PHOPHORUS CONTROL ACTION PLAN

and Total Maximum Daily (Annual Phosphorus) Load Report

THREEMILE POND

Kennebec County

Threemile Pond PCAP-TMDL Report

Maine DEPLW 2002 - 0558

Maine Department of Environmental Protection

and Maine Association of Conservation Districts

Final EPA Review Document

July 8, 2003 (Revised September 3, 2003)

THREEMILE POND

Phosphorus Control Action Plan (PCAP)

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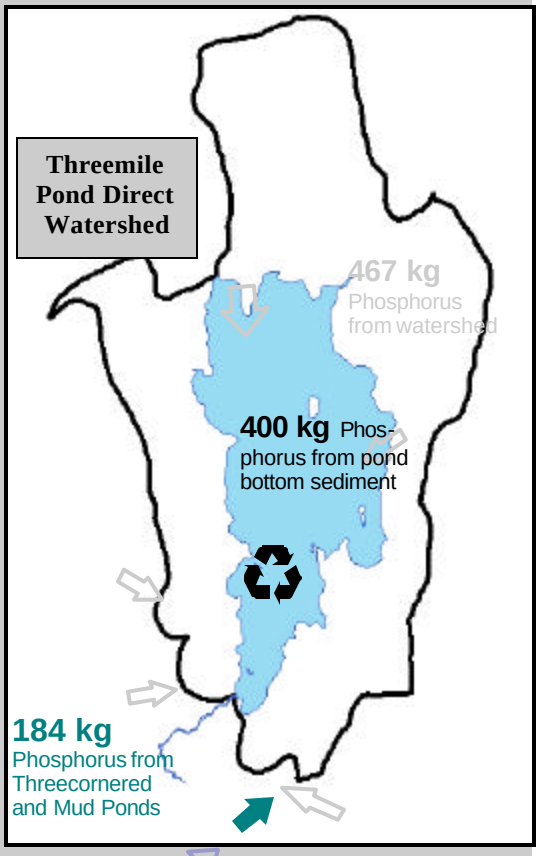
ACKNOWLEDGMENTS

In addition to Maine DEP and US-EPA New England Region I staff (guidance), the following individuals and groups were instrumental in the preparation of this Threemile Pond Phosphorus Control Action Plan and Total Maximum Daily (Annual Phosphorus) Load report: MACD watershed inventory staff (Jodi Michaud Federle, Forrest Bell and Tim Bennett); China Region Lakes Alliance (Reb Manthey); Kennebec County SWCD (Nate Sylvester and Dale Finseth); Threemile Pond Association (President, Dan Dubord); Vassalboro Town Office (Michelle Jandreau, CEO, Kelly Karter and staff); China Town Office (Scott Pierz, CEO and staff); Windsor Town Office (Robert Mills, CEO and staff); the Maine Department of Marine Resources (Matthew O'Donnell and John Perry); the Maine Forest Service (Morten Moesswilde); Maine Department of Inland Fisheries and Wildlife, Region B, Sidney (Jim Lucas); and special thanks to Reb Manthey for the use of her boat to complete the TMDL-associated water quality monitoring during the 2002 sampling season.

THREEMILE POND PHOSPHORUS CONTROL ACTION PLAN
SUMMARY FACT SHEET

Background

THREEMILE POND is a 1,132-acre waterbody located in the towns of China, Vassalboro & Windsor in Kennebec County. It has a direct **watershed** area of 9.3 square miles; a maximum depth of 37 feet, a mean depth of 17 feet; and a **flushing rate** of once per year. The total Threemile Pond watershed drainage area includes the 239-acre subwatershed of Mud Pond, which is considered as an indirect watershed of Threemile Pond.



Threemile Pond has a history of supporting excessive amounts of algae in the late summer, due in large part to the watershed presence of **phosphorus** that is prevalent in area soils and which accumulates over time in the lake bottom sediments. Soil erosion in the Threemile Pond direct watershed can have far-reaching consequences. Soil particles transport phosphorus, which essentially "fertilizes" the lake and decreases water clarity. Excess phosphorus can also harm fish habitat and lead to nuisance algae blooms—floating mats of green scum—or dead and dying algae. Studies have shown that as water clarity decreases, lakeshore property values also decline.

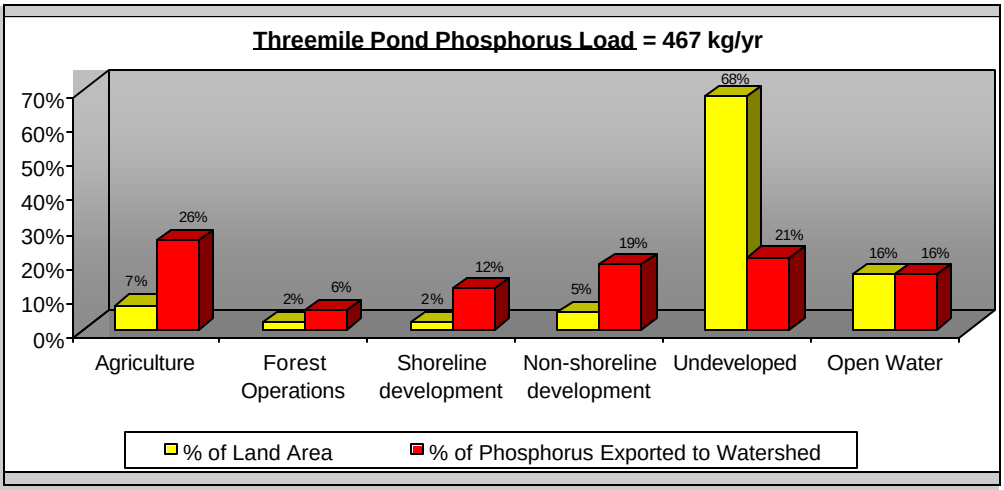
Stakeholder Involvement

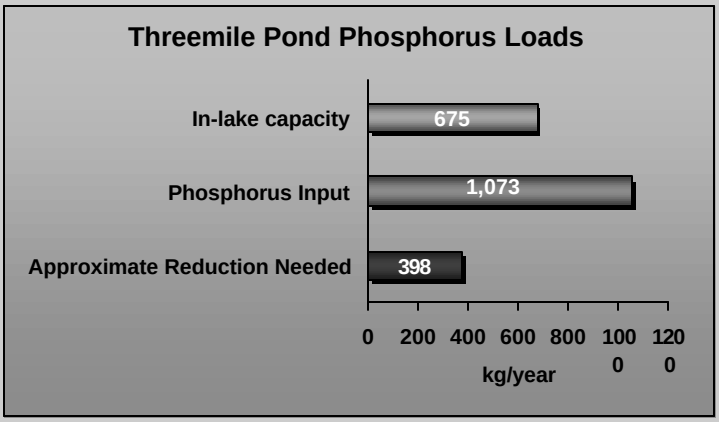
With these issues in mind, federal, state, county, and local groups have been working together to effectively address this nonpoint source water pollution problem. In 2001, the Maine Department of Environmental Protection funded a project in cooperation with the Maine Association of Conservation Districts, Kennebec County Soil and Water Conservation District, China Region Lakes Alliance, and the Threemile Pond Association, to (1) identify and quantify the potential sources of phosphorus; (2) identify the need for **Best Management Practices** to be installed in the watershed; and (3) to develop a feasible implementation plan to effectively reduce total phosphorus loads to Threemile Pond. A final report, completed in the early spring of 2003, is entitled "Threemile Pond Phosphorus Control Action Plan" and Total Maximum Daily (Annual Phosphorus) Load (**TMDL)** report, to be submitted to the US Environmental Protection Agency, New England Region, for their final review and approval.

What We Learned

A land use assessment was conducted for the Threemile Pond watershed to determine potential sources of phosphorus that may run off from land areas during storm events and springtime snow melting. This assessment involved utilizing many resources, including generating and interpreting maps, inspecting aerial photos, and conducting field surveys. Similar assessments have been conducted for associated upstream Threecornered Pond and downstream Webber Pond, located in the neighboring towns of Augusta and Vassalboro.

Based on land use assessments, an estimated 467 kg of phosphorus per year is directly exported to Threemile Pond from the watershed. Over the past two decades, the amount of total phosphorus being recycled internally (400 kg/yr) from the bottom sediments of Threemile Pond during the summertime has been fairly regular - exceeding one-half of Threemile Pond's natural capacity (675 kg TP/year) for in-lake phosphorus assimilation. In addition, the indirect total phosphorus contribution from upstream Mud and Threecornered ponds approximates 184 kg/yr, another 22 kg is added annually to account for future development in the watershed.





The combined internal and external loading (1,073) exceeds Threemile Pond's capacity to effectively process phosphorus by 398 kg/yr, which equals the minimum amount needed to be reduced on an annual basis to ensure that Threemile Pond is eventually free of nuisance summer algae blooms.

What You Can Do To Help!

As a watershed resident there are many things you can do to help restore the water quality of Threemile Pond. Lakeshore owners can use phosphorus-free fertilizers and maintain natural vegetation adjacent to the lake. Agricultural and commercial land users can consult the KC-SWCD or Maine DEP for information regarding Best Management Practices for reducing phosphorus. Watershed residents can become further involved by volunteering to help the Threemile Pond Association and participating in events sponsored by the CRLA. All stakeholders and watershed residents can learn more about their lake and the many resources available, including the full version of the Threemile Pond Phosphorus Control Action Plan (and TMDL) report. Following EPA approval, copies of this detailed report - which provides a full accounting of the project and recommendations for future Best Management Practices implementation - will be available online at: www.state.me.us/dep/blwq/docmonitoring/tmdl2.htm, or printed versions can be viewed and/or copied (at cost) at Maine DEP offices in Augusta (Bureau of Land and Water Quality, Ray Building, AMHI Campus).

Key Terms

- ***Watershed*** *is a drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.*
- ***Flushing rate*** *refers to how often the water in the entire lake water is replaced on an annual basis.*
- ***Phosphorus****: Total Phosphorus (TP) is one of the major nutrients needed for plant growth. It is generally present in small amounts and limits the plant growth in lakes. As phosphorus increases, the amount of algae also increases.*
- ***Best Management Practices*** *are techniques to reduce sources of polluted runoff and their impacts. BMP's are low cost, common sense approaches to reduce storm runoff and velocity to keep soil out of lakes and tributaries.*
- ***TMDL*** *is an acronym for Total Maximum Daily Load which represents the total amount of a pollutant (e.g., phosphorus) that a waterbody can receive on an annual basis and still meet water quality standards.*

Project Premise

This project, funded through a 319-grant from the United States Environmental Protection Agency (EPA), was directed and administered by the Maine Department of Environmental Protection in partnership with the Maine Association of Conservation Districts (MACD), from the summer of 2001 through the late spring of 2003.

The objectives of this project were twofold: First, a comprehensive land use inventory was undertaken to assist Maine DEP in developing a Phosphorus Control Action Plan and Total Maximum Daily Load (TMDL) report for the Threemile Pond watershed. Simply stated, a TMDL is the total amount of **phosphorus** that a lake can receive without harming water quality (see Appendices). The Maine DEP, with the assistance of the MACD Project Team, will incorporate public comments before final submission to the US EPA. *(Specific information on the TMDL process and results can be obtained by contacting Dave Halliwell at the Maine DEP Augusta Office at 287-7649 or at David.Halliwell@maine.gov*).

> ***Total Phosphorus (TP)*** *- is one of the major nutrients needed for plant growth. It is generally present in small amounts and limits the plant growth in lakes. Generally, as the amount of lake phosphorus increases, the amount of algae also increases.*

Secondly, watershed survey work, including a shoreline and septic survey evaluation, was conducted by the Maine DEP-MACD project team to help assess the Threemile Pond watershed. Watershed survey work included assessing direct drainage **nonpoint source (NPS) pollution** sites that were not identified during the Threemile Pond Watershed Nonpoint Source Pollution Survey conducted in 1996 (Maine DEP). The China Region Lakes Alliance (CRLA) — as part of its Watershed Management Plan (1998-2008) — intends to conduct a comprehensive follow-up watershed survey. The results of this assessment and some general recommendations for future conservation work in the watershed have been included to help citizens, organizations, and agencies restore and protect Threemile Pond. ***Note:*** *To protect the confidentiality of landowners in the watershed, site-specific land-use information has not been generally provided as part of this report.*

> ***Nonpoint Source (NPS) Pollution*** *- is polluted runoff that cannot be traced to a specific origin or stating point but appears to flow from many different sources.*

This Phosphorus Control Action Plan (PCAP) project compiles and refines land use data that was derived from various sources, including the watershed municipalities (China, Windsor and Vassalboro), the Threemile Pond Association, the Kennebec County Soil & Water Conservation District (SWCD), and the China Region Lakes Alliance. Local citizens, watershed organizations, and conservation agencies should benefit from this compilation of data as well as the watershed assessment and Best Management Practice (BMP) recommendations. Above all, this document is intended to help Threemile Pond stakeholder groups to effectively prioritize future BMP work in order to obtain the resources necessary for the implementation of NPS pollution mitigation work in the watershed.

Study Methodology

Background information regarding Threemile Pond was obtained using several methods, including a review of previous studies of the lake and watershed area, numerous phone conversations and personal interviews with municipal officials, regional organizations and state agencies and several field tours of the watershed, including boat reconnaissance of the lake and shoreline.

> ***GIS**—or **geographic information system**—combines layers of information about a place to give you a better understanding of that place. The information is often represented as computer-generated maps.*

Land use data were determined using the following methods: (1) **Geographic Information System** (GIS) map analysis; (2) analysis of topographic maps; (3) analysis of town property tax maps and tax data; (4) analysis of aerial photographs (US-FSA 1992 & 1997); and (5) field visits. For the land uses listed in Table 1 (Page 14), much of the undeveloped land use area (i.e., forest, wetland, reverting fields) was determined using GIS maps utilizing data from the Penobscot Bay Land Cover 1995/96 for the Coastal Change Analysis Program. The developed land uses were obtained using the best possible information available through analysis of methods 2 through 5 listed above. Necessary adjustments to the GIS data were made using best professional judgment.

Roadway data were gathered by taking actual road width measurements of the various types of roads (state, town, private/camp) in the watershed. The roads were measured between the two outer edges of the roadside ditches or berms. An average width was used for each of the three road types. Final measurements for all roadways within the watershed were extrapolated using GIS (Penobscot Bay Land Cover 1995/96 Analysis for the Coastal Change Analysis Program), and USGS topographical maps. Finally, the roadway area was determined using linear distances and an average width for each of the three main road types.

Additional land use data (i.e. residential, institutional) were determined using GIS cover mapping, aerial photos, topographic and property tax maps as well as personal consultation and, when necessary, field visits.

Agricultural information within the Threemile Pond watershed was provided by the Kennebec County Soil & Water Conservation District (SWCD). Information regarding harvesting operations was provided by the Maine Forest Service, Department of Conservation.

Past Threemile Pond diagnostic feasibility 314 studies (Maine DEP 1982, 1991-1992, 1993) and in-house alum-treatment reports were also reviewed and extensively used in preparing this PCAP-TMDL report, as was water quality monitoring data provided by the Maine DEP supported VLMP. A considerable amount of valuable lake/watershed information was also gleaned from the files and reports of the China Region Lakes Alliance files (1999-2001).

Study Limitations

Land use data gathered for the Threemile Pond Watershed is as accurate as possible given the available information and resources utilized. However, the final numbers for the land use analysis and phosphorus loading graphics are approximate at best, and should be viewed as carefully researched estimations only.

THREEMILE POND Phosphorus Control Action Plan

DESCRIPTION of WATERBODY and WATERSHED

*The **direct watershed** refers to the land area that drains to any given lake without first passing through another lake or pond.*

THREEMILE POND is a single-basin 1,132 acre (1.8 square miles) drainage lake located within the towns of China, Vassalboro & Windsor (DeLorme Atlas Map 13, MIDAS No. 5416), within Kennebec County. Threemile Pond has a **direct watershed** area of 5,971 acres (Figure 1) or 9.3 square miles, a maximum depth of 37 feet, a mean depth of 17 feet and a flushing rate of once per year. The total Threemile Pond watershed drainage area includes the 239-acre subwatershed of Mud Pond, which is considered in this report as an external load from the indirect watershed.

Drainage System - Threemile Pond generally flows from south to north and is located within a chain of lakes that make up the entire Webber Pond watershed. Threecornered Pond, to the southwest, flows southeast to join with the Mud Pond outlet stream, and continues to flow northeast to drain into Threemile Pond at its southern end. Threemile Pond outlets to Webber Pond via non-303(d) listed Seaward Mills Stream, located at the northwest end of the pond. There are no dams located on Threemile Pond which has three main tributaries, the largest of which, Barton Brook, drains the southern part of the watershed and includes the outflow of Threecornered and Mud ponds (Maine DEP 1982).

Indirect Drainage - Mud Pond is a warm, very shallow 112 acre pond located within the towns of Windsor and China. The pond has a maximum depth of 12 feet and is surrounded by thick, woody emergent wetland vegetation. There is a deep layer of silt and mud on the bottom of the pond, with a strong hydrogen sulfide gas odor present, indicating decaying organic matter (Maine DIFW 2001). An informal public access site to Mud Pond occurs at the outlet stream, located adjacent to State Route 137. The shoreline of Mud Pond is currently undeveloped (Windsor tax records; Robert Mills, personal communication). The Mud Pond watershed contains several residential homes on the steep western portion of this indirect drainage to Threemile Pond (Ibid).

Water Quality Information

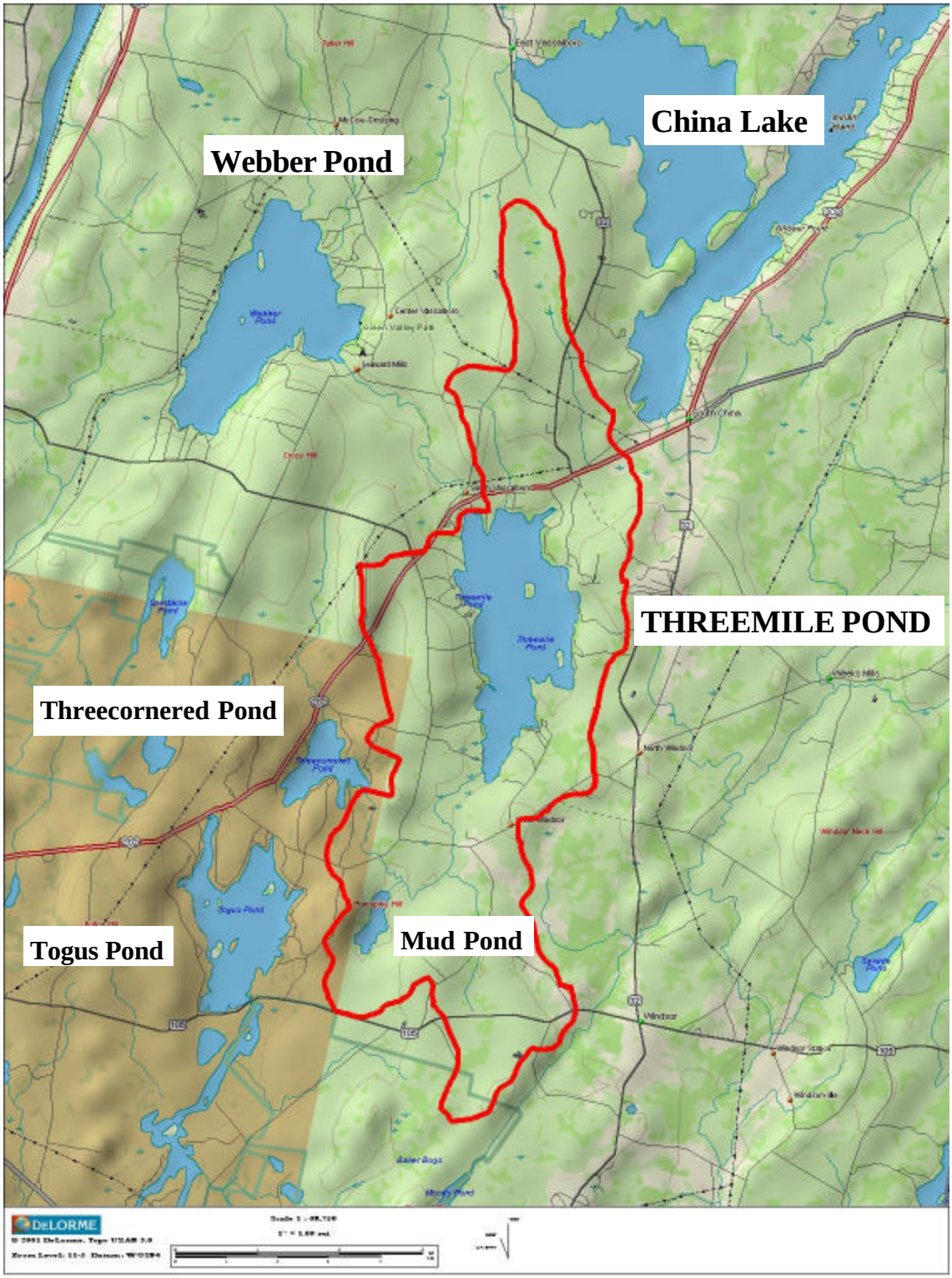
Threemile Pond is on the Maine Department of Environmental Protection's 303(d) list of lakes that do not meet State water quality standards as well as the State's **Nonpoint Source Priority Watersheds** list. Hence, a Phosphorus Control Action Plan (and TMDL) study was completed by the Maine DEP in the spring 2003.

*Waters within designated **NPS priority watersheds** have significant value from a regional or statewide perspective and have water quality that is either impaired or threatened to some degree due to NPS water pollution. This list helps to identify watersheds where state and federal agency resources for NPS water pollution prevention or restoration should be targeted.*

Water quality data for Threemile Pond has been routinely collected through the Maine DEP VLMP since 1977. Continuous **Secchi disk transparencies** have been obtained since 1977 to the present. During this 25-year period, basic chemical information was collected, including 16 years of data for total phosphorus (TP) and 22 years of **chlorophyll-a** data. Together these data document a trend of increasing **trophic state** and hence a violation of the Class GPA criteria requiring a stable or decreasing trophic state.

***Secchi Disk Transparency**—a measure of the transparency of water (the ability of light to penetrate water) obtained by lowering a black and white disk into water until it is no longer visible.*

Figure 1. Threemile Pond Direct Watershed



Nonpoint source (overland) pollution is the main reason for declining water quality in Threemile Pond. During and after storm events, nutrients such as phosphorus – naturally found in Maine soils – drain into the lake from the surrounding watershed by way of streams and overland flow.

Chlorophyll-a *is a measurement of the green pigment found in all plants, including microscopic plants such as algae. It is used as an estimate of algal biomass—the higher the Chl-a number, the higher the amount of algae in the lake.*

Phosphorus can be thought of as a fertilizer – a primary food for all plants, including algae. Phosphorus is naturally limited in lakes. When lakes receive excess phosphorus from NPS pollution, it "fertilizes" the lake by feeding the algae. Too much phosphorus = algae blooms. Algae blooms can damage the ecology and aesthetics of a lake, as well as the economic well-being of the entire community.

Trophic state*—Eutrophication is the process by which lakes are enriched with nutrients, increasing the production of rooted aquatic plants and algae. The extent to which this process has occurred is reflected in a lake's trophic state.*

In-lake Treatment for Blue-Green Algae Control: (Source: Maine DEP 2002). Threemile Pond has experienced severe algae blooms since the 1970's – during which time Maine DEP and local residents and stakeholder groups (e.g., CRLA) have been involved in various attempts to reduce the frequency and magnitude of the algae blooms. In an attempt to seal the phosphorus in lake bottom sediments, Threemile Pond was treated with aluminum compounds in 1988. The results of treatment were not successful and it was decided that further alum treatment was not appropriate until NPS pollution mitigation work was done in the watershed to control external phosphorus loading (Maine DEP 1993).

Threemile Pond has also been treated with copper sulfate compounds that serve as an algaecide, but is also toxic to aquatic life and can have long-lasting environmental effects. In the 1970's the general use of chemical treatments in Maine lakes was made illegal. In 1996, legislation was passed allowing Maine DEP to issue a license for annual copper sulfate compound treatments under certain very restricted conditions, including requiring an active watershed management program to reduce the external phosphorus loading to the lake. In 1997, the Town of China received a license to treat Threemile Pond with copper sulfate to reduce the effects of the most significant algal blooms (those in which the Secchi disk transparency drops below 2 meters).

The license allowed the Town of China to use granular $CuSO_4$ to treat about 700 acres of the pond in mid-late summer when the Secchi disk transparency drops below 2 meters. It must be done under the supervision of a licensed pesticides applicator. The area to be treated must be greater than or equal to a 10-foot depth, and no coves or near-shore areas may be treated. The target dose is 0.03 parts per million of $CuSO_4$ in the upper 10 feet of the water column, a dose similar to those applied in New Hampshire and a few other states. It is similar to the dose applied in the Threemile Pond "experimental" treatment in 1983. The law provides for no more than a five-year license period and no more than one treatment annually during that time. The license also specifies before, during and after treatment monitoring of water and pond sediments to assure target doses are not exceeded.

By arrangement with the Town of China, the Threemile Pond Association has treated the lake each year from 1997 to 2001, with the exception of 2000. In general, the treatment seems to limit the intensity of the algae bloom, but does not effectively clarify the lake, as numerous suspended particles remain and the lake often has an algal re-growth later in the summer. The treatment license

expired in July of 2002 and future use of copper sulfate as an algae management tool for Threemile Pond is not further recommended by the Maine Department of Environmental Protection.

Principle Uses: A state-owned boat landing, newly rebuilt in 1997, is located on the northern end of Threemile Pond on Route 3/202 in South Vassalboro. This trailerable boat access area is also used for swimming. Dominant human use of the Threemile Pond shoreline is residential (both seasonal and year-round occupancy) and recreational – including boating, fishing and beach use. A former commercial campground on the northeastern shore of Threemile Pond has been recently converted to a residential subdivision. The Windsor Boy Scout Troop owns the undeveloped island at the southern end of Threemile Pond which they occasionally use for camping trips (Robert Mills, Windsor CEO, personal communication).

Human Development: Threemile Pond has a moderately developed lakefront with approximately 50 to 60 percent of the shoreline developed (MACD and CRLA 2001). The shoreline of Threemile Pond is almost equally divided between the towns of Windsor, China and Vassalboro. Most of the undeveloped shoreline areas on the south and eastern shores of the lake consist of swampy, wetland areas and are not likely to be developed (Reb Manthey, personal communication). There are 196 shoreline dwellings, of which an estimated 58% are seasonal cottages, while 42% are year-round homes (MACD 2001). There are very few seasonal to year-round conversions in any given year – approximately one per year in Vassalboro and about one every three to four years for the towns of China and Windsor (Vassalboro town records; Scott Pierz, China CEO; Robert Mills, Windsor CEO).

In addition to NPS pollution, rapid population growth rates in the surrounding towns are also a concern for Threemile Pond. The direct watershed is located within the towns of Windsor (45%), China (35%), Vassalboro (17%), and Augusta (3%). Windsor, China and Vassalboro are rural, residential suburbs, located just north of Augusta and about 15 miles south of Waterville in central Kennebec County. The cities of Augusta and Waterville are the closest commercial and employment centers in the area.

Human population growth rates have increased during the 1990 – 2000 time period for the towns of Windsor (16.3%), China (10.5%) and Vassalboro (10%), while Augusta's population has declined by 13% during the past decade (US Census 1990, 2000). The estimated human population of the Threemile Pond watershed is 1,190 people (Municipal Tax Records, US Census 2000).

Fish Assemblage - Anadromous Fish Restoration

Based on records provided by the Maine Department of Inland Fisheries and Wildlife (Maine DIFW) and a recent phone conversation with fish biologist Jim Lucas (Region B, Sidney Maine DIFW office), Threemile Pond (Vassalboro, China, Windsor, Kennebec River – Seven Mile Stream drainage) is currently managed as a mixed warmwater and coldwater fishery and was last surveyed in 1981 (revised 1989). A total of **17** fish species are listed, including **11** native indigenous fishes (American eel, Golden shiner, Common shiner, Fallfish, White sucker, Brown bullhead, Chain pickerel, Banded killifish, Pumpkinseed, Redbreast sunfish, and Yellow perch); **2** annually stocked managed fishes (sea-run Alewife - Maine DMR anadromous fish restoration program, and catchable-size Brown trout -

Maine DIFW); **1** illegally introduced fish (Black crappie); and **3** introduced fishes of uncertain origin (White perch, Smallmouth and Largemouth bass). These latter three non-indigenous sport fish species, along with Chain pickerel, provide a very popular warmwater fisheries in Threemile Pond. According to Maine DIFW records, **anadromous** Sea lamprey, Kennebec River strays, have been historically reported from Threemile Pond, as well as from the downstream situated Webber Pond.

Threemile Pond has historically been plagued with annually occurring severe summer blue green algae blooms and significant depths of **anoxic** waters (about 50% at deep hole, 6-11 meters, 16-42% by volume/area). A significant reduction in the external (watershed) loading of total phosphorus to Threemile Pond may lead to maintaining in-lake nutrient levels - within the assimilative capability of this lake to effectively process available total phosphorus and enhance and/or protect the continued maintenance of the existing warm water and marginally cold water fisheries.

Anadromous *fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn.*

Starting in 1987, the Maine Department of Marine Resources (Maine DMR), Maine DEP and Maine DIFW began a 10-year cooperative study of the relationship between anadromous Alewives, resident freshwater fish species and the water quality of selected lakes (Maine DEP 1995). This study indicates that the aquatic ecology of study lakes are not noticeably affected by Alewife stocking, at least at the introductory rate of 6 fish per acre (Kircheis et al. 2002). In 2001, Maine DMR began stocking Threemile Pond with Alewives as part of the Lower Kennebec River Anadromous Fish Restoration Plan (1986). This plan seeks to restore American shad and Alewives to their historical habitat in the Kennebec River above Augusta (Maine DMR 1986). Stocking in the Sevenmile Stream drainage, which includes Webber, Threemile and Threecornered ponds, was previously deferred for a number of years due to ongoing work to improve existing poor water quality.

Anoxic— *A condition of little or no oxygen in the water. Often occurs near the bottom of fertile, stratified lakes in the summer and under ice in late winter.*

Beginning in 2001, Threemile Pond was stocked by Maine DMR with Alewives at a rate of 2 fish per acre (2,154). The stocking rate for 2002 and beyond will be at least 2 fish/acre and may be increased to a rate of 4 to 6 fish/acre (Matthew O'Donnell, formerly Maine DMR, personal communication). In 2002, the Pond was stocked with 6,237 Alewives, a rate of approximately 6 fish per acre (John Perry, Maine DMR, personal communication).

Watershed Topography and Characteristic Soils: (Source: USDA SCS, 1978): Soils dominating the entire Webber Pond watershed, which includes the Threemile Pond watershed, are fine to medium textured soils characterized as being easily erodible when vegetation is removed (CRLA 1999) and are described by the following three soil associations:

1. **Hollis-Paxton-Charlton-Woodbridge (82%):** Shallow and deep, somewhat excessively drained to moderately well-drained, gently sloping to moderately steep, moderately coarse textured soils, on hills and ridges.
2. **Buxton-Scio-Scantic (12%):** Deep, moderately well-drained to poorly drained, nearly level to sloping, medium textured soils, in flat areas near waterways.
3. **Scantic-Ridgebury-Buxton (6%):** Deep, poorly drained to moderately well-drained nearly level

to sloping, medium textured soils in valleys and moderately coarse textured soil in flat areas or depressions on upland ridges.

Land Use Inventory

The results of the Threemile Pond watershed land use inventory are depicted in Table 1 (following page). The various land uses are categorized by developed vs. undeveloped land. The developed land area comprises approximately 14% of the watershed and the undeveloped land areas, including the surface area of Threemile Pond, comprise the remaining 86% of the watershed. These numbers may be used to help make future planning and conservation decisions relating to the Threemile Pond Watershed. The information in this table was also used as a basis for preparing the Total Maximum Daily Load report (see Appendices).

Descriptive Land Use and Phosphorus Export Estimates

Agriculture: In 1981, Maine DEP conducted a Diagnostic Feasibility Study for the entire Webber Pond watershed, inclusive of the Threemile and Threecornered Pond watersheds. High phosphorus loading was attributed to poor manure handling techniques (winter spreading on grassland) and inappropriate nutrient management. In 1983, a watershed management plan, including a comprehensive listing of needed agricultural conservation practices for the Webber, Threemile and Threecornered pond watersheds, was developed by the Kennebec County Soil & Water Conservation District (SWCD) and the Soil Conservation Service (today known as the Natural Resources Conservation Service or NRCS).

The Kennebec County SWCD worked with farmers cooperatively to address four of seven high priority farms, while two other farms reduced or stopped farming during the 1980s. By 1991, phosphorus contributions from grassland had decreased in both magnitude and relative importance in both of the agricultural-based watersheds (Webber and Threemile ponds). External (watershed) phosphorus loading to Threemile Pond was reduced by an estimated 50% (379 – 560 kg TP) as a result of improved agricultural systems and a reduction in overall farm acreage (Maine DEP 1993).

More recent agricultural land use data for the Threemile Pond direct watershed were provided by the Kennebec County SWCD. Conservation practices implemented in 2001-2002 include the conversion of 19 acres of corn ground to hayland and the creation of one nutrient management plan encompassing approximately 60 acres of hayland and 15 acres of corn crops in the watershed (Kennebec County NRCS).

Today, there are approximately 454 acres of agricultural land remaining within the Threemile Pond watershed, comprising about 7% of the total land area. Agricultural land area (excluding managed forestlands) comprises 6.4% of the total watershed area and 26% of the external phosphorus load.

Forestry: Forestry operations generally have the potential to negatively impact a waterbody by erosion and sedimentation from logging sites. Many local consulting foresters within the Threemile Pond watershed have worked with the China Region Lakes Alliance (CRLA) to minimize potential impacts. Also, many local loggers are Certified Logging Professionals trained to reduce potential

Table 1: THREEMILE Pond Direct Watershed - Land Use Inventory and Total P-Loads.

LAND USE CATEGORY	Total Land Area Acres	Total Land Area %	TP Export Total %
Agricultural & Forested Land		**Threemile Pond**	
Cropland	43	0.6	5.6
Hayland (Manured)	278	3.9	15.6
Low-Intensity Hayland	113	1.6	3.4
Pasture	20	0.3	1.4
Operated Forest Land	164	2.3	5.7
Sub-Totals	**618**	**9%**	**32%**
Shoreline Development		**Threemile Pond**	
Low Impact Residential	48	0.7	1.0
Medium Impact Residential	38	0.5	1.6
High Impact Residential	13	0.2	0.8
Residential Septic Systems	–	0.0	3.6
Camp and Private Roads	28	0.4	4.8
Institutional (Public)	2	0.0	0.3
Sub-Totals	**128**	**2%**	**12%**
Non-Shoreline Development		**Threemile Pond**	
State Roads	34	0.5	4.4
Town Roads	56	0.8	7.3
Trail	4	0.1	0.7
Low Density Residential	214	3.0	4.6
Commercial	14	0.2	1.8
Institutional (Public)	4	0.1	0.3
Sub-Totals	**326**	**5%**	**19%**
Total: DEVELOPED Land	**1,072**	**16%**	**63%**
Non-Developed Land		**Threemile Pond**	
Inactive/Passively Managed Forest	3,598	50.7	12.5
Wetlands	632	8.9	1.1
Scrub Shrub	472	6.6	4.1
Reverting Fields	195	2.7	3.4
Open (Bare) Land	2	0.0	0.2
Total: NON-DEVELOPED Land	**4,899**	**Threemile P.** **69%**	**21%**
Total: Surface Water (Atmospheric)	**1,132**	**16%**	**16%**
TOTAL: DIRECT WATERSHED	**7,103**	**Threemile P.** **100%**	**100%**

environmental impacts associated with forestry (CRLA 1999). Acreages of "operated forest" are estimates of forest acres harvested annually in the Threemile Pond watershed (Forestry data and interpretation provided by Morten Moesswilde, Maine Forest Service).

Maine landowners who harvest more than 2 acres of forest (or 5 acres if partially cut) are required to submit a Forest Operations Notification, including a location map, to the Maine Forest Service, Department of Conservation. After harvest, a Landowner Report of acres actually harvested in a given year is required. These reports provide a reasonable average annual estimate of those acres where some type of partial timber harvesting took place. The estimated "operated forest" acres for Threemile Pond are based on Landowner Reports submitted for 1998-2001 average 164 acres per year, accounting for about 2% of the Threemile Pond watershed area. Landowner Reports also indicate if any clearcutting took place, though none was reported in this period. Harvested forest acres in Maine typically regenerate as forest, whether or not they are under any type of planned forest management or under the supervision of a Licensed Forester. Forest areas without harvesting may be managed passively, or may be under an active management program with no commercial activity occurring in 1998-2001.

Landowner Reports also reflect forest acres that have been clearcut with the intention of converting the land to another use, such as cropland, pasture, or residential use. In the Threemile Pond watershed, there were 21 acres of such forest conversion reported during this four-year time period.

There are 164 acres of operated forestland within the Threemile Pond watershed approximating 2.3% of the total land area and 5.7% of the total phosphorus load.

Shoreline Residential (House and Camp Lots): A shoreline survey was completed in August of 2001 by Maine DEP and MACD project staff. The survey was conducted from a boat, approximately 50 feet from the shoreline. The survey provides a total shoreline structure tally and subjective determination of seasonal versus year-round structures. There are 196 homes and cottages, comprised of 42% year-round dwellings (83) and 58% seasonal dwellings (113).

Table 2 summarizes the NPS pollution impact ratings for the residential shoreline lots. Each shoreline lot was assigned an NPS pollution impact rating using best professional judgment. The impact ratings range from 1 to 5, with 1 being very low impact and 5 being high impact. Lots receiving a rating of 1 would have a full and naturally vegetated shoreline buffer. Conversely, a lot given a score of 5 would have little or no vegetative shoreline buffer and support bare (eroding) soil – a visible source of phosphorus input to the lake.

Overall, 51% of the developed shoreline lots on Threemile Pond have a moderate to high impact on the lake due to inadequate or nonexistent vegetative buffers and/or close proximity to the lake. Many of the shoreline areas have been adequately rip-rapped at the toe of the slopes, but lack vegetative plantings above the rip-rapped areas, necessary to decrease the amount and flow of run-off from the site. Many of the homes and cottages have mowed grass lawns that stretch down to the lake and do not function as adequate shoreline buffers.

To estimate phosphorus loading from residential land use, the shoreline survey data were condensed into three categories - low, medium and high impact. Phosphorus loading coefficients were developed using information on residential lot stormwater export of algal available phosphorus (Dennis et al. 1992). Seasonal and year-round camp and home lots on Threemile Pond comprise 1.4% of the land area and an average of 16.1 kg of total phosphorus annually, which approximates 3.4% of the estimated total phosphorus load.

Table 2. Threemile Pond Shoreline Survey Results (2002)

NPS Pollution Potential Severity Score	Impact rating—characterized by one or more of the following:	Number of shoreline sites identified within each category:	% of sites within each category
1 = very low impact	All natural vegetation—great buffer; good setback from lake	31	16%
2 = low impact	Good natural vegetation; good setback from the lake	64	33%
3 = moderate impact	Lack of adequate buffer; close to lake	75	38%
4 = moderately high impact	Lack of buffer; steep slopes; close to lake	20	10%
5 = high impact	Lack of buffer; steep slopes; close to lake; bare soils	6	3%

Shoreline Septic Systems: Currently, there are no public sewer services for the land area within the Threemile Pond watershed. Vassalboro's Shoreland Zoning Ordinance has a provision for septic waste disposal requiring that by December 31, 1995, all landowners within the Shoreland Zone provide documentation that their system is in compliance with Maine's Subsurface Wastewater Disposal Rules, or install a new system in accordance with this rule. Failure to comply with this shoreland zoning ordinance constitutes a violation and is subject to enforcement action. As a result of this shoreland zoning ordinance, many older septic systems were replaced for an estimated 95% compliance (CRLA 1999; S. Pierz, personal communication, 2001). The towns of China and Windsor do not have similar ordinances in place for Threemile Pond shoreline septic systems.

- *To convert kg of total phosphorus to pounds—multiply by 2.2046*
- *To convert kg/hectare to lbs/acre—multiply by .892*

In order to estimate total phosphorus loading from shoreline septic systems, a simple model was based on the following attributes: seasonal versus year-round occupancy; estimated age of the system; estimated distance of the system to the lake; and an average residence rate of three people per dwelling. These attributes were determined by shoreline survey, town records, personal interviews with municipal officials and Census data.

Estimates of the total phosphorus loading from shoreline residential septic systems on Threemile Pond range from a low of 17 to a high of 54 kg total phosphorus per year, approximating a total watershed phosphorus export of 3.6% or 17 kg TP annually.

Other Shoreline Development: The state-owned public boat launch is located at the north end of Threemile Pond in Vassalboro and is classified as recreational (shoreline) land use. Total phosphorus loading from this access site approximates only 0.3% of the total watershed TP export or 1.2 kg TP annually.

Private/Camp Roadways: There are 20 private/camp roads around Threemile Pond, comprising 11 miles (plus 2 miles of trails). Only six of these have formal road associations (Dan Dubord, personal communication, 2002). Comprising 0.4% of the land area, total phosphorus loading from private camp roads approximates 4.8% of the total watershed TP export or 22.5 kg TP annually.

Overall, shoreline development comprises only 2% of the total watershed area, however it contributes an average of 57 kg of phosphorus annually, which approximates 12% of the estimated external (watershed generated) phosphorus load.

Other Development and Land Uses

These areas consist of non-shoreline development—all lands outside the immediate shoreline area of Threemile Pond, such as state and town roadways, low-density non-shoreline residential areas, and other land uses such as commercial and recreational (public) areas. These land areas were calculated using GIS land use coverage provided by the Kennebec County SWCD, as well as town tax data, aerial photos and field visits (ground-truthing).

Public Roadways: There are approximately 4 miles of state roadways and 14 miles of town roadways within the Threemile Pond watershed. As is generally the case, this particular land use accounts for a much greater percentage of the average total phosphorus load (11.7%) versus its land area (1.3%) in the Threemile Pond watershed.

Low-Density Residential: Municipal tax records and property tax maps were used to determine the number of residential dwellings within the Threemile Pond watershed. An average lot size of one acre was used to estimate the residential land area for a total of 214 acres. This land use is characterized as dispersed, low-density, single-family homes. Non-shoreline residential areas account for 3% of the land area and 4.6% of the total phosphorus load to Threemile Pond.

Commercial: There are approximately 14 acres of commercial land within the Threemile Pond watershed, most of which is concentrated on the Route 3/202 corridor at the north end of the lake in the Town of China (China and Vassalboro tax records). Commercial development is limited to professional and service businesses as well as a municipal salt and sand storage facility. This land use accounts for less than 1% of the land area and 1.8% of the total phosphorus load.

Non-Shoreline Development Summary

Overall, non-shoreline development accounts for 5% of the total land area and contributes an average of 89 kg of total phosphorus annually, approximating 19% of the total phosphorus load.

Phosphorus Loading from Non-Developed Lands

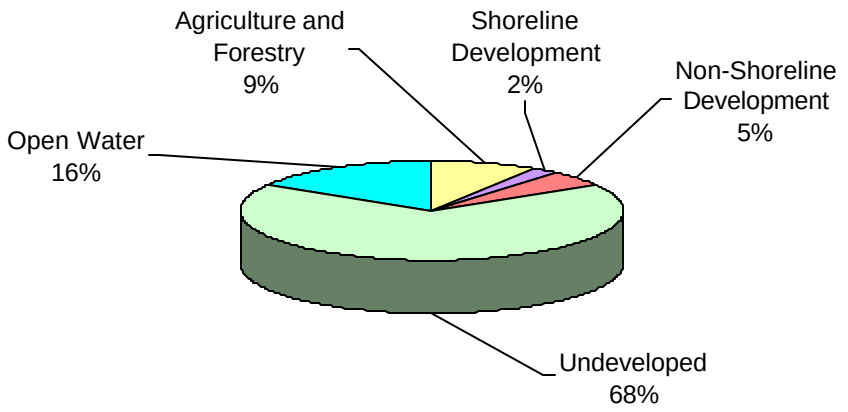
Forests: Of the total land area within the Threemile Pond watershed, 51% (3,598 acres) is forested (Table 1), characterized by privately owned deciduous and mixed forest plots (KC-SWCD GIS, MACD 2002). A total of 12.5% of the phosphorus load (average 58.2 kg) is estimated to be derived from the inactive/passively managed forested areas within Threemile Pond's direct drainage area.

Other Non-Developed Land Areas: Combined wetlands, reverting fields, old field scrub shrub and bare land comprise approximately 18.2% of the Threemile Pond Watershed, which accounts for the remaining 8.8% (40.9 kg) of the total non-cultural total phosphorus export load (99 kg).

Atmospheric Deposition (Open Water) is estimated to account for 73 kg total phosphorus, representing 16% of the total load entering Threemile Pond, with lake surface waters (1,132 acres) comprising 16% of the total watershed area (7,103 acres).

Figure 2 (below) depicts the total land area by land use within the Threemile Pond watershed.

Figure 2. Threemile Pond Direct Watershed Total Land Area Breakdown



PHOSPHORUS LOADS – Watershed, Sediment and In-Lake Capacity

Supporting documentation for the phosphorus loading analysis includes the following: water quality monitoring data from Maine DEP and the Volunteer Lake Monitoring Program, and the development of a phosphorus retention model (see Appendices for detailed information). Following are summary estimates of phosphorus loading for Threemile Pond, as depicted in Figure 3 (following page).

- External total phosphorus loadings to Threemile Pond originate from a combination of external (watershed) and internal (pond sediment) sources of total phosphorus (TP). External watershed TP sources, approximating 467 kg annually have been identified and accounted for by land use (see above).

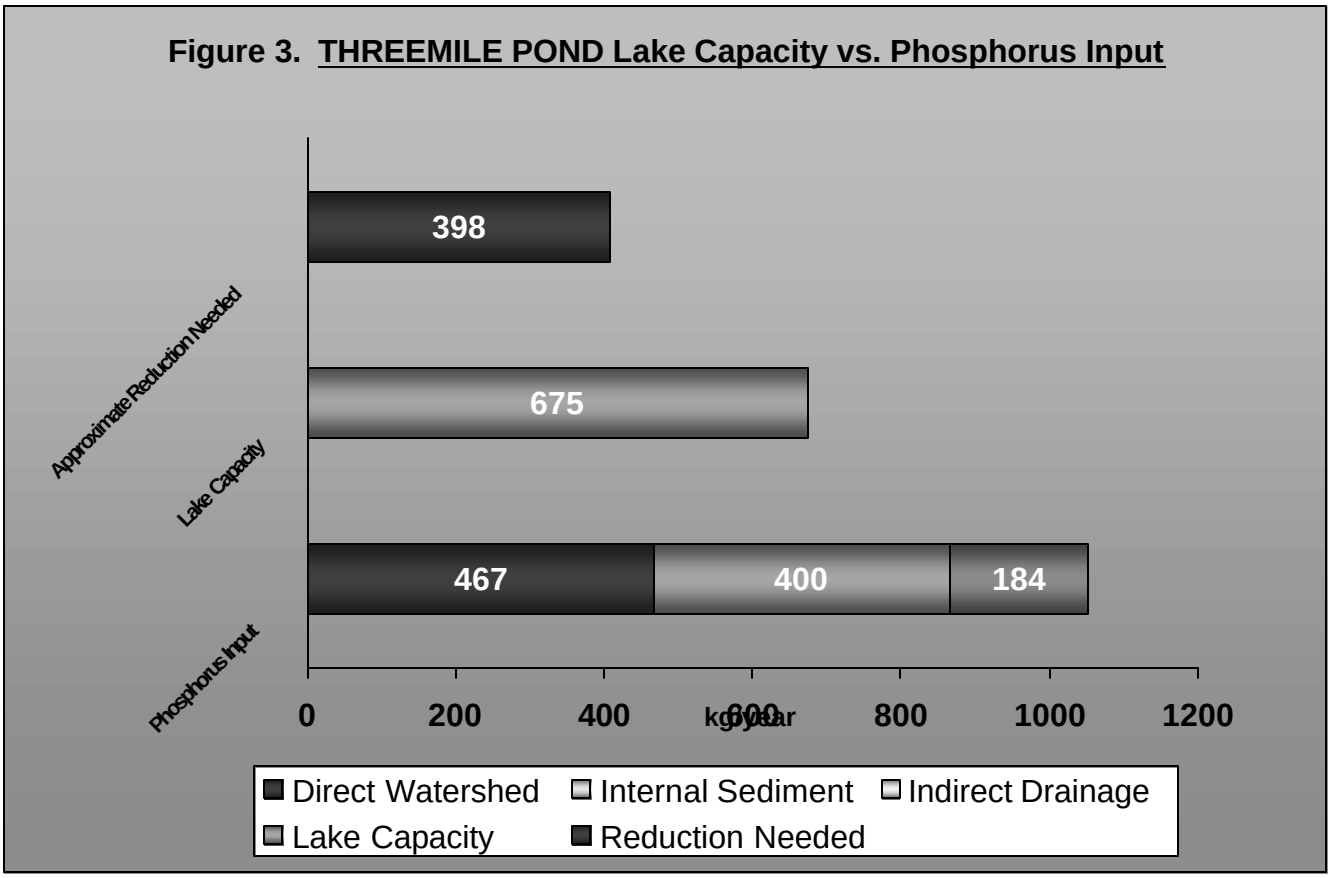
- Total phosphorus loading from the associated upstream Threecornered (154 kg) and Mud (30 kg) ponds accounts for external loading from the indirect watershed of 184 kg annually, determined on the basis of *flushing rate x volume x TP concentration,* and typical area gauged streamflow calculations (Jeff Dennis, Maine DEP, personal communication).

- The relative contribution of internal sources of total phosphorus within Threemile Pond - in terms of pond sediment total phosphorus recycling - range from 201 to 495 kg with an average annual value approximating 400 kg.

- The annual contribution to account for future development is an additional 22 kg, for a total phosphorus load (internal and external sources) of 1,073 kg per year.

- The load allocation (lake assimilative capacity) for all existing and future non-point pollution sources for Threemile Pond is 675 kg of total phosphorus per year, based on a target goal of 15 ppb.

Figure 3. THREEMILE POND Lake Capacity vs. Phosphorus Input



THREEMILE POND

PHOSPHORUS CONTROL ACTION PLAN

Recent and Current NPS/BMP Efforts

Maine DEP completed a Diagnostic and Feasibility study for the Webber Pond Watershed in 1981, which included Threemile and Threecornered ponds. This earlier study documented significant water quality impairment to the ponds as well as recommending steps for restoration. In 1983, the Kennebec County Soil and Water Conservation District, along with the Soil Conservation Service (NRCS), produced the Webber Pond Watershed Plan, which focused on supplementing the ongoing NPS reduction program by controlling internally recycled (pond sediment derived) phosphorus. The Plan included a listing of needed agricultural conservation practices in the watersheds of Threemile, Threecornered and Webber ponds. Seven of 31 farms in the watershed were designated as high priority for conservation measures.

Agricultural BMPs installed within the Threemile Pond Watershed during the 1982 to 1990 time period included two agricultural waste management systems, 2,350 feet of obstruction removal, 10 acres of hayland planting, and 55 acres of strip-cropping. Estimated reductions in external phosphorus loading resulting from the implementation of agricultural conservation practices during 1982 to 1990 was 379 to 560 kg/TP or a 50% reduction in total phosphorus to Threemile Pond (Maine DEP 1993).

Maine DEP completed a diagnostic feasibility study for Threemile Pond restoration in 1987. In subsequent years, substantial support was provided for the restoration of Webber and Threemile ponds under the Clean Lakes Program of EPA, under section 314 of the Clean Water Act. Maine DEP was awarded a Clean Lakes Grant for the Threemile Pond Restoration Project. In 1988 Threemile Pond had an aluminum treatment (See In-Lake Treatment) and remaining project funding was directed toward additional non-agricultural NPS reductions. Total cost-share funds expended during 1990 – 1992 amounted to $23,215.29 in addition to the almost $90,000 PL 566 funds expended by the Soil Conservation Service plus SUDA/ACP funding of the Webber – Threemile Pond watersheds (Maine DEP 1993).

A volunteer watershed survey, sponsored by Maine DEP and the CRLA, was completed for the Threemile Pond watershed in 1996. The watershed was split into sectors and trained volunteers surveyed their sectors for evidence of erosion and sedimentation.

A total of 190 problem sites identified in the 1996 survey, including: 64 road, ditch and culvert problems; 7 stream erosion sites; 37 lake shoreline erosion sites; 68 camp and house lot drainage problems; 8 forestry-related problems; 3 agricultural-related problems; and, 3 “other” category sites. By the end of 1998, 36 of the identified sites had been repaired and/or mitigated, including 32 of the shoreline sites, 1 stream bank site and 3 road sites. These numbers do not include sites where work was done without the assistance of CRLA or sites where technical assistance was provided, but landowners did not report completed site repairs (CRLA 1999).

From June of 1996 to May of 1998, the CRLA administered Phase I of the Webber and Threemile Ponds Watershed Project (Phase II covers Webber Pond). Initially scheduled to last two years, this project was extended to three years with the support of taxpayers. During this three-year period, the CRLA worked to address existing sources of NPS pollution by providing information, offering technical assistance and overseeing the work of the Threemile Pond Conservation Corps. During this time period, 1996 – 1998, the Corps implemented 65 BMPs, including: 47 riprap projects (mostly shoreline), 11 water bars installed on camp roads, and 7 drainage ditch and culvert outfall rip-rap jobs. Corps work also included cleaning out plugged culverts and removing debris from a local swimming beach (CRLA 2000).

More recently, CRLA has developed a Watershed Management Plan for China Lake and Threemile and Webber ponds for the 1998-2008 time period. The goal of this watershed management project is to restore and prevent further degradation of the water quality, as well as to educate local citizens about the effects of their activities on water quality (CRLA 1999). This project works to implement erosion control practices and provide technical assistance to watershed stakeholders. Future projects include the establishment of shoreline buffer strips, completing and updating watershed surveys, exploring options for sustainability without relying on federal funding, updating cover type and land use information and increasing educational efforts and outreach (CRLA 1999). Major elements of this project include site selection and design, BMP project management, Conservation Corps activities, information and education, and water quality monitoring.

During the summer seasons 1999-2001, the Threemile Pond Conservation Corps worked on 31 sites within the watershed, in addition to two camp road projects during the 2001 summer season. Work completed by the Corps includes placement of rip-rap (38), buffer strip plantings (2), road drainage work (1), and French drain installation (1) for a total of $23,130 (TPCC Seasonal Reports 1999 - 2001). During the 2002 summer season, the Corps work includes placement of rip-rap (4), buffer strip planting (1) and ditch stabilization work (1) (Reb Manthey, personal communication).

In December of 2000, the CRLA initiated the Camp Road Runoff Abatement Project (#2001 R-09). This project addresses NPS pollution from camp roads by establishing 10 camp road demonstration sites (between China Lake, Webber and Threemile ponds). Three camp roads in the Threemile Pond watershed were chosen as potential demo sites. Camp roads with formal road associations are given priority for this funding.

During 2001 and 2002, three private/camp roads within the Threemile Pond watershed had BMPs implemented under this project, including culvert stabilization and road crowning and ditching at an estimated cost to landowners of $16,225 with $8,615 being reimbursed by the CRLA (Reb Manthey, personal communication, 2002).

Recommendations for Future Work

Threemile Pond is a waterbody that has impaired water quality due mostly to nonpoint sources and resultant internal (pond bottom) sediment recycling of phosphorus. Specific recommendations regarding Best Management Practices (BMPs) and actions to reduce external watershed total phosphorus loadings in order to improve water quality conditions in Threemile Pond are as follows:

Watershed Management: Since the mid-1990's, the CRLA has taken an active role in documenting and mitigating nonpoint source (NPS) pollution sites throughout the Threemile Pond watershed. The last documented survey was performed in 1996 and the CRLA Watershed Management Plan (1998 – 2008) outlines future plans for surveying the watershed for potential NPS pollution sites. This plan can help achieve locally supported watershed management programs, designed to facilitate widespread implementation of BMPs or other management measures in order to reduce or eliminate NPS pollution in Threemile Pond. The Threemile Pond Association, watershed residents, municipal officials and Maine DEP should support the CRLA in its continued efforts to implement the Watershed Management Plan.

Action Item # 1: Coordinate Existing Watershed Management Efforts		
Activity	**Participants**	**Schedule & Cost**
Develop a Threemile Pond Leadership Team	CRLA, KCSWCD, TPA, MDEP, municipalities, local business, watershed citizens	Annual Roundtable Meetings beginning in 2003—**minimal cost**

Shoreline Residential: These, sometimes heavily developed, areas have the potential to negatively impact the water quality of Threemile Pond. The 2001 MACD shoreline survey found that many of the developed shoreline lots have inadequate or nonexistent vegetative buffers. Many of the shoreline areas have been adequately rip-rapped at the toe of the slopes, but lack vegetative plantings above the rip-rapped areas, necessary to decrease the amount of run-off from the site. Many of the homes and cottages have mowed grass lawns that stretch down to the lake and do not serve as adequate buffers. A serious and concerted effort must be undertaken to encourage all landowners to establish vegetated buffers along the shoreline. Technical assistance by the CRLA and KC-SWCD, as well as the free labor provided by the Threemile Pond (CRLA) Conservation Corps, should be well publicized and taken advantage of by landowners.

Action Item # 2: Educate Watershed Citizens About Buffers		
Activity	**Participants**	**Schedule & Cost**
Develop a Buffer Awareness Campaign for Watershed Citizens	CRLA, KCSWCD, TPA, MDEP, watershed citizens, local nurseries	Ongoing - **~ $5,000/yr**

Public Roadways: Generally, lakeshore camp roads are not always designed and maintained properly, and can be a major source of erosion and sedimentation to lakes. During the 2001 MACD inventory, one camp/private road site was noted for drainage issues – moderate surface erosion, poor shaping and the potential for culvert placement. For free technical assistance with proper camp road maintenance, contact the CRLA or the KC-SWCD. Additionally, 3 sites with previously installed BMPs were noted for needed maintenance. These maintenance issues – such as waterbar and drain clearing – require little effort. Landowners should routinely inspect BMPs that have been installed on or adjacent to their properties to ensure they are working properly. If landowners are unsure of proper maintenance, they should call the CRLA for assistance (445-5021).

One Threemile Pond (town road) site was noted by project staff at a stream crossing/culvert area for severe shoulder erosion, an unstable culvert and severe streambed disturbance. The KC-SWCD provides free technical assistance to municipalities to help improve roadways (622-7847 Ext. 3).

Action Item # 3: Implement Roadway Best Management Practices		
Activity	**Participants**	**Schedule & Cost**
Continue to Implement Roadside BMPs watershed-wide	CRLA, KCSWCD, TPA, MDEP, watershed road associations	Ongoing **$10,000/yr**

Non-Shoreline Residential and Commercial: These properties should be considered as potential problem areas, especially those adjacent to Threemile watershed brooks and streams. These areas should be included in future education and outreach efforts as all residents within the watershed benefit from improved water quality in Threemile Pond.

Action Item # 4: Develop Stewardship Initiatives for Threemile Pond Tributaries		
Activity	**Participants**	**Schedule & Cost**
"Adopt" local streams to promote stewardship efforts including education and water quality monitoring	CRLA, KCSWCD, MDEP Stream Team, local schools, and watershed citizens	Annually beginning in 2003 **$500/yr**

Agriculture and Forestry: Since the early 1980's, the Kennebec County Soil and Water Conservation District and USDA Natural Resources Conservation Service (NRCS) have worked cooperatively with landowners to install conservation practices in the watershed. For free technical assistance, potential cost-share funds or for more information about proper agricultural BMPs, contact the Kennebec County SWCD or NRCS offices in Augusta (622-7847 ext 3).

Forestry operations have the potential to negatively impact a waterbody by erosion and sedimentation from logging sites. Two forestry harvesting sites were noted during the MACD 2001

watershed inventory as potential sources of NPS. One logging site appeared active and was noted for lack of erosion controls while the other site was noted for not being properly re-vegetated when the operation ceased. Individuals should consult with municipal officials for information about permit requirements within their municipality. Foresters, loggers and landowners working in the watershed may contact the Maine Forest Service for technical assistance and may also obtain a copy of the Forestry BMP Guidelines (800-367-0223 or 207-287-2791).

Individual Action by all watershed residents should be encouraged through continued education and outreach efforts. Encouraged actions should include retention or planting of natural vegetation of

Action Item # 5: Conduct Workshops for Agriculture and Forestry Operators		
Activity	**Participants**	**Schedule & Cost**
Conduct workshops encouraging the use of phosphorus control measures	CRLA, KCSWCD, NRCS, MFS, forestry and agriculture community	Annually beginning in 2003 **$1,000/yr**

buffer strips, elimination of phosphorus-containing fertilizers, and use of non-phosphate cleaning detergents and routine maintenance of septic systems.

Individuals are also encouraged to become active members of the Threemile Pond Association. The Association is a valuable resource for watershed residents – and a broader, more active membership base will help ensure that lake watershed education and restoration efforts are successful.

Municipal Action should include ensuring public compliance with local and state water quality laws and ordinances (Shoreland Zoning, Erosion and Sedimentation Control Law, plumbing code,

Action Item # 6: Expand Homeowner Education & Technical Assistance Programs		
Activity	**Participants**	**Schedule & Cost**
Increase outreach and education efforts to watershed citizens including technical assistance to landowners	CRLA, KCSWCD, TPA	Annually beginning in 2003 **$1,500/yr includes printing of educational materials**

phosphorus control ordinance) primarily through education, and enforcement action when necessary.

All municipal officials should attend the Maine Nonpoint Education for Municipal Officials (NEMO) workshop entitled “Linking Land Use to Water Quality”. For more information, contact Maine NEMO at 771-9020. Municipalities should consider seeking the assistance of the KC SWCD (622-7847 ext 3) and/or the CRLA (445-5021) when developing a maintenance plan to consider road impacts on water quality. For a copy of Environmental Management, A Guide for Town Officials, Best Management Practices to Control Nonpoint Source Pollution, contact the Maine DEP at 289-3901.

Action Item # 7: Educate Municipal Officials on Nonpoint Source Pollution		
Activity	**Participants**	**Schedule & Cost**
Educate all Municipal Officials on how to best control nonpoint source pollution	Watershed municipalities, Maine DEP, Maine NEMO, KCSWCD	Immediately—minimal

WATER QUALITY MONITORING PLAN

Historically, the water quality of Threemile Pond has been monitored via measures of Secchi disk transparencies during the open water months since 1977 (DEP and VLMP). Continued long-term water quality monitoring within Threemile Pond will be conducted bi-weekly, from May to October, through the continued efforts of VLMP and CRLA in cooperation with Maine DEP. Under this planned, post-PCAP water quality-monitoring scenario, sufficient data will be acquired to adequately track seasonal and inter-annual variation and long-term trends in water quality for Threemile Pond. A post-PCAP status update report will be routinely prepared five to ten years following EPA approval.

PCAP CLOSING STATEMENT

Since the early 1980's, considerable state and federal funding and local grass roots efforts (Threemile Pond Association and Kennebec County SWCD and Natural Resources Conservation Service, Maine DEP, and more recently, the China Region Lakes Alliance) have supported numerous well-planned and implemented lakeshore and watershed remedial projects designed to address and reduce the external loading of total phosphorus to Threemile Pond. As a result of much hard work and directed efforts over the past decade by Maine DEP and active watershed stakeholders, the water quality and watershed conditions of Threemile Pond are fairly well known and problem areas are being addressed to eliminate watershed phosphorus sources. During the summer months, the Threemile Pond Conservation Corps, under the direction of the CRLA, has spent considerable time and effort in assisting Threemile Pond shoreline residential landowners to implement NPS best management practices to control shoreline zone soil erosion. Continued implementation of a combination of residential shoreline property and roadway BMPs will effectively reduce both the external and ultimately the internally stored sediment phosphorus load within Threemile Pond.

APPENDICES

THREEMILE POND

Total Maximum Daily (Annual Phosphorus) Load

Introduction to Maine Lake TMDLs and Phosphorus Control Action Plans (PCAPs)

You may be wondering what the acronym 'TMDL' represents and what it is all about. TMDL is actually short for 'Total Maximum Daily Load.' This information, no doubt, does little to clarify TMDLs in most people's minds. However, when we think of this as an annual phosphorus load (*Annual Total Phosphorus Load),* it begins to make more sense.

Simply stated, excess nutrients or phosphorus in lakes promote nuisance algae growth/blooms - resulting in the violation of water quality standards as measured by water clarity depths of less than 2 meters. A lake TMDL is prepared to estimate the total amount of total phosphorus that a lake can accept on an annual basis without harming water quality. Historically, development of TMDLs was first mandated by the Clean Water Act in 1972, and was applied primarily to *point sources* of water pollution. As a result of public pressure to further clean up water bodies, lake and stream TMDLs are now being prepared for watershed-generated *Non-Point Sources* (NPS) of pollution.

Nutrient enrichment of lakes through excess total phosphorus originating from watershed soil erosion has been generally recognized as the primary source of NPS pollution. Major land use activities contributing to the external phosphorus load in lakes include residential-commercial developments, roadways, agriculture, and commercial forestry. Statewide, there are 38 lakes in Maine which do not meet water quality standards due to excessive amounts of in-lake total phosphorus.

The first Maine lake TMDL was developed (1995) for Cobbossee Lake by the Cobbossee Watershed District (CWD) - under contract with Maine DEP and US-EPA. TMDLs have been approved by US-EPA for Madawaska Lake (Aroostook County), Sebasticook Lake, East Pond (Belgrade Lakes), and China Lake. PCAP-TMDLs are presently being prepared by Maine DEP, with assistance from the Maine Association of Conservation Districts (MACD) and County Soil and Water Conservation Districts (SWCDs) - for Mousam and Highland Lakes in southern Maine (final EPA review). Ongoing PCAP-TMDL lake studies include: Long and Highland lakes (Bridgton); Annabessacook & Little Cobbossee lakes & Pleasant & Upper Narrows Ponds - the latter four under separate contract with CWD. A non-MACD supported PCAP-TMDL for Unity Pond (Waldo County) is also being developed with the assistance of Unity College staff. PCAP-TMDL studies have also been initiated for Sabattus, Togus, and Lovejoy ponds.

Lake PCAP-TMDL reports are based in part on available water quality data, including seasonal measures of total phosphorus, chlorophyll-a, Secchi disk transparencies, and dissolved oxygen-water temperature profiles. Actual reports include: a lake description; watershed GIS assessment and estimation of NPS pollutant sources; selection of a total phosphorus target goal (acceptable amount); allocation of watershed/land-use phosphorus loadings, and a public participation component to allow for stakeholder review.

PCAP-TMDLs are important tools for maintaining and protecting acceptable lake water quality and are designed to 'get a handle' on the magnitude of the NPS pollution problem and to develop plans for implementing Best Management Practices (BMPs) to address the problem. Landowners and watershed groups are eligible to receive technical and financial assistance from state and federal natural resource agencies to reduce watershed total phosphorus loadings to the lake. **Note:** for non-stormwater regulated lake watersheds, the *development of phosphorus-based lake PCAP-TMDLs are not intended by Maine DEP to be used for regulatory purposes*.

For further information, please contact Dave Halliwell, Maine Department of Environmental Protection, Lakes PCAP-TMDL Program Manager, SHS #17, Augusta, ME 04333 (287-7649).

Water Quality Monitoring (Source: Maine DEP and VLMP 2002): Water quality data for Threemile Pond has been routinely collected since 1977, during which time continuous Secchi disk transparency (SDT) measures have been obtained. During this 27-year period, basic chemical information was collected, including 18 years of data for total phosphorus (TP) and 24 years of chlorophyll-a data.

Water Quality Measures (Source: Maine DEP and VLMP 2002): Threemile Pond is a non-colored lake with average color measures averaging 21 color units (SPU's). Average minimum summer water column transparencies range from 0.4 to 6.0 meters with an average SDT of 3.1 m (10.2'). The range of water column (epilimnion core vs. bottom grab) TP for Threemile Pond is 14 - 46 parts per billion (ppb) with an average of 26 ppb. Chlorophyll-a measures range from 2.5 – 47.6 ppb (183.2 in 1993) with an average of 14.0 ppb. Recent dissolved oxygen (DO) profiles show DO depletion (below 5 parts per million) in the lower one-third to lower one-half of the water column (See Appendix C). The potential for TP to leave the bottom sediments and become available to algae in the water column (internal loading) is moderate to high (Maine DEP 2001). Together, these data indicate a documented trend of increasing trophic state and hence a violation of the Class GPA water quality criteria requiring a stable or decreasing trophic state.

Priority Ranking, Pollutant of Concern and Algae Bloom History: Threemile Pond is listed on the State's 1998 and 2002 (draft) 303(d) list of lakes in non-attainment of water quality standards, and was moved up in the priority development schedule due to its integral role as part of a three pond complex and to meets the needs of an accelerated lakes TMDL program. Threemile Pond is a culturally eutrophic lake – the result of excess external phosphorus loading, primarily from watershed soil erosion and internal lake sediment recycling (CRLA 1999). This lake TMDL has been developed for total phosphorus, the major limiting nutrient to algae growth in freshwater lakes in Maine.

Natural Environmental Background Levels for Threemile Pond are not separated from the total nonpoint source load because of the limited and general nature of available information. Without more and detailed site-specific information on nonpoint source loading, it is very difficult to separate natural background from the total nonpoint source load (US-EPA 1999). There are no known point sources of pollutants to Threemile Pond (MACD 2002).

WATER QUALITY STANDARDS & TARGET GOALS

Maine State Water Quality Standard for nutrients which are narrative, are as follows *(July 1994 Maine Revised Statutes Title 38, Article 4-A*): "Great Ponds Class A (GPA) waters shall have a stable or decreasing trophic state (based on appropriate measures, e.g., total phosphorus, chlorophyll a, Secchi disk transparency) subject only to natural fluctuations, and be free of culturally induced (summertime) nuisance algae blooms which impair their potential use and enjoyment."

Maine DEP's functional definition of nuisance algae blooms include episodic occurrence of Secchi disk transparencies (SDTs) < 2 meters for lakes with low levels of apparent color (<26 SPU) and for higher color lakes where low SDT readings are accompanied by elevated chlorophyll a levels. Threemile Pond is a non-colored lake (average color 15 - 25 SPUs), with relatively poor late summer minimal SDT readings (overall average of 0.4 meters), in association with Chlorophyll a levels of 2.5 - 46 ppb. Currently, Threemile Pond does not meet water quality standards due to annual summertime nuisance algae blooms. This water quality assessment uses historic documented conditions as the primary basis for comparison. Given the context of "impaired use and enjoyment," along with a realistic interpretation of Maine's goal-oriented Water Quality Standards (WQS), we have determined that episodic, non-cyanobacteria based algae blooms (e.g. diatoms), limited to the fall or spring periods only, and are in WQS attainment for GPA waters.

Designated Uses and Anti-degradation Policy: Threemile Pond is designated as a GPA (Great Pond Class A) water in the Maine DEP state water quality regulations. Designated uses for GPA waters in general include: water supply; primary/secondary contact recreation (swimming and fishing);

hydro-electric power generation; navigation; and fish and wildlife habitat. No change of land use in the watershed of a Class GPA water body may, by itself or in combination with other activities, cause water quality degradation that would impair designated uses of downstream GPA waters or cause an increase in their trophic state. Maine DEP's anti-degradation policy requires that "existing in-stream water uses, and the level of water quality necessary to sustain those uses, must be maintained and protected."

Numeric Water Quality Target: The numeric (in-lake) water quality target for Threemile Pond is conservatively set at 15 ppb total phosphorus (675 kg TP/yr). Since numeric criteria for phosphorus do not exist in Maine's state water quality regulations - and would be less accurate targets than those derived from this study - we employed Best Professional Judgment to select a target in-lake total phosphorus concentration that would attain the narrative water quality standard. Springtime (epilimnion core) total phosphorus values in Threemile Pond (April - May) were 23 ppb during 2002, much higher than springtime TP levels in downstream Webber Pond (15 ppb). In-lake (epilimnion core) total phosphorus summertime (June through August) measures averaged 22 ppb. In summary, the numeric water quality target goal of 15 ppb for total phosphorus in Threemile Pond was based on available water quality data (average epilimnion grab/core samples) corresponding to non-bloom conditions, as reflected in suitable (water quality attainment) measures of both Secchi disk transparency (> 2.0 meters) and Chlorophyll-a (< 8.0 ppb).

ESTIMATED PHOSPHORUS EXPORT BY LAND USE CLASS

Table 3 details the numerical data used to determine external phosphorus loading for the Threemile Pond watershed. The key below explains the columns and the narrative that follows the table relative to each of the representative land use classes.

Key for Columns in Table 3

Land Use Class: The land use category that was analyzed for this report

Land Area in Acres: The area of each land use as determined by GIS mapping, aerial photography, Delorme Topo USA software, and field reconnaissance.

Land Area %: The percentage of the watershed covered by the land use.

TP Coeff. Range kg TP/ha: The range of the coefficient values listed in the various literature associated with the corresponding land use.

TP Coeff. Value kg TP/ha: The selected coefficient for each land use category. The total phosphorus coefficient is determined from previous research – usually the median value, if listed by the author. The coefficient is often adjusted using best professional judgment based on conditions including soil type, slope, and best management practices (BMPs) installed.

Land Area in Hectares: Conversion, 1.0 acre = 0.404 hectares

TP Export Load kg P: Total hectares x applicable total phosphorus coefficient

TP Export Total %: The percentage of estimated phosphorus export by the land use.

Table 3. THREEMILE Pond Direct Watershed - Total Phosphorus Export by Land Use Class

LAND USE CLASS	Land Area Acres	Land Area %	TP Coeff. Range kg TP/ha	TP Coeff. Value kg TP/ha	Land Area Hectares	TP Export Load kg TP	TP Export Total %
Agricultural and Forested Land			**Threemile**	**Pond**			
Cropland	43	0.6%	0.26 - 18.6	1.50	17.4	26.0	5.6%
Hayland (Manured)	278	3.9%	0.65 - 1.81	0.65	112.3	73.0	15.6%
Low Intensity Hayland	113	1.6%	0.35 - 1.35	0.35	45.9	16.0	3.4%
Pasture	20	0.3%	0.14 - 4.90	0.81	8.1	6.6	1.4%
Operated Forest Land	164	2.3%	0.20 - 0.60	0.40	66.4	26.5	5.7%
Sub-Totals	**618**	**9%**	**Threemile**	**Pond**	**250**	**148**	**32%**
Shoreline Development							
Low Impact Residential	48	0.7%	0.25 - 1.75	0.25	19.2	4.8	1.0%
Medium Impact Residential	38	0.5%	0.40 - 2.20	0.50	15.2	7.6	1.6%
High Impact Residential	13	0.2%	0.56 - 2.70	0.70	5.3	3.7	0.8%
Residential Septic Systems	**Threemile**	0.0%	**Pond**	**Septic**	**Model**	17.0	3.6%
Camp and Private Roads	28	0.4%	0.60 - 10.0	2.00	11.3	22.5	4.8%
Insitutional (Public Boat Launch)	2	0.0%	0.77 - 4.18	1.50	0.8	1.2	0.3%
Sub-Totals	**128**	**2%**	**Threemile**	**Pond**	**52**	**57**	**12%**
Non-Shoreline Development							
State Roads	34	0.5%	0.60 - 10.0	1.50	13.6	20.5	4.4%
Town Roads	56	0.8%	0.60 - 10.0	1.50	22.8	34.2	7.3%
Trail	4	0.1%	0.60 - 10.0	2.00	1.5	3.1	0.7%
Low Density Residential	214	3.0%	0.25 - 1.75	0.25	86.8	21.7	4.6%
Commercial	14	0.2%	0.77 - 4.18	1.50	5.7	8.5	1.8%
Recreational (Picnic Area)	4	0.1%	0.14 - 4.90	0.80	1.6	1.3	0.3%
Sub-Totals	**326**	**5%**	**Threemile**	**Pond**	**132**	**89**	**19%**
Total: DEVELOPED LAND	**1,072**	**16%**	**Threemile**	**Pond**	**434**	**294**	**63%**
Non-Developed Land							
Inactive/Passively Managed Forest	3,598	50.7%	0.01 - 0.04	0.04	1,456.1	58.2	12.5%
Wetlands	632	8.9%	0.00 - 0.05	0.02	255.7	5.1	1.1%
Scrub Shrub	472	6.6%	0.10 - 0.20	0.10	191.0	19.1	4.1%
Reverting Fields	195	2.7%	0.10 - 0.20	0.20	78.8	15.8	3.4%
Open (Bare) Land	2	0.0%	0.25 - 1.75	0.98	0.9	0.9	0.2%
Total: NON-DEVELOPED Land	**4,899**	**68%**	**Threemile**	**Pond**	**1,982**	**99**	**21%**
Total: Surface Water (Atmospheric)	**1,132**	**16%**	0.11 - 0.21	0.16	**458**	**73**	**16%**
TOTAL: DIRECT WATERSHED	**7,103**	**100%**	**Threemile**	**Pond**	**2,874**	**467**	**100%**

Total Phosphorus Land Use Loads

Estimates of total phosphorus export from different land uses found in the Threemile Pond direct watershed are presented in Table 3 and represent the extent of current external phosphorus loading to the lake. Total phosphorus loading from the associated upstream Threecornered (154 kg TP/yr) and Mud (30 kg TP/yr) ponds account for loading from the indirect watershed (184 kg TP/yr), determined on the basis of *flushing rate x volume x TP concentration*, and typical area gauged streamflow calculations (Jeff Dennis, personal communication).

Total phosphorus loading measures are provided as a range of values to reflect the degree of uncertainty generally associated with such relative estimates (Walker 2000). The watershed total phosphorus loadings were primarily determined using published literature and locally-derived export coefficients as found in Schroeder (1979), Reckhow et al. (1980), Dennis (1986), Dennis et al. (1992), and Bouchard et al. (1995) for residential properties, roadways, agriculture and other types of land uses (institutional, commercial).

In some cases (primarily roads and shoreline residential) selected phosphorus loading coefficients were reduced to account for the estimated bioavailability of the soil runoff sources according to available literature (Lee et al. 1980 and Sonzogni et al. 1982) and to better account for algal available-P export values as reflected in Dennis et al. (1992). These adjustments accounted not only for the readily available SRP (soluble-reactive-phosphorus) in the runoff, but also a substantial portion of the particulate inorganic component, particularly the P which is weakly adsorbed on the surface soil particles (relative to discussion in Chapra 1997, pg. 524). **Note:** *these adjustments in the P-load coefficients did not measurably alter the overall conclusions and final recommendations of the Threemile Pond PCAP-TMDL report regarding identified needs and NPS/BMP implementation plans for the Threemile Pond watershed.*

Agricultural and Forest Operational Lands: Phosphorus loading coefficients as applied to agricultural practices were adopted, in part, from Reckhow et al. 1980: manured hayland 0.65 kg TP/ ha, pasture 0.81 kg TP/ha; and Dennis and Sage 1981: low-intensity hayland 0.35 kg TP/ha; and from past Maine DEP (1982) studies and discussions with Kennebec County SWCD/NRCS offfices: row crops 1.50 kg TP/ha. The phosphorus loading coefficient applied to operated forestland (0.40 kg TP/ ha) was derived (best estimate) from the original Cobbossee Lake TMDL report (Monagle 1995).

Shoreline Residential Lots (House and Camp): The range of phosphorus loading coefficients used (0.25 - 2.70 kg P/ha) were developed using information on residential lot stormwater export of algal available phosphorus from Dennis et al (1992).

Private Camp Roads and Trails: Total phosphorus loading coefficients for private camp roads and trails (2.0 kg P/ha) were chosen based, in part, on previous studies of rural Maine highways (Dudley et al. 1997).

Shoreline Development Summary

Overall, shoreline development comprises 2% of the total watershed area and contributes an average of 57 kg of total phosphorus annually and contributes 12% of the estimated external (watershed generated) total phosphorus load.

Non-Shoreline Development

Residential: Non-shoreline residential areas in the watershed are best characterized as low density residential - reflected in the 0.25 total phosphorus loading coefficient.

Public Roadways: Town and state roadways (36 ha) were assigned a phosphorus loading rate of 1.50 kg per hectare per year. This coefficient was chosen, in part, on the basis of previous studies on rural Maine highways (Dudley et al. 1997) as well as best professional judgement (J. Dennis, DEP).

Non-Developed Land Phosphorus Loading: The phosphorus loading coefficient for inactive-passively managed forested land (0.04) is based on a New England regional study (Likens et al 1977). Other non-cultural land uses include wetlands, grassland, old field scrub shrub and open (bare) land account for remaining 8.8% (41 kg) of the total non-cultural/non-developed total phosphorus export load (99 kg).

Atmospheric Deposition (Open Water) represents lake surface waters (458 ha) and contributes 16 percent (73 kg TP annually) of the total phosphorus load entering Threemile Pond (Table 3). The total phosphorus loading coefficient chosen (0.16 kg TP/ha) is similar to that used for the China Lake TMDL (Kennebec County). The upper range (0.21 kg TP/ha) generally reflects a watershed that is 50 percent forested, combined with agricultural areas interspersed with urban/suburban land uses (Reckhow et al. 1980).

Phosphorus Load Summary

It is our professional opinion that the selected phosphorus export coefficients are appropriate for the Threemile Pond watershed. Results of the land use analysis indicate that a best estimate of the present total phosphorus loading from external (watershed generated) nonpoint source pollution approximates 467 kg TP/yr. This annual external watershed generated loading to Threemile Pond equates to a total phosphorus loading modeled at 11 ppb (494 kg TP/year) - 181 kg below the TMDL target goal of 15 ppb (675 kg TP/year). Obviously, both indirect (Mud and Threecornered ponds) and historically stored-internal sources (pond bottom sediments) of phosphorus are significant additional contributors to the nonpoint pollution related water quality problem in Threemile Pond.

LINKING WATER QUALITY and POLLUTANT SOURCES

Assimilative Loading Capacity - The Threemile Pond TMDL is expressed as an annual load as opposed to a daily load. As specified in 40 C.F.R. 130.2(i), TMDLs may be expressed in terms of either mass per unit time, toxicity, or other appropriate measures. It is thought appropriate to express the Threemile Pond TMDL as an annual load because the lake basin has a relatively slow flushing rate of only one time per year.

The Threemile Pond basin lake assimilative capacity is capped at 675 kg TP/yr as derived from the empirical phosphorus retention model based on a target goal of 15 ppb. This value reflects the modeled annual phosphorus loading responsible for current trophic state conditions, based on a long-term goal of maintaining average phosphorus concentrations at or below 15 ppb.

Future Development: The Maine DEP water quality goal of maintaining a stable trophic state includes a reduction of current P-loading which accounts for recent P-loading and potential future development in the watershed. The methods used by Maine DEP to estimate future growth (Dennis et al. 1992) are inherently conservative, as they provide for relatively high-end regional growth estimates and largely unmitigated P-export from new development. This provides an additional non-quantified margin of safety to ensure the attainment of state water quality goals.

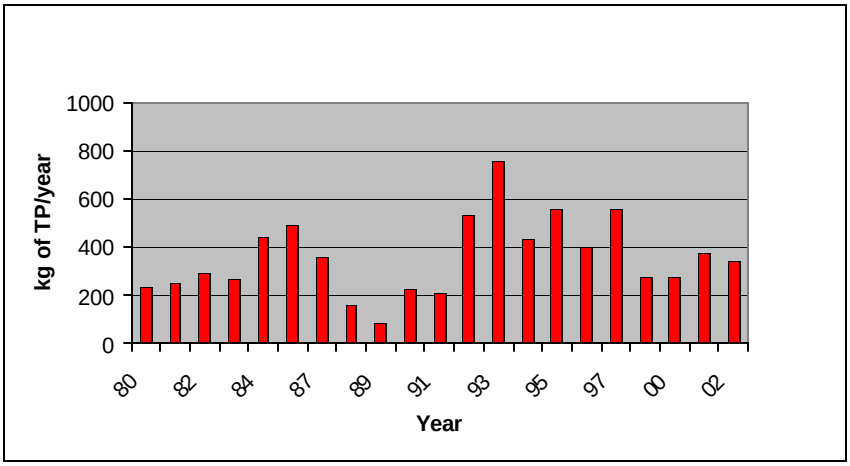
The reason for reducing existing watershed phosphorus loading is that human growth will continue to occur in the watershed, contributing new sources of phosphorus to the lake. Hence, existing phosphorus load sources must be reduced to allow for anticipated new sources of phosphorus to the lake. Previously unaccounted P-loading from anticipated future development on the Threemile Pond watershed approximates 22 kg annually (0.5 x 1 ppb change in trophic state = 44 kg).

Figure 3: ***Alum Treatment Summary***

Years	Ave. Load	Description
80-87	315 kg/acre	Pre-Treatment
88-91	201 kg/acre	Treatment
92-97	495 kg/acre	Post Treatment I
98-02	347 kg/acre	Post Treatment II

Based on the above discussion, the trend of increasing trophic state in Threemile Pond can be halted if the existing watershed phosphorus loading is adequately reduced by approximately 400 kg. Reductions already underway in nonpoint source total phosphorus loadings are expected from the continued implementation of best management practices - see NPS/ BMP Implementation Plan and PCAP Summary.

Figure 4: ***Threemile Pond Yearly Internal Sediment TP Load***



Internal Lake Sediment Phosphorus Mass - The relative contribution of internal sources of total phosphorus within Threemile Pond - in terms of sediment recycling - were analyzed (using lake volume-weighted mass differences between early and late summer) and estimated on the basis of water column TP data from 1980 to 2002 (sans 1985 and 1999). These were the best years for which to complete lake profile TP concentration measures to derive reliable estimates of internal lake loads. Among these years, nuisance algae blooms were experienced during all summers, except for alum treatment years (1988-1991), when internal total phosphorus load estimates averaged only 200 kg (see Figure 3). In contrast, internal TP load estimates from the pre-alum treatment summers of 1980-87 averaged 315 kg and internal TP load estimates from the post alum treatment years (1992-2002) averaged approximately 400 kg.

Linking Pollutant Loading to a Numeric Target - the basin loading assimilative capacity for Threemile Pond was set at 675 kg/yr of total phosphorus to meet the numeric water quality target of 15 ppb of total phosphorus. A phosphorus retention model, calibrated to in-lake phosphorus data, was used to link phosphorus loading to the numeric target.

Supporting Documentation for the Threemile Pond TMDL Analysis –includes the following: Maine DEP and VLMP water quality monitoring data and specification of a phosphorus retention model, including both empirical models and retention coefficients.

Total Phosphorus Retention Model (after Dillon and Rigler 1974 and others)

L = P (A z p) / (1-R) where

675 = **L** = external total phosphorus assimilative capacity (kg TP/year)
15.0 = **P** = spring overturn total phosphorus concentration (ppb)
4.6 = **A** = lake basin surface area (km^2)
4.9 = **z** = mean depth of lake basin (m) **A z p = 22.5**
1.0 = **p** = annual flushing rate (flushes/year)
0.5 = **1- R** = phosphorus retention coefficient, where:
0.5 = **R = 1 / (1+ sq.rt. p)** (Larsen and Mercier 1976)

Previous use of the Vollenwieder (Dillon and Rigler 1974) type empirical model for Maine lakes, e.g., Cobbossee, Madawaska, Sebasticook, East, China, Mousam, Highland, Threecornered, and Webber TMDLs (Maine DEP 2000-2002) have shown this approach to be effective in linking watershed (external) TP loadings to existing in-lake TP concentrations.

Strengths and Weaknesses in the Overall TMDL Analytical Process: The Threemile Pond TMDL

was developed using existing water quality monitoring data, derived watershed export coefficients (Reckhow et al. 1980, Maine DEP 1981 and 1989, Dennis 1986, Dennis et al. 1992, Bouchard et al. 1995, Soranno et al. 1996, and Mattson and Isaac 1999) and a phosphorus retention model which incorporates both empirically derived and observed retention coefficients (Vollenwieder 1969, Dillon 1974, Dillon and Rigler 1974 a and b, and 1975, Kirchner and Dillon 1975). Use of the Larsen and Mercier (1976) total phosphorus retention term, based on localized data (Northeast and Northcentral U.S.) from 20 lakes in the US-EPA National Eutrophication Survey (US-EPA-NES) provides a more accurate model for northeastern regional lakes.

Strengths:

- Approach is commonly accepted practice in lake management.
- Makes best use of available water quality monitoring data.
- Based upon experience with other lakes in the northeastern U.S. region, the empirical phosphorus retention model and export coefficients were determined to be appropriate for the application lake.

Weaknesses:

- Inherent uncertainties of TP load estimates (Reckhow 1979, Walker 2000) and associated variability and generality of TP loading coefficients.

Critical Conditions: Occur in Threemile Pond during the summertime, when the potential (occurrence and frequency) of nuisance algae blooms are greatest. The loading capacity of 15 ppb of total phosphorus was set to achieve desired water quality standards during this critical time period, and will also provide adequate protection throughout the year (see Seasonal Variation).

LOAD ALLOCATIONS (LA's): The load allocation for all existing and future non-point pollution sources for Threemile Pond is 675 kg TP/yr as derived from the empirical phosphorus retention model based on a target goal of 15 ppb. Reductions in nonpoint source phosphorus loadings are expected from the continued implementation of best management practices. As previously mentioned, it was not possible to separate natural background from nonpoint pollution sources in this watershed because of the limited and general nature of the available information. As in other Maine TMDL lakes (see Sebasticook Lake, East Pond, China Lake, and Webber Pond TMDLs), in-lake nutrient loadings in Threemile Pond originate from a combination of external and internal sources of total phosphorus. External (watershed) TP sources, averaging 467 kg annually have been identified and accounted for in the land-use breakdown portrayed in Table 3.

WASTE LOAD ALLOCATIONS (WLA's): As there are no known existing point sources of pollution (including regulated stormwater) in the Threemile Pond watershed, the waste load allocation for all existing and future point sources is set at 0 (zero) kg/year of total phosphorus.

MARGIN OF SAFETY (MOS): An implicit margin of safety was incorporated into the Threemile Pond TMDL through the conservative selection of the numeric water quality target, as well as the selection of relatively conservative phosphorus export loading coefficients for cultural pollution sources (Table 3). Based on both the Threemile Pond historical water quality records and a summary of statewide Maine lakes water quality data for non-colored (< 26 SPU lakes), the target of 15 ppb (675 kg TP/yr in Threemile Pond) represents a highly conservative goal to assure attainment of Maine DEP water quality goals of non-sustained and non-repeated blue-green summertime algae blooms due to NPS pollution or cultural eutrophication. The statewide data base for uncolored Maine lakes indicate that summertime nuisance algae blooms (growth of algae which causes Secchi disk transparency to be less than 2 meters) are more likely to occur at 18 ppb or above. The difference between the in-lake target of 15 ppb (675 kg) and 17 ppb (763 kg), or 88 kg, represents a 12-13% implicit margin of safety for Threemile Pond. An additional unquantified margin of safety for attainment of state water quality goals is provided by the inherently conservative methods used to estimate future growth.

SEASONAL VARIATION: The Threemile Pond TMDL is protective of all seasons, as the allowable annual load was developed to be protective of the most sensitive time of year – during the summer, when conditions most favor the growth of algae and aquatic macrophytes. With a hydraulic retention time of 1 flush/year, the average annual phosphorus loading is most critical to the water quality in Threemile Pond. Maine DEP lake biologists, as a general rule, use more than six flushes annually (bi-monthly) as the cutoff for considering seasonal variation as a major factor (to distinguish lakes vs. rivers) in the evaluation of total phosphorus loadings in aquatic environments in Maine. The best management practices (BMPs) implemented and proposed for the Threemile Pond watershed have been designed to address total phosphorus loading during all seasons.

PUBLIC PARTICIPATION: Adequate ('full and meaningful') public participation in the Threemile Pond TMDL development process was ensured - during which land use and phosphorus load reductions were discussed - through the following avenues:

1. MACD project personnel Jodi Michaud Federle attended several CRLA board meetings from December of 2001 to August of 2002. The board is comprised of members of the lake associations of Threemile Pond, Webber Pond, Threecornered Pond and China Lake and a representative of the Kennebec Water District. The Executive Director of the CRLA attends the meetings as well. An initial TMDL explanation on the lake TMDL development process and ongoing updates were provided at board meetings.

2. MACD project personnel Jodi Michaud Federle and KC-SWCD staff Nate Sylvester toured the lake watershed in September of 2001 in order to field verify agricultural land use in the watershed.

3. During the summer and fall of 2001 and the spring of 2002, MACD project personnel - particularly Threemile Pond Coordinator Jodi Michaud Federle and Forrest Bell - paid numerous visits to the watershed town offices and to the Kennebec County SWCD-NRCS offices in order to compile necessary watershed inventory information.

4. On February 28, 2002, a locally-led watershed conservation meeting was hosted by the KC-SWCD. The meeting was attended by approximately a dozen people, including residents of the Webber, Threemile and Threecornered Pond watersheds. At the meeting, Lake TMDLs were presented and discussed. This stakeholder meeting was held, in part, to meet the requirements of the public participation component of the TMDL process.

5. A follow-up watershed conservation meeting was held on March 28, 2002 hosted by the KC-SWCD at the Vassalboro Town Office. This meeting was attended by 14 people, including residents of the Webber, Threemile and Threecornered Pond watersheds. Water quality information used in creating the TMDL report was supplied to the respective watershed residents.

6. The China Region Lakes Alliance's 2002 spring newsletter featured an article about the TMDL studies for Webber, Threemile and Threecornered ponds.

7. On April 16, 2002, MACD project personnel Jodi Michaud Federle and Forrest Bell toured the watershed to conduct a limited watershed survey.

8. On April 18, 2002, MACD Project personnel Jodi Michaud Federle, project staff Tim Bennett and CRLA's Executive Director, Reb Manthey, toured the lake watershed to conduct a limited watershed survey.

9. On July 27, 2002, MACD Project Coordinator Jodi Michaud Federle, presented Threemile Pond TMDL information to about 25 participants at the Threemile Pond Association Annual Meeting.

Stakeholder and Public Review Comments

A preliminary stakeholder review draft Threemile Pond TMDL report was provided to a dozen individuals who received electronic or hard copy versions of the report on December 6, 2002, and were requested to comment by the end of the two-week review period. The following summarized comments were provided:

Reb Manthey, Executive Director of the CRLA - provided minor edits and general comments to enhance the readability of the report and suggested changes to the text.

Jenna Richardson, CRLA - asked for clarification on internal phosphorus loading, 'natural background' levels, survey methods, and water quality monitoring.

Morten Moesswilde, Maine Forest Service - provided written comments to better distinguish between foresters and loggers mentioned in the report as well as more detail regarding contact information for people looking for technical assistance and/or BMP guidelines.

Public Review Comment (Review Period: March 8 - April 7, 2003) The Public Review document was posted on the Maine DEP website on March 7, 2003 and 'legal' advertising in local newspapers appeared March 15-16, 2003. The following ad was printed in the Morning Sentinel (Waterville) and the Kennebec Journal (Augusta):

> **Webber-Threemile-Threecornered Ponds (Kennebec County) Watershed/Lake Nutrient Control/Management Reports (PCAP-TMDL)**
> In accordance with Section 303(d) of the Clean Water Act, and implementation regulations in 40 CFR Part 130 - the Maine Department of Environmental Protection has prepared combined Phosphorus Control Action Plan (PCAP) and Total Maximum Daily Load (TMDL) nutrient reports (DEPLW 2002-0556/0058/0562) for the Webber, Threemile and Threecornered ponds/watersheds, located in the towns of Vassalboro, China, Windsor, and Augusta, within Kennebec County. These PCAP-TMDL reports identify and estimate non-point source phosphorus loadings within all representative land use classes of the Webber-Threemile-Threecornered ponds/watersheds and the phosphorus reductions needed to establish and maintain acceptable water quality conditions. Public Review drafts of these reports may be viewed at Maine DEP Central Offices in Augusta (Ray Building, Hospital Street-Route 9). Send all comments, in writing-by April 7, 2003, to Dave Halliwell, Lakes TMDL Program Manager, Maine DEP, State House Station #17, Augusta, ME 0433. 207-287-7649 or e-mail: david.halliwell@maine.gov. Files: Webber Pond; Threecornered Pond; Threemile Pond.

Note: *Following the preliminary review, there were no further public comments requiring responses.*

Single Public Review Comment (Morten Moesswilde, Maine Forest Service)

Jodi,

Thanks again for your work on these. The forestry information on all three looks ok to me. Thanks for keeping me posted as well. Let me know if you are doing more of these in the coming field season.

Best regards,
Morten (March 14, 2003)

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