Water Quality Assessment and TMDLs for the Dearborn River Planning Area

FINAL

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Montana Department of Environmental Quality

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Executive Summary

The Montana 1996, 2002, and 2004 303(d) lists reported that several stream segments in the Dearborn River Total Maximum Daily Load Planning Area (TPA) in west-central Montana have impaired beneficial uses. The segments of concern are the Dearborn River, Middle Fork Dearborn River, South Fork Dearborn River, and Flat Creek. Causes of impairment in these stream segments include flow alteration, thermal modifications, other habitat alterations, and siltation (see Table 1-1 in Section 1.1). Habitat alteration, flow alteration, and dewatering are considered “pollution”; siltation and thermal modifications are considered “pollutants.” The U.S. Environmental Protection Agency takes the position that Total Maximum Daily Loads (TMDLs) are required only for “pollutants” that are causing or contributing to impairment of a water body (Dodson, 2001). For this reason, the water quality analysis presented in this report focuses on thermal modifications and siltation. However, flow alterations, habitat alterations, and dewatering are also discussed as potential sources or causes of thermal modification or siltation.

DEQ and EPA selected the Dearborn TPA as a pilot project to evaluate the feasibility of completion of all necessary TMDLs relying primarily on currently available data, use of remote sensing techniques, and application of modeling techniques. The Dearborn TPA was selected for this approach because, with the exception of the headwaters region, the Dearborn TPA is largely under private ownership with limited access. Also, when this approach was originally conceived in July of 2002, all necessary TMDLs for the Dearborn TPA were scheduled for completion by December 31, 2003.

Before proceeding with the TMDL process, the impairment status of the 303(d) listed waterbodies must be verified. There are no numeric criteria for sediment-related pollutants in Montana, only narrative criteria. Narrative criteria were therefore interpreted to derive water quality targets and supplemental indicators, with which siltation impairments could be verified. Using available data, published studies, and best professional judgment, a suite of targets and indicators were derived for streams in the Dearborn TPA (See Table 3-4 in Section 3.3). The primary sediment targets for the Dearborn River, Middle Fork Dearborn River, South Fork Dearborn River, and Flat Creek are percent surface fines, clinger taxa, and the periphyton siltation index. Supplemental indicators include bank stability and riparian condition, macroinvertebrate multimetric index, EPT richness, percent clinger taxa, Montana adjusted NRCS stream habitat surveys, TSS, and turbidity. These targets and supplemental indicators were combined in a weight of evidence approach to determine beneficial use impairments caused by siltation.

The Montana water quality standard for temperature is used as a target to address the thermal modifications 303(d) listing for the Dearborn River. In addition, 3-day maximum and 60-day average supplemental temperature indicators were identified to complement the target. Modeling was also conducted in an attempt to determine “natural” temperature conditions in the Dearborn River. The targets, supplemental indicators, and modeling results were combined in a weight of evidence approach to determine beneficial use impairments caused by thermal modifications in the Dearborn River.

The weight-of-evidence approach was applied to each of these waters to determine whether or not they are currently meeting water quality standards. The results and a summary of the proposed actions are presented in Table 1. In no case did comparison of the available data with the target and supplemental indictor values provide for “black and white” conclusions regarding current water quality impairment status. To be conservative, TMDLs are proposed for siltation in the Middle Fork and South Fork Dearborn Rivers and Flat Creek (See Sections 5.1 to 5.3). Although it appears that Montana’s temperature standards may be exceeded in the Dearborn River, the predicted magnitude of the exceedance is minor, uncertainty in the prediction is high, and the cost of implementation of the solution (i.e., elimination of the diversion of irrigation water into Flat Creek) that would likely be proposed in a TMDL is very high. As a result, further study is proposed to develop a better understanding of the potential temperature impairment in the Dearborn River before proceeding with a TMDL. Finally, the results of the evaluations summarized herein suggest potential nutrient impairments in the Middle and South Forks of the Dearborn River and Flat Creek. Further study is proposed to develop a better understanding of these potential nutrient related impairments.

Table 1. Current Water Quality Impairment Status of Waters in the Dearborn TPA.

Water body Name and Number	Listed Probable Causes	303(d) List Status		Current Status	Proposed Action
		1996	2002		
Dearborn River	Siltation	Impaired	Impaired	Not Impaired	To be indirectly considered in further study as proposed in Section 6.
	Thermal Modification	Impaired	Impaired	Unknown	Further study as proposed in Section 6.
Middle Fork Dearborn River	Siltation	Impaired	Not Listed	Impaired	Address through preparation of a TMDL (Section 5.2).
	Nutrients	Not Listed	Not Listed	Potentially Impaired	Further study as proposed in Section 5.5.
South Fork Dearborn River	Siltation	Not Listed	Impaired	Impaired	Address through preparation of a TMDL (Section 5.1).
	Nutrients	Not Listed	Not Listed	Potential Impaired	Further study as proposed in Section 5.5.
Flat Creek	Siltation	Impaired	Impaired	Impaired	Address through preparation of a TMDL (Section 5.3)
	Nutrients	Not Listed	Not Listed	Potentially Impaired	Further study as proposed in Section 5.5.

1.0 INTRODUCTION

The Dearborn River Total Maximum Daily Load (TMDL) Planning Area (TPA) drains approximately 550 square miles in western Montana (Figure 1-1). Three streams in the Dearborn River TPA appeared on Montana's 1996 303(d) list (MDEQ, 1996) and the listing information is shown in Table 1-1. The causes of impairment include flow alteration, thermal modifications, other habitat alterations, and siltation. The South Fork of the Dearborn River was added to the 2002 303(d) list for de-watering, flow alterations, and siltation.

The purpose of this document is to provide an updated assessment of all waters in the Dearborn River TPA that appear on the 1996, 2002, or 2004 303(d) lists and to present all of the required TMDL elements for those waters that are not currently in compliance with the applicable water quality standards.

Table 1-1. 303(d) Listing Information for the Dearborn TMDL Planning Area

<table>
<tr><th>Segment Name</th><th>Size (miles)</th><th>Use</th><th>Listing Year</th><th>Probable Impaired Uses</th><th>Probable Causes</th></tr>
<tr><td rowspan="3">Dearborn River, from Falls Creek to the Missouri River</td><td rowspan="3">48.6</td><td rowspan="3">B-1</td><td>1996</td><td>Aquatic Life Support
Cold-Water Fishery</td><td>Flow Alteration
Thermal Modifications
Siltation
Habitat Alterations</td></tr>
<tr><td>2002</td><td>Aquatic Life Support
Cold-Water Fishery
Primary Contact Recreation</td><td>Flow Alteration
Thermal Modifications
Siltation</td></tr>
<tr><td>2004</td><td>Aquatic Life Support
Cold-Water Fishery
Primary Contact Recreation</td><td>Flow Alteration
Siltation
Thermal Modifications</td></tr>
<tr><td rowspan="3">Flat Creek, from Henry Creek to Dearborn River</td><td rowspan="3">15.5</td><td rowspan="3">B-1</td><td>1996</td><td>Aquatic Life Support
Cold-Water Fishery</td><td>Flow Alteration
Habitat Alterations
Siltation</td></tr>
<tr><td>2002</td><td>Aquatic Life Support
Cold-Water Fishery</td><td>Flow Alterations
Siltation</td></tr>
<tr><td>2004</td><td colspan="2">Insufficient Data</td></tr>
<tr><td rowspan="3">Middle Fork of the Dearborn River, Headwaters to the Dearborn River</td><td rowspan="3">13.5</td><td rowspan="3">B-1</td><td>1996</td><td>Aquatic Life Support</td><td>Siltation</td></tr>
<tr><td>2002</td><td>Not Listed</td><td>Not Listed</td></tr>
<tr><td>2004</td><td>Not Listed</td><td>Not Listed</td></tr>
<tr><td rowspan="3">South Fork of the Dearborn River, Headwaters to the Dearborn River</td><td rowspan="3">15.8</td><td rowspan="3">B-1</td><td>1996</td><td>Not Listed</td><td>Not Listed</td></tr>
<tr><td>2002</td><td>Aquatic Life Support
Cold-Water Fishery</td><td>Dewatering
Flow Alteration
Siltation</td></tr>
<tr><td>2004</td><td>Aquatic Life Support
Cold-Water Fishery</td><td>Dewatering
Flow Alteration
Siltation</td></tr>
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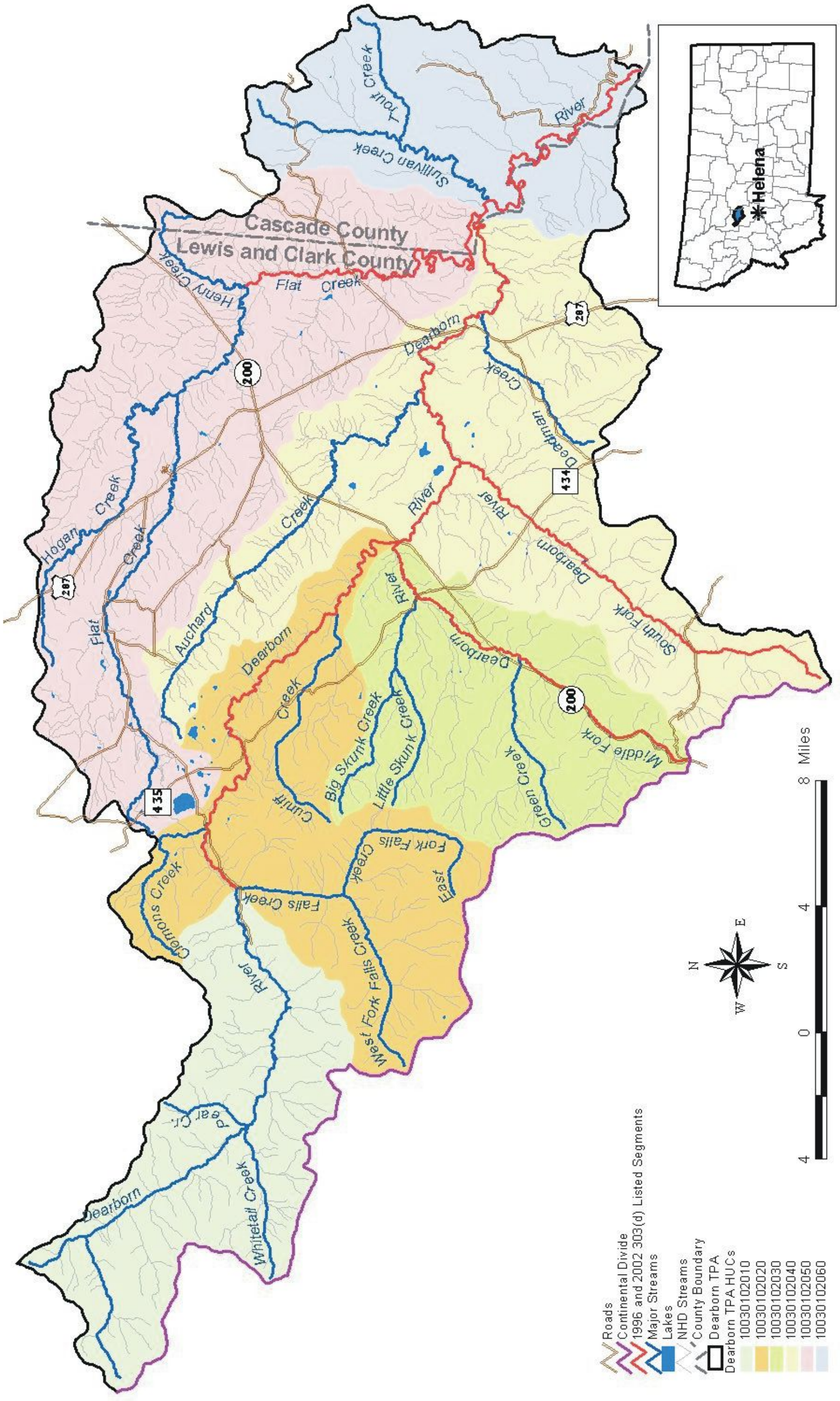

Figure 1-1. Location of 303(d) listed streams in the Dearborn TPA.

1.1 Approach

DEQ and EPA selected the Dearborn TPA as a pilot project to evaluate the feasibility of completion of all necessary TMDLs relying primarily on currently available data, use of remote sensing techniques, and application of modeling techniques. The Dearborn TPA was selected for this approach because, with the exception of the headwaters region, the Dearborn TPA is largely under private ownership with limited access. Also, when this approach was originally conceived in July of 2002, all necessary TMDLs for the Dearborn TPA were scheduled for completion by December 31, 2003.

As described above and in more detail in Section 3.1, the pollutants of concern in the Dearborn TPA included thermal modifications and siltation[1]. This approach focused on these two pollutants (i.e., specifically the water body/pollutant combinations appearing in Table 3-1). The various components of this approach are summarized below in the chronological order in which they were completed.

1.1.1 Watershed Characterization

The first step, the Watershed Characterization presented in Section 2.0, involved compiling available information to develop an understanding of the environmental and socioeconomic characteristics of the watershed that may have an influence on water quality and quantity. The watershed characterization step is a coarse-level, watershed-scale analysis relying primarily on information contained in published reports and through geographic information system (GIS) sources. This step is intended to put the subject water bodies into context with the watersheds in which they occur; provide the necessary information to fine-tune subsequent steps; and provide preliminary, coarse-level information regarding the identity of potential pollutant sources.

1.1.2 Air Photo Analysis

A review of historical aerial photos and a low-level reconnaissance flight were conducted to: 1) assess historical trends in physical stream corridor conditions (with an emphasis on impacts associated with the 1964 flood); 2) preliminarily identify irrigation points of diversion and returns; 3) assess the condition of the riparian corridors; and 4) to conduct a coarse-level assessment of potential sources of sediment and/or thermal modification (see Appendix D).

1.1.3 Compilation of all Available Water Quality Data and Data Gaps Analysis

While the previously described analyses were ongoing, EPA and DEQ began to compile all of the readily available water quality data that had relevance to the listed impairments (i.e., siltation and thermal modification). This first involved obtaining and reviewing all of the information compiled previously by DEQ in support of the 303(d) listings and reviewing DEQ's internal files and databases. All available data were then downloaded from STORET and contacts were made with the various resource agencies in the state in an attempt to obtain all available data (e.g., USGS, Montana Fish, Wildlife and Parks, Montana Department of Natural Resources and Conservation, and United States Natural Resource Conservation Service). The available and relevant data are presented in the water body – by – water body discussions in Section 3.0. The results of this step indicated that the available data were inconclusive regarding

[1] EPA has made a determination that some categories of water quality impairment are best resolved through measures other than TMDLs. Impairment causes including habitat alterations, fish habitat degradation, channel incisement, bank erosion, riparian degradation, stream dewatering, and flow alterations have all been placed in a general category of "pollution" for which TMDLs are not required. On the other hand, TMDLs are required to address impairments caused by discrete "pollutants", such as heavy metals, nutrients, and sediment (Dodson, 2001).

potential fine sediment related impairments, and insufficient data were available to determine if the current temperature regime was largely natural or significantly influenced by anthropogenic sources.

1.1.4 Sampling and Analysis Plan Development and Implementation

A Sampling and Analysis Plan (SAP) was prepared to address fine sediment related data gaps within the constraints of available resources and one field season (see Appendix B). The SAP also included the installation of two continuous temperature data loggers in the main stem Dearborn River to supplement the available data and calculation of the Bank Erosion Hazard Index (BEHI) at two sites to assist in verification of air photo interpretations. Additionally, a quality assurance project plan (QAPP) was prepared to guide data collection activities in the Dearborn River and several other Montana watersheds during the 2003 field season. The SAP was implemented in the summer of 2003. All field data forms and data reports are presented in Appendix B.

1.1.5 Comparison of Available Data to Applicable Water Quality Standards

The applicable water quality standards for both siltation and thermal modification are narrative (see Section 3.2). In general, the narrative criteria do not allow for harmful or other undesirable conditions to occur above naturally occurring levels from discharges to state surface waters. Without a specific number, it is necessary to translate the narrative criteria into measurable water quality goals. As a result, the first step in the comparison of the available data to the applicable water quality standards involved the selection of a suite of targets and supplemental indicators that provided measurable thresholds for evaluation of water quality standards compliance (see Section 3.3). The available data were compared to the selected threshold values for the targets and supplemental indicators to assess compliance with water quality standards. The results are presented in Section 3.4.

In the absence of temperature data from a suitable reference stream or reach, it was not possible to use the available data to determine compliance with the applicable temperature standards (see Section 3.2.2 for Montana’s temperature standard). As a result, a model-based approach was used to simulate current stream temperatures and to simulate stream temperatures in the absence of human-caused sources. The results were used to determine compliance with the applicable water quality standards (Section 3.8.1).

1.1.6 Pollutant Source Assessment

This step involved identifying and quantifying the relative importance of the significant sources of pollutants. Since this document focused primarily on two pollutants, siltation and thermal modification, the source assessment focused on sources of fine sediment, and factors that may contribute to thermal modification.

For fine sediment, the primary sources considered included landscape scale erosion associated with overland flow, sheet/rill erosion, stream bank erosion, and riparian condition. Source identification was accomplished largely through evaluation of current and historic air photos, a low-level aerial flight, and compiling readily available information from various GIS sources. Coarse-level ground truthing occurred via visual site reconnaissance at all public stream crossings, along all public roads, during all sampling events described above, and the lower 19 miles of the main stem Dearborn was floated in June 2003. Source load quantification was largely accomplished using model-based techniques and/or calculations using literature-based relationships (see Section 4.0).

For thermal modification, the analysis focused primarily on the main stem Dearborn River and the sources considered included riparian vegetation (i.e., as a surrogate for shade), geomorphology (i.e., an air photo comparison between historic and current conditions – See Appendix D), and human-caused flow alteration. A simplistic model-based approach was used to determine the significance of human-caused flow alteration (See Section 3.8.1).

In general, the source assessment conducted in the Dearborn TPA is considered preliminary. Although it is felt that this level of source assessment is adequate to identify, and determine the relative importance of sources in context with others within the TPA, additional source assessment will likely be necessary during the future implementation phases.

1.1.7 TMDLs

Total Maximum Daily Loads, allocations, and margins of safety were presented for all waters determined to be impaired (i.e., South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek for siltation – See Section 5.0). It was determined that siltation is not currently impairing beneficial uses in the main stem Dearborn River, therefore no TMDL is necessary (See Section 3.8.1). However, a Voluntary Water Quality Restoration Strategy is proposed to address identified minor sources of siltation along the Dearborn River main stem and to coordinate with the proposed TMDL activities in the tributaries (See Section 5.0). Insufficient information is currently available to definitively determine whether or not thermal modification is a human-caused impairment in the Dearborn River. As a result, no TMDL is proposed at this time to address temperature issues in the main stem Dearborn River, rather, further study is proposed (See Section 6.0).

1.1.8 Adaptive Management Concepts

Adaptive management is an important component of the approach in the Dearborn TPA. The adaptive management strategy presented in Section 6.3 provides a conceptual plan for addressing uncertainties and reacting to new information that may become available in the future.

1.1.9 Response to Public Comment

Finally, this document reflects the public comment submitted to DEQ and EPA during the formal public comment period regarding the November 18, 2004 draft document. A summary of the public comment received and corresponding agency responses are provided in Section 7.0.

1.2 Document Contents

The relevant physical, chemical, biological, and socioeconomic characteristics of the environment in which the subject water bodies exist are described in Section 2 (Watershed Characterization). A summary and evaluation of all available water quality information are presented in Section 3 (Water Quality Concerns and Status). Potential sources of pollutants are discussed in Section 4 (Source Identification). The required TMDL elements for the Middle Fork and South Fork Dearborn Rivers and Flat Creek are presented in Section 5. A monitoring and adaptive management strategy for the Dearborn River is presented in Section 6. And finally, a public involvement summary is presented in Section 7.

2.0 WATERSHED CHARACTERIZATION

The intent of this section of the document is to put the Dearborn River and its tributaries into context with the watershed in which they occur. This section provides the reader with a general understanding of the environmental characteristics of the watershed that may have relevance to the 303(d) listed water quality impairments. This section also provides some detail regarding those characteristics of the watershed that may play a significant role in pollutant loading (e.g., geographical distribution of soil types, vegetative cover, land use).

2.1 Physical Characteristics

The following sections of the document describe the physical characteristics of the watershed, such as its location, climate, hydrologic features, and land use/land cover.

2.1.1 Location

The Dearborn TPA is located entirely within Montana and encompasses approximately 550 square miles of Cascade County and Lewis and Clark County. Bounded by the Sun River watershed on the north, the headwaters originate in the Rocky Mountains and the basin drains generally to the southeast toward the Dearborn River's confluence with the Missouri River. The Continental Divide serves as the western boundary of the Dearborn River TPA. Major tributaries to the Dearborn River include the South Fork Dearborn River, Middle Fork Dearborn River, Falls Creek, Hogan Creek, Flat Creek, and Sullivan Creek. The watershed is in the western portion of the Upper Missouri–Dearborn subbasin and contains six USGS (U.S. Geological Survey) 11-digit hydrologic cataloging units, as shown in Figure 1-1. Typical views of streams in the watershed are shown in the photographs below.


Dearborn River at Upstream Sampling Site


Middle Fork Dearborn River at Rogers Pass


South Fork Dearborn River near Highway 434


Flat Creek above Highway 200

2.1.2 Climate

The National Oceanic and Atmospheric Administration (NOAA) collects data from one climate station in the watershed. The Rogers Pass 9NNE station (NOAA Cooperative station number 247159-4) is in the Middle Fork subwatershed at an elevation of approximately 4,200 feet[2] and data are available for the period from June 15, 1989, to December 31, 2002. A graphical summary of the average climatic characteristics at a station is called a climagraph. The climagraph in Figure 2-1 illustrates annual average precipitation and temperature for the Rogers Pass 9NNE station. This station typifies climate in the middle and lower reaches of the Dearborn TPA, and shows that much of the snowfall occurs from September through May, while most of the rainfall occurs from April through September (WRCC, 2002b). Total annual average precipitation and total annual average snowfall at this station are 18.3 inches and 87.8 inches, respectively. Average monthly temperatures range from a maximum of 64.4 degrees Fahrenheit (°F) in July to a minimum of 21.2 °F in January.

Historical averages for precipitation, snowfall, and temperature are not available for other parts of the watershed. As a result climate conditions in the Dearborn TPA headwaters cannot be assessed with precision. However, annual precipitation and temperature are largely governed by elevation in watersheds with considerable change in topography. Since elevation in the Dearborn TPA varies considerably, it is assumed that conditions in the headwaters are significantly different from conditions at the Rogers Pass 9 NNE station. The headwaters region is likely to have higher average annual precipitation and snowfall and cooler average annual temperatures than the lower elevation regions. In addition, this region is likely to receive snowfall earlier than September and later than May. Significant precipitation may also occur for a longer period of time in the spring and summer.

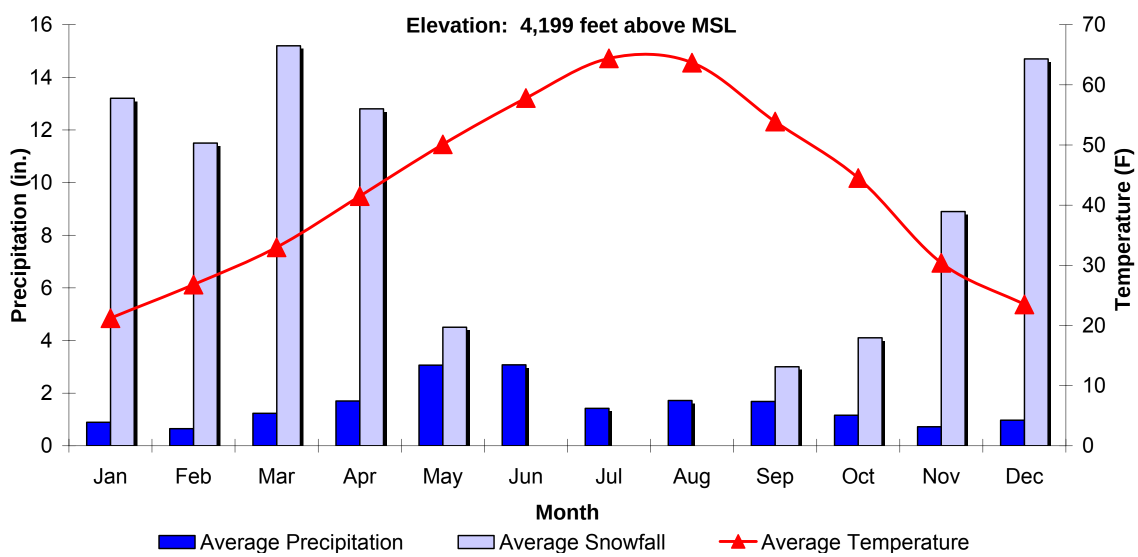

Figure 2-1. Climagraph for Rogers Pass 9NNE MT, Station 247159-4. Data cover the period 1971 to 2000.

[2] There is an inactive climate station also named "Rogers Pass." This station (247156-4) is located at an elevation of 5,540 feet, whereas the active Rogers Pass station (9NNE) is located at an elevation of 4,200 feet. Both stations are shown in Figure 2-2.

2.1.3 Hydrology

Dearborn River Flow Data - Main Stem

There are four USGS flow gages with current and historical flow data in the Dearborn TPA (Figure 2-2 and Table 2-1). Two stations on the Dearborn River main stem were analyzed to obtain a general understanding of flow from the river's headwaters to its mouth at the Missouri River. These stations are the Dearborn River near Clemons (upstream) and the Dearborn River near Craig (downstream). The flow patterns at the two main stem stations are very similar. Figure 2-3 shows that flow increases between March and April as a result of snowmelt. On average, flows continue to increase until a maximum is achieved at the end of May. By the end of July, evaporation, reduced precipitation, reduced snowmelt, and withdrawals cause the river to flow at base flow. Flow slightly increases from upstream to downstream, and the most pronounced changes in flow occur during the rainfall and snowmelt season.

Extreme flood events can significantly alter the morphological characteristics of stream channels and can also affect the condition of the stream's floodplains and riparian corridors. In some cases, the resulting changes are evident many years after the events. One such event occurred in the Dearborn River watershed in June of 1964, when 3 to 16 inches of rain fell over a 40 hour period on a deeper than normal snowpack. The resulting flows significantly increased channel widths, in some cases more than doubling the size of the pre-flood channel. A major decrease in channel stability occurred along with the channel width increases. Gravel bars, eroding banks, and loss of riparian vegetation were apparent throughout much of the Dearborn in post-flood aerial photos (see Appendix D). It is reasonable to assume that rebuilding of floodplain soils on exposed gravel deposits and re-establishment of climax floodplain vegetation communities is still continuing in the present day. Full recovery from the 1964 flood event has been gradual in many alluvial channels along the Rocky Mountain front. Exposed gravel floodplain surfaces are also widespread in portions of the Teton River, Birch Creek, and elsewhere in the area.

Table 2-1. Selected USGS Stream Gages on the Dearborn River

Station ID	Gage Name	Drainage Area (mi^2)	Start Date	End Date
06072000	Dearborn River AB Falls Creek, near Clemons, MT	69.6	5/1/1908	12/31/1911
06072500	Falls Creek near Clemons, MT	37.6	5/1/1908	12/31/1911
06073000	Dearborn River near Clemons, MT	123.0	4/1/1921	9/30/1953
06073500	Dearborn River near Craig, MT	325.0	10/1/1945	9/30/2003

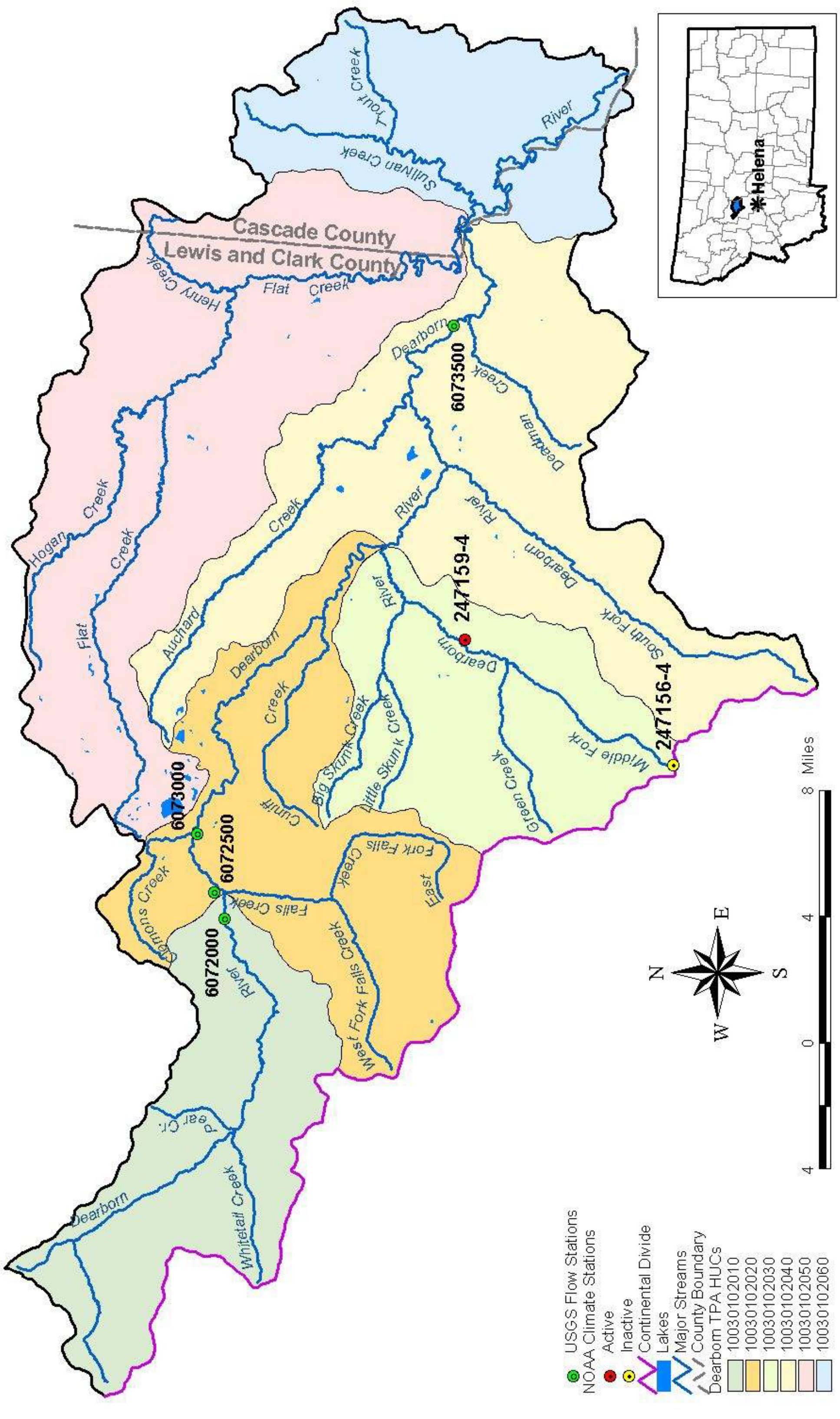

Figure 2-2. Location of USGS gages in the Dearborn TPA.

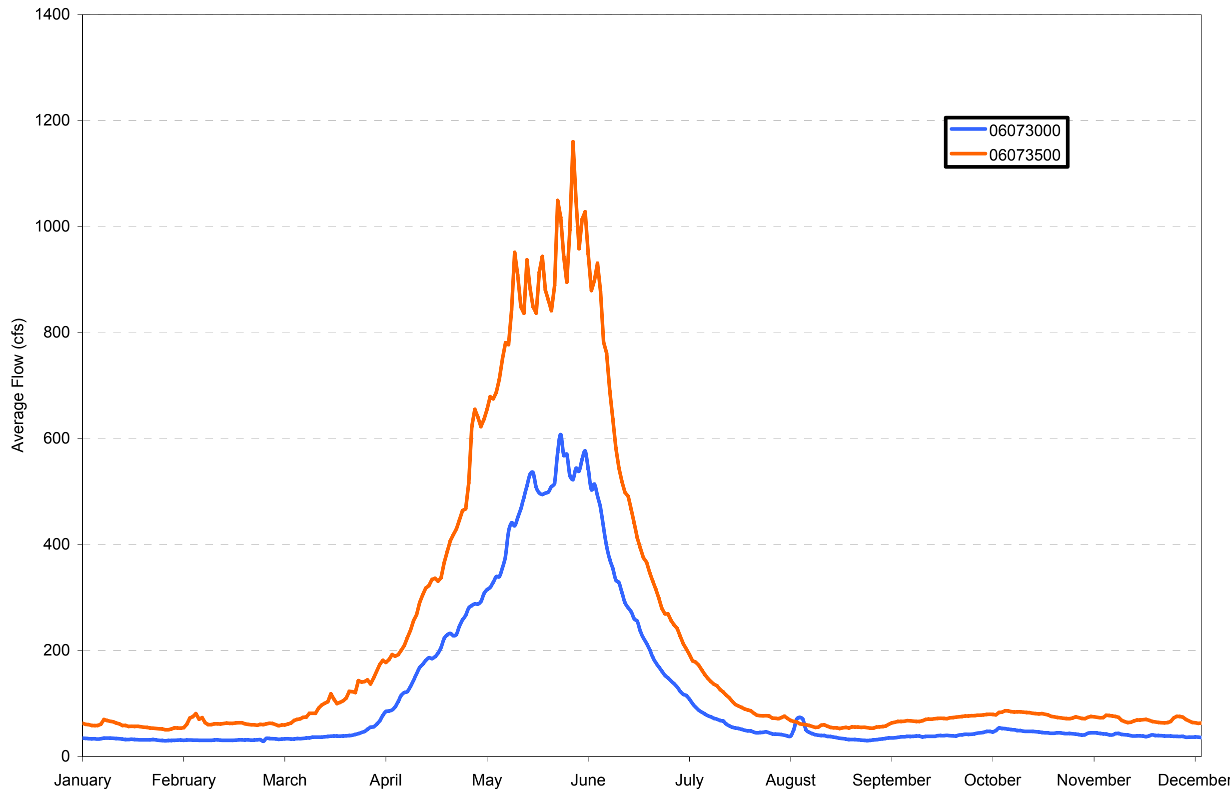

Figure 2-3. Average daily flows at two USGS gages on the Dearborn River main stem. Data show the entire period of record for both gages.

Stream Types

The National Hydrography Data (NHD) provided by EPA and USGS identified the major stream types in the Dearborn River Basin. Most of the streams in the Dearborn TPA were classified as intermittent streams (Table 2-2). Intermittent streams flow for short periods during the course of a year, and flow events are usually initiated by rainfall or snow melt. Perennial stream flow was classified in major streams and tributaries of the basin, including the Dearborn River, South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek (Figure 2-4). Mountain streams and major tributaries of varying sizes have perennial flow due to snowmelt and precipitation; streams at lower elevations are generally intermittent and flow after local rainstorms. Most of the canals, ditches, connectors, and artificial paths are located along Flat Creek.

Table 2-2. Summary of Stream Type in the Dearborn River Basin

Stream Type	Stream Length (feet)	Percentage
Intermittent	4,949,496	72.76
Perennial	1,574,946	23.15
Canal/ditch	248,313	3.65
Artificial Path	28,517	0.42
Connector	1,644	0.02
Total	6,802,916	100.00

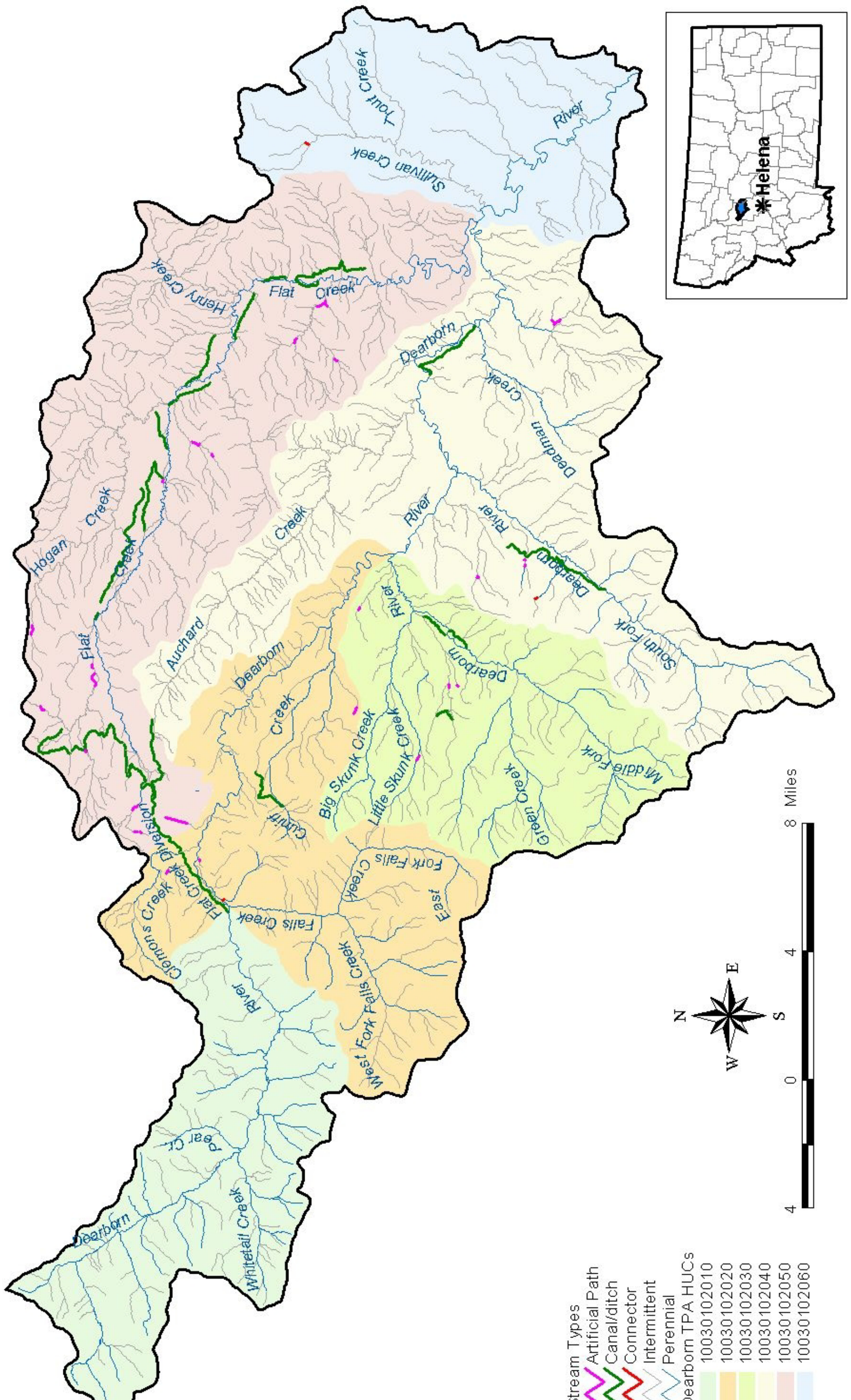

Figure 2-4. Stream types in the Dearborn River watershed.

Irrigation Practices

Irrigation activities have a significant impact on the hydrology of the Dearborn River watershed. The largest diversion in the watershed is located on the upper portion of the Dearborn River main stem and diverts a significant portion of the river's flow into Flat Creek (Figure 2-5 and Figure 2-6). The head gate is used on an "as needed" basis (Barrett, private landowner, December 29, 2004) and no data are available on the daily flows diverted to Flat Creek.

Flow measurements at various points in the Dearborn River watershed were taken on July 24, 2003, to assess the significance of the Flat Creek diversion. The results of these measurements are presented in Table 2-3 and several observations can be made. First, approximately 55 percent of the flow in the Dearborn River was diverted to Flat Creek at the time of the field visit. The Middle and South Forks returned an additional 7.2 cubic feet per (cfs) second (combined) flow to the Dearborn River downstream of the Flat Creek diversion, but flows at the Highway 287 bridge were still only 38 cfs. An additional 15.2 cfs were therefore lost from the Dearborn River as a result of other irrigation diversions, groundwater percolation, and evaporation. These water losses, combined with the loss due to the Flat Creek diversion, affect water quality in the Dearborn River by concentrating pollutants and elevating temperatures. Another observation that can be made is that the volume of water added to Flat Creek is several times greater than would naturally occur in the stream channel. The impact of this is discussed in Sections 3 and 4.

Figure 2-5. Flat Creek diversion gate structure (view from Dearborn River)

Figure 2-6. Flat Creek diversion canal.

Table 2-3. Flow Conditions at Various Locations in the Dearborn River Watershed on July 24, 2003

Location	Measured Flow (cfs)
Dearborn River immediately upstream of Flat Creek diversion	105
Irrigation channel immediately downstream of diversion	58
Dearborn River downstream of Flat Creek diversion (calculated)	47
Middle Fork Dearborn River at confluence with Dearborn River	5
South Fork Dearborn River at confluence with Dearborn River	1.2
Flat Creek at confluence with Dearborn River	4
Dearborn River at Highway 287 Bridge	38

2.1.4 Topography

Figure 2-7 displays the general topography within the Dearborn River TPA, and a shaded relief map of the watershed is presented in Figure 2-8. Elevations range from around 3,422 feet above mean sea level at the confluence with the Missouri River to 9,078 feet at the highest point in the watershed.

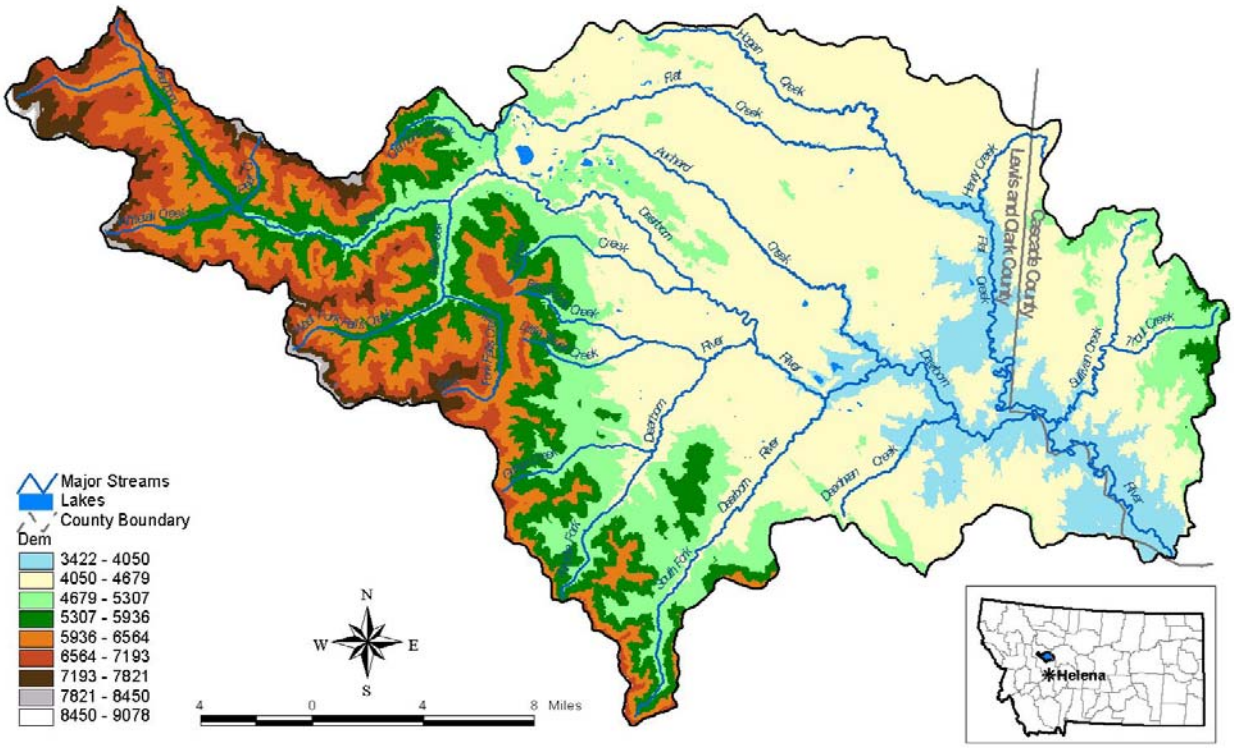

Figure 2-7. Elevation in the Dearborn River watershed.

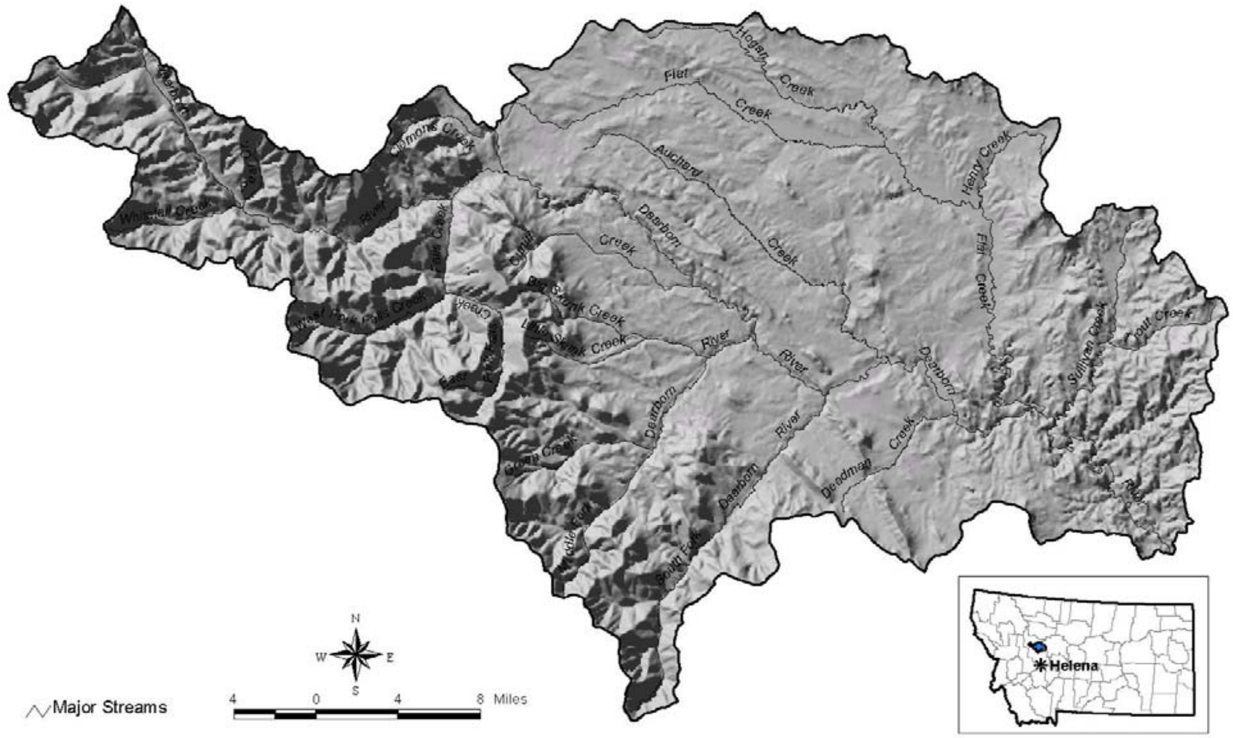

Figure 2-8. Topographic relief in the Dearborn River watershed.

2.1.5 Ecoregions

Omernik (1995) has defined ecoregions as areas with common ecological settings that have relatively homogeneous features including potential natural vegetation, geology, mineral availability from soils, physiography, and land use and land cover. MDEQ uses ecoregions to establish a variety of water quality targets, such as for macroinvertebrate populations and nutrient concentrations. The Dearborn River watershed contains parts of three ecoregions (see Figure 2-9 and Table 2-4).

Table 2-4. Ecoregions in the Dearborn River Watershed

Ecoregion	Area (acres)	Area (square miles)	Percentage
Northern Rockies	84,219	131.6	23.87
Canadian Rockies	83,203	130.0	23.58
Montana Valley and Foothill Prairies	185,392	289.7	52.55
Total	352,814	551.3	100.00

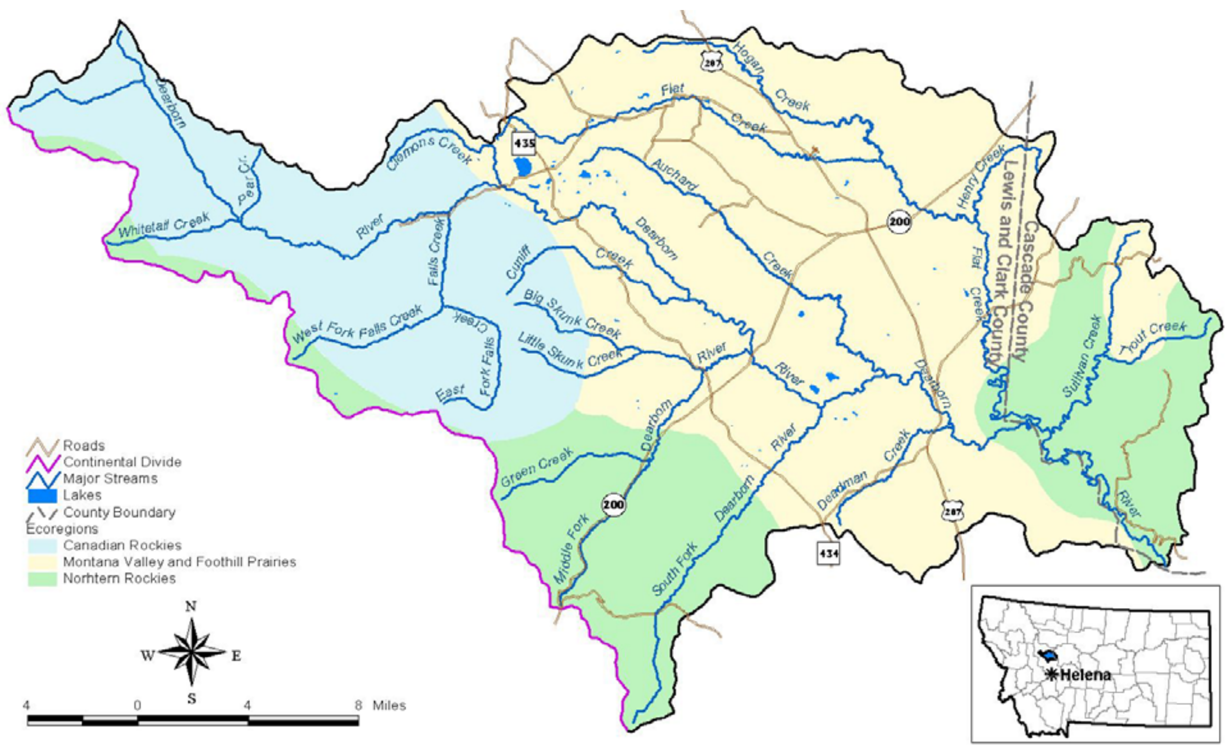

Figure 2-9. Ecoregions in the Dearborn TPA.

2.1.6 Land Use and Land Cover

General land use and land cover data for the Dearborn River basin were extracted from the Multi-Resolution Land Characterization (MRLC) database (MRLC, 1992) and are shown in Table 2-5 and Figure 2-10. This database was derived from satellite imagery taken during the early 1990s and is the most current detailed land use data known to be available for the watershed. Each 98-foot by 98-foot pixel in the satellite image is classified according to its reflective characteristics. A complete list of the MRLC land cover categories and their definitions is given in Appendix A. Table 2-5 summarizes land cover in the Dearborn River TPA and shows that grasslands/herbaceous is the dominant land cover, comprising approximately 55.71 percent of the total land cover. Evergreen forest and shrublands comprise 32.02 percent and 6.56 percent, respectively. Other important cover types are pasture/hay (3.54 percent) and bare rock/sand/clay (1.02 percent). All other land cover types combined account for less than 2 percent of the total watershed area.

Table 2-5. Land Use and Land Cover in the Dearborn TPA (acres)

Land Use/Cover	Dearborn River	Middle Fork Dearborn	South Fork Dearborn	Flat Creek
Grasslands/herbaceous	196,564	20,121	9,104	74,071
Evergreen forest	112,962	18,216	12,466	2,443
Shrubland	23,162	4,463	3,241	1,660
Pasture/hay	12,479	173	160	10,031
Bare rock/sand/clay	3,600	12	4	13
Open water	1,056	5	7	403
Woody wetlands	970	377	90	107
Small grains	872	130	116	0
Deciduous forest	472	34	52	29
Mixed forest	381	1	1	3
Emergent herbaceous wetlands	185	30	14	39
Commercial/industrial/transportation	42	4	8	6
Fallow	42	0	0	0
Perennial ice/snow	22	0	1	0
Row crops	22	10	0	8
Low Intensity Residential	< 1	<1	0	0
Total	**352,831**	**43,575**	**25,263**	**88,812**

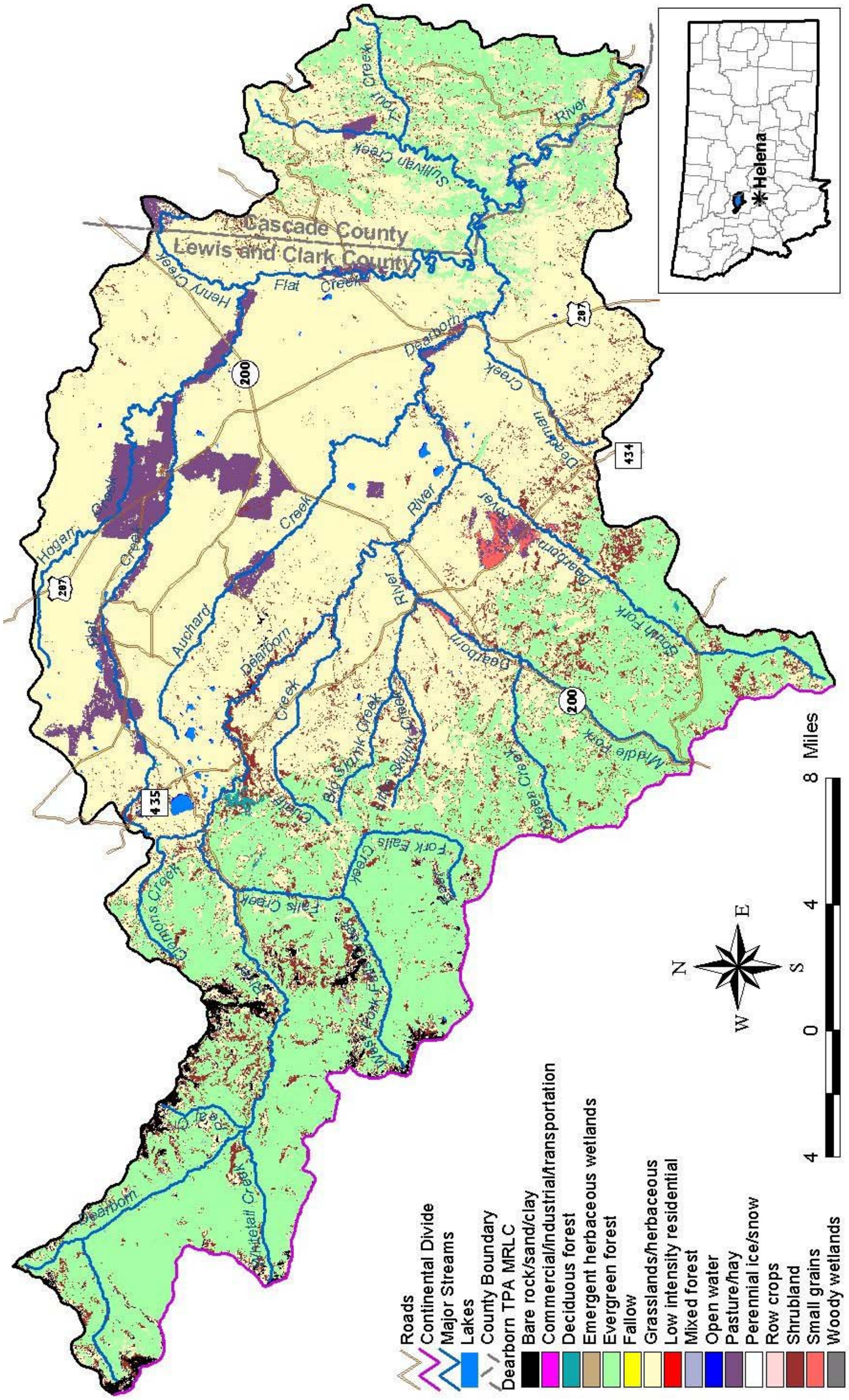

Figure 2-10. MRLC land use/land cover in the Dearborn River watershed.

2.1.7 Vegetative Cover

Vegetative data were gathered from GAP Analysis Projects completed for Montana. The GAP Analyses are a nationwide program conducted under the guidance of the USGS for the purpose of assessing the extent of conservation of native plant and animal species. Since an important part of the analyses is the identification of habitat, detailed vegetative spatial data are usually available for states that have completed their analyses. Like the MRLC data, the spatial data for Montana were derived from satellite imagery taken during the early 1990s. However, the vegetative classification is much more detailed than that of the MRLC; the GAP data include vegetative species such as ponderosa pine, rather than general land cover classes like evergreen forest. Vegetative cover provided by GAP data for the Dearborn River watershed is summarized in Table 2-6 and shown in Figure 2-11.

Table 2-6 and Figure 2-11 show that low to moderate cover grasslands, altered herbaceous lands, and mixed mesic shrubs are the dominant vegetative cover in the middle portion of the basin and occupy 28.92 percent, 15.16 percent, and 8.65 percent of the watershed, respectively. Douglas fir and ponderosa pine collectively occupy approximately 13 percent of the watershed, primarily throughout the South Fork and Middle Fork Dearborn River and the lower reaches of the Dearborn River. In addition, 25,312 acres (7.17 percent) throughout the Falls Creek watershed, Clemons Creek watershed, and the Dearborn River headwaters are classified as standing burnt forest, a result of the 1988 Canyon Creek Fire. Irrigated and dry agricultural lands account for 3.48 percent and 0.61 percent of the watershed, respectively. The remaining land cover classes occupy approximately 23 percent of the Dearborn River TPA.

Table 2-6. Vegetative Cover According to GAP Analysis for the Dearborn River Watershed

Vegetative Cover	Area		Percentage of Watershed
	Acres	Square Miles	
Low/Moderate Cover Grasslands	102,051	159.5	28.92
Altered Herbaceous	53,486	83.6	15.16
Mixed Mesic Shrubs	30,520	47.7	8.65
Douglas Fir	25,552	39.9	7.24
Standing Burnt Forest	25,312	39.6	7.17
Ponderosa Pine	20,520	32.1	5.82
Mixed Xeric Forest	13,108	20.5	3.72
Agricultural Lands - Irrigated	12,270	19.2	3.48
Mixed Subalpine Forest	9,548	14.9	2.71
Rock	8,315	13.0	2.36
Douglas Fir/Lodgepole Pine	7,908	12.4	2.24
Lodgepole Pine	6,809	10.6	1.93
Montane Parklands and Subalpine Meadows	5,162	8.1	1.46
Moderate/High Cover Grasslands	3,973	6.2	1.13
Shrub Riparian	3,847	6.0	1.09
Graminoid and Forb Riparian	2,570	4.0	0.73
Mixed Barren Sites	2,362	3.7	0.67
Mixed Whitebark Pine Forest	2,182	3.4	0.62
Agricultural Lands - Dry	2,164	3.4	0.61
Rocky Mountain Juniper	1,912	3.0	0.54
Cloud Shadows	1,891	3.0	0.54
Conifer Riparian	1,811	2.8	0.51
Limber Pine	1,621	2.5	0.46
Mixed Xeric Shrubs	1,227	1.9	0.35
Clouds	1,203	1.9	0.34
Mixed Mesic Forest	1,133	1.8	0.32
Mixed Broadleaf Forest	1,107	1.7	0.31
Alpine Meadows	849	1.3	0.24
Broadleaf Riparian	504	0.8	0.14
Sagebrush	494	0.8	0.14
Mixed Riparian	478	0.7	0.14
Water	412	0.6	0.12
Mixed Broadleaf and Conifer Forest	280	0.4	0.08
Mines, Quarries, Gravel Pits	244	0.4	0.07
Mixed Broadleaf and Conifer Riparian	12	< 0.1	< 0.01
Total	352,839	551.3	100.00

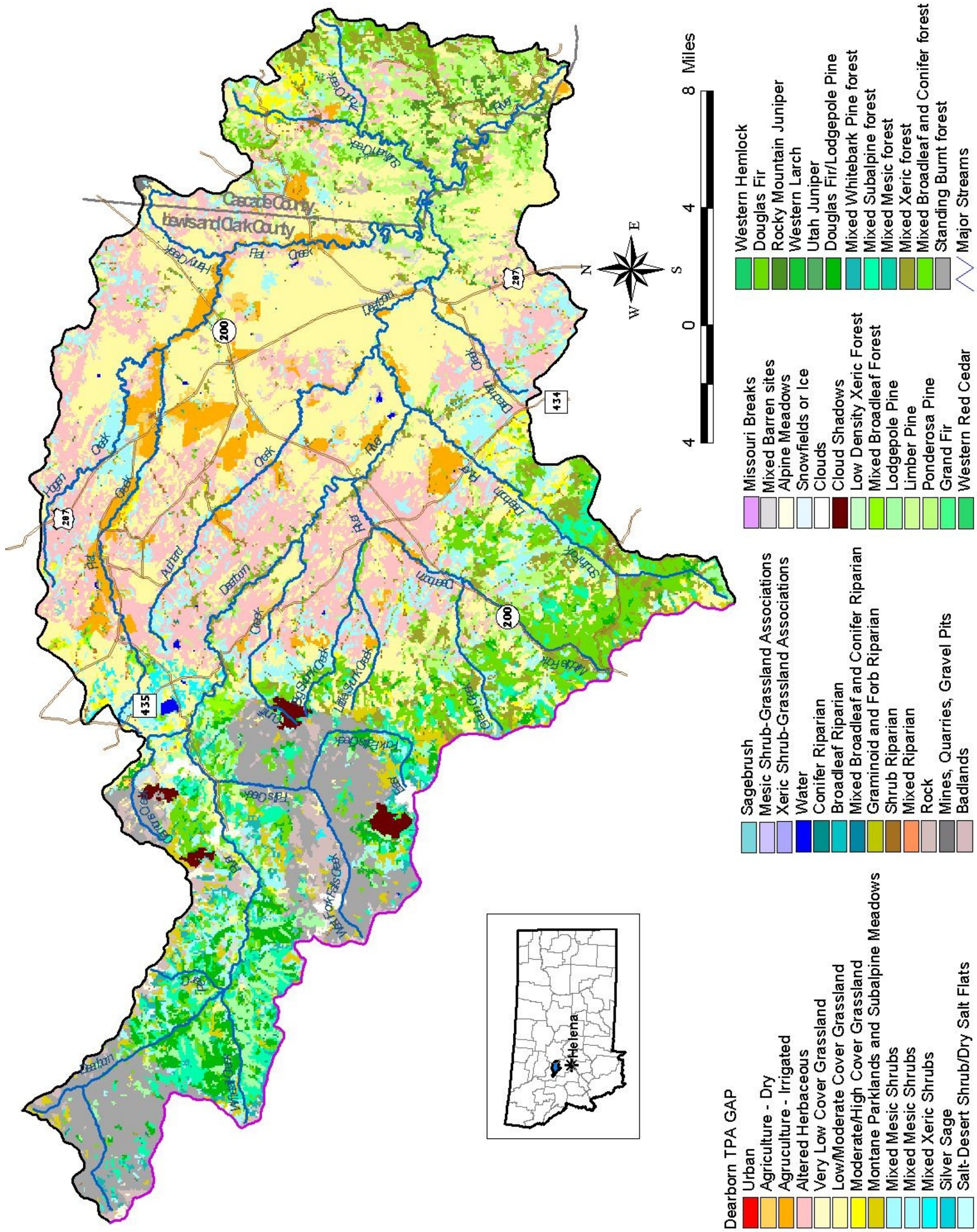

Figure 2-11. GAP vegetative cover in the Dearborn River Watershed.

2.1.8 Soils

Soils data from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the Dearborn River TPA. General soils data and map unit delineations for the United States are provided as part of the State Soil Geographic (STATSGO) database. Geographic information system (GIS) coverages provide accurate locations for the soil map units at a scale of 1:250,000 (USDA, 1995). A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverages can be linked to a database that provides information on chemical and physical soil characteristics. Figure 2-12 shows the general map unit boundaries in the Dearborn River TPA, and the following sections summarize relevant chemical and physical soil data.

Universal Soil Loss Equation (USLE) K-factor

A commonly used soil attribute is the K-factor, a component of the Universal Soil Loss Equation (Wischmeier and Smith, 1978). The K-factor is a dimensionless measure of a soil's natural susceptibility to erosion, and values may range from 0 for water surfaces to 1.00 (although in practice, maximum values do not generally exceed 0.67). Large K-factor values reflect greater inherent soil erodibility. The distribution of K-factor values in the Dearborn River Basin is shown in Figure 2-13, which shows that nearly all the soils in the watershed have K-factors ranging from 0.18 to 0.37, suggesting moderate soil erosion potential. The figure also shows that soils with the highest susceptibility to erosion are located in the headwaters of Flat Creek and Auchard Creek.

Hydrologic Soil Group

The hydrologic soil group classification is a means for grouping soils by similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have the slowest infiltration rates, while sandy soils that are well drained have the fastest infiltration rates. NRCS has defined four hydrologic groups for soils. Data for the Dearborn River TPA were obtained from STATSGO and summarized based on the major hydrologic group in the surface layers of the map unit (Table 2-7) (NRCS, 2001). The resulting hydrologic soil information is displayed in Figure 2-14.

Table 2-7. Hydrologic Soil Groups

Hydrologic Soil Groups	Description
A	Soils with high infiltrations rates. Usually deep, well-drained sands or gravels. Little runoff.
B	Soils with moderate infiltration rates. Usually moderately deep, moderately well-drained soils.
C	Soils with slow infiltration rates. Soils with finer textures and slow water movement.
D	Soils with very slow infiltration rates. Soils with high clay content and poor drainage. High amounts of runoff.

The majority of soils in the middle portion of the Dearborn River Basin are moderately deep, fine-textured C soils, characterized by moderately slow infiltration rates. A large portion of soils in the upper Dearborn TPA have moderate infiltration rates typical of moderately well drained alluvial B soils. The remainder of the basin contains poorly drained D soils. These areas have very slow infiltration rates and high amounts of runoff resulting from high soil clay content.

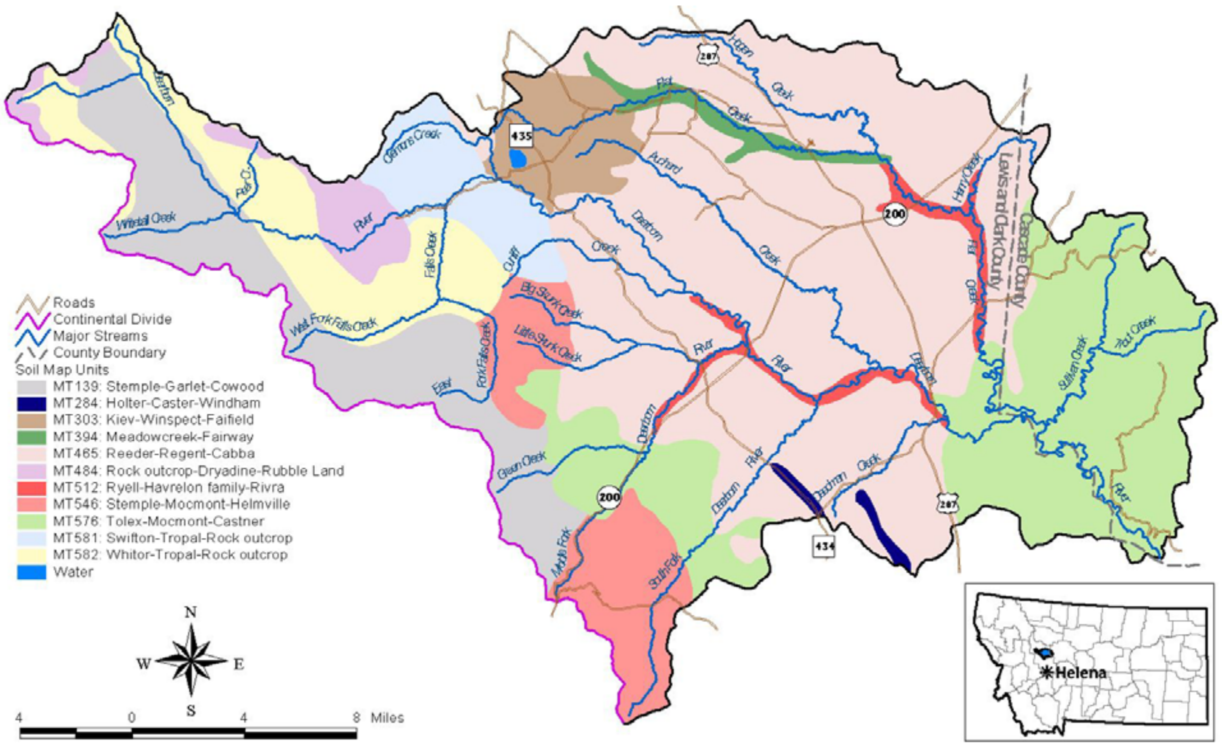

Figure 2-12. General soil units in the Dearborn River TPA.

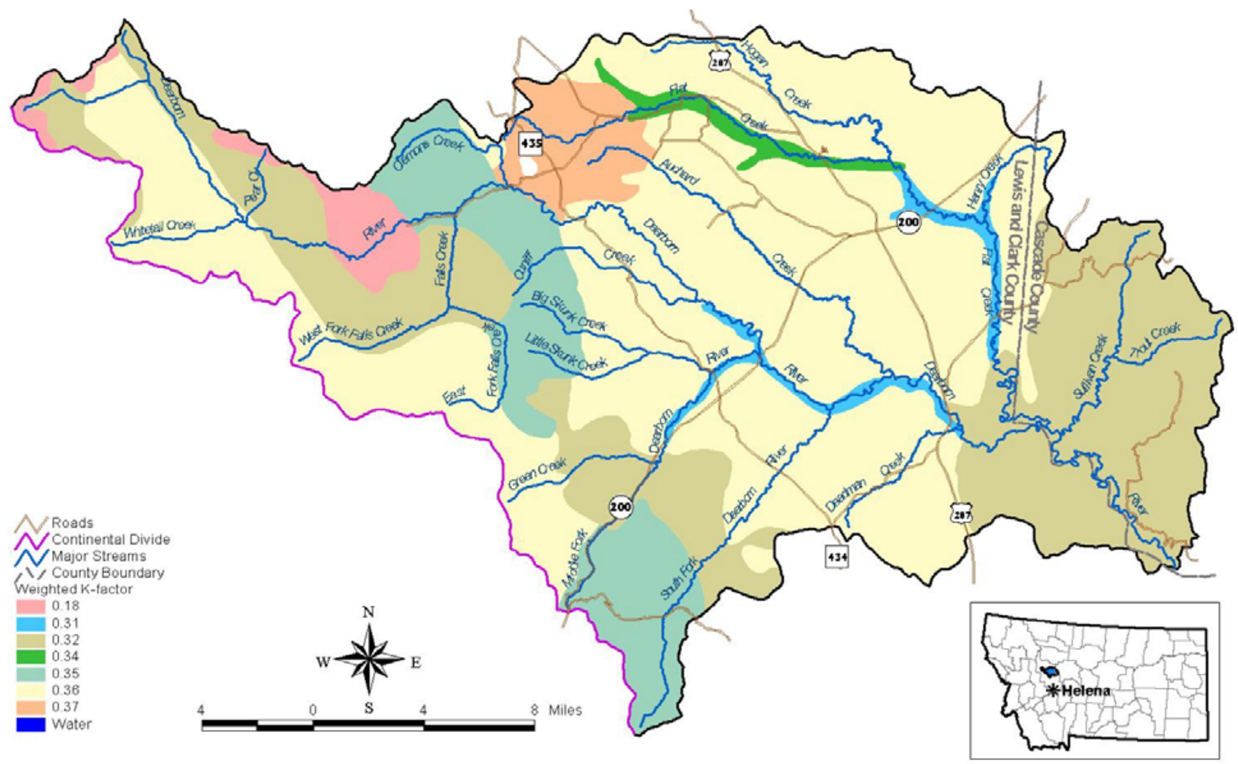

Figure 2-13. Distribution of USLE K-factor.

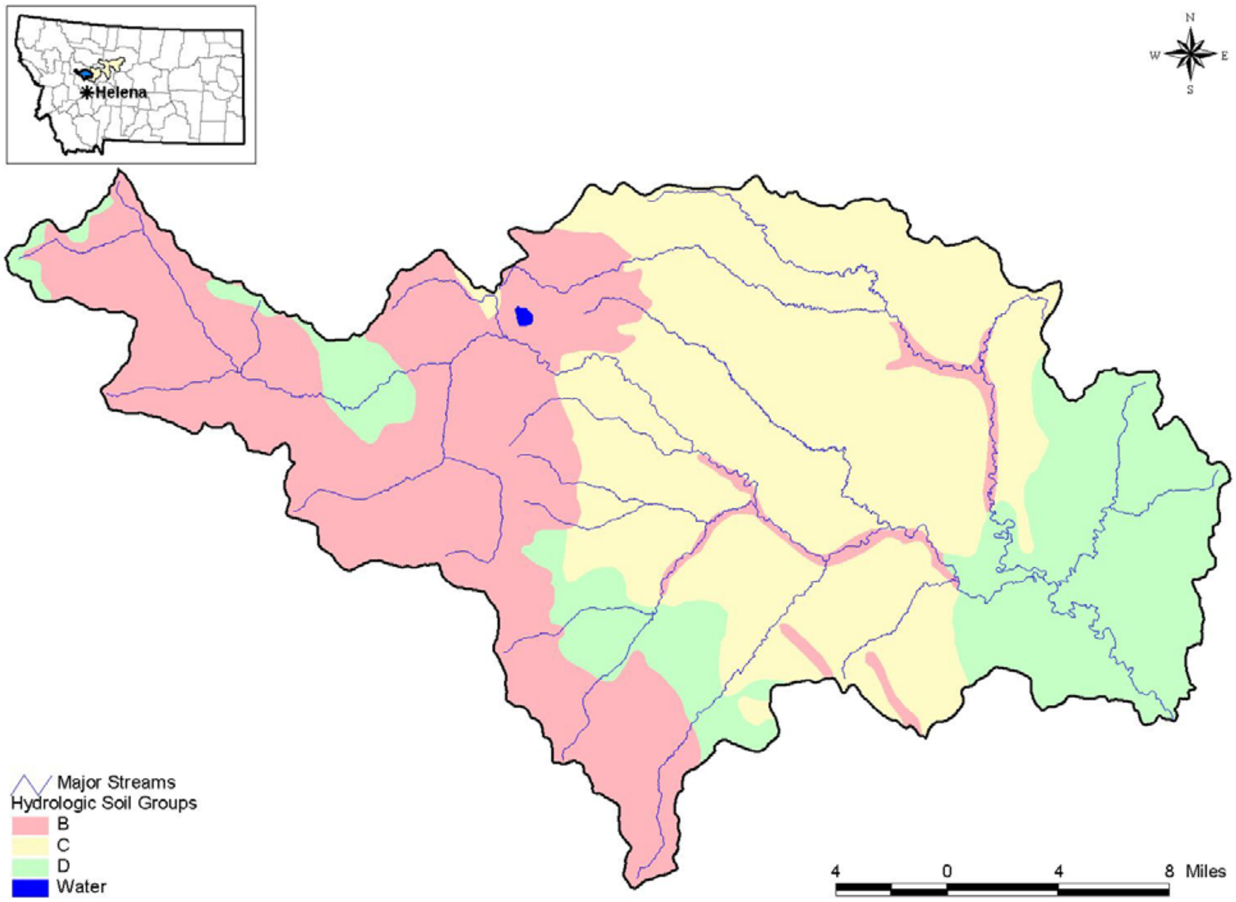

**Figure 2-14.	Distribution of hydrologic soil groups.**

2.1.9 Riparian Vegetation Characteristics

Riparian vegetation was evaluated for several stream segments in the Dearborn River TPA using historical and current aerial and video photography (Land and Water Consulting, 2004). Riparian vegetation along the Dearborn River consisted primarily of open stands of deciduous cottonwoods with extensive areas of herbaceous understory and woody shrub components (Table 2-8). Riparian buffer widths in the evaluated segments of the Dearborn River ranged between 42 and 136 feet wide, with a median width of 46 feet. Although trees were not the dominant vegetation for the Dearborn main stem, the overall coverage was good relative to site potential. Riparian vegetation appeared to be in a seral state with multiple age classes of cottonwood in active alluvial reaches. Upper reaches in the Dearborn River had increasing amounts of coniferous overstory relative to deciduous cottonwood.

Riparian vegetation in the Middle and South Forks of the Dearborn River was characterized by isolated stands of deciduous cottonwood with extensive areas of herbaceous understory and woody shrub components. The headwater regions tended to have a higher percentage of trees. Tree and woody shrub density generally increased toward the headwaters where the reaches transitioned into a coniferous forest.

Vegetation metrics for Flat Creek indicated that riparian tree and woody shrub coverage was extremely low for most reaches. Trees were less than 1 percent in all reaches except the most downstream reach. Overall, woody shrubs covered about 21 percent of the riparian corridor, and herbaceous species averaged 77 percent. Vegetation in the upstream reaches was largely herbaceous, with lesser amounts of remnant and decadent woody shrub species. Riparian buffer width in all of the Flat Creek segments was low relative to potential.

Table 2-8. Riparian Vegetation in the Dearborn River TPA

Reach	Riparian Buffer Width (feet)	Vegetation Type (% of reach)			
		Coniferous/ Deciduous (%)	Woody Shrub (%)	Grass/ Sedge (%)	Bare Ground/ Disturbed (%)
Dearborn River					
DR1	45	16	19	56	10
DR2	42	19	27	49	5
DR3	43	6	25	64	5
DR4	46	12	27	60	1
DR5	72	33	22	41	5
DR6	136	11	39	30	20
South Fork Dearborn River					
SF1	28	3	49	46	2
SF2	61	18	31	51	<1
Middle Fork Dearborn River					
MF1	78	4	37	59	1
MF2	36	11	6	76	8
Flat Creek					
FC1	47	9	12	79	<1
FC2	51	<1	35	64	<1
FC3	64	<1	21	77	1.5
FC4	31	<1	4	93	2

2.2 Cultural Characteristics

The following sections of the report provide information on watershed population and describe land ownership characteristics.

2.2.1 Population

The total population for the watershed is not directly available but may be inferred from the 2000 U.S. Census data, which were downloaded for all towns, cities, and counties whose boundaries lie wholly or partially within the watershed. The proportion of county area within the basin was determined from spatial overlay of county boundaries and the watershed boundary in a GIS. It is assumed that the nonurban population for each county is uniformly distributed within the county. The nonurban county population was multiplied by the county's proportional watershed area and the product was assumed to reflect the county's nonurban population.

The analysis found that approximately 4,000 people reside within the Dearborn River watershed. Table 2-9 presents the watershed's urban and nonurban population totals by county. Figure 1-1 displays the locations of counties, cities, and towns. From the table, it can be seen that the vast majority of the population live in nonurban areas, while 50 people (1.26 percent) reside in the Millford Colony.

Table 2-9. Dearborn River TPA Population Summarized by County

County	Estimated Watershed Population	Percentage of Total Population	Nonurban Population	Percent Nonurban	Urban Population	Percent Urban
Cascade	36	0.91	36	0.91	0	0
Lewis and Clark	3,917	99.09	3,867	97.82	50	1.26
Total	3,953	100	3,903	98.74	50	1.26

Source: U.S. 2000 Census and GIS analysis.

2.2.2 Land Ownership

Various private, tribal, state, and federal agencies hold title to portions of the Dearborn River watershed, as shown in 0 and Figure 2-15. For the watershed as a whole, the majority of land is privately owned, encompassing 250,539 acres, or 71.01 percent of watershed area. The U.S. Forest Service maintains 74,094 acres, 21 percent of total land holdings, while the Montana Department of Natural Resources and Conservation governs more than 22,000 acres (6.32 percent) of the planning area. Furthermore, the Bureau of Land Management holds title to 5,120 acres (1.45 percent). The remaining ownership in the basin accounts for less than one-half of a percentage point of total ownership (approximately 751 acres).

Table 2-10. Land Ownership in the Dearborn River TPA

Land Ownership Description	Area		
	Acres	Square Miles	Percentage
Private land	250,539	391.5	71.01
U.S. Forest Service	74,094	115.8	21.00
Department of Natural Resources and Conservation	22,309	34.9	6.32
Bureau of Land Management	5,120	8.0	1.45
Water	734	1.1	0.21
Montana Fish, Wildlife, and Parks	17	< 0.1	< 0.01
Total	352,813	551.3	100.00

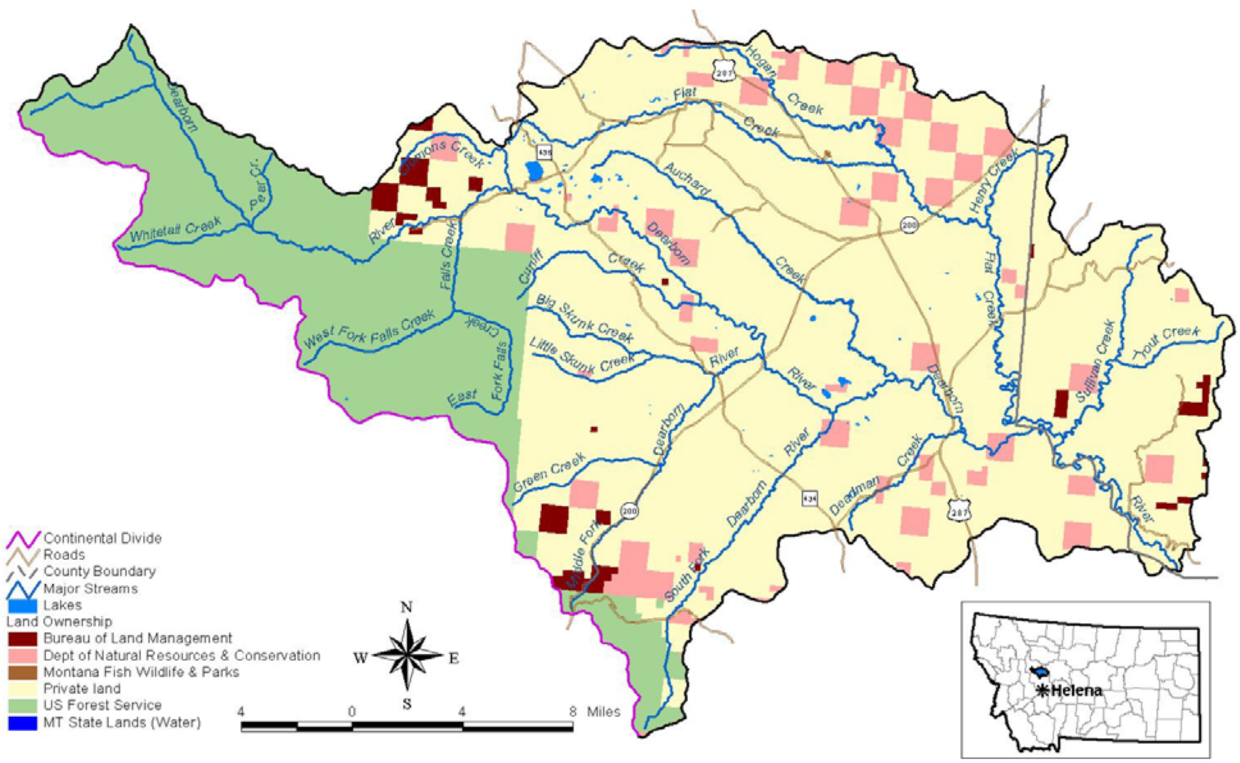

Figure 2-15. Land ownership in the Dearborn TPA.

2.3 Fisheries

The stream segments in the Dearborn River TPA are classified as "B-1" (see Section 3.2.1), which calls for the water to sustain the "growth and propagation of salmonid fishes and associated aquatic life" (ARM, 1996). Fisheries data reported by the Montana Fisheries Information System Database (MFISH, 2004) are presented in Table 2-11 and provide information on the fish species present in the watershed. Qualitative descriptions of the fishery were also discussed with Montana Department of Fish, Wildlife, and Parks (MFWP) personnel.

Table 2-11. Fisheries Data for the Dearborn TPA, Reported by the Montana Department of Fish, Wildlife, and Parks.

Category	Species	Dearborn River	Middle Fork Dearborn River	South Fork Dearborn River	Flat Creek
Native Species of Special Concern	Westslope Cutthroat Trout	X			
Native	White Sucker	X			
Native	Longnose Dace	X			X
Native	Longnose Sucker	X			
Native	Mottled Sculpin	X	X	X	X
Native	Mountain Whitefish	X			X
Native	Lake Chub				X
Native	White Sucker				X
Introduced	Rainbow Trout	X			X
Introduced	Brook Trout	X	X	X	X
Introduced	Brown Trout	X	X	X	X

Rainbow trout and westlope cutthroat trout are two of the more important fish species in the Dearborn TPA and the Dearborn River is the main spawning and rearing tributary to the trout fishery in the Missouri River. Rainbow trout ascend the Dearborn River annually from March through May, spawn, and then return to the Missouri River. After hatching, most rainbow trout rear for one winter in the Dearborn River basin before migrating to the Missouri River during spring runoff. Therefore, habitat and environmental conditions in the Dearborn River Basin set year class strengths for the rainbow trout population in the Missouri River (Leathe, 2004). Figure 2-16 provides information on the number of rainbow trout per mile in the Missouri River at Pelican Point over the past twenty-three years. The data are considered representative of populations in the Dearborn River watershed (Horton, FWP, personal communication, January 12, 2005) and indicate that there is no clear increasing or trend over the period-of-record.

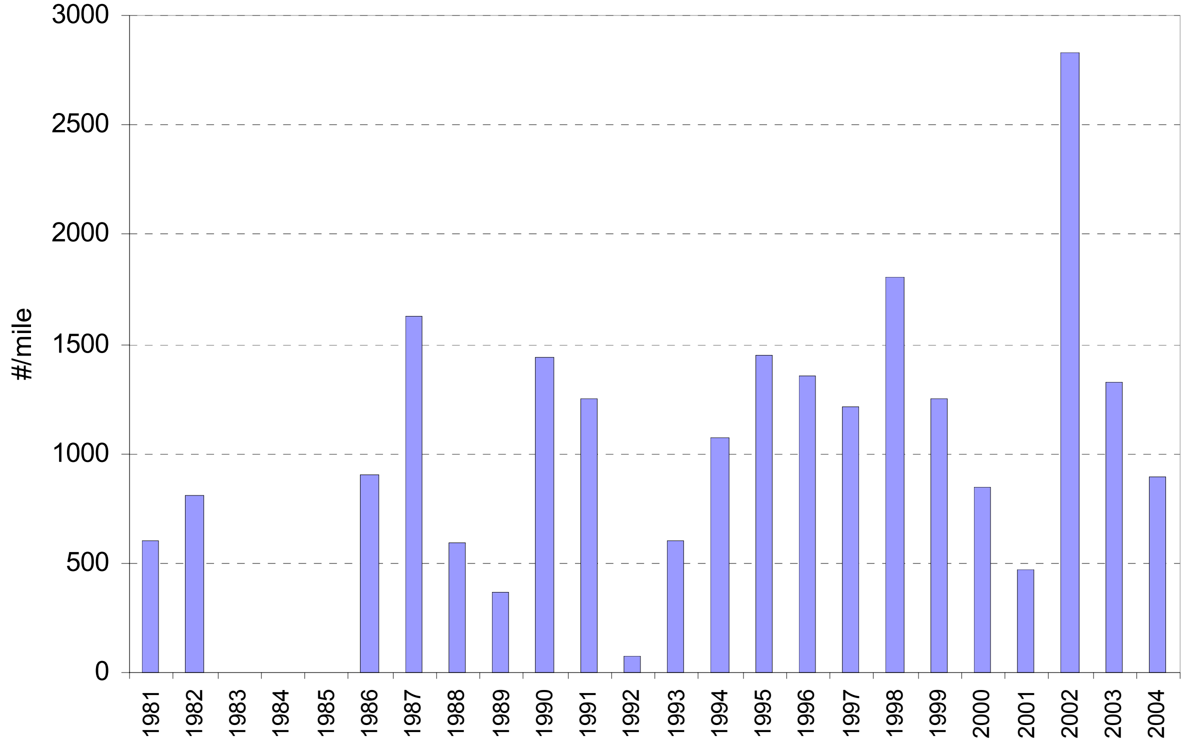

Figure 2-16. Fall estimates of age-1 rainbow trout in the Missouri River at Pelican Point.

Populations of rainbow trout in the Dearborn River watershed have recently been affected by whirling disease, which was first observed in the watershed in 2003. Infection rates in the South Fork and the Middle Fork of the Dearborn are among the highest infection rates observed in Montana (Leathe, 2004). Whirling disease is caused by a tiny metazoan parasite (*Myxobolus cerebralis*) that is native to the Eurasian continent and was introduced into U.S. waters in the late 1950s, possibly with the importation of brown trout. *Myxobolus cerebralis* penetrates the head and spinal cartilage of fingerling trout where it multiplies rapidly, putting pressure on the organ of equilibrium. This causes the fish to swim erratically (hence the name “whirling disease”) and have difficulty feeding and avoiding predators. In severe infections, the disease can cause high rates of mortality in young-of-the-year fish. When each infected fish dies, thousands to millions of the parasite spores are released to the water. Spores can withstand freezing and desiccation, and can survive in a stream for 20 to 30 years. Spores must be ingested by its alternate host, a tiny, common aquatic worm (Tubifex tubifex) where the spore takes on the form that once again will infect trout. The highly infective form released by Tubifex worms is called Triactinomyon. This form hooks onto passing fish and burrows into its nervous system, completing the life cycle. Whirling disease attacks juvenile trout and salmon, but doesn't infect warm water species. Rainbow trout and cutthroat trout appear to be more susceptible than other trout species.

3.0 WATER QUALITY IMPAIRMENT STATUS

This section first presents the status of all 303(d)-listed water bodies in the TPA (i.e., which water bodies are listed as impaired or threatened and for which pollutant). This information is followed by a summary of the applicable water quality standards and a translation of those standards into proposed water quality goals or targets. The remainder of the section is devoted to a water body-by-water body review of available water quality data and an updated water quality impairment status determination for each listed water body.

3.1 303(d) List Status

A summary of the 303(d) list status and history of listings is provided in Figure 3-1. The listed stream segments are shown in Figure 3-1. As mentioned in Section 1.1, all necessary TMDLs must be completed for all pollutant–water body combinations appearing on the 1996 303(d) list. The Montana 1996 303(d) list reported that the Dearborn River, Flat Creek, and the Middle Fork Dearborn River were impaired. The causes of impairment listed for these waterbodies were habitat alterations, flow alteration, siltation, and thermal modification.

In 2002, the South Fork Dearborn River was added to the list of impaired streams in the Dearborn River TPA, and the Middle Fork Dearborn River was de-listed due to a lack of sufficient credible data. The causes of impairment listed for the South Fork Dearborn River were dewatering, flow alteration, and siltation. The draft 2004 303(d) list indicates that the Dearborn River is impaired because of flow alterations, siltation, and thermal modifications; insufficient data are available to assess Flat Creek; the Middle Fork is not listed; and the South Fork is impaired because of dewatering, flow alteration, and siltation.

Habitat alteration and flow alteration are considered “pollution,” while siltation and thermal modifications are considered “pollutants.” It is EPA’s position that TMDLs are required only for “pollutants” that are causing or contributing to water body impairments (Dodson, 2001). Therefore, because TMDLs are required only for pollutants and flow alteration and habitat alteration are not pollutants, the focus of this document is on siltation and thermal modifications. Flow alteration and habitat alteration might certainly constitute potential sources or causes of sediment related impairments, and while no TMDLs are established to specifically address these issues, they will be addressed as sources, as appropriate.

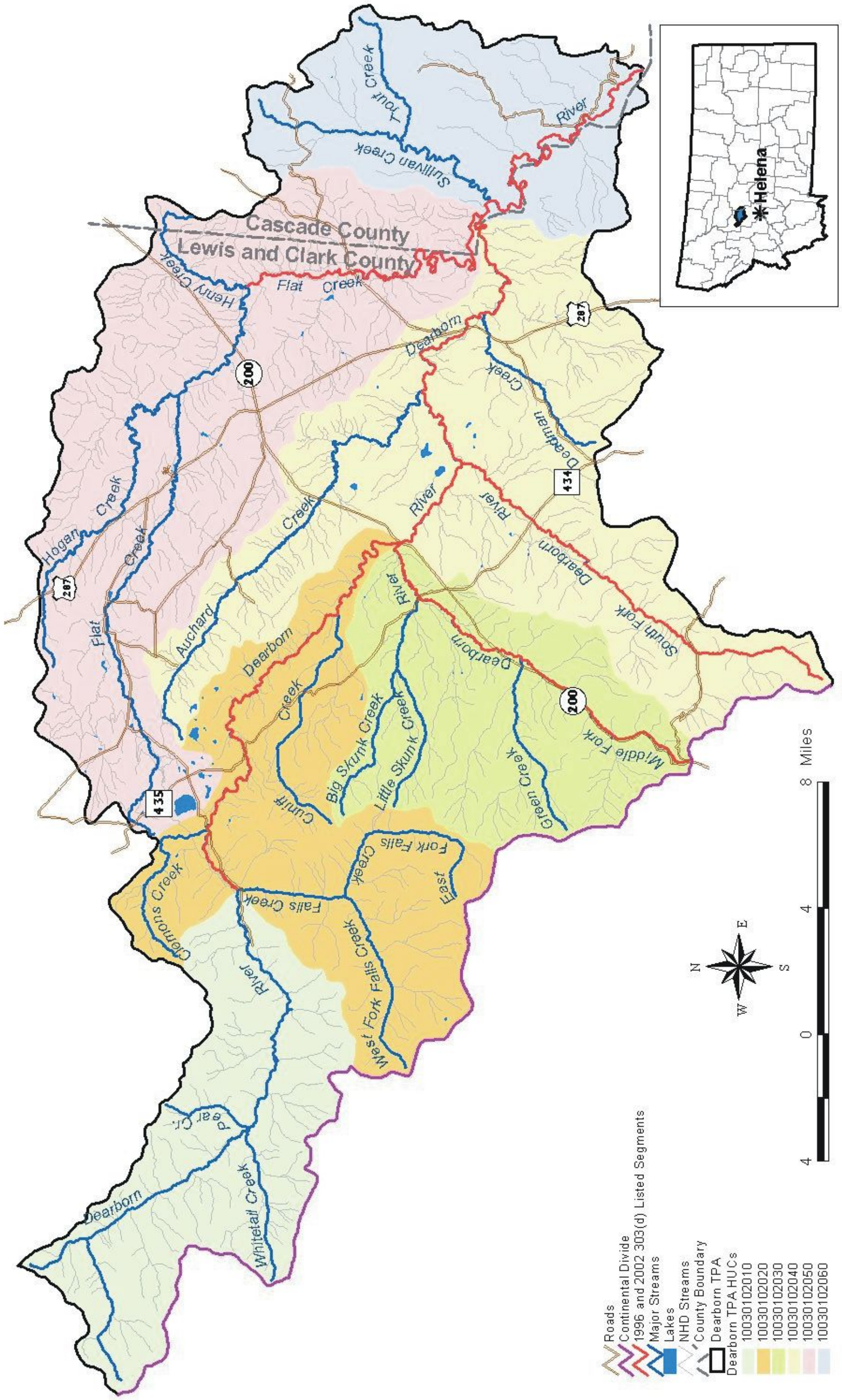

Figure 3-1. Location of 303(d) listed streams in the Dearborn River TPA.

Table 3-1. 303(d) Listing Information for the Dearborn River TPA

Segment Name	Size (mi)	Use Class	Listing Year	Probable Impaired Uses	Probable Causes
Dearborn River, from Falls Creek to the Missouri River	48.6	B-1	1996	Aquatic Life Support Coldwater Fishery	Flow Alteration Thermal Modifications Siltation Habitat Alterations
			2002	Aquatic Life Support Coldwater Fishery Primary Contact Recreation	Flow Alteration Thermal Modifications Siltation
			2004	Aquatic Life Support Coldwater Fishery Primary Contact Recreation	Flow Alteration Siltation Thermal Modifications
Flat Creek, from Henry Creek to Dearborn River	15.5	B-1	1996	Aquatic Life Support Coldwater Fishery	Flow Alteration Habitat Alterations Siltation
			2002	Aquatic Life Support Coldwater Fishery	Flow Alterations Siltation
			2004	Insufficient Data	
Middle Fork of the Dearborn River, Headwaters to the Dearborn River	13.5	B-1	1996	Aquatic Life Support	Siltation
			2002	Not Listed	Not Listed
			2004	Not Listed	Not Listed
South Fork of the Dearborn River, Headwaters to the Dearborn River	15.8	B-1	1996	Not Listed	Not Listed
			2002	Aquatic Life Support Coldwater Fishery	Dewatering Flow Alteration Siltation
			2004	Aquatic Life Support Coldwater Fishery	Dewatering Flow Alteration Siltation

3.2 Applicable Water Quality Standards

Water quality standards include the uses designated for a water body, the legally enforceable standards that ensure that the uses are supported, and a non-degradation policy that protects the high quality of a water body. The ultimate goal of this water quality restoration plan, once implemented, is to ensure that all designated beneficial uses are fully supported and all standards are met. Water quality standards form the basis for the targets described in Section 3.3. The pollutants addressed in this water quality assessment are sediment and thermal modifications. This section provides a summary of the applicable water quality standards for each of these pollutants.

3.2.1 Classification and Beneficial Uses

Classification is the assignment (designation) of a single use or group of uses to a water body based on the potential of the water body to support those uses. Designated uses or beneficial uses are simple narrative descriptions of water quality expectations or water quality goals. There are a variety of “uses” of state waters, including growth and propagation of fish and associated aquatic life; drinking water; agriculture; industrial supply; and recreation and wildlife. The Montana Water Quality Act (WQA) directs the Board of Environmental Review (BER) to establish a classification system for all waters of the state that includes their most beneficial uses, both at the time the Act was originally written and in the future (Administrative Rules of Montana [ARM] 17.30.607–616), and to adopt standards to protect those uses (ARM 17.30.620–670).

Montana, unlike many other states, uses a watershed-based classification system with some specific exceptions. As a result, *all* waters of the state are classified and have designated uses and supporting standards. All classifications have multiple uses and in only one case (A-Closed) is a specific use (drinking water) given preference over the other designated uses. Some waters may not actually be used for a specific designated use (e.g., as a public drinking water supply); however, the quality of that water body must be maintained suitable for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or nonpoint source discharges may not make the natural conditions worse.

Modification of classifications or standards that would lower a water’s classification or a standard (e.g., from B-1 to B-3) or removal of a designated use because of natural conditions can occur only if the water was originally misclassified. All such modifications must be approved by the BER and are undertaken on the basis of a Use Attainability Analysis (UAA) that must meet EPA requirements (40 Code of Federal Regulations [CFR] 131.10(g), (h) and (j)). The UAA and findings presented to the BER during rulemaking must prove that the modification is correct and all existing uses are supported. An existing use cannot be removed or made less stringent.

Descriptions of Montana’s surface water classifications and designated beneficial uses are presented in Table 3-2. All water bodies within the Dearborn River TPA are classified as B-1.

Table 3-2. Montana Surface Water Classifications and Designated Beneficial Uses

Classification	Designated Uses
A-CLOSED CLASSIFICATION:	Waters classified A-Closed are to be maintained suitable for drinking, culinary, and food-processing purposes after simple disinfection.
A-1	Waters classified A-1 are to be maintained suitable for drinking, culinary, and food-processing purposes after conventional treatment for removal of naturally present impurities.
B-1	**Waters classified B-1 are to be maintained suitable for drinking, culinary, and food-processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.**
B-2	Waters classified B-2 are to be maintained suitable for drinking, culinary, and food-processing purposes after conventional treatment; bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.
B-3	Waters classified B-3 are to be maintained suitable for drinking, culinary, and food-processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.
C-1	Waters classified C-1 are to be maintained suitable for bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.
C-2	Waters classified C-2 are to be maintained suitable for bathing, swimming, and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.
C-3	Waters classified C-3 are to be maintained suitable for bathing, swimming, and recreation; and for growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl, and furbearers. The quality of these waters is naturally marginal for drinking, culinary, and food-processing purposes, agriculture and industrial water supply.
I	The goal of the State of Montana is to have these waters fully support the following uses: drinking, culinary, and food-processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply.

3.2.2 Standards

Montana's water quality standards include numeric and narrative criteria, as well as a nondegradation policy that currently applies to the numeric criteria.

Numeric surface water quality standards have been developed for many parameters to protect human health and aquatic life. These standards are in Department Circular WQB-7 (MDEQ, 2004). The numeric human health standards have been developed for parameters determined to be toxic, carcinogenic, or harmful and have been established at levels to be protective of long-term (i.e., lifelong) exposures as well as exposure through direct contact such as swimming.

The numeric aquatic life standards include chronic and acute values that are based on extensive laboratory studies including a wide variety of potentially affected species, a variety of life stages, and various durations of exposure. *Chronic* aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes reproduction, early life stage survival, and growth rates. In most cases the chronic standard is more stringent than the corresponding acute standard. *Acute* aquatic life standards are protective of short-term exposures to a parameter and are not to be exceeded.

High-quality waters are afforded an additional level of protection by the nondegradation rules (ARM 17.30.701 et. seq.,) and in statute 75-5-303 MCA. Changes in water quality must be "non-significant" or an authorization to degrade must be granted by MDEQ. Under no circumstance, however, may standards be exceeded. It is important to note that waters that meet or are of better quality than a standard are high-quality for that parameter, and nondegradation policies apply to new or increased discharges to the water body.

Narrative standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric standards. The term *narrative standards* commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface water quality standards. The General Prohibitions are also called the "free from" standards; that is, the surface waters of the state must be free from substances attributable to discharges that impair the beneficial uses of a water body. Uses can be impaired by toxic or harmful conditions (from one parameter or a combination of parameters) or conditions that produce undesirable aquatic life. Undesirable aquatic life includes bacteria, fungi, and algae.

The standards applicable to the pollutants addressed in the Dearborn River TPA are summarized below.

Sediment

Sediment (i.e., coarse and fine bed sediment) and suspended sediment are addressed by the narrative criteria identified in Table 3-3. The relevant narrative criteria do not allow for harmful or other undesirable conditions related to increases above naturally occurring levels or from discharges to state surface waters. This is interpreted to mean that water quality goals should strive toward a reference condition that reflects a water body's greatest potential for water quality given current and historic land use activities where all reasonable land, soil, and water conservation practices have been applied (see definitions in Table 3-3).

Table 3-3. Applicable Rules for Sediment Related Pollutants

Rule	Standard
17.30.623(2)	No person may violate the following specific water quality standards for waters classified B-1.
17.30.623(2)(f)	No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.637(1)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:
17.30.637(1)(a)	Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.
17.30.637(1)(d)	Create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.
	The maximum allowable increase above naturally occurring turbidity is 0 NTU for A-closed; 5 NTUs for A-1, B-1, and C-1; 10 NTUs for B-2, C-2, and C-3
17.30.602(17)	"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied.
17.30.602(21)	"Reasonable land, soil, and water conservation practices" means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

Temperature

Montana's temperature standards were originally developed to address situations associated with point source discharges, making them somewhat awkward to apply when dealing with primarily nonpoint source issues. In practical terms, the temperature standards address a maximum allowable increase above "naturally occurring" temperatures to protect the existing temperature regime for fish and aquatic life. In addition, Montana's temperature standards address the maximum allowable rate at which temperature changes (i.e., above or below naturally occurring) can occur to avoid producing temperature shock in aquatic life.

For waters classified as B-1, the maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67 ºF) is 1 °F, and the rate of change cannot exceed 2 °F per hour. If the natural occurring temperature is greater than 67 ºF, the maximum allowable increase is 0.5 ºF (ARM 17.30.623(e)).

3.3 Water Quality Goals and Indicators

To develop a TMDL, it is necessary to establish quantitative water quality goals referred to in this document as targets. TMDL targets must represent the applicable numeric or narrative water quality standards and full support of all associated beneficial uses. For many pollutants with established numeric water quality standards, the water quality standard is used directly as the TMDL target. However, one of the pollutants of concern in the Dearborn TPA (siltation) does not have established numeric water quality standards that can be directly applied as TMDL targets. In addition, the numeric standards for thermal modifications are based on a comparison to natural occurring temperatures, which are difficult to determine for the Dearborn TPA. Where targets are established for pollutants with only narrative standards, the target must be a water body-specific, measurable interpretation of the narrative standard.

In the case of the Dearborn TPA, there is no single parameter that can be applied alone to provide a direct measure of beneficial use impairment associated with sediment or thermal modifications. As a result, a suite of targets and supplemental indicators has been selected to help determine when impairments are present (Table 3-4). In consideration of the available data for the Dearborn TPA, the targets are the most reliable and robust measures of impairment and beneficial use support available. As described in the one-by-one discussions of individual targets presented in the following paragraphs, there is a documented relationship between the selected target values and beneficial use support, or sufficient reference data are available to establish a threshold value representing “natural” conditions. In addition to having a documented relationship with the suspected impaired beneficial use, the targets have direct relevance to the pollutant of concern. The targets, therefore, are relied on as threshold values that if exceeded (based on sufficient data), indicate water quality impairment. The targets are also applied as water quality goals by which the ultimate success of implementation of this plan will be measured in the future.

The supplemental indicators provide supporting and/or collaborative information when used in combination with the targets. In addition, some of the supplemental indicators are necessary to determine whether exceedances of targets are a result of natural versus anthropogenic causes. However, the proposed supplemental indicators are not sufficiently reliable to be used alone as a measure of impairment because (1) the cause-effect relationship between the supplemental indicator(s) and beneficial use impairments is weak or uncertain; (2) the supplemental indicator(s) cannot be used to isolate impairment associated with individual pollutants (e.g., to differentiate between an impairment caused by excessive levels of sediment and an impairment caused by high concentrations of metals); or (3) there is too much uncertainty associated with the supplemental indicator(s) to have a high level of confidence in the result.

Table 3-4. Summary of the Proposed Targets and Supplemental Indicators for the Dearborn River TPA

Sediment Target	Threshold Value
Percent Surface Fines < 2mm	< 20 percent
Number of Clinger Taxa	> 14
Periphyton Siltation Index	< 20.0 for mountain streams < 50.0 for plains streams
Sediment – Supplemental Indicator	**Recommended Value**
Bank Stability and Riparian Condition	No significant disturbances
MFVP Macroinvertebrate Multimetric Index	> 75 percent
EPT Richness	> 18.5
Percentage of Clinger Taxa	Best Professional Judgment
Montana Adjusted NRCS Stream Habitat Surveys	> 75 percent
TSS (Mean)	< 10 mg/L
Turbidity	High Flow – 50-NTU instantaneous maximum Summer base flow – 10 NTUs
Thermal Modifications – Target	**Threshold Value**
Temperature (Change in Temperature Due to Anthropogenic Sources, or Variation from a Reference Condition)	< 1° (F)
Thermal Modifications – Supplemental Indicators	**Recommended Value**
Riparian Condition	No significant disturbances
Daily Maximum Temperature Over a 3-Day Period	< 73º F
Average Temperature Over a 60-Day Period	< 53.6º F

Targets and Supplemental Indicators Applied to Beneficial Use Impairment Determinations

The beneficial use impairment determinations presented in Section 3.4 are based on a weight-of-evidence approach in combination with the application of best professional judgment. The weight-of-evidence approach outlined in Figure 3-2, is applied as follows. If none of the target values are exceeded, the water is considered to be fully supporting its beneficial uses and a TMDL is not required. This is true even if one or more of the supplemental indicator values are exceeded. On the other hand, if one or more of the target values are exceeded, the circumstances around the exceedance are investigated and the supplemental indicators are used to provide additional information to support a determination of impairment/non-impairment. In this case, the circumstances around the exceedance of a target value are investigated and it is not automatically assumed that the exceedance represents anthropogenic impairment (e.g., Are the data reliable and representative of the entire reach? Might the exceedance be a result of natural causes such as floods, drought, fire, or the physical character of the watershed?). This is also the case where the supplemental indicators assist by providing collaborative and supplemental information, and the weight-of-evidence of the complete suite of targets and supplemental indicators is used to make the impairment determination. A conservative approach is used if the supplemental indicators are inconclusive. When the supplemental indicators support neither impairment nor non-impairment, it is assumed that the water is impaired.

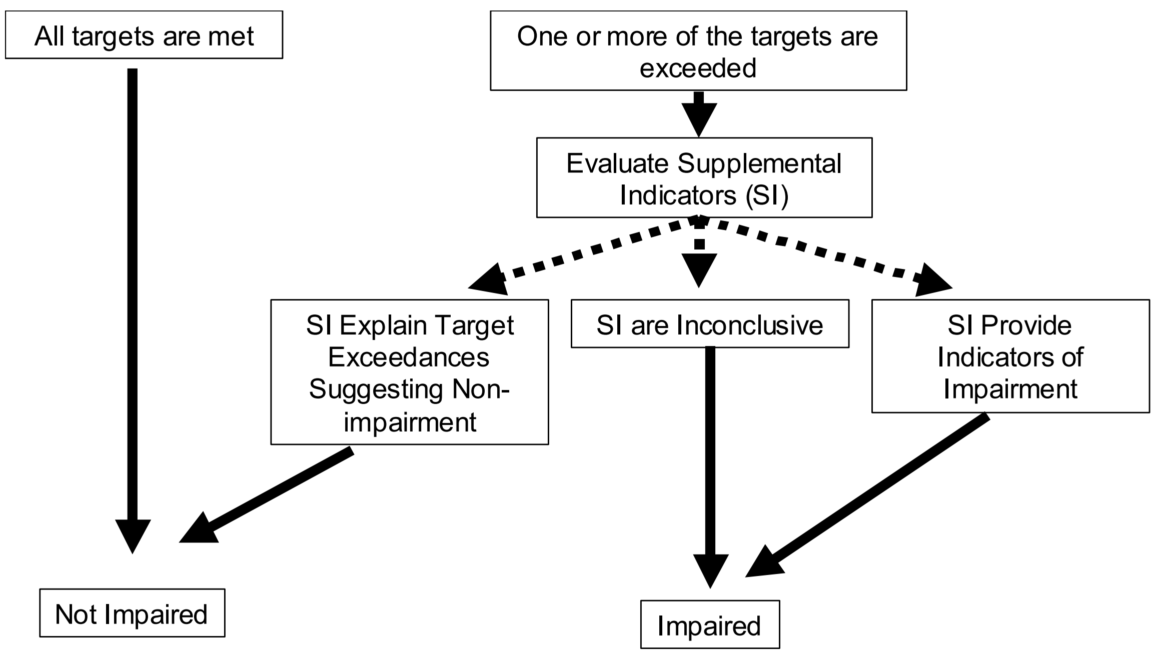

Figure 3-2. Weight-of-evidence approach for determining beneficial use impairments.

Targets and Supplemental Indicators as Water Quality Goals

In accordance with the Montana Water Quality Act (MCA 75-5-703(7) and (9)), the MDEQ is required to assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been attained. This assessment will use the suite of targets specified in Table 3-4 to measure compliance with water quality standards and achievement of full support of all applicable beneficial uses (Figure 3-3). The supplemental indicators will not be used directly as water quality goals to measure the success of this water quality restoration plan. If all of the target threshold values are met, it will be assumed that beneficial uses are fully supported and water quality standards have been achieved. Alternatively, if one or more of the target threshold values are exceeded, it will be assumed that beneficial uses are not fully supported and water quality standards have not been achieved. However, it will not be automatically assumed that implementation of a TMDL was unsuccessful just because one or more of the target threshold values have been exceeded. As noted above, the circumstances around the exceedance will be investigated. For example, might the exceedance be a result of natural causes such as floods, drought, fire, or the physical character of the watershed? In addition, in accordance with MCA 75-5-703(9), an evaluation will be conducted to determine whether:

- the implementation of a new or improved suite of control measures is necessary
- more time is needed to achieve water quality standards, or
- revisions to components of the TMDL are necessary.

Detailed discussions regarding each of the targets and supplemental indicators are presented below.

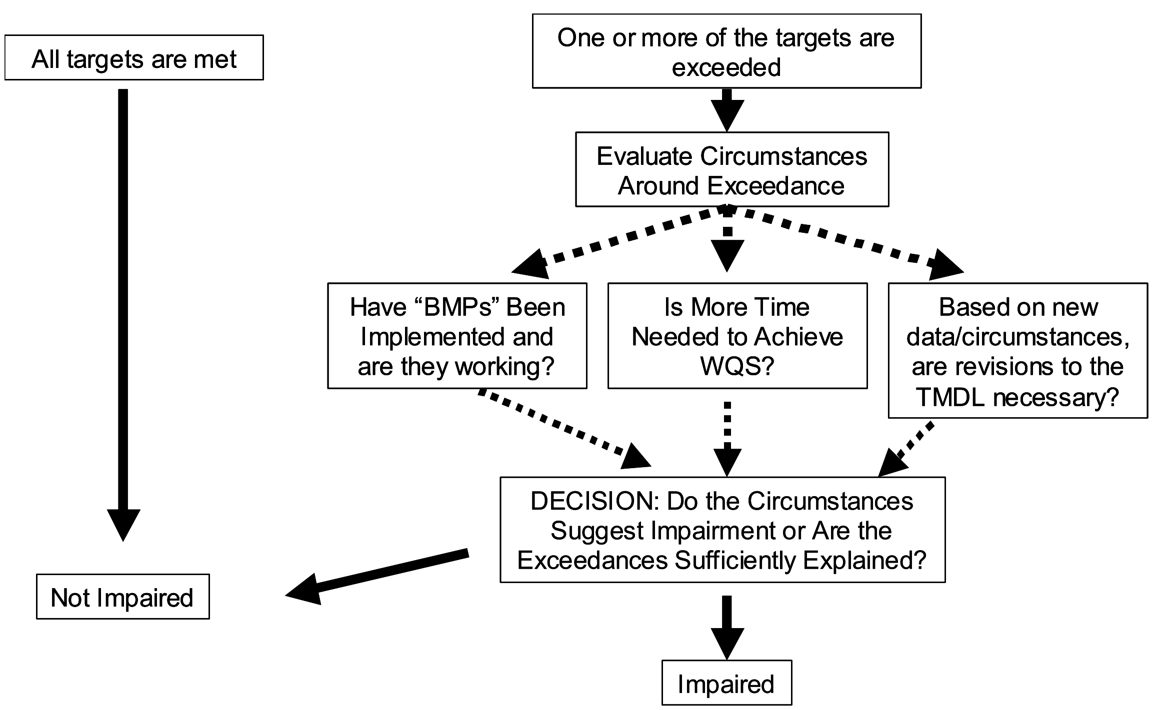

Figure 3-3. Methodology for determining compliance with water quality standards.

3.4 Sediment Targets

The proposed sediment targets for the Dearborn River are the percent surface fines, the number of clinger taxa, and the periphyton siltation index.

3.4.1 Surface Fines

Pebble counts provide an indication of the type and distribution of bed material in a stream. Streams naturally have a wide variety of bed material; however, streams with too much fine material can have lowered spawning rates for many fish species, especially salmonids. Too much fine material also degrades the habitat of aquatic invertebrates, and can cause a shift in the invertebrate population if conditions deteriorate from natural conditions. The state in which there is too much fine sediment in a streambed is often referred to as “embeddedness” or “siltation.” It is desirable (and usually natural) that streams have a low percentage of bed material that is less than 2 millimeters in diameter.

The Wolman pebble count method is one method for determining the amount of fine sediment in a water body. Wolman pebble counts involve walking a transect in a riffle section from bankfull to bankfull width. The field person places one foot in front of the other and, without looking down, selects a rock and measures the intermediate diameter of the rock. This information is recorded and the procedure followed until a minimum of 100 rocks per transect are counted (Wolman, 1954). Pebble count data can be interpreted to compare median particle sizes between streams, evaluate the percentage of fines of less than a specific size, and compare particle distributions between streams. The field sheets used to record Wolman pebble counts at several sites within the Dearborn River TPA in 2003 are included in Appendix B.

Threshold pebble count values have not been fully developed in Montana and suitable reference data are not available for comparison to the data collected in the Dearborn River TPA. Recent work completed in the Boise National Forest in Idaho show a strong correlation between the health of macroinvertebrate communities and percent surface fines, where fine sediments are defined as all particles less than 2 millimeters. The most sensitive species were affected at 20 percent surface fines and a definite threshold was observed at 30 percent surface fines (Relyea, personal communications, April 28, 2004). The New Mexico Environmental Department has also established a percent surface fines target of less than 20 percent for TMDL development (NMED, 2002).

The percent surface fines is a good measure of the siltation of a river system and, when combined with biological indicators and other measures, is a direct measure of stream bottom aquatic habitat. Although it is difficult to directly correlate percent surface fines with loadings in mass per time, the Clean Water Act allows “other applicable measures” for the development of TMDLs, and percent surface fines have been used successfully in other TMDLs where stream bottom deposits, siltation, and aquatic life uses are the major issues of concern (USEPA, 1999). Based on these considerations, less than 20 percent surface fines (2 millimeters) is proposed as one of the TMDL targets for the Dearborn River TPA.

3.4.2 Macroinvertebrates – Number of Clinger Taxa

Macroinvertebrate data help to provide a better understanding of the cumulative and intermittent impacts that may have occurred over time in a stream, and they are a direct measure of the aquatic life beneficial use. Several macroinvertebrate metrics and indexes have been developed to help assess aquatic life beneficial use impairments. Some are useful for assessing the overall health of the aquatic life community, while others help to assess the effects of a specific pollutant. Seven metrics and indexes were selected to summarize the macroinvertebrate data collected in the Dearborn River TPA. These metrics were chosen to help determine if sediment is a cause of impairment to the aquatic life community. Using the methodology described in Section 3.3, the macroinvertebrate metrics and indexes were assigned to one of three categories – macroinvertebrate *targets, supplemental indicators,* and *supporting information*. The three categories are further described below.

- **Targets (i.e., number of clinger taxa) –** There is a documented relationship between the macroinvertebrate metric, aquatic life health, and sediment stressors.

- **Supplemental Indicators (i.e., MFVP macroinvertebrate index; EPT richness; percentage of clinger taxa)** – There is a documented relationship between the macroinvertebrate metric and the overall health of the aquatic life community; however, the metric does not specifically identify sediment as a cause of impairment. Or, there is a documented relationship between the macroinvertebrate metric, aquatic life health, and sediment stressors. However, there is currently no information to suggest an appropriate threshold value.

- **Supporting Information (i.e., percentage of tolerant taxa, Hilsenhoff Biotic Index, and stressor tolerance of dominant taxa)** – The macroinvertebrate metric provides information about the composition of the aquatic life community and may reflect impacts from other stressors (i.e. nutrients) that are beyond the scope of the TMDL.

Based on the available data, only one specific macroinvertebrate metric – number of clinger taxa – appears to have a direct relationship with sediment in a stream. The number of clinger taxa is proposed as a target because clingers have morphological and behavioral adaptations that allow individuals to maintain position on an object in the substrate even in the face of potentially shearing flows. These taxa are also sensitive to fine sediments that fill interstitial spaces, one of the main niches. This metric is calculated as the number of clinger taxa in a sample, and decreases in the presence of sediment stressors. A minimum of 14 clinger taxa are expected in unimpaired Montana streams, and this is proposed as a target for streams in the Dearborn TPA (Bollman, 1998).

The number of clinger taxa are proposed here as a target because of the documented relationship with sediment stressors. The remaining six macroinvertebrate metrics and indexes are considered as supplemental indicators and supporting evidence, and are further described in Section 3.5.1.

3.4.3 Periphyton Siltation Index

MDEQ has collected periphyton samples at sites throughout Montana for more than 15 years. Periphyton are recommended as an additional biological assemblage (USEPA, 2003; USEPA, 1997) and diatoms, in particular, are considered useful water quality indicators because so much is known about the relative pollution tolerances of different taxa and the water quality preferences of common species (Bahls, 2003a; Barbour et al., 1999. MDEQ uses several different diatom indices to assess stream condition.

Analysis of the periphyton data focused on the siltation index, which provides an indication of periphyton health with respect to sediment impact. The siltation index is the sum of the percent abundances of all species in the silt-tolerant diatom genera *Navicula*, *Nitzschia*, and *Surirella*. The following thresholds apply for this index (Bahls, 2003a) and were used as additional targets:

> 20.0 indicates potential sediment impacts for mountain streams
> 50.0 indicates potential sediment impacts for plains streams

3.4.4 Cold-Water Fish Populations

Existing fish data include information on the annual numbers of rainbow and brown trout emigrating from the Dearborn River and estimates of age-1 rainbow trout in the Missouri River at Pelican Point (which are representative of populations in the Dearborn River). However, the available data do not provide readily useful information in relation to the listed segments and impairments. For example, limited data are available regarding fish populations in the Middle Fork, South Fork, and Flat Creek and trends in the population data could be due to a number of factors in addition to fine sediments or temperature. Because of these reasons, fish populations were not used to assess impairment status and are not discussed in the water-body-by-water-body discussion below. Instead, future monitoring should attempt to identify trends and this target should be applied as a water quality goal as described in Section 5.4.

3.5 Sediment Supplemental Indicators

The proposed supplemental indicators for the sediment impairment are the MFVP macroinvertebrate index; EPT richness; percentage of clinger taxa; bank stability and riparian condition; Montana adjusted NRCS stream habitat surveys; total suspended solids, and turbidity.

3.5.1 Macroinvertebrates

As described above in Section 3.4.2, only one specific macroinvertebrate metric – number of clinger taxa – appears to have a direct relationship with sediment in a stream. Therefore, it is the only metric to be included as a *target*. Other metrics having a documented relationship with the health of the aquatic life community are discussed below as *supplemental indicators*. These include the Montana Foothill, Valley, and Plains Index of Biological Integrity (MFVP IBI), percentage of clinger taxa, and number of EPT taxa. Finally, the Hilsenhoff Biotic Index (HBI), percentage of tolerant taxa, and stressor tolerance of the dominant taxa metrics are discussed as *supporting information*. These metrics provide insight into the aquatic life community, but are not necessarily correlated with the overall aquatic life health or sediment stressors. Therefore, the supporting information metrics are not used when making beneficial use determinations.

Montana Foothill, Valley, and Plains Index of Biological Integrity

Macroinvertebrate data are typically organized according to a multimetric index of biological integrity (IBI), or a “multimetric index.” Individual metrics (e.g., clinger taxa, percentage of EPT) are designed to indicate biological response to human-induced stressors. Scores are assigned to individual metrics, summed across several of them, and the total used to compare samples or sampling sites. Three possible multimetric indices have been developed for Montana: (1) Mountain; (2) Foothill Valley and Plains (MFVP); and (3) Plains. The MFVP IBI was chosen for streams in the Dearborn TPA based on site characteristics, primarily elevation. Most of the sites in the Dearborn TPA are within the Montana Valley and Foothill Prairies ecoregion (Woods et al., 1999) and range in elevation from 3,700 feet to 4,900 feet. The MFVP index is most appropriate for these conditions. MDEQ uses a scoring procedure with a maximum possible score of 100 percent. Total scores *greater than 75 percent* are considered within the range of expected natural variability and represent full support of their beneficial use (aquatic life). Streams scoring between 25 and 75 are considered partially supporting their aquatic life uses, and scores lower than 25 percent represent unsupported uses.

It should be noted that the MDEQ scoring index was developed for 2nd to 4th order streams whereas the Dearborn River is a 5th to 6th order stream. Scoring criteria have not yet been developed for larger rivers, and this is another reason the MFVP index is applied as a supplemental indicator rather than as a target.

Percentage of Clingers

As previously discussed, clinger taxa have morphological and behavioral adaptations that allow individuals to maintain position on an object in the substrate even in the face of potentially shearing flows. These taxa are sensitive to fine sediments that fill interstitial spaces, one of the main niches. This metric is calculated as the number of individuals categorized as belonging to clinger taxa as a proportion of the total sample. The number decreases in the presence of stressors. Scientific literature documenting values or other information on the expected percentage of clingers is not available. A higher percentage of clingers suggests little impact from sediment. This metric provides supplemental information on the overall impacts of sediment.

Number of EPT Taxa

This metric is the richness of the sample in taxa that are mayflies (Ephemeroptera), stoneflies (Plecoptera), or caddisflies (Trichoptera). Invertebrates that are members of these groups are generally understood to be sensitive to stressors in streams, whether the stressors are physical, chemical, or biological. Consequently, these taxa are less common in degraded streams. Metric values decrease in the presence of stressors. Bahls et al. (1992) determined that average EPT taxa richness for foothill streams was 16 taxa. This value was combined with the maximum EPT score to select the indicator value of 18.5.

Percentage of Tolerant Taxa

The tolerance value designation is an estimate of the relative capacity of a taxon to survive and reproduce in the presence of stressors (for more discussion of tolerance values, see below). This metric is calculated as the number of tolerant taxa as a proportion of the total taxa richness in a sample, and it increases in the presence of stressors. A higher proportion of tolerant taxa suggests impacts on the biological condition. Since a threshold value for the percentage of tolerant taxa has not been determined, this metric provides supplemental information regarding the possible impacts of other stressors and is not used as a target or supplemental indicator.

Hilsenhoff Biotic Index (HBI)

The HBI is an abundance weighted index developed to assess impacts from organic pollution (Hilsenhoff, 1987). Since the original HBI was developed in Wisconsin, the HBI metric is used to "screen" for possible indications of nutrient impacts. Bahls et al. (1992) determined that the average HBI value for foothill streams was 3.8. This value provides an indicator for comparison and is used in this analysis as supporting information (but not as a target or supplemental indicator).

Stressor Tolerance of Dominant Taxa

Tolerance values of the dominant taxa in a sample can give some indication of the presence of stressors at the site. Tolerance values for Montana benthic macroinvertebrate taxa were provided by Marshall and Kerans (2003 [draft]). Although the objectivity used in developing tolerance values is often unknown, the tolerance values of the dominant taxa were used as additional information to help interpret reach status. For each sampling site, the dominant taxa in each sample and their associated stressor tolerance values were examined. Shifts in taxa dominance were investigated both in an upstream-downstream comparison within a channel, as well as within a single site from one sample event to another (either between 2000 and 2003 or between 2002 and 2003). The tolerance of dominant taxa was used in this analysis as supporting information (but not as a target or supplemental indicator).

3.5.2 Bank Stability and Riparian Condition

Vegetated riparian buffers are a vital functional component of stream ecosystems and are instrumental in providing suitable habitat to aquatic communities. In addition, excessive sediment loading can occur when anthropogenic activities disrupt the natural vegetative cover or destabilize stream banks. Riparian vegetation health and stream bank stability are therefore two additional supplemental indicators selected for the Dearborn River TPA. An aerial assessment of channel and riparian vegetation in the Dearborn River watershed was conducted in 2003. The overall objectives of the aerial assessment were:

- Provide information about surface physical stream corridor conditions as required to support determinations of impairment and beneficial use status.
- Identify potential causes and sources of natural resource concerns when feasible.
- Establish a baseline of current resource conditions and indicators along the stream corridor for future trend monitoring
- Support recommendations for natural resource restoration and protection strategies along the stream corridor and important uplands within the watershed.
- Serve as a source of background information and interpretations to support future requests for technical and financial assistance to carry out watershed planning efforts.

Land and Water Consulting, Inc. conducted the assessment in 2003 (Appendix D). The results of this assessment were used qualitatively in making impairment determinations.

3.5.3 Montana Adjusted NRCS Stream Habitat Surveys

The NRCS stream habitat survey is a visual assessment of stream habitat condition. The rating is based on scores assigned to 11 categories. Six of the categories relate to the condition and type of riparian vegetation; 4 of the categories describe streambank condition; and one category captures the instream characteristics. Montana adjusted NRCS stream habitat surveys, completed for the Dearborn River in 2003, were used to make comparisons to a potential maximum score. This percentage of a maximum score was then used to represent the overall health of the riparian habitat. A score of 0 to 50 percent is considered "not sustainable," 50 to 75 percent is "at risk," and a score of 75 to 100 percent is classified as "sustainable." These scores were used in conjunction with other supporting indicators to determine whether a habitat degradation impact had occurred.

3.5.4 Total Suspended Solids

Siltation is a difficult impairment to quantify and address in a defensible manner because rivers naturally transport sediment loads. Total suspended solids (TSS), or the similar measurement suspended sediment concentration (SSC), are often used as a surrogate for siltation. However, TSS and SSC have limitations for addressing sediment impairments because they measure the amount of suspended solids within the water column during a given flow, and the units are a mass per volume. As the flow increases and decreases, the suspended solids also change in a direct relation to stream energy. To further complicate the issue, seasonality, antecedent rainfall events, and the length, duration, and intensity of precipitation events all contribute to TSS, so it is difficult to determine an appropriate duration by which to evaluate TSS values (e.g., instantaneous maximum, daily average, or monthly average).

Even with these limitations, TSS values can provide some insight into the sediment characteristics of a stream, and a few TSS and SSC data are available in the Dearborn River TPA. These data have been evaluated where available and were considered as collaborative evidence in support of conclusions on water quality impairment status.

Recommended values for TSS and SSC are best based on least-disturbed, reference watersheds that have similar characteristics as the subject watershed. No such reference watersheds have been identified for the Dearborn River. An average of 10.0 milligrams per liter (mg/L) TSS/SSC for the Dearborn River and its tributaries has therefore been chosen based on best professional judgment and taking into consideration that 10 mg/L is the detection limit for TSS. It should be noted that TSS and SSC are treated equally in this analysis, although SSC values have been shown to slightly exceed TSS values in paired studies, depending on the percentage of sand-sized particles in the sample (Gray et al., 2000).

3.5.5 Turbidity

Turbidity is a measure of water clarity that refers to the scattering of light by suspended matter, dissolved organic compounds, and plankton in the water. If water becomes too turbid, it loses the ability to support a wide variety of plants and other aquatic organisms. Suspended particles can also clog fish gills, lowering their resistance to disease and their growth rates, and affecting egg and larval development. The measurement of turbidity is used as an indirect indicator of the concentration of suspended matter, and can also be important in evaluating the available light for photosynthetic use by aquatic plants and algae.

Historical turbidity measures from the 1970s in the Dearborn TPA were reported in Jackson Candle Units (JCUs). These past turbidity measures are actually very different from current measures, and are not directly related on a one-to-one basis. JCUs involved a method in which a candle was placed opposite a water sample, and the resulting clarity was compared against a chart to adequately describe the clarity, or opacity, of the water sample. Current methods of measuring turbidity express results in Nephlometric Turbidity Units (NTUs). These methods rely on a machine to pass light particles into a water sample, and measure the amount of photons received at a 90 degree offset. This reflection of light particles is a direct result of the suspended materials within the water sample that the light encounters as it passes through the sample. Because of these different analytical methods, JCU data cannot be combined and compared to current turbidity data measured and reported as NTUs.

Another challenge associated with evaluating turbidity as a TMDL target is that both organic and inorganic particles affect water clarity. Organic particles are usually a result of a healthy biological community, however, and thus can distort the interpretation of high turbidity readings. Furthermore, organic particulates also have a seasonal variation, with higher concentrations occurring during the summer months. This introduces variability into turbidity measurements and their relationship to other variables because turbidity readings will be affected more by the organic particulates present in the water at certain times of the year, such as in the summer.

Montana’s water quality standard for turbidity varies according to stream classification. The subject waters within the Dearborn River TPA are all classified as B-1. For B-1 waters, the standard is no more than a 5-NTU (instantaneous) increase above naturally occurring turbidity. In the absence of sufficient data to characterize “naturally occurring turbidity,” it is not possible to directly apply this standard as a TMDL target.

As a result, where turbidity data are available they are used only as supplemental indicators. The State of Idaho’s standard to protect cold-water aquatic life will be used as the proposed supplemental indicator value. In accordance with Idaho’s Water Quality Standards and Wastewater Treatment Requirements (58.01.02.250.02.e), turbidity below any applicable mixing zone should not be greater than 50 NTUs (instantaneous). This value will be applied to high flow events or during the time of annual runoff. Some evidence suggests that detrimental effects on biota can occur with turbidity as low as 10 NTUs. The State of Idaho therefore has recommended that chronic turbidity not exceed 10 NTUs during summer base flow, and this value is also used as a supplemental indicator.

3.6 Temperature Targets

An EPA study and several independent studies have shown a strong relationship between cold-water fish (salmonids) and water temperature (USEPA, 1976; Coutant, 1977; Cherry et al., 1977; Bell, 1986; Lee and Rinne, 1980). Increased water temperature can affect fish reproduction and feeding habits. Also, warmer water temperatures can lead to a shift in fish species from cold-water to warm-water fish. Increases in water temperature are not normally lethal to fish because they can avoid areas of warmer water by migrating to other parts of the river. However, prolonged periods of extremely warm water temperatures can be fatal.

The Montana Administrative Rules state that "the maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67º Fahrenheit) is 1° (F) and the rate of change cannot exceed 2° F per hour" (ARM 17.30.623). These numeric criteria are used as the temperature targets for the Dearborn River.

An attempt was made to identify a suitable reference stream with which to assess "naturally occurring temperatures" in the Dearborn River so that the temperature criteria could be more directly applied. Ambient data from the Dearborn were compared with those from other streams of similar size near the Dearborn River, including the Sun River and Little Prickly Pear Creek (Figure 3-4). Table 3-5 shows the average monthly temperatures for four different USGS stations for the years 1995 through 2002. Water temperatures in the Dearborn River were similar to water temperatures in the Sun River and Little Prickly Pear Creek. The Sun River had a greater variability in temperature and, on average, higher summer temperatures than the Dearborn River. Little Prickly Pear Creek had the lowest average summer temperatures. However, both the Sun River and Little Prickly Pear Creek have been listed on a 303(d) list (the 1996 or 2002 303(d) list or both) for thermal modifications, and are therefore not considered appropriate as reference streams for the Dearborn River. No other appropriate reference streams were identified.

Table 3-5. Average Monthly Water Temperatures for the Dearborn River and Other Western Montana Rivers (1995–2002)

Month	Dearborn at Craig, MT (06073500)	Little Prickly Pear at Wolf Creek (06071300)	Sun River at Simms, MT (06085800)	Sun River at Vaughn, MT (06089000)
Watershed Area (square miles)	325	381	1,320	1,854
January	32.8	34.6	32.0	32.1
February	33.7	35.3	32.0	33.4
March	37.9	36.8	38.8	37.8
April	42.7	47.1	49.4	52.2
May	46.7	50.0	55.1	54.2
June	51.1	53.3	52.5	61.2
July	64.5	61.4	68.6	68.6
August	67.1	61.2	64.6	66.3
September	59.0	53.8	61.3	57.7
October	45.2	46.5	48.2	47.5
November	38.2	42.1	39.0	39.6
December	33.8	35.9	32.9	32.7

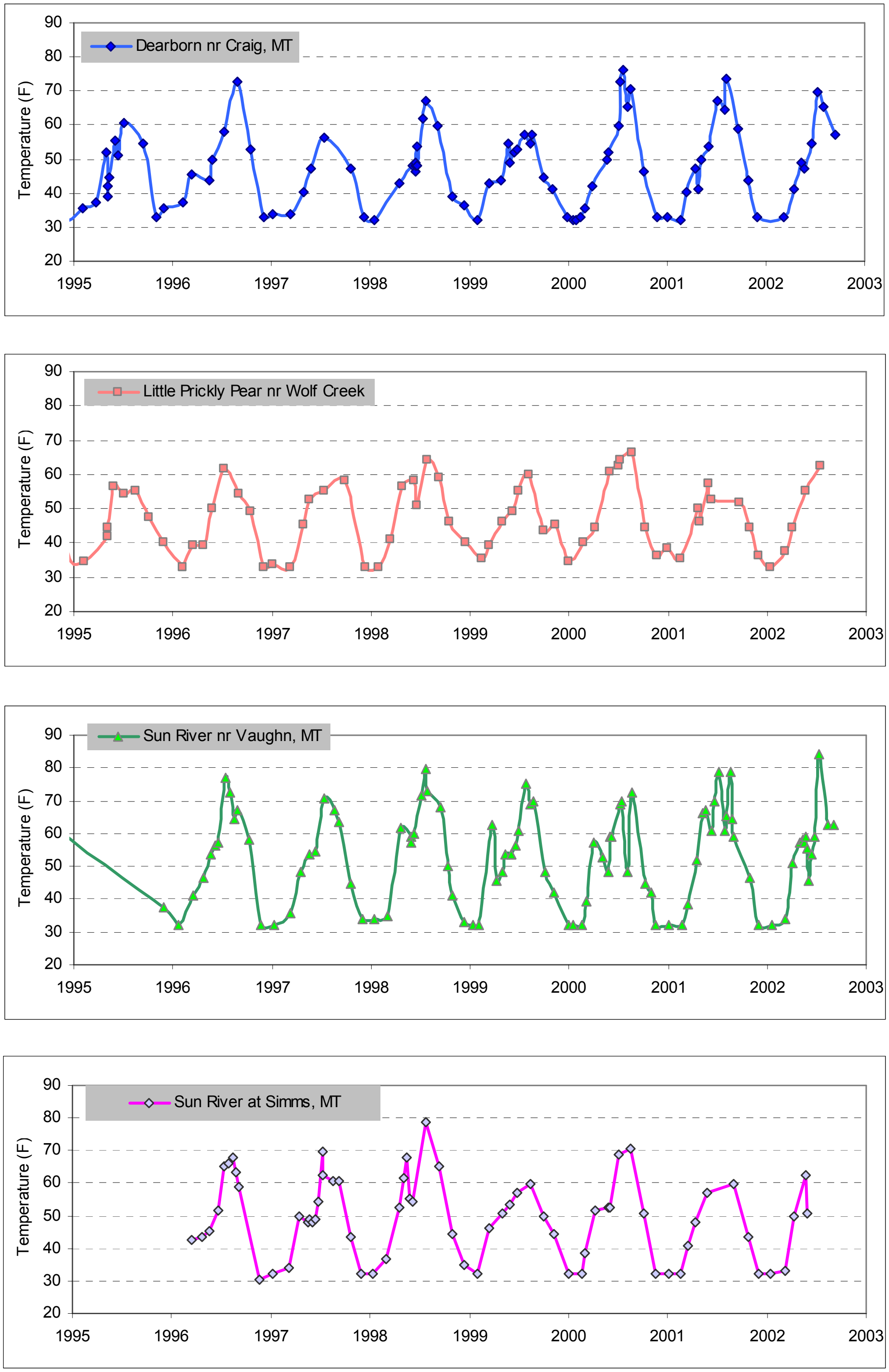

Figure 3-4. Comparison of Dearborn River temperature data to the Sun River and Little Prickly Pear Creek.

3.7 Temperature Supplemental Indicators

Three supplemental indicators were used for temperature impairments in the Dearborn TPA: riparian condition, 3-day maximum temperature, and 60-day average temperature. The riparian condition indicator was discussed above in Section 3.5.2. The two other supplemental indicators are discussed below.

Two sources were consulted in selecting supplemental temperature indicators for the Dearborn River: MFWP's Drought Fishing Closure Policy and ongoing laboratory research at Montana State University.

Among the objectives of MFWP's Drought Fishing Closure Policy is to "protect long-term health of aquatic systems from impacts of severe drought, especially waters supporting species of special concern" and to "provide consistency in decisions across the state" (MFWP, 2004). The policy specifies that exceedance of threshold levels for salmonids and for bull trout will initiate a discussion for appropriate action to protect the fisheries. The thresholds for salmonids (excluding bull trout) are the following:

- Flows are at the 95 percent monthly exceedence level (1-in-20-year low flows); or
- Daily maximum water temperature reaches or exceeds 73 ºF (23 degrees Celsius [ºC]) for at least some period of time during 3 consecutive days.

Thermal requirements specific to westslope cutthroat trout were also investigated because they are reported to inhabit the Dearborn River headwaters. As reported by McMahon et al. (2004), the thermal requirements of westslope cutthroat trout are largely unknown. In addition, increased water temperature is thought to favor non-natives in many cases, yet the effect of temperature on competition between westslope cutthroat and non-natives is unknown. Furthermore, hybridization between westslope cutthroat trout and non-native rainbow trout has resulted in a decline in populations of genetically pure westslopes. McMahon et al. (2004) conducted laboratory tests to assess the thermal requirements of hybrids, as well as how the competitive interaction between hybrids, genetically pure westslope cutthroat trout, and non-natives is influenced by water temperature. The tests were conducted over 60 days and used the acclimated chronic exposure method to assess upper thermal limits and growth optima during 60-day trials. Preliminary results suggest the upper limit for survival of westslope cutthroat trout is near 69.8 °F, whereas peak growth occurred around 53.6 °F. Both the upper lethal and optimal growth temperatures for westslope cutthroat trout were surprisingly similar to previously studied bull trout (Selong et al., 2001).

Both MFWPs' Drought Fishing Closure Policy and the research by McMahon et al. were used to develop temperature supplemental indicators for the Dearborn River. These supplemental indicators are as follows:

- Daily maximum water temperature should not exceed 73.0 ºF for at least some period of time during 3 consecutive days.

- Average temperatures over any 60-day period should not exceed 53.6 ºF.

3.8 Current Water Quality Impairment Status

This section presents summaries and evaluations of all available water quality data for waters appearing on Montana's 1996, 2002, and draft 2004 303(d) lists. The weight-of-evidence approach described above in Section 3.3, using a suite of targets and supplemental indicators, has been applied to verify each of the water quality impairments listed in 1996 and 2002. This section provides supporting documentation for each water body within each of the three major drainages.

3.8.1 The Dearborn River

The main stem of the Dearborn River is primarily an alluvial, gravel bed river with a small to moderately extensive floodplain. Significant reaches of the channel are confined by deeply dissected terrain and canyon walls. Areas of lateral and vertical bedrock control are present, and this confinement has resulted in limited lateral floodplain development in some reaches. A short section of unstable braided channel is present in the transition from the headwaters near Falls Creek/Bean Lake. Typical views of the Dearborn River are shown in Figure 3-5 and Figure 3-6. The locations of all of the mainstem sampling sites are shown in Figure 3-7 and field sheets and photos from the 2003 sampling are included in Appendix B.

Montana's 1996 303(d) list reported that the Dearborn River (from Falls Creek to the Missouri River) was impaired because of siltation, thermal modifications, flow alterations, and habitat alterations. The basis for the 1996 listings is unknown. The same causes of impairment, except habitat alterations, appeared on the 2002 and draft 2004 303(d) lists. MDEQ's Assessment Record Sheet (Phillips, 2000) indicates that the 2002 listings were based on the results of benthic macroinvertebrate surveys, periphyton surveys, and visual observation.

A review of the available data, some of which were not previously considered by MDEQ, is provided below. Available data include Wolman pebble counts, information on macroinvertebrate and periphyton populations, the results of a channel and riparian aerial assessment, stream habitat surveys, total suspended solids, turbidity, and temperature data and modeling.

Figure 3-5. Dearborn River at Highway 200.

Figure 3-6. Dearborn River downstream of Highway 287.

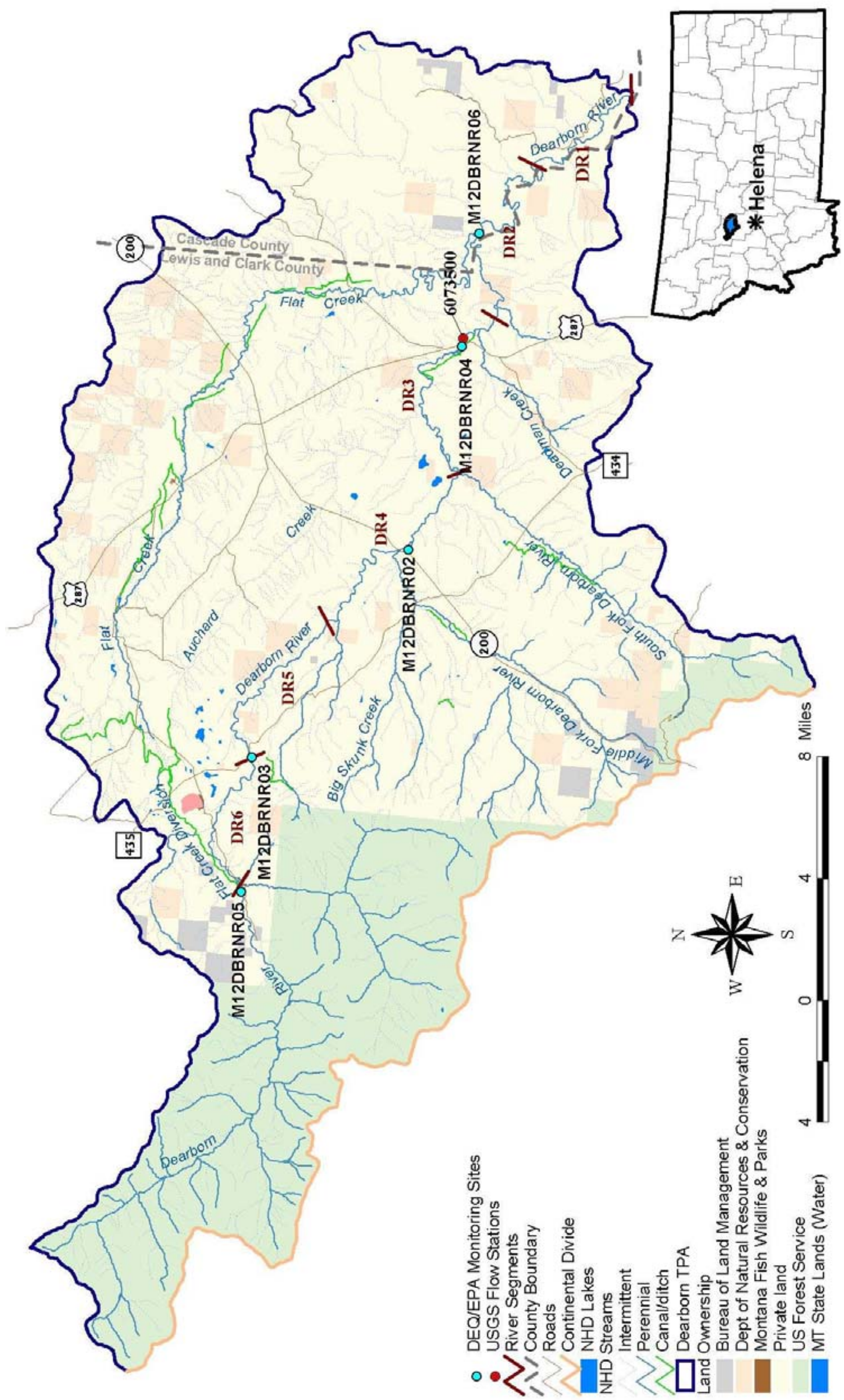

Figure 3-7. Sampling locations in the mainstem Dearborn River.

Surface Fines

Pebble count data have been collected and analyzed for the Dearborn River at four different sites covering the period from September 2002 to July 2003 (Table 3-6). These data were used to create the particle distribution curves shown in Figure 3-8. These data show that the average percent surface fines (less than 2 millimeters) in the Dearborn River at all sites is significantly less than the 20 percent target. The particle size distribution curves are similar at all four sites. The data suggest no sediment impairment.

Table 3-6. Dearborn River Stream Bottom Deposits Data Summary Table

Site ID	Site Name	Percentage < 2mm		
		9/10/2002	6/17/2003	7/24/2003
M12DBRNR05	Dearborn River below Falls Creek above the Falls Creek diversion	—	—	4.9
M12DBRNR03	Dearborn River near Bean Lake	5.6	—	—
M12DBRNR02	Dearborn River downstream of Highway 200	6.5	—	—
M12DBRNR04	Dearborn River at Highway 287	—	10.9	—

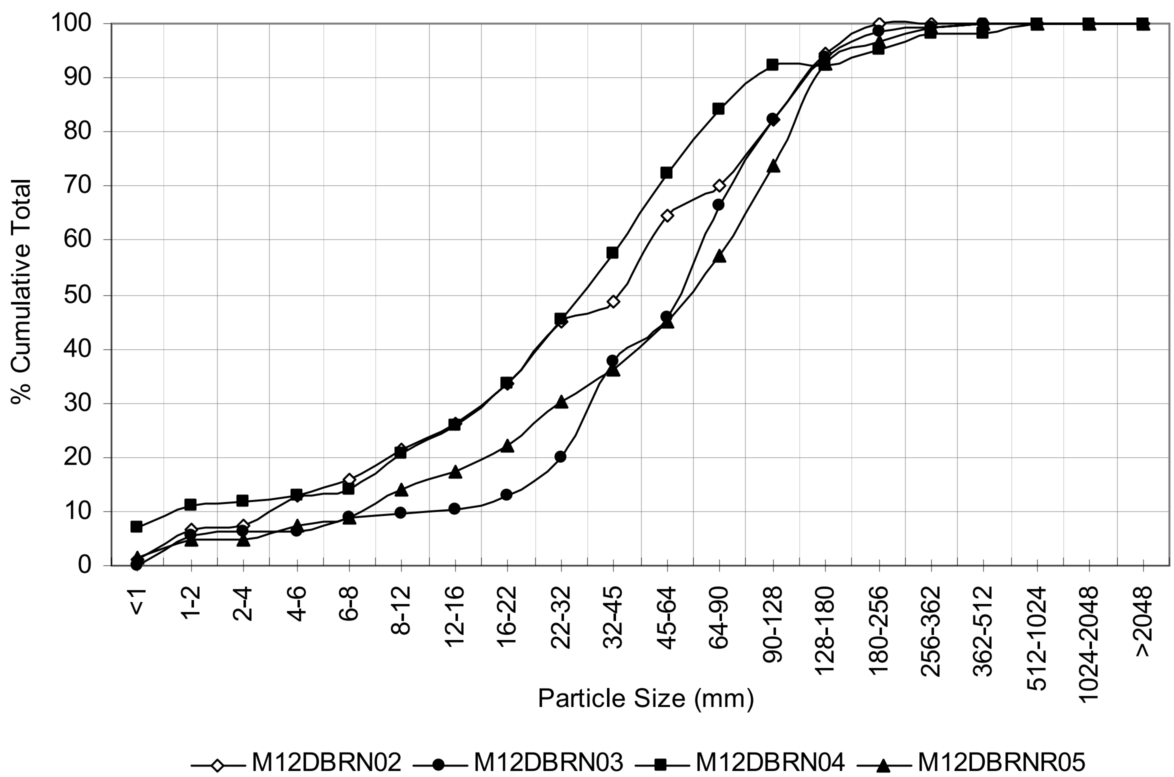

Figure 3-8. Cumulative stream bottom particle distribution for the Dearborn River.

Periphyton Siltation Index

Periphyton samples were collected at five sites along the main stem of the Dearborn River from 2001 to 2003. An EPA field crew sampled two reaches in 2002 and three reaches in 2003. MDEQ has an established statewide monitoring site located at Highway 287 that has been sampled yearly since 2001. Results from the MDEQ 2001 and 2002 statewide sampling events are included in this report; at the time of this report, the 2003 statewide monitoring site data were not available. Results from individual sites are presented in Table 3-1 and in Appendix C.

Based on the periphyton assessments, the main stem Dearborn River suggested no impacts from sediment. Results from two of the five sites indicated excellent biological integrity, and the other three reaches indicated some slight impacts from other stressors (e.g., nutrients) but still maintained good biological integrity.

Table 3-7. Summary of Periphyton Data and Siltation Index for Sites in the Dearborn River.

Site ID	Site Name	Siltation Index		Narrative Summary
		2002	2003	
M12DBRNR02	Dearborn River at Highway 200		1.75	The summary findings for periphyton at this site indicate excellent biological integrity (Bahls, personal communication, 2003b) and full support of aquatic life
M12DBRNR03	Dearborn River near Bean Lake	2.52		The summary findings for periphyton at this site indicate excellent biological integrity
M12DBRNR04	Dearborn River at Highway 287	5.36		The summary findings for periphyton at this site suggested some slight impacts, possibly attributable to increased nutrient concentrations. Overall, periphyton results showed no indication of sediment impacts and indicate full support of aquatic life.
M12DBRNR05	Dearborn River below Falls Creek	9.11	6.9	The summary findings for periphyton at this site suggest some slight impacts at this site, but the overall biological integrity was considered "good" in 2002 and excellent in 2003 (Bahls, 2003b). Overall, periphyton results show no indication of sediment impacts and indicate full support of aquatic life.
M12DBRNR06	Dearborn River below Flat (DB5)		8.56	The summary findings for periphyton suggest some slight impacts at this site, possibly attributable to increased nutrient concentrations. Overall, periphyton results show no indication of sediment impacts and indicate full support of aquatic life.

Macroinvertebrates

Macroinvertebrate samples were collected at five sites along the mainstem Dearborn River from 2001 to 2003. An EPA field crew sampled two reaches in 2002 and three in 2003. In addition, MDEQ has an established statewide monitoring site located at Highway 287 that has been sampled yearly since 2001. Results from the 2001 and 2002 statewide sampling events are included in this report. At the time of this report, the 2003 statewide monitoring site data were not available. Results from individual sites are summarized in Table 3-8 and in Appendix C.

Macroinvertebrate data suggest that the main stem of the Dearborn River is in relatively good condition, exhibiting only slight impact in the downstream areas in 2 years of sampling (2002 and 2003). MFVP scores were considered a screening mechanism to evaluate the presence of possible stressors, but the individual metric values were given more weight in evaluating the biological condition because the MFVP index was not developed for 5^{th} and 6^{th} order streams like the Dearborn River. From 2002 to 2003, the numbers of EPT taxa ranged from 11 to 20. The percentage of tolerant taxa was very low for all reaches (< 30), and four out of five reaches had a high percentage of clingers, ranging from 64 to 75 percent. The ranges of these metric values indicate good conditions in the main stem, although there may be localized impacts from habitat disturbance or other stressors. Based on evaluations of EPT taxa richness, clinger richness, and the characteristics of the dominant taxa, the macroinvertebrate data do not suggest any sediment impacts on the main stem Dearborn River. Increases in the percentage of tolerant taxa and a slightly elevated HBI value at the site below Highway 200 may indicate the presence of other possible stressors, such as nutrients, habitat alterations, or flow alterations, and may warrant further studies (see Section 6.0).

Table 3-8. Summary of Macroinvertebrate Metrics for the Dearborn River.

Site Description	Year	*Targets*	*Supplemental Indicators*			*Supporting Information*		
		# Clinger Taxa	% Clinger Taxa	MFVP IBI	# EPT Taxa	HBI	% Tolerant Taxa	Stressor Tolerance
Threshold or Indicator Value		**>14**	**BPJ**	**>75**	**>18.5**	**<3.8**	**BPJ**	**BPJ**
Dearborn River below Falls Creek (M12DBRNR05)	2003	17	64	83	19	2.92	0.3	Low
Dearborn River near Bean Lake (M12DBRNR03)	2002	10	69	50	11	2.25	8	Low
Dearborn River at Highway 287 (M12DBRNR04)	2001	8	26	50	7	3.89	25	NA
	2002			50				
	2003	17	75	50	14	3.75	15	Moderate
Dearborn River below Flat Creek (M12DBRNR06)	2003	20	75	50	15	3.8	20	Low
Dearborn River at Highway 200 (M12DBRNR02)	2002	12	53	56	14	4.14	29	Moderate
Average		14	60	56	13	3.46	16	Low

To further assess potential impacts to aquatic life (i.e., macroinvertebrates) from sediment, an additional analysis using the recently developed “Fine Sediment Index” (FSI) was also conducted. The Fine Sediment Index was developed using data from more than 600 sites across the western United States and has been shown to be a good indicator of possible sediment impacts. A FSI score was calculated for 5 sites on the Dearborn River using the available macroinvertebrate data. FSI scores have not been developed for the Montana Foothill, Valley, and Plains ecoregion so these scores were compared to 262 streams in the Columbia, Snake, and Northern Basin and Range ecoregion. Previous work on the FSI found that the basin and plains streams in the western U.S. were very similar in the quantity of fine sediment among ecoregions and in the types of macroinvertebrate communities found in these streams.

In general, FSI scores greater than or equal to the 75th percentile are considered non-impaired by fine sediment. All 5 Dearborn River sites scored above the 75th percentile; with three sites indicating no fine sediment related impairments and two with possible slight fine sediment related impairments. One of these two (i.e., Dearborn River near Bean Lake) was not sampled at the ideal time of the year for application of the FSI, and therefore the results should be used with caution. At the other site (i.e., Dearborn River below Highway 200), other stressors such as organic enrichment, temperature, or flow may be affecting the results.

Dearborn River below Falls Creek

This most upstream site of the Dearborn River had the highest FSI score of all five sites sampled. The FSI score of 170 would place this segment above the 90th percentile when compared to streams in the Columbia/Snake/NBR ecoregions. The macroinvertebrate community was somewhat different than the communities found in the lower Dearborn sites. Approximately 20 of the 41 macroinvertebrate taxa were only found in this site when compared to the other sampled Dearborn sites. These taxa were more similar to mountainous stream taxa. This indicates that this segment of the Dearborn is transitional between mountain and plain ecoregions. The most invertebrates (n=292) were also collected at this site but this number seems slightly low when compared to other streams sampled at the same time of year (September). *Drunella doddsi*, *Epeorus longimanus*, *Arctopsyche grandis*, and *Hesperoperla pacifica* all had substantial populations at this site and are all sediment sensitive with their 75th percentile of occurrence at 30% fine sediment (<2mm). The Dearborn River below Falls Creek does not appear to be impacted by fine sediment (<2mm).

Dearborn River near Bean Lake

This segment only had 87 invertebrates collected for a richness of 21 taxa. With such a low number of individuals collected and no replicate sample to verify whether this low number reflects conditions at this site or is merely an artifact of sampling, results from this site should be used with caution. This site along with the Hwy. 200 site had the lowest FSI scores of 105. These scores were just slightly above the Columbia/Snake/NBR cutoff score at the 75th percentile. This along with the presence of *Rhithrogena* and *Drunella doddsi*, who are sediment sensitive with their 75th percentile of occurrence at 30% fine sediment (<2mm), indicates that this segment is slightly to non-impaired for fine sediment. Other sediment sensitive species were present but because only one individual was counted health of the population cannot be determined. It is also worth mentioning that FSI was developed for streams sampled in the fall period at baseflow conditions. This segment was sampled in July which should also be considered when comparing this score to streams sampled in September when typically more invertebrates are present.

Dearborn River at Hwy 200

This segment has one of the highest taxa richness values (n=41) but the lowest FSI-EPT score (n=6). This means that only 6 of the 41 taxa are sediment sensitive. The FSI score was the lowest (105) of the 5 sites, but when compared to the Columbia/Snake/NBR ecoregion is slightly above the 75th percentile. This site does have *Claassenia sabulosa* which has its 75th percentile of occurrence at 20 percent fines. The taxa at this site are different from the other sites in that there are more non-insect taxa. This site may have different flow characteristics or temperature regime from the remaining sites. A high Hilsenhoff Biotic Index indicates possible organic nutrient enrichment.

Dearborn River at Hwy 287
This site had an FSI score of 125 which puts it well above the 75th percentile. The high FSI score coupled with numerous *Claassenia sabulosa* (n=27) (who is very sediment intolerant) indicates no sediment impairment.

Dearborn River below Flat Creek
This segment had a high FSI score of 120 above the 75th percentile and numerous *Claassenia sabulosa* (n=19) indicating fine sediment is not an impairment at this site.

Bank Stability and Riparian Condition

As discussed in section 3.5.2, Land and Water Consulting, Inc., conducted a channel and riparian aerial assessment study in 2003. The results indicated that the majority of stream banks in the surveyed reaches were rated as *good* or *fair* (Table 3-9). The one *poor* rating in the Dearborn River was attributed to natural causes (reach DR3 is in an unconfined channel with an active floodplain). Mass failure was an uncommon source for sediment along the Dearborn River and its tributaries. At a single location, a failing hillside was noted. However, the active failure was attributed to natural sources.

Table 3-9. Bank Stability along the Dearborn River

Reach	Reach Length (miles)	Channel Type	Slope	Sinuosity	Channel Width (feet)	Bank Instability (% of reach)			Overall Channel Condition
						High	Mod	Low	
DR1	8.88	C4	0.005	1.15	115	11.1	44.3	44.5	Good
DR2	9.52	C4	0.006	1.25	117	15.8	42.1	42.1	Good
DR3	8.00	C4	0.007	1.13	120	29.4	35.3	35.3	Fair-Good
DR4	8.15	C4	0.007	1.22	100	11.8	41.2	47.1	Good
DR5	7.436	C4	0.008	1.04	100	31.2	18.8	50.0	Fair
DR6	6.53	D4	0.008	1.1	107	57.1	21.2	21.6	Poor

Riparian vegetation along the Dearborn River consists primarily of open stands of deciduous cottonwood with extensive areas of herbaceous understory. There is very little bare or disturbed ground in the Dearborn River riparian area, most segments having 5 percent or less bare ground. The complete results of the aerial survey are discussed in Appendix C. The average riparian buffer width appeared to be in good condition, ranging from 42 to 49 feet in the lower segments of the Dearborn River and 72 to 136 feet in the upper segments. There are few roads and culverts in the riparian area that could contribute sediment during precipitation or snowmelt events.

Shade provided by riparian vegetation to the stream channel was very limited in all reaches. This is explained in part by low to moderate tree densities and canopy coverage, but also by the fact that tree heights and offset from the channel resulted in minimal shade projected to the water surface. Channel widths exceeding 100 feet limited effective shading potential from even mature cottonwood stands adjacent to the river. The majority of shade on the Dearborn is provided by topography.

The majority of the agricultural uses are not along the stream corridor, and do not appear to be altering the riparian corridor or the geomorphology of the channel. Also, the presence of wide, intact riparian areas acts as a buffer between the agricultural land and the streams.

Upland sources did not appear to contribute appreciable quantities of sediment to the Dearborn main stem or tributaries. Perennial and intermittent tributaries appeared stable, and rangeland did not show evidence of surface erosion, rilling, or other signs of accelerated soil loss due to anthropogenic influences. Forested headwaters were largely pristine. Sediment contribution from cut/fill slopes and road sand appeared to be minimal given the long delivery distance to the channel.

The channel and riparian aerial assessment study included an examination of historical photos. The analysis did not show any strong, localized riparian modification and bank instability, or grazing-related sediment issues. The possibility exists that historical anthropogenic land use factors may play a role in existing conditions. However, past human influence on channel and stream bank sediment sources in the Dearborn appeared minimal based on aerial photo interpretation.

A major decrease in channel stability occurred along with channel width increases after the major flood of 1964. Aerial photos taken in 1995 showed recovery of channel widths to dimensions near (or less than) 1955 values, indicating a strong trend for channel recovery following the 1964 flood. It is reasonable to assume the rebuilding of floodplain soils on exposed gravel deposits and reestablishment of climax floodplain vegetation communities is still continuing in the present day. Full recovery from the 1964 flood has been gradual in many alluvial channels along the Rocky Mountain front. Exposed gravel floodplain surfaces are widespread in portions of the Teton River, Birch Creek, and other nearby watersheds.

Montana Adjusted NRCS Stream Habitat Surveys

The Montana adjusted NRCS visual riparian assessments were completed in 2002 and 2003. The average Dearborn River reach score was 83.7 percent, which is above the recommended value of 75 percent and is indicative of excellent riparian conditions. All three sites were rated as being sustainable (Table 3-10) and suggest that these sites do not contribute significant amounts of sediment to the Dearborn River.

Table 3-10. Dearborn River Riparian Habitat Data Summary

Sample Site Information		Stream Habitat Ratings			
Site ID	Site Name	NRCS Score (% Max)	NRCS Rating	MT Adjusted NRCS Score (% Max)	MT Adjusted NRCS Rating
M12DBRNR04	Dearborn River at Highway 287	85.0	Non Impaired, Fully Supporting	91.0	Sustainable
M12DBRNR02	Dearborn River downstream of Highway 200	87.0	Sustainable	82.0	Sustainable
M12DBRNR03	Dearborn River Near Bean Lake	84.0	Sustainable	78.0	Sustainable
AVERAGE FOR DEARBORN RIVER:		85.3	Non Impaired, Fully Supporting	83.7	Sustainable

Total Suspended Solids

Limited SSC and TSS data are available for the Dearborn River and all of the data are presented in Table 3-11. As indicated by the last column in Table 3-11, most samples were taken during periods of below average flow. The average SSC at station 6073500 (20 mg/L) is above the proposed indicator (10 mg/L) but is based on a relatively small sample set. The median value at site 6073500 is 13 mg/L.

Table 3-11. Dearborn River SSC and TSS Data

Site ID	Date	Parameter	Result (mg/L)	Flow Condition[1]
M12DBRNR02	8/10/02	TSS	<1	36%
M12DBRN03	8/10/02	TSS	< 1	36%
M12DRBNR04	6/17/03	TSS	<10	97%
M12DRBNR04	7/22/03	TSS	<10	21%
M12DRBNR05	7/24/03	TSS	<10	19%
M12DRBNR06	7/24/03	TSS	<10	19%
6073500	6/2/99	SSC	22	312%
6073500	6/22/99	SSC	6	208%
6073500	8/23/99	SSC	13	26%
6073500	11/9/99	SSC	18	29%
6073500	4/4/00	SSC	2	27%
6073500	6/2/00	SSC	3	76%
6073500	8/10/00	SSC	14	6%
6073500	3/19/01	SSC	1	20%
6073500	5/14/01	SSC	62	344%
6073500	7/11/01	SSC	5	46%
6073500	8/9/01	SSC	8	27%
6073500	11/1/01	SSC	19	18%
6073500	4/19/02	SSC	5	75%
6073500	5/28/02	SSC	65	376%
6073500	7/19/02	SSC	19	61%
6073500	4/8/03	SSC	2	65%
6073500	5/27/03	SSC	98	343%
6073500	6/16/03	SSC	5	103%
6073500	7/15/03	SSC	13	28%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs). In the absence of site-specific flow data, this value is meant to provide perspective on overall watershed flows during the time of the sampling.

Turbidity

Only the turbidity samples taken during the TMDL sampling that was completed in June and July of 2003 are available for the Dearborn River (see Table 3-12). All values are well below the 10-NTU target level. In addition, turbidity data from 1973 to 1974 were analyzed, and the 11 samples showed a mean turbidity value of 0.45 JCUs, with a maximum value of 1.0 JCU. Jackson Candle Units are not directly comparable to NTUs; however, these values indicate that the historical turbidity samples were also low.

Table 3-12. Dearborn River Turbidity Data Summary Table

Site ID	Date	Result (NTU)	Flow Condition[1]
M12DRBNR04	7/22/2003	1.39	21%
M12DRBNR04	7/22/2003	1.39	21%
M12DRBNR06	7/24/2003	1.11	19%
M12DRBNR05	7/24/2003	0.76	19%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs). In the absence of site-specific flow data, this value is meant to provide perspective on overall watershed flows during the time of the sampling.

Temperature

Temperature data are available from three locations in the Dearborn River. The USGS gage at the Highway 287 Bridge near Craig, Montana (USGS station 06073500) provides continuous (every 15 minutes) temperature data at the Dearborn River–Highway 287 station for the period from October 1995 through September 2004 (Figure 3-9). Montana Fish, Wildlife, and Parks also records continuous temperature data upstream of Highway 287 and data are available for July 1997 to October 2003. An evaluation of the USGS data indicates that the 3-day daily maximum supplemental indicator (73 degrees F) was exceeded 221 times (7 percent of all days sampled) during the period of record. The 60-day average supplemental indicator (53.6 degrees F) was exceeded 948 times (30 percent).

Two continuous temperature samplers were installed on the Dearborn River from July 25, 2003 to October 23, 2003, as part of the TMDL sampling effort. These were installed on the Dearborn River just downstream of Flat Creek and at the Dearborn River at Highway 200. Figure 3-10 shows that the 3-day daily maximum supplemental indicator was exceeded 36 times (39 percent of all days sampled) downstream of Flat Creek. The 60-day average supplemental indicator was also exceeded 36 times (100 percent). Figure 3-11 shows that at Highway 200 the 3-day daily maximum supplemental indicator was exceeded 34 times (39 percent of all days sampled). The 60-day average supplemental indicator was exceeded 36 times (100 percent).

Montana Fish, Wildlife, and Parks also reported observing a fish kill on August 2, 2000 that was attributed to high temperatures. Dead sculpin and longnose dace were observed scattered throughout shallow water areas upstream of the Highway 287 bridge and the fish kill report noted that: “Hundreds of trout, primarily rainbows from 3” to 20” were packed into a spring area with substantially cooler water than surface water in the Dearborn… Upon spooking the fish, they would move off the bank but once they got into the hot surface water they would return to the cooler spring-influenced area” (FWP, 2000).

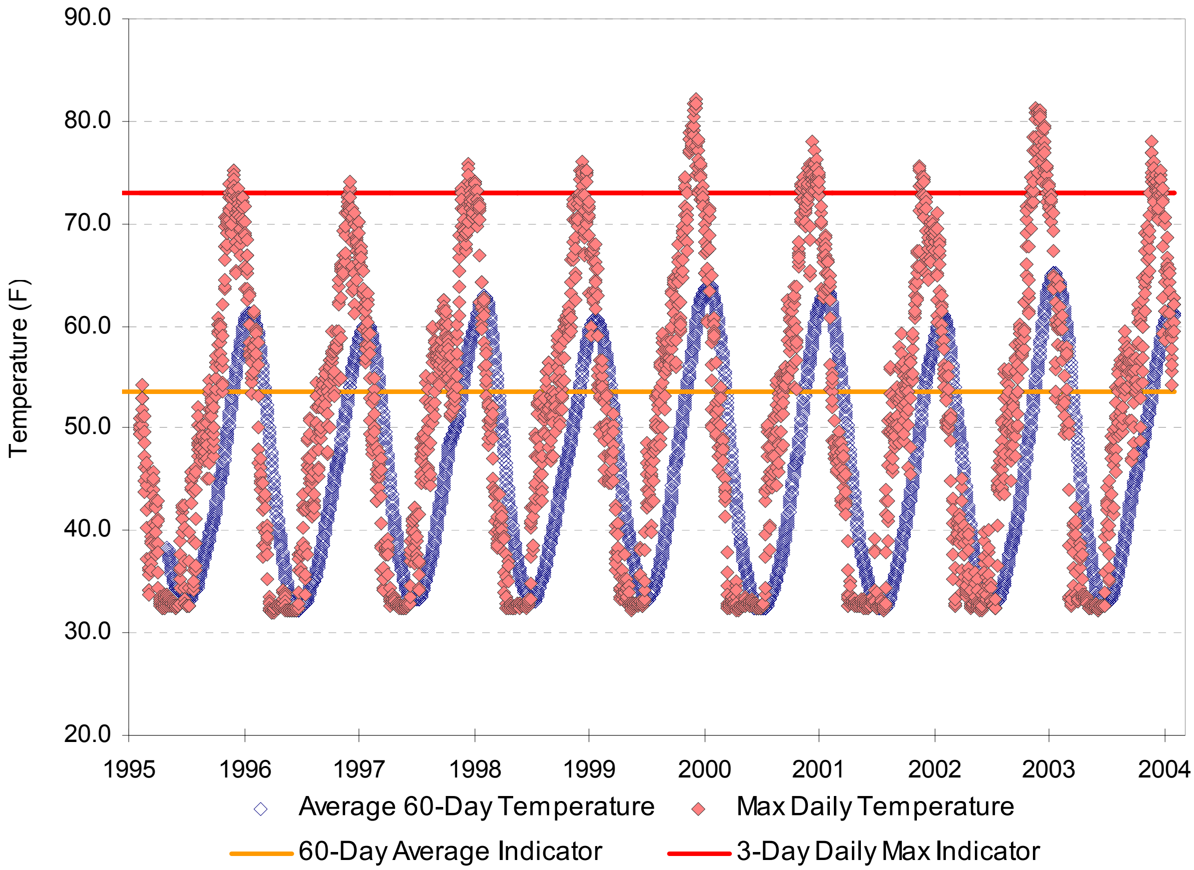

Figure 3-9. Evaluation of continuous temperature data for the Dearborn River at Highway 287 (USGS gage 06073500).

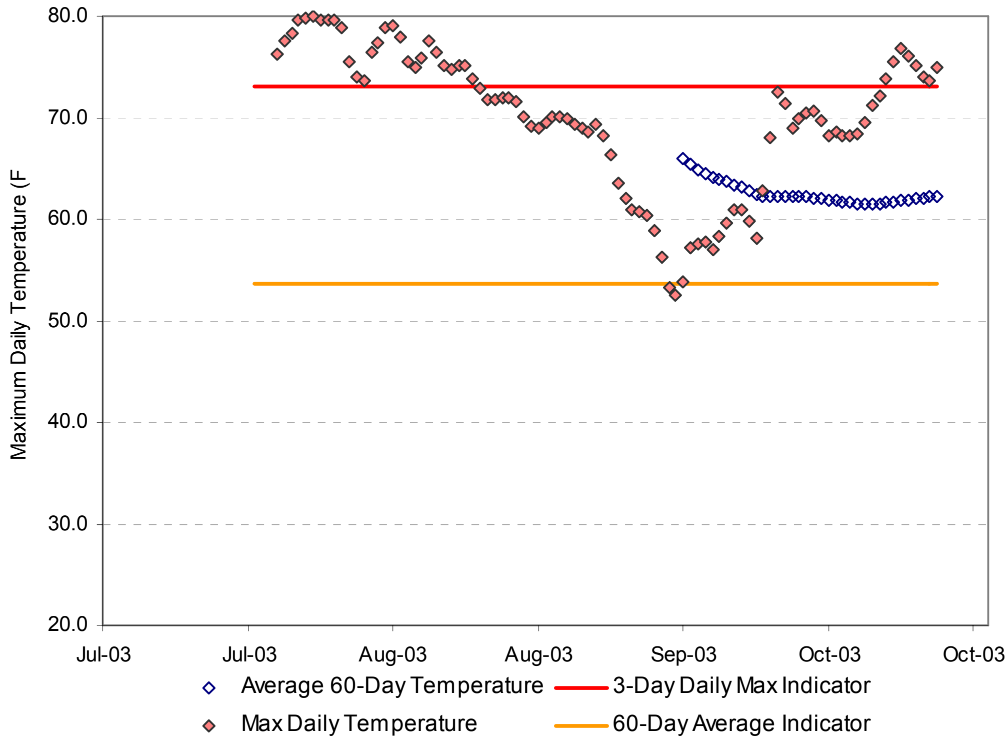

Figure 3-10.   Continuous temperature evaluation for the Dearborn River downstream of Flat Creek.

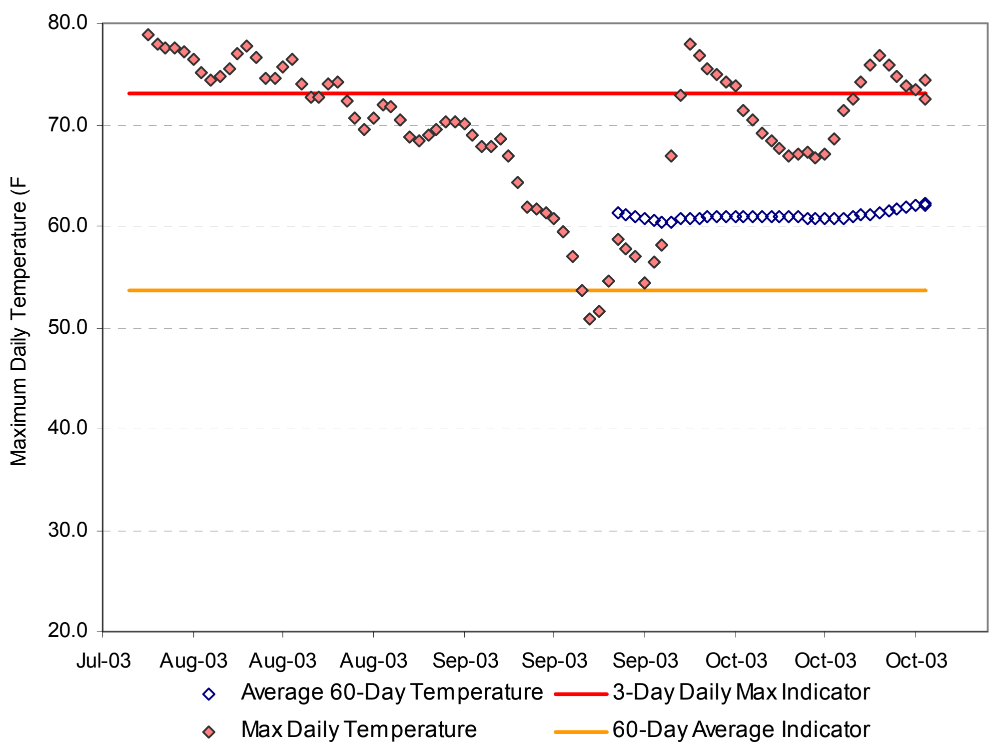

Figure 3-11.   Continuous temperature evaluation for the Dearborn River at the Highway 200 Bridge.

The Montana numeric water quality standards for temperature state that the maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67 ºF) is 1 °F and the rate of change cannot exceed 2 °F per hour. If the naturally occurring temperature is greater than 67º F, the maximum allowable increase is 0.5 ºF (ARM 17.30.623(e)). It is suspected that the upstream irrigation diversion from the Dearborn River to Flat Creek is causing an increase in water temperature in the downstream segments of the Dearborn River. The resulting decreased water depth and volume in the Dearborn River may lead to increased temperatures over natural conditions because shallow, low-volume water bodies are more easily heated. To better understand the effects of the diversion, temperature in the Dearborn River was modeled with the USGS Stream Segment Temperature Model Version 2.0 (SSTEMP) (Bartholow, 2002).

SSTEMP is a simplified, steady-state model capable of predicting the change in temperature along a stream reach. The model simulates the various natural heat flux processes found in a stream such as convection, conduction, and long and short wave radiation. Some of the various user inputs to the model are shown below.

- Hydrology: segment inflow, segment outflow, inflow temperature
- Channel Geometry: segment length, upstream and downstream elevation, wetted width and depth, Manning's "n"
- Meteorology: segment latitude, average daily air temperature, relative humidity, wind speed, ground temperature, thermal gradient, possible sun (percentage), percentage of shade, time of the year

The model predicts mean, minimum, and maximum temperatures at a specified reach outflow under steady-state conditions. It also assumes that conditions along the reach – such as air temperature, shade, and channel shape – do not change. As stated above, the SSTEMP model must be run for a reach with both a known inflow and outflow. Both flows and instream temperatures were collected on July 24, 2003 at two sites in the Dearborn River – upstream of the Flat Creek diversion and downstream of the confluence with Flat Creek. At the time of this report, only these two sites had both flow and temperatures collected on the same day, and also spanned the reach of concern (Dearborn River near the Flat Creek diversion). Therefore, the model was calibrated and run for the 36-mile segment between the two sampling sites. The Dearborn River upstream of the Flat Creek diversion was the known *inflow* site, and temperatures were calibrated and predicted at the Dearborn River downstream of the confluence with Flat Creek (*outflow* site). Because of the constraints of the model inputs (specifically, having a *known outflow*), stream temperatures could not be predicted anywhere else in the river. In the future, additional flow information could be input to the model to predict temperatures throughout the river.

SSTEMP was used to simulate current conditions in the Dearborn River with the Flat Creek diversion and a condition where no water is diverted. As stated above, the model was calibrated with synoptic flow and temperature data obtained on July 24, 2003. The sampling occurred during hot, low flow conditions in which it is expected there would be the most pronounced changes in temperature due to changes in volume (i.e., critical conditions). Flow and temperature data were obtained in the Dearborn River upstream of the diversion, in the diversion, and in the Dearborn River downstream of the confluence with Flat Creek (Table 3-13). The model was calibrated using these values, along with weather information and information about the stream channel conditions. For the purpose of this modeling exercise, it is assumed that the measured temperatures and flows are daily mean values.

Table 3-13. Measured Flow and Temperature Conditions at Various Locations in the Dearborn River Watershed on July 24, 2003

Location	Measured Flow (cfs)	Measured Stream Temperature (ºF)
Dearborn River immediately upstream of Flat Creek diversion	105	56.2
Irrigation channel immediately downstream of diversion	58	56.2
Dearborn River downstream of Flat Creek diversion (calculated)	47	56.2
Dearborn River downstream of Flat Creek confluence	43	67.1

The results of the model calibration indicate that the predicted mean output temperature is similar to the measured outflow temperature at the Dearborn River downstream of Flat Creek. The model was then run for various flow conditions to predict water temperature. Table 3-14 shows the results of this analysis. The model suggests that the loss of water from the irrigation diversion is resulting in increased temperatures in the Dearborn River. The actual temperature of the Dearborn River downstream of Flat Creek was 67.1 ºF. The model predicted that the temperature with no diversion would be 65.9 ºF, assuming no other inputs or withdrawals of flow between the diversion and the downstream monitoring site. This difference of 1.2 ºF is above the standard that allows for only a 1-degree increase in water temperature. However, the range of uncertainty associated with the modeling is +- 2.1 ºF. The impact of the diversion is slightly more dramatic assuming that cool water from the Middle Fork Dearborn River, South Fork Dearborn River, and miscellaneous other tributaries add flow to the Dearborn River (and assuming no other major withdrawals). The difference in temperature in this scenario is 1.9 ºF.

Table 3-14. Measured and Predicted Temperatures for the Dearborn River, July 24, 2003

Location	Flow (cfs)	Stream Temperature (ºF)
Measured		
Dearborn River immediately upstream of Flat Creek diversion	105	56.2
Dearborn River downstream of Flat Creek confluence	43	67.1
Predicted – Dearborn River Downstream of Flat Creek Confluence		
Current Conditions with diversion	43	67
No diversion – Conservative (no flow added or withdrawn)	105	65.9
No diversion – Increased flow	120	65.2

Dearborn River – Impairment Summary

The most significant influences on water quality in the Dearborn River appear to be associated with the 1964 flood and the diversion of a significant portion of the River's flow into Flat Creek. The 1964 flood scoured the stream channel and floodplain resulting in new channel alignments, significant channel widening, and bank erosion. Much of the vegetation existing in the riparian corridor at that time was destroyed. Although the stream channel and riparian vegetation community has returned to near pre-flood conditions, evidence of the flood is still obvious and natural channel/riparian corridor adjustments may be ongoing for years to come. The 1964 flood, however, was a natural event and should not be considered a human-caused source of water quality impairment.

On the other hand, based on the limited flow data collected as part of this analysis, the diversion of approximately 50 percent of the Dearborn River's flow into Flat Creek (during the summer) is a human-caused phenomenon that may be having a negative influence on recreation, habitat for fish and aquatic life, and water temperature. In accordance with the Clean Water Act, however, flow alteration is not considered a pollutant and, therefore, a TMDL is not required to specifically address flow issues unless they can be directly linked to a pollutant (e.g., temperature, sediment, etc.).

Montana's 1996 303(d) list reported that the Dearborn River was impaired by the pollutants siltation and thermal modification. Based on this analysis, it has been concluded that siltation is not causing impairment in the Dearborn River. A modeling analysis is described in Section 3.8.1, in which water temperatures in the Dearborn River were estimated to be between one and two degrees Fahrenheit higher than natural as a result of the flow diversion. This estimated increase is a violation of Montana's water quality standards and a TMDL is, therefore, required to address human-caused thermal modifications. However, the estimated temperature increases are based on limited data and the model is only able to predict temperature changes within ±2.1 degrees (with a 95 percent confidence interval). Therefore, the uncertainty regarding the model predictions is relatively high. Additionally, the most obvious solution (i.e., eliminate the Flat Creek diversion) would likely be very costly yet result in only minor improvements. For example, the resulting one to two-degree temperature decrease associated with elimination of the diversion would do little to improve the fish and aquatic life communities and the expense to irrigators could be very high.

Given the minor gains that would be achieved at this time by preparing and implementing a TMDL, and given the uncertainties associated with the temperature analysis, it is not recommended that a TMDL be prepared at this time. Rather, additional investigations are proposed to develop a better understanding of the magnitude of the potential impacts associated with the Flat Creek diversion and to evaluate the feasibility of more efficient use of irrigation waters in the Flat Creek Watershed (see Section 6).

Table 3-15. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for the Dearborn River

Sediment Target	Threshold Value	Minimum	Average	Maximum
Percent surface fines < 2mm	< 20 percent	4.9	7.0	10.9
Number of Clinger Taxa	> 14	10	14	20
Periphyton Siltation Index	<20.0 for mountain streams <50.0 for plains streams	1.8	5.0	8.6
Sediment – Supplemental Indicators	**Recommended Value**	**Minimum**	**Average**	**Maximum**
Riparian Condition	No significant disturbances	No significant disturbances		
MFVP Macroinvertebrate Multimetric Index	> 75 percent	50	56	83
EPT Richness	>18.5	7	13	19
Percentage of Clinger Taxa	BPJ	26	60	75
Montana Adjusted NRCS Stream Habitat Surveys	> 75 percent	78	84	91
TSS (Mean)	< 10 mg/L	2	9	22
Turbidity	High Flow – 50-NTU instantaneous maximum Summer base flow – 10 NTUs	0.8	1.0	1.4
Thermal Modifications – Target	**Threshold Value**	**Value**		
Maximum Allowable Increase Over Naturally Occurring Temperature	+ 1 °F	+ 1.9 °F		
Thermal Modifications – Supplemental Indicators	**Recommended Value**	**Value**		
Riparian Condition	No significant disturbances	No significant disturbances		
Daily Maximum Temperature Over 3-Day Period	< 73 ºF	13 consecutive days in July/August 2003 with Max Temp > 73 ºF		
Average Temperature Over 60-Day Period	< 53.6 ºF	Average temperature of 64.4 ºF from 7/25/03 to 9/2303		

3.8.2 The South Fork of the Dearborn River

The headwaters of the South Fork of the Dearborn River are in relatively undisturbed, steep, forested terrain. The river becomes an alluvial, gravel substrate channel in the lower reaches with some impacts associated with small-scale logging and agricultural activities. Typical views of the South Fork are shown in Figure 3-12 and Figure 3-13. The locations of all South Fork sampling sites are shown in Figure 3-14 and field sheets from the 2003 sampling are included in Appendix B.

The South Fork of the Dearborn River (from its headwaters to the Dearborn River) did not appear on Montana's 1996 303(d) list. The state's 2002 and 2004 303(d) lists reported that the South Fork of the Dearborn River (from its headwaters to the Dearborn River) was impaired by siltation. MDEQ's Assessment Record Sheet (Nixon, 2001) indicates that the 2002 listing was based on the results of benthic macroinvertebrate surveys, periphyton surveys, surveys of fish and game biologists, and visual observation.

A review of the available data, some of which was not previously considered by MDEQ, is provided below. Available data include Wolman pebble counts, information on macroinvertebrate and periphyton populations, the results of a channel and riparian aerial assessment, stream habitat surveys, and TSS and turbidity data.

Figure 3-12. South Fork of Dearborn River upstream of Blacktail.

Figure 3-13. South Fork Dearborn River near Highway 434.

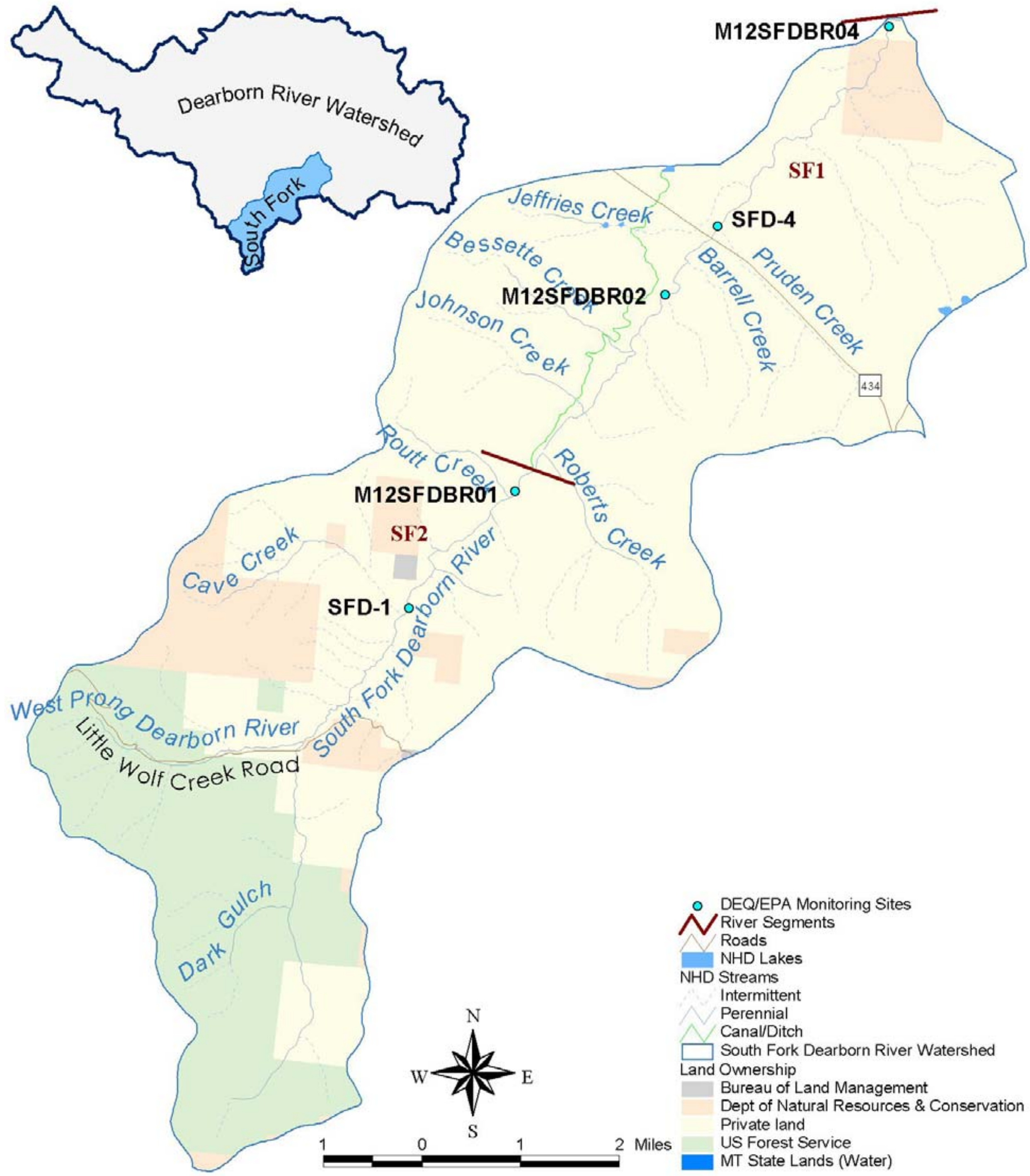

Figure 3-14. Sampling locations in the South Fork Dearborn River watershed.

Surface Fines

Pebble count data were collected and analyzed for the South Fork Dearborn River at three sites in June and July 2003 (Table 3-16). These data were used to create the particle distribution curves shown in Figure 3-15. The percent surface fines is below the threshold value at the upstream and downstream sites but exceeded the indicator value near Highway 434. The aerial survey noted agricultural disturbances along this reach.

Table 3-16. South Fork of the Dearborn River Pebble Counts Data Summary

Site ID	Site Name	Percentage < 2mm	
		6/17/03	7/22/03
M12SFDBR01	Upstream site above Roberts Creek	9.0	—
M12SFDBR02	Above Highway 434	—	25.6
M12SFDBR04	Confluence with Dearborn River	10.4	—

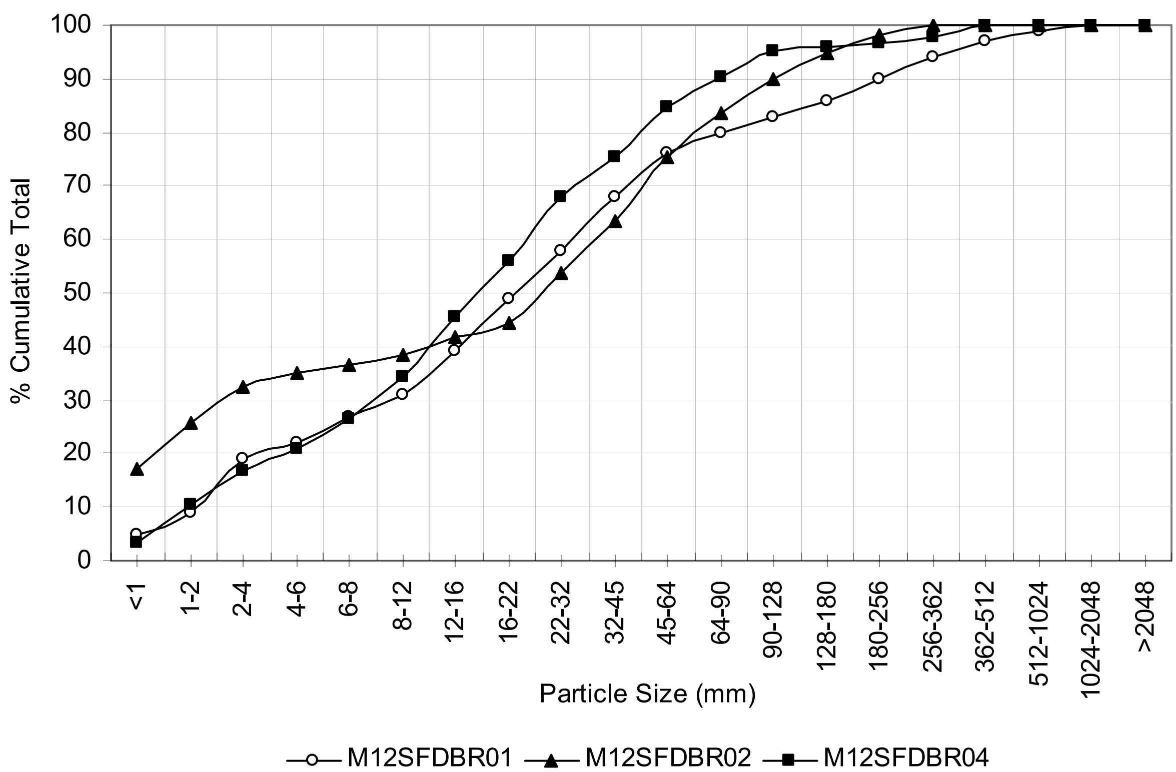

Figure 3-15. Cumulative stream bottom particle distribution for the South Fork of the Dearborn River.

Periphyton Siltation Index

Periphyton samples were collected at five sites along the South Fork of the Dearborn River from 2000 to 2003. MDEQ sampled two reaches in 2000 and EPA sampled three reaches in 2002 and 2003. Results from individual sites are summarized in Table 3-17 and in Appendix C.

Based on an evaluation of the periphyton results, the siltation index increased slightly in a downstream direction and the South Fork of the Dearborn shows slight impairment from sediment and possibly other stressors such as nutrients.

Table 3-17. Summary of Periphyton Siltation Indexes for the South Fork Dearborn River.

Site ID	Site Name	Siltation Index			Narrative Summary
		2000	2002	2003	
SFD-1	South Fork 100 Yards upstream of First Bridge and below Blacktail	8.70			Summary findings for periphyton indicate excellent biological integrity (Bahls, 2001).
M12SFDBR01	South Fork Dearborn River upstream of Blacktail		11.09	15.25	In 2002, diatoms tolerant of organic pollution were abundant at this site (Bahls 2003b). In 2003, the periphyton community had excellent biological integrity (Bahls, 2003b).
M12SFDBR02	South Fork Dearborn River upstream of Highway 434		31.84	52.88	In 2002, the diatom metrics at this site were generally better than those at the upstream site. In 2003, periphyton results suggested slight impacts from nutrient enrichment and sediment.
SFD-4	South Fork Dearborn River Downstream of Highway 434	40.71			
M12SFDBR04	South Fork Dearborn River at Confluence			37.49	

Macroinvertebrates

Macroinvertebrate samples were collected at five sites along the South Fork of the Dearborn River from 2000 to 2003. MDEQ sampled two reaches in 2000 and EPA sampled three reaches in 2002 and 2003. Results from individual sites are summarized in Table 3-18 and in Appendix C.

In light of the macroinvertebrate results, sediment deposition does not appear to affect the aquatic life use for the South Fork of the Dearborn. The HBI and percentage of tolerant taxa both increase as reaches are assessed further downstream. The slightly depressed MFVP index scores at several sites may suggest other stressors (e.g., nutrients) and warrant further study (see Section 5.5).

Table 3-18. Summary of Macroinvertebrate Metrics for the South Fork Dearborn River.

		Targets	*Supplemental Indicators*			*Supporting Information*		
Site Description	**Year**	**# Clinger Taxa**	**% Clinger Taxa**	**MFVP IBI**	**# EPT Taxa**	**HBI**	**% Tolerant Taxa**	**Stressor Tolerance**
Threshold or Indicator Value		**>14**	**BPJ**	**>75**	**>18.5**	**<3.8**	**NA**	**NA**
SFD-1 – South Fork 100 Yards upstream of First Bridge and below Blacktail	2000	12	42	78	14	3.08	7.7	Low
M12SFDBR01 – South Fork Dearborn River upstream of Blacktail	2002	20	52.6	72	18	4.06	20.7	Moderate
	2003	23	84.5	56	21	3.55	6.8	Low
M12SFDBR02 – South Fork Dearborn River upstream of Highway 434	2002	18	21.2	67	17	6.01	14.4	Low
	2003	18	57.9	72	16	3.04	36.9	Moderate
SFD-4 – South Fork Dearborn River downstream of Highway 434	2000	13	66	50	11	3.47	59	Low
M12SFDBR04 – South Fork Dearborn River at Confluence	2003	15	82	72	16	4.44	65.1	Moderate
Average		17	58.0	67	16	3.95	30.1	Low/ Moderate

Bank Stability and Riparian Condition

There are few significant anthropogenic sources of sediment within the upstream portion of the South Fork Dearborn River watershed (Land and Water, 2003). Stream banks were rated fair to excellent during the aerial assessment (Table 3-19). Riparian vegetation is primarily open stands of deciduous cottonwood with extensive areas of herbaceous understory. A single 5,910-foot segment showed loss of riparian vegetation due to logging/riparian clearing that occurred after 1995. Less than 3 percent of the riparian areas had bare or disturbed ground.

Table 3-19. Bank Stability along the South Fork Dearborn River

Reach	Reach Length (miles)	Channel Type	Slope	Sinuosity	Channel Width (feet)	Bank Instability (% of reach)			Overall Channel Condition
						High	Mod	Low	
SF1	5.83	C4	0.012	1.22	34	8.3	50.0	41.7	Fair to Good
SF2	5.56	B4/A3	0.017	1.09	17	1.0	14.3	84.7	Good to Excellent

The aerial survey noted that the lower portion of the South Fork suffered from riparian habitat degradation for approximately 20,500 feet. These areas did show more signs of unstable banks, but the overall channel function did not appear to be impaired. No areas of mass failure were noted in the watershed and little sediment is contributed by tributaries (Land and Water, 2003).

Upland sources did not appear to contribute appreciable quantities of sediment to the South Fork Dearborn River or tributaries. Perennial and intermittent tributaries appeared stable, and rangeland did not show evidence of surface erosion or rilling, or other signs of accelerated soil loss due to anthropogenic influences. Forested headwaters were largely pristine in nature. Sediment contribution from cut/fill slopes and road sand appeared to be minimal given the long delivery distance to the channel.

Montana Adjusted NRCS Stream Habitat Surveys

Montana adjusted NRCS visual riparian assessments were completed at three sites on the South Fork Dearborn River in 2002 and 2003. The average stream reach score was 92.9 percent, well above the recommended value of 75 percent and indicative of excellent riparian condition (Table 3-20). No sites scored below the 75 recommended value.

Table 3-20. Riparian Vegetation in the South Fork Dearborn River

Sample Site Information		Stream Habitat Ratings			
Site ID	Site Name	NRCS Score (% Max)	NRCS Rating	MT Adjusted Score (% Max)	MT Adjusted Rating
M12SFDBR01	South Fork Dearborn Upstream Site above Roberts Creek	94.5	Non Impaired, Fully Supporting	97.5	Sustainable
M12SFDBR02	South Fork Dearborn above U.S Highway 434	85.0	Sustainable	84.0	Sustainable
M12SFDBR04	South Fork Dearborn at Mouth at Dearborn River	98.4	Non Impaired, Fully Supporting	97.1	Sustainable
AVERAGE FOR SOUTH FORK, DEARBORN RIVER:		92.6	Non Impaired, Fully Supporting	92.9	Sustainable

Total Suspended Solids

Very limited TSS samples are available for the South Fork, Dearborn River (Table 3-21) and all data have been collected at low to average flow conditions. All samples were below the detection limit of 10 mg/L and do not suggest a sediment impairment.

Table 3-21. South Fork of the Dearborn River Suspended Sediment Data Summary Table

Site ID	Date	Parameter	Result	Flow Condition[1]
M12SFDBR01	6/17/2003	TSS	<10	97%
M12SFDBR01	7/22/2003	TSS	<10	21%
M12SFDBR02	7/22/2003	TSS	<10	21%
M12SFDBR04	6/17/2003	TSS	<10	97%
M12SFDBR04	7/22/2003	TSS	<10	21%
SFD-1	7/16/2000	TSS	<10	11%
SFD-4	7/11/2000	TSS	<10	15%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs). In the absence of site-specific flow data, this value is meant to provide perspective on overall watershed flows during the time of the sampling.

Turbidity

Very little turbidity data exist for the South Fork Dearborn River. Turbidity samples were taken only during the TMDL sampling that was completed in July 2003 and these turbidity values are presented in Table 3-22. The observed turbidity values are well below the proposed indicator value, although flow conditions during the sampling were low.

Table 3-22. Summary of turbidity data available for the South Fork Dearborn River

Site ID	Date	Result	Flow Condition[1]
M12SFDBR01	7/22/2003	1.28	21%
M12SFDBR02	7/22/2003	0.80	21%
M12SFDBR04	7/23/2003	1.40	21%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT on the date of the sampling by the long-term average flow at Craig, MT (203 cfs).

South Fork Dearborn River – Impairment Summary

The South Fork of the Dearborn River (from its headwaters to the Dearborn River) did not appear on Monatana's 1996 303(d) list. The State's 2002 303(d) list reported that the South Fork of the Dearborn River (from its headwaters to the Dearborn River) was impaired by siltation. MDEQ's Assessment Record Sheet (Nixon, 2001) indicates that the 2002 listing was based on the results of benthic macroinvertebrate surveys, periphyton surveys, surveys of fish and game biologists, and visual observation.

A summary of the results of the updated impairment analysis is presented in Table 3-23. When averaged, the targets are all met and do not indicate water quality impairment associated with sediment. However, examination of the results from some of the individual samples suggests potential localized areas of minor sediment related impairments (e.g., elevated percent fines near Highway 434; low clinger taxa at two locations in 2000; and high periphyton siltation index values upstream of Highway 434 in 2003). Some of the supplemental indicators also suggest potential impairment, not only associated with sediment, but also potentially associated with nutrients. For example, approximately 20,593 feet of the riparian corridor was rated as "poor" due to land use conversions to cropland and pasture and approximately 5900 feet of the riparian corridor appears to have been cleared/logged.

Given that some of the targets are exceeded in some areas of the South Fork, and human-caused sources have been identified, a TMDL is proposed for sediment, in which all of the identified human-caused alterations to the riparian corridor will be addressed (see Section 5.1).

As indicated above, some of the supplemental indicators suggest a potential impairment associated with nutrients. Since this pollutant has never appeared as a cause of impairment on any of Montana's 303(d) lists, a TMDL for nutrients is not required at this time. However, additional study is proposed to develop a better understanding of this potential impairment issue (see Section 5.5).

Table 3-23. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for the South Fork Dearborn River

Sediment Target	Threshold Value	Minimum	Average	Maximum
Percent surface fines < 2mm	< 20 percent	9.0	15	25.6
Number of Clinger Taxa	> 14	12	17	23
Periphyton Siltation Index	<20.0 for mountain streams <50.0 for plains streams	8.7	30.7	53.0
Sediment – Supplemental Indicators	**Recommended Value**	**Minimum**	**Average**	**Maximum**
Riparian Condition	No significant disturbances	20,593 rated "poor"		
MFVP Macroinvertebrate Multimetric Index	> 75 percent	50	67	78
EPT Richness	> 18.5	11	16	21
Percentage of Clinger Taxa	BPJ	21	58	85
Montana Adjusted NRCS Stream Habitat Surveys	> 75 percent	84.0	92.9	97.5
TSS (Mean) [1]	< 10 mg/L	5	5	5
Turbidity	High Flow – 50-NTU instantaneous maximum Summer base flow – 10 NTUs	0.80	1.16	1.28

[1]All suspended sediment samples were below the detection limit.

3.8.3 The Middle Fork of the Dearborn River

The Middle Fork of the Dearborn River has characteristics similar to those of the South Fork, and much of the headwater zone is relatively undisturbed, steep, forested terrain. Land use impacts are apparent in the central and lower reaches. Typical views are shown in Figure 3-16 and Figure 3-17. The locations of all of the mainstem sampling sites are shown in Figure 3-18 and field sheets and photos from the 2003 sampling are included in Appendix B.

Montana's 1996 303(d) list reported that aquatic life uses in the Middle Fork Dearborn River were impaired because of siltation. The basis for the 1996 listing is unknown. Beneficial uses were not evaluated in 2002 because of a lack of sufficient credible data.

A review of the available data, some of which was not previously considered by MDEQ, is provided below. Available data include Wolman pebble counts, information on macroinvertebrate and periphyton populations, the results of a channel and riparian aerial assessment, stream habitat surveys, total suspended solids, turbidity, and temperature data and modeling.

Figure 3-16. Middle Fork Dearborn River near Rogers Pass.

Figure 3-17. Middle Fork Dearborn River downstream of Highway 434.

Figure 3-18. Sampling locations in the Middle Fork Dearborn River watershed.

Surface Fines

Pebble count data were collected and analyzed for the Middle Fork of the Dearborn River at three sites. Data were collected at two of the sites in 2002 and all three sites in June 2003. The data are summarized in Table 3-24. These data were used to create the particle distribution curves shown in Figure 3-19. Four of the five data points show that the percent surface fines in the Middle Fork Dearborn River is less than the 20 percent target. The only site with more than 20 percent surface fines was the site near Rogers Pass in 2002. The 2003 sampling at this site indicates a percent surface fines score of 15.2 percent. This site is the uppermost sampling site, and it is a smaller, steeper gradient and highly vegetated section of stream. There are no major observed impacts in the area, and the 2002 data do not seem to correspond with what is observed in the area.

Table 3-24. Middle Fork of the Dearborn River Stream Bottom Deposits Data Summary Table

Site ID	Site Name	Percentage < 2mm		
		8/28/02	8/29/02	6/19/03
M12MFDBR01	Middle Fork Dearborn near Rogers Pass	22.55	—	15.24
M12MFDBR04	Middle Fork Dearborn below Ingersoll's Road	—	—	17.59
M12MFDBR02	Middle Fork Dearborn downstream of Highway 434	—	10.53	17.36

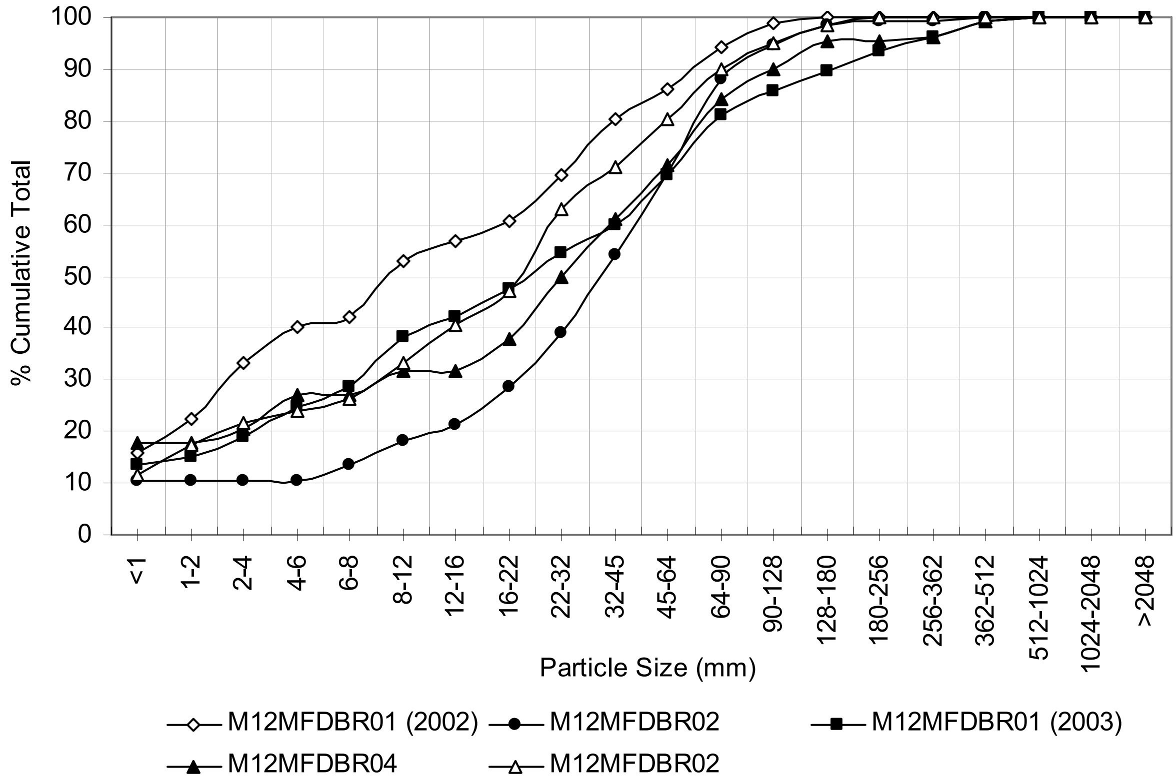

Figure 3-19. Cumulative stream bottom particle distribution for the Middle Fork of the Dearborn River.

Periphyton Siltation Index

Periphyton samples were collected at four sites along the Middle Fork of the Dearborn River from 2000 through 2003. MDEQ sampled two reaches in 2000 and EPA sampled two reaches in 2002 and 2003. Results from individual sites are summarized in Table 3-25 and in Appendix C.

Table 3-25. Summary of Periphyton Siltation Indexes for the Middle Fork Dearborn River.

Site ID	Site Name	Siltation Index			Narrative Summary
		2000	2002	2003	
M12MFDBR01	Middle Fork Dearborn River at Rogers Pass		1.68	4.43	In both years, the diatom community was dominated by organisms found in streams with cold water temperatures and low nutrient concentrations (Bahls, 2003a).
MFD-2	Middle Fork Dearborn River upstream of Highway 200	16.37			Community composition indicated excellent biological integrity (Bahls, 2001).
M12MFDBR04	Middle Fork Dearborn River at Ingersoll	11.89		27.12	In both years, this site seemed to demonstrate a slight increase in organic loading and sediment.
M12MFDBR02	Middle Fork Dearborn River downstream of Highway 434		11.38	36.62	The 2002 results indicate possible impacts from organic loading, but the 2003 results suggest impacts from inorganic nutrients. Periphyton results suggest slight impacts at this site and the presence of other stressors (e.g., nutrients).

Macroinvertebrates

Macroinvertebrate samples were collected at four sites along the Middle Fork of the Dearborn River from 2000 through 2003. MDEQ sampled two reaches in 2000 and EPA sampled two reaches in 2002. In 2003, these sites were resampled and an additional site was added. Results from individual sites are discussed in more detail in Table 3-26 and in Appendix C.

In general, clingers are well represented in all reaches of the Middle Fork Dearborn River (both percent and number of taxa), suggesting that aquatic life is not impacted by sedimentation. In the lower part of the Middle Fork of the Dearborn, the percentage of tolerant taxa metric and the HBI are high and the MFVP index scores are low. These results may reflect localized sources of stressors or nutrient enrichment. The 2002 macroinvertebrate data (e.g. clinger taxa richness, percent clingers) indicates slight impacts to aquatic life from sedimentation compared to the 2003 data which suggests that aquatic life is not affected by sediment. Additional monitoring would help determine whether the difference in the biological community between 2002 and 2003 is a trend, anomaly, or natural variability. In the lower part of the Middle Fork of the Dearborn, the percentage of tolerant taxa and the HBI are high and the MFVP index scores are low. These results may reflect localized sources of stress, habitat alteration, or nutrient enrichment.

Table 3-26. Summary of Macroinvertebrate Metrics for the Middle Fork Dearborn River.

Site Description	Year	*Targets*	*Supplemental Indicators*			*Supporting Information*		
		# Clinger Taxa	% Clinger Taxa	MFVP IBI	# EPT Taxa	HBI	% Tolerant Taxa	Stressor Tolerance
Threshold or Indicator Value		**>14**	**BPJ**	**>75**	**>18.5**	**<3.8**	**NA**	**NA**
M12MFDBR01 - Middle Fork Dearborn River at Rogers Pass	2002	16	37.5	78	18	3.58	36.1	High
	2003	14	85.6	89	15	0.77	0.3	Low
MFD-2 - Middle Fork Dearborn River upstream of Highway 200	2000	19	62.2	56	17	3.60	22.1	High
M12MFDBR04 - Middle Fork Dearborn River at Ingersoll	2000	12	52.9	56	11	4.6	29.6	High
	2003	19	70.3	61	17	3.8	36.7	Moderate
M12MFDBR02 - Middle Fork Dearborn River downstream of Highway 434	2002	11	57.7	44	11	5.34	34.6	High
	2003	18	77.4	61	18	4.08	46.1	High
Average		16	63.4	64	15	3.7	29.4	

Bank Stability and Riparian Conditions

The Middle Fork of the Dearborn showed little influence of anthropogenic, in-channel sediment sources in the headwaters during the aerial assessment. This section of the channel is situated in deeply dissected, forested terrain and no significant channel or riparian modifications were present. Highway 200 has the potential to deliver sediment from cut/fill slopes and applied road sand. However, the aerial assessment did not show any apparent delivery of sediment from the road to the Middle Fork. This is likely due to the long delivery distance from the road to the channel. A possible pathway for road runoff was investigated on the ground, but did not appear to be a probable source for significant sediment delivery to the channel.

The lower reach of the Middle Fork showed evidence of some channel instability related to land use/riparian modification for agriculture. Localized bank instability attributable to anthropogenic sources was present in approximately 6,200 feet (20 percent) of the channel (Land and Water, 2003). However, no significant areas of mass slope failure were noted in the Middle Fork Dearborn River watershed (Table 3-27).

The low-level aerial survey found that riparian vegetation in the upper portion of the watershed was excellent; however, in the lower portion of the watershed, 65 percent of the stream was ranked as having “poor” riparian vegetation. The major influence on this loss in riparian habitat health appeared to be anthropogenic in nature, and linked to agricultural activities. This degradation of riparian habitat was also observed to be causing more bank instabilities and poor stream channel conditions.

Table 3-27. Bank Stability in the Middle Fork Dearborn River

Reach	Reach Length (miles)	Channel Type	Slope	Sinuosity	Channel Width (feet)	Bank Instability (% of reach)			Overall Channel Condition
						High	Mod	Low	
MF1	6.17	C4	0.015	1.25	39	16.7	42.1	41.2	Fair to Good
MF2	1.32	B4/A3	0.025	1.09	30	0.0	48.1	51.9	Good

Montana Adjusted NRCS Riparian Assessment

The Montana adjusted NRCS visual riparian assessments were completed in 2002 and 2003. The average stream reach score was 85.1 percent, which is above the recommended value of 75 percent and is indicative of excellent riparian condition (Table 3-28). However one site in the lower portion of the watershed, M12MFDBR02, showed a habitat score of 66.6 percent, or "at risk." The upper sites showed excellent riparian habitat conditions during the NRCS surveys.

Table 3-28. Middle Fork of the Dearborn River Riparian Habitat Data Summary Table

Sample Site Information		Stream Habitat Ratings			
Site ID	Site Name	NRCS Score (% Max)	NRCS Rating	MT Adjusted Score (% Max)	MT Adjusted Rating
M12MFDBR04	Middle Fork Dearborn below Ingersoll's Road	100.0	Non Impaired, Fully Supporting	99.3	Sustainable
M12MFDBR02	Middle Fork Dearborn downstream of Highway 434 (2002)	74.0	At Risk	66.6	At Risk
M12MFDBR02	Middle Fork Dearborn downstream of Highway 434 (2003)	85.0	Non Impaired, Fully Supporting	86.8	Sustainable
M12MFDBR01	Middle Fork Dearborn near Rogers Pass	93.0	Sustainable	87.5	Sustainable
AVERAGE FOR MIDDLE FORK, DEARBORN RIVER:		88.0	Non Impaired, Fully Supporting	85.1	Sustainable

Total Suspended Solids

Very limited TSS samples are available for the Middle Fork Dearborn River (Table 3-29). All data have been collected at low to average flow conditions and all samples were below the detection limit of 10 mg/L.

Table 3-29. Middle Fork of the Dearborn River Suspended Sediment Data Summary Table

Site ID	Date	Parameter	Result	Flow Condition[1]
MFD-5	7/11/2000	TSS	< 10	15%
MFD-3	7/11/2000	TSS	< 10	15%
MFD-1	7/11/2000	TSS	< 10	15%
M12MFDBR02	6/19/2003	TSS	< 10	93%
M12MFDBR04	6/19/2003	TSS	< 10	93%
M12MFDBR01	6/19/2003	TSS	< 10	93%
M12MFDBR02	7/23/2003	TSS	< 10	21%
M12MFDBR04	7/23/2003	TSS	< 10	21%
M12MFDBR01	7/23/2003	TSS	< 10	21%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs). In the absence of site-specific flow data, this value is meant to provide perspective on overall watershed flows during the time of the sampling.

Turbidity

Very few turbidity data exist on the Middle Fork Dearborn River. Turbidity samples were taken only during the TMDL sampling that was completed in June and July 2003, and these turbidity values are presented in Table 3-30. The observed turbidity values are well below the proposed indicator value, although flow conditions during the sampling were below average.

Table 3-30. Summary of Turbidity Data Available for the Middle Fork Dearborn River

Site ID	Date	Result	Flow Condition[1]
M12MFDBR04	6/19/2003	2.9	93%
M12MFDBR02	6/19/2003	2.8	93%
M12MFDBR01	6/19/2003	1.9	93%
M12MFDBR02	7/23/2003	1.2	21%
M12MFDBR04	7/23/2003	1.0	21%
M12MFDBR01	7/23/2003	0.5	21%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs).

Middle Fork Dearborn River – Impairment Summary

Montana's 1996 303(d) list reported that aquatic life uses in the Middle Fork Dearborn River were impaired due to siltation. The basis for the1996 listing is unknown. Beneficial uses were not evaluated in 2002 because of a lack of sufficient credible data.

Evaluation of the targets and supplemental indicators for the Middle Fork Dearborn River do not provide a "black and white" answer to the question: *Are aquatic life and fisheries beneficial uses impaired due to excessive sediment loading from human-caused sources*? When averaged, the targets are all met and do not indicate water quality impairment associated with sediment. However, examination of the results from some of the individual samples suggests potential localized areas of minor sediment related impairments. Some of the supplemental indicators also suggest potential impairment, although not necessarily associated with sediment. Consideration of the available chemical, physical, and biological data in combination with the identified human-caused sources of impairment suggest that the fish and aquatic life beneficial uses may be slightly below their potential in the lower reaches of the Middle Fork Dearborn River (i.e., several macroinvertebrate indices below recommended values). It is not clear if this is directly attributable to the 303(d) listed cause of impairment (i.e., sediment), degraded habitat, or other factors. To be conservative, a TMDL is proposed for sediment, in which all of the identified human-caused alterations to the stream banks/channel and riparian corridor will be addressed. Additional post-TMDL implementation monitoring is then proposed to determine if the fish and aquatic life communities have improved (see Section 5.5).

Table 3-31. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for the Middle Fork Dearborn River

Sediment Target	Threshold Value	Minimum	Average	Maximum
Percent surface fines < 2mm	< 20 percent	10.5	16.7	22.6
Number of Clinger Taxa	> 14	11	16	19
Periphyton Siltation Index	< 20.0 for mountain streams < 50.0 for plains streams	1.7	15.6	36.6
Sediment – Supplemental Indicators	**Recommended Value**	**Minimum**	**Average**	**Maximum**
Riparian Condition	No significant disturbances	Localized bank instability attributable to anthropogenic sources was present in approximately 6,200 feet of lower reach; 65 percent of the lower reach was also ranked as having “poor” riparian vegetation		
MFVP Macroinvertebrate Multimetric Index	> 75 percent	44	64	89
EPT Richness	> 18.5	11	15	18
Percentage of Clinger Taxa	BPJ	38	63	86
Montana Adjusted NRCS Stream Habitat Surveys	> 75 percent	67	85	99
TSS (Mean) [1]	< 10 mg/L	5	5	5
Turbidity	High Flow – 50-NTU instantaneous maximum Summer base flow – 10 NTUs	0.5	1.7	2.9

[1]All TSS data were below the detection limit of 10 mg/L. One-half the detection limit was used for statistical purposes.

3.8.4 Flat Creek

Flat Creek is a low gradient, meandering channel with fine to very fine gravel bed materials. Flat Creek serves as a conveyance for irrigation water diverted from the main stem of the Dearborn River and channel morphology reflects this altered flow regime. The channel cross section is enlarged because of diverted irrigation flows and some channel erosion/instability in localized areas. Grazing and agricultural uses (pasture and cropland) are widespread along Flat Creek. Typical views are shown in Figure 3-20 and Figure 3-21. Figure 3-22 shows a map of the watershed along with the sampling sites and river segments used in the aerial assessment.

Montana's 1996 and 2002 303(d) lists reported that Flat Creek was impaired by siltation, flow alterations, and habitat alterations. The basis of the 1996 listings is unknown. MDEQ's Assessment Record Sheet indicates that the 2002 listing was based on physical/chemical sampling, benthic macroinvertebrate surveys, habitat surveys, information from local residents, land use information, surveys of fish and game biologists, and visual observation.

A review of the available data, some of which were not previously considered by MDEQ, is provided below. Available data include Wolman pebble counts, information on macroinvertebrate and periphyton populations, the results of a channel and riparian aerial assessment, stream habitat surveys, total suspended solids, turbidity, and temperature data and modeling.

Figure 3-20. Flat Creek at Milford.

Figure 3-21. Flat Creek near Birdtail Road.

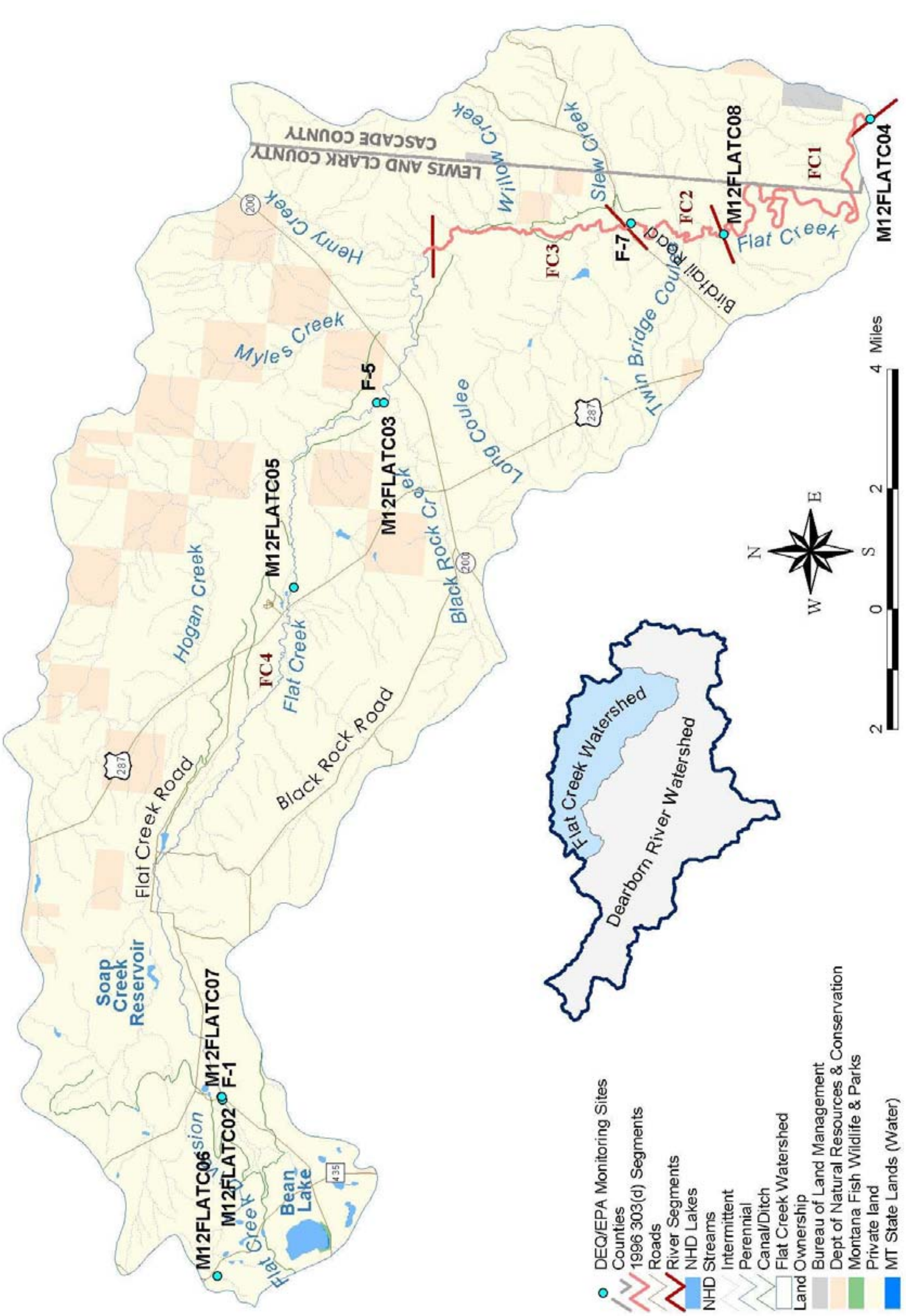

Figure 3-22. Sampling locations in the Flat Creek watershed.

Surface Fines

Pebble count data were collected and analyzed for Flat Creek at four sites in June and July 2003 (Table 3-32). These data were used to create the particle distribution curves shown in Figure 3-23. The data show that the average percent surface fines at three of the sites is below the threshold value of the target. However, the site upstream of Highway 200 was well above the threshold value. It should be noted that the lowermost site at the mouth of Flat Creek is dissimilar to the rest of Flat Creek because it is primarily made up of a bedrock-dominated stream bottom. The percent surface fines in a bedrock-dominated channel would be expected to be low.

Table 3-32. Flat Creek Surface Fines Summary

Site ID	Site Name	Percentage < 2mm	
		6/18/03	7/22/03
M12FLATC05	Flat Creek downstream of Milford Colony	13.2	—
M12FLATC03	Flat Creek upstream of Highway 200	—	32.0
M12FLATC08	Flat Creek below Birdtail Road	15.8	—
M12FLATC04	Flat Creek at Mouth	2.8	—

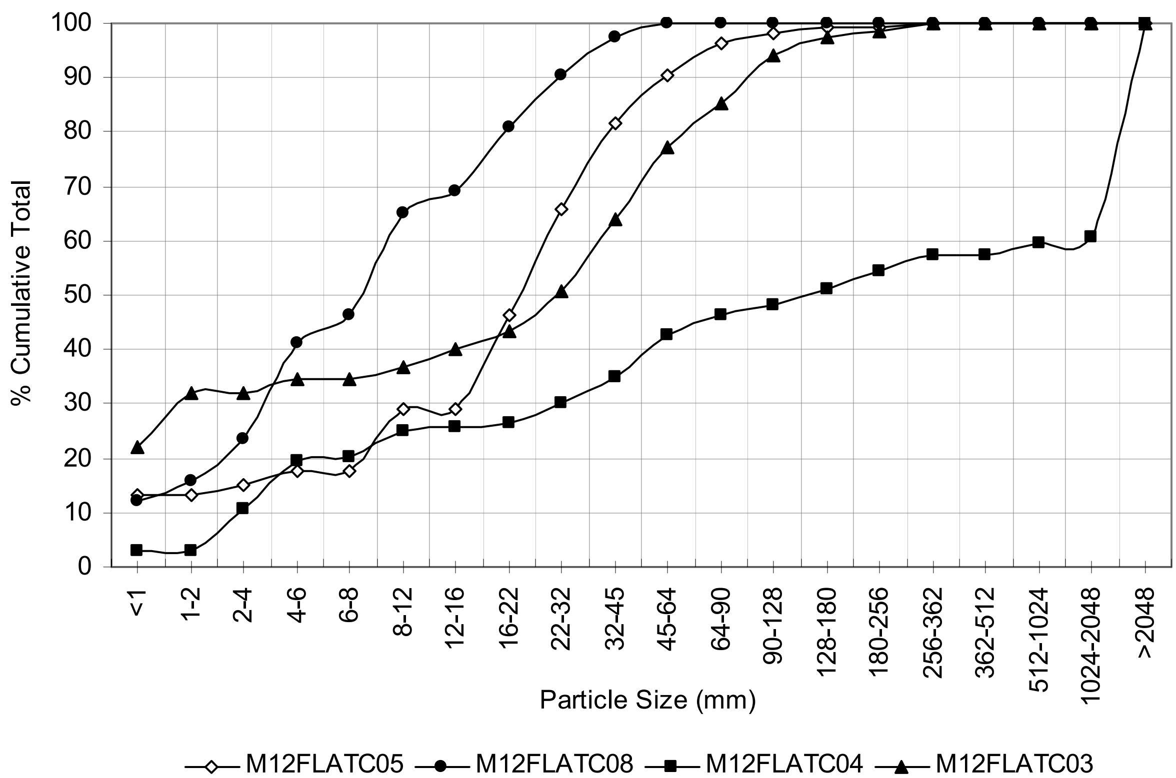

Figure 3-23. Cumulative stream bottom particle distribution for Flat Creek.

Periphyton Siltation Index

Periphyton samples were collected at six sites along Flat Creek. Results from individual sites are discussed in more detail in Table 3-33 and in Appendix C.

The siltation index values for Flat Creek fell within the range considered acceptable for transitional streams (between mountain and plains) and did not suggest sediment impacts. Other stressors such as nutrients appeared to be present at a few sites but do not seem to significantly affect aquatic life use.

Table 3-33. Summary of Periphyton Siltation Indexes for Flat Creek.

Site ID	Site Name	Siltation Index		Narrative Summary
		2000	2003	
M12FLATC02	Flat Creek at Flat Creek Road	24.01		Other periphyton metrics indicated full support of aquatic life (Bahls, 2001).
M12FLATC05	Flat Creek at Milford		25.96	Other periphyton metrics indicated full support of aquatic life.
M12FLATC03	Flat Creek upstream of Highway 200	13.36	23.79	In 2000, this site was dominated by Cladophora, indicating slight impairment of aquatic life (Bahls, 2001).
F-7	Flat Creek upstream of Birdtail Road	26.20		Other periphyton metrics indicated full support of aquatic life.
M12FLATC08	Flat Creek below Birdtail		24.53	The periphyton results do indicate possible impacts from other stressors such as nutrients (Bahls 2003b).
M12FLATC04	Flat Creek at mouth		14.29	The periphyton results do indicate possible impacts from other stressors such as nutrients (Bahls 2003b).

Macroinvertebrates

Macroinvertebrate samples were collected at six sites along Flat Creek in 2000 and 2003. MDEQ sampled three reaches in 2000 and EPA sampled four reaches in 2003. Results from individual sites are summarized in Table 3-34 and in Appendix C.

Of all areas sampled in the Dearborn River drainage, Flat Creek exhibited the poorest macroinvertebrate health. Metrics from the six locations tend toward the extremes of observed values, particularly obvious for number of EPT taxa (low) and the HBI (high). Half of the reaches had clinger values (percentage and number of taxa) indicative of possible sediment impacts. Other sites had clinger values representative of relatively good conditions; however, HBI values at these sites were high and the samples were dominated by taxa that are moderately tolerant of stress.

Table 3-34. Summary of Macroinvertebrate Metrics for Flat Creek.

Site Description	Year	*Targets*	*Supplemental Indicators*			*Supporting Information*		
		# Clinger Taxa	% Clinger Taxa	MFVP IBI	# EPT Taxa	HBI	% Tolerant Taxa	Stressor Tolerance
Threshold or Indicator Value		**>14**	**BPJ**	**>75**	**>18.5**	**<3.8**	**NA**	**NA**
M12FLATC02 - Flat Creek at Flat Creek Road	2000	13	25.7	50	8	5.11	14.1	High
M12FLATC05 - Flat Creek at Milford	2003	15	70.3	44	12	3.94	27.7	Low
M12FLATC03 - Flat Creek upstream of Highway 200	2000	10	59.0	39	10	4.6	41.0	High
	2003	15	70.1	28	10	4.9	38.8	Moderate
F-7- Flat Creek upstream of Birdtail Road	2000	9	43.0	22	7	5.85	58.7	High
M12FLATC08 - Flat Creek below Birdtail	2003	15	52.7	33	9	5.45	34.6	High
M12FLATC04 - Flat Creek at Mouth	2003	13	78.3	28	7	4.65	18.7	Moderate
Average		13	57.0	35	9	4.9	33.4	High

Bank Stability and Riparian Conditions

Flat Creek is a low gradient, meandering channel with fine to very fine gravel bed materials. Flat Creek serves as a conveyance for irrigation water diverted from the main stem of the Dearborn and channel morphology reflects this altered flow regime. The channel cross section is enlarged because of diverted irrigation flows and some channel erosion/instability is present in localized areas. Observed channel instability is likely the result of increased flows due to irrigation diversion and conversion of riparian vegetation to agricultural uses. Grazing and agricultural uses (pasture and cropland) were widespread in Flat Creek and grazing appeared to be of higher density in the lower reaches (Land and Water Consulting, 2003). Channel conditions were rated as poor to fair during the aerial assessment (Table 3-35).

Hogan Creek, a tributary to Flat Creek, showed pronounced turbidity during the 2003 aerial survey (Land and Water, 2003). Sediment sources appeared to originate from channel incisement, exposed soils, and relatively poor vegetation coverage. However, no obvious anthropogenic sources were noted in the watershed. The aerial survey also identified several incised channels in portions of Flat Creek. These were attributed to the increased flows.

Table 3-35. Bank stability in Flat Creek.

Reach	Reach Length (miles)	Channel Type	Slope	Sinuosity	Channel Width (feet)	Bank Instability (% of reach)			Overall Channel Condition
						High	Mod	Low	
FC1	7.49	C4	0.007	1.6	49	11.2	17.7	71.1	Fair
FC2	4.43	C5/E5	0.006	1.55	36	13.1	36.9	50.0	Poor-Fair
FC3	4.35	C5/E5	0.006	1.28	38	14.0	30.8	55.2	Fair
FC4	11.64	C5/E5	0.006	1.3	19	8.4	33.3	58.3	Fair

Montana Adjusted NRCS Riparian Assessment

The Montana adjusted NRCS visual riparian assessments were conducted at three sites along Flat Creek (Table 3-36). The most downstream site was rated “sustainable” but the two upstream sites were rated as being “at risk”.

Table 3-36. Flat Creek Riparian Habitat Data Summary Table

Sample Site Information		Stream Habitat Ratings			
Site ID	Site Name	NRCS Score (% Max)	NRCS Rating	MT Adjusted Score (% Max)	MT Adjusted Rating
M12FLATC08	Flat Creek Below Birdtail Road	51.1	At Risk	61.6	At Risk
M12FLATC04	Flat Creek at Mouth	94.8	Sustainable	94.1	Sustainable
M12FLATC05	Flat Creek at Milford	59.6	At Risk	65.6	At Risk

Total Suspended Solids

The suspended sediment data for Flat Creek are presented in Table 3-37. Similar to other streams in the Dearborn TPA, many values are below the detection limit. However, several samples at various locations along Flat Creek had concentrations between 10 and 14 mg/L, even during low flow conditions.

Table 3-37. Flat Creek Suspended Sediment Data Summary Table

Site ID	Date	Parameter	Result (mg/L)	Flow Condition[1]
F-5	7/12/2000	TSS	13	14%
F-1	7/13/2000	TSS	10	14%
F-7	7/13/2000	TSS	12	14%
M12FLATC02	6/18/2003	TSS	<10	93%
M12FLATC05	6/18/2003	TSS	<10	93%
M12FLATC08	6/18/2003	TSS	<10	93%
M12FLATC04	6/18/2003	TSS	<10	93%
M12FLATC06	6/18/2003	TSS	<10	93%
M12FLATC03	7/24/2003	TSS	<10	19%
M12FLATC06	7/24/2003	TSS	<10	19%
M12FLATC02	7/24/2003	TSS	<10	19%
M12FLATC05	7/24/2003	TSS	14	19%
M12FLATC08	7/24/2003	TSS	<10	19%
M12FLATC04	7/24/2003	TSS	<10	19%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs). In the absence of site-specific flow data, this value is meant to provide perspective on overall watershed flows during the time of the sampling.

Turbidity

Very few turbidity data exist for Flat Creek—only the samples taken during TMDL field sampling in June and July 2003. The turbidity values are presented in Table 3-38. The average value observed in the field during these visits was 6.1 NTUs, which is below the 10-NTU recommended level but higher than values observed at other sites within the Dearborn TPA.

Table 3-38. Flat Creek Turbidity Data Summary Table

Site ID	Date	Result	Flow Condition[1]
M12FLATC05	6/18/2003	10.8	93%
M12FLATC08	6/18/2003	7.4	93%
M12FLATC07	6/18/2003	7.3	93%
M12FLATC06	6/18/2003	1.0	93%
M12FLATC03	7/22/2003	10.1	21%
M12FLATC08	7/23/2003	5.7	21%
M12FLATC05	7/24/2003	10.5	19%
M12FLATC07	7/24/2003	3.5	19%
M12FLATC04	7/24/2003	3.3	19%
M12FLATC06	7/24/2003	0.5	19%

[1]Flow condition is calculated by dividing the recorded flow at Craig, MT, on the date of the sampling by the long-term average flow at Craig, MT (203 cfs). In the absence of site-specific flow data, this value is meant to provide perspective on overall watershed flows during the time of the sampling.

Flat Creek – Impairment Summary

Montana's 1996 and 2002 303(d) lists reported that Flat Creek was impaired by siltation, flow alterations, and habitat alterations. The basis of the 1996 listings is unknown. MDEQ's Assessment Record Sheet (Wilson, 2002) indicates that the 2002 listing was based on physical/chemical sampling, benthic macroinvertibrate surveys, habitat surveys, information from local residents, land use information, surveys of fish and game biologists, and visual observation.

A summary of the results of the updated impairment analysis is presented in Table 3-39. The most significant influences on water quality in Flat Creek appear to be associated with the diversion of a significant portion of the Dearborn River's flow into Flat Creek Flat Creek serves as a conveyance for irrigation water and it's channel morphology reflects this altered flow regime. It is likely that Flat Creek is still in a process of reaching "equilibrium" with this altered flow regime.

As with the Middle Fork and South Fork of the Dearborn River, the Flat Creek target values are not exceeded when averaged across all sample stations and sample dates. However, examination of the results from some of the individual samples suggests potential localized areas of minor sediment related impairments (e.g., high percentage of surface fines near Highway 200, low number of clinger taxa). Some of the supplemental indicators also suggest potential impairment, not only associated with sediment, but also potentially associated with nutrients. For example, significant human caused riparian corridor disturbances were observed associated with grazing and agricultural encroachment, and the macroinvertebrate results generally suggest impairment.

Given that some of the targets are exceeded in some areas of Flat Creek, and human-caused sources have been identified, a TMDL is proposed for sediment (See Section 5.3). As indicated above, some of the supplemental indicators suggest a potential impairment associated with nutrients. Since this pollutant has never appeared as a cause of impairment on any of Montana's 303(d) lists, a TMDL for nutrients is not required at this time. However, additional study is proposed to develop a better understanding of this potential impairment issue (see Section 5.5).

Table 3-39. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Flat Creek

Sediment Target	Threshold Value	Minimum	Average	Maximum
Percent Surface Fines < 2mm	< 20 percent	2.8	16.0	32.0
Number of Clinger Taxa	> 14	9	13	15
Periphyton Siltation Index	<20.0 for mountain streams <50.0 for plains streams	13.4	21.7	26.2
Sediment – Supplemental Indicators	**Recommended Value**	**Minimum**	**Average**	**Maximum**
Riparian Condition	No significant disturbances	Significant disturbances		
MFVP Macroinvertebrate Multimetric Index	> 75 percent	22	35	50
EPT Richness	> 18.5	7	9	12
Percentage of Clinger Taxa	BPJ	26	57	78
Montana Adjusted NRCS Stream Habitat Surveys[1]	> 75 percent	94	94	94
TSS (Mean)	< 10 mg/L	5	8	14
Turbidity	High Flow – 50-NTU instantaneous maximum Summer base flow – 10 NTUs	0.5	6.0	10.8

[1]The stream habitat survey was conducted at only one site along Flat Creek.

3.9 Water Quality Impairment Status Summary

The focus of this analysis was on potential water quality impairments reported in the 1996 and 2002 303(d) lists in the Dearborn, South Fork Dearborn, and Middle Fork Dearborn Rivers and Flat Creek. Each of these waters was listed for sediment related impairments. The Dearborn River was also listed for water quality issues associated with thermal modification. This evaluation considered:

- available data and reports compiled from a variety of sources including MTDEQ, MTFWP, NRCS, USGS and USFS
- chemical, physical, and biological monitoring data collected during a 2003 field survey conducted by EPA
- the results of an aerial survey focusing on riparian and geomorphic integrity and the identification of anthropogenic sources of water quality impairment
- visual observations during numerous site reconnaissance visits in 2003 and 2004 by EPA personnel.

The weight-of-evidence approach described in Section 3.3 was applied to each of these waters to determine whether or not they are currently meeting water quality standards. The results and a summary of the proposed actions are presented in Table 3-40. In no case did comparison of the available data with the target and supplemental indictor values provide for "black and white" conclusions regarding current water quality impairment status. To be conservative, TMDLs are proposed for siltation in the Middle Fork and South Fork Dearborn Rivers and Flat Creek (See Sections 5.1 to 5.3). Although it appears that Montana's temperature standards may be exceeded in the Dearborn River, the predicted magnitude of the exceedance is minor, uncertainty in the prediction is high, and the cost of implementation of the solution (i.e., elimination of the diversion of irrigation water into Flat Creek) that would likely be proposed in a TMDL is very high. As a result, further study is proposed to develop a better understanding of the potential temperature impairment in the Dearborn River before proceeding with a TMDL (Section 1.0). Finally, the results of the evaluations summarized herein suggest potential nutrient impairments in the Middle and South Forks of the Dearborn River and Flat Creek. Further study is proposed to develop a better understanding of these potential nutrient related impairments (Section 5.5).

Table 3-40. Current Water Quality Impairment Status of Waters in the Dearborn TPA.

Water body Name and Number	Listed Probable Causes	303(d) List Status		Current Status	Proposed Action
		1996	2002		
Dearborn River	Siltation	Impaired	Impaired	Not Impaired	To be indirectly considered in further study as proposed in Section 6.
	Thermal Modification	Impaired	Impaired	Unknown	Further study as proposed in Section 6.
Middle Fork Dearborn River	Siltation	Impaired	Not Listed	Impaired	Address through preparation of a TMDL (Section 5.2).
	Nutrients	Not Listed	Not Listed	Potentially Impaired	Further study as proposed in Section 5.5.
South Fork Dearborn River	Siltation	Not Listed	Impaired	Impaired	Address through preparation of a TMDL (Section 5.1).
	Nutrients	Not Listed	Not Listed	Potential Impaired	Further study as proposed in Section 5.5.
Flat Creek	Siltation	Impaired	Impaired	Impaired	Address through preparation of a TMDL (Section 5.3)
	Nutrients	Not Listed	Not Listed	Potentially Impaired	Further study as proposed in Section 5.5.

4.0 SOURCE IDENTIFICATION

As discussed in Section 3, TMDLs are proposed for sediment/siltation in the Middle Fork and South Fork Dearborn Rivers and Flat Creek. This section of the report presents the results of an analysis to estimate sediment loading throughout the watershed to support TMDL development. TMDLs and load allocations are presented in Section 5.0.

4.1 Point Sources

There are no point sources of sediment in the Dearborn River TPA.

4.2 Nonpoint Sources

Nonpoint sources of sediment in the Dearborn River TPA were estimated using a screening level approach solely to gain an understanding of the relative magnitude of the various sources. The primary potential sediment sources identified and considered herein include landscape scale erosion associated with overland flow, sheet/rill erosion, and stream bank erosion. The results of this analysis are summarized below.

Land Soil Erosion

Land soil erosion in the Dearborn River watershed was estimated using the Universal Soil Loss Equation (USLE). The USLE (Wischmeier and Smith, 1978) is the most common and best-known method for estimating gross annual soil loss from upland erosion. The USLE is an index method involving factors that represent how climate, soil, topography, and land use affect soil erosion caused by raindrop impact and surface runoff. Rather than explicitly representing the fundamental processes of detachment, deposition, and transport by rainfall and runoff, the USLE represents the effects of these processes on soil loss. These influences are described by the USLE as follows:

$$A = (R)\,(K)\,(LS)\,(C)\,(P)$$

> Where A is estimated soil loss in tons/acre for a given storm or period; R is a rainfall energy factor; K is a soil erodibility factor; LS is a slope-length, slope steepness factor; C is a vegetative cover factor; and P is a conservation practice factor.

The individual USLE factors for the Dearborn River watershed were estimated based on available GIS data and values in the scientific literature. GIS data layers for elevation, soils, and land cover helped to facilitate the USLE analysis for a large, watershed-scale area such as the entire Dearborn River watershed. Data available for such an analysis included the State Soil Geographic Database and GIS coverage for Montana (STATSGO), the GAP Analysis Program's land cover data for Montana, and the USGS's 30-meter Digital Elevation Models (DEMs) for the topography of the Dearborn River watershed (see Section 2 for maps of these data). The soils and land cover GIS coverages were merged to create a new polygon coverage, where each polygon had a unique combination of land cover and soils information. The polygon data were then entered into a database to calculate a sediment load per polygon. Average slopes were calculated from the DEM data for each unique polygon, and were also entered into the database. Slope lengths were estimated from the DEM data. Each of the USLE parameters and the origin of the data are described below.

- Rainfall and Runoff (*R*) – Estimated for the entire region based on literature values (Haan et al., 1994)
- Soil Erodibility (*K*) – Calculated from the STATSGO data. Average weighted K-factors were calculated using the K-factor for the surface layer of each soil, and the soil's percent composition in the larger map unit.
- Slope and Slope Length (*S*)(*L*) – Average slopes and slope lengths were calculated for each land use using the 30-meter DEM data. Slope and slope lengths were input into defined formulas to calculate a slope factor (*S*) and slope length factor (*L*).

Equation	Conditions
$S = 10.8\sin\theta + 0.03$	$\sin\theta < 0.09$
$S = 16.8\sin\theta - 0.50$	$\sin\theta \geq 0.09$

Note: θ is the slope angle

$$L = \left[\frac{\lambda}{72.6}\right]^m$$

Where λ = slope length, and *m* = the slope length exponent derived from literature values and based on the percent slope and the estimated rill to interrill erosion.

- Cover and Management (*C*) – Literature values based on the GAP land cover classes (Haan, Barfield, and Hayes, 1994)
- Erosion Control Practice (*P*) – Estimated from literature values (Brady, 1990; Haan, Barfield, and Hayes, 1994)

The six USLE soil factors were multiplied together for each unique polygon in the Dearborn River watershed. Annual loads and annual loads per acre were then calculated for each polygon. The results of the USLE analyses for the entire watershed are shown in Figure 4-1 and Table 4-1. The areas with the highest surface erosion were in the middle sections of the Dearborn River watershed near the Dearborn River, Auchard Creek, and Big Skunk Creek. The least amount of surface erosion was estimated to occur in the headwaters region and near the mouth of the Dearborn River near Sullivan Creek.

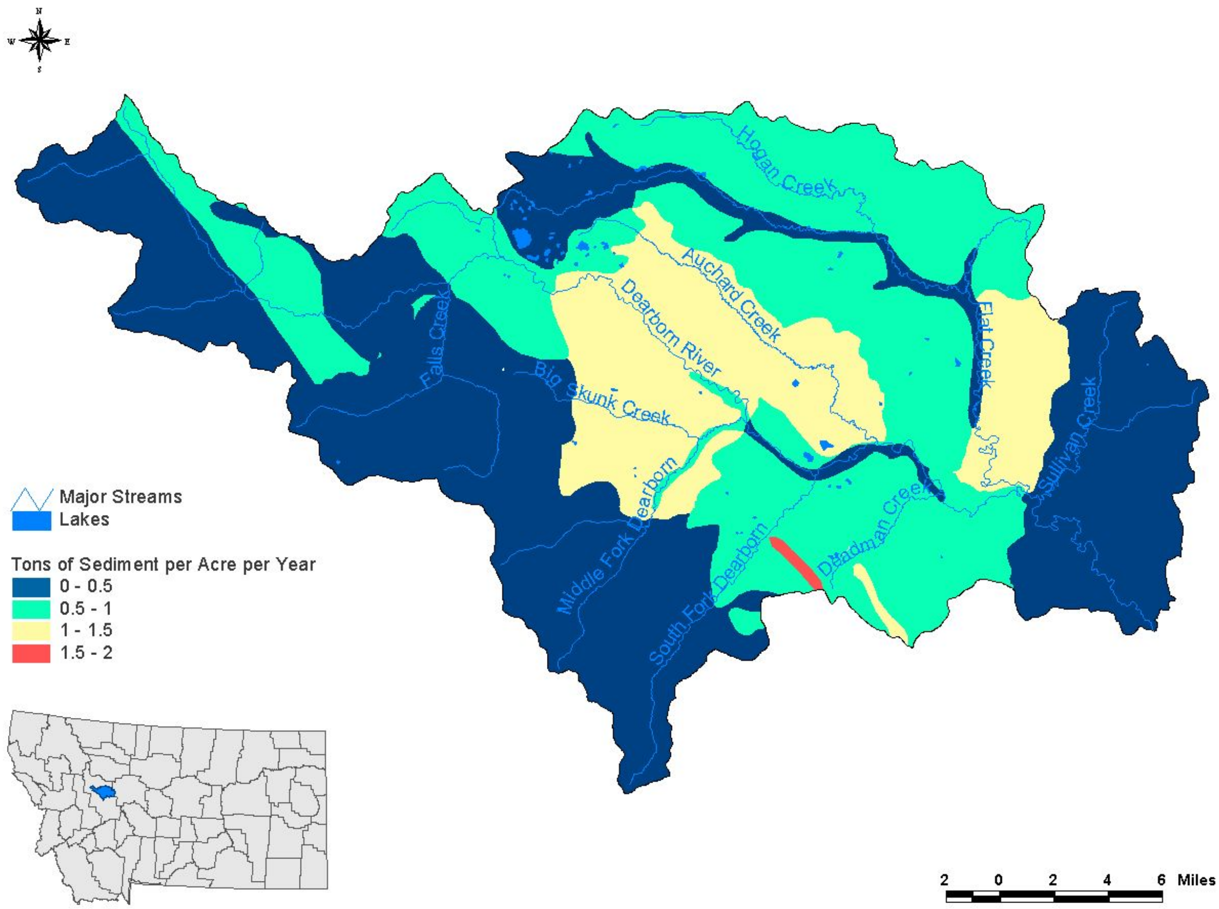

Figure 4-1. USLE soil loss in the Dearborn River watershed.

Table 4-1. USLE Sediment Calculations

Watershed	Watershed Acres	Tons Sediment/Year	Tons Sediment/ Acre/Year
Flat Creek	88,060	65,117	0.74
Middle Fork Dearborn River	43,577	26,205	0.60
South Fork Dearborn River	26,994	11,930	0.44
Falls Creek (Dearborn River Headwaters Region)	25,126	9,465	0.38
Dearborn River (All)	352,812	218,268	0.62

The USLE equation does not consider sediment delivery to a stream, only sediment loss on a plot of land. Vanoni (1975) developed a formula for estimating the sediment delivery ratio (SDR) to streams using watershed area. The formula is shown below.

$$SDR = 0.418(Watershed\_Area)^{-0.135} - 0.127$$

Where watershed area is in square kilometers.

Using this formula, the sediment load to each stream outlet from sheet and rill erosion was estimated (Table 4-1). Loads are smaller than the calculated USLE loads because not all eroded material makes it to the stream. The results indicate that Flat Creek contributes significantly more sediment than either the Middle Fork or the South Fork, due both to its larger drainage area and higher erosion rate.

It should be noted that this method of estimating sheet and rill erosion and sediment delivery has a large margin of error. The results are presented here primarily to provide an understanding of relative land erosion among the Dearborn TPA subwatersheds. The Dearborn River and Falls Creek, although *not* impaired because of sediment, are included in the analysis for comparative purposes.

Table 4-2. Sediment Delivery to the Streams

Watershed	Watershed Size (square km)	Sediment Delivery Ratio	Load to the Stream (tons/year)
Flat Creek	356.4	0.062	4,030
Middle Fork Dearborn River	176.3	0.081	2,115
South Fork Dearborn River	109.2	0.095	1,128
Falls Creek	101.7	0.097	916
Dearborn River (All)	1,427.8	0.030	6,462

Stream Bank Soil Erosion

Because stream bank erosion is spatially variable on a large scale within a watershed, it is very difficult to apply one approach to provide representative data on status and trends in channel health. Furthermore, existing watershed models have limited ability to predict stream bank erosion. Sediment loads from stream bank erosion were therefore estimated according to the results of the field and aerial assessments; corresponding literature values for bank erosion rates (Rosgen, 1996); and soils data from the NRCS (NRCS, 1994).

The results of the aerial assessment for the Dearborn River watershed indicated moderate to high levels of stream bank instability in Flat Creek and some segments of the Dearborn River (see Table 4-3). Bank heights were estimated from cross sections obtained in the various stream segments during the field assessment, and near bank stress was estimated from aerial photos and cross-sectional data. The Rosgen (1996) stream bank erosion curves for Colorado were then used to estimate a stream bank erosion rate for each segment. An average soil bulk density of 1.1 grams per cubic centimeter (g/cm^3) was used to determine the mass of eroded sediment for each segment, based on NRCS soils data. The bank height, bulk density, bank erosion rate, and reach length were multiplied together and summed for each water body to estimate total bank erosion. It should be noted that this method of estimating bank erosion has a large margin of error. The results are presented here primarily to provide an understanding of relative bank erosion among the segments of concern in the Dearborn TPA.

The results of the stream bank erosion analysis are shown in Table 4-4. Flat Creek had very high bank erosion compared with the other streams, and one segment of the Dearborn River also had very high stream bank erosion (the most upstream segment, which has a natural braided channel morphology). Total bank erosion from Flat Creek was approximately 3,000 tons per year more than the total bank erosion from the Dearborn River, even though the evaluated segments of the Dearborn River are 21 miles longer than Flat Creek. The analysis suggests that, relative to each other, the South Fork and Middle Fork of the Dearborn have the least amount of stream bank erosion, the Dearborn River has moderate stream bank erosion, and Flat Creek has significant stream bank erosion.

Table 4-3. Stream Bank Erosion Estimates for the Dearborn River TPA

Reach	Reach Length (miles)	Near Bank Stress	Bank Instability (% of reach)			Bank Erosion Rate (Feet/year)			Total Bank Erosion (Tons/year)	Sediment (Tons//Mile/ Year)
			High	Medium	Low	High	Medium	Low		
Dearborn River										
DR1	8.88	Low	11.1	44.3	44.5	0.18	0.08	0.03	664	75
DR2	9.52	Low	15.8	42.1	42.1	0.18	0.08	0.03	773	81
DR3	8.00	Moderate	29.4	35.3	35.3	0.3	0.2	0.06	1,565	196
DR4	8.15	Low	11.8	41.2	47.1	0.18	0.08	0.03	605	74
DR5	7.44	Moderate	31.2	18.8	50.0	0.3	0.2	0.06	1,303	175
DR6	6.53	High	57.1	21.2	21.6	0.5	0.4	0.15	2,858	438
South Fork Dearborn River										
SF1	5.83	Low	8.3	50.0	41.7	0.18	0.08	0.03	142	24
SF2	5.56	Low	1.0	14.3	84.7	0.18	0.08	0.03	78	14
Middle Fork Dearborn River										
MF1	6.17	Low	16.7	42.1	41.2	0.18	0.08	0.03	170	28
MF2	1.32	Low	0.0	48.1	51.9	0.18	0.08	0.03	26	20
Flat Creek										
FC1	7.49	High	7	60	33	0.5	0.4	0.15	2,641	353
FC2	4.43	High	23	50	27	0.5	0.4	0.15	1,711	386
FC3	4.35	High	14	61	25	0.5	0.4	0.15	1,662	382
FC4	11.64	High	27	55	18	0.5	0.4	0.15	4,832	415

Sheet and rill erosion loads were compared with the bank erosion loads for the entire length of each stream (see Table 4-4). Bank erosion loads were only calculated for the main stem of each subwatershed, and therefore the two loads cannot be directly compared. It is of some note that estimated bank erosion in the main stem of Flat Creek exceeds sheet and rill erosion for the entire Flat Creek watershed by 6,800 tons. Bank erosion along the main stem of the Middle and South Forks of the Dearborn River was only a small percentage of the total estimated overland erosion. As already noted, these load estimates have large margins of error and must be used cautiously when making planning decisions. However, the evidence suggests that there is a large imbalance of bank erosion in Flat Creek compared with other streams in the Dearborn River watershed.

Table 4-4. Land and Stream Bank Erosion Loads in the Dearborn River TPA

Stream	Sheet and Rill Erosion (tons/acres/year)	Bank Erosion (tons/mile/year)	Sheet and Rill Erosion (tons/year)	Bank Erosion (tons/year)
Flat Creek	0.74	389	4,030	10,856
Middle Fork Dearborn River	0.60	26	2,115	196
South Fork Dearborn River	0.44	19	1,128	220
Dearborn River	0.62	160	6,462	7,768

4.3 Source Assessment Uncertainty

The estimates of upland and bank erosion described above are based on the best currently available information but are prone to high margins of error. Although it is felt that the estimates have resulted in sufficient information to reach the conclusions presented in this report, there are still some uncertainties regarding whether or not all of the significant sources have been identified, and regarding the quantification of sediment loads. The primary uncertainties are as follows:

- Insufficient sediment and flow data have been collected to quantify existing sediment loads in the watershed.
- Bank erosion has not been measured to allow for a comparison between actual loads and the estimated loads presented in Section 4.2.
- A comprehensive source assessment inventory has not been conducted to locate and categorize all significant sediment sources.

These uncertainties will be addressed by the proposed activities described in Section 5.

5.0 SOUTH FORK DEARBORN RIVER, MIDDLE FORK DEARBORN RIVER, AND FLAT CREEK SEDIMENT TMDLS

As discussed in Section 3.9, TMDLs focusing on addressing all known anthropogenic sediment sources are proposed for the South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek. The required TMDL elements (i.e., identification of all significant sources, water quality goals or targets, a TMDL, allocation, and margin of safety) are presented in this section.

5.1 South Fork Dearborn River Sediment TMDL

A screening-level analysis of sediment loading in the South Fork Dearborn River watershed was presented in Section 1.0. The results indicate that upland sources of sediment contribute approximately 84 percent of the total sediment load and bank erosion sources contribute approximately 16 percent (Table 4-4). Based on the aerial assessment, however, upland sources were determined to be almost entirely natural with the only anthropogenic sources being isolated areas of bank erosion. Additional information on these anthropogenic sources is presented here.

The location of human-caused sources of bank erosion along the South Fork Dearborn River are shown in Figure 5-1 and an assessment of the riparian condition is shown in Figure 5-2. The headwaters of the South Fork Dearborn River are steep, forested terrain and do not show evidence of anthropogenic sediment sources or accelerated bank erosion. However, a 5,900 foot segment was identified during the aerial assessment that showed a riparian area that was cleared/logged with an expected increase in bank erosion (Figure 5-3). In addition, the lower reach of the South Fork has several miles where the riparian corridor has been converted to agricultural purposes (pasture and grazing) (Figure 5-4). Some impacts to bank stability and channel shading are apparent in this section but are generally of a diffuse nature. Livestock also have direct access to the South Fork at several locations and could be contributing to isolated cases of sedimentation (Figure 5-5).

Most other potential anthropogenic sources of sediment in the South Fork Dearborn River were not considered to be significant (Table 5-1 and Figure 5-6). Several bridges pose a potential risk of sediment loading and should be investigated during TMDL implementation (see Section 5.6). Appendix D includes detailed maps showing the locations of these bridges along with photos from the 2003 low-level aerial assessment. The maps are intended to facilitate additional investigations and the placement of best management practices by identifying precisely the locations of high priority sites.

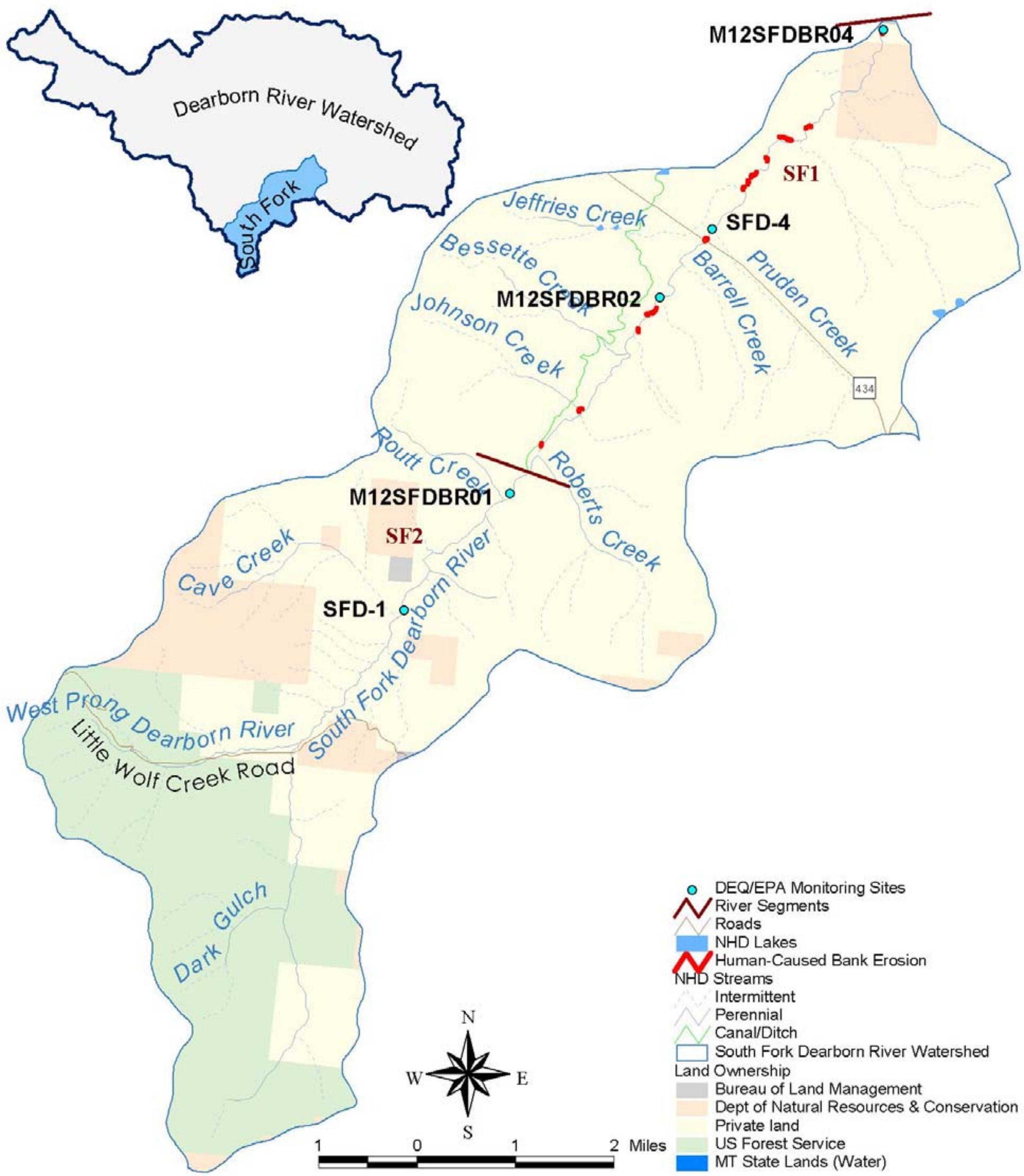

Figure 5-1. Human-caused sources of bank erosion along the South Fork Dearborn River.

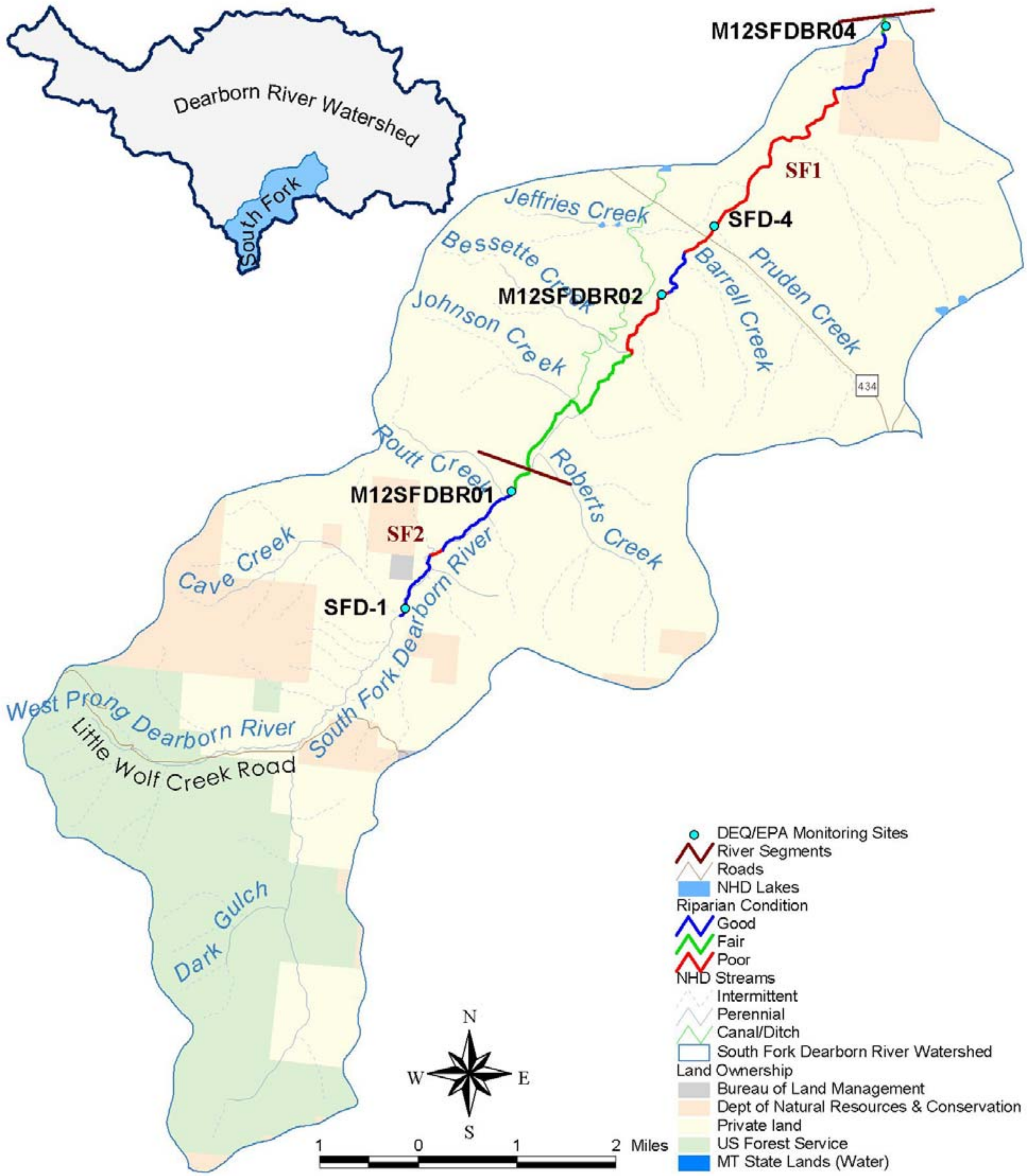

Figure 5-2. Riparian condition along the South Fork Dearborn River.

Figure 5-3. Extensive riparian clearing in the upstream section of the South Fork.

Figure 5-5. Livestock access to South Fork Dearborn River upstream of Highway 434.

Figure 5-4. Extensive riparian clearing in the downstream section of the South Fork.

Table 5-1. Summary of other potential anthropogenic-related sources in the South Fork Dearborn River.

Reach	Rip-rap	Channelization	Impoundments	Instream Structures/ Diversions	Stream Crossings	Other (gravel pits, construction)
SF1	None	None	None	None	Ford near mouth Four bridges	None
SF2	None	None	None	Gibson-Renning ditch diversion	Seven bridges or fords	None

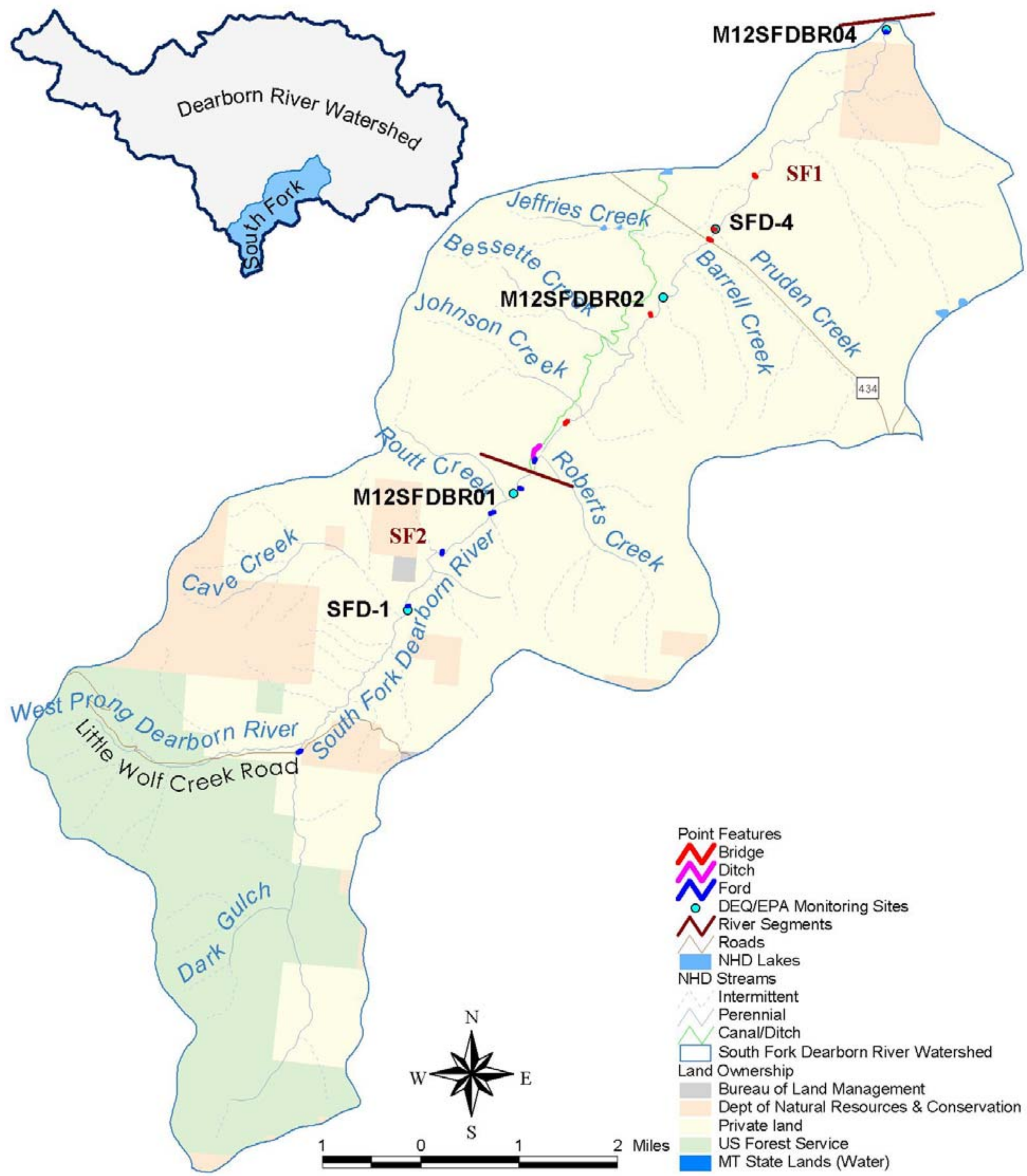

Figure 5-6. Point features along the South Fork Dearborn River.

5.1.1 TMDL and Allocations

A TMDL is composed of the sum of individual waste load allocations (WLAs) for point sources and load allocations (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 the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. This definition is denoted by the following equation:

$$\textbf{TMDL = WLAs + LAs + MOS}$$

There are no point sources of sediment in the South Fork Dearborn River; therefore, the waste load allocation for point sources can be removed from the equation. Furthermore, since people have no control over natural sediment loading, there is no practical purpose for considering natural loading in the TMDL equation. Therefore, the South Fork Dearborn River TMDL is expressed merely as the sum of the allocations to known nonpoint sources. The hypothesis is that there is no more that can be accomplished to solve the problem if all the current anthropogenic sediment sources are addressed. However, given that the estimated loads from anthropogenic sources are very small in comparison with the estimated loads from natural sources, it is not known whether reducing anthropogenic sources will result in significant improvements to the health of the aquatic community. An additional performance-based allocation is that 100 percent of the riparian corridor should be improved to “good” or “excellent” conditions.

To estimate the load reduction associated with addressing all anthropogenic sources of bank erosion, new load estimates were calculated by assuming that all “high instability” reaches identified during the aerial assessment were associated with human activities and could be improved to “medium instability” (see Table 4-3). For the South Fork Dearborn River this is estimated to result in a 9 percent reduction in bank erosion loads and an overall 1 percent reduction in sediment loads. The TMDL and allocations are summarized in Table 5-2 and the proposed restoration and adaptive management strategy is presented in Section 5.6.

Table 5-2. TMDL and Load Allocations for Sediment in the South Fork Dearborn River.

Sources	Current Load (tons/year)		Reduction	Allocation (tons/year) or Approach
Point Sources (WLA)	0		NA	0
Nonpoint Sources (LA)	**Upland Erosion**	1,128	0%	1,128
	Bank Erosion	220	9%	201
	Riparian Vegetation Condition	NA	Performance-based	100% of the riparian corridor should be improved to “good – excellent” condition
	TMDL	1,348	1%	1,329

5.2 Middle Fork Dearborn River Sediment TMDL

A screening-level analysis of sediment loading in the Middle Fork Dearborn River watershed was presented in Section 1.0. The results indicate that upland sources of sediment contribute approximately 92 percent of the total sediment load and bank erosion sources contribute approximately 8 percent (Table 4-4). As with the South Fork Dearborn River, upland sources were determined to be almost entirely natural with the only anthropogenic sources being isolated areas of bank erosion. Additional information on these anthropogenic sources is presented here.

The locations of human-caused sources of bank erosion along the Middle Fork Dearborn River are shown in Figure 5-7 and an assessment of the riparian condition is shown in Figure 5-8. The Middle Fork of the Dearborn River has characteristics similar to those of the South Fork, and much of the headwater zone is relatively undisturbed, steep, forested terrain. Highway 200 has the potential to deliver sediment from cut/fill slopes and applied road sand. However, the aerial assessment did not show any apparent delivery of sediment from the road to the Middle Fork, likely due to the long delivery distance from the road to the channel. A possible pathway for road runoff was investigated on the ground, but did not appear to be a probable source for significant sediment delivery to the channel.

The lower reach of the Middle Fork showed more evidence of channel instability related to land use/riparian modification for agriculture (Figure 5-10 to Figure 5-13). Localized bank instability attributable to anthropogenic sources was present in approximately 6,200 feet of the channel (Land and Water, 2003). However, no significant areas of mass slope failure were noted in the Middle Fork Dearborn River watershed.

Most other potential anthropogenic sources of sediment in the Middle Fork Dearborn River were not considered to be significant (Table 5-3 and Figure 5-9). Several bridges pose a potential risk of sediment loading and should be investigated during TMDL implementation (see Section 5.6). Appendix D includes detailed maps showing the locations of the bridges along with photos from the 2003 low-level aerial assessment. The maps are intended to facilitate additional investigations and the placement of best management practices by identifying precisely the locations of high priority sites.

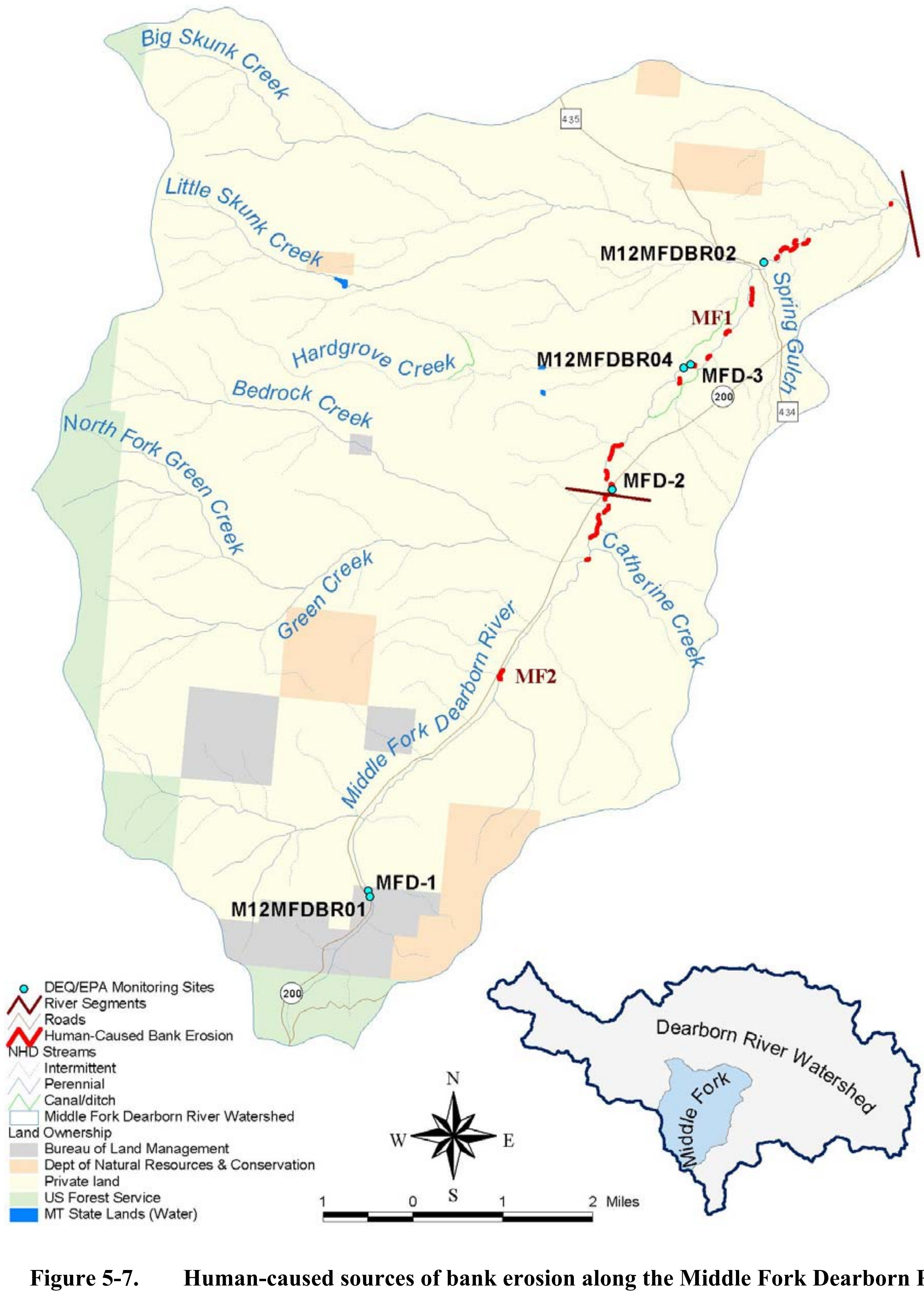

Figure 5-7. Human-caused sources of bank erosion along the Middle Fork Dearborn River.

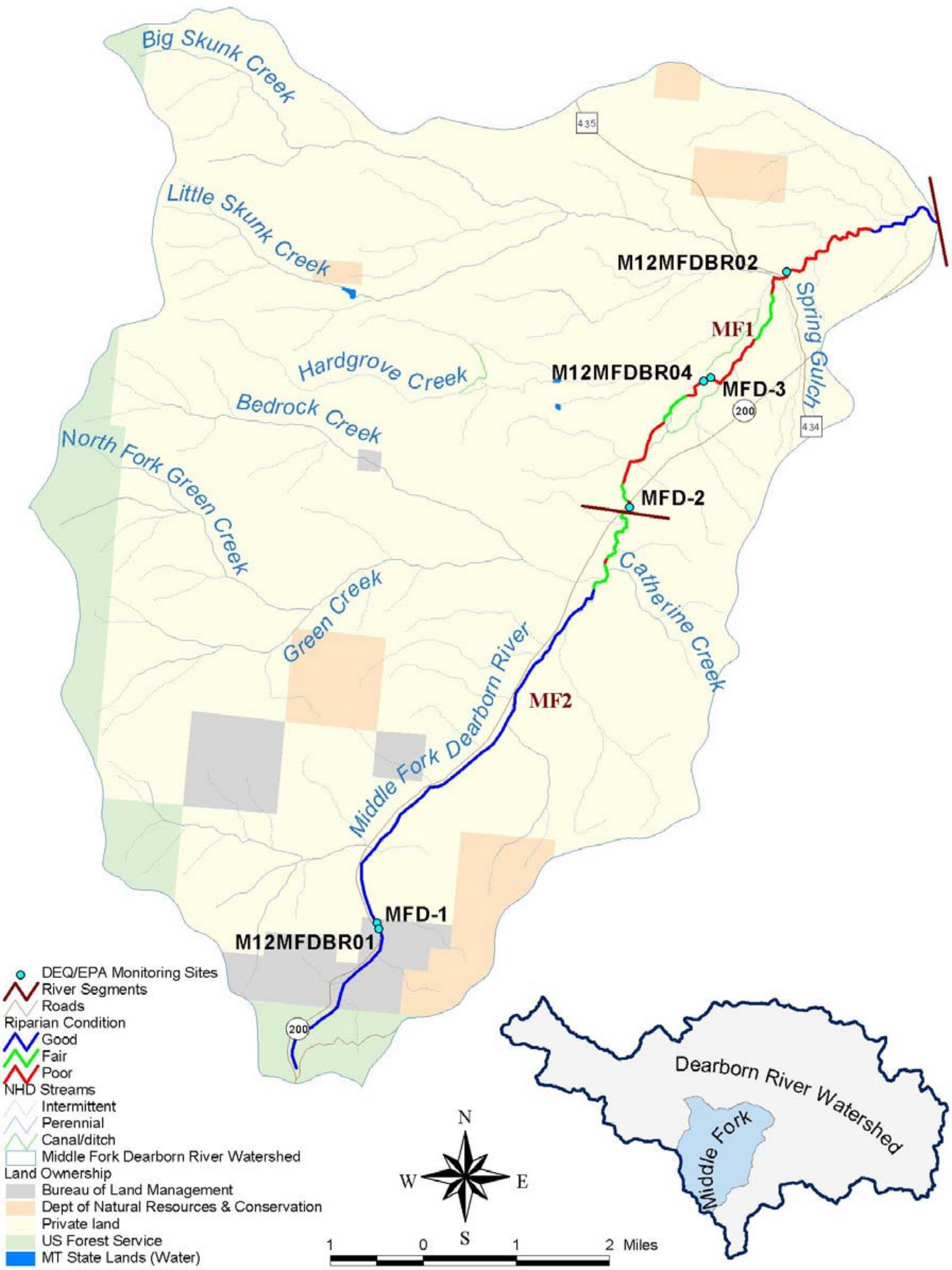

Figure 5-8. Riparian condition along the Middle Fork Dearborn River.

Table 5-3. Summary of other potential anthropogenic-related sources in the Middle Fork Dearborn River.

Reach	Rip-rap	Channelization	Impoundments	Instream Structures/ Diversions	Stream Crossings	Other (gravel pits, construction)
MF1	NA	NA	NA	2 Gillette ditch Borho Ditch diversion	Two bridges	None
MF2	Riprap by Hwy 200 (500 feet)	NA	NA	Nitch ditch Dueringer ditch	Hwy 200 bridge Two additional bridges	None

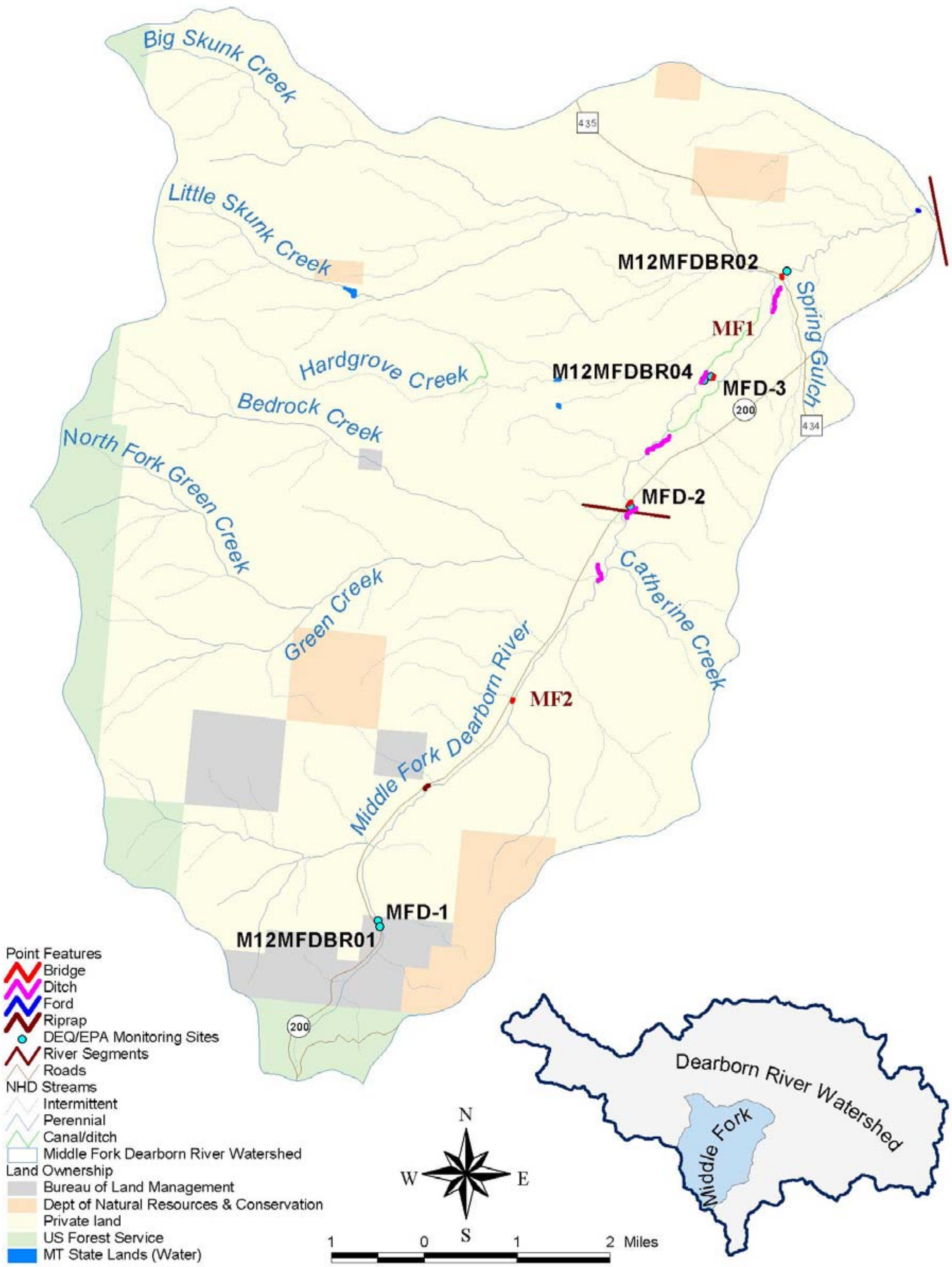

Figure 5-9. Point features along the Middle Fork Dearborn River.

Figure 5-10. Extensive riparian clearing in the downstream section of Middle Fork Dearborn River .

Figure 5-12. Moderate riparian clearing in the downstream section of Middle Fork Dearborn River.

Figure 5-11. Cattle grazing along Middle Fork Dearborn River near Highway 200 Bridge.

Figure 5-13. Lack of riparian vegetation along Middle Fork Dearborn River near confluence with Skunk Creek.

5.2.1 TMDL and Allocations

Similar to the South Fork Dearborn River, no point sources are located in the Middle Fork and most anthropogenic-related sources of sediment are associated with bank erosion. To estimate the load reduction associated with addressing all anthropogenic sources, new load estimates were calculated using the results from the aerial assessment. Results indicated that 45 percent of the “high” and 40 percent of the “medium” bank erosion instability is related to human influences. The TMDL was calculated by assuming that human caused “high instability” reaches could be improved to “medium instability”, and human caused “medium instability” reaches could be improved to “low instability” (see Table 4-3). For the Middle Fork Dearborn River this is estimated to result in a 22 percent reduction in bank erosion loads and an overall 2 percent reduction in sediment loads. The TMDL and allocations are summarized in Table 5-4 and the proposed restoration and adaptive management strategy is presented in Section 5.6.

Similar to the South Fork Dearborn River, an additional performance-based allocation is that 100 percent of the riparian corridor should be improved to “good” or “excellent” conditions.

Table 5-4. TMDL and Load Allocations for Sediment in the Middle Fork Dearborn River.

Sources	Current Load (tons/year)		Reduction	Allocation (tons/year) or Approach
Point Sources (WLA)	0		NA	0
Nonpoint Sources (LA)	Upland Erosion	2,115	0	2,115
	Bank Erosion	196	22%	152
	Riparian Vegetation Condition	NA	Performance-based	100% of the riparian corridor should be improved to “good – excellent” condition
	TMDL	2,311	2%	2,267

5.3 Flat Creek Sediment TMDL

A screening-level analysis of sediment loading in the Flat Creek watershed was presented in Section 1.0. Unlike the Middle Fork and South Fork Dearborn Rivers, the results indicate that bank erosion is a more significant source of sediment (73 percent) than are upland sources (27 percent). This is due to the fact that Flat Creek serves as a conveyance for irrigation water diverted from the main stem of the Dearborn River and channel morphology reflects this altered flow regime. Observed channel instability is likely the result of increased flows due to irrigation diversion and conversion of riparian vegetation to agricultural uses. Grazing and agricultural uses (pasture and cropland) were widespread in Flat Creek and grazing appeared to be of higher density in the lower reaches.

The locations of human-caused sources of bank erosion along Flat Creek are shown in Figure 5-14and an assessment of the riparian condition is shown in Figure 5-15. Numerous areas of high bank erosion potential were identified during the aerial survey and are highlighted in Appendix D. Several of these areas are also shown in the photos below (Figure 5-16 to Figure 5-19).

Most other potential anthropogenic sources of sediment in Flat Creek were not considered to be significant (Table 5-5 and Figure 5-20). Several bridges pose a potential risk of sediment loading and should be investigated during TMDL implementation (see Section 5.6). Appendix D includes detailed maps showing the locations of the bridges along with photos from the 2003 low-level aerial assessment. Areas of high erosion potential are also highlighted in the Appendix D maps.

Table 5-5. Summary of other potential anthropogenic-related sources in the Flat Creek watershed.

Reach	Rip-rap	Channelization	Impoundments	Instream Structures/ Diversions	Stream Crossings	Other (gravel pits, construction)
FC1	None	None	None	None	None	None
FC2	None	None	None	None	One ford One bridge	None
FC3	Minor	None	None	Garino ditch Diversion Diversion a Hamilton ditch diversion	Several bridges and fords	None
FC4	Minor	None	Hogan Cr.	None	None	None

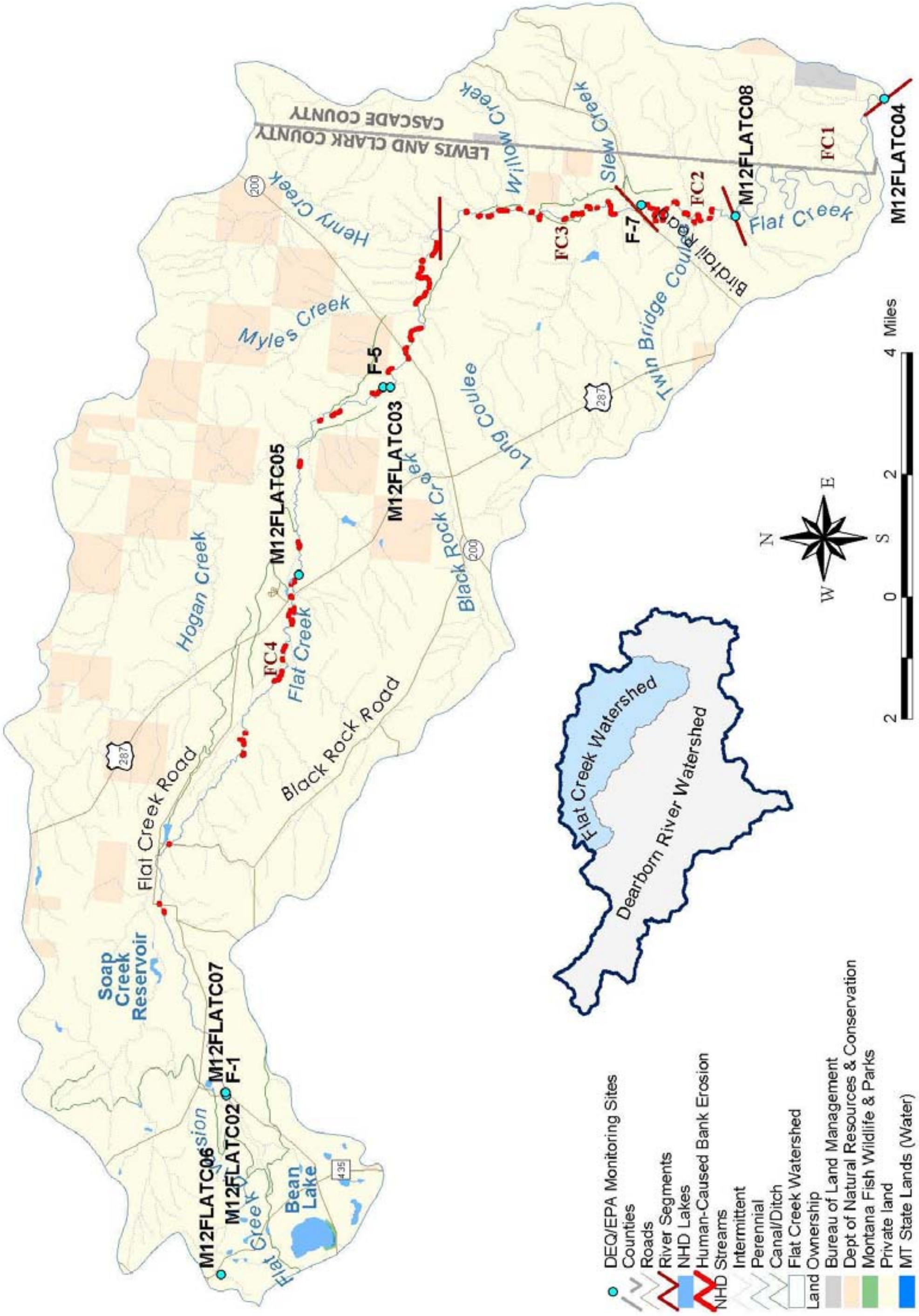

Figure 5-14. Human-caused sources of bank erosion along Flat Creek.

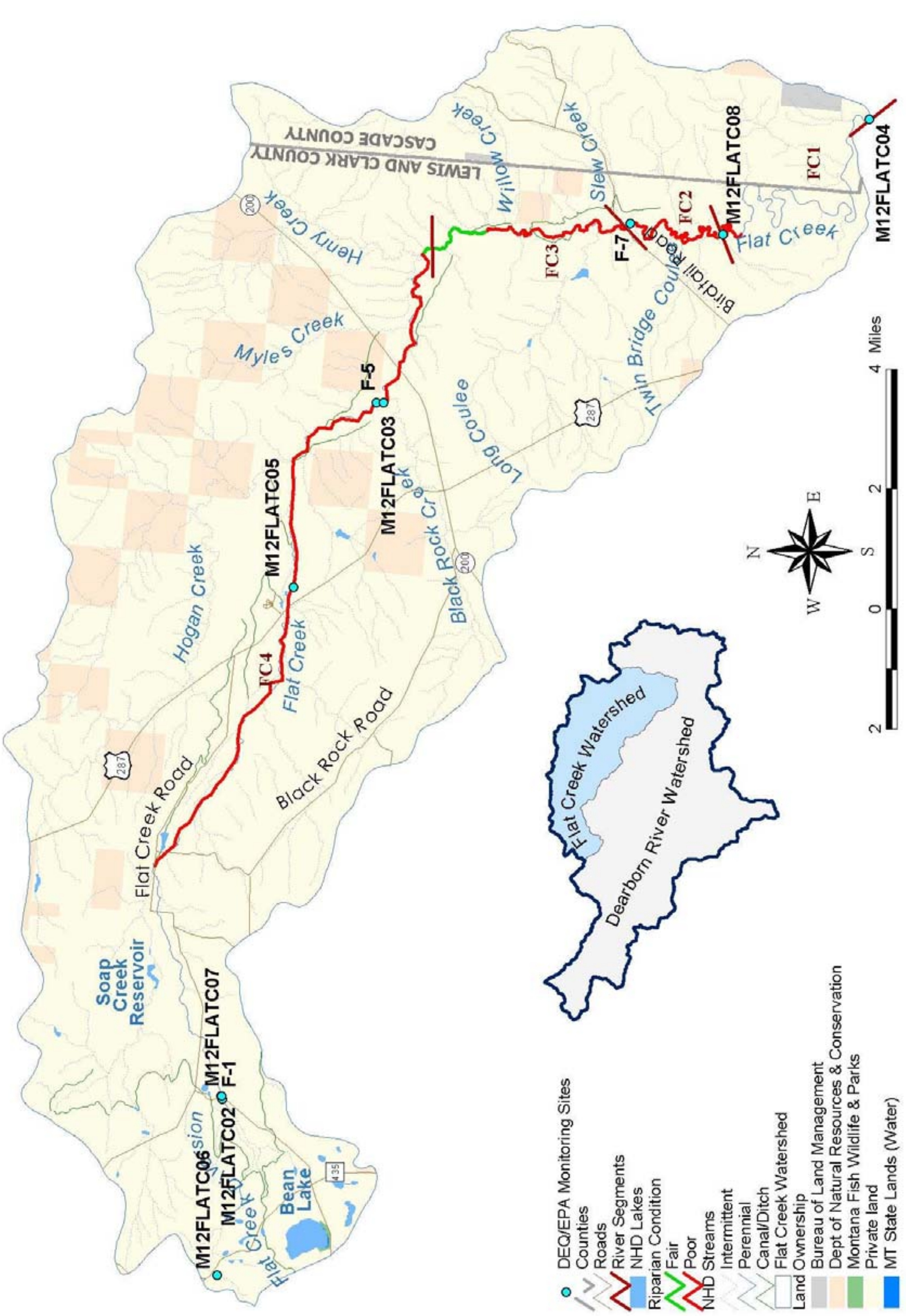

Figure 5-15. Riparian condition along Flat Creek.

Figure 5-16. Flat Creek near Birdtail Road.

Figure 5-18. Cattle grazing in lower Flat Creek.

Figure 5-17. Bank erosion in lower Flat Creek.

Figure 5-19. Bank erosion upstream of Highway 200.

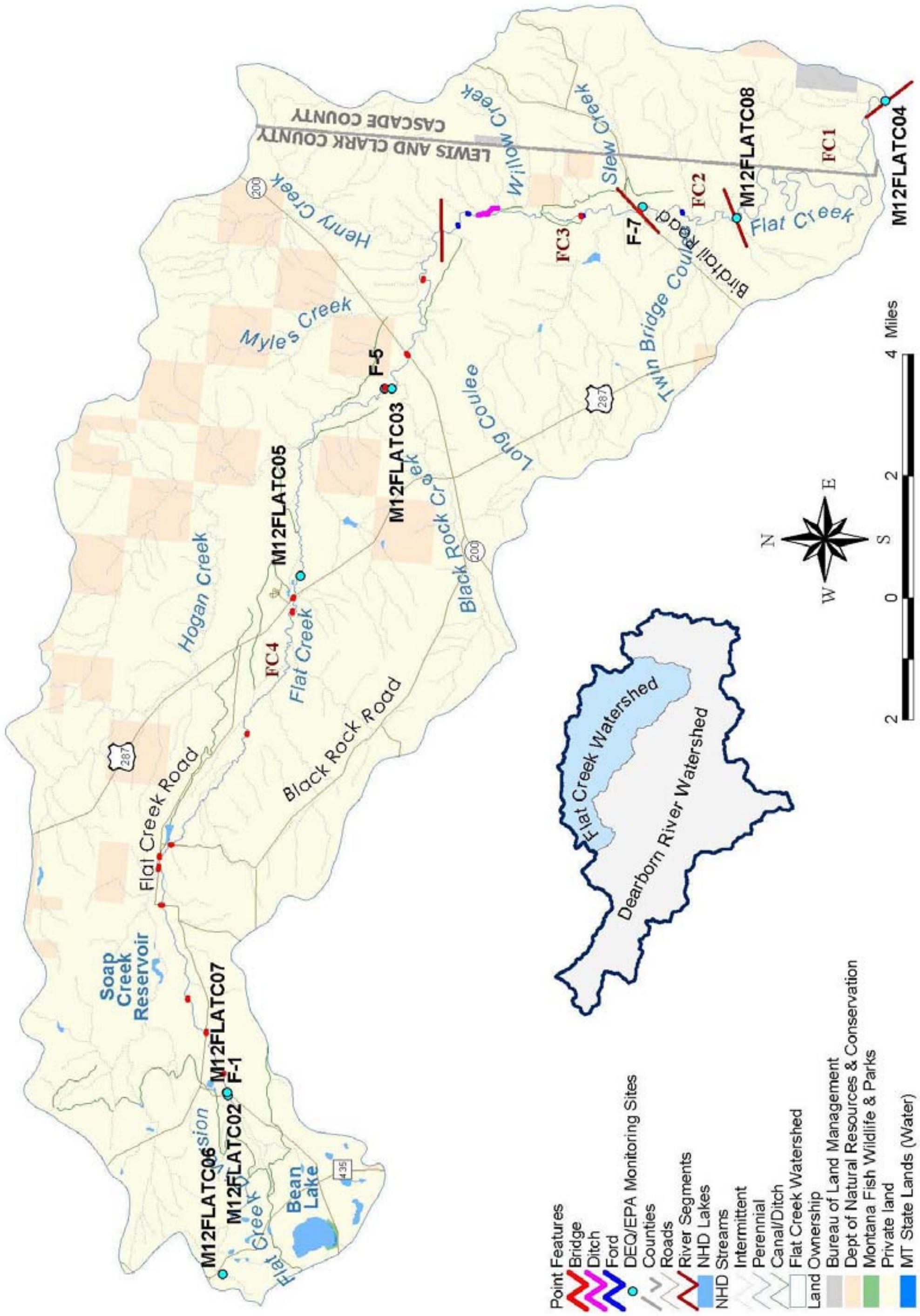

Figure 5-20. Point features along Flat Creek.

5.3.1 TMDL and Allocations

No point sources are located in the Flat Creek watershed. To estimate the load reduction associated with addressing all anthropogenic sources, new load estimates were calculated using the results from the aerial assessment. Results indicated that 90 percent of the "high" and "medium" bank erosion instability is related to human influences (Segment F2, F3, and F4). In segment F1, 80 percent of the "high" and 60 percent of the "medium" bank erosion instability is related to human influences. The TMDL was calculated by assuming that human caused "high instability" reaches could be improved to "medium instability", and human caused "medium instability" reaches could be improved to "low instability" (see Table 4-3). For Flat Creek this is estimated to result in a 40 percent reduction in bank erosion loads and an overall 27 percent reduction in sediment loads. The TMDL and allocations are summarized in Table 5-4 and the proposed restoration and adaptive management strategy is presented in Section 5.6. An additional performance-based allocation is that 100 percent of the riparian corridor should be improved to "good" or "excellent" conditions.

Table 5-6. TMDL and Load Allocations for Sediment in Flat Creek.

Sources	Current Load (tons/year)		Reduction	Allocation (tons/year) or Approach
Point Sources (WLA)	0		NA	0
Nonpoint Sources (LA)	**Upland Erosion**	4,030	0	4,030
	Bank Erosion	10,856	40%	6,846
	Riparian Vegetation Condition	NA	Performance-based	100% of the riparian corridor should be improved to "good – excellent" condition
	TMDL	14,886	27%	10,876

5.4 TMDL Targets

As noted in Section 3.3, MDEQ is required to assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been attained. The process by which this will be accomplished is discussed in Section 3.3 (Targets and Supplemental Indicators Applied as Water Quality Goals) and is shown in Figure 3-3. The sediment targets listed in Table 3-6, and restated below in Table 5-7, are proposed as the thresholds against which compliance with water quality standards will be measured in the South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek. If all the target threshold values are met, it will be assumed that beneficial uses are fully supported and water quality standards have been achieved. Alternatively, if one or more of the target threshold values are exceeded, it will be assumed that beneficial uses are not fully supported and water quality standards have not been achieved. However, it will not be automatically assumed that implementation of this TMDL was unsuccessful just because one or more of the target threshold values have been exceeded. The circumstances around the exceedance will be investigated. For example, the exceedance might be a result of natural causes such as floods, drought, fire or the physical character of the watershed. In addition, in accordance with MCA 75-5-703(9), an evaluation will be conducted to determine whether:

- the implementation of a new or improved suite of control measures is necessary;
- more time is needed to achieve water quality standards;
- revisions to components of the TMDL are necessary, or;
- changes in land management practices occur

Table 5-7. South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek Water Quality Goals.

Sediment Target	Threshold Value
Percent Surface Fines < 2mm	< 20 percent
Number of Clinger Taxa	> 14
Periphyton Siltation Index	< 20.0 for mountain streams < 50.0 for plains streams
Cold-Water Fish Populations[1]	Documented increasing or stable trend

[1] The available fisheries data do not provide readily useful information in relation to the listed segments and impairments. For example, limited data are available regarding fish populations in the Middle Fork, South Fork, and Flat Creek and trends in the population data could be due to a number of factors in addition to, or other than, fine sediments or temperature. Because of these reasons, fish population data cannot be used directly to evaluate success of the implementation of this plan. However, future monitoring should attempt to identify trends in the fishery and, to the extent possible, determine the relationship between these trends and stressors placed on the resource.

5.5 Monitoring and Assessment Strategy

The purpose of the monitoring strategy is to provide answers to the following questions:

1. Has implementation of this plan resulted in attainment of water quality standards and full support of the cold-water fishery beneficial use? (i.e., trend and compliance monitoring)
2. Have all the significant anthropogenic sediment sources been identified? (supplemental monitoring)
3. Are other factors such as nutrients, physical habitat limitations, or stream channel morphology having a significant negative impact on aquatic life? (supplemental monitoring)

It is envisioned that the first step in the implementation of this monitoring and assessment strategy will be the development of a detailed work plan and sampling and analysis plan.

5.5.1 Trend Monitoring

Monitoring of percent surface fines, macroinvertebrates, and periphyton on roughly a 5-year basis is recommended at a minimum at the following sites:

- South Fork Dearborn River at confluence with Dearborn River (M12SFDBR04)
- Middle Fork Dearborn River downstream of Highway 434 (M12MFDBR02)
- Flat Creek below Birdtail Road (M12FLATC08)

MFWP should also continue tracking fish populations in the Dearborn TPA to evaluate whether populations of key species are improving, declining, or remaining steady.

5.5.2 Supplemental Monitoring

Additional monitoring is also suggested to better assess channel, bank, and habitat conditions and to collect supplemental information regarding potential sources of sediment within the watershed. The following activities are recommended:

- Conduct a complete source assessment survey to ground-truth potential sediment sources described above in Sections 5.1 to 5.3 and in Appendix D. The goal of the source assessment survey should be to identify and prioritize all anthropogenic-related sediment sources within the Middle Fork Dearborn River, South Fork Dearborn River, and Flat Creek subwatersheds.
- Identify and complete Rosgen Level II surveys for reference sites in the Middle Fork Dearborn River, South Fork Dearborn River, and Flat Creek to obtain reference cross section information.
- Because nutrients were identified as a potential cause of impairment at several sites in the watershed, additional nutrient data should be collected to better assess current conditions. Dissolved and total phosphorus and nitrogen and algal biomass should be sampled in the Middle Fork Dearborn River, South Fork Dearborn River and Flat Creek.
- Evaluate the condition of cross sections and longitudinal profiles established in 2003.

5.6 Conceptual Restoration Strategy

A phased restoration strategy is proposed. Phase I will involve implementation of the monitoring and assessment strategy described above in Section 5.5 to identify all anthropogenic-related sediment sources. Phase II should involve developing and implementing a detailed Project Implementation Plan to obtain the sediment load reductions from the known anthropogenic sediment sources. The Project Implementation Plan should outline responsibilities, specific types of restoration activities, and a schedule. Potential restoration activities for each of the water bodies are identified below but should not be considered all-inclusive.

The lower end of the upper reach of the South Fork Dearborn River (SF2 in the aerial assessment report) appears to have experienced some impacts from logging and land clearing operations in the riparian area. Natural recovery from logging impacts would be expected to result in improved conditions in this reach. The lower reach of the South Fork (SF1 in the aerial assessment report) experienced some impacts from grazing and removal of riparian vegetation. Suggested restoration activities in the South Fork include improving land use practices and possibly installing riparian fencing to promote riparian vegetation recovery.

Suggested restoration activities in the Middle Fork include improving woody riparian coverage and restoration of over-widened cross sections to reference conditions along impacted segments. Bank restoration can be accomplished with soft bioengineering methods (e.g., geotextile coir fabric wraps) and woody shrub/tree revegetation. Fencing in riparian areas would be beneficial to promote increased coverage of woody species. Off-stream water sources might need to be developed.

Without significant changes to current water management practices, restoration to pristine conditions along Flat Creek is not a realistic objective at this time. There are, however, steps that can be taken to reduce water quality impacts and improve habitat conditions while continuing to accommodate the current flow regime and land use activities. Suggested restoration activities include promoting recovery or enhancing riparian vegetation and reducing sediment impacts through restoration of eroding banks. Establishment of mature tree stands could be expected to significantly stabilize stream banks and provide significant shading to the channel, although it should be recognized that extensive cottonwood riparian communities cannot be expected given the soil characteristics of the area. Willow shrub communities would be more typical, although shading provided by willows would be modest. Strategies to reduce sediment yield could include livestock exclusion in riparian areas, and sloping and revegetation of unstable terraces and banks with revegetation treatments.

5.7 Dealing with Uncertainty and Margin of Safety

Based on the available data evaluated in Section 3.0 and consideration of the fact that the majority of the sediment load delivered to the South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek appears to be largely of natural origin, one could argue that no TMDLs are necessary. However, interpretation of the state's narrative water quality criteria is not a "black-and-white" exercise. The relevant narrative standards prohibit harmful or other undesirable conditions related to pollutant increases above "naturally" occurring levels. The beneficial uses listed as impaired (cold-water fishery and aquatic life) experience a high degree of "natural" variability as do many of the chemical and physical parameters used as targets or supplemental indicators. Are we certain that anthropogenic sediment loads are or are not significantly impacting the health of the aquatic communities? To be conservative and err on the side of water quality protection, TMDLs have been prepared. This fact alone provides a substantial margin of safety.

The phased restoration/alloction approach also provides a margin of safety by addressing the uncertainties regarding the identification/quantification of sediment sources outlined in Sections 5.1 to 5.3.

6.0 PROPOSED FUTURE STUDIES AND ADAPTIVE MANAGEMENT STRATEGY

This section presents proposed future studies to address data gaps and/or uncertainties identified previously. A conceptual strategy for reacting to the results of these, and other, future studies and/or new information that may become available is also presented (i.e., adaptive management strategy).

6.1 Proposed Supplemental Temperature and Flow Study for the Dearborn River

Montana's temperature standards were originally developed to address situations associated with point source discharges, making them somewhat difficult to apply when dealing with primarily nonpoint source issues, such as with the Dearborn River. For waters classified as B-1 (i.e., the Dearborn River), the maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67º Fahrenheit) is 1° (F) and the rate of change cannot exceed 2°F per hour. In practical terms, the temperature standards address a maximum allowable increase above "naturally occurring" temperatures to protect the existing temperature regime for fish and aquatic life. "Naturally occurring," means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied (ARM 17.30.602(17)).

A modeling analysis is described in Section 3.8.1, in which water temperatures in the Dearborn River were estimated to be between one and two degrees Fahrenheit higher than natural as a result of the flow diversion. However, the uncertainty regarding the model predictions is relatively high (± 2 degrees). As a result, it is not possible to determine, with an adequate degree of certainty, whether or not the temperature standards in the Dearborn River are currently met. All that can be said at this point is that the temperature standard in the Dearborn River may currently be exceeded due to human-caused flow alteration. Further study is therefore required. This section of the document presents a conceptual phased plan for a supplemental temperature study in the Dearborn River.

6.1.1 Study Purpose

The primary goal of the proposed supplemental study is to answer the question: Is the State of Montana's water quality standard for temperature exceeded in the Dearborn River? If the results indicate that the temperature standard is met, no further study or action will be necessary. On the other hand, if the results indicate that the temperature standards are exceeded, this study is intended to:

1. Define the "natural" temperature regime for the Dearborn River and establish in-stream temperature goals (or targets) using a refined model-based analysis.
2. Identify, and determine the relative importance of, the sources or causes (e.g., natural, loss of shade, human-caused flow alteration) of the temperature problem.
3. Develop a restoration strategy to achieve the temperature goals, to the extent possible.

Conceptual Scope of Study

Task 1 - Dearborn River Water Balance

The diversion of a portion of the Dearborn River's flow into Flat Creek (during the summer) may be having a negative influence on recreation, habitat for fish and aquatic life, and water temperature. Additionally, there are other areas within the Dearborn Watershed where water is withdrawn for irrigation purposes. For example, diversion structures were noted during the aerial survey presented in Appendix D in the South Fork (Gibson Renning Ditch), Middle Fork (4 diversions noted), and Flat Creek (multiple locations). However, the impacts of the human-caused flow alteration are not fully understood at this time due to a lack of flow data. A summer water balance for the Dearborn River, and significant tributaries such as the Middle Fork, South Fork, Flat Creek, Auchard Creek, Deadman Creek, and Sullivan Creek is necessary to determine the significance of human-caused flow alteration.

Due to the large size of the Dearborn River watershed and the long history of water-use in the basin, a basin-scale hydrologic investigation is proposed to answer the following questions:

1) What is the "natural" hydrologic regime of the Dearborn River and what are the expected "natural" summer flows (in this case, natural refers to in the absence of anthropogenic alteration)?
2) What is the extent of surface water-use in the basin and how is it used?
3) How efficient are the water use mechanisms in the basin?
4) What is the fate of all diverted water in the basin?
5) What is the effect of the timing, magnitude, duration and location of irrigation diversion/return flows?
6) Given all the water-use in the basin and the need for full support of all beneficial uses (e.g., agriculture, drinking water, recreation, fish and aquatic life, etc.), what are the maximum summertime flows that can be achieved in the basin, assuming that all reasonable land, soil, and water conservation practices are employed?

In general, answers to these questions will define the significance of human-caused flow alteration in the Dearborn River and in the primary tributaries. Answer to questions 1 and 6 will define the boundaries for future temperature modeling analyses.

Task 2 - Temperature Data Collection

Sufficient paired temperature and flow data were not available to complete a detailed modeling analysis. Additional data are required to more accurately simulate current water temperatures in the Dearborn River and to simulate the "natural" temperature regime. Ideally, the collection of additional temperature data would be coordinated with the collection of the additional flow data in Task 1.

Other data may also be necessary to refine the modeling analysis. The existing model was "calibrated" to only one sampling event and several key inputs were based on estimated rather than measured data. The model is most sensitive to several weather parameters including the following: air temperature, relative humidity, and wind speed. Other sensitive parameters include inflow temperature, possible sun, total shade, ground temperature, and wetted perimeter. Therefore consideration should be given to the collection of the following data:

- An onsite continuous air temperature meter should be placed somewhere between the Flat Creek diversion and the Dearborn River at Highway 287.

- Total shade and wetted width of the stream should be measured at strategic points along the Dearborn River during future flow monitoring events. Neither parameters are as sensitive as the weather parameters in the modeling analysis, but both are somewhat sensitive and were estimated for the purpose of the analysis presented in this report.

Finally, the temperature affects of the reported riparian degradation in the tributaries to the Dearborn River (see the "Bank Erosion and Riparian Condition" subsections within Sections 3.8.2 – 3.8.4) have not been considered in the temperature analysis presented in Section 3.8.1. Existing and potential shade should be estimated at strategic locations within these tributaries to determine if riparian degradation is having an adverse affect on Dearborn River temperatures.

Task 3 - Temperature Modeling Analysis

The data provided through implementation of the steps described above should allow for completion of a revised modeling analysis. Stream temperatures will be simulated in the Dearborn River for the following scenarios: 1) current condition, 2) the "natural" flow regime, and 3) the "maximum" achievable flow condition. Modeling temperatures in the Dearborn River for the "natural" condition will define the temperature regime that may have existed in the absence of human-caused alteration. Modeling temperatures in the Dearborn River for the "maximum" achievable flow scenarios will define the temperature regime that is likely achievable given current agricultural practices assuming that all reasonable, land, soil, and water conservations practices are employed. Scenario 2 will be compared to the current condition scenario to determine compliance with the Montana temperature standard. If the results indicate that the temperature standards are not violated, no further action will be necessary. Conversely, if the results indicate that the temperature standards are exceeded, preparation of a TMDL will be necessary (Task 4).

Task 4 – Total Maximum Daily Load and Voluntary Water Quality Restoration Strategy

If further study indicates that the temperature standards are violated, a TMDL will be required and the preparation of a Voluntary Water Quality Restoration Strategy is recommended. DEQ will be responsible for the preparation of the TMDL and, ideally, would work with the watershed stakeholders to prepare a Voluntary Water Quality Restoration Strategy, assuming there is sufficient local interest. The total maximum daily load will establish in-stream temperature targets (or goals) that represent achievement of the temperature standard, will define the necessary actions to achieve the targets, and will be prepared in accordance with DEQ and EPA guidelines. Assuming that there are no point sources involved, implementation of the TMDL would be entirely voluntary and would depend upon the voluntary actions of the various watershed landowners and stakeholders.

6.1.2 Schedule and Commitments

Based on preliminary communications between EPA, DEQ and the Montana Department of Natural Resources and Conservation (DNRC), implementation of the Supplemental Temperature and Flow Study will be accomplished through a partnership between these three agencies, with DNRC taking the lead role in Task 1 and EPA and/or DEQ taking the lead role in the remaining tasks. Since Tasks 2 – 4 are dependant upon the results of Task 1, Task 1 will need to be completed first. It is envisioned that Task 1 will be initiated in 2005 or 2006 (depending upon availability of staff resources and funding) and will involve a two to three year study to ensure that a range of flow conditions are evaluated. The remaining tasks will be completed by no later than 2012.

6.2 Suspended Sediment Monitoring

It is well documented that high levels of suspended sediment can directly affect aquatic species health. Suspended sediment has also been widely used as an indicator of sediment accumulation in streambeds, which is also associated with aquatic life impairment (Waters, 1995). Further, in cases where long-term data sets are available suspended sediment data are relatively easy to apply within the TMDL process. For example, when suspended sediment and associated discharge data are available from a suitable "reference" stream, they can easily be used to establish flow-based, not-to-exceed concentration targets to represent a measure of compliance with the State's narrative standards for sediment. Further, in combination with the target values, suspended sediment load reductions can typically be easily estimated to provide for the "TMDL" component of the process (e.g., X% suspended sediment load reduction). Suspended sediment data provide a relatively easy means to assess compliance with Montana's narrative sediment criteria and also provide an efficient means by which to estimate the necessary sediment load reductions to achieve compliance with the standards. Unfortunately, there is insufficient suspended sediment data available for the Dearborn River, and there is little, if any, available reference data to use for comparison purposes. For that matter, there is a paucity of data in general that has direct relevance to Montana's sediment standards in many of the streams appearing on Montana's 303(d) list due to the probable causes of "siltation" and/or "suspended solids".

As a result, EPA and DEQ are pursuing a partnership with the USGS to begin collection of paired flow and suspended sediment data in streams appearing on Montana's 303(d) list due to "siltation" and/or "suspended solids". "Reference" or "least impaired" streams will also be considered in this study. Details regarding this proposal have not yet been fully defined, but the conceptual goal is to begin to compile data that will ultimately facilitate more accurate and efficient interpretation of Montana's narrative sediment standards on a regional basis. It is not envisioned that this proposed study, alone, would fully achieve that goal. This would be one component of the State's monitoring program. However, this is considered one of the steps towards achieving this goal. It is envisioned that the first step will involve compiling all available suspended sediment data (e.g., total suspended solids (TSS), suspended solids concentration (SSC), and/or turbidity data with corresponding flow data) to identify data gaps. This would be followed by the preparation of a sampling and analysis plan and implementation. A pilot monitoring program, involving the Dearborn River and a number of streams within the Eastern Front Region, is proposed as a starting point to evaluate the feasibility and utility of this effort.

6.3 Adaptive Management

First, adaptive management is built into Montana's TMDL process through the Montana Water Quality Act. DEQ is required to assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been achieved. Such an evaluation will be required five years after EPA approves the TMDLs presented in this document. At that time, if water quality standards have not been achieved, in accordance with MCA 75-5-703(9), an evaluation will be conducted to determine if:

- the implementation of a new or improved suite of control measures is necessary
- more time is needed to achieve water quality standards, or
- revisions to components of the TMDL are necessary.

In other words, the Montana Water Quality Act provides for future adaptive management in cases where water quality standards have not been achieved 5-years after the TML has been approved. The potential adaptive management actions are specified directly above and in the act.

This, however, is only one component of the conceptual adaptive management strategy proposed in this document. Additional adaptive management components include:

- Additional flow/temperature studies to determine if temperature standards are, in fact, violated in the main stem of the Dearborn River (See Section 6.1). If the results indicate that they are, a TMDL will be prepared. If not, no further action will be required.

- Additional source assessment is proposed during the implementation phases of the siltation TMDLs for the South Fork Dearborn River, Middle Fork Dearborn River, and Flat Creek to ensure that all significant sources have, in fact, been identified and to develop site-specific restoration plans (See Section 5.5.2).

- Additional suspended sediment monitoring is proposed for the main stem Dearborn River and several other streams within the region to begin to better define the "reference" condition (Section 6.2). In the future, this will provide information specific to the Dearborn River and also provide a means for comparison to other similar streams in the region. If, in the future, it is found that suspended sediment levels in the Dearborn River are higher than expected, additional actions can be taken by DEQ to attempt to correct the problem.

- The evaluations described in this document focused on siltation in the Dearborn River and several of its tributaries and thermal modification in the Dearborn River. However, potential water quality issues were identified suggesting that nutrients, or other stressors may be causing water quality problems in the watershed. Further study is proposed in Section 5.5.2). Future actions will be dependant upon the results of the further study.

7.0 PUBLIC INVOLVEMENT

Due to the lack of a formal, organized watershed stakeholder group in the Dearborn TPA, public involvement was generally limited to the elements required by the Montana Water Quality Act. The Lewis & Clark Conservation District was notified during the initial stages of project development and kept apprised of activities/progress throughout the project. The Conservation District was also partially relied upon to assist in obtaining landowner contact information to gain access for field activities. The Sampling and Analysis Plan prepared to direct field-sampling activities was provided to the Lewis & Clark Conservation District and landowners who provided access for sampling (if they were interested in having a copy) prior to initiation of field activities. Additionally, contacts were made with the Montana Department of Natural Resources, Montana Fish, Wildlife and Parks, U.S. Natural Resource Conservation Service, and USGS to request all available data as well as any information that they may have had regarding local activities.

The draft *Water Quality Assessment and TMDLs for the Dearborn River Planning Area* document was formally released for public review on November 19, 2004. The notice of availability was made through a press release to the following media sources: Cascade Courier, Great Falls Tribune, High Plains Warrior, KEIN-AM/KLFM - FM, Rural Montana, KTVH-TV, KBLL-AM, KFBB-TV, KMTF-TV, KXGF, KMON-AM, KRTV, KTGF- TV, the Helena Independent Record, the Queen City News, and the Associated Press. It was also posted on "Newslinks" which is a subscriber service for all media, and the notice and draft document were posted on DEQ's website (http://www.deq.state.mt.us/index.asp). Phone contacts and visits were also made with the Lewis and Clark Conservation District and NRCS to alert them that the document was available for review, provide them with copies of the draft document, and request their assistance in notifying their constituents within the Dearborn River Watershed. Additionally, phone contacts were attempted with all of the landowners within the watershed, that were previously contacted to obtain permission for sampling, to alert them of the document availability.

The formal public comment period extended from November 19, 2004 to December 20, 2004. A public informational meeting was held on November 8, 2004. A total of seven people attended the meeting. Formal written comments were submitted by four individuals. A summary of the public comments and the EPA/DEQ responses are presented in Appendix E.

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