Little Traverse Bay Watershed Road/Stream Crossing Inventory

Completed by Tip of the Mitt Watershed Council with support from:
Petoskey-Harbor Springs Area Community Foundation's
Little Traverse Bay Protection and Restoration Fund

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TIP OF THE MITT Watershed Council

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Background:

In 2012, a road/stream crossing (RSX) inventory for the Bear River Watershed, a subwatershed of Little Traverse Bay, was conducted by the Tip of the Mitt Watershed Council (TOMWC) as an update to a 2000 inventory conducted by Conservation Resource Alliance (CRA) and TOMWC. During the 2012 inventory, TOMWC determined there were additional stream crossings within the watershed that were not included in the 2000 inventory. In 2013, in an effort to both collect information about the previously missed sites and to update the inventory for the entire Little Traverse Bay Watershed, TOMWC pursued funding through the Petoskey-Harbor Springs Area Community Foundation to complete the Little Traverse Bay Road/Stream Crossing (RSX) Inventory. The inventory was the first watershed-wide update to the previous LTBW RSX inventory conducted in 2002. In total, the 2012-2013 inventories included 121 RSX sites.

Why:

RSXs that are improperly designed or installed, structurally failing, or no longer accommodate current stream conditions affect stream health. They can affect stream hydrology, prevent fish and other aquatic organisms from reaching up-and downstream reaches, increase water temperatures, and are sources of nutrients, sediments, bacteria, heavy metals, and other nonpoint source pollutants. In Northern Michigan, sediments pose the greatest threat to rivers and streams. Sedimentation can adversely impact fish and aquatic organisms by degrading their habitat and reducing water quality.

Watershed Management:

RSX inventories serve as a useful watershed management tool. They help to identify sediment pollution entering surface waters from poorly designed, maintained or aging infrastructure; fish passage barriers due to perched culverts or velocity barriers; and altered stream hydrology due to inadequately designed or installed crossings. Therefore, identifying failing or deficient RSXs is critical to resource management. Regular inventorying of RSXs allows road commissions and resource managers to note change in stream and structure conditions over time. Furthermore, by applying the Great Lakes Road/Stream Crossing protocol, RSXs can be ranked as minor, moderate, or severe as a means of prioritizing them for improvements or replacement.

The Little Traverse Bay Watershed is fortunate to have an active watershed advisory committee to oversee implementation of the Michigan Department of Environmental Quality and Environmental Protection Agency-approved *Little Traverse Bay Watershed Protection Plan* (2007). As part of the plan, several recommendations are included with respect to RSXs:

- D. 1. Develop strategy to update inventories on a regular basis and evaluate site severity taking into account locations identified as environmentally sensitive.
- D.2. Develop a method to keep track of repairs/records of culverts and problems.
- D.3. Develop and implement strategy to restore moderate and minor road/stream crossing sites on a subwatershed basis.
- D.4. Work closely with road commissions to utilize best management practices (BMPs) on road work within the priority areas.

- D.5. Restore most severe road/stream crossings in cooperation with the Emmet and Charlevoix County Road Commissions.

The completion of the inventory fulfills D.1. The database, including the site photos, was also uploaded to www.northernmichiganstreams.org as a means to provide access of the inventory results to resource agencies, road commissions, local governments, and others, which fulfills recommendation D.2.

Methods:

TOMWC staff and interns conducted the field inventory by evaluating each RSX within the Little Traverse Bay Watershed. The purpose of the inventory project was to comprehensively document conditions at all RSX on Little Traverse Bay's tributaries, including the Bear River and its tributaries, Haymarsh and Springbrook Creeks, as well as Walloon Lake's inflow tributaries, Fineout and Schoof's Creeks, and Five-mile Creek, Tannery Creek, and several other unnamed tributaries.

TOMWC utilized the Great Lakes Road/Stream Crossing protocol and corresponding field form, which includes the fields:

At each road-stream crossing, the following general information was collected:

1) Site identification number*;
2) Stream name;
3) Names of survey crew;
4) Date or survey;
5) GPS information (if GPS was employed);
6) County name;
7) Township, range, section (optional);
8) Adjacent landowner information (if known); and
9) Additional comments about the site.

* The previous RSX inventories assigned different systems of site identification. In an effort to apply the same framework across the entire watershed, each site was renamed with the prefix "LTB", followed by a number between one and 264. Of these, only LTB 1 through LTB 121 are included in the database (see page 6 for more information).

Each crossing was documented in terms of crossing type, whether a culvert, bridge, ford, or dam. Culverts, the most common type, were further documented in context of these parameters:

1) Shape (e.g., round, ellipse, square);
2) Inlet type (e.g., projecting, mitered, wingwall);
3) Outlet type (e.g., cascade over riprap, freefall into pool);
4) Structure material (e.g., concrete, metal, plastic);
5) Structure interior whether smooth or corrugated;
6) Structure length, width, and height;
7) General condition of culvert;
8) Substrate material in the structure and depth of embeddedness;
9) Whether structure was plugged or crushed;
10) Water depth at inlet and outlet;
11) Flow velocity at inlet and outlet; and
12) perch height at outlet (if perched).

The stream at each site was documented with regards to:

1) Flow, whether at bankfull, over, or below;
2) scour pools downstream of structure;
3) Ponding upstream of structure; and
4) Channel and flow characteristics associated with a reference riffle, which included bankfull width, wetted width, average stream depth, average flow velocity, and dominant substrate.

The road was assessed in terms of:

1) type/ownership (e.g., county, private);
2) Surface type (e.g., paved, gravel);
3) Road surface condition;
4) Width of road at culvert;
5) Location of low point, whether at stream crossing or at other location;
6) Runoff path, whether along road or into ditch;
7) Embankment slope and fill depth at structure;
8) Length and slope of approaches from both directions; and
9) Ditch information regarding vegetation.

Any erosion at the site was documented using the following:

1) Location;
2) Dimensions: length, width, and depth;
3) Whether eroding material was reaching the stream;
4) The type of eroding material (e.g., sand, clay, gravel);
5) Severity of erosion; and
6) Whether corrective actions could be installed or not.

Additional information collected includes photographs of the site, a site sketch, whether it is considered a priority site, whether a future visit is recommended, and if any invasive species were observed at the site.

All data collected during the inventory was entered into the Great Lakes Road Stream Crossing Inventory Access database by TOMWC staff and interns. The database includes formulas built into each record as a means to rank each site with respect to the following:

<u>Erosion (tons/year):</u>

Erosion is determined in Access using both field measurements and a model.

- 0 to .4 ton of sediment
- .5 to 1 ton of sediment
- 1.1 to 2.5 tons of sediment
- Over 2.6 tons of sediment

<u>Fish Passage Determination:</u>

- 1=Not a barrier
- .9=Barrier at high flows

- .5=Some species and life stages cannot pass at most flows.
- 0=Most species and life stages cannot pass at most flows.

Extent of Erosion:

- Stabilized
- Minor
- Moderate
- Severe
- Very Severe

The database then employs another formula combining the abovementioned categories to give an overall severity calculation ranking:

Severity Calculation:

- Minor
- Moderate
- Severe

Results:

In general, many culverts are undersized. Ideally, the crossing structure, whether it is a bridge, culvert, or other type of structure should span the entire width of the stream channel, and if not, it should be as wide as possible. When the stream is constricted at a crossing, stream hydrology is affected. Stream velocity increases through the crossing and can result in preventing passage of aquatic organisms both up-and downstream, as well as upstream flooding, and downstream scouring of the stream bottom.

Many culverts are aging and they are losing their structural integrity. The majority of the culverts are made of corrugated metal. Although they are able to last for decades, many of them are showing signs of deterioration as evidenced by rust, holes, and many are now compressed or “squashed”, meaning their cross-sections are no longer round or elliptical.

Another common issue noted was the “perched” culvert. Perched culverts occur when the bottom of the culvert is elevated above the streambed. Typically, this applies to the downstream end of the culvert and is the result of either improper setting of the culvert or the stream has eroded away the streambed immediately below the culvert. Perched culverts pose nearly impossible obstacles to aquatic organism passage, particularly macroinvertebrates and smaller fish. Upstream and downstream passage is critical to fish and other organisms so they can access habitat resources, as well as other genetic populations of the same species. Lack of access to stream reaches beyond the RSX isolates populations and causes habitat fragmentation.

Prior to field review, we performed a desktop review using GIS to determine the total number of RSX within the Little Traverse Bay Watershed. We found there are 264 total occurrences where a stream and road intersect. Of those, we determined only 121 were likely to have any flow or a culvert in place, therefore we field reviewed 121 RSX. The resulting rankings, by county, follow:

Table 1: Road Crossing Severity Ranking System

	Charlevoix County	Emmet County	Total
Fish Passage			
1	1	1	2
0.9	17	20	37
0.5	10	40	50
0	19	13	32
Extent of Erosion			
Stabilized	11	33	44
Minor	7	8	15
Moderate	6	12	18
Severe	4	5	9
Very Severe	1	0	1
No Data	18	16	34
Severity Ranking			
Minor	5	9	14
Moderate	13	27	40
Severe	29	38	67
Tons of sediment/year	116.65	77.72	194.37

The Access database is an excellent tool for general sorting of “good” and “bad” RSX; however, it does not allow user to rank sites relative to one another. In other words, there is no mechanism to rank one site as more of a priority than another. Another shortcoming of the database is it does not take into account stormwater runoff inputs. Although erosion from road surfaces is factored into severity ranking, other nonpoint source pollutants are not accounted for. Therefore, TOMWC has identified the priority RSX sites (see page 10) based on results from both the database, discussions with the road commissions and resource managers, and firsthand observation. The priority RSX are likely to change as RSX improvement projects are implemented, funding sources become available for specific types of stream projects, and stream and RSX conditions change.

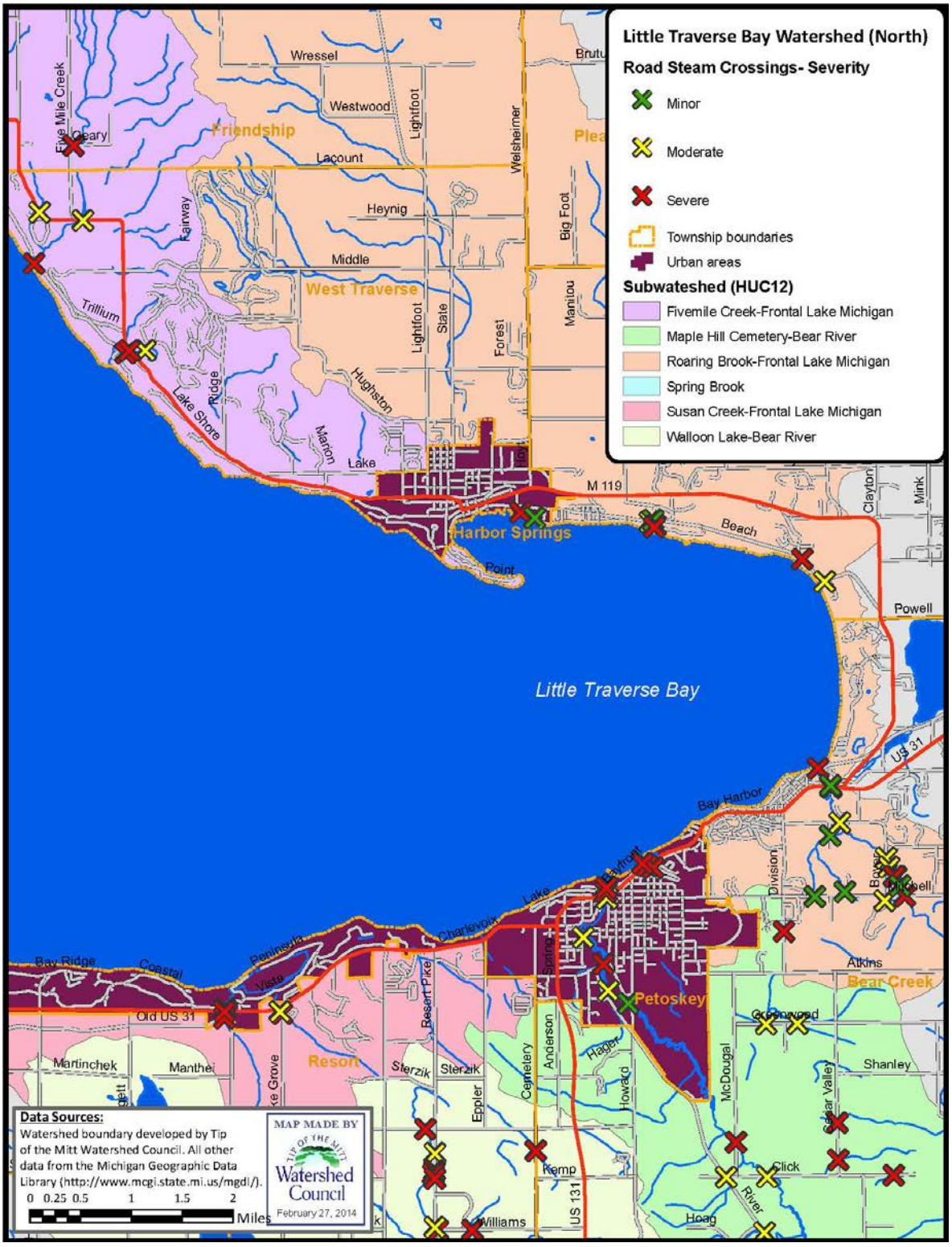

Figure 1: Little Traverse Bay Watershed Road/Stream Crossings (North)

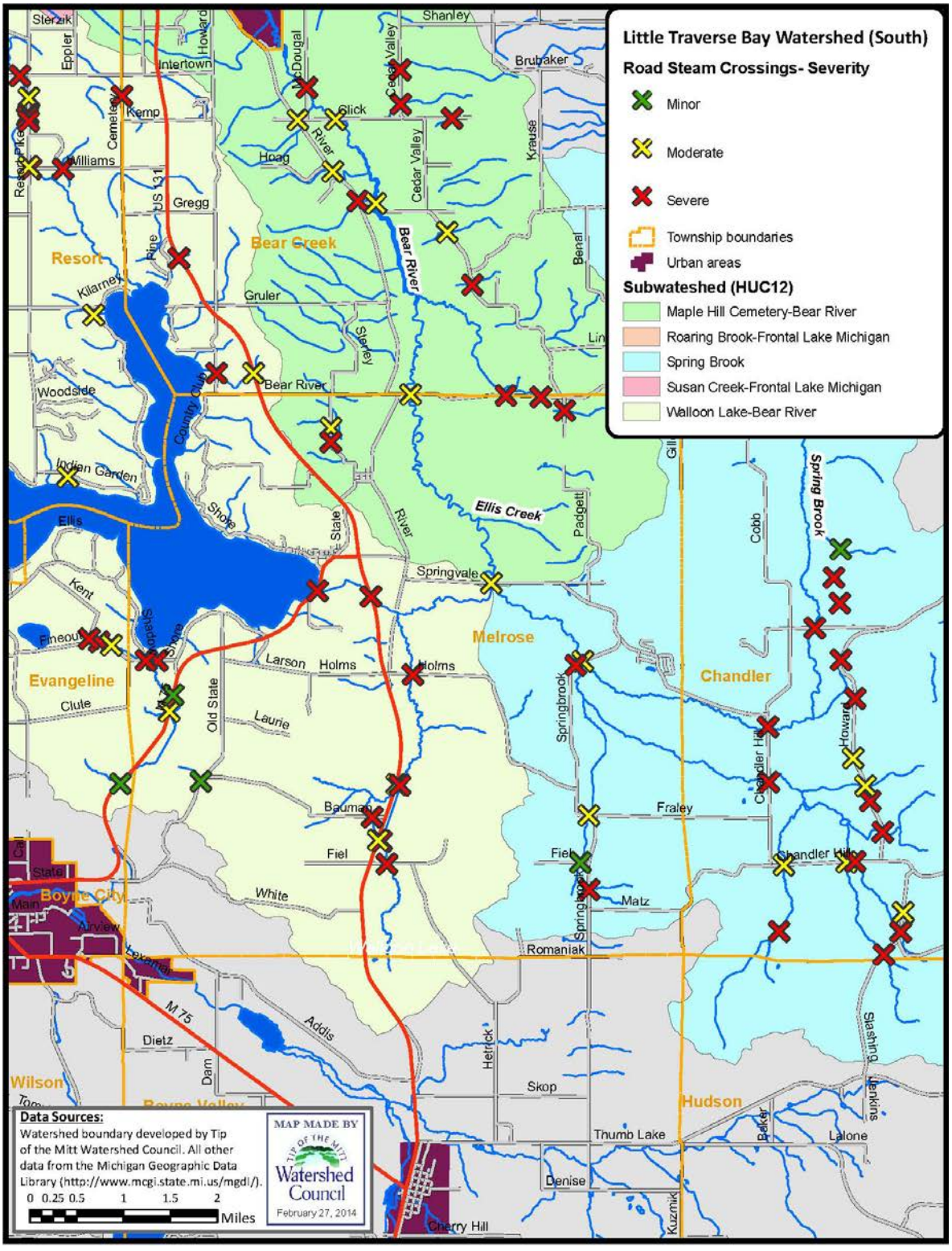

Figure 2: Little Traverse Bay Watershed Road/Stream Crossings (South)

Priority sites for future improvements:

Fineout Creek at Shadow Trails Drive, Charlevoix County (LTB 208)

Current conditions include one, four ft. wide wooden culvert of unknown age. The structure is failing, too narrow for the crossing, and partially crushed. Although the road is paved, the gravel shoulder is continually eroding into the stream. Total erosion is calculated as contributing less than one ton of sediment/year, although more sediment is suspected of entering the stream than what is estimated. Results from the Fineout and Schoof's Creek Monitoring Study (TOMWC, 2013) suggest the RSX may be contributing to lower oxygen levels and high water temperatures in the lower reach of the stream. The adjoining land use consists of high-quality wetlands. The WLTC owns and manages three preserves adjacent to the RSX, totaling over 33 acres of protected lands. They also recently acquired 50 additional acres upstream of the RSX that will protect the wetland corridor which feeds Fineout Creek. These high-quality wetlands and riparian habitat are an important component of the Walloon Lake and Bear River fisheries.

Prior to the inventory, the RSX was identified by the Charlevoix County Road Commission and representatives of the Walloon Lake Trust and Conservancy as a priority site for repair. To no surprise, the inventory process and subsequent Access database evaluation revealed the site has several serious "problems".

- Erosion (tons/year): .76
- Fish Passage Determination: .9
- Extent of Erosion: Very severe
- Severity Calculation: Severe

Proposed RSX Improvement:

- Replace existing timber bridge/culvert structure with new 24-foot span by 6-foot rise precast concrete box culvert. Restore existing paved approaches (50' each side of crossing). Locate new crossing just west of existing. Maintain flows through existing during construction. Temporary sheeting to isolate new culvert location during construction.

Cost: $172,000 based on estimate prepared by Northwest Design Group and includes engineering fees and contingency. Previous estimates for this site suggest the cost may be closer to $75,000.

Figure 3: Fineout Creek at Shadow Trails Dr. Stream inlet.

Figure 4: Fineout Creek at Shadow Trails Dr. Upstream view.

Hay Marsh Creek at Bauman Road, Charlevoix County (LTB 218)

Current conditions include two very undersized, metal culverts that are nearly completely submerged even during low flow. The stream channel has migrated over time and is intersecting with the road at an angle that is exacerbating erosion; severe erosion of the roadbed is occurring on both sides of the crossing. No roadside vegetation is present to help intercept runoff as the road width is narrow. The road bisects the wetland complex, thereby interrupting hydrology and biological processes.

- Erosion (tons/year): 9+
- Fish Passage Determination: .9
- Extent of Erosion: Severe
- Severity Calculation: Severe

Proposed RSX Improvement:

- Replace two corrugated metal pipe (CMP) culverts with new 24-foot span by 6-foot rise precast concrete box culvert. Pave approaches (100' each side of crossing). Locate new crossing just west of existing. Maintain flows through existing during construction. Temporary sheeting to isolate new culvert location during construction.

Cost: $165,000 based on estimate prepared by Northwest Design Group and includes engineering fees and contingency.

Figure 5: Haymarsh Creek at Bauman Rd. Downstream view.

Hay Marsh Creek at Romaniak Rd., Charlevoix County (LTB 215)

Current Conditions include three failing and undersized metal culverts and the gravel from the road surface is washing into the stream. The road width is narrow. Makeshift trash racks at the inlets are installed in an effort to prevent debris buildup inside the culverts.

- Erosion (tons/year): 6.3
- Fish Passage Determination: .9
- Extent of Erosion: Minor
- Severity Calculation: Severe

Proposed RSX Improvement:

- Replace three CMP culverts with new 18-foot span by 4-foot rise precast concrete box culvert. Pave approaches (100' each side of crossing). Locate new crossing just east of existing. Maintain flows through existing during construction. Temporary sheeting to isolate new culvert location during construction.

Cost: $128, 000 based on estimate prepared by Northwest Design Group and includes engineering fees and contingency.

Figure 6: Haymarsh Creek at Romaniak Rd. Stream inlet.

Bear River at Sheridan St., Emmet County (LTB 096)

The three large culverts are perched (elevated) approximately 1' above the base stream flow. The culverts are also showing signs aging. The RSX is a popular paddling pull-out destination given its proximity to the City of Petoskey's Bear River Valley Recreation Area. Unfortunately, the conditions are less than ideal given the river's velocity downstream of the culverts, the sharp bend in the channel immediately following, and the protruding, mitered metal culvert ends.

- Erosion (tons/year): .013
- Fish Passage Determination: 0
  Heather Hettinger, Michigan Department of Natural Resources Fisheries Biologist, noted that the RSX is a barrier to smaller fish species during low flows.
- Extent of Erosion: Minor
- Severity Calculation: Severe

Proposed RSX Improvement: A clear-span timber bridge would allow passage of all fish species, prevent downstream scour and upstream flooding immediately around the crossing, and allow hydrologic processes to restore channel geomorphology.

Cost: $400,000 or more based on costs for the Bear River at Click Rd. timber bridge constructed in 2012.

Figure 7: Bear River at Sheridan St. Stream outlet.

Springbrook Creek at Springvale Road, Charlevoix County (LTB 258)

Current conditions include three, undersized metal culverts in poor condition. The gravel road is contributing sediments and the culverts are constricting flow at the crossing. Fish passage is compromised at high flows. Total erosion is calculated as contributing 5.6 tons/year of sediment. The adjoining land use consists of high-quality wetlands.

- Erosion (tons/year): 5.73
- Fish Passage Determination: .9
- Extent of Erosion: Moderate
- Severity Calculation: Severe
-

Proposed RSX Improvement:

- Replace existing CMP culverts with new 50-foot timber bridge. Pave approaches (100' each side of crossing). Maintain flows through existing culverts during construction.

Cost: $367,000 based on estimate prepared by Northwest Design Group and includes engineering fees and contingency.

Tributary to Springbrook Creek at Slashing Road, Charlevoix County (LTB 244)

Current conditions include moderate localized erosion and a complete fish passage barrier. The undersized, perched and partially crushed culvert is in poor condition. Downstream, both streambanks are severely eroding due to the unstable hydrologic conditions created by the RSX.

- Erosion (tons/year): .26
- Fish Passage Determination: 0
- Extent of Erosion: Moderate
- Severity Calculation: Severe

Proposed RSX Improvement:

- Replace existing CMP culvert with new 87- by 63-inch diameter CMP arch culvert. Restore existing paved approaches (50' each side of crossing). Locate new crossing just north of existing. Maintain flows through existing during construction. Temporary sheeting to isolate new culvert location during construction.

Cost: $60,000 based on estimate prepared by Northwest Design Group and includes engineering fees and contingency.

Figure 8: Tributary to Springbrook Creek at Slashing Road. Stream outlet.

Tannery Creek at U.S. 31, Emmet County (LTB 069)

Current conditions in the area upstream of the RSX include regular and overwhelming flooding. Many of the commercial property owners have expressed great concern and invested resources into short-term fixes. Tip of the Mitt Watershed Council and Northwest Design Group have both conducted watershed studies to better understand the causes behind the flooding. Although results from these studies are not conclusive, the culvert may be undersized. According to a study performed by NDG (2004):

> *The digital (HEC-RAS) model of Tannery Creek shows that the box culvert under US-31 and the culvert under Bank One have a headwater to depth ratio greater than or equal to 1.0 for flows larger than those from a 5-year storm. When the headwater to depth ratio exceeds 1.0, the upstream water surface elevation is above the top of the culvert. For flows above that magnitude, friction losses from the culvert increase as the top surface comes into contact with flowing water. This is not to say that these drainage structures are necessarily "undersized", it simply means that they become less efficient at the higher flows.*

Furthermore, the accumulation of sediment from both upstream and localized sources at the RSX has likely reduced the capacity of the culvert, thereby exacerbating upstream and downstream problems.

- Erosion (tons/year): 0
- Fish Passage Determination: .9
- Extent of Erosion: NA
- Severity Calculation: Minor
-

Proposed RSX Improvement:

- The structure should be replaced with a larger box culvert. Exact dimension to be determined through modeling and engineering studies.

Cost: $800,000 or more based on construction and engineering costs associated with crossings of similar size and design.

Figure 9: Tannery Creek at U.S. 31. Stream outlet.

Tannery Creek at U.S. 31, Emmet County (LTB 068)

Current conditions of the RSX include an undersized culvert. The culvert is smaller than the preceding RSX (LTB 069), approximately 25 feet upstream. During rain events the area between culverts floods and the culverts are completely submerged. The asphalt drive-thru is immediately adjacent to the both the inlet and outlet of the culvert. Stormwater runoff drains directly into the stream.

- Erosion (tons/year): .0019
- Fish Passage Determination: .9
- Extent of Erosion: Stabilized
- Severity Calculation: Minor
-

Proposed RSX Improvement:

- The culvert should be replaced with a larger structure, equal to or larger in size than the U.S. 31 (LTB 069). The streambanks should be stabilized with vegetation to assist with filtration of the stormwater runoff. Drainage should be directed away from the RSX.

Cost: $250,000 based on based on construction and engineering costs associated with crossings of similar size and design.

Figure 10: Tannery Creek at Chase Bank. Stream inlet.

Future efforts:

With the updated inventory now complete, stakeholders will continue to pursue funding to implement priority RSX projects in an effort to improve and protect water quality and habitat on a watershed-wide basis. Recently, TOMWC through the Great Lakes Restoration Initiative –funded *Little Traverse Bay Stormwater Management Initiative*, worked with local road commissions and other stakeholders to replace priority RSXs within the Little Traverse Bay Watershed, including a timber bridge over the Bear River in Emmet County and elliptical culvert at Haymarsh Creek in Charlevoix County. In February, 2014, TOMWC submitted a proposal to the Sustain Our Great Lakes Program to address 4 of the priority sites, as identified through the completed inventory. In addition, the Baiardi Foundation has provided additional funding to support TOMWC's continued work with the road commissions during 2014. Specifically, TOMWC will seek funds to support development of engineering plans, which will position the projects more favorably for the construction-focused grant programs.

TOMWC will continue to work with road commissions to encourage best management practices at RSX. For example, practicing better sediment management on bridge surfaces, re-vegetating eroding embankments and side-slopes, providing discrete and stable pedestrian and paddler access, and diversion of roadway runoff into infiltration basins before reaching the stream are all relatively inexpensive investments that will yield long-term protection of both the stream and alleviate stress on existing infrastructure.

Lastly, we will also repeat the inventory in 5-10 years, as it is recommended, because RSX conditions can change relatively quickly.