FIGURE 2

GLACIAL DEPOSITS IN DOUGLAS COUNTY

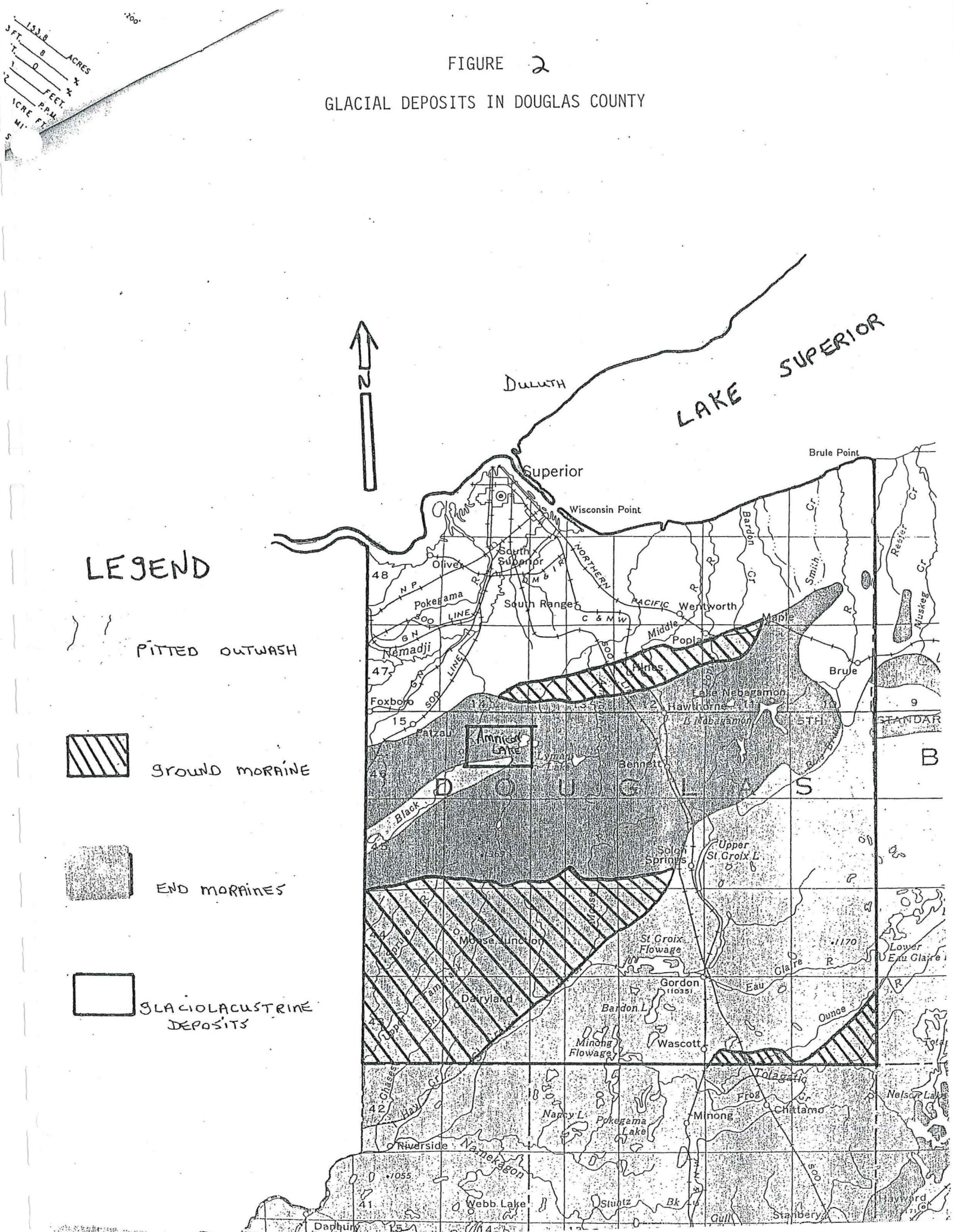
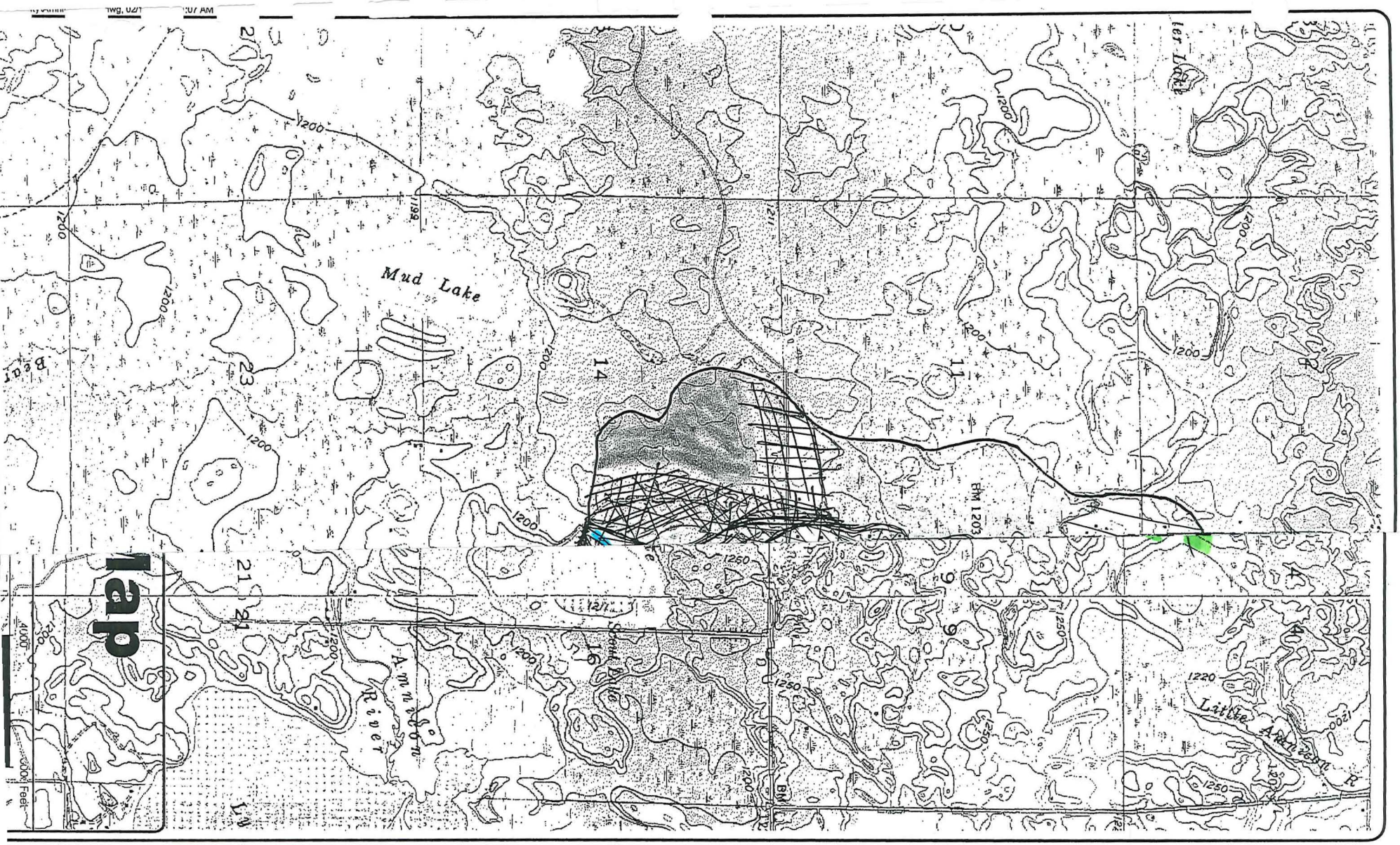


Figure 2

Regional Glacial Geology Map



Map

Thatcher
ENGINEERS • SCIENTISTS • ARCHITECTS • PLANNERS

FIGURE: 1

PROJECT TITLE: Amnicon/Dowling
DRAWING TITLE: Site Map
PROJECT LOCATION: Amnicon/Dowling, WI
LEAK #:
SCALE:
DRAWN BY: TOM

Figure 1

General Location/Watershed Map

Another project we recommend is to develop a prevention and control strategy for alien species near both lakes. For instance, purple loosestrife was noted along Dowling. There would be a benefit to removing or controlling this plant, in order to allow native species to again take hold and flourish.

7.3 Lake Monitoring

Both Amnicon and Dowling Lakes are high quality resources with excellent fisheries. There is some indication that any significant increase in the trophic level of both lakes may be manifested in the critical decrease of fisheries habitat in late winter. Specifically, low dissolved oxygen levels can reduce suitable living space to a few feet in the epilimnion during late winter. Therefore, we recommend dissolved oxygen testing in December, January, February and March to check for the possibility of winterkill. Dissolved oxygen conditions should be correlated with ice-on days and snow cover.

In addition, it is important to monitor both lakes during the growing season (May-September) to check the conditions of the lake. Dissolved oxygen and temperature profiles should be collected at the "deep hole" of both lakes at least once a month during the growing season. Secchi disk readings should also be taken at the same time.

The Self-Help Monitoring Program through the Wisconsin Lakes Partnership of the WDNR was utilized in Dowling Lake in 2001 and 2002. No monitoring records from the program were found for Amnicon at least back to 1995. In our opinion, the lake monitoring efforts need to be reenergized, so if the lake conditions are noticeably improving due to BMP's or lake projects, this can be observed. Similarly if the condition of the lakes is noticeably changing, the WDNR will be notified, so restorative measures may be taken.

Buffer zones that allow the growth of trees, shrubs, and grasses also help to prevent erosion from wave and ice action that can occur, which is responsible for the destruction of important spawning and rearing habitat for fish species. Rip-rapping of shoreline areas is also discouraged unless native plants are planted along with the rip-rap, because of its similar nature to be detrimental to habitat important for spawning and rearing of fish species, through the wave action it usually generates along the shorelines. Buffer zones also enhance the appearance of the lakeshore by giving it a more natural profile. It is also recommended that home owners avoid activities such as excessive fertilization of lawns, clearing shoreline areas of aquatic plants to make "swimming beaches", dumping raked leaves or lawn clippings into the lake, high speed boating in shallow lake areas, and other similar activities. We recommend that the Lake District implement an information and education effort to advise residents of land use activities that could contribute nutrients to the lake system. Dumping leaves, ashes, animal waste, lawn clippings, excessive lawn fertilization, etc. are examples of practices that should be discouraged.

We also recommend that lake shore residents have their soil tested, so they do not use too much fertilizer. We recommend using phosphorus-free-fertilizer, the one with an "O" in the middle for the NPK (nitrogen-phosphorus-potassium) ratio.

We also recommend inspecting and repairing septic systems. Many individual septic systems are not working properly, or are improperly connected to tile lines. Maintain systems with periodic pumping and good use practices.

7.2 Recommended Lake Projects

Below are lake projects that can be completed to improve the lake quality on both lakes.

7.2.1 Shore Protection and Habitat Enhancement

In the spring of 2002 work was done to the shoreline of Amnicon on the west part of the north shore, adjacent to Tri-Lakes Road. The work was done by Ashland, Bayfield, Douglas and Iron (ABDI) County Land Conservation Department. The installation of large rock, rip-rap, fill, geotextile liner and native plants were done in an effort to reduce erosion of shoreline next to the road to protect the shoreline and increase habitat for animals. The plan for this work was designed by the USDA, Natural Resources Conservation Service (NRCS). This project accomplished two goals, reducing sediment loading into the lake and protecting walleye spawning area. Essentially the north shore from the Campground to Finn Point on the east is the preferred walleye spawning area on Amnicon Lake. See Appendix 12 for a map showing the preferred walleye spawning areas on Amnicon Lake.

We recommend a similar project as the above project for areas within the rest of the walleye spawning area on Amnicon Lake. In addition, in this same area we recommend that lakeshore owners "disconnect impervious surfaces", either driveways, manicured lawns, or roads, to the lake. This can be accomplished be redirecting stormwater to vegetated areas or possibly installing impervious "green" driveways.

Before considering dredging or alum addition, the sediment should also be analyzed at the surface and at depth to determine the pre-settlement (approximately 150 years ago) phosphorus conditions of the water column. This could be accomplished by collecting and analyzing sediment cores, specifically looking at the diatom community, which would give you the phosphorus concentrations in the water column at that time. It should also be possible to determine the accumulation rate in the lake(s), specifically the sedimentation rate and the soil erosion rate. Once this is completed, the pre-settlement conditions will be known, so we will know how good we can expect the lake(s) to get.

If it appears Alum addition would be effective after testing is completed, it could be done say once every five years, or perhaps the dosing could be increased to three times in five years. This could all be determined through a feasibility study. Regarding cost, a general rule of thumb for alum treatment is $1000 per lake acre. So for Dowling Lake, the approximate cost would be $154,000.

7. Lake Project Ideas for Protecting Both Lakes

The work performed for this project has given us a snapshot of lake conditions in 2003 and 2004. Compared to the last 25 years, Amnicon has remained stable, barely mesotrophic to eutrophic. Dowling has gotten progressively worse over the same time period, remaining eutrophic. The stage of eutrophication of both lakes is at a level where the possibility exists for significant water quality problems in the future. Phosphorus is a critical nutrient in the eutophication of the lakes and all available measures should be employed to reduce or eliminate all controllable sources of phosphorus to both lakes. The following details how both lakes can be protected. The sections are broken up into three sections: Best Management Practices, Recommended Lake Projects and Lake Monitoring.

7.1 Best Management Practices (BMP's)

This study has shown that the main contributor of phosphorus load is from the watershed, not from human activities. However, the education of homeowners around the lake with respect to septic system and lawn maintenance and shoreline protection is crucial. This is because near shore activities are of greater significance in term of phosphorus loading due to the relatively natural undeveloped condition of the watershed. Minimizing the phosphorus loading that we can control will prevent the lakes from getting worse.

This is especially true considering the extremely high degree of development surrounding both Amnicon and Dowling Lakes. It is encouraged that land owners develop and maintain vegetative, shoreline buffer zones of 20 feet or more if possible. Buffer zones help reduce and interrupt nutrient runoff from associated yards and groundwater that would otherwise enter the lake, thus improving water quality and helping reduce the number of large algae blooms (which are common occurrences on Dowling Lake).

Disturbing the thriving Macrophyte vegetation would allow invasive plants to more readily establish themselves along with increasing the amount of available phosphorous that contributes to algae blooms. In 1993, Dan Ryan from the Wisconsin DNR stated, "Disturbance of the Macrophyte stands should be kept to an absolute minimum." This is still true given the high amount of phosphorus in the water and in the sediment. Sediment samples were collected in Amnicon and Dowling lakes in 2003. Five sediment samples from each lake were analyzed for lead, mercury and oil and grease. (See Appendix 7) Based on the results, the oil and grease levels are fairly high (ranged from 4,000 to 6,000 ppm). This oil and grease could be due to historic outboard motor use, runoff from roads or possibly other sources. This oil and grease level should be considered when contemplating dredging. High levels of lead, mercury and petroleum may affect the cost of removal and disposal of the dredged sediments and could be cost prohibitive. The approximate cost to remove the bottom 1 foot of Dowling would be $1.5 million and to remove 3 feet from Dowling would be $4.5 million. This is using a rate of $6/cubic yard, which is at the low end of the price range.

Amnicon and Dowling Lakes are designated by the Wisconsin DNR as a Priority navigable waterway, and as an Area of Special Natural Resource Interest (ASNRI). Both Lakes are an ANSRI because of the naturally reproducing Muskellunge and Walleye, and Amnicon also has natural areas of Wild Rice. Dredging could endanger these areas of special interest. An Exemption would have to be applied for because of the ANSRI designation. A WDNR permit as well as approval by the Corps of Engineers would also be required prior to dredging being allowed.

Given the nature of the fishery, the current type of vegetation and the danger of exotic plant species such as, Purple Loosestrife and Eurasian Water Milfoil, several additional factors need to be examined before dredging can be recommended. The factors include but are not limited to the likelihood that the WDNR permits would be issued for dredging, a study to determine the yearly sediment loading into the lakes and a study to investigate the nutrient and pollutant make up of the sediments to be dredged.

6.2 Alum Addition

The addition of Alum or Aluminum Sulfate can significantly reduce the total phosphorus level in a lake. Without getting into a discussion of the technical details of the chemical interactions that reduce the phosphorus level, suffice it to say Alum ties up or reduces available phosphorus in the sediments into the water column. There are several things to consider before recommending Alum addition. The type of phosphorus present in the sediments is more important then the density of the sediments. For instance, calcium-bound phosphorus is more inert than iron or Aluminum bond phosphorus. Therefore, iron-bound or Aluminum-bound phosphorus is more likely to be exchangeable than calcium-bound phosphorus. Amnicon and Dowling Lakes are fairly soft lakes (lots of calcium and magnesium in the water). Prior to adding Alum, the water and sediments should be tested to determine the exchangeable phosphorus in the sediments and the hardness, buffering capacity, alkalinity and ph of the water.

modeling performed, we estimate 42% of the loading in Dowling is from internal loading.

Therefore, it is logical that since limiting external loading to Dowling would not greatly change the water quality, we should evaluate in-lake solutions. Three possible restoration solutions were considered; Biomanipulation, Dredging and Alum Addition. Biomanipulation is adjusting the fish species composition in a lake as a restoration technique. After reviewing the fishery data and discussing both lakes with the DNR fish biologists, at this time biomanipulation does not make sense. Specifically, according to Cordell Manz, the pan fish population is relatively low in both lakes and the game fish population, especially bass is increasing. Since the typical biomanipulation strategy is to increase the predators and decrease the pan fish, biomanipulation probably would not work. At this time the DNR would not recommend adjusting the fish population in either lake. However, a comprehensive fish survey is scheduled for 2006 in Amnicon Lake. Once this work is completed, we recommend reviewing the data and reevaluate whether biomanipulation makes sense. Below is a discussion of the other two possible restoration solutions.

6.1 Dredging

Dredging is used to remove sediments, vegetation and debris from a water body. Dredging may be a solution to many problems a water body has, but may also have high costs, both monetary and biological. It is important to define the main reason for a dredging project when determining the feasibility of a project. The assumption made in this report is that the main reason to consider dredging is to develop defined channels for lake property owners to have lake access from their shoreline, but also as a possible means of improving the water quality.

Dredging can improve the ability to navigate waterways, provide deeper channels for fish in winter, and remove nutrients and plant life from the body of water. Removing sediments that are rich in nutrients may help reduce the amount of macrophyte vegetation and algae. Deeper water may also affect dissolved oxygen and water temperature positively. This is due to creating a larger epilimion layer at the beginning of winter, reducing the chance that the lake may become anoxic and causing winter fish kills. Approximately 42% of the loading to Dowling Lake is from internal loading. Based on our research, if 50% of the total loading is due to internal loading from sediments, there may be some benefit in dredging (assuming the underlying sediments are lower in phosphorus concentrations). If internal loading is less than 50% of the nutrient budget, dredging may be of limited value.

Dredging may not be a permanent solution for the lake access problem, and will most likely not be a long term solution for plant growth and available nutrients which contribute to the plant growth. Erosion from the surrounding area needs to be further examined to determine the rate of sedimentation to the lake because having to repeatedly dredge would not be cost effective. This is especially true since both lakes are considered drainage lakes.

As shown above in Scenario 2, by reducing all TP from human activity (surface runoff from medium density urban and rural and septic tanks), mesotrophic status can be attained. This is theoretically the maximum that can be accomplished by Best Management Practices (BMP's).

5.2 Dowling

We considered four TP loading scenarios for Dowling. In the first scenario we eliminated the surface runoff TP from medium density urban and rural residents (Scenario 1). Secondly we removed all septic tanks loading of TP in addition to removing MD urban and rural loading (Scenario 2). Thirdly we reduced the total external TP loading by 50% (Scenario 3). Finally we increased the total TP loading by 25% (Scenario 4). The table below summarizes the expected Wisconsin TSI's for TP, Chlorophyll a and Secchi Depth for all four scenarios:

Scenario	TSI-TP	TSI-Chlorophyll a	TSI-Secchi Depth
1	54	53	55
2	53	52	54
3	50	50	52
4	57	55	57

Table 11

As shown above, even by reducing all TP loading by 50% in Scenario 3, Dowling lake is still only on the border of becoming Mesotrophic. This modeling indicates that employing BMP's alone would not be enough to bring Dowling Lake to Mesotrophic status.

As discussed in Section 3.3.3, significant internal loading is suspected in Dowling Lake. Based on WiLMS Modeling, we estimate 65 kg of the total phosphorus load of 155.4 kg (or 42%) comes from internal loading. If the external phosphorus loading to Dowling is reduced (as discussed above), phosphorus release from the sediment could have a larger effect on phosphorus concentration. If external phosphorus loading was reduced, phosphorus release from sediments would not be expected to decrease immediately. Therefore, the internal loading would be higher (relative to external loading) for several years and may result in higher in-lake phosphorus concentrations then expected given the lower external phosphorus loading.

6. Feasibility Studies

As summarized in the above section, reducing or eliminating all phosphorus loading from human activity (septic tank loading, surface water runoff from lawns and impervious surfaces) would definitely increase water quality in both lakes. Per scenario 2 for Amnicon Lake, this could theoretically bring Amnicon to Mesotrophic Status. However, eliminating all phosphorus loading due to human activity in Dowling would still leave the lake eutrophic (scenario 2). In fact reducing all external loading to Dowling by 50% would still leave Dowling classified as eutrophic (scenario 3). In addition, based on the

Table 8 Table 9

5. Loading Reduction Feasibility Analysis

Both Amnicon and Dowling Lakes are generally located in the Northern Lakes and Forests Ecoregion, which in general consists of sandy glacial outwash deposits. See Appendix 10 for information regarding Ecoregions. Based on additional research of ecoregions and considering that the soils in the area are generally silt and clay, not sand, we used the "Laurentian Mixed Forest Province" instead of the Northern Lakes and Forests in our models. The main difference between the two is the estimated total phosphorus (TP) inflow. The TP inflow for Northern Lakes and Forests Ecoregion is 28 ug/L and for Laurentian Mixed Forest Province Ecoregion the estimated inflow if 83 ug/L. As stated previously, both lakes are currently classified as eutrophic (although Amnicon has higher water quality than Dowling).

Based on WiLMS models, Minnesota Lake Eutrophication Analysis Procedure (MnLEAP) and ecoregion values for the area, the predicted and observed TP values for Amnicon are 28 and 20 respectively. The predicted and observed TP values for Dowling are 33 and 39 respectively. The observed Chlorophyll a and Secchi depth are slightly worse than predicted in Amnicon and much worse than predicted in Dowling. See Appendix 11 for WiLMS and MnLeap Modeling data for both lakes

To determine how the response in water quality (TP, Chlorophyll a and Secchi Depth) varies with respect to changes in loading, we utilized WiLMS to simulate water quality conditions if TP loading was reduced and then what would happen if TP loading was increased. Each of the three water quality indices (TP, Chlorophyll a and Secchi Depth) were correlated to the Wisconsin Trophic State Index (TSI). A Wisconsin TSI of under 50 was considered mesotrophic and 50 and over was considered eutrophic.

5.1 Amnicon

We considered three TP loading scenarios for Amnicon. In the first scenario we removed the surface runoff for the residents around the lake (medium density urban) and the rural part of the watershed (rural) (Scenario 1). In the second scenario we removed all septic tank loading of TP in addition to removing MD Urban and Rural loading (Scenario 2). In the third scenario we increased the total TP loading by 25% (Scenario 3). The table below summarizes the expected Wisconsin TSI's for TP, Chlorophyll a and Secchi Depth for all three scenarios:

Scenario	TSI-TP	TSI-Chlorophyll a	TSI-Secchi Depth
1	50	50	52
2	49	49	50
3	53	52	52

Table 10

Amnicon is not known as a pan fish lake, though it has adequate population. Crappies, bluegill, and perch are commonly found, though few are of adequate size to harvest. Crappies provide more of an opportunity than the bluegill or perch though both population have a higher average size than Dowling. Amnicon's catch per effort/ catch per hour is said to be lower than most lakes in the area as far as pan fish are concerned

Amnicon Panfish	1999	1992
Black Crappie	9.81	4.85
Bluegill	10.77	11.56
Yellow Perch	35.19	27.44

Table 6

Dowling is not considered a lake with a high density of pan fish. While the numbers in fish per hour greatly increased over the 1991 survey, the numbers were still below regional averages for the numbers being caught and do not seem to have size that is desirable for harvest. The black crappie population has also increased and has a slightly better size than the bluegills making them better for harvest, but still not in abundant numbers. There is also a growing population of yellow perch, but again not in a size that would be desirable to harvest.

Dowling Panfish	1991	2003
Black Crappie	6.00/hr	31.03/hr
Bluegill	66.00/hr	100/hr
Yellow Perch	3.42/hr	13.64/hr

Table 7

4.6.3 Bait Fish

The bait fish population in Amnicon Lake seems to be holding steady when looking at the white sucker population. The white sucker fish per hour total in 1992 was 5.68, but in the spring of 1999 was 6.71. This indicates there may have been a slight increase in the population, but could also be holding steady with fish slightly more active in the 1999. The common shiner population never was seen significantly high, however fyke netting is not an accurate method for documenting the bait fish population due to the smaller size of most bait fish.

The bait fish population is also increasing in Dowling judging by the comparison of the recent survey compared a much older survey with a similar method. The white sucker fish per hour total in 1977 was 0.44, but in the fall of 2003 was more than eight fish per hour. In 1977 the common shiner was seen in the shocking at a rate of 0.44 fish per hour and in 2003 was found at the rate of 3.45 fish per hour. Seine netting is the best method to count bait fish, but there was insufficient historical data to make a good comparison.

Amnicon Bait Fish	1999	1992
White Sucker	6.71	5.68
Common Shiner	0.16	0.62

Dowling Bait Fish	1977	2003
White Sucker	0.44/hr	8.62/hr
Common Shiner	0.44/hr	3.45/hr

Thatcher Engineering, Inc.
3055 Old Highway 8, Suite 103
Minneapolis, MN 55418
Phone: 612-781-2188
Fax: 612-781-2241

May 10, 2006

Mr. Danny J. Ryan
Wisconsin DNR
Northern Region Headquarters
810 West Maple Street
Spooner, WI 54801

RE: Final Copies of "2003-2004 Wisconsin DNR Lake Management Planning Grant Report for Amnicon and Dowling Lakes, Douglas County Wisconsin, May 2006"
Wisconsin DNR Large-Scale Lake Management Grants LPL-883-03 and LPL 884-03

Dear Mr. Ryan:

Enclosed for your use are two copies of the above referenced Report.

If you have any questions, please feel free to give me a call.

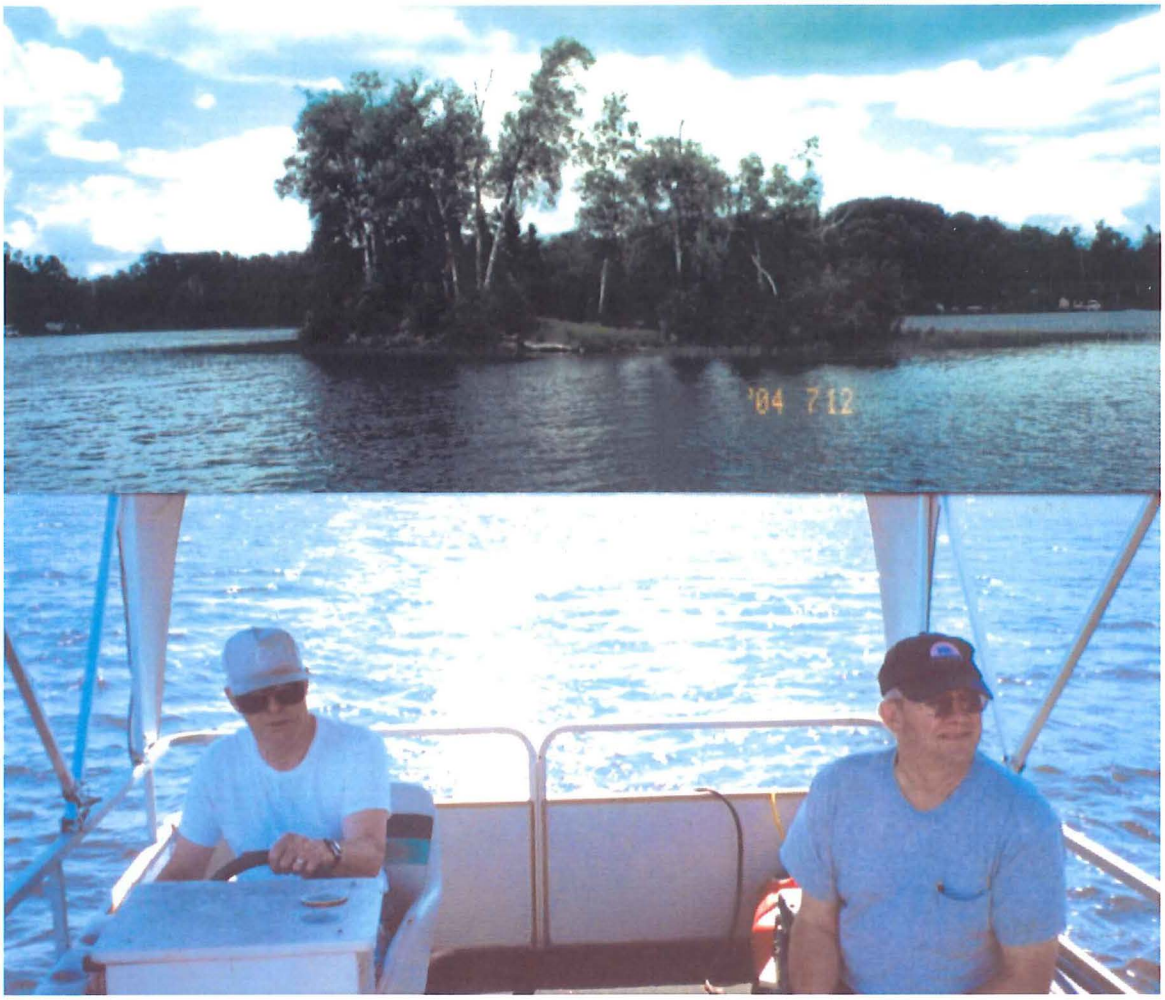
Sincerely,

Dennis P. McComas, P.G.
Vice President
Thatcher Engineering, Inc.

DPM:

Enclosures

Cc: Mr. Dennis Corbin (6 Copies)



2003 – 2004 Wisconsin DNR Lake Management Planning Grant
Report for Amnicon and Dowling Lakes, Douglas County, Wisconsin

May 2006

Prepared by Dennis P. McComas, P.G. and Joshua P. Goplin, E.I.T., Thatcher Engineering Inc.
with contributions from Amnicon and Dowling Lake Management and Sanitary District and the WDNR

2003 – 2004 WDNR Lake Management Planning Grant
Report for Amnicon Lake and Dowling Lake
Douglas County, Wisconsin

Table of Contents

Figures

Appendices

1. Introduction and Project Setting

Dowling Lake is located in west central Douglas County, Wisconsin and is 153 acres in size. The mean depth is 7.2 feet and the maximum depth is 13 feet. Dowling Lake is connected to Amnicon Lake by a ¼ mile long channel which flows towards Amnicon Lake.

Amnicon Lake is located in west central Douglas County, Wisconsin and is 426 acres in size. The mean depth is 9.9 feet and he maximum depth is 31 feet. See Figure 1 for the general location as well as the watersheds for both lakes.

1.1 Goals of Project

This project was funded by a Wisconsin DNR Large-Scale Lake Management Planning Grant awarded to the Amnicon and Dowling Lake Management District. The following project summary is presented by Thatcher Engineering, Inc. (TEI) to the Amnicon and Dowling Lake Management District. The objectives of this project were to characterize existing lake conditions and to make recommendations to protect and improve both lake environments where feasible. There were three goals of this project:

1. Determine the current conditions of both lakes and associated watersheds and describe how the systems function.

2. Determine how the current trophic status for both lakes compares to realistic minimally impacted reference lake values.

3. Identify the primary contributing factors to both lakes eutrophic status, so the residents on the lake and within the watershed as well as users of the lake can prioritize and target those activities identified as most affecting the lake.

1.2 Background of Lakes and Surrounding Area

The drainage area or watershed for Amnicon Lake was calculated by TEI to include 2,615 acres. The drainage area for Dowling Lake was calculated by TEI to include 1,391 acres. See Figure 1 for a map showing the drainage areas for both lakes. The majority of both drainage areas are still undeveloped. The shorelines of both Amnicon and Dowling Lakes are characterized as highly developed, containing 2 and 3 tier development. Summer homes along the shorelines of both lakes became popular in the early 1900's and by the mid 1930's nearly 75 cottages were scattered along 3 sides of Amnicon Lake and nearly 50 cottages along Dowling Lake. Both lakes are currently the most highly developed per acre surface water of all lakes in Douglas County (approximately 300 lakes). Both Amnicon Lake and Dowling Lake support high quality sport fishing, particularly native muskellunge (musky), but also walleye, large-mouth bass and pan fish. The area has been able to retain much of its natural aesthetic beauty.

1.3 Previous Study Results

Previous studies of both lakes, which included acquiring water quality data, have been performed from at least 1978 to present. Based on these studies, the trophic status of Amnicon Lake in the late 1970's, through the 1980's to 1999, which is the last year water samples were analyzed prior to this project, has remained in the upper mesotrophic to lower eutrophic state. During this same time period (late 1970's to 1999), Dowling Lake has gone from lower eutrophic to near the middle of the eutrophic range.

2. Geologic Setting and Soils

Amnicon and Dowling Lakes are shallow drainage lakes of glacial origin, formed approximately 15,000 years ago during the last glacial retreat of the Superior Lobe (see Figure 2).

The central and southwestern part of Douglas County, including the area around Amnicon and Dowling Lakes, is characterized by unsorted glacial deposits typical of those found at the edge of a melting glacier. Properly termed glacial end moraine and ground moraine, these deposits consist of a heterogeneous mixture of boulders, gravel, sand, silt and red clay. The random disposition of these materials results in an irregular pattern of uplands interspersed with marshes and shallow lakes like Amnicon and Dowling.

Soils in the watershed reflect the random distribution of unsorted glacial material. Upland areas are dominated by Gogebic sandy loam, Pence sandy loam, Keweenaw loamy sand and Vilas sand. These soils are rapidly permeable and moderately to strongly acidic. Lowland areas are dominated by Greenwood peat and Seelyeville muck. Greenwood peat is a very poorly drained organic soil that ranges from strongly acid to extremely acid. Seelyeville muck is a deep organic soil that ranges from medium acid to neutral.

3. Watershed Features:

3.1 Drainage Area Delineation

Several previous studies have given estimates of the size of watershed or drainage area of Amnicon and Dowling Lakes. The drainage area is the land area that drains to the lake. We delineated the Amnicon Lake drainage area from a USGS 7.5 min quadrangle map, Amnicon Lake Quadrangle, Wisconsin. The calculated area of the Amnicon drainage area was 2,615 acres, which is slightly smaller than most of the other estimates. There is a sub drainage area for Dowling Lake (which ultimately discharges to Amnicon Lake via a channel), which we calculated to encompass 1,361 acres. See Figure 1 for a map showing both drainage areas.

3.1.1 Landscape and Cover of Watershed

The original forest in the Amnicon Dowling area was mature white pine mixed with hardwoods on the uplands and a mixture of black spruce, tamarack and sedge meadows

on the lowlands. With the opening of a federal land office at Superior in 1855, European immigrants surged into Douglas County to cut timber, prospect for minerals and homestead. By the early 1900's, most of the marketable timber in the area was gone. The partial clearing of the land by logging encouraged a gradual influx of agricultural immigrants to further clear the land for farming. In fact, many influential groups and agencies strongly promoted this "cutover" area of northern Wisconsin as potential farmland. By the 1930's the number of farms in the county declined, which has continued to the present time.

Looking at the most current topographic map of the study area (1993), we calculated the number of acres for each of the four different land covers in both watersheds. These four different land covers were:

1. Medium Density Urban (MD Urban), up to ¼ acre lots
2. Rural Residential, greater than 1 acre lots
3. Wetlands
4. Forest

See Appendix 1 for a summary of this information. The drainage areas for both Amnicon Lake and for Dowling Lake are dominated by forests and wetlands. Of the 2,615 acres for the Amnicon drainage area, 1,918 acres or 73% consists of forests and wetlands. Of the 1,391 acres for the Dowling drainage area, 1,288 acres or 93% consists of forests and wetlands. Although the forest in the area have been clear cut several times in the last 100 plus years, the forests have grown back and current conditions are dominated by undeveloped land use.

3.1.2 Runoff Patterns in Relation to Sensitive Areas

Amnicon Lake has 3 inlets, a permanently flowing inlet from Dowling Lake and two intermittent feeder streams from adjoining marsh land off the north shore. Dowling Lake has at least five small seasonal inlets. Flow into the lake at these sites is highly variable. Surface flow into both lakes is generally slow because 1) most of the watershed is woodland or marsh and 2) there are many small depressional areas within the watershed that have no visible surface outlet.

Regarding stormwater runoff from impervious surfaces, the highest potential for impact to the lakes is where there are directly connected impervious surfaces to the lake. An example of this is a road adjacent to the shoreline, especially if there is a long paved driveway connected to this road. Also of concern are "manicured lawns" which can contribute excess sediment and nutrients to lakes as well. The best approach to minimize the amount of sediments and nutrients entering the lake in the near shore area is to disconnect all impervious surfaces from the lake. This can be accomplished by redirecting stormwater from impervious surfaces to a vegetated area before it enters the