Michigan Department of Environmental Quality
Surface Water Quality Division
August 2002

Total Maximum Daily Load for Mercury for Hammell Creek, Houghton County, Michigan

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations (CFR), Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting Water Quality Standards (WQS). The TMDL process establishes the allowable levels of pollutants for a waterbody based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of mercury that will result in the attainment of the applicable WQS in Hammell Creek, a small waterbody in Houghton County, Michigan.

PROBLEM STATEMENT

Hammell Creek was placed on the Section 303(d) list (Creal and Wuycheck, 2000) in 1998. This TMDL addresses approximately five miles of Hammell Creek in the vicinity of the city of Osceola. The TMDL reach is on the Section 303(d) list as:

Waterbody: **Hammell Creek** WBID#: **221001O**
County: Houghton HUC: 4020103 Size: 5 M
Location: Trapp Rock River confluence upstream.
Problem: **WQS exceedence for mercury.** Rf3RchID: 4020103 306 0.00
TMDL YEAR(s): 2002

Hammell Creek (Figure 1) was placed on the Section 303(d) list due to the exceedence of the WQS for mercury caused by the discharge from the abandoned Osceola Mine to Hammell Creek. Water samples collected by the Michigan Department of Environmental Quality (MDEQ) from the abandoned mine discharge showed mercury concentrations in excess of 0.2 microgram per liter (ug/L) in 1995 and 1997. In 2001, the MDEQ collected low level mercury samples at six stations (Figure 1) within the Hammell Creek watershed and the abandoned Osceola Copper Mine discharge (MDEQ, 2002). The low-level mercury sampling was conducted during the months of September, October, and November 2001. The USEPA Method 1669 was used for sample collection. All water samples were shipped to the MDEQ Environmental Laboratory for analysis using the USEPA Method 1631. Results of the three-month sampling period are contained in Table 1. These results continued to show mercury concentrations in Hammell Creek downstream of the mine discharge exceeded Michigan's water quality standard for mercury due to the abandoned mine discharge (see Source Section).

NUMERIC TARGET

The impaired designated use for Hammell Creek at this location is indigenous aquatic life and wildlife. Rule 323.1100, Designated Uses, of the Michigan WQS requires that this waterbody be protective for other indigenous aquatic life and wildlife. The target levels for this designated use are the toxic substances standards established in Rule 323.1057 of the WQS as follows:

R 323.1057 Toxic Substances.

Rule 57. (1) Toxic substances shall not be present in the surface waters of the state at levels that are or may become injurious to the public health, safety, or welfare, plant and animal life, or the designated uses of the waters. As a minimum level of protection, toxic substances shall not exceed the water quality values specified in, or developed pursuant to, the provisions of subrules (2) to (4) of this rule or conditions set forth by the provisions of subrule (6) of this rule.

For this TMDL, the WQS found in Rule 57(3) Table 4, of 1.3 nanograms per liter (ng/L) for mercury is the target level for the TMDL reach. This WQS is the lowest value of the numerical mercury standards and is for the protection of wildlife. As previously stated, data collected in 2001 documented mercury concentration exceedences of this WQS at Stations 3 through 6.

SOURCE ASSESSMENT

The Hammell Creek watershed is located in Houghton County, Michigan. The listed TMDL reach is from its confluence with the Trap Rock River, upstream to the location of the abandoned Osceola mine discharge. There are no point source discharges to Hammell Creek. Based on the data collected in 2001, the abandoned Osceola mine discharge appears to be the only significant nonpoint source of mercury to Hammell Creek. Upstream of the mine discharge (Station 1), mercury concentrations ranged from less than the level of quantification to 2.5 ng/L, with a geometric mean concentration of 0.83 ng/L. Mercury concentrations from the abandoned mine discharge (Station 2) ranged from 120 ng/L to 130 ng/L, with a geometric mean concentration of 127 ng/L. Mercury concentrations at the first station downstream of the mine discharge (Station 3) also ranged from 120 ng/L to 130 ng/L, with a geometric mean concentration 123 ng/L. Mercury concentrations in the most downstream station (Station 7) ranged from 2.6 ng/L to 8.5 ng/L, with a geometric mean concentration of 4.7 ng/L.

The Osceola Copper Mine mined the Osceola Amygdaloid Lode. The mine proper is 720 acres. The mine started in 1873 with six shafts and employed 1,143 people in 1913. The two southern most shafts (numbers 5 and 6) are the deepest shafts, at about 4,700 feet deep. The mine is connected to the Calumet and Hecla mine shafts 13 through 18. The mine shafts are oriented south to north covering about 3 miles in distance. Copper mining continued through 1921. After the mine shut down, the dewatering pumps ceased operation and the mine shafts filled with water. Gravity forces the water from the abandoned mine at a rate of approximately 2.5 cubic feet per second (cfs), flowing into Hammell Creek. The source of the mercury in the discharge flow has not yet been determined.

LINKAGE ANALYSIS

The link between the mercury concentrations in Hammell Creek and the source is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators and the sources. This provides the basis for estimating the total assimilative capacity of the creek and any needed load reductions. For this TMDL, the primary loading of mercury enters Hammell Creek via the abandoned Osceola mine discharge in the vicinity of the city of Osceola.

The guiding water quality management principle used to develop the TMDL was that compliance with the numeric mercury standard in Hammell Creek depends on the control of the discharge from the abandoned mine. If the mercury input can be controlled, then indigenous aquatic life and wildlife in Hammell Creek will be protected.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by the waterbody while still achieving WQS. This TMDL has been established in accordance with Rule 323.1207. As indicated in the Numeric Target section, the target for this mercury TMDL is the WQS of 1.3 ng/L. Concurrent with the selection of a numeric concentration endpoint, TMDL development also defines the environmental conditions that will be used when defining allowable levels. Many TMDLs are designed around the concept of a "critical condition." The "critical condition" is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other conditions. For example, the critical conditions for the control of point sources in Michigan are given in R 323.1082 and R 323.1090. In many cases, the lowest of the 12 monthly 95% exceedence flows for streams is used as a design condition for point source discharges. For wildlife values such as mercury, R 323.1090 specifies the 90-day, 10-year (90Q10) flow as a design condition. However, given the fact that the 90Q10 flow for Hammell Creek is zero, any mercury discharge to the creek will need to be at or below the numeric target of 1.3 ng/L. The TMDL for mercury in Hammell Creek is equal to the target concentration of 1.3 ng/L. With the only flow in the creek at design condition due to the mine discharge of 2.5 cfs, the TMDL is equal to 0.000018 pounds per day of mercury.

ALLOCATIONS

TMDLs are comprised of the sum of individual Waste Load Allocations (WLAs) for point sources and Load Allocation (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The term TMDL represents the maximum loading that can be assimilated by the receiving water while still achieving WQS. The overall loading capacity is allocated into the TMDL components of WLAs for point sources, LAs for nonpoint sources, and the MOS. As previously stated, this mercury TMDL for Hammell Creek will be expressed on a concentration basis consistent with USEPA regulations at 40 CFR, Section 130.2(i).

WLAs

As stated above, there are no point source discharges in the Hammell Creek watershed that are covered by an NPDES permit. Therefore there is no WLA for this mercury TMDL.

LAs

The abandoned mine discharge mercury contribution to Hammell Creek will be incorporated in the LA portion of the TMDL. Consistent with the discussion in the TMDL Development section, the discharge must be equal to 1.3 ng/L. With a mine discharge rate of 2.5 cfs, the LA for the mine discharge is equal to 0.000018 pounds per day.

Currently, the abandoned mine is discharging at a concentration of approximately 127 ng/L. In order to meet the TMDL requirements established above, the mine discharge will have to be reduced to less than or equal to 1.3 ng/L. This equates to a 99% reduction in the mercury concentration from the present abandoned Osceola mine discharge concentration.

MOS

This section addresses the incorporation of an MOS in the TMDL analysis. The MOS accounts for any uncertainty in establishing the TMDL and should describe the manner in which the MOS is determined and incorporated into the TMDL. The MOS can be either implicit (i.e., incorporated into the TMDL analysis thorough conservative assumptions) or explicit (i.e., expressed in the TMDL as a portion of the loadings).

This TMDL incorporates an implicit conservative MOS by modeling the abandoned mine discharge at the critical condition, which in this case is the 90Q10 flow (0 cfs) for Hammell Creek. Therefore, if the mercury WQS can be met during this flow condition, the WQS will be meet during all other flow conditions.

SEASONAL VARIATION

The mercury TMDL for Hammell Creek considered seasonal variation in the selection of stream design flow and the numeric target. Stream flows in Hammell Creek vary with seasons, with flows generally higher in the spring and lowest in the late summer period. The stream design flow used was 0 cfs, based on the 90Q10 low flow. The numeric target selected was 1.3 ng/L of mercury, based on the wildlife WQS. Since the TMDL is concentration-based and the stream design flow is 0 cfs, the WQS will be met during all seasons.

MONITORING

In 2001, water quality was monitored at six stations from September through November (Figure 1). Watersheds in Michigan are typically evaluated on a five-year rotating basis. The Hammell Creek watershed is scheduled for monitoring again during the 2006 monitoring year. Depending on the pace of the implementation for this mercury TMDL, monitoring may be conducted before 2006.

REASONABLE ASSURANCE ACTIVITIES

The abandoned mine discharge is the dominant source of mercury to Hammell Creek. Implementation activities to meet the TMDL require measures to reduce mercury from this source to acceptable levels. Michigan will be evaluating options to do this as the implementation plan is developed.

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REFERENCES

Creal, W. and J. Wuycheck. 2000. Federal Clean Water Act Section 303(d) List – Michigan's Submittal for Year 2000. Michigan Department of Environmental Quality, Surface Water Quality Division, Report Number MI/DEQ/SWQ-00/018.

MDEQ. 2002. Unpublished low level mercury data collected in the Hammell Creek watershed during the months of September, October, and November 2001.

Table 1. Mercury data for Hammell Creek, Osceola Township, Michigan, for the months of September, October, and November 2001. Mercury values are reported as ng/L.

Stations	September 21, 2001	October 23, 2001	November 28, 2001	Geometric Mean
1	K 0.5	0.9	2.5	0.83
2 (mine discharge)	130	120	130	127
3	130	120	120	123
4	100	93	92	95
5	6.8	11	20	11
6	9.5	6.4	13	9.3
7	2.6	4.6	8.5	4.7

K actual value reported is know to be less than the value given, i.e., substance, if present, is below Reporting Limit.

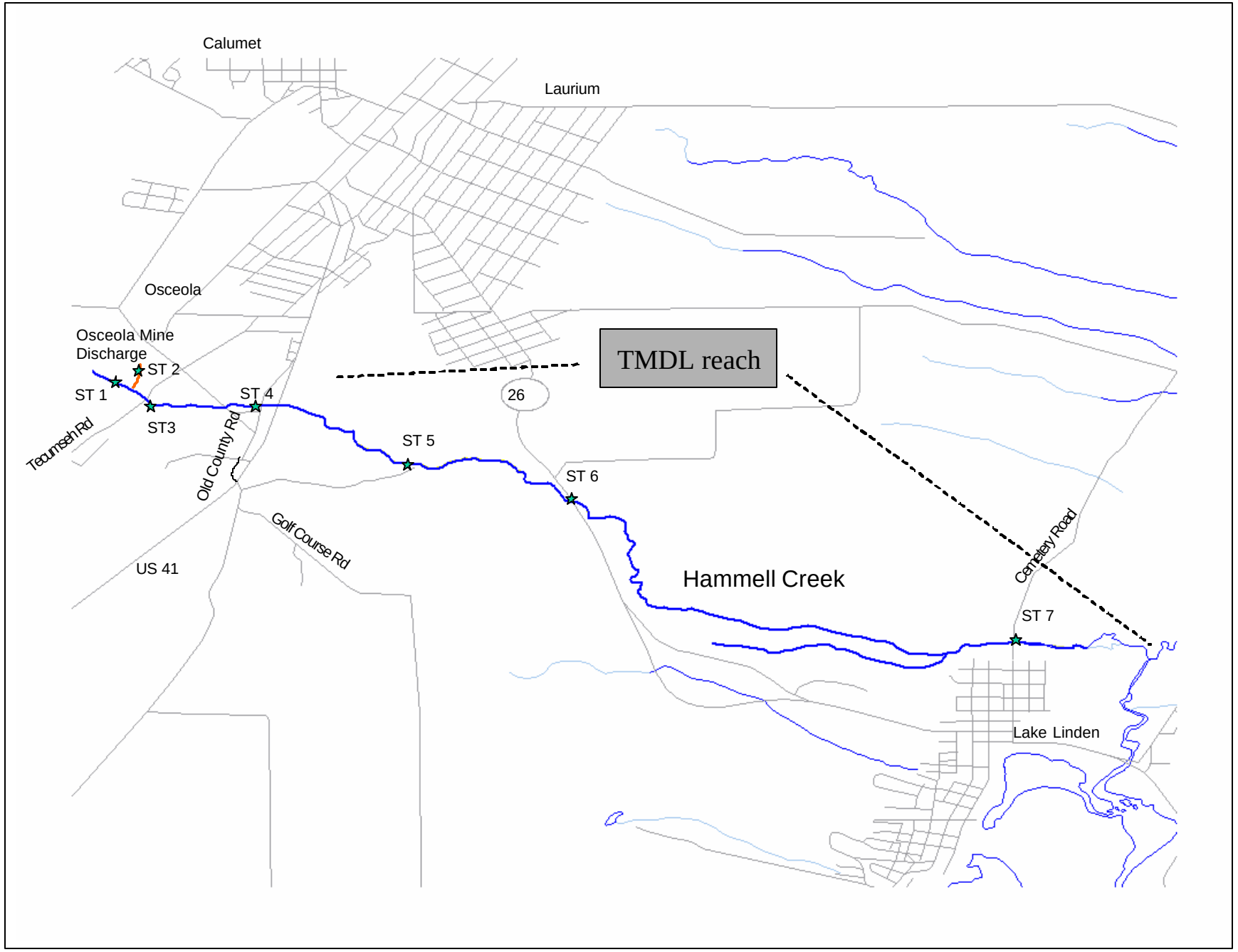

Figure 1. Sampling stations and TMDL reach for the Hammell Creek Watershed, Houghton County, Michigan.