MMA, INC.
CONSULTING ENGINEERS

LAKE PLANNING STUDY

FOR THE

TOWNSEND FLOWAGE

Prepared for:

TOWNSEND FLOWAGE ASSOCIATION

Townsend, WI 54175

MARCH 1995

Prepared by:

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LAKE PLANNING STUDY
FOR THE
TOWNSEND FLOWAGE

EXECUTIVE SUMMARY

The Townsend Flowage is located in Sections 14, 15, 22, 23 and 27 of Township 33 North, Range 15 East in the Township of Townsend in the northern portion of Oconto County, Wisconsin.

The Townsend Flowage is an impoundment consisting of two distinct basins. The northern basin is approximately 173 acres in size and the southern basin is approximately 303 acres in size. The maximum depth of the northern basin is approximately 10-feet. The maximum depth of the southern basin is approximately 30-feet with an average depth of 9-feet (Ref. # 12).

Two streams were dammed to form the present day Townsend Flowage. The largest inlet stream is McCaslin Brook which enters the southern basin on the southwest. The other inlet stream is Mosquito Creek entering the northern basin on the northwest. The outlet to the Townsend Flowage is located on the south end of the south basin. A small concrete and earth dam controls the lake level. Once water flows over the dam, it continues south as McCaslin Brook to the North Branch of the Oconto River.

The Townsend Flowage supports natural reproduction of a number of pan and game fish species. Length frequency information indicates growth is consistent with that observed in other area waters. Fish species found in the Townsend Flowage include: bluegill, yellow perch, black crappie, rock bass, largemouth bass and northern pike (Ref. # 5).

An abundant amount of aquatic plants inhabit the littoral zone (shallow areas) of the Townsend Flowage. The north basin of the Townsend Flowage, which is shallow and has a low flushing rate, has approximately forty-three percent of its area inhabited with a very abundant amount of aquatic plants in the months of August and September. This compares with the south basin which has only about four and one-half percent of its area inhabited with a very abundant amount of aquatic plants.

The aquatic plant of greatest prominence that appeared in approximately seventy-six percent of the Townsend Flowage during the aquatic plant survey was northern milfoil. The second most prominent aquatic plant found at the Townsend Flowage is clasping-leaf pondweed. Clasping-leaf pondweed was found to inhabit approximately sixty-seven

percent of the Townsend Flowage. Bushy pondweed was the third most common aquatic plant found on the Flowage. It was found to inhabit approximately sixty-five percent of the Townsend Flowage.

The overall water quality of the Townsend Flowage is very good.

- Total Phosphorus levels are low (14 ug/l) and N:P ratios are high (20:1 - 30:1), indicating Phosphorus is the limiting nutrient for plant growth.
- Chlorophyll a results are low (3.5 ug/l), indicating a relatively small amount algae growth.
- Fecal coliform tests showed that raw sewage was not indicated in the sample collected.
- Color and Turbidity of water samples were low, indicating very good water clarity.
- Secchi depth (11 - 12-feet) indicated very good water clarity.
- Dissolved oxygen levels in the lake were good in the summer and fair in the winter.
- pH levels were high indicating non-acidic conditions.

Based on Total Phosphorus, Chlorophyll a and water clarity, the Townsend Flowage is considered an Oligotrophic lake (a lake with low nutrient levels).

Since the Townsend Flowage supports natural reproduction of bluegill, yellow perch, black crappie, rock bass, largemouth bass and northern pike, it is recommended that the enhancement of these species be continued through beneficial management practices. As part of these practices, it is recommended that an aquatic plant harvester be used to cut fishing lanes in selected areas of the flowage. Cutting lanes with a harvester allows unobstructed boat travel through dense areas of plants and allows fishing without weeds clogging fish lures. The added benefit to this is that it allows predator fish feeding areas just outside weed beds. This could result in a larger sized fish population, something that a number of fisherman are looking for.

Removing the plants from the Townsend Flowage also reduces the sediment buildup and nutrient deposition from decomposing plants, thereby slowing future plant growth. Dissolved oxygen uptake by decomposing plants is also reduced, resulting in less stress on fish which can have the effect of a larger and healthier fish population.

Sound watershed management and conscientious use of shoreline property are also a part of an aquatic plant management plan. Maintaining good water quality will go along way in keeping aquatic plant growth minimized.

LAKE PLANNING STUDY
FOR THE
TOWNSEND FLOWAGE

Prepared for

THE TOWNSEND FLOWAGE ASSOCIATION
Townsend, Wisconsin

DISTRIBUTION LIST

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LAKE PLANNING STUDY
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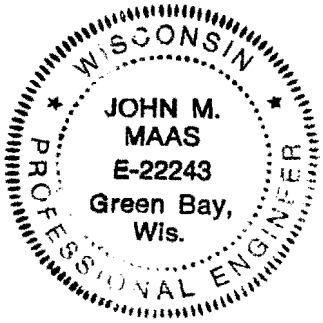
Townsend, Wisconsin

MARCH 1995

I hereby certify that this Report has been prepared under my direct supervision and that I am a Registered Professional Engineer licensed in the State of Wisconsin.



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References

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(Ref. #2) Conversation with Carl and Mary Ellen Gust - Townsend, Wisconsin residents. Mary Ellen was a shoreline resident of the Flowage from 1931 to 1994.

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Note: The references are noted in the report by insertion of (Ref. #00) at the end of each passage pertaining to the particular reference used.

Glossary of Terms

Algae	One-celled (phytoplankton) or multicellular plants either suspended in water (plankton) or attached to rocks and other substrates (periphton). Their abundance is measured by the amount of chlorophyll a in an open water sample, and is commonly used to classify the tropic state of a lake (Ref. #7).
Alkalinity	A measure of the amount of carbonates, bicarbonates and hydroxide present in water (Ref. #4).
Ammonia Nitrogen	A form of nitrogen found in organic materials and many fertilizers. It is the first form of nitrogen released when organic matter decays. It can be used by most aquatic plants and is therefore an important nutrient (Ref. #7).
Chlorophyll a	A green pigment present in all green plant life and required in photosynthesis. The amount found in lake water is related to the amount of algae and is therefore used as an indicator of water quality.
Color	Measured in color units that relate to a standard. A yellow-brown natural color is associated with lakes or rivers receiving wetland drainage. The average color value for Wisconsin lakes is 39 units, with color of state lakes ranging from zero to 320 units. Color affects light penetration and therefore the depth at which plants can grow (Ref. #7).
Eutrophic	Trophic classification of a lake, indicating very productive and fertile conditions (see Eutrophication).
Eutrophication	The process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae. The extent to which this process has occurred is reflected in a lake's trophic classification: oligotrophic (nutrient poor), mesotrophic (moderately productive), and eutrophic (very productive and fertile) (Ref. #7).
Fingerlings	Young fish, 1-4 inches in length.
Fry	Newly hatched Fish
TKN	Total Kjeldahl Nitrogen, ammonium plus organic nitrogen.

Littoral Zone	The shallow area of a lake from the shore to the depth where light no longer penetrates to the bottom.
Loam	Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.
Mesotrophic	Trophic classification of a lake, indicating moderately productive conditions (see Eutrophication).
Oligotrophic	Trophic classification of a lake, indicating nutrient poor conditions (see Eutrophication).
Permeability	The rate that water travels trough soil.
pH	A measure of acidity or alkalinity, numerically equal to 7 for neutral solutions, increasing in acidity as the number decreases from 7 to zero, increasing in alkalinity as the number increases from 7 to 14.
Photosynthesis	The process by which green plants convert carbon dioxide to sugar plus oxygen using sunlight for energy.
Macrophyte	Aquatic vascular plants that grow either floating, emergent or submergent in a body of water.
Specific Conductivity	A measure of water's ability to conduct electricity. Conductivity is reported in micromhos per centimeter. and is directly related to the total dissolved inorganic chemicals in the water. Values are commonly two times the water hardness unless the water is receiving high concentrations of contaminants introduced by humans (Ref. #7).
Turnover	Overturn of the water mass of a lake from the surface to the bottom under uniform temperature conditions due to the action of wind energy.

1.0. INTRODUCTION

The Townsend Flowage (also known as Wheeler Pond) is located in northern Wisconsin in northwestern Oconto County. It is approximately 65 miles north of the city of Green Bay and approximately 50 miles west of the city of Marinette, Wisconsin. The location of the Townsend Flowage is shown on Figure No. 1 - Location Map included in Appendix "A".

This section of the report provides historical and general information regarding the Townsend Flowage and the purpose for preparing this report. Included with the purpose of the report is an outline of the work performed in connection with preparing the report.

1.1. History

As with most of northern Wisconsin prior to the 19th century, the Townsend area was a great virgin forest. The many streams and rivers of the area were once the favorite fishing grounds of native Indians. The streams and rivers eventually empty into the bay of Green Bay. In circa 1826, logging began in Oconto County. The first sawmill was built in Pensaukee around that time to process the logs.

In the later part of the 1870's, it is believed that the Holt Lumber Company built a dam in the location of the present dam on the Townsend Flowage. Its purpose was to back up McCaslin Brook to provide a means to float the logs to the local sawmill that was built on what is now Canary Lane.

The Chicago and Northwestern Railway Company extended rail service to Mountain in 1895 and through Lakewood and Townsend in 1897 (Ref. #1). Townsend was first known as Johnson's Siding. Townsend's main occupation for years was logging and lumbering. The vast virgin timber around the Townsend area was logged off during the late 1800's and early 1900's.

Much of the land around Townsend at that time was owned by the Holt Lumber Company. An excerpt of the 1912 Plat Book of the Townsend area is provided as Figure No. 2, included in Appendix "A". Townsend was part of the Town of Wheeler until 1914. In circa 1914, the unincorporated community of Townsend and the surrounding area became the Town of Townsend.

It is unclear as to the Townsend Flowage levels maintained by the dam during the early 1900's. The 1912 Plat Book shows the Wheeler dam, but does not indicate any back waters. The original dam was not as high as the present dam. The original dam consisted of two spillways with an overflow elevation similar to the surrounding shoreline elevations. Eyewitness accounts of the early to mid 1930's, indicated that no significant backwaters were created by the dam. Prior to the building of the present dam, access could not be gained up McCaslin Brook by boat or canoe since it was mostly bog (Ref. #2).

In the 1930's, fishing was limited to a small portion of what is now the southern basin of the Townsend Flowage. It is presumed to have been the deepest part of the southern basin. The fishing was understood to be very good with an abundance of large northern pike, black bass, perch and bull heads (Ref. #2).

The present dam was built in circa 1937. A 1937 National Forest map indicates the Townsend Flowage in its present form. WDNR records show stocking began in 1937.

Development along the Townsend Flowage has steadily increased from three houses in the 1930's to the present 130 plus houses. Seasonal and year-round homes have been built along McCaslin Brook as well.

In August, 1993, the level on the Townsend Flowage was dropped four feet for dam repairs. At that time, many of the logs and stumps were removed from the Townsend Flowage for the safety of boaters. The Townsend Flowage was returned to normal level by the end of September, 1993. Photographs of the drawdown are included in Appendix "B".

Today, the Townsend Flowage and McCaslin Brook can be accessed and easily traversed by pontoon boats where it was once impassible by canoe. These changes made over the years have been followed by changes in the ecosystem of the Townsend Flowage itself. The following sections of the lake planning study will look at where the Townsend Flowage is, in terms of water and recreational quality.

1.2. General Information

The Townsend Flowage is located in Sections 14, 15, 22, 23 and 27 of Township 33 North, Range 15 East in the Township of Townsend in the northern portion of Oconto County, Wisconsin.

The Townsend Flowage is an impoundment consisting of two distinct basins. The northern basin is approximately 173 acres in size and the southern basin is approximately 303 acres in size. The maximum depth of the northern basin is approximately 10-feet. The maximum depth of the southern basin is approximately 30-feet with an average depth of 9-feet (Ref #3). For complete details on the depths of the Townsend Flowage refer to Figure No. 3 - Hydrographic Map of the Townsend Flowage included in Appendix "A".

Two streams were dammed to form the present day Flowage. The largest inlet stream is McCaslin Brook which enters the southern basin on the southwest. The other inlet stream is Mosquito Creek entering the northern basin on the northwest. The outlet to the Townsend Flowage is located on the south end of the south basin. A small concrete and earth dam, known as the Wheeler Dam, controls the lake level. Once water flows over the dam, it continues south as McCaslin Brook to the North Branch of the Oconto River.

The water level maintained in the Townsend Flowage is controlled by the Wheeler Dam. The height of the weir gate on the dam is controlled by Oconto County Forestry and Parks Department. The water levels to be maintained in the Townsend Flowage are recommended by the Wisconsin Department of Natural Resources (WDNR). The height of the weir gate on the dam is adjusted throughout the year by the Forestry and Parks Department to account for heavy rains and/or rapid spring snow melt. In 1993, the water level in the Townsend Flowage was lowered to allow for repairs to the dam.

The soils in the area of the Townsend Flowage are predominately sandy loams of the Padus-Pence Association. These soils are located on flats and sideslopes of outwash plains. Typically, the surface layer is very dark grayish brown fine sandy loam about three inches thick. The subsoil is a brown sandy loam about fourteen inches thick. The substratum consists of brown loose sand in the upper part and gravelly coarse sand in the lower part to a depth of about 60-inches.

These soils are well drained with permeabilities ranging from moderate to very rapid. Septic system drain fields function satisfactorily, but ground water pollution is a potential because of the rapid permeability of the soils (Ref. #4).

The Townsend Flowage bottom soils are a mixture of muck, sand, gravel and rubble. The Townsend Flowage bottom soils are dominated by muck (sixty-eight percent) followed by sand (twenty-five percent), gravel (five percent) and rubble (two percent) (Ref. #5). For complete details on the Townsend Flowage bottom soils refer to Figure No. 3 - Hydrographic Map of the Townsend Flowage included in Appendix "A".

The annual average precipitation in the Townsend area is 29.72-inches. About 19-inches, or sixty-five percent, usually falls in April through September (Ref. #4).

The Townsend Flowage has dense aquatic plant growth in the shallow areas during the months of August and September. This has made boating and fishing in the shallow areas difficult in years past.

Public access to the Townsend Flowage is gained in one of four places. Figure No. 4 - Public Access, included in Appendix "A", details the location of the four boat landings. A private landing open to the public is located in the Town of Townsend between Nicolet Road and County Road "T" just off of State Highway 32. A public landing is located on the west side of McCaslin Brook approximately ¼ mile southwest of the inlet to the south basin of the Townsend Flowage at the end of Red Maple Lane. Another public landing is located at the end of Bennet Lane on the south basin of the Townsend Flowage. Direct access to the northwest side of the north basin of the Townsend Flowage is gained from Sunset Bay Road. Public access to the Townsend Flowage is further addressed in Section 2.6.

1.3. Purpose

The Townsend Flowage Association was formed on October 3, 1990, with the **"...objective to improve lake habitat, promote the natural beauty and resources in the general interest of property owners and their families."** A copy of the articles of incorporation and the constitution of the Townsend Flowage Association are included in Appendix "C". The Townsend Flowage Association currently consists of 95 members. At the annual meeting, the members elect four Officers and a seven member Board of Directors. The Board of Directors consists of three members each from the north and south basin and one from the McCaslin Brook area.

In August, 1993, the Townsend Flowage Association passed a resolution to seek financial assistance from the WDNR Lake Management Planning Grant Program for the purpose of conducting a lake planning study. The Lake Management Planning Grant Program, authorized under Chapter 144.253, Wisconsin Statutes, provides for assistance to eligible sponsors for the collection and analysis of information needed to protect and restore lakes and their watersheds. Lake planning grants provide seventy-five percent of the project costs up to a maximum of $10,000.00. The lake association pays twenty-five percent of the costs incurred. The Townsend Flowage Association received notice of grant eligibility in late September, 1993.

On October 2, 1993, the Townsend Flowage Association entered into an agreement with MMA, INC. of Green Bay, Wisconsin, to provide the following services in conducting the lake planning study:

- Conduct a post card survey of land owners to identify lake management objectives and goals.
- Obtain water quality samples and analyze the samples through the State Laboratory of Hygiene for appropriate parameters five (5) times, during winter 1993 (ice on), spring 1994 (ice out), June, July and August 1994.
- Prepare an assessment of aquatic and fish community.
- Identify watershed area, delineate environmental sensitive areas (i.e., wetlands and steep slopes), surface water runoff patterns and estimate phosphorus loads.
- Prepare news releases and coordinate and attend an information meeting.
- Address public access to the Townsend Flowage.
- Address all other Flowage management activities and local interest groups.
- Assist in obtaining support letters from all eligible management units.
- Tailor the work undertaken to comply to the greatest extent possible, with the goals, objectives and recommendations of the basin plan.
- Prepare a report summarizing the work and submit it to the WDNR.

2.0. DISCUSSION OF INFORMATION

The following sections of the report discuss the information obtained from a survey of Association members, the water quality sampling and laboratory analysis, an aquatic plant survey, a fish survey, a watershed study and an assessment of public access to the Townsend Flowage.

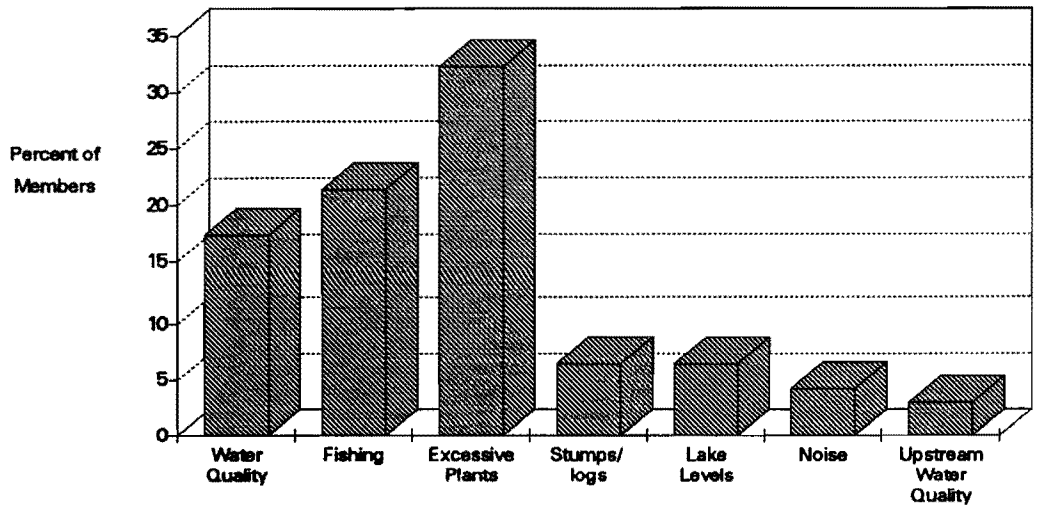
2.1. Membership Survey Results

A letter survey was conducted of the Association members in January, 1995. The Association members were given an opportunity to express their concerns about the Townsend Flowage. The Officers and Board of Directors used the information supplied by the members to establish the goals and objectives for the study. Copies of the returned questionnaires are found in Appendix "D". The survey had an excellent return rate. Eighty-two percent of the members completed and returned the questionnaire. This shows that the Townsend Flowage Association members want to take an active part in the future of the Townsend Flowage.

Based on the results of the survey, the top three concerns of the Association members are:

1) Excessive aquatic plants
2) Poor fishing
3) Water quality

The following figure graphically shows the results of the Association members concerns.



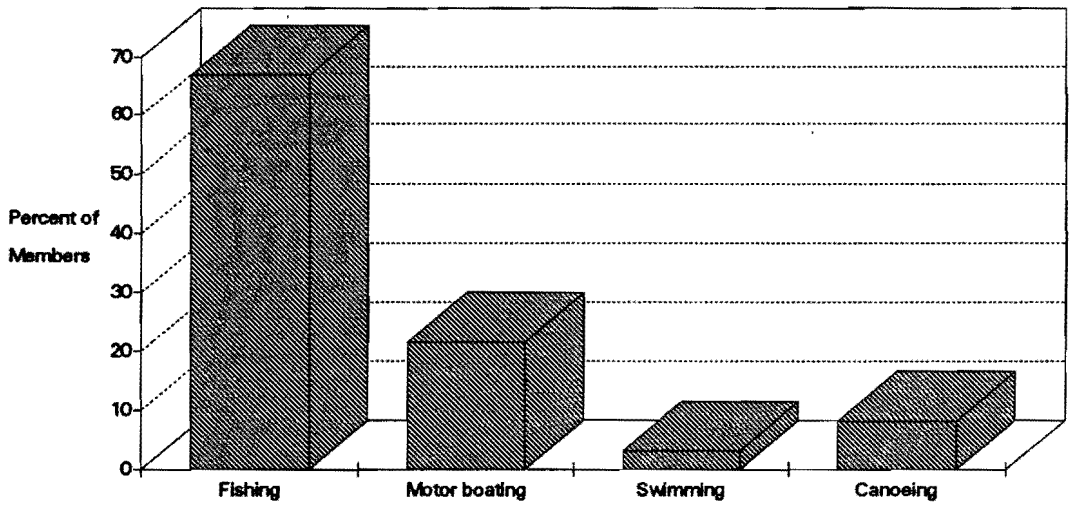
Concerns of Townsend Flowage Association Members

Thirty-two percent of the returns indicated excessive aquatic plants as the top concern of the Association members. Twenty-one percent indicated poor fishing as the top concern with seventeen percent indicating water quality as the top concern.

Based on the results of the survey, the top two primary water recreation activities of the Association members are:

1) Fishing
2) Motor boating

The following figure graphically shows the results of the Association members primary water recreation activities.



Primary Water Recreation Activities

Fishing was indicated as the primary water recreational activity of sixty-six percent of the Assocation members responding to the survey. Motor boating was the primary activity of twenty-two percent of the members.

These two water recreation activities are naturally conflicting. This is apparent when reading the comments on the bottom of the questionnaires. Forty-five percent of those writing in comments expressed some concern about unsafe or annoying watercraft practices.

Seventy-seven percent of the Assocation members indicated they owned an outboard motorboat, fifty-eight percent owned a pontoon boat, forty-three percent of the members indicated that they owned a canoe, forty-two percent a paddle boat and forty-two percent a row boat.

Other noteworthy results from the survey revealed that eighty-four percent of the Assocation members would like to see fish planted again in the Townsend Flowage. Nine percent disagreed, with the remaining Assocation members expressing no opinion. The top three fish indentifed for stocking were walleye, bass and perch.

In the area of aquatic plant management, fifty-five percent of the Assocation members indicated they would support the purchase or rental of an aquatic plant harvester. Thirty-eight percent of the members were opposed to either the purchase or rental of an aquatic plant harvester for the management of aquatic plants. Sixty-one percent of the members would support the use of chemicals, while thirty-one percent of the members were opposed to the use of chemicals for the management of aquatic plants.

If given a choice between the two, fifty-seven percent of those responding would prefer more fish, while forty percent would prefer less aquatic plants.

For complete details of the results of the survey refer to the information included in Appendix "D".

2.2. Water Quality

Water sampling events were conducted five times throughout the year. During the winter - ice on (February 14, 1994), spring - ice out (May 10, 1994), and summer (June 16, July 19 and August 16, 1994).

Water samples were obtained during each sampling event from three locations in the Townsend Flowage. One in the north basin (NF-1), one in the south basin (SF-1) and one from the McCaslin Brook area (SF-2). Figure No. 5- Sample Locations, included in Appendix "A", details the three sample locations.

The following table shows the parameters tested for during each water sampling event.

Water Sampling Parameter and Date Tested

Parameter	Date Tested
Total Phosphorus	February, May, June, July, August
Dissolved Phosphorus	February, May, June, July, August
Total Kjeldahl Nitrogen	May
Nitrate/Nitrite Nitrogen	May
Ammonia Nitrogen	May
Color	May
Turbidity	May
Chlorophyll a	May, June July, August
Fecal Coliform	July

2.2.1. Methods of Sample Collection and Testing

Samples were obtained for laboratory analysis with a vertical Kemmerer style sampler at specified depths and locations. Samples were immediately transferred to appropriate bottles, preserved (if necessary), labelled, packed in ice and sent via overnight express mail to the laboratory. All laboratory analysis was conducted by the Wisconsin State Laboratory of Hygiene in Madison, Wisconsin, using WDNR specified methods.

Sampling and analysis for Total Phosphorus and Dissolved Phosphorus were conducted during all sampling events. Phosphorus is normally the limiting factor in aquatic plant growth. Any indication of above normal concentrations should be noted and correlated to a possible pollution source.

Sampling and analysis for Total Phosphorus, Dissolved Phosphorus, Total Kjeldahl Nitrogen, Nitrate/Nitrite Nitrogen, Ammonia Nitrogen, Color and Turbidity were conducted during the May sampling event. The May sampling event took place shortly after spring turnover to take advantage of the natural mixing action that occurs at that time. During spring and fall turnover in a lake, nutrients and sediments stored on the bottom are resuspended.

Sampling and analysis for Chlorophyll a (a measure of algae growth) were conducted during the May, June, July and August sampling events. These are months when algae growth is expected to be the highest in a lake.

Sampling and analysis for Fecal Coliform (coliform bacteria found in feces) were conducted during the July sampling event. A high Fecal Coliform count is usually an indication of raw sewage entering the lake. A mid-summer test was conducted because this is the time of highest use of on-site systems by lake residents and visitors.

In addition to the above described water sampling, physiochemical parameters were measured in the field. These parameters included Secchi depth, dissolved oxygen (DO), specific conductivity, pH and water temperature.

The Secchi depth is a measure of water clarity. It is determined using a standard secchi disc. The Secchi disk is a black and white circular plastic plate, 20 centimeters (~8 inches) in diameter. The Secchi disc is lowered into the water until it just disappears from sight, then raised again until it is visible. The average depth at which the Secchi disk disappears and reappears is the Secchi depth at that location. Water with greater clarity will have a greater Secchi depth.

Water temperature and DO readings were obtained with a YSI® Model 50B dissolved oxygen meter. The probe, located at the end of a 20-foot cable, was lowered into the water to a specified depth. Readings of both DO and temperature were recorded at the prescribed elevation.

The measurement of specific conductivity (ability to conduct electricity) of the Townsend Flowage's water was done with a Myron® DC4 digital meter. Samples of water were collected randomly from a boat traveling along the shoreline. The conductivity measurements were recorded at each location. Distilled water has a conductivity of zero micromhos. As minerals and nutrients are added to the water the specific conductivity goes up. A base reading was taken in the middle of the Townsend Flowage at the beginning and end of each test. The readings obtained along the shoreline were compared to the base readings. If the shoreline readings are considerably higher than the base readings, it can be assumed that minerals or nutrients are coming from a source nearby, ie., leaking septic drain field system, etc.

The pH (measure of acidity) of surface water in the Townsed Flowage was measured in May, June, July and August with an Orion® model 290A pH meter. Readings for pH were taken at the same location as water samples.

2.2.2. Results of Water Quality Analysis

The following sections of the report summarize the water quality sampling and laboratory analysis conducted on the Townsend Flowage. For complete details of the laboratory results refer to Appendix "E".

Aquatic plants need many elements for growth and survival; Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Phosphorus (P), Sulfur (S), Calcium (Ca), Magnesium (Mg), Potassium (K), and Iron (Fe). A number of other elements are also necessary, but in extremely small amounts. Only two of these elements are considered major limiting nutrients when it comes to plant growth in lakes, they are Nitrogen and Phosphorus (Ref. #6).

2.2.2.1. Phosphorus

Phosphorus is a highly variable nutrient in lakes. Its concentration has probably the greatest effect on aquatic plant growth. The concentration of Phosphorus in the Townsend Flowage was determined as Total Phosphorus and Dissolved Phosphorus.

Dissolved Phosphorus is, as the name implies, dissolved in the water and readily available for aquatic plant uptake. Its concentration generally varies throughout the year.

Total Phosphorus is a better indicator of the amount of Phosphorus ultimately available in a lake for aquatic plant growth. It is the sum of the dissolved Phosphorus and the Phosphorus contained in suspended plant and animal material in the water.

The following table provides the Total and Dissolved Phosphorus concentrations in the Townsend Flowage during sampling in 1994. Figure No. 5, included in Appendix "A", shows the sampling locations. The concentrations are presented in micrograms per liter (ug/l) or parts per billion.

Total and Dissolved Phosphorus Concentrations - Townsend Flowage

Month	Sample	Total Phosphorus (ug/l)	Dissolved Phosphorus (ug/l)
February	SF1-Top	7	2
February	SF1-Bottom	7	2
February	NF1-Top	10	ND
February	SF2-Top	9	ND
May	SF1-Top	16	ND
May	SF1-Bottom	15	ND
June	SF1-Top	13	ND
June	SF1-Bottom	13	ND
July	SF1-Top	14	ND
July	SF1-Bottom	13	ND
August	SF1-Top	13	ND
August	SF1-Bottom	13	ND

*ND indicates Dissolved Phosphorus level below the detectable limit 2 ug/l.
*Top samples were obtained within one meter of the surface.
*Bottom samples were obtained within one meter of the bottom.

Dissolved Phosphorus concentrations should be less then 10 ug/l during spring turnover (May) to prevent summer algae blooms. The results of sampling on the Townsend Flowage indicate concentrations to be less than the detectable limit of 2 ug/l.

The following table provides the average Total Phosphorus concentrations for Wisconsin's natural lakes and impoundments.

Total Phosphorus Concentrations for Wisconsin Lakes and Impoundments Compared to the Townsend Flowage Summer of 1994. (Adapted from Ref. #7 and Ref. #8)

Water Quality Index	Total Phosphorus (ug/l)	State Ave. Total Phosphorus for all Lakes (ug/l)	State Ave. Total Phosphorus for Impoundments (ug/l)	State Ave. Total Phosphorus for Natural Lakes (ug/l)	Townsend Flowage (Summer) Total Phosphorus (ug/l)
Very Poor	> 150				
Poor	55-150		65		
Fair	32-55				
Good	16-32	31		25	
Very Good	2-16				14
Excellent	<2				

The results of Total Phosphorus concentrations are less than those for natural lakes and much less than that for impoundments (Ref. #8).

2.2.2.2. Nitrogen

Nitrogen is a relatively stable nutrient in most lakes compared to Phosphorus. Nitrogen is a major natural component in decomposing plant and animal matter. It exists in lakes in several forms including: nitrate (NO_3), nitrite (NO_2), ammonia (NH_4) and organic nitrogen. Total Kjeldahl Nitrogen (TKN) is the combined total of ammonia and organic nitrogen. Total Nitrogen is the sum of TKN plus nitrate and nitrite nitrogen. The following table provides the results of Nitrogen testing on the Townsend Flowage conducted during spring turnover. The concentrations are presented in milligrams per liter (mg/l) or parts per million.

Results of Testing for Nitrogen - Townsend Flowage, May, 1994

Sample	Ammonia Nitrogen (mg/l)	Nitrate/Nitrite (mg/l)	TKN (mg/l)	Total Nitrogen (mg/l)
SF1-Bottom	0.013	ND	0.3	0.313
SF1-Top	0.014	ND	0.4	0.414

Wisconsin lakes have an average Total Nitrogen concentration of 0.86 mg/l, with seventy-one percent of the lake falling between 0.30 and 1.0 mg/l (Ref #8). The Townsend Flowage falls in the lower part of the spectrum.

The Total Nitrogen to Total Phosphorus ratio (N:P ratio) for the Townsend Flowage was found to be normally between 20:1 and 30:1. N:P ratios greater than 15:1 generally indicate Phosphorus is the limiting nutrient for aquatic plant growth.

2.2.2.3. Chlorophyll a

Chlorophyll a is a green pigment necessary for photosynthesis. The amount of Chlorophyll a found in lake water is used to estimate algae (phytoplankton biomass) in the lake. The concentration of Chlorophyll a found in water samples collected in May, June, July and August (algae season) from the Townsend Flowage are provided in the following table:

Chlorophyll a - Townsend Flowage, 1994

Month	Chlorophyll a (ug/l)
May	4.00
June	4.04
July	2.97
August	2.83

The average concentration of Chlorophyll a in Wisconsin lakes was 14.8 ug/l with sixty-five percent of the lakes having a value of less than 10 ug/l (Ref. #8). The results indicate that the Townsend Flowage is well below the state average for Chlorophyll a.

2.2.2.4. Fecal Coliform

Fecal coliform are coliform bacteria originating from animal feces. A high count from a fecal coliform test usually indicates raw sewage is entering the lake. A mid-summer test was conducted because this is the time of highest use by residents and visitors. The sample taken in July had a count of less than 10 colonies per 100 ml sample.

This indicates that raw sewage was not detected in the sample obtained.

2.2.2.5. Color

The color of a lake is a measure of the amount of material dissolved in the water. Color is mainly aesthetic but it can affect light penetration and heat absorbance of lakes. Tannic and humic acids originating from decomposing plant material can give a lake a natural brown color. The Townsend Flowage was sampled in May for color. The following table provides the water color range from low to high as correlated to standard units (SU) of color and the results of the samples obtained from the Townsend Flowage.

Water Color (Ref. #7)

Range	Color
0-40 units	Low
40-100 units	Medium
>100 units	High

Water Color - Townsend Flowage, May, 1994

Sample	Color (SU)
SF1 - Bottom	15
SF1 - Top	25

The results indicate the color of the Townsend Flowage is low.

2.2.2.6. Turbidity

The turbidity of a lake is a measure of the amount of material suspended in the water. Levels of turbidity between 0 and 2 Jackson Turbidity Units (JTU) were recorded in forty-four percent of a random data set of Wisconsin lakes according to a 14 year study done by Lillie and Mason. The average Turbidity was listed at 3.1 JTU. Nephelometric Turbidity Units (NTU) are the laboratory units used to measure the turbidity of the Townsend Flowage samples. Historically, JTU's were used to measure turbidity. Unfortunately,

because of fundamental differences in optics of a Jackson candle turbidimeter, no instrument could duplicate the results in all turbidity ranges (Ref. #9). Therefore, there is no direct correlation between JTU's and NTU's. However, for the purposes of this report, they can be assumed similar. The Townsend Flowage May, 1994, sample indicated a value of 0.6 NTU.

In which case, the results for the Townsend Flowage indicate relatively low turbidity.

2.2.3. Secchi Depth

Secchi depth is a measure of water clarity. It measures the combination of both color and turbidity and takes into account algae growth as well. Secchi depth is generally a good indicator of a lake's overall water quality. The following table provides a general index of water clarity using Secchi depth:

Water Clarity Index

Water Clarity	Secchi Depth (ft)
Very Poor	3
Poor	5
Fair	7
Good	10
Very Good	20
Excellent	32

The following table provides the actual Secchi depth measured by MMA, Inc. during the summer months of 1994.

Secchi Depths Measured for the Townsend Flowage

Month	Secchi Depth (ft)
May	11.5
June	12.0
July	12.0
August	11.5

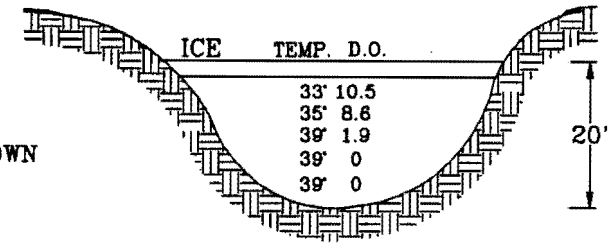
Comparing the Secchi depth measured in the Townsend Flowage to the water clarity index, indicates good to very good water clarity.

2.2.4. Lake Temperature/Dissolved Oxygen

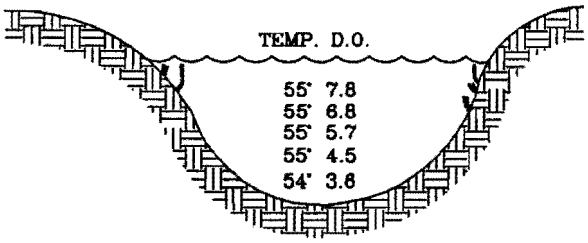
Wave action, mixing of the lake and photosynthesis all add dissolved oxygen (DO) to lake water. Plant and animal respiration and decomposition will decrease the DO supply in a lake. The amount of DO present is also dependent upon water temperature. The lower the temperature of the water, the greater the oxygen solubility and vice versa. The

maximum solubility of oxygen in water at 32° F is 15 mg/l, at 68° F the maximum solubility of oxygen in water is 9 mg/l (Ref. #7). The maximum density (weight per unit volume) of water is at 39° F. All these factors interplay when you assess a lakes DO level at any time of the year. The following figures provide the temperature and DO levels for the Townsend Flowage measured during 1994.

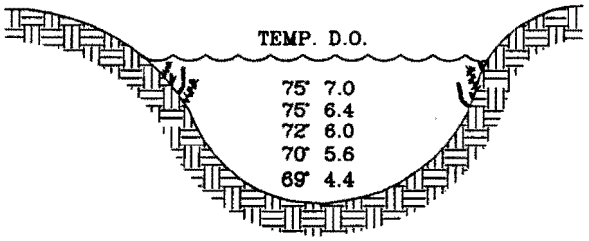
TEMPERATURE (°F)
DISSOLVED OXYGEN (mg/l)
ONE METER INTERVALS SHOWN
SAMPLE LOCATION SF-1



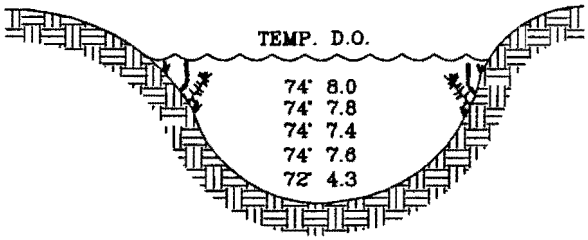
FEBRUARY



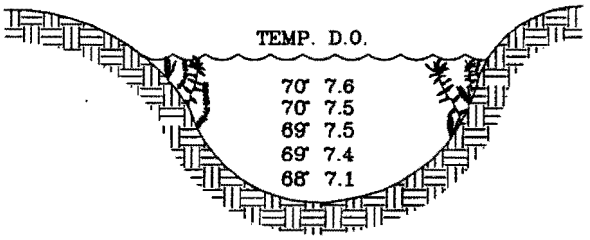
MAY



JUNE



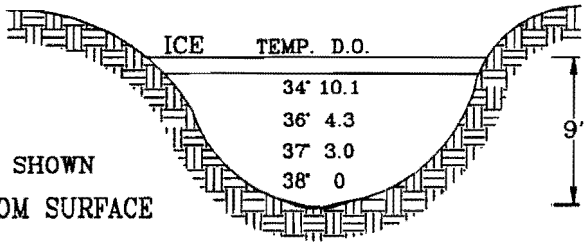
JULY



AUGUST

SOUTH FLOWAGE – WINTER/SUMMER

TEMPERATURE (°F)
DISSOLVED OXYGEN (mg/l)
ONE-HALF METER INTERVALS SHOWN
STARTING AT ONE METER FROM SURFACE
SAMPLE LOCATION NF-1



FEBRUARY

NORTH FLOWAGE – WINTER

TEMPERATURE/DISSOLVED OXYGEN PROFILES

The temperatures and DO levels were measured in the south basin at sample location SF-1 in February, May, June, July and August. During February, the temperature nearest the surface was the coldest recorded at 33° F and the DO level was the highest at 10.5 mg/l. At the bottom, the lake mixing and decomposition of aquatic plant and animal matter reduced the DO level to 0 mg/l. Any fish in this area of the Townsend Flowage at that time would have been found within 2 to 3 meters of the surface since 5 mg/l of DO is the minimum for most fish to survive and grow.

During May, spring turnover occurred. As the sun warms the surface water up to 39° F, it starts to sink to the bottom. Water that is warmer and cooler than 39° F (lighter) begins to rise. A great deal of mixing occurs at this time, until the temperature at the top and bottom are the same. During this turnover, decomposed matter and nutrients on the bottom are resuspended.

During June, July and August, temperatures adjust to the season. The sun maintains the water nearest the surface warm, while the bottom is somewhat cooler. The DO levels remain higher near the surface due to wave action and photosynthesis. No summer stratification appears to take place in the Townsend Flowage. The Townsend Flowage has mixing action throughout its depth. In most lakes greater than 20-feet, a metalimnon layer will exist between the warm surface water layer (epilimnon) and the cooler bottom layer (hypolimnon) and prevent complete mixing.

Temperature and DO levels were measured in the north basin at sample location NF-2 in February. In the north basin, DO levels fell below 5 mg/l within 1 ½ meters of the surface. Since the north basin is more shallow and aquatic plant decay is more prevalent, less DO in the water is expected. This puts more stress on fish remaining in this area. Winterkill can occur when the DO levels falls below 5 mg/l.

2.2.5. Shoreline Specific Conductivity Survey

The specific conductivity (ability to conduct electricity) of the water was measured along the shoreline of the Townsend Flowage in late summer. The purpose of the specific conductivity survey is to detect higher than normal amounts of nutrients entering the Townsend Flowage.

Table No. 1, included in Appendix "F", provides the results of the specific conductivity readings. Figure No. 6 - Specific Conductivity Survey Locations, included in Appendix "A", provides the locations of the conductivity readings. The specific conductivity readings along the shoreline in the north and south basin did not show variations above ten percent of the baseline reading with the exception of the northern portion of the northern basin. Readings became higher as the tests were conducted further to the north. The northeast bay, which is well populated, was very high. However, the highest readings were obtained nearest the culvert which transfers water from the north bay into the northeast bay. This would indicate the source was located in the north bay. This was

confirmed by higher readings as the test was conducted into the mouth of the north bay. Unfortunately, the bay was too clogged with weeds to continue the investigation by boat.

2.2.6. Water Quality Assessment

The overall water quality of the Townsend Flowage is very good.

- Total Phosphorus levels are low (14 ug/l) and N:P ratios are high (20:1 - 30:1), indicating Phosphorus is the limiting nutrient for plant growth.
- Chlorophyll a results are low (3.5 ug/l), indicating a relatively small amount of algae growth.
- Color and Turbidity indicate very good water clarity.
- Secchi depth (11 - 12-feet) indicates very good water clarity.
- Dissolved oxygen levels were good in the summer and fair in the winter.
- pH levels were high, indicating non-acidic conditions.

Based on the Total Phosphorus, Chlorophyll a and water clarity, the Townsend Flowage is considered a Oligotrophic Lake (a lake with low nutrient levels).

2.3. Aquatic Plant Survey Information

2.3.1. Methods of Testing

The aquatic plant (macrophyte) survey was conducted by boat in early September, 1994. Aquatic plants were pulled up with a garden rake in the shallow areas of the Townsend Flowage. In the deeper areas of the Townsend Flowage, a device was lowered to the bottom of the lake and dragged along a transect (straight line across the lake) to retrieve the plants.

Normally, the transect method would be employed as the sole means of determining plant type and density. Since the Townsend Flowage has many shallow areas, each containing a different pattern of plant species, a thorough plant survey along the shoreline was conducted. In the deeper areas of the lake, where the plant species are more consistent, the transect method was employed.

2.3.2. Aquatic Plant Density and Abundance Values

From the aquatic plant samples obtained in September, the individual plant species were identified and the individual plant species were given a density value as follows:

- (1) Rare
- (2) Occasional
- (3) Common
- (4) Very Common
- (5) Abundant

By area, the overall aquatic plant abundance was give a density value as follows:

- (0) Rare
- (1) Occasional
- (2) Moderate
- (3) Abundant
- (4) High
- (5) Very High

Figure Nos. 7 and 8, included in Appendix "A", provides the aquatic plant survey locations in the north and south basin of the Townsend Flowage. Table No. 2, included in Appendix "F", provides a listing of the aquatic plants and their respective locations. Table No. 3, included in Appendix "F", provides the location of aquatic plants with individual plant abundance. Table No. 4, included in Appendix "F", provides the relative plant abundance by area in the north and south basin.

2.3.3. Results of the Aquatic Plant Survey

During the aquatic plant survey conducted in late summer on the Townsend Flowage, seventeen different species of aquatic plants were identified. The three most dominant plant species found are:

1) Northern Milfoil
2) Clasping-Leaf Pondweed
3) Bushy Pondweed

The three most dominate plant species identified are discussed in detail below. For complete details on aquatic plants refer to "Guide to Wisconsin Aquatic Plants" (Ref. #10), provided in Appendix "G".

The most prominent aquatic plant found at the Townsend Flowage is northern milfoil. Northern milfoil was found to inhabit approximately seventy-six percent of the Townsend Flowage. The milfoil plant samples obtained from the Townsend Flowage were originally identified as northern milfoil by MMA, INC. and later, confirmed by Stan Nichols of the Wisconsin Geological and Natural History Survey. Northern milfoil is an aggressive aquatic plant as seen from the percentage of the Townsend Flowage it inhabits.

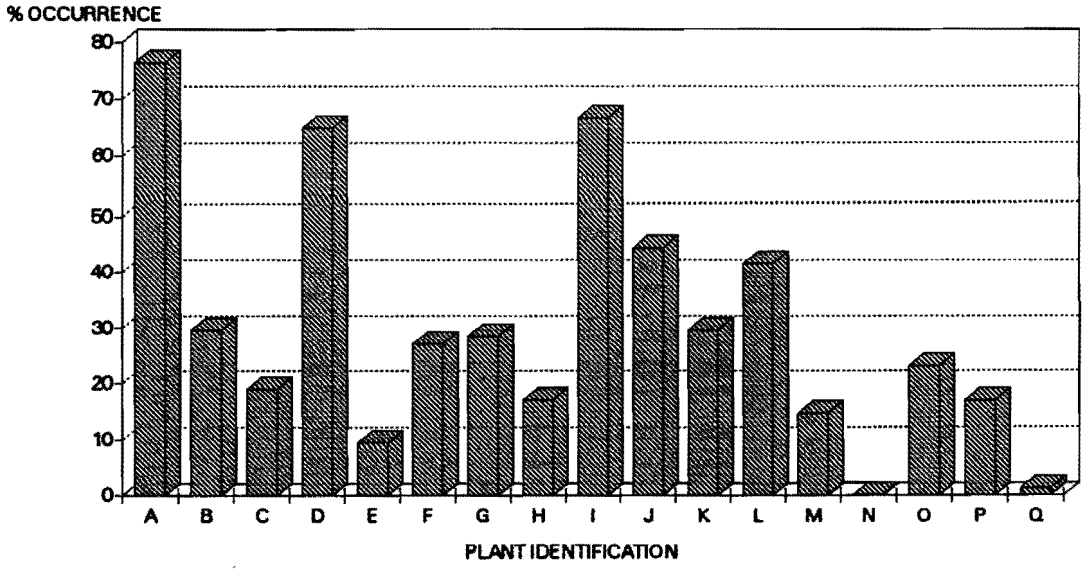
Northern milfoil looks very similar to eurasian milfoil which is a very aggressive non-native species which tends to take over lakes and choke out native aquatic plants. Eurasian milfoil has the reputation of explosive growth and the incredible ability for regeneration. Even though the samples taken from the Townsend Flowage did not indicate any eurasian milfoil, this does not mean that there is none in the Townsend Flowage.

Northern milfoil provides cover for fish and supports insects for fish food. In addition, waterfowl will occasionally eat the fruit and foliage (Ref. #10).

The second most prominent aquatic plant found at the Townsend Flowage is clasping-leaf pondweed. Clasping-leaf pondweed was found to inhabit approximately sixty-seven percent of the Townsend Flowage. Clasping-leaf pondweed is a broad-leaved aquatic plant that provides an attractive cover for fish, such as panfish, largemouth bass, muskellunge and northern pike. Clasping-leaf pondweed also supports insects valuable as food for fish and ducklings (Ref. #10). One beneficial aspect of aquatic plants often overlooked is their ability to reduce the acidity of lakes. During the survey, a crusty substance on the upper surfaces of clasping-leaf pondweed was noted. This crusty substance is the result of the precipitation of calcium carbonate from the photosynthesis process (Ref. #6). Calcium carbonate naturally raises the pH of lakes and reduces the effects of acid rain. Clasping-leaf pondweed is a large producer of calcium carbonate in the Townsend Flowage and thereby helps to maintain the pH level in the Townsend Flowage.

Bushy pondweed was found to inhabit approximately sixty-five percent of the Townsend Flowage. Bushy pondweed along with another Najas species. found on approximately nine percent of the Townsend Flowage tend to grow as beds among other plants on the bottom of the Townsend Flowage. Bushy pondweed provides food for waterfowl and some marsh birds. It provides cover for young largemouth bass and northern pike as well as small bluegills and perch. Bushy pondweed usually does not over populate an area and is best not to be removed or more obnoxious aquatic plants may move in.

All the aquatic plants identified in the Townsend Flowage are provided in the following figure with the approximate percentage of lake area they inhabited. (Plant identification along with its corresponding letter is also shown)



Percent Occurrence of Aquatic Plants in Townsend Flowage.

Plant Identification and Percent Occurrence on Townsend Flowage

PLANT ID	TAXA Common Name (Scientific Name)	% OCCURRENCE
A	Northern Milfoil (Myriophyllum sibiricum)	76%
B	Common Waterweed (Elodea canadensis)	30%
C	Water Celery (Vallisneria americana)	19%
D	Bushy Pondweed (Najas flexilis)	65%
E	Bushy Pondweed (Najas spp.)	9%
F	White Pond Lily (Nymphaea spp.)	27%
G	Narrow-Leaved Pondweed (Potamogeton spp.)	28%
H	Narrow-Leaved Pondweed (Potamogeton pucillus)	17%
I	Clasping-Leaf Pondweed (Potamogeton richardsonii)	67%
J	Water Stargrass (Heteranthera dubia)	45%
K	Yellow Water Lily (Nuphar spp.)	30%
L	Flat Stemmed Pondweed (Potamogeton zosteriformis)	42%
M	Chara (Characeae spp.)	15%
N	Quillwort (Isoetes spp.)	<1%
O	Floating-Leaf Pondweed (Potamogeton natans)	23%

P	Coontail (Ceratophyllum demersum)	17%
Q	Watershield (Braseria schreberi)	1%

The north basin of the Townsend Flowage has approximately forty-three percent of its area inhabited with a "very abundant" amount of aquatic plants in the months of August and September. This compares with the south basin which has only about four and one-half percent of its area inhabited with a "very abundant" amount of aquatic plants. The term "very abundant" refers to a relative quantity of aquatic plants which will inhibit motorized boat travel through these areas because of propeller clogging. These areas in the north and south basin of the Townsend Flowage with very abundant amount of aquatic plants are shown in Figure Nos. 9 and 10, included in Appendix "A".

2.4. Fish Species Information

According to an electro-fishing survey conducted by the WDNR in September, 1984, the Townsend Flowage supports natural reproduction of a number of pan and game fish species. Length frequency information indicates growth is consistent with that observed in other area waters. Fish species found in the Townsend Flowage include: bluegill, yellow perch, black crappie, rock bass, largemouth bass and northern pike (Ref. #11). Information on each of these species is included in Appendix "H". The information in Appendix "H" includes: identification, distribution, habits, habitat, life cycles, fishing hints and environmental concerns for each of these species.

Prior management activities on the Townsend Flowage included periodic stockings between 1937 and 1977 with muskellunge, largemouth bass, northern pike and walleye. Table No. 5, included in Appendix "F", shows WDNR stocking records from 1937 to 1977. The Townsend Flowage was last stocked with walleye in 1976 and muskellunge in 1977. An electro-fishing survey was conducted in August, 1971, to evaluate the Townsend Flowage fishery. A second electro-fishing survey was conducted on September 13, 1984. Survey results included the capture of 86 bluegills ranging from 2.7 and 8.5-inches, with a mean of 6.2-inches. A total of 41 yellow perch were also caught, ranging between 2.5 and 8.7-inches, with a mean of 5.8-inches. Black crappie and rock bass were the only other panfish species captured. Game fish captured included 22 largemouth bass from 5.0 to 20.4-inches with a mean of 12.2-inches, and 8 northern pike between 8.5 and 28.9-inches, with a mean of 20.7-inches (Ref. #11).

The current feeling of local fishermen is that the size of the fish in the Townsend Flowage are small. Indications are that the bluegills are small and the northern pike caught are generally in the 18 to 24-inches range. This situation appears to be confirmed by the electro-fishing survey conducted in 1984.

2.5. Watershed

The watershed area of the Townsend Flowage consists of approximately 17,664 acres located primarily to the north and west of the Townsend Flowage. The watershed extends approximately 3½ miles into Langlade County to the west and just crosses into Forest County to the north. Much of the watershed is located in the Nicolet National Forest. For details of the watershed area refer to Figure No. 11, included in Appendix "A".

The main two carriers of water from the watershed entering the Townsend Flowage are McCaslin Brook and Mosquito Creek. McCaslin Brook drains the largest area to the west and north starting at Sasacat Creek and traveling southeast to Reservoir Pond and finally into the Townsend Flowage. Mosquito Creek enters the northern basin from the northwest. Mosquito Creek drains an area to the north and west from the Mosquito Lake area. The watershed is predominantly forest, wetland with a scattering of residential.

Approximately 2,400 acres of wetland make up part of the Townsend Flowage watershed area. Wetland locations are shown in Figure No. 12, included in Appendix "A". Much of the wetland areas are located in the Nicolet National Forest along the tributaries to the Townsend Flowage.

The estimated Phosphorus loading of the watershed is approximately 1,650 lb/year. This is based on an average Phosphorus export from watersheds of 64 lb/mi²/yr from WDNR research estimates of forested watersheds (Ref. #12) and a drainage basin forested area of 25.8 square miles.

The drainage basin/lake area ratio (DB:LA) of the Townsend Flowage is approximately 37:1. This is based on a watershed (drainage basin) area of 17,664 acres and a lake area of 476 acres.

2.6. Public Access

Public access to Flowage is gained in one of four places refer to Figure No. 4, included in Appendix "A".

A popular boat landing that is open to the public is located in the Town of Townsend between Nicolet Road and County Road "T" just off of State Highway 32. This boat landing is privately owned and maintained by Anderson's Bar located to the north of the landing. This landing provides adequate parking, an asphalt turnaround, a concrete apron and a dock.

Another popular boat landing that gives access to the Townsend Flowage is located at the end of Red Maple Lane. The boat landing is owned and operated by the Town of Townsend. The landing provides parking and a concrete apron. The landing is located on

the west side of McCaslin Brook approximately ¼ mile southwest of the inlet to the south basin of the Townsend Flowage.

The east end of Bennet Lane offers boat access to the south basin of the Townsend Flowage. Located directly across the bay from the Wheeler Dam, this boat landing has a long shallow sand/gravel entrance to the Townsend Flowage. Parking is limited along the road.

There are two boat access points on the north flowage. Only the ramp located on Sunset Bay Road will be discussed, since the landing at the end of Robin Lane is not an improved landing nor is it promoted for use. The boat landing from Sunset Bay Road is located in the northwest section of the north basin. The landing is gravel with limited parking available. This section of the Townsend Flowage tends to be very weedy near the end of summer which tends to limit the landing's use.

3.0. CONCLUSIONS

The following section contains the conclusions drawn from the information collected during the study of the Townsend Flowage.

3.1. Membership Survey

Based on the results of the survey, the top three concerns of the Association members are:

1) Excessive aquatic plants
2) Poor fishing
3) Water quality

Natural beauty/solitude and water recreation were the top two reasons for members to purchase property on the Townsend Flowage.

Most of the members indicated they would like to see fish planted in the Townsend Flowage again.

Over fifty percent of the members indicated they would support either the purchase/rental of an aquatic plant harvester or the use of chemicals for the management of aquatic plants.

3.2. Water Quality

The overall water quality of the Townsend Flowage is very good.

- Total Phosphorus levels are low (14 ug/l) and N:P ratios are high (20:1 - 30:1), indicating Phosphorus is the limiting nutrient for plant growth.
- Chlorophyll a results are low (3.5 ug/l), indicating a relatively small amount of algae growth.
- Color and Turbidity indicate very good water clarity.
- Secchi depth (11 - 12-feet) indicated very good water clarity.
- Dissolved oxygen levels in the Townsend Flowage were good in the summer and fair in the winter.
- pH levels were high, indicating non-acidic conditions.

3.3. Aquatic Plant Survey

During the aquatic plant survey conducted in the late summer on the Townsend Flowage, seventeen different species of aquatic plants were identified. The three most dominant plant species identified are:

1) Northern Milfoil
2) Clasping-Leaf Pondweed
3) Bushy Pondweed

The north basin of the Townsend Flowage contains the greatest abundance of aquatic plants with almost 1/2 of its area inhabited with a "very abundant" amount of aquatic plants.

3.4. Fish Species

The Townsend Flowage supports natural reproduction of a number of pan and game fish species. Length frequency information indicates growth is consistent with that observed in other area waters. Fish species found in the Townsend Flowage include: bluegill, yellow perch, black crappie, rock bass, largemouth bass and northern pike.

3.5. Watershed

The watershed area of the Townsend Flowage consists of approximately 17,664 acres located primarily to the north and west of the Townsend Flowage.

The main two carriers of water from the watershed entering the Townsend Flowage are McCaslin Brook and Mosquito Creek. McCaslin Brook drains the largest area to the west and north starting at Sasacat Creek and traveling southeast to Reservoir Pond and finally to the Townsend Flowage. Mosquito Creek enters the northern basin from the northwest. Mosquito Creek drains an area to the north and west from the mosquito lake area. The watershed is predominantly forest, wetland with a scattering of residential.

3.6. Public Access

Public access to the Townsend Flowage is gained in any one of four locations:

- Highway 32 (Anderson's Landing)
- Red Maple Lane
- Bennet Lane
- Sunset Bay Road

Public access to the Townsend Flowage is adequate to accommodate local residents and visitors.

4.0. RECOMMENDATIONS

The following section contains recommendations on water quality, aquatic plant management, fish management, watershed practices and public access.

4.1. Water Quality Recommendations

Since the water quality of the Townsend Flowage is very good as compared to other Wisconsin Lakes, continued sound ecological practices by residents are necessary to maintain or improve water quality. Education and involvement of Association members should be promoted.

Mailers can be sent to property owners informing them of sound ecological practices which include the following:

- Have your septic system checked by a qualified individual.
- Have your septic tank pumped every three years.
- Keep an undisturbed buffer zone of natural trees and plants between the Townsend Flowage and your dwelling.
- Avoid using chemical fertilizers on your lawn.
- Don't dump leaves or grass clippings in the Townsend Flowage.

It is important that the Townsend Flowage Association continues to monitor the water quality of the Townsend Flowage. The Townsend Flowage Association should join the Wisconsin Self-help Monitoring Program sponsored by the WDNR. As part of the program, lake data is collected by volunteer members of the Townsend Flowage Association. Data is provided to the WDNR to help identify lake trends. Adverse lake trends can be identified and corrected before irreversible damage to the lake has occurred.

4.2. Aquatic Plant Management Recommendations

Association members of the Townsend Flowage Association responding to the letter survey sent in January, 1995, indicated that abundant aquatic plant growth was their number one concern. The Association members indicated that they would like a reduction in the quantity of aquatic plants in the Townsend Flowage.

Since both the north and the south basin of the Townsend Flowage were formed when water was dammed, a portion of the nutrients present in the topsoil that was not removed is still available for plant use. The average depth of the Townsend Flowage is 9-feet (Ref. #3). The combination of the shallow depth, good water clarity and nutrients available creates a conducive environment for aquatic plant growth.

The north basin of the Townsend Flowage has a higher aquatic plant density than does the south basin. The north basin of the Townsend Flowage has a high density of aquatic

plants for several reasons. Very low flow from Mosquito Creek does not carry sediments and nutrients out of the basin. These sediments and nutrients tend to settle out in the northern portion of the north basin. Since the north basin is part of an impoundment, topsoil present prior to the damming of the outlet was not removed and contains nutrients available for plants. Most of the north basin is shallow and allows light to penetrate to the bottom. When nutrients and sunlight are available, aquatic plants will grow.

Aquatic plants are necessary for a viable lake ecosystem. Aquatic plants provide cover and dissolved oxygen necessary for fish. Aquatic plants also provide food for waterfowl and fish and support insect production. As mentioned earlier, plants also reduce the acidity of lake water.

The following sections offer some alternatives available to the Townsend Flowage Association for the management of aquatic plants including a recommended plan by MMA, INC. and the WDNR.

4.2.1. Aquatic Plant Harvesting/Fishing Lanes Alternative

Since it has been established that aquatic plants are needed, it is necessary to look at managing the aquatic plant population to the best benefit of lake as well as fishermen and watercraft enthusiasts. As will be mentioned in the fish management section, the concept of fishing lanes is recommended.

This method of aquatic plant harvesting is not to be confused with the "lawn mowing" technique of aquatic plant harvesting. Cutting fishing lanes minimizes the use of the aquatic plant harvester and selectively harvests certain areas. Cutting lanes with an aquatic plant harvester allows unobstructed boat travel through dense areas of plants and allows fishing without weeds clogging fish lures. The added benefit to this is that it allows predator fish feeding areas just outside weed beds, which can result in a larger sized fish population.

Removing the aquatic plants from the Townsend Flowage also reduces the sediment buildup and nutrient deposition from decomposing aquatic plants, thereby slowing future plant growth. Dissolved oxygen uptake by decomposing aquatic plants is also reduced, resulting in less stress on fish which can have the effect of a larger and healthier fish population.

The purchase of an aquatic plant harvester must be decided by the complete membership. If the decision is to purchase an aquatic plant harvester, a program exists through the Wisconsin Waterways Commission to assist the Association. Cost sharing of fifty percent is available through the Wisconsin Waterways Commission for the purchase of an aquatic plant harvester if eligibility requirements are met. A copy of an aquatic plant management harvesting plan worksheet is located in Appendix "I".

This past year, the Reservoir Pond Sanitary District received monies through the Wisconsin Waterways Commission for the purchase of a new, larger aquatic plant harvester. An option may be to rent or purchase an aquatic plant harvester from the Reservoir Pond Sanitary District or contracting with them for the removal of the aquatic plants. Based on a conversation with Dale Dequaine of the Reservoir Pond Sanitary District, the District does have plans to sell one of the harvesters this year. Private companies are also available for aquatic plant removal.

The advantages of removing aquatic plants are as follows:

- An easy way to temporarily reduce the number of aquatic plants.
- Increased recreational activity possible.
- Access to more areas of the Townsend Flowage by motorized watercraft.
- More fishing areas available through the creation of fishing lanes through weed beds.
- Better fishing since predator fish are able to thrive.
- No damaging effects to the environment or people.
- Reduction of phosphorus loading and sediment to the lake.

The disadvantages to removing aquatic plants are as follows:

- Rental or purchase costs of an aquatic plant harvester must be paid by members.
- There must be a place available to deposit harvested aquatic plant material.
- Increased lake usage by property owners and visitors.
- Some floating aquatic plants from the aquatic plant harvester may deposit on shore.
- Requires more than one cutting per season.

4.2.2. Chemical Aquatic Plant Control Alternative

An option that is available to the Townsend Flowage Association is the application of chemicals to the water to kill aquatic plants. MMA, Inc. and the WDNR strongly discourage the use of chemicals for controlling aquatic plants.

The chemicals available for this purpose are described in detail in WDNR chemical fact sheet publications found in Appendix "J". The chemical fact sheets list manufacturers; indicates effectiveness and selectivity; give use considerations; list water use restrictions; show impacts on fish and other aquatic organisms; give degradation rates and trace contamination; list human health impacts. It is strongly recommended that all board members read this material if chemical control of plants is given serious consideration.

The advantages of chemical control are as follows:

- Quick and easy way to temporarily reduce the number of aquatic plants.
- Increased recreational activity possible.
- Access to most areas of the Townsend Flowage by motorized watercraft is possible.

- More fishing areas available.
- Relatively inexpensive to apply.

The disadvantages to chemical control are as follows:

- A high probability that more noxious weeds will take over the areas treated.
- Chemicals are not selective, good and bad plants are both destroyed.
- Requires yearly applications to control aquatic plants.
- Increased future aquatic plant growth in the Townsend Flowage as well as downstream due to the addition of phosphorus when the plant decays after treatment.
- Unknown long-term health risks to people eating the fish, using the water for swimming or using the groundwater from wells close to the lake.
- Complete upset of the normal lake ecosystem will take place. Destruction of food chain organisms possible.
- Reduction in the amount of dissolved oxygen present in the lake due to both the decay of aquatic plant material as well as the reduction of the number of aquatic plants able to produce oxygen.
- Increased lake acidity due to the destruction of calcium carbonate producing aquatic plants which naturally increase lake pH.
- Some trace contaminants will be resuspended each year during spring and fall turnover.
- Increased shoreline development since more recreational activities are available.
- Increased lake usage by property owners and visitors.
- Permit required by Wisconsin administrative code NR107.

4.2.3. Drawdown Alternative

The water level in the Townsend Flowage can be lowered as it was in 1993 to reduce the amount aquatic plants near shore. The aquatic plants in the near shoreline area would be exposed to drying or freezing. This option has the following advantage:

- Minimal cost to members or taxpayers.

The following are disadvantages to drawdown for aquatic plant management:

- The lake would not be useable for recreation for a minimum of one month.
- This method only has minimal results as noted in amount of aquatic vegetation on the Townsend Flowage in 1994.
- This method alters the ecosystem of the lake and has a negative impact on the fishery.
- Drawdown would have to be done every year.
- Slumping of the shoreline can occur.
- Native aquatic plants can be replaced by more noxious aquatic plant species.

4.2.4. Do Nothing Alternative

The option to do nothing is always available to the Townsend Flowage Association. This option has the following advantages:

- No cost to members or taxpayers.
- Results are known.
- No damaging effects to the environment.
- Slowing of shoreline development since recreational activities are limited.
- Slowing of property value increases (less taxes in the future).

The following are the disadvantages to this option:

- Access to areas of the Townsend Flowage by motorized watercraft is limited.
- Fishing difficult in some areas.
- Water recreational activity limited.
- Floating aquatic plants along the shoreline, cut by boats and property owners.

4.2.5. Recommended Aquatic Plant Management Plan

The best available aquatic plant management plan that benefits fishermen, boaters and the lake environment is the creation of fishing lanes as described in section 4.2.1. The creation of fishing lanes have the potential of improving fishing and watercraft travel while reducing nutrient loading and sedimentation of the Townsend Flowage. It is not a "cure all", but is an environmentally sound way to encourage fish growth while creating access for boaters and fisherman.

4.3. Fish Management Recommendations

Results from the membership letter survey indicated that eighty-four percent of the Association members would like to see fish stocked in the Townsend Flowage. The top three fish chosen for stocking were walleye, bass and perch, in that order. From 1960 to 1977, the Townsend Flowage was stocked with walleye and muskellunge. None of these species currently remain in any appreciable quantity. Since past efforts at stocking the Townsend Flowage with these fish have not had beneficial results, it must be assumed that the Townsend Flowage cannot support the natural reproduction of walleye and muskellunge. Therefore, a stocking program for these fish is not recommended at this time.

The Townsend Flowage does, however, support natural reproduction of bluegill, yellow perch, black crappie, rock bass, largemouth bass and northern pike. It is recommended that the enhancement of these species be continued through beneficial management practices. As part of these practices, it is recommended that an aquatic plant harvester be used to cut fishing lanes in selected areas of the Townsend Flowage. Cutting lanes with an aquatic plant harvester allows unobstructed boat travel through dense areas of plants

and allows fishing without weeds clogging fish lures. The added benefit to this is that it allows predator fish feeding areas just outside weed beds. This could result in a larger sized fish population, something that a number of fisherman are looking for.

Removing the aquatic plants from the Townsend Flowage also reduces the sediment buildup and nutrient deposition from decomposing aquatic plants, thereby slowing future aquatic plant growth. Dissolved oxygen uptake by decomposing aquatic plants is also reduced, resulting in less stress on fish which can have the effect of a larger and healthier fish population.

Once a sound management practice is established, the concept of fish stocking should be considered by the Townsend Flowage Association. If the Townsend Flowage Association does wish to pursue stocking fish, Russ Heiser of the WDNR - Marinette office is able to assist the Association in determining what fish, if any, should be stocked, and where they can be obtained.

4.4. Watershed Recommendations

Since the water quality of the Townsend Flowage is very good, continued sound ecological practices of residents are necessary to maintain or improve water quality. Education and involvement of Association members should be promoted as is recommended in section 4.1 - Water Quality Recommendations.

4.5. Public Access Recommendations

No recommendations are necessary to improve public access. Mr. Anderson should be recognized for maintaining and sharing public access to the Townsend Flowage from Highway 32.

5.0. SUMMARY OF RECOMMENDATIONS

The following is a summary of recommendations provided to improve the ecosystem of the Townsend Flowage:

- Education and involvement of Association members should be promoted to maintain and improve water quality on the Townsend Flowage. Mailers can be sent to property owners informing them of sound ecological practices. Maintaining good water quality will help minimize aquatic plant growth.

- The Townsend Flowage Association should continue to monitor the water quality of the Townsend Flowage. The Townsend Flowage Association should join the Wisconsin Self-help Monitoring Program sponsored by the WDNR. As part of the program, lake data is collected by volunteer members of the Townsend Flowage Association. Data is provided to the WDNR to help identify lake trends. Adverse lake trends can be identified and corrected before irreversible damage to the lake has occurred.

- It is recommended that an aquatic plant harvester be used to cut fishing lanes in selected areas of the Townsend Flowage. This will reduce the sediment buildup and nutrient deposition from decomposing aquatic plants, thereby slowing future aquatic plant growth. Dissolved oxygen uptake by decomposing aquatic plants will also be reduced, resulting in less stress on fish which can have the effect of a larger and healthier fish population. Cutting lanes with an aquatic plant harvester allows unobstructed boat travel through dense areas of plants and allows fishing without weeds clogging fish lures. The added benefit to this is that it allows predator fish feeding areas just outside weed beds. This could result in a larger sized fish population.

- Once a sound fish management practice is established through the use of fishing lanes, the concept of fish stocking should be considered by the Townsend Flowage Association.

6.0. REPORT LIMITATIONS

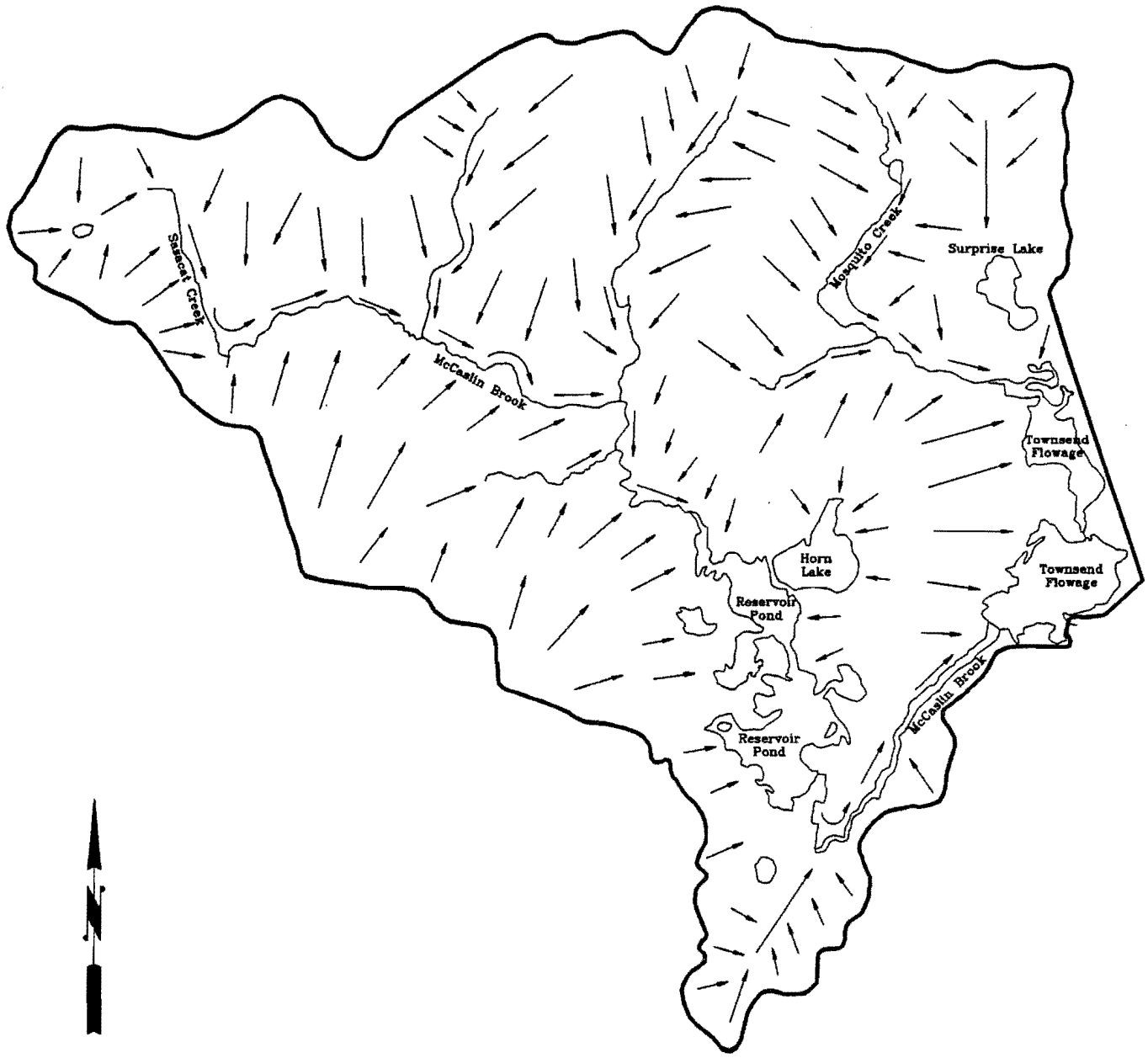
This document was developed and prepared as a limited investigation and evaluation subject to the constraints of cost and time. This document is not intended to represent a total, complete, exhaustive or extensive investigation and evaluation.

The report was performed with the degree of care and levels of skill and experience ordinarily used, under like, or similar circumstances, by Professional Consultants practicing in this general locality and similar areas. No other warranty or guarantee, expressed, or implied, is made with respect to the findings, conclusions and professional advice and opinion included in this document.

The report contained in this document is based upon an observation of site conditions, information provided by the WDNR and investigation of historical and public records.

7.0. USE OF DOCUMENT BY OTHERS

This document has been developed and prepared for a specific application, under specific limitations. This document, therefore, may not be used without the prior written approval of the author(s) and MMA, INC. Any use of this document, or any portion thereof, by any unauthorized user is the sole responsibility of that unauthorized user.



LEGEND

ARROWS INDICATE SURFACE RUNOFF PATTERNS AND WATER FLOW DIRECTION

WATERSHED AREA OF THE TOWNSEND FLOWAGE

SCALE: 1" =6000'	APPROVED BY:	DRAWN BY: SMF
DATE: 3/29/95		REVISED:

TOWNSEND FLOWAGE ASSOCIATION
Townsend, Wisconsin

MMA, INC. – Florence, WI

FIGURE NUMBER: 11

E:\TOWNSEND\WATERSHED.DWG

Wheeler Hotel, Townsend, WI, circa 1953.

East side of Wheeler Dam, Townsend Flowage, circa 1953.

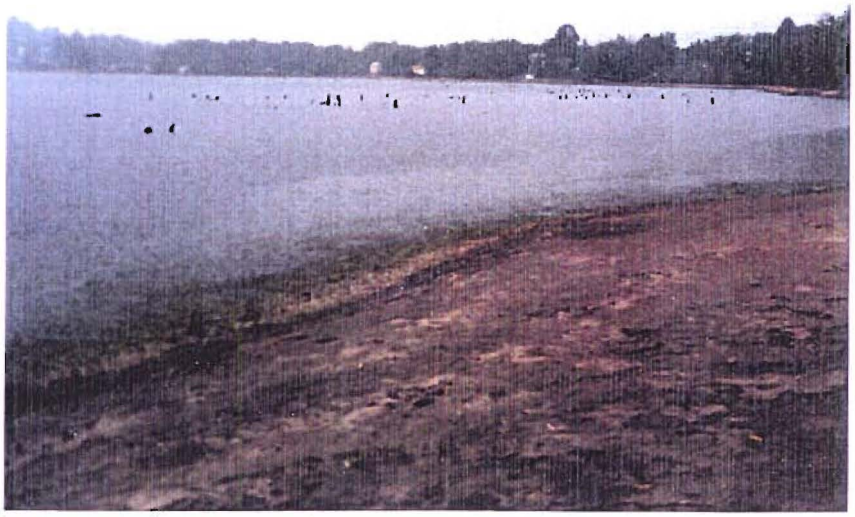
Looking north from the bridge, Townsend Flowage, circa 1953.

Looking southeast on south flowage, Townsend Flowage, circa 1953.

South end of Townsend Flowage, facing northeast, Townsend, WI, circa 1953.

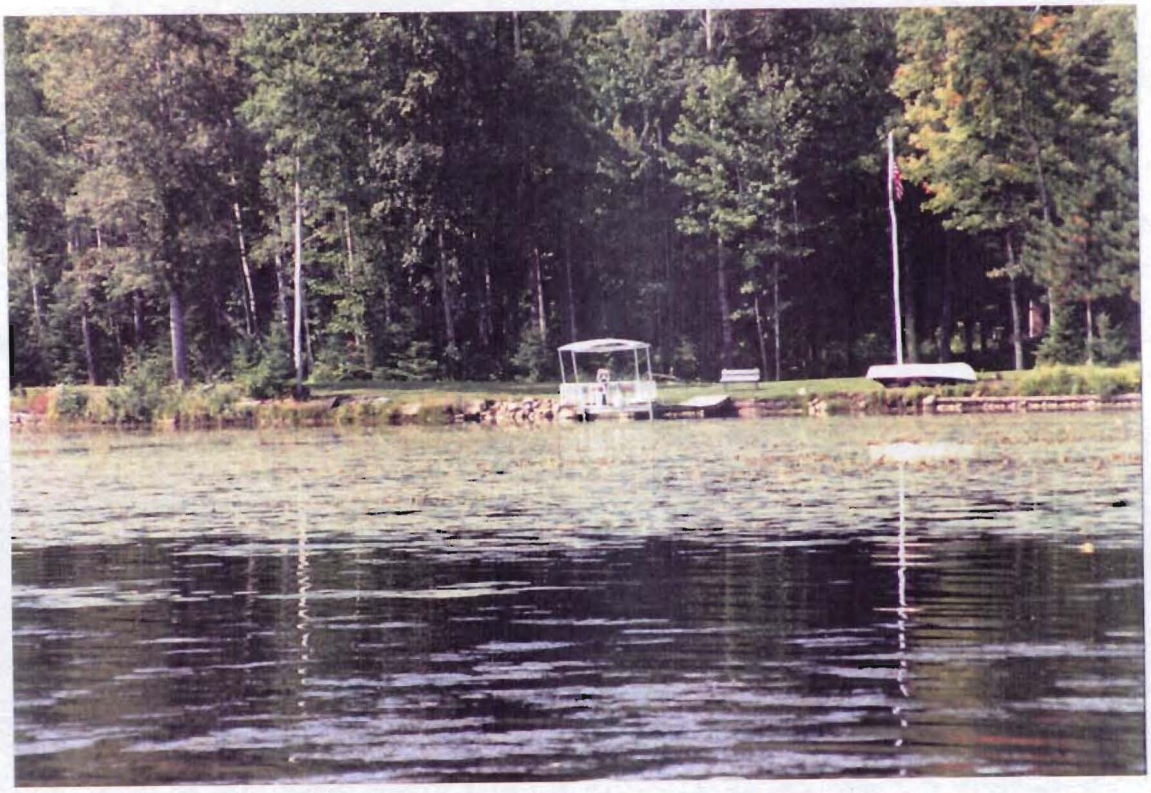
Bridge between north and south flowage, Townsend Flowage, circa 1953.

Townsend Flowage, 1993, drained to repair dam.



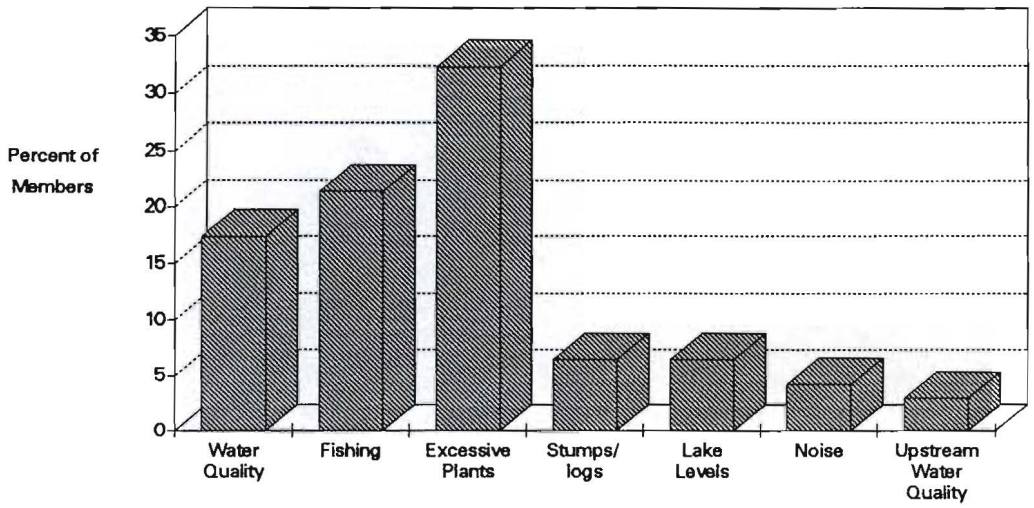
Townsend Flowage, 1993, drained to repair dam.

The Backside of the Dam.

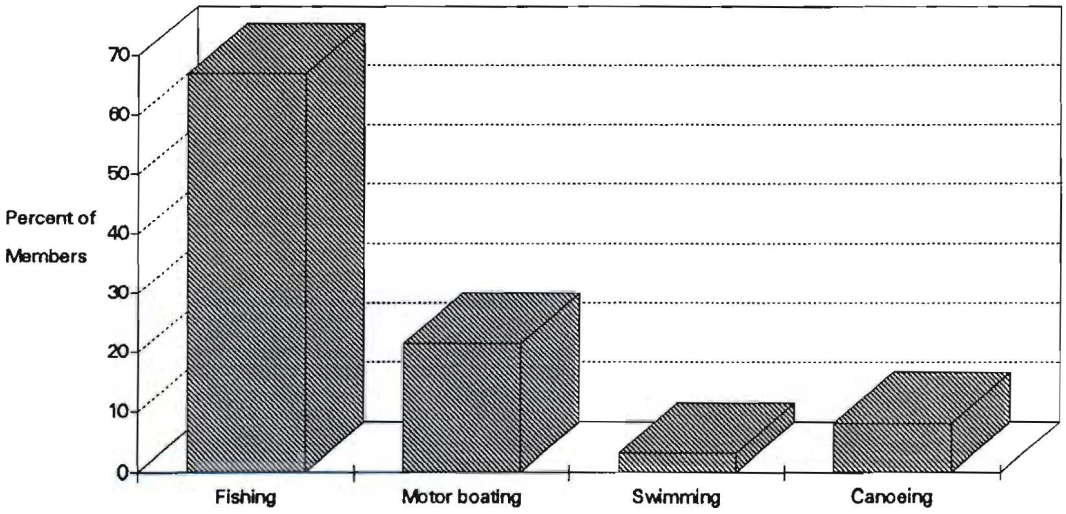


Aquatic Plants in the North Basin.

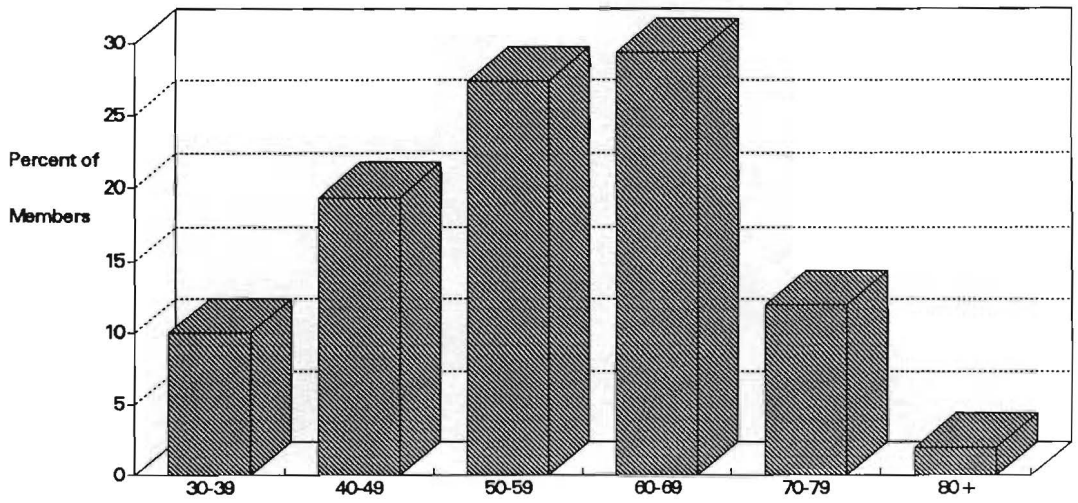
The following figures graphically provide the results of the surveys:



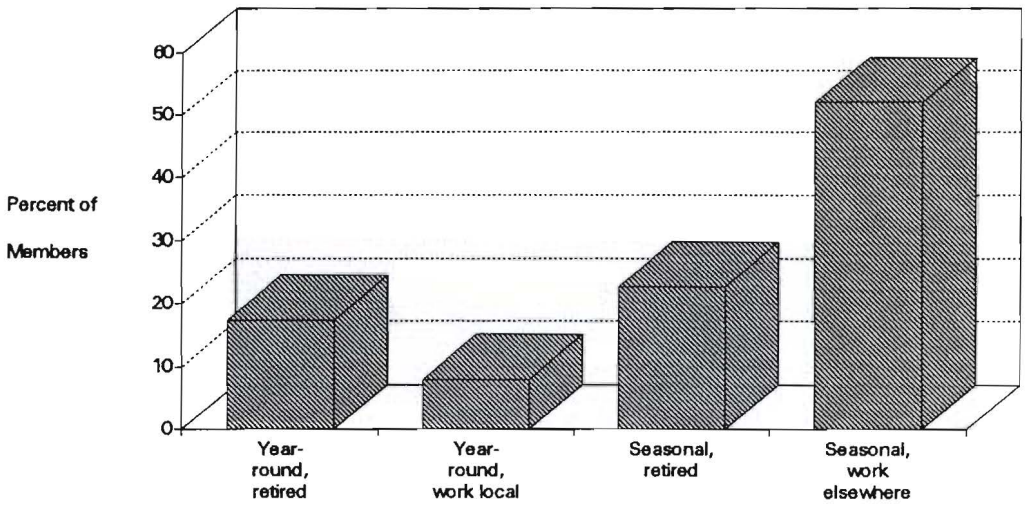
Concerns of Townsend Flowage Association Members



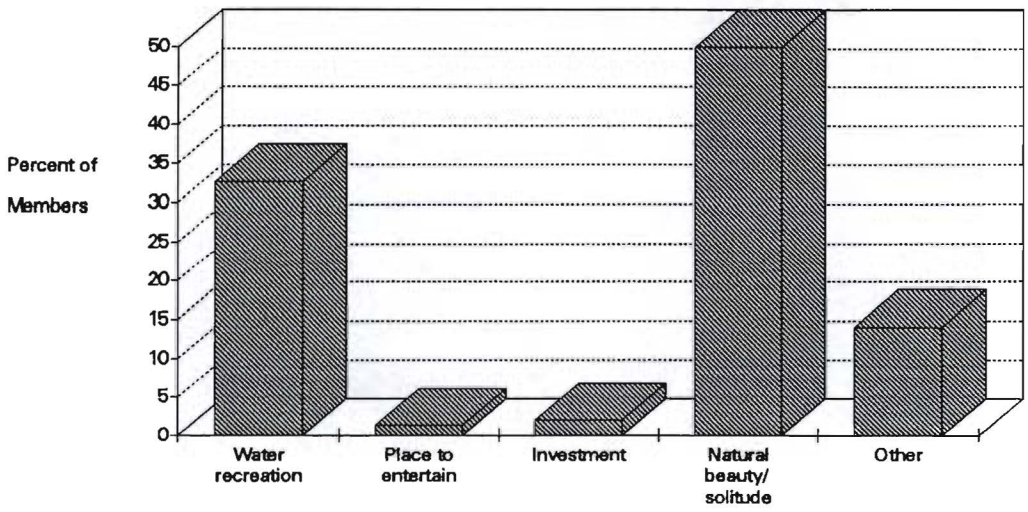
Primary Water Recreation Activities



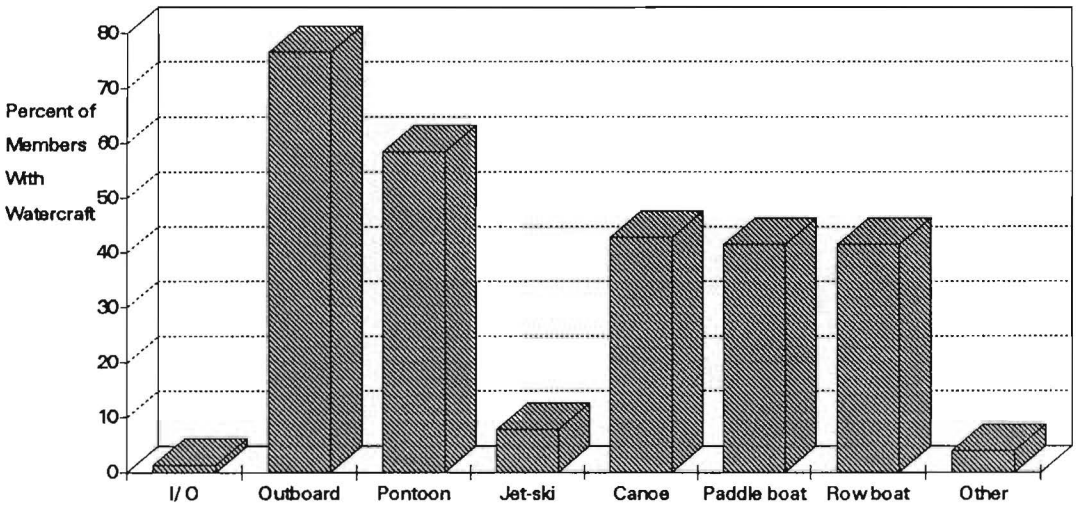
Age of Head of Household of Townsend Flowage Association Members



Residency and Employment of Association Members



Principal Reason for Purchase of Property



Watercraft Owned by Association Members