Total Suspended Solids, Stable Flow, and Wet Weather Event Monitoring in the Sand Creek Watershed

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Grand Valley State University
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1. Introduction

An investigation of streams in west Michigan was conducted to monitor the loading of Total Suspended Solids (TSS) and fluctuations in hydrology. The study sites were located in the lower Grand River watershed and included: Bass River, Sand Creek, Strawberry/Mill Creek, York Creek and an unnamed tributary north of Leonard Street and east of East Beltline (M-44). Each of these watersheds is a tributary to the Grand River and is included on Michigan's 2002 303(d) list as requiring a Total Maximum Daily Load (TMDL) because they were identified as not supporting the designated use for biota. The data for each watershed are summarized in individual reports. This report examines the discharge and loading of TSS at 8 locations in Sand Creek under base flow (dry conditions) and during storm events. The data from this project will be used to develop a Biota TMDL for the Sand Creek watershed.

2. Monitoring Locations and Watershed Description for Sand Creek

Sand Creek has a 35,084 acre watershed located in Kent and Ottawa Counties (Figure 2.1). Land use in the watershed is primarily agricultural (52%), forests, fields, and wetlands (25%), and residential (17%). A summary of land use/and cover statistics is presented in Table 2.1. Stormwater discharge outfalls were inventoried and eight stream locations were selected for flow and TSS monitoring (Figure 2.1). Descriptions and coordinates for the stormwater outfalls and monitoring stations are provided in Table 2.2. Data for the standard Michigan Department of Natural Resources (MDEQ) Steam Survey Form were collected at each monitoring station. The Steam Survey Forms are included in Appendix 1. Photographs of each monitoring station and stormwater location were taken and included in Appendix 2.

3. Sampling Methods

Dry weather sampling was conducted on 6/28/04, 7/14/04, and 7/28/04. One grab sample was collected from each station. Dry weather sampling was preceded by at least 72 hours without precipitation as measured at the Grand Rapids Airport.

Wet weather sampling was conducted on 8/25/04, 8/28/04, and 11/1/04 The wet weather runoff events were in response to precipitation events of 0.1, 1.1, and 1.3 inches that occurred in a 2 hour time period. Sampling was initiated near the start of each rain event. During the rise and fall of the hydrograph, individual grab samples were collected manually at hourly intervals. Wet weather sampling events lasted from 4-6 hrs. TSS samples were collected at the centroid of each stream transect where approximately 50% of cumulative flow occurred. If the stream was wadeable, samples were collected by immersing a 500 milliliter (ml) polyethylene bottle at mid depth. If the stream was not wadeable, a thief sampler was used. Sample containers were placed in coolers with ice and kept at 4^{o}C. One field blank sample was collected for every 20 investigative samples. One field duplicate sample was collected for every 10 investigative samples.

Figure 2.1 Sand Creek Watershed.

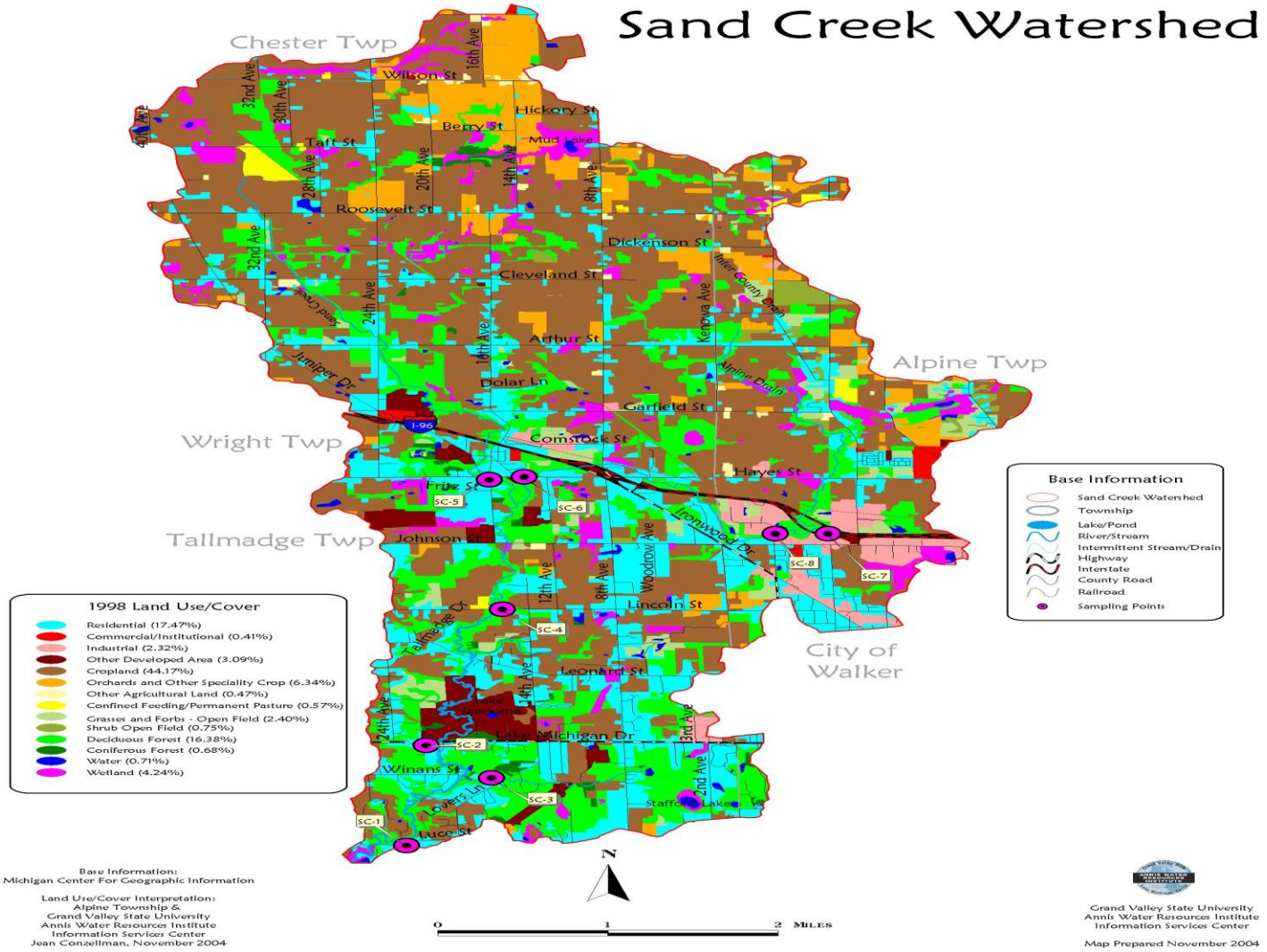


Table 2.1 Sand Creek Land Use and Cover Statistics.

Sand Creek Land Use/Cover		
Map Description	**Acres**	**%**
Commercial/Institutional	145	0.4
Confined Feeding/Permanent Pasture	202	0.6
Coniferous Forest	237	0.7
Cropland	15497	44
Deciduous Forest	5747	16
Grasses and Forbs - Open Field	841	2
Industrial	815	2
Orchards and Other Specialty Crop	2225	6
Other Agricultural Land	164	0.5
Other Developed Area	1083	3
Residential	6129	17
Shrub Open Field	264	0.8
Water	248	0.7
Wetland	1487	4
Total	35084	100

Table 2.2 Sand Creek Monitoring Stations, Stormwater Outfalls, and Coordinates.

Location and GPS Coordinates				
Type	Location	Site ID	Lat. (N)	Long. (W)
Monitoring	Luce Street (Downstream)	SC-1	42.94902	-85.8491
Monitoring	M-45 (Downstream)	SC-2	42.97190	-85.8394
Monitoring	Lovers Lane NW (Upstream)	SC-3	42.96447	-85.8250
Monitoring	Lincoln Avenue (Downstream)	SC-4	43.00185	-85.8259
Monitoring	Hayes Street (Downstream)	SC-5	43.03110	-85.8303
Monitoring	Hayes Street (4 Mile Road) (Upstream)	SC-6	43.03107	-85.8220
Monitoring	Walker Industrial Park (Upstream)	SC-7	43.01835	-85.7778
Monitoring	Hayes Street (4 Mile Road) (Upstream)	SC-8	43.03093	-85.7685
Stormwater			42 59.434	85 49.878
Stormwater			42 58.339	85 50.377

Flow was measured at each location using a Marsh-McBirney Flow Mate 2000 velocity meter according to United States Geological Survey protocols. Transects were established at each location and water depth measurements were collected using a bridge board and sounding reel or a self-leveling rod. The location of each transect was marked by stakes. Depending on stream width, 4 – 12 equally spaced points along each transect were used for depth and flow measurements. Transect locations were selected to minimize interferences from structural anomalies such as debris jams, bridges, and highly eroded areas. Water elevations were measured at the MDEQ reference point located on each culvert or bridge. Flow measurements were collected during each wet and dry weather sampling event. If the stream depth was < 2.5 feet, flow measurements were taken at 0.6 depth at each transect point. If depths were > 2.5 feet, flow measurements were taken at 0.2 and 0.8 depths.

4. Analytical Methods

Total Suspended Solids (TSS) was measured gravimetrically by Environmental Protection Agency (EPA) Method 160.2. A complete method description was provided in the Quality Assurance Project Plan (QAPP). One laboratory blank and one laboratory duplicate were analyzed for every ten investigative samples.

5. Bass River Base Flow Data

Base flow and TSS loading data for the Sand Creek watershed are summarized in Table 5.1. High precipitation amounts in May (10 inches) and June (4.5 inches) resulted in elevated stream levels during the June 28 monitoring event. There was no measurable precipitation for 7 days prior to the June sampling. Rating Curves developed by the MDEQ for each monitoring station and the location of surface elevation reference points are provided in Appendix 3.

6. Bass River Storm Event Data

Storm flow and TSS loading data for the Sand Creek watershed are summarized in Tables 6.1, 6.2, and 6.3 for the 0.1, 1.1, and 1.3 inch rainfall events, respectively.

7. Deviations from the Quality Assurance Project Plan

Some of the field and laboratory duplicates with low suspended solids (<10 mg/l) exceeded the RPD limits. The difference between duplicates ranged from 1-3 mg/l. The small relative difference between duplicates reflects normal variations associated with sampling and analysis at low concentration levels. Based on professional judgment, the data was not qualified. The results of field and laboratory duplicates and blanks were submitted in a separate Quality Assurance report.

Table 5.1 Base Flow TSS Loading Data for Sand Creek.

Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Surface ft	Method
June 28, 2004							
SC-1	Luce St	1.06	37.43	8	1612	17.00	Meter
SC-2	Lake Michigan Drive (M-45)	0.97	34.25	6	1106	25.41	Meter
SC-3	Lovers Lane NW (Tributary)	0.05	1.77	3	29	5.61	Meter
SC-4	Lincoln Ave	0.80	28.25	9	1369	11.62	Meter
SC-5	Hayes St (West of 16th Ave)	0.22	7.77	9	376	11.19	Meter
SC-6	Hayes St (East of 16th Ave)	0.25	8.83	3	143	6.11	Meter
SC-7	Walker Industrial Park (at Wilson Ave)	0.13	4.59	7	173	12.31	Meter
SC-8	Hayes St. (4-mile Road)	0.12	4.24	7	160	4.09	Meter
July 15, 2004							
SC-1	Luce St	0.61	21.54	5	580	17.27	Meter
SC-2	Lake Michigan Drive (M-45)	0.43	15.18	2	163	25.58	Meter
SC-3	Lovers Lane NW (Tributary)	0.01	0.35	3	6	5.78	Meter
SC-4	Lincoln Ave	0.34	12.01	5	323	11.98	Meter
SC-5	Hayes St (West of 16th Ave)	0.07	2.47	8	106	11.55	Meter
SC-6	Hayes St (East of 16th Ave)	0.08	2.82	1	15	6.30	Meter
SC-7	Walker Industrial Park (at Wilson Ave)	0.06	2.12	4	46	12.84	Meter
SC-8	Hayes St. (4-mile Road)	0.05	1.77	2	19	4.19	Meter
July 29, 2004							
SC-1	Luce St	0.41	14.48	1	78	17.29	Meter
SC-2	Lake Michigan Drive (M-45)	0.39	13.77	2	148	25.67	Meter
SC-3	Lovers Lane NW (Tributary)	0.02	0.71	2	8	5.81	Meter
SC-4	Lincoln Ave	0.36	12.71	2	137	12.01	Meter
SC-5	Hayes St (West of 16th Ave)	0.11	3.88	3	63	11.58	Meter
SC-6	Hayes St (East of 16th Ave)	0.07	2.47	2	27	6.40	Meter
SC-7	Walker Industrial Park (at Wilson Ave)	0.05	1.77	2	19	12.80	Meter
SC-8	Hayes St. (4-mile Road)	0.03	1.06	1	6	4.29	Meter

Table 6.1 Sand Creek TSS Loading Data for the 0.1 Inch Rain Event 8/25/04

August 25 Stormflow Data								
Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Loading lb/hr	Water Elevation (ft)	Method
			5:00					
SC-1	Luce Street	0.43	15.18	1	82	3.4	17.15	Meter
SC-2	Lake Michigan Drive (M-45)	0.36	12.71	2	137	5.7	25.45	Meter
SC-3	Lovers Lane NW (Tributary)	0.02	0.71	1	4	0.2	5.74	Meter
SC-4	Lincoln Avenue	0.28	9.89	3	160	6.7	12.00	Meter
SC-5	Hayes Street (West of 16th)	0.05	1.77	2	19	0.8	11.51	Meter
SC-6	Hayes Street (East of 16th)	0.05	1.77	1	10	0.4	6.56	Meter
SC-7	Walker Industrial Park (at Wilson)	0.03	1.06	3	17	0.7	12.89	Meter
SC-8	Hayes St. (4-mile Road)	0.03	1.06	2	11	0.5	6.25	Meter
			6:00					
SC-1	Luce Street	0.44	15.54	3	251	10	17.11	Meter
SC-2	Lake Michigan Drive (M-45)	0.41	14.48	9	701	29	25.30	Meter
SC-3	Lovers Lane NW (Tributary)	0.08	2.82	4	61	3	5.65	Meter
SC-4	Lincoln Avenue	0.30	10.59	5	285	12	11.95	Meter
SC-5	Hayes Street (West of 16th)	0.06	2.12	38	433	18	11.48	Meter
SC-6	Hayes Street (East of 16th)	0.09	3.18	6	103	4	6.50	Meter
SC-7	Walker Industrial Park (at Wilson)	0.04	1.41	12	91	4	12.80	Meter
SC-8	Hayes St. (4-mile Road)	0.04	1.41	5	38	2	6.20	Meter
			7:00					
SC-1	Luce Street	0.46	16.24	8	699	29	17.09	Meter
SC-2	Lake Michigan Drive (M-45)	0.38	13.42	4	289	12	25.35	Meter
SC-3	Lovers Lane NW (Tributary)	0.10	3.53	10	190	8	5.51	Meter
SC-4	Lincoln Avenue	0.32	11.30	7	426	18	11.90	Meter
SC-5	Hayes Street (West of 16th)	0.10	3.53	55	1045	44	11.40	Meter
SC-6	Hayes Street (East of 16th)	0.08	2.82	8	122	5	6.52	Meter
SC-7	Walker Industrial Park (at Wilson)	0.06	2.12	15	171	7	12.54	Meter
SC-8	Hayes St. (4-mile Road)	0.05	1.77	8	76	3	6.18	Meter
			8:00					
SC-1	Luce Street	0.47	16.60	4	357	15	17.05	Meter
SC-2	Lake Michigan Drive (M-45)	0.41	14.48	4	312	13	25.35	Meter
SC-3	Lovers Lane NW (Tributary)	0.05	1.77	8	76	3	5.60	Meter
SC-4	Lincoln Avenue	0.31	10.95	6	354	15	11.92	Meter
SC-5	Hayes Street (West of 16th)	0.07	2.47	10	133	6	11.42	Meter
SC-6	Hayes Street (East of 16th)	0.07	2.47	5	67	3	6.54	Meter
SC-7	Walker Industrial Park (at Wilson)	0.05	1.77	5	48	2	12.50	Meter
SC-8	Hayes St. (4-mile Road)	0.05	1.77	6	57	2	6.20	Meter
			9:00					
SC-1	Luce Street	0.45	15.89	4	342	14	17.10	Meter
SC-2	Lake Michigan Drive (M-45)	0.39	13.77	4	297	12	25.39	Meter
SC-3	Lovers Lane NW (Tributary)	0.04	1.41	4	30	1	5.70	Meter
SC-4	Lincoln Avenue	0.26	9.18	12	593	25	12.05	Meter
SC-5	Hayes Street (West of 16th)	0.06	2.12	5	57	2	11.45	Meter
SC-6	Hayes Street (East of 16th)	0.06	2.12	5	57	2	6.54	Meter
SC-7	Walker Industrial Park (at Wilson)	0.03	1.06	4	23	1	12.64	Meter
SC-8	Hayes St. (4-mile Road)	0.04	1.41	5	38	2	6.25	Meter

Table 6.2 Sand Creek TSS Loading Data for the 1.1 Inch Rain Event on 8/02/04

Site ID:	Name	Discharge m^3/ sec	Discharge cfs	TSS mg/l	Loading lb/d	Loading lb/hr	Water Elevation (ft)	Method
			4:30					
SC-1	Luce Street	0.44	15.54	2	167	6.97	17.10	Meter
SC-2	Lake Michigan Drive (M-45)	0.38	13.42	2	144	6.02	25.35	Meter
SC-3	Lovers Lane NW (Tributary)	0.03	1.06	3	17	0.71	5.70	Meter
SC-4	Lincoln Avenue	0.31	10.95	4	236	9.82	12.11	Meter
SC-5	Hayes Street (West of 16th)	0.06	2.12	3	34	1.43	11.43	Meter
SC-6	Hayes Street (East of 16th)	0.06	2.12	3	34	1.43	6.51	Meter
SC-7	Walker Industrial Park (at Wilson)	0.03	1.06	3	17	0.71	12.72	Meter
SC-8	Hayes St. (4-mile Road)	0.03	1.06	2	11	0.48	6.18	Meter
			6:30					
SC-1	Luce Street	0.59	20.83	35	3925	163.55	17.05	Meter
SC-2	Lake Michigan Drive (M-45)	0.75	26.48	68	9694	403.92	24.35	Meter
SC-3	Lovers Lane NW (Tributary)	0.12	4.24	78	1779	74.13	5.32	Meter
SC-4	Lincoln Avenue	0.51	18.01	33	3199	133.29	11.81	Meter
SC-5	Hayes Street (West of 16th)	0.22	7.77	79	3304	137.65	11.30	Meter
SC-6	Hayes Street (East of 16th)	0.19	6.71	55	1986	82.76	6.18	Meter
SC-7	Walker Industrial Park (at Wilson)	0.13	4.59	43	1063	44.27	11.81	Meter
SC-8	Hayes St. (4-mile Road)	0.11	3.88	21	439	18.30	4.88	Meter
			7:30					
SC-1	Luce Street	0.77	27.19	66	9660	402.49	16.88	Meter
SC-2	Lake Michigan Drive (M-45)	0.89	31.43	55	9304	387.68	25.22	Meter
SC-3	Lovers Lane NW (Tributary)	0.31	10.95	91	5362	223.42	4.81	Meter
SC-4	Lincoln Avenue	0.57	20.13	45	4876	203.15	11.72	Meter
SC-5	Hayes Street (West of 16th)	0.26	9.18	82	4053	168.85	10.90	Meter
SC-6	Hayes Street (East of 16th)	0.21	7.42	60	2395	99.79	6.08	Meter
SC-7	Walker Industrial Park (at Wilson)	0.13	4.59	55	1359	56.63	11.79	Meter
SC-8	Hayes St. (4-mile Road)	0.11	3.88	24	502	20.91	4.81	Meter
			8:30					
SC-1	Luce Street	1.26	44.49	67	16047	668.61	16.62	Meter
SC-2	Lake Michigan Drive (M-45)	1.19	42.02	50	11310	471.24	25.18	Meter
SC-3	Lovers Lane NW (Tributary)	0.17	6.00	74	2391	99.63	5.18	Meter
SC-4	Lincoln Avenue	0.70	24.68	55	7308	304.48	11.44	Meter
SC-5	Hayes Street (West of 16th)	0.34	12.01	64	4136	172.34	10.88	Meter
SC-6	Hayes Street (East of 16th)	0.29	10.24	75	4134	172.26	5.92	Meter
SC-7	Walker Industrial Park (at Wilson)	0.23	8.12	46	2011	83.79	11.61	Meter
SC-8	Hayes St. (4-mile Road)	0.16	5.65	22	669.08	27.88	4.72	Meter
			9:30					
SC-1	Luce Street	1.15	40.61	61	13334	555.59	16.73	Meter
SC-2	Lake Michigan Drive (M-45)	0.98	34.60	48	8941	372.56	25.28	Meter
SC-3	Lovers Lane NW (Tributary)	0.11	3.88	53	1108	46.17	5.30	Meter
SC-4	Lincoln Avenue	0.68	24.01	74	9565	398.53	11.46	Meter
SC-5	Hayes Street (West of 16th)	0.39	13.59	51	3732	155.51	10.78	Meter
SC-6	Hayes Street (East of 16th)	0.29	10.24	58	3197	133.21	5.86	Meter
SC-7	Walker Industrial Park (at Wilson)	0.19	6.71	41	1481	61.70	11.68	Meter
SC-8	Hayes St. (4-mile Road)	0.21	7.42	19	758	31.60	4.65	Meter
			10:30					
SC-1	Luce Street	1.10	38.84	58	12127	505.30	16.81	Meter
SC-2	Lake Michigan Drive (M-45)	0.95	33.54	54	9751	406.30	25.32	Meter
SC-3	Lovers Lane NW (Tributary)	0.08	2.82	31	471	19.64	5.48	Meter
SC-4	Lincoln Avenue	0.73	25.78	66	9158	381.59	11.50	Meter
SC-5	Hayes Street (West of 16th)	0.22	7.77	42	1756	73.18	10.25	Meter
SC-6	Hayes Street (East of 16th)	0.21	7.42	55	2195	91.48	6.02	Meter
SC-7	Walker Industrial Park (at Wilson)	0.13	4.59	37	914	38.10	11.87	Meter
SC-8	Hayes St. (4-mile Road)	0.08	2.82	20	304	12.67	4.89	Meter

Table 6.3 Sand Creek TSS Loading Data for the 1.3 Inch Rain Event on 11/01/04.

Appendix 1

Sand Creek Watershed Survey Forms for Monitoring Stations 2004

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 15:20

Waterbody Name: Sand Creek County: Ottawa Station #: 1

Location: SC-1 Township: Tallmadge Sec 33 T7N R13W ¼ NW ¼ SE

Investigator: BTS, MB Lat: 42.94902 Long: -85.84908

Coordinate Determination Method (check the one that applies):

X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)			25-50		
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft/sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20

(Check all that apply)

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

SUBSTRATE (%) – pg. 22

(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	50%
Sand – coarse grain	50%
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	Very Little
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	Some

RIVER MORPHOLOGY – pg. 23

Riffle	Present					
Pool						
Channel	Natural					
Designated Drain						
Highest Water Mark (ft.)					5-10	

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)			30-100	
Riparian Veg. Width ft.(R)			30-100	
Bank Erosion			M	
Streamside Land Cover			Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

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

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

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:

Erosion during flooding is evident. Sample site downstream of bridge.

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 16:05

Waterbody Name: Sand Creek County: Ottawa Station #: 2

Location: SC-2 Township: Tallmadge Sec 27 T 7N R 13W ¼ NW ¼ NE

Investigator: BTS, MB Lat: 42.9719 Long: -85.83937

Coordinate Determination Method (check the one that applies):

_X_ 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				
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)		10-25			
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20

(Check all that apply)

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

SUBSTRATE (%) – pg. 22

(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	60%
Sand – coarse grain	
Silt/Detritus/Muck - fine grain/organic matter	40%
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

INSTREAM COVER – pg. 23

(check all that apply)

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

RIVER MORPHOLOGY – pg. 23

Riffle						
Pool						
Channel	Natural					
Designated Drain	?					
Highest Water Mark (ft.)				3-5		

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)			30-100	
Riparian Veg. Width ft.(R)			30-100	
Bank Erosion		L		
Streamside Land Cover				
Stream Canopy %		25-50		

Stream Cross Section

Adjacent Land Uses

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

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

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:

Date: 6-28-04

Single Site Watershed Survey Data Sheet

Time: 14:55

Waterbody Name: Sand Creek | County: Ottawa | Station #: 3

Location: SC-3 | Township: Tallmadge | Sec 27 T 7N R 13W ¼ NE ¼ SE

Investigator: MB, BTS | Lat: 42.96447 | Long: -85.825

Coordinate Determination Method (check the one that applies):

_X_ GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Upstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site					
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color	Clear				
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type			L		

PHYSICAL APPEARANCE - pg. 20

(Check all that apply)

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

SUBSTRATE (%) – pg. 22

(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	95%
Silt/Detritus/Muck - fine grain/organic matter	5%
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	Very Little

RIVER MORPHOLOGY – pg. 23

Riffle						
Pool						
Channel	Natural					
Designated Drain	?					
Highest Water Mark (ft.)			1-3			

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)					>100
Riparian Veg. Width ft.(R)					>100
Bank Erosion	0				
Streamside Land Cover					Trees
Stream Canopy %					>50

Stream Cross Section

Adjacent Land Uses

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

* Optional Data Item

Data Sheet Version 4/27/00

Single Site Watershed Survey Data Sheet (page 2)

Date: 6-28-04 **Station #: SC-3**
Upstream Side

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

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:

Very natural, Unimpacted appearance. Sample sites upstream of bridge.

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 17:00

Waterbody Name: Sand Creek County: Ottawa Station #: 4

Location: SC-4 Township: Tallmadge (N), Allendale (E), Georgetown (N) Sec 15 T 7N R 13W ¼ NE ¼ NE

Investigator: MB, BTS Lat: 43.00185 Long: -85.82585

Coordinate Determination Method (check the one that applies):

X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)		10-25			
Avg. Stream Depth (ft.)		1-3			
Water Velocity (ft./sec) *					
Stream Flow Type			L		

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

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

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	10%
Cobble/Gravel –10 to .08 in. diam.	40%
Sand – coarse grain	50%
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	Deep D.S. of bridge
Boulders	
Aquatic Plants	
Logs or Woody Debris	

RIVER MORPHOLOGY – pg. 23

Riffle						
Pool	Present					
Channel	Natural					
Designated Drain	?					
Highest Water Mark (ft.)				3-5		

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)				>100
Riparian Veg. Width ft.(R)				>100
Bank Erosion		L		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Stream Cross Section

Adjacent Land Uses

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

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

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: Sample site downstream of bridge.

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 17:47

Waterbody Name: Sand Creek County: Ottawa Station #: 5

Location: SC-5 Township: Tallmadge (N), Allendale (E), Georgetown (N) Sec 3 T 7N R 13W ¼ NE ¼ NE

Investigator: MB, BTS Lat: 43.0311 Long: -85.83027

Coordinate Determination Method (check the one that applies):

X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Downstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain	≤ 1				
Water Temp./D.O./pH *					
Water Color			Brown		
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)		10-25			
Avg. Stream Depth (ft.)		1-3			
Water Velocity (ft./sec) *					
Stream Flow Type			L		

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

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

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	15%
Cobble/Gravel –10 to .08 in. diam.	
Sand – coarse grain	
Silt/Detritus/Muck - fine grain/organic matter	85%
Hardpan/Bedrock – solid clay/rock surface	
Artificial – manmade	
Unknown	

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

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

RIVER MORPHOLOGY – pg. 23

Riffle			
Pool			
Channel	Natural		
Designated Drain			

Highest Water Mark (ft.)				3-5		

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)		10-30			
Riparian Veg. Width ft.(R)			30-100		
Bank Erosion					
Streamside Land Cover		Grass	Shrub	Trees	
Stream Canopy %		25-50			

Stream Cross Section

Adjacent Land Uses

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

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

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: Sample site downstream of bridge.

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 18:16

Waterbody Name: Sand Creek County: Ottawa Station #: 6

Location: SC-6 Township: Wright Sec 35 T 8N R 13W ¼ SE ¼ SW

Investigator: BTS, MB Lat: 43.03107 Long: -85.82197

Coordinate Determination Method (check the one that applies):

X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Upstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain					Unknown
Water Temp./D.O./pH *					
Water Color	Clear				
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type			L		

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

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

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	10%
Cobble/Gravel –10 to .08 in. diam.	40%
Sand – coarse grain	50%
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	Some
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	Some

RIVER MORPHOLOGY – pg. 23

Riffle			
Pool			
Channel	Natural		
Designated Drain	?		

Highest Water Mark (ft.)	?					

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)	<10			
Riparian Veg. Width ft.(R)		10-30		
Bank Erosion		L		
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %		25-50		

Stream Cross Section

Adjacent Land Uses

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

* Optional Data Item

Data Sheet Version 4/27/00

Date: Station #:
Upstream Side/Downstream Side

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

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: Sample sites upstream of bridge.

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 18:48

Waterbody Name: Sand Creek County: Kent Station #: 7

Location: SC-7 Township: City of Walker Sec 6 T 7N R 12W ¼ SW ¼ SE

Investigator: MB, BTS Lat: 43.01835 Long: -85.77782

Coordinate Determination Method (check the one that applies):

X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Upstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain					unknown
Water Temp./D.O./pH *					
Water Color	Clear				
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)		1-3			
Water Velocity (ft./sec) *					
Stream Flow Type			L		

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

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

SUBSTRATE (%) – pg. 22 (add to 100%)

Boulder – 10 in. diam.	10%
Cobble/Gravel –10 to .08 in. diam.	90%
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	>50%
Deep Pools	
Boulders	
Aquatic Plants	
Logs or Woody Debris	Some

RIVER MORPHOLOGY – pg. 23

Riffle			
Pool			
Channel			Maintained
Designated Drain	?		

Highest Water Mark (ft.)	?

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)	<10			
Riparian Veg. Width ft.(R)	<10			
Bank Erosion	0			
Streamside Land Cover		Grass	Shrub	Trees
Stream Canopy %				>50

Adjacent Land Uses

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

Stream Cross Section

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

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: Sample site upstream of bridge.

Date: 6-28-04 **Single Site Watershed Survey Data Sheet** Time: 19:16

Waterbody Name: Sand Creek County: Kent Station #: 8

Location: SC-8 Township: Alpine Sec 31 T 8N R 12W ¼ SE ¼ SE

Investigator: MB, BTS Lat: 43.03093 Long: -85.76852

Coordinate Determination Method (check the one that applies):

X GPS ___ GPS w/ DBR ___ Digital mapping software ___ Topographic map ___ Other (describe _____)

Map Scale (if known _____)

Upstream Side

PHYSICAL HABITAT

BACKGROUND INFORMATION - pg. 18

Event Conditions noted at site	None				
Days since Rain					unknown
Water Temp./D.O./pH *					
Water Color	Clear				
Waterbody Type-u/s	Stream				
Waterbody Type-d/s	Stream				
Stream Width (ft.)	<10				
Avg. Stream Depth (ft.)	<1				
Water Velocity (ft./sec) *					
Stream Flow Type			L		

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

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

SUBSTRATE (%) – pg. 22
(add to 100%)

Boulder – 10 in. diam.	
Cobble/Gravel –10 to .08 in. diam.	10%
Sand – coarse grain	90%
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			
Pool			
Channel			Maintained
Designated Drain	?		

Highest Water Mark (ft.)	?					

STREAM CORRIDOR – pg. 26

Riparian Veg. Width ft.(L)	<10			
Riparian Veg. Width ft.(R)	<10			
Bank Erosion	0			
Streamside Land Cover		Grass		
Stream Canopy %	<25			

Stream Cross Section

Adjacent Land Uses

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

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

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: Sample sites upstream of bridge.

Appendix 2

Sand Creek Watershed Monitoring Station

and Stormwater Outfall Pictures 2004

SC-1 Downstream

SC-2 Downstream

SC-3 Upstream

SC-4 Downstream

SC-5 Bridge

SC-5 Downstream

SC-6 Downstream

SC-6 Bridge

SC-7 Bridge

SC-7 Downstream

SC-8 Upstream

Stormwater Discharge Pipe of Leonard Street near Failed Dam

Stormwater Discharge from M-45 (South Side of Road) near Aman Park

Stormwater Discharge from M-45 (North Side of Road) near Aman Park

Appendix 3

Sand Creek Watershed

MDEQ Rating Curves 2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division

Stage-Discharge Rating Curve

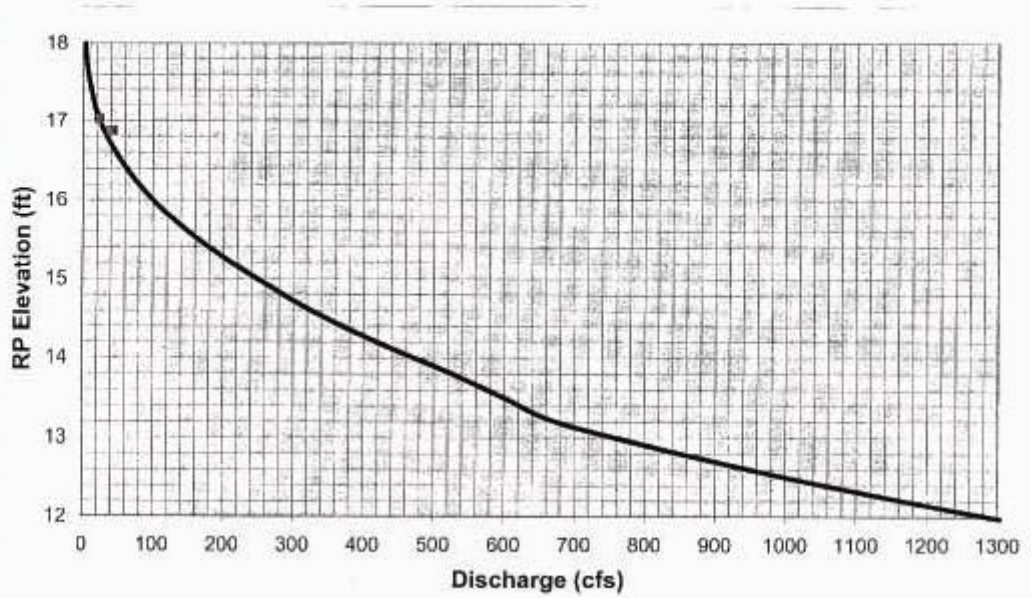
Station: SC-01, Sand Creek at Luce Street

RP: Downstream side of bridge a notched on top of 8th I-beam from the left edge of water.

RP (ft)	Discharge (cfs)
18.0	3.64
17.7	5.93
17.4	11.69
17.1	20.27
16.8	34.25
16.5	54.00
16.2	79.50
15.9	111.29
15.6	149.86
15.3	195.69
15.0	249.09
14.7	305.52
14.4	369.97
14.1	443.04
13.8	525.39
13.5	600.20
13.2	673.65
12.9	805.64
12.6	951.51
12.3	1111.60
12.0	1286.25
11.7	1475.77

Measurements

Date	Discharge	RP
6/28/2004	41.63	16.87
8/30/2004	23.12	17.02

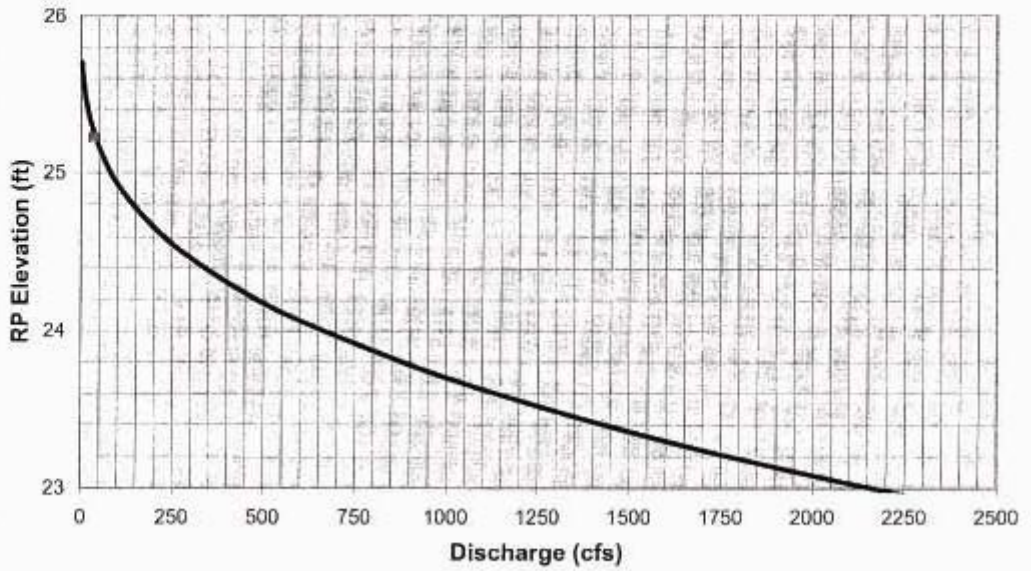


10/19/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage-Discharge Rating Curve

Station: SC-02, Sand Creek at M-45
RP: Downstream side of bridge a notched on top of I-beam.

RP	Discharge	Measurements		
(ft)	(cfs)	Date	Discharge	RP
25.70	2.53	6/28/2004	35.02	25.22
25.55	8.23			
25.40	18.89			
25.25	35.84			
25.10	60.37			
24.95	93.72			
24.80	142.03			
24.65	203.93			
24.50	280.86			
24.35	374.19			
24.20	485.28			
24.05	615.43			
23.90	765.91			
23.75	937.99			
23.60	1132.87			
23.45	1351.76			
23.30	1595.85			
23.15	1866.30			
23.00	2164.27			
22.85	2490.89			



10/19/2004

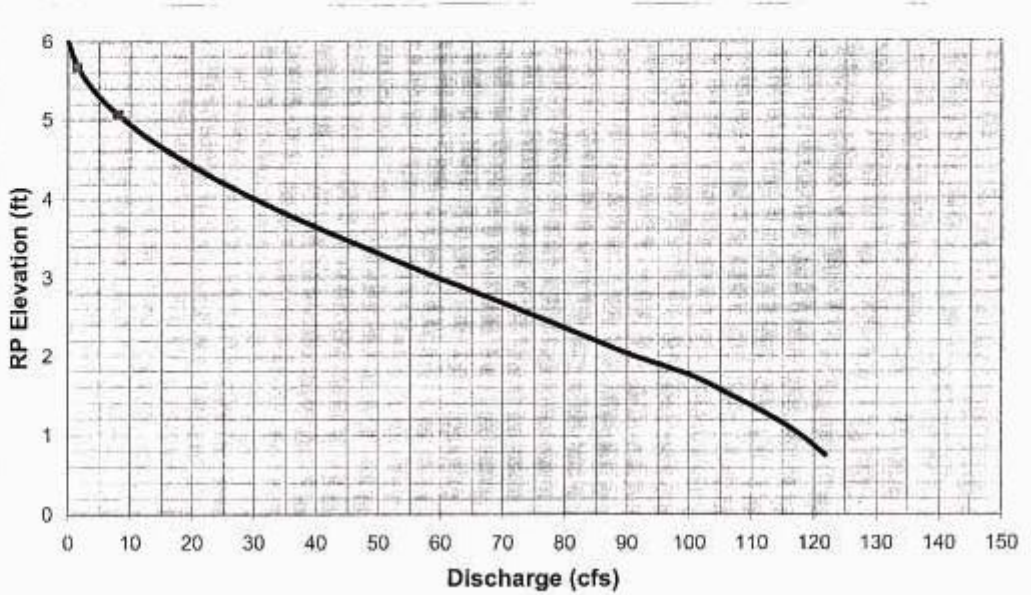
DEQ Michigan Department of Environmental Quality - Land and Water Management Division

Stage-Discharge Rating Curve

Station: SC-03, Unnamed Tributary to Sand Creek at Lover's Lane
RP: Upstream side of culvert a notched on top of circular culvert.

RP	Discharge
(ft)	(cfs)
6.00	0.08
5.75	1.10
5.50	2.91
5.25	5.56
5.00	9.02
4.75	13.22
4.50	18.32
4.25	23.96
4.00	30.18
3.75	37.04
3.50	44.28
3.25	51.83
3.00	59.64
2.75	67.65
2.50	75.47
2.25	83.38
2.00	91.16
1.75	100.26
1.50	106.78
1.25	112.96
1.00	117.98
0.75	121.86

Measurements		
Date	Discharge	RP
8/30/2004	1.45	5.66
5/20/2004	8.08	5.06



10/18/2004

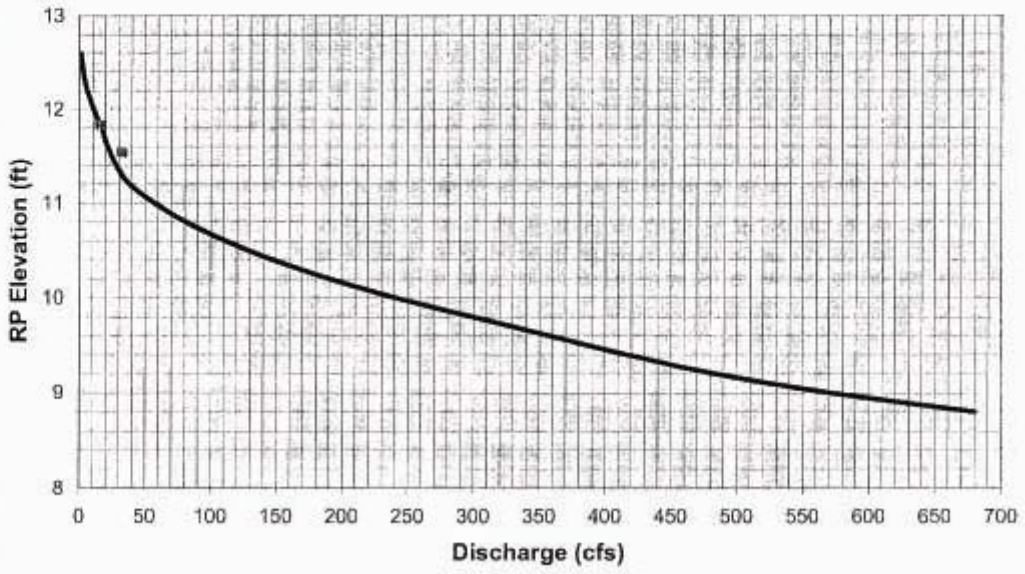
DEQ Michigan Department of Environmental Quality - Land and Water Management Division

Stage-Discharge Rating Curve

Station: SC-04, Sand Creek at Lincoln Street
RP: Downstream side of bridge.

RP	Discharge
(ft)	(cfs)
12.6	0.97
12.4	2.09
12.2	5.78
12.0	10.55
11.8	16.70
11.6	21.36
11.4	27.98
11.2	38.15
11.0	57.24
10.8	81.53
10.6	111.52
10.4	147.71
10.2	190.56
10.0	240.52
9.8	298.02
9.6	356.43
9.4	415.79
9.2	481.80
9.0	570.47
8.8	680.18

Measurements		
Date	Discharge	RP
8/30/2004	16.15	11.83
6/28/2004	32.35	11.53



10/19/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division

Stage Discharge Rating Curve

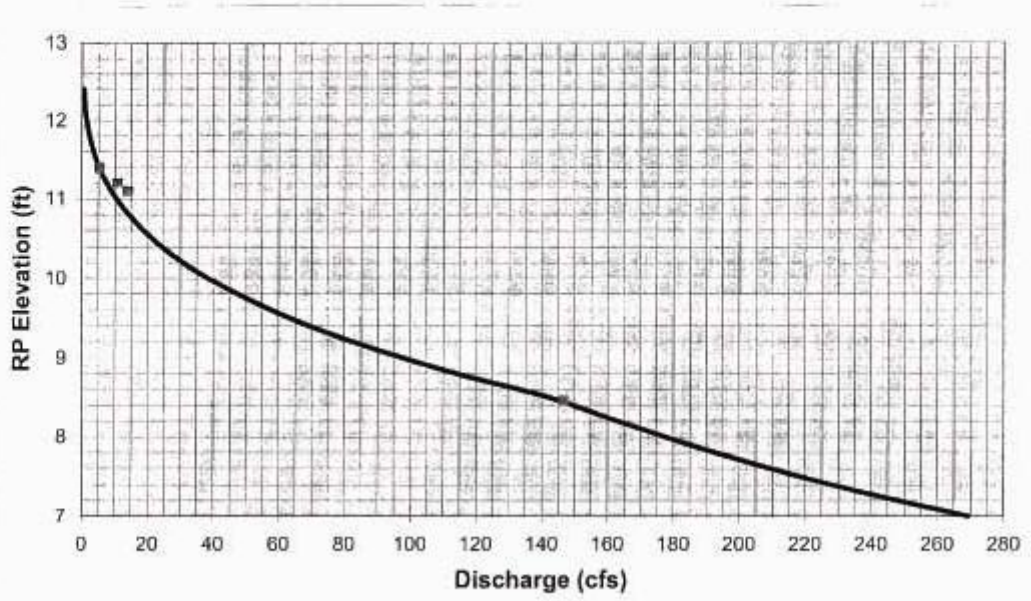
Station: SC-05, 04119243, Sand Creek at Hayes Street

RP: Downstream side of bridge a notched on top of railing between de 2nd and 3rd support railing from the LEW.

RP (ft)	Discharge (cfs)
12.4	0.59
12.1	1.11
11.8	2.30
11.5	4.33
11.2	7.58
10.9	12.29
10.6	18.79
10.3	27.42
10.0	38.51
9.7	52.40
9.4	69.42
9.1	89.89
8.8	114.13
8.5	142.47
8.2	163.42
7.9	184.95
7.6	209.57
7.3	237.63
7.0	269.49

Measurements

Date	R.P.	Dicharge
4/29/2004	11.2	10.9
5/20/2004	8.46	146.57
6/28/2004	11.1	13.98
6/30/2004	11.39	5.37



10/19/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division

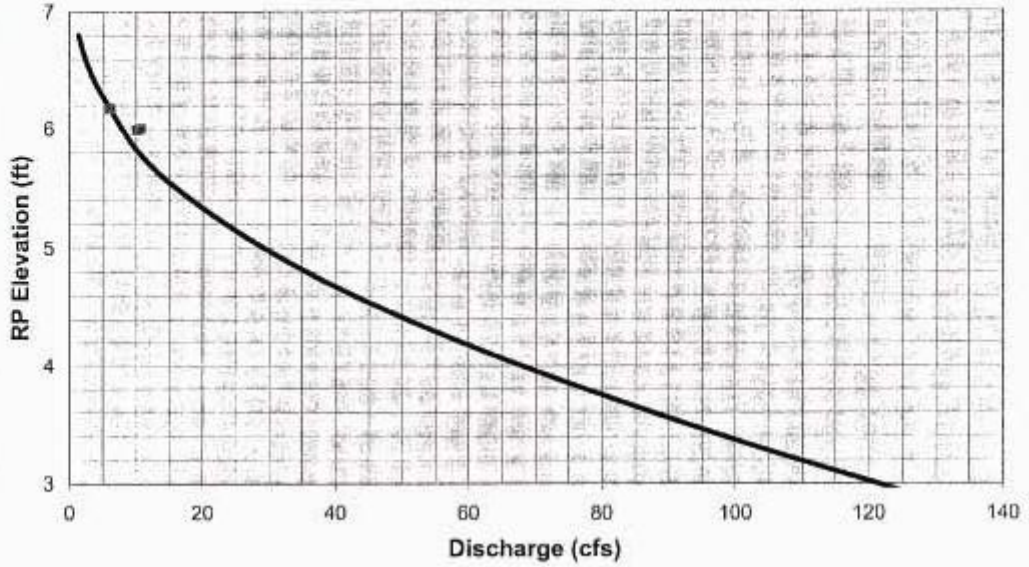
Stage Discharge Rating Curve

Station: SC-06, East Fork Sand Creek at Hayes Road

R.P. Upstream side of bridge top of blue head nail on a tree about 25 feet from bridge on the right edge of water.

RP (ft)	Discharge (cfs)
6.8	1.33
6.6	2.35
6.4	3.77
6.2	5.79
6.0	7.91
5.8	10.38
5.6	13.84
5.4	18.35
5.2	23.51
5.0	29.32
4.8	35.77
4.6	42.87
4.4	50.59
4.2	58.93
4.0	67.88
3.8	77.43
3.6	87.56
3.4	98.27
3.2	109.55
3.0	121.38
2.8	133.75

Measurements		
Date	Discharge	RP
8/30/2004	6.14	6.17
6/28/2804	10.69	6.00
4/29/2004	10.12	5.99

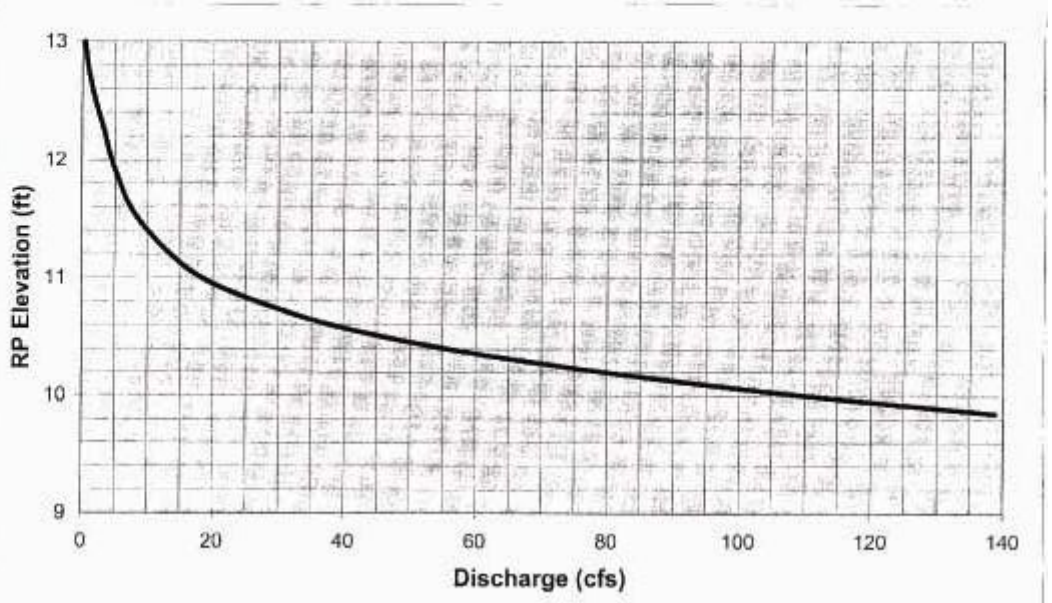


10/19/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage Discharge Rating Curve

Station: SC-07,East Fork Sand Creek at Wilson Avnue
R.P. Downstream side of bridge.

RP (ft)	Discharge (cfs)
13.00	0.48
12.85	0.78
12.70	1.22
12.55	1.82
12.40	2.56
12.25	3.39
12.10	4.02
11.95	4.82
11.80	5.82
11.65	6.90
11.50	8.63
11.35	10.83
11.20	13.52
11.05	16.80
10.90	22.00
10.75	29.18
10.60	38.07
10.45	50.71
10.30	66.73
10.15	86.39
10.00	110.24
9.85	138.85



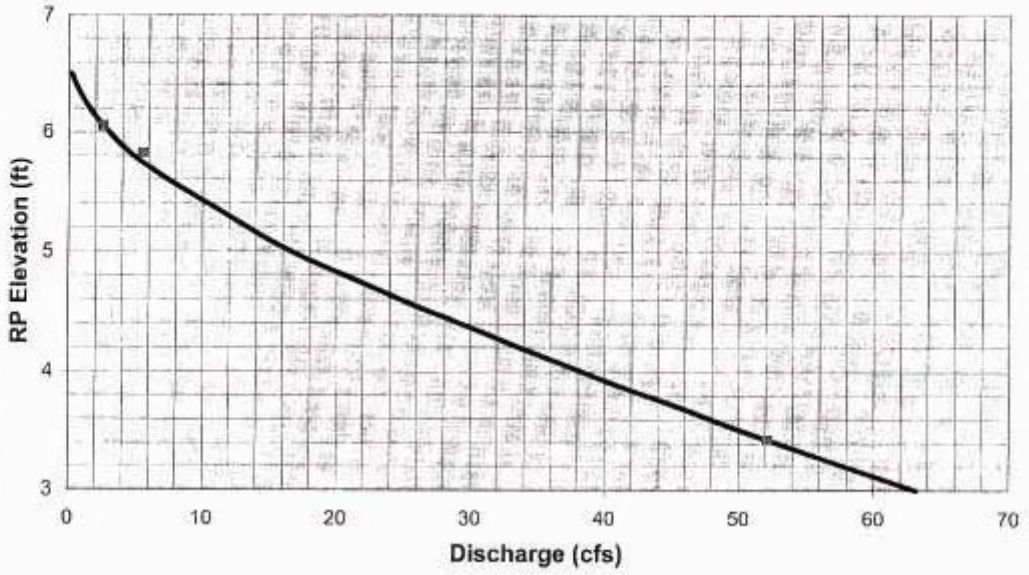
10/19/2004

DEQ Michigan Department of Environmental Quality - Land and Water Management Division
Stage Discharge Rating Curve

Station: SC-08, East Fork Sand Creek at 4 Mile Road
R.P. A notch on the downstream side of private bridge.

RP (ft)	Discharge (cfs)
6.50	0.17
6.33	0.83
6.15	1.84
5.97	3.22
5.80	4.81
5.62	7.08
5.45	9.61
5.27	12.31
5.10	14.91
4.92	18.11
4.75	21.68
4.57	25.38
4.40	29.20
4.22	33.12
4.05	37.15
3.87	41.27
3.70	45.48
3.52	49.77
3.35	54.15
3.17	58.61
3.00	63.15

Measurements		
Date	Discharge	RP
8/30/2004	2.59	6.05
6/28/2804	5.56	5.82
5/20/2004	52.14	3.43



10/19/2004