Water Quality Assessment and TMDLs for the Dearborn River Planning Area

FINAL

Prepared for:
Montana Department of Environmental Quality

Prepared by:
U.S. Environmental Protection Agency
Montana Operations Office
and Tetra Tech, Inc.

Project Manager: Ron Steg

Contributing Authors:
Jason Gildea
Kevin Kratt
Tina Laidlaw
Laura Lundquist
Ron Steg
James Stribling

Photo's by Land and Water Consulting, Inc.
and Tetra Tech, Inc.

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CONTENTS

TABLES

FIGURES

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

Segment Name	Size (miles)	Use	Listing Year	Probable Impaired Uses	Probable Causes
Dearborn River, from Falls Creek to the Missouri River	48.6	B-1	1996	Aquatic Life Support Cold-Water Fishery	Flow Alteration Thermal Modifications Siltation Habitat Alterations
			2002	Aquatic Life Support Cold-Water Fishery Primary Contact Recreation	Flow Alteration Thermal Modifications Siltation
			2004	Aquatic Life Support Cold-Water 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 Cold-Water Fishery	Flow Alteration Habitat Alterations Siltation
			2002	Aquatic Life Support Cold-Water 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 Cold-Water Fishery	Dewatering Flow Alteration Siltation
			2004	Aquatic Life Support Cold-Water Fishery	Dewatering Flow Alteration Siltation

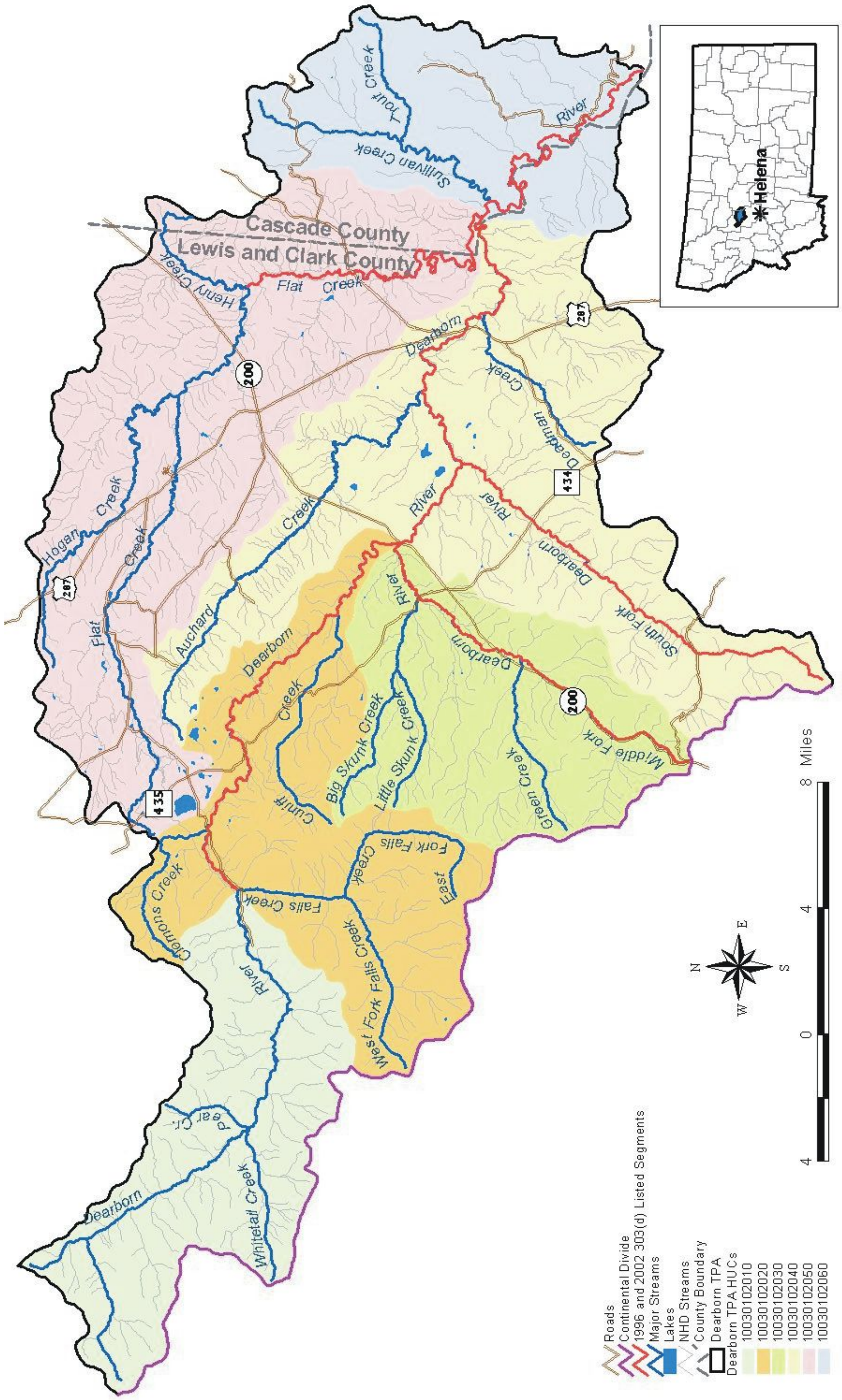


Figure 1-1. Location of 303(d) listed streams in the Dearborn TPA.

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.

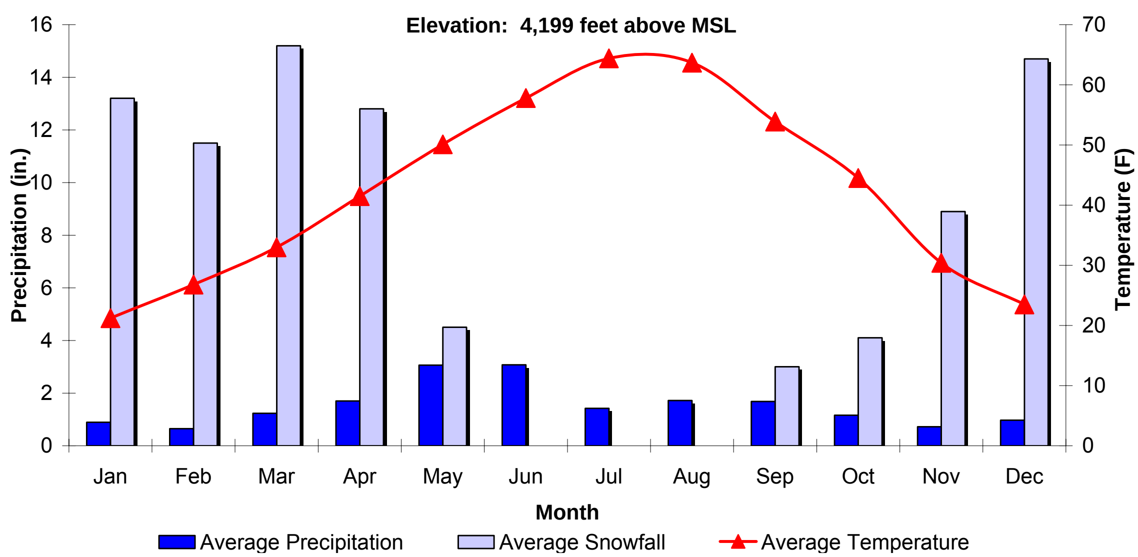


Figure 2-1. Climagraph for Rogers Pass 9NNE MT, Station 247159-4. Data cover the period 1971 to 2000.

[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

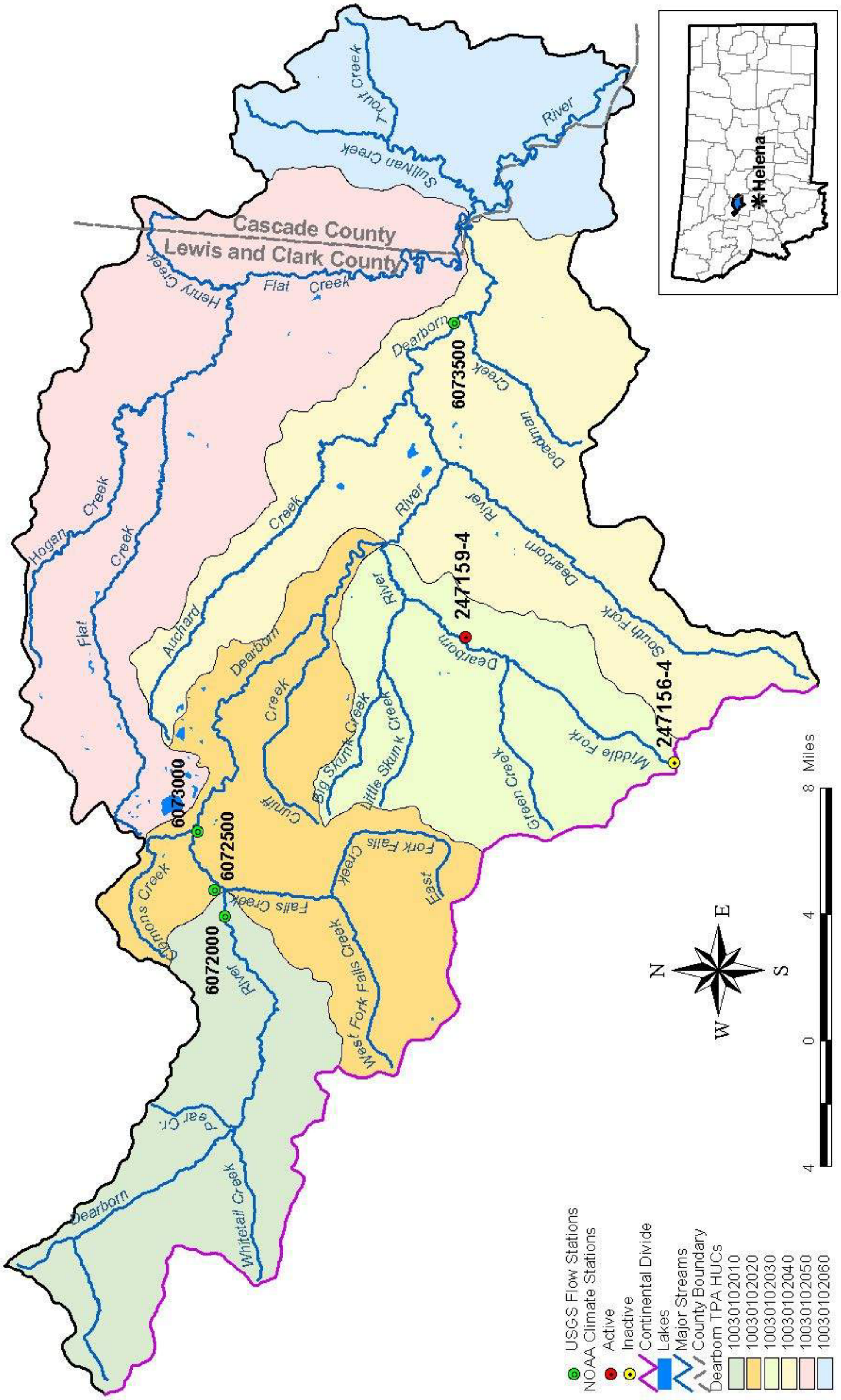


Figure 2-2. Location of USGS gages in the Dearborn TPA.

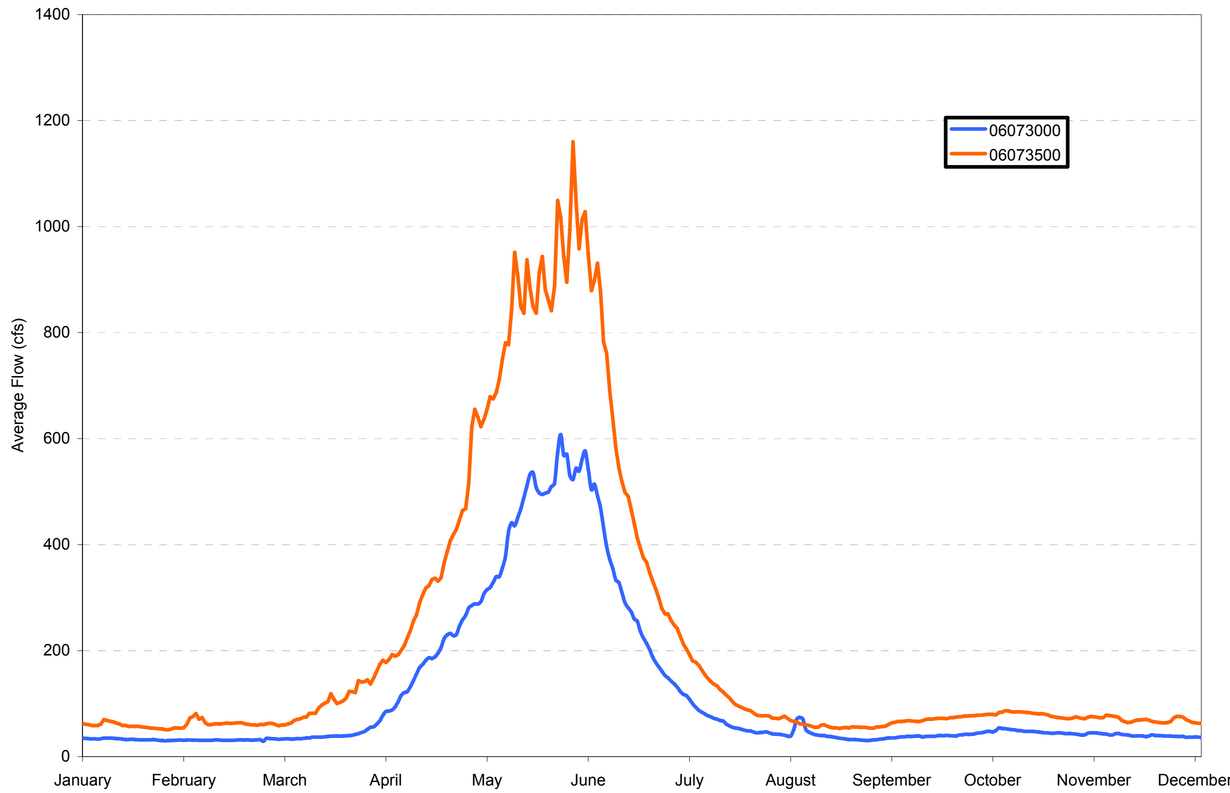


Figure 2-3. Average daily flows at two USGS gages on the Dearborn River main stem. Data show the entire period of record for both gages.

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

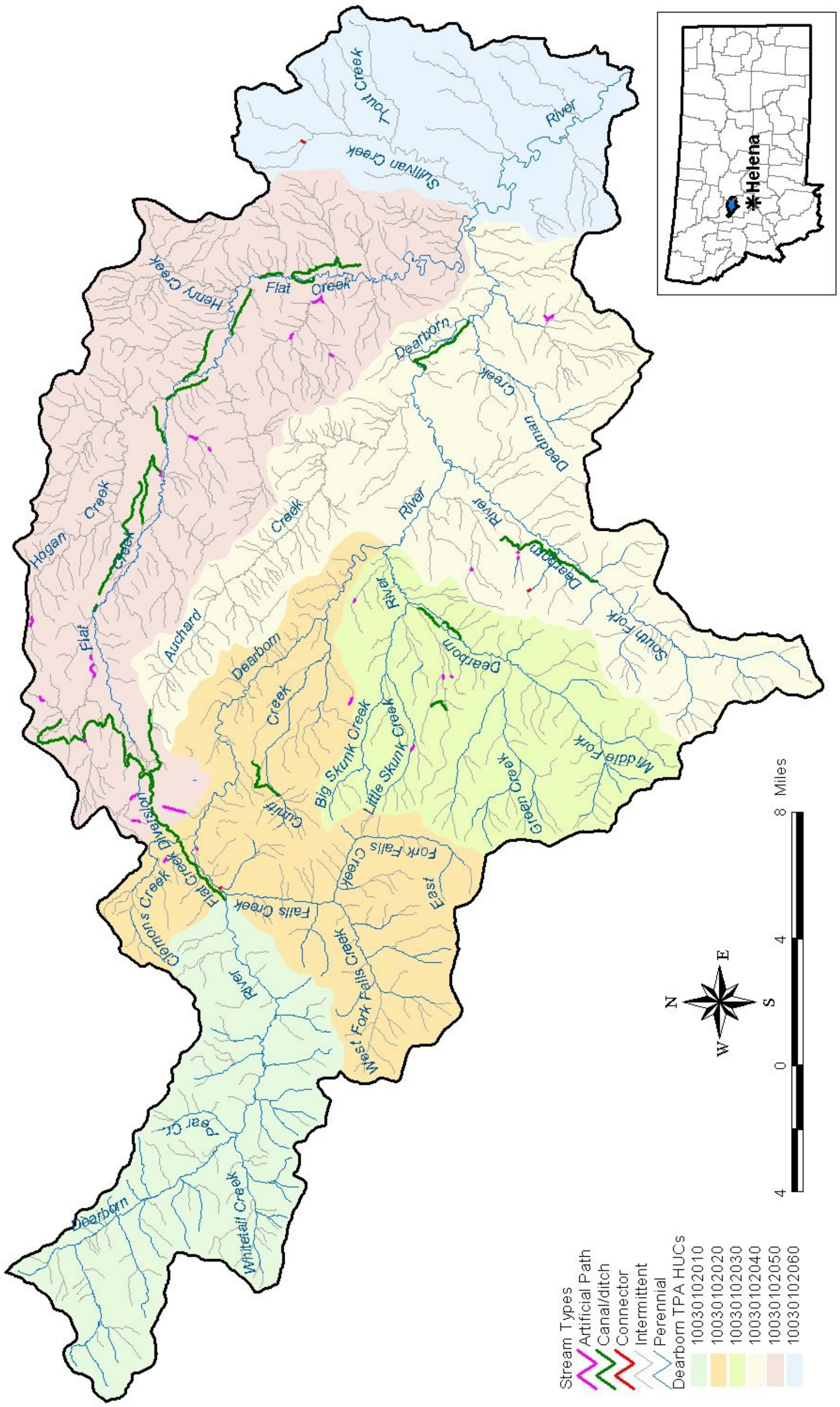


Figure 2-4. Stream types in the Dearborn River watershed.

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.

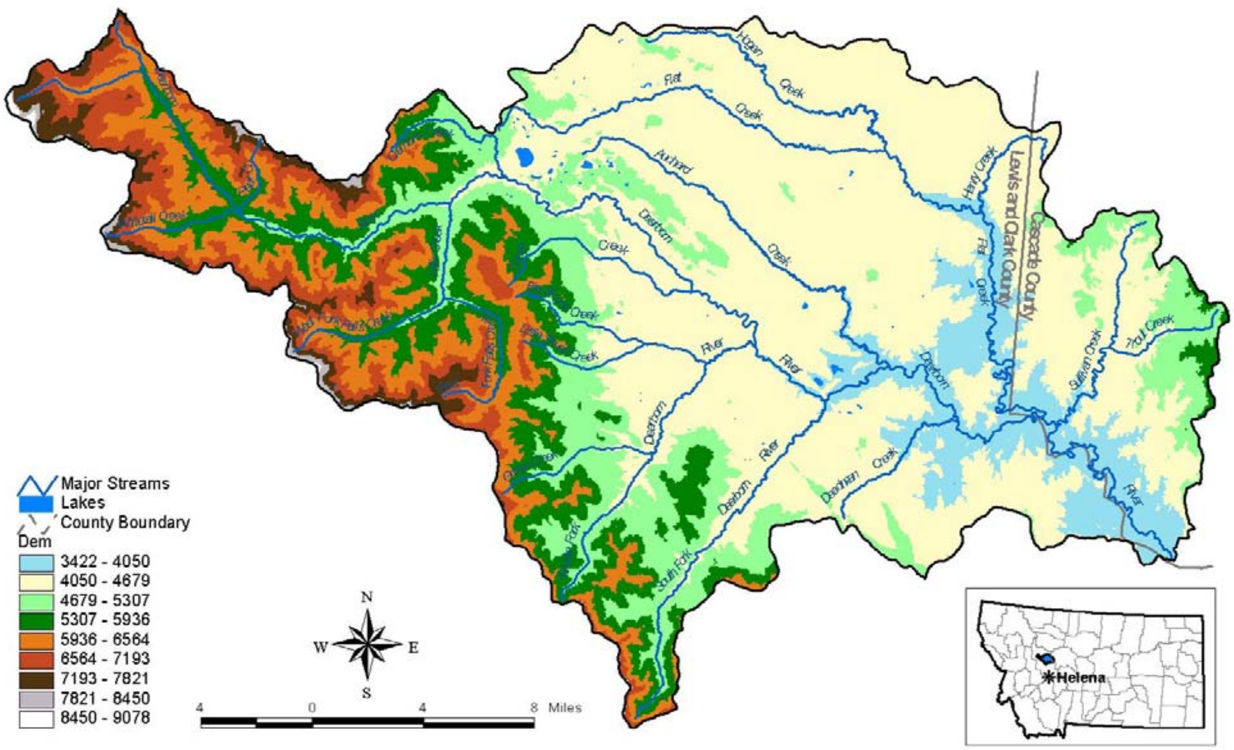


Figure 2-7. Elevation in the Dearborn River watershed.

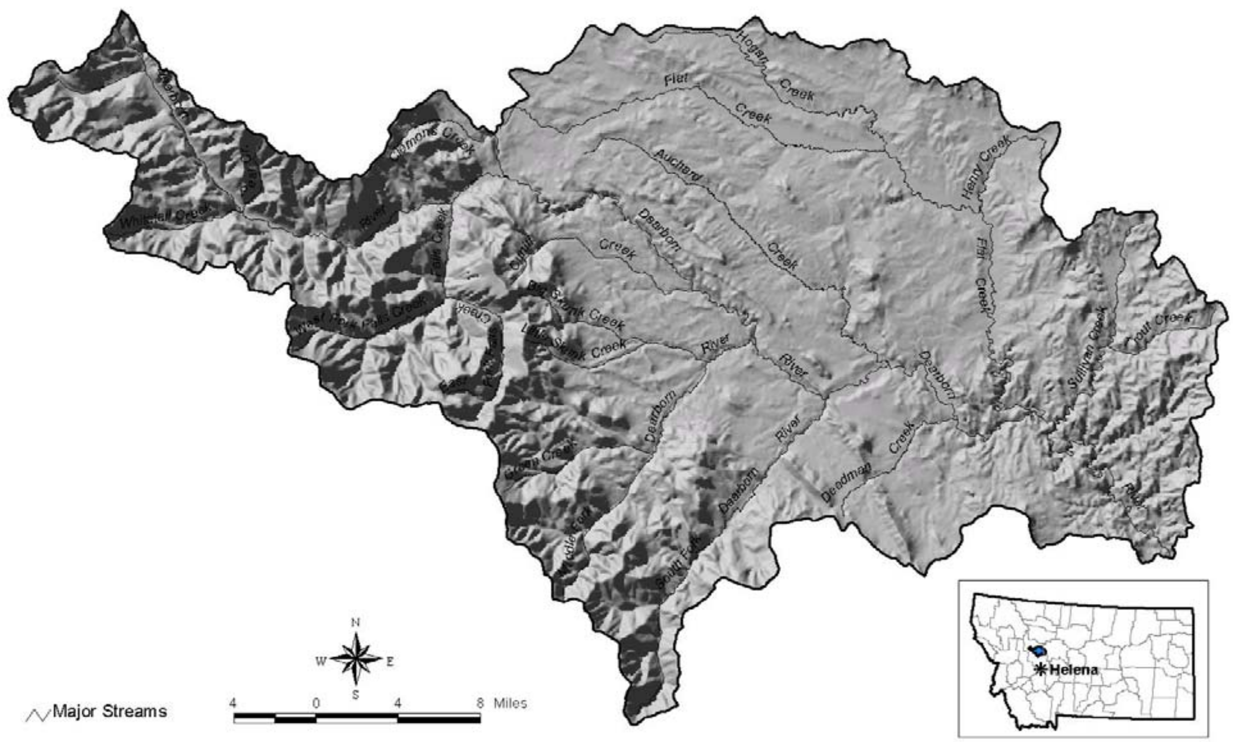


Figure 2-8. Topographic relief in the Dearborn River watershed.

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

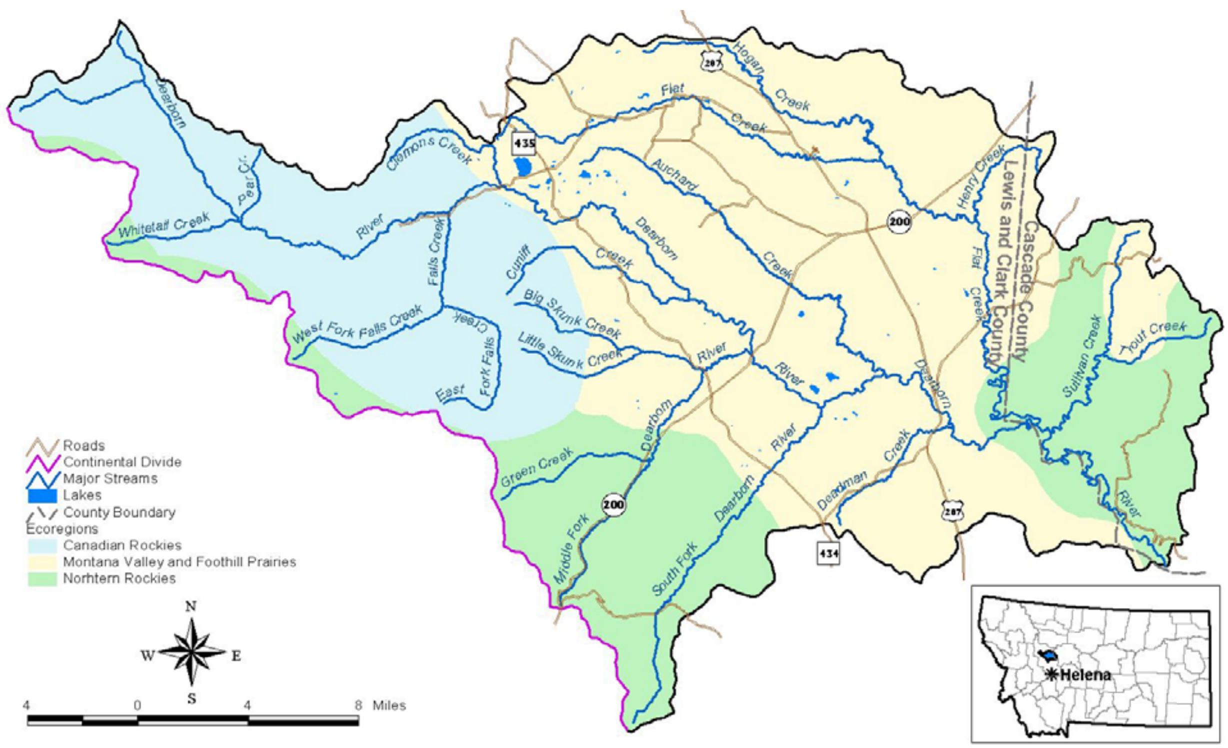


Figure 2-9. Ecoregions in the Dearborn TPA.

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**

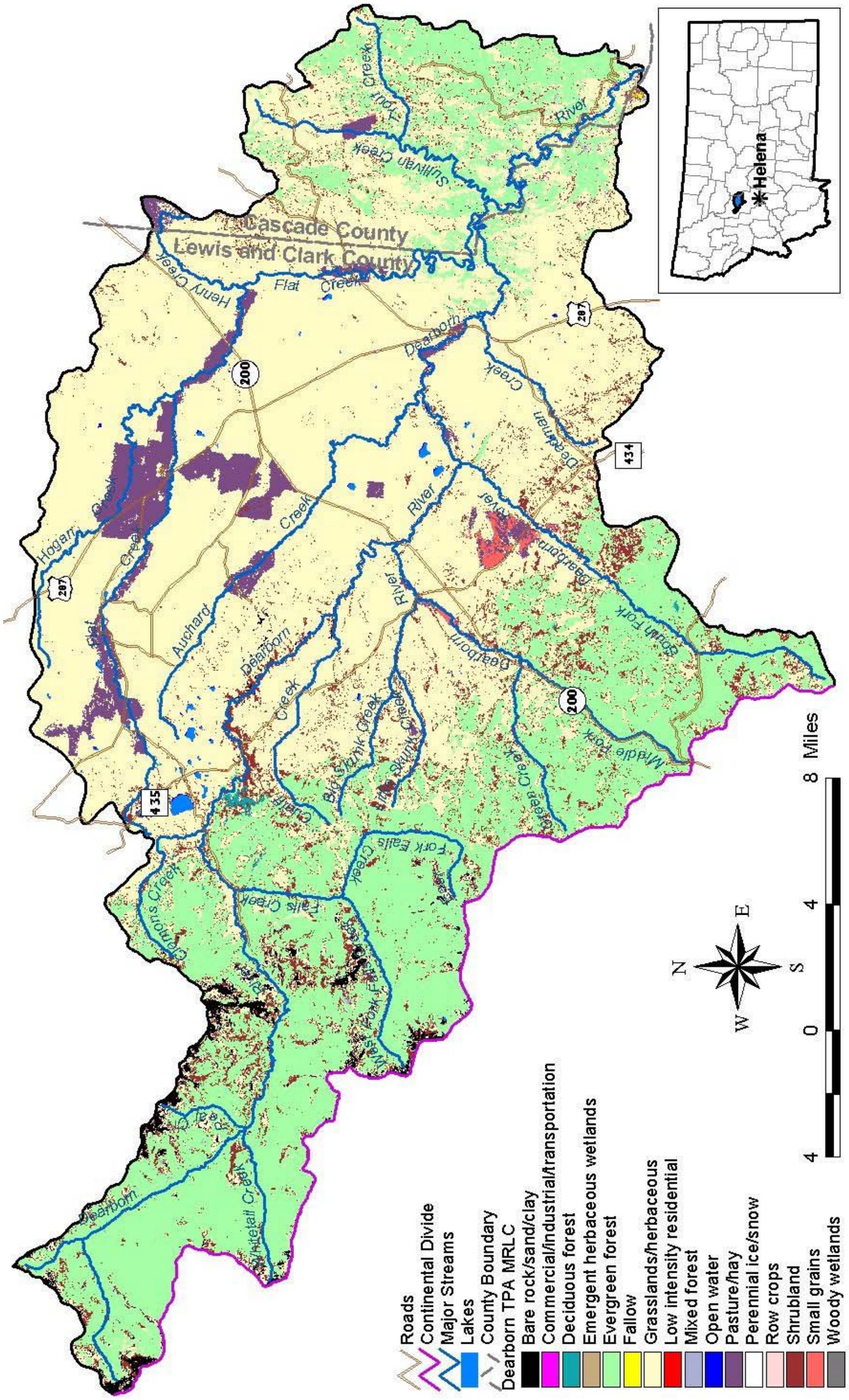


Figure 2-10. MRLC land use/land cover in the Dearborn River watershed.

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

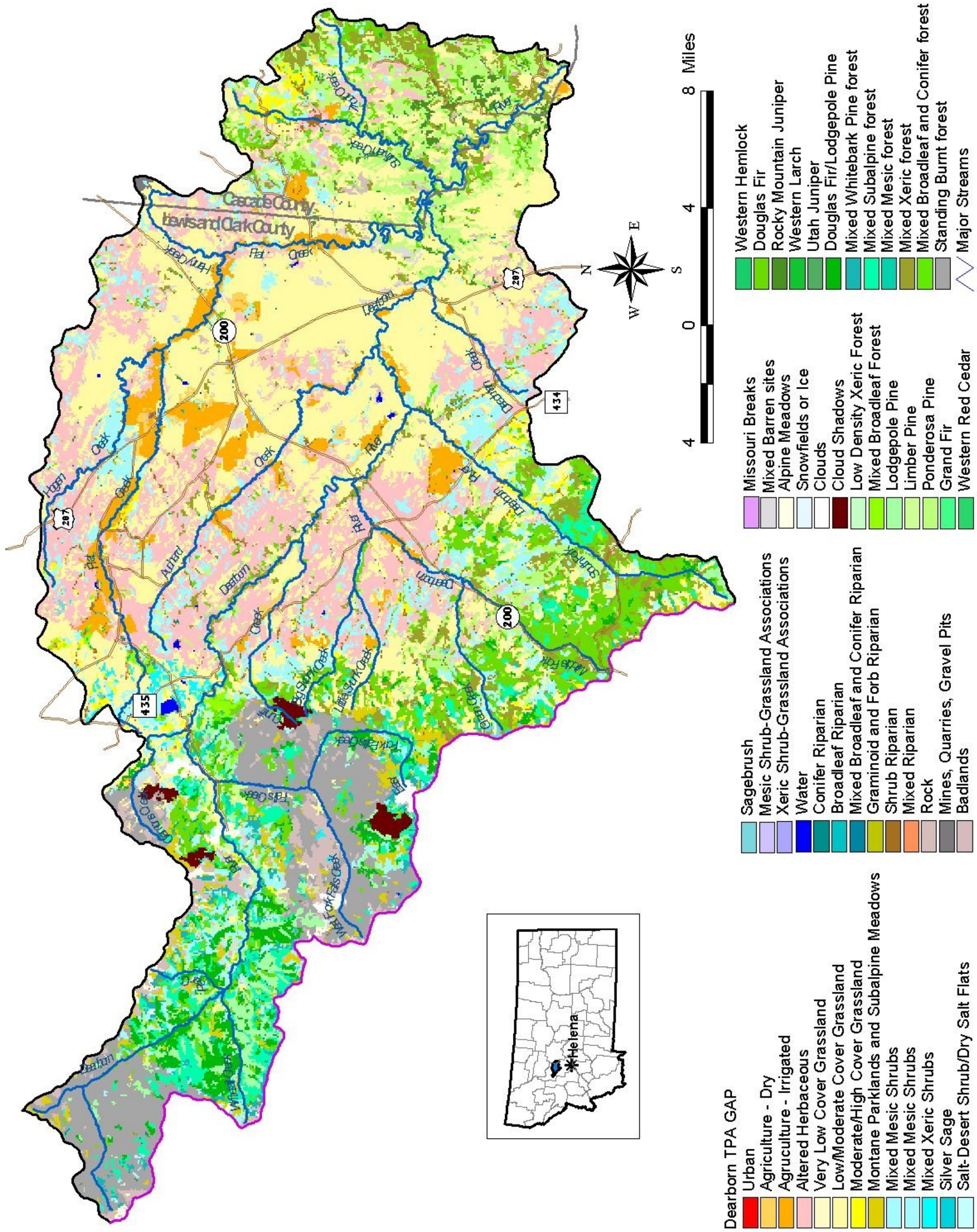


Figure 2-11. GAP vegetative cover in the Dearborn River Watershed.

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.

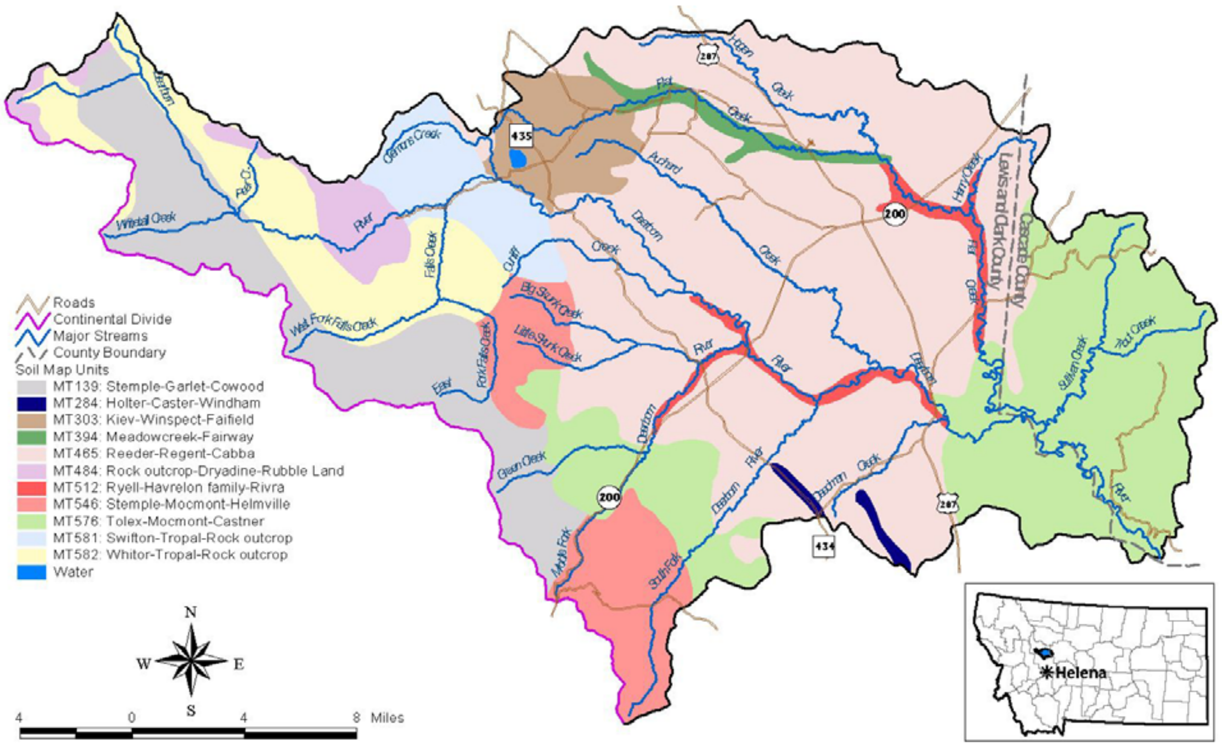


Figure 2-12. General soil units in the Dearborn River TPA.

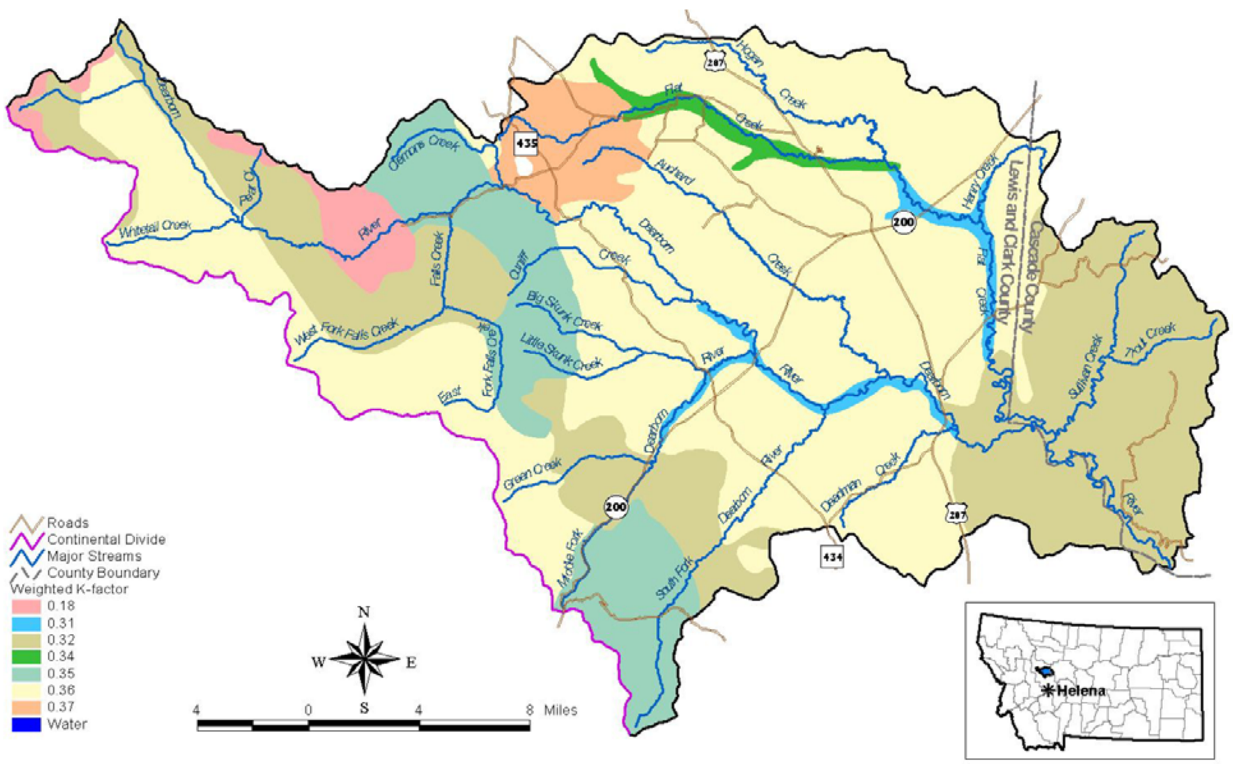


Figure 2-13. Distribution of USLE K-factor.

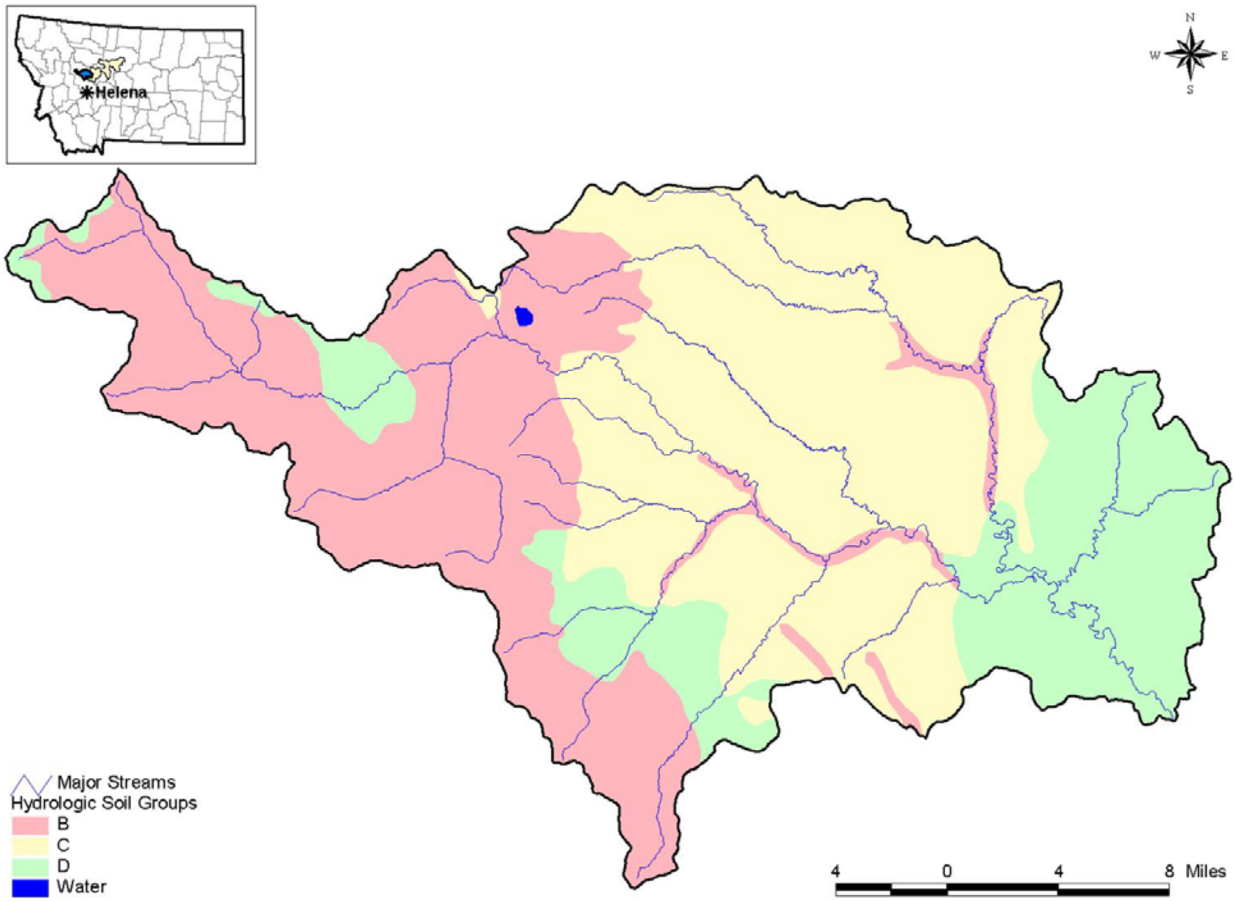


Figure 2-14. Distribution of hydrologic soil groups.

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

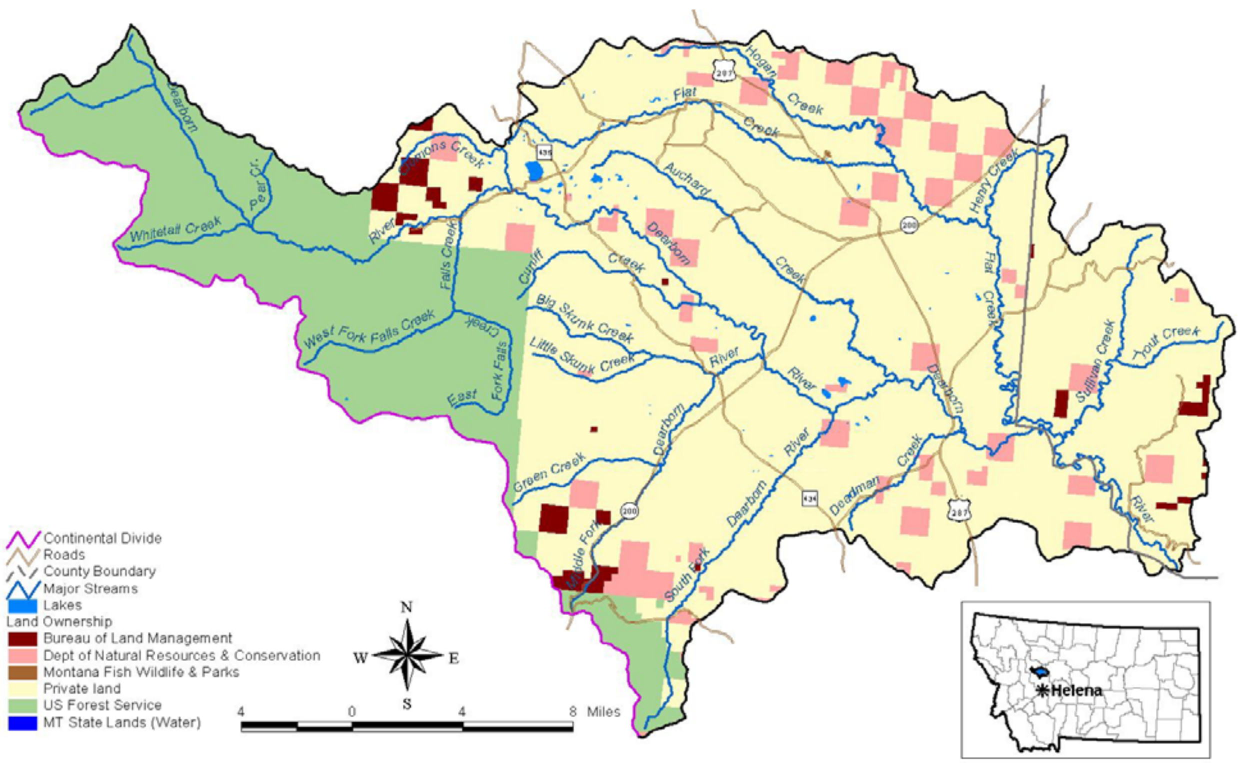


Figure 2-15. Land ownership in the Dearborn TPA.

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.

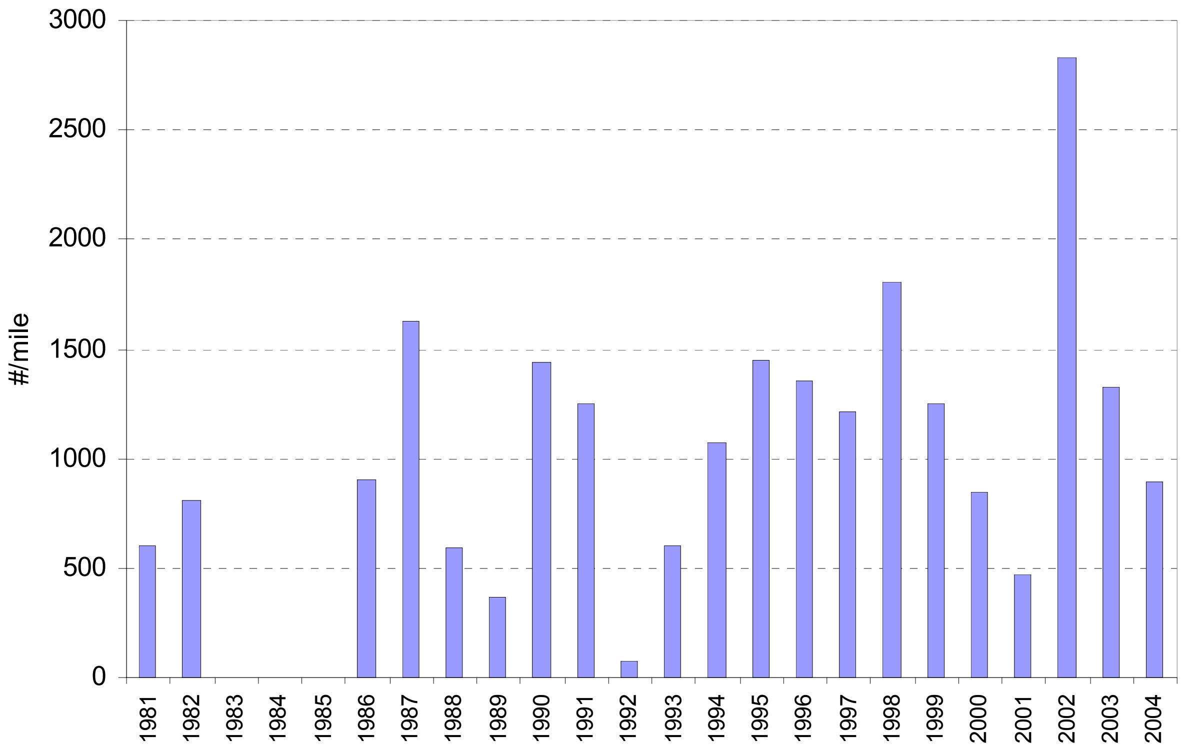


Figure 2-16.   Fall estimates of age-1 rainbow trout in the Missouri River at Pelican Point.

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.

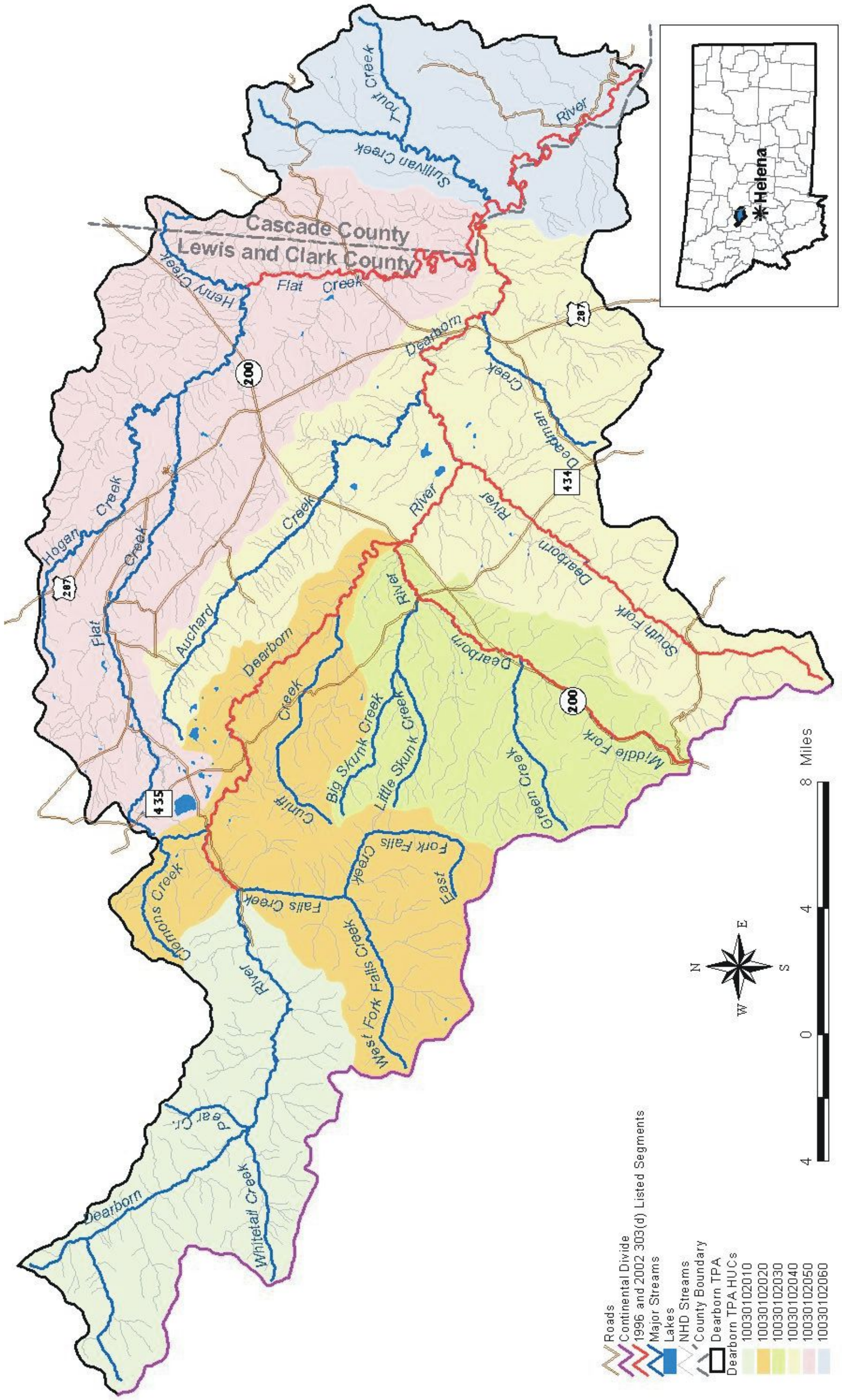


Figure 3-1. Location of 303(d) listed streams in the Dearborn River TPA.

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.

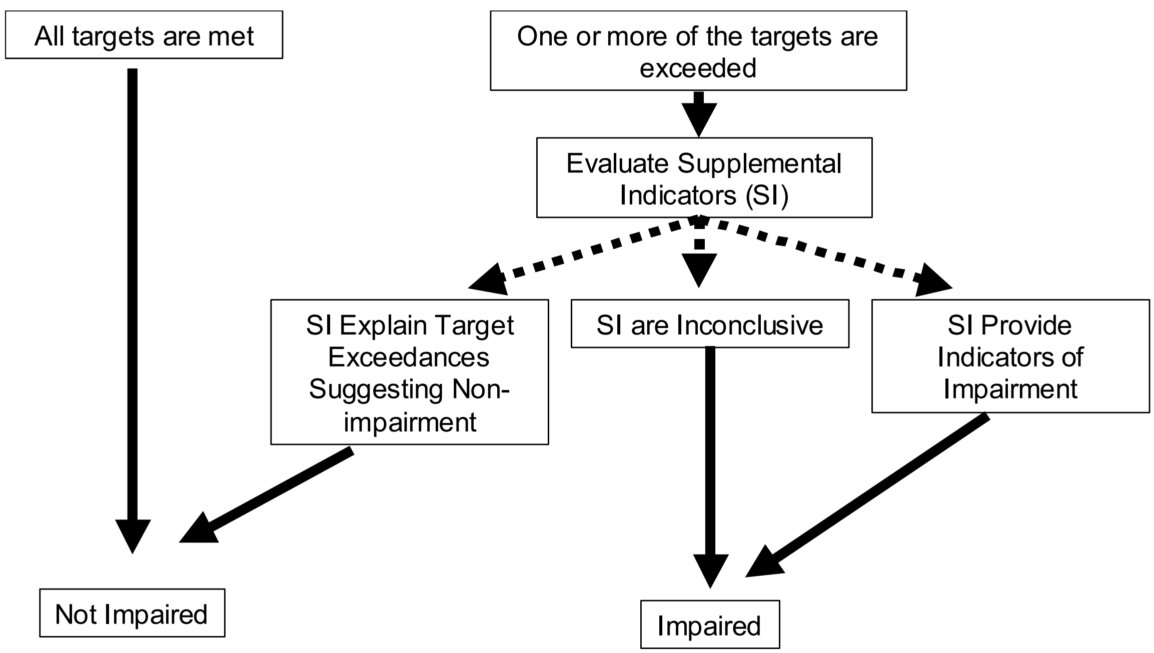


Figure 3-2.   Weight-of-evidence approach for determining beneficial use impairments.

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.

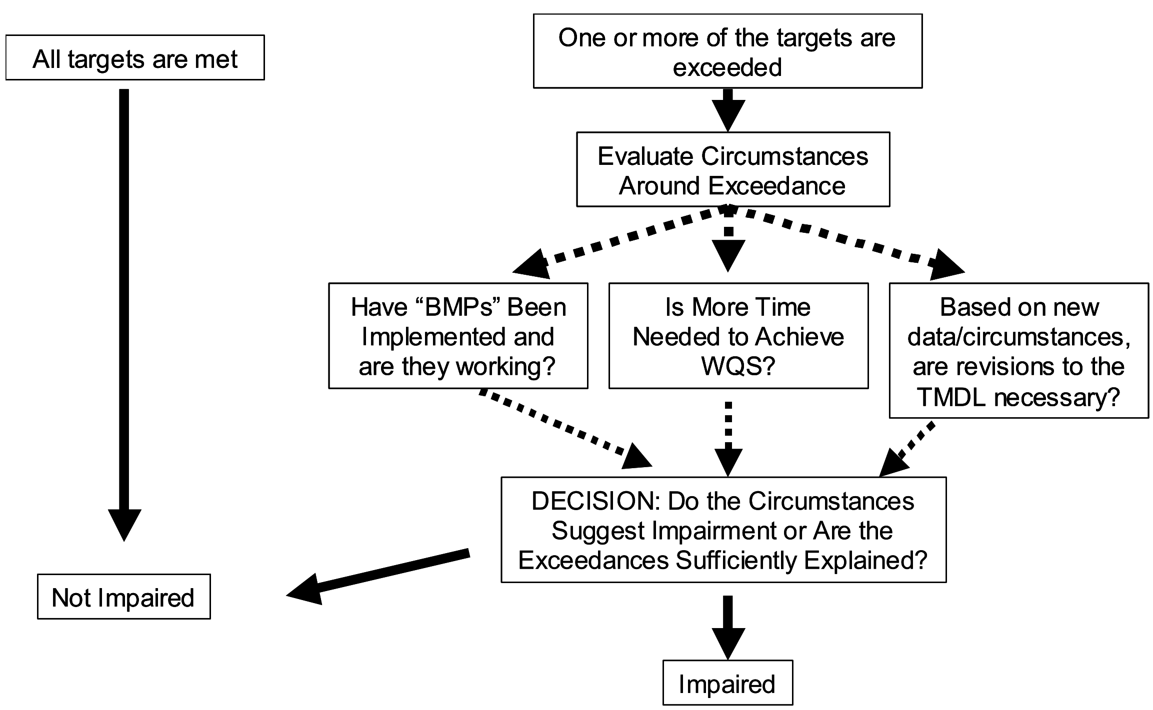


Figure 3-3. Methodology for determining compliance with water quality standards.

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

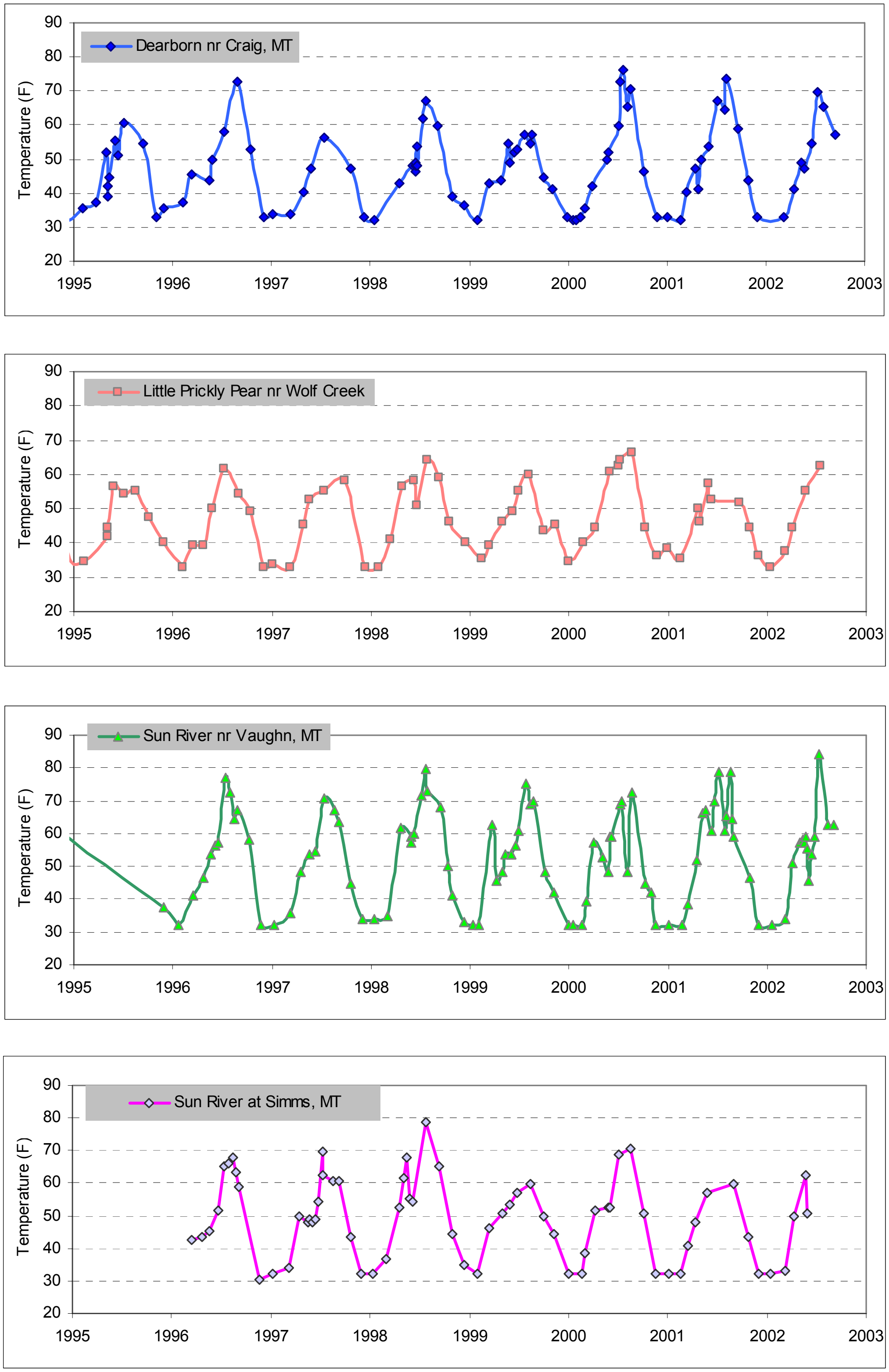


Figure 3-4. Comparison of Dearborn River temperature data to the Sun River and Little Prickly Pear Creek.

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.

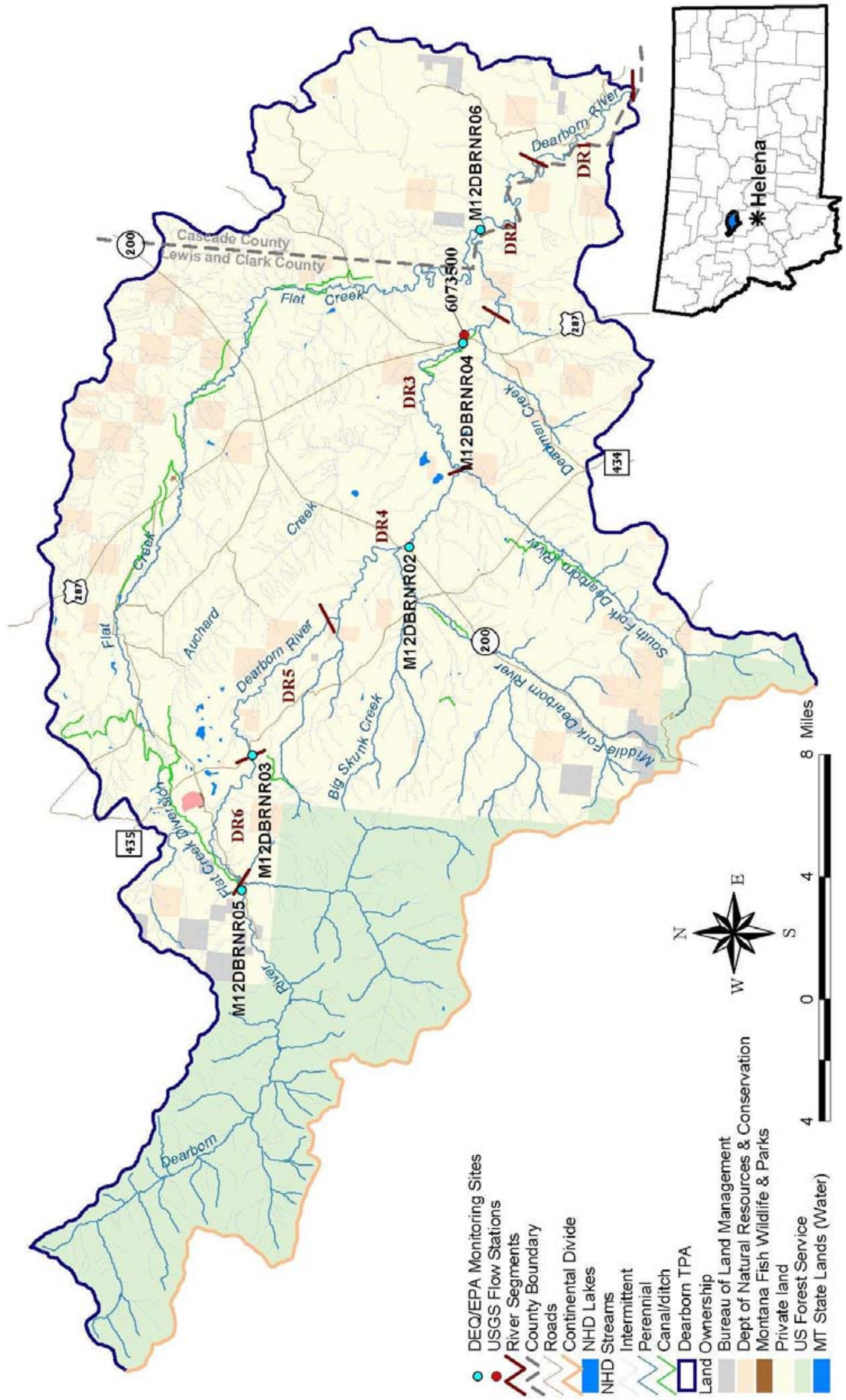


Figure 3-7. Sampling locations in the mainstem Dearborn River.

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	—

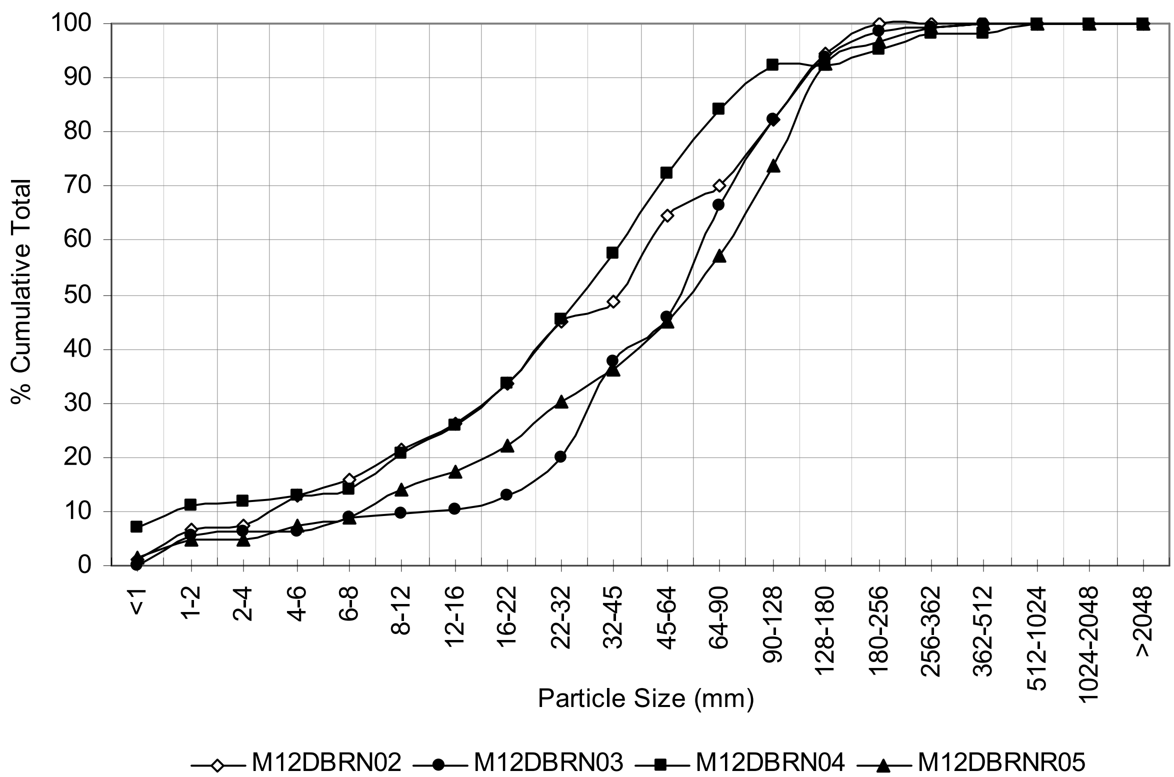


Figure 3-8. Cumulative stream bottom particle distribution for the Dearborn River.

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 5th and 6th 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).

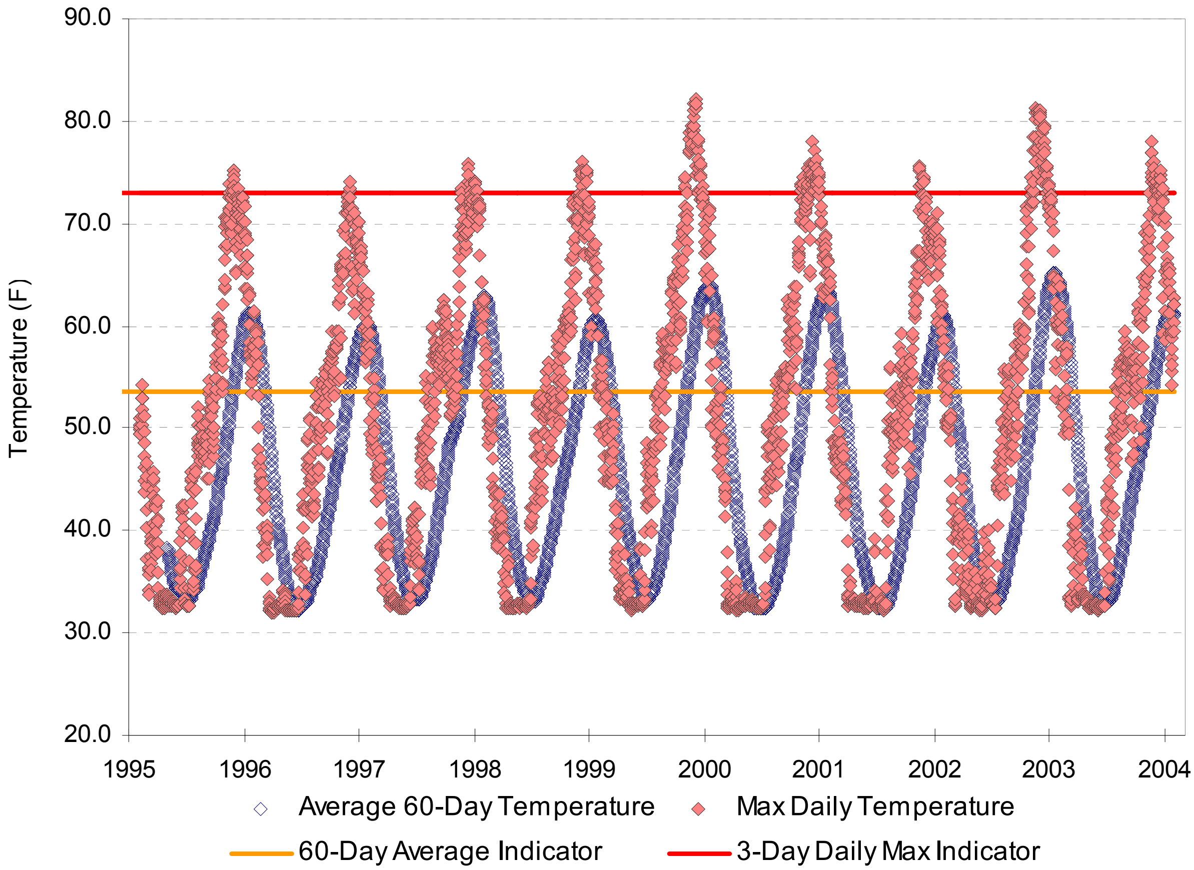


Figure 3-9. Evaluation of continuous temperature data for the Dearborn River at Highway 287 (USGS gage 06073500).

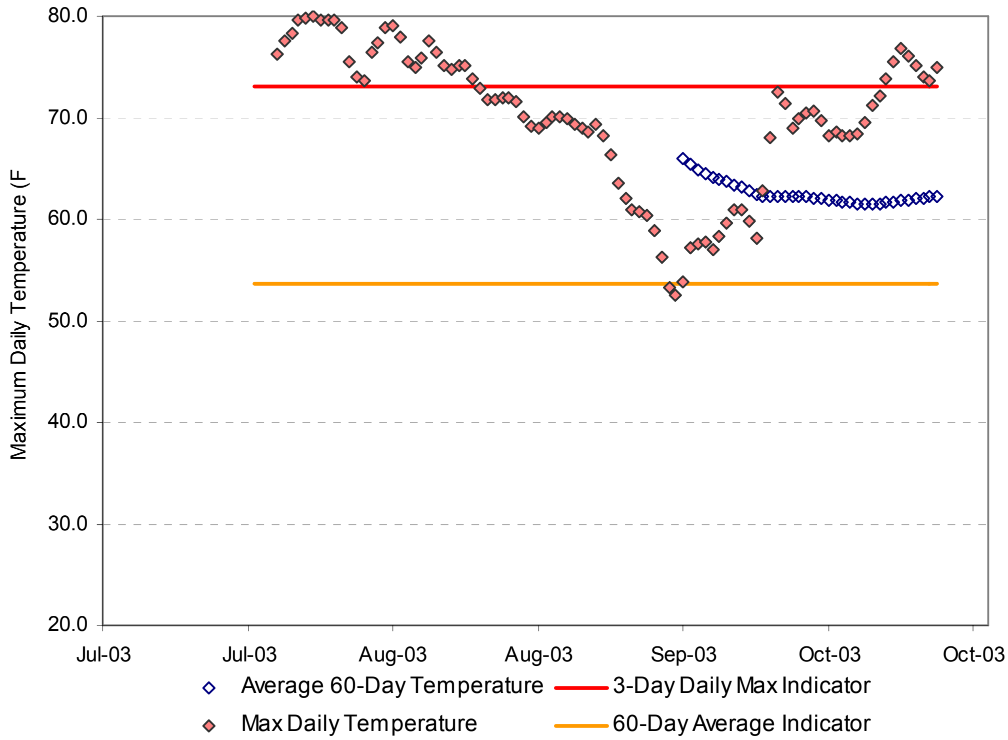


Figure 3-10. Continuous temperature evaluation for the Dearborn River downstream of Flat Creek.

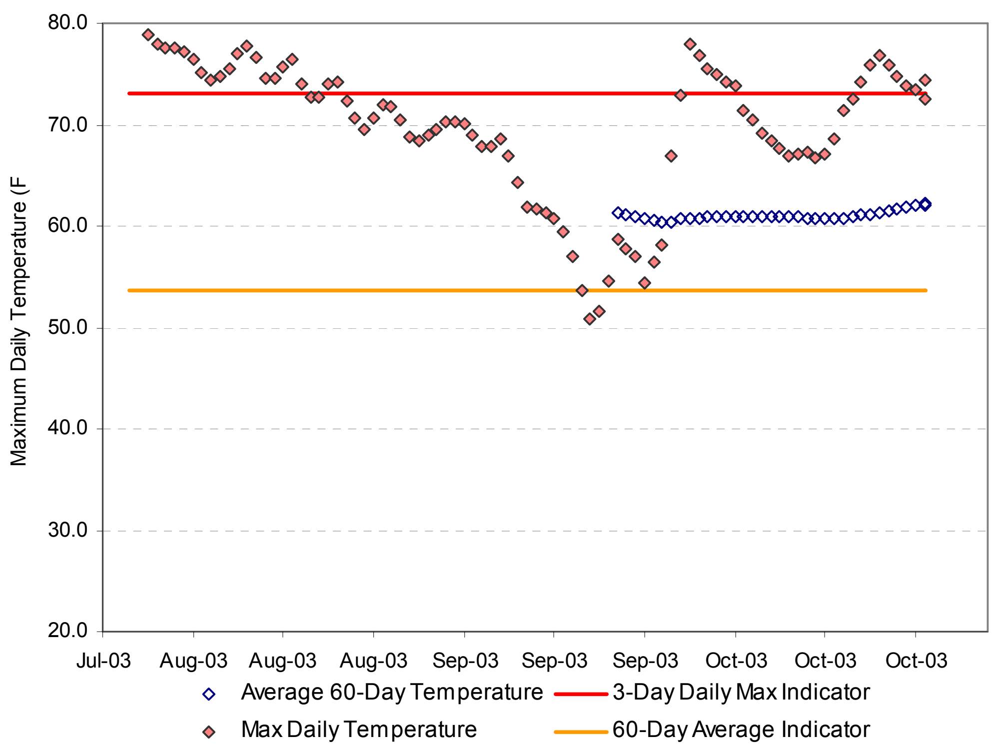


Figure 3-11. Continuous temperature evaluation for the Dearborn River at the Highway 200 Bridge.

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.

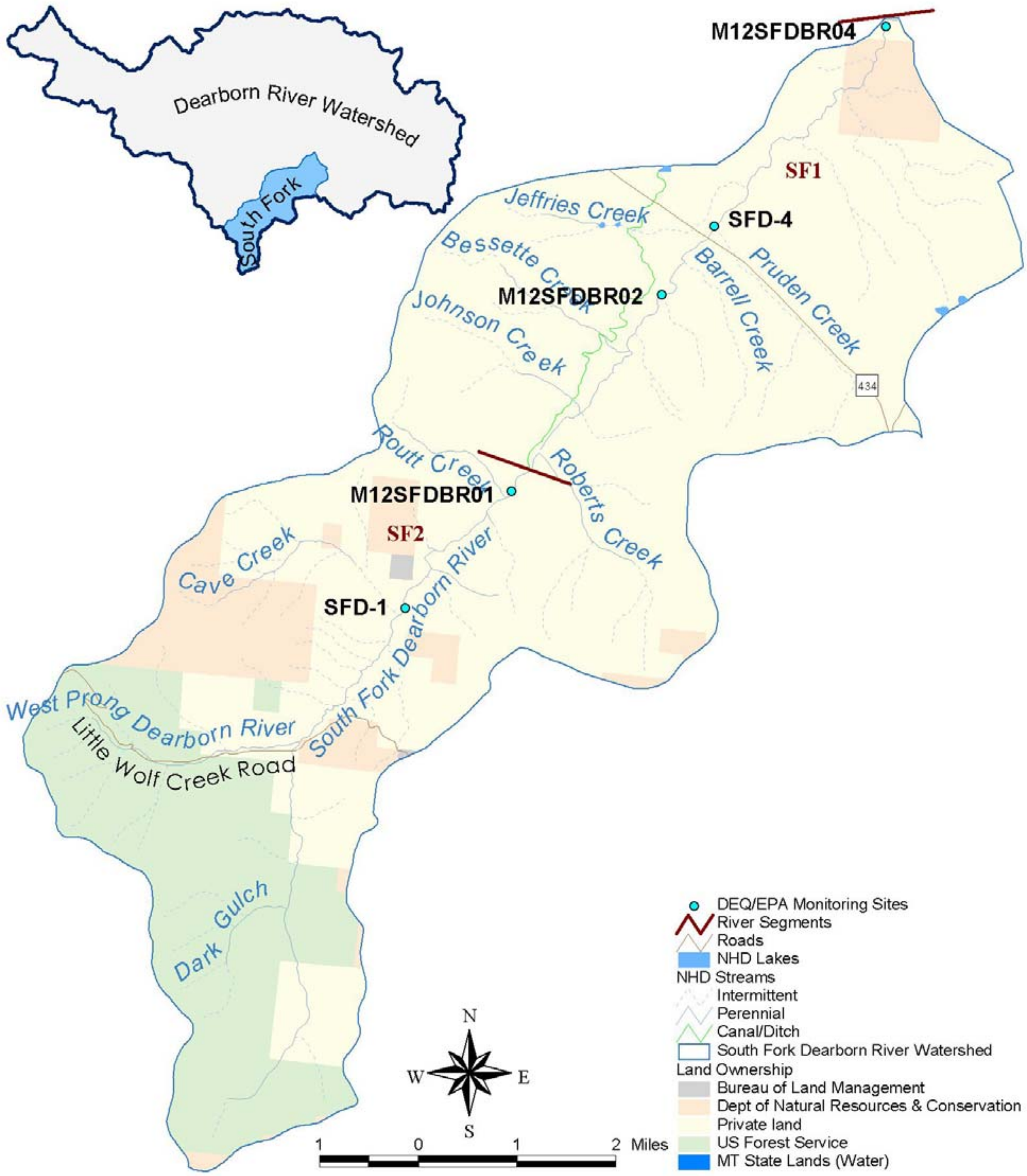


Figure 3-14. Sampling locations in the South Fork Dearborn River watershed.

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	—

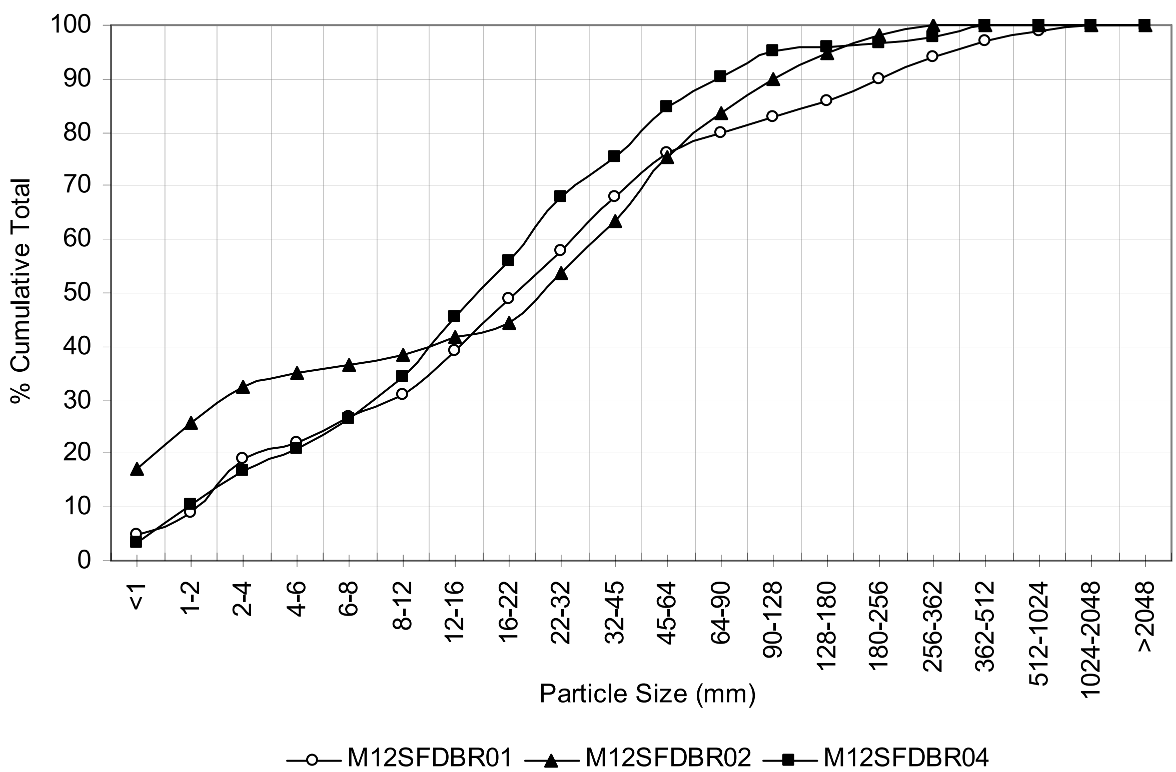


Figure 3-15. Cumulative stream bottom particle distribution for the South Fork of the Dearborn River.

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

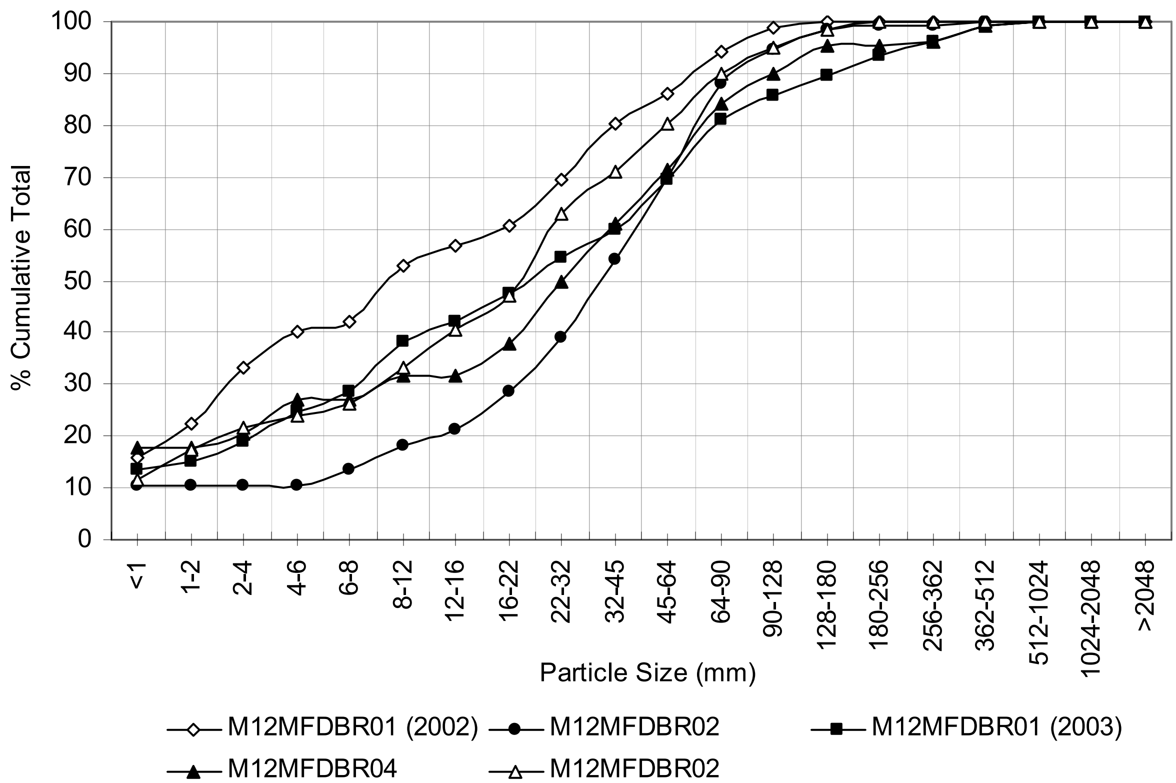


Figure 3-19. Cumulative stream bottom particle distribution for the Middle Fork of the Dearborn River.

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.

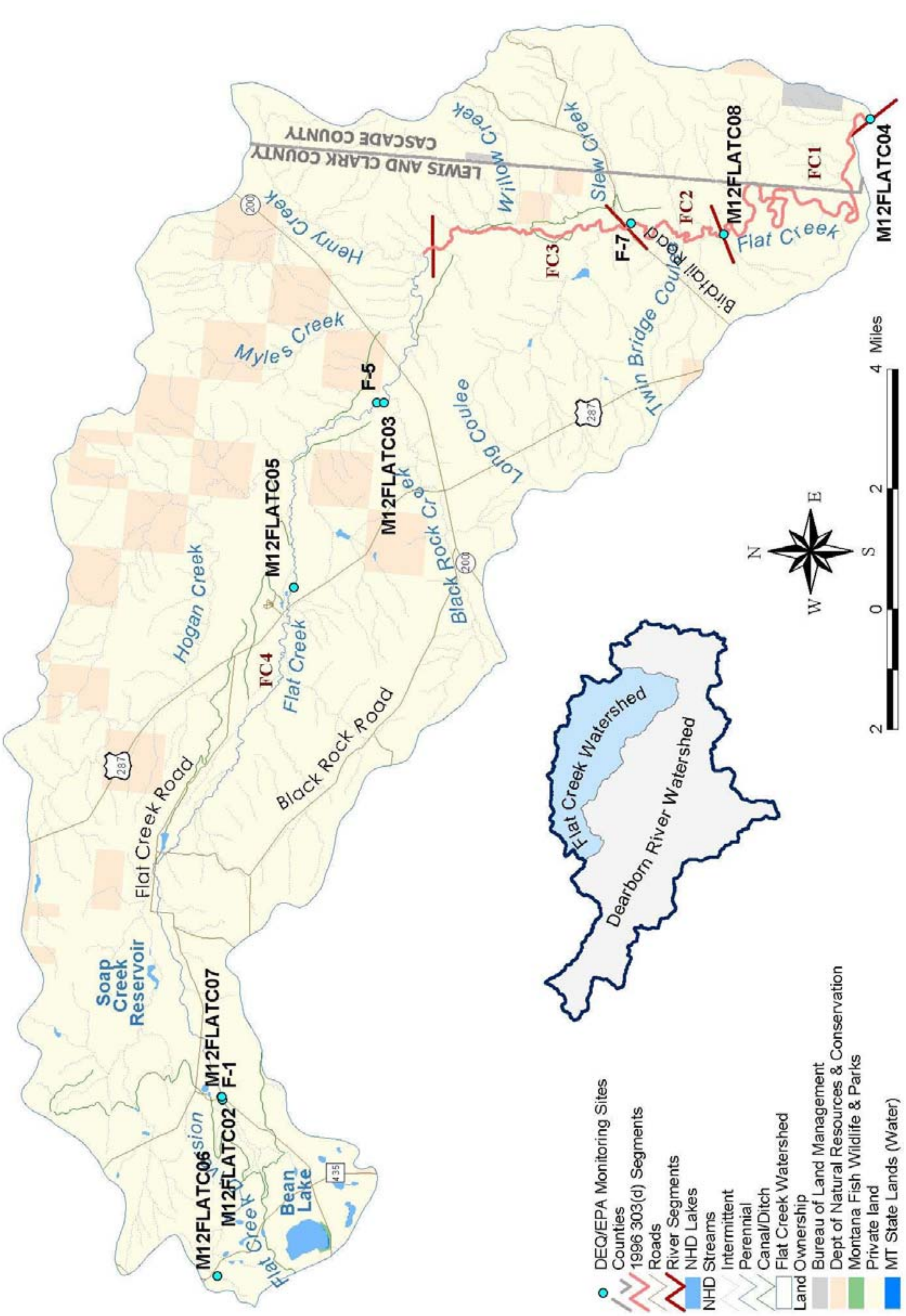


Figure 3-22. Sampling locations in the Flat Creek watershed.

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	—

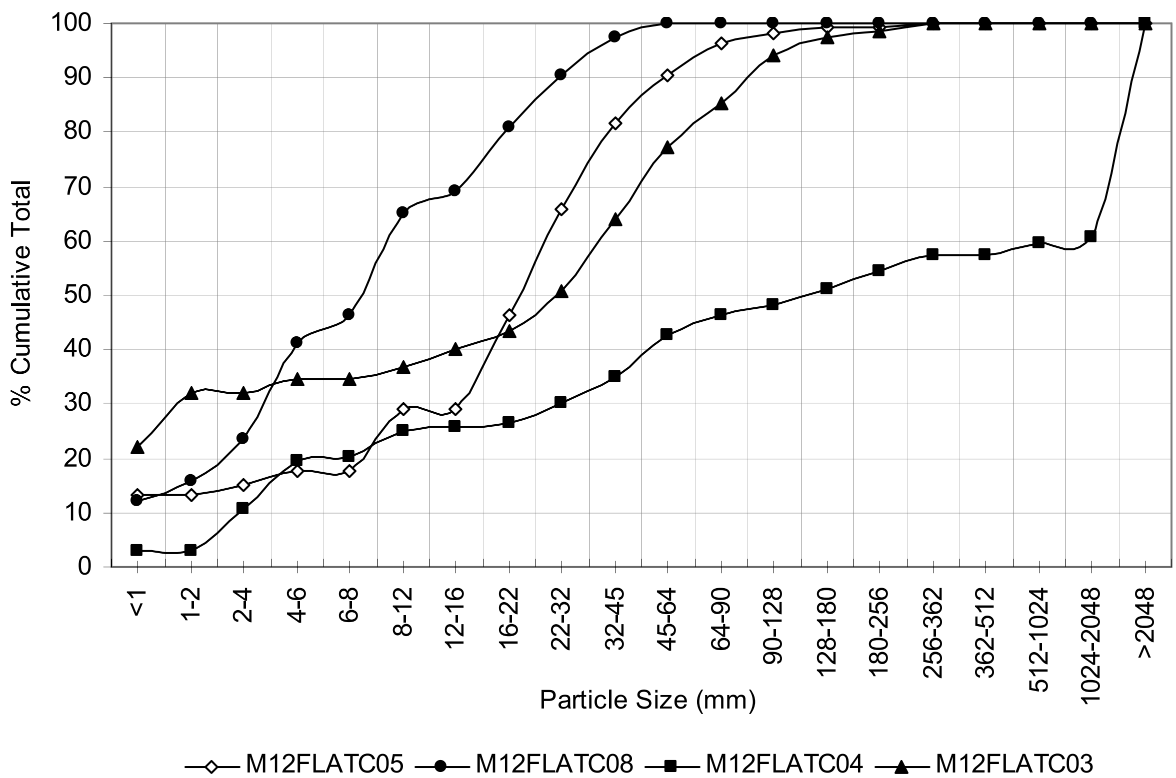


Figure 3-23. Cumulative stream bottom particle distribution for Flat Creek.

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 = 10.8sin θ + 0.03	Sin θ < 0.09
S = 16.8sin θ - 0.50	Sin θ ≥ 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.

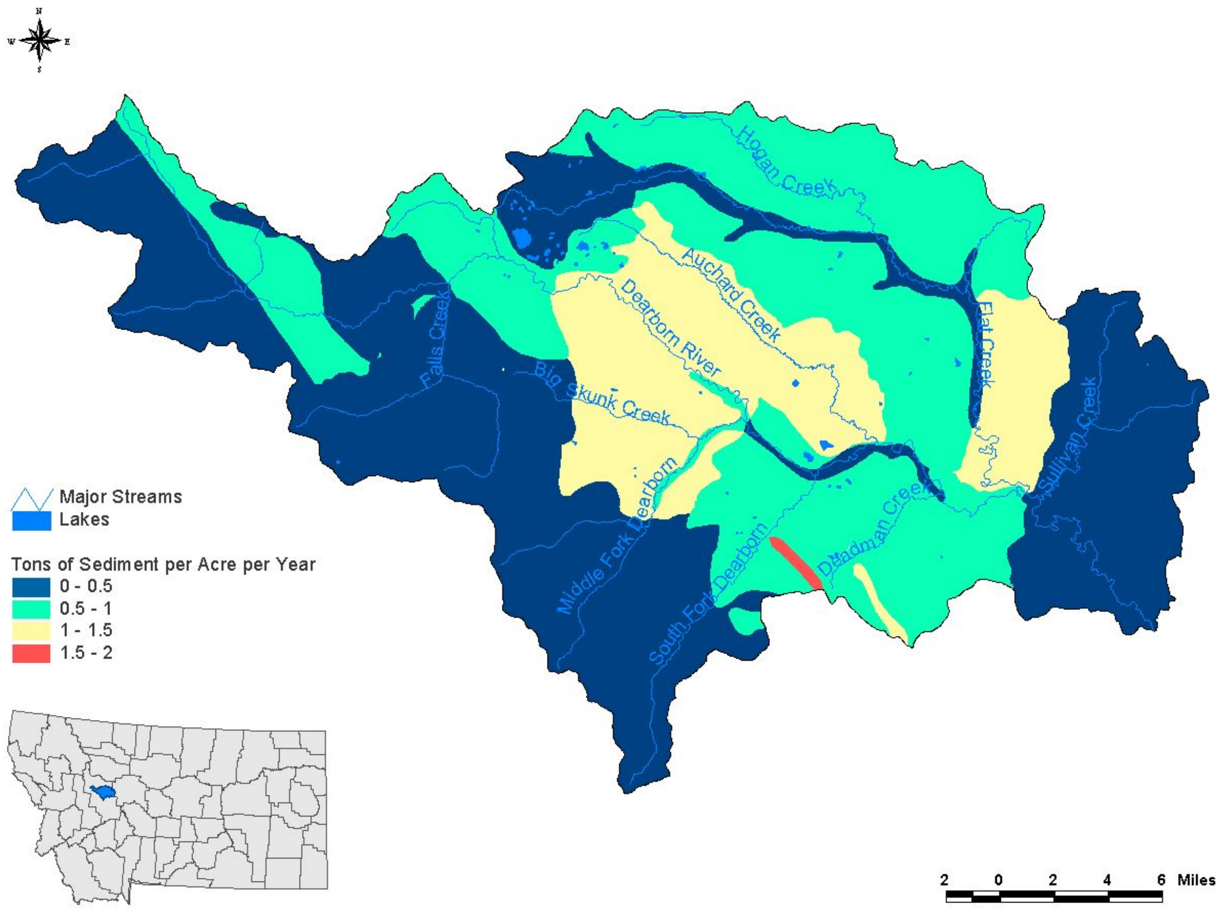


Figure 4-1. USLE soil loss in the Dearborn River watershed.

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.

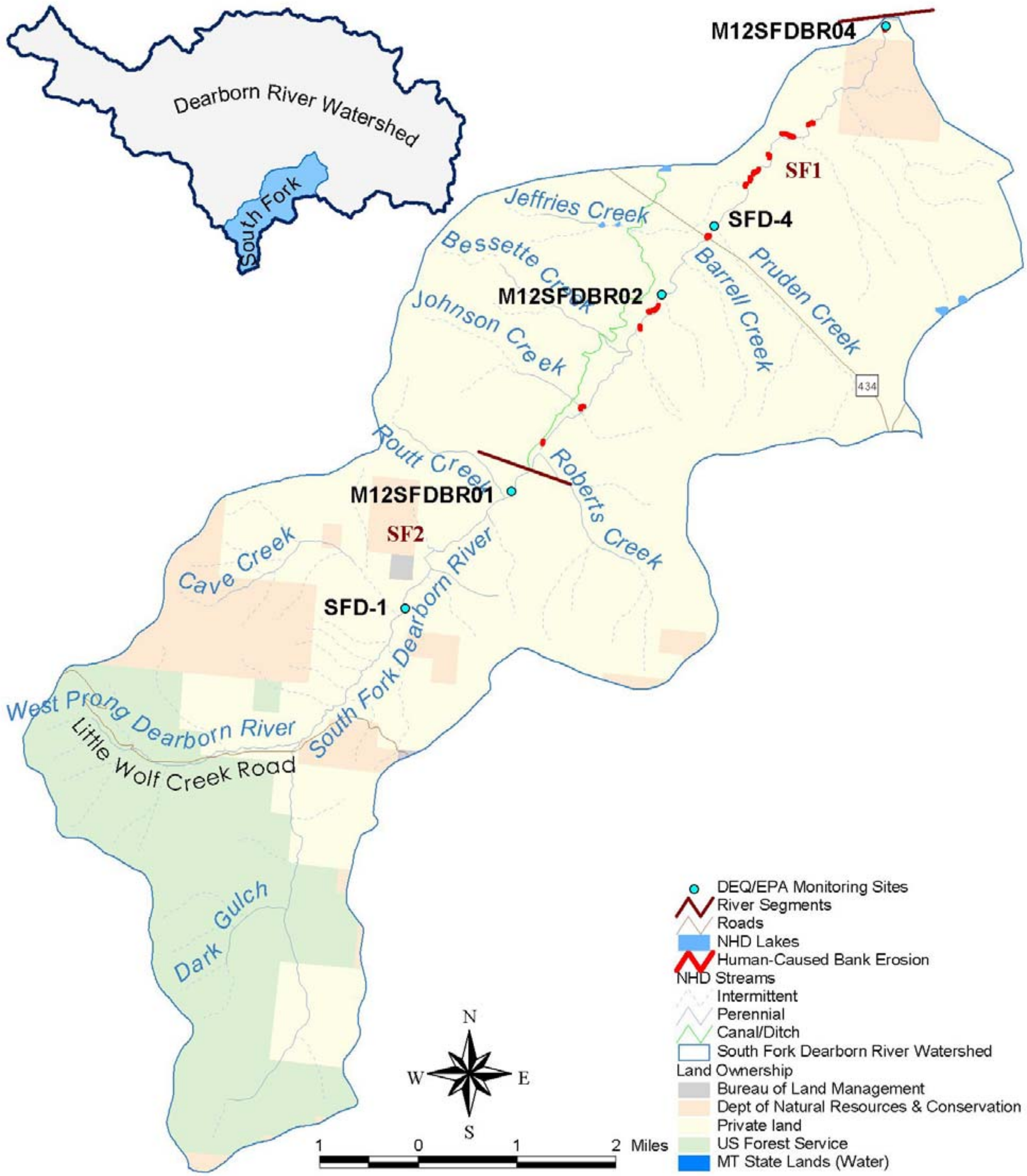


Figure 5-1. Human-caused sources of bank erosion along the South Fork Dearborn River.

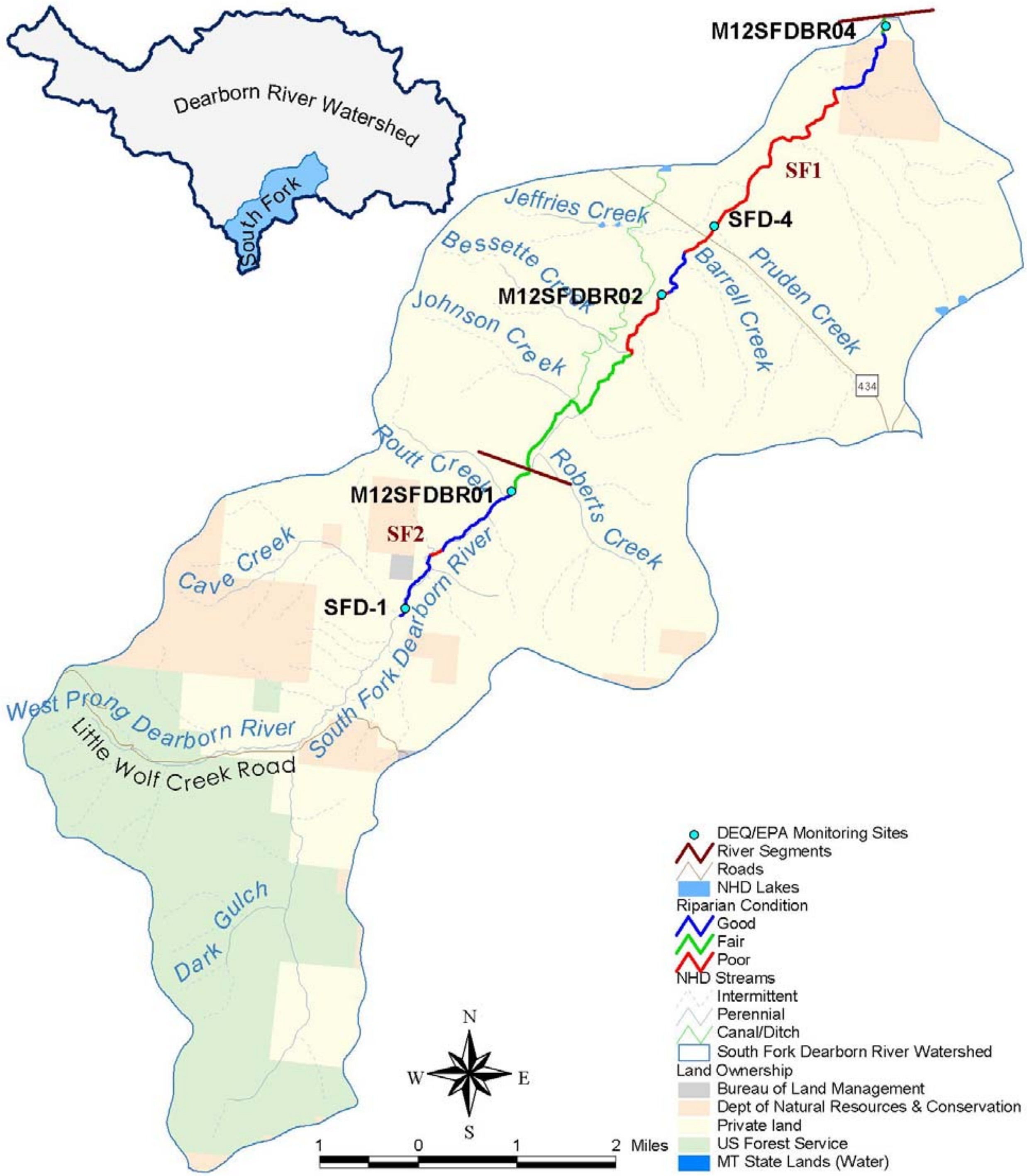


Figure 5-2. Riparian condition along the South Fork Dearborn River.

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

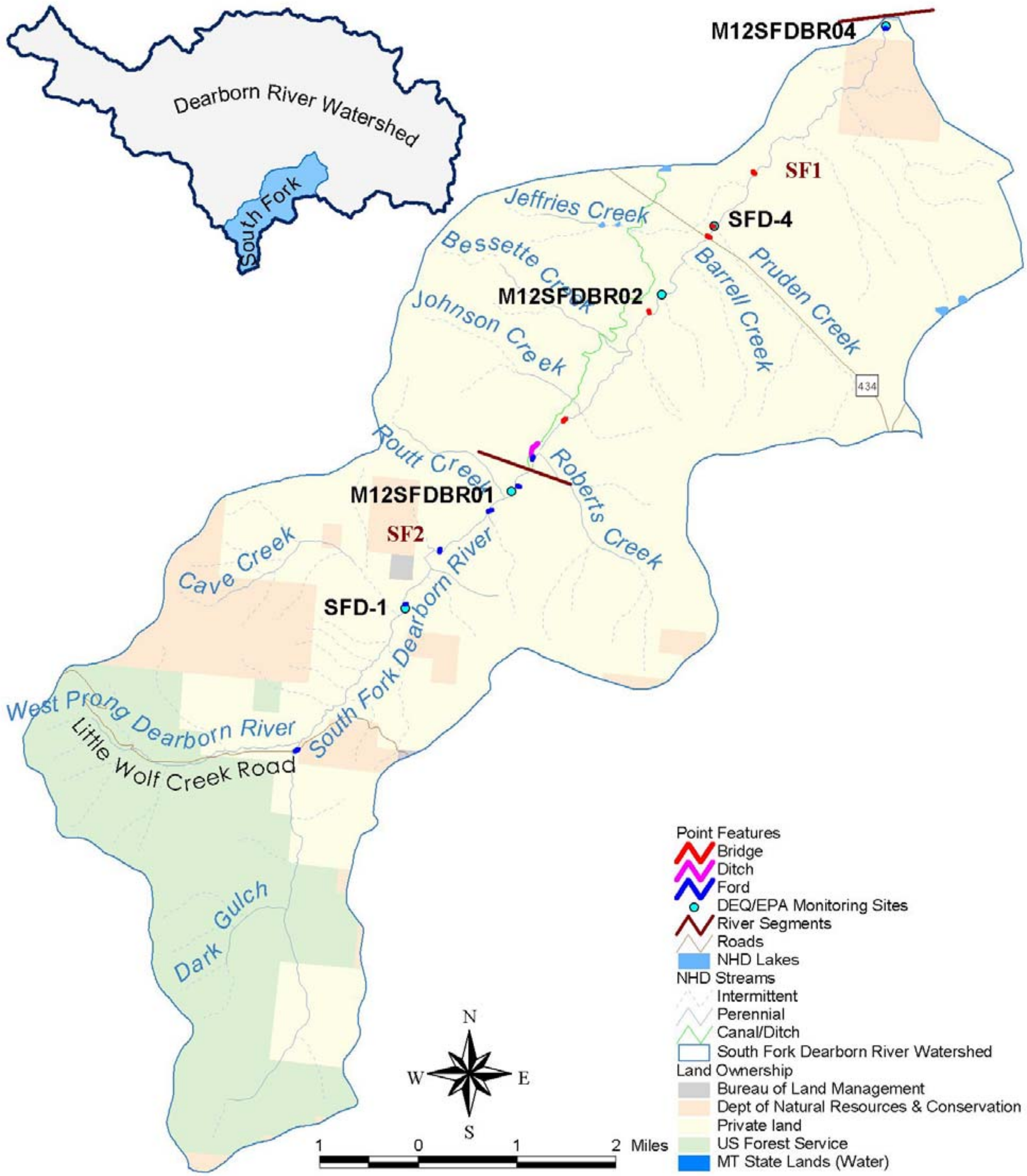


Figure 5-6. Point features along the South Fork Dearborn River.

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:

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

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.

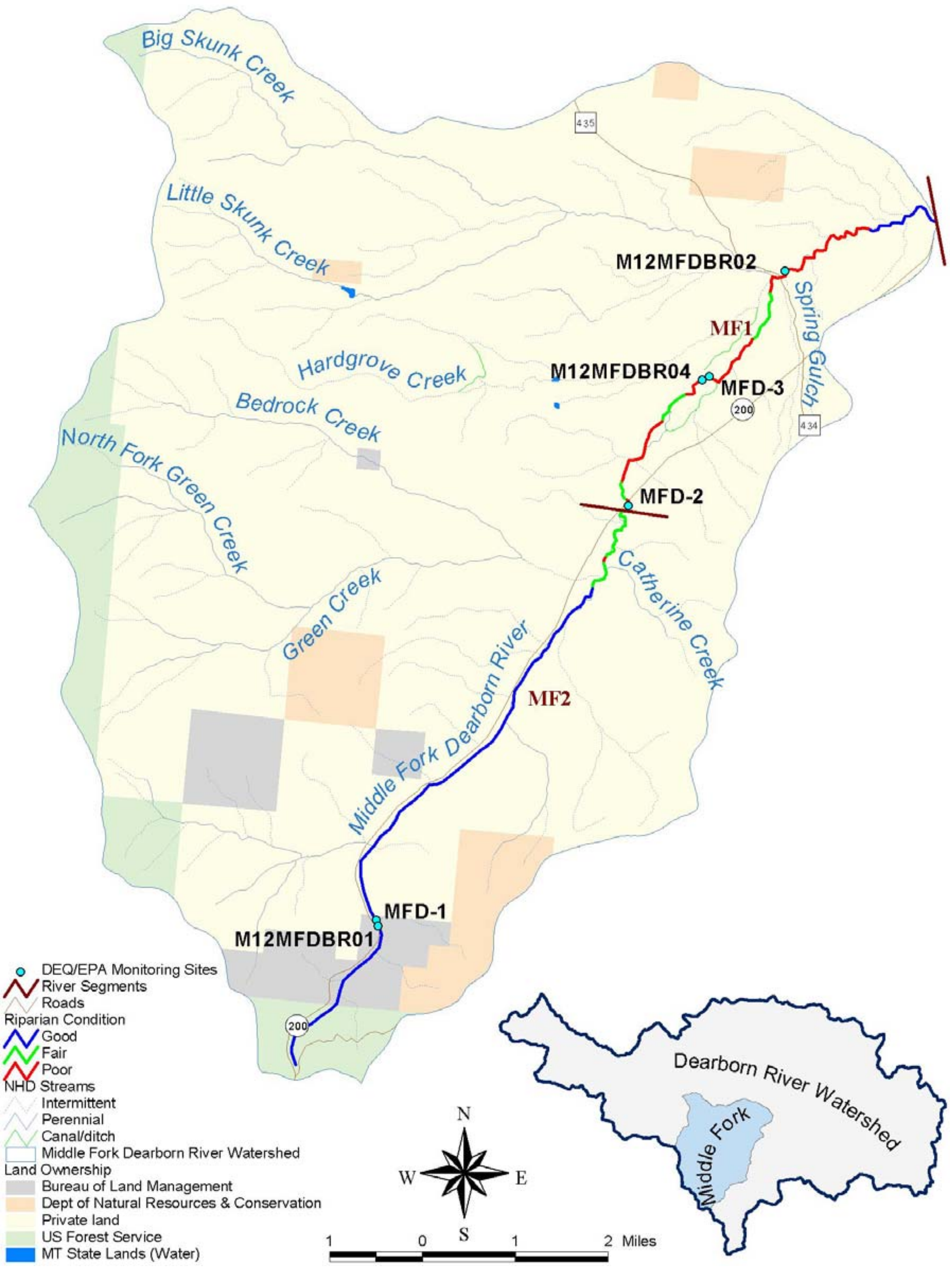


Figure 5-8. Riparian condition along the Middle Fork Dearborn River.

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

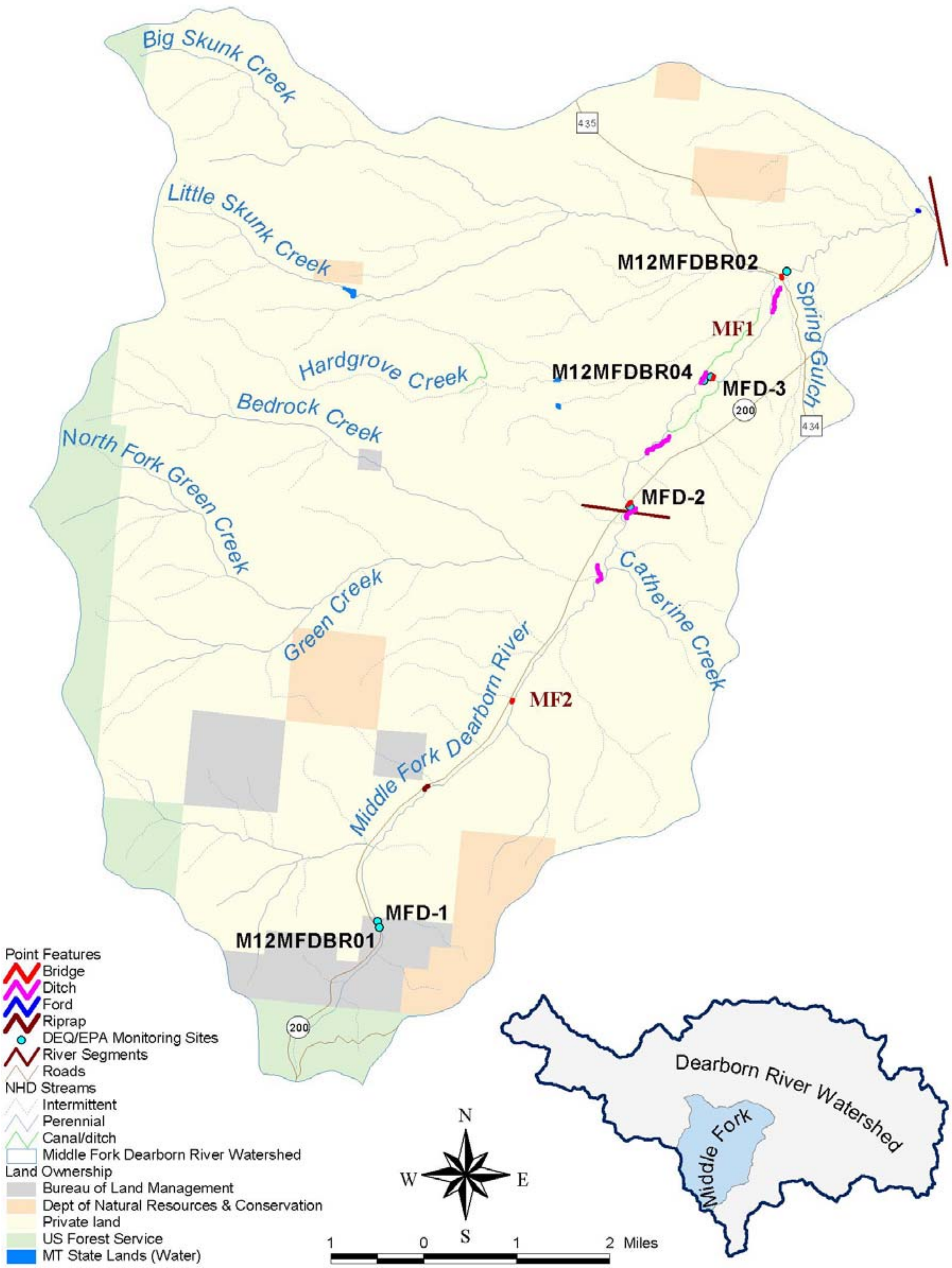


Figure 5-9. Point features along the Middle Fork Dearborn River.

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

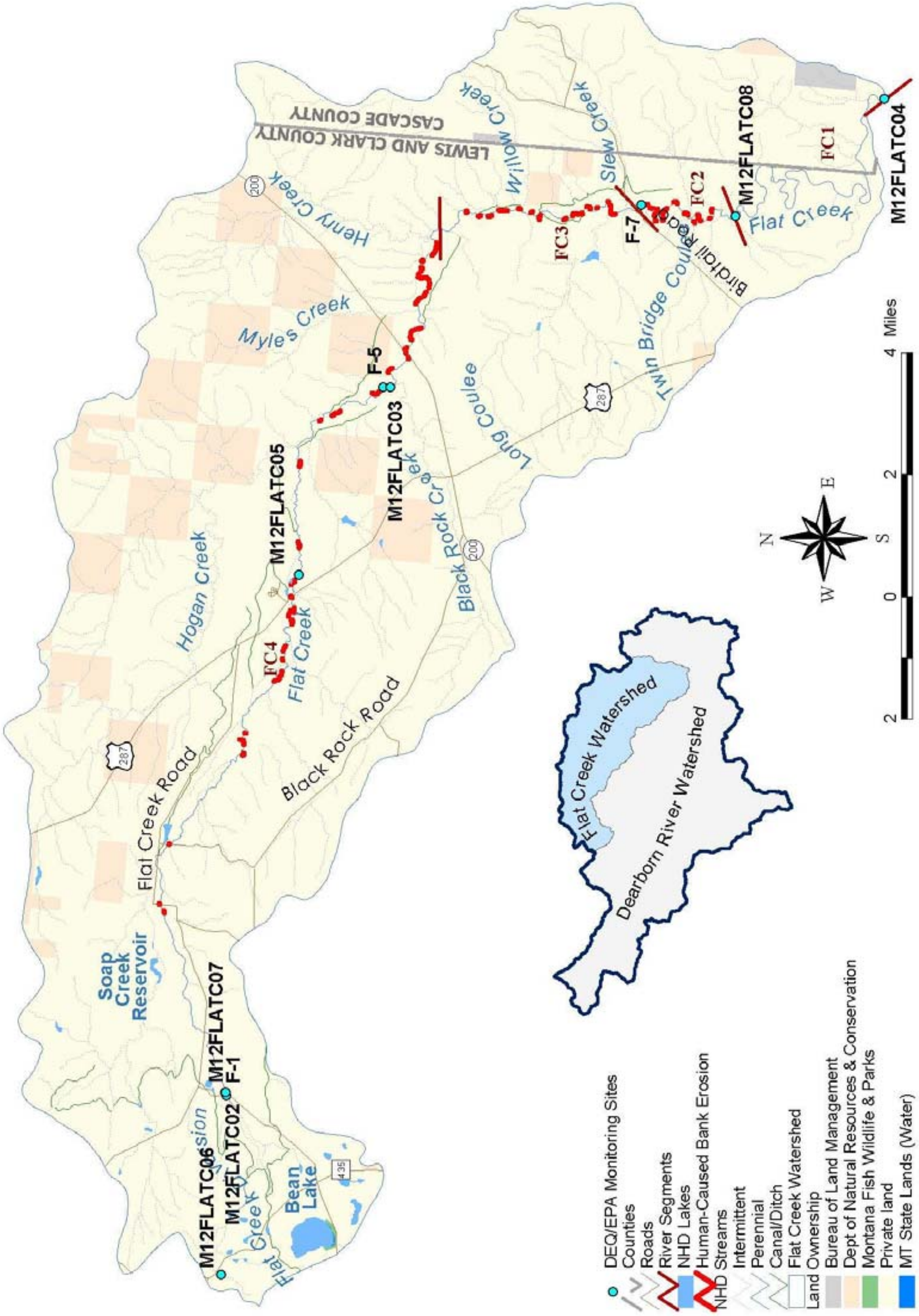


Figure 5-14. Human-caused sources of bank erosion along Flat Creek.

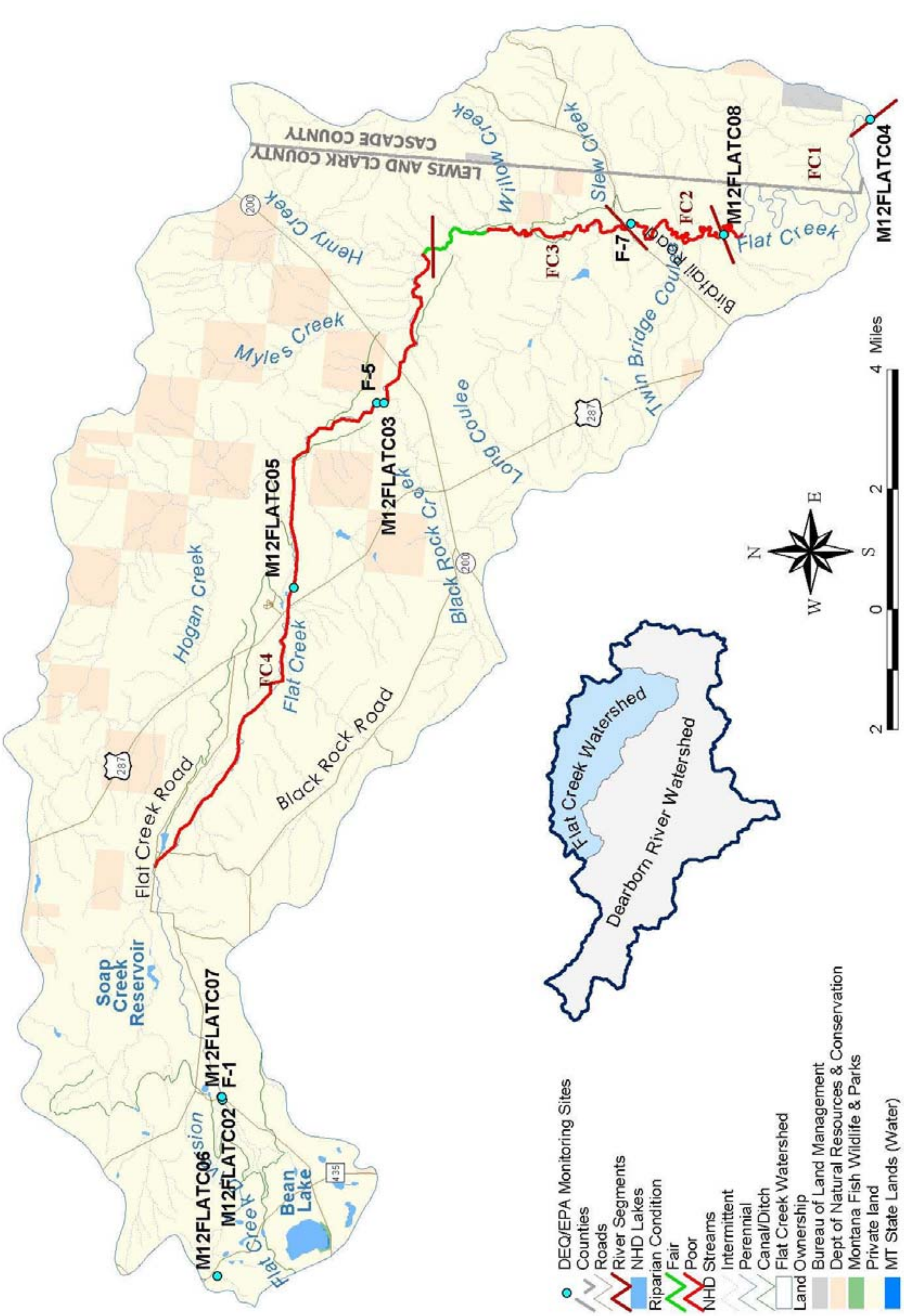


Figure 5-15. Riparian condition along Flat Creek.

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.

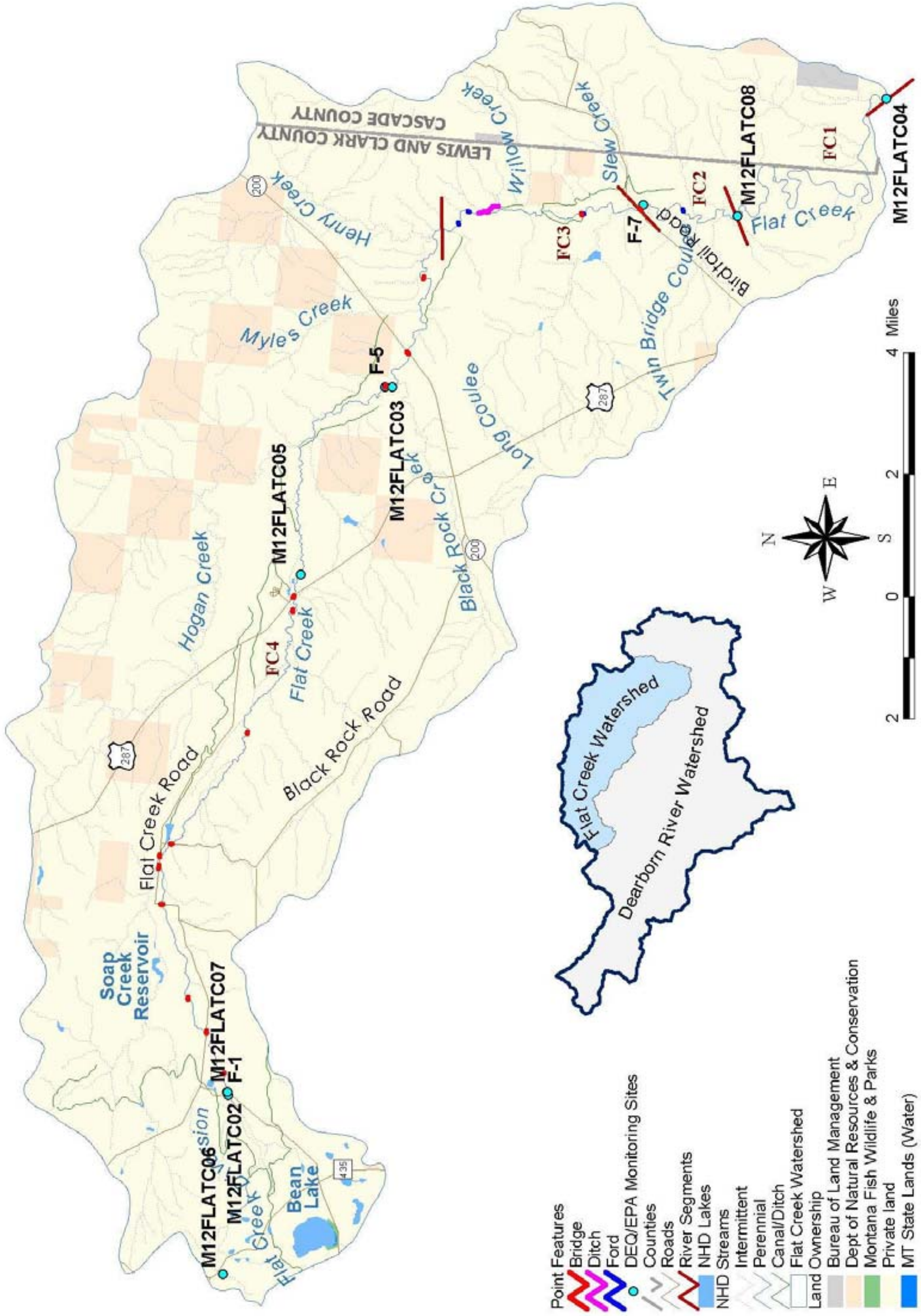


Figure 5-20. Point features along Flat Creek.

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. <u>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.</u> "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 <u>may</u> 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) <u>may</u> 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 <u>all</u> 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.

8.0 REFERENCES

ARM (Administrative Rules of Montana). 1996. Surface Water Quality Standards and Procedures. Administrative Rules of Montana 17.30.601-646, Helena, MT.

———. 2002. Surface Water Quality Standards and Procedures. Administrative Rules of Montana 17.30.601-646, Helena, MT.

Bahls, L.L., B. Bukantis, and S. Tralles. 1992. Benchmark Biology of Montana Reference Streams. Montana Department of Health and Environmental Sciences. Helena, MT.

Bahls, L. 2001. *Support of Aquatic Life Uses in Tributaries of the Dearborn River Based on Composition and Structure of Benthic Algae Community*. Montana Department of Environmental Quality, Helena, MT.

Bahls, L.L. 2003a (Draft). *Biological Integrity of Streams in the Dearborn River TMDL Planning Area Based on the Structure and Composition of the Benthic Algae Community.* May 12, 2003. Prepared for the State of Montana, Department of Environmental Quality, P.O. Box 200901, Helena, MT. Prepared by Hannaea, Loren L. Bahls, 1032 Twelfth Avenue, Helena, MT.

Bahls, L.L. 2003b (Personal communication). Email dated August 22, 2003, to Kevin Kratt, Tetra Tech and Tina Laidlaw, USEPA. (Data and results from 2003 sampling and periphyton assessments in the Dearborn River watershed; 13 locations).

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Bartholow, J.M. 2002. *SSTEMP for Windows: The Stream Segment Temperature Model* (Version 2.0). U.S. Geological Survey Computer Model and Documentation. Available at http://www.fort.usgs.gov.

Bell, M.C. 1986. *Fisheries Handbook of Engineering Requirements and Biological Criteria.* Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers, North Pacific Division, Portland, OR.

Bollman. W. 1998. Improving Stream Bioassessment Methods for the Montana Valley and Foothill Prairies Ecoregion. Master's Thesis (MS), University of Montana, Missoula, Montana.

Bollman. W. 2000. *An Assessment of the Dearborn River Watershed: Habitat and Aquatic Invertebrate Assemblages.* Montana Department of Environmental Quality, Helena, MT.

Bollman. W. 2001. *Aquatic Invertebrates and Habitat at a Fixed Station on the Dearborn River, Lewis and Clark County, Montana.* Montana Department of Environmental Quality, Helena, MT.

Bollman, W. 2003a. (Draft). *A Biological Assessment of Sites in the Dearborn River Drainage: Lewis and Clark County, Montana.* Project TMDL-M12. August and September 2002. Prepared for the Montana Department of Environmental Quality, Helena, MT. Prepared by Rhithron Associates, Inc., Missoula, MT. May.

Bukantis, R. 1998. Rapid Bioassessment Macroinvertebrate Protocols: Sampling and Sample Analysis SOP's. Working draft, April 22, 1997. Montana Department of Environmental Quality. Planning Prevention and Assistance Division. Helena, Montana.

Cherry, D.S.; K.L. Dickinson; J. Cairns, Jr.; and J.R. Stauffer. 1977. Preferred, avoided, and lethal temperatures of fish during rising temperature conditions. *J. Fish Res. Board Can.* 34:239–246.

Coutant, C.C. 1977. Compilation of temperature preference data. *J. Fish Res. Board Can.* 34:739–745.

Deleray, M., L. Knotek, S. Rumsey, and T. Weaver. 1999. Flathead Lake and River System Fisheries Status Report. Montana Fish, Wildlife & Parks. Kalispell, Montana.

Haan, C.T., B.J Barfield, and J.C. Hayes. 1994. Design Hydrology and Sedimentology for Small Catchments. Academic Press, San Diego, California.

Gray, J.R., G. Douglas Glysson, L.M.Turrios, and G. E. Schwartz. 2000. Comparability of Suspended-Sediment Concentration and Total Suspended Solids Data. U.S. Geological Survey Water-Resources Investigations Report 00-4191. Reston, Virginia.

Hilsenhoff, W.L. 1987. An Improved Biotic Index of Organic Stream Pollution. Great Lakes Entomol. 20:31-39.

Land and Water Consulting. 2004. Dearborn TMDL Planning Area. Channel and Riparian Aerial Assessment. July 16, 2004. Missoula, MT.

Leathe, S. 2004. Letter to Montana Department of Environmental Quality Providing Comments on Public Review Draft of Dearborn River TMDL Report. Montana Department of Fish, Wildlife and Parks. December 17, 2004.

Lee, R.M., and J.N. Rinne. 1980. Critical thermal maxima of five trout species in the southwestern United States. *Trans. Amer. Fish Soc.* 109:632–635.

Lewis, B.D., and W.R. Hotchkiss. 1981. *Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming:* U.S. Geological Survey Miscellaneous Investigation Series Map I-1317, scale 1:1,000,000, 6 sheets. Report 88-4045.

Marshall, B.D., and B.L. Kerans. 2003. (Draft). *A Critical Appraisal of Montana's Rapid Bioassessment Protocols (MT RBP) for Evaluating the Ecological Condition* [sic] *Streams and Rivers Using Benthic Macroinvertebrates: Part 2, Current Rreference Criteria and Metrics.* Draft Version 1.1. June 30, 2003. Montana State University, Department of Ecology, 310 Lewis Hall, Bozeman, MT.

McMahon, T.E., B. A. Bear, A. V. Zale, and B. Krise. 2004. Thermal Requirements of Westslope Cutthroat Trout. Wild Fish Habitat Initiative. Montana State University. Bozeman, MT.

MDEQ (Montana Department of Environmental Quality). 1996. *Montana 303(d) List – Streams.* Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division, Monitoring and Data Management Bureau, Helena, MT.

———. 2000. *Montana 303(d) List – A Compilation of Impaired and Threatened Waterbodies in Need of Water Quality Restoration.* Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division, Monitoring and Data Management Bureau, Helena, MT.

———. 2001. *Preliminary Assessment Report, Dearborn Planning Area.* Montana Department of Environmental Quality, Helena, MT.

———. 2002a. *Circular WQB-7 – Montana Numeric Water Quality Standards (v. Jan. 2002)*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division Water Quality Standards Section, Helena, MT.

———. 2002b. Year 2000 303(d) List Database. Montana Department of Environmental Quality, Environet Watershed Information Online Database. Available at http://nris.state.mt.us/scripts/esrimap.dll?name=TMDL&Cmd=INST.

———. 2003. *Sun River Watershed Water Quality Restoration Plan and Total Maximum Daily Loads* [DRAFT}. Montana Department of Environmental Quality, Helena, MT.

MFISH. 2004. Montana Fisheries Information System Database Query. Montana Fish, Wildlife, and Parks . Available at http://nris.state.mt.us/scripts/esrimap.dll?name=MFISH&Cmd=INST (March 30, 2004).

Moeckel, J., D. Potts, and J. Donahue. 1996. *Channel Changes on a Northern Rocky Mountain Front Stream Following a Major Flood.* Watershed Restoration Management, American Water Resources Association.

MRLC. (Multi-Resolution Land Characteristics). 1992. Land use data available for the Multi-Resolution Land Characteristics Consortium. Land use data produced mainly from the 1992 Landsat TM meter coverage (30-meter resolution).

Nixon, A. 2001. Data Assessment Record for the 2002 303(d) List – South Fork Dearborn River. Montana Department of Environmental Quality, Planning Prevention, and Assistance Division. Available at: http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed October 20, 2004.

NMED (New Mexico Environmental Department). 2002. *Protocol for the Assessment of Stream Bottom Deposits on Wadable Streams*. New Mexico Environmental Department, Surface Water Quality Bureau. Santa Fe, New Mexico. Available at http://www.nmenv.state.nm.us/swqb/TMDL_Library.html. Accessed June 20, 2004.

NRCS. 1994. Montana STATSGO Database [Online]. Natural Resources Conservation Service. Available at http://www.ncgc.nrcs.usda.gov/branch/ssb/products/statsgo/.

NRCS (Natural Resources Conservation Service). 2001. *National Soil Survey Handbook* . U.S. Department of Agriculture, Natural Resources Conservation Service. Available at http://www.statlab.iastate.edu/soils/nssh/.

Omernik, J.M. 1995. Ecoregions: A spatial framework for environmental management. In: *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making*. Davis, W.S. and T.P. Simon (eds.) Lewis Publishers, Boca Raton, FL. Pp. 49-62.

Reider, R.G. 1990. *Potential Evapotranspiration.* In Ostresh, L.M., Jr.; R.A. Marston; and W.M. Hudson, *Wyoming Water Atlas.* Wyoming Water Development Commissions and University of Wyoming.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Selong, J.H., T.E. McMahon, A.V. Zale, and F.T. Barrows. 2001. Effect of temperature on growth and survival of bull trout, with application of an improved method for determining thermal tolerance in fishes. *Transactions of the American Fisheries Society* 130:1026–1037.

South Dakota Legislature. 1997. State of South Dakota Water Quality Standards. Available at http://legis.state.sd.us/rules/rules/7451.htm#74:51:01:47.

USDA (U.S. Department of Agriculture). 1965. *Agriculture Handbook No. 296, Land Resource Regions and Major Land Resource Areas of the United States.* U.S. Department of Agriculture.

———. 1995. State Soil Geographic (STATSGO) Data Base – Data Use Information. U.S. Department of Agriculture, Natural Resources Conservation Service Miscellaneous Publication Number 1492 [PDF Format]. Fort Worth, TX.

USEPA. 1997. Revision to Rapid Bioassessment Protocols for Use in Streams And Rivers, Periphyton, Benthic Macroinvertebrates and Fish. U.S. Environmental Protection Agency.

USEPA (U.S. Environmental Protection Agency). 1999. National Recommended Water Quality Criteria – Correction. United States Environmental Protection Agency, Office of Water. EPA822-Z-99-001. Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1999. Protocol for Developing Sediment TMDLs: First Edition. United States Environmental Protection Agency, Office of Water. EPA 841-B-99-004. Washington, DC.

USGS (U.S. Geological Survey). 1999. *Environmental Setting of the Yellowstone River Basin, Montana, North Dakota, and Wyoming.* Water-Resources Investigations Report 98-4269.

Vanoni, V.A. 1975. Sedimentation Engineering. American Society of Civil Engineers. New York, NY.

Walch, Len. 2001. *Summary of Survey Findings in the South Fork Dearborn Drainage in 2001*. Lewis and Clark National Forest.

Wischmeier, W.H., and Smith, D.D. 1978. *Predicting Rainfall Erosion Losses – A Guide to Conservation Planning.* Agricultural Handbook No. 537. U.S. Department of Agriculture, Washington, DC.

Wolman, M.G. 1954. A Method of Sampling Coarse River-Bed Material. Transactions of the American Geophysical Union (EOS), v. 35, p. 951-956.

Woods, Alan J., James Omernik, M. John, A. Nesser, J. Shelden, and Sandra H. Azevedo. 1999. *Ecoregions of Montana* (color poster with map, descriptive text, summary tables, and photographs); (map scale 1:1,500,000). U.S. Geological Survey, Reston, VA.

WRCC (Western Regional Climate Center). 2002a. Station Summary for Powder River 2 and Mizpah 4 NNW Stations. Available at http://www.wrcc.dri.edu/. Accessed April 15, 2002.

———. 2002b. Station Summary for Rogers Pass 9NNE MT, Station. Available at http://www.wrcc.dri.edu/. Accessed April 15, 2002.

APPENDIX A: MULTI-RESOLUTION LAND CHARACTERISTICS (MRLC) CONSORTIUM DATA DESCRIPTION

Land Cover Classes:

Water
11 Open Water
12 Perennial Ice/Snow

Developed
21 Low Intensity Residential
22 High Intensity Residential
23 Commercial/Industrial/Transportation

Barren
31 Bare Rock/Sand/Clay
32 Quarries/Strip Mines/Gravel Pits
33 Transitional

Vegetated; Natural Forested Upland
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest

Shrubland
51 Shrubland

Non-natural Woody
61 Orchards/Vineyards/Other

Herbaceous Upland
71 Grasslands/Herbaceous

Herbaceous Planted/Cultivated
81 Pasture/Hay
82 Row Crops
83 Small Grains
84 Fallow
85 Urban/Recreational Grasses

Wetlands
91 Woody Wetlands
92 Emergent Herbaceous Wetlands

Land Cover Classification System Land Cover Class Definitions:

Water - All areas of open water or permanent ice/snow cover.

11. Open Water - areas of open water, generally with less than 25 percent or greater cover of water (per pixel).

12. Perennial Ice/Snow - All areas characterized by year-long cover of ice and/or snow.

Developed - areas characterized by high percentage (approximately 30 percent or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc).

21. Low Intensity Residential - Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.

22. High Intensity Residential - Includes heavily built up urban centers where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80-100 percent of the cover.

23. Commercial/Industrial/Transportation - Includes infrastructure (e.g. roads, railroads, etc.) and all highways and all developed areas not classified as High Intensity Residential.

Barren - Areas characterized by bare rock, gravel, sad, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.

31. Bare Rock/Sand/Clay - Perennially barren areas of bedrock, desert, pavement, scarps, talus, slides, volcanic material, glacial debris, and other accumulations of earthen material.

32. Quarries/Strip Mines/Gravel Pits - Areas of extractive mining activities with significant surface expression.

33. Transitional - Areas of sparse vegetative cover (less than 25 percent that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.)

Forested Upland - Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); Tree canopy accounts for 25-100 percent of the cover.

41. Deciduous Forest - Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.

42. Evergreen Forest - Areas characterized by trees where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.

43. Mixed Forest - Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.

Shrubland - Areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.

51. Shrubland - Areas dominated by shrubs; shrub canopy accounts for 25-100 percent of the cover. Shrub cover is generally greater than 25 percent when tree cover is less than 25 percent. Shrub cover may be less than 25 percent in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25 percent and shrubs cover exceeds the cover of the other life forms.

Non-natural Woody - Areas dominated by non-natural woody vegetation; non-natural woody vegetative canopy accounts for 25-100 percent of the cover. The non-natural woody classification is subject to the availability of sufficient ancillary data to differentiate non-natural woody vegetation from natural woody vegetation.

61. Orchards/Vineyards/Other - Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.

Herbaceous Upland - Upland areas characterized by natural or semi- natural herbaceous vegetation; herbaceous vegetation accounts for 75-100 percent of the cover.

71. Grasslands/Herbaceous - Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.

Planted/Cultivated - Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.

81. Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.

82. Row Crops - Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.

83. Small Grains - Areas used for the production of graminoid crops such as wheat, barley, oats, and rice

84. Fallow - Areas used for the production of crops that are temporarily barren or with sparse vegetative cover as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.

85. Urban/Recreational Grasses - Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

Wetlands - Areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al.

91. Woody Wetlands - Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

92. Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water

Dearborn River TMDL Planning Area: Appendix B

Table of Contents

SAMPLING AND ANALYSIS PLAN

DEARBORN RIVER MAINSTEM

01/26/05 WED 12:48 FAX 406 761 8477 F3 FWP Region 4 002

FISH KILL REPORT FORM

Waterbody Dearborn River

Name/address/phone number of person reporting kill

Investigators George Liknes

Date of fish kill

Date of investigation 8/2/2000

Geographic extent of fish kill Dead fish were observed upstream of the Highway 287 bridge

Portion of lake/stream surveyed

Species and size of fish killed Mottled Sculpins, Longnose Dace

Number of fish killed (e.g. number per mile or number per acre) Dead sculpin and Longnose Dace were observed scattered throughout shallow water areas between the bridge & thermograph, especially in riffle areas

Known or suspected cause of fish kill Water temperatures exceeded critical thermal maximum.

Temperature measurements 78F @ gage house @ 16:20
max on thermograph = 83F 79F @ thermographs @ 16:42 (N47.20016° W112.10096°)

Dissolved oxygen measurements

Discharge measurements USGS gage (06073500) located at lower end of area walked

Other measurements Thermograph data

Water/fish samples collected

Comments ~~Easily could have been 500+ fish~~ 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. Spring originates on left bank within the rip-rap 12 immediately upstream from USGS gage house. 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 even when I stood on the bank right next to them.

03 – 0822 –__

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DRBRN Date: 7/24/03
Personnel: Laidlaw/Bowker

Waterbody Name: Dearborn River County: Lewis & Clark HUC: 10030102
Station ID: M12DRBNR06 Visit #: ____ Location: Dearborn River Blow Confluence w/Flat Creek
Lat: 47°11'43.6" Long: 112°01'02.7" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0822W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0822M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0822A	(PERI-1) OTHER:
Chlorophyll a	☒		03-0822C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 11:00
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 19.50 A
pH:	8.40
SC: (mS/cm)	.275
SC x 1000 =	µmho/cm
DO: (mg/L)	9.02 / 98.3%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	1.17 NTU
	1.04 NTU

Macroinvertebrate Kick Duration: 3.5 min Kick Length (Ft.): 60'

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-24-03 Site Visit Code: 03-0822

Waterbody: Dearborn River Below Confluence Station ID: M12DRBNR04

Personnel: Laidlaw / Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	15'	~~0~~	~~0~~			
2	17	.3	.19			
3	22	.68	.60			
4	25	1.04	1.18			
5	28	1.1	1.24			
6	31	1.0	1.23			
7	33	1.0	1.43			
8	35	1.15	.56			
9	37	1.55	1.33			
10	39	1.7	2.31			
11	41	1.4	.99			
12	43	1.25	1.69			
13	45	1.20	1.21			
14	47	1.1	1.01			
15	49	.8	.91			
16	51	.8	.75			
17	53	.5	.60			
18	55	.45	.15			
19	57	.2	~~0~~			
20	58	.2	~~0~~			
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2

Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM — RIFFLE/RUN PREVALENCE

Date: 7-24-03 Site Visit Code: 03-0872

Waterbody: Dearborn River Below Site: M12DRBNR06

Personnel: Laidlaw / Bowman

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 9	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 10	9-10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 18	16-20	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 20	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 19	16-20	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 15	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments: bedrock on left side		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments: (bedrock) rock wall dominating at riffle		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments:		

TOTAL SCORE: Score compared to maximum possible:

Place Site Visit

03 – 0725 – __

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-m03
Trip ID: 2003-DRBRN Date: 7/22/03
Personnel: Laidlaw/Bowers

Waterbody Name: Dearborn River
County: Lewis + Clark
HUC: 10030102
Station ID: M12DRBNR04
Visit #: 2
Location: @ Hwy 287 Bridge
Lat: —
Long: —
Verified? ☐ By ____
GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	030725W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0725M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0725A	(PERI-1) OTHER:
Chlorophyll a	☒		03-0725C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 18:45
Q / Flow (cfs)	USGS gage Est. ☐
Temp: (°C)	W 26.94 A
pH:	8.21
SC: (mS/cm)	.285
SC x 1000 =	µmho/cm
DO: (mg/L)	7.55 mg/l 94.8%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	1.12 NTU 1.66 NTU

Macroinvertebrate Kick Duration: 4 min 30 sec Kick Length (Ft.): 120'

Site Visit Comments:

Revised 3/2003 DMA

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7-22-03 Site Visit Code: 03-0725

Waterbody: Dearborn River Site: M12DRBWR04

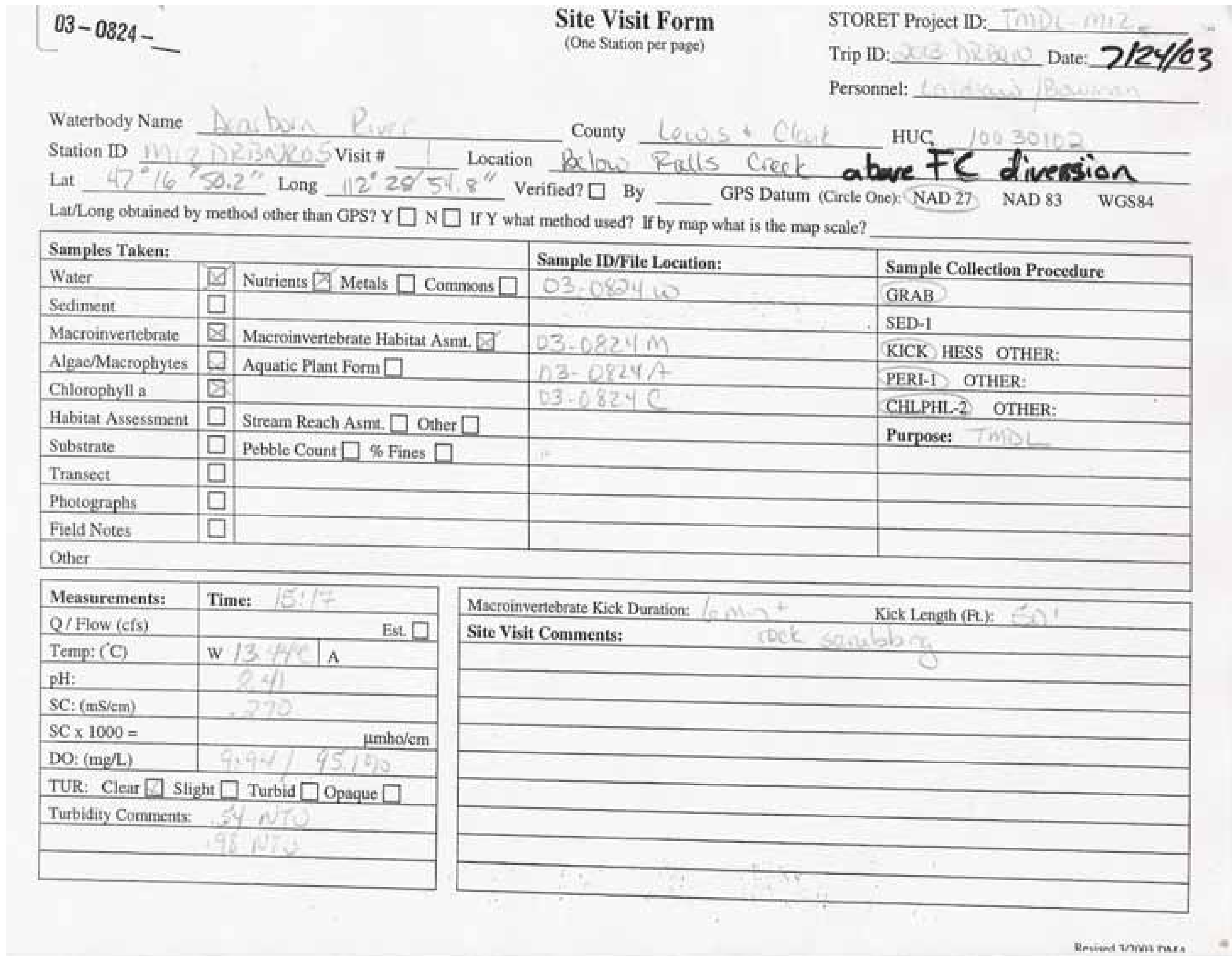
Personnel: Laidlaw Bowman

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 4	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 10	9-10	6-8	3-5	0-2
Comments:	very cobble dominated			
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 11	16-20	11-15	6-10	0-5
Comments:	[illegible] fine sediment			
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 20	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 14	15-20	11-15	6-10	0-5
Comments:				

lots of [illegible] not [illegible]

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 16	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 8.5	9-10	6-8	3-5	0-2
	Left Side 9	Average:		
	Right Side 8	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 8	9-10	6-8	3-5	0-2
	Left Side 8	Average:		
	Right Side 8	Comments: lots of cobble on bars		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 9.5	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 9	Comments:		

TOTAL SCORE: Score compared to maximum possible:



03-0824-__

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003 DRB010 Date: 7/24/03
Personnel: Laidlaw/Bowman

Waterbody Name: Dearborn River County: Lewis + Clark HUC: 10030102
Station ID: M12DRBNR05 Visit #: 1 Location: Below Falls Creek above FC diversion
Lat: 47° 16' 50.2" Long: 112° 28' 54.8" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 (circled) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0824 W	GRAB (circled)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☒	03-0824 M	KICK (circled) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0824 A	PERI-1 (circled) OTHER:
Chlorophyll a	☒		03-0824 C	CHLPHL-2 (circled) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 15:17
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 13.4°C A
pH:	8.41
SC: (mS/cm)	.270
SC x 1000 =	µmho/cm
DO: (mg/L)	9.94 / 95.1%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	.54 NTU .98 NTU

Macroinvertebrate Kick Duration: 6 min + Kick Length (Ft.): 50'
Site Visit Comments: rock scrubbing

Revised 7/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7/24/03 Site Visit Code: 03-0824

Waterbody: Dearborn Rvr above diversion Station ID: M12DRBNR05

Personnel: Shad/Tina

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	4.4 LEW	0.2	0			
2	6.4	0.62	1.21			
3	8.4	0.78	2.35			
4	10.4	1.08	2.54			
5	12.4	1.27	2.24			
6	14.4	1.05	1.63			
7	16.4	1.20	2.58			
8	18.4	1.18	2.32			
9	20.4	1.20	3.02			
10	22.4	1.25	3.25			
11	24.4	1.08	2.36			
12	26.4	1.25	2.74			
13	28.4	1.12	2.13			
14	30.4	0.95	1.48			
15	32.4	1.26	2.30			
16	34.4	1.28	3.05			
17	36.4	1.10	2.83			
18	38.4	0.88	1.28			
19	40.4	0.95	3.61			
20	42.4	0.63	3.82			
21	44.4	0.80	2.20			
22	46.4	0.60	1.04			
23	48.4	0.45	0.48			
24	50.4	0.10	1.08			
25	52.2 REW	0	0			
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 7/24/03 **Site Visit Code:** 03-0824

Waterbody: Dearborn Rvr above FC Diversion **STORET Station ID:** M12DRBNR05

Personnel: Shari/Tina

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count BF	Characteristic Group: PEBL-CNT		
						Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

03 – 0712 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-H12
Trip ID: 2003-DRBRN Date: 6-17-03
Personnel: TT

Waterbody Name: Dearborn River County: Lewis & Clark HUC: 10030102
Station ID: M12DRBNR04 Visit #: ____ Location: Dearborn @ Hwy 287
Lat: 47 11 55.5 Long: 112 06 35.5 Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0712-...	GRAB
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0712C...	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 18:00	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:

no meter for field readings

USGS gaging station did not take flow

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6-17-03 Site Visit Code: 03-0712

Waterbody: Dearborn River @ Hwy 287 Station ID: M12DRBNR04

Personnel: TT (Laidlaw, Brown)

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

NO Flow Taken

Page 1 of 2 Data Mgmt. Approved

Revised 4/2003

NOTE:

First blank is used to mark the bank.
Begin measurements from the left bank (determine left bank while looking downstream).
Initial point is often the tape reading of the waterline & has no depth or velocity to measure.
If this is the case, the first measurement is made at the first point where there is adequate depth (at least 0.2 ft) and measurable velocity.

The value for the "Distance from initial point" field is not necessarily the tape reading. Make sure it is reflective of the true distance from the bank.

If there is a sharp drop in water level near the bank, you must compensate for the discharge that is occurring near the bank. To do so, you must insert a "dummy" value in the first "distance" blank. This value should be equal to the second value (i.e. the first measurement).
At points where there is stagnant water or backflow effects, begin and end measurements at the edge of where positive flow can be measured.
Read depths on wading rod ignoring the "pile-up" effect of water on the rod.
Velocity is measured at six-tenths depth from the water surface by moving the probe support so that the foot indicator marks align
25 to 30 cross-sections are adequate to reduce the level of error.

Sections should be spaced so none contain more than 10% of the flow. Ideal measurements have less than 5% in a section.

Page 2 of 2 Data Mgmt. Approved

Stream Classification

Revised 3/2003

Date: 6-17-03 **Site Visit Code:** 03-0712

Waterbody: Dearborn River @ Hwy 287 **Station ID:** M12DRBNR04

Personnel: TT (Laidlaw Bowman)

Bankfull Width (W_{bkf}) 200.2 Ft.
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section

Mean DEPTH (d_{bkf}) ______ Ft.
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Bnkfl. X-Section AREA (A_{bkf}) ______ Sq. Ft.
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width/Depth RATIO (W_{bkf} / d_{bkf}) ______
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) ______ Ft.
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section

WIDTH of Flood-Prone Area (W_{fpa}) 210.2 Ft.
Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) ______
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 ______ mm.
The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) ______ Ft./Ft.
Channel slope = "rise" over "run" for a reach approximately 20-30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

45+290+290= 625

Channel SINUOSITY (K) ______ map
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Stream Type ______

Comments: Upstream slope Dist=1805

Margin notes: 6.04 use ≈ 6 bankfull values; 3.02 for flood prone; 210-9.8=200.2; benchmark shot 10.47' DRWP01; 11.07 WP03 = 1 mile

Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 6-17-03 Site Visit Code: 03-0712

Waterbody: Dearborn @ Hwy 287 STORET Station ID: M13D

Personnel: TT (Laidlaw, Bowman)

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock	BOULDERS	> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: M12 DRBNR04 Date: 6-17-03 Site Visit Code: 03-0712

Waterbody: Dearborn River Reach Length: 1/2 mile

Waterbody Seg ID: ______ Personnel: Laidlaw / Bowman

Station ID's on reach: ______

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 7 Potential Score: 8

Comments ______

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 4 Potential Score: 6

Comments ______

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 6 Potential Score: 6

Comments ______

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 4 Potential Score: 5

Comments [illegible]

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 2 Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 2 Potential Score: 3

Comments

3 SRAF.xls

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 7 Potential Score: 8

Comments: more riparian veg upstream

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 4 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 6 Potential Score: 8

Comments: mostly grasses
[illegible]

3 SRAF xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

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Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover

8 = Abundant deep pools, wood, debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 6

Comments: many single fish hab. little overhanging veg

12b. Habitat Complexity

6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 3 Potential Score: 4

Comments: missing lots of deep pools + pockets

12c. Spawning Habitat (salmonid streams only)

8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments: lots of cobble / gravel

5 SRAF.xls

12d. Fish Passsage
8 = No potential fish passage barriers apparent.
0 = Potential fish passage barriers present.
N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment
8 = Entrainment of fish into water diversions not an issue.
4 = Entrainment of fish into water diversions may be a moderate issue.
0 = Entrainment of fish into water diversions may be a major issue.

Actual Score: 8 Potential Score: 8

Comments

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation
6 = More than 75% of the stream reach is adequately shaded by vegetation.
4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,
3 = Approximately 25-50% of the stream does not have adequate shade.
0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 3 Potential Score: 4

Comments

Question 14. Algae growth / Nutrients
6 = Algae not apparent. Rocks are slippery.
4 = in small patches or along channel edge
2 = in large patches or discontinuous mats
0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)
N/A = No water

Actual Score: 6 Potential Score: 6

Comments rocks slightly slippery [illegible]

SRAF.xls

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 7 Potential Score: 8

Comments fishing access road nearby

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

SRAF.xls

Site ID: ______________
Site Description: ______________

CROSS-SECTIONAL PROFILE FIELD DATA SHEET

Page ____ of ____
Date: ____
Basin: ____

	REFERENCE		CHANNEL MEASUREMENTS								
			LONGITUDINAL OR X-SECTION		WATER LEVEL		BANKFULL		BANK HEIGHT		
STA	BS (+)	HI	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	NOTES
10'		|									
28'	6.19	LBFE									L BF Edge
39.6'	6.88	side									
49.0	6.38	Bar 1									Bottom of side channel
63.0'	6.8	Bar 2									Point Bar
75.0	5.48	Top Bar									
96.0'	5.88	Bar 3									Top of Point Bar (Bankfull)
110.0	9.07	Left Edge [illegible]									Point Bar
120.0	11.07										H_2O Depth = 0
135.0	11.22	Thalweg									H_2O Depth = 2.15
134.0	10.64										Thalweg H_2O Depth 2.35
150.0	10.60 [?]										H_2O Depth = 1.74
162.0	10.70										H_2O Depth 1.73
172.0	10.20										H_2O Depth 1.83
180.0	9.36	Right edge									H_2O Depth = 1.30
181.0	8.05										H_2O Depth .38
195.0'	7.35										Top of bank
204.0'	6.55	RBKFL									
205.0'											Right bankfull edge

STA – Station
HI – Height of Instrument (Elevation + BS)
BS – Backsight (Shot to a known elevation)
ELEV – If actual elevation (Datum) is unknown, use 100' to begin profile.
FS – Foresight (Shot to new point with unknown elevation)
RP – Reference Point

M12DRBNR05	Date- 7/24/2003	15:17
Dearborn River below confluence with Falls Creek, above Flat Creek Diversion		

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	77	mm
Percentage of Fines (<2mm)	*4.92*	*%*
Stream Type		
Discharge	*105.06*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score	**94.6**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

6 min
50'

Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*105.06*	*cfs*
Temperature, water	13.44	degree C
pH	8.41	
Specific Conductance	0.27	mS/cm
Dissolved Oxygen	9.94	mg/L
Dissolved Oxygen, % Saturation	95.1	%
Turbidity	0.76	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.6	mg/m^3	0.1
Benthic Chlorophyll a	19.7	mg/m^3	0.1
Total Phosphorus, TP	0.056	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results

parameter	*value*	*units*
TOTAL SCORE (max =18)	15	score
PERCENT OF MAX SCORE	83	%
IMPAIRMENT CLASSIFICATION	NON IMPAIRED	
USE SUPPORT	FULL SUPPORT	

		Pebble Count Data			
	Mean size	**Particle Size (mm)**	**Sum**	**% Total**	**Cum. Total**
S/C	0.5	<1	2	1.64	1.64
S	1.5	1-2	4	3.28	4.92
FG	3	2-4		0.00	4.92
FG	5	4-6	3	2.46	7.38
FG	7	6-8	2	1.64	9.02
MG	10	8-12	6	4.92	13.93
MG	14	12-16	4	3.28	17.21
CG	18	16-22	6	4.92	22.13
CG	27	22-32	10	8.20	30.33
CG	38.5	32-45	7	5.74	36.07
CG	54.5	45-64	11	9.02	45.08
SC	77	64-90	15	12.30	57.38
SC	109	90-128	20	16.39	73.77
MC	154	128-180	23	18.85	92.62
LC	218	180-256	5	4.10	96.72
LC	309	256-362	3	2.46	99.18
SB	437	362-512	1	0.82	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	122	100.00	100.00
		D50 particle size (mm)	77		
		% Fines (<2mm)	*4.92*		
	M12DRBNR05	**Date-**	**7/24/2003**	**15:17**	
	Dearborn River below confluence with Falls Creek, above Flat Creek Diversion				

M12DRBRNR04	Date- 7/22/2003	18:45
Dearborn River at Hwy 287		

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*75.00*	*Ft*
Mean Depth	*2.60*	*Ft*
Bnkfull X-sect area	*195.13*	*Sq Ft*
Width/Depth	*28.83*	
Max Depth	*3.49*	*Ft*
Flood prone width	*238.00*	*Ft*
Entrenchement Ratio	*3.17*	
Water slope	*0.0010*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	38.5	mm
Percentage of Fines (<2mm)	*10.89*	*%*
Stream Type	C4	*border C4c due to low slope*
Discharge	*38.00*	*cfs*

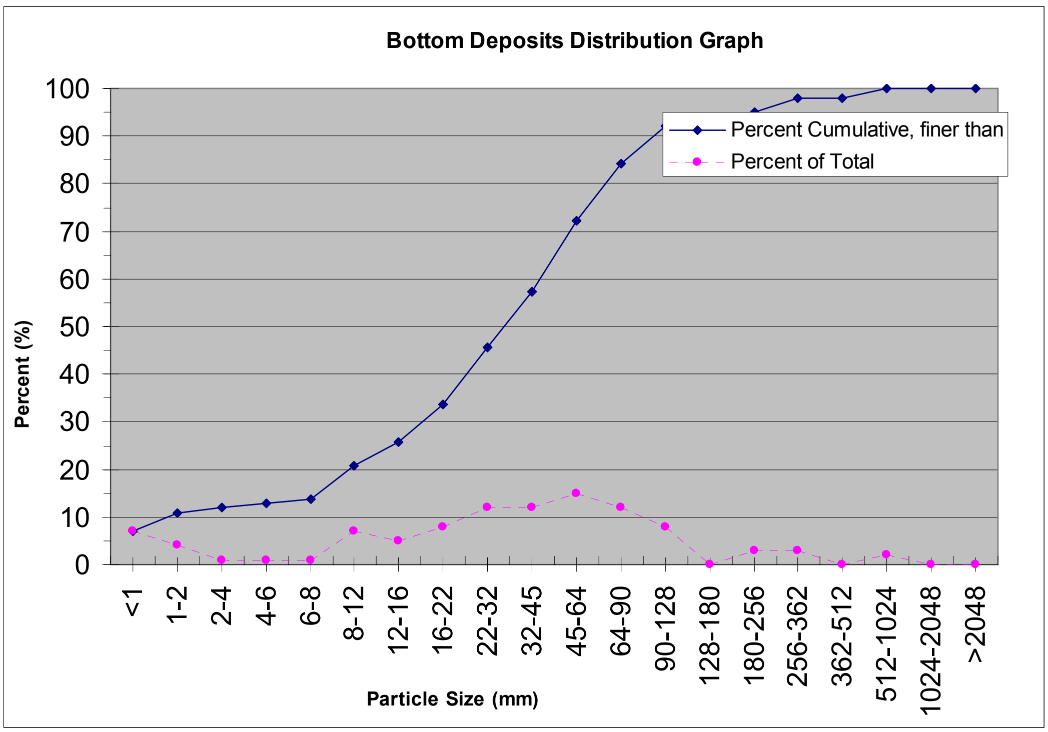
Stream Reach Habitat Assessments		
Parameter	***Value***	***Units***
Stream Reach Assessment Score (NRCS)	**85**	%
Stream Reach Assessment Score (MT adjusted)	**91**	%
Macroinvertabrate Habitat Assessment Score	**91.5**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		4.5 min 120'

Field Measurements of water chemistry		
parameter	***value***	***units***
Flow	*38.00*	*cfs*
Temperature, water	26.94	degree C
pH	8.21	
Specific Conductance	0.285	mS/cm
Dissolved Oxygen	7.55	mg/L
Dissolved Oxygen, % Saturation	94.8	%
Turbidity	1.39	NTU

Lab Results from Field Samples			
parameter	***value***	***units***	***RL***
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	1.8	mg/m^3	0.1
Benthic Chlorophyll a	10.5	mg/m^3	0.1
Total Phosphorus, TP	0.018	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	***value***	***units***
TOTAL SCORE (max =18)	9	score
PERCENT OF MAX SCORE	50	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	7	6.93	6.93
S	1.5	1-2	4	3.96	10.89
FG	3	2-4	1	0.99	11.88
FG	5	4-6	1	0.99	12.87
FG	7	6-8	1	0.99	13.86
MG	10	8-12	7	6.93	20.79
MG	14	12-16	5	4.95	25.74
CG	18	16-22	8	7.92	33.66
CG	27	22-32	12	11.88	45.54
CG	38.5	32-45	12	11.88	57.43
CG	54.5	45-64	15	14.85	72.28
SC	77	64-90	12	11.88	84.16
SC	109	90-128	8	7.92	92.08
MC	154	128-180		0.00	92.08
LC	218	180-256	3	2.97	95.05
LC	309	256-362	3	2.97	98.02
SB	437	362-512		0.00	98.02
MB	768	512-1024	2	1.98	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	101	100.00	100.00
		D50 particle size (mm)	32-45		
		% Fines (<2mm)	10.89		
	M12DRBRNR04	Date-	7/22/2003	18:45	
	Dearborn River at Hwy 287				

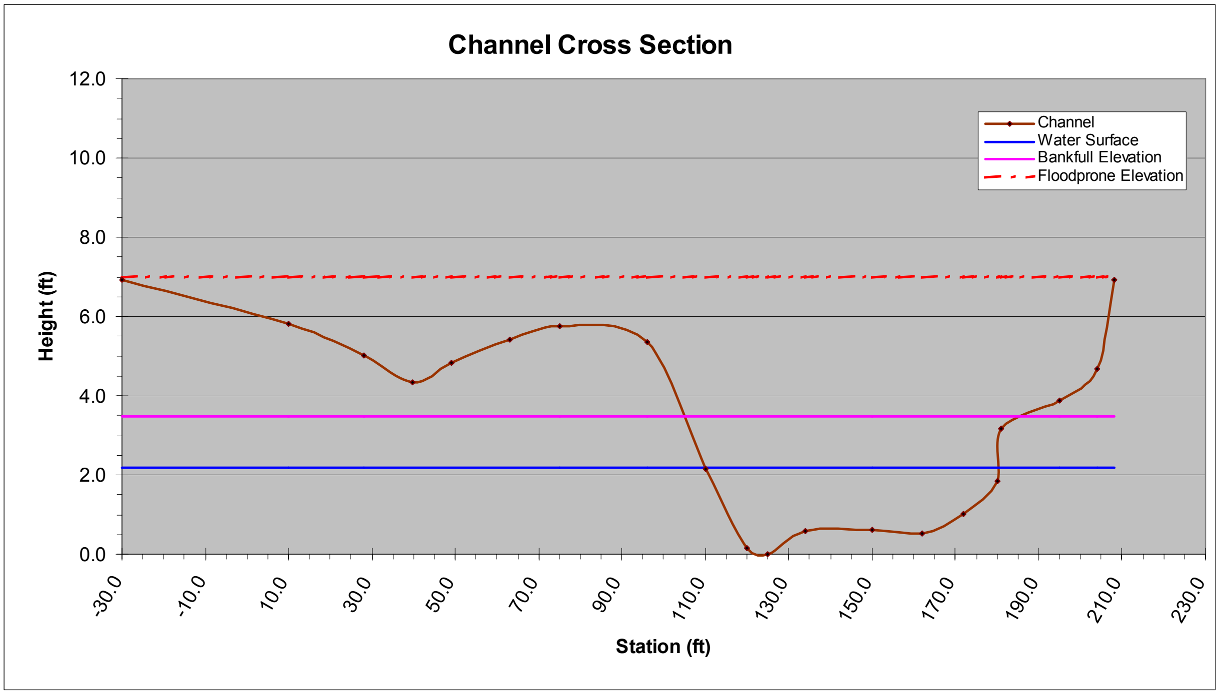


	BEHI Field Measures			BEHI Calculated Values		
	Parameter	*Value*	*Units*	*Parameter*	*Value*	*Units*
Longitudinal Information				*Slope*	*0.0010*	
	Rod reading @ Upstream Edge of Water	10.47	feet	*Sinuousity*		
				Max Depth	*3.49*	feet
	Rod reading @ Downstream Edge of Water	11.07	feet	*Floodprone Height*	*6.98*	feet
	Stream Distance	625.00	feet	*Mean Depth*	*2.60*	feet
	Straightline Distance		feet	*Bankfull Width*	*75.00*	feet
Cross-Sectional Information	Left Edge of Bankfull	110.00	feet	*Floodplrone Width*	*238.00*	feet
	Right Edge of Bankfull	185.00	feet	*Bankfull Area*	*195.13*	ft^2
	Rod reading @ Thalweg	*11.22*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth	*7.73*	feet	*W/D Ratio*	*28.83*	
	Rod reading @ Floodplain Depth	*4.24*	feet	*Cross Sectional Area*	*195.13*	ft^2
	Left Edge of Floodprone depth	-30.00	feet	*Entrenchment Ratio*	*3.17*	
	Right Edge of Floodprone depth	208.00	feet			
BEHI Information	Bank Height		feet			
	Bankfull Height		feet	*Bank Ht/Bankfull Ht*		
	Root Depth		feet	*Root Depth/Bank Ht*		
	Root Density		%	*Root Density*		*%*
	Bank Angle		Degrees	*Bank Angle*		*degrees*
	Surface Protection		%	*Surface Protection*		*%*
Near Bank Stress Information	Velocity at thalweg		ft/sec	*Velocity Gradient*		*ft/sec/ft*
	Tape reading at thalweg		feet	*Near Bank stress /*		
	velocity at left bank		ft/sec	*Mean Shear stress*		
	tape reading at left bank		feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			

M12DRBRNR04	**Date-**	**7/22/2003**	**18:45**
Dearborn River at Hwy 287			

M12DRBRNR04	**Date-**	**7/22/2003**	**18:45**
Dearborn River at Hwy 287			

BEHI Associated Index Value (from form)		***Possible Adjustment Factors***
Bank Ht/Bankfull Ht		Bank Materials
Root Depth/Bank Ht		*Bedrock is always Very Low*
Root Density		*Boulders are always Low*
Bank Angle		*Cobble decrease the category by one unless the mixture of Sand/Gravel is over 50%*
Surface Protection		
Total Index Value		*Gravel- adjust the values up 5-10 pts depending on sand composition*
Numeric Adjustments:		
Bank Materials Index adjustment:		*Sand- adjust the values up 10 pts*
		silt/clay- no adjustment
		Stratification
Bank Stratification Index adjustment:		*5-10 pts upward depending on position of unstable layers relative to bankfull stage*
Total adjusted Index Value:		
Bank Erosion Potential Rating:		


Channel Cross Section
Height (ft)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-30.0
-10.0
10.0
30.0
50.0
70.0
90.0
110.0
130.0
150.0
170.0
190.0
210.0
230.0
Station (ft)
Channel
Water Surface
Bankfull Elevation
Floodprone Elevation

M12DRBNR06	Date- 7/24/2003	11:00
Dearborn River below confluence with Flat Creek on Dearborn Ranch		

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50		mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge	*43.10*	*cfs*

Stream Reach Habitat Assessments			
Parameter	*Value*	*Units*	
Stream Reach Assessment Score (NRCS)		%	
Stream Reach Assessment Score (MT adjusted)		%	
Macroinvertabrate Habitat Assessment Score	**92.3**	%	
OVERALL SITE RATINGS			
Stream Reach Assessment Score (NRCS)			
Stream Reach Assessment Score (MT adjusted)			
Macroinvertabrate Habitat Assessment Score			3.5 min 60'

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*43.10*	*cfs*
Temperature, water	19.5	degree C
pH	8.4	
Specific Conductance	0.275	mS/cm
Dissolved Oxygen	9.02	mg/L
Dissolved Oxygen, % Saturation	98.3	%
Turbidity	1.11	NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	23.9	mg/m^3	0.1
Total Phosphorus, TP	0.098	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	*value*	*units*
TOTAL SCORE (max =18)	9	score
PERCENT OF MAX SCORE	50	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

M12DRBRNR04	Date- 6/17/2003	18;00
Dearborn River at Hwy 287		

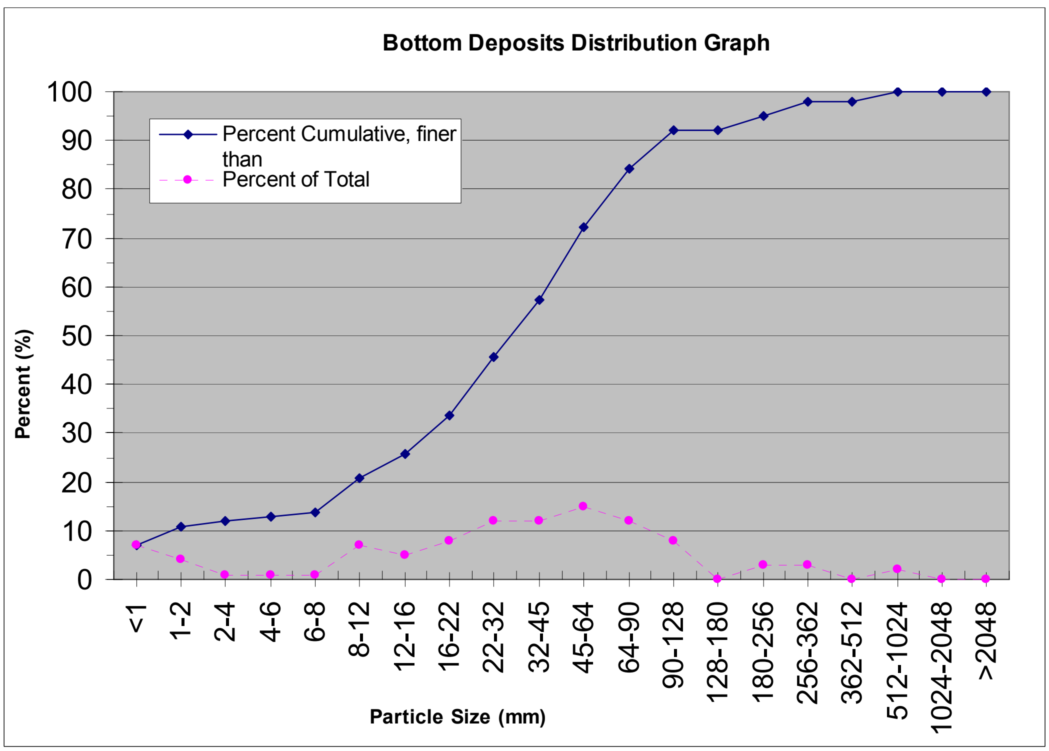
Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*75.00*	*Ft*
Mean Depth	*2.60*	*Ft*
Bnkfull X-sect area	*195.13*	*Sq Ft*
Width/Depth	*28.83*	
Max Depth	*3.49*	*Ft*
Flood prone width	*238.00*	*Ft*
Entrenchement Ratio	*3.17*	
Water slope	*0.0010*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	38.5	mm
Percentage of Fines (<2mm)	*10.89*	*%*
Stream Type		
Discharge	*202.00*	*cfs*

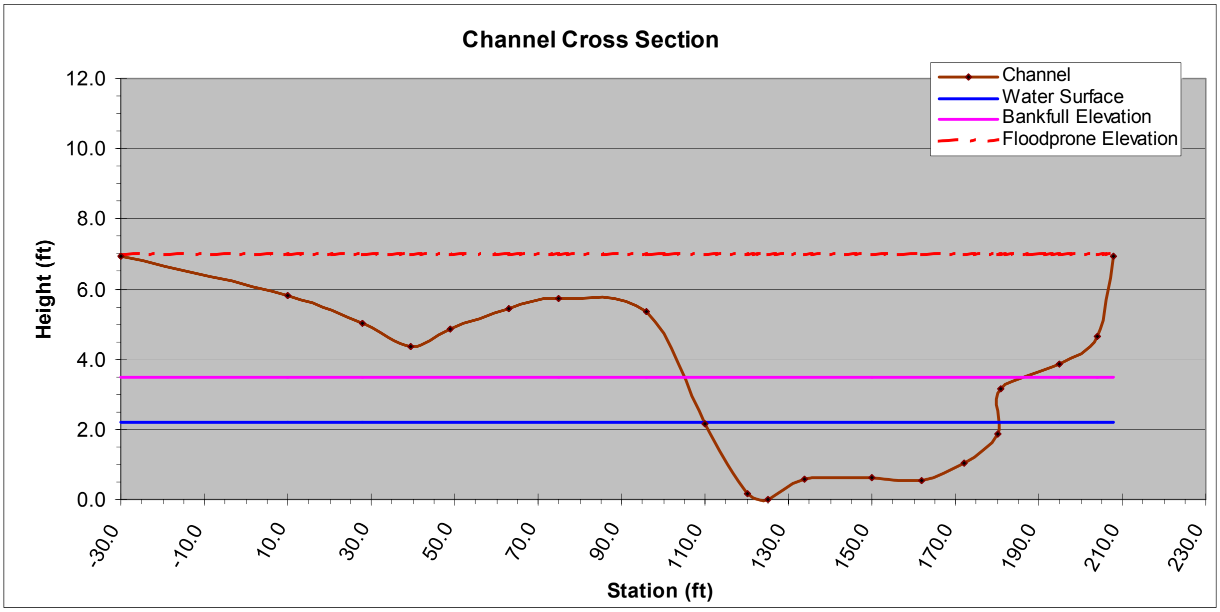
Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**85**	%
Stream Reach Assessment Score (MT adjusted)	**91**	%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*202.00*	*cfs*
Temperature, water	17	degree C
pH		
Specific Conductance		mS/cm
Dissolved Oxygen		mg/L
Dissolved Oxygen, % Saturation		%
Turbidity		NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	12.3	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	7	6.93	6.93
S	1.5	1-2	4	3.96	10.89
FG	3	2-4	1	0.99	11.88
FG	5	4-6	1	0.99	12.87
FG	7	6-8	1	0.99	13.86
MG	10	8-12	7	6.93	20.79
MG	14	12-16	5	4.95	25.74
CG	18	16-22	8	7.92	33.66
CG	27	22-32	12	11.88	45.54
CG	38.5	32-45	12	11.88	57.43
CG	54.5	45-64	15	14.85	72.28
SC	77	64-90	12	11.88	84.16
SC	109	90-128	8	7.92	92.08
MC	154	128-180		0.00	92.08
LC	218	180-256	3	2.97	95.05
LC	309	256-362	3	2.97	98.02
SB	437	362-512		0.00	98.02
MB	768	512-1024	2	1.98	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	101	100.00	100.00
		D50 particle size (mm)	32-45		
		% Fines (<2mm)	*10.89*		
	M12DRBRNR04	**Date-**	**6/17/2003**	**18;00**	





	BEHI Field Measures			BEHI Calculated Values		
	Parameter	*Value*	*Units*	*Parameter*	*Value*	*Units*
Longitudinal Information	Rod reading @ Upstream Edge of Water	10.47	feet	*Slope*	*0.0010*	
				Sinuousity		
	Rod reading @ Downstream Edge of Water	11.07	feet	*Max Depth*	*3.49*	feet
				Floodprone Height	*6.98*	feet
	Stream Distance	625.00	feet	*Mean Depth*	*2.60*	feet
	Straightline Distance		feet	*Bankfull Width*	*75.00*	feet
Cross-Sectional Information	Left Edge of Bankfull	110.00	feet	*Floodplrone Width*	*238.00*	feet
	Right Edge of Bankfull	185.00	feet	*Bankfull Area*	*195.13*	ft^2
	Rod reading @ Thalweg	*11.22*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth	*7.73*	feet	*W/D Ratio*	*28.83*	
	Rod reading @ Floodplain Depth	*4.24*	feet	*Cross Sectional Area*	*195.13*	ft^2
	Left Edge of Floodprone depth	-30.00	feet	*Entrenchment Ratio*	*3.17*	
	Right Edge of Floodprone depth	208.00	feet			
BEHI Information	Bank Height		feet			
	Bankfull Height		feet	*Bank Ht/Bankfull Ht*		
	Root Depth		feet	*Root Depth/Bank Ht*		
	Root Density		%	*Root Density*		*%*
	Bank Angle		Degrees	*Bank Angle*		*degrees*
	Surface Protection		%	*Surface Protection*		*%*
Near Bank Stress Information	Velocity at thalweg		ft/sec	*Velocity Gradient*		*ft/sec/ft*
	Tape reading at thalweg		feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank		ft/sec			
	tape reading at left bank		feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			

MIDDLE FORK DEARBORN RIVER

03 – 0720 –__

Site Visit Form
(One Station per page)

STORET Project ID: TMDL M12
Trip ID: 2003-DRBRN Date: 6.19.03
Personnel: Laidlaw/Bowman

Waterbody Name: Middle Fork Dearborn County: Lewis & Clark HUC: 10030102
Station ID: M12MFDBR04 Visit #: ____ Location: Below Ingersoll's Road
Lat: 47°11'34.5" Long: 112°17'25.0" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0720	GRAB
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0720C (benthic + water)	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 12:30
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 15.69	A
pH:	8.11
SC: (mS/cm)	.246 m[ex] .302
SC x 1000 =	µmho/cm
DO: (mg/L)	8.88/89.3
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	0.73 NTU ① 0.99 NTU ②

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:

great site

no bank erosion, spring in reach

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6-19-03 Site Visit Code: 03-0730

Waterbody: Middle Fork Dearborn Station ID: M12MFDAR04

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	12' LEW	0.4	0			
2	13'	0.55	0.10			
3	14	0.85	0.10			
4	15	0.75	0.62			
5	16	0.90	0.88			
6	17 Thalweg	0.90	0.96			
7	18	0.85	1.19			
8	19	0.8	1.09			
9	20	0.5	1.24			
10	21	0.5	1.22			
11	22	0.5	1.43			
12	23	0.5	1.53			
13	24	0.4	1.54			
14	25	0.5	1.54			
15	26	0.6	1.38			
16	27	0.65	1.30			
17	28	0.70	1.27			
18	29	0.85	1.06			
19	30	0.80	1.12			
20	31	0.60	0.91			
21	32	0.50	0.60			
22	33	0.30	0.46			
23	34' REW	0	0			
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2

Data Mgmt. Approved

Revised 3/2003

Stream Classification

Date: 6-19-03 **Site Visit Code:** 03-0720

Waterbody: Middle Fork Dearborn [illegible] **Station ID:** M10MFDBR04

Personnel: Laidlaw Bowman

Bankfull Width (W_{bkf}) ______ Ft.
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section

Mean DEPTH (d_{bkf}) ______ Ft.
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Bnkfl. X-Section AREA (A_{bkf}) ______ Sq. Ft.
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width/Depth RATIO (W_{bkf} / d_{bkf}) ______
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) ______ Ft.
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section

WIDTH of Flood-Prone Area (W_{fpa}) ______ Ft.
Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) ______
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 ______ mm.
The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) ______ Ft./Ft.
Channel slope = "rise" over "run" for a reach approximately 20-30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Slope Between
Length: 136
Height: 6.90
Upstream Length 147.5
Height 4.60

Channel SINUOSITY (K) ______
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Stream Type ______

Comments: 0.0006

Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 6-19-03 **Site Visit Code:** 03-07[illegible]

Waterbody: Middle Fork Dearborn **STORET Station ID:** M[illegible]MFDBR04

Personnel: Laidlaw / Bowman

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Sum	% of Total	Cum. Total
	PEBBLE COUNT					Characteristic Group: PEBL-CNT		
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Silt along banks associated w/vegetation

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: M12MFDBR04 Date: 6-19-03 Site Visit Code: 03-0720

Waterbody: Middle Fork Dearborn - Blw [illegible] falls Reach Length: ¼ mile

Waterbody Seg ID: ______ Personnel: Laidlaw/Bowman

Station ID's on reach: ______

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: ______ Potential Score: ______

Comments

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 6 Potential Score: 6

Comments

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 6 Potential Score: 6

Comments

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: [illegible] Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: [illegible] Potential Score: 3

Comments

2 SRAF.xls

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 8 Potential Score: 8

Comments

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 4 Potential Score: 4

Comments: great buffer between ag land + stream

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 8 Potential Score: 8

Comments

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adeq ate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, cor tinuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

4 SRAF.xls

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Ha itat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile H lding/Escape Cover

8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 8 Potential Score: 8

Comments

12b. Habitat Complexity

6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 6

Comments

12c. Spawning Habitat (salmonid streams only)

8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

5 SRAF.xls

12d. Fish Passsage

8 = No potential fish passage barriers apparent.

0 = Potential fish passage barriers present.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment

8 = Entrainment of fish into water diversions not an issue.

4 = Entrainment of fish into water diversions may be a moderate issue.

0 = Entrainment of fish into water diversions may be a major issue.

Actual Score: 8 Potential Score: 8

Comments

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,

3 = Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 4 Potential Score: 4

Comments

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 5 Potential Score: 6

Comments some algae on rocks in shallow sections

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation in[illegible]acts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 8 Potential Score: 8

Comments [illegible]

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

8 SRAF.xls

Site ID: __________
Site Description: __________

CROSS-SECTIONAL PROFILE FIELD DATA SHEET

45.5
-21.7
27.0

Page ____ of ____
Date: ________
Basin: ________

8.35
6.66
1.69 = Bankfull depth

	REFERENCE		CHANNEL MEASUREMENTS								
			LONGITUDINAL OR X-SECTION		~~WATER LEVEL~~		BANKFULL		BANK HEIGHT		
STA	BS (+)	HI	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	NOTES
21.7	6.63'		LBFE								
28.0	6.67		BF								
48.0	8.35'		Thalweg DTW = 1.3								
48.7	6.68		RBFE								
14.3'	3.33		LFE								Bn
138'	3.33		RFE								BF depth = 1.69'
											Flood depth = 3.38'
											BF width = 27.0'
											Flood width = 123.7

STA = Station
HI = Height of Instrument (Elevation + BS)
BS = Backsight (Shot to a known elevation)
ELEV = If actual elevation (Datum) is unknown, use 100' to begin profile.
FS = Foresight (Shot to new point with unknown elevation)
RP = Reference Point

03 – 0727 – __

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DEBORN Date: 7-23-03
Personnel: Laidlaw / Bowman

Waterbody Name: Middle Fork Dearborn County: Lewis & Clark HUC: 10030102
Station ID: M12MFDBR01 Visit #: ____ Location: Middle Fork at Rogers Pass
Lat: ____ Long: ____ Verified? ☐ By: ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0727W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0727M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0727A	(PERI-1) OTHER:
Chlorophyll a	☒		03-0727C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☐			
Other				

Measurements:	Time: 1130	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W 7.86°C	A
pH:	8.38	
SC: (mS/cm)	.241	
SC x 1000 =	µmho/cm	
DO: (mg/L)	10.81 mg/L / 95.5%	
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:	0.23 & 0.68	

Macroinvertebrate Kick Duration: 2 min Kick Length (Ft.): 25'

Site Visit Comments:

[illegible] might have been source of increased turbidity

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7/23/03 Site Visit Code: 03-0727

Waterbody: MFD @ Rogers Pass Station ID: M12MFDBR01

Personnel:

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	0.8 LEW	0.10	0			
2	1.0	0.10	0			
3	1.5	0.20	0.04			
4	2.0	0.20	0.08			
5	2.5	0.20	0.40			
6	3.0	0.30	0.34			
7	3.5	0.30	0.41			
8	4.0	0.30	0.48			
9	4.5	0.25	0.31			
10	5.0	0.25	0.78			
11	5.5	0.25	0.60			
12	6.0	0.25	0.56			
13	6.5	0.20	0.18			
14	7.0	0.20	.23			
15	7.5 REW	0.10	0			
16						
17						
18						
19						
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28						
29						
30						

Page 1 of 2

Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7/23/03 Site Visit Code: 03-0727
Waterbody: MFD @ Rogers Pass Site: M12MFDBR01
Personnel:

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score:	9-10 10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score:	9-10 10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score:	16-20 19	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score:	16-20 19	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score:	16-20 19	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score:	16-20 19	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10 10	6-8	3-5	0-2
	Left Side 10	Average: 10		
	Right Side 10	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10	6-8	3-5	0-2
	Left Side 10	Average: 10		
	Right Side 10	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10	6-8	3-5	0-2
	Left Side 9	Average: 9.5		
	Right Side 10	Comments:		

TOTAL SCORE: **Score compared to maximum possible:**

03 – 0729 –___

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-MI2
Trip ID: 2003-DRBRN Date: 7/23/03
Personnel: Laidlaw/Bowman

Waterbody Name: Middle Fork Dearborn County: Lewis & Clark HUC: 10030102
Station ID: M12MFDBR02 Visit #: 2 Location: Below Hwy 434
Lat: ___ Long: ___ Verified? ☐ By ___ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ___

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☐ Metals ☐ Commons ☐	03-0729W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0729M	KICK HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0729A	PERI-1 OTHER:
Chlorophyll a	☒		03-0729C	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 1415
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 20.5°C A
pH:	8.27
SC: (mS/cm)	.311
SC x 1000 =	µmho/cm
DO: (mg/L)	9.23 102.8%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	1.23 NTU
	1.24 NTU

Macroinvertebrate Kick Duration: 1 min 42 sec Kick Length (Ft.): 25'

Site Visit Comments:

macroalgae + ...

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-23-03 Site Visit Code: 03-0729

Waterbody: Middle Fork Dearborn Below 434 Station ID: M12MFDBR02

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	2' LEW	0	0			
2	3'	0.20	0			
3	4'	0.3	0.05			
4	5'	0.45	0.75			
5	6	0.3	0.80			
6	7.0	0.5	1.00			
7	8.0	0.45	0.67			
8	9.0	0.50	0.50			
9	10.0	0.45	0			
10	11.0	0.40	0.29			
11	12.0	0.40	0.62			
12	13.0	0.40	0.61			
13	14.0	0.40	0.92			
14	15.0	0.45	0.91			
15	16.0	0.45	1.09			
16	17.0	0.50	1.17			
17	18.0	0.47	0.98			
18	19.0	0.50	0.93			
19	20.0	0.35	0.56			
20	21.0	0.35	0.81			
21	22.0	0.30	0.48			
22	23.0	0.30	0.48			
23	24.0	0.20	0.36			
24	25.0	0.15	0.11			
25	26.0	0.10	0.01			
26	26.7 REW	0	0			
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7/23/03 Site Visit Code: 03-0729

Waterbody: MFD @ Murphy's blw Hwy 434 Site: M12MFDBR02

Personnel:

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score:	9-10 9	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score:	9-10	6-8 8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score:	16-20 17	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score:	16-20 18	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score:	16-20	11-15 13	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score:	16-20 17	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10	6-8	3-5	0-2
	Left Side 8	Average: 8		
	Right Side 8	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10 9	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10	6-8	3-5	0-2
	Left Side ~~9~~ 8	Average: ~~9~~ 8,5		
	Right Side 9	Comments:		

TOTAL SCORE: Score compared to maximum possible:

03 – 0728 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-MI 2
Trip ID: 2003-DRLRN Date: 7/23/03
Personnel: Laidlaw/Bowman

Waterbody Name: Middle Fork Dearborn River County: Lewis + Clark HUC: 10030102
Station ID: M12MFDBR04 Visit #: 2 Location: At Ingersolls Road
Lat: — Long: — Verified? ☐ By ___ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ___

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☐ Metals ☐ Commons ☒	03.0728W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☒	03-0728M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0728A	(PERI-1) OTHER:
Chlorophyll a	☐			(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 13:00
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 15.59 A
pH:	8.19
SC: (mS/cm)	297
SC x 1000 =	µmho/cm
DO: (mg/L)	9.84 / 102.9%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	.36 NTU + 1.24 NTU

Macroinvertebrate Kick Duration: 2 min 40 sec. Kick Length (Ft.): 40'

Site Visit Comments:
Spring downstream of sampling st (collected some algae there)

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-23-03 Site Visit Code: 03-0708

Waterbody: Middle Station ID: M12MCDBR04

Personnel: Bowman/Laidlaw

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	2.0'	0	0	1		
2	3.0'	.4	.08	1		
3	4.0	.5	.50	1		
4	5.0	.5	.26			
5	6.0	.55	.63			
6	7.0	.58	.97			
7	8.0	.55	0			
8	9.0	.6	.81			
9	10.0	.65	.79			
10	11.0	.56	.95			
11	12.0	.65	1.01			
12	13.0	.52	1.17			
13	14.0	.4	1.10			
14	15.0	.3	.90			
15	16.0	.23	.88			
16	17.0	.30	.95			
17	18.0	.25	.67			
18	19.0	.20	.61			
19	20.0	.20	.70			
20	21.0	.20	.62			
21	22.0	.20	.28			
22	24.0	.10	.08			
23	25.8	0	0			
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7-23-03 Site Visit Code: 03-6729

Waterbody: Middle Fork Dearborn @ Ingersolls Site: M17MFDBR04

Personnel: Laidlaw / Bowman

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 8	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 8	9-10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score:	16-20	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 17	16-20	11-15	6-10	0-5
Comments:	upstream bridge			
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 15	16-20	11-15	6-10	0-5
Comments:	deposition in glides + pools / approx 30% silt			

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 16	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 9	9-10	6-8	3-5	0-2
	Left Side 9	Average:		
	Right Side 9	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 9	9-10	6-8	3-5	0-2
	Left Side 9	Average:		
	Right Side 9	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 9	9-10	6-8	3-5	0-2
	Left Side 9	Average:		
	Right Side 9	Comments:		

TOTAL SCORE:

Score compared to maximum possible:

03 – 0718 –__

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12

Trip ID: 2003-DRBRN Date: 6-19-03

Personnel: Laidlaw / Dewalan

Waterbody Name: Middle Fork Dearborn County: Lewis & Clark HUC: 10030102

Station ID: M12MFDBR02 Visit #: ____ Location: Downstream of Hwy 434

Lat: 47° 12' 37.4" Long: 112° 16' 31.6" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0718 W	GRAB
Sediment	☐		[illegible]	SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0718 C (benthic / water)	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☐			
Other				

Measurements:	Time: 9:30	
Q / Flow (cfs)		Est. ☐
Temp: (°C)	W 13.35	A
pH:	9.00	
SC: (mS/cm)	.208 mS/cm .247 mS	
SC x 1000 =		µmho/cm
DO: (mg/L)	90.8 / 9.38	
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments: 2.8 NTU		

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:

Samples taken at 9:45

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 10-19-03 Site Visit Code: 03-0716

Waterbody: Middle Fork Station ID: M13MFDBR

Personnel: Laidlaw / Bowman

	**Distance from initial point	**Depth	**Velocity (1 point)	**Width	**Area	**Discharge
1	18' LEW	0	0			
2	19.5	.25	0.37			
3	21.0	.40	0.98			
4	22.5	.70	1.11			
5	24.0	.70	1.05			
6	25.5	.60	0.98			
7	27.0	.40	1.07			
8	28.5	.60	1.33			
9	30.0	.65	1.55			
10	31.5	.70	1.26			
11	33.0	.60	1.34			
12	34.5	.60	1.30			
13	36.0	.60	1.11			
14	37.5	.60	1.19			
15	39.0	.50	0.23			
16	40.5	.45	0.57			
17	42.0	.45	0.24			
18	43.5	.35	0			
19	44.0 REW	0	0			
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 6-19-03 **Site Visit Code:** 03-0718

Waterbody: Middle Fork Dearborn **STORET Station ID:** M12MFDBR02

Personnel: Laidlaw / Bauman

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
						Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: M12MFDBR02 Date: 6-19-03 Site Visit Code: 03-0718

Waterbody: Middle Fork Dearborn - D.S. Hwy 434 Reach Length: 1/4 mile

Waterbody Seg ID: ______ Personnel: ______

Station ID's on reach: ______

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments ______

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 4 Potential Score: 5

Comments ______

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 5 Potential Score: 6

Comments ______

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 5 Potential Score: 6

Comments

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 2 Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 2 Potential Score: 3

Comments

2 SRAF.xls

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 7 Potential Score: 8

Comments: Right & Left Banks very different

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 2 Potential Score: 4

Comments:

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 6 Potential Score: 8

Comments: needs more willows instead of grasses

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 5 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

4 SRAF.xls

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover
8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 3 Potential Score: 4

Comments

12b. Habitat Complexity
6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 3 Potential Score: 3

Comments

12c. Spawning Habitat (salmonid streams only)
8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 5 Potential Score: 6

Comments

5 SRAF.xls

12d. Fish Passsage

8 = No potential fish passage barriers apparent.

0 = Potential fish passage barriers present.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment

8 = Entrainment of fish into water diversions not an issue.

4 = Entrainment of fish into water diversions may be a moderate issue.

0 = Entrainment of fish into water diversions may be a major issue.

Actual Score: 8 Potential Score: 8

Comments

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,

3 = Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 3 Potential Score: 4

Comments

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 5 Potential Score: 6

Comments

SRAF.xls

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 3 Potential Score: 4

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 3 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments: Ditch nearby parallels stream

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 6 Potential Score: 8

Comments: grazing

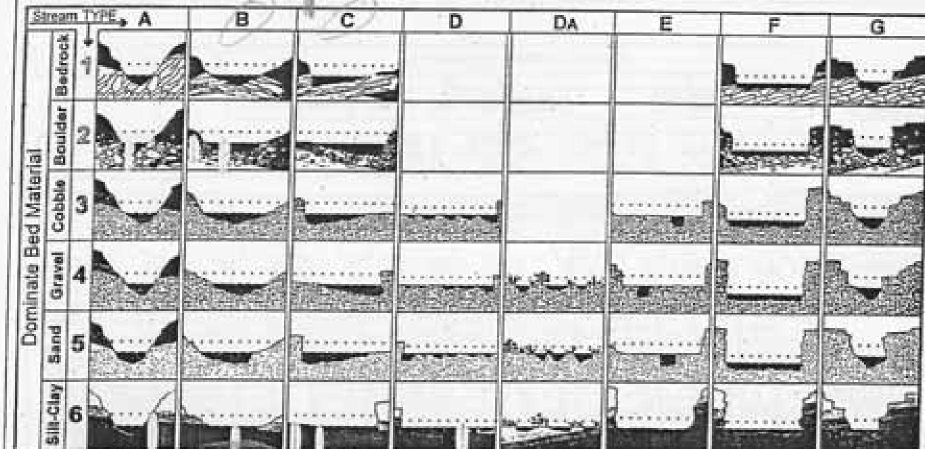
Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

SRAF.xls



	A	B	C	D	DA	E	F	G
Entrchmnt	< 1.4	1.4 - 2.2	> 2.2	n/a	> 4.0	> 2.2	< 1.4	< 1.4
W/D Ratio	< 12	> 12	> 12	> 40	< 40	< 12	> 12	< 12
Sinuosity	1 - 1.2	> 1.2	> 1.2	n/a	variable	> 1.5	> 1.2	> 1.2
Slope	.04-.099	.02-.039	< .02	< .04	< .005	< .02	< .02	.02-.039

Figure 1.2 Rosgen's representation of longitudinal, cross sectional, and plan views of major stream types. From Rosgen, 1996.

03 – 0721 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DRBRN Date: 6/19/03
Personnel: Laidlaw Bowman

Waterbody Name: Middle Fork Dearborn County: Lewis & Clark HUC: 10030102
Station ID: M12MFDBR01 Visit # ____ Location: Near Rogers Pass
Lat: 47°04' 10.5" Long: 112°01' 11.4" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 (circled) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	D3-0721W	GRAB
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0721C (benthic & ...)	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 15:20	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W 10.29	A
pH:	8.40	
SC: (mS/cm)	.200 / EC .144	
SC x 1000 =	µmho/cm	
DO: (mg/L)	10.35 mg/L - 91.0%	
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:	2.36 NTU	
	1.58 NTU	

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:
sampled during ... [illegible]

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6-19-03 Site Visit Code: 03-0721

Waterbody: Middle Fork Dearborn near Rogers Pass Station ID: M12MFDBR01

Personnel: Lindberg/Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	16 (LEW)	.30	.70			
2	17	.35	.75			
3	18	.35	.78			
4	>>21	.35	1.13			
5	V20	.35	1.33			
6	22	.35	.90			
7	23	.35	.89			
8	23.4 (REW)	Ø	Ø			
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

lightning storm took flows quickly

Page 1 of 2 Data Mgmt. #

M12MFDBR01	Date-	7/23/2003	11:30
Middle Fork Dearborn, Upstream near Roger's Pass			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope	*0.0259*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge	*0.56*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score	**96.5**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		2 min 25'

Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*0.56*	*cfs*
Temperature, water	9.86	degree C
pH	8.38	
Specific Conductance	0.241	mS/cm
Dissolved Oxygen	10.81	mg/L
Dissolved Oxygen, % Saturation	95.5	%
Turbidity	0.46	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.3	mg/m^3	0.1
Benthic Chlorophyll a	11.6	mg/m^3	0.1
Total Phosphorus, TP	0.033	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	0.09	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results

parameter	*value*	*units*
TOTAL SCORE (max =18)	16	score
PERCENT OF MAX SCORE	89	%
IMPAIRMENT CLASSIFICATION	NON IMPAIRED	
USE SUPPORT	FULL SUPPORT	

M12MFDBR04	Date-	7/23/2003	13:00
Middle Fork Dearborn, Below Ingersoll's Rd.			

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*27.00*	*Ft*
Mean Depth	*0.65*	*Ft*
Bnkfull X-sect area	*17.60*	*Sq Ft*
Width/Depth	*41.42*	
Max Depth	*1.69*	*Ft*
Flood prone width	*123.70*	*Ft*
Entrenchement Ratio	*4.58*	
Water slope	*0.0068*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)		*%*
Stream Type	C4	
Discharge	*5.98*	*cfs*

Stream Reach Habitat Assessments		
Parameter	***Value***	***Units***
Stream Reach Assessment Score (NRCS)	**100**	%
Stream Reach Assessment Score (MT adjusted)	**99.3**	%
Macroinvertabrate Habitat Assessment Score	**86.9**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

2.75 min
40'

Field Measurements of water chemistry		
parameter	***value***	***units***
Flow	*5.98*	*cfs*
Temperature, water	18.59	degree C
pH	8.19	
Specific Conductance	0.297	mS/cm
Dissolved Oxygen	9.64	mg/L
Dissolved Oxygen, % Saturation	102.9	%
Turbidity	1	NTU

Lab Results from Field Samples			
parameter	***value***	***units***	***RL***
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	2.1	mg/m^3	0.1
Benthic Chlorophyll a	34.9	mg/m^3	0.1
Total Phosphorus, TP	0.031	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	***value***	***units***
TOTAL SCORE (max =18)	11	score
PERCENT OF MAX SCORE	61	%
IMPAIRMENT CLASSIFICATION	SLIGHT IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

M12MFDBR02	Date-	7/23/2003	14:15
Middle Fork Dearborn, Downstream of Hwy 434			

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*34.50*	*Ft*
Mean Depth	*2.20*	*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth	*15.68*	
Max Depth	*2.40*	*Ft*
Flood prone width	*72.50*	*Ft*
Entrenchement Ratio	*2.10*	
Water slope	*0.0074*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)		*%*
Stream Type	B4c	*almost a C*
Discharge	*5.94*	*cfs*

Stream Reach Habitat Assessments			
Parameter	***Value***	***Units***	
Stream Reach Assessment Score (NRCS)	**85**	%	
Stream Reach Assessment Score (MT adjusted)	**86.8**	%	
Macroinvertabrate Habitat Assessment Score	**82.7**	%	
OVERALL SITE RATINGS			
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting, threatened**		
Stream Reach Assessment Score (MT adjusted)			
Macroinvertabrate Habitat Assessment Score			1.75 min 25'

Field Measurements of water chemistry		
parameter	***value***	***units***
Flow	*5.94*	*cfs*
Temperature, water	20.5	degree C
pH	8.27	
Specific Conductance	0.311	mS/cm
Dissolved Oxygen	9.23	mg/L
Dissolved Oxygen, % Saturation	102.8	%
Turbidity	1.24	NTU

Lab Results from Field Samples			
parameter	***value***	***units***	***RL***
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	1.3	mg/m^3	0.1
Benthic Chlorophyll a	14.7	mg/m^3	0.1
Total Phosphorus, TP	0.028	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	***value***	***units***
TOTAL SCORE (max =18)	11	score
PERCENT OF MAX SCORE	61	%
IMPAIRMENT CLASSIFICATION	SLIGHT IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	BEHI Field Measures				BEHI Calculated Values		
	Parameter		*Value*	*Units*	*Parameter*	*Value*	*Units*
Longitudinal Information	Rod reading @ Upstream Edge of Water		6.08	feet	*Slope*	*0.0074*	
					Sinuousity		
	Rod reading @ Downstream Edge of Water		9.18	feet	*Max Depth*	*2.40*	feet
					Floodprone Height	*4.80*	feet
	Stream Distance		420.00	feet	*Mean Depth*	*2.20*	feet
	Straightline Distance			feet	*Bankfull Width*	*34.50*	feet
Cross-Sectional Information	Left Edge of Bankfull		0.00	feet	*Floodplrone Width*	*72.50*	feet
	Right Edge of Bankfull		34.50	feet	*Bankfull Area*		ft^2
	Rod reading @ Thalweg		*4.80*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth		*2.40*	feet	*W/D Ratio*	*15.68*	
	Rod reading @ Floodplain Depth		*0.00*	feet	*Cross Sectional Area*	*0.00*	ft^2
	Left Edge of Floodprone depth		0.00	feet	*Entrenchment Ratio*	*2.10*	
	Right Edge of Floodprone depth		72.50	feet			
BEHI Information	Bank Height			feet			
	Bankfull Height		2.40	feet	*Bank Ht/Bankfull Ht*	*0.00*	
	Root Depth			feet	*Root Depth/Bank Ht*		
	Root Density			%	*Root Density*		*%*
	Bank Angle			Degrees	*Bank Angle*		*degrees*
	Surface Protection			%	*Surface Protection*		*%*
Near Bank Stress Information	Velocity at thalweg			ft/sec	*Velocity Gradient*		*ft/sec/ft*
	Tape reading at thalweg			feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank			ft/sec			
	tape reading at left bank			feet	*A nb / A*		
	Near bank stress						
	Mean shear stress						
	Near bank x-sectional area			ft^2			
	M12MFDBR02	**Date-**	**7/23/2003**	**14:15**			
	Middle Fork Dearborn, Downstream of Hwy 434						

M12MFDBR01	Date-	6/19/2003	15:20
Middle Fork Dearborn, Upstream near Roger's Pass			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope	*0.0259*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)	*15.24*	*%*
Stream Type		
Discharge	*2.40*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

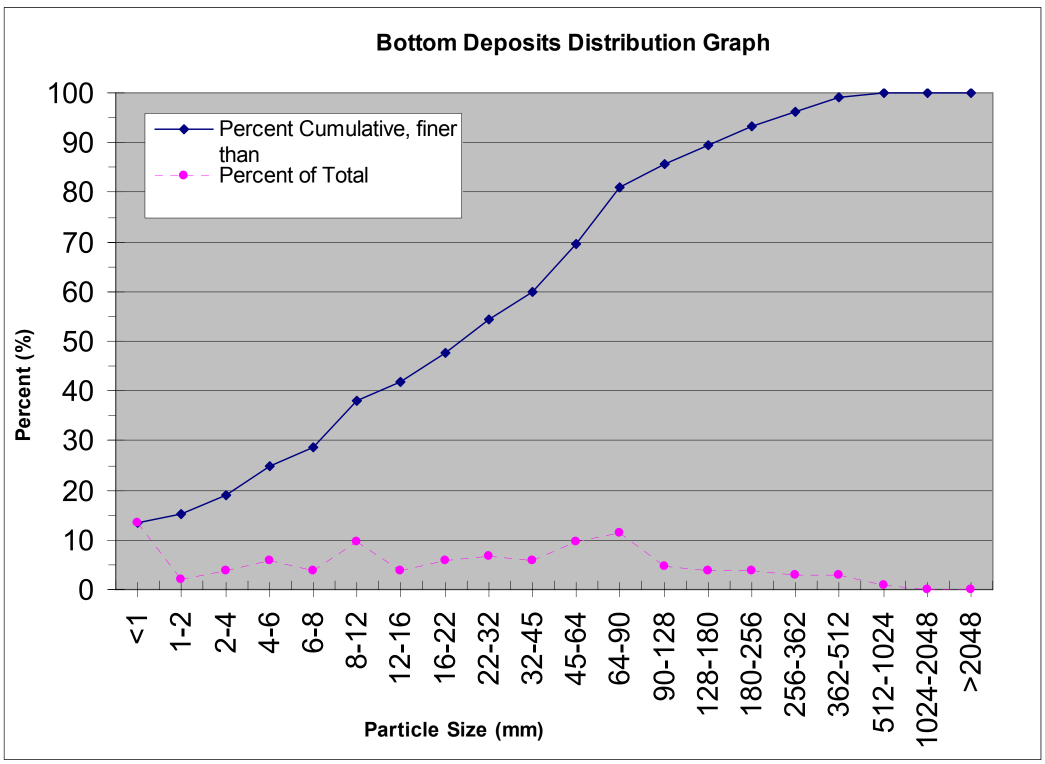
Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*2.40*	*cfs*
Temperature, water	10.29	degree C
pH	8.4	
Specific Conductance	0.2	mS/cm
Dissolved Oxygen	10.25	mg/L
Dissolved Oxygen, % Saturation	91	%
Turbidity	1.97	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.6	mg/m^3	0.1
Benthic Chlorophyll a	9.2	mg/m^3	0.1
Total Phosphorus, TP	0.005	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	0.04	mg/L	0.01
Total Nitrogen, TN		mg/L	

	Mean size	Pebble Count Data Particle Size (mm)	Sum	% Total	Cum. Total
S/C	0.5	<1	14	13.33	13.33
S	1.5	1-2	2	1.90	15.24
FG	3	2-4	4	3.81	19.05
FG	5	4-6	6	5.71	24.76
FG	7	6-8	4	3.81	28.57
MG	10	8-12	10	9.52	38.10
MG	14	12-16	4	3.81	41.90
CG	18	16-22	6	5.71	47.62
CG	27	22-32	7	6.67	54.29
CG	38.5	32-45	6	5.71	60.00
CG	54.5	45-64	10	9.52	69.52
SC	77	64-90	12	11.43	80.95
SC	109	90-128	5	4.76	85.71
MC	154	128-180	4	3.81	89.52
LC	218	180-256	4	3.81	93.33
LC	309	256-362	3	2.86	96.19
SB	437	362-512	3	2.86	99.05
MB	768	512-1024	1	0.95	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	105	100.00	100.00
		D50 particle size (mm)	22-32		
		% Fines (<2mm)	15.24		
	M12MFDBR01	Date-	6/19/2003	15:20	
	Middle Fork Dearborn, Upstream near Roger's Pass				



M12MFDBR04	Date- 6/19/2003	12:30
Middle Fork Dearborn, Below Ingersoll's Rd.		

Geomorphology Data

parameter	*value*	*units*
Bankfull Width	*27.00*	*Ft*
Mean Depth	*0.65*	*Ft*
Bnkfull X-sect area	*17.60*	*Sq Ft*
Width/Depth	*41.42*	
Max Depth	*1.69*	*Ft*
Flood prone width	*123.70*	*Ft*
Entrenchement Ratio	*4.58*	
Water slope	*0.0068*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)	*17.59*	*%*
Stream Type		
Discharge	*13.58*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**100**	%
Stream Reach Assessment Score (MT adjusted)	**99.3**	%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

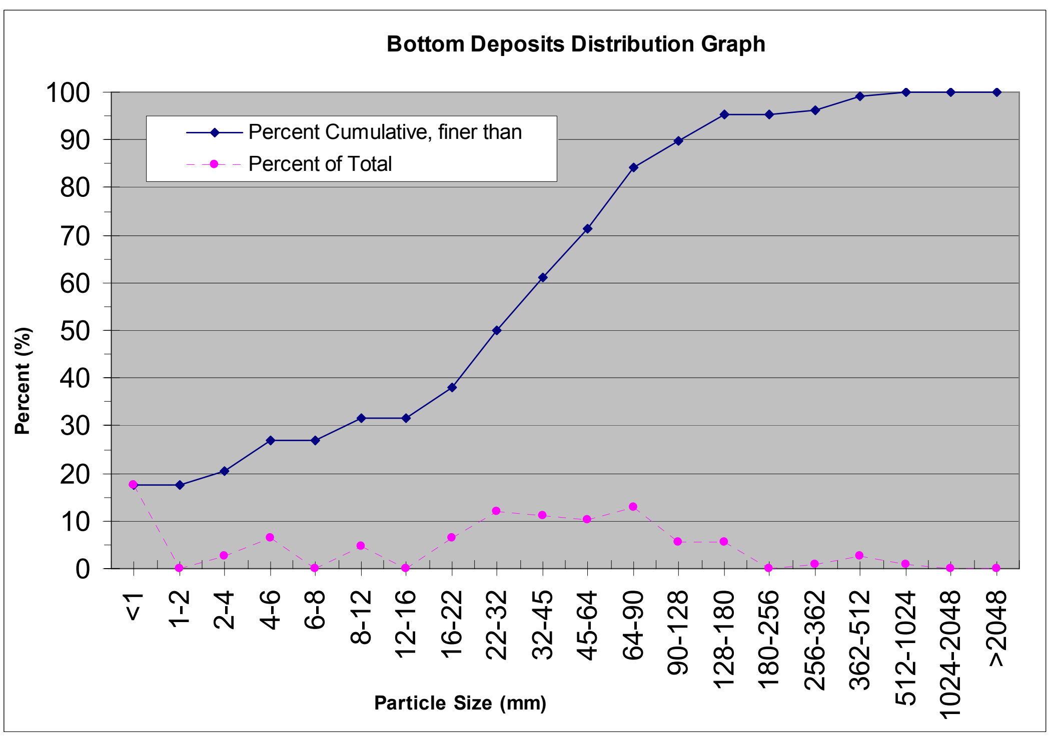
Field Measurements of water chemistry

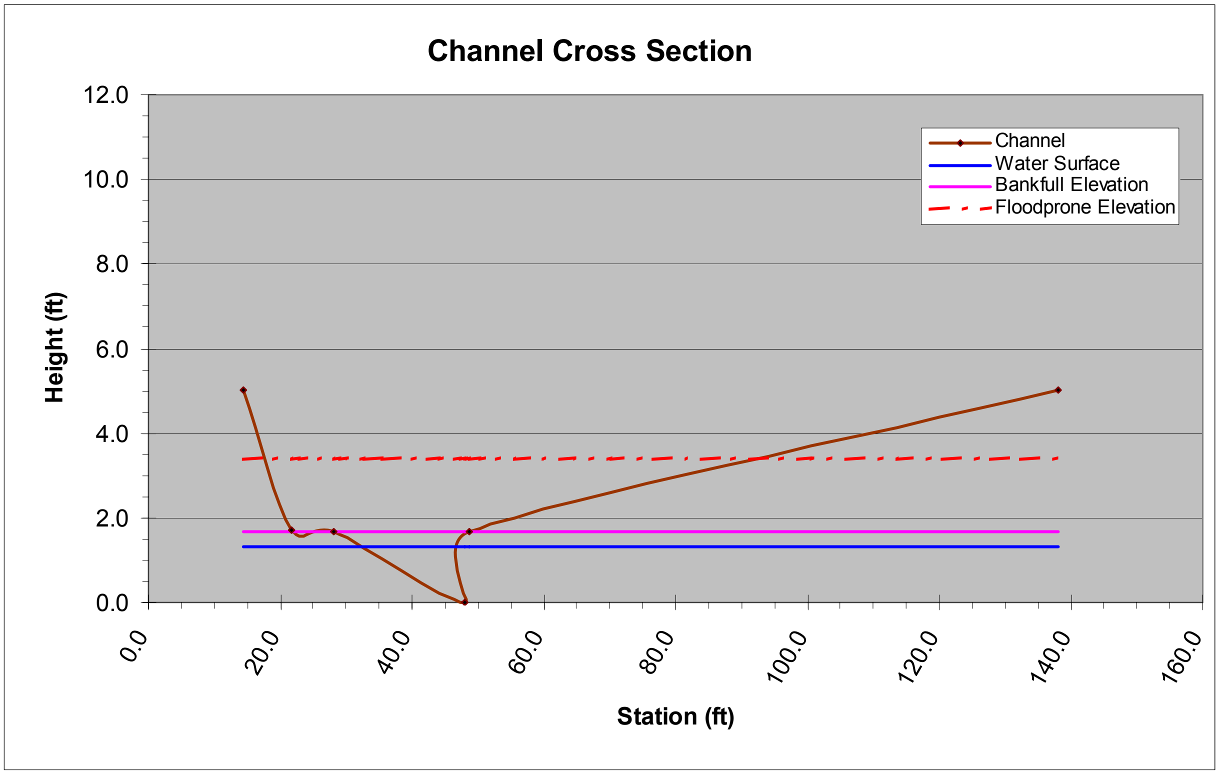
parameter	*value*	*units*
Flow	*13.58*	*cfs*
Temperature, water	15.69	degree C
pH	8.11	
Specific Conductance	0.246	mS/cm
Dissolved Oxygen	8.88	mg/L
Dissolved Oxygen, % Saturation	89.5	%
Turbidity	2.85	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.6	mg/m^3	0.1
Benthic Chlorophyll a	16.8	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

	Mean size	Pebble Count Data			
		Particle Size (mm)	*Sum*	*% Total*	*Cum. Total*
S/C	0.5	<1	19	17.59	17.59
S	1.5	1-2		0.00	17.59
FG	3	2-4	3	2.78	20.37
FG	5	4-6	7	6.48	26.85
FG	7	6-8		0.00	26.85
MG	10	8-12	5	4.63	31.48
MG	14	12-16		0.00	31.48
CG	18	16-22	7	6.48	37.96
CG	27	22-32	13	12.04	50.00
CG	38.5	32-45	12	11.11	61.11
CG	54.5	45-64	11	10.19	71.30
SC	77	64-90	14	12.96	84.26
SC	109	90-128	6	5.56	89.81
MC	154	128-180	6	5.56	95.37
LC	218	180-256		0.00	95.37
LC	309	256-362	1	0.93	96.30
SB	437	362-512	3	2.78	99.07
MB	768	512-1024	1	0.93	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	108	100.00	100.00
		D50 particle size (mm)	22-32		
		% Fines (<2mm)	**17.59**		
	M12MFDBR04	**Date-**	**6/19/2003**	**12:30**	
	Middle Fork Dearborn, Below Ingersoll's Rd.				





	BEHI Field Measures			BEHI Calculated Values		
	Parameter	***Value***	***Units***	***Parameter***	***Value***	***Units***
Longitudinal Information	Rod reading @ Upstream Edge of Water	4.60	feet	*Slope*	*0.0068*	
				Sinuousity		
	Rod reading @ Downstream Edge of Water	6.40	feet	*Max Depth*	*1.69*	feet
				Floodprone Height	*3.38*	feet
	Stream Distance	263.50	feet	*Mean Depth*	*0.65*	feet
	Straightline Distance		feet	*Bankfull Width*	*27.00*	feet
Cross-Sectional Information	Left Edge of Bankfull	21.70	feet	*Floodplrone Width*	*123.70*	feet
	Right Edge of Bankfull	48.70	feet	*Bankfull Area*	*17.60*	ft^2
	Rod reading @ Thalweg	*8.35*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth	*6.66*	feet	*W/D Ratio*	*41.42*	
	Rod reading @ Floodplain Depth	*4.97*	feet	*Cross Sectional Area*	*17.60*	ft^2
	Left Edge of Floodprone depth	14.30	feet	*Entrenchment Ratio*	*4.58*	
	Right Edge of Floodprone depth	138.00	feet			
BEHI Information	Bank Height		feet			
	Bankfull Height		feet	*Bank Ht/Bankfull Ht*		
	Root Depth		feet	*Root Depth/Bank Ht*		
	Root Density		%	*Root Density*		*%*
	Bank Angle		Degrees	*Bank Angle*		*degrees*
	Surface Protection		%	*Surface Protection*		*%*
Near Bank Stress Information	Velocity at thalweg		ft/sec	*Velocity Gradient*		*ft/sec/ft*
	Tape reading at thalweg		feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank		ft/sec			
	tape reading at left bank		feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			

M12MFDBR02	Date- 6/19/2003	9:30
Middle Fork Dearborn, Downstream of Hwy 434		

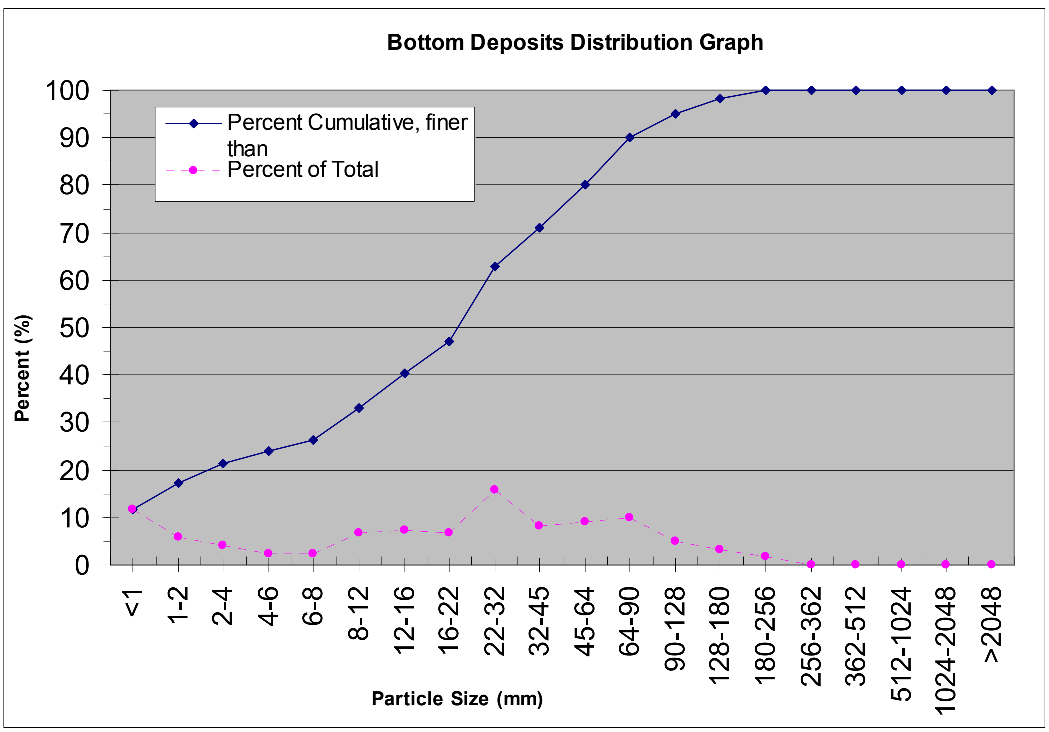
Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*34.50*	*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth	*2.40*	*Ft*
Flood prone width	*72.50*	*Ft*
Entrenchement Ratio	*2.10*	
Water slope	*0.0074*	
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50		mm
Percentage of Fines (<2mm)	*17.36*	*%*
Stream Type		
Discharge	*13.72*	*cfs*

Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**85**	%
Stream Reach Assessment Score (MT adjusted)	**86.8**	%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting, threatened**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*13.72*	*cfs*
Temperature, water	13.35	degree C
pH	8	
Specific Conductance	0.208	mS/cm
Dissolved Oxygen	9.39	mg/L
Dissolved Oxygen, % Saturation	90.2	%
Turbidity	2.8	NTU

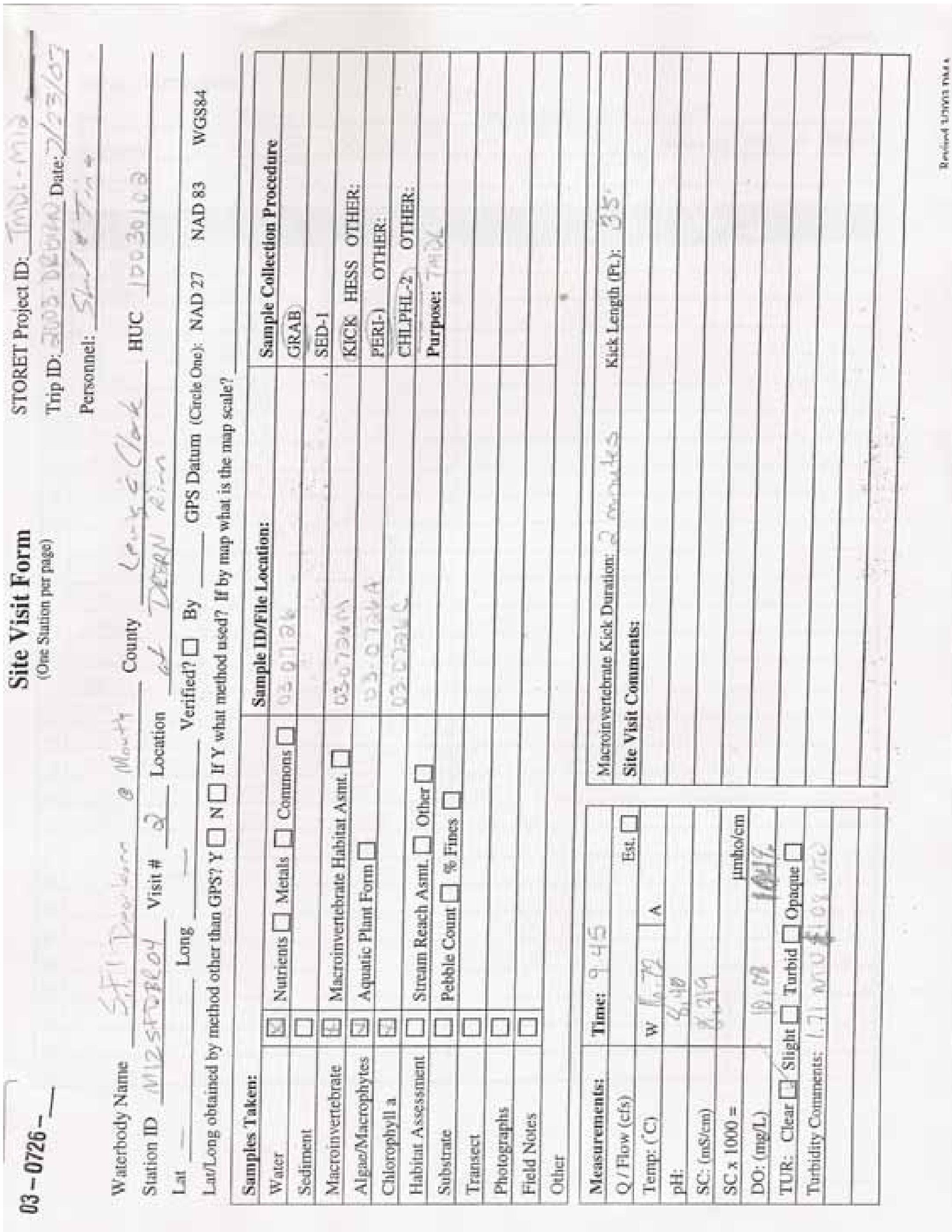
Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.6	mg/m^3	0.1
Benthic Chlorophyll a	22.2	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	14	11.57	11.57
S	1.5	1-2	7	5.79	17.36
FG	3	2-4	5	4.13	21.49
FG	5	4-6	3	2.48	23.97
FG	7	6-8	3	2.48	26.45
MG	10	8-12	8	6.61	33.06
MG	14	12-16	9	7.44	40.50
CG	18	16-22	8	6.61	47.11
CG	27	22-32	19	15.70	62.81
CG	38.5	32-45	10	8.26	71.07
CG	54.5	45-64	11	9.09	80.17
SC	77	64-90	12	9.92	90.08
SC	109	90-128	6	4.96	95.04
MC	154	128-180	4	3.31	98.35
LC	218	180-256	2	1.65	100.00
LC	309	256-362		0.00	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	121	100.00	100.00
		D50 particle size (mm)			
		% Fines (<2mm)	17.36		
	M12MFDBR02	Date-	6/19/2003	9:30	
	Middle Fork Dearborn, Downstream of Hwy 434				



	BEHI Field Measures			BEHI Calculated Values		
	Parameter	***Value***	***Units***	***Parameter***	***Value***	***Units***
Longitudinal Information	Rod reading @ Upstream Edge of Water	6.08	feet	*Slope*	*0.0074*	
				Sinuousity		
	Rod reading @ Downstream Edge of Water	9.18	feet	*Max Depth*	*2.40*	feet
				Floodprone Height	*4.80*	feet
	Stream Distance	420.00	feet	*Mean Depth*		feet
	Straightline Distance		feet	*Bankfull Width*	*34.50*	feet
Cross-Sectional Information	Left Edge of Bankfull	0.00	feet	*Floodplrone Width*	*72.50*	feet
	Right Edge of Bankfull	34.50	feet	*Bankfull Area*		ft^2
	Rod reading @ Thalweg	*4.80*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth	*2.40*	feet	*W/D Ratio*		
	Rod reading @ Floodplain Depth	*0.00*	feet	*Cross Sectional Area*	*0.00*	ft^2
	Left Edge of Floodprone depth	0.00	feet	*Entrenchment Ratio*	*2.10*	
	Right Edge of Floodprone depth	72.50	feet			
BEHI Information	Bank Height		feet			
	Bankfull Height		feet	*Bank Ht/Bankfull Ht*		
	Root Depth		feet	*Root Depth/Bank Ht*		
	Root Density		%	*Root Density*		*%*
	Bank Angle		Degrees	*Bank Angle*		*degrees*
	Surface Protection		%	*Surface Protection*		*%*
Near Bank Stress Information	Velocity at thalweg		ft/sec	*Velocity Gradient*		*ft/sec/ft*
	Tape reading at thalweg		feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank		ft/sec			
	tape reading at left bank		feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			

SOUTH FORK DEARBORN RIVER



03 – 0726 – __

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-MID
Trip ID: 2003 DRBRN Date: 7/23/03
Personnel: Shel & Tina

Waterbody Name: S.F. Dearborn @ Mouth County: Lewis & Clark HUC: 10030102
Station ID: M12SFDBR04 Visit #: 2 Location: at DEARN Rim
Lat: — Long: — Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☐ Metals ☐ Commons ☐	03-0726	GRAB (circled)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	030726M	KICK HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0726A	PERI-1 (circled) OTHER:
Chlorophyll a	☒		03-0726C	CHLPHL-2 (circled) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 9:45
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 16.72 A
pH:	8.40
SC: (mS/cm)	8.319
SC x 1000 =	µmho/cm
DO: (mg/L)	10.08 104%
TUR: Clear ☐ Slight ☒ Turbid ☐ Opaque ☐	
Turbidity Comments: 1.71 NTU & 1.08 NTU	

Macroinvertebrate Kick Duration: 2 minutes Kick Length (Ft.): 35'

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7/23/03 Site Visit Code: 03-0726

Waterbody: SFD @ Mouth Station ID: M12SFDBR04

Personnel: SD/Tim

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	1.0 LEW	0	0			
2	2.0	0.20	0			
3	3.0	0.45	0.04			
4	4.0	0.52	0.09			
5	5.0	0.50	0.22			
6	6.0	0.40	0.17			
7	7.0	0.35	0.18			
8	8.0	0.25	0.18			
9	9.0	0.35	0.18			
10	10.0	0.30	0.19			
11	11.0	0.35	0.19			
12	12.0	0.35	0.06			
13	13.0	0.38	0			
14	14.0	0.35	0.08			
15	15.0	0.40	0.25			
16	16.0	0.41	0.19			
17	17.0	0.50	0.23			
18	18.0	0.50	0.18			
19	19.0	0.50	0.15			
20	20.0	0.45	0.11			
21	21.0	0.40	0.08			
22	22.0	0.20	0.13			
23	23.0 REW	0.15	0			
24						
25						
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Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7/23/03 Site Visit Code: 03-0726

Waterbody: SFD @ mouth Site: M12SFDBR04

Personnel: Laidlaw / Bowman

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score:	9/10 9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score:	9-10	8 6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score:	16-20 18	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score:	16-20 18	11-15	6-10	0-5
Comments:	Road Crossings			
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score:	16-20	11-15 14	6-10	0-5
Comments:	Some fines, not too bad			

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score:	16-20	11-15 15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10 9	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10 9	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10 9	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		

TOTAL SCORE: Score compared to maximum possible:

03 – 0724 –___

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12

Trip ID: 2003-DRBRN Date: 7/22/03

Personnel: Laidlaw/Bowman

Waterbody Name: South Fork Dearborn County: Lewis + Clark HUC: 10030102

Station ID: M12SFDBR02 Visit #: 1 Location: S Fork U.S. Hwy 434

Lat: 47°09'08.7" Long: 112°13'33.0" Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0724W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0724M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0724A	(PERI-1) OTHER:
Chlorophyll a	☒		03-0724C	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 1545
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 24.16°C A
pH:	8.43
SC: (mS/cm)	.316
SC x 1000 =	µmho/cm
DO: (mg/L)	8.67 103.2%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments: 0.95 0.65	

Macroinvertebrate Kick Duration: 1:30 minutes Kick Length (Ft.):

Site Visit Comments:

Revised 3/2002

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-22-03 Site Visit Code: 03-0794

Waterbody: South Fork Upstream Hwy 434 Station ID: M12SFDBR01

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	10	0	0	0		
2	11	.25	0			
3	12	.2	.03			
4	13	.2	0			
5	14	.28	.78			
6	15	.4	.77			
7	16	.4	.46			
8	17	.38	1.01			
9	18	.32	.44			
10	19	.30	.57			
11	20	.35	.10			
12	21	.4	.67			
13	22	.38	.08			
14	23	.30	.18			
15	24	.25	.11			
16	25	.2	0			
17	26	0	0			
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Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM — RIFFLE/RUN PREVALENCE

Date: 7-22-03 Site Visit Code: 03-0724

Waterbody: South Fork Dearborn Site: M12SFDBR02

Personnel:

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score:	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 7	9-10	6-8	3-5	0-2
Comments:	cobble, gravel			
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 16	16-20	11-15	6-10	0-5
Comments:	Some but not greater than 25%			
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 19	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 16	16-20	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 15	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 8.5	9-10	6-8	3-5	0-2
	Left Side 8	Average:		
	Right Side 9	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 10	9-10	6-8	3-5	0-2
	Left Side	Average:		
	Right Side	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 10	9-10	6-8	3-5	0-2
	Left Side	Average:		
	Right Side	Comments: cropland off to this side - large buffer		

TOTAL SCORE:

Score compared to maximum possible:

03 – 0723 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DEBBON Date: 7/22/03
Personnel: Laidlaw / Bowman

Waterbody Name South Fork Dearborn County Lewis & Clark HUC 10030102
Station ID M12SFDBR01 Visit # 2 Location Upstream of Blacktail Ranch
Lat 47°07'15.5" Long 112°15'16.3" Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0723W	GRAB
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0723M	KICK HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0723A	PERI-1 OTHER:
Chlorophyll a	☒		03-0723C	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☒			
Other				

Measurements:	Time: 1400	
Q / Flow (cfs)		Est. ☐
Temp: (°C)	W 18.55°C	A
pH:	8.39	
SC: (mS/cm)	.274	
SC x 1000 =	274	µmho/cm
DO: (mg/L)	9.36 mg/l 100%	
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments: 85 NTU 173 NTU		

Macroinvertebrate Kick Duration: 2 minutes Kick Length (Ft.): 50'

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-22-03 Site Visit Code: 03-0723

Waterbody: S Fork Dearborn U S Blacktail Road Station ID: M12SFDBR01

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	3.5	0	0	0		
2	4.5	.25	0	1		
3	5.5	.32	.20	1		
4	6.5	.50	.26	1		
5	7.5	.50	.50	1		
6	8.5	.85	.64	1		
7	9.5	.90	.65	1		
8	10.5	.95	.44	1		
9	11.5	1.0	.49	1		
10	12.5	1.0	.34	1		
11	13.5	.9	.34	1		
12	14.5	.85	.55			
13	15.5	.85	.54			
14	16.5	.85	.44			
15	17.5	.85	0			
16	18.5	.85	.30			
17	19.5	.95	.15			
18	20.5	1.05	.01			
19	21.5	.92	.01			
20	22.5	.50	0			
21	23.0	0	0			
22						
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Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7-22-03 Site Visit Code: 03-0723

Waterbody: S Fork Dearborn u/s Blacktail Ranch Site: M12SFDBR01

Personnel: Laidlaw / Bowman

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 9	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 7	9-10	6-8	3-5	0-2
Comments:	mix of cobble			
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 18	16-20	11-15	6-10	0-5
Comments:	looks great			
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 20	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstrucions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 19	16-20	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 15	16-20	11-15	6-10	0-5
Comments:	lower flows than June but still good			
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 9	9-10	6-8	3-5	0-2
	Left Side 10	Average: 9		
	Right Side 8	Comments: old cattle crossing		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 9	9-10	6-8	3-5	0-2
	Left Side 9	Average:		
	Right Side 10	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments:		

TOTAL SCORE: Score compared to maximum possible:

* Reference Site

Place Site ...
03 – 0710 – ___

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DEBU Date: 6-17-03 11:20am
Personnel: Tina, Shad

Waterbody Name: South Fork Dearborn County: Lewis & Clark HUC: 10030102
Station ID: M12SFDBRD01 Visit #: ___ Location: Upstream of Blacktail Lanes
Lat: 47° 07' 15.5" Long: 112° 15' 15.3" Verified? ☐ By ___ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☒ If Y what method used? If by map what is the map scale? ___

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0710 W	(GRAB)
Sediment	☒			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0710C (both benthic & water column)	(CHLPHL-2) OTHER:
Habitat Assessment	☒	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☒	Pebble Count ☒ % Fines ☒		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 1115	
Q / Flow (cfs)		Est. ☐
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =		µmho/cm
DO: (mg/L)		

TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐
Turbidity Comments:

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:
field measurements not taken b/c meter not with crew

Revised 3/2003 DMA

Revised 4/2/03

TOTAL DISCHARGE:

Date: 6-17-03 Site Visit Code: 03-0710

Waterbody: S Fork Dearborn Upstream on Blacktail Station ID: M12SFDBR01

Personnel: Laidlaw | Bowman

	**Distance from initial point (ft)	**Depth (ft)	**Velocity (at point) (ft/s)	**Width	**Area	**Discharge
1	25.6 LEW	0.35	0.22			
2	26	0.6	0.53			
3	27	0.7	0.59			
4	28	0.9	1.18			
5	29	0.9	1.61			
6	30	1.1	1.29			
7	31	1.2	1.30			
8	32	1.3	0.80			
9	33	1.4	0.77			
10	34	1.25	0.55			
11	35	1.05	0.58			
12	36	1.13	0.61			
13	37	1.15	0.75			
14	38	1.17	0.79			
15	39	1.05	0.63			
16	40	1.00	0.69			
17	41	1.10	0.28			
18	42	1.10	0.13			
19	43	0.70	Ø			
20	44.2 REW	Ø	Ø			
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2

Data Mgmt. Approved

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SUBSTRATE DEQ/MDM

Date: 6-17-03 **Site Visit Code:** 03-0710

Waterbody: S Fork Dearborn-Blacktail **STORET Station ID:** M12SFDBR01

Personnel: Laidlaw / Bowman

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: M12SFDBK01 Date: 6-17-03 Site Visit Code: 03-0710

Waterbody: South Fork Dearborn - Blacktail Reach Length: ______

Waterbody Seg ID: ______ Personnel: ______

Station ID's on reach: ______

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments ______

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 6 Potential Score: 6

Comments ______

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 6 Potential Score: 6

Comments ______

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 35% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 35% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratin_s for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 6 Potential Score: 6

Comments

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 3 Potential Score: 3

Comments

Question 7, Di_turbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 3 Potential Score: 3

Comments

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 8 Potential Score: 8

Comments

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 4 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 8 Potential Score: 8

Comments

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

4 SRAF.xls

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover

8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 6

Comments: Shallow, high gradient, Deep pools not present but not characteristics

12b. Habitat Complexity

6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 3 Potential Score: 3

Comments

12c. Spawning Habitat (salmonid streams only)

8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

5 SRAF.xls

12d. Fish Passsage

8 = No potential fish passage barriers apparent.

0 = Potential fish passage barriers present.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment

8 = Entrainment of fish into water diversions not an issue.

4 = Entrainment of fish into water diversions may be a moderate issue.

0 = Entrainment of fish into water diversions may be a major issue.

Actual Score: 8 Potential Score: 8

Comments

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation.

3 = Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 3 Potential Score: 4

Comments

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

SRAF.xls

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 8 Potential Score: 8

Comments: some small scale logging & cattle grazing seasonally (small herd ≤150)

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

BANK ERODIBILITY HAZARD INDEX

Date: ______________

Stream Name: ______________

Cross-section #: Bank: (right/left)

PHOTO POINTS	Camera #	Photo #
1. Downstream to x-section		
2. Left pin to right pin		
3. Right pin to left pin		
4. Mid-channel to left bank		
5. Mid-channel to right bank		

NOTES:
BEHI not needed; minimal eroding banks

BANK EROSION POTENTIAL

CRITERIA	VERY LOW		LOW		MODERATE		HIGH		VERY HIGH		EXTREME		BEHI DATA: BANKFULL		FLOODPRONE	
	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX
Bank Ht/Bkf Ht	1.0-1.1	1.0-1.9	1.1-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10				
Root Depth/Bank Ht	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	29-0.15	6.0-7.9	0.14-0.05	8.0-9.0	<0.05	10				
Root density (%)	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10				
Bank Angle (degrees)	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10				
(slope)	0-0.36		0.37-1.73		1.74-5.67		5.68-0.0		1.01-(1.81)		<(-1.81)					
Surface Prot. (%)	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10				
TOTALS										+		Total				
		5-9.5		10-19.5		20-29.5		30-39.5		40-45		46-50				
Adjustments Numerical											Adjust Numerical					

Conclusions for Bankfull BEHI

Bank Erosion Potential: ______________

Near Bank Stress: ______________

Estimated Bank Loss/yr: ______________

Conclusions for Floodprone BEHI

Bank Erosion Potential: ______________

Near Bank Stress: ______________

Estimated Bank Loss/yr: ______________

BANK MATERIALS: CIRCLE ONE

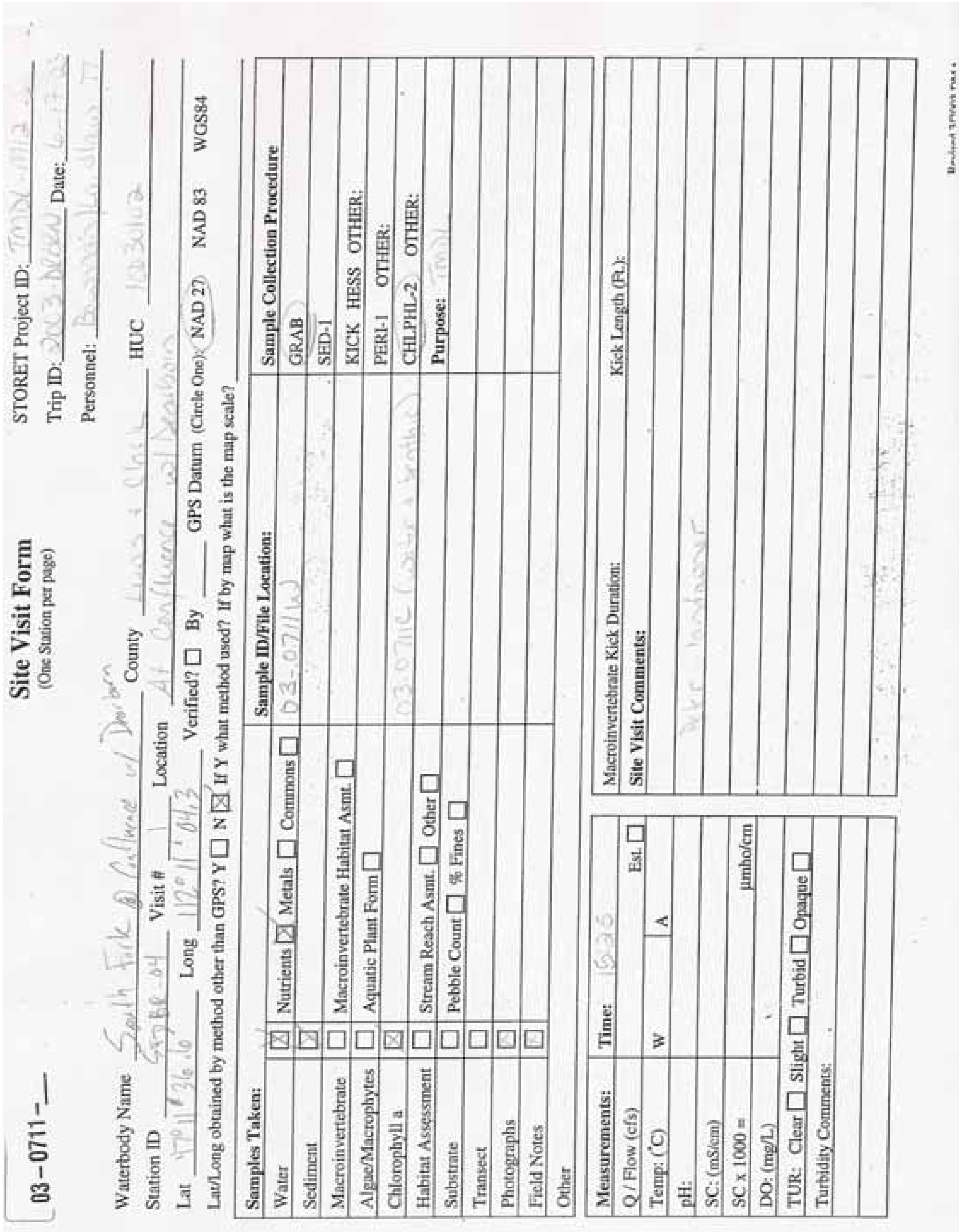
- BEDROCK: Bank erosion potential always very low
- BOULDERS: Bank erosion potential low
- COBBLE: Decrease by one category unless mixture of Gravel/Sand is over 50%, then no adjustment
- GRAVEL: Adjust values up by 5-10 points depending on composition of Sand
- SAND: Adjust values up by 10 points
- SILT/CLAY: No adjustment-unless a part of unconsolidated bank, then adjust up to 10 points
- STRATIFICATION: 5-10 points (upward) depending on position of unstable layers in relation to bankfull stage

Bank Profile Data (Rise and Run from Toe Pin)

RISE	RUN	NOTES

NEAR BANK STRESS RATING	Amb/A**	Value
Low	0.32 or Less	
Moderate	0.33-0.41	
High	0.042-0.45	
Very High	0.046-0.50	
Extreme	0.51 or more	

Bank Profile Sketch



03 – 0711 – ___

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DRBRN Date: 6-17-03
Personnel: [illegible]

Waterbody Name: South Fork @ Confluence w/ Dearborn County: Lewis + Clark HUC: 10030102
Station ID: S??DBR-04 Visit #: 1 Location: At Confluence w/ Dearborn
Lat: 47°11' 36.6" Long: 112°11' 04.3" Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☒ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0711W	GRAB
Sediment	☒			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0711C (water + benthic)	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 1525	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:

[illegible]

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6-17-03 Site Visit Code: 03-0711

Waterbody: South Fork - confluence Station ID: M12SFDBR-01

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	14.3 LEW	.3	0			
2	15.3	.4	.39			
3	16.3	.65	.56			
4	17.3	.75	.79			
5	18.3	.70	.71			
6	19.3	.60	.68			
7	20.3	.55	.73			
8	21.3	.55	.77			
9	22.3	.55	.85			
10	23.3	.50	.81			
11	24.3	.50	.83			
12	25.3	.55	.78			
13	26.3	.60	.53			
14	27.3	.60	.68			
15	28.3	.50	.85			
16	29.3	.55	1.04			
17	30.3	.60	.76			
18	31.3	.65	.70			
19	32.3	.70	.63			
20	33.3	.59	.65			
21	34.3	.65	.55			
22	35.3	.55	.50			
23	36.3	.50	.40			
24	37.3	0	0			
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 6-17-03 **Site Visit Code:** 03-0711

Waterbody: South Fork Dearborn **STORET Station ID:** M12SFDBR-04

Personnel: Laidlaw / Bowman

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Nisdex algae

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: 6-17-03 Date: 6-17-03 Site Visit Code: 03-0711

Waterbody: South Fork Dearborn- Confluence Reach Length: ____

Waterbody Seg ID: ____ Personnel: Laidlaw / Bowman

Station ID's on reach: ____

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments ____

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 6 Potential Score: 6

Comments ____

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 5 Potential Score: 6

Comments Some fines material in eddies & point bars

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 6 Potential Score: 6

Comments

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 2 Potential Score: 3

Comments Characteristic of Dearborn

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 3 Potential Score: 3

Comments

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 8 Potential Score: 8

Comments

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 4 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 8 Potential Score: 8

Comments

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

4 SRAF.xls

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover

8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 8 Potential Score: 8

Comments

12b. Habitat Complexity

6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 6

Comments

12c. Spawning Habitat (salmonid streams only)

8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 7 Potential Score: 8

Comments

5 SRAF.xls

12d. Fish Passsage
8 = No potential fish passage barriers apparent.
0 = Potential fish passage barriers present.
N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment
8 = Entrainment of fish into water diversions not an issue.
4 = Entrainment of fish into water diversions may be a moderate issue.
0 = Entrainment of fish into water diversions may be a major issue.

Actual Score: 8 Potential Score: 8

Comments

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation
6 = More than 75% of the stream reach is adequately shaded by vegetation.
4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,
3 = Approximately 25-50% of the stream does not have adequate shade.
0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 3 Potential Score: 4

Comments

Question 14. Algae growth / Nutrients
6 = Algae not apparent. Rocks are slippery.
4 = in small patches or along channel edge
2 = in large patches or discontinuous mats
0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)
N/A = No water

Actual Score: 5 Potential Score: 6

Comments Moss in stream

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 4 Potential Score: 4

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 8 Potential Score: 8

Comments Irrigation upstream however - empty & pods

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 8 Potential Score: 8

Comments

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK.
LESS THAN 50% = NOT SUSTAINABLE

M12SFDBR02	Date- 7/22/2003	15:45
South Fork of Dearborn at Thompsons Ranch, above Hwy 434		

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)	*25.64*	*%*
Stream Type		
Discharge	*1.85*	*cfs*

Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score	**84.2**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

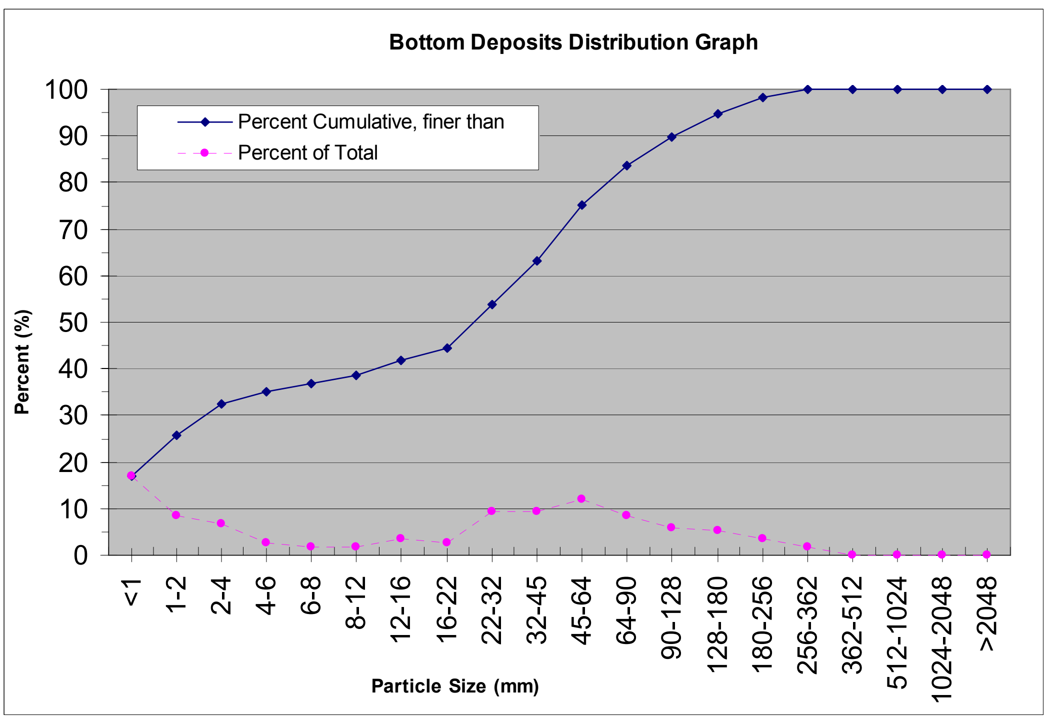
1.5 min
35'

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*1.85*	*cfs*
Temperature, water	24.16	degree C
pH	8.43	
Specific Conductance	0.316	mS/cm
Dissolved Oxygen	8.67	mg/L
Dissolved Oxygen, % Saturation	103.2	%
Turbidity	0.8	NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	1.2		0.1
Benthic Chlorophyll a	25		0.1
Total Phosphorus, TP	0.019		0.004
Total Kiejdahl Notrogen, TKN	ND		0.5
Nitrate + Nitrite	ND		0.01
Total Nitrogen, TN			

Macroinvertabrate Data Results		
parameter	*value*	*units*
TOTAL SCORE (max =18)	13	score
PERCENT OF MAX SCORE	72	%
IMPAIRMENT CLASSIFICATION	SLIGHT IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
	Mean size	***Particle Size (mm)***	***Sum***	***% Total***	***Cum. Total***
S/C	0.5	<1	20	17.09	17.09
S	1.5	1-2	10	8.55	25.64
FG	3	2-4	8	6.84	32.48
FG	5	4-6	3	2.56	35.04
FG	7	6-8	2	1.71	36.75
MG	10	8-12	2	1.71	38.46
MG	14	12-16	4	3.42	41.88
CG	18	16-22	3	2.56	44.44
CG	27	22-32	11	9.40	53.85
CG	38.5	32-45	11	9.40	63.25
CG	54.5	45-64	14	11.97	75.21
SC	77	64-90	10	8.55	83.76
SC	109	90-128	7	5.98	89.74
MC	154	128-180	6	5.13	94.87
LC	218	180-256	4	3.42	98.29
LC	309	256-362	2	1.71	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	117	100.00	100.00
		D50 particle size (mm)			
		% Fines (<2mm)	***25.64***		
	M12SFDBR02	**Date-**	**7/22/2003**	**15:45**	
	South Fork of Dearborn at Thompsons Ranch, above Hwy 434				



M12SFDBR04	Date-	7/23/2003	9:45
South Fork Dearborn, at Confluence with Dearborn River			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	18	mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge	*1.15*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**98.4**	%
Stream Reach Assessment Score (MT adjusted)	**97.1**	%
Macroinvertabrate Habitat Assessment Score	**84.6**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		2 min 35'

Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*1.15*	*cfs*
Temperature, water	16.72	degree C
pH	8.4	
Specific Conductance	0.319	mS/cm
Dissolved Oxygen	10.08	mg/L
Dissolved Oxygen, % Saturation	104	%
Turbidity	1.4	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	15.4	mg/m^3	0.1
Total Phosphorus, TP	0.039	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results

parameter	*value*	*units*
TOTAL SCORE (max =18)	13	score
PERCENT OF MAX SCORE	72	%
IMPAIRMENT CLASSIFICATION	SLIGHT IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

M12SFDBR01	Date-	7/22/2003	14:00
South Fork Dearborn, Upstream site on Blacktail Ranch			

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge	*4.84*	*cfs*

Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**100**	%
Stream Reach Assessment Score (MT adjusted)	**99.3**	%
Macroinvertabrate Habitat Assessment Score	**89.6**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		2 min 50'

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*4.84*	*cfs*
Temperature, water	18.55	degree C
pH	8.39	
Specific Conductance	0.274	mS/cm
Dissolved Oxygen	9.36	mg/L
Dissolved Oxygen, % Saturation	100	%
Turbidity	1.28	NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	20.2	mg/m^3	0.1
Total Phosphorus, TP	0.078	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	*value*	*units*
TOTAL SCORE (max =18)	10	score
PERCENT OF MAX SCORE	56	%
IMPAIRMENT CLASSIFICATION	SLIGHT IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

M12SFDBR01	Date-	6/17/2003	11:15
South Fork Dearborn, Upstream site on Blacktail Ranch			

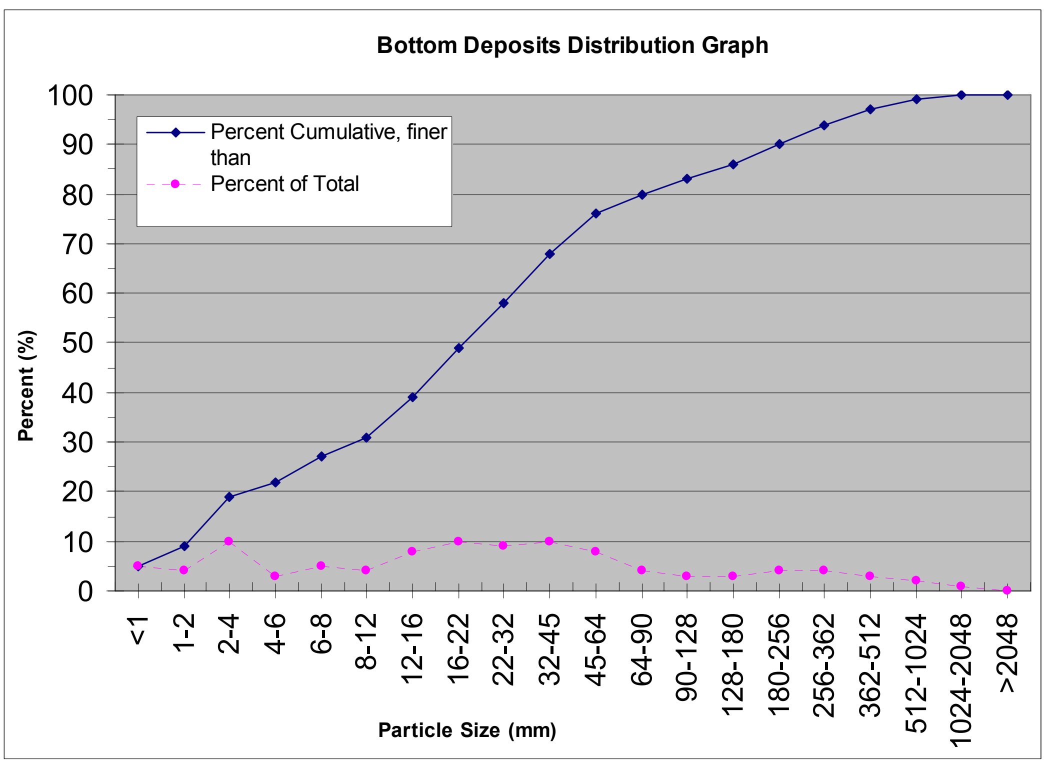
Geomorphology Data		
parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)	*9.00*	*%*
Stream Type		
Discharge	*13.98*	*cfs*

Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**100**	%
Stream Reach Assessment Score (MT adjusted)	**99.3**	%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*13.98*	*cfs*
Temperature, water		degree C
pH		
Specific Conductance		mS/cm
Dissolved Oxygen		mg/L
Dissolved Oxygen, % Saturation		%
Turbidity		NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.9	mg/m^3	0.1
Benthic Chlorophyll a	16.5	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	5	5.00	5.00
S	1.5	1-2	4	4.00	9.00
FG	3	2-4	10	10.00	19.00
FG	5	4-6	3	3.00	22.00
FG	7	6-8	5	5.00	27.00
MG	10	8-12	4	4.00	31.00
MG	14	12-16	8	8.00	39.00
CG	18	16-22	10	10.00	49.00
CG	27	22-32	9	9.00	58.00
CG	38.5	32-45	10	10.00	68.00
CG	54.5	45-64	8	8.00	76.00
SC	77	64-90	4	4.00	80.00
SC	109	90-128	3	3.00	83.00
MC	154	128-180	3	3.00	86.00
LC	218	180-256	4	4.00	90.00
LC	309	256-362	4	4.00	94.00
SB	437	362-512	3	3.00	97.00
MB	768	512-1024	2	2.00	99.00
LB	1536	1024-2048	1	1.00	100.00
BR		>2048		0.00	100.00
		TOTALS	100	100.00	100.00
		D50 particle size (mm)	22-32		
		% Fines (<2mm)	**9.00**		
M12SFDBR01	**Date-**	**6/17/2003**	**11:15**		
South Fork Dearborn, Upstream site on Blacktail Ranch					



M12SFDBR04	Date- 6/17/2003	15:25
South Fork Dearborn, at Confluence with Dearborn River		

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	18	mm
Percentage of Fines (<2mm)	*10.40*	*%*
Stream Type		
Discharge	*8.85*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)	**98.4**	%
Stream Reach Assessment Score (MT adjusted)	**97.1**	%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

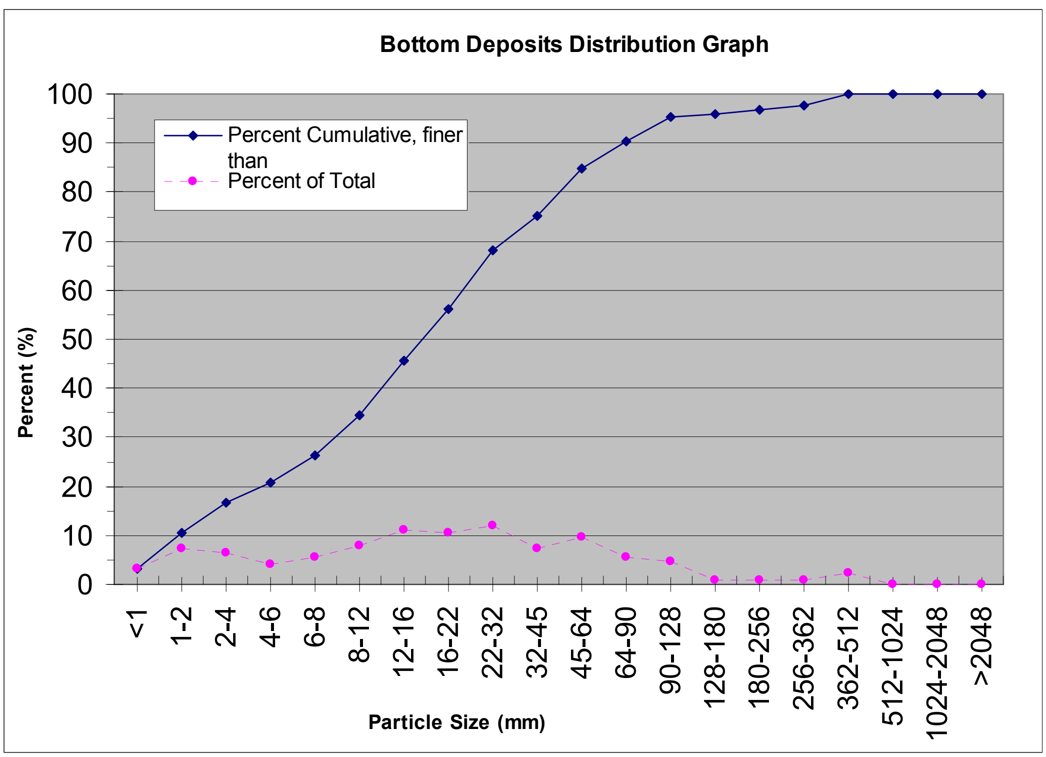
Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*8.85*	*cfs*
Temperature, water		degree C
pH		
Specific Conductance		mS/cm
Dissolved Oxygen		mg/L
Dissolved Oxygen, % Saturation		%
Turbidity		NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	27.6	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	0.5	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

	Mean size	Pebble Count Data			
		Particle Size (mm)	Sum	% Total	Cum. Total
S/C	0.5	<1	4	3.20	3.20
S	1.5	1-2	9	7.20	10.40
FG	3	2-4	8	6.40	16.80
FG	5	4-6	5	4.00	20.80
FG	7	6-8	7	5.60	26.40
MG	10	8-12	10	8.00	34.40
MG	14	12-16	14	11.20	45.60
CG	18	16-22	13	10.40	56.00
CG	27	22-32	15	12.00	68.00
CG	38.5	32-45	9	7.20	75.20
CG	54.5	45-64	12	9.60	84.80
SC	77	64-90	7	5.60	90.40
SC	109	90-128	6	4.80	95.20
MC	154	128-180	1	0.80	96.00
LC	218	180-256	1	0.80	96.80
LC	309	256-362	1	0.80	97.60
SB	437	362-512	3	2.40	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	125	100.00	100.00
		D50 particle size (mm)	16-22		
		% Fines (<2mm)	10.40		
	M12SFDBR04	Date-	6/17/2003	15:25	
	South Fork Dearborn, at Confluence with Dearborn River				



FLAT CREEK

03-0717-__

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DRBRN Date: 6/18/03
Personnel: Laidlaw / Bowman

Waterbody Name: Flat Creek County: Lewis & Clark HUC: 10030102
Station ID: M12FLATC07 Visit #: ____ Location: Flat Creek on Flat Creek Rd (near old DEQ F-1)
Lat: 47°19'47.0" Long: 112°23'00.2" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-07172	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-07170 (water + benthic)	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 20:30	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W	A
pH:		
SC: (mS/cm)		
SC x 1000 =	µmho/cm	
DO: (mg/L)		

TUR: Clear ☐ Slight ☒ Turbid ☐ Opaque ☐
Turbidity Comments: 7.29

Macroinvertebrate Kick Duration: Kick Length (Ft.):
Site Visit Comments:
sampled upstream of bridge

Revised 3/2003 DMA

Place Site Visit Label Here 03-0713

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12

Trip ID: 2003-DRBRIV Date: 6/18/03

Personnel: Laidlaw /Bowman

Waterbody Name: Flat Creek County: Lewis + Clark HUC: 10030102

Station ID: M12FLATC04 Visit #: ____ Location: Above confluence w/Dearborn At Mouth

Lat: 47° 11' 47.3" Long: 112° 01' 06.0" Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-07130	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0713C	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 9:15	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W 13.57	A
pH:	8.37	
SC: (mS/cm)	401	
SC x 1000 =	0.457 µmho/cm	
DO: (mg/L)	95.7% 8.95	
TUR: Clear ☐ Slight ☒ Turbid ☐ Opaque ☐		
Turbidity Comments:		

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6/18/03 **Site Visit Code:** 03-0713

Waterbody: Flat Creek @ Mouth **Station ID:** M12FLATC04

Personnel: Laidlaw / Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	(0) 16	0	0			
2	18	0.8	0.05			
3	20	1.3	0.12			
4	22	1.45	0.29			
5	24	1.5	0.49			
6	26	1.5	0.47			
7	28	1.5	0.54			
8	30	1.5	0.44			
9	32	1.5	0.54			
10	34	1.35	0.42			
11	36	1.35	0.53			
12	38	1.35	0.43			
13	40	1.05	0.28			
14	42	1.05	0.30			
15	44	1.2	0.39			
16	46	1.4	0.32			
17	48	1.35	0.35			
18	50	1.4	0.41			
19	52	1.5	0.29			
20	54	1.35	0.14			
21	56	1.3	0.13			
22	58	1.1	0.12			
23	60	1.05	0.05			
24	62	0.6	0.01			
25	64	0	0			
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 6-18-03 **Site Visit Code:** 03-0713

Waterbody: Flat Creek - At Mouth **STORET Station ID:** M12FlatC04

Personnel: Laidlaw / Bowman

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

- relatively turbid, some moss on rocks, minor algae on rocks,
- caddisflies observed

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: M12Flat C04 Date: 6-18-03 Site Visit Code: 03-6713

Waterbody: Flat Creek At Mouth Reach Length: ______

Waterbody Seg ID: ______ Personnel: ______

Station ID's on reach: ______

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 8 Potential Score: 8

Comments

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 6 Potential Score: 6

Comments

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 4 Potential Score: 6

Comments sediment apparent on bottom substrate

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 2 Potential Score: 2

Comments: bed rock

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for mo t riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 6 Potential Score: 6

Comments

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 2 Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 3 Potential Score: 3

Comments

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 6 Potential Score: 6

Comments

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 4 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 8 Potential Score: 8

Comments

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

4 SRAF.xls

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover
8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 6

Comments

12b. Habitat Complexity
6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 6

Comments

12c. Spawning Habitat (salmonid streams only)
8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: NA Potential Score:

Comments

5 SRAF.xls

12d. Fish Passsage
8 = No potential fish passage barriers apparent.
0 = Potential fish passage barriers present.
N/A = Stream would not support fish under natural conditions.
Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment
8 = Entrainment of fish into water diversions not an issue.
4 = Entrainment of fish into water diversions may be a moderate issue.
0 = Entrainment of fish into water diversions may be a major issue.
Actual Score: 8 Potential Score: 8

Comments

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation
6 = More than 75% of the stream reach is adequately shaded by vegetation. — topography
4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,
3 = Approximately 25-50% of the stream does not have adequate shade.
0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.
Actual Score: 6 Potential Score: 6

Comments

Question 14. Algae growth / Nutrients
6 = Algae not apparent. Rocks are slippery.
4 = in small patches or along channel edge
2 = in large patches or discontinuous mats
0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)
N/A = No water
Actual Score: 4 Potential Score: 6

Comments macrophytes present along shoreline

6 SRAF.xls

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: NA Potential Score:

Comments

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 4 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation Impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 6 Potential Score: 8

Comments: Possibly enhanced flow from irrigation return

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: ______ Potential Score: ______

Comments

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

8 SRAF.xls

03-0715-__

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003 DEARN Date: 8/1/03
Personnel: Laidlaw / Bowman

Waterbody Name: Flat Creek County: Lewis & Clark HUC: 10030102
Station ID: M12FLATC05 Visit #: ___ Location: Downstream of Milford Colony
Lat: 47°19'20.9" Long: 112°11'48.8" Verified? ☐ By ___ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ___

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0715W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0715C (water + benthic)	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 17:00	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W 21.96	A
pH:	8.65	
SC: (mS/cm)	.290	
SC x 1000 =	µmho/cm	
DO: (mg/L)	9.06 108.6%	
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments: Turbidity 10.8 NTU		

Macroinvertebrate Kick Duration: Kick Length (Ft.):

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6/18/03 **Site Visit Code:** 03-0715

Waterbody: Flat Creek d/s Mitford Canyon **Station ID:** M12FLATC05

Personnel: Laidlaw / Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	LOW 15.4 ft	1.28 ft	0.70			
2	16.5	1.22	1.91			
3	17.5	1.12	1.97			
4	18.5	1.00	2.11			
5	19.5	0.95	2.15			
6	20.5	0.95	2.06			
7	21.5	1.05	2.17			
8	22.5	1.09	2.01			
9	23.5	0.95	1.82			
10	24.5	0.90	2.16			
11	25.5	0.87	2.30			
12	26.6	0.85	2.10			
13	27.5	0.90	2.14			
14	28.5	0.78	2.06			
15	29.5	0.65	2.00			
16	30.5	0.63	2.04			
17	31.5	0.60	1.89			
18	32.5	0.62	0.36			
19	EOW 33.3	0.50	0.0			
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2

Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 6-18-03 **Site Visit Code:** 03-0715

Waterbody: Flat Creek b/s Mitchell Gulch **STORET Station ID:** M12FLATC05

Personnel: Laidlaw Bowman

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
						Sum	% of Total	Cum. Total
1	Silt / Clay		< 1	HHT HHT HHT		0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4	II		0		0.00%
4	Fine	GRAVELS	4 - 6	III		0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12	HHT HHT II		0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22	HHT HHT HHT HHT		0		0.00%
9	Coarse	GRAVELS	22 - 32	HHT HHT HHT HHT II		0		0.00%
10	Very Coarse	GRAVELS	32 - 45	HHT HHT HHT III		0		0.00%
11	Very Coarse	GRAVELS	45 - 64	HHT HHT		0		0.00%
12	Small	COBBLES	64 - 90	HHT II		0		0.00%
13	Small	COBBLES	90 - 128	II		0		0.00%
14	Large	COBBLES	128 - 180	I		0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362	I		0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

Revision 3/2003

Stream Reach Assessment Form

Station ID: M12FlatC05 Date: 6/18/03 Site Visit Code: 03-0715

Waterbody: Flat Crk Reach Length: ________

Waterbody Seg ID: ________ Personnel: ________

Station ID's on reach: ________

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 4 Potential Score: 8

Comments: lateral erosion outside banks cutting

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 3 Potential Score: 6

Comments: 50% eroding

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 3 Potential Score: 6

Comments: ________

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: 4 Potential Score: 6

Comments 70%

Question 6, Weeds :

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 2 Potential Score: 3

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 2 Potential Score: 3

Comments

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 2 Potential Score: 6

Comments [illegible] riparian

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 3 Potential Score: 4

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: 4 Potential Score: 6

Comments

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 4 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover
8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 8

Comments

12b. Habitat Complexity
6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: 3 Potential Score: 4

Comments

12c. Spawning Habitat (salmonid streams only)
8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 2 Potential Score: 4

Comments

5 SRAF.xls

12d. Fish Passsage

8 = No potential fish passage barriers apparent.

0 = Potential fish passage barriers present.

N/A = Stream would not support fish under natural conditions.

Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment

8 = Entrainment of fish into water diversions not an issue.

4 = Entrainment of fish into water diversions may be a moderate issue.

0 = Entrainment of fish into water diversions may be a major issue.

Actual Score: 8 Potential Score: 8

Comments do not know

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation

6 = More than 75% of the stream reach is adequately shaded by vegetation.

4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,

3 = Approximately 25-50% of the stream does not have adequate shade.

0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.

Actual Score: 2 Potential Score: 4

Comments depends on potential

Question 14. Algae growth / Nutrients

6 = Algae not apparent. Rocks are slippery.

4 = in small patches or along channel edge

2 = in large patches or discontinuous mats

0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)

N/A = No water

Actual Score: 3 Potential Score: 6

Comments

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 2 Potential Score: 4

Comments Cows

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: 2-3 Potential Score: 4

Comments

7 SRAF.xls

Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 4 Potential Score: 8

Comments upstream ditch comes in

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 4 Potential Score: 8

Comments

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

03 – 0716 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003 DRBRN Date: 6/11/03
Personnel: Laidlaw/Bowman

Waterbody Name: Flat Crk County: Lewis + Clark HUC: 10030102
Station ID: M12FLATC06 Visit #: ____ Location: Diversion from Dearborn River
Lat: 47°16'55.2" Long: 112°18'54.3" Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☐ Metals ☐ Commons ☐	03-0716W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0716C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 1720	
Q / Flow (cfs)		Est. ☐
Temp: (°C)	W 13.12	A
pH:	8.43	
SC: (mS/cm)	0.227	
SC x 1000 =		µmho/cm
DO: (mg/L)	9.47 / 90%	
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐		
Turbidity Comments: .1 NTU		

Macroinvertebrate Kick Duration: Kick Length (Ft.):
Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 6-18-03 **Site Visit Code:** 03-0716

Waterbody: Flat Crk Diversion **Station ID:** M12FlatC06

Personnel:

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	14	0	0	0		
2	15	.4	.13			
3	16	.85	.50			
4	17	1.28	1.50			
5	18	1.8	1.46			
6	19	2.1	1.50			
7	20	2.6	1.73			
8	21	3.0	1.97			
9	22	3.0	1.75			
10	23	3.0	2.07			
11	24	2.9	2.20			
12	25	2.8	1.97			
13	26	2.6	2.10			
14	27	2.55	2.06			
15	28	2.5	2.06			
16	29	2.5	1.73			
17	30	2.5	1.87			
18	31	2.49	1.54			
19	32	2.1	1.19			
20	33	1.8	1.25			
21	34	1.4	0.55			
22	35	0.75	0.09			
23	36	0	0			
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

03 – 0714 – __

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003 DRBRN Date: 6-18-03
Personnel: Laidlaw / Bowman

Waterbody Name: Flat Creek
County: Lewis + Clark HUC: 10030102
Station ID: M12FLATC08 Visit #: ____ Location: below Birdtail Rd
Lat: 47° 13' 44.0 N Long: 112° 03' 36.8 Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☐	03-0714[illegible]	GRAB
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0714C (water + [illegible])	CHLPHL-2 OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☒	Pebble Count ☒ % Fines ☐		
Transect	☒			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 13:30	
Q / Flow (cfs)	Est. ☐	
Temp: (°C) 21.51	W 21.51	A
pH: 8.44	8.44	
SC: (mS/cm) .477	.477	
SC x 1000 =	µmho/cm	
DO: (mg/L) 11.3 - 126.4%		
TUR: Clear ☐ Slight ☒ Turbid ☐ Opaque ☐		
Turbidity Comments: 7.39 NTU		

Macroinvertebrate Kick Duration: ____ Kick Length (Ft.): ____

Site Visit Comments:

BEHI measurements taken

Revised 3/2003 DMA

Stream Classification

Revised 3/2003

Date: 6-18-03 Site Visit Code: 03-0714

Waterbody: Flat Creek Station ID: M12FlatC08

Personnel: Laidlaw, Knutson, Ska, Bowman

Bankfull Width (W_{bkf}) ______ Ft.
WIDTH of the stream channel, at bankfull stage elevation, in a riffle section

Mean DEPTH (d_{bkf}) ______ Ft.
Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Bnkfl. X-Section AREA (A_{bkf}) ______ Sq. Ft.
AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width/Depth RATIO (W_{bkf} / d_{bkf}) ______
Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) ______ Ft.
Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section

WIDTH of Flood-Prone Area (W_{fpa}) 97 Ft.
Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) ______
The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 ______ mm.
The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) ______ Ft./Ft.
Channel slope = "rise" over "run" for a reach approximately 20-30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) ______
Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Stream Type ______

Comments:

Data Mgmt. Approved

Revised 4/2003

TOTAL DISCHARGE:

Date: 6-18. Site Visit Code: 03-0714

Waterbody: Flat Ck. Station ID: M12FlatC08

Personnel: Total - 73-49=24

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	49	.9	ø			
2	5ø	1.3	ø			
3	51	1.5	ø			
4	52	1.6	ø			
5	53	1.2	ø			
6	54	1.2	ø			
7	55	1.15	.ø1			
8	56	1.5	~~.26~~ .14			
9	57	1.4	.25			
10	58	1.5	.21			
11	59	1.5	.58			
12	6ø	1.8	.75			
13	61	2.1	.96			
14	62	2.5	.92			
15	63	2.7	.79			
16	64	~~2.5~~ 2.5	.82			
17	65	2.3	.66			
18	66	2.4	.56			
19	67	2.3	.5ø			
20	68	2.1	.33			
21	69	2.ø	.28			
22	7ø	1.85	.26			
23	71	1.3	ø			
24	72	.9	ø			
25	73	~~.5~~ .65	ø			
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

Revised 3/2003 DMA 91

SUBSTRATE DEQ/MDM

Date: 6-14-03 **Site Visit Code:** 03-0714

Waterbody: Flat Creek Below Birdtail **STORET Station ID:** M12FlatC08

Personnel: Flowery wate plnt in riffle

PEBBLE COUNT								
Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Characteristic Group: PEBL-CNT		
						Sum	% of Total	Cum. Total
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

Site ID: M.2FlatC08

CROSS-SECTIONAL PROFILE FIELD DATA SHEET

Site Description: "Flat Creek D upstream end of canyon on Dearborn Branch"

Page ____ of ____
Date: 6-18-03
Basin: ____

Downstream EOW HI = 14.25
upstream EOW HI = 12.05
Stream length = 1360 ft
Straight line = 517 ft

	Reference		Channel Measurements: Longitudinal or X-Section		Water Level 0.0W		Bankfull		Bank Height		
STA	BS (+)	HI	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	NOTES
10	6.68	vertical face	height = 8.8'								
13.6	9.41										
29	10.43										
37	10.79										
44	10.74	Bank full									
47	11.43	Bank full	edge of point								
49	13.98	LEOW			0						
49.5	15.07				1.06						
54	15.7				1.65						
56.6	15.33				1.35						
60.5	16.06				2.03						
63.5	16.62	Thalweg			2.55						
69.3	15.68				1.65						
74.0	14.29	REOW			0.22	overhanging bank					
75.7	11.83										
80	11.23	Bank Full									
85	8.42										
100	2.94										
110	-5.09										

STA = Station
HI = Height of Instrument (Elevation + BS)
BS = Backsight (Shot to a known elevation)
ELEV = If actual elevation (Datum) is unknown, use 100' to begin profile.
FS = Foresight (Shot to new point with unknown elevation)
RP = Reference Point

Revision 3/2003

Stream Reach Assessment Form

Station ID: MidFlatC08 Date: 6-18-03 Site Visit Code: MidFlatC08

Waterbody: Flat Creek Blow B.rdtail Rd Reach Length:

Waterbody Seg ID: Personnel: Laidlaw, Knutson, Bowman

Station ID's on reach:

Question 1, Stream Incisement:

8 = channel stable, no active downcutting occurring; old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation will established in the riparian area. (Stage 1 and 5, Schumm's model)

6 = channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling bands, solid disturbance evident. (Stage 4).

4 = small headcut, in early stage, is present. Immediate action may prevent further degradation (early Stage 2).

2 = unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common. (Stage 3)

0 = channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting/headcuts. (Stage 2)

The presence of active headcuts should nearly always keep the stream reach from being rated sustainable.

Actual Score: 6 Potential Score: 8

Comments

Question 2, Percent of Streambanks with Active Lateral Cutting:

6 = the lateral bank erosion is in balance with the stream and its setting

4 = there is a minimal amount of active lateral bank erosion occurring

2 = there is a moderate amount of active lateral bank erosion occurring

0 = there is excessive lateral bank erosion occurring

Actual Score: 1 Potential Score: 6

Comments

Question 3, The Stream is in Balance with the Water and Sediment Being Supplied by the Watershed:

6 = the stream exhibits no excess sediment/bedload deposition, sediment occurs on point bars and other locations as would be expected in a stable, dynamic system

4 = sediment clogged gravel's are apparent in riffles or pools, or other evidence of excess sediment apparent

2 = mid-channel bars are common

0 = stream is braided (except naturally occurring braided systems), having at least 3 active channels

Actual Score: 3 Potential Score: 5

Comments

1 SRAF.xls

Question 4, Sufficient Soil Present to Hold Water and Act as a Rooting Medium:

3 = more than 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

2 = 65% to 85% of the riparian area with sufficient soil to hold water and act as a rooting medium

1 = 35% to 65% of the riparian area with sufficient soil to hold water and act as a rooting medium

0 = 35% or less of the riparian area with sufficient soil to hold water and act as a rooting medium

Actual Score: 3 Potential Score: 3.

Comments

Question 5, Percent of Streambank with Vegetation having a Deep, Binding Rootmass: (see Appendix I for stability ratings for most riparian, and other, species)

6 = more than 80% of the streambank comprised of plant species with deep, binding root masses

4 = 60% to 80% of the streambank comprised of plant species with deep, binding root masses

2 = 30% to 60% of the streambank comprised of plant species with deep binding root masses

0 = less than 30% of the streambank comprised of plant species with deep binding root masses

Actual Score: ______ Potential Score: ______

Comments Right Bank - lacking veg. cover - steep - 40% cover
Left Bank - 95% cover

Question 6, Weeds:

3 = No noxious weeds are present

2 = 0-1% of the riparian area has noxious weeds

1 = 1%-5% of the riparian area has noxious weeds

0 = over 5% of the riparian area has noxious weeds

Actual Score: 1 Potential Score: 2.

Comments

Question 7, Disturbance-Caused Undesirable Plants:

3 = 1% or less of the riparian area has undesirable plants

2 = 1%-5% of the riparian area has undesirable plants

1 = 5%-10% of the riparian area has undesirable plants

0 = over 10% of the riparian area has undesirable plants

Actual Score: 2 Potential Score: 2.

Comments

Question 8, Woody Species Establishment and Regeneration: (Note: Skip this question if the riparian area has no potential for woody species)

8 = all age classes of native woody riparian species present (see table, Fig 2)

6 = one age class of native woody riparian species clearly absent, all others well represented. For sites with potential for trees and shrubs, there may be one age class of each absent. Often, it will be the middle age group(s) that is (are) lacking. Having mature individuals and a young age class present indicate potential for recovery.

4 = two age classes of native riparian shrubs and/or two age classes of riparian trees clearly absent, other(s) well represented, or the stand is comprised of mainly mature, decadent or dead plants

2 = disturbance induced, (i.e., facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Re-evaluate Question 1, incisement, if this has happened.

0 = some woody species present (>10% cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation). OR, the site has at least 5% cover of Russian olive and/or salt cedar

Actual Score: 8 Potential Score: 8

Comments

Question 9, Utilization of Trees and Shrubs: (Note: Skip this question if the riparian area has no potential for woody species)

4 = 0-5% of the available second year and older stems are browsed

3 = 5%-25% of the available second year and older stems are browsed

2 = 25%-50% of the available second year and older stems are browsed.

1 = more than 50% of the available second year and older stems are browsed. Many of the shrubs have either a "clubbed" growth form, or they are high-lined or umbrella shaped.

0 = there is noticeable use (10% or more) of unpalatable and normally unused woody species.

Actual Score: 1 Potential Score: 4.

Comments

Question 10, Riparian/Wetland Vegetative Cover in the Riparian Area/Floodplain and Streambank:

8 = 85% or more of the riparian/wetland plant cover has a stability rating ≥ 6

6 = 75%-85% of the riparian/wetland plant cover has a stability rating ≥ 6

4 = 65%-75% of the riparian/wetland plant cover has a stability rating ≥ 6

2 = 55%-65% of the riparian/wetland plant cover has a stability rating ≥ 6

0 = less than 55% of the riparian/wetland plant cover has a stability rating ≥ 6

Actual Score: Potential Score:

Comments

3 SRAF.xls

Question 11, Riparian Area/Floodplain Characteristics are Adequate to Dissipate Energy and Trap Sediment.

6 = active flood or overflow channels, large rock, or woody material present and adequate to dissipate energy and trap sediment. There is little surface erosion and no evidence of long, continuous erosional areas on floodplain/riparian area or streambank. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

4 = rock and/or woody material is present, but generally of insufficient size to dissipate energy. Some sediment trapping occurring. Occasional evidence of surface erosion. Generally not severe enough to have developed channels.

2 = inadequate rock and/or woody material available for dissipation of energy or sediment trapping. There is surface erosion (scouring) and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = riparian area/floodplain lacking any of these attributes: 1)adequate flood or overflow channels, 2) large rock, or 3) woody material suitable for energy dissipation and sediment trapping. Erosional areas are long and continuous. Lacking vegetation or substrate materials adequate to resist further erosion. Surface erosion is obvious on the floodplain/riparian area. Headcuts are present that have the potential to create meander cut-offs.

Actual Score: 6 Potential Score: 6

Comments

SUMMARY

		Actual Score	Possible Points	Potential Score
QUESTION 1:	Stream Incisement	0	0, 2, 4, 6, 8	0
QUESTION 2:	Lateral Cutting	0	0, 2, 4, 6	0
QUESTION 3:	Stream Balance	0	0, 2, 4, 6	0
QUESTION 4:	Sufficient Soil	0	N/A, 0, 1, 2, 3	0
QUESTION 5:	Rootmass	0	N/A, 0, 2, 4, 6	0
QUESTION 6:	Weeds	0	0, 1, 2, 3	0
QUESTION 7:	Undesirable Plants	0	0, 1, 2, 3	0
QUESTION 8:	Woody Species Establishment	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 9:	Browse Utilization	0	N/A, 0, 1, 2, 3, 4	0
QUESTION 10:	Riparian/Wetland Vegetative Cover *	0	N/A, 0, 2, 4, 6, 8	0
QUESTION 11:	Riparian Area/Floodplain Characteristics *	0	N/A, 0, 2, 4, 6	0
	Total	0	61	0
Potential Score for most Bedrock or Boulder streams (questions 1, 2, 3, 6, 7, 11)		0	(32)	0
Potential Score for most low energy "E" streams (questions 1 – 7, 10, 11)		0	(49)	0

RATING: = Actual Score / Potential Score X 100 = % rating #DIV/0!

80-100% = SUSTAINABLE
50-80% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

Montana Department of Environmental Quality Supplemental Questions

The score for these questions does not have an effect on the rating above.
Note: Answers to these questions must consider the potential of the stream.

Question 12. Fisheries Habitat / Stream Complexity Note: the answers to question 12 will be averaged

12a. Adult and Juvenile Holding/Escape Cover
8 = Abundant deep pools, woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic

6 = Fish habitat is common (see above).

4 = Fish habitat is noticeably reduced. Most pools are shallow and/or woody debris, undercut banks, overhanging vegetation, boulders, root wads and/or aquatic vegetation are of limited supply.

2 = Pools and habitat features are sparse or non-existent or there are fish barriers.

0 = There is not enough water to support a fishery

N/A = Stream would not support fish under natural conditions

Actual Score: 6 Potential Score: 8

Comments

12b. Habitat Complexity
6 = A mixture of juvenile and adult cover types is present. High flow juvenile and adult refugia are present.

3 = Primarily adult or juvenile cover types are present. High flow refugia are reduced.

0 = High flow refugia are lacking.

N/A = Stream would not support fish under natural conditions

Actual Score: # 3 Potential Score: 4

Comments

12c. Spawning Habitat (salmonid streams only)
8 = Areal extent of spawning substrate, morphology of spawning areas, and composition of spawning substrate are excellent.

4 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate reduced.

0 = Areal extent of spawning substrate, morphology of spawning areas, and/or quality of spawning substrate greatly reduced.

N/A = Stream would not support fish under natural conditions.

Actual Score: 4 Potential Score: 5

Comments

5 SRAF.xls

12d. Fish Passsage
8 = No potential fish passage barriers apparent.
0 = Potential fish passage barriers present.
N/A = Stream would not support fish under natural conditions.
Actual Score: 8 Potential Score: 8

Comments

12e. Entrainment
8 = Entrainment of fish into water diversions not an issue.
4 = Entrainment of fish into water diversions may be a moderate issue.
0 = Entrainment of fish into water diversions may be a major issue.
Actual Score: 4 Potential Score: 5

Comments Headgates present upstream through drainage

12a-e Avg. Score Actual Score 0 Potential Score 0

Question 13. Solar Radiation
6 = More than 75% of the stream reach is adequately shaded by vegetation.
4 = 50-75% of the stream reach does not have adequate shading or the water temperature is probably elevated by irrigation,
3 = Approximately 25-50% of the stream does not have adequate shade.
0 = More than 75% of the stream reach does not have adequate shade by vegetation or the water temperature is probably drastically altered by irrigation, etc.
Actual Score: 0 Potential Score: 4

Comments

Question 14. Algae growth / Nutrients
6 = Algae not apparent. Rocks are slippery.
4 = in small patches or along channel edge
2 = in large patches or discontinuous mats
0 = Mats cover bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions)
N/A = No water
Actual Score: 4 Potential Score: 6

Comments

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Question 18. Irrigation impacts (Assess during critical low flow periods or you may need to inquire locally about this. Evaluate effects from de-watering or inter-basin transfer of water.)

8 = There are no noticeable impacts from irrigation

6 = Changes in flow resulting from irrigation practices are noticeable, however flows are adequate to support aquatic organisms.

4 = Flows support aquatic organisms, but habitat, especially riffles are drastically reduced or impacted.

2 = The flow is low enough to severely impair aquatic organisms

0 = All of the water has been diverted from the stream

N/A = Stream reach is ephemeral.

Actual Score: 6 Potential Score: 8

Comments: Upstream - there are diversion ditches

Question 19. Landuse activities – Sources

8 = Landuse practices do not appear to significantly impact water quality or the riparian vegetation. Any impacts that occur appear to be natural.

6 = There are some signs of impact from landuse activities such as grazing, dryland agriculture, irrigation, feedlots, mining, timber harvesting, urban, roads, etc.

4 = Impacts from landuse activities are obvious and occur throughout most of the stream reach. For example, there are obvious signs of human induced erosion, saline seeps or overgrazing within the watershed.

2 = Landuse impacts are significant and widespread. Visual observation and photo documentation would provide overwhelming evidence that the stream is impaired.

0 = Land use impacts are so intrusive that the stream has lost most of its natural features. The stream does not appear to be capable to support most forms of aquatic life

Actual Score: 4 Potential Score: 8

Comments: cattle grazing

Total Actual 0 Total Potential 0

RATING Total / Potential x 100 #DIV/0!

OVERALL RATING (Total NRCS Actual + Total MT Supplement Actual) / (Total NRCS Potential + Total MT Supplement Potential) x100 #DIV/0!

75-100% = SUSTAINABLE
50-75% = AT RISK
LESS THAN 50% = NOT SUSTAINABLE

Question 15. Surface oils, turbidity, salinization, precipitants on stream bottom and/or water odor

6 = none

4 = Slight

2 = Moderate

0 = Extensive

N/A = No water

Actual Score: 6 Potential Score: 6

Comments

Question 16. Bacteria

4 = There are no known anthropogenic sources of bacteria

2 = Likely sources of bacteria are present. Wastewater or concentrated livestock operations are the most common sources.

0 = Feedlots are common or raw sewage is entering the stream

Actual Score: 2 Potential Score: 4

Comments Livestock

Question 17. Macroinvertebrates

4 = The stream has a healthy and diverse community of macroinvertebrates. Stream riffles usually have an abundance of may flies, caddis flies and/or stone flies.

2 = The stream is dominated by pollution tolerant taxa such as fly and midge larva.

0 = Macroinvertebrates are rare or absent

N/A = Stream reach is ephemeral

Actual Score: Potential Score:

Comments not sampled at this time

7 SRAF.xls

03 – 0722 –__

Site Visit Form
(One Station per page)

STORET Project ID: Tmbr-M12
Trip ID: 2003-DRBRN Date: 7/22/03
Personnel: Laidlaw/Bowman

Waterbody Name: Flat Creek County: Lewis & Clark HUC: 10030102
Station ID: M12FLATC03 Visit #: 2 Location: Upstream of Hwy 200 (near DEQ F-5)
Lat: 47°18'19.2" Long: 112°07'35.0" Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 (circled) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0722W	GRAB (circled)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☒	03-0722M	KICK HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☒	03-0722A	PERI-1 (circled) OTHER:
Chlorophyll a	☒		03-0722C	CHLPHL-2 (circled) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☒			
Field Notes	☒			
Other				

Measurements:	Time: 9:45
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 18.32 | A
pH:	8.01
SC: (mS/cm)	.313
SC x 1000 =	µmho/cm
DO: (mg/L)	9.83 104.38
TUR: Clear ☐ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	9.08 10.6

Macroinvertebrate Kick Duration: 1.5 minutes Kick Length (Ft.): 35
Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-22-03 Site Visit Code: 03-0722

Waterbody: Flat Creek US Hwy 200 Station ID: M12FlatC03

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	2'	0	0	0		
2	3	.2	.1	1		
3	4	.35	.25	1		
4	5	.5	.65	1		
5	6	.5	.68	1		
6	7	.6	.64	1		
7	8	.66	.66	1		
8	9	.7	.87	1		
9	10	.78	.91	1		
10	11	.80	.98			
11	12	.85	.97			
12	13	.85	.93			
13	14	.95	.85			
14	15	.95	.86			
15	16	1.0	.95			
16	17	.8	1.09			
17	18	.90	1.04			
18	19	.90	1.01			
19	20	.80	1.12			
20	21	.80	1.40			
21	22	.70	1.14			
22	23	.56	0			
23	23.5	0	0			
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2

Data Mgmt. Approved

Revised 3/2003

Stream Classification

Date: **Site Visit Code:**

Waterbody: **Station ID:**

Personnel:

BE III lat/long 47°18'36.1" / 112°07'56.6'

Bankfull Width (W_{bkf}) 27' Ft.

WIDTH of the stream channel, at bankfull stage elevation, in a riffle section

Mean DEPTH (d_{bkf}) ________ Ft.

Mean DEPTH of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Bnkfl. X-Section AREA (A_{bkf}) ________ Sq. Ft.

AREA of the stream channel cross-section, at bankfull stage elevation, in a riffle section.

Width/Depth RATIO (W_{bkf} / d_{bkf}) ________

Bankfull WIDTH divided by bankfull mean DEPTH, in a riffle section.

Maximum DEPTH (d_{mbkf}) ________ Ft.

Maximum depth of the bankfull channel cross-section, or distance between the bankfull stage and thalweg elevations, in a riffle section

WIDTH of Flood-Prone Area (W_{fpa}) ________ Ft.

Twice maximum DEPTH, or (2 x d_{mbkf}) = the stage/elevation at which flood-prone area WIDTH is determined. (riffle section)

Entrenchment Ratio (ER) ________

The ratio of flood-prone area WIDTH divided by bankfull channel WIDTH. (W_{fpa} / W_{bkf}) (riffle section)

Channel Materials (Particle Size Index) D50 ________ mm.

The D50 particle size index represents the median diameter of channel materials, as sampled from the channel surface, between the bankfull stage and thalweg elevations.

Water Surface SLOPE (S) ________ Ft./Ft.

Channel slope = "rise" over "run" for a reach approximately 20-30 bankfull channel widths in length, with the "riffle to riffle" water surface slope representing the gradient at bankfull stage.

Channel SINUOSITY (K) Height 13.06 @ 325" / Upstream Height = 10.92 Distance = 242.5'

Sinuosity is an index of channel pattern, determined from a ratio of stream length divided by valley length (SL/VL); or estimated from a ratio of valley slope divided by channel slope (VS/S).

Straight line distance = 381'

Stream Type ________

Comments:

Data Mgmt. Approved

Revised 3/2003 DMA

SUBSTRATE DEQ/MDM

Date: 7-22-03 **Site Visit Code:** 03-0722

Waterbody: Flat Creek **STORET Station ID:** M12FLATC03

Personnel: Laidlaw/Bowman

bankfull is all vegetated

PEBBLE COUNT

Row ID	Particle Category		Size (mm)	Riffle Count	(Other) Count	Sum	% of Total	Cum. Total
					Bankfull (all vegetated) Characteristic Group: PEBL-CNT			
1	Silt / Clay		< 1			0		0.00%
2	Sand		1 - 2			0		0.00%
3	Very Fine	GRAVELS	2 - 4			0		0.00%
4	Fine	GRAVELS	4 - 6			0		0.00%
5	Fine	GRAVELS	6 - 8			0		0.00%
6	Medium	GRAVELS	8 - 12			0		0.00%
7	Medium	GRAVELS	12 - 16			0		0.00%
8	Coarse	GRAVELS	16 - 22			0		0.00%
9	Coarse	GRAVELS	22 - 32			0		0.00%
10	Very Coarse	GRAVELS	32 - 45			0		0.00%
11	Very Coarse	GRAVELS	45 - 64			0		0.00%
12	Small	COBBLES	64 - 90			0		0.00%
13	Small	COBBLES	90 - 128			0		0.00%
14	Large	COBBLES	128 - 180			0		0.00%
15	Large	COBBLES	180 - 256			0		0.00%
16	Small	BOULDERS	256 - 362			0		0.00%
17	Small	BOULDERS	362 - 512			0		0.00%
18	Medium	BOULDERS	512 - 1024			0		0.00%
19	Large	BOULDERS	1024 - 2048			0		0.00%
20	Bedrock		> 2048			0		0.00%
21	Total # Samples			0	0	0	0.00%	

Pebble Count Data Entry Form

Site ID: ____________
Site Description: ____________

CROSS-SECTIONAL PROFILE FIELD DATA SHEET

Page ____ of ____
Date:
Basin:

Flat Creek 03

7-22-03
*remember - measurements from right to left

	REFERENCE		CHANNEL MEASUREMENTS								
			LONGITUDINAL OR X-SECTION		WATER LEVEL		BANKFULL		BANK HEIGHT		
STA	BS (+)	HI	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	FS (-)	ELEV	NOTES
2'	6.81										Right Edge
26'	7.65										
42'	6.96										
58'	7.44										
60'	8.87										Right Edge of flood (?)
67'	8.99										
78'	9.08										
83'	10.27										Right Bankfull (?)
85'	11.34										Right Edge
85.4'	13.16	1.07 ([illegible])									Right Edge of Water
89'	13.60	1.54	[illegible]								Thalweg
96'	13.24	1.15									
103.2'	12.84	.14									Left Edge of Water
104.0	10.78										Left Bank
110.0	10.00										Left Bankfull
114.0	9.03										Left Flood (?)
117.0	7.91										
123.0	3.63										Upper most site

STA = Station
HI = Height of Instrument (Elevation + BS)
BS = Backsight (Shot to a known elevation)
ELEV = If actual elevation (Datum) is unknown, use 100' to begin profile.
FS = Foresight (Shot to new point with unknown elevation)
RP = Reference Point

BANK ERODIBILITY HAZARD INDEX

Date: ______________________

Stream Name: ______________________

Cross-section #: Bank: (right/left)

NOTES:

PHOTO POINTS	Camera #	Photo #
1. Downstream to x-section		
2. Left pin to right pin		
3. Right pin to left pin		
4. Mid-channel to left bank		
5. Mid-channel to right bank		

BANK EROSION POTENTIAL

CRITERIA	VERY LOW		LOW		MODERATE		HIGH		VERY HIGH		EXTREME		BEHI DATA BANKFULL		BEHI DATA FLOODPRONE	
	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX	VALUE	INDEX
Bank Ht/Bf Ht	1.0-1.1	1.0-1.9	1.11-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.0	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10				
Root Depth/Bank Ht	1.0-0.9	1.0-1.9	0.89-0.50	2.0-3.9	0.49-0.30	4.0-5.9	.29-0.15	6.0-7.9	0.14-0.05	8.0-9.0	<0.05	10				
Root density (%)	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	14-5	8.0-9.0	<5.0	10				
Bank Angle (degrees)	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	91-119	8.0-9.0	>119	10				
(slope)	0-0.36		0.37-1.73		1.74-5.67		5.68-0.0		1.01-(1.81)		<(-1.81)					
Surface Prot. (%)	100-80	1.0-1.9	79-55	2.0-3.9	54-30	4.0-5.9	29-15	6.0-7.9	15-10	8.0-9.0	<10	10				
TOTALS										-		Total				
		5-9.5		10-19.5		20-29.5		30-39.5		40-45		46-50				
Adjustments											Adjust					
Numerical											Numerical					

Conclusions for Bankfull BEHI

Bank Erosion Potential: ______________

Near Bank Stress: ______________

Estimated Bank Loss/yr: ______________

Conclusions for Floodprone BEHI

Bank Erosion Potential: ______________

Near Bank Stress: ______________

Estimated Bank Loss/yr: ______________

BANK MATERIALS: CIRCLE ONE

BEDROCK: Bank erosion potential always very low

BOULDERS: Bank erosion potential low

COBBLE: Decrease by one category unless mixture of Gravel/Sand is over 50%, then no adjustment

GRAVEL: Adjust values up by 5-10 points depending on composition of Sand

SAND: Adjust values up by 10 points

SILT/CLAY: No adjustment-unless a part of unconsolidated bank, then adjust up to 10 points

STRATIFICATION: 5-10 points (upward) depending on position of unstable layers in relation to bankfull stage

Some gravel layers stratifications

NEAR BANK STRESS RATING	Amb/A**	Value
Low	0.32 or Less	
Moderate	0.33-0.41	
High	0.042-0.45	
Very High	0.046-0.50	
Extreme	0.51 or more	

Bank Profile Data (Rise and Run from Toe Pin)

RISE	RUN	NOTES

Bank Ht = 4'
BF Ht =
Root Depth = .5
Root Density = 20%
Bank ∠° = 40°
Surface Protection = 80%

Bank Profile Sketch

03 – 0821 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DEBORN Date: 7/24/03
Personnel: Laidlaw/Bowman

Waterbody Name: Flat Creek County: Lewis + Clark HUC: 10030102
Station ID: M12 FlatC04 Visit #: 2 Location: Flat Creek at Mouth
Lat: — Long: — Verified? ☐ By ____ GPS Datum (Circle One): NAD 27 (circled) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☐ Metals ☐ Commons ☒	03-0821W	GRAB (circled)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0821M	KICK (circled) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0821A	PERI-1 (circled) OTHER:
Chlorophyll a	☒		03-0821C	CHLPHL-2 (circled) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		**Purpose:** TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 1000	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W 14.92	A
pH:	8.40	
SC: (mS/cm)	.366	
SC x 1000 =	µmho/cm	
DO: (mg/L)	10.14 / 111.4%	
TUR: Clear ☐ Slight ☒ Turbid ☐ Opaque ☐		
Turbidity Comments:	3.54 NTU	
	3.01 NTU	

Macroinvertebrate Kick Duration: 2 min 30 sec Kick Length (Ft.): 30'

Site Visit Comments:
lots of bedrock in reach

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-24-03. Site Visit Code: 03-0821

Waterbody: Flat Creek @ Mouth Station ID: M12FlatC02/

Personnel:

	**Distance from initial point	* Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	2'	Ø	Ø			
2	4	.7	Ø			
3	6	.95	.03			
4	8	1.05	.11			
5	10	1.05	.19			
6	12	.95	.16			
7	14	1.0	.15			
8	16	1.0	.22			
9	18	.9	.15			
10	20	.75	.20			
11	22	.85	.22			
12	24	.62	.18			
13	26	.45	.17			
14	28	.65	.20			
15	30	.82	.13			
16	32	.8	.17			
17	34	.9	.08			
18	36	1.1	.05			
19	38	.73	.Ø			
20	40	.08	.Ø			
21	42	.38	.04			
22	44	.49	Ø			
23	46	.1	.Ø			
24	46.6					
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7-24-03 Site Visit Code: 03-0821

Waterbody: Flat Creek At Mouth Site: Mid Flat C04

Personnel: Laidlaw Bowman

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score: 8.5	9-10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score: 5	9-10	6-8	3-5	0-2
Comments:	mostly bedrock >60%			
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score: 16	16-20	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score: 10	16-20	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score: 15	16-20	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score: 18	16-20	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score: 10	9-10	6-8	3-5	0-2
	Left Side 10	Average:		
	Right Side 10	Comments:		

TOTAL SCORE: Score compared to maximum possible:

03-0823-__

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DRBRN Date: 7/24/03
Personnel: SK/ ...

Waterbody Name: Flat Creek County: Lewis + Clark HUC: 10030102
Station ID: M12FLATC05 Visit #: 2 Location: Downstream of Milford Colony
Lat: — Long: — Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0823W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☐	03-0823M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0823A	(PERI-1) OTHER:
Chlorophyll a	☒		03-0823C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 13:30
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 17.68 A
pH:	8.32
SC: (mS/cm)	.273
SC x 1000 =	µmho/cm
DO: (mg/L)	9.14 96%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	10.4 & 10.5

Macroinvertebrate Kick Duration: 3 min Kick Length (Ft.): 35'

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7/24/03 Site Visit Code: 03-0823

Waterbody: Flat Creek B/lw Milford Colony Station ID: M18FlatC05

Personnel: Thi/Shad

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	Ø 3.0 LEW	Ø	Ø			
2	4.0	0.30	0.43			
3	5.0	0.39	0.94			
4	6.0	0.32	1.25			
5	7.0	0.48	1.44			
6	8.0	0.50	1.73			
7	9.0	0.61	2.18			
8	10.0	0.63	2.56			
9	11.0	0.68	1.75			
10	12.0	0.80	1.54			
11	13.0	0.78	1.83			
12	14.0	1.00	1.85			
13	15.0	1.12	1.73			
14	16.0	1.25	0.40			
15	16.5 REW	0.20	Ø			
16						
17						
18						
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29						
30						

Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM RIFFLE/RUN PREVALENCE

Date: 7/24/03 Site Visit Code: 03-DS23

Waterbody: Flat Creek b/w Milford Site: M12FLATCDS

Personnel: Shad / Tina

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score:	9-10	6-8 8.5	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score:	9-10	6-8 7	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score:	16-20 16	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be resent, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score:	16-20 18	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score:	16-20	11-15 12	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score:	16-20 18	11-15	6-10	0-5
Comments:				
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10	6-8	3-5	0-2
	Left Side 7	Average: 7		
	Right Side 7	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10	6-8	3-5	0-2
	Left Side 9	Average: 8.5		
	Right Side 8	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		

TOTAL SCORE: Score compared to maximum possible:

03 – 0825 – __

Site Visit Form
(One Station per page)

STORET Project ID: TMDL-M12
Trip ID: 2003-DRBRN Date: 7-2-03
Personnel: Laidlaw / Bowman

Waterbody Name: Flat Creek County: Lewis + Clark HUC: 10030102
Station ID: M12FLATC06 Visit #: 2 Location: Diversion from Dearborn
Lat: — Long: — Verified? ☐ By ____ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ____

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0825W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0825C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 1645
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 14.70 A
pH:	8.46
SC: (mS/cm)	.263
SC x 1000 =	µmho/cm
DO: (mg/L)	9.67 95.4
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	.43 NTU .58 NTU

Macroinvertebrate Kick Duration: N/A Kick Length (Ft.): N/A
Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-24-03 Site Visit Code: 03-0825

Waterbody: Flat Creek - Diversion Station ID: M12FlatC06

Personnel: Laidlaw / Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	1	.20	0	1		
2	2	.32	.60	1		
3	3	.80	1.65	1		
4	4	1.15	1.60	1		
5	5	1.50	1.85	1		
6	6	1.50	1.98	1		
7	7	1.45	2.80	1		
8	8	1.50	305	1		
9	9	1.40	301	1		
10	10	1.40	3.12	1		
11	11	1.40	2.68	1		
12	12	1.35	3.18	1		
13	13	1.4	2.38	1		
14	14	1.4	2.81	1		
15	15	1.4	2.60	1		
16	16	1.35	2.74	1		
17	17	1.3	2.44	1		
18	18	1.3	2.21	1		
19	19	1.3	1.32	1		
20	20	0.9	1.12	1		
21	21.0	0.6	.60	1		
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

21.1.1.12

MACROINVERTEBRATE HABITAT ASSESSMENT FIELD FORM — RIFFLE/RUN PREVALENCE

Date: 7-24-03 Site Visit Code: 03-0825

Waterbody: Dearborn Rvr above FC diversion Site: M12[illegible]C06

Personnel: [illegible] / Tina

HABITAT PARAMETER	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1A. Riffle Development	Well-developed riffle; riffle as wide as stream & extends two times width of stream.	Riffle as wide as stream but length less than two times width.	Reduced riffle area that is not as wide as stream & its length less than two times width.	Riffles virtually non-existent
1A. score:	9-10 10	6-8	3-5	0-2
Comments:				
1B. Benthic Substrate	Diverse substrate dominated by cobble.	Substrate diverse with abundant cobble, but bedrock, boulders, fine gravel, or sand prevalent.	Substrate dominated by bedrock, boulders, sand, or silt; cobble present.	Monotonous fine gravel, sand, silt, or bedrock substrate.
1B. score:	9-10 10	6-8	3-5	0-2
Comments:				
2. Embeddedness	Gravel, cobble, or boulder particles are between 0-25% surrounded by fine sediment (particles less than 6.35 mm [.25"]).	Gravel, cobble, or boulder particles are between 25-50 % surrounded by fine sediment.	Gravel, cobble, or boulder particles are between 50-75% surrounded by fine sediment.	Gravel, cobble, or boulder particles are over 75% surrounded by fine sediment.
2. score:	16-20 20	11-15	6-10	0-5
Comments:				
3. Channel Alteration (channelization, straightening, dredging, other alterations)	Channel alterations absent or minimal; stream pattern apparently in natural state.	Some channelization present, usually in areas of crossings, etc. Evidence of past alterations (before past 20 years) may be present, but more recent channel alteration is not present.	New embankments present on both banks; 40-80% of the stream reach channelized & disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized & disrupted.
3. score:	16-20 19	11-15	6-10	0-5
Comments:				
4. Sediment Deposition	Little or no enlargement of bars & less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old & new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, & bends; moderate deposition in pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
4. score:	16-20 19	11-15	6-10	0-5
Comments:				

5. Channel Flow Status	Water fills baseflow channel; minimal amount of channel substrate exposed.	Water fills > 75% of the baseflow channel; < 25% channel substrate exposed.	Water fills 25-75% of the baseflow channel; riffle substrates mostly exposed.	Very little water in channel, & mostly present as standing pools.
5. score:	16-20 18	11-15	6-10	0-5
Comments:	Low flows; Much cobble exposed on edges – NOT BAD			
6. Bank Stability (score each bank) NOTE: Determine left or right side while facing downstream.	Banks stable; no evidence of erosion or bank failure; little apparent potential for future problems.	Moderately stable; infrequent, small areas of erosion mostly healed over.	Moderately unstable; moderate frequency & size of erosional areas; up to 60% of banks in reach have erosion; high erosion potential during high flow.	Unstable; many eroded areas; "raw" areas frequent along straight sections & bends; obvious bank sloughing; 60-100% of banks have erosion scars on sideslopes.
6. score:	9-10	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		
7. Bank Vegetation Protection (score each bank) NOTE: reduce scores for annual crops & weeds which do not hold soil well (e.g. knapweed).	Over 90% of the streambank surfaces covered by stabilizing vegetation; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation; disruption evident, but not affecting full plant growth potential to any great extent; more than one-half of potential plant height evident.	50-70% of the streambank surfaces covered in vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of potential plant height remaining.	Less than 50% of the streambank surfaces covered by vegetation; extensive disruption of vegetation; vegetation removed to 2 inches or less.
7. score:	9-10	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		
8. Vegetated Zone Width (score each side)	Width of vegetated zone > 100 feet.	Width of vegetated zone 30-100 feet.	Width of vegetated zone 10-30 feet.	Width of vegetated zone < 10 feet.
8. score:	9-10	6-8	3-5	0-2
	Left Side 9	Average: 9		
	Right Side 9	Comments:		

TOTAL SCORE:

Score compared to maximum possible:

03 – 0826 –__

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12-
Trip ID: 2003-DRBRA Date: 7-24-03
Personnel: Laidlaw / Bowman

Waterbody Name: Flat Creek County: Lewis & Clark HUC: 10030102
Station ID: M12FlatC07 Visit #: 2 Location: Flat Creek Road
Lat: — Long: — Verified? ☐ By ___ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84
Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ___

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0826W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☐	Macroinvertebrate Habitat Asmt. ☐		KICK HESS OTHER:
Algae/Macrophytes	☐	Aquatic Plant Form ☐		PERI-1 OTHER:
Chlorophyll a	☒		03-0826C	(CHLPHL-2) (OTHER:) Both
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 13:00
Q / Flow (cfs)	Est. ☐
Temp: (°C)	W 13.11°C A
pH:	8.50
SC: (mS/cm)	.259
SC x 1000 =	µmho/cm
DO: (mg/L)	9.51 mg/l / 94.6%
TUR: Clear ☒ Slight ☐ Turbid ☐ Opaque ☐	
Turbidity Comments:	3.65
	3.44 NTU

Macroinvertebrate Kick Duration: N/A Kick Length (Ft.):

Site Visit Comments:

Revised 3/2003 DMA

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-24-03 **Site Visit Code:** 03-0826

Waterbody: Flat Creek **Station ID:** M12FlatC07

Personnel: Laidlaw Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	1	1.0	.09			
2	2	1.2	.67			
3	3	1.2	1.84			
4	4	1.3	2.10			
5	5	1.3	2.03			
6	6	1.0	2.30			
7	7	0.9	2.45			
8	8	1.0	2.95			
9	9	0.9	2.27			
10	10	1.2	2.70			
11	11	1.20	3.15			
12	12	1.2	3.17			
13	13	1.2	2.48			
14	14	0.9	0.61			
15	15	0.6	0.05			
16	16	0.65	.35			
17	17	0.62	1.37			
18	18	0.65	1.67			
19	19	0.45	0			
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

03-0820-

Site Visit Form

(One Station per page)

STORET Project ID: TMDL-M12

Trip ID: 2003-D2BEN Date: ______

Personnel: Laidlaw / Bowman

Waterbody Name: Flat Creek County: Lewis + Clark HUC: 10030102

Station ID: M17FLATC08 Visit #: 2 Location: 1 miles below Bedtail

Lat: – Long: – Verified? ☐ By ______ GPS Datum (Circle One): (NAD 27) NAD 83 WGS84

Lat/Long obtained by method other than GPS? Y ☐ N ☐ If Y what method used? If by map what is the map scale? ______

Samples Taken:			Sample ID/File Location:	Sample Collection Procedure
Water	☒	Nutrients ☒ Metals ☐ Commons ☒	03-0820W	(GRAB)
Sediment	☐			SED-1
Macroinvertebrate	☒	Macroinvertebrate Habitat Asmt. ☒	03-0820M	(KICK) HESS OTHER:
Algae/Macrophytes	☒	Aquatic Plant Form ☐	03-0820A	(PERI-1) OTHER:
Chlorophyll a	☒		03-0820C	(CHLPHL-2) OTHER:
Habitat Assessment	☐	Stream Reach Asmt. ☐ Other ☐		Purpose: TMDL
Substrate	☐	Pebble Count ☐ % Fines ☐		
Transect	☐			
Photographs	☐			
Field Notes	☐			
Other				

Measurements:	Time: 16:00	
Q / Flow (cfs)	Est. ☐	
Temp: (°C)	W 21.98	A
pH:	8.40	
SC: (mS/cm)	.438	
SC x 1000 =	µmho/cm	
DO: (mg/L)	11.26 mg/l (129%)	
TUR: Clear ☐ Slight ☒ Turbid ☐ Opaque ☐		
Turbidity Comments:	4.98 NTU	
	0.46	

Macroinvertebrate Kick Duration: 2 minutes Kick Length (Ft.):

Site Visit Comments:

Revised 4/2003

TOTAL DISCHARGE:

Date: 7-23-02 Site Visit Code: 03-0820

Waterbody: Flat Creek Below B.Hail Station ID: M12FlatC08

Personnel: Laidlaw / Bowman

	**Distance from initial point	**Depth	**Velocity (at point)	**Width	**Area	**Discharge
1	2	.40	.03	0		
2	3.5	.65	.16	1.5		
3	5.0	1.0	.21	1.5		
4	6.5	1.15	.26	1.5		
5	8.0	1.0	.26	1.5		
6	9.5	1.05	.35	1.5		
7	11.0	1.22	.5	1.5		
8	12.5	1.32	.34	1.5		
9	14.0	1.25	.29	1.5		
10	15.5	1.40	.17	1.5		
11	17.0	1.45	.19	1.5		
12	18.5	1.45	.23	1.5		
13	20.0	1.57	.02	1.5		
14	21.5	1.5	.03	1.5		
15	23.0	1.32	0	1.5		
16	24.5	.98	0	1.5		
17	26.0	.48	0	1.5		
18	27.3	0	0			
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Page 1 of 2 Data Mgmt. Approved

M12FLATC06	Date-	6/18/2003	17:20
Flat Creek, Diversion from the Dearborn River			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50		mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge	*76.22*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*76.22*	*cfs*
Temperature, water	13.12	degree C
pH	8.43	
Specific Conductance	0.227	mS/cm
Dissolved Oxygen	9.47	mg/L
Dissolved Oxygen, % Saturation	90	%
Turbidity	1	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	2.1	mg/m^3	0.1
Benthic Chlorophyll a	30.7	mg/m^3	0.1
Total Phosphorus, TP	0.009	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

M12FLATC02	Date-	6/18/2003	20:30
Flat Creek on Flat Creek Rd, just above Culvert			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50		mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge		*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry

parameter	*value*	*units*
Flow		*cfs*
Temperature, water		degree C
pH		
Specific Conductance		mS/cm
Dissolved Oxygen		mg/L
Dissolved Oxygen, % Saturation		%
Turbidity	7.29	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	8.3	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

M12FLATC05	Date-	6/18/2003	17:00
Flat Creek DS of Milford Colony			

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)	*13.16*	*%*
Stream Type		
Discharge	*30.84*	*cfs*

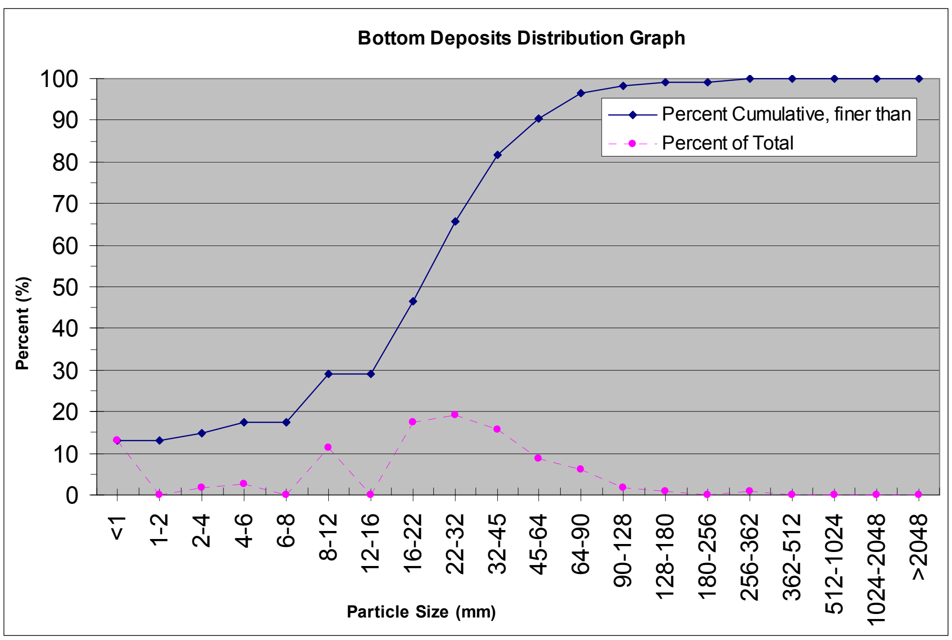
Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*30.84*	*cfs*
Temperature, water	21.96	degree C
pH	8.69	
Specific Conductance	0.29	mS/cm
Dissolved Oxygen	9.06	mg/L
Dissolved Oxygen, % Saturation	103.6	%
Turbidity	10.8	NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	31	mg/m^3	0.1
Total Phosphorus, TP	0.012	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	*value*	*units*
TOTAL SCORE (max =18)	8	score
PERCENT OF MAX SCORE	44	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Pebble Count Data			
		Particle Size (mm)	*Sum*	*% Total*	*Cum. Total*
S/C	0.5	<1	15	13.16	13.16
S	1.5	1-2		0.00	13.16
FG	3	2-4	2	1.75	14.91
FG	5	4-6	3	2.63	17.54
FG	7	6-8		0.00	17.54
MG	10	8-12	13	11.40	28.95
MG	14	12-16		0.00	28.95
CG	18	16-22	20	17.54	46.49
CG	27	22-32	22	19.30	65.79
CG	38.5	32-45	18	15.79	81.58
CG	54.5	45-64	10	8.77	90.35
SC	77	64-90	7	6.14	96.49
SC	109	90-128	2	1.75	98.25
MC	154	128-180	1	0.88	99.12
LC	218	180-256		0.00	99.12
LC	309	256-362	1	0.88	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	114	100.00	100.00
		D50 particle size (mm)	22-32		
		% Fines (<2mm)	**13.16**		
M12FLATC05	**Date-**	**6/18/2003**	**17:00**		
Flat Creek DS of Milford Colony					



M12FLATC08	Date- 6/18/2003	13:30
Flat Creek below Birdtail Rd on Dearborn Ranch		

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*33.00*	*Ft*
Mean Depth	*3.67*	*Ft*
Bnkfull X-sect area	*120.96*	*Sq Ft*
Width/Depth	*9.00*	
Max Depth	*5.49*	*Ft*
Flood prone width	*100.00*	*Ft*
Entrenchement Ratio	*3.03*	
Water slope	*0.0017*	
Channel Sinuosity	*2.59*	
BEHI Index Score (adjusted)	29.00	
BEHI Rating	*Moderate*	
Channel D50	10	mm
Percentage of Fines (<2mm)	*15.79*	*%*
Stream Type		
Discharge	*17.35*	*cfs*

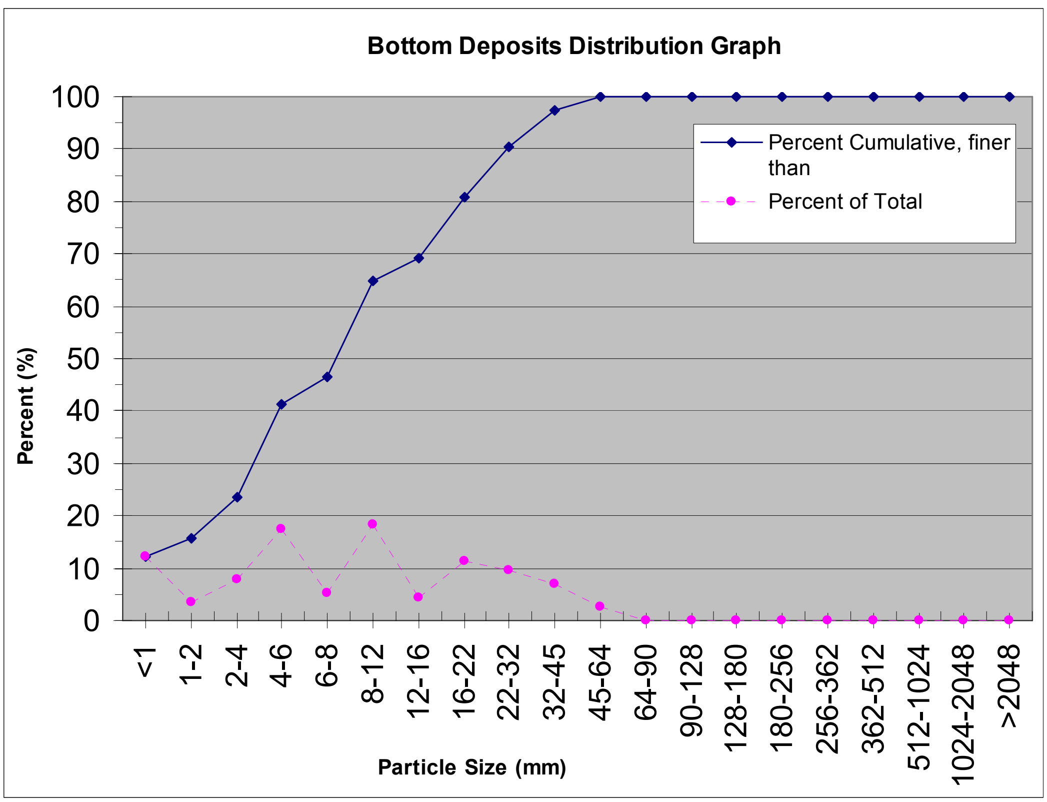
Stream Reach Habitat Assessments		
Parameter	***Value***	***Units***
Stream Reach Assessment Score (NRCS)	**94.8**	%
Stream Reach Assessment Score (MT adjusted)	**94.1**	%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

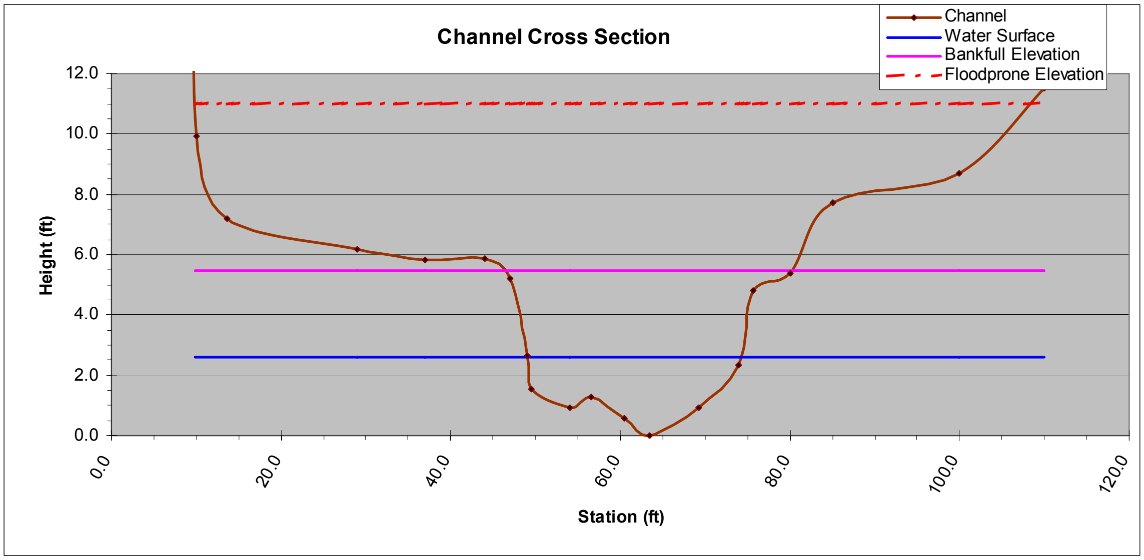
Field Measurements of water chemistry		
parameter	***value***	***units***
Flow	*17.35*	*cfs*
Temperature, water	21.51	degree C
pH	8.44	
Specific Conductance	0.477	mS/cm
Dissolved Oxygen	11.3	mg/L
Dissolved Oxygen, % Saturation	126.6	%
Turbidity	7.39	NTU

Lab Results from Field Samples			
parameter	***value***	***units***	***RL***
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.9	mg/m^3	0.1
Benthic Chlorophyll a	12.9	mg/m^3	0.1
Total Phosphorus, TP	0.061	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	***value***	***units***
TOTAL SCORE (max =18)	6	score
PERCENT OF MAX SCORE	33	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	14	12.28	12.28
S	1.5	1-2	4	3.51	15.79
FG	3	2-4	9	7.89	23.68
FG	5	4-6	20	17.54	41.23
FG	7	6-8	6	5.26	46.49
MG	10	8-12	21	18.42	64.91
MG	14	12-16	5	4.39	69.30
CG	18	16-22	13	11.40	80.70
CG	27	22-32	11	9.65	90.35
CG	38.5	32-45	8	7.02	97.37
CG	54.5	45-64	3	2.63	100.00
SC	77	64-90		0.00	100.00
SC	109	90-128		0.00	100.00
MC	154	128-180		0.00	100.00
LC	218	180-256		0.00	100.00
LC	309	256-362		0.00	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	114	100.00	100.00
		D50 particle size (mm)	8-12		
		% Fines (<2mm)	**15.79**		
M12FLATC08	Date-	6/18/2003	13:30		
Flat Creek below Birdtail Rd on Dearborn Ranch					





	BEHI Field Measures			BEHI Calculated Values		
	Parameter	***Value***	***Units***	***Parameter***	***Value***	***Units***
Longitudinal Information	Rod reading @ Upstream Edge of Water	12.03	feet	*Slope*	*0.0017*	
				Sinuousity	*2.59*	
	Rod reading @ Downstream Edge of Water	14.25	feet	*Max Depth*	*5.49*	feet
				Floodprone Height	*10.97*	feet
	Stream Distance	1340.00	feet	*Mean Depth*	*3.67*	feet
	Straightline Distance	517.00	feet	*Bankfull Width*	*33.00*	feet
Cross-Sectional Information	Left Edge of Bankfull	47.00	feet	*Floodplrone Width*	*100.00*	feet
	Right Edge of Bankfull	80.00	feet	*Bankfull Area*	*120.96*	ft^2
	Rod reading @ Thalweg	*16.62*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth	*11.13*	feet	*W/D Ratio*	*9.00*	
	Rod reading @ Floodplain Depth	*5.65*	feet	*Cross Sectional Area*	*120.96*	ft^2
	Left Edge of Floodprone depth	10.00	feet	*Entrenchment Ratio*	*3.03*	
	Right Edge of Floodprone depth	110.00	feet			
BEHI Information	Bank Height	11.00	feet			
	Bankfull Height	5.88	feet	*Bank Ht/Bankfull Ht*	*1.87*	
	Root Depth	1.00	feet	*Root Depth/Bank Ht*	*0.09*	
	Root Density	25.00	%	*Root Density*	*25*	%
	Bank Angle	70.00	Degrees	*Bank Angle*	*70*	*degrees*
	Surface Protection	50.00	%	*Surface Protection*	*50*	%
Near Bank Stress Information	Velocity at thalweg	0.79	ft/sec	*Velocity Gradient*	*0.06*	*ft/sec/ft*
	Tape reading at thalweg	63.00	feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank	0.00	ft/sec			
	tape reading at left bank	49.00	feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			

BEHI Associated Index Value (from form)		***Possible Adjustment Factors***
Bank Ht/Bankfull Ht	6.00	Bank Materials
Root Depth/Bank Ht	8.00	*Bedrock is always Very Low*
Root Density	6.00	*Boulders are always Low*
Bank Angle	5.00	*Cobble decrease the category by one unless the mixture of Sand/Gravel is over 50%*
Surface Protection	4.00	
Total Index Value	***29.0***	*Gravel- adjust the values up 5-10 pts depending on sand composition*
Numeric Adjustments:		
Bank Materials Index adjustment:		*Sand- adjust the values up 10 pts*
		silt/clay- no adjustment
Bank Stratification Index adjustment:		Stratification
		5-10 pts upward depending on position of unstable layers relative to bankfull stage
Total adjusted Index Value:	***29.0***	
Bank Erosion Potential Rating:		**Moderate**

M12FLATC04	Date- 6/18/2003	9:15
Flat Creek at confluence with Dearborn River on Dearborn Ranch		

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	154	mm
Percentage of Fines (<2mm)	*2.80*	*%*
Stream Type		
Discharge	*19.51*	*cfs*

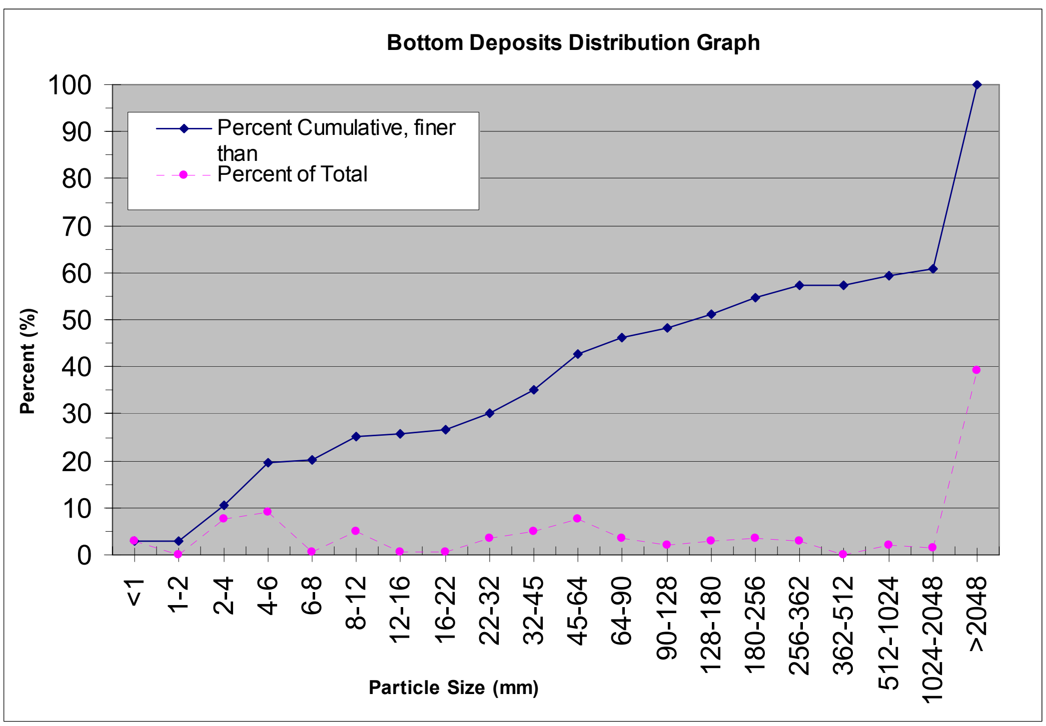
Stream Reach Habitat Assessments		
Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry		
parameter	*value*	*units*
Flow	*19.51*	*cfs*
Temperature, water	18.51	degree C
pH	8.37	
Specific Conductance	0.401	mS/cm
Dissolved Oxygen	8.95	mg/L
Dissolved Oxygen, % Saturation	95.7	%
Turbidity		NTU

Lab Results from Field Samples			
parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	16.6	mg/m^3	0.1
Total Phosphorus, TP	0.034	mg/L	0.004
Total Kiejdahl Notrogen, TKN	0.8	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results		
parameter	*value*	*units*
TOTAL SCORE (max =18)	5	score
PERCENT OF MAX SCORE	28	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	4	2.80	2.80
S	1.5	1-2		0.00	2.80
FG	3	2-4	11	7.69	10.49
FG	5	4-6	13	9.09	19.58
FG	7	6-8	1	0.70	20.28
MG	10	8-12	7	4.90	25.17
MG	14	12-16	1	0.70	25.87
CG	18	16-22	1	0.70	26.57
CG	27	22-32	5	3.50	30.07
CG	38.5	32-45	7	4.90	34.97
CG	54.5	45-64	11	7.69	42.66
SC	77	64-90	5	3.50	46.15
SC	109	90-128	3	2.10	48.25
MC	154	128-180	4	2.80	51.05
LC	218	180-256	5	3.50	54.55
LC	309	256-362	4	2.80	57.34
SB	437	362-512		0.00	57.34
MB	768	512-1024	3	2.10	59.44
LB	1536	1024-2048	2	1.40	60.84
BR		>2048	56	39.16	100.00
		TOTALS	143	100.00	100.00
		D50 particle size (mm)	128-180		
		% Fines (<2mm)	**2.80**		
M12FLATC04	**Date-**	**6/18/2003**	**9:15**		
Flat Creek at confluence with Dearborn River on Dearborn Ranch					



M12FLATC06	Date-	7/24/2003	16:45
Flat Creek, Diversion from the Dearborn River			

Geomorphology Data

parameter	value	units
Bankfull Width		Ft
Mean Depth		Ft
Bnkfull X-sect area		Sq Ft
Width/Depth		
Max Depth		Ft
Flood prone width		Ft
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50		mm
Percentage of Fines (<2mm)		%
Stream Type		
Discharge	57.91	cfs

Stream Reach Habitat Assessments

Parameter	Value	Units
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry

parameter	value	units
Flow	57.91	cfs
Temperature, water	14.7	degree C
pH	8.46	
Specific Conductance	0.263	mS/cm
Dissolved Oxygen	9.67	mg/L
Dissolved Oxygen, % Saturation	95.4	%
Turbidity	0.46	NTU

Lab Results from Field Samples

parameter	value	units	RL
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	1.8	mg/m^3	0.1
Benthic Chlorophyll a	5.7	mg/m^3	0.1
Total Phosphorus, TP	ND	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	0.056	mg/L	0.01
Total Nitrogen, TN		mg/L	

M12FLATC02	Date-	7/24/2003	18:00
Flat Creek on Flat Creek Rd, just above Culvert			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50		mm
Percentage of Fines (<2mm)		*%*
Stream Type		
Discharge	*34.47*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*34.47*	*cfs*
Temperature, water	15.11	degree C
pH	8.5	
Specific Conductance	0.259	mS/cm
Dissolved Oxygen	9.51	mg/L
Dissolved Oxygen, % Saturation	94.6	%
Turbidity	3.55	NTU

Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	3.6	mg/m^3	0.1
Benthic Chlorophyll a	19.2	mg/m^3	0.1
Total Phosphorus, TP	0.069	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

M12FLATC05	Date-	7/24/2003	13:30
Flat Creek DS of Milford Colony			

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	27	mm
Percentage of Fines (<2mm)	*13.16*	*%*
Stream Type		
Discharge	*13.44*	*cfs*

Stream Reach Habitat Assessments

Parameter	***Value***	***Units***
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score	**80**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

3 min
35'

Field Measurements of water chemistry

parameter	***value***	***units***
Flow	*13.44*	*cfs*
Temperature, water	17.68	degree C
pH	8.32	
Specific Conductance	0.273	mS/cm
Dissolved Oxygen	9.14	mg/L
Dissolved Oxygen, % Saturation	96	%
Turbidity	10.45	NTU

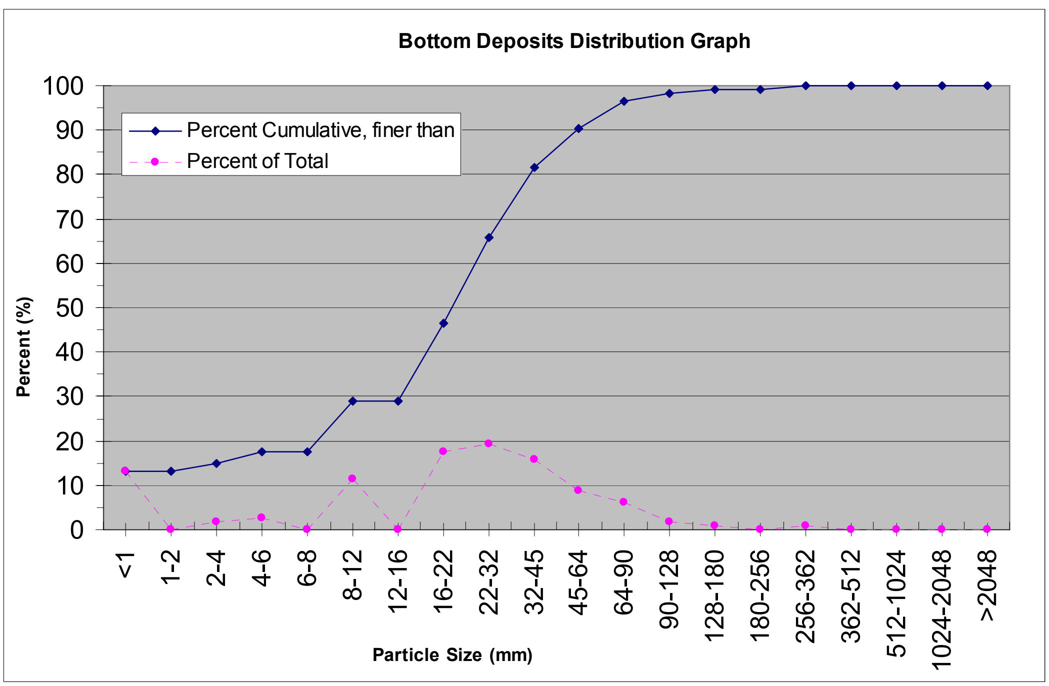
Lab Results from Field Samples

parameter	***value***	***units***	***RL***
Total Suspended Solids, TSS	14	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	14	mg/L	10
Water Column Chlorophyll a	2.1	mg/m^3	0.1
Benthic Chlorophyll a	22.2	mg/m^3	0.1
Total Phosphorus, TP	0.069	mg/L	0.004
Total Kiejdahl Notrogen, TKN	0.6	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results

parameter	***value***	***units***
TOTAL SCORE (max =18)	8	score
PERCENT OF MAX SCORE	44	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	15	13.16	13.16
S	1.5	1-2		0.00	13.16
FG	3	2-4	2	1.75	14.91
FG	5	4-6	3	2.63	17.54
FG	7	6-8		0.00	17.54
MG	10	8-12	13	11.40	28.95
MG	14	12-16		0.00	28.95
CG	18	16-22	20	17.54	46.49
CG	27	22-32	22	19.30	65.79
CG	38.5	32-45	18	15.79	81.58
CG	54.5	45-64	10	8.77	90.35
SC	77	64-90	7	6.14	96.49
SC	109	90-128	2	1.75	98.25
MC	154	128-180	1	0.88	99.12
LC	218	180-256		0.00	99.12
LC	309	256-362	1	0.88	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	114	100.00	100.00
		D50 particle size (mm)	22-32		
		% Fines (<2mm)	**13.16**		
	M12FLATC05	**Date-**	**7/24/2003**	**13:30**	
	Flat Creek DS of Milford Colony				



M12FLATC03	Date-	7/22/2003	9:45
Flat Creek Upstream of Hwy 200, on Dearborn Ranch property			

Geomorphology Data		
parameter	*value*	*units*
Bankfull Width	*23.00*	*Ft*
Mean Depth	*2.15*	*Ft*
Bnkfull X-sect area	*49.39*	*Sq Ft*
Width/Depth	*10.71*	
Max Depth	*3.15*	*Ft*
Flood prone width	*63.00*	*Ft*
Entrenchement Ratio	*2.74*	
Water slope	*0.0046*	
Channel Sinuosity	*1.23*	
BEHI Index Score (adjusted)	30.10	
BEHI Rating	*MDDERATE-HIGH*	
Channel D50	27	mm
Percentage of Fines (<2mm)	*31.97*	*%*
Stream Type	C4	*borderline E4, just needs more sinuou*
Discharge	*13.42*	*cfs*

Stream Reach Habitat Assessments		
Parameter	***Value***	***Units***
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score		%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

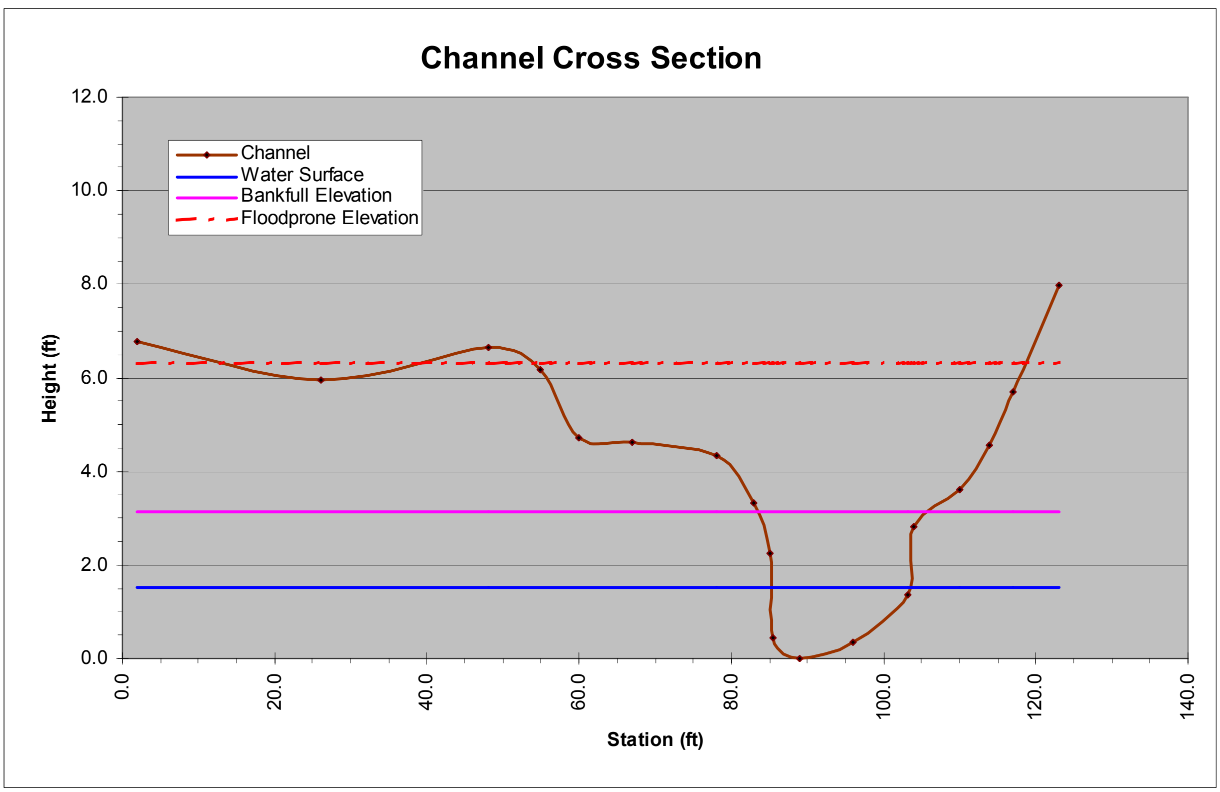
1.58 min
30'

Field Measurements of water chemistry		
parameter	***value***	***units***
Flow	*13.42*	*cfs*
Temperature, water	18.32	degree C
pH	8.01	
Specific Conductance	0.313	mS/cm
Dissolved Oxygen	9.83	mg/L
Dissolved Oxygen, % Saturation	104.3	%
Turbidity	10.14	NTU

Lab Results from Field Samples			
parameter	***value***	***units***	***RL***
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	2.4		0.1
Benthic Chlorophyll a	31.6		0.1
Total Phosphorus, TP	0.025		0.004
Total Kiejdahl Notrogen, TKN	ND		0.5
Nitrate + Nitrite	ND		0.01
Total Nitrogen, TN			

Macroinvertabrate Data Results		
parameter	***value***	***units***
TOTAL SCORE (max =18)	5	score
PERCENT OF MAX SCORE	28	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	27	22.13	22.13
S	1.5	1-2	12	9.84	31.97
FG	3	2-4		0.00	31.97
FG	5	4-6	3	2.46	34.43
FG	7	6-8		0.00	34.43
MG	10	8-12	3	2.46	36.89
MG	14	12-16	4	3.28	40.16
CG	18	16-22	4	3.28	43.44
CG	27	22-32	9	7.38	50.82
CG	38.5	32-45	16	13.11	63.93
CG	54.5	45-64	16	13.11	77.05
SC	77	64-90	10	8.20	85.25
SC	109	90-128	11	9.02	94.26
MC	154	128-180	4	3.28	97.54
LC	218	180-256	1	0.82	98.36
LC	309	256-362	2	1.64	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	122	100.00	100.00
		D50 particle size (mm)	27		
		% Fines (<2mm)	31.97		
	M12FLATC03	Date-	7/22/2003	9:45	
	Flat Creek Upstream of Hwy 200, on Dearborn Ranch property				



	BEHI Field Measures			BEHI Calculated Values		
	Parameter	Value	Units	Parameter	Value	Units
Longitudinal Information	Rod reading @ Upstream Edge of Water	10.92	feet	Slope	0.0046	
				Sinuousity	1.23	
	Rod reading @ Downstream Edge of Water	13.05	feet	Max Depth	3.15	feet
				Floodprone Height	6.30	feet
	Stream Distance	467.50	feet	Mean Depth	2.15	feet
	Straightline Distance	381.00	feet	Bankfull Width	23.00	feet
Cross-Sectional Information	Left Edge of Bankfull	83.00	feet	Floodplrone Width	63.00	feet
	Right Edge of Bankfull	106.00	feet	Bankfull Area	49.39	ft^2
	Rod reading @ Thalweg	*13.60*	feet	FloodproneArea		ft^2
	Rod reading @ Bankfull Depth	*10.45*	feet	W/D Ratio	10.71	
	Rod reading @ Floodplain Depth	*7.30*	feet	Cross Sectional Area	49.39	ft^2
	Left Edge of Floodprone depth	55.00	feet	Entrenchment Ratio	2.74	
	Right Edge of Floodprone depth	118.00	feet			
BEHI Information	Bank Height	4.00	feet			
	Bankfull Height	2.82	feet	*Bank Ht/Bankfull Ht*	*1.42*	
	Root Depth	0.50	feet	*Root Depth/Bank Ht*	*0.13*	
	Root Density	20.00	%	*Root Density*	*20*	*%*
	Bank Angle	40.00	Degrees	*Bank Angle*	*40*	*degrees*
	Surface Protection	80.00	%	*Surface Protection*	*80*	*%*
Near Bank Stress Information	Velocity at thalweg		ft/sec	*Velocity Gradient*		*ft/sec/ft*
	Tape reading at thalweg		feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank		ft/sec			
	tape reading at left bank		feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			

M12FLATC03	Date-	7/22/2003	9:45
Flat Creek Upstream of Hwy 200, on Dearborn Ranch property			

BEHI Associated Index Value (from form)		***Possible Adjustment Factors***
Bank Ht/Bankfull Ht	5.20	Bank Materials
Root Depth/Bank Ht	8.00	*Bedrock is always Very Low*
Root Density	6.40	*Boulders are always Low*
Bank Angle	3.00	*Cobble decrease the category by one unless the mixture of Sand/Gravel is over 50%*
Surface Protection	1.50	
Total Index Value	***24.1***	*Gravel- adjust the values up 5-10 pts depending on sand composition*
Numeric Adjustments:		
Bank Materials Index adjustment:	0	*Sand- adjust the values up 10 pts*
		silt/clay- no adjustment
Bank Stratification Index adjustment:	6	Stratification
		5-10 pts upward depending on position of unstable layers relative to bankfull stage
Total adjusted Index Value:	***30.1***	
Bank Erosion Potential Rating:		**MDDERATE-HIGH**

M12FLATC08	Date-	7/23/2003	16:00
Flat Creek below Birdtail Rd on Dearborn Ranch			

Geomorphology Data

parameter	value	units
Bankfull Width	33.00	Ft
Mean Depth	3.67	Ft
Bnkfull X-sect area	120.96	Sq Ft
Width/Depth	9.00	
Max Depth	5.49	Ft
Flood prone width	100.00	Ft
Entrenchement Ratio	3.03	
Water slope	0.0017	
Channel Sinuosity	2.59	
BEHI Index Score (adjusted)	29.00	
BEHI Rating	Moderate	
Channel D50	10	mm
Percentage of Fines (<2mm)	15.79	%
Stream Type	E4	Sinuosity and W/D made it E over C
Discharge	5.39	cfs

Stream Reach Habitat Assessments

Parameter	Value	Units
Stream Reach Assessment Score (NRCS)	**94.8**	%
Stream Reach Assessment Score (MT adjusted)	**94.1**	%
Macroinvertabrate Habitat Assessment Score	**66.2**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)	**Non Impaired, Fully Supporting**	
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		3 min 40'

Field Measurements of water chemistry

parameter	value	units
Flow	5.39	cfs
Temperature, water	21.98	degree C
pH	8.4	
Specific Conductance	0.438	mS/cm
Dissolved Oxygen	11.26	mg/L
Dissolved Oxygen, % Saturation	129	%
Turbidity	5.72	NTU

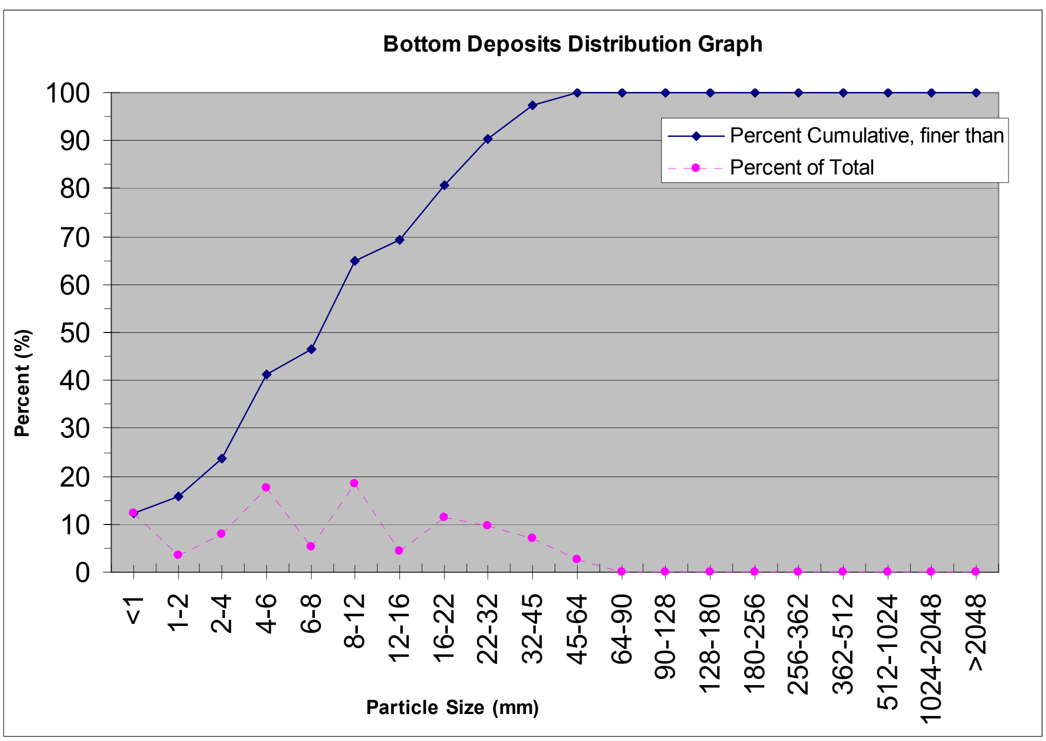
Lab Results from Field Samples

parameter	value	units	RL
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	0.9	mg/m^3	0.1
Benthic Chlorophyll a	32.8	mg/m^3	0.1
Total Phosphorus, TP	0.057	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results

parameter	value	units
TOTAL SCORE (max =18)	6	score
PERCENT OF MAX SCORE	33	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	14	12.28	12.28
S	1.5	1-2	4	3.51	15.79
FG	3	2-4	9	7.89	23.68
FG	5	4-6	20	17.54	41.23
FG	7	6-8	6	5.26	46.49
MG	10	8-12	21	18.42	64.91
MG	14	12-16	5	4.39	69.30
CG	18	16-22	13	11.40	80.70
CG	27	22-32	11	9.65	90.35
CG	38.5	32-45	8	7.02	97.37
CG	54.5	45-64	3	2.63	100.00
SC	77	64-90		0.00	100.00
SC	109	90-128		0.00	100.00
MC	154	128-180		0.00	100.00
LC	218	180-256		0.00	100.00
LC	309	256-362		0.00	100.00
SB	437	362-512		0.00	100.00
MB	768	512-1024		0.00	100.00
LB	1536	1024-2048		0.00	100.00
BR		>2048		0.00	100.00
		TOTALS	114	100.00	100.00
		D50 particle size (mm)	8-12		
		% Fines (<2mm)	15.79		
	M12FLATC08	Date-	7/23/2003	16:00	
	Flat Creek below Birdtail Rd on Dearborn Ranch				



	BEHI Field Measures			BEHI Calculated Values		
	Parameter	*Value*	*Units*	*Parameter*	*Value*	*Units*
Longitudinal Information	Rod reading @ Upstream Edge of Water	12.03	feet	*Slope*	*0.0017*	
				Sinuousity	*2.59*	
	Rod reading @ Downstream Edge of Water	14.25	feet	*Max Depth*	*5.49*	feet
				Floodprone Height	*10.97*	feet
	Stream Distance	1340.00	feet	*Mean Depth*	*3.67*	feet
	Straightline Distance	517.00	feet	*Bankfull Width*	*33.00*	feet
Cross-Sectional Information	Left Edge of Bankfull	47.00	feet	*Floodplrone Width*	*100.00*	feet
	Right Edge of Bankfull	80.00	feet	*Bankfull Area*	*120.96*	ft^2
	Rod reading @ Thalweg	*16.62*	feet	*FloodproneArea*		ft^2
	Rod reading @ Bankfull Depth	*11.13*	feet	*W/D Ratio*	*9.00*	
	Rod reading @ Floodplain Depth	*5.65*	feet	*Cross Sectional Area*	*120.96*	ft^2
	Left Edge of Floodprone depth	10.00	feet	*Entrenchment Ratio*	*3.03*	
	Right Edge of Floodprone depth	110.00	feet			
BEHI Information	Bank Height	11.00	feet			
	Bankfull Height	5.88	feet	*Bank Ht/Bankfull Ht*	*1.87*	
	Root Depth	1.00	feet	*Root Depth/Bank Ht*	*0.09*	
	Root Density	25.00	%	*Root Density*	*25*	*%*
	Bank Angle	70.00	Degrees	*Bank Angle*	*70*	*degrees*
	Surface Protection	50.00	%	*Surface Protection*	*50*	*%*
Near Bank Stress Information	Velocity at thalweg	0.79	ft/sec	*Velocity Gradient*	*0.06*	*ft/sec/ft*
	Tape reading at thalweg	63.00	feet	*Near Bank stress / Mean Shear stress*		
	velocity at left bank	0.00	ft/sec			
	tape reading at left bank	49.00	feet	*A nb / A*		
	Near bank stress					
	Mean shear stress					
	Near bank x-sectional area		ft^2			
	M12FLATC08	**Date- 7/23/2003**	**16:00**			
	Flat Creek below Birdtail Rd on Dearborn Ranch					

M12FLATC08	**Date- 7/23/2003**	**16:00**
Flat Creek below Birdtail Rd on Dearborn Ranch		

BEHI Associated Index Value (from form)		***Possible Adjustment Factors***
		Bank Materials
Bank Ht/Bankfull Ht	6.00	*Bedrock is always Very Low*
Root Depth/Bank Ht	8.00	*Boulders are always Low*
Root Density	6.00	*Cobble decrease the category by one unless the mixture of Sand/Gravel is over 50%*
Bank Angle	5.00	
Surface Protection	4.00	
Total Index Value	***29.0***	*Gravel- adjust the values up 5-10 pts depending on sand composition*
Numeric Adjustments:		
Bank Materials Index adjustment:		*Sand- adjust the values up 10 pts*
		silt/clay- no adjustment
		Stratification
Bank Stratification Index adjustment:		*5-10 pts upward depending on position of unstable layers relative to bankfull stage*
Total adjusted Index Value:	***29.0***	
Bank Erosion Potential Rating:		**Moderate**

M12FLATC04	Date- 7/24/2003	10:00
Flat Creek at confluence with Dearborn River on Dearborn Ranch		

Geomorphology Data

parameter	*value*	*units*
Bankfull Width		*Ft*
Mean Depth		*Ft*
Bnkfull X-sect area		*Sq Ft*
Width/Depth		
Max Depth		*Ft*
Flood prone width		*Ft*
Entrenchement Ratio		
Water slope		
Channel Sinuosity		
BEHI Index Score (adjusted)		
BEHI Rating		
Channel D50	154	mm
Percentage of Fines (<2mm)	*2.80*	*%*
Stream Type		
Discharge	*4.08*	*cfs*

Stream Reach Habitat Assessments

Parameter	*Value*	*Units*
Stream Reach Assessment Score (NRCS)		%
Stream Reach Assessment Score (MT adjusted)		%
Macroinvertabrate Habitat Assessment Score	**86.5**	%
OVERALL SITE RATINGS		
Stream Reach Assessment Score (NRCS)		
Stream Reach Assessment Score (MT adjusted)		
Macroinvertabrate Habitat Assessment Score		

2.5 min
30"

Field Measurements of water chemistry

parameter	*value*	*units*
Flow	*4.08*	*cfs*
Temperature, water	19.92	degree C
pH	8.4	
Specific Conductance	0.366	mS/cm
Dissolved Oxygen	10.14	mg/L
Dissolved Oxygen, % Saturation	111.4	%
Turbidity	3.28	NTU

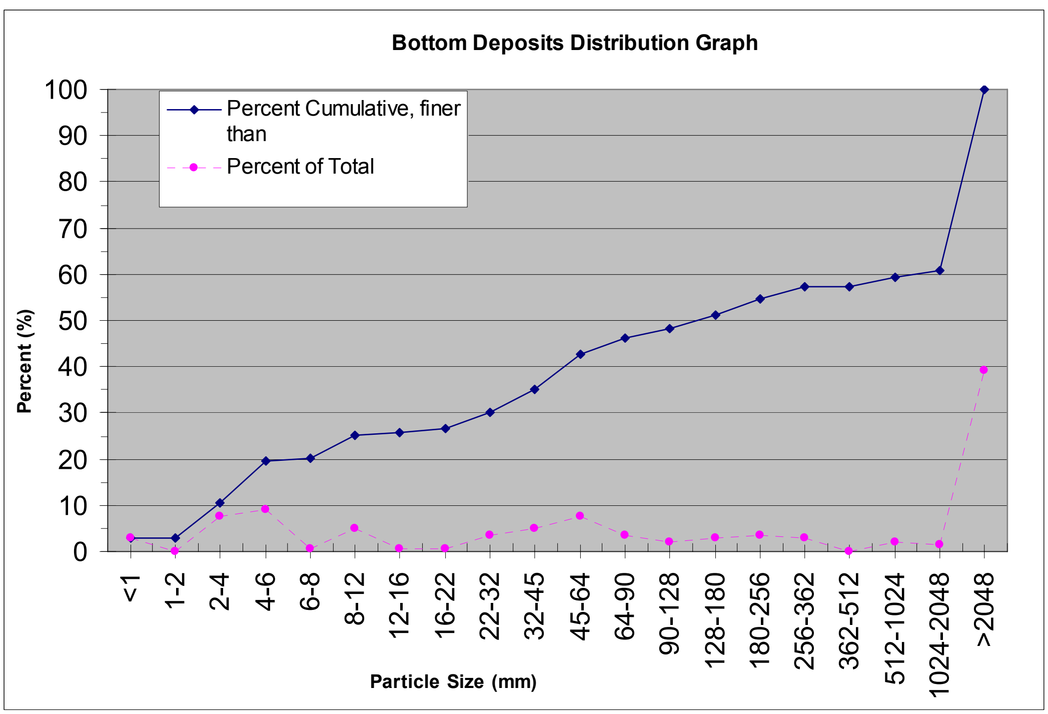
Lab Results from Field Samples

parameter	*value*	*units*	*RL*
Total Suspended Solids, TSS	ND	mg/L	10
Volatile Suspended Solids, VSS	ND	mg/L	10
TSS-VSS	ND	mg/L	10
Water Column Chlorophyll a	ND	mg/m^3	0.1
Benthic Chlorophyll a	14.3	mg/m^3	0.1
Total Phosphorus, TP	0.019	mg/L	0.004
Total Kiejdahl Notrogen, TKN	ND	mg/L	0.5
Nitrate + Nitrite	ND	mg/L	0.01
Total Nitrogen, TN		mg/L	

Macroinvertabrate Data Results

parameter	*value*	*units*
TOTAL SCORE (max =18)	5	score
PERCENT OF MAX SCORE	28	%
IMPAIRMENT CLASSIFICATION	MODERATE IMPAIRMENT	
USE SUPPORT	PARTIAL SUPPORT	

	Mean size	Particle Size (mm)	Sum	% Total	Cum. Total
		Pebble Count Data			
S/C	0.5	<1	4	2.80	2.80
S	1.5	1-2		0.00	2.80
FG	3	2-4	11	7.69	10.49
FG	5	4-6	13	9.09	19.58
FG	7	6-8	1	0.70	20.28
MG	10	8-12	7	4.90	25.17
MG	14	12-16	1	0.70	25.87
CG	18	16-22	1	0.70	26.57
CG	27	22-32	5	3.50	30.07
CG	38.5	32-45	7	4.90	34.97
CG	54.5	45-64	11	7.69	42.66
SC	77	64-90	5	3.50	46.15
SC	109	90-128	3	2.10	48.25
MC	154	128-180	4	2.80	51.05
LC	218	180-256	5	3.50	54.55
LC	309	256-362	4	2.80	57.34
SB	437	362-512		0.00	57.34
MB	768	512-1024	3	2.10	59.44
LB	1536	1024-2048	2	1.40	60.84
BR		>2048	56	39.16	100.00
		TOTALS	143	100.00	100.00
		D50 particle size (mm)	128-180		
		% Fines (<2mm)	*2.80*		
	M12FLATC04	**Date-**	**7/24/2003**	**10:00**	
	Flat Creek at confluence with Dearborn River on Dearborn Ranch				



BIOLOGICAL DATA AND REPORTS

APPENDIX C: DEARBORN RIVER MACROINVERTEBRATE AND PERIPHYTON ANALYSIS

DEARBORN RIVER MACROINVERTEBRATE AND PERIPHYTON ANALYSIS

The following tables and figures provide additional detail for the macroinvertebrate and periphyton data collected in the Dearborn River watershed. Macroinvertebrate data were collected from five sites in the Dearborn River between 2000 and 2003, and five samples were collected during that time.

DEARBORN RIVER

Table C-1. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance and periphyton values for the Dearborn River.

Chart ID	Sample Site ID / Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
DB-1	M12DBRNR05 Dearborn blw. Falls	Macroinvertebrates						
		%tolerant taxa					0.3	
		no. EPT taxa					19	
		%clingers					63.7	
		no. clinger taxa					17	
		HBI					2.92	
		Total score					15	
		% score					83	
		Dominant taxa					*Serratella*	2
							Epeorus	1
							Eukiefferiella	3
		Periphyton						
		Siltation Index					1.75 - no stress	
		Disturbance Index					26.97 - minor stress	
DB-2	M12DBRNR03 Dearborn u/s	Macroinvertebrates						
		%tolerant taxa			8			
		no. EPT taxa			11			
		%clingers			69			
		no. clinger taxa			10			
		HBI			2.25			
		Total score			9			
		% score			50			
		dominant taxa			*Rhithrogena*	0		
					Brachycentrus	1		
					Cricotopus	8		
		Periphyton						
		Siltation Index			2.52 - no stress			
		Disturbance Index			43.27 - minor stress			
DB-3	M12DBRNR02 Dearborn @ Hwy 200	Macroinvertebrates						
		%tolerant taxa			29.15			
		no. EPT taxa			14			

Chart ID	Sample Site ID Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
		%clingers			53.4			
		no. clinger taxa			12			
		HBI			4.14			
		Total score			10			
		% score			56			
		dominant taxa			*Zaitzevia*	5		
					Hydropsyche	4		
					Rhithrogena	0		
		Periphyton						
		Siltation Index						
		Disturbance Index						
DB-4	M12DBRNR04 Dearborn @ 287	Macroinvertebrates						
		%tolerant taxa	24.56				14.6	
		no. EPT taxa	7				14	
		%clingers	26.32				74.9	
		no. clinger taxa	8				17	
		HBI	3.89				3.75	
		Total score	9				9	
		% score	50				50	
		dominant taxa					*Brachycentrus*	1
							Rheotanytarsus	6
							Claasenia	2
							Hydropsyche	4
		Periphyton						
		Siltation Index					6.9 - no stress	
		Disturbance Index					39.87 - minor stress	
DB-5	M12DBRNR06 Dearborn blw. Flat	Macroinvertebrates						
		%tolerant taxa					20.1	
		no. EPT taxa					15	
		%clingers					75.3	
		no. clinger taxa					20	
		HBI					3.8	
		Total score					9	
		% score					50	
		dominant taxa					*Hydropsyche*	4
							Claasenia	2
							Brachycentrus	1
		Periphyton						
		Siltation Index					8.56 - no stress	
		Disturbance Index					17.84 - no stress	

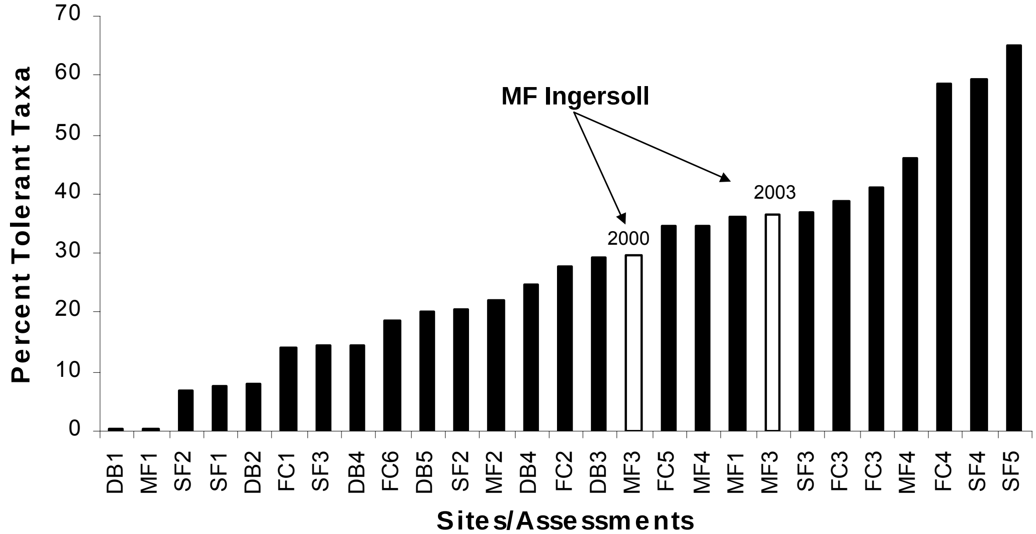


Figure C-1. Range of values for the metric Percent Tolerant Taxa over a 4-year sampling period, arranged in ascending order, by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

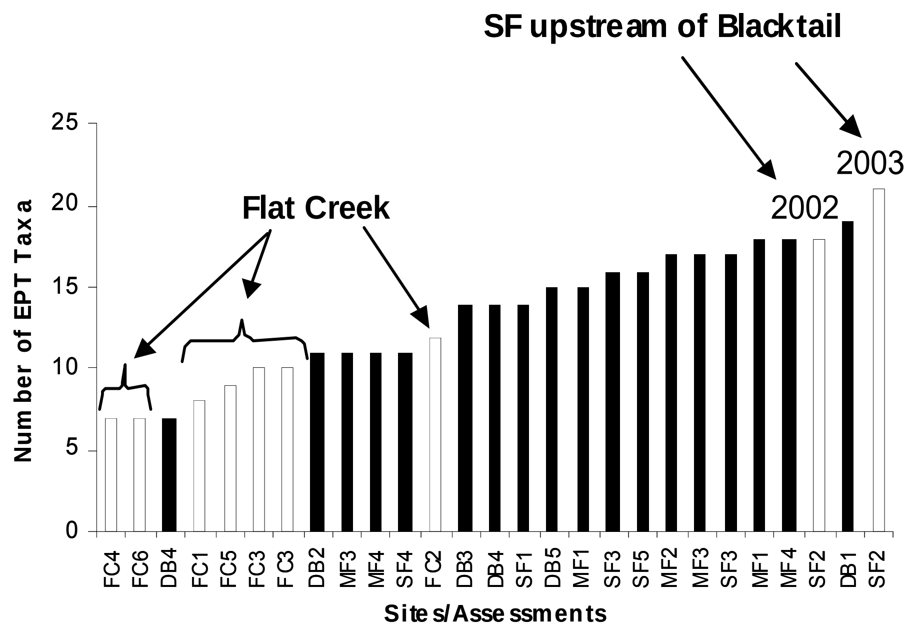


Figure C-2. Range of values for the metric Number of EPT Taxa over a 4-year sampling period, arranged in ascending order by site. Several sites were sampledin both 2002 and 2003.

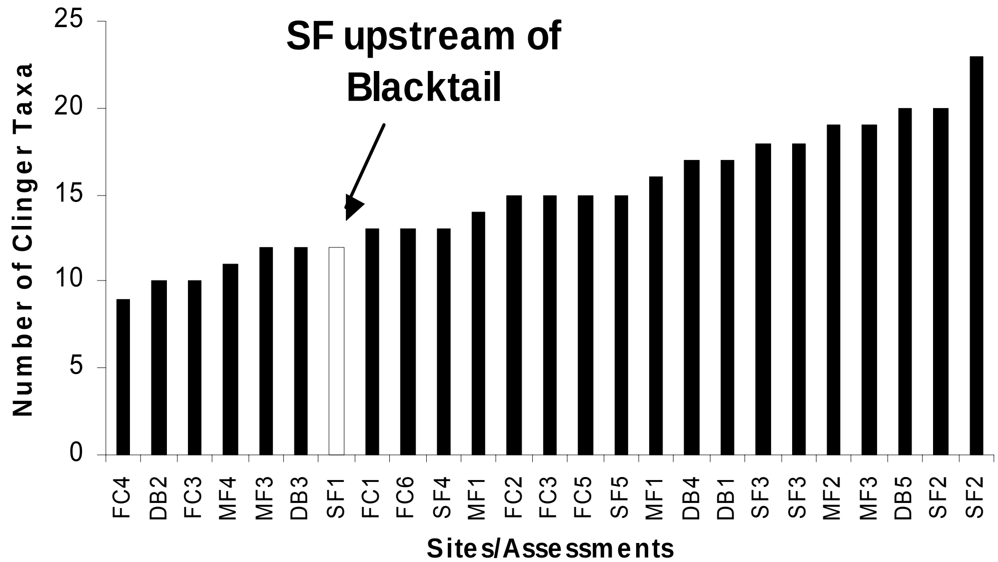


Figure C-3. Range of values for the metric Number of Clinger Taxa over a 4-year sampling period, arranged in ascending order by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

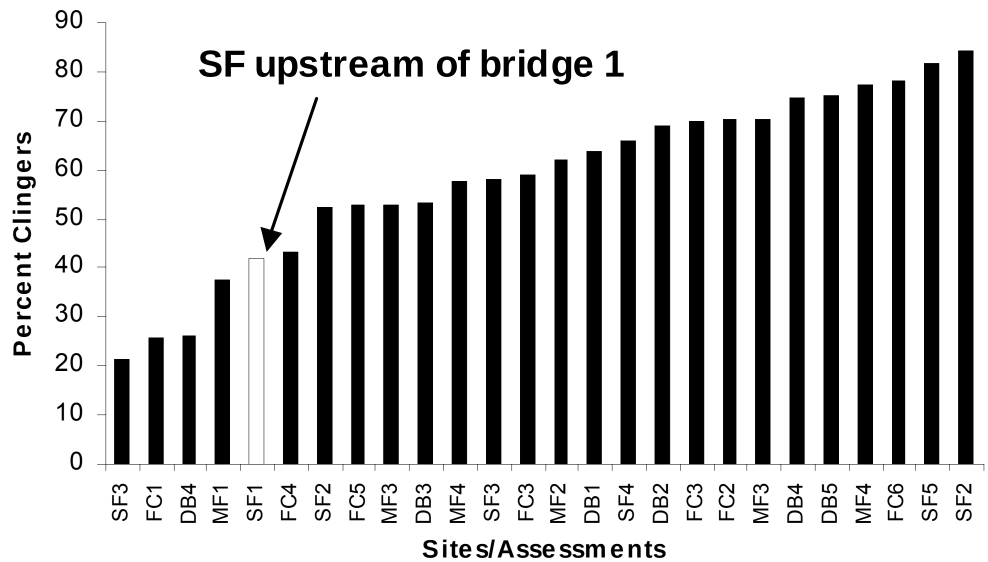


Figure C-4. Range of values for the metric Percent Clingers over a 4-year sampling period, arranged in ascending order, by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

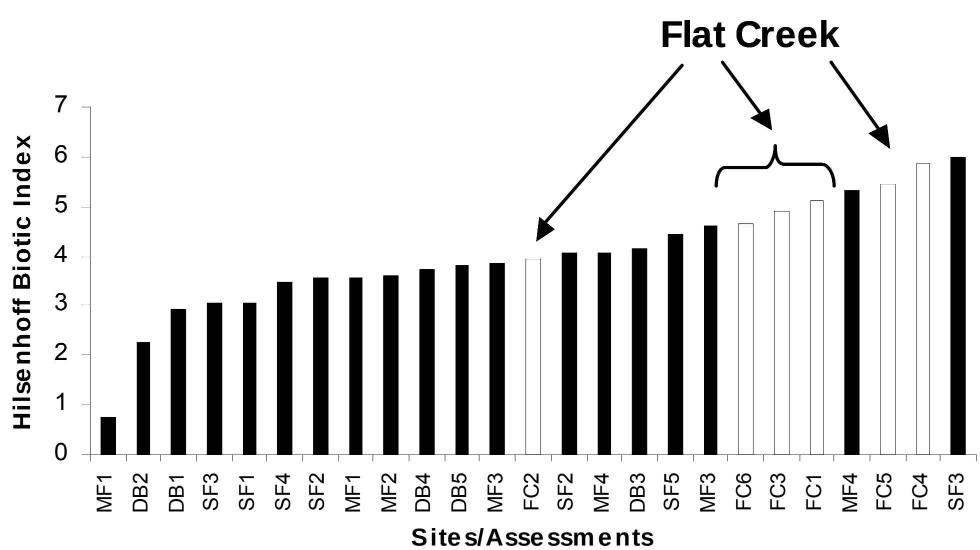


Figure C-5. Range of values for the metric Hilsenhoff Biotic Index over a 4-year sampling period, arranged in ascending order, by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

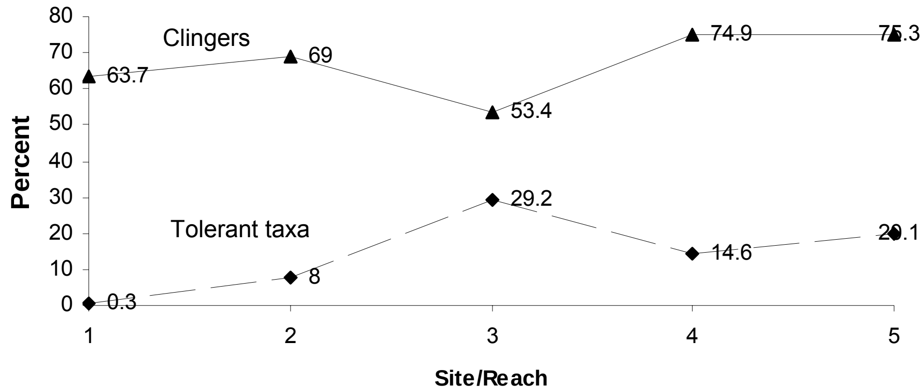


Figure C-6. Percent Clingers and Percent Tolerant Taxa from five reaches sampled on the Dearborn River mainstem from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-1.

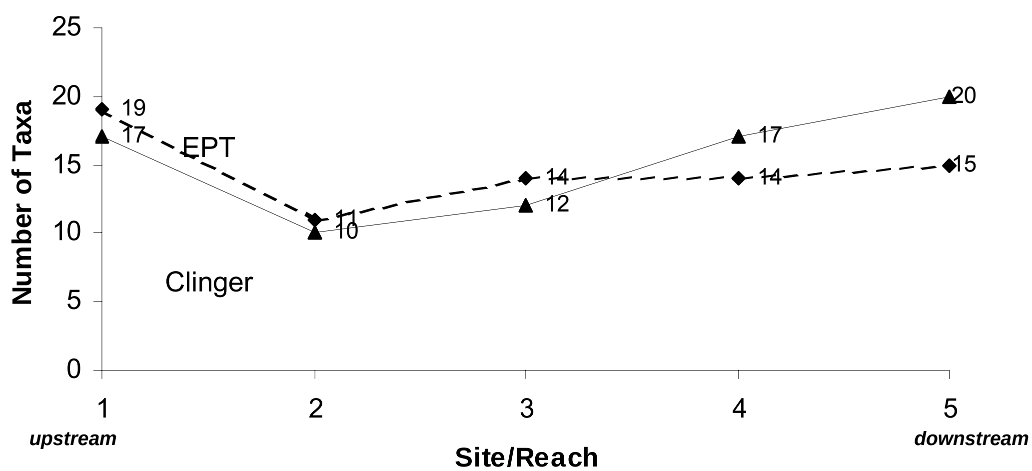


Figure C-7. Number of EPT Taxa and Clinger Taxa sampled from five reaches on the Dearborn River mainstem from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-1.

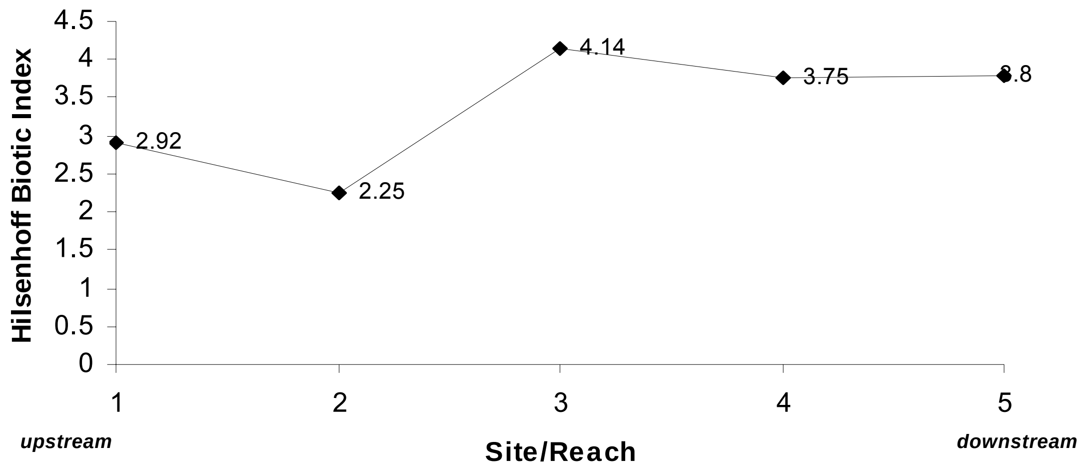


Figure C-8. Hilsenhoff Biotic Index from samples taken along five reaches of the Dearborn River mainstem from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-1.

SOUTH FORK DEARBORN RIVER

Table C-2. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance, and periphyton values for the South Fork of the Dearborn River

chart ID	Sample Site ID / Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
SF-1	SFD-1 SF Dearborn 100yds u/s first bridge and below Blacktail	**Macroinvertebrate**						
		%tolerant taxa	7.69					
		no. EPT taxa	14					
		%clingers	41.76					
		no. clinger taxa	12					
		HBI	3.08					
		Total score	14					
		% score	78					
		dominant taxa	*Orthocladius*	**7**				
			Psychoglypha	**0**				
			Serratella	**2**				
		Periphyton						
		Siltation Index						
		Disturbance Index						
SF-2	M12SFDBR01 SF Dearborn u/s Blacktail	**Macroinvertebrate**						
		%tolerant taxa			20.7		6.8	
		no. EPT taxa			18		21	
		%clingers			52.6		84.5	
		no. clinger taxa			20		23	
		HBI			4.06		3.55	
		Total score			13		10	
		% score			72		56	
		dominant taxa			*Orthocladius*	**7**	*Simulium*	**4**
					Pagastia	**2**	*Serratella*	**2**
					Zaitzevia	**5**	*Epeorus*	**1**
		Periphyton						
		Siltation Index			11.09 - no stress			
		Disturbance Index			16.91 - no stress			
SF-3	M12SFDBR02 SF Dearborn u/s 434	**Macroinvertebrate**						
		%tolerant taxa			14.4		36.9	
		no. EPT taxa			17		16	
		%clingers			21.23		57.9	
		no. clinger taxa			18		18	
		HBI			6.01		3.04	
		Total score			12		13	
		% score			67		72	
		dominant taxa			*Eukiefferiella*	**3**	*Agapetus*	**0**
					Tvetenia	**4**	*Lepidostoma*	**1**
					Skwala	**3**	*Ochrotrichia*	**4**
		Periphyton						
		Siltation Index			31.84 - no stress			
		Disturbance Index			6.87 - no stress			
SF-4	SFD-4 SF Dearborn d/s	**Macroinvertebrate**						
		%tolerant taxa	59.25					
		no. EPT taxa	11					

chart ID	Sample Site ID / Site Name	Metrics/Variables	2000 Value	2000 TV	2002 Value	2002 TV	2003 Value	2003 TV
	434	%clingers	66.14					
		no. clinger taxa	13					
		HBI	3.47					
		Total score	9					
		% score	50					
		dominant taxa	*Optioservus*	**3**				
			Sweltsa	**0**				
		Periphyton						
		Siltation Index						
		Disturbance Index						
SF-5	M12SFDBR04 / SF Dearborn @ Confluence	**Macroinvertebrate**						
		%tolerant taxa					65.1	
		no. EPT taxa					16	
		%clingers					81.7	
		no. clinger taxa					15	
		HBI					4.44	
		Total score					13	
		% score					72	
		dominant taxa					*Optioservus*	**3**
							Zaitzevia	**5**
							Nixe	**4**
		Periphyton						
		Siltation Index						
		Disturbance Index						

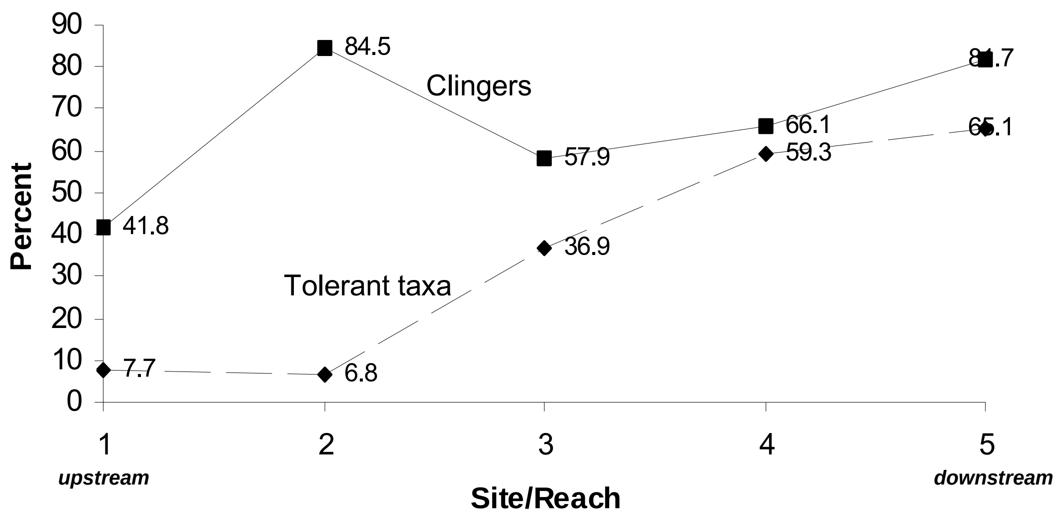


Figure C-9. Percent clingers and percent tolerant along 5 sites of the South Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-2.

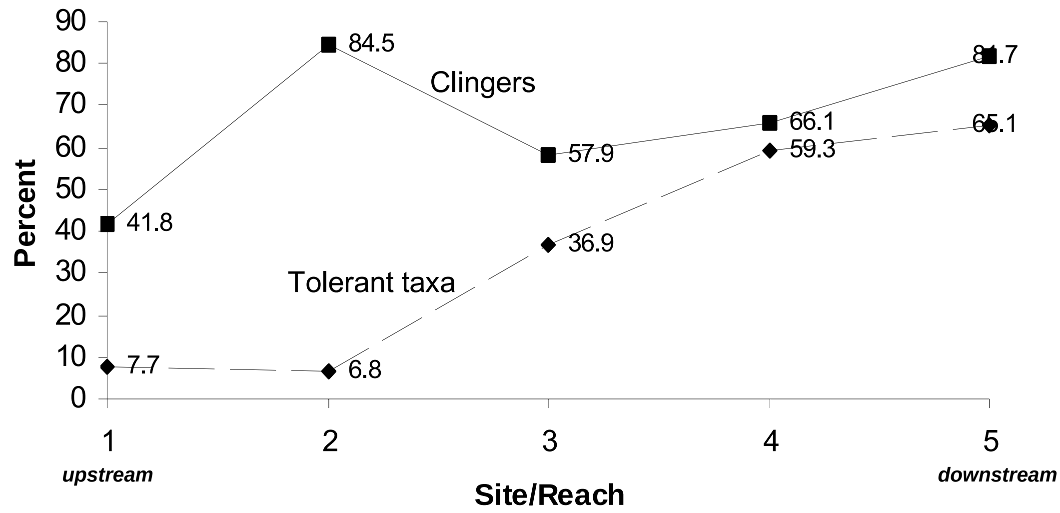


Figure C-10. Percent clingers and percent tolerant along 5 sites of the South Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-2.

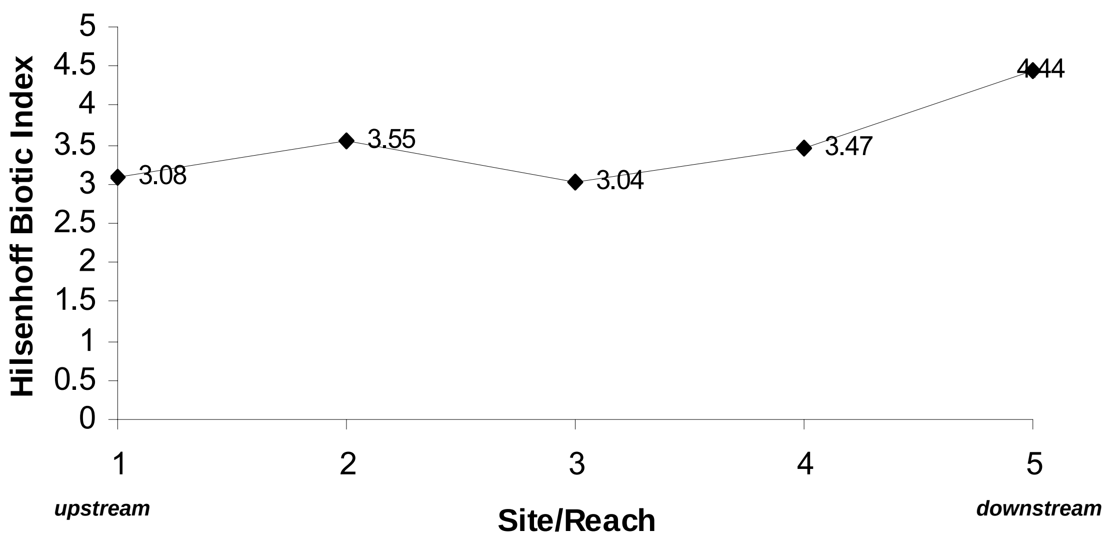


Figure C-11. Hilsenhoff Biotic Index from samples collected along 5 sites of the South Fork Dearborn River, sampled from 2000-2003; the most recent data from each sites are shown. Reach numbers refer to Table C-2.

MIDDLE FORK DEARBORN RIVER

Table C-3. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance, and periphyton values for the Middle Fork of the Dearborn River

Middle Fork of the Dearborn River Biological Data Summary Table								
Chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
MF-1	M12MFDBR01 MF Dearborn @ Rogers Pass	**Macroinvertebrates**						
		%tolerant taxa			36.1		0.3	
		no. EPT taxa			18		15	
		%clingers			37.5		85.6	
		no. clinger taxa			16		14	
		HBI			3.58		0.77	
		Total score			14		16	
		% score			78		89	
		dominant taxa			*Baetis*	**5**	*Epeorus*	**1**
					Drunella	**1**	*Cinygmula*	**0**
					Hydrobaenus	**8**	*Drunella*	**1**
		Periphyton						
		Siltation Index			4.43 - no stress			
		Disturbance Index			55.38 - mod. stress			
MF-2	MFD-2 MF Dearborn u/s 200	**Macroinvertebrates**						
		%tolerant taxa	22.1					
		no. EPT taxa	17					
		%clingers	62.2					
		no. clinger taxa	19					
		HBI	3.6					
		Total score	10					
		% score	56					
		dominant taxa	*Pagastia*	**2**				
			Ochrotrichia	**4**				
			Orthocladius	**7**				
		Periphyton						
		Siltation Index						
		Disturbance Index						
MF-3	M12MFDBR04 MF Dearborn @ Ingersoll	**Macroinvertebrates**						
		%tolerant taxa	29.55				36.7	
		no. EPT taxa	11				17	
		%clingers	52.9				70.3	
		no. clinger taxa	12				19	
		HBI	4.6				3.86	
		Total score	10				11	
		% score	56				61	
		dominant taxa	*Polypedilum*	**7**			*Zaitzevia*	**5**
			Orthocladius	**7**			*Brachycentrus*	**1**
			Optioservus	**3**			*Optioservus*	**3**
			Zaitzevia	**5**				
		Periphyton						
		Siltation Index						
		Disturbance Index						
MF-4	M12MFDBR02 MF Dearborn	**Macroinvertebrates**						
		%tolerant taxa			34.6		46.1	
		no. EPT taxa			11		18	

Middle Fork of the Dearborn River Biological Data Summary Table								
Chart ID	**Sample Site ID** **Site Name**	**Macroinvertebrate Metrics/Variables**	**2000**		**2002**		**2003**	
			Value	**TV**	**Value**	**TV**	**Value**	**TV**
	d/s 434	%clingers			57.7		77.4	
		no. clinger taxa			11		18	
		HBI			5.34		4.08	
		Total score			8		11	
		% score			44		61	
		dominant taxa			*Tanytarsus*	**7**	*Zaitzevia*	**5**
					Optioservus	**3**	*Optioservus*	**3**
					Zaitzevia	**5**	*Brachycentrus*	**1**
		Periphyton						
		Siltation Index			11.38 - no stress			
		Disturbance Index			22.54 - no stress			

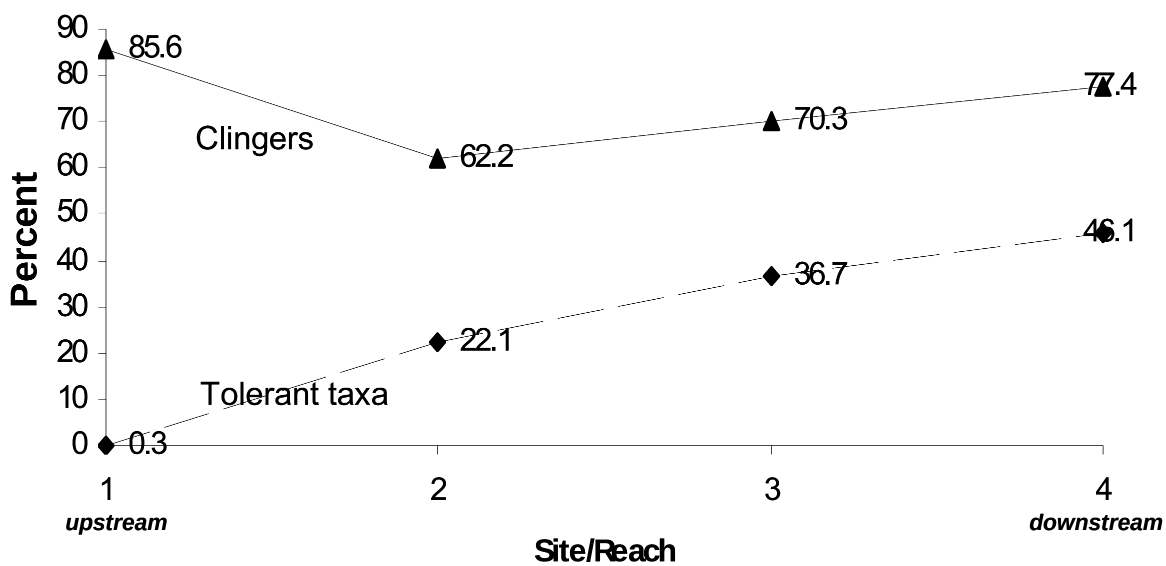


Figure C-12. Percent clingers and tolerant taxa from samples collected along 4 sites of the Middle Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-3.

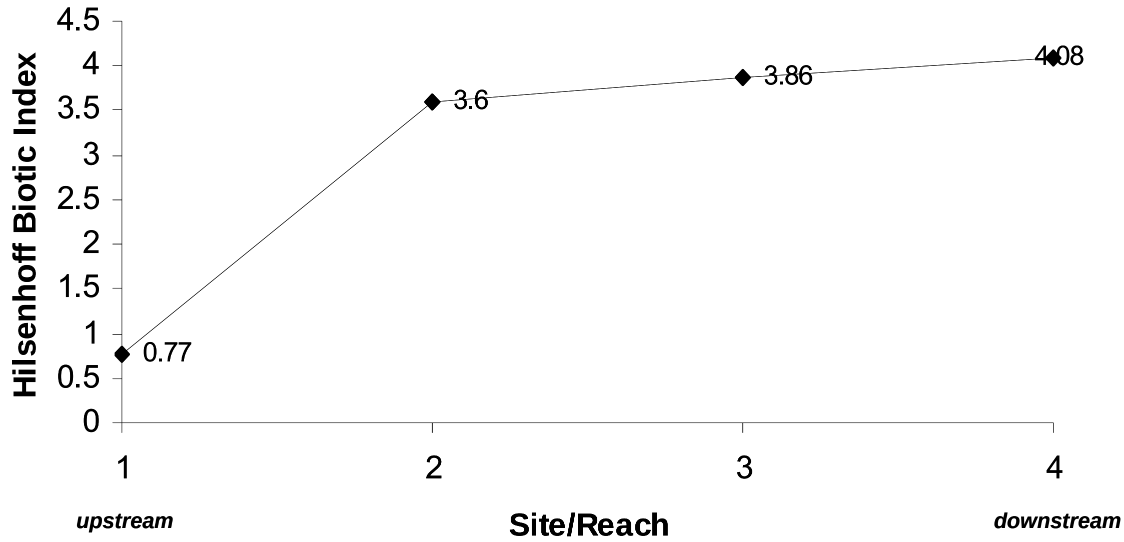


Figure C-13. Hilsenhoff Biotic Index from samples collected along 4 sites of the Middle Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-3.

FLAT CREEK

Table C-4. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance values for Flat Creek

Flat Creek Macroinvertebrate Data Summary Table								
chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
FC-1	M12FLATC02 Flat creek on Flat Crk Rd.	**Macroinvertebrates**						
		%tolerant taxa	14.1					
		no. EPT taxa	8					
		%clingers	25.7					
		no. clinger taxa	13					
		HBI	5.11					
		Total score	9					
		% score	50					
		dominant taxa	*Orthocladius*	7				
			Eukiefferiella	3				
			Cricotopus	8				
		Periphyton						
		Siltation Index						
		Disturbance Index						
FC-2	M12FLATC05 Flat creek @ Milford	**Macroinvertebrates**						
		%tolerant taxa					27.7	
		no. EPT taxa					12	
		%clingers					70.3	
		no. clinger taxa					15	
		HBI					3.94	
		Total score					8	
		% score					44	
		dominant taxa					*Brachycentrus*	1
							Baetis	5
							Optioservus	3
		Periphyton						
		Siltation Index					25.96 - no stress	
		Disturbance Index					18.6 - no stress	
FC-3	M12FLATC03 Flat creek u/s Hwy 200	**Macroinvertebrates**						
		%tolerant taxa	41				38.8	
		no. EPT taxa	10				10	
		%clingers	59				70.1	
		no. clinger taxa	10				15	
		HBI	4.58				4.9	
		Total score	7				5	
		% score	39				28	
		dominant taxa					*Hydropsyche*	4
							Brachycentrus	1
							Optioservus	3
		Periphyton						
		Siltation Index					33.79 - no stress	
		Disturbance Index					14.48 - no stress	
FC-4	F-7 Flat creek u/s Birdtail Rd	**Macroinvertebrates**						
		%tolerant taxa	58.68					
		no. EPT taxa	7					
		%clingers	43.11					
		no. clinger taxa	9					
		HBI	5.85					

Flat Creek Macroinvertebrate Data Summary Table								
chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
		Total score	4					
		% score	22					
		dominant taxa	*Simulium*	**4**				
			Baetis	**5**				
			Tricorythodes	**5**				
		Periphyton						
		Siltation Index						
		Disturbance Index						
FC-5	**M12FLATC08** **Flat creek blw. Birdtail**	**Macroinvertebrates**						
		%tolerant taxa					34.6	
		no. EPT taxa					9	
		%clingers					52.7	
		no. clinger taxa					15	
		HBI					5.45	
		Total score					6	
		% score					33	
		dominant taxa					*Baetis*	**5**
							Hydropsyche	**4**
							Cheumatopsyche	**7**
		Periphyton						
		Siltation Index					24.53 - no stress	
		Disturbance Index					4.34 - no stress	
FC-6	**M12FLATC04** **Flat creek @ Mouth**	**Macroinvertebrates**						
		%tolerant taxa					18.7	
		no. EPT taxa					7	
		%clingers					78.3	
		no. clinger taxa					13	
		HBI					4.65	
		Total score					5	
		% score					28	
		dominant taxa					*Hydropsyche*	**4**
							Antocha	**5**
							Optioservus	**3**
		Periphyton						
		Siltation Index					14.29 - no stress	
		Disturbance Index					2.98 - no stress	

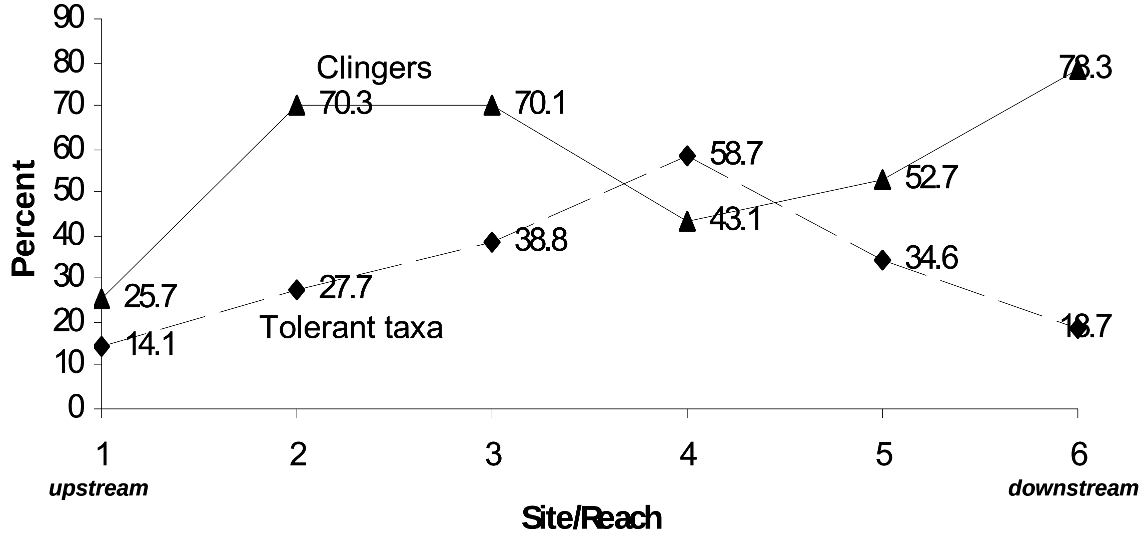


Figure C-14. Percent clingers and tolerant taxa from samples collected along 6 sites of the Flat Creek mainstem, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-4.

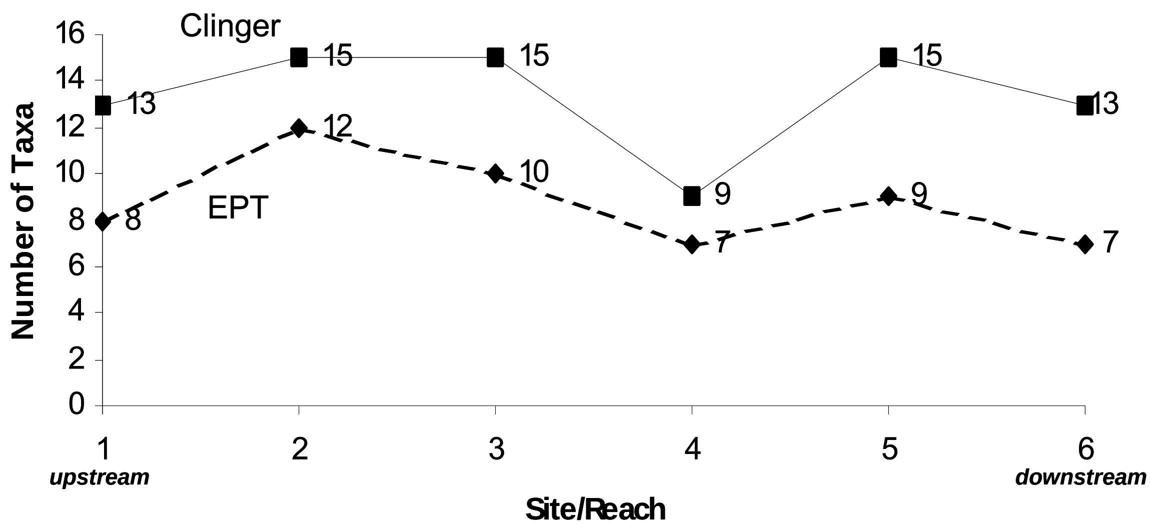


Figure C-15. Number of clinger and EPT taxa from samples collected along 6 sites of the Flat Creek mainstem, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-4.

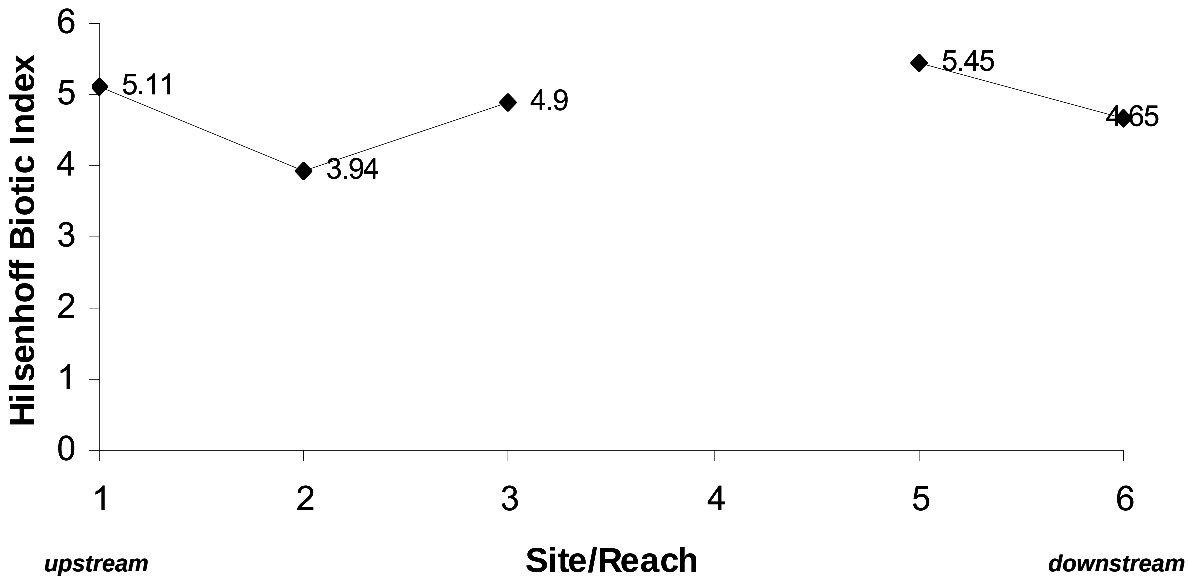
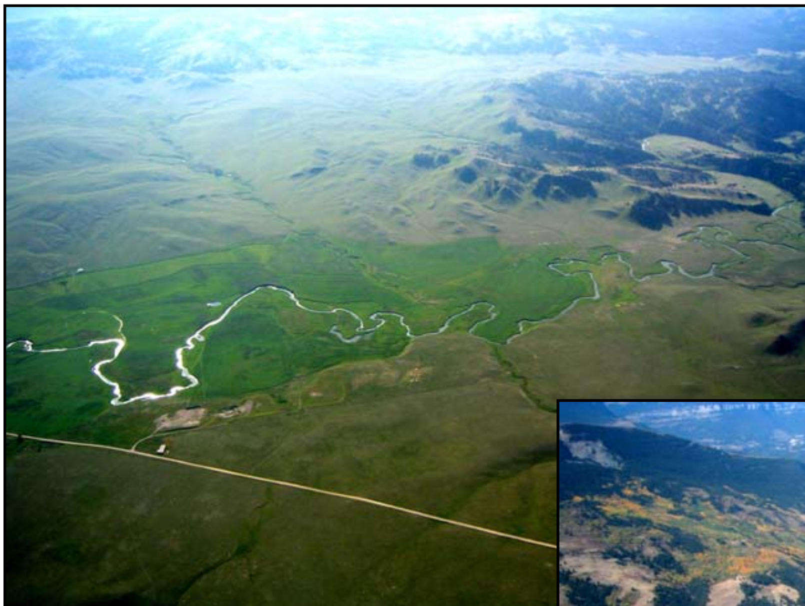


Figure C-16. Hilsenhoff Biotic Index from samples collected along 6 sites of the Flat Creek mainstem, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-4.

APPENDIX D: CHANNEL AND RIPARIAN AERIAL ASSESSMENT

DEARBORN TMDL PLANNING AREA

Channel and Riparian Aerial Assessment



Prepared for:

TETRA TECH
1468 W. 9th Street, Suite 620
Cleveland, OH 44113

Prepared by:

LAND & WATER CONSULTING, INC.
PO Box 8254
Missoula, MT 59807

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Project #: 110487.3

TABLE OF CONTENTS

APPENDICES (AVAILABLE UPON REQUEST FROM MONTANA DEQ)

FIGURES

TABLES

1.0 INTRODUCTION

An assessment of channel and riparian vegetation in the Dearborn River watershed was conducted using aerial methods to provide support for TMDL planning. The Dearborn River watershed is a tributary to the Missouri River in western central Montana, north of Helena. This assessment includes the Dearborn River, the Middle and South forks of the Dearborn, and Flat Creek.
The overall objectives of the aerial assessment were as follows:

- 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.

Assessment methods included interpretation of available aerial photographs and aerial reconnaissance. These are described in the following section.

2.0 METHODS

The aerial assessment included both photo interpretation and fixed-wing rapid aerial assessment. Photo interpretation was accomplished prior to the flights so interpretations could be confirmed during the flyovers. Aerial photos considered in the Dearborn assessment included flights from 1955, 1964, and 1995 (**Table 2-1**).

Table 2-1 ***Aerial Photo Sources***

Source	Date	Coverage
NRCS	1955	Central Dearborn Mainstem, portions of Flat Creek
NRCS	1964	Central Dearborn Mainstem, portions of Flat Creek
NRCS, Digital Orthoquads	1995	Complete Coverage of Watershed

Still photographs of the 2003 aerial reconnaissance are found in **Appendix C** (separate volume). Plots of the 1995 aerial photos with 2003 still photo inserts are found in **Appendix D**. These photo inserts were captured from continuous video coverage recorded in Hi-8 format and are a subset of photos found in **Appendix C**.

Specifically, the photo assessment included the following:

- Define Rosgen Level 1 classification and reach breaks,
- Stream length changes/meander cutoffs/sinuosity measurements,
- Channel bar/aggradation/incisement conditions and other indicators of vertical stability problems,

- Bank erosion and trend over time based on historic aerial photographs (channel width measured to evaluate movement of the stream and identify stream widening/narrowing),
- Riparian conditions and plant community characteristics (e.g. plant community, percent canopy cover/density),
- Location of major wetlands,
- Major sediment sources or mass wasting in the project area,
- Major land use changes,
- Potential reference condition metrics,
- Location of roads/culverts/channel intersections,
- Location of major water diversions,
- Areas that appear to be adversely impacted and require field investigations.

The aerial assessment involved two fixed-wing flights over the listed reaches and major tributaries. Video (Hi-8 format) and still photographs were recorded at an oblique angle (approx. 30 degrees ahead from vertical) from an elevation of 4500 ft and an average air speed of 90 mph. A second flight was made to confirm physical feature attribute data along the stream corridor. An aircraft with 2 crewmembers (a pilot, and a technician to record features) conducted the inventory.

Documentation of physical features was based on the visual observation and interpretation of the technician. Recorded features included:

Point Features
- Impoundments – Reservoirs on or immediately adjacent to the stream corridor,
- Instream Structures – Diversions, turnouts, pump sites,
- Headcuts – Active downcutting on side drainages,
- Potential Water Quality Point Sources - Corrals, feedlots, sewage discharge, irrigation return flows, dump sites, etc. along or adjacent to the stream corridor,
- Stream Crossings – Bridges, pipelines, culverts, ford crossings,
- Riparian Characteristics -
- Vegetation attributes (trees, shrub, mixed, grass sedge),
- Density (% Canopy Coverage),
- Point of reference characterized by apparent disturbance (low density, limited age class distribution, or species diversity, low vigor) by any source,
    - Point of reference characterized by apparent low levels of disturbance,
- Other – Car bodies, gravel pits, construction sites, etc. located along the stream.

Linear Features
- Bank Erosion – Accelerated, active erosion of stream banks,
- Mass Bank Sloughing – Natural sloughing of high terraces/banks,
- Rock Riprap – Round river stone, angular rock or other bank armor,
- Channelized Segment –artificial (human-induced) manipulation of the channel,
- Other (incised channel, etc.).

Data was marked on 1995 digital orthoquads (DOQ's). Variables measured are detailed in **Appendix A** and data tables are found in **Appendix B**.

3.0 RESULTS

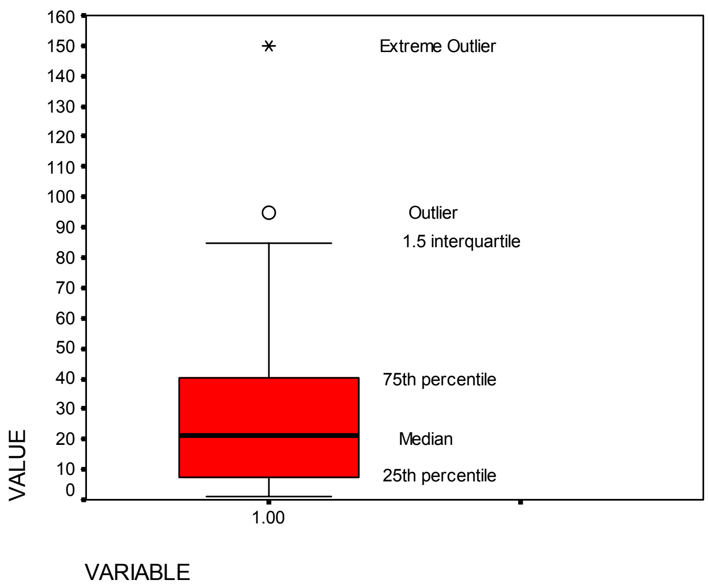
This section presents an analysis of channel and riparian condition for the Dearborn River Watershed. Analysis of results is grouped into stream reaches with identification as follows:

- DR: Dearborn Mainstem (6 Reaches, DR1, DR2, DR3, DR4, DR5, DR6).
- SF: South Fork of the Dearborn (2 reaches, SF1, SF2).
- MF: Middle Fork of the Dearborn (2 reaches, MF1, MF2).
- FC: Flat Creek (4 reaches, FC1, FC2, FC3, FC4).

Reach locations are depicted in **Figure 1** (pocket insert). Point observations for each variable were made at 10 to 70 locations within each reach depending on reach length and variability. This corresponded to a transect/point observation interval of approximately 1100 to 2500 feet within each delineated reach. Reference point numbers are found on the aerial photo sheets.

Results of analyses are presented as boxplots showing the central tendency (median) and distribution of data (**Figure 3-1**).

Figure 3-1. Example Boxplot



The central black bar is the median or 50th percentile value, which is equivalent to the average when data are normally distributed. The 25th and 75th percentiles are shown as the lower and upper extents of the box. The “whiskers” represent the value of 1.5 times the interquartile range. Circles represent outliers in the distribution of data, and asterisks represent extreme outliers. Normally distributed data would have a symmetrical form around the median value.

3.1 Channel Morphology and Condition

3.1.1 Background

Dearborn River
The mainstem of the Dearborn River is primarily an alluvial, gravel bed river (Rosgen Type C4) 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 (Reach DR6).

Middle Fork Dearborn
The Middle Fork of the Dearborn River is a C4 channel in the foothills/plains; however, a significant portion of the total stream length is a steeper gradient, headwaters B3/4 and A3 type channel. The channel makes this transition to B type morphology upstream of Highway 200 which then parallels the Middle Fork of the Dearborn to the headwaters. The extensive road fill slopes from Highway 200 do not encroach on the floodplain or result in geomorphic impacts to the perennial reaches of the Middle Fork. Lower reaches of the Middle Fork are predominately C4 type channel. Channel stability appeared to be closely related to riparian health. Increased channel width and bank instability were associated with loss of riparian vegetation.

South Fork Dearborn
The South Fork has characteristics similar to the Middle Fork, and much of the headwater zone is relatively undisturbed, steep forested terrain. Some land use (vegetation removal) impacts on channel morphology are apparent in the central reaches, and riparian vegetation is largely limited to willow and other shrub species. The river becomes an alluvial, gravel substrate channel (Rosgen C4) in the lower reaches. Channel stability appeared correlated to riparian vegetation health to some extent.

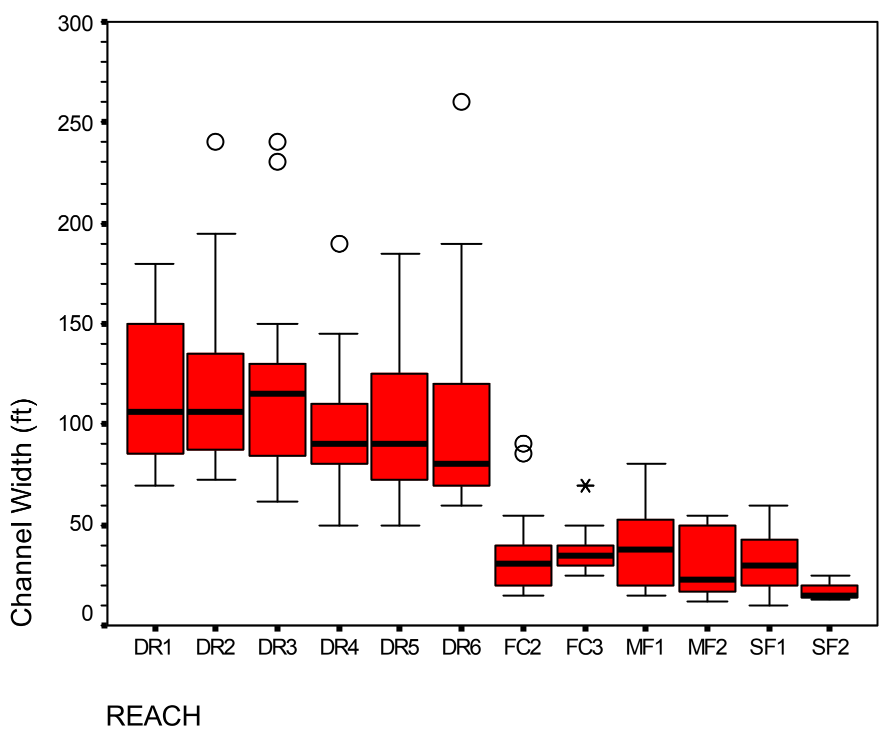
Flat Creek
Flat Creek is a low gradient, meandering channel with fine to very fine gravel bed materials (Rosgen C4/F4 channel type, tending towards C5/F5 in upper reaches). Flat Creek serves as a conveyance for irrigation water diverted from the mainstem of the Dearborn and channel morphology reflects this altered flow regime. Channel cross section is enlarged due to 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. Grazing appeared to be of higher intensity in the lower reaches.

3.1.2 Channel Characteristics

Dearborn Mainstem
Six reaches were defined for the Dearborn mainstem (**Table 3-1**). Much of the mainstem channel was a Rosgen C4 channel type, although local inclusions of coarser substrate C3 or bedrock controlled channel appeared to be present in some areas.

Channel width ranged from 100 to 120 feet, generally increasing in the downstream direction. Channel width measures approximate bankfull width, but may be biased slightly high due to the tendency to include recently deposited gravel, or older un-vegetated gravel deposits near bankfull elevation in this measurement. The uppermost reach (DR6) had a short braided section that was a D4 channel type. Channel slope decreased from 0.008 in the upper reach (DR6) to 0.005 in the lower reach (DR1), and sinuosity ranged from 1.1 to 1.25 overall.

Figure 3-2 Channel Width in the Dearborn Watershed in 1995



Bank stability was assessed using 1995 aerial photos and video coverage. Stability scores were intended to approximate Rosgen Bank Erosion Hazard Index (BEHI) values. Banks rated "high" were generally vertical banks or high terraces with primarily herbaceous riparian vegetation. Moderate scores were assigned to banks that had sparse or patchy woody vegetation and steep to moderately sloped banks. Banks that had abundant woody vegetation and moderate to low angled banks were assigned a "low" score. This aerial assessment method was a coarse, screening level tool and could not evaluate for all the factors (e.g. bank height ratio, surface protection, etc) required to make a BEHI assessment. Nevertheless, it provided a simplified approach to rapid assessment of bank stability which was able to discern potential sediment source areas.

BEHI scores were similar for Dearborn mainstem reaches DR1, DR2, and DR4, with 8 to 12.3% of banks with "high" scores, and 87-92% in the moderate to low (i.e. stable) category. Reach DR3 had a higher proportion of banks in the high category (27%). Unlike downstream reaches DR1 and DR2, which are located in dissected "canyonland" topography, DR3 had an unconfined channel and active floodplain. Elevated width to depth ratios and meander cutoffs were therefore characteristic of this reach. BEHI ranking in reaches DR5 and DR6 indicated more instability than downstream reaches, with 21 to 47% of banks falling in the high (i.e. unstable) category. In particular, reach DR6 showed a significant proportion of unstable banks due to the braided (Rosgen D4) morphology. Aerial photos from 1955 and 1964 were not available to assess whether this braided character was related to flood damage in 1964. However, the location of reach DR6 in the transition from confined valley to unconfined plains is a common location for sediment adjustments to occur, and braided D or unstable C morphology is frequently observed.

Table 3-1 ***Stream Channel Characteristics – Dearborn Watershed, 1995***

Reach	Reach Length (mi)	Channel Type	Slope	Sinuosity	Channel Width (ft)	BEHI Rating (% of Reach)			Overall Channel Stability
						High	Mod	Low	
DR1	8.88	C4	0.005	1.15	115	8.1	38.3	53.6	Good
DR2	9.52	C4	0.006	1.25	117	12.3	42.1	45.6	Good
DR3	8.00	C4	0.007	1.13	120	27.4	35.3	37.3	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	21.2	28.8	50.0	Fair
DR6	6.53	D4	0.008	1.1	107	47.1	26.2	26.6	Poor
SF1	5.83	C4	0.012	1.22	34	8.3	25.0	65.7	Fair to Good
SF2	5.56	B4/A3	0.017	1.09	17	0.0	9.0	84.7	Good to Excellent
MF1	6.17	C4	0.015	1.25	39	10.6	35.3	54.1	Fair to Good
MF2	1.32	B4/A3	0.025	1.09	30	0.0	19.4	80.6	Good-Excellent
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

A reference reach representative of unconfined C4 channel morphology was not readily apparent in the central reaches of the Dearborn. Review of aerial photography and 2003 aerial reconnaissance indicated that much of the C4 channel outside of the "canyon" or confined areas was laterally active with frequently high width to depth ratios and variable density of tree/woody shrub riparian vegetation.

Overall, BEHI scores were consistent with unimpacted bank conditions in reaches DR1, DR2, and DR4 for this channel type and geologic setting. Human impacts were not associated with "high" scores in these reaches and these banks were generally natural landscape features. Reach DR3 had a significant proportion of banks in the "high" category. Reach DR3 was an unconfined alluvial channel and BEHI scores would be expected to be higher for this reach. However, human impacts were apparent in portions of this reach and high BEHI rankings also appeared to be related to degraded riparian vegetation in some areas. The upper reaches DR5 and DR6 also had a large proportion of high BEHI scores. In particular, DR6 ranked poorly due to natural braided channel morphology. High BEHI scores were not related to human impacts and are likely related to natural processes rather than land use issues.

Dearborn South Fork

Two reaches were defined for the Dearborn South Fork (**Table 3-1**). Rosgen classification suggests that the lower reach (SF1) was a C4 channel type, and the upper reach (SF2) was a B4 to A3 channel. Analysis for the upper reach extended into the beginning of the forested headwaters.

Average channel width in SF1 was 34 feet, and the upstream reach SF2 averaged 17 feet. Channel slope decreased from 0.017 in the upper reach (SF2) to 0.012 in the lower reach (SF2), and sinuosity was 1.09 and 1.22, respectively.

Bank stability in the South Fork was generally good, with only 8.3% of banks in reach SF1 showing high BEHI scores, and <1% unstable banks in the upper reach SF2. Reach SF1 did show evidence of moderate instability with 25% of banks in this category. SF2 had significantly less bank in the moderate category (9%); the majority of the channel banks (85%) ranked good for stability (i.e. “low” BEHI ranking).

The relative differences in SF1 and SF2 bank stability are related primarily to channel type, and secondarily to vegetation and/or land use. SF2 is primarily forested A and B channel types in the headwaters, and has a relatively limited component of C channel in the lower part of the reach. SF2 is inherently more stable than SF1 because of this morphology.

Vegetation does appear to play a role in channel morphology and stability in the lower reach SF1. This is apparent from examination of aerial photography and visually comparing adjacent reaches with different vegetation densities. Hay/pasture and grazing in SF1 were associated with higher BEHI scores. The influence of riparian vegetation modification is more pronounced in the Middle Fork than the South Fork, however.

Dearborn Middle Fork

Two reaches were defined for the Dearborn Middle Fork (**Table 3-1**). The lower reach (MF1) was a Rosgen C4 channel type, and the upper reach (MF2) was a B4 at the lower end, and an A3 channel type in the headwaters. Analysis for the upper reach MF2 extended only partway into the forested headwaters because overhead canopy and small channel size limited quantitative measures. Average channel width in MF1 was 39 feet, and the upstream reach MF2 averaged 30 feet.

Bank stability assessment in the Middle Fork reach MF1 showed 11% of banks in reach MF1 with high BEHI scores and 35% with moderate scores. The upper reach MF2 had no banks with high BEHI scores. It should be noted that the aerial assessment did not cover detailed assessment of the uppermost reaches of MF2 due to dense canopy cover. Had this been feasible, the overall BEHI rating of reach MF2 would improve substantially due to more stable channel types/reaches in the headwaters.

Vegetation appeared to play a strong role in channel morphology and stability in the lower reach MF1. This is apparent from examination of aerial photography and visually comparing adjacent reaches with different vegetation densities. High and moderate BEHI scores were associated with loss of riparian vegetation and agricultural impacts.

Flat Creek

Four reaches were defined for Flat Creek (**Table 3-1**). The lower reach (FC1) was a Rosgen C4 channel type. Morphology suggested that substrate is predominately coarse gravel with bedrock control in some areas. Central reaches FC2 and FC3 appeared to be Rosgen types C5 or E5 channel types. The uppermost reach FC4 was also classified as a C5/E5 channel type. Average channel width in the lower reach of Flat Creek (FC1) was 49 feet, central reaches (FC2 and FC3) averaged 36 and 38 feet respectively. Flat Creek Reach FC4 had an average width of 19 feet.

Flat Creek appeared slightly incised in the central reaches. This suggested that Flat Creek has experienced downcutting (tending to F5 channel type) due to the diversion of irrigation water and is re-establishing equilibrium C or E morphology.

BEHI assessment indicated that 8.4 to 11.2% of bank length in Flat Creek scored “high”. Moderate bank erosion scores accounted for 18-37% of total bank length. Reaches FC1, FC2, FC3, and FC4 were similar in the distribution of bank stability. It should be noted that eroding banks originated both from human impacts and also areas where the active channel intersected natural terraces and hillsides. Eroding banks associated with topographic features can be related to human impacts; however, they can also be natural and unrelated to land use. In this case, the majority of eroding banks were associated with human impacts.

Flat Creek is a highly altered system with diverted irrigation water and extensive conversion of riparian areas to pasture or cropland. Loss of beaver from the system may also be a significant factor in modified channel morphology. Reference reaches were not apparent in Flat Creek. Prior to conversion to an irrigation conveyance, the channel of Flat Creek was certainly a narrower, more stable channel. Given the current flow regime and corresponding geomorphic adjustments, potential “reference” or “equilibrium” conditions and potential bank stability criteria would be best defined through field investigation.

3.2 Riparian Condition

Fully functioning, healthy riparian vegetation communities can reduce stream bank erosion, filter sediment, dissipate the energy of flood flows, and provide a healthy and contiguous environment for both terrestrial and aquatic biota.

The distribution and composition of the riparian vegetation community is a function of the physical and chemical properties of the soils, moisture, elevation, and aspect. Site characteristics can be altered by both natural and man-induced causes. For example, an extreme flood event in the Dearborn River drainage in 1964 significantly altered the physical characteristics of many stream floodplains as well as the character of the riparian vegetation communities. The effects from 1964 flooding are still evident in the riparian community (see **Section 3.3**). Man's actions can also have an effect on the riparian vegetation community. Riparian harvest, the presence of roads, stream crossings, agricultural encroachment, irrigation, and grazing can all have deleterious effects on riparian vegetation communities.

A potentially significant anthropogenic factor in riparian vegetation communities is grazing. Present-day grazing pressure is mainly related to cattle although at the turn of the century large bands of sheep were prevalent. Contemporary grazing pressure is not necessarily more intense than pre-settlement conditions. Lewis reported observing vast numbers of buffalo along the rivers in 1806 while traveling through the Dearborn-Sun area, including "not less than 10,000 buffalo" within a two-mile radius near the Sun River confluence with the Missouri. It should be recognized that interpretations of "unimpaired" riparian condition necessarily have a somewhat short-sighted perspective relative to historical "reference" conditions.

With this caveat, interpretation of "unimpaired" or reference riparian characteristics in the following discussion is generally a spatial comparison between "least impaired" reaches (i.e., maximum observed riparian coverage) vs. "impaired" reaches (i.e., areas that show evidence of conversion to agricultural uses or elevated grazing pressure). A description of selected features of the riparian corridor is presented on a stream-by-stream basis in the following sections.

The riparian buffer width was estimated by measurement from 1995 aerial photos and is reported for each of the study reaches. Riparian buffer width was measured as the distance that natural riparian vegetation extended from the streambank across the floodplain. Three classes of vegetation were delineated and the percent cover of each was reported for each of the study reaches. The vegetative community types included coniferous/deciduous tree, woody shrub, herbaceous, and bare ground.

Finally, a qualitative assessment of the integrity of the riparian buffer was conducted. For the purposes of this analysis, buffer integrity was ranked as good, fair, or poor. A "good" ranking represented a natural riparian vegetation community that extends uninterrupted from the edge of the active stream channel to the apparent topographic extent of the floodplain. A "fair" ranking represented a riparian buffer that showed evidence of possible vegetation alterations from grazing or other land use, but was generally intact along the stream channel. A "poor" ranking represents a natural riparian vegetation community that was restricted to the immediate proximity of channel margins, and/or a riparian buffer with obvious evidence of riparian harvest or conversion from a natural vegetation community to agriculture or impervious surfaces. In general, these rankings could be equated to "fully functioning, functioning at-risk, and non-functioning" type classification.

It should be noted that the aerial assessment techniques applied in this study are not adequately sensitive to detect all potential impacts to the riparian vegetative community. For example, the potential deleterious effects of low intensity or moderate grazing would not likely be detectable. Grazing impacts would likely only be noted in relatively extreme cases. Nonetheless, a "poor" ranking clearly raises a "red flag" that the condition of the riparian corridor may be limiting water quality and a "good" ranking likely eliminates the potential concern.

Dearborn Mainstem

Riparian vegetation was primarily open stands of deciduous cottonwood type (6 to 33% coverage), with extensive areas of herbaceous understory (30-64% coverage) and woody shrub components (19-39% coverage) (**Table 3-2**).

Table 3-2 ***Dearborn Mainstem Riparian Vegetation Features***

Reach	Riparian Buffer Width (ft)	Vegetation Type (% of reach)				
		Con/Dec (%)	Woody Shrub (%)	Grass/Sedge (%)	Total Woody (%)	Bare Ground/ Disturbed (%)
DR1	45	16	19	56	34	10
DR2	42	19	27	49	46	5
DR3	43	6	25	64	31	5
DR4	46	12	27	60	39	1
DR5	72	33	22	41	55	5
DR6	136	11	39	30	50	20

Although tree components were not the dominant vegetation component for the Dearborn mainstem, the overall coverage was good relative to the site potential. Riparian vegetation generally appeared to be in a seral state with multiple age classes of Cottonwood in active alluvial reaches (e.g. reach DR3). Upper reaches DR4, DR5, and DR6 had increasing amounts of coniferous overstory relative to deciduous Cottonwood.

Average riparian buffer width was fairly constant, ranging from 42 to 48 feet in reaches DR1 to DR4. Upper reaches DR5 and DR6 showed progressively greater riparian buffer widths (72 and 136 feet, respectively). This riparian buffer width appeared low relative to channel width (100 feet), but it should be noted that floodplain extents were limited by topographic features in many locations. Microsite factors (e.g. floodplain elevation, aspect, shading, etc.) also played an important role in vegetation distribution.

Representative photos for each Dearborn Mainstem Reach are found in **Figures 3-3 to 3-8**.

Figure 3-3. Dearborn Reach DR1

Figure 3-4. Dearborn Reach DR2

Figure 3-5. Dearborn Reach DR3

Figure 3-6. Dearborn Reach DR4

Figure 3-7. Dearborn Reach DR5

Figure 3-8. Dearborn Reach DR6

Shade provided by riparian vegetation to the stream channel was very limited on all reaches of the Dearborn mainstem. This resulted in part from low to moderate tree densities and canopy coverage, but also because tree heights and offset from the channel resulted in minimal shade projected to the water surface (e.g. **Figure 3-3**). Channel widths exceeding 100 feet limited effective shading potential from even mature Cottonwood stands adjacent to the river. The majority of shade to the Dearborn mainstem was related to topographic influences (see **Figures 3-3, 3-4, 3-7**).

Impervious/urban impacts on the mainstem of the Dearborn were infrequent and were limited to isolated road crossings and channel modifications. Bare ground or disturbed areas were present as gravel bar deposits or rock formations. Bare ground was largely unrelated to anthropogenic influences. Bare ground was especially characteristic of the braided reach in DR6 (20%).

Potential reference conditions for riparian vegetation in the Dearborn mainstem were difficult to establish based on clear delineation of pristine or un-impacted reach locations within the watershed. Review of historic aerial photographs and 2003 aerial reconnaissance did not suggest that reach-specific or localized grazing pressure had resulted in riparian impairment over most of the Dearborn. Upstream and downstream comparisons of adjoining reaches did not generally indicate any localized impairment to riparian condition or coverage related to human influence. Conversion of riparian communities to cropland or pasture was not characteristic of any reach of the Dearborn mainstem except for reach DR3. Reach DR3 showed some impacts from loss of riparian vegetation. Elsewhere in the Dearborn mainstem, human influence appeared minimal. Existing conditions likely represent relatively unimpacted vegetation characteristics. Much of the Dearborn mainstem is relatively inaccessible with a small, confined floodplain not well-suited to agricultural uses. This may account for the apparent low level of human impacts.

Dearborn Middle and South Fork

The distribution of riparian vegetation components in the Middle and South Forks is found in **Table 3-3** and is discussed in the subsequent sections separately for each stream reach.

Table 3-3 ***Riparian Vegetation Features***

Reach	Riparian Buffer Width (ft)	Vegetation Type (% of reach)				
		Con/Dec (%)	Woody Shrub (%)	Grass/Sedge (%)	Total Woody (%)	Bare Ground/ Disturbed (%)
SF1	28	3	49	46	52	2
SF2	61	18	31	51	49	<1
MF1	78	4	37	59	40	1
MF2	36	11	6	76	16	8

Dearborn South Fork

Riparian vegetation in lower Reach SF1 was characterized by isolated stands of deciduous cottonwood (3%) with extensive areas of herbaceous understory (46%) and woody shrub components (49%) (**Table 3-3**). Upper reach SF2 was mixed stands of deciduous cottonwood or conifers (18%) with extensive areas of herbaceous understory (51%) and woody shrub components (31%). Tree and woody shrub species increased towards the headwaters, and the upper portions of reach SF2 transitioned to a dominant coniferous overstory. Average riparian buffer width was 28 feet in reach SF1 and 61 feet in SF2.

Impervious/urban impacts on the South Fork of the Dearborn were infrequent, and were limited to isolated road crossings and channel modifications. Bare ground or disturbed areas were present as gravel bar deposits and were related to floodplain/land use in some cases.

Figures 3-9 and 3-10 contrast the ‘good’ and ‘poor’ riparian conditions for the South Fork of the Dearborn in the lower reach SF1. Woody species were predominately shrub/willow in ‘good’ reaches. Loss of riparian corridor due to conversion to agricultural uses resulted in reduced riparian buffer widths in many locations.

Figure 3-9. Central Portion of South Fork SF1 'Good'

Figure 3-10. Central Portion of South Fork SF1 'Poor'

The headwaters portion of the South Fork SF2 was primarily coniferous forest and did not show any significant influence from anthropogenic activities (**Figure 3-11**). Portions of the central and lower section of South Fork reach SF2 appeared to reflect the impacts of logging and riparian vegetation clearing (**Figure 3-12**). The aerial assessment could not determine whether grazing also impacted riparian coverage in this reach.

Figure 3-11. Upper Portion of South Fork SF2 'Good'

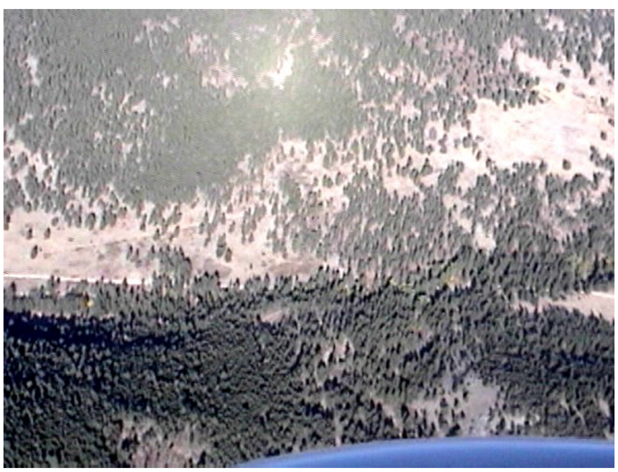


Figure 3-12. Lower Portion of South Fork SF2 'Poor'

Assessment of riparian vegetation impacts indicated that approximately 50% (20,593 feet) of riparian corridor was rated "poor" in lower reach SF1 (**Table 3-4**). An additional 29% (12,042 feet) was considered "fair", and 21% (8,725 feet) was in "good" condition. Cropland and conversion to pasture accounted for riparian impacts. Locations of reaches coded by impact are found in **Appendix E**.

Table 3-4. ***Riparian Vegetation Impact on the Dearborn South Fork (SF1)***

Impairment Status	Length	(%)
Good	8,725	21%
Fair	12,042	29%
Poor	20,593	50%
Total	41,361	100%

The upper reach of the South Fork SF2 showed post-1995 impacts from logging/riparian clearing along 5910 feet of channel. This resulted in a "poor" rating for this segment of the reach, although overall the headwaters were in "good" condition relative to site potential.

Vegetation assessment for the South Fork indicated that riparian coverage was sub-optimal in the lower reach SF1 and had significant conversion to herbaceous vegetation types. Riparian vegetation was lacking in woody shrub and tree components and was not in optimal condition relative to site potential. The upper reach SF2 had limited impacts from riparian clearing.

Dearborn Middle Fork

Riparian vegetation in lower reach MF1 was characterized by isolated stands of deciduous cottonwood (4%) with extensive areas of herbaceous understory (59%) and woody shrub components (37%) (**Table 3-3**). Upper reach MF2 was mixed stands of deciduous cottonwood or conifers (11%) with extensive areas of herbaceous understory (76%) and woody shrub components (6%). Tree and woody shrub species increased towards the headwaters, and the upper portions of reach MF2 transitioned to a dominant coniferous overstory. Vegetation coverage values were biased in reach MF2 because the aerial assessment focused on the lower end with more human impacts. Average riparian buffer width was 78 feet in reach MF1 and 36 feet in MF2.

Impervious/urban impacts on the Middle Fork of the Dearborn were generally limited to isolated road crossings. Bare ground or disturbed areas were present as gravel bar deposits and were related to land use/riparian vegetation loss in some locations.

Figures 3-13 to 3-15 contrast 'good' and 'poor' riparian conditions for the Middle Fork in the lower reach MF1. Woody species in the lower reach of the Middle Fork (MF1) were primarily woody shrubs. Tree components were not a significant part of the overall riparian coverage in 'good' reaches (**Figure 3-13**). Extensive clearing of riparian vegetation was apparent in the lower reach of the Middle Fork (**Figures 3-14 and 3-15**). The upper reach MF2 in the headwaters of the Middle Fork was mainly coniferous forest and was not significantly impacted by land use (**Figure 3-16**). Encroachment on riparian vegetation by Highway 200 was minimal except in a short section at the lower end of reach MF2.

Figure 3-13. Middle Fork Dearborn (MF1) 'Good' Reach

Figure 3-14. Middle Fork Dearborn (MF1) 'Fair' Reach

Figure 3-15. Middle Fork Dearborn (MF1) 'Poor' Reach

Figure 3-16. Middle Fork Dearborn (MF2) Reach

Assessment of riparian vegetation impacts indicated that approximately 65% (20,593 feet) of riparian corridor was rated "poor" in lower reach MF1 (**Table 3-5**). An additional 29% (12,042 feet) was considered "fair", and 21% (8,725 feet) was in "good" condition. Cropland and conversion to pasture accounted for riparian impacts. Locations of reaches coded by impact are found in **Appendix E**.

Table 3-5. ***Riparian Vegetation Impact on the Dearborn Middle Fork (MF1)***

Impairment Status	Length	(%)
Good	9,743	29%
Fair	1,837	7%
Poor	21,286	65%
Total	32,886	100%

Overall, riparian vegetation in MF1 was lacking in deciduous tree and woody shrub components and was not in optimal condition relative to site potential. The headwaters reach MF2 appeared to be in good condition with a full complement of conifer/deciduous overstory in most areas except for a short section in the lowermost portions near Highway 200.

Flat Creek

Vegetation metrics for Flat Creek indicated that riparian tree and woody shrub coverage was extremely low for most reaches. Tree components were less than 1% in all reaches except downstream reach FC1 (9%). Overall, woody shrubs comprised about 21% of the riparian corridor (**Table 3-6**), and herbaceous species averaged 77%.

Table 3-6 ***Riparian Vegetation Characteristics on Flat Creek***

Reach	Riparian Buffer Width (ft)	Vegetation Type (% of reach)				
		Con/Dec (%)	Woody Shrub (%)	Grass/Sedge (%)	Total Woody (%)	Bare Ground/ Disturbed (%)
FC1	47	9	12	79	21	0
FC2	61	<1	35	64	35	<1
FC3	78	<1	21	77	21	2
FC4	36	<1	4	93	4	2

The lowermost reach FC1 had the highest frequency of tree components, although herbaceous species were the dominant vegetation type (**Figure 3-17**). Average riparian buffer width was 47 feet in reach FC1 and was composed of about 79% herbaceous vegetation and 21% mixed conifer/deciduous and woody shrubs

Vegetation in the upstream reaches FC2, FC3, FC4 was largely herbaceous, with lesser amounts of remnant and decadent woody shrub species. Riparian buffer width (36 to 78 feet) was low in these upper reaches of Flat Creek relative to potential (**Figures 3-19 to 3-21**).

Impervious/urban impacts on Flat Creek were associated with road crossings and channel modifications. Bare ground or disturbed areas were relatively localized and had minor impacts to riparian vegetation.

Flat Creek would not be expected to support a significant Cottonwood overstory given the relatively arid plains location, channel type, and fine-grained floodplain substrate. Willow, snowberry and other shrubs would be expected to be the dominant riparian component in this geologic setting. It should be noted that less visible forms of woody species (e.g. sandbar willow) were not easily identified with aerial assessment. As a result, woody shrub components may be underestimated. Nevertheless, it is apparent that the high proportion of herbaceous vegetation likely does not represent optimal conditions for reaches FC2, FC3, and FC4. Flat Creek would potentially support a much more extensive woody shrub component especially given the augmented flow regime. The entire length of Flat Creek was considered to be in the "poor" category for riparian impacts.

Figure 3-17. Flat Creek Reach FC1 Unconfined Lower Reach

Figure 3-18. Flat Creek Reach FC1 Confined Lower Reach

Figure 3-19. Flat Creek Reach FC2 Reach

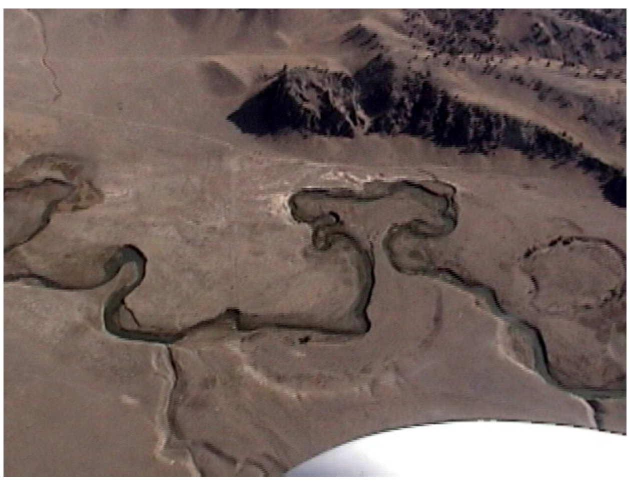


Figure 3-20. Flat Creek Reach FC3 Reach

Figure 3-21. Flat Creek Reach FC4 Reach

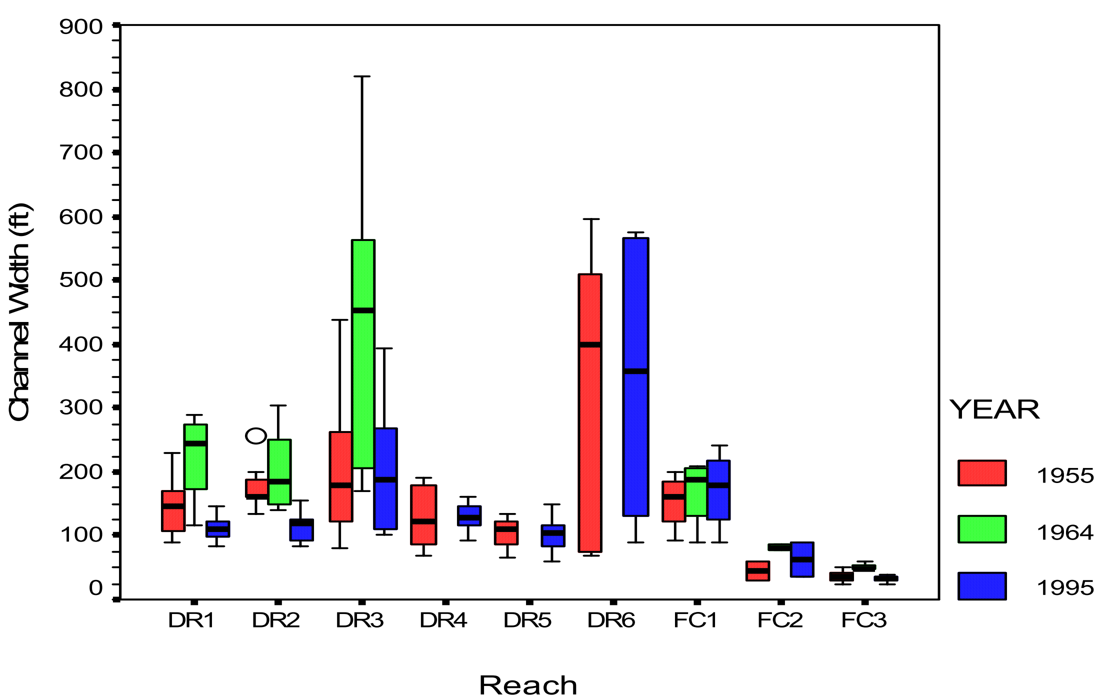
3.3 Temporal Changes in Channel Condition

A review of historic aerial photos was undertaken to evaluate changes in channel conditions over time. Aerial photo coverage for 1955, 1964, and 1995 was limited to the central portion of the study area on the mainstem of the Dearborn and portions of Flat Creek. Channel geometry including active channel width, stability, and riparian coverage were assessed and compared for those areas with coverage for the time period. The full set of coverage for the Dearborn reaches including 1955, 1964, and 1995 flights was available for reaches DR1, DR2, and DR3. The Flat Creek reaches FC1, FC2, FC3 also had coverage for these years. Dearborn Reaches DR4, DR5, and DR6 had coverage for 1955 and 1995 only, and no coverage was available for the Middle and South Forks of the Dearborn.

3.3.1 Channel Widths

Channel width was measured as the distance between the vegetative indicators that defined bank margins. In this analysis, topographic limits such as terraces, hillsides, and rock walls also helped define channel extents. Channel width approximates bankfull width in many cross sections but would exceed true bankfull measures especially for the 1964 measurements. For example, the measures of width in 1964 are larger than the geomorphic bankfull width because they include large expanses of gravel bar deposits and disturbed floodplain surfaces. Greatly increased width following the 1964 flood reflects loss of vegetation within the bankfull floodplain in addition to probable enlargement of channel cross section.

Figure 3-22. Estimated Channel Width in the Dearborn Planning Area in 1955, 1964, and 1995



In general, measurements showed that channel widths increased substantially following the 1964 flood, and that 1995 widths were comparable to pre-flood (1955) values (**Figure 3-22**).

Channel response to the 1964 flood resulted in significantly increased channel widths. In Dearborn reach DR1, channel width increased about 50%, from a 1955 value of 146 feet to 223 feet post-flood (**Table 3-7**). The Dearborn reach DR2 increased about 17% from a 1955 value of 176 feet to 205 feet post-flood, and reach DR3 nearly doubled in width to 429 feet. By 1995 these reaches had returned to pre-flood channel widths. DR1 and DR2 were narrower in 1995 compared to 1955. For reaches DR4 and DR5, 1964 data was not available. However, 1955 and 1995 measures show channel widths to be nearly identical.

Table 3-7. *Temporal Changes in Channel Width*

Reach	Channel Width (ft)		
	1955	1964	1995
DR1	146	223	111
DR2	176	206	117
DR3	206	429	203
DR4	129	NA	130
DR5	104	NA	106
DR6	342	NA	346
FC1	153	169	172
FC2	45	81	62
FC3	37	52	33

Flat Creek reaches FC2 and FC3 also showed significant increases in channel width post-1964 flood. FC1 appeared relatively unaffected with channel widths increasing only slightly in 1964.

To state the obvious, a major decrease in channel stability occurred along with channel width increases after the 1964 flood. No metrics were calculated for bank erosion to demonstrate this point. Recovery of channel widths in 1995 to dimensions near (or less than) 1955 values indicates a strong trend for channel recovery following the 1964 flood. 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 widespread in the portions of the Teton River, Birch Creek, and elsewhere in the area.

3.3.2 Temporal Changes in Canopy Coverage

A review of historic aerial photos was undertaken to evaluate changes in riparian vegetation over time. Conifer/deciduous tree, woody shrub, herbaceous, and bare ground classes were quantified. Aerial photo coverage for 1955, 1964, and 1995 was for the Dearborn, and portions of Flat Creek. The full set of coverage for the Dearborn reaches including 1955, 1964, and 1995 flights was available for reaches DR1, DR2, and DR3. The Flat Creek reaches FC2 and FC3 also had coverage for these years. Dearborn Reaches DR4, DR5, and DR6 had coverage for 1955 and 1995 only, and no coverage was available for the Middle and South Forks of the Dearborn.

Dearborn Mainstem

Changes in riparian coverage and composition were variable in the Dearborn mainstem (**Table 3-8**). The composite of conifer/deciduous trees and woody shrubs suggested that woody vegetation was unchanged in reach DR1 from 1955 to 1995. Dearborn reach DR2 decreased from 34% in 1955 to 27% in 1964, and increased to 46% in 1995. Reach DR3 also decreased from 1955 to 1964 (34% to 23%), and increased to 31% coverage in 1995. Reaches DR4 and DR5 both showed a 10-15% decrease in woody vegetation from 1955 to 1995. No data was available for 1964 in the upper reaches of the Dearborn.

Table 3-8. ***Temporal Changes in Tree/Woody Shrub Canopy Coverage***

Reach	Canopy Coverage (%)		
	1955	1964	1995
DR1	33.6	34.7	34.1
DR2	33.9	26.8	46.4
DR3	34.0	22.5	30.5
DR4	49.6	NA	38.9
DR5	69.3	NA	54.6
DR6	NA	NA	49.5
SF1	NA	NA	51.8
SF2	NA	NA	48.7
MF1	NA	NA	40.4
MF2	NA	NA	16.3
FC1	NA	NA	20.9
FC2	30.5	30.5	35.0
FC3	19.9	18.3	21.4
FC4	NA	NA	4.3

Boxplots of individual riparian vegetation components are shown in (**Figures 3-23 to 3-26**). Conifer and deciduous tree coverage in reach DR1 was similar in 1955 and 1995, and was significantly higher in 1964 (**Figure 3-23**). Reach DR2 was similar in 1955 and 1964, and increased in 1995. Reach DR3 showed little change in tree coverage from 1955 to 1995. Reach DR4 decreased from 1955 to 1995, and reach DR5 increased tree coverage over the same time period. No historic data was available for reach DR6.

Overall, woody shrub coverage tended to increase in the upstream direction, with median values of 10-20% in the lower reaches, and values of 25-50% in the upper reaches. Shrub component was generally similar in 1955 and 1995 for most reaches, with the exception of reach DR5 that showed a decrease in woody shrub coverage. Trees increased in this reach over the same time period.

Figure 3-23. Conifer/Deciduous Coverage in the Dearborn Mainstem in 1955, 1964, and 1995

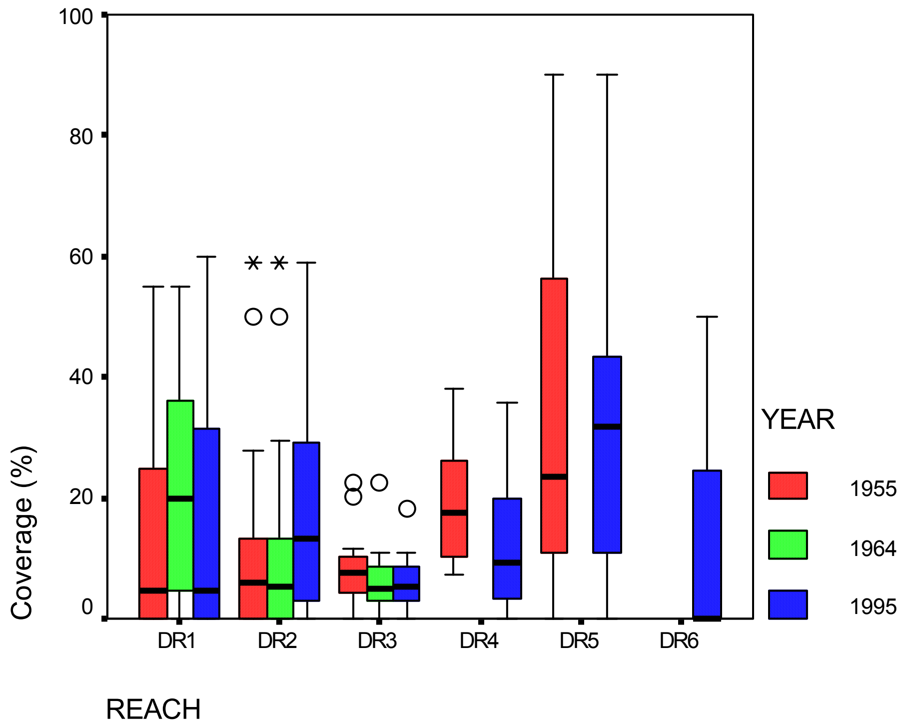
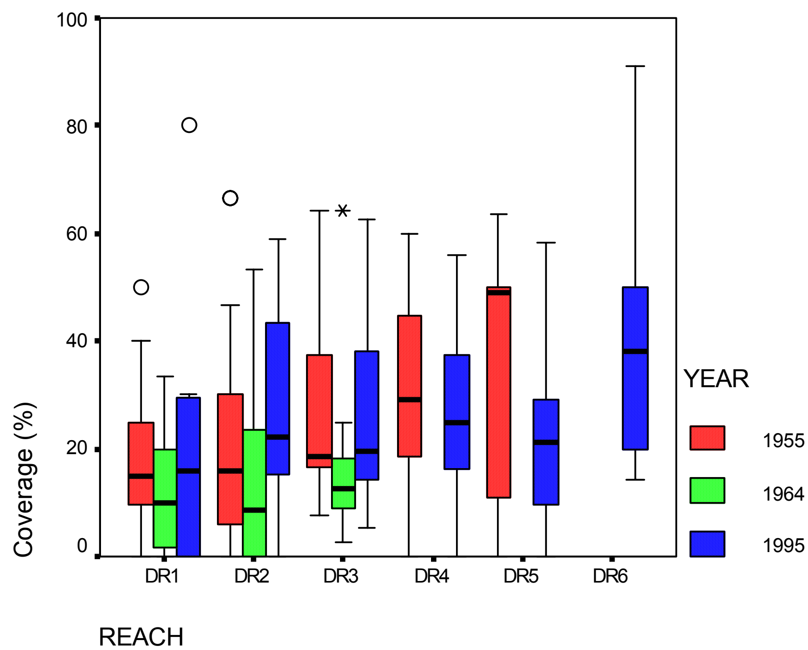
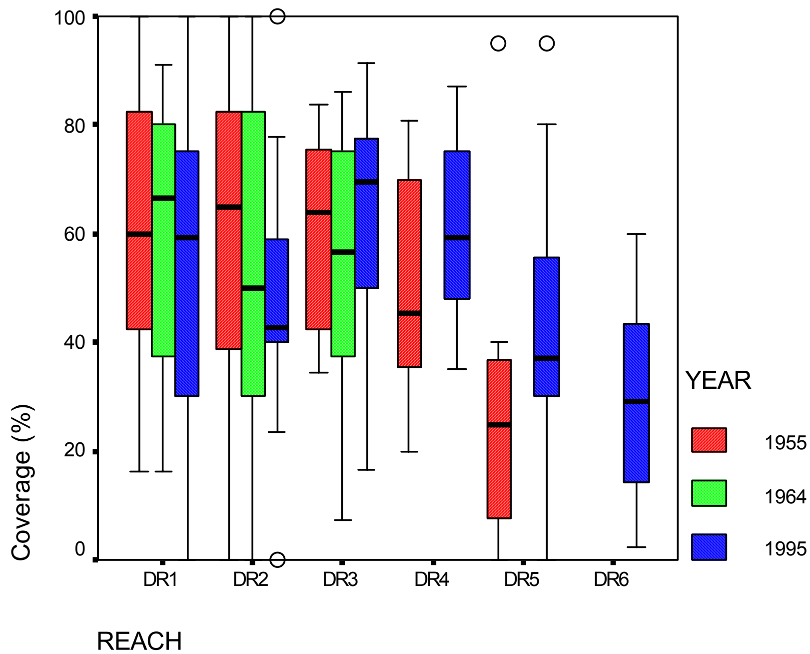


Figure 3-24. Woody Shrub Coverage in the Dearborn Mainstem in 1955, 1964, and 1995



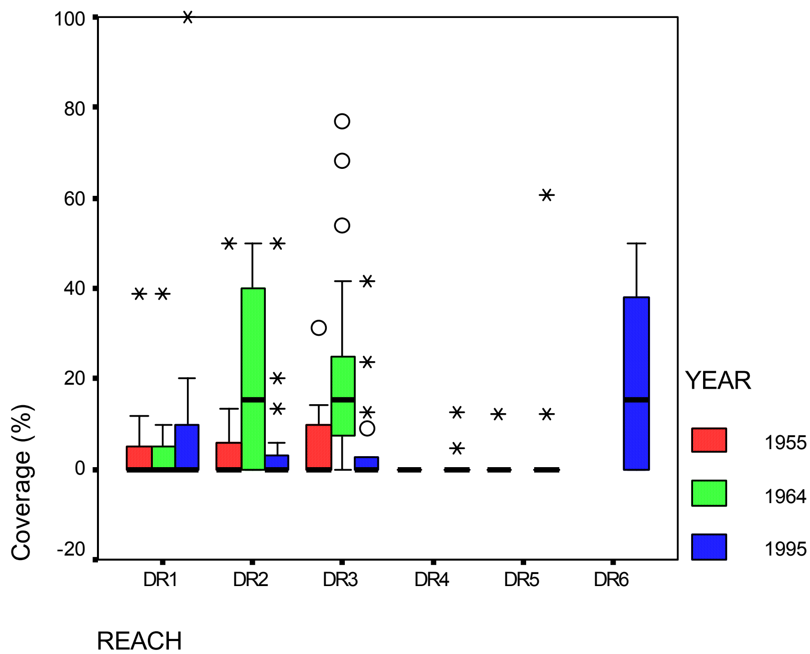
Overall, herbaceous coverage tended to increase in the downstream direction with median values of 60-70% in the lower reaches, and values of 20-40% in the upper reaches (**Figure 3-25**). Herbaceous coverage in reach DR1 was similar in 1955 and 1995, and showed a small increase in 1964. Reach DR2 herbaceous coverage decreased from 1955 to 1995, and showed corresponding increases in trees and shrubs. Reach DR3 showed a drop in herbaceous coverage in 1964, and was slightly higher in 1995 than 1955. Reaches DR4 and DR5 showed significant increases in herbaceous coverage from 1955 and 1995. Decreases in shrub coverage were also noted during this period. No 1955 or 1964 data was available for reach DR6.

Figure 3-25. Herbaceous Coverage in the Dearborn Mainstem in 1955, 1964, and 1995



Overall, bare ground was a minor component in riparian areas, generally less than 10% (**Figure 3-26)**. Significant increases in disturbed, bare ground was observed following the 1964 flood in DR2 and DR3. This increase in disturbed ground returned to pre-flood levels in 1995.

Figure 3-26. Bare Ground in the Dearborn Mainstem in 1955, 1964, and 1995

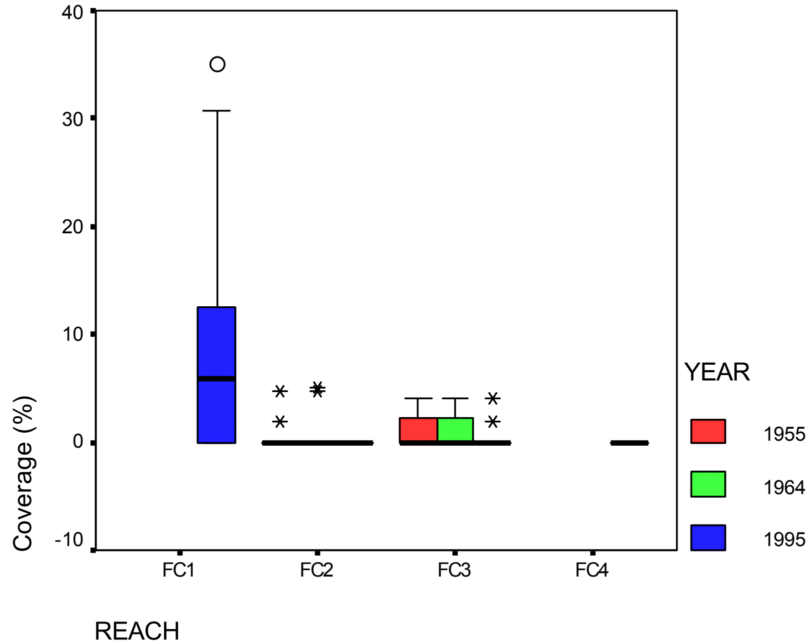


In summary, the lower three reaches of the Dearborn (DR1, DR2, and DR3) generally showed similar or greater tree and woody shrub coverage in 1995 as compared to 1955. With the exception of reach DR1, tree coverage as a proportion of total riparian vegetation did not change significantly as a result of the 1964 flood. Woody shrub coverage did tend to decrease in these reaches in 1964, but returned to pre-flood (1955) levels by 1995.

Flat Creek

Aerial coverage was available for 1955, 1964, and 1995 for Flat Creek reaches FC2 and FC3. Tree coverage in Flat Creek was generally minimal with the exception of FC1 (9%). No significant changes in tree coverage were apparent for Flat Creek reaches FC2 and FC3 from 1955 to 1995.

Figure 3-27. Conifer/Deciduous Coverage in Flat Creek in 1955, 1964, and 1995



The proportion of woody shrub coverage tended to increase in Flat Creek reach FC2 and FC3 from 1955 to 1995. The increase amounted to 5 to 10% greater woody coverage in 1995 relative to 1955 (**Figure 3-28**). Herbaceous coverage also tended to decrease over the same time period reaches FC2 and FC3 (**Figure 3-29)**. No historical coverage was available for reaches FC1 and FC4.

Figure 3-28. Woody Shrub Coverage in Flat Creek in 1955, 1964, and 1995

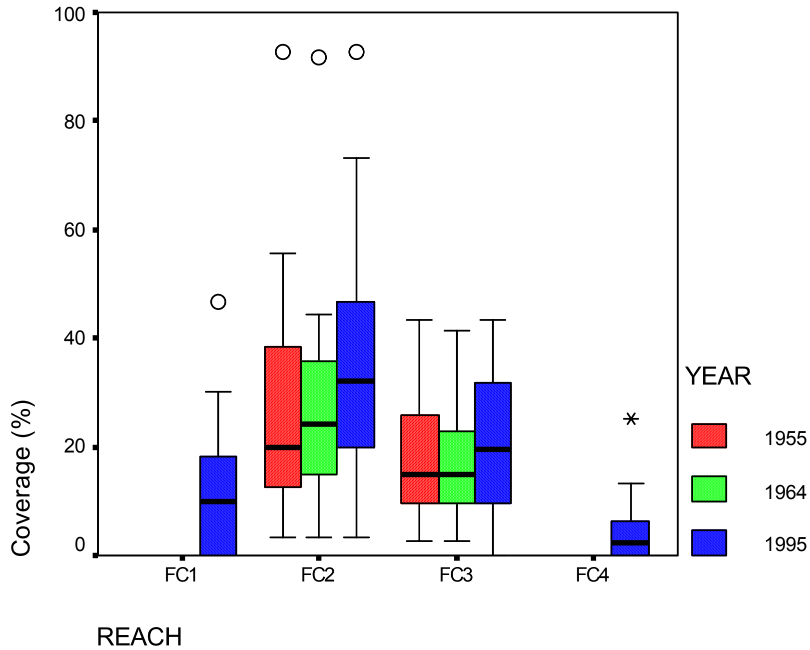
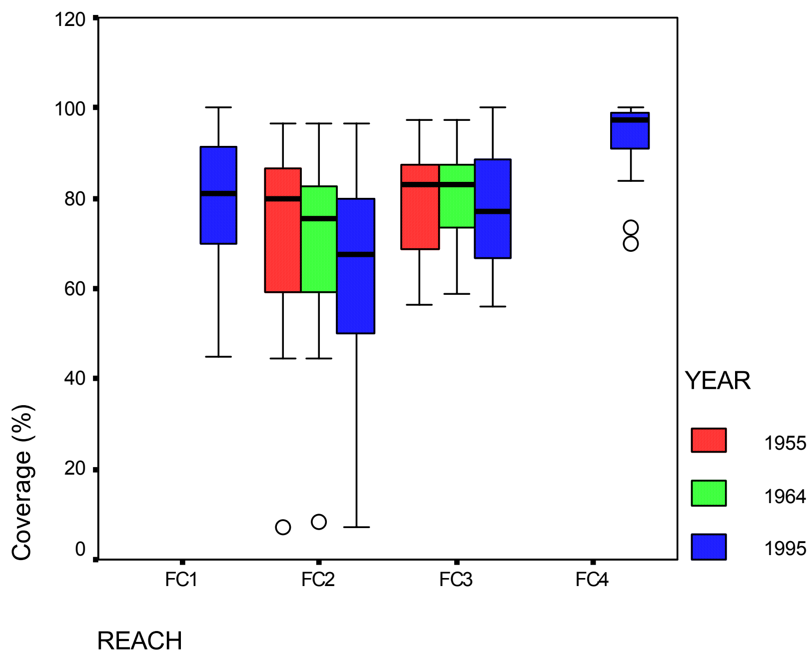
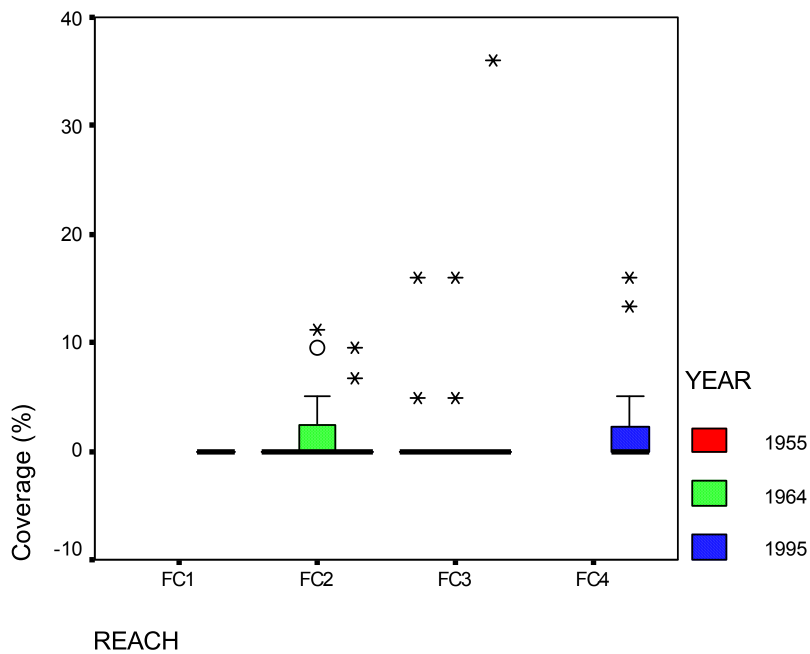


Figure 3-29. Herbaceous Coverage in Flat Creek in 1955, 1964, and 1995



Bare ground was infrequent in Flat Creek and amounted to less than 1% overall. A slight increase in bare ground was observed in 1964 in reach FC2, but was otherwise unchanged from 1955 to 1995.

Figure 3-30. Bare Ground in Flat Creek in 1955, 1964, and 1995



In summary, the central reaches of Flat Creek appeared to show an increase in woody shrub coverage and a decrease in herbaceous coverage from 1955-1995.

3.4 Sediment Source Areas

Potential sediment source areas were inventoried based on 1995 digital orthophotos and the results of 2003 aerial reconnaissance. Sediment sources inventoried included bank erosion, mass failure of terraces/slopes, headcutting from tributary drainages, incised reaches, and delivery from upland sources.

On the mainstem Dearborn and portions of Flat Creek an additional review of historic aerial photos was undertaken to evaluate changes in sediment sources over time and to help interpret trends. Aerial photo coverage for 1955, 1964, and 1995 was limited to these areas and was not conducted on other waterbodies in the project area.

3.4.1 In-Channel Sources

Overall, sediment sources in the Dearborn planning area were predominately derived from in-channel scour and fill processes. The bank stability (**Section 3.2.1**) assessment showed that significant sediment sources exist in portions of most stream segments. Eroding banks were classified as either "natural" or "anthropogenic" based on professional judgment considering factors such as adjoining land use, apparent channel modifications, vegetation alterations, and visual comparison to potential channel characteristics of up and downstream reaches. Length of eroding banks was quantified for the lower Middle Fork reach MF1 and Flat Creek (all reaches).

Dearborn Mainstem

Very little evidence of channel or riparian modification was apparent on the mainstem of the Dearborn based on aerial assessment. Much of the channel is located in deeply incised terrain with a confined floodplain. No cultivated farmland is present within the floodplain of the Dearborn mainstem except in reach DR3. Potential human impacts in most of the Dearborn would be largely limited to riparian vegetation alterations associated with grazing pressure and bank trampling. Review of aerial photographs and 2003 aerial reconnaissance did not indicate that any obvious grazing or land use conversion had impacted riparian or bank conditions in the Dearborn mainstem overall. Pre-1955 conditions are unknown, and the possibility exists that more intensive historical grazing (e.g. intensive sheep and cattle grazing) could have altered riparian communities to some extent. This issue cannot be addressed directly in this study.

Examination of historic photos as well as upstream-downstream comparisons did not show any strong localized riparian modification, associated bank instability, or grazing-related sediment sources with the exception of reach DR3. Conversion of riparian areas to hay/pasture may play a role in bank stability within portions of the upper 2.5 miles in this reach. Reach DR3 was an unconfined C4 channel which would be expected to have significant natural erosion and depositional processes. Sediment in the Dearborn mainstem appears to be derived almost entirely from natural alluvial channel processes.

Middle Fork

The Middle Fork of the Dearborn showed little influence of anthropogenic, in-channel sediment sources in the headwaters (MF2). This section of the channel is situated in deeply dissected, forested terrain and no significant channel or riparian modifications were present. Logging activity and road systems in the headwaters did not appear to contribute elevated quantities of sediment. Highway 200 has the potential to contribute 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. Long delivery distance from the road to the channel is likely to limit sediment contribution in most locations. A possible pathway for road runoff was investigated on the ground but did not appear to be a source of significant sediment delivery to the channel. Spring snowmelt does have the potential to deliver road sand to the Middle Fork, but a comprehensive field investigation was beyond the scope of this study. Evaluating this potential source of sediment would require additional field work to determine if concentrated flow pathways are present.

The lower reach of the Middle Fork (MF1) showed evidence of channel instability related to land use/riparian modification for agriculture. In-channel sediment sources were present due to human-induced channel instability in some areas. An estimate of eroding bank lengths was made from the 1995 digital orthoquads and interpretation of the 2003 aerial video flight (**Table 3-9**). Bank erosion was classified into “high”, “moderate”, and “low” categories. These rankings are intended to correspond to probable Rosgen Bank Erosion Hazard Index (BEHI) values. Banks in the high and moderate categories were evaluated to determine if anthropogenic factors were a contributing factor to bank instability. Human land use impacts were assumed if riparian conversion to agriculture or grazing effects on streambanks appeared to be a significant factor in bank stability. An evaluation of bank stability in adjoining upstream and downstream reaches assisted in this interpretation.

Table 3-9 ***Bank Erosion, Middle Fork Reach MF1***

Category	Length (ft)	%	% Anthropogenic related
High	3486	10.6	45%
Moderate	11609	35.3	40%
Low	17791	54.1	NA
Total	32886	100.0	NA

Approximately 45% of eroding banks (1,569 feet) in the high category were associated with human related impacts. In several areas, eroding terraces were natural or not primarily related to human impacts. For example, a natural stream position along the valley margin can result in an eroding terrace feature that is mostly unrelated to adjoining land use.

Eroding banks in the moderate category associated with land use impacts totaled 4640 feet, accounting for 40% of eroding banks in this category. The remaining 60% of banks in the moderate category were not directly associated with land use impacts and represented natural, relatively unimpaired bank conditions for this channel type (Rosgen C4). The entire reach of the lower Middle Fork (MF1) has experienced some level of grazing pressure and conversion of riparian vegetation to agricultural uses. Drawing a clear distinction between human-impacted and natural banks from an aerial assessment was difficult. Additional challenges include the diffuse nature of possible grazing impacts and the potential for "response" reaches to reflect upstream impairment (e.g. increased sediment load) rather than immediate land use impacts. The value of 40% (4640) feet of streambank in the moderate category is intended to represent a conservative estimate of stream length directly impacted by land use activities.

South Fork

The headwaters of the South Fork (SF2) were steep, forested terrain and did not show evidence of anthropogenic sediment sources or accelerated bank erosion. The lower reach of SF2 had a 5900 foot segment of riparian area that was cleared/logged and some increases in sediment yield may be possible. Channel stability appeared to be impacted to some extent and additional investigation on the ground may be warranted.

The lower reach (SF1) of the South Fork had several miles where the riparian corridor had been converted to agricultural purposes (pasture and grazing). Some impacts to bank stability and channel shading were apparent but were generally of a diffuse nature. A BEHI assessment was not completed and additional field assessment may be required to evaluate these areas as potential sediment sources.

Flat Creek

Flat Creek has significant anthropogenic sources of sediment related to the altered flow regime and related channel adjustments. Diverted irrigation water greatly exceeds pre-development flow rates and results in an enlarged channel cross section and actively eroding banks. Grazing and conversion of riparian areas to pasture and cropland have also contributed to sediment impairments.

Flat Creek serves as an irrigation conveyance with flows exceeding 70 cfs diverted into the channel from the Dearborn mainstem. Prior to diversion of water the channel was likely a stable, meandering E type channel (transitioning to C) with a riparian zone composed predominately of willow-woody shrub species, and possibly lesser amounts of Cottonwood in the lower reaches. Sediment yield from eroding streambanks would have been relatively low compared to current conditions. Auchard Creek, a small tributary to the Dearborn (and parallel to Flat Creek), shows good channel stability and few actively eroding banks.

Present day channel morphology and channel adjustments have significantly increased sediment yield from Flat Creek. No pre-modification or reference data were available; however, it is likely that the majority of increased sediment yield from eroding banks on Flat Creek can be attributed to land use impacts. Loss of beaver from the system may also contribute to channel alterations including downcutting and bank erosion.

An estimate of eroding bank lengths was made from the 1995 digital orthoquads and interpretation of the 2003 aerial video flight (**Table 3-10**). Bank erosion was classified into "high", "moderate", and "low" categories. These rankings are intended to correspond to probable Rosgen Bank Erosion Hazard Index (BEHI) values.

Table 3-10 ***Bank Erosion, Flat Creek***

Reach/Category	Total Length (ft)	%	% Anthropogenic related
FC1			
High	4593	11.2	80%
Moderate	7259	17.7	60%
Low	29,158	71.1	
Total	41,010	100.0	
FC2			
High	3066	13.1	90%
Moderate	8635	36.9	90%
Low	11,701	50.0	
Total	23,401	100.0	
FC3			
High	3215	14.0	90%
Moderate	7074	30.8	90%
Low	12,678	55.2	
Total	22,967	100.0	
FC4			
High	7802	8.4	90%
Moderate	30,929	33.3	90%
Low	54,149	58.3	
Total	92,880	100.0	
Grand Total	32886	100.0	

In reach FC1, approximately 80% of eroding banks in the high category were associated with land use impacts totaling 3674 feet. Natural eroding terraces and hillsides not primarily related to land use accounted for 20% of eroding banks in the "high" category. Eroding banks in the moderate category associated with land use impacts totaled 4355 feet, accounting for 60% of eroding banks in this category. Approximately 40% of banks in the moderate category were not directly attributable to land use impacts and represented natural variability for this channel type (Rosgen C4).

Reaches FC2, FC3, and FC4 showed similar distributions of eroding banks in each category. Banks in the high category ranged from 8.4 to 14% of total reach length and 90% of these banks were related to human impacts. Total length of impacted banks in the high category was 2759, 2894, and 7022 feet in reaches FC2, FC3, and FC4, respectively.

Banks in the moderate category ranged from 31% to 37% of total reach length. Like banks in the “high” category, 90% of the banks in the moderate category were associated with agricultural impacts and alterations related to increased flow in Flat Creek. Total length of impacted banks in the moderate category was 7771, 6366, and 27,836 feet in reaches FC2, FC3, and FC4, respectively.

Although values of 80-90% human impacted banks may appear to be an extreme number, it should be noted that extensive riparian conversion to pasture and cropland as well as grazing impacts were widespread in Flat Creek. Sustained summer irrigation flow greatly exceeds the natural hydrograph of Flat Creek. This increased flow from irrigation diversion appeared to be a significant factor in bank stability. As a result of these considerations nearly all bank erosion in the “high” and “moderate” categories was attributed to human impacts.

3.4.2 Mass Failure

Mass failure was an uncommon source for sediment within the Dearborn and tributaries. A single location on the Dearborn mainstem showed evidence of active mass failure in Reach DR6, and was related to natural processes. Shallow-seated slumps were located on unconsolidated parent material, and contributed sediment directly to the Dearborn mainstem in this location (**Figure 3-31**). Limited areas of dry ravel/rilling were present but infrequent on steep slopes adjacent to the active channel in Reach DR4 (**Figure 3-32**). These natural sources of sediment would be expected to contribute fines to the channel during extreme rainfall events and also during peak flow events that erode the toe of the slope.

Figure 3-31. Slumps in Dearborn Mainstem Reach 6

Figure 3-32. Dry Ravel/Rilling in the Dearborn Mainstem Reach 4

No anthropogenic related sources of mass failure or delivery of sediment to the Dearborn mainstem were observed. No mass failure was observed in the Middle or South forks of the Dearborn.

A significant major source of mass failure was sloughing of high banks along Flat Creek. This was considered under the bank erosion category of sediment sources since it is primarily related to fluvial action and bank stability.

3.4.3 Headcutting/Incised Reaches

Active headcutting and sediment delivery to listed reaches was not characteristic of small channels draining upland areas. No active gully formation was observed in either ephemeral or perennial tributaries. Vertical stability in tributaries was good, and headcut formation in rangeland did not appear to be a significant source of sediment in the Dearborn Planning Area.

A series of three gullies were observed along reach DR5 in the Dearborn mainstem (**Figure 3-33**). These gullies appeared stable and may be a remnant of heavy precipitation/surface runoff in the spring of 1964 or other intense rainfall events.

The majority of smaller drainages and tributaries to the Dearborn mainstem appeared to be vertically stable, and were not a significant source of sediment to the Dearborn (**Figure 3-34**). The Middle and South forks of the Dearborn did not show any significant sources of sediment from influent tributaries.

Incised channel conditions were observed in portions of Flat Creek and were most probably related to the increased flow regime of diverted irrigation water. Loss of beaver from Flat Creek may also contribute to apparent localized changes in base level.

Figure 3-33. Gullies in the Dearborn Mainstem Reach 5

Figure 3-34. Typical Smaller Contributing Drainages to the Dearborn Mainstem

3.4.4 Upland Sources

Upland sources did not appear to contribute appreciable quantities of sediment to the Dearborn mainstem 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 and unroaded in the mainstem and South Fork of the Dearborn. The Middle Fork of the Dearborn had minor impacts from Highway 200 in the upper headwaters (in the ephemeral portion). Sediment contribution from cut/fill slopes and road sand from Highway 200 appeared to be minimal due to the long delivery distance to the channel.

Hogan Creek (Tributary to Flat Creek, above the listed reach) showed pronounced turbidity during the 2003 aerial survey (**Figure 3-35**). Sediment sources appeared to originate from channel incisement, exposed soils and relatively poor vegetation coverage in this drainage. Soils appeared to be fine-textured and relatively arid. No obvious anthropogenic influence appeared to account for turbid water originating from Hogan Creek, although grazing may contribute to sparse vegetation coverage. Several small impoundments (presumably for stockwater) on Hogan Creek likely limit the potential delivery of sand/silt fractions to Flat Creek (**Figure 3-36**). In addition, the relative loading of sediment from Hogan Creek is likely to be low due to the low elevation and runoff volume.

Upland sources of sediment in Hogan Creek warrant additional field investigation to establish whether they are a significant contributor to impairment in Flat Creek.

Figure 3-35. Hogan Creek, Tributary to Flat Creek Reach 4.

Figure 3-36. Upper Hogan Creek, Tributary to Flat Creek Reach 4.

3.5 Cultural Features

An inventory of cultural, anthropogenic channel modifications was undertaken using 1995 aerial photos and aerial reconnaissance in 2003 (**Table 3-11**). Overall, the main cultural feature was stream crossings including bridges and fords. Stream crossings did not appear to have any significant up or downstream impacts on channel function other than minor localized effects. Very little bank stabilization/rip-rap or channelization was apparent in the reaches studied and did not account for any significant impacts to channel morphology.

No impoundments were observed in the primary reaches studied, although a number of small stockwater impoundments were present in smaller tributary streams to Flat Creek (e.g. Hogan Creek). These impoundments are unlikely to contribute significantly to either thermal or sediment impairments to Flat Creek and may help sustain summer baseflows in some cases. Small impoundments in Hogan Creek may reduce sediment loading to Flat Creek though this influence is likely to be minimal based on contributing area and water yield for the drainage.

Diversion structures were present in the Dearborn mainstem (Dearborn Canal), South Fork (Gibson Renning Ditch), Middle Fork (4 diversions), and Flat Creek (multiple locations). An assessment of diversion rates/capacity was beyond the scope of this study, and additional field investigation may be warranted to determine the influence of these diversions on flow and thermal impairments.

No major anthropogenic point sources for sediment or temperature impairment were noted. The Milford Colony has several lagoons/holding ponds located along the riparian corridor of Flat Creek (**Figures 3-37, 3-38**). Water quality in these lagoons is unknown and potential impacts to Flat Creek could not be determined in this study. The possible influence of these features on water quality may warrant additional investigation, although the potential to affect sediment or thermal impairments is likely to be minimal.

Figure 3-37. Milford Colony

Figure 3-38. Milford Colony

Table 3-11 ***Cultural Features – Dearborn River***

Reach	Rip-rap/other stabilization	Channelization	Impoundments	Instream Structures/ Diversions	Stream Crossings	Potential Water Quality Point Sources	Other (gravel pits, construction)
DR1	NA	NA	NA	NA	Train Bridge at Mouth Ford near pt. 3 Ford above pt. 5 Ford near pt. 11	NA	NA
DR2	NA	NA	NA	NA	NA	NA	NA
DR3	Minor rip-rap near bridge	NA	NA	Ditch near SF Mouth	Hwy 285 Bridge Small bridge nr pt. 2	NA	NA
DR4	NA	NA	NA	NA	Hwy 200 Bridge	NA	NA
DR5	NA	NA	NA		Bridge near pt. 16	NA	
DR6	250 ft at pt 13	NA	NA	Bean Ditch near pt 12 Dearborn Canal bl pt. 14	Bridge near pt. 8 Siphon out below pt. 6	NA	NA
SF1	NA	NA	NA	NA	Ford near mouth Bridge bl pt. 11 2 Bridges abv pt. 14 Bridge abv pt. 19	NA	NA
SF2	NA	NA	NA	Gibson-Renning ditch diversion nr pt 3	2 bridges nr pt 3 Bridge or ford blw pt 5? Bridge or ford abv SF-9 Bridge or ford between SF-10 and 11 Bridge or ford blw SF-10 Bridge nr SF-13	NA	NA
MF1	NA	NA	NA	2 Gillette ditch Borho Ditch diversion	Bridge nr pt 10 Bridge nr pt 17	NA	NA
MF2	Riprap by Hwy 200 blw MF-12 - 500ft	NA	NA	Nitch ditch Dueringer ditch	Hwy 200 bridge Bridge abv MF-10 Ford? Blw MF-14	NA	NA
FC1	NA	NA	NA	NA	NA	NA	NA
FC2	NA	NA	NA	NA	Ford nr pt. 15 Bridge-end of reach	NA	
FC3	Minor	NA	NA	Garino ditch Diversion Diversion a Hamilton ditch diversion between 11 and 12	Bridge and ford between pt 7 and 8 Ford between pt 21 and 22 Ford between pt 19 and 20	NA	NA
FC4	Minor	NA	Hogan Cr.	NA	NA	Milford Colony	NA

4.0 SUMMARY AND CONCLUSIONS

This study is based on an aerial reconnaissance conducted in October 2003 and the interpretation of historic aerial photographs from 1995, 1964, and 1995. Channel morphology, riparian condition, and source areas were evaluated to assess potential sources of impairment in the Dearborn planning area.

4.1 Potential Impairments

Dearborn Mainstem
The study indicated that anthropogenic influences have not substantially degraded the condition of riparian vegetation or channel function on most reaches of the Dearborn mainstem. No significant human impacts related to land use, conversion of riparian areas to pasture/cropland, or grazing were apparent except in reach DR3. Conversion of riparian areas to hay/pasture may play a role in bank stability within portions of the upper 2.5 miles in this reach. Most reaches of the mainstem had a small, confined floodplain that was relatively inaccessible and not well suited for agriculture. This probably explains the lack of human impacts to the channel and riparian community.

The 1964 flood had significant influence on channel stability and riparian vegetation in the Dearborn mainstem. Gravel bars, eroding banks and loss of riparian vegetation were apparent throughout much of the Dearborn in the post-flood aerial photos. Increased channel width and reduced riparian coverage were especially prevalent in alluvial reach DR3. Geologic structural constraints appeared to limit impacts from extreme flooding in other reaches. Riparian and channel conditions were generally comparable in 1955 and 1995, suggesting that the channel recovered from flood effects in the subsequent 41 years.

The deciduous cottonwood overstory in the Dearborn mainstem appeared to be in a seral state with multiple age classes of trees represented in many locations. This appeared to be related to natural fluvial processes rather than agricultural land use impacts with the exception of reach DR3. Shade provided by riparian vegetation did not appear to be substantial even in mature deciduous or coniferous riparian communities adjacent to the channel.

Sediment source areas were limited to natural processes including morphologically active channel segments, natural terraces and slopes, and natural bank erosion. Overall, land use and human impacts did not account for any significant increase in sediment sources or impairment. Reach DR3 had several locations with eroding banks that may be attributable to loss of riparian woody vegetation and impacts from agricultural uses.

Comparison of historic photos did not indicate any significant trend in human-related impacts to channel stability or riparian vegetation on the mainstem. Except for reach DR3, upstream and downstream comparisons also did not show any reach-specific impacts from human activities. In summary, the mainstem of the Dearborn appeared to be near full potential for riparian vegetation and channel/streambank stability given natural factors.

South Fork of the Dearborn

The South Fork of the Dearborn showed evidence of human impacts on riparian vegetation in both reaches studied. The upper reach SF2 was in good overall condition with a mature overstory of dominantly coniferous vegetation. A single 5910 foot segment of channel showed loss of riparian vegetation due to logging/riparian clearing that occurred after 1995. This resulted in loss of shade to the channel, but streambank stability appeared to be good overall.

The lower reach SF1 showed widespread impacts to riparian vegetation from agricultural activities. Approximately 50% of the total length ranked “poor” in terms of riparian condition. Eroding banks were associated with loss of riparian vegetation in several locations. Impairment to channel function did not appear to be severe in many instances, however.

Middle Fork of the Dearborn

The Middle Fork of the Dearborn is a steep, forested channel in the headwaters portion (reach MF2). Highway 200 and limited residential development are present along the riparian corridor. The Middle Fork showed minimal impacts to riparian vegetation and bank stability from human impacts in the upper reach MF2. No delivery of sediment from Highway 200 was apparent based on aerial reconnaissance and limited ground observation.

The lower reach of the Middle Fork (MF1) showed significant impacts to the riparian vegetation community. Approximately 65% of the riparian vegetation was ranked “poor” due to conversion of riparian vegetation to agricultural uses including grazing, pasture, and hay meadows. Bank stability and overall channel condition were sub-optimal; approximately 40-45% of the eroding banks were associated with human impacts.

Flat Creek

Flat Creek is a substantially altered system due to the diversion of irrigation water from the Dearborn mainstem. Sustained irrigation diversion and increased baseflow have resulted in impacts including enlarged channel cross section and probable channel downcutting. Flat Creek has adjusted to this altered flow regime to a large extent however eroding banks continue to contribute elevated sediment to the Dearborn mainstem. Grazing and conversion of riparian vegetation to pasture and agricultural use has significantly reduced woody species relative to site potential and contributed to sediment impairments. Almost no shade is provided by riparian overstory in most of Flat Creek except for the lower reach FC1.

Most of the increased sediment from eroding banks can be attributed to human impacts in Flat Creek. An estimated 80-90% of eroding banks in the “high” category were related to agricultural practices including increased flow, grazing, hay production, and cropping. Although woody species coverage increased from 1955-1995, riparian vegetation appeared to be sub-optimal relative to site potential.

4.2 Restoration Focus Areas

Dearborn Mainstem

The Dearborn mainstem had reaches with high channel instability (e.g. reach DR6), but these areas were related to natural channel process and do not appear to reflect existing or historical anthropogenic impacts. Evidence for this includes 1) the lack of human-related activity, 2) the lack of significant channel alterations, and 3) inherent instability related to geology and fluvial process. Therefore, no active restoration of riparian vegetation or channel planform/geometry is recommended for reaches of the Dearborn mainstem with the possible exception of reach DR3.

Reach DR3 was an unconfined Rosgen C4 type channel with channel instability in the upstream area. Conversion of riparian vegetation to hay/pasture has likely accelerated bank erosion in several areas. Recommended restoration activities include stabilization and revegetation of eroding banks with bioengineered geotextile treatments. Fencing and/or establishment of woody riparian buffer would help improve long-term stability.

Middle Fork of the Dearborn

No mitigation or restoration activities are recommended for the headwaters reach MF2 of the Middle Fork due to the relative lack of human impacts. Additional field investigation may be warranted to verify that no significant impacts from road sand occur on the Middle Fork.

Numerous areas of the lower reach of the Middle Fork have experienced some riparian impacts and channel instability mainly related to agricultural practices. Conversion of riparian corridors to pasture/agricultural uses has resulted in reduced riparian coverage. Approximately 4500 feet of channel showed a relatively high level of impacts to channel stability, and an additional 6600 feet had moderate impacts. Suggested restoration activities in the Middle Fork include improving woody riparian coverage and restoration of over-widened channel cross sections to reference conditions along impacted segments. Bank restoration can be accomplished with soft bioengineering methods (i.e. geotextile coir fabric wraps) and woody shrub/tree revegetation. Fencing or grazing rest-rotation in riparian areas would be beneficial to promote increased coverage of woody species. Offstream water sources may need to be developed.

South Fork of the Dearborn

The upper reach of the South Fork of the Dearborn is a steep, forested headwaters channel with minimal anthropogenic impacts. The headwaters are relatively undisturbed conifer forest in good condition and do not require any restoration or further assessment. The lower end of the upper reach (SF2) appears to have experienced some impacts from both logging/land clearing operations in the riparian area. Natural recovery from logging impacts would be expected to result in improving conditions in this reach. Some agricultural impacts (pasture/grazing/cropping) are present in reach SF2. Additional field assessment is recommended to determine if riparian clearing and agricultural impacts to the channel represent a significant impairment.

The lower reach SF1 experienced impacts from grazing and removal of riparian vegetation. Channel and riparian conditions were generally better than the lower reach of the Middle Fork. Additional field assessment in reach SF1 would be beneficial to establish whether any active restoration is required. Suggested restoration activities in the South Fork include improving land use practices and possibly riparian fencing to promote riparian vegetation recovery.

Flat Creek

Riparian vegetation appears to have been significantly degraded due to livestock grazing (see discussion of FC2, FC3 and FC4 above), and to a lesser extent, 1964 flood effects. There are extensive portions of Flat Creek that are most likely impaired due to reduced channel shading and poor habitat as a result of degraded riparian vegetation.

The flow regime in Flat Creek is largely artificial. Restoration to pristine conditions is therefore 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. Suggested restoration activities include promoting recovery or enhancing riparian vegetation, and reducing sediment impacts through restoration of eroding banks. Restoration activities in Flat Creek to address thermal impairment should seek to increase shading through enhancement of woody riparian components. Establishment of mature tree stands could be expected to provide significant shading to the channel, although it should be recognized that extensive Cottonwood riparian communities would not be expected to be typical of this edaphic setting. Willow shrub communities would be more typical, though shading provided by willow would be modest. Strategies to reduce sediment yield would include sloping and revegetation of unstable terraces/banks with geotextile/revegetation treatments.

APPENDIX E: RESPONSE TO PUBLIC COMMENTS

Response to Comments

As described in Section 6.0, the formal public comment period extended from November 19, 2004 to December 20, 2004 for the draft "Water Quality Assessment and TMDLs for the Dearborn River Planning Area". Four individuals submitted formal written comments and one individual met with EPA in person to present comments verbally. Their comments have been summarized/paraphrased and organized by topic below. The original comment letters are located in the project files at DEQ and may be reviewed upon request.

Responses prepared by EPA and DEQ follow. Where specific modifications to the document have been made in response to comments, they are noted in the responses. Notable modifications between the draft and final versions of this document include:

- The introduction (i.e., Section 1.0) has been modified to include a description of the technical approach used in the Dearborn TPA.
- Section 6.0 (entitled "Proposed Monitoring Strategy for the Dearborn River" in the draft document) has been revised and is now entitled "Proposed Future Studies and Adaptive Management Strategy". The revised section presents proposed future studies to address identified data gaps and/or uncertainties. A conceptual adaptive management strategy is also included in this section.
- A "Public Involvement" section (i.e., Section 7.0) has been added to the final document.
- A supplemental evaluation of the macroinvertebrate data collected in the mainstem Dearborn River, focusing on use of a Fine Sediment Index (Relyea, 2005), was conducted and is now included in Section 3.8.1. The results of this supplemental analysis are similar to the results from the previous analysis and, in general do not suggest fine sediment impairments in the mainstem Dearborn River.
- The analysis of temperature conditions in the Dearborn River was updated to include continuous (every 15-minute) data available for the period 1995 to 2004. These data did not add significantly to the temperature analysis that was reported in the draft document because they do not provide additional insight as to natural temperatures in the Dearborn River.

A. Temperature and Flow Issues

A1. **Comment:** The analysis regarding temperature pollution in the Dearborn River was inadequate and needs to be reevaluated.

Response: First, as stated in the draft document, we agree that the temperature analysis is inadequate and that further study is necessary. The question that needs to be answered is this: Is Montana's temperature standard violated in the Dearborn River? 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, 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. If the naturally occurring temperature is greater than 67º F, the maximum allowable increase is 0.5º F (ARM 17.30.623(e)). <u>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.</u> So, it is not possible to directly apply Montana's temperature standard to the Dearborn River without knowing what the "naturally occurring" temperature regime is in the Dearborn River. Since temperature data were not collected in the Dearborn River before it was impacted by human's actions, it will never be possible to know definitively what the "naturally occurring" temperature regime is for the Dearborn River.

We began the process by compiling all available temperature and flow data for the Dearborn River and tributaries and we also installed three continuous temperature recorders in the Dearborn River. We then sought similar data from streams that may be considered suitable reference streams for the Dearborn River (i.e., minimally impacted streams with similar hydrologic/geomorphic characteristics in similar settings). Streams that meet these characteristics would generally need to be along the Front Range and may include the Sun River, Teton River, Dupuyer Creek, Cut Bank Creek, Little Prickly Pear Creek and possibly others. Unfortunately, we were unable to locate a suitable reference stream that was not already significantly impacted by human activity and/or with sufficient data for comparison purposes. That left us with the modeling option that is articulated in Section 3.8.1.

We are well aware of the fact that there is a great deal of uncertainty associated with this approach. The results suggested a 1.2 °F increase in temperature associated with irrigation withdrawals. The model error was plus or minus 2.1 degrees. These results do not allow us to confidently answer the question: Is Montana's temperature standard violated in the Dearborn River? Therefore, we not only agree with the comment that *the analysis regarding temperature pollution in the Dearborn River was inadequate and needs to be reevaluated*, but we proposed additional study in Section 6.0 of the document to develop a better understanding of the potential temperature issues. Note that Section 6.0 of the document has been modified in response to public comment and DEQ/EPA have committed to a supplemental temperature study.

A2. **Comment:** This analysis did not consider all of the available temperature data. For example, FWP has spring through fall temperature data (recorded every half hour) from 1997 through 2004 near the Hwy 287 Bridge and the USGS collected data every 15 minutes through the period of record, and hourly readings (or better) are available through the USGS data archives (Steve Lynn, USGS, personal communications, 12/17/04). These data should be analyzed and reconsidered in regard to the TMDL for temperature.

Response: We were not aware of these additional temperature data. The FWP data were not mentioned during our conversation with Mr. Travis Horton (FWP) on June 24, 2004. In response to this comment, we contacted Mr. Horton and obtained the FWP temperature data. Temperature data were requested from USGS on April 7, 2004 and the only 15-minute data that were provided were for the period October 1, 2001 to June 16, 2003. These 15-minute temperature data are presented in Figure 3-10 of the public review draft report and were used during the analysis. In response to this comment, we contacted Steve Lynn on January 7, 2005 and obtained all of the available temperature data (which cover the period October 1, 1995 to September 30, 2004). These data were added to the final report but did not added significantly to the temperature analysis that was reported in the draft document because they do not provide additional insight as to natural temperatures in the Dearborn River. The data will be utilized in the proposed supplemental temperature study presented in Section 6.0 of the final document.

A3. **Comment:** The cumulative influence of riparian alterations in the basin (tributaries and mainstem) and their effect on water temperature throughout the basin should be evaluated.

Response: We agree and this is addressed in Section 6.0 of the final document.

A4. **Comment:** The narrative on page 13 of the draft document regarding the use of the head gate at the Flat Creek diversion is in error. The head gate is used on an as needed basis.

Response: Comment noted. The final document has been modified to address this comment.

B. Fish

B1. The following two comments suggested that the draft document did not adequately describe or consider the cold-water fishery. They also pointed out a potential relationship between temperature, nutrients, sediment and whirling disease. A single response is provided for these two similar comments.

B1a. **Comment:** The description of the cold-water fishery in the Dearborn River was not accurate. The Dearborn River is the main spawning and rearing tributary to the Blue Ribbon 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. FWP has over 20 years of data relating to the production of trout in the Dearborn River, and impacts from low flows and high water temperatures are evident in these data. In addition, FWP has 5 years of data estimating the annual numbers of emigrating rainbow and brown trout.

B1b. **Comment:** The TMDL is thoroughly inadequate in how it describes the fishery of the Dearborn watershed. The description of connectedness with the Missouri River fishery is especially poor. For example, the agencies should have more rigorously reviewed - and consulted with FWP on - data used for estimating populations by age-class in the river. This includes correlating juvenile abundance (especially yearling fish) in the Missouri and the data on young of the year from screw trap capture in the Dearborn. These data can help determine how water years, temperature and possibly sediment transport affect annual production of Missouri River trout spawned in the Dearborn. We note that the Middle and South Forks, as well as Flat Creek, have populations of resident trout. There are very little data on these populations, so it's difficult to determine with any certainty whether the targets and threshold values in the TMDL are protective enough... Finally, there is no accounting in the TMDL for the relationship between temperature, nutrients and sediment to spore densities for whirling disease. Infection levels of whirling disease in fish in the middle and south forks are alarming, averaging a 4.9 in 2003 samples. A 4.9 is extremely hot, meaning there is essentially no recruitment in the sample population. Whirling disease occurrence is directly related to habitat conditions and temperature. It may be that the sediment targets, thresholds and supplemental indicators used for this TMDL are wholly inadequate for maintaining "increasing or stable" trends for coldwater fish populations.

Response: We have added a discussion of the Dearborn River fishery in Section 2.0 to enhance the description of the fishery provided in the final document.

Relative to whirling disease, it should be noted that this document focused on water quality standards compliance associated with discharges of pollutants (i.e., fine sediment and temperature). Montana's water quality standards for both sediment and temperature address allowable increases over "naturally occurring" levels. In general, if sediment and temperature levels are similar to "natural", including a consideration of all "reasonable land, soil, and water conservation practices" (ARM 17.30.602(21)), it is assumed that the water quality standards have been met. At this point in time, neither the Montana Water Quality Act nor the federal Clean Water Act provide for more protection relative to the potential relationship between these two pollutants and whirling disease.

Finally, based on the available data, the Middle Fork Dearborn River, South Fork Dearborn River, and Flat Creek are considered impaired by fine sediment. Sediment load reductions have been proposed (Sections 5.1.1, 5.2.1, and 5.3.1), targets have been established (Section 5.4), and a phased conceptual restoration strategy has been proposed beginning with supplemental monitoring activities (Section 5.5 and 5.6). Implementation of this plan should result in reduced fine sediment levels. Therefore, to the extent that whirling disease is linked to fine sediment levels in these tributaries, whirling disease should also be addressed.

At this point in time, limited information is available on the relationship between whirling disease, temperature, fine sediments, and other habitat conditions. We are not aware of any studies, research, or literature that specifically correlate whirling disease with in-stream fine sediment levels in any measurable way. If future studies result in the establishment of such a correlation, TMDL targets can be modified if deemed appropriate, and in compliance with the State's water quality standards, at that time.

C. Fine Sediment/Pebble Counts

C1. **Comment:** At several points throughout the public review draft (e.g., p 79) statements were made concluding that excessive fine sediments were not impacting aquatic life or were not a significant impact to aquatic life. These statements are not supported by field data since not all types of aquatic life were investigated. Investigations on aquatic life were limited to algae and macroinvertebrates, and did not consider the various life-history stages of the many fish species. For example, fine sediments have been shown to cause suffocation of salmonid eggs in redds, or to prevent emergence of newly hatched fish. Increased nutrients, fine sediments, and organic materials may increase whirling disease infection levels in rainbow trout by creating more habitat for tubifex worms. Whirling disease has recently become a problem in the Dearborn River basin. Infection rates in the South Fork and the Middle Fork of the Dearborn are among the highest infection rates observed in Montana.

Response: Montana's 303(d) list addresses "aquatic life" and "cold-water fish" as two separate beneficial uses that must be supported. When we refer to aquatic life in the document, we are not referring to or including fish. We are well aware of the fact that fine sediments can affect the various life-history stages of many fish species. All of the targets and supplemental indicators presented in Table 3-4 have either a direct or indirect link to support of both the "aquatic life" and "cold-water fish" beneficial uses.

C2. The following four comments all pertain to the use of pebble count data and, therefore, are addressed together. Combined, the comments suggested that:

- Too much reliance was placed on the use of the pebble count data
- The pebble count data may or may not be spatially or temporally representative
- No discussion of statistical certainty was provided.

C2a. **Comment:** Reliance on pebble count data without any discussion of data quality objectives associated with these measures is not in accordance with EPA's guidance on data quality objectives. Pebble counts are a biased measure, particularly in estimating the finer gradations. In addition, this is most commonly used as a geomorphic measure. Studies applying this method to evaluate fine sediment stress typically train field observers to avoid the larger particle bias. There was no mention of training to reduce this type of bias. In addition, the document contains no discussion of the precision, accuracy, or representativeness of substrate conditions along the length of the Dearborn River.

C2b. Comment: The only nominally valid data related to sediment we found are from Wolman pebble counts. However, pebble counts are inherently biased towards the larger fractions in sediment. It is unclear whether the agencies reviewed whether bias occurred because the TMDL does not include a Quality Assurance Plan addressing precision, accuracy and representativeness in the data. We note that even if the quality of the pebble counts meets standards, too few were done in too few places to provide a statistically valid representation of substrate conditions in the Dearborn River and its main tributaries. Basically, the agencies have taken limited data and stretched it to make sweeping conclusions about long reaches of stream.

C2c. Comment: The EPA reports the results of five pebble counts for the entire river without addressing the representativeness of this sampling scheme. Do these few sampling sites adequately describe substrate composition for the entire Dearborn?

C2d. Comment: Statistical certainty is another technical aspect of natural resource planning that is left out of this TMDL document. The pebble count data are an example of this; the EPA removes siltation as a pollutant largely based on data without determining whether pebble counts reflected the “real” substrate composition in the river. It is not scientifically credible to make these decisions without replicating samples and performing statistics.

Response: Since Montana’s water quality standards for sediment are narrative; there is no single parameter that can be applied alone to provide a direct measure of beneficial use impairment associated with sediment. The weight of evidence approach described in Section 3.3 of the document is predicated upon this fact. The surface fines target (using pebble count data) was selected specifically to provide <u>one</u> measure of potential sediment impairment associated with the aquatic life and cold-water fisheries beneficial use. Pebble counts were developed and have been regularly used by state and federal agencies to ascertain the amount of surface fines affecting streams (CDPHE 2002, EPA TMDL Sediment Guidance Year 1999). Furthermore, as stated in Section 3.4.1, “*Recent work completed in the Boise National Forest in Idaho show a strong correlation between the health of macroinvetebrate communities and percent surface fines….*” The information provided by pebble counts were used in combination with the information provided by <u>all</u> of the other targets and supplemental indicators to reach conclusions about water quality impairment.

It should further be recognized that the highest observed percentile for fine sediment (<2mm) was 11 percent at the most downstream station in the watershed. This value was well below the proposed target of 20 percent. The remaining fine sediment values ranged from 4.9 to 6.5 percent in the upstream reaches. Despite the small sample size in the Dearborn mainstem, we feel that the statistical likelihood of a substantial number of observations approaching or exceeding the 20 percent fine sediment threshold is low.

The following QAPP was used to guide all data collection activities in the Dearborn River and several other Montana watersheds during the 2003 field season:

Tetra Tech, Inc. 2003. *Data Collection for Physical, Chemical, and Biological Characterizations of the Montana TMDL Planning Areas (TPAs)*. Prepared for the U.S. Environmental Protection Agency. June 23, 2003.

This QAPP addresses the issues of methods, precision, accuracy, and representativeness. Furthermore, the personnel who conducted the pebble count analysis were trained individuals with extensive field experience who understood how the data were to be used and the importance of collecting unbiased results.

C3. **Comment:** Do these pebble counts reflect substrate composition in trout spawning areas?

Response: Pebble counts were not intended to reflect substrate conditions in spawning areas. The pebble counts were designed to reflect substrate condition where the biological samples (i.e., macroinvertebrates) were collected. Pebble count data, when used in combination with macroinvertebrate data, are thought to provide insight into overall watershed health relative to sediment. Thus, while substrate conditions in trout spawning habitat were not specifically measured, it is felt that the methods employed herein, provided a watershed scale perspective regarding potential fine sediment impairments.

C4. **Comment:** The pebble count data also ignore the important issue of seasonality. Pebble count data were collected at various times; however, the authors do not attempt to evaluate substrate composition in critical periods. The Dearborn River is an important spawning area for the Missouri River fishery, yet there are no data to evaluate substrate characteristics during spawning and incubation of either spring or fall spawning fishes. Pebble counts performed after spring runoff will miss conditions present during spring spawning and will also reflect the effect of scouring during high flows. Addressing seasonality will greatly strengthen determinations associated with siltation as a pollutant of concern.

Response: We acknowledge that seasonality in pebble count data may exist to some extent. However, we feel that the existing data indicate that fine sediment (<2mm) is unlikely to exceed the target of 20 percent regardless of season (see response in C2d above). Given pragmatic sampling considerations during elevated spring run-off, Wolman pebble counts were designed to be conducted during baseflow periods. Baseflow periods represent low stream power conditions and potentially the maximum accumulation of fine sediment. Pebble counts taken during elevated flow conditions would likely result in similar or lower fine sediment results. Additionally, sampling during baseflow reduces year-to-year variability because the observations are made during the same timeframe.

D. Aerial Survey

D1. The following two comments suggested that too much reliance was placed on the results of the aerial survey and field verification should have been conducted. A single response for both comments is provided.

D1a. **Comment:** The document over extends the appropriate use of the aerial photo analysis. Similar to other types of information used in this report, there is no discussion of data quality objectives. In other watersheds, assessments of aerial imagery are treated appropriately as a coarse screen that guides field sampling. It is simply not credible to use aerial photo analyses without validating the results on the ground. Detecting eroding banks from aerial photos is easier when observing lateral bank migration, and much of the Dearborn is laterally confined; thus, this type of methodology would underestimate bank erosion.

D1b. **Comment:** In our opinion, the EPA overextends the aerial photo survey in this TMDL plan. The proper role of an aerial survey is an initial investigation to guide further studies. In other words, it is an initial screen, not an end in itself. The EPA uses this aerial survey without conducting a field assessment to verify results. Field verification is especially important when addressing sediment loading from eroding banks. Many eroding banks may not be visible from aerial photos. Moreover, the use of lateral channel migration as an indication of eroding banks may not work in a laterally confined system like the Dearborn River. Without field verification, we have serious concerns about applying the results of the aerial survey effort to decisions regarding sediment loading and riparian function. We encourage the EPA to conduct the necessary field assessments to resolve this deficiency.

Response: The basis for our technical approach is described in Section 1.1 of the final document. This project relied on the results of the aerial photo analysis because (1) historical photos were available from 1955, 1964, and 1995 to assess trends and the impacts of the 1964 flood, (2) the low-level (4500 feet) survey conducted in 2003 provided source assessment information on the entire watershed, and (3) limited access across private property precluded the collection of watershed-scale data via any other means. Private lands comprise 71 percent of the watershed and total approximately 390 square miles.

The results of the aerial photo analysis generally matched observations made on the ground. For example, on-the-ground Bank Erodibility Hazard Index (BEHI) surveys were conducted at two sites on Flat Creek during the summer of 2003 and generally matched the findings of the aerial assessment report. Visual assessments made during sampling also were consistent with the findings of the aerial assessment report. Also, for the Middle and South Forks, private and/or public roads parallel the streams for much of their length. Field crews drove or walked much of these watersheds conducting visual surveys with the intent of verifying observations made from the air. Finally, EPA and DEQ floated the reach of the Dearborn River from Highway 287 downstream to the confluence with the Missouri River in 2002.

D2. **Comment:** Riparian measures consisted entirely of qualitative evaluations during the aerial photo assessments and a qualitative questionnaire with very low spatial coverage. As with other data presented in this document, there is no discussion of data quality objectives for these data. Qualitative questionnaires have high interobserver bias, and thus may not be reliable when eliminating probable causes of impairment.

Response: Data quality objectives are discussed in the QAPP. Data regarding riparian condition (i.e. coverage, presence/absence, large scale modifications) was used only in the context of the supplemental indicators. As described in Section 3.3, the supplemental indicators were not considered sufficiently reliable to be used alone as a measure of impairment. "Riparian Condition", and all of the supplemental indicators were only used when one or more of the target threshold values were exceeded to provide supporting and/or collaborative information when used in context with all of the other available data.

Three individuals familiar with the Dearborn Watershed worked collaboratively to assess and review riparian assessments made from aerial photos. All staff recognized the inherent limitations of a remote sensing method to draw any detailed conclusions about riparian health. However, it should be recognized that extremes in riparian coverage and function (e.g. wide, extensive riparian corridor versus total riparian removal) can be reliably evaluated from aerial photos. This "screening level" of analysis was considered appropriate to identify potential major impacts.

D3. The following two comments suggested that ground-truthing should have been completed to verify the result of the aerial surveys. A single response is provided below.

D3a. Comment: The aerial evaluation of riparian health and channel stability is fine for a coarse filter review. However, few conclusions can be made from this sort of examination without validating conditions on the ground. The agencies should have tested conclusions made from the aerial reviews with fieldwork, perhaps using vegetative transects, channel transects, or even at least a Pfankuch type evaluation. We note that the consultant's report is riddled with expressions like "appeared to", "did not appear to", etc. Therefore it's clear even the consultants are unsure about making firm conclusions from their reviews of two sets of aerial imagery and last year's over flight. Without a description of the quality assurance expected from these qualitative "data", the conclusions are highly suspect. For instance, we note that it can sometimes be difficult to make any conclusions of eroding banks from the air, especially in confined channel types, which is the case of the Dearborn on much of its length. We also note that evaluating riparian health from the air can be tricky without an on-the-ground perspective. For example, it appears the aerial evaluations were made from inspections during dry years or seasons when bank saturation - a condition that can trigger instability - wasn't present.

D3b. Comment: On-the-ground bank stability surveys should have been used to verify conclusions made about bank stability from aerial photographs.

Response: On-the-ground Bank Erodibility Hazard Index (BEHI) surveys were conducted at two sites on Flat Creek during the summer of 2003 and generally matched the findings of the aerial assessment report. Visual assessments made during sampling also were consistent with the findings of the aerial assessment report. Also, for the Middle and South Forks, private and/or public roads parallel the streams for much of their length. Field crews drove or walked much of these watersheds conducting visual surveys with the intent of verifying observations made from the air. Finally, EPA and DEQ floated the reach of the Dearborn River from Highway 287 downstream to the confluence with the Missouri River in 2002.

D4. Comment: Criteria used to classify sediment sources as "natural" or human caused in the aerial survey were not apparent.

Response: The aerial survey relied upon fixed wing aerial reconnaissance, and review of historic aerial photos. The primary human activity potentially influencing sediment sources is related to agricultural land use in the watershed. Sediment sources were classified as "human caused" primarily based on the extent of riparian vegetation removal and apparent impacts on channel stability associated with riparian alterations. Adjacent stream reaches with intact or greater riparian coverage provided a basis for comparison and interpretation of potentially impacted reaches. Another human cause for sediment source specific to Flat Creek is channel enlargement and eroding banks related to irrigation flow augmentation. Sediment sources within Flat Creek were generally attributed to human cause due to this flow alteration. Natural sediment sources were considered to be those areas not clearly associated with riparian modification or intensive agricultural land uses. Eroding landscape features such as terraces/hillsides were included in the natural sources category.

This approach provided a qualitative, screening level method of identifying potential human caused sediment sources. We agree that not all potentially human caused erosion or sediment sources would be identified using this approach. For example, intense grazing within riparian areas may result in channel modifications or localized erosion that might not be identified unless visible channel instability resulted. Potential sources within confined channels were also difficult to assess using this approach.

E. Habitat/Riparian Condition

E1. The following two comments suggested that anthropogenic impacts can exacerbate the effects of naturally occurring disturbances. A single response is provided below.

E1a. **Comment:** Some habitat degradation due primarily to naturally occurring disturbances (the 1964 flood and forest fires) in the Dearborn River basin were discounted as not being influenced by human activity; however, there was and is an anthropogenic effect both before and after such events that must be considered (e.g., land use activities in the Dearborn River basin may have exacerbated the effect of the 1964 flood).

E1b. **Comment:** Although we agree that naturally occurring events (floods, forest fire, etc) have an impact on the form and function of lotic systems, we believe that anthropogenic impacts exacerbate the effects of these events. The anthropogenic influences can include more destructive fires (due to years of fire suppression and build up of fuels), less stable riverbanks due to land management activities, etc. Inferring that the events were natural and their damage unpreventable discounts the anthropogenic influences. Finally, we propose that many of the habitat survey results could have been influenced by the long-term drought in the Dearborn River basin, and suggest some discussion on these potential influences.

Response: We agree that the effects of naturally occurring disturbances might have been exacerbated by anthropogenic activities. This may be especially relevant in unconfined channel types where riparian vegetation plays an important role in stable channel morphology. However, quantifying the extent to which this might have occurred in the Dearborn River is very difficult. The decision that anthropogenic activities were not, in general, a significant factor is due in part to the fact that the vast majority of the watershed is relatively undisturbed. For example, the available land use data suggest that anthropogenic land uses (i.e., pasture/hay, small grains, commercial/industrial, fallow, row crops, and low intensity residential) account for less than 4 percent of the total watershed area. Furthermore, some anthropogenic activities fall within the definition of "natural conditions" per the provisions of 75-5-306 MCA (i.e., Natural refers to "*conditions or materials present in the runoff or percolation over which man has no control <u>or from developed land where all reasonable land, soil and water conservation practices have been employed</u>*."

E2. **Comment:** The cumulative habitat degradation impacts in the tributaries (increased sediment, decreased flow, increased temperature, etc) should be evaluated on the mainstem Dearborn River. In other words, the habitat impacts in tributaries are causing habitat problems in the mainstem river.

Response: There is no indication based on the available data that that habitat degradation in the tributaries is currently causing problems associated with sediment in the mainstem Dearborn River. The Dearborn has percent fine sediment values well below threshold target values.

However, we do agree that habitat alterations may have an affect on downstream water temperatures. This has been addressed in the final document in Section 6.0.

E3. **Comment:** It is unclear why the NRCS habitat survey was only conducted in the lower reach of the Flat Creek drainage. We argue that this area is not representative of habitat conditions in the upstream reach. If more sites cannot be inventoried in the upper basin, the results from the one reach downstream should not be considered as part of the analyses.

Response: Habitat surveys were conducted at two additional sites along Flat Creek (including one farther upstream) but were mistakenly left out of the draft report. In addition, the reported score for the site below Birdtail Road was wrong. The corrected scores appear in the final report and suggest that habitat is at risk below Birdtail Road and at Milford and sustainable at the mouth.

We agree that the habitat in the lower reach of Flat Creek is not representative of conditions upstream. However, the aerial survey we conducted allowed us to view and assess (at least at the "coarse" level) habitat conditions along the entirety of Flat Creek. Further, collecting additional field data upstream (where conditions are poorer) would not have resulted in a different conclusion regarding impairment status (i.e., Flat Creek would still be considered impaired and a sediment TMDL would be deemed necessary).

E4. The following two comments questioned the methods for sample site selection and suggested that the results of the riparian surveys were averaged across major ecotones. A single response is provided below.

E4a. **Comment:** It was not clear how sites were selected for habitat monitoring throughout the planning area. In the tributaries, the results from surveys were averaged across major ecotones. Had the results been considered excluding the headwater forested areas of the Middle and South Fork the conclusions may have been different.

E4b. **Comment:** Conclusions on riparian health seem to have been averaged across eco-types. This misrepresents conditions on the ground. For instance, we note that when looking at the South Fork of the Dearborn, the agencies combine the more stable channel conditions from forested uplands on public land with those found on the heavily damaged pasture sites on private land. Averaging them together, it's easier to conclude the South Fork is in decent shape. However, by bracketing the evaluations by shorter stream reaches and by eco-type and channel type, the conclusions will be different. We note that data seems to be used selectively. For example, the agencies make conclusions about Flat Creek's stability based on an NRCS cross-section located where the channel is naturally confined. This is misleading. There should also be corresponding data upstream or downstream in meandering meadow reaches.

Response: Sampling locations were selected to represent upstream, downstream, and transitional reaches of the subject streams. Sites were chosen based on the presence of historic sampling locations, changes in land use or landform, and the confluence with tributaries.

The location of the sampling sites was taken into consideration during the analysis and conclusions were not made based on averaging the values. For example, the impairment summary for the Middle Fork (page 82) states: "*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."* We disagree that the conclusions might have been different if we had bracketed the evaluations by eco-type, channel-type, etc. We still think the conclusion would have been that the Middle Fork, South Fork, and Flat Creek are impaired and that sediment TMDLs are necessary.

E5. **Comment:** My family has lived in the Flat Creek drainage since the late 1800's. Historically, there were never willows along Flat Creek.

Response: We recognize that willow and other shrub communities can be quite variable and reflect a combination of site characteristics (geology, soils, hydrology, etc), climate, land use, and other factors. Flow in Flat Creek is enhanced due to irrigation diversion, which may also alter willow establishment and survival. Other potential factors include historical grazing (pre-settlement bison, post-settlement sheep, etc). The relative impact of these influences is difficult to quantify. Flat Creek does currently support a variable coverage of willows and other riparian species. We would agree that willow coverage was potentially different at the turn of the century than the present day.

F. Methods

F1. The following three comments suggested that EPA and DEQ should have developed a QAPP and SAP. A single response is provided below.

F1a. **Comment:** The development of this TMDL document did not follow the typical pattern and method used on past TMDLs developed in Montana. In the past cases, a logical, orderly approach was employed where an initial, phase 1 assessment involved compilation and synthesis of available data, identification of data gaps, and development of quality assurance project plan (QAPP). The lack of the QAPP sets the stage for a technically poor plan that over extends the use of low-quality data. Field investigations directly related to the Dearborn River TMDL plan were negligible and apparently not guided by a QAPP or sampling and analysis plan (SAP), both of which are EPA requirements.

F1b. **Comment:** It appears the agencies did not attempt to fill data gaps with new information. Instead, it appears the available data--most of vague quality--were made to fit into pre-determined conclusions about watershed health, water quality and pollutant allocation.

F1c. **Comment:** Nowhere in the document did we find a methodical description of all available data that were reviewed. Nor did we find a description of data gaps, or the Quality Assurance Plan DEQ/EPA employed when both agencies apparently agreed the limited data used were valid. The result has been a hodge podge description of data reviewed. Moreover, it is difficult to determine whether any of the data used meets EPA's quality assurance quality control requirements.

Response: The development of the Dearborn River TMDL did in fact follow the pattern described in this comment. Available data were first compiled and analyzed, data gaps were identified, a Sampling and Analysis Plan was prepared, a quality assurance project plan (QAPP) was prepared, and additional data were collected. The field sampling that occurred in summer 2003 and the low-level aerial survey were both intended to fill identified data gaps. A description of all of the data that were reviewed appears throughout Section 3.0 of the document and raw data are available in Appendix B.

The following QAPP was used to guide data collection activities in the Dearborn River and several other Montana watersheds during the 2003 field season:

Tetra Tech, Inc. 2003. *Data Collection for Physical, Chemical, and Biological Characterizations of the Montana TMDL Planning Areas (TPAs)*. Prepared for the U.S. Environmental Protection Agency. June 23, 2003.

The SAP and QAPP are both available for public review (the QAPP document is 439 pages long) upon request.

F2. **Comment:** It appears that in preparing this plan, the EPA was more concerned with administrative outcomes, namely meeting strict time demands. Although we do understand time constraints, the focus should be on producing a technically sound plan that truly restores and protects aquatic resources in the Dearborn River watershed. With a reprieve in the TMDL deadlines, we hope that the EPA shifts priorities to improving water quality and restoring fisheries, rather than solely meeting administrative goals

Response: 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. This approach is described in Section 1.1 of the final document. 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. We disagree that the Dearborn analysis was technically insufficient. Qualified technical experts assessed available and newly collected data that met defined data quality objectives and appropriately applied the TMDL regulations to the information. We do agree, however, that data gaps exists, such as the remaining question of temperature impairment on the mainstem of the Dearborn, and that data uncertainty is too high to make a final decision regarding temperature impairment. Therefore, as noted in our response to comment #A1, we have outlined follow-up studies to better support final decision making.

F3. **Comment:** Another concern regarding EPA's approach and lack of technical standards relates to the other watersheds assigned to EPA for TMDL development. This plan does not compare favorably to other TMDLs in terms of technical merit and public involvement. Unless the EPA follows its own guidelines for watershed monitoring and planning, TMDLs developed by the EPA will be less likely to protect and restore our waters. The technical insufficiencies of the Dearborn TMDL also have ramifications for the quality of plans approved by the EPA. The EPA is responsible for approval of TMDLs. Our concern is that if the EPA produces substandard TMDLs, they will likewise approve substandard TMDLs.

Response: EPA and MDEQ have established a joint approach to development of TMDLs/Watershed Restoration Planning in Montana. By standardizing the steps, from assessment of all currently available data, determination of data gaps, following the MDEQ approved Quality Assurance Project Plans for sampling and analysis, consistent use of laboratories, application of defensible analytical tools, confirmation of impairment status, identification of pollutant sources, setting of targets, allocation of loads, forthright presentation of data uncertainty, proposed follow up actions and internal/external peer and public review, both agencies are attempting to meet a level of technical rigor that is scientifically defensible given the constraints of time and the state of the science. The Dearborn TPA process followed this standardized protocol.

Although EPA and MDEQ have established a consistent approach, each case will dictate a slightly different application based on the unique circumstances within the watershed. As described in our response to Comment F2, the Dearborn TPA is largely under private ownership with limited access. These unique features are the reason 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. Based on the results, we feel that this approach was adequate for the tributaries (Middle Fork, South Fork, and Flat Creek) and the siltation listing on the mainstem of the Dearborn River. However, the level of certainty associated with this approach was inadequate regarding the temperature analysis in the mainstem Dearborn River. The document acknowledges the uncertainty associated with the temperature analysis and EPA and DEQ have committed to the completion of a supplemental flow and temperature study in Section 6.0.

G. Public Notice and Document Availability

G1. **Comment:** We have concerns regarding the level of public involvement incorporated in this process. Specifically, it appears that the EPA did not follow the example of other watersheds in Montana, where a local watershed group, local fisheries managers, conservation groups, landowners, and other stakeholders or interested parties were part of the process. The lack of stakeholder participation is a considerable concern in getting landowners to accept and implement plans. Also, failure to include local natural resource professionals results in a document that does not reflect an informed understanding of the river's fisheries. We strongly recommend that the EPA include more stakeholders to produce a TMDL document that incorporates the knowledge of individuals working and living in the watershed.

Response: 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.

Further opportunities provided to the public regarding review of the draft document are described in Comment G2 below.

G2. **Comment:** Not providing public notice to organizations such as ours who have long demonstrated an interest in water quality and watershed health. We learned about the impending release the recent spate of draft TMDLs only through a reporter, right before the comment deadline for the Flathead Headwaters TMDL. Thus we couldn't plan appropriately for the type of review we like to do, which includes consultation with additional professionals.

Response: 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. We also made phone contact, and visited, 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, we made phone contact with all of the landowners within the watershed, that we previously made contact with to obtain permission for sampling, to alert them of the document availability.

We regret that your organization was not specifically notified, but feel that adequate public notice was, in fact, provided. DEQ is currently in the process of developing an improved TMDL public notification/information program. In the future, we hope to ensure that all interested parties are provided adequate notification.

G3. **Comment:** A final consideration directed primarily at DEQ relates to the timing of releasing TMDLs for public review. This year, the DEQ bombarded the public with plans at the year's end. The number of plans released so close in time presents a hardship to parties interested in more than one watershed. We suggest that DEQ stagger the release of these documents so as not to shortchange the public participation process. Once again the reprieve in the deadline should allow DEQ/EPA more flexibility in planning the release of these plans.

Response: The courts and our constituents have been asking for DEQ and EPA to increase the pace of TMDL development since the program officially began in Montana in the late 1990's. The pace of TMDL development in Montana has increased annually since the year 2000 and is expected to continue to increase. This, inevitably, will result in an increased burden on the public to review more and more TMDL documents on an annual basis.

To date, the timing of the release of public review drafts has largely been driven by a rigorous, court-imposed schedule with annual milestones. Given a court-imposed schedule, Montana's TMDL Program has operated on a calendar year basis since the year 2000, with TMDL documents scheduled for completion by the end of December every year. This has resulted in the release of most of the public review drafts in October, November, or December on an annual basis.

Nonetheless, DEQ appreciates the challenges the public may face when multiple draft documents are published at the same time. DEQ is working to address numerous issues including:

- developing standard procedures for notification of document availability,
- pre-specifying convenient locations for the public to review the drafts (such as local libraries),
- standardizing text viewing software for review of the documents electronically, and
- creating a streamlined process for receiving and recording public comment.

It is also important to note that DEQ is strategizing on ways to better inform the public on upcoming public draft releases so that the public can prepare and schedule appropriately with the timing of the release of each draft document.

Further, although many public review draft TMDL documents will continue to be released in the last three months of the year, some future modifications to the release of TMDL documents are planned. For example, a phased approach will be taken for some of the larger and more complex TMDL Planning Areas, where the required TMDL elements will be presented in a series of "volumes". The first volume for a given TMDL Planning Area may contain the first two sections or chapters of the typical TMDL document (i.e., Watershed Characterization and water quality Impairment Status). The remaining sections of the typical TMDL document (i.e., source assessment, total maximum daily loads, targets, allocations, margin of safety, etc.) will be presented in subsequent volumes, as appropriate based on the scale and complexity of the TMDL Planning Area. In 2005, it is envisioned that the first "volumes" (i.e., Volume I) of several TMDL documents will be released during the first half of the year. Subsequent volumes will then be made available to the public when they are completed. This will provide the public with more time to review DEQ's more complex TMDL documents and will ensure that the entire public review time period is spread out throughout the year, rather than waiting for the last three months of the year.

Additionally, some TMDL documents are scheduled for completion throughout 2005. These will be made available for public review as soon as they are completed, thus avoiding the last three months of the year.

G4. **Comment:** When we examined the Dearborn TMDL on the website last week, we found not all the pages were available. Thinking it could be a problem with our version of Acrobat Reader, we double-checked with several other TMDLs on the DEQ site. We had no problem reading those, leading us to conclude that perhaps the problem was with DEQ. After several hours of investigation, including calls to DEQ, we finally found an administrative staffer at the agency that helped us understand the problem; not all the TMDL documents on DEQ's site were done using the same version of Acrobat, but the agency hadn't bothered to tell the public. Thus, though technically the problem was on our end, DEQ could have facilitated things and saved time for reviewers by simply noting on its website that the public needs different versions of Acrobat Reader for reviewing different TMDLs.

Response: In an effort to produce documents that are easy for the average person to read and understand, we often include large numbers of graphics and photographs. This results in large electronic files that are often difficult to download. In the future, we will ensure that all downloadable document files are small enough for the average person with a "home computer" to download and will also improve our website to make all necessary directions for downloading more obvious.

H. Miscellaneous Topics

H1. **Comment:** I believe that "the fires in 1989" caused the biggest sediment problems in the Dearborn drainage. I observed turbid flows in the Flat Creek diversion for at least a couple of years after the fire. Ice scour during spring floods has caused many of the bank erosion problems.

Response: We agree that the 1989 fires and ice scour have contributed to the current sediment problem in the Dearborn drainage. Table 2-6 of the report indicates that approximately 7 percent of the watershed (primarily in the headwaters) consists of "standing burnt forest". However, we believe that there are also localized problems caused by human activities, especially in Flat Creek.

H2. **Comment:** This study was conducted during a period of drought that has occurred for at least the last 5 years.

Response: We agree that the current drought conditions have likely biased some of the observed problems and attempted to address this by evaluating the 1955, 1964, and 1995 aerial photographs. Future study of the Dearborn River drainage is recommended once the current drought ends.