Lake Planning Grant Watershed Study

Greater Bass Lake & Lady Lake
Town of Upham
Langlade County, Wisconsin

MSA Project No. 250038

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS (continued)

LIST OF CHARTS

LIST OF APPENDICES

EXECUTIVE SUMMARY

The Greater Bass Lake & Lady Lake Protection and Rehabilitation District conducted a lake planning watershed study during the summer of 2000. The District has approximately 200 residences which use on-site wastewater treatment systems for disposing of household wastewater. In general, these are septic systems which use a septic tank followed by a drainfield or seepage pit. Many of these systems are more than 20 years old. Concern over the effect these systems are having on the groundwater and lake water quality prompted the District to initiate this study. All of the septic systems in the District that were constructed prior to 1990 were inspected to determine if they were in compliance with the State Plumbing Code, COMM 83. Plumbing codes in effect since 1969 have required a minimum separation distance from a septic system soil dispersal area to groundwater. The zone of unsaturated soil below a system, required by the plumbing code, provides the only treatment media the septic tank effluent passes through before discharge to the groundwater.

The septic system inspections found that 60% of the sites in the District do not meet plumbing code requirements. However, because of groundwater flow direction in the lake area, septic systems were found not to be a big contributor to the nutrient loading of the lake. Other sources of nutrient contribution to the lake, from watershed sources, were also reviewed and are delineated in the report. The phosphorus loading model projects phosphorus input to the lake system from all sources to be in the range of 96 to 210 kilograms per year. This study provides the Lake District members with a tool for evaluating the sources of nutrients to the lake and a benchmark for all future analysis of the nutrient budget.

INTRODUCTION

The following report is a description of and results from a lake planning grant watershed study of Greater Bass Lake & Lady Lake conducted during the summer of 2000. The protection of these lakes is of great concern to local government authorities, namely the Greater Bass Lake & Lady Lake Protection & Rehabilitation District, the Town of Upham, and Langlade County. While lake water quality is presently considered by many in the district to be quite good, there is concern about growing impacts on water quality of some of the practices of the lake users and shoreline owners.

This study was undertaken to determine the condition of the septic systems serving residents in the District. A portion of the septic systems in the District were inspected in 1995, this study provided funds to complete the inspections of the remaining systems. Another goal of this project was to provide a tool for education of the District members. The watershed boundary mapping and land use maps will be of great value for future decision making by the District members. The scope of this study included the following items:

★Evaluate septic systems for code compliance
★Delineate the watershed boundaries
★Characterize the land uses in the watershed
★Provide a phosphorus loading budget for the lake
★Aquatic weed identification

PURPOSE

The Greater Bass Lake & Lady Lake Protection & Rehabilitation District has become concerned that nutrients released by septic systems might have a detrimental effect on the water quality of Greater Bass Lake & Lady Lake and as the existing septic systems age and require replacement, there may be insufficient area for replacement systems (other than with a holding tank).

The Greater Bass Lake & Lady Lake Protection & Rehabilitation District secured funds from the WisDNR Lake Management Planning Grant program to evaluate existing residential septic systems on Greater Bass Lake & Lady Lake and to provide base maps of the watershed and a nutrient budget for the lake. This project in part was to assess the potential effect of on-site septic systems on Greater Bass Lake & Lady Lake nutrient status by examining the existing systems and applying a nutrient loading model to determine their significance to the lake nutrient budget. The nutrient budget, developed as part of a previous study (1983), was re-evaluated for the residential component based on current development and the findings from this survey. The results can be used to evaluate the need for wastewater management alternatives and cooperative management strategies to correct any deficiencies.

PREVIOUS STUDIES

Several studies have been performed to analyze the Lake, its content and the surrounding watershed. These studies have provided evidence of non code compliant septic system installations as well as the importance of protecting the lake during changing adjacent land use. The studies include the following:

Greater Bass Lake, Langlade County
Feasibility Study Results; Management Alternatives (WDNR, 1983)

Planning Grant Study (Northern Lake Service, 1992)

Sanitary Sewer Report (MSA, 1995)

Wastewater Feasibility Study (MSA, 1996)

The Feasibility Study Results prepared by WDNR in 1983 established the direction of groundwater flow(see Figure 4) and provided a base for a nutrient budget. The direction of groundwater flow in the area is generally out of and away from Greater Bass Lake. Groundwater flow direction has a great impact on the analysis of the various nutrient budget sources evaluated in this report, in particular the septic system contribution. The impact of on-site septic systems located along the shoreline of Greater Bass Lake & Lady Lake on lake water quality is much less considering the direction of groundwater flow. Nonpoint sources of nutrients, such as, atmospheric, stream inflow and runoff have a much greater impact on the lake water quality than the minor flows received from the groundwater entering the lake.

The purpose of the Planning Grant Study conducted by Northern Lakes in 1992 was to determine current water quality for comparison to past and future data and provide a basis for recommending improvement/preservation strategies.

The Sanitary Sewer Report conducted by MSA in 1995 provided an assessment of the code compliance of the septic systems' located in the Greater Bass Lake District. The results of that study reveled that 72% of the septic systems inspected were non-code compliant. Approximately one third of the septic systems in the District were inspected in 1995. The results of that study lead to the Wastewater Feasibility Study conducted by MSA in 1996 which evaluated the alternatives for wastewater treatment and disposal.

WATERSHED DESCRIPTION

Greater Bass Lake & Lady Lake are located in the Town of Upham, Langlade County. The boundary of the Protection and Rehabilitation District is shown in Figure 1 in the back of this report. Figure 2 defines the direct drainage basin and the entire watershed of Greater Bass Lake. Greater Bass Lake is a 258 acre, drainage lake with a maximum depth of 27 feet, 6.9 miles of shoreline and a watershed of 2707 acres. The shoreline is approximately 95% uplands and 5% wetland and conifers. (From Surface Water Resources of Langlade County, WDNR-1977) Greater Bass Lake is heavily developed along the shoreline with approximately 200 residences located in the district. The direct drainage basin contains 718 acres including the lake surface area. The direct drainage basin was used for the nutrient budget calculations because the larger total watershed drains through Summit Lake which in turn drains into Greater Bass Lake. It was felt that separating the direct drainage basin from the total watershed more accurately shows the actual nutrient budget of the lake.

The ratio of the drainage basin to lake area is 1.78:1. This low ratio is a reflection of a small watershed in relation to the lake area. The effects on the lake from this relationship are that there is a long retention time of the water remaining in the lake before outflow.

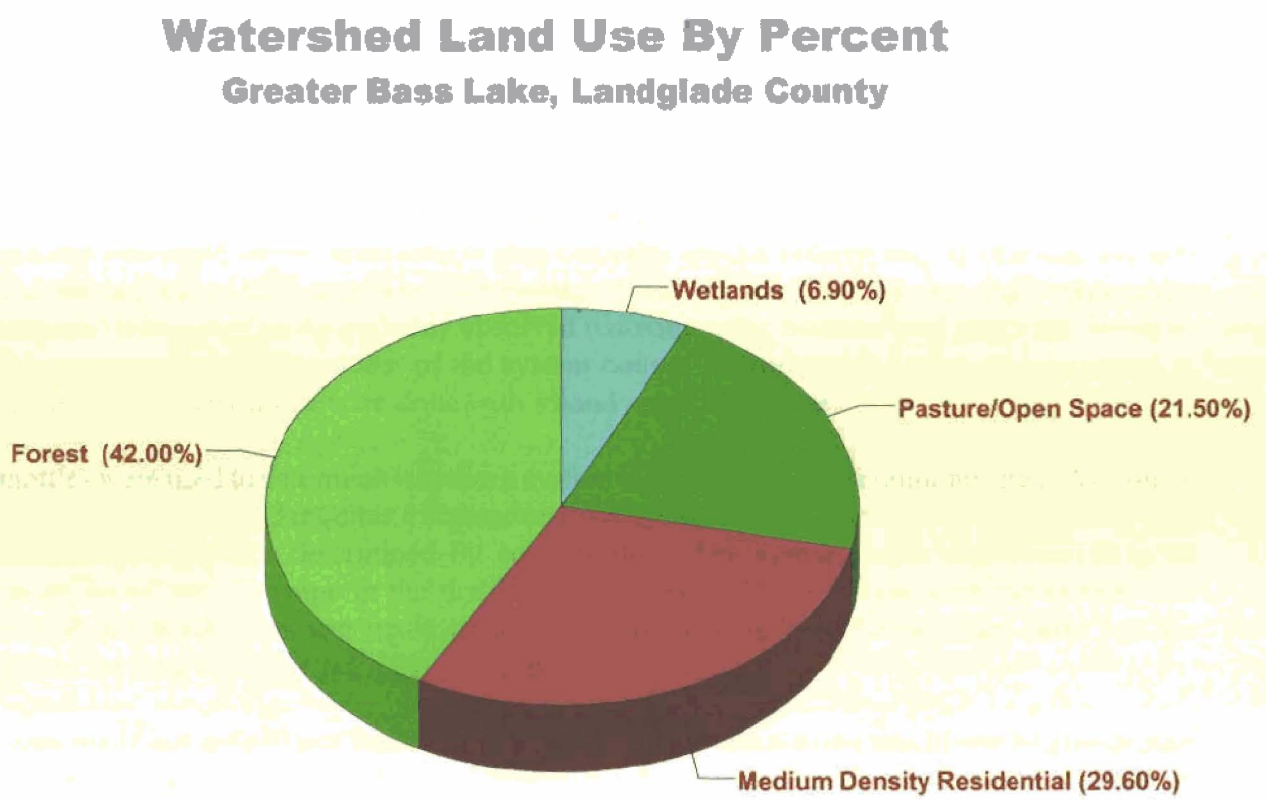
Lady Lake is a small lake located northeast of Greater Bass Lake and separated from Greater Bass Lake by a narrow, higher ridge of land. Lady Lake watershed basin is mostly forested uplands with very little development occurring in the watershed.

LAND USE

A map of the land use in the total watershed and the direct drainage basin is presented in Figure 3. The areas of land use were gathered from aerial photographs, dated 1992, WDNR Wetland maps and a drive-through recognizance. The following table shows the land use, in the direct drainage basin, by acreage and as a percentage of the watershed. Chart 1 contains a depiction of the total land use in the direct drainage basin.

Land Use	Acres	% of Watershed
Forest	193.7	42%
Low to Medium Density Urban (Lake front residential)	136.2	29.6%
Pasture/grass/open space	98.9	21.5%
Wetlands	31.7	6.9%

Chart 1


Watershed Land Use By Percent
Greater Bass Lake, Landglade County
Wetlands (6.90%)
Pasture/Open Space (21.50%)
Forest (42.00%)
Medium Density Residential (29.60%)

SEPTIC SYSTEM INSPECTION

The septic system evaluation examined all existing systems in the district that were constructed prior to 1990. The sanitary survey results from this study were combined with the results of the septic system study conducted in 1995.

A copy of each inspection report can be found in Appendix A. Each site was inspected to determine the location and depth of the drainfield or soil dispersal unit of the system. If relevant, the soil conditions to a depth of three feet below the system were evaluated. Depth, color, and texture of the soil horizons were noted along with any observed redoximorphic features (soil mottles). Depth to observed water (if within three feet of the system bottom), bedrock and/or refusal was noted, if applicable. Soil observations were done with a hand auger and spade.

Soil mottles were used to determine whether a system is located in a code compliant area. Wisconsin Plumbing Code COMM 83 requires a separation between the bottom of the drainfield and any zone of seasonal saturation, as determined by soil mottles. The system depth was determined by measuring down the vent pipe in the drainfield or drywell. Once the depth of the system was established, a measurement was made to determine the relative height above lake level and the distance to the lake shoreline from the vent pipe.

Observations of sewage effluent surfacing or direct discharge into the lake would result in the system being classified as non code compliant. If these pipes, lines, tiles, etc. were not observed, this does not guarantee that illegal lines directing sewage effluent to the lake do not exist. These pipes or drain lines are impossible to detect when they are below the soil/water surface.

SEPTIC SYSTEM INSPECTION RESULTS

The results of the Greater Bass Lake & Lady Lake septic system evaluation are summarized below. Individual inspection reports for the year 2000 are found in Appendix A. In the back of this report are a number of figures which highlight some of the data summarized below. Figure 5 compares the septic systems' ages with the breakdown of ages of all systems on the Lake. Figures 6 and 7 show graphically how the drainfields are located with respect to vertical and horizontal separation distance from the lake.

Summary of Septic System Survey Results
(combined 1995 & 2000 results)

Total number of sites inspected -	145
Number of systems installed since 1990 -	33
Number of Holding Tanks -	19
Total number of systems in the District -	197
Number of sites which were not COMM 83, State Plumbing Code Compliant -	87*
Number of sites with drainfield or pit ponding -	10**
Non-code compliant rate -	
1995 study	72%
2000 study	46%
Combined results	60%
Age of septic systems inspected -	See Figure 5
Average age of failing septic system -	27 yrs
Vertical separation distance from drainfield to groundwater -	See Figure 6
Horizontal distance from drainfield to lake -	See Figure 7

Notes:
*A site that is listed as "passed" is not to be construed as a recommendation of the system; it simply means that within the parameters of this study, the system could be reconstructed in the place and at the depth it currently occupies. A replacement system, of course, could be larger and usually would be configured differently from the existing system in most cases.

** A site that is listed as "ponded" indicates that, at the time of inspection, septic effluent was ponded in the drainfield vent more severely than normally expected. This was noted to alert the landowner to a potential hydraulic failure and to keep a watchful eye on the drainfield and the water usage in their home.

ASSESSMENT OF RESULTS

The results of the septic evaluation showed:

1) 60% of septic systems had unsaturated soil separation distances less than required.

2) Soils beneath drainfields were predominately sands of relatively high permeability.

3) Vertical separation distance from the bottom of the drainfield to groundwater in 57% of the systems inspected is 5 ft or less.

4) 63% of the septic systems are greater than 20 years old.(excluding holding tanks)

The assessment of the results examined both the implications of the non-code compliant rate and how the nature of the soils surrounding Greater Bass Lake & Lady Lake were likely to impact nutrient release from all septic systems.

60% of the septic systems examined on Greater Bass Lake & Lady Lake were non-code compliant because they do not meet the minimum separation between the bottom of the system and seasonally high groundwater. In a number of cases, seepage pits were constructed to a depth below the groundwater level observed at the time of the inspection. The vertical separation distance between the drainfield and the saturated soil zone is important because much of the treatment of septic effluent in the soil occurs within the unsaturated zone. Most of the non-code compliant systems we found were constructed at least 20 years ago, with the average age of a non-code compliant system being 27 years old.

Septic systems that fail hydraulically cannot be as easily quantified into a percentage of non-code compliant systems. Excessive ponding of a drainfield is a sign that hydraulic failure is likely to happen to a system. Looking at our studies on both lakes, we found there were 10 systems with excessive ponding observed in the drainfield vents. These systems were generally in the age group of >30 years old. As a general trend, hydraulic failure is more likely to happen in the older systems. Hydraulic failure which was noted in newer systems was usually associated with highly saturated soil conditions.

Hydraulic failure occurs in a septic system when the organic clogging mat formed in the drainfield prevents effluent from discharging into the ground and, either, backs up into the house or travels up to the ground's surface. Clogging mat formation is common in any septic system. Septic tank effluent contains organics that naturally accumulate in a drainfield over the systems' lifetime. In time, the clogging mat will be so impermeable that hydraulic failure occurs. Factors, other than time that will bring about hydraulic failure include excessive household water use, the over-use of a garbage disposal that loads a system with too many organics and/or solids, loading of a septic tank with harmful agents (bleaches, paint thinners, etc.) that reduce septic tank effectiveness, and the failure to remove solids from the tank at regular intervals. These factors are either coupled with time to shorten the useful life of a system or can be totally independent of time and a system can fail within a few years of installation if not properly taken care of. The long life span of a lot of the systems at Greater Bass Lake has to do with the pattern of use they are subjected to. Many of the systems are used only during the summer months. In some cases they are only used on weekends and on an occasional weekly basis. The built in resting period the drainfield receives promotes a longer life span. As cottages and homes become full time residences the hydraulic failure rate of systems is likely to increase.

The consequences of hydraulic failure in Greater Bass Lake & Lady Lake include the eventual possibility that the system may discharge wastewater to the ground surface and provide a more direct pathway for nutrients to enter the lake. It also suggests a situation where the owner should be considering installation of a replacement system.

The septic system evaluation also examined the soil near the drainfields. The soil that the septic system uses as the primary filter has to be considered on its own when we are looking at water quality implications in the Greater Bass Lake & Lady Lake area. Mapped primarily as Antigo-Pence Association, these are outwash soils, which provide an efficient means of disposal for wastewater. Hydraulic conductivity in the subsoils ranges from 6.0 to 20 inches/hour. These high values indicate that water can move very rapidly through the profile. This is the major benefit of using these soils for septic system absorption fields but may not provide as much time in the soil profile for reducing nutrient concentrations. Sandy soils do not provide a long enough retention time to remove nutrients such as phosphorus from the wastewater stream. Nitrogen, a nutrient found in all domestic wastewater, is converted to Nitrate-Nitrite as it passes through the soil. The discharge of this nutrient to the groundwater occurs more rapidly in sandy soil conditions and when there is inadequate separation distance between the drainfield and groundwater.

In this study, the principle nutrient of concern from septic effluent is phosphorus. Phosphorus is normally the limiting nutrient in lakes such as Greater Bass Lake & Lady Lake and elevated concentrations can trigger algae blooms in lakes (Lindemann, 1997). Based on a review of the literature, we expect some phosphorus removal by the soil underneath a drainfield. In the non-calcareous, acid sands surrounding Greater Bass Lake & Lady Lake, most of the phosphorus removal comes from iron and aluminum sorption (Reneau, 1989). Once the soil's capacity for these reactions is exhausted, the soil would allow more phosphorus to move into the groundwater (VanRyswyk, 1996). We expect that in soils with a low sorption capacity, like the non-calcareous sands we find in the Greater Bass Lake area, the capacity for phosphorus is relatively low. The soil has more limited capacity to retain phosphorus and continued loading from septic systems exhausts that capacity (Postma, 1992; Renneau, 1989).

Septic systems located in non-code compliant areas allow nutrients, such as phosphorus, to enter the groundwater faster than a system which has a greater separation distance to groundwater. For systems installed in the same soil, it is expected that those systems with more unsaturated soil between the drainfield and the groundwater will more effectively remove nutrients, at least initially. With time, the capacity of soils to remove phosphorus is expected to decrease. Consequently, separation distance, the amount of phosphorus which enters the drainfield, and the ability of the drainfield to distribute the waste through the unsaturated zone are all expected to impact the ability of the system to remove nutrients. Uniform effluent distribution and smaller loading rates within the drainfield aid phosphorus removal in the soil by increasing the amount of soil available to treat the phosphorus in the effluent (VanRyswyk, 1996). Many of the older systems are seepage pits which concentrate the discharged effluent in a very small area. The effluent is not evenly distributed in the soil dispersal unit as compared to the newer systems designed based upon the morphological evaluations performed today. Gravity fed distribution is the most common type of distribution for these older systems, as well as the newer ones. Typically, gravity systems do not have equal distribution of the effluent in the drainfield. Effluent from the tank passes through the first holes in the drainfield pipe that they come into contact with, not fully utilizing the drainfield.

The principle function of an on-site septic system is to dispose of household wastewater. In general, on-site septic systems were not designed to remove nutrients from wastewater (Shaw, 1998). While previous studies have indicated that the groundwater flow is generally away from the lake discharges from all of the septic systems in the district are impacting the groundwater. Nutrients from poorly filtered septic system effluent may not be entering the lake but they are definitely migrating into the groundwater. Our study found there was a large percentage of non-code compliant systems, we found most of the systems to be located in the sandy, non-calcareous soils that dominate the area. The relative importance of these systems to the lake is explored in more detail by re-examining the nutrient budget for the lake.

NUTRIENT BUDGET

The key nutrient influencing plant growth in 80% of Wisconsin lakes is phosphorous. The nutrient budget developed in this report indicates the probable loading of this nutrient from all the sources in the direct drainage basin. To determine phosphorous (P) loading to Greater Bass Lake, the potential loading from land use was predicted using a mathematical model. The most likely P export coefficients from the above land uses was selected and computed using the Wisconsin Lake Modeling Suite (WiLMS) version 3.1.

No recent laboratory analytical results were available to determine phosphorous levels in the lake, but it is assumed that the levels are relatively low, based on watershed land use and the clarity of the water.

The results of the nonpoint P contribution from the atmosphere and land use in the watershed was computed. There is a 70% probability that the nonpoint loading contribution is between 34 and 146 kg/ year with the most likely amount as 59 kg/year.

The P contribution from the stream inflow was computed as a point source. The WDNR collected inflow stream measurements in 1980 and calculated water flow. This value was used for predicting P contribution from stream flow. The potential P loading from this source is 60 kg/year which is the highest contributor and is 49.1% of the total P loading.

The nutrient loading model evaluated the phosphorous loading from the direct drainage basin which has a land area of 460 acres. In Table 1, the watershed land use summary is shown along with the projected loading of phosphorus inputs from those land types. This is an approximate means of estimating phosphorus loading and is based on the observations made from other studies and reports in Wisconsin. In 2000, this model projects direct drainage basin phosphorous loading of 96 to 210 kg/year. This is a very wide range, and reflects the considerable uncertainty associated with average phosphorus loading from different land uses. It is also slightly more phosphorus than was earlier projected in the 1983 study. Although the results use updated phosphorus export coefficients, they also generalize the contribution of different land use to phosphorus release. Although it is not within the scope of this study, the overall importance of phosphorus loading to the lake would require a more accurate assessment of phosphorus contributions from the Summit Lake stream inflow. The values established in 1983 may or may not be accurate today because of changes within the total watershed and increased loadings from new residential units built on Summit Lake since the study.

As the nutrient budget shows the importance of phosphorus release from septic systems on Greater Bass Lake is not considered to be very significant. This is primarily due to the groundwater flow direction. It was assumed that the discharge from 75% of the septic systems was being directed away from the lake. The accuracy of this assumption is dependent on the lake water levels and the climate conditions in any particular year. There may be periods of time when septic system effluent discharge is making it's way to the lake in greater concentrations than shown here. The increased phosphorus release from septic systems may be more important locally where their increased nutrient input to the lake might enrich the sediments and encourage plant growth (Lindemann, 1997).

The phosphorus budget developed in this work updated the watershed/direct drainage basin boundaries and land use inventory used in the previous studies and projected phosphorus loading from all sources in the direct drainage basin at the current development state.

Chart 2 shows the phosphorus loading using the "most likely" loading from both the direct drainage basin and the septic systems. In general terms, the septic system loads are approximately 2% of the total phosphorus projected to enter Greater Bass Lake this year. This projection must be interpreted generally, as there is a very wide range in watershed sources loading described. In comparison to the previously reported total watershed phosphorus loading which was in the range of approximately 112 kg/year (1983 study), this study projects a total "most likely" loading of 122 kg/year. Using updated watershed, land use and phosphorus export coefficients suggests that there could be more phosphorus entering the lakes from the watershed, although this would require additional field verification to confirm.

DISCUSSION

The results of this study suggest the on-site septic systems currently serving the Greater Bass Lake & Lady Lake area are not a significant source of phosphorus to the lake. Although it appears they are a smaller source of phosphorus to the lake than other watershed inputs, they are contributing nutrients to the groundwater. The groundwater is the source of all the potable drinking water in the surrounding area. They are likely to grow in importance as: a) future development increases the number of on-site waste systems, b) the phosphorus retention capacity of the subsurface soils is likely to be reduced over time resulting in increased loading, and c) hydraulic failures of on-site systems with time coupled with a lack of available space to site new on-site waste systems.

Over time, increased development within the near-shore area of the lakes is projected to increase the amount of phosphorus which will be released from erosion runoff and lawn maintenance practices Both the total quantity of phosphorus released and the relative importance of this as a source of phosphorus to the lake will increase. A trend to more manicured lawns by District members will contribute a greater phosphorus load to the lake. Education of the members regarding the use of phosphate free lawn fertilizers will help a great deal to diminish this impact.

The availability of nutrients to the aquatic plant community in Greater Bass Lake is somewhat effected by the motorized activities that take place on the lake surface. Motorized water craft can have significant impact on sensitive aquatic ecosystems (Asplund, 1999). Motorized traffic can *stir up sediments...and contribute to nuisance algae blooms*, Minnesota Lakes Magazine, August, 1999. Resuspension of nutrients in the sediment can make them available for plant uptake and use. This is especially important in the littoral zone, the near-shore, shallow water habitat of the lake. Because of the steep angle of the jet ski during acceleration, this activity presumably could produce more turbulence and reintroducing nutrients to the lake system more than other activities. It is important to remember that the slow no wake restriction of all motorized traffic should not only be enforced in the area near the shoreline but also in those areas of the lake that are shallower than 5 feet. In Greater Bass Lake there are areas, especially in the northern end of the lake, where the distance between the shorelines is narrow and the water is shallow. These areas are most sensitive to the resuspension of nutrients created by propeller and jet ski turbulence.

A related topic to the discussion of a nutrient budget for the Greater Bass Lake District is the aquatic plant identification project. Over the years a number of plant identification lists have been generated by various individuals. It is important to periodically monitor the lake for invasive species and keep track of the plant community. Appendix B of this report contains an identification list and map of the aquatic plants in Greater Bass and Lady Lake.

Table 1

Date: 10/18/00 Scenario: 1

Lake Id: Greater Bass Lake

Watershed Id: Direct Basin

Hydrologic and Morphometric Data

Tributary Drainage Area: 460.5 acre
Total Unit Runoff: 12.00 in.
Annual Runoff Volume: 460.5 acre-ft
Lake Surface Area <As>: 258.0 acre
Lake Volume <V>: 2686.0 acre-ft
Lake Mean Depth <z>: 10.4 ft
Precipitation - Evaporation: 5.3 in.
Hydraulic Loading: 1573.1 acre-ft/year
Areal Water Load <qs>: 6.1 ft/year
Lake Flushing Rate <p>: 0.59 1/year
Water Residence Time: 1.71 year
Observed spring overturn total phosphorus (SPO): 0.0 mg/m^3
Observed growing season mean phosphorus (GSM): 0.0 mg/m^3
% Phosphorus Reduction: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ---		
-1								
Row Crop AG	0.0	0.50	1.50	3.00	0.0	0	0	0
Mixed AG	0.0	0.30	1.00	1.40	0.0	0	0	0
Pasture/Grass	98.9	0.10	0.20	0.30	6.6	4	8	12
HD Urban	0.0	1.00	1.30	2.00	0.0	0	0	0
MD Urban	136.2	0.28	0.28	0.28	12.7	15	15	15
Rural Residential	0.0	0.05	0.10	0.25	0.0	0	0	0
Wetlands	31.7	0.10	0.10	0.10	1.1	1	1	1
Forest	193.7	0.05	0.09	0.18	5.8	4	7	14
	0.0	0.00	0.00	0.00	0.0	0	0	0
	0.0	0.00	0.00	0.00	0.0	0	0	0
	0.0	0.00	0.00	0.00	0.0	0	0	0
	0.0	0.00	0.00	0.00	0.0	0	0	0
	0.0	0.00	0.00	0.00	0.0	0	0	0
	0.0	0.00	0.00	0.00	0.0	0	0	0
Lake Surface	258.0	0.10	0.27	1.00	23.1	10	28	104
						34	59	146

POINT SOURCE DATA

Point Sources	Water Load (m^3/year)	Low (kg/year)	Most Likely (kg/year)	High (kg/year)	Loading %
Stream Inflow	1231876.0	59.8	59.8	59.8	49.1
	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0

SEPTIC TANK DATA

Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	210.0				
% Phosphorous Retained by Soil		98.0	98.0	98.0	
Septic Tank Loading (kg/year)		1.26	2.10	3.36	1.7

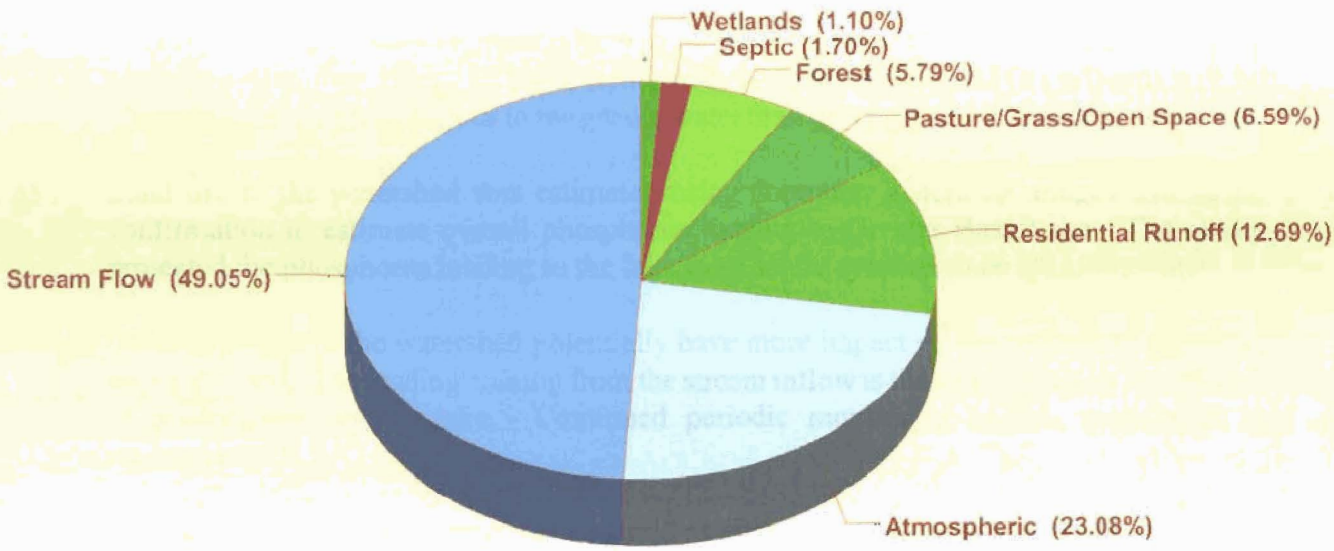
TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	211.9	268.7	463.9	100.0
Total Loading (kg)	96.1	121.9	210.4	100.0
Areal Loading (lb/ac-year)	0.82	1.04	1.80	
Areal Loading (mg/m^2-year)	92.08	116.72	201.52	

Chart 2

Percent Phosphorous Contribution

Greater Bass Lake, Landglade County



CONCLUSIONS

1) 60% of the septic systems evaluated did not meet the code requirements for the separation of unsaturated soils beneath the drainfield. 57% of the drainfields/seepage pits are in the 0 to 5' range above groundwater. 63% of the systems are at least 20 years old.

2) The sandy soils observed during the septic system evaluation are not likely to retain all of the phosphorus which is released to the drainfield. Although it is difficult to project phosphorus leaching to the groundwater, studies have shown that the retention of phosphorous in sandy soils decreases over time. Older systems with poor distribution of the effluent will be discharging more phosphorous to the groundwater than new properly designed systems will.

3) Land use in the watershed was estimated using computer generated images and visual confirmation to estimate overall phosphorus loading to Greater Bass Lake. The model projected the phosphorus loading to the lake from septic systems to be 2% of the total.

4) Other activities in the watershed potentially have more impact on the nutrient budget than septic systems. The loading coming from the stream inflow is the single greatest contributor of phosphorous to the lake. Continued periodic monitoring of this contributor is recommended.

5) It is expected that as properties develop and as more land owners use lawn fertilizers, the impact of the residential component of the nutrient budget will increase. Use of Phosphate free lawn amendments should help reduce the impact of this source. The District is should encourage the use of these products which are available through local distributors.

6) Motorized vehicle use in shallow areas on the lake may not contribute to the amount of Phosphorous in the lake, but this activity can cause a resuspension of the lake bottom sediment and the potential release of bound up Phosphorous back into the lake system. Education of the District members regarding the impact of this activity in shallow and near-shore areas is recommended. Strict enforcement of the slow no-wake rules, especially for jet skis, will help with this potential source of nutrients. The District should also consider adding slow no-wake zones in all of the shallower areas of the lake regardless of distance from the nearest shoreline.

RECOMMENDATIONS

We strongly urge the district board members not to become complacent regarding the water quality of Greater Bass and Lady lake. Although presently the water quality is good and nutrient levels are not highly elevated, changes in the nutrient loading budget can occur over time. With that in mind, we recommend the following for your consideration:

- institute a long-term monitoring program to track water quality
- provide education to the District members about low phosphate lawn fertilizer
- insist on adequate erosion control measures at all construction sites
- consider outright purchase or obtaining development rights of lands in the direct drainage basin which will offer "buffer" zones to the lake
- reassess areas of the lake for additional slow no-wake zones

WORKS CITED

Lindemann, James, Byron Shaw, and Brett McKinney 1996. An Evaluation of the Impacts Septic Systems Have on the Groundwater and Surface Water Quality of Minoqua Lake, Wisconsin. College of Natural Resources, University of Wisconsin - Stevens Point.

Nichols, D. Jeffery, Duane C. Wolf, Mark A. Gross, and E. Moye Rutledge, 1997. Renovation of Septic Effluent in a Stratified Sand Filter. Site Characterization and Design of On-Site Septic Systems, ASTM STP 1324. M.S. Bedinger, J.S. Fleming, and A.I. Johnson. Eds., American Society for Testing and Materials.

Postma, Frank B., Arthur J. Gold, and George W. Loomis 1992. Nutrient and Microbial Movement from Seasonally-Used Septic Systems. J. Environ. Health. 55:5-10.

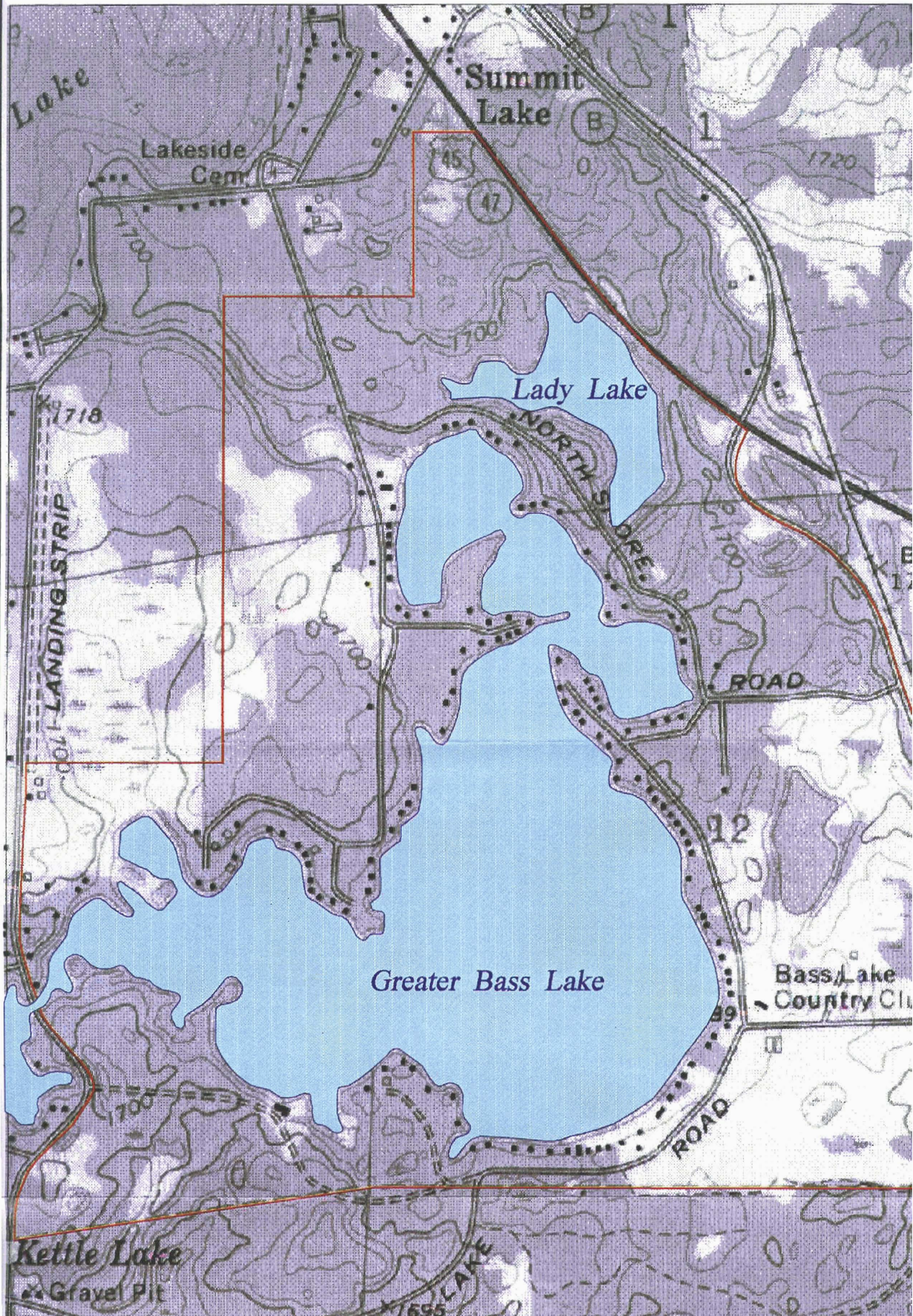
Reneau, R.B. Jr., C. Hagedorn, and M.J. Degen 1989. Fate and Transport of Biological and Inorganic Contaminants from On-Site Disposal of Domestic Wastewater. J. Environ. Qual., 18:135-143.

Shaw, Byron. Quote from "The Lakeland Times, Oct. 23, 1998". UW-Extension. University of Wisconsin- Stevens Point.

VanRyswyk, William S. 1997. An Evaluation of Conventional Septic Systems and Their Impact on Groundwater Quality in the Central Wisconsin Sand Plain. College of Natural Resources. University of Wisconsin - Stevens Point.

Asplund, Tom 1999. Too many boats, or not enough lake? Minnesota Lakes Magazine.

GREATER BASS LAKE
LANGLADE COUNTY, WISCONSIN
DISTRICT BOUNDARY MAP
FIGURE #1



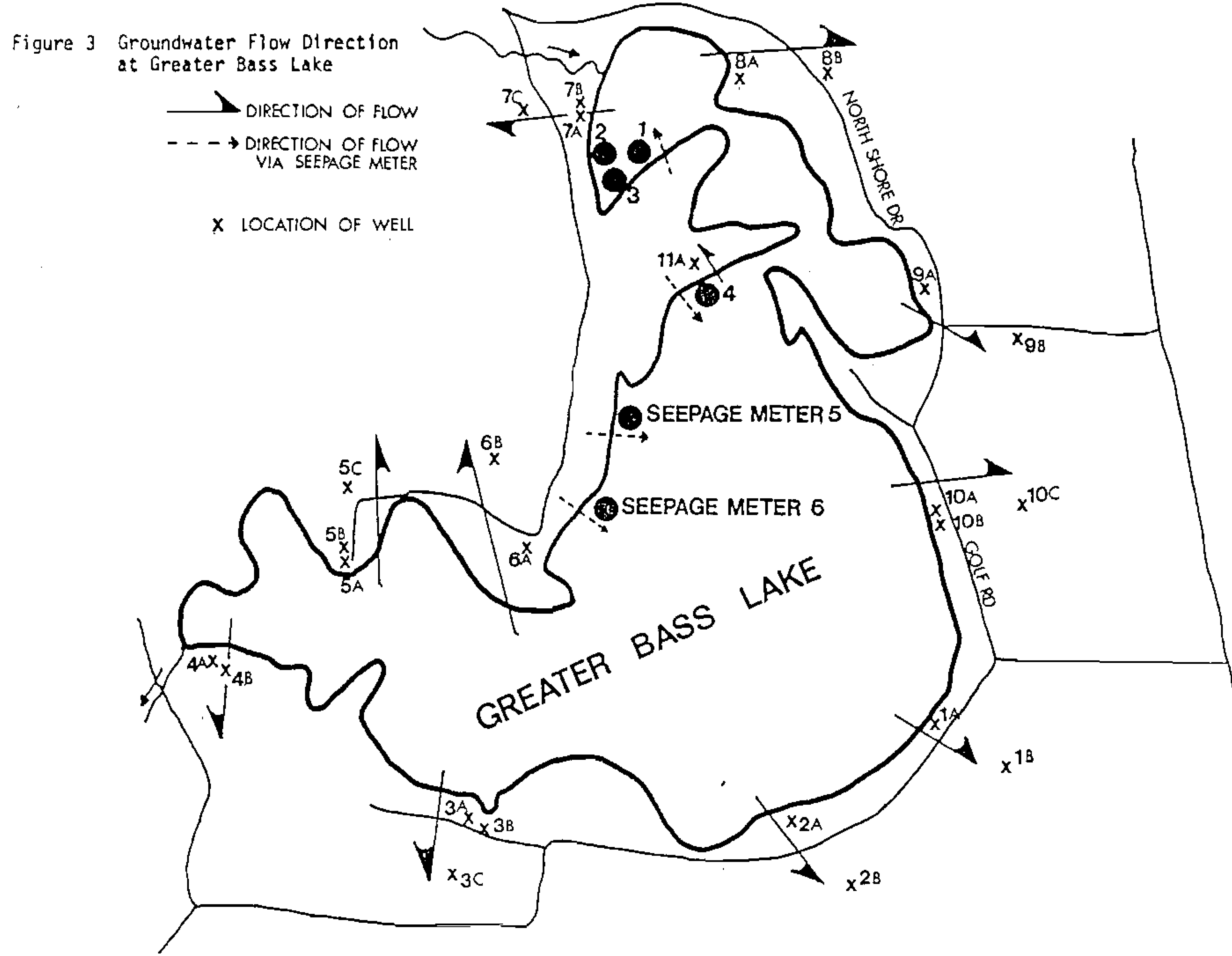
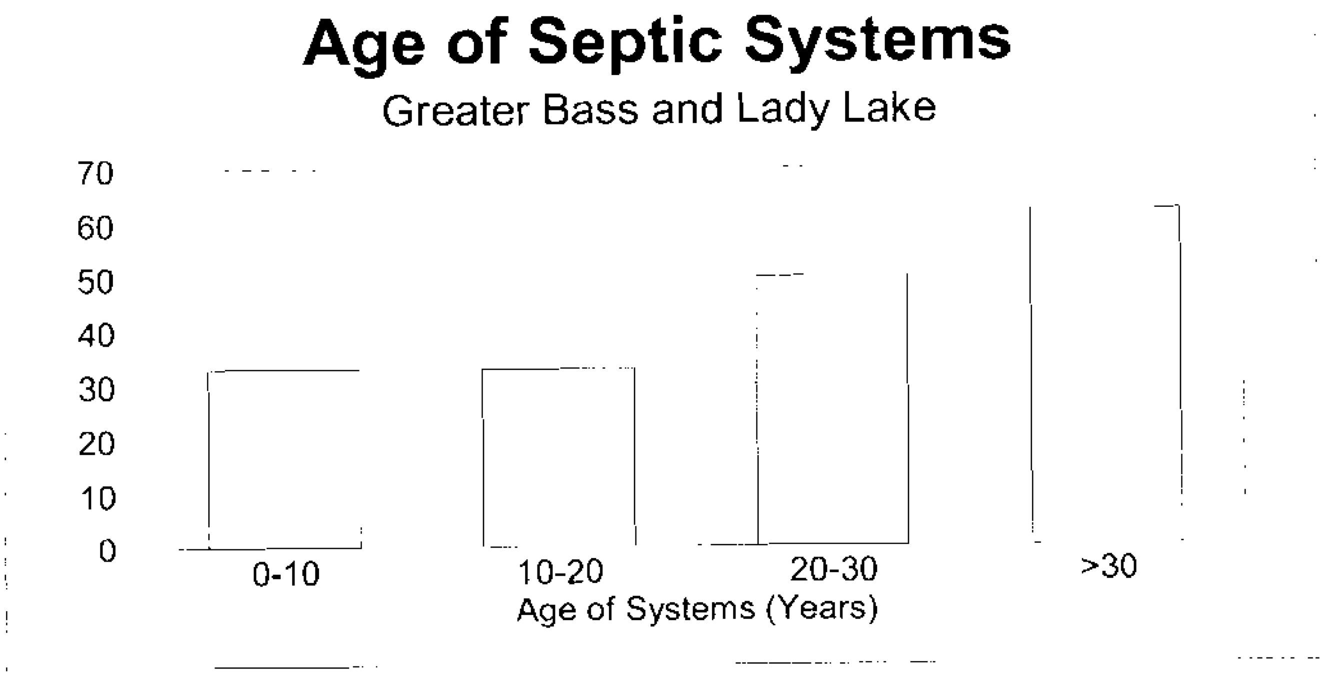


FIGURE 4

From: 1983 DNR Feasibility Study

Figure 5



Age of Septic Systems
Greater Bass and Lady Lake
70
60
50
40
30
20
10
0
0-10
10-20
20-30
>30
Age of Systems (Years)

Figure 6

ELEVATION DIFFERENCE BETWEEN SYSTEM AND LAKESHORE

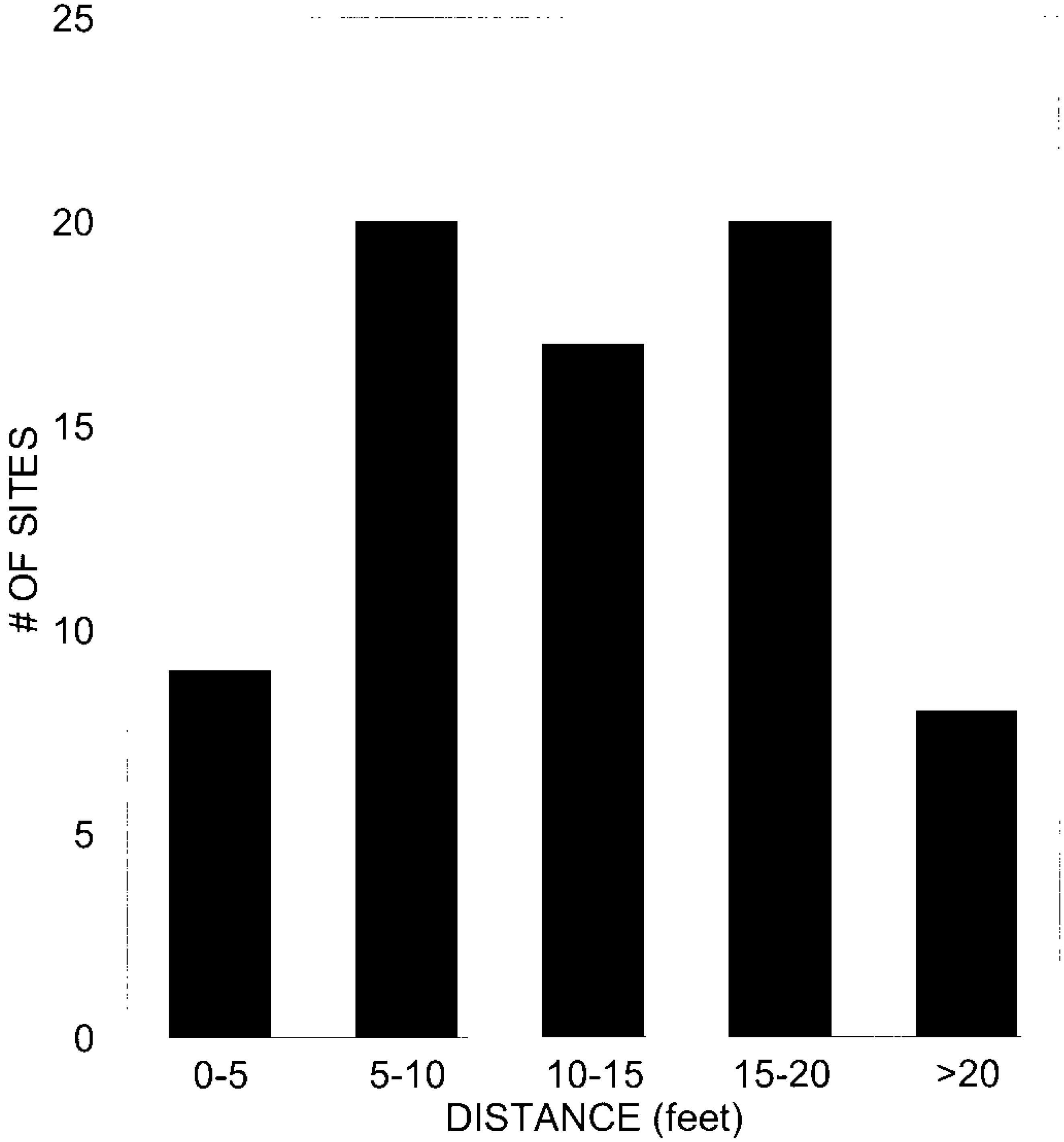


Figure 7

Elevation Difference Between System Groundwater

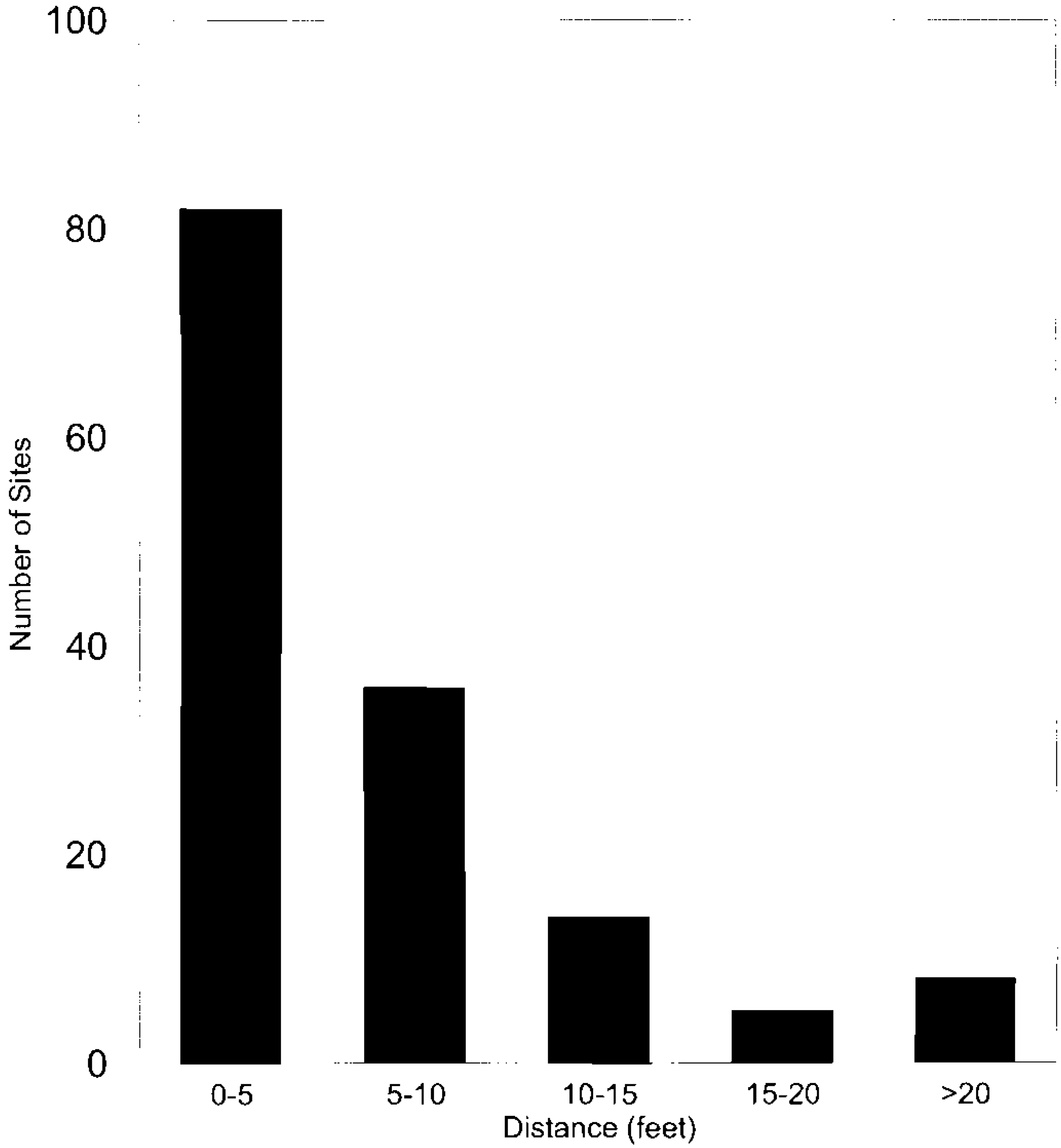
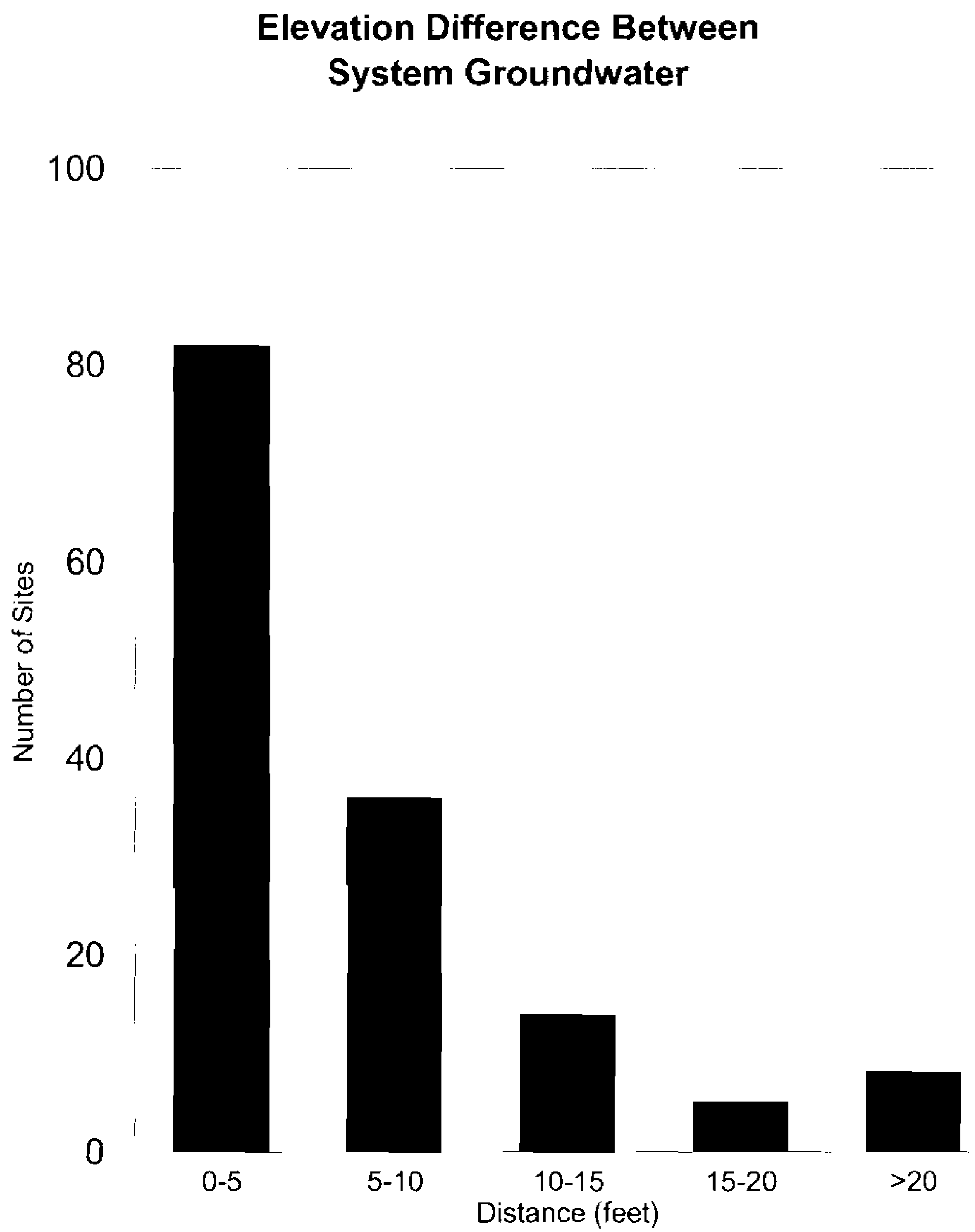


Figure 7



Elevation Difference Between
System Groundwater
100
80
60
40
20
0
Number of Sites
0-5
5-10
10-15
15-20
>20
Distance (feet)

AQUATIC PLANT IDENTIFICATION

MSA conducted an aquatic plant survey on August 19 and 20, 2000. As many as thirty-six aquatic plants have been identified in previous surveys in 1932, 1980 and in July 2000. The purpose of this assessment is to compliment the survey data and depict locations of the more common aquatic vegetation species. The most prevalent species were evaluated for mapping purposes and twenty-four species were selected and shown in the inserted map on the next page. One additional species was selected to map because it is considered a threatened species by the WDNR.

Commonly Found Aquatic Plants in Greater Bass Lake

- Arrowhead species (sp.)
- purple Bladderwort
- water Bullrush
- Burweed sp.
- water Knotweed
- Lily sp.
- Milfoil sp.
- Pondweed sp.
- common Rush
- lake Quillwort
- water shield
- waterwort

The vegetation in Bass Lake is dominated by purple bladderwort *(Uticularia purpurea)*. These species thrive in low pH lakes, such as Bass Lake, and are generally along more placid shorelines. Although purple bladderwort is the most common species, it is considered rare in Wisconsin.

The threatened species mentioned above is algal-leaved pondweed *(Potamogeton confervoides)* and is shown in Figure 8A. In the survey conducted in 1980, it was listed as a common aquatic species in Bass Lake; although, there were very limited sitings this year. Illustrations of nine of the more common plants are contained in Appendix B. To date, all species identified have been native to Wisconsin.

AQUATIC PLANT-SPECIES LOCATIONS AND DENSITIES

Plant Depth and Observed Densities

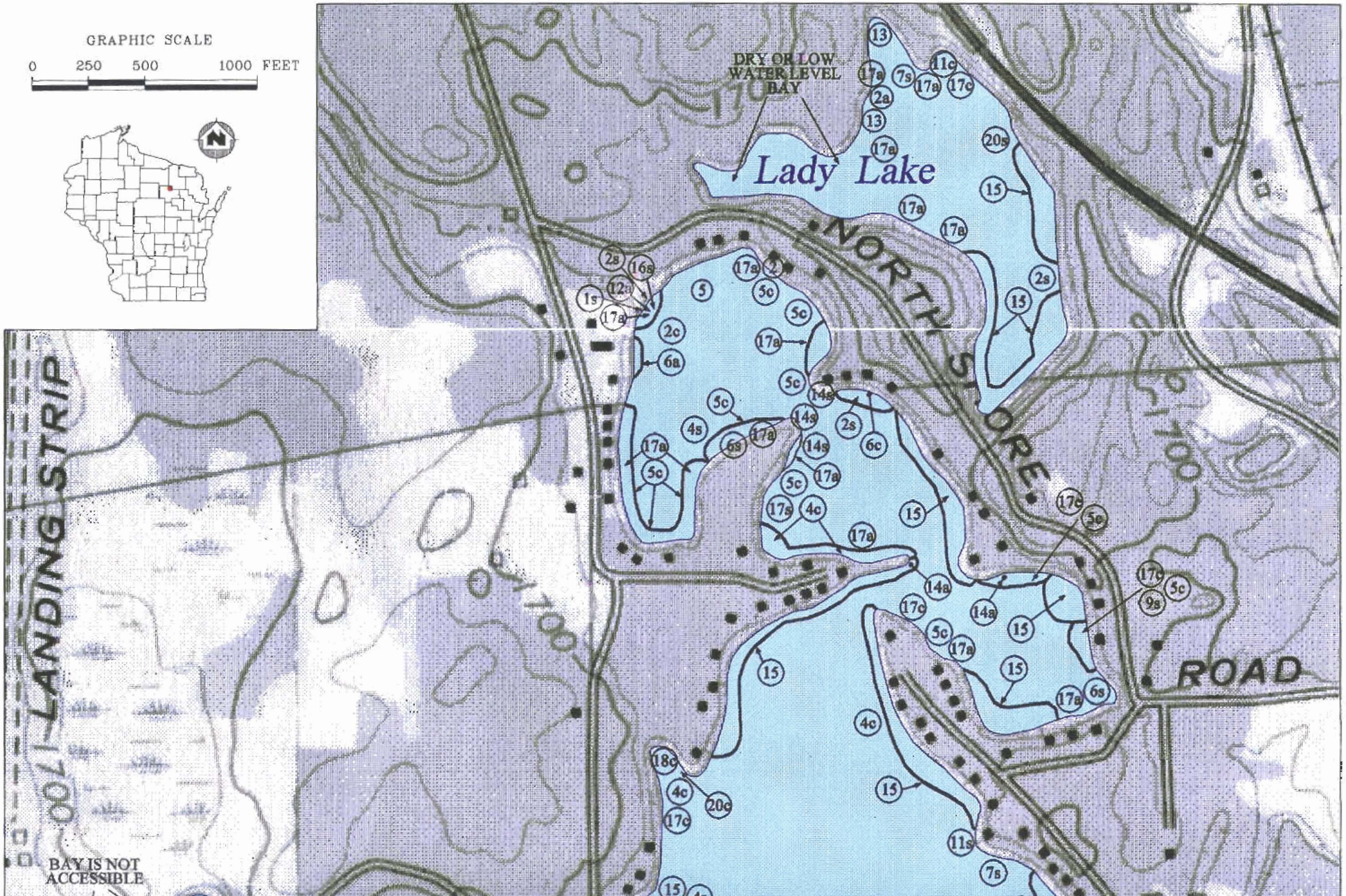
The maximum depth of aquatic plant growth was generally 12 ft. deep. The stream inlet area has a rich diversity of aquatic plants. Much of the shoreline along the east side has very sparse vegetative growth which primarily has a sand and gravel bottom.

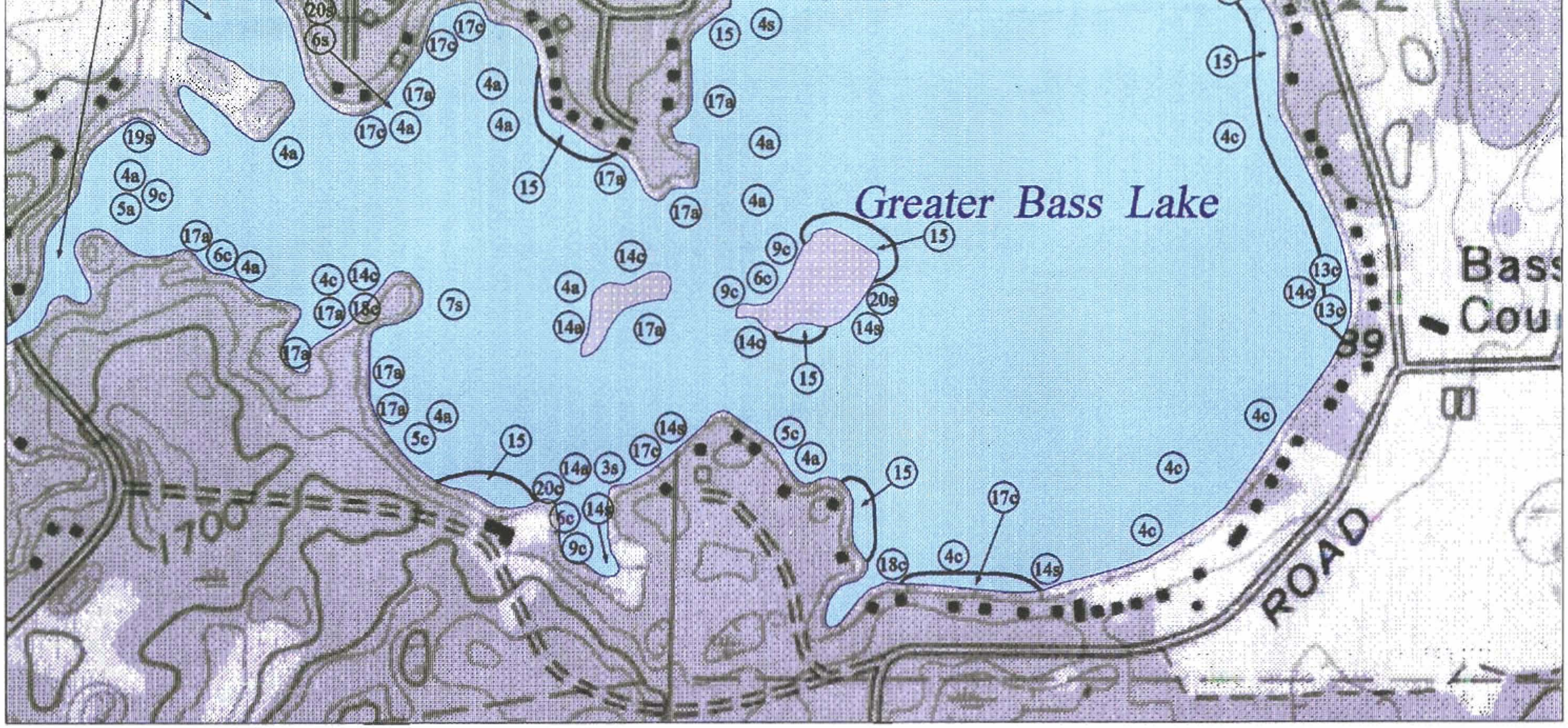
Plant Species Densities

Purple bladderwort (Figure 1A) is the dominant species in the main body of Bass Lake and millfoil species dominate the upper portion of the lake. Water shield (Figure 2A) is the dominant species in Lady Lake.

Both quillwort and water shield are usually found in soft water lakes such as Bass Lake. In Bass Lake quillwort is an abundant species on certain shoreline points that have shallow water and a gravel bottom. Water shield is abundant in protected bays that have a highly organic bottom. Waterwort is very small and looks like plant seedlings. These were more noticeable in calm areas with sandy bottoms.

GREATER BASS LAKE
LANGLADE COUNTY, WISCONSIN
AQUATIC PLANT MAP





	COMMON NAME	SCIENTIFIC NAME
1	common & arum-leaved arrowheads	Sagittaria latifolia Sagittaria cuneata
2	water bullrush	Scripus sp.
3	narrow-leaf & floating leaf burweed	Sparganium angustifolium Sparganium fluctuans
4	purple bladderwort,	Utricularia purpurea
5	Dwarf water milfoil & farwell's milfoil	Myriophyllum tenellum Myriophyllum farwellii
6	fragrant water lily	Nymphaea odorata
7	yellow pond lily	Nuphar advena
8	fern pondweed	Potamogeton robbinsii
9	floating leaf pondweed, oake's pondweed, & ribbon-leaf pondweed	Potamogeton natans Potamogeton oakesianus Potamogeton epihydrus
10	pipewort	Eriocaulon aquaticum

	COMMON NAME	SCIENTIFIC NAME
11	common rush	Juncus effusus
12	creeping spike rush	Eleocharis palustris
13	needle spike rush	Eleocharis acicularis
14	lake quillwort	Isoetes sp.
15	very sparse vegetation	
16	water arum	Calla palustris
17	water shield	Brasenia schreberi
18	waterwort	Elatine minima
19	algae-leafed pondweed	Potamogeton confervoides
20	water knotweed	Polygonum amphibium

AQUATIC PLANT DENSITIES

a	ABUNDANT
c	COMMON
S	SPARSE

MSA PROFESSIONAL SERVICES
TRANSPORTATION • MUNICIPAL • REMEDIATION
DEVELOPMENT • ENVIRONMENTAL

DRAFTED: LSR
PLOTTED: 10/19/00
PROJECT:
FILE: G PROJECTS MAP WI MISC BASS_LAKE bass_weed_map