

# UPPER MISSISSIPPI RIVER RESTORATION

# **POST-CONSTRUCTION**

# PERFORMANCE EVALUATION REPORT

2014

FOR

**BANNER MARSH** 

HABITAT REHABILITATION AND ENHANCEMENT PROJECT



US Army Corps of Engineers ® Rock Island District LA GRANGE POOL

RIVER MILES 138.5 – 143.9

FULTON & PEORIA COUNTIES, ILLINOIS

#### ACKNOWLEDGEMENTS

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# **EXECUTIVE SUMMARY**

**General.** The design of the Banner Marsh Habitat Rehabilitation and Enhancement Project (HREP) was to provide the physical conditions necessary to improve and enhance wetland habitat quality. As stated in the Definite Project Report, the Banner Marsh HREP was undertaken to address the following primary problem: loss of habitat for migratory waterfowl and local wildlife due to agricultural and mining activities over the past century.

Purpose. The purposes of this Performance Evaluation Report (PER) are as follows:

- 1. Document the pre- and post-construction monitoring activities for the Banner Marsh HREP
- 2. Summarize and evaluate project performance on the basis of project goals and objectives as stated in the Definite Project Report (DPR)
- 3. Summarize project operation and maintenance efforts, to date
- 4. Provide recommendations concerning future project performance evaluation
- 5. Share lessons learned and provide recommendations concerning the planning and design of future HREP projects

Project Goals and Objectives. The specific goals and objectives as stated in the DPR were to:

- 1. Enhance Wetland Habitat
  - a. Increase littoral zone for ducks and fish
  - b. Improve flood control reliability
- 2. Enhance Terrestrial Habitat
  - a. Increase food and cover for terrestrial birds and mammals
- 3. Enhance Aquatic Habitat
  - a. Increase Diversity in Aquatic Habitat

**Project Performance Monitoring.** Pre- and post-project monitoring, both qualitative and quantitative, was performed in accordance with the Section 14, Project Performance Assessment, from the original DPR. Monitoring and performance evaluation was conducted by the U.S. Army Corps of Engineers, and Illinois Department of Natural Resources. The period of data collection covered in this report includes quantitative and qualitative post-project monitoring through 2013, and anecdotal information through 2013.

**Evaluation of Project Objectives.** For the evaluation period of 2004 to 2013, observations were made with regard to the efficacy of the objectives in meeting project goals. In addition, general conclusions were drawn regarding project measures that may affect future project design.

Overall, the HREP is performing as designed. Water quality is excellent, as indicated by pH, dissolved oxygen and water clarity values. Abundant aquatic vegetation is present; essentially all locations in the HREP with water have aquatic vegetation present. However, invasive species, such as Phragmites and Eurasian watermilfoil, have gained a dominant foothold.

Abundant waterfowl have been observed, including several sets of Mute Swans. Relative stocking density has increased for larger fish, and the fishery has remained stable. The native grass plantings have remained intact, with little observed invasive species encroachment. The plantings provide excellent cover for nesting waterfowl.

The flood control measures are performing adequately. The pump station's original issues with cavitation have been resolved, although condensation issues still remain. Water control stoplogs are difficult to use and leak, but the levee has performed well during flood events.

**Evaluation of Project Operation and Maintenance.** The Operation and Maintenance (O&M) manual was completed in January 2005. Periodic maintenance is required on the pump station, stoplogs structure, levee access road, littoral zones and planting sites. O&M costs to date were not provided by the Illinois Department of Natural Resources.

# UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT

#### 2013

#### **BANNER MARSH**

# HABITAT REHABILITATION AND ENHANCEMENT PROJECT LAGRANGE POOL ILLINOIS RIVER MILES 138.5 – 143.9 FULTON & PEORIA COUNTIES, ILLINOIS

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# UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM POST-CONSTRUCTION PERFORMANCE EVALUATION REPORT

#### 2014

#### **BANNER MARSH**

#### HABITAT REHABILITATION AND ENHANCEMENT PROJECT

#### LAGRANGE POOL

#### ILLINOIS RIVER MILES 138.5-143.9

#### **FULTON & PEORIA COUNTIES, ILLINOIS**

#### INTRODUCTION

The Upper Mississippi River Restoration Program (UMRR) is a Federal-State partnership to manage, restore and monitor the UMR ecosystem. The UMRR-EMP was authorized by Congress in Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) and reauthorized in 1999. Subsequent amendments have helped shape the two major components of EMP – the Habitat Rehabilitation and Enhancement Projects (HREPs) and Long Term Resource Monitoring (LTRM). Together, HREPs and LTRM are designed to improve the environmental health of the UMR and increase our understanding of its natural resources.

Habitat Rehabilitation and Enhancement Project (HREP) construction is one element of the UMRR-EMP. In general, the projects provide site-specific ecosystem restoration, and are intended and designed to counteract the adverse ecological effects of impoundment and river regulation through a variety of modifications, including flow introductions, modification of channel training structures, dredging, island construction, and water level management. Interagency, multi-disciplinary teams work together to plan and design these projects.

The Banner Marsh HREP (Banner Marsh) is part of the UMRR. This project consisted of repair of the existing levee, rehabilitation of the existing pump station, repair to the pump station service road, installation of two water control structures, littoral zone grading and native grass planting, that were designed to enhance wetland, aquatic and terrestrial habitat.

#### 1. Purpose of Project Evaluation Reports

The purposes of this Project Evaluation Report for the Banner Marsh HREP are to:

1. Document the pre and post-construction monitoring activities for the Banner Marsh HREP

- 2. Summarize and evaluate project performance on the basis of project goals and objectives as stated in the Definite Project Report (DPR)
- 3. Summarize project operation and maintenance efforts, to date
- 4. Provide recommendations concerning future project performance evaluation
- 5. Share lessons learned and provide recommendations concerning the planning and design of future HREP projects

# 2. Scope

This report summarizes available monitoring data, operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) information, and project observations made by the U.S. Army Corps of Engineers (USACE), and Illinois Department of Natural Resources (IL DNR). The period of data collection covered in this report includes the pre-construction monitoring 1995 to post-construction monitoring as of 2013.

# 3. Project References

Published reports which relate to the Banner Marsh HREP are presented below.

- Banner Marsh State Fish and Wildlife Area, Upper Mississippi River System Environmental Management Program, Definite Project Report (R-11PR) with Integrated Environmental Assessment, LaGrange Pool, Illinois Waterway, September 1995.
- Banner Marsh State Fish and Wildlife Area, Upper Mississippi River System Environmental Management Program, Post Construction Initial Performance Evaluation Report (IPER), LaGrange Pool, Illinois Waterway River Miles 138.5 – 143.9, September 2002.
- 3. Banner Marsh HREP Operation and Maintenance Manual, LaGrange Pool, Illinois Waterway River Miles 138.5 143.9, January 2005.
- 4. Banner Marsh State Fish and Wildlife Area, Upper Mississippi River System Environmental Management Program, 2 Year Post Construction Addendum to Initial Performance Evaluation Report, LaGrange Pool, Illinois Waterway, January 2004.

# 4. Project Location

Banner Marsh is located in Fulton and Peoria Counties, Illinois, on the right descending bank of the Illinois River, between river miles 138.5 and 143.9 (Figure 1 – Banner Marsh HREP project area). The project is operated by the IL DNR and is located in the 5,524 acre Banner Marsh State Fish and Wildlife Area. The town of Kingston Mines is located 1.5 miles east of the project area.



Figure 1. Banner Marsh HREP Project Area

# PROJECT PURPOSE

# 1. Overview

The design of the Banner Marsh HREP was to provide the physical conditions necessary to improve and enhance wetland, aquatic and terrestrial habitat quality. The specific objectives as stated in the Definite Project Report (DPR) were to: increase flood control reliability, increase food and cover for terrestrial fauna, increase the littoral zone and increase diversity in the aquatic habitat. In order to achieve these goals, the decrease in the areas of habitat at the site needed to be addressed. The problems, opportunities, goals, objectives and measures implemented to address the goals and objectives are listed in Table 1.

# Table 1. Problems, goals, objectives, and measures

PROBLEMS	GOALS	OBJECTIVES	RESTORATION MEASURES		
Land use changes over past century leading to loss of wetland, terrestrial and aquatic habitat	Enhance Wetland Habitat	Increase littoral zone	Provide reliable water control/source for contiguous channels.		
		Improve flood control reliability	Clear and stabilize levee. Pump Station rehabilitation.		
	Enhance Terrestrial Habitat	Increase food and cover	Plant native warm season grasses.		
	Enhance Aquatic Habitat	Increase diversity	Littoral zone grading.		

# PROJECT DESCRIPTION

# 1. Project Measures

Banner Marsh included a combination of littoral zone grading, levee and pump station repair, water control structures and prairie plantings (see Figure 2 for locations of measures). A detailed description of each of these measures is provided below.

- 1. <u>Levee Improvement</u>. The existing levee slopes were restored to their original condition with a 2.5 horizontal feet on 1 vertical foot slope. Riprap was placed on selected reaches of the levee that were historically vulnerable to scouring.
- 2. <u>Pump Station Rehabilitation</u>. The pump station was originally constructed in the early 1900's. Rehabilitation of the pump station included:
  - New electrical transformers, service entrance, breakers lighting
  - New roof, siding, doors, and insulation
  - Repair of brick foundation
  - New concrete cap
  - New concrete floor overlay
  - New decking and stairs over forebay
  - New trashrack

• New 24 inch discharge pipe and flap gate for existing 24 inch Couch pump.

After rehabilitation, a new 48-inch submersible pump manufactured by EBARA Corp. was installed with new controllers, a discharge can, and approximately 30 feet of new pipe. The new pipe was attached to the existing 48-inch pipe where it enters the levee. A new flap gate was installed on the existing pipe. This new pump is used primarily for backup pumping or during periods of extended precipitation, when the smaller pump is unable dewater the marsh.

The rated capacity of the 24-inch 100-horsepower pump is 13,600 gallons per minute at a 21.0-foot total hydraulic head with 885 revolutions per minute. The rated capacity of the 48-inch 265-horsepower pump is 39,000 gallons per minute at a 15.2-foot total dynamic head with 710 revolutions per minute. Primary pumping is performed with the 24-inch pump and backup pumping is performed with the 48inch pump. Simultaneous pumping can be performed with both pumps, although they are electrically interlocked to prevent simultaneous start-up and early re-start. The pump station is operated automatically with manual override for both pumps. The electric service provided to the pump station building is 480-volt, 800-amp, three-phase power.

If automatic mode is used the pump station will start evacuating the HREP when the water level exceeds 431.0 and will continue pumping until the water level drops to elevation 430.0, at which time the 48-inch pump will automatically stop. The 24-inch pump will continue operation until it stops at elevation 429.0. With the pump controls remaining in the "AUTO" position, the pump station will automatically turn on the 24-inch pump at water elevation 430.0 and the 48-inch pump at water elevation 431.0. If either "pump off" float should fail, the pumps will automatically shut off by a "Low Water" float at elevation 428.0.

The pump station was furnished with a new galvanized steel trash rack and platform grating. The trash rack bar openings are spaced at 2.5 inches center-to-center. The sump and location of the 48-inch pump were modified from the original plans due to an unforeseen submerged foundation footing and a formed suction intake from the original construction of the pump station.

Both pumps are located within a building that is refurbished steel framed, insulated, and sided. Discharge pipes slope downward through the levee section to a riprapped discharge apron. Each pipe is equipped with a flap gate and a combination air/vacuum relief valve. Staff gages were permanently installed on the riverside slope of the levee. The reference elevation for the forebay was marked to be the inside bottom steel channel of the floatwell, elevation 432.14 feet.

3. <u>Service Road Repair</u>. Bell's Landing Road was raised to a constant elevation of 439.0 feet. A 24-foot wide shoulder extends out beyond the power poles to allow service

trucks and personnel access to the power lines without having to reach across water.

- 4. <u>Water Control Structures</u>. There are two corrugated metal pipe stoplog structures. Each structure consists of a 48-inch horizontal inlet pipe, a 60-inch vertical riser pipe with 4-inch stoplog slots, and a 48-inch horizontal outlet pipe. Each structure is provided with 25 stoplogs, a lifting hook, and a lockable, hinged metal grating cover. Pipe bollards protect the structures from vehicular damage. Staff gages installed upstream of each structure provide accurate water level measurement. The structures are designed to allow water levels to be varied within an 8-foot range between fully open and fully closed.
- 5. <u>Littoral Zone/Contour Grading.</u> Littoral zone grading occurred as a result of controlled borrow operations. Approximately 35 acres of borrow area were excavated to an unknown depth. The design called for excavation of the borrow areas to an elevation of 433.5, but the borrow areas where never surveyed. According to the design, the areas were to be re-flooded to water elevation 435, as to provide the desired 18 inches of water depth.
- 6. <u>Native Grass Planting.</u> Sites were selected for prairie planting in the southwest quadrant of the project area. Approximately 144 acres were planted. Herbicide treatments were conducted in April and May 2003. Only 100 of the 144 acres were disked before seeding. Disking, seeding and mulching were conducted in late May 2003. Species were intermixed to avoid solid blocks of individual species. Native grass species such as Big Bluestem and Prairie Dropseed were planted, as well as forbes such as Milk Vetch and Purple Coneflower. A complete listing of plant species and seeding rates is included in the January 2005 Operation and Maintenance Manual.

# 2. Project Construction

The Banner Marsh HREP was approved for construction in January 1998 at a cost of \$5,062,154 (equivalent to \$7,373,757 in FY14). The Stage 1 Contract was awarded in March 1998 and consisted of levee rehabilitation and service road repair and was completed in April 1999. Stage II was awarded in September 1999 and consisted of pump station repair, riprap placement water control structure placement. Stage II was completed in July 2001. The Stage III Contract was awarded in March 2003 and consisted of disking, seeding and mulching activities, and was completed in May 2003. Management criteria for the interior of the wildlife unit were changed by the sponsor after the contract was awarded. The water levels in the wildlife area were raised during construction, which did not match criteria in the original contract specifications. According to the original design, the area would be re-flooded to water elevation 435 to provide the desired 18 inches of water depth; however, the IL DNR is currently maintaining a water depth of approximately three feet.



Figure 2. Banner Marsh HREP Project Features

# 3. Project Operation and Maintenance

<u>General.</u> Operation and maintenance responsibilities for Banner Marsh were originally outlined in the DPR. The acceptance of these responsibilities was formally recognized by an agreement signed by the IL DNR and the Rock Island District, USACE.

A detailed description of all operation and maintenance requirements can be found in the Project Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual (OMRR&R Manual). The OMRR&R Manual for the project delegated responsibilities and procedures for post project activities. Project operation and maintenance generally consists of the following:

- 1. Advance measures ensuring availability of labor and materials.
- 2. Project Inspections conducted annually each May.
- 3. Inspection of levees during periods of high water.
- 4. Maintain levee sod cover, profile, control excess vegetation.
- 5. Operate pump station to control water levels in wildlife management area.
- 6. Periodically inspect pump station. Inspect after high water events.
- 7. Conduct preventive and corrective action activities at pump station.
- 8. Addition or removal of stoplogs in water control structures as required to maintain desired water levels in wildlife management area.
- Inspection of water control structures immediately following drainage of wildlife management area and after high water event for damage and seepage. Conduct periodic inspections of Stoplog Structure. Conduct corrective action activities based on inspections.
- 10. Periodically inspect pump station service road, and conduct corrective action based on inspections.
- 11. Periodically inspect prairie plantings, mow and burn based on inspections.

<u>Project Measures Requiring Operation and Maintenance.</u> Maintenance of the project measures was to be completed on an as needed basis to maintain their structural integrity and continued function in the manner for which they were designed. The main measures in need of repair are the water control structures. The structures are difficult to use and leak due to beaver damage.

# **PROJECT PERFORMANCE MONITORING**

# 1. General

Performance monitoring of Banner Marsh has been conducted by USACE to help determine the extent to which the design meets the habitat improvement objectives. Information from this monitoring will also be used, if required, for adaptive management.

The monitoring and performance evaluation matrix is outlined in Table 2. Pre- and post-project monitoring, both qualitative and quantitative by each of the involved agencies is summarized below.

1. <u>U.S. Army Corps of Engineers</u>: The success of the project relative to original project objectives shall be measured utilizing data, field observations, and project inspections

provided by IL DNR and USACE. The Corps of Engineers is responsible for post-project analyses of water quality and vegetation. The Corps of Engineers has overall responsibility to measure and document project performance.

2. <u>Illinois Department of Natural Resources</u>: The IL DNR is responsible for operating and maintaining the Banner Marsh HREP.

Table 2.	Monitoring and	Performance	<b>Evaluation Matrix</b>
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Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Problem Analysis	System-wide problem definition. Evaluates planning assumptions	Sponsor	Sponsor	Sponsor	Leads into pre-project monitoring; defines desired conditions for plan formulation
Pre-project monitoring	Identifies and defines problems at HREP site. Established need for proposed project feature	Sponsor	Sponsor	Sponsor	Attempts to begin defining baseline. See DPR.
Baseline monitoring	Establishes baselines for performance evaluation	USACE	Field station or sponsor thru Cooperative Agreements or Corps	USACE	See DPR for location and sites for data collection and baseline information. Actual data collection will be accomplished during Plans & Specification phase.
Data Collection for Design	Includes identification of project objectives, design of project, and development of performance evaluation plan	USACE	USACE	HREP	Comes after fact sheet. This data aids in defining the baseline
Construction Monitoring	Assesses construction impacts; assess permit conditions are met	USACE	USACE	HREP	Environmental protection specifications to be included in construction contract documents. Inter-agency field inspections will be accomplished during project construction phase
Performance Evaluation Monitoring	Determine success of project as related to objectives	USACE (quantitative), sponsor (field observations)	USACE or sponsor thru Cooperative Agreements or Corps	HREP	Comes after construction phase of project
Analysis of Biological Responses to Project	Evaluates predictions and assumptions of habitat unit analysis. Determine critical impact levels, cause-effect relationships, and effect on long- term losses of significant habitat	USACE	USACE	HREP	Problem Analysis and Trend Analysis studies of habitat projects

# 2. Project-Induced Habitat Changes

The Banner Marsh HREP habitat conditions remain, as designed, and continue to provide aquatic, wetland and grassland habitat benefits.

# 3. Non-Project-Induced Habitat Changes

Phragmites (*Phragmites australis*) (Photo 1), an exotic plant, has gained a dominant foothold at Banner Marsh in many of the wetland areas near any open water. While the upland prairies are still intact, phragmites is found in the low areas near the prairies.



Photo 1. Phragmites australis

Eurasian watermilfoil (*Myriophyllum spicatum*) (Photo 2) is another invasive plant. This is a rooted submerged aquatic plant. Milfoil starts spring growth sooner than native aquatic plants and can shade out these beneficial plants. When milfoil invades new territory, typically the native species diversity of aquatic plants declines. While some species of waterfowl will eat milfoil, it is not considered to be a good food source. Milfoil reproduces extremely rapidly and can infest an entire lake within two years of introduction to the system.

The project's borrow areas are dominated by Eurasian watermilfoil.



Photo 2. Large beds of water milfoil dominates the vegetation community in this borrow site.

The invasive plant dilemma at Banner Marsh has a large impact on the HREP's overall goals. The phragmites and Eurasian watermilfoil dominance is out-competing the native vegetation. This is compounded by the reduction of the IL DNR's on-site management abilities in the last 10 years.

# **PROJECT EVALUATION**

# 1. Construction and Engineering

Construction began in 1999 and was completed in May 2003. Stage 1 and Stage II consisted of levee repairs, roadway repairs, pump station repairs, water control structures and littoral zone grading. Stage III consisted of native plant seeding.

Modification of construction plans included pump station sump area differing conditions, and levee repairs in some areas were not as major as anticipated.

#### 2. Costs

In the original DPR, cost estimates for the entirety of the project were \$4,378,343 (equivalent to \$6,821,280 in FY14). Initial construction costs were \$5,062,154 (equivalent to \$7,866,629 in

FY14). As of the 2014 Inspection Report, the total cost of the Banner Marsh HREP planning, design and construction was \$6,923,875 (equivalent to \$9,867,685 in FY14).

# 3. Operation and Maintenance

In the original DPR, over the 50-year project life the estimated cost was \$2,475,500. From the estimate, an average annual operation and maintenance cost was calculated to be \$49,510. This amount included pump station operation, inspections, pump replacement and maintenance, levee maintenance, planting maintenance and inlet channel dredging, and annual replacement of an estimated 140 tons of riprap. No information on total OMRR&R costs to date could be obtained from the sponsor.

# 4. Ecological Effectiveness

The Banner Marsh objectives and how they pertain to the ecological effectives of the project are discussed below. Table 3 summarizes the performance evaluation plan and schedule for the Banner Marsh goals and objectives.

# A. Increase Diversity in Aquatic Habitat

<u>General.</u> Littoral zone excavation and grading was a by-product of borrow operations. The littoral zone is important habitat for fish spawning, waterfowl and waterbird feeding and fish and waterfowl rearing. The Year 50 target is 106 acres of aquatic habitat less than 18 inches deep.

<u>Pre- and Post-Project Conditions.</u> Prior to construction, littoral zone habitat was very limited in Banner Marsh. The shear walls along the shoreline of the numerous ponds and lakes in Banner Marsh limited the fisheries potential because of the lack of shallow areas for spawning.

Water quality is excellent at Banner Marsh. Post-project water quality monitoring performed during the year 2013 at Banner Marsh indicates that conditions are acceptable to support aquatic life. In depth analysis of water quality data, including pH, alkalinity, dissolved oxygen, turbidity and total suspended solids is included in Appendix C (Water Quality). The primary water quality concern identified in the planning stages of the project was that acidic soils, a remnant of prior coal mining activities, could cause low pH values in areas where littoral zone grading occurred. This concern has been shown to be unwarranted, as none of the pH values observed during the monitoring period were low. It is possible that future runoff/erosion events could expose underlying acidic soils, but in light of several high rainfall years that have occurred since project completion, the current pH values, and the alkalinity (buffering capacity) that is present, it is unlikely that low pH problems will occur.

The stable water control and water clarity combine to produce an abundance of aquatic vegetation. While much of this vegetation is exotic water milfoil, there are other species such as pondweed (Potamogeton ssp.) (Photo 3), arrowhead (Sagittaria sp.), Willow (Salix sp.), and coontail (*Ceratophyllum demersum*) to name a few.



Photo 3. Long-leaf pondweed

Rob Hilsabeck, IL DNR biologist, has conducted plant surveys at Banner Marsh since project completion. These plant surveys are included in Appendix A, Vegetation Surveys.

<u>Conclusion.</u> The project measures continue to be successful providing aquatic diversity. Water clarity and vegetation (quantity and diversity) response is excellent. The most worrisome detail at Banner Marsh is the overabundance of invasive plant species. Local management efforts should focus on invasive plant control. Future project evaluations need to include field measurement of aquatic habitat acreage.

It is recommended that seasonal water quality monitoring be discontinued at Banner Marsh until evidence is presented that suggests a low pH problem may exist. Opportunities for uncovering future problems include observations by IL DNR personnel made during fisheries studies, and spot pH measurements by USACE Water Quality and Sedimentation Section personnel while working in the vicinity of the Banner Marsh HREP on other Illinois River water quality projects.

#### **B.** Increase Littoral Zone for Ducks

<u>General.</u> Littoral zone excavation and grading was a by-product of borrow operations. To allow for adequate management of water levels in the littoral zone, rehabilitation of the existing pumphouse and installation of water control structures was conducted. The Year 50 target for this objective is 350 acres of aquatic vegetation.

<u>Pre- and Post-Project Conditions.</u> Prior to construction, littoral zone habitat was very limited in the HREP. The shear walls along the shoreline of the numerous ponds and lakes in Banner Marsh limited the fisheries potential because of the lack of shallow areas for spawning. In addition, the dilapidated state of the existing pumphouse did not allow for proper management of water levels within the Banner Marsh leveed area.

The post construction conditions in 2013 remain useful to waterfowl. Several sets of mute Swans (*Cygnus olor*) (Photo 4) were utilizing the borrow areas for nesting, rearing of young, and feeding. In 2012, a paper (Stafford, Eichholz and Phillips, 2012) was published studying the exotic mute swans impact to wetlands through degradation of submerged aquatic vegetation (SAV) communities. The study found above-ground biomass of vegetation did not differ between exclosures and controls; however, mean below-ground biomass was greater in exclosures (52.0 g/m<sup>2</sup>, SE0 6.0) than in controls (34.4 g/m<sup>2</sup> SE0 4.0)



Photo 4. A mute swan family at Banner Marsh. Note the abundance of aquatic vegetation. Also note the phragmites in the background.

<u>Conclusion</u>. The project measures were successful in providing the ability to increase the littoral zone for ducks and fish based on the abundance of aquatic vegetation used by fish for spawning and rearing habitat and by waterfowl during the nesting and migration seasons. These benefits have not diminished yet the increase presence of invasive species threaten to impact the overall quality of the project. Future project evaluations need to include field measurement of littoral zone acreage.

# C. Increase Littoral Zone for Fish

The IL DNR conducts annual fish surveys at the various water bodies at Banner Marsh. Appendix B contains these annual reports. Since project construction in 2001, the Banner Marsh fishery has been stable. Since 2010, the relative stocking density for some species has continued to increase. The restriction of the largemouth bass harvest in 2000 (12-18" protected slot), availability of increased habitat, along with other variables, have contributed to this success despite other outside influences such as years with drought, years with high precipitation, and a colder than average winter in 2013-14.

#### D. Improve Flood Control Reliability

<u>General.</u> To provide flood protection to meet seasonal and annual reliability goals, restoration of the perimeter levee was conducted. The existing levee side slopes were restored to the original 2.5:1 slope, and riprap was placed on selected sections that were historically susceptible to scouring. The DPR listed the Year 50 target for this objective as zero lineal feet of eroded levee.

<u>Pre- and Post-Project Conditions.</u> The perimeter levee was constructed in the early 1900's as a 50 year flood protection measure. The levee materials were highly erosive, and required continual maintenance to resolve the ongoing erosion. Restoration of the levee was critical to maintain protection of Banner Marsh from Illinois River flooding.

The levee was restored with 2.5:1 slopes and with select areas of riprap. The level of protection that the levee provides is now above the 0.005 exceedance probability (200 year event). Related to flood control was the rehabilitation of the pump station and installation of water control structures conducted as part of the HREP construction. Managers inspect the levee, pump station and water control structures periodically, prior to and after flood events, and during maintenance activities.

HREP managers indicate no problems associated with the levee. The levee has performed adequately during recent flood events. The primary concern is the landside slope is too steep to mow in some areas. The pump station is performing adequately. Primary concerns at the pump station include condensation issues related to lack of building insulation, causing electronic malfunctions. In addition, floats are not operating correctly. The original 48-inch pump that cavitated has been replaced. The pump station uses the 24-inch pump primarily, with the 48-inch pump utilized as an auxiliary or during floods. Water control structures leak and are difficult to use, and are damaged frequently by beavers. No survey profiles of the levee were conducted during the evaluation period.

<u>Conclusion.</u> The project measures were mostly successful in improving flood control reliability based on anecdotal evidence provided by the HREP managers. While the levee is performing up to design standards and is preventing flooding of the HREP, issues remain with the pump station and water control structures. It is recommended that further investigation into solutions for these issues be conducted by a joint USACE/IL DNR team.

It is also recommend the metric for determining success be modified from the current objective of zero lineal feet of eroded levee. Instead, cross section and profile surveys should be conducted as to determine that the levee is still maintaining the 0.005 exceedance probability level of protection.

# E. Increase Food and Cover for Terrestrial Birds and Mammals

<u>General.</u> Approximately 144 acres of native prairie grasses were planted in upland areas surrounding the borrow areas. The grasses are to provide escape and nesting cover, and a

variety of food sources for upland birds and animals. The Year 50 target for this objective is 144 acres of native grasses.

<u>Pre- and Post-Project Conditions.</u> Prior to construction, the upland areas at Banner Marsh consisted primarily of brome grass and scattered honey locust, providing little to no habitat value.

During a 2013 site visit, the monitoring team observed successful warm season, native grass habitat in the once, monotypic brome fields. The site was comprised of the grasses little bluestem (*Andropogon scoparius*), big blue stem (*Andropogon gerardii*) (Photo 5), and Indian grass (*Sorghastrum nutans*). Although side oats gramma (*Bouteloua curtipendula*) was not found on this particular site visit, its presence is likely given the success of the other planted species. Another plant not observed was perennial ryegrass (*Lolium perenne*). This was used primarily as a cover crop on the site and is likely to be no longer growing on the site. A cover crop reduces soil erosion and will slow the growth of quick-to-grow invasive plants like thistle and cocklebur. Some of the forb species included False Sunflower (*Heliopsis helianthoides*) (Photo 6), Culver's Root (*Veronicastrum virginicum*) (photo 7), Gray-headed Coneflower (*Ratibida pinnata*) (photo 8), compass plant (*Silphium laciniatum*), rattlesnake master (*Eryngium yuccifolium*), and butterfly milkweed, (*Asclepias tuberose*) (photo 9), and Cup Plant (*Silphium perfoliatum*) (photo 10).



Photo 5. Big bluestem (Andropogon gerardii)



Photo 6. False Sunflower (Heliopsis helianthoides)



Photo 7. Culver's Root (Veronicastrum virginicum)



Photo 8. Gray-headed Coneflower (Ratibida pinnata)



Photo 9. Butterfly Milkweed, (Asclepias tuberose)



Photo 10. Cup plant (Silphium perfoliatum)

<u>Conclusion.</u> The project measures have provided outstanding terrestrial habitat meeting increased food and cover for birds and mammals. The prairie is providing excellent cover for nesting waterfowl. The prairie's location is near the borrow areas and adjacent to a wet swale. For their nesting requirements waterfowl like Mallards (*Anas platyrhynchos*) prefer this proximity to water. However, due to a loss of littoral nesting and rearing habitat at Banner Marsh due to invasive plant dominance, Mallard production has decreased over the years. In one study, there were not enough Mallards nesting at Banner Marsh to continue a long-term study (Yetter et al., 2009). Future project evaluations need to include field measurement of native plant acreage.

Goal	al Objective Enhancement Units		Monitoring Target Values			Feature Measurement	
				Year 0 without project	Year 11 with project	Year 50 target with project	Measurement
Wetland itat	Increase Littoral Zone for ducks and fish	Water Control Structures Littoral Zone Grading	Acres of aquatic vegetation	0	Not Measured*	350	Perform aerial surveys
Enhance Hab	Improve Flood Control Reliability	Levee Restoration	Lineal feet of eroded levee	22900	Not Measured*	0	Levee system transects, profiles and observations
Enhance Aquatic Habitat	Increase Diversity in Aquatic Habitat	Littoral Zone Grading	Acres of habitat < 18 inches deep	0	Not Measured*	106	Hydrographic Soundings
Enhance Terrestrial Habitat	Increase food and cover for terrestrial birds and mammals	Native warm season grasses	Acres of native grass	0	Not Measured*	144	Aerial Photography

# Table 3. Performance Evaluation and Monitoring Schedule

\*Quantitative analysis not conducted, qualitative analysis provided in Ecological Effectiveness section of this PER.

#### LESSONS LEARNED AND RECOMMENDATIONS FOR FUTURE SIMILAR PROJECTS

Exotic or invasive species management is becoming a critical obstacle to meeting our habitat management goals. Many of these wetland and aquatic species thrive in disturbed soils, are quick to root and grow, thereby out competing the native vegetation we generally plant or attempt to restore as part of our HREP projects.

Future management efforts will have to depend on minimal ground disturbance, an aggressive revegetation program, and an invasive species management plan to control the invasive plants for the life of the project.

Beaver damage has occurred to the wooden stoplogs at the Banner Marsh HREP, causing leakage and malfunctions. It is recommended that future stoplog structure designs incorporate a non-wood material for the stoplogs

Utilize the following from the 2012 Mississippi River Environmental Management Program Environmental Design Handbook:

1. Since HREPs are constructed in typically wet and potentially flooded areas, ensure that the hydraulic conditions at the site are clear in the contract specifications so that bidders are fully aware of "normal" conditions. Ensure that the contract specifications include a submittal for a detailed high water action plan. The plan should include procedures for rising high water and for dewatering after a high water event.

2. The existing pump station structure was modified as part of the HREP to install a new 48" submersible pump. The existing sump was modified and an antivortexing plate was installed prior to pump installation. The pump was factory tested but not to the low sump elevation level as specified. After installation, the pump developed a cavitation noise in the sump level operating range during operation of the pump, which has led to complete failure. As a result, heavy rains have caused localized flooding within the MSMU. It may also cause accelerated wear of pump components, thus shortening the expected service life of the pump. The pump was pulled for inspection and measurements with no conclusive findings. The pump was reinstalled with the cavitation noise present and a spare impeller was purchased for replacement in the future. The recommendation has been to continue using the pump as normal. Under normal operation, the 48" submersible pump is a backup that only turns on when the 24" service pump is unable to keep up. The 24" service pump can handle about 90% of the annual MSMU pumping requirements. 3. The 48" pump controller failed twice. The first failure was due to condensation in the pump controller cabinet, which caused a component in the soft start drive to fail. The condensation was caused when the power was turned off to the entire pump station by opening the main breaker. This made it impossible for the pump controller cabinet heater to function and condensation resulted. The Site Manager was instructed to not turn off the main breaker anymore. No O&M Manual was available at the time to provide instruction for pump operation. The second failure was a different component in the soft start drive, which is believed to have failed due to stress caused from the first failure. Both problems were corrected by replacing the faulty components. If further components of the soft start drive fail, it has been recommended replacing the entire drive, which is only one part of the pump controller.

4. A light was installed on the outside of the pump building so that the Site Manager can verify that the pump is running from his house rather than having to drive out to the pump station.

5. The pump floatation system would freeze up, so the Site Manager purchased a bubbler system to prevent floats from freezing.

6. One of the stoplog structures is starting to rust due to the high acidity of the water in the project area or it may be a natural occurrence. The Site Manager may need to repaint this structure.

7. The stoplog structures have been difficult to operate. The Site Manager has recommended that the stoplog structures have a sluice gate installed to stop flow. This would facilitate placement and removal of stoplogs.

8. In the other stoplog structure, the stoplogs have a tendency to float. The Site Manager has wedged objects between the C-frame and the end of the stoplogs as a remedial effort to keep the stoplogs from floating. It has been recommended that the stoplog structures have locking mechanisms installed to prevent the stoplogs from floating or the procedure for installing the stoplogs needs to be changed.

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# Appendix A Vegetation Surveys

# AQUATIC VEGETATION SURVEY 1995 BANNER MARSH 7/7/95

<u>GLASFORD T PENNISULA:</u> (map code A) Recently inundated in 1993, flooded willows and cottonwood approximately 80 percent mortality. Less than 5 percent aquatic vegetation coverage, composed of Duckweed, azolla, leafy pondweed and water smartweed.

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Recently inundated in 1993, flooded willows and cottonwood approximately 80 percent mortality. Less than 5 percent aquatic vegetation coverage, composed of Duckweed, leafy pondweed and sagittaria (submerged form).

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Recently inundated in 1993, flooded willows approximately 30 percent mortality.

Aquatic vegetation coverage 50 percent, composed of coontail, curly leaf pondweed, american pondweed, water milfoil, leafy pondweed and small pondweed.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage 80 percent from the shore out to 8 feet depth. Composed of american pondweed, coontail, water milfoil, sago pondweed, brittle naid, leafy pondweed and small pondweed.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) Aquatic vegetation coverage over 70 percent in water less than 8 feet. Composed of american pondweed, sago pondweed, small pondweed and water milfoil.

<u>GLASFORD T HIDDEN COVE:</u> (map code **F**) Aquatic vegetation coverage over 60 percent. Composed of coontail, american pondweed and sago pondweed.

<u>WHEEL LAKE SECTION</u>: (map code G) Recently inundated willows, dogwoods and various brush experiencing 95 percent mortality. Aquatic vegetation coverage less than 5 percent coverage of coontail, water milfoil, eurasian milfoil, creeping primrose, sago pondweed, leafy pondweed and american pondweed.

This area currently contains less aquatic vegetation coverage than expected. The potential exists for coverage greater than 50 percent due to average depths less than 8 feet.

The current low coverage is probably due to recent inundation and the presence of carp rooting activity.

#### JOHNSON LAKE AREA, surveyed 7/14/95

**JOHNSON EXTENSION:** (map code **H**) Aquatic vegetationn coverage of approximately 40 percent. Composed predominately of thick mats of milfoil- both water and eurasian in equal quantity. Also present were leafy pondweed, coontail, curly leaf and american pondweed.

The extensive mats of milfoil appeared to be under going a substantial die-back, probably due to the high temperatures during the previous 2 weeks. An associated die-back of eurasian milfoil has occurred at Spring Lake across the river. The spread

and ecology of eurasian milfoil needs to be evaluated, and these lakes will be monitored in the future.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage of approximately 70 percent, composed almost entirely of a thick mat of milfoils (eurasian and water). Also noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Treatment of this lake should be considered in early spring of 1996 to return to a 30 percent coverage and to encourage aquatic vegetation diversity. The aquatic herbicide Sonar maybe the appropriate choice and will be evaluated.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) Recently inundated in 1993, abundant shallow water less than 6 feet deep. Aquatic vegetation coverage approximately 15 percent. Composed of american lotus, water milfoil, eurasian milfoil, sago pondweed, american pondweed, coontail, leafy pondweed, small pondweed, curly leaf pondweed, and brittle naid. Also noted were areas of water smartweed, cattail, softstem bulrush and spike rush forming a emergent border.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Aquatic vegetation coverage of approximately 20 percent and a 80 percent coverage level in water less than 6 feet deep. Composed of water/eurasian milfoils, american pondweed, coontail, curlyleaf pondweed, leafy pondweed, small pondweed and sago pondweed. Also noted were water willow on the north west shore and creeping primrose on the south east shore. In general, the emergent vegetation has not become fully established yet. I feel in the near future the emergent plant community will establish in these shallow water areas created by inundation.

JOHNSON LAKE EAST ARM: (map code L) Aquatic vegetation coverage of less than 10 percent, occuping all available areas less than 8 feet deep. Composed of eurasian milfoil, american pondweed, coontail, small pondweed, water milfoil, curlyleaf pondweed and sago pondweed.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Recently inundated cottonwood, willow, dogwood and other trees experiencing 80 percent mortality. Aquatic vegetation coverage of approximately 85 percent. Composed mainly of azolla, with coontail, duckweed and american pondweed also present.

JOHNSON LAKE BACK DITCH: (map code N) Recently inundated cottonwood, willow, dogwood and brush experiencing 80 percent mortality. Aquatic vegetation coverage of approximately 80 percent. Composed of eurasian/water milfoils, american pondweed and coontail. Duckweed and creeping primrose also present in shallow static areas.

**<u>SHOVEL LAKE surveyed 9/1/95:</u>** (map code **O**) Aquatic vegetation coverage of less than 10 percent, occuping all available areas less than 8 feet deep. Composed of coontail, american pondweed, sago pondweed and curlyleaf pondweed.

**<u>PUMPHOUSE LAKE AND DITCH:</u>** (map code **P**) Recently inundated willows, cottonwoods and brush experiencing 70 percent mortality.

Aquatic vegetation coverage of approximately 20 percent. Composed of eurasian/water milfoil, coontail, azolla, and duckweed. This area is scheduled to be reshaped into a large shallow littoral zone under the HREP project. The submergent and emergent plant development into this new area will be documented when this occurs.

<u>LAKE #29 surveyed 9/28/95:</u> (map code  $\mathbf{Q}$ ) No aquatic vegetation present. This lake contains a numerous carp population which has eliminated the aquatic vegetation. The rehabilitation of the fish population this fall should improve water quality and thus habitat for aquatic vegetation. This lake will be monitored in the future to assess the results.

<u>LAKE #14 and #15:</u> (map code **R**) No aquatic vegetation present. These lakes contain a numerous carp population which has eliminated the aquatic vegetation. These lakes should undergo fish population rehabs when the water level of the marsh is lowered for the HREP project.

#### **ISOLATION DITCH:** (map code **S**) No aquatic vegetation present.

This water area contains a numerous carp population and will undergo fish population rehabilitation during the HREP project.

# AQUATIC VEGETATION SURVEY 1996 BANNER MARSH 7/9-7/12/96

<u>GLASFORD T PENINSULA:</u> (map code A) Recently inundated in 1993, flooded willows and cottonwood approximately 100 percent mortality. Isolated rooted aquatic vegetation of leafy pondweed, 35 percent aquatic vegetation coverage, composed of Duckweed and filamentous algae. Water smartweed & cattails present.

**<u>GLASFORD T FORK LAKE:</u>** (map code **B**) Recently inundated in 1993, flooded willows and cottonwood approximately 50 percent mortality. 75 percent aquatic vegetation coverage, composed of Duckweed and filamentous algae. Emergents include cattail, water smartweed, marsh milkweed and cottonwood tree seedlings.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Recently inundated in 1993, flooded willows approximately 30 percent mortality.

Aquatic vegetation coverage 50 percent, composed of coontail, duckweed, curly leaf pondweed, american pondweed, sago pondweed, leafy pondweed and small pondweed.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage 50 percent from the shore out to 10 feet depth. Composed of american pondweed, coontail, duckweed, brittle naiad, and leafy pondweed. Emergents include small groups of cattail and water willow.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) Aquatic vegetation coverage over 50 percent in water less than 8 feet. Composed of sago pondweed, coontail, brittle naiad and water milfoil. Emergent includes 50% dieback of cattails from 1995, probably due to higher water levels.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Pioneer growth of cattails, willows, water smartweed and other emergents around a .25 acre shallow water pool containing filamentous algae.

<u>GLASFORD T HIDDEN COVE:</u> (map code **F**) Aquatic vegetation coverage 10 percent. Composed of coontail, american pondweed and brittle naiad. Cattail dieback.

<u>WHEEL LAKE SECTION:</u> (map code G1) Recently inundated willows, dogwoods and various brush experiencing 100 percent mortality. Aquatic vegetation coverage less than 10 percent coverage of coontail, water milfoil, duckweed, creeping primrose, sago pondweed, and small pondweed.

This area currently contains less aquatic vegetation coverage than expected. The potential exists for coverage greater than 50 percent due to average depths less than 8 feet. Good blue-green algal bloom present.

<u>WHEEL LAKE SECTION</u>; (map code G2) 100% mortality on cottonwood, elm and brush. Aquatic vegetation surface coverage 20%, dominated by coontail, water milfoil also present. Cattails the main emergent.

<u>WHEEL LAKE, Kids pond & lake:</u> (map code G3) Aquatic vegetation surface coverage 50%, composed of water milfoil, southern naiad, filamentous algae, american pondweed. Emergents include water smartweed, softstem bulrush, water plantain and willow tree seedlings.

#### JOHNSON LAKE AREA

**JOHNSON EXTENSION:** (map code **H**) Aquatic vegetation coverage of approximately 35 percent. Composed predominately of mats of water milfoil and coontail. Water milfoil dominate in basin near Twp. road, while coontail dominated all coves toward No Access Road culvert. Also present were leafy pondweed, sago pondweed, brittle naiad and american pondweed. Emergents include cattails and water willow.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage of less than 5 percent composed of water milfoil. Also noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Treatment of this lake on 6/4/96 with 1 quart of the aquatic herbicide Sonar appears to have reduced the Eurasian milfoil coverage from a high of 70% surface coverage in 1995.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) Recently inundated in 1993, abundant shallow water less than 6 feet deep. Aquatic vegetation coverage approximately 25 percent. Composed of american lotus, water milfoil, eurasian milfoil, sago pondweed, american pondweed, and coontail. Emergent border increasing noted were areas of water smartweed, cattail, softstem bulrush, water plantain, olney's bulrush and spike rush.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Aquatic vegetation coverage of approximately 20 percent and a 80 percent coverage level in water less than 6 feet deep. Composed of water milfoil, american pondweed, coontail, curlyleaf pondweed, leafy pondweed, small pondweed, sago pondweed and water stargrass.

Emergents included cattails, water willow on the north west shore and creeping primrose on the south east shore.

JOHNSON LAKE EAST ARM: (map code L) Aquatic vegetation coverage of less than 10 percent, occupying all available areas less than 8 feet deep. Composed of american pondweed, coontail, small pondweed, water milfoil, curlyleaf pondweed and sago pondweed.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Recently inundated cottonwood, willow, dogwood and other trees experiencing 100 percent mortality. Aquatic vegetation coverage of approximately 85 percent. Composed mainly of duckweed, azolla, coontail and american pondweed also present.

**JOHNSON LAKE BLUE LAKE AREA:** (map code M2) 99% mortality on cottonwood and willow trees. Boat accessible in 1996, greatly expanded littoral zone. Aquatic vegetation coverage of 20% surface area. Dominated by coontail, water milfoil, american pondweed and duckweed. Emergents include reed grass, cattail, softstem bulrush, spike rush, marsh mallow, rice cutgrass and water plantain.

JOHNSON LAKE BACK DITCH: (map code N) Recently inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Aquatic vegetation coverage of approximately 40 percent. Composed of water milfoil, american pondweed, southern naiad, sago pondweed, coontail, leafy pondweed. Duckweed and creeping primrose also present in shallow static areas. Water surface acreage greatly expanded over 1995 levels. Emergents include water smartweed, marsh mallow, cattails and softstem bulrush.

**<u>SHOVEL LAKE copperas creek arm:</u>** (map code **O1**) Aquatic vegetation coverage of less than 10 percent, occupying all available areas less than 8 feet deep. Composed predominately of coontail, also noted american pondweed, sago pondweed, curlyleaf pondweed, brittle naiad, small pondweed, waterstar
grass, southern naiad and leafy pondweed. 100% mortality on flooded willows. Emergents include reed grass, cattails and purple turtle head.

**SHOVEL LAKE at T & channel:** (map code **O2**) T cove dominated by coontail and sago pondweed out to 12 feet. T channel dominated by coontail with duckweed, leafy pondweed, sago pondweed, and curlyleaf pondweed present.

**SHOVEL LAKE canal cove:** (map code **O3**) 50% surface coverage of coontail, sago pondweed, curlyleaf pondweed, american pondweed, small pondweed and brittle naiad. Emergents included button bush, cattail, softstem bulrush and spike rush.

**SHOVEL LAKE boat ramp arm:** (map code **O4**) Aquatic vegetation mainly coontail, also american pondweed, sago pondweed and water stargrass. Emergents include cattails and softstem bulrush.

**<u>SHOVEL LAKE lotus lake:</u>** (map code **O5**) Large concentration of Lotus, also coontail. Newly created shallow areas with water level increase.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) Recently inundated willows, cottonwoods and brush experiencing 100 percent mortality. Aquatic vegetation coverage of approximately 20 percent. Water level 2 feet higher than 1995 survey and twice the surface area. Composed of water milfoil, coontail, duckweed, american pondweed, sago pondweed and filamentous algae. The emergents include cattail and water smartweed.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Aquatic vegetation returned in 1996 with a coverage of less than 5% of surface and was leafy pondweed.

<u>LAKE #14 and #15:</u> (map code **R**) No aquatic vegetation present. These lakes contain a numerous carp population which has eliminated the aquatic vegetation. These lakes should undergo fish population rehabs when the water level of the marsh is lowered for the HREP project.

**ISOLATION DITCH:** (map code **S**) No aquatic vegetation present.

This water area contains a numerous carp population and underwent a fish population rehabilitation in October 1996.

# AQUATIC VEGETATION SURVEY 1997 BANNER MARSH 7/15/97

<u>GLASFORD T PENINSULA:</u> (map code A) Recently inundated in 1993, but now 80% dry. Willows and cottonwood approximately 100 percent mortality. 60% coverage of water smartweed, water plantain, rice cutgrass, sedges and spikerush.

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Recently inundated in 1993, but now 60% dry. Willows and cottonwood approximately 50 percent mortality. 95% coverage of duckweed and watermeal on remaining water, and water smartweed, sedges and spikerush along mudflats.

**<u>GLASFORD T BEAVER CHUTE:</u>** (map code **C**) Recently inundated in 1993, but now 90% dry. Willows approximately 30 percent mortality. Aquatic vegetation present included American pondweed, sago, water milfoil, coontail and duckweed. Emergents include water smartweed, rice cutgrass and sedges.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage 20 percent from the shore out to 8 feet depth. Composed of american pondweed, small pondweed, leafy pondweed, coontail, sago pondweed, elodea, water milfoil. Emergents include small water smartweed, spike rush, sedges and creeping water primrose.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) 50% dry from 1996. Aquatic vegetation coverage over 50 percent and composed of coontail. Emergent includes cattail, water smartweed, buckwheat and buttonbush.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Pioneer growth of cattails, willows, water smartweed and other emergents around a dry .25 acre shallow water area.

<u>GLASFORD T HIDDEN COVE:</u> (map code F) Aquatic vegetation coverage 5 percent and composed of coontail. Emergents include creeping primrose, water smartweed, cattail and sedges.

<u>WHEEL LAKE SECTION:</u> (map code **G1** and **G2**) This section not completely surveyed in 1997. Area approximately 40% dry by August 1997.

<u>WHEEL LAKE, Kids pond & lake:</u> (map code G3) Aquatic vegetation surface coverage 50%, composed of water milfoil, southern naiad, filamentous algae, american pondweed. Emergents include water smartweed, softstem bulrush, water plantain and willow tree seedlings.

# JOHNSON LAKE AREA

**JOHNSON EXTENSION:** (map code **H**) 30% exposed mudflats from 1996 water level. Aquatic vegetation coverage of approximately 15 percent. Composed predominately of mats of water milfoil and coontail. Water milfoil dominate in basin near Twp. road, while coontail dominated all coves toward No Access Road culvert. Also present were leafy pondweed, sago pondweed, brittle naiad and american pondweed. Emergents at former waters' edge include cattails and water willow.

**DRAGON FLY LAKE:** (map code I) Less than 1% coverage of leafy pondweed. Noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Water clarity less than 5 inches and turbid, rough fish population present. Fish rehabilitation scheduled and completed on 9/2/97.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) 50% exposed mudflats from 1996 water level. Aquatic vegetation coverage approximately 35 percent. Composed of american lotus, water milfoil, eurasian milfoil, sago pondweed, american pondweed, and coontail. Emergent border at former waters' edge composed of water smartweed, cattail, softstem bulrush, water plantain, olney's bulrush and spike rush.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Aquatic vegetation coverage of approximately 10 percent and a 80 percent coverage level in water less than 3 feet deep. Composed of water milfoil, american pondweed, coontail, curlyleaf pondweed, leafy pondweed, sago pondweed and water stargrass. Emergents have not colonized the newly exposed mud flats yet.

JOHNSON LAKE EAST ARM: (map code L) Aquatic vegetation coverage of less than 1 percent, occupying all available areas less than 8 feet deep. Composed of american pondweed, coontail.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100 percent mortality. Aquatic vegetation coverage of less than 5% and composed mainly duckweed, coontail and american pondweed.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) 99% mortality on cottonwood and willow trees. Not boat accessible in 1997, past littoral zone now dry. Aquatic vegetation coverage of 1% surface area. Composed of coontail, american pondweed and creeping primrose. Emergents not on new mud flats, but at former waters' edge include reed grass, cattail, softstem bulrush, spike rush, marsh mallow, rice cutgrass and water plantain.

JOHNSON LAKE BACK DITCH: (map code N) Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Aquatic vegetation coverage of less than 5 percent. Composed of american pondweed, sago pondweed, and coontail. Creeping primrose and water smartweeds present in shallow static areas. Water surface acreage reduced from 1996 levels. Emergents at former waters' edge include water smartweed, marsh mallow, cattails and softstem bulrush.

**SHOVEL LAKE copperas creek arm:** (map code **O1**) Aquatic vegetation coverage of approximately 10 percent, occupying all available areas less than 8 feet deep. Composed predominately of coontail, sago pondweed, curlyleaf pondweed, brittle naiad, water star grass, water milfoil and giant duckweed. 100% mortality on flooded willows. Emergents include reed grass, cattails and purple turtle head.

**<u>SHOVEL LAKE at T & channel:</u>** (map code **O2**) T cove coverage less than 10% and dominated by coontail, leafy pondweed and sago pondweed out to 12 feet. T channel coverage 15% and composed of coontail, sago pondweed, duckweed and giant duckweed.

**<u>SHOVEL LAKE canal cove:</u>** (map code **O3**) 40% surface coverage of coontail, sago pondweed, american pondweed, southern naiad, water stargrass and brittle naiad. Emergents included button bush, cattail, softstem bulrush, sagittaria and spike rush.

**<u>SHOVEL LAKE boat ramp arm:</u>** (map code **O4**) Aquatic vegetation coverage about 15% and mainly coontail, american pondweed, curlyleaf pondweed, sago pondweed, brittle naiad, leafy pondweed and water stargrass. Emergents include cattails and softstem bulrush.

<u>SHOVEL LAKE lotus lake:</u> (map code O5) Large concentration of Lotus, also coontail. Shoreline mudflats present with water level drawdown.

**<u>PUMPHOUSE LAKE AND DITCH</u>**: (map code **P**) Formerly inundated willows, cottonwoods and brush experiencing 100 percent mortality. Aquatic vegetation coverage of approximately 10 percent in lake and 0% in ditch. Over 50% of area dry. Composed of water milfoil, coontail, american pondweed, sago pondweed.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. 1997 water clarity 4 feet, aquatic vegetation coverage of 5% of surface area and found in all areas under 6 feet of water, composed of leafy pondweed and american pondweed.

<u>LAKE #14 and #15:</u> (map code **R**) No aquatic vegetation present water turbid less than 7 inch clarity. These lakes contain a numerous carp population which has eliminated the aquatic vegetation. These lakes were rehabilitated 9/2/97 and vegetation should begin to return in 1998.

**ISOLATION DITCH:** (map code **S**) No aquatic vegetation present. This water area contains a numerous carp population and underwent a fish population rehabilitation in October 1996.

# AQUATIC VEGETATION SURVEY 1998 BANNER MARSH 7/24/97

**<u>GLASFORD T PENINSULA:</u>** (map code **A**) Inundated in 1993, dry in 1997, but now 95% wet. Willows and cottonwood approximately 100 percent mortality. Aquatic vegetation present - less than 10% coverage of filamentous algae, leafy pondweed, small pondweed, bungleweed, smartweed greatly reduced from 1997, rice cutgrass hanging on, and duckweed present.

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Inundated in 1993, 60% dry in 1997, but now 100% wet again. Willows and cottonwood approximately 90 percent mortality. Less than 50% coverage of duckweed and water smartweed and cattails along edges.

**<u>GLASFORD T BEAVER CHUTE:</u>** (map code **C**) Inundated in 1993, 90% dry in 1997, but now 100% wet again. Willows approximately 30 percent mortality. Aquatic vegetation coverage approximately 65 % coverage of American pondweed, sago, duckweed and curlyleaf pondweed. Emergents include rice cutgrass and cattails.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage less than 1 percent from the shore out to 8 feet depth. Composed of american pondweed and coontail. Emergents from 1997 underwater.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) 100% water coverage. Aquatic vegetation coverage 100% on the bottom and composed of brittle and southern naiad. Emergent includes a fringe of cattails.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present. Aquatic vegetation composed of brittle naiad, curlyleaf, water milfoil, small pondweed, american pondweed, coontail. Pioneer growth of cattails, willows, water smartweed, rumex and creeping primrose.

<u>GLASFORD T HIDDEN COVE</u>: (map code **F**) Aquatic vegetation coverage less than 5 percent and composed of coontail and brittle naiad. Emergents include creeping primrose, and cattails.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Area approximately 40% dry by August 1997 now 100% water coverage. 100% mortality on trees, but button bush still surviving. Aquatic vegetation coverage of less than 5% and composed of water milfoil, coontail, and creeping water primrose and duckweed in the back of coves.

7/28/98

<u>WHEEL LAKE, Kids pond & lake:</u> (map code G3) Kids pond has less than 1% coverage of water milfoil, southern naiad and filamentous algae. A beaver cutdown the majority of the cottonwood trees along the edge. Adjacent Lake has an approximate 70% coverage of aquatic vegetation composed of water milfoil, southern naiad, filamentous algae, american pondweed and duckweed. Emergents include water smartweed, softstem bulrush, water plantain, cattails and marsh milkweed.

# JOHNSON LAKE AREA

**JOHNSON EXTENSION:** (map code **H**) 90% coverage by water compared to 1994-96 water level, approximately 1 foot lower. Aquatic vegetation coverage of approximately 15 percent and composed of

water milfoil, brittle naiad, american pondweed, sago pondweed and curlyleaf pondweed. Emergents include a dense cattail border and the presence of softstem bulrush.

**DRAGON FLY LAKE:** (map code I) Less than 1% coverage of leafy pondweed. Noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Water clarity approximately 1 foot. Fish rehabilitation completed on 9/2/97, restocked with fathead minnows and smallmouth bass June 1998.

## 7/24/98

**JOHNSON LAKE REARING POND ARM:** (map code **J**) 100% water level. Aquatic vegetation coverage approximately 5 percent. Composed of american lotus, water milfoil, sago pondweed, brittle naiad, and curlyleaf pondweed. Emergent border at former waters' edge composed of rumex, rice cutgrass, cattail, and softstem bulrush. Lotus beds much reduced from 1997 and the cattails have increased since 1996.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Aquatic vegetation coverage of approximately 5 percent in water less than 3 feet deep. Sparse vegetation in deeper water. Composed of american pondweed, coontail, and leafy pondweed.

Emergents from 1997 underwater i.e. water smartweed and rice cutgrass.

<u>JOHNSON LAKE EAST ARM</u>: (map code L) Aquatic vegetation coverage of less than 1 percent, occupying all available areas less than 8 feet deep. Composed of american pondweed, small pondweed, sago pondweed and leafy pondweed.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100 percent mortality. Aquatic vegetation coverage of less than 5% and composed mainly water milfoil, duckweed, curlyleaf pondweed. Emergents include creeping water primrose and smartweed.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) 100% mortality on cottonwood and willow trees. Boat accessible in 1998, dry in 1997. Aquatic vegetation coverage of 25% surface area. Composed of coontail, water milfoil, american pondweed, curlyleaf pondweed, sago pondweed, brittle naiad and creeping primrose. Emergents at waters' edge include reed grass (increasing density yearly), smartweed, cattail, softstem bulrush, spike rush, marsh mallow, rice cutgrass and water plantain.

JOHNSON LAKE BACK DITCH: (map code N) Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Aquatic vegetation coverage of less than 5 percent. Composed of american pondweed, sago pondweed, water milfoil, coontail and duckweed present. Creeping primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow, cattails and softstem bulrush.

**SHOVEL LAKE copperas creek arm:** (map code **O1**) Aquatic vegetation coverage of approximately 5 percent, less than previous years. Composed predominately of coontail, southern naiad, sago pondweed, small pondweed, azola, american pondweed, water milfoil and giant duckweed. 100% mortality on flooded willows. Emergents include reed grass, cattails and softstem bulrush. Reed grass is progressing along the shoreline and becoming more dense.

**<u>SHOVEL LAKE at T & channel:</u>** (map code **O2**) T cove coverage less than 15% and dominated by coontail, american pondweed, southern naiad, leafy pondweed, giant duckweed, azola, water star grass and sago pondweed.

## 7/24/98

**SHOVEL LAKE canal cove:** (map code **O3**) 5% surface coverage of coontail, sago pondweed, american pondweed, southern naiad, and brittle naiad. Emergents included button bush, cattail, softstem bulrush and spike rush.

**<u>SHOVEL LAKE boat ramp arm:</u>** (map code **O4**) Aquatic vegetation coverage about 15% and mainly coontail, american pondweed, curlyleaf pondweed, sago pondweed, southern naiad, leafy pondweed and water stargrass. Emergents include cattails, softstem bulrush, spike rush and willows.

**<u>SHOVEL LAKE lotus lake:</u>** (map code **O5**) Large concentration of Lotus - 90% coverage. also waterstar grass and american pondweed.

**<u>PUMPHOUSE LAKE AND DITCH</u>**: (map code **P**) 90% coverage with water now, 50% dry in 1997. Formerly inundated willows, cottonwoods and brush experiencing 100 percent mortality. Aquatic vegetation coverage of approximately 5 percent in lake and 0% in ditch. Composed of water milfoil, coontail, american pondweed, and leafy pondweed.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. 1998 water clarity 4 feet, aquatic vegetation coverage of 5% of surface area and found in all areas under 6 feet of water, composed of leafy pondweed and american pondweed.

<u>LAKE #14 and #15:</u> (map code **R**) Aquatic vegetaion coverage of 1% and composed of water milfoil These lakes were partially rehabilitated on 9/2/97 and vegetation should begin to return if the carp population stays under control.

**ISOLATION DITCH:** (map code **S**) No aquatic vegetation present. This water area was very low in 1997.

# AQUATIC VEGETATION SURVEY 1999 BANNER MARSH 8/5/99

<u>GLASFORD T PENINSULA:</u> (map code A) Inundated in 1993, dry in 1997, but now 100 wet, highest water level ever observed. Willows and cottonwood approximately 100 percent mortality. Aquatic vegetation present - 50% coverage of filamentous algae, leafy pondweed, small pondweed, and water milfoil. Surface coverage less than 20% in deep water areas. Emergents include bungleweed, smartweed, cattails, and creeping water primrose. Water clarity over 4 feet also noted large number of bullfrog tadpoles and smallmouth bass from 2-4".

**<u>GLASFORD T FORK LAKE:</u>** (map code **B**) Inundated in 1993, 60% dry in 1997, but now 100% wet, highest water level ever observed. Willows and cottonwood approximately 90 percent mortality. 50% coverage of duckweed, water meal and filamentous algae. Water smartweed and cattails along edges. Mosquito fish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 100% wet, highest water level ever observed. Willows approximately 30 percent mortality. Aquatic vegetation coverage approximately 65 % coverage of American pondweed, coontail, sago, duckweed, giant duckweed and curlyleaf pondweed. Emergents include smartweed, rice cutgrass and cattails.

<u>GLASFORD T XTRA POND</u>: (map code B2) Partial inundation in 1993, highest water ever observed in 1999. 100% willow mortality. Aquatic vegetation coverage of 50% and composed of leafy pondweed, small pondweed and filamentous algae. Emergents include cattials, water plantain, and sphagnum moss. Bluegill present.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage 70 percent from the shore out to 8 feet depth. Composed of american pondweed, brittle naiad, creeping water primrose and coontail. New island and channels being added in 1999, no vegetation established yet.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) 100% water coverage. Aquatic vegetation coverage 100% on the bottom and composed of brittle naiad, southern naiad and coontail. Emergent includes a fringe of cattails and 50 lotus pads present for first time. Lotus located on North side near the middle ditch. Water clarity over 4 feet.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present, highest water level ever observed. Aquatic vegetation composed of brittle naiad, curlyleaf, water milfoil, small pondweed, american pondweed, coontail. Solid vegetation coverage of cattails, willows, water smartweed, rumex, sedges and creeping primrose. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field.

**<u>GLASFORD T HIDDEN COVE:</u>** (map code **F**) Aquatic vegetation coverage 15 percent and composed of coontail and brittle naiad. Emergents include creeping primrose, and cattails. Water level at historical high and attached to back ditch with easy boat access. Water clarity 3 feet.

<u>WHEEL LAKE SECTION:</u> (map code G1 and G2) Area approximately 40% dry by August 1997 now 100% water coverage. 100% mortality on trees, but button bush still surviving. Aquatic vegetation coverage 10% and composed of water milfoil, coontail, brittle naiad, sago and creeping water primrose

and duckweed in the back of coves. Lotus beds present for first time, 100 leaf colony located on right hand side just past cut through from T, 100 leaf colony located on west side toward the kids pond in back cove and 200 leaf colony on east side of back cove.

Levee channel and flat has 35% coverage of coontail, american pondweed and water milfoil. Water smartweed present on the shoreline. Water clarity 2.5 feet.

WHEEL LAKE, Kids pond & lake: (map code G3) Kids pond has less than 1% coverage of water milfoil, southern naiad and filamentous algae. A beaver cutdown the majority of the cottonwood trees along the edge. Adjacent Lake has an approximate 70% coverage of aquatic vegetation composed of water milfoil, southern naiad, filamentous algae, american pondweed and duckweed. Emergents include water smartweed, softstem bulrush, water plantain, cattails and marsh milkweed.

## JOHNSON LAKE AREA

**JOHNSON EXTENSION:** (map code **H**) 100% coverage by water compared to 1994-96 water level. Aquatic vegetation coverage of approximately 15 percent and composed of water milfoil, brittle naiad, american pondweed, sago pondweed and curlyleaf pondweed. Emergents include a dense cattail border and the presence of softstem bulrush.

**DRAGON FLY LAKE:** (map code I) Less than 1% coverage of leafy pondweed and coontail. Noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Water clarity approximately 1.5 feet. Fish rehabilitation completed on 9/2/97, restocked with fathead minnows and smallmouth bass June 1998.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) 100% water level. Aquatic vegetation coverage approximately 15 percent. Composed of american pondweed, american lotus, water milfoil, sago pondweed, brittle naiad, and curlyleaf pondweed. Emergent border at former waters' edge composed of rumex, rice cutgrass, cattail, and softstem bulrush. Lotus beds increasing again and the cattails have increased since 1996.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Aquatic vegetation coverage of approximately 50 percent in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, and leafy pondweed. Emergents at edge include water smartweed and rice cutgrass.

JOHNSON LAKE EAST ARM: (map code L) Aquatic vegetation coverage of less than 1 percent, occupying all available areas less than 8 feet deep. Composed of american pondweed, small pondweed, sago pondweed and leafy pondweed.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100 percent mortality. Aquatic vegetation coverage of less than 15% and composed mainly water milfoil, american pondweed, duckweed, curlyleaf pondweed. Emergents include creeping water primrose and smartweed.

**JOHNSON LAKE BLUE LAKE AREA:** (map code M2) 100% mortality on cottonwood and willow trees. Boat accessible in 1998, dry in 1997. Aquatic vegetation coverage of 50% surface area. Composed of coontail, water milfoil, american pondweed, curlyleaf pondweed, sago pondweed, brittle naiad and creeping primrose. Emergents at waters' edge include reed grass (increasing density yearly), smartweed, cattail, softstem bulrush, spike rush, marsh mallow, rice cutgrass and water plantain.

JOHNSON LAKE BACK DITCH: (map code N) Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Aquatic vegetation coverage of less than 25 percent. Composed of american pondweed, sago pondweed, water milfoil, coontail and duckweed present. Creeping primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow, cattails and softstem bulrush.

**SHOVEL LAKE:** Normal stable water level was present in the Shovel lake section in 1999.

**SHOVEL LAKE copperas creek arm:** (map code **O1**) Aquatic vegetation coverage of approximately 15 percent, less than previous years. Composed predominately of coontail, southern naiad, sago pondweed, small pondweed, azola, american pondweed, water milfoil, water stargrass and giant duckweed. 100% mortality on flooded willows. Emergents include reed grass, cattails and softstem bulrush. Reed grass is progressing along the shoreline and becoming very dense.

**<u>SHOVEL LAKE at T & channel:</u>** (map code **O2**) T cove coverage 70% and dominated by coontail, milfoil, american pondweed, southern naiad, leafy pondweed, giant duckweed, azola, water star grass and sago pondweed.

**SHOVEL LAKE canal cove:** (map code **O3**) 25% surface coverage of coontail, sago pondweed, american pondweed, southern naiad, and brittle naiad. Emergents included button bush, cattail, softstem bulrush and spike rush.

**SHOVEL LAKE boat ramp arm:** (map code **O4**) Aquatic vegetation coverage about 15% and mainly coontail, american pondweed, curlyleaf pondweed, sago pondweed, southern naiad, leafy pondweed and water stargrass. Emergents include cattails, softstem bulrush, spike rush and willows.

**<u>SHOVEL LAKE lotus lake:</u>** (map code **O5**) Large concentration of Lotus - 90% coverage. also waterstar grass and american pondweed.

**<u>PUMPHOUSE LAKE AND DITCH:</u>** (map code **P**) 50% dry in 1999. Formerly inundated willows, cottonwoods and brush experiencing 100 percent mortality. Aquatic vegetation coverage of approximately 5 percent in lake and 0% in ditch. Composed of water milfoil, coontail, american pondweed, and leafy pondweed.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. 1999 water clarity 4 feet, aquatic vegetation coverage of 5% of surface area and found in all areas under 6 feet of water, composed of leafy pondweed and american pondweed.

**LAKE #14 and #15:** (map code **R**) Aquatic vegetaion coverage of 1% and composed of water milfoil and filamentous algae. These lakes were partially rehabilitated on 9/2/97 and vegetation should begin to return if the carp population stays under control.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

# **AQUATIC VEGETATION SURVEY 2000 BANNER MARSH**

7/21/00

Wheel Lake overall water level is the highest ever observed. Water clarity is two feet.

<u>GLASFORD T PENINSULA:</u> (map code A) Inundated in 1993, dry in 1997, but now 100 wet, highest water level ever observed. Willows and cottonwood approximately 100% mortality. Aquatic vegetation present - 10% coverage of filamentous algae, leafy pondweed, small pondweed, southern naiad and duckweed. Surface coverage less than 5% in deep water areas. Emergents include bungleweed, smartweed, cattails, and creeping water primrose. Water clarity over 8 feet. Also noted large number of bullfrog tadpoles and smallmouth bass from 2-4".

**<u>GLASFORD T FORK LAKE:</u>** (map code **B**) Inundated in 1993, 60% dry in 1997, but now 100% wet, highest water level ever observed. Willows and cottonwood approximately 100% mortality. 50% coverage of duckweed, water meal and filamentous algae. Water smartweed, water plantain, creeping water primrose and cattails along edges. Mosquito fish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 100% wet, highest water level ever observed. Willows approximately 90% mortality. Aquatic vegetation coverage approximately 10% coverage of american pondweed, coontail, sago, duckweed, giant duckweed and water milfoil. Emergents include smartweed, rice cutgrass and cattails.

**<u>GLASFORD T XTRA POND</u>**: (map code B2) Partial inundation in 1993, highest water ever observed in 1999. 100% willow mortality. Aquatic vegetation coverage of 5% and composed of leafy pondweed, small pondweed, brittle naiad, sago and filamentous algae. Emergents include cattails, water plantain, and sphagnum moss. Mosquito fish present.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage 10% from the shore out to 5 feet depth. Composed of american pondweed, small pondweed, brittle naiad, coontail and sago. Emergents include cattails and marsh milkweed. New island and channels being added in 1999, 5% coverage of sago pondweed, brittle naiad, american pondweed and coontail.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) 100% water coverage. Aquatic vegetation coverage 100% on the bottom/50% on the surface. Composed of brittle naiad, southern naiad, coontail and water milfoil. Emergent includes a fringe of cattails and 100 lotus pads present for the second year. Lotus located on North side near the middle ditch. Water clarity over 2 feet.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present, highest water level ever observed. Aquatic vegetation composed of brittle naiad, water milfoil, small pondweed, american pondweed, leafy pondweed, coontail, sago, southern naiad, duckweed and giant duckweed. Solid vegetation coverage of cattails, willows, water smartweed, rumex, sedges and creeping primrose. Cattails stand increasing. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field.

**<u>GLASFORD T HIDDEN COVE</u>**: (map code **F**) Aquatic vegetation coverage 5% and composed of coontail, brittle naiad, american pondweed and sago. Emergents include creeping primrose, and cattails. Water level at historical high and attached to back ditch with easy boat access. Water clarity 1.5 feet.

<u>WHEEL LAKE SECTION:</u> (map code G1 and G2) Water clarity 1.5 feet. Area approximately 40% dry by August 1997 now 100% water coverage. 100% mortality on trees, but button bush still surviving. Aquatic vegetation in protected cover with 10% coverage and composed of water milfoil, coontail, brittle

naiad, sago, creeping water primrose increasing and duckweed in the back of coves. Lotus beds present for first time in 1999, 100 leaf colony located on right hand side just past cut through from T (not present in 2000), 100 leaf colony located on west side toward the kids pond in back cove and 100 leaf colony on east side of back cove. New 10 leaf lotus patch against levee on west end. Emergents include cattails, rumex, smartweed, rice cutgrass and marsh milkweed.

Levee channel and flat has 10% coverage of coontail, sago, american pondweed and water milfoil. Water smartweed and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

WHEEL LAKE, Kids pond & lake: (map code G3) Kids pond has less than 1% coverage of water milfoil, southern naiad and filamentous algae. It was treated with 1 quart of Sonar in the spring of 2000. A beaver cutdown the majority of the cottonwood trees along the edge. Adjacent Lake has an approximate 70% coverage of aquatic vegetation composed of water milfoil, southern naiad, filamentous algae, american pondweed and duckweed. Emergents include water smartweed, softstem bulrush, water plantain, cattails and marsh milkweed.

# JOHNSON LAKE AREA - 7/28/2000

Water level is 6" lower than the maximum it has ever been.

**JOHNSON EXTENSION:** (map code **H**) 100% coverage by water compared to 1994-96 water level. Aquatic vegetation coverage of approximately 15% and composed of water milfoil, brittle naiad, american pondweed, sago pondweed and curlyleaf pondweed. Emergents include a dense cattail border and the presence of softstem bulrush.

**DRAGON FLY LAKE:** (map code I) Less than 1% coverage of leafy pondweed and coontail. Noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Water clarity approximately 1.5 feet. Fish rehabilitation completed on 9/2/97, restocked with fathead minnows and smallmouth bass June 1998.

JOHNSON LAKE REARING POND ARM: (map code J) 100% water level. Aquatic vegetation coverage approximately 50%. Composed of american pondweed, american lotus, water milfoil, sago pondweed and coontail. Emergent border at former waters' edge composed of rumex, rice cutgrass, cattail, smartweed, creeping water primrose and softstem bulrush. Lotus beds increasing again and the cattails have increased since 1996. Lotus coverage 40%.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 6 feet. Aquatic vegetation coverage of approximately 50% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, chara, brittle naiad, water stargrass and leafy pondweed. Emergents at edge include water smartweed, creeping water primrose and rice cutgrass. Cattails are increasing.

**JOHNSON LAKE EAST ARM:** (map code L) Water clarity approximately 4 feet. Aquatic vegetation coverage of less than 1 percent, occupying all available areas less than 6 feet deep. Composed of american pondweed, sago pondweed, leafy pondweed, water milfoil and coontail.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Aquatic vegetation 80% coverage and 7 feet deep. Composed of mainly coontail, water milfoil, american pondweed, duckweed, filamentous algae and azola. Emergents include creeping water primrose, smartweed and cattails. A small group of lotus, about 25-30, on the north side of the ditch.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 1<sup>1</sup>/<sub>2</sub> feet. 100% mortality on cottonwood and willow trees. Boat accessible in 1998, dry in 1997. Aquatic vegetation coverage of 50% surface area at 8 feet deep. Composed of coontail, water milfoil, sago pondweed, brittle naiad and creeping primrose. Emergents at waters' edge include reed grass (increasing density yearly), smartweed, cattail, spike rush, marsh mallow, and rice cutgrass. Leafy pondweed is present at the entrance to the canal.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 4½ feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Aquatic vegetation coverage 70 percent with 6 - 7 feet depth. Composed of american pondweed, water milfoil and coontail. Creeping primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow, cattails, water plantain and softstem bulrush. About 100 lotus leaf pads present on the west side of the main back ditch.

**SHOVEL LAKE:** Normal stable. Water level was present in the Shovel lake section until August of 2000. Then, with connection to the new enlarged area, the water level dropped 3 feet in August in the main lake section and rose 4 feet in the attached area. Water level should equalize in 2001. Large brush piles added along main lake outside border with HREP project in 2000.

**SHOVEL LAKE copperas creek arm:** (map code **O1**) Aquatic vegetation coverage of approximately 5%, less than previous years. Composed predominately of coontail and water milfoil. Present in small quantities is southern naiad, sago pondweed, small pondweed, azola, american pondweed, water milfoil, water stargrass and giant duckweed. 100% mortality on flooded willows. Emergents include reed grass, cattails and softstem bulrush. Reed grass is progressing along the shoreline and becoming very dense up half of arm on inside.

**<u>SHOVEL LAKE at T & channel:</u>** (map code **O2**) T cove coverage 100% and dominated by coontail, milfoil, american pondweed, southern naiad, leafy pondweed, giant duckweed, azola, water star grass and sago pondweed. Large brush piles added in channel, boat access remaining open.

**SHOVEL LAKE canal cove:** (map code **O3**) Cove 50% dry, but new lake connection along west edge is 25% surface coverage of coontail, sago pondweed, american pondweed, leafy pondweed, southern naiad, and brittle naiad. Emergents included button bush, cattail, softstem bulrush and spike rush.

**SHOVEL LAKE boat ramp arm:** (map code **O4**) Aquatic vegetation coverage about 15% and mainly coontail, american pondweed, curlyleaf pondweed, sago pondweed, southern naiad, leafy pondweed and water stargrass. Emergents include cattails, softstem bulrush, spike rush and willows. Area reduced due to water level reduction.

**<u>SHOVEL LAKE lotus lake:</u>** (map code **O5**) Large concentration of Lotus - 90% coverage; also waterstar grass and american pondweed. Water level 2 feet lower in August on in 2000.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) 50% dry in 2000. Water level up 2 feet in August. Flooded terrestrial vegetation present. 2 feet of water to reach highest levels. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of approximately 5% in lake and 0% in ditch. Composed of water milfoil, coontail, american pondweed, and leafy pondweed.

**SHOVEL LAKE ADDITION:** 75% dry in 2000 until August when 3 feet of water added from Shovel Main Lake. Flooded terrestrail vegetation 50% coverage. At least 3 more feet to fill with water to reach

highest levels in past.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. 2000 water clarity 3 feet, aquatic vegetation coverage of 5% of surface area and found in all areas under 6 feet of water, composed of leafy pondweed, american pondweed and water milfoil. Water level approximately 4 feet lower than highest level.

<u>LAKE #14 and #15:</u> (map code **R**) Aquatic vegetaion coverage of 1% and composed of water milfoil and filamentous algae. These lakes were partially rehabilitated on 9/2/97 and vegetation has not returned due to the carp population not under control. Will attempt to rehabilitate in winter of 2000 - completed in Noavember 2000.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

# AQUATIC VEGETATION SURVEY 2001 BANNER MARSH 8/2/01

Wheel Lake overall water level is one foot lower than in 2000. Water clarity is one foot.

**GLASFORD T PENINSULA:** (map code **A**) Inundated in 1993, dry in 1997, but now 100 wet, highest water level ever observed. Willows and cottonwood approximately 100% mortality. Vast majority of trees fallen down. Aquatic vegetation present - 5% coverage of filamentous algae, water milfoil, sago, leafy pondweed, small pondweed, southern naiad and duckweed. Surface coverage less than 5% in deep water areas. Water lilies from 2001 spring planing survived. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Water clarity over 8 feet. Also noted large number of bullfrog tadpoles and smallmouth bass from 2-4". Bluegills present.

**GLASFORD T FORK LAKE:** (map code **B**) Inundated in 1993, 60% dry in 1997, 100% wet in 2000, highest water level ever observed. Water level about one foot lower than in 2000. Willows and cottonwood approximately 100% mortality. Most trees fallen down. 50% coverage of duckweed, water meal, coontail and filamentous algae. Water smartweed, water plantain, creeping water primrose and cattails along edges. Mosquito fish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 100% wet, highest water level ever observed. Willows approximately 90% mortality. Aquatic vegetation coverage approximately 10% coverage of american pondweed, coontail, brittle naiad, duckweed, giant duckweed and water milfoil. Emergents include smartweed, rice cutgrass and cattails. Film scum toward the shoreline.

**<u>GLASFORD T XTRA POND</u>**: (map code B2) Partial inundation in 1993, highest water ever observed in 1999. 100% willow mortality. Aquatic vegetation coverage of 20% and composed of brittle naiad, sago, azola, chara and duckweed. Emergents include a bunch of cattails, water plantain, and sphagnum moss. Mosquito fish present.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage of 2% from the shore out to 3 feet depth. Composed of american pondweed, sago pondweed, brittle naiad, southern naiad and coontail. Emergents include cattails, creeping water primrose and marsh milkweed. New island and channels being added in 1999.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) 2% water coverage. Very limited rooted aquatic vegetation. Emergent includes a fringe of cattails and 100 lotus pads present for the second year. Lotus located on North side near the middle ditch. Water clarity over 2 feet.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present, highest water level ever observed. Drier with low water level. Aquatic vegetation composed of a bunch of brittle naiad, water milfoil, small pondweed, american pondweed, horned pondweed, sago and southern naiad. Solid vegetation coverage of cattails, willows, sedges, water plantain and creeping water primrose. Cattails stand increasing. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field.

<u>GLASFORD T HIDDEN COVE:</u> (map code F) Aquatic vegetation coverage less than 2%.Emergents include creeping water primrose and cattails. Water level at historical high and attached to back ditch with easy boat access. Water clarity 1.5 feet.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 1.5 feet. Area approximately 40% dry by August 1997 now 100% water coverage. 100% mortality on trees, but button bush still surviving. Aquatic vegetation in protected cover with less than 5% coverage and composed of water milfoil, coontail, and duckweed in the back of coves. Lotus beds present for first time in 1999, 100 leaf colony located on right hand side just past cut through from T (not present in 2000 or 2001), 100 leaf colony located on west side toward the kids pond in back cove and 100 leaf colony on east side of back cove. Large lotus patch of about 2000 against levee on west end. Emergents include cattails, rumex, smartweed, rice cutgrass, creeping water primrose and marsh milkweed.

Levee channel and flat has less than 2% coverage of coontail, sago, american pondweed and water milfoil. Water smartweed, marsh mallow and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

WHEEL LAKE, Kids pond & lake: (map code G3) Kids pond has 5% coverage of water milfoil, southern naiad and filamentous algae. It was treated with 1 quart of Sonar in the spring of 2000. A beaver cutdown the majority of the cottonwood trees along the edge. Adjacent Lake has an approximate 90% coverage of aquatic vegetation composed of water milfoil, southern naiad, filamentous algae, american pondweed and duckweed. Emergents include water smartweed, softstem bulrush, water plantain, cattails, marsh milkweed and creeping water primrose.

# JOHNSON LAKE AREA - 8/2/2001

Reading on staff gauge is 436.1.

**JOHNSON EXTENSION:** (map code **H**) 100% coverage by water compared to 1994-96 water level. Aquatic vegetation coverage of approximately 25% and composed of water milfoil, brittle naiad, american pondweed, sago pondweed and curlyleaf pondweed. Emergents include a dense cattail border and the presence of softstem bulrush. Water clarity 6 feet.

**DRAGON FLY LAKE:** (map code I) Less than 10% coverage of leafy pondweed and coontail. Noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Water clarity approximately 1.5 feet.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) 100% water level. Aquatic vegetation coverage approximately 5%. Composed of american pondweed, american lotus, water milfoil, sago pondweed and coontail. Emergent border at former waters' edge composed of rumex, rice cutgrass, cattail, smartweed, water plantain, creeping water primrose and softstem bulrush. Lotus beds increasing again and the cattails have increased since 1996. Lotus coverage 60%.

JOHNSON LAKE BIG BASIN: (map code K) Water clarity 4 feet. Aquatic vegetation coverage of approximately 10% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, chara, brittle naiad, water stargrass, southern naiad and small pondweed. Emergents at edge include water smartweed, creeping water primrose, sofstem bulrush, rumex and rice cutgrass. Cattails are increasing. On the west shore ain big bay, 11 clumps of water lilies. 17 clumps of water lilies on east side.

**JOHNSON LAKE EAST ARM:** (map code L) Water clarity approximately 6 feet. Aquatic vegetation coverage of less than 5 percent, occupying all available areas less than 6 feet deep. Composed of american pondweed, sago pondweed, water stargrass, water milfoil and coontail.

JOHNSON LAKE EAST DITCH: (map code M) Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 20% coverage and 7 feet deep. Composed of mainly coontail, water milfoil, american pondweed, sago, brittle naiad and azola. Emergents include creeping water primrose, smartweed and cattails. A small group of lotus, about 25-30, on the north side of the ditch.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 10 inches. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage of 10% surface area at 8 feet deep. Composed of coontail, water milfoil, sago pondweed, brittle naiad, water stargrass and creeping primrose. Emergents at waters' edge include reed grass (increasing density yearly), smartweed, cattail, spike rush, marsh mallow(increasing in coverage), and rice cutgrass. Leafy pondweed is present at the entrance to the canal.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 4½ feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 50%t with 6 - 7 feet depth. Composed of american pondweed, sago, small pondweed, water milfoil and coontail. Creeping water primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow and cattails. About 1000 lotus leaf pads present on the west side of the main back ditch.

# 8/10/2001

**SHOVEL LAKE:** Normal level. Water level high in spring and dropped approximately one foot by August. Water level equalized in 2001. Large brush piles that were added along main lake outside border with HREP project in 2000 were now flooded. Water clarity 2.5 feet in main lake. **SHOVEL LAKE copperas creek arm:** (map code **O1**) Aquatic vegetation coverage less than 5%, less than previous years. Composed predominately of coontail. Present in small quantities is southern naiad, sago pondweed, azola, american pondweed, brittle naiad, water milfoil, water stargrass and giant duckweed. 100% mortality on flooded willows. Emergents include reed grass, cattails, rice cut grass, sedges, Eleocharis (scouring rush), and softstem bulrush. Reed grass is progressing along the shoreline and becoming very dense up half of arm on inside.

**<u>SHOVEL LAKE at T & channel:</u>** (map code **O2**) T cove coverage 50% and dominated by coontail, milfoil, american pondweed, southern naiad, common duckweed, brittle naiad, giant duckweed, and sago pondweed. Large brush piles added in channel, boat access remaining open.

**SHOVEL LAKE canal cove:** (map code **O3**) Cove 20% dry, but new lake connection along west edge is 15% surface coverage of coontail, sago pondweed, american pondweed, leafy pondweed, southern naiad, water milfoil, water stargrass, curlyleaf pondweed, and brittle naiad. Emergents included button bush, cattail, softstem bulrush and spike rush and sedges.

**SHOVEL LAKE boat ramp arm:** (map code **O4**) Aquatic vegetation coverage less than 1% of mainly coontail, american pondweed, sago pondweed, giant duckweed, water milfoil, leafy pondweed and water stargrass. Emergents include cattails, softstem bulrush, spike rush, sedges, Phragmites and willows. Area reduced due to water level reduction.

**<u>SHOVEL LAKE lotus lake:</u>** (map code **O5**) Large concentration of Lotus - 20% coverage. Aquatic vegetation composed of water star grass, american pondweed, leafy pondweed, azola, sago pondweed, water milfoil, brittle naiad, and southern naiad. Emergents include marsh milkweed, softstem bulrush, cattails and sedges. Water level up one foot.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) Staff gauge at pump House Lake at 435.95. 100% wet in 2001. Water level down one foot in August. Flooded terrestrial vegetation present. 2 feet of water to reach highest levels. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of approximately 10% in lake and 5% in ditch. Composed of water milfoil, coontail, american pondweed, and leafy pondweed.

**SHOVEL LAKE ADDITION glove lake:** 99% dry in 2000. Aquatic vegetation coverage of 2% in 2001 composed of coontail, water milfoil, american pondweed, sago pondweed, leafy pondweed, brittle naiad, azola, giant duckweed, common duckweed, water stargrass and southern naiad. Emergents include Phragmites, cattails, marsh milkweed, smartweeds, softstem bullrush, sedges and rushes. Original isolated ponds still have 80% coverage with rooted vegetation.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. 2001 water clarity 4 feet. Aquatic vegetation coverage 10% of surface area and found in all areas under 6 feet of water, composed of leafy pondweed, american pondweed and water milfoil. Water level approximately 3 feet lower than highest level.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001. Aquatic vegetation coverage of 10% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population now under control. Water clarity over 10 feet. Fifteen water lilies present in main lake from Spring 2001 transplanting.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

# AQUATIC VEGETATION SURVEY 2002 BANNER MARSH 7/15/02

Wheel Lake overall water level is highest ever and was approximately 1 foot higher in Spring 2002. Water clarity is one foot.

**GLASFORD T PENINSULA:** (map code **A**) Inundated in 1993, dry in 1997, but now 100 wet, highest water level ever observed in Spring 2002. One foot higher than present. Willows and cottonwood approximately 100% mortality. Vast majority of trees fallen down. Aquatic vegetation present - 90% coverage of filamentous algae, water milfoil, coontail, sago, leafy pondweed, small pondweed, southern naiad, duckweed and filamentous algae. Water lilies from 2001 spring planing survived and 50 plants present and flowering. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Water clarity over 3 feet. Also noted large number of bullfrog tadpoles. Noted recent low D.O. fish kill. Bluegills predominately.

**GLASFORD T FORK LAKE:** (map code **B**) Inundated in 1993, 60% dry in 1997, 100% wet in 2000, highest water level ever observed. Water level about one foot higher in Spring 2002. Willows and cottonwood approximately 100% mortality. Most trees fallen down. 80% coverage of duckweed, water meal, coontail and filamentous algae. Water smartweed, water plantain, creeping water primrose and cattails along edges. Mosquito fish present. Noted recent low D.O. fish kill.

**GLASFORD T BEAVER CHUTE:** (map code **C**) Inundated in 1993, 90% dry in 1997, but now 100% wet, highest water level ever observed. Willows approximately 100% mortality. Aquatic vegetation coverage approximately 50 % coverage of american pondweed, coontail, duckweed, giant duckweed, sago, water milfoil and filamentous algae. Emergents include creeping water primrose, marsh mallow, smartweed, rice cutgrass and cattails. Film scum toward the shoreline.

**<u>GLASFORD T XTRA POND</u>**: (map code B2) Partial inundation in 1993, highest water ever observed in 1999. 100% willow mortality. Aquatic vegetation coverage of 5% and composed of water meal, brittle naiad, and duckweed. Emergents include a bunch of cattails, water plantain, rice cutgrass and sphagnum moss. Mosquito fish present. Carp probably entered in Spring 2002.

<u>GLASFORD T at T on west shore:</u> (map code **D**) Aquatic vegetation coverage of 2% from the shore out to 3 feet depth. Composed of sago, water milfoil, curlyleaf pondweed, leafy pondweed and coontail. Emergents include cattails, creeping water primrose and marsh milkweed. New island and channels were added in 1999. Vegetation coverage of 5%. Composed of american pondweed, southern naiad, brittle naiad.

<u>GLASFORD T on levee side and shallow bay:</u> (map code E) 5% water coverage. Very limited rooted aquatic vegetation. Coontail and water milfoil. Emergents include creeping water primrose, water smartweed and a fringe of cattails and 200 lotus pads present for the second year. Lotus located on North side near the middle ditch. Water clarity 1'.

**<u>GLASFORD T, IDOT MITIGATION SITE:</u>** (map code **E1**) Up to 6 acres of hydric soil present, highest water level ever observed. Drier with high water level. Aquatic vegetation composed of a bunch of brittle naiad, water milfoil, duckweed, giant duckweed, azola, curlyleaf pondweed, purple fringed riccia, horned pondweed, sago and southern naiad. Rooted aquatic vegetation level greatly reduced. Solid vegetation coverage of cattails, willows, sedges, water plantain, smartweed, rice cutgrass and creeping water primrose. Cattails stand increasing. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did encroach into ag

field.

**<u>GLASFORD T HIDDEN COVE</u>** (map code **F**) Aquatic vegetation coverage less than 2%. Composed of water milfoil, sago and coontail. Emergents include creeping water primrose, cattails and water smartweed. Water level at historical high and attached to back ditch with easy boat access. Water clarity 2 feet.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 1 foot. 100% mortality on trees, but button bush still surviving. Aquatic vegetation in protected cover with less than 5% coverage and composed of water milfoil, coontail, sago and duckweed in the back of coves. Lotus beds present for first time in 1999. Absent is 2002 is leaf colony located on west side toward the kids pond in back cove and 50 leaf colony on east side of back cove. Large lotus patch of about 2000 against levee on west end. Emergents include cattails, rumex, smartweed, rice cutgrass, creeping water primrose and marsh milkweed.

Levee channel and flat has 5% coverage of coontail, sago, american pondweed and water milfoil. Water smartweed, marsh mallow and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

WHEEL LAKE, Kids pond & lake: (map code G3) Kids pond has 25% coverage of water milfoil, southern naiad and blue-green algae. It was treated with 1 quart of Sonar in the spring of 2002. A beaver cutdown the majority of the cottonwood trees along the edge. 95% of cattails killed by Sonar. Adjacent Lake has an approximate 90% coverage of aquatic vegetation composed of filamentous algae, coontail and water milfoil. Emergents include water smartweed, softstem bulrush, water plantain, cattails, marsh milkweed and creeping water primrose. Sonar leeching due to high water.

# JOHNSON LAKE AREA - 7/16/2002

Reading on staff gauge is 436.1.

**JOHNSON EXTENSION:** (map code **H**) Highest water level over for extended season. 100% coverage by water. Aquatic vegetation coverage of approximately 40% and composed of water milfoil, brittle naiad, coontail, american pondweed, sago pondweed and curlyleaf pondweed. Emergents include a dense cattail border and the presence of softstem bulrush. Water clarity 8 feet.

**DRAGON FLY LAKE:** (map code I) Less than 10% coverage of leafy pondweed and coontail. Noted cattails, bur reed, sagittaria and water plantain in a developing emergent zone. Water clarity approximately 1.5 feet.

JOHNSON LAKE REARING POND ARM: (map code J) 100% water level. Aquatic vegetation coverage approximately 30%. Composed of coontail, american pondweed, american lotus, water milfoil, brittle naiad, sago and curlyleaf pondweed. Emergent border at former waters' edge composed of rumex, rice cutgrass, cattail, smartweed, creeping water primrose and softstem bulrush. Sedge border developing. Lotus beds increasing again and the cattails have increased since 1996. Lotus coverage 60%.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 8 feet. Aquatic vegetation coverage of approximately 100% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, leafy pondweed, brittle naiad, water stargrass, southern naiad and small pondweed. Emergents at edge include water smartweed, creeping water primrose, marsh milkweed, sofstem bulrush, rumex and rice cutgrass. Cattails are increasing. On the west shore ain big bay, 17 clumps of water lilies. 20 clumps, with about 10 pads in each, of water lilies on east side. 15' sedge border developing around water vegetation.

**JOHNSON LAKE EAST ARM:** (map code L) Water clarity approximately 10+ feet. Aquatic vegetation coverage of less than 5 percent, occupying all available areas less than 8 feet deep. Composed of american pondweed, sago, curlyleaf pondweed, water stargrass, water milfoil and coontail.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage and 8 feet deep. Composed predominately of coontail, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed and cattails. A group of lotus, about 200, on the north side of the ditch.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 2 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage of 95% surface area at <8 feet deep. Composed of coontail, water milfoil, sago, curlyleaf pondweed, leafy pondweed, water stargrass and creeping primrose. Emergents at waters' edge include reed grass (increasing density yearly), smartweed, cattail, spike rush, marsh mallow(increasing in coverage), marsh milkweed and rice cutgrass. Water stargrass is present at the entrance to the canal. Sedge border developing along water's edge.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 9 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 95% with 10 feet depth. Composed predominately of coontail, water milfoil, american pondweed, sago and coontail. Creeping water primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow and cattails. Several thousand lotus leaf pads present on the west side of the main back ditch.

#### 7/16/02

**SHOVEL LAKE:** Water level highest ever in spring 2002 and dropped approximately one foot by August. Water clarity 5.5 feet in main lake.

**SHOVEL LAKE copperas creek arm:** (map code **O1**) Aquatic vegetation coverage 20%. Composed predominately of coontail. Present in small quantities is sago pondweed, azola, brittle naiad, water milfoil, duckweed, giant duckweed, filamentous algae and water stargrass. 100% mortality on flooded willows. Emergents include reed grass, cattails, rice cut grass, sedges, Eleocharis (scouring rush), and softstem bulrush. Reed grass is progressing along the shoreline and becoming very dense up half of arm on inside.

**SHOVEL LAKE at T & channel:** (map code **O2**) T cove coverage 20% and dominated by coontail, milfoil, duckweed, giant duckweed, sago and leafy pondweed. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE canal cove:** (map code **O3**) Cove 20% dry, but new lake connection along west edge is 60% surface coverage of coontail, sago pondweed, american pondweed, duckweed, giant duckweed, southern naiad, water milfoil, water stargrass and brittle naiad. Emergents include button bush, cattail, softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Reed grass present.

**<u>SHOVEL LAKE boat ramp arm:</u>** (map code **O4**) Water clarity 7 feet. Aquatic vegetation coverage 1% of mainly coontail, american pondweed, sago pondweed, giant duckweed, water milfoil, duckweed, southern naiad, leafy pondweed and water stargrass. Emergents include cattails, softstem bulrush, spike

rush, sedges, rice cutgrass, Phragmites and willows.

**<u>SHOVEL LAKE lotus lake:</u>** (map code **O5**) Large concentration of Lotus - 50% coverage. Aquatic vegetation composed of water star grass, american pondweed, leafy pondweed, coontail, sago, curlyleaf pondweed, water milfoil, and southern naiad. Emergents include marsh milkweed, softstem bulrush, cattails and sedges.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) Staff gauge at pump House Lake highest level over 435.95. 100% wet in 2002. Water level down one foot in August. Flooded terrestrial vegetation present. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of approximately 10% in lake and 5% in ditch. Composed of water milfoil, coontail, american pondweed, leafy pondweed and water stargrass.

Emergents include indigo bush, creeping water primrose, rumex and water smartweed.

**SHOVEL LAKE ADDITION glove lake:** 99% dry in 2000. Aquatic vegetation coverage of 10%. Composed of coontail, water milfoil, american pondweed, sago pondweed, leafy pondweed, brittle naiad, filamentous algae, duckweed, water stargrass and southern naiad. Emergents include Phragmites, cattails, creeping water primrose, marsh milkweed, smartweeds, softstem bullrush, sedges and rushes. Original isolated ponds had 80% coverage with rooted vegetation in 2001. My newly created basin now 80% coverage with rooted aquatic vegetation. Water clarity is 6 feet.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. 2001 water clarity 4 feet. Aquatic vegetation coverage 10% of surface area and found in all areas under 6 feet of water, composed of brittle naiad, coontail, southern naiad, filamentous algae, leafy pondweed, american pondweed and water milfoil. Emergents include creeping water primrose, smartweed and rumex. Water level up to maximum.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001. Aquatic vegetation coverage of 10% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population now under control. Water clarity over 10 feet. Fifteen water lilies present in main lake from Spring 2001 transplanting.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

# AQUATIC VEGETATION SURVEY BANNER MARSH 2003 7/8/03; 7/16/03

Water clarity one foot.

**<u>GLASFORD T PENINSULA:</u>** (map code **A**) Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 50% coverage of filamentous algae, coontail, sago, leafy pondweed, small pondweed and duckweed. Water lilies from 2001 spring planing survived and 30 plants present and flowering. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails increasing. Also noted large number of bullfrog tadpoles. Bluegills and Largemouth Bass present. Water clarity over 3 feet.

**<u>GLASFORD T FORK LAKE:</u>** (map code **B**) Inundated in 1993, 60% dry in 1997, 100% wet in 2000, high water level maintained. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 40% coverage of duckweed, water meal, coontail, southern naiad and filamentous algae. Water smartweed, water plantain, creeping water primrose and cattails along edges. Large numbers of mosquito fish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 100% wet, highest water level ever observed. Willows 100% mortality. Aquatic vegetation 50 % coverage of american pondweed, filamentous algae, duckweed, giant duckweed, sago, water milfoil and coontail predominant. Emergents include rice cutgrass and cattails.

**GLASFORD T XTRA POND:** (map code B2) Almost connected to main lake; beaver dam only blockage. 100% willow mortality. Aquatic vegetation 10% composed of brittle naiad, water milfoil, filamentous algae, american pondweed and duckweed. Emergents include a complete band of cattails all around edge, water plantain, rice cutgrass and sphagnum moss, which is declining rapidly. Mosquito fish present.

<u>GLASFORD T at T on WEST SHORE:</u> (map code **D**) Aquatic vegetation coverage < 2% from the shore out to 3 feet depth. Composed of sago, curlyleaf pondweed, and coontail. Emergents include cattails, button bush and marsh milkweed. New island and channels were added in 1999. Vegetation coverage < 5% composed of american pondweed, southern naiad, brittle naiad.

<u>GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:</u> (map code E) < 5% water coverage. Very limited rooted aquatic vegetation of coontail and water milfoil. Emergents include a fringe of cattails and 100 lotus pads present for the third year. Lotus located on North side near the middle ditch. Water clarity 6".

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present, high water level maintained. Aquatic vegetation < 5% composed of coontail, water milfoil, and sago. Rooted aquatic vegetation level greatly reduced. Solid vegetation coverage of cattails, willows, sedges, water plantain, smartweed, and rice cutgrass. Cattails stand increasing. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did encroach into ag field.

<u>GLASFORD T HIDDEN COVE</u>: (map code F) Aquatic vegetation coverage < 5% composed of water milfoil and sago. Emergents include creeping water primrose and cattails. Water level at historical high and attached to back ditch with easy boat access. Water clarity 6".

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 1 foot. 100% mortality on trees. Aquatic vegetation in protected cover < 5% composed of water milfoil, coontail, sago, american pondweed and duckweed in the back of coves. Lotus beds present for first time in 1999. 50 leaf colony on east side of back cove. Large lotus patch of about 200 against levee on west end. Emergents include cattails, rumex, smartweed, rice cutgrass, creeping water primrose, marsh milkweed and phragmites.

Levee channel and flat has 5% coverage of coontail, sago, and water milfoil. Water smartweed, marsh mallow and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

WHEEL LAKE KIDS POND & LAKE: (map code G3) Kids pond has < 5% coverage of southern naiad and blue-green algae. Emergent present is creeping water primrose. It was treated with 1 quart of Sonar in the spring of 2002. A beaver cutdown the majority of the cottonwood trees along the edge. 95% of cattails killed by Sonar. Adjacent Lake has 90% coverage of aquatic vegetation composed of filamentous algae, coontail, leafy pondweed, small pondweed, duckweed and water milfoil. Emergents include water smartweed, softstem bulrush, cattails, and creeping water primrose. Willow border getting denser.

# JOHNSON LAKE AREA - 7/16/2003

Reading on staff gauge is 436.5 on 7/8/03 and 436.8 on 7/16/03.

**JOHNSON EXTENSION:** (map code **H**) Highest water level over an extended season. 100% coverage by water. Aquatic vegetation coverage 40% and composed of water milfoil, brittle naiad, coontail, american pondweed, sago pondweed, filamentous algae, duckweed, and water stargrass. Emergents include a dense cattail border, creeping water primrose, rumex, rice cutgrass and the presence of softstem bulrush. Water clarity 6 feet.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage < 30% composed of sago, water milfoil, water smartweed and coontail. Emergents include cattails, bur reed, creeping water primrose, rice cutgrass and rumex. Water clarity approximately 3 feet.

JOHNSON LAKE REARING POND ARM: (map code J) 100% water level. Aquatic vegetation coverage 90% composed of coontail, american pondweed, lotus, water milfoil, brittle naiad, and sago. Emergent border at former waters' edge composed of rumex, rice cutgrass, and cattails. Sedges present. Phragmites present on north shore. Lotus beds increasing again and the cattails have increased since 1996. Lotus coverage 90%.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 8 feet. Aquatic vegetation coverage of approximately 80% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, brittle naiad, water stargrass, southern naiad and filamentous algae. Emergents at edge include water smartweed, creeping water primrose, marsh milkweed, softstem bulrush, rumex and rice cutgrass. Cattails are increasing. On the east side in big bay, 6 clumps of water lilies. On the west shore in big bay, 26 clumps, with about 10 pads in each, of water lilies. 5' sedge border developing around water vegetation.

<u>JOHNSON LAKE EAST ARM</u>: (map code L) Water clarity 8 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, sago, curlyleaf pondweed, water stargrass, water milfoil, brittle naiad and coontail.

JOHNSON LAKE EAST DITCH: (map code M) Formerly inundated cottonwood, willow, dogwood

and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage and 8 feet deep. Composed predominately of coontail, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, phragmites and cattails. A group of lotus, about 200, on the north side of the ditch.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 1.5 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 40% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, leafy pondweed, water stargrass, duckweed, small pondweed, filamentous algae, and american pondweed. Emergents at waters' edge include smartweed, cattail, spike rush, marsh mallow(increasing in coverage), marsh milkweed, creeping water primrose and rice cutgrass. Sedge border developing along water's edge where phragmites is not present. Phragmites extremely thick where border has developed.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 8 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 85% with 10 feet depth. Composed predominately of coontail, water milfoil, american pondweed, and sago. Creeping water primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow and cattails, increasing in density. Several thousand lotus leaf pads present on the west side of the main back ditch. 7/8/03

**<u>SHOVEL LAKE:</u>** Water clarity 6 feet.

SHOVEL LAKE COPPERAS CREEK ARM: (map code O1) Aquatic vegetation coverage 10% composed predominately of coontail. Present in small quantities is sago pondweed, azola, brittle naiad, water milfoil, duckweed, giant duckweed, filamentous algae, small pondweed, leafy pondweed and american pondweed. 100% mortality on flooded willows. Emergents include reed grass, cattails, and rice cutgrass. Reed grass is progressing along the shoreline and becoming very dense up \_ of arm on inside.

**SHOVEL LAKE at T & CHANNEL:** (map code **O2**) T cove coverage 80% and dominated by coontail, milfoil, duckweed, giant duckweed, sago, filamentous algae and small pondweed. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) New lake connection along west edge and cove is 30% coverage of coontail, sago pondweed, american pondweed, duckweed, giant duckweed, southern naiad, water milfoil, water stargrass, curlyleaf pondweed and small pondweed. Emergents include button bush, cattail, softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Reed grass present.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 7 feet. Aquatic vegetation coverage 1% of mainly coontail, american pondweed, sago pondweed, water milfoil, duckweed, southern naiad, brittle naiad, small pondweed and water stargrass. Emergents include cattails, creeping water primrose, softstem bulrush, spike rush, sedges, rice cutgrass, phragmites and willows.

**<u>SHOVEL LAKE LOTUS LAKE:</u>** (map code **O5**) Large concentration of Lotus - 80% coverage. Aquatic vegetation composed of american pondweed, coontail, sago, curlyleaf pondweed, water milfoil, brittle naiad and southern naiad. Emergents include cattails, rumex and sedges.

**<u>PUMPHOUSE LAKE AND DITCH</u>**: (map code **P**) 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of approximately 10% in lake and 35% in ditch. Composed of water milfoil, coontail, american pondweed, leafy pondweed and water stargrass. Emergents include indigo bush, creeping water primrose, rumex and

water smartweed, and rice cutgrass.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Aquatic vegetation coverage 70% composed of coontail, water milfoil, sago, filamentous algae, duckweed, and small pondweed. Emergents include phragmites, cattails, softstem bullrush, sedges and rushes. Original isolated ponds had 80% coverage with rooted vegetation in 2001. Newly created basin now 70% coverage with rooted aquatic vegetation. Water clarity is 6 feet.

**<u>GLOVE LAKE:</u>** 5% vegetation coverage composed of water milfoil, sago, coontail, duckweed, american pondweed, curlyleaf pondweed, water stargrass, southern naiad, and leafy pondweed. Emergents include rumex, water smartweed, cattails, and creeping water primrose.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 3 feet. Aquatic vegetation coverage 10% of surface area and found in all areas under 6 feet of water. Composed of sago, water stargrass, brittle naiad, coontail, southern naiad, filamentous algae, leafy pondweed, american pondweed and water milfoil. Water level 3' low.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage 10% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population still under control for now. Water clarity 3 feet.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

# AQUATIC VEGETATION SURVEY BANNER MARSH 2004 7/7/04; 7/9/04

# 7/7/04 - Water clarity one foot.

**<u>GLASFORD T PENINSULA:</u>** (map code **A**) Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 75% coverage of filamentous algae, coontail, sago, water milfoil and duckweed. Water lilies from 2001 spring planing survived and 1000 plants present and flowering. Emergents include bungleweed, smartweed, cattails, rice cutgrass, water plantain and creeping water primrose. Cattails increasing. Bluegills and mosquito fish present.

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Inundated in 1993, 60% dry in 1997, 100% wet in 2000, high water level maintained. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 10% coverage of duckweed, water meal, coontail, and filamentous algae. Water smartweed, rice cutgrass, creeping water primrose and cattails increasing along edges. Large numbers of mosquito fish present. Lake chubsuckers present?

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 100% wet, highest water level ever observed. Willows 100% mortality. Aquatic vegetation 35 % coverage of azola, filamentous algae, duckweed, giant duckweed, sago, water milfoil and coontail predominant. Emergents include rice cutgrass and cattails.

<u>GLASFORD T XTRA POND</u>: (map code B2) Almost connected to main lake; beaver dam only blockage. 100% willow mortality. Aquatic vegetation 10% composed of sago and water milfoil. Emergents include a complete band of cattails(increasing) all around edge, water plantain, rice cutgrass and sphagnum moss, which is remaining in a small patch. Mosquito fish present.

<u>GLASFORD T at T on WEST SHORE:</u> (map code D) Aquatic vegetation coverage < 2% from the shore out to 3 feet depth. Composed of sago, American pondweed, water milfoil and coontail. Emergents include cattails and marsh milkweed. New island and channels were added in 1999. Vegetation coverage < 5% composed of american pondweed, water milfoil and coontail. High Canadian geese use.

<u>GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:</u> (map code E) Aquatic vegetation 10% coverage. Very limited rooted aquatic vegetation of water milfoil. Emergents include a fringe of cattails and 200 lotus pads present for the third year. Lotus located on North side near the middle ditch. Water clarity 1'.

**GLASFORD T, IDOT MITIGATION SITE:** (map code **E1**) Up to 6 acres of hydric soil present, high water level maintained. Aquatic vegetation 5% composed of water milfoil, leafy pondweed, American pondweed and sago. Rooted aquatic vegetation level greatly reduced. Solid vegetation coverage of cattails, willows, sedges, water plantain, smartweed, and rice cutgrass. Cattails stand increasing. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did encroach into ag field.

<u>GLASFORD T HIDDEN COVE</u>: (map code **F**) Aquatic vegetation coverage < 5% composed of water milfoil, duckweed, coontail, leafy pondweed and sago. Emergents include creeping water primrose and cattails. Water level at historical high and attached to back ditch with easy boat access. Water clarity 1'.

WHEEL LAKE SECTION: (map code G1 and G2) Water clarity 6". 100% mortality on trees.

Aquatic vegetation in protected cover 10% and composed of water milfoil, coontail, sago, american pondweed and duckweed in the back of coves. Lotus beds present for first time in 1999. 100 leaf colony on east side of back cove. Large lotus patch of about 1000 against levee on west end. Emergents include cattails, smartweed, rice cutgrass, creeping water primrose, marsh milkweed and phragmites.

Levee channel and flat has 5% coverage of coontail, sago, and water milfoil. Water smartweed, marsh mallow and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

WHEEL LAKE KIDS POND & LAKE: (map code G3) Kids pond has < 2% coverage of filamentous algae. Emergent present is creeping water primrose. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. A beaver cutdown the majority of the cottonwood trees along the edge. Adjacent Lake has 95% coverage of aquatic vegetation composed of water milfoil. Emergents include water smartweed, softstem bulrush, cattails, and creeping water primrose. Willow border getting denser. Bluegills and bambusia present.

# ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003/2004. South side area supports large lotus colony (10,000+ plants). Submerged aquatic vegetation coverage 10% and composed of American pondweed, water milfoil coontail and sago.

JOHNSON LAKE AREA - 7/7/2004 Reading on staff gauge is 436.6.

**JOHNSON EXTENSION:** (map code **H**) 8/3/2004, Highest water level over an extended season. 100% coverage by water. Aquatic vegetation coverage 80% in water <8' and composed predominantly of coontail and water milfoil. Also present filamentous algae, American pondweed, brittle naiad, southern naiad and water stargrass. Emergents include a dense cattail border, creeping water primrose, marsh milkweed and phragmites. Water clarity 3.5 feet.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage < 30% composed of sago, water milfoil, water smartweed and coontail. Emergents include cattails, bur reed, creeping water primrose, rice cutgrass and rumex. Water clarity approximately 3 feet.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) 100% water level. Aquatic vegetation coverage 90% composed of coontail, american pondweed, lotus, water milfoil, brittle naiad, and sago. Emergent border at former waters' edge composed of rumex, rice cutgrass, and cattails. Sedges present. Phragmites present on north shore. Lotus beds increasing again and the cattails have increased since 1996. Lotus coverage 80%.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 2 feet. Aquatic vegetation coverage of approximately 25% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, water stargrass, azola and filamentous algae. Emergents at edge include water smartweed, creeping water primrose, marsh milkweed, softstem bulrush, rumex and rice cutgrass. Cattails are increasing. On the east side in big bay, 1 large clump with 300 pads of water lilies. On the west shore in big bay, 18 clumps, with about 4 pads in each, of water lilies. 3' sedge border developing around water vegetation.

**JOHNSON LAKE EAST ARM:** (map code L) Water clarity 4 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, sago, curlyleaf pondweed, water stargrass, water milfoil, filamentous algae and coontail. Emergents are creeping water primrose.

JOHNSON LAKE EAST DITCH: (map code M) Water clarity 6 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage and 8 feet deep. Composed predominately of coontail, water milfoil, american pondweed and filamentous algae. Emergents include creeping water primrose, water smartweed, spikerush, phragmites(increasing) and cattails. A group of lotus, about 400, on the north side of the ditch.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 4 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 60% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, leafy pondweed, duckweed, small pondweed, filamentous algae, and american pondweed. Emergents at waters' edge include smartweed, cattail, spike rush, marsh mallow(stressed), creeping water primrose and rice cutgrass. Sedge border developing along water's edge where phragmites is not present. Phragmites extremely thick where border has developed.

**JOHNSON LAKE BACK DITCH:** (map code **N**) Water clarity is 4 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 85% with 10 feet depth. Composed predominately of coontail and water milfoil. Also present are american pondweed and sago. Creeping water primrose and rice cutgrass present in shallow static areas. Many emergents from 1997 underwater - water smartweed, marsh mallow and cattails, increasing in density. Several thousand lotus leaf pads present on the west side of the main back ditch.

## 7/9/04 SHOVEL LAKE: Water clarity 5 feet.

SHOVEL LAKE COPPERAS CREEK ARM: (map code O1) Water clarity 3 feet. Aquatic vegetation coverage 10% composed predominately of coontail. Present in small quantities is sago pondweed, azola, water milfoil, duckweed, giant duckweed, filamentous algae, small pondweed, leafy pondweed and american pondweed. 100% mortality on flooded willows. Emergents include reed grass, cattails, and rice cutgrass. Reed grass is progressing along the shoreline and becoming very dense up 2/3 of arm on inside. Up until this point, highest vegetation coverage observed was 80% at water <6 feet.

**SHOVEL LAKE at T & CHANNEL:** (map code **O2**) T cove coverage 70% and dominated by coontail, milfoil, duckweed, giant duckweed, sago, filamentous algae, azola, American pondweed, leafy pondweed and small pondweed. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) Water clarity 2 feet. New lake connection along west edge and cove is 40% coverage of coontail, sago pondweed, american pondweed, duckweed, giant duckweed, azola, brittle naiad, southern naiad, water milfoil, water stargrass, and small pondweed. Emergents include button bush, cattail(increasing), softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Reed grass present.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 5 feet. Aquatic vegetation coverage 1% of mainly coontail, american pondweed, sago pondweed, water milfoil, duckweed, azola, filamentous algae, southern naiad, brittle naiad and water stargrass. Emergents include cattails, creeping water primrose, softstem bulrush, spike rush, sedges, rice cutgrass, phragmites(present in very small scattered patches) and willows.

**<u>SHOVEL LAKE LOTUS LAKE:</u>** (map code **O5**) Large concentration of Lotus - 80% coverage.

Aquatic vegetation composed of american pondweed, coontail, sago, curlyleaf pondweed, water milfoil, filamentous algae and duckweed. Emergents include cattails, rumex and sedges. Young willows present.

**<u>PUMPHOUSE LAKE AND DITCH</u>**: (map code **P**) 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Water clarity 4 feet. Aquatic vegetation coverage of approximately 80% in water <6'. Composed of water milfoil, coontail, , leafy pondweed, sago and filamentous algae. Emergents include indigo bush, cattails, marsh milkweed and softstem bulrush.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Aquatic vegetation coverage 75% composed of coontail(present in water<8'), water milfoil, sago, filamentous algae, duckweed, brittle naiad, curlyleaf pondweed and small pondweed. Emergents include phragmites, cattails, softstem bullrush, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2004. Newly created basin now 70% coverage with rooted aquatic vegetation. Water clarity is 4 feet.

**<u>GLOVE LAKE:</u>** 10% vegetation coverage composed of water milfoil, sago, coontail, duckweed, giant duckweed, azola, and filamentous algae. Emergents include water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose.

**LAKE #29 surveyed:** (map code **Q**) 7/13/04 The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 8 feet. Aquatic vegetation coverage 5% of surface area and found in all areas under 8 feet of water. Composed of sago, brittle naiad, coontail, southern naiad, filamentous algae, duckweed, leafy pondweed, american pondweed and water milfoil. Water level at overflow.

<u>LAKE #14 and #15:</u> (map code **R**) 7/13/04 Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage 10% composed of water milfoil, southern naiad, leafy pondweed, coontail and filamentous algae. Carp population still under control for now. Water clarity 1.5 feet.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

# AQUATIC VEGETATION SURVEY BANNER MARSH 2005 7/11/05; 7/14/05

7/11/05, Water clarity three feet.

**<u>GLASFORD T PENINSULA</u>**: (map code **A**) Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies from 2001 spring planing survived and 100 plants present. Bluegills and mosquito fish present. Aquatic vegetation 75% coverage of filamentous algae, coontail, water milfoil, duckweed. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level 1 foot below high water mark and water clarity over 3 feet.

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Inundated in 1993, 60% dry in 1997, 100% wet in 2000, water level 1 foot below high water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 20% coverage of coontail and filamentous algae. Water smartweed, water plantain, creeping water primrose and cattails along edges and phragmites present in small patches. Large numbers of mosquito fish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 100% wet. Water level 6 inches below high water mark. Willows 100% mortality. Aquatic vegetation 80% coverage of american pondweed, filamentous algae, giant duckweed, sago, curly leaf pondweed and coontail predominant. Emergents include rice cutgrass, creeping water primrose and cattails.

<u>GLASFORD T XTRA POND</u>: (map code B2) Almost connected to main lake; beaver dam only blockage. 100% willow mortality. Aquatic vegetation 100% coverage of sago and coontail.. Emergents include a complete band of cattails all around edge, rice cutgrass and sphagnum moss, which is declining rapidly. Mosquito fish present.

<u>GLASFORD T at T on WEST SHORE:</u> (map code **D**) Aquatic vegetation coverage < 2% from the shore out to 3 feet depth. Composed of sago, curlyleaf pondweed, american pondweed, water milfoil, southern naiad and coontail. Emergents include cattails and marsh milkweed. New island and channels were added in 1999. Vegetation coverage < 5% composed of american pondweed, southern naiad, water milfoil and coontail. High Canada goose use.

<u>**GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:**</u> (map code **E**) < 5% water coverage. Very limited rooted aquatic vegetation of coontail and water milfoil. Emergents include a fringe of cattails and 100 lotus pads present for the third year. Lotus located on North side near the middle ditch. Water clarity 6".

**GLASFORD T, IDOT MITIGATION SITE:** (map code **E1**) Up to 6 acres of hydric soil present, high water level maintained. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did not encroach into ag field. Aquatic vegetation 95% coverage and composed of water milfoil, sago, leafy pondweed, american pondweed, southern naiad, brittle naiad and elodea. Rooted aquatic vegetation level greatly increased from 2004. Solid vegetation coverage of cattails, willows, sedges, water plantain, smartweed, and rice cutgrass. Cattails stand increasing.

<u>GLASFORD T HIDDEN COVE:</u> (map code F) Aquatic vegetation coverage 5% composed of water milfoil, coontail, leafy pondweed and sago. Emergents include creeping water primrose and cattails.

Water level 1 foot below historical high. Water clarity 2 feet.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 6 inches. 100% mortality on trees. Aquatic vegetation in protected cover 10% composed of water milfoil, coontail, sago, and american pondweed in the back of coves. Lotus beds present for first time in 1999. 50 leaf colony on east side of back cove. Large lotus patch of about 1000 against levee on west end. Emergents include cattails, rumex, smartweed, rice cutgrass, creeping water primrose, marsh milkweed and phragmites.

Levee channel and flat has 5% coverage of coontail, sago, and water milfoil. Water smartweed, marsh mallow and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

**WHEEL LAKE KIDS POND & LAKE:** (map code **G3**) Kids pond has < 2% coverage of filamentous algae. Emergent present is creeping water primrose. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Adjacent Lake has 95% coverage of aquatic vegetation composed of filamentous algae, coontail, leafy pondweed, small pondweed, duckweed and water milfoil. Emergents include water smartweed, softstem bulrush, cattails, and creeping water primrose. Willow border is getting denser.

# ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. South side area supports large lotus colony (10,000+ plants). Submerged aquatic vegetation: 10% coverage- american pondweed, water milfoil, coontail, sago.

# JOHNSON LAKE AREA - 7/14/2005

Reading on staff gauge is 435.95.

**JOHNSON EXTENSION:** (map code **H**) Water clarity of 3.5 feet. High water level over an extended season. 100% coverage by water. Aquatic vegetation coverage 60% in water <8' and composed of water milfoil, brittle naiad, coontail, american pondweed, filamentous algae, and water stargrass. Emergents include a dense cattail border, creeping water primrose, marsh milkweed and an increasing phragmites border.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage 95% composed of sago, water milfoil, water smartweed, filamentous algae and coontail. Emergents include cattails, bur reed, creeping water primrose, rice cutgrass and rumex. Water clarity approximately 3 feet.

JOHNSON LAKE REARING POND ARM: (map code J) 100% water level. Aquatic vegetation coverage 40% in water <8' deep composed of predominantly of coontail, american pondweed, lotus, water milfoil, water star grass and sago. Emergent border at former waters' edge composed of rumex, rice cutgrass, and cattails. Sedges and water smartweed present. Phragmites increasing rapidly along north and south shores. Lotus beds stable and the cattails have increased since 1996. Lotus coverage 40%.

JOHNSON LAKE BIG BASIN: (map code K) Water clarity 2 feet. Aquatic vegetation coverage of approximately 25% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, water stargrass, and filamentous algae. Emergents at edge include water smartweed, creeping water primrose, marsh milkweed, softstem bulrush, rumex and rice cutgrass. Cattails are increasing. On the east side in big bay, 1 large clump with 500 pads of flowering water lilies. On the west shore in big bay, 10 clumps, with about 10 pads in each, of nonflowering water lilies. 3'

sedge border developing around water vegetation.

<u>JOHNSON LAKE EAST ARM</u>: (map code L) Water clarity 5 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, sago, curlyleaf pondweed, water milfoil, filamentous algae and coontail.

Emergents include creeping water primrose, cattails, phragmities and sedges forming on delta from route 24 watershed.

JOHNSON LAKE EAST DITCH: (map code M) Water clarity 5 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 75% coverage at 8 feet deep. Composed predominately of coontail, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, spikerush, phragmites and cattails. A group of lotus, about 400, on the north side of the ditch.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 1.5 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 50% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, leafy pondweed, water stargrass, small pondweed, filamentous algae, and american pondweed. Emergents at waters' edge include smartweed, cattail, spike rush, marsh mallow(increasing in coverage), creeping water primrose and rice cutgrass. Sedge border developing along water's edge where phragmites is not present. Phragmites extremely thick where border has developed.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 5 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 50% at 8 feet depth. Composed predominately of coontail, water milfoil, american pondweed, filamentous algae and sago. Creeping water primrose and rice cutgrass present in shallow static areas. Cattails increasing in density. Phragmites and marsh milkweed present. Several thousand lotus leaf pads present on the west side of the main back ditch.

# 7/11/2005

**SHOVEL LAKE:** Water clarity 5 feet.

SHOVEL LAKE COPPERAS CREEK ARM: (map code O1) Water clarity 4 feet. Aquatic vegetation coverage 5% composed predominately of water milfoil. 10% coverage in water <6 feet. Present in small quantities is sago pondweed, filamentous algae, small pondweed, leafy pondweed, coontail and american pondweed. 100% mortality on flooded willows. Emergents include reed grass, cattails, and rice cutgrass. Phragmites is progressing along the shoreline and becoming very dense up \_ of arm on inside.

**SHOVEL LAKE at T & CHANNEL:** (map code **O2**) T cove coverage 50% and dominated by coontail, milfoil, duckweed, giant duckweed, sago, curlyleaf pondweed, filamentous algae and small pondweed. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) New lake connection along west edge and cove is 25% coverage of coontail, sago pondweed, american pondweed, duckweed, giant duckweed, brittle naiad, southern naiad, leafy pondweed, water milfoil, elodea, water stargrass, and small pondweed. Emergents include button bush, cattail, softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Phragmites in present and increasing.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 5 feet. Aquatic vegetation coverage 1% of mainly coontail, american pondweed, sago pondweed, water milfoil, duckweed, filamentous algae, southern naiad, brittle naiad and water stargrass. Emergents include cattails, creeping water primrose, softstem bulrush, spike rush, sedges, rice cutgrass, phragmites (increasing in small scattered patches) and willows.

**<u>SHOVEL LAKE LOTUS LAKE:</u>** (map code **O5**) Large concentration of Lotus - 70% coverage. Aquatic vegetation composed of american pondweed, coontail, sago, water milfoil, filamentous algae and duckweed. Emergents include cattails, rumex and sedges. Young willows present.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) Water clarity 4 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 80% in water <6'. Composed of water milfoil, coontail, and american pondweed, sago and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, soft stem bullrush and creeping water primrose. Indigo bush is present.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Aquatic vegetation coverage 50% composed of coontail, water milfoil, sago, filamentous algae, duckweed, and american pondweed. Emergents include phragmites, cattails, softstem bullrush, creeping water primrose, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2004. Newly created basin now 50% coverage with rooted aquatic vegetation. Water clarity is 4 feet.

**<u>GLOVE LAKE</u>**: 5% vegetation coverage composed of water milfoil, sago, coontail, duckweed, giant duckweed, water stargrass, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 8 feet. Aquatic vegetation coverage 5% of surface area and found in all areas under 6 feet of water. Composed of sago, water stargrass, brittle naiad, coontail, southern naiad, filamentous algae, leafy pondweed, american pondweed and water milfoil. Water level 3' low.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage 10% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population still under control for now. Water clarity 3 feet.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

**DRAGONFLY LAKE**: 90% coverage of coontail, water milfoil and filamentous algae.

# AQUATIC VEGETATION SURVEY BANNER MARSH 2006 7/12/06; 8/2/06

8/2/06, Water clarity three feet.

<u>GLASFORD T PENINSULA:</u> (map code A) 3 feet low. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies from 2001 spring planing survived and 100 plants present? Bluegills and mosquito fish present. Aquatic vegetation 85% coverage of filamentous algae, coontail, water milfoil, duckweed. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level 3 feet below high water mark and water clarity over 3 feet . Large edge effect of sedges.

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level 1 foot below high water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 80% coverage of duckweed and filamentous algae. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails along edges and phragmites present in small patches. Large numbers of mosquito fish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 80% dry. Water level 6 inches below high water mark. Willows 100% mortality. Aquatic vegetation 10% coverage of american pondweed, filamentous algae, sago, and coontail predominant. Emergents include rice cutgrass, creeping water primrose and cattails.

<u>GLASFORD T XTRA POND</u>: (map code B2) Almost dry. 100% willow mortality. Aquatic vegetation 100% coverage of coontail and filamentous algae. Emergents include a complete band of cattails all around edge. Rice cutgrass has expanded. Mosquito fish present. Lycopdium still present.

<u>GLASFORD T at T on WEST SHORE:</u> (map code **D**) Aquatic vegetation coverage < 2% from the shore out to 3 feet depth. Composed of sago, american pondweed, water milfoil, southern naiad and coontail. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage < 5% composed of american pondweed, southern naiad, water milfoil and coontail. Expanded edge of sedges due to low water. High Canada goose use.

**GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:** (map code E) 30% dry. < 5% water coverage. Very limited rooted aquatic vegetation of coontail and water milfoil. Emergents include a fringe of cattails and 1000 lotus pads present for the third year. Lotus located on North side near the middle ditch. Water clarity 8".

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present, high water level maintained. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did not encroach into ag field. Area is dry with no vegetation coverage. Solid vegetation coverage of cattails, willows, water plantain, smartweed, and rice cutgrass. Large edge of sedges. Cattails stand increasing.

<u>GLASFORD T HIDDEN COVE:</u> (map code F) Aquatic vegetation coverage 5% composed of southern naiad, water milfoil, coontail, and sago. Emergents include creeping water primrose and cattails. Water level 3 feet below historical high. Water clarity 1 foot.

WHEEL LAKE SECTION: (map code G1 and G2) Water clarity 1 foot. 100% mortality on trees.

Aquatic vegetation in protected cover 5% composed of water milfoil, coontail, sago, and american pondweed in the back of coves. Lotus beds present for first time in 1999. 50 leaf colony on east side of back cove. Large lotus patch of about 10,000 against levee on west end. Emergents include cattails, rumex, smartweed, rice cutgrass, creeping water primrose, marsh milkweed and phragmites.

Low water level at levee channel and flat has 5% coverage of coontail, sago, and water milfoil. Water smartweed, marsh mallow and creeping water primrose present on the shoreline. Water clarity 1.5 feet.

**WHEEL LAKE KIDS POND & LAKE:** (map code G3) Kids pond has 70% coverage of filamentous algae. Emergent present is creeping water primrose. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Adjacent Lake is very low with 100% coverage of aquatic vegetation composed of filamentous algae, coontail, leafy pondweed, small pondweed, duckweed and water milfoil. Emergents include water smartweed, softstem bulrush, cattails, and creeping water primrose. Willow border is getting denser.

# ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. South side area supports large lotus colony (10,000+ plants). Submerged aquatic vegetation: 10% coverage- american pondweed, water milfoil, coontail, sago.

Reading on staff gauge on 7/12/2006 is 434.8; on 8/2/2006 staff gauge reads 434.5

**JOHNSON EXTENSION:** (map code **H**) Water clarity of 5 feet. Low water level. Aquatic vegetation coverage 60% in water <8' and composed of water milfoil, brittle naiad, coontail, american pondweed, curlyleaf pondweed, southern naiad, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, softstem bulrush, elodea and an increasing phragmites border.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage 95% composed of sago, water milfoil, water smartweed, filamentous algae and coontail. Emergents include cattails, bur reed, creeping water primrose, rice cutgrass and rumex. Water clarity approximately 3 feet.

JOHNSON LAKE REARING POND ARM: (map code J) Water level low. Aquatic vegetation coverage 90% in water <8' deep composed of predominantly of coontail, american pondweed, lotus, water milfoil, curlyleaf pondweed, filamentous algae and sago. Emergent border at former waters' edge composed of rumex, rice cutgrass, and cattails. Sedges and water smartweed present. Phragmites increasing rapidly along north and south shores. Lotus beds stable and the cattails have increased since 1996. Lotus coverage 40%. Rice cutgrass and phragmites advancing along the dry edge.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 5 feet. Aquatic vegetation coverage of approximately 50% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, water stargrass, curlyleaf pondweed, chara, brittle naiad and filamentous algae. Emergents at edge include marsh milkweed, softstem bulrush, rumex and rice cutgrass. Cattails and phragmites are increasing. On the east side in big bay, 1 large clump with 300 pads of flowering water lilies. On the west shore in big bay, 7 clumps, with about 7 pads in each, of nonflowering water lilies present on exposed mud flat. 3' sedge border developing around water vegetation expanding this year due to low water level. Sedge border much larger this year due to low water level.

JOHNSON LAKE EAST ARM: (map code L) Water clarity 5 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil,
filamentous algae and coontail. Emergents include cattails, phragmites and sedges forming on delta from route 24 watershed.

JOHNSON LAKE EAST DITCH: (map code M) Water clarity 5 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage at 8 feet deep. Composed predominately of coontail, water milfoil, curlyleaf pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, spikerush, phragmites and cattails. A group of lotus, about 50 lotus pads surviving on dry land, on the north side of the ditch. Large area of exposed mud flats.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 1.5 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 60% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, leafy pondweed, water stargrass, small pondweed, filamentous algae, and american pondweed. Emergents at waters' edge include smartweed, cattail, spike rush, marsh mallow(increasing in coverage), creeping water primrose and rice cutgrass. Sedge border developing along water's edge where phragmites is not present. Phragmites extremely thick where border has developed. Due to low water level, edge effect much larger. Traditional access <10" deep.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 5 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 90% at 8 feet depth. Composed predominately of coontail, water milfoil, american pondweed, filamentous algae. Creeping water primrose and rice cutgrass present in shallow static areas. Cattails increasing in density. Phragmites present. Several thousand lotus leaf pads present on the west side of the main back ditch. Expanded sedge border due to low water level.

### 8/2/2006

SHOVEL LAKE: Water clarity 5 feet.

**SHOVEL LAKE COPPERAS CREEK ARM:** (map code **O1**) Water clarity 1.5 feet. Aquatic vegetation coverage <2% composed predominately of water milfoil. 2% coverage in water <6 feet. Present in small quantities is filamentous algae. 100% mortality on flooded willows. Emergents include reed grass, cattails, and rice cutgrass. Phragmites is progressing very fast along the shoreline and becoming very dense up < of arm on inside.

**<u>SHOVEL LAKE at T & CHANNEL</u>**: (map code **O2**) T cove coverage 50% and dying milfoil and azola, duckweed, sago, filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) New lake connection along west edge and cove is 25% coverage of coontail, sago pondweed, brittle naiad, southern naiad, leafy pondweed, water milfoil, water stargrass, and small pondweed. Emergents include button bush, cattail, softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Phragmites in present and increasing.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 2 feet. Aquatic vegetation coverage 1% of mainly coontail, american pondweed, sago pondweed, water milfoil, filamentous algae, southern naiad, brittle naiad and water stargrass. Emergents include cattails, creeping water primrose, softstem bulrush, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side) and willows.

**<u>SHOVEL LAKE LOTUS LAKE:</u>** (map code **O5**) Large concentration of Lotus - 45% coverage. Aquatic vegetation composed of coontail, water milfoil, filamentous algae and duckweed. Emergents include cattails, creeping water primrose, rumex and sedges. Young willows present.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) See JL Extension. Water clarity 5 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 60% in water <6'. Composed of water milfoil, coontail, and american pondweed, sago and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, soft stem bullrush and creeping water primrose. Indigo bush is present.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Aquatic vegetation coverage 60% composed of coontail, water milfoil, sago, filamentous algae, and american pondweed. Emergents include phragmites, cattails, softstem bullrush, creeping water primrose, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. Newly created basin now 60% coverage with rooted aquatic vegetation. Water clarity is 3 feet. Phragmites increasing significantly on west side.

**<u>GLOVE LAKE</u>**: 5% vegetation coverage composed of water milfoil, sago, coontail, duckweed, giant duckweed, water stargrass, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 8 feet. Aquatic vegetation coverage 5% of surface area and found in all areas under 6 feet of water. Composed of sago, water stargrass, brittle naiad, coontail, southern naiad, filamentous algae, leafy pondweed, american pondweed and water milfoil. Water level 5' low.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage 10% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population still under control for now. Water clarity 3 feet.

**ISOLATION DITCH:** (map code **S**) No submerged, aquatic vegetation present.

**DRAGONFLY LAKE:** 90% coverage of coontail, water milfoil and filamentous algae. Level 2' low. Water clarity 5 feet.

# **AQUATIC VEGETATION SURVEY BANNER MARSH 2007**

8/3/07, Water clarity 5 feet.

<u>GLASFORD T PENINSULA:</u> (map code A) 1 feet low. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies from 2001 spring planing survived and 100 plants present. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 50% coverage of filamentous algae, coontail, leafy pondweed, duckweed. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level 1 feet below high water mark and water clarity over 3 feet . Large edge effect of sedges reduced.

**GLASFORD T FORK LAKE:** (map code **B**) Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level 2.5 foot below high water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 5% coverage of coontail and leafy pondweed. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails along edges and phragmites increasing in small patches. Large numbers of mosquito fish and green sunfish present.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 50% wet. Willows 100% mortality. Aquatic vegetation 75% coverage of american pondweed, filamentous algae and coontail predominant. Water milfoil and brittle naiad signs of dying back. Large clump of phragmites near the entrance to the chute. Emergents include rice cutgrass, creeping water primrose, softstem bulrush, sedges and cattails.

<u>GLASFORD T XTRA POND</u>: (map code B2) 2 feet below high water mark. 100% willow mortality. Aquatic vegetation 75% coverage of milfoil and filamentous algae. Emergents include a complete band of cattails all around edge. Rice cutgrass present. Mosquito fish present. Lycopodium still present barely.

<u>GLASFORD T at T on WEST SHORE:</u> (map code **D**) Aquatic vegetation coverage 10 % from the shore out to 6 feet depth. Composed of sago, american pondweed, water milfoil, brittle naiad, and southern naiad. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage 70% composed of american pondweed, southern naiad, water milfoil and coontail. Expanded edge of sedges partially flooded due to low water. Cattails and phragmites increasing.

**<u>GLASFORD T, IDOT MITIGATION SITE:</u>** (map code **E1**) Up to 6 acres of hydric soil present, high water level maintained. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did not encroach into ag field. 50% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, milfoil, brittle naiad, sago, american pondweed, southern naiad and duckweed. Solid vegetation coverage of cattails, willows, water plantain, smartweed, marsh weed and rice cutgrass. Well developed stand of cattails.

### **<u>GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:</u>** (map code **E**)

90% water coverage. 60% rooted aquatic vegetation of coontail, water milfoil, brittle naiad, and southern naiad. Emergents include a strong cattail border and 5000 lotus pads present since 2003. Lotus located on North side near the middle ditch. Water clarity 2 feet.

**<u>GLASFORD T HIDDEN COVE</u>** (map code **F**) Aquatic vegetation coverage 80% in water less than 6 feet composed of water milfoil, brittle naiad and sago. Milfoil experiencing strong die back. Emergents include creeping water primrose, sedges, rice cutgrass and cattails. Water level 1 feet below historical high. Water clarity 4 feet.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 2 feet. 100% mortality on trees. Aquatic vegetation in protected cover 20% in water less than 6 feet. Composed of water milfoil, coontail, brittle naiad, sago, and american pondweed in the back of coves. Milfoil experiencing die back. Lotus beds present for first time in 1999. Lotus colony nonexistent on east side of back cove. Large lotus patch of about 1000 against levee on west end. Two, 2000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Cattails and phragmites increasing.

Low water level at levee channel and flat has 45% coverage of southern naiad, sago, and water milfoil. Milfoil is dying back. Cattails, phragmites, and marsh mallow present on the shoreline. Water clarity 1.5 feet.

WHEEL LAKE KIDS POND & LAKE: (map code G3) Kids pond has 70% coverage of sago, coontail, brittle naiad and filamentous algae. Emergent present is creeping water primrose. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

In Adjacent Lake the water level is 1 foot low with 50% coverage of aquatic vegetation composed of filamentous algae, coontail, leafy pondweed, southern naiad and water milfoil. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005.

South side area supports large lotus colony (10,000+ plants) with 85% coverage with marsh milkweed, phragmites and cattails present too.

Submerged aquatic vegetation: 10% coverage- american pondweed, water milfoil, coontail, brittle naiad and filamentous algae.

### JOHNSON LAKE AREA - 8/1/2007

Reading on staff gauge on 8/1/2007 is 436.2.

**JOHNSON EXTENSION:** (map code **H**) Water clarity of 6 feet. Aquatic vegetation coverage 90% in water <8' and composed of water milfoil, brittle naiad, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border.

**WEST LAKE**: Water clarity 14 feet. 80% coverage in water less than 8 feet deep. Composed of milfoil, coontail and american pondweed. Strong phragmites border developing.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage 85% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity greater than 6 feet.

JOHNSON LAKE REARING POND ARM: (map code J) Water level low. Water clarity 6 feet. Aquatic vegetation coverage 50% in water <6' deep composed of predominantly of coontail, american pondweed, lotus, water milfoil, brittle naiad and sago. Emergent border at former waters' edge composed of marsh milkweed, rice cutgrass, and cattails. Sedges and water smartweed present. Phragmites increasing rapidly along north and south shores. Lotus beds decreasing. Lotus coverage 20%. Rice cutgrass and phragmites advancing along the dry edge. **JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 12 feet. Aquatic vegetation coverage of approximately 50% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, water stargrass, southern naiad, brittle naiad and filamentous algae. Large areas of milfoil dying back very rapidly. Emergents at edge include marsh milkweed, softstem bulrush, creeping water primrose and rice cutgrass. Cattails and phragmites are increasing. On the east side in big bay, 1 large clump with 1000 pads. On the west shore in big bay, 4 clumps, with about 5 pads in each, of nonflowering water lilies present on exposed mud flat. Sedge border present.

<u>JOHNSON LAKE EAST ARM</u>: (map code L) Water clarity 7 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, filamentous algae, brittle naiad, sago and coontail.

Emergents include cattails, phragmites, creeping water primrose and sedges forming on delta from route 24 watershed.

**JOHNSON LAKE EAST DITCH:** (map code **M**) Water clarity 4 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage at 8 feet deep. Composed predominately of coontail, water milfoil (present and rapidly dying back), and filamentous algae. Emergents include creeping water primrose, water smartweed, spikerush, rice cutgrass, marsh milkweed, phragmites (increasing) and cattails. A group of lotus, about 1000 lotus pads surviving on dry land, on the north side of the ditch. Large area of exposed mud flats.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 4 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 80% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, southern naiad, brittle naiad, water stargrass, filamentous algae, and american pondweed. Milfoil suffering a strong dieback. Emergents at waters' edge include cattail, spike rush, marsh mallow(increasing in coverage), creeping water primrose and rice cutgrass. Sedge border developing along water's edge where phragmites is not present. Phragmites extremely thick where border has developed. Due to low water level, edge effect much larger. Traditional access <10" deep.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 6 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 90% at 8 feet depth. Composed predominately of coontail, water milfoil, american pondweed, filamentous algae. Milfoil rapidly dying off. Creeping water primrose and rice cutgrass present in shallow static areas. Cattails increasing in density. Phragmites present. Several thousand lotus leaf pads present on the west side of the main back ditch. Expanded sedge border due to last year's low water level.

SHOVEL LAKE: Water clarity 5 feet. 8/1/2007

**SHOVEL LAKE COPPERAS CREEK ARM:** (map code **O1**) Water clarity 3 feet. Aquatic vegetation coverage composed predominately of water milfoil, sago and southern naiad. 70% coverage in water <6 feet. Milfoil experiencing a strong summer die back. Present in small quantities is filamentous algae. 100% mortality on flooded willows. Emergents include phragmites and creeping water primrose. Phragmites is progressing very fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

**SHOVEL LAKE at T & CHANNEL:** (map code **O2**) T cove coverage 60% of american pondweed, azola, duckweed, sago, and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) Water clarity 1.5 feet. New lake connection along west edge and cove is 40% coverage of coontail, sago pondweed, brittle naiad, southern naiad, leafy pondweed, american pondweed, water milfoil, filamentous algae and water stargrass. Emergents include button bush, cattail, creeping water primrose, softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Phragmites in present and increasing.

**<u>SHOVEL LAKE COVE AT T</u>**: Water clarity 5 feet. 95% coverage in water less than 6 feet deep. Aquatic vegetation composed of milfoil, sago and filamentous algae.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 5 feet. Aquatic vegetation coverage 95% of mainly milfoil, coontail, american pondweed, sago pondweed, water milfoil, filamentous algae, southern naiad, and brittle naiad. Emergents include cattails, creeping water primrose, softstem bulrush, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side and small patches on the east side) and willows.

**SHOVEL LAKE LOTUS LAKE:** (map code **O5**) Water clarity 5 feet. Large concentration of Lotus - 45% coverage. Aquatic vegetation composed of coontail (dominant), water milfoil, filamentous algae and sago. Emergents include cattails, rice cutgrass, rumex and sedges. Young willows present.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) See JL Extension. Water clarity 5 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 90% in water <8'. Composed of water milfoil (dominant), coontail, and american pondweed, sago and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, soft stem bullrush and creeping water primrose. Indigo bush is present.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 6 feet. Aquatic vegetation coverage 70% composed of coontail, water milfoil, sago, filamentous algae, and american pondweed. Coontail growing in water over 8 feet deep. Emergents include phragmites, cattails, softstem bullrush, creeping water primrose, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. Newly created basin now 70% coverage with rooted aquatic vegetation. Phragmites increasing significantly on west side.

**<u>GLOVE LAKE</u>**: 70% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, small pondweed, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose. Phragmites present in small patches becoming well established.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 6 feet. Aquatic vegetation coverage 10% of surface area and found in all areas under 6 feet of water. Composed of sago, brittle naiad, coontail, filamentous algae, american pondweed and water milfoil. Water level 2' low.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 5% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population expanding again. Water clarity 3 feet.

**ISOLATION DITCH:** (map code **S**) Water clarity 1.5 feet. 20% coverage of milfoil and filamentous algae.

# **AQUATIC VEGETATION SURVEY BANNER MARSH 2008**

8/29/08, water clarity 3 feet.

**GLASFORD T PENINSULA:** (map code **A**) 1 feet low. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies from 2001 spring planing survived and 20 plants present. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 75% coverage of filamentous algae, coontail. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level at high water mark and water clarity over 6 feet . Large edge effect of sedges gone..

<u>GLASFORD T FORK LAKE:</u> (map code **B**) Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level at high water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation <5% coverage of coontail and leafy pondweed. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails along edges and phragmites increasing in huge patches. Large numbers of mosquito fish and green sunfish present, maybe carp too?.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 50% wet. Willows 100% mortality. Aquatic vegetation 95% coverage of american pondweed, filamentous algae and coontail predominant. Water milfoil, brittle naiad, duckweed, azola and sago pondweed. Large clump of phragmites near the entrance to the chute. Emergents include rice cutgrass, creeping water primrose, softstem bulrush, sedges and large cattail border.

**GLASFORD T XTRA POND:** (map code B2) 2 feet below high water mark. 100% willow mortality. Aquatic vegetation 20% coverage of milfoil, coontail, sago, and brittle naiad. Emergents include a complete band of cattails all around edge. Rice cutgrass present. Mosquito fish, bluegill and largemouth bass observed. Connected to main lake by beaver run. Strong cattail and phragmites border developing. Lycopodium not observed.

<u>GLASFORD T at T on WEST SHORE:</u> (map code **D**) Aquatic vegetation coverage <1 % from the shore out to 6 feet depth. Composed of american pondweed, and brittle naiad. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage 50% composed of american pondweed, southern naiad, brittle naiad, water milfoil and coontail. Expanded edge of softstem bullrush and sedges. Cattails and phragmites increasing.

<u>GLASFORD T, IDOT MITIGATION SITE:</u> (map code E1) Up to 6 acres of hydric soil present, high water level maintained. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels. Spring water did not encroach into ag field. 50% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, milfoil, brittle naiad, sago, american pondweed, southern naiad and leafy pondweed. Solid vegetation coverage of cattails, willows, marsh milk weed and rice cutgrass. Well developed stand of cattails. Small sedge border developing on water's edge.

### **<u>GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:</u>** (map code E)

20% rooted aquatic vegetation of coontail, sago, water milfoil, brittle naiad, leafy pondweed and southern naiad. Emergents include a strong cattail border and 5000 lotus pads present since 2003. Lotus located on North side near the middle ditch. Water clarity 2.5 feet.

**<u>GLASFORD T HIDDEN COVE:</u>** (map code **F**) Aquatic vegetation coverage 30% in water less than 6 feet composed of water milfoil, coontail, brittle naiad and sago. Emergents include creeping water primrose, sedges, rice cutgrass and cattails. Water level back up to historical high. Water clarity 2.5 feet.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 2 feet. 100% mortality on trees. Aquatic vegetation in protected cover 10% in water less than 6 feet. Composed of water milfoil, coontail, brittle naiad, sago, southern naiad and american pondweed in the back of coves. Lotus beds present for first time in 1999. Lotus colony 6 pads on east side of back cove. Large lotus patch of about 1000 against levee on west end. 10,000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Cattails and phragmites border increasing around entire lake. Strong coverage of coontail and water milfoil.

WHEEL LAKE KIDS POND & LAKE: (map code G3) Kids pond has ,1% coverage of sago, coontail, brittle naiad and filamentous algae. Emergent present is creeping water primrose and cattails. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Treated May 2008 with 2 quart sonar. Good results on cattails and submerged aquatics.

In Adjacent Lake the water level is 1 foot low with 60% coverage of aquatic vegetation composed of filamentous algae, coontail, leafy pondweed, southern naiad and water milfoil. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005.

South side area supports large lotus colony (10,000+ plants) with 95% coverage with marsh milkweed, phragmites and cattails present too.

Submerged aquatic vegetation: 10% coverage- american pondweed, water milfoil, coontail, brittle naiad and filamentous algae.

### JOHNSON LAKE AREA - 8/29/2008

Reading on staff gauge on 8/29/2008 is 435.8.

**JOHNSON EXTENSION:** (map code **H**) Water clarity of 7 feet. Aquatic vegetation coverage 90% in water <8' and composed of water milfoil, brittle naiad, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border.

<u>WEST LAKE:</u> Water clarity 14 feet. 80% coverage in water less than 8 feet deep. Composed of milfoil, coontail and american pondweed. Strong phragmites border developing.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage 85% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity greater than 6 feet.

JOHNSON LAKE REARING POND ARM: (map code J) Water clarity 5 feet. Aquatic vegetation coverage 80% in water <6' deep composed of predominantly of coontail, american pondweed, lotus, water milfoil, brittle naiad and sago. Emergent border at former waters' edge composed of rice cutgrass, and cattails. Phragmites increasing dramatically around entire section. Lotus beds decreasing. Lotus coverage 20%. Rice cutgrass and phragmites advancing along the dry edge.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 8 feet. Aquatic vegetation coverage of approximately 70% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, chara, southern naiad, brittle naiad and filamentous algae. Emergents at

edge include marsh milkweed, softstem bulrush, creeping water primrose and rice cutgrass. Cattails and phragmites are increasing dramatically. Sedge border present.

JOHNSON LAKE EAST ARM: (map code L) Water clarity 7 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, sago and coontail.

Emergents include cattails, small batches of phragmites present, creeping water primrose and sedges forming on delta from route 24 watershed.

JOHNSON LAKE EAST DITCH: (map code M) Water clarity 8 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage at 10 feet deep. Composed predominately of coontail, water milfoil, american pondweed and filamentous algae. Emergents include creeping water primrose, water smartweed, spikerush, rice cutgrass, marsh milkweed, phragmites (dramatically increasing) and cattails. A group of lotus, about 2000 lotus pads on the north side of the ditch. Large area of exposed mud flats.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 6 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 90% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, southern naiad, brittle naiad, leafy pondweed, water stargrass, filamentous algae, and american pondweed. Emergents at waters' edge include cattail, spike rush, marsh mallow(increasing in coverage), creeping water primrose and rice cutgrass. Sedge border developing along water's edge where phragmites is not present. Phragmites extremely thick where border has developed. Due to low water level, edge effect much larger. Traditional access <10" deep. 300 lotus pads developing on west side of back lake. Clusters of marshmallow persisting outside of phragmites border.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 7 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 90% at 8 feet depth. Composed predominately of coontail, water milfoil, american pondweed, and sago. Creeping water primrose and rice cutgrass present in shallow static areas. Cattails and Phragmites border dramatically increasing in density. Several thousand lotus leaf pads present on the west side of the main back ditch.

SHOVEL LAKE: Water clarity 5 feet. 8/14/2008

**SHOVEL LAKE COPPERAS CREEK ARM:** (map code **O1**) Water clarity 3 feet. Aquatic vegetation coverage composed predominately of water milfoil, and sago. 70% coverage in water <6 feet. Milfoil experiencing a mild summer die back. Present in small quantities is filamentous algae. 100% mortality on flooded willows. Emergents include phragmites. Phragmites is progressing very fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

<u>SHOVEL LAKE at T CHANNEL:</u> (map code O2) T channel coverage 75% of milfoil, southern naiad, brittle naiad, coontail, azola, duckweed, sago, and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) Water clarity 1.5 feet. New lake connection along west edge and cove is 30% coverage of coontail, sago pondweed, brittle naiad, southern naiad, leafy pondweed, azola, american pondweed, water milfoil, filamentous algae and water stargrass. Emergents include button bush, cattail, creeping water primrose, softstem bulrush, rice cutgrass, rumex, spike rush and sedges. Phragmites and cattails are increasing.

**SHOVEL LAKE COVE AT T**: Water clarity 5 feet. 95% coverage in water less than 6 feet deep. Aquatic vegetation composed of milfoil, southern naiad, brittle naiad, american pondweed, duckweed, azola, sago and filamentous algae. Emergents include softstem bulrush.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 5 feet. Aquatic vegetation coverage 95% of mainly milfoil, coontail, american pondweed, sago pondweed, filamentous algae, southern naiad, and brittle naiad. Emergents include cattails, creeping water primrose, softstem bulrush, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side and small patches on the east side) and willows.

**<u>SHOVEL LAKE LOTUS LAKE:</u>** (map code **O5**) Water clarity 6 feet. Large concentration of Lotus - 75% coverage. Aquatic vegetation composed of coontail (dominant), water milfoil, filamentous algae and sago. Emergents include cattails, rice cutgrass, rumex and sedges.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) See JL Extension. Water clarity 7 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 90% in water <8'. Composed of water milfoil (dominant), coontail, and american pondweed, sago and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, soft stem bullrush and creeping water primrose. Indigo bush is present. Phragmites increasing dramatically.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 4 feet. Aquatic vegetation coverage 60% composed of coontail, water milfoil, sago, filamentous algae, and american pondweed. Coontail growing in water over 8 feet deep. Emergents include phragmites, cattails, softstem bullrush, creeping water primrose, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. Newly created basin now 60% coverage with rooted aquatic vegetation. Phragmites increasing significantly on west side.

**<u>GLOVE LAKE</u>**: 75% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, brittle naiad, southern naiad, small pondweed, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose. Phragmites present in small patches becoming well established.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 6 feet. Aquatic vegetation coverage 50% of surface area and found in all areas under 6 feet of water. Composed of sago, brittle naiad, southern naiad, coontail, filamentous algae, american pondweed and water milfoil. Water level 1' below overflow.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 5% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population expanding again. Water clarity 3 feet.

**ISOLATION DITCH:** (map code **S**) Water clarity 2.5 feet. 60% coverage of milfoil, coontail, azola, and duckweed.

# **AQUATIC VEGETATION SURVEY BANNER MARSH 2009**

8/12/09, water clarity 2.5 feet.

**GLASFORD T PENINSULA:** (map code **A**) 1 feet low. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Southern portion connected to main lake in Spring 2009 with the high water level. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies from 2001 spring planing survived and 20 plants present. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 95% coverage of filamentous algae, milfoil, duckweed and coontail. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level at highest water mark and water clarity over 6 feet . Large edge effect of sedges gone.

**GLASFORD T FORK LAKE:** (map code **B**) Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level at highest water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 5% coverage of coontail, azola, sago and leafy pondweed. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails along edges and phragmites increasing in huge patches. Large numbers of mosquito fish and green sunfish present. Water level past phragmities border and water clarity over 5 feet.

<u>GLASFORD T BEAVER CHUTE:</u> (map code C) Inundated in 1993, 90% dry in 1997, but now 50% wet. Willows 100% mortality. Aquatic vegetation 95% coverage of american pondweed, filamentous algae and coontail predominant. Water milfoil, brittle naiad, duckweed, giant duckweed, azola and sago pondweed. Complete clump of phragmites border with cattails. Emergents include rice cutgrass, creeping water primrose, softstem bulrush, and sedges.

<u>GLASFORD T XTRA POND</u>: (map code B2) Above high water mark. 100% willow mortality. Aquatic vegetation 95% coverage of milfoil, and coontail. Emergents include a complete band of cattails all around edge. Rice cutgrass present. Mosquito fish, bluegill and largemouth bass observed. Connected to main lake by beaver run. Strong cattail and phragmites border developed. Lycopodium not observed.

**<u>GLASFORD T at T on WEST SHORE:</u>** (map code **D**) Aquatic vegetation coverage <5 % from the shore out to 6 feet depth. Composed of american pondweed, sago and brittle naiad. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage 50% composed of american pondweed, southern naiad, brittle naiad, water milfoil and coontail. Expanded edge of softstem bullrush and sedges. Cattails and phragmites increasing substantially.

**GLASFORD T, IDOT MITIGATION SITE:** (map code **E1**) Up to 30 acres of hydric soil present, highest water level. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels, new moist soil area developed in ag. Field behind the tree border. Spring water did encroach into ag field. 65% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, milfoil, brittle naiad, sago, american pondweed, southern naiad and leafy pondweed. Solid vegetation coverage of cattails, willows, marsh milk weed and rice cutgrass. Well developed stand of cattails with very little phragmitites. Sedge border developing on water's edge in new edge in ag. field.

<u>GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:</u> (map code E) 80% rooted aquatic vegetation of coontail, sago, water milfoil, brittle naiad, leafy pondweed and southern naiad. Emergents include a strong cattail border and 15,000 lotus pads present since 2003. Lotus located on North side near the middle ditch. Phragmitites patch present on North edge. Water clarity 2.5 feet.

**<u>GLASFORD T HIDDEN COVE</u>**: (map code **F**) Aquatic vegetation coverage 30% in water less than 6 feet composed of water milfoil, coontail, duckweed, brittle naiad and sago. Emergents include creeping water primrose, sedges, water smartweed, rice cutgrass and cattails. Water clarity 2.5 feet.

**WHEEL LAKE SECTION:** (map code **G1** and **G2**) Water clarity 2 feet. 100% mortality on trees. Aquatic vegetation in protected cover 20% in water less than 6 feet. Composed of water milfoil, coontail, brittle naiad, sago, southern naiad and american pondweed in the back of coves. Lotus beds present for first time in 1999. Large lotus patch of about 20,000 against levee on west end. 10,000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Cattails and phragmites border increasing around entire lake. Strong coverage of coontail and water milfoil. South western moist soil unit now completely inundated and providing excellent submerged aquatic vegetation area. Coverage 95% dominated by coontail and water milfoil.

WHEEL LAKE KIDS POND & LAKE: (map code G3) Kids pond has ,5% coverage of sago, coontail, brittle naiad and filamentous algae. Emergent present is creeping water primrose and cattails. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Treated May 2008 with 2 quart sonar. Good results on cattails and submerged aquatics.

Water level very high in the spring of 2009 and no fish were added from the spring trapnet survey. In Adjacent Lake the water level is highest ever with 10% coverage of aquatic vegetation composed of filamentous algae, coontail, and water milfoil. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007, now phragmitites border is very dense.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. Water level highest ever in 2009.

South side area supports large lotus colony (10,000+ plants) with 95% coverage with marsh milkweed, phragmites and cattails present too.

Submerged aquatic vegetation: 80% coverage- american pondweed, water milfoil, coontail, brittle naiad and filamentous algae.

### JOHNSON LAKE AREA - 8/7/2009

Reading on staff gauge on 8/7/2009 is 437.2. Water clarity 9 feet. Current high water mark for 2009 appeared to be 437.8.

**JOHNSON EXTENSION:** (map code **H**) Water clarity of 6 feet. Aquatic vegetation coverage 90% in water <8' and composed of water milfoil, southern naiad, chara, water star grass, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border.

<u>WEST LAKE</u>: Water clarity 14 feet. 80% coverage in water less than 8 feet deep. Composed of milfoil, coontail, filamentous algae, water stargrass, brittle naiad, southern naiad, and american pondweed and creeping water primrose. Strong phragmites border developing.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage 85% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity greater than 6 feet.

<u>JOHNSON LAKE REARING POND ARM</u>: (map code J) Water clarity 3 feet due to algal bloom. Aquatic vegetation coverage 40% in water <6' deep composed of predominantly of coontail, american pondweed, lotus, water milfoil, brittle naiad and sago. Emergent border at former waters' edge composed of water smartweed and cattails. Phragmites increasing dramatically around entire section. Lotus beds decreasing. Lotus coverage 10%. Phragmites advancing along the dry edge.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 9 feet. Aquatic vegetation coverage of approximately 70% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, southern naiad, brittle naiad and filamentous algae. Emergents at edge include softstem bulrush, creeping water primrose and rice cutgrass. Cattails and phragmites are increasing dramatically. Sedge border present. Water lilies from 2001 planting: 200 pads present on west side of duck blind point with flowers present. East side of big basin there are 200 pads present and no flowers.

<u>JOHNSON LAKE EAST ARM</u>: (map code L) Water clarity 9 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, sago, leafy pondweed and coontail.

Emergents include cattails, small batches of phragmites present, creeping water primrose and sedges forming on delta from route 24 watershed.

JOHNSON LAKE EAST DITCH: (map code M) Water clarity 8 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage at 10 feet deep. Composed predominately of coontail, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, phragmites (dramatically increasing) and cattails. A group of lotus, about 250 lotus pads on the north side of the ditch. Large area of mud flats.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 6 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 90% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, leafy pondweed, water stargrass, filamentous algae, and american pondweed. Emergents at waters' edge include cattail, spike rush, marsh mallow(increasing in coverage), creeping water primrose. Phragmites extremely thick where border has developed. 300 lotus pads developing on east side of back lake. Clusters of marshmallow persisting outside of phragmites border.

Shoreline 90% coverage of cattails and phragmitites.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 7 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 100% at 8 feet depth. Composed predominately of coontail, filamentous algae, water milfoil, american pondweed, and sago. Creeping water primrose and water smart weed present in shallow static areas. Cattails and Phragmites border dramatically increasing in density and shoreline coverage almost 100%. Several hundred lotus leaf pads present on the west side of the main back ditch.

JOHNSON LAKE BACK DITCH BASIN/ STAFF GAUGE ARM: 80% coverage in water <8 feet, composed of coontail, milfoil, sago, american pondweed. Shoreline coverage almost 100 % of phragmitites, cattails, creeping water primrose and water smartweed. East side has lotus patch that covers approximately 5 acres.

SHOVEL LAKE: Water clarity 5 feet. 7/31/2009

**SHOVEL LAKE COPPERAS CREEK ARM:** (map code **O1**) Water clarity 8 feet. Aquatic vegetation coverage composed predominately of water milfoil and coontail (50/50). 80% coverage in water <6 feet. Milfoil experiencing a mild summer die back. Present in small quantities is filamentous

algae. 100% mortality on flooded willows. Emergents include phragmites. Phragmites is progressing very fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

**<u>SHOVEL LAKE at T CHANNEL</u>**: (map code **O2**) Water clarity 4 feet. T channel coverage 25% of milfoil, southern naiad, coontail, azola, duckweed, sago, and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) Water clarity 4 feet. New lake connection along west edge and cove is 30% coverage of coontail, sago pondweed, southern naiad, leafy pondweed, giant duckweed, duckweed, azola, american pondweed, water milfoil, filamentous algae. 85% coverage in water <8 feet. Emergents include button bush, cattail, creeping water primrose. Phragmites and cattails now flooded and decreasing on east edge.

**SHOVEL LAKE COVE AT T**: Water clarity 8 feet. 95% coverage in water less than 6 feet deep. Aquatic vegetation composed of milfoil, coontail, leafy pondweed, southern naiad, brittle naiad, american pondweed, duckweed, azola, sago and filamentous algae. Phragmities increasing on western edge and creeping water primrose present.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 5 feet. Aquatic vegetation coverage 95% in water <6 feet, composed of mainly milfoil, coontail, sago pondweed, filamentous algae, southern naiad, and brittle naiad. Emergents include cattails, creeping water primrose, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side and small patches on the east side).

**SHOVEL LAKE LOTUS LAKE:** (map code **O5**) Water clarity 3.5 feet. Large concentration of Lotus - 75% coverage. Aquatic vegetation 100% coverage in water <8 feet and composed of coontail (dominant), water milfoil, filamentous algae and sago. Emergents include cattails, rice cutgrass, creeping water primrose and sedges.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**) See JL Extension. Water clarity 7 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 90% in water <8'. Composed of water milfoil (dominant), coontail, and american pondweed, sago and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, sedges, soft stem bullrush and creeping water primrose. Indigo bush is present. Phragmites increasing dramatically.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 2 feet (due to algal bloom). Aquatic vegetation coverage 80% composed of coontail, water milfoil, sago, filamentous algae, and american pondweed. Coontail growing in water over 8 feet deep. Emergents include phragmites, cattails, softstem bullrush, creeping water primrose, marsh milkweed, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. In 2009 now 90% coverage with rooted aquatic vegetation. Phragmites increasing significantly on all sides.

**<u>GLOVE LAKE</u>**: 80% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, water star grass, azola, american ponweed, duckweed, brittle naiad, southern naiad, small pondweed, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose.

Phragmites present in small patches becoming well established.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly

improved water quality and thus habitat for aquatic vegetation. Water clarity 2.5 feet (due to algal bloom). Aquatic vegetation coverage 10% of surface area and found in all areas under 6 feet of water. Composed of coontail, filamentous algae, american pondweed and water milfoil. Water level at overflow.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 5% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population expanding again. Water clarity 3 feet.

**ISOLATION DITCH:** (map code **S**) Water clarity 1.5 feet. 95% coverage of milfoil, coontail, water meal, and duckweed.

# **AQUATIC VEGETATION SURVEY BANNER MARSH 2010**

8/26/10, water clarity 2.5 feet.

**GLASFORD T PENINSULA:** (map code **A**) 6 inches higher than high water mark. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Southern portion connected to main lake since Spring 2009 with the high water level. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies not observed 2001 spring planing and 20 plants present in 2009. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 50% coverage of filamentous algae, duckweed and coontail. Emergents include bungleweed, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level at highest water mark and water clarity over 6 feet . Large edge effect of sedges gone. Beaver dam maintaining high water level.

**<u>GLASFORD T FORK LAKE:</u>** (map code **B**) Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level at highest water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 75% coverage of coontail, azola, and duckweed. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails along edges and phragmites increasing in huge patches. Large numbers of mosquito fish and green sunfish present. Water level past phragmities border and water clarity over 5 feet.

**GLASFORD T BEAVER CHUTE:** (map code **C**) Inundated in 1993, 90% dry in 1997, but now 50% wet. Water clarity 3 feet. Willows 100% mortality. Aquatic vegetation 95% coverage of american pondweed, filamentous algae and coontail predominant. Water milfoil, naiad, duckweed, giant duckweed, azola and sago pondweed. Complete clump of phragmites border with cattails. Emergents include rice cutgrass, creeping water primrose, softstem bulrush, and sedges.

<u>GLASFORD T XTRA POND:</u> (map code B2) Above high water mark. 100% willow mortality. Aquatic vegetation 65% coverage of predominately coontail. Filamentous algae, azola, duckweed and giant duckweed also present. Emergents include a complete band of cattails all around edge. Rice cutgrass present. Mosquito fish, bluegill and largemouth bass observed. Connected to main lake by beaver run. Strong cattail and phragmites border developed.

<u>GLASFORD T at T on WEST SHORE:</u> (map code **D**) Aquatic vegetation coverage <5 % from the shore out to 6 feet depth. Composed of american pondweed, sago and coontail. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage 10% composed of american pondweed, southern naiad, brittle naiad, water milfoil, duckweed and coontail. Expanded edge of softstem bullrush and sedges. Cattails and phragmites increasing substantially. Water turbid in color, appears to be carp influenced.

**<u>GLASFORD T, IDOT MITIGATION SITE:</u>** (map code **E1**) Up to 30 acres of hydric soil present, highest water level. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels, new moist soil area developed in ag. Field behind the tree border. Spring water did encroach into ag field. 30% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, milfoil, brittle naiad, sago, duckweed, azola, filamentous algae, giant duckweed and leafy pondweed. Solid vegetation coverage of cattails, willows, marsh milk weed, creeping water primrose and rice cutgrass. Well developed stand of cattails with very little phragmitites. Sedge border developing on water's edge in new edge in ag. field.

### **<u>GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:</u>** (map code **E**)

25% rooted aquatic vegetation of coontail, sago, water milfoil, and

filamentous algae. Emergents include a strong cattail border and 10,000 lotus pads present since 2003. Lotus located on North side near the middle ditch. Phragmitites patch present on North edge and cattails on South. Water clarity 2 feet.

**<u>GLASFORD T HIDDEN COVE</u>**: (map code **F**) Aquatic vegetation coverage 20% in water less than 6 feet composed of coontail, duckweed, giant duckweed, filamentous algae and sago. Emergents include creeping water primrose, water smartweed, and rice cutgrass. Water clarity 2.5 feet.

WHEEL LAKE SECTION: (map code G1 and G2) Water clarity 2 feet. 100% mortality on trees. Aquatic vegetation in protected cover 10% in water less than 6 feet. Composed of water milfoil, coontail, sago, duckweed, filamentous algae and american pondweed in the back of coves. Lotus beds present for first time in 1999. Large lotus patch of about 20,000 against levee on west end. 20,000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Cattails and phragmites border increasing around entire lake. Sedges present on mud points. Strong coverage of coontail and water milfoil. South western moist soil unit now completely inundated and providing excellent submerged aquatic vegetation area. Coverage 85% dominated by coontail, sago, american pondweed and water milfoil.

WHEEL LAKE KIDS POND & LAKE: (map code G3) Kids pond has ,90% coverage in water less than 6 feet, of coontail, brittle naiad, sothern naiad and filamentous algae. Emergent present is creeping water primrose on entire border, sedges and cattails. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Treated May 2008 with 2 quart sonar. Good results on cattails and submerged aquatics.

Water level very high in the spring of 2009 and no fish were added from the spring trapnet survey. In Adjacent Lake the water level is highest ever with 80% coverage of aquatic vegetation composed of filamentous algae, coontail, duckweed and water milfoil. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007, now phragmitites border is very dense.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. Water level highest ever in 2009. South side area supports large lotus colony (5000+ plants) with 95% coverage with marsh milkweed, phragmites and cattails present too.

Submerged aquatic vegetation: 80% coverage- american pondweed, water milfoil, coontail, and filamentous algae. Lotus being overtaken by phragmites.

**<u>NORTH SIDE</u>**: 75% coverage of coontail, milfoil, american pondweed, filamentous algae. Emergents include phragmities, willow, cattails, creeping water primrose, water smartweed. Water clarity 5 feet.

### JOHNSON LAKE AREA - 8/19/2010

Reading on staff gauge on 8/19/2010 is 436.5. Water clarity 9 feet. Reading on staff gauge on 9/2/2010 is 436.4.

**JOHNSON EXTENSION:** (map code **H**) Water clarity of 9 feet. Aquatic vegetation coverage 90% in water <8' and composed of water milfoil, leafy pondweed, chara, water star grass, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border.

<u>WEST LAKE:</u> Water clarity 14 feet. 50% coverage in water less than 8 feet deep. Composed of milfoil, coontail, eloeda, leafy pondweed, sago, water stargrass, brittle naiad, southern naiad, and

american pondweed and creeping water primrose. Strong phragmites border developed.

**DRAGON FLY LAKE:** (map code I) Aquatic vegetation coverage 85% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity greater than 6 feet. Starhead topminnows present.

**JOHNSON LAKE REARING POND ARM:** (map code **J**) Water clarity 2 feet due to algal bloom. Aquatic vegetation coverage 20% in water <6' deep composed of predominantly of coontail, water milfoil, and sago. Emergent border at former waters' edge composed of water smartweed and creeping water primrose. Phragmites around entire section. Lotus beds decreasing. Lotus coverage 20%. Phragmites advancing along the dry edge. Starhead topminnows present.

**JOHNSON LAKE BIG BASIN:** (map code **K**) Water clarity 10 feet. Aquatic vegetation coverage of approximately 70% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, southern naiad, leafy pondweed, brittle naiad and water stargrass. Emergents at edge include softstem bulrush, creeping water primrose and rice cutgrass. Cattails and phragmites are increasing dramatically. Sedge border present. Water lilies from 2001 planting: 200 pads present on west side of duck blind point with flowers present. East side of big basin there are 500 pads present with flowers. Starhead topminnows present.

<u>JOHNSON LAKE EAST ARM</u>: (map code L) Water clarity 7 feet. Aquatic vegetation coverage < 5%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, sago, leafy pondweed, filamentous algae and coontail.

Emergents include cattails, small batches of phragmites present, creeping water primrose and sedges forming on delta from route 24 watershed. Starhead topminnows present.

JOHNSON LAKE EAST DITCH: (map code M) Water clarity 6 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 90% coverage at 10 feet deep. Composed predominately of coontail, azola, duckweed, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, phragmites (almost completely around entire shoreline edges) and cattails. A group of lotus, about 250 lotus pads on the north side of the ditch. Starhead topminnows present.

JOHNSON LAKE BLUE LAKE AREA: (map code M2) Water clarity is 3 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 90% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, duckweed, filamentous algae, and american pondweed. Emergents at waters' edge include cattail, spike rush, marsh mallow(increasing in coverage), water smartweed and creeping water primrose. Phragmites extremely thick where border has developed. 50 lotus pads developing on east side of back lake. Clusters of marshmallow persisting outside of phragmites border.

Shoreline 100% coverage of cattails and phragmitites. Starhead topminnows present at entrance channel to this section.

JOHNSON LAKE BACK DITCH: (map code N) Water clarity is 9 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 100% at 8 feet depth. Composed predominately of coontail, filamentous algae, water milfoil, american pondweed, leafy pondweed and sago. Creeping water primrose and water smart weed present in shallow static areas. Cattails and Phragmites border dramatically increasing in density and shoreline coverage almost 100%. Several hundred lotus leaf pads present on the west side of the main back ditch. Starhead topminnows present.

JOHNSON LAKE BACK DITCH BASIN/ STAFF GAUGE ARM: Water clarity is 9 feet. 80% coverage in water <8 feet, composed of coontail, milfoil, sago, american pondweed and curly leaf pondweed. Shoreline coverage almost 100 % of phragmitites, cattails, creeping water primrose and water smartweed. East side has lotus patch that covers approximately 5 acres. Starhead topminnows present.

### **SHOVEL LAKE:** Water clarity 5 feet. 8/26/2010

SHOVEL LAKE COPPERAS CREEK ARM: (map code O1) Water clarity 8 feet. Aquatic vegetation coverage composed predominately of coontail, also water milfoil and sago present. 80% coverage in water <6 feet. Milfoil experiencing a mild summer die back. Present in small quantities is filamentous algae. 100% mortality on flooded willows. Emergents include phragmites and creeping water primrose. Phragmites is progressing very fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

**SHOVEL LAKE at T CHANNEL:** (map code **O2**) Water clarity 6 feet. T channel coverage 100% of milfoil, coontail, azola, duckweed, giant duckweed and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** (map code **O3**) Water clarity 4 feet. New lake connection along west edge and cove is brittle naiad, coontail, sago pondweed, leafy pondweed, duckweed, american pondweed, water milfoil, filamentous algae. 85% coverage in water <8 feet. Emergents include button bush, cattail, creeping water primrose. Phragmites and cattails now flooded and decreasing on east edge.

**SHOVEL LAKE COVE AT T:** Water clarity 8 feet. 95% coverage in water less than 6 feet deep. Aquatic vegetation composed of milfoil, coontail(predominant), leafy pondweed, southern naiad, brittle naiad, american pondweed, duckweed, azola, sago and filamentous algae. Phragmities increasing on western edge and creeping water primrose present.

**SHOVEL LAKE BOAT RAMP ARM:** (map code **O4**) Water clarity 5 feet. Aquatic vegetation coverage 100% in water <6 feet, composed of coontail, american pondweed, sago pondweed, filamentous algae, and brittle naiad. Emergents include cattails, creeping water primrose, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side and completely on the east side).

**SHOVEL LAKE LOTUS LAKE:** (map code **O5**) Water clarity 3.5 feet. Large concentration of Lotus - 100% coverage. Aquatic vegetation 100% coverage in water <8 feet and composed of coontail (dominant), leafy pondweed, duckweed, filamentous algae and sago. Emergents include cattails, rice cutgrass, creeping water primrose and sedges.

**PUMPHOUSE LAKE AND DITCH:** (map code **P**). Water clarity 3 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 50% in water <8'. Composed of water milfoil (dominant), coontail, and american pondweed, sago and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, sedges, soft stem bullrush and creeping water primrose. Indigo bush is present. Phragmites increasing dramatically.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 2 feet (due to algal bloom). Aquatic vegetation coverage 80% composed of coontail, water milfoil, sago, filamentous algae, leafy pondweed, and duckweed. Coontail growing in water over 8 feet deep. Emergents include phragmites, cattails, water smart weed, creeping water primrose, marsh milkweed, sedges and rushes.

Original isolated ponds had 95% coverage with rooted vegetation in 2006. In 2009 now 90% coverage with rooted aquatic vegetation. Phragmites increasing significantly on all sides.

<u>GLOVE LAKE:</u> 50% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, leafy pondweed, duckweed, southern naiad, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose. Phragmites present in small patches becoming well established.

**LAKE #29 surveyed:** (map code **Q**) The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 1.5 feet (due to algal bloom). Aquatic vegetation coverage 5% of surface area and found in all areas under 6 feet of water. Composed of coontail, and american pondweed. Water level above overflow all spring. Starhead topminnows present.

**LAKE #14 and #15:** (map code **R**) Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 5% composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population expanding again. Water clarity 3 feet. Connected ditch 100% coverage of coontail, azola, duckweed, giant duckweed and filamentous algae.

**ISOLATION DITCH:** (map code **S**) Water clarity 1.5 feet. 50% coverage of milfoil and coontail.

## **AQUATIC VEGETATION SURVEY BANNER MARSH 2011**

### 7/15/11, water clarity 2.5 feet.

<u>GLASFORD T PENINSULA:</u> 6 inches higher than high water mark. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Southern portion connected to main lake since Spring 2009 with the high water level. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies not observed 2001 spring planing and 20 plants present in 2009. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 85% coverage of filamentous algae, duckweed and coontail, leafy pondweed, azola, milfoil and southern naiad. Emergents included, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Water level at highest water mark and water clarity 2 feet . Large edge effect of sedges gone. Beaver dam maintaining high water level. Water level approximately 1 foot higher than main lake due to beaver dam construction.

**<u>GLASFORD T FORK LAKE:</u>** Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level at highest water mark. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 85% coverage of coontail, azola, and duckweed. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails decreasing along edges and phragmites increasing almost completely around the perimeter. Large numbers of mosquito fish and green sunfish present. Water level past phragmities border and water clarity over 5 feet.

**<u>GLASFORD T BEAVER CHUTE:</u>** Inundated in 1993, 90% dry in 1997, but now 50% wet. Water clarity 3 feet. Willows 100% mortality. Aquatic vegetation 85% coverage of american pondweed, curley leaf pondweed, leafy pondweed, brittle naiad, filamentous algae and coontail predominant. Water milfoil, naiad, duckweed, giant duckweed, azola and sago pondweed. Complete clump of phragmites border with cattails. Emergents include rice cutgrass, and smartweed.

**<u>GLASFORD T XTRA POND</u>**: Above high water mark. Water clarity 4 feet. 100% willow mortality. Aquatic vegetation 40% coverage of predominately coontail. Azola, duckweed and giant duckweed also present. Emergents include a complete band of cattails all around edge. Rice cutgrass present. Connected to main lake by beaver run. Phragmites border 100% with some cattails present.

**<u>GLASFORD T at T on WEST SHORE:</u>** Aquatic vegetation coverage <5 % from the shore out to 6 feet depth. Water clarity 2.5 feet. Composed of american pondweed, milfoil, brittle naiad, and coontail. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage 10% composed of american pondweed, sago, curley leaf pondweed, azola, brittle naiad, water milfoil, duckweed and coontail. Expanded edge of softstem bullrush and sedges. Cattails and phragmites increasing substantially. Water turbid in color, appears to be carp influenced.

**GLASFORD T, IDOT MITIGATION SITE:** Up to 30 acres of hydric soil present, highest water level. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels, new moist soil area developed in ag. Field behind the tree border. Spring water did encroach into ag field. 70% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, curley leaf pondweed, southern naiad, milfoil, brittle naiad, sago, duckweed, azola, filamentous algae, giant duckweed and leafy pondweed. Solid vegetation coverage of cattails, willows, marsh milk weed, creeping water primrose and rice cutgrass. Well developed stand of cattails with very little phragmitites. Sedge border developing on water's edge in new edge in ag. field. 50 % of Ag. Field volunteer cattails and smartweed due to higher water level.

### **GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:**

30% rooted aquatic vegetation of coontail, sago, water milfoil, brittle naiad, duckweed, azola, and filamentous algae. Emergents include a strong cattail border and 10,000 lotus pads present since 2003. Lotus located on North side near the middle ditch. Phragmitites patch present on North edge and cattails on South. Water clarity 3 feet.

**<u>GLASFORD T HIDDEN COVE:</u>** Aquatic vegetation coverage 10% in water less than 6 feet composed of coontail, duckweed, giant duckweed, milfoil, brittle naiad, filamentous algae and sago. Emergents include cattails, creeping water primrose, water smartweed, and rice cutgrass. Water clarity 2 feet.

**WHEEL LAKE SECTION:** Water clarity 2 feet. 100% mortality on trees. Aquatic vegetation in protected cover 10% in water less than 6 feet. Composed of water milfoil, azola, coontail, sago, duckweed, filamentous algae and american pondweed in the back of coves. Lotus beds present for first time in 1999. Large lotus patch of about 20,000 against levee on west end. 20,000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Cattails and phragmites border increasing around entire lake. Sedges present on mud points. Strong coverage of coontail and water milfoil. South western moist soil unit now completely inundated and providing excellent submerged aquatic vegetation area. Coverage 85% dominated by coontail, sago, filamentous algae, duckweed, azola, giant duckweed and water milfoil.

**WHEEL LAKE KIDS POND & LAKE:** Kids pond has ,10% coverage in water less than 6 feet, of filamentous algae. Emergent present is creeping water primrose on entire border, sedges and cattails. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Treated May 2008 with 2 quart sonar. Good results on cattails and submerged aquatics.

Submerged rooted aquatics completely removed by Avast treatment in Spring 2011.

Water level very high in the spring of 2011 and fish were added from the spring trapnet survey.

In Adjacent Lake the water level is highest ever with 60% coverage of aquatic vegetation composed of filamentous algae, and duckweed. Avast treatment in Kids Pond also worked in this attached lake with high water. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007, now phragmitites border is very dense.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. Water level highest ever in 2009. South side area supports large lotus colony (5000+ plants) with 95% coverage with marsh milkweed, phragmites and cattails present too.

Submerged aquatic vegetation: 80% coverage- american pondweed, water milfoil, coontail, and filamentous algae. Lotus being overtaken by phragmites.

### NORTH SIDE:

75% coverage of coontail, milfoil, american pondweed, filamentous algae. Emergents include phragmities, willow, cattails, creeping water primrose, water smartweed. Water clarity 5 feet.

### JOHNSON LAKE AREA - 7/15/2011

Reading on staff gauge on 7/15/2011 is 437.2. Water clarity 10 feet. Reading on staff gauge on 8/24/2011 is 436.4. **JOHNSON EXTENSION:** Water clarity of 10 feet. Aquatic vegetation coverage 90% in water <8' and composed of water milfoil, leafy pondweed, southern naiad, chara, water star grass, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border.

**WEST LAKE**: Water clarity 14 feet. 80% coverage in water less than 8 feet deep. Composed of milfoil, coontail, eloeda, sago, water stargrass, brittle naiad, southern naiad, and american pondweed and creeping water primrose. Strong phragmites border developed.

**DRAGON FLY LAKE:** Aquatic vegetation coverage 85% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity greater than 6 feet. Starhead topminnows present.

JOHNSON LAKE REARING POND ARM: Water clarity 2 feet due to algal bloom. Aquatic vegetation coverage 20% in water <6' deep composed of predominantly of coontail, water milfoil, and sago. Emergent border at former waters' edge composed of water smartweed and creeping water primrose. Phragmites around entire section. Lotus beds decreasing. Lotus coverage 20%. Phragmites advancing along the dry edge. Starhead topminnows present.

**JOHNSON LAKE BIG BASIN:** Water clarity 14 feet. Aquatic vegetation coverage of approximately 90% in water less than 7 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, southern naiad, leafy pondweed, brittle naiad and water stargrass. Emergents at edge include softstem bulrush, creeping water primrose and rice cutgrass. Cattails and phragmites are increasing dramatically. Sedge border present. Water lilies from 2001 planting: 500 pads present on west side of duck blind point with flowers present. East side of big basin there are 500 pads present with flowers. Starhead topminnows present.

**JOHNSON LAKE EAST ARM:** Water clarity 8 feet. Aquatic vegetation coverage 95%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, sago, leafy pondweed, duckweed, giant duckweed, filamentous algae and coontail. Milfoil dying back quickly. Emergents include cattails, small batches of phragmites present, creeping water primrose and sedges forming on delta from route 24 watershed. Starhead topminnows present.

**JOHNSON LAKE EAST DITCH:** Water clarity 10 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 100% coverage at 12 feet deep. Composed predominately of coontail, water milfoil, american pondweed, sago and filamentous algae. Milfoil experiencing rapid dieback. Emergents include creeping water primrose, water smartweed, phragmites (almost completely around entire shoreline edges) and cattails. A group of lotus, about 100 lotus pads on the north side of the ditch. Starhead topminnows present.

JOHNSON LAKE BLUE LAKE AREA: Water clarity is 10+ feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 100% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, duckweed, and filamentous algae. Milfoil experiencing rapid dieback. Emergents at waters' edge include cattail, marsh mallow(increasing in coverage), and creeping water primrose. Phragmites extremely thick where border has developed. 50 lotus pads developing on east side of back lake. Clusters of marshmallow persisting outside of phragmites border.

Shoreline 100% coverage of cattails and phragmitites. Starhead topminnows present at entrance channel to this section.

**JOHNSON LAKE BACK DITCH:** Water clarity is 14+ feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 100% at 10 feet depth. Composed predominately of coontail, filamentous algae, water milfoil, american pondweed, and sago. Milfoil dying back dramatically. Creeping water primrose and water smart weed present in shallow static areas. Cattails and Phragmites border dramatically increasing in density and shoreline coverage almost 100%. Several hundred lotus leaf pads present on the west side of the main back ditch. Starhead topminnows present.

JOHNSON LAKE BACK DITCH BASIN/ STAFF GAUGE ARM: Water clarity is 14+ feet. 90% coverage in water <8 feet, composed of coontail, milfoil, sago, american pondweed, duckweed, filamentous algae and curly leaf pondweed. Shoreline coverage almost 100 % of phragmitites, cattails, creeping water primrose and water smartweed. East side has lotus patch that covers approximately 10 acres. Starhead topminnows present.

### SHOVEL LAKE: Water clarity 12+ feet. 8/24/2011

**SHOVEL LAKE COPPERAS CREEK ARM:** Water clarity 6 feet. Aquatic vegetation coverage composed predominately of coontail, also water milfoil, filamentous algae, duckweed and sago present. 90% coverage in water <6 feet. Milfoil experiencing 100% die back. Present in small quantities is filamentous algae. 100% mortality on flooded willows. Emergents include phragmites and creeping water primrose. Phragmites is progressing very fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

**<u>SHOVEL LAKE at T CHANNEL</u>**: Water clarity 8 feet. T channel coverage 60% of milfoil, coontail, azola, duckweed, sago, giant duckweed and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** Water clarity 4 feet. New lake connection along west edge and cove is coontail, sago pondweed, duckweed, water stargrass, american pondweed, water milfoil, filamentous algae. 75% coverage in water <6 feet. Emergents include button bush, cattail, creeping water primrose, Phragmites and cattails..

**SHOVEL LAKE COVE AT T**: Water clarity 10 feet. 95% coverage in water less than 6 feet deep. Aquatic vegetation composed of milfoil (dying back dramatically), coontail(predominant), leafy pondweed, southern naiad, brittle naiad, american pondweed, duckweed, water stargrass, sago and filamentous algae. Phragmities increasing on western edge and creeping water primrose present.

**SHOVEL LAKE BOAT RAMP ARM:** Water clarity 12 feet. Aquatic vegetation coverage 100% in water <8 feet, composed of coontail, american pondweed, sago pondweed, filamentous algae, and leafy pondweed. Milfoil present, but 90% mortality from warm water temperatures. Emergents include cattails, creeping water primrose, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side and completely on the east side).

**SHOVEL LAKE LOTUS LAKE:** Water clarity 3 feet due to algal bloom. Large concentration of Lotus - 100% coverage. Aquatic vegetation 100% coverage in water <8 feet and composed of coontail (dominant), duckweed, giant duckweed, milfoil and sago. Emergents include cattails, rice cutgrass, creeping water primrose and sedges.

**<u>PUMPHOUSE LAKE AND DITCH:</u>** Water clarity 10 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 90% in

water <8'. Composed of water milfoil (dominant), coontail, and american pondweed, sago, southern naiad and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, sedges, soft stem bullrush and creeping water primrose. Indigo bush is present. Phragmites increasing dramatically.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 4 feet (due to algal bloom). Aquatic vegetation coverage 80% in water < 6 feet and composed of coontail, water milfoil, sago, filamentous algae, southern naiad, leafy pondweed, and duckweed. Coontail growing in water over 8 feet deep. Milfoil experiencing massive dieback. Emergents include phragmites, cattails, creeping water primrose, marsh milkweed, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. In 2009 now 90% coverage with rooted aquatic vegetation. Phragmites increasing significantly on all sides.

**<u>GLOVE LAKE</u>**: 60% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, brittle naiad, duckweed, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose. Phragmites present in small patches becoming well established.

**LAKE #29 surveyed:** The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 1.5 feet (due to algal bloom). Aquatic vegetation coverage 5% of surface area and found in all areas under 6 feet of water. Composed of coontail, and american pondweed. Water level above overflow all spring. Starhead topminnows present.

**LAKE #14 and #15:** Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 15% and composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population present again. Water clarity 4 feet. Connected ditch 100% coverage of coontail, azola, duckweed, giant duckweed and filamentous algae.

**ISOLATION DITCH:** Water clarity 2.5 feet. 10% coverage of milfoil and coontail.

# **AQUATIC VEGETATION SURVEY BANNER MARSH 2012**

8/30/12, water clarity 2.5 feet.

**<u>GLASFORD T PENINSULA:</u>** 3 feet low. Inundated in 1993, dry in 1997, wet since the Spring of 2002. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies not observed 2001 spring planing and 20 plants present in 2009. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 50% coverage of filamentous algae, duckweed, milfoil and coontail. Emergents included, smartweed, cattails, rice cutgrass and creeping water primrose. Cattails and Phragmites increasing substantially. Large edge effect of sedges. Beaver dam maintaining water level.

**<u>GLASFORD T FORK LAKE:</u>** Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level 4 feet low and 6 inch clarity in 2012. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 20% coverage of coontail. Large sedge border with the low water level. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails decreasing along edges and phragmites increasing almost completely around the perimeter. Large numbers of mosquito fish and green sunfish present.

**<u>GLASFORD T BEAVER CHUTE:</u>** Inundated in 1993, 90% dry in 1997, 50% wet in 2010 and 75% dry. Water clarity 3 feet. Willows 100% mortality. Aquatic vegetation 85% coverage of american pondweed, filamentous algae and coontail predominant, Water milfoil, duckweed, giant duckweed, azola and watermeal. Complete clump of phragmites border with cattails. Emergents include rice cutgrass, and smartweed and large sedge border with low water level.

**<u>GLASFORD T XTRA POND</u>**: 4 feet low. 100% willow mortality. Aquatic vegetation 30% coverage of predominately coontail and filamentous algae. Emergents include a complete band of cattails all around edge. Rice cutgrass present and large sedge border with low water level. Phragmites border 100% with some cattails present.

**GLASFORD T at T on WEST SHORE:** Aquatic vegetation coverage <5 % from the shore out to 6 feet depth. Water clarity 2.5 feet. Composed of american pondweed, milfoil, brittle naiad and coontail. Emergents include cattails. New island and channels were added in 1999 and almost completely dry in 2012. Vegetation coverage 10% composed of american pondweed, southern naiad, brittle naiad, water milfoil, and coontail. Expanded edge of softstem bullrush and sedges. Cattails and phragmites increasing substantially. Water turbid in color, appears to be carp influenced. Large sedge border with the low water level.

**GLASFORD T, IDOT MITIGATION SITE:** Up to 30 acres of hydric soil present, cove almost completely dry. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels, new moist soil area developed in ag. Field behind the tree border. Spring water did encroach into ag field. 50% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, curley leaf pondweed, southern naiad, milfoil, sago, and southern naiad. Solid vegetation coverage of cattails, willows, marsh milk weed, creeping water primrose and rice cutgrass. Well developed stand of cattails with very little phragmitites. Sedge border developing on water's edge in new edge in ag. field. 50% of Ag. Field volunteer cattails and smartweed due to higher water level.

### **GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:**

95% rooted aquatic vegetation of coontail, sago, water milfoil, and duckweed. Milfoil dramatically dying back. Emergents include a strong cattail border and 10,000 lotus pads present since 2003. Lotus located on North side near the middle ditch. Phragmitites patch present on North edge and cattails on South.

Water clarity 3 feet. Large sedge border with low water.

**<u>GLASFORD T HIDDEN COVE:</u>** Aquatic vegetation coverage 60% in water less than 6 feet composed of coontail, duckweed, milfoil, and filamentous algae. Emergents include cattails, creeping water primrose, water smartweed, and rice cutgrass. Water clarity 2 feet. Large sedge border with low water level.

**WHEEL LAKE SECTION:** Water clarity 2 feet and 3feet low. 100% mortality on trees. Aquatic vegetation in protected cover 20% in water less than 6 feet. Composed of water milfoil, coontail, sago, duckweed, filamentous algae and american pondweed in the back of coves. Lotus beds present for first time in 1999. Large lotus patch of about 20,000 against levee on west end. 20,000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Cattails and phragmites border increasing around entire lake. Sedges present on mud points. Strong coverage of coontail and water milfoil. South western moist soil unit now completely inundated and providing excellent submerged aquatic vegetation area. Completely dry, Large sedge border with low water level.

WHEEL LAKE KIDS POND & LAKE: Kids pond has 30% coverage in water less than 6 feet, of coontail, milfoil, sago and filamentous algae. Emergent present is creeping water primrose on entire border, sedges and cattails. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide. Treated May 2008 with 2 quart sonar. Good results on cattails and submerged aquatics. Submerged rooted aquatics completely removed by Avast treatment in Spring 2011.

Water level very high in the spring of 2011 and fish were added from the spring trapnet survey.

Very low water level in 2012 at approximately 4 feet low.

In Adjacent Lake the water level is lowest ever with 50% coverage of aquatic vegetation composed of filamentous algae, and duckweed. Avast treatment in Kids Pond also worked in this attached lake with high water. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007, now phragmitites border is very dense. Large sedge border with low water level.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. Water level highest ever in 2009. Water level very low in 2012. South side area supports large lotus colony (5000+ plants) but Lotus being overtaken by phragmities in 2012. 95% coverage with phragmites and cattails.

Submerged aquatic vegetation: 60% coverage- american pondweed, water milfoil, coontail, and filamentous algae. Strong sedge border with thick creeping water primrose band.

### NORTH SIDE:

75% coverage of coontail, milfoil, american pondweed, duckweed and filamentous algae. Emergents include phragmities, willow, cattails, creeping water primrose, water smartweed. Water clarity 3 feet. Strong sedge border with thick creeping water primrose band.

### JOHNSON LAKE AREA - 9/13/2012

Reading on staff gauge on 9/13/2012 is 435.0. Water clarity 15 feet +.

JOHNSON EXTENSION: Water clarity of 9 feet. Aquatic vegetation coverage 90% in water <8' and

composed of water milfoil, southern naiad, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border. Large sedge border with low water level. SHT present in large numbers.

<u>WEST LAKE</u>: Water clarity 10 feet. 90% coverage in water less than 8 feet deep. Composed of milfoil, coontail, eloeda, sago, leafy pondweed, water stargrass, brittle naiad, southern naiad, and american pondweed and creeping water primrose. Strong phragmites border developed. Large sedge border with low water level on interior road bay.

**DRAGON FLY LAKE:** Aquatic vegetation coverage 15% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity 2 feet. Starhead topminnows present. Algal bloom and turbidity present. Dragonfly feeder was completely dry in August 2012.

JOHNSON LAKE REARING POND ARM: Water clarity 2 feet due to algal bloom and pelican activity. Aquatic vegetation coverage 20% in water <6' deep composed of predominantly of coontail, water milfoil, and sago. Emergent border at former waters' edge. Phragmites around entire section. Lotus beds decreasing. Lotus coverage 20%. Phragmites advancing along the dry edge. Starhead topminnows present. Large sedge border with low water level.

**JOHNSON LAKE BIG BASIN:** Water clarity 15 feet+. Aquatic vegetation coverage of approximately 80% in water less than 10 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, southern naiad, brittle naiad and water stargrass. Emergents at edge include softstem bulrush, creeping water primrose, smartweed and rice cutgrass. Cattails and phragmites are increasing dramatically. Sedge border present. Water lilies from 2001 planting: 500+ pads present on west side of duck blind point with flowers present. East side of big basin there are 200 pads present with flowers. Starhead topminnows present. Large sedge border with low water level.

JOHNSON LAKE EAST ARM: Water clarity 8 feet. Aquatic vegetation coverage 80%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, sago, leafy pondweed, duckweed, southern naiad, filamentous algae and coontail. Milfoil dying back quickly. Emergents include cattails, small batches of phragmites present, creeping water primrose and sedges forming on delta from route 24 watershed. Starhead topminnows present. Large sedge border with low water level.

JOHNSON LAKE EAST DITCH: Water clarity 8 feet+. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 100% coverage at 8 feet deep. Composed predominately of coontail, azola, duckweed, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, phragmites (almost completely around entire shoreline edges) and cattails. A group of lotus, about 50 lotus pads on the north side of the ditch. Small patch of water lilies present at the beginning of ditch. Large sedge border with low water level. Starhead topminnows present.

JOHNSON LAKE BLUE LAKE AREA: Water clarity is 3 feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 60% surface area at less than 6' deep. Composed of coontail, water milfoil, sago, duckweed, giant duckweed, azola, brittle naiad and filamentous algae. Emergents at waters' edge include cattail, marsh mallow(increasing in coverage), and creeping water primrose. Phragmites extremely thick where border has developed. Clusters of marshmallow persisting outside of phragmites border. Shoreline 100% coverage of cattails and phragmitites. Large sedge border with low water level. Starhead topminnows present.

**JOHNSON LAKE BACK DITCH:** Water clarity is 6 feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation coverage 100% at 8 feet depth. Composed predominately of coontail, filamentous algae, water milfoil, american pondweed, and sago. Milfoil dying back dramatically. Creeping water primrose and water smart weed present in shallow static areas. Cattails and Phragmites border dramatically increasing in density and shoreline coverage almost 100%. Several hundred lotus leaf pads present on the west side of the main back ditch. Starhead topminnows present.

JOHNSON LAKE BACK DITCH BASIN/ STAFF GAUGE ARM: Water clarity is 15+ feet. 80% coverage in water <8 feet, composed of coontail, milfoil, sago, american pondweed. Shoreline coverage almost 100 % of phragmitites, cattails, creeping water primrose and water smartweed. East side has lotus patch that covers approximately 15 acres. Starhead topminnows present.

**SHOVEL LAKE:** Water clarity 15+ feet. 9/12/2012

**SHOVEL LAKE COPPERAS CREEK ARM:** Water clarity 8 to 20 feet plus. Aquatic vegetation coverage composed predominately of coontail, also water milfoil, and sago present. 80% coverage in water <12 feet. Milfoil experiencing a mild summer die back. Present in moderate quantities is filamentous algae. 100% mortality on flooded willows. Emergents include phragmites and creeping water primrose. Phragmites is progressing very fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

**<u>SHOVEL LAKE at T CHANNEL</u>**: Water clarity 6 feet. T channel coverage 75% of milfoil, coontail, azola, duckweed, giant duckweed and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open.

**SHOVEL LAKE CANAL COVE:** Water clarity 6 feet. New lake connection along west edge and cove is coontail, sago pondweed, american pondweed, water milfoil, filamentous algae. 75% coverage in water <8 feet. Emergents include button bush, cattail, creeping water primrose, Phragmites and cattails now flooded and decreasing on east edge. Large sedge border with low water level.

**SHOVEL LAKE COVE AT T**: Water clarity 15 feet plus. 85% coverage in water less than 10 feet deep. Aquatic vegetation composed of milfoil (dying back dramatically), coontail(predominant), southern naiad, brittle naiad, american pondweed, water stargrass, sago and filamentous algae. Phragmities increasing on western edge and creeping water primrose present.

**SHOVEL LAKE BOAT RAMP ARM:** Water clarity 15 feet. Aquatic vegetation coverage 100% in water <8 feet, composed of coontail, american pondweed, sago pondweed, water milfoil, filamentous algae, brittle naiad and leafy pondweed. Emergents include cattails, creeping water primrose, spike rush, sedges, rice cutgrass, phragmites (increasing in large patch on the west side and completely on the east side). Large sedge border with low water level.

**SHOVEL LAKE LOTUS LAKE:** Water clarity 6 feet. Reduced concentration of Lotus - 10% coverage along entire shoreline. Aquatic vegetation 90% coverage in water <8 feet and composed of coontail (dominant), duckweed, filamentous algae and sago. Emergents include cattails, rice cutgrass, creeping water primrose and sedges. Large sedge border very dense with low water level.

**<u>PUMPHOUSE LAKE AND DITCH</u>**: Water clarity 9 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 90% in water <8'. Composed of water milfoil (dominant), coontail, and american pondweed, sago, southern naiad and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, sedges,

soft stem bullrush and creeping water primrose. Large sedge border with low water level. Indigo bush is present. Phragmites increasing dramatically. Starhead topminnows present in large numbers.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 2 to 8 feet (due to algal bloom and waterfowl turbidity). Aquatic vegetation coverage 80% in water < 6 feet and composed of coontail, water milfoil, sago, filamentous algae, southern naiad, and leafy pondweed. Coontail growing in water over 8 feet deep. Emergents include phragmites, cattails, creeping water primrose, marsh milkweed, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. In 2009 now 90% coverage with rooted aquatic vegetation. In 2012 now 70% coverage with rooted aquatic plants. Phragmites increasing significantly on all sides. Large sedge border very dense with low water level. Large number of starhead topminnows present along powerline and entry road. Not observed in main part of Shovel Lake or other Shovel Lake areas.

**<u>GLOVE LAKE</u>**: Water clarity 6 feet with algae bloom and slight turbidity. 80% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, leafy pondweed, brittle naiad, duckweed, southern naiad, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose. Phragmites present in small patches becoming well established. Large sedge border with low water level.

**LAKE #29 surveyed:** The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 3 to 7 feet (due to algal bloom). Aquatic vegetation coverage 70% of surface area and found in all areas under 8 feet of water. Composed of coontail, sago, water milfoil and american pondweed. Water level above overflow all spring. Starhead topminnows present.

**LAKE #14 and #15:** Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 15% and composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population present again. Water clarity 4 feet. Connected ditch 100% coverage of coontail, azola, duckweed, giant duckweed and filamentous algae.

**ISOLATION DITCH:** Water clarity 2 feet. 60% coverage of milfoil, filamentous algae, American pondweed and coontail. Creeping water primrose the dominant emergent plant.

# **AQUATIC VEGETATION SURVEY BANNER MARSH 2013**

7/18/13, water clarity 3 feet.

**GLASFORD T PENINSULA:** At the historical high water mark. Inundated in 1993, dry in 1997, but now 100% wet, since the Spring of 2002. Southern portion connected to main lake since Spring 2009 with the high water level. Willows and cottonwood 100% mortality. Vast majority of trees fallen down. Water lilies not observed 2001 spring planing and 20 plants present in 2009. YOY Bluegills, largemouth bass and mosquito fish present. Aquatic vegetation 85% coverage of filamentous algae, duckweed and coontail, leafy pondweed, azola, milfoil and southern naiad. Emergents included, smartweed, cattails, rice cutgrass and creeping water primrose. Phragmites increasing substantially. Water level at highest water mark and water clarity 3 feet . Large edge effect of sedges gone. Beaver dam maintaining high water level. Water level approximately 1 foot higher than main lake due to beaver dam construction.

**<u>GLASFORD T FORK LAKE:</u>** Inundated in 1993, 60% dry in 2006, 100% wet in 2000, water level at highest water mark 2013. Willows and cottonwood 100% mortality. Most trees fallen down. Aquatic vegetation 40% coverage of coontail. Sedges, rice cutgrass, water smartweed, water plantain, creeping water primrose and cattails decreasing along edges and phragmites completely around the perimeter. Large numbers of mosquito fish and green sunfish present. Water level past phragmities border and water clarity over 3 feet.

**<u>GLASFORD T BEAVER CHUTE:</u>** Inundated in 1993, 90% dry in 1997, but 50% wet in 2011 and 100% wet in 2013. Water clarity 2 feet. Willows 100% mortality. Aquatic vegetation 100% coverage of american pondweed, curley leaf pondweed, leafy pondweed, brittle naiad, filamentous algae and coontail predominant. Water milfoil, naiad, duckweed, giant duckweed, azola and sago pondweed. Complete phragmites border. Emergents include a small area of rice cutgrass, and smartweed.

**<u>GLASFORD T XTRA POND</u>**: At historical high water mark. Water clarity 3 feet. 100% willow mortality. Aquatic vegetation 20% coverage of predominately coontail, brittle naiad and filamentous algae. Emergents include a complete band of phragmites. Connected to main lake by beaver run.

<u>GLASFORD T at T on WEST SHORE:</u> Aquatic vegetation coverage <10 % from the shore out to 6 feet depth. Water clarity 3 feet. Composed of american pondweed, milfoil, brittle naiad, and coontail. Emergents include cattails. New island and channels were added in 1999. Vegetation coverage 50% composed of american pondweed, sago, curley leaf pondweed, filamentous algae, southern naiad, brittle naiad, water milfoil, duckweed and coontail. Expanded edge of softstem bullrush and sedges. Cattails and phragmites increasing substantially. Water turbid in color, appears to be carp influenced.

**GLASFORD T, IDOT MITIGATION SITE:** Up to 30 acres of hydric soil present, highest water level. Cottonwood tree and Willow tree fringe developing back from water edge in agriculture field with higher water levels, new moist soil area developed in ag. Field behind the tree border. Spring water did encroach into old ag field. 80% coverage out to 6 feet deep. Aquatic vegetation composed of coontail, curley leaf pondweed, southern naiad, milfoil, brittle naiad(predominant), sago, duckweed, filamentous algae, and leafy pondweed. Solid vegetation coverage of cattails, willows, creeping water primrose and rice cutgrass. Well developed stand of cattails with very little phragmitites. Sedge border developing on water's edge in new edge in ag. field. 50 % of Ag. Field volunteer cattails and smartweed due to higher water level.

### **GLASFORD T ON LEVEE SIDE AND SHALLOW BAY:**

50% rooted aquatic vegetation of coontail, sago, water milfoil, brittle naiad, and filamentous algae.

Emergents include a cattail border and 50,000 lotus pads present since 2003. Lotus located on North side near the middle ditch and east side. Phragmitites patch growing vigorous on the North and East edge, and cattails on South. Water clarity over 3 feet.

**<u>GLASFORD T HIDDEN COVE:</u>** Aquatic vegetation coverage 70% in water less than 6 feet composed of coontail, duckweed, giant duckweed, milfoil, brittle naiad, filamentous algae and sago. Emergents include cattails, creeping water primrose, water smartweed, and rice cutgrass. Water clarity 7 feet.

<u>WHEEL LAKE SECTION:</u> Water clarity 3 feet with algal bloom. 100% mortality on trees. Aquatic vegetation in protected cover 80% in water less than 6 feet. Composed of water milfoil, brittle naiad, southern naiad, coontail, sago, duckweed, filamentous algae and american pondweed in the back of coves. Lotus beds present for first time in 1999. Large lotus patch of about 50,000 against levee on west end. 20,000 pad lotus groups along base of levee. Emergents include cattails, rice cutgrass, creeping water primrose, and phragmites. Phragmites border increasing around entire lake. Sedges present on mud points. Strong coverage of coontail and water milfoil. South western moist soil unit now completely inundated and providing excellent submerged aquatic vegetation area. Coverage 75% dominated by coontail, sago, filamentous algae, duckweed, giant duckweed and water milfoil.

**WHEEL LAKE KIDS POND & LAKE:** Kids pond has, 40% coverage in water less than 6 feet, of filamentous algae. Emergent present is creeping water primrose on entire border, sedges and cattails. It was treated with 1 quart of Sonar in the spring of 2002 and 1 quart of Sonar in the spring of 2004. In June of 2005, the pond was treated with Reward herbicide.

Treated May 2008 with 2 quart sonar. Good results on cattails and submerged aquatics.

Submerged rooted aquatics completely removed by Avast treatment in Spring 2011.

Water level very high in the spring of 2011 and fish were added from the spring trapnet survey. Water level low in 2012, started high in 2013 and low by fall.

In Adjacent Lake the water level is normal with 40% coverage of aquatic vegetation composed of filamentous algae, brittle naiad, southern naiad and creeping water primrose. Avast treatment in Kids Pond also worked in this attached lake with high water. Emergents include softstem bulrush, cattails, water plantain and creeping water primrose. Willow border was getting denser, but cleared with bulldozer in fall 2007, now phragmitites border is very dense.

### ENTRY ROAD SHALLOW WATER AREAS:

Completely inundated throughout 2003-2005. Water level highest ever in 2009. High again in 2013. South side area supports large lotus colony (5000+ plants) with 95% coverage with phragmites and cattails present too. Phragmites progressing fast. Lotus being overtaken by phragmites.

Submerged aquatic vegetation: 80% coverage- american pondweed, southern naiad, brittle naiad, water milfoil, coontail, and filamentous algae. Water clarity over 8 feet.

### NORTH SIDE:

50% coverage of coontail, milfoil, american pondweed, filamentous algae. Emergents include phragmities, willow, cattails, creeping water primrose, water smartweed. Water clarity 2 feet. Lotus patch of 5,000 pads in the center.

### JOHNSON LAKE AREA - 7/18/2013

Reading on staff gauge on 7/18/2013 is 436.1 Water clarity 14 feet. Zebra mussels present at boat ramp since 2011.

JOHNSON EXTENSION: Water clarity of 12 feet. Aquatic vegetation coverage 70% in water <8'

and composed of water milfoil, leafy pondweed, southern naiad, chara, water star grass, coontail, american pondweed, sago and filamentous algae. Emergents include a dense cattail border, creeping water primrose, and an increasing phragmites border.

**WEST LAKE**: Water clarity 14 feet. 70% coverage in water less than 8 feet deep. Composed of milfoil, coontail, sago, water stargrass, brittle naiad, and american pondweed and creeping water primrose. Strong phragmites border developed.

**DRAGON FLY LAKE:** Aquatic vegetation coverage 50% composed of water milfoil and coontail. Emergents include cattails, bur reed, creeping water primrose, marsh milkweed, phragmites and sedges. Water clarity greater than 4 feet. Starhead topminnows present.

JOHNSON LAKE REARING POND ARM: Water clarity 3 feet due to algal bloom. Aquatic vegetation coverage 80% in water <6' deep composed of predominantly of coontail, water milfoil, and sago. Water milfoil dying back dramatically. Emergent border at former waters' edge composed of water smartweed and creeping water primrose. Phragmites around entire section. Lotus beds decreasing. Lotus coverage 10%. Phragmites advancing along the dry edge. Starhead topminnows present.

**JOHNSON LAKE BIG BASIN:** Water clarity 14 feet. Aquatic vegetation coverage of approximately 90% in water less than 8 feet deep. Composed predominantly of american pondweed, coontail, water milfoil, sago, southern naiad, leafy pondweed, brittle naiad and water stargrass. Emergents at edge include softstem bulrush, creeping water primrose and rice cutgrass. Cattails and phragmites are increasing dramatically. Sedge border present. Water lilies from 2001 planting: 500 pads present on west side of duck blind point with no flowers present. East side of big basin there are 1500 pads present with flowers. Starhead topminnows present.

**JOHNSON LAKE EAST ARM:** Water clarity over 8 feet. Aquatic vegetation coverage 95%, occupying all available areas less than 8 feet deep. Composed of american pondweed, water milfoil, sago, leafy pondweed, duckweed, giant duckweed, filamentous algae and coontail. Milfoil dying back quickly. Emergents include cattails, large batches of phragmites present, creeping water primrose and phragmites forming on delta from route 24 watershed. Starhead topminnows present by the thousands.

**JOHNSON LAKE EAST DITCH:** Water clarity over 10 feet. Formerly inundated cottonwood, willow, dogwood and other trees experiencing 100% mortality. Vast majority of trees fallen down. Aquatic vegetation 100% coverage at 12 feet deep. Composed predominately of coontail, duckweed, water milfoil, american pondweed, sago and filamentous algae. Emergents include creeping water primrose, water smartweed, phragmites (almost completely around entire shoreline edges) and cattails. A group of lotus, about 400 lotus pads on the north side of the ditch. 100 pad of waterlilies by entrance with flowers, and 100 pads ½ way down the ditch. Starhead topminnows present by the thousands.

JOHNSON LAKE BLUE LAKE AREA: Water clarity is 10+ feet. 100% mortality on cottonwood and willow trees. Boat accessible since 1998, dry in 1997. Aquatic vegetation coverage 100% surface area at less than 8' deep. Composed of coontail, water milfoil, sago, duckweed, and filamentous algae. Emergents at waters' edge include cattail, marsh mallow, and creeping water primrose. Phragmites extremely thick where border has developed. 50 lotus pads developing on east side of back lake. Clusters of marshmallow persisting outside of phragmites border. Shoreline 100% coverage of cattails and phragmitites. Starhead topminnows present. 100 pad of water lilies by entrance with flowers.

**JOHNSON LAKE BACK DITCH:** Water clarity is 14+ feet. Formerly inundated cottonwood, willow, dogwood and brush experiencing 100 percent mortality. Trees fallen down. Aquatic vegetation

coverage 100% at 10 feet depth. Composed predominately of coontail, duckweed, filamentous algae, water milfoil, american pondweed, and sago. Creeping water primrose and water smart weed present in shallow static areas. Cattails and Phragmites border dramatically increasing in density and shoreline coverage almost 100%. 4000 lotus leaf pads present on the west side of the main back ditch and covers over an acre. Starhead topminnows present.

JOHNSON LAKE BACK DITCH BASIN/ STAFF GAUGE ARM: Water clarity is 14+ feet. 90% coverage in water <8 feet, composed of coontail, milfoil, sago, american pondweed, duckweed, filamentous algae and curly leaf pondweed. Shoreline coverage almost 100 % of phragmitites, cattails, creeping water primrose and water smartweed. East side has lotus patch that covers approximately 15 acres. Starhead topminnows present by the thousands.

**SHOVEL LAKE:** Water clarity 15+ feet. 7/19/2013

**SHOVEL LAKE COPPERAS CREEK ARM:** Water clarity 15 feet. Aquatic vegetation coverage composed predominately of coontail, also water milfoil, filamentous algae, duckweed and sago present. 90% coverage in water <10 feet. Milfoil experiencing strong die back. 100% mortality on flooded willows. Emergents include phragmites and creeping water primrose. Phragmites has progressed fast along the shoreline and becoming very dense. It has now expanded in large patches all the way to the end.

**<u>SHOVEL LAKE at T CHANNEL</u>**: Water clarity 6 feet. T channel coverage 60% of milfoil, coontail, azola, duckweed, sago, giant duckweed and filamentous algae. Large brush piles added in channel in 2000, boat access remaining open. Creeping water primrose strong at the entrance.

**SHOVEL LAKE CANAL COVE:** Water clarity 15 feet. New lake connection along west edge and cove is coontail, sago pondweed, duckweed, water stargrass, american pondweed, southern naiad, water milfoil, filamentous algae. 90% coverage in water <8 feet. Emergents include button bush, cattail, creeping water primrose, Phragmites increasing dramatically..

**SHOVEL LAKE COVE AT T**: Water clarity 15 feet. 95% coverage in water less than10 feet deep. Aquatic vegetation composed of milfoil (dying back), coontail(predominant), leafy pondweed, southern naiad, brittle naiad, american pondweed, duckweed, water stargrass, sago and filamentous algae. Phragmities increasing on western edge and creeping water primrose present.

**SHOVEL LAKE BOAT RAMP ARM:** Water clarity 15 feet. Aquatic vegetation coverage 100% in water <10 feet, composed of coontail(predominant), american pondweed, sago pondweed, water star grass, chara, filamentous algae, and leafy pondweed. Milfoil present, but dying back from warm water temperatures. Emergents include cattails, creeping water primrose, spike rush, sedges, rice cutgrass, phragmites (completely along all shoreline and getting thicker).

**SHOVEL LAKE LOTUS LAKE:** Water clarity 10 feet. Large concentration of Lotus - 100% coverage along shoreline out to 8 feet deep. Aquatic vegetation 100% coverage in water <8 feet and composed of coontail (dominant), duckweed, giant duckweed, milfoil and sago. Emergents include cattails, rice cutgrass, creeping water primrose and sedges.

**<u>PUMPHOUSE LAKE AND DITCH</u>**: Water clarity 12 feet. 100% wet in 2003. Formerly inundated willows, cottonwoods and brush experiencing 100% mortality. Aquatic vegetation coverage of 90% in water <10'. Composed of water milfoil, coontail, and american pondweed, sago, southern naiad and filamentous algae. Emergents include good edge border of cattails, marsh milkweed, sedges, soft stem

bullrush and creeping water primrose. Indigo bush is present. Phragmites increasing dramatically. Over 20 mute swans present.

**SHOVEL LAKE ADDITION:** 99% dry in 2000, 100% wet in 2003. Water clarity is 8 feet. Aquatic vegetation coverage 90% in water < 6 feet and composed of coontail, water milfoil, sago, filamentous algae, southern naiad, leafy pondweed, brittle naiad and duckweed.

Coontail growing in water over 8 feet deep. Milfoil experiencing slight dieback. Emergents include phragmites, cattails, creeping water primrose, marsh milkweed, sedges and rushes. Original isolated ponds had 95% coverage with rooted vegetation in 2006. In 2009 now 90% coverage with rooted aquatic vegetation. Phragmites increasing significantly on all sides. Over 12 mute swans present. Starhead topminnows observed as far as leaning tower.

**<u>GLOVE LAKE</u>**: Water clarity 4 feet with algal bloom. 90% vegetation coverage in water less than 6 feet deep. Composed of water milfoil, sago, coontail, brittle naiad, southern naiad, duckweed, and filamentous algae. Emergents include cattails, water plantain, rice cutgrass, softstem bulrush, sedges and creeping water primrose. Phragmites present in large patches and becoming well established.

**LAKE #29 surveyed:** The rehabilitation of the fish population in the fall of 1995 greatly improved water quality and thus habitat for aquatic vegetation. Water clarity 1.5 feet (due to algal bloom). Aquatic vegetation coverage 5% of surface area and found in all areas under 6 feet of water. Composed of coontail, and american pondweed. Water level above overflow all spring. Starhead topminnows present.

**LAKE #14 and #15:** Completed rehabilitation of fish population fall of 2001, recontaminated in 2002. Aquatic vegetation coverage less than 25% and composed of water milfoil, southern naiad, leafy pondweed and filamentous algae. Carp population present again. Water clarity 4 feet. Connected ditch 100% coverage of coontail, azola, duckweed, giant duckweed and filamentous algae.

**ISOLATION DITCH:** Water clarity 1 feet. 40% coverage of milfoil, duckweed and coontail. Creeping water primrose with a 10% coverage.

Appendix B

Fish Surveys
DATE OF REPORT:2/3/2014FISHERIES MANAGER:Rob HilsabeckDISTRICT No.:4LAKE NAME:Shovel LakeBMSFWA COUNTY:FultonWATER No.:0505OWNERSHIP:StateACREAGE:200

D.F.M.	DATE	R.F.M.	DATE

1. All Fish - 2 pole and line fishing only except carp may be taken by bow and arrow devices, gigs or spears during May through August.

Species	Size Limit	<u>Creel Limit</u>				
Largemouth bass	12-18 inch protected slot	3 fish/day*				
Smallmouth bass	Length limit (effective 4	4/1/2000)				
Channel catfish	NONE	6 fish/day				
Walleye	14 inch minimum	6 fish/day				
White & Black Crappi	e 9 inch minimum.	25 fish/day				
Muskie	42 inch minimum	1 fish/day				
	(Effective 4/1/2000)					

\*daily limit includes all largemouth and smallmouth bass either singly or in the aggregate.

**2.** 1. Water level at the Johnson Lake section staff gauge were periodically recorded.

- 2. Spring Trapnet survey 4/2 and 4/3 in 2013.
- 3. Stocked 200, 11.2 inch Muskie 10/10/13.
- 4. Completed Vegetation Survey- 7/19/13.
- 5. Conducted Fall Population Survey using D.C.

electrofishing - 10/9/13.

6. Registered 49 tournament fishing groups for 2012, with 11 events at the Shovel Access.

SHOVEI	LAK	Е									Page	e 2
LMB 2	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	3 LMP
Stock#	<b>‡</b> 159	167	113	84	93	81	113	103	100	120	127	100+
PSD	64	56	64	55	63	53	57	62	73	59	65	40-60
RSD14	45	34	39	41	45	41	33	46	54	43	42	10-20
RSD16	20	16	20	20	28	27	20	29	38	21	27	
RSD18	3	1	4	8	11	7	8	11	17	12	10	
Wr	94	91	95	92	94	93	95	94	93	92	91	90+
YAR	.1	.1	.4	.5	2.1	.7		.1	0	.1	.1	1-10
CPUE	1.9	2.1	2.1	1.3	1.5	.93	1.3	.99	1.7	1.7	1.3	1/mn
EFFORT	84	78	55	67	61	87	86	104	58	72	98	min.
GROWTH	IGOOD	GOOI	D GOOI	GOOI	D GOOI	GOOI	GOOI	) GOO	D GOO	D GOOI	GOC	DD
BLG												
Stock#	<b>#</b> 91	127	2	1	1	71	8	31	37	3	38	
PSD	6	2	100	100	100	6	62	23	27	67	92	20-40
RSD7	1	.8	0	100	0	0	12	0	3	0	0	5-20
RSD7.5	5 0	0	0	100	0	0	0	0	0	0	0	
Wr	67	82			93	83	83	97	84	80	87 9	90-110
GROWTH	IPOOR	POOF	R POOF	R POOI	R POOF	R POOF	R POOF	r avg	. POOR	POOR	POOF	ર
BLC												
Stock#	<b>‡</b> 36	14	61	46	2	33	24	29	53	40	13	
PSD	75	93	98	91 1	100	79	79	93	94	100	92	40-60
RSD9	33	64	84	52 2	100	61	50	59	51	95	92	20-30
RSD10	19	29	61	26	50	24	38	48	36	70	62	
Wr	94	84	94	86	88	88	90	89	92	90	94	90+
GROWTH	IAVG.	GOOI	D AVG.	.GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOI	)
CCF												
Stock#	<b>‡</b> 8	35	9	4	1	22	12	2	2	3	3	
PSD	63	86	89 1	L00 1	100	96	100	50	100	67	100	50-70
RSD18	38	80	56 1	L00 1	100	96	92	50	100	67	67	10-25
<b>Wr</b> 1	L04	106	106 1	L14 1	118	103	114	100	118	102	1178	3 90+
WAE			_			_	_			_	_	
Stock#	<b>#</b> 4	15	2	1	1	7	7	1	4	0	2	
PSD 1	100	100	100	100	100	100	100	100	100		100	40-60
<b>RSD18</b> 1	L00	93	100	100	100	100	100	100	100			
Wr	94	98	104	125	91	94	98	87	110		110	90+

SHOVEL	LAKE
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MUE	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	$\mathbf{LMP}$
Stock	<b>:#</b> 11	53	33	15	0	27	10	11	18	28	15	
PSD	36	76	80			89	90	73	94	61	100	
RSD42	2 0	0	7			0	10	0	б	4	7	
Wr										110	89	
CPUE	.79	3.31	2.06	.5	0	1.35	.56	1.1	1.0	) 1.8	3 1.0	.3/N

4. In 2013, the water level in the majority of the marsh started near the staff gauge reading of 435.0, rose to approximately 437 at the end of May and then slowly dropped through the year to 435.0. This water level was followed the extremely wet spring and then minor drought, and should have minor effect on fish management. A perfect cycle will be the higher spring through early summer water levels to promote good spawning and recruitment. Then the summer/fall drawndown would allow the condensing of the prey fish with the predators.

In 2013, spring trapnetting and fall D.C. electrofishing were used to survey the fish population.

The largemouth bass population appears to be defined by a high percentage of fish from 7 to 21 inches in length with good average Relative weights. In 2000, the bass regulation for the Marsh was changed from a 14 inch minimum size limit and 1 fish per day - to a 12 to 18 inch protected slot length with a harvest of 3 fish under or over the slot per day.

The 2013 fall electrofishing survey indicated a size structure that is continuing to maintain a good level and stability since 2001. The PSD of 65, the RSD14 of 42, the RSD16 of 27 and the RSD 18 of 10 were all very good and consistent over the last 5 years.

The goal of the protected slot length limit was to create a high density bass population that is composed of fish large enough to be efficient predators upon the high density of slow growing panfish and the rough fish population. The benefit to bass anglers will be more fish surviving past 14 inches to catch, and for anglers wanting to harvest bass will be the opportunity to harvest more fish.

#### SHOVEL LAKE

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14 muskie were sampled in the spring trapnet survey. The collected fish ranged from 30 to 45 inches.

The first stocking of 450 fish at 11 inches was in 1999. In 2000, a total of 200, 2001-600, 2002-200, 2003-200, 2004-0, and 200 annually from 2005 through 2013 at an average size of 11.2 inches were stocked.

Illinois (Jake Wolf) muskie strain appear to be doing good in this lake.

In the future, I plan to continue the selective removing of male muskie from Shovel Lake during the spring trapnetting surveys. These fish will be transported and released into another lake in Banner Marsh with a very high gizzard shad forage base. The goal of this effort is to reduce the overall muskie density in Shovel Lake, while increasing the space and food for the remaining female muskie. In 2004, 36 males from the Shovel Lake trapnet catch were moved to Lake #29 at Banner Marsh and 17 males in 2005 were moved and in 2006 5 males were moved. No fish were moved in 2007, but 11 males were moved to West Lake in 2008. No fish were moved in 2009. The male to female ratio has been: 2003 (2.00), 2004 (2.40), 2005 (1.21), 2006 (.55), 2008 (.86), 2009 (.50), 2010 (8.00), 2011 (2.60), 2012 (2.29) and (1.80).

The bluegill population was sampled by 38 stock size fish in the fall electrofishing survey. The bluegill population continues to have a poor size structure with a RSD7 of 0 and relative weight average of 87.

The walleye population was represented by 2 stock size fish. The last walleye stocking was 900, 5 inch walleye that were fin clipped on the left pectoral fin in 1997.

3 channel catfish were sampled in 2013 with an RSD18 of 100 and an excellent Wr of 118.

# LAKE MANAGEMENT STATUS REPORT SHOVEL LAKE

The black crappie population was surveyed by 13 stock size fish in 2013. The PSD was 92 and the the RSD9 was 92. The body condition was only good with a Wr value at 94. The crappie population continues a trend of a moderate population of legal size fish.

No white crappie were surveyed in 2013. This population is present in a very low density of quality fish.

In 2000, the HREP project added a large amount of habitat to the Shovel lake section. The addition of large woody structure (downed trees and brush piles) was completed along the shoreline of the main lake and the connection to the canal, lotus lake, glove lake and goose mound lake was completed and has provided a major increase in littoral area when this section of the Marsh was refilled in 2001.

A brood stock introduction of redspotted sunfish was completed in 2010. A total of 100 redspotted sunfish were introduced on 5/7/1010. These fish were propagated at the Fish Preserve Lake at Emiquon. The fish were released into the new addition section of Shovel Lake. No red spots were sampled in 2013. Future fish surveys will attempt to document survival and recruitment.

A brood stock introduction of 100 starhead topminnows was completed into the Shovel extension area on 8/31/11. These fish were propagated in the shower house pond at Jubilee State Park. Adult and YOY starhead topminnows were observed and collected on 9/12/2012 and 7/19/2013 in Shovel Lake extension area. Future fish surveys will attempt to document survival and recruitment.

Recommended Lake Management Activities with Rationale for Implementation:

Fish Stocking - Channel catfish 390/year 3.9/acre 8 in. - Muskie 200/year 1/acre 12 in.

Supplemental stocking is required for all the above species due to no natural recruitment at Shovel Lake.

#### SHOVEL LAKE

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- Brook Silverside (Labidesthes sicculus), Lake Chubsucker (Erimyzon sucetta)iron color shiner (Notropis chalybaeus), starhead topminnow (Fundulus dispar), bowfin, spotted gar and Glass Shrimp(Palaemonetes kadiakensis). Consider and evaluate the potential of reintroducing these historically native species back into the marsh in an effort to enhance the diversity of the current food chain and provide additional forage base.

Biological Surveys - Conduct annual surveys to measure trends in fishery population dynamics, angling regulations and progress toward management goals. In the fall, utilize by standardized methods; D.C. electrofishing to sample a target number of at least 100 stock-size largemouth bass. In the spring, assess the walleye, muskie, black crappie, bluegill, redear and channel catfish populations by a trap net survey. Additional gill net surveys maybe required to sufficiently sample channel catfish.

Toxicant Fish Control - limited application may be necessary to rehabilitate seasonally-isolated ponds which contain severely imbalanced fish populations.

Aquatic Vegetation Control - limited need or application due management goal of providing diverse, significant habitat for fish and wildlife. Adjacent kids fishing pond may be treated with fluridone or diquat dibromide to maintain less than 20% coverage of aquatic vegetation. Will continue vegetation survey to document trends and exotic species (i.e. Eurasian milfoil). The 2013 vegetation survey was completed.

Habitat Enhancement - The major addition of woody habitat (downed trees and brush piles) along the final cut banks of Shovel Lake in 2000 added significant habitat. And the connection to the rest of the Shovel Lake section increased the littoral zone of Shovel Lake by over 100% with the addition of approximately 100 more surface acres of water.

#### SHOVEL LAKE

Lake access - coordinate with the site staff on the development of shoreline fishing areas. The raising of the township road, powerline roadway has provided another easily accessible shoreline fishing area. Negotiations are continuing with the power company to raise the roadway along the powerlines at the base of the levee. When this occurs, another shoreline fishing area will be created. The district fisheries biologist will continue to register and coordinate the daily fishing tournaments in an effort to reduce congestion at the three main boat ramps. In 2013, a total of 49 fishing tournaments were registered at Banner Marsh (11 on Shovel Lake) and no conflicts were reported.

Water Level - coordinate with the site staff on the documentation of the water level utilizing the installed staff gauge.

Creel Survey - A creel survey for the Banner Marsh Complex was completed in 2006.

Site Map - update the site map of the water bodies as needed.

Shovel Lake Largemouth Bass Index Table

Year	Stock a	# PSD	RSD14	RSD15	RSD16	RSD17	RSD18	RSD19
1996	123	42.3	13.0	8.9	7.3	7.3	5.7	
1997	205	25.4	6.3	3.9	2.4	2.4	2.0	
1998	101	55.4	21.8	11.9	5.0	3.0	2.0	
1999	110	64.5	19.1	4.5	1.8	1.8	.9	
	New regu	ulation	12-18″	protected	l slot,	3 fish	daily cr	eel
2000	154	62.3	30.5	14.9	5.2	3.9	1.9	
2001								
2002	134	62.7	45.5	38.1	21.6	12.7	3.7	
2003	159	64.2	45.3	34.6	20.1	10.1	3.1	
2004	167	56.3	33.5	26.3	16.2	8.4	1.2	
2005	113	63.7	38.9	31.0	20.4	11.5	4.4	
2006	84	54.8	40.5	29.8	20.2	19.0	8.3	
2007	93	63.4	45.2	36.6	28	16.1	10.8	
2008	81	53.1	40.7	30.9	27.2	19.8	7.4	
2009	113	56.6	32.7	25.7	19.5	15.9	8.0	
2010	103	62.1	45.6	42.7	29.1	23.3	10.7	5.7
2011	100	73.0	53.7	46.0	38.0	32.4	17.0	8.3
2012	120	59	43	38	21	16	12	6
2013	127	65.4	41.7	37	26.8	20.5	10.2	3.9

Electrofishing 2013S. Shovel Lake Banner Marsh. SPECIES FREQUENCY \_\_\_\_\_ BLC 7 CCF 1 LMB 132 MUE 1 RSF 2 YLB 1 Total frequency: 144. Electrofishing Trapnetting 2013T. Shovel Lake Banner Marsh. SPECIES FREQUENCY \_\_\_\_\_ BLC 6 BLG 39 BRH 3 CCF 2 LMB 4 MUE 14 RSF 16 WAE 2 Total frequency: 86. Largemouth Bass 2013S. Shovel Lake Banner Marsh. LMB STOCK INDEX TABLE \_\_\_\_\_ YEAR STOCK N YAR (N) PSD (N) RSD1 (N) RSD2 (N) RSD3 (N) 20cm, 7.9in 19cm, 7.5in 30cm, 11.8in 36cm, 14.2in 41cm, 16.1in 46cm, 18.1in \_\_\_\_\_ 2013 127 0.1 (5) 65.4 (83) 41.7 (53) 26.8 (34) 10.2 (13) Largemouth Bass 2013S. Shovel Lake Banner Marsh. LMB STOCK INDEX TABLE \_\_\_\_\_ YEAR STOCK N YAR (N) PSD (N) RSD1 (N) RSD2 (N) RSD3 (N) 20cm, 7.9in 19cm, 7.5in 30cm, 11.8in 38cm, 15.0in 43cm, 16.9in 48cm, 18.9in \_\_\_\_\_ 2013 127 0.1 (5) 65.4 (83) 37.0 (47) 20.5 (26) 3.9 (5) Black Crappie 2013 Shovel Lake Banner Marsh. BLC STOCK INDEX TABLE \_\_\_\_\_ YEAR STOCK N YAR (N) PSD (N) RSD1 (N) RSD2 (N) RSD3 (N) 13cm, 5.1in 0cm, 0.0in 20cm, 7.9in 23cm, 9.1in 25cm, 9.8in 28cm, 11.0in \_\_\_\_\_ \_\_\_\_ 2013 13 NA NA 92.3 (12) 92.3 (12) 61.5 (8) 46.2 (6) Bluegill 2013 Shovel Lake Banner Marsh. BLG STOCK INDEX TABLE \_\_\_\_\_ \_\_\_\_\_ YEAR STOCK N YAR (N) PSD (N) RSD1 (N) RSD2 (N) RSD3 (N) 8cm,3.1in 0cm,0.0in 15cm,5.9in 16cm,6.3in 17cm,6.7in 18cm,7.1in \_\_\_\_\_ \_\_\_\_\_ -----\_\_\_\_\_ 2013 38 NA NA 42.1 (16) 21.1 (8) 2.6 (1) 0.0 (0)BLG Channel Catfish 2013 Shovel Lake Banner Marsh. CCF STOCK INDEX TABLE YEAR STOCK N YAR (N) PSD (N) RSD1 (N) RSD2 (N) RSD3 (N) 28cm,11.0in 0cm,0.0in 41cm,16.1in 46cm,18.1in 0cm,0.0in 0cm,0.0in \_\_\_\_\_ NA NA 100.0 (3) 66.7 (2) NA NA NA 2013 3 NA

Muskie 2013 S	e Shovel Lake Ba	anner Marsh.	MUE S	STOCK II	NDEX TA	BLE				
YEAR	STOCK N 51cm,20.1in	YAR (N) Ocm,0.0in	PSD 76cm,	(N) 29.9in	RSD1 107cm,	(N) 42.1ir	RSD2 n0cm,0	(N) .0in	RSD3 0cm,0.	(N) 0in
2013	15	NA NA	100.0	(15)	6.7	(1)	NA	NA	NA	NA

### Largemouth Bass

LENG MM	TH GROUP INCHES	TOTAL L-FREQ	MEAN W GRAMS	EIGHT LBS	NO. WEIGHED	MEZ WR (9	AN CO 95%)	NDITION KN (95	~~~~~~ %)
170 - 179	6.7 - 7.1	1	60.0	0.13	1	90	_	0.86	
180 - 189	7.1 - 7.5	1	80.0	0.18	1	93	_	0.91	-
190 - 199	7.5 - 7.9	3	90.0	0.20	3	92 (	16)	0.89 (	0.2)
200 - 209	7.9 - 8.3	4	90.0	0.20	3	82 (	8)	0.80 (	0.1)
210 - 219	8.3 - 8.7	2	120.0	0.26	2	94 (	77)	0.92 (	0.8)
220 - 229	8.7 - 9.1	2	150.0	0.33	2	99 (	20)	0.98 (	0.2)
230 - 239	9.1 - 9.4	2	162.5	0.36	2	95 (	25)	0.94 (	0.2)
240 - 249	9.4 - 9.8	3	186.7	0.41	3	93 (	9)	0.94 (	0.1)
250 - 259	9.8 - 10.2	7	198.3	0.44	3	87 (	1)	0.88 (	0.0)
260 - 269	10.2 - 10.6	9	215.0	0.47	3	85 (	12)	0.86 (	0.1)
270 - 279	10.6 - 11.0	5	244.0	0.54	3	81 (	13)	0.83 (	0.1)
280 - 289	11.0 - 11.4	5	285.0	0.63	3	86 (	6)	0.88 (	0.1)
290 - 299	11.4 - 11.8	5	330.0	0.73	3	89 (	10)	0.92 (	0.1)
300 - 309	11.8 - 12.2	б	363.3	0.80	3	90 (	24)	0.93 (	0.3)
310 - 319	12.2 - 12.6	6	405.0	0.89	3	89 (	11)	0.92 (	0.1)
320 - 329	12.6 - 13.0	7	455.0	1.00	3	91 (	2)	0.95 (	0.0)
330 - 339	13.0 - 13.4	4	371.2	0.82	4	69 (	44)	0.72 (	0.5)
340 - 349	13.4 - 13.8	3	553.3	1.22	3	93 (	11)	0.98 (	0.1)
350 - 359	13.8 - 14.2	4	581.7	1.28	3	90 (	5)	0.94 (	0.0)
360 - 369	14.2 - 14.6	3	625.0	1.38	3	86 (	8)	0.91 (	0.1)
370 - 379	14.6 - 15.0	3	673.3	1.48	3	87 (	4)	0.92 (	0.0)
380 - 389	15.0 - 15.4	3	808.3	1.78	3	93 (	8)	0.98 (	0.1)
390 - 399	15.4 - 15.7	5	845.0	1.86	3	91 (	20)	0.97 (	0.2)
400 - 409	15.7 - 16.1	5	970.0	2.14	3	97 (	5)	1.04 (	0.1)
410 - 419	16.1 - 16.5	4	976.7	2.15	3	89 (	15)	0.96 (	0.2)
420 - 429	16.5 - 16.9	4	1128.3	2.49	3	96 (	10)	1.03 (	0.1)
430 - 439	16.9 - 17.3	4	1281.7	2.82	3	101 (	3)	1.09 (	0.0)
440 - 449	17.3 - 17.7	6	1313.3	2.89	3	97 (	13)	1.05 (	0.1)
450 - 459	17.7 - 18.1	3	1380.0	3.04	3	96 (	8)	1.04 (	0.1)
460 - 469	18.1 - 18.5	3	1441.7	3.18	3	91 (	11)	0.99 (	0.1)
470 - 479	18.5 - 18.9	5	1535.0	3.38	3	91 (	15)	0.99 (	0.2)
480 - 489	18.9 - 19.3	1	1940.0	4.28	1	109	_	1.20	-
490 - 499	19.3 - 19.7	2	1667.5	3.68	2	88 (	99)	0.96 (	1.1)
500 - 509	19.7 - 20.1	0	-	-	0	-	-	-	-
510 - 519	20.1 - 20.5	1	1970.0	4.34	1	89	-	0.98	-
520 - 529	20.5 - 20.9	1	2090.0	4.61	1	89	-	0.99	-
	TOTALS:	132	25586.9	56.39	92	91 Av	verag	e	

2013S. Shovel Lake Banner Marsh. LMB LENGTH FREQUENCY/CONDITION

Black Crappie

LENG	TH GROUD	 тотат.	MEAN WI		NO		TEAN COL		
MM	INCHES	L-FREQ	GRAMS	LBS	WEIGHED	WR	(95%)	KN (9	95%)
190 - 199	7.5 - 7.9	1	105.0	0.23	1	92		0.92	
200 - 209	7.9 - 8.3	0	-	-	0	-	-	-	-
210 - 219	8.3 - 8.7	0	-	-	0	-	-	-	-
220 - 229	8.7 - 9.1	0	-	-	0	-	-	-	-
230 - 239	9.1 - 9.4	1	170.0	0.37	1	79	-	0.79	-
240 - 249	9.4 - 9.8	3	208.3	0.46	3	86	( 12)	0.86	( 0.1)
250 - 259	9.8 - 10.2	2	240.0	0.53	2	88	( 181)	0.88	( 1.8)
260 - 269	10.2 - 10.6	0	-	-	0	-	-	-	-
270 - 279	10.6 - 11.0	0	-	-	0	-	-	-	-
280 - 289	11.0 - 11.4	1	325.0	0.72	1	82	-	0.82	-
290 - 299	11.4 - 11.8	1	455.0	1.00	1	101	-	1.01	-
300 - 309	11.8 - 12.2	1	535.0	1.18	1	104	-	1.04	-
310 - 319	12.2 - 12.6	0	-	-	0	-	-	-	-
320 - 329	12.6 - 13.0	1	625.0	1.38	1	108	-	1.08	-
330 - 339	13.0 - 13.4	0	-	-	0	-	-	-	-
340 - 349	13.4 - 13.8	1	815.0	1.80	1	107	-	1.07	-
350 - 359	13.8 - 14.2	0	-	-	0	-	-	-	-
360 - 369	14.2 - 14.6	1	850.0	1.87	1	93	-	0.93	-
	TOTALS:	13	4328.3	9.54	13	94	Average	e	

2013 Shovel Lake Banner Marsh. BLC LENGTH FREQUENCY/CONDITION

Bluegill

2013 Shovel Lake Banner Marsh. BLG LENGTH FREQUENCY/CONDITION

LENGT	TH GROUP	TOTAL	MEAN WE	IGHT	NO.	MEAN CO	ONDITION
MM	INCHES	L-FREQ	GRAMS	LBS	WEIGHED	WR (95%)	KN (95%)
70 - 79	2.8 - 3.1	1	5.0	0.01	1	78 -	0.72 -
80 - 89	3.1 - 3.5	0	-	-	0		
90 - 99	3.5 - 3.9	3	11.7	0.03	3	76 ( 33	) 0.72 ( 0.3)
100 - 109	3.9 - 4.3	1	30.0	0.07	1	128 -	1.23 -
110 - 119	4.3 - 4.7	2	22.5	0.05	2	79 ( 186	) 0.76 ( 1.8)
120 - 129	4.7 - 5.1	0	-	-	0		
130 - 139	5.1 - 5.5	3	40.0	0.09	3	84 ( 47	) 0.82 ( 0.5)
140 - 149	5.5 - 5.9	13	56.5	0.12	13	88 ( 8	) 0.87 ( 0.1)
150 - 159	5.9 - 6.3	8	68.1	0.15	8	91 ( 9	) 0.90 ( 0.1)
160 - 169	6.3 - 6.7	7	73.6	0.16	7	79 ( 5	) 0.79 ( 0.1)
170 - 179	6.7 - 7.1	1	115.0	0.25	1	94 -	0.94 -
	TOTALS:	39	422.4	0.93	39	87 Avera	ge

Channel Catfish 2013 Shovel Lake Banner Marsh. CCF LENGTH FREQUENCY/CONDITION

LENG MM	TH GROUP INCHES	TOTAL L-FREQ	MEAN W GRAMS	EIGHT LBS	NO. WEIGHED	MR	EAN CC (95%)	NDITION KN (95	28) 1	
420 - 429	16.5 - 16.9	1	700.0	1.54	1	 99		0.95	_	
430 - 439	16.9 - 17.3	0	-	-	0	-	-	-	-	
440 - 449	17.3 - 17.7	0	-	-	0	-	-	-	-	
450 - 459	17.7 - 18.1	0	-	-	0	-	-	-	-	
460 - 469	18.1 - 18.5	0	-	-	0	-	-	-	-	
470 - 479	18.5 - 18.9	0	-	-	0	-	-	-	-	
480 - 489	18.9 - 19.3	0	-	-	0	-	-	-	-	
490 - 499	19.3 - 19.7	0	-	-	0	-	-	-	-	
500 - 509	19.7 - 20.1	0	-	-	0	-	-	-	-	
510 - 519	20.1 - 20.5	0	-	-	0	-	-	-	-	
520 - 529	20.5 - 20.9	0	-	-	0	-	-	-	-	
530 - 539	20.9 - 21.3	0	-	-	0	-	-	-	-	
540 - 549	21.3 - 21.7	0	-	-	0	-	-	-	-	
550 - 559	21.7 - 22.0	0	-	-	0	-	-	-	-	
560 - 569	22.0 - 22.4	0	-	-	0	-	-	-	-	
570 - 579	22.4 - 22.8	0	-	-	0	-	-	-	-	
580 - 589	22.8 - 23.2	1	2990.0	6.59	1	142	-	1.39	-	
590 - 599	23.2 - 23.6	0	-	-	0	-	-	-	-	
600 - 609	23.6 - 24.0	0	-	-	0	-	-	-	-	
610 - 619	24.0 - 24.4	0	-	-	0	-	-	-	-	
620 - 629	24.4 - 24.8	0	-	-	0	-	-	-	-	
630 - 639	24.8 - 25.2	1	3040.0	6.70	1	113	-	1.11	-	
	TOTALS:	3	6730.0	14.83	3	118	Averag	ſe		

#### Walleye

2013 Shovel Lake Banner Marsh. WAE LENGTH FREQUENCY/CONDITION

LENG	TH GROUP INCHES	TOTAL L-FREQ	MEAN W	EIGHT LBS	NO. WEIGHED	N WR	1EAN CO (95%)	NDITIO KN (9	 N 5%)	-
570 - 579 580 - 589 590 - 599 600 - 609	22.4 - 22.8 22.8 - 23.2 23.2 - 23.6 23.6 - 24.0	1 0 0 1	2485.0 - 2445.0	5.48 - 5.39	1 0 0 1	118 - - 102	- - - -	1.36 - 1.17		-
	TOTALS:	2	4930.0	10.87	2	110	Averag	e		

		LENGI	TH GROUP	2	TOTAL	MEAN W	EIGHT	NO.	Μ	IEAN CO	NDITIC	DN
	N	ИN	INCHE	ES	L-FREQ	GRAMS	LBS	WEIGHED	WR	(95%)	KN (9	95%)
770	-	779	30.3 -	30.7	1	3450.0	7.60	1	98	-	1.52	-
780	-	789	30.7 -	31.1	0	-	-	0	-	-	-	-
790	-	799	31.1 -	31.5	1	3650.0	8.04	1	95	-	1.51	-
800	-	809	31.5 -	31.9	1	3560.0	7.85	1	89	-	1.42	-
810	-	819	31.9 -	32.3	1	3430.0	7.56	1	82	-	1.32	-
820	-	829	32.3 -	32.7	0	-	-	0	-	-	-	-
830	-	839	32.7 -	33.1	2	3822.5	8.42	2	86	( 86)	1.40	( 1.4)
840	-	849	33.1 -	33.5	0	-	-	0	-	-	-	-
850	-	859	33.5 -	33.9	0	-	-	0	-	-	-	-
860	-	869	33.9 -	34.3	1	4812.0	10.61	1	95	-	1.58	-
870	-	879	34.3 -	34.6	1	5303.0	11.69	1	101	-	1.69	-
880	-	889	34.6 -	35.0	2	4924.0	10.85	2	92	( 45)	1.55	( 0.8)
890	-	899	35.0 -	35.4	0	-	-	0	-	-	-	-
900	-	909	35.4 -	35.8	0	-	-	0	-	-	-	-
910	-	919	35.8 -	36.2	2	5970.0	13.16	2	99	( 15)	1.71	( 0.3)
920	-	929	36.2 -	36.6	0	-	-	0	-	-	-	-
930	-	939	36.6 -	37.0	0	-	-	0	-	-	-	-
940	-	949	37.0 -	37.4	0	-	-	0	-	-	-	-
950	-	959	37.4 -	37.8	0	-	-	0	-	-	-	-
960	-	969	37.8 -	38.2	0	-	-	0	-	-	-	-
970	-	979	38.2 -	38.6	0	-	-	0	-	-	-	-
980	-	989	38.6 -	39.0	0	-	-	0	-	-	-	-
990	-	999	39.0 -	39.4	0	-	-	0	-	-	-	-
1000	-	1009	39.4 -	39.8	1	7546.0	16.63	1	93	-	1.70	-
1010	-	1019	39.8 -	40.2	0	-	-	0	-	-	-	-
1020	-	1029	40.2 -	40.6	0	-	-	0	-	-	-	-
1030	-	1039	40.6 -	40.9	1	6000.0	13.22	1	67	-	1.24	-
1040	-	1049	40.9 -	41.3	0	-	-	0	-	-	-	-
1050	-	1059	41.3 -	41.7	0	-	-	0	-	-	-	-
1060	-	1069	41.7 -	42.1	0	-	-	0	-	-	-	-
1070	-	1079	42.1 -	42.5	0	-	-	0	-	-	-	-
1080	-	1089	42.5 -	42.9	0	-	-	0	-	-	-	-
1090	-	1099	42.9 -	43.3	0	-	-	0	-	-	-	-
1100	-	1109	43.3 -	43.7	0	-	-	0	-	-	-	-
1110	-	1119	43.7 -	44.1	0	-	-	0	-	-	-	-
1120	-	1129	44.1 -	44.5	0	-	-	0	-	-	-	-

2013 Shovel Lake Banner Marsh. MUE LENGTH FREQUENCY/CONDITION

Muskie

1130 -	1139	44.5 - 44.	90	-	-	0	-	-	-	-
1140 -	1149	44.9 - 45.	3 1	8917.0	19.65	1	71	-	1.41	-
		TOTALS:	15	61384.5	135.29	15	89 i	Avera	qe	

Appendix C Water Quality

# Appendix C – Water Quality

# Introduction.

The Definite Project Report (DPR) for the Banner Marsh State Fish and Wildlife Area Habitat Rehabilitation and Enhancement Project (HREP) called for littoral zone grading to be utilized as an enhancement feature to help meet two of the project's goals: enhancing wetland habitat and enhancing aquatic habitat. The objective of providing an increase in littoral zone area was to optimize feeding and rearing habitat for waterfowl and spawning habitat for fish. The desired water depth for the littoral zone, approximately ½ meter, was accomplished primarily by grading steep, high bank shorelines to flat shallow areas.

Approximately 90 percent of the Banner Marsh complex has been surface-mined. The area was stripmined for coal from the 1940s through the 1970s, with these operations resulting in rock and shale overburden materials (gob) being placed on the land surface. Most of the mined land has been reclaimed to varying degrees. Some of the gob piles have been capped and other areas throughout the complex with acidic soils have been treated with lime to neutralize the soils. Since restoration grading activities within the Banner Marsh complex could possibly expose acidic soils, it was anticipated pH would be the major water quality parameter of concern. Thus, post-project water quality evaluation efforts emphasized monitoring for pH and related parameters.

Post-project water quality monitoring at the Banner Marsh complex was accomplished through a combination of collecting grab samples and deploying a multiparameter continuous monitor (sonde). All monitoring was performed by Corps' Water Quality and Sedimentation Section (EC-HQ) personnel during the year 2013. Grab samples were collected at five sites, located in areas close to where littoral zone grading occurred. At site W-I142.6F (see Figure A-1), field measurements were taken and water samples were collected for laboratory analysis, while at sites W-I139.1H, W-I139.1J, W-I139.2H and W-I139.2J (see Figure A-2) only a limited number of field measurements were taken. Site W-I142.6F was accessed by boat, while the remaining sites were reached by wading from shore.

# **Results and Discussion.**

Grab sample results for site W-I142.6F are shown in Table A-1. The Illinois General Use Water Quality Standards state that pH should be within the range of 6.5 to 9.0 (except for natural causes). All pH values from site W-I142.6F were within this range, with a minimum of 7.72 and a maximum of 8.52. Alkalinity is essentially a measure of the acid-neutralizing capacity of water (also referred to as buffering capacity). The total alkalinity concentrations at site W-I142.6F ranged from 150 to 180 mg/L as CaCO<sub>3</sub>. This range would suggest the lake has some buffering capacity present to neutralize acidic inputs. Dissolved oxygen (DO) concentrations at the site were sufficient to support aquatic life with concentrations ranging from 7.28 to 13.25 mg/L. Water clarity was very good: turbidity (average 3.3 NTU) and total suspended solids (average 4.9 mg/L) values were quite low, while Secchi disk measurements averaged nearly 1.00 meter. Chlorophyll concentrations were very low, with most less than the detection limit of 1.0 mg/m<sup>3</sup>. Low chlorophyll concentrations indicate algae were virtually nonexistent at the sampling location. Observations made during sampling trips indicated shoreline macrophyte growth was abundant during the growing season. The water quality measurements and visual observations made at this site suggest that the lake is a macrophyte dominated system as opposed to an algae dominated system.

Grab sample results for sites W-I139.1H, W-I139.1J, W-I139.2H and W-I139.2J are shown in Tables A-2 and A-3. The minimum pH value at the four sampling locations was 7.99 at site W-I139.2H. All pH values at the three remaining sampling sites exceeded 8.00. During the growing season at sites W-I139.1J and W-I139.2J, many pH values were greater than 9.0, with some exceeding 10.0! These values are extremely high, but since they are due to natural causes (photosynthesis occurring in the abundant shoreline vegetation), they are not considered in violation of the Illinois General Use Water Quality Standard for pH. Plant photosynthesis also resulted in high DO concentrations. Supersaturated DO concentrations were common at all four sites, while the minimum concentration observed was 6.73 mg/L at site W-I139.2H on June 25<sup>th</sup>.

A sonde was deployed through the ice at site W-I142.6F from January 16<sup>th</sup> to March 7<sup>th</sup>, 2013. The sonde was positioned about one meter off of the bottom, at a location where the lake was approximately two meters deep. Water clarity at this site precluded deploying a sonde here during the summer months due to the increased potential for vandalism/theft. Water temperature and pH results from the January 16<sup>th</sup> deployment are shown in Figure A-3. Temperatures ranged from 1.64°C on February 3<sup>rd</sup> to 4.72°C on February 15<sup>th</sup>, while pH values ranged from 7.27 on March 7<sup>th</sup> to 8.28 on February 9<sup>th</sup>. All pH values were within the range of the Illinois General Use Water Quality Standard for pH (6.5 to 9.0). The sonde was also programmed to collect DO data; however, a malfunction occurred. A comparison of sonde pH data to grab sample DO concentrations taken at depth when the sonde was deployed (8.21 mg/L) and retrieved (12.00 mg/L), suggests DO concentrations were likely sufficient to sustain aquatic life throughout the deployment period.

## Conclusions.

Post-project water quality monitoring performed during the year 2013 at the Banner Marsh HREP indicates that conditions are acceptable to support aquatic life. The primary water quality concern identified in the planning stages of the project was that acidic soils, a remnant of prior coal mining activities, could cause low pH values in areas where littoral zone grading occurred. This concern has been shown to be unwarranted, as none of the pH values observed during the monitoring period were low. It is possible that future runoff/erosion events could expose underlying acidic soils, but in light of several high rainfall years that have occurred since project completion, the current pH values, and the alkalinity (buffering capacity) that is present, it is unlikely that low pH problems will occur. Therefore, it is recommended that seasonal water quality monitoring is discontinued at the Banner Marsh HREP until evidence is presented that suggests a low pH problem may exist. Opportunities for uncovering future problems include observations by Illinois DNR personnel made during fisheries studies, and spot pH measurements by Corps' EC-HQ personnel while working in the vicinity of the Banner Marsh HREP on Illinois River water quality projects.



Figure A-1. Location of sampling site W-I142.6F



Figure A-2. Location of sampling sites W-I139.1H, W-I139.1J, W-I139.2H and W-I139.2J

Table A-1. Water quality monitoring results from samples collected at site W-I142.6F

	WATER	WAVE	AIR	WIND SPEED	WIND	CLOUD
DATE	DEPTH (M)	HEIGHT (CM)	<u>TEMP. (°C)</u>	<u>(MPH)</u>	DIRECTION	COVER (%)
1/16/2013	2.140	-	-2	6	SW	0
3/7/2013	1.860	-	0	3	E	98
6/11/2013	0.900	1	28	2	SW	55
6/25/2013	3.290	1	21	2	W	80
7/9/2013	2.800	1	31	2	W	85
7/23/2013	3.040	0	28	3	Ν	75
8/6/2013	2.930	1	31	2	SW	60
8/20/2013	2.860	1	32	2	W	25
9/4/2013	2.680	0	31	2	W	10
9/17/2013	2.080	1	23	0	-	98
MIN.	0.900	0	-2	0	-	0
MAX.	3.290	1	32	6	-	98
AVG.	2.458	1	22	2	-	59

		DISSOLVED		TOTAL	SPECIFIC	
	WATER	OXYGEN	рН	ALKALINITY	CONDUCTANCE	TURBIDITY
DATE	<u>TEMP. (°C)</u>	<u>(MG/L)</u>	<u>(SU)</u>	(MG/L as CaCO <sub>3</sub> )	<u>(µMHOS/CM @ 25°C)</u>	<u>(NTU)</u>
1/16/2013	3.4	13.25	8.52	-	951	-
3/7/2013	3.4	12.46	8.13	156	763	4.0
6/11/2013	25.2	10.70	7.74	180	900	3.4
6/25/2013	26.3	7.28	8.17	174	942	4.6
7/9/2013	28.3	9.16	7.72	173	924	4.0
7/23/2013	30.3	8.88	8.06	166	932	2.8
8/6/2013	28.1	8.72	8.38	165	942	2.2
8/20/2013	27.3	9.85	8.28	151	945	2.7
9/4/2013	28.2	9.10	8.45	150	931	2.8
9/17/2013	24.5	8.42	8.33	153	947	2.9
MIN.	3.4	7.28	7.72	150	763	2.2
MAX.	30.3	13.25	8.52	180	951	4.6
AVG.	22.5	9.78	_	163	918	3.3

		SUSPENDED				
	SECCHI DISK	SOLIDS	CHLORO. a	CHLORO. b	CHLORO. c	PHEO. a
DATE	DEPTH (CM)	<u>(MG/L)</u>	<u>(MG/M3)</u>	<u>(MG/M3)</u>	<u>(MG/M3)</u>	<u>(MG/M3)</u>
1/16/2013	-	-	-	-	-	-
3/7/2013	-	-	-	-	-	-
6/11/2013	79.0	6.9	<1.0	<1.0	<1.0	<1.0
6/25/2013	72.0	7.6	<1.0	<1.0	<1.0	<1.0
7/9/2013	90.0	5.0	1.2	<1.0	1.1	1.3
7/23/2013	100.0	5.5	<1.0	<1.0	<1.0	<1.0
8/6/2013	129.0	<1.0	<1.0	<1.0	<1.0	<1.0
8/20/2013	136.0	4.5	<1.0	<1.0	1.2	<1.0
9/4/2013	85.0	5.6	<1.0	<1.0	1.3	<1.0
9/17/2013	107.0	3.8	<1.0	1.0	1.6	<1.0
MIN.	72.00	<1.0	<1.0	<1.0	<1.0	<1.0
MAX.	136.00	7.6	1.2	1.0	1.6	1.3
AVG.	99.75	4.9	0.6	0.6	0.9	0.6

 Table A-2.
 Water quality monitoring results from samples collected at sites W-I139.1H and W-I139.1J

			DISSOLVED		SPECIFIC
		WATER	OXYGEN	рН	CONDUCTANCE
<u>SITE</u>	DATE	<u>TEMP. (°C)</u>	(MG/L)	<u>(SU)</u>	<u>(µMHOS/CM @ 25°C)</u>
W-I139.1H	1/16/2013	2.8	15.75	8.33	1566
W-I139.1H	3/7/2013	3.1	13.66	8.15	763
W-I139.1H	6/11/2013	25.8	9.41	8.21	1347
W-I139.1H	6/25/2013	27.2	8.69	8.09	1387
W-I139.1H	7/9/2013	29.8	9.37	8.10	1389
W-I139.1H	7/23/2013	29.7	10.32	8.11	1412
W-I139.1H	8/6/2013	27.5	10.42	8.26	1446
W-I139.1H	8/20/2013	29.1	11.09	8.44	1484
W-I139.1H	9/4/2013	28.8	10.76	8.59	1486
W-I139.1H	9/17/2013	23.8	8.41	8.19	1514
MIN.	-	2.8	8.41	8.09	763
MAX.	-	29.8	15.75	8.59	1566
AVG.	-	22.8	10.79	-	1379

			DISSOLVED		SPECIFIC
		WATER	OXYGEN	рΗ	CONDUCTANCE
SITE	DATE	<u>TEMP. (°C)</u>	<u>(MG/L)</u>	<u>(SU)</u>	<u>(µMHOS/CM @ 25°C)</u>
W-I139.1J	1/16/2013	2.4	16.95	8.54	1098
W-I139.1J	3/7/2013	4.1	13.13	8.30	763
W-I139.1J	6/11/2013	25.9	9.43	8.62	872
W-I139.1J	6/25/2013	27.1	8.81	9.34	890
W-I139.1J	7/9/2013	30.3	10.91	8.74	880
W-I139.1J	7/23/2013	30.3	12.26	9.52	905
W-I139.1J	8/6/2013	28.1	14.25	9.85	905
W-I139.1J	8/20/2013	31.3	14.44	10.30	952
W-I139.1J	9/4/2013	30.1	15.47	9.79	946
W-I139.1J	9/17/2013	23.0	17.21	9.68	955
MIN.	-	2.4	8.81	8.30	763
MAX.	-	31.3	17.21	10.30	1098
AVG.	-	23.3	13.29	-	917

 Table A-3.
 Water quality monitoring results from samples collected at sites W-I139.2H and W-I139.2J

			DISSOLVED		SPECIFIC
		WATER	OXYGEN	рΗ	CONDUCTANCE
<u>SITE</u>	DATE	<u>TEMP. (°C)</u>	(MG/L)	<u>(SU)</u>	<u>(µMHOS/CM @ 25°C)</u>
W-I139.2H	1/16/2013	2.2	15.81	8.60	1248
W-I139.2H	3/7/2013	2.9	13.68	8.25	762
W-I139.2H	6/11/2013	23.3	12.05	8.21	1054
W-I139.2H	6/25/2013	25.6	6.73	8.01	1057
W-I139.2H	7/9/2013	27.6	9.73	7.99	1024
W-I139.2H	7/23/2013	29.5	11.62	8.68	1040
W-I139.2H	8/6/2013	26.1	10.29	8.51	1074
W-I139.2H	8/20/2013	26.4	11.50	8.81	1064
W-I139.2H	9/4/2013	27.0	11.29	8.91	1080
W-I139.2H	9/17/2013	22.2	9.82	8.51	1104
MIN.	-	2.2	6.73	7.99	762
MAX.	-	29.5	15.81	8.91	1248
AVG.	-	21.3	11.25	-	1051

			DISSOLVED		SPECIFIC
		WATER	OXYGEN	рΗ	CONDUCTANCE
SITE	DATE	<u>TEMP. (°C)</u>	(MG/L)	<u>(SU)</u>	<u>(μMHOS/CM @ 25°C)</u>
W-I139.2J	1/16/2013	2.1	18.78	8.61	1198
W-I139.2J	3/7/2013	3.1	13.86	8.34	763
W-I139.2J	6/11/2013	25.1	15.41	9.12	854
W-I139.2J	6/25/2013	26.3	10.12	9.73	854
W-I139.2J	7/9/2013	28.9	12.25	9.02	869
W-I139.2J	7/23/2013	30.3	15.56	9.60	906
W-I139.2J	8/6/2013	27.6	15.11	10.10	904
W-I139.2J	8/20/2013	28.7	8.34	10.51	950
W-I139.2J	9/4/2013	28.9	15.71	9.83	986
W-I139.2J	9/17/2013	23.2	19.14	9.98	1012
MIN.	-	2.1	8.34	8.34	763
MAX.	-	30.3	19.14	10.51	1198
AVG.	-	22.4	14.43	-	930



Figure A-3. Temperature and pH values collected with a sonde at site W-I142.6F from 1/16/13-3/7/13

