PHOSPHORUS CONTROL ACTION PLAN

and Total Maximum Daily (Annual Phosphorus) Load Report

TOGUS (Worromontogus) POND

Kennebec County, Maine

Togus (Worromontogus) Pond PCAP-TMDL Report

Maine DEPL 2005 - 0702

Maine Department of Environmental Protection

Maine Association of Conservation Districts

Final EPA Submittal - 22 July 2005

TOGUS (Worromontogus) POND

Phosphorus Control Action Plan (PCAP)

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TOGUS (Worromontogus) POND

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ACKNOWLEDGMENTS

In addition to Maine DEP and US-EPA New England Region I staff, the following individuals, groups and agencies were instrumental in the preparation of this Togus Pond combined Phosphorus Control Action Plan and Total Maximum Daily Load report: MACD staff (Jodi Michaud Federle, Forrest Bell, Fred Dillon and Tim Bennett); Kennebec County Soil and Water Conservation District (Nate Sylvester, Josh Platt, Melissa Halsted, Jennifer McLean and Dale Finseth); Worromontogus (Togus) Lake Association (John Pucciarelli, President and Pat Williams), Maine Department of Agriculture (David Rocque); Maine Forest Service (Chris Martin); Maine Department of Inland Fisheries and Wildlife (Jim Lucas and Bill Woodward); Maine Department of Marine Resources (Nate Gray); Colby College (Dave Firmage and CEAT Class); Maine Volunteer Lake Monitoring Program (John Pucciarelli, sampler); and a very special thanks to Worromontogus Lake Association member and sampling facilitator, Dave Crum.

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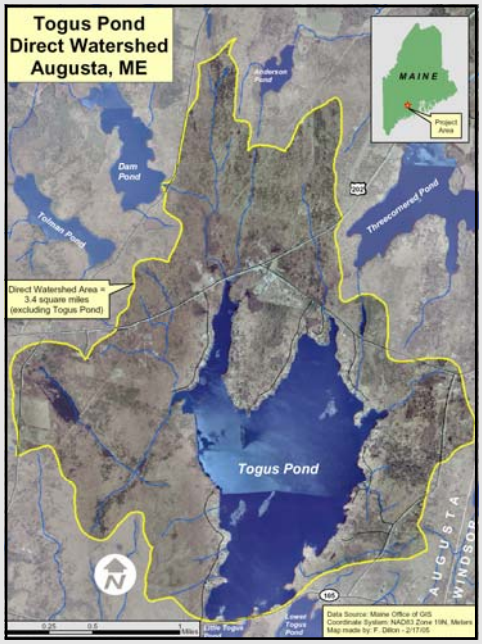
Background

TOGUS (Worromontogus) POND is a 643-acre waterbody located in the City of Augusta in Kennebec County, Maine. Togus Pond has a direct **watershed** (see map) area of 3.4 square miles; a maximum depth of 49 feet (15 meters), a mean depth of 18 feet (5.5 meters); and a **flushing rate** of 0.81 times per year.



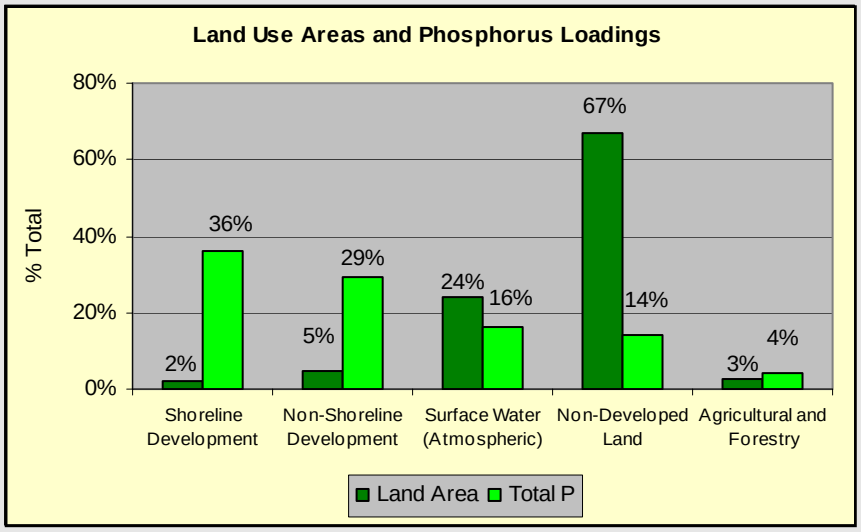
Togus Pond has a history of supporting excessive amounts of algae in the late summer-early fall, due in large part to the contribution of **phosphorus** that is prevalent in area soils and has accumulated in the pond bottom sediments. Soil erosion in the watershed can have far-reaching consequences, as soil particles effectively transport phosphorus, which serves to "fertilize" 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 lake water clarity decreases, lakeshore residential property values also decline.

Stakeholder Involvement

Federal, state, county, and local groups have been working together to effectively address this nonpoint source water pollution problem. From 2003-05, the Maine Department of Environmental Protection funded a project in cooperation with the Maine Association of Conservation Districts to identify and quantify potential sources of phosphorus and identify **Best Management Practices (BMPs)** implementation needs in the Togus Pond watershed. A final report, completed in the summer of 2005, is entitled "Togus Pond Phosphorus Control Action Plan" and doubles as a **TMDL** report, to be submitted to the US Environmental Protection Agency, New England Region, for their review and final approval.

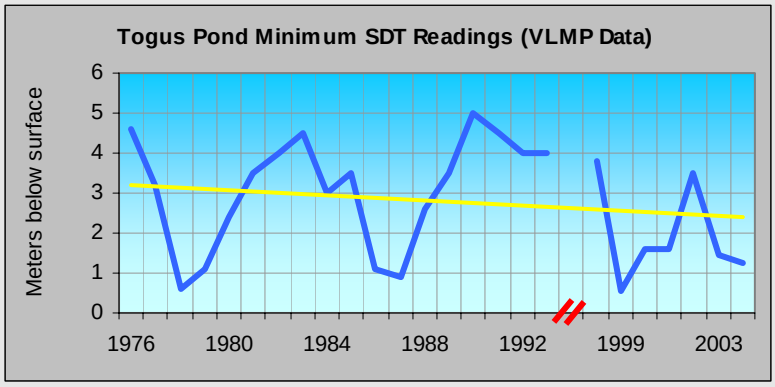
What We Learned

A land use assessment was conducted for the Togus Pond watershed to determine potential sources of phosphorus that may run off from land areas during storm events and springtime snow melting. This assessment was carried out in various ways, including map generation and interpretation, aerial photo interpretation, and field reconnaissance.



An estimated 277 kilograms (kg) of phosphorus is exported on an annual basis to Togus Pond from the direct watershed. The bar chart (left) illustrates the land area for each representative land use as compared to the phosphorus export load for each land use.

The total phosphorus contribution from indirect drainage sources (Dam Pond) was estimated at 57 kg/year.



Secchi disk transparency (SDT) measures water clarity. As the yellow trend line indicates, Togus Pond's water clarity (although cycling) has generally been decreasing since measurements first began in 1976.

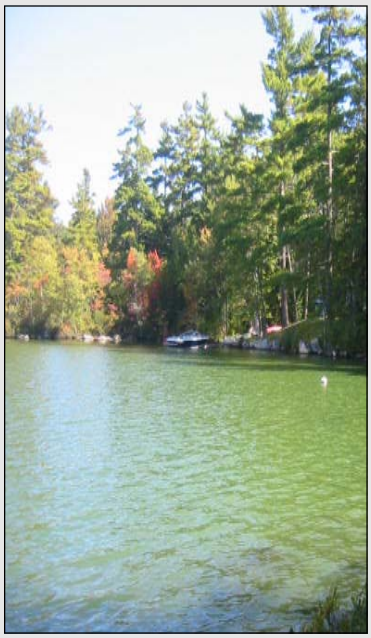
Over the past two decades the amount of phosphorus being recycled internally (200 kg TP/year = average value) from Togus Pond bottom sediments during the summertime is over one-half of Togus Pond's natural capacity (370 kg total phosphorus per year) for in-lake phosphorus assimilation.

Phosphorus Reduction Needed

The natural capacity of Togus Pond to effectively process **370** kg of TP on an annual basis without harming water quality equals an in-lake phosphorus concentration of 15 ppb. Togus Pond's average maximum summertime total phosphorus (TP) concentration for the past 7-years (1998 to 2004) is 20 ppb - equal to an additional 125 kg/yr (5 ppb x 25 kg/yr). Accounting for a 12.5 kg/yr allocation for future development, the total amount of phosphorus needed to be reduced to attain water quality standards (algal bloom-free conditions) in Togus Pond approximates **138** kg/yr.

What You Can Do To Help!

As a watershed resident, there are many things you can do to protect the water quality of Worromontogus Pond. Lakeshore owners can use phosphorus-free fertilizers and maintain natural vegetation adjacent to the lake. Agricultural and commercial land users can consult the Kennebec County Soil and Water Conservation District or Maine Department of Environmental Protection for information regarding Best Management Practices (BMPs) for reducing phosphorus loads. Watershed residents can always become involved by volunteering to aid the Worromontogus Lake Association and participating in events sponsored by State agencies and local organizations. The estimated phosphorus loading to Togus lake originates from both shoreline and non-shoreline areas (see graph above), so all watershed residents must take ownership of lake restoration. Lake stakeholders and watershed residents can learn more about their lake and the many resources available, including review of the Togus Pond Phosphorus Control Action Plan. Following final EPA approval, copies of this detailed report, with recommendations for future NPS/BMP work, will be available online at www.maine.gov/dep/blwq/docmonitoring/tmdl2.htm, or 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 is replaced on an annual basis..*
- ***Phosphorus****: is one of the major nutrients needed for plant growth. It is naturally present in small amounts and limits the plant growth in lakes. Generally, 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****, an acronym for Total Maximum Daily Load, 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 lakes PCAP-TMDL project, funded through a Clean Water Act Section 319-grant from the United States Environmental Protection Agency (EPA), was directed and administered by the Maine Department of Environmental Protection (Maine DEP) under contract with the Maine Association of Conservation Districts (MACD), from the summer of 2003 thru the spring of 2005.

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 (PCAP) and a Total Maximum Daily Load (TMDL) report for the Togus Pond watershed. Simply stated, a PCAP identifies BMPs designed to reduce phosphorus loading to a lake while a TMDL is the total amount of phosphorus that a lake can receive without harming water quality. Maine DEP, with assistance from the MACD, will fully address and incorporate public comments before final submission to the US EPA. *(For more specific information on the TMDL process and results, refer to the Appendices or contact Dave Halliwell at the Maine DEP Augusta Office at 287-7649 or at David.Halliwell@maine.gov*).

Secondly, watershed assessment work, including a shore-line and septic survey evaluation, was conducted by the Maine DEP-MACD project team to help assess **total phosphorus** reduction techniques that would be beneficial for the Togus Pond watershed. Watershed survey work included assessing additional direct drainage **nonpoint source (NPS) pollution** sites that were not identified during the 319-funded Togus Pond Watershed Survey conducted in 2003 (KC-SWCD). The results of this assessment report include recommendations for future conservation work in the watershed to help citizens, organizations, and agencies restore and protect Togus Pond. **Note:** *To protect the confidentiality of landowners in the Togus Pond watershed, site-specific information has not been provided as part of this PCAP-TMDL report.*

Total Phosphorus (TP) - *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.*

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

This Phosphorus Control Action Plan (PCAP) report compiles and refines land use data derived from various sources, including the municipalities of Augusta, the Kennebec County Soil & Water Conservation District (KC-SWCD), and the Maine Forest Service (MFS). Local citizens, watershed organizations, and conservation agencies should benefit from this compilation of both historical and recently collected data as well as the watershed assessment and the NPS Best Management Practice (BMP) recommendations. Above all, this document is intended to help Togus Pond stakeholder groups to effectively prioritize future BMP work in order to obtain the funding resources necessary for further NPS pollution mitigation work in their watershed.

Study Methodology

Togus Pond background information was obtained using several methods, including a review of previous studies of the lake and watershed, 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 area.

Land use data were determined using several methods, including (1) **Geographic Information System (GIS)** map analysis, (2) analysis of topographic maps, (3) analysis of aerial photographs and (4) **ground-truthing**. Much of the non-developed land use area (i.e., forest, wetland, grassland) was determined using a GIS layer which is a combination of Maine Gap Analysis (GAP) landcover and USGS Multi Resolution Landcover Characterization (MRLC) landcover layers. It was created at the request of Maine DEP Bureau of Land and Water Quality (BLWQ) staff. It includes those classes in each layer which are best suited to calculating impermeability of watersheds. Both MRLC and GAP (and also Maine COMBO) are based on 1992 Landsat imagery. The developed land use areas were obtained using the best possible information available through analysis of methods 2 through 4 listed above.

GIS *- or* ***geographic information systems*** *- combine layers of information about a place to provide a better understanding of that particular locale. This information is often represented in digital map format.*

Ground-truthing *involves conducting field reconnaissance in a watershed to confirm the relative accuracy of computer generated maps.*

All land use GIS data was compiled under subcontract by the Kennebec County Soil and Water Conservation District (KC-SWCD). Final adjusted phosphorus loading numbers (see Table 3, page 26) were modeled using overlays of soils, slope, and installed Best Management Practices. All of the land use coverage data for developed areas was re-configured using aerial overlays and then ground-truthing the watershed.

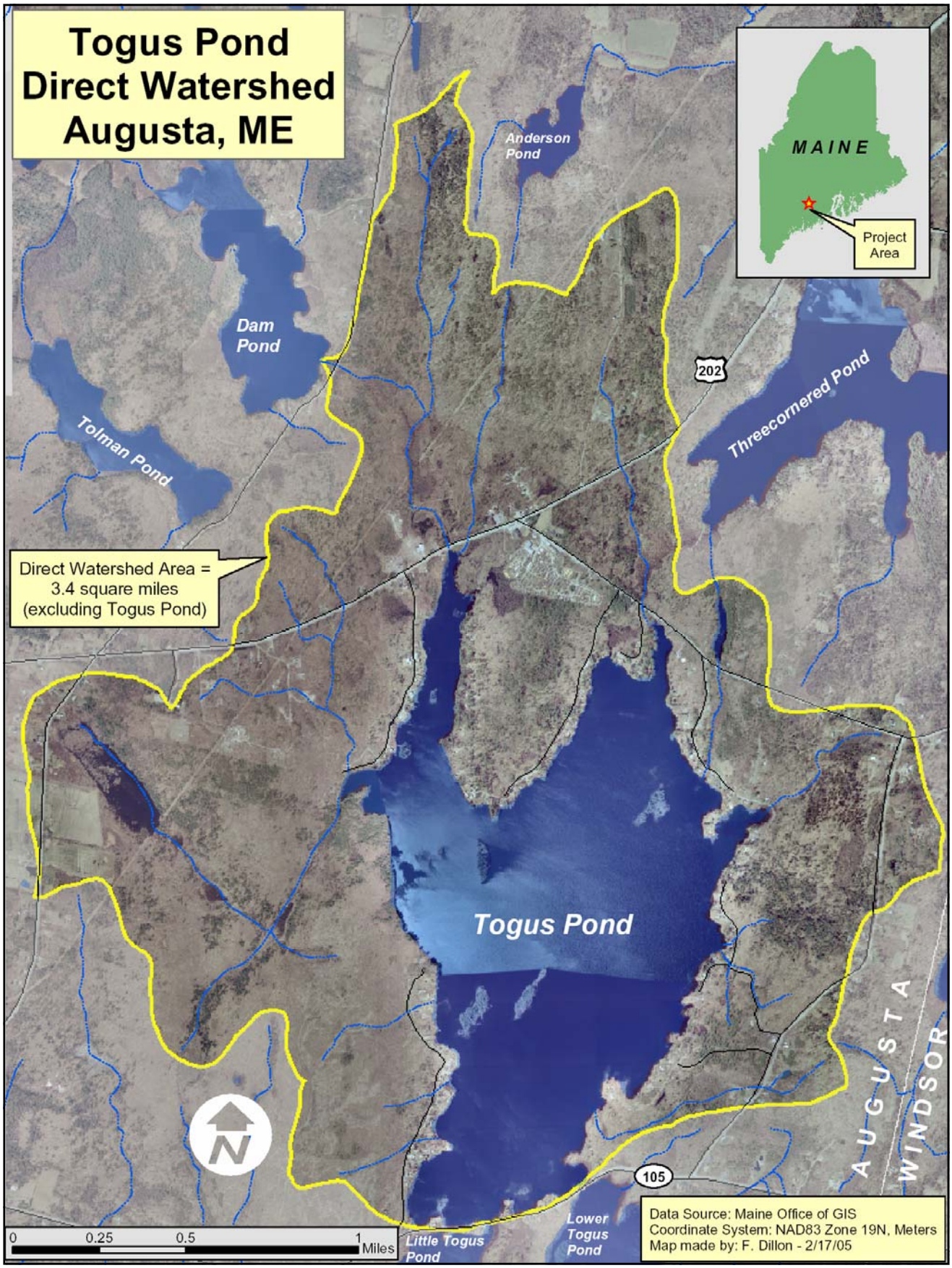
Roadway widths were estimated from previous PCAP reports where actual measurements were made for the various road types. In general, state-owned roads were found to be 22 meters wide; town-owned roads were found to be 16 meters wide; and privately-owned roads were found to be 6 meters wide. GIS was used to calculate total road surface area.

Agricultural information within the Togus Pond watershed was reviewed by the Kennebec County Soil and Water Conservation District in Augusta. Landuse information regarding forestry harvesting operations was reviewed by the Maine Forest Service, Department of Conservation.

Study Limitations

Land use data gathered for the Togus Pond watershed is as accurate as possible given all of the available information and resources utilized. However, final numbers for the land use analysis and phosphorus loading numbers are approximate, and should be viewed only as carefully researched estimations. The rationale for these estimations is summarized in Table 3 on page 26 and described in detail on pages 27-31.

Figure 1. Map of Togus Pond Direct Watershed



TOGUS POND Phosphorus Control Action Plan

DESCRIPTION of WATERBODY (MIDAS Number 9931) and WATERSHED

TOGUS (Worromontogus) POND is a 643 acre single-basin waterbody (260 hectares), located in the City of Augusta (DeLorme Atlas, Map 13), within Kennebec County in central Maine. Togus Pond has a **direct watershed** area (see Figure 1) of 2,184 acres (3.4 square miles) including lake surface area. The Togus Pond watershed is located entirely within the City of Augusta. Togus Pond has a maximum depth of 49 feet (15 meters), overall mean depth of 18 feet (5.5 meters), and an annual flushing rate of 0.81.

***Togus** is derived from the Native American word **Worromontogus**, which translates into "land of many springs."*

*The **direct watershed** refers to the land area that drains to a waterbody without first passing through an associated lake or pond.*

Drainage System – over a dozen tributaries empty into Togus Pond (Figure 1), all of which are identified as intermittent streams on the United States Geological Survey's 1:24,000 topographic map. One of the primary inputs into Togus Pond is from the outlet tributary from Dam Pond**,** which is part of the indirect watershed. In the early 1900's, a dam was built on Togus Stream which created Lower Togus Pond and increased the level of Togus Pond by 3 or 4 feet resulting in its present size and depth. This outlet dam has also been known to occasionally restrict the flow from Lower Togus Pond so that it may back up into Togus Pond at the Route 105 culvert crossing.

Water Quality Information

Togus Pond is listed on the Maine DEP'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, the preparation of a Phosphorus Control Action Plan (and TMDL) was prepared, publicly reviewed, and completed - during the spring-summer of 2005.

***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.*

Based on **Secchi disk transparencies,** measures of both total phosphorus and **chlorophyll-a**, the water quality of Togus Pond is considered to be poor and the potential for nuisance summertime algae blooms is high (Maine VLMP 2005). Together, these water quality data document a trend of increasing **trophic state,** in direct violation of the Maine DEP Class GPA water quality criteria requiring a stable or decreasing trophic state. (Please refer to pg. 24 - TMDL appendix, for description of GPA standard).

***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.*

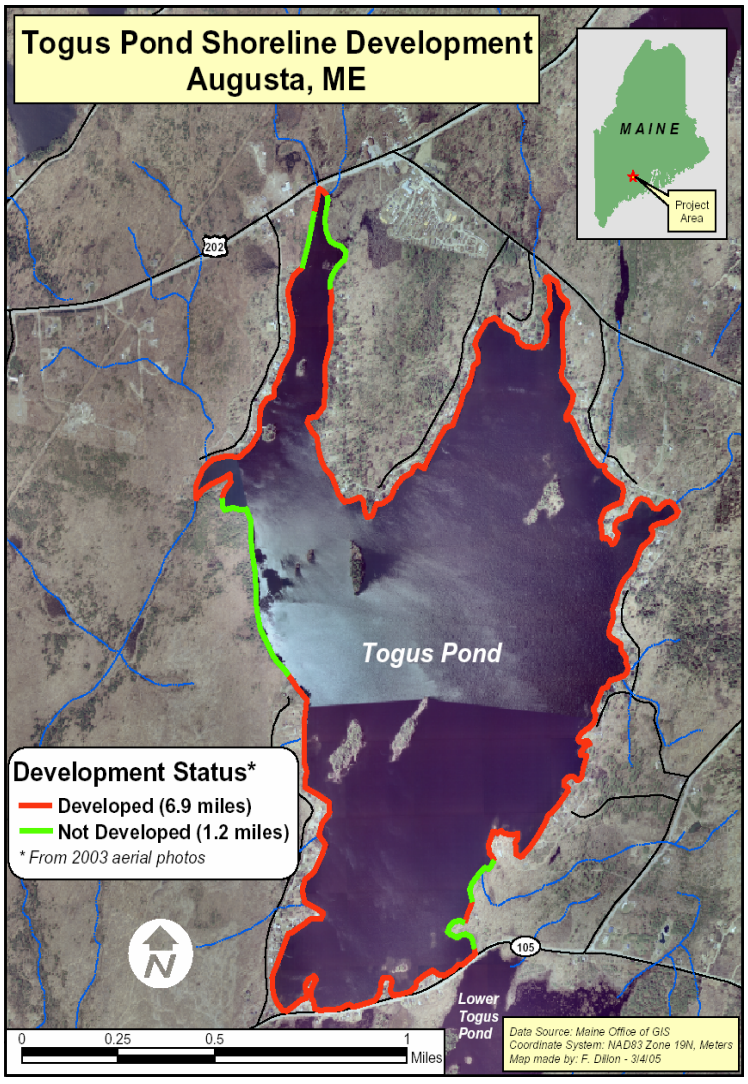
***Trophic state—**the degree of eutrophication of a lake. Transparency, chlorophyll a levels, phosphorus concentrations, amount of macrophytes, and quantity of dissolved oxygen in the hypolimnion can be used to assess*

Nonpoint source pollution is the main reason for declining water quality in Togus Pond. During 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 and are deposited and stored in the lake bottom sediments.

Phosphorus is naturally limited in lakes and can be thought of as a fertilizer, a primary food for plants, including algae. When lakes receive excess phosphorus from NPS pollution, it "fertilizes" the lake by feeding the algae. Too much phosphorus can result in nuisance algae blooms, which can damage the ecology and aesthetics of a lake, as well as the economic well-being of the entire lake watershed. Reports of summertime nuisance algae blooms in Togus Pond date back to at least the early 1930's. Beginning around 1937, area residents began copper sulfate applications in the spring to prevent the occurrence of algae blooms. In 1941 a water quality survey indicated that hypolimnetic (bottom layer) dissolved oxygen levels were below 1 part per million and consequently could not support trout and salmon. Subsequent water quality studies in 1971 and 1976 found conditions similar to those in 1941. In 1979, copper sulfate applications were discontinued so the Maine DEP could conduct its own water quality diagnostic study. The results from this more in-depth study (Maine DEP 1983) generally coincided with earlier findings.

Principle Uses: The primary uses of the Togus Pond shoreline are residential (both seasonal and year-round occupancy) and recreational - boating, fishing, camping and swimming/beach use. Official Togus Pond public access sites do not currently exist, although area residents routinely use the Route 105 culvert crossing as an informal boat launch to gain access to both Togus and Lower Togus Ponds. An unimproved boat launch is owned by an association of shoreline residents on the eastern shore of Togus Pond.

Human Development: Togus Pond is highly developed with seasonal and year-round residences along about 6.9 miles (85%) of the shoreline. There are 200 shoreline housing units (73% of which are year-round) and it is estimated that the shoreline supports nearly 400 year-round residents. In addition to this high level of development, NPS pollution is also a concern for the Togus Pond watershed. Consequently, Togus Pond is on the State's **Nonpoint Source Priority Watersheds** list due to excessive phosphorus and prevalence of nuisance summertime algal blooms.



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

Togus Pond Fish Assemblage & Fisheries Status

Based on records provided by the Maine Department of Inland Fisheries and Wildlife (Maine DIFW) and recent conversations with fisheries biologists Jim Lucas and Bill Woodward (Region B, Sidney DIFW office), Togus Pond (City of Augusta - Kennebec River drainage) is managed as a mixed coldwater (annually stocked brown trout) and warmwater (black bass and chain pickerel) fishery. Togus Pond was originally surveyed by Maine DIFW in 1941, while their lake fisheries report was revised in 1953 and 1997. A total of **13** fish species are listed, including: **8** native indigenous fishes (American eel, golden shiner, white sucker, brown bullhead, chain pickerel, banded killifish, yellow perch, and pumpkinseed); and **5** previously introduced fishes (white perch, smallmouth and largemouth bass, landlocked rainbow smelt and brown trout). Reportedly, Togus Pond supports a quality landlocked rainbow smelt population and is opened to the commercial harvest of rainbow smelt. Togus Pond is included in the list for the Maine Department of Marine Resources anadromous alewife restoration project, but to date, has not been stocked (personal communication, Nate Gray, Maine DMR).

Largemouth bass

Chain pickerel

According to Maine DIFW reports and recent Maine DEP summertime temperature-oxygen profile measures, a ***dissolved oxygen*** deficiency (***anoxia***) exists in the deeper cooler water of Togus Pond which greatly diminishes the potential for coldwater fishery management. Improvements in water quality will serve to enhance fisheries conditions in Togus Pond. Given that the trophic state of Togus Pond has been disturbed by cumulative human impacts over the past several decades, then a significant reduction in the total phosphorus load in the Togus Pond watershed may lead to maintaining in-lake nutrient levels within the natural assimilative capacity of this lake to effectively process phosphorus and enhance existing landlocked smelt and brown trout fisheries.

Dissolved Oxygen—*refers to the amount of oxygen measured in the water. It is used by aquatic organisms for respiration. The higher the temperature, the less oxygen the water can hold. Oxygen will naturally decline during the summer months as water temperatures rise.*

Rainbow smelt

Brown trout

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

General Soils Description (Source: USDA SCS 1978):

The Togus Pond Watershed is characterized by the Hollis-Paxton-Charlton-Woodbridge general soil associations. These soils are classified as shallow and deep, somewhat excessively drained to moderately well drained, gently sloping to moderately steep, with moderately coarse textures. They fall within the C (65%), C/D (30%) and D (5%) hydrologic soil groups, which all have fairly low permeability rates and allow for greater amounts of surface runoff.

Land Use Inventory

The results of the Togus Pond watershed land use inventory are depicted in Table 1 (following page). The various land uses are categorized by developed land vs. non-developed land. The developed land area comprises approximately 9% of the watershed (much of it along the shoreline of Togus Pond) and the undeveloped land including the water surface area of Togus Pond, comprises the remaining 91% of the watershed. These numbers may be used to help make future planning and conservation decisions relating to the Togus Pond watershed. The information in Table 1 was also used as a basis for preparing the Total Maximum Daily (Annual Phosphorus) Load report. (For a detailed explanation please refer to pages 26-31 in the Appendix).

Descriptive Land Use and Phosphorus Export Estimates

- ***To convert kg of total phosphorus to pounds, multiply by 2.2046***

Agriculture: Over the past several decades agricultural land uses have declined significantly in the Togus Pond watershed (CEAT 2004). Today, agriculture plays a very minor role in the local economy and the amount of land used for agricultural purposes in the Togus Pond direct watershed is minimal compared to other land uses. Agricultural land is estimated to comprise 34 acres (1.2%) of the watershed land area and contribute 10 kg (3.7%) of the total phosphorus loading to Togus Pond. These data were mapped using GIS software and verified by aerial photography and in consultation with the Kennebec County SWCD office.

Operated Forest Land: The estimated operated forest land for the Togus Pond direct watershed consists of 41 acres. This estimate is based on a GIS analysis of land uses and represents 1.4% of the total land area and less than 1% of the total phosphorus load to Togus Pond. While poorly managed forestry operations have the potential to negatively impact a waterbody through erosion and sedimentation from logging sites, properly managed forestry operations generally do not. Sustainable forest management can enhance water quality through sequestering excess nutrients particularly in forested riparian areas. 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.

Shoreline Residential (House and Camp Lots): Shoreline lake residences can have a comparatively large total phosphorus loading impact to lakes in comparison to their relatively small percentage of the total land area in the watershed. This is somewhat true for Togus Pond where the developed shoreline area accounts for slightly more than 1% of the land area yet is estimated to contribute almost 4% of the total phosphorus load to Togus Pond (Table 1).

Table 1. TOGUS Pond Direct Watershed
Land Use Inventory and Phosphorus Loads

LAND USE CLASS	Land Area (Acres)	Land Area (% Total)	Total Phosphorus Export (% Total)
Agricultural and Forested Land			
Non-manured Hayland	34	1.2%	3.7%
Operated Forest Land	41	1.4%	0.6%
Sub-Totals	**75**	**3%**	**4%**
Shoreline Development			
Septic Systems	**Togus Pond**	**Septic Model**	24.9%
Private/Camp Roads	21	0.7%	7.1%
Medium Density Residential	16	0.5%	2.6%
Low Density Residential	17	0.6%	1.4%
Sub-Totals	**53**	**2%**	**36%**
Non-Shoreline Development			
Public Roads	79	2.7%	20.8%
Commercial-Industrial	19	0.6%	4.5%
Low Density Residential	28	1.0%	2.4%
Medium Density Residential	8	0.3%	1.3%
High Density Residential	1		0.3%
Sub-Totals	**135**	**5%**	**30%**
Total: DEVELOPED LAND	**263**	**9%**	**70%**
Non-Developed Land			
Undisturbed/unmanaged Forest	1,745	60.4%	12.4%
Grassland	47	1.6%	1.5%
Scrub/shrub	7	0.2%	0.1%
Wetlands	136	4.7%	0.0%
Total: NON-DEVELOPED Land	**1,935**	**67%**	**14%**
Total: Surface Water (Atmospheric)	**691**	**24%**	**16%**
TOTAL: DIRECT WATERSHED	**2,889**	**100%**	**100%**

In order to evaluate the impact of these shoreline homes, MACD project staff conducted a shoreline residential survey in the summer of 2003. This visual survey was carried out while observing the Togus Pond shoreline from a boat and the results are based on subjective determinations of potential impact ratings using best professional judgment. The visual survey included a residential dwelling tally along with rating estimates for potential NPS pollution impacts based on the following factors: presence or lack of vegetated buffers, distance of dwelling from shoreline, shoreline erosion, presence of bare/exposed soil and percent slope of the lot. In addition to the impact rating, project staff estimated the residency status of the dwelling (seasonal vs. year-round) and other notable features such as retaining walls or boat launches.

The shoreline survey identified 183 residences around the perimeter of Togus Pond. Undeveloped land is located mostly along the northwestern and central western shorelines. Year-round and seasonal dwellings numbered 133 and 50, respectively. Table 2 outlines the buffer findings from the survey, which indicated that 85% (categories 3, 4, and 5) of the shoreline dwellings exhibit inadequate or nonexistent shoreline buffers. The total phosphorus loading from shoreline residential land uses, were classified as low or medium-density residential. Phosphorus loading coefficients were developed using information on residential lot stormwater export of algal available phosphorus (Dennis et al. 1992). Seasonal and year-round residences (excluding septic—see following section) on Togus Pond comprise slightly more than 1% of the land area and an average of 9 kg of total phosphorus annually, which approximates 4% of the estimated total phosphorus load.

Table 2. Togus Pond Shoreline Survey Results (2003)

Buffer Rating	Number (%) of shoreline sites identified within each category
0 = Undisturbed	5 (2.5%)
1 = Best Buffer	8 (4%)
2 = Good Buffer	17 (8.5%)
3 = Some Buffer	66 (33%)
4 = Sparse Buffer	74 (37%)
5 = No Buffer	30 (15%)

Shoreline Septic Systems: Total phosphorus export loading from residential septic systems within the 100-foot shoreline zone was assessed for Togus Pond based on the shoreline survey and personal interviews with City of Augusta officials. A simple model used the results from the shoreline survey to estimate total phosphorus loading from shoreline septic systems. The following attributes were included in the model: seasonal or year-round occupancy status; estimated age of the system; estimated distance of the system to the lake; and an average of 3 people per dwelling. An estimate of low, medium or high groundwater flow values were also factored into the model.

For purposes of these calculations it was assumed that 50% of the dwellings along the shoreline had septic systems installed after 1974. Based on the results of the shoreline survey, 58% of residences (and their septic systems) were estimated to lie less than 50' from the shoreline while the remainder were estimated to lie beyond 50' from the shoreline. Nearly 73% of the shoreline residences were assumed to be occupied on a year-round basis while the remainder were assumed to be seasonal.

The ability of shoreline soils to filter and purify septic tank effluent are also critical considerations in determining the suitability of septic systems for treating domestic wastewater (Cinnamon 1994). Much of the Togus Pond shoreline is dominated by Hollis-Paxton-Charlton-Woodbridge very stony fine sandy loams, with slopes ranging from 3 – 30% (USDA SCS 1978). Assuming that septic systems are properly designed, sited, installed and maintained, these soils are nearly ideal with enough silt and clay for treatment of the effluent, but coarse enough to handle the hydraulics as well as a restrictive layer that protects the true water table (David Rocque, Maine Department of Agriculture, personal communication). Currently, there are no public sewer services within the Togus Pond shoreline zone area (City of Augusta).

Based on all of these factors, estimates of the loading from residential septic systems on Togus Pond range from a low of 40 kg to a high of 124 kg of total phosphorus per year. Assuming a mid-range value of 69 kg of total phosphorus per year, shoreline septic systems represent the single largest contributor (at nearly 25%) of the total phosphorus loading to Togus Pond.

Private/Camp Roads: NPS pollution associated with shoreline roads can vary widely, depending upon road type, slope and proximity to a surface water resource. Routine maintenance of unimproved roads and associated drainage structures is often inadequate. For Togus Pond, total phosphorus loading from shoreline roads was estimated using GIS land use data to determine the overall area occupied by this category. The average width for shoreline roads in the Togus Pond watershed was estimated to be about 6 meters (based on the findings from previous PCAP-TMDL reports). Based on these factors, shoreline roads were determined to cover about 21 acres and contribute an estimated 7% (20 kg/yr) of the total phosphorus load to the direct watershed.

Overall, shoreline development comprises less than 2% of the total watershed area, yet contributes an average of 100 kg of total phosphorus annually, which approximates 36% of the estimated phosphorus load.

Non-Shoreline Development and Land Uses

Non-Shoreline Development consists of all lands outside the immediate shoreline of Togus Pond - including residential areas, commercial-industrial areas, and state and town roads. All of these land use areas were calculated using GIS land use data.

Public Roads: The areal extent of public roads was determined by estimating widths based on previous Maine lake PCAP-TMDL reports (16 meters and 22 meters for town and state-owned roads, respectively) to determine the amount of total phosphorus loading from this land use category. Based on these factors, public roads contribute an estimated 58 kg/year (20.8%) of the total phosphorus load to Togus Pond's direct watershed.

Commercial-Industrial: This land use category consists of approximately 19 acres, primarily in the form of an auto recycling facility in the central-northern portion of the direct watershed. An estimated 4.5% (13 kg/year) of the total phosphorous load to Togus Pond is derived from this land use category.

Residential: Low, medium and high density residential land uses combined consist of approximately 37 acres (28 acres for low, 8 acres for medium, and 1 acre for high density) and contribute an estimated 12 kg/year (4%) of the total phosphorus loading to the Togus Pond direct watershed.

Phosphorus Loading from Non-Developed Lands and Water

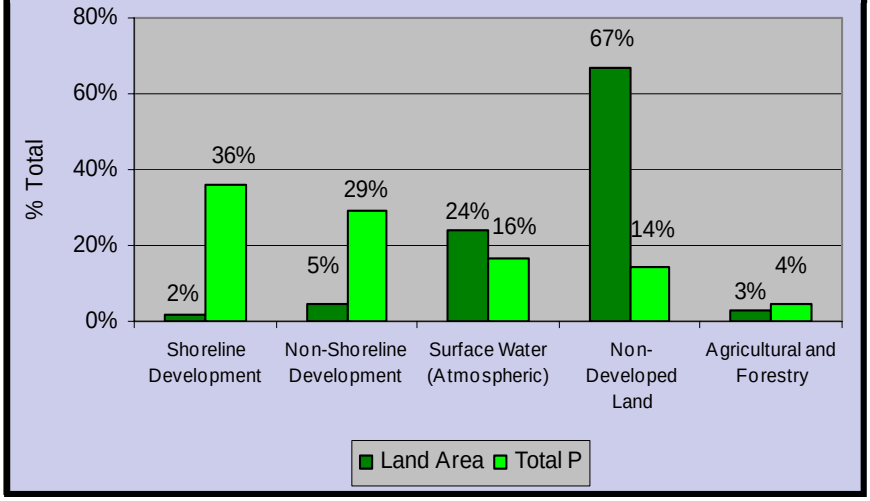
Undisturbed/Unmanaged Forests: Of the total land area within the Togus Pond watershed, 1,745 acres are forested, characterized by privately-owned non-managed deciduous and mixed forest plots. Approximately 12.4% of the phosphorus load (34 kg/year) is estimated to be derived from non-commercial forested areas within Togus Pond's direct drainage area.

Other Non-Developed Land Areas: Combined wetlands, grasslands/reverting fields and scrub shrub account for the remaining 6.5% of the land area and 1.6% of the total phosphorus export load.

Atmospheric Deposition (Open Water): Togus Pond surface waters (691 acres) comprise nearly 24% of the total watershed area and account for an estimated 45 kg of total phosphorus per year, representing 16.3% of the total direct watershed load entering Togus Pond.

The lower phosphorus loading coefficient chosen (0.16 kg/ha) is similar to that used for nearby central Maine lakes in Kennebec County, while the upper range (0.21 kg/ha) generally reflects a watershed that is 50 percent forested, combined with agricultural areas interspersed with urban/suburban land uses (Reckhow et al. 1980). **Figure 2** depicts the percentage of total land area covered by each land use.

Figure 2: Land Use Areas and TP Loadings
Togus Pond Direct Watershed



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). Please note that two methods were used in our total phosphorus loading analysis to assist with the preparation of this report: 1) a GIS-based land use and indirect load models; and 2) an in-lake phosphorus concentration model. However, the phosphorus reduction needed for the Togus Pond TMDL was determined using only the in-lake phosphorus concentration model.

GIS-based Land Use and Indirect Load Method

Watershed Land Uses: Total phosphorus loadings to Togus Pond originate from a combination of external watershed and internal lake sediment sources. Watershed total phosphorus sources, totaling approximately **277 kg** annually have been identified and accounted for by land use (See Table 3 - page 26).

Loading from the Indirect Watershed: Total phosphorus loading from associated upstream sources (Dam Pond) accounts for an estimated indirect watershed average load of **57** kg annually, determined on the basis of *flushing rate x volume x TP concentration*.

The sum of these two potential sources of TP indicates that an estimated **334** kg/yr may be contributing to the current in-lake phosphorus levels of Togus Pond. However, these models do not take into account many of the complex factors that affect lake water quality (for example, in addition to watershed loading the internal sediment TP load is estimated to be 200 kg/yr). Instead, these figures provide stakeholders with estimates that should assist with targeting NPS-BMP implementation measures in the watershed.

In-lake Concentration Method (TMDL)

Pond Capacity: The assimilative capacity for all existing and future non-point pollution sources for Togus Pond is 370 kg of total phosphorus per year, based on a target goal of 15 ppb (See Phosphorus Retention Model - page 29).

Target Goal: A change in 1 ppb in phosphorus concentration in Togus Pond is equivalent to 25 kg. The difference between the target goal of **15** ppb and the average maximum summertime total phosphorus concentration (**20** ppb) is 5 ppb (5 x 25) or **125** kg.

Future Development: The annual total phosphorus contribution to account for future development for Togus Pond is **12.5** kg (0.50 x 25).

Reduction Needed: Given the target goal and a 12.5 kg allocation for future development, the total amount of phosphorus needed to be reduced, on an annual basis, to maintain water quality standards in Togus Pond, is estimated to be **138** kg (125 + 12.5).

PHOSPHORUS CONTROL ACTION PLAN

Recent and Current NPS/BMP Efforts

As mentioned previously, the Kennebec County Soil and Water Conservation District (KC-SWCD) conducted a watershed survey in 2003 of the entire Togus watershed, which includes Togus Pond, Little Togus Pond, Lower Togus Pond and Togus Stream. Historical water quality monitoring data indicates that all of these surface water resources suffer from some level of impairment. To determine the probable causes of water quality impacts, the watershed survey included a land use assessment (similar to the one completed for this report) and identification of nonpoint source (NPS) pollution problem sites. There were 144 NPS sites documented, the vast majority of which were road-related and 95 of which were rated as medium or high priorities. Best Management Practices (BMPs) were recommended to address these problem NPS sites and restore the Togus Watershed to current state water quality standards. Complete watershed survey report can be found at the KC-SWCD website www.KCSWCD.org/Projects/Togus%20Stream.htm.

The KC-SWCD currently manages a DEP-funded "319" NPS Program Grant in the Togus Watershed. The project is in its second year of implementation. The purpose of the project is to reduce the amount of sediment reaching the Togus Ponds and Togus Stream. The project fosters intensive implementation of BMPs on identified NPS sites through cost-share agreements with landowners. Project staff also offer technical assistance to landowners in order to achieve voluntary remediation on as many of the numerous low priority sites as possible. The project will also measure the reduction of sediment entering the Togus Watershed by estimating sediment reductions from as many medium and high priority implementation sites as are feasible. BMPs (road repairs and buffer plantings) have been implemented at 18 sites as of May 2005. At least 30 sites total are planned for the project, which is scheduled to end in the spring of 2006.

In 2004, Colby College's Environmental Assessment Team (CEAT) conducted an investigation of the Togus Pond watershed. CEAT assessed the water quality by analyzing several physical, chemical and biological water quality parameters. To obtain a historical perspective, CEAT compared their 2004 water quality monitoring data to data collected in previous years by Maine DEP. They also conducted an assessment of watershed land use patterns and produced models to identify possible sources of degradation to the current and future water quality of Togus Pond. CEAT developed recommendations to reduce phosphorus loading from the Togus Pond watershed, many of which are similar to those presented in this PCAP report. For a summary of their findings visit the CEAT website at www.colby.edu/biology/BI493/ClassPres04.html.

Recommendations for Future Work

Togus Pond is a waterbody that has impaired water quality due mostly to historical nonpoint source (NPS) pollution and resultant internal sediment recycling of phosphorus. Specific recommendations regarding recent and current efforts in the watershed, Best Management Practices (BMPs), and actions to reduce external watershed total phosphorus loadings in order to improve water quality conditions in Togus Pond are as follows:

Watershed Management: Many different organizations (i.e., Maine DEP, KC-SWCD, Colby College, and Worromontogus Lake Association) have been involved in the restoration of Togus Pond's water quality. It will be important to coordinate existing information about the past and present restoration projects that have been undertaken in order to adequately assess future NPS BMP needs in the watershed.

Action Item # 1: Coordinate existing watershed management efforts		
Activity	**Participants**	**Schedule & Cost**
Develop a Togus Pond Steering Team	KC-SWCD, Maine DEP, Togus Pond Association, City of Augusta, and interested watershed citizens	Annual Roundtable Meetings beginning in 2005—**minimal cost**

Shoreline Residential areas have the potential to negatively impact the lake's water quality. According to the 2003 shoreline survey conducted for this PCAP report, there are 183 shoreline dwellings, over 50% of which were identified as having inadequate or nonexistent vegetated buffers. The survey also noted that nearly 60% of shoreline dwellings are situated less than 50' from the lake. With so many homes in close proximity to the water's edge, it is critical that adequate, effective buffers are in place in order to decrease and slow run-off from shore land sites.

An effort should be undertaken to encourage landowners to establish adequate and effective vegetated buffers along the shoreline. Buffer planting workshops are a popular outreach activity through the DEP-funded 319 watershed projects. In addition to the actual technical training they provide an excellent opportunity to engage landowners in NPS projects. For a copy of The Buffer Handbook, contact the Maine DEP's Bureau of Land & Water Quality in Augusta (287-2112) or for technical assistance regarding buffers, contact the KC-SWCD (622-7847 Ext 3).

Action Item # 2: Educate watershed citizens about shoreline buffers		
Activity	**Participants**	**Schedule & Cost**
Develop a Buffer Awareness Campaign for Watershed Citizens	Togus Pond Association, KC-SWCD, Maine DEP, City of Augusta, watershed citizens	Begin immediately—$2,500/year

Roadways: As noted previously, over 90% of the NPS problem sites identified by the 2003 KC-SWCD watershed survey were related to roads, which if not properly designed and maintained can be a major source of erosion and sedimentation to the lake. This PCAP report confirms the KC-SWCD's watershed survey findings since public and private roads combined were estimated to contribute nearly 30% of the total phosphorus load per year to Togus Pond. As such, Togus Pond stakeholders should consider implementing the recommendations presented in the KC-SWCD's

Action Item # 3: Implement roadway best management practices		
Activity	**Participants**	**Schedule & Cost**
Continue to Implement Roadside BMPs watershed-wide	KC-SWCD, Maine DEP, Togus Pond Association, City of Augusta	Annually beginning in 2005 **$50,000/yr**

watershed survey report to target roads for BMP installation and remediation.

Agriculture and Forestry: Both of these activities are located low in the Togus Pond watershed and a minimal number of NPS problem sites were identified for each land use type through KC-SWCD's 2003 watershed survey. Even so, it is still important to consider BMP recommendations for agricultural and forestry land uses, which include providing education on conservation practices and planning assistance. The KC-SWCD, Natural Resources Conservation Service and Maine Forest Service all provide technical assistance for using proper agricultural and forestry BMPs. For more information contact the KC-SWCD offices in Kennebec County (622-7847) or Maine Forest Service (1-800-367-0223), which also provides copies of Forestry BMP guidelines (*Best Management Practices for Forestry: Protecting Maine's Water Quality*) and other forest management assistance.

Action Item # 4: Conduct workshops for agriculture and forestry operators		
Activity	**Participants**	**Schedule & Cost**
Conduct workshops encouraging the use of phosphorus control measures	KC-SWCD, MFS, local forestry and agriculture community	Annually beginning in 2005 **$1,000/yr**

Non-Shoreline Residential and Commercial: Combined, these types of land uses are estimated to contribute nearly 9% of the total phosphorus load to Togus Pond. Therefore, particular attention should be given to properties adjacent to Togus Pond watershed brooks and streams.

Action Item # 5: Develop stewardship initiatives for Togus Pond tributaries		
Activity	**Participants**	**Schedule & Cost**
"Adopt" local streams to promote stewardship efforts including education and water quality monitoring.	Togus Pond Association, KC-SWCD, Maine DEP, Stream Team, local schools and watershed citizens.	Annually beginning in 2005 **$2,500/yr**

Septic Systems: Older, poorly designed and installed septic systems within the shoreland zone may contribute significantly to water quality problems, adding to the cumulative phosphorus load to Togus Pond. While Togus Pond septic systems – when properly sited, constructed and maintained – should not affect water quality, many septic systems do not meet all of these criteria and thus are potential contributors of phosphorus and other contaminants to lake water. Septic systems around Togus Pond that are sited in coarse, sandy soils with minimal filtering capacity are especially likely to contribute nutrients to lake waters, as are older septic systems which pre-date Maine's 1974 Plumbing Code.

Action Item # 6: Expand homeowner education and technical assistance programs		
Activity	**Participants**	**Schedule & Cost**
Increase outreach and education efforts to watershed citizens including technical assistance to landowners	KC-SWCD, Maine DEP, Togus Pond Association	Annually beginning in 2005 $7,500/yr includes printing of educational materials

Recommendations for reducing existing phosphorus inputs to lakes include seeking replacement of pre-Plumbing Code septic systems and other poorly functioning systems within the shoreland zone of Togus Pond. Identification of potential problem systems can be accomplished through town records and sanitary surveys. Lakeshore residents who believe they may have problems with their septic systems are encouraged to contact their town office for possible technical and/or financial assistance. In some cases, a revolving loan fund could be established to assist in the replacement of malfunctioning septic systems. Above all, educational efforts should make residents aware of impending problems and possible cost-effective solutions.

Individual Action: All watershed residents should be encouraged through continued education and outreach efforts, including: retention or planting of natural vegetation of buffer strips, use of non-phosphate detergents, elimination of phosphorus-containing fertilizers, adequate maintenance of septic systems.

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) through education and enforcement action, when necessary.

WATER QUALITY MONITORING PLAN

Historically, the water quality of Togus Pond has been monitored via measures of Secchi disk transparencies during the open water months since 1977 (Maine DEP and VLMP). Continued long-term water quality monitoring of Togus Pond will be conducted monthly, from May to October, through the continued efforts of Maine VLMP. Under this planned, post-TMDL water quality-monitoring plan, sufficient data will be acquired to adequately track seasonal and inter-annual variation and long-term trends in water quality in Togus Pond. A post-TMDL adaptive management status report will be prepared five to ten years following EPA approval.

PCAP CLOSING STATEMENT

The Kennebec County Soil and Water Conservation District (KC-SWCD), in cooperation with the Worromontogus Lake Association, have worked diligently since at least the early to mid-1990's to address nonpoint source pollution in the Togus Pond watershed. The KC-SWCD provides technical assistance to eligible and interested parties (e.g., residents, lake associations, planning boards) to mitigate phosphorus export from existing NPS pollution sources and to prevent excess loading from future sources. It is critical that the City of Augusta recognizes the value of Togus Pond as a local water resource and its connection to the community and local economy by providing strong support to lake restoration and protection efforts. The City should be asked for continued support of and cooperation with KC-SWCD and the Worromontogus Lake Association in the pursuit of regional lake protection and improvement. This teamwork approach by regional and local groups, in conjunction with the continued water quality protection efforts of KC-SWCD, Worromontogus Lake Association, Colby College, and other partners lends a high probability that NPS awareness and NPS-BMP implementation within the Togus Pond watershed will increase in future years.

APPENDICES

TOGUS (Worromontogus) POND

Total Maximum Daily (Annual Phosphorus) Load

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 32 lakes in Maine which do not meet water quality standards due to excessive amounts of in-lake total phosphorus - the great majority of which are located in south-central Maine (Kennebec County).

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), China Lake, Webber, Threemile and Threecornered ponds (Kennebec County), Mousam Lake, the Highland lakes in Falmouth and Bridgton, Annabessacook Lake, Pleasant Pond, Upper Narrows Pond and Little Cobbossee Lake (under contract with CWD), Sabattus, Toothaker Unity ponds and Long Lake (Bridgton). 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 Duckpuddle and Lovejoy ponds. PCAP-TMDL studies have also been initiated for Lilly, Hermon-Hammond, and Sewall ponds, as well as two of the remaining seven 303(d) listed PCAP-TMDL waterbodies in Aroostook County.

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 effectively address the lake's water pollution 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 generally intended by Maine DEP to be used for regulatory purposes*.

For further information, 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 monitoring data for Togus Pond (station 1, deep hole) has been collected annually since 1976. Hence, this present water quality assessment is based on 25 years (1994 to 1997 missing) of Secchi disk transparency (SDT) measures, combined with 14 years of epilimnion core total phosphorus (TP) data, 15 years of water chemistry and 20 years of chlorophyll-a monitoring data.

Water Quality Measures: (Source: Maine DEP and VLMP 2004) Historically, Togus Pond has had a range of SDT measures ranging from 0.6 to 8.5 meters, with a grand average of 4.4 m; an epilimnion core TP range of 10 to 22 with an average of 16 parts per billion (ppb), and chlorophyll-a measures ranging from 1.8 to 36.7, with an average of 8.4 ppb. Recent dissolved oxygen (DO) profiles indicate moderately low levels of DO in deep areas of the lake. Late summer dissolved oxygen levels in 2003 and 2004 remained fairly low (0-4 ppm) with 50% of the water column (lower 8 meters or 7-15 meters) unsuitable for salmonid species (e.g., brown trout). The potential for total phosphorus to leave the bottom sediments and become available to algae in the water column (internal loading) is moderate (Maine DEP 2000).

Priority Ranking, Pollutant of Concern and Algae Bloom History: Togus Pond is listed on Maine's Section 5A of the 2004 303(d) list (approved by EPA on May 9, 2005) of waters in non-attainment of Maine State water quality standards and was moved up in the priority development order due to stakeholder interest and need to complete an accelerated approach to lakes TMDL development. The Togus Pond TMDL has been developed for total phosphorus, the major limiting nutrient to algae growth in freshwater lakes in Maine.

The water quality of Togus Pond during the summers of 2003-04 appears to have declined, in contrast to 2001-02. Average water transparencies dropped from 3.2 - 4.7 to 2.3 - 3.6 meters; total phosphorus increased from 10 - 14 to 16 - 21 ppb); and chlorophyll-a levels rose from 5.1 - 9.1 to 27 - 35 ppb. On the basis of measured water transparencies below 2 meters in the summertime, nuisance algae blooms were prevalent during 5 of the last 10 years, and 4 of the last 5 years. Only 2002 showed a suitable summertime average of SDT equal to 3.5 meters. Estimates of total phosphorus export from different land uses found in the Togus Pond direct watershed are presented in Table 1 and 3.

Total phosphorus loading from the associated upstream sources (Dam Pond = 57 kg/TP/yr) accounts for loading from the indirect watershed, determined on the basis of flushing rate x volume x TP concentration, and typical area gauged streamflow calculations (Jeff Dennis, personal communication).

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

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 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 (<30 SPU) and for higher color lakes where low SDT readings are accompanied by elevated chlorophyll a levels. Togus Pond is a non-colored lake (average color 17 SPUs), with relatively low late summer

minimal SDT readings (annual average of 0.6 meters), in association with moderate/low chlorophyll a levels (8.4 ppb annual average). Currently, Togus Pond does not meet water quality standards due to a significant decline in water transparency trends over time, combined with monitored annual summertime hypolimnetic dissolved oxygen deficiencies. This water quality assessment uses historic documented conditions as the primary basis for comparison.

Designated Uses and Antidegradation Policy: Togus 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'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 Togus Pond is set at 15 ppb total phosphorus (370 kg/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. Epiliminion core samples for spring-time (May - early June) total phosphorus levels in Togus Pond historically approximated 13 - 16 ppb during the time period 1999 - 2004. In contrast, during 2000 - 2004, in-lake (epilimnion core) total phosphorus summertime (June through August) measures averaged approximately 20 ppb (19-21 average range), indicative of algal bloom conditions.

In summary, the numeric water quality target goal of 15 ppb for total phosphorus in Togus Pond was based on available late spring - early summer pre water column stratification data, generally 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 Togus Pond watershed. The key below explains the columns and the narrative that follows the table (pages 27-28) 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 total phosphorus coefficient values listed in the 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 (BMP's) 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 exported by the land use.

Table 3. TOGUS Pond Direct Watershed - Estimated Phosphorus Export by Land Use

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	GIS Adjusted* kg TP	TP Export Total %
Agricultural and Forested Land								
Non-manured Hayland	34	1.2%	0.35 - 1.35	0.64	14	9	10	3.7%
Operated Forest Land	41	1.4%	0.04 - 0.60	0.08	17	1	2	0.6%
Sub-Totals	**75**	**3%**	**-**	**-**	**30**	**10**	**12**	**4%**
Shoreline Development								
Septic Systems		**Togus**	**Pond**	**Septic**	**Model**	69	69	24.9%
Private/Camp Roads	21	0.7%	0.60 - 10.0	2	8	17	20	7.1%
Medium Density Residential	16	0.5%	0.40 - 2.20	1	6	6	7	2.6%
Low Density Residential	17	0.6%	0.25 - 1.75	0.5	7	3	4	1.4%
Sub-Totals	**53**	**2%**	**-**	**-**	**22**	**96**	**100**	**36%**
Non-Shoreline Development								
Public Roads	79	2.7%	0.60 - 10.0	1.5	32	48	58	20.8%
Commercial-Industrial	19	0.6%	0.77 - 4.18	1.5	8	11	13	4.5%
Low Density Residential	28	1.0%	0.25 -1.75	0.5	11	6	7	2.4%
Medium Density Residential	8	0.3%	0.40 - 2.20	1.0	3	3	4	1.3%
High Density Residential	1	0.04%	0.56 - 2.70	1.4	0	1	1	0.3%
Sub-Totals	**135**	**5%**	**-**	**-**	**55**	**69**	**81**	**30%**
Total: DEVELOPED LAND	**263**	**9%**	**-**	**-**	**106**	**175**	**193**	**70%**
Non-Developed Land								
Undisturbed/unmanaged Forest	1,745	60.4%	0.01 - 0.08	0.04	706	28	34	12.4%
Grassland	47	1.6%	0.10 - 0.20	0.2	19	4	4	1.5%
Scrub/shrub	7	0.2%	0.10 - 0.20	0.1	3	0	0	0.1%
Wetlands	136	4.7%	0.00 - 0.05	0	55	0	0	0.0%
Total: NON-DEVELOPED Land	**1,935**	**67%**	**-**	**-**	**783**	**32**	**39**	**14%**
Total: Surface Water (Atmospheric)	**691**	**24%**	**0.11 - 0.21**	**0.16**	**280**	**45**	**45**	**16%**
TOTAL: DIRECT WATERSHED	**2,889**	**100%**	**-**	**-**	**1,170**	**252**	**277**	**100%**

Total Phosphorus Land Use Loads

Estimates of total phosphorus export from different land uses found in the Togus Pond watershed are presented in Table 3, representing the extent of the current direct watershed phosphorus loading to the lake (277 kg/yr). Total phosphorus loading from the associated upstream source of Dam Pond (57 kg/yr) accounts for loading from the indirect watershed, determined on the basis of *flushing rate (x volume x TP concentration (ppb),* representing typical area gauged stream flow calculations.

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 loading values were primarily determined using 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 (e.g., recreational, commercial).

Agricultural and Operational Forest Lands: Phosphorus loading coefficients as applied to agricultural land uses were adopted from past Maine DEP 1982 studies for nonmanured hayland (0.64 kg/ha/yr).

The phosphorus loading coefficient applied to operated forest land (0.08 kg/ha/yr) was changed from previous PCAP-TMDL reports after consulting with Maine Forest Service staff. The rationale for this change is based on the fact that properly managed harvest areas will generally act as phosphorus sinks during periods of regeneration. According to the Maine Forest Service, nearly 3,500 water quality inspections conducted throughout the state in 2003, approximately 7% of the harvested sites posed “unacceptable” risks to water quality.

Previous lake PCAP-TMDL reports identified a “worst case” upper limit phosphorus loading coefficient of 0.6 kg/ha/yr for operated forestland. Therefore, for any given watershed in Maine we determined that applying this “worst case” coefficient to 7% of operated forest land while applying the “best case” coefficient (0.04 kg/ha/yr) to the remaining operated forest land would provide a relatively accurate estimate of total phosphorus loading from operated forest land. Combining worst case and best case coefficients yields the new phosphorus loading coefficient for operated forest land of 0.08 kg/ha/yr [(0.07 x 0.6) + (0.93 x 0.04)].

Residential Lots (House and Camp): The range of phosphorus loading coefficients used (0.25 – 2.70 kg/ha/yr) were developed from information on residential lot stormwater export of phosphorus as derived from Dennis et al (1992). Phosphorus loading coefficients for the various intensities of residential development are as follows: low density residential development (0.50 kg/ha/yr); medium density residential development (1.0 kg/ha/yr); and high density residential development (1.4 kg/ha/yr).

Private and Public Roads: The total phosphorus loading coefficient for private/camp and public roads (2.0 kg/ha/yr for private/camp roads and 1.50 kg/ha/yr for public roads) was chosen, in part, from previous studies of rural Maine highways (Dudley et al. 1997) and phosphorus research by Jeff Dennis (Maine DEP).

Other Developed Land Uses: Recommendations by Jeff Dennis were used to establish the total phosphorus loading coefficient for commercial-industrial land uses (1.50 kg/ha/yr), industrial (1.50 kg/ha/yr).

Total Developed Lands Phosphorus Loading: A total of 69.6% (193 kg) of the phosphorus loading to Togus Pond is estimated to have been derived from the cumulative effect of the preceding cultural land use classes: agriculture and forestry (4.3% - 12 kg); non-shoreline development (29.3% - 81 kg) and shoreline development (36% - 100 kg), including septic systems (24.9% - 69 kg) as depicted in Table 3.

Non-Developed Lands Phosphorus Loading: The phosphorus export coefficient for undisturbed/ unmanaged forest land (0.04 kg/ha/yr) is based on a New England regional study (Likens et al 1977) and phosphorus availability recommendation by Jeff Dennis. The phosphorus export coefficient for grassland (0.20 kg/ha/yr) and scrub/shrub (0.10 kg/ha/yr) is based on research by Bouchard in 1995 (0.20 kg/ha/yr). The export coefficient for wetlands is based on research by Bouchard 1995, and Monagle 1995 (0.0 kg/ha/ yr). The phosphorus loading coefficient chosen for surface waters (atmospheric deposition) was (0.16 kg/ha/yr) and was originally used in the China Lake TMDL (Kennebec County).

Shoreline Erosion: Undeveloped areas of the lake shoreline that may be eroding due to natural causes (i.e., wind, wave and ice action) are not included as a source of phosphorus due to the difficulty in quantifying impact area and assigning suitable phosphorus loading coefficients.

Phosphorus Load Summary

It is our professional opinion that the selected export coefficients are appropriate for the Togus Pond watershed. Results of the land use analysis indicate that a best estimate of the present total phosphorus loading from external nonpoint source nutrient pollution (direct = 277 kg and indirect = 57 kg drainages) approximates 334 kg/yr.

LINKING WATER QUALITY and POLLUTANT SOURCES

Assimilative Loading Capacity: The Togus 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 and justifiable to express the Togus Pond TMDL as an annual load because the lake basin has an annual flushing rate of 0.81 flushes, over one half less than the 1.50 average flushing rate for Maine lakes.

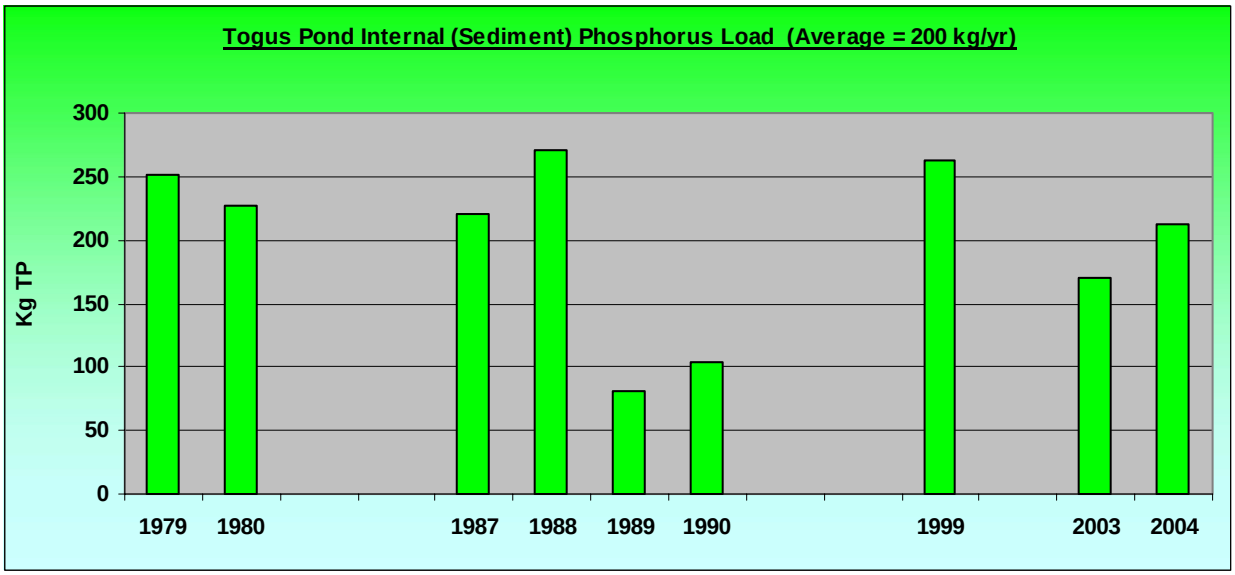
The Togus Pond basin lake assimilative capacity is capped at 370 kg/yr, as derived from the empirical phosphorus retention model based on a target goal of 15 ppb. This value reflects the modeled annual phosphorus loading responsible for current trophic state conditions, based on a long term goal of maintaining 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 both recent P-loading as well as 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 non-mitigated P-export from new development. This provides an additional non-quantified margin of safety to ensure the attainment of state water quality goals. Previously unaccounted P-loading from anticipated future development on Togus Pond watershed approximates 12.5 kg annually (0.50 x 25 kg or 1 ppb change in trophic state).

Undoubtedly, human growth will continue to occur in the Togus Pond watershed, contributing new sources of phosphorus to the lake. Hence, existing phosphorus source loads must be reduced by at least 12.5 kg to allow for anticipated new sources of phosphorus to Togus Pond. However, an additional 125 kg total phosphorus reduction is necessary due to existing nutrient enrichment concentrations in excess of lake capacity target goals (20 - 15 = 5 ppb x 25).

Overall, the presence of nuisance algae blooms in Togus Pond may be reduced, along with halting the trend of increasing trophic state, if the existing total phosphorus loading is reduced by approximately 138 kg/yr. Reductions already underway in nonpoint source total phosphorus loadings are expected from the continued implementation of best management practices - primarily from improvements to roadways and residential shoreline vegetative buffer plantings (see NPS/ BMP Implementation Plan and PCAP Summary).

Internal Lake Sediment Phosphorus Mass: The relative contribution of internal sources of total phosphorus within Togus Pond - in terms of sediment TP recycling - were analyzed (using lake volume-weighted mass differences between early and late summer) and estimated on the basis of water column TP data. The only years for which adequate lake profile TP concentration measures were available to derive reliable estimates of internal lake mass were from 1979-80, 1987-90, 1999 and 2003-2004, which ranged from a low of 81 and a high of 271, with an average of 200 kg/yr. Given the relatively high levels of phosphorus in the water column and the presence of nuisance algae blooms, it was expected that internal sediment derived phosphorus mass would be a significant problem in Togus Pond.



Linking Pollutant Loading to a Numeric Target: The basin loading assimilative capacity for Togus Pond was set at 370 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 numeric target.

Supporting Documentation for the Togus 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: **(1 ppb change = 25 kg)**

370 = **L** = external total phosphorus load capacity (kg TP/year)
15 = **P** = spring overturn total phosphorus concentration (ppb) = Target Goal
2.6 = **A** = lake basin surface area (km^2)
5.5 = **z** = mean depth of lake basin (m) **A z p = 11.58**
0.81 = **p** = annual flushing rate (flushes/year)
0.47 = **1- R** = phosphorus retention coefficient, where:
0.53 = **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 (Falmouth), Webber, Threemile, Threecornered, Annabessacook, Pleasant, Sabattus, Unity, Upper Narrows, Highland (Bridgton) and Little Cobbossee TMDLs (Maine DEP 2000-2005) have all shown this approach to be effective in linking watershed total phosphorus (external) loadings to existing in-lake total phosphorus concentrations.

Strengths and Weaknesses in the Overall TMDL Analytical Process: The Togus Pond TMDL was developed using existing lake 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 north-central U.S.) from 20 lakes in the US-EPA National Eutrophication Survey (US-EPA-New England) 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 was determined to be appropriate for the application lake.

Weaknesses:

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

Critical Conditions occur in Togus Pond during the summertime, when the potential (both 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 Togus Pond equals 370 kg TP on an annual basis and represents, in part, that portion of the lake's assimilative capacity allocated to non-point (overland) sources of phosphorus (from Table 3). Direct external TP sources (approximating 277 kg annually) have been identified and accounted for in the land-use breakdown portrayed in Table 3. Further reductions in non-point source phosphorus loadings are expected from the continued implementation of NPS best management practices (see summary, pages 18 - 21). As previously mentioned, it was not possible to separate natural background from non-point 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, and China Lake TMDLs), in-lake nutrient loadings in Togus Pond originate from a combination of direct and indirect external (watershed + Dam Pond) and internal (lake sediment) sources of total phosphorus.

WASTE LOAD ALLOCATIONS (WLA's): There are no known existing point sources of pollution (including regulated storm-water sources) in the Togus Pond watershed, hence, 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 Togus 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 Togus Pond historical records and a summary of statewide Maine lakes water quality data for non-colored (< 30 SPU) lakes - the target of 15 ppb (370 kg TP/ yr in Togus 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 and stable or decreasing trophic state. The statewide data base for uncolored Maine lakes indicate that summer 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. A non-quantified margin of safety for attainment of state water quality goals is additionally

provided by the inherently conservative methods used by Maine DEP to estimate future growth in the Togus Pond watershed.

SEASONAL VARIATION: The Togus 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 an average flushing rate of 0.81 flushes/year, the average annual phosphorus loading is most critical to the water quality in Togus 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. Nonpoint source best management practices (BMPs) proposed for the Togus Pond watershed have been designed to address total phosphorus loading during all seasons.

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

1. **March 17, 2003**: MACD staff member Jodi Michaud Federle assisted with a 1 day training session for an upcoming watershed survey of Togus Pond. The event was sponsored by the Kennebec County Soil and Water Conservation District (KC-SWCD).
2. **April 4, 2003**: MACD staff member Jodi Michaud Federle provided an overview of the PCAP-TMDL process to the Worromontogus Lake Association.
3. **July 2003**: MACD staff members Jodi Michaud Federle and Tim Bennett conducted a shoreline survey of Togus Pond with the assistance of Nate Sylvester from the KC-SWCD and Dave Crum from the Worromontogus Lake Association.
4. **December 9, 2004**: Maine DEP TMDL Lakes Program Manager Dave Halliwell and MACD staff member Fred Dillon attended a Worromontogus Lake Association meeting where the Colby College Environmental Assessment Team presented the findings from their land use and water quality analyses.
5. **January 27, 2005**: Maine DEP TMDL Lakes Program Manager Dave Halliwell and MACD staff member Fred Dillon attended a KC-SWCD Togus Watershed NPS Project Steering Committee meeting.
6. **May 3, 2005**: MACD staff member Fred Dillon attended a Worromontogus Lake Association meeting to provide an update of the Togus Pond PCAP-TMDL.

STAKEHOLDER AND PUBLIC REVIEW PROCESS and COMMENTS

A stakeholder review document (see below) was distributed electronically on Tuesday, May 3, 2005 (through May 18th, 2-week review period) to the following individuals who expressed a specific interest, participated in the field work or helped develop the draft Togus Pond PCAP-TMDL report: Kennebec County SWCD staff (Dale Finseth, Nate Sylvester, Josh Platt, Jennifer McLean); Rick Kersbergen (University of Maine Cooperative Extension); Roy Bouchard, Jeff Dennis, Barry Mower and Jessie Mae MacDougall (Maine DEP); Chris Martin (Maine Forest Service); David Roque (Maine Department of Agriculture); Pat Williams & John Pucciarelli (Worromontogus Lake Association); Maine DIFW (Jim Lucas and Bill Woodward); Maine DMR (Nate Gray); David Firmage (Colby College); and Bruce Keller (City of Augusta).

Dear Togus Pond Stakeholders:

> Attached is the **PRELIMINARY STAKEHOLDER** review draft of the Togus Pond Phosphorus Control Action Plan (PCAP) - Total Maximum Daily Load (TMDL) report prepared by the Maine Association of Conservation Districts and Maine Department of Environmental Protection. Please review the draft and, if necessary, respond by Wednesday, 18 May, 2005. All comments will be reviewed and considered by the Maine DEP and the Maine Association of Conservation Districts. Individual responses to the preliminary draft review will not generally be provided; however, acceptable changes will be incorporated into the final public review document.

PUBLIC REVIEW PROCESS: The final public review document of the Togus Pond PCAP-TMDL was made available to the general public for the formal public review process during the May 27 to June 24 four-week period. The following statement was advertised in the *Kennebec Journal* over a 2-weekend period (June 4-5 and 18-19, 2005):

> 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 a combined **Phosphorus Control Action Plan (PCAP)** and **Total Maximum Daily Load (TMDL)** nutrient report for the **Togus Pond** (DEPLW 2005-0702) watershed, located within the City of Augusta. This **PCAP-TMDL** report identifies and provides best estimates of non-point source phosphorus loads for all representative land use classes in the **Togus Pond** direct watershed and the total phosphorus reductions required to restore and maintain acceptable water quality conditions. A Public Review draft of this report may be viewed at Maine DEP Central Offices in Augusta (Ray Building, Hospital Street - Route 9, Land & Water Bureau) or on-line: http://www.maine.gov/dep/blwq/comment.htm. Please send all comments, in writing - by June 24, 2005, to Dave Halliwell, Lakes TMDL Program Manager, Maine DEP, State House Station #17, Augusta, ME 04333. or e-mail: david.halliwell@maine.gov
>
> In addition to EPA New England review (16 June 2005), written public review comments were limited to those submitted by Jennifer McLean and Nate Sylvester (Watershed Project Managers) for the Kennebec County Soil and Water Conservation District in Augusta, Maine (see following page for substantive comments). Minor editorial remarks provided by KC-SWCD were also incorporated into this final report as best possible.

Kennebec County Soil and Water Conservation District

Public Review Comments

June 1, 2005

Context: The Kennebec County Soil & Water Conservation District (the District) manages a Maine DEP "319" NPS Program Grant in the Togus Watershed. The project is in its second year of implementation. An NPS survey was conducted in 2004, identifying 114 sites, the great majority being road-related. This year's work will continue with BMP installation and outreach events. Throughout the life of the project, the District convenes a project Steering Committee, which includes plant operation staff of the Togus VA, the Worromontongus (Togus) Pond Association, fish conservation groups, and members of the public who live in the area. BMPs (road repairs and buffer plantings) have been implemented at 18 sites as of May 2005. At least 30 sites total are planned for the project, which is scheduled to end in the spring of 2006. The District also contributed to the land use analysis of the draft PCAP/TMDL Report.

General Comments: The draft report is thorough and well researched and reflects the dedication and professionalism of the author and the Bureau of Land and Water Quality. There were only a few places in the report where we thought that more detail may be helpful to the reader and these are explained below.

***Explanation of modeling and coefficients*:** A detailed explanation of the pollutant loading and nutrient retention modeling is included in the Appendix. It would be helpful to reference this and the calculations in Table 3 (pg. 26) in the body of the report - under Study Methodology (pg. 7) and in a few lines under "Descriptive Land Use and Phosphorus Export Estimates" (pg. 12) before describing the individual land uses.

***Detail on current 319 grant for BMP implementation*:** In addition to the 2003 shoreline survey referenced under "Recent and Current NPS/BMP Efforts"(pg. 18) it may be helpful to add a paragraph on the DEP-funded BMP implementation project on Togus:

"The KCSWCD presently manages a DEP-funded "319" NPS Program Grant in the Togus Watershed. The project is in its second year of implementation. The purpose of the project is to reduce the amount of sediment reaching the Togus Ponds and Togus Stream. The project fosters intensive implementation of BMPs on identified NPS sites through cost-share agreements with landowners. Project staff also offer technical assistance to landowners in order to achieve voluntary remediation on as many of the numerous low priority sites as possible. The project will also measure the reduction of sediment entering the Togus Watershed by estimating sediment reductions from as many medium and high priority implementation sites as are feasible. BMPs (road repairs and buffer plantings) have been implemented at 18 sites as of May 2005. At least 30 sites total are planned for the project, which is scheduled to end in the spring of 2006."

Recommendations: The Annual Roundtable Meeting (Action Item #1) is an excellent recommendation, given that it is often difficult to maintain continuity of NPS work between grant projects. KCSWCD supports this recommendation. We also strongly support Action Item #2: buffer training. We suggest adding a comment on the buffer workshops: (after line beginning with "An effort should be undertaken..." "Buffer planting workshops are a popular outreach activity through the DEP-funded 319 watershed projects. In addition to the actual technical training they provide an excellent opportunity to engage landowners in NPS projects."

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