METHODS FOR DETERMINING VEGETATION & FISH HEALTH

Overview
Biodiversity is important in maintaining a healthy lake ecosystem. Biodiversity is considered to be a principle driver of ecosystem function and critical to ecosystem resilience and stability. A diverse ecosystem provides a number of services such as nutrient recycling, improved water quality, and increased recreational opportunities. Human disturbances often lead to a decrease in species diversity resulting in a weakening and/or loss of support to the ecosystem services provided by healthy biotic community.

The development of health assessment indices have provided a means in which natural resources managers can evaluate and monitor the health of a lake’s biological community to help focus restoration and preservation efforts. The species that make up a community vary in their tolerance to human disturbances, therefore, as the episodic and cumulative disturbances occur to a system a decrease in species richness and a shift to species that are very tolerant to disturbance. Assessment tools developed by the MnDNR use these tolerance differences to relate the relative health of a given lake. Specifically, different sets of tools have been developed to relate the health of the fish community (Fish IBI) and another set of tools for the vegetation community (FQI).

Floristic Quality Index
The Floristic Quality Index (FQI) is a vegetation health assessment tool that is based on a metric of species richness and a Coefficient of Conservatism (C), which is a score (0 -10) that relates a species site fidelity and tolerance to disturbance. Thus, species that have narrow habitat ranges and/or low tolerance to stress have high C-values. Therefore, the more species observed in a lake and the greater the C-values the greater the system health.

FQI assessment was designed to allow for health assessment from various community sampling techniques. Three different survey methods can be used: Minnesota Biological Survey methods, MnDNR transects or point intercept surveys (most common). All three methods have limitations yet all are relatively good at capturing and evaluating the health of the vegetation community.

Due to natural differences in species composition between deep and shallow lakes and ecoregions, two unique sets of thresholds were developed for FQI scoring for the North Central Hardwoods ecoregion (Table 1). The MnDNR has performed at least one survey and FQI assessment on all of the CRWD lakes presented in this appendix. Each lake report card shows the most recent FQI score for each lake and how it relates to the impairment thresholds presented in Table 1. It should be pointed out that the report cards only show FQI assessments conducted by the MnDNR, and therefore do not include any FQI assessments based on surveys performed by CRWD or other parties.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Deep</th>
<th>Shallow</th>
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</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>32.4</td>
<td>26.0</td>
</tr>
<tr>
<td>Impaired</td>
<td>18.6</td>
<td>17.7</td>
</tr>
</tbody>
</table>

Table 1: Minnesota Department of Natural Resources North Central Hardwoods ecoregion point intercept and transect sampling FQI impairment thresholds for deep and shallow lakes.

Fish Index of Biotic Integrity
The Fish IBI is comprised of multiple metrics that integrate aspects of species richness, community assemblage, and trophic composition. The combining of all individual metrics results in a single score that relates the relative health of the fish community with healthier systems having greater overall scores. Low scores are typically associated to imbalanced communities filled with tolerant species and high scores are typically received when communities are balanced and filled with intolerant species.

Fish IBI sampling includes trap and gill net surveys along with nearshore backpack electrofishing and beach seining. Together these various sampling gears are able to capture information from various habitats throughout a lake and also target all fish species.

Minnesota lakes that fall within lake classes 20 - 43 (Schupp lake classification) have been partitioned into four distinct Fish IBIs. Lake class groups are clustered together using eight lake attributes that account for the expected variability of a fish community due natural phenomenon (Table 2).

<table>
<thead>
<tr>
<th>Classification</th>
<th>Tool 2</th>
<th>Tool 4</th>
<th>Tool 5</th>
<th>Tool 7</th>
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</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>64</td>
<td>59</td>
<td>61</td>
<td>NA</td>
</tr>
<tr>
<td>Impaired</td>
<td>44</td>
<td>28</td>
<td>24</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 2: Minnesota Department of Natural Resources fish IBI tool classification.

Due to these expected differences and unique IBIs each tool has its own set of thresholds to generalize the relative health of a lake’s fish community (Table 3).

<table>
<thead>
<tr>
<th>Classification</th>
<th>Tool 2</th>
<th>Tool 4</th>
<th>Tool 5</th>
<th>Tool 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>64</td>
<td>59</td>
<td>61</td>
<td>NA</td>
</tr>
<tr>
<td>Impaired</td>
<td>44</td>
<td>28</td>
<td>24</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 3: Minnesota Department of Natural Resources impairment thresholds for fish IBI tools.

The MnDNR has performed Fish IBI assessments on six lakes throughout the CRWD: Cedar, Betsy, Louisa, Clearwater, School Section, and Bass. The lake report cards for each of these lakes present the Fish IBI score and how it relates to the impairment thresholds presented in Table 3.

More information on Fish IBI methodology can be found on the MnDNR’s website:
http://www.dnr.state.mn.us/waters/surfacewater_section/lake_ibi/index.html
ALBION LAKE

QUICK FACTS
- Littoral Area: 251 acres
- Residence Time: 1477 days
- Surface Area: 251 acres
- Subwatershed Area: 1,094 acres
- Maximum Depth: 9 feet
- Upstream Waters: None

Common Fish: Common carp, black bullhead
Dominant Vegetation: Sago pondweed
Invasive Species: Curly-leaf pondweed
Status: Impaired; TMDL Completed 2010

TO DO LIST
- Rough fish management
- AIS management
- Manage upstream loads

Fish Health (IBI)
- Impaired
- Supporting
*Fish IBI has not been assessed

Vegetation Health (FQI)
12.7
- Impaired
- Supporting
- Exceptional
*Sample date: 8/14/2015

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High
*Sediment release rate has not been assessed
ALBION LAKE

2019 Water Quality

Lake not sampled

Historic Water Quality

Albion - Historical TP [ug/l]

Albion - Historical Chl-a [ug/l]

Albion - Historical Secchi [m]
BASS LAKE

QUICK FACTS

- **Littoral Area**: 96 acres
- **Surface Area**: 222 acres
- **Subwatershed Area**: 796 acres
- **Maximum Depth**: 34 feet
- **Upstream Waters**: None

**Common Fish**: Bluegill, Northern Pike, Yellow Bullhead, Largemouth Bass

**Dominant Vegetation**: Currently obtaining vegetation info from DNR

**Invasive Species**: Currently obtaining vegetation info from DNR

**Status**: Not impaired

TO DO LIST

- Protect water quality
- Manage upstream loads
- AIS management and prevention

**Fish Health (IBI)**

- Impaired
- Supporting
- Exceptional

*Sample date: 8/09/2017

**Vegetation Health (FQI)**

- Impaired
- Supporting
- Exceptional

*Sample date: 8/10/2015

**Sediment P Release (mg/m²/day)**

- Low
- Moderate
- High

*Sediment release rate has not been assessed
CEDAR LAKE

QUICK FACTS
- Littoral Area: 315 acres
- Surface Area: 790 acres
- Subwatershed Area: 9,715 acres
- Maximum Depth: 108 feet
- Upstream Waters: Swartout, Albion, Henshaw

Common Fish: Bluegill, Northern Pike, Walleye, Largemouth Bass

Dominant Vegetation: Coontail, northern water milfoil, chara

Invasive Species: Eurasian water milfoil, curly-leaf pondweed

Status: Not Impaired

TO DO LIST
- AIS management
- Rough fish management in upstream lakes
- Manage upstream soluble P loads

Fish Health (IBI)
- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High

*Sample date: 6/14/2006
*Sample date: 8/17/2015
*Sediment release rate has not been assessed
CEDAR LAKE

2019 Water Quality

Historic Water Quality

Cedar - 2019 TP [ug/l]

Cedar - Historical TP [ug/l]

Cedar - 2019 Chl-a [ug/l]

Cedar - Historical Chl-a [ug/l]

Cedar - Secchi Depth [m]

Cedar - Historical Secchi Depth [m]
CLEAR LAKE

QUICK FACTS
- Littoral Area: 441 acres
- Residence Time: 686 days
- Surface Area: 529 acres
- Subwatershed Area: 6,801 acres
- Maximum Depth: 18 feet
- Upstream Waters: None

Common Fish: Northern Pike, Black Crappie, Walleye, Bluegill
Dominant Vegetation: Coontail
Invasive Species: Eurasian water milfoil, Curly-leaf pondweed
Status: Impaired, TMDL completed in 2009

TO DO LIST
- AIS Management
- Manage rough fish
- Manage upstream soluble P loads

Fish Health (IBI)
- Impaired
- Supporting

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High

*Sample date: 8/22/2017

*Sample date: 2009
CLEAR LAKE

2019 Water Quality

Historic Water Quality

Clear - 2019 TP [ug/l]

Clear - Historical TP [ug/l]

Clear - 2019 TP [ug/l]

Clear - Historical Chl-a [ug/l]

Clear - 2019 Secchi Depth [m]

Clear - Historical Secchi Depth [m]
CLEARWATER LAKE

QUICK FACTS

- **Littoral Area**: 1,596 acres
- **Surface Area**: 3,158 acres
- **Subwatershed Area**: 100,232 acres
- **Maximum Depth**: 73 feet
- **Upstream Waters**: Clearwater River, Augusta, Cedar, Otter, and Pleasant Lake

**Common Fish**
- Bluegill, Northern Pike, Walleye, Largemouth Bass, Yellow Bullhead

**Dominant Vegetation**
- Obtaining Recent Survey from DNR

**Invasive Species**
- Eurasian water milfoil, curly-leaf pondweed, zebra mussels

**Status**
- Not Impaired

TO DO LIST

▲ Protect water quality
▲ Manage upstream loads
▲ AIS management

Fish Health

<table>
<thead>
<tr>
<th>Status</th>
<th>IBI</th>
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<tbody>
<tr>
<td>Impaired</td>
<td>0</td>
</tr>
<tr>
<td>Supporting</td>
<td>45</td>
</tr>
<tr>
<td>Exceptional</td>
<td>64</td>
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*Sample date: 7/15/2008

Vegetation Health

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<tr>
<th>Status</th>
<th>FQI</th>
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<tbody>
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<td>Impaired</td>
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<tr>
<td>Supporting</td>
<td>18.6</td>
</tr>
<tr>
<td>Exceptional</td>
<td>32.4</td>
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</table>

*Sample date: 8/10/2015

Sediment P Release

<table>
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<tr>
<th>Level</th>
<th>(mg/m²/day)</th>
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<tbody>
<tr>
<td>Low</td>
<td>0</td>
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<tr>
<td>Moderate</td>
<td>3.3</td>
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<tr>
<td>High</td>
<td>7.5</td>
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*Sediment release rate has not been assessed
Grass Lake

Quick Facts:
- Littoral Area: 62 acres
- Surface Area: 71 acres
- Subwatershed Area: 101,508 acres
- Maximum Depth: 35 feet
- Upstream Waters: Clearwater Lake, Clearwater River, Bass Lake

Common Fish: Bluegill, Northern Pike, Yellow Bullhead

Dominant Vegetation: No Recent Survey

Invasive Species: Zebra Mussels

Status: Not Impaired

Fish Health (IBI):
- Impaired
- Supporting
- Exceptional

*Fish IBI has not been assessed

Vegetation Health (FQI):
- Impaired
- Supporting
- Exceptional

*Sediment release rate has not been assessed

*Sample date: 8/01/2005

To Do List:
- Protect water quality
- Manage upstream loads
- AIS Management
GRASS LAKE

2019 Water Quality

Lake not sampled
HENSHAW LAKE

QUICK FACTS
- Littoral Area: 271 acres
- Residence Time: 1,697 days
- Surface Area: 272 acres
- Subwatershed Area: 903 acres
- Maximum Depth: 8 feet
- Upstream Waters: None

Common Fish: Black Bullhead, Common Carp
Dominant Vegetation: Sago pondweed, Coontail, Bushy pondweed
Invasive Species: Curly-leaf pondweed
Status: Impaired, TMDL Completed 2010

TO DO LIST
- Rough fish management
- AIS management
- Internal load management study
- Manage upstream load

Fish Health (IBI): Impaired, Supporting
Vegetation Health (FQI): Impaired, Supporting, Exceptional
Sediment P Release (mg/m²/day): Low, Moderate, High

*Fish IBI has not been assessed
*Sample date: 8/26/2014
*Sediment release rate has not been assessed
2019 Water Quality

Lake not sampled
LITTLE MUD LAKE

QUICK FACTS

- **Littoral Area**: 25.1 acres
- **Residence Time**: 1299 days
- **Surface Area**: 37.4 acres
- **Subwatershed Area**: 294 acres
- **Maximum Depth**: 42 feet
- **Upstream Waters**: None

**Common Fish**: No Recent Survey

**Dominant Vegetation**: Coontail

**Invasive Species**: Eurasian watermilfoil

**Status**: Not Impaired

TO DO LIST

- Rough fish management
- AIS management
- Internal load management study
- Manage upstream load

**Fish Health (IBI)**

- *Fish IBI has not been assessed*

**Vegetation Health (FQI)**

- *Vegetation FQI has not been assessed*

**Sediment P Release (mg/m²/day)**

- *Sediment release rate has not been assessed*

Below the map, data on various lake characteristics is displayed in tables and charts.
2019 Water Quality

Lake not sampled

Historic Water Quality

**TP (ug/L)**

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**Chlorophyll-a (ug/L)**

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**Secchi Depth (m)**

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Growing Season Average

Deep Lake Standard
**LAKE AUGUSTA**

**QUICK FACTS**
- **Littoral Area:** 65 acres
- **Residence Time:** 55 days
- **Surface Area:** 187 acres
- **Subwatershed Area:** 62,936 acres
- **Maximum Depth:** 82 feet
- **Upstream Waters:** Caroline, Louisa, Marie
- **Common Fish:** Bluegill, Northern Pike, Crappie, Yellow Bullhead, Common Carp
- **Dominant Vegetation:** No species was dominant (>50% occurrence)
- **Invasive Species:** Eurasian water milfoil, curly-leaf pondweed, zebra mussels
- **Status:** Impaired, TMDL completed in 2010

**TO DO LIST**
- Manage upstream loads
- AIS management

**Fish Health (IBI)**
- Impaired
- Supporting
- Exceptional
  - 0
  - 45
  - 64
  - 100
  - *Sample date: 7/28/2017*

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional
  - 0
  - 18.6
  - 32.4
  - 4.5
  - *Sample date: 9/6/2016*

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High
  - 0
  - 3.3
  - 7.5
  - *Sample date: 2010*
LAKE BETSY

QUICK FACTS

- Littoral Area: 90 acres
- Residence Time: 33 days
- Surface Area: 154 acres
- Subwatershed Area: 43,789 acres
- Maximum Depth: 29 feet
- Upstream Waters: Clearwater River

Common Fish: Channel Catfish, Northern Pike, Black Crappie, Bluegill, Common Carp

Dominant Vegetation: Coontail, Curly-leaf pondweed

Invasive Species: Curly-leaf pondweed

Status: Impaired, TMDL completed in 2009

LAKE BETSY

TO DO LIST

▲ Rough fish management
▲ Internal load reduction study and implementation
▲ Manage upstream loads
▲ AIS management

Fish Health (IBI)

- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)

- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)

- Low
- Moderate
- High

*Sample date: 7/27/2012
*Sample date: 8/22/2017
*Sample date: 2009
LAKE BETSY

2019 Water Quality

Historic Water Quality

Betsy - 2019 TP [ug/l]

Betsy - Historical TP [ug/L]

Betsy - 2019 Chl-a [ug/L]

Betsy - Historical Chl-a [ug/L]

Betsy - 2019 Secchi Depth [m]

Betsy - Historical Secchi [m]
LAKE CAROLINE

QUICK FACTS
- Littoral Area: 46 acres
- Residence Time: 26 days
- Surface Area: 135 acres
- Subwatershed Area: 60,132 acres
- Maximum Depth: 45 feet
- Upstream Waters: Louisa, Marie

Common Fish: Black Crappie, Bluegill, Northern Pike, Largemouth Bass, Common Carp, Walleye, White Sucker

Dominant Vegetation: No Recent Survey

Invasive Species: Curly-leaf pondweed, Eurasian watermilfoil

Status: Impaired, TMDL completed in 2010

TO DO LIST
- Manage upstream loads
- AIS management
- Internal load management study

Fish Health (IBI)
- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High

*Fish IBI has not been assessed
*Sample date: 6/28/2005
*Sediment release rate has not been assessed
LAKE CAROLINE

2019 Water Quality

Historic Water Quality

Lake not sampled
LAKE LOUISA

QUICK FACTS

- Littoral Area: 122 acres
- Residence Time: 17 days
- Surface Area: 189 acres
- Subwatershed Area: 58,881 acres
- Maximum Depth: 44 feet
- Upstream Waters: Clearwater River, Lake Betsy

Common Fish: Bluegill, Northern Pike, Largemouth Bass, White Sucker

Dominant Vegetation: Coontail

Invasive Species: Curly-leaf pondweed

Status: Impaired, TMDL Completed 2009

TO DO LIST

- Manage upstream loads
- AIS management
- Internal load management study

LAKE LOUISA Status: Impaired, TMDL Completed 2009

Fish Health (IBI)

- Impaired
- Supporting 64
- Exceptional 100

Vegetation Health (FQI)

- Impaired
- Supporting 32.4
- Exceptional

Sediment P Release (mg/m²/day)

- Low
- Moderate 3.3
- High 7.5

*Sample date: 8/17/2006
*Sample date: 6/20/2005
*Sediment release rate has not been assessed
*Sample date: 2003

▲ Manage upstream loads
▲ AIS management
▲ Internal load management study
LAKE LOUISA

2017 Water Quality

Louisa - 2019 TP [ug/l]

[Graph showing TP [ug/l] data for 2019 with Deep Lake Standard]

Louisa - 2019 Chl-a [ug/l]

[Graph showing Chl-a [ug/l] data for 2019 with Deep Lake Standard]

Louisa - 2019 Secchi Depth [m]

[Graph showing Secchi Depth [m] data for 2019 with Deep Lake Standard]

Historic Water Quality

Louisa - Historical TP [ug/l]

[Graph showing Historical TP [ug/l] data with Deep Lake Standard and linear trend]

Louisa - Historical Chl-a [ug/l]

[Graph showing Historical Chl-a [ug/l] data with Deep Lake Standard and linear trend]

Louisa - Historical Secchi Depth [m]

[Graph showing Historical Secchi Depth [m] data with Deep Lake Standard and linear trend]
LAKE MARIE

QUICK FACTS
- Littoral Area: 107 acres
- Residence Time: 24 days
- Surface Area: 146 acres
- Subwatershed Area: 59,837 acres
- Maximum Depth: 36 feet
- Upstream Waters: Clearwater River, Louisa

- Common Fish: Black Crappie, Bluegill, Northern Pike, White Sucker, Yellow Perch
- Dominant Vegetation: Coontail, Canadian waterweed
- Invasive Species: Curly-leaf pondweed
- Status: Impaired, TMDL Completed 2009

TO DO LIST
- Manage upstream loads
- AIS management
- Internal load management study

Fish Health (IBI)
- Impaired
- Supporting

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Impaired
- Supporting
- Exceptional

Lake Marie
Common Fish
Dominant Vegetation
Invasive Species
Status

Fish Health
Vegetation Health
Sediment P Release
**NIXON LAKE**

**QUICK FACTS**
- Littoral Area: 33 acres
- Surface Area: 60 acres
- Subwatershed Area: 690 acres
- Maximum Depth: 67 feet
- Upstream Waters: None

**Common Fish**
- Bluegill, Northern Pike, Yellow Bullhead, Largemouth Bass

**Dominant Vegetation**
- Currently obtaining vegetation info from DNR

**Invasive Species**
- Currently obtaining vegetation info from DNR

**Status**
- Not Impaired

**TO DO LIST**
- Protect water quality
- Manage upstream loads
- AIS management and prevention

**Surface Area**: 60 acres  
**Subwatershed Area**: 690 acres  
**Maximum Depth**: 67 feet  
**Upstream Waters**: None

**Fish Health (IBI)**
- **Impaired**
- **Supporting**

*Fish IBI has not been assessed*

**Vegetation Health (FQI)**
- **Impaired**
- **Supporting**
- **Exceptional**

*Vegetation FQI has not been assessed*

**Sediment P Release (mg/m²/day)**
- **0**
- **3.3**
- **7.5**

*Sediment release rate has not been assessed*
2019 Water Quality

Lake not sampled

Historic Water Quality

TP

Growing Season Average
Deep Lake Standard

Chlorophyll-a

Growing Season Average
Deep Lake Standard

Secchi Depth

Growing Season Average
Deep Lake Standard
OTTER LAKE

QUICK FACTS

- Littoral Area: 32 acres
- Surface Area: 92 acres
- Subwatershed Area: 10,574 acres
- Maximum Depth: 51 feet
- Upstream Waters: Lake Laura

- Common Fish: Black Crappie, Bluegill, Northern Pike, Largemouth Bass, Walleye
- Dominant Vegetation: Diverse community
- Invasive Species: Curly-leaf pondweed, Eurasian water milfoil
- Status: Not impaired

TO DO LIST

- Protect water quality
- Manage upstream loads

Fish Health (IBI)

- Impaired
- Supporting
- Exceptional

Vegetation Health (FQI)

- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)

- Low
- Moderate
- High

*Fish IBI has not been assessed
*Sample date: 8/15/2011
*Sediment release rate has not been assessed
OTTER LAKE

**2019 Water Quality**

Lake not sampled

**Historic Water Quality**

- **TP (ug/L)**
  - Growing Season Average
  - Deep Lake Standard

- **Chlorophyll-a (ug/L)**
  - Growing Season Average
  - Deep Lake Standard

- **Secchi Depth (m)**
  - Growing Season Average
  - Deep Lake Standard
**PLEASANT LAKE**

**QUICK FACTS**
- **Littoral Area**: 260 acres
- **Surface Area**: 597 acres
- **Subwatershed Area**: 4,325 acres
- **Maximum Depth**: 74 feet
- **Upstream Waters**: None

**Common Fish**: Bluegill, Yellow Bullhead, Northern Pike, Pumpkinseed Sunfish

**Dominant Vegetation**: Curlyleaf, Coontail, chara species, Eurasian watermilfoil

**Invasive Species**: Currently obtaining vegetation info from DNR

**Status**: Not impaired

**TO DO LIST**
- Manage watershed loads
- Protect water quality
- Operate outlet to minimize flooding

**Fish Health (IBI)**
- Impaired
- Supporting
- Exceptional
- *Fish IBI has not been assessed*

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional
- 31.2

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High
- 7.5

*Sample date: 8/21/2017*

*Sediment release rate has not been assessed*
2019 Water Quality

Historic Water Quality

Pleasant - 2019 TP [ug/l]

Pleasant - Historical TP [ug/l]

Pleasant - 2019 Chl-a [ug/l]

Pleasant - Historical Chl-a [ug/l]

Pleasant - 2019 Secchi Depth [m]

Pleasant - Historical Secchi [m]
**SCHOOL SECTION LAKE**

**QUICK FACTS**
- **Littoral Area**: 188 acres
- **Surface Area**: 193 acres
- **Subwatershed Area**: 1,843 acres
- **Maximum Depth**: 12 feet
- **Upstream Waters**: None

**Common Fish**
- Black bullhead, Bluegill, Northern Pike

**Dominant Vegetation**
- Northern water milfoil, Illinois pondweed, muskrass

**Invasive Species**
- Curly-leaf pondweed

**Status**: Not impaired

**TO DO LIST**
- Operate outlet to minimize flooding
- Protect water quality

**Fish Health (IBI)**
- Impaired
- Supporting
- Exceptional
- Sample date: 8/18/2008

**Vegetation Health (FQI)**
- Impaired
- Supporting
- Exceptional
- Sample date: 8/11/2011

**Sediment P Release (mg/m²/day)**
- Low
- Moderate
- High
- *Sediment release rate has not been assessed*
SCOTT LAKE

QUICK FACTS

- Littoral Area: 52 acres
- Residence Time: 12 days
- Surface Area: 80 acres
- Subwatershed Area: 51,000 acres
- Maximum Depth: 23 feet

Upstream Waters: Clearwater River, Lake Betsy, Union Lake

- Common Fish: Black Crappie, Bluegill, Channel Catfish, White Sucker
- Dominant Vegetation: No Recent Survey
- Invasive Species: Curly-leaf pondweed
- Status: Impaired, TMDL Completed 2009

TO DO LIST

▲ Rough fish management
▲ Manage upstream loads
▲ Internal load management study

Legend:
- Monitoring Locations
- Inflow
- Outflow
- Subwatershed

**Fish Health (IBI)**

<table>
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<th>Supporting</th>
<th>Exceptional</th>
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<tr>
<td>13.3</td>
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*Fish IBI has not been assessed*

**Vegetation Health (FQI)**

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<tbody>
<tr>
<td>0</td>
<td>18.6</td>
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*Sample date: 7/28/1997*

**Sediment P Release (mg/m²/day)**

<table>
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<tbody>
<tr>
<td>0</td>
<td>3.3</td>
<td>7.5</td>
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</table>

*Sample date: 2010*
2019 Water Quality

Lake not sampled

Historic Water Quality

Scott - Historical TP [ug/l]

Scott - Historical Chl-a [ug/l]

Scott - Historical Secchi Depth [m]
SWARTOUT LAKE

QUICK FACTS
- Littoral Area: 171 acres
- Residence Time: 460 days
- Surface Area: 171 acres
- Subwatershed Area: 5,551 acres
- Maximum Depth: 12 feet
- Upstream Waters: Henshaw, Albion

Common Fish: Black Bullhead, Black Crappie, Common Carp
Dominant Vegetation: Coontail, sago pondweed, bushy pondweed
Invasive Species: Curly-leaf pondweed
Status: Impaired, TMDL Completed 2010

TO DO LIST
- AIS management
- Rough fish management
- Manage upstream loads

Fish Health (IBI)
- Impaired
- Supporting
*Fish IBI has not been assessed

Vegetation Health (FQI)
- Impaired
- Supporting
- Exceptional

Sediment P Release (mg/m²/day)
- Low
- Moderate
- High
*Sample date: 2/22/2018

*Sample date: 8/14/2015
2019 Water Quality

Lake not sampled

Historic Water Quality

Swartout - Historical TP [ug/l]

Swartout - Historical Chl-a [ug/l]

Swartout - Historical Secchi Depth [m]
UNION LAKE

QUICK FACTS

- **Littoral Area**: 27 acres
- **Residence Time**: 291 days
- **Surface Area**: 93 acres
- **Subwatershed Area**: 4,741 acres
- **Maximum Depth**: 35 feet
- **Upstream Waters**: None

**Common Fish**
- Black Crappie, Bluegill, Northern Pike, Largemouth Bass

**Dominant Vegetation**
- Coontail, curly-leaf pondweed, sago pondweed

**Invasive Species**
- Curly-leaf pondweed

**Status**
- Impaired, TMDL Completed 2009

TO DO LIST
- Manage upstream loads

Fish Health (IBI)

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*Fish IBI has not been assessed

Vegetation Health (FQI)

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<th>Supporting</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>18.6</td>
<td>32.4</td>
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*Sample date: 6/17/2016

Sediment P Release (mg/m²/day)

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<th></th>
<th>Low</th>
<th>Moderate</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>3.3</td>
<td>7.5</td>
</tr>
</tbody>
</table>

*Sediment release rate has not been assessed