Cochnewagon Lake NPS Watershed Restoration Project, Phase II
Final Project Report

Cobbossee Watershed District, Grantee

Contact person: Wendy Dennis, Project Coordinator
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I. Project Overview

Introduction

This Cochnewagon Lake NPS Watershed Restoration Project, Phase II was a coordinated program of technical assistance, education, and implementation of BMPs (best management practices), to address non-point source pollution in the Cochnewagon Lake watershed in Monmouth, Kennebec County, Maine. The project was directed by the Cobbossee Watershed District (CWD), a special purpose district created to protect and improve waterbodies within the Cobbosseecontee Stream watershed, which includes Cochnewagon Lake. The CWD has collected the vast majority of the water quality data for Cochnewagon Lake since 1975. CWD implemented an in-lake nutrient inactivation (alum) treatment in 1986 that improved the water quality of Cochnewagon Lake to a mesotrophic condition that lasted for nearly twenty years. Eventually, however, the effectiveness declined, as evidenced by late summer algal blooms and associated elevated chlorophyll and phosphorus concentrations that have plagued the lake for more than a decade. During that time, the CWD has been developing and conducting a restoration plan for the lake, including the following programs.

- Cochnewagon Lake Watershed Survey, *#2008PP28*, 2009-2010.
- Cochnewagon Lake NPS Watershed Protection (Restoration) Project Phase I, *#2011RR02*, 2011-2013.
- Cochnewagon Lake Watershed Based Plan, *#2013RT26*, 2014-2015.
- Cochnewagon Lake NPS Watershed Restoration, Phase II, *#2017RT03*, 2017-2019.
- Cochnewagon Lake Restoration, Phase III: In-Lake Alum Treatment, *#20180001*, 2018-2020.

Purpose

The Maine Department of Environmental Protection (DEP) listed Cochnewagon Lake as one of Maine's impaired waterbodies in 2012. Therefore, in 2014 the CWD led the development of the watershed based plan for Cochnewagon Lake, which generated comprehensive and integrated solutions to the water quality problems. Two restoration projects emerged as the essential components of the Cochnewagon Lake Watershed Based Plan (January 2016) that would be needed to restore Cochnewagon Lake to a mesotrophic state without late summer blue-green algal blooms. Beginning in 2017, the Cochnewagon Lake NPS Watershed Restoration Project, Phase II, was conducted to reduce phosphorus inputs to the lake from external (watershed) sources. A separate restoration project (Phase III) to reduce internal (in-lake) phosphorus sources was also implemented by CWD during the latter part of the NPS watershed project.

The watershed project was designed to implement BMPs at 15 road/driveway sites and 20 shorefront sites to achieve the phosphorus reduction goals outlined in the Watershed Based Plan (WBP). Technical and financial assistance to the Town of Monmouth (public roads), to private camproad owners, and to shorefront property owners, were the tools that enabled the proposed BMP projects to materialize. Specifically, CWD, often accompanied by DEP, met with the property owners to discuss appropriate site specific techniques such as road turnouts, ditch stabilization, settling basins, for example, to reduce polluted runoff from roads and driveways. The property owners were responsible for obtaining cost estimates for materials and labor. CWD

prepared Cost Sharing Agreements outlining the work that would be done, the funding to be provided by the 319 grant – usually 60% of the project cost, and the responsibility of each party, including continued maintenance of the BMPs. Almost all of these property owners had been approached prior to the start of the project regarding the nature of the problems and the plan to procure grant funding to address them. A different approach was utilized for shorefront sites. There were more lakeside properties that could benefit from implementing BMPs than there was time and money to include them all in the program. Therefore, with the exception of three properties that CWD had put on a priority list, all shorefront property owners were invited to participate on a first-come first-served basis. CWD contracted with the Friends of Cobbossee Watershed (FOCW) to meet with interested shorefront property owners and explain techniques to stabilize soil and infiltrate runoff. Property owners then had the opportunity to have FOCW's Youth Conservation Corps (YCC) install the BMPs and incur only the cost of materials.

The project also carried out several of the education and outreach actions specified in the WBP. CWD partnered with FOCW to bring education programs and information to students, shorefront property owners, watershed residents, and public officials. These included classroom instruction, school field trips, an adult field trip, public meetings, meetings with small groups, and flyers mailed and handed out. The citizens on the Steering Committee assisted with some of the planning and publicity and made it more effective. These efforts were designed to promote awareness of, and participation in, the project's specific lake restoration efforts, as well as provide information needed to carry on lake protection activities after the project ended.

Cochnewagon Lake water quality monitoring was conducted by CWD to update the robust database for Cochnewagon Lake and enable ongoing trend analysis and restoration planning.

Successes and Problems

The project was highly successful in accomplishing goals for technical assistance, education, BMP implementation, and estimated pollutants controlled.

- CWD and FOCW exceeded the technical assistance goal for assisting private camp road associations and shorefront property owners. This indicates that not only did the project partners work diligently, but also the watershed residents were very responsive to learning about pollution control and what they could do to restore the lake. (See task 3.)
- Public meetings and educational events on-lake and lake-side, for adults and students, were quite successful. A high degree of interaction transpired between the presenters and the participants. Both students and adults asked many questions and offered ideas and perspectives. FOCW provided in-classroom education at all three levels (elementary, middle, high school) in Monmouth schools for all years of the project. A watershed knowledge and stewardship base is growing. (See task 7).
- BMPs were installed on seven roads on the candidate site list, plus one driveway and two technically challenging shorefront sites, under the Cost Sharing Agreement process between CWD and property owners, as described above. Goals were met regarding the number of NPS sites for BMP implementation through this program. Many BMP projects exceeded expectations. (See task 4.)

- YCC conducted 23 shorefront BMP projects over the course of three summers. The YCC season is short, necessitating a steady and coordinated output in a compressed time period. With the project extended to a third year, the crew and their leader did a great job of reaching the YCC goal. (See task 5).
- Pollutant control estimates indicate the WBP goal was met for external phosphorus loading reduction of 15 kilograms from roads and shorefront properties. (See task 6).

With that as an overview, a more specific image of this successful project emerges in the subsequent sections: "II. Task Summary" and, "IV. Project Outcomes".

Three specific incidents stand out as presenting challenges to meeting project BMP implementation goals, each with different results.

1. Unfortunately, one anticipated road project to reduce stormwater that directly discharges through a culvert into Cochnewagon Lake did not get done. This was disappointing, after investing much time in identifying the problem, conducting field visits with DEP staff to design a solution, meeting with the adjacent residents, and having reserved grant funding for the project. Complications regarding land ownership and road association rights for the property where the work needed to be done were not worked out. No resolution is on the horizon at this time. Much thanks to one citizen who worked very hard towards a different outcome.
2. BMP implementation planned at one shorefront site owned by the Town of Monmouth did not get done, but, BMPs are expected to be installed there in the coming year. It is unfortunate that the inaccessibility of the site due to the alum treatment earlier in the season, and then the subsequent work load of the Public Works Department (PWD), prevented them from getting to this project before weather conditions closed this year's work window. For this BMP project, a section of the shoreline at the Monmouth Beach Park will be stabilized with riprap where erosion has undercut trees and the shoreline vegetated buffer is being endangered. The Town of Monmouth has invested heavily in improvements to this public lakeside property and the lake water quality, and there is a solid expectation that this project will get done, just not as part of the phase II grant.
3. Problems surfaced during one BMP installation at a privately owned shorefront property. The YCC installed thirty infiltration steps on a steep hillside. This was the last YCC project of the season and the crew worked overtime, spending many more hours of work than anticipated. The job could not be finished to the property owners' satisfaction. Site conditions at both ends of the staircase – large rocks below the surface and large tree roots above the surface – made accessing either end of the staircase difficult. CWD, DEP, and FOCW developed a solution to the problem and CWD then entered into an agreement with a landscaping contractor for the additional work. During the two months it took to resolve the problem, the property owners were very anxious and much communication was required. In hindsight, a project of this scale was not appropriate for a YCC hand-tools-only project, but the availability of project construction funds and commitment of the grantee and sub-grantee to resolve the situation led to a happy ending.

Project success came from a strong foundation of information, relationships, and on the ground BMP examples built under previous EPA/DEP funded projects, as well as ongoing municipally-

funded planning and monitoring by CWD, involvement by the Town of Monmouth, collaboration with FOCW, and continuous dedicated volunteerism by a group of citizens working with CWD in the Cochnewagon Lake watershed.

Key Project Personnel

- Cobbossee Watershed District: Wendy Dennis, *Project Coordinator*. Ryan Burton, Bill Monagle, and seasonal staff Erica Hutchinson and Matt Dennis.
- Maine DEP: Wendy Garland and Mary Ellen Dennis, *Agreement Administrators*. David Waddell and Art Mcglauflin, technical engineering services.
- Friends of Cobbossee Watershed: Tamara Whitmore, Executive Director. Cami Wilbert, Education Director. Mitch Deblois and Cameron Dufour, YCC leaders. YCC crew.
- Town of Monmouth: Public Works Department, Bruce Balfour, *Director*, and crew.
- Road owner project leaders: Todd Gifford, Shawn Laverdiere, Bob Ristuccia, David Shaw.
- Steering Committee: An invaluable group of citizens, listed in Task 2.

II. Task Summary

Task 1- Project Management

1. CWD signed a Grant Agreement with the Maine DEP in December 2016 that enabled project startup in January 2017.
2. CWD signed a Memorandum of Understanding with the Friends of Cobbossee Watershed (FOCW) in June 2017 for project services related to technical assistance, education, and Youth Conservations Corps.
3. CWD Project Coordinator Wendy Dennis managed all project tasks, documented project expenses and match, documented project sites information on a Site Tracker spreadsheet, prepared Cost-Sharing Agreements, and prepared and submitted deliverables to DEP including semi-annual Progress Reports, annual Pollutants Controlled Reports, NPS site reports, summary tables of technical assistance and BMP inspections, a water quality report, and the Final Project Report.

Task 2 – Project Steering Committee

The CWD Project Coordinator established a Steering Committee in 2017. The Steering Committee was a great group of committed people who had already been working on the restoration of Cochnewagon Lake in various ways. They were: members of the former Watershed Based Plan Steering Committee; and/or of the former Cochnewagon Citizens Committee; and/or leaders of groups that had cost-shared on BMP implementation during Phase I; and/or dedicated staff involved in previous Cochnewagon Lake projects. The citizen members opened up a two-way avenue, directing information about the project out to the people in the watershed, and feedback into the project from road associations, shorefront property owners, and town officials.

The Steering Committee was comprised of a core group of 12 members, with average attendance of 10 per meeting. There were 8 citizen volunteers, providing a wide range of representation; two CWD staff; one FOCW staff; and the DEP project administrator. An additional FOCW staff person and an additional DEP staff person attended one meeting each.

STEERING COMMITTEE

Volunteer Members	**Representing**	**Other representation/interest**
Bruce Balfour	Town of Monmouth, *Director of Public Works*	
Kathy Boggan	P2 Road Association	Shorefront property owner
Todd Gifford	Dearborn Ridge Road Owners Assoc.	Shorefront property owner
Ginger Jordan-Hillier	CWD Trustees, *Town of Monmouth*	Monmouth citizen
Doug Ludewig	CWD Trustees, *Town of Monmouth;* Monmouth Select Board, *Chair*	
Joe Saunders	CWD Trustees, *Town of Monmouth;* Beach Road Association	Shorefront property owner Volunteer water monitor
David Shaw	Town of Monmouth, *Code Enforcement Officer;* Packard Road (private ownership)	Shorefront property owner
Paulee Willette	Paradise Point Association	Shorefront property owner
Staff Members		
Ryan Burton	CWD	
Wendy Dennis	CWD	
Mary-Ellen Dennis	DEP – 2017	
Wendy Garland	DEP – 2018 & 2019	
Tamara Whitmore	FOCW	

The Steering Committee met six times during the project. Five meetings were in 2018, on 3/6, 5/8, 6/5, 7/10, and 8/14. A sixth meeting on 6/25/19 was a combined watershed project and alum treatment project Steering Committees meeting. Between meetings the citizen members were talking to their watershed neighbors, writing articles for local newspapers, distributing notices about project events, monitoring water clarity, and preparing road associations and individual landowners to participate in BMP implementation.

Task 3 – Technical Assistance for Road Associations and Shorefront Property Owners

3A. Roads.

1. CWD Project Coordinator Wendy Dennis met with, and communicated by phone and email with, leaders of Dearborn Ridge Road Owners Association, P2 Road Association, Robinson Pines Colony, the private portion of Packard Road, and, also held a special meeting for members of Paradise Point Association, to discuss NPS sites and BMPs, and explain the cost sharing program. Working with a total of 5 private road groups exceeded

the goal of 4 stated in the workplan. She also had frequent communications and meetings with the Monmouth Public Works Director about the same. The time and work contributed by Todd Gifford, Bob Ristuccia, Shawn Laverdiere, Dave Shaw, Paulee Willette, and Bruce Balfour, respective road representatives, was greatly appreciated. Dave Waddell of Maine DEP was involved in many of the on-site meetings and provided valuable ideas and explanations to the landowners. The technical assistance led to BMP projects described under task 4.

3B. Shorefront.

2. CWD mailed a flyer primarily prepared by FOCW to all 101 property owners around Cochnewagon Lake, offering them technical assistance with lakefront BMPs and inviting them to call FOCW or CWD for a site visit. FOCW's Slow the Flow program was described. Property owners could receive a free evaluation called LakeSmart-Start! that included recommendations for their property, and they could then decide to sign up with the YCC for BMP implementation (free labor when grant associated).
3. **Over the course of the project, 26 shorefront property owners received a LakeSmart-Start! technical assistance visit from FOCW, exceeding the project goal of 20.** Following each visit, FOCW prepared a written plan of problems and recommendations, including photos and sketches, and helped with obtaining DEP permits.
4. CWD also visited 4 shorefront properties to provide technical assistance. Those sites had more complex problems and technical recommendations, and each required multiple visits. The goal of 10 shorefront site visits by CWD was met, therefore, although not according to the original vision of single visits to different sites.
5. CWD compiled information on specific sites visited and the corresponding recommendations and outcomes in a table that was submitted to DEP (Deliverable #2).
6. The shorefront technical assistance program led to 21 BMP implementation projects, described under task 5.

Task 4 – NPS Abatement Projects with Cost Sharing

1. CWD Project Coordinator managed the implementation of BMPS to reduce erosion and NPS pollution at all road and driveway sites, as well as a few shorefront sites that were too complex for the YCC shorefront BMP program.
2. **CWD entered into 10 Cost Sharing Agreements (CSAs), and 1 Construction Plan (CP),** with 8 responsible parties: the Town of Monmouth; Dearborn Ridge Road Owners Association; P2 Road Association; Robinson Pines Colony; William Cushman and David Shaw; Craig and Brooke Daigle; Hope & Dion Olmstead and Down to Earth Landscaping.
3. **BMPs were installed on 15 road/driveway sites and 3 shorefront sites, meeting the workplan goal**.
   - The tally isn't exactly straightforward. It includes two new road sites that were unknown when the project was planned. It involved swapping a low priority site for a new, higher priority, site on one road because the association couldn't afford to do both projects. One targeted driveway project far from the lake did not get fixed, although the receiving road ditch did. Instead, one new driveway project, which was within 150 feet of the lake and therefore a higher priority, was implemented. One road project was done by a private landowner with no grant funding or guidance. One NPS

site fell under DOT jurisdiction; it was partially addressed outside of the grant project. One important road crossing project, and an associated railroad culvert site, did not get done. In terms of lake protection, the lack of progress on that site is the most noticeable lack of achievement of an otherwise great project. One important road project involving two sites, which had erroneously been initially counted as one site, did get completed. Time ran out for one anticipated shoreline stabilization site, but every expectation is that it will be done next summer. One shorefront project not on the cost sharing target list became an immediate need. One new road site with a landowner interested in matching funds surfaced in October, which was too late to address before the construction season and grant period ended. The point of including this information in the task summary is to illustrate that it is impossible to plan in advance exactly how many and which NPS sites will be addressed in a BMP implementation program. Although not all original target sites, or new sites, received mitigation, perhaps as much work was accomplished as could be expected in the time period allowed.

4. **BMP work occurred on 7 roads**. The CSAs covered NPS sites on Cochrane Drive, Packard Road, Pine Drive, Pine Hill Road, and Robinson Drive. The Construction Plan covered one site on Pine Drive. An NPS site on Chick Drive was mitigated privately without a CSA or public funding, and a Main Street site was addressed by DOT since it is a state maintained road.
5. **Specific BMPS for roads and driveways** aimed to reduce road surface erosion by: shortening the flow path and diverting water off the road/driveway surfaces, by crowning or tilting the roads and directing runoff to ditches and turnouts. Existing turnouts often needed to be improved, and new turnouts added. Road surface erosion was also addressed by re-surfacing the roads with better material. In Phase I, that material was always gravel with the appropriate percent of fines. In this Phase II project, there were four roads where portions of them were resurfaced with a more compact material, either recycled asphalt or bluestone. Other BMPs were employed to reduce ditch erosion and culvert inlet and outlet erosion, primarily stabilization with rock armor (or occasionally vegetation where ditch shape allowed it). Steep ditch banks were cut back to a gentler slope and vegetated above the water line. Rock-lined plunge pools were installed at the end of ditches and culvert outlets to trap sediment from being transported to receiving waters. Level spreaders were constructed at discharge points to create a non-concentrated flow, often through whatever buffer was available.
   - *Acknowledgments: CWD developed BMP recommendations for all sites; however, the specific details needed were mostly provided by other professionals working with the CWD Project Coordinator. David Waddell of DEP provided either written or verbal recommendations for all sites. Art Mcglauflin of DEP assisted on some sites. Two contractors, Michael Cyr of Larry & Sons, and Chris Dube of Dube Gravel, provided recommendations. Public Works Director Bruce Balfour provided some solutions on town sites.*
6. **The Project Coordinator prepared 13 NPS Site Reports** for the projects involving grant funds. These reports are the best source for details of the BMPs implemented at each site, accompanied by photos, and including costs.

Task 5 – NPS Abatement Projects - Youth Conservation Corps

1. **FOCW's Youth Conservation Corps (YCC) completed 21 BMP projects at 18 shorefront properties** to control erosion and/or reduce phosphorus runoff. The project goal was 20 shorefront sites mitigated by YCC. Although there were 18 sites based on ownership, three sites had extensive enough projects that crews had to be deployed in two different years to complete the work. Thus, the YCC fulfilled their responsibility to the project.
2. The number of BMPs implemented exceeds 21 because some properties had multiple BMPs implemented: for example one property had BMPs installed to infiltrate roof runoff, to reduce erosion on a foot path, to create shorefront buffer of mulch and plants, and to prevent shoreline erosion by the placement of riprap.
3. The most challenging YCC project was installation of infiltration steps on a steep hillside, as discussed in section I. of this report.
4. The YCC program is popular but only available for a short time each year due to limited funding. That makes it difficult to address all the shoreland sites where BMPs are needed when a grant project lasts only 2 or 3 years.
5. FOCW prepared NPS site reports for the shoreland BMP implementation projects.

Task 6 – Pollutants Controlled Reports

CWD Project Coordinator estimated sediment and phosphorus pollutant load reductions at all BMP sites, utilizing the EPA Region 5 Load Reduction Model and/or the USDA Forest Service Water Erosion Prediction Project (WEPP) Model. Two Annual Pollutants Controlled Reports were submitted to DEP.

The pollutant load reduction estimates for the Cochnewagon Lake NPS Watershed Protection Project, Phase II, are 45 tons of sediment and 35 pounds of phosphorus per year. The total phosphorus reduction, converted to 16 kilograms, meets the WBP goal of 15 kg phosphorus per year. A total of 1,518 feet length of shoreline and streambank was protected by the BMP projects.

Task 7 – Implement a Public Information and Education Program

CWD and FOCW, with help from the Steering Committee, conducted outreach activities related to lake and watershed restoration.

1. CWD Project Coordinated presented project updates at 16 meetings of the CWD Board of Trustees. Minutes of these meetings were distributed to the eight member municipalities in the Cobbossee Watershed District.
2. Two articles written by the CWD Project Coordinator, and five by CWD Trustee and Steering Committee member/Monmouth Select Board Chair Doug Ludewig, were published in the local *Community Advertiser* newspaper.
3. CWD and FOCW prepared and mailed a flyer entitled "Help Protect Cochnewagon Lake!" to all 101 property owners around Cochnewagon Lake, advertising the lake restoration project and offering them assistance with shorefront stabilization. This was very successful as it generated the majority of property owner requests that led to YCC implementation projects.

4. CWD hosted two public meetings at Cumston Hall in Monmouth in July 2018. The first focused on landowners considering a road related BMP implementation project. The second meeting had a broader community appeal and was hosted jointly by CWD and FOCW. Most attendees already had some understanding of the restoration project from previous advertising and conversations; their questions, therefore, were interestingly specific rather than general.
5. FOCW provided their *Otter II* pontoon boat for CWD's Ryan Burton and Wendy Dennis to conduct a Cochnewagon Lake educational boat tour for shorefront property owners. The tour focused on:

- looking at riprap and buffer BMPs that had been implemented at several lakefront properties, as well as examples of shorefront properties that were in need of NPS protective measures;
- a discussion of historical watershed protection activities, for which it was immensely valuable to have on board the owner of the dairy farm bordering the lake, as he could describe the BMPs implemented at the farm (for example manure storage facilities and nutrient management plans) and answer many questions;
- a stop at the CWD water quality monitoring station and a demonstration of a water quality test;
- an enjoyable morning on the water with an opportunity to also discuss important factors that were out of sight, such as the water quality impact of the sediments at the bottom of the lake, and the road improvement projects happening in the watershed beyond the shoreline.

6. The Monmouth Beach Park at Cochnewagon Lake was the site where FOCW conducted two educational field experiences. The first was in September 2017, for 15 high school students in an environmental class. CWD assisted, with Burton demonstrating water quality monitoring and Dennis teaching limnological concepts. The second was in May 2018, for **45 sixth graders** (middle school). The students rotated among six stations to explore different lake protection concepts: water quality testing; small water creatures; invasive aquatic plants; build a buffer; plant a buffer; and create posters on watershed issues. Some of the high school students from the fall field session attended to assist with the middle schoolers, as did CWD. FOCW did a tremendous job of providing locally relevant watershed science, and, teachers were disappointed that there was not grant funding for a repeat experience the following year.
7. FOCW's Education Director taught 100 hours of watershed education curriculum to Monmouth students at the elementary, middle, and high schools. The instruction focused on NPS prevention, highlighted Cochnewagon Lake, and was provided entirely as match to this project.

Task 8 – Implement a Program to Evaluate and Promote Road BMP Maintenance

CWD inspected maintenance status of BMPS at 12 NPS sites. BMPs at 10 sites had been installed in 2011 or 2012 during the Phase I NPS Watershed Project for Cochnewagon Lake, and therefore had been in place for seven to eight years, and BMPs at 2 sites were installed during this Phase II project and had been in place for one year. It was known from speaking with the responsible parties that maintenance had been performed in the past on the older sites, although dates of the most recent maintenance actions were not always known. The most difficult

maintenance aspect to keep up with appeared to be leaf removal from ditches, plunge pools, turnouts, and culverts, resulting in reduced capacity to receive road and ditch runoff. Sediment removal also was needed at a couple of ditches and culverts; others were quite clean. Movement of rocks at some culvert inlets and outlets was causing culvert blockage and seemed to be an area of neglected maintenance.

BMPs appeared to be functioning well in most cases and a little more scheduling of inspections by the responsible parties would probably solve the maintenance issues reported. Responsible parties are willing to cooperate. One party, who saw the Project Coordinator out inspecting, called the next day to report why they were late on maintenance and that they would get it done. Unexpected maintenance needed at one site was taken care of by the responsible party in a timely manner such that the Project Coordinator only saw the result of the new maintenance efforts rather than the need. A summary table of the inspections was submitted to DEP.

Task 9 – Lake Water Quality Monitoring

1. The CWD Project Coordinator developed a lake monitoring program for the year 2017. The lead field person was Ryan Burton, CWD, and the accompanying CWD field staff was one of the following: Matt Dennis, Erica Hutchinson, or Wendy Dennis. Joe Saunders, an experienced certified volunteer monitor, augmented water clarity data with measurements on six dates.
2. **Water quality monitoring was conducted from May 12 through November 21, 2017**, on a bi-weekly to weekly basis, varying by parameter sampled.
3. Secchi disk transparency was measured on **26 dates**.
4. Chlorophyll-a measurements were performed by the Maine Health and Environmental Testing Lab (HETL) on water samples collected and filtered by CWD on **13 dates**.
5. Total phosphorus measurements were performed by HETL on water samples collected by CWD on **13 dates**.
6. Temperature and dissolved oxygen were measured at every meter depth by CWD on **20 dates**.
7. Zooplankton samples were collected **monthly on three dates** by CWD and analyzed by Kenneth Wagner, PhD.
8. CWD Project Coordinator prepared a Sampling and Analysis Plan (SAP) for the project.
9. Ryan Burton, CWD, entered all data into a database and submitted it to DEP.
10. CWD Project Coordinator prepared a Summary Water Quality Report.
11. Water quality monitoring in 2017 occurred prior to most BMP installation. Therefore the data confirm the occurrence of algal blooms, as well as elevated chlorophyll and phosphorus, and the need for the BMPS that were subsequently installed in 2018 and 2019.

III. Deliverables Summary

All 7 deliverables listed in the project workplan were submitted by the Project Coordinator.

1. (Task 1)

Sub-grantee agreements.

1-1 Memorandum of Understanding between CWD and FOCW, signed June 2017. Submitted 6/5/17.

Semi-annual Progress Reports.

1-2 through 1-6. NPS Progress Reports 1-5.
Submitted 11/20/17, 5/15/18, 11/29/18, 5/13/19, 11/15/19.

NPS Site Tracker summary. 1-7 Submitted 2/4/20.

Final Project Report. 1-8 Submitted 2/7/20.

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2. Technical assistance outcome summary table. (Task 3b). Submitted 1/17/20

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3. NPS Site Report for each NPS site.

Task 4 Projects with Cost Sharing

3-2-1 through 3-2-7. 7 NPS Site Reports. Submitted 1/23/20.
3-2-8 through 3-2-11. 4 NPS Site Reports. Submitted 1/24/20.
3-2-12. 1 NPS Site Report. Submitted 1/27/20.
3-2-13. 1 NPS Site Report. Submitted 1/29/20.

Task 5 Youth Conservation Corps

3-1 YCC NPS Site Reports 2017-2019. Submitted 1/21/20.

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4. Annual Pollutants Controlled Reports. (Task 6)

4-1 Year 2018 Pollutants Controlled Report. Submitted 1/30/19.
4-2 Year 2019 Pollutants Controlled Report. Submitted 1/3/20.

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5. Copies of newspaper articles and key public outreach materials (Task7).

5-1 Technical Assistance Flyer to property owners. Submitted 1/17/20.
5-2 Monmouth Middle School Watershed Field Experience. Submitted 2/4/20.
5-3 Cochnewagon Lake Restoration Project July 2018 Events. Submitted 2/4/20.
5-4 Community Advertiser article 7-14-18. Submitted 2/4/20.
5-5 Community Advertiser article 10-20-18. Submitted 2/4/20.
5-6 Project Report for CWD Trustees meeting Feb 14 2017. Submitted 2/4/20.

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6. Summary table of Road BMP Maintenance inspections. (Task 8). Submitted 1/29/20.

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7. Sampling and Analysis Plan (SAP), Summary Water Quality Report. (Task 9)

7-1 **SAP.** Submitted 7/31/18.
7-2 **Summary Water Quality Report.** Submitted 1/31/20.

IV. Project Outcomes

A. List of Major Outcomes

1) Technical transfer was a high priority and the associated goals were achieved.

1. CWD, with help from DEP, provided site-specific NPS control techniques to five associations (formal and informal) responsible for private roads and also to the Town of Monmouth, responsible for public roads, in the Cochnewagon Lake watershed.
2. FOCW provided LakeSmart-Start! technical assistance visits and reports to 26 Cochnewagon Lake shorefront property owners.

2) BMP implementation was the highest priority and success was correspondingly high.

1. CWD entered into 11 Cost Sharing Agreements (10 CSAs and 1 CP) with 8 responsible parties for installing and maintaining BMPs on roads, driveways, and shorefront sites.
2. BMP work occurred on 7 roads.
3. BMPs were installed on 15 road/driveway sites and 3 shorefront sites, meeting the workplan goal.
4. FOCW's Youth Conservation Corps (YCC) completed 21 BMP projects at 18 shorefront properties to control erosion and/or reduce phosphorus runoff.

3) Pollution reduction was achieved.

1. An estimated 45 tons of sediment and 35 pounds of phosphorus per year were reduced by BMPs.
2. The WBP plan goal of 15 kilograms phosphorus annual external load reduction was met.

4) Public information and education outreach efforts were targeted and successful.

1. 101 (all) Cochnewagon Lake property owners received by mail "Help Protect Cochnewagon Lake! Flyers, which led to 26 technical assistance visits and 21 shorefront BMP projects, as well as unquantifiable educational benefits.
2. All Cochnewagon Lake residents were personally delivered a notice about two Cochnewagon Lake Restoration Project events. As a result, the pontoon boat was full for a lake tour featuring NPS problems, BMPs, and water quality, and, 25% of residents attended the evening public meeting sponsored by CWD and FOCW.
3. 45 middle school students and 15 high school students participated in watershed science activities and instruction on the shores of Cochnewagon Lake. Posters and lists of watershed issues created by the students demonstrated some of the concepts they gleaned from the experience. They showed potential to be lake and watershed stewards.
4. 100 hours of NPS watershed classroom education were provided to students in elementary, middle, and high school in Monmouth, where Cochnewagon Lake is located.
5. Municipal officials received minutes of 16 meetings of CWD Trustees that included updates on the Cochnewagon Lake NPS Watershed Restoration project. CWD receives ongoing support for NPS work from 8 municipalities.
6. Local citizens were kept informed by articles in the *Community Advertiser*, a widely-read free local newspaper. The Cochnewagon Lake community is within the paper's distribution area.

5) **CWD's pilot program of inspecting established BMPS to determine maintenance needs was beneficial.** BMPS that had been installed at 10 sites at least 7 years ago indicated little serious repair work was needed, which bodes well for the BMPs installed under this Phase II project. Routine cleanout frequency needs to be improved, but that is not difficult to do and appears to be more of a matter of paying attention to a schedule.

6) **Water quality monitoring collected an extensive amount of data that is sufficient to describe Cochnewagon Lake's condition and to track future improvement resulting from restoration efforts.**
   1. **CWD conducted water quality monitoring from May 12 through November 21, 2017**, on a bi-weekly to weekly basis, varying by parameter sampled.
   2. This resulted in Secchi disk transparency measurements on **26 dates,** temperature and dissolved oxygen measurements on **20 dates**; and chlorophyll and phosphorus measurements on **13 dates**.

B. Environmental Results

The NPS pollutant load reduction in the Cochnewagon Lake watershed from BMPs implemented along roads, driveways, and shorefront was estimated to be 45 tons of sediment and 35 pounds of phosphorus per year, using EPA approved models. A quantitative load reduction goal for watershed generated phosphorus was established in the 2016 WBP at 15 kilograms. <u>The total phosphorus reduction for the project was calculated as 16 kilograms; therefore the WBP goal has been met.</u> There is considerable uncertainty in the models, but, if they do closely predict the nutrient reduction, then Cochnewagon Lake phosphorus levels in spring and early summer, which are dependent on external loading, should be within the mesotrophic range.

The later summer phosphorus is dependent on internal loading. CWD's preliminary evaluation of water quality data collected following the Phase III alum treatment indicates substantial reductions in the internal phosphorus loading in 2019. The water quality data collected in 2017 as part of this Phase II watershed project was used in the internal loading evaluation.

C. Lessons Learned

For a watershed BMP project to succeed, it is essential to establish relationships with watershed and lakeshore residents before and early in the project. The BMP implementation goals depend on those residents taking action and spending money. People need to care about the project goal, understand what their role is, and trust the grantee and project partners. The groundwork for that was laid well before this Phase II project began and was carried into the project implementation. CWD, FOCW, town officials, and the Steering Committee citizens learned to work well together; and, they took the time to become familiar with and welcomed in the Cochnewagon neighborhood (or at worst case, at least recognized.) Know the watershed. Meet the people. Educate and be educated locally. Be available. That's what works.

Multiple visits to an NPS site are usually necessary for effective BMP design and implementation. Visits during different seasons or weather conditions are useful. More than one visit with the

landowner yields better information about the site, as well as what BMPs they will likely maintain.

The watershed grant program has been a critical program to foster NPS pollution control in lake watersheds. One program-related problem is time. The typical two-year time frame, which fortunately can sometimes be extended to a third year, is too short. Despite the extensive pre-grant work done to identify NPS sites and potential solutions, and bring them to the attention of property owners, no firm plans can be made until the grant funding is secure. Road associations and individual landowners are reluctant to gather or definitely reserve the required matching funds before grant funds are available. Those matching funds have to be realistically available before entering into a cost sharing agreement (CSA). Until firm plans with contractors and private financing have been completed, no implementation can take place. Once the CSA is signed, contractor availability becomes a limiting factor. Property owners who choose to perform the labor themselves also can run into situations that require postponement for perhaps just one more year. That was the case with three different matching entities in this Phase II project. The cumulative time needed to physically implement the BMPs fits within a two-year project if all the sub-projects could be lined up sequentially, but the nature of the process as described above, applied to numerous distinct projects, begs for a longer timeframe. Much has to fall into place at the last minute. It's actually rather amazing how much does get accomplished!

V. Summary of Total Expenditures

NPS Grant	Non-Federal Match	Total
$ 95,117	**$ 95,319**	**$190,436**

Cover photos, CWD:
top row: Cochrane Drive, before & after
middle: Cochnewagon Lake loon
bottom: Robinson Drive, before & after

Annabessacook Lake (Winthrop & Monmouth) Watershed Based Plan (2020 – 2029)

NPS Grant Project #2017PT14

Prepared for the
Maine Department of Environmental Protection
by Cobbossee Watershed District

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Cobbossee Watershed District (CWD) was the grantee and provided the bulk of non-federal matching funds required for the project. This Watershed-based Plan was prepared by CWD's Project Manager Bill Monagle. Assisting on the project were CWD staff Ryan Burton and Wendy Dennis.

A Steering Committee was comprised of Bill Monagle (CWD), Wendy Garland (MDEP), Tamara Whitmore (Friends of the Cobbossee Watershed), Mike Levey (Annabessacook Lake Improvement Association), Dave Shaw (Monmouth Codes Officer) and Mark Arsenault (Winthrop Codes Officer).

CWD's water quality monitoring program was partially supported by the watershed-based plan grant, and the data produced were essential for developing the Plan. Water quality monitoring staff in 2018 included CWD Water Resources Technician Ryan Burton and Summer Intern Stephanie Dwinal. Additional water clarity monitoring was contributed by certified volunteer monitor Mike Becker.

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Annabessacook Lake (Winthrop & Monmouth) Watershed Based Plan (2020 – 2029)

This updated 2019 plan succeeds the initial 2007 Annabessacook Lake Watershed-Based Plan and compliments - with updated information - the Annabessacook Lake Phosphorus Control Plan and Total Maximum Daily Load (TMDL) completed by the Maine Department of Environmental Protection (MDEP), Cobbossee Watershed District (CWD), and the Maine Association of Conservation Districts (MACD) in May of 2004.

Document Purpose

The purpose of the Watershed Based Plan, herein referred to as the "plan", is to lay out a strategy and schedule, beginning in 2020, for NPS mitigation in the watershed to stabilize and improve Annabessacook Lake. A current approved Watershed-Based Plan is required to apply §319 funds to help restore and impaired (TMDL) waterbody. The EPA believes preparation of the plan is necessary to ensure that §319 funded projects make progress towards restoring NPS impaired waters. A Watershed-Based Plan must be designed to achieve the pollutant load reductions called for in a TMDL and address EPA's 9 mandatory elements for watershed planning.

Scope of Plan

The plan is designed to outline and describe actions that are expected to be implemented over the course of a ten-year period (2020 to 2029) in the Towns of Monmouth and Winthrop in the direct watershed of Annabessacook Lake. In the Annabessacook Lake (Monmouth & Winthrop) PCAP-TMDL (MDEP 2004), it was reported a need for an estimated reduction in annual loading from the then current level of 332 kg/yr plus and additional 83 kg/yr to address future development. The total, or 415 kg, approximated 15% of the annual phosphorus load to Annabessacook Lake from all sources (the direct and indirect watersheds and internal loading). Based on recent (2017-2018) data, Annabessacook Lake exhibited annual average epilimnetic total phosphorus concentrations in both years of 15 ppb, which represents the target established in the TMDL. This plan is intended to incorporate measures in the watershed to realize a degree of protection equal to a minimum of 2% reduction (28 kg) in the annual phosphorus loading from the direct watershed, which in the TMDL was estimated to contribute 1,315 kg/yr to the lake. It is anticipated that there will be further decline in the internal load of 50 kg/yr as well as a reduction in the contribution from Cochnewagon Lake, immediately upstream, of approximately 30 kgP/yr, which is the result of a recent 2019 nutrient inactivation (i.e., alum) treatment (NPS #20180001).

Lake Water Quality Objective

In general, the main objective of this plan is to restore Annabessacook Lake. More specifically, this means the goal is to achieve a stable or decreasing trophic state and eliminate the occasional late summer or early fall nuisance algae blooms. Based on a review of in-lake phosphorus levels and the timing of reduced Secchi disk transparencies and elevated chlorophyll-a concentrations, the avoidance of algal blooms of any severity will require the internal load to decline. It is anticipated that this could be accomplished by an estimated 2% reduction (28 kgP/yr) in the external phosphorus loading from the direct watershed and a continued "natural" decline in the internal load of approximately 50 kgP/yr and the above noted 30 kgP/yr reduction from Cochnewagon Lake. In doing so, the lake would satisfy the objective of this plan and could be removed from the §303(d) Impaired Waterbody list.

> ***Watershed*** *– All of the land directly surrounding a lake and which serves as a source of water through tributaries, ditches, direct overland flow, or via groundwater.*

Description of Watershed & Lake Water Quality

Annabessacook Lake is a 1,391 acre (563 ha) lake located in the Towns of Monmouth and Winthrop in Kennebec County, Maine. The lake has a direct watershed area of 13,543 acres, and is located primarily in the Towns of Monmouth and Winthrop, with a small portion located in the Town of Wales (Androscoggin County). A map of the watershed is depicted on Figure 1. There are also four lakes (Maranacook Lake, Lower Narrows Pond, Wilson Pond, and Cochnewagon Lake) immediately upstream of Annabessacook Lake that collectively contribute to its hydrologic and nutrient budgets. The lake has a maximum depth of 47 feet and a mean depth of 17 feet, and has a flushing rate of 3.7 flushes per year. The lake is drained by its outlet, Jug Stream, which flows southeasterly into Cobbossee Lake.

The Cobbossee Watershed District (CWD) has classified the lake as having poor/restorable water quality based on over forty years of data collected by CWD staff. This classification, and concern, for the lake is due in large part to increases in total phosphorus concentration, reduced water clarity, and severe depletion of dissolved oxygen in bottom waters. The MDEP has placed Annabessacook Lake on its Nonpoint Source Priority Watersheds list and the list of Lakes Most at Risk from New

> ***Phosphorus*** *– An essential plant nutrient that is considered most responsible for the proliferation of algae and aquatic plant growth in lakes.*

Development under the state's Stormwater Law. Additionally, the lake is listed on Maine's §303d (TMDL) list, designating it as a lake that does not meet State water quality standards. As mentioned above, an EPA-approved Phosphorus Control Plan (and TMDL) was prepared by the MDEP, the CWD, and the MACD in 2004.

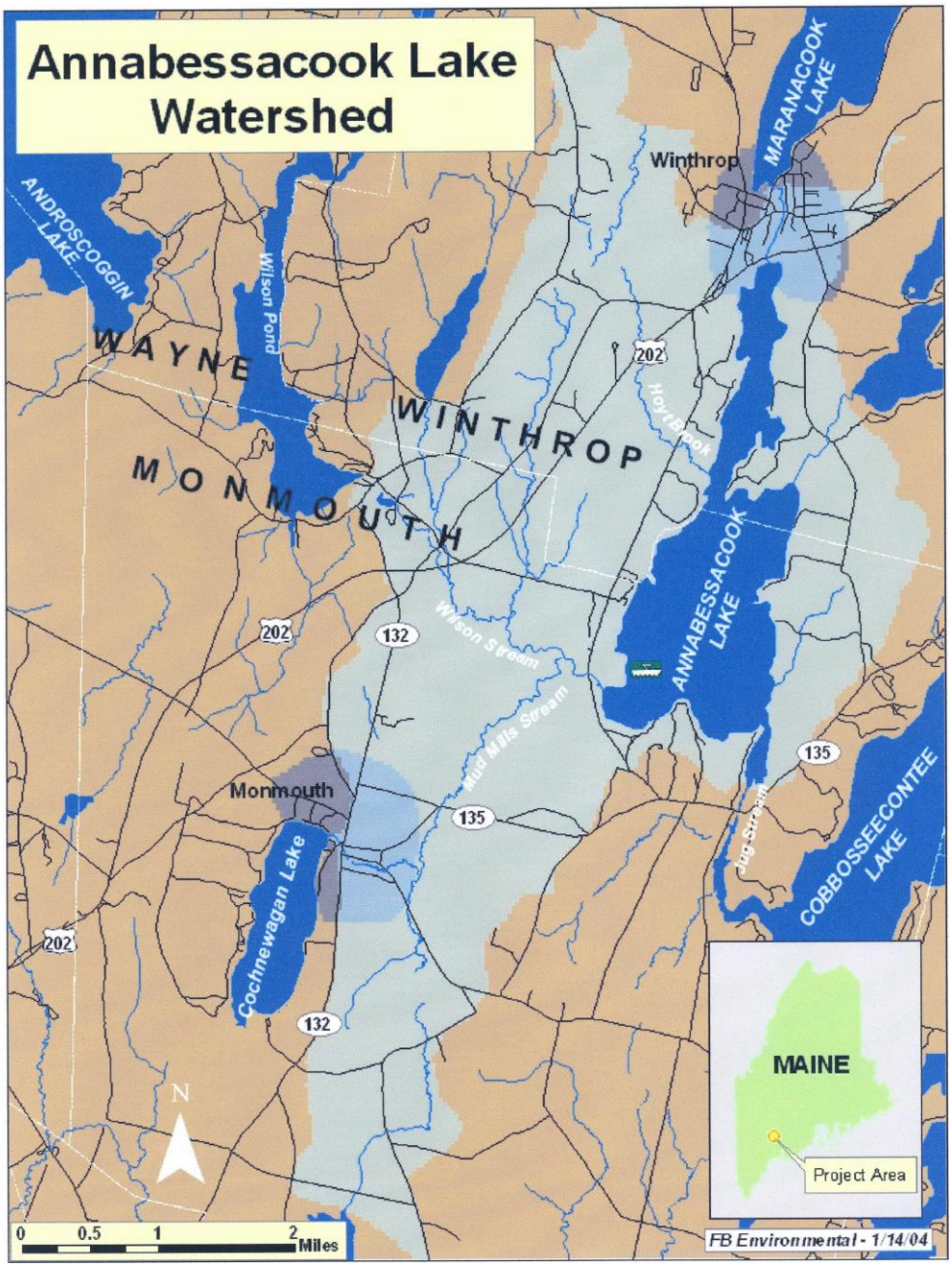
The lake's immediate shoreline is modestly developed, with approximately 200 shorefront residences, of which just over half are year-round residences. The shorefront properties are serviced by a network of private camp roads, and there is a large campground with approximately 100 sites along the eastern shore in Winthrop. The urban center of Winthrop is located at the north end of the lake. The centers of Monmouth and North Monmouth are more distant from the lakeshore, but are located near or on major tributaries to the lake.

Anglers value Annabessacook Lake as a wonderful lake to fish for largemouth bass. The Maine Department of Inland Fisheries and Wildlife manage the lake as a warm water (largemouth bass) fishery. There are several bass tournaments held every year on the lake. There is only one public boat access facility on the lake. The lake is also enjoyed for swimming, boating, and general aesthetic beauty. Unfortunately, in 2013 the invasive aquatic plant, Variable-leaf Water-milfoil (*Myriophyllum heterophyllum*), was discovered in the lake prompting swift action on the part of the CWD, ALIA, FOCW, DEP, and others to assess the infestation and implement strategies to control or eradicate the invader.

The lake has a long history of supporting nuisance algae blooms, and the watershed community has through the years demonstrated a strong commitment to improving the lake. The CWD was formed in the early 1970's to direct activities to improve Annabessacook Lake and other lakes of the Cobbossee Stream drainage. The CWD began monitoring the lake's water quality in 1975, and immediately began working closely with the Annabessacook Lake Improvement Association (ALIA), the Maine DEP and the local citizens to correct problems in the lake and in the watershed. Nonpoint source pollution (NPS) is, and has been, the main reason for water quality decline in Annabessacook Lake. A land use inventory associated with the 2004 PCP-TMDL suggested that NPS represented a major problem in the watershed. This was reaffirmed by a recent watershed survey (2019) complimented by a review of general land use cover in the watershed as well as that of medium and large scale developments approved by the municipal planning boards and that have been successfully completed. Additionally, the lake suffers from the internal recycling of phosphorus from bottom sediments during periods of stratification and

hypolimnetic anoxia, although since the early 1980's this has been on a near-steady decline.

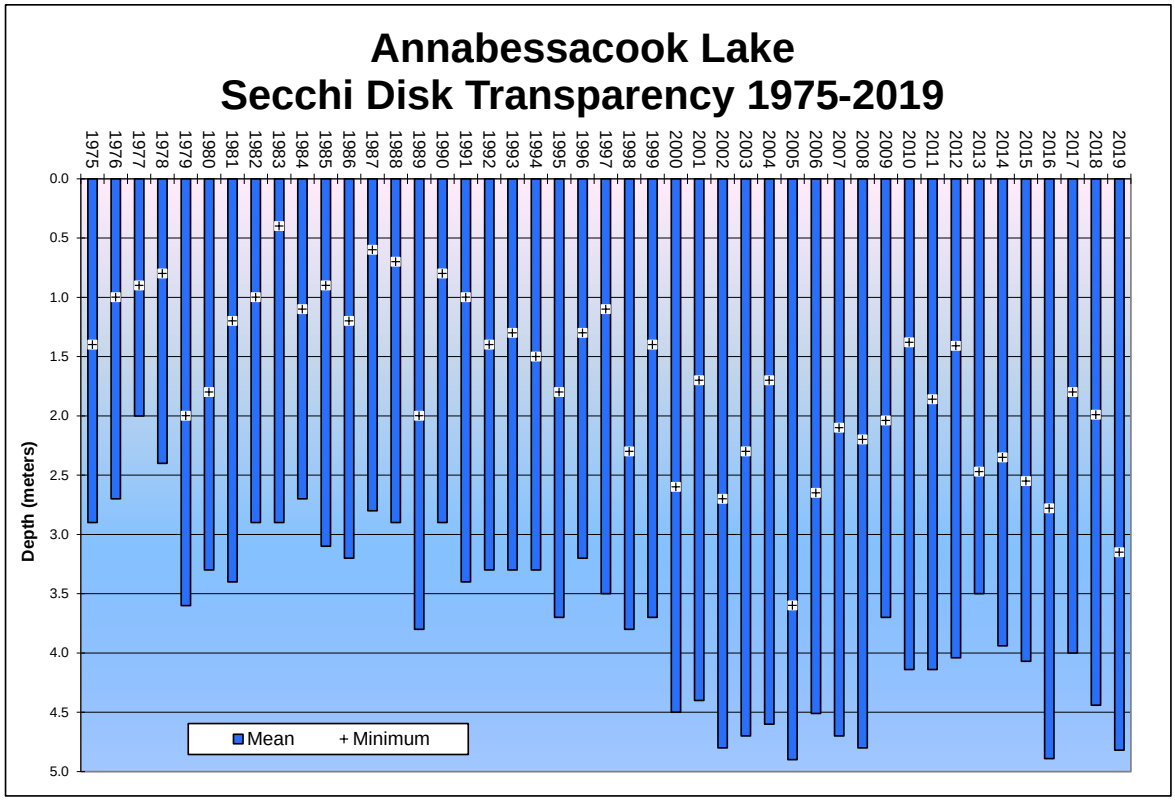
Figure 1. Map of Annabessacook Lake Direct Watershed



From: Annabessacook Lake (Monmouth & Winthrop) PCAP-TMDL (MDEP 2004)

The CWD has monitored Annabessacook Lake water quality for over 40 years. Since the late 1990's Annabessacook Lake has been exhibiting improved water clarity, expressed as Secchi disk transparency (SDT), throughout the summer period (Fig. 2). Over the 22-year period, 1998 – 2019, the SDT was observed to be less than the 2.0 meter "nuisance algae bloom" level in only eight of those years. However, although the lake has exhibited signs of improvement and general stability, it continues to exhibit stress (e.g., depleted oxygen and reduced clarity during late summer and early fall) and has not reached the point at which it should be removed from the §303d list.

Figure 2.



The lake's water clarity and dissolved oxygen problems are attributed primarily to NPS pollution that washes into the lake from the surrounding watershed. With agriculture on the wane throughout the watershed, and a deceleration in the internal recycling of phosphorus from Annabessacook Lake sediments, soil erosion and stormwater runoff from the urbanized portions of Winthrop and Monmouth remain the two predominant sources of NPS pollution to Annabessacook Lake. The 2004 TMDL estimated that non-shoreline development was responsible for 45 percent of the annual phosphorus load to the lake, with residential and commercial contributing the majority of this fraction, or 40 percent of the total annual load. The

network of camp roads around the perimeter of the lake, as well as numerous shorefront properties, had been identified as sources of eroding soil, and many of the shorefront properties were determined to have inadequate shorefront vegetation to buffer runoff from developed areas.

Prior Work

Annabessacook Lake has been the subject of lake restoration spanning more than a half-century. The lake began experiencing algae blooms as early as 1939, largely due to municipal and industrial discharges. In the mid-1960's residents responded to "pea soup" conditions and mats of rotting vegetation by treating the lake with copper sulfate, but to less than desired success. In 1967, it was determined that over 13,600 kilograms (30,000 pounds) of phosphorus per year were entering Annabessacook lake, 93 percent of which were from municipal and industrial discharges from the village areas of Winthrop, North Monmouth, and Monmouth Center (USEPA 1980).

- By 1972, a newly constructed trunkline sewer conveyed these discharges to the Augusta Sanitary District in Augusta, and by 1976, all point source discharges to the lake had been eliminated.

- Following the sewage diversion, there was some improvement, but the high phosphorus concentrations continued along with nuisance algae blooms. Frustrated after decades of failure to improve the water quality of Annabessacook Lake, as well as several other lakes in the Cobbossee chain of lakes, the Cobbossee Watershed District was formed in 1972 to oversee and coordinate efforts to improve and protect the lakes of the CWD.

- A 1975 Federal water quality management planning grant from the US Environmental Protection Agency (EPA) under §208 of the Clean Water Act (CWA) enabled the CWD to work with the Southern Kennebec Valley Regional Planning Commission to perform detailed diagnostic studies throughout the CWD and develop strategies for lake restoration. Annual phosphorus budgets for Annabessacook Lake resulting from these studies suggested that more than half of the phosphorus load to the lake was from agricultural runoff and from internal phosphorus recycled from highly enriched lake sediments.

- In 1977, the CWD received a CWA §314 (i.e., Clean Lakes Program) grant from EPA to address the above noted sources. Major grant-related projects throughout the CWD including cost-sharing opportunities for local farmers to

construct manure storage facilities, as well as a 1978 nutrient inactivation (i.e., alum) treatment of Annabessacook Lake sediments to arrest the internal release of phosphorus to overlying, surface waters. However, the lake continued to support a late summer or early fall nuisance algae bloom every year until the late 1990's, with the exception of 1989 (minimum SDT of 2.0 meters).

- In 1990, the CWD received a CWA §205j water quality planning grant from EPA to update the 1977 §208 water quality management plan for Annabessacook Lake. This study concluded that there needed to be further reduction in nonpoint source pollution, particularly from residential and commercial development, roadways, and hayland, and that the Mill Stream urban watershed should be targeted for phosphorus export reduction.

- In 2003, the CWD pursued and received funds from the Maine DEP collected as compensation fees from land use developers unable to satisfy Stormwater Law standards for phosphorus runoff to the purchase a high-tech regenerative-air street sweeper that the Towns of Winthrop and Monmouth would jointly operate to clean in-town streets and those roads near stream crossings to reduce sediment and phosphorus pollution from these surfaces. This program is still active and is an effective program conservatively estimated to reduce phosphorus loading to the lake from urban areas by between 100 and 150 kg/yr.

- In 2004, the Annabessacook Lake PCAP-TMDL Report, prepared by the Maine DEP with assistance from the CWD and Maine Association of Conservation Districts, was completed and approved by U.S. EPA.

- Between 2007 and 2013, the CWD received two CWA §319 grants from EPA to conduct Annabessacook Lake Rehabilitation Projects, Phases I (NPS #2007RR07) & II (NPS #2011RT15). These projects, which provided substantial gains in addressing numerous NPS sources in the watershed, were conducted in partnership with the Friends of the Cobbossee Watershed. In total, BMPs were installed on 34 NPS sites, primarily gravel camp roads, and the FOCW's Youth Conservation Corps stabilized nearly three-quarters of a mile of eroding shoreline on 32 shorefront properties. The Phase II project included an extensive

watershed education and public outreach effort, based largely on intercept survey results, to educate homeowners on measures they can take to reduce NPS, including an emphasis on using only phosphorus-free lawn fertilizer which was a state-wide initiative of the Maine DEP during that period.

Throughout these past four-plus decades, the CWD has continued working with local citizens and town officials, including planning boards, code enforcement officers, and road crews, as well as the Annabessacook Lake Improvement Association, the Maine DEP, and other state and federal agencies to improve lake water quality further. And as noted above, the CWD has been teaming with the Friends of the Cobbossee Watershed to expand education and outreach and general watershed protection throughout the CWD. As a result of these efforts, Annabesssacook Lake has met the in-lake total phosphorus goal of 15 ppb and is on the doorstep of being removed from the state's §303d List of Impaired Waterbodies. There is more work to be accomplished in the watershed, however, to support the progress regarding the phosphorus loading that has been exhibited and to continue improving conditions to completely eliminate the occasional algae bloom.

It has been over 40 years since the CWD and DEP conducted a nutrient inactivation project (i.e., alum treatment) on Annabessacook Lake, but the year 2016 confirmed the influence that internal loading continues to have on the water clarity of the lake. In 2016, there was very little summer precipitation and stormwater runoff, which was effectively akin to turning the watershed off and enabling the observation of individual lake behavior as nearly closed systems. By the end of the summer period, Annabessacook Lake did support an algae bloom that was fueled by internal loading of phosphorus from bottom sediments, and although the "bloom" did not meet the DEP's definition of a severe algae bloom (i.e., SDT < 2 m.), the water clarity dropped from 7.1 meters in early August to 2.1 meters by early September. It's worth noting that during this same period, numerous other local lakes that are influenced largely by watershed-driven NPS experienced excellent water clarity. As it is likely that the cost:benefit ratio for a second nutrient inactivation (i.e., alum) treatment in Annabessacook Lake would be considered too high, then the continued reduction in the internal loading of phosphorus to the lake during late summer and early fall, as has been documented, will likely be relied upon for the occasional algae bloom to be eliminated.

Nine Mandatory Elements (A – I) of the Watershed Based Plan Required by EPA

A. Causes and Sources of Water Quality Impairment

The occurrence of nuisance algae blooms and oxygen depletion in Annabessacook Lake have been attributed primarily to historic point source discharges of municipal and industrial sewage, which still haunt the lake in the form of internal recycling of nutrient rich sediments, and nonpoint source pollution that washes in from the surrounding direct watershed. Two of four immediately upstream lakes, Cochnewagon Lake and Wilson Pond, have been experiencing a range in water quality in recent decades. Cochnewagon Lake which had received an initial alum treatment in 1986 to control internal recycling of phosphorus from lake sediments, required a second alum treatment in 2019 as the lake's water clarity had declined as the effectiveness of the 1986 treatment became exhausted as expected. As a result of this recent treatment, it is anticipated that the total phosphorus contribution to Annabessacook Lake from Cochnewagon as a result of this late alum treatment will be reduced by 30 kg/yr. Wilson Pond began exhibiting a decline in water clarity in the late 1980's and was placed on the Maine DEP's list of impaired lakes (i.e., §303(d)) in 2006 and has since been on a steady, gradual decline. As a result, inputs from these lakes may have contributed negatively to some extent to Annabessacook Lake water quality or have slowed its improvement, at least up until the present. It should be noted that the 2009 Wilson Pond Watershed-Based Plan has expired and is due for renewal.

Point source discharges to Annabessacook Lake were eliminated in the early 1970's, but the lake has continued to support late summer or early fall nuisance algae blooms, although these have occurred less frequently of late. Oxygen depletion in bottom waters remains a constant annual occurrence, however. Phosphorus is considered the pollutant of primary concern. The 2004 Annabessacook Lake PCAP-TMDL report emphasized the need to correct erosion problems, encourage better land use practices in the shoreland zone as well as in the more urbanized centers of Winthrop and Monmouth, and improve road drainage design and maintenance practices on both private and public roadways. All of these recommendations remain valid, and have been implemented to varying extent since that time (see Prior Work above).

In the development of the PCAP-TMDL Report for Annabessacook Lake, land use in the watershed was determined using several methods including (1) Geographical Information System map analysis, (2) analysis of topographic maps, (3) analysis of

town property tax maps and building permit records, (4) update of a 1990 Annabessacook Lake Watershed Land Use/Land Cover analysis of aerial photographs (with ground-truthing), (5) a 1990 National Wetlands Inventory for Monmouth, and (6) field visits. The CWD also conducted an in-depth survey of shorefront properties and shoreline conditions. In preparing this updated plan, current land use was reviewed using land use information available through the website, www.modelmywatershed.org, as recommended by Maine DEP, as well ground-truthing, reviewing local municipal land use development records, and a comparison of historical Google-Earth imagery. Based on the updated analyses, very little has changed with respect to land use in the watershed. Over the past ten-year period, for instance, only three major commercial or institutional developments involving 11 acres have occurred and roughly 34 acres of former grassland or pasture have converted to regrowth. It should be noted that since the economic recession of 2008, there has been very little economic and/or land use development activity in the majority of the municipalities of the CWD.

Of the nearly 200 shorefront dwellings around the lake as documented in the PCAP-TMDL, approximately 80% were at that time deemed to have moderate to high NPS pollution impact due to a combination of inadequate buffers, close proximity to the shoreline, and the presence of bare and/or eroding soils. Approximately 20% of these properties have been serviced by the Friends of the Cobbossee Watershed's Youth Conservation Corps during the two Annabessacook Lake Rehabilitation Projects (i.e., CWA §319) over the past decade, largely via shoreline stabilization or buffer strip installation. The recent 2019 watershed survey indicated that shorefront development continues to represent a source of NPS, however most of the identified sites were ranked as low to medium severity.

The May 2004 PCAP/TMDL reported that an annual phosphorus load reduction of 415 kg/yr (or 15%) would be required for Annabessacook Lake to attain bloom-free conditions. To achieve this, it was determined that the average annual epilimnetic total phosphorus concentration would need to decline from 17 ppb to 15 ppb, a 2 ppb decrease. Of the 2,817 kg/yr that were estimated to enter the lake, only 1,315 kg/yr (47%) were estimated to originate as NPS pollution from the direct watershed. The bulk of the remainder was associated with upstream lakes (26%) and internal recycling from Annabessacook Lake sediments (16.5%). As that plan was intended to provide a schedule of actions over the ten-year timeframe 2007-2016, an interim target of 183 kgP/yr was established and considered adequate to provide a decrease of 1.0 ppb in total phosphorus concentration in the lake. As noted previously in the Scope of Plan section, the annual average epilimnetic goal of 15 ppb has apparently

been achieved based on recent CWD data. This is largely the result of activities supported through the two Annabessacook Lake Rehabilitation Projects, Phases I & II (CWA §319) and an aggressive municipal street sweeping program and other collateral and undocumented improvements in watershed housekeeping.

It is also worth noting that the internal recycling component of the annual phosphorus load to Annabessacook Lake had been gradually declining since the 1978 nutrient inactivation (i.e., alum) treatment. It is hypothesized that sediment stores of phosphorus that accumulated over many years prior to sewage diversion and the alum treatment, are gradually becoming exhausted as they are seasonally released and gradually purged, or flushed, from the lake. Prior to preparing the initial 2007 plan, regression analysis performed on the internal loading in Annabessacook Lake for the 17-year period 1983 to 2001 suggested a rate of decline of approximately 17 kg/yr. In 2001, the load was calculated as 465 kg/yr, which at that time, represented the lowest recorded annual loading. At this rate, the internal recycling component was predicted to be 224 kg/yr, or a reduction of 241 kg/yr by the year 2016. If this reduction in internal loading had been realized, then it was postulated that the combined watershed loading reduction (i.e., interim goal of 183 kg/yr) and internal load reduction (241 kg/yr) would produce a net reduction of 424 kg/yr, or enough to achieve the goal set in the PCAP-TMDL. However, a review of more recent data indicates that that steady rate of decline was not maintained, although the internal load has significantly declined, with loading rates ranging from 330 kg/yr to 400 kg/yr in 2017 and 2018, respectively.

The goal of further reducing the annual phosphorus load to Annabessacook Lake by 28 kg/yr from the direct watershed will require that several sources, identified and prioritized in the PCAP-TMDL Report and the initial Plan be addressed, including:

- Shoreline Development – Approximately 20% of all residential properties and 50% of the camp and private roads will be addressed.
- Non-Shoreline Development* – Approximately10% of all town roads, 15% of all low density residential, 75% of all high density residential, and 15% of commercial land uses will be addressed.

***NOTE:** Because much of the activities described for Non-Shoreline Development will likely not be the result of an active pursuit during any future watershed projects, but rather the result of public education and outreach efforts, no attempt is being made to forecast load reductions as presented in Table 1 above for activities associated with Shoreline Development. Regarding the street sweeping program, however, we recognize

it to mitigate between 100 and 150 kgP/yr and have included the cost to continue the program in Element D below.

B. Estimate of Load Reduction to Expected from Management Measures

Nonpoint source reduction from watershed BMP implementation

The external loading reduction goal is 28 kg/yr of phosphorus, or 2% of the estimated direct watershed load, to provide a reasonable margin of safety to maintain, and hopefully reduce, the average epilimnetic total phosphorus concentration of 15 ppb. This has been discussed under "Element a" above. This goal is reasonable given that loading from nonpoint sources have already been reduced by a considerable amount.

Many of the nonpoint source problems in the watershed are associated with roads. This Plan prioritizes road site BMP (best management practice) implementation to provide most of the phosphorus reduction needed to meet the 28 kg TP/yr reduction goal. Pollutant reduction calculations for road BMPs implemented at 34 sites in the Annabessacook Lake Rehabilitation Projects, Phases I & II, as well as those from other lake watershed projects the CWD has conducted, were reviewed for future road BMPs in this Plan. It is conceivable that up to 26 kg TP/yr might be reduced, but it is unlikely that all of this phosphorus will be in a form readily available for algal uptake, so the net result on algal growth may be equivalent to a lesser mass of phosphorus (Table 1).

Another 2 kg P/yr targeted reduction from external loading will be accomplished through the erosion and nonpoint source prevention program for property owners, which will be directed primarily, although not exclusively, at developed areas along the shorefront. The estimated reduction was calculated in two ways. EPA's Region 5 "Michigan Method" (http://it.tetratech- ffx.com/step1/), adjusted for lower soil phosphorus content based on CWD monitoring results, was used to estimate phosphorus reduction from shoreline erosion control, and phosphorus reduction from planting vegetative buffers was based on DEP's manual "Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development" (MEDEP, 2016[a] & 2016[b]).

Internal phosphorus recycling reduction from natural decline

Although not a "planned" management action, the anticipation is a substantially reduced internal loading over the next ten-year period, although to a lesser degree that this source has declined over the past two decades. The CWD believes that it is reasonable to expect a reduction in the annual internal load of 50 kg/yr by 2029. If

achieved, this would produce an annual internal load of approximately 315 kg/yr., or a 33 percent reduction from that reported in the 2004 TMDL.

Table 1: External and Internal Phosphorus Load Reduction Goals for Annabessacook Lake

I. External P Sources	BMP goals	P source reduction goals, kg P/yr	P source reduction goals, % total load
Roads public & private mostly gravel roads	BMPs at 30 sites	26 kg	1.9%
Shorefront Properties eroding shorelines residential lot NPS	BMPs at 40 sites	2 kg	0.1%
Total anticipated		28kg	2.0%
External Load Goal		28 kg	2%
II. Internal P Sources			
Anaerobic sediments	N/A	>=50 kg [1]	Approx. 33% [1]

[1] The expectation is for the internal loading to continue to decline by 50 kg/yr by 2029. This would produce a total reduction of approximately 33% from the estimated loading (465 kg/yr) reported in the TMDL..

To estimate the anticipated annual load reduction, the extent of BMP usage and BMP efficiency rates were applied to each category targeted for watershed management efforts during the period 2020 to 2029.

C. Description of Management Measures

The 2004 Annabessacook Lake PCAP-TMDL Report emphasized the need to correct erosion problems, encourage better land use practices in the shoreland zone as well as in the more urbanized centers of Winthrop and Monmouth, and improve road drainage design and maintenance practices on both private and public roadways. There has been much accomplished since then in these regards, primarily as products of the two CWA §319-funded projects, but there remains more work to be done. The anticipated implementation scheme is as follows:

Shoreline Development

Residential

It is estimated that nearly one-fifth (20%) of shorefront properties will be addressed. This is roughly consistent with the degree of activity over the past

decade which saw 44 shorefront property owners receiving technical assistance and construction service through the FOCW's Youth Conservation Corps, The majority of these were the result of public outreach by the CWD and the FOCW, and it is this approach that will be followed. Both organizations have effective communication with members of ALIA, which has a high present membership amongst shorefront owners. Based on CWD's general familiarity and the recent watershed survey results, the most common BMPs will likely be vegetated buffers, shoreline stabilization, stormwater diversion measures, rain gardens, and general better grounds-keeping practices (e.g., no lawn fertilization, etc).

Camp/Private Roads

Approximately 50% of the camp roads associated with shoreline development will need to be addressed. The CWD and the Annabessacook Lake Improvement Association have long recognized the impact that private camp roads in the shoreline area have on Annabessacook Lake. There are about 18 camp roads surrounding the lake, several that are well designed and maintained. Most, however, would benefit greatly by improved drainage systems or surface modifications, and regular maintenance. Those roads which pose the greatest threat and/or the highest degree of successful implementation will be selected first. Publicly held demonstrations and promotion through the ALIA newsletter and other local publications will further serve to encourage participation by all private road associations or groups.

Non-Shoreline Development

State and Town Roads

The CWD has a long history of working with the public works departments from the Towns of Winthrop and Monmouth, as well as with the Maine Department of Transportation throughout the CWD on road related projects to protect water quality. Problems continue to exist on town roads, particularly in the more rural areas. Although some of town road related problems may require reconstruction or modifications that will require significant financial expenditures, most of these likely pertain to routine maintenance practices. The most common BMPs will be improved drainage through combinations of culverts, turnouts, proper ditching design and stabilization, and general surface improvements. The majority of in-town (urban) roads are relatively well maintained with engineered storm sewers. In 2003, the Towns of Winthrop and Monmouth began a robust street sweeping program, focusing on the majority of in-town roads and the more rural roads that are in proximity to tributaries and small drainages to Annabessacook Lake. The

street sweeper, a high-tech regenerative air sweeper, was financed through a Stormwater Law Program grant from the Maine DEP. This BMP, which began after the 2001 TMDL project lake monitoring effort, is to continue indefinitely.

Residential/Commercial

Of the residential component of the non-shoreline development, approximately 15% of low density residential and 75% of high density residential land uses will be addressed. Approximately 15% of the commercial land use will be addressed. The urban fractions of these land use components will be addressed both directly and indirectly *(e.g., municipal BMPs such as routine street sweeping).* The 2004 RCAP-TMDL estimated that these land uses collectively represented about 39% of the phosphorus load from the direct watershed, and the majority of the residential and commercial property resides within the more densely developed urban centers of Monmouth and Winthrop.

Within the urban areas, most properties lack the acreage to install wet ponds, buffers, etc. Therefore, it is anticipated that a public education and outreach program aimed at promoting responsible lawn care and erosion control practices, and pet waste management, among others, will be most appropriate here. It is worth noting that in the 2004 PCAP-TMDL, the in-town roads were included in this category as supporting infrastructure. And it should be recognized that a portion of the phosphorus generated from the individual properties within the town centers contributes to the in-town roads as "wash-off". Therefore, phosphorus mitigation that is accomplished by the street sweeping programs within this category addresses a portion of this phosphorus load.

In the more rural areas, there are likely to be more opportunities to install structural or vegetative BMPs. Depending on individual site-specific features, BMPs might include vegetated buffers, drainage swales (both grassed swales and dry swales, level spreaders), rain gardens, and in some cases, stormwater ponds or engineered systems (e.g., StormTreat Systems). The education and outreach program noted above will also extend to these areas.

Agricultural

Hayland accounted for more than 22% of the annual phosphorus load to Annabessacook Lake as reported in the PCAP-TMDL. The vast majority of this was ascribed to non-manured hayland. With regard to manured hayland, based on the PCAP-TMDL, this category accounted for a mere 1.4% of the total

watershed load. The CWD is not aware at this time that much has changed regarding this assessment and plans no management actions to address this category. However, because of the magnitude of this general category, continued scrutiny of all hayfields should be continued to remain apprised of any newly adopted fertilization practices on hayfields.

D. Technical and Financial Assistance needed to Implement this Plan

The cost of successfully implementing this updated 10-year watershed plan is approximately $1.3 million. This general, 'best guess' estimate is based on the following assumptions: municipal street sweeping ($500,00 or 50,000/yr); 12 camp road repairs/upgrades ($120,000); residential shoreline development-based projects such as buffers, rip-rap, etc. ($72,500); watershed education ($200,000); lake water quality and BMP monitoring and assessment ($150,000); and miscellaneous public and private projects such as town and state road projects and in-town residential and commercial based projects ($250,000). The major sources of funding the program will be federally funded Section 319 projects, local cash and in-kind match.

Cobbossee Watershed District will continue serving as the 319 grantee and will be responsible for the successful and complete implementation of all project activities. In non-319 related activities, the CWD will continue monitoring Annabessacook Lake water quality, managing lake water levels to control erosion and flooding, and providing technical assistance to watershed citizens and the Towns of Monmouth and Winthrop. As the designated Stormwater Administrator for projects subject to DEP Stormwater Permitting, the CWD will seek to apply any pertinent phosphorus compensation fees to address eligible and certified NPS problems to offset impacts from new developments.

Maine Department of Environmental Protection will administer project funding and continue to provide technical support in lake water quality related matters.

US Environmental Protection Agency will provide project funding and guidance.

Annabessacook Lake Improvement Association will have representatives serving on the steering committee, and will continue to provide support to the CWD and other local lake groups to advance lake improvement and protective measure.

Friends of the Cobbossee Watershed will promote public education and information through a variety of programs aimed at all levels throughout the watershed, and will provide technical assistance to shorefront property owners seeking to implement BMPs.

The Towns of Winthrop and Monmouth will provide in-kind support through the continued aggressive program of street sweeping that began in 2003, and also providing labor and/or materials to address road-related NPS problems. The towns will also continue their strong enforcement of local and state ordinances that address lake water quality issues

E. Information & Education Outreach

An education and information program is central to any effort to reduce NPS in the Annabessacook Lake watershed. The program will address all levels of the community, including shoreline and non-shoreline related development as well as public school programs. The high concentration of non-shoreline residential and commercial land uses and the density of in-town streets in the urban centers of Winthrop, Monmouth, and North Monmouth, in particular, lends to the success of an I&EO campaign to address this significant NPS source.

Public education in the watershed will be largely conducted by the Friends of the Cobbossee Watershed, the CWD, and the ALIA. Membership in the ALIA is one of the oldest lake associations in the state, and is well over 50% around the shoreline. The ALIA serves as a great vehicle for dissemination of outreach materials. The CWD has for decades provided public education through local publications, contributions to ALIA meetings and newsletters, and through project related demonstrations. The Friends of the Cobbossee Watershed (FOCW) lend support to a common mission to protect area lakes. They (FOCW) have top-notch watershed education programs including a LakeSmart Start! Program to provide community-wide technical assistance and education, the Tadpole Patrol program, targeted to elementary school children as well as adults, and a year-round watershed education program tailored to students, grades 4 through 7. Additionally, the FOCW provides on-lake education via their education vessel, the pontoon boat, The Otter II. These three principal groups will coordinate their respective programs to maintain a long-term E&O campaign that reaches all levels of the community to educate them about lake and watershed protection in general, and about project specific information, with the

goal watershed-wide appreciation of lake issues and adoption of lake protective practices.

F. Implementation Schedule

2020: The CWD will re-survey the watershed for NPS sites in the spring when NPS sites are most visible, particularly those related to shorefront properties and camp/gravel roads surrounding the lake. All information will be entered in to the Annabessacook Lake NPS Site-tracker Spreadsheet.

2020 – 2029: The Towns of Winthrop and Monmouth will maintain a robust street sweeping program within the respective urban centers and on high priority roads near stream crossings.

2021-2023: Implement NPS Project - Annabessacook Lake Rehabilitation Project, Phase III (Monmouth & Winthrop).

2024: The CWD will review lake water quality monitoring data to date, coupled with an assessment of the results of the Phase III project. Based on this assessment and consultation with MDEP, if a Phase IV project were to be warranted, a grant proposal would be prepared and submitted to MDEP, and if funded, would likely commence in 2025.

2025 – 2027: Implement NPS Project – Annabessacook Lake Rehabilitation Project – Phase IV (Monmouth & Winthrop).

2020-2029: The CWD will continue their longstanding water quality monitoring program and with MDEP will assess water quality data and gage the success of watershed implementation work and if the stated goals are being met.

2020 – 2029: Cobbossee Watershed District and the Friends of the Cobbossee Watershed will continue programs to provide education and outreach to watershed citizens, municipal officials, and local schools.

Table 2. Action Plan & Milestones	Schedule	Who	Potential Funding Sources	Estimated Cost
Address the External Phosphorus Load in Annabessacook Lake				
Address NPS Problems on Private Camp Roads				
Conduct rainy day road survey and update NPS Site Tracker with additional NPS sites	2020	CWD, ALIA	CWD	$500
Address Priority Sites Identified in the Watershed Survey and NPS Site Tracker through Phase III and Phase IV Projects (Goal – 12 sites)	2020-2027	CWD, Towns, Road Associations	Towns, Road Associations, US EPA (319), Maine DEP	$120,000
Address NPS Problems on Shorefront Residential Properties				
Provide landowners with technical assistance and utilize the FOCW's Youth Conservation Corps to install residential BMPs (Goal – 20 sites)	2020-2029	FOCW, CWD	FOCW, Towns, US EPA (319), ALIA, Landowners	$72,000
Address Non-Shoreline NPS Sites				
Continue the intensive street sweeping program in urban centers of Winthrop and Monmouth (6-10 times/year)	2020-2029	Towns	Towns, Stormwater Compensation Fees	$500,000
Implement BMPs at commercial, town road or residential sites	2020-2029	Towns, Landowners	Towns, US EPA (319)	$250,000
Education, Outreach & Communications				
Prepare and distribute press releases about watershed restoration	Ongoing	CWD, FOCW	CWD, FOCW	$1,000
Promote vegetated buffers, responsible lawn care and erosion control practices, septic maintenance and pet waste management.	2020-2029	CWD, FOCW, ALIA	CWD, FOCW, ALIA, US EPA (319)	$50,000
Educate youth about water quality and watershed stewardship through Tadpole Patrol program and pontoon boat Otter II program	Ongoing	FOCW	FOCW	$20,000
Prevent New Sources of NPS Pollution				
Attend regular planning board meetings and provide input on development proposed for the watershed	Ongoing	CWD	n/a	n/a
Work with town planning boards to strengthen town ordinances and ensure timely enforcement of current rules that protect water quality	Ongoing	CWD	n/a	n/a
Conduct Long-Term Monitoring & Assessment				
Continue collecting intensive baseline water quality data	Ongoing	CWD, ALIA	CWD, ALIA	$150,000
Set up NPS Site Tracker & update annually	Ongoing	CWD	CWD, US EPA (319)	$500/yr

G. Milestones to Measure Progress Implementing Management Actions

It is expected that by 2023 between 4 and 6 of the most severe camp road problems will be resolved (or about 33 percent of the camp roads surrounding the lake) as well as problems associated with 20 shorefront properties. Corrective measures on a couple (~2 to 3) sites along state and/or town roads are also expected to be performed, and will largely involve measure to address the changing climate (i.e., drainage enhancements). An undetermined number of non-shorefront residential and commercial properties will be addressed, either actively, or as a response to publicity of the Phase II project and the ongoing Education and Outreach efforts. All in-town roads and town roads near stream crossing will continue to be swept indefinitely, a minimum of 6 to 10 times per year (based on location). Towns will be encouraged to maintain strict adherence to local ordinance requirements pertaining to stormwater and phosphorus runoff and all schools will continue to include lake and watershed protection in their educational curricula.

By 2027, an additional 4 to 6 camp roads could be addressed, as well as an additional 20 shorefront properties, but this will largely depend on the progress made to date with regard to water quality improvements.

H. Criteria to Determine Progress in Attaining WQ Standards & Load Reductions

<u>Attaining Water Quality Standards</u>

Maine water quality criteria require lakes have a stable or improving trophic state and be free of culturally induced algal blooms. Maine's functional definition of a nuisance algae bloom is an annual minimum Secchi disk transparency (SDT) of less than 2.0 meters (i.e., an algae bloom is declared if the SDT falls below 2.0 meters once during the year). The CWD, on the other hand, has slightly more stringent standards, with the minimum acceptable SDT being 3.0 meters. As with all lakes in the Cobbossee Stream watershed, this is the CWD's ultimate goal for Annabessacook Lake. However, over the course of the ten year plan period, the interim goals are that the occasional observation of a "nuisance" algae bloom will cease sequentially as scheduled in Table 3,

The CWD, with support from Lake Stewards of Maine: *Maine Volunteer Lake Monitoring Program*, will continue monitoring the lake monthly for a host of parameters, including Secchi disk transparency and total phosphorus. The MDEP placed Annabessacook Lake on the 303(d) list primarily due to the occurrence of

nuisance algae blooms (i.e., SDT < 2 m) at some point during the open water season. During fourteen of the past twenty-two years (1998 -2019), the lake has not exhibited such a bloom, but it has suffered such a bloom in five of the past ten years. It is anticipated that if this trend were to slightly improve and the lake is deemed to attain water quality standards, then DEP could elect to remove the lake from the 303(d) list.

Table 3. Water Quality Benchmarks	Interim Targets		
	2020-2022	2023-2026	2027-2029
Stabilize or Decrease In-lake Annual Average Epilimnetic (0 to 6 m) Total Phosphorus concentration	15 ppb (Stable)	<= 15 ppb	<= 14 ppb
Decrease in the Maximum Observed Average Epilimnetic (0 to 6 m) Total Phosphorus concentration on any single event	<= 20 ppb	<= 18 ppb	<= 17 ppb
Reduction of 5 kg per year in the Annual Internal Load	15	20	15
Decreased number years observing annual minimum SDT less than 2 meters?	<= 2	<= 1	0

Note: the symbol, <=, denotes "less than or equal to".

Load Reductions

The BMPs that are proposed over the course of this plan are projected to provide a reduction in annual phosphorus loading to the lake of about 28kg/yr from the direct watershed. For the majority of major BMPs that are expected to be implemented, pollutant load reduction estimates will be made using methods approved and recommended by the EPA (It is anticipated that there will be numerous BMPs implemented as a result of education and outreach and project related demonstrations that will evade scrutiny).

And as previously noted, there is an expected reduction in the internal load of 50 kgP/yr by the year 2029 (see scheduled interim targets in Table 3) as well as a reduction of 30 kgP/yr in the contribution from Cochnewagon Lake upstream. It is anticipated that the collective reduction of greater than 100 kgP/yr from all sources will serve to stabilize and or reduce the annual average epilimnetic phosphorus concentration over the 10-year Plan period. This would in turn promote a lowering in the maximum observed instantaneous epilimnetic total phosphorus concentration which recently has ranged from 18 ppb to 20 ppb. These maximum values tend to coincide with late summer and fall mixis as the

phosphorus-rich hypolimnion becomes entrained or mixed with surface waters, but with the expected decline in the internal loading component, the expectation is that the annual maximum epilimnetic average total phosphorus concentration would not exceed 17 ppb.

I. Monitoring Progress Compared to Criteria

CWD and DEP will periodically monitor progress as follows:

Attaining Water Quality Standards

The CWD will continue monitoring Annabessacook Lake water quality monthly from May through October each year. Water Quality parameters include Secchi disk transparency (SDT), temperature, dissolved oxygen, chlorophyll a, total phosphorus, and total alkalinity. The CWD's water quality database is augmented with monthly SDT readings from a volunteer monitor (VLMP). With this continued monitoring effort, short-term and long-term trends in water quality parameters, particularly SDT and total phosphorus, will be easily documented. These data will be particularly valuable in alerting the CWD of any needs to make adjustments in the watershed plan.

Load Reduction Estimates

Estimates of NPS pollutant load reductions and resources protected should be prepared as project work proceeds. Pollutant load reduction estimates should be developed and reported as follows. During design or installation of BMPs at NPS sites, appropriate filed measurements should be recorded to prepare written estimates of pollutant load reductions. Estimates should be prepared for NPS sites, unless there is no applicable estimation method for a given site. Methods to be used are the EPA Region 5 Load Estimation Model (see website http://it.tetratech-ffx.com/step1) and/or the federal WEPP Road Model (http://forest.moscowfsl.wsu.edu/fswepp/). For BMPs that provide other means of treatment, such as infiltration or bio-retention, the CWD will review other publications (e.g., MDEP, 2016[a] & 2016[b]) for estimates of pollutant removal.

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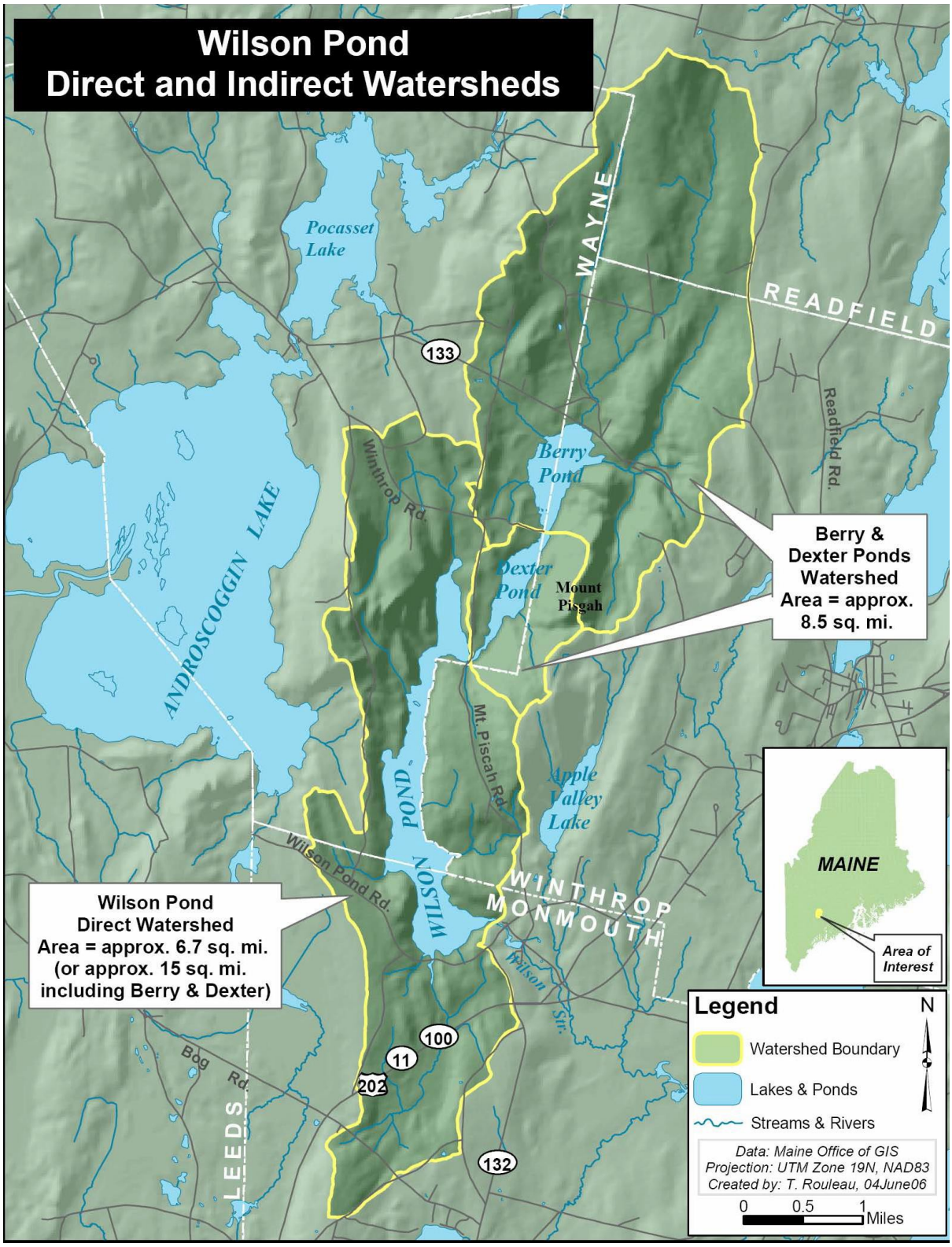
Wilson Pond
Direct and Indirect Watersheds
Pocasset Lake
WAYNE
READFIELD
133
Readfield Rd.
Berry Pond
Winthrop Rd.
ANDROSCOGGIN LAKE
Dexter Pond
Mount Pisgah
Berry & Dexter Ponds Watershed Area = approx. 8.5 sq. mi.
Mt. Pisgah Rd.
Apple Valley Lake
WILSON POND
Wilson Pond Rd.
WINTHROP
MONMOUTH
Wilson Sta.
Wilson Pond Direct Watershed Area = approx. 6.7 sq. mi. (or approx. 15 sq. mi. including Berry & Dexter)
Bog Rd.
100
11
202
132
LEEDS
MAINE
Area of Interest
Legend
N
Watershed Boundary
Lakes & Ponds
Streams & Rivers
Data: Maine Office of GIS
Projection: UTM Zone 19N, NAD83
Created by: T. Rouleau, 04June06
0 0.5 1 Miles

Attachment #1

Aerial Photo of Wilson Pond, September 2018

Reference – (Work Plan; Section III.b)