Water Pollution in Crafts Run and Robinson Run, Monongalia County, West Virginia

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1. INTRODUCTION

In Monongalia County, West Virginia—just north of Morgantown and near the West Virginia/Pennsylvania border—Robinson Run drains approximately 7.7 square miles and discharges into the Monongahela River (See Figure 1). Robinson Run and Crafts Run, a tributary, are polluted by acid mine drainage (AMD) from coal mines (Pavlick et al., 2005). Several mines in this watershed accept coal combustion waste (CCW). CCW can generate offsite pollution (National Research Council, 2006), and such pollution has been documented in West Virginia (Hansen and Christ, 2005).

This report describes data collected recently by Downstream Strategies (DS), compiles self-monitoring data collected by CORESCO, and compares these data with state water quality criteria and other relevant thresholds.

According to a 2005 assessment of the watershed:

> "The Robinson Run watershed and the surrounding area on the west side of the Monongahela River have supported a significant amount of coal mining for decades. Coal mining operations—including surface and underground mines, preparation plants, refuse areas, and coal loading facilities for transport on the Monongahela River—are still active today." (Pavlick et al., 2005, p.1)

The West Virginia Department of Environmental Protection (WVDEP) listed Robinson Run and Crafts Run (stream codes M-4 and M-4-A, respectively) as impaired for pH, aluminum, iron, and manganese in its 2002 303(d) list (WVDEP, 2002).[1] A total maximum daily load (TMDL) report, completed in 2002, calls for substantial reductions of AMD discharges to return Robinson Run to health (USEPA, 2002).

Within the watershed, 11 coal mines were abandoned before the 1977 Surface Mining Control and Reclamation Act (SMCRA). An additional six coal mine operators forfeited their performance bonds after 1977. In 2005, 13 coal mines were still active in the watershed, operating under seven National Pollutant Discharge Elimination System (NPDES) permits. (Pavlick et al., 2005)

Three currently active CORESCO NPDES permits discharge to Crafts Run and Robinson Run. The first, WV1002619, is for CORESCO's preparation plant, related facilities, and two refuse disposal areas. This permit was first issued in 1986 and has been modified 27 times (WVDEP, 2009a). According to the current permit, it is associated with surface mines O-0063-83 (Refuse Disposal Area Number 2), O-0082-83 (Preparation Plant), and O-1015-93 (Refuse Disposal Area Number 3).

The second permit, WV1017314, covers the Crafts Run Refuse Disposal facility. This permit was issued in 2000 and has been modified twice. According to WVDEP, it is associated with one mining permit: O-1012-97 (WVDEP, 2009b). An outfall from Sediment Pond #2 on the site of the Crafts Run Refuse Disposal facility overlaps with the boundaries of Refuse Disposal Area Number 3 and is permitted under mining permit O-1015-93 and NPDES permit WV1002619.

The third permit, WV1011740, regulates discharges from the Crooked Run Quarry. It was issued in 1997 and has been modified six times. According to WVDEP, it is associated with one quarry permit: Q-1009-96 (WVDEP, 2009c).

Although the Robinson Run watershed was extensively mined in the past, the primary purpose of each of the current permits is coal waste disposal. Each refuse disposal area accepts large amounts of CCW (WVDEP, 2001, 2010a, and 2010b). This waste is mixed with refuse from the preparation plant and disposed of on-site. Since 1983, CORESCO has been expanding its refuse disposal operations. Now, CORESCO intends to drastically increase the amount of CCW disposed of in the Robinson Run watershed through proposed

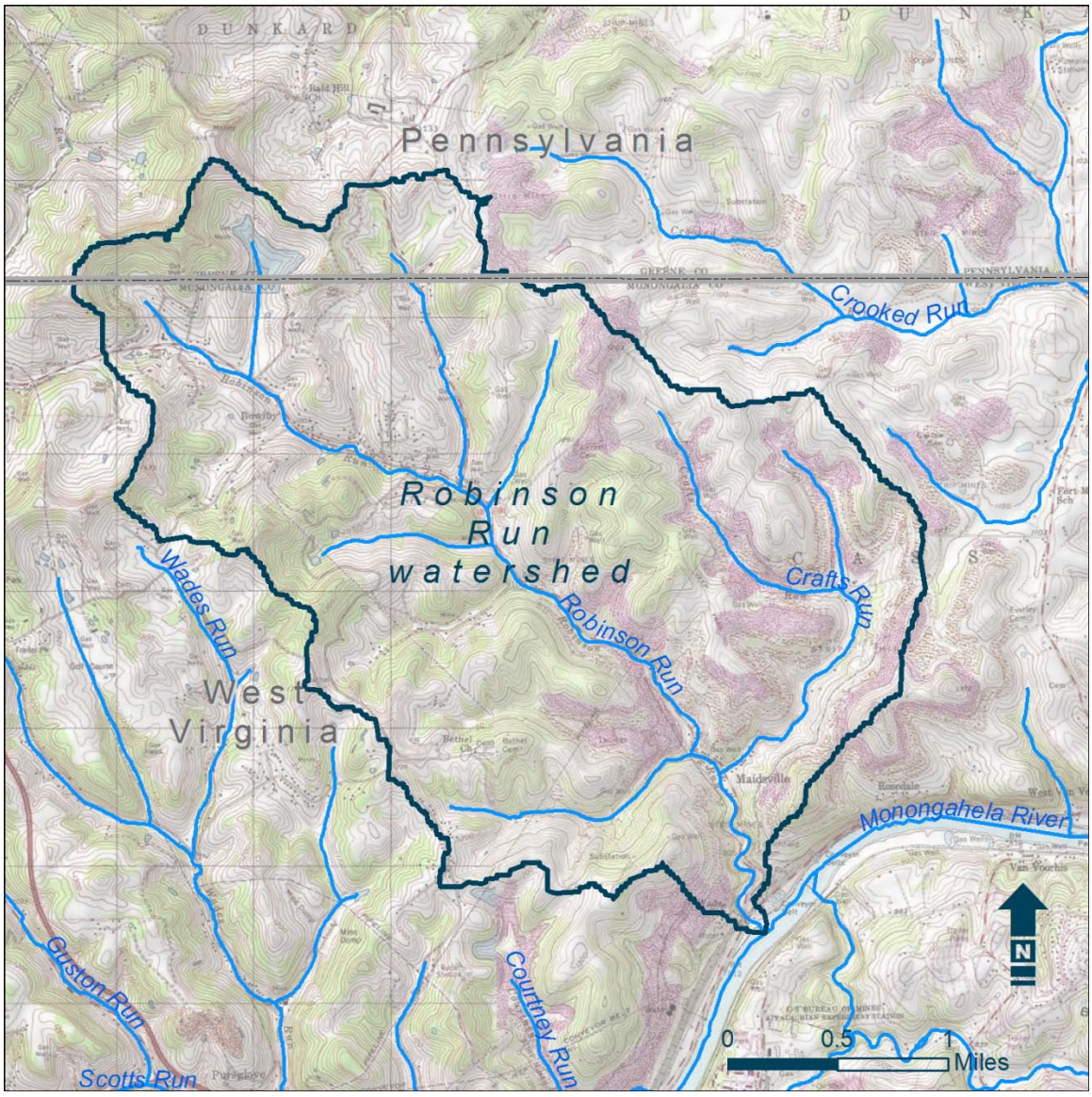
[1] Subsequent modifications to the aluminum and manganese criteria have affected these listings.

revisions to the WV1002619 and O-1015-93 permits. CORESCO intends to place 2.8 millions of tons of CCW and refuse waste each year as a result of these revisions. CCW would come from a number of local power plants, including Longview (WVDEP, 2010a).

Considering the amount of CCW and coal refuse that is being disposed in the Robinson Run watershed, local citizens and Public Justice are concerned about water quality. Crafts Run is the principal receiving stream of many discharges from these sites.

The company has collected self-monitoring data for outfalls and nearby streams in compliance with its permits; these discharge monitoring report (DMR) data are compiled in this report. In addition, DS sampled water at six sites in and adjacent to Crafts Run and Robinson Run on September 8, 2011.

Figure 1: The Robinson Run watershed



2. WATER QUALITY THRESHOLDS

Several types of thresholds are useful for judging whether or not pollutant concentrations are harmful. West Virginia surface water quality criteria are of primary concern; streams that exceed these criteria are impaired, and NPDES permits must be written to ensure that these criteria are met.

Three additional thresholds are considered in this report:

- national recommended water quality criteria;
- thresholds to protect West Virginia's narrative standards; and
- federal maximum contaminant level (MCL) drinking water standards.

2.1 West Virginia surface water quality criteria

Three designated uses are most relevant for the streams in Robinson Run and Crafts Run: public water supply (Category A), warm water fishery streams (Category B1), and water contact recreation (Category C). Table 1 illustrates the relevant criteria for the parameters discussed in this report, and Table 2 illustrates the criteria for dissolved cadmium, which vary stream-to-stream based on hardness.

NPDES permits are to be written such that discharges do not cause or contribute to violations of these criteria. If criteria are not met, WVDEP must list the stream as impaired and a TMDL must be calculated. TMDLs determine the maximum levels of pollution that can be discharged while still meeting criteria; TMDLs then assign pollution reductions to NPDES permittees as well as nonpoint sources of pollution.

In the tables in Chapters 3 and 4, which report on the DS and CORESCO data, cells are highlighted orange when concentrations exceed these West Virginia's surface water quality criteria.

2.2 National recommended water quality criteria

USEPA publishes surface water quality criteria recommendations for states to adopt (USEPA, 2009). These criteria are also instructive for determining whether pollutant concentrations measured in Crafts Run and Robinson run are of concern. Table 3 lists these recommended criteria for the parameters measured by DS or included in CORESCO's DMRs.

In the tables in Chapters 3 and 4, which report on the DS and CORESCO data, cells are outlined in black when concentrations exceed these recommended criteria.

2.3 Federal maximum contaminant level drinking water standards

MCLs are defined as the highest level of a contaminant that is allowed in drinking water. They are set as close to the maximum contaminant level goal (MCLG)[2] as feasible using the best available analytical and treatment technologies and taking cost into consideration. MCLs are enforceable drinking water standards. (USEPA, 2006)

Table 4 illustrates the MCLs relevant to this project. While they are not enforceable limits in streams, MCLs are still instructive for comparison against measured concentrations of pollutants.

In the tables in Chapters 3 and 4, which report on the DS and CORESCO data, cells are also outlined in black when concentrations exceed MCLs.

[2] MCLGs, which are not compiled in this report, are non-enforceable health goals, which are set at levels at which no known or anticipated adverse effect on the health of persons occurs and which allow an adequate margin of safety (USEPA, 2006).

Table 1: West Virginia surface water quality criteria

Parameter	Units	Public water supply (A)	Warm water fishery streams (B1)	Water contact recreation (C)
Acidity, total	mg/L	-	-	-
Alkalinity, total as $CaCO_3$	mg/L	-	-	-
Aluminum	µg/L	-	-	-
Aluminum, dissolved	µg/L	-	750	-
Antimony	µg/L	14	-	4,300
Arsenic	µg/L	10	-	10
Barium	µg/L	1,000	-	-
Beryllium	µg/L	0.0077	130	-
Beryllium, dissolved	µg/L	-	-	-
Boron	µg/L	-	-	-
Cadmium	µg/L	-	-	-
Cadmium, dissolved	µg/L	10	See Table 2	-
Calcium	µg/L	-	-	-
Chloride	mg/L	250	230	250
Chromium	µg/L	-	-	-
Chromium, hexavalent, dissolved	mg/L	0.05	0.011	-
Chromium, hexavalent, total	mg/L	-	-	-
Conductivity	µmhos/cm	-	-	-
Copper	µg/L	1,000	-	-
Fluoride	mg/L	1.4	-	-
Hardness, total	mg/L	-	-	-
Iron	µg/L	1,500	1,500	-
Lead	µg/L	50	-	-
Magnesium	µg/L	-	-	-
Manganese	µg/L	1,000	-	-
Mercury	µg/L	0.14	2.4	0.15
Molybdenum	µg/L	-	-	-
Nickel	µg/L	510	-	4,600
pH	SU	6-9	6-9	6-9
Selenium	µg/L	50	5	-
Settleable solids	mL/L	-	-	-
Sulfate	mg/L	-	-	-
Thallium	µg/L	1.7	-	6.3
Total dissolved solids	mg/L	-	-	-
Total suspended solids	mg/L	-	-	-
Vanadium	µg/L	-	-	-
Zinc	µg/L	-	-	-

Source: 47 Code of State Rules (CSR), Series 2. Note: Parameters are listed if they were measured in Downstream Strategies samples or in discharge monitoring reports or for reference when interpreting a parameter that was measured. "-" = no criterion.

Table 2: Hardness-dependent dissolved cadmium criteria for warm water fishery (B1) use (µg/L)

Parameter	Criterion
Crafts Run watershed	
Upstream Crafts Run (PJ1)	0.33
Pittsburgh Seep #2 (PJ3)	1.26
Downstream Crafts Run (PJ2)	0.96
Crafts Run Mouth (PJ5)	0.92
Robinson Run watershed	
Upstream Robinson Run (PJ7)	1.04
Downstream Robinson Run (PJ6)	1.06

Source: Calculated based on formula in 47 Code of State Rules, Series 2.

Table 3: National recommended water quality criteria

Parameter	Units	Recommended criterion
Acidity, total	mg/L	-
Alkalinity, total as $CaCO_3$	mg/L	20
Aluminum	µg/L	87
Aluminum, dissolved	µg/L	-
Antimony	µg/L	5.6
Arsenic	µg/L	0.018
Barium	µg/L	1,000
Beryllium	µg/L	-
Beryllium, dissolved	µg/L	-
Boron	µg/L	-
Cadmium	µg/L	0.25
Cadmium, dissolved	µg/L	-
Calcium	µg/L	-
Chloride	mg/L	230
Chromium	µg/L	-
Chromium, hexavalent, dissolved	mg/L	-
Chromium, hexavalent, total	mg/L	0.011
Conductivity	µmhos/cm	-
Copper	µg/L	1,300
Fluoride	mg/L	-
Hardness, total	mg/L	-
Iron	µg/L	300
Lead	µg/L	2.5
Magnesium	µg/L	-
Manganese	µg/L	50
Mercury	µg/L	0.77
Molybdenum	µg/L	-
Nickel	µg/L	52
pH	SU	6.5-9
Selenium	µg/L	5
Settleable solids	mL/L	-
Sulfate	mg/L	-
Thallium	µg/L	0.24
Total dissolved solids	mg/L	250
Total suspended solids	mg/L	-
Vanadium	µg/L	-
Zinc	µg/L	120

Source: USEPA (2009). Note: Parameters are listed if they were measured in Downstream Strategies samples or in discharge monitoring reports or for reference when interpreting a parameter that was measured. "-" = no national recommended water quality criterion. The values shown for each parameter are the most stringent of (1) freshwater CMC, (2) freshwater CCC, and (3) human health for the consumption of water + organism. For boron, hardness, and total suspended solids, USEPA (2009) refers to a narrative statement in the original document. The recommended total dissolved solids criterion is for "solids dissolved and salinity."

Table 4: Federal maximum contaminant levels

Parameter	Units	Maximum contaminant level
Acidity, total	mg/L	-
Alkalinity, total as $CaCO_3$	mg/L	-
Aluminum	µg/L	-
Aluminum, dissolved	µg/L	-
Antimony	µg/L	6
Arsenic	µg/L	10
Barium	µg/L	2,000
Beryllium	µg/L	4
Beryllium, dissolved	µg/L	-
Boron	µg/L	-
Cadmium	µg/L	5
Cadmium, dissolved	µg/L	-
Calcium	µg/L	-
Chloride	mg/L	-
Chromium	µg/L	100
Chromium, hexavalent, dissolved	mg/L	-
Chromium, hexavalent, total	mg/L	-
Conductivity	µmhos/cm	-
Copper	µg/L	1,300
Fluoride	mg/L	4
Hardness, total	mg/L	-
Iron	µg/L	-
Lead	µg/L	15
Magnesium	µg/L	-
Manganese	µg/L	-
Mercury	µg/L	2
Molybdenum	µg/L	-
Nickel	µg/L	-
pH	SU	-
Selenium	µg/L	50
Settleable solids	mL/L	-
Sulfate	mg/L	-
Thallium	µg/L	2
Total dissolved solids	mg/L	-
Total suspended solids	mg/L	-
Vanadium	µg/L	-
Zinc	µg/L	-

Source: USEPA (2006). Note: Parameters are listed if they were measured in Downstream Strategies samples or in discharge monitoring reports or for reference when interpreting a parameter that was measured. "-" = no maximum contaminant level. The mercury MCL is for inorganic mercury. The value listed for copper is the action level at the tap.

2.4 Thresholds to protect West Virginia's narrative standards

Two West Virginia narrative water quality standards are particularly relevant to the pollution in Robinson Run and Crafts Run. The first prohibits discharges of "[m]aterials in concentrations which are harmful…to…aquatic life" (47 CSR 2-3.2.e), and the second prohibits discharges that cause "significant adverse impacts to the …biological components of aquatic ecosystems" (47 CSR 2-3.2.i).

Recent USEPA guidance, together with a growing set of scientific literature, suggests that certain measures of dissolved ions are appropriate indicators for these narrative standards. More specifically, Table 5 lists levels of conductivity, TDS, and sulfate consistent with protecting aquatic life.

The conductivity benchmark of 300 µS/cm comes from USEPA's (2011) recent study on this topic. The TDS benchmark is taken from WVDEP; although the West Virginia Legislature ultimately did not approve it in its 2010 session, WVDEP proposed a surface water quality criterion of 500 mg/L for TDS. The sulfate threshold of 50 mg/L is taken from testimony from scientific experts at the December 2010 evidentiary hearing before the West Virginia Environmental Quality Board on appeal 10-34-EQB.

In the tables in Chapters 3 and 4, which report on the DS and CORESCO data, cells are outlined in black when concentrations exceed these thresholds.

Table 5: Levels of dissolved ions protective of West Virginia narrative standards

Parameter	Units	Protective level
Conductivity	µS/cm	300
Total dissolved solids	mg/L	500
Sulfate	mg/L	50

Source: Conductivity from USEPA (2011). TDS from WVDEP proposal to West Virginia Legislature. Sulfate from expert testimony for appeal 10-34-EQB.

3. DOWNSTREAM STRATEGIES SAMPLING

3.1 Sampling locations

DS sampled six sites and also collected a field blank.[3] Sampling was conducted on both Crafts Run and Robinson Run. We named each sample using a descriptive name together with its laboratory abbreviation (PJ1 through PJ7). Figure 2 displays these locations as blue stars.

The first set of samples was taken along Crafts Run. The most upstream sample, "Upstream Crafts Run (PJ1)," was taken from the outlet of a pond located at the headwaters of Crafts Run. This sample was taken from the approximate location of the UCR1 instream monitoring station associated with permit WV1002619.

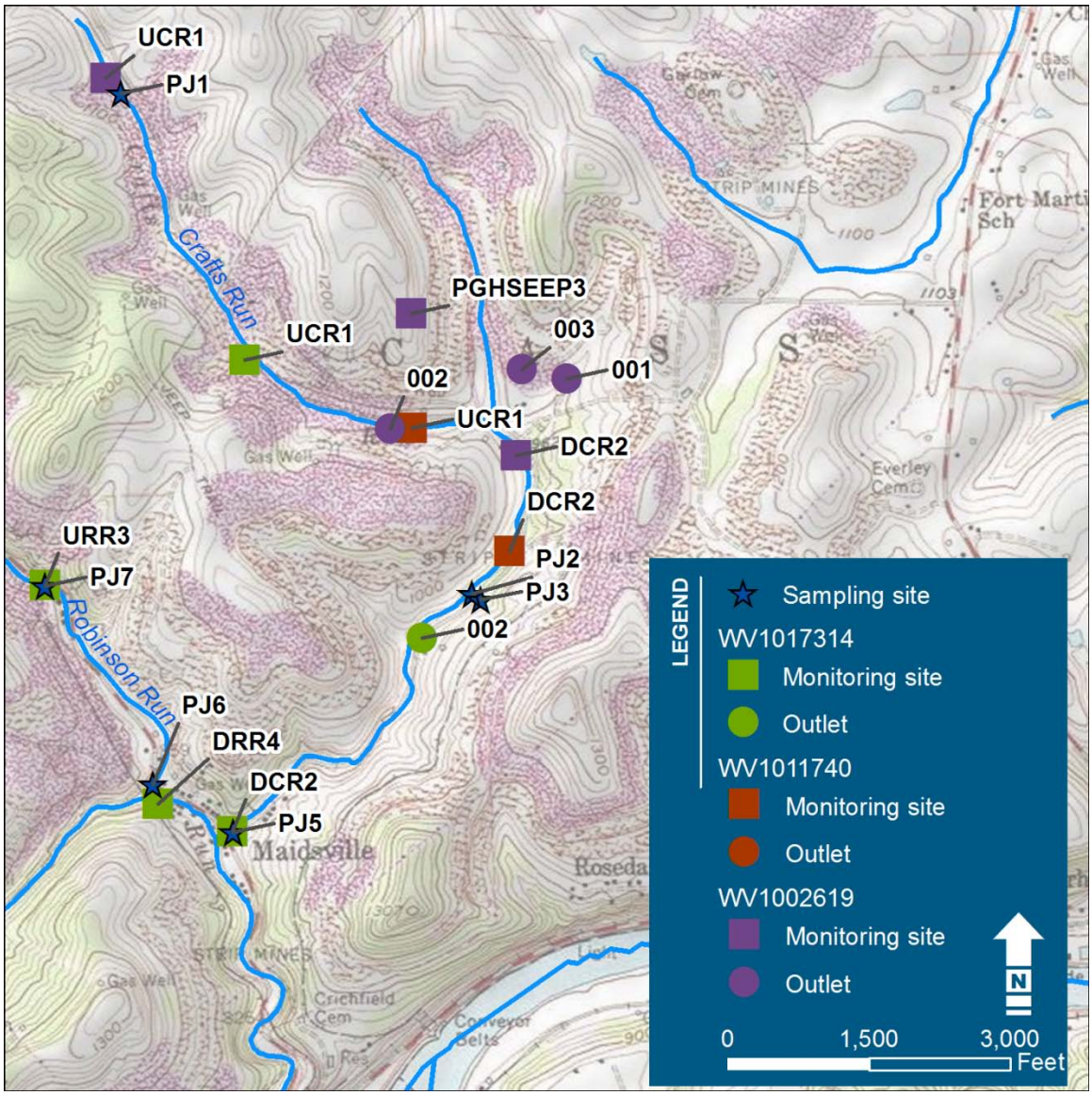
A second sample, "Downstream Crafts Run (PJ2)," was taken at approximately 7,900 feet from the first sample and 75 feet downstream from the mouth of a small unnamed tributary. This small tributary has an NPDES water monitoring site named "Pittsburgh Seep #2" located approximately 100 feet upstream of its mouth. To measure the direct impact of this seep, a third sample, "Pittsburgh Seep #2 (PJ3)," was taken at the approximate location of Pittsburgh Seep #2.

The last sample of this first set, "Crafts Run Mouth (PJ 5)," was taken from Crafts Run at the approximate location of instream monitoring station DCR2 associated with permit WV1017314, which is about 100 feet upstream from the mouth of Crafts Run.

A pair of samples was taken along Robinson Run. "Upstream Robinson Run (PJ7)" was taken at the approximate location of instream monitoring station URR3 associated with permit WV1017314. The final sample, "Downstream Robinson Run (PJ6)," was taken in Robinson Run at the approximate location of instream monitoring station DRR4 associated with permit WV1017314. This monitoring location is approximately 40 feet upstream of a small unnamed tributary to Robinson Run, and is also upstream of the confluence of Crafts Run with Robinson Run.

[3] See Appendix A for information regarding the field blank.

Figure 2: Sampling locations for Downstream Strategies and CORESCO monitoring



Note: Downstream Strategies sampling site PJ4 was a field blank and is not mapped.

3.2 Field methods and notes

The weather on the sampling date was overcast and approximately 65 °F. In the three days preceding the monitoring date, a total of 4.05 inches of rain fell, with 1.45 inches falling the previous day (National Oceanic and Atmospheric Administration, 2011).

Global positioning system (GPS) coordinates of the sampling sites were recorded. At all sample sites, pH, specific conductivity (microsiemens per centimeter, or µS/cm), and temperature (degrees Celsius, or °C) were measured in the field using a handheld Oakton pH/CON 300 meter. To take the measurements, probes were placed into the body of water at the same location from which the grab samples were taken. Field pH values were not recorded until the meter held a reading stable to 0.01 standard units for at least 15 seconds. On the same morning as the monitoring, the meter was calibrated for pH using pH 10, pH 7, and pH 4 buffers beginning at 8:12 AM. The meter was also calibrated for specific conductivity using a 1,000 µS/cm standard solution at 8:19 AM.

We also collected grab samples for laboratory analysis. The first water sample was collected at 9:15 AM. Samples were taken in four types of clean bottles that were supplied by Pace Analytical Services in Greensburg, Pennsylvania. Pace placed preservatives in the bottles that needed them. Once collected, samples were stored in a cooler with ice and kept cold overnight until transferred to the Pace courier at 10:00 AM the next morning. An appropriate chain of custody form was used.

At each site, samples were collected in:

1) 1 liter (L) polyethylene bottles without preservatives for analysis of alkalinity, acidity, chloride, fluoride, hardness, laboratory pH, total dissolved solids (TDS), conductivity, and sulfate;

2) 250 milliliter (mL) polyethylene bottles containing a small amount of nitric acid for measurement of aluminum, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, thallium, and vanadium;

3) 250 mL polyethylene bottles containing a small amount of nitric acid, which were sent to Pace's Minnesota lab for analysis of antimony; and

4) 250 mL polyethylene bottles containing a small amount of nitric acid for analysis of dissolved aluminum, dissolved beryllium, and dissolved cadmium.

All stream samples were taken from the thalweg. For bottle type 1, samples were taken by tilting the bottles carefully into the current and filling to approximately 1 cm of the lip. For bottle types 2 and 3, samples were taken by first filling a decontaminated beaker and then pouring the water into the bottles. For bottle type 4, samples were taken by filling the bottles with field-filtered water. Water was field filtered by submerging a decontaminated syringe in the water to be sampled, filling the syringe by removing the plunger, and then replacing the plunger while submerged. Next, the syringe was removed from the water and a filter tip sized at 0.45 microns was placed on the syringe. The liquid was then pushed through the filter into the sampling container. This procedure was repeated several times to obtain enough water to fill the bottle.[4]

[4] At the Upstream Crafts Run (PJ1) site, because of low depth in the pond outlet, a decontaminated beaker was used to fill the first three types of bottles; the bottle requiring field-filtered water was filled normally.

3.3 Monitoring results

Table 6 presents field measurements at all sampling sites; Table 7 and Table 8 present laboratory results for the Crafts Run and Robinson Run samples, respectively. The pH and conductivity results are comparable between the field and laboratory measurements at all sites. In explaining our results, we use field pH and the laboratory conductivity results.

Table 6: Field measurements

Sample site	Field temperature (°C)	pH	Conductivity (µS)
Crafts Run watershed			
Upstream Crafts Run (PJ1)	17.5	7.29	321
Pittsburgh Seep #2 (PJ3)	15.6	2.98	2,320
Downstream Crafts Run (PJ2)	17.7	6.70	1,324
Crafts Run Mouth (PJ5)	18.2	4.15	1,282
Robinson Run watershed			
Upstream Robinson Run (PJ7)	18.6	7.87	1,640
Downstream Robinson Run (PJ6)	18.4	7.66	1,645

Source: Field data collected by Downstream Strategies on September 8, 2011. Note: Cells shaded orange violate a state water quality criterion. Cells with a black boundary exceed one or more of the other thresholds.

Table 7: Water chemistry results for Crafts Run samples

Parameter	Units	Upstream Crafts Run (PJ1)	Downstream Crafts Run (PJ2)	Pittsburgh Seep #2 (PJ3)	Crafts Run Mouth (PJ5)
Acidity, total	mg/L	ND	ND	360	54
Alkalinity, total as $CaCO_3$	mg/L	106	64	ND	ND
Aluminum	µg/L	655	4,600	27,400	13,800
Aluminum, dissolved	µg/L	ND	ND	26,800	6,100
Antimony	µg/L	ND	ND	ND	ND
Arsenic	µg/L	ND	ND	ND	ND
Barium	µg/L	47	24.5	ND	29.2
Beryllium	µg/L	ND	ND	3.5	1.7
Beryllium, dissolved	µg/L	ND	ND	3.7	1.4
Boron	µg/L	ND	301	70.9	194
Cadmium	µg/L	ND	ND	ND	ND
Cadmium, dissolved	µg/L	ND	ND	ND	ND
Calcium	µg/L	41,600	221,000	303,000	205,000
Chloride	mg/L	ND	6.8	ND	4.8
Chromium	µg/L	ND	ND	6.4	ND
Chromium, hexavalent, total	mg/L	ND	ND	ND	ND
Conductivity	µmhos/cm	338	1,420	2,520	1,350
Fluoride	mg/L	0.16	0.59	1.1	0.65
Hardness, total	mg/L	152	714	1,060	675
Iron	µg/L	600	7,940	56,100	21,500
Lead	µg/L	ND	ND	6.5	ND
Magnesium	µg/L	11,600	39,200	7,3000	39,600
Manganese	µg/L	41.3	1,290	2,020	1,470
Mercury	µg/L	ND	ND	ND	ND
Molybdenum	µg/L	ND	ND	ND	ND
Nickel	µg/L	ND	32.9	171	81
pH	SU	7.5	6.7	2.9	4.7
Selenium	µg/L	ND	ND	ND	ND
Sulfate	mg/L	40.6	642	1,290	660
Thallium	µg/L	ND	ND	ND	ND
Total dissolved solids	mg/L	175	1,040	2,160	1,050
Vanadium	µg/L	ND	ND	ND	ND

Source: Laboratory results for samples collected by Downstream Strategies on September 8, 2011. Note: Cells shaded orange violate a state water quality criterion. Cells with a black boundary exceed one or more of the other thresholds. ND = not detected.

Table 8: Water chemistry results for Robinson Run samples

Parameter	Units	Upstream Robinson Run (PJ7)	Downstream Robinson Run (PJ6)
Acidity, total	mg/L	ND	ND
Alkalinity, total as $CaCO_3$	mg/L	142	128
Aluminum	µg/L	787	1,540
Aluminum, dissolved	µg/L	89.1	94.9
Antimony	µg/L	ND	ND
Arsenic	µg/L	ND	ND
Barium	µg/L	32.1	31.5
Beryllium	µg/L	ND	ND
Beryllium, dissolved	µg/L	ND	ND
Boron	µg/L	192	189
Cadmium	µg/L	ND	ND
Cadmium, dissolved	µg/L	ND	ND
Calcium	µg/L	230,000	233,000
Chloride	mg/L	7.2	7.1
Chromium	µg/L	ND	ND
Chromium, hexavalent, total	mg/L	ND	ND
Conductivity	µmhos/cm	1,760	1,760
Fluoride	mg/L	0.19	0.22
Hardness, total	mg/L	805	820
Iron	µg/L	1,040	2,310
Lead	µg/L	ND	ND
Magnesium	µg/L	55,700	57,800
Manganese	µg/L	120	161
Mercury	µg/L	ND	ND
Molybdenum	µg/L	ND	ND
Nickel	µg/L	ND	ND
pH	SU	7.8	7.7
Selenium	µg/L	ND	ND
Sulfate	mg/L	728	692
Thallium	µg/L	ND	ND
Total dissolved solids	mg/L	1,250	1,270
Vanadium	µg/L	ND	ND

Source: Laboratory data on samples collected by Downstream Strategies on September 8, 2011. Note: Cells shaded orange violate a state water quality criterion. Cells with a black boundary exceed one or more of the other thresholds. ND = not detected.

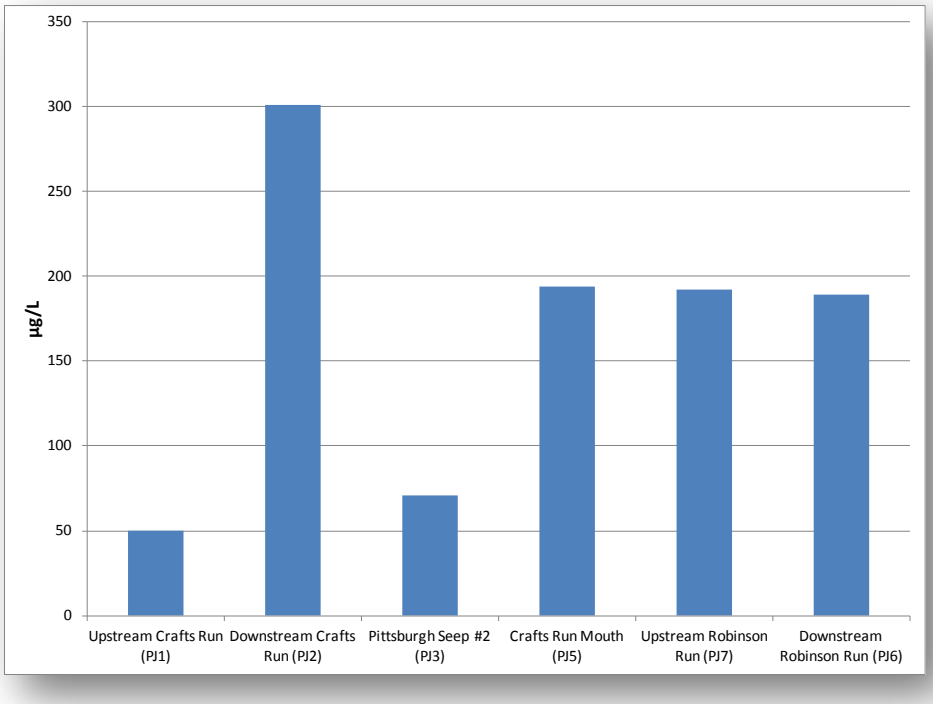
3.3.1 *Patterns over space*

The DS dataset was collected on a single day and therefore cannot show trends over time; however, it can show patterns over space. For example, Figure 3 illustrates boron concentrations from upstream to downstream on Crafts Run and Robinson Run.

At the Upstream Crafts Run (PJ1) site, boron was not detected. In Figure 3, it is charted as 50 µg/L, the minimum detection level. At the next downstream site, Downstream Crafts Run (PJ2), boron concentrations rose to 301 µg/L. While this is downstream of the Pittsburgh Seep #2 (PJ3) site, the high boron levels do not appear to be coming from this seep. By the time Crafts Run reaches Robinson Run at the Crafts Run Mouth (PJ5) site, boron concentrations had decreased to 194 µg/L.

While West Virginia does not have surface water quality criteria for boron, CCW contains a significant amount of boron, and boron leaches faster from CCW at lower pH (Cox, 1978). In a review of CCW damage cases, high boron concentrations were found at many of the 31 reviewed sites (Stant, 2010).

Figure 3: Boron results for Crafts Run and Robinson Run samples



Source: Laboratory data on samples collected by Downstream Strategies on September 8, 2011.Note: Values less than method detection levels are reported at method detection levels.

4. CORESCO'S SELF-MONITORING DATA

CORESCO has monitored its outlets and selected instream locations pursuant to its NPDES permits. These data were analyzed for the three permits of interest.

4.1 Maximum concentrations

Table 9 through Table 11 show the maximum concentrations found for each parameter and for each monitoring location. Within these tables, cells shaded orange violate a state water quality criterion, and cells with a black boundary exceed one or more of the other thresholds.[5]

Table 9: Maximum concentrations from discharge monitoring reports for WV1011740

Parameter	Units	DCR2	UCR1
Aluminum	µg/L	285	276
Aluminum, dissolved	µg/L	190	144
Iron	µg/L	486	301
Manganese	µg/L	608	68
pH	SU	7.7	7.9

Source: Discharge monitoring reports from January 2007 through February 2011. Note: Cells shaded orange violate a state water quality criterion. Cells with a black boundary exceed one or more of the other thresholds. pH values are minimums, not maximums. Values less than method detection levels are reported at method detection levels.

[5] Hexavalent chromium results were omitted from this analysis because of discrepancies in the DMR data between values reported in mg/L and ug/L, which made it impossible to determine which numbers and units were correct.

Table 10: Maximum concentrations from discharge monitoring reports for WV1002619

Parameter	Units	001	002	003	DCR2	PGHSEEP3	UCR1
Aluminum	µg/L	360	450	330	3430	556	432
Aluminum, dissolved	µg/L	218	181	98	760	167	241
Arsenic	µg/L	11.04	1.9	4.76	2.93	1.91	1.9
Barium	µg/L	58	52	46	38	42	74
Cadmium	µg/L				0.22	0.1	
Chloride	mg/L	19.8	9.35	13.3	42.6	65	
Copper	µg/L	38.01	20.91	26.04	23.23	26	28
Hardness, total (as CaCO3)	mg/L	584	1,184	1,114	2,100	1,839	806
Iron	µg/L	424	630	281	2,291	1,890	556
Lead	µg/L	0.31	0.54	0.48	10.41	9	1.7
Manganese	µg/L	657	466	765	1,836	2,592	72
Mercury	µg/L	0.001	0.017	0.001	0.064	0.084	0.048
pH	SU	7.5	7.3	8	7.4	7.5	1
Selenium	µg/L	6.44	1.81	8.27	3.13	4.38	2.48
Settleable solids	mL/L	0.26	0.26				
Sulfate	mg/L	1,350	650	1,200	2,200	1,650	120
Total dissolved solids	mg/L	3,108	1,008	1,620	2,676	2,556	460
Total suspended solids	mg/L	11	26	22	61		39
Zinc	µg/L	21	13	13	174	166	121

Source: Discharge monitoring reports from March 2006 to December 2010. Note: Cells shaded orange violate a state water quality criterion. Cells with a black boundary exceed one or more of the other thresholds. pH values are minimums, not maximums. Values less than method detection levels are reported at method detection levels. Monitoring location UTUCR1 was omitted from the analysis because it contained samples from a single date, May 31, 2009, and the results appeared to be unreliable.

Table 11: Maximum concentrations from discharge monitoring reports for WV1017314

Parameter	Units	002	DCR2	DRR4	UCR1	URR3
Aluminum	µg/L	366	64,370	22,920	390	21,220
Aluminum, dissolved	µg/L	67	63,660	16,096	179	11,623
Arsenic	µg/L	1.2	18.2	1.2		1.2
Barium	µg/L	26	17	19		20
Cadmium	µg/L	0.1	2.71	0.21		0.1
Copper	µg/L	19	48.15	11.15		18
Hardness, total (as CaCO3)	mg/L	368	1,844	1,656		1,646
Iron	µg/L	326	81,435	93,060	817	94,735
Lead	µg/L	0.09	19.07	11.06		9
Manganese	µg/L	376	4,828	936	110	898
Mercury	µg/L	0.005	0.018	0.01		0.015
Nickel	µg/L	8	316	10		18
pH	SU	7.3	2.7	4.2	7.8	4.3
Selenium	µg/L	8.42	2.68	2.81		2.65
Settleable solids	mL/L	0.26				
Sulfate	mg/L	247	2,200	2,300	150	1,700
Total dissolved solids	mg/L	484	2,692	2,800	368	2,280
Total suspended solids	mg/L	15				

Source: Discharge monitoring reports from May 2007 to March 2011. Note: Cells shaded orange violate a state water quality criterion. Cells with a black boundary exceed one or more of the other thresholds. pH values are minimums, not maximums. Values less than method detection levels are reported at method detection levels.

4.2 Trends over time

The maximum concentrations presented in the previous three tables help identify the parameters of greatest concern based on violations of state surface water quality standards and exceedances of other relevant thresholds. The following charts help clarify patterns over time and help tease out where ionic pollution, AMD, and CCW are present in the study area.

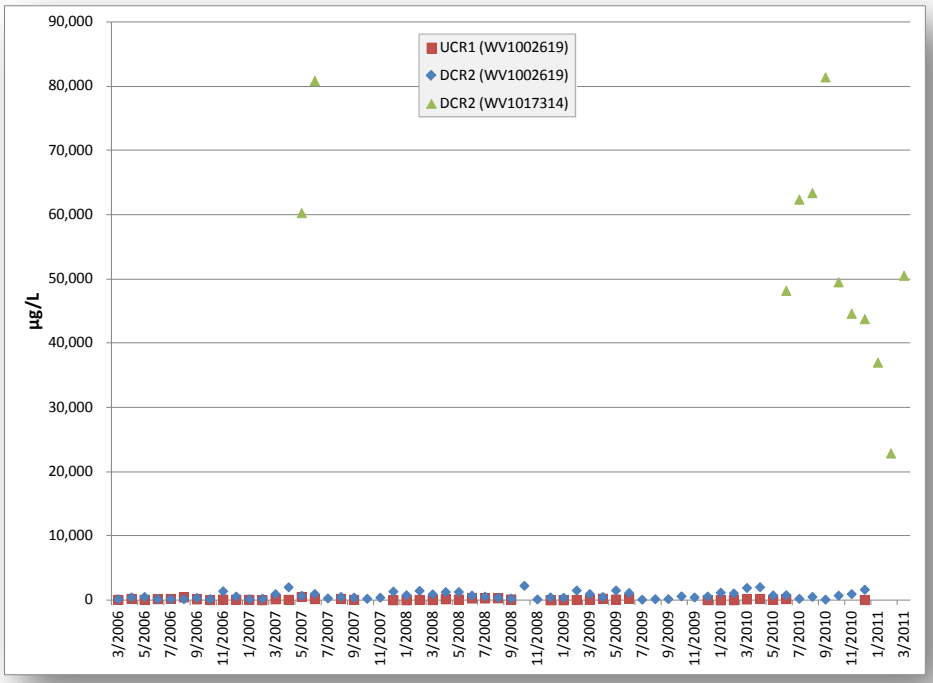
4.2.1 *Acid mine drainage pollutants*

Figure 4 and Figure 5 clarify patterns in AMD; these figures show iron and aluminum concentrations over time measured by CORESCO at three key locations in the Crafts Run watershed. The first location, UCR1 associated with permit WV1002619, is the most upstream monitoring station available and is shown by the purple square in the top-left corner of the map in Figure 2. Iron and aluminum concentrations at UCR1 are very low.

The next downstream location, DCR2 associated with permit WV1002619, is the purple square in Figure 2 after Crafts Run passes several outfalls and turns toward the south. Iron and aluminum levels at this monitoring location are somewhat higher than UCR1. Iron levels violate state surface water quality standards from time to time, but they are still generally low. Aluminum concentrations are for total, not dissolved, aluminum, and are therefore not directly comparable to surface water quality standards.

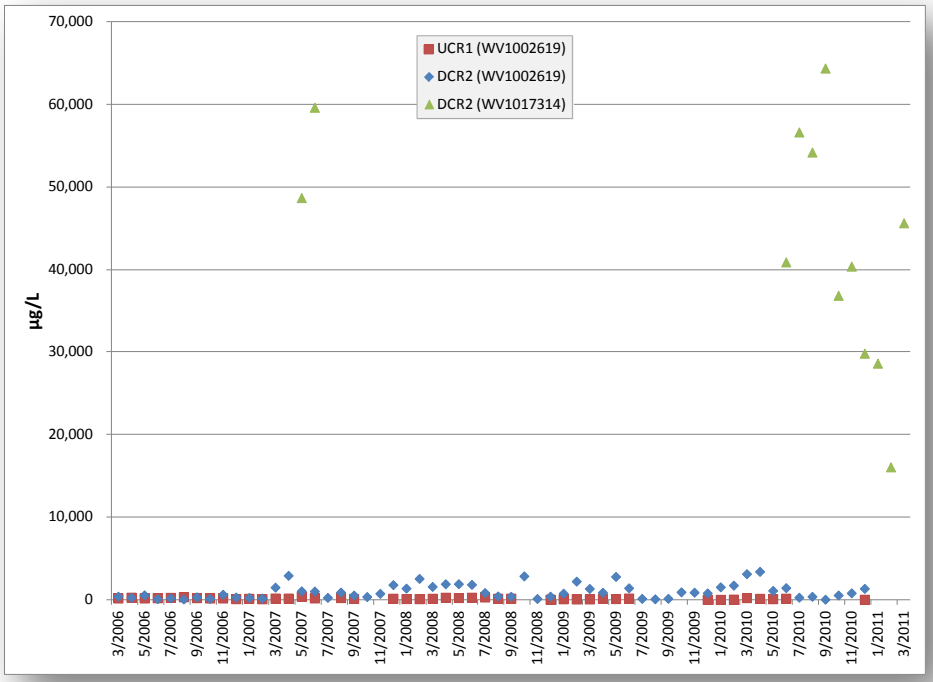
The third location, DCR2 associated with permit WV1017314, is located at the mouth of Crafts Run and is shown as a green square in Figure 2. Iron and aluminum levels are significantly higher here than at either of the two upstream locations, and are one to three orders of magnitude greater than the concentrations measured the same month at DCR2 associated with permit WV1002619. Surface water quality standards for iron are always violated. Clearly, a significant amount of AMD enters Crafts Run between these two monitoring points named DCR2.

Figure 4: Iron concentrations over time



Source: Discharge monitoring reports. Note: Values less than method detection levels are reported at method detection levels. The iron surface water quality criteria are 1,500 µg/L for public water supply (A) and for warm water fishery streams (B1).

Figure 5: Aluminum concentrations over time

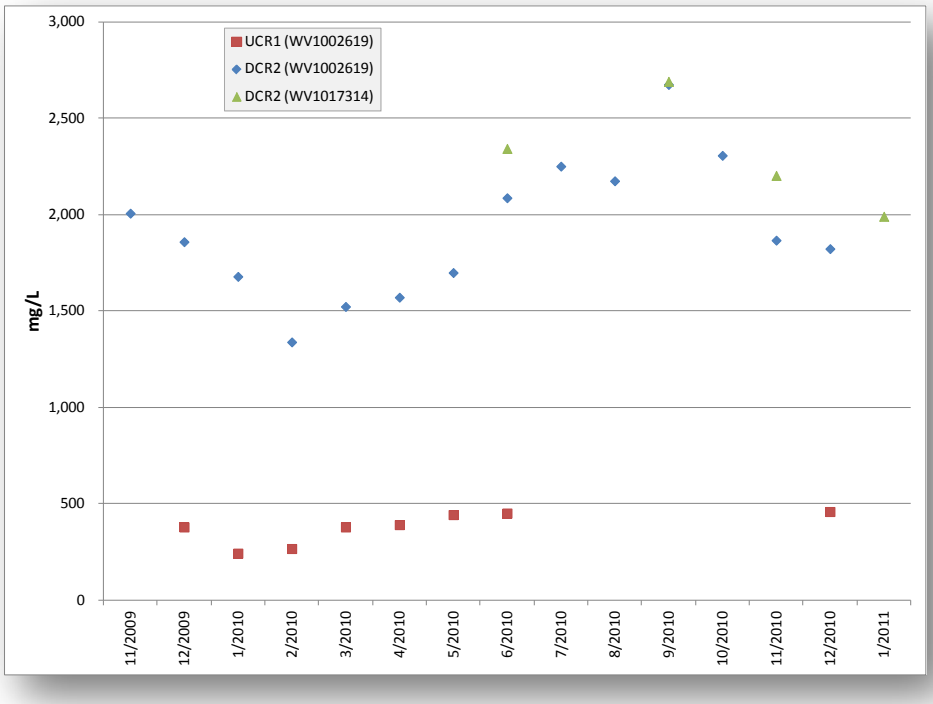


Source: Discharge monitoring reports. Note: Values less than method detection levels are reported at method detection levels. While this chart shows total aluminum, the surface water quality criterion is for dissolved aluminum: 750 µg/L for warm water fishery streams (B1).

4.2.2 *Dissolved ions linked to narrative standards*

Figure 6 shows trends in TDS concentrations over time at the same three monitoring locations. In contrast to the AMD results, TDS measurements at the middle monitoring station, DCR2 associated with permit WV1002619, are much more similar to those at the most downstream station, and much less similar to those at the most upstream station. Clearly, a significant source of dissolved solids enters Crafts Run between UCR1 and DCR2, both associated with WV1002619. At the topmost station, all TDS values are below the 500 mg/L threshold, but at both of the other stations, all TDS values are greater than twice this threshold.

Figure 6: Total dissolved solids concentrations over time



Source: Discharge monitoring reports. Note: Values less than method detection levels are reported at method detection levels. The threshold used in this report for total dissolved solids is 500 mg/L.

5. DISCUSSION

The tables and charts in Chapters 3 and 4 present the recent data collected by DS as well as the self-monitoring data reported by CORESCO in its DMRs. In addition, the tables highlight exceedances of West Virginia surface water quality criteria (orange shading) as well as exceedances of the other three types of thresholds presented in this report (black borders).

5.1 Crafts Run

5.1.1 *Crafts Run headwaters*

General observations

The headwaters of Crafts Run are characterized by DS' Upstream Crafts Run (PJ1) monitoring site, as well as CORESCO's UCR1 site associated with permit WV1002619. Both of these sites are located above impacts from the CORESCO permits.

The DS data show that Crafts Run is cleaner here than at other downstream locations. For example, conductivity, TDS, and sulfate levels were considerably lower than levels measured at all other locations on both Crafts Run and Robinson Run.[6]

Violations of state surface water quality criteria

According to the DS and CORESCO monitoring data, no surface water quality criteria were exceeded in the headwaters of Crafts Run (See Table 7 and Table 10). The one exception was a minimum pH level of 1 reported by CORESCO; however, this data point is highly suspect.

Exceedances of other relevant thresholds

Even though water quality criteria are not exceeded, some parameters exceeded other thresholds; these exceedances are noted by black boundaries in the relevant tables.

5.1.2 *Crafts Run above Pittsburgh Seep #2*

General observations

Crafts Run then flows past coal mining and refuse disposal sites. AMD is generally still not a problem above Pittsburgh Seep #2, as demonstrated by the low levels of iron and aluminum in Crafts Run at the DCR2 site associated with WV1002619 (See Figure 4 and Figure 5). However, in the same stretch of Crafts Run, TDS levels are already high, indicating that ionic pollution is likely leading to a violation of the narrative water quality standard (See Figure 6).

Violations of state surface water quality criteria

As Crafts Run flows downstream, it first passes CORESCO site UCR1 associated with permit WV1017314. No measurements at this site exceed surface water quality criteria (See Table 11).

[6] Barium is the single exception: the concentration at the Upstream Crafts Run (PJ1) monitoring site is higher than at the other DS sites.

It then passes Outfall 002 from permit WV1002619. Self-monitoring data from Outfall 002 show no exceedances of surface water quality criteria (See Table 10).

The next instream monitoring station, UCR1 associated with permit WV1011740, also shows no exceedances of surface water quality criteria (See Table 9).

Discharges from Outfalls 001 and 003 associated with permit WV1002619, then reach Crafts Run. As shown by the orange shaded cell in Table 10, Outfalls 001 and 003 have discharged selenium at concentrations that exceed the state surface water quality criterion. Outfall 001 has also discharged arsenic at a concentration that exceeds the state surface water quality criterion. These measurements indicate potential pollution from CCW.

The next instream monitoring location, DCR2 associated with permit WV1002619, demonstrates several exceedances of surface water quality criteria: dissolved aluminum, iron, and manganese concentrations have exceeded criteria at this location. High levels of these three metals typically indicate AMD pollution from coal mines. However, as illustrated by Figure 4 for iron and Figure 5 for aluminum, these violations are not nearly as significant or frequent as those witnessed further downstream.

A second instream monitoring location with the same name, DCR2, is associated with permit WV1011740 and is located downstream. Interestingly, no violations of surface water quality criteria were found at this site.

Exceedances of other relevant thresholds

In Crafts Run above Pittsburgh Seep #2, TDS levels are already high, indicating that ionic pollution is likely leading to a violation of the narrative water quality standard (See Figure 6).

5.1.3 *Crafts Run Crafts Run below Pittsburgh Seep #2*

General observations

During the DS monitoring sweep, concentrations of certain pollutants increased from the Upstream Crafts Run (PJ1) site to the Downstream Crafts Run (PJ2) site. Aluminum, for example, increased from 655 to 4,600 µg/L, iron increased from 600 to 7,940 µg/L, and manganese increased from 41.3 to 1,290 µg/L. At the same time, pH decreased from 7.5 to 6.7, alkalinity decreased, and sulfate increased from 40.6 to 642 mg/L. These changes clearly indicate an inflow of acid mine drainage between these two sites.

Concentrations of other parameters also increased. Boron, chloride, and nickel, which were not detected at the Upstream Crafts Run (PJ1) site, were detected at the downstream site (See Figure 3 for an illustration of these boron levels). Fluoride levels also increased from upstream to downstream.

Before flowing into Robinson Run, Crafts Run passes Outfall 002 associated with permit WV1017314. Toward the mouth of Crafts Run, AMD impacts are clearly evident. With the exception of the Pittsburgh Seep #2 (PJ3) site, aluminum, iron, manganese, and sulfate concentrations are higher at the mouth of Crafts Run than any other instream measurements in Crafts Run or Robinson Run.

In addition, concentrations of the following parameters increased between the Downstream Crafts Run (PJ2) and Crafts Run Mouth (PJ5) sites: barium, total and dissolved beryllium, fluoride, and nickel.

Violations of state surface water quality criteria

The Pittsburgh Seep #2 (PJ3) site clearly discharges AMD: pH, dissolved aluminum, iron, and manganese concentrations violate surface water quality criteria (See Table 7). Beryllium concentrations also violate the surface water quality criterion.

The DS site named Downstream Crafts Run (PJ2) is located approximately 75 feet below the point where this seep enters Crafts Run. This monitoring location was chosen to allow the seep sufficient distance to mix with Crafts Run. Based on visual observation, the flow in Crafts Run was considerably larger than the flow from the seep during the DS monitoring trip. At this location, iron and manganese levels still exceed criteria; however, pH, dissolved aluminum, and beryllium levels no longer exceeded their respective criteria.

The maximum selenium concentration measured at Outfall 002 associated with permit WV1017314 exceeds the state surface water quality criterion. This indicates potential pollution from CCW.

Boron levels at the Downstream Crafts Run (PJ2) site also indicate potential pollution from CCW (See Figure 3).

As the Crafts Run Mouth (PJ5) site, pH, dissolved aluminum, iron, and manganese concentrations violate surface water quality criteria (See Table 7). The beryllium concentration also violates its criterion. Boron levels are still elevated, indicating that CCW pollution is still evident.

CORESCO's self-monitoring data confirms that the mouth of Crafts Run is highly polluted. At site DCR2 associated with permit WV1017314, pH, dissolved aluminum, iron, and manganese concentrations violate surface water quality criteria (See Table 11). Arsenic has also exceeded its criterion here.

Exceedances of other relevant thresholds

At the two DS monitoring locations along this stretch of Crafts Run—Downstream Crafts Run (PJ2) and Pittsburgh Seep #2 (PJ3)—high levels of conductivity, TDS, and sulfates were recorded. These levels greatly exceeded the thresholds that indicate impairment of West Virginia's narrative standards.

Also, the lead concentration measured at Pittsburgh Seep #2 (PJ3) exceeded the national recommended water quality criterion and the MCL, while the nickel concentration measured at this site exceeded the national recommended water quality criterion. The maximum lead concentration recorded at DCR2 associated with WV1017314 also exceeded the national recommended water quality criterion and the MCL.

At the mouth of Crafts Run, conductivity, TDS, and sulfate levels are very high and indicate violations of state narrative standards.

Cadmium and nickel concentrations measured by CORESCO exceed other thresholds presented in this report.

5.2 Robinson Run

General observations

As Robinson Run flows from the Upstream Robinson Run (PJ7) to the Downstream Robinson Run (PJ6) site, changes in certain parameters indicate an influence from AMD: alkalinity decreases somewhat, while aluminum, iron, and manganese increase. However, several parameters remain at the same, or nearly the same levels, including: dissolved aluminum, barium, boron, chloride, fluoride, and pH. Many other parameters were not detected at either site.

Two CORESCO instream monitoring stations are located at approximately the same locations as the DS sites: URR3 and DRR4, both associated with permit WV1017314.

Violations of state surface water quality criteria

According to the DS data, the only violation of surface water quality criteria is for iron at the Downstream Robinson Run (PJ6) site.

The CORESCO self-monitoring data show that violations of state criteria have occurred in the past for dissolved aluminum, iron, and pH at both Robinson Run sites.

Exceedances of other relevant thresholds

At both DS sites, conductivity, TDS, and sulfate levels are very high and indicate violations of state narrative standards.

At both CORESCO sites, TDS and sulfate levels are also very high. In addition, arsenic and lead concentrations exceed other relevant thresholds.

6. CONCLUSIONS

On September 8, 2011 DS monitored six sites in and near Crafts Run and Robinson Run. In addition, CORESCO has monitored outfalls and instream locations pursuant to its NPDES permits. The following conclusions are based on both the DS and CORESCO datasets.

6.1 General observations

Crafts Run is relatively unpolluted in its headwaters. Crafts Run is cleaner in its headwaters than at all other downstream locations. AMD parameters were not apparent, nor were trace metals associated with CCW.

Pollution levels generally increase from upstream to downstream on Crafts Run. According to recent data collected on a single day by DS, pollution levels generally increase as Crafts Run flows downstream past coal mining and refuse disposal operations. This was true for AMD parameters as well as several other parameters such as boron, chloride, nickel, and fluoride.

6.2 Trace metal concentrations and potential pollution from coal combustion waste

Evidence of CCW pollution was found in several locations along Crafts Run and Robinson Run. While boron was not detected at the Upstream Crafts Run (PJ1) site, its concentration was significantly higher in all other locations monitored by DS. Boron is found in high levels in CCW, leaches faster at low pH, and has been found at numerous other CCW sites.

Several outfalls have discharged arsenic and selenium at concentrations that exceed surface water quality criteria. As Crafts Run flows downstream past coal mining and refuse disposal areas, it passes several permitted outfalls. Outfalls 001 and 003 associated with permit WV1002619 have discharged selenium, and Outfall 001 has discharged arsenic, in concentrations that exceed state surface water quality criteria. Further downstream, the maximum selenium concentration measured at Outfall 002 from permit WV1017314 exceeded its surface water quality criterion.

Beryllium concentrations at two instream monitoring locations exceeded the surface water quality criterion. These sites include the Pittsburgh Seep #2 (PJ3) and Crafts Run Mouth (PJ5) sites.

The maximum arsenic concentration at one instream monitoring location exceeded the surface water quality criterion. This occurred at the mouth of Crafts Run at CORESCO site DCR2 associated with permit WV1017314.

These measurements indicate potential pollution from CCW.

6.3 Acid mine drainage pollution

AMD pollution is most evident below Pittsburgh Seep #2. AMD concentrations increase somewhat in Crafts Run above this seep, but are still generally low. Below this seep, however, AMD pollution levels are very significantly higher.

Monitoring at numerous instream locations has found pH, dissolved aluminum, iron, and manganese levels that indicate AMD pollution. AMD is evident in Crafts Run at DCR2 associated with permit WV1002619, Pittsburgh Seep #2 (PJ3), Downstream Crafts Run (PJ2), Crafts Run Mouth (PJ5), and DCR2 associated with permit WV 1017314. On Robinson Run, AMD is event at the Downstream Robinson Run (PJ6) site and at CORESCO's URR3 and DRR4 sites.

6.4 Indicators of violations of narrative water quality standards

High levels of conductivity, TDS, and sulfate are apparent in instream monitoring locations across the watershed. With the exception of the uppermost monitoring station that is located above impacts from CORESCO's sites, pollution levels exceeded the thresholds that indicate impairment to state narrative standards. In these upstream locations that are above major AMD impacts, this ionic pollution can still lead to violations of state narrative standards.

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APPENDIX A: FIELD BLANK

A field blank sample, "Field Blank (PJ4)," was used for quality assurance/quality control. On the day of monitoring, in between the collection of samples PJ2 and PJ3, an approximately pencil-width stream was maintained while pouring distilled, deionized water into the same types of containers used for the other samples.

Table 12 includes results for the field blank. With the exception of conductivity, which was detected at a very low level, no other parameters were detected in the field blank. These results give confidence that the concentrations found in the non-field blank samples represent true environmental conditions.

Table 12: Water chemistry results for the field blank

Parameter	Units	Field blank (PJ4)
Acidity, total	mg/L	ND
Alkalinity, total as $CaCO_3$	mg/L	ND
Aluminum	µg/L	ND
Aluminum, dissolved	µg/L	ND
Antimony	µg/L	ND
Arsenic	µg/L	ND
Barium	µg/L	ND
Beryllium	µg/L	ND
Beryllium, dissolved	µg/L	ND
Boron	µg/L	ND
Cadmium	µg/L	ND
Cadmium, dissolved	µg/L	ND
Calcium	µg/L	ND
Chloride	mg/L	ND
Chromium	µg/L	ND
Chromium, hexavalent, total	mg/L	ND
Conductivity	µmhos/cm	1.5
Fluoride	mg/L	ND
Hardness, total	mg/L	ND
Iron	µg/L	ND
Lead	µg/L	ND
Magnesium	µg/L	ND
Manganese	µg/L	ND
Mercury	µg/L	ND
Molybdenum	µg/L	ND
Nickel	µg/L	ND
pH	SU	5.4
Selenium	µg/L	ND
Sulfate	mg/L	ND
Thallium	µg/L	ND
Total dissolved solids	mg/L	ND
Vanadium	µg/L	ND

Note: ND = not detected.

APPENDIX B: LABORATORY DATA SHEETS

Pace Analytical Services, Inc.
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ1 **Lab ID: 3053552001** Collected: 09/08/11 09:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	**41600**	ug/L	500	1		09/14/11 15:09	7440-70-2	
Magnesium	**11600**	ug/L	200	1		09/14/11 15:09	7439-95-4	
Total Hardness	**152**	mg/L	2.1	1		09/14/11 15:09		
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	**655**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:09	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:09	7440-38-2	
Barium	**47.0**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:09	7440-39-3	
Beryllium	ND	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:09	7440-41-7	
Boron	ND	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:09	7440-42-8	
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:09	7440-43-9	
Calcium	**41600**	ug/L	1000	1	09/13/11 18:26	09/14/11 15:09	7440-70-2	
Chromium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:09	7440-47-3	
Iron	**600**	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:09	7439-89-6	
Lead	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:09	7439-92-1	
Magnesium	**11600**	ug/L	200	1	09/13/11 18:26	09/14/11 15:09	7439-95-4	
Manganese	**41.3**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:09	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:09	7439-98-7	
Nickel	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:09	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:09	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:09	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:09	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	ND	ug/L	50.0	1	09/19/11 10:50	09/20/11 08:52	7429-90-5	
Beryllium, Dissolved	ND	ug/L	1.0	1	09/19/11 10:50	09/20/11 08:52	7440-41-7	
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 08:52	7440-43-9	
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 17:23	7440-36-0	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 14:58	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**338**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	ND	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	**106**	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**175**	mg/L	10.0	1		09/13/11 15:23		

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ1 **Lab ID: 3053552001** Collected: 09/08/11 09:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	**0.16**	mg/L	0.10	1		09/23/11 00:00	16984-48-8	
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**7.5**	Std. Units	1.0	1		09/12/11 19:29		H6
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	0.010	1		09/09/11 20:20	18540-29-9	H3
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	ND	mg/L	3.0	1		09/22/11 11:55	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	**40.6**	mg/L	20.0	2		09/21/11 10:59	14808-79-8	

Sample: PJ2 **Lab ID: 3053552002** Collected: 09/08/11 10:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	**221000**	ug/L	500	1		09/14/11 15:13	7440-70-2	
Magnesium	**39200**	ug/L	200	1		09/14/11 15:13	7439-95-4	
Total Hardness	**714**	mg/L	2.1	1		09/14/11 15:13		
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	**4600**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:13	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:13	7440-38-2	
Barium	**24.5**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:13	7440-39-3	
Beryllium	ND	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:13	7440-41-7	
Boron	**301**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:13	7440-42-8	
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:13	7440-43-9	
Calcium	**221000**	ug/L	1000	1	09/13/11 18:26	09/14/11 15:13	7440-70-2	
Chromium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:13	7440-47-3	
Iron	**7940**	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:13	7439-89-6	
Lead	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:13	7439-92-1	
Magnesium	**39200**	ug/L	200	1	09/13/11 18:26	09/14/11 15:13	7439-95-4	
Manganese	**1290**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:13	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:13	7439-98-7	
Nickel	**32.9**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:13	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:13	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:13	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:13	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	ND	ug/L	50.0	1	09/19/11 10:50	09/20/11 08:55	7429-90-5	
Beryllium, Dissolved	ND	ug/L	1.0	1	09/19/11 10:50	09/20/11 08:55	7440-41-7	

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ2 **Lab ID: 3053552002** Collected: 09/08/11 10:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 08:55	7440-43-9	
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 17:28	7440-36-0	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 14:59	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**1420**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	ND	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	**64.0**	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**1040**	mg/L	10.0	1		09/13/11 15:23		
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	**0.59**	mg/L	0.10	1		09/23/11 00:00	16984-48-8	
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**6.7**	Std. Units	1.0	1		09/12/11 19:29		H6
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	0.010	1		09/09/11 20:20	18540-29-9	H3
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	**6.8**	mg/L	3.0	1		09/22/11 11:55	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	**642**	mg/L	100	10		09/21/11 00:00	14808-79-8	

Sample: PJ3 **Lab ID: 3053552003** Collected: 09/08/11 10:45 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	**303000**	ug/L	500	1		09/14/11 15:30	7440-70-2	
Magnesium	**73000**	ug/L	200	1		09/14/11 15:30	7439-95-4	
Total Hardness	**1060**	mg/L	2.1	1		09/14/11 15:30		

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ3 **Lab ID: 3053552003** Collected: 09/08/11 10:45 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	**27400**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:30	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:30	7440-38-2	
Barium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:30	7440-39-3	
Beryllium	**3.5**	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:30	7440-41-7	
Boron	**70.9**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:30	7440-42-8	
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:30	7440-43-9	
Calcium	**303000**	ug/L	1000	1	09/13/11 18:26	09/14/11 15:30	7440-70-2	
Chromium	**6.4**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:30	7440-47-3	
Iron	**56100**	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:30	7439-89-6	
Lead	**6.5**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:30	7439-92-1	
Magnesium	**73000**	ug/L	200	1	09/13/11 18:26	09/14/11 15:30	7439-95-4	
Manganese	**2020**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:30	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:30	7439-98-7	
Nickel	**171**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:30	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:30	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:30	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:30	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	**26800**	ug/L	50.0	1	09/19/11 10:50	09/20/11 08:58	7429-90-5	
Beryllium, Dissolved	**3.7**	ug/L	1.0	1	09/19/11 10:50	09/20/11 08:58	7440-41-7	
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 08:58	7440-43-9	
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 17:33	7440-36-0	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 15:01	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**2520**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	**360**	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	ND	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**2160**	mg/L	10.0	1		09/13/11 15:23		
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	**1.1**	mg/L	0.10	1		09/23/11 00:00	16984-48-8	

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ3 **Lab ID: 3053552003** Collected: 09/08/11 10:45 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**2.9**	Std. Units	1.0	1		09/12/11 19:29		H6
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	1.0	100		09/09/11 20:20	18540-29-9	H3
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	ND	mg/L	3.0	1		09/22/11 11:56	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	**1290**	mg/L	200	20		09/21/11 00:00	14808-79-8	

Sample: PJ4 **Lab ID: 3053552004** Collected: 09/08/11 11:00 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	ND	ug/L	500	1		09/14/11 15:34	7440-70-2	
Magnesium	ND	ug/L	200	1		09/14/11 15:34	7439-95-4	
Total Hardness	ND	mg/L	2.1	1		09/14/11 15:34		
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	ND	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:34	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:34	7440-38-2	
Barium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:34	7440-39-3	
Beryllium	ND	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:34	7440-41-7	
Boron	ND	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:34	7440-42-8	
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:34	7440-43-9	
Calcium	ND	ug/L	1000	1	09/13/11 18:26	09/14/11 15:34	7440-70-2	
Chromium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:34	7440-47-3	
Iron	ND	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:34	7439-89-6	
Lead	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:34	7439-92-1	
Magnesium	ND	ug/L	200	1	09/13/11 18:26	09/14/11 15:34	7439-95-4	
Manganese	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:34	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:34	7439-98-7	
Nickel	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:34	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:34	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:34	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:34	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	ND	ug/L	50.0	1	09/19/11 10:50	09/20/11 09:13	7429-90-5	
Beryllium, Dissolved	ND	ug/L	1.0	1	09/19/11 10:50	09/20/11 09:13	7440-41-7	
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 09:13	7440-43-9	

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ4 **Lab ID: 3053552004** Collected: 09/08/11 11:00 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 17:37	7440-36-0	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 15:06	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**1.5**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	ND	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	ND	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	ND	mg/L	10.0	1		09/13/11 15:23		
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	ND	mg/L	0.10	1		09/23/11 00:00	16984-48-8	
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**5.4**	Std. Units	1.0	1		09/12/11 19:29		H6
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	0.010	1		09/09/11 20:20	18540-29-9	H3
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	ND	mg/L	3.0	1		09/22/11 00:00	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	ND	mg/L	10.0	1		09/21/11 00:00	14808-79-8	

Sample: PJ5 **Lab ID: 3053552005** Collected: 09/08/11 11:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	**205000**	ug/L	500	1		09/14/11 15:38	7440-70-2	
Magnesium	**39600**	ug/L	200	1		09/14/11 15:38	7439-95-4	
Total Hardness	**675**	mg/L	2.1	1		09/14/11 15:38		
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	**13800**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:38	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:38	7440-38-2	

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ5 **Lab ID: 3053552005** Collected: 09/08/11 11:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Barium	**29.2**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:38	7440-39-3	
Beryllium	**1.7**	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:38	7440-41-7	
Boron	**194**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:38	7440-42-8	
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:38	7440-43-9	
Calcium	**205000**	ug/L	1000	1	09/13/11 18:26	09/14/11 15:38	7440-70-2	
Chromium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:38	7440-47-3	
Iron	**21500**	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:38	7439-89-6	
Lead	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:38	7439-92-1	
Magnesium	**39600**	ug/L	200	1	09/13/11 18:26	09/14/11 15:38	7439-95-4	
Manganese	**1470**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:38	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:38	7439-98-7	
Nickel	**81.0**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:38	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:38	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:38	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:38	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	**6100**	ug/L	50.0	1	09/19/11 10:50	09/20/11 09:16	7429-90-5	
Beryllium, Dissolved	**1.4**	ug/L	1.0	1	09/19/11 10:50	09/20/11 09:16	7440-41-7	
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 09:16	7440-43-9	
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 18:10	7440-36-0	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 15:08	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**1350**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	**54.0**	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	ND	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**1050**	mg/L	10.0	1		09/13/11 15:23		
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	**0.65**	mg/L	0.10	1		09/23/11 00:00	16984-48-8	
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**4.7**	Std. Units	1.0	1		09/12/11 19:29		H6

Pace Analytical Services, Inc.
1638 Roseytown Road - Suites 2,3,4
Greensburg, PA 15601
(724)850-5600

ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ5 **Lab ID: 3053552005** Collected: 09/08/11 11:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	0.010	1		09/09/11 20:20	18540-29-9	H3
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	**4.8**	mg/L	3.0	1		09/22/11 11:57	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	**660**	mg/L	100	10		09/21/11 00:00	14808-79-8	

Sample: PJ6 **Lab ID: 3053552006** Collected: 09/08/11 12:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	**233000**	ug/L	500	1		09/14/11 15:41	7440-70-2	
Magnesium	**57800**	ug/L	200	1		09/14/11 15:41	7439-95-4	
Total Hardness	**820**	mg/L	2.1	1		09/14/11 15:41		
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	**1540**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:41	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:41	7440-38-2	
Barium	**31.5**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:41	7440-39-3	
Beryllium	ND	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:41	7440-41-7	
Boron	**189**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:41	7440-42-8	
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:41	7440-43-9	
Calcium	**233000**	ug/L	1000	1	09/13/11 18:26	09/14/11 15:41	7440-70-2	
Chromium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:41	7440-47-3	
Iron	**2310**	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:41	7439-89-6	
Lead	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:41	7439-92-1	
Magnesium	**57800**	ug/L	200	1	09/13/11 18:26	09/14/11 15:41	7439-95-4	
Manganese	**161**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:41	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:41	7439-98-7	
Nickel	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:41	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:41	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:41	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:41	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	**94.9**	ug/L	50.0	1	09/19/11 10:50	09/20/11 09:19	7429-90-5	
Beryllium, Dissolved	ND	ug/L	1.0	1	09/19/11 10:50	09/20/11 09:19	7440-41-7	
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 09:19	7440-43-9	
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 18:14	7440-36-0	

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ6 **Lab ID: 3053552006** Collected: 09/08/11 12:15 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 15:09	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**1760**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	ND	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	**128**	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**1270**	mg/L	10.0	1		09/13/11 15:23		
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	**0.22**	mg/L	0.10	1		09/23/11 00:00	16984-48-8	
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**7.7**	Std. Units	1.0	1		09/12/11 19:29		H6
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	0.010	1		09/09/11 20:20	18540-29-9	H3
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	**7.1**	mg/L	3.0	1		09/22/11 11:58	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	**692**	mg/L	200	20		09/23/11 09:56	14808-79-8	

Sample: PJ7 **Lab ID: 3053552007** Collected: 09/08/11 12:45 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
2340B Hardness, Total (Calc.)	Analytical Method: SM 2340B							
Calcium	**230000**	ug/L	500	1		09/14/11 15:45	7440-70-2	
Magnesium	**55700**	ug/L	200	1		09/14/11 15:45	7439-95-4	
Total Hardness	**805**	mg/L	2.1	1		09/14/11 15:45		
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Aluminum	**787**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:45	7429-90-5	
Arsenic	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:45	7440-38-2	
Barium	**32.1**	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:45	7440-39-3	
Beryllium	ND	ug/L	1.0	1	09/13/11 18:26	09/14/11 15:45	7440-41-7	
Boron	**192**	ug/L	50.0	1	09/13/11 18:26	09/14/11 15:45	7440-42-8	

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ7 **Lab ID: 3053552007** Collected: 09/08/11 12:45 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
6010 MET ICP	Analytical Method: EPA 6010B Preparation Method: EPA 3005							
Cadmium	ND	ug/L	3.0	1	09/13/11 18:26	09/14/11 15:45	7440-43-9	
Calcium	**230000**	ug/L	1000	1	09/13/11 18:26	09/14/11 15:45	7440-70-2	
Chromium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:45	7440-47-3	
Iron	**1040**	ug/L	70.0	1	09/13/11 18:26	09/14/11 15:45	7439-89-6	
Lead	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:45	7439-92-1	
Magnesium	**55700**	ug/L	200	1	09/13/11 18:26	09/14/11 15:45	7439-95-4	
Manganese	**120**	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:45	7439-96-5	
Molybdenum	ND	ug/L	20.0	1	09/13/11 18:26	09/14/11 15:45	7439-98-7	
Nickel	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:45	7440-02-0	
Selenium	ND	ug/L	8.0	1	09/13/11 18:26	09/14/11 15:45	7782-49-2	
Thallium	ND	ug/L	10.0	1	09/13/11 18:26	09/14/11 15:45	7440-28-0	
Vanadium	ND	ug/L	5.0	1	09/13/11 18:26	09/14/11 15:45	7440-62-2	
6010 MET ICP,Dissolved	Analytical Method: EPA 6010 Preparation Method: EPA 3005							
Aluminum, Dissolved	**89.1**	ug/L	50.0	1	09/19/11 10:50	09/20/11 09:22	7429-90-5	
Beryllium, Dissolved	ND	ug/L	1.0	1	09/19/11 10:50	09/20/11 09:22	7440-41-7	
Cadmium, Dissolved	ND	ug/L	3.0	1	09/19/11 10:50	09/20/11 09:22	7440-43-9	
6020 MET ICPMS	Analytical Method: EPA 6020							
Antimony	ND	ug/L	0.50	1	09/17/11 17:57	09/21/11 18:19	7440-36-0	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	ND	ug/L	0.20	1	09/14/11 10:56	09/14/11 15:11	7439-97-6	
120.1 Specific Conductance	Analytical Method: EPA 120.1							
Specific Conductance	**1760**	umhos/cm	1.0	1		09/23/11 00:00		
2310B Acidity, Total	Analytical Method: SM 2310B							
Acidity, Total	ND	mg/L	10.0	1		09/15/11 19:00		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	**142**	mg/L	10.0	1		09/15/11 19:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**1250**	mg/L	10.0	1		09/13/11 15:23		
4500FC Fluoride	Analytical Method: SM 4500F/C							
Fluoride	**0.19**	mg/L	0.10	1		09/23/11 00:00	16984-48-8	
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B							
pH at 25 Degrees C	**7.8**	Std. Units	1.0	1		09/12/11 19:29		H6
Chromium, Hexavalent	Analytical Method: SM 3500-Cr D							
Chromium, Hexavalent	ND	mg/L	0.010	1		09/09/11 20:20	18540-29-9	H3

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ANALYTICAL RESULTS

Project: Stream Samples
Pace Project No.: 3053552

Sample: PJ7 **Lab ID: 3053552007** Collected: 09/08/11 12:45 Received: 09/09/11 11:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
4500 Chloride	Analytical Method: SM 4500-Cl-E							
Chloride	**7.2**	mg/L	3.0	1		09/22/11 12:01	16887-00-6	
ASTM D516-9002 Sulfate Water	Analytical Method: ASTM D516-90,02							
Sulfate	**728**	mg/L	200	20		09/23/11 09:57	14808-79-8	