STREAM CROSSING WATERSHED SURVEY PROCEDURE

April 27, 2000

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STREAM CROSSING WATERSHED SURVEY PROCEDURE

A. OBJECTIVES

This set of watershed and stream survey forms is intended to be used as a quick screening tool to increase the amount of information available on the water quality of Michigan's rivers, and the sources of pollutants to the rivers. The survey procedure was designed to provide standardized assessment and data recording procedures that can be used by a variety of Surface Water Quality Division (SWQD) staff and trained volunteers. It does not take the place of the Surface Water Quality Division's more comprehensive Procedure 51 surveys ("Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers") that are conducted by SWQD aquatic biologists to assess current water quality status.

This watershed survey assessment procedure is designed to address several general objectives:

?? Increase the information available on the water quality of Michigan rivers and the sources of pollutants, for use by Division staff and local watershed groups.

?? Provide for consistent data collection and management statewide.

?? Serve as a quick screening tool to identify issues and the need for more in depth investigations (the visual assessment portion of the survey should take an experienced surveyor no more than 5-10 minutes per site to complete).

?? Provide information for use in the Division's Procedure 51 stream assessments to help determine the following: (1) where monitoring stations should be established; (2) how far upstream a station is representative; and (3) what pollutant sources are present (identified in federal clean water act Section 305[b] reporting categories) for incorporation into the Procedure 51 assessment reports.

This survey procedure is one of several assessment procedures that will be used to meet the Division's long-term goal to "Improve the identification of nonpoint pollution sources and impacts in Michigan watersheds to effectively target resources by 2011." A short-term goal has been established for this survey procedure, which states that the Division will "Conduct NPS physical assessments in 80% of Michigan's watersheds (10,000-20,000 acres in size) by FY2006."

B. GENERAL CONCEPTS

The survey forms are to be completed at locations where a road crosses a stream. There are two types of survey effort incorporated by the forms.

The first form is a two-page visual assessment of stream conditions and watershed characteristics observed by an investigator from the road stream crossing. The surveyor should include any appropriate observations that can be seen along the entire length of the stream visible from the road crossing. Only observations that are actually seen are to be recorded. No "educated guesses" are to be made about what should be there or is probably there. If something cannot be seen, it should not be recorded. The one exception is if a significant source or stream impact is known to be upstream of a particular site, a comment about its presence can be made in the comment section of the form.

The second one-page form is an optional form to be used at select stations where additional instream assessment work—primarily the characterization of benthic macroinvertebrate communities—is desired. The level of training needed to complete the instream form is greater than that needed for the visual form.

It is important to keep in mind the intent and limitations of this type of survey. The watershed survey data sheet portion of the survey was designed to be completed using visual assessments; therefore, the data are inherently subjective. Additionally, in order to increase the amount of data that can be collected, this survey process was designed to be conducted by a variety of personnel with different knowledge levels of water quality, aquatic biology, and nonpoint source pollution issues. Consequently, the survey procedure is useful as a qualitative screening tool to identify issues and the potential need for more in-depth studies. It is not intended to be used as a scientifically rigorous quantification of water quality or watershed conditions.

The limitations of this survey procedure were taken into account in establishing the objectives, the content and design of the form, and the methods for conducting the assessments. There are a variety of quality assurance and quality control (QA/QC) items (described at the end of this document) implemented specifically to minimize subjective variation and account for different knowledge levels among the people conducting the survey. These QA/QC activities should facilitate the accurate collection of quality data on a statewide basis. Nevertheless, when the survey data are interpreted, the analysis needs to take into account the numerous sources of data variability present as a result of the assessment methodology, particularly when drawing conclusions or making watershed management recommendations.

C. SURVEY DESIGN

1. Selecting Watersheds to Survey

One of the watershed survey objectives is to provide information that can be used to help determine where sampling locations should be established for the Division's Procedure 51 stream assessments. In order for the watershed survey information to be available for this SWQD use, streams scheduled for Procedure 51 assessments should be surveyed the prior year with this stream crossing survey (Figure 1). Watersheds may be surveyed earlier than their scheduled year if necessary because of workload demands, but the surveys should be done as close in time to the scheduled year as possible. Using this schedule, watersheds would be re-surveyed approximately every five years.

If watershed survey information is to be collected for other reasons, such as for a local watershed planning or assessment effort, select watersheds or subwatersheds as appropriate based on the objectives of that project. For example, if agricultural sources are known or suspected sources of a pollutant of concern in a particular major watershed, the survey may want to focus on the subwatersheds with the most agricultural land use.

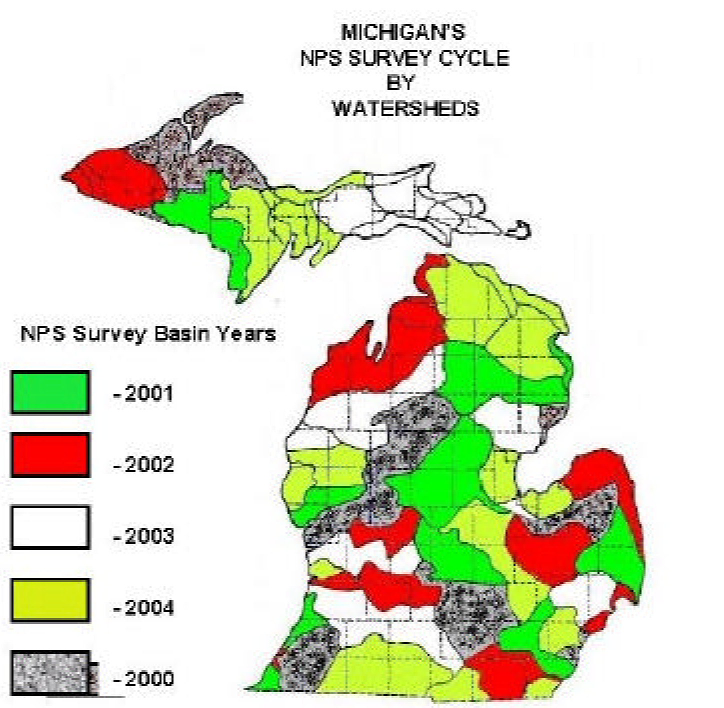

Figure 1. Schedule for stream crossing watershed surveys.

2. Watershed Survey Scope

The approach used to survey a particular watershed, and the scope of that assessment, should be determined prior to beginning the fieldwork. This initial survey planning effort should cover: which stations will be assessed, the general order in which they will be assessed, assigning station numbers, determining what information will be collected at each site (some of the data are optional), and what time of year the survey will be done.

3. Selecting Survey Stations

One of the basic questions that needs to be answered in planning the assessment is: how many stream crossing sites should be surveyed within a watershed to adequately characterize it, and where should they be located? That depends on a variety of factors including the heterogeneity of land use, soils, topography, hydrology, and other characteristics within the watershed. Consequently, this question can only be answered on a watershed-by-watershed basis.

A general guideline is to try to survey a minimum of 30% of the stream crossing sites within a watershed, with the sites distributed such that each subwatershed (and in turn their subwatersheds) are assessed to provide a representative depiction of conditions found throughout the watershed. At least one site should be surveyed in each tributary, with the location of this site being near the mouth of the tributary. The distribution of sampling stations within the watershed should also achieve adequate geographic coverage. Consider establishing stations upstream and downstream of suspected pollutant source areas, or major changes in land use, topography, soil types, water quality, and stream hydrology (flow volume, velocity or sinuosity).

The previous paragraphs lay out the minimum quantity of data needed to meet the statewide SWQD objective. However, this procedure identifies several other objectives that apply to individual watersheds. If the intent of a particular watershed survey is to meet some of these watershed specific objectives, then additional data are needed. A general guideline in this case is that most stream crossing sites within a watershed need to be assessed to fully meet the procedure objectives.

4. Watershed Map

Make a single map for the watershed on which to delineate sub-basins and stations. One way this can be done is by copying the appropriate pages of maps, such as those in the *Michigan Atlas & Gazetteer*, and then cutting, pasting, and copying until there is a single sheet that includes the entire survey area.

5. Sub-basins

In many cases, but not all, it is desirable to divide the watershed into appropriately sized sub-basins that facilitate data collection and analysis. There are no limits on how many stations can be in a single watershed or sub-basin; however, think about the smallest area for which a distinct summary analysis of the data may be needed, and delineate the watershed appropriately.

6. Station IDs

A station ID is comprised of both: (1) a 2-4 letter abbreviation for the name of the sub-basin or river segment being surveyed, and (2) a number that is derived sequentially in an upstream direction starting with 01 at the downstream end of the sub-basin or river segment. The letters and numbers should be separated by a hyphen. For example, the third station upstream of the Pine River mouth could be coded as “PR-03”.

In order to make the best decisions on assigning appropriate station IDs to facilitate data entry and analyses, it is important to consider that the computer database for this assessment survey includes four columns for river names in addition to the station ID column. Computer sorts and data summaries can be made for any “name” in any of the five columns. The first column—or organizational tier—corresponds roughly to the USGS major river basins for Michigan, such as the Manistee River. The second column corresponds to the larger tributaries to major rivers, such as the Pine River tributary to the Manistee River. The third column corresponds roughly to sub-basin names, such as the Pine River East Branch. The fourth column uses the waterbody name entered on the watershed survey data sheet, which may be a segment of river already named in one of the preceding levels, or a headwater tributary such as Edgett Creek, a tributary to the Pine River East Branch. The fifth column is the station ID name.

It makes sense to “name” stations (the letter portion of the station ID) to either facilitate data summaries that cannot be obtained by sorting on any of the first four columns, or to use a name that groups the stations by one of the four river names in order to help organize the data. For example, it might be useful for data analysis purposes to divide the Pine River into upstream and downstream sub-basins. Whereas one could identify all these stations as PR-???, if the Pine River upstream stations are coded as PRU or PU, data could be summarized for those two areas separately by sorting the data on the station ID field. Sorting on any of the four river name fields would not group the data to accomplish the same analyses.

Station IDs Part 1: Letter Abbreviation Designations

Assign each watershed or sub-basin a unique 2-4 capital letter designation for ID purposes. This letter designation will be part of the surveyor-defined station identification number and should be descriptive of the primary river in that watershed or sub-basin. Note that a separate *unique station identifier* (USI) will also be automatically assigned in the database (and stored in a separate column) for each station when the data are entered. The USI is different from the letter-number station ID designation created by the surveyor and it will distinguish among any similarly coded station designations anywhere in the state. However, to minimize potential data analysis difficulties, try not to repeat any letter codes within the geographic area where you are conducting assessments.

Station IDs Part 2: Station Numbers

Assign numbers to all stations that will be surveyed in each watershed, except in certain cases when the surveyor intends to select some stations in the field based on observed stream or watershed characteristics. Start at the downstream end of the watershed and number upstream. If more than 40-60 stations are identified within a sub-basin, one should consider dividing that sub-basin into smaller sub-basins to facilitate easier data analysis. Station numbers for each sub-basin should begin with "01". When a tributary confluence is reached, that entire tributary should be numbered before continuing upstream with numbering on the mainstream (Figure 2). If additional stations need to be added later—which sometimes happens in the field when a road crossing is encountered that is not on a map—use a decimal system for additions. For instance, if two stations are added between stations 16 and 17, the station numbers would be 16.1 and 16.2, with 16.1 being the one closest to station 16.

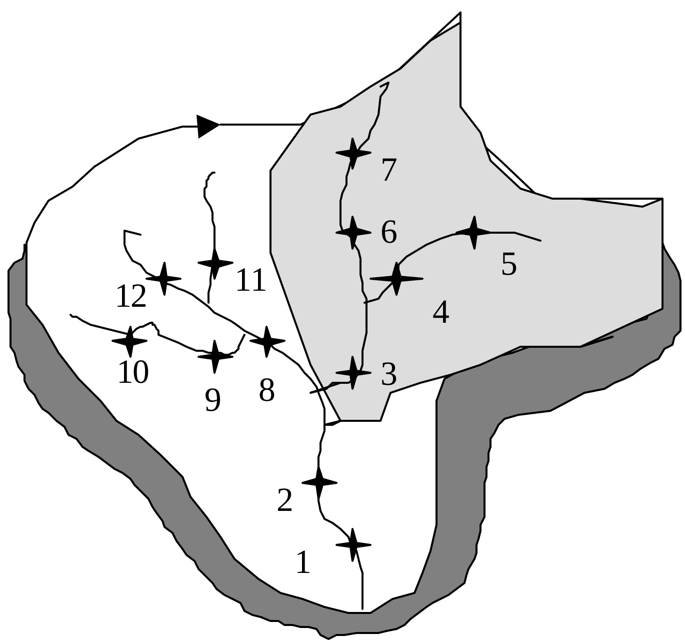

Figure 2. Numbering sequence for survey stations.

7. Station Survey Order

Determine in which order the stations will be surveyed. It does not matter if the investigator works from downstream stations to upstream stations, or the reverse. Many people prefer to work from upstream to downstream so they know what conditions existed upstream of the site they are currently surveying. Others prefer to work from downstream to upstream so they can look for specific types of pollutants/sources based on stream impacts they have noted. Some people determine survey order based on travel logistics.

Regardless of which direction is preferred by a surveyor, within a given sub-basin, the survey should be conducted in a single direction to facilitate properly answering and interpreting the watershed survey form question (on the second page) asking whether the station is similar to the previously assessed station. For the same reason, if more than one investigator (or team) is conducting a survey in a watershed, it is important that all stations within a single sub-basin are surveyed by the same investigator, if possible. Working in a single direction also helps to confirm which photographs (taken at each station) go with each station.

8. Time of Year

The time of year in which a survey is conducted is important. Surveys should not be conducted when there is snow on the ground or ice on the water because sources and impacts may be hidden from view. The best time for getting an unobstructed view of the landscape is in the early spring before leaf-out, followed next by late fall after leaf drop. However, if potential nutrient enrichment of the watershed to be surveyed is a major consideration, then summer is often the best time to conduct the survey because there may be more aquatic plant or algae growth visible as a potential manifestation of nutrient enrichment. Surveys conducted during or shortly after storm runoff events may help to identify sources of pollutants, but increased stream turbidity during that time may make assessment of instream conditions difficult. Furthermore, all stations within a single watershed should be surveyed as closely together in time as possible to facilitate relative data comparisons among stations surveyed under similar stream flow and seasonal conditions.

D. DATA SHEETS

Date: | # Watershed Survey Data Sheet | **Time:**

Waterbody Name: **County:** **Station #:**
Location: **Township:** **Sec T R ¼ ¼**
Investigator: **Lat:** **Long:**
Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____________)
Map Scale (if known ___________________)

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	= 1	2	3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type -u/s	Stream	Lake	Impound	Wetland	
Waterbody Type -d/s	Stream	Lake	Impound	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec) *					
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20

	U/S (Check all that apply)		D/S (Check all that apply)	
Aquatic Plants	Present	Abundant	Present	Abundant
Floating Algae	Present	Abundant	Present	Abundant
Filamentous Algae	Present	Abundant	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant	Present	Abundant
Turbidity	Present	Abundant	Present	Abundant
Oil Sheen	Present	Abundant	Present	Abundant
Foam	Present	Abundant	Present	Abundant
Trash	Present	Abundant	Present	Abundant

SUBSTRATE (add to 100%) – pg. 22

	U/S (%)	D/S (%)
Boulder – 10 in. diam.		
Cobble/Gravel –10 to .08 in. diam.		
Sand – coarse grain		
Silt/Detritus/Muck - fine grain/organic matter		
Hardpan/Bedrock – solid clay/rock surface		
Artificial – manmade		
Unknown		

INSTREAM COVER – pg. 23

	U/S (X)	D/S (X)
Undercut Banks		
Overhanging Vegetation		
Deep Pools		
Boulders		
Aquatic Plants		
Logs or Woody Debris		

RIVER MORPHOLOGY – pg. 23

	U/S			D/S		
Riffle	Present	Abundant		Present	Abundant	
Pool	Present	Abundant		Present	Abundant	
Channel	Natr	Recov	Maintnd	Natr	Recov	Maintnd
Designated Drain	?	Y	N	?	Y	N
Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

Stream Cross Section

STREAM CORRIDOR – pg. 26

	U/S				D/S			
Riparian Veg. Width ft.(L)	< 10	10-30	30-100	>100	10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	< 10	10-30	30-100	>100	10	10-30	30-100	>100
Bank Erosion	0	L	M	H	0	L	M	H
Streamside Land Cover	B	Gr	Sh	Trees	B	Gr	Sh	Trees
Stream Canopy %	<25	25-50	> 50		<25	25-50	> 50	

Adjacent Land Uses

Wetlands	L	R	L	R
Shrub or Old Field	L	R	L	R
Forest	L	R	L	R
Pasture	L	R	L	R
Crop Residue	L	R	L	R
Rowcrop	L	R	L	R
Residential Lawns, Parks	L	R	L	R
Impervious Surfaces	L	R	L	R
Disturbed Ground	L	R	L	R
No Vegetation	L	R	L	R

*** Optional Data Item**

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Date: **Watershed Survey Data Sheet** **(page 2)** **Station #:**

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28													
	U/S			D/S				U/S			D/S		
Crop Related Sources	S	M	H	S	M	H	Land Disposal	S	M	H	S	M	H
Grazing Related Sources	S	M	H	S	M	H	On-site Wastewater Systems	S	M	H	S	M	H
Intensive Animal Feeding Operations	S	M	H	S	M	H	Silviculture (Forestry NPS)	S	M	H	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	S	M	H	Resource Extraction (Mining NPS)	S	M	H	S	M	H
Channelization	S	M	H	S	M	H	Recreational/Tourism Activities (general)	S	M	H	S	M	H
Dredging	S	M	H	S	M	H	?? Golf Courses	S	M	H	S	M	H
Removal of Riparian Vegetation	S	M	H	S	M	H	?? Marinas/Recr. Boating (water releases)	S	M	H	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	S	M	H	?? Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	S	M	H	Debris in Water	S	M	H	S	M	H
Upstream Impoundment	S	M	H	S	M	H	Industrial Point Source	S	M	H	S	M	H
Construction: Highway/Road /Bridge/Culvert	S	M	H	S	M	H	Municipal Point Source	S	M	H	S	M	H
Construction: Land Development	S	M	H	S	M	H	Natural Sources	S	M	H	S	M	H
Urban Runoff (Residential /Urban NPS)	S	M	H	S	M	H	Source(s) Unknown	S	M	H	S	M	H

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS:

Single Site Watershed Survey Data Sheet

Date: **Time:**
Waterbody Name: **County:** **Station #:**
Location: **Township:** **Sec T R ¼ ¼**
Investigator: **Lat:** **Long:**
Coordinate Determination Method (check the one that applies):
___ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe ____________)
Map Scale (if known ___________________)

Upstream Side/Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None	Light	Moderate	Heavy	
Days since Rain	= 1	2	3	Unknown	
Water Temp./D.O./pH *					
Water Color	Clear	Gray	Brown	Black	Green
Waterbody Type -u/s	Stream	Lake	Impound	Wetland	
Waterbody Type -d/s	Stream	Lake	Impound	Wetland	
Stream Width (ft.)	<10	10-25	25-50	>50	
Avg. Stream Depth (ft.)	<1	1-3	>3	Unknown	
Water Velocity (ft./sec) *					
Stream Flow Type	Dry	Stagnant	L	M	H

PHYSICAL APPEARANCE - pg. 20
(Check all that apply)

Aquatic Plants	Present	Abundant
Floating Algae	Present	Abundant
Filamentous Algae	Present	Abundant
Bacterial Sheen/Slimes	Present	Abundant
Turbidity	Present	Abundant
Oil Sheen	Present	Abundant
Foam	Present	Abundant
Trash	Present	Abundant

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	
Silt/Detritus/Muck - fine grain/organic matter	
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23
(check all that apply)

Undercut Banks	
Overhanging Vegetation	
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle	Present	Abundant	
Pool	Present	Abundant	
Channel	Natural	Recovering	Maintained
Designated Drain	?	Y	N

Highest Water Mark (ft.)	?	<1	1-3	3-5	5-10	>10

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)	<10	10-30	30-100	>100
Riparian Veg. Width ft.(R)	<10	10-30	30-100	>100
Bank Erosion	0	L	M	H
Streamside Land Cover	Bare	Grass	Shr	Trees
Stream Canopy %	<25	25-50		>50

Stream Cross Section

Adjacent Land Uses

Wetlands	L	R
Shrub or Old Field	L	R
Forest	L	R
Pasture	L	R
Crop Residue	L	R
Rowcrop	L	R
Residential Lawns, Parks	L	R
Impervious Surfaces	L	R
Disturbed Ground	L	R
No Vegetation	L	R

*** Optional Data Item**

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: **Station #:**

Upstream Side/Downstream Side

POTENTIAL SOURCES (Severity: S – slight; M – moderate; H – high) – pg. 28							
Crop Related Sources	S	M	H	Land Disposal	S	M	H
Grazing Related Sources	S	M	H	On-site Wastewater Systems	S	M	H
Intensive Animal Feeding Operations	S	M	H	Silviculture (Forestry NPS)	S	M	H
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS)	S	M	H	Resource Extraction (Mining NPS)	S	M	H
Channelization	S	M	H	Recreational/Tourism Activities (general)	S	M	H
Dredging	S	M	H	?? Golf Courses	S	M	H
Removal of Riparian Vegetation	S	M	H	?? Marinas/Recr. Boating (water releases)	S	M	H
Bank and Shoreline Erosion/ Modification/Destruction	S	M	H	?? Marinas/Recr. Boating (bank or shoreline erosion)	S	M	H
Flow Regulation/ Modification (Hydrology)	S	M	H	Debris in Water	S	M	H
Upstream Impoundment	S	M	H	Industrial Point Source	S	M	H
Construction: Highway/Road /Bridge/Culvert	S	M	H	Municipal Point Source	S	M	H
Construction: Land Development	S	M	H	Natural Sources	S	M	H
Urban Runoff (Residential/ Urban NPS)	S	M	H	Source(s) Unknown	S	M	H

SITE SUMMARY INFORMATION – pg. 33			
SURVEY DIRECTION	N/A	U/S	D/S
SITE SIMILARITY	?	Y	N
OVERALL SITE RANKING	L	M	H
SITE FOLLOW-UP RANK	L	M	H

COMMENTS:

Instream Survey Data Sheet

Average Water Depth (ft.):
Is the substrate covered with excessive silt? ( ) Yes ( ) No
Substrate Embeddedness: ( ) 0-25% ( ) 25-50% ( ) > 50%

Benthic Macroinvertebrates

Describe the types of habitats and substrates from which invertebrates were collected:

Use letter codes (R = 1-10, C = 11 or more) to record the approximate numbers of organisms in each taxa found in the stream reach.

Group 1 Sensitive	Group 2 Somewhat-Sensitive	Group 3 Tolerant
_____Beetle adults (Coleoptera)	_____Beetle larvae (Coleoptera)	_____Aquatic worms (Oligochaeta)
_____Caddisfly larvae (Trichoptera)	_____Clams (Pelecypoda)	_____Leeches (Hirudina)
_____Hellgrammites (Megaloptera)	_____Cranefly larvae (Diptera)	_____Midge larvae (Diptera)
_____Mayfly nymphs (Ephemeroptera)	_____Crayfish(Decapoda)	_____ Pouch snails (Gastropoda)
_____Gilled Snails (Gastropoda)	_____Damselfly nymphs (Odonata)	_____Sowbugs (Isopoda)
_____Stonefly nymphs (Plecoptera)	_____Dragonfly nymphs (Odonata)	_____True Bugs (Hemiptera)
_____Water penny (Coleoptera)	_____Scuds (Amphipoda)	_____Other Diptera
_____Blackfly larvae (Diptera)	_____Alderfly larvae (Megaloptera)	

Group 1	Group 2	Group 3
____# of R's * 5.0 =____	____# of R's * 3.0 =____	____# of R's * 1.1 = ____
____# of C's * 5.3 =____	____# of C's * 3.2 =____	____# of C's * 1.0 = ____
Group 1 Total =____	Group 2 Total =____	Group 3 Total = ____

Total Stream Quality Score (sum of totals for Groups 1-3) = _____

____Excellent (>48) ____Good (34-48) ____Fair (19-33) ____Poor (<19)

During the sampling and evaluation, did you observe any fish or wildlife? ( ) Yes ( ) No

If yes, please describe (if possible):

(Data Sheet Version 4/27/00)

E. INSTRUCTIONS FOR COMPLETING DATA SHEETS

1. Watershed Survey Data Sheets

a. Site Identification Information

Photographs:

Taking Pictures

Take one photo looking upstream from the road crossing and one photo looking downstream. The photos should be composed (framed) to best represent site conditions. Take the photos in the same sequence at each station to help in later assigning the photos to the proper upstream/downstream designation at the sites. The photos should include at least some of the riparian corridor—how much depends on which areas are significant to include in the photo. Additional photos may be taken to highlight a particular item of concern in the river or upland landscape. Photos may also be taken between stations to record a specific river concern or source area, but these photos should be assigned to the pertinent upstream or downstream station to keep them organized.

Camera Type

Photos may be taken with a traditional 35 millimeter film camera or with a digital camera, whichever the surveyor prefers.

Photo Storage

Regardless whether the original photo was taken with film or digitally, two copies of each photo will be maintained. A copy of each photo will be entered into a computer database that will store all the survey information: digital shots can be transferred directly and traditional developed photos can be scanned in. The original photo will be filed with the paper data forms—digital copies can be kept on their original storage media and conventional photo prints can be clipped to the appropriate station forms. Be sure to label the photos (on the back of individual print photos or on the storage media of digital photos) as soon as possible to minimize the possibility of not being able to determine which photos are for which stations.

Date: Record the month, day and year.

Time: Use 24-hr time (e.g. 1:00 PM should be recorded as 1300).

Waterbody Name: The waterbody name should be the name of the river or river branch, as given on the U.S. Geological Survey topographic map for the area corresponding to the ***station location***. For tributary streams to major rivers, record the tributary stream name here, ***not*** the major river name. For instance, if the stream being surveyed is the North Branch of the Chippewa River, but the station is on Hogg Creek, record Hogg Creek as the waterbody name. If the tributary is an unnamed tributary, record as "Unnamed Tributary to" followed by the name of the next named stream downstream. In the above example, a station on an unnamed tributary of Hogg Creek would be recorded as "Unnamed Tributary to Hogg Creek".

County: Record county name.

Station #: Record station number. Station numbers should use both: (1) a 2-4 letter abbreviation for the name of the sub-basin or river segment being surveyed [see previous discussion on Survey Design], and (2) a number that is derived sequentially in an upstream direction, starting with 01 at the downstream end of the sub-basin or river segment. The letters and numbers should be separated by a hyphen. For example, the third station upstream of the Pine River mouth would be coded as "PR-03".

Location: Record the name of the road crossing the stream. If the same road crosses a single stream two or more times in the same sub-basin, it is sometimes desirable to record the road name relative to the nearest crossroads (e.g. "Green Road between Brown Road and Hill Road"). If the same road crosses a single stream two or more times *in the same township section*, record the road name relative to the distance from the nearest crossroad (e.g. "Green Road 1/8 mile east of Brown Road").

Township: Record the township name.

Sec: Record the township section number, town number, range number, and section ¼ ¼ designations (e.g. SW ¼ of the NW ¼).

Investigator: Record the name of the person conducting the survey (doing the assessment and filling out the form) at this particular site. A last name is generally sufficient.

Lat: Record the latitude coordinates of the road crossing location.

Long: Record the longitude coordinates of the road crossing location.

Coordinate Determination Method: Check the method used to calculate the latitude/longitude location coordinates.

Map Scale: If a map is used to determine latitude/longitude coordinates, record the scale of measurement (e.g. 1:25,000) if known.

Upstream Side/Downstream Side: This category is on the Single Site Watershed Survey Data Sheet only. The "single site" sheet is designed primarily for use by those groups participating in the Division's volunteer monitoring program and it includes only enough response categories for assessing one side of a stream crossing. If using this data sheet, circle either Upstream Side or Downstream Side, as appropriate, to designate which side of the stream crossing is being assessed.

b. Background Information

Event Conditions Noted at Site: A stream "event" occurs when water runoff from a significant weather event, such as a major rainstorm or fast snowmelt, causes an increase in river flow. Note that high water flow conditions can exist (particularly in the spring) that are not related to storm events. Also, rainstorms can occur that result in no increase in stream flow and therefore there is no stream event.

Circle the appropriate description of event conditions exhibited ***in the stream***. Event conditions are increased river flow above what would be considered typical or normal for the stream for the time of year. The surveyor needs to determine this based on the following:

?? Their knowledge of recent weather conditions (e.g. how much it has rained recently).
?? Visual stream observations (look for event related conditions such as a rising or recently elevated water level, water running off the land into the stream, fast stream water velocity, increased water turbidity, an increase in the amount of debris being carried by the stream, etc.).
?? The surveyor's knowledge (or best guess) of what is typical flow for that (or a similar) stream, in that geographic area, for that season of the year.

None	-	No event conditions are evident. Stream flow conditions exist that are typical for the season of the year. Note that it is possible to have "high" flow conditions that are not due to a recent storm event.
Light	-	Stream exhibits increased turbidity from normal and/or the water level of the stream (stage height) is somewhat elevated above what would be considered typical for the season of the year.
Moderate	-	Stream stage height is elevated substantially above typical flow conditions for the stream, for that time of year.
Heavy	-	Bank full or flooding conditions exist.

Days Since Rain: Circle the appropriate number of days that have passed since the last significant rain ended. This information is based on what you know about recent weather in the vicinity of the site. If you do not know, circle "unknown".

Water Temp: This is an optional data item. The person coordinating a particular watershed survey will determine if temperature measurements will be made. If measured, record the water temperature to the nearest degree fahrenheit or centigrade, making sure to include the scale units.

Water D.O.: This is an optional data item. The person coordinating a particular watershed survey will determine if dissolved oxygen (DO) measurements will be made. If measured, record the DO level in the river. If DO is measured, it is important that the water temperature be measured also.

Water pH: This is an optional data item. The person coordinating a particular watershed survey will determine if pH measurements will be made. If measured, record the pH of the stream to the nearest tenth.

Water Color: Circle the choice that best represents the color of the water.

Waterbody Type-u/s: Characterize the waterbody upstream of the road crossing and circle the appropriate category. Impd=impoundment.

Waterbody Type-d/s: Characterize the waterbody downstream of the road crossing and circle the appropriate category. Impd=impoundment.

*****

Continue with the next four stream criteria if a stream is present upstream OR downstream of the road crossing.

*****

Stream Width (ft): Circle the range that represents the average stream width in feet. Make this observation using best professional judgement of the distance. This can be done by pacing off the distance (counting the number of steps taken) on the road crossing from one edge of the stream to the other. There is no need to measure the distance with a tape measure or similar device, however, it is best to have previously paced off distances of 10, 25 and 50 feet so that the number of strides is known to these category endpoints.

Avg. Stream Depth (ft): Circle the appropriate depth range in feet. If the water is turbid and the depth cannot be determined, circle “Unknown”. This observation is for the average depth of the stream that is consistently observed. In other words, if the stream is mostly shallow, but is 5ft deep in the channel, the >3ft category should be circled. However, if the stream is generally shallow (<1ft), but has a pool that is 3ft deep, circle the <1ft category since a pool is not representative of the average depth of <1ft observed over most of the stream. Remember that water often looks shallower than it is. The primary purpose of this data observation is to identify sites that would be suitable for wading for potential future instream assessments.

Water Velocity (ft/sec): This is an optional data item. The person coordinating a particular watershed survey will determine if water velocity measurements will be made. If measured, record the approximate surface water velocity in feet per second, observed at the surface in the area of fastest river flow that is not impacted by the road crossing. The preferred method is to observe how far downstream surface bubbles, foam, leaves, or other floating objects, travel in one second (or observe for 10 seconds and divide the distance by 10). Another method is to step off the width of the road, time how long it takes a particular object (e.g. leaf, stick, grass blade) to float from the upstream side of the bridge to the downstream side, and divide the number of seconds into the distance to get feet per second. In some cases, the water velocity measured at the road crossing will not accurately represent actual stream velocity. This may occur at road crossings where the river width is abnormally restricted by the size of passage beneath the road (such is often the case with culverts), which can cause faster flow through the culvert than is observed in the stream. In such a case, it is better to measure water velocity further upstream or downstream (by looking further upstream or downstream from the bridge, not by going to a different location), if possible.

Stream Flow Type: Circle the category that best represents general flow volume in the stream. Note that in this case, "average" flow refers to the annual average flow. If a river flow is reduced in the summer, due to dry and hot conditions, circle "L" because it is below average, even though low flow may be typical for that stream in the summer.

Dry	=	No standing or flowing water, sediments may be wet.
Stagnant	=	Water present but not flowing, can be shallow or deep.
L (low)	=	Flowing water present, but flow volume would be considered to be below average for the stream.
M (medium)	=	Water flow is in average range for the stream.
H (high)	=	Water flow is above average for the stream.

c. Physical Appearance

Starting with this section of the form and continuing to the end, the person conducting the survey should evaluate each category twice—once for the upstream (U/S) side of the road crossing, and a second time for the downstream (D/S) side. ***The exception to this is that people participating in the Division's volunteer monitoring program may want to use the alternative Single Site Watershed Survey Data Sheet, which only includes assessment categories for one side of the stream crossing*.** From this point on, the surveyor is assessing two distinct sites. The conditions observed at one site should not bias the surveyor's assessment of conditions at the other. Usually it is easiest to complete the rest of the form for either the upstream or downstream site first, and then move to the other side of the road crossing and complete the remainder of the form for the remaining site. Most people do the upstream site first since it is listed on the form first.

Check the stream upstream and downstream, for as far as can be seen from the road stream crossing, for the presence of any of the following characteristics. If a category type (e.g. aquatic plants) is not present in the stream, do not record anything. If a category type can be seen, in any amount, circle "present". If a category type is present in a large portion of the stream, circle "abundant".

Aquatic Plants: This category refers to aquatic macrophytes only, not terrestrial species. By definition, macrophytes are any plant species that can be readily seen without the use of optical magnification. However, the usage here is directed primarily toward aquatic vascular plants—plants with a vascular system that typically includes roots, stems and/or leaves. This includes duckweed, as it is a floating vascular plant. Certain large algae species that superficially look like vascular plants, such as Chara, can be recorded here as well. If the person conducting the survey is knowledgeable about aquatic plants, the particular type or species of plant(s) can be noted in the comment section at the end of the form. Floating, suspended, or filamentous algae species should be recorded in one of the algae categories and not here.

Floating Algae: The presence of suspended algae (single celled organisms that may or may not form colonies) or floating algae mats/bundles should be recorded here. This includes bluegreen algae mats/bundles, whether floating on the surface, suspended in the water column, or present at the bottom.

Filamentous Algae: Algae that appear in stringy or ropy strands, such as Cladophora. The strands may or may not be attached to other objects in the waterbody.

Bacterial Sheen/Slimes:
-Bacterial sheens occur as oily appearing sheens on the water surface, often with a silverish cast to them. The sheens are produced from bacterial decomposition activity, and occur most often in still water areas of lake edges and coves, as well as wetland areas. The sheen can be distinguished from petroleum products by breaking into distinct platelets when poked with a stick or otherwise physically disturbed, whereas petroleum products remain viscous.
-Bacterial slimes are bacterial growths that are visible as a slimy-appearing coating of stream or lake substrates. They can be various colors, including black and orange.

Turbidity: Water appears cloudy—it is not transparent. Turbidity is caused by suspended particulates such as silt, sand, algae, or fine organic matter. Turbid water is opaque to varying degrees, preventing the observer from seeing very far into it. Note that water can have a color to it that is not turbidity, such as the brown transparent water often associated with swampy areas. If the water is slightly turbid, circle "present". If it is moderately turbid to very turbid, circle "abundant".

Oil Sheen: An oily appearing sheen on the water surface caused by petroleum products. A thin sheen will often have a rainbow of hues visible. The sheen can be distinguished from bacterial sheens by remaining viscous when poked with a stick or otherwise physically disturbed, whereas bacterial sheens break into distinct platelets.

Foam: Naturally occurring foam often looks like soap suds on the water surface and can be white, grayish or brownish. Foam is produced when water with dissolved organic material is aerated and can range in extent from individual bubbles to mats several feet high. Foam is typically produced in streams when water flows through rapids or past surface obstructions such as logs, sticks and rocks. Simple wave action can produce foam in lakes. This naturally occurring foam is quite common. Natural foam can be distinguished from soap suds by rubbing it between ones fingers. If the suds disintegrate and leave only wet fingers or a gritty residue, the foam is natural. If the suds feel slippery and soapy, it is not natural foam.

Trash: Use this category to record the presence of general litter, such as paper, bottles, cans, etc., either in the waterbody or along the riparian banks. Use some reasonable discretion when completing this category. A single piece of gum wrapper on one bank would not be sufficient cause for checking "present".

d. Substrate

Substrate is the material that makes up the bottom of the stream or lake. In general, good quality substrates (from an aquatic habitat perspective) contain a large amount of course aggregate material—such as gravels and cobbles—with a minimal amount of fine particles surrounding or covering the interstitial pore spaces. These stable materials provide the solid surfaces necessary for the colonization of attached algae and the development of diverse macroinvertebrate communities.

Using the particle size and composition guidance provided below, identify the percent areal extent of each substrate type present. Round off to the nearest 10% increment. For example, do not record 25%, use either 20% or 30%. The composition estimate should include the entire area of the stream bottom that is visible from the road stream crossing, including substrates near or under the bridge. Sometimes it is not possible to determine the substrate type all the way across a river because it is too deep or the water is turbid. In these cases, assign the appropriate percentage amount to the "unknown" category.

Substrate Type		**Composition and Size**
Boulder	-	Rocks 10 inches in diameter or larger.
Gravel-Cobble	-	Rocks 1/12 inch to 10 inches in diameter.
Sand	-	Rocks 0.06 to 2 millimeters in diameter.
Silt-Muck-Detritus	-	Silt is usually clay, very fine sands, or organic soils, 0.004 to 0.06 millimeters in diameter. Muck is decomposing organic material of very fine diameter. Detritus is small particles of organic material such as pieces of leaves, sticks, and plants.
Hardpan-Bedrock	-	Solid surface. Hardpan is usually packed clay, <0.004 millimeters in diameter. Bedrock is a solid rock surface (the tops of buried boulders are not bedrock).

Artificial	-	Human made, such as concrete piers, sheet piling or rock riprap (that portion of shoreline erosion protection structures that extends below the water surface is considered substrate).
Unknown	-	The portion of the stream bottom for which a substrate type determination can not be made because the bottom can not be seen due to water depth or turbidity.

e. Instream Cover

Instream cover generally refers to habitat cover that is available to fish to: (1) protect them from predators, or (2) avoid certain stream conditions such as fast flow velocities or direct sunlight. Check all the instream cover types on the data form that are present in the stream reach for as far as can be seen—except, only check those cover types that are in areas of sufficient water depth (usually greater than 6 inches). Types of cover include the following:

Undercut Banks	-	Stream banks that overhang the stream because water has eroded some of the material beneath them.
Overhanging Veg	-	Terrestrial vegetation that extends out from shore over the surface of the stream within a foot or two of the water surface (includes trees, shrubs, grasses, etc.). This category also includes sweeping vegetation, which is terrestrial shoreline vegetation that extends into the water itself (such as low hanging branches on shrubs) and is therefore often “swept” in a downstream direction by the current .
Deep Pools	-	A depression or “hole” in the bottom of the stream where the water is substantially deeper than the average water depth of the stream.
Boulders	-	Rocks 10 inches in diameter or larger.
Aquatic Plants	-	Aquatic macrophytes.
Logs/woody Debris	-	Logs, branches and roots.

f. River Morphology

Riffle

Riffles are areas of naturally occurring, short, relatively shallow, zones of fast moving water followed by a pool. The water surface is visibly broken (often by small standing waves) and the river bottom is normally made up of gravel, rubble and/or boulders. Riffles are not normally visible at high water and may be difficult to identify in large rivers. The size of, and distance between, riffles is related to stream size. In large mainstream reaches, such as the Manistee or Muskegon rivers, riffles may be present in the form of rapids.

Present	-	A riffle can be positively identified.
Abundant	-	A series of riffles and pools are visible.

Pool

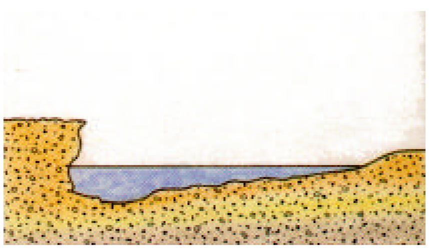
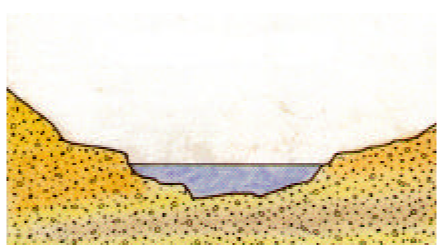
Pools are areas of relatively deep, slow moving water. The key word here is "relatively". Water depth sufficient to classify an area as a pool can vary from around 8 inches in small streams, to several feet in wadable streams, to tens of feet in large rivers. Pools are often located on the outside bend of a river channel and downstream of a riffle zone or obstruction. The water surface of a pool is relatively flat and unbroken. The presence of pools in large rivers may be difficult to identify because of an increase in relative scale, and an often limited ability to see to the bottom of deep or turbid stream reaches.

Present	-	At least one pool can be identified.
Abundant	-	A series of pools in a riffle pool sequence are visible.

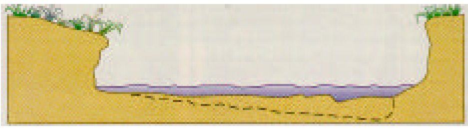
Channel

The channel condition, for the purposes of this assessment, is classified as Natural, Recovering, or Maintained.

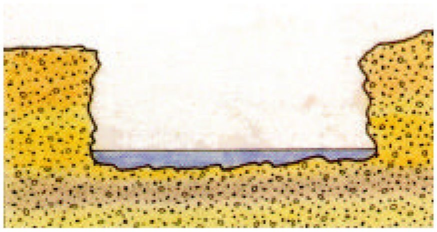
Natural Stream - A natural stream has not been altered from its defined pattern, dimension and profile by artificial means, which includes straightening and widening. It is not necessarily stable, however. The stream has a non-uniform cross section with distinct pool and riffle sequences, although in large rivers the pool/riffle sequences may be difficult to identify. Mild to extreme meanders are often visible. The banks are vegetated and there are no signs of spoil piles or dikes along sides. The stream is not channelized or artificially controlled.

Recovering - A recovering stream is one that has been straightened or otherwise controlled, and is evolving back to a stable pattern, dimension and profile. The stream channel is relatively straight, or is overly wide with a channel within the wider channel. Meanders may be beginning to form as evidenced by bank erosion and pool formation. Pools and riffles should be forming but may be sparse. Point bars may be forming. Vegetation may be sparse or very young. Defined dikes or spoil piles along the stream bank can be identified.



Maintained - A maintained stream channel is one that is actively controlled through dredging, widening, straightening, or the formation of dikes along the stream channel. The stream channel is straight, wide and shallow at low flow, and has a uniform cross section. Bank vegetation is typically sparse or very young. Pools and Riffles are not existent or very sparse.



<u>Designated Drain</u>

If the surveyor knows whether or not the stream segment being assessed is a legally designated drain under the Michigan Drain Code, circle “Y” (yes) or “N” (no). If the surveyor does not know, circle the “?”.

<u>Highest Water Mark</u>

The highest water mark is the maximum height to which the stream water level rises at the site, as determined by the visible evidence present. This level is typically reached during floods or high flow conditions. The highest water mark is determined as the distance in feet <u>**above the present water level**</u> at the site. If the surveyor cannot visibly determine how far the stream rises at the site, circle the “?” on the form.

The highest water mark may be visible as discoloration on bridge pilings or abutments, stream debris (trash, leaves, weeds) left along the stream banks or in tree/shrub branches, ice scour marks on trees or streambanks, or muddy residues left in floodplains or on streamside vegetation.

Stream Cross Section

Draw a rough cross section of the stream profile. This should be just a general approximation. Do not spend more than a few seconds on this.

g. Stream Corridor

The questions in this section are used to characterize terrestrial land cover and land use in the vicinity of the stream, often referred to as the stream corridor.

Riparian Vegetative Width

The riparian vegetative width is the width of the streamside natural vegetation zone along the stream banks. The width is measured from the edge of the stream to the end of the contiguous block of natural vegetation. Natural vegetation is defined as including trees, shrubs, old fields, wetlands, or planted vegetative buffer strips (often used in agricultural areas and stormwater runoff control). Agricultural crop land and lawns are **not** considered natural vegetation for the purposes of this question. Circle the appropriate distance (in feet) that represents the **average, or most representative** (>50% of the lineal bank distance) width of the vegetation zone for each side of the river. Left and right banks are determined from the perspective of facing downstream.

Bank Erosion

Bank erosion may occur as a result of natural flow conditions, or may be caused by human activities. Determine the severity of erosion that has taken place and circle the appropriate category. Record the most severe magnitude of erosion observed on either bank.

0 - The banks appear stable and there is no evidence of erosion. These banks have stable toes and sidewalls, are most likely well vegetated or structurally stabilized, and have no evidence of exposed tree roots or leaning trees due to eroded soil. They are not being altered by water flows, livestock access, or recreational access.

L - Low evidence of erosion. Streambanks are stable but are being lightly altered. Less than 10% of the streambank is receiving any kind of stress. Stress that is noted is very light. Less than 10% of the bank is sloughing, broken down, or actively eroding.

M - Moderate evidence of erosion. At least 75% of the streambank is in stable condition. Between 10% and 25% of the streambank is sloughing, broken down, or actively eroding.

H - High evidence of erosion. Less than 75% of the streambank is in stable condition. Over 25% of the streambank is sloughing, broken down, or actively eroding. Streambank sidewalls may have been scraped by machinery or scouring flows, banks may be slumped, bank toe may be severely undercut. Tree roots may be exposed or fallen/leaning trees may be present.

Streamside Land Cover

Circle the letter of the dominant type of cover that exists at the streambank “edge” (within the first 20 feet or so of the stream edge) along the reach of river that can be seen from the road stream crossing.

B - Bare ground. No, or almost no, streamside vegetation.
G - Grasses, wildflowers, ferns, sedges (non-woody vegetation).
S - Shrubs and small trees. Woody vegetation less than 15 feet high.
T - Trees (15 feet tall or higher).

Stream Canopy

The stream canopy is the amount of leafy vegetation that extends out over a stream (at any height) and shades the water from direct sunlight. The amount of stream canopy should be recorded as the amount of water shading that would be present if the sun were directly over the stream.

0 - None. No shading of stream when sun is directly overhead.
L - Low. Less than 25% of the stream would be shaded.
M - Moderate. 25-50% of the stream is shaded.
H - High. Over 50% of the stream is shaded.

Adjacent Land Uses

Circle the appropriate left or right streambank designation for all of the following land uses that are adjacent to the stream. Land use along the entire length of stream that can be seen from the road stream crossing should be evaluated. This might include land that is beyond the riparian corridor. “Adjacent” requires the use of some judgement on the part of the surveyor, but generally refers to any land that can be seen from the crossing and is reasonably close to the stream such that pollutants could run off it into the stream. For example, if a 20-acre corn field is near a stream but separated from it by a 10’ grass/shrub buffer strip, the “Rowcrop” category should be circled. If the same field were 100’ from the stream and the intervening distance was wooded, the “Forest” category should be circled.

Wetlands	-	Wetland vegetation is present. May or may not include standing water. Could include shrubs and trees.
Shrub or Old Field	-	Meadow or field that has not been recently cultivated or grazed. Often represented by tall grasses and shrubs.
Forest	-	Trees present in forested setting (includes small woodlots). Trees may be cultivated or natural.
Pasture	-	Field showing signs of being recently or actively grazed by livestock (vegetation is cropped close to the ground).
Crop Residue	-	An agricultural crop residue remains, after harvest and/or tillage, which covers 30% or more of the field surface.
Rowcrop	-	Agricultural cropland planted in rows and cultivated.
Res. Lawns, Parks	-	An expanse of maintained grass, often found in residential lawns and parks.
Impervious	-	Impervious surfaces (water can not penetrate them) are present near the water. Includes paved surfaces and roofs.
Disturbed Ground	-	Soil has been disturbed (plowed, cleared, bulldozed, excavated) for construction or agriculture. Vegetation is not present on disturbed ground but may be present in adjacent areas.
No Vegetation	-	Bare ground. No vegetation is present on the soil, but it is not disturbed ground.

h. Potential Sources

The intent of this section is to evaluate the relative importance of potential sources in terms of pollutant contribution to the waterbody at a given site in the watershed. The evaluation assesses the potential for pollutant inputs at the site, **NOT pollutant impacts**, or the potential for pollutant impacts. Pollutant impacts, as indicated by visual manifestations, were evaluated previously on the first page of the data sheet.

Evaluating potential sources of pollutants to a waterbody is a three step process: identification of potential sources, evaluation of pathways for pollutants to get to the waterbody, and finally evaluation of the severity (magnitude) of this pollutant input or loading. The three steps of this process will result in scoring identified sources on the survey sheet as Slight, Moderate, or High Priority in terms of the severity or amount of their pollutant contribution to the waterbody at the site being surveyed.

(1) Source Identification

Visually evaluate the various land use/land change activities at the site for potential sources of pollution. Note all potential sources for the area that can be seen (choosing from among the list of sources on page two of the survey data sheet). For example, is there evidence of soil disturbance at the site, or land uses such as residential lawns, agricultural fields, parking lots, urban areas, etc., near the waterbody. Use the source definitions provided to help identify what potential sources may exist. If it is known that a significant source exists upstream between the road crossing and the next road crossing, such as a wastewater treatment plant, it may be important to note the presence of that source, but it should be recorded in the comments section since it was not visible at the site.

(2) Pollutant Pathway

Next, for each potential source that has been identified, evaluate how pollutants could get from the source to the water. An evaluation of likely pathways for pollutants to enter the waterbody provides information regarding the potential for the identified sources to contribute pollutants. The following provides a quick outline of some visual observations to consider in evaluating pollutant pathways. Pay particular attention to likely water runoff patterns at the site that may occur during rainfall or snowmelt events.

- ?? Gully/rill erosion provides a direct pathway for pollutants to enter the stream in a concentrated flow when the land slopes toward the stream. Pollutants associated with eroding soils will vary depending on the type of land use activity.
- ?? Tile/pipe discharges are potential direct pathways for pollutants.
- ?? Bare soils near the edge of a waterbody provide a likely pathway for sediment to get to the waterbody.
- ?? Maintained lawns to the edge of a waterbody provide a likely pathway for nutrients and pesticides to the waterbody.
- ?? Land disturbance/use activities to the edge of a waterbody provide a likely pathway for various pollutants to the waterbody.
- ?? Open areas of disturbed soils and/or bare soils devoid of vegetation provide a potential pathway for pollutants via wind erosion.
- ?? Steep streambanks (steeper than a 2:1 slope) devoid of vegetation are likely pathways for sediment.
- ?? No canopy over the waterbody is a pathway for dramatic thermal increase in water temperature during the day.
- ?? Impervious surfaces (parking lots, roads, roof tops, etc.) provide a likely pathway for various pollutants, and may increase flows in the watershed causing flashiness.
- ?? Culverts/bridges may not be aligned with the stream, or may be undersized, and could provide a likely pathway for flow to create streambank erosion both upstream and downstream of the culvert or bridge.

(3) Severity Ranking

Finally, for each source for which a pathway has been identified, evaluate how severe the pollutant loading is. Rank each source identified as Slight, Moderate or High severity for the contribution of pollutants, based on the magnitude or quantity of pollutants likely to be delivered to the stream. At present, the surveyor must use their judgement on assigning a slight, moderate or high rating. Eventually, it is expected that there will be a reference photo collection that will provide an example for each rating level in each of the subject categories.

The severity ranking is based only on *pollutant inputs* from the specific source *at the site*, not on visible stream impacts or impacts the pollutant may cause downstream. The pollutant loads from the identified source(s) may or may not have an impact at the site. Assessment of the impact on the waterbody at this site should have been evaluated on the first page of the survey form.

Evaluation of the source, location and pathways can provide a reasonable assessment of the severity of the pollutant loading. The following provides a quick outline of some visual observations to consider in evaluating the severity of pollutant loading.

?? Proximity to waterbody – generally the closer the use, or land disturbance activity, is to the waterbody, the greater the likelihood for pollutant delivery.
?? Slope to waterbody – generally the steeper the slope/topography to the waterbody, the greater the likelihood of overland pollutant delivery.
?? Conveyance to waterbody (ditch, pipe, etc.) – generally a conveyance from the use, or land disturbance activity, increases the likelihood of pollutant delivery.
?? Imperviousness – impermeable surfaces reduce the amount of land area available for water infiltration and increase the potential for overland runoff. Additionally, if a watershed is greater than 10% impervious, it will start to show some systemic problems due to impacts from flow. If a watershed is greater than 25% impervious, the natural hydrology is generally heavily impaired.
?? Intensity and type of use, or land disturbance activity – generally the more intensive the activity the greater the likelihood for the generation of pollutants. Certain activities may have specific types of pollutants associated with them.
?? Size of erosion area – generally the larger the erosion area the greater the likelihood for sediment delivery.
?? Soil type – clay is less permeable than sand, and therefore would create a greater potential for overland runoff of pollutants.
?? Presence and type of vegetation – the greater the vegetative buffer around a waterbody, the better the filtration of pollutants from nearby land disturbance and use activities. Certain types of vegetative buffers work better than others and should be evaluated on a case-by-case basis.

Note: It is usually most time efficient to go through this three-step process individually for each source as it is identified, and then go on to the next source identified (if more than one exists), rather than to evaluate all sources at the same time.

Potential Source Category Definitions.

Source Category	**Use this Source Category if …**
Crop Related Sources (1050)*	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the farmed area. Possible pathways: farming to the edge of the drain, gully/rill erosion off field, tile discharge, wind erosion off field.**
Grazing Related Sources (1350)	**… there is clear evidence that grazing of animals near or in the waterbody has resulted in the degradation of streambanks or stream beds, sedimentation, nutrient enrichment, and/or potential bacterial contamination.**
Intensive Animal Feeding Operations (1600)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from either runoff from the operation or land application of animal manure. Possible pathways: overland flow, tile discharge.**
Highway/Road/Bridge Maintenance and Runoff (Transportation NPS) (8300)	**… there is clear evidence that transportation infrastructure is creating increased flow, runoff of pollutants, or erosion areas in or adjacent to the waterbody.**
Channelization (7100)	**… there is clear evidence that the natural river channel has been straightened to facilitate drainage.**
Dredging (7200)	**… there is clear evidence that a waterbody has been recently dredged. Evidence might include: spoil piles on side of waterbody, disturbed bottom, disturbed banks.**
Removal of Riparian Vegetation (7600)	**… there is clear evidence that vegetation along the waterbody has been recently removed (within the last few years).**
Bank and Shoreline Erosion/ Modification/Destruction (7700)	**… there is clear evidence that the banks or shoreline of a waterbody have been modified through either through human activities or natural erosion processes.**
Flow Regulation/ Modification (Hydrology) (7400)	**… there is reasonably clear evidence that flow modifications in the watershed have created unstable flows resulting in streambank erosion.**
Upstream Impoundment (7350)	**… there is reasonably clear evidence that an upstream impoundment has contributed to impacts on downstream sites. Impacts may be: nuisance algae, increased temperatures, streambank erosion from unstable flows.**
Construction: Highway/Road /Bridge/Culvert (3100)	**… there is clear evidence that on going or recent construction of transportation infrastructure is contributing pollutants to the waterbody.**
Construction: Land Development (3200)	**… there is clear evidence that on going or recent land development is contributing pollutants to the waterbody.**
Urban Runoff (Residential/ Urban NPS) (4000)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from an urban/residential area. Possible pathways: gully/rill erosion, pipe/storm sewer discharge, wind erosion, runoff from lawns or impervious surfaces.**
Land Disposal (6000)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from an area where waste materials (trash, septage, hazardous waste, etc.) have been either land applied or dumped. Possible pathways: gully/rill erosion, pipe discharge, wind erosion, or direct runoff.**
On-site Wastewater Systems (e.g. septic systems-6500)	**… there is reasonably clear evidence of nutrient enrichment and/or sewage odor is present, and there is reason to believe the area is unsewered.**

Source Category	Use this Source Category if …
Silviculture (Forestry NPS) (2000)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the forest management area. Possible pathways: logging to the edge of the waterbody, gully/rill erosion off site, pumped drainage, erosion from logging roads, wind erosion off site.**
Resource Extraction (Mining NPS) (5000)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the mined area. Possible pathways: gully/rill erosion off site, pumped drainage, runoff from mine tailings, wind erosion off site.**
Recreational/Tourism Activities (general) (8700)	**… you are unable to clearly identify the recreational source as related to a golf course, or recreational boating activity. Foot traffic causing erosion would fall into this category.**
Golf Courses (8710)	**… there is a reasonably clear pathway for pollutants to enter the waterbody from the golf course area. Possible pathways: overland runoff, gully/rill erosion off course, tile discharge, wind erosion off course.**
Marinas/Recr. Boating (water releases) (7910)	**… if you can reasonably determine that releases of pollutants to a waterbody such as septage or oil/gasoline are due to recreational boating activities.**
Marinas/Recr. Boating (streambank erosion)	**… you can reasonably determine that streambank erosion is due to wake from recreational boating activities.**
Debris in Water (8520)	**… debris in the water either is discharging a potential pollutant, or is causing in stream impacts due to modifications of flow. Possible examples: Leaking barrel, Refrigerator, Tires, etc. This does not include general litter (e.g. paper products).**
Industrial Pt. Source (0110)	**… there is reasonably clear evidence that an upstream industrial point source has contributed pollutants.**
Municipal Pt. Source (0200)	**… there is reasonably clear evidence that an upstream municipal point source has contributed pollutants.**
Natural Sources (8600)	**… there is reasonably clear evidence that natural sources are contributing pollutants. Possible examples: streambank erosion, pollen, foam, etc.**
Source(s) Unknown (9000)	**… if you see an impact but are unable to clearly identify any likely sources.**

* The numbers in parentheses under Source Category are not relevant to conducting the survey and can be ignored by the surveyor. The numbers refer to U.S. Environmental Protection Agency reporting categories under Section 305(b) of the federal Clean Water Act and are included here to facilitate source reporting in SWQD Procedure 51 reports.

i. Site Summary Information

Survey Direction

Watershed surveys will normally be conducted in either an upstream (U/S) or downstream (D/S) direction from one site to the next, in order to provide continuity in interpreting changes in the watershed. Circle the survey direction used. If the survey is being conducted to evaluate singular sites, and not for characterization of a watershed (i.e. multiple sites in the same watershed), then circle "Not Applicable" (N/A) for the survey direction.

Site Similarity

This is a shorthand way to allow quick evaluation of whether **physical habitat** at sites upstream or downstream of the current site are similar to the physical habitat of the site being evaluated. If the physical habitat is **nearly identical** to the previous site, circle "Y" for Site Similarity. If there are differences between sites, even small ones, circle "N". In most circumstances, sites will probably **not** be similar since there are often a few physical habitat conditions that differ among adjacent sites. If there is uncertainty as to whether the site is similar to the previous site, or N/A is circled under survey direction, then circle "?" for Site Similarity.

Overall Site Ranking

This is a shorthand way to allow quick evaluation of how important a site is for **remediation activities** regarding **sources** of pollution. If the majority of pollution sources are rated as slight in severity, circle "L", low priority for remedial actions. If the majority of pollution sources are rated moderate in severity, circle "M", medium priority for remedial actions. If the majority of pollution sources are rated high in severity, circle "H", high priority for remedial actions.

Site Follow-Up Ranking

This is a shorthand way to allow quick evaluation of how important a site is for **timely follow-up activities** regarding **sources** of pollution. Follow up activity ranking should be based on the following criteria:

?? Identified short-term need, such as for construction sites.
?? Ability to rapidly address the issue, such as with a phone call, site visit, or enforcement.
?? Unknown issues that should be investigated further, such as a pipe discharge of unknown origin.

Comments

Any observations about the site that were not covered elsewhere on the survey form should be recorded in this section. If certain survey responses require clarification or elaboration, those should be described here as well. The comment section can also be used to add detail to the site characterization, such as listing the types of aquatic plants or algae present, if known.

Sometimes while traveling to or from a site, significant factors that could potentially affect water quality (e.g. land use, habitat, and pollutant sources) are observed. If these conditions were observed between this site and the next upstream site, they should be recorded here, with a notation that the conditions cannot be seen from the site. These "between site" observations are often important for characterizing conditions in a watershed and should be recorded whenever possible.

2. Instream Survey Data Sheet

a. General Considerations

The instream survey data sheet (primarily covering benthic macroinvertebrate collections) is an optional form that will usually only be completed at a small number of selected sites relative to the number of sites visually surveyed. Many watersheds may not have any instream data collected from them. The form is primarily intended for those groups participating in the Division's volunteer stream monitoring program. However, others may use the form should they desire some benthic macroinvertebrate data from some of their sites.

The criteria used to select sites for instream assessment work include those criteria discussed earlier in the "Survey Design" section on selecting survey stations. Additionally, when evaluating the potential impacts from a suspected pollutant source area, stations should be located upstream and downstream of the source area. In all cases, the site should be representative of the area of stream surveyed, it should contain a diverse range of instream cover, and it should contain some gravel/cobble bottom substrates.

This instream assessment work should only be conducted by properly trained personnel. Conducting the instream survey and completing the instream data sheet requires more intensive training than that needed for completing the watershed survey data sheet. Training should be given only by Gary Kohlhepp, Great Lakes and Environmental Assessment Section (GLEAS), SWQD (517-335-1289); Nicole Vidales, GLEAS, SWQD (517-241-9534); or other aquatic biologists designated by them.

b. Assessment Procedures

Average Water Depth

To measure average water depth (ft), three measurements should be made at random points along the representative reach length being surveyed (preferably in stable sand areas), and these values averaged for a mean depth. If the stream is too deep for measurements, an estimate will suffice.

Siltation

Some siltation along stream margins is normal. However, silt that settles on gravel, cobble, and woody debris in the main stream channel can have a negative impact on the benthic invertebrates that colonize these substrates and also can affect fish reproduction. Note on the data form whether there is obvious siltation on the dominant substrate types in the main stream channel.

Embeddedness

Embeddedness refers to the extent to which gravel, cobble, or boulders are surrounded or covered by fine material (such as silt or sand). The more the substrate is embedded, the less its surface area is exposed to the water and available for colonization by invertebrates. Record the appropriate level of embeddedness observed in the stream reach. This is measured as the percentage of an **individual** substrate piece, such as a rock, that is covered on average.

Benthic Macroinvertebrates

The sampling effort expended to collect benthic macroinvertebrates at each site should be sufficient to ensure that all types of benthic invertebrate habitats are sampled in the stream reach. This generally will be about 30 minutes of total sampling time per station.

Sample collection should begin at the downstream end of the stream reach and work upstream.

Macroinvertebrate samples should be collected from all available habitats within the stream reach using a dip net with a one millimeter (mm) mesh, a kick screen made from doweling and window screening, or by hand picking. Habitat types can include gravel, cobble, silt, sand, submerged wood, leaf packs, algal mats, and aquatic plants. Habitat and substrate types from which macroinvertebrates were collected (or collections were attempted) should be recorded on the form.

All organisms collected should be placed into a jar or bucket to form one composite sample. The composite sample should be rinsed and all large pieces of debris removed. The remaining sample contents should be emptied into an enamel pan with a light-colored bottom.

The organisms in the pan should be identified to order using the taxonomic keys provided, and the abundance of each taxon in the stream segment should be estimated and recorded on the survey form (R=Rare [1-10 organisms], C=Common [11 or more organisms]).

The total stream quality score should be calculated as indicated on the survey form. This score is then used to rank the site as excellent, good, fair, or poor.

During the macroinvertebrate survey, volunteers should take note of any fish or wildlife (frogs, turtles, ducks, etc.) that may be visible in/on the stream and document any observations on the survey form.

F. DATABASE

This section has not been drafted yet, because the database has not been developed. Once the database is developed, instructions will be issued on how to use the database, input data, and conduct data analyses. These instructions will cover the following items at a minimum.

1. Format
2. Entering Data
3. Maintenance
4. Data Analysis
5. Standard Reports

G. QUALITY ASSURANCE/QUALITY CONTROL

1. Concept

Quality assurance is an integrated system of management practices used to verify that the quality control system is operating within acceptable limits and to evaluate the quality of the data. Quality control is a system of technical procedures implemented to produce measurements of needed quality. Some of the basic quality assurance and quality control (QA/QC) components of this stream crossing watershed survey procedure include: assignment of staff roles and responsibilities, personnel training, determining the confidence level required for the data, field data collection audits, replicate surveys, database entry audits, database management, data analysis, report preparation, and periodic procedure evaluations.

2. Data Principles

This section describes the type, quantity and quality of data needed to meet the procedure objectives and support decisions based on the survey results.

a. Data Type

The types of data to be collected were carefully considered in the development of the survey forms and have been determined to be appropriate for the goals of this procedure. Most of the data collected for the watershed survey data sheet are obtained by simple visual observation. The observations are recorded by mostly choosing among preselected possible responses. Additionally, some water quality and biological data may be collected at selected locations by appropriate personnel.

b. Data Quantity

The minimum quantity of data needed is that which will meet the SWQD goal of assessing 80% of Michigan's watersheds. The question of how many stream crossing sites should be surveyed within a watershed to adequately characterize it was discussed in detail earlier in this document in the Survey Design section. The basic concept is that the number and distribution of stations within a watershed is determined on a watershed-by-watershed basis. The general guideline is to try to survey a minimum of 30% of the stream crossing sites within a watershed, with the sites distributed such that each subwatershed (and their subwatersheds) is assessed to provide a representative depiction of conditions found throughout the watershed. At least one site should be surveyed in each tributary and adequate geographic coverage of the watershed should be obtained.

The previous paragraph lays out the minimum quantity of data needed to meet a statewide SWQD objective. However, this procedure identifies several other objectives that apply to individual watersheds. If the intent of a particular watershed survey is to meet some of these watershed-specific objectives, then additional data are needed. The general guideline in this case is that most stream crossing sites within a watershed need to be assessed to fully meet the procedure objectives.

c. Data Quality

The quality of data needed is that which will meet the procedure objectives and support water quality management decisions based on the data. As stated earlier in this document, the watershed survey data sheet portion of the survey was designed to be completed using visual assessments; therefore, the data are inherently subjective. Additionally, in order to increase the amount of data that can be collected, this survey process was designed to be conducted by a variety of personnel with different knowledge levels of water quality, aquatic biology, and nonpoint source pollution issues. Furthermore, land use and water quality conditions vary considerably throughout the state such that a condition that might be considered a major problem in more pristine areas, potentially may not be judged as being so bad in another part of the state. Some conditions in streams also vary seasonally, such as stream flow, aquatic plant growth, and the amount of leafy material present in the stream. Consequently, there are a variety of QA/QC items implemented specifically to minimize variation from both subjective observations and environmental conditions in order to facilitate the accurate collection of quality data on a statewide basis.

3. Initial Field Tests

Initial field tests need to be done to confirm the accuracy (bias), precision (reproducibility), and comparability of the data. Field tests will involve having several trained people independently assess conditions at a set of selected sites. By having a variety of people assess the same site, the results can be checked to see how well the various survey results match each other to check precision. The sites chosen should also exhibit a large range of water quality and land use conditions to check accuracy and comparability. These field tests should be done at the startup of the survey effort as a pretest of the data forms and instructions.

4. Tiers of Data Quality

As discussed previously, this survey process was designed to be conducted by a variety of personnel with different knowledge levels of water quality, aquatic biology, and nonpoint source pollution issues, in order to increase the amount of data that can be collected. To facilitate accuracy and comparability of data results, all data will be classified into one of three data quality tiers.

Tier 1. It is expected that the best quality data—with respect to accuracy, precision and comparability—will be collected by personnel with the most water quality training, and experience working with nonpoint source pollution issues. Consequently, Tier 1 data will be that collected by SWQD staff and other water quality professionals.

Tier 2. Tier 2 data is the next level down, and is that data collected by volunteers that have gone through a training program specific to conducting the stream crossing watershed surveys.

Tier 3. Tier 3 data is considered to be of variable quality, and is that data collected by schools, 4H groups, and other similar organizations. Although Tier 3 data may be of less rigorous quality than Tier 1 and Tier 2 data, the information is useful for identifying potential problem sites, for later follow-up investigation by others, that might not have otherwise been surveyed. Additional benefits accrue from the educational aspects of the students/volunteers learning about the issues and conducting the surveys.

5. Spot Field Checks

Spot field checks should be done periodically. This will involve having a second investigator go out to a site that was recently surveyed by another person and conduct an independent assessment of the site. The results can be compared to evaluate the accuracy of site depiction and the reproducibility of the results between surveyors.

6. Reference Photos

Soon after project implementation, a reference photo collection should be assembled with photos that show examples of each response category for each potential source on the watershed survey data sheet. Using “Bank and Shoreline Erosion” as an example, reference photos showing slight, moderate, and high erosion sites, would help maintain a consistent frame of reference for surveyors throughout the state, and would be an educational aid when training new surveyors.

7. Database

This section has not been drafted yet because the database itself has not been completely developed, but it will cover the following items.

Database Development
Database Structure (organization)
Data Entry (templates, “out of range” checks, spot data entry checks)
Database Maintenance/Management
Data Analysis
Standard Reports

8. Post-Implementation Evaluation

Post-implementation evaluation should be most intensive immediately after project startup to verify the following: the data sheets are appropriate for the information that is requested; that surveyors are interpreting the data sheets correctly; that the instructions are clear; that surveyors are accurately identifying and recording conditions at the sites; and that results are reproducible and comparable.

9. Training

Personnel conducting stream crossing watershed surveys should be trained prior to conducting the survey.

Training on completing the Watershed Survey Data Sheet, or the Single Site Watershed Survey Sheet, can be given by any SWQD staff who have been trained on the survey procedure and have experience using it to evaluate sites. Any questions that arise that cannot be answered by the trainer should be directed to Charlie Bauer, Saginaw Bay District Office, SWQD (517-686-8025).

The training for conducting the instream survey and completing the Instream Survey Data Sheet is more intensive than that needed for completing the watershed or single site data sheets. Training should be given only by Gary Kohlhepp, Great Lakes and Environmental Assessment Section (GLEAS), SWQD (517-335-1289); Nicole Vidales, GLEAS, SWQD (517-241-9534); or other aquatic biologists designated by them.