Parvin Branch and Tarkiln Branch Watershed Restoration Master Plan

APPENDIX F

Benthic bioassessment metric values

Benthic Macroinvertebrate Sampling

Three sample sites were established: two on Parvin Branch (PB1 and PB2) and one on Tarkiln Branch (TB1). These sites were sampled for benthic macroinvertebrates on June 9, 2005 and September 5, 2005 and were also used for surface water monitoring. Benthic macroinvertebrate sampling was completed on June 9, 2005 by Citizens United to Protect the Maurice River and its Tributaries (CUPMRT) and TRC Omni Environmental Corp. (TRC Omni). During this sampling event, Dr. Amy Soli of TRC Omni provided training in benthic macroinvertebrate collection techniques. CUMPRT completed the benthic macroinvertebrate sampling on September 5, 2005.

Benthic macroinvertebrates were collected using a 500 µm mesh kick-net. Invertebrates were collected by kicking a 1 m^2 area upstream of the kick-net in order to dislodge the invertebrates. Three 1 m^2 areas representing a variety of habitats were sampled at each stream site; the invertebrates and substrate collected were combined into one composite sample. Large pieces of substrate collected in the net were inspected for invertebrates (and discarded), as was the kick-net. Captured invertebrates were placed in bottles containing 80% ethanol and labels with site identification information. Vegetation (e.g. leafpacks) and substrate collected in the kick-net were also placed in the bottles for later inspection to remove organisms. A supplemental qualitative sample of coarse particulate organic matter (CPOM) was also collected at each site during each sampling episode and preserved separately in 80% ethanol.

Various benthic metrics based on diversity and pollution tolerance were calculated following the guidelines of Barbour et al. (1999) and the NJDEP's BFBM RPB(2006, 2004) (Appendix H). Richness indices included taxa richness; Ephemeroptera, Plecoptera, and Trichoptera (EPT) richness; %EPT; and % contribution dominant family (%CDF). EPT richness is the total number of Ephemeroptera, Plecoptera, and Trichoptera taxa in each sample; %EPT is percentage of the total number of organisms in each sample belonging to the EPT orders. The %CDF is the percentage of the total number of organisms in each sample in the numerically dominant family. Taxa were also classified as being tolerant, semi-tolerant, or intolerant to pollution based on Family Tolerance Values (FTV) provided by the NJDEP BFBM. Using the FTV's, the Modified Family Biotic Index (FBI) was calculated. The NJDEP bases their FBI on that developed by Hilsenhoff (1988). The bioassessment indices (taxa richness, EPT, %EPT, %CDF, and FBI) were calculated for each site for each sampling date.

The preserved benthic samples were later sorted in the laboratory. All Benthic macroinvertebrates were identified to the lowest practical taxonomic level, usually to family. Benthic macroinvertebrate sorting and identification was conducted by CUPMRT. Dr. Amy Soli of TRC Omni provided a quality

assurance check for the identification of benthic macroinvertebrate samples. Dr. Soli evaluated a minimum of 10% of the samples to verify proper identification of benthic macroinvertebrates. A list of taxa collected, and the number of individuals of each taxa, is located in Appendix H. Benthic macroinvertebrate data were analyzed using benthic metrics discussed in the US EPA's Rapid Bioassessment Protocols manual (Barbour et al., 1999) and the NJDEP's Bureau of Freshwater and Biological Monitoring's (BFBM) Rapid Bioassessment Protocol (RBP).

Benthic macroinvertebrate sampling yielded between 2 and 12 taxa and 6 and 123 individuals per site. With the exception of PB1 on 9/5/2005 and TB1 on 9/5/2005, the predominant taxon in each sample was Chironomidae (midge flies), a pollution tolerant organism. Physidae was the dominant taxon in the TB1 sample on 9/5/2005. Bivalvia (Pelecypoda) was the dominant taxon in the PB1 sample on 9/5/2005. Both Physidae and Bivalvia are pollution tolerant organisms. None of the samples contained members of the Ephemeroptera, Plecoptera, or Trichoptera. Ephemeroptera, Plecoptera, and Trichoptera (the EPT taxa) are traditionally considered to be sensitive taxa and their presence implies minimal water quality impairment. While their absence cannot be used to prove poor water quality (since habitat, water temperature, and other physiochemical parameters may instead contribute to their absence), it does provide additional evidence of impaired water quality. Few semi-tolerant taxa were also found and included Dytiscids, Calopterygidae, Coenagrionidae, Aeshnidae, and Tipulidae.

Appendix F shows the benthic bioassessment metric values. The benthic data was analyzed for five bioassessment indices: taxa richness, taxa richness, EPT richness, % CDF, % EPT, and the Hilsenhoff Family Biotic Index (FBI). These indices are used by the NJDEP BFBM and are used to calculate the New Jersey Impairment Score (NJIS). Taxa richness and EPT richness are measurements commonly used as indicators of water quality because decreases in these parameters indicate decreasing water quality. Percent dominance is of interest because a shift towards dominance by relatively few taxa indicates environmental stress. Percent EPT is measured because increases in this metric denote improved water quality. (Kurtz et al. 2000) Finally, the HFBI (a.k.a. the modified family biotic index) is used as an indicator of organic pollution, with lower HFBI values indicating a lower likelihood of organic pollution (Hilsenhoff 1988).

As was mentioned, these five metrics are used by the NJDEP to classify streams as being non-impaired, moderately impaired, or severely impaired (NJDEP 2004). The NJIS for sample PB1 on 6/9/2005 and the PB1 sample on 9/5/2005 was 6 and 15, respectively. Thus, the NJIS indicated that PB1 was severely impaired on 6/9/2005 and moderately impaired on 9/5/2005. The NJIS for samples PB2 on 6/9/2005 and 9/5/2005 was 3, indicating severely impaired conditions on both sampling dates. Finally, the NJIS for the TB1 sample on 6/9/2005 was 9 and 6 from the 9/5/2005 sample. Thus, the NJIS indicated that TB1 was moderately impaired on 6/9/2005 and severely impaired on 9/5/2005.

The benthic macroinvertebrate data indicated impaired water quality at all stations on all sample dates. First, there were no sensitive taxa identified from any of the samples, especially the EPT taxa. In addition, taxa richness was relatively low; higher NJIS are associated with taxa richness greater than 10. The %CDF also indicated impaired conditions; %CDF of less than 40 is associated with non-impaired (or relatively unimpaired) waters. The %CDF was less than 40 in only one sample- PB1 on 9/5/2005 (one date with the moderately impaired classification). Finally, the FBI was always between 5.67 and 6.77. According to the NJIS, these values indicate moderately impaired water quality. Hilsenhoff (1988) designates streams with HFBI values of between 5.76 and 6.50 to be of fairly poor water quality, indicating that substantial organic pollution is likely.

Parvin Branch and Tarkiln Branch Macroinvertebrate Taxa: Classification, Enumeration, and Bioassessment Indices							
Site		PB1	PB1	PB2	PB2	TB1	TB1
Date		6/9/2005	9/5/2005	6/9/2005	9/5/2005	6/9/2005	9/5/2005
Sample (% Sorted)		100	100	100	100	100	100
Taxon	Description	Total	Total	Total	Total	Total	Total
Simuliidae	Blackflies	8				4	
Chironomidae	Midges	75	9	19	5	68	8
Dytiscidae	Beetles					12	2
Elmidae	Beetles	1	4				
Haliplidae	Beetles		9				
Calopterygidae	Damselflies		11				2
Coenagrionidae	Damselflies	1	1				
Aeshnidae	Dragonflies		1				
Amphipoda	Scuds			2	1		
Asellidae	Sowbug			1			
Physidae	Snails	13	8			16	51
Planorbidae	Snails					1	
Bivalvia (Pelecypoda)	Clams	4	22			1	
Oligochaeta	Worms	7	8	4		20	1
Cambaridae	Crayfish		2				
Tipulidae	Cranefly	1	2				
Culicidae	Mosquito		1				
Collembola	Springtail (semi-aquatic)					1	
Egg Masses		Yes					Yes
Cases		Yes					
Salamanders			Yes		Yes		Yes
Non-Macro. Taxa			3				
Taxa Richness		8	12	4	2	8	5
Total Individuals [a]		110	78	26	6	123	64
EPT		0	0	0	0	0	0
%EPT		0	0	0	0	0	0
% Dominant Family Contribution		68.18	28.21	73.08	83.33	55.28	79.69
Modified Family Boiotic Index		6.30	6.44	6.23	5.67	6.41	6.77

a) The NJDEP does not include Total Individuals as a metric when calculating the NJIS Score.

Parvin Branch and Tarkiln Branch Macroinvertebrate Taxa: Modified Family Biotic Index Calculations

Site		PB1	PB1	PB1	PB1	PB1	PB1	PB2	PB2	PB2	PB2	PB2	PB2	TB1	TB1	TB1	TB1	TB1	TB1
Date		6/9/2005	6/9/2005	6/9/2005	9/5/2005	9/5/2005	9/5/2005	6/9/2005	6/9/2005	6/9/2005	9/5/2005	9/5/2005	9/5/2005	6/9/2005	6/9/2005	6/9/2005	9/5/2005	9/5/2005	9/5/2005
Taxon	Description	Total	Tolerance Score	x_it_i	Total	Tolerance Score	x_it_i	Total	Tolerance Score	x_it_i	Total	Tolerance Score	x_it_i	Total	Tolerance Score	x_it_i	Total	Tolerance Score	x_it_i
Simuliidae	Blackflies	8	6	48										4	6	24			
Chironomidae	Midges	75	6	450	9	6	54	19	6	114	5	6	30	68	6	408	8	6	48
Dytiscidae	Beetles													12	5	60	2	5	10
Elmidae	Beetles	1	4	4	4	4	16												
Haliplidae	Beetles				9	5	45												
Calopterygidae	Damselflies				11	5	55										2	5	10
Coenagrionidae	Damselflies	1	9	9	1	9	9												
Aeshnidae	Dragonflies				1	3	3												
Amphipoda	Scuds							2	4	8	1	4	4						
Asellidae	Sowbug							1	8	8									
Physidae	Snails	13	7	91	8	7	56							16	7	112	51	7	357
Planorbidae	Snails													1	6	6			
Bivalvia (Pelecypoda)	Clams	4	8	32	22	8	176							1	8	8			
Oligochaeta	Worms	7	8	56	8	8	64	4	8	32				20	8	160	1	8	8
Cambaridae	Crayfish				2	5	10												
Tipulidae	Cranefly	1	3	3	2	3	6												
Culicidae	Mosquito				1	8	8												
Collembola	Springtail (semi-aquatic)													1	10	10			
Total		110		693	78		502	26		162	6		34	123		788	64		433
Modified Family Biotic Index				**6.30**			**6.44**			**6.23**			**5.67**			**6.41**			**6.77**

Parvin Branch and Tarkiln Branch Macroinvertebrate Taxa: NJIS Score and Biological Assessment												
Site	PB1	PB1	PB1	PB1	PB2	PB2	PB2	PB2	TB1	TB1	TB1	TB1
Date	6/9/2005	6/9/2005	9/5/2005	9/5/2005	6/9/2005	6/9/2005	9/5/2005	9/5/2005	6/9/2005	6/9/2005	9/5/2005	9/5/2005
Taxa Richness	8	3	12	6	4	0	2	0	8	3	5	3
EPT	0	0	0	0	0	0	0	0	0	0	0	0
%EPT	0	0	0	0	0	0	0	0	0	0	0	0
% Dominant Family Contribution	68.18	0	28.21	6	73.08	0	83.33	0	55.28	3	79.69	0
Family Boiotic Index	6.30	3	6.44	3	6.23	3	5.67	3	6.41	3	6.77	3
NJIS SCORE		6		15		3		3		9		6
BIOLOGICAL ASSESSMENT	Severly impaired		Moderately Impaired		Severly impaired		Severly impaired		Moderately Impaired		Severly impaired	

Biometrics	6	3	0
Taxa Richness	>10	10-5	4-0
E+P+T	>5	5-3	2-0
% CDF (% Percent Dominance)	<40	40-60	>60
% EPT	>35	35-10	<10
Modified Family Biotic Index	<5	5-7	>7