Using Adaptive Strategies for Effective Watershed Management

Comfort Lake-Forest Lake Watershed District

Question?

- Does your agency, organization or non-profit have unlimited funds?
  - If you answered **YES**; the rest of this presentation is optional.
  - If you answered **NO**; then you may find this approach useful.

Project prioritization

- With limited funds, there is a simple reality that "**Not all projects are good projects**".

- In fact, this presentation will also focus on the economic principle known as the Pereto Principle.

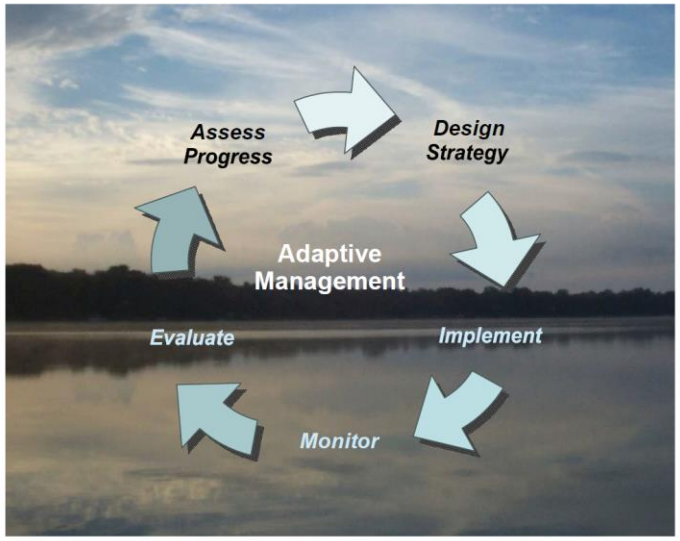
- Also known as the **80/20** rule, the law of the vital few, or the principle of factor sparsity, it states that, for many events, roughly 80% of the effects come from 20% of the causes.

Adaptive Management

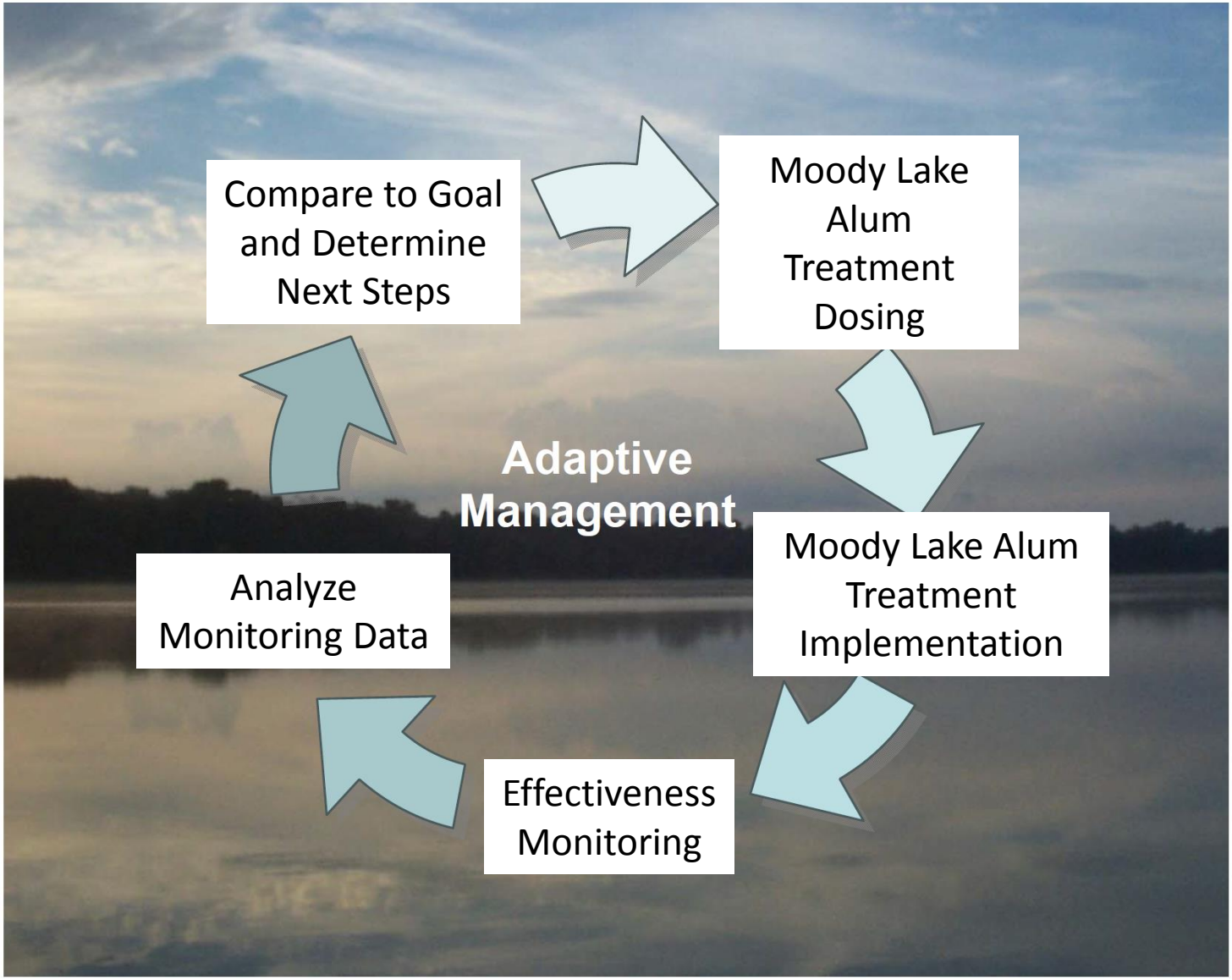
2. INTRODUCTION

Water resources are dynamic systems, fluctuating with climate, shifting with seasons, and changing over years and decades. The management of water resources requires an equally dynamic strategy; a strategy that can adapt and change with the climate, the seasons, and through the years as the resources reflect the changing conditions of the watershed.

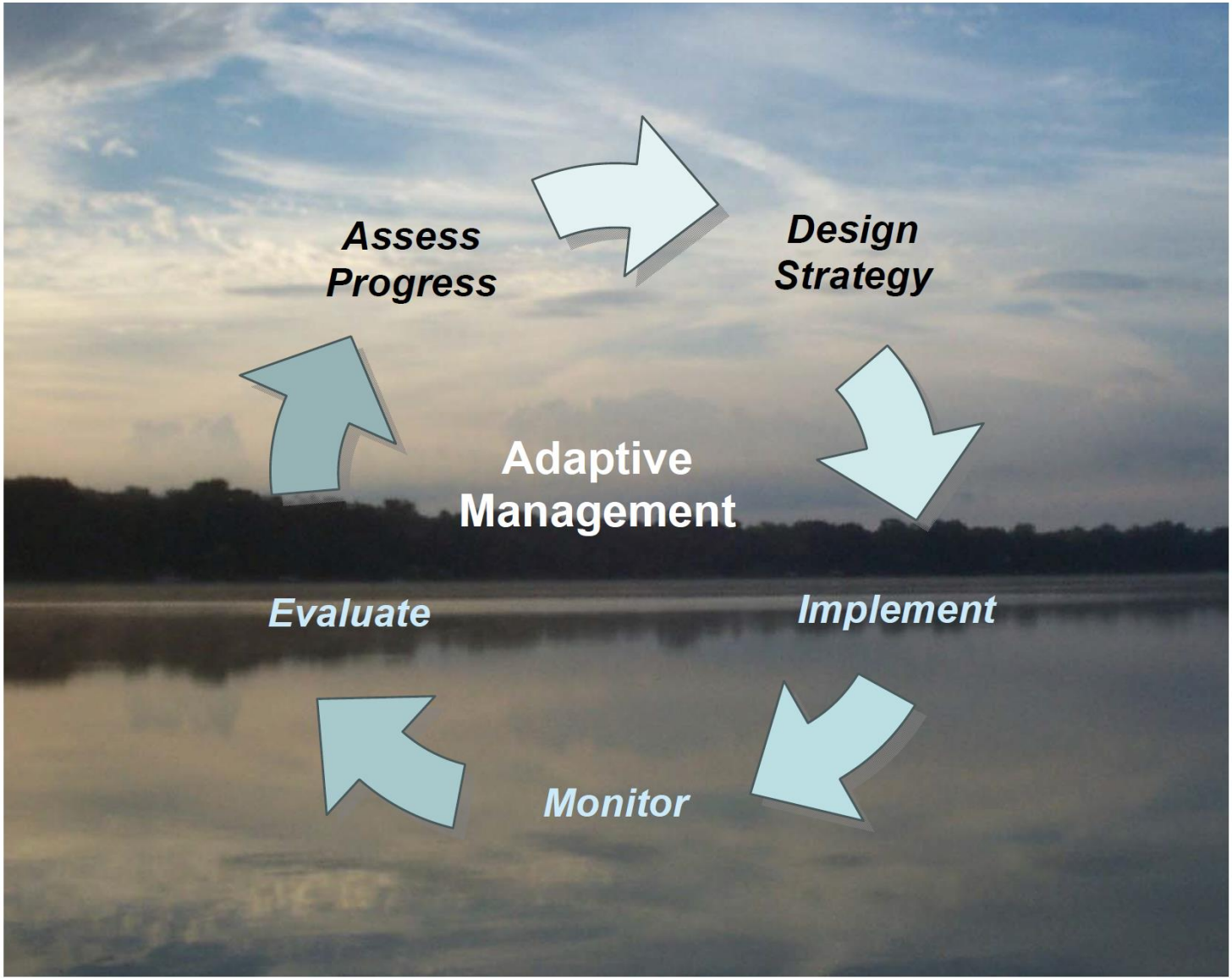
Adaptive management is an iterative approach of implementation, evaluation, and course correction that reflects the dynamic nature of water resources. The District sets an adaptive management policy to be able to react to changing conditions while also remaining mindful of the long term goals for the resources of the District. One of the primary goals of the District is to restore and maintain lake water quality as appropriate to each resource. Excess nutrients are the main factor degrading water quality in most District Lakes. Nutrient load reduction projects have been initially defined as included in this Plan. However, the incorporation of additional practices, changes to the siting or type of practice, and changes to project scheduling may be needed to reflect conditions observed in the watershed. In-lake conditions do not necessarily respond quickly to changes in the watershed. Adaptive management decisions will therefore be made based on long term observed trends in lake water quality as well as evaluations of the effectiveness of specific practices.



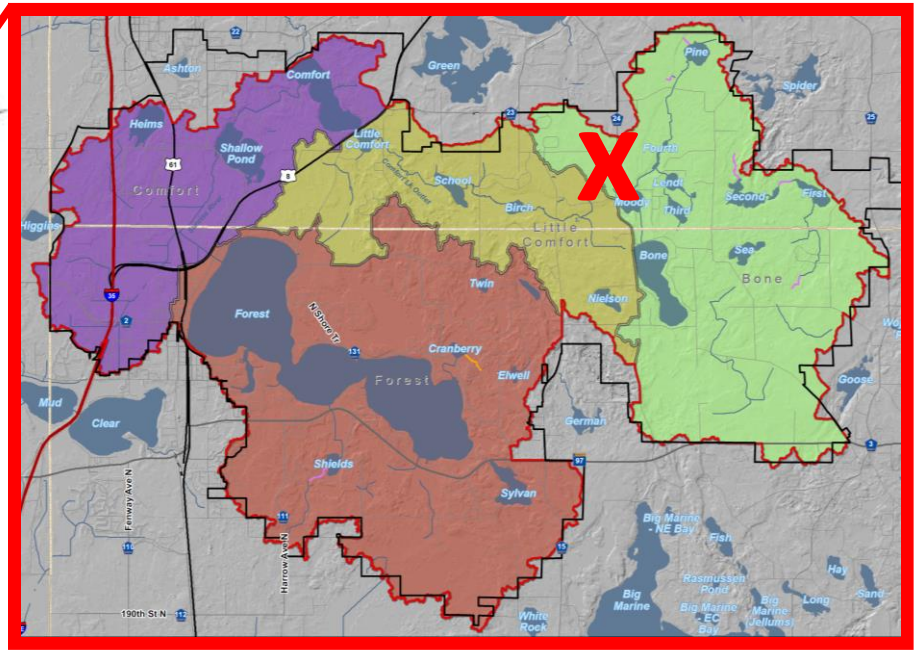
Adaptive Management



Adaptive Management



Project Location

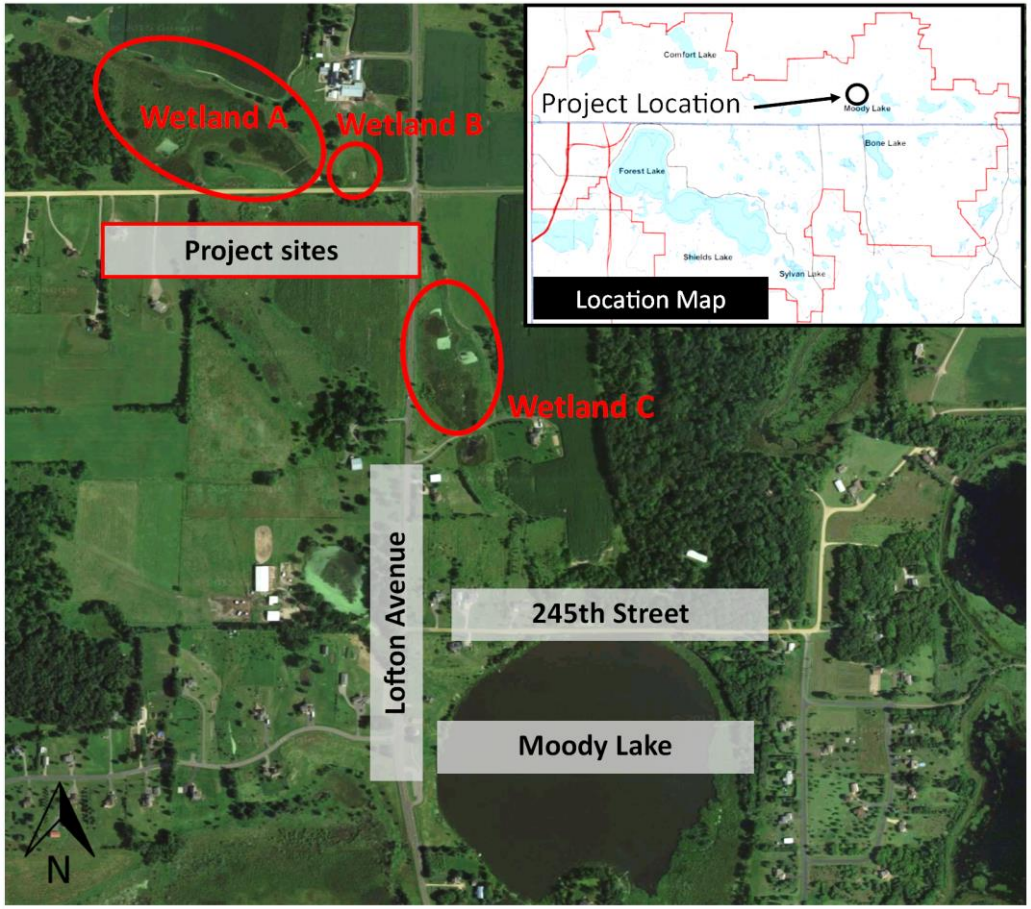


Project Overview

Multi-Year Adaptive Management Projects

Address highest watershed phosphorus loads then internal loading

- Watershed Load
  - Wetland A/B rehabilitations and managed livestock access (2017)
  - Wetland C project (2018)
  - Wetland A/B spot alum treatments (2018)
  - Peterson Pond (2018)
- Internal Load
  - *Rough fish harvest (2012)*
  - *Winter aeration system (annual)*
  - Whole-lake alum treatment (2018)



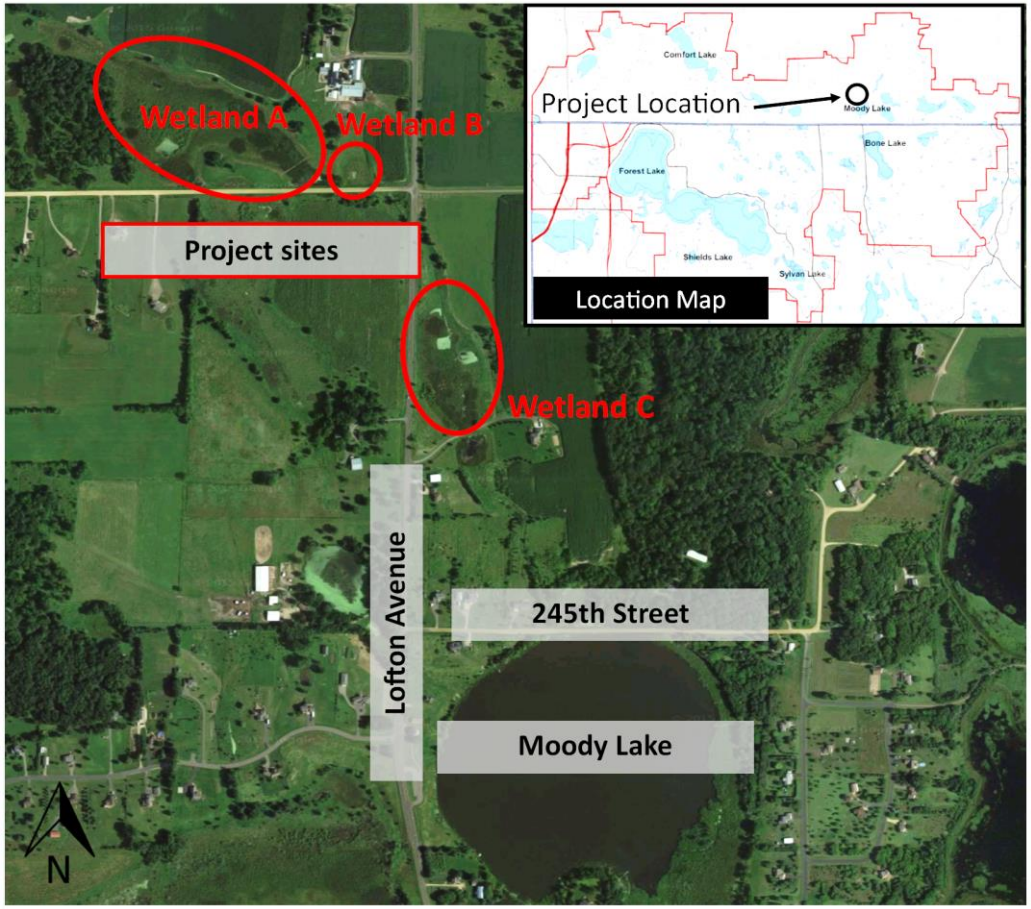
Project Location: southern Chisago County, MN

Project Overview

Multi-Year Adaptive Management Projects

Address highest watershed phosphorus loads then internal loading

- Watershed Load
  - Estimated phosphorus reduction = 445 pounds per year *(80% of watershed load reduction goal)*
- Internal Load
  - Estimated phosphorus reduction = 324 pounds per year



Project Location: southern Chisago County, MN

Design Strategy

6-Lake TMDL Study & Implementation Plan (2010)

- 86% (879 pounds per year) reduction in phosphorus load required for Moody Lake to meet TMDL.
- Internal load reduction will have to be greater than 70% unless phosphorus load from watershed is nearly eliminated.

Source	Current Modeled Load (lbs/day)	Current Modeled Load (lbs/year)	% TP Reduction Needed	TP Reduction Needed (lbs/year)
Unregulated MS4 portions of Municipalities: Chisago Lake Township	1.17	427	88%	376
Unregulated MS4 portions of Municipalities: City of Scandia	0.03	11	82%	9
Livestock	0.53	193	88%	170
Internal	1.01	369	88%	324
Atmospheric and Groundwater	0.02	7	0%	0
Upstream Lakes	0.04	15	0%	0
TOTAL	**2.8**	**1,022**		**879**

Moody Lake Sequential Diagnostic Study (2013-2014)

- Key Findings
  - Portions of NW watershed contribute majority of P load to Moody Lake.
  - NE watershed runoff being treated by Fourth Lake.
  - Lofton Pond = low flow but high P concentration
  - Moody Lake strongly stratified during growing season

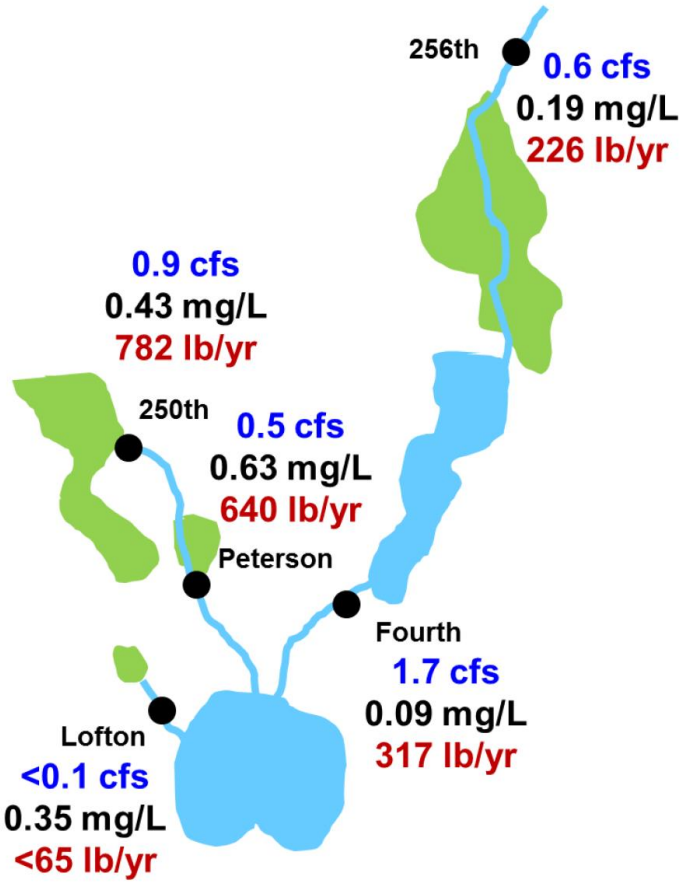


Figure 13. Moody Lake Watershed Flow, Total Phosphorus Concentration, and Total Phos. Loads

Moody Lake Sequential Diagnostic Study (2013-2014)

- Next Steps
  - Targeted management in NW watershed (wetland rehab, ag BMPs, Lofton Pond)
  - Moody Lake Alum Treatment
  - Long-term BMP Maintenance

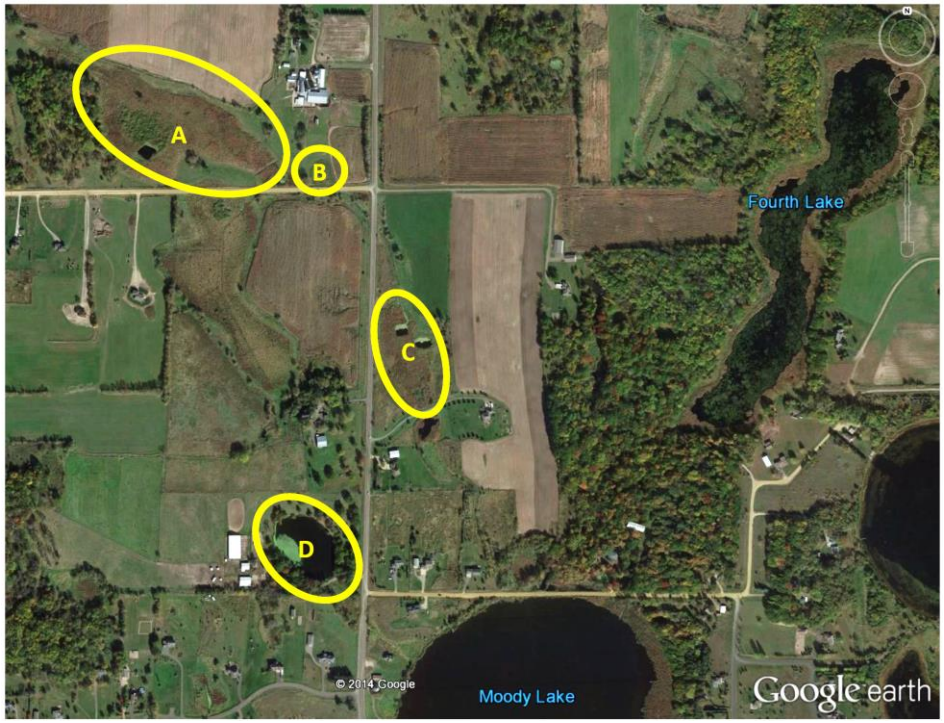
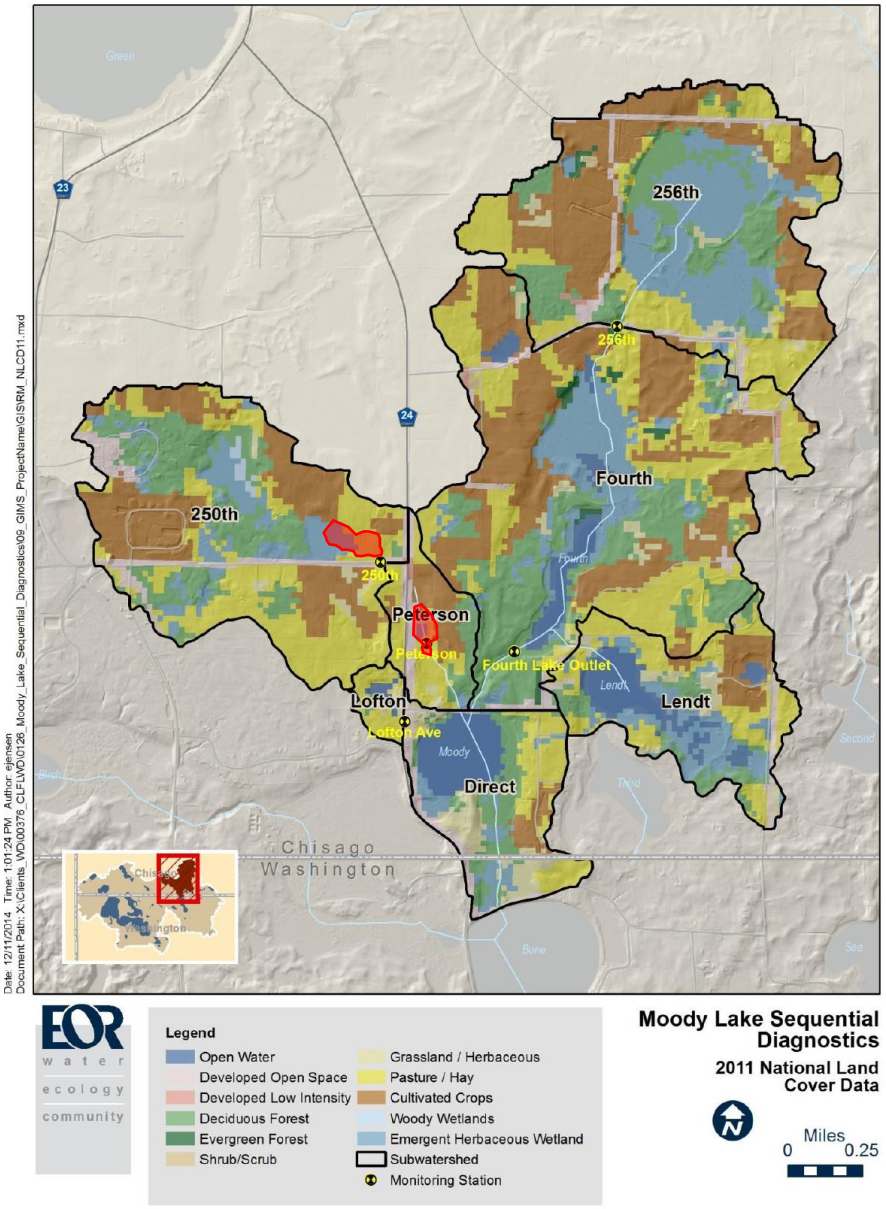


Figure 20. Recommended rehabilitative actions in the northwest Moody Lake watershed

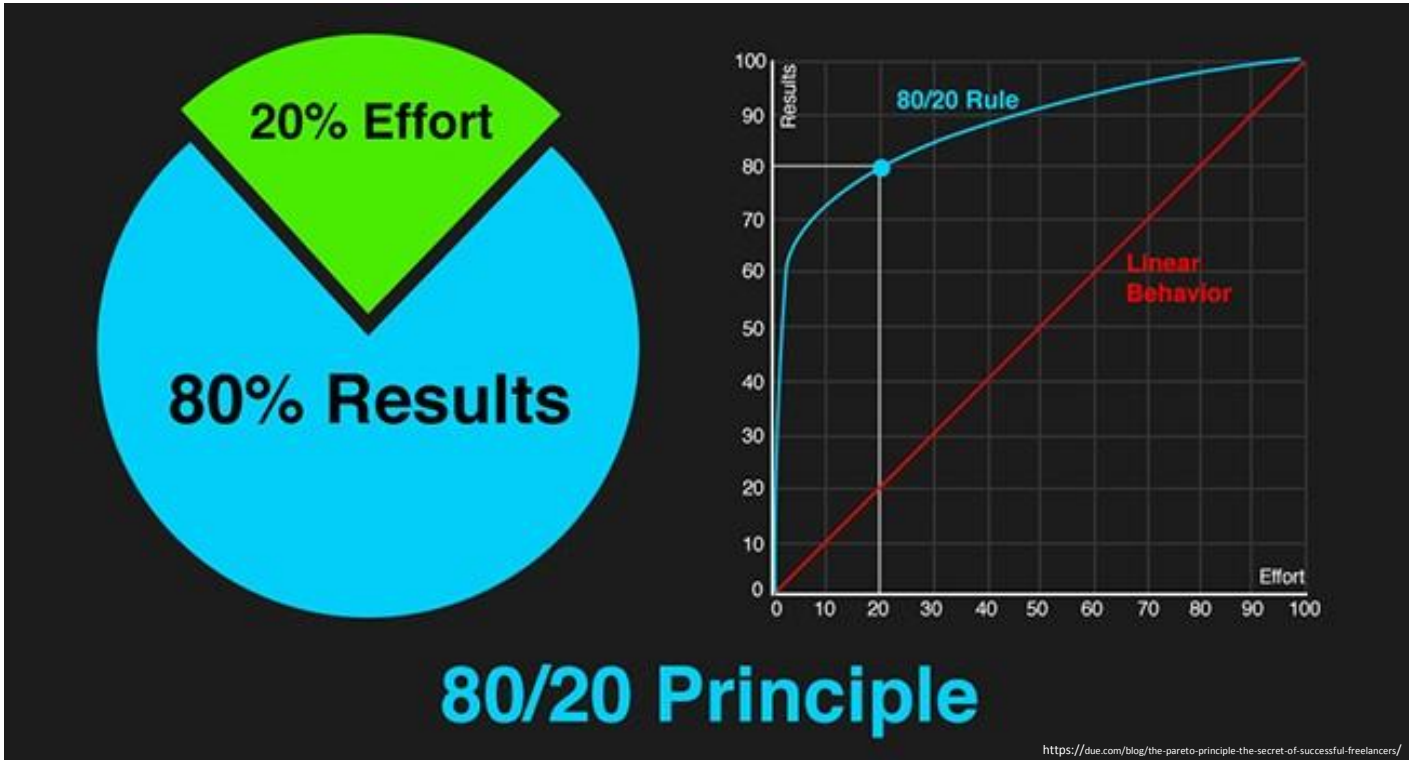
Design Strategy



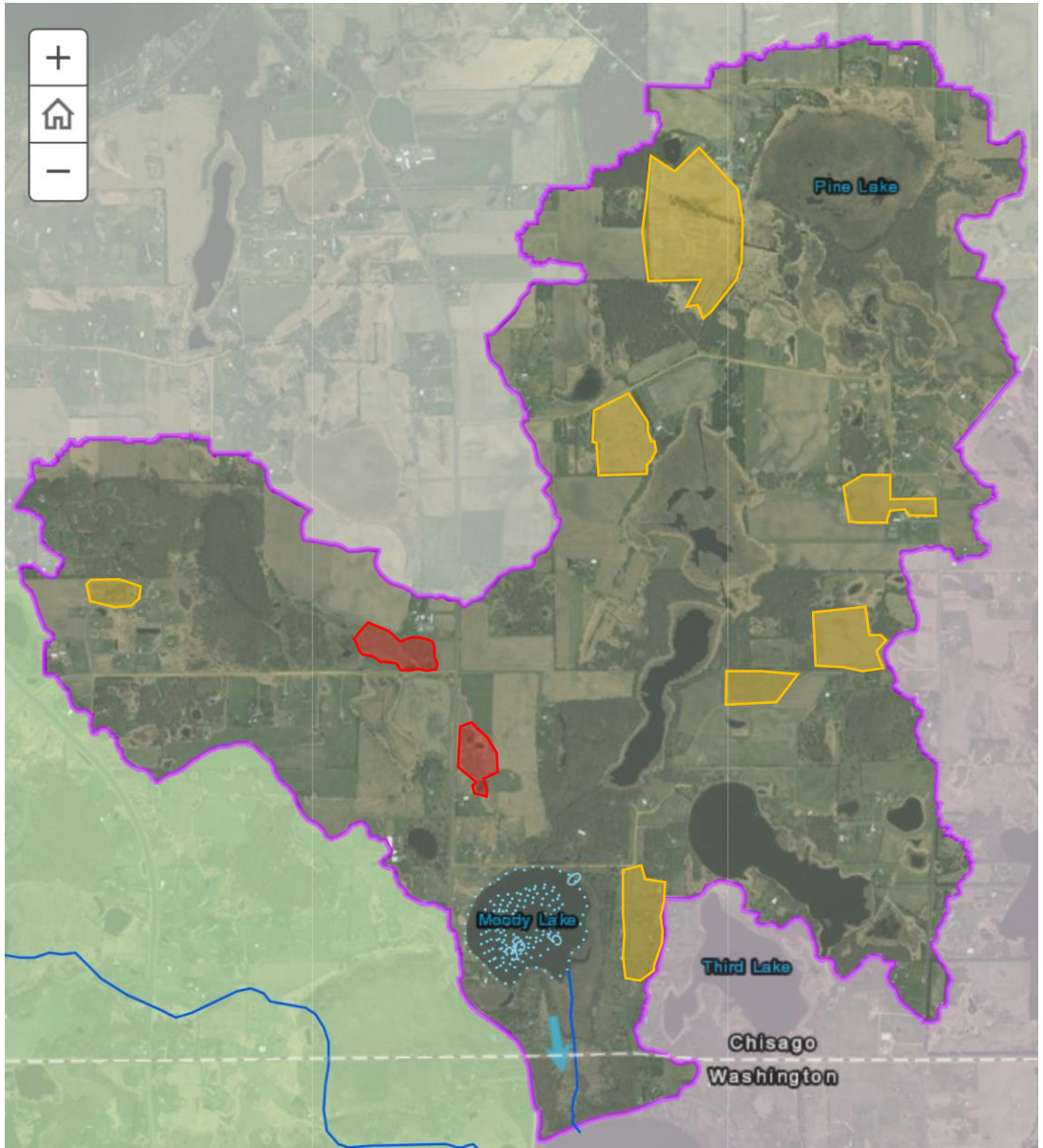
- Moody subshed area = 2,315 acres
- **80%** of goal watershed load reduction achieved by implementing project on ~12 acres of land (**.5%** of subshed area)

Design Strategy

- 80/20 Rule (a.k.a. the Pareto Principle)
  - Vilfredo Pareto: 80% of Italy's wealth is owned by 20% of the population
  - Can be applied to almost anything

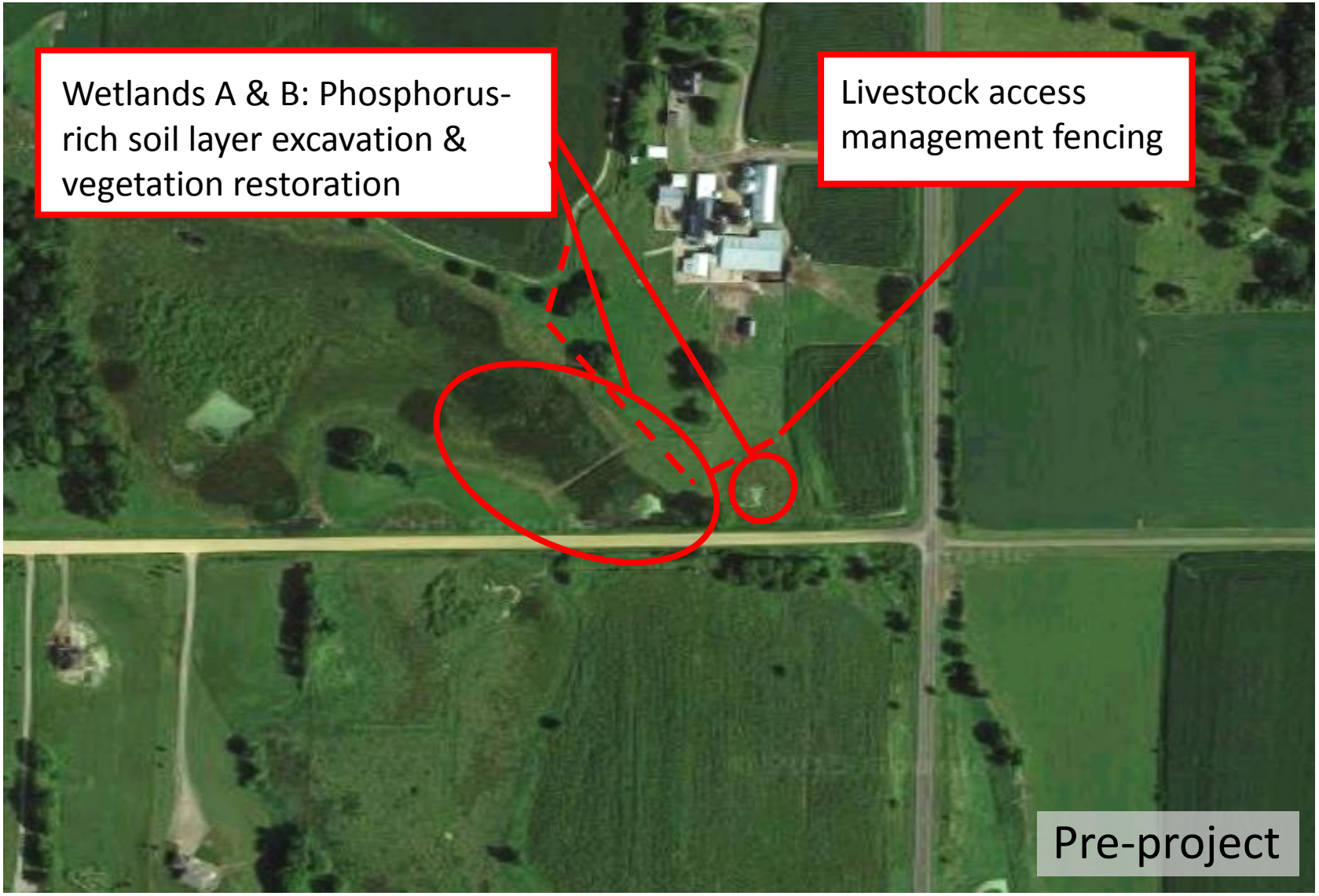


Design Strategy



- 80% of nonpoint source pollution may be coming from 20% (or less) of the watershed
- Could have implemented dozens of projects all over the watershed without coming close to this reduction

Design Strategy



Design Strategy

Implement

Groundbreaking Ceremony (1/27/2017)

The groundbreaking was noted with shovels of dirt. The ceremonial dirt movement was courtesy of watershed district managers, a Chisago Lake Township Supervisor, a representative for the contractor, two farm family members and the District Director and District Engineering firm. See story.

Watershed District begins wetland rehabilitation project

A wetland rehabilitation is taking place this winter to help improve water quality in downstream basins and flowages.

Peterson Companies is contracted to do the work, and the site is south of Big Green Lake, on farms owned by the Mattson and Zaruba families. The landowners were thanked by conservation officials for cooperating with the Comfort Lake Forest Lake Watershed District to create functional wetlands again.

The idea is to rehab the wetlands to retain phosphorus, a nutrient traveling through farm country in the watershed system.

Phosphorus encourages excessive growth of nuisance plants which degrades water quality.

The CLFL Watershed District Director Michael Kinney, commented at the groundbreaking last week, that 445 pounds of phosphorus per year will be naturally filtered out of the watershed and will not enter the closest basin, Moody Lake or others downstream, once this rehab project is done.

The state Board of Soil and Water Resources (BWSR) grant being applied to this project was $429,284. The watershed district, which covers the southwest end of Chisago County and the north part of Washington County, pays for $107,221.

Chisago County Press

Implement

Construction

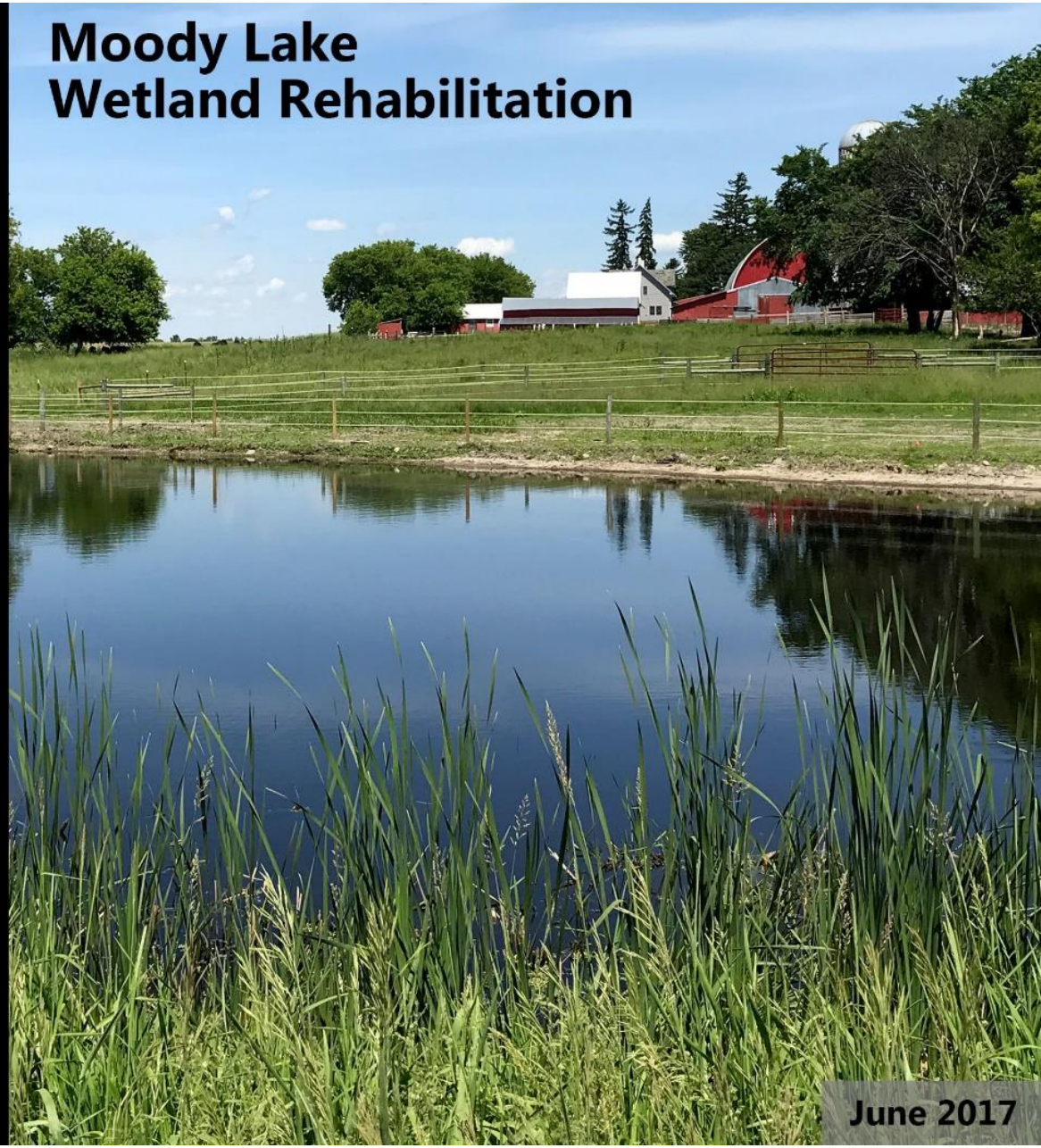
- Contractor: Peterson Companies (Chisago City)


2/13/17


8/15/17

Time blended photo: winter to late summer

Moody Lake
Wetland Rehabilitation



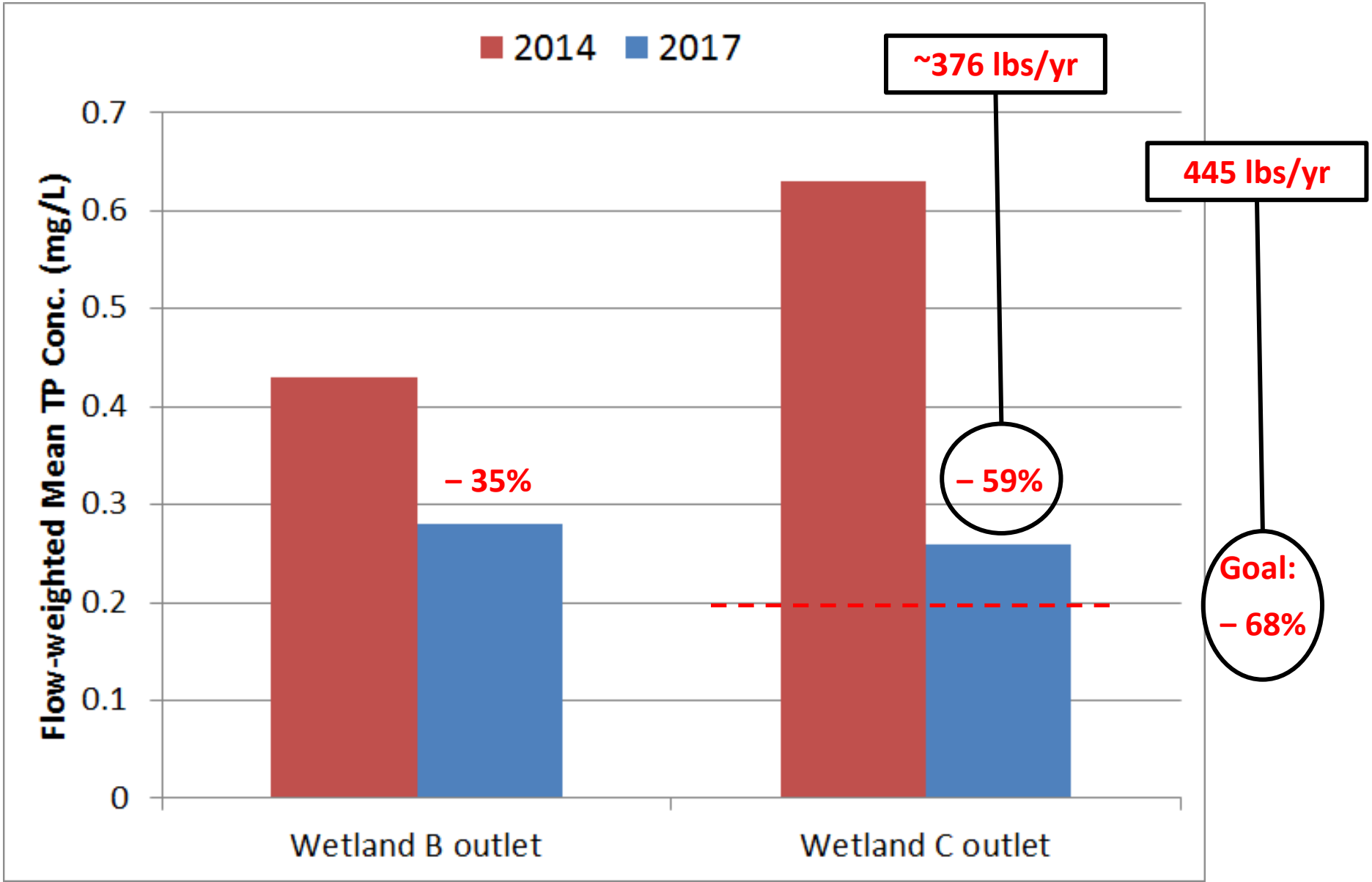
Monitor

- Construction/site restoration completed in early spring ‘17
- Project effectiveness monitoring through spring/summer

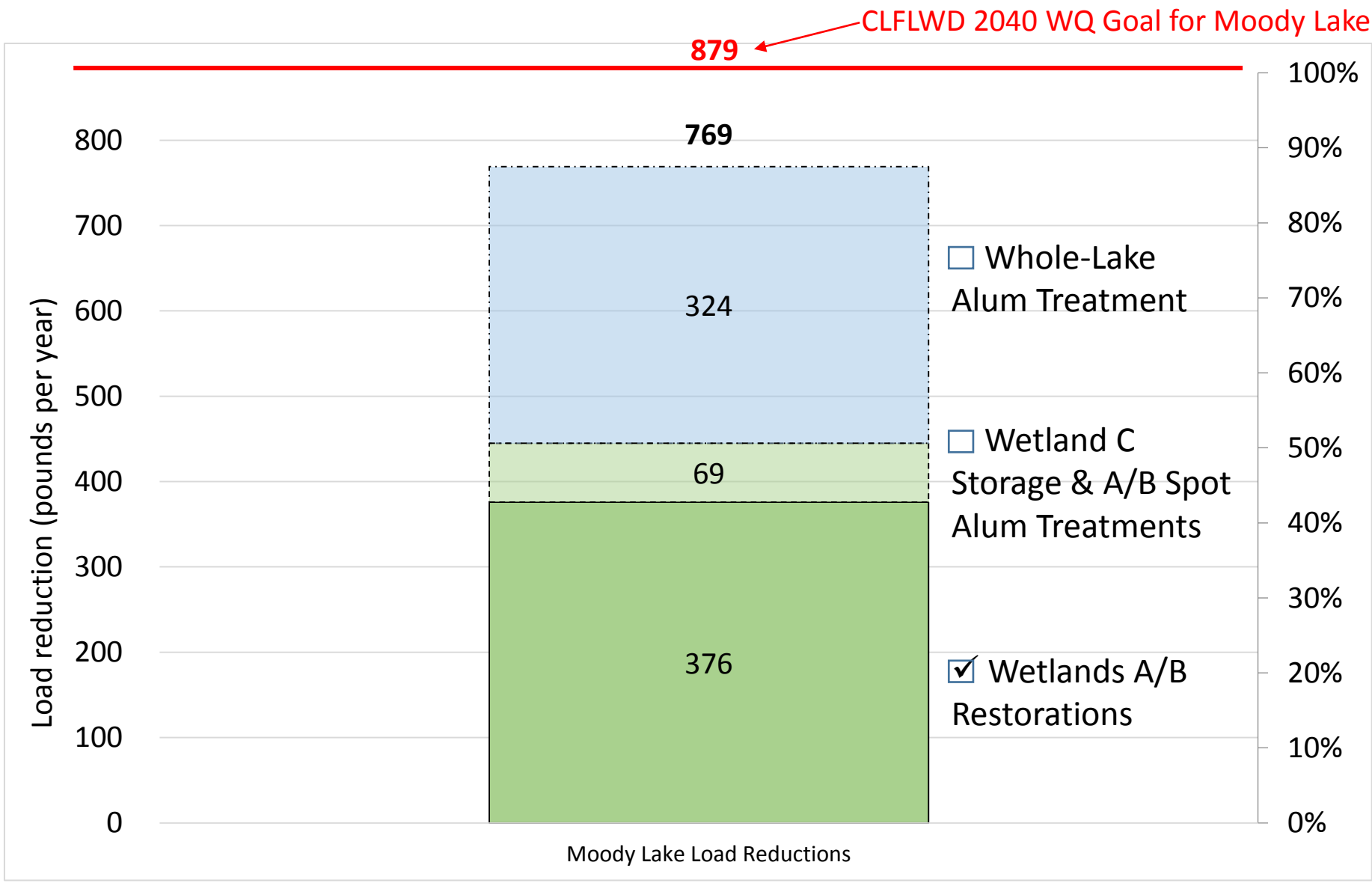
Monitor


Monitoring sites
250th St
Wetland A/B
South Inlet
250th St
24
Wetland C
Peterson Downstream
Lofton Ave
245th St
© 2017 Google

Evaluate

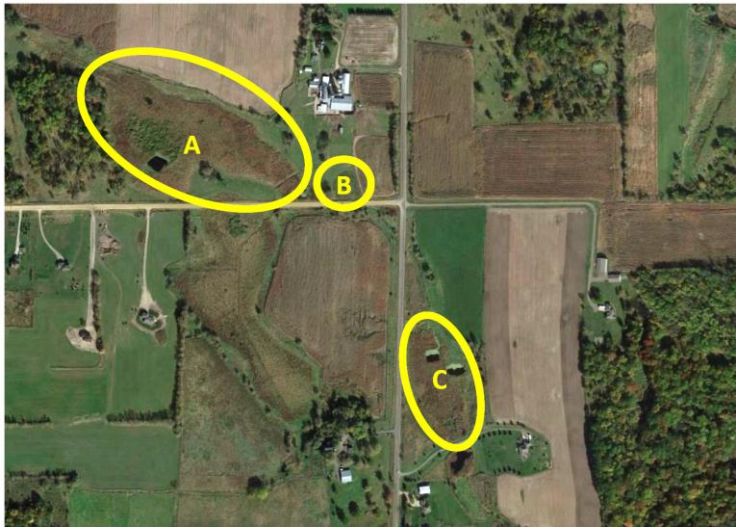

2014
2017
~376 lbs/yr
445 lbs/yr
Flow-weighted Mean TP Conc. (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
– 35%
– 59%
Goal:
– 68%
Wetland B outlet
Wetland C outlet

Assess Progress



Design Strategy

- Wetland C
  - Install riser in driveway culvert downstream of Wetland C
  - Increase storage in wetland
- Wetlands A/B Alum Spot Treatments
  - Bind additional phosphorus in wetlands
- Peterson Pond
  - Excavate to increase storage and slow flow rate
- Further reduce watershed load by 69 pounds per year



Design Strategy

- Moody Whole-Lake Alum Treatment
  - Reduce internal load by 324 pounds per year

Project Funding (Grants)

Wetland Rehabilitation	
FY16 Clean Water Fund Grant	$429,284
Clean Water Act Section 319 Grant (2016)	$78,028
CLFLWD Estimated Local Match (actual local spend; two grants overlap required match amounts)	$112,402
Total Project Budget	**$619,714**

Whole-Lake Alum Treatment	
FY18 Clean Water Fund Grant	$135,000
CLFLWD Grant Match	$100,000
Total Project Budget	**$235,000**

Total grant awards: $642,312

Minnesota Pollution Control Agency

United States Environmental Protection Agency

Minnesota Board of Water & Soil Resources

Clean Water Land & Legacy Amendment

Project Expenses (Additional costs)

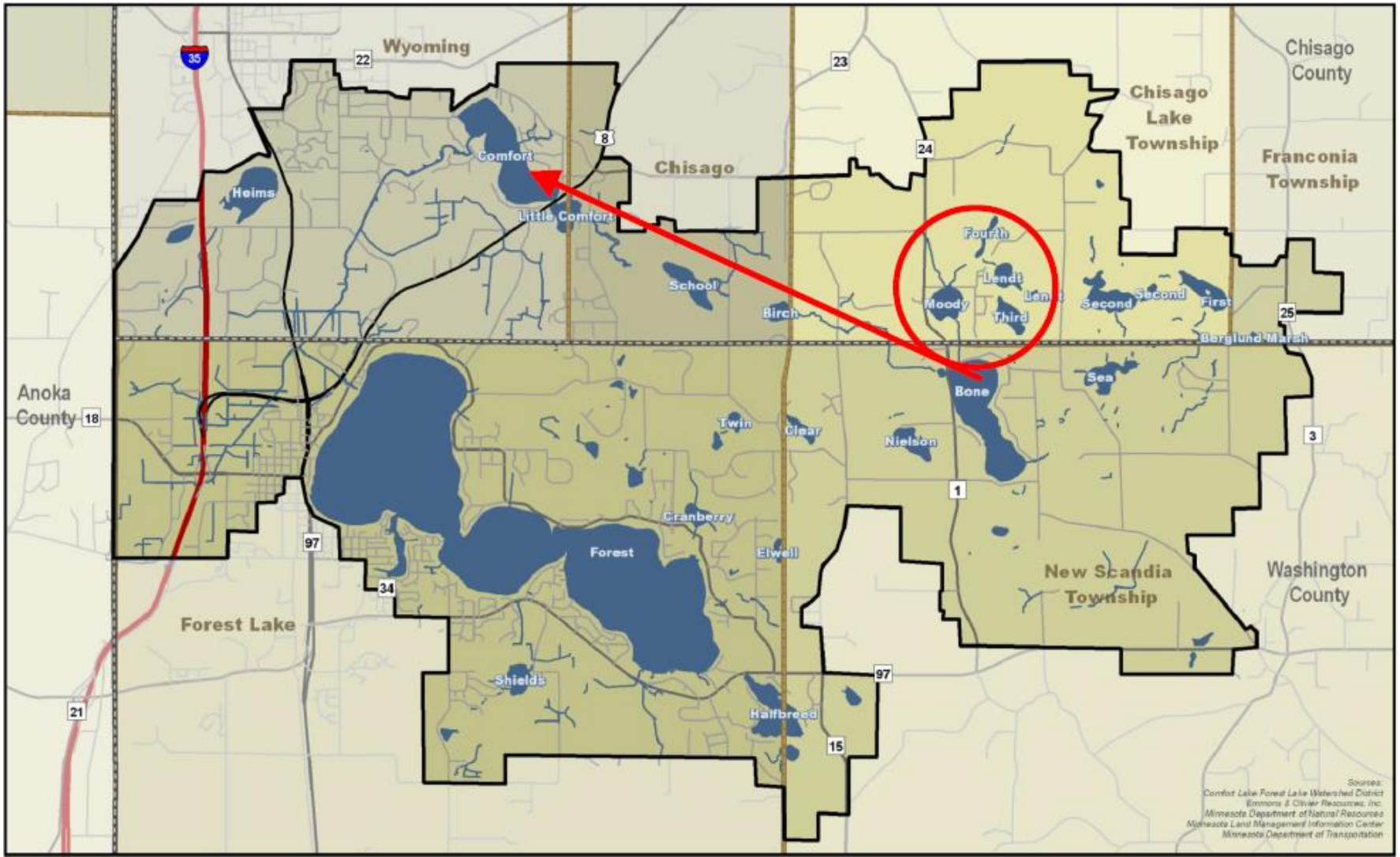
Phase	Timeline	Estimated/Actual Cost
Diagnostic Monitoring & Project Feasibility (pre-project, no grants)	Complete	$58,000
Wetland Rehab Phase 1 – Wetland A/B	Complete	$415,730
Wetland Rehab Phase 2 – Wetland C, Wetland Alum Treatments, Peterson Pond	2018	$153,785
Wetland Rehab – Effectiveness Monitoring	2017 & 2018	$50,216
Whole Lake Alum Treatment	2018	$235,000
Whole Lake Alum Treatment O&M (potential additional alum treatment before 25 years)	TBD	$235,000
Total estimated project lifetime cost		**$1,147,731**

Cost-Benefit Analysis

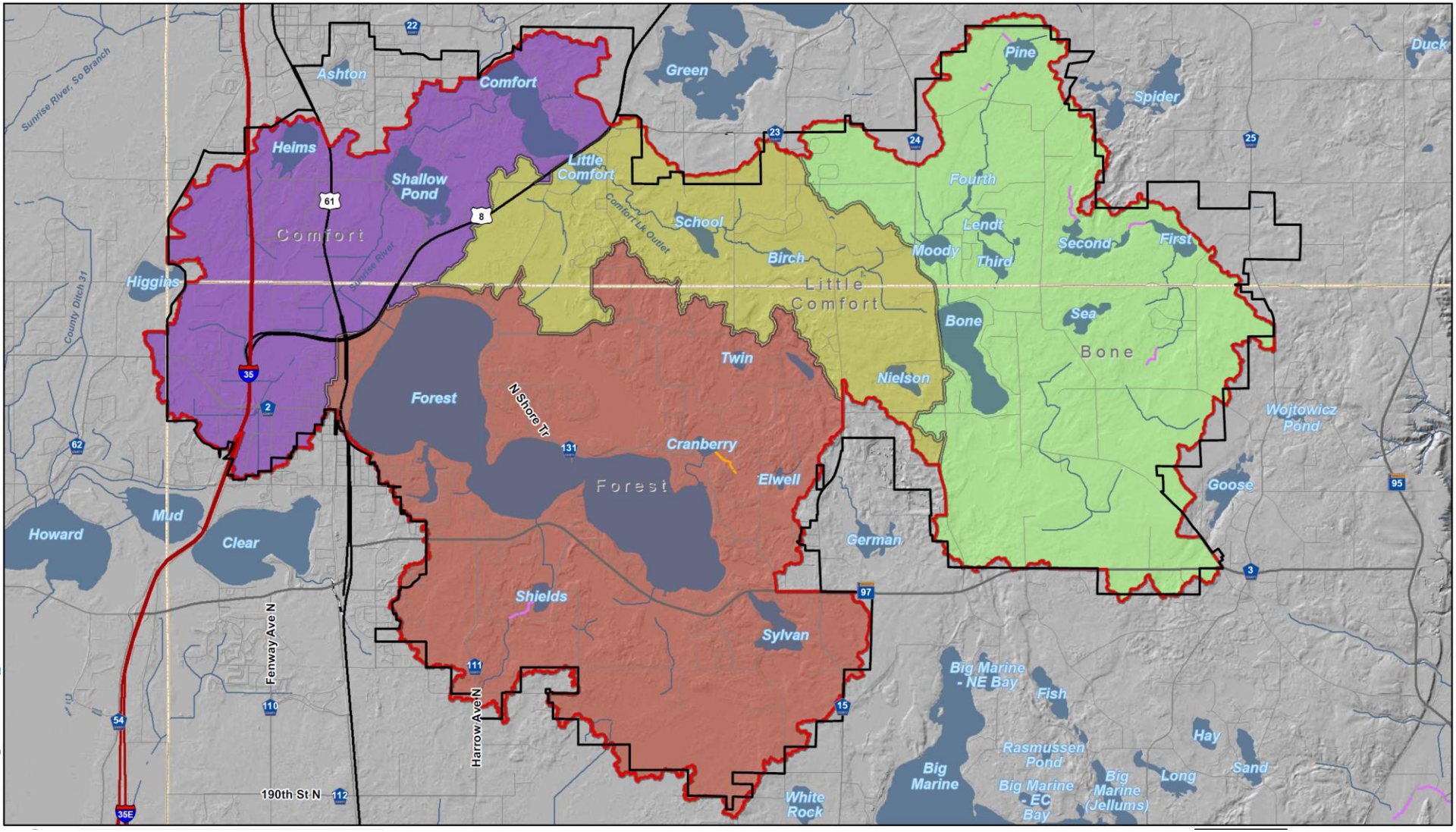
Estimated project lifetime cost	$1,147,731
Total phosphorus removal over 25-year project lifespan • Watershed load (445 lbs * 25 years) • Internal load (324 lbs * 25 years)	19,225
Cost per pound of P removed over lifespan	**$60/lb**

Design Strategy – Moving Downstream

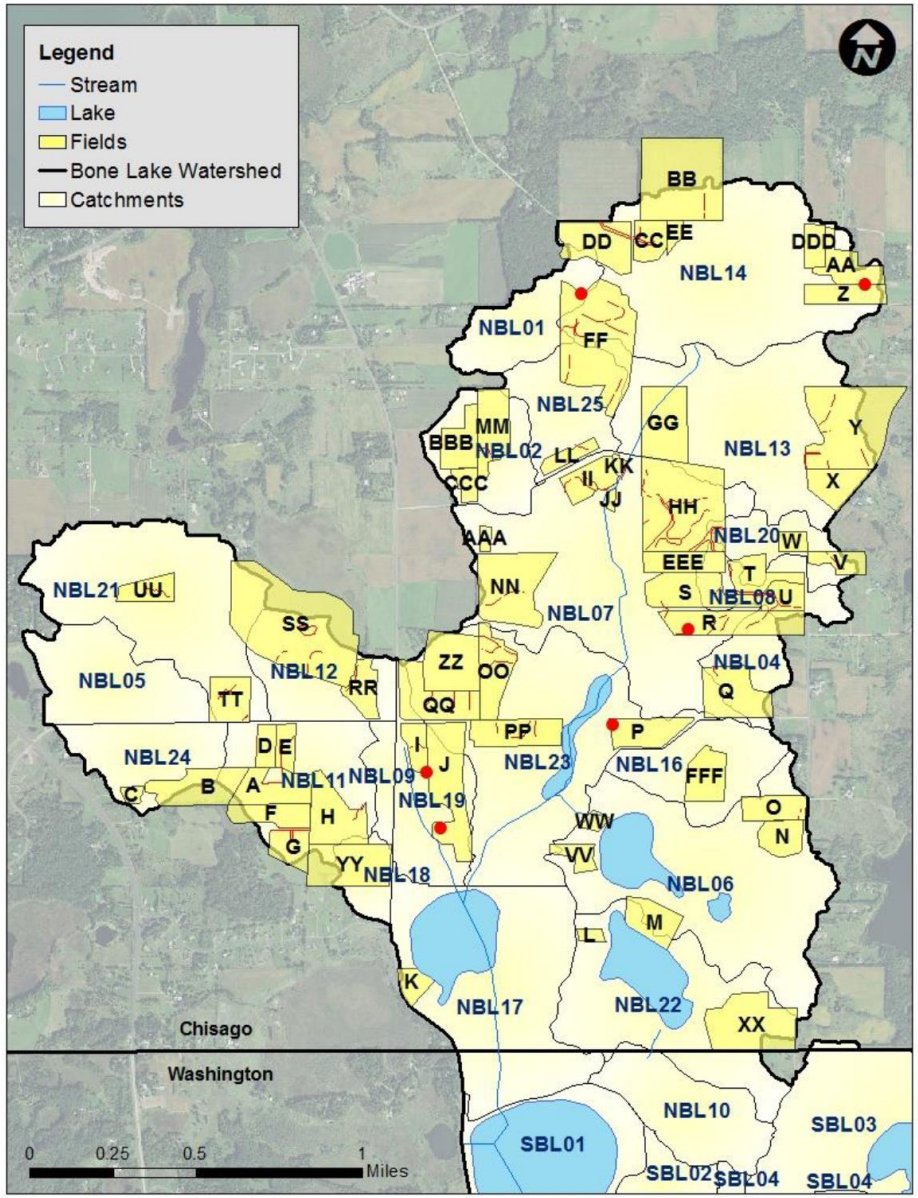
Moody Lake is the headwaters of the CLFLWD northern flow network



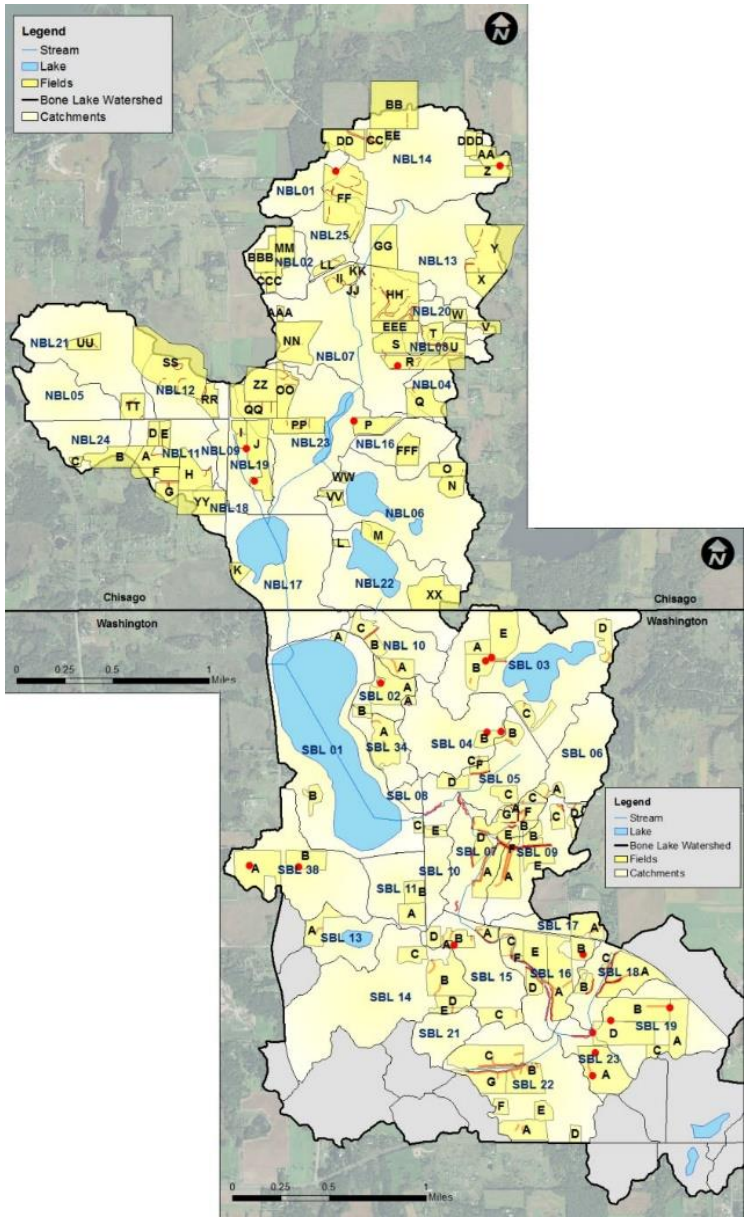
Design Strategy – Moving Downstream



Project Prioritization Strategy & the Bone Lake Rural Subwatershed Assessment



Project Prioritization Strategy & the Bone Lake Rural Subwatershed Assessment



Project Prioritization Strategy & the Bone Lake Rural Subwatershed Assessment

Top 50 Fields – Cost per Pound TP Reduction

TABLE 2. TOP 50 FIELDS RANKED BY COST PER POUND OF TOTAL PHOSPHORUS REDUCTION PER FIELD

Field Identification*	Total Phosphorus Reduction (Lb/year)	Sediment Reduction (Tons/year)	Soil Reduction (Tons/year)	Estimated Cost - Design, Installation, 10 year Maintenance	Cost per Pound of Phosphorus
SBL 16-F	10.2	8.3	0.5	$1,991	**$195**
SBL 22-B	68.3	63.8	48.3	$21,948	**$321**
SBL 18-A	55.7	52.2	36.5	$19,604	**$352**
SBL 17-A	18.6	21.9	21.9	$6,655	**$358**
SBL 09-A	39.5	34.7	19.2	$15,055	**$381**
SBL 03-D	14.7	17.3	17.3	$5,618	**$381**
SBL 13-A	12.7	14.9	14.9	$5,068	**$400**
SBL 06-A	10.1	11.8	11.8	$4,368	**$435**
SBL 16-A	33.5	35.2	28.3	$14,767	**$441**
SBL 15-C	9.4	11.0	11.0	$4,180	**$447**
SBL 22-C	31.2	33.3	30.1	$15,853	**$509**
SBL 14-A	6.8	8.0	8.0	$3,493	**$515**
SBL 15-B	38.8	45.6	49.8	$21,057	**$543**
SBL 15-E	6.5	6.5	6.5	$3,593	**$553**
NBL 11-E*	5.5	1.2	3.7	$3,104	**$566**
SBL 14-B	22.9	23.5	36.7	$12,985	**$568**
NBL 11-A*	4.8	2.5	0.1	$2,802	**$579**
NBL 14-DD	9.5	0.6	4.9	$5,484	**$580**
SBL 03-C*	5.1	6.1	6.1	$3,055	**$594**
SBL 14-D*	5.2	5.2	5.2	$3,218	**$615**
SBL 09-D*	4.6	5.4	5.4	$2,905	**$634**
SBL 07-F*	3.7	2.2	0.2	$2,591	**$706**
NBL 08-T	6.8	1.0	3.8	$4,889	**$717**
SBL 22-G	11.2	11.0	8.9	$8,756	**$782**
SBL 15-A	9.4	10.6	10.8	$7,361	**$782**
SBL 03-B	60.3	52.0	100.5	$48,880	**$811**
SBL 09-E*	4.3	3.6	1.8	$3,574	**$831**
SBL 18-C*	1.9	1.0	0.2	$1,655	**$853**
SBL 07-A	9.3	7.7	0.8	$8,037	**$866**
SBL 16-C*	0.3	0.2	0.1	$264	**$942**
SBL 05-C*	2.6	2.1	0.2	$2,519	**$984**
SBL 19-D	21.6	21.6	48.5	$21,407	**$992**
SBL 02-A	14.4	16.9	49.0	$14,438	**$1,004**
NBL 07-HH	122.4	84.4	112.4	$124,911	**$1,021**
SBL 03-E	13.6	16.0	58.2	$14,438	**$1,060**

Project Prioritization Strategy & the Bone Lake Rural Subwatershed Assessment

Top 50 Fields – Cost per Pound TP Reduction

TABLE 2. TOP 50 FIELDS RANKED BY COST PER POUND OF TOTAL PHOSPHORUS REDUCTION PER FIELD

Field Identification*	Total Phosphorus Reduction (Lb/year)	Sediment Reduction (Tons/year)	Soil Reduction (Tons/year)	Estimated Cost - Design, Installation, 10 year Maintenance	Cost per Pound of Phosphorus
NBL 07-NN	32.1	37.8	37.8	$35,587	**$1,108**
NBL 07-11	54.0	63.0	63.3	$60,301	**$1,116**
NBL 07-KK*	0.9	0.1	0.6	$1,060	**$1,153**
SBL 05-B*	4.0	4.7	13.3	$4,705	**$1,188**
NBL 20-V	17.8	17.8	17.8	$21,652	**$1,218**
NBL 02-MM	17.0	17.0	17.0	$20,720	**$1,219**
NBL 04-Q	7.4	7.4	7.4	$8,961	**$1,219**
NBL 08-S	21.0	19.9	20.1	$25,699	**$1,225**
NBL 12-SS	39.1	38.5	38.4	$48,096	**$1,230**
NBL 14-CC	13.7	11.4	12.5	$17,010	**$1,240**
SBL 16-E*	3.4	2.2	1.2	$4,304	**$1,273**
NBL 14-FF	96.7	91.0	93.7	$124,388	**$1,286**
SBL 19-A	16.5	16.5	83.3	$21,407	**$1,297**
SBL 07-G*	3.5	2.6	1.1	$4,596	**$1,325**
SBL 38-A	16.0	16.0	66.7	$21,407	**$1,340**

*These fields do not rank in the top 50 when ranked by total phosphorus reduction and do not have a profile included in this report.

Project Prioritization Strategy & the Bone Lake Rural Subwatershed Assessment

Top 50 Fields – Total Phosphorus Reduction

TABLE 1. TOP 50 FIELDS RANKED BY TOTAL PHOSPHORUS REDUCTION PER FIELD

Field Identification	Total Phosphorus Reduction (Lb/year)	Sediment Reduction (Tons/year)	Soil Reduction (Tons/year)	Estimated Cost - Design, Installation, 10 year Maintenance	Cost per Pound of Phosphorus
NBL 07-HH	**122.4**	84.4	112.4	$124,911	$1,021
NBL 14-FF	**96.7**	91.0	93.7	$124,388	$1,286
NBL 07-R	**73.0**	73.0	82.0	$108,638	$1,489
SBL 22-B	**68.3**	63.8	48.3	$21,948	$321
SBL 03-B	**60.3**	52.0	100.5	$48,880	$811
SBL 18-A	**55.7**	52.2	36.5	$19,604	$352
NBL 07-11	**54.0**	63.0	63.3	$60,301	$1,116
SBL 09-A	**39.5**	34.7	19.2	$15,055	$381
NBL 13-Y	**39.5**	38.8	54.8	$69,595	$1,763
NBL 12-SS	**39.1**	38.5	38.4	$48,096	$1,230
SBL 15-B	**38.8**	45.6	49.8	$21,057	$543
NBL 23-PP	**37.9**	37.9	43.7	$53,302	$1,406
SBL 16-A	**33.5**	35.2	28.3	$14,767	$441
NBL 07-NN	**32.1**	37.8	37.8	$35,587	$1,108
SBL 22-C	**31.2**	33.3	30.1	$15,853	$509
NBL 21-TT	**27.3**	29.1	28.5	$75,725	$2,772
SBL 23-A	**25.9**	22.0	82.1	$45,048	$1,737
NBL 23-OO	**24.6**	25.0	59.9	$117,773	$4,797
NBL 23-QQ	**23.1**	23.1	44.8	$54,545	$2,365
SBL 14-B	**22.9**	23.5	36.7	$12,985	$568
SBL 19-D	**21.6**	21.6	48.5	$21,407	$992
NBL 08-S	**21.0**	19.9	20.1	$25,699	$1,225
SBL 19-B	**19.1**	20.3	86.1	$31,837	$1,667
SBL 17-A	**18.6**	21.9	21.9	$6,655	$358
NBL 20-V	**17.8**	17.8	17.8	$21,652	$1,218
NBL 02-MM	**17.0**	17.0	17.0	$20,720	$1,219
SBL 19-A	**16.5**	16.5	83.3	$21,407	$1,297
NBL 19-J	**16.2**	26.6	14.7	$30,792	$1,901
SBL 38-A	**16.0**	16.0	66.7	$21,40	$1,340
SBL 38-B	**14.9**	17.5	64.5	$21,407	$1,441
SBL 03-D	**14.7**	17.3	17.3	$5,618	$381
SBL 02-A	**14.4**	16.9	49.0	$14,438	$1,004
NBL 14-CC	**13.7**	11.4	12.5	$17,010	$1,240
SBL 03-E	**13.6**	16.0	58.2	$14,438	$1,060
SBL 13-A	**12.7**	14.9	14.9	$5,068	$400
SBL 22-G	**11.2**	11.0	8.9	$8,756	$782

Project Prioritization Strategy & the Bone Lake Rural Subwatershed Assessment

Top 50 Fields – Total Phosphorus Reduction

TABLE 1. TOP 50 FIELDS RANKED BY TOTAL PHOSPHORUS REDUCTION PER FIELD

Field Identification	Total Phosphorus Reduction (Lb/year)	Sediment Reduction (Tons/year)	Soil Reduction (Tons/year)	Estimated Cost - Design, Installation, 10 year Maintenance	Cost per Pound of Phosphorus
SBL 16-F	**10.2**	8.3	0.5	$1,991	$195
NBL 14-UU	**10.1**	10.7	9.9	$43,375	$4,278
SBL 06-A	**10.1**	11.8	11.8	$4,368	$435
NBL 14-DD	**9.5**	0.6	4.9	$5,484	$580
SBL 15-A	**9.4**	10.6	10.8	$7,361	$782
SBL 15-C	**9.4**	11.0	11.0	$4,180	$447
SBL 07-A	**9.3**	7.7	0.8	$8,037	$866
SBL 22-A	**8.4**	8.8	27.8	$12,603	$1,506
NBL 04-Q	**7.4**	7.4	7.4	$8,961	$1,219
NBL 14-BB	**7.2**	7.2	20.2	$24,553	$3,420
NBL 08-T	**6.8**	1.0	3.8	$4,889	$717
SBL 14-A	**6.8**	8.0	8.0	$3,493	$515
SBL 15-E	**6.5**	6.5	6.5	$3,593	$553
SBL 04-B	**5.9**	6.9	16.0	$21,408	$3,635

Questions

Mike Kinney, District Administrator
Comfort Lake-Forest Lake Watershed District
44 Lake Street South
Forest Lake, MN
Michael.Kinney@CLFLWD.org