APPENDIX A
THUNDER BAY RIVER WATERSHED HISTORICAL WATER QUALITY DATA

Historical data indicates that increased pressure from development, agriculture, and land use practices along with eroding surfaces, lack of resource planning, and enforcement are negatively affecting the water resources in the area. Some of the *known* threats to the watershed were identified as: erosion, sediment, thermal pollution, loss of riparian buffers, coliform bacteria, logging practices, road/stream crossings, livestock access, stormwater discharge, and excess nutrients. A list of *suspected* pollutants and causes include: faulty septic systems, lack of land use planning, improper animal waste facilities, runoff from feedlots, phosphorus, pesticide, and fertilizer application from agriculture and residential applications.

The following is a list of studies completed within the watershed area which highlight known or suspected pollutants threatening the watershed. Some of the studies discuss the source of the pollution and offer recommendations on how to reduce or eliminate the pollutants.

A Biological Survey of the Thunder Bay River Watershed, 2003 MDEQ

- Biological, chemical, and physical habitat conditions of the Thunder River (including the North, Upper South, and Lower South Branches) were assessed.
- It was determined that Hubbard Lake and Beaver Lake were not meeting the Michigan Water Quality Standards (MWQS). Both lakes have been listed on the 303(d) non-attainment list for exhibiting elevated mercury or polychlorinated biphenyl levels in fish.
- The macro-invertebrate community and water chemistry data collected indicated that all stations sampled met the requirements of the MWQS.

Resource Assessment of Alpena County, 2001 Alpena Conservation District

- The County of Alpena was determined to be at risk of groundwater contamination resulting from high water table (50 feet from the surface in some areas) and highly permeable soils. There is also an occurrence of karst topography in parts of the county, potentially serving as direct conduits for surface runoff to contaminate groundwater.
- Erosion has been identified as a major contributing factor to surface water pollution.
- Pollutants and bacteria from faulty septic systems could be a major factor in the County's decline of water quality.
- Agricultural and residential applications may be contributing to the water quality decline.
- Sedimentation and thermal pollution along the riparian corridors and the loss of riparian buffers has contributed to the decline in cold water fisheries in some rivers.

Source Water Assessment Report for the Alpena Water Supply, 2000 U.S. Geological Survey.

- Nonpoint sources of concern to the Alpena water supply are primarily from agriculture and livestock in the Thunder Bay River Watershed, and from residential and commercial sources in Alpena and surrounding communities.
- The periodic presence of coliform bacteria at detectable levels in the water source is indicative of a relationship between runoff and soil conditions.

A Biological Survey of the Thunder Bay River and Selected Tributaries, 1997 MDEQ.

- Macro-invertebrate data collected at selected sites suggested water quality was acceptable and revealed no clear biological integrity impairment.
- Physical habitats at five of eight locations were rated moderately to severely impaired. The study noted that historical logging practice, current road/stream crossings, and livestock access contribute to the impaired habitat conditions.

- Water and sediment chemistry data revealed unusual characteristics related to stormwater discharge at the Village of Hillman, and livestock access near Curran.
- Nitrogen, phosphorus, chemical oxygen demand, and suspended solids were elevated in the eastern branch of Wolf Creek and near the Village of Hillman.

Northeast Michigan Karst Aquifer Protection Plan, 1996 Presque Isle Soil Conservation District.

- A critical area was defined based on aquifer sensitivity and the probability for groundwater contamination. Portions of the North Branch of the Thunder Bay River fall within this sensitive area.
- Priority pollutants identified for the sensitive area include the following: Pathogens, Nitrates, Sediment, Pesticides, Hydrocarbons, Salts, and Heavy Metals.

Thunder Bay River Basin Report, 1995 United States Department of Agriculture, Forest Service and Natural Resources Conservation Service

Local coordinating committees identified the following sources that may potentially threaten water quality.

- Old or poorly maintained septic systems that are not up to current code may be contributing pollutants such as nutrients and bacteria to the watershed.
- Sedimentation is seen as a major threat to surface water quality. Erosion sources include agricultural cropland, livestock pasture, forest harvesting areas, eroding streambanks and lakeshores, runoff from roads, drainage ditches, and construction sites.

Streambank Erosion Inventory, Thunder Bay River Michigan, 1993 USDA Soil Conservation Service

- The inventory identified 11 streambank erosion sites on the Lower South Branch and 23 streambank erosion sites on the North Branch.

Biological Survey of the North Branch, Thunder Bay River Montmorency County Michigan, 1989 MDEQ

- The study found that the North Branch of the Thunder Bay River was impacted by nonpoint source sedimentation and nutrient enrichment originating from cattle access and crop runoff.

Agriculture Areas of Water Quality Concern, 1980 NEMCOG

- Four sites within the watershed were deemed as having the potential to contribute nonpoint source pollution. (The remaining two sites are not located within the scope of this plan)
- Butterfield Creek--Several dairy operations are located within a quarter mile of the river. Erosion of cropland is a concern since over 90% of the watershed is in row crop production.
- Wolf Creek--Three livestock operations are located on the river. Lack of animal waste systems, runoff from feed lots, and livestock access to surface water suggests the possibility of a water quality problem.

Water Quality of the Thunder Bay River, 1980 NEMCOG

- The average Water Quality Index for all 21 stations is 82 on a scale of 100, again suggesting that the overall quality of water in the Thunder Bay River system is good.
- The sources potentially responsible for the decreasing water quality in the vicinity of the City of Alpena includes rural nonpoint source pollution, industrial and sanitary waste discharge and urban runoff.
- In 1981, a study conducted by the Northeast Michigan Council of Governments also identified urban runoff and stormwater runoff as serious threats to the water quality.

A Water Quality Survey of 48 Lakes in Northeast Michigan, 1979 NEMCOG

- This study was conducted to designate a lake classification based on Carlson's Trophic State Index (TSI). This classification is based on secchi depth, total phosphorus, and chlorophyll a levels.
- Hubbard Lake was classified as mesotrophic, whereas, Fletcher Pond was classified as borderline eutrophic.
- The study recommended that lake associations and local communities institute effective lake management programs. Recommendations include decreased nutrient input and proper riparian stewardship.

Hubbard Lake, Alcona County, Michigan-Water Quality Study, 1976 MSU

- Nine of ten stations sampled indicated high counts of Fecal Streptococci Bacteria, evidence of septic system effluent.
- Lakeview Drive canal exhibited higher concentrations of nitrate and organic nitrogen, alkalinity, conductivity, chlorides, total dissolved solids, color, silica, calcium, magnesium, sodium, sulfate and iron.
- The greater visibility of algae and aquatic plant growth indicates higher dissolved phosphorus concentration.

The study recommended strict nutrient control measures, highlighting more stringent septic requirements.

APPENDIX B

Streambank Erosion Inventory

Site Number:_____ Date:_____
County:_____ Map Sheet Number_____
Photo Numbers:_____ Personnel:_____

LOCATION

Township Name:_____ Township Number:_____Range_____Section_____

GPS Coordinates_____N_____W

Owners: FEDERAL COUNTY STATE PRIVATE_____

Landmarks, Features:_____

SITE INFORMATION

BANK--While looking downstream: RIGHT LEFT

Is there access to the site for equipment?: YES NO

If no, distance to nearest road (estimate):_____

CONDITION OF BANK (Circle)

A. TOE IS UNDERCUTTING
B. TOE IS STABLE, UPPER BANK ERODING
C. TOE AND UPPER BANK ERODING
D. PERCENT OF VEGETATIVE COVER ON BANK: 0-10% 10-50% 50-100%
E. OTHER (Describe):_____
F. PROBLEM TREND: INCREASING DECREASING

APPARENT CAUSE OF EROSION (Circle any applicable)

A. LAND USE (MOWING, CLEARCUTTING, DEVELOPMENT)
B. FOOT TRAFFIC, BOAT ACCESS, FISHING SITE
C. PEAKING (THUNDER BAY POWER)
D. SURFACE WATER ENTERING
E. BEND OR OBSTRUCTION IN RIVER
F. WILDLIFE USE
G. WAVE ACTION
H. BANK SEEPAGE
I. OTHER:_____

Streambank Erosion Inventory, continued

AMOUNT OF EROSION AND SLOPE RATIO

A. SIDESLOPE OF BANK (Circle one):
Vertical 1:1 2:1 3:1 4:1 or Flatter
B. LENGTH OF ERODED BANK: _____
C. AVERAGE HEIGHT OF ERODED BANK: _____

RIVER CONDITIONS

A. APPROXIMATE WIDTH OF RIVER:_____
B. DEPTH OF RIE:_____AT_____FROM THE BANK
C. CURRENT: SLOW MODERATE FAST

SOIL TEXTURE

SAND CLAY LOAM GRAVEL STRATIFIED SAND OVER CLAY
OTHER_____

SEVERITY OF SITE: MINOR MODERATE SEVERE

TYPE OF RECOMMENDED TREATMENT (Circle all that apply);

A. ROCK RIP-RAP
B. BIOLOGS/TREE REVETMENTS
C. TREE REVETMENT
D. BANK SLOPING
E. STAIRWAYS
F. BANK SEEDING OR PLANTING
G. BRUSH PLACEMENT
H. FENCING
I. OTHER_____

DRAWING OF SITE, COMMENTS

APPENDIX C

Thunder Bay River Watershed
Streambank Erosion Severity Index

Condition of bank	Points	Soil type or texture	Points
Toe and upper bank eroding	5	Sand	3
Toe undercutting	3	Gravel	2
Toe stable, upper bank eroding	1	Stratified	2
		Clay, loam	1
Problem trend		**Vegetative cover on bank slope**	
Increasing	5	0-10%	5
Decreasing or stable	1	10-50%	3
		40-100%	1
Side-slope of bank		**Apparent cause of erosion**	
Vertical, 1:1	5	Light access traffic	1
2:1, 3:1	2	Obstruction in river	1
4:1 or flatter	1	Bank seepage	1
		Gullying by side channels	1
		Bend in river	2
		Wave action (impoundments)	2
		Road-stream crossing; grade/shoulder runoff	3
		Moderate access traffic	3
		Heavy access (foot, horse, etc.) traffic	5
Length of eroded bank		**Mean height of eroded bank**	
More than 50 ft.	5	More than 20 ft	7
20 to 50 ft.	3	10 to 20 ft	5
Less than 20 ft.	1	5 to 10 ft	3
		less than 5 ft	1
Depth of river		**Current**	
3 ft or over	2	Fast	2
Less than 3 ft	1	Slow	1
		Total Points for Site	

Accumulative points indicate extent of erosion, i. e., the site rating, as follows:

More than 36-----Severe
30 to 36----------Moderate
Less than 30------Minor

Appendix D
Hubbard Lake Shoreline Inventory Form

Date:____________________ Technician:_______________________ Weather:_________________________

Site #	GPS	Description	Cladophora	Clado Habitat	Greenbelt	Erosion
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy
			N Lt Med Hvy	Y N	0 .5 1 1.5 2 2.5 3	N Lt Med Hvy

APPENDIX E
ROAD STREAM CROSSING FIELD DATA FORM

Collected By: _____ Field ID:
Date: _____ Site ID:

LOCATION

Stream
Name:_____County:_____RoadName:_____
Crossing Name:_____Township:_____T_____R_____Sec._____

Type of Crossing:
_____Bridge
_____Single Culvert
_____Twin Culvert
_____Triple Culvert
_____Box Culvert
_____Other_____

Adjacent Landowners:
_____USA
_____State
_____Local Gov't
_____Private
_____Other

ROAD DATA

Width at Crossing: _____ft.
Road Surface: _____Paved
_____Gravel
_____Sand
_____Other_____

Approaches:

	Left	Right
Length:	_____ft.	_____ft.
Slope:	_____ 0%	_____
	_____ 1-5%	_____
	_____ 6-10%	_____
	_____ >10%	_____

Maintenance: _____Seasonal
_____Year around

Location of Low Point:
_____At stream
_____Other _____
_____

Ditch Shoulder Vegetation:

Upstream		Downstream
_____	None	_____
_____	Partial	_____
_____	Heavy	_____

Existing Drainage Control Features:

_____None _____Present and Functional
_____Need Repair_____

Width of Grade, including Shoulder and Ditches:_____ft.

Runoff Path:_____Roadway _____Ditch

CULVERT DESCRIPTION

Length: _____ft.
Diameter: _____ft.
Material: _____Galvanized
_____Concrete
_____Other_____

Condition: _____Good
_____Fair
_____Poor

Flow Through Culvert: _____Clear
_____Obstructed

Fish Passage Problems:_____

	Inlet	Outlet
Fill Depth:	_____ft.	_____ft.
Embankment:	_____Vertical	_____
	_____ 1:1	_____
	_____ 1.5:1	_____
	_____ 2:1	_____
	_____ >2:1	_____

STREAM CHARACTERISTICS

	Upstream	Downstream
Ave. Width:	_____ft.	_____ft.
Ave. Depth:	_____ft.	_____ft.
Ave Current:	_____ Slow	_____
	_____ Moderate	_____
	_____ Fast	_____
Predominate Substrate:	_____ Sand	_____
	_____Sand/gravel	_____
	_____ Gravel	_____
	_____ Muck	_____

Adjacent Wetlands:_____Yes _____No
Water Temperature:_____
Visible Down cutting:_____

Comments:_____
_____
_____

CONDITIONS AND TREATMENT

Erosion Conditions:

_____ Streambank Erosion Adjacent to Crossing
_____ Embankment Erosion
_____ Culvert Outlet Erosion
_____ Pool Formation at Culvert Outlet
_____ Shoulder/Ditch Erosion
_____ Sand/Soil Over Crossing
_____ Other_____

Recommended Treatment:

_____Pavement
_____Pave Curb & Gutter
_____Erosion Control Structures ( )
_____Sediment Basins ( )
_____Extend Culvert ( )
_____Diversion Outlets ( )
_____Increase Fill
_____Replace Culverts ( )
_____Other_____

Extent:

_____Minor _____Moderate _____Severe

Reason for Recommendation:_____

Cause: _____
_____

PHOTOS Film Numbers:_____

SITE SKETCH

APPENDIX F

Severity Scoring Worksheet

Road/Stream Crossing Inventory
Thunder Bay River Watershed

Site I. D. _____

Factors Contributing to Severity	Points	Site Score
ROAD SURFACE	Paved: 0 pt Gravel: 3 pt Sand and Gravel: 6 pt Sand: 9 pt	
LENGTH OF APPROACHES	0-40 ft: 1 pt 41-1000 ft (0.008-0.189 mi.): 3 pt 1001-2000 ft (0.19-0.379 mi.): 5 pt > 2000 ft (>0.379 mi.): 7 pt	
SLOPE OF APPROACHES	0 %: 0 pt 1-5%: 3 pt 6-10 %: 6 pt >10 %: 9 pt	
VEGETATIVE COVER OF SHOULDERS & DITCHES	Heavy: 1 pt Partial: 3 pt None: 5 pt	
WIDTH OF ROAD, SHOULDERS & DITCHES	< 15 ft: 0 pt 16-20 ft: 1 pt > 20 ft. 2 pt	
EMBANKMENT SLOPE	Bridges: 0 pt >2:1 slope: 1 pt 1:5-2:1 slope: 3 pt Vertical or 1;1 slope: 5pt	
STREAM DEPTH	0-2 ft: 1 pt >2 ft: 2 pt	
STREAM CURRENT	Slow: 1 pt Moderate: 2 pt Fast: 3 pt	
EXTENT OF EROSION	Minor: 1 pt Moderate: 3 pt Severe: 5 pt	
TOTAL	**0-15 Minor** **16-29 Moderate** **≥ 30 Severe**	

Appendix G:
Definition Of Terms Used In Road/Stream Crossing Data Collection

- *Adjacent Landowners:* Ownership was determined from county plat book maps**,** however recent changes in ownership may not be reflected, and should be re-checked prior to any improvement work.
- *Average Width of Grade:* The distance between and including both ditches and the roadway.
- *CMP:* Corrugated metal pipes of various diameters and lengths, also referred to as culverts.
- *Corrective Measures/Drainage Control Features:* Any best management plan measures used to correct site-specific erosion problems, generally these include diversion outlets, erosion blankets, and sediment basins.
- *Depth of Fill:* A vertical measurement of the amount of soil between the top of the culvert and the grade of the road.
- *Embankment:* The slope associated with the inlet and outlet of a corrugated metal pipe or box culvert, however in the case of bridges, embankment refers to the slope of the stream bank adjacent to the crossing.
- *Extent of Erosion:* An arbitrary estimate of site specific erosion, where if little to no erosion is evident it is considered by default to be minor. Moderate and extreme follow accordingly to the severity of conditions, including grading spoils and gully formation respectively. However, these estimates do not reflect erosion potential.
- *Fish Passage Problem:* This refers to the flow through a culvert and whether or not fish passage is possible, as certain obstructions have the potential to impede passage.
- *Flow through Culvert:* An indication of obstruction to flow. *Clear* indicates that current flow is unaffected by the presence of any type of road/stream crossing. *Obstructed* flow is generally associated with large debris accumulations, such as beaver dams, or due to large sediment inputs associated with run-off or grading.
- *Intermittent:* A stream that flows only temporarily or only at certain times annually, and may remain dry for the majority of the year.
- *Length of Approaches:* The downward slope of a road approaching a stream crossing, where typically the stream is located at the low point.
- *Perennial:* A stream that flows continually year around, however, predictable changes in discharge are observed on an annual basis.
- *Recommended Treatment:* One or more best management practices are recommended for each site. The practices were selected based on proven ability to reduce sedimentation and are generally accepted by road and resource professionals. In some cases, the road commission may select an alternative treatment; the recommendations serve only as a starting point.
- *Run-off Pathway:* The course of run-off to a stream channel, this may be via two general routes, the road or ditch/shoulder. Typically, roads with a surface of either gravel or sand result in run-off traveling down the road, however exceptions exist, especially if the road is convex or crowned.
- *Slope of Approaches:* The ratio of an increase in height over the distance of a given road and is usually expressed as a percentage.
- *Stream Current:* Average upstream and downstream current was observed and classified as slow, medium, or fast. These descriptions correspond to velocities of approximately: slow = 0 to 0.5 ft/sec; medium = 0.5 to 2.5 ft/sec; and fast = >2.5 ft/sec.
- *Vegetation:* Defines the presence, absence, and relative abundance/condition of existing vegetation on the embankments of a given crossing. Generally, vegetation that is at all disturbed by access or road grading is considered to be partial.
- *Visible Down Cutting:* This indicates the scouring of the stream channel at the outlet of the culvert resulting in pool formation.
- *Wetlands:* Any stand of vegetation that is typical of an area of land that is at least partially inundated by water for part of the year.

Appendix H:

Agricultural Inventory for the Thunder Bay River Watershed

(Data form for farm operations within 1000 feet of surface water.)

Date:_____ Observer:_____ Stream:_____

1) LOCATION

County Township No.: Range: Section:
GPS Coordinates:
Property Owner:

2) FARM INFORMATION

Type of operation: □ Livestock □ Crops □ Orchard
Estimated size of farm:_____acres
General topography: □ Flat □Gently rolling □ Moderately rolling □ Steeply rolling
Estimated riparian frontage of farm:_____feet

3) SITE INFORMATION

Soil type: □ Clay □ Organic □ Sand □ Loam
Stream Conditions:

- Approximate width of stream:_____ • Current:____fast ____moderate ____ slow

Are there drains at this site? □ Yes □ No
Are there foreseeable risks to: □ surface water, □ groundwater, or □ wetlands from the farm site?

4) APPARENT POLLUTANT SOURCES

□ Unrestricted Livestock Access to Water

- Approximate length length of access:_____

□ Crop production adjacent to water (poor buffer/filter strip)

- Approximate length of production area along waterway:_____
- Distance from crops to water:_____ • Type of crops:_____
- Conservation tillage (reduced till or no till)_____

□ Feedlot runoff

- Size of feedlot:_____ • Proximity to waterway_____ft. • Slope_____

□ Manure Storage area runoff

- Size of area:_____ • Proximity to waterway_____ft. • Slope_____

□ Manure Application within 150 feet of a waterway
□ Poor storage of fertilizer/pesticides
□ Is the land Irrigated Y N
□ Other (please describe, such as oil & gas operation, silage runoff, milking parlor runoff, mining, farm road runoff, etc.):_____

5) RECOMMENDED TREATMENT

a. Exclusion Fencing
   - Total amount of fencing (for both sides of stream, if necessary) needed:_____ft.
b. Livestock crossing/livestock access
c. Alternate water source
d. Riparian buffer/filter strip
   - Width of buffer strip recommended:_____ft. • Length of buffer strip:_____ft.
e. Fertilizer/pesticide storage
f. Erosion control structures:_____
g. Animal waste facility
h. Feedlot diversion and water retention basin
i. Nutrient Management Plan
j. Other:_____

6) SEVERITY OF SITE

□ Slight □ Moderate □ Severe

7) PERCEIVED LEVEL OF COOPERATION FROM LANDOWNER (if known)

□ Very willing to implement BMPs □ Somewhat willing □ Unwilling □ Unknown

Please sketch map of site, showing direction of runoff, proximity to waterbody, and noting any site-specific concerns.

Additional notes for treatment (cost estimate):

Appendix I

LOAD REDUCTION CALCULATIONS FOR
THUNDER BAY RIVER WATERSHED INITIATIVE: PHASE TWO

Agricultural Load Reduction Estimations

Calculation Formula
Erosion Calculation: Height x Length x Severity Index x Soil Index = Channel Erosion Equation
Nutrient reduced (lb/yr) = Sediment reduced (T/yr) x Nutrient conc. (lb/lb soil) x 2000 lb/T x correction factor

County	Pollutant Source	Management Practice	Total Soil Saved Tons/year	# Phosphorus Saved/year	# Nitrogen Saved/year
Alcona County	4 Livestock feed lots (approximately 410 cattle)	Exclusion Fencing Buffer Strips Watering facility Stream Crossings Waste facility	434.6	182.0	229.9
Alpena County	5 Livestock feed lots (approximately 192 cattle, about 120 of which are dairy)	Buffer Strip Watering Facility Stream Crossing Runoff Diversion Runoff Basin Waste Facility	383.4	360.9	192.6
Montmorency County	1 Livestock feed lot (approximately 100 dairy cattle)	Exclusion Fencing Buffer Strip	8.5	8.5	4.2
Presque Isle County	2 Livestock feed lots (approximately 300 cattle, about 190 of which are dairy)	Runoff Diversion Runoff Basin Buffer Strip Watering facility Stream Crossing	25.5	25.5	12.7

Streambank Load Reductions

Formula Used for Streambank Erosion Calculations:
Erosion Calculation: Height x Length x Severity Index x Soil Index = Channel Erosion Equation

County	Pollutant Source	Cumulative Length of Bank	Management Practice	Average Total Soil Saved Tons/year
Alcona County	1 Moderate erosion site	70 ft.	Install stairway & fishing platform Bank seeding/planting	16.6
Alpena County	14 Moderate erosion sites	1,680 ft.	Install stairways Bank seeding/planting Bio-logs Tree revetments Fencing Rock riprap	232.3
	2 Severe erosion sites	400 ft.	Bio-logs Tree revetments Stairways Bank seeding/planting	118.3

Road/Stream Crossing Load Reductions

Road Stream Crossings Calculations:
Erosion Calculation: Height x Length x Severity Index x Soil Index = Channel Erosion Equation

County	Pollutant Source	Pollutant Cause	Management Practice	Average Total Soil Saved Tons/year
Alcona County	5 Severe Road/Stream Sites	Embankment erosion Sand/soil over crossing Pool formation Culvert outlet erosion	Pave approaches, curb & gutter Erosion control structures Improve/replace/extend culvert Diversion outlet Increase fill over culvert	53.0
Alpena County	1 Severe Road/ Stream Site	Shoulder/ditch erosion Sand/soil over crossing	Pave approaches, curb & gutter Erosion control structures	22.5
	5 Moderate Road/Stream Sites	Streambank erosion Embankment erosion Sand/soil over crossing Shoulder/ditch erosion Pool formation	Pave approaches, curb & gutter Erosion control structures Diversion outlet Sediment basin	7.8
Montmorency County	2 Severe Road/ Stream Sites	Embankment erosion Sand/soil over crossing Shoulder/ditch erosion	Pave approaches, curb & gutter Erosion control structures Increase fill over culvert Diversion outlet	56.3
	2 Moderate Road/ Stream Sites	Embankment erosion Sand/soil over crossing	Pave approaches, curb & gutter Increase fill over culvert Improve/replace/extend culvert Diversion outlet	17.0

Appendix J

The Project Implementation Timeline is a schedule for implementing the NPS management measures identified in this plan. The bulleted items represent interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

THUNDER BAY RIVER WATERSHED INITIATIVE: PHASE TWO **PROJECT IMPLEMENTATION TIMELINE**	
SHORELINE PROTECTION-RIPARIAN LANDOWNER RECOMMENDATIONS	
Follow up initial shoreline survey with an educational program for property owners around the lake.	3-5 yrs.
Conduct workshops for property owners on proper methods of erosion control, lawn care practices that protect water quality, proper siting, installation, and maintenance of septic systems, maintaining a greenbelt, and reducing runoff.	3-5 yrs.
◆ Send summary of survey results, brochures on practical & effective actions to protect water quality to shoreline residents.	1 yr.
◆ Develop & assemble educational packet (septic maintenance, maintaining greenbelts, proper fertilizer application, etc.) to distribute to riparian landowners	2 yrs.
◆ Help landowners design a site plan to protect their shoreline.	3 yrs.
◆ Develop & institute a consistent, reliable water quality monitoring program	On-going
Educate new riparian landowners in shoreline stewardship practices	3-5 yrs.
◆ Work to familiarize Real estate agents, developers, excavators & landscape/lawn care companies with shoreline stewardship practices for protecting water quality.	3-5 yrs
Complete a comprehensive lake assessment of Hubbard Lake	2-4 yrs.
Develop a plan to monitor water quality for Lake Hubbard	2-4 yrs.
◆ Develop comprehensive list of monitoring activities; include such indicators of lake water quality as DO, condition of biological communities, shoreline algae temperature, conductivity, pH, flow, trophic state, nutrients, land cover types, types & quality of habitat, non-native species, and presence of metals & chemicals.	2 yrs.
◆ Draft plan for data management & reporting, develop QAPP	2 yrs.
◆ Pursue funding for implementation of plan	2-4 yrs.
Educate public in ways to identify and deter the spread of invasive species	2-3 yrs.
◆ Develop & provide educational materials to riparian landowners, boaters & fisherman describing species found; effects on native species, habitat, recreation, & water quality; importance of deterring their spread by good lake usage practices	2-3 yrs.
Add information to database to facilitate identifying the locations of Cladophora growths during repeat shoreline surveys and in making property owner contacts.	3-6yrs. +
Inform those owners of properties with Cladophora growths of the specific results for their property	3-6 yrs.
◆ Conduct landowner survey; use to interpret cause of growth, offer individualized recommendations	2-5 yrs.
◆ After survey, perform site visits/water testing; analyze survey results	3-6 yrs.
◆ Repeat survey every 3-5 years	Ongoing
Compile accurate parcel & ownership information for shoreline database based on knowledge of Association members/shoreline residents & County Equalization Departments within the watershed.	Ongoing
Encourage lake associations in shoreline monitoring activities	Ongoing
Reduce amounts of nutrients entering water bodies from septic systems	3-10 yrs.
Encourage inspection of (& upgrades to substandard) septic systems around lake.	3-10 yrs.
◆ Meet with townships to amend ordinances; include a required inspection of septic systems at the time of property sale or transfer	3-5 yrs.
◆ Meet with townships to phase in a septic system inspection program	10 yrs.
STREAMBANK PROTECTION RECOMMENDATIONS	
Stabilize priority streambank erosion sites through the installation of corrective measures.	1-10 yrs.
Implement structural BMP's to reduce the amount of sediment from entering the river.	1-10 yrs.
◆ Develop site plans, obtain proper permits and landowner permission for 16 sites recommended for treatment	5 yrs.

◆ Secure funding and organize materials	1-2 yrs.
◆ Organize work crew and install BMP's at each of the16 sites	10 yrs.

Improve existing access sites by creating stairs, walkways, fishing platform, etc.	2-9 yrs.
• Develop site plans, obtain proper permits and landowner permission for improvement to/construction of access structures and stairways at sites	2-9 yrs.
• Secure funding and organize materials	2-5 yrs
• Organize work crew and implement BMP's for 1 site per year	3-4 yrs
Protect/restore riparian shade vegetation; restore aquatic habitat where impairment is suspected	1-6 yrs.
Educate landowners as to importance of shade vegetation	1 yr.
• Include greenbelt restoration/maintenance information in workshops for riparian landowners, stress connection between loss of vegetation and increased temperatures of coldwater fisheries, and importance of using native vegetation when restoring greenbelts	1 yr.
Restore impaired aquatic habitat	2-5 yrs.
• Organize river/lake cleanup days, recruit volunteers	2-5 yrs.
• Conduct yearly river/lake cleanups utilizing volunteers	2-5 yrs.
• Increase amount of woody debris at suitable sites	2-5 yrs.
Develop plan to increase fish passage at hydroelectric dams	2-6 yrs.
• Work with organizations such as Thunder Bay Power & Thunder Bay River Restoration Committee to determine BMPs for fish passage	2-3 yrs.
• Select best alternative; draft work plan & timetable for implementation	2-6 yrs.
AGRICULTURE RECOMMENDATIONS	
Restrict livestock access to the rivers and streams	1-6 yrs.
Develop site plans, provide water source for livestock and create proper stream crossings	1-6 yrs.
• Create site plans for 11 sites recommended for treatment	1-3 yrs.
• Obtain proper permits and landowner permission	1-3 yrs.
• Secure funding and organize materials	2-3 yrs.
• Organize work crews and install BMPs	2-6 yrs.
Install corrective measures to reduce runoff at agricultural sites of concern.	1-7 yrs.
• Develop plans; install devices to reduce runoff.	1-7 yrs.
• Develop plans for 14 identified areas of concern	1 yr.
• Obtain proper permits and landowner permission	1 yr.
• Secure funding and organize materials	1-4 yrs.
• Organize work crew and install BMP's	2-7 yrs.
ROAD/STREAM CROSSING RECOMMENDATIONS	
Reduce the amount of sediment by establishing a road/stream crossing improvement program designed to correct identified problems	2-10 yrs.
• Stabilize erosion at 16 road/stream crossings recommended for treatment	2-10 yrs.
• Develop site plans, obtain proper permits and landowner permission for priority sites	2 yrs.
• Secure funding and organize materials	2 yrs.
• Organize work crew and implement BMPs at the selected sites	2-10 yrs.
LAND USE RECOMMENDATIONS	
Establish Responsible Land-Use Practices	1-10 yrs.
Develop Thunder Bay Watershed Land Use Development Guidelines; model after the Grand Traverse Bay Guidelines & Recommended Land Use Regulations	1-5 yrs.
• Work with local government on the adoption of guidelines & regulations that provide for the protection of the water resources.	1-2 yrs.
• Develop and distribute at meetings: handouts covering model stormwater management, site plan review standards, recommended setback distances, stormwater management guidelines, greenbelt provision language, and a checklist; include emergency contact number for hazardous materials spill	2 yrs.
• Encourage removal of sewage/storm drains which discharge directly to watershed	2-5 yrs.
Deliver presentations to local units of government	1-3 yrs.
• Revise NEMCOG's PowerPoint Presentation on the connection between land use practices, nonpoint source pollution and water quality.	1 yr.
• Deliver presentations to Co. Planning Commissions & Co. Chapters of the Michigan Townships Associations	2 yrs.
Protect/restore sensitive areas such as wetlands and riparian corridors	Ongoing

Involve Riparian Landowners in lake and stream protection efforts	Ongoing
• Encourage compliance to "no wake" laws through signage explaining reason for "no wake", and by working with enforcement agencies and river watch groups	Ongoing

• Encourage riparian landowners to maintain/create native conservation buffers	On going
VOLUNTARY LAND PROTECTION PROJECTS	
Develop database of Priority Parcels within watershed	1-3 yrs.
Identify priority Parcels within the watershed	1-3 yrs.
• Develop criteria for determining what constitutes a priority parcel	1-2 yrs.
• Identify priority parcels of land utilizing GIS data from watershed inventory	1-2 yrs.
• Develop priority parcel map for watershed	2 yrs.
• Obtain land owner information of priority parcels from County Equalization Department	2-3 yrs.
Provide voluntary land protection information to riparian landowners	1-2 yrs
Develop and/or compile informational materials on easement and land donation programs to priority property owners.	1-2 yrs
• Assemble information packets and distribute to owners of priority land parcels in the watershed	1-2 yrs
Organize and hold a workshop on voluntary land protection techniques	1-2 yrs
• Develop and assemble workshop materials	1-2 yrs
• Organize workshop	1-2 yrs
• Contact priority parcel landowners to participate in workshop	1-2 yrs
Contact and meet with at least ten priority property owners for consideration of conservation easement, and/or land donation.	2 yrs.
• Contact and meet with at least 5 priority property owners each year	2 yrs.
GENERAL EDUCATION RECOMMENDATIONS	
Encourage Co. Road Commissions to explore maintenance alternatives at road/stream crossings.	1 yr.
Create model road/stream crossing site in cooperation with county road commissions	1 yr.
• Meet with Road Commissions to select model site & plan for implementation	1 yr.
Make public aware of importance of using Best Management Practices at road/stream crossings, streambank erosion sites, stormwater runoff and agricultural sites of concern.	1-5 yrs
Develop watershed protection display to take advantage of educational opportunities at local events	1-5 yrs.
• Develop brochures and/or information packets explaining the importance of using BMPs at road/stream crossings, streambank erosion sites, stormwater runoff and agricultural sites of concern	1-2 yrs.
• Set up display and distribute information at fairs and appropriate community events once or more each year. Displays will include educational materials, photos, & brochures	3-5 yrs.
Develop and implement school programs concerning water quality education.	1-5 yrs.
Implement a water quality program in area schools	1-5 yrs.
• Conduct a water resource curriculum review	1-2 yrs.
• Involve teachers and students in educational water testing/monitoring	2-5 yrs.
• Establish interactive database to which students can enter classroom data	2-5 yrs.
• Review and compile existing instructional materials for elementary and secondary students that focus on water resources, include list of water resource web-sites	2-3 yrs.
• With input from teachers, modify selected materials to make more locally relevant	2-3 yrs.
• Develop Lesson Study project	2-5 yrs.
Develop Educational Tools for Citizens of the Watershed	1-6 yrs.
Involve and educate the public on actions they can take to reduce nonpoint source pollution	2 yrs.
• Create and have installed: watershed signs, logo, drain stenciling	1-3 yrs.
• Create a series of detailed water drainage maps, 100 year flood	6 yrs.
• Create and distribute residential landowner brochures "Protect Your Watershed"; include emergency numbers for hazardous substance spills	1 yr.

Appendix K

PROJECT SUMMARY

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
Shoreline Protection	Conduct workshops for property owners	Watershed Critical Area	$10,000	Number of workshop participants	Workshops held in Alpena, Alcona & Montmorency Counties
	Educate new Riparian Land-owners in shoreline stewardship practices	All Riparian parcels in watershed	$4,000	Number of land-owners contacted	Riparian parcels on Hubbard Lake
	Develop plan to monitor water quality	Hubbard Lake Subwatershed	$15,000	Plan approved by year 2, implemented by year 4	Hubbard Lake
	Educate public to identify and deter spread of invasive species	Watershed Critical Area	$5,000	Number of households reached	North, South, and Upper South Branches of Thunder Bay River
	Develop & maintain parcel database for Hubbard Lake to facilitate identification of potential problems on the lake	Riparian parcels on Hubbard Lake	$6,500-$11,000	75%-100% of Riparian parcels entered into database.	Hubbard Lake
	Reduce amounts of nutrients entering waterbodies	Meet with townships to amend/ pass ordinances to include required inspection of septic systems at time of sale. Phase in septic system inspection program	$4,000	Number townships with ordinances so amended.	Posen, Metz, Bismarck Montmorency, Rust, Clinton, Comins, Mitchell, Caledonia, Alcona, Hawes Ossineke, Green, WilsonAlpena, Maple Ridge, and Long Rapids Townships

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
Streambank Protection	Implement structural BMPs to reduce amount of sediment entering river	16 streambank erosion sites	$128,460	Complete 2 sites per year	Sites SB01; SB02; SB06; SB08; SB09; SB10; SB11;SB12;SB13; SB14;SB15; SB16; SB17;SB18; SB19; & SB20
	Improve existing access sites by creating stairs, walkway, fishing platform	14 access sites	$25,100	Complete 1-2 sites per year	Sites SB01; SB02; SB06; SB08; SB09; SB10; SB11; SB12; SB13; SB14; SB15; SB18; SB19; SB20
	Restore impaired aquatic habitat through yearly river/ lake cleanups, increase amount of woody debris at suitable sites	Watershed critical area	$2,400	Sufficient # of volunteers to complete cleanups in critical area of watershed	North, South, & Upper South Branches of TBR
	Develop plan to increase fish passage at hydroelectric dams	Thunder Bay River	$3,000	Draft plan ready to implement 2-6 yrs.	Hubbard Lake Dam, Lower South Branch Dam

Remediate Agricural Impacts	Restrict livestock access to water bodies by installing fencing, proper stream crossings, water devices	Watershed critical area	$166,580	Complete 2-4 sites per year	Sites ALC02-ALC04; ALC06; ALP01; ALP04; ALP16; ALP19; ALP21; MO02; PI03
	Install corrective measures such as buffer strips, water runoff diversion, runoff basins, waste storage/utilization, to reduce runoff at agricultural sites	Watershed critical area	$248,545	Complete 2-4 sites per year	Sites ALC02-ALC04; ALC06; ALP01; ALP04; ALP06; ALP16; ALP19; ALP21; MO02; MO05; PI02; PI03
Remediate Road/Stream Crossing impacts	Reduce amount of sediment entering waterbodies at road/stream crossings	Watershed critical area	$421,000	Complete 2-4 sites per year	Sites ALC11; ALC12; AL 15; ALC29; ALC52; ALP01;ALP21; ALP51; ALP65; ALP66; ALP80; MO12; MO13; MO16; MO18; OS01

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
Increase Watershed-based Land Use practices	Work with local governments to develop TBR Watershed Land Use Development Guidelines	17 local units of government	$20,000	Guidelines implemented by 2-3 units of local government per year	Posen, Metz, Bismarck Montmorency, Rust, Clinton, Comins, Mitchell, Caledonia, Alcona, Hawes, Ossineke, Green, Wilson, Alpena, Maple Ridge, and Long Rapids Townships
	Protect & restore sensitive areas such as wetlands and riparian corridors through sign-age, enforcement agencies, river-watch groups. Encourage use of native conservation buffers	Watershed Critical Area	$5,000	Number of landowners in critical area contacted	All wetlands & riparian corridors in watershed critical area
Voluntary Land Use Protection	Develop database of priority parcels within the watershed	Watershed	$5,000	Data collected for 50% of watershed in 18 months, 100% in 3 yrs.	All counties of watershed
	Provide voluntary land protection information to riparian landowners through educational packets, workshop, meetings with priority parcel landowners	Watershed	$5,000	Workshop attendance; number of landowners receiving educational packets; 5 priority parcel landowners contacted each year.	All priority parcels in watershed

Task	Recommended Strategy	Scope	Cost	Measure of Success	Recommended Locations
General Education Program	Encourage Co. Road Commissions to explore maintenance alternatives at road/stream crossings through presentations & model road/stream crossing site.	All counties of watershed	$30,000	Completed model road/stream crossing site in 18 months	A priority road/stream crossing sites selected in cooperation with the road commissions
	Develop watershed protection display to take advantage of educational opportunities at local events	All counties of watershed	$3,000	Watershed protection display presented at one or more community events each year	County fairs, local festivals & community events, watershed-based conferences
	Develop & Implement school programs concerning water quality education	Schools located in Watershed	$6,000	Complete water resource curriculum review in 18 months. Educational water testing /monitoring in schools in 2 yrs. Develop, implement lesson study project in 2-5 yrs.	Pellston Schools, Cheboygan Area Schools
	Develop educational tools for citizens of the watershed	Watershed		Distribute “Protect Your Watershed” brochures—1yr. Watershed signs, logo drain stenciling projects completed—3 yrs. Create series of water drainage maps, 100-year flood—6 yrs.	Watershed critical area