Management Plan:
Miljala Channel Tributary Watershed,
Town of Lake Mills, WI

April 2014

Final Report for
Wisconsin Department of Natural Resources
Lake Planning Grants LPL-1412-11 and LPL-1413-11

Project #1511a

In cooperation with
The Rock Lake Improvement Association

Jefferson County Land and Water Conservation Department

Montgomery Associates
Resource Solutions, LLC • ma-rs.org

COTTAGE GROVE OFFICE | 119 South Main Street, Cottage Grove, WI 53527 | 608-839-4422
MILWAUKEE OFFICE | 10437 Innovation Drive, Suite 305 | Wauwatosa, WI 53226 | 414-380-1044

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Project Contacts

Rock Lake Improvement Association

Larry Clark
Grant Committee Chair
P.O. Box 255
Lake Mills, WI 53551
(920) 648-2552
julie.clark@charter.net
http://www.rocklake.org/

Jefferson County Land and Water Conservation Department

Patricia Cicero
Water Resources Management Specialist
311 S. Center Avenue
Jefferson WI 53549-1701
(920) 674-7121
patriciac@jeffersoncountywi.gov

Montgomery Associates: Resource Solutions, LLC (MARS)

Steve Gaffield
119 South Main Street
Cottage Grove, WI 53527
(608) 839-4422
steve@ma-rs.org

1 Introduction

The Miljala Channel is located on the western shore of Rock Lake, in the Town of Lake Mills, Wisconsin (Figure 1). This management plan for the watershed draining to the Miljala Channel was developed by Montgomery Associates: Resource Solutions, LLC (MARS) in cooperation with the Rock Lake Improvement Association and the Jefferson County Land and Water Conservation Department. It describes a planning level approach to managing nonpoint source sediment, bacteria and phosphorus loads to the Channel and Rock Lake. Development of this plan was funded by Wisconsin Department of Natural Resources (DNR) Lake Planning Grants LPL-1412-11 and LPL-1413-11, and this report documents work conducted for these grants.

The Miljala Channel receives drainage from an agricultural ditch with a watershed of 177 acres. Land in the watershed includes active agricultural fields, natural areas of Korth Park, and limited residential areas.

Figure 1. Miljala Channel watershed location.[1]

2 Grant Activities

2.1 Pollutant Source Investigations in 2009 and 2010

[1] Reprinted from "The Miljala Channel of Rock Lake: Sediment Control and Water Quality Improvement", Water Resources Management Workshop, Nelson Institute for Environmental Studies, University of Wisconsin-Madison, 2012.

Initial activities for the grants to identify pollutant sources and develop mitigation recommendations were conducted in 2009 and 2010 by the Rock Lake Improvement Association, the Jefferson County Land and Water Conservation Department, Underwater Habitat Investigations, LLC, and Hey and Associates, Inc. These activities are documented in a report submitted to the DNR in 2010[2]. Information in that report has been taken into consideration in development of the conclusions and recommendations presented in this document.

2.2 University of Wisconsin-Madison Water Resource Management Practicum

During the 2011 – 2012 academic year, the University of Wisconsin – Madison Nelson Institute for Environmental Studies Water Resources Management Workshop (UW Workshop) investigated pollutant sources and mitigation alternatives for the Miljala Channel watershed[3]. The graduate students in the workshop reviewed available information about the watershed, monitored surface water and groundwater quality and quantity, and analyzed several pollution control strategies under the supervision of Professors Kenneth Potter and Jean Bahr. Their work is incorporated in the conclusions and recommendations presented in this report.

2.3 Wetland Delineation

A wetland boundary delineation was conducted by Eco-Resource Consulting, LLC in part of the watershed where construction of pollution control practices was recommended by the Water Resources Management Workshop, and for which access was granted by land owners. The purpose of the delineation was to provide information on the location of regulatory wetlands to identify permitting constraints on future activities, and to provide insights into hydrologic and soil conditions in the watershed. The complete wetland delineation report is included in Appendix A.

Wetland boundary location (on the land that was surveyed) is shown on Figure 2. The boundary is generally close to the ditch except for two more extensive wetland areas in Korth Park and immediately upstream of Cedar Lane. The ditch channel is typically incised 5 – 6 feet into the muck soils, and this has presumably lowered the water table and reduced the extent of wetlands.

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[2] Rock Lake Improvement Association, 2010. Final Report: Water Quality Monitoring and Evaluation of Pollutant Sources withing the Southwest Subwatershed of Rock Lake.

[3] University of Wisconsin - Madison, 2012. The Miljala Channel of Rock Lake: Sediment Control and Water Quality Improvement. Nelson Institute for Environmental Studies, Water Resources Management Workshop. Available online at: http://www.nelson.wisc.edu/docs/miljala_channel_8.9.13.pdf

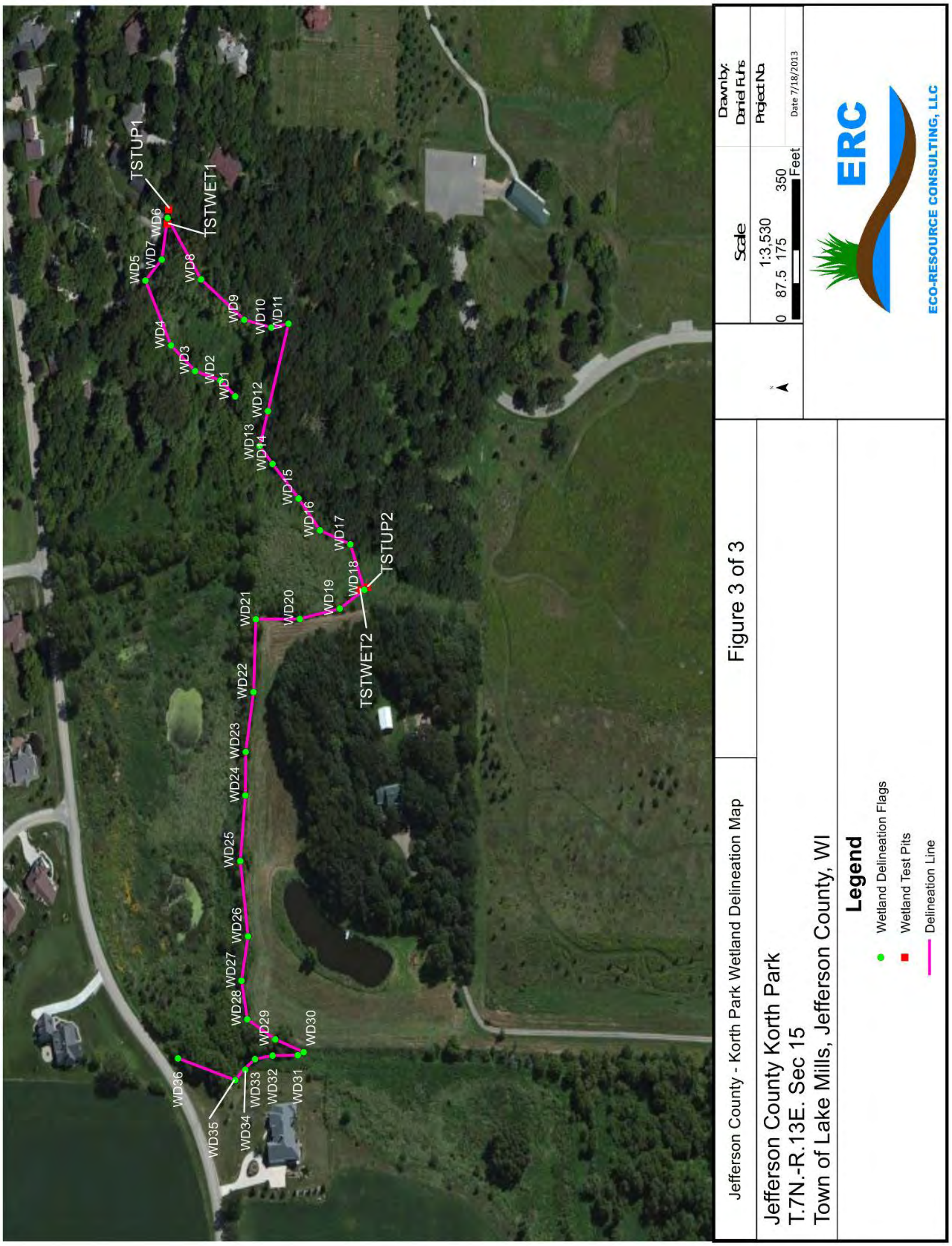

Figure 2. Wetland boundary delineation. (See appendix A for full report.)

2.4 Topographic Survey

The Jefferson County Surveyor conducted an elevation survey along several transects crossing the ditch (Figure 3). This provides data useful in evaluating pollution control alternatives. Although the survey was limited to several transects, this provides information on the longitudinal slope of the ditch (Table 1). It also provides a check on the accuracy of Jefferson County's LiDAR mass points, which provide much greater coverage of the project area. The LiDAR point elevations are typically about 0.5 to 1 foot higher than the elevations of nearby survey points; thus they appear to provide a reasonable representation of the land surface but should not be used to determine precise elevations.

Table 1. Ditch slope between Jefferson County survey transects.

Transects	Slope (%)
1-2	0.41
2-3	0.32
3-4	0.55
4-5	0.51
5-6	0.25

Figure 3. Topographic survey transects.

2.5 Inventory of Birds, Mammals, Reptiles, and Amphibians

Surveys of birds and amphibians were performed by volunteers, students, and professionals. In addition, other animals (including mammals and reptiles) were recorded when project participants were on site for other work.

Birds

On June 2, 2011, Nolan Kollath, an experienced birder and naturalist, performed a bird survey in the study area from 10:30 am to 12:15 pm. A total of 25 species were present (Table 2). The red-headed woodpecker is listed as a species of Special Concern in Wisconsin. Although they are declining in Wisconsin, they remain common in the southern part of the state. The red-headed woodpecker is a migratory bird that arrives in Wisconsin in April/May, nests in May/June, and leaves the state in September/October. An adult often will return to the same breeding site each year. They occur regulary in oak savannas and upland habitats with scattered trees, and in floodplain forests. The red-headed woodpecker identified in the survey was found in the savanna of Korth Park.

Table 2. Results of the frog and toad survey.

Species	Number of birds documented
Red-winged Blackbird	26
Canada Goose	6
American Robin	5
Common Grackle	5
Song Sparrow	5
Yellow Warbler	5
Common Yellowthroat	4
Northern Cardinal	4
American Crow	3
American Goldfinch	3
Rose Breasted Grosbeak	3
Brown-headed Cowbird	2
Indigo Bunting	2
Kingbird	2
Baltimore Oriole	1
Barn Swallow	1
Black-capped Chickadee	1
Gray Catbird	1
Great Crested Flycatcher	1
Green Heron	1
House Finch	1
Kestrel	1
Mourning Dove	1
Red-headed Woodpecker	1
Tufted Titmouse	1

Frogs and Toads

The frogs and toads in the watershed were surveyed by Nolan Kollath and Lee Gatzke, a volunteer. They followed the protocols described in the Wisconsin Frog and Toad Survey manual developed by the Wisconsin Department of Natural Resources. Five sampling sites were chosen and were visited in May, June, and July of 2011. This timeframe was selected because different species are active during different months. The 5 locations are depicted in Figure 4.

There were 7 species of frogs and toads indentified: chorus frog, spring peeper, Eastern gray tree frog, Cope's gray frog, American toad, green frog, and American bullfrog (Table 3).

Table 3. Results of the frog and toad survey.

Location	Call Index*								
	May 1, 2011		June 2, 2011		July 5, 2011				
	Chorus Frog	Spring peeper	Eastern gray treefrog	Cope's gray treefrog	American toad	Eastern gray treefrog	Cope's gray treefrog	Green frog	Bullfrog

1					1			1	1
2									
3	2	2	1	1		1	2	1	
4	1	2	1				1	1	
5	1								

* The call index is an approximate estimate of the numbers of calling males of a particular species, according to the following index values:
1 – Individuals can be counted. There is space between calls.
2 – Calls of individuals can be distinguished but there is some overlapping of calls.
3 – Full chorus. Calls are constant, continuous and overlapping.

The habitat preference and additional information about each species is listed below:

American Bullfrog – found in any permanent body of water including lakes, ponds, rivers, and creeks. Tadpoles prefer habitats with tall, undisturbed shoreline vegetation and abundant submergent and floating aquatic vegetation.

American toad – live in a wide variety of habitats ranging from prairies to wetlands to forests. They are somewhat adapted to urban settings where they occasionally persist in gardens and parks. They lay eggs in long strands, unique among Wisconsin's amphibians. Toad tadpoles form schools, which is also unique among Wisconsin frogs.

Chorus frog – found in marshes, wet prairies, river-bottom forests, shrub wetlands and old moist fields.

Cope's gray frog – live primarily along forest or woodlot edges and in oak savannahs, favoring brush over trees.

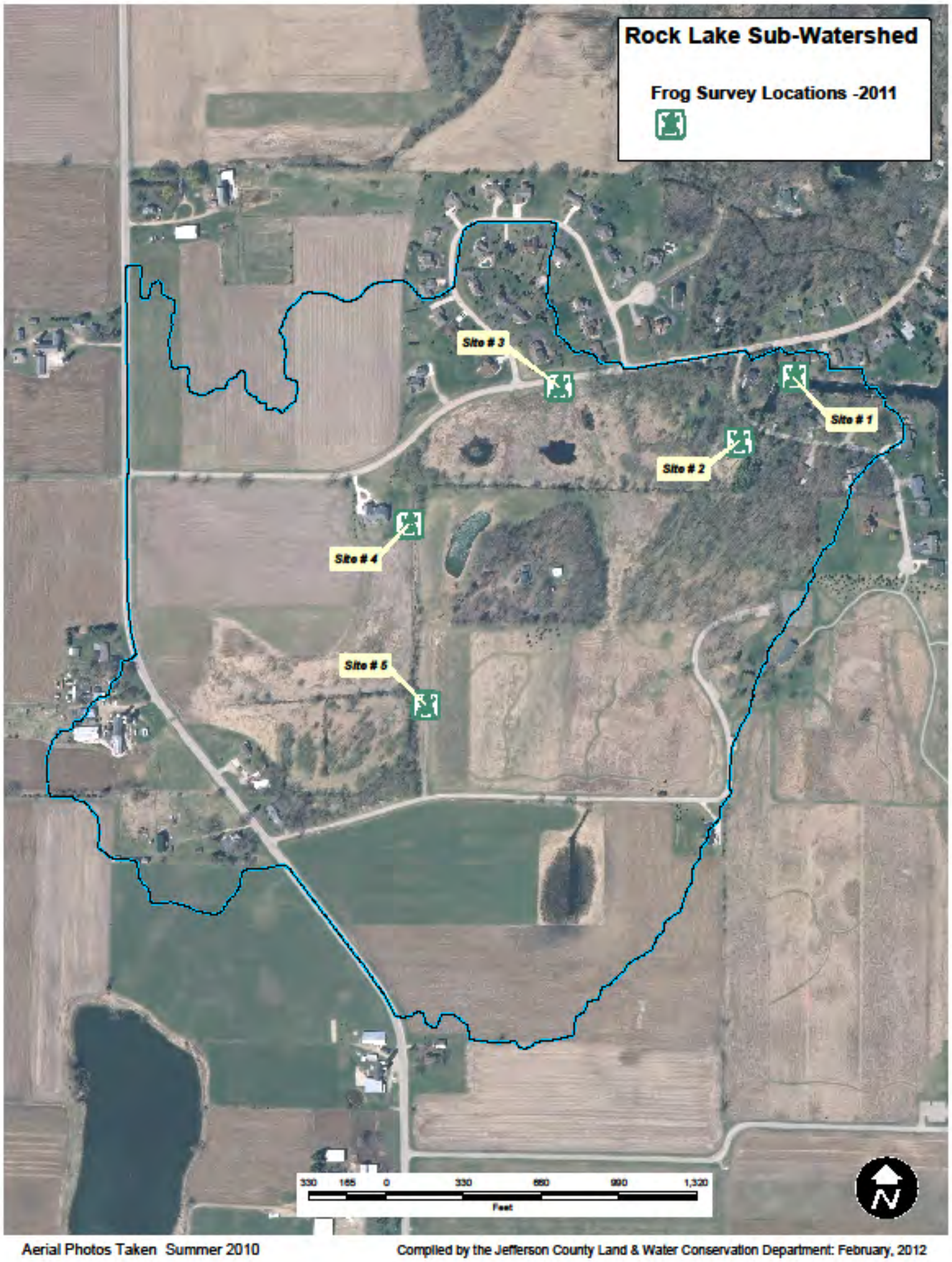

Figure 4. Frog and toad survey locations.

Eastern gray tree frog – found in forest and large woodlot dwellers. They breed in semi-permanent to permanent wetlands. The chameleon-like eastern gray treefrog changes color with temperature or substrate color.

Green frogs – permanent bodies of water including deep marshes, large ponds, and lakes. Eggs are laid in a mass attached to floating vegetation on the water's surface. Their young often overwinter as tadpoles. Studies show that heavy shoreline development significantly reduces populations, primarily because of lost natural shoreline vegetation.

Spring peeper – live primarily in moist forests and larger woodlots and breed in wetlands within and adjacent to these habitats. They most successfully reproduce in fishless wetlands. The Wisconsin Frog and Toad Survey indicate that this species is in decline, even though they are still widespread and common.

The American bullfrog (*Rana catesbeiana*) is listed as a State Special Concern species. In Wisconsin, bullfrogs appear to favor oligotrophic to mesotrophic waters, often breeding where dense submergent vegetation filters out the majority of the suspended solids. Adult bullfrogs overwinter in water to avoid freezing. Bullfrogs are active from April through mid-October. They breed from mid-May through late July or later. Females can lay up to 20,000 eggs in large films among floating vegetation on the water's surface. Larvae overwinter before transforming the following year or, or in rare situations, in their second full year.

Macroinvertebrates

Students in Quentin Carpenter's UW-Madison Environmental Studies Field Ecology Workshop identified macroinvertebrates in the ditch and in another stream north of the watershed in the Fall of 2011. By identifying macroinvertebrates, a biotic index is determined that gives an indication into the health of the stream. The Biotic index scores are: 1.0-2.1 Poor, 2.1-2.6 Fair, 2.6-3.5 Good, and ≥ 3.6 Excellent.

The Miljala watershed stream had a biotic index of 2.0 which indicates poor conditions. However, dragonfly larvae were found, and this species is semi-sensitive to pollutants. The stream to the north of the watershed had a biotic index of 1.75 and included midge larvae, crane fly larvae, and tubifex worms. Previous biotic indices taken at this stream to the north in 2009 and 2010 ranged from 1.0-1.8.

Other Species

During the course of the study, other species that were observed include snapping turtles, muskrats, deer, sandhill cranes, mallards, and raccoons.

2.6 Water Clarity Measurements

The initial project scope included the measurement of water clarity in the Miljala navigation channel where the channel outlets to the lake. The readings could then be compared to the clarity at the deep hole of the lake. The intent was that this data could be "used to understand how discharges from the channel may be impacting near shore habitats for fish and aquatic plants."

Upon further consideration of this task, it was determined that the comparison of near-shore and deep-lake water clarity would not be an equal comparison. Water clarity readings in a shallow and productive bay will most likely be less than the water clarity at the deep hole which is 60 feet deep. Therefore, the project team decided to take water clarity readings in the channel, at the mouth of the channel and in other shallow bays on the west side of the lake.

Sampling was done on July 27, 2012 between 10:15 am and 11:45 am. The weather was partly cloudy with air temperatures approximately 75° F. The water level at the outlet dam was recorded as 827.32 ft. A 120 cm transparency tube was used to measure the clarity. The results are shown in Table 4.

Table 4. Water Clarity Measurements

Channel or Lake Location	Specific Location	Water Clarity
Miljala Channel	Downstream of turbidity curtain	97.3 cm
	Mid-length of channel	85.3 cm
	End of channel (not in lake)	95.0 cm
Lake	Out from channel	88.6 cm
	North of mouth of channel (2nd house)	≥ 120 cm
	Korth Bay, out from shelter	≥ 120 cm
	Out from Elm Point channel	≥ 120 cm
	Out from Glacial Drumlin Trail bridge	≥ 120 cm
	Schultz Bay (north west)	≥ 120 cm

The data show that the water clarity in the lake is better than the clarity in the navigation channel and in the lake just out from the channel. It is typical for sediment particles to drop out of the water column at the mouth (where the channel outlets into the lake). And the data seem to support that process. However, it is important to note that water clarity can also be impacted by algae and any sediment disturbance. Rough fish and boat motor wakes can cause sediment to be mixed into the water column. Therefore, the lower water clarity in the channel could be caused by these localized disturbances.

It is important to note that all of the clarity measurements taken in the channel and the lake are considered very good. As such, these measurements are not suggestive of negative impacts to the fish or aquatic life in the channel or the lake. Alternatively, poor water clarity that is sustained over a long time can have negative impacts to fish and other aquatic life.

Another important note is that the data reported in the table above represents one point in time. There are several factors that can impact the clarity of the water for a short duration of time. On June 6, 2009, the clarity at the middle of the navigation channel was measured as ≥ 120 cm.

2.7 Trophic State Model of Rock Lake

The original grant for the project included an effort to run a trophic state model for Rock Lake. When the grants were being amended, the Land and Water Conservation Department researched the need for this modeling.

A trophic state model uses estimated and measured data to estimate the phosphorus loading to a lake. The estimated data includes land use percentages, annual runoff volumes, and annual amount of precipitation and evaporation. The measured data includes watershed area, lake surface area, lake volume and the average phosphorus measurement at the deep hole.

A trophic state model was completed for the Rock Lake chain of lakes by the Department of Natural Resources as part of the Water Resources Appraisal for the Rock Lake Priority Lake Project, July 1997 (Table 5). Inputs included Rock Lake outflow volume (2,683 acre/feet or 4.4 watershed inches) and land uses. Calibration of the model was done with deep hole data plus land use surveys. More information can be obtained from the 1997 report.

Table 5. Results of trophic state model completed by the DNR in 1997.

Subwatershed	Drainage Area (acres)	Estimated Phosphorus Load (lbs/yr)	Estimated Outflow Phosphorus Load (lbs/yr)
Mud Lake subwatershed	4,609	2,309	491
Marsh Lake subwatershed	1,679	581	259
Rock Lake subwatershed	1,582	1,430	95

The Water Resources Appraisal report also includes a discussion of the results of internal phosphorus load sampling which was reported as low. The low level of internal phosphorus loading is primarily due to the calcium carbonate in the lake.

DNR Water Resources Appraisal report author Dave Marshall stated that an update to this model is not necessary, and an update would not produce any new information. University of Wisconsin-Madison Professor Ken Potter stated that these models are estimates of loading based on inputs that are also estimates. John Panuska, the Wisconsin Department of Natural Resources modeler who implemented the 1997 model, also stated that updating the model would not provide any more information that was obtained from the original model. He did not recommend that the model be updated.

Research was done to determine if there was data output for every subwatershed contained in the 3 main watersheds of Mud, Marsh, and Rock Lakes. This information would be helpful for comparing the Miljala subwatershed to other subwatersheds in the basin. However, the data was no longer available from the Department of Natural Resources.

2.8 Drainage Tile Survey

The grant project included a survey to determine if any drainage tiles discharge to the ditch. On April 10, 2011, staff from the Jefferson County Land and Water Conservation Department and volunteers from the Rock Lake Improvement Association walked the length of the ditch to search for tile drains. The survey was done when vegetation was not growing in order to have more visibility. The only drainage tile that was found was the one that was already known – a large metal pipe that outlets to the ditch from Korth Park.

2.9 Private Well Monitoring

As part of the grant, well water sampling kits and instructions were made available to residents in the Miljala watershed and also in the Rock Lake watershed. If citizens decided to share the data with RLIA, then any nitrate nitrogen problems would be plotted. Well monitoring kits were given to at least 9 landowners (both in and out of the Miljala watershed) at the RLIA annual meeting in 2012. None of the homeowners shared their sample analysis.

2.10 Regulatory Ordinance Review

The grant project included a review of local stormwater and erosion control ordinances to recommend any necessary changes to the language and enforcement procedures.

The UW-Madison students reviewed the Town of Lake Mills' Land and Subdivision Regulations. Their findings are found on pages 47 and 48 of their report and are summarized below. The Land and Water Conservation Department reviewed the ordinances of the City of Lake Mills and Jefferson County.

The State standards and rules associated with stormwater management are located in Chapter NR 151 of the Wisconsin Administrative Code. This State rule was used when reviewing the local ordinances. Under NR 151, developments must use practices that will achieve a post-development runoff rate that is equal to or less than the runoff from a one-year, 24-hour storm and a 2-year, 24-hour storm during pre-development conditions.

NR 151 also includes standards for infiltration of stormwater:

- Low impervious developments (that have ≤40% connected impervious areas) are required to have post-infiltration of runoff volumes be at least 90% of the pre-development infiltration volume.
- Moderate impervious developments (that have 40% to 80% connected impervious areas) are required to have post-infiltration of runoff volumes be at least 75% of the pre-development infiltration volume.
- High impervious developments (that have >80% connected impervious areas) are required to have post-infiltration of runoff volumes be at least 60% of the pre-development infiltration volume.

The Town of Lake Mills' ordinance regulates peak runoff rates for the 10-year storm events. It also contains language that regulates impervious surfaces. It states that impervious surfaces shall not exceed 20% of the entire lot unless best management practices are implemented to control 90% of the post construction runoff.

It should be noted that the Jefferson County Zoning Department is planning to update their ordinances in 2014. Though the ordinance language isn't up to date, the County currently requires that developments follow the NR 151 rules. They require that the applicant submit proof that they obtained all the necessary DNR permits. In addition, if the size of the development is less than the permit threshold for the State, the County still requires the applicant to follow the State guidelines.

The City of Lake Mills has an administrative rule entitiled Regulation of Stormwater Runoff. There is language in this rule that states that the City's requirements do not pre-empt any stormwater management regulation in NR 151.004. This particular section in NR 151 specifically addresses the situation when State performance standards will not be sufficient to achieve water quality standards. In order to be more inclusive of the State's rules, the NR 151 reference in the City's rule should be changed to be "the Non-Agricultural Performance Standards contained in Subchapter III of NR 151."

Based on the review of the various ordinances, the following actions are recommended:

Runoff Rates

- The Town of Lake Mills should update their ordinance to specifically reference the NR 151 requirements because the current ordinance regulates peak runoff rates for only the 10-year storm events.
- Jefferson County should update their ordinance to specifically reference the NR 151 requirements.
- The City of Lake Mills should update their rule to specifically reference the NR 151 requirements.

Infiltration Standards

- The Town of Lake Mills should update their ordinance to specifically reference the NR 151 requirements.
- Jefferson County should update their ordinance to specifically reference the NR 151 requirements.
- The City of Lake Mills should update their rule to specifically reference the NR 151 requirements.

2.11 Public Participation

Stakeholder engagement is critical to successful implementation of nonpoint source pollution mitigation measures on public and private land in the Miljala Channel watershed. Through this project, numerous public meetings have been held to provide information and solicit input. These public participation activities are summarized in Appendix B.

2.12 Technical Advisory Committee

The grant stated that a technical advisory committee would be convened. The RLIA definitely obtained advice from a range of experts throughout the project. However, there wasn't a committee per se that was convened. The following people and entities provided technical advice and their expertise:

- Eco-Resource Consulting, LLC: Stephen Hjort, Senior Biologist/Principal
- Jefferson County Planning and Zoning Department: Michelle Staff,
- Underwater Habitat Investigations, LLC: Dave Marshall, Aquatic Biologist
- University of Wisconsin-Madison: Jean Bahr, Professor of Geoscience; Ken Potter, Professor of Civil and Environmental Engineering and Environmental Studies; Quentin Carpenter, Senior Lecturer in Environmental Studies
- US Army Corps of Engineers: Stacy Marshall, Biologist/Program Manager
- Wisconsin Department of Natural Resources: Susan Graham, Water Resources Management Specialist; Travis Schroeder, Water Regulations and Zoning Specialist
- Wisconsin Waterfowl Association: Peter Ziegler, Project Director; Jeff Nania, retired

3 Pollutant Source Identification Results

3.1 Sediment

The Miljala Channel has been dredged to remove sediment in 1998, 2005, 2009 and 2011. A turbidity barrier was put in the channel downstream of the Cedar Lane culvert in 2009. The UW Workshop collected samples of the sediment deposited behind the turbidity barrier between 2009 and 2011 and found it to be predominately sand with some muck. The UW Workshop identified erosion of the ditch bed and banks between monitoring sites 2 and 5 as the major sediment source, as did the 2010 report. It also noted gullies that appeared to be delivering sediment from the cultivated field west of the ditch.

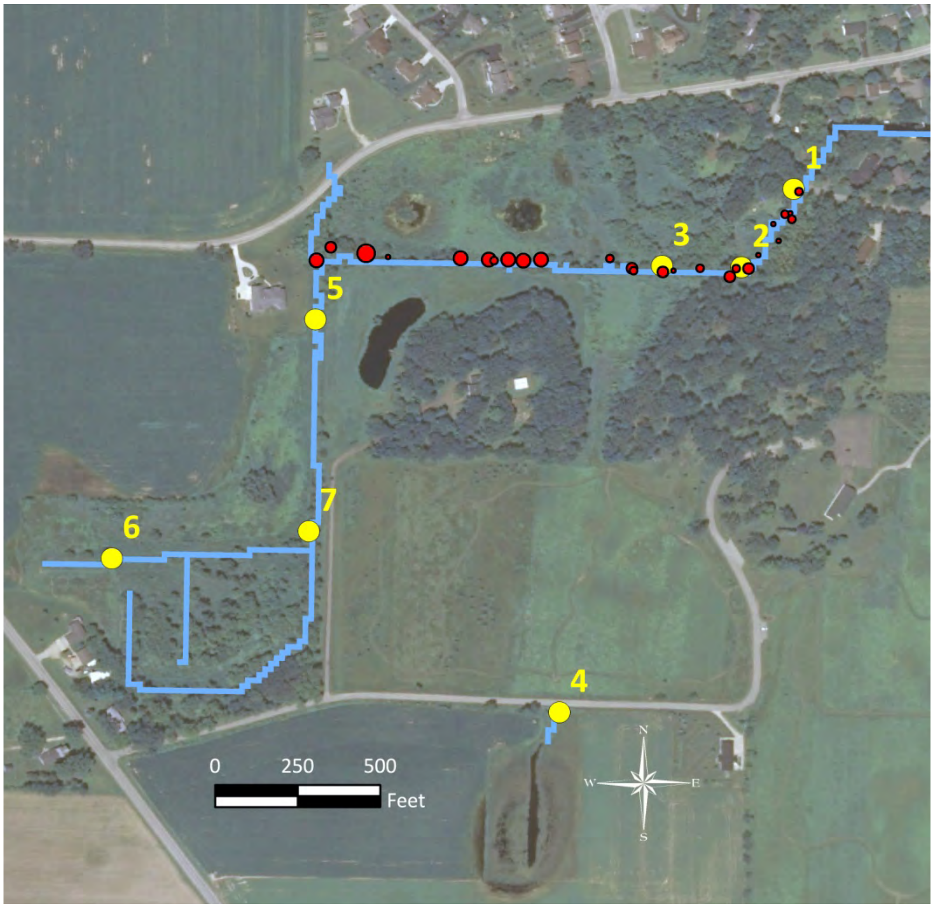

Figure 5. Surface water sampling sites used by the UW-Madison workshop are shown in yellow. Red circles indicate exposed sediment in the ditch bank, with the diameter of the circle proportional to the area of exposed soil.

MARS estimated the volume of sediment that accumulated behind the turbidity barrier between 2009 and 2011 based on field estimates of the area behind the barrier and the depth of dredging reported by local resident Wes Dawson (7 ft). Assuming the sediment accumulated to within 1 ft of the water surface implies a sediment thickness of 6 ft. An estimated 7,200 cubic feet of sediment was deposited during this two-year period (Table 6). For comparison, in 1995 R.A. Smith and Associates, Inc. estimated an annual sediment load to the lake of 41 tons/year from this watershed using the WINHUSLE model. At an approximate density of 100 lbs/cubic foot, this equates to 820 cubic feet per year of sediment. Reasons why the model estimate is higher than the load estimate based on data from 2009 – 2011 may be that (1) the model used a watershed area of 231 acres, but the UW-Workshop concluded that only 177 acres contribute flow to the ditch; (2) land use changes since the model was developed; (3) the likelihood that some sediment is transported past the turbidity barrier; and (4) imprecision in the model estimates.

Table 6. Estimated sediment volume behind turbidity barrier from 2009 – 2011.

Quantity	Amount
Channel width	40 ft
Distance from culvert to barrier	30 ft
Average sediment depth	6 ft
Total Volume	7,200 ft^3 270 yd^3
Equivalent annual volume	135 yd^3

3.2 Phosphorus

The UW Workshop collected phosphorus samples from the ditch during baseflow and stormflow conditions, and from shallow groundwater monitoring wells. Water samples from the ditch had high dissolved orthophosphate fractions: 62.7% during base flow and 77.6% during storm flow. In addition, the concentration of phosphorus increased upstream from Cedar Lane to locations adjacent to the cultivated field west of the ditch. Groundwater concentrations were considerably lower than concentrations in the ditch. The high dissolved fraction suggests a manure or fertilizer source, and the UW Workshop identified chicken manure spreading in the watershed as the most likely phosphorus source.

3.3 Bacteria

Elevated bacteria concentrations were found in samples collected by the UW Workshop and previous grant activities documented in the 2010 report. The Workshop found that bacteria concentrations were higher during runoff events than during baseflow conditions. This indicates that leaking septic systems are not likely to be a significant source of this bacteria, because storm runoff would be expected to dilute water from septic systems. The UW Workshop also noted higher concentrations of bacteria after extended warm, dry periods, suggesting growth of persistent bacteria populations in the soil that get flushed down the ditch in wet weather. No single source of bacteria could be identified by the UW Workshop. Manure spreading and wildlife were identified as likely sources of bacteria.

4 Alternatives

Numerous alternatives have been suggested to reduce the sediment, phosphorus and bacteria loads from the Miljala Watershed. Alternatives considered in this investigation are summarized in Table 1 and discussed in more detail in the following sections. Recommendations are based on effectiveness, feasibility and cost, emphasizing actions that can be implemented rather inexpensively and have multiple benefits.

Table 1. Summary of Pollution Reduction Alternatives

Alternative	Pollutants Controlled	Recommended Timing	Implementation Issues	Cost
Keep turbidity barrier in channel	Sediment	Until no longer needed	Structure needs repairs. Ongoing dredging necessary. Renewed dredging permit needed.	Moderate
Advocate nutrient management plan revision	Phosphorus Bacteria	Now	Requires cooperation of farmers and chicken facility.	No cost to RLIA
Promote stormwater "green infrastructure" to reduce runoff	Sediment Phosphorus	Now	Education needed to promote voluntary implementation of "green" stormwater infrastructure.	Low
Improve vegetated buffer	Sediment Phosphorus	Now	Landowner cooperation needed. Long-term vegetation maintenance required.	Low
Stabilize ditch banks	Sediment	When property access allows.	Landowner cooperation needed. Wetland restoration component needed for permitting.	High
Restore marsh	Sediment Phosphorus Bacteria	Same time as, or after, ditch bank stabilization	Landowner cooperation needed. Wetland restoration component needed for permitting. Upstream sediment load needs to be reduced first.	High

4.1 Keep Turbidity Barrier in Channel

Description

The turbidity barrier (Figure 6) can be kept in place in the channel below Cedar Lane until sediment has been controlled by other methods and the barrier is no longer needed. This would require continued dredging of sediment trapped upstream of the barrier. The frequency of dredging will depend on climatic patterns, particularly the number of large storms that occur each year because these events have been shown to transport much of the accumulated sediment. The channel was dredged in 2005 and 2009 before the turbidity barrier was installed in 2009, and again in 2011. This suggests that additional dredging may be needed every several years until other methods can begin to reduce the sediment load from the watershed.

Figure 6. Turbidity barrier in Miljala Channel

Effectiveness

The turbidity barrier appears to be an effective sediment trap, but its trapping efficiency declines as sediment accumulates behind it and the water becomes shallow. Once that occurs, much of the sediment from the ditch is carried over the barrier and into the channel. In addition, the barrier is not effective for reducing the dissolved phosphorus and bacteria loads to the rest of the channel and Rock Lake.

Implementation Issues

Continued maintenance of the turbidity barrier structure would be necessary, and trees and shrubs along Cedar Lane would need to be cleared to provide access for dredging equipment. A location for spreading the dredge spoils would also need to be arranged.

Leaving watershed conditions as-is will result in continued downward and lateral erosion of the ditch. This could impact property owners by loss of riparian land through bank erosion, and it would continue to impact existing wetlands by drawing down the water table.

The Wisconsin DNR has indicated that the existing permit for the turbidity barrier structure does not require renewal and will be applicable for the foreseeable future. However, a new permit will be required for future dredging, including approval of the dredge spoil disposal site.

Cost

The volume of sediment deposited behind the curtain is highly weather dependent. Therefore, the frequency of dredging that would be required is quite uncertain. As described in Section 3.1, the area behind the turbidity barrier filled with sediment in two years between 2009 and 2011, with an estimated 270 yd^3 of sediment removed. Predicting future dredging needs based on only two years of data is uncertain, but this is the best information available. In addition, the frequent dredging that has been required since 1998 suggests that it will continue to be required frequently for current watershed conditions and weather patterns. Table 7 summarizes the estimated cost of dredging and maintaining the turbidity barrier.

Table 7. Planning-Level Cost Estimate for Channel Barrier Maintenance and Dredging. Assumes 2-year dredging cycle.

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
1	Mobilization	1	LS	$1,000	$1,000
2	Dredge and haul soil	270	CY	$8	$2,200
3	Barrier maintenance allowance	1	EA	$1,000	$1,000
Subtotal					$4,200
Construction Cost with 30% Contingency					$5,500
Engineering and Permitting (~10%)					$500
Total Estimated Cost with Contingency for 2-year cycle					$6,000
Estimated Average Annual Cost					**$3,000**

4.2 Advocate Nutrient Management Plan Revision

Description

This alternative would involve making changes to the nutrient management plan to reduce or eliminate manure spreading on the farm field east of County Highway S and south of Shorewood Hills Road (Figure 7). These fields drain to the ditch on the Scheel property. Chicken manure is spread on these fields typically every other year. Discussions are in progress with the property owner, the farmer leasing the land, and the manure generating operation to evaluate the feasibility of reducing or eliminating manure spreading on this property. There are some elements of the nutrient management plan that should be updated, including the distance from the field to water. Now that the ditch has been deemed navigable by the DNR, the distance to water should be measured to the ditch, not to the lake. Soil samples are also required to be taken every 4 years. The current soil test (2011) lists the soil phosphorus as 93 ppm. This level is considered excessively high. As a DNR permitted facility, if the soil phosphorus is greater than 100 ppm, the phosphorus manure application rate cannot be more than 50% of the crop phosphorus removal over a 4-year time period.

Effectiveness

This action would reduce or eliminate the most prominent phosphorus source identified by the UW Workshop in the Miljala watershed.

Figure 7. Location of chicken manure spreading.

Implementation Issues

These fields are actively used for row crop agriculture (corn and soybeans), and the farmers involved in generating and spreading the manure and in cropping the land need to maintain viable agricultural operations. There are many technical issues that must be evaluated by these parties to determine the feasibility of altering current farming practices on this property.

Cost

This option would not require a financial investment by the RLIA, but encouraging a change in farming practices will require a time commitment to maintain communication with the farmers involved.

4.3 Promote Stormwater "Green Infrastructure"

Description

This alternative could be used to reduce runoff volume and peak discharge throughout the watershed, particularly in residential areas and along roadways. "Green infrastructure" refers to stormwater management practices that use vegetated areas to reduce stormwater runoff, rather than engineered basins and sewers. Some of these stormwater practices are inexpensive and easily implemented by property owners, including rain gardens that allow runoff to soak into the soil, and rain barrels that capture roof runoff for irrigation use (Figures 8 and 9). The RLIA could conduct outreach to promote such voluntary stormwater management measures on private property and town road right-of-ways. Reducing stormwater runoff would help reduce the flow and sediment transport in the ditch.

Figure 8. Rain garden capturing roof runoff.

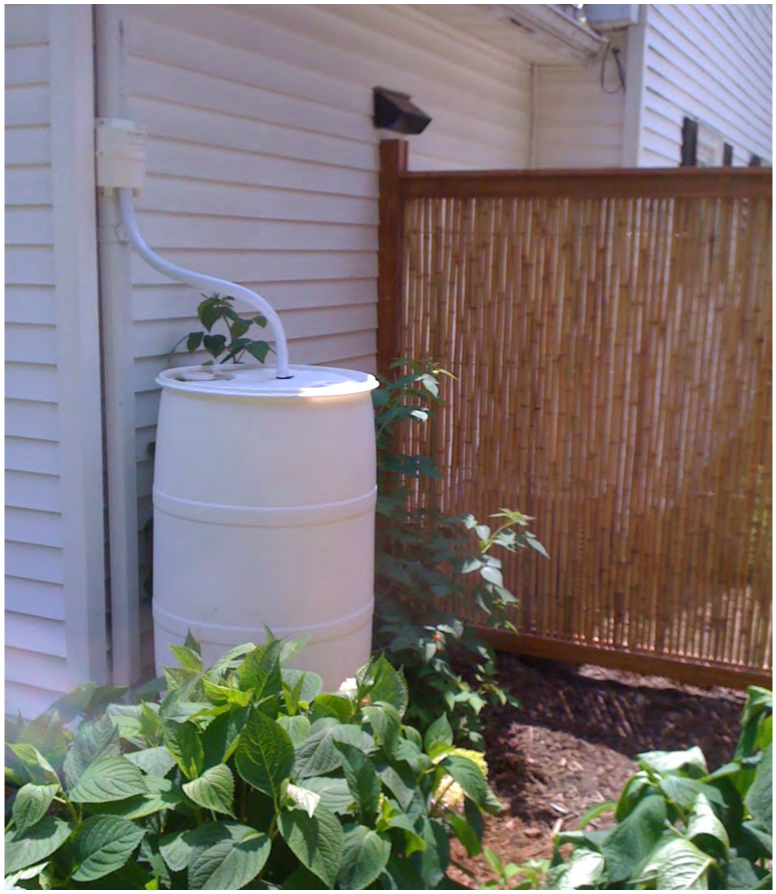

Figure 9. Rain barrel capturing roof runoff (from Sustain Dane)

Effectiveness

Residential areas, such as the Shorewood Meadows subdivision, occupy a little more than 10% of the Miljala Channel watershed area. Thus, the flow-reduction benefit to the ditch of improved stormwater management in residential areas would be modest. However, these measures could generate good will that would help encourage actions by other property owners.

Implementation Issues

Improved stormwater management is not required by any ordinance for existing developments. Implementation of these measures would rely on voluntary actions on private property and along public roads.

Cost

This option would have no cost other than for education materials (newsletters, fliers, etc.), and it would require a time commitment to produce educational materials and communicate with property owners. Before producing any materials, the RLIA should search for materials already in existence that they can use.

4.4 Install Vegetated Buffer

Description

One of the recommendations of the University of Wisconsin workshop is to install a vegetated buffer west of the ditch on the Scheel property (Figure 10). This buffer would filter runoff from the farm field between the ditch and CTH S. Runoff from part of the field north of Shorewood Hills Road drains under the road in a culvert and would also pass through the buffer before reaching the ditch. Maintenance of a vegetated buffer was previously attempted in this location 12 years ago when this land was placed in the Cropland Reserve Program. However, the buffer vegetation was not able to be maintained adequately, and the area is currently dominated by weeds (mainly ragweed). The existing vegetation provides poor soil cover, and the UW Workshop students noted eroding soil in this area that should be stabilized. The potential buffer area is approximately 5.5 acres.

Restoration of the buffer would entail tilling or raking the area to remove the ragweed and other invasive plants and to prepare the soil for seeding, spreading seed for native wet meadow species during the fall, and maintaining the native vegetation intensively over a two-year establishment period. Maintenance during this establishment period would likely include mowing three times the first year and twice the second year. Long-term maintenance starting the third year would include hand weeding and herbicide application to control invasive plant species.

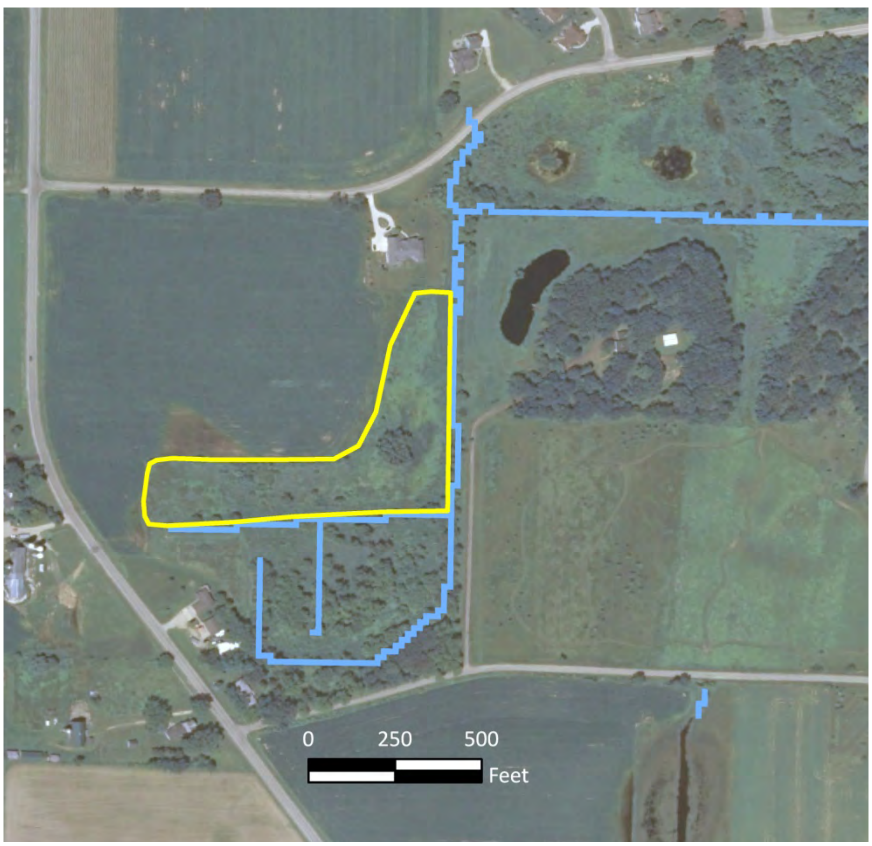

Figure 10. Potential extent of vegetative buffer.

Effectiveness

Riparian buffers can be effective measures to trap sediment and associated phosphorus. The UW Workshop noted soil erosion in the field to the west of the proposed buffer and identified it as an important phosphorus source. Thus, the buffer would be well situated to intercept sediment and phosphorus from the cropland. However, the UW Workshop also found that two-thirds to three-quarters of the phosphorus in water samples from the ditch was dissolved orthophosphate. Vegetated buffers are thought to be less effective at retaining dissolved phosphorus than phosphorus bound to sediment, however some reduction in phosphorus load in the buffer is likely. In addition, a wide, densely vegetated buffer could attenuate stormwater runoff through infiltration into the soil, providing some reduction in peak flows and sediment transport in the ditch.

Implementation Issues

Because the buffer area is on private property, the cooperation of the landowner is necessary to implement this alternative. A preliminary discussion with the property owner indicated that this is possible. A formal access agreement with the landowner for installation and ongoing maintenance of the buffer is recommended.

The landowner indicated that soft soil conditions made vegetation maintenance for the previous buffer installation difficult. It is likely that a 4-wheel ATV can traverse the area for mowing, but it is possible that some areas may need to be maintained with hand-held equipment such as commercial string trimmers. This can be accomplished efficiently in small areas.

Jefferson County requires a permit for certain land disturbing activities within 500 feet of a navigable water, which now includes the Miljala ditch. Therefore, the project plan should be submitted to the Jefferson County Planning and Zoning Department to determine the permitting requirements.

Cost

The bulk of the cost of restoring the buffer would be incurred during the first two years when native vegetation is established. Ongoing maintenance starting in the third year and continuing indefinitely would be required to maintain the native vegetation at a lower annual cost. Table 8 summarizes the estimated cost for buffer establishment.

Some costs could be potentially reduced if dedicated volunteers are found to assist with planting, mowing, and removal of invasive plants. The buffer area could also be reduced to match available funds, although some areas of eroding soil might not be stabilized in that case.

Table 8. Estimated cost for riparian buffer establishment and maintenance.

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
1	Tilling / raking	1	EA	$500	$500
2	Seed purchase	5.5	AC	$625	$3,400
3	Seed application	8	HR	$65	$500
4	Mowing (first 2 years)	5	EA	$640	$3,200
Subtotal					$7,600
Implementation Cost with 30% Contingency					$9,900
Planning, Design & Permitting (10%)					$1,000
Estimated Installation Cost					**$10,900**
5	**Annual Invasive Species Maintenance**	1	YR	$1,000	**$1,000**

4.5 Stabilize Ditch Banks

Description

The existing ditch channel is badly eroding, especially in the east-west trending reach upstream of Cedar Lane (see Figure 5). Existing vegetation is dominated by fast growing trees such as box elder, and the shade from the trees inhibits understory growth and results in bare, erodible soil on the banks. When the box elder trees fall they disturb a large area of soil on the ditch bank, and the fallen trunk deflects the water current into the bank causing further erosion.

The UW Workshop identified this section of the ditch as a major source of sediment to the Miljala Channel and recommended mitigating this area through a combination of ditch bank stabilization and marsh restoration. Ditch bank stabilization was recommended in areas where water levels cannot be raised to create a marsh without impacting upstream property uses – in particular the east-west reach of the ditch upstream of Korth Park. Marsh restoration is discussed in Section 4.6.

Stabilization of this 1,200 ft section of the ditch would entail removing trees from the ditch banks, excavating the ditch banks to a shallow, stable angle, and seeding native wet meadow vegetation (e.g. Figure 11). Appendix C includes conceptual drawings for both the ditch stabilization and marsh restoration, which ideally would be implemented in tandem.

Newly established vegetation adjacent to the ditch would be mowed during the first two years to aid its establishment, and ongoing maintenance would include hand pulling and spot herbicide treatment of invasive species, re-seeding natives as necessary, and mowing to prevent regrowth of trees. The total width of the stabilized ditch will depend on the angle needed to produce a stable bank. The conceptual design presented in this report assumes an angle of 4:1; this should be confirmed with additional investigation as described below. The approximate width and depth of the ditch shown on Figure C-3 are based on the limited topographic survey data available at this time.

Figure 11. Ditch with right bank recently re-sloped and planted with grass. Left bank not stabilized.

The relatively steep slope of this ditch reach (approximately 5%) suggests that the ditch is actively downcutting into its bed. Continued downcutting could destabilize the banks by undercutting them. Therefore, two rock grade control structures (e.g. Figure 12) are recommended to prevent further downcutting. These structures entail a narrow section of rip-rap placed perpendicular to flow and buried in a trench so that the top of the rock structure is at the current ditch bed elevation. These structures would be approximately 4 feet wide and 3 feet deep; exact dimensions and the size of rock should be determined during final design. Suggested locations for grade controls are shown on Figure C-2.

Figure 12. Example of rip rap grade control buried in channel bed.

An alternative design that can enhance stability and retention of sediment and nutrients is a "two-stage" ditch. This is similar to that described above, with the addition of a narrow bench within the ditch (Figure 13). The inset channel is designed to maintain drainage at low flows and to convey small runoff events. The main channel is designed to convey large flood events. Because the inset channel is narrower than a trapezoidal ditch bottom, water depth and velocity of lower flows are increased. This helps to prevent sediment deposition in the channel and to maintain drainage function. Floods spill out of the inset channel and spread over the bench; this reduces flow depth and velocity at the main ditch bank and can reduce bank erosion. In addition, the bench acts as a miniature floodplain where sediment and nutrients can be trapped and wetland vegetation can be established. Due to the additional width of the benches on both sides of the low-flow channel, the overall width of a two-stage design and excavation required to construct the channel are greater than for a traditional trapezoidal ditch cross section (approximately 70 feet vs. 50 feet).

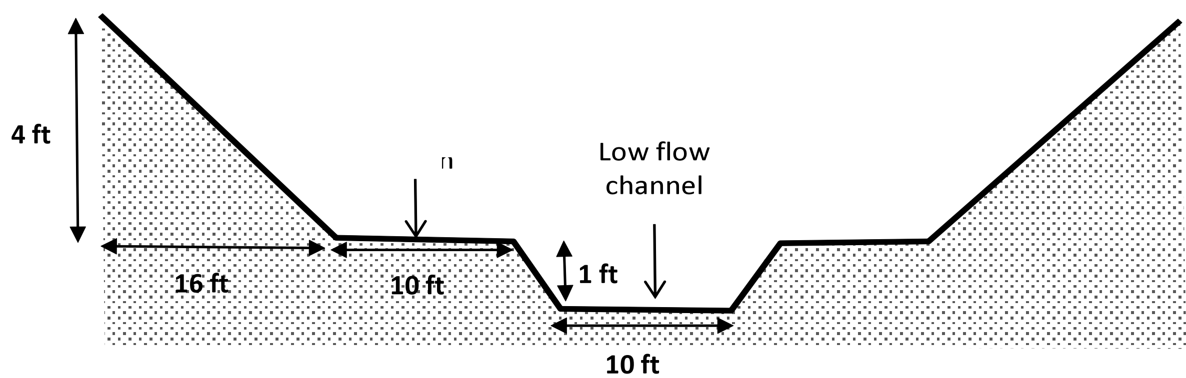

Figure 13. Typical two-stage ditch cross section.

Effectiveness

This alternative would stabilize the major source of sediment identified by the UW Workshop and previous grant investigation activities. This would benefit both the Miljala Channel and a marsh restoration, if implemented. Removal of box elder trees and establishment of native wet meadow vegetation would provide additional habitat and aesthetic value.

A ditch with a traditional trapezoidal cross section would not likely provide attenuation of sediment and phosphorus from upstream sources. A two-stage design, however, could trap some sediment and phosphorus on its floodplain benches. The water quality benefits of two-stage ditches are the focus of current research, and their effectiveness is not well documented. Although their primary benefit appears to be stabilization of the ditch banks, the benches have been shown to trap and store some sediment from upstream due to the reduced flow velocity and vegetation on the benches. Uptake of phosphorus by native vegetation on the benches is likely, but long-term trapping efficiency has not yet been demonstrated.

Implementation Issues

The ditch runs through private property, and no maintenance easement exists. Therefore, cooperation of the riparian property owners will be essential for implementation. With either potential design, the overall width of the ditch would be wider than the existing conditions due to reducing the bank slope angle, and the property owners would need to be agreeable to this.

The angle that would be required to create a stable ditch bank is uncertain. Some grass covered ditch banks in other locations in the watershed appear to be stable at a slope of 3:1 (e.g. the north-south trending part of the ditch immediately upstream of the "elbow" just north of Site 5 on Figure 5. The soils along the east-west reach of the ditch are mapped as Houghton Muck, and field observations indicate the presence of muck and sand in the banks. Maintaining a stable slope in muck or sand is more challenging than in cohesive soils. No systematic geotechnical investigation of the soil properties in the ditch bank has been conducted, and this should be undertaken for preparation of the final stabilization design. This would entail soil borings along the length of the ditch on both the north and south banks to determine soil texture and engineering properties. The final ditch designer should determine the number, depth and locations of the borings, but a reasonable estimate would be 10 ft borings every 100 ft, for a total of 14 borings.

Maintenance of the riparian vegetation in this area has been difficult for landowners. It will be important to mow the banks regularly to prevent trees from recolonizing the banks, shading out the native wetland vegetation, and destabilizing the banks. This could be accomplished by a tractor with an articulated mowing arm that can reach down the bank slope, or with hand-held commercial string trimmers that are capable of cutting saplings. An access agreement will be needed for construction and long-term maintenance.

In order to be permitted by the Wisconsin Department of Natural Resources under the general permit for wetland restoration, establishment of native wetland vegetation will need to be part of the project. This is consistent with other aspects of the project but will require an ongoing maintenance effort to control invasive species. A two-stage design would provide more area for restored wetland vegetation than a trapezoidal ditch design. The U.S. Army Corps of Engineers is also involved in the permitting process.

Jefferson County requires a permit for certain land disturbing activities within 500 feet of a navigable water, which now includes the Miljala ditch. The removal of vegetation within 35 feet of navigable water is also regulated. Therefore, a project plan should be submitted to the Jefferson County Planning and Zoning Department to determine any permitting requirements. Land disturbing activities have not been permitted by Jefferson County when they are done in a shoreland-wetland district, which now includes the area where the ditch is eroding the most. The project managers should meet with the Jefferson County officials to determine what steps could be taken go forward with a project that will be a benefit to the quality of the wetland, stream and lake.

Cost

The cost of this alternative is significantly impacted by the cost of earthwork, and the cost estimate includes a 30% contingency to account for uncertainty in the earthwork unit price. The estimates below (Tables 9 and 10) assume that hauling excavated soil off site will be required due to regulatory wetland and property owner constraints on spreading soil nearby. If it is possible to avoid trucking soil off the site, the unit price for earthwork could be substantially reduced (possibly as low as $3/cubic yard). The choice of a trapezoidal or two-stage design also has a large cost impact; the two-stage design could be approximately 50% more expensive, depending on the earthwork unit price.

As discussed above, a geotechnical investigation is recommended to provide information for design of stable ditch bank slope angles. An allowance of $5,000 is included in the cost estimate for soil borings along the banks and laboratory analyses of grain size and other engineering properties.

Some costs could be potentially reduced if dedicated and qualified volunteers are found to assist with tree removal, seeding, mowing, and removal of invasive plants.

Table 9. Planning-Level Cost for Trapezoidal Ditch for 1200 lineal feet.

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
1	Geotechnical investigation	1	LS	$5,000	$5,000
2	Site Preparation				
	Construction Mobilization	1	LS	$1,000	$1,000
	Clearing and grubbing trees	1.0	AC	$3,500	$3,500
3	Earthwork				
	Strip, pile & replace topsoil	667	CY	$3	$2,000
	Excavate and haul soil	1778	CY	$8*	$14,200
4	Rock Grade Controls				
	Excavate trench	44.4	CY	$8*	$400
	Place rip rap	44.4	CY	$57	$2,500
5	Vegetation Restoration				
	Native & nurse seed	1.0	AC	$625	$600
	Seeding labor	4.0	HR	$65	$300
	Mowing first 2 years	5	EA	$270	$1,400
Subtotal					$30,900
Construction Cost with 30% Contingency					$40,200
Engineering and Permitting (10%)					$4,000
Total Estimated Installation Cost					**$44,200**
6	**Annual Maintenance**	1	EA	$500	**$500**

* Earthwork unit rate could be lower if hauling soil off-site is not necessary.

Table 10. Planning-Level Cost for Two-Stage Ditch for 1200 lineal feet.

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
1	Geotechnical investigation	1	LS	$5,000	$5,000
2	Site Preparation				
	Construction Mobilization	1	LS	$1,000	$1,000
	Clearing and grubbing trees	1.4	AC	$3,500	$4,900
3	Earthwork				
	Strip, pile & replace topsoil	889	CY	$3	$2,700
	Excavate and haul soil	4400	CY	$8*	$35,200
4	Rock Grade Controls				
	Excavate trench	57.8	CY	$8*	$500
	Place rip rap	57.8	CY	$57	$3,300
5	Vegetation Restoration				
	Native & nurse seed	1.4	AC	$625	$900
	Seeding labor	4.0	HR	$65	$300
	Mowing first 2 years	5	EA	$270	$1,400
Estimated Construction Cost					$55,200
Construction Cost with 30% Contingency					$71,800
Engineering and Permitting (10%)					$7,200
Total Estimated Installation Cost					**$79,000**
6	**Annual Maintenance**	1	EA	$500	**$500**

* Earthwork unit rate could be lower if hauling soil off-site is not necessary.

4.6 Restore Marsh

Description

As discussed in Section 4.5, restoration of a marsh along the ditch upstream of Cedar Lane is a prominent recommendation of the UW Workshop report. This would trap sediment and associated phosphorus, take up some dissolved phosphorus in vegetation and the soil, and slow flow velocities. It would also provide wetland habitat that would benefit wildlife and provide educational opportunities.

The size and location of a restored marsh would depend on which landowners are willing to grant access for marsh construction, available funding, and constraints on water level changes to avoid unwanted upstream impacts. The RLIA has initiated discussions with property owners, but no agreements are in place at this time.

Marsh restoration would entail plugging the ditch approximately 100 ft upstream of Cedar Lane to raise the normal water level, plus a shallow scrape adjacent to the ditch to remove invasive reed canary grass sod and create a shallow pool for marsh vegetation to grow. Figures C-2 and C-3 in Appendix C show a conceptual layout and cross sections for the restored marsh and the upstream ditch stabilization. The marsh area would be approximately 0.75 acres, with emergent wetland vegetation established in deeper portions and wet meadow vegetation established in shallower areas. A smaller forebay would be created upstream of the marsh to capture sediment. This would be important to protect the marsh vegetation from the disturbance of rapid sediment accumulation, and to capture sediment in an area designed to be periodically dredged as it fills with sediment.

Raising water levels would have to be consistent with the needs of adjacent and upstream property owners. At present, it is necessary to avoid raising the normal water level on the Schropshire property, and this constrains the normal pool elevation to a maximum of about 832 ft. This allows raising the water level upstream of Cedar Lane by approximately 3 ft. At this water level, a marsh of 0.75 acres with a water depth of approximately 1 foot could be created with a scrape about 2 ft deep. The Natural Resources Conservation Service has standard designs for ditch plugs that entail filling at least a 50-ft length of the ditch for sandy soils (see Appendix C). Flow out of the scrape would occur to the side of the ditch plug in an area with capacity to safely pass large flows.

The UW Workshop report proposed a second scrape of about 0.5 acres farther upstream in Korth Park. Because the bottom of the ditch in this area is at an elevation of 830.5 ft to 831 ft, it would only be possible to raise the water surface by about 1 ft (to elevation 832 ft) without impacting upstream properties. Most of the existing land surface in the proposed scrape area is at an elevation of 835 ft to 836 ft, which would require excavating 4 ft to 5 ft deep to create a water depth of 1 ft. Wetland restoration scrapes this deep are considerably more expensive due to the additional earthwork required, they disturb a larger area because they require a longer slope to blend into the surrounding land surface, and the native seedbank is more likely to be scraped away. Thus, a second marsh restoration in this location is not recommended at this time; however it could be implemented in the future if constraints on water levels change.

Effectiveness

The UW Workshop calculated that 0.6 acres of marsh would be sufficient to trap sand and approximately half of the transported muck if the marsh was designed to have a 1-ft water level rise during the 1-year event. This water level “bounce” is generally considered acceptable for wetland restorations.

Phosphorus bound to sediment particles would be effectively trapped in the wetland, although some seasonal remobilization can be expected in the fall when vegetation dies and releases nutrients. Uptake of dissolved phosphorus by vegetation is likely, but the same remobilization effect is likely.

Pathogenic bacteria may be attenuated in a marsh, due to slower travel times, exposure to sunlight, and competition from other bacteria in wetland communities. However, the effectiveness of wetlands for reducing bacteria loads is uncertain, and an open water environment that attracts geese and other wildlife could increase bacteria loads.

Implementation Issues

As discussed above, it will be necessary to avoid unwanted water level impacts on upstream properties. This constrains the locations and water levels of potential wetland designs. It is possible that these constraints will change in the future, making additional wetland restoration options possible.

It is recommended that a marsh restoration be implemented only after the buffer and ditch stabilization are in-place to reduce the upstream sediment load. Otherwise, the marsh would likely be overwhelmed by sediment that would compromise the restored vegetation. The forebay cannot reasonably be constructed large enough to capture the current sediment load and would probably fill up every few years without upstream sediment controls. Stabilization of the upstream ditch and installation of the buffer should significantly reduce upstream sedimentation generation, meaning the forebay could effectively trap sediment for longer periods between maintenance dredging.

Ongoing maintenance will be required to control invasive vegetation and enhance the growth of native wetland species. With muck soils and wet conditions, this work may need to be conducted with hand-held equipment.

Muskrat activity is possible in a restored marsh, as they are common in the watershed. Muskrats can disturb vegetation and create open water areas that are attractive to geese. Muskrats and geese could contribute to the bacteria load in the watershed, and this activity should be discouraged. It may be necessary to remove muskrats from the wetland periodically.

Jefferson County requires a permit for certain land disturbing activities within 500 feet of a navigable water, which now includes the Miljala ditch. The removal of vegetation within 35 feet of navigable water is also regulated. Therefore, the project plan should be submitted to the Jefferson County Planning and Zoning Department to determine the permitting requirements. Land disturbing activities have not been permitted by Jefferson County when they are done in a shoreland-wetland district, which now includes the area where the wetland restoration is proposed. The project managers should meet with the Jefferson County officials to determine what steps could be taken go forward with a project that will be a benefit to quality of the wetland, stream and lake.

Cost

The excavation of the scrape is the most expensive aspect of a marsh restoration, and the total project cost will be driven by the unit price for excavation and disposal of the soil. How far the soil needs to be hauled will likely be the major factor in determining the unit price. The excavation spoils cannot be placed in a regulatory wetland, and this limits options for spreading the soil nearby, as does the presence of significant wooded areas where spreading the soil is not feasible. It is likely that the soil will have to be hauled off site in trucks, and the cost estimate in Table 11 assumes it will.

Some costs could be potentially reduced if dedicated and qualified volunteers are found to assist with tree removal, seeding, removal of invasive plants, and muskrat removal.

Table 11. Estimated cost of a 0.75 acre marsh restoration upstream of Cedar Lane.

Item	Description	Quantity	Unit	Unit Price	Estiamted Cost
1	Site Preparation				
	Construction mobilization	1	LS	$1,000	$1,000
	Tree clearing and grubbing	0.7	AC	$3,476	$2,500
2	Earthwork				
	Strip, pile & replace topsoil	912	CY	$3	$2,700
	Excavate and haul	3130	CY	$8	$25,000
3	Control Structures				
	Place & compact ditch plug	110	CY	$3	$300
	Import & place clay for keyway	20	CY	$8	$200
	Turf reinforcement mat on overflow	20	SY	$9	$200
	Stone weeper at forebay	11	CY	$52	$600
4	Erosion Control & Restoration				
	Emergent seed	0.50	AC	$800	$400
	Wet meadow seed	0.25	AC	$625	$200
	Seeding labor	8.0	HR	$65	$500
	2 years maintenance	5	EA	$320	$1,600
Estimated Construction Cost					$35,200
Construction Cost with 30% Contingency					$45,800
Engineering and Permitting (10%)					$4,600
Total Estimated Installation Cost					**$50,400**
6	Annual Maintenance				
	Invasive control	1	EA	$1,000	$1,000
	Annual allowance for dredging	100	CY	$10	$1,000
	Annual Maintenance				**$2,000**

* Earthwork unit rate could be lower if hauling soil off-site is not necessary.

5 Recommendations

For all of the alternatives discussed above, it will be important for RLIA to continue communication with property owners and other concerned parties to obtain permission to property access and to build partnerships to assist in advocacy, education, funding, and long-term maintenance. Specific actions to implement each alternative are discussed in more detail below. It should be noted that RLIA involvement in implementing these recommendations is contingent on funding.

5.1 Turbidity Barrier

The turbidity barrier in the channel should be maintained until other pollution control measures render the barrier unnecessary. The RLIA should contribute technical expertise and communication to support the efforts undertaken by the landowners adjacent to the navigation channel. Actions to be taken by the landowners include applying to the DNR for a dredging permit when the sediment containment area behind the barrier is full, and identifying a funding source for the dredging and periodic maintenance of the barrier structure. The last dredging occurred in 2011. The current dredging permit expires in November 2014, so the landowners are planning to dredge the area in September or October 2014.

5.2 Nutrient Management Plan Revision

The nutrient management plan for the Scheel property is the responsibility of Daybreak Foods. The RLIA and Jefferson County Land and Water Conservation Department should continue to communicate with Daybreak Foods and the other farmers involved in working that land, but any changes to the nutrient management plan are outside of the control of the RLIA.

5.3 Stormwater Management

The RLIA should take the lead in promoting improved stormwater management in the Miljala Channel watershed, but actual implementation of voluntary measures is beyond the control of the RLIA. Implementation actions could include newsletter articles, links on the RLIA website to sources of information on “green” stormwater management, and possibly volunteer work days to install rain barrels and rain gardens. Outreach activities could begin in 2014.

5.4 Vegetated Buffer

The RLIA should pursue implementation of the vegetated buffer, with cooperation from the property owner. Implementation steps include:

- Determining eligibility for federal funding or other government programs (This appears unlikely because the land is not active cropland);
- Negotiating an agreement with property owner for access for installation and long-term maintenance;
- Developing a native plant species seed mix and the details of vegetation establishment;
- Identifying parties willing and able to conduct long-term maintenance of the native vegetation;
- Obtaining funding for installation and ongoing maintenance;
- Installing the buffer as described in Section 4.

Buffer restoration could be started as soon as property access is arranged, funding is secured, and a maintenance plan is identified.

5.5 Ditch Stabilization

The RLIA should pursue the ditch stabilization. Necessary steps to implement this alternative include:

- Negotiating an access agreement with the property owners along the section of ditch to be stabilized;
- Deciding between a traditional trapezoidal ditch cross section or a two-stage design;
- Identifying parties willing and able to conduct ongoing vegetation maintenance;
- Identifying a funding source and determining the budget for the project (This may impact the choice of ditch stabilization design);

- Obtaining a Ch. 30 permit from the DNR and a Section 404 permit from the U.S. Army Corps of Engineers (Ideally, this would be accomplished via a DNR general permit for wetland restoration);
- Hiring an engineer to complete the design and construction plans and specifications, and to assist in hiring a contractor;
- Performing / coordinating long-term maintenance.

The implementation schedule hinges on property owner permission and funding. Once property access is arranged and a viable plan for long-term maintenance is identified, grant funding applications should be submitted. One logical target is the Wisconsin DNR Lake Protection Grant, with an application deadline of February 1, 2015 and approximate award date of April 15, 2015. Once funding is secured, an engineer can be hired to complete permit applications in the spring or summer of 2015. If permit approvals were obtained late in 2015, the final design could be completed in the winter, and the project could be bid and constructed in 2016.

5.6 Marsh Restoration

Recommended actions, responsibilities and schedule for restoration of a marsh are the same as for the ditch stabilization, except that the remaining design decisions would be the specific location and size of the wetland scrapes. This will depend on which property owners are willing to grant access for the project, and the amount of earthwork that available funding can support. Implementation of a marsh restoration should be at the same time as or after the ditch stabilization and buffer installation to protect the marsh from excessive sedimentation.

5.7 Monitoring

Over the course of the project, there has been a wide variety of sampling done in the watershed. Additional monitoring may be warranted as described below.

If there are opportunities to implement the recommendations, then additional water monitoring should be conducted to determine if reductions in sediment, phosphorus, and bacteria pollution are achieved. A monitoring plan should be developed with the implementation plans for the chosen practices. Monitoring should at least be done at the sampling site upstream of the Cedar Lane road culvert. The Jefferson County LWCD is available to assist in this endeavor.

The project team had planned to take a water sample at the outlet of the Cedar Lane culvert for colifage genotyping. This test could potentially identify whether the bacteria is from a human source, animal source, or both. Though there has not been much success with this test in Wisconsin, the project managers felt that the test was worthwhile because of the public concerns over bacteria pollution.

Colifage genotype sampling has very precise requirements: adequate storm water flow during collection ideally when the ground is already saturated and water temperatures are less than 68 F. In addition, the State Laboratory of Hygiene needs 48 hours advance notice, and the sample taken and delivered to the lab during a Monday, Tuesday, Wednesday, or early morning Thursday. Due to these constraints, a colifage genotyping sample was not able to be collected prior to the writing of this document. However, the RLIA should consider paying for this test when the sampling conditions are ideal. The Jefferson County Land and Water Conservation Department has agreed to take the sample and deliver it to the lab.

5.8 Funding

Both the Water Resources Management workshop report and the 2010 RLIA report on the watershed include sections on potential sources for funding. These sections should be referenced when determining how to fund any practices that will be implemented.

Recently, the Wisconsin Department of Natural Resources changed the deadlines for some of their grant applications. As of the date of this report, the deadlines for these grants are as follows:

- Lake Protection Grant: February 1
- Lake Management Planning (large & small scale): December 10

- River Protection Management: February 1
- River Protection Planning: December 10

Appendix A. Wetland Delineation Report

Appendix B. Public Participation

During the project implementation, the public was involved in several different ways in order to inform and educate them and to obtain their feedback to help refine the possible recommendations.

There were several public meetings over the course of the project. They are summarized below.

April 19, 2012 – UW Student presentation
- The UW-Madison graduate students provided a summary of the project and their sampling plans for 2012.
- They answered questions from the public.
- 29 people in attendance

August 25, 2012 – Rock Lake Improvement Association Annual Meeting
- The UW-Madison graduate students provided some preliminary results and ideas for solutions.
- They answered questions from the public.
- 45 people in attendance

August 25, 2012 – UW Student Field Tour
- The UW-Madison graduate students gave a tour of the study site. They highlighted a number of their sampling sites, and explained some of the instrumentation and sampling methods.
- They answered questions from the public.
- Approximately 10 people in attendance

April 23, 2013 – UW Student Final presentation
- The UW-Madison graduate students presented their project results in Madison as part of their program requirements. The presentation was more technical in nature than their previous public meetings held in Lake Mills. However, there were some Lake Mills citizens in attendance.

November 15, 2012 – UW Student presentation
- The UW- Madison graduate students provided a summary of the project, results of their sampling, and suggested recommendations.
- They answered questions from the public.
- 33 people in attendance

August 19, 2013 – Rock Lake Improvement Association Annual Meeting
- Steve Gaffield provided a summary of the project, and talked about possible recommendations.
- He answered questions and obtained feedback from the public.
- 47 people in attendance

December 16, 2013 – Presentation by Steve Gaffield
- Steve Gaffield explained the findings of the sampling and explained the locations and types of practices that could be implemented to control the sediment, phosphorus, and bacteria.
- He answered questions and obtained feedback from the public.
- 20 people in attendance

In addition to the public meetings, the Rock Lake Improvement Association wrote several articles for the local newspapers. These articles advertised the public meetings and explained the project deliverables and progress.

Finally, the Rock Lake Improvement Association recognized the importance of communicating to the property owners that live adjacent to the stream/ditch and the navigation channel. Efforts were made to keep them updated on the sampling activities and the project results. This was through phone conversations and inviting them to all of the public presentations.

Prior to finalizing the recommendations, meetings were arranged with property owners along the stream/ditch who were available. In November and December of 2013, meetings were held with the following people and included Steve Gaffield (MARS), Patricia Cicero (LWCD), Larry Clark (RLIA), and Jim Shaw (RLIA):

- Roger and Beth Shropshire (property owners)
- Leroy Scheel (property owner)
- Hope and Steve Oostdik (property owners)
- Joe Nehmer (Jefferson County Parks Department)
- Arlie Wilke (operator of farmland), Dave Schroeder (farmer & manure spreader), Darren Schroeder (farmer), Chris Roedl (Daybreak Foods), and Philip Laatsch (crop consultant)

Appendix C. Conceptual Drawings of Recommended Ditch Stabilization and Marsh Restoration