Aquatic Survey of Lower Dunkard Creek

Greene County

October – November, 2008

PA Department of Environmental Protection:

Bureau of Abandoned Mine Reclamation, Cambria Office
Field Operations, Southwest Regional Office
and
Bureau of District Mining Operations, California Office

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Department of Environmental Protection
Bureau of Abandoned Mine Reclamation

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D.E.P.
SOUTHWEST REGION
2009 FEB -9 PM 12: 15

Introduction

The Shannopin deep mine complex was abandoned in 1992 and began to flood at that time. The pool was expected to discharge at the surface, into Dunkard Creek, in 2004 or 2005. A mining company, Dana Mining, had operating deep mines in the vicinity of the Shannopin Mine and had coal reserves that were inaccessible due to the flooded Shannopin mine pool. A non-profit company, AMD Reclamation, Inc., was established to address AMD discharges from deep mine pools. An agreement was reached in 2003 that provided Commonwealth grants and loans to construct an AMD treatment facility to treat the Shannopin discharge. A $1.8 million grant was provided by the DEP Bureau of Abandoned Mine Reclamation (BAMR) and additional grants and loans were provided by PennVEST and the Department of Community and Economic Development. AMD Reclamation Inc. proposed to draw down the mine pool to facilitate Dana's mining operations and construct and operate treatment facilities. The treatment plant was constructed and put into operation in 2004. A second treatment plant was constructed in 2007, in order to facilitate a more rapid drawdown of the mine pool. A post-mining activity permit (IW) was issued by the California District Mining Office for the treatment plant construction and operation. This permit, and related Consent Order and Agreement, allowed a discharge of up to 3,500 gpm of treated mine water at BAT limits. The permit was amended in 2005 to allow for the increased flow from the second plant. The two plants are permitted to discharge up to 7,500 gpm.

BAMR staff completed a biological survey of lower Dunkard Creek (Mount Morris to mouth) in October and November of 2008. Assistance was provided by biologists from the Southwest Regional Office and the California District Mining Office. The purpose of the survey was to evaluate the biological condition of Dunkard Creek with the addition of the treated AMD discharge and to determine if additional remedial work was needed to completely restore Dunkard Creek. These surveys are routinely completed to evaluate the success of AMD treatment and abatement projects funded by BAMR.

Survey Methods

Four stations were established on Dunkard Creek. These stations largely corresponded with earlier surveys completed by the Southwest Region and others. Station DC5 was located approximately four miles upstream of the treatment plant, just downstream of the town of Mount Morris (see map, Attachment A). Station DC6 was located just downstream of Meadow Run and the treated discharge, which is piped along Meadow Run and enters Dunkard Creek just downstream of the mouth of Meadow Run. Station DC7 was located near Bobtown, approximately five miles below DC6, and below several AMD discharges from abandoned deep mines. Station DC8A was located approximately two miles below DC7 and just downstream of additional abandoned discharges, and Station DC8 was at the mouth of Dunkard Creek, just upstream of the confluence with the Monongahela River. Station DC8A was established because the deep water conditions at Station 8 prevented macroinvertebrate sampling and fish sampling using a towboat.

The Southwest Regional staff conducted fish surveys at Stations DC5 and DC7, using a towboat electrofishing unit. The survey was conducted over a 200 meter length of stream. Fish were

identified to species and counted, on site and in the lab. Southwest Regional staff also collected macroinvertebrates using the Department's 2007 ICE protocol (6-kicks per station using a D-framed net), and measured field chemistry parameters. BAMR staff collected water samples, which were shipped on ice to DEP's Harrisburg water lab for analysis using Standard Methods, measured stream flows using a Marsh-McBirney Flo-Mate flow meter, completed habitat evaluation forms (glide/pool prevalence) and identified the insects in the lab to genus for statistical analysis to determine an IBI score (using 2007 ICE protocols). Water samples, insects and flow measurements were collected at all stations on October 20, 2008. The fish survey at Station DC5 was completed on October 20. Due to the large number of fish collected and the extensive processing time at Station DC5, staff had to return on November 24 to complete the survey at Station DC7.

Results

Station DC5

The fish survey at this station resulted in very large numbers of fish – a total of 22 species and 1,056 individuals (see Attachment B for fish survey results). Field water quality parameters indicated relatively good water quality, including pH of 6.87 and conductivity of 661 us/cm (see Attachment C for DEP field and laboratory chemistry results). The habitat survey resulted in a score of 125, which generally indicates marginal habitat (see Attachment D for habitat evaluation scores and macroinvertebrate sample summaries). This low score was the result of a lack of substrate due to a prevalence of bedrock, a prevalence of shallow pools over deep pools and sediment deposition. This marginal habitat was the likely reason for a relatively low benthic IBI score of 50.2 (scores between 50 and 63 are generally considered impaired, with scores below 50 always considered impaired). Visually, the stream had a slightly cloudy appearance at this station. Lab results of water samples taken verified good water quality, with AMD parameters below PA Code Ch. 93 water quality standards except for sulfates at 570 mg/l, above the Ch. 93 level of 250 mg/l, and total dissolved solids (TDS) of 1,182 mg/l, above the Ch. 93 level of 750 mg/l for aquatic life criteria. A second water sample was collected just above Station DC6 (called DC5B) to look for water quality changes since there were four miles of stream between Station DC5 and DC6. This sample verified there was no substantive change in water quality over this distance.

Station DC6

This station was located approximately 500 meters below Meadow Run and the Shannopin discharge point, in order to allow for adequate mixing. A water sample was also collected at the Shannopin discharge (sample point SHDSG). Field chemical parameters gave an immediate indication of significant water quality changes in Dunkard Creek – pH of 7.10 and conductivity of 4,022 us/cm. In addition, a white precipitate was observed on the rocks at the edge of the stream, which appeared to be gypsum (CaSO4). These field observations were verified by lab analysis of the water samples collected – sulfates had risen to 6,171 mg/l and TDS to 9,552 mg/l. Other mine drainage parameters were at very low concentrations. This station had a habitat evaluation score of 147, generally considered sub-optimal. It had improved over DC5 due to better substrate, better pool variability and less sediment accumulation. The macro IBI indicated

deterioration in biological conditions compared to DC5 with an ICE score of 31.3, significantly below the impairment threshold of 50 - 63. The water sample collected at the Shannopin discharge verified this discharge as the primary source of the elevated sulfates and TDS, with a sulfate level of 8,865 mg/l and TDS of 13,290. This is significantly higher than samples taken of the pool prior to construction of the treatment plant. No fish sampling was done at this station.

Station DC7

Conditions at this station, approximately five miles downstream of DC6, appeared similar to DC6. The white precipitate was still evident on substrate at the water's edge. Field measurements indicated a conductance of 3,596 us/cm. Lab results of a water sample collected measured a sulfate level of 6,398 mg/l and TDS of 9,238 mg/l. Habitat continued to improve, with a glide/pool score of 154. The stream comes close to a riffle/run prevalence at this location and has generally good habitat. The macro IBI showed a slight improvement at 41.3, but was still well below the threshold of impairment (below 50 - 63). The Southwest Regional staff completed the fish survey at a later date, November 24, 2008. At that time, no fish were found in a 150 meter stretch of stream using the electrofishing equipment (the full 200 meter length wasn't surveyed due to deep water and ice on one side of the stream). Several AMD discharges from abandoned mines in the Taylortown area enter between DC6 and DC7. The excess alkalinity from the Shannopin discharge allowed the stream to easily assimilate the acidity from these discharges. Lab alkalinity only dropped from 223 mg/l at DC6 to 159 mg/l at DC7.

Station DC8A

This station was just below where additional abandoned deep mines discharge into Dunkard Creek in the Bobtown area. This station clearly shows the impact of these discharges, as iron precipitation was evident. Field measurements showed that the stream was still assimilating the acidity (pH of 6.75), but the conductance remained high at 3,581 us/cm. The habitat score of 144 was adversely affected by the iron precipitate, as well as marginal instream cover, channel sinuosity and flow status. The benthic IBI score showed further degradation, with a score of 37.8. Lab analysis of stream chemistry showed sulfates and TDS continued to be high, at 5,878 mg/l and 8,752 mg/l respectively, alkalinity was reduced to 117 mg/l, and iron levels had increased significantly to 7.75 mg/l. There was no fish survey completed at this location.

Station DC8

Only a water sample was collected at this station. The lab results showed greatly improved conditions – sulfates of 318 mg/l, iron of 0.177 mg/l and pH of 7.7. Visually, the stream also looked unimpaired. However, there are at least two reasons to doubt that these samples truly represent the water quality of Dunkard Creek at its mouth. First, a clean tributary comes in just upstream of this station, on the same side of the creek as the sample was collected. Secondly, it appears that the Monongahela River has backed up into the mouth of Dunkard Creek at this location. For these reasons, the water quality at this station should not be considered indicative of the water quality Dunkard Creek is providing to the Monongahela River.

Discussion

While the construction of the Shannopin treatment plant was successful in preventing an outbreak of extremely acidic mine drainage into Dunkard Creek, it is apparent that the current pumping rate and drawdown is causing significant problems. The water quality in the mine pool has deteriorated since the commencement of the pool draw down (an adjacent pool is currently being pumped to the Shannopin pool, which may have contributed to this deterioration). The concentration of nearly all mine drainage parameters has dramatically increased. That, coupled with the increased discharge volume from the second plant, has greatly increased the sulfate and TDS load entering Dunkard Creek. Other mine drainage pollutants are being effectively removed by the two treatment plants.

At the time of the sampling, very low stream flow conditions existed. However, a review of over 60 years of USGS data from a staff gauge located near DC7 determined that the fall 2008 flows were not atypical (USGS03072000 Dunkard Creek at Shannopin, PA). The flow at DC5, above the Shannopin discharge, was measured at 5.37 cfs during the October 20 sampling. There were 41 years between 1941 and 2005 where autumn flows were at or below 5.3 cfs at the gauging station. Such lows were seen almost annually, except for a period from 1972 until 1981. Under these low-flow conditions, the stream is unable to assimilate the sulfate and TDS load. Whether the elevated stream TDS and sulfate levels exist under higher stream flow conditions is unknown at this time (see Attachment E for USGS flow data and historical sulfate concentrations).

This survey has determined that, at the time of the survey, the Shannopin effluent had apparently caused degradation and the loss of a fishery in almost four miles of Dunkard Creek (from DC6 to Taylortown where the first significant abandoned mine drainage enters). Previous reports (Dunkard Creek Hydrologic Unit Plan, 2003, and others) determined that 6.2 miles of lower Dunkard Creek were degraded by AMD. Occasional fish kills were documented in the Taylortown area. At the time of the 2008 survey, approximately 10.1 miles were found to be degraded from sulfates/dissolved solids, and unable to support a fishery.

PA Code Ch. 93 Water Quality Standards for sulfates are 250 mg/l (critical use – drinking water) and for TDS are 500 mg/l as a monthly average and 750 mg/l maximum (critical use – drinking water). Where the critical use is aquatic life, the allowable TDS level increases to 1,500 mg/l. A recent study of the impact of treated AMD on fish in nearby Ten Mile Creek has determined that a TDS level in the range of 2,000 - 2,300 mg/l is the threshold for impairment to fish (Kimmel, 2009). Other studies have shown no significant effects on salmonid species up to 2,000 mg/l (Weber-Scannell et al, 2007). TDS that is primarily CaSO4 has been reported to have significant effects on chironomid (midge) larvae above 1,100 mg/l (Weber-Scannell et al, 2007). TDS has been shown to produce a lethal effect on 50% of the exposed population (LD50) of flathead minnows (Pimephales promelas) at 5,600 mg/l based upon a 96 hour exposure (Wikipedia). Clearly, with this information, it is reasonable to explain that the complete lack of fish at the DC7 station survey was a result of the in-stream TDS levels of 9,238 mg/l. Also, clearly, when looking at the lab results of Dunkard Creek at DC5, 5B, 6 and 7, and the Shannopin effluent, the Shannopin plant is the primary source of the elevated TDS.

One positive observation during the October sampling was that iron precipitate from the Shannopin discharge was very localized and only extended for a few hundred feet below the discharge. Records show that the plant has been routinely discharging less than 1 mg/l of iron, even though BAT limits allows for a discharge of 3 mg/l as a 30-day average. At the lower actual discharge concentrations, iron precipitate apparently is not causing a problem in Dunkard Creek.

Note that threatened and endangered mussel species were documented to exist in Dunkard Creek prior to the construction of the Shannopin plant. The discharge point was re-located a short distance downstream during permitting to avoid a major mussel bed near the mouth of Meadow Run. The 2008 biological survey did not include an evaluation of impacts to mussels from the Shannopin plant.

Conclusions and Recommendations

While the construction and operation of the Shannopin mine drainage treatment plant prevented an uncontrolled break-out of AMD into Dunkard Creek, the current operation of the plant under low-flow conditions has caused adverse impacts to Dunkard Creek. At least under these low-flow conditions, the plant effluent has caused almost four miles of Dunkard Creek to be unable to support fish life where a fishery previously existed. The Shannopin plant discharge permit is currently under review by the California District Mining Office for a 5-year renewal. The results of this survey indicate that the current permitting and operation is not providing adequate protection to support aquatic life in Dunkard Creek in low-flow conditions. In addition, the California DMO is reviewing other permit applications relating to Dana Mining Company, a power company, GenPower and another coal company, Foundation Coal, that potentially involve activities in Dunkard Creek. All these activities and their respective permits have the potential to impact Dunkard Creek and the restoration of the fishery.

BAMR has been contacted by the Greene County Conservation District concerning a partnership for restoring Dunkard Creek. In addition, BAMR is currently reviewing all watersheds with previously approved HUPs to make decisions about whether restoration goals have been met, or whether additional projects should be completed to meet the goals. BAMR staff will need to defer making these decisions on Dunkard Creek pending the outcome of the permitting actions by California DMO.

The Monongahela River was found to have elevated levels of TDS during the low-flow conditions that existed last fall. This caused much publicity, particularly with regard to potential impacts to water supplies along the Mon River. While the source of TDS in the Mon River is still being debated (gas well waste fluids are believed to have contributed to the TDS load), certainly the high loading from the Shannopin plant is a significant source of TDS to the Mon River. This situation also should be considered during the current permitting process.

Additional recommendations of this report include collecting water samples under higher flow conditions to determine whether the elevated sulfate/TDS levels seen in October also exist under different stream flow conditions. This information will be useful in determining at what flow levels the high TDS/sulfates are a problem to aquatic life.

The Department is currently planning the construction of several new chemical treatment plants to treat high volume discharges. In at least one of these, the proposed scenario will be similar to Shannopin – a mine pool will be drawn down at an accelerated rate to facilitate mining. All these proposed plants need to be evaluated to determine whether they have a potential to cause elevated sulfate/TDS conditions in the receiving stream, particularly in low-flow conditions. This possibility needs to be taken into consideration and evaluated during the project planning stage, during permitting, where appropriate, and during the planning of plant operations.

Acknowledgements

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Attachments

References

1. PA Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, Cambria Office, "Dunkard Creek Project Development Files."

2. PA Department of Environmental Protection, Bureau of Abandoned Mine Reclamation, Cambria Office, "Dunkard Creek Hydrologic Unit Plan, Greene County, Pennsylvania."

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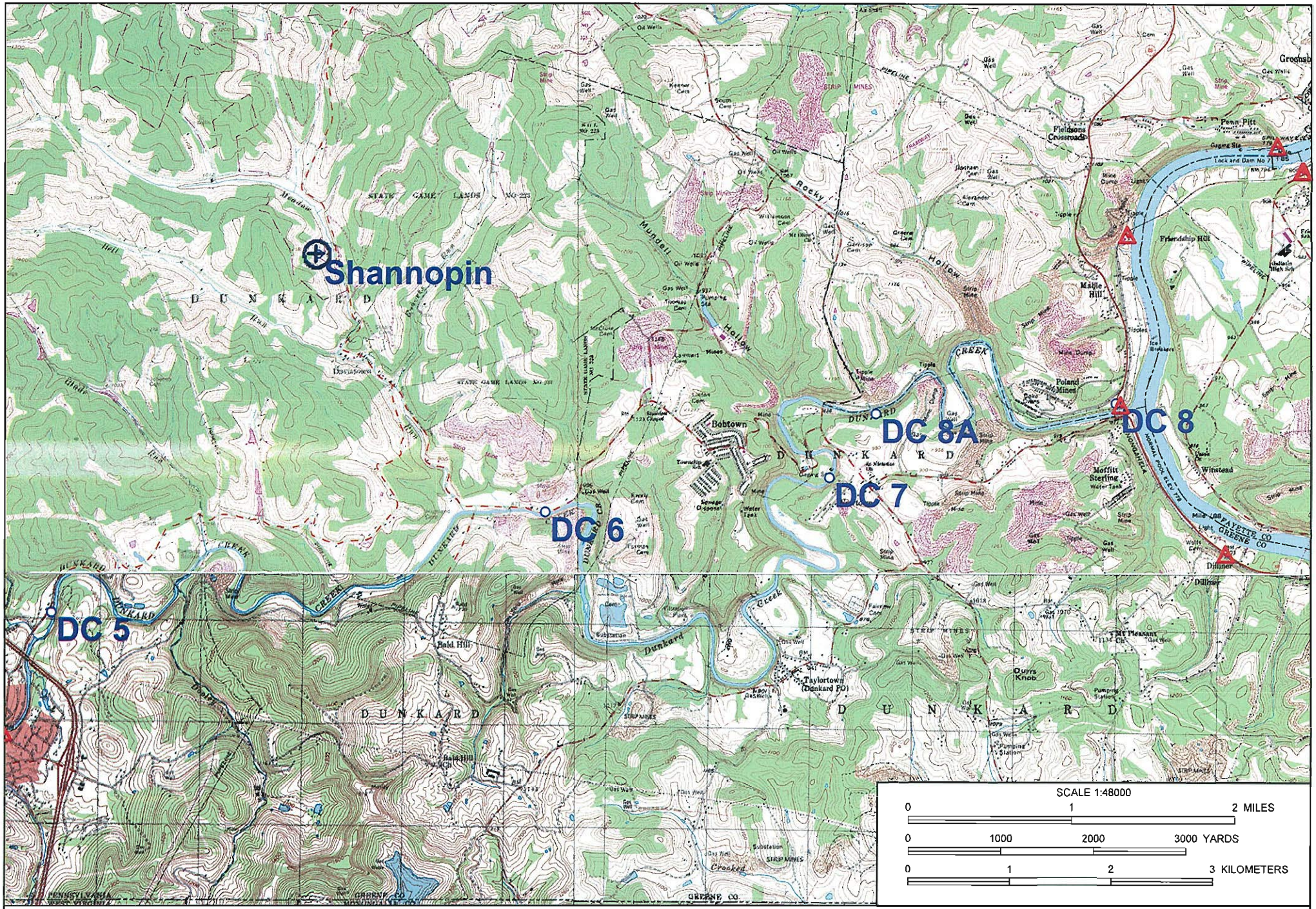
4. Joel Koricich (2009), PA Department of Environmental Protection, California District Mining Office (personal communication).

5. PA Department of Environmental Protection, Bureau of Laboratories, "Sample Information System Files (2009)."

6. Wikipedia.org, "Total Dissolved Solids (2008)."

7. United States Geologic Survey, "USGS03072000 Dunkard Creek at Shannopin, PA," National Water Information System: Web Interface.

8. P. K. Weber-Scannell, et al (2007), "Effects of Total Dissolved Solids on Aquatic Organisms: A Review of Literature and Recommendation for Salmonid Species," American Journal of Environmental Sciences 3 (1): 1-6.



Name: MASONTOWN
Date: 1/30/2009
Scale: 1 inch equals 4000 feet

Location: 039° 45' 37.43" N 079° 59' 26.40" W
Caption: Attachment A - Dunkard Creek Sampling Stations

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Attachment B: Fish Survey Results

Fish species - Station DC5 Collection Date: 10/20/2008

Common Name	*Genus*	*Species*		Total Number
Central stoneroller	*Campostoma*	*anomalum*		151
Spotfin shiner	*Cyprinella*	*spiloptera*		36
Striped shiner	*Luxilus*	*chrysocephalus*		45
Rosyface shiner	*Notropis*	*rubellus*		116
Mimic shiner	*Notropis*	*volucellus*		108
Creek chub	*Semotilus*	*atromaculatus*		8
Bluntnose minnow	*Pimephales*	*notatus*		175
Nothern hog sucker	*Hypentelium*	*nigricans*		179
Silver redhorse	*Moxostoma*	*anisurum*		1
Golden redhorse	*Moxostoma*	*erythrurum*		1
Black redhorse	*Moxostoma*	*duquesnei*		23
Yellow bullhead	*Ameiurus*	*natalis*		1
Rock bass	*Ambloplites*	*rupestris*		2
Bluegill	*Lepomis*	*macrochirus*		5
Smallmouth bass	*Micropterus*	*dolomieui*		39
Greenside darter	*Etheostoma*	*blennioides*		103
Rainbow darter	*Etheostoma*	*caeruleum*		16
Fantail darter	*Etheostoma*	*flabellare*		2
Johnny darter	*Etheostoma*	*nigrum*		1
Variegate darter	*Etheostoma*	*variatum*		18
Banded darter	*Etheostoma*	*zonale*		22
Blackside darter	*Percina*	*maculata*		4
			22	1056

Macroinvertebrates (collected during electrofishing)

Common Name	Family	*Genus*	
Dragonflies Nymphs	Maromiidae	*Macromia*	3
Crayfish	Cambaridae	*Orconectes*	8

Fish Species - Station DC7 Collection Date: 11/24/2008

None found

ATTACHMENT C

DEP SIS HISTORICAL AND 10-20-08 LAB RESULTS

DATE COLECTED	MP	Flow (cfs)	Flow (gpm)	AL (UG/L)	ALK (MG/L)	CL (MG/L)	Fe (UG/L)	FE+2 (UG/L)	FLDPH (pH units)	HOT A (MG/L)	MN (UG/L)	pH (pH units)	SO4 (MG/L)	SPCON (umhos/cm)	TDS (MG/L)	TSS (MG/L)	**Sulfate Load (lb/day)**	**TDS Load (lb/day)**
11-Apr-96	DC5			135	68	10.6	167		7.5	0	52	7.4		406	246	4		
16-May-96	DC5			2240	60	6	2350			0	135	7.4	65	222	164	74		
13-Jun-96	DC5			209	106	29	218		7.8	0	69	7.4	417	1068	834	2		
11-Jul-96	DC5			275	118	26	427		7.8	0	101	7.3	565	1490	1282	2		
08-Aug-96	DC5				100	20			8.2	0		7.4	325	897	306	2		
05-Sep-96	DC5			265	152	36	294			0	72	8.3	228	862	578	22		
10-Oct-96	DC5			142	98	18	249		8	0	32	7.9	318	820	598	16		
12-Dec-96	DC5			177	74	12	313		7.7	0	41	7.2	115	436	298	6		
09-Jan-97	DC5			135	84	16	220		7.6	0	49	7.3	187	597	408	2		
13-Feb-97	DC5			135	76	15	170		7.5	0	56	7.2	148	486	2	50		
13-Mar-97	DC5			181	66	9	304		7.4	0	42	6.8	123	414	314	2		
10-Apr-97	DC5			135	94	25	224		7.5	0	49	7.5	284	781	236	2		
05-Aug-97	DC5			313	156	74	333		7.5	0	291	7.8	1000	2880	2728	16		
21-Oct-08	DC5	5.37	2410.1	200	162.6	153.2	312		6.87	-142.8	162	8	570.4	661	1182	14	**16523.8**	**34241.2**
11-Apr-96	DC6			135	74	13.5	153		7.6	0	78	7.5		445	276	8		
16-May-96	DC6			2370	56	6	2780			0	209	7.5	104	246	204	74		
13-Jun-96	DC6			203	116	36	146		7.9	0	62	7.5	380	1080	814	2		
11-Jul-96	DC6			223	116	26	266		7.7	0	124	7.2	327	969	896	2		
08-Aug-96	DC6				114	22			8.1	0		7.2	271		730	2		
05-Sep-96	DC6			256	172	70	397			0	85	8.4	620	1800	1380	28		
10-Oct-96	DC6			135	114	23	195		7.6	0	36	7.6	366	933	636	20		
12-Dec-96	DC6			135	82	15	293		7.8	0	57	7.2	112	493	568	2		
09-Jan-97	DC6			135	90	18	230		7.9	0	63	7.4	205	629	384	2		
13-Feb-97	DC6			135	84	18	183		7.9	0	61	7.3	197		410	60		
13-Mar-97	DC6			185	72	8	349			0	85	6.8	118	414	362	2		
10-Apr-97	DC6			135	112	21	139		7.5	0	57	6.9	268	778	650	10		
05-Aug-97	DC6			384	138	55	242		7.8	0	217	8.1	366	213	1938	2		
21-Oct-08	DC6	13.42	6022.9	200	223	257.4	181		7.1	-191.6	740	8	6171	4022	9552	44	**446750.8**	**691519.0**
11-Apr-96	DC7			858	62	11.9	1010		7.5	0	204	6.8		478	294	12		
16-May-96	DC7			2670	56	7	3040			0	203	7.4	99	276	200	76		
13-Jun-96	DC7			1020	86	31	775		7.4	0	317	6.9	435	1080	864	2		
11-Jul-96	DC7			885	74	20	484		7.4	0	313	6.7	258	765	714	2		
08-Aug-96	DC7				90	17				0		6.9	251	735	430	2		
05-Sep-96	DC7			1000	96	56	600			0	448	7.6	922		1874	20		
10-Oct-96	DC7			681	100	22	624		7.9	0	128	7.9	339	918	624	2		
12-Dec-96	DC7			351	76	15	562		7.5	0	111	7.1	132	503	40	8		
09-Jan-97	DC7			516	82	16	669		7.7	0	147	7	207	618	378	2		
13-Feb-97	DC7			520	76	16	675		7.3	0	134	7	202	575	272	100		
13-Mar-97	DC7			798	62	8	914		7.5	0	166	6.7	136		346	2		
10-Apr-97	DC7			701	86	21	729		7.5	0	182	7	262	780	568	6		
05-Aug-97	DC7			1240	60	42	703		6.3	0	666	6.7	637	1962	1806	12		
21-Aug-03	DC7			954	65.6	28.2	579	30		0	464	7.2	298.1			8		
21-Oct-08	DC7	21.2	9514.56	242	158.6	240.2	127		6.8	-145	455	7.9	6398.2	3596	9238	36	**731730.2**	**1056504.0**
21-Oct-08	DC8A	18.61	8352.2	301	117.2	221.9	7750		6.75	-104	852	7.4	5877.6	3581	8752	34	**590070.2**	**878640.1**
21-Oct-08	SHDSG			200	243.8	343.2	931			-220.6	1250	7.8	8864.6		13290	56		

ATTACHMENT C

Shannopin Treated Discharge-Historical

DATE COLECTED	Company Name	INITIAL FLOW	FINAL FLOW	AL (UG/L)	ALK (MG/L)	CL (MG/L)	FE (UG/L)	FLDPH (pH units)	HOT A (MG/L)	MN (UG/L)	NA (MG/L)	pH (pH units)	SO4 (MG/L)	TDS (MG/L)	TSS (MG/L)
10/4/2004	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	69.2		26800	7.5	-1.4	6450		6.4	1775.6		26
11/1/2004	AMD RECLAMATION INC	25 Gal/Min	25 Gal/Min	500	295		300	8	-258.2	2290		7.9	1256.5		4
11/22/2004	AMD RECLAMATION INC	2700 Gal/Min	2700 Gal/Min	500	114.4		300		-71.6	446		8.6	2388.1		38
12/8/2004	AMD RECLAMATION INC	2500 Gal/Min	2500 Gal/Min	500	113.8		300	8	-84.8	373		8.5	1485.8		10
1/25/2005	AMD RECLAMATION INC	2500 Gal/Min	2500 Gal/Min	500	69.8		461	8	-50.2	232		8.7	2817.6		12
4/12/2005	AMD RECLAMATION INC	1000 Gal/Min	1000 Gal/Min	500	143.6		523	8	-100.6	562		8.5	4495.9		8
5/17/2005	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	300.2		300	8	-223.4	1330		8.2	3459.8		52
7/25/2005	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	101.6		419	8.5	-71.4	314		8.6	3300		28
8/17/2005	AMD RECLAMATION INC	3200 Gal/Min	3200 Gal/Min	500	152.4		300	8.5	-85.2	1310		8.2	5378		32
9/6/2005	AMD RECLAMATION INC	3450 Gal/Min	3450 Gal/Min	500	149.4		3070	8	-99.4	870		8.3	3681.7		42
10/26/2005	AMD RECLAMATION INC	2850 Gal/Min	2850 Gal/Min	500	219.2		551	8	-171.6	547		8.3	3995.4		54
12/12/2005	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	107.4		1490	8	-52.8	284		8.5	4234.1		16
5/18/2006	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	73.2		300	8	-49.4	164		8.9	5122.8		14
8/17/2006	AMD RECLAMATION INC	3500 Gal/Min	3500 Gal/Min	500	119.6		300	8.5	-95.4	297		8.6	5309.5		18
9/28/2006	AMD RECLAMATION INC	3200 Gal/Min	3200 Gal/Min	500	156.4		300	8	-122.6	530		8.3	4771.4		16
10/30/2006	AMD RECLAMATION INC	3200 Gal/Min	3200 Gal/Min	500	143.6		300	8	-116.8	522		8.4	6414.8		120
1/29/2007	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	115.8		300	8	3.4	256		8.4	5027		12
4/17/2007	AMD RECLAMATION INC	3500 Gal/Min	3500 Gal/Min	500	100.6		300	8	-61.2	135		8.8	4966.5		14
7/19/2007	AMD RECLAMATION INC	3300 Gal/Min	3300 Gal/Min	500	129.2		350		-92.4	258		8.5	5654.2		14
11/8/2007	AMD RECLAMATION INC	3500 Gal/Min	3500 Gal/Min	500	220.8		599	8.5	-183	1400		8.2	8373.4		42
2/27/2008	AMD RECLAMATION INC	3000 Gal/Min	3000 Gal/Min	500	140.6		692	8.5	-99	275		8.6	8404.6		56
5/6/2008	AMD RECLAMATION INC	6000 Gal/Min	6000 Gal/Min	500	207		843		-173.2	643		8.2	8145.6		40
7/10/2008	AMD RECLAMATION INC	4000 Gal/Min	4000 Gal/Min	500	203		1012	8.5	-170.2	487		8.2	7727.8		46
10/22/2008	AMD RECLAMATION INC	4000 Gal/Min	4000 Gal/Min	500	276.6		300	8	-208.8	1162		8.1	8143.8		52
11/17/2008	AMD RECLAMATION INC	2000 Gal/Min	2000 Gal/Min	200	125.4	435.2	244		-89.2	230	3110	8.3	8077.8	14526	18

SIS download; flows have not been verified

Attachment D: Macroinvertebrate and Habitat Evaluation Results

Macroinvertebrate Sample Summary

version: 3.0 2/2/2009 2:10:20 PM

Assessment ID: 59019
Station ID: 20081020-1230-kspyker (Latitude: 39.7446, Longitude: -80.0615)
Method: 6-Dframe Composite, 200 subsample
Location: DC5--Dunkard Creek at Mt Morris

Metrics:

Total # Organisms: 294	Hilsenhoff: 4.97	%EPT: 60	FCPRSH: 11
Taxa Richness: 23	Beck3: 3	Beck4: 12	Modified %EPT: 33
Modified Caddis: 1	EPT: 11	%Mayflies: 21	%Dominant: 28
Caddisfly Taxa: 5	Mayfly Taxa: 5	Modified EPT: 6	Modified %Mayflies: 21
%Intol-Limestone: 14	%Tol-Limestone: 1	%Intol-Freestone: 43	%Tol-Freestone: 57
Shannon Diversity: 2.10			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1020500100	Isonychia	3	3
1020600600	Stenacron	1	4
1020600701	Stenonema	1	4
1021000200	Caenis	1	7
1021600100	Tricorythodes	56	4
1040300100	Taeniopteryx	35	2
1060200100	Corydalus	1	4
1080100100	Chimarra	1	4
1080300500	Polycentropus	1	6
1080400600	Cheumatopsyche	49	6
1080400700	Hydropsyche	2	5
1080700800	Leucotrichia	27	6
1101000200	Psephenus	2	4
1101300200	Dubiraphia	1	6
1101300600	Optioservus	7	4
1101301000	Stenelmis	14	5
1120200000	Ceratopogonidae	1	6
1120900100	Atherix	1	2
1121200500	Hemerodromia	2	6
1121900400	Tipula	1	4
1121901500	Hexatoma	2	2
1122200000	Chironomidae	82	6
11000000000	Oligochaeta	3	10

Habitat:

1 Instream Cover:	6	2 Epifaunal Substrate:	5	
3 Embeddedness:	5	4 Velocity/Depth Regimes:	10	
5 Channel Alterations:	15	6 Sediment Deposition:	8	
7 Frequency of Riffles:	11	8 Channel Flow Status:	11	
9 Condition of Banks:	13	10 Bank Vegetation:	11	**Total**
11 Grazing or Disruptive:	16	12 Riparian Vegetation:	14	125

Impairment:

Insufficient?	Y	Impaired?	N/A	Biology Impaired?	N/A
Habitat Impaired?	N/A	Rock picks influenced?	N	Impact Localized?	N

Designated Use needs reevaluation? N

Attachment D: Macroinvertebrate and Habitat Evaluation Results

Macroinvertebrate Sample Summary

version: 3.0 2/2/2009 2:17:10 PM

Assessment ID: 59020
Station ID: 20081020-1336-kspyker (Latitude: 39.7560, Longitude: -79.9999)
Method: 6-Dframe Composite, 200 subsample
Location: DC6--Dunkard Creek 1000 ft downstream of Medow Run

Metrics:

Total # Organisms: 253	Hilsenhoff: 5.58	%EPT: 4	FCPRSH: 6
Taxa Richness: 15	Beck3: 0	Beck4: 5	Modified %EPT: 3
Modified Caddis: 1	EPT: 3	%Mayflies: 2	%Dominant: 64
Caddisfly Taxa: 2	Mayfly Taxa: 1	Modified EPT: 2	Modified %Mayflies: 2
%Intol-Limestone: 0	%Tol-Limestone: 1	%Intol-Freestone: 30	%Tol-Freestone: 70
Shannon Diversity: 1.32			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1021600100	Tricorythodes	5	4
1030800200	Argia	1	6
1060100100	Sialis	4	6
1060200100	Corydalus	3	4
1080400600	Cheumatopsyche	2	6
1080700000	Hydroptilidae	3	4
1090100900	Petrophila	1	5
1101000200	Psephenus	7	4
1101300600	Optioservus	17	4
1101301000	Stenelmis	40	5
1120200000	Ceratopogonidae	3	6
1121200500	Hemerodromia	1	6
1121400200	Chrysops	2	7
1122200000	Chironomidae	163	6
11000000000	Oligochaeta	1	10

Habitat:

1 Instream Cover:	11	2 Epifaunal Substrate:	13	
3 Embeddedness:	10	4 Velocity/Depth Regimes:	13	
5 Channel Alterations:	16	6 Sediment Deposition:	11	
7 Frequency of Riffles:	9	8 Channel Flow Status:	16	
9 Condition of Banks:	11	10 Bank Vegetation:	11	**Total**
11 Grazing or Disruptive:	16	12 Riparian Vegetation:	10	147

Impairment:

Insufficient?	Y	Impaired?	N/A	Biology Impaired?	N/A
Habitat Impaired?	N/A	Rock picks influenced?	N	Impact Localized?	N

Designated Use needs reevaluation? N

Comments:

Land Use:
Impairment:

Attachment D: Macroinvertebrate and Habitat Evaluation Results

Macroinvertebrate Sample Summary

version: 3.0 2/2/2009 2:19:03 PM

Assessment ID: 59018
Station ID: 20081020-1100-kspyker (Latitude: 39.7582, Longitude: -79.9709)
Method: 6-Dframe Composite, 200 subsample
Location: DC7--Dunkard Creek at Bobtown near USGS gaging station

Metrics:

Total # Organisms: 160	Hilsenhoff: 5.03	%EPT: 24	FCPRSH: 3
Taxa Richness: 11	Beck3: 1	Beck4: 3	Modified %EPT: 0
Modified Caddis: 0	EPT: 2	%Mayflies: 0	%Dominant: 54
Caddisfly Taxa: 2	Mayfly Taxa: 0	Modified EPT: 0	Modified %Mayflies: 0
%Intol-Limestone: 1	%Tol-Limestone: 1	%Intol-Freestone: 86	%Tol-Freestone: 14
Shannon Diversity: 1.49			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1060200400	Nigronia	2	2
1080400700	Hydropsyche	29	5
1080700800	Leucotrichia	9	6
1090100900	Petrophila	2	5
1101000200	Psephenus	3	4
1101300200	Dubiraphia	1	6
1101300600	Optioservus	14	4
1101301000	Stenelmis	87	5
1120200000	Ceratopogonidae	2	6
1122200000	Chironomidae	10	6
11000000000	Oligochaeta	1	10

Habitat:

1 Instream Cover:	11	2 Epifaunal Substrate:	11	
3 Embeddedness:	10	4 Velocity/Depth Regimes:	13	
5 Channel Alterations:	18	6 Sediment Deposition:	11	
7 Frequency of Riffles:	11	8 Channel Flow Status:	10	
9 Condition of Banks:	15	10 Bank Vegetation:	16	**Total**
11 Grazing or Disruptive:	16	12 Riparian Vegetation:	12	154

Impairment:

Insufficient?	Y	Impaired?	N/A	Biology Impaired?	N/A
Habitat Impaired?	N/A	Rock picks influenced?	N	Impact Localized?	N

Designated Use needs reevaluation? N

Comments:

Land Use:
Impairment:

Attachment D: Macroinvertebrate and Habitat Evaluation Results

Macroinvertebrate Sample Summary

version: 3.0 2/2/2009 2:21:22 PM

Assessment ID: 59017
Station ID: 20081217-1513-kspyker (Latitude: 39.7645, Longitude: -79.9660)
Method: 6-Dframe Composite, 200 subsample
Location: DC8a--Dunkard Creek downstream of bobtown at gated road

Metrics:

Total # Organisms: 39	Hilsenhoff: 5.15	%EPT: 28	FCPRSH: 3
Taxa Richness: 7	Beck3: 1	Beck4: 3	Modified %EPT: 0
Modified Caddis: 0	EPT: 1	%Mayflies: 0	%Dominant: 56
Caddisfly Taxa: 1	Mayfly Taxa: 0	Modified EPT: 0	Modified %Mayflies: 0
%Intol-Limestone: 3	%Tol-Limestone: 5	%Intol-Freestone: 92	%Tol-Freestone: 8
Shannon Diversity: 1.21			

Taxa:

Code	Standardized ID Level	Number	Tolerance
1060200100	Corydalus	1	4
1060200400	Nigronia	1	2
1080400700	Hydropsyche	11	5
1101300600	Optioservus	1	4
1101301000	Stenelmis	22	5
1122200000	Chironomidae	1	6
11000000000	Oligochaeta	2	10

Habitat:

1 Instream Cover:	10	2 Epifaunal Substrate:	13	
3 Embeddedness:	6	4 Velocity/Depth Regimes:	16	
5 Channel Alterations:	18	6 Sediment Deposition:	6	
7 Frequency of Riffles:	8	8 Channel Flow Status:	8	
9 Condition of Banks:	15	10 Bank Vegetation:	17	**Total**
11 Grazing or Disruptive:	18	12 Riparian Vegetation:	11	146

Impairment:

Insufficient?	Y	Impaired?	N/A	Biology Impaired?	N/A
Habitat Impaired?	N/A	Rock picks influenced?	N	Impact Localized?	N

Designated Use needs reevaluation? N

Comments:

Land Use:
Impairment:

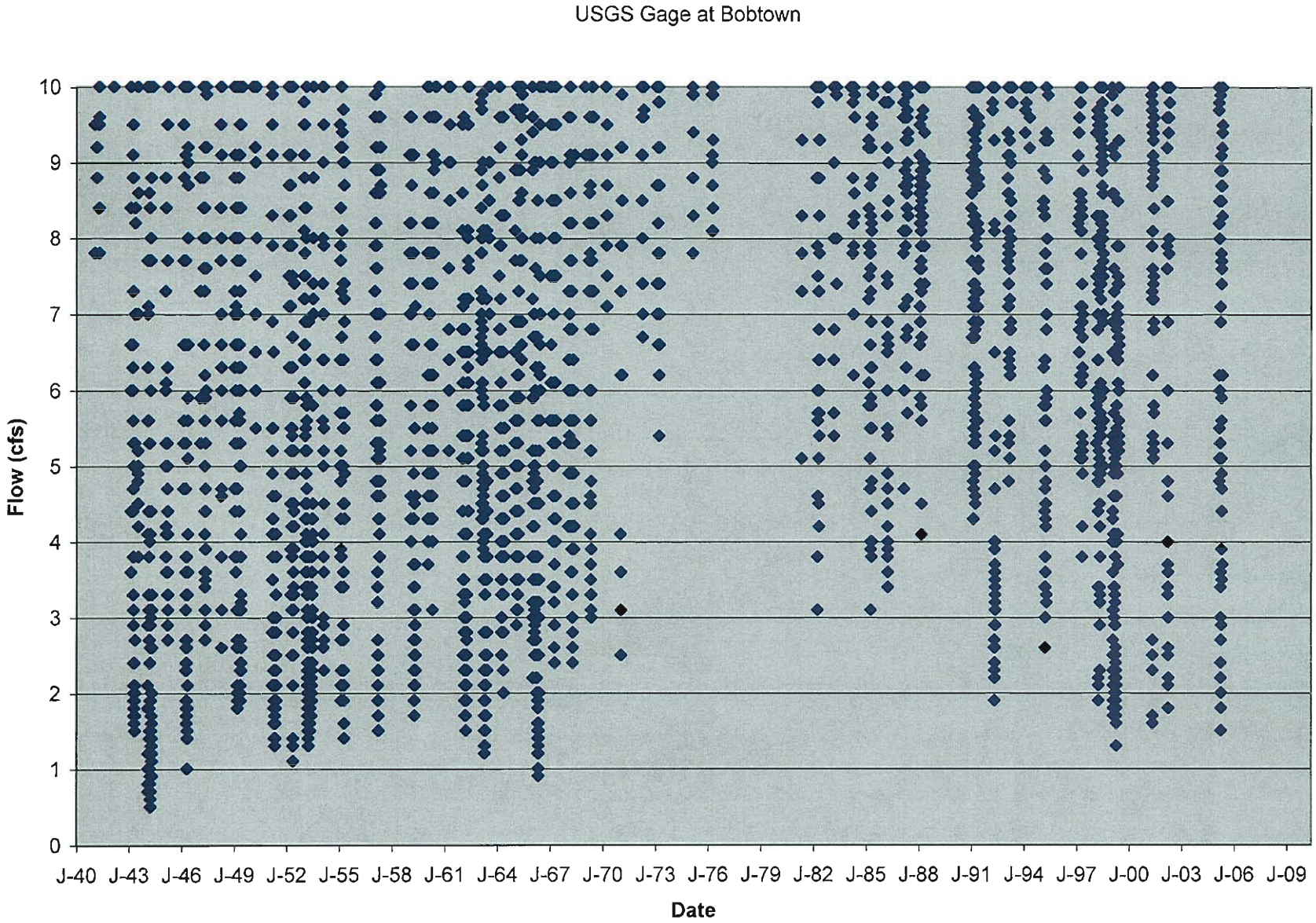
Metric Name	Standardization Value	*Observed Value*	Standardized Metric Score	Adjusted Metric Score
Beck's Index (version 3)	39	*1*	0.026	0.026
EPT Taxa Richness	23	*1*	0.043	0.043
Total Taxa Richness	35	*7*	0.200	0.200
Shannon Diversity Index (freestone)	2.90	*1.21*	0.417	0.417
Hilsenhoff Biotic Index	1.78	*5.15*	0.590	0.590
Percent Intolerant Individuals (freestone)	92.5	*92.0*	0.995	0.995
	DC8a	FREESTONE IBI Score =		37.8

Metric Name	Standardization Value	*Observed Value*	Standardized Metric Score	Adjusted Metric Score
Beck's Index (version 3)	39	*1*	0.026	0.026
EPT Taxa Richness	23	*2*	0.087	0.087
Total Taxa Richness	35	*11*	0.314	0.314
Shannon Diversity Index (freestone)	2.90	*1.49*	0.514	0.514
Hilsenhoff Biotic Index	1.78	*5.03*	0.605	0.605
Percent Intolerant Individuals (freestone)	92.5	*86.0*	0.930	0.930
	DC7	FREESTONE IBI Score =		41.3

Metric Name	Standardization Value	*Observed Value*	Standardized Metric Score	Adjusted Metric Score
Beck's Index (version 3)	39	*0*	0.000	0.000
EPT Taxa Richness	23	*3*	0.130	0.130
Total Taxa Richness	35	*15*	0.429	0.429
Shannon Diversity Index (freestone)	2.90	*1.32*	0.455	0.455
Hilsenhoff Biotic Index	1.78	*5.58*	0.538	0.538
Percent Intolerant Individuals (freestone)	92.5	*30.0*	0.324	0.324
	DC6	FREESTONE IBI Score =		31.3

Metric Name	Standardization Value	*Observed Value*	Standardized Metric Score	Adjusted Metric Score
Beck's Index (version 3)	39	*3*	0.077	0.077
EPT Taxa Richness	23	*11*	0.478	0.478
Total Taxa Richness	35	*23*	0.657	0.657
Shannon Diversity Index (freestone)	2.90	*2.10*	0.724	0.724
Hilsenhoff Biotic Index	1.78	*4.97*	0.612	0.612
Percent Intolerant Individuals (freestone)	92.5	*43.0*	0.465	0.465
	DC5	FREESTONE IBI Score =		50.2

ATTACHMENT E



Attachment E

USGS Dunkard Creek at DC7 – Historical Sulfate Concentrations