JORDAN LAKE MANAGEMENT PLAN

FIRST EDITION AUGUST 2006
Adopted September 2006
Revised August 16, 2014

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JORDAN LAKE WATERSHED MANAGEMENT PLAN

List of Lake Advisory Group Members

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PROCEDURE FOR MODIFYING LAKE MANAGEMENT PLAN

The Jordan Lake District will maintain an agenda item of "modifying lake management plan" on its meeting notices. Although suggested changes or additions can be presented at any time, they will only be acted upon at the annual meeting. It is anticipated that the Lake Advisory Group will continue to function as a research and advisory group for the Lake District.

BASELINE INFORMATION

The Jordan Lake Surface Watershed, located Jackson Township, Adams County, Wisconsin, covers approximately 7 square miles. The ground watershed is also entirely in Jackson Township and slightly larger about 8 square miles) than the surface watershed. The ground watershed lies west and north of the lake itself. There are no major streams in either watershed. There are some private lakes/ponds in both watersheds, mostly located close to Jordan Lake.

Jordan Lake is a natural seepage lake. A seepage lake is a natural lake fed by precipitation, limited surface runoff and groundwater. The water level of a seepage lake is affected greatly by variations in the groundwater level. Jordan Lake does not have either a stream inlet or outlet. The lake has 213 surface acres and a recognized maximum depth of 82'. It is the largest and deepest natural lake in Adams County.

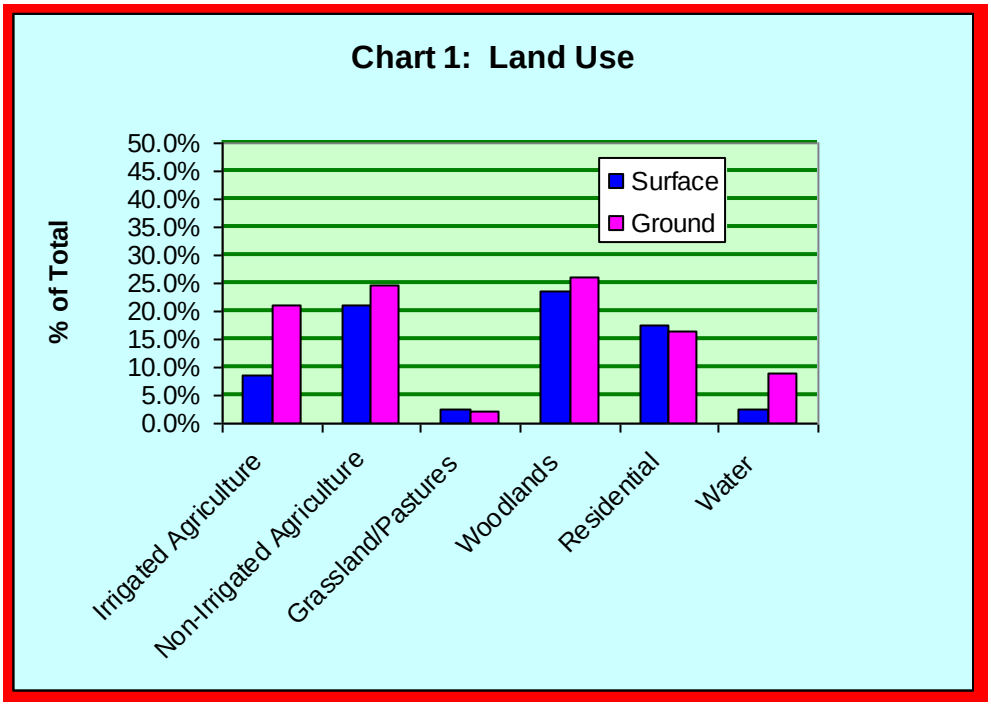
Watershed Land Use

Land Use is very important in looking at ways to maintain or improve water quality. Studies have shown that types of land use affect sedimentation rate, erosion rate and runoff rate (with included pollutants). Increased sedimentation can not only fill in shallow areas of water, but also causes excessive turbidity that harms aquatic life by destroying habitat and smothering oxygen. Increased runoff carries with it pollutants besides sediments, including pathogens, nutrients that affect algal & aquatic plant growth (nitrogen & phosphorus), pesticide residue, fertilizer chemicals, organic matter, metals, petroleum products and road salt. Increased runoff can also reduce ground water recharge and increase shore erosion. Addition of such substances not only degrade water quality and habitat, but also limit aesthetic and recreational enjoyment.

Studies also suggest that an increase in impervious surface around a waterbody of 20% may negatively impact water quality. Impervious surfaces include areas such as pavements, roofs, decks, sidewalks, compacted soil, cement patios, etc. Similarly, traditional closely-mowed lawns, as opposed to unmown lawns or native vegetation, tend to have high runoff rates and low infiltration rates. Soil types may also influence runoff amounts. Research in Indiana established the difference in average runoff

amounts, based on land use. Runoff from general residential (i.e., not necessarily highly-developed) was twice as much as runoff from forested land. Runoff in highly-developed areas may be up to fourteen times more than forested lands and twice as much as from agricultural lands. With a highly-developed residential shore, residential runoff at Jordan Lake will be one of the main negative impacts on its overall water quality in the future if steps are not taken to address this problem.

The Adams County Land & Water Conservation Department conducted a land use evaluation for both the ground and surface watersheds of Jordan Lake in 2004. The (2004) surface watershed land use was 21.2% (950 acres) non-irrigated agriculture, 8.7% (390 acres) irrigated agriculture, 26.5% (1187 acres) water (including Jordan Lake), 23.6% (1057 acres) forests, 17.4% (780 acres) residential and 2.6% (116 acres) open grassland/pasture. Currently, according to phosphorus-loading modeling done by the Adams County Land & Water Conservation Department, residential land use around the lake is contributing about 15% of the phosphorus loading, with agriculture contributing another 36%. Some phosphorus loading, such as that from woodlands or other water surfaces, is not controllable by humans; however, some of the phosphorus loading from residential and agricultural inputs is controllable. Residential practices such as not using lawn fertilizers, installing native vegetation and/or unmowed buffers and controlling runoff from impervious surfaces can reduce phosphorus input. Agricultural practices such as conservation tillage, increased residue and field buffers can reduce agricultural phosphorus input.



Non-irrigated agriculture took up 24.75% (1267 acres) of the ground watershed acreage, with an additional 21.11% (1081 acres) in irrigated agriculture. 26.2% (1341 acres) of the ground watershed is in forests, with the rest of the ground watershed being 16.6% (850 acres) residential, 9.02% (462 acres) water and 2.32% (119 acres) open grassland/pasture.

There are a few small businesses in the watershed, mostly located around the lake. These include a restaurant/bar, campsites and resorts. According to the Wisconsin State Historical Society, the only archeological site in the watersheds is a burial mound group located on the northeast side of the lake's western lobe.

Public Use and Value

In 2006, the Adams County Land & Water Conservation Department conducted a mailed citizen survey about lake issues. 70% of those responding had lakefront property on Jordan Lake. 19% of the respondents were full-time residents; 31% were year-around weekend residents; the remaining were summer or occasional residents. While only 4% of the respondents had owned their property less than 5 years, 62% had owned their land over 20 years. Most respondents owned some kind of boat, with pontoon boats dominating, then foot-paddle & fishing boats.

52% of the respondents felt the lake water quality had stayed substantially the same in the time they'd been coming to the lake, but some 42% felt the water quality had declined. Declining water quality was attributed most strongly to the invasion of exotic species (46%), recreational overuse (32%), and development (28%).

60% of the respondents felt aquatic "weed" growth had increased. In fact, aquatic plant growth was identified as the most problematic water quality issue, with human use coming a far second.

The main reasons respondents chose to use Jordan Lake were its good water quality, its distance from their primary residence and the quality of its fishing. The four most popular uses of the lake by the respondents were motorized boating, fishing, swimming and waterskiing/tubing.

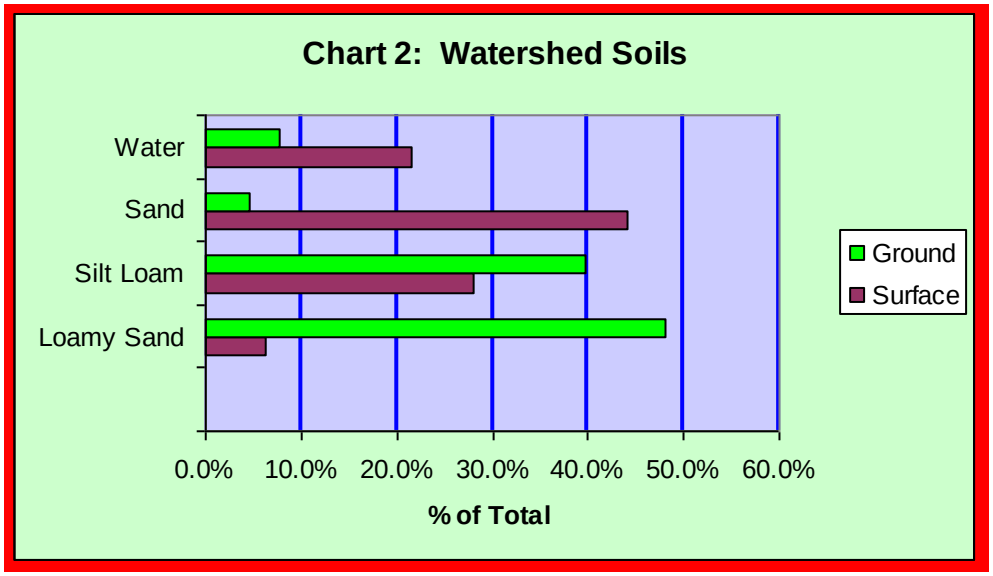
There is a county-park owned public boat ramp on the northwest side of the lake, entered off of County Road G.

Soils in the Watershed

Soils in the both watersheds range from silt loams to sands, with slopes from nearly flat to over 12%. (over 1/3 more than 6% slope). In the surface watershed, the

dominant soil type is Sand (44.2%), followed by Silt Loam (28%) and Loamy Sand (6.3%). Water covers 21.6% of the surface watershed.

Loamy Sand dominates the ground watershed (48%), followed by Silt Loam (39.8%) and Sand (4.5%). Water comprises 7.7% of the ground watershed.



Sands and Loamy Sands are generally well-drained to somewhat excessively drained, with moderate to rapid permeability in the surface layer and slow to rapid permeability in the subsurface layers. Land runoff is slow to rapid, mostly depending on slope. Available water capacity ranges from usually low, as is natural fertility organic matter content. There are wide ranges of suitability for cropping, tree-production and engineering uses. Most of these soils have erosion, blowing and drought hazards as well. Depth to groundwater is mostly over 20', although there are some areas of perched water tables. Bedrock is mostly sandstone.

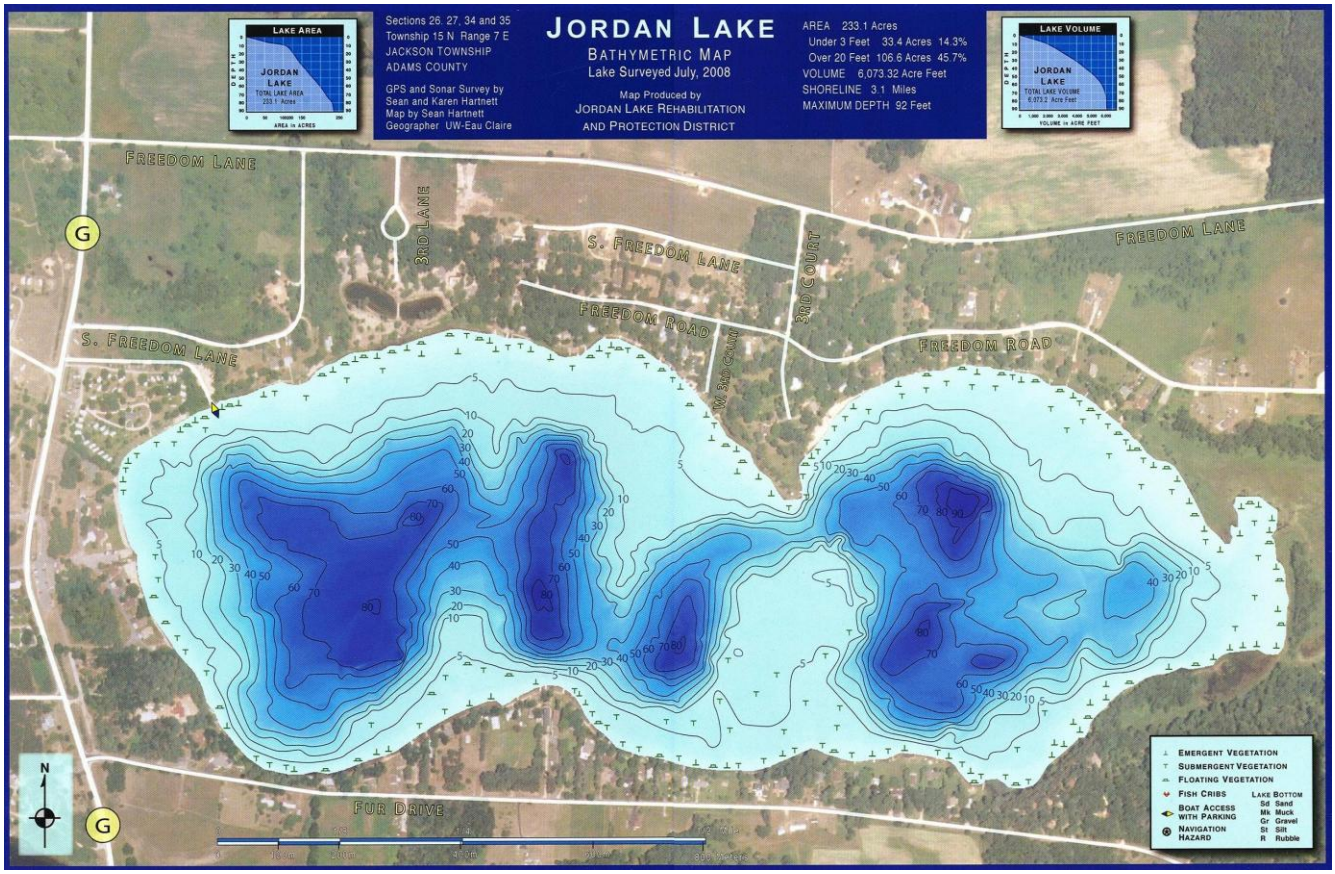
Silt Loams are well-drained with moderately slow to slow permeability. Runoff in cultivated areas tends to be rapid. Available water capacity, natural fertility and organic matter content are all medium. These soils can be subject to ponding in heavy rains. These soils are generally good for cultivated crops (if erosion control is used), hay, pasture and trees, but poor for most engineering purposes. Heavy use of these soils when they are wet may result in compaction and surface runoff.

Lake Basin Shape

Jordan Lake has an irregular shore and widely-varying depths. It has a broad littoral zone around the edges of the lake, after which it drops off sharply in several places to depths of up to 100 feet. Most of the depths under 20 feet are populated with aquatic plants.

According to a 2005 aquatic plant survey, sand was found at 80.6% of the sample sites. Also found were muck (18.2%) and rock (1.2%). In some instances, sediment type can be a limiting factor for aquatic plant growth, but this does not appear to be the case on Jordan Lake, based on the 2005 survey information.

Prior to the 1980 water rise, a vegetated sandbar separated the lake into two distinct lobes that were connected by a narrow channel about 30' deep.



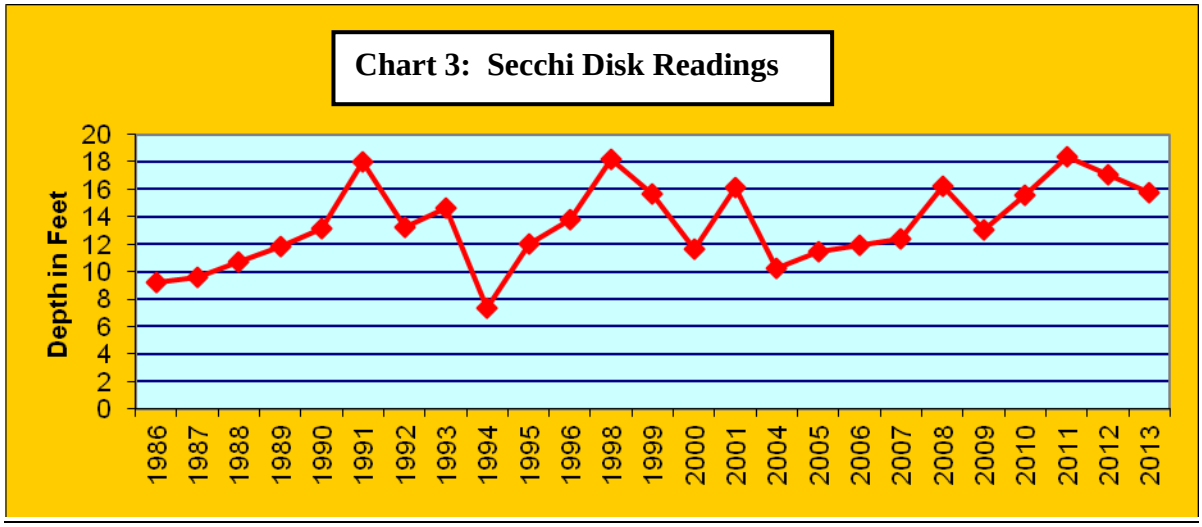
Lake Chemistry

One indicator of water quality is a lake's trophic status. Oligotrophic lakes have clear, often cold, water with low overall productivity and very desirable fisheries of large game fish. Eutrophic lakes have poor water clarity, with high production of plants and frequent algal blooms likely. Eutrophic lakes also may have fish kill histories due to oxygen depletion and often have rough fish, such as carp, that contribute to the "muddiness" of the lake water. Mesotrophic lakes are those in between oligotrophic and eutrophic lakes, with more production and accumulated organic matter than oligotrophic lakes, but only occasional algal blooms, and a good mixed fishery.

There are three lake chemistry readings that Wisconsin has traditionally used to determine a lake's trophic status. These are Secchi disk readings, which test water clarity; total phosphorus level, which indicates the amount of phosphorus available for

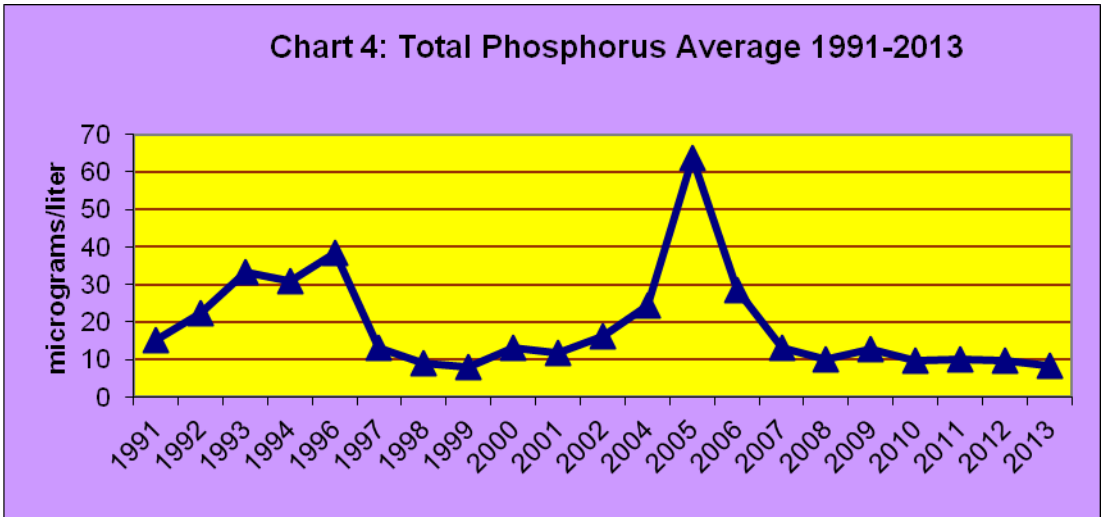
aquatic plant and algae production; and cholorophyll a, which correlates to algal blooms. Three groups have been involved in taking these measurements: citizen volunteers through the WDNR Self-Help Lake Monitoring Program (1986-2002;2007-2012), the Wisconsin Department of Natural Resources (1992-1994), and the Adams County Land & Water Conservation Department (2002-2006).

Secchi Disk Readings: Secchi disk readings taken in Jordan Lake over the years have generally been good. The average growing season water clarity reading from 1991-2013 was 13.5 feet. All of these readings put Jordan Lake in the oligotrophic or mesotrophic class based on water clarity, with a trophic score of 42.

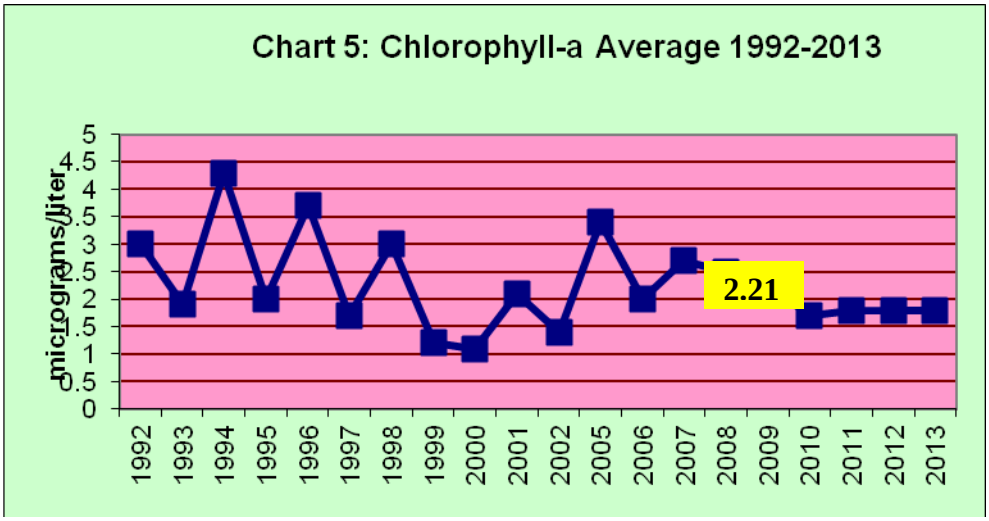


Total Phosphorus Readings: From 1992 through 2002, the WDNR tested Jordan Lake's total phosphorus level one to six times per year, taking separate surface and bottom measurements for the years 1992-1996. From 1992-1995, the WDNR average surface phosphorus reading was 34 micrograms/liter; from 1995-1998, the WDNR surface average decreased to 15 micrograms/liter. For 1999-2002, the surface phosphorus average for WDNR testing was 12 micrograms/liter.

WDNR phosphorus results from water from Jordan Lake's bottom tended to be higher than that at the surface. From 1992-1996, the average bottom phosphorus reading was 61 micrograms/liter. The 1992-1995 WDNR average phosphorus bottom reading was 70.5 mg/l, elevated for a natural lake. The overall growing season total phosphorus average from 1991-2013 was 19.1 micrograms/liter.



Chlorophyll a: Chlorophyll a is the third factor often used in evaluating water quality, since studies have shown it is correlated with algal bloom frequency. The WDNR did not take any readings of Chlorophyll a for Jordan Lake, but the Self-Help Monitoring citizens did take some, as did Adams County LWCD. Average Self-Help Monitoring results showed Chlorophyll a readings from 1993-2002 was 2.28 milligrams/liter. Adams County LWCD's average Chlorophyll a reading for 2003-2005 was 2.21 milligrams/liter. These are low levels of Chlorophyll a, indicative of an oligotrophic, fairly clear lake with good water quality. Using the Carlson Trophic Level determinations, this gives Jordan Lake a chlorophyll a trophic level of 39, in the "oligotrophic" class. Growing season average for 1991-2012 was 2.3 micrograms/liter, very low.



The waters of Jordan Lake tend to be around neutral, with pH readings between 6.11 to 8.12. The lake has hard water with sufficient alkalinity to protect its fishery from the effects of acid rain or other acidic deposits. Since regular testing started in 2004, all hardness testing results have been "hard" or "moderately hard" for Jordan

Lake. Hard water lakes tend to have clearer water and more diverse fishery than soft water lakes. The lake, with its varying depths, maintains sufficient oxygen levels in the lake so that fish kill from low oxygen are not likely to be a problem.

Readings for sodium, chloride, magnesium, sulfate and potassium in Jordan's waters have all been low, below any caution levels.

A problem that may need to be dealt with is aging septic systems. Of the 2006 survey respondents, 66.7% had septic systems over 10 years old, with most of them being in the 500 to 1000 gallon size. 62.5% had septic sites within 100' of the shoreline.

The three "trophic" parameters suggest that Jordan Lake is maintaining good water clarity and low Chlorophyll a readings, but that phosphorus levels, especially in the lower depths of the lake, have risen substantially in the last 20 years or so. Phosphorus is especially important related to density & frequency of aquatic plants and of algal blooms. One pound of phosphorus (2.2 kilograms) in the water can produce 500 pounds of algae. Nutrient loading is the most common cause of elevated phosphorus levels, so the Jordan Lake Management Plan should investigate how phosphorus levels will be lowered.

Jordan Lake thus scores 42 TSI on Secchi Disk readings; 39 on Chlorophyll a readings; and 43 TSI on Phosphorus Levels, for an average TSI reading of 41, placing it in the "mesotrophic" class overall.

	Score	TSI Level Description
	30-40	**Oligotrophic:** clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
Jordan Lake →	40-50	**Mesotrophic:** moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
	50-60	**Mildly Eutrophic:** decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant grrowth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
	60-70	**Eutrophic:** dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
	70-80	**Hypereutrophic:** heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

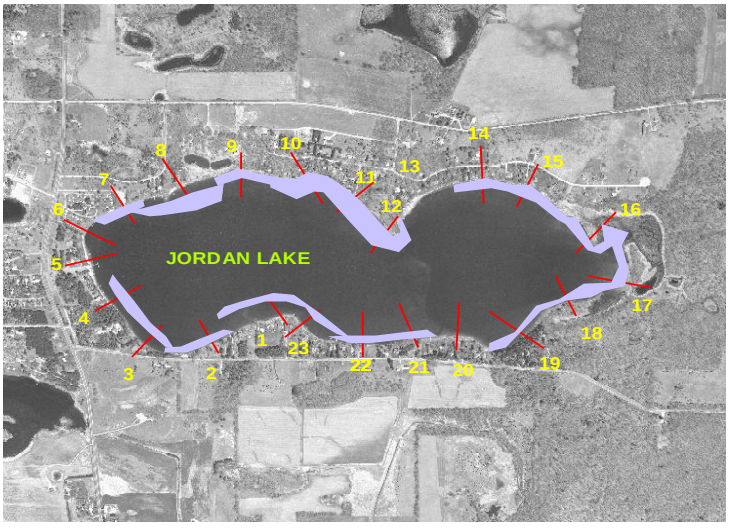
Aquatic Plants

A private firm performed two field aquatic plant surveys on Jordan Lake in 2005, one in the spring and one in the summer. 19 named species were found in addition to a variety of emergent rushes and sedges. Two of the 19 species were the exotics Eurasian watermilfoil and curly-leaf pondweed. These exotics tended to be found mostly in the littoral area or around boat launches & piers.

The species with the highest frequency in both the spring and summer surveys was *Chara*, a plant-like algae. In the spring 2005 survey, *Potamogeton amplifolius* and *Potamgeton richardsonii* were the next most frequent aquatic plant, while in the summer survey, *Najas flexilis* was the only other plant with a frequency over 10%. The 2005 surveys showed decreases in both of the two exotic aquatic plant species that have entered Jordan Lake: Curly-Leaf Pondweed and Eurasian Watermilfoil.

Due to difficulties with some aquatic plant identification in the private survey, an aquatic plant survey was completed by the Adams County Land & Water Conservation Department in Summer 2006. 35 aquatic plant species were found, with 32 native and 3 exotic invasives. *Chara* spp (Muskgrass) was the most frequently-occurring "plant" in that survey as well, with the next most frequently-occurring plants being *Najas flexilis* (Bushy Pondweed), *Potamogeton pectinatus* (Sago Pondweed) and *Sagittaria latifolia* (Arrowhead or Duck Potato). The lake was surveyed again in 2010, 2012 and 2013. 29 species were found. In all surveys, *Chara* was the most frequently-occurring and dominant species.

Floating Plants in Jordan Lake 2006



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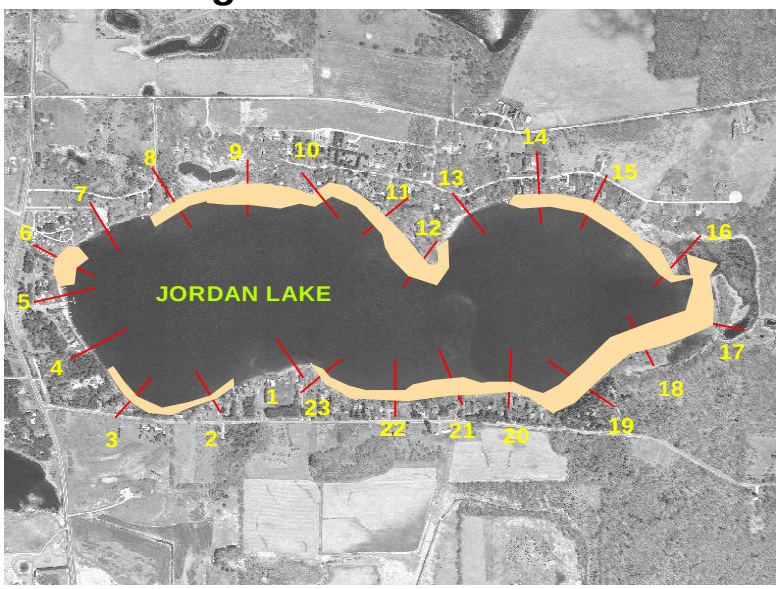
Floating-Leaf or Free-Floating Plants Found 2006

Emergent Plants Found 2006



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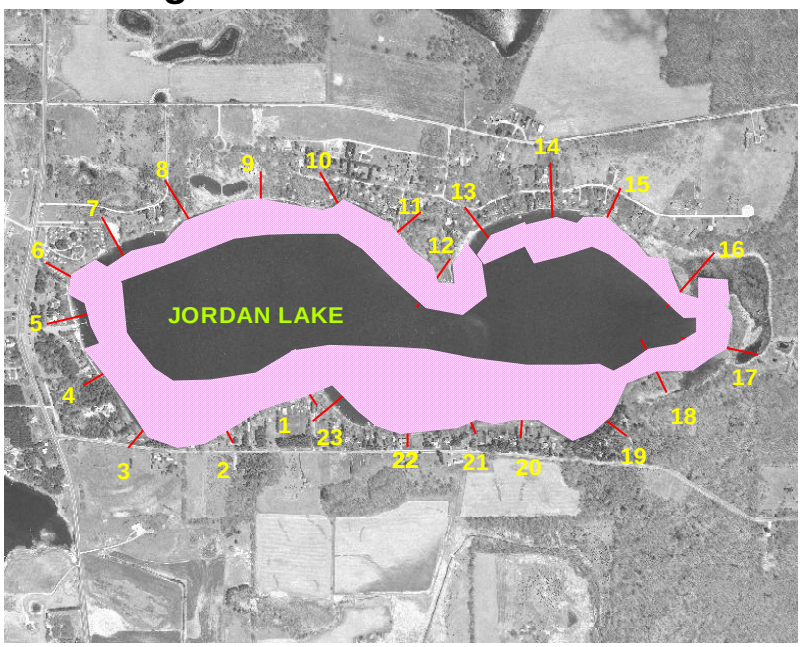
Emergent Plants Found 2006

Submergent Plants in Jordan Lake 2006



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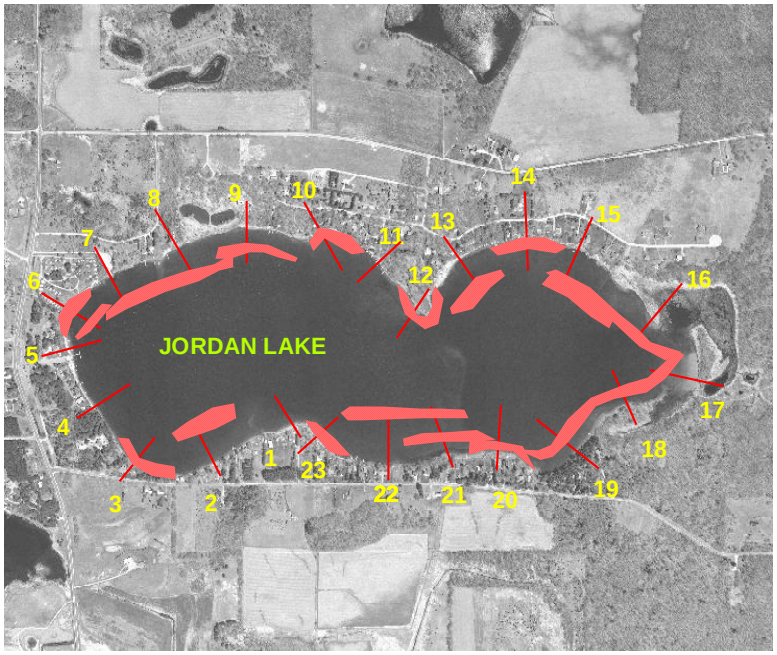
Submergent Plants Found

Historically, aquatic plant and algal growth have been addressed only by chemical treatment. Diquat was applied 1981-1982. Various brands of 2-4, D were used in 1997-2005. Limited mechanical harvesting (30 tons) on Jordan Lake did occur in 2002 by the Jordan Lake Association. The chemical treatments do appear to be reducing the amount of EWM in Jordan Lake, based on the applications for chemical

input—the amount of acreage being treated in 2006 was less than the prior years. In 2002, 25 acres were treated; in 2003, it was 27.7. Starting in 2004, acreage treated has been declining: in 2004, it went down to 25.72 acres, then down to 13.96 acres in 2005 and down to **2.28 acres** in 2006.

During the 2006 survey, the exotics were found in small patches, rather than in large amounts. Considering that 32 of the 35 species found were native aquatic plants, it appears that so far, the aquatic plant community in Jordan Lake is still diverse and healthy. Care must be taken to keep it that way.

Exotic Aquatic Vegetation Found In Jordan Lake 2006



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Exotic Aquatic Vegetation Found 2006

Chemical Applications

Year	Diquat	AV70	Aquacide	2,4-D	Navigate	DMA 4_IVM	Aqua-Kleen
	(gal)	(gal)	(lbs)	(lbs)	(lbs)	(gal)	(lbs)
1981	1.5	4					
1982	5						
1990			15				
1997				20			
1998			100	60			
1999			115				
2000			100		25		

2001			175				
2002					2005		
2003					1050	210	
2004					245.88		3763
2005					2745		
2006					385		
	6.5	4	505	80	6455.88	210	3763
	gal	gal	lbs	lbs	lbs	gal	lbs

Fishery

Jordan Lake has a diverse fishery, with largemouth bass and bluegill being historically the most abundant fish. Black crappie, bullheads, and northern pike were common, but walleyes and perch tend to be scarce. The lake does not have a history of fish kills from low oxygen.

Banded killifish (*Fundulus diaphanous*), a threatened/endangered fish species, has been found in Jordan Lake in the past.

WDNR stocking records for Jordan Lake date back to 1933 when 308 black bass were stocked. The lake was stocked annually from 1933 through 1950, mostly with bass, panfish, walleye and northern pike. Between 1953 and 1981, WDNR stocked the lake only occasionally, mostly with brown and rainbow trout. From 1981 through 2002, Jordan Lake was stocked annually by the WDNR. The bulk of this stocking was walleye (146,051), brown trout (about 9000), largemouth bass (5325) and northern pike (1800).

The most recent fishery survey occurred in 2006. It found predator fish such as largemouth bass and northern pike; panfish including bluegills, black crappie, pumpkinseed; and both yellow perch and brown trout.

Shoreline Use

During a 2004 survey of the shore, it appeared that most of the shoreline did not have a buffer of native vegetation going 35' landward from the shore. 60% of the shore sites had traditional lawn, with another 18% having hard structures such as decks or rock riprap. The plant survey completed in 2006 revealed that 71.73% of the Jordan Lake shoreline was covered with disturbance, with only 28.27% having native vegetation. Traditional mowed cultivated lawn had the highest coverage, covering 42.17% of the shore. These types of disturbed shorelines have been found to contribute negatively to water quality. They do not provide food or shelter for wildlife and fish and may degrade spawning beds. They tend to increase runoff and excess nutrients. The lack of plant cover tends to warm the water by disturbed areas, encouraging the growth of algae and nuisance aquatic plants. Also, cover like hard surface retaining walls

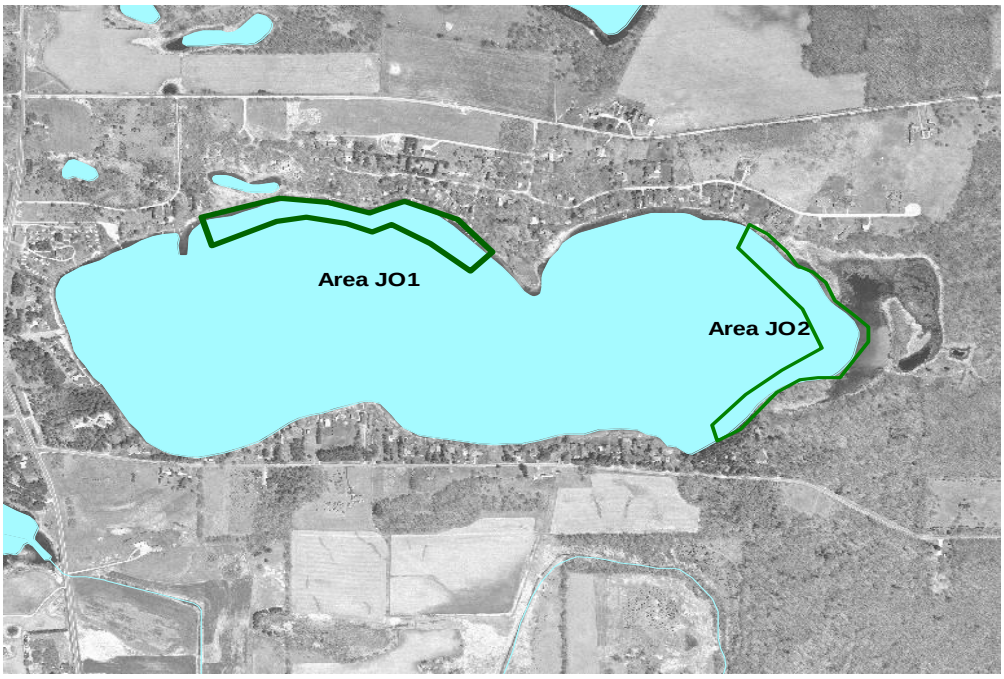
deflect waves off the walls, stirring up sediments and destroying vegetation. In addition, the Jordan Lake water level rose in the mid-1980s, changing the shore parameters.

Shorelands are critical habitat necessary for the protection and enhancement of lake water quality, fisheries, wildlife and aquatic life. They provide shelter and food for wildlife and fish. They support spawning beds, cover and feeding areas for fish and invertebrates. Native vegetation filters and traps pollutants and excess nutrients, preventing them from entering the lake water, thus protecting water quality. They provide significant aesthetic beauty and can also serve as a visual and audio buffer between the shoreland residents and lake traffic or noise. It is essential to protect existing natural shorelands and restore shoreland habitats that have been eliminated or degraded by nearshore development. Natural shorelands contain a mixture of native plants including trees, shrubs, grasses and forbs (wildflowers) that provide critical habitat for water-dependent wildlife and help filter stormwater runoff by removing excessive nutrients and sediments before they reach the lake.

Critical Habitat/Sensitive Areas

Under Wisconsin Rule 107.05(3)(i)(I), the Wisconsin DNR can evaluate a lake and declare particular areas of the lake as "sensitive or critical habitat areas." These are defined as "areas of aquatic vegetation offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water." These areas were designated in 2006-2007 and are shown on the following map.

Critical Habitat Areas--Jordan



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Wildlife and Endangered/Threatened Resources

The only known endangered or threatened resource on the state or federal lists found in either of the Jordan Lake watersheds is the Banded Killifish. Two families of bald eagles nest around the lake, as do sandhill cranes.

However, in the summer of 2011, the rarest *Charaophytes* in the world, *Lychnothamnus barbatus*, was found in Jordan Lake after being found in Wolf Lake near Jordan the year before. These findings were the first confirmed presence of this species in North, South or Central America. In Europe, it is classified as threatened with extinction. It has been found mostly in rather large deep lakes with steep slopes and narrow shallow zones.

Priority Watershed

From 1992-2002, many conservation practices were planned in the Jordan Lake surface watershed as part of the state's Priority Watershed Program for Neenah Creek. That plan indicated that the watershed had no inventoried animal lots. According to this plan, upland sediment delivery to the lake was estimated at 372 tons per year, with upland erosion being identified as a major source of sediment in the watershed. Sediment delivery from ponds or lakeshores was estimated to be 22 tons per year.

The plan made some recommendations: (1) reduction of runoff from lawn fertilizers, which was believed to be a problem in the lake; (2) installation of shoreline buffers; (3) purchase of an easement on the undeveloped east shore to protect northern pike spawning grounds; (4) development and implementation of a lake management/protection plan. The only one of these goals that has been accomplished is the development of this lake management plan. It does include going forward on recommendations (1), (2) and (3).