Michigan Department of Environmental Quality
Water Bureau
August 2005

Total Maximum Daily Load for Biota for Strawberry Creek Kent 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 water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of a pollutant to a water body based on the relationship between pollutant sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reduction necessary from both point and nonpoint sources (NPS) to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify appropriate actions to achieve and maintain the coldwater designated fish community and supporting habitat quality, specifically, by providing and maintaining stable flow conditions and minimizing sedimentation of habitat resulting from stream bank and upland soil erosion. This TMDL follows the phased approach due to inherent uncertainties in deriving numeric targets and estimating loading from NPS. Under the phased approach, load allocations (LAs) and waste load allocations (WLAs) are calculated using the best available data and information, recognizing the need for additional monitoring data to determine if the load reductions required by the TMDL lead to attainment of WQS. The phased approach provides for the implementation of the TMDL while additional data are collected to reduce uncertainty.

PROBLEM STATEMENT

The TMDL reach of Strawberry Creek, a coldwater designated water body tributary to Mill Creek, thence to the Grand River, is located in Alpine Township of Kent County just north of Comstock Park and the city of Grand Rapids (Figure 1). The identified designated use impairment (Rule 100 of the Part 4 rules, Water Quality Standards (WQS), promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451)) was the support of indigenous aquatic life, in this case, the coldwater (trout) fish populations. Indications of the stream not meeting coldwater designated uses were the collection of less than 50 fish individuals during the 1992 biological assessment (Wuycheck, 1994), the extreme flashiness of the stream flow due to direct diversion of storm water runoff to the stream (rapid increases and decrease in stream flow in response to substantive wet weather runoff events), and impaired habitat. These conditions served as the basis for placing Strawberry Creek on Michigan's Section 303(d) list of impaired water bodies requiring the development of a TMDL (Wolf and Wuycheck, 2004). The TMDL reach is about three miles in length and is identified on the Section 303(d) list as follows:

STRAWBERRY CREEK WBID#: **082805G**
County: KENT HUC: 04050006 Size: 3 M
Location: NW of Grand Rapids, Mill Creek confluence u/s 3 miles.
Problem: **Fish community rated poor.**
TMDL YEAR(s): 2006 RF3RchID: 4050006 839

This document represents the basis for the development of a biota TMDL that focuses on the restoration of the fish community within the impacted perennial reach of Strawberry Creek to meet Michigan's WQS.

Within the approximately 1852 acre Strawberry Creek watershed, the flow of the entire reach of the stream, upstream of Alpine Avenue (M-37), is classified by the United States Geological Survey (USGS) topographic map as intermittent and from there downstream to the Mill Creek confluence as perennial (Figure 1). It appears that the stream is largely groundwater dependent, which sustains flow during dry-weather periods. It is influenced by wet weather runoff events, especially in the urbanized reaches due to impervious surface sources (e.g., asphalted roads, parking lots, roof tops). Impervious surfaces minimize and/or prevent water percolation into the soils and groundwater. The Great Lakes and Environmental Assessment Section (GLEAS) Procedure 51 (MDEQ, 1990) was used to assess the biological community and habitat in June 1992 (Wuycheck, 1994). Procedure 51 requires the collection of a minimum of 50 fish to determine WQS attainment. A total of 30 fish consisting of 28 brown trout, 1 rainbow trout, and 1 blacknose dace were collected. Therefore, the fish community was rated as not meeting WQS. The macroinvertebrate community scored a -4 (minimally acceptable) downstream of Westshire Avenue within a survey reach located in Westshire Park. Wuycheck (1994) recommended that soil erosion and runoff control best management practices (BMPs) be implemented throughout the Mill Creek watershed, including Strawberry Creek to minimize impacts on the biological community and overall stream quality.

A revised version of the GLEAS Procedure 51 (MDEQ) was used for the July 2004 reassessment of Strawberry Creek (Rockafellow, 2005). As with the 1991 version (used for the June 1992 stream survey), the revised Procedure 51 requires a minimum collection of 50 to 100 individual fish as an adequate number to determine WQS attainment. In the case of a coldwater designated stream, such as Strawberry Creek, the presence of at least one percent or more trout is necessary to achieve the coldwater designated use. The fish community assessed during the standard 30-minute survey of July 2004, within the Westshire Park reach, consisted of 43 individuals of one taxon, brown trout. Lengths of the trout ranged from 2 to 12 inches indicating the support of various age classes. The fish community assessed consisted of 100 percent trout and, based on the above Procedure 51 rating process, was determined as <u>not</u> meeting the coldwater designated use support since less than 50 fish were collected.

Procedure 51 scoring and rating of the macroinvertebrate community of either a coldwater or warmwater designated stream is based on the assessment of nine metrics with total score ranges and ratings of 5 to 9 as excellent, 4 to -4 as acceptable, and -5 to -9 as poor. A moderately impaired but acceptable macroinvertebrate community (score of -3) characterized the stream within the Westshire Park reach in July 2004 (Rockafellow, 2005).

Habitat quality was assessed in June 1992 and July 2004 within the Westshire Park reach using two different GLEAS Procedure 51 protocols (MDEQ, 1990). The habitat assessment of June 1992 was conducted using the original Procedure 51 scoring, whereas, the July 2004 habitat assessment used a revised version. The Procedure 51 habitat assessment protocol used in June 1992, involved score ranges and ratings of less than 35, representing poor habitat quality, 35 to 70 as fair, 71 to 106 as good, and 107 to 135 points as excellent. The June 1992 habitat score and rating within the Westshire Park reach was 73 indicating overall good conditions. The updated Procedure 51 (revised 2002) has score ranges of less than 56, 56 to 104, 105 to 154, and 155 to 200 points with ratings of poor, marginal, good, and excellent, respectively. The July 2004 score and rating of the ten habitat quality metrics used for assessment of the Westshire Park stream reach was 136, a rating of good. However, scores for the individual metric categories of Embeddedness, Flow Stability, and Bank Stability during both the 1992 and 2004 surveys indicated individual scores of 50 percent or less than their respective maximum potential scores. Such metric scores reflect unstable habitat attributable to flashy, wet weather runoff conditions that contribute to impairment of the biological community. Increased embeddedness of substrate (e.g., gravels, cobble) degrades viable areas important to biota for colonization, reproduction, and refugia. Flow instability, e.g., flashy stream flows, contributes to

bank erosion which increases sedimentation. A reduction in sedimentation is expected to improve the P51 habitat scores and result in improved biota community scores.

Total suspended solids (TSS) and flow monitoring in the Strawberry Creek watershed was conducted during the months of June, July, and August 2004 to assess stream TSS and flow conditions during stable flow (dry weather) conditions and in response to wet weather runoff events. The monitoring was under the direction of Dr. Rick Rediske of Michigan's Grand Valley State University's Annis Water Research Institute (Muskegon, Michigan) as part of a USEPA grant awarded to the Cadmus Group, Inc. (USEPA Contract: 68-C8-0010). The project design, defined by the Michigan Department of Environmental Quality (MDEQ), required monitoring three times during the survey period to characterize stable flow TSS concentrations and flow during dry weather, and to monitor at least three wet weather runoff events to assess increases in stream TSS and flow in response to wet weather events of 0.1 inches or greater. During wet weather runoff events, effort was directed towards sampling TSS hourly during the rise and fall of the stream's hydrograph.

Results from monitoring at the Stony Creek Avenue site indicated an average TSS concentration of 2 to 3 milligrams per liter (mg/l) during dry-weather, stable, base flow conditions assessed on July 29, July 14, and July 28, 2004 (Cadmus Group, 2005). The wet weather event monitoring at the Stony Creek Avenue site, in response to precipitation events of 0.1, 1.1, and 1.4 inches on August 25, August 2, and August 28, 2004, respectively, showed event average (event maximum) TSS concentrations of 13 mg/l (22 mg/l), 154 mg/l (350 mg/l), and 119 mg/l (195 mg/l), respectively. This information indicates that precipitation events of 1.0 inch or greater result in runoff events in the watershed that substantially increase the amount of TSS in transport in Strawberry Creek. In-stream flows measured at Stony Creek Avenue during the three wet weather event monitoring dates of August 25, August 2, and August 28, 2004, experienced increases from 3.5 to 5.0 cubic feet per second (cfs), 3.9 to 12.0 cfs, and 8.8 to 18.7 cfs, respectively, within one hour of the event onset.

There are no National Pollutant Discharge Elimination System (NPDES) individual permitted point sources that discharge to Strawberry Creek. However, based on available information in the MDEQ Water Bureau's NPDES permit Management System (NMS, 2005), Alpine Township, the Kent County Drain Commissioner, and the Kent County Road Commission have certificates of coverage under a Phase II MS4 general storm water permit (Table 1). An estimated 93 acres or 5 percent of the Strawberry Creek watershed (1852 acres) is impervious; e.g., parking lots and building roof tops (Purdue, 2005). Such areas are commonly designed to divert precipitation runoff directly to nearby water bodies to facilitate rapid drainage. An increase in the number of acres of impervious surface in a watershed (10 percent or greater) and the associated increase of directed runoff to water bodies has been demonstrated to result in substantial degradation of biological communities (WPT, 1994). Such areas need implementation of storm water management plans to minimize impairment of designated uses of receiving water bodies. Reductions in storm water runoff rates to Strawberry Creek will result in reduced flashy stream flows, provide stable stream flow conditions, and reduce stream bank erosion that can adversely impair aquatic life.

NUMERIC TARGETS

The impaired designated use for Strawberry Creek relates to coldwater fish species, which is primarily trout. Michigan's WQS require the protection of a variety of designated uses, including coldwater fisheries [Rule 100(7)]. Attainment of WQS for the coldwater designated use will be demonstrated based on continued assessments of the fish community to determine the presence of trout in acceptable numbers.

The primary numeric target is based on the GLEAS Procedure 51 (MDEQ, 1990). The biota TMDL target is to meet designated uses for both warmwater and coldwater fish. The measure of success will be based on fish community assessments conducted in two successive years, following the implementation of BMPs. Both the June 1992 and July 2004 fish community assessments indicated the coldwater designated use was not adequately being supported in the Westshire Park reach of Strawberry Creek.

A secondary numeric target based on TSS will be used to further assess continuing/protective BMP usage as development continues in the Strawberry Creek watershed. The secondary target goal is a mean annual, in-stream TSS concentration of 80 mg/l for wet weather runoff events. This secondary numeric target may be overridden by achievement of the biological numeric target. The secondary numeric target is intended to help guide proper control over NPS of excessive suspended solids loads from runoff that result in sedimentation of habitat and excessive runoff discharge rates and instantaneous volumes that increase stream bank erosion.

The mean annual target concentration of 80 mg/l TSS is based on a review of existing conditions and published literature on the effects of TSS to aquatic life. Vohs et al., (1993) indicated that a chemically inert suspended solids concentration of 100 mg/l appears to separate those streams with a fish population from those without. Gammon (1970) demonstrated decreases in the standing crop of both fishes and macroinvertebrates in river reaches continuously receiving suspended solids loadings of less than 40 mg/l. The European Inland Fisheries Advisory Commission (EIFAC) stated that in the absence of other pollution, a fishery would not be harmed at suspended solids concentrations less than 25 mg/l (EIFAC, 1980).

Alabaster (1972) provided the following water quality goals for suspended solids (finely divided solids) for the protection of fish communities:

Optimum	= $\leq$ 25 mg/l
Good to Moderate	= >25 to 80 mg/l
Less than Moderate	= >80 to 400 mg/l
Poor	= >400 mg/l

Since the TMDL purpose is to restore and maintain the biological community to an acceptable condition and attain WQS, a value of 80 mg/l as a mean annual TSS target for wet weather events was chosen for Strawberry Creek as a secondary target.

Overall, the secondary target of 80 mg/l TSS is intended to evaluate solids load effects and assist in orienting, focusing, and maintaining corrective and preventative actions for source reductions. Additional or revised TSS targets, based on flow-related considerations, may be developed as additional data on Strawberry Creek become available. At this time, sufficient site-specific data are unavailable regarding the flow and TSS concentration relationship associated with storm water sources during wet weather runoff periods to establish specific numeric targets. Therefore, to allow for additional data collection, if necessary, this TMDL is established as a phased TMDL.

SOURCE ASSESSMENT

Increases in stream flow conditions of Strawberry Creek can best be described as reasonably stable in response to the 1.1- and 1.4-inch wet weather runoff events of August 2 and August 28, 2004, respectively, as conducted by the Grand Valley State University's Water Research Institute (WRI) (Cadmus Group, 2005).

From the Mill Creek confluence upstream, land use in the Strawberry Creek watershed is dominated by forested, agriculture, residential, and commercial uses (Figure 2, Table 2). Development within a watershed alters its hydrologic characteristics because increased areas of impervious surface, construction activities, and cultivation in a watershed often result in increased runoff of solids and pollutant loads being discharged to stream reaches within the watershed (Fongers and Fulcher, 2001; and Schueler and Holland, 2000). Substantial reductions in vegetative riparian zones and pervious areas throughout the watershed of Strawberry Creek and the extensive use of structural features, including paved impervious surface areas (e.g., roads and parking lots), curb and gutter, and numerous direct storm sewer discharges dominate the landscape and contribute to rapid precipitation runoff rates to Strawberry Creek. The absence of vegetative buffer strips along the banks of streams that flow through agriculturally cultivated land often result in the loss of valuable soils due to erosion and runoff during wet weather runoff events.

Determination of the annual TSS loads to the Strawberry Creek watershed from the various land use categories involved estimates of the acres of each land use category (Cadmus Group, 2005), a mean annual rainfall of 32 inches, and the USEPA's PLOAD simple method model approach (USEPA, 2001). This model is a pollutant loading model that uses runoff event mean concentration values, soil runoff coeffcients, and annual rainfall data to compute annual loadings of different pollutants to surface waters. TSS export coefficients used in the model were derived from the Rouge River Project (Cave et al., 1994) and considered representative of TSS exports in the Strawberry Creek watershed. The estimated annual TSS load from the WLA sources versus the NPS land use categories (LA) in the Strawberry Creek watershed is about 144,138 pounds and 63,052 pounds, respectively, for an overall total annual load of 207,190 pounds (Table 2). The total estimated annual TSS load to Strawberry Creek from NPDES non-storm water point sources (WLA) is 0 percent, NPDES general storm water sources (WLA) is 30 percent, and nonpoint sources (LA) is 70 percent. An annual load estimate for TSS is only used for comparative purposes to better express the most probable sources and potential magnitude of the TSS loads to Strawberry Creek. A comparison is then made with TSS reductions for the different land use categories based on reducing TSS loads to meet the 80 mg/l TSS target.

LINKAGE ANALYSIS

A suitable method used to develop a TMDL that addresses the severity of the impacts of sedimentation to a biological community is to measure sediment impacts on stable, colonizable substrates in the stream channel and the associated changes in the biological community.

Increased siltation and embeddedness of colonizable substrates resulting from excessive bank erosion and sedimentation has been demonstrated to impair the biological integrity of rivers by obscuring or reducing the suitability of colonizable or useable substrate by stream biota (Waters, 1995). With improved habitat through the reduction in sedimentation, both fish and macroinvertebrate communities respond with an increase in species diversity and an increase in the number of individuals of each species. As a result, the Procedure 51 assessment scores and ratings for quality of the fish community and habitat are expected to increase as sedimentation rates decline, sediment resuspension (as TSS) declines, embeddedness decreases, and habitat diversity increases. These latter characteristics will serve to demonstrate improvement in habitat conditions, WQS attainment, and overall stream quality as expressed through an acceptably rated biological community.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by a water body while still achieving WQS. The TMDL is based on maintaining reduced sediment loads and bank erosion

throughout the watershed to a level that supports and maintains a biological community that meets WQS. Using the Procedure 51 metrics scores, a minimum sustained numeric target of at least 1 percent trout in a fish community, comprised of at least 50 to 100 individuals in the survey collection will serve as the primary target for this biota TMDL.

Concurrent with the selection of numeric endpoints, this TMDL also defines the environmental conditions that will be used when defining allowable levels. Some TMDLs are designed around the concept of critical condition. A 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 important conditions. For example, the critical conditions for the control of point sources in Michigan are provided in Rule 82 (mixing zones) and Rule 90 (applicability of WQS) of Michigan's WQS. In general, the lowest monthly 95 percent exceedance flow for a stream is used to establish effluent limits for point sources. Excessive runoff flows to Strawberry Creek are attributable to wet weather driven discharges and are recognized as a critical condition that affects stream flow stability. Efforts will be directed toward reducing impacts from severe wet weather runoff events and associated extreme stream flows.

The secondary target of 80 mg/l TSS is used to develop a TMDL goal for TSS during wet weather runoff events. Of specific concern is direct runoff from wet weather storm water discharges in the area (553 total acres) of urbanized/built-up land use categories that represent about 30 percent of the land use area in the entire Strawberry Creek watershed (1852 acres).

ALLOCATIONS

TMDLs are comprised of the sum of individual WLAs for permitted point sources and LAs for NPS and natural background levels. A margin of safety (MOS), either implicit or explicit, accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving waters. Conceptually, this relationship is defined by the equation:

$$TMDL = \Sigma^{WLAs} + \Sigma^{LAs} + MOS$$

The TMDL represents a maximum load of a pollutant or stressor that can be discharged to a receiving water and still meet WQS. The overall TMDL capacity is allocated among the three TMDL components: WLA for point sources, LA for NPS and background loads, and the MOS.

WLA

The estimated total annual TSS load from all non-storm water NPDES permitted point sources is zero (Table 2) since there are no such permittees in the watershed at this time.

Based on acres of land use categories listed in Table 2 under "Urban/Industrial/Built-Up," and TSS export coefficients derived from the Rouge River project (Cave et al., 1994), a total annual TSS load estimate of approximately 144,138 pounds is attributable to NPDES municipal permitted storm water runoff discharges to the Strawberry Creek watershed. However, all categories, except "Industrial" are predicted to be meeting the 80 mg/L target secondary target (Cave et al., 1994).

To achieve the goal of 80 mg/L as an annual average wet weather event concentration from all WLA sources, a reduction of 10 percent in TSS loads is necessary from all WLA sources, resulting in a projected annual WLA of 129,591 pounds (Table 2).

Any necessary TSS limits will be established with an effluent limit based on available treatment technology that applies to the discharge type. Such an approach makes it unnecessary to consider mixing zone scenarios and would include permitted storm water point source

contributions to the WLA, which are considered controllable through the existing NPDES permit requirements, including the Phase I and Phase II Municipal Separate Storm Sewer System (MS4) programs. Phase I of the federal Storm Water Regulations requires owners or operators of MS4s with a service population of greater than 100,000 to obtain a permit. Phase II of the federal regulation, along with Michigan's Phase II rules, requires a public entity (e.g., county, township, city, village, or institution) to obtain a certificate of coverage if it is located in a federally defined urbanized area and has the power and authority to control storm water discharges to an MS4. It will be necessary to employ "maximum extent practicable" treatment for MS4 discharges. The MS4 permittees shall implement BMPs for attainment of the secondary in-stream target of 80 mg/l TSS as a mean annual average concentration during wet weather runoff events. The intent is to attenuate the runoff delivery rates and volume inputs to Strawberry Creek in order to reduce flashiness, better stabilize and normalize flow conditions, and minimize stream bank erosion, TSS resuspension, and sedimentation impacts on habitat and biological communities.

LA

The LA component of the TMDL defines the load capacity for a pollutant from nonpoint sources including the following land use categories: agricultural, forested/shrub/open land, and/or water bodies (Table 2). An estimated annual TSS load of 63,052 pounds (LA) is attributed to these categories of NPS in the watershed. All but the agricultural land uses are treated as background load sources because runoff concentrations of TSS are typically less than 80 mg/l (Cave, 1994). Therefore, the only targeted load reduction source is from agricultural sources, which has a runoff average TSS concentration of 149 mg/l (Cave et al., 1994). A 45 percent annual reduction from a current estimated TSS load of 51,879 pounds to 28,623 pounds from the agricultural land use areas in the watershed is indicated based on PLOAD model estimates. The estimated reduction is based on achieving a runoff mean annual average target concentration of 80 mg/l TSS during wet weather runoff events.

In summary, the proposed annual TSS load to Strawberry Creek (WLA + LA) to meet WQS is 169,387 pounds per year, an overall reduction of 18 percent from existing estimated loads (207,191 pounds per year). With the absence of any individual NPDES non-storm water permitted point source discharges in the Strawberry Creek watershed, 0 percent of the annual load is allocated to individual NPDES permitted point sources, 70 percent (129,591 pounds per year) is allocated to the NPDES permitted MS4 storm water outfalls covered under the Phase II MS4 Storm Water Programs, and 30 percent (39,796 pounds per year) is allocated to the LA.

To achieve the primary and secondary TMDL targets, a reduction in the wet weather runoff of TSS load through controls in the runoff rates and volume discharges is necessary. This goal will require continuous employment of BMPs that attenuate the runoff delivery rates and volume inputs to Strawberry Creek in order to reduce flashiness, better stabilize stream flow conditions, minimize stream bank erosion, TSS resuspension, and excessive sedimentation that impacts habitat quality.

MOS

The MOS in a TMDL is used, in part, to account for variability of source inputs to the system and is either implicit or explicit. An MOS is implicit for a biota TMDL because the quality of the biological community, its integrity, and overall composition represent an integration of the effects of the spatial and temporal variability in sediment loads to the aquatic environment.

To determine progress in meeting the fish community and habitat target scores, follow-up biological and habitat quality assessments will be conducted during stable flow conditions during the months of June through September. The results will best reflect an MOS that is implicit and

express integration of the effects of the variability in sediment loads in the aquatic environment and minimize seasonal variability. Managed reductions in wet weather event runoff volumes to Strawberry Creek are expected to reduce solids loadings, stream bank erosion, and sediment resuspension thereby improving stream habitat suitable for designated use support.

SEASONALITY

Seasonality is addressed in the TMDL in terms of sampling periods for fish communities. To minimize temporal variability in the biological community, sampling will be conducted during June through September of the monitoring year during stable, low flow conditions.

MONITORING PLAN

Monitoring will be conducted by the MDEQ during the rotating five-year basin cycle to assess progress toward achieving the biota TMDL target and implementation of applicable BMPs and control measures. Subsequent to implementation of BMPs, annual sampling of the biota and habitat quality at locations in the vicinity of Westshire Park reach, at a minimum, will be conducted during two consecutive years to demonstrate attainment of TMDL targets at these sites. For best comparative purposes, follow-up biological and habitat assessments will be conducted during June to September, during stable, base flow conditions. Every effort will be made to sample during similar stream habitat conditions and reassess the same sampling locations.

Once BMPs are in place to minimize the effects of runoff and flashy conditions in Strawberry Creek, stream flow and TSS sampling can be implemented during dry and wet weather events to measure progress toward the secondary numeric target of 80 mg/l as a mean annual value during wet weather runoff events if the primary targets for the fish community are not achieved.

REASONABLE ASSURANCE

The primary action being taken to protect Strawberry Creek is the use of effective BMPs and other control measures to reduce runoff peak flows that result in increased flashiness within the stream. Increased flashiness causes resuspension of solids and bank erosion resulting in substantial increases in TSS concentrations that can impair habitat quality and designated use support. Control measures potentially include the reduction of municipal storm water discharge volumes, chemical-specific permit limits, and approved BMPs for areas currently not covered by a permit.

Rule 323.2161a(8), which addresses municipal storm water discharges, states that “A permittee shall comply with any more stringent effluent limitations in the national permit, including permit requirements that modify, or are in addition to, the minimum measures based on a total maximum daily load (TMDL) or equivalent analysis.” In addition, Rule 323.2161a(10) states that “The department may establish monitoring requirements in accordance with state or watershed specific monitoring plans or as needed for a permittee to demonstrate the pollution reduction achieved by implementing best management practices.” Also, for sites of new construction, R323.2161a(3e) specifically requires development of a program to evaluate the post-construction storm water runoff from projects, including an ordinance designed to prevent or minimize water quality impacts including extreme flow volumes and conditions.

The regulatory mechanisms are available to reduce the storm water impacts of the urban/industrial/built-up sources on Strawberry Creek. Where the necessary data are available, requirements will be established in the NPDES permits. Where necessary, additional data to determine specific loadings and flow volumes associated with these sources will be collected through the NPDES permit requirements.

In addition to establishment of permit requirements, the NPDES storm water permittees in the watershed are required to collectively develop a watershed management plan (by October 1, 2005) that includes short- and long-term goals and attainment actions, public education plans, illicit discharge elimination plans, and the development (by each local unit of government within Strawberry Creek) of their individual storm water prevention plans. Alpine Township, the Kent County Drain Commissioner, and the Kent County Road Commission have been issued NPDES certificates of coverage that are used to manage MS4 outfalls to Strawberry Creek (Table 1).

A Lower Grand River Watershed (LGRW) Planning Project watershed management plan outlines strategies and recommendations to effectively reduce nonpoint source pollution (Grand Valley Metropolitan Council, 2004). Several interactive tools and two guidebooks were created in addition to the management plans to assist subwatersheds in their individual watershed planning efforts. A strategy was also developed for a LGRW provisional organization that will provide basin-wide oversight, implement regional and watershed-wide initiatives, and prioritize water quality concerns.

The MDEQ district staff will continue to work with interest groups in the Strawberry Creek watershed to assist in defining and designing approvable actions and programs that assess, develop, plan, and implement BMPs and control measures that best minimize or prevent soil erosion and excessive runoff rates to the Strawberry Creek watershed.

Recommended actions include:

- Monitoring of any point source discharges (present or future), identify sources of excessive wet weather TSS loadings and flow volumes to Strawberry Creek through NPDES permit conditions. Establish permit conditions as necessary.

- Upgrade and maintain the current vegetative riparian zone to reduce soil erosion and sediment loads to Strawberry Creek from sources within the watershed. BMPs need to be employed within the riparian zone adjacent to the agricultural, urbanized, residential, industrialized, and commercial areas to minimize sediment loss through erosion and direct runoff to minimize stream habitat impairment.

- Implementation of BMPs in the storm water permits program that reduces sediment loadings and moderates runoff release rates and excessive runoff to the Strawberry Creek watershed are expected to improve, protect, and maintain designated use support throughout the watershed. The goals are for continuing management and minimization of solids loadings and increased flow stability throughout the watershed so that the WQS are maintained and protected.

Prepared By: John Wuycheck
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
August 16, 2005

REFERENCES:

Alabaster, J.S. 1972. Suspended Solids and Fisheries. Proceedings of the Royal Society of London, Series B 180:395-406.

Cadmus Group. 2005. Total Suspended Solids, Stable Flow, and Wet Weather Event Monitoring in the Strawberry Creek Watershed. MDEQ Staff Report Number MI/DEQ/WB-05/020.

Cave, K., T. Quarsebarth, and E. Harold. 1994. Selection of Storm Water Pollutant Loading Factors. Rouge River National Wet Weather Demonstration Project Technical Memorandum RPO-MOD-TM34.00. Detroit, Michigan.

Creal, W., S. Hanshue, and S. Kosek. 1996. Update of GLEAS Procedure 51 Metric Scoring and Interpretation. MDEQ Report Number MI/DEQ/SWQ-96/068.

EIFAC. 1980. Water Quality Criteria for European Freshwater Fish; Report on Combined Effects on Freshwater Fish and Other Aquatic Life of Mixtures of Toxicants in Water. SH 328. E85, No. 37.

Fongers, D. and J. Fulcher. 2001. Hydrologic Impacts Due to Development: The Need for Adequate Runoff Detention and Stream Protection. MDEQ, Land and Water Management Division. 20 pp.

Gammon, J.R. 1970. The Effect of Inorganic Sediment on Stream Biota. Water Pollut. Contr. Research Series. Water Quality 18050 DWC12/70. USEPA Printing Office. 145 pp.

Grand Valley Metropolitan Council. 2004. Section 319 Nonpoint Source Pollution Prevention Program – Lower Grand River Watershed Planning Project. Project No. G02408. MDEQ Tracking No. 2002-0011.

MDEQ. 1990. Great Lakes and Environmental Assessment Section Procedure 51, Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers, April 24, 1990. Revised June 1991, August 1996, January 1997, and May 2002.

NMS. 2005. NPDES Management System. MDEQ Water Bureau's Permit Tracking System Database.

Purdue. 2005. University of Purdue Web site: *The link provided was broken. This online document was revised 6/30/2017.* and the L-THIA model.

Rockafellow, D. 2005. A Biological Survey of Selected Tributaries to the Lower Grand River and Water Chemistry Data from the Lower Grand River, Ionia, Kent, Newaygo, and Ottawa Counties, Michigan. June, July, and August 2004. DRAFT MDEQ Report.

Schueler, T. and H. Holland. 2000. The Practice of Watershed Protection: Techniques for Protecting Our Nation's Streams, Lakes, Rivers, and Estuaries. Published by the Center for Watershed Protection.

USEPA. 2001. PLOAD Version 3.0 – An ArcView GIS Tool to Calculate NPS of Pollution in Watershed and Storm Water Projects – User Manual. 48 pp.

Vohs, P., I. Moore, and J. Ramsey. 1993. A Critical Review of the Effects of Turbidity on Aquatic Organisms in Large Rivers. Report by Iowa State University, Ames, Iowa, for the U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 93-s002. 139 pp.

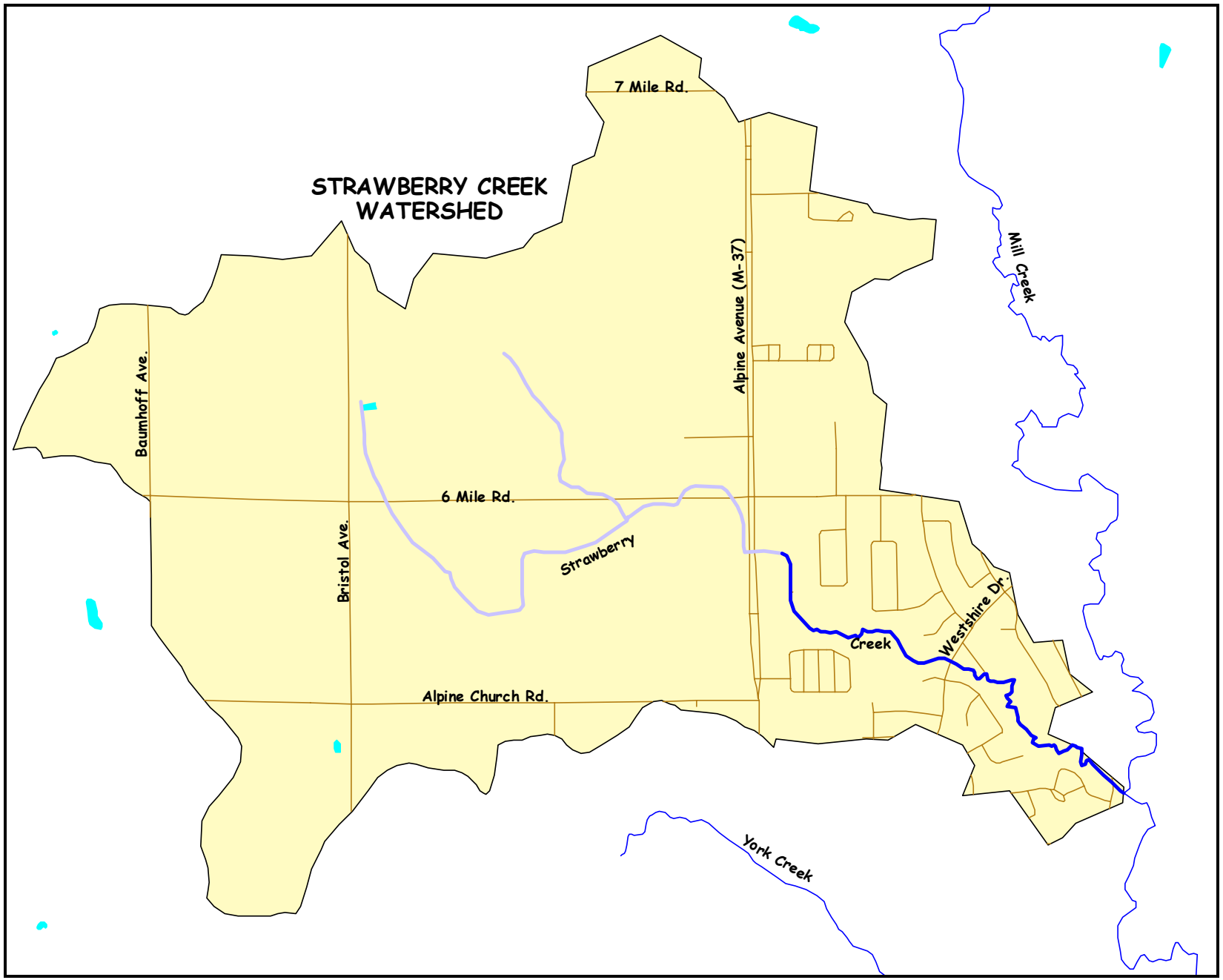
Waters, T. 1995. Sediment in Streams - Sources, Biological Effects and Control. American Fisheries Society Monograph 7, American Fisheries Society, Bethesda, MD.

Wolf and Wuycheck. May 2004. Water Quality and Pollution Control in Michigan: 2004 Sections 303(d) and 305(b) Integrated Report. MDEQ Report #MI/DEQ/WD-04/029.

WPT (Watershed Protection Techniques). 1994 - The Importance of Imperviousness. Vol. 1, No. 3.

Wuycheck, J. 1994. A Biological Assessment of Mill Creek and Strawberry Creek, Kent County, Michigan. June 9, 1992. MDEQ Report Number MI/DNR/SWQ-94/039.

Figure 1. Strawberry Creek Biota TMDL Reach and Watershed, Kent County, Michigan.



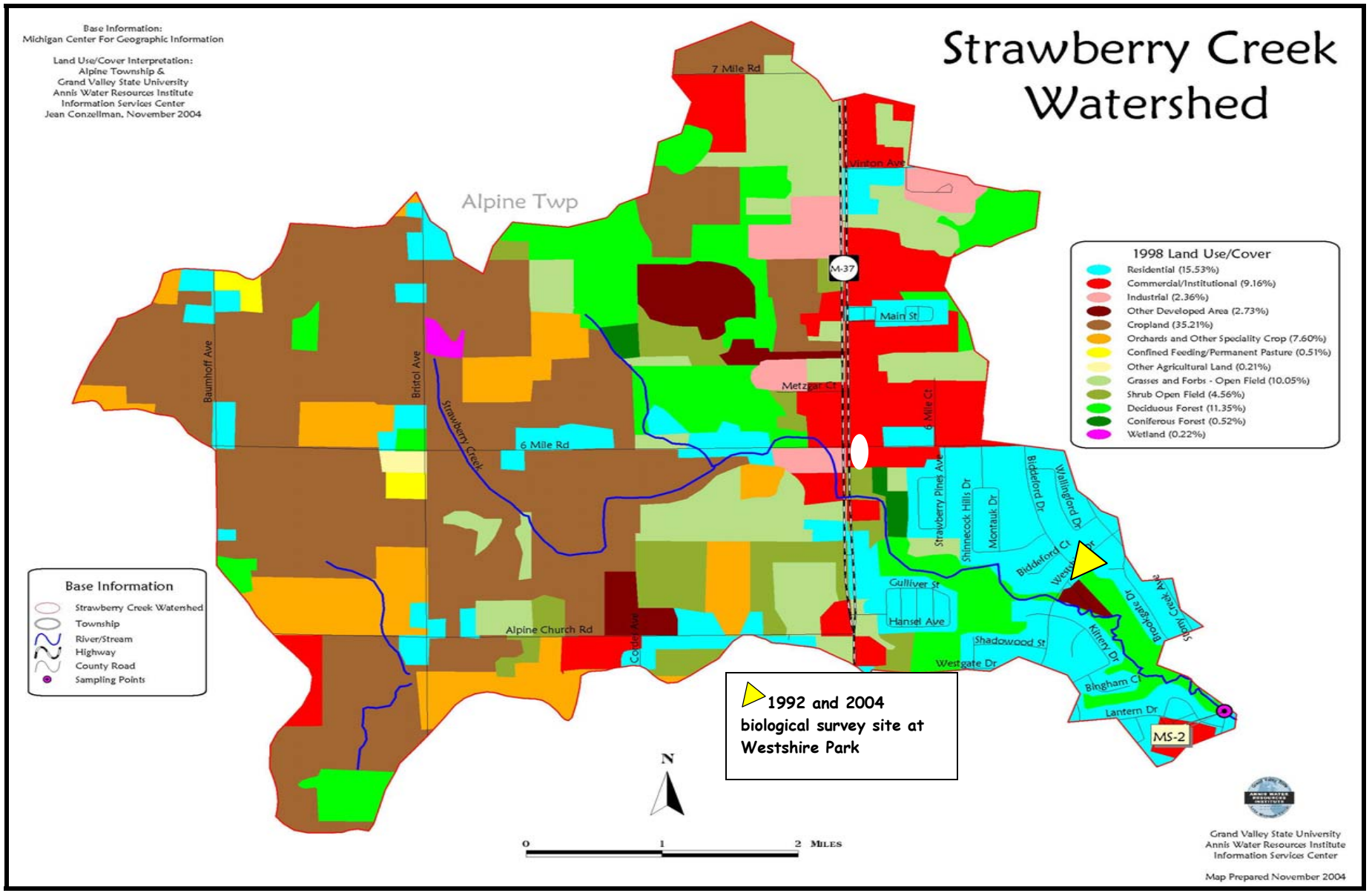


Figure 2. Strawberry Creek watershed land use (1998 database).

Table 1. NPDES Permits in the Strawberry Creek Watershed (NMS, 2005).

Industrial Storm Water General Permits:

- Behr Industries Corp. – MIS110562
- Rapid Engineering Inc. – MIS111103

MS4 Watershed General Storm Water NPDES Permits (Phase II MS4 Program):

- Alpine Township MS4-Kent – MIG610121
- Kent CRC MS4 (Kent County Road Commission) – MIG610129
- Kent CDC MS4 (Kent County Drain Commission) – MIG610130

Table 2. Land use categories and TSS loads in the Strawberry Creek watershed, Kent County, Michigan (Source: WRI – Cadmus Group, 2005.)

Source Category	Acres	Estimate Current TSS (pounds/year)*	TMDL TSS Target Load TSS (pounds/year)
WLA Components:			
NPDES Non-Storm Water TSS Load	None	None	None
Urban/Industrial/Built-Up			
Residential	288	55,548	55,548
Commercial and Service	170	47,340	47,340
Industrial	44	31,413	16,866 (46% reduction)
Other Urban Buildup	51	9,837	9,837
Subtotal:		144,138	129,591 (10% WLA reduction)
WLA Total:	553	144,138	129,591 **(WLA)**
LA Components:			
Agricultural Land			
Cropland	652	41,967	23,154 (45% reduction)
Orchards, Groves, Vineyards, etc.	141	9,076	5,007 (45% reduction)
Confined Feeding/Pasture	9	579	320 (45% reduction)
Other Agricultural Land	4	257	142 (45% reduction)
Subtotal:	806	51,879	28,623
(Background Sources)			
Forested/Shrub/Open Land			
Open Land/Shrub/Range Land	270	6,113	6,113
Forested (Deciduous/Conifer)	220	4,980	4,980
Water Body			
Wetlands	4	80	80
LA Subtotal:	1300	63,052	39,796 **(LA)** – (37% reduction)
Overall Totals:	**1852**	**207,190**	**169,387** (18% overall reduction)

**TSS load estimates based on PLoad Version 3 model (USEPA, 2001), land use acres derives from 1998 land use database coverage and a mean annual rainfall value of 32 inches.*