IPS ENVIRONMENTAL AND ANALYTICAL SERVICES
Appleton, Wisconsin

PHASE II
MACHICKANEE FLOWAGE MANAGEMENT PLAN
OCONTO COUNTY, WISCONSIN

REPORT TO:
MACHICKANEE FLOWAGE ADVANCEMENT ASSOCIATION

April, 1996

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SUMMARY

The Machickanee Flowage is an impoundment of the Oconto River located in southeast Oconto County, Wisconsin. The 463 acre pool is maintained by a dam owned by the Oconto Electric Cooperative and is characterized by good water quality and prolific aquatic plant growth. An initial resource assessment was made in 1991-1993 (Phase I Machickanee Flowage Management Plan); this document supplements the 1993 report and outlines further efforts toward development of a comprehensive lake management plan.

The majority of the relatively large Machickanee Flowage watershed (1,000 square miles) is predominantly forested (75%) with open/agricultural influence near the impoundment. Machickanee Flowage nutrient levels were low in comparison to most impoundments. Total phosphorus levels peaked during spring/summer and total nitrogen was seasonally quite consistent. Event monitoring indicated several areas of concern in the watershed.

Eurasian Water Milfoil (*Myriophyllum spicatum*) is abundant in Machickanee Flowage; some change in macrophyte abundance distributions were observed between 1992 and 1994. Localized stands of Purple Loosestrife (*Lythrum salicaria*) are also present.

Recreational use of Machickanee Flowage is reported to be light to moderate. The impoundment receives most use during the Summer months, mainly in non-consumptive activities such as viewing nature, wildlife watching and fishing. The abundance of aquatic plants may well interfere with the recreational use of Machickanee Flowage and detract aesthetic values.

Recommendations for the continued management of the Machickanee Flowage resource include:

- **Areas of concern in the watershed should be managed (best management practices) for nutrient and sediment contributions to surface and groundwaters. Designation of the basin as a priority watershed would greatly facilitate this area-wide assessment.**

- **Water quality monitoring should be continued to track trends and develop an accurate nutrient budget. A monitoring site should be added to the outlet and event sampling should continue. Well testing should be encouraged given the high levels of nitrates in regular and event samples.**

- **Mechanical harvest should be considered as a means of controlling aquatic plant growth. Cut areas should be located on a map and made available at public access points. Purple Loosestrife should be removed by a volunteer organization or the Association.**

- **A committee should be formed to address use conflicts as they may evolve.**

INTRODUCTION

This report presents the results and discussion of Phase II efforts the for Lake Management Plan, Machickanee Flowage, Oconto County, Wisconsin. Specific physical properties of the resource, a preliminary description of methods, and other introductory and technical information were presented in the Phase I report (printed in 1993).

Machickanee Flowage is an impoundment of the Oconto River located in southeast Oconto County, Wisconsin. The impoundment was created by construction of a dam in 1851; the existing dam (known as the Stiles Dam) was built in 1949, has a head of about 19 feet and is owned and operated for hydroelectric power generation by the Oconto Electric Cooperative. Machickanee Flowage currently has good recreational use potential, prolific aquatic plant growth and significant wildlife use.

The Machickanee Flowage Advancement Association (MFAA) was formed to help provide leadership and coordination of preservation efforts. The MFAA, received its first Wisconsin Department of Natural Resources (WDNR) Lake Management Planning Grant in October, 1991 and selected IPS Environmental & Analytical Services (IPS) of Appleton, Wisconsin as its consultant to begin management planning efforts. Phase I efforts included assessment

activities (for water quality and aquatic plants) and a public involvement program. The Phase II grant was received in October, 1993; Phase II efforts included continuation of the water quality monitoring and public involvement programs, more intensive review of areas of concern in the watershed, assessment of aquatic plant management techniques and development of recreational use alternatives for the impoundment.

DESCRIPTION OF AREA

Machickanee Flowage is a drainage lake (i.e., with a permanent inlet and outlet) located in the Town of Stiles (North) and Abrams (South), in Oconto County, Wisconsin (Figure 1). Like other impoundments, Machickanee Flowage has extensive shallow areas (maximum depth = 21 feet, average depth = 6 feet, volume = 2,778 acre-feet) (1), exhibits periodic flushing, acts as a sediment trap (fills in) and has a relatively large watershed (1400 times more land than lake surface area) compared to natural lakes. Impoundments are characteristically more prone to non-point source nutrient and sediment inputs.

The general topography of Oconto County is related to glacial activity and a majority of the county is drained by the Oconto River which flows southeast and east to Green Bay, a large bay of Lake Michigan. The groundwater in Oconto County generally is of very good quality and suitable for most domestic, municipal, and industrial uses. The quality of groundwater differs locally depending on composition, solubility, and surface area of soil and rock particles through which the water moves and the length of time that the water is in contact with these materials.

Major soil types near the Flowage are excessively drained Shawano fine sands on 2 - 30 percent slopes, Oconto fine sandy loam on

_Figure 1. Location Map, Machickanee Flowage, Oconto County, Wisconsin.

2 - 30 percent slopes, and poorly drained Cormant loamy fine sands on 0 - 1 percent slopes. Soil permeability is moderate to rapid and are generally unsuited for septic systems because of ponding (Cormant), steep slope (Shawano, Oconto) or inability to filter septate (Shawano, Oconto) (2).

Public access to Machickanee Flowage is available at three locations. A paved boat ramp is maintained by Oconto County on the south shore near the Stiles Dam, and carry on/walk-in access sites are located off Machickanee Lane and Birchwood Shores on the north shore (3).

The Machickanee Flowage shoreline is moderately developed, mostly seasonal, and primarily forested; sanitary service is via septic systems. Wildlife observed during the planning effort include waterfowl (mallards, teal, wood ducks, Canada geese, sandhill cranes, great blue heron), beaver, muskrat, white-tailed deer, and various species of turtles and frogs.

METHODS

FIELD PROGRAM

Machickanee Flowage routine water quality samples were taken during January, May, June, July, and September, 1994 and February, May, July, August, and September, 1995. Samples were collected mid-depth in the water column at Stations 1901 and Station 1902 and near surface and bottom at Station 1903 (Table 1, Fig. 2). Secchi depth, water temperature, pH, dissolved oxygen (DO), and conductivity were measured in the field; samples for other parameters were submitted via overnight carrier to the Wisconsin State Laboratory of Hygiene for analysis (see Phase I document for equipment and methods).

In addition to regular monitoring sites, five event sampling sites were located at tributary or intermittent inflows throughout the watershed (Table 1, Fig. 2) to help assess the extent of nutrient inflows. Phase II event samples were collected by MFAA on July 7, 1994.

Aquatic plant surveys were conducted in Phase I and repeated in Phase II (at two transects; E and F) to assess differences (if any) in the types and abundance of aquatic plants. Phase I aquatic plant activities included assessment of aquatic plant control techniques; control methods identified and discussed

Table 1. Sampling Station Locations, Machickanee Flowage, 1994 - 1995.

Regular Monitoring

Site	Latitude/Longitude	Depth
1901	44° 51' 16" 88° 06' 06"	6.0 feet
1902	44° 51' 19" 88° 04' 02"	7.0 feet
1903	44° 51' 26" 88° 04' 22"	21.0 feet

Event Monitoring

Site	Description
19E1	Brehmer Creek inlet (perennial) draining forested land and entering near Station 1901
19E2	Intermittent inlet draining forested land North of the flowage
19E3	Intermittent inlet draining forested land South of the flowage
19E4	Splinter Creek entering on the north shore
19E5	Intermittent inlet 100 yards East of Machickanee Lane

MACROPHYTE TRANSECTS

Transect	Origin Latitude/Longitude	Transect Length(m)	Bearing (Degrees)	Depth Range[1]
E	44° 51' 07" 88° 04' 27"	350	110	1/2/3
F	44° 51' 43" 88° 03' 31"	12	60	1/2/3

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[1] 1 = 0.0 - 0.5m (0.0 - 1.7ft)
2 = 0.5 - 1.5m (1.7 - 5.0ft)
3 = 1.5 - 3.0m (5.0 - 10.0ft)

_Figure 2. Sample Sites, Machickanee Flowage, 1994 - 1995.

included aquatic herbicides, mechanical harvest, benthic barriers (screening), and SCUBA cutting (clear and selective).

OTHER

Public Involvement Program

Public involvement activities were coordinated to inform and educate the MFAA about lake management in general and specifics regarding the Machickanee Flowage resource. Activities included news releases, IPS newsletters, meeting attendance and presentations to the MFAA. A summary of public involvement activities is outlined in Appendix I.

Recreational Use Survey

A recreational use survey of the MFAA membership was conducted to obtain property and lake use, water use opinions and demographics information. About 32 questionnaires were distributed (one per household) by MFAA volunteers to maximize the return rate. A sample survey questionnaire is included in Appendix II.

FIELD DATA DISCUSSION

The water quality and biological characteristics of Machickanee Flowage are directly related to the Oconto River and its basin. Watershed area, soil and cover types, slopes and land uses all directly and indirectly influence the Machickanee Flowage resource.

WATER QUALITY

Surface or mid-depth phosphorus levels in-lake (ave. = 0.029, median = 0.028, σ = 0.013 mg/l) and at the inlet (ave. = 0.028, median = 0.031, σ = 0.010 mg/l) (Tables 2-4, Fig. 3) were well below those expected for impoundments (ave. = 0.064, median = 0.035, σ = 0.100 mg/l) and drainage lakes (ave. = 0.040, median = 0.025, σ = 0.064), but were higher than for lakes in the northeast region of Wisconsin (ave. = 0.019, median = 0.016, σ = 0.021) (4). NOTE: Some total phosphorus data are indicated to have exceeded the recommended holding time before analysis. A study has shown, however, that phosphorus data remains accurate for samples analyzed well after the 28 day holding time (5).

In-lake (ave. = 0.77, σ = 0.14) and inlet (ave. = 0.73, σ = 0.067) surface or mid-depth total nitrogen levels (Tables 2-4, Fig. 4) were similar and slightly lower than those expected for

impoundments (ave. = 1.06, σ = 0.54), drainage lakes (ave. =

Table 2. Water Quality Parameters, Station 1901, Machickanee Flowage, 1994 - 1995.

PARAMETER	SAMPLE[1]	DATE 01/26/94	05/12/94	06/27/94	07/24/94	09/07/94	02/08/95	05/15/95	07/24/95	08/22/95	09/27/95
Secchi (feet)		>3.0	2.7	5.1	4.7	3.4	NR[2]	3.3	3.7	2.7	4.6
Cloud Cover (percent)		0	0	10	20	0	0	20	0	0	80
Temperature (degrees Celsius)	M	0.64	13.90	23.46	23.82	15.85	0.91	15.91	22.44	23.83	11.52
pH (surface units)	M	NR	7.10	7.83	9.92	7.37	7.50	7.73	7.35	7.73	7.38
D.O. (mg/l)	M	11.43	8.95	9.78	9.31	7.82	13.18	10.68	8.33	8.61	8.77
Conductivity (umhos/cm)	M	287	232	272	284	270	305	234	295	277	295
Laboratory pH (surface units)	M	NR	7.93	NR	NR	NR	NR	8.23	NR	NR	NR
Total Alkalinity (mg/l)	M	NR	114	NR	NR	NR	NR	108	NR	NR	NR
Total Solids (mg/l)	M	NR	170	NR	NR	NR	NR	172	NR	NR	NR
Tot. Kjeld. Nitrogen (mg/l)	M	<0.2	0.5	NR	NR	NR	0.3	0.6	NR	NR	NR
Ammonia Nitrogen (mg/l)	M	0.089	0.035	NR	NR	NR	0.056	ND[3]	NR	NR	NR
NO_2 + NO_3 Nit. (mg/l)	M	0.448	0.199	NR	NR	NR	0.497	0.166	NR	NR	NR
Total Nitrogen (mg/l)	M	<0.648	0.699	NR	NR	NR	0.797	0.766	NR	NR	NR
Total Phosphorus (mg/l)	M	0.015	0.030	0.029	0.033	0.034[4]	0.013	0.031	0.034	0.044	0.019
Dissolved Phos. (mg/l)	M	0.005	ND	0.005	0.007	0.003	0.002	0.005	0.002	0.023	ND
Nit./Phos Ratio	M	43.2	23.3	--	--	--	61.3	24.7	--	--	--
Chlorophyll a (ug/l)	S	NR	7.83	7.81	10.8	7.28	NR	5.6	2.58	NR	NR

[1] M = mid-depth; [2] NR = no reading; [3] ND = not detectable;
[4] holding time exceeded by SLOH

Table 3. Water Quality Parameters, Station 1902, Machickanee

Flowage, 1994 - 1995.

PARAMETER	SAMPLE[1]	DATE 01/26/94	05/12/94	06/27/94	07/24/94	09/07/94	02/08/95	05/15/95	07/24/95	08/22/95	09/27/95
Secchi (feet)		NR[2]	2.9	>5.0	>5.0	5.2	NR	2.6	>5.0	>5.0	>5.0
Cloud Cover (percent)		10	0	15	20	0	0	20	0	0	80
Temperature (degrees Celsius)	M	1.09	14.33	23.79	24.15	19.34	2.39	15.66	24.86	24.83	12.68
pH (surface units)	M	NR	7.22	8.25	8.03	7.74	6.51	8.05	9.18	8.74	8.08
D.O. (mg/l)	M	10.53	8.90	10.52	10.73	10.43	12.84	9.85	12.4	NR	10.7
Conductivity (umhos/cm)	M	299	229	254	279	264	321	229	240	245	279
Laboratory pH (surface units)	M	NR	7.97	NR	NR	NR	NR	8.24	NR	NR	NR
Total Alkalinity (mg/l)	M	NR	112	NR	NR	NR	NR	105	NR	NR	NR
Total Solids (mg/l)	M	NR	162	NR	NR	NR	NR	164	NR	NR	NR
Tot. Kjeld. Nitrogen (mg/l)	M	0.4	0.5	NR	NR	NR	0.3	0.6	NR	NR	NR
Ammonia Nitrogen (mg/l)	M	0.094	0.040	NR	NR	NR	0.031	ND[3]	NR	NR	NR
NO_2 + NO_3 Nit. (mg/l)	M	0.460	0.175	NR	NR	NR	0.508	0.161	NR	NR	NR
Total Nitrogen (mg/l)	M	0.860	0.675	NR	NR	NR	0.808	0.761	NR	NR	NR
Total Phosphorus (mg/l)	M	0.014	0.027	0.061	0.036	0.024[4]	0.012	0.032	0.023	0.024	0.013
Dissolved Phos. (mg/l)	M	0.006	ND	0.006	0.004	ND	ND	0.006	ND	0.005	ND
Nit./Phos Ratio	M	61.43	25.0	--	--	--	67.33	23.8	--	--	--
Chlorophyll a (ug/l)	S	NR	10.4	9.69	12.2	9.55	NR	6.13	0.32	NR	NR

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[1] M = mid-depth; [2] NR = no reading; [3] ND = not detectable;
[4] holding time exceeded by SLOH

Table 4. Water Quality Parameters, Station 1903, Machickanee Flowage, 1994 - 1995.

PARAMETER	SAMPLE[1]	DATE 01/26/94	05/12/94	06/27/94	07/24/94	09/07/94	02/08/95	05/15/95	07/24/95	08/22/95	09/27/95
Secchi (feet)		NR[2]	3.1	3.0	4.7	5.6	NR	3.2	3.9	2.9	7.9
Cloud Cover (percent)		10	0	20	20	0	0	30	0	0	70
Temperature (degrees Celsius)	S	0.58	15.02	24.05	23.97	17.68	0.99	14.54	24.84	26.41	13.13
	B	1.25	14.48	22.15	23.40	17.36	1.09	14.46	23.54	22.91	12.37
pH (surface units)	S	7.10	7.32	7.94	7.84	7.65	NR	8.05	8.59	7.81	7.89
	B	6.57	7.22	7.20	7.57	7.53	NR	7.60	7.71	7.57	7.49
D.O. (mg/l)	S	11.89	9.22	10.05	7.87	8.95	12.82	9.14	9.71	7.56	9.14
	B	7.96	8.80	5.01	6.74	8.40	12.12	8.85	6.29	6.52	8.34
Conductivity (umhos/cm)	S	301	227	271	282	263	309	228	289	279	283
	B	301	229	278	284	264	310	229	296	278	293
Laboratory pH (surface units)	S	NR	7.98	NR	NR	NR	NR	8.05	NR	NR	NR
	B	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total Alkalinity (mg/l)	S	NR	111	NR	NR	NR	NR	104	NR	NR	NR
	B	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Total Solids (mg/l)	S	NR	164	NR	NR	NR	NR	166	NR	NR	NR
	B	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Tot. Kjeld. Nitrogen (mg/l)	S	0.3	0.4	NR	NR	NR	0.4	0.7	NR	NR	NR
	B	0.4	0.4	NR	NR	NR	0.3	0.7	NR	NR	NR
Ammonia Nitrogen (mg/l)	S	0.104	0.029	NR	NR	NR	0.474	ND[3]	NR	NR	NR
	B	0.116	0.040	NR	NR	NR	0.046	ND	NR	NR	NR
NO_2 + NO_3 Nit. (mg/l)	S	0.467	0.177	NR	NR	NR	0.495	0.155	NR	NR	NR
	B	0.418	0.168	NR	NR	NR	0.468	0.162	NR	NR	NR
Total Nitrogen (mg/l)	S	0.767	0.577	NR	NR	NR	0.895	0.855	NR	NR	NR
	B	0.818	0.568	NR	NR	NR	0.868	0.862	NR	NR	NR
Total Phosphorus (mg/l)	S	0.012	0.030	0.041	0.039	0.027[4]	0.014	0.026	0.034	0.053	0.015
	B	0.017	0.033	0.039	0.042	0.025[4]	0.013	0.027	0.029	0.038	0.017
Dissolved Phos. (mg/l)	S	0.004	0.002	ND[3]	0.002	0.003	ND	0.021	0.003	0.015	ND
	B	0.006	ND	0.002	0.004	ND	ND	0.005	0.001	0.014	ND
Nit./Phos Ratio	S	63.92	19.23	--	--	--	63.93	32.9	--	--	--
	B	48.12	17.21	--	--	--	66.77	31.9	--	--	--
Chlorophyll a (ug/l)	S	NR	11.40	19.4	16.1	9.49	NR	7.37	1.56	19.8	3.56

[1] S = surface, B = bottom; [2] NR = no reading; [3] ND = not detectable; [4] holding time exceeded by SLOH

Figure 3. Surface or Mid-Depth Total Phosphorus Levels for Machickanee Flowage, 1994 - 1995.

Figure 4. Surface or Mid-depth Total Nitrogen Levels for

Machickanee Flowage, 1994 - 1995.

0.95, σ = 0.55), and lakes in the central region of Wisconsin (ave. = 0.72, σ = 0.31) (4).

Regular monitoring data (1994 - 1995) indicated a seasonal trend of low winter and higher spring/summer total phosphorus levels. Total nitrogen levels were seasonally quite consistent.

Event monitoring indicated relatively higher total phosphorus levels at Sites 19E5 (0.348 mg/l), 19E1 (0.123) and 19E3 (0.115) (Table 5); a similar trend was observed during November, 1992

Table 5. Event Water Quality Parameters, Machickanee Flowage, July 7, 1994.

PARAMETER	SAMPLE SITE				
	19E1	19E2	19E3	19E4	19E5
TKN	1.5	1.1	1.0	0.3	4.0
NH_4-N (mg/l)	0.027	0.030	0.057	0.045	0.037
NO_2+NO_3-N (mg/l)	0.369	0.094	0.143	0.066	0.148
Total N (mg/l)	1.869	1.19	1.057	0.366	4.148
Total P (mg/l)	0.123	0.064	0.115	0.036	0.348
Diss. P (mg/l)	0.003	0.002	0.003	ND[1]	0.007
N/P Ratio	15.2	18.6	9.19	10.17	11.92

[1] ND = not detectable

(Appendix III). Site 19E5 also exhibited the highest total nitrogen level (4.148 mg/l) during the 1994 sampling.

AQUATIC PLANT CONTROL

Coontail, Eurasian milfoil, and flat-stem pondweed were the most abundant aquatic plants observed at transects E and F during 1994 (Tables 6-8). These data represent a substantial abundance shift, particularly relative to milfoil species, from that observed at these sites during 1992 (Fig. 5).

Aquatic herbicide treatment, mechanical harvest, dredging, benthic barriers, installation of floating platforms, rototilling and SCUBA cutting were identified and discussed relative to their applicability to Machickanee Flowage in the Phase I report. These, along with drawdown and biological alternatives, are compared relative to effectiveness and other concerns on Table 9.

The introduction of native or exotic aquatic insects (moths, weevils, etc.) may be a future alternative method for the control of aquatic nuisance plants, specifically Eurasian milfoil.

Research indicates there is some potential for milfoil control with a native weevil (*Euhrychiopsis lecontei*), but work is still in the experimental stage. Small scale field work and laboratory

tests have indicated that this aquatic weevil appears to be able to cause milfoil to decline without causing significant damage to native aquatic plant species (6).

Unfortunately, there are numerous questions that remain to be answered, such as whether or not aquatic herbicides will affect the survival of the weevils, whether or not weevils will control milfoil in its early stages of invasion, how many weevils are required to cause milfoil decline given a certain amount of milfoil present, etc.

It is known that the weevils will not eliminate Eurasian watermilfoil from a lake. However, researchers believe that in some lakes, weevils have played an important role in causing milfoil to decline to a point where the plant no longer interferes with normal lake use (6).

RECREATIONAL USE

About 53 percent of all survey respondents (n = xx) indicated they were permanent residents. Average occupancy for all residents was 8.0 months (Table 10); seasonal residents averaged 4.0 months. Respondents indicated 56 watercraft with an average of 1.9/household. Most common watercraft types (in order) were boats with less than 25 horsepower motors, canoes and row/paddle boats, boats with 26 - 50 horsepower motors, and pontoon boats.

Table 6. Macrophyte Species Observed, Transects E and F, Machickanee Flowage, 1994.

Taxa	Code
Coontail (Ceratophyllum demersum)	CERDE
Common Waterweed (Elodea canadensis)	ELOCA
Filamentous algae	FILAL
Small duckweed (Lemna minor)	LEMMI
Water Milfoil (other than Eurasian)	MYRSPE
Eurasian Water Milfoil (Myriophyllum spicatum)	MYRSPI
Bushy Pondweed (Najas sp.)	NAJSP
White water lily (Nymphaea sp.)	NYMSP
Leafy pondweed (Potamogeton foliosus)	POTFO
Flat-Stem Pondweed (Potamogeton zosteriformis)	POTZO
Sago Pondweed (Potamogeton pectinatus)	POTPE
Eel Grass (water celery) (Vallisneria americana)	VALAM

Table 7. Occurrence and Abundance of Macrophytes by Depth, Transects E and F, Machickanee Flowage, July 1994.

	Depth Ranges					
CODE	1 (N=2)		2 (N=2)		3 (N=2)	
	% of Sites	Σ Abundance (range)	% of Sites	Σ Abundance (range)	% of Sites	Σ Abundance (range)
MYRSPI	0	0	100	6(3)	100	7(3-4)
CERDE	50	2(2)	100	7(3-4)	100	7(3-4)
FILAL	50	1(1)	0	0	0	0
VALAM	0	0	50	1(1)	0	0
POTFO	50	1(1)	50	2(2)	50	1(1)
POTZO	50	3(3)	100	5(2-3)	100	3(1-2)
NYMSP	100	6(2-4)	100	3(1-3)	0	0
LEMMI	100	2(1)	0	0	0	0
ELOCA	100	3(1-2)	100	4(2)	50	1(1)
NAJSP	50	4(4)	0	0	0	0
MYRSPE	0	0	50	1(1)	0	0
POTPE	50	2(2)	50	2(2)	0	0

Table 8. Abundance Distribution and Substrate Relations for Selected Macrophytes, Transects E and F, Machickanee Flowage, July 1994.

Transect	Substrate	Species Code											
		MYRSPE	CERDE	VALAM	FILAL	NYMSP	ELOCA	MYRSPI	POTZO	NAJSP	POTPE	POTFO	LEMMI
E1	sand	0	0	0	1	4	1	0	3	0	0	1	1
E2	sand	1	3	0	0	2	1	3	3	0	2	2	0
E3	sand	0	3	0	0	0	0	4	1	0	0	1	0
F1	sand/muck	0	2	0	0	2	2	0	0	4	2	0	0
F2	sand/muck	0	4	1	0	1	2	3	2	0	0	0	0
F3	silt/muck	0	4	0	0	0	1	3	2	0	0	0	0

Figure 5. Abundance Comparison for Selected Macrophytes, Transects E and F, Machickanee Flowage, July 1992 and July 1994.

Table 9. Comparison of Aquatic Plant Control Alternatives for Machickanee Flowage, Oconto County, WI.

Effects on Ecosystem	MECHANICAL HARVESTING Removes plant material, some small fish	AQUATIC HERBICIDES possible residual effects	DREDGE removes preferred habitat, disturbs sediment	ROTOTILL disturbs sediments	SCUBA removes plant material	BOTTOM SCREENS covers plants	DRAWDOWN decreased water quality downstream, possible fishery effects	BIOLOGICAL needs more research
Effective Large-scale	yes	yes	yes	yes	no	no	yes	yes
Effective Small-scale	no	yes	yes	no	yes	yes	no	no
Species Selective	possibly	possibly	yes	no	yes	no	no	yes
Removes Nutrients	yes	no	yes	no	yes	no	no	no
WDNR Acceptability	high-minimal environmental impacts	medium-permit required	low-many environmental impacts	medium-sediment impacts	high-minimal impacts	medium-for small areas permit required	medium-limited success	low-many unknowns
Public Acceptability	high-immediate benefits	medium/low-many "anti-chemical" advocates	medium	medium/low-new technology	high-immediate effects	medium-difficult to maintain	medium/high-will allow frontage clean-up	low

Table format taken from "Minnesota Aquatic Plant Control Draft Reconnaissance Report," August 1989.

Table 10. Machickanee Flowage Recreational Use Parameters.

Parameter	
Average monthly occupancy	8.0
Average number of watercraft (per response)	1.9
Average number of adults (per respondent household)	2.1
Average number of children 12 - 18 years old (per respondent household)	0.2
Average number of children less than 12 years old (per respondent household)	0.1
Percent of respondents leaving comments	60.0

Machickanee Flowage respondents disagreed (71% "strongly disagree" or "disagree" responses) there are too many watercraft on Machickanee Flowage and that the number of watercraft cause safety problems (77%) (Table 11, Appendix II). They were nearly split relative to adequate water safety enforcement on weekdays (58% agree), weekends (52%) and holidays (52%). Concensus was somewhat against the enactment of more ordinances (67%) and limiting boat numbers (64%). Respondents overwhelmingly agreed there was adequate public boater access (93%) to and were split relative to establishment of a public beach (52%).

EXOTIC SPECIES

Aquatic plant surveys (1992; Phase I) and visual observations (1991 - 1995) indicated native water milfoil species (mainly *Myriophyllum exalbescens*) and Eurasian Water Milfoil (*Myriophyllum spicatum*) to be widespread and abundant in the Machickanee Flowage. Eurasian Water Milfoil is an exotic plant which spreads quickly, often occurs at nuisance levels, displaces more desirable native vegetation and can alter plant and animal assemblages within a lake. There were no observations of Zebra Mussels.

Purple Loosestrife, however, was present in several areas of the Machickanee Flowage (Figure 6). Purple Loosestrife is an exotic plant with a bright purple flower, originally propagated in the

Table 11. Percentage of "Strongly Agree" and "Agree" Responses, Machickanee Flowage, Oconto County, WI.

Opinion		
There are too many watercraft on Machickanee Flowage	29	
The current number of watercraft causes safety problems		23
There is adequate water safety enforcement:		
weekdays		58
weekends		52
holidays	52	
The current number of watercraft diminish aesthetics:		
weekdays		17
weekends		38
holidays	42	
Additional water use regulations need to be enacted and enforced		33
There should be limits set on the number of watercraft		36
There is adequate public boater access to Machickanee Flowage	93	
There should be a public swimming beach on Machickanee Flowage	52	

United States by the horticulture industry for flower gardens. It blooms late June to July and produces seeds soon after. The plant is able to outcompete native wetland vegetation and modify entire plant (and thus animal) assemblages.

Figure 6. Purple Loosestrife Growth Areas, Machickanee

Flowage, 1995.

BASELINE CONCLUSIONS

Physical characteristics of the impoundment make Machickanee Flowage prone to sedimentation, prolific aquatic plant growth, non-point source nutrient inflows, and variable water quality affected by parent river flow conditions. Water quality is good with in-lake nutrient levels lower than generally expected for for impoundments. Machickanee Flowage supports widespread nuisance aquatic plant growth including large areas of Eurasian Water Milfoil. Areas of Purple Loosestrife are also present.

Recreational Use

Recreational use may be restricted by widespread and abundant macrophytic growth throughout much of the open-water season. Adequate water quality, nutrients and extensive soft, shallow shelf areas make conditions in Machickanee Flowage (like many other impoundments) conducive to nuisance aquatic plant growth.

Resident responses to the recreational use survey indicated that recreational use conflicts are not an apparent concern at this time. There was, however, a significant increase in "strongly agree" and "agree responses" that the number of watercraft diminish aesthetics on weekends and holidays when compared to weekdays. Respondents were relatively evenly divided as to adequate water safety enforcement. Clear concensus was not apparent regarding additional regulations address the situation.

MANAGEMENT RECOMMENDATIONS

Machickanee Flowage management should target areas watershed issues including erosion control and surface runoff reduction, manure containment, and fertilizer management. Water quality monitoring should be continued to track trends, develop a better nutrient budget for the impoundment and to detect changes within the watershed. Monitoring should include regular (quarterly) sampling of the inlet, mid-lake and deepest point and event sampling of erosional runoff sites similar to or the same as those sampled previously. Self-help secchi monitoring should be continued; rainfall monitoring should be initiated.

Mechanical harvest should be initiated for widespread aquatic plant control in the downstream portion of the impoundment; small channels in upstream portions (especially around islands and piers) should also be harvested. Management for wetland habitat (with side benefits of nutrient removal) should be considered for the upstream reach. Areas harvested (especially channels) should be buoyed or identified on a map and made available at access points. Screening and SCUBA/hand removal should be encouraged for small localized areas where harvester access is limited. Partial drawdown may be considered to allow landowners to more effectively manage frontage areas.

Land purchase may be pursued for wetland protection near the impoundment and/or throughout the watershed. Wetland protection will help to increase awareness and protect water quality. Signs should be posted at access points informing lake users of Eurasian Water Milfoil, Purple Loosestrife and Zebra Mussels. A sign reading "remove weeds from trailer" should be painted on the main ramp.

Identified purple loosestrife stands should be treated as soon as it is practical to do so; localized growth areas or individual plants should be treated first and more extensive growth areas later. It is best to treat plants before flowering (May to mid June). Plants are treated by cutting the top off and spraying the remainder with a Roundup-surfactant mix; plants in standing water should be treated with a Rodeo-surfactant mix. Chemicals can be applied using hand spray bottles or larger chemical sprayers. Sites should be revisited in subsequent years to treat remnant individuals.

Local townships, Oconto County and the State of Wisconsin, should take a cooperative effort in protection of the Machickanee Flowage resource by the regulation of land uses and land use practices. Efforts should continue to pursue the designation of the Oconto River Watershed as a priority watershed to obtain cost-share funding to implement long term conservation practices.

The MFAA should form a committee to address direct education or prevention measures to attempt minimization of use conflicts. These may include

- Development of maps for distribution which define best potential use zones for different recreational activities (fishing, canoeing, pleasure boating, viewing wildlife etc.),

- Brochures, for visitors at access points, emphasizing "water use ethics" along with information on available restrooms, access points and applicable regulations and ordinances,

- Development of water accessible restrooms and waste disposal facilities for boaters,

- Continuation of a reasonable ramp fee at some/all access points with the money collected directed toward access maintenance or lake management/protection activities (other potential sources of funding listed in Appendix IV), and

- Riparian landowners education about pertinent ordinances (dock design/size, boat numbers per pier, building near lakeshores, near-lake improvements, etc.).

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5. Bowman, G. and R. Shuknecht. 1991. Memo regarding stability of total phosphorus and total kjeldahl nitrogen samples exceeding holding times. Unpublished.

6. Vermont Department of Environmental Conservation. 1993. A Report from the Milfoil Study Committee on the Use of Aquatic Herbicides to Control Eurasian Watermilfoil. 41 p.

APPENDIX I

SUMMARY OF PUBLIC INVOLVEMENT ACTIVITIES
Machickanee Flowage Management Plan

The Machickanee Flowage Advancement Association (MFAA) initiated steps to develop a comprehensive lake management plan under the Wisconsin Department of Natural Resources (WDNR) Lake Management Planning Grant Program in the Fall of 1991. A public involvement program was immediately initiated as part of the planning process. The following is a summary of Phase I and Phase II major public involvement efforts.

Planning Advisory Committee

A working group comprised of MFAA Commissioners, WDNR and IPS representatives was established at the start of the program. The group provided planning direction and served as main reviewer of the draft plan document.

Brochures

Informational brochures were and will be developed and distributed which outlines objectives, elements and ways for MFAA members to get involved in the planning process.

Meetings

IPS presented progress reports, provided information about the resource and interpretations of these results at the MFAA annual meetings.

Print Media

A quarterly IPS newsletter entitled "Lake Management News" was developed and distributed to the MFAA for the Board's use and distribution among the membership. A special "Machickanee Flowage Edition" was also developed to notify the MFAA of any late developments in the planning program.

Surveys

Recreational use surveys were distributed to the membership to solicit input from members.

APPENDIX II
RECREATIONAL USE SURVEY RESULTS
Machickanee Flowage Management Plan

APPENDIX II
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APPENDIX III
HISTORICAL EVENT WATER QUALITY PARAMETERS

APPENDIX IV

POTENTIAL FUNDING SOURCES FOR PLAN IMPLEMENTATION

Potential sources of funds to assist plan implementation include:

County:

- Conservation funds from the state to be used for natural resources projects (old predator fund). Erosion control cost share funds through Land Conservation Committee.

State:

- WDNR Priority Watershed Program. This program has been modified to include priority lakes. The program provides 50-80% cost share for installing "best management practices" to combat nonpoint source water pollutants. Projects are selected by the WDNR and administered by the County Land Conservation Committee.

- WDNR Lake Management Grants. Funding is available to local governments and lake management organizations for the collection and analysis of information needed to manage lakes. The state may pay for 75% of the cost and up to $10,000 for any one project. The remaining 25% must be provided by the local organization or cash contributions from other sources. Projects may include: gathering and analysis of physical, chemical and biological information, describing present and potential land uses within lake watersheds, reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, sanitation or pollution control, gathering and analyzing information from lake property owners, community residents and lake users, developing alternative courses of action and recommendations.

- WDNR Lake Protection Grants. Another 75% cost share program which allows lake management organizations to obtain funds to protect or restore lakes and their ecosystems. Activities eligible for funding include: the purchase of property which will contribute to the protection or improvement of the natural ecosystem and water quality of a lake, the restoration of wetlands, the development of regulations and ordinances, and any lake improvement projects recommended in a DNR approved plan including lake restoration, watershed management, pollution prevention and control projects.

APPENDIX III
(continued)

- WDNR's Recreational Boating Facilities Program (NR 7). Program has been expanded to include qualified lake associations as applicants. This program is administered by the WDNR and supervised by the Wisconsin Waterways Commission. Forty percent of funds are allocated to the Great Lakes, 40% to inland lakes and 20% is discretionary. Financial assistance is available for safe recreational boating projects including: "...dredging of channels of waterways for recreational boating purposes, acquisition of capital equipment necessary to cut and remove aquatic plants, and acquisition of aids to navigate and regulatory markers." A 50% cost share is provided.

- Dam Repairs. Counties, cities, villages, towns and public inland lake protection and rehabilitation districts are eligible for 50% cost sharing of dam maintenance, repair, modification or abandonment. Three million dollars is allocated annually and dams must be inspected by the WDNR and be under directives to be repaired.

- DATCP Farmers' Fund (AG 165). Assists farmers with construction of animal waste management installations (county sets design standards). Soil Erosion Control (AG 160) funds targeted to areas that counties have identified as priorities in the County Erosion Control Plan (the watershed including Machickanee Flowage is not currently identified as a priority soil erosion area).

- Stewardship Program. Ten year $250,000 to protect environmentally sensitive areas and acquire or maintain recreational areas. The funds are raised by state sale of bonds. Potential lake applications include:

  Habitat Restoration Areas - $1.5M annually to encourage private landowners and non-profit organizations to adopt management practices favorable to wildlife.

  Urban Green Space - $750,000 annually for 50% grants to municipalities to protect scenic or ecological sites from development.

APPENDIX III
(continued)

Streambank Protection - $1M annually to WDNR to purchase streambank easements of at least 66 feet and to provide fencing.

Federal:

- EPA Clean Lakes Program (appropriations pending). Limited amount of cost share funding for planning and implementing public lake protection and restoration projects. WDNR must apply for the funds on behalf of lake organization. Requires EPA feasibility study.

- US Army Corps of Engineers. Can provide limited cost share funds to states to support selected aquatic plant management projects. Must be identified by WDNR as high priority and have an in-depth aquatic plant management plan.

- USDA (1985 Federal Farm Bill). Program to take land out of agricultural production. While these funds go to individual farmers, lake leaders may want to encourage farmers to use these programs. Conservation Reserve Program is purchasing the right to keep some Wisconsin farmland out of cultivation for 10 years. County office administers the program.

- FmHA Loan program to farmers in exchange for Conservation Easements. Long-term easements take land adjacent to wetlands, lakes and streams out of production. Annual multi-year set-aside programs.

- SCS. Beginning in 1983, SCS has provided large grants to selected areas to enhance water quality.

Miscellaneous:

Programs that might be useful in certain situations include: Trout Stamp land purchase program (WDNR), Water Bank Program (ASCS), water safety patrol aids (WDNR), Land and Water Conservation Fund (US Dept. of Interior and WDNR), Forest Incentive Program (ASCS), Mining Investment and Local Impact Fund (Wis. Dept. of Revenue) and Septic Tank Replacement Program (WDNR).

PHASE II
LAKE MANAGEMENT PLAN
MACHICKANEE FLOWAGE
OCONTO COUNTY, WISCONSIN

Prepared for

Machickanee Flowage Advancement Association

by

April, 1996