









It's ALL NATURAL Poplar River Case Study April 2018









The Setting









V Brady, NRRI, Lake Superior Streams website

Founded upon a ROCK!

SUPERIOR NATIONAL AT LUTSE

Welcome to our full-service golf course, where guests can enjoy golf passes, superb amenities, outstanding service and 27 holes of magnificent g







2001	2005	2009	2013	2017			
North Shore Pollutant Load Study							
	Environmental Report - SE Group/NAWE						
	Alternati	ive Urban Areawide Review - (Cook County				
	Poplar River	Management Board					
		Poplar River Turbidit	y Assessment - RTI/URS	5			
		Macroinvertebrate a	nd Habitat Study - NRR	I/UMD			
		Poplar Ri	ver Sediment Source As	sessment - U of M			
			Water Appropriat [:] DNR	ion Environmental Review -			
	Lower Poplar River Watershed Sediment Source Assessment - U of M						
	Turbidity TMDL						
		BMP Implementation					
				De-list for turbidity ?			





Get Organized

The PRMB members represent over 90% of the private land in the lower watershed, which ensures landowner cooperation with projects. Since 2005, both public and private dollars have helped to leverage multiple grants that have been successfully awarded and managed within the



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Projects	1
Directors & Partne	ers
Resources	
Pressroom	
Meetings	
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- Contact	

Welcome to the Poplar River Management Board website.

Set among Lake Superior's unique mountain-like topography, the high profile Poplar River watershed is a vital natural area, trout fishery and economic engine for the North Shore. For over a decade, the Poplar River Management Board (PRMB) has been working in partnership with the Cook County Soil and Water Conservation District and others toward the goal of improving the three-mile impaired reach of the river

Landowners formed PRMB to:

Develop broad partnership with stakeholders: SWCD, MPCA, MDNR, others

Develop good science to understand the impairment

Raise funds to implement solutions

Be proactive

Implement solutions in parallel with TMDL study, not after it

Vehicle for communication with MPCA re TMDL

Vehicle for public input and participation

Be one of the first to de-list



Our goal is to <u>understand</u> what the data represents so that we can use it most effectively.

The Board consists of landowners along the lower Poplar River with the specific goal of identifying and implementing conservation projects and practices that will meet the MPCA's water quality standards and be removed from the impaired waters list.

Members contribute annually to fund research and administration.

Studies, Reports and Plans

- 2005 Environmental Report; prepared by North American Wetland Engineering for Lutsen Mountains
- 2006 Lower Poplar River: Alternative Urban Areawide Review; Cook County, MN
- 2008 Poplar River Turbidity Assessment; by RTI International for U.S. Environmental Protection Agency
- 2008 Poplar River Macroinvertebrate and Habitat Study; by Natural Resources Research Institute (NRRI)
- 2010 Poplar River Sediment Source Assessment; by University of Minnesota
- 2011 Lower Poplar River Watershed Sediment Source Assessment; by U of MN for MN Pollution Control Agency
- 2012 Revision of Lower Poplar River Watershed Sediment Source Assessment and updated WEPP model results
- 2013 Poplar River Watershed, Total Maximum Daily Load (TMDL) Impairment; by MPCA
- 2014 Poplar River Water Quality Restoration, Implementation Plan for Turbidity Reduction; by MPCA
- 2015 BANCS Assessment of channel erosion in 4.2 miles of Poplar River and Tributary; by Cook SWCD/(TSA3)
- 2015 Lower Poplar River Watershed Flowpath Erosion Assessment; By Cook SWCD and TSA3
- 2016 Lake Superior North Watershed Assessment and Monitoring; by MPCA

Get Informed, Stay the Course

Lutsen Mountains works to pre Sediment reduction the Poplar River

work continues on Poplar River

Posted on July 29, 2015 by Webmaster

Public Invited to Poplar River Informational Meeting

Contact: Dave Stark, Cook County Soil & Water Conservation District

receive and still meet water quality standards.

The Cook County Soil and Water Conservation District (SWCD) will host the first of

Agency (MPCA) study of the Poplar River's possible pollution sources. The meeting

will be held at Cathedral of the Pines, located at 760 Caribou Trail in Lutsen from 7

to 9 p.m. This meeting was originally scheduled for March 1, but was cancelled due

MPCA water quality monitoring results indicated turbidity levels exceeding state

standards. As a result, the Poplar River was added to the Minnesota Pollution

Control Agencyís (MPCA) list of impaired waters in 2004. Once a water body is

The SWCD is serving as the local resource agency for the project and has

Institute for biological sampling and Minnesota Sea Grant for outreach and

such as the imegaslumpi erosion-control project initiated by the Poplar River

Management Board will be discussed. A U.S. Environmental Protection Agency

contractor is working with MPCA and will complete the majority of the study's

technical work. The EPA contractor will provide an overview of this work and

added to this list, the MPCA is required to determine its Total Maximum Daily Load.

The TMDL is the maximum amount of a pollutant or pollutants the water body can

subcontracted the University of Minnesota Duluthis Natural Resources Research

education. Presentations on how this effort links to other river-related activities

May 21, 2007

to snow.

Tuesday, June 7, 6:30 to 7:30 p.m. Cathedral of the Pines

760 Caribou Trail, Lutsen, MN

discuss the TMDL process.



est ski area in the vation Minnesota has to provide the Favorite tool and our itment to providing several proposed public meetings June 7 to discuss the Minnesota Pollution Control ly and protect the

> priority commitments of the Poplar River. mountain-like River watershed is a

economic engine for the North Shore. It runs t

Management Board (PRMB), lead by Lutsen Me i partnership with the Cook County Soil and Wa

identifying and impleme s and be removed from th

ediment by 35% and PRM



River and Lake Superior. PRMB. the Cook County SWCD. the stakeholders identified and implemented \$1.7 million in con addressed the most significant sources of sediment and is gi





Staff reports

Tightline project is the largest of four Great Lake Commission grant projects intended to reduce sediment into the Poplar River at Lutsen Mountains. Engineers estimate that the project will reduce sediment by 90 tons per year and will be able to handle a 100- year rain storm. Above: This giant pipe is part of the project and it is designed to help slow down the energy of the water flowing down the hill. Left: Riprap has been installed along the channel that discharges into the Poplar River. Riprap works by absorbing and deflecting the energy of the water flow before it reaches the streambed.

Download Presentation

This last construction season saw the completion of two more significant sediment reduction projects by the Poplar River Management Board (PRMB) in collaboration with the Cook County Soil and Water Conservation District (SWCD).

With the completion of these projects, we continue to make significant and measurable progress in reducing sediment in the Lower Poplar River," said Tom Rider, president of the Poplar River Management Board.



piects intended to reduce sediment Poplar River was placed on the PCA) Impaired Rivers List because identified as a major contributor of

aully was an ongineered



 (\mathbf{A}) Poplar River Sediment Source Assessment

PowerPoint PPT Presentation





Final WEPP Modeling & Source Estimates

Additional Field & GIS Analysis

Revised WEPP Modeling



Initial Water Erosion Prediction Project Modeling

Field Measurements

* Modeling & Source Assessment



Upper watershed: 72,000 acres Lower watershed: 1,300 acres





Figure 11	Avera	ge monthl	ly turbidi	ity result	ts at the	upstr
2001 – 2006	data.	Sampling	frequenc	y varies	significa	antly
			be const	ulted wh	en inter	pretin

	Table 18 Comparison of annual loads at both sampling stations.						
	Downstream Upstream Load (tons/year) Percent of load at S000-						
	(Station	(Station	from lower Poplar	261 attributable to lower			
Year	S000-261)	S001-753)	River Watershed	Poplar River Watershed			
2001	3250	1055	2194	68%			
2002	1162	169	994	85%			
2003	1377	282	1095	80%			
2004	1831	474	1358	74%			
2005	1592	465	1127	71%			

Sediment Source	NAWE (tons/yr)	RTI (tons/ac/yr)	RTI (tons/yr)	
Developed		0.8	25	
Forest		0.32	280	
Golf	179	0.25	15	T
Ski		4.03	661	
Roads				
Ravines			225***	T la
Slumps, overland flow erosion	12)		48&&&	Tech
Slumps, mass wasting			726&&	d
Channel incision			53	צויך
Upland channels				
Total		N/A	1,985%	

Poplar River at Lutsen, MN (USGS Gage: 04012500) flow (estimated) 1976-2006 flow data; Loading Capacity at 12 mg/ITSS



Percent of Days Flow is Equaled or Exceeded

Table 5 Load Reductions Needed for Each Flow Zone Based on Load Duration Curve Approach

	Flow Zone					
		Moist Mid-Range Dry				
	High Flows	Conditions	Flows	Conditions	Low Flows	
Flow Interval (CFS)	> 260	260 - 68	68 - 41	41 - 18	< 18	
Flow Interval (%)	0-10%	10-40%	40 - 60%	60 - 90%	90 - 100%	
Capacity in lbs/day						
(tons)	25,297(13)	7,532 (4)	3,281(<2)	1,904	736	
Current Load in lbs/day ¹						
(tons)	240,623(120)	23,853(13)	28,607(14)	1,956	207	
Reduction in tons	<mark>107</mark>	<mark>9</mark>	<mark>12</mark>	<1	None	

¹ Current Load is equal to the 90th percentile value for each flow zone.

² Percent Reduction needed is based on a comparison of the 90th percentile daily load to the capacity at the mid-point of the flow zone.

Sediment Sources: Ski Slopes

- Soil Samples collected
- Major concerns
 - Gully formation
 - Less infiltration
 - Proximity to river
 - Graded slopes
- Ski slopes ranked according to sediment delivery potential score based on:
 - Gully formation
 - Distance to river
 - Area of the slope
 - Amount of vegetation
 - Berming
 - Grading

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Figure 5.3. Cumulative mean annual sediment yield from ski slopes under various cover conditions

FINAL WEPP

Modeling &

Estimates

Source

Revised WEPP Modeling

Land use dependent infiltration capacity

data obtained from 33 paired field infiltration tests

Field

Table 5.2. Mean annual sediment (tons/acre/year) delivered to the toe of the hillslope for various conditions of added artificial snow (given as depth of snow water equivalent), vegetative cover, and slope length. The vegetative cover is expressed by type, either short grass prairie (SG) or tall grass prairie (TG) and by leaf area index (LAI). LAI of .5 indicates poorest quality vs. 4.0 high quality with dense coverage on plant and dense leaf drop on soil.

The slope length used for nearly all of the calculations was 680 feet. See last item, shortened slope.

Vegetative cover	Sn	ow water equivalent o	of artificial snow (incl	ies)
Type, LAI	0 inches	10.8 inches	20.9 inches	31.5 inches
SG, 0.5	3.0 t/a/y	5.0 t/a/y	12.6 t/a/y	53.8 t/a/y
SG, 2.0	0.32	0.97	1.3	3.5
SG, 4.0	0.22	1.3	0.96	2.3
TG, 0.5	2.7	4.6	11.2	47.3
TG, 2.0	0.27	0.93	1.0	2.8
TG, 4.0	0.23	0.86	0.77	1.93
SG, 0.5 with half slope length (340 feet)	0.96	0.5	0.3	0.08

Ski slope sediment scores Maximum potential score 55. Graded and non-graded slopes vary across the resort.

Ski Run	Mountain	Total Score	Sediment Delivery Potential
Lower Caribou	Moose	11	low
Lower Cascade	Moose	11	low
Lower Meadow	Moose	16	low
Bull Access	Moose	19	low
Lower Bull Run	Moose	19	low
Moose Drop	Moose	19	low
Sugar Maple	Mystery	45	very high
Log Chute	Mystery	39	high
White Birch	Mystery	42	very high
Grouse Gully	Mystery	42	very high
Jack Alder	Mystery	40	very high
Brule	Eagle	27	medium
River Run	Eagle	29	medium
Lower Bridge	Eagle	32	high
Timber Jack	Eagle	29	medium
Karen's Corner	Ullr	32	high
Ullr	Ullr	27	medium
Flapjack	Ullr	27	medium
4-Corners	Ullr	32	high

Final WEPP Modeling & Source Estimates

nal Field &

estimates for various sediment sources in the Lower

		0.00	ac/yr)	RTI (tons/yr)	(tons/ac/yr)	(tons/yr)
	Developed		0.8	25	0&	0æ
	Forest		0.32	280	0.006&	5&
	Golf	179	0.25	15	0.07&	6 ^{&}
	Ski	5	4.03	661	0.98 - 3.93&	143 - 575&
Field M	Roads				0.72**	35**
Initial WEPP Me	Ravines		(22)	225##	(11	243##
	Slumps, overland flow erosion			48&&&	61.7 ^{&&&&}	284&&&&
	Slumps, mass wasting		34	726&&	27.7***	188****
	Channel incision		800.4	53	0	0
	Upland channels			30 -3	8).	312&
	Total		N/A	1,985%	N/A	938 - 1,370

- Erosion control training & certification 1.
- Early streambank armoring 1998
- Formation of Poplar River Manageme 3.
- Brule Mountain tight line stormwate 2005/6
- Eagle Mountain storm water system 5.
- Elimination of work roads, road signi 6. erosion - 2004-2008

- Ullr Mountain rock-lined ditches & sto 9. -2009

- 12. Caribou Highlands 'flow pathway'- a surfacing, holding ponds - 2012/13
- 13. Lower Eagle Mountain Road road s 2012/13
- 14. Mystery Mountain 'flow pathway' improvements roads/ski runs water bars, rock-lined ditches, road re-surfacing – 2012/13

this work is complex and, absent an "unlimited funding" scenario, will be completed in stages over time, with each stage building on the work of the Mega-slump repair to minimize erosi past studies. The most recent Moose/Mystery Mountain culvert an work by V of MON is very helpful in paving the way to 10. North Road improvements - rock-lin further work on the ski hill, and 11. Ullr Mountain tightline – major ravine in particular, understanding what the model represents and which factors are most important in driving sediment production.

Poplar River Mega Slump Project - During

Poplar River Mega Slump Project – Tree Planting

MN Conservation Corps crews planting trees, shrubs, and grasses on the stabilized slump with the expectation they will spread over the bank and reduce erosion from wind and raindrops.

Poplar River Mega Slump Project - After

- 10. North Road improvements rock-lined ditches, st
- 11. Ullr Mountain tightline major ravine erosion rep
- Caribou Highlands 'flow pathway' a series of road surfacing, holding ponds – 2012/13
- Lower Eagle Mountain Road road surface and di 2012/13
- Mystery Mountain 'flow pathway' improvements ditches, road re-surfacing – 2012/13

Constructed Weirs and Rip Rap at Toe of Slump

- 12. Caribou Highlands 'flow surfacing, holding ponds
- Lower Eagle Mountain R 2012/13
- 14. Mystery Mountain 'flow ditches, road re-surfacing

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er bars, rock-lined

Activities

A 500-foot section of the Ulir Mountain Trail was stabilized with riprap and reseeding.

Poplar River Management Board Investments:

- Brule Tightline -- \$156,272
- Eagle Mountain Stormwater system -- \$83,871
- Elimination/Revegetation 50% of trails/roads -- \$42,650
- Stormwater improvements to roads -\$54,265
- PRMB cash contributions --\$124,950
- GLC grant match Ullr Tightline 2011/others 2012-13 -- \$147,000
- 2014 Targeted Watershed match -- \$265,000

Total PRMB: \$874,008

Public Investments in Poplar River:

- 2006 Coastal Program Grant Megaslump Study -- \$30,000
- 2007 CWL Grant Megaslump & other projects -- \$350,000
- 2009 GLC Grant Ullr Tightline -- \$30,000
- 2010 GLC Grant -- \$687,000
- 2014 BWSR Targeted Watershed Grant -- \$829,000

Total Public: \$1,926,000

The calculated annual total suspended solids (TSS) loads are lower in recent years than in the first half of the decade.

- 2002 2006 about 1,000 tons per year average load
- 2009 2011 about 660 tons per year average load
- Suggests 35 percent decrease
- Average annual precipitation fairly similar (26.3 versus 27.7 inches).
- Expect continued decrease in sediment loading

	<u>TSS Standa</u>	rd Exceedances Dat	<u>a Summary</u>			
		2002 - 2007	2009 - 2016			
Year	% > 10 mg/L	Pre-BMP 6-year Average	Post-BMP 8-year Average	TSS Standard		
2002	47%	29%		10%		
2003	33%	29%		10%		
2004	28%	29%		10%		
2005	28%	29%		10%		
2006	10%	29%		10%		
2007	27%	29%		10%		
2008*	14%			10%		
2009	10%		8%	10%		
2010	12%		8%	10%		
2011	4%		8%	10%		
2012	3%		8%	10%		
2013	11%		8%	10%		
2014	10%		8%	10%		
2015	8%		8%	10%		
2016	2%		8%	10%		
Pre-BMP 6-year Ave	erage 29%					
Post-BMP 8-year	8%					
Average						

Continued Roles and Responsibilities of Cooperating Partners

Objective	Lead / Partners	Objective measurements/Outcomes
Top 10 BMPs as identified in GLRI grant proposal. 400 tons sediment reduced.	Area landowners / SWCD, BWSR, MPCA, DNR	4 projects completed in 2010-2013. 6 remain, mostly associated with road improvements/ski runs. Review recent WEPP model report for additional critical sources to target. Prioritize projects and continue to implement BMPs
Completed BMPs are assessed annually, maintained per schedule	Landowners / SWCD	Annual checklist completed. Repairs completed as needed.
Erosion/stormwater ordinance enforced	Cook County Zoning / MPCA	100 $\%$ Permits issued meet code. 100% Inspection reports complete and in compliance
Lutsen AUAR mitigation plan elements enforced for new developments	Cook County Zoning / AUAR committee, landowners	New developments defined by mitigation plan standards/limits. Special strategies are tracked e.g. the number of Low Impact Development practices installed
Monitoring & data evaluation: Biological data - 2013/14, Stream flow and chemistry ongoing	MPCA, DNR / SWCD, landowners	Stream chemistry, flow, biology, geomorphology collected and assessed via Intensive Water Monitoring protocols. Reports associated with IWM shared with stakeholders for future BMP work discussions.
Landowner education and engagement	PRMB landowner organization / SWCD, MPCA, DNR	# of projects completed, PRMB regular meetings well attended and broad stakeholder group, SWCD info/planning and outreach efforts include Poplar River, training certifications up-to-date
Re-route of the wastewater lagoon discharge pipe to eliminate surface erosion on the mega-slump face	PRMB landowner organization, Caribou Highlands Resort / SWCD, MPCA, DNR	Re-route is installed and functional, slump surface is re-vegetated and stable
Upper watershed managed for continued high water quality	Upper watershed landowners, USFS, county offices / SWCD, DNR	Periodic water quality monitoring and fisheries reports indicate high quality water. Agency staff share info/data with PRMB, local stakeholders

STAYING ENGAGED

Figure 1. Cross section #1 through the proposed project area showing boring soil types and horizontal drains installations (no longer proposed). The green colored line is the depth at which seeps occur on the hillside and the depth at which the slope failure originates based on monitoring data.

Table 1. Estimated sediment reduction of remaining proposed projects in the Lower Poplar River Watershed

Remaining Sediment Reduction Projects in the Lower Poplar River Watershed	Estimated Sediment Reduction (tons/yr)
Catwalk Slope Stabilization	9,750 (Max); 50 (Min)
Poplar River bank stabilization at Sugar Maple Trail	155
South Branch of Poplar Tributary Restoration	100
Meadows Gully???	?
Waterbars and slope stabilization at Moose Return Trail	3
10th Mountain critical planting area	3
Lutsen Mountains Base Area Stormwater Detention Pond	?
Other road stabilization projects	?

Findings of the MPCA review committee

- "From 2005 through 2017, landowners in the immediate watershed of the impairment have completed a lengthy list
 of BMP work. This included near-channel BMPs to mitigate eroded streambanks and ravines, and upland BMPS to
 mitigate a host of erosion sites. The result has been significant improvements in TSS concentrations. While the
 nominal percentage of exceedances of the standard has remained above 10% at site S004-406; the measurements
 were taken for the purpose of load monitoring, and are hence biased towards rain events and not representative of
 overall conditions. The additional use of hydrologic monitoring data and FLUX modeling, however, allows the
 accurate estimation of daily TSS concentrations and provides a very good basis for assessment of water quality
 related to the attainment of the TSS standard.
- Exceedances of the standard, calculated in this manner, have decreased from an average of 29% in years 2002-2007 to an average of 8% in years 2009-2016 (the most recent year for which such calculations are available).
- Delisting is recommended."
- For information about the impaired waters list https://www.pca.state.mn.us/water/minnesotas-impaired-waterslist

https://vimeo.com/124979852

A HAPPY ENDING BUT....