Evaluating Appropriate Existing and Designated Uses of Straight Creek (Lee County, VA) Using Current Macroinvertebrate, Habitat and Water Quality Data

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Background

The Powell River watershed (USGS Hydrologic Unit Code #06010206) includes portions of Virginia's Wise and Lee Counties. The Powell River flows through Virginia and Tennessee and joins the Clinch River at the Norris Reservoir. Straight Creek (located in Lee County) is a tributary to the North Fork of the Powell River (Figure 1, MapTech 2006).

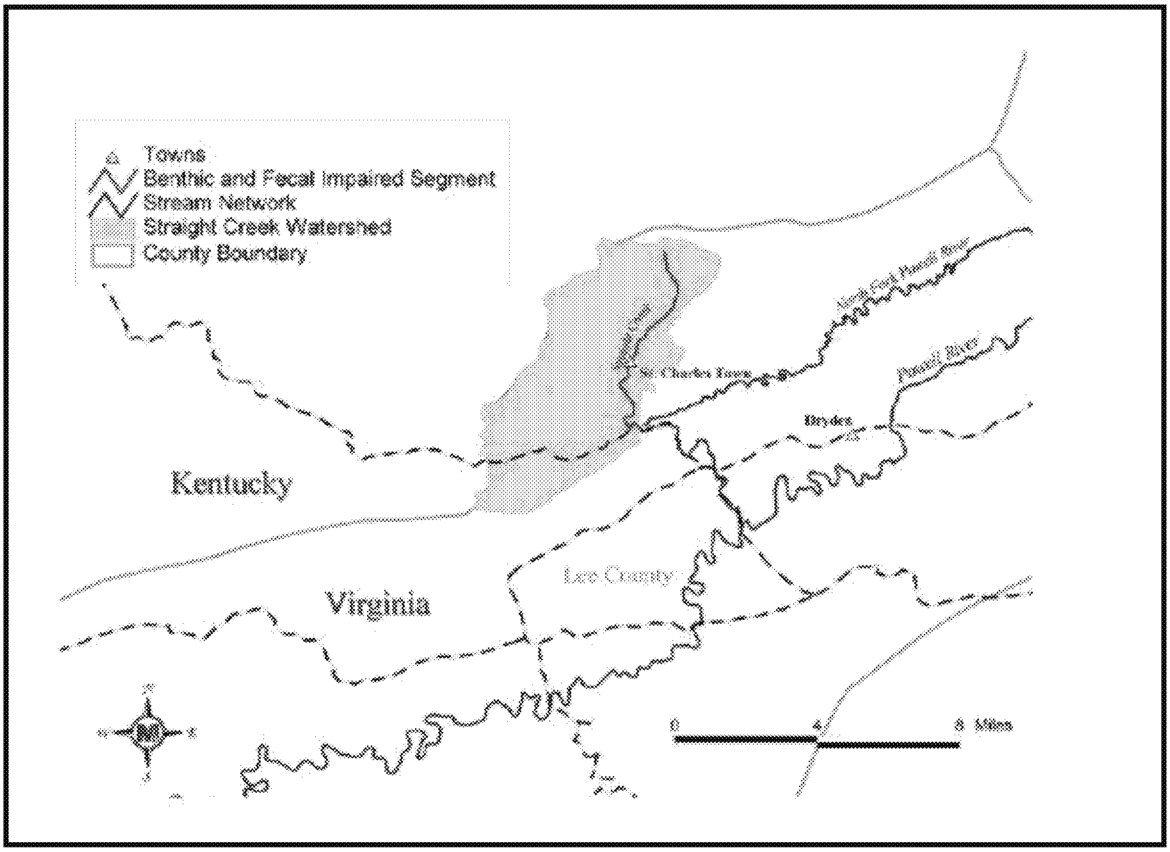

Figure 1. Location of the Straight Creek Watershed (MapTech 2006)

The Straight Creek watershed contains approximately 27.7 square miles (17,728 acres). Major tributaries include Stone Creek, Puckett Creek, Baileys Trace, Gin Creek and Big Branch. The land use is estimated to be primarily forested (80%) with significant amounts of abandoned (11.3%) and active mine lands (7.4%) (MapTech 2006). Active permitted mining operations occur in the headwaters of Gin Creek (Powell Mountain), Baileys Trace (Powell Mountain) and Straight Creek (Lone Mountain). The areas shown as permitted mining land use on Baileys Trace and at the headwaters of Straight Creek are primarily associated with coal preparation plants and ancillary support areas (VMIG 2008). The majority of the abandoned mine lands in the watershed are highwalls and their associated benches. Residential areas are scattered throughout the watershed along the valley bottoms, and are estimated to be less than 1% of the land use, with St. Charles being the largest town in the watershed (population in July 2007 was 153) (www.city-data.com) (Figure 2 and Table 1, MapTech 2006).

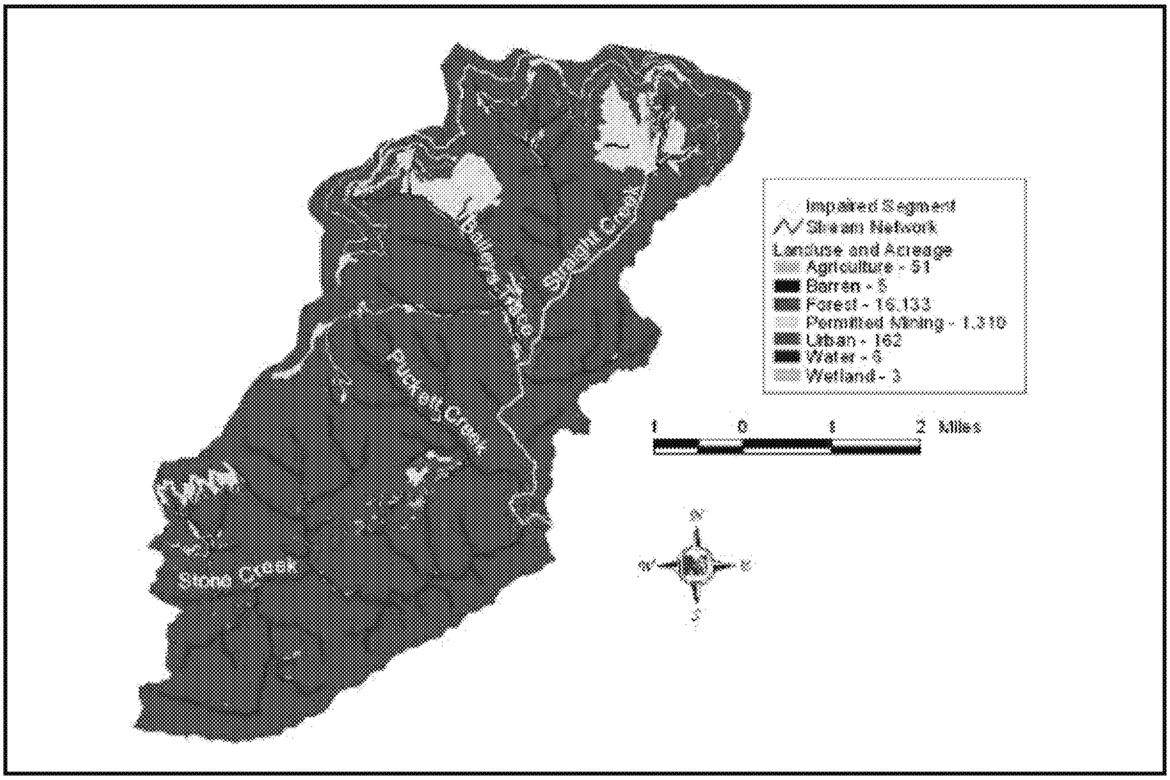

Figure 2. Land Use in Straight Creek (MapTech 2006)

Table 1. Land Uses in Straight Creek Watershed (MapTech 2006)

Land Use	Acres	% of total
AML	1991	11.3
Barren	5	0.0
Commercial	17	0.1
Forest	14142	80.0
Pasture/Hay	42	0.2
Permitted Mining	1310	7.4
Residential	145	0.8
Row Crops	9	0.1
Water	6	0.0
Wetlands	3	0.0
Total Acres	**17670**	**100**

The mainstem of Straight Creek was initially listed on the *Virginia 1994 TMDL Report* for violations of the bacteria standard and then on the *Virginia 1996 Section 303(d) TMDL Priority List* for violations of the narrative General Standard (based on family-level macroinvertebrate surveys). Elevated levels of fecal coliform bacteria recorded at Virginia Department of Environmental Quality (VDEQ) ambient water quality monitoring stations showed that this stream segment does not support the primary contact recreation use (*e.g.*, swimming, wading and fishing). VDEQ analyzed macroinvertebrate samples using a modified Rapid Bioassessment Protocol (RBP) II method (comparison of test sites to single reference sites which do support the aquatic life use) to assess the aquatic life use in Straight Creek as moderately impaired. VDEQ also listed several tributaries of Straight Creek for impaired aquatic life use on the 1996 303(d) list including Stone Creek, Ely Creek, Puckett Creek, Lick Branch of Puckett Creek, Gin Creek and Baileys Trace.

The United States Environmental Protection Agency (EPA) has consistently stated that states should use biological assessments to determine impairments of aquatic life designated uses when the states develop their Section 303(d) lists. EPA has also repeatedly stated that biological assessments are an extremely useful way to determine water quality impairments because biological assessments directly measure whether the aquatic life use is being supported. Furthermore, the biological data integrate and reflect the effect of both physical and chemical stressors. This has been EPA's position since at least 1994 (see ww.epa.gov/owow/tmdl/1994guid.html) and was reiterated in the most recent comprehensive guidance on 303(d) listings in 2005 (See Sections IV.H & IV.K of the 2006 Integrated Report Guidance at www.epa.gov/owow/tmdl/2006IRG/report/2006irg-sec4.pdf).

VDEQ used the process outlined in EPA's Stressor Identification Guidance Document (USEPA 2000) to identify the most probable stressors in Straight Creek. Chemical and physical monitoring data from VDEQ and Virginia Department of Mines, Minerals and Energy (DMME) monitoring sites provided evidence to support or eliminate potential stressors. VDEQ considered several potential stressors including sediment, total dissolved solids, toxics, low dissolved oxygen, nutrients, pH, metals, conductivity, temperature and organic matter. Following the analysis, VDEQ classified potential stressors into three categories:

- Non-Stressor: Those stressors with data indicating normal conditions, without water quality standard violations or without the observable impacts usually associated with a specific stressor.

- Possible Stressor: Those stressors with data indicating possible links, but inconclusive data.

- Most Probable Stressor: The stressor(s) with the most consistent information linking it with the degraded benthic and habitat metrics.

For Straight Creek, VDEQ concluded that sediment and total dissolved solids (TDS) are the most probable stressors causing impairment of the aquatic life use. VDEQ used these stressors to develop the TMDL to address benthic impairment (MapTech, Inc. 2006). We reviewed the stressor identification analysis for Straight Creek and concurred with the findings. However, it is important to note that additional stressors associated with residential land use (straight pipes and failing septic systems) may also be contributing nutrients, organics, household chemicals and other toxicants. However, these types of intermittent and diffuse discharges are often difficult to characterize with the available monitoring data.

Biological Monitoring, Inc. (BMI) was contracted by the Virginia Mining Issues Group (VMIG is an industry stakeholder group) to provide technical expertise regarding TMDL issues in Straight Creek. Industry TMDL issues focus primarily on Straight Creek's aquatic life use impairment, the most probable stressors impairing the use, and potential remediation goals. VMIG questioned whether complete aquatic life use attainment is possible based on required effluent limits and cost effective and reasonable best management practices. Therefore, VMIG proposed to conduct an aquatic life Use Attainability Analysis (UAA) to determine appropriate and achievable goals for Straight Creek. In October 2007, VMIG submitted a UAA study plan to characterize the existing and designated uses of Straight Creek to VDEQ (Biological Monitoring Inc. 2007). VMIG also developed an Implementation Plan for the Straight Creek and Tributaries Total Maximum Daily Load Study (VMIG 2008).

Use of Biological Data to Determine Existing and Designated Aquatic Life Uses

Section 101(a)(2) of the Clean Water Act states that "…it is the national interim goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983." Clean Water Act Section 303(c)(2)(A) requires water quality standards to "protect the public health and welfare, enhance the quality of water, and serve the purposes of this Chapter." EPA's regulations at 40 C.F.R. Part 131 interpret and implement these provisions through a requirement that water quality standards protect section 101(a)(2) uses unless those uses have been shown to be unattainable, effectively creating a rebuttable presumption of attainability. Unless the state rebuts this presumption, a default designation of the section 101(a)(2) uses applies. This approach was upheld in Idaho Mining Association v. Browner, 90 F.Supp. 2d 1078, 1092 (D. Id. 2000). Where a state believes that a use specified in section 101(a)(2) is not attainable and wishes to remove or subcategorize this use, a state or tribe must show that the use change will not result in removing an existing use and complete a UAA (see Appendix 2 for relevant regulatory text from the Federal Water Quality Standards regulation at 40 C.F.R. § 131.10).

EPA's regulations define existing uses as "...those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." Existing uses are relevant to two provisions in the Federal regulation – 40 C.F.R. § 131.10(g), designated uses, and 40 C.F.R. § 131.12(a)(1), antidegradation. Overall, these provisions: 1) prohibit removal of a designated use that would also remove an existing use and 2) require the maintenance and protection of existing instream water uses and the level of water quality necessary to protect existing uses when implementing a state's or tribe's antidegradation policy.

A waterbody will have achieved some degree of use related to aquatic life on or after November 28, 1975. In some cases, the use and water quality actually achieved may be more degraded than the designated use assigned to the waterbody. For example, while the water quality since November 28, 1975 may never have been sufficient to support the diverse aquatic community associated with the waterbody's designated use, it is likely that the water quality in the waterbody supports or has supported some less diverse community of organisms. When such uses have been achieved on or after November 28, 1975, EPA considers the use reflecting the highest degree of aquatic life achieved to be "existing" uses. Where a state is designating its uses or revising its designated uses, the state must ensure that the resulting water quality will not jeopardize the less diverse aquatic community (and thus the existing use).

Furthermore, states are not bound by their designated use classification categories when describing existing uses. When evaluating the uses actually achieved along a continuum of biological condition, the existing uses of a waterbody are the "highest degree of uses" and water quality necessary to support those uses, that have been achieved since November 28, 1975, independent of the designated use. "Highest degree of uses" generally means the degree of use closest to those supported by minimally impacted conditions, which usually is associated with the highest level of water quality and biological condition. In other words, even if a biological condition comparable to the designated use has never been achieved since November 28, 1975, the highest biological condition achieved since November 28, 1975 must be protected as the existing use. States can describe the biological condition using a variety of bioassessment tools such as taxa lists, indicator taxa, individual metrics (e.g. composition, tolerance) or multimetric indices that combine several individual metrics, taxa lists and indicator taxa.

EPA's existing use regulations ensure that the waterbody's highest degree of uses and the necessary levels of water quality actually achieved on or after November 28, 1975 will be maintained and protected consistent with the overall objective of the Clean Water Act (CWA) to restore and maintain the physical, chemical, and biological integrity of the nation's waters. Thus, 40 C.F.R. §§ 131.10(g) and 131.12(a)(1) define the absolute "floor" or minimum use and necessary level of water quality achieved that must be maintained and protected in a waterbody. In other words, even if a state finds that the existing use is less than the designated use, and a new use is appropriate, the state must assign a use that is at least equivalent to the biological condition of the existing aquatic life use. A state can not assign a new use that does not protect the highest existing use achieved in the waterbody.

A state should determine existing uses on a site-specific basis to ensure it has identified the highest degree of uses and water quality necessary to support the uses that have been achieved since November 28, 1975. When describing existing uses, states should articulate not only the use(s) that has been achieved, but also the water quality supporting the specific use(s) that has been achieved. For aquatic life, states should consider the available biological data as an indicator of both water quality and the actual aquatic life use, in conjunction with any available chemical water quality data. Both historical (since

November 28, 1975) and current data should be used to make sure the highest degree of uses and water quality are described.

In May 2008, the Wheeling Freshwater Biology Team (FBT) collected macroinvertebrate, water chemistry and habitat data to provide USEPA and VDEQ with an additional independent dataset on the current biological condition of Straight Creek and selected major tributaries. VDEQ's final analysis of existing uses and appropriate designated uses should consider all available water quality, habitat and biological data (including additional assemblages such as fish) to ensure that the highest use is characterized accurately. Most of the existing data we have reviewed was collected on the mainstem of Straight Creek. We collected more data on some of the major tributaries of Straight Creek. We offer our data as additional information on the existing and appropriate designated uses of Straight Creek and some major tributaries and to make recommendations on the appropriate extent and timing of the UAA study plan.

Methods

We sampled field chemistry and physical parameters (specific conductivity, temperature, dissolved oxygen, % saturation of dissolved oxygen and pH) at 23 sites in the Straight Creek watershed and at 1 site in a nearby reference watershed (Clear Creek) from May 6-8, 2008. We collected macroinvertebrate samples and RBP visual habitat information at 8 of the sites in the Straight Creek watershed and at the reference site on Clear Creek, a direct tributary to the North Fork of the Powell River. These 8 sites were located on the mainstem of Straight Creek (2 sites), Gin Creek (2 sites), Baileys Trace (2 sites), Fawn Branch (1 site) and Big Branch (1 site). We also collected additional water quality samples (total metals, hardness, alkalinity, major anions and cations, and nutrients) at 5 sites, including the mainstem of Straight Creek (2 sites), Gin Creek (2 sites) and Baileys Trace (1 site). We selected sites to bracket mining and residential influences on the main stem of Straight Creek and its major tributaries. The complete list of 23 sites is shown in Table 2. The subset of 8 sites where we collected macroinvertebrates in the Straight Creek watershed is shown in Figure 3.

We collected macroinvertebrates from riffles using a 0.3-m-wide d-frame net (595-µm mesh) in the spring index period (May 2008) using the VDEQ method. We composited 6 d-frames (each 1/3 m^2) collected from a 100-m reach at each site for a total of approximately 2 square meters. In the laboratory, we randomly subsampled organisms in gridded pans to obtain 200 ± 20% individuals. We identified individuals to the genus level for most groups, except Turbellaria, Nematoda, Hydracarina, and Oligochaeta. For calculation of the multimetric Virginia Stream Condition Index (VSCI) we subsampled all samples to 110 organisms using a Fortrant program (http://129.123.10.240/WMCPortal/modelSection.aspx?section¼125&title¼ build&tabindex¼-1; Western Center for Monitoring and Assessment of Freshwater Ecosystems, Utah State University, Logan, Utah). For family-level analyses, we collapsed genera and summed them to family names in the database.

The VSCI uses eight core metrics that are scored individually and then combined into a single index value (Tetra Tech 2003). The eight metrics include EPT taxa, Total taxa, % Ephemeroptera, % Plecoptera plus Trichoptera less Hydropsychidae (a predominantly pollution tolerant caddisfly family), % Chironomidae, % Top 2 Dominant Taxa, HBI (a modified Family biotic index), and % Scrapers. Standard values and standardization equations for the VSCI metrics are shown in Table 3. For a detailed explanation of the multimetric index development please review the document 'A Stream Condition Index for Virginia Non-Coastal Streams' at http://www.deq.virginia.gov/watermonitoring/pdf/vastrmcon.pdf.

Figure 3. Sampling sites where macroinvertebrates were collected (May 2008)

Table 2. Sampling Sites on Straight Creek and Selected Tributaries (May 5-6, 2008)

Site #	Location	temp	cond	pH	DO (%sat)	Macroinverts: VSCI Score	water quality sample
1	Gin Creek at Darbyville Church	13.8	742	8.6	10.83 (--)	23.5	X
2	Gin Creek ds of Powell Mountain Coal	15.2	804	8.5	10.3 (103)	61.3	X
3	UNT to Gin Creek	12.3	1040	8.4	10.1 (95)		
4	Gin Creek us of UNT	15.3	760	8.4	10.1 (101)		
5	UNT to Straight Creek receives Lone Mountain refuse fill	18.6	1323	8.3	9.1 (98)		
6	Straight Creek us of Lone Mountain UNT	15.9	519	8.2	9.6 (98)		
7	Straight Creek ds of Lone Mountain UNT	16.8	782	8.2	9.6 (98)	56.2	X
8	Straight Creek ds of residences, us of St. Charles	18.0	577	9.0	12.5 (132)	16.3	X
9	Baileys Trace ds of Thermal Coal Sign	18.2	717	8.7	9.6 (103)	37.9	X
10	UNT to Bailey Trace at substation	13.3	93	7.4	9.3 (89)		
11	Deep mine seep? near #10	15.2	1362	2.8	9.9 (99)		
12	Bailey Trace ds Powell Mountain Coal gate	15.6	923	8.4	9.7 (98)	72.5	X
13	Potts Branch ds residences	16.9	206	7.4	7.2 (74)		
14	Fawn Branch ds residences	17.2	224	8.4	9.8 (102)	35.4	
15	Big Branch ds of Dearth Hollow	11.7	170	7.9	10.1 (93)	73.2	
16	Big Branch ds of Murphys Hollow	12.5	217	7.7	10.1 (95)		
17	UNT to Straight Creek in St. Charles	11.9	320	3.3	10.3 (96)		
18	Thermal Coal discharge	16.8	1585	8.5	8.7 (90)		
19	Puckett Creek at mouth	17.8	503	9.0	10.5 (111)		
20	Puckett Creek us of Baker Hollow Rd and AMD project	16.5	289	8.7	10.0 (103)		
21	Puckett Hollow most us site	14.5	314	8.1	9.2 (90)		
22	Puckett Creek	18.0	309	8.8	10.8 (114)		
23	Straight Creek near mouth at Hawkthorn Rd	19.1	687	8.8	11.1 (120)		
27	Clear Creek	12.2	20	6.8	9.8 (91)	79.7 75.7	

Table 3. VSCI Metrics: Standard Best Values and Scoring Equations.

Metrics that decrease with stress	Standard (best value) X_{95}	X_{min}	Standardization equation (Section 3.6, Equation 1; X=metric value)
Total taxa	22	0	score = 100 × (X/22)
EPT taxa	11	0	score = 100 × (X/11)
% Ephemeroptera	58.9	0	score = 100 × (X/58.9)
% Plec+Tric less Hydropsych.	34.8	0	score = 100 × (X/34.8)
% Scrapers	49.1	0	score = 100 × (X/49.1)
Metrics that increase with stress	**Standard (best value) X_5**	**X_{max}**	**Standardization equation (Section 3.6, Equation 2; X=metric value)**
% Chironomidae	0	100	score = 100 × [(100-X)/(100-0)]
% Top 2 Dominant	29.5	100	score = 100 × [(100-X)/(100-29.5)]
HBI (family)	3.2	10	score = 100 × [(10-X)/(10-3.2)]
Final index score for a site is determined by averaging the site's 8 unitless standardized metric scores, using a maximum metric score of 100 for any metric whose individual score at a site exceeded 100.			

The VSCI was originally developed using Virginia's historical biomonitoring database, which contained a significant number of upstream control sites that VDEQ used for point source assessments using the Rapid Bioassessment Protocols (RBP) (Barbour et al. 1999). Reference sites in the central Appalachian ecoregion, piedmont ecoregions and headwater streams were limited in that dataset. This dataset also included pseudoreplication of some sites.

In 2006, VDEQ used their independent probabilistic database (sample n=350) with data collected from 2001-2004, to validate the VSCI (VDEQ 2006) (http://www.deq.virginia.gov/export/sites/default/watermonitoring/pdf/scival.pdf). The probabilistic dataset was free of the pseudoreplication issues inherent in the historical dataset. VDEQ used this data set to fill data gaps, test the proposed VSCI against several classification variables including season, stream size, ecoregion, bioregion, river basin, regional office, and sampling technique, and to review the recommended best standard values for the eight core metrics. VDEQ confirmed that the VSCI works well to discriminate between sites with acceptable water quality and habitat versus sites with degraded water quality and habitat. VDEQ found potential seasonal, ecoregion, bioregion, basin size, and sampling method patterns in the ordinations. However, VDEQ decided the patterns were not strong enough to support recalibrating the VSCI by season, sampling method, bioregion, or basin size. VDEQ also concluded that it was not necessary to revise the metric best standard values used for scoring individual metrics and calculating the VSCI.

VDEQ suggested slight adjustments to the interpretation of the VSCI scores for assessing aquatic life uses. The 10th percentile from their probabilistic data set was 58.5 while the 10th percentile from Tetra Tech's original analysis of targeted data was 61.3. The average 10th percentile cutoff from both data sets was 59.9. VDEQ rounded the assessment threshold to 60. For the VDEQ 2008 305(b)/303(d) Integrated Water Quality Report, VDEQ assessed streams with VSCI scores ≥ 60 as "fully supporting the aquatic life use" and streams with VSCI scores < 60 as"impaired" (VDEQ 2007). We used this threshold to determine aquatic life use impairment.

We collected chemical variables at the subset of 5 sites, including alkalinity, hardness, sulfate, chloride, sodium, potassium, total phosphorous, nitrite + nitrate, total Al, total As, total Cr, total Pb, total Ni, total Ca, total Cu, total Fe, total Mg, total Mn, total Se and total Zn. We also recorded in situ physicochemical variables (pH, specific conductance, dissolved oxygen, % saturation of dissolved oxygen and temperature) at the time of benthic sampling at all 23 sites with a portable multiparameter sonde (Hydrolab Quanta; Hydrolab Corp., Austin, Texas).

We collected field chemistry measurements and water chemistry measurements mid-stream and followed EPA Region III sampling submission guidelines for proper containers, preservatives, holding time and shipping requirements. The water quality samples were analyzed for major cations and ions, nutrients, and metals by the EPA Region 3 Environmental Science Center Laboratory in Fort Meade, MD.

We scored the physical habitat (0–20 points/metric; 0–200 points for total score) at all sites using the RBP (Barbour et al. 1999). We considered a subset of the RBP habitat metrics (epifaunal substrate, embeddedness, sediment deposition, channel alteration, bank stability, riparian zone width and the total score) for this assessment, based on our knowledge of these metrics in relation to watersheds with mining and residential land uses, and their overall responsiveness in these small Central Appalachian streams.

Results

Macroinvertebrates

At several sites in the Straight Creek watershed, the VSCI scores (Table 4 and Figure 4) indicated current attainment of the aquatic life use (Sites 2 on Gin Creek, 12 on Baileys Trace, and 15 on Big Branch) or close to attainment (Site 7 on Straight Creek). Other sites are clearly impaired (Sites 1 on Gin Creek, 8 on Straight Creek, 9 on Baileys Trace and 14 on Fawn Branch). The sites closest to the mining operations were in better condition than those downstream, where the additional effects of residential land use and other stressors were reflected in the lower VSCI scores. Our results confirm this pattern on Gin Creek, Baileys Trace and Straight Creek, which was evident in earlier VDEQ macroinvertebrate data (Maptech 2006), USFWS data (USFWS 2007) and industry data (VMIG 2008) collected on the mainstem of Straight Creek. VSCI scores, individual metric values and taxonomic lists for each site are provided in Tables 4, 5 and 6 (Table 6 appears in Appendix 1).

Table 4. VSCI Scores (May 2008)

Station ID	Stream Name	Location	Latitude DD	Longitude DD	VSCI
Straight 1	Gin Creek	at Darbyville Church	36.82716	83.05145	23.5
Straight 2	Gin Creek	DS of Powell Mountain	36.83558	83.05439	61.3
Straight 7	Straight Creek	DS of Lone Mountain	36.83341	83.03385	56.2
Straight 8	Straight Creek	DS of residences, US of St. Charles	36.82072	83.04351	16.3
Straight 9	Baileys Trace	DS of Thermal Coal sign	36.80597	83.05875	37.9
Straight 12	Baileys Trace	DS Powell Mountain Coal Co.	36.82265	83.07014	72.5
Straight 14	Fawn Branch	US of trash collection area	36.81155	83.06407	35.4
Straight 15	Big Branch	US of residences	36.80301	83.04108	73.2
Ref 27	Clear Creek	DS of Fawn Hollow Road REF	36.9336	82.5836	79.7
Ref 27	Clear Creek (dup)	DS of Fawn Hollow Road REF	36.9336	82.5836	75.7

Actual 200± 20% pick was computer subsampled to 110 individuals for VSCI calculations.

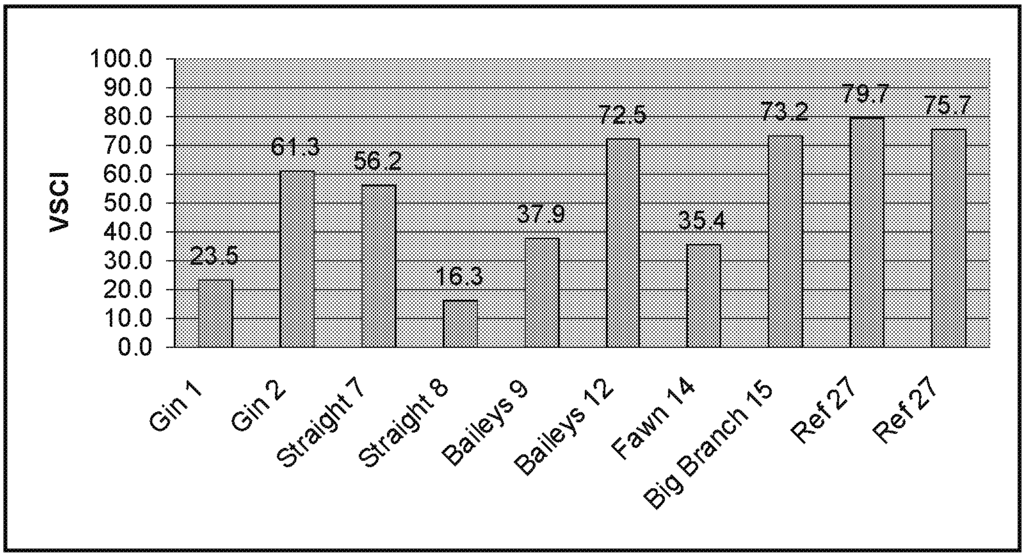

Figure 4. VSCI Scores (May 2008)

Table 5. Individual Metric Values (May 2008)

Station ID	Straight 1	Straight 2	Straight 7	Straight 8	Straight 9	Straight 12	Straight 14	Straight 15	Ref 27	Ref 27
Stream Name	Gin Creek	Gin Creek	Straight Creek	Straight Creek	Baileys Trace	Baileys Trace	Fawn Branch	Big Branch	Clear Creek	Clear Creek (dup)
Location	at Darbyville Church	DS of Powell Mountain	DS of Lone Mountain	DS of residences, US of St. Charles	DS of Thermal Coal sign	DS Powell Mountain Coal Co.	US of trash collection area	US of residences	DS of Fawn Hollow Road REF	DS of Fawn Hollow Road REF
Latitude DD	36.82716	36.83558	36.83341	36.82072	36.80597	36.82265	36.81155	36.80301	36.9336	36.9336
Longitude DD	83.05145	83.05439	83.03385	83.04351	83.05875	83.07014	83.06407	83.04108	82.5836	82.5836
VSCI	23.5	61.3	56.2	16.3	37.9	72.5	35.4	73.2	79.7	75.7
# Individuals	110	110	110	110	110	110	110	110	110	110
# Total Taxa (Family)	9	13	16	9	13	17	10	17	26	22
# EPT Taxa (Family)	4	8	8	1	6	10	5	13	15	15
% Ephemeroptera	11.0	12.4	3.6	0.0	23.2	19.4	17.2	23.6	23.9	19.4
% Plec+Trich-Hydropsychid	1.0	60.4	38.5	1.2	3.9	47.5	8.0	72.4	41.8	52.7
% Scrapers	0.0	5.6	1.2	2.0	4.3	9.2	4.2	3.7	13.4	15.8
% Chironomidae	82.78	17.20	42.51	94.05	62.20	11.98	66.81	2.03	13.93	16.67
% 2 Dominant Taxa (Family)	93.30	69.60	65.18	95.24	84.25	49.31	81.93	68.29	41.29	59.46
HBI (Family)	5.76	2.12	3.95	5.92	5.24	2.74	5.07	1.67	2.72	2.27

Site 27 was located on Clear Creek, and served as a local reference. We collected replicate samples on Clear Creek (our Standard Operating Procedures require at least 10% replication). The VSCI scores for these two samples were 79.7 and 75.7, indicating full support of the aquatic life use. The two subsamples from this site contained numerous Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) taxa (collectively called EPT taxa) including *Ameletus, Acentrella, Baetis, Plauditus, Drunella, Ephemerella, Eurylophella, Cinygmula, Epeorus, Stenonema, Leptophlebiidae (prob. Paraleptophlebia), Sweltsa, Leuctra, Amphinemura, Peltoperla, Acroneuria, Pteronarcys, Taeniopteryx, Ceratopsyche, Cheumatopsyche, Diplectrona, Lepidostoma, Dolophilodes, Polycentropus* and *Rhyacophila.*

Photo 1. Site 27. Clear Creek looking downstream


Photo 2. Site 27. Clear Creek looking upstream

Site 7 was located on the mainstem of Straight Creek, downstream of the Lone Mountain processing discharge point. The VSCI score at this site was 56.2, indicating slight impairment of the aquatic life use. Although 43% of the subsample was composed of Chironomidae, many of the other taxa collected are common to headwater streams. The subsample collected from this site contained several EPT taxa including *Ameletus, Acentrella, Baetis, Plauditus, Ephemerella, Leuctra, Amphinemura, Isoperla, Cheumatopsyche and Hydroptila*. The relative abundances of these taxa in the subsample were low, except for *Leuctra* and *Amphinemura*.


Photo 3. Site 7. Straight Creek looking downstream

Site 8 was located further downstream on the mainstem of Straight Creek, downstream of the first clutch of residences, but still upstream of St. Charles. The VSCI score at this site declined to 16.3, which was the lowest VSCI score encountered in this survey. Chironomidae made up 94% of the individuals in the subsample. The taxa list at this site was quite diminished compared to upstream. For example, the only EPT taxa found at this site was the stonefly *Leuctra*, and the subsample only contained 3 individuals.

Photo 4. Site 8. Straight Creek looking downstream

Site 2 was located on Gin Creek, downstream of the Powell Mountain discharge. The VSCI score at this site was 61.3, indicating attainment of the aquatic life use. Chironomidae made up only 17.2% of the subsample. The subsample from this site contained several EPT including *Acentrella, Baetis, Plauditus, Ephemerella, Epeorus, Leuctra, Amphinemura, Perlesta, Cheumatopsyche, Diplectrona, Hydropsyche* and *Dolophilodes*. *Leuctra* was the most abundant taxon in the subsample.

Photo 5. Site 2. Gin Creek looking downstream

Site 1 was located further downstream on Gin Creek, downstream of the Darbyville Church. The VSCI score at this site declined to 23.5. Chironomidae made up 82.8% of the subsample. The subsample from this site contained fewer EPT taxa and they were all present at low relative abundances: *Acentrella, Baetis, Plauditus, Eurylophella, Leuctra,* and *Cheumatopsyche*.

Photo 6. Site 1. Gin Creek looking upstream

Photo 7. Site 1. Gin Creek looking downstream

Site 12 was located on Baileys Trace, downstream of the Powell Mountain Coal operation. The VSCI score for this site was 72.5 indicating the aquatic life use is fully supported in this reach. Chironomidae made up only 12% of the subsample. The subsample from this site contained many EPT taxa including *Acentrella, Baetis, Plauditus, Ephemerella, Epeorus, Leuctra, Amphinemura, Perlesta, Taeniopteryx, Cheumatopsyche, Chimarra* and *Rhyacophila*. The stonefly *Leuctra* was the dominant taxon in the subsample.

Photo 8. Site 12. Baileys Trace looking downstream

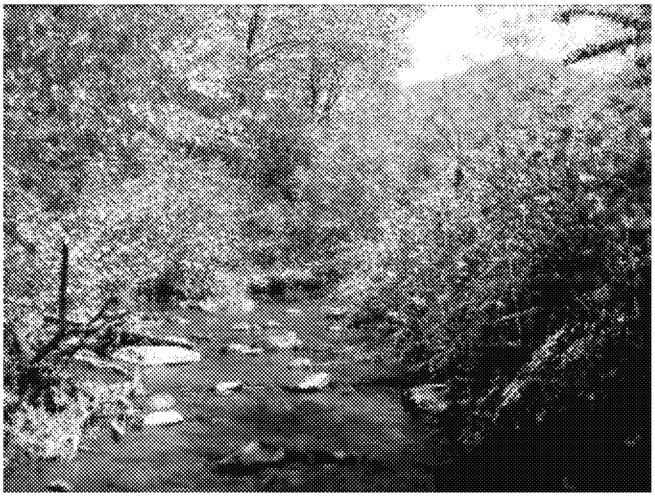

Photo 9. Site 12. Baileys Trace looking upstream

Site 9 was located further downstream on Baileys Trace, downstream of the Thermal Coal sign and a defunct bridge over Bailey Trace. The VSCI score for this site was 37.9. Chironomidae made up 62.2% of the subsample. The subsample from this site contained several EPT taxa including *Acentrella, Baetis, Plauditus, Epeorus, Leptophlebiidae* (prob. *Paraleptophlebia*), *Leuctra, Amphinemura, Ceratopsyche* and *Cheumatopsyche*.

Photo 10. Site 9. Baileys Trace looking downstream

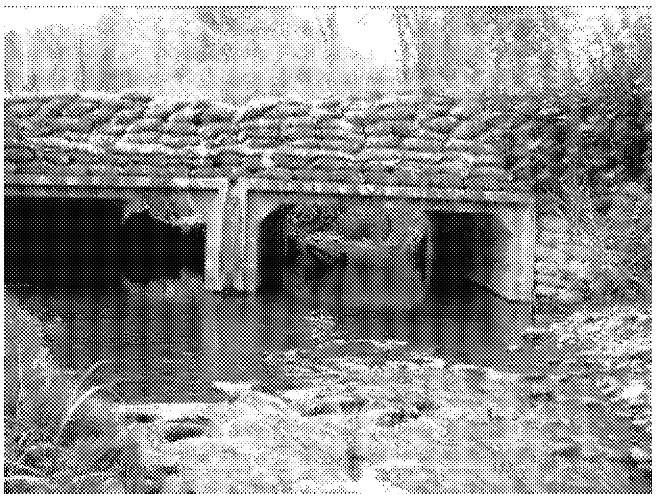

Photo 11. Site 9. Baileys Trace looking upstream

Site 14 was located on Fawn Branch, upstream of the trash collection center. The VSCI score for this site was 35.4. Chironomidae made up 66.8% of the subsample. The subsample from this site contained several EPT taxa including *Acentrella, Baetis, Plauditus, Ephemerella, Eurylophella, Epeorus, Leuctra, Cheumatopsyche* and *Hydropsyche*.

Photo 12. Site 14. Fawn Branch looking downstream

Photo 13. Site 14. Fawn Branch looking upstream

Site 15 was located on Big Branch, upstream of any residences. The VSCI score for this site was 73.2, indicating full support of the aquatic life use. Chironomidae made up only 2% of the subsample. The subsample from this site contained several EPT taxa including *Acentrella, Baetis, Ephemerella, Epeorus, Stenacron, Paraleptophlebia, Leuctra Amphinemura, Isoperla, Agapetus, Diplectrona, Wormaldia, Polycentropus* and *Neophylax*. *Leuctra* and *Amphinemura* dominated the subsample.


Photo 14. Site 15. Big Branch looking downstream


Photo 15. Site 15. Big Branch looking upstream

Habitat

The RBP visual habitat assessment scores are provided in Table 7. Note that individual parameters are scored on a scale of 0 to 20. Scores from 16-20 are considered "optimal". Scores from 11 to 15 are considered "suboptimal" but the habitat is generally still capable of supporting macroinvertebrate and fish assemblages that would support aquatic life uses. Scores from 6 to 10 are considered "marginal" and scores from 0 to 5 are considered "poor". We consider epifaunal substrate, embeddedness, sediment deposition, channel alteration, bank stability, riparian zone width, and the total scores to be most relevant to the objectives of this study. The channel flow status and velocity/depth measures vary with season and the water year and tend to be more a function of natural conditions unless otherwise noted in the field (e.g. channel alteration causing dewatering or over wide channels).

Table 7. Individual and Total RBP Habitat Scores (May 2008)

Station ID	Stream Name	Epi Sub	Emb	VelDep	Sed Dep	Flow Status	Chan Alt	Rif Freq	LB Stab	RB Stab	LB Veg	RB Veg	LB Rip	RB Rip	Total RBP
Straight 1	Gin Creek	15	14	10	11	15	15	18	9	5	8	3	9	1	133
Straight 2	Gin Creek	16	14	10	12	15	15	18	7	7	6	4	5	3	132
Straight 7	Straight Creek	12	12	10	8	14	15	14	7	7	5	5	7	2	117
Straight 8	Straight Creek	13	12	10	11	15	15	17	8	8	6	6	5	4	130
Straight 9	Baileys Trace	17	17	10	14	16	13	15	9	8	9	4	9	2	143
Straight 12	Baileys Trace	17	12	10	10	16	15	17	8	9	3	8	2	8	135
Straight 14	Fawn Branch	16	14	10	11	15	13	18	9	7	8	3	8	1	133
Straight 15	Big Branch	18	15	10	12	14	18	17	7	8	8	8	7	9	151
Straight 27	Clear Creek	19	19	18	19	15	18	18	10	10	10	10	9	10	185

Scores for epifaunal substrate, embeddedness, channel alteration and bank stability were generally in the optimal to suboptimal range. The substrates were dominated by boulder, cobble or large gravel substrates and provided adequate habitat for aquatic life. At a few sites (7 and 12), the sediment deposition scores were in the high marginal range. At a few sites (2 and 7), the bank vegetation scores were in the marginal range. At several sites (1, 2, 7, 8, 12 and 14) the riparian vegetative zone scores were in the marginal range. Riparian zones were commonly disturbed by roads, lawns, houses and other buildings. Disturbance of the riparian zone can alter shading and increase stream temperatures, decrease the delivery of coarse organic matter to the stream, decrease certain types of fish and macroinvertebrate habitat, and decrease stream bank stability.

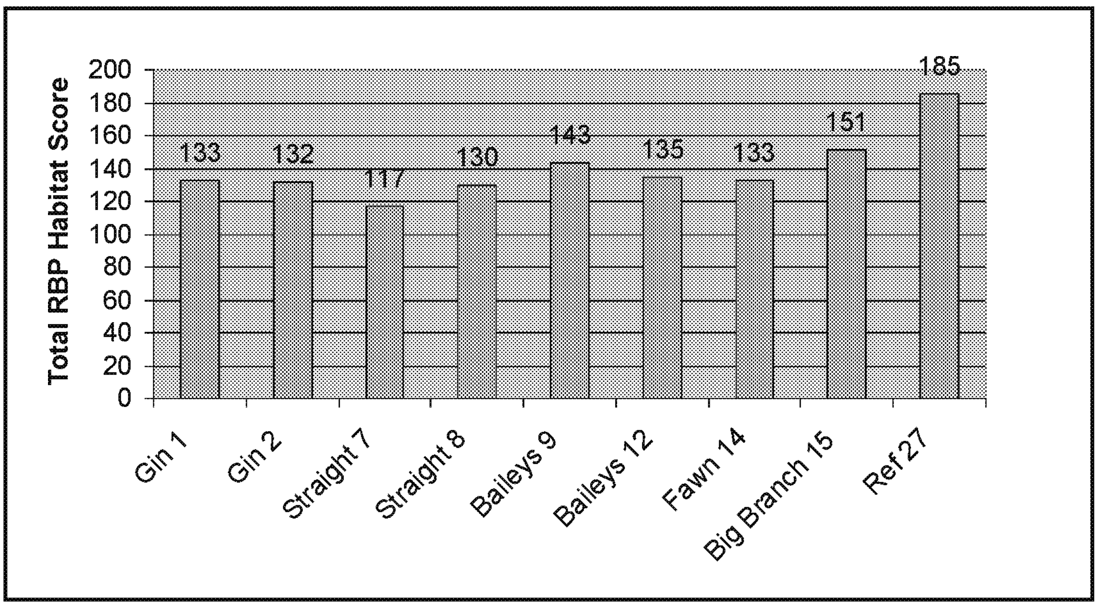

Figure 5. Total RBP Habitat Scores (May 2008)

Water Quality

In Situ Measurements

We observed several tributaries with low conductivity, indicating generally good water quality with a potential to support the aquatic life use (Table 2): Baileys Trace tributaries including Potts Branch (site 13, sp. Cond = 206 µS/cm), Fawn Branch (site 14, sp. Cond = 224 µS/cm), and an unnamed tributary (UNT) (site 10, sp. Cond. = 93 µS/cm); Big Branch (site 15, sp. Cond. = 170 µS/cm and site 16, sp. Cond. = 217 µS/cm); and Puckett Creek upstream of the US Army Corps of Engineers (USACE) Acid Mine Drainage (AMD) treatment site (site 20, sp. Cond. = 289 µS/cm, site 21, sp. Cond = 314 µS/cm, and site 22, sp. Cond. = 309 µS/cm). Many of these sites have no active mining but have a few residences.

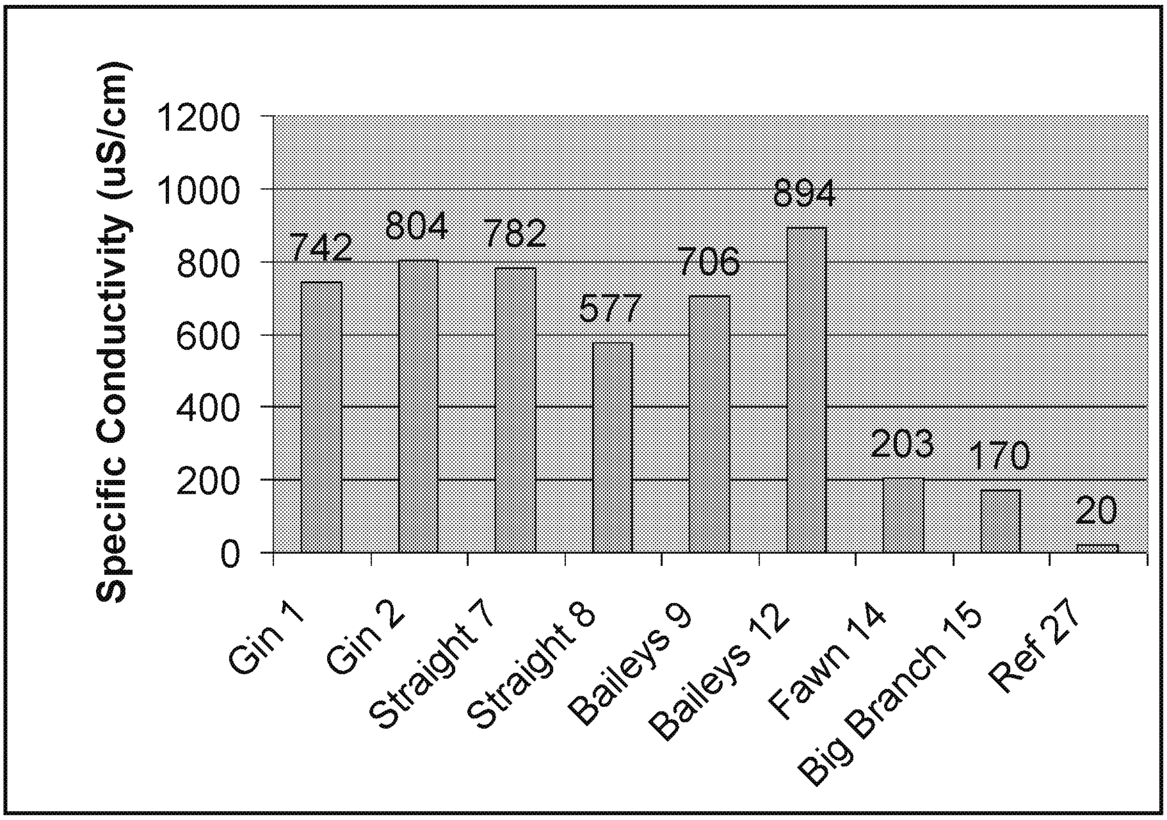

Figure 6. Specific Conductivity (May 2008)

Generally, we observed the highest conductivity levels nearest coal mining operations (both active and inactive) and upstream of residences (Figure 6). We found a few sites with acidic mine drainage (site 11, a ground water seep on Baileys Trace, with a pH of 2.8 and site 17, a UNT on Straight Creek, with a pH of 3.3). We also observed a white precipitate on the substrate of Straight Creek, just upstream and downstream of site 17. The precipitate seemed to originate from a groundwater discharge point just upstream of site 17. This precipitate could be aluminum. Both of these acidic discharges were small and not discharging much flow at the time of this visit.

The conductivity levels in Straight Creek and its tributaries are elevated compared to background levels in the unmined portions of the watershed and at the reference site. Conductivity on the main stem of Straight Creek ranged from 519 µS/cm upstream of the UNT which receives the Lone Pine Coal refuse fill to 782 µS/cm directly downstream of the Lone Mountain refuse fill to 577 µS/cm in the mid reaches to 687 µS/cm at the mouth. The conductivity levels in Gin Branch ranged from 804 µS/cm downstream of Powell Mountain Coal to 742 µS/cm in Darbyville, and in Baileys Trace they ranged from 923 µS/cm downstream of Powell Mountain Coal to 717 µS/cm near the mouth. Puckett Creek ranged from 314 µS/cm at the most upstream site to 503 µS/cm at the mouth.

Laboratory Water Quality Samples

The laboratory water chemistry results in the headwaters of Gin Creek, Straight Creek and Baileys Trace reflect the water quality changes due solely to mining (sites are located upstream of any residential stressors). Conductivity is elevated in the headwaters of Gin Creek, Straight Creek and Baileys Trace compared to Fawn Branch and Big Branch. The additional water quality data available in Gin Creek and Straight Creek show typical increases in hardness, alkalinity and sulfate normally associated with alkaline mine drainage (Table 8). Note that the dominant anions and cations are bicarbonate, sulfate and sodium. This differs from alkaline mine drainage in southern WV where calcium and magnesium are normally the dominant cations.

Trace metals were often not detected in the water column (Al, As, Cr, Pb and Se) or detected at levels less than the available water quality criteria (Ni, Cu, Fe, Mn and Zn). However, in our opinion, this does not completely rule out metals as a possible stressor. In watersheds with potential sources of metals (e.g. mining) there is potential for sediment contamination and metal uptake via dietary exposure. Water quality criteria do not account for this exposure route and do not protect aquatic life from metal contamination of instream sediments. We did not collect any data on metal concentrations of stream sediments.

Some of the sites located downstream of residences have some evidence of nutrient enrichment causing increased algal productivity, since the dissolved oxygen (DO) concentrations represented supersaturated conditions (e.g. site 8 on Straight Creek had a DO % saturation of 132%, and site 23 on Straight Creek had a DO % saturation of 120%). The nitrate+nitrite concentrations were not high (all < 1 mg/l). Unfortunately, the detection limit for total phosphorous in these analyses was too high (0.05 mg/l) to detect any differences between the sites.

Table 8. Water Quality Parameters (May 2008)

Station ID	Straight 1	Straight 2	Straight 7	Straight 8	Straight 9
Stream Name	Gin Creek	Gin Creek	Straight Creek	Straight Creek	Baileys Trace
Temp (oC)	13.80	15.20	16.80	18.00	16.55
pH	8.60	8.50	8.20	9.00	8.65
DO (mg/L)	10.83	10.30	9.60	12.50	9.85
Sp Cond (umhos/cm)	742	804	782	577	706
Alkalinity (mg/L)	219	249	332	158	228
Hardness	133	140	173	139	87
Sulfate (mg/L)	143	152	172	208	130
Chloride (mg/L)	14.2	15.9	9.22	6.23	7.46
Sodium (mg/L)	127	141	190	124	147
Potassium (mg/L)	4.08	4.7	5.07	4.2	4.08
Total Phosphorous (mg/L)	0.05	0.05	0.05	0.05	0.05
NO2-NO3-N (mg/L)	0.053	0.098	0.623	0.102	0.195
Total Al (mg/L)	<0.2	<0.2	<0.2	<0.2	<0.2
Total As (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001
Total Cr (mg/L)	<0.002	<0.002	<0.002	<0.002	<0.002
Total Pb (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001
Total Ni (mg/L)	0.0024	0.0019	0.0031	0.0021	0.0015
Total Ca (mg/L)	32	33.8	44.4	34.6	19.3
Total Cu (mg/L)	0.0033	0.0024	0.0036	0.0022	0.003
Total Fe (mg/L)	0.396	<0.1	0.272	<0.1	<0.1
Total Mg (mg/L)	12.8	13.6	15.1	12.8	9.49
Total Mn (mg/L)	0.0238	0.0064	0.0423	0.0123	0.0049
Total Se (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005
Total Zn (mg/L)	0.0051	0.002	0.0035	0.0022	0.0023

Associations Between Biological Condition, Water Quality and Habitat

Our previous research in the southern coal fields of West Virginia (Pond et al. 2008) found that total dissolved solids (TDS) are a plausible cause of aquatic life use impairment downstream of alkaline coal mine drainage. In that study, we found that all mined sites with specific conductance > 500 µS/cm were rated as impaired using a genus-level multimetric index. In this study, we found that some sites with conductivity > 500 µS/cm were rated as not impaired using the family-level VSCI (sites 2 and 12, see Figure 7). There could be two reasons for this. First, our work with other EPA R III states indicates that family level indices and genus level indices agree on attainment decisions around 80% of the time. Family-level indices appear to underreport impairment compared to genus level indices. It is likely that a genus-level multi-metric index would assess more sites in this study as impaired. VDEQ currently uses the family-level VSCI for the purposes of determining existing uses, appropriate designated uses, and impairment of aquatic life uses.

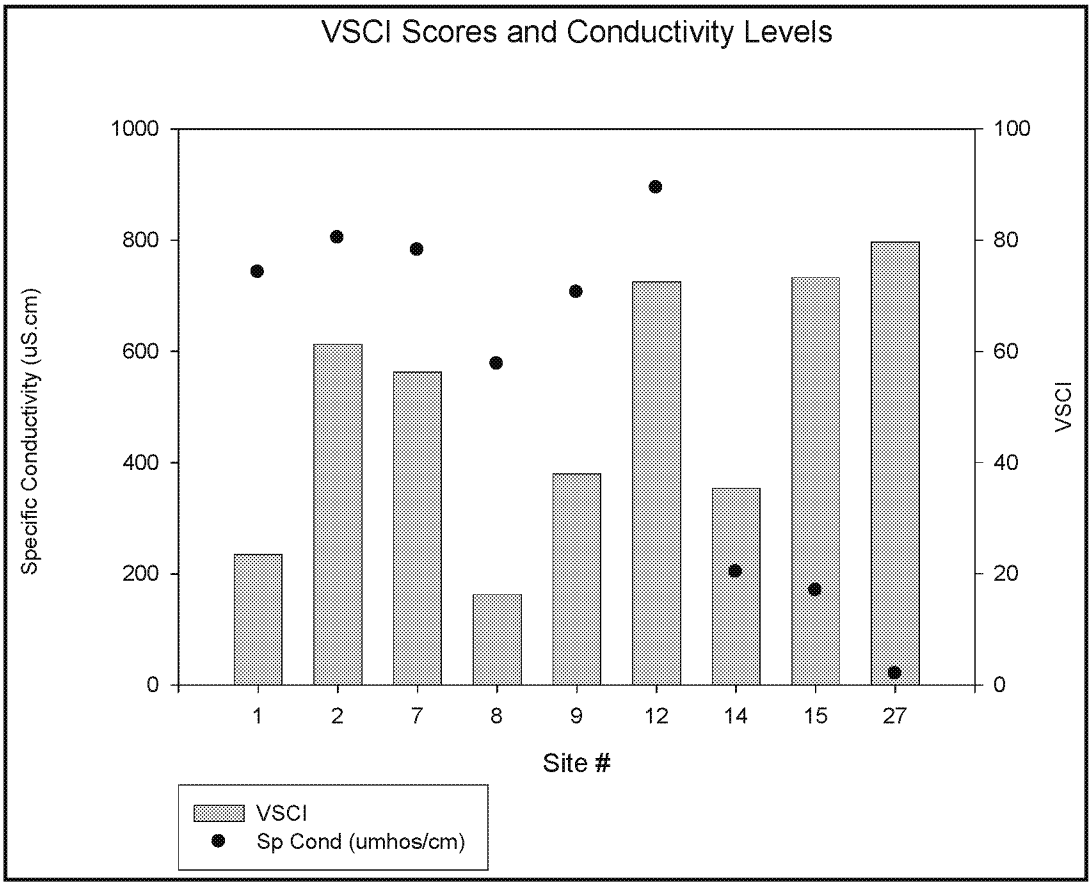

Figure 7. USEPA VSCI Scores and Conductivity (May 2008)

Secondly, the ion matrix and concentrations of the TDS in Straight Creek is different from the alkaline mine drainage we studied in the coal fields of southern West Virginia. The dominant ions in the coal mining discharge in our previous work were bicarbonate, sulfate, magnesium and calcium (Bryant et al. 2002). In the southern coal fields, the ions were elevated above background as follows: K^+, 5x; $HCO3^-$, 15x; Mg^{2+}, 32x; Cl^-, 2x; SO_4^{2-}, 38x; Ca^{2+}, 18x; and Na^+, 5x. The dominant ions in the Straight Creek TDS appear to be bicarbonate, sulfate and sodium and the ion concentrations are not as elevated as in the southern WV coal fields. In Straight Creek, the ion matrix downstream of the mines was elevated above the same background levels as follows: K^+, 3x; $HCO3^-$, 12x; Mg^{2+}, 3x; Cl^-, 4x; SO_4^{2-}, 10x; Ca^{2+}, 4x; and Na^+, 61x . Both the ion matrix and the total concentrations of ions are different in the Straight Creek mine drainage.

Many of these ions can be toxic to aquatic life. Mount et al. (1997) recognized the toxicity of major ions and developed predictive models to assess the acute toxicity attributable to major ions using the surrogates *Ceriodaphnia dubia*, *Daphnia magna* and *Pimephales promelas*. They reported that the relative ion toxicity was $K > HCO3 \approx Mg > Cl > SO4$; this order was confirmed by Tietge et al. (1997), who used the models to quantify and predict the toxicity from major ions but also identified toxicity from other toxic compounds in some high-salinity waters. Sodium and calcium were not found to be toxic to these organisms, and in fact calcium had an ameliorating effect on the toxicity of the other ions. The dominant cation in Straight Creek, Na^+, was not a toxicant to the surrogate organisms tested by Mount et al. (1997).

Regardless of the ion matrix, we recommend that VDEQ continue to monitor specific conductivity instream and in point source effluents as an accurate and cost effective means to indicate TDS levels, general water quality status and water quality trends in the watershed. This is particularly important since active and inactive coal mining is a major land use in the watershed and is one source of elevated TDS and conductivity.

As stated earlier, in all three streams, we found further degradation of the aquatic life use downstream where the additional effects of residential land use and other stressors are reflected in the lower VSCI scores. In our study, the increased impairment (indicated by lower VSCI scores and more tolerant taxa), did not correspond with increased conductivity measures, indicating that stressors other than conductivity or TDS are probably causing the additional degradation in the macroinvertebrate community (see Figure 7). However, the increased impairment downstream also did not correlate to decreased total RBP habitat scores (see Figure 8). We do not believe differences in physical habitat explain the differences in the VSCI scores from upstream to downstream that we observed in our study.

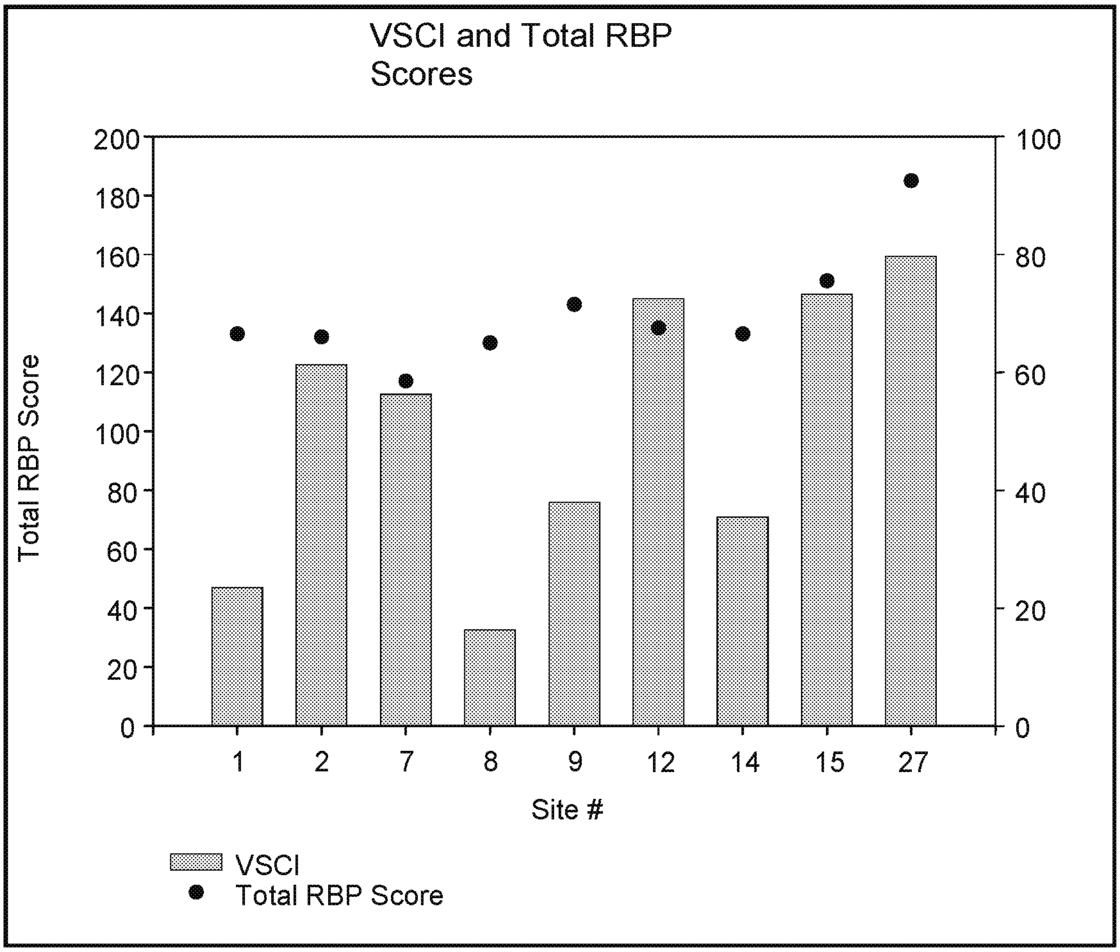

Figure 8. VSCI Scores and Total RBP Scores (May 2008)

It is possible that the increased degradation we observed downstream of residential areas is caused by unmeasured pollutants, household chemicals and toxicants that are intermittently discharged from straight pipes or failing septic systems. It is also possible that these residential reaches experience more scouring during rainfall events due to the increased impervious surfaces, channelization and incision present in the residential areas. Frequent scouring can create unstable habitats for aquatic life.

Discussion

In this study, we found evidence that portions of Straight Creek and its tributaries are already supporting the designated aquatic life use as defined by VDEQ (i.e., family-level VSCI scores indicate current attainment). In these segments, the designated use is an existing use, as defined in EPA's regulations at 131.3(e), and therefore may not be removed. For example, we found the aquatic life use to be currently attained in the headwaters of Gin Creek (VSCI score 61.3), Baileys Trace (VSCI score 72.5) and Big Branch (VSCI score 73.2).

In our study, we found the aquatic life use was slightly impaired (VSCI score 56.2) in the headwaters of Straight Creek (Figure 4). Two recent independent studies reported that the VSCI scores recently indicated attainment of the aquatic life use nearer the headwaters of Straight Creek (USFWS 2007 and VMIG 2008, Figure 9). After reviewing these other available data sources, we conclude that the designated use in the headwaters of Straight Creek is an existing use and can not be removed.

In addition, Soucek (2001) sampled three sites on Puckett Creek, upstream of any acid mine drainage inputs, and found diverse assemblages of macroinvertebrates including many mayflies (e.g. *Epeorus, Stenonema, Ameletus, Ephemerella, Eurylophella*), caddisflies (e.g. *Lepidostoma, Diplectrona*) and stoneflies (e.g. *Leuctra, Amphinemura, Yugus*). These available data suggest that the designated uses in these reaches of Puckett Creek may have been existing uses, and therefore the designated uses should not be removed from these reaches.

We sampled physical and chemical parameters at several sites in the Straight Creek watershed (Table 2) where we did not sample macroinvertebrates or collect additional water chemistry samples. Specific conductivity can be a very good general indicator of water quality. For example, although we did not collect macroinvertebrates in Puckett Creek, the conductivity at three sites in the watershed were all < 500 µS/cm, indicating fairly good water quality. This indicates that some reaches of Puckett Creek probably have the potential to support the designated aquatic life use, and Soucek (2001) confirms that the upper reaches of Puckett Creek have contained diverse assemblages of macroinvertebrates.

VDEQ's final analysis of existing uses should consider all available water quality, habitat and other biological data (including additional assemblages such as fish) to ensure that the highest use (the existing use) is characterized accurately. For example, USGS

(Hufshmidt et al. 1981) published hydrology and water quality data for the Straight Creek watershed following the Surface mining Control and Reclamation Act of 1977. The USGS had synoptic monitoring sites on Bailey Trace, Puckett Creek, and on the mainstem of Straight Creek. The 1981 report indicates that total dissolved solids at these sites was in the range of 50-150 mg/L in that time period, indicating fairly good water quality. These TDS levels correspond to specific conductivity levels of 71-214 µS/cm. This report also indicates that pH, acidity, alkalinity and dissolved iron were not serious problems in Baileys Trace and were not significantly different from unmined streams but that dissolved manganese was somewhat elevated (> 200 µg/L) in Baileys Trace, Puckett Creek and the mainstem of Straight Creek. The water quality data collected in this study indicated total Mn levels were all far less than 200µg/l.

Other sites in our study have impaired aquatic life uses (Sites 1 on Gin Creek, 8 on Straight Creek, 9 on Baileys Trace, and 14 on Fawn Branch). However, these sites still support some aquatic life, as evidenced by the taxa lists. The existing use in these reaches clearly includes an aquatic life use, but the historical data should be carefully reviewed to determine the highest use attained (the existing use).

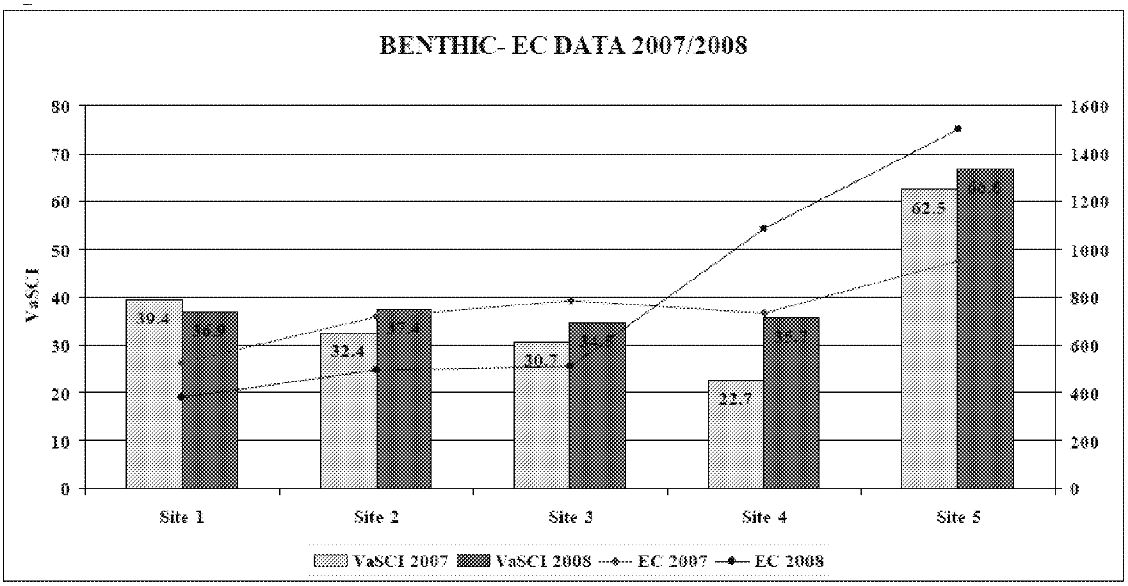

Figure 9. USFWS and VMIG Benthic and Electrical Conductivity (EC) Data (VMIG 2008)

We observed increased stress and subsequent impairment of the aquatic life use further downstream in Baileys Trace, Gin Creek and Straight Creek where residential land use and additional stressors increased. Our findings agree with the earlier studies conducted on the mainstem of Straight Creek (MapTech 2006, USFWS 2007, VMIG 2008, Figure 9, VSCI scores and electrical conductivity (EC)). We have observed similar increased impairment with additional stressors in studies of watersheds with mining and residential land uses in southern WV (Green et al. 2000) and KY (Pond 2004).

The TMDL states there are 140 failing septic systems and 216 straight pipes contributing to the bacteria load. This TMDL Implementation plan calls for the elimination of all straight pipes and failing septic systems. For example, the North St. Charles Sewer Project is underway and when completed will eliminate approximately 110 failing septic systems or straight pipes in Straight Creek. In addition, the coal industry proposed a decentralized sewage system for the Fawn Branch/Dominion community. We understand that a grant was obtained for this project, and designs are in development. The system will be operated by the St. Charles Water and Sewer Authority, who will oversee the hookups to the mainline. This action would not only reduce the bacterial loads and hopefully restore the recreational use, but should also prevent nutrients, organics, household chemicals and toxicants from entering streams, which should also positively impact the aquatic life use.

The Implementation Plan also calls for the restoration and reclamation of high priority abandoned mine lands (AML), reclamation/revegetation of disturbed forest lands, restoration/stabilization of eroding stream segments, greater enforcement for nonpoint source (NPS) contributors, and mandatory implementation of Best Management Practices (BMPs).

We support addressing residential sources as an obvious first step. VDEQ should also continue to evaluate existing and proposed mining activities to make sure that the biological condition and aquatic life uses do not degrade due to mining activity. This is especially important given that currently the aquatic life uses are attained or close to being attained nearest the mining activity. Additional mining activity has the potential to further impair the aquatic life uses in those locations.

The coal industry has also reported that they have implemented BMPs to provide rapid reclamation and revegetation of disturbed areas, accelerate road sump/pond clean-out schedules and a process change at the Lone Mountain coal preparation plant which reduced chemical oxygen demand by approximately 65% (presentation by Keith Mohn, Lone Mountain Processing, 2008).

The Implementation Plan addresses TDS loadings in the same manner as sediment loadings, through stream bank stabilization, restoration of riparian buffers, and restoration of AML lands. This report does not offer many actions to be taken at mining point sources to reduce TDS loadings. Our data indicate that TDS concentrations were highest nearest the mining point sources. Stream bank stabilization projects aimed at reducing sediment loads will not likely reduce TDS loadings. Furthermore, streambank stabilization and channel reconfiguration projects offer many benefits, but they do not always fully restore aquatic habitats and in some cases have even been shown to favor aquatic life typical of disturbed environments (Tullos et al. 2009), at least initially.

Recommendations

A state or tribe should determine existing uses on a reach-specific basis to ensure that they identify the highest degree of uses and water quality necessary to support the uses that have been achieved in a waterbody since November 28, 1975. When describing existing uses, states and tribes should articulate not only the highest aquatic life use that has been achieved (using the biological measures), but also, if possible, the water quality supporting that specific aquatic life use. For aquatic life, states and tribes should consider the available biological data as an integrating indicator of water quality, habitat quality and the actual use, in conjunction with any available chemical water quality and habitat data. In other words, the biological data will integrate and reflect the effect of all water quality and habitat quality stressors on the aquatic life use, whether or not there are data available for all water quality and habitat quality stressors. Furthermore, states can use biological data to directly describe existing aquatic life uses in a very specific way (e.g. highest VSCI scores range from 50 to 60 in a particular reach over a three year period), outside of the definitions of the state's designated use structure. This is to ensure that at a minimum, the highest degree of existing use and biological condition for a specific waterbody is protected. Once the existing uses have been defined, the state should also make an evaluation of the potential condition of each stream, in order to assign the appropriate designated use.

Biological data are the best direct measure of the existing and appropriate aquatic life uses in the watershed. To support TMDL implementation, and the UAA, we recommend that VDEQ review all available sources of biological data and, if deemed necessary, collect additional macroinvertebrate samples throughout the watershed (including all major tributaries) to confirm the attainment status of all tributaries. Where the existing use is attaining or has attained the designated use, the use can not be removed. We recommend that any tributaries or reaches that are close to attaining the use (and therefore reasonably have the potential to attain the use) should retain the designated aquatic life use.

Other reaches or tributaries that are currently impaired should be carefully evaluated to characterize the existing use, and the potential for improvement following point and nonpoint source controls, before considering the refinement of the aquatic life use.

States and tribes should also carefully consider how refinement of aquatic life uses might impact downstream reaches. For example, a state may decide to refine an aquatic life use in an urbanized reach, and have lower biocriteria thresholds for that urbanized reach, but may not change the numeric water quality criteria for that reach because of concerns regarding protection of downstream aquatic life uses.

We recommend that VDEQ continue to carefully manage permitted activities in the watershed so that water quality does not degrade further due to coal mining or other land use activities in the Straight Creek watershed. Water quality should be maintained at the current levels to protect the existing uses in the Straight Creek watershed and in downstream waters.

We recommend that the UAA study should be delayed until the TMDL is implemented in Straight Creek. The coal industry developed a TMDL Implementation Plan (VMIG 2008) that proposes several activities that should improve water quality and biological condition. We believe that the TMDL implementation should have a positive effect on the biological communities and associated aquatic life uses in the mainstem of Straight

Creek. It remains to be seen whether these projects will result in full attainment of the aquatic life use in those reaches that are currently impaired.

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Appendix 1. Tables

Table 6. Taxonomic Lists (from 200±20% organism subsample)

Table 6. Taxonomic Lists (from 200±20% organism subsample)

Order	Family	Genus	Gin Creek 1	Gin Creek 2	Straight Creek 7	Straight Creek 8	Baileys Trace 9	Baileys Trace 12	Fawn Branch 14	Big Branch 15	Clear Creek 27
		Nematoda									1
Coleoptera	Elmidae	Optioservus			2	3	6	14			
Coleoptera	Elmidae	Oulimnius		3							8
Coleoptera	Psephenidae	Ectopria		1							2
Coleoptera	Psephenidae	Psephenus		7		2	3	5	9	1	
Decapoda	Cambaridae	Cambarus							1	1	2
Diptera	Blephariceridae	Blephmaricera									3
Diptera	Ceratopogonidae	Bezzia/Palpomyia									2
Diptera	Ceratopogonidae	Probezzia									1
Diptera	Chironomidae	Chironomus					1				
Diptera	Chironomidae	Corynoneura							2		1
Diptera	Chironomidae	Cricotopus	20								
Diptera	Chironomidae	Cricotopus/Orthocladius	40	12	25	120	50	16	36		2
Diptera	Chironomidae	Diamesa	23	3	5	7	4	1	13		
Diptera	Chironomidae	Eukiefferiella	10		20		2	2	4		6
Diptera	Chironomidae	Micropsectra			10		5				1
Diptera	Chironomidae	Microtendipes	10								4
Diptera	Chironomidae	Nilotanypus								1	1
Diptera	Chironomidae	Parametriocnemus	30	8	10	30	55		48		
Diptera	Chironomidae	Paratrichocladius		14		30			20		
Diptera	Chironomidae	Polypedilum	10		10			2			3
Diptera	Chironomidae	Rheocricotopus									1
Diptera	Chironomidae	Stempellinella									4
Diptera	Chironomidae	Tanytarsus						1			14
Diptera	Chironomidae	Thienemanniella							1	1	
Diptera	Chironomidae	Thienemannimyia	10	10	10	50	25	2	8	2	8
Diptera	Chironomidae	Tvetenia	20		15		16	2	27	1	

Table 6. Taxonomic Lists (from 200±20% organism subsample)

Order	Family	Genus	Gin Creek 1	Gin Creek 2	Straight Creek 7	Straight Creek 8	Baileys Trace 9	Baileys Trace 12	Fawn Branch 14	Big Branch 15	Clear Creek 27
Diptera	Empididae	Chelifera			1						
Diptera	Empididae	Empididae		1		1		2			
Diptera	Empididae	Hemerodromia	3	1	6			1	2		
Diptera	Sciaridae	Corynoptera									2
Diptera	Simuliidae	Prosimulium									1
Diptera	Simuliidae	Simulium	1		16	1	6	1	4		6
Diptera	Tipulidae	Antocha			1		1	2			
Diptera	Tipulidae	Hexatoma									2
Diptera	Tipulidae	Limnophila									1
Diptera	Tipulidae	Molophilus									1
Diptera	Tipulidae	Pseudolimnophila									1
Diptera	Tipulidae	Tipula		1							
Ephemeroptera	Ameletidae	Ameletus			1						7
Ephemeroptera	Baetidae	Acentrella	9	7	2		8	9	8	11	6
Ephemeroptera	Baetidae	Baetidae			1		1				
Ephemeroptera	Baetidae	Baetis	12	4	3		39	30	6	26	3
Ephemeroptera	Baetidae	Plauditus	1	3	1		8	1	22		16
Ephemeroptera	Ephemerellidae	Drunella									8
Ephemeroptera	Ephemerellidae	Ephemerella		14	1			1	2	12	2
Ephemeroptera	Ephemerellidae	Eurylophella	1						2		1
Ephemeroptera	Heptageniidae	Cinygmula									4
Ephemeroptera	Heptageniidae	Epeorus		3			2	1	1	4	4
Ephemeroptera	Heptageniidae	Heptageniidae									5
Ephemeroptera	Heptageniidae	Stenacron								4	
Ephemeroptera	Heptageniidae	Stenonema									1
Ephemeroptera	Leptophlebiidae	Leptophlebiidae					1				6
Ephemeroptera	Leptophlebiidae	Paraleptophlebia								1	
Haplotaxida	Naididae	Naididae	1		2	1					
Lumbriculida	Lumbriculidae	Lumbriculidae	4		2	3	5				
Megaloptera	Corydalidae	Corydalus				1					
Megaloptera	Corydalidae	Nigronia					1				

Table 6. Taxonomic Lists (from 200±20% organism subsample)

Order	Family	Genus	Gin Creek 1	Gin Creek 2	Straight Creek 7	Straight Creek 8	Baileys Trace 9	Baileys Trace 12	Fawn Branch 14	Big Branch 15	Clear Creek 27
Odonata	Gomphidae	Gomphidae			1			2		2	1
Plecoptera	Chloroperlidae	Chloroperlidae								1	
Plecoptera	Chloroperlidae	Sweltsa									1
Plecoptera	Leuctridae	Leuctra	2	131	56	3	8	67	19	107	95
Plecoptera	Nemouridae	Amphinemura		9	27		2	20		61	7
Plecoptera	Peltoperlidae	Peltoperla									1
Plecoptera	Perlidae	Acroneuria									4
Plecoptera	Perlidae	Perlesta		1				9			
Plecoptera	Perlodidae	Isoperla			2					3	
Plecoptera	Perlodidae	Perlodidae			1						1
Plecoptera	Pteronarcyidae	Pteronarcys									11
Plecoptera	Taeniopterygidae	Taeniopteryx						2			1
Trichoptera	Glossosomatidae	Agapetus								3	
Trichoptera	Hydropsychidae	Ceratopsyche					1				2
Trichoptera	Hydropsychidae	Cheumatopsyche	2	5	3		4	19	2		1
Trichoptera	Hydropsychidae	Diplectrona		5						1	9
Trichoptera	Hydropsychidae	Hydropsyche		1					1		
Trichoptera	Hydropsychidae	Hydropsychidae			4						
Trichoptera	Hydroptilidae	Hydroptila			9						
Trichoptera	Lepidostomatidae	Lepidostoma									3
Trichoptera	Philopotamidae	Chimarra						4			
Trichoptera	Philopotamidae	Dolophilodes		10							3
Trichoptera	Philopotamidae	Wormaldia								1	
Trichoptera	Polycentropodidae	Polycentropus								1	2
Trichoptera	Rhyacophilidae	Rhyacophila						1			4
Trichoptera	Uenoidae	Neophylax								1	

Appendix 2.

Relevant Regulatory Text from the Federal Water Quality Standards regulation (WQS Regulation) at 40 C.F.R. § 131.10

(a) Each State must specify appropriate water uses to be achieved and protected. The classification of the waters of the State must take into consideration the use and value of water for public water supplies, protection and propagation of fish, shellfish, and wildlife, recreation in and on the water, agricultural, industrial, and other purposes including navigation. In no case shall a State adopt waste transport or waste assimilation as a designated use for any waters of the United States.
(b) In designating uses of a water body and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters.
(c) States may adopt sub-categories of a use and set the appropriate criteria to reflect varying needs of such sub-categories of uses, for instance, to differentiate between cold water and warm water fisheries.
(d) At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limitations required under sections 301(b) and 306 of the Act and cost-effective and reasonable best management practices for nonpoint source control.
(e) Prior to adding or removing any use, or establishing sub-categories of a use, the state shall provide notice and an opportunity for a public hearing under § 131.20(b) of this regulation.
(f) States may adopt seasonal uses as an alternative to reclassifying a water body or segment thereof to uses requiring less stringent water quality criteria. If seasonal uses are adopted, water quality criteria should be adjusted to reflect the seasonal uses, however, such criteria shall not preclude the attainment and maintenance of a more protective use in another season.
(g) States may remove a designated use which is not an existing use, as defined in § 131.3, or establish subcategories of a use if the State can demonstrate that attaining the designated use is not feasible because:

(1) Naturally occurring pollutant concentrations prevent the attainment of the use; or

(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

(4) Dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or

(5) Physical conditions related to natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

(6) Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

(h) States may not remove designated uses if:

(1) They are existing uses, as defined in § 131.3, unless a use requiring more stringent criteria is added; or

(2) Such uses will be attained by implementing effluent limits required under sections 301(b) and 306 of the Act and by implementing cost-effective and reasonable best management practices for nonpoint source control.

(i) Where existing water quality standards specify designated uses less than those which are presently being attained, the State shall revise its standards to reflect the uses actually being attained.

(j) A State must conduct a use attainability analysis as described in § 131.3(g) whenever:

(1) The State designates or has designated uses that do not include the uses specified in section 101(a)(2) of the Act; or

(2) The State wishes to remove a designated use that is specified in section 101(a)(2) of the Act or to adopt subcategories of uses specified in section 101(a)(2) of the Act which require less stringent criteria.

(k) A State is not required to conduct a use attainability analysis under this regulation whenever designating uses which include those specified in section 101(a)(2) of the Act.