Maranacook Lake
Watershed Management Plan
February 2008

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Kennebec County Soil & Water Conservation District
Towns of Readfield and Winthrop
Maranacook Watershed Committee
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Maine Department of Environmental Protection

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* Grant Sponsor
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Cover Photo: North basin of Maranacook Lake from Train Trestle. Photo by Bill Monagle.

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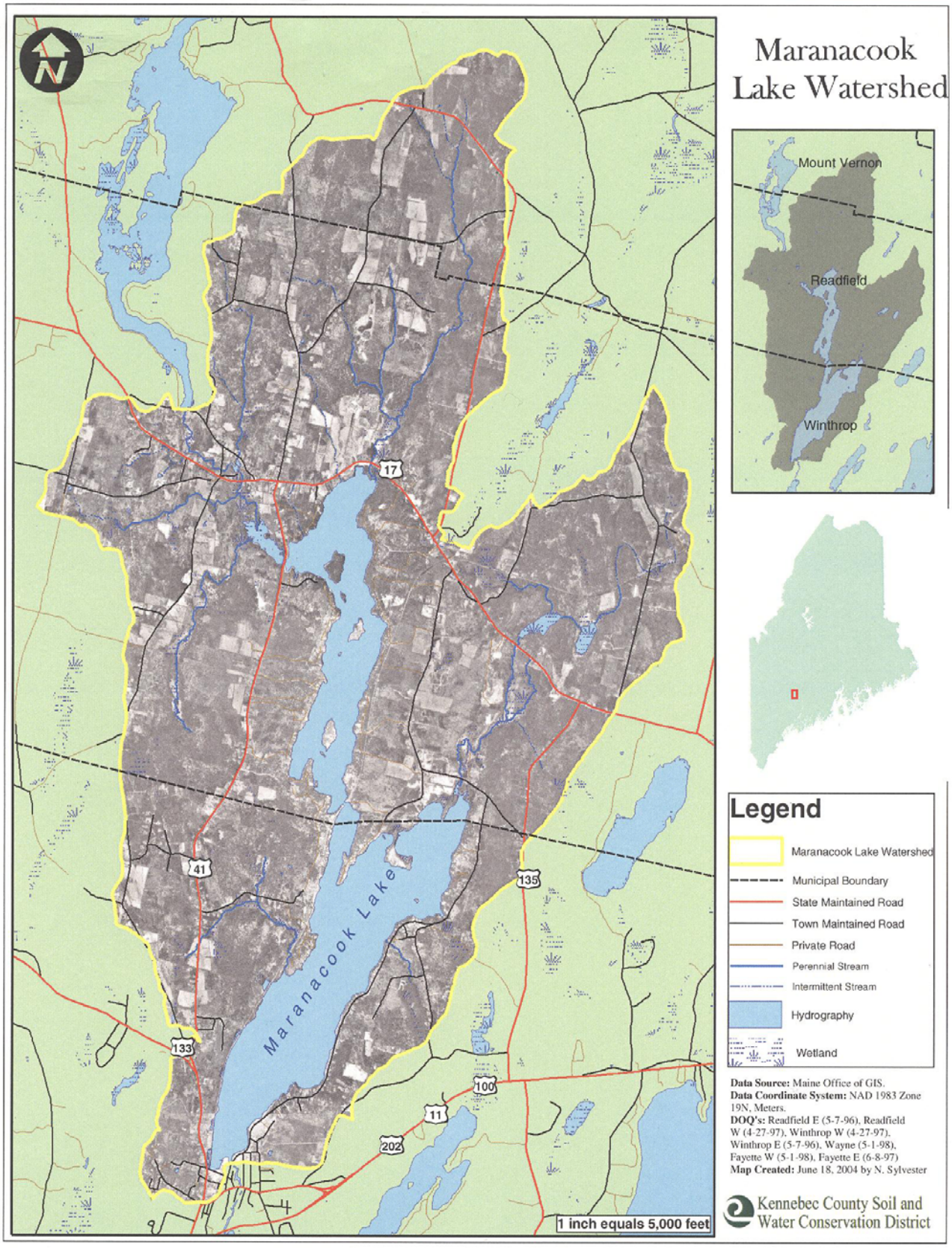
I. EXECUTIVE SUMMARY

Introduction & Background Information

Maranacook Lake is located in Kennebec County, Maine, and is bordered by the towns of Readfield and Winthrop. The lake has two distinct basins; the north basin is located primarily in Readfield and the south basin in Winthrop. The lake encompasses a surface area of 1,762 acres (713 ha) and drains a total land area of 17,514 acres (7,088 ha), inclusive of the watersheds of Torsey Pond (including Desert Pond) and Mill Pond (including Brainard Pond) upstream. The direct drainage area to the lake encompasses 14,091 acres (5,575 ha). The lake receives drainage from four perennial streams and numerous unnamed intermittent tributaries. The perennial streams feeding the lake are Tingley Brook, Beaver Brook, Roseanne Brook, and Dead Stream. Dead Stream represents the confluence of the outlet stream from Torsey Pond and several other perennial feeder streams. Land cover in the watershed is dominated by forest, with human based land uses being dominated by agriculture (12%) and development (e.g., residential, commercial, roads, etc.) at 2% cover. As part of the project to develop this Watershed Management Plan, a public survey was conducted in 2005. A questionnaire was developed and made available to the public in the local Community Advertiser, the Kennebec County Soil and Water Conservation District's webpage, and at the town offices of Readfield and Winthrop. Based on the results of this survey, the majority (87%) of respondents considered Maranacook Lake as having high value to the community. Popular activities include swimming, boating, fishing, and winter activities.

Maranacook Lake water quality is threatened by nonpoint source (NPS) pollution, particularly the north basin of the lake. NPS originates from virtually all land use types in the watershed, especially those most heavily influenced by human activity. Although NPS is comprised of a wide range of pollutants, ranging from bacteria to heavy metals, petroleum and petroleum by-products, among others, the pollutant of concern with regard to the degradation of Maranacook Lake is phosphorus. In Maine lakes, as in most lakes of north-temperate latitude, phosphorus is the plant nutrient that is considered the most responsible for accelerating the growth of aquatic vegetation, including algae. Excessive phosphorus loading to lakes results in nuisance growth of rooted vegetation and reduced water clarity as a result of dense algae blooms. An accumulation of organic matter (e.g., plant material) causes depletion of dissolved oxygen as the organic matter decays. The reduced dissolved oxygen can be detrimental to fish habitat, particularly cold water species, and can lead to increased phosphorus loading from lake sediments. Human activities accelerate the introduction of phosphorus to lake water through the use of fertilizers, petroleum-based by-products, other synthetic products, on-site wastewater disposal systems, particularly malfunctioning or antiquated systems, and by the disturbance of local soils. Because phosphorus has a tendency to adsorb to fine soil particles, soil erosion represents a potential major source of phosphorus NPS. Stormwater runoff following rain events, runoff during spring snowmelt, atmospheric deposition, and groundwater recharge are major vectors for phosphorus introduction to lakes.

The Cobbossee Watershed District (CWD) was formed in 1973 with the purpose of protecting and improving the lakes and streams of the Cobbossee Stream watershed. Since its inception, the CWD has been monitoring the district lakes and have implemented efforts to protect them. Based on over twenty-years of water quality data collected by the CWD, the north basin exhibits poorer water quality than the south basin. Water clarity of the north basin is routinely at or below the average for Maine lakes, and


Maranacook Lake Watershed
Mount Vernon
Readfield
Winthrop
Maranacook Lake
17
41
135
133
100
11
202
1 inch equals 5,000 feet
Legend
Maranacook Lake Watershed
Municipal Boundary
State Maintained Road
Town Maintained Road
Private Road
Perennial Stream
Intermittent Stream
Hydrography
Wetland
Data Source: Maine Office of GIS.
Data Coordinate System: NAD 1983 Zone 19N, Meters.
DOQ's: Readfield E (5-7-96), Readfield W (4-27-97), Winthrop W (4-27-97), Winthrop E (5-7-96), Wayne (5-1-98), Fayette W (5-1-98), Fayette E (6-8-97)
Map Created: June 18, 2004 by N. Sylvester
Kennebec County Soil and Water Conservation District

annually exhibits a loss of dissolved oxygen in the deeper waters. Based on the CWD's data, the Maine DEP has categorized both basins as having moderate/sensitive water quality. The classification, and concern, for the north basin is due in large part to increases in total phosphorus concentration, reduced water clarity, and depletion of dissolved oxygen in bottom waters.

The Maine Department of Environmental Protection (MDEP) has listed Maranacook Lake on the Nonpoint Source Priority Watershed List, based upon marginal water quality, sensitivity to change, being a community focal point, and having high use and an outstanding fishery. The MDEP has also listed Maranacook Lake as a "Lake at Most Risk from Development", according to the Stormwater Management Law, Chapter 502, which provides for measures and standards to be implemented to control the impacts of certain developments in watersheds of these "lakes at most risk".

In addition to the threats imposed by NPS, Maranacook Lake is also at risk from "biological pollution" in the form of non-native invasive aquatic species. Over the past decade, Maine lakes confirmed to host invasive aquatic species, particularly aquatic plants such as variable leaf water milfoil, have increased dramatically. A few of those lakes, Lake Auburn, Messalonskee Lake, and Pleasant Pond (a CWD water body) form a rather tight geographic triangle around Maranacook Lake. In the 2005 public survey noted earlier, invasive aquatic plants ranked highest along with phosphorus pollution as the greatest threats to Maranacook Lake.

Since the 1980s, the CWD has conducted numerous projects aimed at curtailing the phosphorus load to Maranacook Lake and other lakes in the Cobbossee Stream watershed. Early, runoff from agriculture and new development were targeted as significant phosphorus sources. The CWD arranged, through a supporting grant, to provide cost-sharing opportunities for farmers to implement BMPs, primarily manure storage facilities. The CWD then directed its attention to addressing stormwater runoff from new development. The DEP developed water quality standards, stormwater analysis methods for engineers, produced handbooks, and held workshops on erosion control and stormwater BMPs. The CWD established, and has maintained, a program to provide technical review to supplement the state (i.e., DEP) and local (i.e., planning boards) review processes. Recently (2000), the CWD partnered with the Kennebec County Soil and Water Conservation District (KCSWCD) and the Town of Readfield to survey the watershed of the north basin of Maranacook Lake, identifying camp road-related problems and formulating solutions to those problems. As part of this project, a camp road demonstration project was conducted to educate the public about proper camp road design and maintenance. Since the early 2000s, both the KCSWCD and Friends of the Cobbossee Watershed have been very active in addressing soil erosion in the watershed, particularly camp road related erosion and shoreline erosion, as well as providing public education. And with regard to biological (i.e., non-native aquatic species) pollution, the CWD initiated programs to educate the public about the threat of infestation as well as a program of boat inspections in the early 2000s to prevent infestations. Since that time, the Friends of the Cobbossee Watershed have assumed those responsibilities with the CWD providing technical support.

Maranacook Lake remains a very high priority for the CWD and the Towns of Readfield and Winthrop. There is very high interest in the development of a plan to outline on-going activities aimed at protecting or improving the lake. In 2005, a Watershed Committee comprised of 10 citizen volunteers and representatives of the towns, the CWD, KCSWCD, and the FCW, was formed to develop such a plan. Committee meetings, held approximately monthly for one year, were commonly characterized by the productive exchange of information and ideas between the dedicated committee members, and ultimately resulted in establishing attainable water quality goals and the development of strategies to

achieve those goals. This effort was supported by a grant awarded to the CWD by the MEDEP in 2004 (Project #2004P-08), and which was funded under §319 of the federal Clean Water Act.

The Watershed Management Plan Goal & Implementation Strategy

The goal of the Maranacook Lake Watershed Management Plan is to maintain or improve the water quality of Maranacook Lake for present and future generations. The Maranacook Lake Watershed Committee, comprised of members of the project team, Maine DEP, and citizen volunteers, identified the following seven objectives and associated activities to facilitate the successful realization of this goal:

1. Invasive Aquatic Species.

    a. Boat Inspections – Both public launch sites.
    b. Increase Public Awareness of Issue.
    c. Establish Invasive Plant Patrol (IPP)
    d. Develop Rapid Response Plan in the Event Invasive Species Detected.

2. Monitor Water Resources.

    a. Continue the Monitoring of Maranacook Lake and Torsey Pond (CWD), and Monitor Tingley Brook and other Tributaries Seasonally and during Episodic Events.
    b. Expand Monitoring to Bi-Weekly via Volunteer Lake Monitoring Program.

3. Promote Careful Utilization of Undeveloped Areas of the Watershed.

    a. Promote and Maintain Water Quality Regulations in the Two Towns.
    b. Require Stormwater and Phosphorus Control Plans for all Levels of Development.
    c. Work with Conservation and Open-space Programs to Target Buffer Areas and Other Sensitive Areas.

4. Control Shoreline Erosion.

    a. Shoreline Stabilization Projects – Private Contractors, AmeriCorps or Youth Conservation Corps.
    b. Training & Guidance on Shoreline Stabilization.
        - Use trained volunteers.
        - Include proper vegetation & stabilization.

5. Eliminate or Reduce Known NPS Sites.

    a. Implement BMPs at High Priority Sites and Future Identified Sites.
    b. Establish & Maintain Long-term Technical Assistance & Cost-Sharing to Address Sites Not Associated With The NPS Survey.
    c. Promote Vegetated Buffers.
    d. Establish Mechanisms for Camp Road Upgrade and Cost-Sharing.

- explore new & additional funding sources, e.g., impact fees, compensation fees.
- encourage use of the DOT's Local Roads Center's "Road Surface Management System".

e. Provide Incentives for Septic Upgrades.
f. Provide BMP Education to Landowners.
g. Educate and Enforce Erosion & Sedimentation Control Law (i.e., address existing sources).
h. Recruit Assistance from MLA to Conduct Periodic NPS Surveys – Update Initial Survey Results.

6. Establish Consistent Water Quality Protective Measures in On-Going Watershed Activities.

   a. Promote BMP Usage for Other Land Uses (i.e., forestry, roads, agriculture, etc.).
   b. Require Contractors to Become Certified in Erosion and Sedimentation Control (Amend Land Use Ordinance).
   c. Establish Watershed Overlay District or Alternative (uniform land use standards for both towns).
   d. Revise Ordinances to Limit Development on Steep Slopes or in Forested Wetlands, and Expand Comprehensive Plans to Address All Land Use Issues Identified in this Plan.
   e. Inventory and manage the Lake's Floodplain to Identify, Remove, and Prevent Potential Sources of Contamination to the Lake during Flood Events.

7. Enhance Public Awareness through Education and Public Outreach.

   a. Promote and Enhance Watershed Education in Local Schools.
   b. Promote and Enhance Watershed Education for the General Public.
      - Utilize Newsletters, Websites, and Public Distribution Outlets.
      - Prepare an MLA "Welcome Wagon" Packet of Watershed Information to be distributed to Shorefront Residents.
   c. Enhance Informational Program for Municipal Officials, including Boards, Commissions, Councils, etc.
   d. Establish Education Committee to Facilitate This Objective and Coordinate the Various Educational objectives (Evaluate, Identify Gaps, Propose Strategy for Lon-term Education, and Coordinate Implementation).

Overview of Information & Education

The success of the watershed management plan will hinge on the general public's recognition of the value of lake resources and an understanding of the interconnectedness of watershed activities and lake water quality. A plan to provide watershed residents and public officials with the necessary information upon which to nurture an appreciation of Maranacook Lake and to base environmentally responsible decisions to protect the lake involves four key components:

1. The establishment of an Education Committee to coordinate all watershed education-related efforts.

2. Programs to educate the general public about overall lake and watershed education, as well as issues specific to Maranacook Lake will occur on an ongoing basis. Newsletters, newspapers, internet websites, and available public distribution outlets represent a few of the anticipated vectors for information dissemination.

3. The MLA will prepare and disseminate a "welcome wagon" packet of information aimed at informing shorefront residents of the close interconnectedness of lake water quality and activities in the shoreland zone, and actions they can take to help protect the lake.

4. Lake and watershed-based education will be promoted in the local schools. High schools in both Readfield and Winthrop have strong earth science programs, but although the Friends of the Cobbossee Watershed has made strides at introducing their watershed education program to local schools, school curricula should be expanded in the way of lake and watershed science.

Financial Needs and Support

The cost associated with performing all of the activities included in the WMP total approximately $136,000. Of this, roughly $30,000 is associated with either start-up, or one-time fees. The remainder, $106,000 would represent annual costs. The annual costs, however, may be adjusted, that is, either increased or decreased, as the plan is being implemented. This may be particularly true for costs associated with BMP implementation at priority NPS sites, as many of the fixes will be long-term thereby reducing the annual construction costs. It should be noted that much of the non-construction related costs are associated with programs that are currently in place, and could be considered "in-kind" service, and would therefore, require minimal, if any, additional funding support. Potential sources of financial support for the WMP are presented in detail in the section of the plan dealing with financial support.

II. WATERSHED MANAGEMENT PLAN GOAL & IMPLEMENTATION STRATEGY

Water Quality Goal

In general, the goal of the WMP is:

To maintain or improve the quality of Maranacook Lake.

This rather broad goal would be achieved by:

- Preventing the introduction of invasive aquatic species (flora & fauna).
- Avoiding algae blooms, defined by the CWD as water clarity less than 3 meters.
- Improvement of the water clarity of the North Basin to no less than the state-wide average for Maine lakes.
- A decreasing or stable trophic state.
- No loss in fishery habitat.
- No increase in phosphorus concentration over the long-term (i.e. 10-yr.) average for the lake.

The water quality varies between the north and south basins, sometimes widely. The south basin, the deepest lake in Kennebec County at 128 feet, generally is at or near the top of the list of the 28 lakes of the CWD water clarity-wise. The north basin, on the other hand exhibits water clarity just below the state average, and is much shallower than the south basin. Despite the disparities in current water quality and basin morphometry, the above goal applies to both basins.

Based on the 2005 public survey/questionnaire conducted as part of the effort to prepare this WMP, nearly two-thirds of respondents ranked Maranacook Lake water quality as very good to excellent (i.e., 4 or greater on a scale of 5) and most (87%) believe the lake warrants a high level of protection. Phosphorus pollution and invasive aquatic plants (e.g., variable leaf watermilfoil) were equally ranked as the greatest threats to Maranacook Lake. Respondents viewed septic systems, residential land use, and shoreline erosion as the most significant sources of phosphorus pollution.

IMPLEMENTATION STRATEGY

The WMP is laid out in the following tables listing the activities, responsible agents, estimated schedules, and estimated costs. Several of the activities are existing activities and are being financially supported by the acting agents. Others represent new activities, some of which will be ongoing in nature, and will require new sources of funding. In general, the goal is to have all activities of the plan in place within an initial three year period. Some activities will require annual funding support, others will require initial start-up support, and others still will require funding on a periodic basis.

Key to Responsible Entities: CWD – Cobbossee Watershed District; DEP – Maine Department of Environmental Protection; DOT – Department of Transportation; DIFW – Department of Inland Fisheries & Wildlife; FCW – Friends of Cobbossee Watershed; KCSWCD – Kennebec County Soil & Water Conservation District; KLT – Kennebec Land Trust; MLA – Maranacook Lake Association; NRCS – Natural Resource Conservation Service; VLMP – Maine Volunteer Lake Monitoring Program; Y - Year of Plan Implementation.

Objective 1. Prevent the Introduction of Non-native Invasive Aquatic Species

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Boat Inspections – Public Boat Launches.	FCW, MLA, CWD, DEP (training and funding)	Ongoing	$5,000/yr
b. Increase Public Awareness of Issue.	FCW,MLA,CWD,DEP, Natural Areas Program, Towns	Ongoing	$1,000/yr
c. Establish Invasive Plant Patrol	FCW, MLA,CWD, DEP,VLMP	Y1	$300
d. Develop Rapid Response Plan in the Event Invasive Species are Detected.	DEP, FCW, CWD, Towns, DIFW	Y2	0 – unknown

Objective 2. Provide Complete and Long-Term Monitoring of Water Resources

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Continue Monitoring of Maranacook Lake and Torsey Pond (CWD), and Monitor Tingley Brook and other Tributaries Seasonally and during Episodic Events.	CWD, MLA, Schools	Ongoing	Unknown
b. Expand Monitoring to Bi-Weekly via VLMP.	CWD, VLMP	Ongoing	$0

Objective 3. Promote the Careful Utilization of Undeveloped Areas of the Watershed.

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Promote and Maintain Water Quality -Related Regulations in both towns.	CWD, Towns	Ongoing	$0
b. Require Stormwater and Phosphorus Control Plans for all Development.	CWD, Towns, KCSWCD, DEP	Y2	$2,000 / yr
c. Work w/ Conservation and Open-space Programs to Target Buffer Areas and Other Sensitive Areas.	KCSWCD, CWD, Towns, KLT, MLA	Y2	$3,000 / yr

Objective 4. Control Shoreline Erosion.

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Shoreline Stabilization Projects – Private Contractors, AmeriCorps or Youth Conservation Corps (Friends?).	FCW, KCSWCD, CWD	Ongoing	Unknown, but expected in 10's of $1,000
b. Training and Guidance on Shoreline Stabilization. - Trained Property Owners - Including Proper Vegetation and Stabilization.	KCSWCD, FCW, CWD	Y1	$ 4,000

Objective 5. Eliminate or Reduce Known NPS Sites.

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Implement BMPs at High Priority Sites and Future Identified Sites.	KCSWCD, FCW, CWD, Towns	Ongoing	$20,000 – $30,000/yr
b. Establish and Maintain Long-Term Technical Assistance & Cost-Sharing to Address Sites Not Associated with the NPS Survey.	KCSWCD, FCW, CWD	Ongoing	$10,000/ yr
c. Promote Vegetated Buffers. Tree & Shrub ordering deadline - April	MLA, KCSWCD, FCW, DEP (lakesmart), CWD, Towns	Ongoing	$2,500/yr
d. Establish Mechanisms for Camp Road Upgrade and Cost-Sharing. - explore new & additional funding sources, e.g., impact fees, compensation fees, endowment, contributed services. - encourage use of the DOT's Local Roads Center's "Road Surface Management System".	Towns, CWD, FCW, KCSWCD, DOT	Y2 – Y3.	$5,000
e. Provide Incentives for Septic Upgrades.	Towns	Ongoing	Unknown
f. Provide BMP Education to Landowners.	KCSWCD, FCW, CWD, MLA, Towns	Ongoing	$2,000/yr
g. Educate and Enforce Erosion & Sedimentation Control Law (i.e., address existing sources).	Towns(E), KCSWCD, CWD, DEP(E), FCW E = enforcement	Y2 – Y3	$6,000/yr
h. Recruit Assistance from MLA to conduct periodic NPS surveys and to Update the Identified NPS Problems and Solutions from the Initial NPS Survey. (1/5 of watershed per year)	MLA, CWD, KCSWCD	Ongoing	$2,000/yr

Objective 6. Establish Consistent Water Quality Protective Measures in Ongoing Watershed Activities.

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Promote BMP Usage for Other Land Uses (i.e., forestry, public roads, agriculture, etc.).	KCSWCD, NRCS, Towns, CWD, DEP	Y2 - Ongoing	$1,000/yr
b. Require Contractors to Become Certified in Erosion and Sedimentation Control – Ordinance Change.	Towns	Y2	Ordinance
c. Establish Watershed Overlay District or Alternative (uniform land use standards for both towns). - add side boxes explaining differences in town standards and the watershed overlay concept.	Towns, CWD, KCSWCD	TBD	Unknown
d. Revise Ordinance to limit development on steep slopes or forested wetlands, and expand Comp Plan to address **all MLWMP Land Use** issues.	Towns, CWD	When Comp Plans are Updated	Unknown
e. Inventory and manage the Lake's Floodplain to Identify, Remove, and Prevent Potential Sources of Contamination to the Lake during Flood Events.	Towns, CWD	TBD	Unknown

Objective 7. Enhance Public Awareness Through Education and Public Outreach.

Activity	Responsible Entities	Estimated Completion	Estimated Cost
a. Promote and Enhance Watershed Education in Local Schools.	**FCW,** KCSWCD, CWD, DEP	Ongoing	$15,000/yr
b. Promote and Enhance Watershed Education for the General Public. • Utilize Newsletters, Websites, and Public Distribution Outlets. • Prepare MLA "Welcome Wagon" packet for Shorefront Residents.	FCW, CWD, KCSWCD, MLA, DEP, Towns.	Ongoing	TBD (likely $10,000 start-up, then $2,000/yr)
c. Enhance Informational Program for Municipal Officials, including Boards, Commissions, Councils, etc.	CWD, DEP, KCSWCD, FCW	Ongoing	$2,000/yr
d. Establish Education Committee to Coordinate the Various Educational Activities. (Evaluate, Identify Gaps, and Propose Strategy for long-term Ed, coordinate implementation	**CWD**, FCW, KCSWCD, MLA, DEP, Towns	Y1, ongoing activity	$7,500 initial, then $3,500/yr

PROJECT MANAGEMENT

Oversight of the watershed management plan will be primarily the responsibility of the CWD. The CWD will remain in constant communication with the other participating groups, most notably, the KCSWCD, FCW, MLA, and municipal officials from the Towns of Readfield and Winthrop.

There are a myriad of activities associated with the management plan. Each of the participating groups noted above will be involved to some extent in undertaking the elements of the plan. The CWD, with on-staff limnologists and three decades of water quality monitoring and protection related efforts on and around Maranacook Lake, will continue assessing in-lake conditions and working with other groups (i.e., KCSWCD, FCW, Towns) to address watershed-wide nonpoint source control through a combination of BMP implementation and public education to prevent deterioration of the lake. Volunteers from the MLA will assist, to some extent, in the majority of the project components.

Since its inception in the early 1970's, the CWD has worked closely with the Towns of Readfield and Winthrop to protect and improve lake water quality. During this period the CWD has partnered with the KCSWCD, the Maine DEP, and the Natural Resources Conservation Service to address NPS in several lake watersheds, including Maranacook Lake. During the past several years, the FCW has worked closely with the CWD as well to address NPS, invasive aquatic plants, and public education. Recently, the CWD, the KCSWCD, and the FCW have closely coordinated their respective programs to minimize duplication of efforts and cast as broad of a net as possible over the multiple elements of watershed management.

PLAN EVALUATION

The CWD will be responsible for tracking the progress of the various components of the WMP. Annually, the CWD, in communication with representatives of the other project groups, will evaluate the success of the WMP to date and prepare an annual lake water quality status report. The success of the WMP will be based on:

- water quality protection and improvement
- number of boat inspections
- continued absence of non-native invasive aquatic plants
- proper control of lake water levels
- degree of consistency in land use ordinances and regulations
- inclusion of watershed education in local school curricula
- installation of BMPs
- number of upgraded camp roads
- compliance with the Erosion and Sediment Control Law
- number of requests for technical assistance
- number of newly certified contractors
- successful establishment of an education committee
- number of "Welcome Wagon" packets disseminated
- number of public service announcements/articles regarding WMP

The various components of the WMP will be assessed for their continued relevance on a regular basis. Modification of the WMP may occur due to a need to eliminate or expand the various activities. The CWD will from time to time, but at least annually, meet with representatives of the other project groups to discuss the progress of the WMP, and to determine, what, if any, modifications are warranted.

FINANCIAL SUPPORT

Watershed Towns

The municipalities that comprise the Cobbossee Stream watershed have long recognized the value of local lakes to their respective economies and general quality of life. As a result, member towns of the CWD have provided the necessary support to the District to continue watershed-wide efforts to protect and improve the local lakes for more than three decades. It is anticipated that the Towns of Readfield and Winthrop will be supportive of the recommendations of the Watershed Management Plan and the responsibilities and activities of the participating entities.

Property owners

Private property owners throughout the watershed will likely be primary sources of funding. A main focus of the planned education programs will be to educate landowners about the interconnectedness of the watershed and lake water quality and to exercise environmentally responsible land management practices. Provided that funding and resources are available, cost-sharing opportunities may be extended to shorefront property owners to stabilize shorelines, create shorefront buffer strips, or repair erosion problems, as well as to private camp road owners.

Government Grants

Federal and state grants to the CWD and other organizations will be another source of funding, particularly for elements of the plan that will involve major capital expenses.

Organizational in-kind support

There will be significant in-kind support provided by the majority of entities responsible for the plan. That is, grants or loans from other agencies will be unnecessary. The CWD, will provide continued support through its routine services to the member towns and through its programs to monitor and protect lake water quality and manage water levels. Other entities, such as the Friends of the CW, the KCSWCD, and the MLA, as well as town officials, will through their regular programs offer various levels of support.

DEP's Small Community Grant Program

Property owners whose septic systems need to be replaced, and that have been identified as a threat to lake water quality, will be encouraged to seek a septic system replacement grant through the DEP's Small Community Grant Program. This program, available to low and moderate income property owners, can provide 25% to 100% of the cost to correct qualifying problems associated with septic systems.

III. BACKGROUND INFORMATION & PLAN SUPPORT

MARANACOOK LAKE WATERSHED

Maranacook Lake is a relatively large lake located within the towns of Readfield and Winthrop. The lake has two distinct basins, with the north basin located completely in Readfield, and the south basin primarily in Winthrop, although a small portion of Readfield has shore frontage on the south basin. The shore frontage is nearly equally distributed between the two towns, inclusive of frontage associated with islands, with 11.6 miles of shoreline in Readfield and 10.2 miles in Winthrop. Each basin has a distinct watershed, as well as somewhat varying water quality

BASIN	Watershed Towns	Maximum Depth (FT)	Water Quality Category	Basin Size (acres)	Watershed Size (acres)	Flushing Rate (per Year)
North	Readfield Mt. Vernon Winthrop	39	Moderate / Sensitive	597	8,243	3.37
South	Winthrop Readfield	128	Moderate / Sensitive	1,166	5,848	0.81
			Total Acres	**1,763**	**14,091**	

Maranacook Lake is a relatively large lake, covering 1,763 acres and occupying two separate basins. The direct watershed (i.e., land draining directly to Maranacook Lake without flowing through Torsey Pond, which is immediately upstream) covers 14,091 acres. Three towns contribute to the watershed and include Readfield, Mt. Vernon, and Winthrop. The breakdown of acreage by town is as follows:

Mt. Vernon	1,301 acres
Readfield	9,731 acres
Winthrop	3,059 acres

The watershed is marked by rolling, wooded hills, with areas of considerable relief along the east and western shores of the south basin. Based on a General Soil Map of Kennebec County (USDA 1978), the predominant soil associations in the watershed are the Hollis-Paxton-Charlton-Woodbridge association (prevalent throughout, and encompassing most of the shoreline areas), followed by the Scantic-Ridgebury-Buxton (primarily in wetland areas) and the Berkshire-Lyman-Peru (also near wetland areas and the Beaver Brook inlet area) associations.

Upstream of Maranacook Lake lies three ponds, of which Torsey Pond is the most significant. Torsey Pond is a 507-acre water body that has water quality categorized by the Maine DEP as moderate/sensitive due to oxygen depletion in the bottom waters (i.e., hypolimnion) during periods of thermal stratification. Of the other relatively small ponds in the direct watershed, Brainard Pond (20 ac) and Mill Pond (12 ac) are located in Readfield, with Brainard Pond discharging to Mill Pond. Desert Pond, a small 22-acre pond, lies immediately upstream of Torsey Pond in the Town of Mount Vernon.

There are 4 major stream systems that contribute to Maranacook Lake. These are:

North Basin	
Tingley Brook	3.2 miles plus 2.5 tributary miles.
Dead Stream	1.4 miles plus 5.6 tributary miles
South Basin	
Roseanne Brook	1.3 miles plus 0.3 tributary miles
Beaver Brook	1.5 miles plus 1.1 tributary miles
Total Stream Miles	16.9 miles

There are approximately 233 acres of wetlands throughout the watershed. The majority of these are associated with Beaver Brook entering the south basin, and the lower reaches of Dead Stream and Tingley Brook in the north basin. Based on the National Wetlands Inventories for Winthrop (US Dept. of Interior 1992) and Readfield (USDI 1990), the wetlands are generally a equal mixture of palustrine scrub-shrub, palustrine emergent, and palustrine forested wetlands. Aside from those wetlands at the mouths, or lower reaches, of the tributaries, there are no significant wetlands that are contiguous with the shoreline of Maranacook Lake.

ASSESSMENT OF WATER QUALITY AND USES OF WATERBODIES

The water quality of the two basins of Maranacook Lake has been monitored by the CWD since the mid-1970s. Water Quality summaries for both basins dating to 1980 are presented in Appendix A. As these data show, the south has the better water quality of the two basins. The south basin expresses better average water quality compared to other Maine lakes based on Secchi Disk Transparency (SDT) and total phosphorus and Chlorophyll-a (an indicator of algae in the water column) concentrations. Although there is a general decline in dissolved oxygen over the course of the summer moths, this deep (128 ft) basin maintains adequate concentrations to sustain a cold-water fishery. Not since 1981 has the deeper waters exhibited anoxia (i.e., oxygen less than 1 ppm). By contrast, the north basin exhibits overall water quality that would be considered on par with average Maine lakes. The average water clarity, or SDT, tends to be 1 to 2 meters less than in the south basin, and total phosphorus concentrations are about a third greater (3 ppb) than in the south basin. Dissolved oxygen tends to become depleted in the deeper water of this shallower (39 ft) basin by July and remains devoid of dissolved oxygen through September. As result, the north basin is unsuitable for coldwater fishes during periods of thermal stratification. And, to some degree, the anoxic conditions likely contribute to the elevated total phosphorus levels observed in this basin. As dissolved oxygen becomes depleted, phosphorus in the sediments, normally inactive under oxic conditions due to a reaction with iron and oxygen, is released from the sediments back into the overlying water. Currently, the water quality of both basins is categorized as moderate/sensitive by the Maine DEP.

The lake serves as a major focal point for both the Town of Winthrop and Readfield. Both towns support public beaches and there are state-owned public boat launching facilities in each town as well. The lake is used for all types of water-based activity including swimming, kayaking, canoeing, motor-boating, and fishing during the open water seasons, and snowmobiling, cross-country skiing and fishing during the winter months. Fishing is generally good in the lake. A lake fish species inventory prepared

by the Maine Department of Inland Fish & Wildlife (DIFW) lists 15 species inhabiting the lake. The DIFW has stocked brook trout, brown trout, and lake trout in the lake annually since 1989. The lake is also a popular venue for bass (both smallmouth and largemouth) fishing tournaments in summers.

As mentioned above, Maranacook Lake is a highly valued and utilized resource for both Readfield and Winthrop. The State of Maine has also recognized the value of the lake, and the potential threat to the lake imposed by increasing development in the watershed, as it is listed on the State's List as a Priority Waterbody and is also on the State's 'List of Lakes Most at Risk from Development'. Shorefront property in both towns contributes greatly to both towns' property tax bases. As has been demonstrated in Maine markets (Michael et al. 1996), the value of shorefront property is directly related, at least in part, to water clarity. Therefore, financial incentives exist to continue, and increase, efforts to protect the lake.

STATUS OF OTHER WATER BODIES IN THE WATERSHED

Of the two ponds immediately upstream of Maranacook Lake, only Torsey Pond is on the CWD's lake monitoring schedule and is the only one for which there is known water quality information. As with Maranacook Lake, the CWD began monitoring Torsey Pond water quality in 1976. The water quality of Torsey Pond is generally good. The bottom waters of the pond become anoxic during summer/early fall period rendering it unsuitable as a coldwater fishery, although the DIFW lists the hardy brown trout as its only salmonid resident on its inventory. However, the DIFW does list both brown trout and the brook trout on its list of stocked species. In general, aside from the depletion of oxygen in bottom waters, the water quality of Torsey Pond more closely resembles that of the south basin of Maranacook Lake than that of the north. Torsey Pond is listed on the State's Priority Waterbody List.

The second pond immediately upstream from Maranacook Lake is Mill Pond. Mill Pond lies just downstream of another small pond, Brainard Pond. There exists no water quality data for either of these ponds.

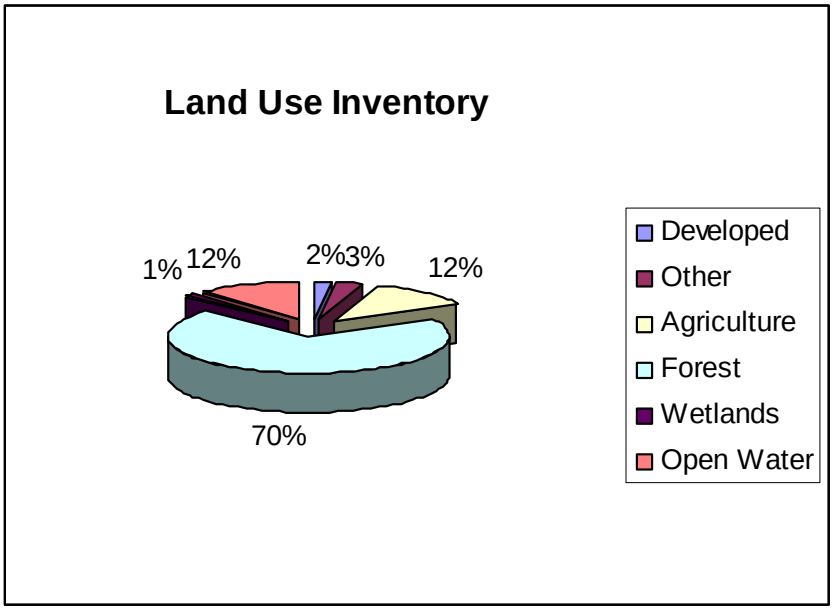
THREATS TO WATER QUALITY & POLLUTANTS OF CONCERN

As was mentioned earlier in this plan, phosphorus enrichment represents the major threat to Maranacook Lake water quality. In lakes of north temperate latitudes, phosphorus trends to be the plant nutrient that limits the growth of algae. Although phosphorus is a naturally occurring element and is present to some degree in all natural waters, through human activities its impact on receiving water bodies is accelerated and magnified, entering lakes primarily as NPS, and generated or liberated from a myriad of sources throughout the watershed. The potential, or likelihood, exists that phosphorus is released to some degree from the lake sediments, particularly those in the north basin. The largest contributors of phosphorus, however, are likely soil erosion and human development in the watershed. Soil erosion associated with camp roads as well as throughout the watershed has been identified as a widespread problem as has been confirmed by the NPS survey conducted as part of the development of this management plan as well as an earlier (2000) survey of camp roads in the watershed. Soil particles carry phosphorus that is adsorbed to the particle surfaces, and once introduced to surface waters, the phosphorus may become available as a nutrient for plant and algae growth. Phosphorus, being the plant nutrient most limiting to freshwater algae, can cause increases in the amount of algae in the water column of lakes resulting in reduced water clarity. There are other sources of soil erosion, of course, including the potential for soil erosion around the approximately 23-mile shoreline of the lake, particularly during spring flooding events.

Aquatic invasive species, especially aquatic plants, represent an additional threat to the lake ecosystem. Variable water-milfoil (*M. heterophyllum*) is becoming increasingly more widespread in Maine lakes and ponds. This species is not native in Maine and represents a major threat to native aquatic ecosystems as well as to the recreational utility of lakes and ponds.

LAND USE INVENTORY AND NPS ASSESSMENT

Land use information for the watershed of Maranacook Lake was provided by the Kennebec County Soil and Water Conservation District and is based on Geographic Information System information from 2004. This information updates earlier (1974) land use information compiled by the CWD and the former Southern Kennebec Valley Regional Planning Commission in 1975-1977 as part of a planning grant funded under §208 of the Clean Water Act. The updated general land uses based on percentage of the total contributing area are presented on the following chart.



Based on the information provided in this recent inventory, forested lands make up the largest land use category (70%), and include deciduous, evergreen, and mixed forest, as well light and heavy partial cut and regenerating forest. More than half of this area is in mixed forest. Agriculture (12%) and Developed (12%) make up the next two largest categories. Agricultural land uses include cultivating crops, and pasture/haylands, and likely includes reverting fields as well. The Developed category include primarily low and medium intensity residential development as well as some commercial and institutional (e.g., school grounds). The most urbanized part of the watershed is represented by a small portion of the Winthrop downtown area at the south end of the lake. Other land uses (3%) include state, town, and private roads, and gravel pits.

The land cover and land use in the watershed is certainly expected to change with time. Land cover that is currently classified as forest or agriculture likely will gradually change to residential or commercial, or a combination thereof. Based on principles outlined in the Maine DEP's technical guide, **PHOSPHORUS CONTROL IN LAKE WATERSHEDS:** *A Technical Guide to Evaluating New Development* (MDEP 1992), land use development within the watershed is expected to grow at about

25% over a span of 50 years. Development of any kind in a lake watershed cannot be expected to expand without causing some increase in stormwater runoff and increases in phosphorus export. Both basins are classified by DEP as Moderate-Sensitive and have been assigned a "High" level of protection and acceptable increase in in-lake total phosphorus of 0.75 parts per billion over the 50 year period, and planning boards from both Readfield and Winthrop rely on the CWD to review proposed new development to ensure that controls are employed to provide adequate phosphorus control. Unfortunately, new single family home construction and the current contributors to NPS are exempt from the review process. Therefore, an effective long-term watershed management plan must actively address existing sources of NPS.

There have been several early efforts to survey NPS sites in the watershed of Maranacook Lake. As part of the 1975-1977 §208 planning effort, the CWD conducted a sanitary survey of the shoreline of Maranacook Lake as well as a survey and inventory of the agricultural land uses n the watershed. In 1980, the CWD received a Clean Water Act §314 (i.e., Clean Lakes Program) grant to provide cost-sharing incentives for agricultural BMP implementation in the watershed. More recently (2000), the Town of Readfield received federal funding passed through the MDEP (Project #98-18) to conduct a volunteer camp road survey in the direct watershed of the north basin of Maranacook Lake. In this study, which included 25 camp roads, 108 NPS problems were identified on 24 roads; 8 were considered high priority; 13 considered medium priority; and 4 were considered low. The Town of Readfield, along with the CWD, the Kennebec County Soil and Water Conservation District (KCSWCD), and a private environmental consulting firm, worked with volunteers, landowners and the public to identify and make recommendations to solve some of the major ongoing road runoff problems. Recommendations included sufficient road crowning, removal of grader berms, armoring culvert inlets and outlets, and stabilizing bare soil.

As part of the effort to prepare this watershed management plan, an NPS survey of the watershed was conducted during the spring of 2004 and 2005. The watershed was divided into 43 sectors for manageability and was conducted primarily by CWD staff with limited contributions from volunteers. There were 82 total NPS sites identified, and these were characterized by general land use type, nature of the NPS problem, magnitude, and the proximity of the site to a water resource, and based on the collected information, sites were prioritized for NPS severity as high, medium, or low. The surveyors were supplied with aerial photographs for orientation and recording/locating sites on the photos, and descriptive information was recorded on individual field sheets. In general, there were 13 subcategories of NPS sites described, and in several cases, a particular site satisfied more than one category. Of the 82 sites, 34 were considered to be High Priority. A breakdown of NPS sites by land use type is shown in the table below. As the data suggest, the majority of NPS sites that were identified were related to roads (state, town, and private, collectively). This is also reflected in the range of problem descriptions, as between 22% and 43% of all identified NPS problems were related to either culverts, ditch erosion, road surface erosion, or shoulder erosion. Land classified as residential includes all problems associated with this land use category, including lack of adequate vegetated buffers, and soil erosion as well as driveway erosion. Agriculture, a relatively large contributor to the watershed-wide land use (12%), surprisingly accounted for only 4% of the NPS-related problems, and the few that were identified were related to soil erosion. This is not surprising, as the NPS survey was to be conducted from edge of properties along public and private roadways, with property owner permission required for a more in-depth inspection.

Percent Occurrence of Identified NPS Sites by Land Use Type

LAND USE TYPE	Percent of NPS Sites
Road	**62%**
Residential	**20%**
Active Construction	**2%**
Commercial	**4%**
Agricultural	**4%**
Recreation	**1%**
Undefined	**9%**

To most efficiently address NPS problems as identified in this survey, it is recommended that the highest priority sites be tackled first. Not surprisingly, 27 of the 34 sites identified as "high priority" were related to roads. A table presenting the complete NPS survey results is presented in Appendix B. As can be seen, the "high priority" sites generally share common symptoms, including shoulder erosion, road surface erosion, culvert erosion, and ditch erosion. Site-specific BMPs to address these problems should be prescribed prior to work being performed as conditions may have changed since the survey was performed. The most common BMPs to address the high priority sites will be re-grading and stabilization of roadside shoulders, adding surface material to eroded roads and reshaping them as required, replacing new culverts where needed and stabilizing culvert inlets and outlets, and reshaping and stabilizing roadside ditches and installing turnouts to buffer areas where deemed beneficial.

OTHER FACTORS AFFECTING WATER QUALITY

Although sedimentation and phosphorus loading from NPS in the watershed represent the most significant and most highly perceived threats to Maranacook Lake water quality, other factors remain that influence not only water quality per se, but the lake ecosystem as a whole, and these are listed below. This WMP will attempt to address the most influential and widespread of these, while others, although beyond the scope of the WMP, will be monitored for possible future action.

Internal Recycling

The release of phosphorus from bottom sediments is a potentially significant source of phosphorus loading to the lake, particularly the north basin. Both basins thermally stratify during the summer period, but the bottom waters (i.e., hypolimnion) of the north basin become devoid of dissolved oxygen during the summer and early fall which tends to facilitate the release of phosphorus from bottom sediments. This is supported by water quality data collected by the CWD that shows elevated phosphorus concentrations in these deeper waters during late summer and early fall. In the deeper south basin, oxygen levels remain relatively high throughout the stratified period and based on CWD water quality data, there are no indications that internal recycling in this basin is an issue.

Septic systems

Lake water quality can be severely threatened by antiquated, poorly designed, or malfunctioning septic systems particularly those located in unsuitable soils. Fortunately for Maranacook Lake, the area of densest waterfront development, Memorial Drive in Winthrop, is served by public sewer and water. There are numerous older homes and summer camps, however, that would likely benefit from upgraded systems. The WMP includes provisions (Activity 5.e) to provide incentives for upgrading or repairing inadequate or malfunctioning systems.

Manure / Nutrient Management

Lake water quality can become significantly degraded by excessive nutrient inputs from agricultural land uses, particularly those resulting from improper manure storage and spreading in proximity to drainageways leading ultimately to the lake. Nutrient and manure management practices in the watershed should be examined and where necessary, programs should be established to encourage the adoption of more environmentally responsible practices and to provide incentives to farmers to implement the necessary changes. A component of the WMP (Activity 6.a) addresses this matter.

Herbicide / Pesticide Use

Herbicides and pesticides may pose threats to lake water quality, particularly if applied near open waterways. By nature, these compounds are toxic to the targeted species and possibly non-targeted species as well and generally elicit an opposite effect in aquatic systems than do nutrients. They have the potential to severely threaten natural plant and animal communities and disrupt delicate ecosystem balance. Because of the complexity of aquatic systems that vary in acidity, depth, rate of water movement, etc., the impact of these compounds is nearly impossible to predict and very difficult to detect as well. Common sources include usage along power lines, roadways, agriculture, and along railroad Right-Of-Ways. In the Maranacook Lake watershed, the Guilford Railroad runs immediately along the west shore of the south basin and continues northward nearby the north basin and pesticide application practices should be reviewed and, if necessary, alternatives explored. Although these compounds were not included specifically in any WMP objective or activity, they will be addressed under Activity 6.a.

Winter Road Sanding

Aquatic habitats can be negatively impacted by excessive sedimentation including introduction of sand applied to watershed roads during the winter months. The biggest concern would be on roadways near the lake shore or major tributaries to the lake. Based on previous studies conducted on roadways in Maine (Dudley et. al., 1997), phosphorus loading resulting from road sanding could be a relatively minor issue compared to that from sedimentation resulting from eroded camp roads. Although the amount of total phosphorus from road sanding operations can be substantial, the fraction that is utilizable by algae is probably less than that from surface material eroded from camp roads. In any case, if localized problems are identified, the public works departments of both towns and the MDOT will be alerted and alternative application and/or removal methods can be discussed.

Shoreline Erosion

There has been much concern expressed by shorefront property owners of the erosion of Maranacook Lake shoreline and the property damage that results as well as the potential impact to lake water quality. Large boat wakes have been raised as one possible culprit, but by and large it is high water levels during fall and spring that have raised the greatest concern. With nearly 22 miles of shoreline, the concern is a

valid one. In 2006 during the preparation of this WMP, the dam, which had been incorrectly rebuilt in the mid-1990's, was adjusted to the proper spillway elevation. Although this has shown to provide for better water level control, flooding still occurs during periods of heavy rain and/or snowmelt but is less persistent.

Invasive Aquatic Species

Over the past decade, there has been a heightened awareness of the threats to lake ecosystems posed by invasive aquatic species, including both aquatic flora and fauna. During this time, infestations of non-native aquatic plants have been documented in dozens of Maine lakes, most notably by variable water-milfoil (*Myriophyllum heterophyllum*). There is a host of other non-native aquatic plants, some more sinister than *M. heterophyllum*, that have been found in Maine lakes or have been confirmed in lakes of neighboring New England states. Within the Cobbossee Watershed, only Pleasant Pond, the most downstream lake in the watershed, has been found to be infested with *M. heterophyllum*. Among other Maine lakes that are also infested with this plant include two nearby lakes, Lake Auburn and Messalonskee Lake, so the risk is high that it could be inadvertently transported to other lakes of the CWD, including Maranacook Lake. A high degree of vigilance is needed to prevent an infestation in Maranacook Lake and other regional lakes.

NPS CONTROLS & MEASURES TO PROTECT WATER QUALITY

1. Specific Sources of NPS Pollution

Previous efforts to survey the Maranacook Lake watershed to identify and prioritize NPS problems sites have been discussed previously. Of the high priority NPS sites identified in the most recent survey associated with the WMP preparation, the majority (62%) were related to road-related problems, with approximately half associated with private roadways and half with public (i.e., town and state) roads. The 2000 camp road survey identified 8 high-priority NPS sites on the 25 camp roads ringing the north basin of the lake. Both of the survey efforts included recommendations to address specific road-related problems. As roads appear to represent the most widespread source of NPS, both survey efforts will be reviewed and evaluated to determine where BMP installation is most needed and most influential on lake water quality.

2. Watershed Activities and/or Infrastructural Deficiencies Supporting NPS

- Private and/or Camp Roads As both the 2000 and 2004/2005 survey results suggest, camp roads represent a potentially significant contributor of sediment and phosphorus to the lake. Many camp roads were designed years ago and were poorly designed and/or located and were primarily intended for seasonal use. In recent years there has been an increase in the rate of the conversion of many seasonal camps to year round homes as well as the construction of new residences on these road networks all of which place an increased stress on their condition. Due to the private ownership status of these roads, there are not the standard design and maintenance requirements that exist for public roadways. And most importantly, there are fewer opportunities to provide the necessary funding to properly upgrade and maintain them. One element of this WMP (Activity 5.d) will seek to address this problem.

- Town and State Road Maintenance There has been significant improvement over the past several years in the maintenance of town and state roads as well as an increase in the concern for potential

impacts to nearby water resources, due in large part to increased education and training efforts of the Maine DOT and the DEP. The NPS surveys identified several high priority sites along public roads, but these are likely to be easily correctible by public works/DOT highway department staff. Maintenance practices and sediment/ erosion control practices during repair efforts go largely overlooked during NPS survey and should be examined and where necessary, modified. Several elements (i.e., Activities 5.a, 6.a, and 7.c) are included in the WMP to address this.

- Residential Maintenance Although the percentage of land associated with residential land use in this watershed is relatively low, the maintenance practices, or lack thereof, applied to residential properties can have significant influence on lake water quality. Excessive and unimpeded drainage from roof tops and driveways, improper lawn and garden care, exposed and eroded soils, are among the many possible ways that residential properties can increase pollutant runoff to receiving water bodies. There are numerous activities in the WMP that will address residential land uses.

- New Development The land use and zoning ordinances for both the Towns of Readfield and Winthrop provide good control over new development to protect lake water quality from soil erosion and phosphorus runoff, and both have historically relied on the CWD for technical support to the respective planning boards and CEOs, and review of stormwater and phosphorus control plans. However, these performance standard requirements largely apply to only subdivisions and commercial developments. By and large, individual, single family construction is exempt from these requirements, but consideration should be given to impose a similar level of control on these properties as on the larger, site review type developments that more frequently require planning board approval. A few activities listed in the WMP (i.e., Activities 6.a, 6.b & 6.c) would help address these deficiencies and related concerns.

- Shoreline Stabilization The erosion of shoreline property has great potential to contribute excessive amounts of soil and associated phosphorus to the lake. As mentioned earlier, this has been a widespread concern expressed by property owners on Maranacook Lake. The 2006 adjustment of the main spillway on the outlet dam will alleviate erosion to a point, but as shoreline erosion is a natural and largely unavoidable process during episodic high-water events, it will continue to occur. There are proper shoreline maintenance practices and stabilization methods that shorefront property owners can implement to minimize the soil loss, and the WMP includes several activities (Activities 4.a & 4.b) to address this.

- Agriculture and Forestry Practices The large majority of the land in the watershed is dedicated to forest cover or agriculture. As mentioned earlier, improper and unwise nutrient (including manure) management practices on agricultural lands can have a negative impact on lake water quality. Current information can be sought from the Department of Agriculture, Food, and Rural Resources (DAFRR) pertaining to manure and nutrient management practices in the watershed, and the DAFRR, as well as the Natural Resources Conservation Service (NRCS), can be encouraged to update farm-specific information where necessary. The DAFRR approves nutrient management plans for those farms that are required to file and implement one, and inspects those farms for compliance with agricultural BMPs, and the NRCS provides technical assistance for the design and implementation of BMPs by cooperating farmers in the watershed on which better farm management is needed. Similarly, information regarding forestry practices in the watershed should be researched and reviewed, and where necessary, appropriate BMPs adopted to protect lake water quality.

- Invasive Aquatic Species With two well established and popular public boat launch facilities, Maranacook Lake is vulnerable to the introduction of invasive aquatic species (IAS) transported to the lake via boats recently launched in nearby lakes in which IAS infestations have been documented. A program of boat inspections at both boat launches has been in progress for a few years and should continue. Also, an Invasive Plant Patrol program should be initiated as well as a protocol for immediate action if an infestation is suspected.

3. Regulation

As mentioned above, both the Towns of Readfield and Winthrop have strong ordinance language to regulate stormwater and phosphorus runoff from new development so there is little need to make radical changes there. However, the expansion of these requirements to address single family and other minor developments should be examined. And in general, land use controls and permit requirements for both towns should be reviewed and consideration given to more consistent standards for activities that affect lake water quality, including timber harvesting and earth moving.

4. Education Needs

Information and education related to lake and watershed protection for the watershed community at large will be addressed. Based on the 2005 public survey, the majority (48%) of respondents felt that it the general public that is most in need of a heightened awareness of lake water quality issues. Therefore, a major thrust of a public education campaign should be an ongoing effort to reach out to the general public about lake and watershed issues, which could be best accomplished through newsletters, newspapers and the local *Community Advertiser*, internet websites, outreach efforts of the MLA, and general availability of information at public distribution outlets. The inclusion of watershed and lake science into the local school curricula was also rated as a high priority (24%) by respondents in the public survey. As high schools in both Readfield and Winthrop have strong earth science programs, those programs will be encouraged to continue addressing lake and watershed science, or to incorporate into the earth science curricula where needed. The Friends of the Cobbossee Watershed District have already embarked on addressing this need in local schools. The need to educate public officials was not ranked as a high priority by survey respondents (17%). Officials in both Readfield and Winthrop, as well as other towns of the CWD, remain apprised of lake and watershed issues through their membership and close partnership and communication with the CWD.

5. Local Support

As original municipal members of the CWD since 1972, the Towns of Readfield and Winthrop have long recognized the value of Maranacook Lake and other local lakes to the region as well as demonstrating their continued commitment and support to protect and/or improve lake water quality. At all levels of municipal government, the towns, to some degree, work cooperatively with the CWD on matters that deal with lake water quality protection, and are represented on the CWD Board of Trustees. The CWD has, for over thirty years, monitored Maranacook Lake water quality, worked with property owners throughout the watershed to protect and improve water quality, and has worked closely with local CEOs and planning boards to ensure that development in the watershed is done so as not to impose undue stress on lake water quality. The Kennebec County Soil and Water Conservation District has long been active in the county working with land owners to encourage environmentally responsible land use practices to protect water resources. In recent years, the KCSWCD has become more active in lake and watershed projects within the CWD. The Friends of the Cobbossee Watershed, a non-profit organization formed in 2002, has become heavily involved in watershed education, assisting property owners with dealing with erosion problems, and orchestrating efforts to prevent the introduction of invasive aquatic plants. The Maranacook Lake Association, after several years of dissolution, actively

reformed in 2004 during the early stages of developing this plan, and has maintained a strong membership base and high activity level.

As mentioned earlier in the Project Management section, the responsibility to oversee the implementation of the plan will rest primarily with the CWD. There will be many participants in the plan, of course, and as stated above, many of the partnerships and activities exist and are in place to implement a successful watershed-wide strategy to address NPS problems to protect Maranacook Lake water quality and overall ecological health.

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Contact Information

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APPENDIX A

Water Quality Summaries
North and South Basins of Maranacook Lake

(data source: Cobbossee Watershed District)

COBBOSSEE WATERSHED DISTRICT

Water Quality Data For Maranacook Lake
North Basin

	SECCHI DISK TRANSPARENCY, Meters		TOTAL PHOSPHORUS, Parts per billion (ppb)			CHLOROPHYLL-A, Parts per billion (ppb)		OXYGEN DEPLETION
Year	Mean	Minimum	Spring	Mean, or late summer	Maximum	Mean	Maximum	Upper limit of anoxia, meters
1980	Ins. data	2.3	24	No data	Ins. data	Ins. data	Ins. data	7
1981	4.5	3.6	14	12*	Ins. data	2.9	5.6	7
1982	4.9	4.5	10	14*	Ins. data	2.9	4.6	7
1983	4.3	3.6	8	No data	Ins. data	4.8	6.8	7
1984	5.0	3.8						5
1985	5.2	3.9	8	11*	Ins. data			8
1986	4.6	4.0	19	No data	Ins. data			10
1987	5.1	4.4	13	12*	Ins. data			7
1988	4.8	4.3						7
1989	Ins. data	3.2						6
1990	4.6	3.3	10	**12**	14	5.1	8.7	6
1991	4.4	3.0	No data	14*	Ins. data			7
1992	4.9	3.5	12	**12**	14	4.5	5.9	7
1993	4.9	3.5	15	**12**	15	6.5	11.9	7
1994	4.9	4.0						7
1995	5.2	4.2	11	**11**	14	4.3	7.7	7
1996	3.8	2.5						6
1997	4.2	3.2						6
1998	4.3	3.5	11	**13**	20	6	10.7	5
1999	4.7	3.4						6
2000	5.1	3.7						7
2001	4.9	3.9	19	**14**	19	5.9	8.6	7
2002	5.0	3.9	12	**12**	16	5.5	9.2	6
2003	5.1	4.5	No data	14*	Ins. data			7
2004	5.0	3.9						6
2005	5.0	3.7	17	**11**	17	4.4	6.8	7
2006	4.5	3.0						7

Ins. data = insufficient data; *=Late summer value, other values are 5 or 6 month season mean; anoxia=<1ppm

May 2007

COBBOSSEE WATERSHED DISTRICT

Water Quality Data For Maranacook Lake
South Basin

	SECCHI DISK TRANSPARENCY, meters		TOTAL PHOSPHORUS, parts per billion (ppb)			CHLOROPHYLL-a, parts per billion (ppb)		OXYGEN DEPLETION
Year	Mean	Minimum	Spring	Mean, or late summer	Maximum	Mean	Maximum	Upper limit of anoxia, meters
1980	Not enough data	5.7				4.7	6.8	Not enough data
1981	5.8	4.7	12	10*		2.4	4.6	32
1982	6.6	5.9	9	9*		2.7	4.9	X
1983	5.5	4.5	6			3.8	6.3	X
1984	6.1	5.1						X
1985	6.9	5.7	6	7*				X
1986	6.1	5.4	10					X
1987	5.8	4.8	19	8*				X
1988	6.7	6.1						X
1989	Not enough data	4.7						X
1990	6.3	5.5	9	8	9			X
1991	5.4	3.0				3.3	6.55	X
1992	5.5	5.0	10	11	15	4.6	5.75	X
1993	6.7	4.3	13	10	13	4.9	4.9	X
1994	6.1	5.4						X
1995	6.7	5.1	7	8	10	3.9	6.35	X
1996	4.9	3.1						X
1997	5.8	3.9						X
1998	5.5	4.6	7	10	18	4.9	7.36	X
1999	7.1	5.2						X
2000	6.0	4.5						X
2001	7.5	5.6	15	9	15	4.7	6.7	X
2002	7.3	6.5	8	8	9	3.9	6.0	X
2003	7.4	6.1						X
2004	7.4	5.6						X
2005	6.2	5.2	8	8	9	5.2	11.3	X
2006	6.3	5.2						X

*Late summer value, X =no anoxia; oxygen present all the way to the bottom

May 2007

APPENDIX B

Maranacook Lake Watershed
NPS Survey Results

(Survey conducted during 2004-2005)

Form A: NPS Site Survey Form

1) Observed By:_____ 2) Date :_____ 3) Map ID# (label on attached map):_____

4) Picture(s) ID: _____5) GPS:_____

6) Location of site:_____

7) Road Name:_____ 8)Town:_____

9) Pole#_____ 10) Section Length:____(ft) or Area:_____(sq.Ft) 11)Pole#_____

Site Information

12) Land Use:

(Agriculture) (Commercial) (Road) (Residential) (Recreational) (Construction Site) (Forestry)

13) NPS Problem(s): Circle all that apply

(Culvert Inlet or Outlet Erosion) (Shoulder Erosion) (Ditch Erosion) (Road Surface Erosion)

(Erosion of Property) (Driveway Erosion) (Recreational Trail Erosion) (Parking Lot Erosion)

(Clogged Culvert) (Stream is cloudy) (Lack of Buffer) (Shoreline/Streambank Erosion)

(Unstable/Bare Soil) (Other)

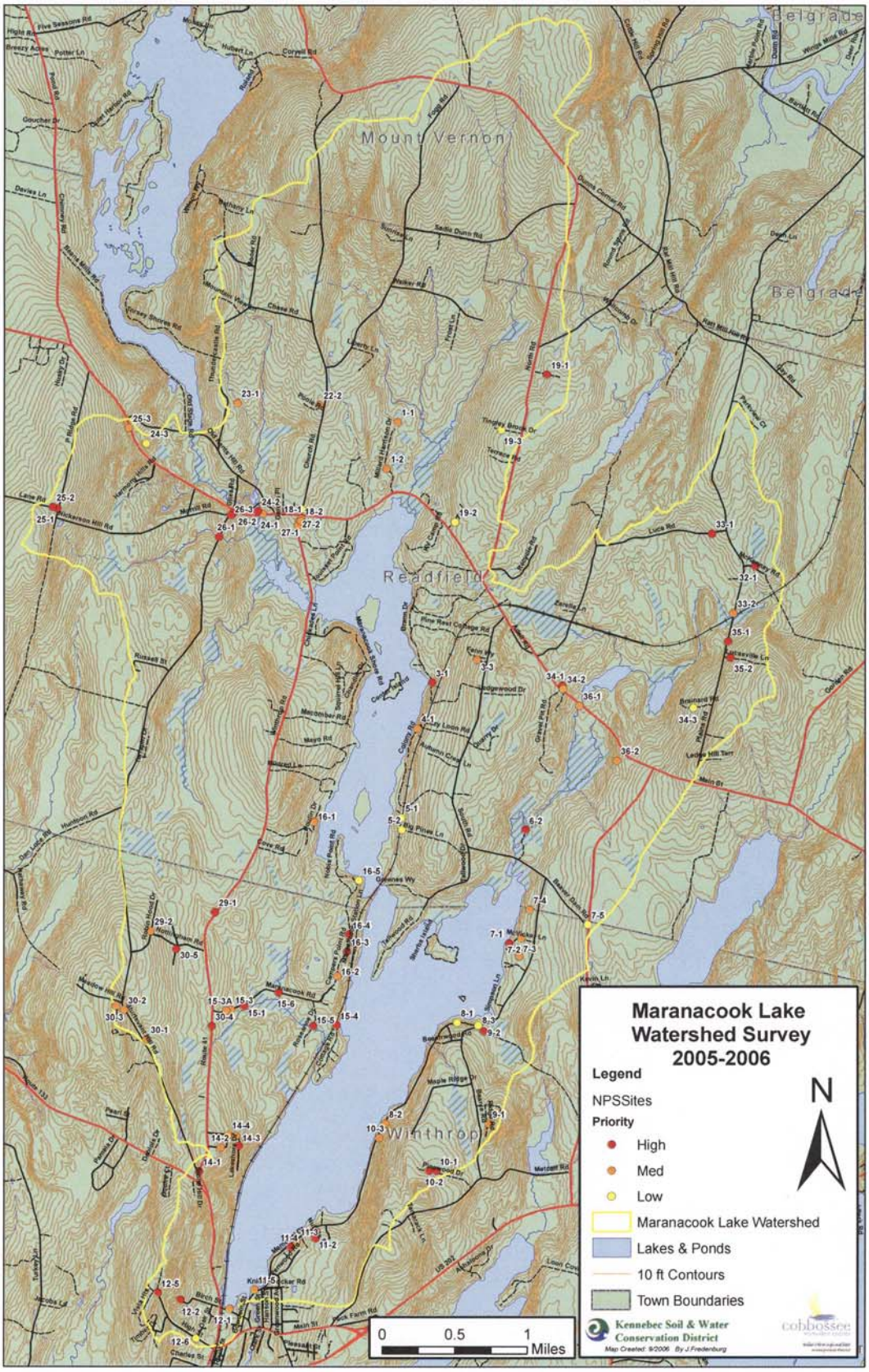
14) Size of Soil Erosion Site:

(Small): *< a pick-up truck load of material*
(Moderate): *= a pick-up truck load of material*
(Large): *> a pick-up truck load of material*

15) Proximity to Natural Resource:

(Far): *>100 ft from lakes, streams, wetlands, road ditches, or other waterways.*
(Close): *< 100 ft from lakes, streams, wetlands, road ditches, or other waterways.*
(Very Close): *adjacent to lakes, streams, wetlands, road ditches, or other waterways.*

Notes, Recommendations (optional):


Maranacook Lake
Watershed Survey
2005-2006
Legend
NPSSites
Priority
High
Med
Low
Maranacook Lake Watershed
Lakes & Ponds
10 ft Contours
Town Boundaries
N
0
0.5
1
Miles
Kennebec Soil & Water
Conservation District
Map Created: 9/2006 By J.Fredenburg
cobbossee
Mount Vernon
Readfield
Winthrop
Belgrade

SiteID	Priority	NPSProblem	NPSProbl_1	NPSProbl_2	NPSProbl_3	SiteSize	Proximity
1-1	med	Erosion of Property	Unstable/Bare Soil			Moderate	Close
1-2	med						
3-1	high	Shoulder Erosion	Road Surface Erosion			Moderate	Very Close
3-3	med	Road Surface Erosion				Moderate	Close
4-1	med	Erosion of Property	Clogged Culvert	Unstable/Bare Soil			Very Close
5-1	low	Road Surface Erosion					Far
5-2	low	Road Surface Erosion				Small	Far
6-2	high	Shoulder Erosion	Road Surface Erosion			Large	Very Close
7-1	high	Culvert Erosion	Ditch Erosion	Streambank Erosion		Moderate	Very Close
7-2	med	Culvert Erosion	Shoulder Erosion	Road Surface Erosion		Moderate	
7-3	med	Ditch Erosion	Road Surface Erosion			Large	Far
7-4	med	Ditch Erosion	Road Surface Erosion			Large	Far
7-5	low	Shoulder Erosion	Ditch Erosion			Moderate	Far
8-1	low	Erosion of Property	Driveway Erosion			Small	Close
8-2	med	Streambank Erosion				Moderate	Close
8-3	low	Shoulder Erosion				Small	Close
9-1	med	Shoulder Erosion				Small	Very Close
9-2	high	Recreational Trail Erosion				Large	Very Close
10-1	high	Culvert Erosion				Moderate	Very Close
10-2	high	Ditch Erosion	Road Surface Erosion			Moderate	Very Close
10-3	med	Driveway erosion				Small	Very Close
11-1	high	Road Surface Erosion				Moderate	Very Close
11-2	high					Moderate	Very Close
11-3	med	Shoulder Erosion				Small	Very Close
11-4	high	Road Surface Erosion				Moderate	Very Close
11-5	med	Unstable/Bare Soil				Small	Very Close
12-1	med	Parking Lot Erosion	Lake is Cloudy	Lack of Buffer		Small	Very Close
12-2	high	Culvert Erosion	Ditch Erosion	Shoulder Erosion		Moderate	Very Close
12-5	high	Culvert Erosion	Ditch Erosion	Shoulder Erosion		Large	Very Close
12-6	low	Shoulder Erosion				Small	Far
14-1	high	Culvert Erosion	Ditch Erosion	Shoulder Erosion		Large	Very Close
14-2	med	Shoulder Erosion				Moderate	Close
14-3	high	Culvert Erosion	Shoulder Erosion			Moderate	Very Close
14-3A	med	Shoulder Erosion				Small	Very Close
14-4	med	Shoulder Erosion	Ditch Erosion	Erosion of Property		Small	Very Close
15-1	high	Shoulder Erosion	Ditch Erosion	Driveway Erosion	Unstable/Bare Soil	Large	Very Close
15-3	med	Shoulder Erosion	Road Surface Erosion			Small	Very Close
15-3A	med						
15-4	high	Culvert Erosion	Shoulder Erosion	Road Surface Erosion		Moderate	Very Close
15-5	high	Culvert Erosion	Shoulder Erosion	Road Surface Erosion		Large	Very Close
15-6	high						
16-1	med	Culvert Erosion	Shoulder Erosion	Road Surface Erosion		Small	Very Close
16-2	med	Shoulder Erosion				Small	Very Close
16-3	high	Culvert Erosion	Shoulder Erosion			Moderate	Very Close
16-4	high	Shoulder Erosion	Road Surface Erosion			Moderate	Very Close
16-5	low	Shoulder Erosion				Small	Close
18-1	med	Culvert Erosion	Shoulder Erosion	Ditch Erosion	Parking Lot Erosion	Small	Very Close
18-2	med	Culvert Erosion	Shoulder Erosion	Ditch Erosion		Small	Very Close
19-1	high	Ditch Erosion	Road Surface Erosion			Large	Very Close
19-2	low	Road Surface Erosion				Small	Close
19-3	low	Road Surface Erosion				Small	Far
22-1	low	Unstable/Bare Soil				Small	Far
22-2	med	Driveway Erosion				Moderate	Close
23-1	med	Ditch Erosion				Small	Very Close
24-1	med	Other				Small	Very Close
24-2	high	Road Surface Erosion				Moderate	Very Close
24-3	low	Driveway Erosion				Small	Close
25-1	high	Ditch Erosion	Unstable/Bare Soil			Moderate	Very Close
25-2	high						
25-3	med	Shoulder Erosion	Ditch Erosion	Driveway Erosion	Unstable/Bare Soil	Small	Very Close
26-1	high	Shoulder Erosion	Ditch Erosion			Large	Very Close
26-2	high	Culvert Erosion	Shoulder Erosion	Ditch Erosion		Moderate	Very Close
26-3	high						
27-1	med	Lack of Buffer	Tracking			Small	Very Close
27-2	med	Culvert Erosion	Shoulder Erosion	Ditch Erosion		Small	Very Close
29-1	high	Shoulder Erosion				Large	Very Close
29-2	med	Shoulder Erosion	Ditch Erosion	Driveway Erosion		Moderate	Close
30-1	med	Shoulder Erosion	Unstable/Bare Soil			Moderate	Close
30-2	med	Unstable/Bare Soil				Moderate	Close
30-3	med	Road Surface Erosion	Unstable/Bare Soil			Moderate	Close
30-4	high	Shoulder Erosion				Large	Very Close
30-5	high	Road Surface Erosion	Driveway Erosion	Unstable/Bare Soil		Large	Close
32-1	high	Road Surface Erosion					Very Close
33-1	high	Ditch Erosion	Unstable/Bare Soil			Moderate	Very Close
33-2	med	Road Surface Erosion	Unstable/Bare Soil			Moderate	
34-1	high	Erosion of Property	Shoreline Erosion	Unstable/Bare Soil		Large	Very Close
34-2	med	Parking Lot Erosion				Moderate	Close
34-3	low	Culvert Erosion	Ditch Erosion	Road Surface Erosior	Unstable/Bare Soil	Moderate	Far
35-1	high	Culvert Erosion	Ditch Erosion	Driveway Erosion	Stream is Cloudy	Large	Very Close
35-2	high	Culvert Erosion	Shoulder Erosion	Ditch Erosion	Clogged Culvert	Large	Very Close
36-1	med	Road Surface Erosion				Small	Very Close
36-2	med	Erosion of Property	Unstable/Bare Soil			Moderate	Close