ROCK-KOSHKONONG LAKE DISTRICT
WISCONSIN LAKE PLANNING GRANT PROGRAM
PROJECT NUMBER LPL-868-03
FINAL REPORT

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Prepared for:

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EXECUTIVE SUMMARY

The Rock-Koshkonong Lake District received a Lake Planning Grant in the fiscal year 2003 from the Wisconsin Department of Natural Resources (WDNR). The purpose of this grant was to collect information for the purposes of assisting WDNR in preparing and implementing a comprehensive lake management plan to protect and restore the water quality in Lake Koshkonong.

The information collection activities included: conducting another annual aquatic vegetation survey and data inclusion in the GIS database, the continued Cooperative Lake Study with WDNR staff to observe erosional processes and ecological response, monthly water quality monitoring at four locations and preparation of this summary report.

The Rock-Koshkonong Lake District and its consultant RSV Engineering, Inc. have met the project objectives of gathering information on these issues, and this information is presented herein.

Evaluation of the information collected as part of the previous three planning grants along with the data collected during the 2003 Planning Grant have resulted in recommendations for further study. These recommendations include:

- The continued annual monitoring of aquatic vegetation and water quality parameters.
- The continued wetland and shoreline loss studies as part of the Cooperative Lake Study.
- The continued cooperation with WDNR in preparation of a Comprehensive Lake Management Plan for Lake Koshkonong.

Stephen J. Hjort
Senior Biologist

1.0 INTRODUCTION

Lake Koshkonong is a reservoir of the Rock River system. Lake Koshkonong is located primarily in Jefferson County with a small portion in southeastern Dane County. The southwestern portion of the lake and the downriver stretch of the Rock River extend to the Indianford Dam in Rock County. Lake Koshkonong is a natural widening of the Rock River that was previously a large shallow marsh. The construction of a dam at Indianford in the 1850's impounded the river to create what we now know as Lake Koshkonong (Figure 1). The shallow marsh slowly changed over time into a shallow open water lake after the impoundment was created.

The surface area of the lake is approximately 10,500 acres with about 27 miles of shoreline. The maximum depth of Lake Koshkonong is 7 feet during normal conditions and the volume of the lake is approximately 56,000 acre-feet.

The Rock-Koshkonong Lake District (RKLD) is the largest Lake District in the State of Wisconsin with over 4000 members. RKLD spans portions of three counties, namely, Jefferson, Rock and Dane Counties. The district boundary begins at the Indianford Dam in Rock County and continues uninterrupted upstream to the Fort Atkinson city limits, then continues upstream to the Jefferson city limits (Figure 2). RKLD was formed to better manage the valuable water resource of the Rock River and Lake Koshkonong.

The mission of RKLD is "to protect, preserve and improve the natural resources of the lake and river for an equal balance of wildlife, habitat and recreational enjoyment for all."

2.0 PROJECT DESCRIPTION

The goals and objectives of RKLD for the Lake Planning Grant 2003-1 were to collect information to continue the planning process for the purpose of assisting WDNR in the preparation and maintenance of a Comprehensive Lake Management Plan to protect and restore the water quality in Lake Koshkonong. The data collected will also be used to assist the U.S. Army Corps of Engineers in their evaluation during the Feasibility Study phase, and subsequent phases of the Section 206 Habitat Restoration Project planned for Lake Koshkonong.

A description of these activities is presented below.

2.1. Project Objectives

1. Continue the Volunteer Lake Monitoring Program and expand the program to include the collection of water quality data in two additional areas in the lake. RKLD asked the volunteers to also collect data in an area that wind effects are severe such as in Stinkers Bay near the Northshore Inn and also in a protected bay area such as Haights Bay. The intent of this additional data collection is to use this data collected by the volunteers and wind speed data obtained from the USGS Internet website to see if a correlation exists between the data.

2. Continue the aquatic vegetation assessment activities in 2003 to document the amount and diversity of emergent and submergent aquatic vegetation in the lake to aid in preparation of a restoration plan for both submergent and wetland flora. The methodologies would be similar to the areal survey methods used in 2000 - 2002 including rake sampling methods in select areas that are consistent with Deppe and Lathrop, 1992 methodologies.

3. Continue to participate in the Cooperative Lake Study with Department staff to document the ecological response to the erosional setting on the Lake Koshkonong shorelines. This study may also include observations by the Lake Study team to document other factors of the ecosystem dynamics.

4. Conduct monthly water quality monitoring in the same four (4) locations as studied in 2001. The parameters of the monitoring program include pH, temperature, specific conductance, dissolved oxygen, and water clarity using a Secchi disc. The water quality monitoring will be performed from April through October 2003. This data set will assist in the long-term evaluation of water quality trends for lake management and also for determining the success of the USACOE Section 206 project.

5. Prepare a summary report of the data collected during 2003, and incorporate previous year's data for the purposes of assisting WDNR in comprehensive lake management planning.

3.0 PROJECT RESULTS

3.1. Task 1 – Volunteer Lake Monitoring Program

RKLD members did not participate in WDNR-sponsored Volunteer Lake Monitoring Program in 2003. RKLD will make a concerted effort to reinstate this program in 2004.

3.2. Task 2- Assessment of Aquatic Vegetation

Past records indicate that Lake Koshkonong once contained vast areas of aquatic vegetation. This aquatic vegetation provided habitat for many game- and panfish species and attracted large concentrations of waterfowl each year that came to feed and rest on this large waterbody. Currently, the areal distribution and diversity of aquatic vegetation is much reduced from earlier times.

RKLD collected aquatic vegetation data identifying the amount and diversity of aquatic vegetation in the lake in 2000, 2001, 2002, and again in 2003. The purpose of the 2000 data collection activity was to provide a baseline for future monitoring of the aquatic vegetation component of the ecosystem.

The aquatic vegetation surveys were conducted on September 8, 2000, June 20, 2001, June 12, 2002, and during the period of June 11 to June 20, 2003. The reason for the lateness of the 2000 survey was the unusually long duration of high water conditions during the summer of 2000 resulting in turbid water conditions that would not allow the survey methodology to be used. The 2001, 2002 and 2003 surveys were conducted during more "normal" water level and water temperature regimes.

The methodology used to collect the aquatic vegetation data in all four years was to conduct a near-shore survey of the lake to identify and document the areal extent of aquatic vegetation. Due to the limited amount of vegetation present in Lake Koshkonong

and the fact that aquatic vegetation only occurs in near-shore areas, this methodology was employed versus standard transects from shore to shore across the width of the lake. During 2002 and 2003, the survey included four rake samples at select locations to characterize and quantify the average density and composition of the beds of aquatic vegetation.

The shoreward and lakeward extents of the weedbeds were identified with waypoint coordinates and notes were collected on species identification and relative density. Extremely shallow water depths (<1 foot) at the shoreward extent of aquatic vegetation beds was collected on foot and the lakeward extents in water depths greater than 2-feet were collected from an anchored boat position.

This GPS data was then entered into a Geographic Information System (GIS) "layer" for the purpose of documenting the location of the aquatic vegetation, creating a database for each location, and for graphic presentation.

Figure 3 depicts the locations and species observed during 2000, Figure 4 depicts the locations and species observed during 2001, Figure 5 depicts the locations and species observed during 2002, and Figure 6 depicts the locations and species observed during 2003.

A RSV aquatic biologist identified the aquatic species at each location and noted the species and relative densities. The species observed during the 2000 survey included: sago pondweed (Potamogeton pectinatus), curly pondweed (Potamogeton crispus), coontail (Ceratophyllum demersum), yellow water lily (Nuphar lutea), white water lily (Nymphaea odorata), and lesser duckweed (Lemna minor). Due to the unrooted nature of the lesser duckweed, it was not mapped as aquatic vegetation on the GIS mapping.

The species observed during the 2001 survey included: sago pondweed (Potamogeton pectinatus), curly pondweed (Potamogeton crispus), coontail (Ceratophyllum demersum),

yellow water lily (Nuphar lutea), white water lily (Nymphaea odorata), common water milfoil (Myriophyllum sibiricum), floating-leaved pondweed (Potamogeton natans), and lesser duckweed (Lemna minor). Lesser duckweed was not mapped due to the unrooted nature of the species and floating-leaved pondweed was not mapped due to the small number of stalks found during the survey.

The species observed during the 2002 survey included: sago pondweed (Potamogeton pectinatus), curly pondweed (Potamogeton crispus), coontail (Ceratophyllum demersum), yellow water lily (Nuphar lutea), white water lily (Nymphaea odorata), floating-leaved pondweed (Potamogeton natans), and lesser duckweed (Lemna minor). Lesser duckweed was not mapped due to the unrooted nature of the species. Due to the small amount of floating-leaved pondweed observed in the 2002 survey, this species was not mapped separately or included as a component of the mixed species weedbed designation. Yellow water lily was observed in only one area is included with a vegetation association in Haights Bay.

The species observed during the 2003 survey included: sago pondweed (Potamogeton pectinatus), curly pondweed (Potamogeton crispus), coontail (Ceratophyllum demersum), yellow water lily (Nuphar lutea), white water lily (Nymphaea odorata), and lesser duckweed (Lemna minor). Lesser duckweed was not mapped due to the unrooted nature of the species. Yellow water lily was observed in only one area and is included with a vegetation association in Haights Bay. The areal coverage of submergent aquatic vegetation was similar to 2001 and 2002, however; the species composition and diversity was reduced. Sago pondweed dominated the submergent aquatic beds with very limited observation of other species during the survey and in subsequent lake monitoring events.

raw data comparing spp densities?

The 2003 survey was conducted in similar fashion to the survey of 2002 with the collection of four (4) rake samples at select locations similar to the locations in 2002 with the exception of Rake Sample # 1 which was moved slightly due to the absence of submergent vegetation at that location in 2003. The locations of the four rake samples

are indicated on Figure 6. The survey was begun at Blackhawk Island and proceeded in a counter-clockwise fashion around the lake. RSV employed Spatial Data Surveys, LLC to collect the global positioning satellite technology (GPS) data. The GPS model used was a Trimble 5700 RTK System with an accuracy range of 3-5cm.

In addition to the field RC rating of the vegetation density, the vegetation samples were also collected and weighed after towel drying for an objective measure of density. This allows the use of statistical analysis of objective data versus the variability and subjectivity of the RC method.

The RC rating system is one method for assessing the relative density of a rake grab sample and the RC rating table is presented below.

RC Method Density Rating Criteria Table

Rake Coverage (% rake head coverage by species)	Density Rating
81 – 100	5
61 – 80	4
41 – 60	3
21 – 40	2
1 – 20	1

A comparison of Rake Sample RC Method Density Ratings and mass measurements in grams (g) is included in the table on Page 10. The rake samples were collected in four areas that historically contain submergent aquatic vegetation. The approximate coordinates for these areas are:

Rake Sample #1 - West of Stinkers Bay at N 42° 54' 13.5", W 88° 57' 18.3"

Rake Sample #2 – West of Koshkonong Creek at N 42° 52' 57.9", W 88° 59' 08.9"

Rake Sample #3 – Lautz Bay at N 42° 51' 14.3", W 88° 57' 47.9"

Rake Sample #4 – Haights Bay at N 42° 51' 29.2", W 88° 56' 04.2"

Just ONE rake pull @ each location?

Density + Mass not ~~divided by~~ measured for each plant species?

Sample #s ∆ed @ locations from 2002 - 2003.

Question whether 4 rake pulls is enough to conclude anything about the whole-lake plant community, but if it did, Diversity decreased bt 2002-2003, Density of sago increased at all 4 loc's.

Rake Sample No. 1

Year	RC Density	Mass
2002	1	81.4 g
2003	1	96.1 g

Rake Sample No. 2

Year	RC Density	Mass
2002	1	31.5 g
2003	2	121.5 g

Rake Sample No. 3

Year	RC Density	Mass
2002	1	18.2 g
2003	1	28.1 g

Rake Sample No. 4

Year	RC Density	Mass
2002	1	99.7 g
2003	3	194.9 g

In comparing the 2002 and 2003 rake samples, the relative density of the submergent aquatic vegetation was similar in Rake Sample locations 1 and 3 and increased during 2003 in Rake Sample locations 2 and 4. Three species of submergent aquatics were observed in the four rake sample locations in 2002. Only one species, sago pondweed, was observed in the four rake sample locations in 2003. All three observed species are relatively tolerant of many environmental conditions such as turbidity, high concentrations of nutrients and/or pollutants and fluctuating water levels. The winter drawdown of 2002-2003 occurred for the greatest duration on record and many of the near-shore areas that contained submergent aquatics were desiccated and frozen for over four months. The drought-like conditions of summer 2002 through summer of 2003, and

the duration and magnitude of the winter drawdown may be contributing factors to the lack of species diversity in the 2003 aquatic vegetation survey. Photos of the 2002 and 2003 Rake Samples are included in Appendix A.

→ were the locations of rake samples exposed during the winter drawdown?

To summarize the aquatic vegetation survey data collected from 2000–2003, the areal coverage, density and diversity of aquatic vegetation all increased from 2000 to 2001. The reasons for this increase are not known but water levels were more stable and water clarity was better during late spring/early summer 2001 than in 2000, and water levels were only slightly higher than normal during 2001 compared to this period in 2000 when an extended high water period occurred for much of the growing season. The observed areal coverage was somewhat reduced in certain areas in 2002 compared to 2001 and 2003, but the aquatic beds were in the same general areas. Coontail and curly pondweed beds that were expanding in size and density in select areas in 2001 and 2002 were noticeably absent in 2003. Drought like conditions and/or lower water levels throughout the winter of 2002-2003 may be contributing factors in this observation.

Coverage data are not quantified
Density data for 2000, 2001?
How did diversity increase?
Coontail is a very weak rooter; may not have floated in

★ Need to strengthen study design to get anything useful in future grants!

3.3. Task 3 – Cooperative Lake Study Monitoring

The Cooperative Lake Study began in March of 2002 and has continued through Oct 31, 2003 on a seasonal basis. The field dates for the study include March 13, 2002, May 28, 2002, July 9, 2002, November 4, 2002, January 23, 2003, May 13, 2003, July 16,2003 and October 31, 2003. During these eight field inspection events, RSV and WDNR staff staked out 30 feet by 30 feet plots and further divided the plot into four 15 feet by 15 feet quadrants. Each quadrant was labeled A through D with Quadrant A being the leftmost quadrant when looking at the plot from the lake and proceeding clockwise to Quadrant D. The following field inspection summaries for each plot includes descriptions of conditions observed during the study period. Appendix B contains the Field Monitoring Sheet for each plot with written and graphic representations of observations.

Gilberts Bay Forest

The Gilberts Bay Forest plot was staked and observations began on March 7, 2002 and continued through October 31, 2003. This plot is characterized as being a floodplain forest (formerly Southern Wet and Southern Wet-Mesic Forest of Curtis). The plot contains black willow (Salix nigra), green ash (Fraxinus pennsylvanica), American elm (Ulmus americana), silver maple (Acer saccharinum) in the tree/shrub layer. Herbaceous vegetation was first observed in the plot during the May 13, 2003 field inspection. This herbaceous layer was observed consistently from May thorough October 2003. The herbaceous layer consisted of stinging nettle (Urtica dioica), jewelweed (Impatiens capensis), a currant species (Ribes sp.) during the May 13, 2003 inspection and species abundance increased during the 2003 growing season mainly along the shoreline Quads A & D but some herbs were observed in all plots. A three feet wide area along the shoreline of Quads A & D was observed in the July and October 2003 field inspections that included the species observed in the May 2003 field inspection and the following new species; smartweed (Polygonum amphibum), lamb's quarters (Chenopodium album), dandelion (Taraxacum officinale), wild radish (Raphanus raphanistrum), bugleweed (Lycopus americanus), pepperweed (Lepidium campestre), Canada thistle (Cirsium arvense), cocklebur (Xanthium strumarium), millet (Echinochloa sp.) and seedling silver maple. Low water or drought-like conditions during 2002-2003 are likely the primary factor in the observation of many facultative and facultative-upland herb species in this plot.

Carcajou Floodplain Forest

The Carcajou Floodplain Forest plot was staked and observations began on February 2, 2002 and continued through October 31, 2003. This plot is characterized as being a floodplain forest. The plot contains green ash (Fraxinus pennsylvanica), American elm (Ulmus americana), silver maple (Acer saccharinum) in the tree/shrub layer. Herbaceous vegetation was first observed in the plot during the July 9, 2002 field inspection and

included <1% of an unidentifiable grass species and smartweed in Quads B & C. Between the July and November 2002 field inspections, the landowner cut down one silver maple in Quad A and one blue vervain (Verbena hastata) plant was observed in Quad D. During the November 2002 field inspection, numerous bivalves were observed in very shallow water near shore. Shoreline erosion was observed along the shoreline in Quads A & D. This erosion was likely a result of wave erosion on this unprotected main lake shoreline that is subject to significant wave energy. Areas adjacent to the plot that contained riprap armor did not exhibit the same erosional conditions as this plot exhibited. During the January 2003 field inspection, staff ice-augered through 8 inches of ice and about one inch into frozen sediment 20 feet lakeward from plot. Lake sediment was frozen to and below the ice layer.

A significant herbaceous layer was observed consistently from May thorough October 2003. The herbaceous layer consisted of stinging nettle, smartweed, bugleweed, jewelweed, Canada thistle and wood nettle (Laportea canadensis) during the May 13, 2003 inspection and species abundance increased during the 2003 growing season. Additional species observed in October 2003 included; lamb's quarters, pepperweed, dandelion, millet, an unidentifiable Aster species, sneezeweed (Helenium autumnale) evening nightshade (Solanum dulcamara), monkeyflower (Mimulus ringens) and seedling quaking aspen (Populus tremuloides). The presence of the herbaceous layer during 2003 is again likely a result of the drought-like conditions in 2002-2003 allowing the colonization of common invasive species. The landowner cut down the American elm in Quad A between the May and October field inspections. The elm was considered to be in healthy condition as of the May 2003 field inspection but was near the leading edge of the continued erosion of the shoreline.

Haights Bay Shallow Marsh

The Haights Bay Shallow Marsh plot was staked and observations began on May 28, 2002 and continued through October 31, 2003. This plot is characterized as being an

emergent aquatic wetland. The plot originally contained smartweed, river bulrush (Scirpus fluviatilis), common reed grass (Phragmites australis) and blue flag iris (Iris versicolor). Stinging nettle and narrow-leaved cattail (Typha angustifolia) were first observed in the plot in November 2002. The landowner burned portions of the marsh adjacent to the plot over the winter of 2002-2003. In addition, the landowner installed a shallow riprap barrier about 10 feet lakeward of the original shoreline of the plot as part of a WDNR $10K Wetland Restoration Grant.

In May 2003, southern water cress (Rorippa sylvestris) was observed in the plot. River bulrush in Quad A had increased from 60 % to 90% and common reed grass had decreased from 10% to 0% when compared to 2002 areal coverage. In July 2003, the entire plot area was almost completely vegetated and the vegetation was colonizing the area between the former lakeshore and the riprap barrier. Wild millet has colonized the riprap barrier completely. Smartweed, stinging nettle and common reed grass density had increased compared to 2002. During the October 2003 field inspection, stinging nettle had increased and field mint and Canada thistle are first identified in the plot. Common reed grass increased in three of the Quads and river bulrush dominated the areal coverage in all of the Quads in the October 2003 field inspection. Softstem bulrush (Scirpus validus) was observed for the first time lakeward of the plot and riprap in the vicinity of the plot.

Carcajou Shallow Marsh

The Carcajou Shallow Marsh plot was staked and observations began on February 22, 2002 and continued through October 31, 2003. This plot is characterized as being an emergent aquatic wetland. The plot originally contained narrow-leaved cattail, smartweed, river bulrush, common reed grass, cocklebur and bugleweed. Significant erosional losses occurred (30% of plot vegetation and organic layer) between the first plot field inspection and the second inspection in May 2002. This erosional scenario was not observed in the other plots during this time frame and was likely due to the location

of this shallow marsh on the main lake, which is subject to significantly more wave energy than the Haights Bay plot location. Additional erosional losses occurred along the shoreline between the May and July field inspections.

Stinging nettle and arrowhead (Sagittaria latifolia) were first observed in the plot in July 2002. In the areas that were eroded during the spring/summer of 2002, yellow nutsedge (Cyperus esculentus) colonized the exposed sediments along with sparse smartweed and river bulrush. Stinging nettle density increased in all Quads during the late summer of 2002 and the plot exhibited some revegetation in the eroded area. The landowner burned portions of the marsh including the plot over the winter of 2002-2003 removing a significant portion of the organic layer in the plot. The landowner installed a shallow riprap barrier about 30 feet lakeward of the original shoreline of the plot as part of a WDNR $10K Wetland Restoration Grant.

The July 2003 field inspection revealed a noticeable change in vegetation density and community. The eroded area vegetated with yellow nutsedge in 2002 was replaced and colonized by monkeyflower (Mimulus ringens) in 2003. Various new invasive weedy species including curly dock (Rumex crispus), wild cucumber (Echinocystis lobata), jewelweed, southern water cress, reed canary grass (Phalaris arundinacea), swamp milkweed (Asclepias incarnata) were observed in 2003. A marked increase in the density of stinging nettle was observed in the July 2003 field inspection. Sparse river bulrush was observed sprouting in shallow water lakeward of original plot shoreline likely due to low (normal summer target) and stable water levels during the 2003 summer growing season.

The October 2003 field inspection revealed another increase in the density and areal coverage of stinging nettle in Quads B and C; and the first observations of nightshade, blue vervain; and seedling American elm and quaking aspen (Populus tremuloides). The previously eroded area had completely revegetated and river bulrush density increased within the plot and extended lakeward three to five feet along the shoreline of Quad D.

In summary, significant erosion was observed in the Carcajou Shallow Marsh during the spring/summer of 2002. The drought-like conditions of late summer 2002 through fall of 2003 resulted in limited erosion along the shorelines of the study plots with the exception of the Carcajou Floodplain Forest plot which continued to erode and would be a likely candidate for riprap protection. Both the Gilberts Bay and Carcajou Floodplain Forests exhibited a significant increase in herb layer vegetation during the drought-like conditions of 2002-2003. The Gilberts Bay Forest is slightly higher in elevation than the Carcajou Forest and the low water period did not result in noticeable erosion but rather this area was the recipient of a deposition of wave-induced sediment that facilitated the colonization of invasive species along the shoreline.

The placement of riprap under the $10K Wetland Restoration Grant Program along the shorelines of the two shallow marsh areas and adjacent to the Carcajou Forested Floodplain plot has shown great promise with respect to reducing erosion and increasing emergent aquatic vegetation in these areas. The ultimate test of the effectiveness of the riprap protection will be after the next extended high water period.

With respect to the ecological response in the plots, the appearance of common invasive species in all of the plots during the 2002-2003 low water period is cause for concern. Lake Koshkonong water levels were at or below target elevations from July 2002 through with the exception of a four week period in May 2003 when water levels rose to 777.45 msl then dropped to near the summer target water level of 776.20 msl. The relatively low water levels, although within the normal Operating Order range, allowed normally saturated to inundated sediments to become desiccated to saturated permitting the colonization of invasive species including many species not normally found in emergent aquatic wetlands. If water levels were to be stabilized at these relatively low levels, the current emergent aquatic wetland community will likely change and be dominated by wet meadow and invasive species and the emergent aquatic plant community will shift lakeward.

3.4. Task 4 – Water Quality Monitoring

Water quality monitoring was performed on a monthly basis from April through October of 2003. The monitoring locations were consistent with the locations monitored during 2001 and 2002. The data was collected from April 18, 2003 to October 13, 2003 on a monthly schedule. Care was taken to collect data on days that had wind velocities below 15 miles per hour (mph) and normally below 10 mph. Tables 1-1 through 1-4 present the 2003 data collected and the 2001 and 2002 data is included in Appendix C.

The data indicates that water levels rose during the month of May to the annual high of 777.45 msl on May 20 and declined to near summer target elevations by June 1. Water levels remained in the summer target range except for a four-week stretch from mid-August to mid-September when water levels dropped below 776.00 msl due to drought-like conditions and work on the Indianford Dam. Water temperatures rose from April through June then declined slightly in July and rose again to the annual high temperature of 76°F in August. Water temperatures then gradually dropped in September and October. The warmest month was August with water temperature in the mid to upper 70°F range.

Algae blooms began in June and persisted through October. Secchi disc readings varied from 2.0 feet to 1.0 feet or less from July through October lake wide. Secchi readings have generally been the greatest during the month of June during 2001 and 2002 and have occurred at water level elevations greater than 777.00 msl, however Secchi readings greater than 1.5 feet have occurred during September and October. In 2003, the greatest Secchi depth readings were in May (two locations), June (one location) or August (one location). Evaluation of the water quality data revels that there is not a strong correlation between Secchi readings greater than 1.5 feet and any other parameter. What does this tell us about the lake?

Dissolved oxygen concentrations (DO) near or below 4 milligrams per Liter (mg/L) were recorded at the Outlet upstream of STH 59 during June. The lowest recorded DO was in

at the Outlet on June 30, 2003 at a level of 4.15 mg/L. The highest recorded DO was 12.87 mg/L in Haights Bay on May 14, 2003. Generally, DO levels greater than 10 mg/L were observed when water temperatures were below 55°F cooler early and late in the season.

4.0 RECOMMENDATIONS

After evaluation of the data collected as part of the 2001, 2002 and 2003 Lake Planning Grants and research regarding management options in impoundments, RSV has the following recommendations for further study.

- Reinstate the Volunteer Lake Monitoring Program.
- Continue to monitor aquatic vegetation on an annual basis for the purposes of assessing the trends in aquatic vegetation stands in the lake.
- Continue to monitor water quality in Lake Koshkonong to assess the trends in water quality throughout the temperate time of the year.
- Continue to collect information on the wetland and shoreline losses as part of the cooperative Lake Study with WDNR to assess the trends in erosion.
- Continue to work and cooperation with WDNR in preparation of a comprehensive lake management plan for Lake Koshkonong.
- Research Federal and State programs to reduce the amount of nutrients and sediments that are being discharged into the Rock River to reduce the nutrient loading.

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Table 2.1 2001 Lake Monitoring Data for Haight's Bay, Lake Koshkonong

Water					2'				4'			
DATE	Elevation [1]	Total Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO
5/29/2001	777.63	4.0			19.2	9.03	541	16.81	19.1	8.92	543	16.71
6/15/2001	777.75	4.2	3.00	Brown	23.5	8.28	589	3.58	23.8	8.33	585	3.48
6/25/2001	778.47	4.5	2.50	Green	22.9	8.34	562	6.28	22.9	7.95	514	5.65
7/11/2001	776.89	3.5	0.75	Green	23.1	8.86	583	5.35				
7/24/2001	776.16	2.9	0.50	Green	28.2	8.94	434	9.69				
8/6/2001	776.37	2.9	0.50	Green	26.9	8.96	545	6.92				
8/20/2001	776.21	2.8	0.50	Green	19.8	9.08	556	7.58				
9/13/2001	776.92	3.9	1.25	Green	20.4	8.71	609	9.21				
9/27/2001	777.22	4.5	1.00	Green	12.0	8.65	653	9.22	12.1	8.52	640	8.23
10/11/2001	776.43	3.8	1.50	Brown	11.6	8.88	684	10.42				
10/24/2001	776.85	3.8	1.50	Brown	14.1	8.41	638	11.63				

[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235 located 4.5 miles northeast of Newvil
Temperature is presented in degrees Celsius (^{0}C).
pH is presented in standard pH units.
Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).
DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).

Table 2.2 2001 Lake Monitoring Data for the Outlet, Lake Koshkonong

Water					2'				4'				6'			
DATE	Elevation [1]	Total Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO	Temp	pH	Cond	DO
5/29/2001	777.63	6.0			18.5	8.10	615	4.60	18.3	8.15	615	4.57	18.2	8.16	617	4.53
6/15/2001	777.75	6.0	4.00	Brown	23.3	8.16	609	3.25	23.5	8.19	604	3.12	23.6	8.20	604	3.05
6/25/2001	778.47		2.00	Green	23.3	8.43	543	7.34	23.2	8.43	546	7.21	23.1	8.45	550	7.06
7/11/2001	776.89	6.0	1.00	Green	23.1	8.85	567	6.04	23.9	8.83	560	5.51	24.0	8.24	559	4.78
7/24/2001	776.16	4.9	1.00	Green	28.0	8.85	538	7.01	28.0	8.82	544	5.40				
8/6/2001	776.37	5.5	0.50	Green	26.6	9.03	526	6.11	26.7	9.02	526	5.14				
8/20/2001	776.21	5.0	0.50	Green	20.7	9.16	534	5.45	20.5	9.14	536	5.25				
9/13/2001	776.92	5.8	1.25	Green	19.8	8.45	658	6.90	19.8	8.49	658	6.78				
9/27/2001	777.22	6.0	1.00	Green	12.3	8.84	677	9.04	12.5	8.84	675	8.92	12.6	8.20	669	7.63
10/11/2001	776.43	5.2	1.25	Green	12.1	8.93	653	9.13	12.2	8.93	651	8.74				
10/24/2001	776.85	5.3	1.25	Brown	13.2	9.06	640	12.96	13.1	9.06	654	13.06				

[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235 located 4.5 miles northeast of Newville

Temperature is presented in degrees Celsius (^{0}C).

pH is presented in standard pH units.

Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).

DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).

Table 2.3 2001 Lake Monitoring Data for Crescent Bay, Lake Koshkonong

Water					2'				4'			
DATE	Elevation [1]	Total Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO
5/29/2001	777.63	3.5			18.7	8.17	670	4.66	18.2	8.19	666	4.15
6/15/2001	777.75	3.5	2.00	Brown	23.2	8.35	590	5.41				
6/25/2001	778.47	4.1	1.50	Green	22.8	8.65	597	9.01	22.9	8.67	598	8.67
7/11/2001	776.89	3.0	1.25	Green	22.8	8.52	598	4.74				
7/24/2001	776.16	2.7	1.00	Green	26.2	8.69	688	7.80				
8/20/2001	776.21	2.6	0.50	Green	20.9	9.07	532	9.95				
9/13/2001	776.92	3.1	1.75	Green	20.3	8.60	665	6.21				
9/27/2001	777.22	3.9	1.75	Green	11.9	8.22	705	8.22				
10/11/2001	776.43	3.3	1.25	Green	12.1	8.75	657	9.60				
10/24/2001	776.85	3.0	1.25	Brown	13.2	8.33	785	8.52				

[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235 located 4.5 miles northeast of Newvil

Temperature is presented in degrees Celsius (^{0}C).

pH is presented in standard pH units.

Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).

DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).

Table 2.4 2001 Lake Monitoring Data for Blackhawk Island, Lake Koshkonong

Water					2'				4'				6'			
DATE	Elevation [1]	Total Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO	Temp	pH	Cond	DO
5/29/2001	777.63	5.0			17.9	8.83	630	13.76	17.8	8.84	628	13.76				
6/15/2001	777.75	5.1	1.00	Brown	23.5	8.09	539	6.21	23.7	8.08	536	5.97				
6/25/2001	778.47	5.9	1.75	Brown	22.7	8.09	536	7.18	22.7	8.08	536	7.02				
7/11/2001	776.89		1.00	Green	25.1	8.62	611	7.15	25.4	8.61	610	6.66	25.4	7.74	631	6.08
7/24/2001	776.16	4.8	1.00	Green	28.7	8.35	656	3.83	28.7	8.26	658	3.08				
8/20/2001	776.21	5.0	0.50	Green	21.9	8.30	659	6.10	21.9	7.97	637	5.74				
9/13/2001	776.92	5.5	1.00	Green	19.9	8.27	654	8.10	20.0	8.27	651	7.98				
9/27/2001	777.22	5.7	1.50	Green	12.6	8.24	733	9.46	12.9	8.24	729	9.33				
10/11/2001	776.43	4.9	1.25	Green	13.1	8.75	740	10.85	13.1	8.20	709	10.35				
10/24/2001	776.85	5.1	1.00	Brown	13.2	8.64	737	9.73	13.0	8.64	738	9.53				

[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235 located 4.5 miles northeast of Newville
Temperature is presented in degrees Celsius (^{0}C).
pH is presented in standard pH units.
Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).
DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).

Table 3.1 2002 Lake Monitoring Data for Haight's Bay, Lake Koshkonong.

DATE	Water	Total			2'				4'			
	Elevation[1]	Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO
04/17/02	778.20	5.5	1.75	Brown	19.2	9.10	556	9.68	19.1	NC	557	9.66
05/14/02	777.42	5.0	1.00	Brown	8.9	7.99	582	9.46	9.2	7.8	581	9.32
06/17/02	777.75	4.9	1.50	Br/Gr	20.5	8.68	557	13.67	20.0	8.58	588	14.49
07/16/02	776.20	3.0	1.00	Green	25.5	8.74	542	8.87				
08/16/02	776.25	2.9	1.00	Green	22.1	8.42	619	4.05				
09/12/02	776.26	3.1	1.00	Green	18.6	8.61	662	5.61				
10/15/02	776.19	3.0	1.00	Green	8.8	9.03	570	14.06				

Temperature is presented in degrees Celsius (^{0}C).
pH is presented in standard pH units.
Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).
DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).
NC - Not Collected due to malfunction of submersible pH probe. Surface pH measurement collected with backup pH unit.
1 Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235.

Table 3.2 2002 Lake Monitoring Data for the Outlet, Lake Koshkonong.

DATE	Water	Total			2'				4'				6'			
	Elevation[1]	Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO	Temp	pH	Cond	DO
04/17/02	778.20	7.0	1.75	Brown	18.2	9.00	579	11.25	18.1	NC	581	11.20	18.0	NC	581	11.10
05/14/02	777.42	6.5	1.00	Brown	9.5	8.45	572	10.13	9.7	8.73	572	10.1	9.7	8.82	572	9.98
06/17/02	777.75	6.3	3.00	Green	20.5	8.42	611	7.41	20.3	8.43	614	7.3	20.2	8.43	615	7.15
07/16/02	776.20	4.8	1.00	Green	26.1	8.92	533	10.61	25.9	8.87	536	9.44				
08/16/02	776.25	4.9	1.00	Green	21.8	8.82	573	4.72	22.1	8.90	571	4.31				
09/12/02	776.26	4.8	1.50	Green	19.1	8.54	651	4.13	19.6	8.51	647	4.16				
10/15/02	776.19	4.7	2.00	Green	8.9	8.67	571	9.27	8.8	8.67	571	9.40				

Temperature is presented in degrees Celsius (^{0}C).
pH is presented in standard pH units.
Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).
DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).
NC - Not Collected due to malfunction of submersible pH probe. Surface pH measurement collected with backup pH unit.
[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235.

Table 3.3 2002 Lake Monitoring Data for Crescent Bay, Lake Koshkonong.

DATE	Water	Total			2'				4'				6'			
	Elevation[1]	Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO	Temp	pH	Cond	DO
04/17/02	778.20	6.0	1.75	Brown	18.8	9.10	558	9.75	18.7	NC	561	9.84	18.7	NC	561	9.84
05/14/02	777.42	3.9	1.50	Brown	9.5	8.44	669	10.95								
06/17/02	777.75	3.7	3.7+	Br/Gr	20.5	8.32	633	6.90	20.0	8.46	641	8.03				
07/16/02	776.20	3.3	1.00	Green	24.4	8.80	618	10.81								
08/16/02	776.25	3.5	1.00	Green	21.2	8.57	647	5.12								
09/12/02	776.26	3.3	3.00	Green	18.8	8.45	695	2.17								
10/15/02	776.19	3.2	1.00	Br/Gr	8.8	8.79	598	10.80								

Temperature is presented in degrees Celsius (^{0}C).
pH is presented in standard pH units.
Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).
DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).
NC - Not Collected due to malfunction of submersible pH probe. Surface pH measurement collected with backup pH unit.
[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235.

Table 3.4 2002 Lake Monitoring Data for Blackhawk Island, Lake Koshkonong.

DATE	Water	Total			2'				4'				6'			
	Elevation[1]	Depth	Secchi	Color	Temp	pH	Cond	DO	Temp	pH	Cond	DO	Temp	pH	Cond	DO
04/17/02	778.20	4.5	1.50	Brown	19.8	8.80	635	10.81	19.7	NC	641	10.66				
05/14/02	777.42	6.0	1.50	Brown	9.9	8.78	594	11.81	9.9	8.81	606	11.99	9.9	8.76	613	12.05
06/17/02	777.75	5.8	3.00	Br/Gr	20.4	8.49	597	8.76	20.3	8.47	599	8.15	20.1	8.40	611	7.56
07/16/02	776.20	5.8	1.00	Green	25.0	8.89	591	12.48	25.0	8.6	639	9.09				
08/16/02	776.25	5.8	1.00	Green	23.5	8.51	643	5.98	23.2	8.61	641	5.00				
09/12/02	776.26	5.7	1.00	Green	19.7	7.96	773	5.85	20.2	8.01	752	5.62				
10/15/02	776.19	5.6	1.00	Green	10.7	8.12	582	13.61	10.4	8.54	583	13.47				

Temperature is presented in degrees Celsius (^{0}C).
pH is presented in standard pH units.
Conductivity (Cond) represents specific conductance and is presented in microSiemans per centimeter (uS/cm).
DO represents dissolved oxygen and is presented in milligrams per liter (mg/l).
NC - Not Collected due to malfunction of submersible pH probe. Surface pH measurement collected with backup pH unit.
[1] Measurement is above mean sea level, and represents mean value for the day. USGS gage number 05427235.