Anna S Refuse Pile and Wilson Creek Evaluation
Babb Creek Watershed, Tioga County

June 25, 2010

Technical Report Provided by Hedin Environmental through the Trout Unlimited AMD Technical Assistance Program

Background

The Babb Creek Watershed Association (BCWA) requested assistance in evaluating the effects of an unreclaimed abandoned refuse pile that covers approximately 3.8 acres of the hillside above Wilson Creek. The refuse pile appears to be the result of the cleaning of coal from the former Anna S and Mitchell deep mines that are located adjacent to the mine dump site. Refuse from this site starts at the base of a haul road near the top of the hillside and covers the slope to the stream with the base of the refuse looming over the edge of the stream. The stream at times erodes the base of the refuse washing material into the stream as evidenced by the presence of refuse material downstream from the site.

The primary technical assistance involved hydrologic, chemical and biological assessments of Wilson Creek above and below the refuse pile. Flow and chemistry were measured twice and macroinvertebrates were measured once. Little difference in chemical or biological conditions was found, suggesting that the refuse has minimal affect on the stream. A secondary request from the BCWA was advice regarding revegetating the refuse pile. One of us (Hedin) has conducted experiments on coal spoils that showed that natural colonization of acid mine spoils by native trees can be enhanced with surface applications of fertilizer, agricultural lime and mulch. Several experimental amendment plots were established on the refuse using this approach. This report presents the Technical Assistance findings.

Data Results and Discussion

The stream was sampled on two occasions. On March 27, 2009, Neil Wolfe and Ted Weaver (Hedin Environmental) measured flow and collected water samples while Becky Dunlap (Trout Unlimited) sampled for macroinvertebrates. On April 27, 2009, Neil Wolfe and Ted Weaver measured flow and collected water samples. The sampling stations on both days were the same and are described below.

- "*WC @ Delmar Township Line*": this point is upstream of any influence of refuse or the Anna S and Mitchell Mines
- "*WC upstream @ base of refuse*": this point represents Wilson Creek immediately above the refuse
- "*WC below refuse at Bridge Run*": this point represents Wilson Creek below the refuse

Water quality sampling point locations are shown in Figure 1. Flow and water chemistry results are shown in Table 1. Both sampling efforts found negligible chemical degradation of Wilson Creek at all three stations. If AMD was impacting the stream at the refuse pile, the effect would be an increase in metals and sulfate, and a decrease in pH and alkalinity. No substantive differences were found in these parameters between the upstream and downstream stations. Metals (Fe, Al, and Mn) were less than 1 mg/L for all parameters at all stations with the exception of Fe at *WC Upstream @ Base of Refuse* on March 27. This result is considered a sampling or laboratory error because the stream was not visibly stained with Fe at this station and none of the other parameters indicate degradation. The differences in alkalinity, acidity, and sulfate between the stations – which are only a few mg/L – are within the sampling and analytical errors for these parameters.

Wilson Creek was good quality at all stations. The stream is considered a cold water fishery which has instream standards of: pH 6-9; alkalinity > acidity, Fe < 1.0 mg/L and Mn < 1.0 mg/L. The stream met these criteria at the Delmar Township Line and at Bridge Run. Sulfate concentrations were less than 25 mg/L at all stations. AMD generally has sulfate concentrations > 500 mg/L and AMD-impacted streams have sulfate concentrations > 100 mg/L. This result indicates that there was minimal AMD entering the stream on these two sampling dates.

Refuse Pile Investigation

An investigation of the refuse pile's potential as a fuel source was made by reviewing test results from the PADEP Bureau of Abandoned Mine Reclamation (BAMR) and Phoenix Resources, a local company that operates a landfill in the watershed. BAMR conducted a sampling program in 2005 to determine the refuse pile's volume and fuel value. BAMR estimates that there are 66,588 cubic yards (~70,000 tons) of refuse at the site. BAMR collected 16 samples from holes dug by hand and found an average value of 3,893 BTU/lb. Figure 2 shows the location of the BAMR test pits. Phoenix Resources used an excavator to collect 21 samples from 6 test pit locations. The average BTU value from the Phoenix samples was 3,004 BTU/lb. Generally, refuse must have at least 6,000 BTU/lb to warrant its value as fuel for coal-powered generation plant. Both investigations found that the refuse is not suitable for burning by existing power plants.

Phoenix Resources had also looked at the possibility of using the refuse for its landfill activities. It was determined that the costs to recover and transport the material to the landfill were too high.

If the refuse does not have enough value to justify it removal by a third party, then BCWA could consider stabilizing the site to lessen the erosion of refuse into Wilson Creek. The best method for stabilizing the refuse is through its revegetation. A simple low-cost revegetation procedure involves the stimulation of natural reforestation processes. Surface amendments of limestone, fertilizer and light mulch were found to stimulate colonization of aspen and maples onto bare acidic coal mine spoils in western

PA[1]. A similar approach for the Wilson refuse pile would be very inexpensive. On April 27, 2009 three test plots were prepared on the refuse. The first test plot measuring 10 feet by 10 feet was located on top of the refuse pile overlooking Wilson Creek marked out with orange steel flags. The site was prepared by raking the surface of the spoil with a standard garden rake while adding 10 pounds of agricultural lime and 5 pounds of 10-10-10 fertilizer to the surface (see Photo 4). Several flakes of hay mulch were then spread onto the surface to help trap seeds soon to be dispersed from local aspen and birch. A second plot identical to the first was prepared on the side slope facing Wilson Creek starting at the top edge. A third site was prepared at the top of the slope on the pile and consists of a 50 foot long strip 2 feet wide. A rake was not used to break up the spoil and no mulch was used. Approximately 20 pounds of agricultural lime and 5 pounds of fertilizer were applied to the surface. The plots were investigated in May and June 2009. No colonization by trees into the plots was observed at that time. Tree seedlings were observed in shaded fringe areas outside the study plots suggesting that shade provides more moisture for the seedlings to be established. The black refuse surface may result in extreme surface temperatures that inhibit colonization by trees, even with moderation of surface chemistry through lime, fertilizer and mulch. If BCWA wishes to revegetate the refuse pile, it will need to implement standard refuse revegetation procedures.

Conclusions and Recommendations

An assessment was made of the impact of a large coal refuse pile on the quality of Wilson Creek, a tributary to Babb Creek. Flow and chemistry were measured twice and stream benthos was sampled once. No evidence of degradation was found. Wilson Run met the cold water fishery standards both upstream and downstream of the refuse pile. Assessments of the feasibility to remove the refuse for fuel value were reviewed. The refuse has low BTU content and is not suitable for use as fuel. The refuse is poorly vegetated and its erosion into Wilson Run is apparent from rills and gullies and the presence of refuse in the streambed. In order to lessen the erosion, the pile could be revegetated. A simple natural reforestation method was attempted, but early observations indicate failure.

[1] Hedin, R. S. and E. R. Hedin. 1990. Stimulation of aspen establishment on unreclaimed mine spoils, In: D. H. Graves and R. W. DeVore (eds), 1990 National Symposium on Mining (University of Kentucky, OES Publications, Lexington, KY) pp. 85-95

Figure 1. Aerial photo of Wilson Creek sampling points

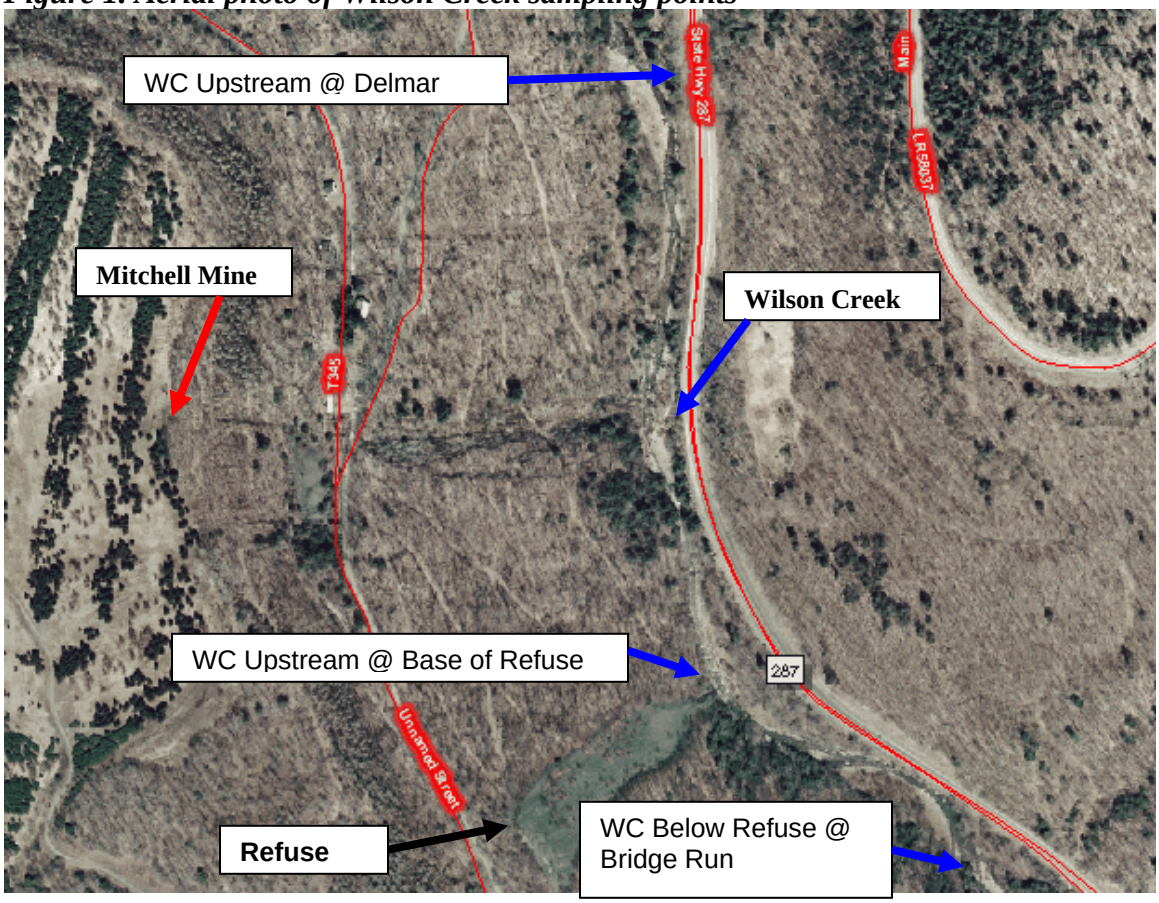


Figure 2. Photo showing the location of BAMR refuse pile sampling points.

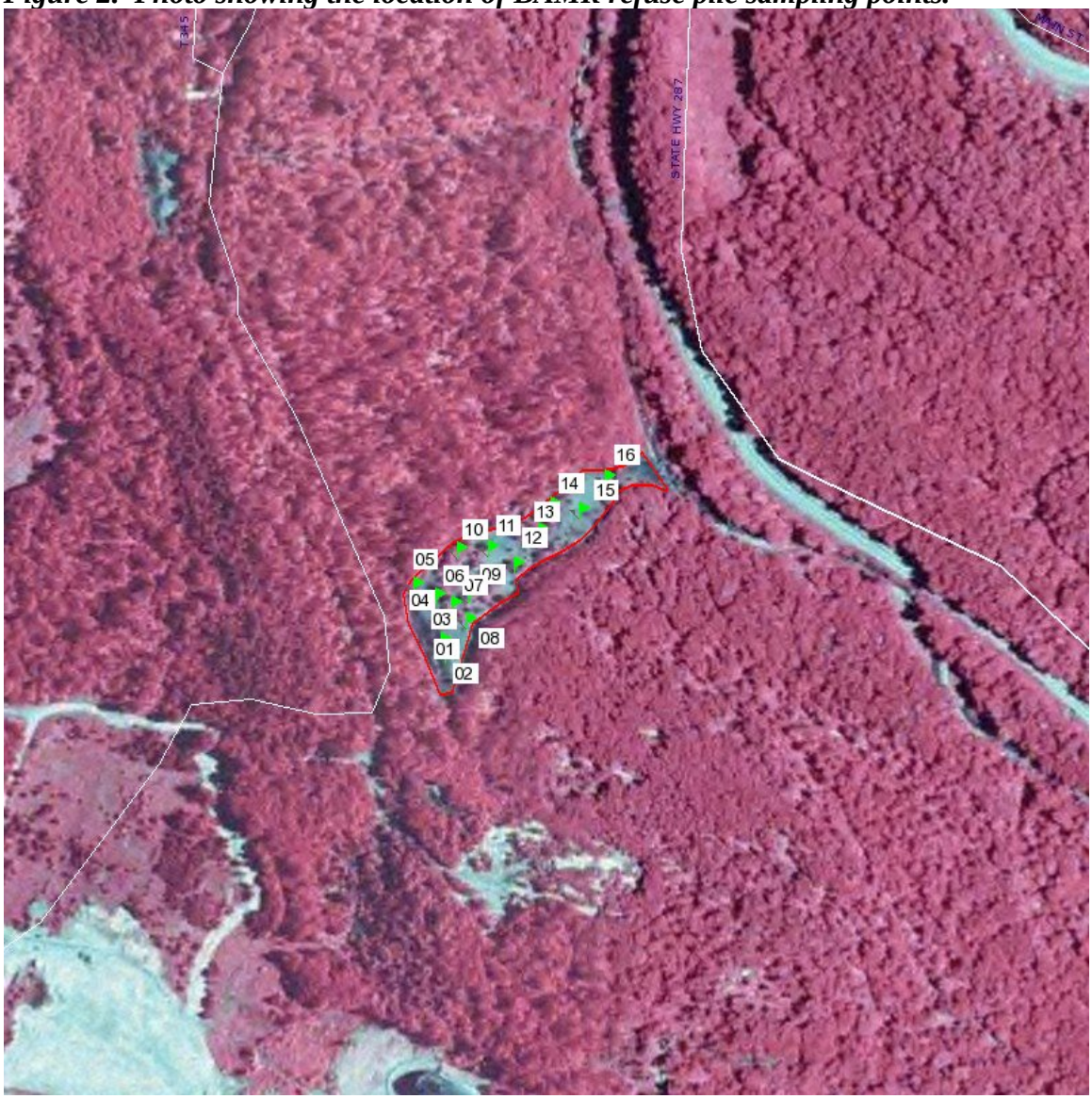


Photo 1. Sample point above refuse pile

Photo 2. Collecting macroinvertebrates

Photo 3. Measuring flow at Point above Bridge Run

Photo 4. Experimental test plots on Wilson Creek refuse pile slope

Table 1. Sampling results for Wilson Creek (WC) in the spring of 2009

Sample ID	**Sample**	**flow**	**pH**	**Cond**	**Alk**	**Acid**	**Fe**	**Mn**	**Al**	**SO4**
	Date	**gpm**		**umhos**	**mg/L $CaCO_3$**		**mg/L**	**mg/L**	**mg/L**	**mg/L**
WC @ Delmar Twp. Line	03/27/09	6,497	7.29	122	26	-18	0.04	0.02	0.29	13
WC Upstream @ Base of Refuse	03/27/09	6,573	6.95	125	24	-19	1.77	0.05	0.66	15
WC Below Refuse @ Bridge Run	03/27/09	6,650	7.35	141	26	-18	0.04	0.05	0.42	22
WC @ Delmar Twp. Line	04/27/09	4,221	7.38	116	33	-26	0.08	0.02	0.04	11
WC Upstream @ Base of Refuse	04/27/09	4,239	6.93	125	29	-20	0.04	0.04	0.11	14
WC Below Refuse @ Bridge Run	04/27/09	4,257	7.02	129	30	-22	0.04	0.06	0.21	17

Biological Assessment for Wilson Creek
Babb Creek Watershed, Tioga County

Technical Report Provided Through
Trout Unlimited AMD Technical Assistance Program

Background

The Babb Creek Watershed Association requested a technical assistance grant to evaluate the biological impacts of a refuse pile located on the hillside of Wilson Creek. Benthic macroinvertebrate data were collected above and below the refuse pile and compliment water quality and quantity data collected by Hedin Environmental used to develop recommendations regarding the stabilization or reclamation of the refuse.

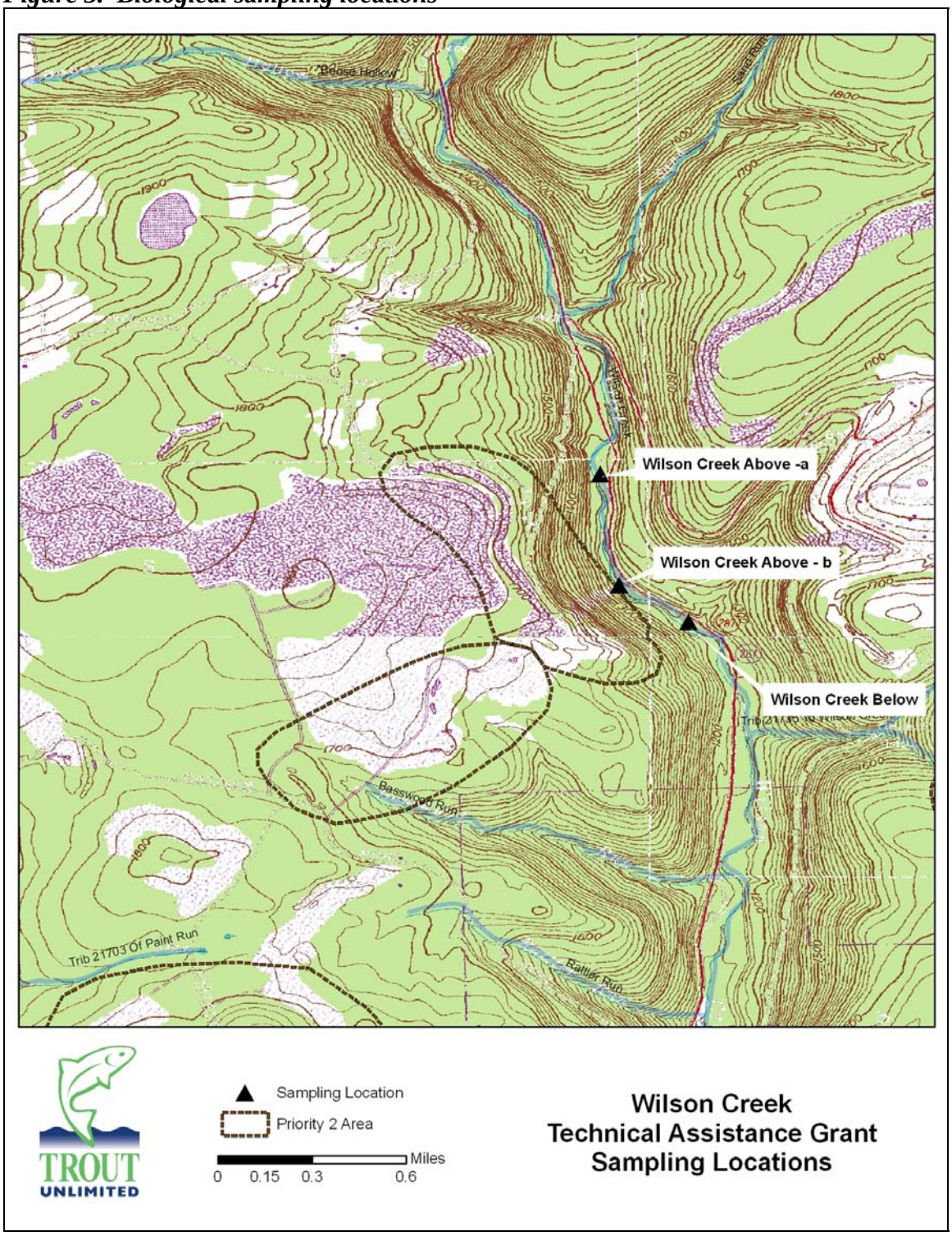
Benthic macroinvertebrate collections were made at three locations (Table 2, Figure 3) in Wilson Creek on March 26th 2009 by TU personnel. These collections were made according to Pennsylvania Department of Environmental Protection's (DEP) Instream Comprehensive Evaluation (ICE) protocol (specifically section C.1.b. *Antidegradation Surveys*). In short benthic macroinvertebrate samples consisted of a combination of six D-frame efforts in a 100-meter stream section. These efforts were spread out so as to select the best riffle habitat areas with varying depths. Each effort consisted of an area of 1 m^2 to a depth of at least 4 inches as substrate allowed and was conducted with a 500 micron mesh 12-inch diameter D-frame kick net. The six individual efforts were composited and preserved with ethanol for processing in the lab.

No sub-sampling was required for these samples as the individual counts were less than or near 200. Individuals were identified to genus or to the next highest taxonomic level possible. The samples were evaluated according to the six metrics comprising the DEP's Index of Biological Integrity (Total Taxa Richness, EPT Taxa Richness, Beck's Index V.3, Shannon Diversity, Hillsenhoff Biotic Index, and Percent Sensitive Individuals). These metrics were standardized and used to determine if the stream is meeting its Aquatic Life Use (ALU) as designated by the DEP.

Table 2. Site Locations

Sample Point ID	Description	Latitude	Longitude
Wilson Creek Above (a)	Delmar Township Line	41.63247	-77.2998
Wilson Creek Above (b)	Below Old Mitchell Discharge Location	41.62733	-77.2989
Wilson Creek Below	Downstream of Refuse Pile	41.62566	-77.2957

Figure 3. Biological sampling locations



Wilson Creek Above (a) - (Delmar Township Line)

This site was located approximately 1,700 feet upstream of the refuse pile and upstream of where the Mitchell discharge entered Wilson Creek before it was relocated in 2005. Data collected at this site indicate no substantial impairments (Tables 3 and 4). The average of adjusted standardized core metric score (65.7) included as part of the Index of Biological Integrity (IBI) for this site indicate that the stream is meeting the benchmark for aquatic life use attainment. In addition, field chemistry data collected at this site do not indicate impaired conditions.

The aforementioned IBI score was the highest measured amongst the sites sampled in this survey (Figure 4).

Table 3 .Wilson Creek Above (a) - IBI Metrics

METRIC	OBSERVED VALUE	STANDARDIZED METRIC SCORE	ADJUSTED STANDARDIZED METRIC SCORE
Total Taxa Richness	24	0.727	0.727
EPT Taxa Richness (PTV 0 – 4)	9	0.474	0.474
Beck's Index, version 3	19	0.500	0.500
Hilsenhoff Biotic Index	4.04	0.735	0.735
Shannon Diversity	2.99	1.046	1.000
Percent Sensitive Individuals (PTV 0 – 3)	42.9	0.507	0.507
		IBI SCORE =	**65.7**

Table 4. Wilson Creek Above (a) field chemistry

pH	6.82
Temperature (C)	8.1
Alkalinity (mg/L)	24
Flow (cfs)	14.47

Wilson Creek Above (b) - (Below Old Mitchell Discharge Location)

This site was located directly upstream of the refuse pile and directly below the location where the Mitchell discharge entered Wilson Creek before it was relocated in 2005. The average of adjusted standardized core metric score (43.2) included as part of the IBI for this site indicates that the stream at this location does not meet the benchmark for aquatic life use attainment (Table 5).

The reduced IBI score does not appear to be a facsimile of water quality impairments as indicated by field chemistry (Table 6). Instead, the reduced IBI score could potentially be a result of degraded benthic macroinvertebrate habitat associated with the historical

Mitchell discharge. A more thorough examination of habitat would be required to substantiate this hypothesis.

Table 5. Wilson Creek Above (b) IBI Metrics

METRIC	OBSERVED VALUE	STANDARDIZED METRIC SCORE	ADJUSTED STANDARDIZED METRIC SCORE
Total Taxa Richness	11	0.333	0.333
EPT Taxa Richness (PTV 0 – 4)	7	0.368	0.368
Beck's Index, version 3	9	0.237	0.237
Hilsenhoff Biotic Index	3.59	0.790	0.790
Shannon Diversity	1.76	0.614	0.614
Percent Sensitive Individuals (PTV 0 – 3)	21.2	0.251	0.251
		IBI SCORE =	**43.2**

Table 6. Wilson Creek Above (b) field chemistry

pH	6.71
Temperature (C)	8.5
Alkalinity (mg/L)	25
Flow (cfs)	

Wilson Creek Below - (Downstream of Refuse Pile)

This site was located downstream approximately 1,000 feet below the refuse pile. Data collected at this location indicate that further evaluation is required to determine if the stream is meeting the aquatic life use attainment benchmark as the average of adjusted standardized core metric score (59.4) is between 50 and 63 (Table 7). Closer examination of the metrics associated with the IBI indicate that this site would probably not be considered impaired since the percent of sensitive individuals is not less than 20%, the dominate taxa are not tolerant species, and Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are not absent from the sample (Appendix I).

The IBI score at this site is lower than the most upstream site but higher than the score at the site located directly above the refuse pile (Figure 4). Given that field water chemistry values are similar it is again hypothesized that this change in score is a reflection of habitat instead of water quality.

Table 7. Wilson Creek Below IBI Metrics

METRIC	OBSERVED VALUE	STANDARDIZED METRIC SCORE	ADJUSTED STANDARDIZED METRIC SCORE
Total Taxa Richness	12	0.364	0.364
EPT Taxa Richness (PTV 0 – 4)	7	0.368	0.368
Beck's Index, version 3	11	0.289	0.289
Hilsenhoff Biotic Index	2.32	0.947	0.947
Shannon Diversity	1.78	0.622	0.622
Percent Sensitive Individuals (PTV 0 – 3)	82.1	0.972	0.972
		IBI SCORE =	**59.4**

Table 8. Wilson Creek Below field chemistry

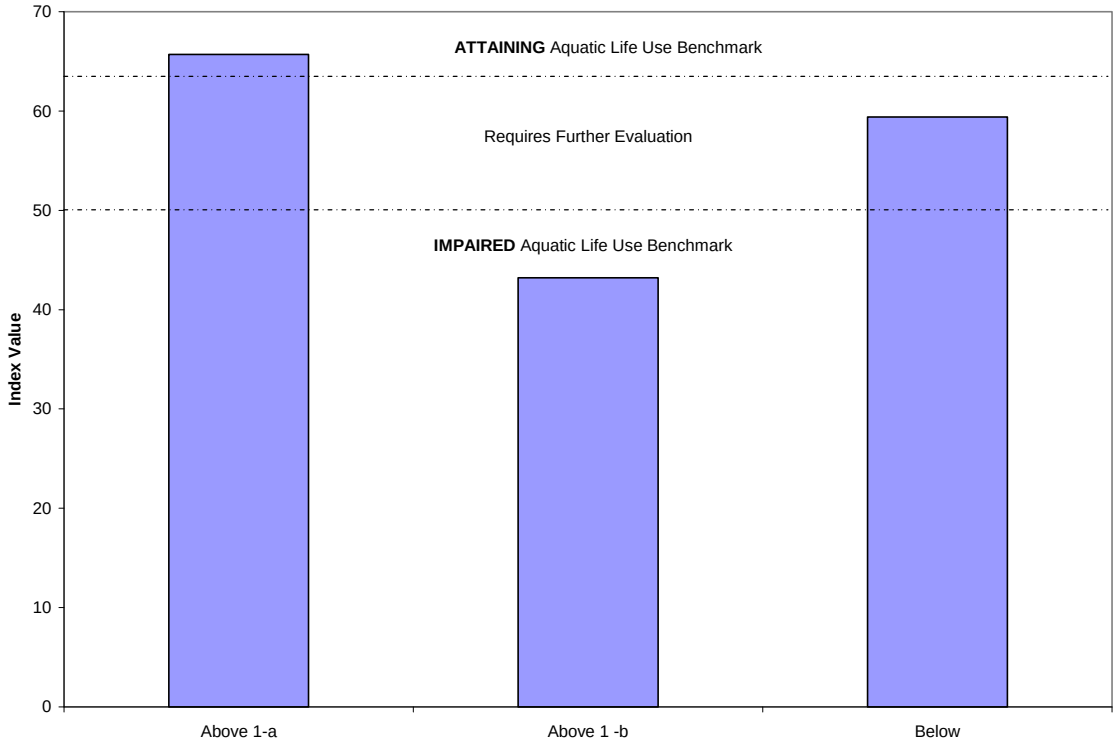
pH	6.82
Temperature (C)	6.1
Alkalinity (mg/L)	24
Flow (cfs)	14.81

Summary

Wilson Creek at the Delmar Township Line contained the most robust benthic macroinvertebrate population. A marked decrease in IBI scores was noted downstream. However, the highest degree of reduction in the IBI score is noted between the Delmar Township Line and the site where the Mitchell discharge historically entered Wilson Creek. Rather than continuing to decline though, the IBI score increases between the historical Mitchell discharge site and the site located below the refuse pile.

Subsequently, the change in benthic populations is believed to be more correlated to habitat degradation from the historical Mitchell discharge rather than water quality impacts from the refuse pile.

Figure 4. Index of Biological Integrity Values



APPENDIX I

BENTHIC MACROINVERTEBRATE TAXA

Wilson Creek Above (a): Delmar Township Line

Order	Family	Genus	Count
Ephemeroptera	Baetidae	Baetis	5
	Heptageniidae	Epeorus	2
		Maccaffertium	1
	Ephemerellidae	Ephemerella	2
Odonata	Gomphidae	Ophiogomphus	1
Plecoptera	Nemouridae	Prostoia	1
	Perlidae	Agnetina	1
		Acroneuria	2
	Perlodidae		1
		Cultus	1
	Chloroperlidae	Sweltsa	3
Trichoptera	Hydropsychidae	Ceratopsyche	5
		Cheumatopsyche	5
Coleoptera	Elmidae	Optioservus	1
	Empididae		1
		Chelifera	2
	Tipulidae	Antocha	2
		Hexatoma	2
	Chironomidae	Chironomidae	11
		Total Count	49

Wilson Creek Above (b): Below Old Mitchell Discharge Location

Order	Family	Genus	Count
Ephemeroptera	Baetidae	Baetis	5
		Diphetor	1
	Heptageniidae	Epeorus	4
		Cinygmula	4
	Ephemerellidae	Ephemerella	3
		Eurylophella	26
	Leptophlebiidae		18
Trichoptera	Hydropsychidae	Ceratopsyche	1
		Cheumatopsyche	1
	Rhyacophilidae	Rhyacophila	1
	Limnephilidae	Neophylax	2
		Total Count	66

Wilson Creek Below: Downstream of Refuse Pile

Order	Family	Genus	Count
Ephemeroptera	Baetidae	Baetis	2
	Heptageniidae	Epeorus	7
		Cinygmula	1
	Ephemerellidae	Eurylophella	5
Plecoptera	Nemouridae	Amphinemura	1
	Chloroperlidae	Sweltsa	2
Trichoptera	Hydropsychidae	Ceratopsyche	1
		Cheumatopsyche	1
	Lepidostomatidae	Lepidostoma	1
	Limnephilidae	Neophylax	8
Diptera	Simuliidae	Prosimulium	26
		Stegopterna	1
		Total Count	56