1414 West Hamilton Avenue
P.O. Box 8
Eau Claire, WI 54702-0008

January 19, 2012

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

Subject: 2011 Water Quality Monitoring Report For Big Falls Flowage (P-2390-01), Thornapple Flowage (P-2475) And Turtle-Flambeau Flowage (P-2390-02)

Dear Secretary:

Enclosed are the results of the water quality monitoring that Northern States Power Company – Wisconsin (NSPW) conducted during the 2011 field season on Big Falls and Thornapple Flowages. The samples were obtained after ice-out, in late July, and late August per the Federal Energy Regulatory Commission's license requirement to monitor long-term changes in water quality.

Also included in the report are the water quality sampling results for the Turtle-Flambeau Flowage (TFF) conducted by the Citizen's Self-help Lake Monitoring Program. The results of the TFF monitoring are being provided to you pursuant to Item J of the Water Quality Certificate of the Commission's order amending the Big Falls license to include the Turtle-Flambeau Flowage.

The results for Big Falls and Thornapple are summarized for the past eight years. While there appears to be some variability in some of the parameters analyzed, for the most part, the results have been relatively consistent. The data collected in 2011 is consistent with data from the previous years' sampling.

The WDNR and USFWS were provided 30 days to submit comments but none were received. Should you have any questions regarding this report, feel free to contact Matthew Miller of this office at (715) 737-1353 or by electronic mail at matthew.j.miller@xcelenergy.com.

Sincerely,

William Zawacki
Director, Hydro Plants

Enclosure: Water Quality Monitoring Report

c: Mr. Jeff Scheirer – WDNR (cover letter only)
Mr. Nick Utrup – USFWS (cover letter only)
Project Files

2011 Water Quality Monitoring Report for Big Falls Flowage (P-2390-01), Thornapple Flowage (P-2475) and Turtle Flambeau Flowage (P-2390-02)

Northern States Power Company – WI
An Xcel Energy Company

January 2012

APPENDIX A

2011 Water Quality Fieldwork Data Sheets & Lab Analysis For Big Falls And Thornapple Flowages

Water Quality Sampling - Big Falls Flowage

Date: 4-29-11 *
Temperature: _____
Weather Conditions: _____
Depth of Bottom Sample: _____
Secchi Disk Reading: _____

Dissolved Oxygen and Temperature Profile

Depth (ft)	Temperature (C)	Dissolved Oxygen (mg/l)
Surface		
2		
4		
6		
8		
10		
12		
14		
16		
18		
20		
22		
24		
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks: * BIG FALLS NOT SAMPLED DUE TO 12 FT. DRAWDOWN FOR LEFT EMBANKMENT REPAIRS

H:\excel5\bigfalls\wqsheet

Water Quality Sampling - Thornapple Flowage

Date: 4-29-11
Temperature: 45°
Weather Conditions: SUNNY - WIND S @ 5-10
Depth of Bottom Sample: 23 FT
Secchi Disk Reading: 3.5 FT

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	6.9	12.5
2	6.8	12.4
4	6.8	12.4
6	6.8	12.4
8	6.8	12.4
10	6.8	12.4
12	6.8	12.4
14	6.8	12.3
16	6.8	12.3
18	6.8	12.3
20	6.8	12.3
22	6.8	12.3
24	BOTTOM	
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks: RIVER FLOWS ≈ 5,600 CFS
NO NAVIGATION HAZARDS OBSERVED
SAMPLES TAKEN AT 4TH BUOY FROM WEST
NO ACTIVITY AT NEST SITE - 1 IMMATURE EAGLE SOARING IN VICINITY

H:\excel5\thornapp\wqsheet

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367
Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Operation
Enviromental Services-WI

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0411
Date of Report 8/24/2011

Sample Description: BOTTOM
Location: THORNAPPLE
Customer Sample I.D.:
Chain of Custody #.: 207385

LabWorks I.D. EG94075
Laboratory I.D.: 1184.24
Collection Date: 4/29/2011
Date Submitted: 5/3/2011

Constituent	Result	Units	Analyst	Reporting Limit (RL)	Analytical Method	Analysis Start Date
Total Phosphorus	0.03	mg/L P	HRG	0.01	EPA 365.3	5/4/2011

Comments related to sample number EG94075:

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367
Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Enviromental Services-WI

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0411
Date of Report 8/24/2011

Sample Description: SURFACE
Location: THORNAPPLE
Customer Sample I.D.:
Chain of Custody #.: 207385

LabWorks I.D. EG94074
Laboratory I.D.: 1184.23
Collection Date: 4/29/2011
Date Submitted: 5/3/2011

Constituent	Result	Units	Analyst	Reporting Limit (RL)	Analytical Method	Analysis Start Date
Chlorophyll-a	2.7	ug/L	NLS	0.041	SM 19th 10200 H	5/4/2011
Send Chlorophyll A	Completed		MM			5/2/2011
Total Phosphorus	0.03	mg/L P	HRG	0.01	EPA 365.3	5/4/2011

Comments related to sample number EG94074:

Water Quality Sampling - Big Falls Flowage

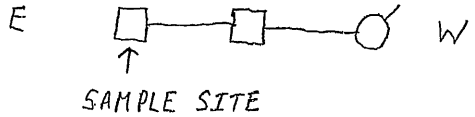
Date: 7-26-11
Temperature: 76°
Weather Conditions: M. SUNNY LIGHT WINDS
Depth of Bottom Sample: 11.5 M @ 1044.
Secchi Disk Reading: 4 FEET

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	25.8	6.58
2	25.8	6.56
4	25.6	6.66
6	25.2	6.56
8	25.2	6.59
10	25.2	6.58
12	25.2	6.53
14	25.1	6.52
16	24.9	6.38
18	24.5	6.32
20	24.5	6.32
22	24.3	6.29
24	24.3	6.33
26	24.2	6.27
28	24.1	6.31
30	24.1	6.25
32	24.1	6.20
34	24.1	6.18
36	24.1	6.11
38	BOTTOM	BOTTOM
40		
42		
44		
46		

Remarks: - NO NAVIGATION HAZARDS
- 1 MATURE EAGLE SOARING ABOVE TAILRACE & PERCHED IN TREE ON ISLAND ACROSS FROM WEST SITE

H:\excel5\bigfalls\wqsheet



Water Quality Sampling - Thornapple Flowage

Date: 7-26-11
Temperature: 80°
Weather Conditions: SUNNY - LIGHT WINDS
Depth of Bottom Sample: 20 FT
Secchi Disk Reading: 4.5 FEET

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	26.4	6.56
2	26.3	6.54
4	25.9	6.54
6	25.6	6.47
8	25.7	6.46
10	25.5	6.45
12	25.4	6.41
14	24.6	6.14
16	24.2	5.76
18	24.2	5.68
20	23.7	5.00
22	BOTTOM	BOTTOM
24		
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks: - NO NAVIGATION HAZARDS
- NO ACTIVITY AT EAGLE NEST
- RIVER FLOW ≈ 830 CFS

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367

Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Enviromental Service

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0711
Date of Report 8/23/2011

Sample Description: BOTTOM
Location: BIG FALLS FLOWAGE
Customer Sample I.D.:
Chain of Custody #.: 216119

LabWorks I.D. EH01413
Laboratory I.D.: 1204.27

Collection Date: 7/26/2011
Date Submitted: 7/28/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst.	Analysis Start Date
Phosphorus	0.06	mg/L P	0.01	0.01	EPA 365.3	HRG	8/3/2011

Comments related to sample number EH01413:

1518 Chestnut Avenue N
Minneapolis, MN 55403
Phone: (612)630-4506
Fax: (612) 630-4367
Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Enviromental Service

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0711
Date of Report 8/23/2011

Sample Description: SURFACE
Location: BIG FALLS FLOWAGE
Customer Sample I.D.:
Chain of Custody #.: 216119

LabWorks I.D. EH01412
Laboratory I.D.: 1204.27
Collection Date: 7/26/2011
Date Submitted: 7/28/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.04	mg/L P	0.01	0.01	EPA 365.3	HRG	8/3/2011
Chlorophyll-a	7.3	ug/L	0.041	0.041	SM 19th 10200 H		7/28/2011

Comments related to sample number EH01412:

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367

Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Environmental Servic

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0711
Date of Report 8/23/2011

Sample Description: BOTTOM
Location: THORNAPPLE FLOWAGE
Customer Sample I.D.:
Chain of Custody #.: 216119

LabWorks I.D. EH01415
Laboratory I.D.: 1204.30

Collection Date: 7/26/2011
Date Submitted: 7/28/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.04	mg/L P	0.01	0.01	EPA 365.3	HRG	8/18/2011

Comments related to sample number EH01415:

1518 Chestnut Avenue N
Minneapolis, MN 55403
Phone: (612)630-4506
Fax: (612) 630-4367
Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Environmental Servic

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0711
Date of Report 8/23/2011

Sample Description: SURFACE

Location: THORNAPPLE FLOWAGE

Customer Sample I.D.:

Chain of Custody #.: 216119

LabWorks I.D. EH01414
Laboratory I.D.: 1204.29

Collection Date: 7/26/2011
Date Submitted: 7/28/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.05	mg/L P	0.01	0.01	EPA 365.3	HRG	8/3/2011
Chlorophyll-a	5.4	ug/L	0.041	0.041	SM 19th 10200 H		7/28/2011

Comments related to sample number EH01414:

Water Quality Sampling - Big Falls Flowage

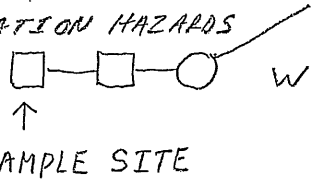
Date: 8-24-11
Temperature: 72
Weather Conditions: SUNNY WIND NW @ 10-15
Depth of Bottom Sample: 34.8
Secchi Disk Reading: 3 FT

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	22.3	7.51
2	22.3	7.52
4	22.3	7.53
6	22.2	7.54
8	22.1	7.60
10	22.0	7.59
12	21.9	7.46
14	21.8	7.45
16	21.7	7.52
18	21.6	7.49
20	21.6	7.55
22	21.6	7.52
24	21.5	7.55
26	21.5	7.53
28	21.5	7.56
30	21.5	7.58
32	21.5	7.57
34	21.5	7.56
36	21.5	7.52
38	Bottom	Bottom
40		
42		
44		
46		

Remarks: - 2 EAGLES OBSERVED SOARING ABOVE PARK AREA BELOW LEFT EMBANKMENT
- FLOWS ≈ 1,150 CFS
- NO NAVIGATION HAZARDS

H:\excel5\bigfalls\wqsheet



Water Quality Sampling - Thornapple Flowage

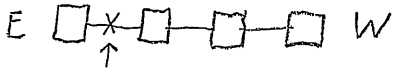
Date: 8-24-11
Temperature: 78 SUNNY, NW WIND - 15-20
Weather Conditions: Mostly sunny - beutiful day 78°
Depth of Bottom Sample: 20 FT
Secchi Disk Reading: 3 FT

Dissolved Oxygen and Temperature Profile

Depth	Temperature (C)	Dissolved Oxygen (mg/l)
Surface	23,7	6,52
2	23,7	6,50
4	23,0	6,36
6	22,7	6,26
8	22,7	6,23
10	22,6	6,16
12	22,5	6,08
14	22,3	5,94
16	22,1	5,73
18	22,0	5,60
20	22,0	5,60
22	Bottom	Bottom
24		
26		
28		
30		
32		
34		
36		
38		
40		
42		
44		
46		

Remarks: - NO NAVIGATION HAZARDS
- FLOWS ≈ 1,150 CFS
- NO ACTIVITY AT EAGLE NEST

H:\excel5\thornapp\wqsheet



SAMPLE SITE BETWEEN 3RD & 4TH BUOY FROM WEST

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367

Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Enviromental Services-WI

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0811
Date of Report 9/23/2011

Sample Description: BOTTOM
Location: BIG FALLS FLOWAGE
Customer Sample I.D.:
Chain of Custody #.: 217279

LabWorks I.D. EH04240
Laboratory I.D.: 1211.07

Collection Date: 8/24/2011
Date Submitted: 8/26/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.04	mg/L P	0.01	0.01	EPA 365.3	HRG	9/1/2011

Comments related to sample number EH04240:

Samples out of temp @ 8°C

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367

Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Enviromental Services-WI

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0811
Date of Report 9/23/2011

Sample Description: SURFACE
Location: BIG FALLS FLOWAGE
Customer Sample I.D.:
Chain of Custody #.: 217279

LabWorks I.D. EH04239
Laboratory I.D.: 1211.06

Collection Date: 8/24/2011
Date Submitted: 8/26/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.04	mg/L P	0.01	0.01	EPA 365.3	HRG	9/1/2011
Chlorophyll-a	3.8	ug/L	0.041	0.041	SM 19th 10200 H		8/30/2011

Comments related to sample number EH04239:

Samples out of temp @ 8°C

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367

Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Environmental Services-WI

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0811
Date of Report 9/23/2011

Sample Description: BOTTOM
Location: THORNAPPLE FLOWAGE
Customer Sample I.D.:
Chain of Custody #.:#.: 217279

LabWorks I.D. EH04242
Laboratory I.D.: 1211.09

Collection Date: 8/24/2011
Date Submitted: 8/26/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.05	mg/L P	0.01	0.01	EPA 365.3	HRG	9/1/2011

Comments related to sample number EH04242:

Samples out of temp @ 8°C

1518 Chestnut Avenue N
Minneapolis, MN 55403

Phone: (612)630-4506
Fax: (612) 630-4367

Contact: Christine Keefe
Lab Certification MN ID: 027-053-197
Lab Certification WI ID:999071150

Minneapolis Testing Laboratory Report

Report To: Hydro Regulatory-WI
Environmental Services-WI

Attention: Matt Miller
Leroy Wilder

Work Request # WIHY0811
Date of Report 9/23/2011

Sample Description: SURFACE
Location: THORNAPPLE FLOWAGE
Customer Sample I.D.:
Chain of Custody #.: 217279

LabWorks I.D. EH04241
Laboratory I.D.: 1211.08

Collection Date: 8/24/2011
Date Submitted: 8/26/2011

Constituent	Result	Units	Limit of Detection (LOD)	Limit of Quantitation (LOQ)	Analytical Method	Analyst	Analysis Start Date
Phosphorus	0.04	mg/L P	0.01	0.01	EPA 365.3	HRG	9/1/2011
Chlorophyll-a	2.5	ug/L	0.041	0.041	SM 19th 10200 H		8/30/2011

Comments related to sample number EH04241:

Samples out of temp @ 8°C

APPENDIX B

Summary Of Total Phosphorous And Chlorophyll A Data For Big Falls And Thornapple Flowages 2004 - 2011

Summary of Water Quality Data for the Big Falls and Thornapple Flowages (2004 - 2011).

	Big Falls Flowage			Thornapple Flowage		
Date	Surface Total Phosphorus (mg/L P)	Surface Chlorophyll-A (ug/L)	Bottom Total Phosphorus (mg/L P)	Surface Total Phosphorus (mg/L P)	Surface Chlorophyll-A (ug/L)	Bottom Total Phosphorus (mg/L P)
5/5/2004	0.053	1.55	0.031	0.035	1.80	0.036
7/28/2004	0.037	3.10	0.084	0.050	4.60	0.049
8/25/2004	0.024	3.35	0.042	0.029	4.10	0.027
4/19/2005	0.050	0.50	0.057	0.055	0.70	0.051
7/25/2005	0.031	0.60	0.044	0.031	1.50	0.045
8/31/2005	0.020	1.50	0.092	0.029	2.75	0.030
4/26/2006	0.023	0.94	0.035	0.026	2.35	0.024
7/24/2006	0.029	0.50	0.099	0.035	4.03	0.041
8/23/2006	0.048	1.50	0.035	0.050	2.11	0.040
4/30/2007	0.028	1.95	0.067	0.039	4.50	0.033
7/31/2007	0.029	4.81	0.043	0.037	3.35	0.032
8/29/2007	0.052	4.45	0.027	0.049	2.93	0.033
4/30/2008	0.024	0.579	0.031	0.030	0.961	0.029
7/23/2008	0.032	2.80	0.043	0.041	11.0	0.051
8/26/2008	0.030	3.70	0.047	0.032	13.0	0.034
4/28/2009	0.030	5.5	0.033	0.040	11.0	0.033
7/28/2009	0.033	6.9	0.099	0.021	4.8	0.053
8/24/2009	0.021	5.0	0.032	0.023	3.6	0.075
4/28/2010	0.025	4.2	0.048	0.029	7.2	0.016
7/27/2010	0.07	1.8	0.05	0.07	0.76	0.07
8/31/2010	0.05	3.8	0.06	0.01	0.69	0.06
4/29/2011	**NA***	**NA***	**NA***	**0.03**	**2.70**	**0.03**
7/26/2011	**0.04**	**7.3**	**0.06**	**0.05**	**5.40**	**0.04**
8/24/2011	**0.04**	**3.8**	**0.04**	**0.04**	**2.50**	**0.05**
Average (Ice-out sample)	0.03	1.90	0.04	0.04	3.90	0.03
Average (July sample)	0.04	3.48	0.07	0.04	4.43	0.05
Average (August sample)	0.04	3.39	0.05	0.03	3.96	0.04

* No sampling conducted as reservoir was drawndown for repairs to left embankment

APPENDIX C

Summary Of Dissolved Oxygen And Temperature Data For Big Falls Flowage 2004 - 2011

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2004.

Date: 5/5/2004
Secchi Disk (ft.): 5.5
Depth of Bottom Sample: 11.5 m
Weather Conditions: cloudy, S wind, 50 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	12.4	10.1
2.0	12.4	10.4
4.0	12.4	10.4
6.0	12.4	10.2
8.0	12.3	10.3
10.0	12.2	10.4
12.0	12.1	10.4
14.0	12.1	10.6
16.0	12.1	10.6
18.0	12.0	10.6
20.0	11.9	10.5
22.0	11.8	10.3
24.0	11.7	10.3
26.0	11.6	10.3
28.0	11.6	10.3
30.0	11.6	10.2
32.0	11.6	10.2
34.0	11.6	10.2
36.0	11.5	10.2
38.0	11.3	10.1
40.0	11.3	9.7

Date: 7/28/2004
Secchi Disk (ft.): 6.5
Depth of Bottom Sample: 12 m
Weather Conditions: clear, S wind, 75 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.2	7.4
2.0	24.2	8.0
4.0	24.1	8.1
6.0	24.0	8.1
8.0	24.0	7.6
10.0	23.9	7.1
12.0	23.9	6.4
14.0	23.7	6.1
16.0	23.5	6.0
18.0	23.3	5.7
20.0	23.1	5.6
22.0	23.0	5.3
24.0	22.8	5.1
26.0	22.7	4.9
28.0	22.5	4.1
30.0	22.4	4.4
32.0	22.2	4.2
34.0	22.0	3.9
36.0	21.7	3.2
38.0	20.4	1.1

Date: 8/25/2004
Secchi Disk (ft.): 6.5
Depth of Bottom Sample: 37 ft.
Weather Conditions: cloudy, 75 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	21.2	8.9
2.0	21.2	8.9
4.0	19.8	8.8
6.0	19.7	8.8
8.0	19.6	8.7
10.0	19.6	8.7
12.0	19.6	8.6
14.0	19.6	8.5
16.0	19.6	8.4
18.0	19.5	8.3
20.0	19.4	8.4
22.0	19.2	8.3
24.0	19.2	8.2
26.0	19.0	8.2
28.0	18.8	7.8
30.0	18.7	7.8
32.0	18.4	7.4
34.0	18.2	7.2
36.0	17.9	5.4
38.0	17.6	4.4

Could not sample earlier due to excessively high river flows

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2005.

Date: 4/19/2005
Secchi Disk (ft.): 5.5
Depth of Bottom Sample: 11 m
Weather Conditions: partly cloudy, S wind, 70 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.4	10.1
2.0	15.2	10.2
4.0	14.9	10.2
6.0	14.8	10.2
8.0	14.8	10.2
10.0	14.8	10.2
12.0	14.8	10.2
14.0	14.8	10.2
16.0	14.8	10.2
18.0	14.7	10.1
20.0	14.6	10.1
22.0	14.7	9.8
24.0	14.8	9.9
26.0	14.7	10.0
28.0	14.7	10.0
30.0	14.7	10.0
32.0	14.6	10.0
34.0	14.6	10.0
36.0	14.6	10.0
38.0	14.5	9.9
40.0	14.3	9.6

Date: 7/25/2005
Secchi Disk (ft.): 4
Depth of Bottom Sample: 12.5 m
Weather Conditions: cloudy, S wind, 75 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	26.5	6.3
2.0	26.4	6.2
4.0	26.2	6.0
6.0	26.1	5.9
8.0	26.1	5.9
10.0	26.0	5.7
12.0	25.9	5.9
14.0	25.7	5.6
16.0	25.5	5.3
18.0	25.4	5.0
20.0	25.2	5.2
22.0	25.1	5.0
24.0	25.1	5.0
26.0	25.1	5.1
28.0	25.1	5.2
30.0	25.0	5.5
32.0	24.9	5.3
34.0	24.9	5.1
36.0	24.8	4.2
38.0	22.4	0.2

Date: 8/31/2005
Secchi Disk (ft.): 7
Depth of Bottom Sample: 37 ft.
Weather Conditions: Mostly sunny, 65 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	21.6	8.2
2.0	21.5	8.2
4.0	21.3	8.3
6.0	21.2	8.1
8.0	21.1	8.0
10.0	21.1	8.0
12.0	21.0	8.0
14.0	21.0	8.0
16.0	21.0	8.0
18.0	20.9	8.0
20.0	20.9	7.9
22.0	20.9	7.7
24.0	20.8	7.5
26.0	20.8	7.4
28.0	20.6	6.9
30.0	20.5	6.7
32.0	20.5	6.6
34.0	20.5	6.5
36.0	20.5	6.4
38.0	20.5	2.3

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2006.

Date:	4/26/2006
Secchi Disk (ft.):	4
Depth of Bottom Sample:	13 m
Weather Conditions:	sunny, west wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	12.4	9.9
2.0	12.1	10.0
4.0	12.0	10.0
6.0	12.0	10.0
8.0	11.9	10.0
10.0	11.3	10.0
12.0	11.2	10.2
14.0	11.2	10.2
16.0	11.2	10.2
18.0	11.1	10.1
20.0	11.1	10.0
22.0	11.1	9.8
24.0	11.1	9.8
26.0	11.0	9.9
28.0	11.0	9.9
30.0	11.0	9.9
32.0	11.0	9.9
34.0	11.0	9.9
36.0	11.0	9.9
38.0	11.0	9.9
40.0	Bottom	Bottom

Date:	7/24/2006
Secchi Disk (ft.):	6
Depth of Bottom Sample:	15 m
Weather Conditions:	Partly cloudy, south wind at 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.9	7.6
2.0	25.4	7.5
4.0	25.2	7.3
6.0	25.1	7.2
8.0	25.0	6.9
10.0	24.9	6.8
12.0	24.8	6.4
14.0	24.7	6.1
16.0	24.5	5.8
18.0	24.5	5.6
20.0	24.2	6.1
22.0	24.0	6.4
24.0	24.0	6.4
26.0	23.9	6.3
28.0	23.8	6.3
30.0	23.8	6.2
32.0	23.8	5.9
34.0	23.7	5.5
36.0	21.8	0.6
38.0	Bottom	Bottom
40.0		

Date:	8/23/2006
Secchi Disk (ft.):	5
Depth of Bottom Sample:	38 ft.
Weather Conditions:	Cloudy, south wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	23.3	8.3
2.0	23.3	8.3
4.0	23.1	8.2
6.0	23.1	8.1
8.0	23.1	8.1
10.0	23.1	8.1
12.0	23.1	8.0
14.0	23.0	7.9
16.0	22.9	7.5
18.0	22.8	7.1
20.0	22.7	7.0
22.0	22.7	7.0
24.0	22.5	6.8
26.0	22.3	6.3
28.0	22.2	6.0
30.0	22.1	5.8
32.0	22.1	5.8
34.0	22.0	5.6
36.0	22.0	5.3
38.0	22.0	5.1
40.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2007.

Date: 4/30/2007
Secchi Disk (ft.): 4
Depth of Bottom Sample: 12 m
Weather Conditions: Partly cloudy, light wind

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.8	9.40
2.0	15.8	9.59
4.0	15.7	9.74
6.0	15.5	9.82
8.0	15.4	9.76
10.0	15.4	9.74
12.0	15.4	9.66
14.0	15.3	9.54
16.0	15.2	9.47
18.0	15.2	9.39
20.0	15.2	9.35
22.0	15.2	9.33
24.0	15.2	9.28
26.0	15.2	9.23
28.0	15.2	9.08
30.0	15.2	9.05
32.0	14.8	8.99
34.0	13.9	8.85
36.0	12.9	8.75
38.0	Bottom	Bottom
40.0		

Date: 7/31/2007
Secchi Disk (ft.): 7
Depth of Bottom Sample: 12 m
Weather Conditions: Mostly sunny, south wind at 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	28.1	7.43
2.0	27.8	7.46
4.0	27.4	7.41
6.0	27.3	7.30
8.0	27.2	7.28
10.0	27.1	6.82
12.0	27.0	6.68
14.0	26.9	6.47
16.0	26.8	6.26
18.0	26.8	6.08
20.0	26.6	5.45
22.0	26.4	5.18
24.0	26.3	5.15
26.0	26.0	4.85
28.0	25.8	4.78
30.0	25.5	4.27
32.0	25.4	4.00
34.0	24.0	0.43
36.0	Bottom	Bottom
38.0		
40.0		

Date: 8/29/2007
Secchi Disk (ft.): 6
Depth of Bottom Sample: 12 m
Weather Conditions: Mostly sunny N wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface		
2.0		
4.0		
6.0	DO/Temperature profile was not taken due to equipment problems	
8.0		
10.0		
12.0		
14.0		
16.0		
18.0		
20.0		
22.0		
24.0		
26.0		
28.0		
30.0		
32.0		
34.0		
36.0		
38.0		
40.0		

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2008.

Date: 4/30/2008
Secchi Disk (ft.): 4.5
Depth of Bottom Sample: 11 m
Weather Conditions: 50 F, sunny, south wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	5.8	11.8
2.0	5.9	11.8
4.0	5.7	11.9
6.0	5.7	11.9
8.0	5.7	11.9
10.0	5.7	11.9
12.0	5.7	11.9
14.0	5.7	11.9
16.0	5.7	11.9
18.0	5.7	11.9
20.0	5.7	11.9
22.0	5.7	11.9
24.0	5.7	11.9
26.0	5.7	11.9
28.0	5.7	11.9
30.0	5.7	11.9
32.0	5.7	11.9
34.0	5.7	11.8
36.0	5.7	11.8
38.0	5.7	6.0
40.0	Bottom	Bottom

Date: 7/23/2008
Secchi Disk (ft.): 5.5
Depth of Bottom Sample: 10 m
Weather Conditions: 73 F, sunny, south wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.7	7.60
2.0	24.4	7.58
4.0	24.2	7.58
6.0	24.1	7.50
8.0	24.0	7.36
10.0	23.9	7.31
12.0	23.8	7.27
14.0	23.7	7.27
16.0	23.7	7.19
18.0	23.7	7.09
20.0	23.5	6.95
22.0	23.5	6.84
24.0	23.5	6.75
26.0	23.3	6.06
28.0	23.3	6.05
30.0	23.2	5.61
32.0	23.1	5.34
34.0	23.1	4.82
36.0	Bottom	Bottom

Date: 8/26/2008
Secchi Disk (ft.): 5.5
Depth of Bottom Sample: 11 m
Weather Conditions: 71 F, sunny, southeast wind 5-10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.7	7.04
2.0	22.5	6.95
4.0	22.3	6.91
6.0	22.3	6.77
8.0	22.3	6.31
10.0	22.2	6.39
12.0	21.9	6.71
14.0	21.8	6.82
16.0	21.8	6.93
18.0	21.7	6.91
20.0	21.7	6.80
22.0	21.6	6.80
24.0	21.6	6.82
26.0	21.6	6.91
28.0	21.6	6.91
30.0	21.5	6.82
32.0	21.5	6.81
34.0	21.4	6.83
36.0	21.4	6.71
38.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2009.

Date: 4/28/2009
Secchi Disk (ft.): 5.0
Depth of Bottom Sample (ft) 38
Weather Conditions: mostly sunny, wind NE @ 10
Temperature (F): 51

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	9.4	10.65
2.0	9.4	10.65
4.0	9.4	10.64
6.0	9.3	10.64
8.0	9.3	10.64
10.0	9.3	10.63
12.0	9.3	10.62
14.0	9.2	10.62
16.0	9.2	10.61
18.0	9.2	10.61
20.0	9.2	10.60
22.0	9.2	10.60
24.0	9.2	10.59
26.0	9.2	10.58
28.0	9.2	10.57
30.0	9.2	10.57
32.0	9.2	10.56
34.0	9.2	10.56
36.0	9.2	10.54
38.0	9.2	10.14
40.0	Bottom	Bottom

Date: 7/28/2009
Secchi Disk (ft.): 6.5
Depth of Bottom Sample (ft) 36
Weather Conditions: partly sunny, wind W @ 15
Temperature (F): 66

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.7	7.86
2.0	22.8	7.82
4.0	22.7	7.81
6.0	22.7	7.79
8.0	22.7	7.79
10.0	22.7	7.75
12.0	22.5	7.55
14.0	22.4	7.03
16.0	22.3	6.59
18.0	22.1	6.22
20.0	22.0	6.07
22.0	21.7	5.95
24.0	21.6	5.91
26.0	21.6	5.69
28.0	21.4	5.41
30.0	21.3	5.20
32.0	21.2	4.58
34.0	20.3	2.52
36.0	Bottom	Bottom

Date: 8/24/2009
Secchi Disk (ft.): 6.5
Depth of Bottom Sample: 36
Weather Conditions: sunny, wind S @ 10
Temperature (F): 80

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	21.0	8.61
2.0	20.8	8.70
4.0	20.0	8.55
6.0	19.9	8.38
8.0	19.7	7.69
10.0	19.5	7.26
12.0	19.3	7.29
14.0	19.2	7.51
16.0	19.0	7.71
18.0	18.8	8.33
20.0	18.7	8.19
22.0	18.7	8.22
24.0	18.7	8.19
26.0	18.7	8.17
28.0	18.5	7.95
30.0	18.5	7.93
32.0	18.5	7.92
34.0	18.5	7.84
36.0	18.4	7.48
38.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2010.

Date: 4/28/2010
Secchi Disk (ft.): 5.0
Depth of Bottom Sample (ft) 36
Weather Conditions: mostly sunny, light winds
Temperature (F): 50

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	14.8	10.79
2.0	14.2	10.52
4.0	14.1	10.41
6.0	14.0	10.23
8.0	14.0	10.10
10.0	13.9	10.04
12.0	13.8	9.94
14.0	13.8	9.87
16.0	13.7	9.85
18.0	13.4	9.70
20.0	13.2	9.63
22.0	13.1	9.52
24.0	13.1	9.57
26.0	13.0	9.53
28.0	13.0	9.44
30.0	13.0	9.33
32.0	13.0	9.20
34.0	13.0	9.19
36.0	12.9	9.12
38.0	Bottom	Bottom

Date: 7/27/2010
Secchi Disk (ft.): 3.0
Depth of Bottom Sample (ft) 36
Weather Conditions: cloudy, S wind @ 7
Temperature (F): 75

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.7	6.44
2.0	24.7	6.29
4.0	24.6	6.35
6.0	24.6	6.26
8.0	24.6	6.49
10.0	24.6	6.34
12.0	24.6	6.27
14.0	24.6	6.34
16.0	24.6	6.26
18.0	24.4	6.21
20.0	24.4	6.22
22.0	24.4	6.20
24.0	24.2	6.21
26.0	24.1	6.17
28.0	23.9	6.13
30.0	23.8	6.06
32.0	23.6	6.02
34.0	23.5	5.95
36.0	23.4	5.7
38.0	Bottom	Bottom

Date: 8/31/2010
Secchi Disk (ft.): 3.0
Depth of Bottom Sample: 36
Weather Conditions: partly cloudy, S wind @ 10
Temperature (F): 79

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.2	6.70
2.0	24.2	6.68
4.0	24.2	6.68
6.0	24.2	6.67
8.0	24.2	6.66
10.0	24.2	6.66
12.0	24.2	6.66
14.0	24.2	6.66
16.0	24.1	6.63
18.0	24.0	6.60
20.0	24.0	6.59
22.0	24.0	6.60
24.0	24.0	6.60
26.0	24.0	6.58
28.0	24.0	6.60
30.0	24.0	6.59
32.0	23.9	6.59
34.0	23.9	6.55
36.0	23.8	6.34
38.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Big Falls Flowage in 2011.

Date: 4/29/2011
Secchi Disk (ft.):
Depth of Bottom Sample (ft):
Weather Conditions: mostly sunny, light winds
Temperature (F):

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface		
	Not Sampled Due To Reservoir Drawdown	
	Bottom	Bottom

Date: 7/26/2011
Secchi Disk (ft.): 4.0
Depth of Bottom Sample (ft) 36
Weather Conditions: mostly sunny, light winds
Temperature (F): 76

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.8	6.58
2.0	25.8	6.56
4.0	25.6	6.66
6.0	25.2	6.56
8.0	25.2	6.59
10.0	25.2	6.58
12.0	25.2	6.53
14.0	25.1	6.52
16.0	24.9	6.38
18.0	24.5	6.32
20.0	24.5	6.32
22.0	24.3	6.29
24.0	24.3	6.33
26.0	24.2	6.27
28.0	24.1	6.31
30.0	24.1	6.25
32.0	24.1	6.20
34.0	24.1	6.18
36.0	24.1	6.11
38.0	Bottom	Bottom

Date: 8/24/2011
Secchi Disk (ft.): 3.0
Depth of Bottom Sample: 36
Weather Conditions: sunny, wind NW @ 10-15
Temperature (F): 72

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.3	7.51
2.0	22.3	7.52
4.0	22.3	7.53
6.0	22.2	7.54
8.0	22.1	7.60
10.0	22.0	7.59
12.0	21.9	7.46
14.0	21.8	7.45
16.0	21.7	7.52
18.0	21.6	7.49
20.0	21.6	7.55
22.0	21.6	7.52
24.0	21.5	7.55
26.0	21.5	7.53
28.0	21.5	7.56
30.0	21.5	7.58
32.0	21.5	7.57
34.0	21.5	7.56
36.0	21.5	7.52
38.0	Bottom	Bottom

APPENDIX D

Summary Of Dissolved Oxygen And Temperature Data For Thornapple Flowage 2004 - 2011

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2004.

Date:	5/5/2004
Secchi Disk (ft.):	5
Depth of Bottom Sample:	6 m
Weather Conditions:	cloudy, S wind, 60 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	10.0	10.1
2.0	10.0	10.3
4.0	10.0	10.4
6.0	10.0	10.6
8.0	10.0	10.6
10.0	9.9	10.6
12.0	9.9	10.6
14.0	9.9	10.6
16.0	9.8	10.6
18.0	9.8	10.6
20.0	9.8	10.3

Could not sample earlier due to high river flows

Date:	7/28/2004
Secchi Disk (ft.):	5
Depth of Bottom Sample:	19.5 ft
Weather Conditions:	partly sunny, 75 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	23.2	7.6
2.0	23.2	7.6
4.0	22.6	7.1
6.0	22.1	6.5
8.0	21.9	6.2
10.0	21.9	6.2
12.0	21.8	6.2
14.0	21.3	5.8
16.0	21.1	6.2
18.0	20.4	2.4
20.0	19.2	0.9

Date:	8/25/2004
Secchi Disk (ft.):	5.5
Depth of Bottom Sample:	6 m
Weather Conditions:	overcast, 70 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	20.4	9.4
2.0	20.3	9.2
4.0	20.2	9.0
6.0	20.1	8.8
8.0	19.9	8.4
10.0	19.8	8.4
12.0	19.5	8.0
14.0	19.4	7.9
16.0	19.4	7.9
18.0	19.3	7.7
20.0	18.6	5.9

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2005.

Date:	4/19/2005
Secchi Disk (ft.):	5
Depth of Bottom Sample:	6 m
Weather Conditions:	cloudy, S wind, 70 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	10.2	10.7
2.0	10.2	10.7
4.0	10.1	10.8
6.0	10.1	10.8
8.0	10.1	10.8
10.0	10.0	10.8
12.0	9.9	10.8
14.0	9.8	10.8
16.0	9.8	10.8
18.0	9.8	10.8
20.0	9.8	10.8

Date:	7/25/2005
Secchi Disk (ft.):	4
Depth of Bottom Sample:	6 m
Weather Conditions:	cloudy, S wind, 82 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.4	7.4
2.0	25.0	7.0
4.0	24.7	6.7
6.0	24.5	6.4
8.0	24.4	6.0
10.0	23.8	5.2
12.0	23.5	5.3
14.0	23.3	4.8
16.0	23.2	4.6
18.0	22.3	0.8
20.0		

Date:	8/31/2005
Secchi Disk (ft.):	5.5
Depth of Bottom Sample:	6 m
Weather Conditions:	sunny, S wind, 70 F

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.4	8.1
2.0	21.9	7.9
4.0	21.5	7.7
6.0	21.4	7.4
8.0	21.3	7.4
10.0	21.3	7.4
12.0	21.3	7.3
14.0	21.2	7.3
16.0	21.2	7.2
18.0	21.2	7.2
20.0	21.2	7.1

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2006.

Date:	4/26/2006
Secchi Disk (ft.):	4
Depth of Bottom Sample:	6 m
Weather Conditions:	sunny, W wind @15 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	13.9	10.1
2.0	13.9	10.2
4.0	13.7	10.2
6.0	13.3	10.1
8.0	13.0	10.0
10.0	12.4	9.9
12.0	12.3	9.8
14.0	12.3	9.7
16.0	12.3	9.7
18.0	12.3	9.7
20.0	12.3	9.5
22.0	Bottom	Bottom

Date:	7/24/2006
Secchi Disk (ft.):	6
Depth of Bottom Sample:	5 m
Weather Conditions:	Mostly sunny, S wind@10mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.1	7.6
2.0	24.6	7.4
4.0	24.3	7.2
6.0	24.0	6.8
8.0	23.8	6.7
10.0	23.6	6.4
12.0	23.5	6.2
14.0	22.8	5.0
16.0	19.7	0.3
18.0	Bottom	Bottom

Date:	8/23/2006
Secchi Disk (ft.):	4
Depth of Bottom Sample:	6 m
Weather Conditions:	cloudy, S wind@5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	24.3	9.6
2.0	24.1	9.4
4.0	23.6	8.6
6.0	23.3	7.9
8.0	23.3	7.8
10.0	23.2	7.6
12.0	23.2	7.4
14.0	23.1	7.0
16.0	23.0	6.7
18.0	22.9	5.6
20.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2007.

Date:	4/30/2007
Secchi Disk (ft.):	5
Depth of Bottom Sample:	6 m
Weather Conditions:	cloudy, S wind @10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	15.3	11.26
2.0	14.7	11.27
4.0	14.4	11.33
6.0	14.3	11.32
8.0	14.3	11.28
10.0	14.1	11.28
12.0	14.0	11.20
14.0	13.9	11.13
16.0	13.8	10.90
18.0	13.1	10.43
20.0	Bottom	Bottom
22.0		

Date:	7/31/2007
Secchi Disk (ft.):	5
Depth of Bottom Sample:	6 m
Weather Conditions:	Mostly sunny, S wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	27.1	8.50
2.0	26.7	8.31
4.0	25.9	7.54
6.0	25.8	7.35
8.0	25.8	7.27
10.0	25.7	7.22
12.0	25.7	7.04
14.0	25.5	6.81
16.0	25.5	6.79
18.0	25.1	6.27
20.0	24.7	5.78
22.0	Bottom	Bottom

Date:	8/29/2007
Secchi Disk (ft.):	5
Depth of Bottom Sample:	6 m
Weather Conditions:	Mostly sunny, S wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface		
2.0	DO/Temperatures profiles were not taken	
4.0	due to equipment malfunction	
6.0		
8.0		
10.0		
12.0		
14.0		
16.0		
18.0		
20.0		

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2008.

Date:	4/30/2008
Secchi Disk (ft.):	4
Depth of Bottom Sample:	NA
Weather Conditions:	55 F, sunny, south wind @ 10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface		
2.0		
4.0		
6.0	DO/temperature profile not taken	
8.0	due to problems with DO meter	
10.0		
12.0		
14.0		
16.0		
18.0		
20.0		

Date:	7/23/2008
Secchi Disk (ft.):	5
Depth of Bottom Sample:	5.5 m
Weather Conditions:	78 F, partly cloudy, south wind @ 5 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.1	7.56
2.0	24.7	7.43
4.0	24.2	7.27
6.0	23.5	6.95
8.0	23.1	6.70
10.0	23.1	6.70
12.0	22.9	6.46
14.0	22.4	5.48
16.0	21.8	4.36
18.0	21.6	4.12
20.0	Bottom	Bottom

Date:	8/26/2008
Secchi Disk (ft.):	5
Depth of Bottom Sample:	5 m
Weather Conditions:	76 F, sunny, southeast wind @ 5-10 mph

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.3	9.64
2.0	22.0	9.46
4.0	21.8	9.25
6.0	21.6	8.99
8.0	21.5	8.82
10.0	21.4	8.73
12.0	21.4	8.70
14.0	21.3	8.65
16.0	21.3	8.62
18.0	21.3	8.60
20.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2009.

Date:	4/28/2009
Secchi Disk (ft.):	5.5
Depth of Bottom Sample (ft):	20
Weather Conditions:	mostly sunny, wind NE @ 10
Temperature (F):	57

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	8.3	10.90
2.0	8.3	10.95
4.0	8.2	10.96
6.0	8.2	10.93
8.0	8.2	10.93
10.0	8.2	10.94
12.0	8.2	10.92
14.0	8.2	10.91
16.0	8.2	10.90
18.0	8.1	10.90
20.0	8.1	10.86
22.0	Bottom	Bottom

Date:	7/28/2009
Secchi Disk (ft.):	7
Depth of Bottom Sample (ft)	18
Weather Conditions:	cloudy, wind W @ 5
Temperature (F):	67

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	22.4	8.65
2.0	22.3	8.42
4.0	21.8	7.18
6.0	21.4	6.78
8.0	21.1	6.16
10.0	21.0	5.97
12.0	20.7	6.16
14.0	18.1	3.71
16.0	17.0	1.45
18.0	15.7	0.00
20.0	Bottom	Bottom

Date:	8/24/2009
Secchi Disk (ft.):	6.5
Depth of Bottom Sample (ft	18
Weather Conditions:	sunny, wind S @ 10-15
Temperature (F):	77

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	21.1	9.95
2.0	20.9	9.79
4.0	20.6	9.41
6.0	20.1	8.76
8.0	19.7	8.68
10.0	19.6	8.86
12.0	19.5	8.27
14.0	19.2	6.89
16.0	19.1	6.65
18.0	18.6	5.23
20.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2010.

Date:	4/28/2010

Date:	7/27/2010

Date:	8/31/2010

Secchi Disk (ft.):	5.0
Depth of Bottom Sample (ft):	20
Weather Conditions:	p. cloudy, S winds 5-10
Temperature (F):	59

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	13.8	11.90
2.0	13.7	11.74
4.0	12.6	11.83
6.0	12.4	11.70
8.0	12.3	12.02
10.0	12.2	12.01
12.0	11.8	10.50
14.0	11.5	10.63
16.0	11.2	10.44
18.0	11.2	10.37
20.0	11.2	10.25

Secchi Disk (ft.):	3
Depth of Bottom Sample (ft)	20
Weather Conditions:	p. cloudy, S wind @ 5
Temperature (F):	84

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	25.4	4.46
2.0	25.0	4.44
4.0	24.6	4.37
6.0	24.5	4.38
8.0	24.5	4.37
10.0	24.5	4.30
12.0	24.3	4.23
14.0	24.3	4.23
16.0	24.2	4.35
18.0	24.2	4.37
20.0	24.2	4.3
22.0	Bottom	Bottom

Secchi Disk (ft.):	3
Depth of Bottom Sample (ft	20
Weather Conditions:	cloudy, S wind @ 10
Temperature (F):	81

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	23.0	5.82
2.0	22.8	5.75
4.0	22.8	5.74
6.0	22.7	5.71
8.0	22.6	5.71
10.0	22.6	5.71
12.0	22.6	5.71
14.0	22.6	5.71
16.0	22.6	5.70
18.0	22.6	5.70
20.0	22.6	5.7
22.0	Bottom	Bottom

Dissolved Oxygen and Temperature Profiles for the Thornapple Flowage in 2011.

Date:	4/29/2011
Secchi Disk (ft.):	3.5
Depth of Bottom Sample (ft):	22
Weather Conditions:	sunny, wind S @ 5-10
Temperature (F):	45

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	6.9	12.5
2.0	6.8	12.4
4.0	6.8	12.4
6.0	6.8	12.4
8.0	6.8	12.4
10.0	6.8	12.4
12.0	6.8	12.4
14.0	6.8	12.3
16.0	6.8	12.3
18.0	6.8	12.3
20.0	6.8	12.3
22.0	6.8	12.3
24.0	Bottom	Bottom

Date:	7/26/2011
Secchi Disk (ft.):	4.5
Depth of Bottom Sample (ft)	20
Weather Conditions:	sunny, light winds
Temperature (F):	80

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	26.4	6.56
2.0	26.3	6.54
4.0	25.9	6.54
6.0	25.6	6.47
8.0	25.7	6.46
10.0	25.5	6.45
12.0	25.4	6.41
14.0	24.6	6.14
16.0	24.2	5.76
18.0	24.2	5.68
20.0	23.7	5.00
22.0	Bottom	Bottom

Date:	8/24/2011
Secchi Disk (ft.):	3
Depth of Bottom Sample (ft	20
Weather Conditions:	sunny, NW wind 15-20
Temperature (F):	78

Depth (ft.)	Temperature (celsius)	Dissolved Oxygen (mg/l)
Surface	23.7	6.52
2.0	23.7	6.50
4.0	23.0	6.36
6.0	22.7	6.26
8.0	22.7	6.23
10.0	22.6	6.16
12.0	22.5	6.08
14.0	22.3	5.94
16.0	22.1	5.73
18.0	22.0	5.60
20.0	22.0	5.60
22.0	Bottom	Bottom

APPENDIX E

2011 Water Quality Monitoring Report

Turtle-Flambeau Flowage (FERC Project No. 2390-02)

(Developed by Citizens Lake Monitoring Program & WDNR)

Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River 2011 Results

Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River was sampled **13** different days during the 2011 season. Parameters sampled included:

- water clarity
- temperature
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River (Iron County, WBIC: 2294900) was 5.45 feet. The average for the Northwest Georegion was 7.6 feet. Typically the summer (July-Aug) water was reported as **CLEAR** and **YELLOW**.

Chemistry data was collected on Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River. The average summer Chlorophyll was 6.8 µg/l (compared to a Northwest Georegion summer average of 18.6 µg/l). The summer Total Phosphorus average was 21.5 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River was 49. The TSI suggests that Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River was **mesotrophic**. Mesotrophic lakes are characterized by moderately clear water, but have a increasing chance of low dissolved oxygen in deep water during the summer.

Lake Water Quality 2011 Annual Report

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

Site Name	Storet #
Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River	263182

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
05/06/2011					20			51				
05/06/2011	3.25	1	NO			60			HIGH	CLEAR	YELLOW	1-Beautiful, could not be nicer
05/16/2011	3.25	1	NO			60			HIGH	CLEAR	YELLOW	1-Beautiful, could not be nicer
06/01/2011	3.5	1.1	NO			59			HIGH	CLEAR	BROWN	1-Beautiful, could not be nicer
06/12/2011	4.75	1.4	NO			55			HIGH	CLEAR	YELLOW	1-Beautiful, could not be nicer
06/25/2011				3.8	21		45	52				
06/25/2011	4.75	1.4	NO			55			HIGH	CLEAR	YELLOW	1-Beautiful, could not be nicer
07/06/2011	5	1.5	NO			54			HIGH	CLEAR	YELLOW	2-Very minor aesthetic problems
07/20/2011	5.5	1.7	NO			53				CLEAR	YELLOW	2-Very minor aesthetic problems
07/31/2011				5.39	18		48	51				
07/31/2011	6	1.8	NO			51				CLEAR	YELLOW	2-Very minor aesthetic problems
08/13/2011	5.75	1.8	NO			52				CLEAR	YELLOW	3-Enjoyment somewhat impaired (algae)
												3-Enjoyment

08/24/2011	5	1.5	NO			54				CLEAR	YELLOW	somewhat impaired (algae)
09/12/2011	6.25	1.9	NO			51				CLEAR	YELLOW	3-Enjoyment somewhat impaired (algae)

05/06/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	46.7	
6	45.8	
9	45.6	
12	45.3	
15	44.9	
16.75	44.9	

06/25/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	70.1	
6	68.7	
9	64.7	
12	62.9	
15	62.6	
18	62.4	

07/31/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	80.4	
6	77.7	
9	77.3	
12	75.5	
15	74.8	

08/24/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	72.5	
6	72.1	
9	71.9	
12	71.6	
15	71.6	
17	71.4	

Date	Collector Comments
05/06/2011	Day before fishing opener- lots of boat traffic- osprey on the nest on the powerpole on Popko Circle- across from the islands near our site. Kit Bogenschneider recording data.
05/16/2011	It's been a cool spring. Kit Bogenschneider recording data.
06/01/2011	Generally windy- but this site is protected from whitecaps most days. Kit Bogenschneider recording.
06/12/2011	Almost dead calm. Kit Bogenschneider recording data
06/25/2011	Kit Bogenschneider recording data.
07/06/2011	Kit Bogenschneider recording data. Pretty day- winds nearly calm.
07/20/2011	4th day of extreme heat- recorded by Kit Bogenschneider
07/31/2011	data recorded by Kit Bogenschneider

08/24/2011	Cloudless sky- breezy- data recorded by Kit Bogenschneider
09/12/2011	data recorded by Kit Bogenschneider

Date	Data Collectors	Project
05/06/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
05/06/2011	Heather Palmquist	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
05/16/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
06/01/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
06/12/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
06/25/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
06/25/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
07/06/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
07/20/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
07/31/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
07/31/2011	Heather Palmquist	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
08/13/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
08/17/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
08/24/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv
09/12/2011	Gary Bogenschneider	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flow; At Turtle And L Turtle Riv

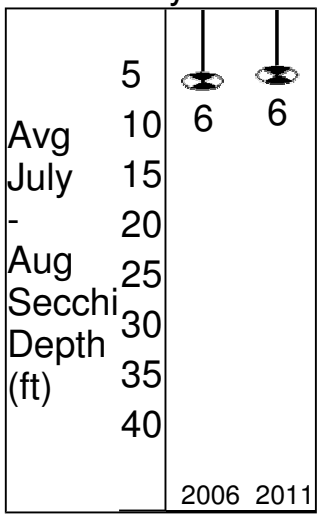
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 09/21/2011

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

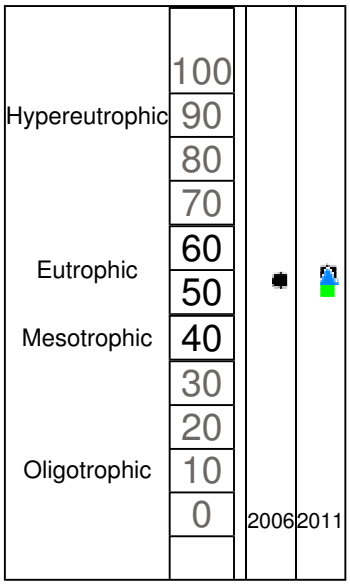


Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
2006	6.2	6	6.8	7
2011	5.5	5	6	5

Report Generated: 09/21/2011

Trophic State Index Graph



Monitoring Station: Turtle Flambeau Flowage - Confluence Of Turtle River And Little Turtle River, Iron County

Past Summer (July-August) Trophic State Index (TSI) averages.

● = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own

Turtle Flambeau Flowage - Deep Hole 2011 Results

Turtle Flambeau Flowage - Deep Hole was sampled **5** different days during the 2011 season. Parameters sampled included:

- water clarity
- temperature
- dissolved oxygen
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - Deep Hole (Iron County, WBIC: 2294900) was 4.75 feet. The average for the Northwest Georegion was 7.6 feet. Typically the summer (July-Aug) water was reported as **MURKY** and **BROWN**. This suggests that the secchi depth may have been mostly impacted by suspended sediments, tiny particles of soil or organic matter that are suspended in the water. Shallow lakes are often turbid because wind stirs up sediment from the bottom. High suspended sediments are often found in flowages and impoundments where precipitation runoff from the watershed transports solids via an incoming stream.

Chemistry data was collected on Turtle Flambeau Flowage - Deep Hole. The average summer Chlorophyll was 10.2 µg/l (compared to a Northwest Georegion summer average of 18.6 µg/l). The summer Total Phosphorus average was 28.5 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - Deep Hole was 52. The TSI suggests that Turtle Flambeau Flowage - Deep Hole was **eutrophic**. This TSI usually suggests decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.

Lake Water Quality 2011 Annual Report

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

Site Name	Storet #
Turtle Flambeau Flowage - Deep Hole	263059

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
04/27/2011	4.5	1.4	NO		23	55		52	NORMAL	CLEAR	BROWN	2-Very minor aesthetic problems
06/27/2011	5	1.5	NO	9.78	30	54	52	54	LOW	CLEAR	BROWN	2-Very minor aesthetic problems
07/26/2011	5	1.5	NO	7.27	36	54	50	56	LOW	MURKY	BROWN	2-Very minor aesthetic problems
08/15/2011	4.5	1.4	NO			55			LOW	MURKY	BROWN	2-Very minor aesthetic problems

04/27/2011		
Depth FEET	Temp. DEGREES C	D.O. MG/L
0	4.7	9.66
3	4.7	9.64
6	4.6	9.61
9	4.6	9.6
12	4.6	9.59
15	4.6	9.59
20	4.6	9.58
25	4.6	9.56
30	4.6	9.55
35	4.6	9.53
40	4.6	9.53
45	4.6	9.53

06/27/2011		
Depth FEET	Temp. DEGREES C	D.O. MG/L
0	20.6	7.7
3	20.2	7.63
6	19.7	7.34
9	19.5	7.23
12	18.9	6.81
15	18.7	6.59
20	17.7	5.62
25	16	4.68
30	12.4	2.51
35	10.9	.78
40	10.2	.51
45	10.2	.17

07/26/2011		
Depth FEET	Temp. DEGREES C	D.O. MG/L
0	27.1	7.05
3	26.1	6.98
6	24.5	6.52
9	24.3	6.25
12	24.1	6.08
15	23.7	6.02
20	18.1	.86
25	14.8	.18
30	12.9	.04
35	12	.05
40	11.6	.08
45	11.7	.12

08/15/2011		
Depth	Temp.	D.O.

FEET	DEGREES C	MG/L
0	23.4	7.4
3	23.3	7.34
6	22.7	6.7
9	22.4	6.43
12	22.3	6.35
15	21.9	6.03
20	20	2.39
25	15.5	.06
30	13	.06
35	11.8	.08
40	11.4	.11
45	11.3	.15

Date	Collector Comments
04/27/2011	Cloudy/Overcast
06/27/2011	Sunny/Clear
07/26/2011	Sunny/Clear
08/15/2011	Sunny/Slight Overcast

Date	Data Collectors	Project
04/27/2011	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
05/28/2011	Heather Palmquist	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
06/27/2011	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
07/26/2011	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole
08/15/2011	James Leever	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage; Deep Hole

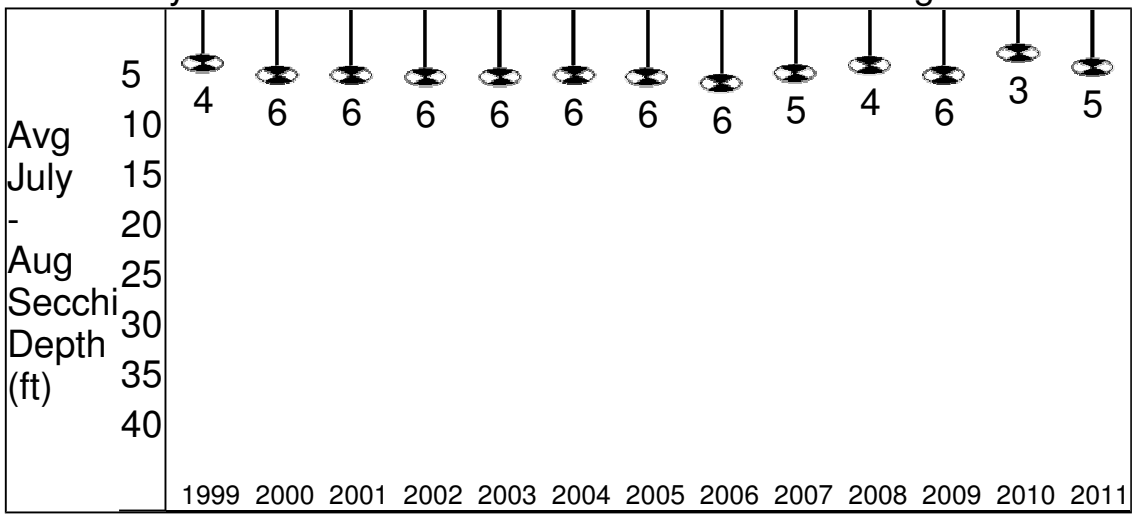
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 09/21/2011

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

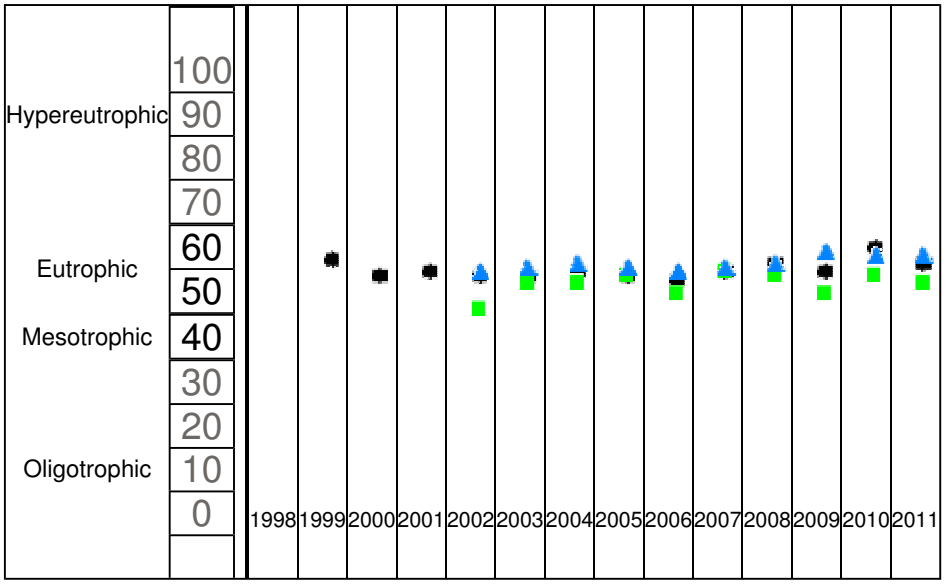


Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1999	4.3	4.25	4.25	1
2000	5.6	4.7	6.5	2
2001	5.5	5.3	5.6	2
2002	5.8	5.5	6	3
2003	5.8	5.5	6	2
2004	5.5	5	6	2
2005	5.8	5	6.5	2
2006	6.3	6	6.5	2
2007	5.3	5	5.5	2
2008	4.5	4.5	4.5	2
2009	5.5	5	6	2
2010	3.4	3	5.5	6
2011	4.8	4.5	5	2

Report Generated: 09/21/2011

Trophic State Index Graph



Monitoring Station: Turtle Flambeau Flowage - Deep Hole, Iron County

Past Summer (July-August) Trophic State Index (TSI) averages.

= Secchi = Chlorophyll = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We

Turtle Flambeau Flowage - NW Basin 2011 Results

Turtle Flambeau Flowage - NW Basin was sampled **13** different days during the 2011 season. Parameters sampled included:

- water clarity
- temperature
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - NW Basin (Iron County, WBIC: 2294900) was 7.06 feet. The average for the Northwest Georegion was 7.6 feet. Typically the summer (July-Aug) water was reported as **MURKY** and **BROWN**. This suggests that the secchi depth may have been mostly impacted by suspended sediments, tiny particles of soil or organic matter that are suspended in the water. Shallow lakes are often turbid because wind stirs up sediment from the bottom. High suspended sediments are often found in flowages and impoundments where precipitation runoff from the watershed transports solids via an incoming stream.

Chemistry data was collected on Turtle Flambeau Flowage - NW Basin. The average summer Chlorophyll was 8.2 µg/l (compared to a Northwest Georegion summer average of 18.6 µg/l). The summer Total Phosphorus average was 17 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - NW Basin was 51. The TSI suggests that Turtle Flambeau Flowage - NW Basin was **eutrophic**. This TSI usually suggests decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.

Lake Water Quality 2011 Annual Report

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

Site Name	Storet #
Turtle Flambeau Flowage - NW Basin	263049

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
05/08/2011	4.75	1.4	NO			55				CLEAR	BROWN	1-Beautiful, could not be nicer
05/08/2011					27			54				
05/18/2011	5.75	1.8	NO			52				CLEAR	BROWN	1-Beautiful, could not be nicer
06/04/2011	5.5	1.7	NO			53				CLEAR	BROWN	1-Beautiful, could not be nicer
06/17/2011	6	1.8	NO			51				CLEAR	BROWN	1-Beautiful, could not be nicer
06/27/2011				2.73	11		42	47				
06/27/2011	5.5	1.7	NO			53				MURKY	BROWN	1-Beautiful, could not be nicer
07/12/2011	6.5	2	NO			50				MURKY	BROWN	1-Beautiful, could not be nicer
07/26/2011				5.74	16		48	50				
07/26/2011	7.25	2.2	NO			49				MURKY	BROWN	1-Beautiful, could not be nicer
08/11/2011	7	2.1	NO			49				MURKY	BROWN	1-Beautiful, could not be nicer
08/23/2011				10.6	18		53	51				
08/23/2011	7.5	2.3	NO			48				MURKY	BROWN	2-Very minor aesthetic problems
09/06/2011	7	2.1	NO			49				MURKY	BROWN	2-Very minor aesthetic problems
												2-Very minor

09/19/2011	6	1.8	NO			51				MURKY	BROWN	aesthetic problems
09/28/2011	6	1.8	NO			51				MURKY	BROWN	2-Very minor aesthetic problems
10/07/2011	7.5	2.3	NO			48				MURKY	BROWN	2-Very minor aesthetic problems

05/08/2011		
Depth FEET	Temp. DEGREES F	D.O.
0	52.1	
3	51.9	
6	51.6	
9	46.7	
12	45.6	
15	45.1	
18	44.9	
21	44	
24	43.5	
27	42.8	
30	42.6	
33	42.4	
36	42.2	

06/27/2011		
Depth FEET	Temp. DEGREES F	D.O.
0	67.2	
3	67.2	
6	67.1	
9	67.1	
12	67.1	
15	65.4	
18	64.7	
21	63.6	
24	55.5	
27	50.3	
30	47.6	
36	45.8	
42	45.6	

07/26/2011		
Depth FEET	Temp. DEGREES F	D.O.
0	70.5	
3	70.5	
6	70.5	
9	70.5	
12	70.5	
15	70.3	
18	70.1	
21	65.6	
24	57	
27	51.6	
30	49.4	
36	47.6	
42	47.3	

Date	Collector Comments
05/08/2011	Station ID corrected to 263049 per note from Sandy Wickman- DNR.
05/08/2011	walleye opener - heavy boat traffic
06/04/2011	calm
06/17/2011	calm for 3 days
06/27/2011	Station ID corrected to 263049 per note from Sandy Wickman- DNR.
07/26/2011	Station ID corrected to 263049 per note from Sandy Wickman- DNR.
08/23/2011	Station ID corrected to 263049 per note from Sandy Wickman- DNR.
08/23/2011	small algae bloom
09/28/2011	algae bloom algae bloom
10/07/2011	very windy

Date	Lab Comments
05/08/2011	LAB REAGENT BLANK EXCEEDES LOD BY -0.0019 MG/L
05/08/2011	NO SAMPLE RECEIVED- NO TEST DONE

Date	Data Collectors	Project
05/08/2011	Heather Palmquist and Jim Blum	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
05/08/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
05/18/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
06/04/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
06/17/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
06/27/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
06/27/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
07/12/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
07/26/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
07/26/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
08/11/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
08/23/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
08/23/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
09/06/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
09/19/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
09/28/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin
10/07/2011	Jim Blum	Citizen Lake Monitoring - Water Quality - Turtle Flambeau Flowage - NW Basin

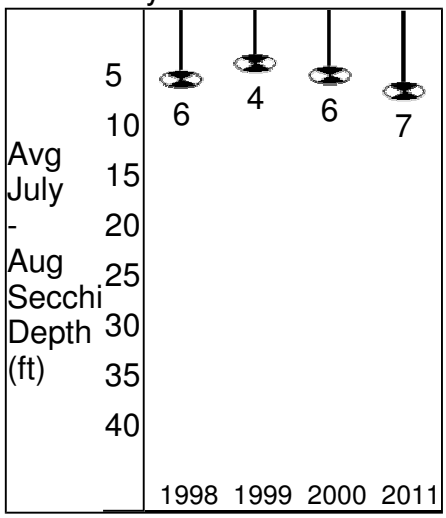
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI (TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 11/28/2011

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

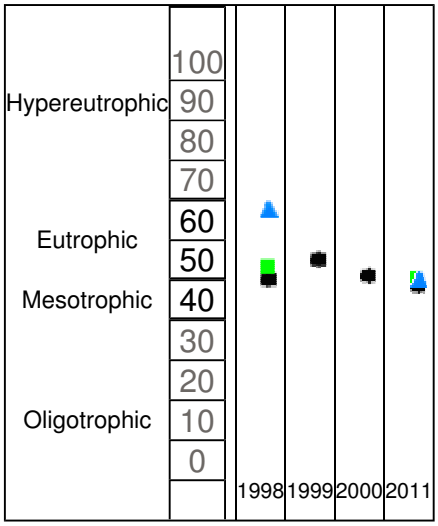


Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1998	6	5.7	6.2	2
1999	4.3	4.25	4.3	2
2000	5.6	4.5	6.5	4
2011	7.1	6.5	7.5	4

Report Generated: 11/28/2011

Trophic State Index Graph



Monitoring Station: Turtle Flambeau Flowage - NW Basin, Iron County

Past Summer (July-August) Trophic State Index (TSI) averages.

● = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We base the overall TSI on the Chlorophyll TSI when we have Chlorophyll data. If we don't have chemistry data, we use TSI Secchi. We do this rather than averaging, because the TSI is used to predict biomass. This makes chlorophyll the best indicator. Visit Bob Carlson's website, dipin.kent.edu/tsi.htm, for more info.

Turtle Flambeau Flowage - Near Murrays Landing 2011 Results

Turtle Flambeau Flowage - Near Murrays Landing was sampled **14** different days during the 2011 season. Parameters sampled included:

- water clarity
- temperature
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - Near Murrays Landing (Iron County, WBIC: 2294900) was 3.5 feet. The average for the Northwest Georegion was 7.6 feet. Typically the summer (July-Aug) water was reported as **CLEAR** and **BROWN**. This suggests that the Secchi depth may have been mostly impacted by tannins, stain from decaying matter. Tannins are natural and not a result of pollution. Tannins can be distinguished from suspended sediment because the water, even though it's brown, it looks clear, like tea. Though tannins are not harmful per se, they are often not perceived as aesthetically pleasing as clear water. Tannins can also be important for decreasing light penetration into the water and decreasing algal growth.

Chemistry data was collected on Turtle Flambeau Flowage - Near Murrays Landing. The average summer Chlorophyll was 2.4 µg/l (compared to a Northwest Georegion summer average of 18.6 µg/l). The summer Total Phosphorus average was 22 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - Near Murrays Landing was 41. The TSI suggests that Turtle Flambeau Flowage - Near Murrays Landing was **mesotrophic**. Mesotrophic lakes are characterized by moderately clear water, but have a increasing chance of low dissolved oxygen in deep water during the summer.

Lake Water Quality 2011 Annual Report

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

Site Name	Storet #
Turtle Flambeau Flowage - Near Murrays Landing	10019764

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
05/08/2011					26			53				
05/08/2011	3	0.9	NO			61			NORMAL	CLEAR	BROWN	1-Beautiful, could not be nicer
06/22/2011				2.13	22		41	52				
06/22/2011	4.5	1.4	NO			55			NORMAL	CLEAR	BROWN	1-Beautiful, could not be nicer
08/15/2011				2.41	22		41	52				
08/15/2011	3.5	1.1	NO			59			NORMAL	CLEAR	BROWN	1-Beautiful, could not be nicer

05/08/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	53.9	
6	53.7	

06/22/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	64.4	
6	64.4	
9	64.4	

08/15/2011		
Depth FEET	Temp. DEGREES F	D.O.
3	72.8	
6	72.8	

Date	Collector Comments
05/08/2011	clear skies- calm
06/22/2011	clear skies- slight breeze

Date	Lab Comments
05/08/2011	NO SAMPLE RECEIVED- NO TEST DONE

Date	Data Collectors	Project

05/08/2011	Chris Niehaus	Turtle Flambeau Flowage Monitoring
05/08/2011	Heather Palmquist	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
06/19/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)
06/22/2011	Chris Niehaus	Turtle Flambeau Flowage Monitoring
06/22/2011	Heather Palmquist	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
07/01/2011	John Preuss	Water Guard - Iron County
07/09/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)
07/10/2011	Filip Grgic	Clean Boats- Clean Waters - Iron County (county staff)
07/17/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)
07/22/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)
07/30/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)
08/13/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)
08/15/2011	Chris Niehaus	Turtle Flambeau Flowage Monitoring
08/15/2011	Heather Palmquist	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
08/17/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
08/19/2011	Filip Grgic	Clean Boats- Clean Waters - Iron County (county staff)
08/27/2011	Ryan Motiff	Clean Boats- Clean Waters - Iron County (county staff)

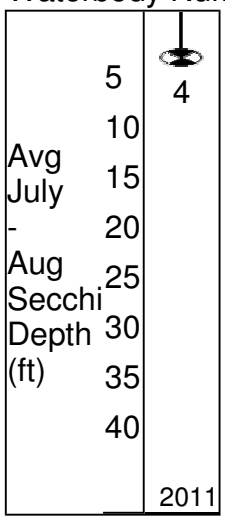
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 11/28/2011

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

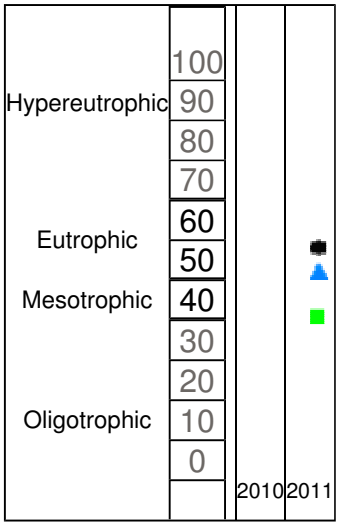


Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
2011	3.5	3.5	3.5	1

Report Generated: 11/28/2011

Trophic State Index Graph



Monitoring Station: Turtle Flambeau Flowage - Near Murrays Landing, Iron County
Past Summer (July-August) Trophic State Index (TSI) averages.

● = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We base the overall TSI on the Chlorophyll TSI when we have Chlorophyll data. If we don't have chemistry data, we use TSI Secchi. We do this rather than averaging, because the TSI is used to predict biomass. This makes chlorophyll the best indicator. Visit Bob Carlson's website, dipin.kent.edu/tsi.htm, for more info.

Turtle Flambeau Flowage - SC Basin 2011 Results

Turtle Flambeau Flowage - SC Basin was sampled **7** different days during the 2011 season. Parameters sampled included:

- water clarity
- temperature
- dissolved oxygen
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - SC Basin (Iron County, WBIC: 2294900) was 4.13 feet. The average for the Northwest Georegion was 7.6 feet. Typically the summer (July-Aug) water was reported as **CLEAR** and **YELLOW**.

Chemistry data was collected on Turtle Flambeau Flowage - SC Basin. The average summer Chlorophyll was 10 µg/l (compared to a Northwest Georegion summer average of 18.6 µg/l). The summer Total Phosphorus average was 36.5 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - SC Basin was 52. The TSI suggests that Turtle Flambeau Flowage - SC Basin was **eutrophic**. This TSI usually suggests decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.

Lake Water Quality 2011 Annual Report

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

Site Name	Storet #
Turtle Flambeau Flowage - SC Basin	263050

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
05/10/2011	3	0.9	NO		35	61		56				
05/11/2011	3	0.9	NO			61			HIGH	MURKY	BROWN	2-Very minor aesthetic problems
06/16/2011	3.5	1.1	NO	5.82	26	59	48	53	HIGH	CLEAR	BROWN	2-Very minor aesthetic problems
07/31/2011	4	1.2	NO	7.37	40	57	50	57	HIGH	CLEAR	YELLOW	2-Very minor aesthetic problems
08/23/2011	4.25	1.3	NO			56			NORMAL	CLEAR	YELLOW	2-Very minor aesthetic problems

05/11/2011

Depth FEET	Temp. DEGREES F	D.O.
3	53.9	
6	53.6	
9	53.4	
12	53.2	
15	53	
18	53	

06/16/2011

Depth FEET	Temp. DEGREES F	D.O. MG/L
0	66.2	7.56
3	65.6	7.36
6	65.3	7.38
9	65.3	7.38
12	65.3	7.39
15	65.1	7.32
18	65.1	
21	63.8	

07/31/2011

Depth FEET	Temp. DEGREES F	D.O. MG/L
0	76.8	7.39
3	76.8	7.34
6	76.4	6.88
9	75.9	6.13
12	75.2	5.11
15	74.4	1.67
18	72.8	
21	70.5	

08/23/2011

Depth FEET	Temp. DEGREES F	D.O. MG/L
0	69.6	7.38
3	70.1	7.42

6	70.1	7.4
9	70.1	7.34
12	70.1	7.28
15	69.8	6.97
18	69.4	
21	69.2	

Date	Collector Comments
05/11/2011	storms 2 days prior
06/16/2011	rained one day prior
07/31/2011	heavy storms 2 days prior
08/23/2011	rained just before we took the reading.

Date	Lab Comments
05/10/2011	NO BOTTLE RECEIVED- NO TEST DONE

Date	Data Collectors	Project
05/01/2011	JAMES KREITLOW	
05/10/2011	JAMES KREITLOW	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
05/11/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
06/16/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
07/31/2011	Heather Palmquist	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
07/31/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
08/17/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
08/23/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring

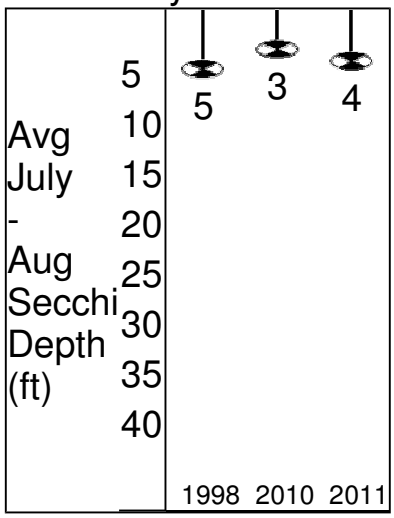
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI(SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 09/21/2011

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

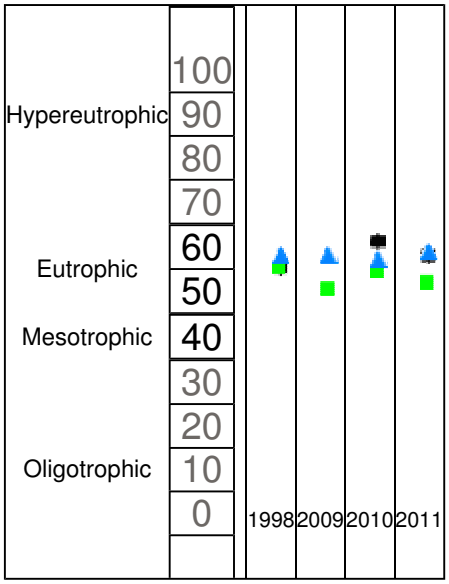


Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1998	4.9	4.8	4.9	2
2010	3	3	3	2
2011	4.1	4	4.25	2

Report Generated: 09/21/2011

Trophic State Index Graph



Monitoring Station: Turtle Flambeau Flowage - SC Basin, Iron County
Past Summer (July-August) Trophic State Index (TSI) averages.

● = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We

Turtle Flambeau Flowage - SW Basin 2011 Results

Turtle Flambeau Flowage - SW Basin was sampled **20** different days during the 2011 season. Parameters sampled included:

- water clarity
- total phosphorus
- chlorophyll

The average summer (July-Aug) secchi disk reading for Turtle Flambeau Flowage - SW Basin (Iron County, WBIC: 2294900) was 4.58 feet. The average for the Northwest Georegion was 7.6 feet. Typically the summer (July-Aug) water was reported as **MURKY** and **BROWN**. This suggests that the secchi depth may have been mostly impacted by suspended sediments, tiny particles of soil or organic matter that are suspended in the water. Shallow lakes are often turbid because wind stirs up sediment from the bottom. High suspended sediments are often found in flowages and impoundments where precipitation runoff from the watershed transports solids via an incoming stream.

Chemistry data was collected on Turtle Flambeau Flowage - SW Basin. The average summer Chlorophyll was 11.8 µg/l (compared to a Northwest Georegion summer average of 18.6 µg/l). The summer Total Phosphorus average was 26.5 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Turtle Flambeau Flowage - SW Basin was 53. The TSI suggests that Turtle Flambeau Flowage - SW Basin was **eutrophic**. This TSI usually suggests decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.

Lake Water Quality 2011 Annual Report

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

Site Name	Storet #
Turtle Flambeau Flowage - SW Basin	263048

Date	SD (ft)	SD (m)	Hit Bottom	CHL	TP	TSI (SD)	TSI (CHL)	TSI (TP)	Lake Level	Clarity	Color	Perception
05/09/2011					20			51				
06/26/2011				5.79	20		48	51				
07/13/2011				6.48	25		49	53				

Date	Lab Comments
05/09/2011	NO BOTTLE RECEIVED- NO TEST DONE
07/13/2011	HOLDING TIME EXCEEDED BY 2 DAYS

Date	Data Collectors	Project
05/01/2011	JAMES KREITLOW	
05/09/2011	JAMES KREITLOW	IRON COUNTY: Turtle-Flambeau Flowage AIS Project
05/17/2011	JAMES KREITLOW	
06/16/2011	JAMES KREITLOW	
06/26/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
07/13/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring
08/17/2011	Heather Palmquist	Turtle Flambeau Flowage Monitoring

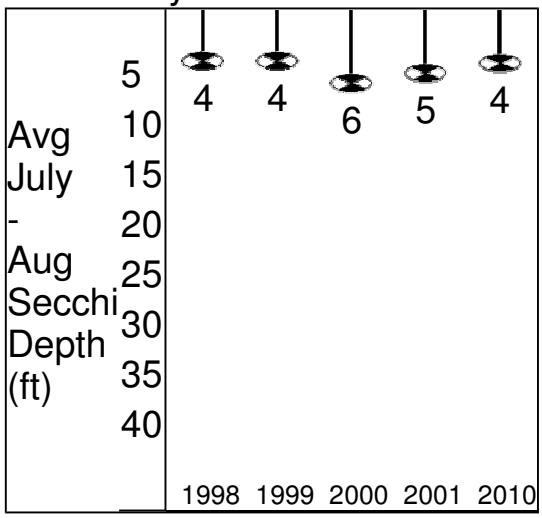
SD = Secchi depth measured in feet converted to meters; Chl = Chlorophyll a in micrograms per liter(ug/l); TP = Total phosphorus in ug/l, surface sample only; TSI (SD), TSI(CHL), TSI(TP) = Trophic state index based on SD, CHL, TP respectively; Depth measured in feet.

Wisconsin Department of Natural Resources **Wisconsin Lakes Partnership**

Report Generated: 09/21/2011

Turtle Flambeau Flowage
Iron County
Waterbody Number: 2294900

Lake Type: DRAINAGE
DNR Region: NO
GEO Region:NW

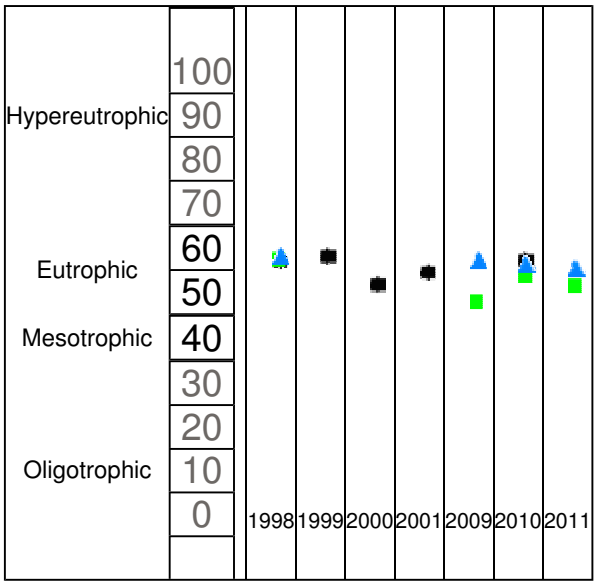


Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1998	4.2	3.5	4.9	2
1999	4.1	4	4.2	3
2000	6.4	6.25	6.5	4
2001	5.4	5.4	5.4	1
2010	4.3	4	4.5	2

Report Generated: 09/21/2011

Trophic State Index Graph



Monitoring Station: Turtle Flambeau Flowage - SW Basin, Iron County
Past Summer (July-August) Trophic State Index (TSI) averages.

● = Secchi ■ = Chlorophyll ▲ = Total Phosphorus

TSI(Chl) = TSI(TP) = TSI (Sec)	It is likely that algae dominate light attenuation.
TSI(Chl) > TSI(Sec)	Large particulates, such as Aphanizomenon flakes dominate
TSI(TP) = TSI(Sec) > TSI (Chl)	Non-algal particulate or color dominate light attenuation
TSI(Sec) = TSI(Chl) >= TSI (TP)	The algae biomass in your lake is limited by phosphorus
TSI(TP) > TSI(Chl) = TSI (Sec)	Zooplankton grazing, nitrogen, or some factor other than phosphorus is limiting algae biomass

TSI	TSI Description
TSI < 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
TSI 30-40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
TSI 40-50	Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer.
TSI 50-60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only.
TSI 60-70	Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible.
TSI 70-80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
TSI > 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Trophic state index (TSI) is determined using a mathematical formula (Wisconsin has its own version). The TSI is a score from 0 to 110, with lakes that are less fertile having a low TSI. We

APPENDIX F

Agency Correspondence

1414 West Hamilton Avenue
P.O. Box 8
Eau Claire, WI 54702-0008

November 29, 2011

Mr. Jeff Scheirer
Wisconsin DNR
875 South 4th Avenue
Park Falls, WI 54552

Subject: 2011 Water Quality Monitoring Report For Big Falls Flowage (P-2390-01), Thornapple Flowage (P-2475) And Turtle-Flambeau Flowage (P-2390-02).

Dear Mr. Scheirer:

Enclosed are the results of the water quality sampling for Big Falls and Thornapple flowages that Northern States Power Company – Wisconsin (NSPW) conducted during the 2011 field season. The samples were taken after ice-out and in late July and August. The samples were acquired from the deepest point of the reservoirs immediately upstream from the boat restraining barriers. The results are summarized for the past eight years and while there appears to be some variability in the parameters analyzed, for the most part, the results have been relatively consistent. The data collected in 2011 is consistent with data from the previous years' sampling.

Also included in the report are the water quality sampling results for the Turtle-Flambeau Flowage (TFF) gathered by the Wisconsin Citizen Lake Monitoring Program. The results of the TFF monitoring are being provided to you pursuant to the 2008 Water Quality Certification for Big Falls Hydro and the Federal Energy Regulatory Commission's subsequent order amending the Big Falls license to include the Turtle-Flambeau Flowage.

Please provide me with any comments that you might have by January 5, 2012. Should you have any questions concerning this report, feel free to contact me by telephone at (715) 737-1353 or by electronic mail at matthew.j.miller@xcelenergy.com.

Sincerely,

Matthew J. Miller

Matthew J. Miller
Hydro Licensing Specialist

Enclosure: 2011 Water Quality Monitoring Report

c: Nick Utrup – USFWS
Project Files

1414 West Hamilton Avenue
P.O. Box 8
Eau Claire, WI 54702-0008

November 29, 2011

Mr. Nick Utrup
U.S. Fish & Wildlife Service
2661 Scott Tower Drive
New Franken, WI 54229-9565

Subject: 2011 Water Quality Monitoring Report For Big Falls Flowage (P-2390-01), Thornapple Flowage (P-2475) And Turtle-Flambeau Flowage (P-2390-02).

Dear Mr. Utrup:

Enclosed are the results of the water quality sampling for Big Falls and Thornapple flowages that Northern States Power Company – Wisconsin (NSPW) conducted during the 2011 field season. The samples were taken after ice-out and in late July and August. The samples were acquired from the deepest point of the reservoirs immediately upstream from the boat restraining barriers. The results are summarized for the past eight years and while there appears to be some variability in the parameters analyzed, for the most part, the results have been relatively consistent. The data collected in 2011 is consistent with data from the previous years' sampling.

Also included in the report are the water quality sampling results for the Turtle-Flambeau Flowage (TFF) gathered by the Wisconsin Citizen Lake Monitoring Program. The results of the TFF monitoring are being provided to you pursuant to the 2008 Water Quality Certification for Big Falls Hydro and the Federal Energy Regulatory Commission's subsequent order amending the Big Falls license to include the Turtle-Flambeau Flowage.

Please provide me with any comments that you might have by January 5, 2012. Should you have any questions concerning this report, feel free to contact me by telephone at (715) 737-1353 or by electronic mail at matthew.j.miller@xcelenergy.com.

Sincerely,

Matthew J. Miller

Matthew J. Miller
Hydro Licensing Specialist

Enclosure: 2011 Water Quality Monitoring Report

c: Jeff Scheirer – WDNR
Project Files

Document Content(s)