

Michigan Department of Environmental Quality

Water Division

September 2003

Total Maximum Daily Load for Biota for Little Black Creek

Muskegon County, Michigan

INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, 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 an appropriate reduction in sediment loads from existing sources in the Little Black Creek Watershed that will result in WQS attainment.

PROBLEM STATEMENT

The TMDL reach of Little Black Creek, a coldwater designated water body, is located in Muskegon County and extends from Mona Lake upstream to Violet Avenue, located just north of the Marathon Petroleum defunct refinery site (Figure 1). The impaired designated uses (Michigan's WQS Rule 100) include the lack of support of coldwater fish and other aquatic life (macroinvertebrate) communities. This condition served as the basis for placing Little Black Creek on Michigan's Section 303(d) list of impaired water bodies requiring the development of a TMDL. The TMDL reach is about seven miles in length and is identified in the Section 303(d) list (Creal and Wuycheck, 2002) as follows:

LITTLE BLACK CREEK

WBID#: **082701T**

County: MUSKEGON

HUC: 04060101

Size: 7 M

Location: Mona Lake inlet upstream.

Problem: **Fish and macroinvertebrate communities rated poor.**

TMDL YEAR(s): 2003

RF3RchID: 4060101

This document represents the basis for the development of a biota TMDL that focuses on the restoration of the biological communities of the impacted reach of Little Black Creek in order to meet Michigan's WQS designated uses. In addition, two other TMDLs are scheduled for development in the Mona Lake Watershed. A final Black Creek biota TMDL is scheduled for September 2003 and two other TMDLs for Mona Lake proper, one for PCBs and the other for mercury are scheduled for Mona Lake in 2009 and 2011, respectively (Creal and Wuycheck, 2002).

The headwater reach of Little Black Creek upstream of Laketon Avenue is classified by the United States Geological Survey as intermittent and perennial from Laketon Avenue downstream to the Mona Lake confluence. Within the seven mile biota TMDL reach, impairment is attributed to degraded water quality, habitat quality, and overall stream quality due to a variety of sources in this highly urbanized and industrialized watershed. Historically, specific sources of contaminant loads and reduced water quality included the defunct Marathon Petroleum refinery site; Keating Avenue storm sewer (source of oils, grease, heavy metals, and PCBs (Evans, 1982)); the defunct Peerless Plating site (processes included copper, nickel, chromium, zinc and cadmium plating, and pickling operations that discharged to two seepage ponds, a source of groundwater contamination venting to Little Black Creek (Sylvester, 1977b)); the municipal sanitary/industrial wastewater pump station at Getty Road; the now defunct Muskegon Heights Wastewater Treatment Plant; the defunct municipal landfill upstream of Broadway Avenue; and Webb Chemical Company groundwater seepage upstream of Broadway Avenue and the Merriam Street storm sewer downstream of Airline Road. The Marathon Petroleum refinery site, Peerless Plating site, and landfill site are all now defunct operations, but remain sites of environmental concern because they serve as continued potential sources of environmental contaminants or impaired water quality to Little Black Creek.

A fish tissue taint (taste) test was conducted in October 1977 using caged brown bullhead catfish that were submersed in Little Black Creek in the vicinity of Seaway Drive for a two-week period (Kenaga, 1977). The taste test indicated a discernable tainting of the flavor.

Recent Michigan Department of Environmental Quality (MDEQ) biological and chemical surveys of Little Black Creek studies of 1991, 1996, and 2001 (Wuycheck, 1992; Walker, 2000; and Walker, 2002, respectively), all indicate that fish community is rated poor because the species composition remains unrepresentative of a coldwater stream (absence of trout). Macroinvertebrate communities assessed in August 2001 (Walker, 2002) continue to demonstrate degraded communities at Airline Road and Summit Avenue.

Walker (2002) reported poor rated macroinvertebrate communities at Airline Road and Summit Avenue with metric scores of -7 and -5, respectively with acceptable macroinvertebrate community at Roberts Street with a metric score of -1. The number of fish individuals, as well as macroinvertebrate diversity and density were low at Airline Road. Habitats at the three stations were rated fair to good. Airline Road has substantial sedimentation that affects biological communities and industrial and municipal storm water runoff/washoff is considered a probable source of the impairment from numerous outfalls in the lower reach (Figures 2 and 3).

Petrochemical odors from sediments and venting groundwater still persist in the Laketon Road area (defunct Marathon Petroleum refinery site) downstream to at least Black Creek Road. No petrochemical odors were evident at Roberts Street during the 2001 survey. The number and concentrations of various volatile organic compounds in water at Laketon Avenue are lower than in 1996, generally. Since the 1996, MDEQ survey, stream sediments have demonstrated a substantial increase in cadmium concentrations at Sherman Boulevard, as well as elevated concentrations of chromium, copper, lead, nickel, and zinc. Sediment poly-aromatic hydrocarbons (PAHs) concentrations in sediment samples collected downstream of Roberts Street, upstream of Sherman Boulevard (and Peerless Plating site), Sherman Boulevard, and Summit Avenue all exceeded Probable Effect Concentration (PEC) guideline values. PCBs (0.6 and 0.57 milligrams per kilogram (mg/kg)) were in sediment samples from Sherman Boulevard and Hoyt Street. Little Black Creek suffers from the effects of dredging/ditching on flow conditions and habitat quality, historic and potentially ongoing contamination from current and historic loadings, and the effects of runoff/washoff volume and quality from the various storm water inputs throughout the watershed. Staff (Berdinski, 2001 - personal communication) of the MDEQ, Water Division, indicates that the pathogen issue was removed since the pump station overflow at Sherman Boulevard/Getty Road

location appears to be very limited in occurrence. Berdinski (2003 – personal communication) indicates that the Getty Street pump station (G) had a by-pass in January 2001, due to a broken force main that required the by-pass at Getty Street. Prior (from 1995 through 1998), the Getty Street station had one to two overflow/failures. Numerous repairs, primarily electrical have been made to upgrade the station. The station did not fail again until July 2002, where a reported 200,000 gallons were by-passed to Little Black Creek. Two other stations identified as N and K, have had reported losses of 150,000 gallons and 200 gallons in May 1998 and October 2001, respectively. The former resulted from severe storm event, the latter due to shorting out of the electrical system by a squirrel. The nutrient enrichment and nuisance conditions previously noted in prior surveys appear to have been diminished. Observations during the August 2001, biological and habitat assessment indicated the absence of nuisance algal growths throughout.

The primary contributors to poor stream quality include excessive erosion and runoff/washoff, elevated runoff volumes, and runoff rates from substantial areas of impervious surfaces in this highly urbanized/industrialized watershed that cause flashy, unstable flow conditions. These factors result in stream bank erosion, siltation, and sedimentation of biologically important and desirable habitat. The June 2001 habitat assessments were conducted at Roberts Street, Summit Avenue, and Airline Road. No physical and biological evaluations were conducted at or upstream of Black Creek Road because the stream was substantially modified due to dredging and channelization activities. The reach of stream in the vicinity of Laketon Avenue/Walker Road was dredged in 1993, as part of the attempted remediation of the Marathon Petroleum defunct refinery site. Walker (2002) indicated that approximately 75 percent of Little Black Creek has reportedly been dredged.

Downstream of Black Creek Road, habitat quality scored 63 (rated fair) at Roberts Street, 77 (rated good) at Summit Avenue, and 63 (rated fair) at Airline Road. A habitat score range of 35 to 70 defines a fair rating; however, habitats with scores in the lower end of this range are not expected to support acceptable macroinvertebrate communities. Expectations are that with continued, excessive runoff/washoff solids and hydrologic loadings and metals, contaminated sediments will continue to impair Little Black Creek and not support its coldwater fish and other aquatic life designated uses. Reductions in storm sewer runoff rates and solids loads from both controllable industrial and municipal storm water runoff sites, along with reduced stream bank erosion through more stable flow management are necessary to reduce impacts on the aquatic life.

NUMERIC TARGETS:

The impaired designated use for Little Black Creek is aquatic life. Michigan's WQS require, as a minimum, the protection of a variety of designated uses, including aquatic life (Rule 100(1) (f)). The fish and macroinvertebrate communities of Little Black Creek are impacted due to habitat loss primarily from excessive sedimentation and unstable flow conditions. Achievement of WQS for the aquatic life designated use is to be demonstrated via assessments of the integrity of the macroinvertebrate community and habitat quality.

The primary numeric targets involve the use of Michigan's biological community and habitat quality assessment Procedure 51 (MDEQ, 1997 and 1998). The biota TMDL target is to achieve a macroinvertebrate community with an acceptable, reproducible score equal to or greater than -4. The macroinvertebrate community scores will be evaluated based on a minimum of two Procedure 51 biological assessments conducted in two consecutive years, following the implementation of Best Management Practices (BMPs) to minimize sediment loadings to the subject TMDL reach.

The Procedure 51 stream habitat quality assessment has been revised and will also be used (MDEQ, 2002). Prior to the revision, a minimum habitat quality score of 65 (approaching the upper

end of the fair habitat score range of 35 to 70) was established as the minimum target for the habitat quality at all locations assessed. The habitat assessment target score of 65 was used to represent adequate control of anthropogenic sediment sources, so as to improve habitat quality and the biological community. This targeted score is closely associated with macroinvertebrate community scores of -3 or greater, providing better results than a minimally acceptable value of -4. This level of conservation is appropriately high enough to minimize both temporal and spatial variability within the watershed and buffer variability within the macroinvertebrate and habitat assessment protocol. The habitat assessment score of 96 (the most recent Procedure 51 habitat assessment procedure) proportionately equates to the score of 65 of the previous assessment procedure. Therefore, a habitat target score of 96 (approaches the upper range of the marginal score range of 56 to 104 which equates to the 35 to 70 point score of the previous habitat rating system) or greater will also be used to demonstrate acceptable stream quality conditions.

A secondary numeric target for total suspended solids (TSS) will be used to further assess improvements in Little Black Creek. The secondary target goal is represented by a mean annual, in-stream TSS concentration of 80 milligrams per liter (mg/l) to characterize wet-weather runoff/washoff events. This secondary numeric target may be overridden by achievement of the biological and habitat numeric targets. However, if the TSS numeric target is achieved but the biota or habitat numeric targets are not achieved, then the TSS target may have to be reevaluated. Achievement of the secondary numeric target will help guide proper control over NPS of excessive suspended solids loads from runoff, as well as the runoff discharge rates and instantaneous runoff volumes that affect increased stream flow instability, stream bank erosion, and increased suspended solids concentrations.

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. Vohs et al., (1993) indicated that chemically inert suspended solids of 100 mg/l appears to separate those streams with a fish population from those without. The European Inland Fisheries Advisory Commission stated that, in the absence of other pollution, a fishery would not be harmed at suspended solids concentrations less than 25 mg/l. Good to moderate fisheries can be found at 25 to 80 mg/l suspended solids, good fisheries were unlikely to be found at 80 to 400 mg/l, while only poor fisheries would be found at 400 mg/l (Alabaster, 1972). Decreases were demonstrated in the standing crop of both fish and macroinvertebrate in an area receiving suspended solids loadings of no more than 40 mg/l (Gammon, 1970).

Water quality criteria for suspended solids (finely divided solids) may be represented by the following categories:

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 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 Little Black Creek.

Overall, the secondary target of 80 mg/l TSS (as a mean annual value) is intended to evaluate solids loading affects and assist in orienting and focusing corrective actions for source reductions. Additional TSS targets, based on flow related considerations may be developed as additional data on Little Black Creek becomes available.

SOURCE ASSESSMENT :

From the Mona Lake confluence upstream, land use in the watershed is dominated by residential, commercial, industrial, and suburban development. Such development within a watershed alters its hydrologic characteristics because increased areas of impervious surface runoff and washoff (solids loads) are commonly directed to streams within the watershed. Typically, such development and associated land use modification practices increase rapid precipitation runoff and washoff of suspended solids and contaminant loads to the receiving waters (Fonger and Fulcher, 2001). Substantial reductions in vegetative riparian zones and pervious areas, especially, in the middle and lower watershed of Little Black 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 portions of the landscape and contribute to rapid precipitation runoff rates to Little Black Creek. This condition fosters stream bank erosion, unstable flow conditions, and sedimentation of desirable habitat in Little Black Creek. Therefore, the sources of sediment loadings to Little Black Creek are primarily attributable to periodic erosion and storm water runoff/washoff from impervious surfaces associated with the urban, residential, industrial, and commercial-dominated land uses in the watershed.

Both fish and macroinvertebrate communities have been impacted by a variety of sources over the past 15 years. Historically, nuisance plant growths, oils, petroleum odors, and sedimentation were evident (Walker, 2002). The periodic bypass of sanitary sewage/industrial wastewater to the stream from the Getty Street pump station has occurred at least twice due to power failure. About 80,000 gallons of untreated effluent was bypassed in early June 1991 and most recently in the summer of 2001. The 1991 (Wuycheck, 1992), 1996 (Walker, 2000), and 2001 (Walker, 2002) Procedure 51 assessments of Little Black Creek indicate the absence of trout in the stream. However, the Michigan Department of Natural Resources (MDNR), Fisheries Division records indicate that trout have not been found or planted in Little Black Creek based on records beginning in the 1930s (Harrington, 2003 – personal communication). Roberts Street is the most natural area (wooded wetland along the stream margin) with extensive growths of tag alders adjacent to the stream.

The stream reach at Laketon Avenue has periodic venting and/or overflow of contaminated ground water from the now defunct Marathon Petroleum refinery site located northeast of the intersection of Laketon Avenue and Walker Road. An air stripper treatment system was originally installed and a National Pollutant Discharge Elimination System (NPDES) permitted discharge authorized (historically, Permit #MI0048119) in the late 1980s. Due to elevated ammonia and reduced dissolved oxygen in the treated groundwater, the company tried reapplying treated groundwater to the site, re-circulating and re-treating to resolve the problem. The NPDES discharge permit was terminated in 1996 because the air stripper that was used to treat the groundwater became inoperable. The treatment unit was abandoned because the system became solidified due to the accumulation of iron released from the petroleum contaminated groundwater during the treatment process. Marathon is currently relying on phytoremediation and air sparging to treat the groundwater moving off-site. The air sparging operations (both on- and off-site) began in November 2001 (Hopkins, 2003 – personal communication). However, a strong, pungent, foul odor is still associated with water from the site that enters Little Black Creek. The odor was evident in Little Black Creek during the 2001 assessment (Walker, 2002) about 1.5 miles downstream of the defunct refinery site.

Further downstream just northeast of the intersection of Sherman Avenue and Getty Street, the now defunct Peerless Plating site (a USEPA superfund site and Michigan 307 site) historically discharged metal plating toxicants to seepage lagoons that ultimately vented contaminants to Little Black Creek. Current efforts by the USEPA are to capture and treat the contaminated groundwater

before it vents to Little Black Creek. The MDEQ plans to place more monitoring wells at the site in 2003 or 2004 to assure that the contaminated groundwater plume is completely captured and treated (Krajcovic, 2003 – personal communication). Just downstream at Getty Street, the Getty Street sewage pump station, has periodically (at least twice in the past 11 years, the most recent in 2002) bypassed raw sewage, industrial wastewater, and domestic debris to the stream (Berdinski, 2003 – personal communication). Upstream of Broadway Road, eroded debris from a now defunct municipal landfill, and contaminated seeps from the Webb Chemical Company site historically entered Little Black Creek. Webb Chemical Company now captures and treats contaminated groundwater prior to discharge to Little Black Creek under NPDES Permit #MI0049719 issued in 1992. The facility is currently authorized to discharge 0.115 million gallons per day (mgd) of treated groundwater to the stream (Table 1).

Evans (1982) reported elevated cadmium concentrations in water and sediment samples downstream of Peerless Plating site just upstream of Sherman Avenue, and the presence of 1 to 5 mg/kg of PCBs in sediments immediately downstream of the Keating Avenue storm sewer (tributary to the storm sewer were Johnson Products, Sealed Power, American Porcelain, Kershman (Coil Anodizers), American Coil and Spring, and Amstore). Evans (1982) concluded that there were definite improvements in the biological community at all stations assessed based on the presence of mayflies which were absent in 1977 (Sylvester, 1977a) but the stream remained degraded both biologically and chemically and did not support its designated use as a coldwater stream. Coldwater fish species remained absent in Little Black Creek, thereby, not supporting its coldwater designation. Stream temperatures collected during the various stream surveys of Little Black Creek indicate summer temperatures in the mid to upper 60s, sufficient to support trout and other coldwater taxa.

Water samples collected from six locations throughout the watershed in August 2001 indicated that a variety of parameters such as ion, metals, and volatile organic chemicals were detected at several stations at concentrations above background levels. None of the chemicals at the time, were present above their respective WQS Rule 57 water quality values. The chemical oxygen demand and total organic carbon concentrations at the Laketon Avenue/Walker Road location were substantially greater than the other stations. This was attributed to the venting of petroleum contaminated groundwater from the Marathon Petroleum's defunct refinery site.

Sediment samples collected from six locations throughout the watershed (Walker, 2002) continue to demonstrate elevated heavy metal concentrations that exceed PEC guidelines (MacDonald et al., 2000), as provided in Table 3. Lead remains elevated in sediments throughout the TMDL reach; chromium is elevated at Roberts Street; cadmium, chromium, copper, lead, nickel, and zinc remain highest at Sherman Boulevard at the Peerless Plating site; cadmium, chromium, lead, and/or zinc remain elevated further downstream at Summit Avenue, Airline Road, and/or Hoyt Street.

Of the six NPDES permitted dischargers in the watershed, one has an individual permit, four have general permits, and one is authorized as a USEPA Superfund site (Table 1 and Figure 2). Three of the facilities discharge treated groundwater and the other three discharge non-contact cooling water. Twenty-four NPDES permitted industrial storm water permits and 39 (municipal, township, road commission, county drain commission, and/or private) Phase II – MS4 program storm water runoff sites discharge to Little Black Creek during wet-weather events (Tables 1 and 2; Figures 2 and 3).

Collectively, none of the six point source facilities are required to monitor TSS in their effluent discharged to Little Black Creek (Table 1). The combined maximum design discharge total of 0.884 mgd or 323 million gallons/year applies to the six dischargers. Therefore, a worst-case estimate of TSS load for these six facilities was made assuming a TSS monthly average

concentration of 30 mg/l; a typical monthly average permit limit provided in NPDES permits. The estimated TSS load from the six permitted facilities (individual, general, and Superfund site) is 221 pounds/day or 80,750 pounds/year.

Annual TSS loads to the Little Black Creek Watershed from the various land use categories involved estimates of the acres of each land use category (Denning, 2003 – personal communication); a mean annual rainfall of 31 inches and the use of USEPA’s Simple Method model approach (USEPA, 2001). The estimated annual TSS load from the urban/industrial/built-up land use category versus the remaining NPS land use categories (LA component) in the Little Black Creek Watershed is about 770,086 pounds and 39,198 pounds, respectively (Table 4). The overall total estimated annual TSS load to the Little Black Creek from point sources, storm water, and NPS is approximately 890,034 pounds and represents approximately 9%, 87%, and 4%, respectively.

In summary, excessive sedimentation and flashy flow conditions in Little Black Creek occurs due to elevated runoff/washoff and associated TSS loads from the impervious urban areas in the watershed. Such development has disrupted the natural hydrology of Little Black Creek, especially, during wet-weather runoff/washoff events. These alterations to the Little Black Creek Watershed have destabilized stream banks, increased solids loads, shortened runoff/washoff rate of delivery to the stream and reduced or eliminated desirable fish and macroinvertebrate habitat. Denning (2003-personal communication) indicates that 1426 acres (32%) of the Little Black Creek watershed area was determined to be impervious surfaces. Stream degradation can be demonstrated at relatively low levels of 10 to 20% impervious surface areas discharged to a water body (WPT, 1994).

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 sedimentation has been demonstrated to impair the biological integrity of rivers (Waters, 1995) by obscuring or reducing the suitability of colonizable or useable substrate by stream biota. With a reduction in sedimentation, the macroinvertebrate community typically responds with an increase in species diversity and an increase in the number of individuals of each species. This commonly results from increased habitat diversity as sedimentation rates decline. As a result, the Procedure 51 assessment scores and ratings for quality of the macroinvertebrate community and habitat are expected to increase as sedimentation rates decline, 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. Because the biotic community has been impaired by excessive sedimentation and flow instability, this TMDL will be based on the response of the fish and macroinvertebrate communities to the reduction of sedimentation. The TMDL is based on reducing sediment loads throughout the watershed to a level that supports a biological community of the stream that meets WQS. Using the metrics from Procedure 51, a numeric score of -4 for both fish and macroinvertebrate communities and a habitat score of 96 or greater will serve as primary targets for this biota TMDL.

Concurrent with the selection of numeric endpoints, TMDL development 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 Rules 323.1082 and 323.1090 of Michigan's WQS. In general, the lowest monthly 95% exceedance flow for a stream is used to establish effluent limits for point sources. However, the primary sediment inputs to Little Black Creek are attributable to wet-weather driven discharges. As such, there is no single condition that is protective for all conditions, but efforts are directed towards wet-weather runoff/washoff events.

The target of 80 mg/l TSS was used to develop a secondary TMDL loading goal for TSS loads during wet-weather runoff/washoff events, especially from the urban/industrial/built-up land use category that represents about 60% of the land use area in the watershed.

ALLOCATIONS:

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

$$\text{TMDL} = S^{\text{WLAs}} + S^{\text{LAs}} + \text{MOS}$$

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 load capacity is allocated among the three TMDL components: **WLA** for point sources, **LA** for NPS and background loads, and the **MOS**.

WLA:

Presently, the estimated total annual TSS load from all accountable sources is approximately 890,034 pounds. The individual and general NPDES permits and substantive requirement documents point sources TSS load to Little Black Creek is estimated at 80,750 pounds/year (Table 1). Based on land use category TSS export coefficients (Cave, 1994), a total annual TSS load estimate of approximately 770,086 pounds is attributable to storm water runoff/washoff discharges to the Little Black Creek Watershed associated with the urban/industrial/built-up sources (Table 4). The projected annual TSS load (80,750 pounds) from the individual and general NPDES permitted and substantive requirements document point sources is considered acceptable. However, the combined effect on Little Black Creek by runoff/washoff loads of TSS from the urban/industrial/built-up category should be reduced in order to achieve an in-stream mean annual wet-weather TSS concentration goal of 80 mg/l or less by reducing runoff/washoff delivery rates to Little Black Creek. If the goal of 80 mg/l TSS were achieved, this would represent a 17% reduction in TSS load to Little Black Creek resulting in a projected annual WLA of 717,349 pounds of TSS. Reduced runoff/washoff delivery rates to Little Black Creek will play an important role in achieving the 80 mg/l goal by reducing TSS loads from upland sources, stream bank erosion, and re-suspension of in-place TSS.

For treated NPDES permitted point source discharges, the receiving stream design flow equals the lowest 95% exceedance flow. However, it is proposed that any TSS limits in NPDES point source permits be established at the target of 30 mg/l or less, which then makes it unnecessary to consider mixing zone scenarios. The point source contributions to the WLA are considered controllable

through the existing NPDES permit requirements and storm water through the Phase II MS4 program.

LA:

The LA component defines the load capacity for a pollutant that is nonpoint in origin that includes the following land use categories: Agricultural, forested/shrub/open land, wetland, and water bodies (Table 4). An estimated annual TSS load of 39,198 pounds is attributed to these categories of NPS in the watershed. All but the agricultural land use are considered as background load sources. Therefore, the only targeted load reduction source is from agricultural sources. A 45% annual reduction (499 to 275 pounds) from cropland areas in the watershed is recommended resulting in an annual LA, TSS load target of 38,699 pounds, based on achieving the 80 mg/l TSS target concentration during wet-weather runoff/washoff events.

In summary, the reduced accumulative annual TSS load estimate to Little Black Creek (WLA + LA) is 756,323 pounds/year, an overall 15% reduction. Eleven percent (80,750 pounds/year) is allocated to the individual and general NPDES permitted and substantive requirements document point source component of the WLA along with 84% (636,599 pounds) to the NPDES permitted industrial storm water and the municipal storm water outfalls covered under the Phase II MS4 Storm Water Program, and the remainder of 5% (38,974 pounds) attributed to the LA. To achieve the WLA, a reduction in the storm water runoff/washoff of TSS load is recommended, especially, in the urban/industrial/built-up land use categories. The percent reduction in the TSS load is based on the reduction of wet-weather runoff event TSS loads with a goal of an annual average in-stream target of 80 mg/l TSS during wet-weather runoff/washoff events.

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 loadings to the aquatic environment.

The habitat target score of 96 or greater will be used to demonstrate acceptable stream quality conditions and represent adequate control of anthropogenic sediment sources to assure improved habitat quality and the biological communities. This targeted score is closely associated with macroinvertebrate community scores of -3 or greater, potentially providing better results than a minimally acceptable value of -4.

For comparison of survey assessment with results from 2001, follow-up biological and habitat quality assessments will be conducted during stable flow conditions within the months of June through September. The results will best reflect an MOS that is implicit and express an integration of the effects of the variability in sediment loads in the aquatic environment and minimize seasonal variability.

Seasonality: Seasonality is addressed in the TMDL in terms of sampling periods for fish and macroinvertebrate communities. To minimize temporal variability in the biological community, sampling will be conducted during June through September of each year during stable flow conditions. For assessing TSS loads to Little Black Creek, seasonal event monitoring will be conducted to define and characterize both hydraulic and TSS loads from the Little Black Creek watershed that influences the biota TMDL reach.

MONITORING PLAN:

Monitoring will be conducted by the MDEQ to assess progress towards meeting the biota TMDL targets, following implementation of applicable BMPs and control measures. Subsequently, annual sampling of the macroinvertebrate community and habitat quality at locations in the vicinity of Laketon Avenue, Sheridan Road, Black Creek Road, Roberts Street, Sherman Boulevard, Summit Avenue, and Airline Road as a minimum, will be conducted until assessment results from two consecutive years demonstrate attainment of TMDL targets at these sites. For best comparative purposes, follow-up biological and habitat assessments will be conducted in a June to August timeframe, during stable flow conditions. Every effort will be made to sample during similar stream conditions and assess the same sampling locations.

In-stream monitoring of TSS, stream flow, and representative land use runoff/washoff characteristics for a variety of stable flow and wet-weather events will be necessary to refine the TSS loadings estimates for the Little Black Creek Watershed. This information will further define the level of TSS load reduction necessary, seasonally, climatologically, and annually.

Once the BMPs are in place to minimize the effects of runoff and flashy conditions that exist in Little Black Creek, stream flow and TSS sampling can be implemented so as to measure progress towards the secondary numeric target of 80 mg/l as a mean annual TSS value during wet-weather runoff events. Multiple sampling during critical high flow events, as well as low flow events, needs to be assessed to better estimate TSS loads in Little Black Creek.

REASONABLE ASSURANCE:

The focus of the actions to protect Little Black Creek is directed towards installing BMPs and other control measures to reduce and minimize solids loads and excessive runoff/washoff discharge rates to the TMDL reach. The former action is to reduce sedimentation impacts, the latter to minimize the erosive effects to the stream. Overall, control measures include: individual and general NPDES permit limits, storm water permit limits, and approved BMPs for areas currently not under any permit.

For the WLA, existing individual and general NPDES permit requirements for these sources will be adequate to meet the target.

Storm water permits, pursuant to Part 21, Wastewater Discharge Permits, of Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, require the collective units of government within a watershed to develop a watershed management plan that includes the detailing of 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 the Little Black Creek Watershed) of their individual storm water prevention plans.

The MDEQ district staff will continue to work with and assist interest groups in the Little Black Creek Watershed. The purpose is 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 Little Black Creek Watershed.

The MDEQ, Guidebook of BMPs for Michigan Watersheds (Peterson et al., 1993, as modified), can be used to develop BMP elements that should include:

- Upgrade and maintain the current vegetative riparian zone to reduce soil erosion and loadings to the Little Black Creek from sources within the watershed. BMPs need to be employed within the riparian zone adjacent to the urbanized, residential, industrialized, and commercial areas to minimize the loss through erosion and direct runoff/washoff, thereby minimizing habitat impairment of the Little Black Creek.
- Implementation of BMPs in the storm water permits program that reduces sediment loadings and moderate runoff release rates and excessive runoff/washoff to the Little Black Creek Watershed are expected to improve and protect designated use support throughout the watershed. The goals are for reduced solids loadings and greater flow stability throughout the watershed so that WQS are restored and protected. Recent guidance regarding runoff detention and stream protection is provided by Fongers and Fulcher, 2001.

The MDEQ approval of BMPs and implementation plans will be required prior to implementation of proposed structural improvements.

There is a Mona Lake Watershed Project that is being conducted and involves the Community Foundation of Muskegon County, Grand Valley State University's Annis Water Resource Institute, the communities of Muskegon Heights, Norton Shore, and Muskegon. Findings from this project are expected to enhance and augment the development of the Little Black Creek TMDL implementation plan.

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July 2003

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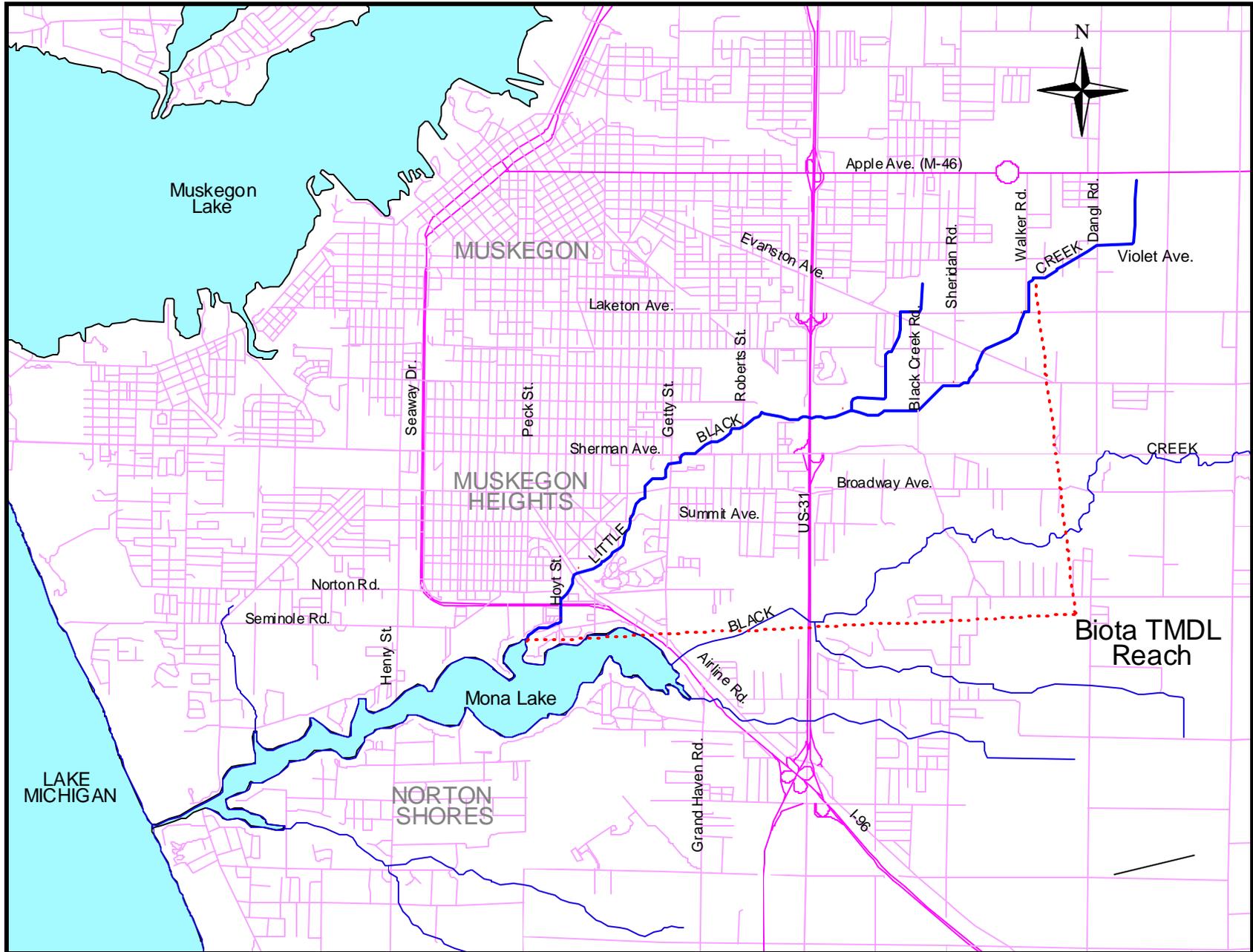


Figure 1. Little Black Creek Biota TMDL Reach, Muskegon County, Michigan.

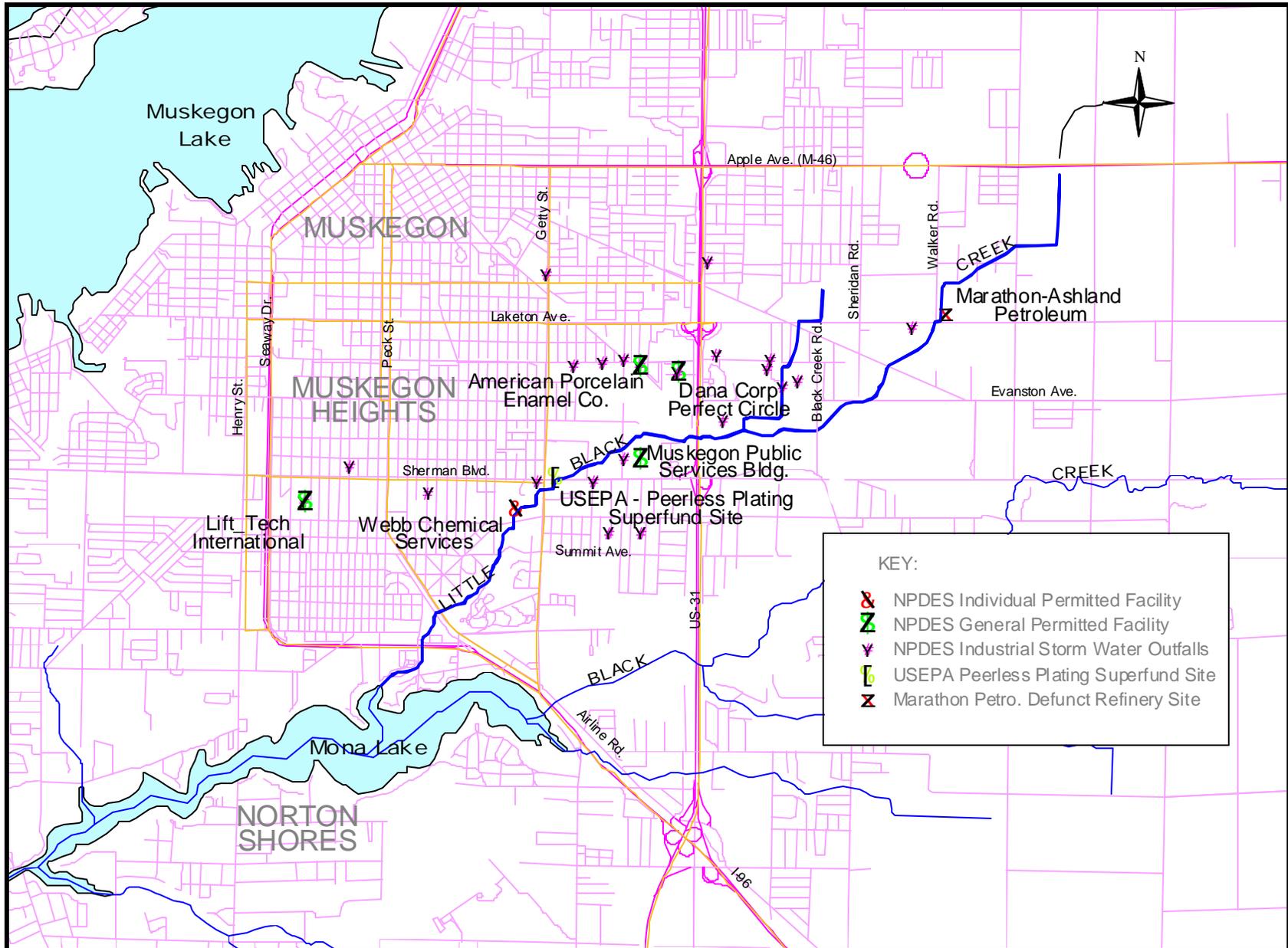


Figure 2. NPDES permitted (individual, general, and industrial storm water) facility outfalls to Little Black Creek Watershed, Muskegon, Muskegon County, Michigan.

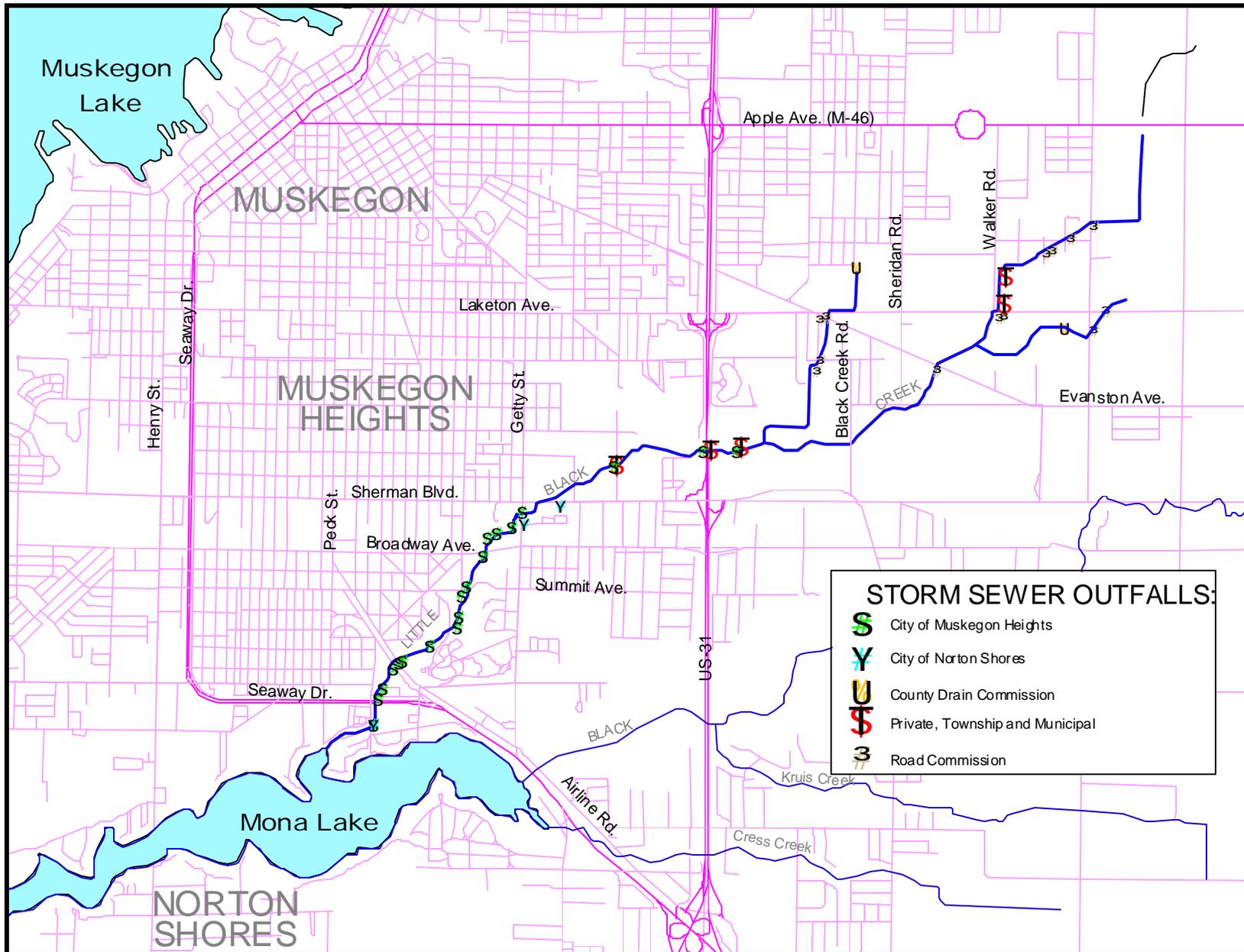


Figure 3. Muskegon County Phase II sites storm sewer outfalls other than NPDES permitted industrial storm water outfalls. Source: Fishbeck, Thompson, Carr and Huber Project G01513A for Muskegon County.

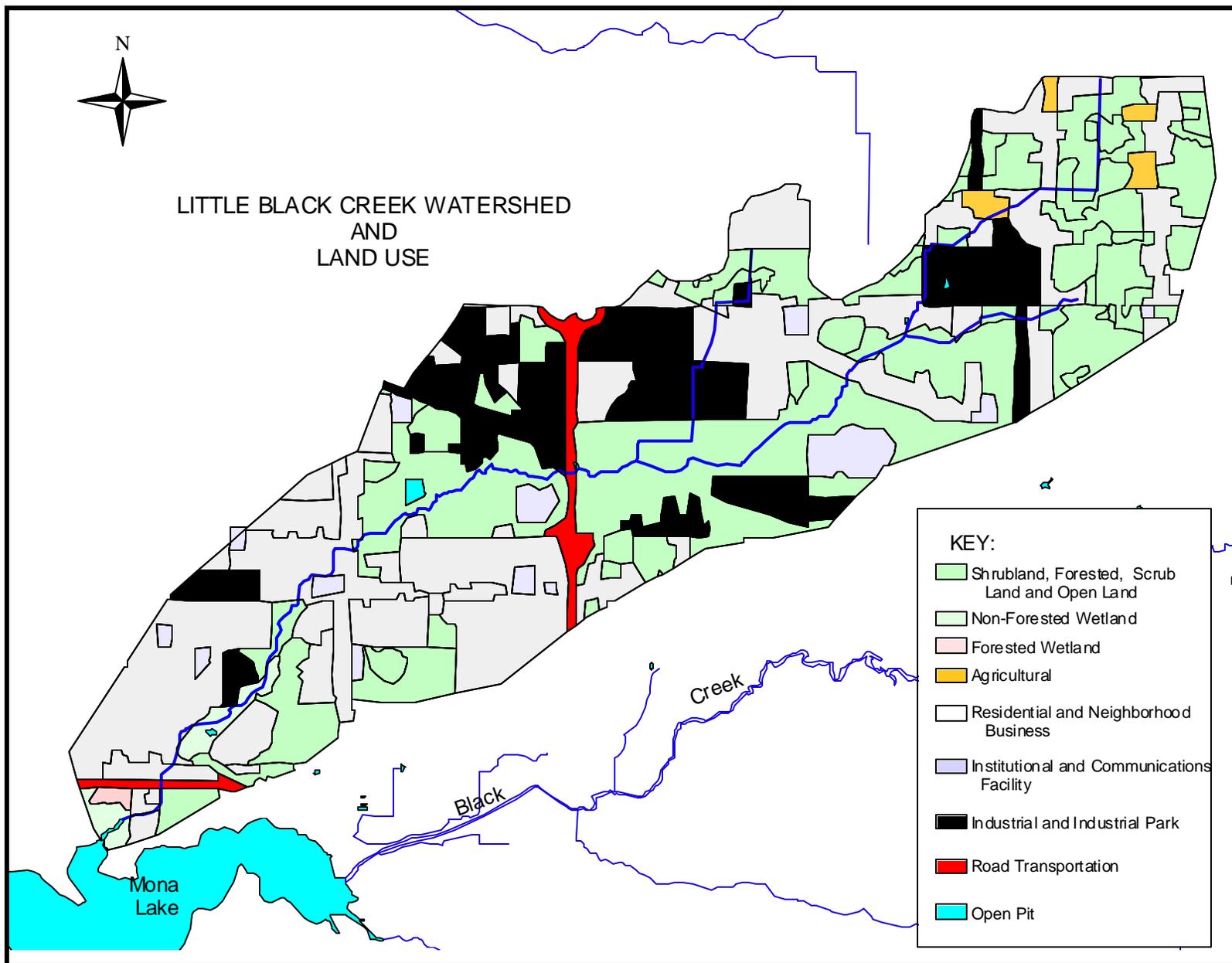


Figure 4. Land use categories in the Little Black Creek Watershed, Muskegon County, Michigan.
(Source: Denning, 2003 with 1997 database).

Table 1. Individual, general, and industrial storm water NPDES permitted outfalls tributary to the Little Black Creek Watershed and estimated TSS loads for non-storm water outfalls. (Source: MDEQ/WD NPDES permit Management System. *mgd = million gallons per day.

PERMIT NUMBER	FACILITY	DESIGN FLOW (mgd*)	Latitude (decimal degrees)	Longitude (decimal degrees)	Annual TSS Load at 30 mg/l (pounds)
Individual NPDES Permits:					
MIO049719	Webb Chemical Services	0.115	43.20221	-86.22863	10,500
General NPDES Permits:					
MIG080174	Muskegon Public Services Bldg	0.144	43.20694	-86.21278	13,150
MIG250327	Lift-Tech International	0.025	43.20278	-86.25556	2,300
MIG250329	American Porcelain Enamel Co	0.06	43.21556	-86.21278	5,500
MIG250338	Dana Corp-Perfect Circle	0.3	43.21490	-86.20790	27,400
US EPA Superfund Site:					
MIU990007	US EPA-Peerless Plating-SF	0.24	43.20528	-86.22361	21,900
Total Daily Design Flow (mgd):		0.884			80,750
Industrial Storm Water NPDES Permits:					
MIR011219	Hodgeon & Anderson		43.20611	-86.24972	
MIR011632	Fleet Engineering Inc		43.21528	-86.19639	
MIS310067	Asphalt Paving Inc-Muskegon		43.20472	-86.21861	
MIS310074	Wilbert Burial Vault-Musk		43.22417	-86.22472	
MIS310098	Adac Plastics Inc-Muskegon		43.22528	-86.20417	
MIS310099	Dana Corp-Perfect Circle		43.21490	-86.20790	
MIS310112	Best Block Co-Muskegon Heights		43.20472	-86.22583	
MIS310117	US Army-Keating-Muskegon		43.21556	-86.22111	
MIS310130	Holland USA		43.21667	-86.20306	
MIS310132	Almond Products Inc		43.20000	-86.21250	
MIS310171	Lift-Tech International		43.20278	-86.25556	
MIS310172	Johnson Technology Inc		43.21417	-86.19250	
MIS310207	K L Industries Inc		43.21056	-86.20222	
MIS310208	American Porcelain Enamel Co		43.21556	-86.21278	
MIS310229	UPS-Muskegon		43.20694	-86.21472	
MIS310249	Port City Die Cast		43.21917	-86.17806	
MIS310256	Lorin Industries		43.21611	-86.21472	
MIS310261	DSC Products Inc-Muskegon		43.21361	-86.19444	
MIS310269	Bekaert Corp		43.20417	-86.18750	
MIS310320	Quality Plating Co-Muskegon		43.20000	-86.21667	
MIS310345	American Coil Spring Co		43.21583	-86.21750	
MIS310350	Thermodisc Midwest Components		43.21611	-86.19611	
MIS310374	American Grease Stick-Muskegon		43.20361	-86.23972	

Table 2. Muskegon County storm water outfalls under private, township, municipal; County Drain Commission and County Road Commission jurisdiction tributary to Little Black Creek.
 Source: Fishbeck, Thompson, Carr, and Huber Project No. G01513A for Muskegon County.

Outfall Number	Jurisdiction	Location	Latitude DD	Longitude DD
MH0803	City of Muskegon Heights	Hoyt Street	43.18758	-86.24054
MH0802	City of Muskegon Heights	Service Street	43.18963	-86.24014
MH0801	City of Muskegon Heights	West Norton Street	43.19037	-86.23958
MH0513	City of Muskegon Heights	Merriam Street	43.19192	-86.23849
MH0512	City of Muskegon Heights	Airline Road	43.19245	-86.23789
MH0511	City of Muskegon Heights	Airline Road	43.19256	-86.23745
MH0510	City of Muskegon Heights	Morton Avenue	43.19370	-86.22463
MH0509	City of Muskegon Heights	Mona View Drive	43.19520	-86.23168
MH0508	City of Muskegon Heights	Mona View Drive	43.19594	-86.23157
MH0507	City of Muskegon Heights	Summit Avenue	43.19770	-86.23130
MH0506	City of Muskegon Heights	East Collins Avenue	43.19840	-86.23076
MH0505	City of Muskegon Heights	Broadway Avenue	43.20078	-86.22898
MH0504	City of Muskegon Heights	Broadway Avenue	43.20213	-86.22852
MH0503	City of Muskegon Heights	Broadway Avenue	43.20247	-86.22757
MH0502	City of Muskegon Heights	West of Getty Street	43.20297	-86.22592
MH0501	City of Muskegon Heights	Getty Street	43.20415	-86.22491
NS0402	City of Norton Shores	Getty Street	43.20321	-86.22499
NS0401	City of Norton Shores	Sherman Boulevard	43.20464	-86.22083
NS0804	City of Norton Shores	Hoyt Street	43.18759	-86.24054
MT3402	Road Commission	Keating Avenue	43.21506	-86.19367
MT3401	Road Commission	Werengo Street	43.21595	-86.19331
MT2703	Road Commission	Laketon Avenue	43.21909	-86.19326
MT2702	Road Commission	Laketon Avenue	43.21931	-86.19270
MT2701	County Drain	Center Street	43.22262	-86.19863
MT3501	County Drain	West of Dangl Street	43.21848	-86.16582
MT3502	Road Commission	Evanston Avenue	43.21514	-86.18101
MT2606	Road Commission	Walker Road	43.21940	-86.17381
MT2607	Road Commission	Laketon Avenue	43.21921	-86.17420
MT2605	Private & Twp/Municipal	Walker Road	43.22022	-86.17391
MT2604	Private & Twp/Municipal	Walker Road	43.22232	-86.17381
MT2603	Road Commission	Debaker Road	43.22421	-86.16927
MT2602	Road Commission	Violet Avenue	43.22450	-86.16869
MT2601	Road Commission	Todd Street	43.22536	-86.16662
MT2502	Road Commission	Dangl Road	43.22633	-86.16429
MT3601	Road Commission	Dangl Road	43.21838	-86.16430
MT2503	Road Commission	Laketon Avenue	43.21909	-86.16273
MT3301	Private & Twp/Municipal	Roberts Street	43.20772	-86.21496
MT3302	Private & Twp/Municipal	Harvey Street (US -31)	43.20885	-86.20492
MT3403	Private & Twp/Municipal	Keating Street	43.20905	-86.20168

Table 3. Selected analytical results for sediment samples collected from selected locations in Little Black Creek, Muskegon County, August 27, 2001. All units are in mg/kg (dry weight). Analytes are those for which there are literature based toxicity reference values. (Source: Walker, 2002)

Station Location/Parameter	Hoyt Street	Airline Road	Summit Avenue	Sherman Boulevard	upstream Sherman Boulevard	Roberts Street	Black Creek Road	Laketon Avenue	PEC Value*
Metals plus									
Arsenic	3	7.4	4.3	8.1	5.2	12	13	16	33
Cadmium	13	53	21	2860	2.4	1.4	0.71	0.26	5
Chromium	199	94	39	211	61	220	38	7.9	111
Copper	107	135	76	167	94	45	25	3.2	149
Lead	232	258	133	231	198	118	156	29	129
Nickel	52	49	21	322	35	15	6	5.9	49
Zinc	719	636	305	1960	545	313	137	50	459
Semi-Volatile Organics									
Anthracene	0.84	<0.89	1.2	<0.89	1.9	<0.99	<0.63	<0.46	0.845
Benzo (a) Anthracene	1	<0.89	2.5	2.8	5.4	3.4	<0.63	<0.46	1.05
Benzo (a) Pyrene	1.1	1.1	3.5	4.8	8.4	5	<0.63	<0.46	1.45
Chrysene	1.4	1.1	4.5	5.2	8.8	6.7	<0.63	<0.46	1.29
Fluoranthene	2.8	2	8.6	8.7	17	9.7	<0.63	<0.46	2.23
Phenanthrene	1.6	<0.89	3.8	3.8	6.3	4.1	<0.63	<0.46	1.17
Pyrene	2.4	1.8	6.7	7.3	13	8.1	<0.63	<0.46	1.52
Total PAHs	14.09	7.5	41.3	47	86.8	53.6	---	---	22.8
Polychlorinated Biphenyls									
PCB-1254	0.57	---	---	0.6	---	<0.10	---	---	0.676

* Probable Effect Concentration Values – Guidelines from MacDonald et al., 2000. Shaded areas exceed PEC values.

Table 4. Annual TSS loads based on NPDES permitted point sources and various land use categories in the Little Black Creek Watershed. Estimated annual TSS loads and recommended TSS reductions (WLA and LA) are derived.

Source Category	Acres	Estimated Current TSS (Pounds/Year)*	TMDL TSS Target Load TSS (Pounds/Year)
<u>WLA Components:</u>			
NPDES Permitted Point Source TSS Load:		80,750	80,750
Urban/Industrial/Built-Up			
Residential	1373	256,544	
Industrial	417	288,410	
Commercial and Service	645	174,001	
Mixed Urban/Built-Up	108	20,108	
Transportation/Comm/Util.	115	31,023	
Subtotal:	2658	770,086	636,599 (17% reduction)
Total:		850,836	717,349 (WLA)
<u>LA Components:</u>			
Agricultural Land			
Cropland	8	499	275 (45% reduction)**
<i>(Background Source)</i>			
Forested/Shrub/Open Land			
Deciduous	1107	24,278	24,278
Shrub/Brush Land	592	12,984	12,984
Evergreen	40	877	877
Wetland			
Nonforested			
Forested	29	560	560
Water Body			
Open Pit (Lake)	5	-	-
Total:	1781	39,198	38,974 (LA)
Overall Totals:	4439	890,034	756,323 (overall 15% reduction)

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*Load estimates based on PLoad Version 3 model (USEPA, 2001), land use acres derived from 1997 land use database coverage from GVSU (Denning, 2003), and a mean annual rainfall value of 31 inches. **Agricultural land use may not be a factor in 2003 since reportedly no active sites.