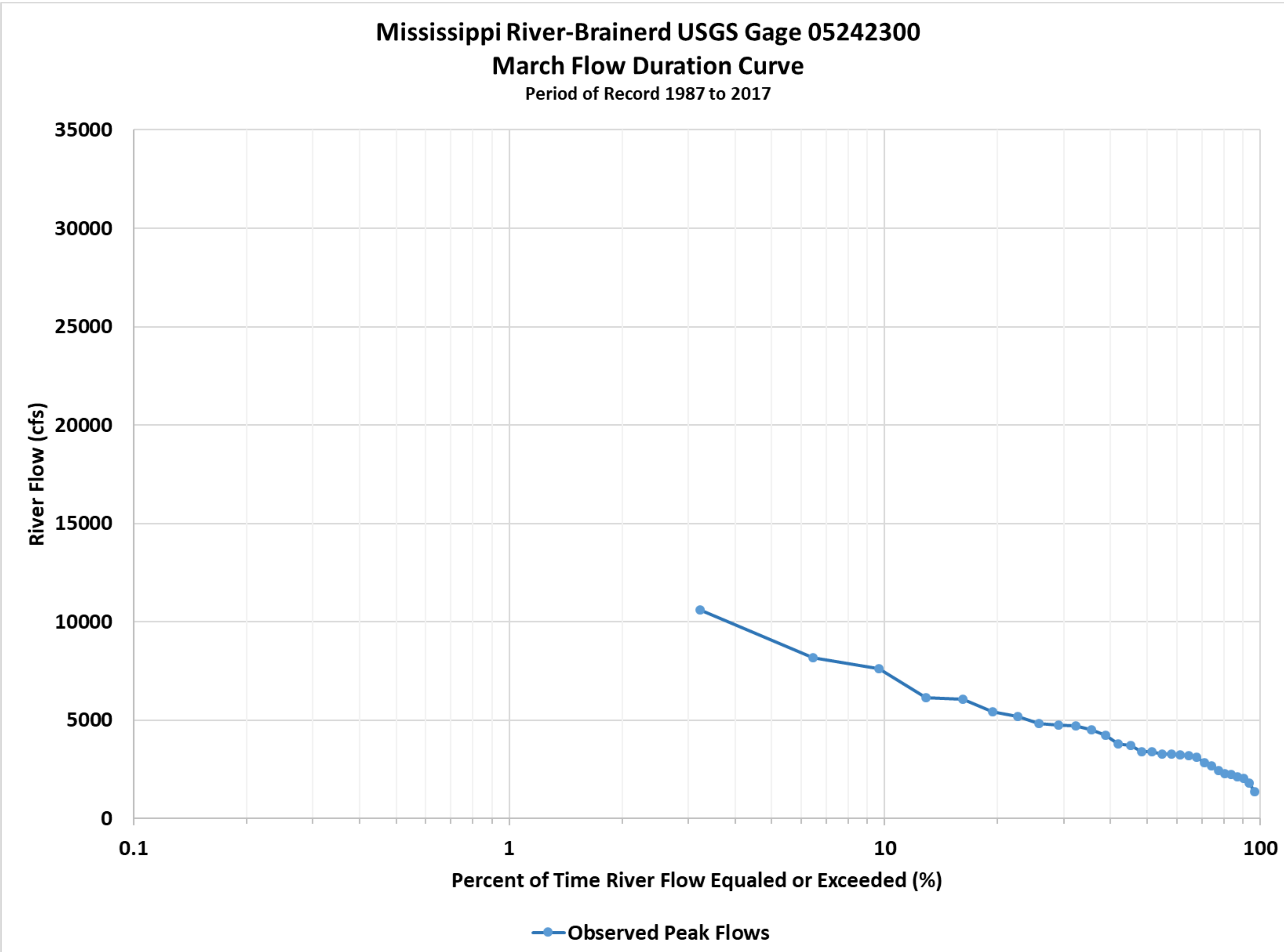

Mississippi River-Brainerd USGS Gage 05242300
Annual Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows
Trendline

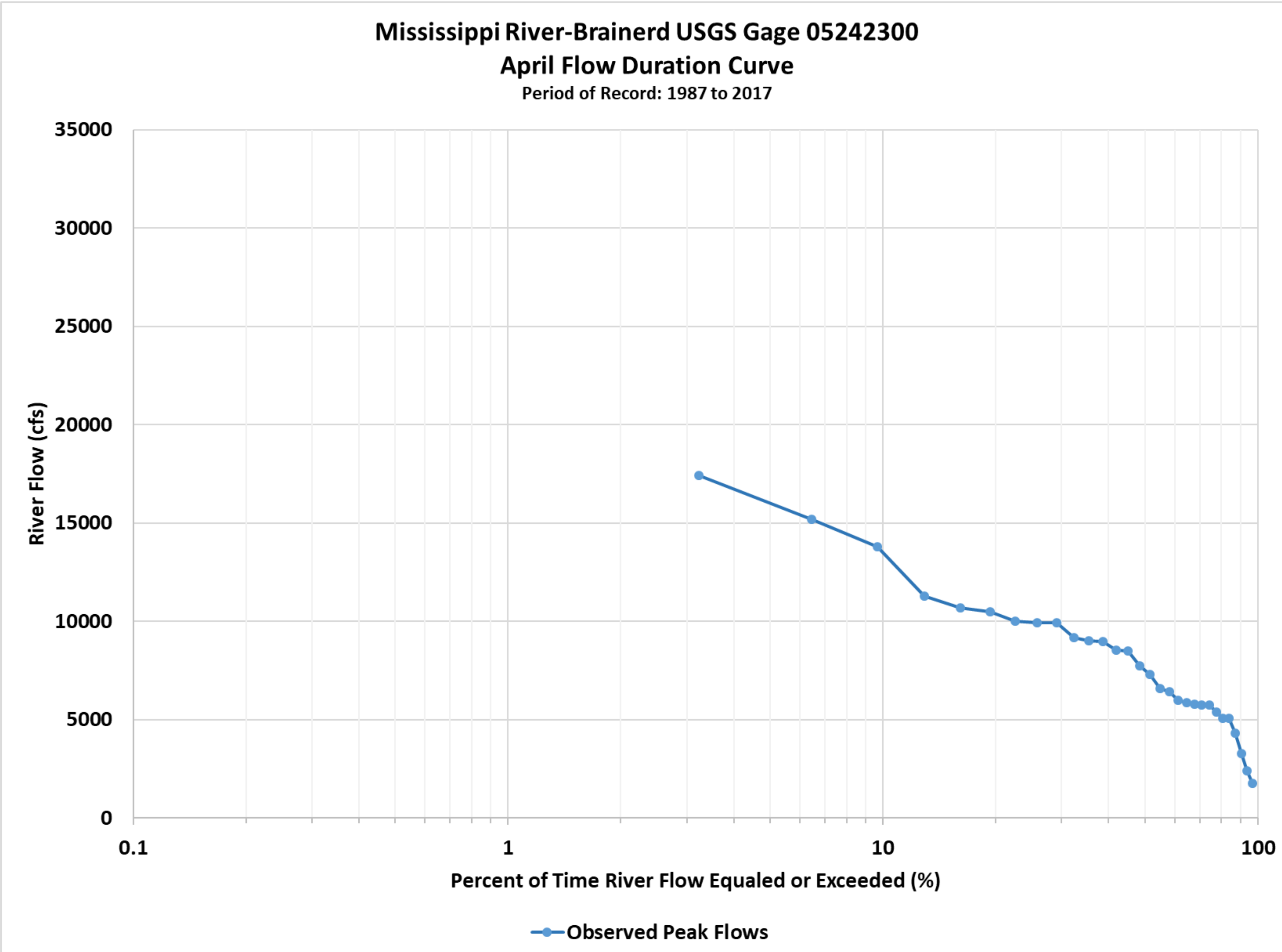


Mississippi River-Brainerd USGS Gage 05242300
January Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows

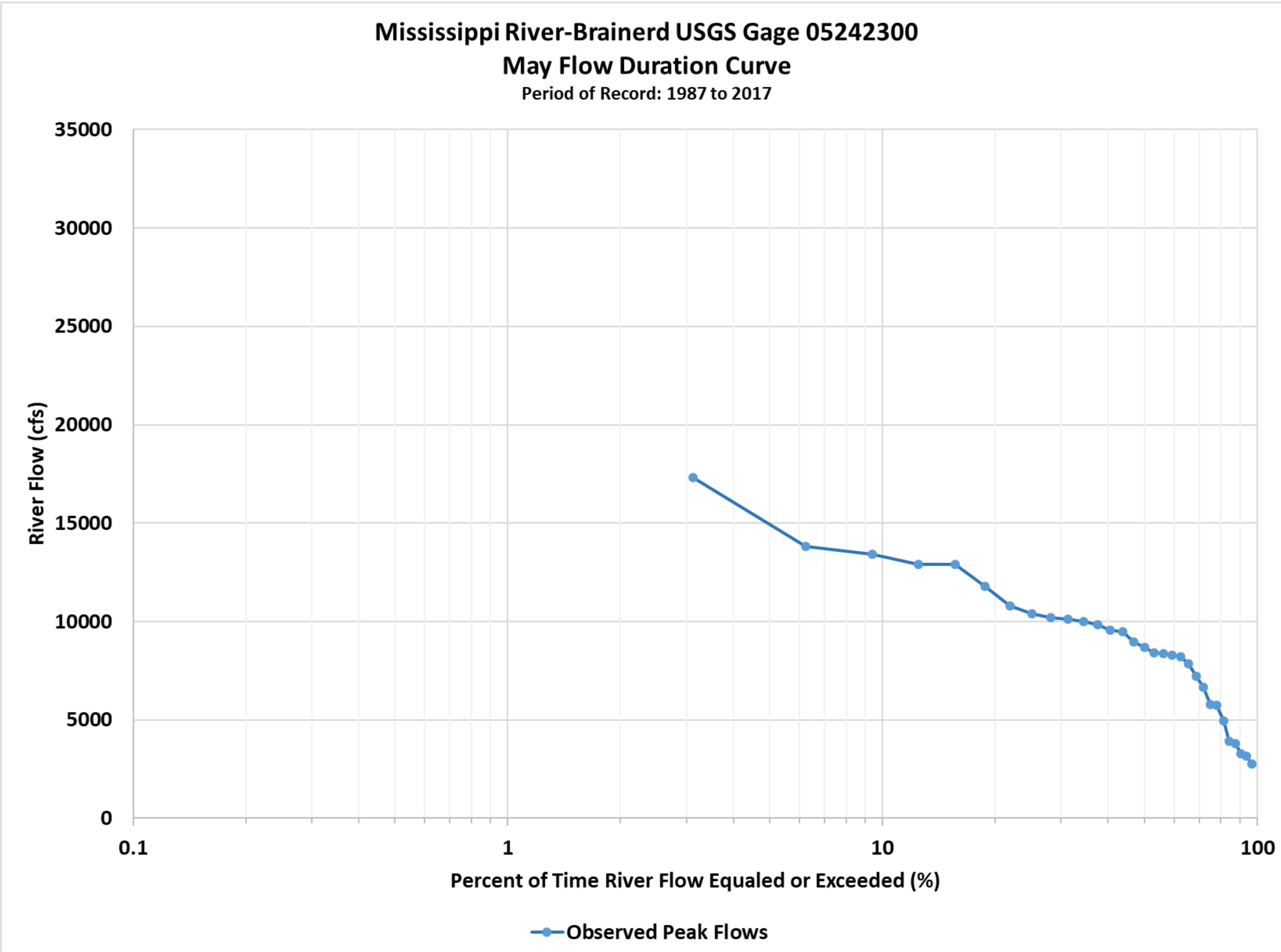


Mississippi River-Brainerd USGS Gage 05242300
February Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows

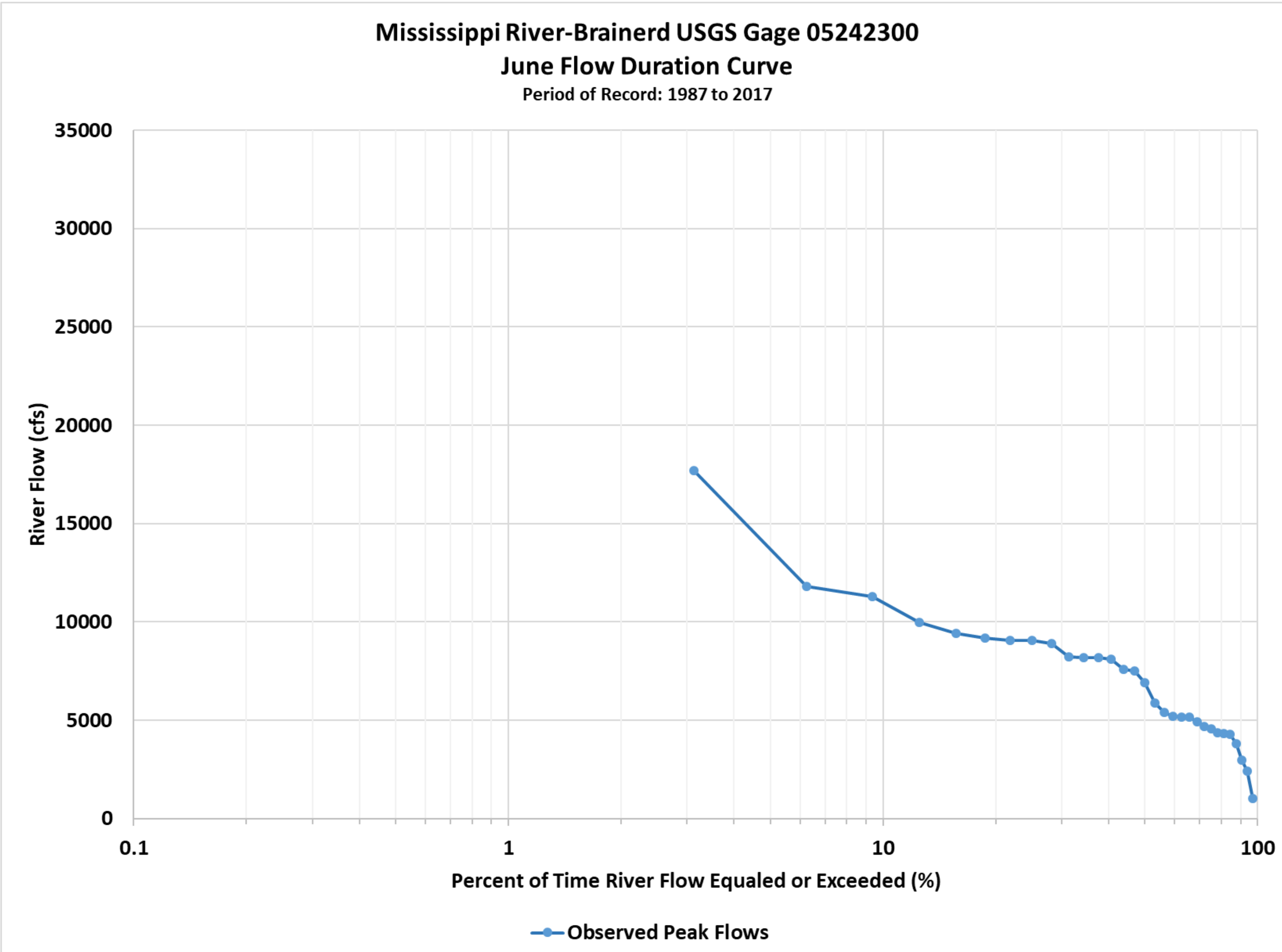

Mississippi River-Brainerd USGS Gage 05242300
March Flow Duration Curve
Period of Record 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows



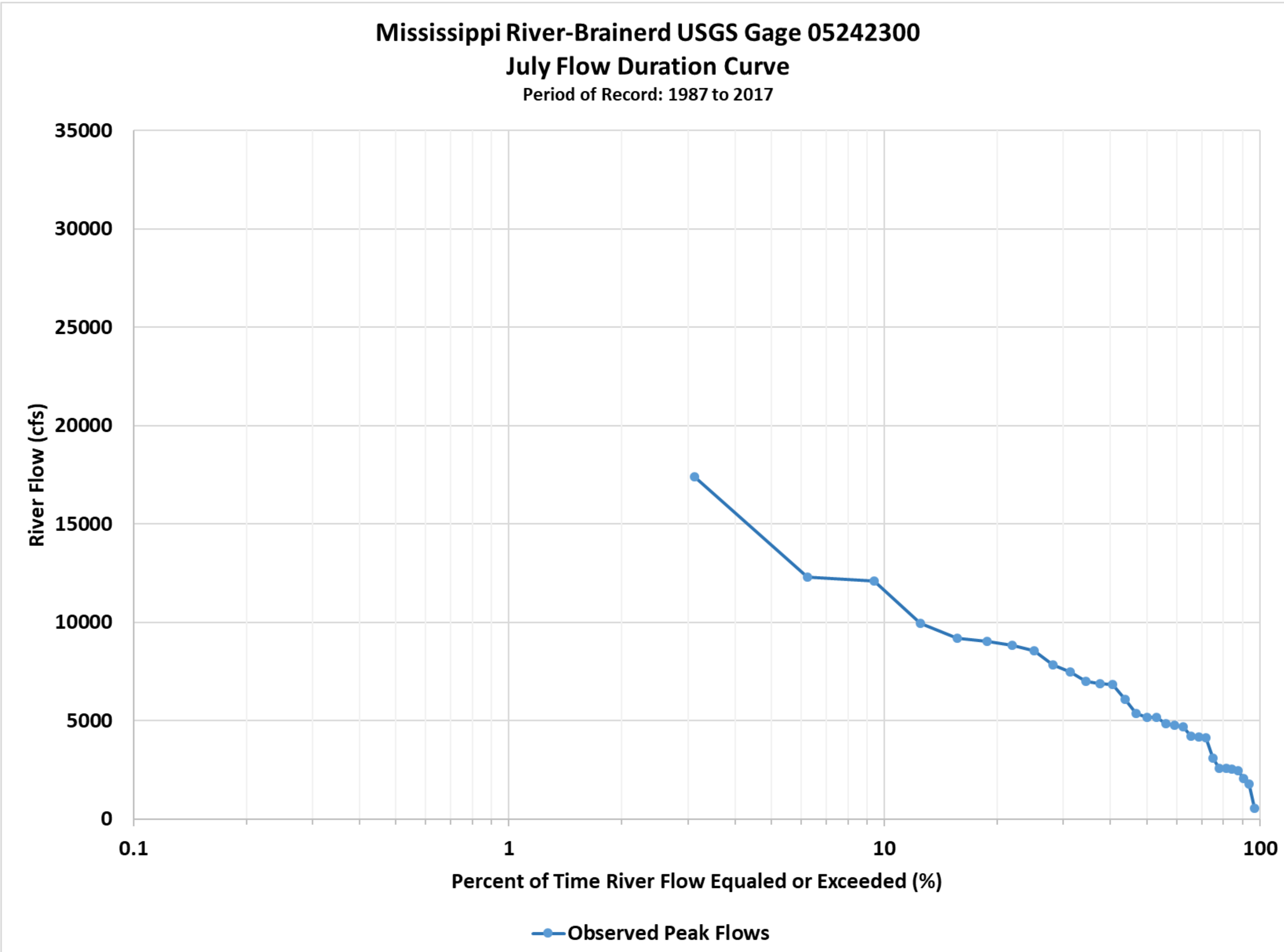
Mississippi River-Brainerd USGS Gage 05242300
April Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows

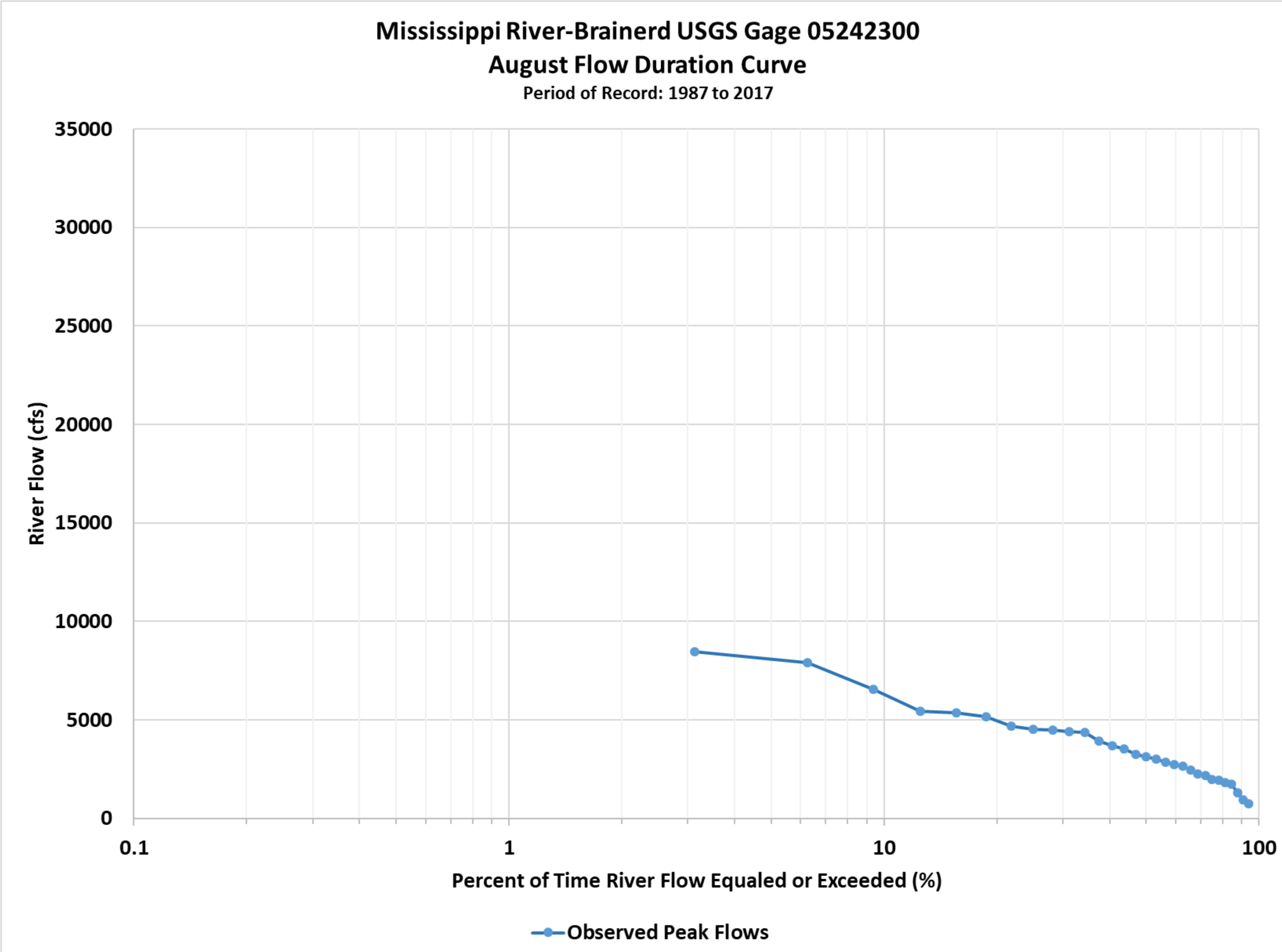


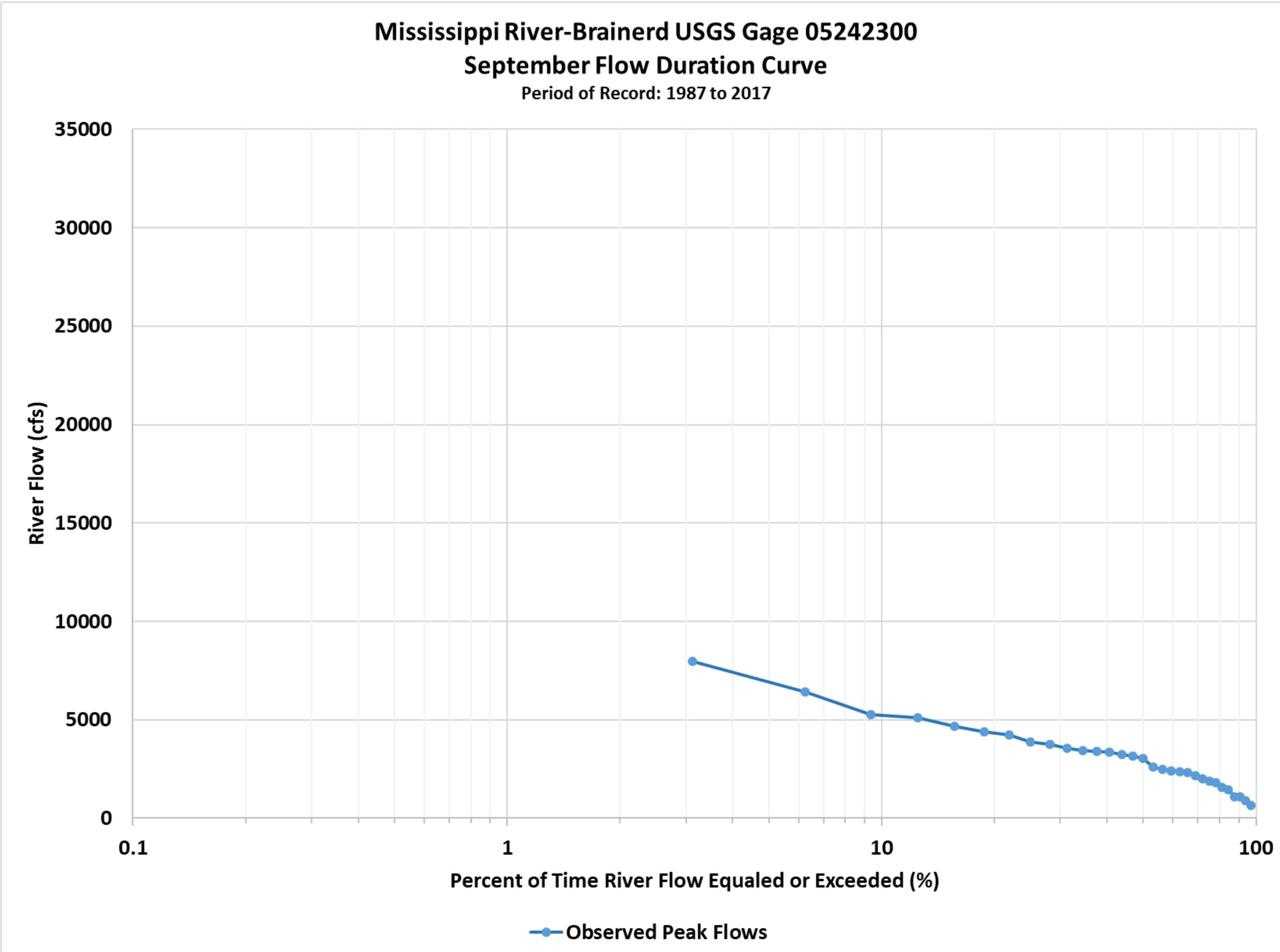
Mississippi River-Brainerd USGS Gage 05242300
May Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows

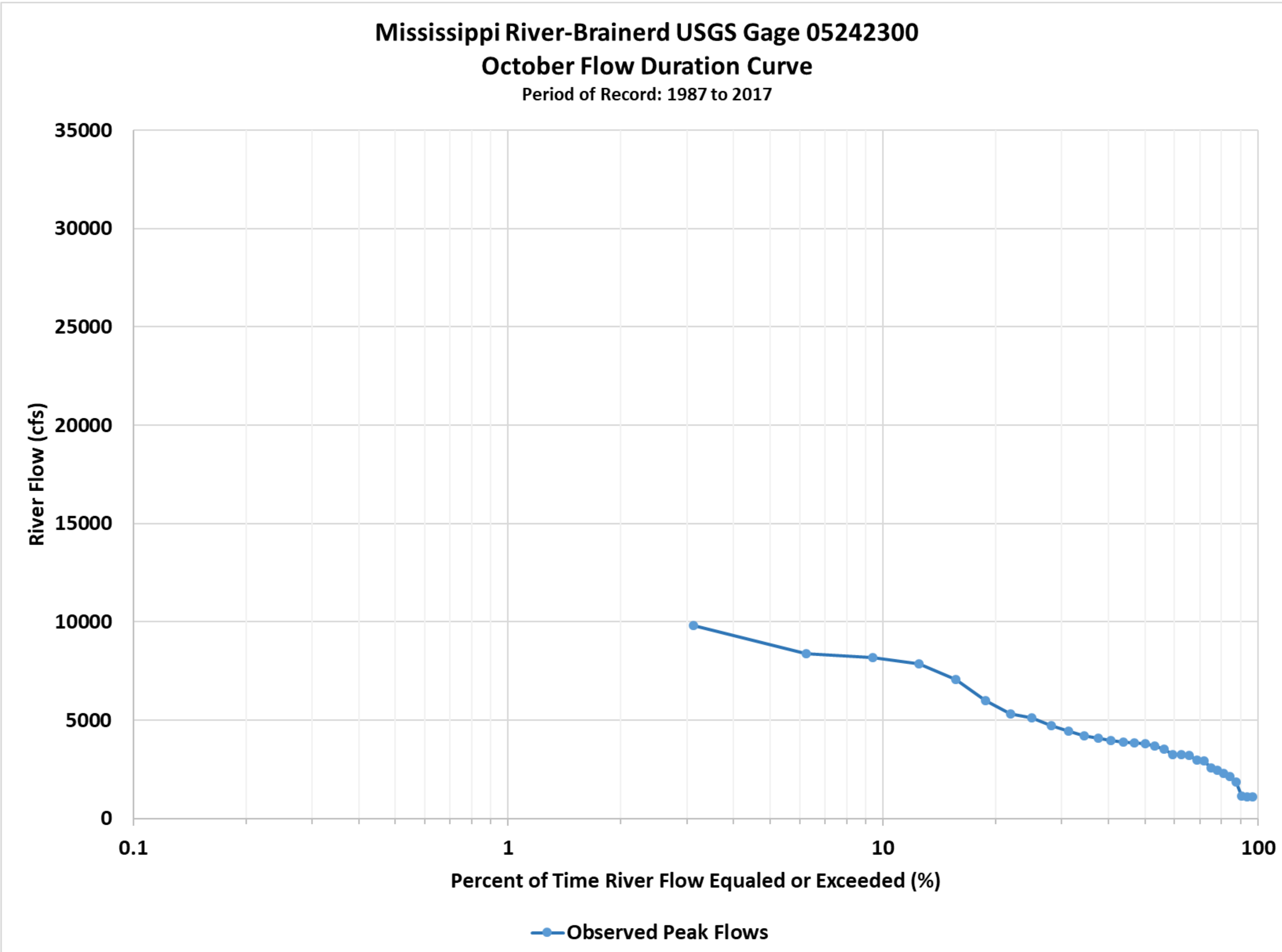


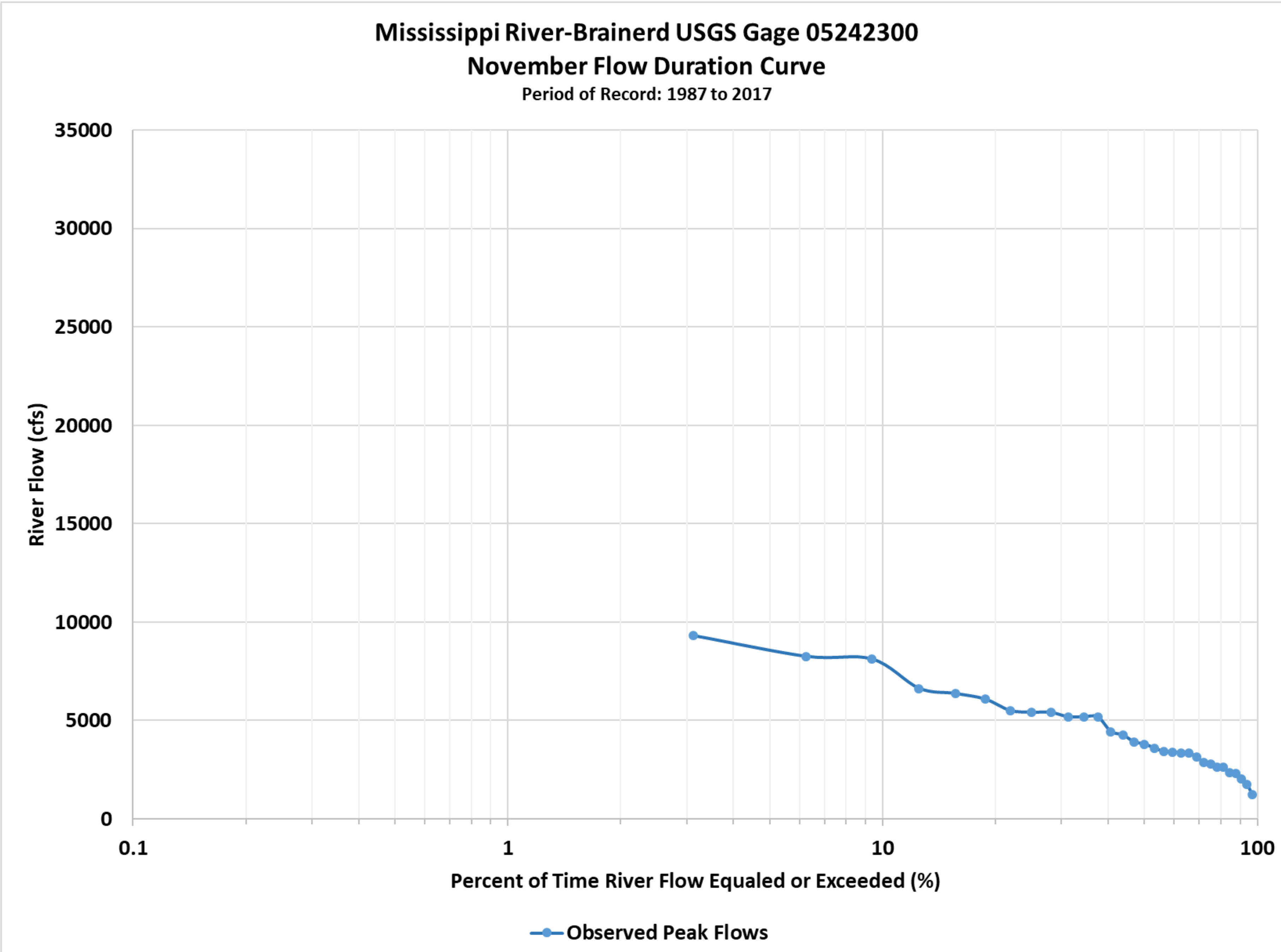
Mississippi River-Brainerd USGS Gage 05242300
June Flow Duration Curve
Period of Record: 1987 to 2017
35000
30000
25000
20000
15000
10000
5000
0
River Flow (cfs)
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows

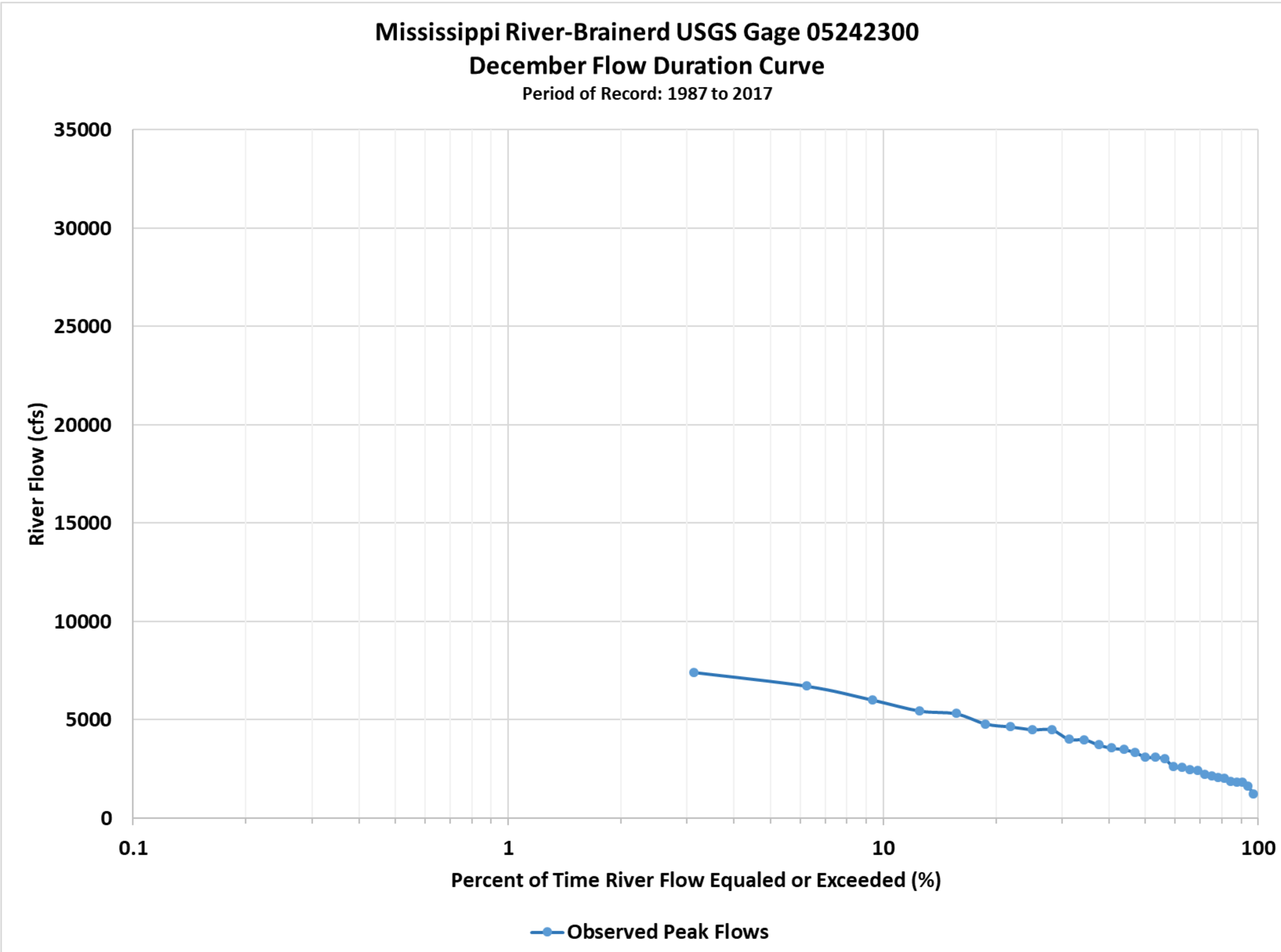

Mississippi River-Brainerd USGS Gage 05242300
July Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows


Mississippi River-Brainerd USGS Gage 05242300
August Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows

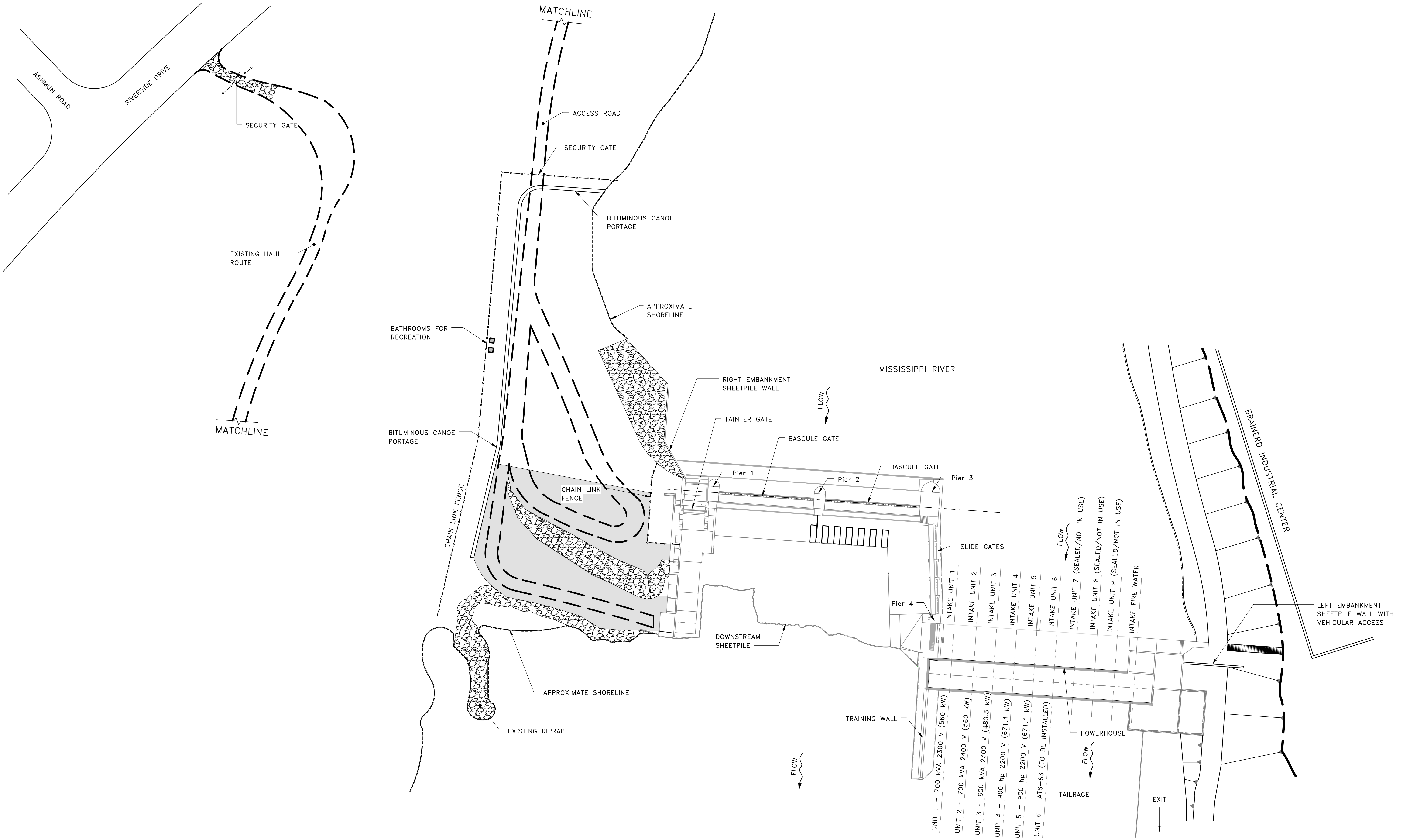

Mississippi River-Brainerd USGS Gage 05242300
September Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows


Mississippi River-Brainerd USGS Gage 05242300
October Flow Duration Curve
Period of Record: 1987 to 2017
35000
30000
25000
20000
15000
10000
5000
0
River Flow (cfs)
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows


Mississippi River-Brainerd USGS Gage 05242300
November Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows



Mississippi River-Brainerd USGS Gage 05242300
December Flow Duration Curve
Period of Record: 1987 to 2017
River Flow (cfs)
35000
30000
25000
20000
15000
10000
5000
0
0.1
1
10
100
Percent of Time River Flow Equaled or Exceeded (%)
Observed Peak Flows



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CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE

EXHIBIT DRAWING – NOT FOR CONSTRUCTION

NO.	BY	CHK	DATE	REVISION DESCRIPTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
PRINTED NAME ADELE L. BRAUN
SIGNATURE
DATE ______ LICENSE # 49586

CLIENT							
BID							
CONSTRUCTION							
RECORD							
RELEASED TO/FOR	A	B	C	0	1	2	3
	DATE RELEASED						

BARR
Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office:
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN 55435
Ph: 1-800-225-1966
Fax: (218) 262-3460
www.barr.com

Scale	N/A
Date	8/01/2018
Drawn	
Checked	
Designed	
Approved	

BRAINERD PUBLIC UTILITIES
BRAINERD, MINNESOTA

BRAINERD HYDROELECTRIC PROJECT
BRAINERD, MINNESOTA

Site Plan

BARR PROJECT NO. 23/18-1016.05
CLIENT PROJECT NO. ---
DWG NO. G-06
REV NO.

Appendix B

Exhibit A – Project Description Attachments (CEII)

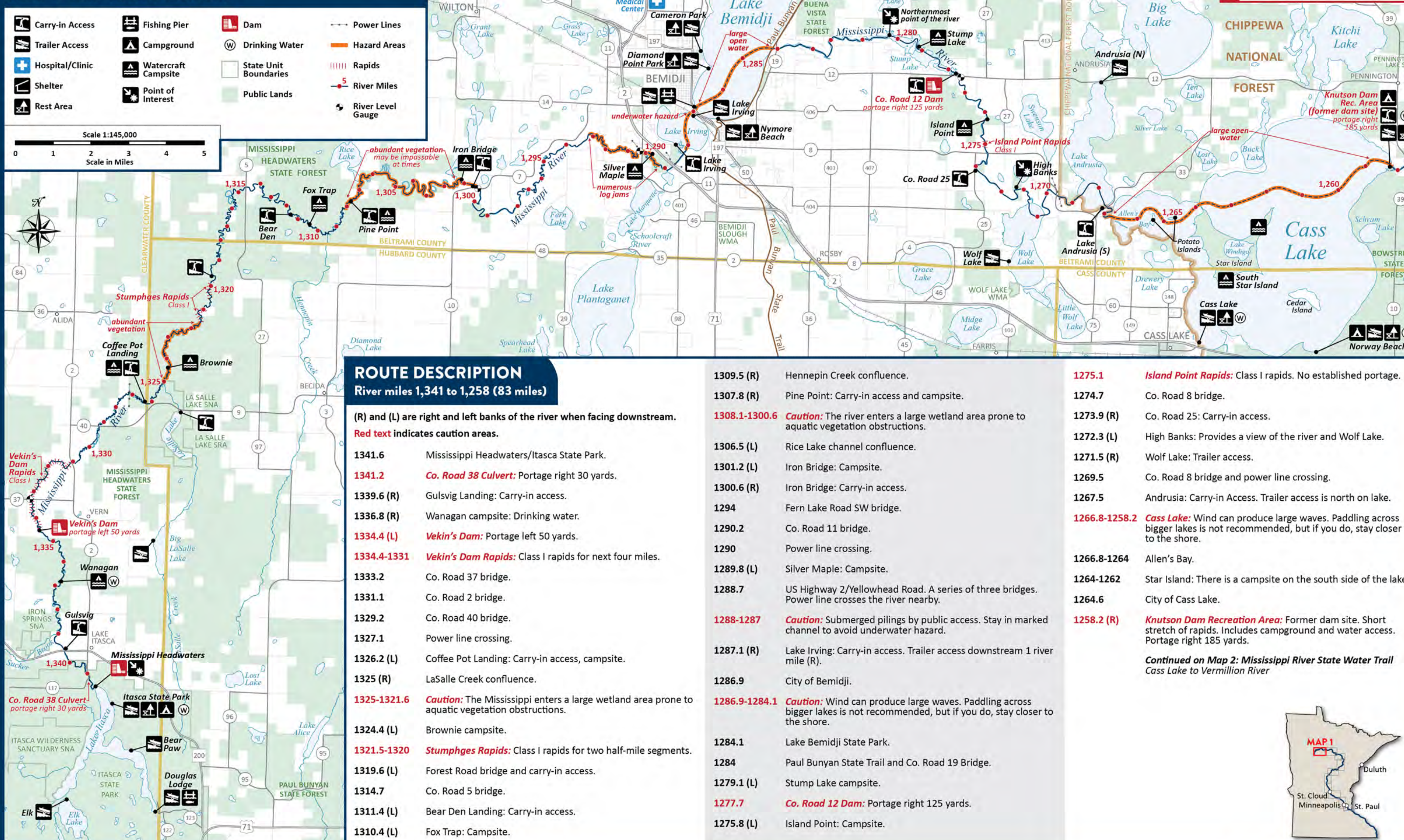
- Distribution Grid
- Single Line Diagram

Appendix C

Exhibit E – Environmental Report Attachments (Public)

- Minnesota River Trail Maps
- Consultation Letter from the MPCA, dated March 18, 2018
- Project Boundary (Figure E-1)
- Drawing G-06 Principal Project Features
- Project Figures (Figure E-2 through Figure E-8)
- Dissolved Oxygen and Temperature Study Report
- Fish Impingement and Entrainment Study Report
- Botanical Resources Memo
- Updated IPAC List
- Recreation Use and Inventory Study
- Distribution List

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 1 - Lake Itasca to Cass Lake



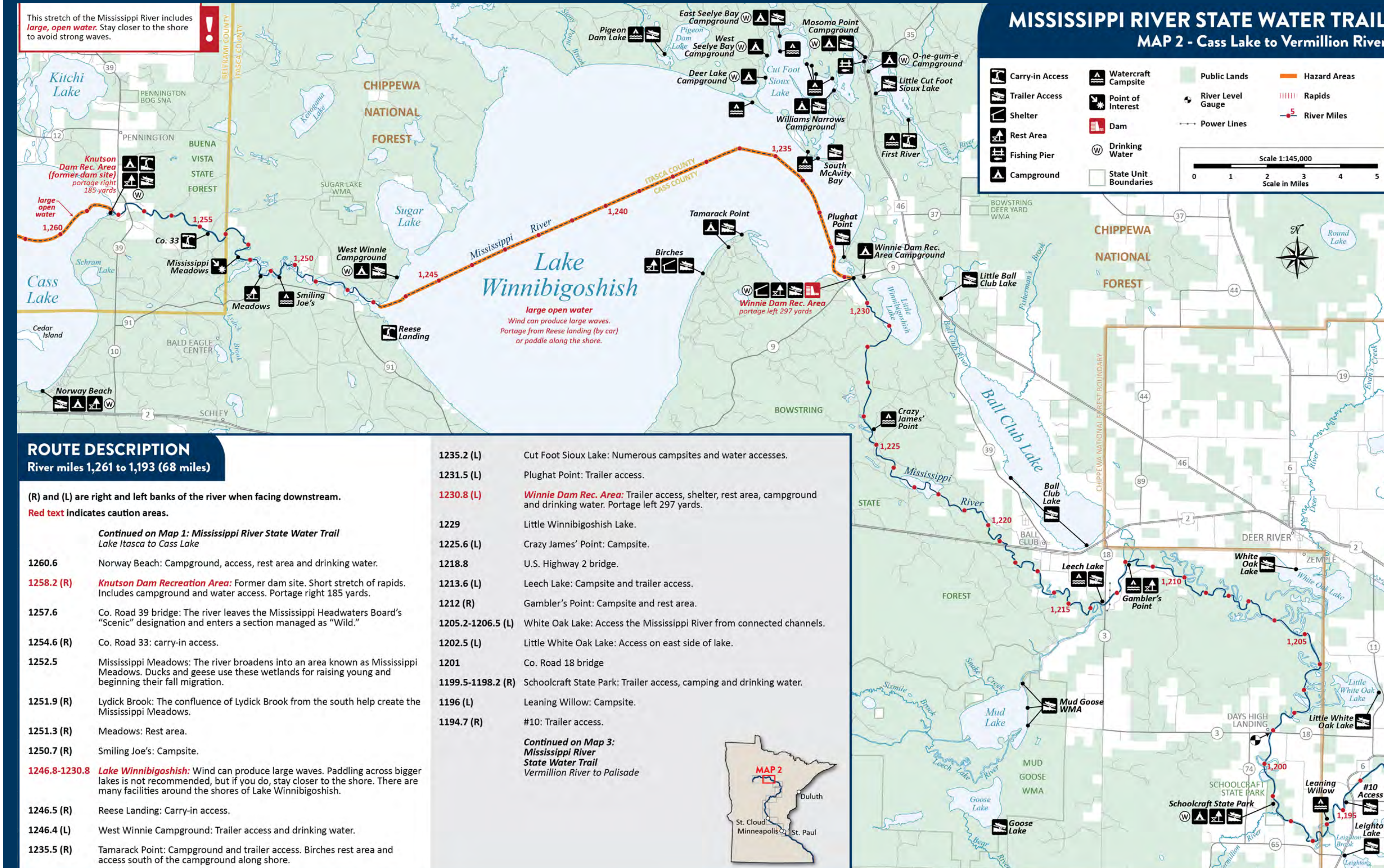
ROUTE DESCRIPTION
River miles 1,341 to 1,258 (83 miles)

(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

1341.6	Mississippi Headwaters/Itasca State Park.
1341.2	*Co. Road 38 Culvert:* Portage right 30 yards.
1339.6 (R)	Gulsvig Landing: Carry-in access.
1336.8 (R)	Wanagan campsite: Drinking water.
1334.4 (L)	*Vekin's Dam:* Portage left 50 yards.
1334.4-1331	*Vekin's Dam Rapids:* Class I rapids for next four miles.
1333.2	Co. Road 37 bridge.
1331.1	Co. Road 2 bridge.
1329.2	Co. Road 40 bridge.
1327.1	Power line crossing.
1326.2 (L)	Coffee Pot Landing: Carry-in access, campsite.
1325 (R)	LaSalle Creek confluence.
1325-1321.6	*Caution:* The Mississippi enters a large wetland area prone to aquatic vegetation obstructions.
1324.4 (L)	Brownie campsite.
1321.5-1320	*Stumphges Rapids:* Class I rapids for two half-mile segments.
1319.6 (L)	Forest Road bridge and carry-in access.
1314.7	Co. Road 5 bridge.
1311.4 (L)	Bear Den Landing: Carry-in access.
1310.4 (L)	Fox Trap: Campsite.
1309.5 (R)	Hennepin Creek confluence.
1307.8 (R)	Pine Point: Carry-in access and campsite.
1308.1-1300.6	*Caution:* The river enters a large wetland area prone to aquatic vegetation obstructions.
1306.5 (L)	Rice Lake channel confluence.
1301.2 (L)	Iron Bridge: Campsite.
1300.6 (R)	Iron Bridge: Carry-in access.
1294	Fern Lake Road SW bridge.
1290.2	Co. Road 11 bridge.
1290	Power line crossing.
1289.8 (L)	Silver Maple: Campsite.
1288.7	US Highway 2/Yellowhead Road. A series of three bridges. Power line crosses the river nearby.
1288-1287	*Caution:* Submerged pilings by public access. Stay in marked channel to avoid underwater hazard.
1287.1 (R)	Lake Irving: Carry-in access. Trailer access downstream 1 river mile (R).
1286.9	City of Bemidji.
1286.9-1284.1	*Caution:* Wind can produce large waves. Paddling across bigger lakes is not recommended, but if you do, stay closer to the shore.
1284.1	Lake Bemidji State Park.
1284	Paul Bunyan State Trail and Co. Road 19 Bridge.
1279.1 (L)	Stump Lake campsite.
1277.7	*Co. Road 12 Dam:* Portage right 125 yards.
1275.8 (L)	Island Point: Campsite.
1275.1	*Island Point Rapids:* Class I rapids. No established portage.
1274.7	Co. Road 8 bridge.
1273.9 (R)	Co. Road 25: Carry-in access.
1272.3 (L)	High Banks: Provides a view of the river and Wolf Lake.
1271.5 (R)	Wolf Lake: Trailer access.
1269.5	Co. Road 8 bridge and power line crossing.
1267.5	Andrusia: Carry-in Access. Trailer access is north on lake.
1266.8-1258.2	*Cass Lake:* Wind can produce large waves. Paddling across bigger lakes is not recommended, but if you do, stay closer to the shore.
1266.8-1264	Allen's Bay.
1264-1262	Star Island: There is a campsite on the south side of the lake.
1264.6	City of Cass Lake.
1258.2 (R)	*Knutson Dam Recreation Area:* Former dam site. Short stretch of rapids. Includes campground and water access. Portage right 185 yards.

Continued on Map 2: Mississippi River State Water Trail Cass Lake to Vermillion River

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 2 - Cass Lake to Vermillion River



ROUTE DESCRIPTION
River miles 1,261 to 1,193 (68 miles)

(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

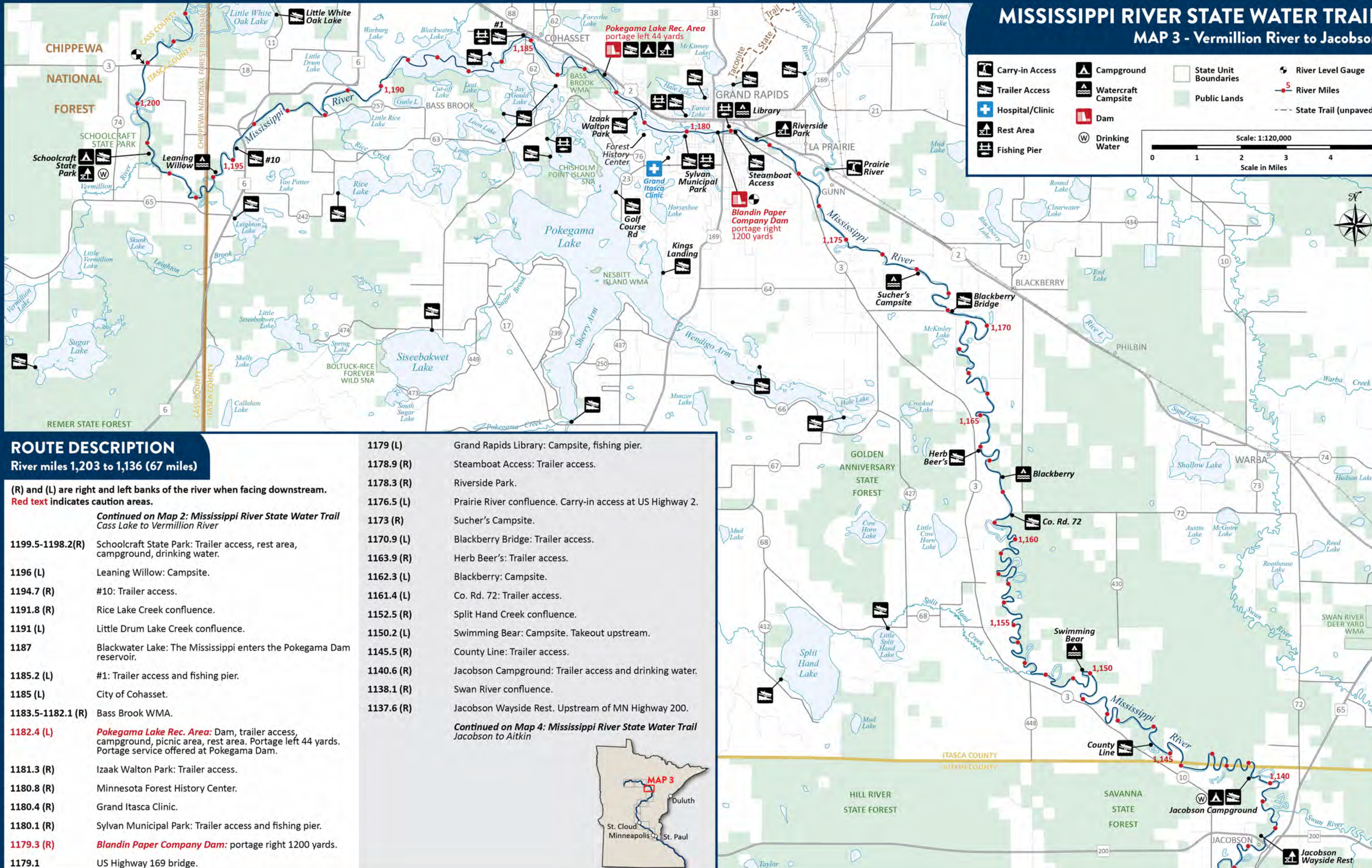
Continued on Map 1: Mississippi River State Water Trail *Lake Itasca to Cass Lake*

1260.6	Norway Beach: Campground, access, rest area and drinking water.
1258.2 (R)	*Knutson Dam Recreation Area:* Former dam site. Short stretch of rapids. Includes campground and water access. Portage right 185 yards.
1257.6	Co. Road 39 bridge: The river leaves the Mississippi Headwaters Board's "Scenic" designation and enters a section managed as "Wild."
1254.6 (R)	Co. Road 33: carry-in access.
1252.5	Mississippi Meadows: The river broadens into an area known as Mississippi Meadows. Ducks and geese use these wetlands for raising young and beginning their fall migration.
1251.9 (R)	Lydick Brook: The confluence of Lydick Brook from the south help create the Mississippi Meadows.
1251.3 (R)	Meadows: Rest area.
1250.7 (R)	Smiling Joe's: Campsite.
1246.8-1230.8	*Lake Winnibigoshish:* Wind can produce large waves. Paddling across bigger lakes is not recommended, but if you do, stay closer to the shore. There are many facilities around the shores of Lake Winnibigoshish.
1246.5 (R)	Reese Landing: Carry-in access.
1246.4 (L)	West Winnie Campground: Trailer access and drinking water.
1235.5 (R)	Tamarack Point: Campground and trailer access. Birches rest area and access south of the campground along shore.
1235.2 (L)	Cut Foot Sioux Lake: Numerous campsites and water accesses.
1231.5 (L)	Plughat Point: Trailer access.
1230.8 (L)	*Winnie Dam Rec. Area:* Trailer access, shelter, rest area, campground and drinking water. Portage left 297 yards.
1229	Little Winnibigoshish Lake.
1225.6 (L)	Crazy James' Point: Campsite.
1218.8	U.S. Highway 2 bridge.
1213.6 (L)	Leech Lake: Campsite and trailer access.
1212 (R)	Gambler's Point: Campsite and rest area.
1205.2-1206.5 (L)	White Oak Lake: Access the Mississippi River from connected channels.
1202.5 (L)	Little White Oak Lake: Access on east side of lake.
1201	Co. Road 18 bridge
1199.5-1198.2 (R)	Schoolcraft State Park: Trailer access, camping and drinking water.
1196 (L)	Leaning Willow: Campsite.
1194.7 (R)	#10: Trailer access.

Continued on Map 3: Mississippi River State Water Trail *Vermillion River to Palisade*

MISSISSIPPI RIVER STATE WATER TRAIL

MAP 3 - Vermillion River to Jacobson



ROUTE DESCRIPTION

River miles 1,203 to 1,136 (67 miles)

(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

Continued on Map 2: Mississippi River State Water Trail
Cass Lake to Vermillion River

1199.5-1198.2(R)	Schoolcraft State Park: Trailer access, rest area, campground, drinking water.
1196 (L)	Leaning Willow: Campsite.
1194.7 (R)	#10: Trailer access.
1191.8 (R)	Rice Lake Creek confluence.
1191 (L)	Little Drum Lake Creek confluence.
1187	Blackwater Lake: The Mississippi enters the Pokegama Dam reservoir.
1185.2 (L)	#1: Trailer access and fishing pier.
1185 (L)	City of Cohasset.
1183.5-1182.1 (R)	Bass Brook WMA.
1182.4 (L)	***Pokegama Lake Rec. Area:*** Dam, trailer access, campground, picnic area, rest area. Portage left 44 yards. Portage service offered at Pokegama Dam.
1181.3 (R)	Izaak Walton Park: Trailer access.
1180.8 (R)	Minnesota Forest History Center.
1180.4 (R)	Grand Itasca Clinic.
1180.1 (R)	Sylvan Municipal Park: Trailer access and fishing pier.
1179.3 (R)	***Blandin Paper Company Dam:*** portage right 1200 yards.
1179.1	US Highway 169 bridge.
1179 (L)	Grand Rapids Library: Campsite, fishing pier.
1178.9 (R)	Steamboat Access: Trailer access.
1178.3 (R)	Riverside Park.
1176.5 (L)	Prairie River confluence. Carry-in access at US Highway 2.
1173 (R)	Sucher's Campsite.
1170.9 (L)	Blackberry Bridge: Trailer access.
1163.9 (R)	Herb Beer's: Trailer access.
1162.3 (L)	Blackberry: Campsite.
1161.4 (L)	Co. Rd. 72: Trailer access.
1152.5 (R)	Split Hand Creek confluence.
1150.2 (L)	Swimming Bear: Campsite. Takeout upstream.
1145.5 (R)	County Line: Trailer access.
1140.6 (R)	Jacobson Campground: Trailer access and drinking water.
1138.1 (R)	Swan River confluence.
1137.6 (R)	Jacobson Wayside Rest. Upstream of MN Highway 200.

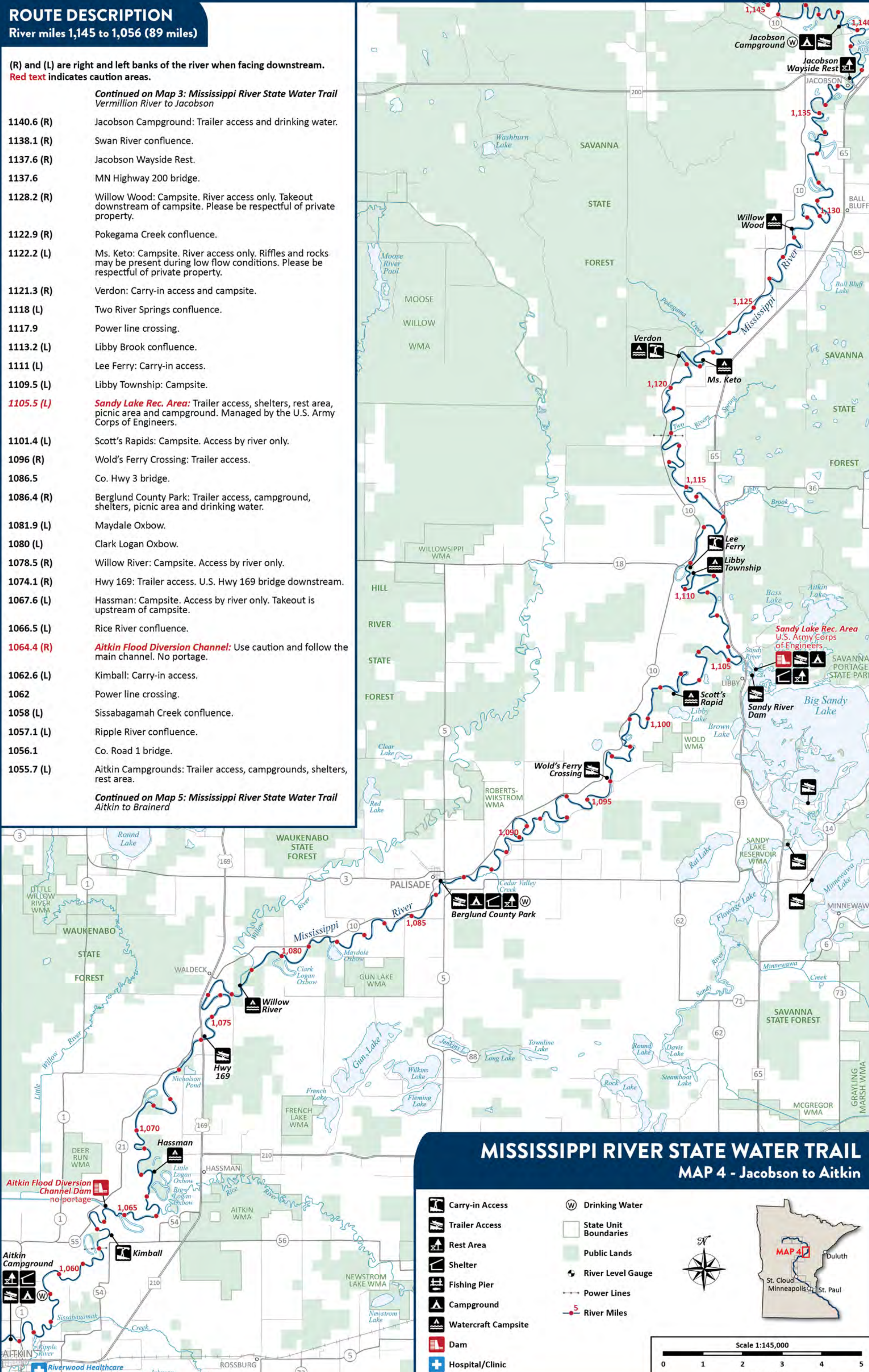
Continued on Map 4: Mississippi River State Water Trail
Jacobson to Aitkin

ROUTE DESCRIPTION

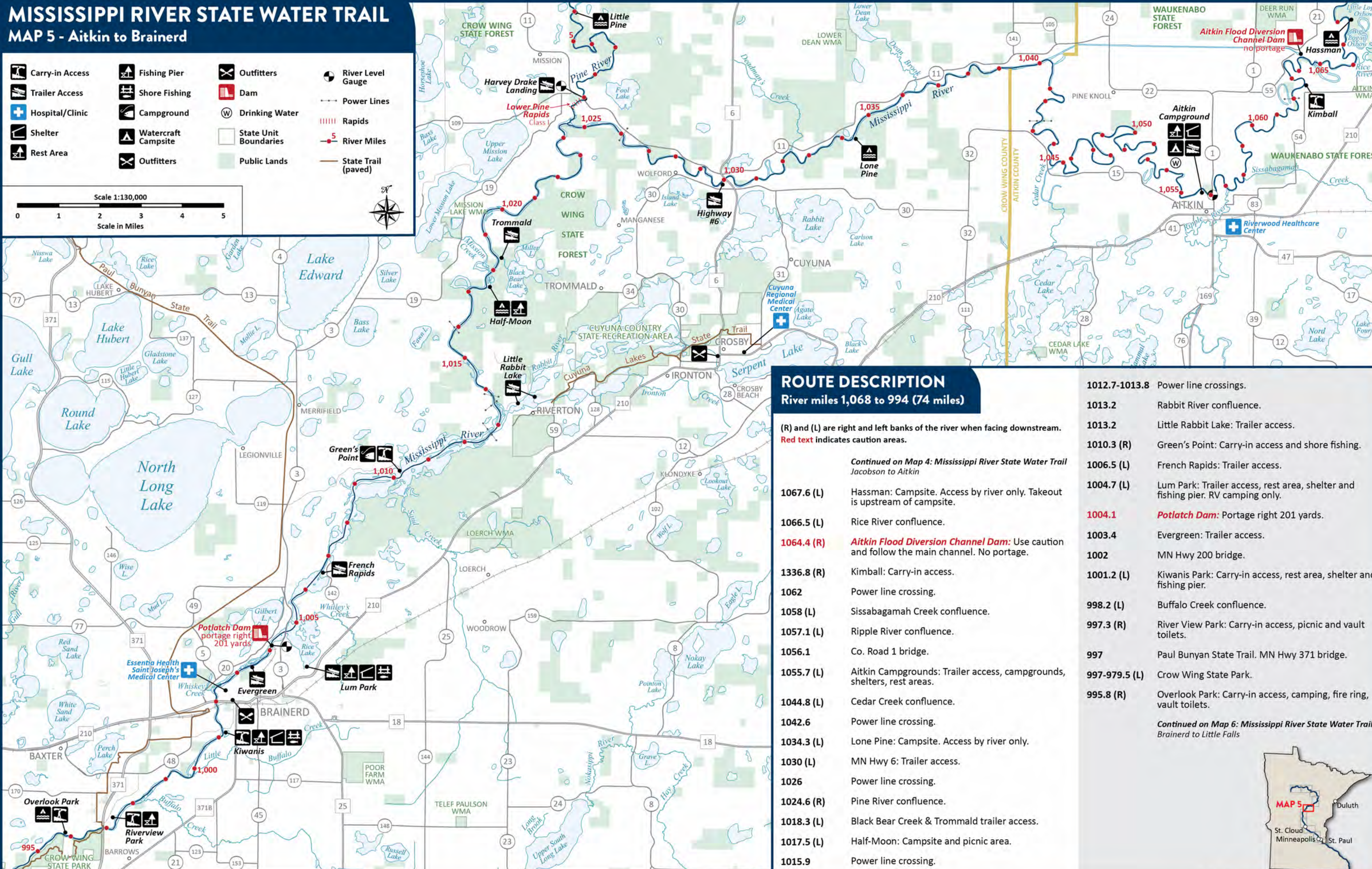
River miles 1,145 to 1,056 (89 miles)

(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

	Continued on Map 3: Mississippi River State Water Trail *Vermillion River to Jacobson*
1140.6 (R)	Jacobson Campground: Trailer access and drinking water.
1138.1 (R)	Swan River confluence.
1137.6 (R)	Jacobson Wayside Rest.
1137.6	MN Highway 200 bridge.
1128.2 (R)	Willow Wood: Campsite. River access only. Takeout downstream of campsite. Please be respectful of private property.
1122.9 (R)	Pokegama Creek confluence.
1122.2 (L)	Ms. Keto: Campsite. River access only. Riffles and rocks may be present during low flow conditions. Please be respectful of private property.
1121.3 (R)	Verdon: Carry-in access and campsite.
1118 (L)	Two River Springs confluence.
1117.9	Power line crossing.
1113.2 (L)	Libby Brook confluence.
1111 (L)	Lee Ferry: Carry-in access.
1109.5 (L)	Libby Township: Campsite.
1105.5 (L)	***Sandy Lake Rec. Area:*** Trailer access, shelters, rest area, picnic area and campground. Managed by the U.S. Army Corps of Engineers.
1101.4 (L)	Scott's Rapids: Campsite. Access by river only.
1096 (R)	Wold's Ferry Crossing: Trailer access.
1086.5	Co. Hwy 3 bridge.
1086.4 (R)	Berglund County Park: Trailer access, campground, shelters, picnic area and drinking water.
1081.9 (L)	Maydale Oxbow.
1080 (L)	Clark Logan Oxbow.
1078.5 (R)	Willow River: Campsite. Access by river only.
1074.1 (R)	Hwy 169: Trailer access. U.S. Hwy 169 bridge downstream.
1067.6 (L)	Hassman: Campsite. Access by river only. Takeout is upstream of campsite.
1066.5 (L)	Rice River confluence.
1064.4 (R)	***Aitkin Flood Diversion Channel:*** Use caution and follow the main channel. No portage.
1062.6 (L)	Kimball: Carry-in access.
1062	Power line crossing.
1058 (L)	Sissabagamah Creek confluence.
1057.1 (L)	Ripple River confluence.
1056.1	Co. Road 1 bridge.
1055.7 (L)	Aitkin Campgrounds: Trailer access, campgrounds, shelters, rest area.
	Continued on Map 5: Mississippi River State Water Trail *Aitkin to Brainerd*



MISSISSIPPI RIVER STATE WATER TRAIL
MAP 5 - Aitkin to Brainerd



ROUTE DESCRIPTION
River miles 1,068 to 994 (74 miles)

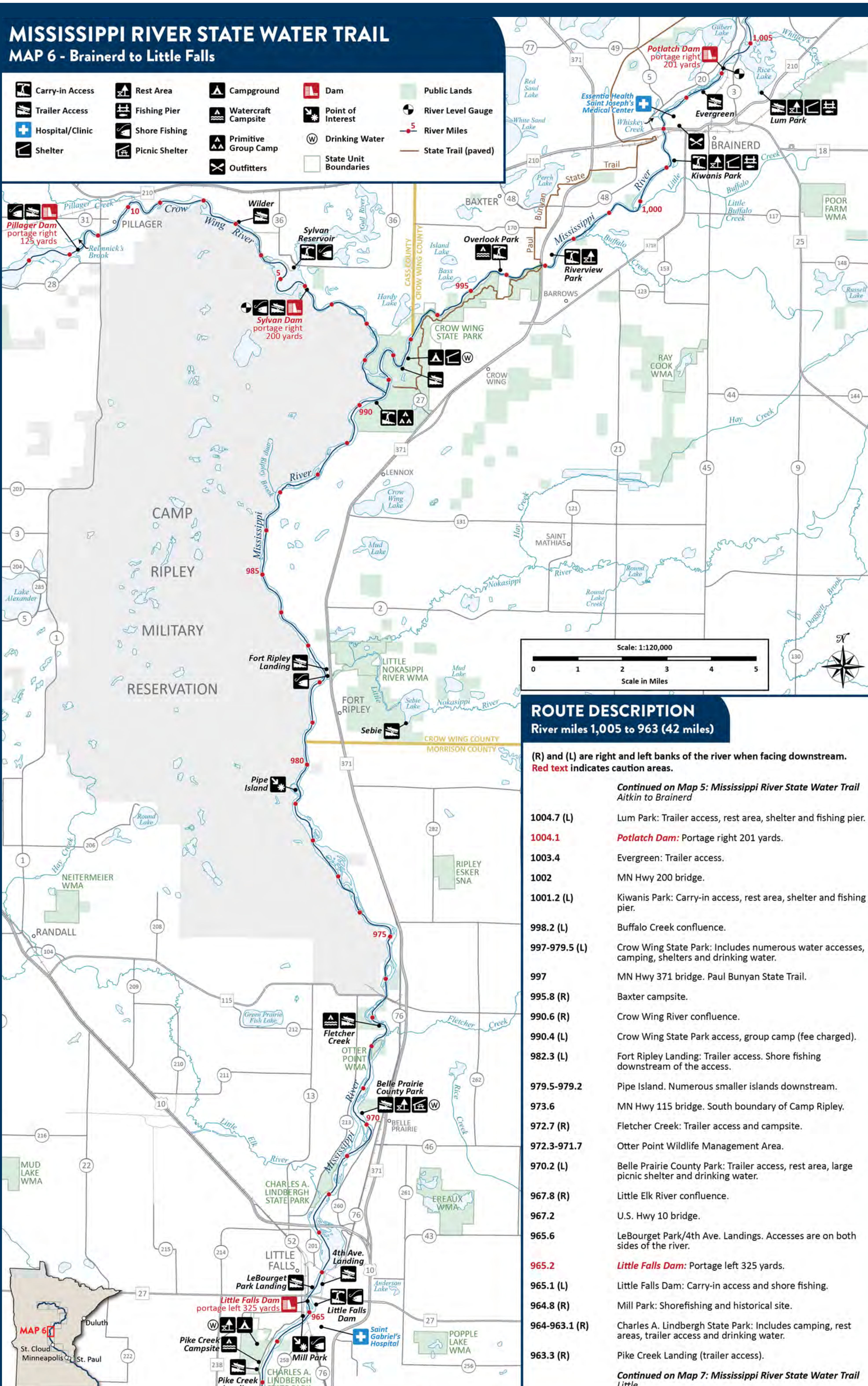
(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

Continued on Map 4: Mississippi River State Water Trail *Jacobson to Aitkin*

1067.6 (L)	Hassman: Campsite. Access by river only. Takeout is upstream of campsite.
1066.5 (L)	Rice River confluence.
1064.4 (R)	*Aitkin Flood Diversion Channel Dam:* Use caution and follow the main channel. No portage.
1336.8 (R)	Kimball: Carry-in access.
1062	Power line crossing.
1058 (L)	Sissabagamah Creek confluence.
1057.1 (L)	Ripple River confluence.
1056.1	Co. Road 1 bridge.
1055.7 (L)	Aitkin Campgrounds: Trailer access, campgrounds, shelters, rest areas.
1044.8 (L)	Cedar Creek confluence.
1042.6	Power line crossing.
1034.3 (L)	Lone Pine: Campsite. Access by river only.
1030 (L)	MN Hwy 6: Trailer access.
1026	Power line crossing.
1024.6 (R)	Pine River confluence.
1018.3 (L)	Black Bear Creek & Trommald trailer access.
1017.5 (L)	Half-Moon: Campsite and picnic area.
1015.9	Power line crossing.
1012.7-1013.8	Power line crossings.
1013.2	Rabbit River confluence.
1013.2	Little Rabbit Lake: Trailer access.
1010.3 (R)	Green's Point: Carry-in access and shore fishing.
1006.5 (L)	French Rapids: Trailer access.
1004.7 (L)	Lum Park: Trailer access, rest area, shelter and fishing pier. RV camping only.
1004.1	*Potlatch Dam:* Portage right 201 yards.
1003.4	Evergreen: Trailer access.
1002	MN Hwy 200 bridge.
1001.2 (L)	Kiwanis Park: Carry-in access, rest area, shelter and fishing pier.
998.2 (L)	Buffalo Creek confluence.
997.3 (R)	River View Park: Carry-in access, picnic and vault toilets.
997	Paul Bunyan State Trail. MN Hwy 371 bridge.
997-979.5 (L)	Crow Wing State Park.
995.8 (R)	Overlook Park: Carry-in access, camping, fire ring, vault toilets.

Continued on Map 6: Mississippi River State Water Trail *Brainerd to Little Falls*

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 6 - Brainerd to Little Falls



ROUTE DESCRIPTION
River miles 1,005 to 963 (42 miles)

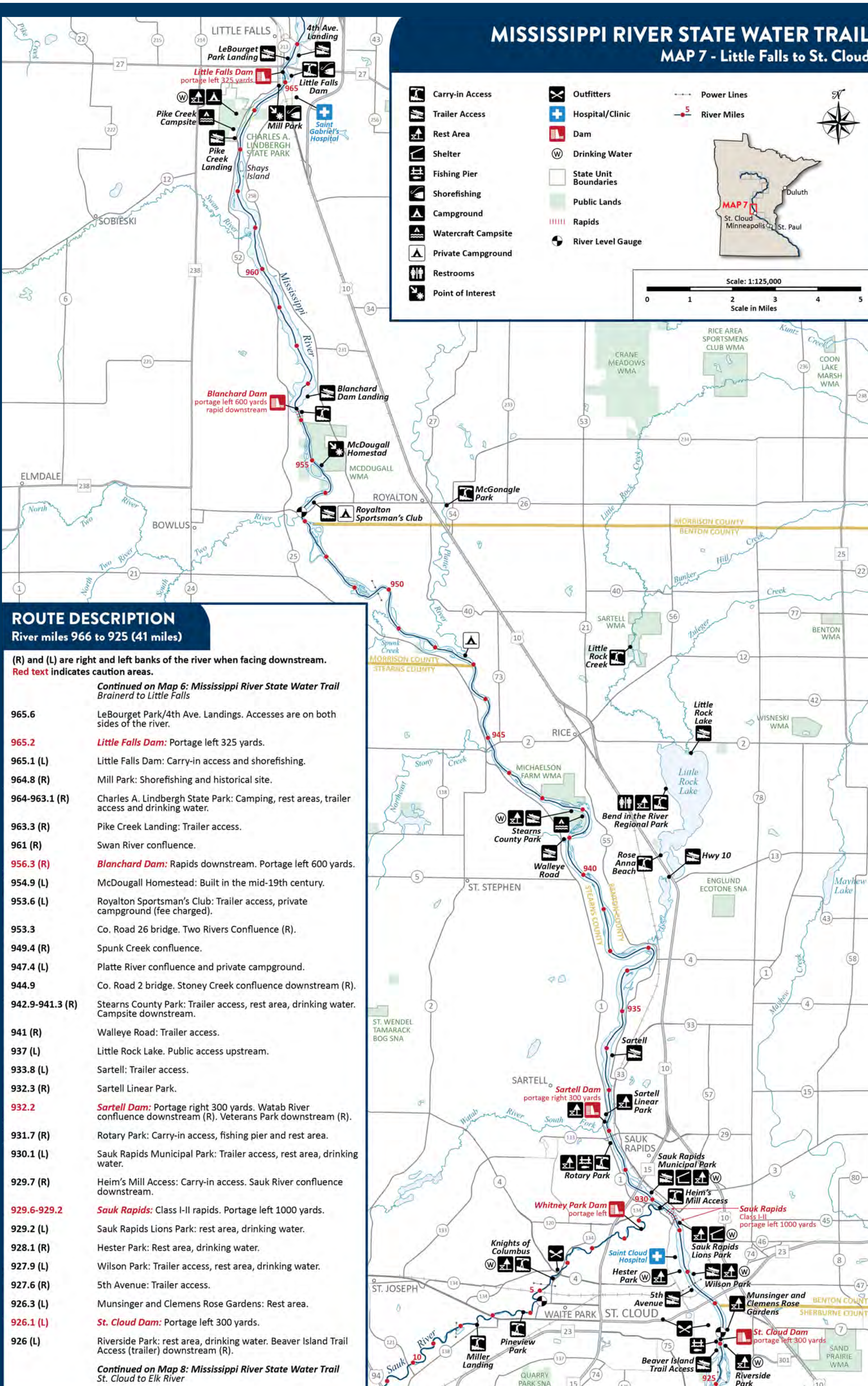
(R) and (L) are right and left banks of the river when facing downstream. Red text indicates caution areas.

Continued on Map 5: Mississippi River State Water Trail Aitkin to Brainerd

1004.7 (L)	Lum Park: Trailer access, rest area, shelter and fishing pier.
1004.1	***Potlatch Dam:*** Portage right 201 yards.
1003.4	Evergreen: Trailer access.
1002	MN Hwy 200 bridge.
1001.2 (L)	Kiwanis Park: Carry-in access, rest area, shelter and fishing pier.
998.2 (L)	Buffalo Creek confluence.
997-979.5 (L)	Crow Wing State Park: Includes numerous water accesses, camping, shelters and drinking water.
997	MN Hwy 371 bridge. Paul Bunyan State Trail.
995.8 (R)	Baxter campsite.
990.6 (R)	Crow Wing River confluence.
990.4 (L)	Crow Wing State Park access, group camp (fee charged).
982.3 (L)	Fort Ripley Landing: Trailer access. Shore fishing downstream of the access.
979.5-979.2	Pipe Island. Numerous smaller islands downstream.
973.6	MN Hwy 115 bridge. South boundary of Camp Ripley.
972.7 (R)	Fletcher Creek: Trailer access and campsite.
972.3-971.7	Otter Point Wildlife Management Area.
970.2 (L)	Belle Prairie County Park: Trailer access, rest area, large picnic shelter and drinking water.
967.8 (R)	Little Elk River confluence.
967.2	U.S. Hwy 10 bridge.
965.6	LeBourget Park/4th Ave. Landings. Accesses are on both sides of the river.
965.2	***Little Falls Dam:*** Portage left 325 yards.
965.1 (L)	Little Falls Dam: Carry-in access and shore fishing.
964.8 (R)	Mill Park: Shorefishing and historical site.
964-963.1 (R)	Charles A. Lindbergh State Park: Includes camping, rest areas, trailer access and drinking water.
963.3 (R)	Pike Creek Landing (trailer access).

Continued on Map 7: Mississippi River State Water Trail Little

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 7 - Little Falls to St. Cloud



ROUTE DESCRIPTION
River miles 966 to 925 (41 miles)

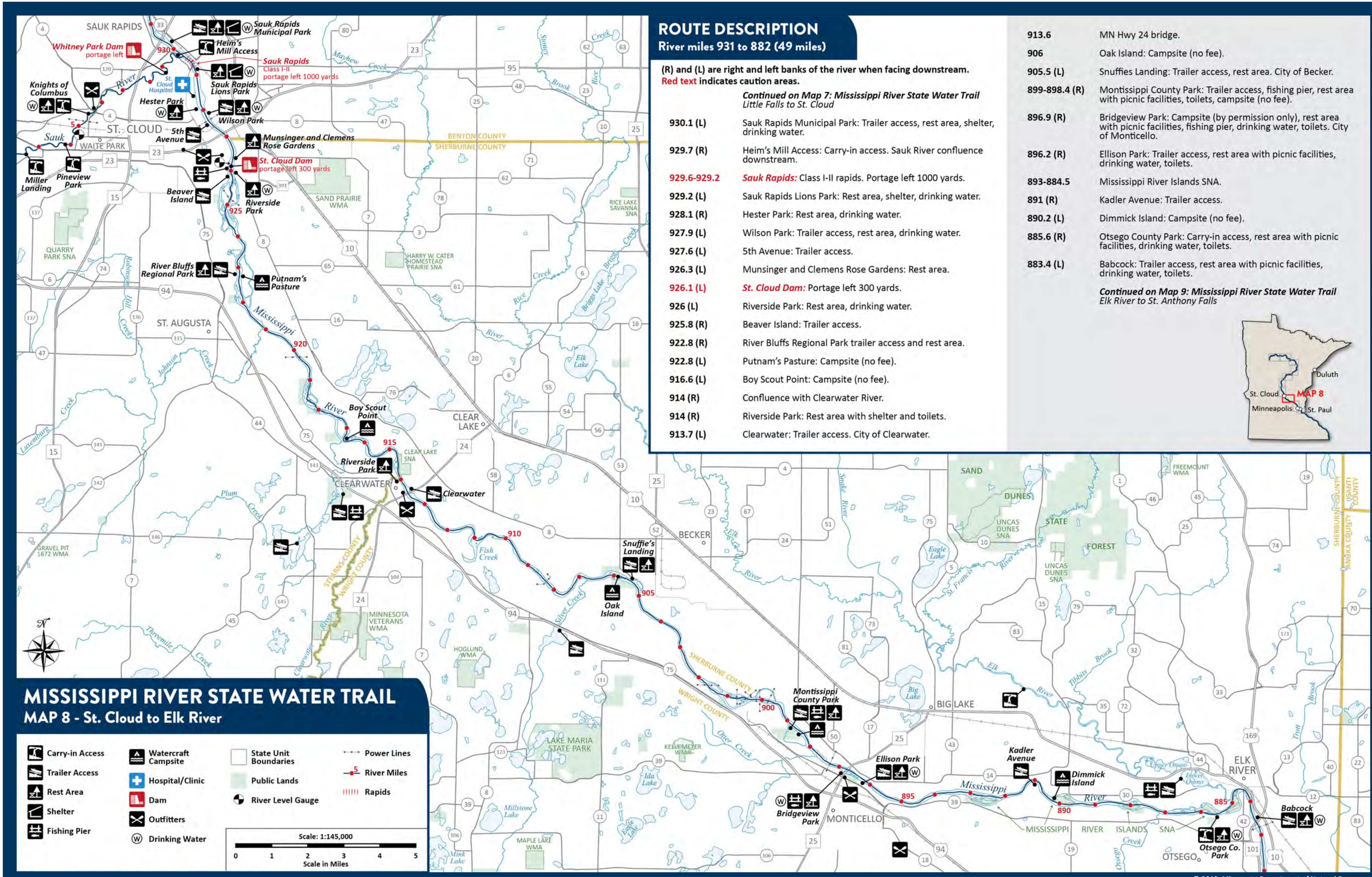
(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

Continued on Map 6: Mississippi River State Water Trail *Brainerd to Little Falls*

965.6	LeBourget Park/4th Ave. Landings. Accesses are on both sides of the river.
965.2	*Little Falls Dam:* Portage left 325 yards.
965.1 (L)	Little Falls Dam: Carry-in access and shorefishing.
964.8 (R)	Mill Park: Shorefishing and historical site.
964-963.1 (R)	Charles A. Lindbergh State Park: Camping, rest areas, trailer access and drinking water.
963.3 (R)	Pike Creek Landing: Trailer access.
961 (R)	Swan River confluence.
956.3 (R)	*Blanchard Dam:* Rapids downstream. Portage left 600 yards.
954.9 (L)	McDougall Homestead: Built in the mid-19th century.
953.6 (L)	Royalton Sportsman's Club: Trailer access, private campground (fee charged).
953.3	Co. Road 26 bridge. Two Rivers Confluence (R).
949.4 (R)	Spunk Creek confluence.
947.4 (L)	Platte River confluence and private campground.
944.9	Co. Road 2 bridge. Stoney Creek confluence downstream (R).
942.9-941.3 (R)	Stearns County Park: Trailer access, rest area, drinking water. Campsite downstream.
941 (R)	Walleye Road: Trailer access.
937 (L)	Little Rock Lake. Public access upstream.
933.8 (L)	Sartell: Trailer access.
932.3 (R)	Sartell Linear Park.
932.2	*Sartell Dam:* Portage right 300 yards. Watab River confluence downstream (R). Veterans Park downstream (R).
931.7 (R)	Rotary Park: Carry-in access, fishing pier and rest area.
930.1 (L)	Sauk Rapids Municipal Park: Trailer access, rest area, drinking water.
929.7 (R)	Heim's Mill Access: Carry-in access. Sauk River confluence downstream.
929.6-929.2	*Sauk Rapids:* Class I-II rapids. Portage left 1000 yards.
929.2 (L)	Sauk Rapids Lions Park: rest area, drinking water.
928.1 (R)	Hester Park: Rest area, drinking water.
927.9 (L)	Wilson Park: Trailer access, rest area, drinking water.
927.6 (R)	5th Avenue: Trailer access.
926.3 (L)	Munsinger and Clemens Rose Gardens: Rest area.
926.1 (L)	*St. Cloud Dam:* Portage left 300 yards.
926 (L)	Riverside Park: rest area, drinking water. Beaver Island Trail Access (trailer) downstream (R).

Continued on Map 8: Mississippi River State Water Trail *St. Cloud to Elk River*

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 8 - St. Cloud to Elk River



ROUTE DESCRIPTION
River miles 931 to 882 (49 miles)

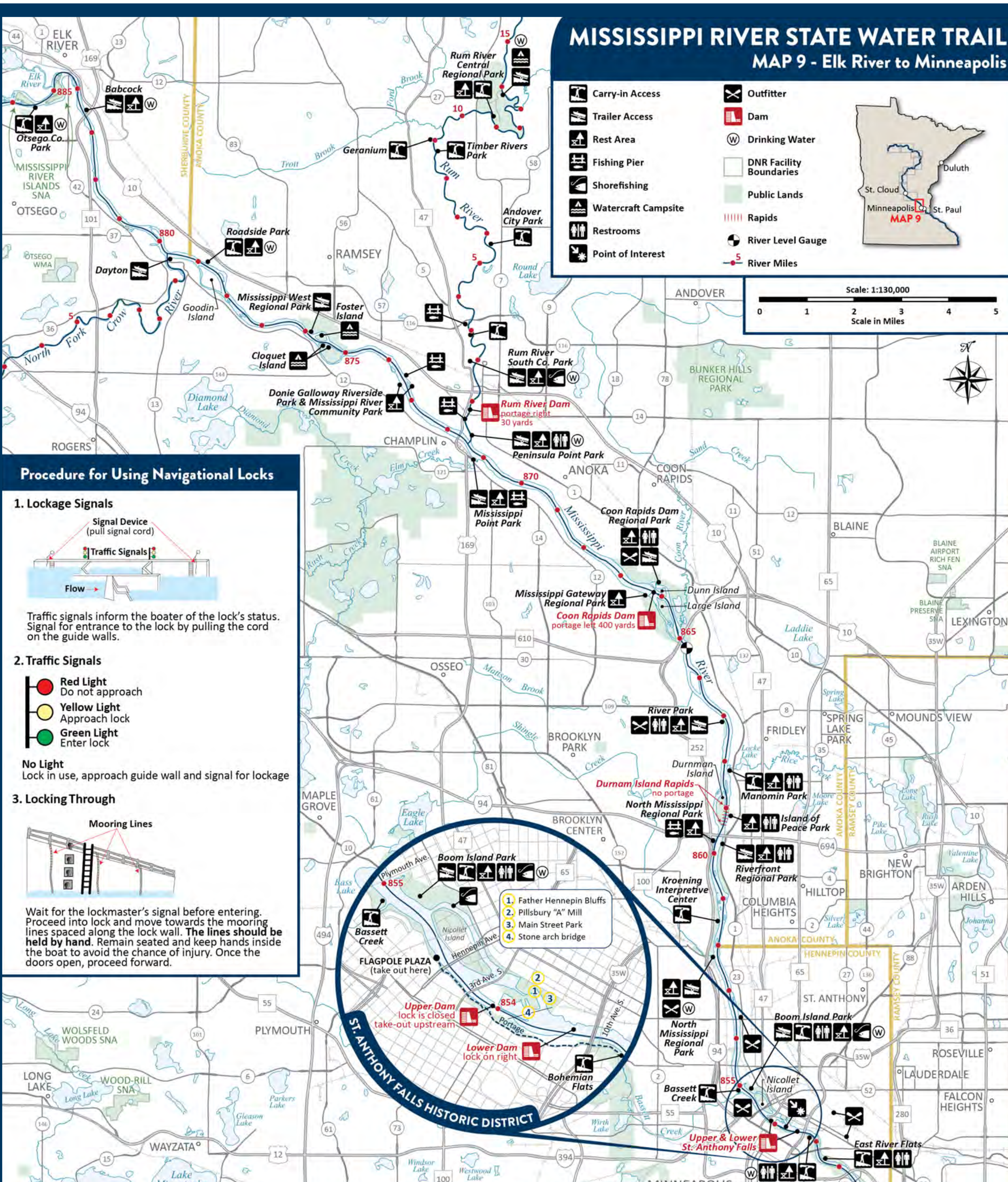
(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

Continued on Map 7: Mississippi River State Water Trail
Little Falls to St. Cloud

930.1 (L)	Sauk Rapids Municipal Park: Trailer access, rest area, shelter, drinking water.
929.7 (R)	Heim's Mill Access: Carry-in access. Sauk River confluence downstream.
929.6-929.2	***Sauk Rapids:*** Class I-II rapids. Portage left 1000 yards.
929.2 (L)	Sauk Rapids Lions Park: Rest area, shelter, drinking water.
928.1 (R)	Hester Park: Rest area, drinking water.
927.9 (L)	Wilson Park: Trailer access, rest area, drinking water.
927.6 (L)	5th Avenue: Trailer access.
926.3 (L)	Munsinger and Clemens Rose Gardens: Rest area.
926.1 (L)	***St. Cloud Dam:*** Portage left 300 yards.
926 (L)	Riverside Park: Rest area, drinking water.
925.8 (R)	Beaver Island: Trailer access.
922.8 (R)	River Bluffs Regional Park trailer access and rest area.
922.8 (L)	Putnam's Pasture: Campsite (no fee).
916.6 (L)	Boy Scout Point: Campsite (no fee).
914 (R)	Confluence with Clearwater River.
914 (R)	Riverside Park: Rest area with shelter and toilets.
913.7 (L)	Clearwater: Trailer access. City of Clearwater.
913.6	MN Hwy 24 bridge.
906	Oak Island: Campsite (no fee).
905.5 (L)	Snuffies Landing: Trailer access, rest area. City of Becker.
899-898.4 (R)	Montissippi County Park: Trailer access, fishing pier, rest area with picnic facilities, toilets, campsite (no fee).
896.9 (R)	Bridgeview Park: Campsite (by permission only), rest area with picnic facilities, fishing pier, drinking water, toilets. City of Monticello.
896.2 (R)	Ellison Park: Trailer access, rest area with picnic facilities, drinking water, toilets.
893-884.5	Mississippi River Islands SNA.
891 (R)	Kadler Avenue: Trailer access.
890.2 (L)	Dimmick Island: Campsite (no fee).
885.6 (R)	Otsego County Park: Carry-in access, rest area with picnic facilities, drinking water, toilets.
883.4 (L)	Babcock: Trailer access, rest area with picnic facilities, drinking water, toilets.

Continued on Map 9: Mississippi River State Water Trail
Elk River to St. Anthony Falls

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 9 - Elk River to Minneapolis



Procedure for Using Navigational Locks

1. Lockage Signals

Signal Device (pull signal cord)
Traffic Signals
Flow

Traffic signals inform the boater of the lock's status. Signal for entrance to the lock by pulling the cord on the guide walls.

2. Traffic Signals

Red Light Do not approach

Yellow Light Approach lock

Green Light Enter lock

No Light Lock in use, approach guide wall and signal for lockage

3. Locking Through

Mooring Lines

Wait for the lockmaster's signal before entering. Proceed into lock and move towards the mooring lines spaced along the lock wall. **The lines should be held by hand**. Remain seated and keep hands inside the boat to avoid the chance of injury. Once the doors open, proceed forward.

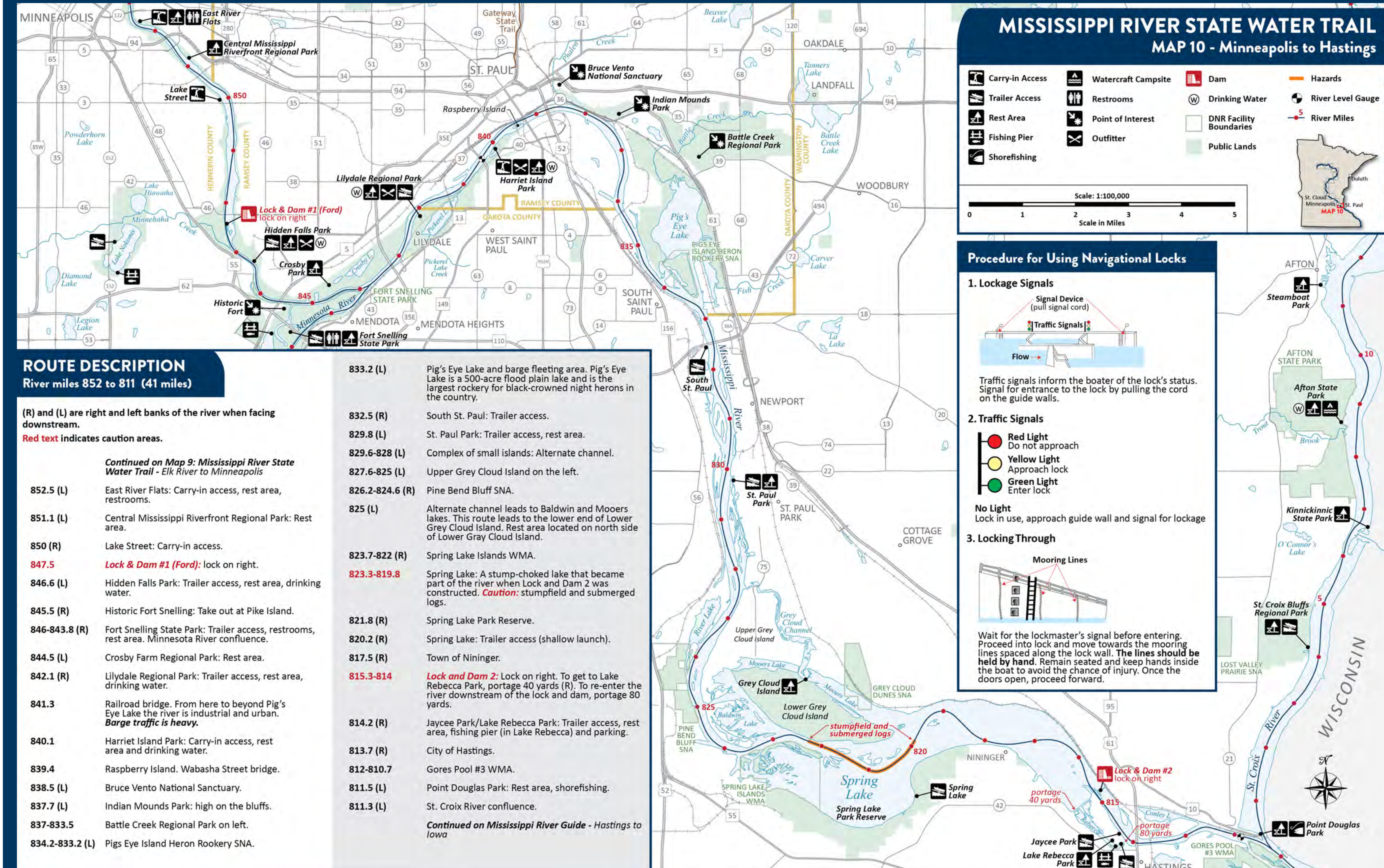
ROUTE DESCRIPTION
River miles 886 to 851 (35 miles)

(R) and (L) are right and left banks of the river when facing downstream.

Red text indicates caution areas.

	***Continued on Map 8: Mississippi River State Water Trail** - St. Cloud to Elk River*
893-887.8	Mississippi River Islands SNA.
885.5 (R)	Otsego Co. Park: Carry-in access, rest area with picnic facilities, drinking water, toilets.
883.5 (L)	Babcock: Trailer access, rest area with picnic facilities, drinking water, toilets.
879.6 (R)	Dayton: Trailer access. North Fork Crow River confluence.
878.9 (L)	Roadside Park: Carry-in access, rest area, drinking water.
875.9 (L)	Mississippi W. Regional Park: Trailer access.
875.8-875	Foster Island/Cloquet Island: 3 campsites accessible by river only (no fee).
873.4 (R)	Donie Galloway Riverside Park: Rest area.
873.3 (L)	Mississippi River Community Park: Rest area.
871.4 (L)	Rum River Confluence.
871.4 (L)	Peninsula Point Park: Trailer access, rest area with picnic shelter, restrooms, drinking water.
871.1 (R)	Mississippi Point Park: Trailer access, rest area, fishing pier.
866.4 (L)	Coon Rapids Dam Regional Park: Trailer access, rest area, restrooms.
866.2 (R)	Mississippi Gateway Regional Park: Rest area.
866.2	***Coon Rapids Dam:*** portage left 400 yards.
862.9 (R)	River Park: Trailer access, rest area, restrooms.
861.9 (L)	Manomin Park: Carry-in access, rest area with picnic facilities, restrooms. Rice Creek confluence.
861.5-860.7	Islands of Peace Park: Rest area with picnic facilities, restrooms.
861-860.5	***Durnam Island Rapids:*** Class I Rapids. Rest area (R).
860.3 (L)	Riverfront Regional Park: Trailer access, rest area, restrooms.
858.5 (R)	Kroening Interpretive Center: Carry-in access.
860.4-857.6 (R)	North Mississippi Regional Park: Trailer access, rest area, drinking water.
857.8 (R)	Shingle Creek confluence.
855-853.5	St. Anthony Falls Historic District (see inset).
854.9 (L)	Boom Island Park: Water access, rest area with picnic facilities, shorefishing, drinking water, restrooms.
854.8 (R)	Bassett Creek: Carry-in access. Bassett Creek confluence.
854.6-854.1	Nicollet Island. Main channel runs right. ***Caution:*** The left channel takes you within 50 feet of the upper falls. **STAY AWAY!**
854.4-853.1 (R)	Portage around lock and dam closures, 1.5 miles. Take out at Flagpole Plaza, and put in at Bohemian Flats (see inset).
854	Upper St. Anthony Falls lock and dam: ***Permanently Closed***. Exit the river upstream of the lock.
853.7	Stone Arch Bridge: Second oldest railroad bridge on the Mississippi River.
853.5	Lower St. Anthony Falls Dam: Lock is on right.
853.1 (R)	Bohemian Flats: Carry-in access, rest area, drinking water, restrooms.
852.5 (L)	East River Flats: Carry-in access, rest area, restrooms.
	***Continued on Map 10: Mississippi River State Water Trail** - Minneapolis to Hastings*

MISSISSIPPI RIVER STATE WATER TRAIL
MAP 10 - Minneapolis to Hastings



Carry-in Access	Watercraft Campsite	Dam	Hazards
Trailer Access	Restrooms	Drinking Water	River Level Gauge
Rest Area	Point of Interest	DNR Facility Boundaries	River Miles
Fishing Pier	Outfitter	Public Lands	
Shorefishing			

Scale: 1:100,000
0 1 2 3 4 5
Scale in Miles

St. Cloud, Minneapolis, St. Paul, Duluth, MAP 10

ROUTE DESCRIPTION
River miles 852 to 811 (41 miles)

(R) and (L) are right and left banks of the river when facing downstream.
Red text indicates caution areas.

***Continued on Map 9: Mississippi River State Water Trail** - Elk River to Minneapolis*

852.5 (L)	East River Flats: Carry-in access, rest area, restrooms.
851.1 (L)	Central Mississippi Riverfront Regional Park: Rest area.
850 (R)	Lake Street: Carry-in access.
847.5	***Lock & Dam #1 (Ford):*** lock on right.
846.6 (L)	Hidden Falls Park: Trailer access, rest area, drinking water.
845.5 (R)	Historic Fort Snelling: Take out at Pike Island.
846-843.8 (R)	Fort Snelling State Park: Trailer access, restrooms, rest area. Minnesota River confluence.
844.5 (L)	Crosby Farm Regional Park: Rest area.
842.1 (R)	Lilydale Regional Park: Trailer access, rest area, drinking water.
841.3	Railroad bridge. From here to beyond Pig's Eye Lake the river is industrial and urban. ***Barge traffic is heavy.***
840.1	Harriet Island Park: Carry-in access, rest area and drinking water.
839.4	Raspberry Island. Wabasha Street bridge.
838.5 (L)	Bruce Vento National Sanctuary.
837.7 (L)	Indian Mounds Park: high on the bluffs.
837-833.5	Battle Creek Regional Park on left.
834.2-833.2 (L)	Pigs Eye Island Heron Rookery SNA.
833.2 (L)	Pig's Eye Lake and barge fleeting area. Pig's Eye Lake is a 500-acre flood plain lake and is the largest rockery for black-crowned night herons in the country.
832.5 (R)	South St. Paul: Trailer access.
829.8 (L)	St. Paul Park: Trailer access, rest area.
829.6-828 (L)	Complex of small islands: Alternate channel.
827.6-825 (L)	Upper Grey Cloud Island on the left.
826.2-824.6 (R)	Pine Bend Bluff SNA.
825 (L)	Alternate channel leads to Baldwin and Mooers lakes. This route leads to the lower end of Lower Grey Cloud Island. Rest area located on north side of Lower Gray Cloud Island.
823.7-822 (R)	Spring Lake Islands WMA.
823.3-819.8	Spring Lake: A stump-choked lake that became part of the river when Lock and Dam 2 was constructed. ***Caution:*** stumpfield and submerged logs.
821.8 (R)	Spring Lake Park Reserve.
820.2 (R)	Spring Lake: Trailer access (shallow launch).
817.5 (R)	Town of Nininger.
815.3-814	***Lock and Dam 2:*** Lock on right. To get to Lake Rebecca Park, portage 40 yards (R). To re-enter the river downstream of the lock and dam, portage 80 yards.
814.2 (R)	Jaycee Park/Lake Rebecca Park: Trailer access, rest area, fishing pier (in Lake Rebecca) and parking.
813.7 (R)	City of Hastings.
812-810.7	Gores Pool #3 WMA.
811.5 (L)	Point Douglas Park: Rest area, shorefishing.
811.3 (L)	St. Croix River confluence.

***Continued on Mississippi River Guide** - Hastings to Iowa*

Procedure for Using Navigational Locks

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(pull signal cord)
Traffic Signals
Flow

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Yellow Light
Approach lock

Green Light
Enter lock

No Light
Lock in use, approach guide wall and signal for lockage

3. Locking Through

Mooring Lines

Wait for the lockmaster's signal before entering. Proceed into lock and move towards the mooring lines spaced along the lock wall. **The lines should be held by hand.** Remain seated and keep hands inside the boat to avoid the chance of injury. Once the doors open, proceed forward.

Brainerd
Public Utilities
8027 Highland Scenic Road
Post Office Box 373
Brainerd, MN 56401-0373
(218) 829-8726 • www bpu.org

March 21, 2016

Federal Energy Regulatory Commission
Office of the Secretary
888 Frist Street NE, RM1A
Washington DC 20426

Attn: Kimberly D. Bose
Secretary

Subject: AMJET Turbine Application - Brainerd Public Utilities
FERC Non-Capacity License Amendment Application: Supplemental Information: Minnesota Pollution Control Agency 401 Certification
Docket Number – P-2533-006
Accession No.: 200150805-534

Dear Ms. Bose:

In regards to the above referenced application to the Federal Regulatory Commission (FERC), Brainerd Public Utilities (BPU) contacted the Minnesota Pollution Control Agency (MPCA) and requested a 401 Certification for the proposed project. The response letter from MPCA (Attachment 1), the original project 401 Certification (Attachment 2), and the recently received US Army Corps. of Engineers 404 Section 10 Certification (Attachment 3) are included as supplemental information to the FERC Application.

MPCA has concluded that the original 401 Certification remains in effect and the BPU does not need a new 401 Certification for the proposed project. Therefore, we request that FERC consider the attached supplemental information and resume review of the application.

If you have any questions, please contact me at (218) 825-3213 or SMagnuson@bpu.org. Thank you for your continued support and assistance regarding this Project.

Sincerely,
Brainerd Public Utilities

Scott Magnuson
Superintendent

Enclosure: Attachment 1 Response from Minnesota Pollution Control Agency Regarding 401 Certification Request
Attachment 2 Copy of Existing 401 Certification October 20, 1992
Attachment 3 Copy of 404 Section 10 US Army Corp of Engineers

cc: Paul Roos, AMJET Turbine Systems LLC
Norman Bishop, Knight Piésold and Co.

Attachment 1

Response from Minnesota Pollution Control Agency Regarding 401 Certification Request

Minnesota Pollution Control Agency

520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300
800-657-3864 | Use your preferred relay service | info.pca@state.mn.us | Equal Opportunity Employer

March 18, 2016

Mr. Scott Magnuson
Superintendent, Brainerd Public Utilities
8027 Highland Scenic Road
PO Box 373
Brainerd, MN 56401-0373

RE: Brainerd Public Utilities AMJET Turbine Application, FERC Non-Capacity License Amendment, Docket Number P-2533-006

Dear Mr. Magnuson:
This letter is submitted by the Minnesota Pollution Control Agency (MPCA) under authority of Section 401 of the Clean Water Act (CWA) (33 USC 1251 et seq.), Minn. Stat. chs. 115 and 116, and Minn. R. 7001.1400-7001.1470, 7050, 7052, and 7053.

On March 10, 2016, Brainerd Public Utilities (BPU) requested a Section 401 Certification from the MPCA for a Non-Capacity License Amendment to existing FERC License #2533-006. The MPCA has reviewed the information provided, including the existing FERC license and the application materials for the Non-Capacity License Amendment.

The Brainerd Hydroelectric project was originally proposed by and licensed to Potlatch Corporation; BPU acquired the license on March 13, 2014, and agreed to accept all of the terms and conditions of the license and be bound by the license as if it were the original licensee. The MPCA views the original Section 401 Certification as part of the terms and conditions of the original license.

On June 26, 1989, in a letter from Timothy K. Scherkenbach, Director of the Division of Water Quality, the MPCA indicated that the Brainerd Hydroelectric project would be considered certified provided that a formal operating plan was submitted to address the water quality concerns during emergency, repair, or other unusual flow conditions. That operating plan was submitted in February 1991, with interagency discussions in April 1991, and a final Plan of Operation was submitted on October 24, 1991. On October 20, 1992, the MPCA, in a letter from Duane L. Anderson, Manager, Assessment and Planning Section in the Water Quality Division, notified then-owner Potlatch Corporation that the Plan of Operation was approved and the project was certified.

Based on the information you provided on March 10, 2016, stating that there will be no significant structural changes for the installation of the new turbine unit, no change to the dam or reservoir, and no changes to the existing operations of the project, the MPCA believes that the original Section 401 Certification for this project remains in effect and BPU does not need a new Section 401 Certification.

A Section 401 certification does not release the applicant from obtaining all necessary federal, state and local permits, nor does it limit more restrictive requirements set through any such program. It does not eliminate, waive or vary the applicant's obligation to comply with all state water statutes and rules through the construction, installation and operation of the project, including, but not limited to, the National Pollution Discharge Elimination System, State Disposal System permitting program, and Minn. R. 7050.

This MPCA's decision is made, in part, on the applicant's representations that environmental review under the Minnesota Environmental Quality Board's Rules, Minn. R. ch. 4410, is not needed for the project or, alternatively, that all necessary environmental reviews and related decisions have been completed. If environmental review for this project is needed and has not been completed, this MPCA Certification decision is null and void and of no legal effect. In that situation, MPCA reserves the right to make a Section 401 decision when the environmental review process is completed.

This letter does not release the applicant from any liability, penalty or duty imposed by Minnesota or federal statutes, regulations, rules or local ordinances and it does not convey a property right or an exclusive privilege. If you have any questions or require additional information regarding this certification, please contact me at 651-757-2607.

Sincerely,

Catherine Neuschler
Supervisor, Agency Rules Unit
Environment and Energy Section
Resource Management and Assistance Division

CN:je

cc: Catherine Schumacher, Knight Piesold

Attachment 2

Copy of Existing 401 Certification October 20, 1992

RVH

NOV 18 1992

Silver Celebration 25/20

Minnesota Pollution Control Agency

Celebrating our 25th anniversary and the 20th anniversary of the Clean Water Act

CRP

OCT 23 1992

RECEIVED
JAN 11 1993
T. G. PALKIE

October 20, 1992

cc TGP

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Charles R. Pottenger
Vice President and General Manager
Potlatch Corporation - Northwest Paper Division
207 Avenue C
Post Office Box 510
Cloquet, Minnesota 55720

Dear Mr. Pottenger:

RE: Potlatch Corporation
Brainerd Hydroelectric Project
Mississippi River
FERC Project # 2533

This letter is in response to Mead & Hunt's letter of October 24, 1991, requesting Section 401 water quality certification for the project referenced above. In a letter dated June 5, 1989, Mead & Hunt requested the Clean Water Act Section 401 water quality certification for the same project and the Minnesota Pollution Control Agency (MPCA) responded on June 26, 1989.

At that time, the MPCA certified the Brainerd Hydroelectric Project with the condition that a formal operating plan, addressing water quality concerns during emergencies, repair, and other unusual flow conditions, would be developed and submitted to the Minnesota Department of Natural Resources (MDNR). This certification applied only to the hydroelectric facility discharge and did not affect other permits required for the Potlatch Corporation at its Brainerd facility.

A Plan of Operation was developed for the Brainerd plant and was submitted to the MPCA in February 1991. This plan was reviewed and the MPCA determined that the conditions set forth in the Section 401 certification were met. Therefore, the 401 water quality certification stands as issued by the MPCA.

If you have any questions on this, please call Judy Bostrom either through the MPCA's toll-free telephone number (1-800-657-3864) or directly at 1-612-296-7315.

Sincerely,

for

Duane L. Anderson, Manager
Assessment and Planning Section
Water Quality Division

DLA:ls

cc: Mr. Milo Anderson, U.S. Environmental Protection Agency, Chicago
Ms. Lois Cashell, Federal Energy Regulatory Commission
Mr. Turre Sandstrom, Potlatch Corporation, Cloquet

Attachment 3

Copy of 404 Section 10 US Army Corp of Engineers

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 FIFTH STREET EAST, SUITE 700
ST. PAUL MN 55101-1678

MAR 7 2016

REPLY TO
ATTENTION OF

Operations
Regulatory (2013-00480-RQM)

Mr. Scott Magnuson
Brainerd Public Utilities
8027 Highland Scenic Road
Baxter, Minnesota 56425

Dear Mr. Magnuson:

We have reviewed information about your permit application to install a 516 sq. ft. test generator in the Mississippi River at the Wausau Paper Mills Dam as depicted in the attached drawing labeled 2013-00480-RQM one of one. The project site is in Sec. 18, T. 45 N., R. 30 E., Crow Wing County, Minnesota.

Department of the Army Regional General Permit-003-MN (RGP-003-MN) provides authorization under section 404 of the Clean Water Act for certain categories of activities involving the discharge of dredged or fill material into waters of the U.S. or activities conducted in/over/under waters covered by Section 10 of the Rivers and Harbors Act. We have determined that the described work is authorized by RGP-003-MN category O, provided the attached Standard Conditions are followed.

This determination covers only the project as described above. If the design, location, or purpose of the project is changed, our office should be contacted to make sure the work would not result in a violation of Federal law.

If your project will require off-site fill material that is **not** obtained from a licensed commercial facility, you must notify us at least five working days before start of work. A cultural resources survey may be required if a licensed commercial facility is not used.

This General Permit is valid until January 31, 2017, unless modified, reissued, or revoked. The time limit for completing the work described above ends on that day. It is the permittee's responsibility to remain informed of changes to the General Permit program. If this authorized work is not undertaken within the above time period, or the project specifications have changed, our office must be contacted to determine the need for further approval or re-verification.

It is the permittee's responsibility to ensure that the work complies with the terms of this letter and any enclosures, AND THAT ALL REQUIRED STATE AND LOCAL PERMITS AND APPROVALS ARE OBTAINED BEFORE WORK PROCEEDS.

A preliminary jurisdictional determination (JD) has been prepared for the site of your project. The preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps representative identified in the final paragraph of this letter. You also may provide new information for further consideration by the Corps to reevaluate the JD. If this JD is acceptable, please sign and date both copies of the Preliminary Jurisdictional Determination Form and return one copy to the address below within 15 days from the date of this letter.

U.S. Army Corps of Engineers
St. Paul District
180 5th Street East, Suite 700
St. Paul, Minnesota 55101-1678
Attn: project manager

If you have any questions, contact **Rob Maroney** in our Brainerd field office at (651) 290-5766. In any correspondence or inquiries, please refer to the Regulatory number shown above.

Sincerely,

for

Stacey M. Jensen
Acting Chief, Regulatory Branch

Enclosure:
2013-00480-RQM one of one

2013-00480-RQM one of one

This map does not represent a survey | Base Map Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

U.S. Army Corps of Engineers
St. Paul District

Terms and Conditions of Regional General Permit-003-MN Activity O: Residential, Commercial, Agricultural and Institutional Developments

The following description of residential, commercial, agricultural and institutional development activities authorized under Regional General Permit-003-Minnesota (RGP-003-MN) is excerpted from RGP-003-MN. Read RGP-003-MN in its entirety at http://www.mvp.usace.army.mil/regulatory/. All projects authorized under RGP-003-MN must also follow the Standard Conditions of RGP-003-MN and any terms specified in the RGP-003-MN verification letter.

O. Residential, Commercial, Agricultural and Institutional Developments. Discharges of dredged or fill material in waters of the U.S. or work in Section 10 waters for a single and complete project for the construction or expansion of residential, commercial, agricultural, or institutional operations or developments that do not result in impacts to more than ½ acre of waters of the U.S. or 500 linear feet of a stream. Activities authorized include building foundations, building pads, and attendant features. Attendant features include, but are not limited to: roads, parking lots, garages, utility lines, geothermal systems, yards, storm water management facilities, culvert installation, and recreational facilities that are integral to the development.

For any development or subdivision, the aggregate total loss of waters of the U.S. authorized under this category cannot exceed ½ acre. This RGP category does not authorize maintenance dredging for the primary purpose of navigation. The disposal of excavated or dredged material into a water of the U.S. obtained from a maintenance dredging operation is not authorized under this RGP category. No new stream channelization or stream relocation work is authorized under this RGP category. **(Section 10 RHA / Section 404 CWA)**

Notification Requirements: The project proponent must notify the District Engineer by submitting a PCN and receive written confirmation that the project is authorized by the RGP-003-MN.

STANDARD CONDITIONS

All RGP-003-MN authorizations are subject to the following standard conditions, as applicable, in addition to any case-specific conditions imposed by the District Engineer. These conditions and any special conditions must be satisfied for any RGP authorization to be valid:

1. Mitigation/Sequencing. Discharges of dredged or fill material into waters of the U.S. **must be minimized or avoided to the maximum extent practicable.**

When determining the least environmentally damaging practicable on-site alternative, impacts to all resources including jurisdictional waters, non-jurisdictional waters, and high quality uplands should be considered.

Mitigation in all its forms (avoiding, minimizing, or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal. Compensatory mitigation requirements are determined on a case by case basis and may be required to reduce adverse effects of a project, either temporary or permanent, to the minimal level.

The District Engineer will determine appropriate compensatory mitigation requirements in accordance with Federal guidelines and established District policy.

Generally, compensatory wetland mitigation shall be required for projects that impact more than:

400 square feet in a shoreland wetland protection zone,

2,000 square feet in a "less-than-50 percent" county,

5,000 square feet in a "50%-to-80%" county, and

10,000 square feet in a "greater than 80%" county.

as shown on the attached map labeled enclosure 5:

When the above project thresholds are exceeded, the compensatory mitigation requirement applies to the project's total wetland impacts, including the threshold amounts specified above. Use of Corps-approved mitigation banks and in-lieu fee procedures are generally acceptable methods of providing compensatory mitigation for small projects having compensatory mitigation requirements of 1/4 acre or less.

Compensatory mitigation shall be designed to replace the functions lost as result of the project. Where certain functions and services of waters of the U.S. are permanently adversely affected as a result of the authorized discharge, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility right of way, or are temporarily affected, such as the temporary conversion of forested or scrub-shrub wetlands in a linear project corridor, compensatory mitigation may be required to reduce the adverse effects of the project to the minimal level.

For activities where compensatory mitigation is required, project proponents should include a mitigation plan prepared in accordance with 33 CFR Part 332, and *the St. Paul District Policy for Wetland Compensatory Mitigation in Minnesota* (http://www.mvp.usace.army.mil/regulatory/default.asp?pageid=924&subpageid=387). The plan prepared should describe the measures proposed to ensure that the activity complies with the Section 404(b)(1) guidelines (40 CFR Part 230). In cases where a Corps-approved bank is proposed to be used, a statement of intent to use the bank is generally sufficient. Compensatory mitigation required by other Federal or state programs may, but will not necessarily, satisfy this Clean Water Act requirement.

2. Navigation. (a) No activity may cause more than a minimal adverse effect on navigation. (b) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the U.S. No claim shall be made against the U.S. on account of any such removal or alteration.

3. Suitable fill material. No activity may use unsuitable material (e.g., trash, debris, car bodies, unprocessed asphalt, etc.). All fill (including riprap) authorized under this RGP, must be free from toxic pollutants in toxic amounts.

4. Proper maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety.

5. Erosion and siltation controls. Appropriate erosion and siltation controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark, must be permanently stabilized at the earliest practicable date. Work should be done in accordance with state-approved, published practices, such as defined in Minnesota Pollution Control Agency document, PROTECTING WATER QUALITY IN URBAN AREAS - BEST MANAGEMENT PRACTICES FOR MINNESOTA.

Upon completion of earthwork operations, all exposed slopes, fills, and disturbed areas must be given sufficient protection by appropriate means such as landscaping, or planting and maintaining vegetative cover, to prevent subsequent erosion. Cofferdams shall be constructed and maintained so as to prevent erosion into the water. If earthen material is used for cofferdam construction, sheet piling, riprap or a synthetic cover must be used to prevent dam erosion.

6. Removal of temporary fills. Temporary fills are allowed to remain in place for up to three months. Upon request the District Engineer may extend this period, allowing temporary fills to remain in place for up to a total of 180 days, where appropriate.

At the end of the specified timeframe, temporary fills must be removed in their entirety and the affected areas returned to their preconstruction contours and elevation. The areas affected by temporary fills must be re-vegetated with native, non-invasive plant species, as appropriate.

7. Obstruction of high flows. To the maximum extent practicable, discharges must not permanently restrict or impede the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters).

8. **Historic Properties, Cultural Resources**. (a) No activity which may affect historic properties listed, or potentially eligible for listing, on the National Register of Historic Places is authorized, until the District Engineer has complied with the requirements of Section 106 of the National Historic Preservation Act (NHPA). Federal project proponents should follow their own procedures for complying with the requirements of Section 106, and provide documentation of compliance with those requirements. Information on the location and existence of historic resources can be obtained from the State Historic Preservation Office and the National Register of Historic Places. (b) If cultural resources, such as historic structures or buildings, or archaeological remains are identified in the project area, or are discovered during activities authorized by this permit, you must immediately stop work and notify the District Engineer of what you have found. We will initiate the Federal and state coordination required to satisfy our responsibilities under Section 106 of the NHPA. (c) Rock or fill material used for activities authorized by this permit must either be obtained from existing quarries or, if a new borrow site is opened up to obtain fill material, the Corps must be notified prior to the use of the new site to determine whether a cultural resources survey of the site is necessary.

9. Adverse effects from impoundments. If the activity creates an impoundment of water, adverse effects on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow shall be minimized to the maximum extent practicable.

10. Migratory Bird breeding areas. Activities in waters of the U.S. that serve as breeding areas for migratory birds, including waterfowl, must be avoided to the maximum extent practicable.

11. Aquatic life movements. No activity may substantially disrupt the movement of those species of aquatic life indigenous to the water body, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water.

12. Spawning areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

13. Equipment. Heavy equipment working in wetlands must be placed on mats, or other measures must be taken to minimize soil disturbance. Equipment should be clean and free of greases, oils, fuels, and sediments prior to working within aquatic habitats.

14. Tribal rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

15. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river has determined that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service.)

16. Water quality standards. All work or discharges to a watercourse resulting from permitted construction activities, particularly hydraulic dredging, must meet applicable Federal, State, and local water quality and effluent standards on a continuing basis.

17. Preventive measures. Measures must be adopted to prevent potential pollutants from entering the watercourse. Construction materials and debris, including fuels, oil, and other liquid substances, shall not be stored in the construction area in a manner that would allow them to enter the watercourse as a result of spillage, natural runoff, or flooding. To the extent practicable and appropriate measures should be taken to control and minimize the spread of invasive species via equipment transfer.

18. Spill contingency plan. A contingency plan must be formulated that would be effective in the event of a spill. This requirement is particularly applicable in operations involving the handling of petroleum products. If a spill of any potential pollutant should occur, it is the responsibility of the permittee to remove such material, to minimize any contamination resulting from this spill, and to immediately notify the State Duty Officer at 1-800-422-0798 and the U.S. Coast Guard at 1-800-424-8802.

19. **Disposal sites.** If dredged or excavated material is placed on an upland disposal site (above the ordinary high-water mark), the site must be securely diked or contained by some other acceptable method that prevents the return of potentially polluting materials to the watercourse by surface runoff or by leaching. The containment area, whether bulkhead or upland disposal site, must be fully completed prior to the placement of any dredged material.

20. Water intakes/activities. No activity may occur in the proximity of a public water supply intake, except where the activity is for repair or improvement of the public water supply intake structures or adjacent bank stabilization.

21. Endangered Species. (a) No activity is authorized which is likely to adversely affect a threatened or endangered species as identified under the Federal Endangered Species Act (ESA), or which is likely adversely affect critical habitat of such species. (b) No activity is authorized which may affect a listed species or critical habitat unless consultation under the ESA addressing the effects of the proposed activity has been completed. Non-federal permittees shall notify the District Engineer if any listed species or critical habitat might be affected or is in the vicinity of the project, and shall not begin work on the activity until notified by the District Engineer that the requirements of the ESA have been satisfied and that the activity is authorized. Federal project proponents should follow their own procedures for complying with the requirements of the ESA and provide documentation of compliance with those requirements. (c) No activity is authorized which is likely to jeopardize a proposed species or which is likely to adversely modify proposed critical habitat. (d) Authorization of an activity under RGP-003-MN does not authorize the take of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with incidental take provisions, etc.) from the U.S. Fish and Wildlife Service (USFWS), both lethal and non-lethal takes of protected species are in violation of the ESA. General information on the location of threatened and endangered species and their critical habitat is provided in Attachment A and Enclosures 3-7. Information can also be obtained directly from the offices of the USFWS Twin Cities Field office (TCFO) at 612-725-3548. (e) If it becomes apparent that a federally listed endangered plant or animal species will be affected by work authorized by this permit, work must be stopped immediately and the St. Paul District Corps of Engineers must be contacted for further instruction.

22. Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. Notification to the Corps is required for projects within 0.5 miles (2640 feet) of an eagle nest. There are approximately 1300 bald eagle nests distributed among 64 of Minnesota's 87 counties. In Minnesota, bald eagles typically nest in old, large diameter trees within approximately 500 feet of a water body.

It is recommended that the project proponent also contact the USFWS TCFO (612-725-3548) if the proposed project will disturb a bald eagle or a bald eagle nest. Projects involving the placement of potentially lethal infrastructure (communication towers, wind turbines, transmission lines, etc) within two miles of a bald eagle nest may warrant additional review.

For more information concerning the Bald and Golden Eagle Protection Act or the Migratory Bird Treaty Act refer to the following websites:

http://www.fws.gov/migratorybirds/mbpermits.html http://www.fws.gov/midwest/eagle/protect/index.html

http://www.fws.gov/midwest/eagle/guidelines/disturbnestingbaea1.html

23. Expiration Date. Unless otherwise specified in the District's letter confirming your project complies with the requirements of this RGP, the time limit for completing work authorized by RGP-003-MN ends upon the expiration date of this RGP-003-MN. Activities authorized under the RGP-003-MN that have commenced construction or are under contract to commence construction, will remain authorized provided the activity is completed within 12 months of the date of the RGP-003-MN expiration, suspension, or revocation; whichever is sooner. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least three months before the expiration date is reached.

24. Maintenance and Transfer. You must maintain the authorized activity in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

25. Inspection. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of RGP-003-MN.

26. State Section 401 Water Quality Certification. The State of Minnesota Pollution Control Agency has issued a 401 certification for the RGP-003-MN. Permittees must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached.

27. Coastal Zone Management consistency determination. The State of Minnesota has determined that the RGP-003-MN is consistent with the CZM program.

Further Information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to Section 404 of the Clean Water Act (33 U.S.C. 1344) and/or Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).

2. Limits of this authorization.

a. RGP-003-MN does not obviate the need to obtain the other Federal, state, or local authorizations required by law.

b. RGP-003-MN does not grant any property rights or exclusive privileges.

c. RGP-003-MN does not authorize any injury to the property or rights of others.

d. RGP-003-MN does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In authorizing work, the Federal Government does not assume any liability, including but not limited to the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or un-permitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or un-permitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Project Proponent's Data: The determination by this office that an activity is not contrary to the public interest will be made in reliance on the information provided by the project proponent.

5. Reevaluation of Decision. This office may reevaluate its decision on an authorization at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. The permittee fails to comply with the terms and conditions of this permit.

b. The information provided by the permittee in support of the preconstruction notification proves to have been false, incomplete, or inaccurate (see 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that is appropriate to use the suspension, modification, or revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring the permittee to comply with the terms and conditions of the permit and for the initiation of legal action where appropriate.

6. This Office may also reevaluate its decision to issue RGP-003-MN at any time the circumstances warrant.

Circumstances that could require a reevaluation include, but are not limited to, the following: significant new information surfaces which this office did not consider in reaching the original public interest decision. Such a reevaluation may result in a determination that is appropriate to use the suspension, modification, or revocation procedures contained in 33 CFR 325.7.

Document Content(s)

Barr Footer: ArcGIS 10.7.1, 2020-10-09 10:56 File: I:\Projects\23\18\1016\Maps\Reports\Draft_Application_August2020\Exhibit_E\Figure01 Project Location Map.mxd User: MRQ

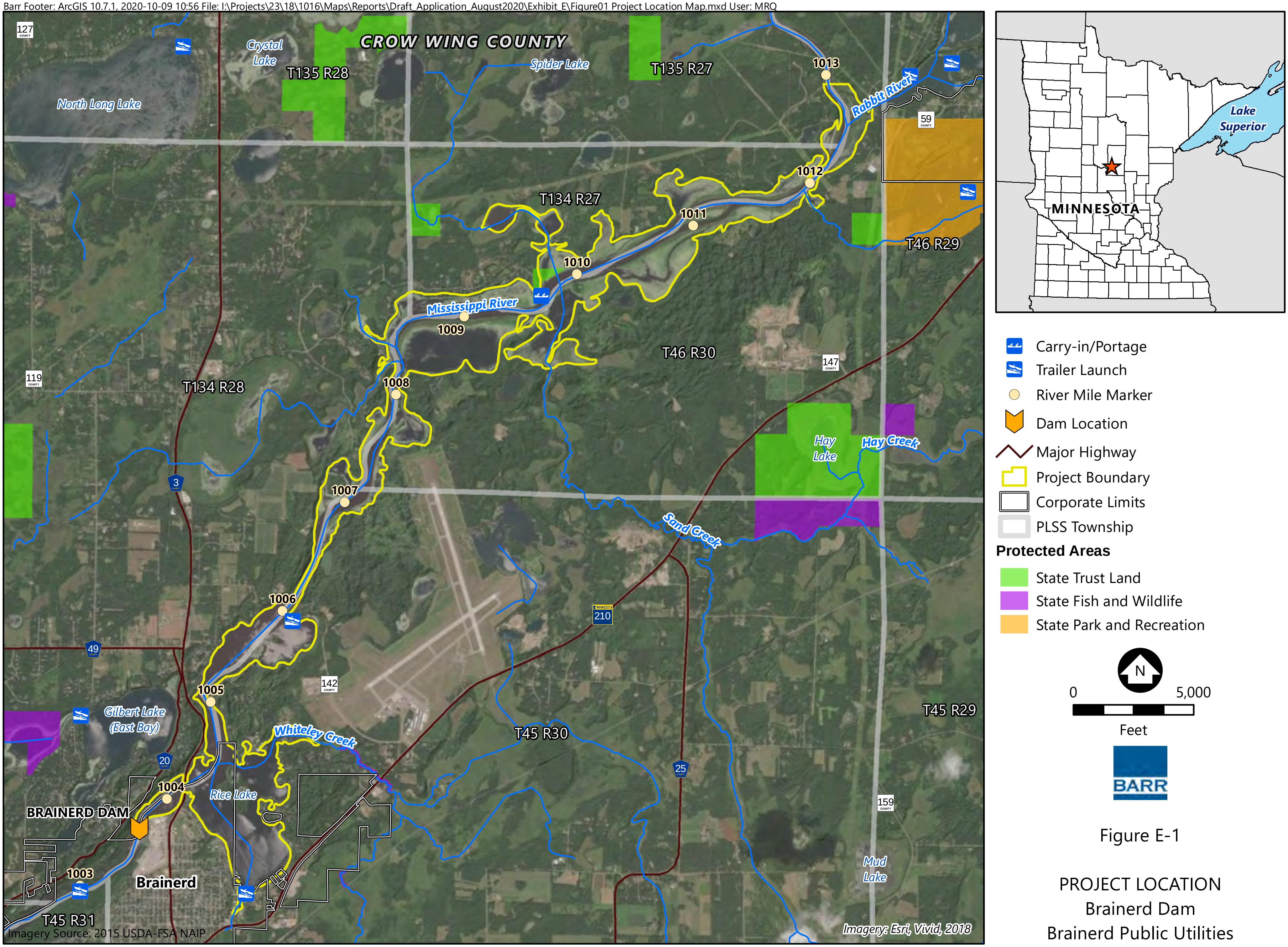
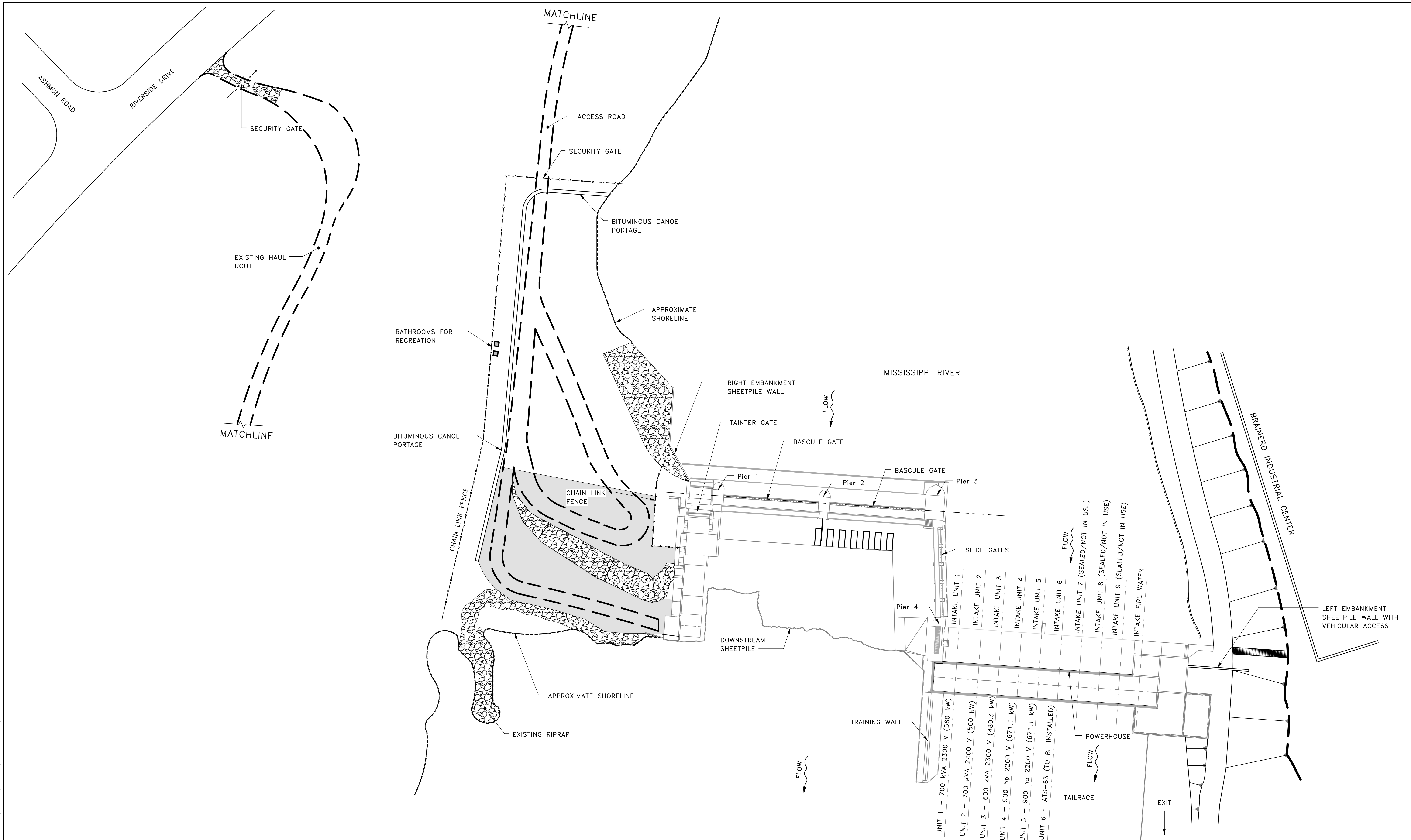


Figure E-1

PROJECT LOCATION
Brainerd Dam
Brainerd Public Utilities



CONTAINS CRITICAL ENERGY INFRASTRUCTURE INFORMATION – DO NOT RELEASE

EXHIBIT DRAWING – NOT FOR CONSTRUCTION

NO.	BY	CHK	DATE	REVISION DESCRIPTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
PRINTED NAME ADELE L. BRAUN
SIGNATURE
DATE ______ LICENSE # 49586

	A	B	C	0	1	2	3
CLIENT							
BID							
CONSTRUCTION							
RECORD							
RELEASED TO/FOR	DATE RELEASED						

BARR
Corporate Headquarters: Minneapolis, Minnesota Ph: 1-800-632-2277

Project Office: BARR ENGINEERING CO. 4300 MARKETPOINTE DRIVE SUITE 200 MINNEAPOLIS, MN 55435 Ph: 1-800-225-1966 Fax: (218) 262-3460 www.barr.com

Scale	N/A
Date	8/01/2018
Drawn	
Checked	
Designed	
Approved	

BRAINERD PUBLIC UTILITIES
BRAINERD, MINNESOTA

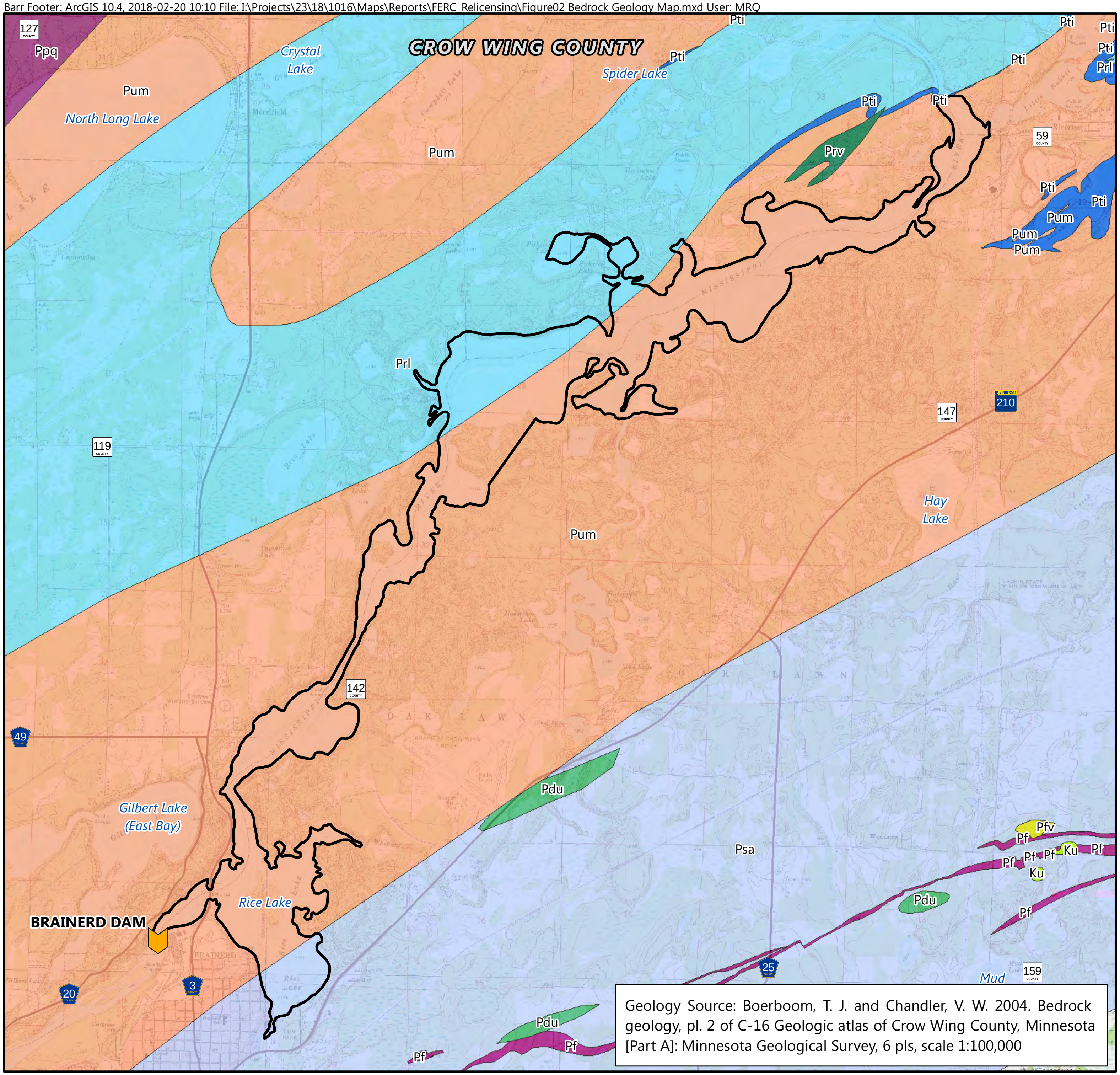
BRAINERD HYDROELECTRIC PROJECT
BRAINERD, MINNESOTA

Site Plan

BARR PROJECT NO. 23/18-1016.05
CLIENT PROJECT NO. ---
DWG NO. G-06
REV NO.

C:\Users\Public\Documents\2318101600_R14_S_BrainerdHydro_CENTRAL_alb2.rvt
8/9/2018 3:27:24 PM

Barr Footer: ArcGIS 10.4, 2018-02-20 10:10 File: I:\Projects\23\18\1016\Maps\Reports\FERC_Relicensing\Figure02 Bedrock Geology Map.mxd User: MRQ



Dam Location

Project Boundary

Major Highway

Geologic Unit

Mesozoic Rocks

Ku - Cretaceous rocks, undivided

Paleoproterozoic Rocks - Animikie Group

Ppq - Pokegama Quartzite

North Range Group

Prl - Rabbit Lake Formation: slate, siltstone, and very fine-grained graywacke

Pti - Trommald Formation

Prv - Rabbit Lake Formation: interlayered mafic volcanic and volcaniclastic rocks and hypabyssal intrusions

Pum - Mahnomen Formation: Upper Member

Miscellaneous Rock Units

Psa - Metasedimentary rocks

Pf - Iron-formation

Pfv - Felsic volcanic rocks

Pdu - Metadiabase

N

0 5,000 10,000

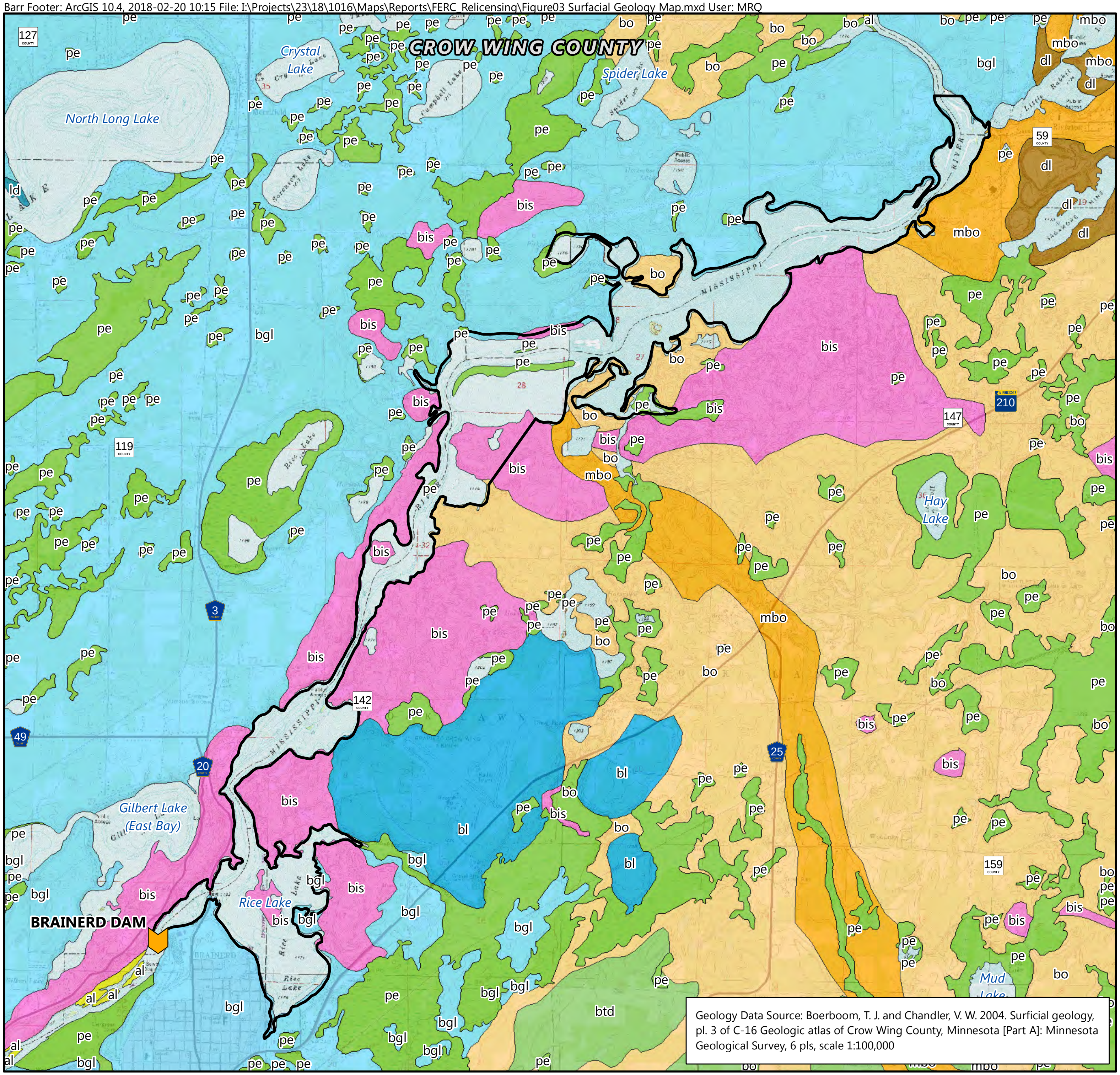
Feet

BARR

Figure E-2

BEDROCK GEOLOGY
Brainerd Dam
Brainerd Public Utilities

Barr Footer: ArcGIS 10.4, 2018-02-20 10:15 File: I:\Projects\23\18\1016\Maps\Reports\FERC_Relicensing\Figure03 Surfacial Geology Map.mxd User: MRQ



Geology Data Source: Boerboom, T. J. and Chandler, V. W. 2004. Surficial geology, pl. 3 of C-16 Geologic atlas of Crow Wing County, Minnesota [Part A]: Minnesota Geological Survey, 6 pls, scale 1:100,000

Dam Location

Project Boundary

Major Highway

Geologic Unit

Holocene and Late Pleistocene

- al - Floodplain alluvium
- dl - Land disturbed by iron-ore mining
- ld - Lacustrine sediments
- pe - Peat and other organic sediments

Pleistocene

Mille Lacs Deposits of the Cromwell Formation

- mbo - Mixed outwash

Brainerd Assemblage

- bgl - Glacial Lake Brainerd deposits
- bis - Ice-contact stratified materials
- bl - Lake sand and silt
- bo - Outwash
- btd - South Long Lake till deposits

N

0 5,000 10,000

Feet

BARR

Figure E-3

SURFICIAL GEOLOGY
Brainerd Dam
Brainerd Public Utilities

Barr Footer: ArcGIS 10.4, 2018-02-20 10:21 File: I:\Projects\23\18\1016\Maps\Reports\FERC_Relicensing\Figure04 Surficial Soils Map.mxd User: MRQ

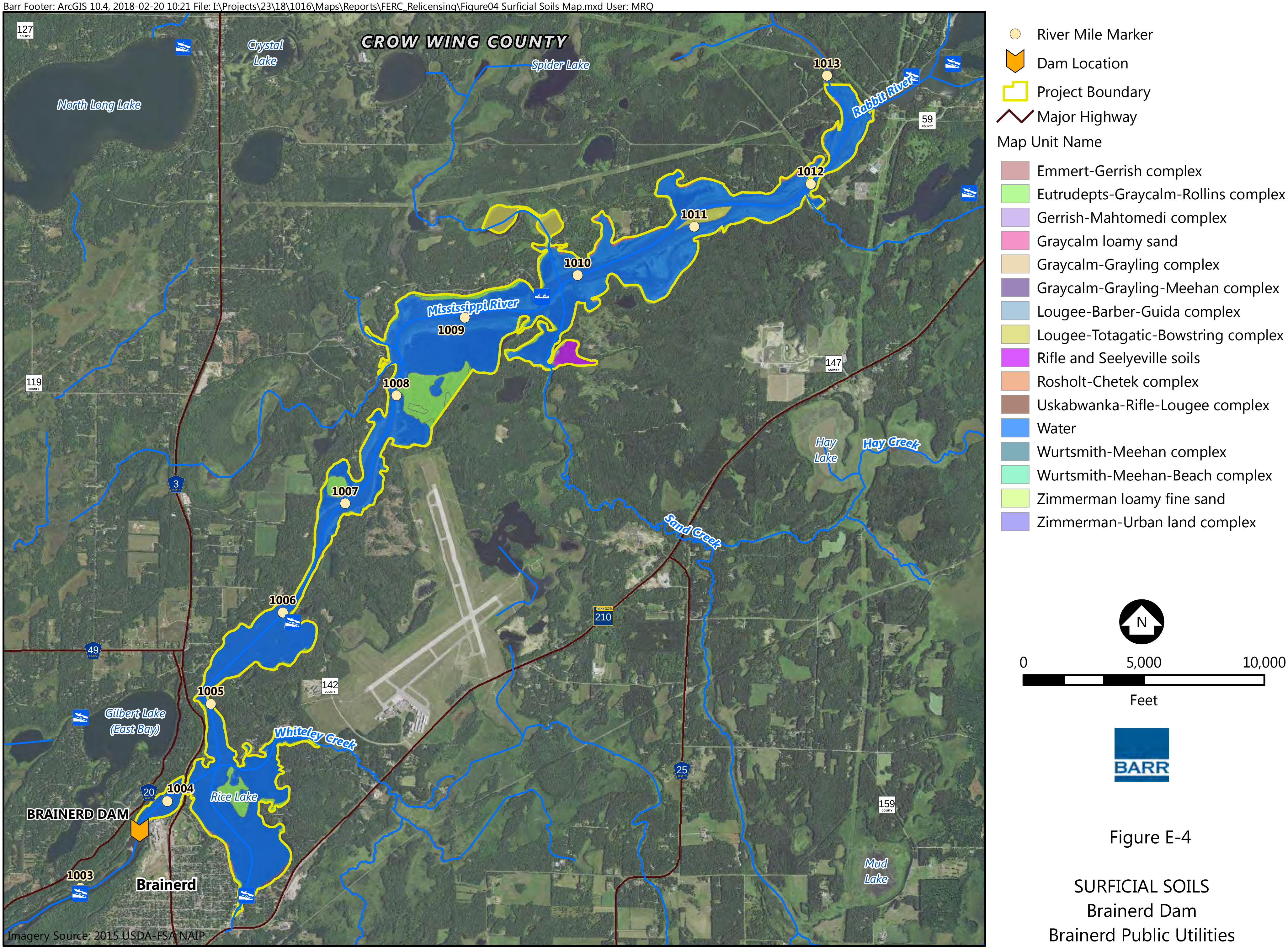
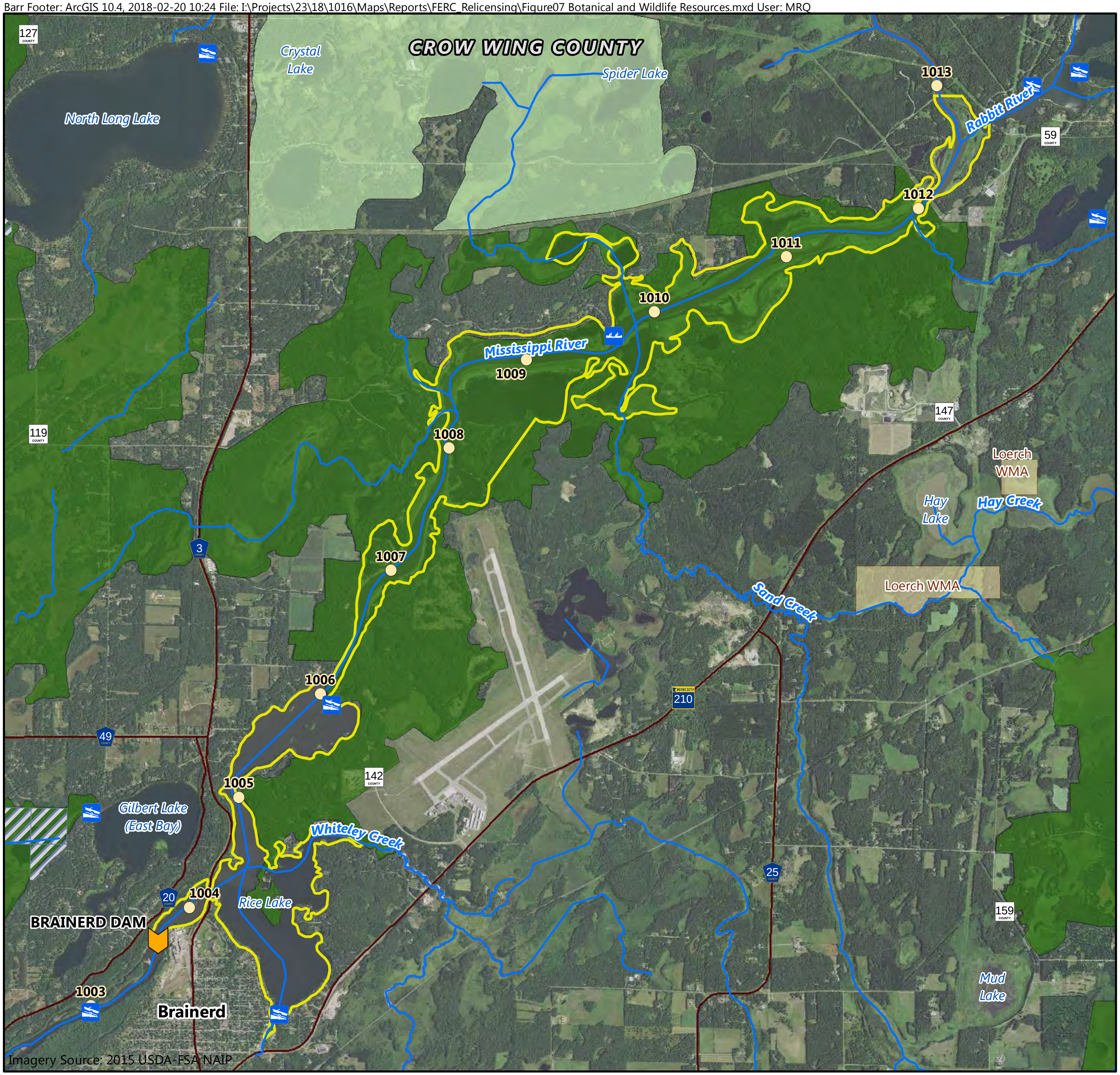


Figure E-4

SURFICIAL SOILS
Brainerd Dam
Brainerd Public Utilities



River Mile Marker
Dam Location
Project Boundary
Major Highway
State Wildlife Management Area
DNR Fisheries Lands

MBS Sites of Biodiversity Significance
Outstanding
High
Moderate
Below

N

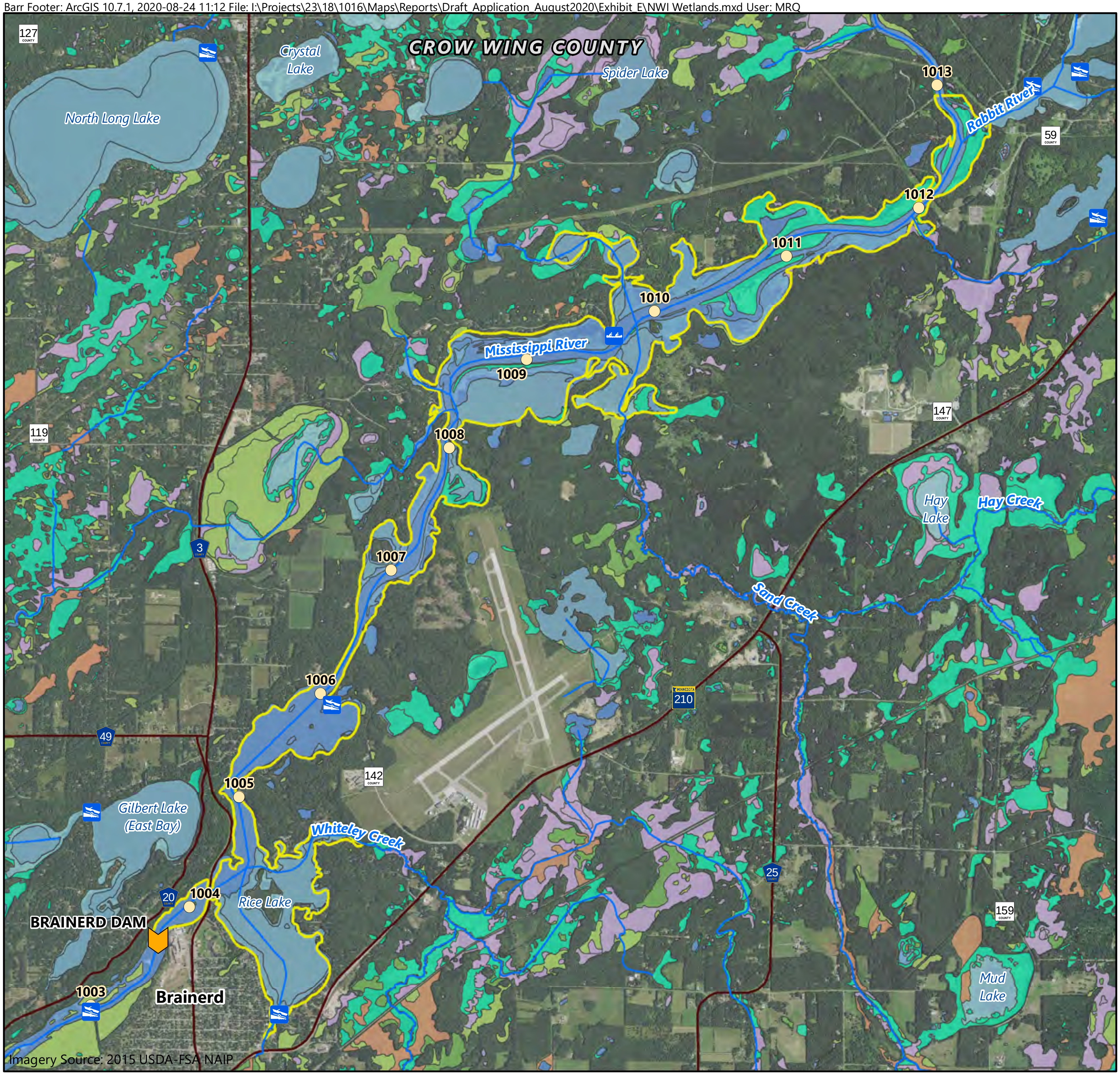
0 5,000 10,000
Feet

BARR

Figure E-5

BOTANICAL AND WILDLIFE RESOURCES
Brainerd Dam
Brainerd Public Utilities

Barr Footer: ArcGIS 10.7.1, 2020-08-24 11:12 File: I:\Projects\23\18\1016\Maps\Reports\Draft_Application_August2020\Exhibit_E\NWI Wetlands.mxd User: MRQ



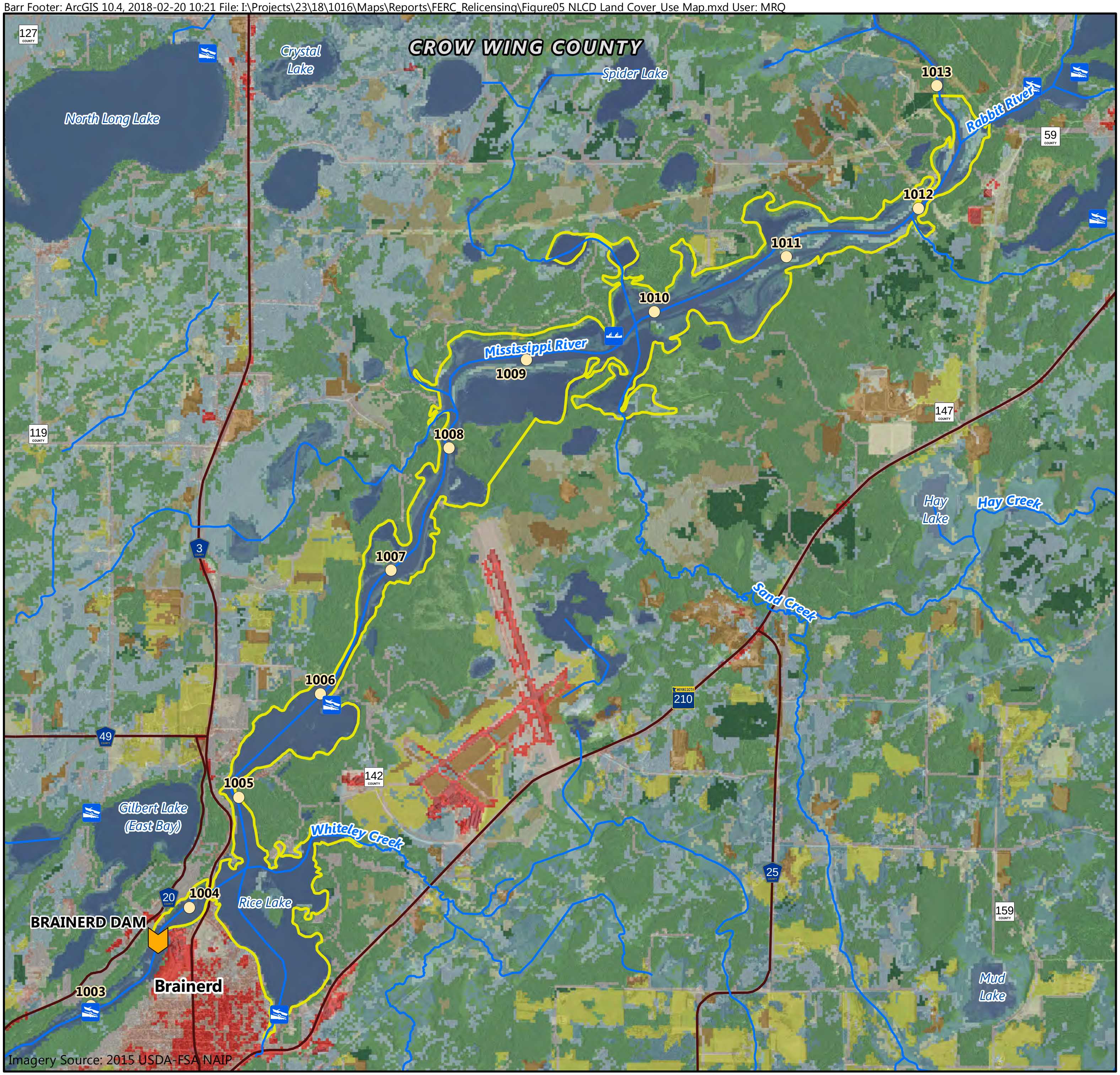
River Mile Marker
Dam Location
Project Boundary
Major Highway
Wetlands (National Wetlands Inventory)
Freshwater Emergent Wetland
Freshwater Forested Wetland
Freshwater Forested/Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Freshwater Shrub Wetland
Freshwater Shrub/Emergent Wetland
Lake
Riverine

0 5,000
Feet

BARR

Figure E-6

WETLANDS
Brainerd Dam Brainerd
Public Utilities



River Mile Marker
Dam Location
Project Boundary
Major Highway

National Land Cover Dataset 2011

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

N

0 5,000 10,000
Feet

BARR

Figure E-7

LAND COVER
Brainerd Dam
Brainerd Public Utilities

Barr Footer: ArcGIS 10.7.1, 2020-10-21 12:19 File: I:\Projects\23\18\1016\Maps\Reports\Draft_Application_August2020\Exhibit_E\Recreation Resources.mxd User: MRQ

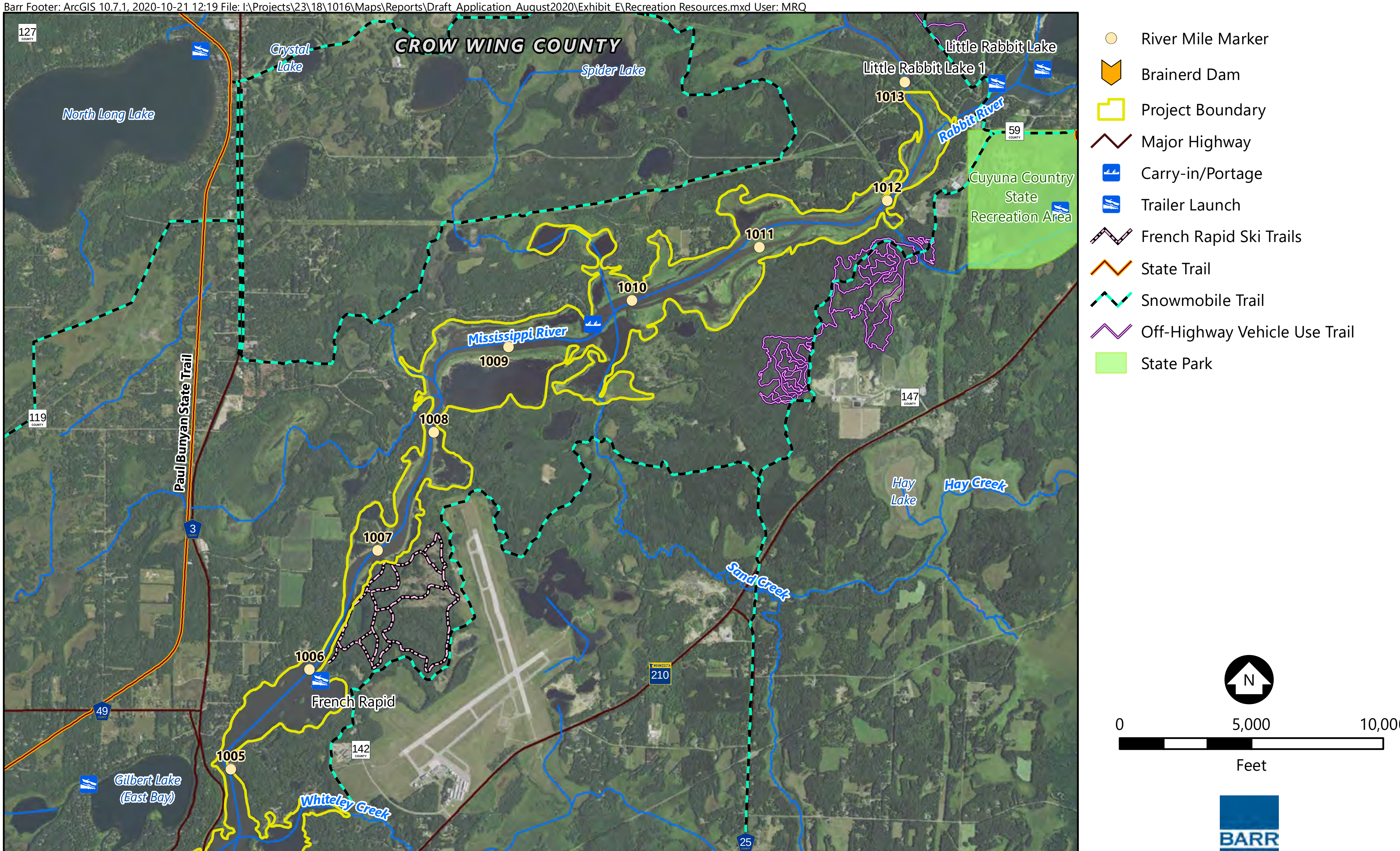


FIGURE E-8

RECREATION RESOURCES
Brainerd Hydroelectric Project
Brainerd Public Utilities

Dissolved Oxygen and Temperature Study Report

Brainerd Hydroelectric Project
FERC License No. 2533

Prepared for:
Brainerd Public Utilities
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Dissolved Oxygen and Temperature Study Report
Brainerd Hydroelectric Project

January 22, 2020

Preface

Brainerd Public Utilities (BPU) began the renewal process for the Federal Energy Regulatory Commission (FERC) license of the Brainerd Hydroelectric Project FERC Project No. 2533 (Project). As part of the relicensing process a Dissolved Oxygen and Temperature study (Study) was requested. This report documents the methods and results of the Study that investigated water temperature and dissolved oxygen of the Mississippi River near the Project.

FERC must give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, FERC must equally consider the environment, recreation, fish and wildlife, and other non-developmental values of the Project, as well as power and other developmental values.

Water quality at the Project supports an aquatic ecosystem that provides public opportunities, including sport fisheries. FERC considers the effects of Project operation on dissolved oxygen (DO) and temperature relevant to its public interest determination.

The MPCA has a water quality monitoring station approximately 1,700 feet upstream of the Project, and the U.S. Geological Survey (USGS) operates water quality monitoring stations downstream of the Project. However, none of these stations have recorded measurements for DO and temperature.

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Abbreviations and Acronyms

% Sat	Percent Saturation
°C	degrees Celsius
BPU	Brainerd Public Utilities (Licensee)
BPUC	Brainerd Public Utilities Commission
CFR	Code of Federal Regulations
cfs	cubic feet per second
DO	Dissolved Oxygen (expressed as milligrams per liter or percent saturation)
DQA	Data Quality Assessment
FERC	Federal Energy Regulatory Commission
mg/L	milligrams per liter
MPCA	Minnesota Pollution Control Agency
NAD83	North American Datum 1983
NGVD	National Geodetic Vertical Datum 1929
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
Project	Brainerd Hydroelectric Project
QA	quality assurance
RSP	Revised Study Plan
Study	Dissolved Oxygen and Temperature Study
USGS	U.S. Geological Survey

Definitions

Licensee	The license was issued to the city of Brainerd and its Brainerd Public Utilities Commission (BPUC). Brainerd Public Utilities (BPU) manages the Project.
Project	Brainerd Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2533 (Project)
Project Area	The area within the Project boundary consisting of "…lands necessary for the operation and maintenance of the Project and for other Project purposes…" (1)
Project Boundary	The boundary line defined in the Project license issued by the FERC that surrounds the "…lands necessary for the operation and maintenance of the Project and for other Project purposes…" (1)
Relicensing	The process of acquiring a new FERC license for an existing hydropower project under expiration of the existing FERC license

1.0 Introduction

Brainerd Public Utilities (BPU) is in the process of relicensing the Brainerd Hydroelectric Project (Project) with the Federal Energy Regulatory Commission (FERC). As required by the December 10, 2018 Revised Study Plan (RSP) (2) for the Project, this document describes the Dissolved Oxygen and Temperature Study (Study) completed in 2019.

1.1 Known Resource Management Goals

The state of Minnesota has established water quality standards (3) to protect water resources for uses such as fishing, swimming, and other recreation and to sustain aquatic life. These standards are a measure to identify polluted waters or healthy waters in need of protection and guide the limits on what regulated facilities can discharge to surface water. These rules are administered by the MPCA. The MPCA is continually working to revise, develop, and otherwise improve Minnesota's water quality standards.

1.2 Public Interest Considerations

FERC must give equal consideration to all uses of the waterway on which a project is located, and what conditions should be placed on any license that may be issued. In making its license decision, FERC must equally consider the environment, recreation, fish and wildlife, and other non-developmental values of the Project, as well as power and other developmental values.

Water quality at the Project supports an aquatic ecosystem that provides public opportunities, including sport fisheries. FERC considers the effects of Project operation on dissolved oxygen (DO) and temperature relevant to its public interest determination.

1.3 Existing Information

The MPCA has a water quality monitoring station approximately 1,700 feet upstream of the Project, and the U.S. Geological Survey (USGS) operates water quality monitoring stations downstream of the Project. However, none of these stations have recorded measurements for DO and temperature.

2.0 Project Location, Facilities, and Watershed

2.1 Licensee

The Project is owned and operated by the city of Brainerd and its Public Utilities Commission under a license from the FERC as Project No. 2533.

2.2 Project Location

The Project is located in Crow Wing County on the Mississippi River near the northeast side of Brainerd, Minnesota, as shown in Figure 2-1. The Project is located approximately 130 miles north of the Minneapolis – St. Paul metropolitan area.

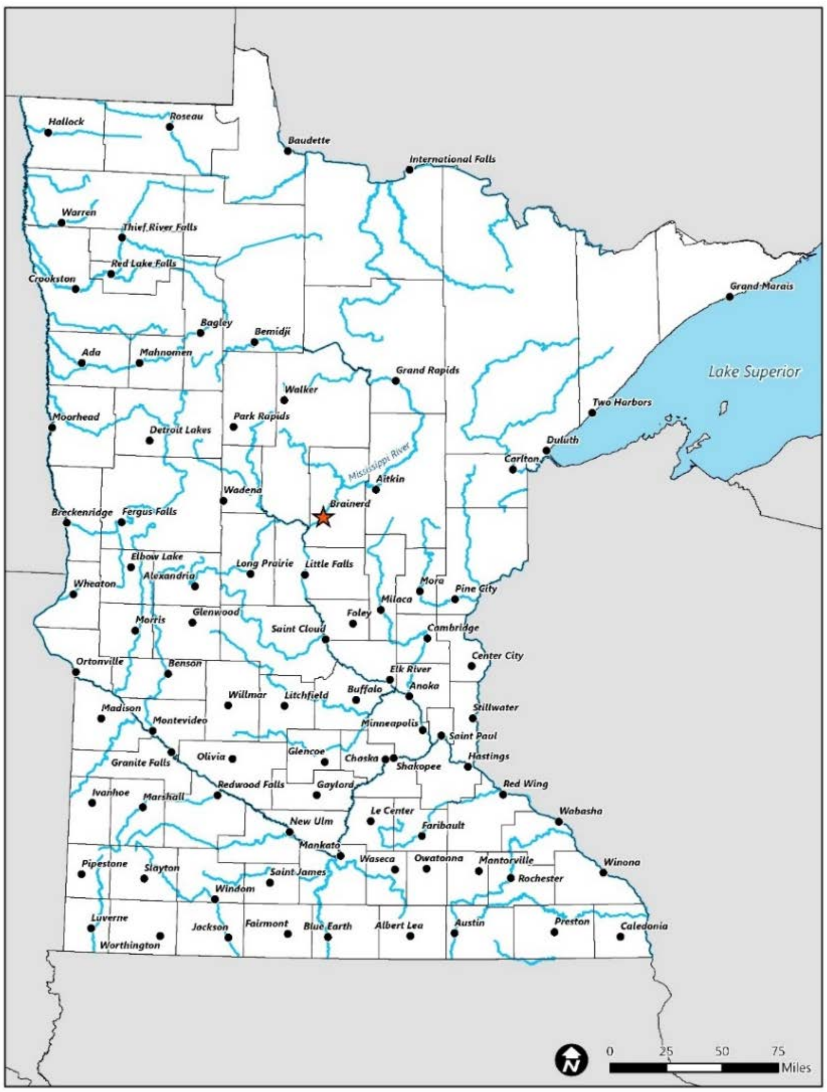


Figure 2-1 Project Location

2.3 Project Overview

From the left bank of the Mississippi River (looking downstream), the Project consists of a short left embankment, a 256-foot-long powerhouse, a 78-foot-long slide gate section, a 207-foot-long bascule (crest) gate section, a single 20-foot-wide steel tainter gate, and a 200-foot-long right embankment, as shown in Figure 2-2. The Project is located on land owned by BPU and is a run-of-river hydroelectric project with an authorized installed capacity of 3,542.5 kW.

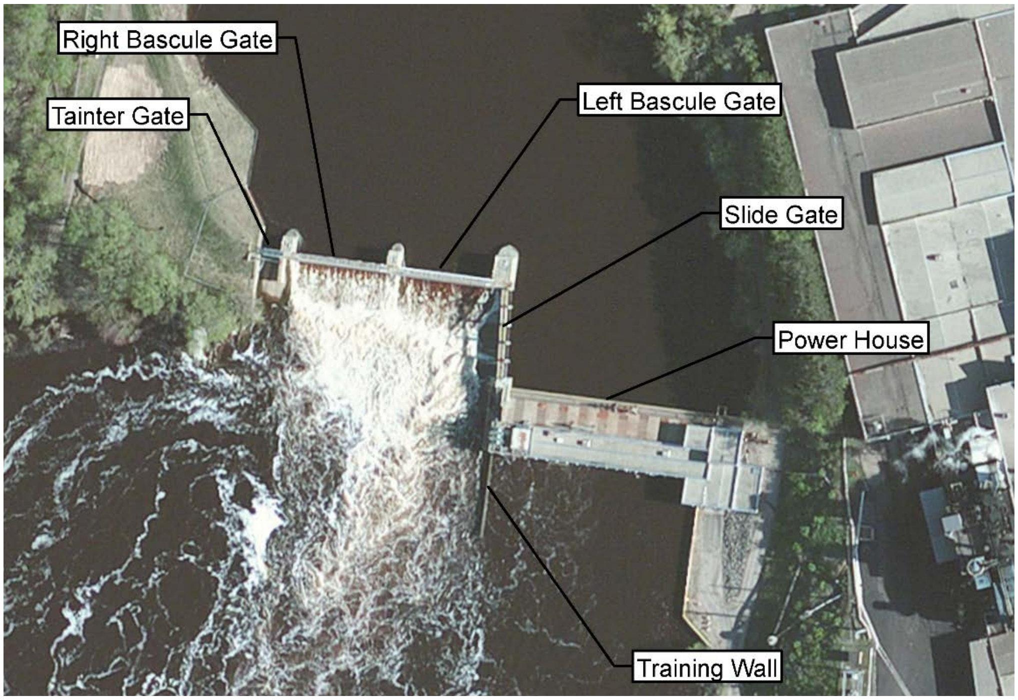


Figure 2-2 Project Overview

2.3.1 Watershed and Regional Water Quality

The Project is located in the Mississippi-Brainerd (#10) major watershed. A brief review of aerial photography indicates that land uses immediately upstream include native hardwood forests, agriculture, and private residential. The reservoir created by the BPU dam extends approximately 8 miles to the northeast of the Project.

In its January 2017 publication on the water quality of the Upper Mississippi River (4), the Minnesota Pollution Control Agency (MPCA) notes that the river upstream and downstream of Brainerd is “Fairly Healthy” and “mostly meets the river life and recreation standards”. The stretch of river immediately upstream of Brainerd (Grand Rapids, Minnesota to Brainerd, Minnesota) failed to meet river life standards because of sediment levels in the water, while the downstream stretch (from Brainerd, Minnesota to St. Cloud, Minnesota) met water quality standards for both river life and recreation.

3.0 Study Plan

This Study was requested to evaluate the DO concentration of water entering the Project's powerhouse intakes within the reservoir, then discharged immediately downstream of the powerhouse into the Mississippi River during summer conditions.

3.1 Objectives

The objectives of the Study are to:

- Identify the DO concentration and temperature of water entering the Project intakes;
- Describe any temporal variations of DO concentration and temperature;
- Identify the DO and temperature profile within the Project reservoir in the vicinity of the intakes; and,
- Describe the changes of DO concentrations and temperature in the river downstream of the Project.

4.0 Methods

This section describes the methods used in the Study, which were outlined in the RSP.

4.1 Monitoring Locations

This Study identified four monitoring locations; one upstream and three downstream locations. The upstream location is located immediately upstream of the Project intake, at the intersection of the slide gates and the powerhouse. In accordance with the RSP, this monitoring location had to be placed with 33 feet of the intakes. The downstream locations are located 150 feet (Site 1), 300 feet (Site 2), and 450 feet (Site 3) downstream of the Project. Figure 4-1 shows the monitoring locations in relation to the Project.

Water depths vary between each of the monitoring locations. In the reservoir (upstream location), water depth was approximately 6 feet, and generally slow-moving (pool). Water depths at Site 1, Site 2, and Site 3 were approximately 15 feet, 30 feet, and 12 feet, respectively, due to irregularities in the riverbed downstream of the Project. At the downstream monitoring locations, water was deeper and flowing quickly (runs).

4.2 Study Variables

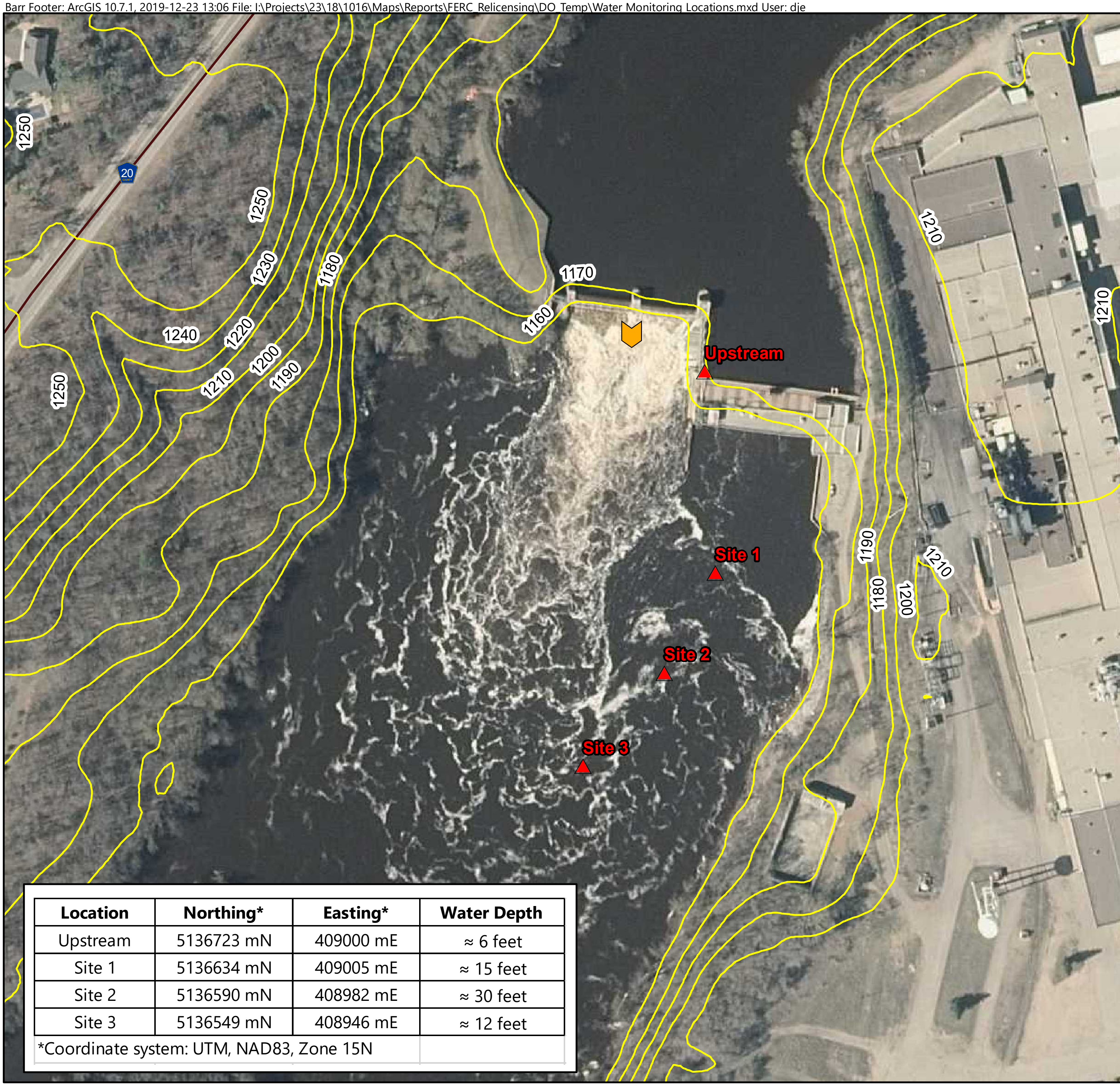
The RSP identified DO and water temperature as the water quality monitoring variables of interest. These variables are effective indicators for overall health of the aquatic system, as fish and other organisms require DO and temperature within certain ranges.

During data collection, information on water condition (odor, color, contents, etc.), hydrology, and Project operations (spillway and generator flow) was also collected. Although this Study was not designed to model the variables associated with DO and temperature, the inclusion of these supplemental variables may provide context to DO and water temperature results. Information on each of the variables is described Sections 4.2.1, 4.2.2, and 4.2.3 .

4.2.1 Dissolved Oxygen

All natural surface waters contain some amount of DO, which is used by living aquatic organisms for respiration. This amount of DO can be quantified as either a concentration (typically in units of milligrams per liter (mg/L) for surface waters), or as a percent saturation (100-percent saturation indicates the water contains a maximum amount of DO at equilibrium). Concentration of DO in surface waters varies with temperature, pressure, turbulence, depth, the concentration of other solutes in the water, and biochemical factors, such as organismal respiration and decomposition of organic matter. In general, DO concentrations are highest when waters are cold, turbulent, and clear; DO concentrations are lowest when waters are warm, stagnant, and contain decomposing organic matter.

DO concentrations of 6 to 10 mg/L are not uncommon for natural surface waters in the summer months. At 5°C, equilibrium DO value is 12.75 mg/L, and at 30°C the equilibrium value is 7.54 mg/L (5). Concentration of DO in water can be raised by photosynthesis of algae or submerged aquatic vegetation, Barr Footer: ArcGIS 10.7.1, 2019-12-23 13:06 File: I:\Projects\23\18\1016\Maps\Reports\FERC_Relicensing\DO_Temp\Water Monitoring Locations.mxd User: dje



Location	Northing*	Easting*	Water Depth
Upstream	5136723 mN	409000 mE	≈ 6 feet
Site 1	5136634 mN	409005 mE	≈ 15 feet
Site 2	5136590 mN	408982 mE	≈ 30 feet
Site 3	5136549 mN	408946 mE	≈ 12 feet
*Coordinate system: UTM, NAD83, Zone 15N			

Monitoring Locations (6/7/2019)

Elevation (feet AMSL)

Dam Location

Major Highway

N

0 200 400

Feet

BARR

FIGURE 4-1

WATER QUALITY MONITORING LOCATIONS
Brainerd Dam
Brainerd Public Utilities

or lowered by excessive biochemical oxygen demands. Diurnal DO fluctuations are often a function of photosynthesis during daylight hours producing oxygen, and respiration from organisms consuming oxygen. DO concentrations also fluctuate seasonally.

4.2.2 Temperature

Water temperature influences the oxygen saturation level and is related to DO as discussed above. Water temperature is generally a function of air temperature and the temperatures of source waters (groundwater, precipitation, and surface runoff). Seasonally, highest water temperatures tend to co-occur with highest air temperatures.

4.2.3 Condition and Contents

In addition to the target variables of DO and temperature, field staff also recorded qualitative observations on the condition and contents of water, such as surficial foam, algal blooms, fish kills, odors, color, organic sheen, etc. This information was collected to provide context to the dataset, and to potentially explain any low DO concentrations.

4.3 Monitoring Schedule

In accordance with the RSP, data collection monitoring was completed on a weekly basis, between June 1 and September 30. Within the weekly requirement, monitoring events were scheduled according to weather conditions and personnel availability. This Study did not use data-logging instruments, so continuous data on DO and temperature are not available.

4.4 Monitoring Personnel

The data collection was completed by BPU employees that work at the Project, with guidance and oversight from Barr Engineering Co.. The decision to have BPU employees conduct the monitoring was based on the BPU employees' familiarity with the operations of the Project, BPU employee availability, and associated cost savings.

4.5 Monitoring Procedures

For more consistent results, field staff conducted weekly monitoring events in accordance with the following procedural specifications:

1. Conduct a calibration check on the data collection instrument, and re-calibrate the instrument if the calibration value exceeds manufacturer recommendations.
2. Record water levels at the Project (upstream and downstream), flow at the USGS station, spillway flowage, and generator speeds.
3. Document overall site conditions (including current and recent weather)
4. Using the skiff, navigate to the monitoring location that is farthest downstream (Site 3), and conduct monitoring as follows:

a. Anchor boat at the monitoring location.

b. Lower instrument probe into the water, using an anchored guide line or a weighted probe to counteract drift effects from fast-moving water and ensure that the probe is lowered vertically into the water.

c. Commence monitoring at a depth of 3 feet below the water surface.

d. Field staff will allow instrument readings to stabilize before recording values.

e. Field staff will record dissolved oxygen concentration (mg/L), dissolved oxygen saturation (% Sat), and water temperature (°C).

f. Continue monitoring at 3-foot intervals until riverbed is encountered.

g. Collect photographs and make qualitative observations on water condition and contents.

5. Move upstream to next monitoring location (Site 2), and repeat monitoring procedures as noted in Step 4 above.

6. Move upstream to next monitoring location (Site 1), and repeat monitoring procedures as noted in Step 4 above.

7. Motor back downriver to the public boat landing, trailer the boat, and return to the Project.

8. Access the upstream monitoring location from the walkways atop the Powerhouse, and repeat monitoring procedures as noted in Step 4 above.

9. Transmit field data and recordkeeping.

During each monitoring event, field staff collected photographs at each of the monitoring locations. These photographs document useful information that can be used for understanding the results, such as location, weather conditions, water levels, water condition, and spillway usage. These photographs also verify that monitoring was conducted at the noted days and times.

4.6 Equipment

The following essential equipment was used to collect the necessary data to support Study objectives; other non-essential parts, supplies, or maintenance tools are not included in this list:

- Measurements for DO and temperature were taken with a specific instrument: a YSI Optical DO Model EcoSense® ODO200. An optical DO instrument was selected for use because it does not require a “warm-up” time, requires less frequent maintenance, and it is possible for the calibration to hold for several months. BPU purchased this instrument in new condition immediately prior to the start of the Study. Equipment calibration and maintenance work are noted in Section 4.8.

- Field staff used the cameras from mobile phones to collect photographs while completing the monitoring.
- Access to the downstream monitoring locations was gained using a small metal skiff with a gasoline outboard motor. This skiff is owned by the BPU, and kept for the purpose of navigating waters near the Project.

4.7 Hydrology Monitoring

In addition to collecting in-situ DO and temperature measurements, BPU collected the following information to aid in the analysis of the data and provide context to the collected results:

- Reservoir Water Elevation
- Downstream Water Elevation
- Flow @ USGS gage #05242300
- Generator Speed (percent, for Generators 1 through 5)

4.7.1 Precipitation Data

Daily precipitation data were obtained from the Minnesota State Climatology Office, using the web-based "Nearest Station Precipitation Data Retrieval" tool. The tool searches and pulls the data closest to the selected target location for the timeframe chosen. The following parameters were used to obtain precipitation data:

- Target Location: Crow-wing-Oak lawn-Brainerd 45N 30W S18 (latitude: 46.33750 longitude: 94.18361)
- Year: 2018-2019
- Number of missing days allowed per month: 3
- Retrieve daily data

The closest location found was 2 miles away at the Brainerd National Weather Service Station, located in Section 36 of Township 45 North, Range 31 West.

4.7.2 Water Elevation Data

As part of its normal operation, BPU operates and maintains instrumentation to record water levels upstream and downstream of the Project. Immediately prior to each monitoring event, personnel recorded water levels in both the upstream reservoir and the downstream river.

4.7.3 Flow Data

BPU measures the flow of the Mississippi River at USGS stream gage #05242300 (located at the Project) as part of its normal operation. BPU also tracks the flow of water over the spillways. Both flow values are recorded in cubic feet per second (cfs). Immediately prior to each monitoring event, personnel recorded flow values from both meters.

4.7.4 Generator Speed

BPU operates and maintains instrumentation to track the speed of each of the five generators at the Project as part of its normal operation. Generator usage can be throttled, so usage is recorded as a percentage, with full operation of a generator recorded as “100 percent”. Immediately prior to each monitoring event, personnel recorded the speed of each of the five generators at the Project.

4.8 Quality Assurance

Quality assurance (QA) measurements were designed and implemented to verify the field data collected during this Study are suitable for their intended purpose. QA measures include the training of field staff, the development of data collection forms, calibration and maintenance of monitoring equipment, and data review. These QA measures are described in detail in Sections 4.8.1 - 4.8.5.

4.8.1 Training

As noted in Section 4.4, the monitoring data was collected by BPU with guidance from Barr. For consistency throughout the season, a training session was held at the Project on May 28, 2019, prior to the start of the Study. The training session included discussion and demonstrations on the following topics:

- Study plan objectives
- Water chemistry
- Equipment operation and calibration
- Monitoring procedures
- Data collection requirements

Immediately following the discussion and equipment demonstrations, BPU conducted a monitoring event under Barr supervision, to gain experience with the instrument and monitoring procedures. In addition, Barr maintained regular communication with the BPU staff to answer questions and to verify the work was being completed as planned.

4.8.2 Data Collection Forms

For the collection of complete and consistent data, Study-specific field data forms were developed and used when collecting data. These forms were designed to guide field staff in the calibration and operation of the instrument, and in the collection of field data. The blank data forms are included in Appendix A.

4.8.3 Equipment Calibration

Although the monitoring was done with an instrument resistant to calibration drift, the monitoring staff performed a calibration check of the DO sensor immediately prior to each monitoring event. In accordance with procedures specified by the manufacturer, the instrument was re-calibrated if the absolute percent difference of the instrument reading and the expected reading was greater than 2 percent. Calibration of the temperature sensor is not possible on the instrument, so calibration checks of temperature were not performed. BPU staff completed a written record of each calibration check, and of each recalibration.

4.8.4 Equipment Maintenance

BPU purchased a new instrument immediately prior to the commencement of the Study. Because a new instrument was used, and no equipment malfunctions were observed during the Study, no equipment maintenance was needed. The manufacturer recommends that the DO sensor should be replaced prior to the start of each season for best results.

4.8.5 Data review

Upon completion of a monitoring event, BPU staff transmitted monitoring data to Barr, to review for completeness and reasonableness. This QA measure was implemented so that if incomplete or confounding data were recorded, additional monitoring could be completed during the same week and compliance with the data collection schedule could be maintained. In addition to the review of weekly data packet, a post-study data quality assessment (DQA) was performed to determine the usability of the dataset. A summary of the DQA is included in Section 6.1.

5.0 Results

This section presents graphical representations and brief summaries of the data collected during the Study. Data are included for DO, temperature, precipitation, water elevations, generator usage, and spillway usage. Appendix B contains a tables of measurements, Appendix C contain charts of DO and temperature, and Appendix D contains representative photographs taken during the monitoring events.

5.1 Results

This section presents graphical representations and brief summaries of the data collected during the Study. Figure 5-1, Figure 5-2, and Figure 5-3 show average values over time for each variable and monitoring location. Appendix B contains raw data and charts.

5.1.1 Dissolved Oxygen

DO measurements were collected at each of the four monitoring locations as both concentrations (mg/L) and saturations (% Sat). Figure 5-1 shows the average DO concentrations at each monitoring location over the course of the Study. Figure 5-2 shows the average DO saturation at each monitoring location over the course of the Study. For both figures, average values were obtained by calculating the mean value for the profile data collected at each monitoring location.

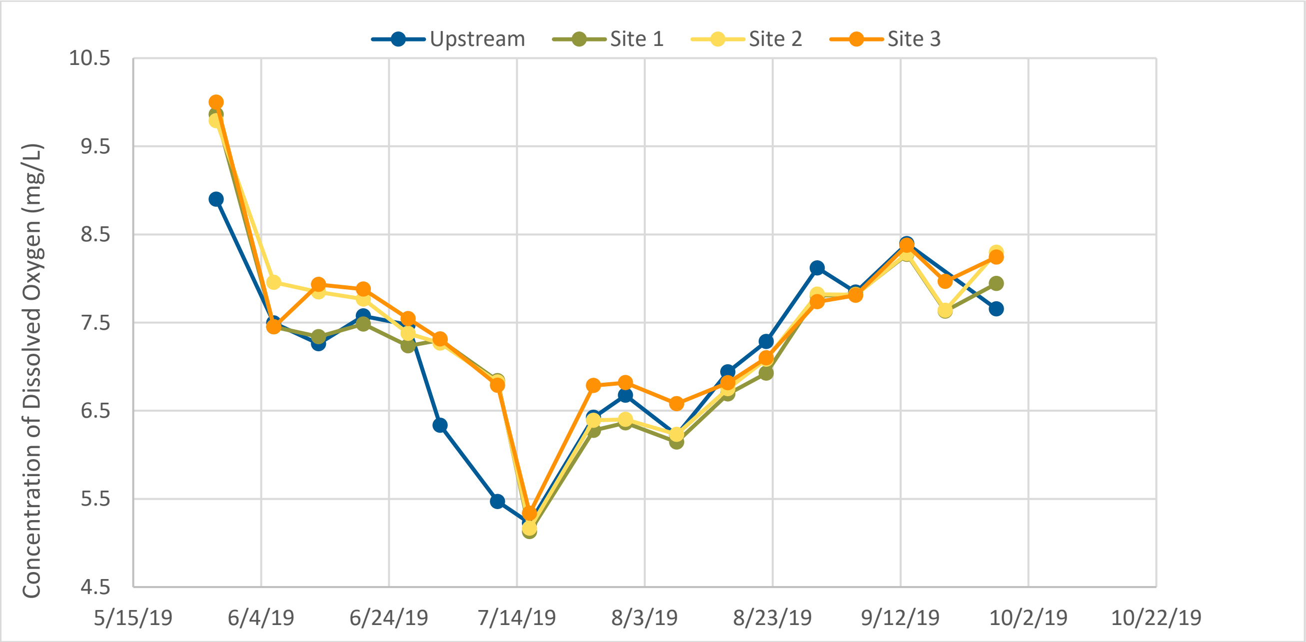


Figure 5-1 **Average DO Concentrations**

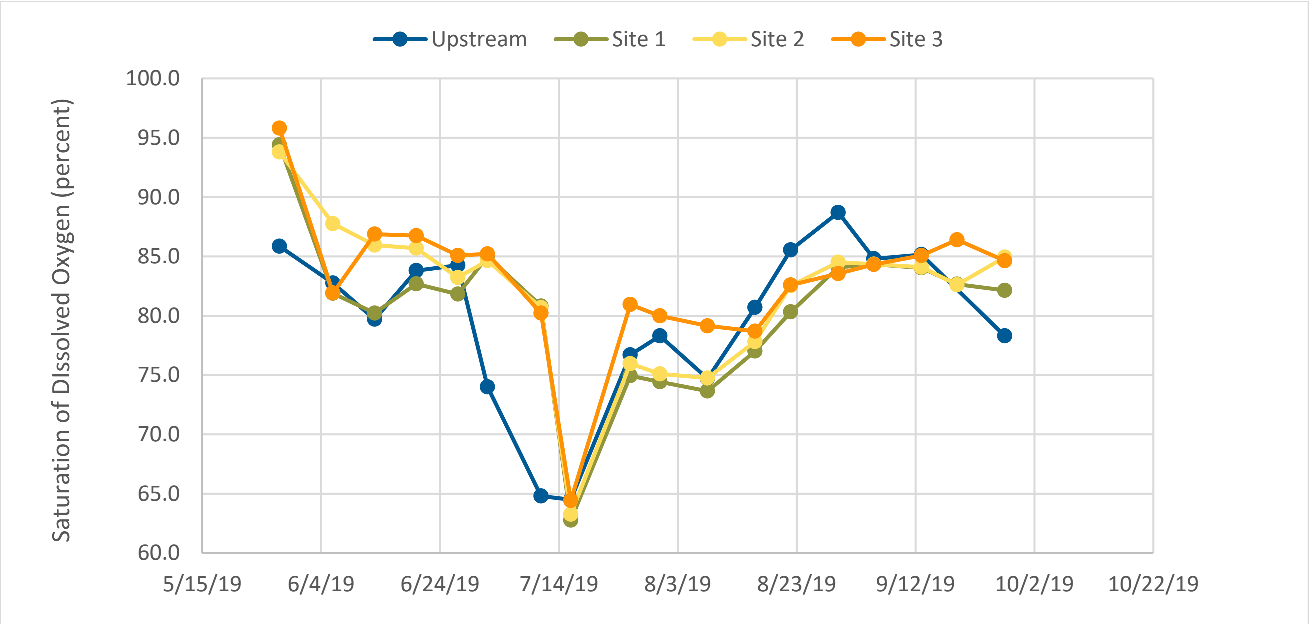


Figure 5-2 Average DO Saturation

5.1.2 Temperature

Figure 5-3 shows the average water temperature at each monitoring location over the course of the Study. Average values were obtained by calculating the mean value for the profile at each monitoring location.

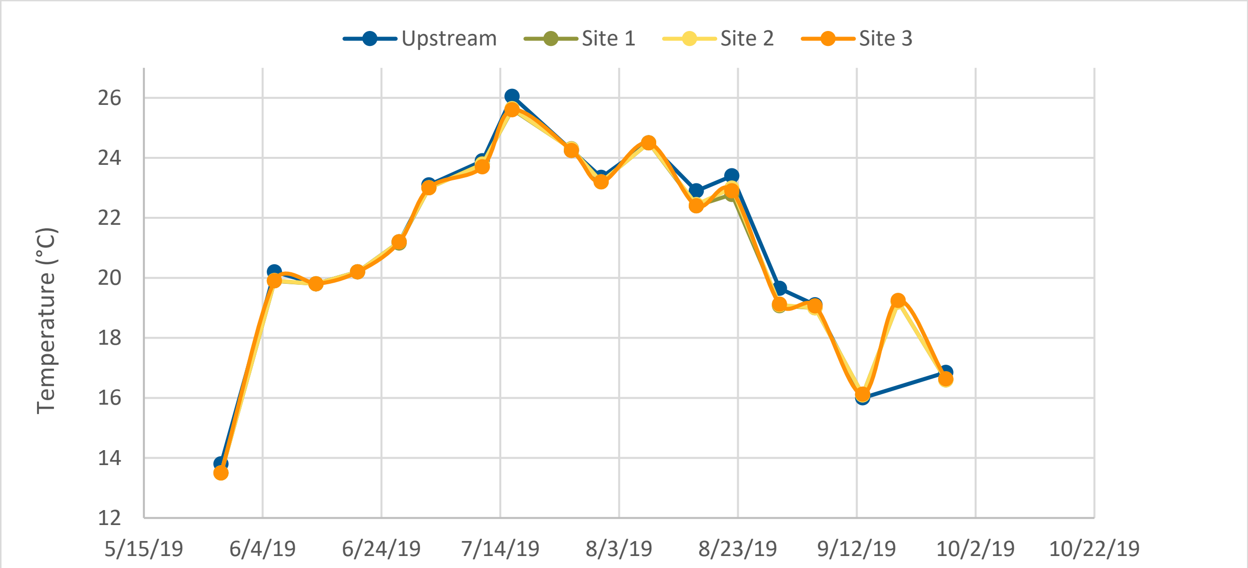


Figure 5-3 Average Temp

5.2 Hydrology

This section provides a brief description of hydrology at the site, including precipitation at the nearest weather station, water levels (both upstream and downstream of the dam), generator usage, and spillway usage.

5.2.1 Precipitation

Figure 5-4 depicts the daily precipitation totals. Data were downloaded from Brainerd station (which is closest to the Project), but it is recognized that the Project is many miles of the Mississippi River headwaters, so the Brainerd station does not represent all the precipitation that occurs within the catchment upriver of the Project.

The following observations were made about precipitation:

- During the Study there were four events that yielded greater than 1 inch of precipitation.
- The largest event during the Study occurred on July 15th and yielded 2.26 inches of precipitation.

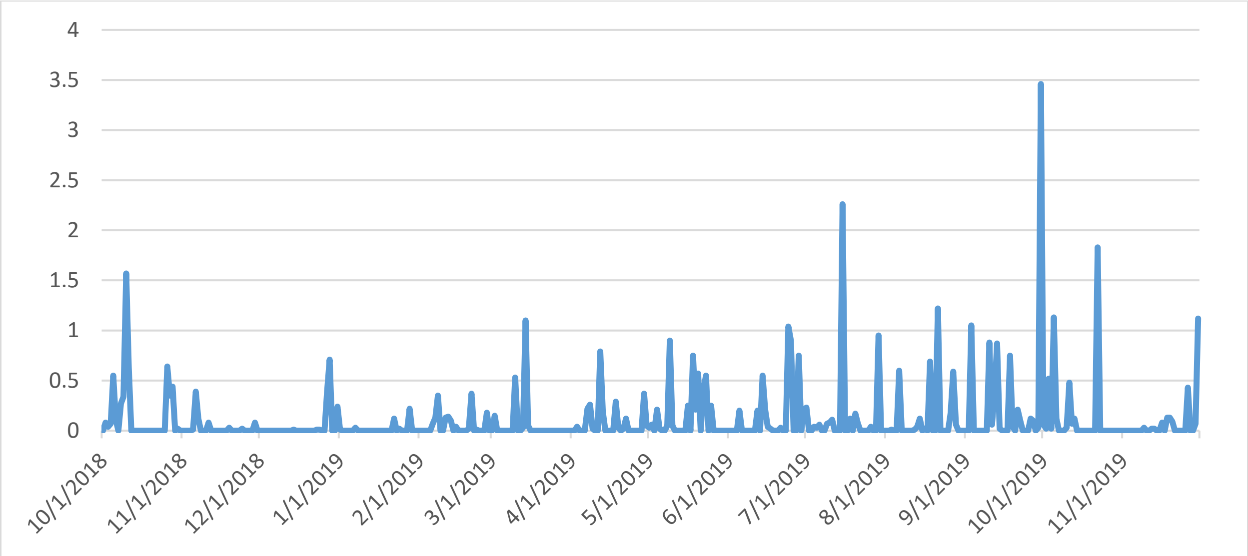


Figure 5-4 Precipitation data at NWS-Brainerd

5.2.2 Flow and Water Levels

Figure 5-5 shows a comparison of weekly flow and water level measurements at the Project. Flows were recorded in cfs, and water levels were recorded in feet. Figure 5-5 indicates flow at the spillway and USGS Gage upstream, follow the same pattern as the downstream water over the course of the Study. The highest flows at the spillway and USGS Gage occurred at the beginning of the Study (6,750 cfs and 8,730 cfs respectively) and the lowest flows occurred in August 2019 (521 cfs and 2,720 cfs respectively).

According to weekly measurements, water levels in the reservoir remained consistent during the Study, varying less than half a foot. Downstream water levels were highest early in the season (approximately 1,166 feet) and then stayed fairly constant for the remainder of the Study, varying less than three feet.

Flow and water level data indicate a large surge of water passed through the Project for about two weeks in early July.

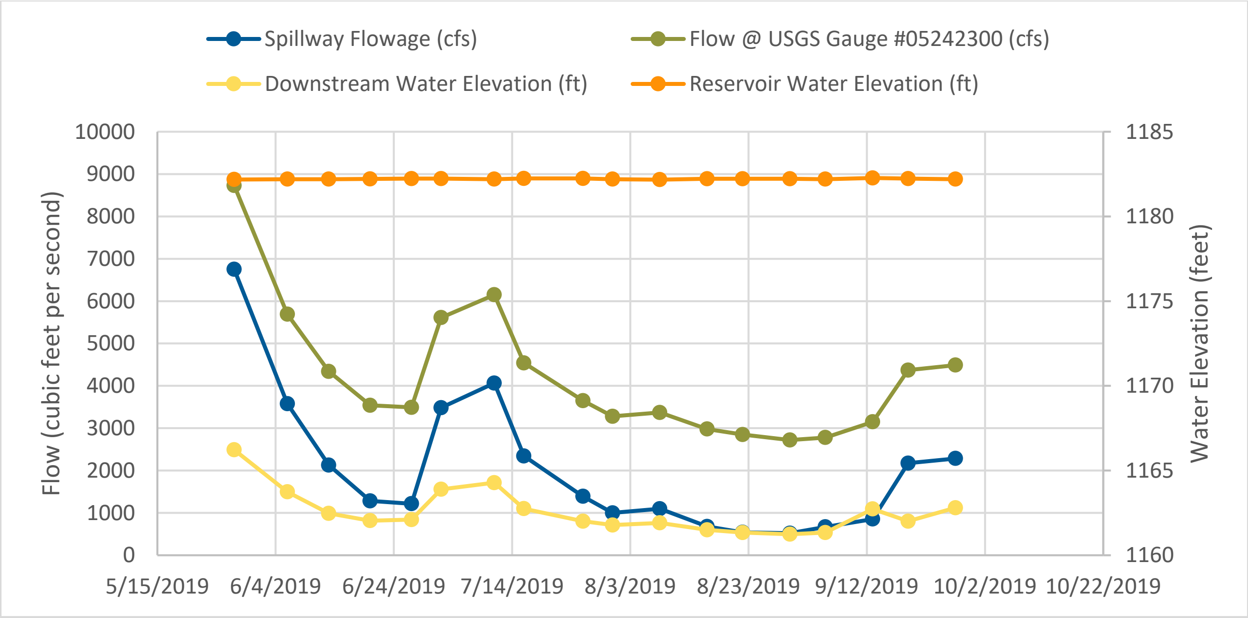


Figure 5-5 Water Level Comparisons

5.2.3 Generator Speed

Weekly data suggest that the Project generators were operating at, or near full, capacity for the duration of the Study. Generator 1 and Generator 2 were operating at 100% speed during each monitoring event. Generator 3 was operating at 100% speed for sixteen of the eighteen monitoring events. Generator 4 and 5 were operating at 100% speed for seventeen of the eighteen monitoring events.

6.0 Discussion

6.1 Data Quality Assessment

This Study includes a DQA, which considers the data collected in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC), and can be useful for determining limitations and usability of the dataset, and establishing credibility of the Study. This DQA assumes that all collected data are valid and useful, unless evidence demonstrates otherwise.

In this Study, data were generated by in-situ measurements, instead of by sample collection and laboratory analysis. Therefore, typical data validation techniques used in the review of laboratory-generated data (i.e., comparisons of duplicates, matrix spikes, blanks, etc.) are not possible. Instead, this DQA relies on qualitative information to make inferences about the suitability of the data.

This DQA only considers the data; it does not include an assessment of the hydrologic data included in the Study (e.g., water levels, generator usage, spillway usage, or precipitation). These data are presented as-is, with no assessment on data quality or suitability for use.

6.1.1 Precision

Precision is a measure of repeatability and the consistency of measurements. In this DQA, data precision is evaluated through a review of instrument specifications (from the manufacturer). Table 6-1 shows the specifications for the instrument used in the Study (6) and includes the range of conditions in which the instrument was intended to be used, the resolution with which the instrument can quantify change, and the expected accuracy of the instrument.

Table 6-1 Specifications for YSI ODO200 DO/Temperature Instrument

Parameter	Range	Resolution	Accuracy
Temperature	0 to 50 °C*	0.1 °C	± 0.3 °C
Dissolved Oxygen	0.0 to 200 % air saturation	0.1 % air saturation	± 1.5 % of reading or ± 1.5 % air saturation, whichever is greater
	0.00 to 20.0 mg/L	0.01 mg/L	± 1.5 % of reading or ± 1.5 mg/L, whichever is greater

* Automatic dissolved oxygen temperature compensation range is 0 to 45 °C.

A review of Minnesota Water Quality Standards (3) indicates that DO values are generally reported to the tenth of a milligram per liter, so an instrument that can detect change to one hundredth of a milligram per liter is deemed precise for this Study.

The monitored waters were within the intended usability range of the instrument, so the resolution values shown in Table 6-1 are applicable.

These findings suggest that the data are sufficiently precise for the intended use as baseline data.

6.1.2 Accuracy

Accuracy is a measure of how close a measured value is to the true value. However, in this DQA, data accuracy is subjectively inferred through a review of instrument specifications (from the manufacturer), and a review of instrument calibration and maintenance records. The RSP did not provide any specifications for the necessary accuracy of the data. A review of data accuracy is presented below:

- **Instrument Specifications**: Table 6-1 shows the expected accuracy of the instrument used in this Study.

- **Calibration/Maintenance Records**: Field data indicate that calibration checks on the DO sensor were performed prior to each monitoring event. Field staff re-calibrated the instrument whenever a calibration check determined that the calibration was outside of the target range. During the eighteen-week Study, the meter was re-calibrated four times. Calibration records are not included in this report, but are available upon request.

  As noted in the instrument operation manual, calibration of the temperature sensor is neither available nor required, but a verification of the temperature sensor could be accomplished by touching the instrument's temperature sensor to a National Institute of Standards and Technology -traceable thermistor and observing the measurements. An accuracy check on the temperature sensor was not completed in 2019, but the instrument was new from the manufacturer immediately prior to the commencement of this Study, so the reasonably reliable temperature data were expected.

These findings suggest that the data are sufficiently precise for the intended use as baseline data.

6.1.3 Representativeness

Representativeness is a determination of whether the measurements made during the Study represent actual conditions of the water, and the water body as whole. In this DQA, data representativeness is evaluated through a review of monitoring location placement, monitoring frequency, and measurement frequency. A review of data representativeness is below:

- **Placement of Monitoring Locations:** Monitoring locations were positioned within the river, in accordance with the RSP. Although the upstream monitoring location adequately represents the water flowing into the intakes, it is likely that the upstream monitoring location does not fully represent the DO and temperature conditions throughout the entire reservoir, because water depth at the upstream monitoring location is typically only about 6-feet deep.

- **Monitoring Frequency:** In accordance with the RSP, monitoring data was conducted weekly. This monitoring frequency is sufficient to detect weekly variations, but is not sufficient to detect daily variations in DO and temperature.

- **Measurement Frequency:** In accordance with the RSP, measurements were collected as profiles: measurements were taken 3 feet below the water surface, and continuing at 3-foot intervals until the riverbed was encountered. The measurement frequency in each profile is sufficient to detect change in variables with depth. Data were collected for the entire water column at each monitoring location. A review of the data suggests that there is minimal variation in chemistry within the water column, possibly due to the mixing introduced by the generators and spillways of the Project.

These findings suggest that the data are sufficiently representative for the intended use as baseline data.

6.1.4 Completeness

Completeness is a determination of whether all necessary monitoring was completed, and completed according to schedule. In this DQA, data completeness is evaluated through a review of monitoring dates and monitoring data. A review of data representativeness is below:

- **Monitoring Events:** A review of the monitoring dates indicates that 18 monitoring events were completed weekly, between June 1 and September 30, in accordance with the RSP.
- **Monitoring Frequency:** A review of the monitoring data indicates that all necessary measurements were completed, with the following exceptions:
  - Upstream monitoring on September 19, 2019. Post-monitoring consultation with the field staff indicates that this data omission was accidental. This weekly dataset was submitted to Barr for review on October 4, 2019, so there was no time to conduct additional measurements for that sampling week.

These findings suggest that the data are sufficiently complete for the intended use as baseline data.

6.1.5 Comparability

Comparability is a determination of whether the collected data are comparable between weekly monitoring events, and whether they are comparable to prior monitoring studies. The 2019 Study constitutes the first year of baseline monitoring at this Project, so the DQA does not include a year-to-year comparison. In this DQA, data comparability is evaluated through a review of the consistency of monitoring procedures. A review of data comparability is below:

- **Monitoring Consistencies:** A review of the monitoring data indicates that the following aspects were completed consistently:
  - Monitoring was completed weekly (during business hours, as dictated by personnel availability and favorable weather conditions);
  - Calibration checks were completed weekly, and instrument calibrations were done as necessary;
  - Monitoring was completed using same instrument and procedures;
  - Monitoring was completed downstream to upstream; and,

- Field data were generally recorded consistently.

These findings suggest that the data are sufficiently comparable (on a week-to-week basis) for the intended use as baseline data.

6.1.6 Data Quality Assessment Summary

The DQA, which included a review of each PARCC parameter, did not identify any reasons to disqualify the data.

6.2 Study Objectives

Section 3.1.1 of the RSP (2) established four study objectives, which are listed and discussed in Sections 6.2.1-6.2.4.

6.2.1 Study Objective #1: Identify the DO concentration and temperature of water entering the Project intakes

The monitoring data indicate the following about the water entering the Project intakes:

- DO concentration at the upstream monitoring location ranged from 5.22 to 8.90 mg/L, with a seasonal mean of 7.16 mg/L.
- DO saturation at the upstream monitoring location ranged from 64.3- to 88.9-percent saturation, with a seasonal mean of 79.6-percent saturation.
- Water temperature at the upstream monitoring location ranged from 13.8 to 26.1°C, with a seasonal mean of 21.0°C.

6.2.2 Study Objective #2: Describe any temporal variations of DO concentration and temperature

The monitoring data indicate the following about temporal variation in DO concentration and water temperature.

- In this Study, DO concentrations recorded during the Study tended to be greatest in late May. DO concentrations generally decreased until mid-July, when DO values were lowest, then increased to early-season levels. DO saturation values also followed a very similar seasonal pattern, and vary inversely with water temperature
- In this Study, water temperatures were lowest early in the growing season, peaked around mid-July, and then generally decreased for the rest of the season.
- These patterns of seasonal variability and the inverse relationship between DO and temperature were not unexpected. Microvariations from week to week were also not unexpected, because the monitoring was conducted on a weekly basis, instead of daily or hourly.

This Study has met Objective #2, within the following context:

- The monitoring was completed on a weekly basis; therefore, this Study can only identify DO and temperature variations that occur on a corresponding weekly basis. Because more frequent monitoring was not conducted, this Study cannot show variations that occur on an hourly or daily basis.

- The monitoring was completed over an 18-week period between June 1 and September 30. Therefore, the Study cannot describe variations that occur outside of this time frame.

6.2.3 Study Objective #3: Identify the DO and temperature profile within the Project reservoir in the vicinity of the intakes

Profile data from the upstream monitoring location suggest that DO and temperature in the reservoir do not vary dramatically with depth. Appendix C contains charts of the profiles, which show very little variation for the duration of the season. The differences between the upper and lower measurements within the profile are less than 0.2 mg/L for DO concentration, less than 2 %Sat for DO Saturation, and less than 0.5 °C for water temperature. These data suggest that the water in the reservoir is well-mixed immediately prior to entering the Project intakes for the duration of the summer season.

This Study has met Objective #3, within the following context:

- The water at the upstream monitoring location was comparatively shallow (approximately 6 feet deep), as compared the downstream location, and was unlikely to exhibit significant variation in DO or temperature with depth. Although it is expected that the reservoir contains deeper pools within 33 feet of the intakes, accessing these areas would have been unsafe with the equipment available to monitoring staff. Also, safely-accessible deep pools in the reservoir would be of sufficient distance from the intakes, as to be not representative of the water entering the intakes. Therefore, the selection process of the upstream monitoring location prioritized safe access and close proximity to intakes over greater water depth.

6.2.4 Study Objective #4: Describe the changes of DO concentrations and temperature in the river downstream of the Project.

A comparison of surficial data between the downstream monitoring locations (Site 1, Site 2, and Site 3), suggest the following:

- DO concentrations in the water downstream of the Project generally increase with distance downriver, but only slightly. In general, the increase in DO concentration from Site 1 to Site 3 is less than 0.5 mg/L. This trend persisted with depth in the profile, and was also present for the duration of the Study.

- DO saturation in the water downstream of the Project does not appear to vary consistently with distance downriver. In general, the variability of DO saturation from Site 1 to Site 3 is less than 10 % Sat. This trend persisted with depth in the profile, and was also present for the duration of the Study.

- Temperature in the water downstream of the Project does not appear to vary consistently with distance downriver. In general, the variability of DO saturation from Site 1 to Site 3 is less than 1°C. This trend persisted with depth in the profile, and was also present for the duration of the Study.

This Study has met Objective #4, within the following context:

- The RSP specified that monitoring occur no more than 450 feet downstream of the Project. Therefore, conditions for locations greater than 450 feet downstream of the site are not described by this Study.

7.0 Summary

As detailed in Section 5.0, the Study satisfied the objectives outlined in the RSP, which were to:

- Identify the DO concentration and temperature of water entering the Project intakes;
- Describe any temporal variations of DO concentration and temperature;
- Identify the DO and temperature profile within the Project reservoir in the vicinity of the intakes; and,
- Describe the changes of DO concentrations and temperature in the river downstream of the Project.

This Study was not designed to explain the causes of variation of DO and temperature in the vicinity of the Project. This study does not attempt to determine if current discharges from the Project meet existing water quality standards (3) because continuous measures would be required.

In support of the Study objectives noted above, the data collected by the Study can be summarized as follows:

- DO concentration at the upstream monitoring location ranged from 5.22 to 8.90 mg/L, with a seasonal mean of 7.16 mg/L. Water temperature at the upstream monitoring location ranged from 13.8 to 26.1°C, with a seasonal mean of 21.0°C.
- DO concentrations do not vary dramatically between upstream and downstream locations.
- DO concentrations are highest in early summer and fall, and lowest mid-summer.
- DO concentration and water temperature do not vary dramatically with water depth, either upstream or downstream.

A DQA has determined that the 2019 data are sufficiently complete and usable for the intended purpose of this Study. Additionally, weekly records suggest that the Project was operating at, or near, full capacity for the duration of the Study.

8.0 References

1. **Federal Energy Regulatory Commission (FERC).** *Division of Hydropower Administration & Compliance, Compliance Handbook.* Washington : Department of Energy, 2015.

2. **Barr Engineering Co.** Revised Study Plan - Brainerd Hydroelectric Project FERC License No. 2533. December 10, 2018.

3. **Minnesota Legislature.** Minnesota Administrative Rules, Chapter 7050, Waters of the State. *Minnesota Legislature.* [Online] https://www.revisor.mn.gov/rules/7050/.

4. **Minnesota Pollution Control Agency.** Our Upper Mississippi River: Monitoring and Assessment Study. *Minnesota Pollution Control Agency.* [Online] https://www.pca.state.mn.us/sites/default/files/wq-iw8-08ab.pdf.

5. **Hem, John D.** Study and Interpretation of the Chemical Characteristics of Natural Water. 3rd. s.l. : U.S. Geological Survey Water Supply Paper 2254, 1985.

6. **YSI Incorporated.** EcoSense ODO200 Handheld. *YSI a xylem brand.* [Online] 2017. Item #606335REF, Rev C, December 2017. https://www.ysi.com/File%20Library/Documents/Manuals/YSI-ODO200-ODO200M-User-Manual-English.pdf.

7. **Minnesota Pollution Control Agency.** Minnesota's Impaired Waters List. *Minnesota Pollution Control Agency.* [Online] https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.

8. —. Our upper Mississippi River Monitoring and Assessment Study. [Online] https://www.pca.state.mn.us/sites/default/files/wq-iw8-08ab.pdf.

Appendix A

Field Data Forms

Weekly Sampling Procedure

1. Complete a calibration check on the ODO200 instrument by referencing and completing the **Calibration Check Procedure** form (once per event).

2. Recalibrate DO sensor if necessary, using the **Calibration Procedure** form (once per event).

3. Complete **Sampling Event Data Form** (once per event).

4. Sample at Site 3 (most downstream location) and record data on **Sampling Data Form**.

5. Sample at Site 2 (middle downstream location) and record data on **Sampling Data Form**.

6. Sample at Site 1 (least downstream location) and record data on **Sampling Data Form**.

7. Go to Upstream location (East Pier) and record data on **Sampling Data Form**.

8. At time of sampling, collect photographs of: spillway, upstream towards reservoir, downstream towards river, and riverbanks

9. Do a final review of all data pages, and complete all field notes.
Each sampling event should generate the following field data:
 - A Calibration Check Form
 - A Calibration Form (if necessary)
 - A Sampling Event Data Form
 - A Sampling Data Form for each sampling location
 - Photographs

10. Transfer field data to digital spreadsheet.

11. Email scanned field data pages, photographs, and field data spreadsheet to Dan Engel (dengel@barr.com).

Reminders/Tips:

Don't change sensor cap without changing the calibration values in the instrument.

Be sure that instrument cable is vertical in the water, so depth measurements are accurate.

Don't let the tip of the sensor dry out (sponge in gray tube should be wet at all times).

Direct questions to Dan Engel at Barr Engineering Company (dengel@barr.com; 218-410-1579).

ODO200 Calibration Check Procedure

Date/Time: ______________________________

Staff Name(s): ______________________________

1 **Saturate sponge inside gray sensor cover with fresh tap water; pour out excess.**

2 **Remove sensor guard (not sensor cap), and dry off temperature and DO sensors.**

3 **Replace sensor guard onto sensor.**

4 **Place sensor (with guard) inside gray sensor cover.**

5 **Turn on ODO200 instrument, wait 10 minutes for sensors to stabilize.**

6 **Local barometric pressure from www.weather.gov (inches Hg):** ______________

7 **Convert local barometric pressure from "inches Hg" to "mm Hg":**

Multiply value from Step 6 by **25.4** to get BP in units of "mm Hg": ______________

8 **Determine true local barometric pressure (not elevation-adjusted) in mm Hg[1]:**

Subtract **29.0** from Step 7 result to get true barometric pressure: ______________

9 **Calibration value for current true barometric pressure[2]:** ______________

10 **Current DO measurement (% saturation):** ______________

Don **Absolute value of difference between DO measurement and calibration value:**

|(Step 9 value) - (Step 10 value)| : ______________

12 **Calibration needed? (circle one)** **Yes** **No**

If difference is ≤ **2**, current calibration is **acceptable**.

If difference is **> 2**, current calibration is **unacceptable, and unit should be calibrated**.

[1] This calculation assumes that the calibration check is performed at the BPU dam break room, which has an elevation of approximately 1,160 feet above mean sea level. See page 10 of operation manual for the detailed calculation.

[2] See Appendix A of the YSI200 Operation Manual to determine the calibration value (using the local, true, barometric pressure value).

APPENDIX A-DO% CALIBRATION VALUES

Calibration Value	Pressure			
D.O. %	in Hg	mmHg	kPa	mbar
101%	30.22	767.6	102.34	1023.38
100%	29.92	760.0	101.33	1013.25
99%	29.62	752.4	100.31	1003.12
98%	29.32	744.8	99.30	992.99
97%	29.02	737.2	98.29	982.85
96%	28.72	729.6	97.27	972.72
95%	28.43	722.0	96.26	962.59
94%	28.13	714.4	95.25	952.46
93%	27.83	706.8	94.23	942.32
92%	27.53	699.2	93.22	932.19
91%	27.23	691.6	92.21	922.06
90%	26.93	684.0	91.19	911.93
89%	26.63	676.4	90.18	901.79
88%	26.33	668.8	89.17	891.66
87%	26.03	661.2	88.15	881.53
86%	25.73	653.6	87.14	871.40
85%	25.43	646.0	86.13	861.26
84%	25.13	638.4	85.11	851.13
83%	24.83	630.8	84.10	841.00
82%	24.54	623.2	83.09	830.87
81%	24.24	615.6	82.07	820.73
80%	23.94	608.0	81.06	810.60
79%	23.64	600.4	80.05	800.47
78%	23.34	592.8	79.03	790.34
77%	23.04	585.2	78.02	780.20
76%	22.74	577.6	77.01	770.07
75%	22.44	570.0	75.99	759.94
74%	22.14	562.4	74.98	749.81
73%	21.84	554.8	73.97	739.67
72%	21.54	547.2	72.95	729.54

ODO200 Calibration Procedure

Date/Time: ______________________________

Staff Name(s): ______________________________

1 **Saturate sponge inside gray sensor cover with fresh tap water; pour out excess.**

2 **Remove sensor guard (not sensor cap), and dry off temperature and DO sensors.**

3 **Replace sensor guard onto sensor.**

4 **Place sensor (with guard) inside gray sensor cover.**

5 **Turn on ODO200 instrument, wait 10 minutes for sensors to stabilize.**

6 **Local barometric pressure from www.weather.gov (inches Hg):** ______________

7 **Convert local barometric pressure from "inches Hg" to "mm Hg":**

Multiply value from Step 6 by **25.4** to get BP in units of "mm Hg": ______________

8 **Determine <u>true</u> local barometric pressure (not elevation-adjusted) in mm Hg:**

Subtract **29.0** from Step 7 result to get <u>true</u> barometric pressure[1]: ______________

9 **Convert <u>true</u> barometric pressure from "mm Hg" to "millibars":**

Multiply value from Step 8 by **1.333**: ______________

10 **Press "CAL" button on instrument.**

11 **Use the Up/Down buttons to select the true, local barometric pressue (in millibars).**

Use value from Step 9; select closest integer.

12 **Press "Enter" button.**

13 **When prompted to enter a salinity value, leave at "0 ppt".**

14 **Press "Enter" button; calibration is complete.**

[1] This calculation assumes that the calibration is performed at the BPU dam break room, which has an elevation of approximately 1,160 feet above mean sea level. See page 10 of operation manual for the detailed calcution.

[2] See Appendix A of the YSI200 Operation Manual for calibration values.

Sampling Event Data

Sampling Event Date:	
Sampling Start Time:	**Sampling End Time:**
Sampler(s):	
Current Weather Conditions:	
Recent Weather (past few days):	
Reservoir Water Elevation (feet*):	
Downstream Water Elevation (feet*):	
Flow @ USGS gauge #05242300 (cfs):	
Spillway Flowage (cfs):	
Generator 1 (% speed):	
Generator 2 (% speed):	
Generator 3 (% speed):	
Generator 4 (% speed):	
Generator 5 (% speed):	
Water Condition (Odor, Color, Clarity, etc.)**:**	
Hydrology/Sampling Comments:	

*BPU facility reports elevation according to Memphis Datum; subtract 8.16 feet to convert to NGVD 29.

Sampling Data

Sampling Location:

Sampling Date:

Sampling Time:

Total Water Depth:

Habitat (Pool, Run, Riffle)**:**

Sampling Depth (feet)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Water Temperature (°C)
3			
6			
9			
12			
15			
18			
21			
24			
27			
30			
33			

Comments:

Sampling Data

Sampling Location:

Sampling Date:

Sampling Time:

Total Water Depth:

Habitat (Pool, Run, Riffle)**:**

Sampling Depth (feet)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Water Temperature (°C)
3			
6			
9			
12			
15			
18			
21			
24			
27			
30			
33			

Comments:

Sampling Data

Sampling Location:

Sampling Date:

Sampling Time:

Total Water Depth:

Habitat (Pool, Run, Riffle)**:**

Sampling Depth (feet)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Water Temperature (°C)
3			
6			
9			
12			
15			
18			
21			
24			
27			
30			
33			

Comments:

Sampling Data

Sampling Location:

Sampling Date:

Sampling Time:

Total Water Depth:

Habitat (Pool, Run, Riffle)**:**

Sampling Depth (feet)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Water Temperature (°C)
3			
6			
9			
12			
15			
18			
21			
24			
27			
30			
33			

Comments:

Sampling Data

Sampling Location:

Sampling Date:

Sampling Time:

Total Water Depth:

Habitat (Pool, Run, Riffle)**:**

Sampling Depth (feet)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)	Water Temperature (°C)
3			
6			
9			
12			
15			
18			
21			
24			
27			
30			
33			

Comments:

Appendix B

Dissolved Oxygen and Temperature Data Table

Week	Sample Date	Sample Location	Sample Time	Dissolved Oxygen (mg/L)										
				3 ft	6 ft	9 ft	12 ft	15 ft	18 ft	21 ft	24 ft	27 ft	30 ft	33 ft
1	5/28/19	Upstream	14:16	8.90	8.90									
	5/28/19	Site 1	13:46	9.95	9.92	9.92	9.90	9.88	9.87	9.88	9.87			
	5/28/19	Site 2	13:40	9.86	9.86	9.83	9.82	9.80	9.79	9.78	9.78	9.78	9.74	9.76
	5/28/19	Site 3	13:30	9.98	10.00	10.00								
2	6/6/19	Site 1	10:12	7.53	7.49	7.48	7.46	7.44	7.41	7.40	7.40			
	6/6/19	Site 2	10:03	8.37	8.26	8.18	7.77	8.13	8.17	7.64	7.81	7.79	7.69	7.71
	6/6/19	Site 3	10:10	7.53	7.49	7.48	7.46	7.44	7.41	7.40	7.40			
	6/6/19	Upstream	11:17	7.48	7.51									
3	6/13/19	Site 1	10:33	7.42	7.46	7.32	7.27	7.23						
	6/13/19	Site 2	10:10	7.93	7.92	7.91	7.90	7.86	7.84	7.82	7.80	7.77	7.72	
	6/13/19	Site 3	10:00	7.94	7.95	7.93	7.91							
	6/13/19	Upstream	11:00	7.26	7.26									
4	6/20/19	Site 1	10:08	7.53	7.51	7.49	7.47	7.46	7.44					
	6/20/19	Site 2	9:44	7.81	7.80	7.78	7.80	7.78	7.76	7.75	7.72	7.70		
	6/20/19	Site 3	9:36	7.85	7.91	7.87	7.89	7.84	7.92					
	6/20/19	Upstream	10:35	7.58	7.57									
5	6/27/19	Site 1	9:15	7.32	7.30	7.28	7.25	7.03						
	6/27/19	Site 2	9:07	7.43	7.38	7.35	7.35	7.39	7.39	7.35				
	6/27/19	Site 3	9:00	7.62	7.59	7.57	7.56	7.53	7.52	7.49	7.48			
	6/27/19	Upstream	9:45	7.48	7.47									
6	7/2/19	Site 1	9:07	7.32	7.32	7.31	7.32	7.31	7.29	7.28	7.27			
	7/2/19	Site 2	9:14	7.31	7.30	7.30	7.29	7.27	7.26	7.25	7.23	7.20		
	7/2/19	Site 3	9:00	7.36	7.34	7.33	7.32	7.30	7.29	7.29	7.28			
	7/2/19	Upstream	9:41	6.34	6.33									
7	7/11/19	Site 1	9:50	6.85	6.88	6.85	6.84	6.81	6.81					
	7/11/19	Site 2	9:45	6.87	6.85	6.84	6.81	6.82	6.80	6.79				
	7/11/19	Site 3	9:30	6.84	6.82	6.81	6.81	6.78	6.76	6.75	6.73			
	7/11/19	Upstream	10:25	5.50	5.44									
8	7/16/19	Site 1	13:53	5.17	5.16	5.14	5.13	5.12	5.10	5.08				
	7/16/19	Site 2	13:47	5.25	5.22	5.20	5.18	5.14	5.13	5.11	5.10			
	7/16/19	Site 3	13:37	5.28	5.25	5.16	5.12	5.38	5.63	5.54				
	7/16/19	Upstream	14:18	5.22	5.23									
	7/16/19													
9	7/26/19	Site 1	9:32	6.32	6.31	6.29	6.28	6.26	6.25	6.23				
	7/26/19	Site 2	9:23	6.57	6.47	6.37	6.33	6.36	6.33	6.24	6.27	6.48	6.49	
	7/26/19	Site 3	9:16	6.88	6.86	6.68	6.92	6.77	6.71	6.68				
	7/26/19	Upstream	10:19	6.43	6.42									
10	7/31/19	Site 1	11:00	6.42	6.40	6.38	6.35	6.34	6.33	6.32				
	7/31/19	Site 2	10:55	6.47	6.45	6.43	6.42	6.41	6.39	6.28	6.36			
	7/31/19	Site 3	10:45	6.70	7.03	6.80	6.76	6.88	6.77	6.83	6.78			
	7/31/19	Upstream	11:29	6.70	6.65									
11	8/8/19	Site 1	10:35	6.18	6.16	6.14	6.12	6.13	6.14					
	8/8/19	Site 2	10:30	6.24	6.25	6.29	6.27	6.21	6.20	6.25	6.23	6.15		
	8/8/19	Site 3	10:22	6.65	6.67	6.62	6.61	6.55	6.46	6.50				
	8/8/19	Upstream	11:04	6.24	6.21									
12	8/16/19	Site 1	11:58	6.73	6.69	6.69	6.69	6.67	6.67					
	8/16/19	Site 2	11:53	6.79	6.77	6.75	6.74	6.74	6.73	6.79	6.75	6.69		
	8/16/19	Site 3	11:46	6.89	6.87	6.85	6.84	6.81	6.80	6.77	6.76	6.76		
	8/16/19	Upstream	12:33	6.94	6.94									
13	8/22/19	Site 1	13:53	6.90	6.93	6.90	6.95	6.95						
	8/22/19	Site 2	13:48	7.15	7.13	7.13	7.12	7.08	7.06	7.04	7.03	7.02		
	8/22/19	Site 3	13:42	7.16	7.15	7.13	7.11	7.09	7.08	7.07	7.06	7.05		
	8/22/19	Upstream	13:42	7.29	7.28									
14	8/30/19	Site 1	13:42	7.84	7.82	7.80	7.79	7.79	7.80	7.79				
	8/30/19	Site 2	13:36	7.88	7.86	7.85	7.83	7.80	7.79	7.79	7.80	7.79		
	8/30/19	Site 3	13:29	7.85	7.83	7.77	7.73	7.72	7.70	7.66	7.63			
	8/30/19	Upstream	14:29	8.14	8.10									
15	9/5/19	Site 1	13:47	7.86	7.85	7.82	7.81	7.80	7.79					
	9/5/19	Site 2	13:41	7.86	7.85	7.84	7.82	7.81	7.79	7.78	7.77			
	9/5/19	Site 3	13:35	7.92	7.89	7.84	7.83	7.81	7.79	7.76	7.74	7.71		
	9/5/19	Upstream	14:16	7.85	7.84									
16	9/13/19	Site 1	13:31	8.30	8.29	8.27	8.26	8.27	8.25					
	9/13/19	Site 2	13:27	8.35	8.33	8.33	8.30	8.27	8.27	8.24	8.23	8.22		
	9/13/19	Site 3	13:20	8.47	8.45	8.44	8.40	8.37	8.37	8.33	8.29	8.27		
	9/13/19	Upstream	13:57	8.41	8.38									
17	9/19/19	Site 1	14:18	7.66	7.65	7.64	7.63	7.62	7.61	7.60				
	9/19/19	Site 2	14:13	7.73	7.71	7.68	7.67	7.65	7.62	7.60	7.59	7.58	7.56	
	9/19/19	Site 3	14:07	8.09	8.07	8.07	8.06	7.99	7.98	7.89	7.85	7.70		
	9/19/19													
18	9/27/19	Site 1	9:21	8.11	7.87	7.84	7.91	7.91	8.02					
	9/27/19	Site 2	9:13	8.34	8.33	8.31	8.30	8.29	8.28	8.29	8.28	8.25		
	9/27/19	Site 3	9:08	8.27	8.28	8.26	8.26	8.25	8.23	8.23	8.22	8.19		
	9/27/19	Upstream	9:49	7.67	7.64									

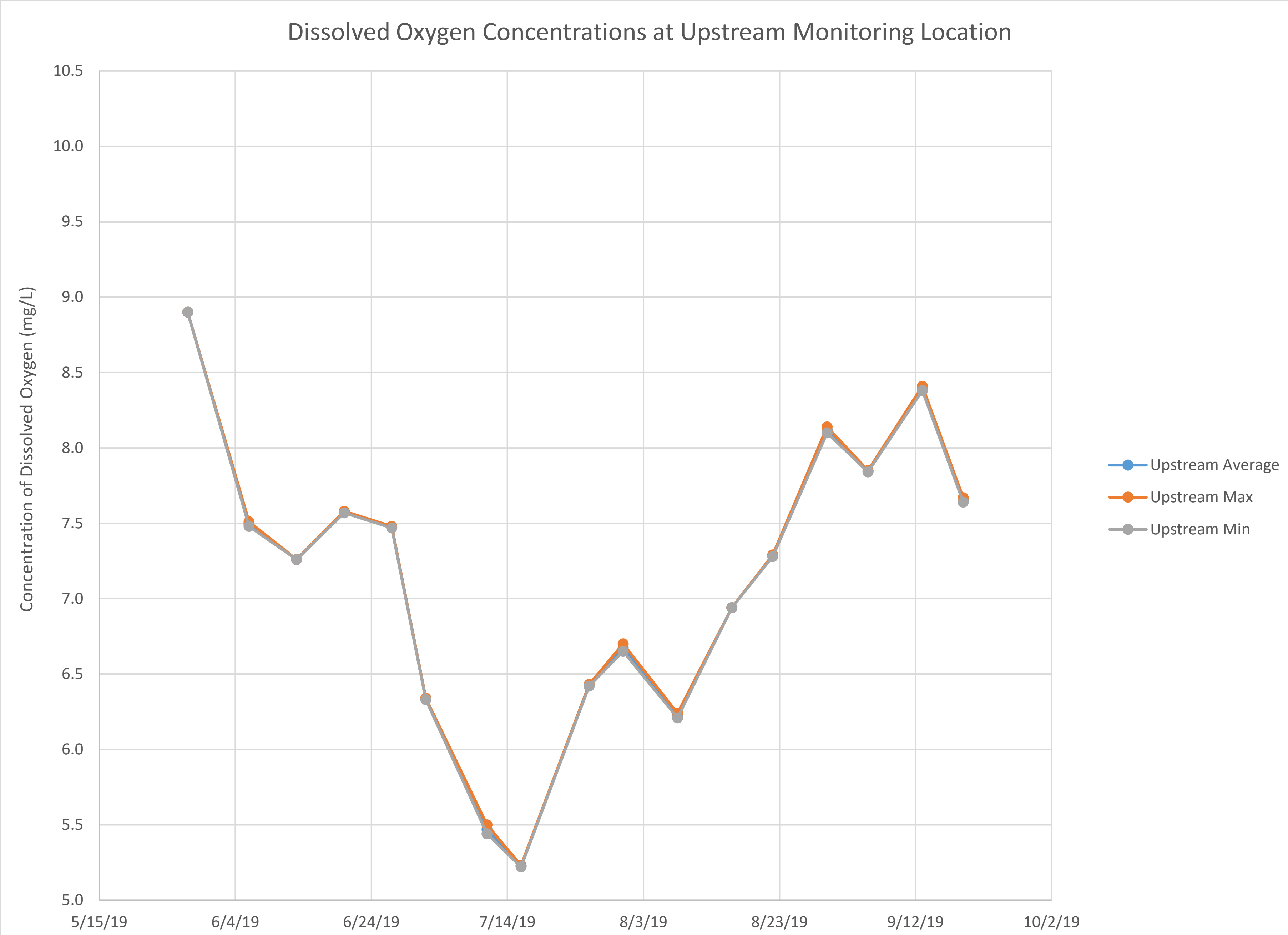
Week	Sample Date	Sample Location	Sample Time	Dissolved Oxygen (% Saturation)										
				3 ft	6 ft	9 ft	12 ft	15 ft	18 ft	21 ft	24 ft	27 ft	30 ft	33 ft
1	5/28/19	Upstream	14:16	85.9	85.8									
	5/28/19	Site 1	13:46	95.4	95.2	95.2	95.0	94.9	94.7	94.4	94.5			
	5/28/19	Site 2	13:40	94.6	94.4	94.3	94.2	94.0	93.8	93.7	93.8	93.7	93.6	93.7
	5/28/19	Site 3	13:30	95.8	95.9	95.7								
2	6/6/19	Site 1	10:12	83.0	82.5	82.1	81.9	81.8	81.4	81.3	81.1			
	6/6/19	Site 2	10:03	91.5	91.1	89.4	88.7	90.2	89.9	84.4	84.2	85.3	85.1	85.5
	6/6/19	Site 3	10:10	83.0	82.5	82.1	81.9	81.8	81.4	81.3	81.3			
	6/6/19	Upstream	11:17	82.8	82.7									
3	6/13/19	Site 1	10:33	81.0	80.7	80.5	79.8	79.1						
	6/13/19	Site 2	10:10	87.0	86.7	86.6	86.5	86.2	85.9	85.7	85.3	84.9	84.7	
	6/13/19	Site 3	10:00	86.8	87.1	86.9	86.7							
	6/13/19	Upstream	11:00	79.8	79.6									
4	6/20/19	Site 1	10:08	83.2	82.9	82.8	82.6	82.4	82.2					
	6/20/19	Site 2	9:44	86.2	86.1	85.8	86.0	85.9	85.6	85.5	85.2	84.9		
	6/20/19	Site 3	9:36	86.7	87.2	86.9	87.1	86.6	86.0					
	6/20/19	Upstream	10:35	83.9	83.7									
5	6/27/19	Site 1	9:15	82.4	82.1	81.8	81.6	81.2						
	6/27/19	Site 2	9:07	82.9	83.4	82.8	83.2	83.2	83.5	83.5				
	6/27/19	Site 3	9:00	85.9	85.5	85.4	85.1	84.6	84.6	84.4	85.1			
	6/27/19	Upstream	9:45	84.4	84.1									
6	7/2/19	Site 1	9:07	85.3	85.2	85.1	85.2	85.1	84.8	84.7	84.6			
	7/2/19	Site 2	9:14	85.3	85.1	85.0	84.9	84.6	84.6	84.5	83.9	83.9		
	7/2/19	Site 3	9:00	85.9	85.5	85.4	85.3	85.1	84.9	84.8	84.8			
	7/2/19	Upstream	9:41	74.1	73.9									
7	7/11/19	Site 1	9:50	81.4	81.3	81.2	80.4	80.3	80.3					
	7/11/19	Site 2	9:45	81.2	81.1	80.8	80.6	80.5	80.4	80.1				
	7/11/19	Site 3	9:30	81.0	80.6	80.5	80.4	80.2	79.8	79.7	79.5			
	7/11/19	Upstream	10:25	65.1	64.5									
8	7/16/19	Site 1	13:53	63.1	63.2	63.0	62.8	62.7	62.4	62.2				
	7/16/19	Site 2	13:47	64.5	63.9	63.7	63.4	63.0	62.7	62.6	62.3			
	7/16/19	Site 3	13:37	64.2	64.0	63.1	63.7	64.5	65.8	65.7				
	7/16/19	Upstream	14:18	64.7	64.3									
	7/16/19													
9	7/26/19	Site 1	9:32	75.5	75.3	75.2	74.8	74.8	74.6	74.4				
	7/26/19	Site 2	9:23	78.7	76.1	75.9	75.3	76.4	75.1	74.5	74.6	76.6	76.4	
	7/26/19	Site 3	9:16	82.5	81.9	80.3	81.1	81.0	80.2	79.6				
	7/26/19	Upstream	10:19	76.8	76.6									
10	7/31/19	Site 1	11:00	74.9	74.9	74.7	74.4	74.3	74.0	73.8				
	7/31/19	Site 2	10:55	75.9	75.5	75.3	75.1	75.0	74.8	74.7	74.5			
	7/31/19	Site 3	10:45	77.8	81.4	81.0	80.4	80.4	79.2	80.2	79.5			
	7/31/19	Upstream	11:29	78.7	77.9									
11	8/8/19	Site 1	10:35	74.1	73.8	73.7	73.5	73.4	73.4					
	8/8/19	Site 2	10:30	75.0	74.9	75.3	74.7	74.6	74.7	75.0	74.3	74.2		
	8/8/19	Site 3	10:22	81.1	80.1	79.5	79.0	78.3	77.8	78.2				
	8/8/19	Upstream	11:04	75.0	74.4									
12	8/16/19	Site 1	11:58	77.4	77.0	77.0	77.1	76.8	76.8					
	8/16/19	Site 2	11:53	78.4	78.1	77.9	77.7	77.6	77.7	78.2	77.6	77.2		
	8/16/19	Site 3	11:46	79.5	79.4	79.0	78.8	78.6	78.3	78.2	78.2	78.2		
	8/16/19	Upstream	12:33	80.8	80.6									
13	8/22/19	Site 1	13:53	80.4	79.9	80.1	80.6	80.6						
	8/22/19	Site 2	13:48	83.3	83.0	83.0	82.9	82.6	82.3	82.2	81.9	81.6		
	8/22/19	Site 3	13:42	83.4	83.1	83.0	82.7	82.5	82.4	82.1	82.1	82.0		
	8/22/19	Upstream	13:42	85.7	85.4									
14	8/30/19	Site 1	13:42	84.2	84.3	84.1	83.8	84.0	84.2	84.0				
	8/30/19	Site 2	13:36	85.2	85.0	84.8	84.7	84.4	84.0	84.1	84.2	84.2		
	8/30/19	Site 3	13:29	85.1	85.0	83.9	83.4	83.1	83.1	82.5	82.3			
	8/30/19	Upstream	14:29	88.9	88.5									
15	9/5/19	Site 1	13:47	84.8	84.6	84.3	84.2	84.1	84.0					
	9/5/19	Site 2	13:41	84.9	84.6	84.6	84.5	84.3	84.0	83.9	83.9			
	9/5/19	Site 3	13:35	86.0	85.0	84.8	84.5	84.2	84.0	83.7	83.5	83.2		
	9/5/19	Upstream	14:16	84.9	84.7									
16	9/13/19	Site 1	13:31	84.4	84.1	84.0	83.9	84.0	83.8					
	9/13/19	Site 2	13:27	84.9	84.6	84.6	84.1	83.9	83.9	83.7	83.6	83.5		
	9/13/19	Site 3	13:20	86.2	85.9	85.8	85.2	85.0	85.0	84.6	84.1	83.9		
	9/13/19	Upstream	13:57	85.5	84.8									
17	9/19/19	Site 1	14:18	83.0	83.0	82.8	82.6	82.5	82.4	82.3				
	9/19/19	Site 2	14:13	83.6	83.4	83.2	83.1	82.4	82.4	82.3	82.0	82.0	81.7	
	9/19/19	Site 3	14:07	87.3	88.0	87.5	87.3	86.8	86.1	85.6	85.2	83.8		
	9/19/19													
18	9/27/19	Site 1	9:21	85.4	81.8	81.2	81.0	81.1	82.3					
	9/27/19	Site 2	9:13	85.3	85.3	85.1	85.0	84.8	84.8	84.9	84.6	84.6		
	9/27/19	Site 3	9:08	85.1	84.9	84.7	84.8	84.8	84.6	84.6	84.2	84.0		
	9/27/19	Upstream	9:49	78.5	78.1									

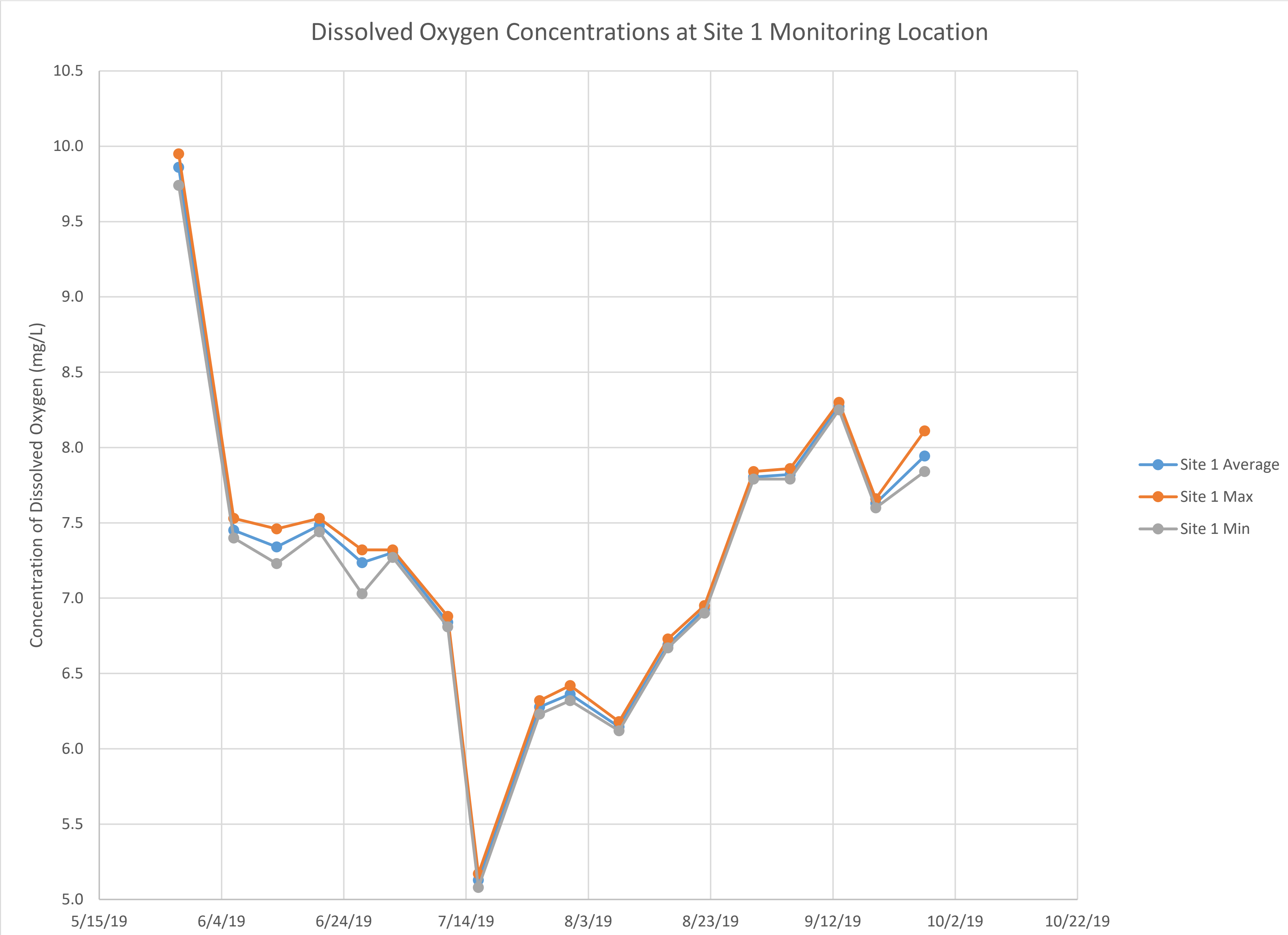
Week	Sample Date	Sample Location	Sample Time	Water Temperature (°C) 3 ft	6 ft	9 ft	12 ft	15 ft	18 ft	21 ft	24 ft	27 ft	30 ft	33 ft
1	5/28/19	Upstream	14:16	13.8	13.8									
	5/28/19	Site 1	13:46	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5			
	5/28/19	Site 2	13:40	13.5	13.5	13.5	13.5	13.5	13.4	13.4	13.5	13.5	13.5	13.5
	5/28/19	Site 3	13:30	13.5	13.5	13.5								
2	6/6/19	Site 1	10:12	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9			
	6/6/19	Site 2	10:03	19.9	19.9	19.9	19.9	20.0	19.9	19.9	19.9	19.9	19.9	19.9
	6/6/19	Site 3	10:10	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9			
	6/6/19	Upstream	11:17	20.3	20.1									
3	6/13/19	Site 1	10:33	19.8	19.8	19.8	19.8	19.8						
	6/13/19	Site 2	10:10	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	
	6/13/19	Site 3	10:00	19.8	19.8	19.8	19.8							
	6/13/19	Upstream	11:00	19.8	19.8									
4	6/20/19	Site 1	10:08	20.2	20.2	20.2	20.2	20.2	20.2					
	6/20/19	Site 2	9:44	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2		
	6/20/19	Site 3	9:36	20.2	20.2	20.2	20.2	20.2	20.2					
	6/20/19	Upstream	10:35	20.2	20.2									
5	6/27/19	Site 1	9:15	21.1	21.1	21.2	21.2	21.2						
	6/27/19	Site 2	9:07	21.2	21.2	21.2	21.2	21.2	21.2	21.2				
	6/27/19	Site 3	9:00	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2			
	6/27/19	Upstream	9:45	21.2	21.2									
6	7/2/19	Site 1	9:07	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0			
	7/2/19	Site 2	9:14	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0		
	7/2/19	Site 3	9:00	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0			
	7/2/19	Upstream	9:41	23.1	23.1									
7	7/11/19	Site 1	9:50	23.8	23.8	23.8	23.8	23.8	23.8					
	7/11/19	Site 2	9:45	23.7	23.8	23.8	23.8	23.8	23.8	23.8				
	7/11/19	Site 3	9:30	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7			
	7/11/19	Upstream	10:25	23.9	23.9									
8	7/16/19	Site 1	13:53	25.7	25.6	25.6	25.6	25.6	25.6	25.6				
	7/16/19	Site 2	13:47	25.7	25.7	25.7	25.6	25.6	25.6	25.6	25.6			
	7/16/19	Site 3	13:37	25.6	25.6	25.6	25.6	25.6	25.6	25.6				
	7/16/19	Upstream	14:18	26.1	26.0									
	7/16/19													
9	7/26/19	Site 1	9:32	24.3	24.3	24.3	24.3	24.3	24.3	24.3				
	7/26/19	Site 2	9:23	24.2	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	
	7/26/19	Site 3	9:16	24.2	24.2	24.2	24.2	24.3	24.3	24.3				
	7/26/19	Upstream	10:19	24.2	24.3									
10	7/31/19	Site 1	11:00	23.2	23.2	23.2	23.2	23.2	23.2	23.2				
	7/31/19	Site 2	10:55	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2			
	7/31/19	Site 3	10:45	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2			
	7/31/19	Upstream	11:29	23.4	23.3									
11	8/8/19	Site 1	10:35	24.5	24.5	24.5	24.5	24.5	24.5					
	8/8/19	Site 2	10:30	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5		
	8/8/19	Site 3	10:22	24.5	24.5	24.5	24.5	24.5	24.5	24.5				
	8/8/19	Upstream	11:04	24.5	24.5									
12	8/16/19	Site 1	11:58	22.4	22.4	22.4	22.4	22.4	22.4					
	8/16/19	Site 2	11:53	22.5	22.5	22.5	22.5	22.4	22.4	22.4	22.4	22.4		
	8/16/19	Site 3	11:46	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4		
	8/16/19	Upstream	12:33	22.9	22.9									
13	8/22/19	Site 1	13:53	22.7	22.8	22.8	22.8	22.8						
	8/22/19	Site 2	13:48	23.0	23.0	23.0	22.9	23.0	23.0	23.0	23.0	23.0		
	8/22/19	Site 3	13:42	22.9	22.9	22.9	22.9	22.9	22.9	22.9	22.9	22.9		
	8/22/19	Upstream	13:42	23.4	23.4									
14	8/30/19	Site 1	13:42	19.1	19.1	19.1	19.0	19.0	19.1	19.1				
	8/30/19	Site 2	13:36	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1	19.1		
	8/30/19	Site 3	13:29	19.2	19.3	19.1	19.1	19.1	19.1	19.1	19.0			
	8/30/19	Upstream	14:29	19.6	19.7									
15	9/5/19	Site 1	13:47	19.0	19.0	19.0	19.0	19.0	19.0					
	9/5/19	Site 2	13:41	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0			
	9/5/19	Site 3	13:35	19.2	19.1	19.1	19.1	19.1	19.0	19.0	19.0	19.0		
	9/5/19	Upstream	14:16	19.1	19.1									
16	9/13/19	Site 1	13:31	16.1	16.1	16.1	16.1	16.1	16.1					
	9/13/19	Site 2	13:27	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1		
	9/13/19	Site 3	13:20	16.2	16.2	16.1	16.1	16.1	16.1	16.1	16.1	16.1		
	9/13/19	Upstream	13:57	16.0	16.0									
17	9/19/19	Site 1	14:18	19.2	19.2	19.2	19.2	19.2	19.2	19.2				
	9/19/19	Site 2	14:13	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	
	9/19/19	Site 3	14:07	19.3	19.3	19.3	19.3	19.2	19.2	19.2	19.2	19.2		
	9/19/19													
18	9/27/19	Site 1	9:21	16.6	16.6	16.6	16.6	16.6	16.6					
	9/27/19	Site 2	9:13	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6		
	9/27/19	Site 3	9:08	16.8	16.7	16.6	16.6	16.6	16.6	16.6	16.6	16.6		
	9/27/19	Upstream	9:49	16.9	16.8									

Week	Sample Date	Sample Location	Sample Time	Habitat (Pool, Run, Riffle)	Notes
1	5/28/19	Upstream	14:16	Run	Good Flow
	5/28/19	Site 1	13:46	Pool	Abundant foam, site at end of apron
	5/28/19	Site 2	13:40	Run	Abundant foam
	5/28/19	Site 3	13:30	Run	Abundant foam
2	6/6/19	Site 1	10:12	Pool	
	6/6/19	Site 2	10:03	Run	
	6/6/19	Site 3	10:10	Pool	
	6/6/19	Upstream	11:17	Run	New sampling location at slide gate #1 approximatley 10' from intake
3	6/13/19	Site 1	10:33	Pool	
	6/13/19	Site 2	10:10	Run	
	6/13/19	Site 3	10:00	Run	
	6/13/19	Upstream	11:00	Run	
4	6/20/19	Site 1	10:08	Pool	
	6/20/19	Site 2	9:44	Run	
	6/20/19	Site 3	9:36	Run	slower flows are helping us to get the sensor to the bottom of the river
	6/20/19	Upstream	10:35	Run	
5	6/27/19	Site 1	9:15	Pool	
	6/27/19	Site 2	9:07	Run	
	6/27/19	Site 3	9:00	Run	
	6/27/19	Upstream	9:45	Run	
6	7/2/19	Site 1	9:07	Run	foam floating on the water surface. Water very turbulent.
	7/2/19	Site 2	9:14	Run	foam floating on the water surface. Water very turbulent.
	7/2/19	Site 3	9:00	Run	foam floating on the water surface
	7/2/19	Upstream	9:41	Run	
7	7/11/19	Site 1	9:50	Run	
	7/11/19	Site 2	9:45	Run	
	7/11/19	Site 3	9:30	Run	
	7/11/19	Upstream	10:25	Riffle	
8	7/16/19	Site 1	13:53	Riffle	water flow (cfs) over the spillway has slowed down
	7/16/19	Site 2	13:47	Pool	water flow (cfs) over the spillway has slowed down
	7/16/19	Site 3	13:37	Pool	water flow (cfs) over the spillway has slowed down
	7/16/19	Upstream	14:18	Run	
	7/16/19				
9	7/26/19	Site 1	9:32	Run	
	7/26/19	Site 2	9:23	Run	
	7/26/19	Site 3	9:16	Run	
	7/26/19	Upstream	10:19	Run	
10	7/31/19	Site 1	11:00	Riffle	
	7/31/19	Site 2	10:55	Riffle	
	7/31/19	Site 3	10:45	Riffle	
	7/31/19	Upstream	11:29	Run	
11	8/8/19	Site 1	10:35	Riffle	
	8/8/19	Site 2	10:30		
	8/8/19	Site 3	10:22	Run	
	8/8/19	Upstream	11:04	Run	
12	8/16/19	Site 1	11:58	Run	
	8/16/19	Site 2	11:53	Riffle	
	8/16/19	Site 3	11:46	Riffle	
	8/16/19	Upstream	12:33	Riffle	
13	8/22/19	Site 1	13:53	Run	
	8/22/19	Site 2	13:48	Riffle	
	8/22/19	Site 3	13:42	Pool	
	8/22/19	Upstream	13:42	Riffle	
14	8/30/19	Site 1	13:42	Run	
	8/30/19	Site 2	13:36	Run	
	8/30/19	Site 3	13:29	Pool	
	8/30/19	Upstream	14:29	Run	
15	9/5/19	Site 1	13:47	Run	
	9/5/19	Site 2	13:41	Riffle	
	9/5/19	Site 3	13:35	Riffle	
	9/5/19	Upstream	14:16	Riffle	
16	9/13/19	Site 1	13:31	Run	
	9/13/19	Site 2	13:27	Run	Some Foam on Water
	9/13/19	Site 3	13:20	Riffle	Some Foam on Water
	9/13/19	Upstream	13:57	Run	
17	9/19/19	Site 1	14:18	Run	No foam coming out of the PowerHouse.
	9/19/19	Site 2	14:13	Riffle	Foam Blanket 10'X75' no other foam around it.
	9/19/19	Site 3	14:07	Run	Small amounts of foam on the water at this site.
	9/19/19			Run	Sampling from Slide Gate 2.
18	9/27/19	Site 1	9:21	Run	Foam floating on the water surface.
	9/27/19	Site 2	9:13	Run	Foam floating on the water surface.
	9/27/19	Site 3	9:08	Run	Foam floating on the water surface.
	9/27/19	Upstream	9:49	Run	Sampling from Slide Gate 2.

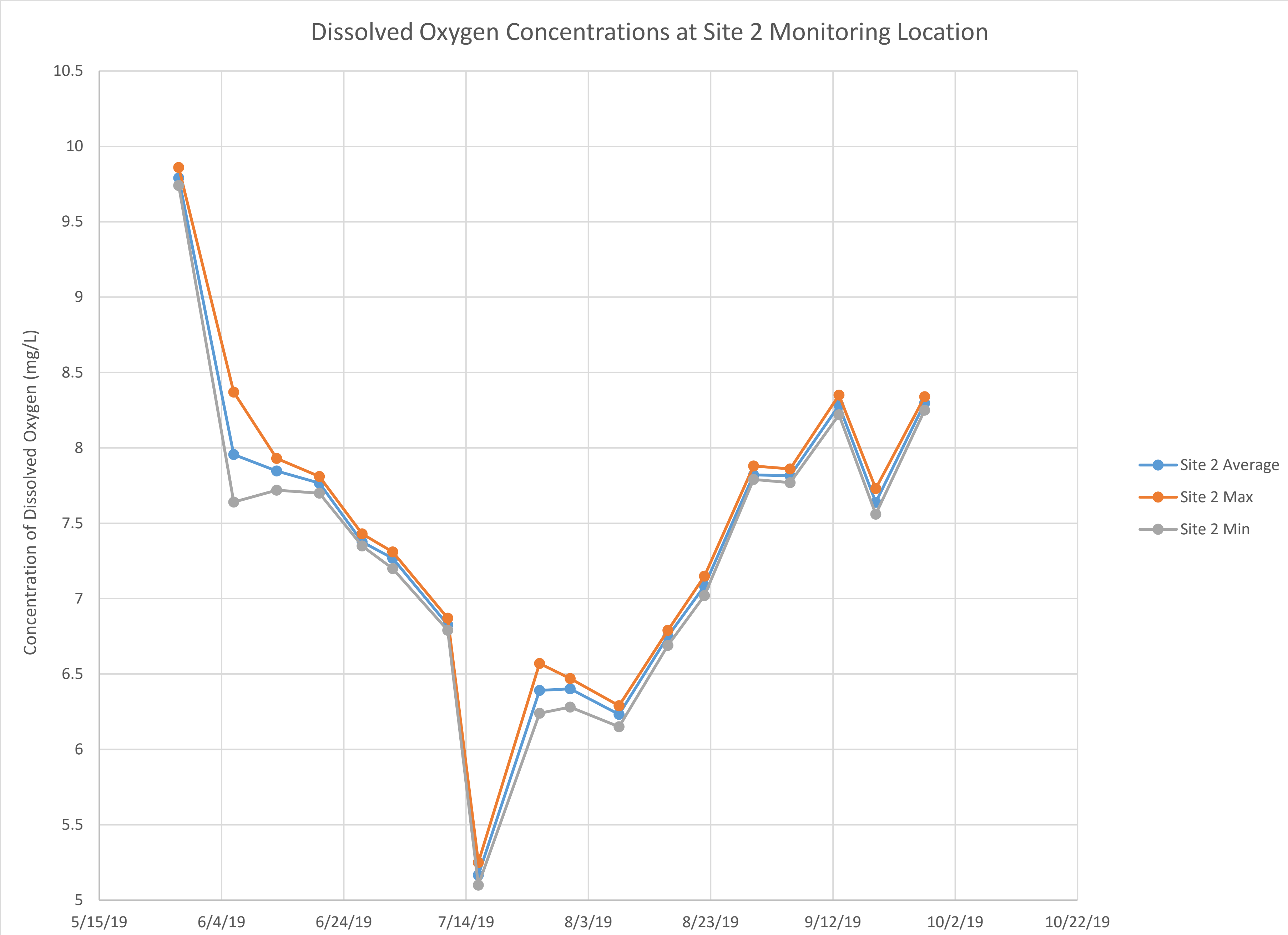
Appendix C

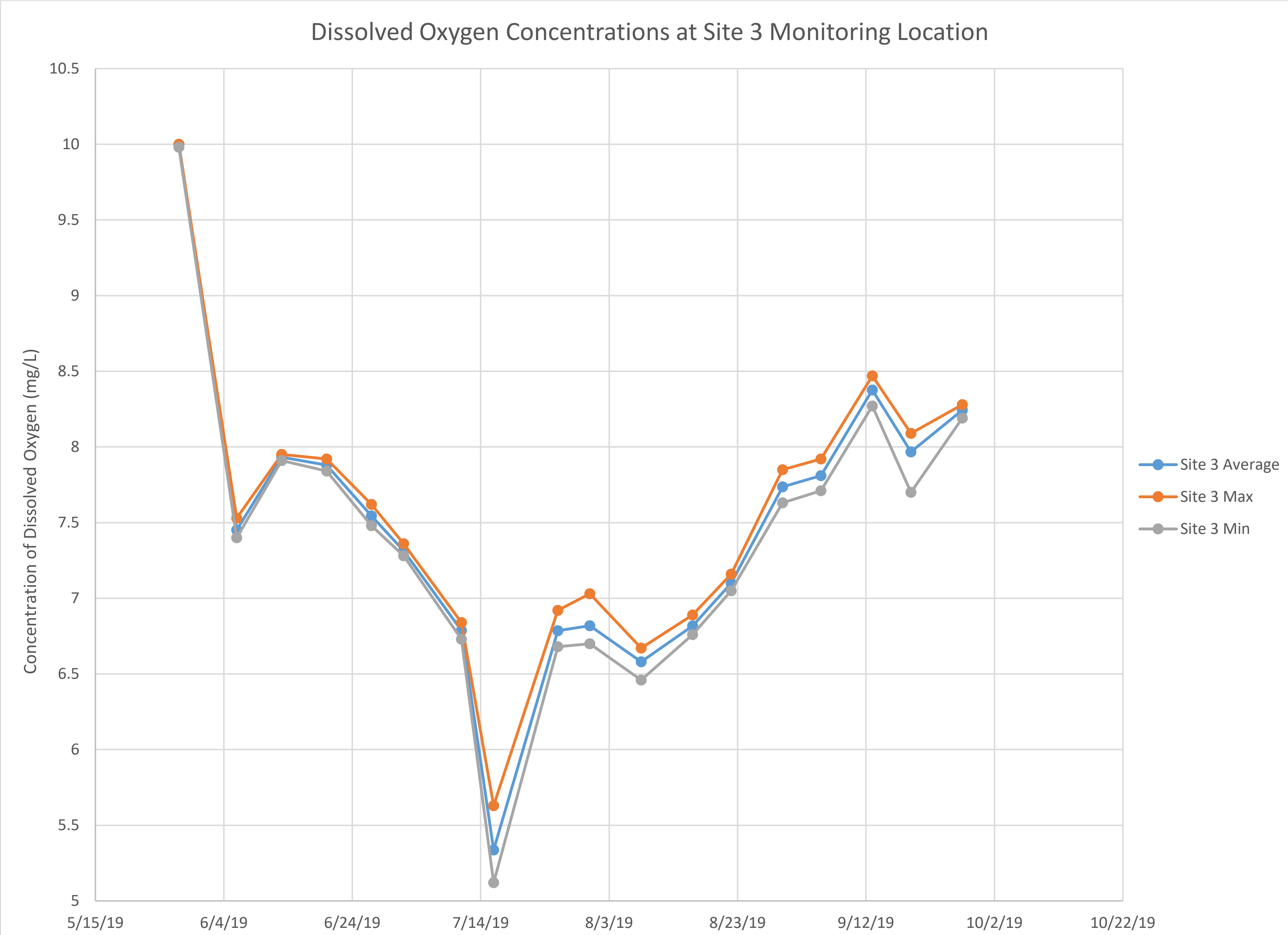
Dissolved Oxygen and Temperature Charts


Dissolved Oxygen Concentrations at Upstream Monitoring Location
Concentration of Dissolved Oxygen (mg/L)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
Upstream Average
Upstream Max
Upstream Min

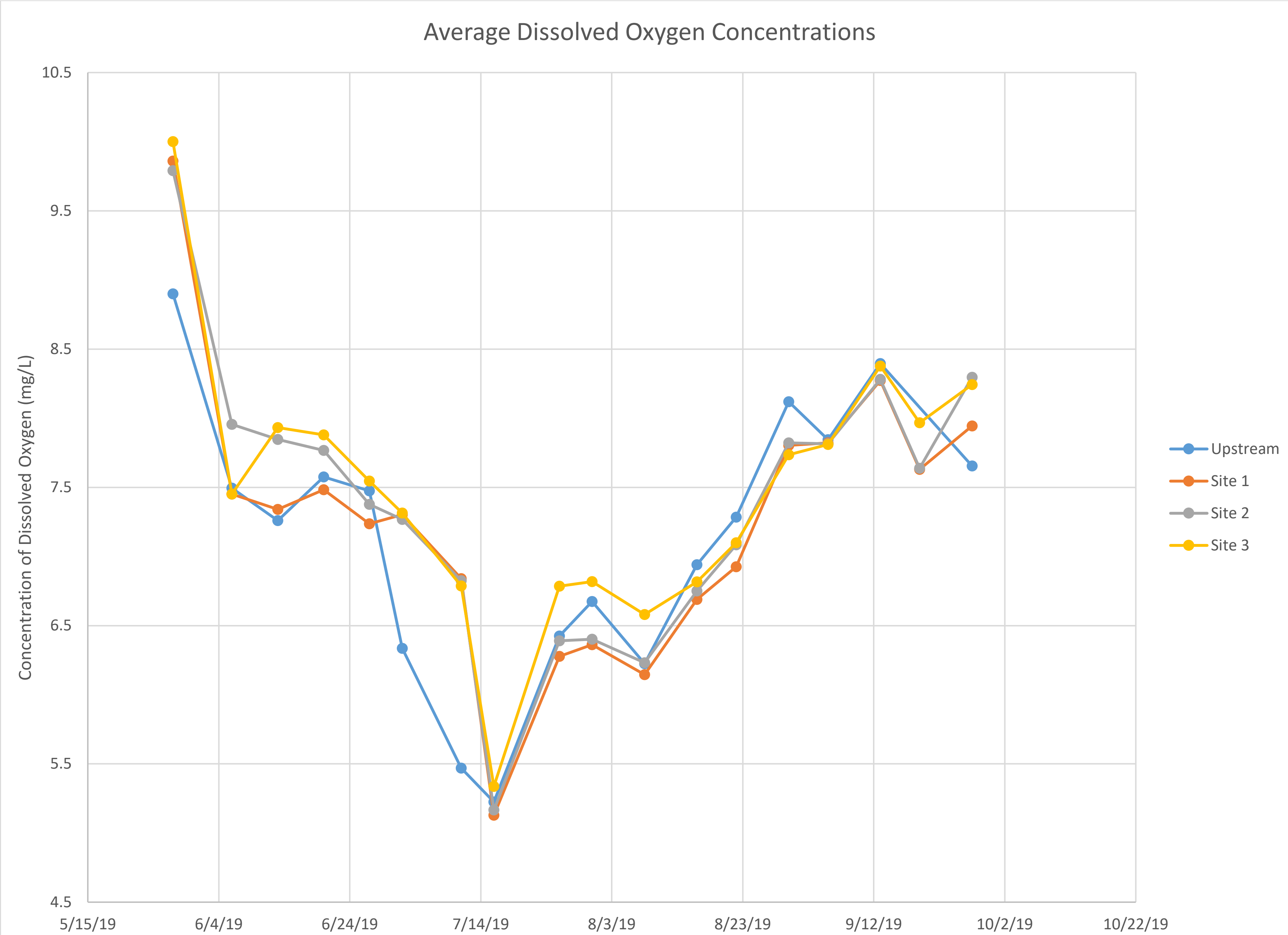


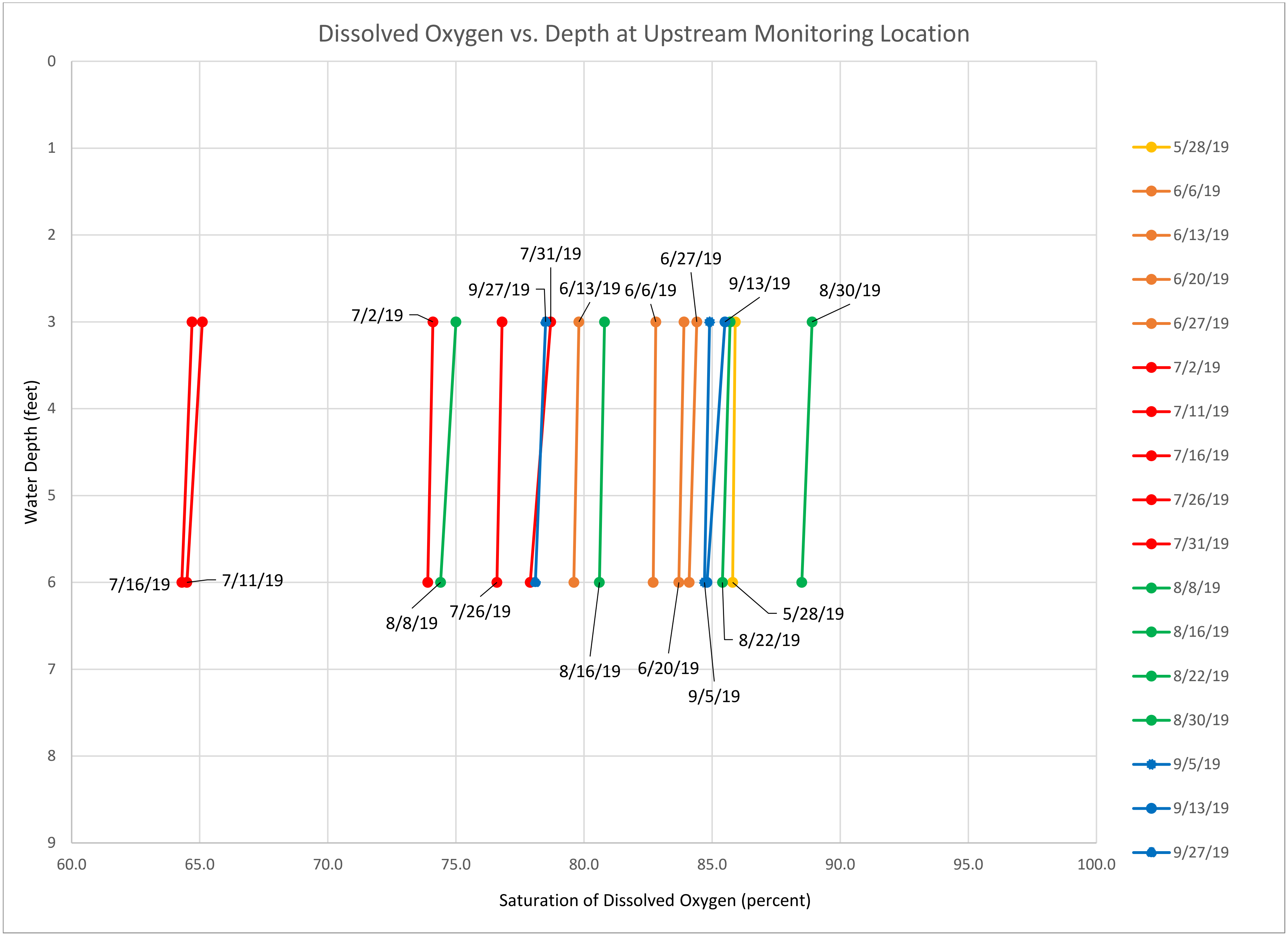
Dissolved Oxygen Concentrations at Site 1 Monitoring Location
Concentration of Dissolved Oxygen (mg/L)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 1 Average
Site 1 Max
Site 1 Min


Dissolved Oxygen Concentrations at Site 2 Monitoring Location
Concentration of Dissolved Oxygen (mg/L)
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 2 Average
Site 2 Max
Site 2 Min

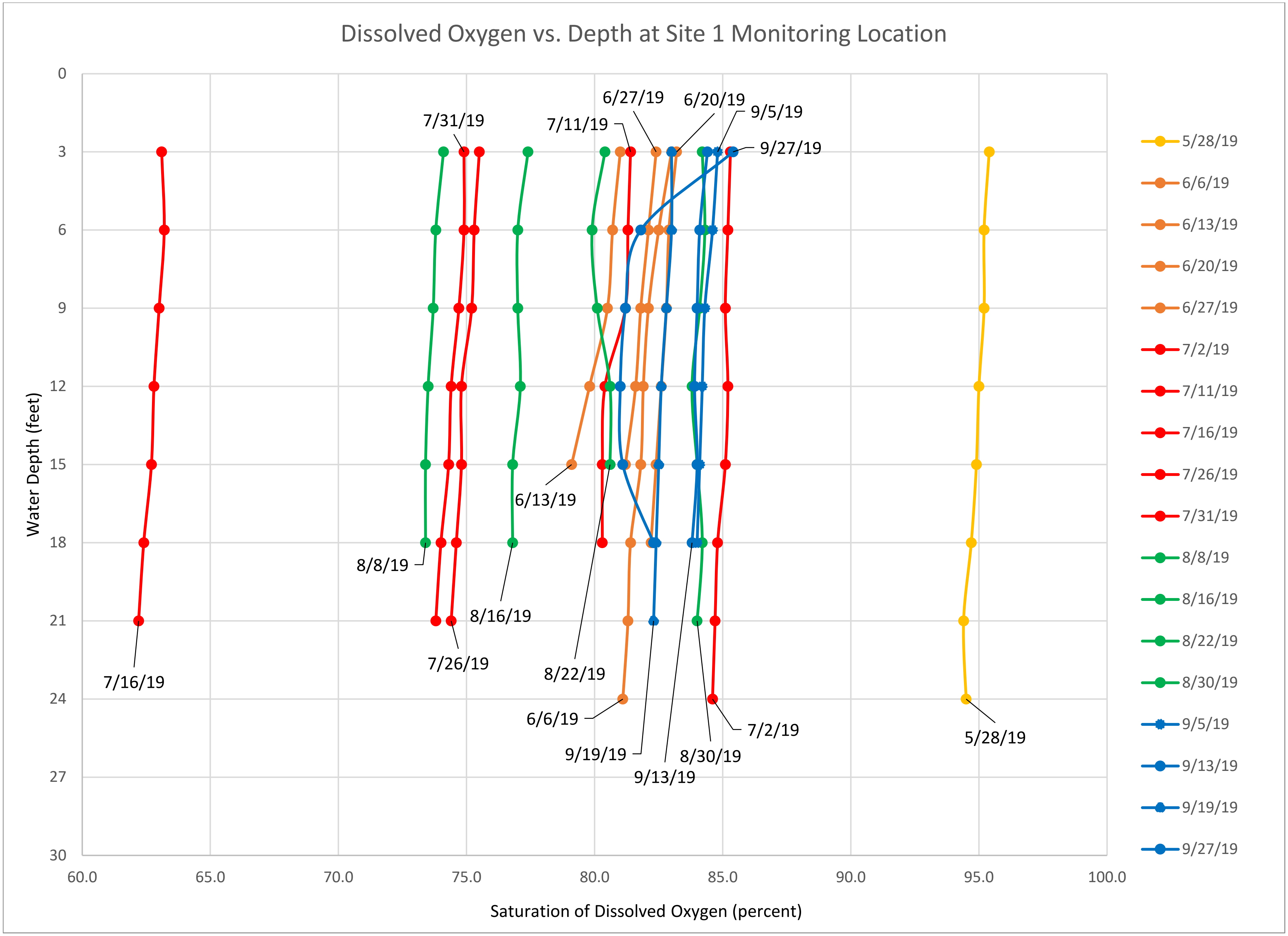


Dissolved Oxygen Concentrations at Site 3 Monitoring Location
Concentration of Dissolved Oxygen (mg/L)
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 3 Average
Site 3 Max
Site 3 Min


Average Dissolved Oxygen Concentrations
Concentration of Dissolved Oxygen (mg/L)
10.5
9.5
8.5
7.5
6.5
5.5
4.5
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Upstream
Site 1
Site 2
Site 3



Dissolved Oxygen vs. Depth at Upstream Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
1
2
3
4
5
6
7
8
9
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
7/31/19
6/27/19
9/27/19
6/13/19
6/6/19
9/13/19
8/30/19
7/2/19
7/16/19
7/11/19
8/8/19
7/26/19
5/28/19
8/22/19
8/16/19
6/20/19
9/5/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/27/19


Dissolved Oxygen vs. Depth at Site 1 Monitoring Location
Water Depth (feet)
0
3
6
9
12
15
18
21
24
27
30
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
Saturation of Dissolved Oxygen (percent)
7/31/19
7/11/19
6/27/19
6/20/19
9/5/19
9/27/19
6/13/19
8/8/19
8/16/19
7/16/19
7/26/19
8/22/19
6/6/19
9/19/19
9/13/19
8/30/19
7/2/19
5/28/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
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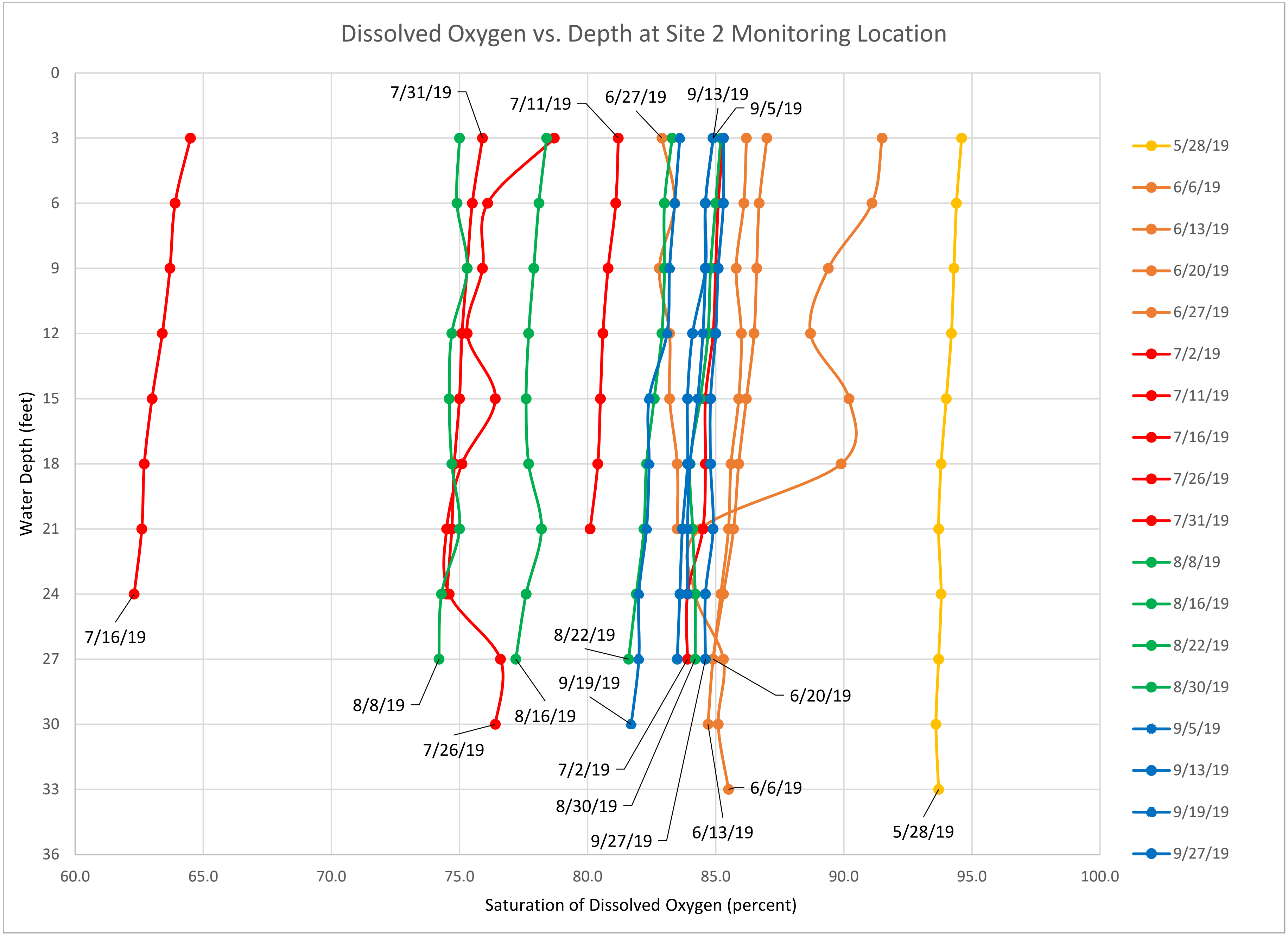
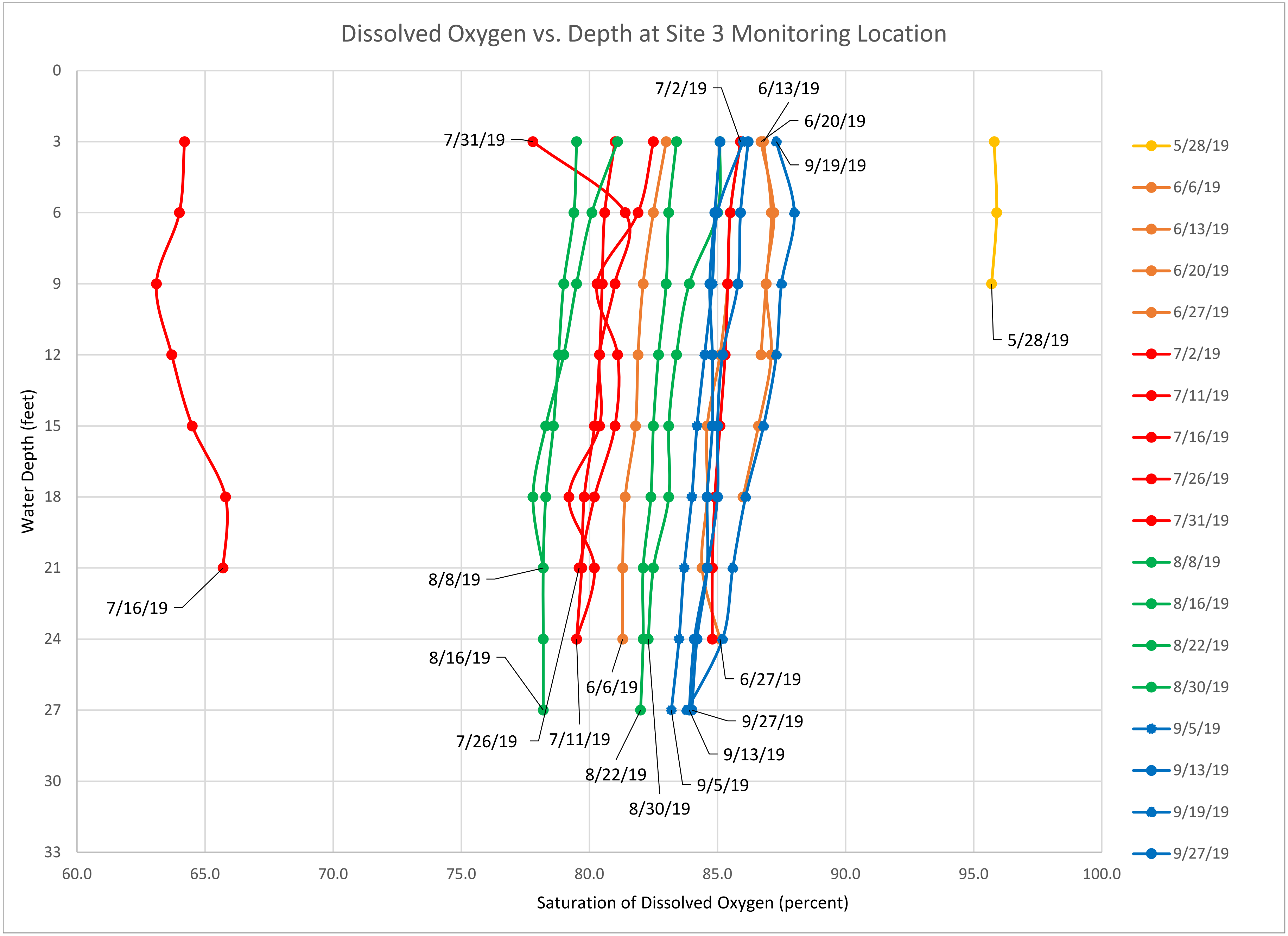
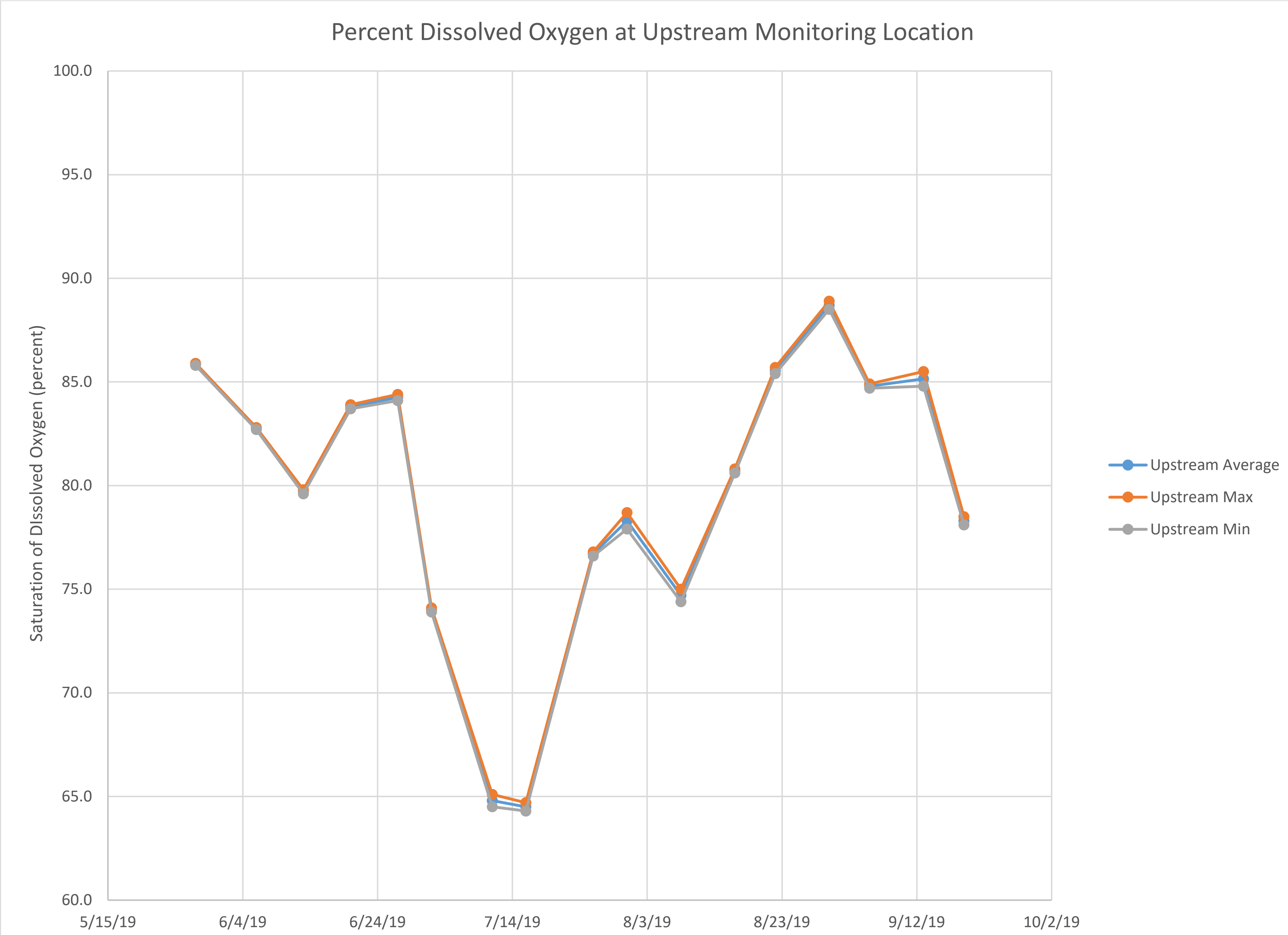
9/13/19
9/19/19
9/27/19



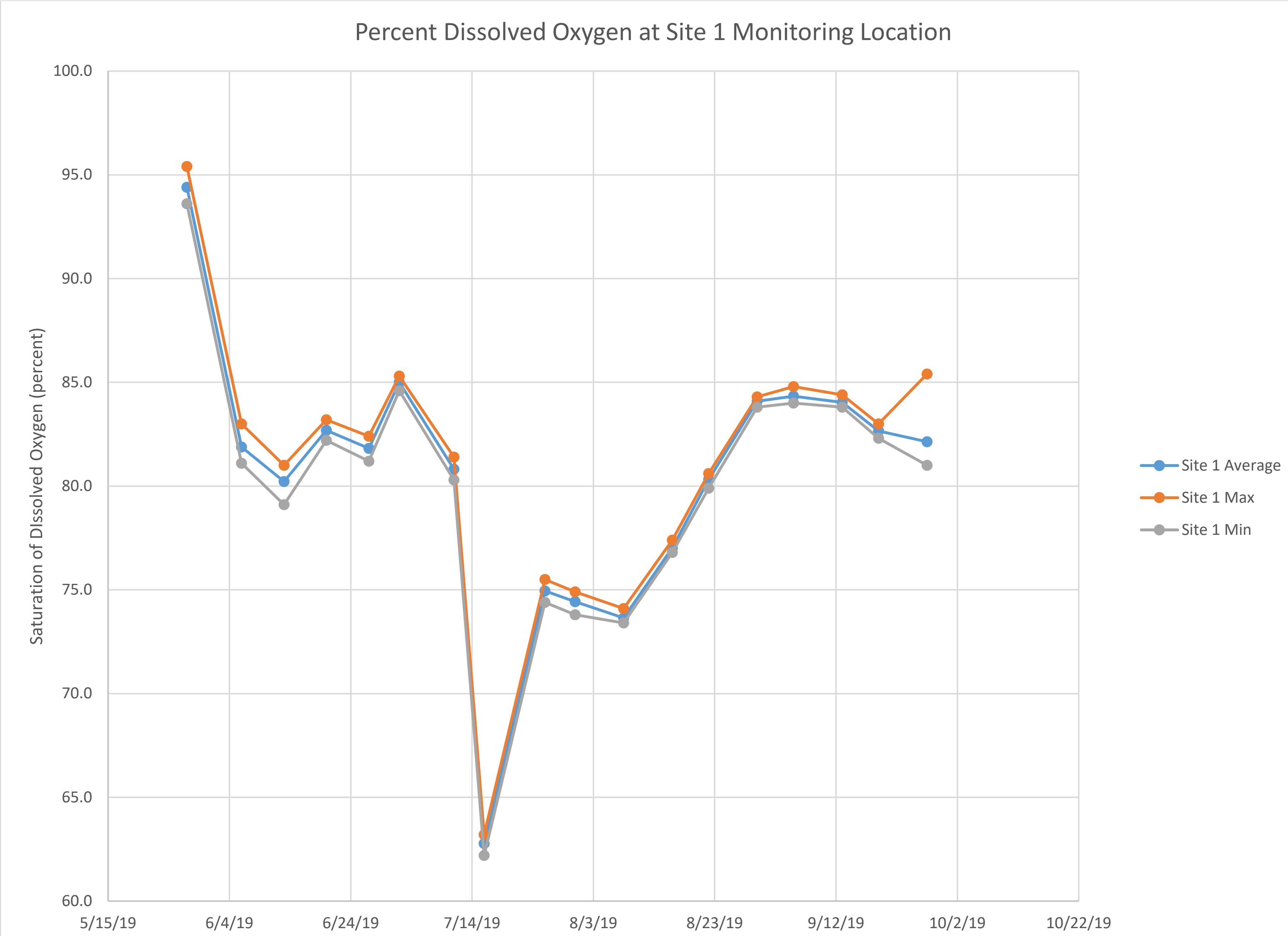
Dissolved Oxygen vs. Depth at Site 2 Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
3
6
9
12
15
18
21
24
27
30
33
36
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
7/31/19
7/11/19
6/27/19
9/13/19
9/5/19
7/16/19
8/22/19
9/19/19
6/20/19
8/8/19
8/16/19
7/26/19
7/2/19
8/30/19
9/27/19
6/13/19
6/6/19
5/28/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/19/19
9/27/19

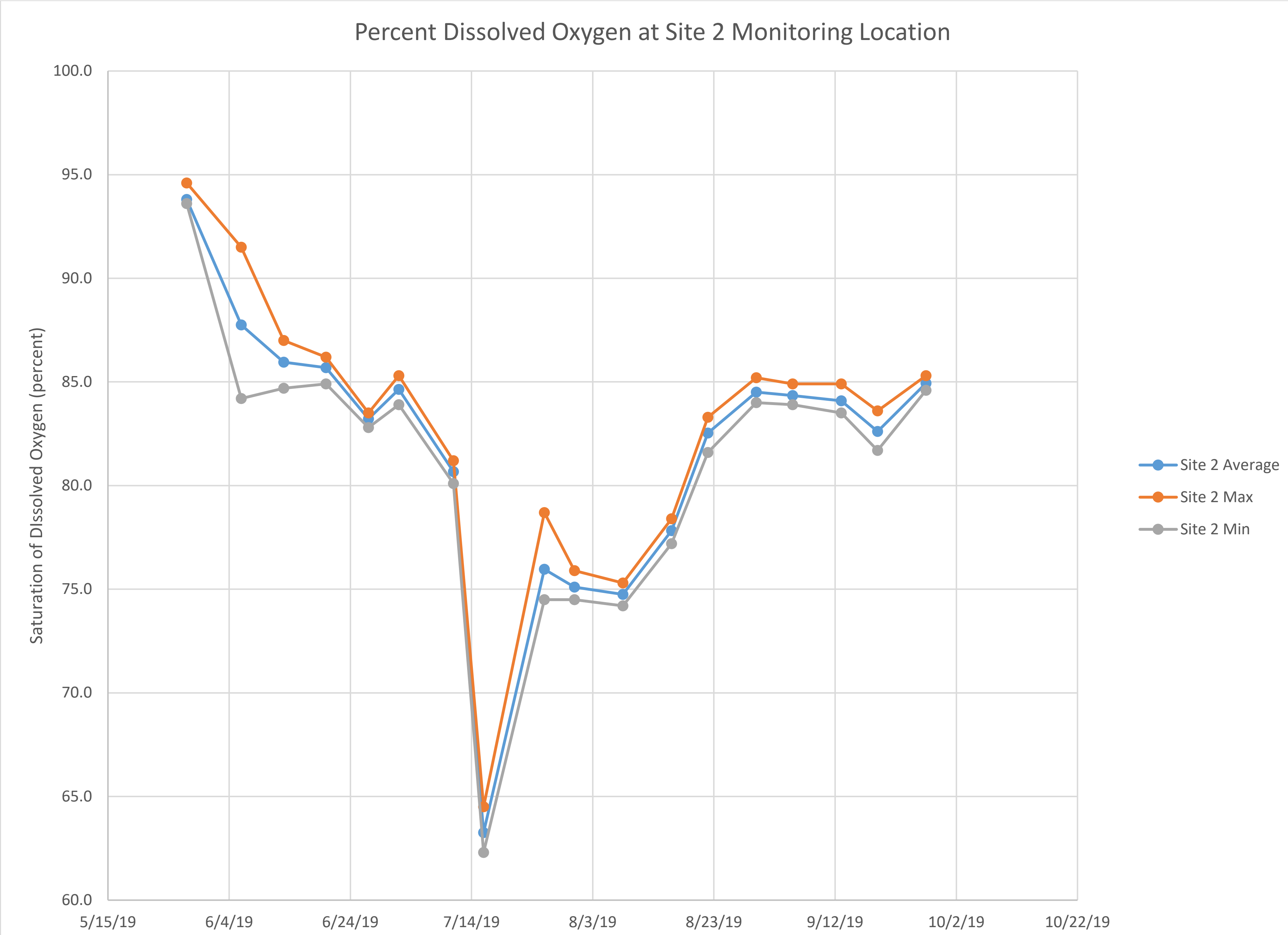


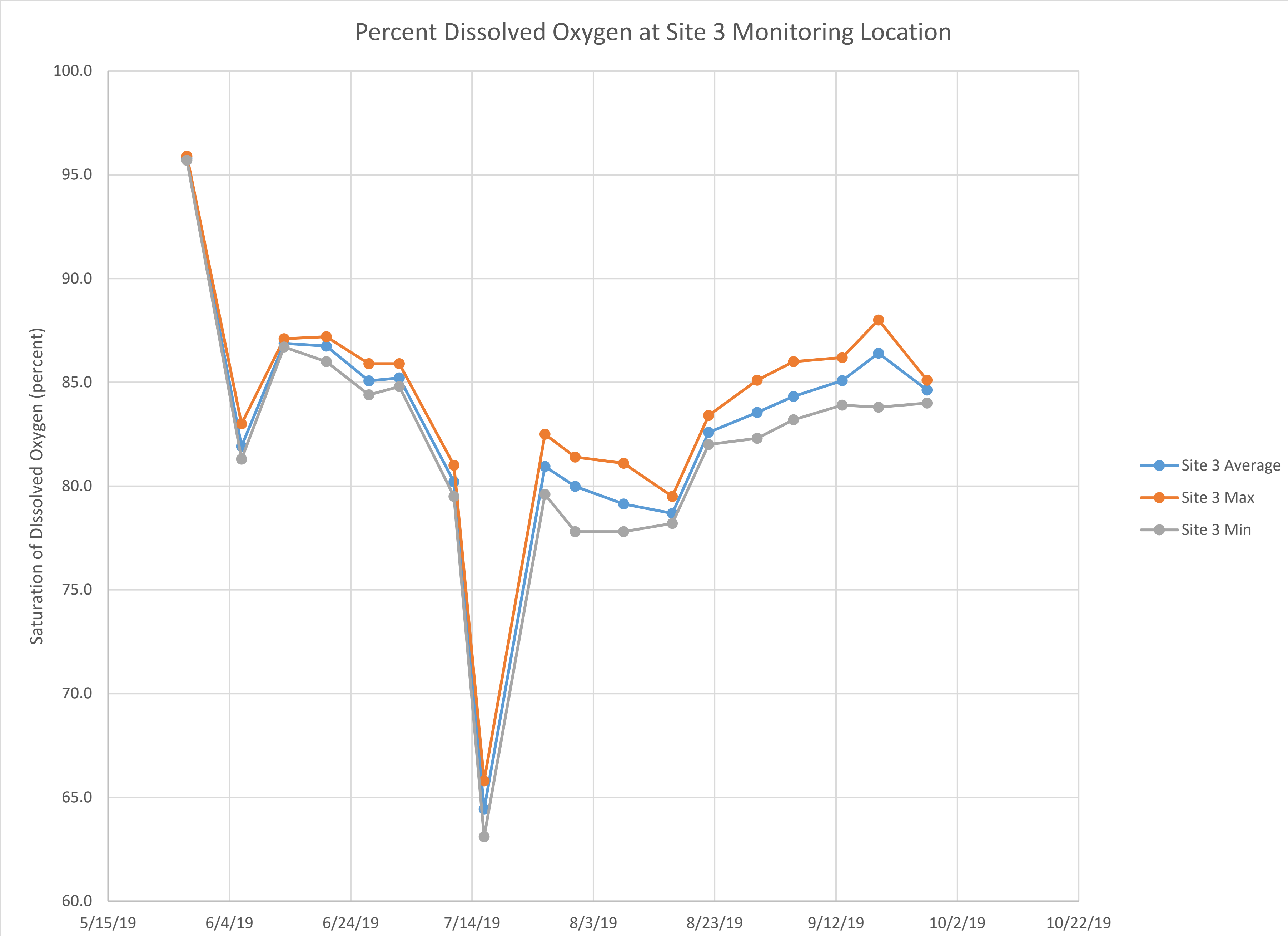
Dissolved Oxygen vs. Depth at Site 3 Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
3
6
9
12
15
18
21
24
27
30
33
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
7/2/19
6/13/19
6/20/19
9/19/19
7/31/19
5/28/19
7/16/19
8/8/19
8/16/19
6/6/19
6/27/19
9/27/19
9/13/19
7/26/19
7/11/19
8/22/19
9/5/19
8/30/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/19/19
9/27/19



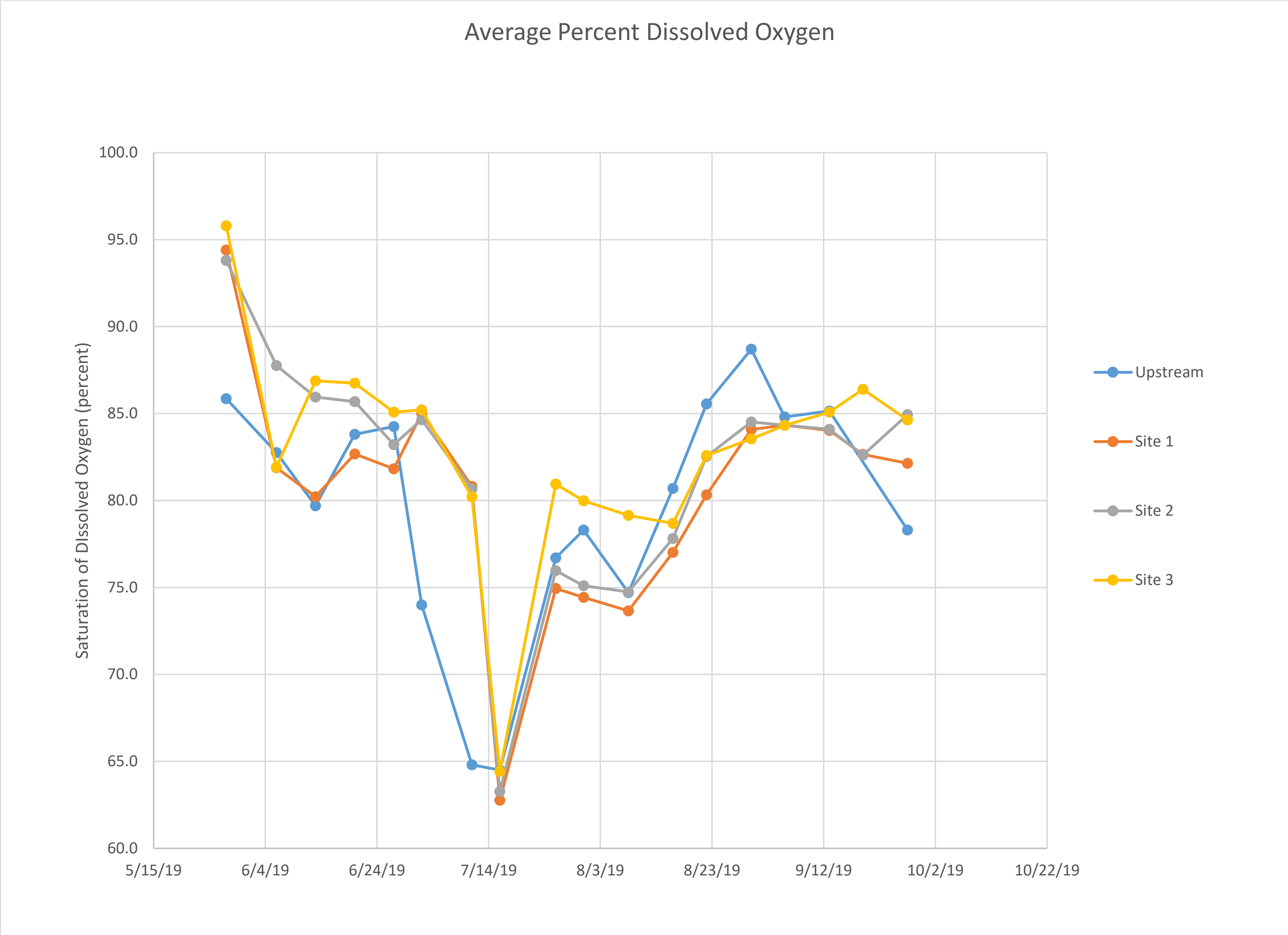
Percent Dissolved Oxygen at Upstream Monitoring Location
Saturation of DIssolved Oxygen (percent)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
Upstream Average
Upstream Max
Upstream Min

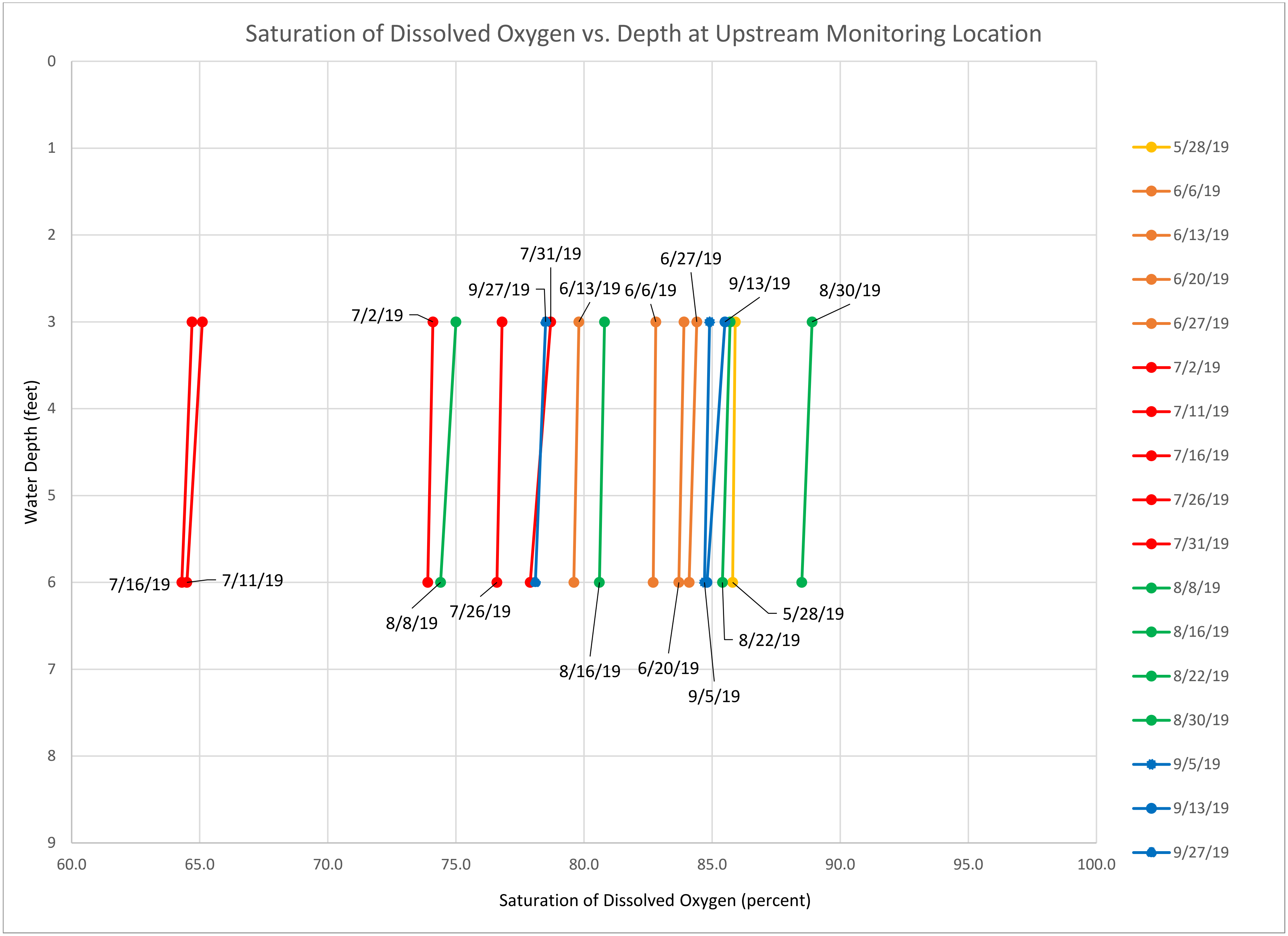

Percent Dissolved Oxygen at Site 1 Monitoring Location
Saturation of DIssolved Oxygen (percent)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 1 Average
Site 1 Max
Site 1 Min

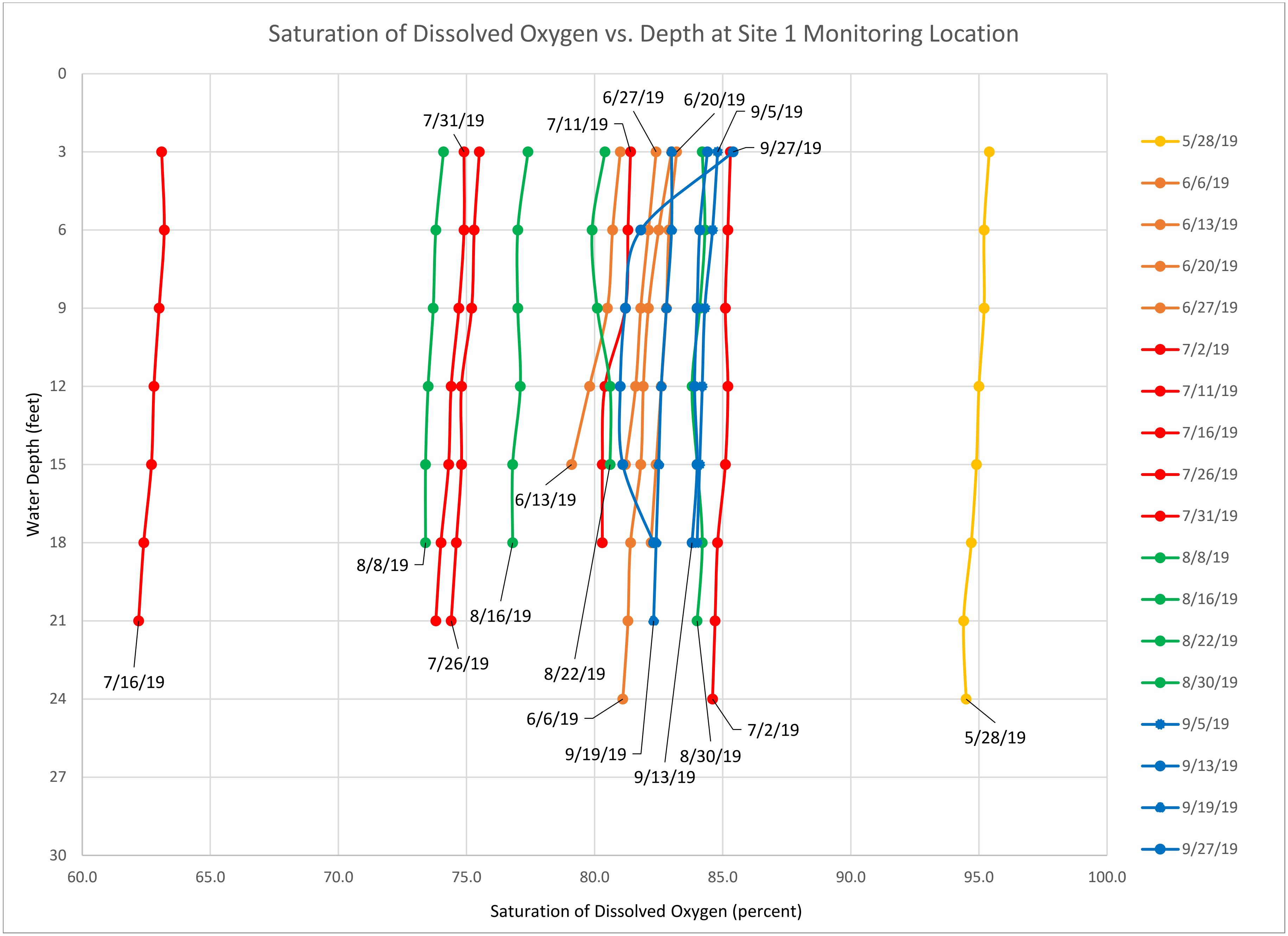

Percent Dissolved Oxygen at Site 2 Monitoring Location
Saturation of DIssolved Oxygen (percent)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 2 Average
Site 2 Max
Site 2 Min

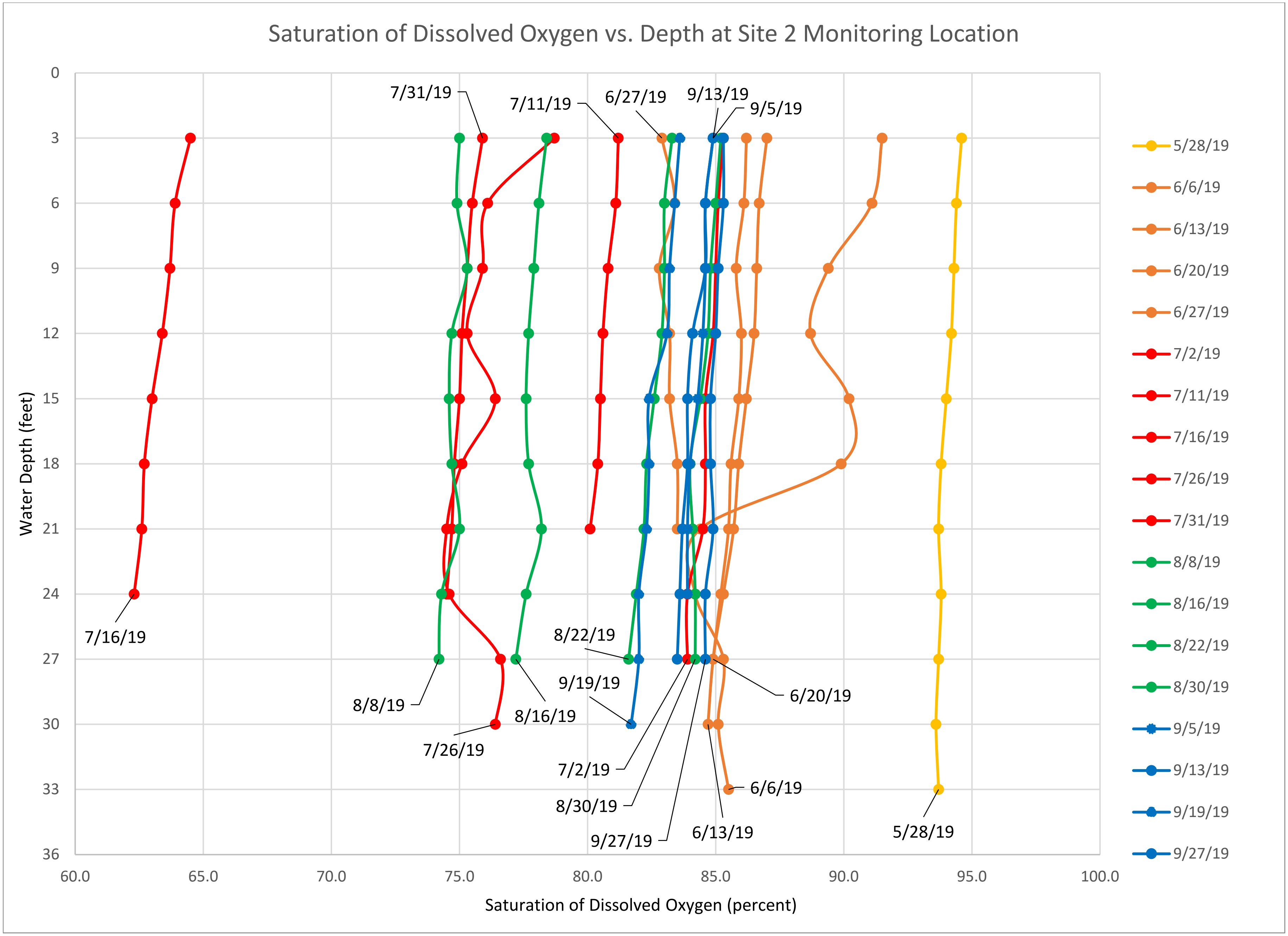


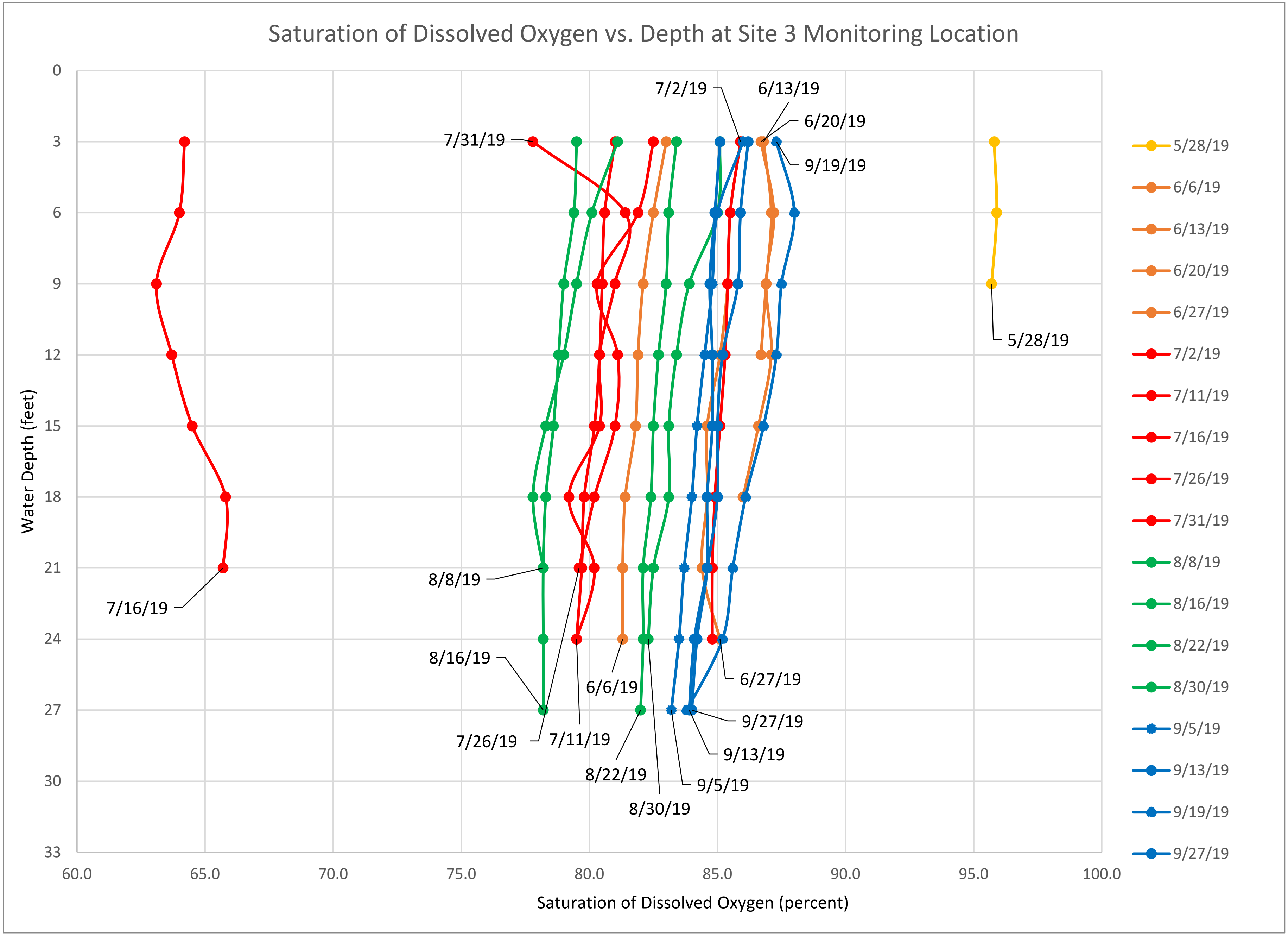
Percent Dissolved Oxygen at Site 3 Monitoring Location
Saturation of Dissolved Oxygen (percent)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 3 Average
Site 3 Max
Site 3 Min


Average Percent Dissolved Oxygen
Saturation of DIssolved Oxygen (percent)
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Upstream
Site 1
Site 2
Site 3

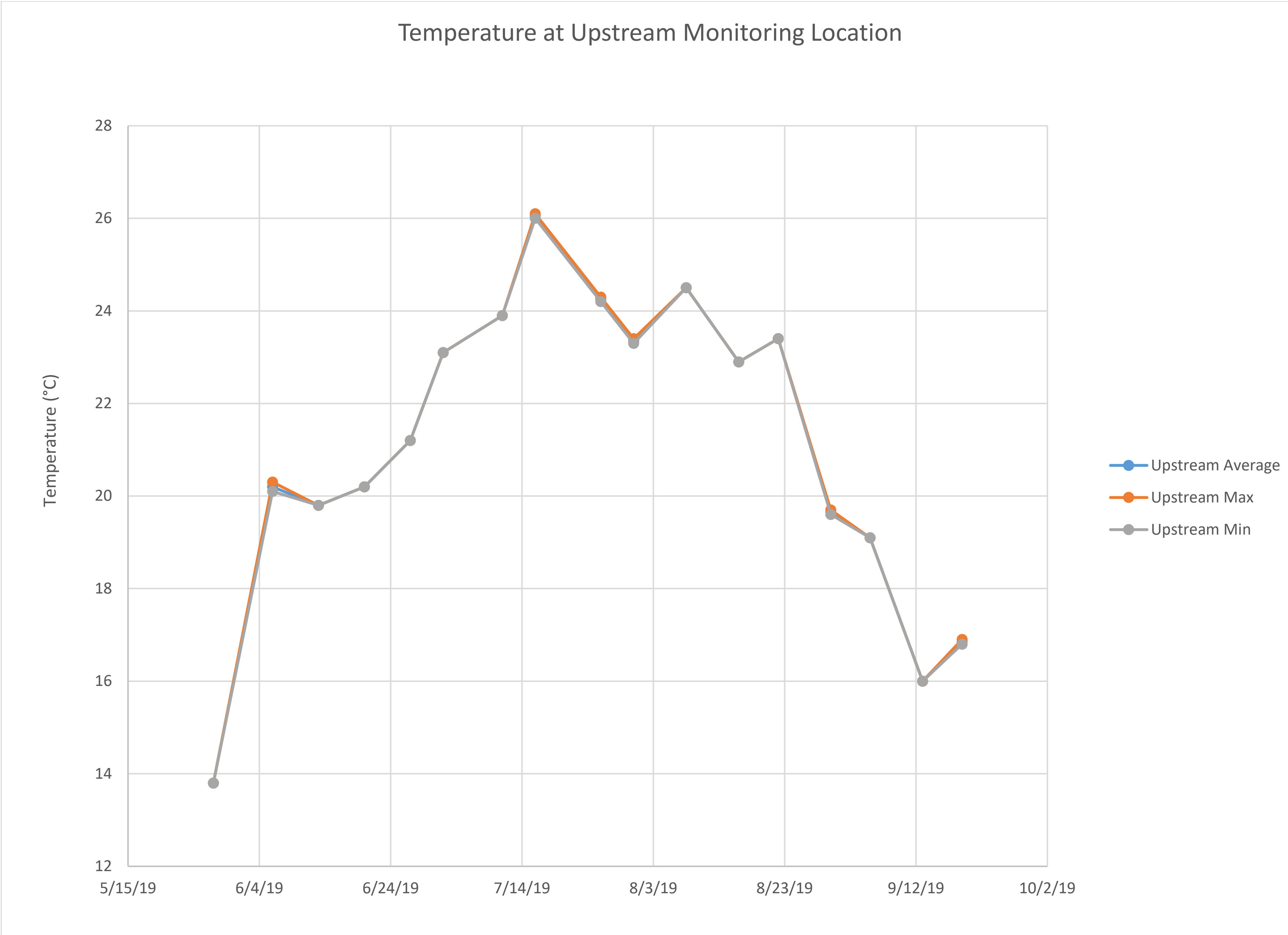

Saturation of Dissolved Oxygen vs. Depth at Upstream Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
1
2
3
4
5
6
7
8
9
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
7/31/19
6/27/19
9/27/19
6/13/19
6/6/19
9/13/19
8/30/19
7/2/19
7/16/19
7/11/19
8/8/19
7/26/19
5/28/19
8/22/19
8/16/19
6/20/19
9/5/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/27/19


Saturation of Dissolved Oxygen vs. Depth at Site 1 Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
3
6
9
12
15
18
21
24
27
30
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/19/19
9/27/19

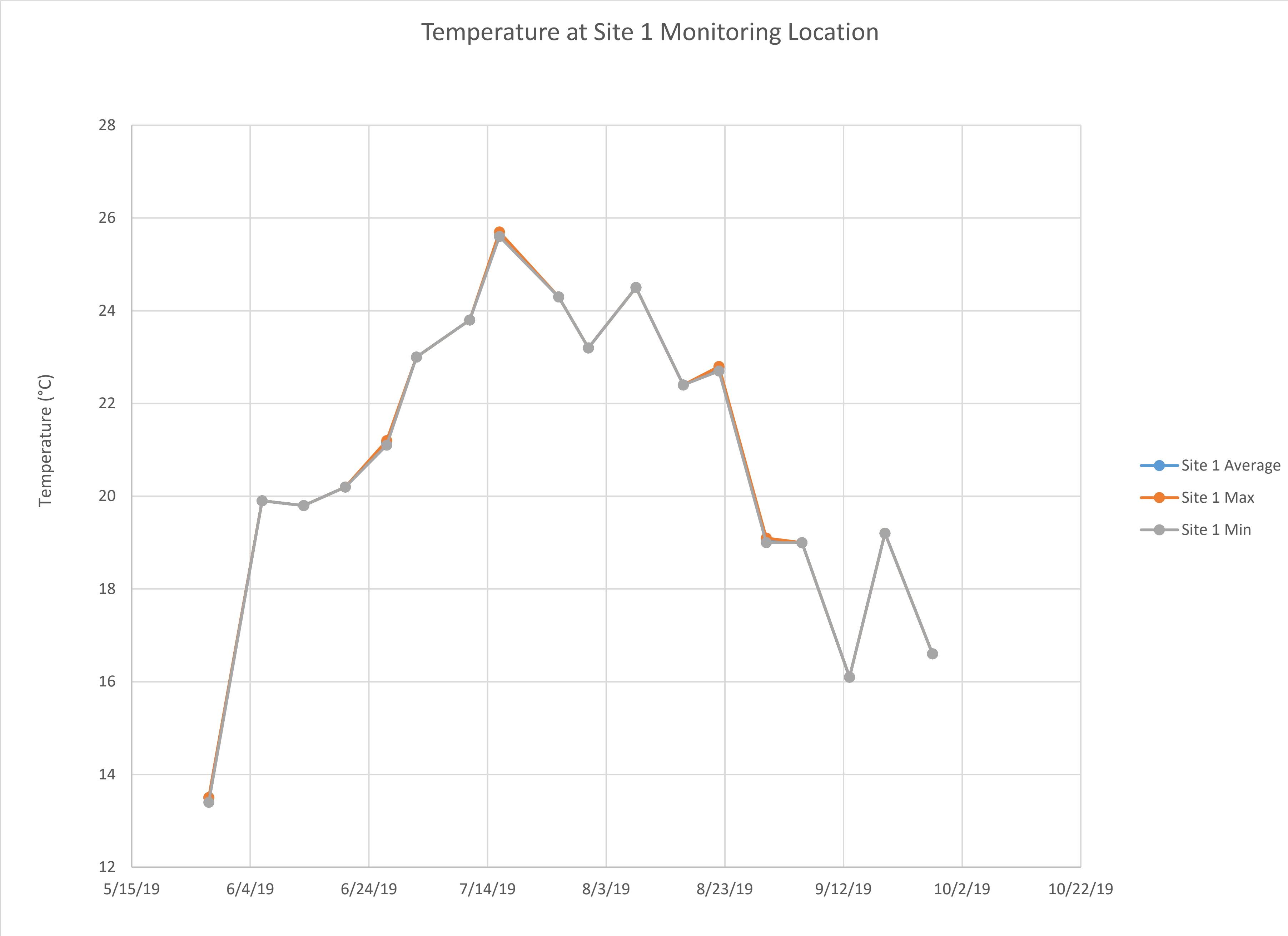

Saturation of Dissolved Oxygen vs. Depth at Site 2 Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
3
6
9
12
15
18
21
24
27
30
33
36
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/19/19
9/27/19



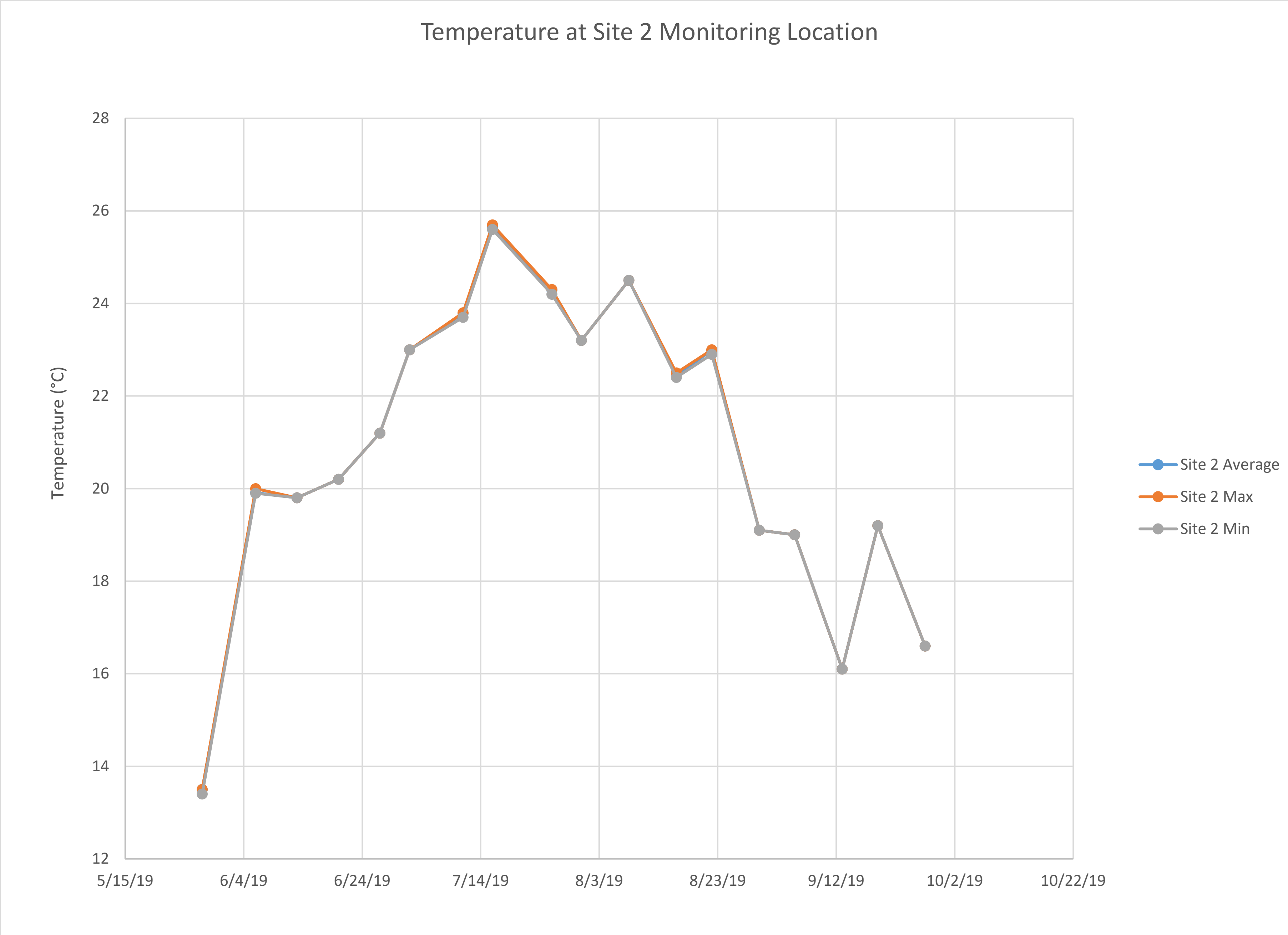
Saturation of Dissolved Oxygen vs. Depth at Site 3 Monitoring Location
Water Depth (feet)
Saturation of Dissolved Oxygen (percent)
0
3
6
9
12
15
18
21
24
27
30
33
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
7/2/19
6/13/19
6/20/19
9/19/19
7/31/19
5/28/19
7/16/19
8/8/19
8/16/19
6/6/19
6/27/19
9/27/19
9/13/19
7/26/19
7/11/19
8/22/19
9/5/19
8/30/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/19/19
9/27/19

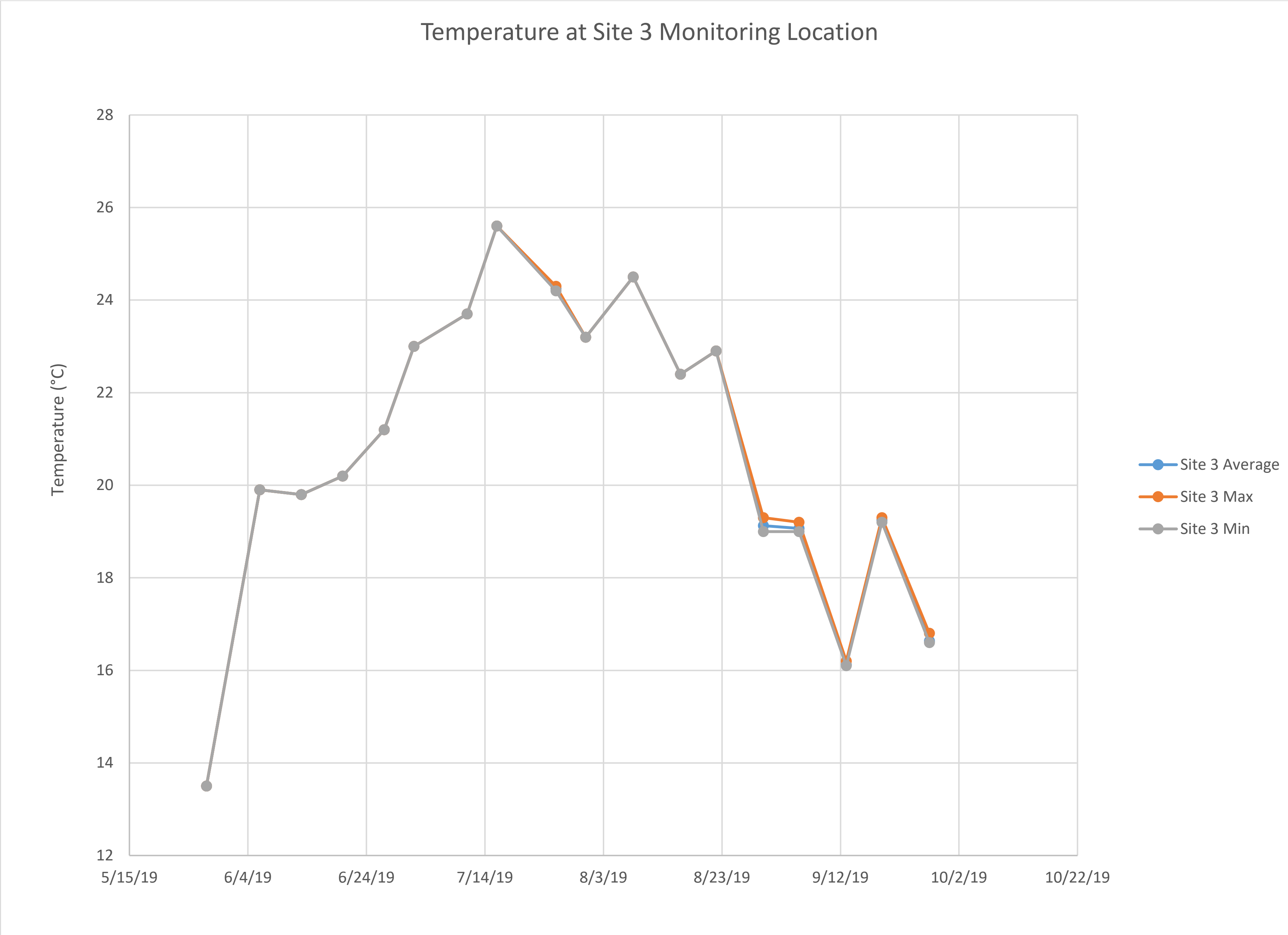


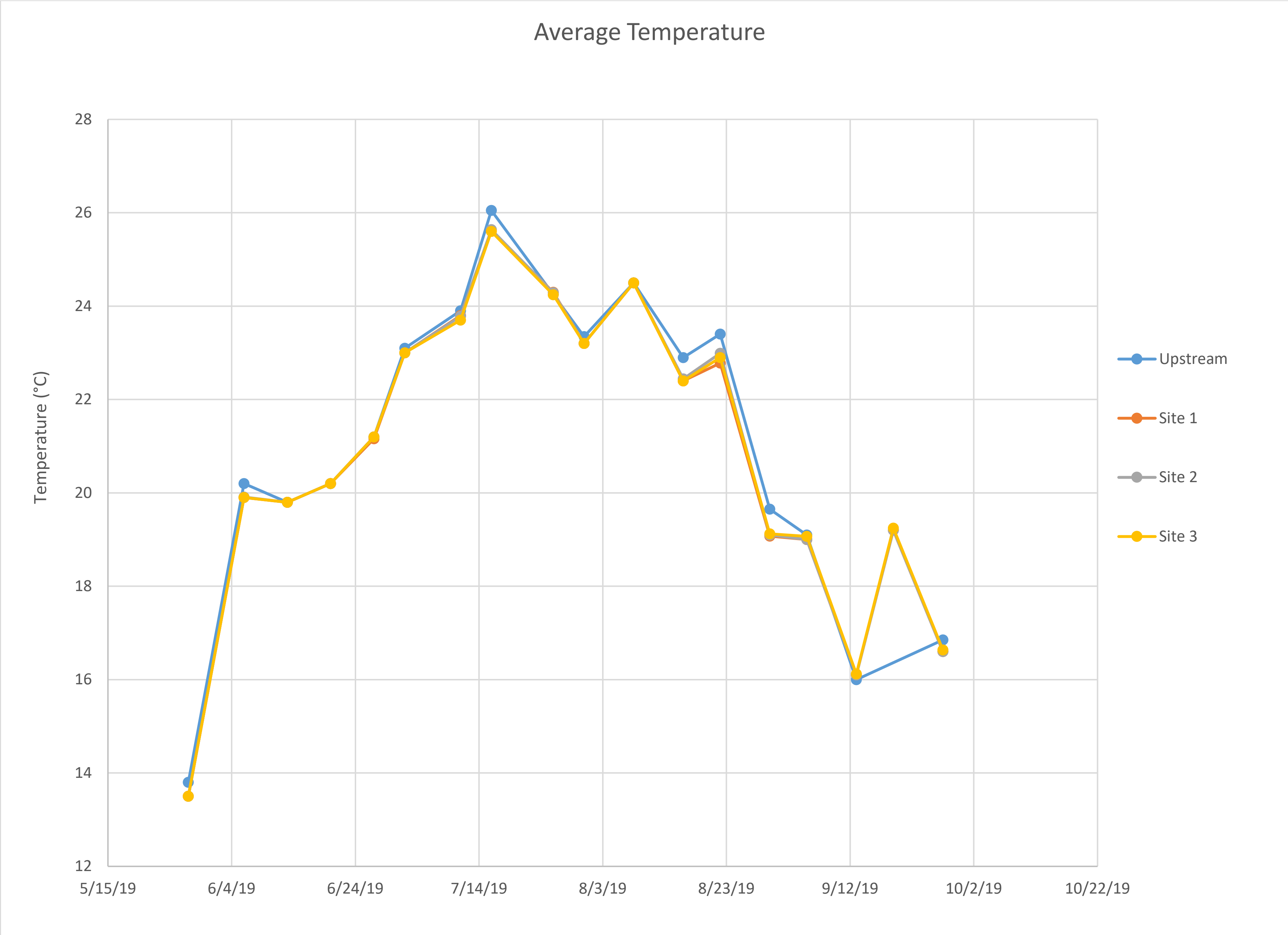
Temperature at Upstream Monitoring Location
Temperature (°C)
28
26
24
22
20
18
16
14
12
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
Upstream Average
Upstream Max
Upstream Min



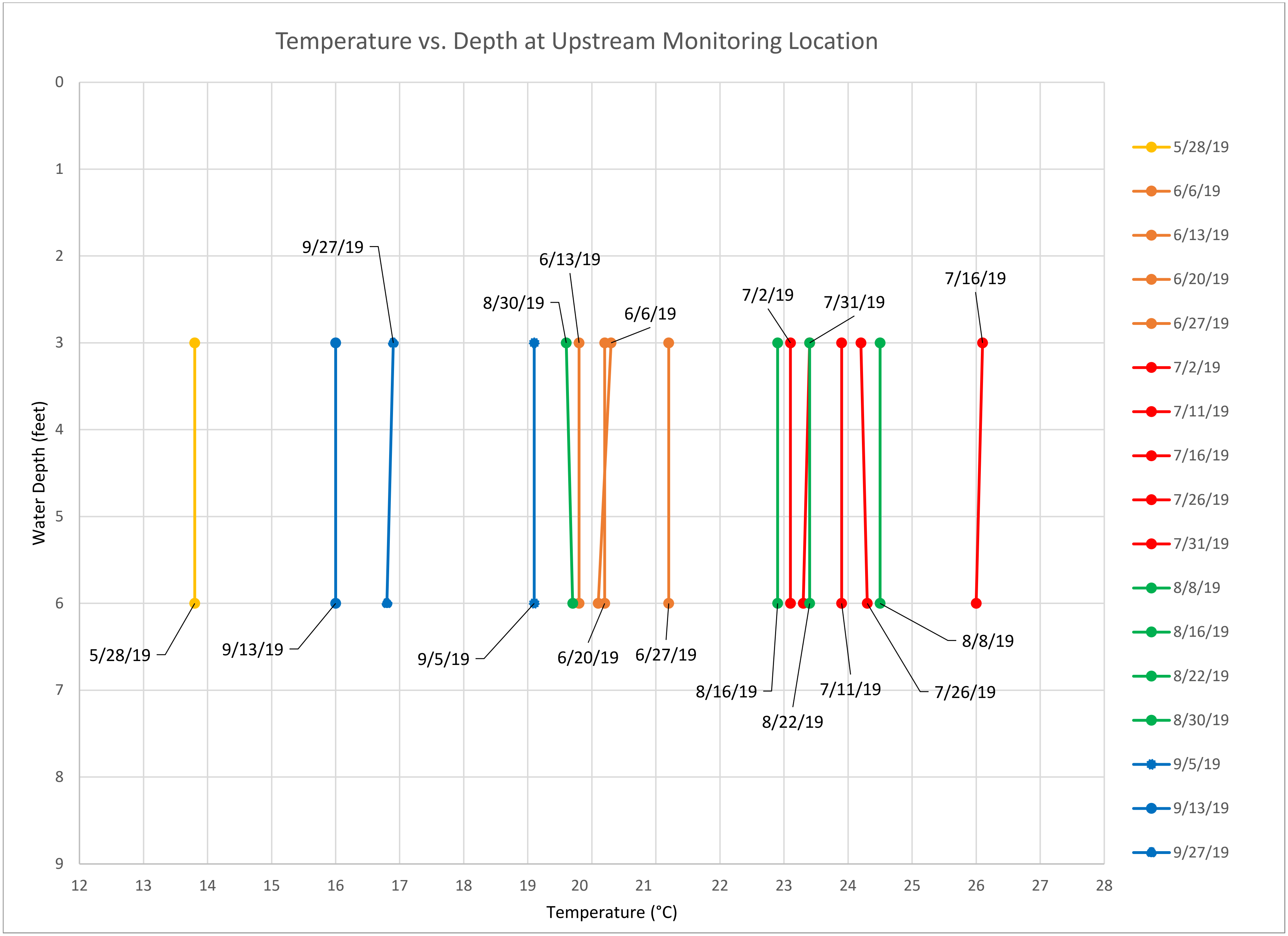
Temperature at Site 1 Monitoring Location
Temperature (°C)
28
26
24
22
20
18
16
14
12
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 1 Average
Site 1 Max
Site 1 Min


Temperature at Site 2 Monitoring Location
Temperature (°C)
28
26
24
22
20
18
16
14
12
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 2 Average
Site 2 Max
Site 2 Min


Temperature at Site 3 Monitoring Location
Temperature (°C)
28
26
24
22
20
18
16
14
12
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Site 3 Average
Site 3 Max
Site 3 Min



Average Temperature
Temperature (°C)
28
26
24
22
20
18
16
14
12
5/15/19
6/4/19
6/24/19
7/14/19
8/3/19
8/23/19
9/12/19
10/2/19
10/22/19
Upstream
Site 1
Site 2
Site 3


Temperature vs. Depth at Upstream Monitoring Location
Water Depth (feet)
Temperature (°C)
0
1
2
3
4
5
6
7
8
9
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
9/27/19
6/13/19
8/30/19
6/6/19
7/2/19
7/31/19
7/16/19
5/28/19
9/13/19
9/5/19
6/20/19
6/27/19
8/16/19
8/22/19
7/11/19
7/26/19
8/8/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
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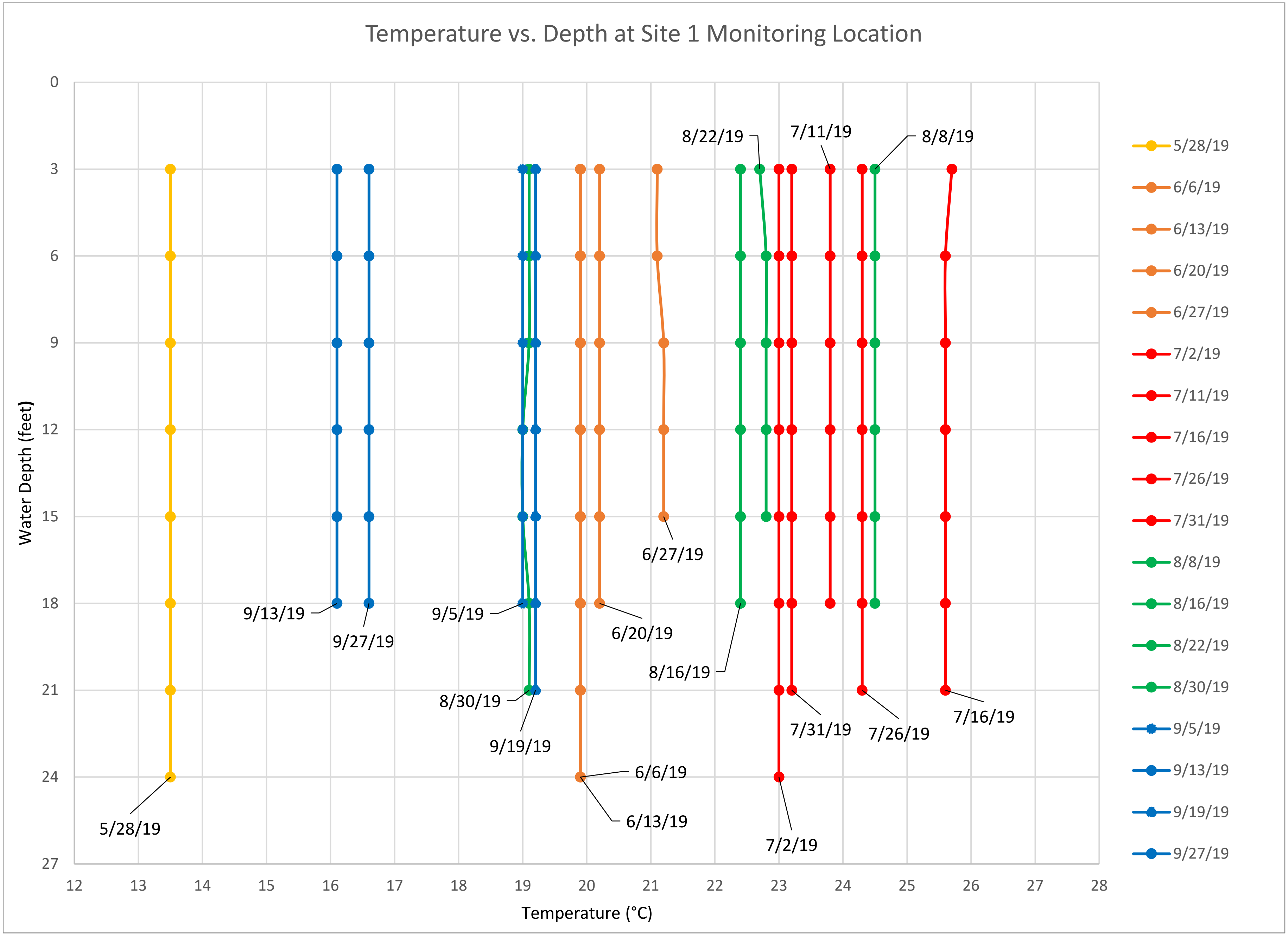
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/27/19



Temperature vs. Depth at Site 1 Monitoring Location
Water Depth (feet)
Temperature (°C)
0
3
6
9
12
15
18
21
24
27
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
8/22/19
7/11/19
8/8/19
6/27/19
9/13/19
9/27/19
9/5/19
6/20/19
8/16/19
8/30/19
9/19/19
7/31/19
7/26/19
7/16/19
6/6/19
6/13/19
5/28/19
7/2/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
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8/22/19
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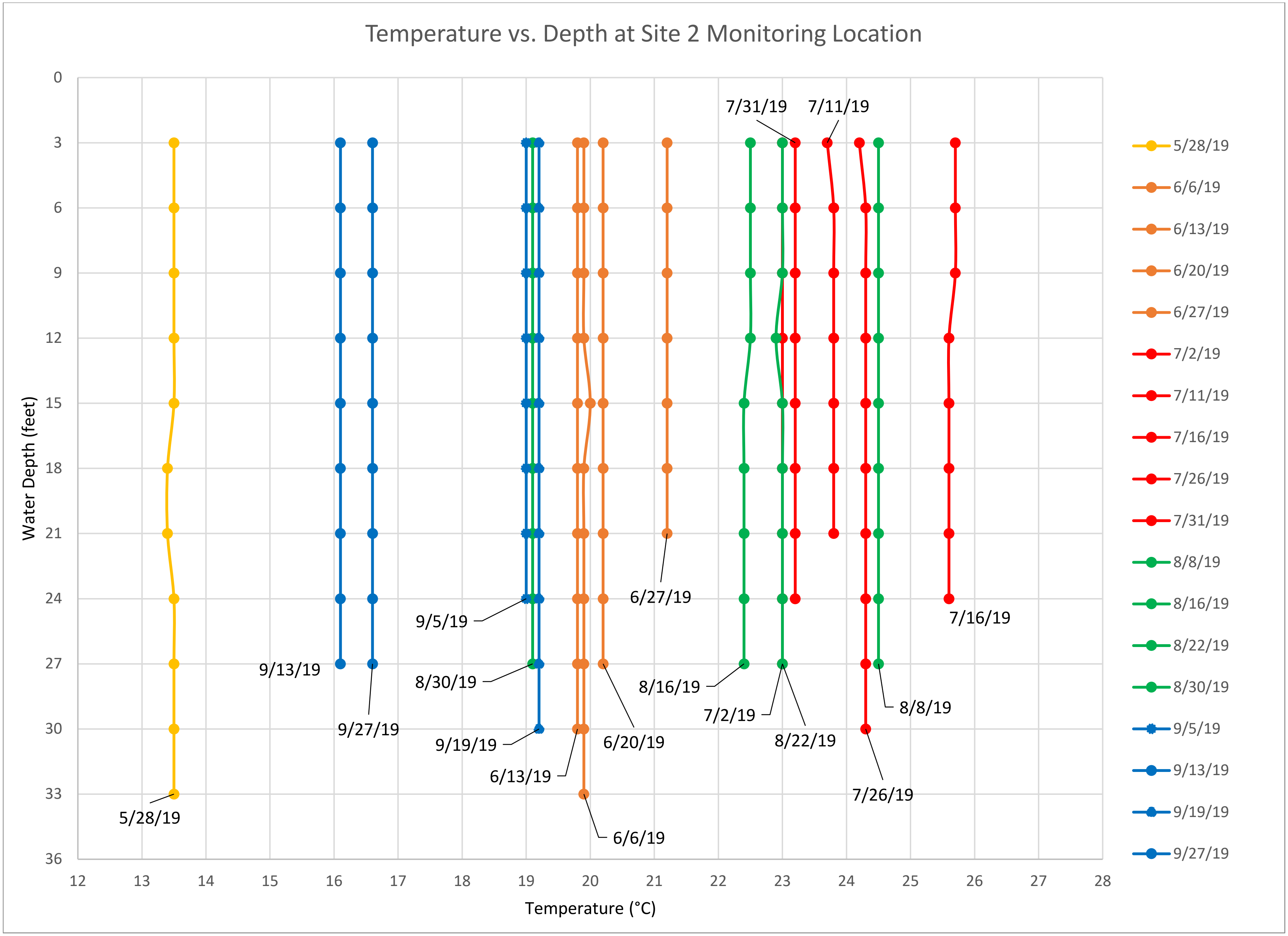
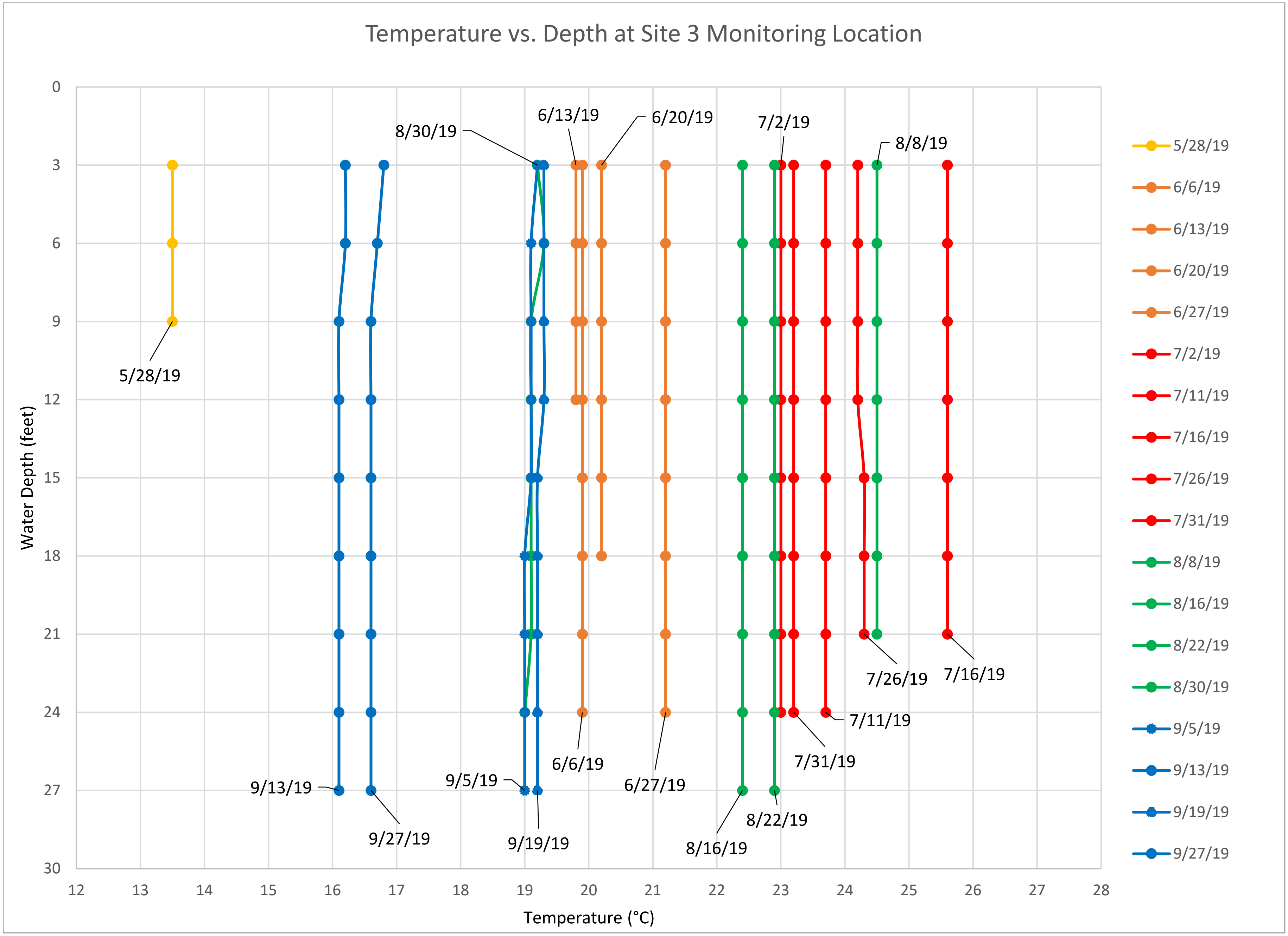
9/5/19
9/13/19
9/19/19
9/27/19



Temperature vs. Depth at Site 2 Monitoring Location
Water Depth (feet)
Temperature (°C)
0
3
6
9
12
15
18
21
24
27
30
33
36
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
7/31/19
7/11/19
6/27/19
9/5/19
7/16/19
9/13/19
8/30/19
8/16/19
8/8/19
7/2/19
9/27/19
9/19/19
6/20/19
8/22/19
6/13/19
7/26/19
5/28/19
6/6/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
8/16/19
8/22/19
8/30/19
9/5/19
9/13/19
9/19/19
9/27/19



Temperature vs. Depth at Site 3 Monitoring Location
Water Depth (feet)
Temperature (°C)
0
3
6
9
12
15
18
21
24
27
30
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
8/30/19
6/13/19
6/20/19
7/2/19
8/8/19
5/28/19
7/26/19
7/16/19
7/11/19
7/31/19
6/6/19
6/27/19
9/5/19
9/13/19
9/27/19
9/19/19
8/16/19
8/22/19
5/28/19
6/6/19
6/13/19
6/20/19
6/27/19
7/2/19
7/11/19
7/16/19
7/26/19
7/31/19
8/8/19
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9/13/19
9/19/19
9/27/19

Appendix D

Site Photographs

Photograph 1: Facing upstream toward BPU facility, with bascule gates visible on the left and the powerhouse visible on the right. Foam on water surface is caused by naturally-occurring tannins in the water (July 11, 2019).

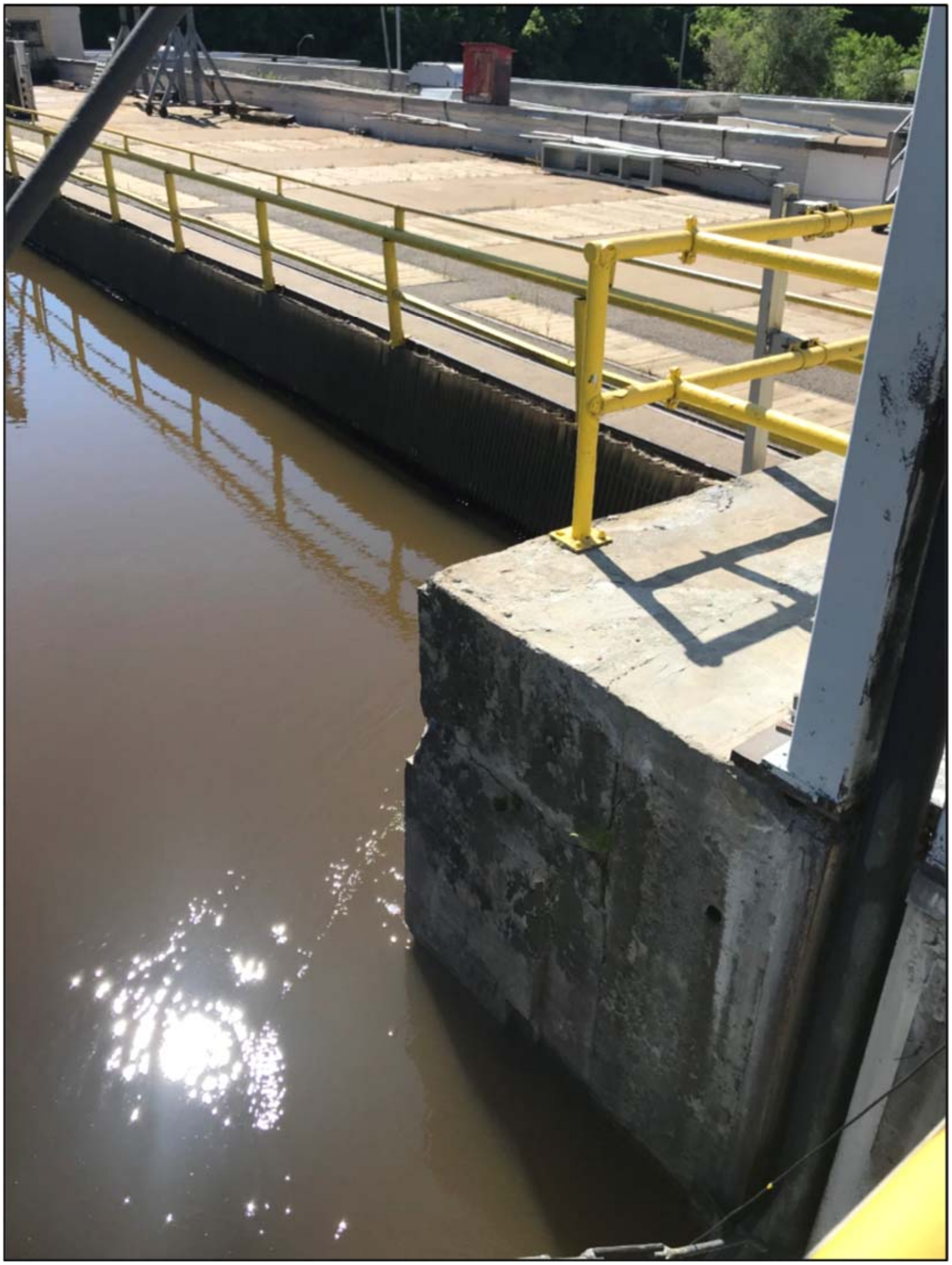
Photograph 2: Facing upstream toward BPU facility, including tainter gate (on left) and bascule gates (on right). Water is currently flowing over both bascule gates (July 16, 2019).

Photograph 3: Facing upstream toward BPU facility powerhouse at time of water sampling. Photograph taken from sampling location “Site 1” (August 8, 2019).

Photograph 4: Facing upstream (north) from west side of BPU powerhouse, towards reservoir. Photograph taken from “Upstream” sampling location (July 11, 2019).

Photograph 5: Facing downstream (south) from west side of BPU powerhouse (July 11, 2019).

Photograph 6: Facing east bank of Mississippi River, from "Site 3" downstream sampling location (June 20 11, 2019).



Photograph 7: Facing southeast from "Upstream" sampling location at intersection of powerhouse and slide gates (June 13, 2019).

Fish Impingement and Entrainment Study

Brainerd Hydroelectric Project
FERC License No. 2533

Prepared for:
Brainerd Public Utilities
Brainerd, Minnesota

January 22, 2020

Available for Public Release

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Fish Impingement and Entrainment Study
Brainerd Hydroelectric Project

January 22, 2020

Preface

Brainerd Public Utilities (BPU) began the renewal process for the Federal Energy Regulatory Commission (FERC) license of the Brainerd Hydroelectric Project (FERC Project No. 2533) (Project). As part of the relicensing process a fish entrainment and impingement and turbine mortality was requested by FERC. A desktop analysis of fish entrainment and impingement was conducted using data available from field studies conducted at various hydroelectric facilities across the United States. The Electric Power Research Institute (EPRI) has developed a database of hydro turbine fish entrainment and survival studies that will be a key resource in developing a proper desktop analysis for the Project.

This desktop assessment approach relies on results of published turbine entrainment and passage survival studies and site-specific project and turbine design specifications to estimate entrainment rates and fish passage survival. The potential for fish impingement on the intake trashracks was evaluated qualitatively using publicly available information about fish morphology and swimming speeds, trashrack spacing, and calculated approach velocities at intake areas. Estimates derived from this desktop study are expected to be suitable for determining general potential for levels of entrainment and impingement that may occur as a result of the Project operations; the findings should not be considered absolute quantitative results.

Impingement is the potential for fish to become trapped against the inner intake trashracks due to high velocity conditions at the powerhouse intake. Entrainment is the passage of fish into the powerhouse intakes and passed through the turbine units. Alden Research Laboratory, Inc. (Alden) conducted the work for Sections 4.44 - 4.6 and 5.2 - 5.5.

Fish Impingement and Entrainment Study
Brainerd Hydroelectric Project

January 22, 2020

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Abbreviations and Acronyms

BPU	Brainerd Public Utilities (Licensee)
CFR	Code of Federal Regulations
cfs	cubic feet per second
EPRI	Electric Power Research Institute
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
ft/s	feet per second
MNDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
Project	Brainerd Hydroelectric Project
RC%	relative percent composition
RSP	Revised Study Plan

Definitions

Project	Brainerd Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2533 (Project)
Project Area	The area within the Project boundary consisting of "…lands necessary for the operation and maintenance of the Project and for other Project purposes…" (1)
Project boundary	The boundary line defined in the Project license issued by the FERC that surrounds the "…lands necessary for the operation and maintenance of the Project and for other Project purposes…" (1)
Relicensing	The process of acquiring a new FERC license for an existing hydropower project under expiration of the existing FERC license

1.0 Introduction

1.1 Background

Brainerd Public Utilities (BPU) has begun renewing the Federal Energy Regulatory Commission (FERC) license of the Brainerd Hydroelectric Project FERC Project No. 2533 (Project). As part of the relicensing process, an assessment of fish entrainment and impingement and turbine mortality was requested by FERC, as defined in the Revised Study Plan (RSP) (2). A desktop analysis of entrainment and impingement was conducted using data available from field studies conducted at various hydroelectric facilities across the United States. The Electric Power Research Institute (EPRI) has developed a database of hydro turbine fish entrainment and survival studies (3) that was used as a resource in developing the desktop analysis for the Project.

1.2 Turbine Entrainment, Impingement, and Mortality

Entrainment is the passage of fish into the powerhouse intakes and through the turbine units as water is passed through the powerhouse. Impingement occurs when fish become trapped against the inner intake trashracks due to high velocity conditions at the powerhouse intake. Most entrained or impinged fish are in the early life stages (typically of lengths less than 8 inches) that are incapable of avoidance or unable to safely swim away from the intake of the turbines. Entrainment and mortality rates can vary depending on river flow, sizes of fish, seasonal differences, species of fish, fish swimming ability, and turbine design and configurations (4); FERC 1997. Mortality of fish passing through turbines can be caused by shear stress, mechanical injuries (grinding, blade strike), and pressure changes.

1.3 Fish Community

The Brainerd area provides premier fish habitat. In addition to the Mississippi River, immediately upstream of Rice Lake, an impoundment of the Mississippi River partially created by the Project, provides important fisheries habitat near the Project. As such, it contains both typical lake and riverine fish species (5).

The Minnesota Department of Natural Resources (MNDNR) surveyed the Rice Lake fishery in August 2014 and sampled 17 fish species, including black crappie, bluegill, bowfin (dogfish), brown bullhead, channel catfish, greater redhorse, hybrid sunfish, largemouth bass, northern pike, pumpkinseed, rock bass, shorthead redhorse, silver redhorse, smallmouth bass, walleye, yellow bullhead, and yellow perch (5). Although no muskellunge were sampled during the survey, there are reports of this fish species being caught in both Rice Lake and the adjoining reach of the Mississippi River, as the MNDNR stocks this species in the Mississippi River. The MNDNR also stocks walleye in this region. Smallmouth bass is the primary management species of fish in Rice Lake, while walleye, northern pike, and muskellunge are secondary management species (5).

2.0 Project Location, Facilities, and Operation

This section provides a description of the Project and operation.

2.1 Licensee

The Project is owned and operated by the city of Brainerd and it's Public Utilities Commission under a license from the FERC as Project No. 2533.

2.2 Project Location

The Project is located in Crow Wing County on the Mississippi River near the northeast side of Brainerd, Minnesota, as shown in Figure 2-1. The Project is located approximately 130 miles north of the Minneapolis – St. Paul metropolitan area.

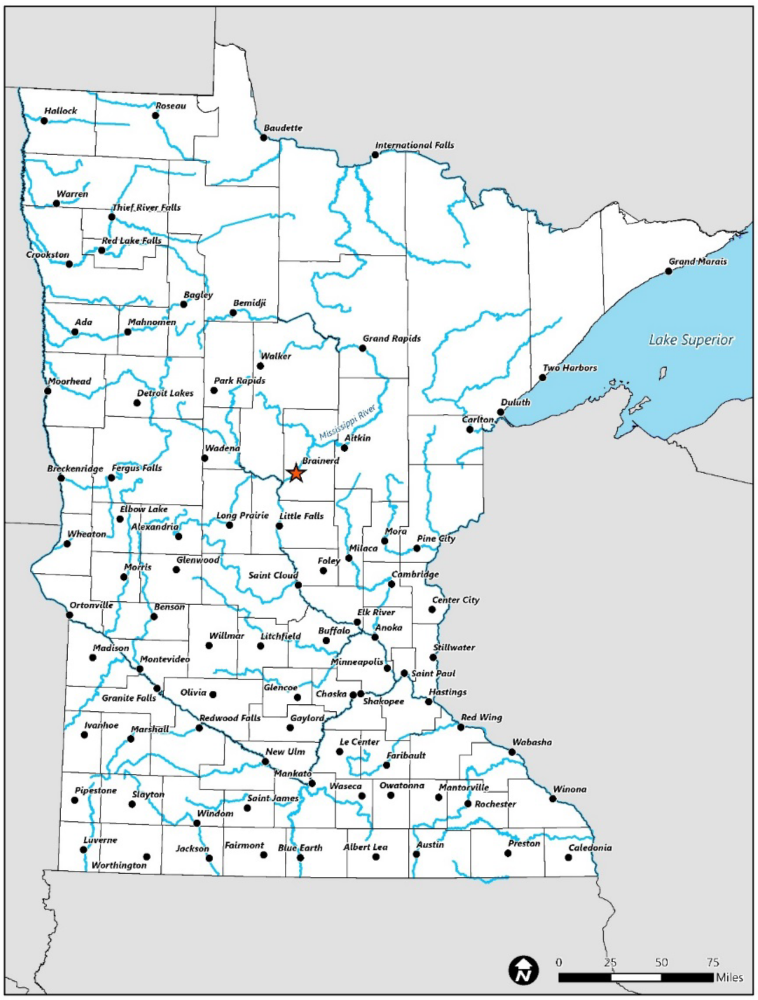

Figure 2-1 Project Location

2.3 Project Overview

From the left bank of the Mississippi River (looking downstream), the Project consists of a short left embankment, a 256-foot-long powerhouse, a 78-foot-long slide gate section, a 207-foot-long bascule (crest) gate section, a single 20-foot-wide steel tainter gate, and a 200-foot-long right embankment, as shown in Figure 2-2. The Project is located on land owned by BPU and is a run-of-river hydroelectric project with an authorized installed capacity of 3,542.5 kW.

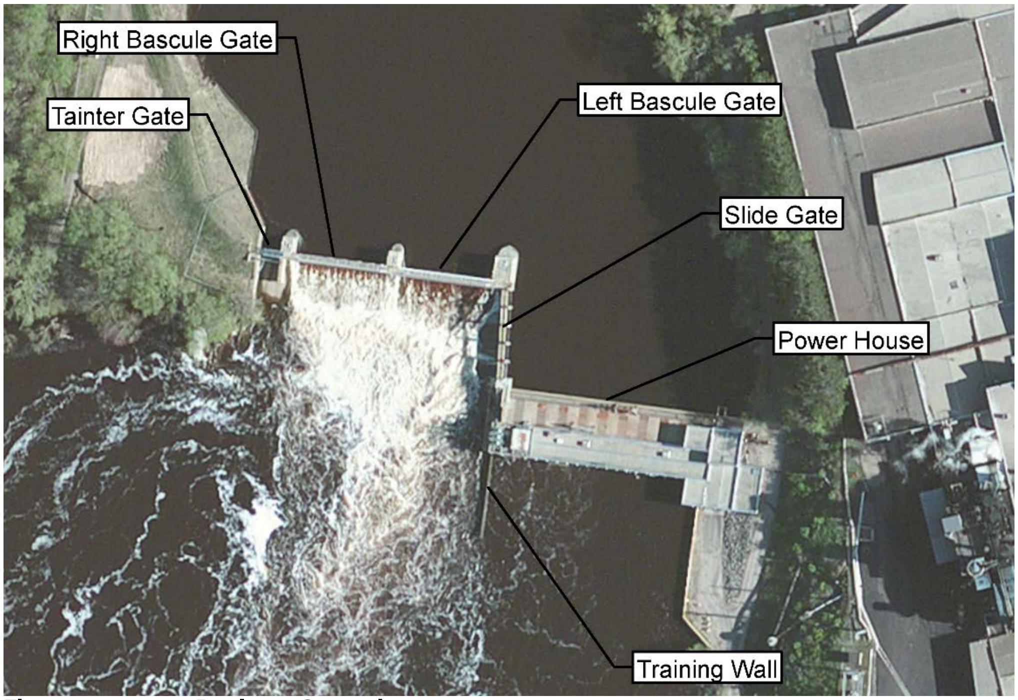

Figure 2-2 **Project Overview**

2.4 Study Boundary

This fish impingement and entrainment study boundary included the powerhouse and infrastructure (such as intakes, trashracks, and turbines) impacting the fish community in the upstream reservoir.

3.0 Study Goals and Objectives

3.1 Goals and Objectives

The goal of this study is to evaluate the potential for fish entrainment and impingement at the Project and its potential effects on the health of the Upper Mississippi River fishery. The objectives of this study are to:

- Describe the physical characteristics of the intake structures, including the location, dimensions, and the velocity distribution in front of each structure;
- Analyze fish species for factors that influence their vulnerability to impingement, entrainment, and turbine survival;
- Assess the potential for fish species impingement at the Project;
- Estimate entrainment rates and turbine-passage survival rates for fish species at the Project; and
- Describe the likely effects of Project-induced entrainment or impingement on fish resources, based on the physical characteristics of the Project.

3.2 Public Interest Considerations

Sections 4(e) and 10(a) of the Federal Power Act (FPA) require that FERC give equal consideration to all uses of the waterway on which a project is located. In making its license decision, FERC must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the Project, as well as power and developmental values.

Fish populations in the Project Boundary support a sport fishery. As such, the effects that operating the Project may have on fisheries resources are relevant to FERC's public interest determination.

4.0 Methodology

4.1 Methodology Overview

The methodology for this analysis will follow standard methods and data sources previously accepted by FERC or standard methods used by fisheries management professionals for desktop evaluation of impingement, entrainment, and turbine mortality ((6), (4), (7)). Fish that are small enough to pass through the Project's trashracks will be considered susceptible to entrainment. Fish large enough to be physically excluded due to size (length, width/body depth) will be considered as potentially susceptible to impingement or entrainment because of individual species habitat use, behaviors, or swimming abilities.

Fish species and abundance information available from the MNDNR and the Minnesota Pollution Control Agency (MPCA) will be used to characterize the fisheries community composition upstream of the Project. Fish species will be grouped into family groups and size classes for evaluation. For species/family groups, where no comparable or applicable data can be found, the survival rate reported for a similar group/size class will be substituted. Fish species/groups for evaluation will be developed in conjunction with the MNDNR. Preliminary review of fisheries data indicates evaluation of walleye, smallmouth bass, largemouth bass, channel catfish, yellow perch, northern pike, bigmouth buffalo, white sucker, shorthead redhorse, and silver redhorse will be considered as potential target species/groups.

Fish entrainment data from other similar hydroelectric projects (head, turbine type, flow capacity, etc.) were selected from the databases available from the EPRI (3) to develop a project estimate using the Project-specific fish species/group assemblages. The evaluation will be sequenced with the following inputs:

1. Develop a matrix of entrainment studies that can be applied to the Project.
2. Calculate and estimate fish entrainment rates at the Project site based on available Project operation information. Estimate the maximum approach velocity at each turbine, based on the size of the intake area and the maximum hydraulic capacity at each turbine. Entrainment will be defined as the number of fish/volume of water entrained.
3. Utilize reservoir-specific species compositions in conjunction with applicable prior studies to characterize the composition of the fish community susceptible to impingement or entrainment.
4. Apply physical, biological, or reservoir factor filters that may impact susceptibility to impingement or entrainment at the Project.
5. Estimate turbine mortality rates of entrained fish using a blade strike probability and mortality model (8), (9), (10).
6. Estimate impingement potential for fish too large to pass through intake trashrack bar spacing.
7. Report estimates of entrainment and mortality on a monthly fish group/size and fish per volume of water passed through the Project turbines. Estimated monthly entrainment rates will be

reported based on the relative abundance of species according to existing fisheries data from the MNDNR.

4.2 Factors Affecting Impingement, Entrainment, and Survival

Site factors affecting impingement, entrainment, and survival include the layout and operating system of the turbines and dam. The turbines operate at different hydraulic capacities and therefore have differing intake velocities. This will impact cross-sectional velocities approaching the intake trashracks. These velocities were used to determine the likelihood of how various fish species become impinged and entrained. Turbine survival (i.e., blade strike probability and mortality) is determined by fish length, runner diameter and rotational speed, number of blades, and inflow angle and velocity. Table 4-1 includes design and operation specifications for the Project's two turbine designs.

Table 4-1 Summary of Turbine Design and Operation Parameters for the Project.

Design Parameter	Units 1 & 2	Units 3 - 5
Turbine Type	Francis (horizontal)	Francis (horizontal)
Flow Capacity (cfs)	665	493
Rotational Speed (rpm)	128.5	128.5
Blade Tip Speed (ft/s)	25.2	31.2
Number of Blades	16	16
Blade Spacing (ft)	0.7	0.5
Leading Edge Blade Thickness (in)	0.4	0.4
Runner Diameter (ft)	3.75	2.71
Hub Diameter (ft)	3.5	2.5
Radial/Axial Flow Velocity (ft/s)	11.7	14.2
Absolute Flow Velocity (ft/s)	15.7	20.9
Relative Velocity of Flow to Blade (ft/s)	18.76	21.23

4.3 Intake Velocities and Trashrack Exclusion

Project intake cross-sectional velocities were calculated based on the wetted surface areas of the intake trashracks at the powerhouse for each turbine. The powerhouse is a 256-foot long structure with flume intakes measuring approximately 16.0 – 17.5 feet wide. The distance from normal water elevation to the concrete sill at the trashrack is approximately 16 feet. Trashracks are located in front of the intakes to minimize fish entrainment. Trashracks consist of 3 inch by ¼ inch bars spaced at 2 inches on center. Intake velocity was calculated as the product of the width and height of the trashracks. This was then used to calculate the maximum flow through the intake trashracks based upon the total maximum hydraulic capacity of each of the turbines. The final trashrack cross-sectional velocity was calculated by taking the total hydraulic capacity and dividing by the total wetted area of the trashracks (Table 4-2).

Trashrack exclusion assessment includes estimating fish lengths for the target fish species that would be excluded or impinged by the 1.75-inch trashrack clear spacing. These species would have swim burst speeds that could withstand intake velocities and avoid entrainment.

Table 4-2 Project Turbine Cross-Sectional Velocities and Trashrack Clear Spacing

Unit Number	Maximum Hydraulic Capacity (cfs)	Trashrack Surface Area (ft^2)	Cross Sectional Velocity at Maximum Hydraulic Capacity (ft/sec)	Trashrack Clear Spacing (in)
1 (Francis)	665	280	2.38	1.75
2 (Francis)	665	280	2.38	1.75
3 (Francis)	493	256	1.93	1.75
4 (Francis)	493	256	1.93	1.75
5 (Francis)	493	256	1.93	1.75

4.4 Impingement Assessment Methods

The risk of impingement is assessed by determining the size at which fish are physically excluded by the trashrack bar spacing and by comparing species and life stage swimming speeds to intake approach flow velocities. Proportional body measurements from Smith (11) were used to determine the ratio of body width to total length for each species, which was then used to estimate the length at which a particular species would be physically excluded by the 1.75 inch (44 mm) clear bar spacing of the trashrack. The maximum total length identified for each species from the literature (12) was then compared to the estimated length of exclusion to determine if a species may have individuals that could be susceptible to impingement (i.e., reach a length at which physical exclusion would occur). Critical swim speeds for fish large enough to be physically excluded from entrainment were compiled from the available scientific literature and used to determine if impingement could potentially occur.

4.5 Entrainment Assessment Methods

Entrainment rates were calculated using data from field studies that were compiled into a turbine entrainment database by EPRI (3). The information in the applicable studies provided by the EPRI were assembled and screened based on entrainment data that could potentially be used for this study. Studies were selected from the screened projects that were the most similar and applicable to the Project. Criteria used in this selection included:

- Trashrack clear spacing of 1.75 – 2.40 inches
- Impoundment volume of 620 – 6400 acre-ft
- Similar station general flow capacities (1288 – 2400 cfs)
- Similar station operation (run of river, peaking, etc.)

- Biological similarities to the fish species, assemblages, and water quality

Nine sites in the EPRI database were identified as having generating-flow capacities, trashrack spacing, and impoundment volume, similar to those of the Project. Enough data was reported for six of the sites to calculate monthly and annual entrainment numbers at the Project by species and size (<200 mm and 200 to 380 mm in length) (Table 4-3). A 380-mm fish length was selected as a conservative estimate of the size at which fish will no longer fit through the 1.75-inch bar spacing of the intake trashracks.

The entrainment data (reported as fish entrained per million cubic feet of generation flow) from the selected sites were averaged by month for each species and size group. The average monthly entrainment rates were multiplied by the estimated average monthly generation flow (million cubic feet) at the Project to estimate the number of fish entrained monthly and annually (i.e., sum of monthly estimates).

Table 4-3 Site Characteristics for the Project and Other Similar Projects in the EPRI Entrainment Database

Site Name	Reservoir Area (acres)	Reservoir Volume (acre-ft)	Total Plant Capacity (cfs)	Operating Mode	Trashrack Spacing (in)
BPU Project	2500	13000	2800	ROR	1.75
Caldron Falls	1180	NR	1300	Peak	2.00
Colton	195	620	1503	Peak	2.00
Johnsonville	450	6430	1288	Peak	2.00
Potato Rapids	288	NR	1380	ROR	1.75
Sandstone Rapids	150	NR	1300	Peak	1.75
Schaghticoke	164	1150	1640	ROR	2.13

Note(s): NR indicates data were not reported for a given site and parameter.
ROR = Run of River

4.5.1 Fish Species Composition

Fish collection data from the MNDNR Fish Mapping Application (13) were used to compile a list of species and relative percent composition (RC %) occurring in the upper portion of the mainstem Mississippi River (Table 4-4). Common shiner (14.1 percent), yellow perch (13.5 percent), bluegill (12.0 percent), and spotfin shiner (10.1 percent) represent the largest percentage of species collected in the Upper Mississippi River.

The RC % values were calculated based on catches of species at sampling sites from Grand Rapids hydroelectric plant to the Project, including sampling from Rice Lake from 1999 to present. This list of species provides a comprehensive assessment of the fish community impacted and species potentially vulnerable for entrainment.

Table 4-4 Fish Species of the Upper Mainstem Mississippi River from the Project to Grand Rapids Dam including Rice Lake

Common Name	N[1]	RC %
Common shiner	528	14.10%
Yellow perch	504	13.46%
Bluegill	448	11.97%
Spotfin shiner	379	10.12%
Shorthead redhorse	314	8.34%
Black crappie	254	6.79%
Northern pike	148	3.95%
White sucker	141	3.77%
Johnny darter	126	3.37%
Walleye	99	2.65%
Silver redhorse	96	2.56%
Smallmouth bass	92	2.46%
Pumpkinseed	85	2.27%
Logperch	69	1.85%
Trout-perch	69	1.85%
Mimic shiner	67	1.79%
Rock bass	66	1.76%
Central mudminnow	57	1.52%
Largemouth bass	41	1.10%
Yellow bullhead	35	0.93%
Finescale dace	21	0.56%
Channel catfish	13	0.35%
Fathead minnow	12	0.32%
Brook stickleback	12	0.32%
Greater redhorse	9	0.24%
Blacknose shiner	8	0.21%
Muskellunge	7	0.19%
Brook silverside	7	0.19%
Bowfin (dogfish)	7	0.19%
Hybrid sunfish	7	0.19%

Common Name	N[1]	RC %
Hornyhead chub	4	0.12%
Brown bullhead	3	0.08%
Golden shiner	3	0.08%
Burbot (eelpout)	3	0.08%
Longnose dace	2	0.05%
Brassy minnow	2	0.05%
Golden redhorse	2	0.05%
Blackchin shiner	1	0.03%
Bigmouth buffalo	1	0.03%
Bluntnose minnow	1	0.03%
Spottail shiner	1	0.03%
Total	**3,744**	**100%**

N[1]: Numbers (N) represent those collected in the sub-reach from Project upstream to the Grand Rapids Dam and within Rice Lake, of which the associated RC% was used to represent the community composition of this reach that is susceptible to entrainment at the Project.

4.6 Turbine Survival Assessment Methods

Turbine survival for all target species was estimated using a theoretical blade strike probability and mortality model similar to the methods reported by Franke et al. (8)). The theoretical blade strike model provides an estimate of blade strike probability based on fish length and turbine design parameters that influence the likelihood of strike for a fish approaching a turbine runner and passing between two blades. For fish struck by a blade, probability of strike mortality is estimated using laboratory data from blade strike studies conducted with rainbow trout and multiple fish lengths, blade leading edge thicknesses, and strike velocities (14), (15). Predictive blade strike survival models are considered appropriate means for estimating turbine survival at low head projects (<100 ft) because other injury mechanisms (e.g., damaging pressure regimes, shear, and turbulence) are considered to be inconsequential or expected to produce very low injury and mortality rates (8). Alden has used the theoretical model to estimate turbine survival of Shortnose Sturgeon entrained through the units at the Hadley Falls Station (16), for Atlantic Salmon and kelts entrained at 15 projects in the Maine Penobscot River basin (17), for shad and herring at projects in Rhode Island and Connecticut, and for riverine fishes passing through turbines in the Holyoke Canal System (18), at three projects in Vermont (19) (20) , and at a small project in Minnesota (21) (17). The results of these evaluations have been accepted by state and federal resource agencies and by FERC.

The probability that a fish will be struck by a turbine blade is a function of the distance over which blade leading edges move compared to the total distance between two consecutive leading edges in the time it takes a fish to be carried or swim past the arc of leading edge motion (Figure 4-1). Consequently, the probability of strike is identified in Equation 1 (9) (10):

$$P_S = \frac{nNL\cos\theta}{60V_{ax}}$$ **Equation 1**

Where:

P_S	= probability of strike (non-dimensional)
n	= runner rpm
N	= number of leading edges (blades)
L	= fish length
θ	= angle between absolute and axial velocity vectors (degrees)
V_{ax}	= axial velocity

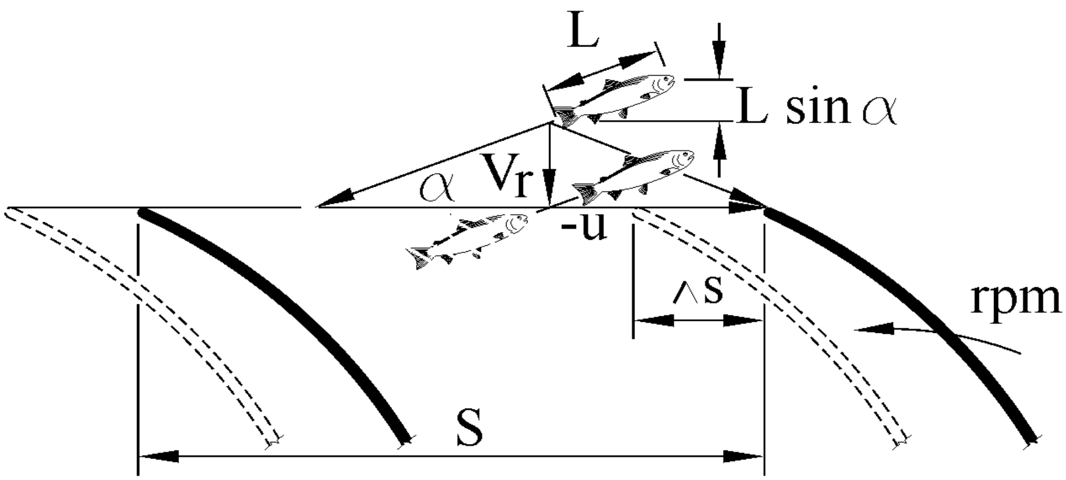

Figure 4-1 Schematic of Absolute Inflow, Axial Velocity, and Relative Velocity of Flow (and Fish) to a Blade Leading Edge. A Vertical Section of a Propeller Type Unit is depicted. The Parameter Δs is the Incremental Blade Motion in the Time Fish Move through the Leading-Edge Circumference.

The strike probability model assumes that fish orient along the absolute inflow direction. Note that cosθ = sinα, where α is the angle between the absolute inflow velocity and a tangent line to the runner circumference. The parameter Lcosθ (or Lsinα) is the projected fish length in the axial direction. The flow angle for axial-flow turbines is defined as the angle between the absolute velocity and tangential velocity, α.

The relative water-to-blade velocity (Equation 2) (i.e., strike velocity, assuming fish travel at the same speed as the approaching flow) is used with fish length-to-blade thickness ratios (*L/t*) to determine the strike mortality coefficient, *K*, based on data from blade strike tests conducted with rainbow trout (14) (15). Since *K* represents the probability that fish struck by a turbine blade will be killed, P_S (blade strike probability) is multiplied by *K* to estimate turbine passage survival (S_T):

$$S_T = 1 - (K)(P_S)$$ **Equation 2**

Other sources of injury and mortality associated with turbine passage (e.g., damaging pressure changes, shear, and turbulence) are not expected to impact fish passing through the Project turbines due to the relatively low head of the project. Design and operation parameters for the Project turbines used in the calculations of blade strike probability and mortality are provided in Table 4-1.

5.0 Results and Discussion

The assessments of impingement and entrainment at the Project were conducted for fish species that comprise at least one percent of the species composition of the upstream populations based on available sampling data.

5.1 Factors Affecting Impingement, Entrainment, and Survival

Susceptibility to entrainment or impingement may be influenced by a number of factors and their representation at the Project (Table 5-1). Habitat conditions upstream of the intakes may influence the sizes, species, and type of fish susceptible to impingement and entrainment. Because of this, species such as Black Crappie may be more susceptible to entrainment if there is a shallow littoral zone near the intakes or if the shoreline provides an area for spawning because juveniles often group in schools and are at lengths less than 200 mm. Similarly, White Sucker juveniles <200mm may frequent shoreline areas and be subject to entrainment. Benthic species may have higher potential for entrainment due to common foraging habits that could lead them to the vicinity of the Project's intakes.

Table 5-1 Factors Influencing Fish Entrainment and Survival

Factor		Influence on Entrainment/Turbine Mortality[1]	Representation at the Project
Entrainment	Intake adjacent to shoreline	Near shore intakes may potentially entrain higher numbers of fish than offshore intakes due to tendency of fish to follow shorelines or orient to physical structures in shorelines.	Yes
	Intake location in littoral zone	The littoral zone (generally from the shoreline to extent of aquatic vegetation or approximately 10 ft deep) is the most productive region of a reservoir and is where most species spawn and rear their young.	No
	Abundant littoral zone fishes	Centrarchids and other reservoir species such as catfish that spend most of their lives in near shore habitats tend to be the most abundant species in an assemblage.	Yes
	Abundant clupeids	Entrainment rates may potentially be higher at projects where clupeids such as gizzard shad, threadfin shad, and alewife are relatively abundant.	No
	Obligatory migrants	Obligatory migrants are those species that must migrate within and between freshwater systems to fulfill certain life cycles. Depending on time of year, turbine flow can represent the majority of river flow cues while migrating downstream.	No
	Intake depth (ft at full pond)	Fish are usually more abundant in shallower portions of a reservoir year-round.	16
	Winter drawdown	Drawdowns may put fish in proximity to intakes.	No
	Normal hydraulic capacity (cfs)	Values used with respect to entrainment rate.	2,800
	Avg approach velocity (ft/s)	Approach velocities may correlate with intake rates, although siting may be more important. Velocities greater than fish burst swim speeds suggest potential inability to escape entrainment or impingement.	1.93 & 2.38

Factor		Influence on Entrainment/Turbine Mortality[1]	Representation at the Project
	Water quality	Poor water quality (e.g., stratification and low dissolved oxygen in the hypolimnion) may reduce fish susceptibility to entrainment	No
	Additional downstream passage routes	Sluiceways, spillways, or other bypass structures may reduce turbine entrainment by providing an alternate route of downstream passage.	Yes
Survival	Turbine type	The size of water passage spaces relative to fish size may increase the probability of contact with structural elements. Francis runners have more closely spaced bucket/blades than Kaplan/propeller-type units.	Francis - horizontal
	High speed (rpm)	Higher turbine speeds potentially increase the likelihood of fish contact with structural elements.	No
	Avg survival rates of small fish (<200 mm)	More than 90% of fishes entrained at hydro projects are small. High survival rates reduce the overall impact to fish populations.	87%
	Pressurized intake tunnel	High hydrostatic pressure in a penstock at high head sites may be suddenly released as fish acclimated to a higher pressure pass from pressurized areas of deep water to tailwaters at normal hydrostatic pressure. The sudden relief from high pressure increases the potential risk to fish of decompression trauma.	No

(1) From (6), (3), and (22)

5.2 Impingement Assessment

Physical exclusion is expected to occur for some larger fish of all species except common shiner, mimic shiner, spotfin shiner, johnny darter, logperch, trout-perch, and central mudminnow (Table 5-2). The estimated average approach velocity at the Project ranged from 1.93 to 2.38 feet per second (ft/s). Mean critical swim speeds ranged from 0.6 to 11.8 ft/s for all species assessed (Table 5-3). However, burst speeds of fish that are too large to pass through the bar spacing at the Project intake will be considerably higher than the critical swim speeds. Consequently, impingement on the trashrack is not expected to occur for any of the target species that reach a length at which they would be too large to pass through the 1.75-inch clear bar spacing.

Table 5-2 Total Length (TL) Information for Fish Species Upstream of the Project

Family	Species	Body Width/TL Ratio	Average TL (mm)	TL at 44-mm Body Width	Max TL (mm)	Physical Exclusion at Max TL[1]
Catostomidae	Shorthead Redhorse	0.13	408	211	750	Yes
	Silver Redhorse	0.13	325	205	740	Yes
	White Sucker	0.15	407	301	650	Yes
Centrarchidae	Black Crappie	0.10	275	443	490	Yes
	Bluegill	0.13	190	332	410	Yes
	Largemouth Bass	0.13	400	329	970	Yes
	Pumpkinseed	0.12	100	355	400	Yes
	Rock Bass	0.16	154	283	430	Yes
	Smallmouth Bass	0.13	80	340	690	Yes
Cyprinidae	Common Shiner	0.11	83	411	180	No
	Mimic Shiner	0.10	57	435	80	No
	Spotfin Shiner	0.11	70	390	110	No
Escodiae	Northern Pike	0.08	400	567	1370	Yes
Percidae	Johnny Darter	0.12	39	372	72	No
	Logperch	0.10	125	421	180	No
	Walleye	0.12	540	353	1070	Yes
	Yellow Perch	0.11	191	385	1220	Yes
Percopsidae	Trout-Perch	0.14	88	324	200	No
Umbridae	Central Mudminnow	0.14	81	306	140	No

(1) Determination of whether physical exclusion from passing through the 1.75-inch clear spacing at the intake would occur based on body width at maximum total length

Table 5-3 Swim Speeds Reported in the Literature for Selected Target Species that Occur Upstream of the Project

Common Name	Scientific Name	Mean Length or Range (mm)	Mean Length Critical Swim Speed (ft/s)	Min Length (mm)	Min Length Critical Swim Speed (ft/s)	Max Length (mm)	Max Length Critical Swim Speed (ft/s)	Length for Burst Swim Speed (mm)	Burst Swim Speed (ft/s)	Reference	Surrogate
Black Crappie	*Pomoxis nigromaculatus*	170-371	1.6-2.4	160	1.1	NR	NR	NR	NR	(23), (24)	
Bluegill	*Lepomis macrochirus*	NR	NR	51	0.9	150	1.2	157.5	4.3	(25), (26), (27)	
Central Mudminnow	*Umbra limi*	109	0.7	NR	NR	NR	NR	NR	NR	(23)	Northern Pike
Common Shiner	*Luxilus cornutus*	36	1.4	36	1.4	NR	NR	63.5	4	(7), (23)	Mimic Shiner/Emerald Shiner
Johnny Darter	*Etheostoma nigrum*	36	1.3	NR	NR	NR	NR	NR	NR	(23)	Rio Grande Darter
Largemouth Bass	*Micropterus salmoides*	104	1.1-1.6	150	1.8	269	2.2	NR	NR	(23), (28), (29), (30)	
		56-112	0.7-1.6	NR	NR	NR	NR	NR	NR	(31), (32), (33), (34)	
Logperch	*Percina caprodes*	103	1.1	50	0.59	151	1.4			(23)	Yellow Perch
Mimic Shiner	*Notropis volucellus*	36	1.4	36	1.4	NR	NR	63.5	4	(7), (23)	Emerald Shiner for burst speeds
Northern Pike	*Esox lucius*	109	0.7	NR	NR	NR	NR	NR	NR	(23)	
		119-620	0.6-1.5	NR	NR	NR	NR	NR	NR	(35)	
Pumpkinseed	*Lepomis gibbosus*	127	1.2	NR	NR	NR	NR	NR	NR	(36)	
Rock Bass	*Ambloplites rupestris*	NR	NR	51	0.9	150	1.2	157.5	4.3	(25), (26), (27)	Bluegill
Shorthead Redhorse	*Moxostoma macrolepidotum*	NR	NR	396	3.4	434	5	NR	NR	Sustained speed: (37)	
Silver Redhorse	*Moxostoma anisurum*	NR	NR	518	3.2	559	4.6	NR	NR	Sustained speed: (37)	
Smallmouth Bass	*Micropterus dolomieu*	300	2.9	122	0.9	378	3.9	NR	NR	(23)	
		NR	NR	262	1.6	NR	NR	NR	NR	(38)	
Spotfin Shiner	*Cyprinella spiloptera*	307	2.2	NR	NR	NR	NR	NR	NR	(29)	
Trout-Perch	*Percopsis omiscomaycus*	NR	NR	NR	NR	NR	NR	NR	NR	No data	
Walleye	*Sander vitreus*	81-391	1.2-2.8	79	1.2	381	2.7	16-57	5.2-8.5	(23), (39)	
White Sucker	*Catostomus commersonii*	383	11.8	165	1.6	500	20	NR	NR	(23)	
		170	2	NR	NR	NR	NR	NR	NR	(35)	
Yellow Perch	*Perca flavescens*	103	1.1	50	0.59	151	1.4	NR	NR	(23)	

NR = not reported

5.3 Entrainment Estimates

In estimates derived from sites with similar characteristics as the Project's, black crappie had the highest entrainment rate of fish shorter than 200 mm, followed by white suckers (Table 5-4). Black Crappie entrainment was highest in mid- to late summer, and may have been due to both the fishes' tendency to travel in large groups and the summer peak of young-of-the-year fish (white sucker young typically orientate to shoreline features.

For the fish 200 to 380 mm long, entrainment was highest for Black Crappie and Shorthead Redhorse (Table 5-5). Black Crappie are usually found in areas near the shoreline which would make them more likely to encounter the Project's intake. Shorthead Redhorse is a benthic species that are likely to orientate to the bottom within the vicinity of the Project's intake structures. This contributes to the higher potential for entrainment for bottom feeding species at various life stages. Estimated total annual entrainment for all species combined was approximately 290,000 for fish less than 200 mm long and 5,600 for fish 200 to 380 mm long (Table 5-4, Table 5-5).

Table 5-4 Monthly and Annual Entrainment Estimates for Fish Less Than 200 mm in Length

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Black Crappie	446	380	233	5,660	1,047	972	11,502	55,557	24,228	5,317	13,838	5,450	124,631
Bluegill	0	0	129	485	270	1039	277	3,081	3,284	1,772	4,499	69	14,905
Central Mudminnow	0	0	46	138	130	0	0	0	0	0	31	0	346
Common Shiner	0	140	0	50	1,208	40	20	47	16	40	163	2135	3,858
Johnny Darter	0	0	92	269	743	460	578	166	12	0	0	0	2,320
Largemouth Bass	0	199	312	349	5	4,819	8,674	1,250	2,602	971	5,013	345	24,540
Logperch	0	0	0	57	432	303	98	76	0	97	134	0	1,197
Mimic Shiner	668	1,213	896	58	336	886	105	48	0	17	128	633	4,988
Northern Pike	0	0	0	30	0	244	1,371	445	75	64	96	0	2,325
Pumpkinseed	156	71	175	144	266	624	523	1,352	5,658	2,052	1,276	571	12,868
Rock Bass	33	0	0	142	525	393	154	168	1,429	761	75	69	3,750
Shorthead Redhorse	0	0	0	13	7	1,887	223	216	318	740	96	139	3,638
Silver Redhorse	0	0	0	0	0	38	0	7	10	0	0	0	54
Smallmouth Bass	0	0	0	4	17	711	6,499	1,300	13,188	1472	323	199	23,712
Spotfin Shiner	0	0	0	0	0	0	0	36	32	0	0	0	68
Trout-perch	0	0	0	33	0	0	0	0	0	292	30	35	389
Walleye	0	0	0	33	8	1,229	1,496	1,941	1,102	1,074	252	189	7,326
White Sucker	120	81	115	157	259	8,826	21,648	447	88	1,875	200	235	34,050
Yellow Perch	88	140	23	4,850	1,838	921	5,087	1,306	3,377	2,629	2,958	280	23,499
Grand Total	1,512	2,226	2,022	12,472	7,093	23,390	58,256	67,443	55,418	19,173	29,110	10,351	288,465

Table 5-5 Monthly and Annual Entrainment Estimates for Fish with Lengths of 200 to 380 mm

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Black Crappie	0	0	0	69	28	130	24	353	662	45	11	39	1,361
Bluegill	0	0	0	16	0	5	4	2	0	0	16	0	43
Central Mudminnow	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Shiner	0	0	0	0	0	0	0	0	0	0	0	0	0
Johnny Darter	0	0	0	0	0	0	0	0	0	0	0	0	0
Largemouth Bass	0	0	21	0	30	0	0	0	152	0	100	0	303
Logperch	0	0	0	0	0	0	0	0	0	0	0	0	0
Mimic Shiner	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern Pike	0	0	0	12	21	16	0	0	0	45	16	0	109
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Bass	71	0	0	5	104	28	2	21	96	39	6	0	372
Shorthead Redhorse	67	0	0	67	378	127	76	6	26	96	0	0	843
Silver Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth Bass	0	0	0	5	67	50	102	58	256	106	0	0	643
Spotfin Shiner	0	0	0	0	0	0	0	0	0	0	0	0	0
Trout-perch	0	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	0	0	0	52	144	150	41	29	31	124	39	0	610
White Sucker	17	0	50	38	35	42	5	77	220	55	89	16	645
Yellow Perch	0	0	50	56	26	42	74	88	214	62	61	0	672
Grand Total	154	0	122	319	833	589	327	634	1,657	572	338	55	5,600

5.4 Blade Strike and Turbine Survival

Turbine survival for units 1 and 2 ranged from 83.7 to 97.2%, whereas units 3, 4, and 5 ranged from 70.4 to 93.4% (Table 5-6, Table 5-7). For units 1 and 2, the average turbine survival based on calculations is 87.8% and for units 3, 4, and 5 it is 77.4%. The projected survival rate for all units combined at the Project is 82.6%.

Table 5-6 Turbine Survival Estimates by Fish Length for the Project Units 1 and 2

Fish Length	Blade Strike Probability (P_S)	Probability of Strike Mortality (P_M)	Turbine Passage Survival (%) (S_T)
50	0.36	0.078	97.2
100	0.71	0.104	92.6
150	1.00	0.119	88.1
200	1.00	0.129	87.1
250	1.00	0.138	86.2
300	1.00	0.144	85.6
350	1.00	0.150	85.0
400	1.00	0.155	84.5
450	1.00	0.159	84.1
500	1.00	0.163	83.7

Table 5-7 Turbine Survival Estimates by Fish Length for the Project Units 3, 4, and 5

Fish Length	Blade Strike Probability (P_S)	Probability of Strike Mortality (P_M)	Turbine Passage Survival (%) (S_T)
50	0.46	0.143	93.4
100	0.92	0.189	82.6
150	1.00	0.216	78.4
200	1.00	0.235	76.5
250	1.00	0.250	75.0
300	1.00	0.262	73.8
350	1.00	0.272	72.8
400	1.00	0.281	71.9
450	1.00	0.289	71.1
500	1.00	0.296	70.4

5.5 Mortality Estimates

Monthly and annual entrainment mortality estimates were calculated by multiplying entrainment numbers by the average turbine survival estimates for each size group, assuming that 40% of fish pass through units 1 and 2 and 60% through units 3 through 5 (i.e., unit 1 and 2 survival rates for each size group were multiplied by 0.4 and unit 3-5 rates were multiplied by 0.6, with the sum of the products used for the entrainment mortality calculations).

Black Crappie and White Sucker had the highest mortality for fish less than 200 mm long (Figure 5-1) and Black Crappie and Shorthead Redhorse had the highest mortality for fish 200 to 380 mm long. Both figures were simplified to include species with greater than 1% mortality. There was no estimated entrainment mortality for nine of the 19 species in the 200 to 380 mm size range (Figure 5-2). Overall, fish less than 200 mm long had total annual mortality estimates of approximately 36,000 (Table 5-8) and fish 200 to 380 mm long had a total annual mortality of approximately 1,200 (Table 5-9).

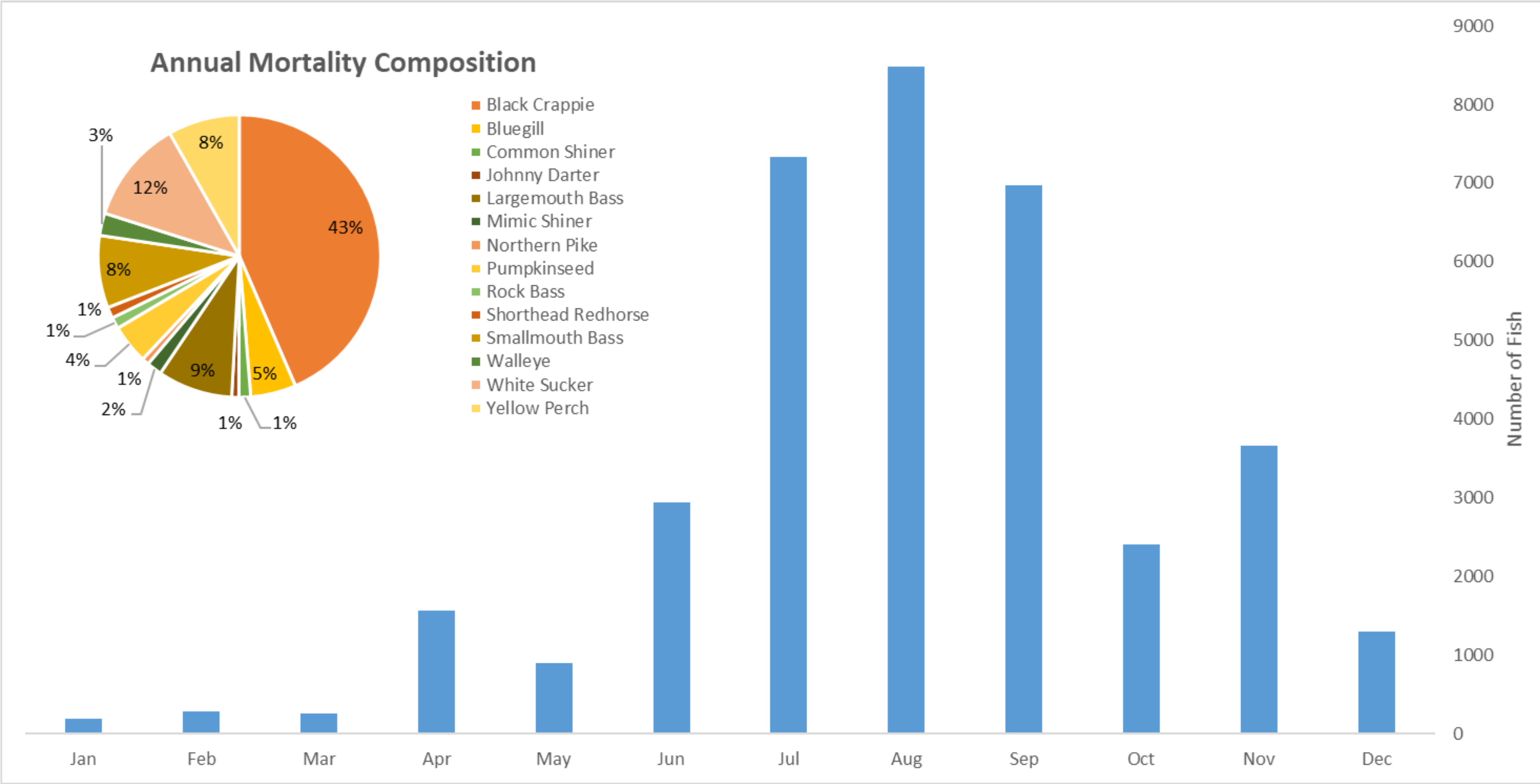

Figure 5-1 **Combined Monthly and Annual Entrainment Mortality Estimates for Fish Species less than 200 mm (Includes only species with greater than 1% mortality)**

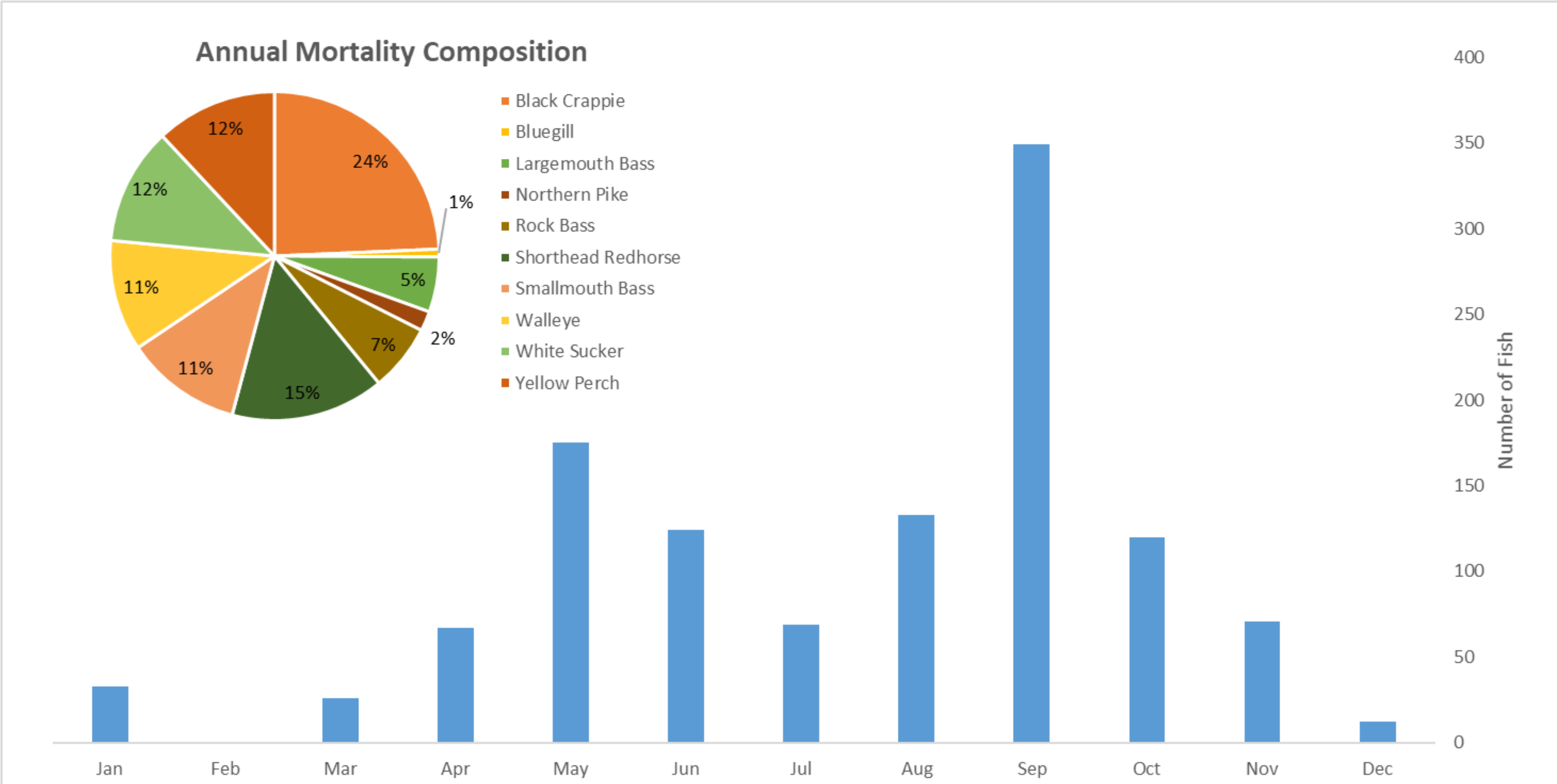

Figure 5-2 **Combined Monthly and Annual Mortality Estimates for Fish Species 200 to 380 mm (Includes only species with greater than 1% mortality)**

Table 5-8 Monthly and Annual Entrainment Mortality Estimates for Fish Less Than 200 mm in Length

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Black Crappie	56	48	29	712	132	122	1447	6989	3048	669	1741	686	15679
Bluegill	0	0	16	61	34	131	35	388	413	223	566	9	1875
Central Mudminnow	0	0	6	17	16	0	0	0	0	0	4	0	43
Common Shiner	0	18	0	6	152	5	3	6	2	5	21	269	485
Johnny Darter	0	0	12	34	93	58	73	21	1	0	0	0	292
Largemouth Bass	0	25	39	44	1	606	1091	157	327	122	631	43	3087
Logperch	0	0	0	7	54	38	12	10	0	12	17	0	151
Mimic Shiner	84	153	113	7	42	111	13	6	0	2	16	80	628
Northern Pike	0	0	0	4	0	31	172	56	9	8	12	0	292
Pumpkinseed	20	9	22	18	33	78	66	170	712	258	160	72	1619
Rock Bass	4	0	0	18	66	49	19	21	180	96	9	9	472
Shorthead Redhorse	0	0	0	2	1	237	28	27	40	93	12	17	458
Silver Redhorse	0	0	0	0	0	5	0	1	1	0	0	0	7
Smallmouth Bass	0	0	0	1	2	89	818	163	1659	185	41	25	2983
Spotfin Shiner	0	0	0	0	0	0	0	5	4	0	0	0	9
Trout-perch	0	0	0	4	0	0	0	0	0	37	4	4	49
Walleye	0	0	0	4	1	155	188	244	139	135	32	24	922
White Sucker	15	10	14	20	33	1110	2723	56	11	236	25	30	4284
Yellow Perch	11	18	3	610	231	116	640	164	425	331	372	35	2956
Grand Total	190	280	254	1569	892	2942	7329	8484	6972	2412	3662	1302	36289

Table 5-9 Monthly and Annual Entrainment Mortality Estimates for Fish with Lengths of 200 to 380 mm

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Black Crappie	0	0	0	14	6	27	5	74	140	10	2	8	287
Bluegill	0	0	0	3	0	1	1	0	0	0	3	0	9
Central Mudminnow	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Shiner	0	0	0	0	0	0	0	0	0	0	0	0	0
Johnny Darter	0	0	0	0	0	0	0	0	0	0	0	0	0
Largemouth Bass	0	0	4	0	6	0	0	0	32	0	21	0	64
Logperch	0	0	0	0	0	0	0	0	0	0	0	0	0
Mimic Shiner	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern Pike	0	0	0	2	4	3	0	0	0	9	3	0	23
Pumpkinseed	0	0	0	0	0	0	0	0	0	0	0	0	0
Rock Bass	15	0	0	1	22	6	0	4	20	8	1	0	78
Shorthead Redhorse	14	0	0	14	80	27	16	1	5	20	0	0	178
Silver Redhorse	0	0	0	0	0	0	0	0	0	0	0	0	0
Smallmouth Bass	0	0	0	1	14	11	21	12	54	22	0	0	135
Spotfin Shiner	0	0	0	0	0	0	0	0	0	0	0	0	0
Trout-perch	0	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	0	0	0	11	30	32	9	6	6	26	8	0	129
White Sucker	4	0	11	8	7	9	1	16	46	12	19	3	136
Yellow Perch	0	0	11	12	5	9	16	19	45	13	13	0	141
Grand Total	33	0	26	67	175	124	69	133	349	120	71	12	1179

6.0 Conclusion

Using a desktop analysis approach, the annual average number of fish less than 200 mm long expected to become entrained at the Project is approximately 290,000. Of that, approximately 36,000 will suffer mortality from entrainment. It was estimated that approximately 5,600 fish would become entrained with total lengths of 200 to 380 mm, and of those, approximately 1,200 suffering mortality. These estimations are based on species lists and relative composition data from the Mississippi River between Brainerd and the Grand Rapids Dam, entrainment data from the EPRI database, and the Project's operational specifications.

Physical exclusion is expected to occur for some larger fish of all species except Common Shiner, Mimic Shiner, Spotfin Shiner, Johnny Darter, Logperch, Trout-perch, and Central Mudminnow. Consequently, impingement on the trashrack is not expected to occur for any of the target species that reach a length at which they would be too large to pass through the 1.75-inch clear bar spacing.

Based on our evaluation and sampling by the MNDNR, population dynamics in the reach would remain as is and the status quo of Muskellunge and other game species, both above and below the Project, would be maintained. Black Crappie were estimated to have the highest entrainment and mortality rates for both size classes. The projected survival rate for all units combined at the Project is 82.6%.

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Memorandum

To: File
From: Daniel Tix, PhD and Shanna Braun
Subject: Botanical Resources Review for Brainerd Public Utilities
Date: 11/30/2018
Project: BPU – FERC Relicensing, Revised Study Plan

Background

FERC requested a Botanical Resources Study in a letter dated June 27, 2018 to map and/or confirm vegetation types within the Project boundary, including age-class and composition of forested area; rare, threatened, or endangered plant species or potential habitats; and document presence, absence, and location of invasive plant species.

In its August 20, 2018 Proposed Study Plan (PSP), BPU did not adopt this study request for the following reasons:

- The Project is operated as a run-of-river project and maintains a target elevation of 1174.04 feet, with fluctuations limited to 0.1 foot. As such, adjacent lands experience little change in water elevation, posing minimal change to vegetation communities and habitat types.
- There are no federally listed threatened or endangered plant species found in Crow Wing County, where the Project is located. In addition, there are no designated critical habitats for any federally listed species in Crow Wing County.
- Based on review using the Minnesota Department of Natural Resources (MNDNR) Natural Heritage Inventory System (NHIS) database, there are no state-listed plant species in the vicinity of the Project boundary.
- The Minnesota Department of Agriculture's Noxious Weed Mapper was reviewed to assess the presence of noxious weed infestations within the Project boundary. There are three mapped noxious weed occurrences in the Project area: two purple loosestrife occurrences observed in 2007/2008 and one common tansy occurrence observed in 2013. Mapped noxious weed occurrences are included in the attached Noxious Weed Records figure. This information was not included in the PAD.
- The only land BPU owns adjacent to the Project boundary is immediately surrounding the dam and auxiliary facilities. This land primarily comprises access roadways and facility structures. BPU actively mows and manages weeds on green spaces associated with these areas.
- BPU does not own or manage additional lands beyond the Project boundary limits and is not authorized to dictate vegetation management, including noxious weed control, of these lands.

In its November 6, 2018 letter providing comments on the PSP, FERC requested additional, site-specific data on botanical resources occurring at the project to analyze the range of effects to botanical and wildlife resources at the project. This memorandum includes the finding of additional botanical resources review.

Botanical Resources Review

Barr Botanist (Daniel Tix, PhD) performed a site-specific desktop botanical resources analysis based on review of available, relevant photographs from other work Barr has performed in the project boundary. The area reviewed included the area of the project facilities and the riparian corridor upstream and northeast of the project to County Road 3 as this reflected the special boundaries of the study area specified by FERC in its study request (see Attachment 1).

Historical Review

A review of aerial photography from 1937 (Attachment 2) shows the land along the north and south side of the botanical analysis area were mostly open, free of trees. Small patches of trees were present, on the north side of a road north of the reservoir. As such, vegetation within the area evaluated is predominantly secondary growth.

Species List

Based on the desktop review, the following plant species occur in the analysis area:

- Penn Sedge (*Carex pennsylvanica*)
- White snakeroot (*Ageratina altissima*)
- Meadow rue (*Thalictrum* spp.)
- Elm (*Ulmus* spp.)
- Oak (*Quercus* spp.)
- Willow shrubs (*Salix* spp.)
- Willow trees (*Salix* spp.) – likely black willow (*S. nigra*) or possibly peach-leaved willow (*S. amygdaloides*), crack willow (*S. fragilis*), or whitecrack willow (*S. rubens*)
- Red pine (*Pinus resinosa*)
- River grape (*Vitis riparia*)
- Sumac (*Rhus* spp.)
- Cottonwood (*Populus deltoides*)

Representative photos are included as Attachment 3.

Age Class, Species Composition, and Relative Density of Forested Understory

Trees within the forested upland area above the banks appear to be approximately 40 to 60 feet tall. These trees are likely more than 40 years old, but not older than 80 years. Large trunks were not observed; as such, there is no evidence of trees more than 100 years old. It is possible that some older and larger trees are present, but these are not evident from the shoreline.

Some red pines were observed that appear to be planted in rows. They appear to be 50 to 70 feet tall and are presumably 40 to 60 years old. They are mostly on the northern shore in discontinuous patches; there is not a single plantation.

An island within the analysis area has several smaller trees, likely willow, green ash, and elm that have relatively sparse canopy cover. Trees are likely 30 to 50 years old. Dense shrubs are also present with river grape and possibly other vines.

Within the evaluation area, the forested understory appears to have moderate coverage of shrubs and understory woody species. There also appears to be relatively thorough cover of the forest floor with herbaceous species. In general, the forested habitat appears to be relatively low quality secondary growth that is dominated by native trees, shrubs, and herbaceous species; though, portions are apparently planted pine. The species composition is typical of other common native forest stands in relatively disturbed habitats.

Presence of Snags or Old-growth Hardwoods with Sloughing Bark

Some snags are present, but since the forest areas reviewed appear to be relatively young and comprised of secondary growth, there are not many large dead trees. Most of the snags are likely smaller. Most of the sloughing bark likely occurs on dead branches of living trees or smaller dead trees.

Invasive Species

The Minnesota Department of Agriculture's Noxious Weed Mapper was again reviewed in November 2018 to assess the presence of noxious weed infestations within the analysis area, with additional emphasis given to the vicinity of County Road 3. Common tansy was recorded upstream of the analysis area, but no noxious weed species were recorded within the analysis area (Attachment 1).

One invasive species, reed canary grass (*Phalaris arundinacea*), was observed along the shorelines within the analysis area. Coverage was relatively light and confined to the shoreline due to steep shoreline slopes and wooded coverage of the area upslope and open water below.

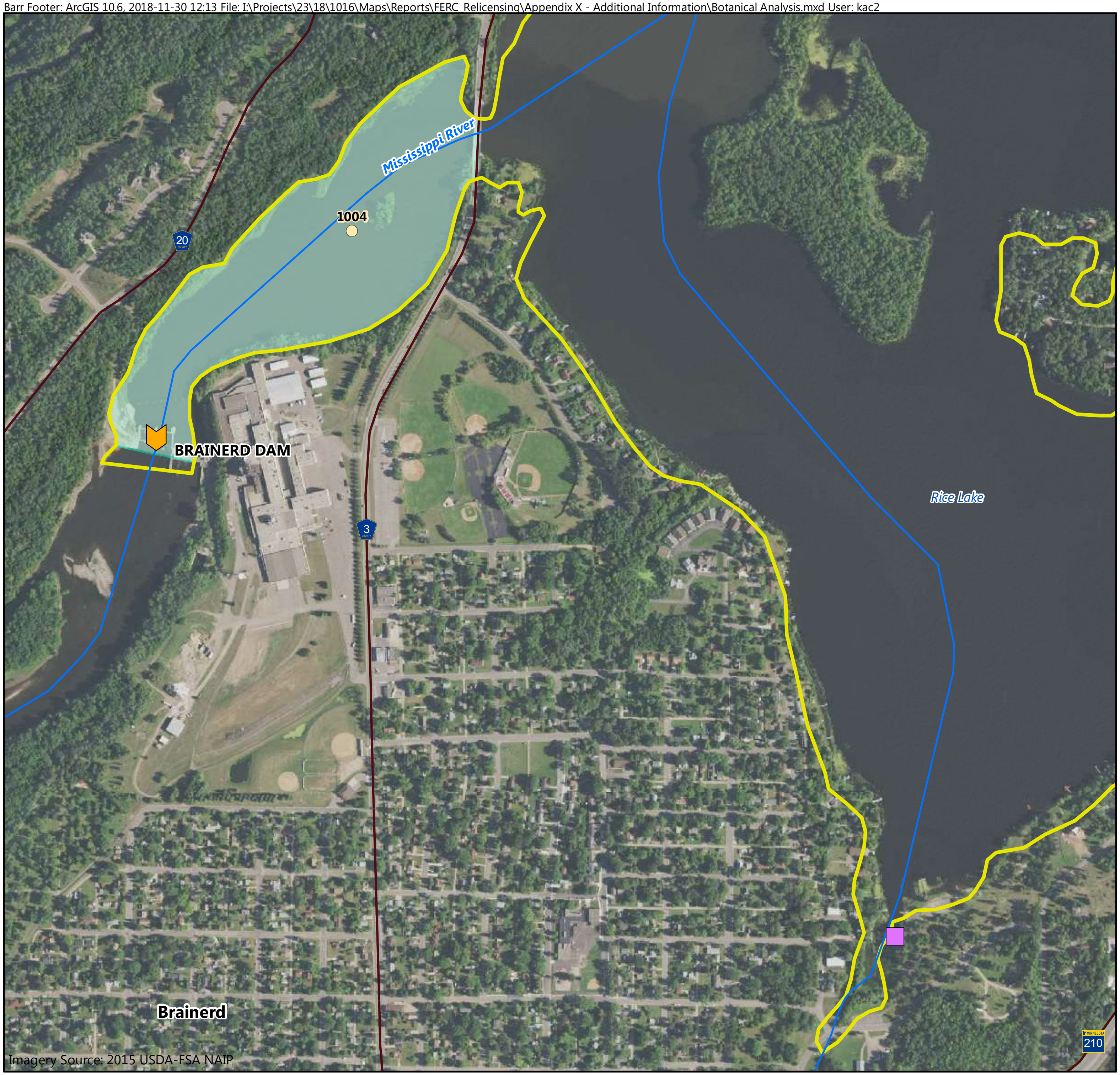
Attachments

Attachment 1 – Botanical Study Figure

Attachment 2 – 1937 Aerial Image

Attachment 3 – Representative Photos

Barr Footer: ArcGIS 10.6, 2018-11-30 12:13 File: I:\Projects\23\18\1016\Maps\Reports\FERC_Relicensing\Appendix X - Additional Information\Botanical Analysis.mxd User: kac2



River Mile Marker
Dam Location
Project Boundary
Botanical Analysis Area
Noxious Weed Record
Common Tansy
Major Roadway

0 800 1,600
Feet

BARR

Attachment 1
DESKTOP BOTANICAL ANALYSIS
Brainerd Dam
Brainerd Public Utilities


Evaluation Area
Attachment 2
1937 Aerial Imagery

Photo 1 – Shoreline taken from dam, view northwest

Photo 2 – Shoreline taken from dam, view northeast

Photo 3 – Representative shoreline in analysis area, view northwest

Photo 4 – Representative shoreline close-up in analysis area, view west

Photo 5 – Representative shoreline taken from northeast side of island, view south.

Photo 6 – Representative shoreline taken from vicinity of County Road 3 bridge, view south

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:
Consultation Code: 03E19000-2017-SLI-0538
Event Code: 03E19000-2018-E-00835
Project Name: Brainerd Dam FERC License Renewal

February 14, 2018

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The attached species list identifies any federally threatened, endangered, proposed and candidate species that may occur within the action area the area that is likely to be affected by your proposed project. The list also includes any designated and proposed critical habitat that overlaps with the action area. This list is provided to you as the initial step of the consultation process required under section 7(c) of the Endangered Species Act, also referred to as Section 7 Consultation.

Section 7 of the Endangered Species Act of 1973 requires that actions authorized, funded, or carried out by Federal agencies not jeopardize federally threatened or endangered species or adversely modify designated critical habitat. To fulfill this mandate, Federal agencies (or their designated non-federal representatives) must consult with the Service if they determine their project may affect listed species or critical habitat. Agencies must confer under section 7(a)(4) if any proposed action is likely to jeopardize species proposed for listing as endangered or threatened or likely to adversely modify any proposed critical habitat.

Under 50 CFR 402.12(e) (the regulations that implement Section 7 of the Endangered Species Act) the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally. You may verify the list by visiting the ECOS-IPaC website http://ecos.fws.gov/ipac/ at regular intervals during project planning and implementation and completing the same process you used to receive the attached list. As an alternative, you may contact this Ecological Services Field Office for updates.

Please use the species list provided and visit the U.S. Fish and Wildlife Service's Region 3 Section 7 Technical Assistance website at - http://www.fws.gov/midwest/endangered/section7/

s7process/index.html. This website contains step-by-step instructions that will help you determine if your project will have an adverse effect on listed species or critical habitat and will help lead you through the Section 7 process.

For all **wind energy projects** and **projects that include installing towers that use guy wires or are over 200 feet in height**, please contact this field office directly for assistance, even if no federally listed plants, animals or critical habitat are present within the action area.

Although no longer protected under the Endangered Species Act, be aware that bald eagles (*Haliaeetus leucocephalus*) are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*) and Migratory Bird Treaty Act *(*16 U.S.C. 703 *et seq*), as are golden eagles (*Aquila chrysaetos*). Projects affecting these species may require measures to avoid harming eagles or may require a permit. If your project is near a bald eagle nest or winter roost area, see our Eagle Permits website at http://www.fws.gov/midwest/midwestbird/EaglePermits/index.html. The information available at this website will help you determine if you can avoid impacting eagles or if a permit may be necessary.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- Migratory Birds

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

Project Summary

Consultation Code: 03E19000-2017-SLI-0538

Event Code: 03E19000-2018-E-00835

Project Name: Brainerd Dam FERC License Renewal

Project Type: ** OTHER **

Project Description: The project includes renewal of the facility's existing FERC license.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/46.4162336541563N94.15018854453277W

Counties: Crow Wing, MN

Endangered Species Act Species

There is a total of 2 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. 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.

Mammals

NAME	STATUS
Gray Wolf *Canis lupus* Population: MN There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4488	Threatened
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

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 maps of where birders and the general public have sighted birds in and around your project area, visit E-bird tools such as the E-bird data mapping tool (search for the name of a bird on your list to see specific locations where that bird has been reported to occur within your project area over a certain timeframe) and the E-bird Explore Data Tool (perform a query to see a list of all birds sighted in your county or region and within a certain timeframe). 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 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
American Bittern *Botaurus lentiginosus* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/6582	Breeds Apr 1 to Aug 31

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. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Black Tern *Chlidonias niger* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20
Black-billed Cuckoo *Coccyzus erythropthalmus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
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
Cape May Warbler *Setophaga tigrina* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jun 1 to Jul 31
Connecticut Warbler *Oporornis agilis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jun 15 to Aug 10
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
Evening Grosbeak *Coccothraustes vespertinus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 15 to Aug 10
Golden Eagle *Aquila chrysaetos* 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. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31
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

NAME	BREEDING SEASON
Harris's Sparrow *Zonotrichia querula* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Rusty Blackbird *Euphagus carolinus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Jul 20
Semipalmated Sandpiper *Calidris pusilla* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wood Thrush *Hylocichla mustelina* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31
Yellow Rail *Coturnicops noveboracensis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9476	Breeds May 15 to Sep 10

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.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in your project's counties 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:

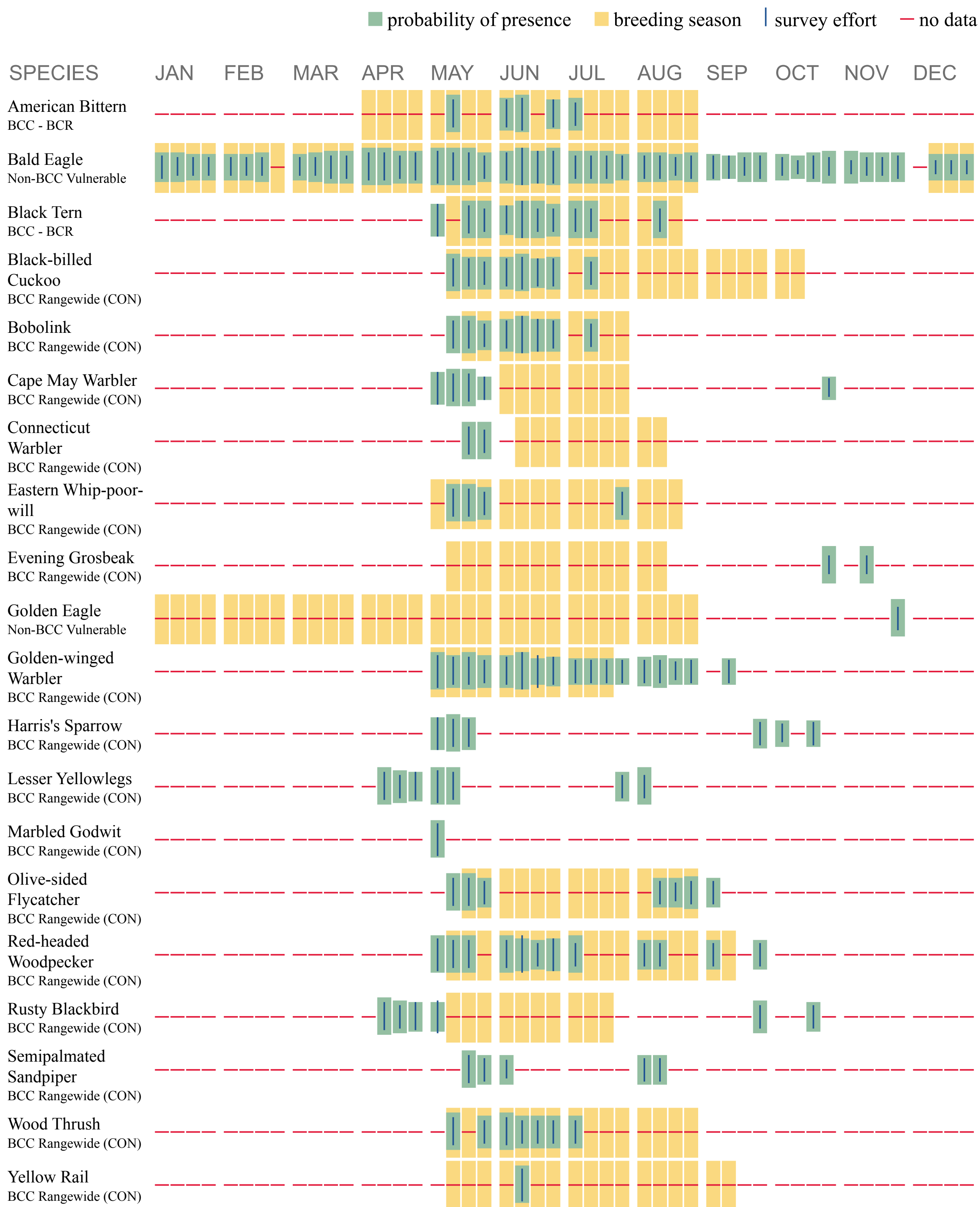
1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability 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 counties of your project area. 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.



probability of presence
breeding season
survey effort
no data
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
American Bittern
BCC - BCR
Bald Eagle
Non-BCC Vulnerable
Black Tern
BCC - BCR
Black-billed Cuckoo
BCC Rangewide (CON)
Bobolink
BCC Rangewide (CON)
Cape May Warbler
BCC Rangewide (CON)
Connecticut Warbler
BCC Rangewide (CON)
Eastern Whip-poor-will
BCC Rangewide (CON)
Evening Grosbeak
BCC Rangewide (CON)
Golden Eagle
Non-BCC Vulnerable
Golden-winged Warbler
BCC Rangewide (CON)
Harris's Sparrow
BCC Rangewide (CON)
Lesser Yellowlegs
BCC Rangewide (CON)
Marbled Godwit
BCC Rangewide (CON)
Olive-sided Flycatcher
BCC Rangewide (CON)
Red-headed Woodpecker
BCC Rangewide (CON)
Rusty Blackbird
BCC Rangewide (CON)
Semipalmated Sandpiper
BCC Rangewide (CON)
Wood Thrush
BCC Rangewide (CON)
Yellow Rail
BCC Rangewide (CON)

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 and/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 counties 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 E-bird Explore Data 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 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 entry on your migratory bird species list indicates a breeding season, it is probable that the bird breeds in your project's counties 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 BGEPA should such impacts occur.

Recreation Use and Inventory Study

Brainerd Hydroelectric Project
FERC License No. 2533

Prepared for:
Brainerd Public Utilities
Brainerd, Minnesota

January 22, 2020

Available for Public Release

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
Phone: 952.832.2600

Recreation Use and Inventory Study
Brainerd Hydroelectric Project

January 22, 2020

Preface

Brainerd Public Utilities (BPU) began the renewal process for the Federal Energy Regulatory Commission (FERC) license of the Brainerd Hydroelectric Project FERC Project No. 2533 (Project). This Recreation Use and Inventory Study was requested by the FERC and Minnesota Department of Natural Resources (MNDNR) to generate current inventory and use information of existing recreation opportunities. FERC has responsibility for ensuring compliance with Section 10(a) of Federal Power Act and that recreation facilities meet recreational demand over the term of the new license. FERC policy requires licensees to provide reasonable public recreation opportunities consistent with safe, effective facility operations.

BPU provides recreational opportunities within the Project Boundary in accordance with the conditions of its existing license. It also has a responsibility for ongoing monitoring of the recreation facilities within the Project Boundary and maintenance of its recreation facilities throughout the license term (1). FERC requires licensed projects to provide reasonable public recreation opportunities consistent with the safe and effective operation of the Project. FERC also has ongoing responsibility to ensure that those recreation facilities meet recreational demand over the term of the new license.

MNDNR requested recreational-use surveys be completed for flowing and impounded stretches of the river but did not provide spatial boundaries in their request. As such, the Recreation Use and Inventory Planning Study extents were primarily limited to the four facilities located within the Project Boundary (canoe portage, Lum Park, French Rapids access, and Green's Point access) as directed by FERC, during study plan development.

Recreation Use and Inventory Study
Brainerd Hydroelectric Project

January 22, 2020

Contents

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Abbreviations and Acronyms

BPU	Brainerd Public Utilities
FERC	Federal Energy Regulatory Commission
MNDNR	Minnesota Department of Natural Resources
Project	Brainerd Hydroelectric Project
RSP	Revised Study Plan

Definitions

Licensee: The license was issued to the city of Brainerd and its Brainerd Public Utilities Commission (BPUC). Brainerd Public Utilities (BPU) manages the Project.

Project: Brainerd Hydroelectric Project, Federal Energy Regulatory Commission (FERC) No. 2533 (Project)

Project Boundary: The boundary line defined in the Project license issued by the FERC that surrounds the "…lands necessary for the operation and maintenance of the Project and for other Project purposes…" (2)

Relicensing: The process of acquiring a new FERC license for an existing hydropower project under expiration of the existing FERC license

1.0 Introduction

Brainerd Public Utilities (BPU) is in the process of relicensing the Brainerd Hydroelectric Project (Project) with the Federal Energy Regulatory Commission (FERC). As required by the December 10, 2018 Revised Study Plan (RSP) (3) for the Project, this document describes the Recreation Use and Inventory Planning Study completed in 2019.

Section 4(e) and 10(a) of the Federal Power Act require that FERC give equal consideration to all uses of the waterway on which a project is located. In making its license decision, FERC must equally consider the environmental, recreational, fish and wildlife, and other non-developmental values of the Project, as well as power and developmental values.

The Project allows for and supports several recreation opportunities, including boating, hiking, fishing, watersports, and passive recreation activities. As such, the Project's effects on recreational resources is relevant to FERC's public interest determination.

2.0 Project Overview

The Project is owned and operated by the city of Brainerd and its Public Utilities Commission under a license from the FERC as Project No. 2533. The Project is located in Crow Wing County on the Mississippi River near the northeast side of Brainerd, Minnesota, as shown in Figure 2-1. The Project is located approximately 130 miles north of the Minneapolis – St. Paul metropolitan area.

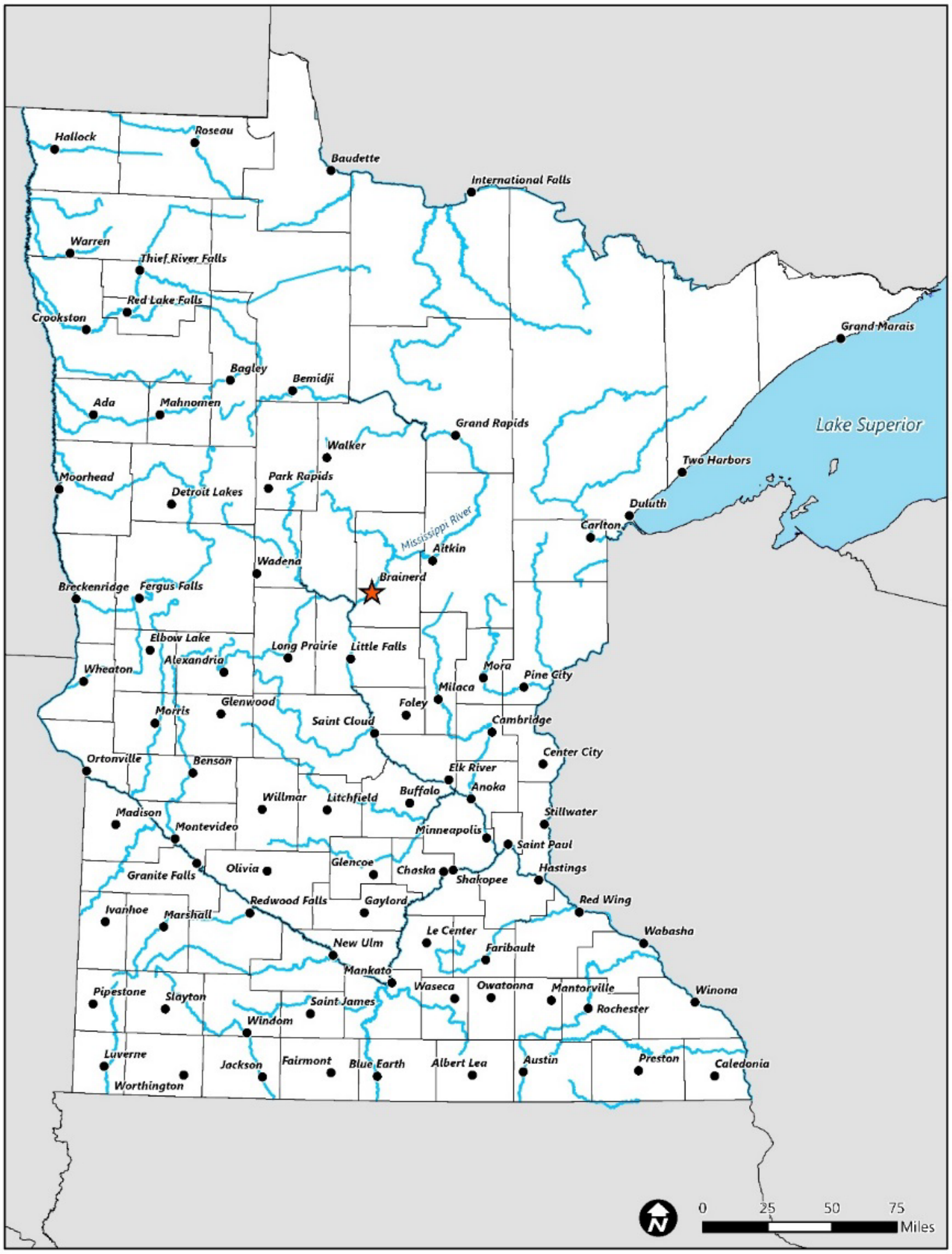


Figure 2-1 Project Location

From the left bank of the Mississippi River (looking downstream), the Project consists of a short left embankment, a 256-foot-long powerhouse, a 78-foot-long slide gate section, a 207-foot-long bascule (crest) gate section, a single 20-foot-wide steel tainter gate, and a 200-foot-long right embankment, as shown in Figure 2-2. The Project is located on land owned by BPU and is a run-of-river hydroelectric project, with an authorized installed capacity of 3,542.5 kilowatts.

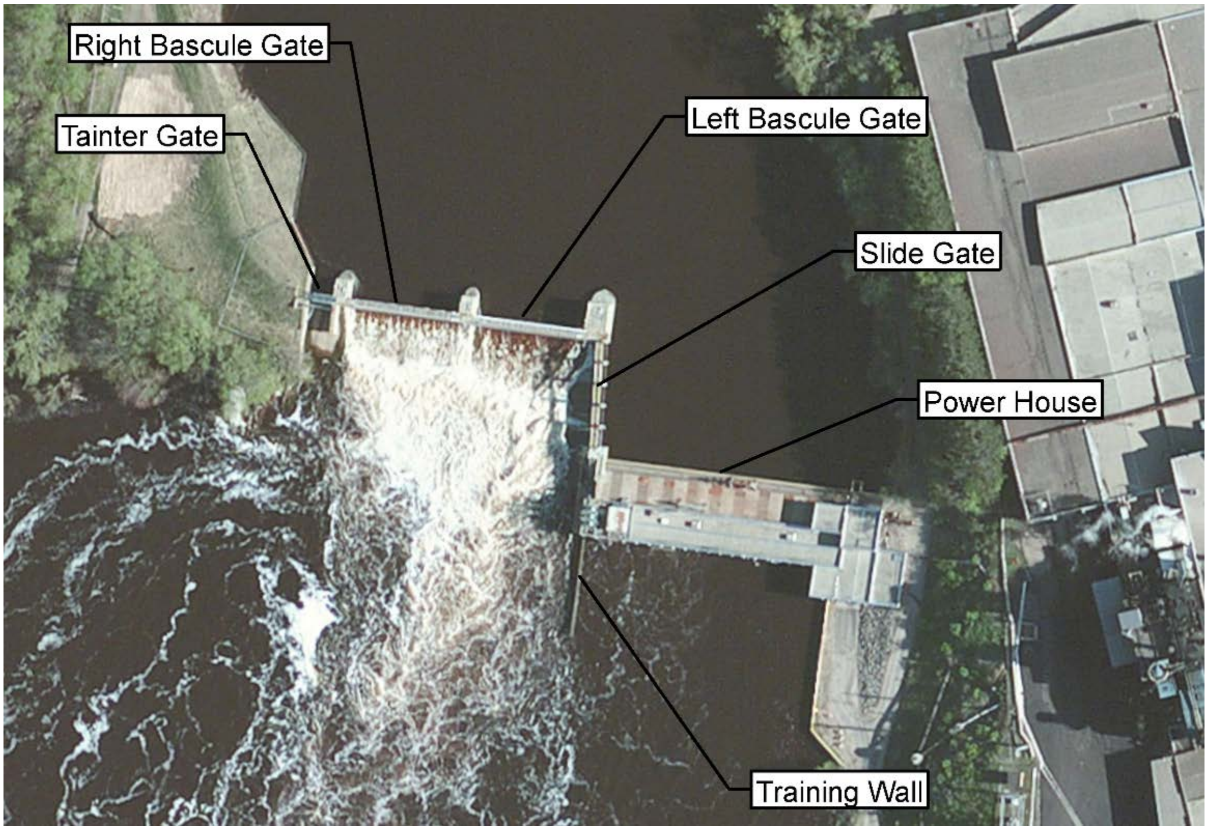
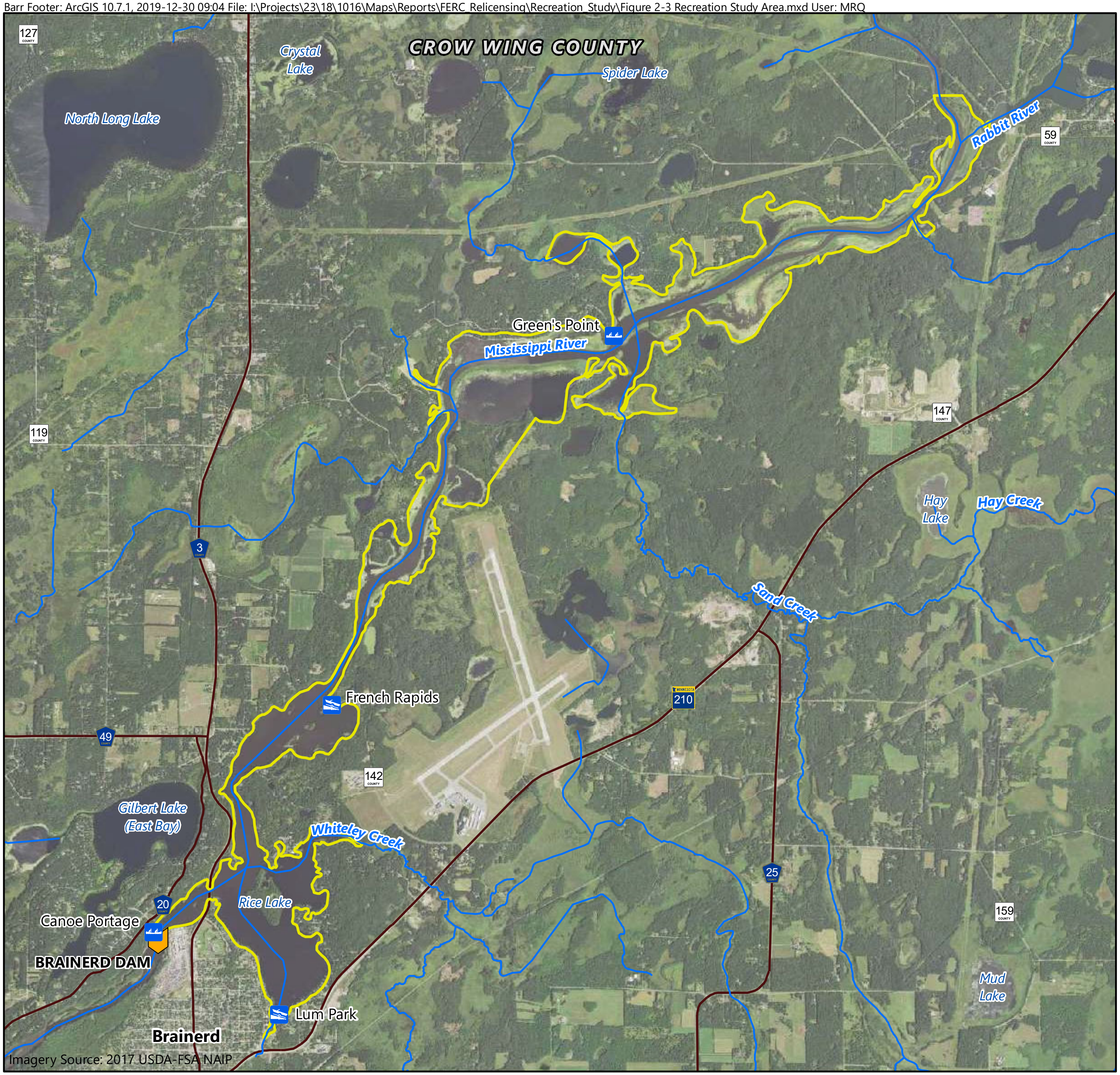


Figure 2-2 Project Overview

2.1 Study Boundary

This recreation use and inventory study focused on recreational use areas within the Project Boundary, including a canoe portage, Lum Park, French Rapids access, and Green's Point access. The location of these facilities is shown on Figure 2-3 and defined further in Section 5.0.

Barr Footer: ArcGIS 10.7.1, 2019-12-30 09:04 File: I:\Projects\23\18\1016\Maps\Reports\FERC_Relicensing\Recreation_Study\Figure 2-3 Recreation Study Area.mxd User: MRQ



Brainerd Dam

Project Boundary

Major Highway

Carry-in/Portage

Trailer Launch

N

0 5,000 10,000

Feet

0 1

Miles

BARR

Figure 2-3

RECREATION STUDY AREA
Brainerd Hydroelectric Project
Brainerd Public Utilities

3.0 Study Goals and Objectives

3.1 Goals and Objectives

The recreation use and inventory planning study was proposed to assess the condition and usage of recreation sites and associated facilitates within the Project Boundary. This study was requested by the Minnesota Department of Natural Resources (MNDNR) with comments for consideration provided by the FERC.

The goals of this study were to gather information from existing recreation sites and associated facilities, evaluate existing recreational use and capacity, and estimate future recreation demands within the Project Boundary. The goals of this study were met by performing the following objectives:

- Identify the condition of all informal and formal recreation sites and facilities wholly or partially within the Project Boundary;
- Determine current and projected capacity at each recreation site/facility;
- Identify who owns, operates, and maintains each recreation site/facility; and
- Conduct visitor surveys during the recreation season to determine the adequacy of Project recreation facilities and whether modifications or upgrades are needed to meet current or future recreation needs.

4.0 Methods

This section describes methods used for data collection and data analysis of 2019 study elements, including facility inventory and condition assessment, recreation use, and spot counts. The study plan required BPU to conduct studies at recreation sites located within the Project Boundary (Figure 2-3).

4.1 Facility Inventory and Condition Assessment

The facility inventory and condition assessment included a brief description for each site and location of the facilities in relation to the Project Boundary. A worksheet was developed to consistently document and address the site conditions (Appendix A). BPU used the worksheet to assign ratings to different project features ranging from restroom facility condition to the amount of erosion found along the shoreline. The following items were addressed:

- Identification of whether or not the facility is located within the Project Boundary
- Ownership and party responsible for operation and maintenance of each facility
- Type, number, and condition of amenities provided, including parking and signage
- General observations of site use and accessibility
- Identification of areas that show signs of erosion or other forms of instability

Facilities were assigned a condition rating score ranging from 1 to 5, as defined in Table 4-1.

Table 4-1 Facility Inventory and Assessment Condition Rating Scale

Rating	Condition	Description
1	Poor	Critically damaged, needs immediate repair or replacement, past intended life use
2	Marginal	Is defective and in need of replacement, but is still in a workable condition
3	Adequate	Is moderately deteriorated, has not exceeded its intended life use, minor compliance issues
4	Good	May be slightly defective, no longer new, is overall functional and in working condition
5	Excellent	In new or like new condition, no visible defects

Online resources, local knowledge, and signage were used to determine hours and seasons of operation. Many of these areas are maintained within appropriate seasonal conditions. Photographs were taken as a means to visually document facility conditions. Representative photos are included in Section 5.0 of this document with larger images in Appendix B.

4.2 Recreation Use Survey

BPU conducted a recreation use survey at each of the four sites included in the facility inventory and condition assessment effort. A recreational use survey questionnaire was developed to assist with consistent data collection (Appendix C). The questionnaire was converted to an electronic, tablet-based format for BPU staff to use on site. Collected data was automatically uploaded to an online storage space, allowing for more reliable data backup during the survey period.

The schedule for the recreational use surveys was created in accordance with the RSP (3). All sampling days and times were randomly selected to account for variable time of day use patterns (Table 4-2). The recreation use surveys were completed during the recreation season to capture recreational use occurring while the facilities were open to the public. The recreation season for this Project was defined as the opening weekend of fishing season (mid-May) to the opening weekend of waterfowl hunting season (late September).

The recreation use survey was administered to facility users to gain user feedback on existing recreation facilities and opportunities. This survey recorded the number of people in a party, their primary reason for visiting the site (i.e., type of recreation), their perception of level of site use, and their opinions on the amount and types of recreation opportunities offered within the Project Boundary.

4.3 Spot Counts

Spot counts were conducted in conjunction with the recreation use survey. Spot counts were intended to be brief in duration to provide a snapshot of use at each recreation site. Spot counts lasted approximately 5 minutes and recorded the number of vehicles parked at a site and the number of trailers. This information was also collected electronically via tablet and was used in estimating site use.

Table 4-2 Recreation Survey Schedule

Month	Date	Survey Order	Time	Weekday/ Weekend/ Holiday
May	May 24, 2019 Friday	Green's Point access	8:00-10:00 am	Weekday
		Canoe Portage	10:15am-12:15pm	
		Lum park	1:00-3:00 pm	
		French Rapids access	3:15-5:15 pm	
	May 26, 2019 Sunday	French Rapids access	8:00-10:00 am	Holiday Weekend (Memorial Day)
		Lum park	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		Canoe Portage	3:15-5:15 pm	
	May 28, 2019 Tuesday	French Rapids access	8:00-10:00 am	Weekday
		Canoe Portage	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		Lum park	3:15-5:15 pm	
	May 30, 2019 Thursday	French Rapids access	8:00-10:00 am	Weekday
		Lum park	10:15am-12:15pm	
		Canoe Portage	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	
June	June 6, 2019 Thursday	Lum park	8:00-10:00 am	Weekday
		Canoe Portage	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		French Rapids access	3:15-5:15 pm	
	June 15, 2019 Saturday	Green's Point access	8:00-10:00 am	Weekend
		French Rapids access	10:15am-12:15pm	
		Lum park	1:00-3:00 pm	
		Canoe Portage	3:15-5:15 pm	
	June 19, 2019 Wednesday	French Rapids access	8:00-10:00 am	Weekday
		Lum park	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		Canoe Portage	3:15-5:15 pm	
	June 23, 2019 Sunday	Lum park	8:00-10:00 am	Weekend
		French Rapids access	10:15am-12:15pm	
		Canoe Portage	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	

Month	Date	Survey Order	Time	Weekday/ Weekend/ Holiday
July	July 6, 2019 Saturday	Canoe Portage	8:00-10:00 am	Holiday Weekend (4th of July)
		Lum park	10:15am-12:15pm	
		French Rapids access	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	
	July 14, 2019 Sunday	French Rapids access	8:00-10:00 am	Weekend
		Green's Point access	10:15am-12:15pm	
		Canoe Portage	1:00-3:00 pm	
		Lum park	3:15-5:15 pm	
	July 22 Monday	Canoe Portage	8:00-10:00 am	Weekday
		Lum park	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		French Rapids access	3:15-5:15 pm	
	July 30 Tuesday	Lum park	8:00-10:00 am	Weekday
		Green's Point access	10:15am-12:15pm	
		French Rapids access	1:00-3:00 pm	
		Canoe Portage	3:15-5:15 pm	
August	August 7, 2019 Wednesday	French Rapids access	8:00-10:00 am	Weekday
		Canoe Portage	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		Lum park	3:15-5:15 pm	
	August 11, 2019 Sunday	French Rapids access	8:00-10:00 am	Weekend
		Green's Point access	10:15am-12:15pm	
		Canoe Portage	1:00-3:00 pm	
		Lum park	3:15-5:15 pm	
	August 19, 2019 Monday	Lum park	8:00-10:00 am	Weekday
		Canoe Portage	10:15am-12:15pm	
		French Rapids access	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	
	August 31, 2019 Sunday	French Rapids access	8:00-10:00 am	Weekend
		Canoe Portage	10:15am-12:15pm	
		Green's Point access	1:00-3:00 pm	
		Lum park	3:15-5:15 pm	

Month	Date	Survey Order	Time	Weekday/ Weekend/ Holiday
September	September 1, 2019 Sunday	Canoe Portage	8:00-10:00 am	Holiday Weekend (Labor Day)
		French Rapids access	10:15am-12:15pm	
		Lum park	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	
	September 5, 2019 Thursday	Canoe Portage	8:00-10:00 am	Weekday
		Green's Point access	10:15am-12:15pm	
		French Rapids access	1:00-3:00 pm	
		Lum park	3:15-5:15 pm	
	September 14, 2019 Saturday	Lum park	8:00-10:00 am	Weekend
		French Rapids access	10:15am-12:15pm	
		Canoe Portage	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	
	September 20, 2019 Friday	Canoe Portage	8:00-10:00 am	Weekday
		Lum park	10:15am-12:15pm	
		French Rapids access	1:00-3:00 pm	
		Green's Point access	3:15-5:15 pm	

5.0 Results and Discussion

5.1 Facility Inventory and Assessment

The following sections characterize the evaluated recreation sites and include descriptions of each site's amenities, recreation features, photographs, signage, and conditions of amenities and structures based on the worksheet and rating scale described in Section 4.1.

5.1.1 Canoe Portage

The canoe portage is owned and maintained by BPU and is located within the Project Boundary off Riverside Drive, west of the right embankment. The canoe portage allows portage access around the Project and is open 24 hours. The site access includes informative and warning signage explaining site rules, as well as asphalt and concrete trails to portage canoes. Recreational activities include shoreline fishing and canoeing/kayaking. The site offers two concrete restroom facilities, and landscaping at the site is well maintained, primarily through mowing. Facility conditions at the canoe portage site resulted in an average condition rating of '4.0 – Good' based on individual amenity ratings shown in Table 5-1.

Table 5-1 Canoe Portage Recreation Inventory and Condition Assessment

Canoe Portage Amenities	Rating/Condition	Comments
Canoe Portage/Carry In 	4 – Good	Asphalt and concrete trail for canoe portage use, a few chipped out areas of asphalt, but easily avoidable.
Site Furnishings	3 – Adequate	Canoe rack set up next to restrooms.
Signage 	3 – Adequate	Canoe portage signs visible from river, other signs near restrooms.

<table>
<tr><th>Canoe Portage Amenities</th><th>Rating/Condition</th><th>Comments</th></tr>
<tr><td>Restrooms
</td><td>4 – Good</td><td>Two concrete outhouses with updated fixtures inside, new paint.</td></tr>
<tr><td>Landscaping
</td><td>4 – Good</td><td>Grass is maintained via mowing, no other significant landscaping at site.</td></tr>
<tr><td>Shoreline
</td><td>4 – Good</td><td>No evidence of erosion.</td></tr>
</table>

5.1.2 Lum Park

Lum Park is owned and maintained by the city of Brainerd. The site is located within the Project Boundary and is accessed from NE Washington Street in northeast Brainerd. The site is open May 1 through October 31. Restrooms are closed for the season at the discretion of the city of Brainerd once freezing temperatures are possible. The site access includes signage with directions to the boat ramp, camping, and the beach, as well as warning signs for aquatic nuisance species. There is a large paved parking area for 30 truck trailers, a second parking area with 45 single parking spaces marked, and a paved pathway throughout the park. A motorized boat launch provides access to Rice Lake and the Mississippi River. Additional recreational amenities include three sets of playground equipment, two sand volleyball courts, a fishing pier, a disc golf course, a public swimming beach, and picnic facilities. Camping facilities do not allow tent camping. Each camping space is typically about 40 feet by 55 feet in size, and has water, 30/50 amp electric hookups, Wi-Fi service, fire rings, and picnic tables.

Recreational activities provided by Lum Park include reservoir fishing, shoreline fishing, swimming, disc golfing, sand volleyball, bird watching, camping, picnicking, and boating. The site is generally well maintained and winterized as seasonal conditions indicate. The site offers men and women's bathrooms with running water, drinking fountains, and vending machines. Both small and large pavilions (four total) offer a multitude of picnic tables and grills. Facility conditions at Lum Park resulted in an average condition rating of '4.0 – Good' based on individual amenity ratings shown in Table 5-2.

Table 5-2 Lum Park Recreation Inventory and Condition Assessment

Lum Park Amenities	Rating/Condition	Comments
Playgrounds	4 – Good	Three sets of playground equipment, all in good condition.
Fishing Pier 	4 – Good	T-shaped fishing pier near beach and boat ramp.
Volleyball Courts	3 - Adequate	Two sand volleyball courts near campground.
Camping Facilities	3 - Adequate	Camper use only, no tents, open field with hook-ups, used frequently. Fire wood available.
Other Sporting Fields – Disc Golf 	4 – Good	Disc golf – newer baskets and tee boxes. Used quite a lot from observations.

<table>
<tr><th>Lum Park Amenities</th><th>Rating/Condition</th><th>Comments</th></tr>
<tr><td>Site Furnishings
</td><td>4 – Good</td><td>A few bike racks, lots of benches throughout and many picnic tables, in four separate pavilions.</td></tr>
<tr><td>Docks</td><td>3 – Adequate</td><td>One older dock at boat launch could use some work, close to water surface and small.</td></tr>
<tr><td>Trailer Accessible Boat Ramp
</td><td>4 – Good</td><td>Concrete planks, in a nice bay for easy loading and unloading, good approach to ramp.</td></tr>
<tr><td>Potable Water
</td><td>3 – Adequate</td><td>Drinking fountain at restroom building.</td></tr>
<tr><td>Signage

</td><td>4 – Good</td><td>Many signs throughout park.</td></tr>
</table>

Lum Park Amenities	Rating/Condition	Comments
Parking Spaces 	4 – Good	30 truck trailer spots, 45 single vehicle spots.
Parking Lot Surface	4 – Good	All parking is paved, approximately 10 years old, striped, no potholes.
Restrooms 	3 – Adequate	Men and women's restrooms with running water and four stalls in each unit. Vending machine located outside. Some surfaces need to be painted.
Picnic Shelters 	4 – Good	Four pavilions, one large with 20 picnic tables, three others smaller with 10 tables each. New roofs, fresh paint on structures, concrete floors.
Turf	5 – Excellent	Lots of grass area, very well maintained by City.
Park Trees 	4 – Good	Numerous types and sizes of trees, all pruned

Lum Park Amenities	Rating/Condition	Comments
Shoreline 	4 – Good	No evidence of erosion.

5.1.3 French Rapids Access

The French Rapids access is owned and maintained by Crow Wing County and is open year-round. This site is located within the Project Boundary and can be accessed from County Road 142, near its intersection with State Highway 210 East in Oak Lake Township, approximately four miles northeast of Brainerd. The site's access point includes a motorized boat launch, directional signage leading to the motorized boat launch, a picnic area, and a maintained gravel parking area. Recreational activities include nearly 6 miles of groomed skiing and hiking trails with signs indicating routes, reservoir fishing, shoreline fishing, and boating. This site does not offer restrooms or potable water sources. Facility conditions at French Rapid Access resulted in a condition rating of '3.0 – Adequate' based on individual amenity ratings shown in Table 5-3.

Table 5-3 French Rapids Access Recreation Inventory and Condition Assessment

French Rapids Amenities	Rating/Condition	Comments
Trailer Accessible Boat Ramp 	3 – Adequate	Concrete planks, good approach to ramp.
Signage 	3 – Adequate	Two signs leading to landing, invasive species signs, ski trail signs.

Parking Spaces	2 – Marginal	Open gravel-parking area, hard to determine total parking space count.
Parking Lot Surface	2 – Marginal	Semi-maintained gravel parking area with puddles in potholes during rain events.
Turf	2 – Marginal	Trees and gravel, not a lot of turf
Shoreline 	4 – Good	No evidence of erosion.

5.1.4 Green's Point Access

Green's Point access is maintained by the MNDNR. The site is located within the Project Boundary and can be accessed from County Road 3 at the end of Executive Acres Road, approximately 10 miles northeast of the City of Brainerd. Green's Point is open year-round and the site includes signage with invasive species warnings, fishing regulations, and site information signs, as well as a paved cul-de-sac for parking. This location features a carry-in boat launch point and a shoreline fishing area. Recreational activities include reservoir and shoreline fishing, bird watching, and boating. This site does not offer restrooms or potable water sources. Facility conditions at Green's Point were given a condition rating of '3.0 – Adequate' based on individual amenity ratings shown in Table 5-4.

Table 5-4 Green's Point Access Recreation Inventory and Condition Assessment

Green's Point Amenities	Rating/Condition	Comments
Canoe Portage/Carry In 	4 – Good	Grass trail down to river for canoe carry in, with a small permanent dock.
Docks	3 – Adequate	One small permanent docking area.

Green's Point Amenities	Rating/Condition	Comments
Signage 	3 – Adequate	Public water access sign on County Road 3, good signage at parking lot.
Parking Spaces 	2 – Marginal	Cul-de-sac shaped parking lot with few spaces and no designated trailer parking. Most observed vehicles in lot were trucks with canoes on top.
Parking Lot Surface	2 – Marginal	Asphalt parking area at end of road.
Shoreline 	4 – Good	No evidence of erosion.

5.2 Recreation Use Survey

This section reports the results of the spot counts and recreation use surveys conducted at the four recreation sites. Recreational use surveys were collected from 21 users (Figure 5-1) across the eight survey days. Raw survey data is provided in Appendix D. The majority of survey responses were received from users at Lum Park, which Section 5.1 indicates has more amenities than the other three facilities.

Not all users responded to every question in the survey; as a result, some survey totals may be less than 21. Survey results were grouped into the following general categories: user characteristics, recreational activity and preference, duration and timing of visits, user concerns and perceptions, and user satisfaction and feedback.

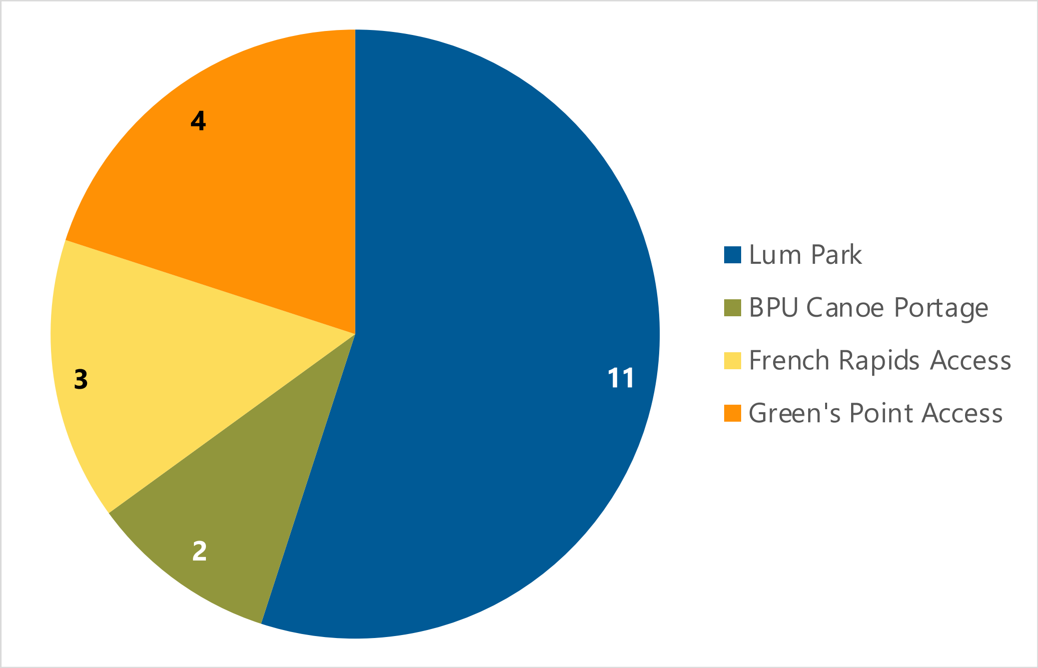


Figure 5-1 Survey Response Count by Facility

5.2.1 Use Characteristics by Location

The majority of the surveyed users visited the recreational facilities either as individuals or with one other person (Figure 5-2). Lum Park had the highest variability in group size with several groups of 3 to 5 and 6 to 10. Green's Point had the second largest group size ranging from 1 to 5, French Rapids Access had an average of 2 people per party, and the canoe portage had an average of 1 visitor per group.

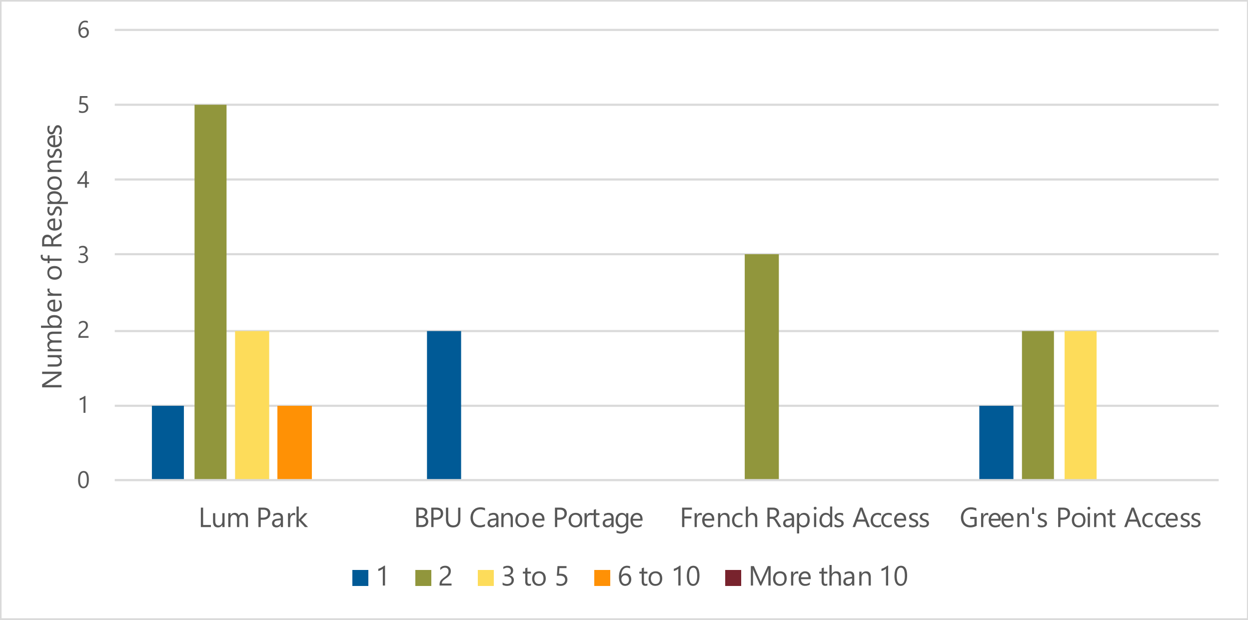


Figure 5-2 Average Surveyed Group Size by Facility

The majority of users across all surveyed locations typically arrive in a single vehicle, though responses at Lum Park, the French Rapids access, and the Green's Point access indicated occasional carpooling (Figure 5-3).

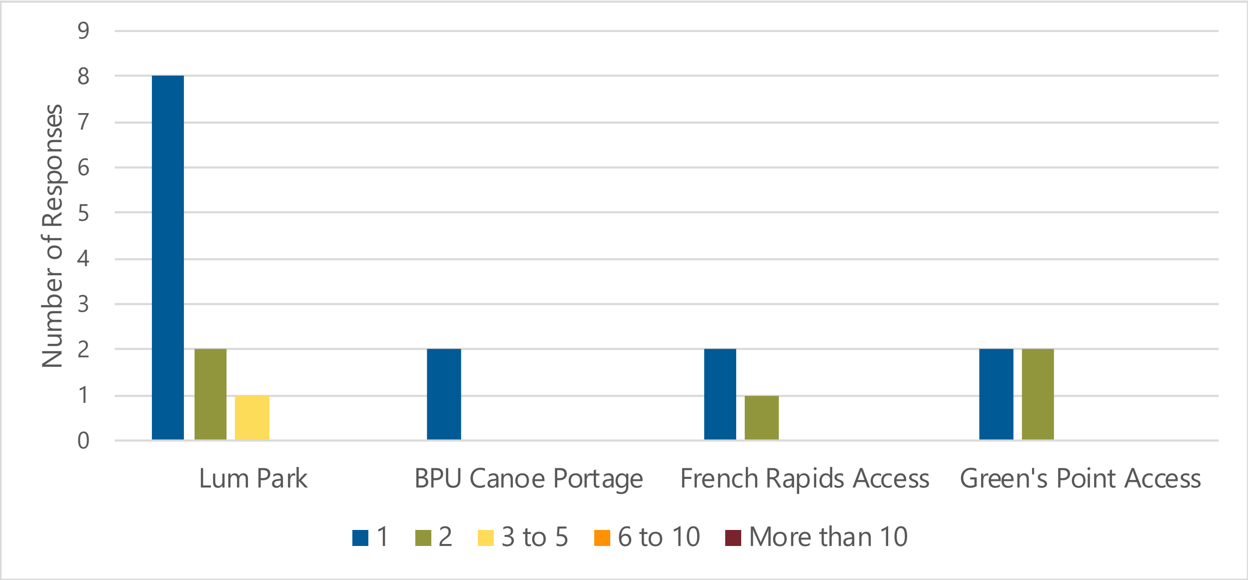


Figure 5-3 Number of Vehicles at Facility per Group of Users

To determine the frequency of use, survey participants were asked how often they visit the facility each year. Approximately 47 percent of respondents indicated that they visit the facility 1 to 3 times a year (Figure 5-4). When averaged against the number of survey respondents at a location, the French Rapids Access respondents tend to visit this location more frequently than users at the other surveyed locations, with an average response of 6-10 times a year.

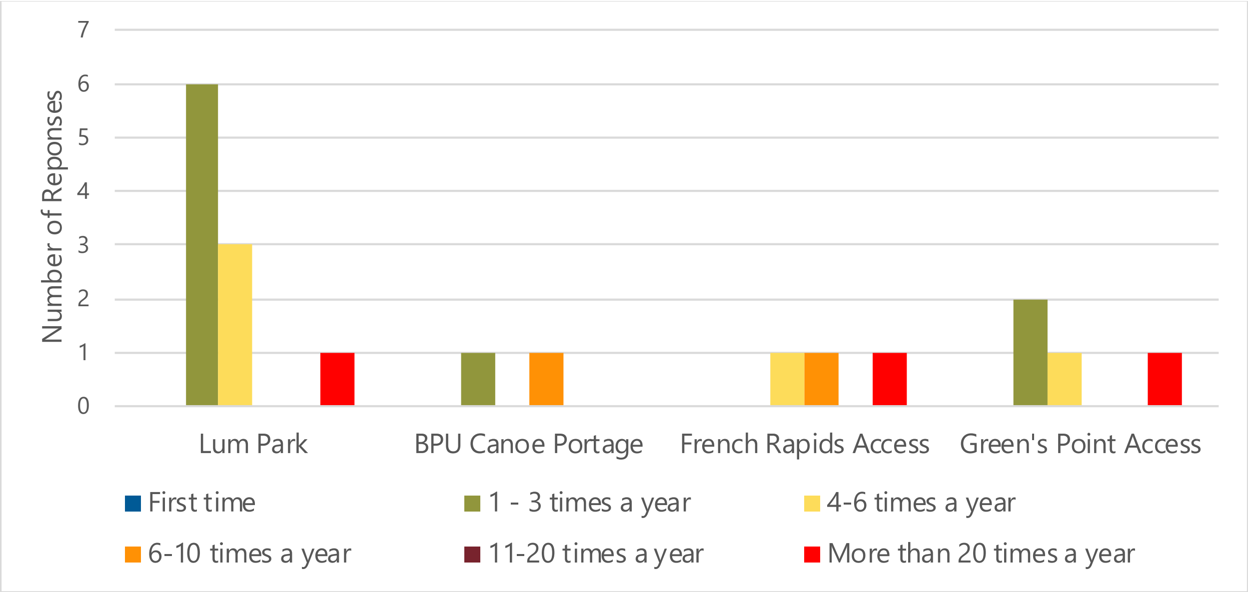


Figure 5-4 Annual Frequency of Site Visit

5.2.2 User Recreational Activity and Location Preference

The surveyed facilities offer a variety of recreational opportunities unique to each location, as described in Section 5.1. Recreational users were asked why they chose the specific facility and what activities they were there to participate in.

Lum Park users stated they primarily use the facility for fishing and boating (Figure 5-5); 53 percent of surveyed users identified fishing as their planned activity and 38 percent planned to use the facility for boating (motorized boating). In addition, one user planned to use the facility for a picnic. Fishing was noted as an intended use at all four recreation facilities, one user identified canoeing/kayaking use at the canoe portage, and one user identified they were at French Rapids access for other use. Camping, hunting, trapping, wildlife viewing, and swimming were activities included in the surveys, but were not selected by survey participants.. As such, these uses are not included in summary Figure 5-5.

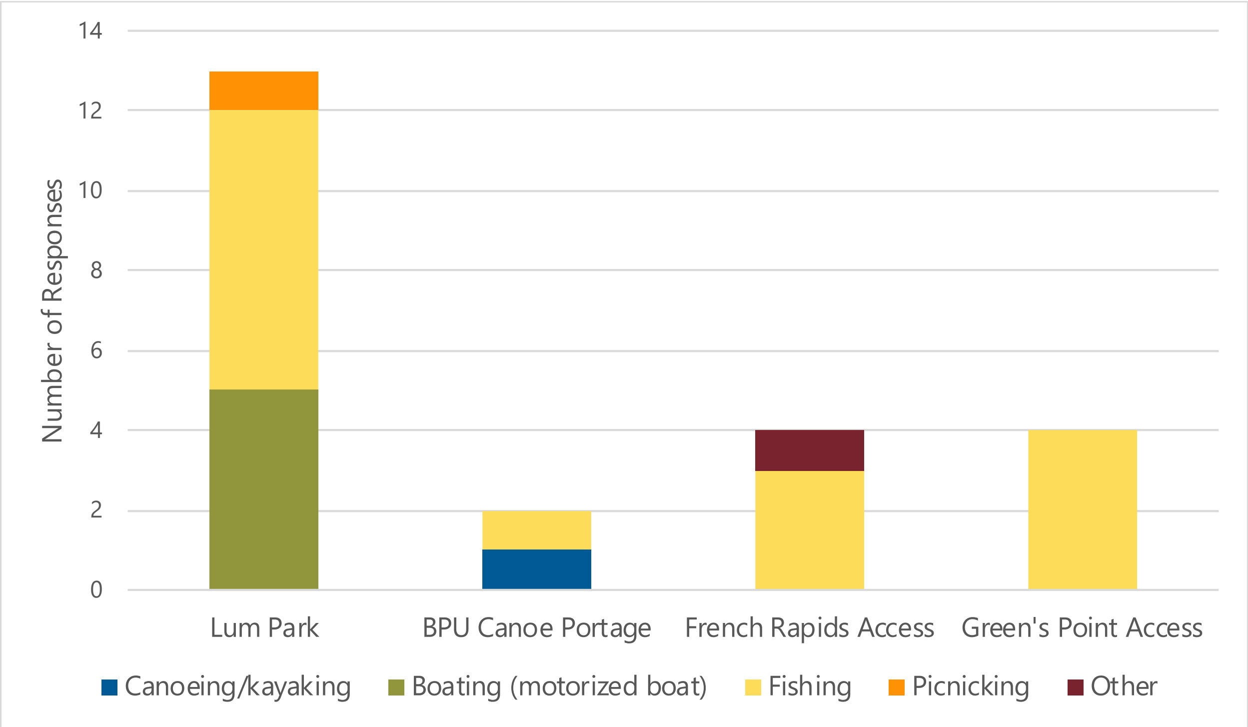


Figure 5-5 Planned Recreational Activity by Facility

All survey participants noted they choose to recreate at the specific facilities due to facility proximity to their homes. In addition, participants preferred to use Lum Park due to its available boat launch and lack of congestion. The canoe portage survey participants chose to use this facility because it has a portage. Both French Rapids access and Green's Point access users responded that they also use these facilities for fishing quality.

The surveyed facilities offer a variety of recreational amenities. Recreational users were asked which of the facility's amenities were most important to them. Nearly every survey participant, at each facility, responded that general access was important to them (Figure 5-6). Lum Park had the most variety in identified amenity importance, with participants valuing the boat launch, parking, boat dock, fishing dock, picnic tables, and trash receptacles. This variety in identified amenity importance is likely due to Lum Park offering more recreational amenities than the other surveyed facilities. The canoe portage users valued the facility's restrooms and general access. French Rapids access and Green's Point access users valued the general accessibility of each facility, while the French Rapids access users also placed importance on the site's parking (Figure 5-6). ADA accessibility, signs and information, and lighting were amenities included in the surveys, but were not selected by survey participants. As such, these amenities are not included in summary Figure 5-6.

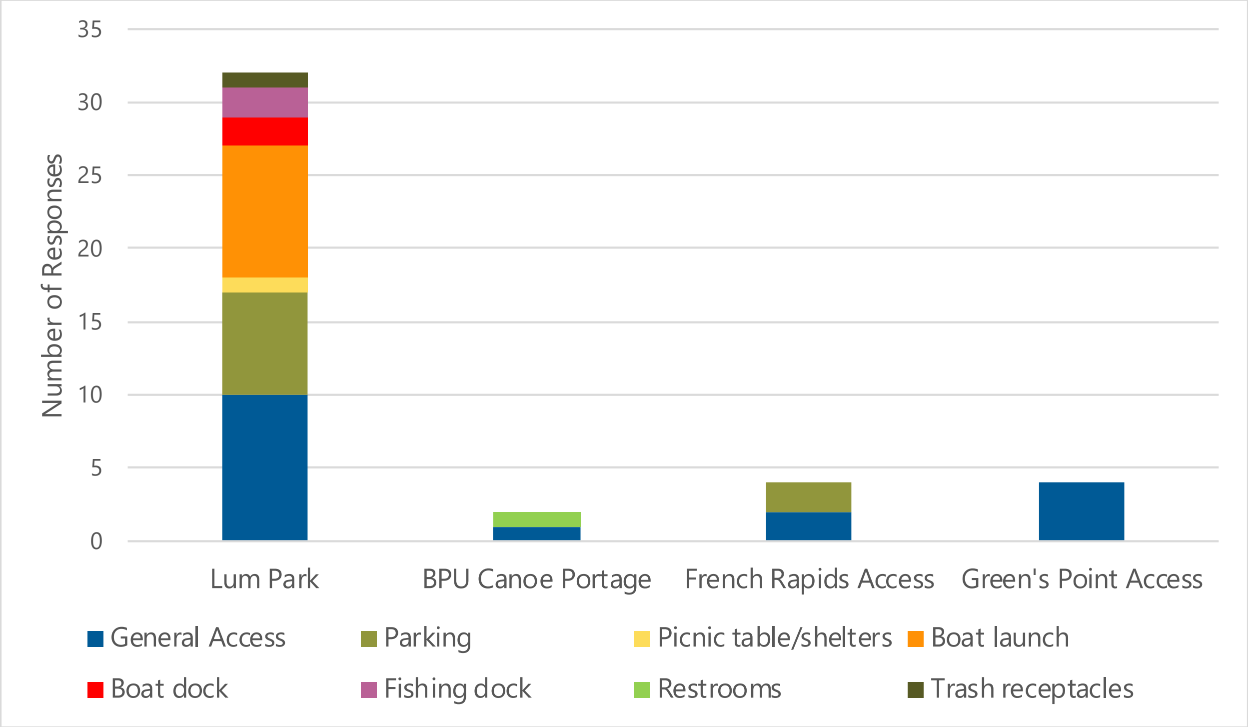


Figure 5-6 Important Facility Amenities

5.2.3 Duration and Timing of Visit

The frequency and duration of use for the surveyed facilities were fairly consistent. The majority of survey participants primarily use the parks during the summer months between June and September. Only one user noted they visit Lum Park in the spring between April and May, and one person noted they visit the Green's Point access in fall between October and November (Figure 5-7).

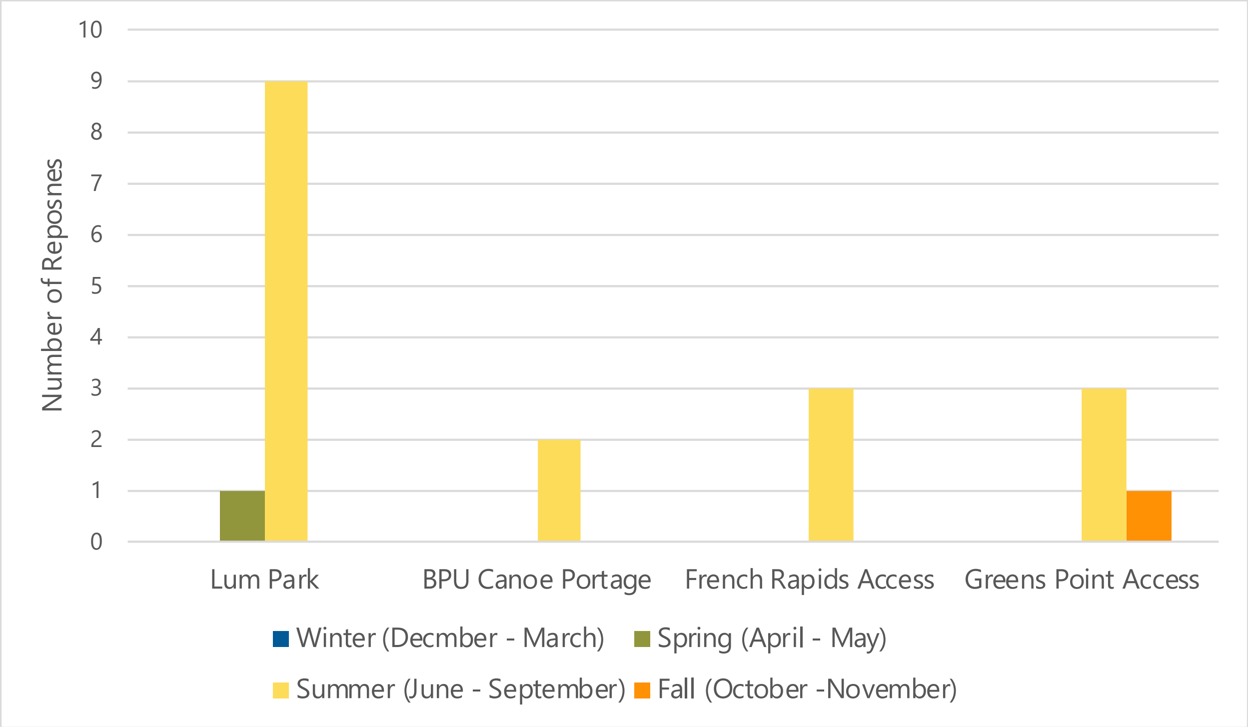


Figure 5-7 Seasonal Tendencies of Facility Use

The duration of recreational visits at each facility typically ranged between 2 to 4 hours (Figure 5-8). Two users noted they stay at the facility for more than 4 hours, with three users noting they stay at the facility for less than 2 hours.

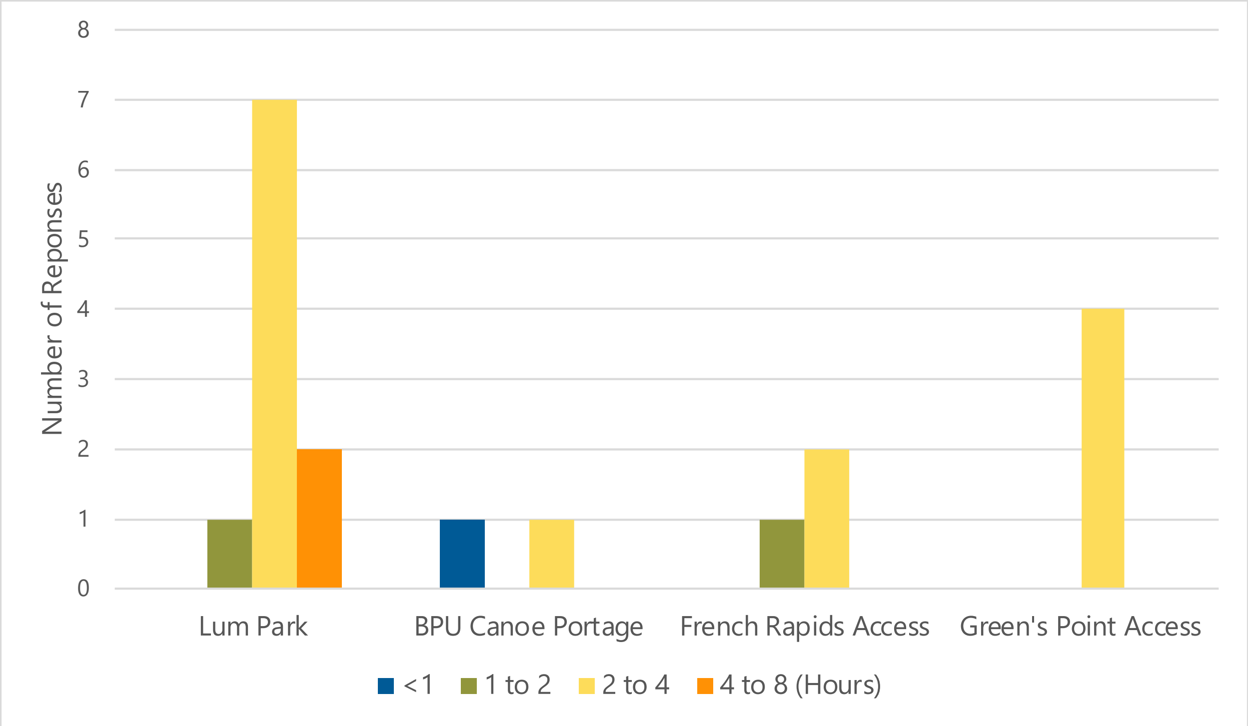


Figure 5-8 Typical Duration of Visit

5.2.4 User Capacity Perception

Overall, a majority of surveyed users perceived the facilities as not very busy (Figure 5-9) and that they preferred to recreate at these facilities because they are typically not very busy. Approximately 40 percent of Lum Park users stated the facility was moderately busy during the July 4th weekend. No users experienced any conflict with other users or recreational activities.

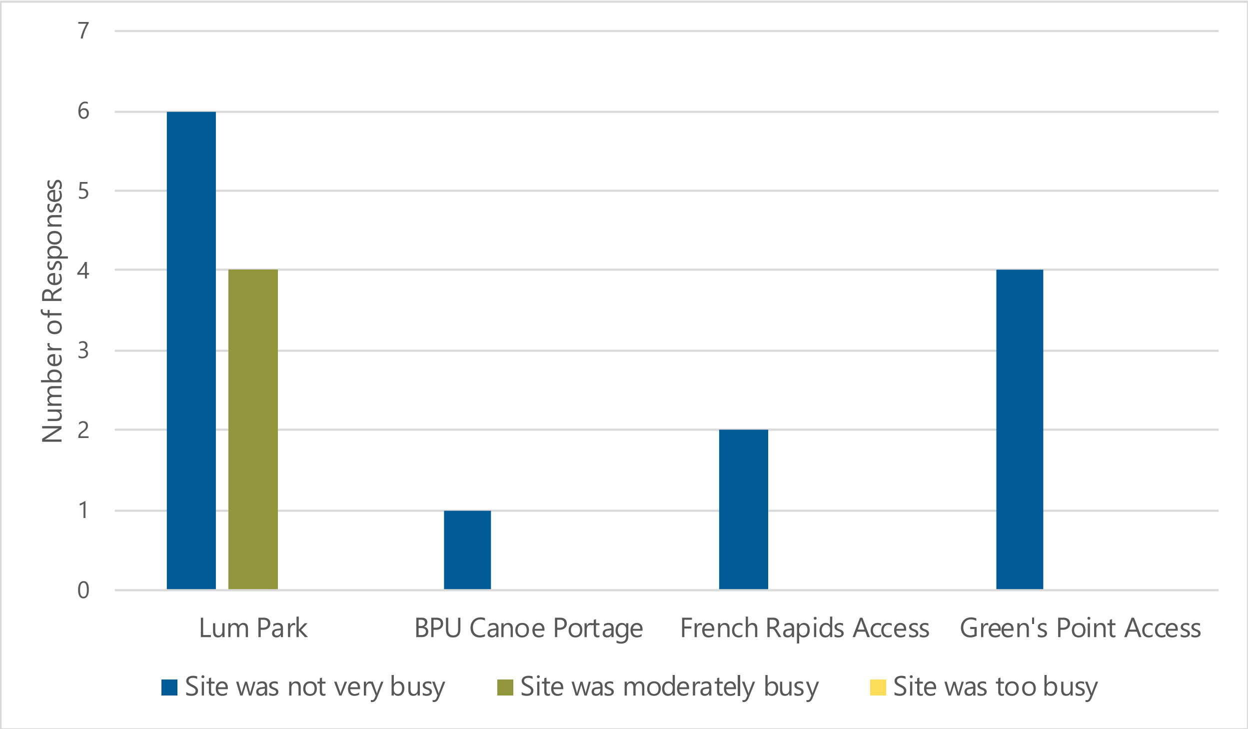


Figure 5-9 Perception of Site Capacity

5.2.5 User Satisfaction and Feedback

User satisfaction among all of the survey participants was high, with 95 percent of respondents stating that they were satisfied with the number of available recreational amenities at a given facility. One respondent indicated they were unsatisfied with Lum Park due to the length of time it took to complete a boat inspection and this recreational use questionnaire. Similarly, 95 percent of surveyed users stated that they found the overall condition of the facilities satisfactory and that they would recreate at the respective facilities again.

When prompted if there were additional recreation amenities needed at the facilities, participants stated no additions are needed. Two participants provided additional comments as part of the survey: one user of the French Rapids access noted that they liked how the park was never busy, and one user of Lum Park stated that they liked fishing at the fishing pier.

5.3 Spot Counts

Spots counts of the number of vehicles and trailers present at each facility were conducted to obtain a snapshot of use at each facility. The spot counts indicated Lum Park exhibited more use than the other facilities, presumably due to hosting more recreational amenities than the other facilities. Spots counts at the canoe portage, French Rapids access, or Green's Point access, did not identify any vehicles or trailers (Table 5-5).

Table 5-5 Spot Counts

Date	Number of Vehicles	Number of Trailers
Lum Park		
June 21, 2019 (Weekday)	5	5
June 25, 2019 (Weekday)	2	2
June 26, 2019 (Weekday)	3	3
July 7, 2019 (Holiday Weekend)	7	7
July 8, 2019 (Weekday)	1	1
July 9, 2019 (Weekday)	0	0
July 11, 2019 (Weekday)	7	5
July 16, 2019 (Weekday)	0	0
July 19, 2019 (Weekday)	3	3
July 25, 2019 (Weekday)	1	1
July 30, 2019 (Weekday)	4	4
July 30, 2019 (Weekday)	0	0
August 7, 2019 (Weekday)	1	1
September 5, 2019 (Weekday)	3	3
September 5, 2019 (Weekday)	4	4
Canoe Portage		
June 25, 2019 (Weekday)	0	0
July 30, 2019 (Weekday)	0	0
September 5, 2019 (Weekday)	0	0
French Rapids Access		
July 7, 2019 (Holiday Weekend)	0	0
July 8, 2019 (Weekday)	0	0
July 30, 2019 (Weekday)	0	0
September 5, 2019 (Weekday)	0	0
Green's Point Access		
June 25, 2019 (Weekday)	0	0
July 8, 2019 (Weekday)	0	0

6.0 Site Recommendations

Over the course of the study period, survey respondents were asked to provide suggestions related to site improvement needs. Additionally, when performing condition assessments, field staff made notes related to visitor safety, signage, and/or potentially useful amenities at each site. The suggestions and recommendations for each site are discussed below.

6.1.1 Canoe Portage

The canoe portage is a small park-like space that provides recreational users a canoe portage to the Mississippi River, as well as on-site restrooms and opportunities for shoreline fishing. The surveyed users at the canoe portage noted they were overall satisfied with the amenities and condition of the facility. Overall, the park is in good condition, receiving an average condition score of 4.0 (Good) on a 5-point scale. Continued routine maintenance of existing site amenities is recommended; no additional amenities or non-routine maintenance are recommended based on this recreation use and inventory study.

6.1.2 Lum Park

Lum Park provides a variety of amenities to recreational users, including motorized boat access to Rice Lake and is popular with anglers for its fishing pier. Approximately 90 percent of the survey participants were satisfied with the amenities provided at this site. One user was moderately unsatisfied due to the length of time it took to complete a boat inspection and this recreational use questionnaire. Overall, the park is in good condition, receiving an average condition score of 4.0 (Good) on a 5-point scale. Continued routine maintenance of existing site amenities is recommended; no additional amenities or non-routine maintenance are recommended based on this recreation use and inventory study.

6.1.3 French Rapids Access

The French Rapids access provides motorized boat access to the Mississippi River via a paved launch. The site is primarily used for boat access and shoreline fishing. The surveyed users at French Rapids access noted they were satisfied with the amenities and condition of the facility.

BPU staff noted that parking and turf management were adequate at this facility, contributing to the site's average condition score of 3.0 (Adequate) on a 5-point scale. The current parking consists of a small gravel surface that is infrequently maintained and contains potholes resulting in puddles during rain events. Although the parking lot is appropriately sized for the amount of site use, more frequent lot surface maintenance, to minimize the presence of potholes, is recommended. The turf score for the site was marginal due to the absence of significant turf areas at this site. Given the site's primary purpose is to provide boating access, the lack of turf does not contribute significantly to site use. No additional amenities or maintenance are recommended based on this recreation use and inventory study.

6.1.4 Green's Point Access

Green's Point access provides a walk-in access for canoes and kayaks to the Mississippi River, as well as opportunities for shoreline fishing. Survey participants at the Green's Point access primarily used the site for shoreline fishing. Overall, the park's condition is adequate, receiving an average condition score of 3.0

(Adequate) on a 5-point scale. All survey participants noted they were satisfied with the amenities provided and overall condition of the site. Continued routine maintenance of existing site amenities is recommended; no additional amenities or non-routine maintenance are recommended based on this recreation use and inventory study.

7.0 References

1. **Mead & Hunt.** *Recreational Use Monitoring Plan, Brainerd Hydroelectric Project, FERC Project No. 2533*. Brainerd, Minnesota : Potlatch Corporation, May 1994.

2. **Federal Energy Regulatory Commission (FERC).** *Division of Hydropower Administration & Compliance, Compliance Handbook.* Washington : Department of Energy, 2015.

3. **Barr Engineering Co.** Revised Study Plan - Brainerd Hydroelectric Project FERC License No. 2533. December 10, 2018.

Appendix A

Facility Inventory Assessment Form

Facility Inventory Assessment - Dam Site Canoe Portage

Date:10-14-19	Site Name:canoe Portage	Evaluator:Scott Magnuson	Facility Ownership:Brainerd Public Utilities

Directions: Please Include condition of each amenity based on the following ratings; please take photo documentation of all amenities

1 - Poor	In poor condition: Critically damaged, needs immediate repair or replacement, past intended life use
2 - Marginal	In marginal condition: is defective and in need of replacement, but is still in a workable condition
3 - Adequate	In adequate condition: is moderately deteriorated, has not exceeded its intended life use, minor compliance issues
4 - Good	In good condition: may be slightly defective, no longer new, is overall functional and in working condition
5 - Excellent	In excellent condition: In new or like new condition, no visible defects

Recreation Amenities

Type	Notes/Comments (please mark N/A if not present at location)	Ratings	Photo Checklist
Playgrounds	**N/A**		
Fishing Pier	**N/A**		
Basketball Court	**N/A**		
Tennis Court	N/A		
Soccer Fields	N/A		
Baseball Fields	N/A		
Volleyball Courts	N/A		
Softball Fields	N/A		
Camping Facilities	N/A		
Pathways/Trails	N/A		
Canoe Portage/Carry In	tar and concrete trail for canoe portage use, a few chipped out areas of tar, but easily avoidable	4	yes
Other Sporting Fields	N/A		
Site Amenities			
Site Furnishings (benches, bike racks, picnic tables, etc.)	Canoe rack set up next to restrooms	3	yes
Docks	N/A		
Trailer Accessible Boat Ramp	N/A		
Potable Water	N/A		
Lighting	N/A		
Signage (include # of signs in notes)	canoe portage signs seen from river, other signs near restrooms	3	yes
Parking Spaces (include # of spaces in notes)	N/A		
Parking Lot Surface (paved/unpaved, condition)	N/A		
Park Structures			
Restrooms	two concrete outhouses with updated fixtures inside, new paint	4	yes
Picnic Shelters	N/A		
Recreation Center	N/A		
Natural			
Turf	N/A		
Park Trees	N/A		
Landscaping	Landscaping/turf are very well kept	4	yes
Shoreline (erosion, invasive weeds, etc.)	shoreline is in good shape	4	yes
Natural Areas			

Comments

there is a comment card option at this site, and we receive numerous compliments on the facility

Facility Inventory Assessment - Lum Park

Date:10-14-19	Site Name:Lum Park	Evaluator:Scott Magnuson	Facility Ownership:City of Brainerd

Directions: Please Include condition of each amenity based on the following ratings; <u>please take photo documentation of all amenities</u>

1 - Poor	In poor condition: Critically damaged, needs immediate repair or replacement, past intended life use
2 - Marginal	In marginal condition: is defective and in need of replacement, but is still in a workable condition
3 - Adequate	In adequate condition: is moderately deteriorated, has not exceeded its intended life use, minor compliance issues
4 - Good	In good condition: may be slightly defective, no longer new, is overall functional and in working condition
5 - Excellent	In excellent condition: In new or like new condition, no visible defects

Type	Notes/Comments (please mark N/A if not present at location)	Ratings	Photo Checklist
Recreation Amenities			
Playgrounds	**Three sets of playground equipment, all in good condition**	**4**	yes
Fishing Pier	**T-shaped fishing pier, in good condition, near beach and boat ramp**	**4**	yes
Basketball Court	**N/A**		
Tennis Court	N/A		
Soccer Fields	N/A		
Baseball Fields	N/A		
Volleyball Courts	Two sand volleyball courts near campground, no nets at time of evaluation (Fall time)	3	yes
Softball Fields	N/A		
Camping Facilities	Camper use only, no tents, open field with hook-ups, used frequently. Fire wood available.	3	yes
Pathways/Trails	N/A - all open area throughout park		
Canoe Portage/Carry In	N/A		
Other Sporting Fields	Disc golf - newer baskets and tee boxes. Used quite a lot from observations	4	yes
Site Amenities			
Site Furnishings (benches, bike racks, picnic tables, etc.)	A few bike racks, lot's of benches throughout and lots of picnic tables, in four separate pavillions	4	yes
Docks	one older dock at boat launch, could use some work, close to water surface and fairly small	3	yes
Trailer Accessible Boat Ramp	concrete planks, in a nice bay for easy loading and unloading, good approach to ramp helps speed things up	4	yes
Potable Water	drinking fountains at restroom building	3	yes
Lighting			
Signage (include # of signs in notes)	lots of signage throughout park, to many to count. Everything is well marked.	4	yes, some
Parking Spaces (include # of spaces in notes)	30 truck trailer spots, 45 single vehicle spots	4	yes
Parking Lot Surface (paved/unpaved, condition)	all parking is paved, probably 10 years old, but striped and in very good condition, no potholes	4	yes
Park Structures			
Restrooms	mens and womens restrooms with running water, four stalles in each unit, vending machine outside. Needs some paint, but building in good s	3	yes
Picnic Shelters	four pavilions, one large with 20 picnic tables, three others smaller, 10 tables each. New roofs, fresh paint on structure, concrete floor	4	yes
Recreation Center	N/A		
Natural			
Turf	lots of grass area, very well maintained by city parks crew	5	yes
Park Trees	numerous types and size of trees, all in good shape/pruned	4	yes
Landscaping	not much extra landscaping other than grass		
Shoreline (erosion, invasive weeds, etc.)	shoreline is in good shape	4	
Natural Areas			

Comments

There is a swimming beach at the site, about 75 feet of shoreline and 20 feet deep. Nice sand and very clean (weeds, sticks etc.) Overall, this is a very nice park with fishing facilities and boat launch. The site is very well groomed, and gets used quite frequently. Inside of the restroom building, there are showers, one in the mens and one in the womens. these are in good shape, they were moved from the "beach" building in 2006.

Facility Inventory Assessment - FrenchRapids

Date:10-14-19	**Site Name:French Rapids**	**Evaluator:Scott Magnuson**	**Facility Ownership:Crow Wing County**

Directions: Please Include condition of each amenity based on the following ratings; <u>please take photo documentation of all amenities</u>

1 - Poor	In poor condition: Critically damaged, needs immediate repair or replacement, past intended life use
2 - Marginal	In marginal condition: is defective and in need of replacement, but is still in a workable condition
3 - Adequate	In adequate condition: is moderately deteriorated, has not exceeded its intended life use, minor compliance issues
4 - Good	In good condition: may be slightly defective, no longer new, is overall functional and in working condition
5 - Excellent	In excellent condition: In new or like new condition, no visible defects

Type	Notes/Comments (please mark N/A if not present at location)	Ratings	Photo Checklist
Recreation Amenities			
Playgrounds	**N/A**		
Fishing Pier	**N/A**		
Basketball Court	**N/A**		
Tennis Court	N/A		
Soccer Fields	N/A		
Baseball Fields	N/A		
Volleyball Courts	N/A		
Softball Fields	N/A		
Camping Facilities	N/A		
Pathways/Trails	Trailhead for cross country ski trail		
Canoe Portage/Carry In	N/A		
Other Sporting Fields	N/A		
Site Amenities			
Site Furnishings (benches, bike racks, picnic tables, etc.)	N/A		
Docks	N/A		
Trailer Accessible Boat Ramp	concrete planks, good approach to ramp helps speed things up	3	yes
Potable Water	N/A		
Lighting	N/A		
Signage (include # of signs in notes)	two signs leading to landing, invasive species signs, ski trail signs	3	yes, some
Parking Spaces (include # of spaces in notes)	just a gravel area, hard to really determine total parking space count	2	yes
Parking Lot Surface (paved/unpaved, condition)	semi-maintained gravel parking area, puddles during rain events	2	yes
Park Structures			
Restrooms	N/A		
Picnic Shelters	N/A		
Recreation Center	N/A		
Natural			
Turf	trees and gravel, not a lot of turf	2	yes
Park Trees	N/A		
Landscaping	N/A		
Shoreline (erosion, invasive weeds, etc.)	shoreline is in good shape	4	
Natural Areas			

Comments

not a lot of fishing activity going on at this sight, there was a fair amount of people just sitting in their cars

Facility Inventory Assessment - Greens Point

Date:10-14-19	**Site Name:Greens Point**	**Evaluator:Scott Magnuson**	**Facility Ownership:MnDNR**

Directions: Please Include condition of each amenity based on the following ratings; <u>please take photo documentation of all amenities</u>

1 - Poor	In poor condition: Critically damaged, needs immediate repair or replacement, past intended life use
2 - Marginal	In marginal condition: is defective and in need of replacement, but is still in a workable condition
3 - Adequate	In adequate condition: is moderately deteriorated, has not exceeded its intended life use, minor compliance issues
4 - Good	In good condition: may be slightly defective, no longer new, is overall functional and in working condition
5 - Excellent	In excellent condition: In new or like new condition, no visible defects

Type	Notes/Comments (please mark N/A if not present at location)	Ratings	Photo Checklist
Recreation Amenities			
Playgrounds	**N/A**		
Fishing Pier	**N/A**		
Basketball Court	**N/A**		
Tennis Court	N/A		
Soccer Fields	N/A		
Baseball Fields	N/A		
Volleyball Courts	N/A		
Softball Fields	N/A		
Camping Facilities	N/A		
Pathways/Trails	N/A		
Canoe Portage/Carry In	Nice grass trail down to river for canoe carry in, with a small, permanent dock	4	yes
Other Sporting Fields	N/A		
Site Amenities			
Site Furnishings (benches, bike racks, picnic tables, etc.)	N/A		
Docks	one small premanent docking area	3	yes
Trailer Accessible Boat Ramp	N/A		
Potable Water	N/A		
Lighting	N/A		
Signage (include # of signs in notes)	public water access sign on CR3, good signage at parking lot	3	yes
Parking Spaces (include # of spaces in notes)	really just a cul-de-sac, not a lot of parking, no designated trailer parking, but mostly trucks with canoes on top.	2	yes
Parking Lot Surface (paved/unpaved, condition)	tared parking area at end of road, see above	2	yes
Park Structures			
Restrooms	N/A		
Picnic Shelters	N/A		
Recreation Center	N/A		
Natural			
Turf	N/A		
Park Trees	N/A		
Landscaping	N/A		
Shoreline (erosion, invasive weeds, etc.)	shoreline is in good shape	4	yes
Natural Areas			

Comments

I was at this site in October, saw three duck hunting parties just coming off the water, they were all satisfied with the facility

Appendix B

Recreation Facility Inventory and Condition Assessment Photo Log

Canoe Portage

BPU Canoe Portage Photo 1: Asphalt path for canoe portage, restroom facilities, and canoe rack

BPU Canoe Portage Photo 2: General site landscaping

BPU Canoe Portage Photo 3: Restroom facilities and garbage can

BPU Canoe Portage Photo 4: Concrete path for canoe portage; signs showing warnings for the area

BPU Canoe Portage Photo 5: Asphalt path for canoe portage use

BPU Canoe Portage Photo 6: Concrete path for canoe portage use and signage with site rules

BPU Canoe Portage Photo 7: Asphalt path for canoe portage use and signage with site rules

BPU Canoe Portage Photo 8: Shoreline; buoys warning of BPU facility

BPU Canoe Portage Photo 9: Shoreline at canoe portage with large riprap in the background

Lum Park

Lum Park Photo 1: Access signage for boat trailer parking

Lum Park Photo 2: Access signage providing direction to beach, boat ramp, and camping area

Lum Park Photo 3: Boat trailer parking area and restroom structure

Lum Park Photo 4: Parking area for vehicles with boat trailers

Lum Park Photo 5: Parking lot for single vehicles with nearby mature trees and picnic shelter/pavilion

Lum Park Photo 6: Large picnic shelter available for reservations; capacity for approximately 20 picnic tables

Lum Park Photo 7: Picnic shelter with picnic tables stored for end of season

Lum Park Photo 8: Picnic shelter with picnic tables stored for end of season

Lum Park Photo 9: Men and women's restroom facility with running water with adjacent handicap parking

Lum Park Photo 10: Restroom facilities with playground in the background and adjacent handicap parking

Lum Park Photo 11: Potable water source

Lum Park Photo 12: Signage and disposable bags for cleaning up after pets

Lum Park Photo 13: Sand volleyball courts with nets removed for season

Lum Park Photo 14: Bike rack with playground equipment in the background

Lum Park Photo 15: Paved walking path adjacent to disc golfing course

Lum Park Photo 16: Landscaping with large mature trees adjacent to paved walking path

Lum Park Photo 17: Park bench under mature trees

Lum Park Photo 18: Signage for invasive species and potential swimming hazards

Lum Park Photo 19: Signage for aquatic and invasive species next to T-shaped pier for shoreline fishing

Lum Park Photo 20: Trailer accessible boat ramp with dock

Lum Park Photo 21: Sandy swimming beach near dock

Lum Park Photo 22: Swimming beach and adjacent shoreline

French Rapids Access

French Rapids Access Photo 1: Signage with directions to French Rapids access

French Rapids Access Photo 2: Additional signage providing directions to French Rapids access

French Rapids Access Photo 3: Trailhead with site information and trail maps

French Rapids Access Photo 4: Trailer accessible boat ramp

French Rapids Access Photo 5: Shoreline providing canoe access next to the trailer accessible boat ramp

French Rapids Access Photo 6: Shoreline showing no signs of erosion

Green's Point Access

Green's Point Access Photo 1: Asphalt parking area at end of road, no striped/designated parking spots

Green's Point Access Photo 2: Green's Point site access signage

Green's Point Access Photo 3: Signage at the site access for fishing regulations, exotic species alerts, aquatic nuisance species, and site use rules

Green's Point Access Photo 4: Access stairs to small permanent dock, shoreline, and trails

Green's Point Access Photo 5: Shoreline and grass trail along shoreline

Green's Point Access Photo 6: Grass trail along the shoreline

Green's Point Access Photo 7: Canoe portage/carry in access and trail along shoreline

Green's Point Access Photo 8: Canoe portage/carry in access point

Green's Point Access Photo 9: Additional canoe portage/carry in access point

Green's Point Access Photo 10: Shoreline adjacent to small permanent dock

Appendix C

Recreation Use Survey Questionnaire

Revised Study Plan
Brainerd Hydroelectric Project
FERC License No. 2533
Recreational Use Questionnaire

1. Which facility are you using today?
   - BPU Canoe portage
   - Lum Park
   - French Rapids access
   - Green's Point access

2. How many people are in your party, including you?
   - 1
   - 2
   - 3-5
   - 6-10
   - More than 10

3. How many vehicles did your group come with?
   - 1
   - 2
   - 3-5
   - 6-10
   - More than 10

4. How often do you visit this facility?
   - First time
   - 1-3 times a year
   - 4-6 times a year
   - 6-10 times a year
   - 11-20 times a year
   - More than 20 times a year

5. What type of recreation activity(ies) do you plan to/did you participate in today?
   - Canoeing/kayaking
   - Boating (motorized boat)
   - Camping
   - Fishing
   - Hunting
   - Trapping
   - Wildlife viewing
   - Swimming

- Picnicking
- Other ___________________________________

6. Why did you choose to come to this recreation site versus another recreation site today?
   - (open-ended response)

7. When you come here, how long do you usually stay (hours)
   - <1 hour
   - 1-2 hours
   - 2-4 hours
   - 4-8 hours
   - >8 hours

8. What time of year do you typically come here?
   - Winter (December – March)
   - Spring (April – May)
   - Summer (June – September)
   - Fall (October – November)

9. Did you experience any difficulty accessing the resources you were hoping to access when you came here today?
   - Yes
   - No

10. During your visit to this site today, what was your perception on the amount of use occurring?
    - Site was not very busy
    - Site was moderately busy
    - Site was too busy

11. During your visit to this site today, did you experience any conflict with other recreational activities or visitors?
    - Yes (please explain)
    - No

12. What amenities are most important to you when recreating at this site (choose all that apply)?
    - General access
    - ADA accessibility
    - Parking
    - Signs and information
    - Picnic table/shelters
    - Boat launch

- Boat dock
- Fishing dock
- Lighting
- Restrooms
- Trails
- Trash receptacles

13. Overall, how satisfied were you with the number of available recreational amenities at this facility?
    - Satisfied
    - Moderately satisfied
    - Neither satisfied nor unsatisfied
    - Moderately unsatisfied
    - Unsatisfied (explain why)

14. Overall, how would you rate the overall condition of this recreation site?
    - Satisfactory
    - Moderately satisfactory
    - Neither satisfactory nor unsatisfactory
    - Moderately unsatisfactory
    - Unsatisfactory (explain why)

15. Are there any additional recreation amenities needed at this recreation site?
    - Yes (write-in what)
    - No

16. Would you recreate at this site again in the future?
    - Yes
    - No

17. Any additional comments or suggestions?

Appendix D

Recreational Use Survey Raw Data

Weather Conditions	Which facility are you using today?	How many people are in your party, including you?	How many vehicles did your group come with?	How often do you visit this facility?	What type of recreation activity(ies) do you plan to/did you participate in today?	If Other, please explain.	Why did you choose to come to this recreation site versus another recreation site today?	When you come here, how long do you usually stay (hours)?	What time of year do you typically come here?	Did you experience any difficulty accessing the resources you were hoping to access when you came here today?	If Yes, please explain.	During your visit to this site today, what was your perception on the amount of use occurring?	During your visit to this site today, did you experience any conflict with other recreational activities or visitors?	What amenities are most important to you when recreating at this site (choose all that apply)?	Overall, how satisfied were you with the number of available recreational amenities at this facility?	If Unsatisfied, please explain why.	Overall, how would you rate the overall condition of this recreation site?	If Unsatisfied, please explain why.	Are there any additional recreation amenities	If Yes, write-in what.	Would you recreate at this site again in the future?	Any additional comments or suggestions?	CreationDate
clear, sunny, calm	BPU Canoe portage	1	1	6-10 times a year	Fishing		close to home	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access	Satisfied		Satisfactory		No		Yes		5/30/2019 16:34
	BPU Canoe portage	1	1	1-3 times a year	Canoeing_kayaking		portage	<1 hour	Summer (June – September)	No		Site was not very busy	No	General_access,Restrooms	Satisfied		Satisfactory		No		Yes		6/4/2019 16:48
	BPU Canoe portage																						6/25/2019 18:33
	BPU Canoe portage				Other	nobody here				No		Site was not very busy	No										7/7/2019 14:29
	BPU Canoe portage																						7/30/2019 13:29
	BPU Canoe portage																						9/5/2019 13:30
	French Rapids access	2	1	6-10 times a year	Fishing		like fish off shore	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access,Parking	Satisfied		Satisfactory		No	we like it somewhat primative	Yes		5/26/2019 13:32
	French Rapids access	2	1	4-6 times a year	Fishing		to fish off shore, close to home	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access	Satisfied		Satisfactory		No		Yes	like the fact its never busy	5/30/2019 13:16
	French Rapids access																						7/7/2019 15:51
	French Rapids access																						7/8/2019 18:28
	French Rapids access																						7/30/2019 15:42
	French Rapids access																						9/5/2019 17:14
overcast	French Rapids access	2	2	More than 20 times a year		these guys are here for sex !! guys on guys	evidently for sex	1-2 hours	Summer (June – September)	No		Site was not very busy	No	Parking	Satisfied		Satisfactory		No		Yes	Im done doing surveys at this location. Beautiful access taken over by gays, and people are either scared or too embarrased to use this landing. its not being utilized for anything else.	9/5/2019 17:35
	Green's Point access	2	2	More than 20 times a year	Fishing		close to home	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access	Satisfied		Satisfactory		No		Yes		5/28/2019 20:24
	Green's Point access	3-5	2		Canoeing_kayaking	with notes in them. out																never made contact with them	5/28/2019 20:46
	Green's Point access	1	1	1-3 times a year	Fishing		shore fishing	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access	Satisfied		Satisfactory		No		Yes		6/6/2019 18:15
	Green's Point access																						6/25/2019 18:04
sunny and calm	Green's Point access	2	2	1-3 times a year	Fishing	shore fishing	close to home and ussually good fishing	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access	Satisfied		Satisfactory		No		Yes		7/7/2019 16:10
	Green's Point access																						7/8/2019 18:50
overcast	Green's Point access	3-5	1	4-6 times a year	Fishing			2-4 hours	Fall (October – November)	No		Site was not very busy	No	General_access	Satisfied		Satisfactory		No		Yes		9/5/2019 15:41
	Lum Park	2	1	1-3 times a year	Fishing		other lake acesses are always too busy . not so here	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access,Parking,Boat_launch,Boat_dock,Trash_receptacles	Satisfied		Satisfactory		No		Yes		5/26/2019 15:35
sunny 60 deg	Lum Park	3-5	1	1-3 times a year	Boating_motorized_boat,Fishing		close to home	4-8 hours	Summer (June – September)	No		Site was not very busy	No	General_access,Parking,Boat_launch	Satisfied		Satisfactory		No		Yes		5/26/2019 15:38
	Lum Park	1	1	1-3 times a year	Boating_motorized_boat		to try boat out for the first time this year. not busy here	1-2 hours	Spring (April – May)	No		Site was not very busy	No	General_access,Boat_launch,Boat_dock,Parking	Satisfied		Satisfactory		No		Yes		5/26/2019 15:41
	Lum Park																					one car and boat trailer never talked to them	5/28/2019 20:47
	Lum Park	2	1	More than 20 times a year	Fishing		close to home	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access,Fishing_dock	Satisfied		Satisfactory		No		Yes		5/28/2019 20:57
sunny,calm	Lum Park		2		Boating_motorized_boat,Fishing,Other	two trucks with trailers in parking lot , never talked to them																	5/30/2019 15:16
sunny, calm	z	2	1	4-6 times a year	Fishing,Picnicking		close to home	2-4 hours	Summer (June – September)	No		Site was not very busy	No	General_access,Parking,Picnic_table_shelters,Fishing_dock	Satisfied		Satisfactory		No		z	fishing off fishing pier	5/30/2019 16:03
sunny	Lum Park				Boating_motorized_boat,Other	spot check two trucks with boat trailers, appear to be fisherman????																	6/6/2019 18:38
	Lum Park																						6/21/2019 15:22
	Lum Park																						6/25/2019 18:22
	Lum Park																						6/26/2019 18:48
	Lum Park																						7/7/2019 14:45
	Lum Park	2	1	4-6 times a year	Fishing		close to home and a good access	4-8 hours	Summer (June – September)	No		Site was moderately busy	No	General_access,Parking,Boat_launch	Satisfied		Satisfactory		No		Yes		7/7/2019 14:49
sunny calm	Lum Park	3-5	1	1-3 times a year	Fishing		location	2-4 hours	Summer (June – September)	No		Site was moderately busy	No	General_access,Boat_launch	Moderately unsatisfied	weed inspectors take up time and now you asking questions too not happy	Satisfactory		No		No	not if continually bothered with questions just want to go fishing	7/7/2019 14:58
0 degrees sunny and cal	Lum Park	6-10	3-5	1-3 times a year	Boating_motorized_boat	pontoon ride	close to home ussually not busy	2-4 hours	Summer (June – September)	No		Site was moderately busy	No	General_access,Boat_launch	Satisfied		Moderately satisfactory		No		Yes		7/7/2019 15:32
sunny and calm	Lum Park	3-5	2	1-3 times a year	Boating_motorized_boat	potoon ride family get together weekend	close to home	2-4 hours	Summer (June – September)	No		Site was moderately busy	No	General_access,Parking,Boat_launch	Satisfied		Satisfactory		No		Yes		7/7/2019 15:35
	Lum Park																						7/8/2019 18:17
	Lum Park																						7/9/2019 18:31
	Lum Park																						7/11/2019 18:47
	Lum Park																						7/16/2019 18:49
	Lum Park																						7/19/2019 18:57
	Lum Park																						7/25/2019 18:08
	Lum Park																						7/30/2019 14:58
calm\sunny	Lum Park	2	1	4-6 times a year	Fishing		good fishing	2-4 hours	Summer (June – September)	No		Site was not very busy	No	Boat_launch,Parking,Boat_dock	Satisfied		Satisfactory		No		Yes		7/30/2019 15:02
	Lum Park																						7/30/2019 16:34
	Lum Park																						8/7/2019 15:41
	Lum Park																						9/5/2019 11:29
	Lum Park																						9/5/2019 17:35

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Appendix D

Exhibit E – Environmental Report Attachments (CEII)

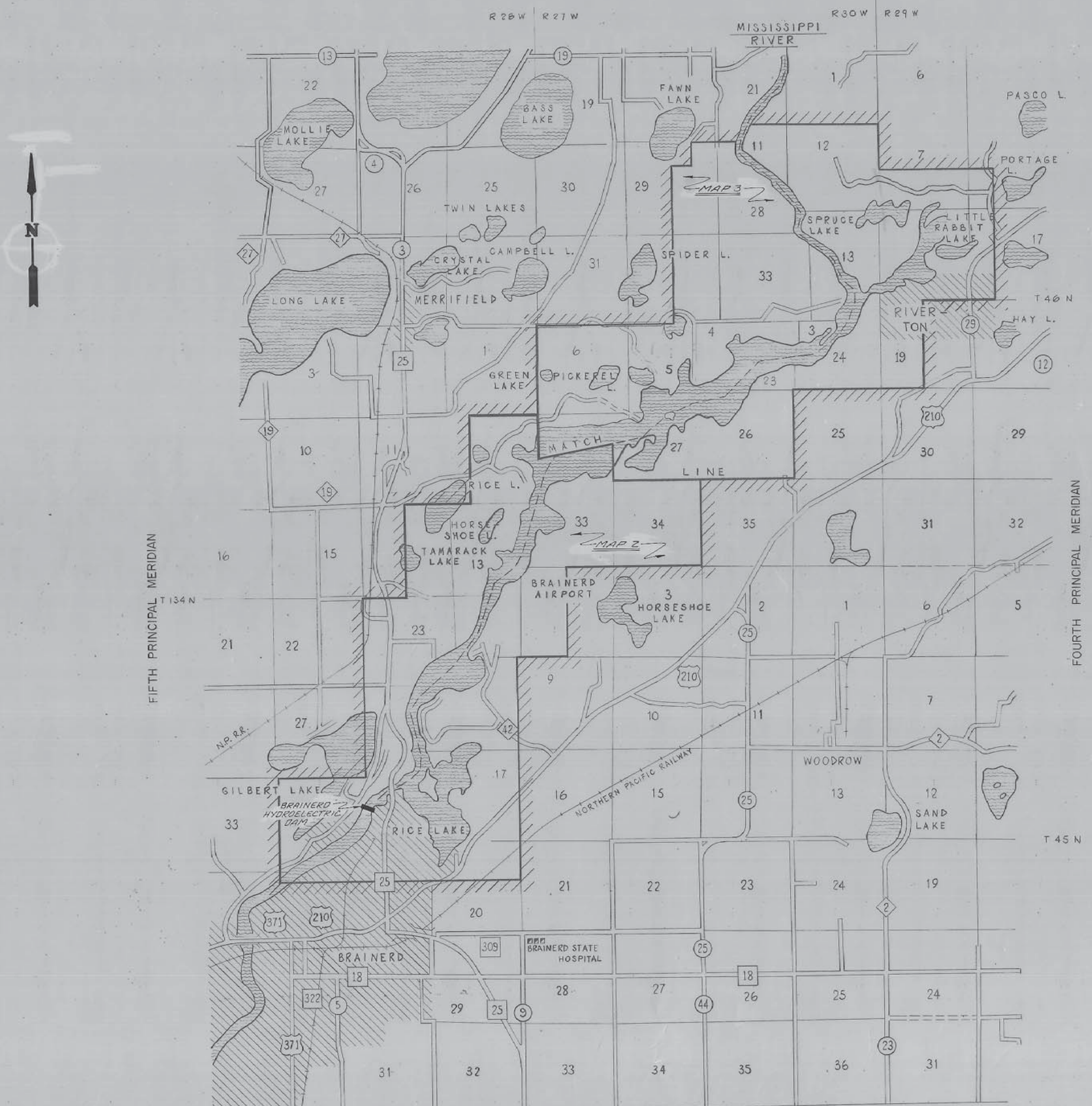
Appendix D is reserved for information that will be filled with the Final License Application. This appendix is not used for the Draft License Application.

Appendix E

Exhibit F – Project Drawings (CEII)

Appendix F

Exhibit G – Project Maps (Public)



COUNTY - CROW WING
STATE OF MINNESOTA

THIS MAP IS REPRODUCED IN PART FROM THE MINNESOTA DEPARTMENT OF HIGHWAYS 1965 CROW WING COUNTY MAP.

LEGEND:
CORPORATE LIMITS
LIMITS FOR MAPS 1 & 2

0 1/4 1/2 3/4 1 2 3
SCALE: 2" = 1 MILE

"THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE BY THE UNDERSIGNED

C.R. Pottenger 12/13/91

EXHIBIT G — MAP 1 of 3

POTLATCH CORPORATION — BRAINERD, MINNESOTA

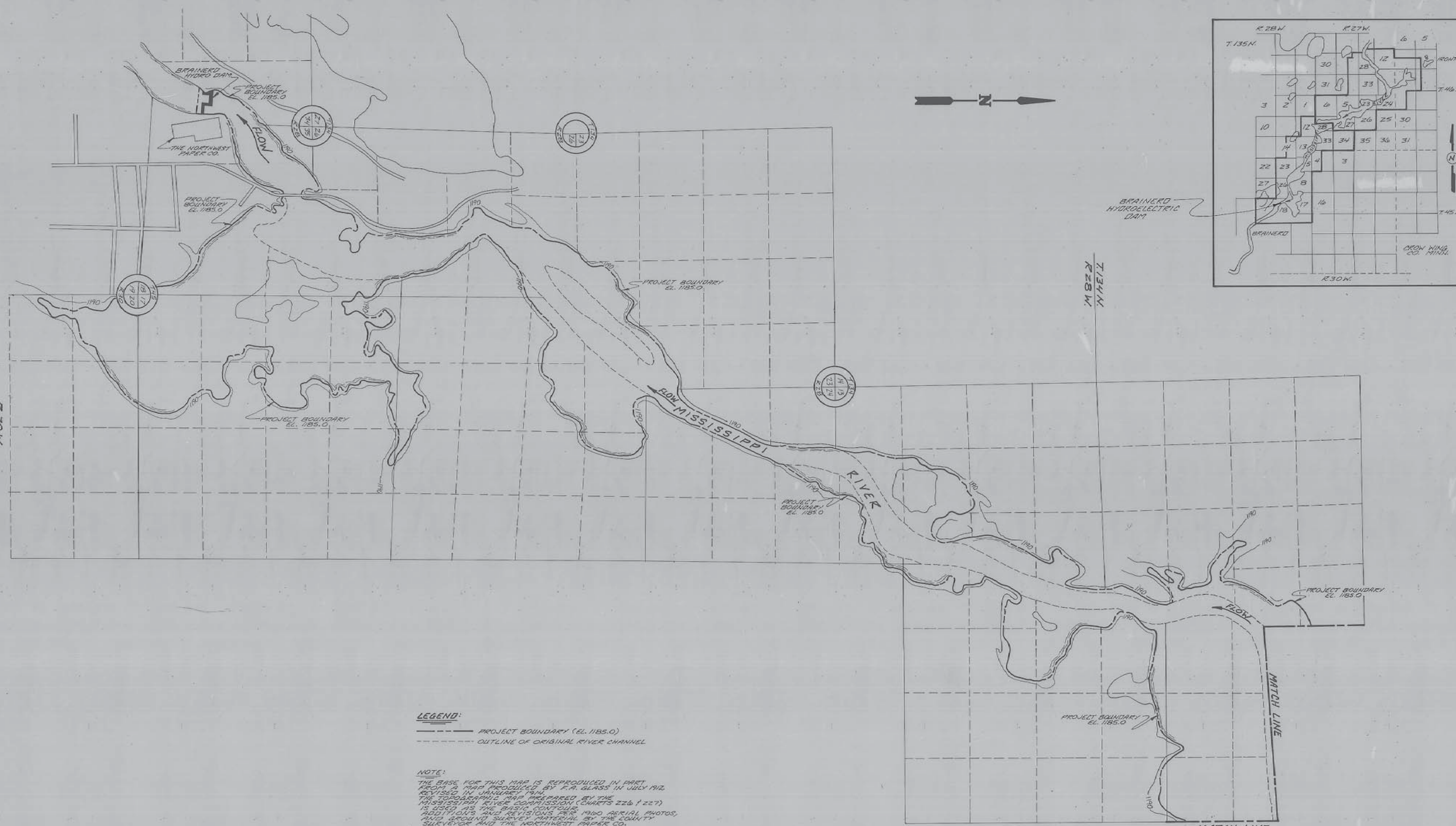
BRAINERD HYDROELECTRIC PROJECT
F.E.R.C. PROJECT No. 2533
MISSISSIPPI RIVER
CROW WING COUNTY, MINNESOTA
PROJECT BOUNDARY

SCALE: AS SHOWN
DATE: DECEMBER, 1991

MEAD & HUNT INC.
Consulting Engineers
Madison, Wisconsin

F2276

F.E.R.C. No. 2533-10



LEGEND:

PROJECT BOUNDARY (EL. 1185.0)

OUTLINE OF ORIGINAL RIVER CHANNEL

NOTE:

THE BASE FOR THIS MAP IS REPRODUCED IN PART FROM A MAP PRODUCED BY F.A. GLASS IN JULY 1912, REVISED IN JANUARY 1914.
THE TOPOGRAPHIC MAP PREPARED BY THE MISSISSIPPI RIVER COMMISSION (CHARTS 226 & 227) IS USED AS THE BASIC CONTOUR.
ADDITIONS AND REVISIONS PER 1960 AERIAL PHOTOS, AND GROUND SURVEY MATERIAL BY THE COUNTY SURVEYOR AND THE NORTHWEST PAPER CO.

SCALE: 6.4" = 1 MILE

FEET: 1000' 500' 0 1000' 2000'

MILES: 0 1/8 1/4 1/2 3/4 1

"THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE BY THE UNDERSIGNED

C.R. Pottinger 12/13/91

T.A. Sanfilippo 12/13/91

EXHIBIT G — MAP 2 of 3

POTLATCH CORPORATION — BRAINERD, MINNESOTA

BRAINERD HYDROELECTRIC PROJECT

F.E.R.C. PROJECT No. 2533

MISSISSIPPI RIVER

CROW WING COUNTY, MINNESOTA

PROJECT BOUNDARY

SCALE: AS SHOWN
DATE: DECEMBER, 1991

MEAD & HUNT INC.
Consulting Engineers
Madison, Wisconsin

F227C

F.E.R.C. No. 2533-11

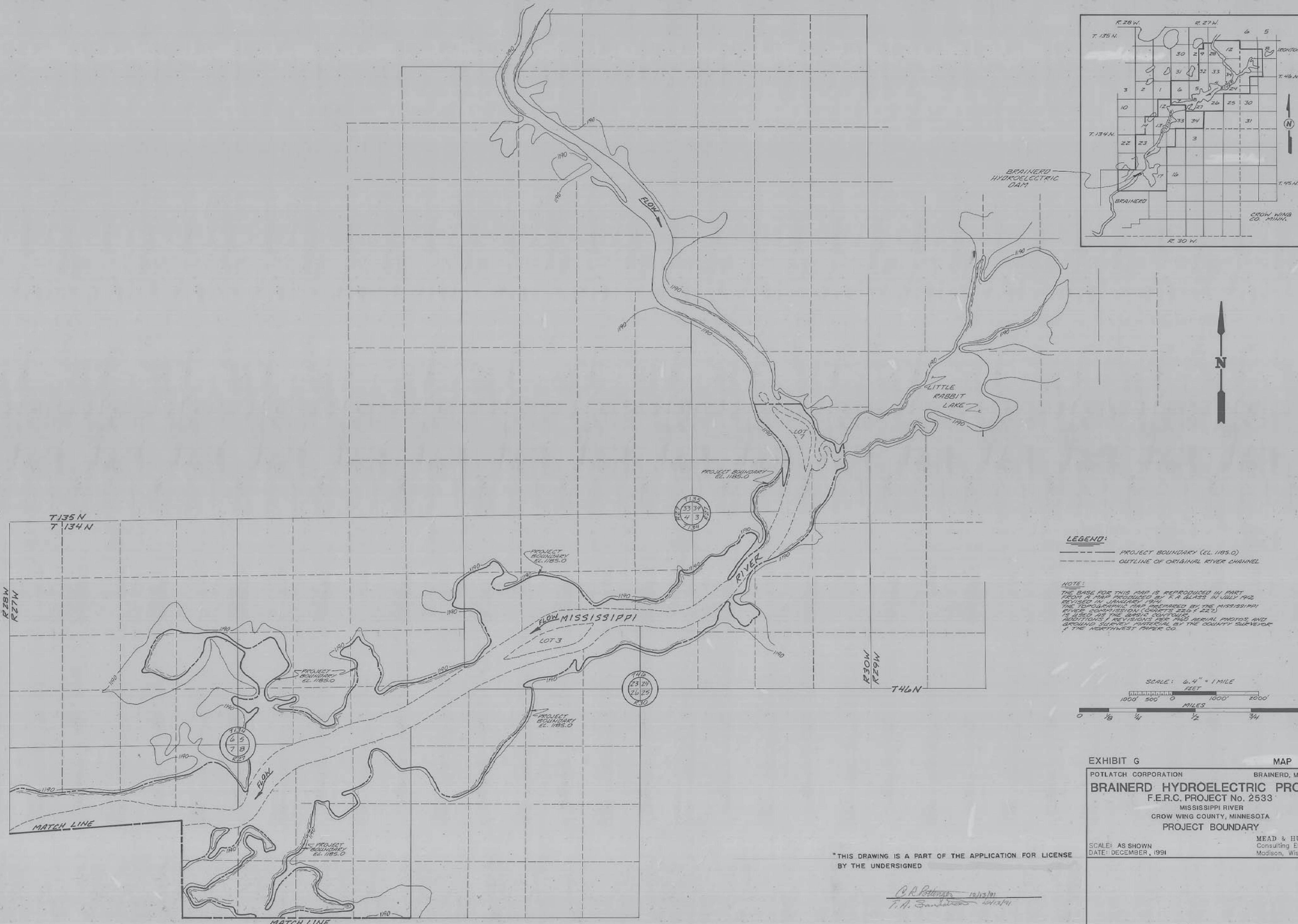


EXHIBIT G

MAP 3 of 3

POTLATCH CORPORATION — BRAINERD, MINNESOTA

BRAINERD HYDROELECTRIC PROJECT

F.E.R.C. PROJECT No. 2533

MISSISSIPPI RIVER

CROW WING COUNTY, MINNESOTA

PROJECT BOUNDARY

SCALE: AS SHOWN
DATE: DECEMBER, 1991

MEAD & HUNT INC.
Consulting Engineers
Madison, Wisconsin

*THIS DRAWING IS A PART OF THE APPLICATION FOR LICENSE BY THE UNDERSIGNED

C.R. Pottenger 12/13/91
T.A. Sandstrom 12/13/91

F2276

F.E.R.C. No. 2533-12