Final Total Maximum Daily Load for pH, Cadmium, Iron, Nickel and Zinc, 16 Pollutant-Waterbody Combinations on 6 Stream Segments, Hopkins County, Kentucky

Copperas Creek, photo by KDOW

July 2015

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Kentucky Department for Environmental Protection
Division of Water

This report is approved for release

Peter Goodmann, Director
Division of Water

7/2/2015
Date

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GLOSSARY OF ACRONYMS

APEL	Alternate Precipitation Effluent Limits
AMD	Acid Mine Drainage
AML	Abandoned Mine Lands
APHA	American Public Health Association
BMP	Best Management Practices
CAH	Coldwater Aquatic Habitat
CFR	Code of Federal Regulations
CHIA	Cumulative Hydrologic Impact Assessment
D.C.	District of Columbia
DEP	Department for Environmental Protection
DMP	Division of Mine Permits
DMRE	Division of Mine Reclamation and Enforcement
DMR	Discharge Monitoring Report
DNR	Department for Natural Resources
ELG	Effluent Limit Guidelines
EPA	Environmental Protection Agency
ft^3	Cubic Feet
GIS	Geographic Information System
GNIS	Geographic Names Information System
HUC	Hydrologic Unit Code
ICIS	Integrated Compliance Information System
KAR	Kentucky Administrative Regulations
KDMM	Kentucky Department of Mines and Minerals
KDOW	Kentucky Division of Water
KGS	Kentucky Geological Survey
KRC	Kentucky Revenue Cabinet
KRS	Kentucky Revised Statutes
KPDES	Kentucky Pollutant Discharge Elimination System
L	Liter
LA	Load Allocations
MBI	Macroinvertebrate Bioassessment Index
MGD	Million Gallons per Day
ml	milliliter

MOS	Margin of Safety
N/A	Not Applicable
NHD	National Hydrography Dataset
NLCD	National Landcover Database
NTU	Nephelometric Turbidity Units
OMSL	Office of Mine Safety and Licensing
PCR	Primary Contact Recreation
PCS	Permit Compliance System
QAPP	Quality Assurance Project Plan
RM	River Mile
RPA	Reasonable Potential Analysis
SCR	Secondary Contact Recreation
SDE	Spatial Data Engine
SFN	State File Number
SMCRA	Surface Mining Control and Reclamation Act
SMIS	Surface Mining Information System
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
UT	Unnamed Tributary
WAH	Warmwater Aquatic Habitat
WBID	Waterbody Identification Number
WET	Whole Effluent Toxicity
WHO	World Health Organization
WKY	Western Kentucky (Coal Bed Designation)
WLA	Waste Load Allocation
WQC	Water Quality Criteria

Total Maximum Daily Load (TMDL) Synopsis

State: Kentucky
Major River Basin: Green/Tradewater
USGS HUC8 #: 05140205
County(s): Hopkins
Pollutant(s) of Concern: pH, Cadmium, Iron, Nickel and Zinc

Table S.1 Impaired Waterbodies Addressed in this TMDL Document

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources	Impaired Use (Support Status)
Caney Creek of Tradewater River 0.0 to 8.2	pH	Hopkins	KY488837_01	Acid Mine Drainage; Surface Mining	WAH, PCR, SCR (not supporting)
Copper Creek of Richland Creek 0.0 to 2.7	pH, Iron, Zinc	Hopkins	KY490078_01	Coal Mining	WAH, PCR, SCR (not supporting)
Copperas Creek of Caney Creek 0.0 to 3.6	pH, Cadmium, Iron, Nickel, Zinc	Hopkins	KY490083_01	Coal Mining	WAH, PCR, SCR (not supporting)
Fox Run of Caney Creek 0.0 to 1.1	pH	Hopkins	KY492415_01	Coal Mining	WAH, PCR, SCR (not supporting)
Hurricane Creek of Tradewater River 0.0 to 1.8	pH, Iron, Zinc	Hopkins	KY494821_01	Coal Mining	WAH, PCR, SCR (not supporting)
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6	pH, Iron, Zinc	Hopkins	KY494821-0.3_01	Coal Mining	WAH, PCR, SCR (not supporting)

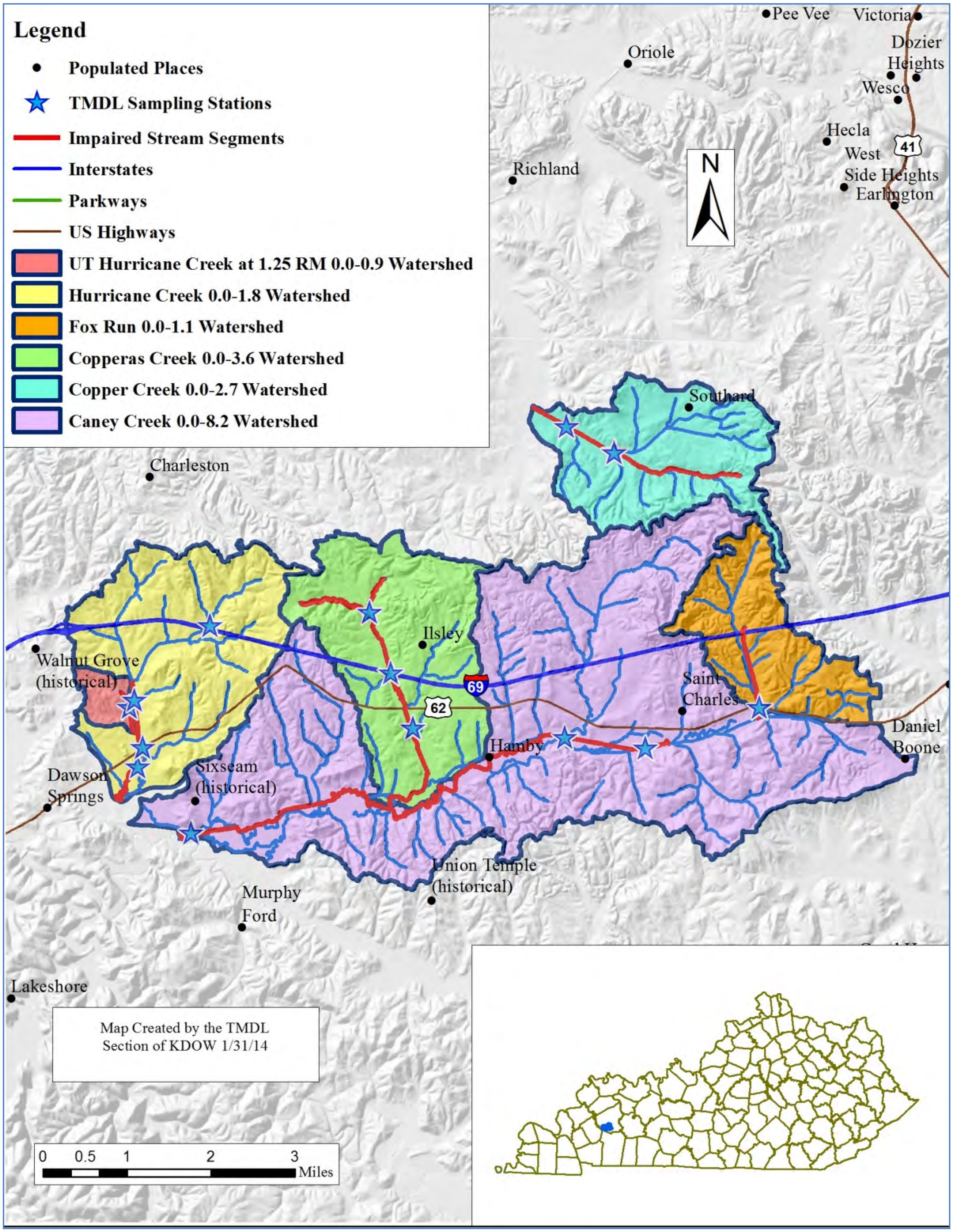


Figure S.1 Location of the TMDL Watershed, Sampling Stations and Assessed Stream Segments

Kentucky Water Quality Criteria (WQC) and the TMDL Endpoint (i.e. Water Quality Standard/ TMDL Target):

Table S.2 pH WQC and TMDL Endpoint

Condition	WQC, pH standard units	TMDL Load, Hydrogen Ions, lb/day [1]
All Conditions	6.0 (upper limit of hydrogen ion loading)	$Q_S \times 2.067$
All Conditions	9.0 (lower limit of hydrogen ion loading)	$Q_S \times 2.067E\text{-}3$

[1] QS is the flow in the stream in ft^3/s.

Table S.3 Iron WQC and TMDL Endpoint

Condition	WQC, mg/L	TMDL Load, lb/day[1]
Chronic–aquatic life is adversely affected	1.0	$Q_S \times 5.3938$
Acute	4.0	$Q_S \times 21.575$

[1] QS is the flow in the stream in ft^3/s.

Table S.4 Cadmium, Nickel and Zinc WQCs and TMDL Endpoints

Condition	WQC, µg/L[1]	TMDL Load, lb/day[2]
Cadmium		
Chronic	$e^{(0.7409*(\ln(hardness))-4.719)}$	$Q_S \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$
Acute	$e^{(1.0166*(\ln(hardness))-3.924)}$	$Q_S \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$
Nickel		
Chronic	$e^{(0.846*(\ln(hardness))+0.0584)}$	$Q_S \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$
Acute	$e^{(0.846*(\ln(hardness))+2.255)}$	$Q_S \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$
Zinc		
Chronic	$e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
Acute	$e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$

[1] Hardness is in units of mg/L as $CaCO_3$.
[2] Q_S is the flow in the stream in ft^3/s.

Table S.5 Net Alkalinity TMDL Endpoint

Condition	Net Alkalinity[1], lb/day
All Conditions	≥ 0

[1] Net alkalinity is defined as the alkalinity in mg/L as $CaCO_3$ minus the calculated acidity; the calculated acidity is determined using the following equation: Calculated Acidity, mg/L as $CaCO_3$ = $50 \times ((10^{(3-pH)}) + (3 \times Fe\ mg/L/55.8) + (2 \times Mn\ mg/L/54.9) + (3 \times Al\ mg/L/27))$.

TMDL Equation and Calculations:

A TMDL calculation is performed as follows:

TMDL = WLA + LA + MOS
Equation S.1

The WLA has two components:

WLA = Mining-WLA + Future Growth-WLA
Equation S.2

Where:
TMDL: the WQC, expressed as a load.
MOS: the Margin of Safety, which can be an implicit or explicit additional reduction applied to sources of pollutants that accounts for uncertainties in the relationship between effluent limits and water quality. For this TMDL, the MOS is implicit.
TMDL Target: the TMDL minus the MOS.
WLA: the Wasteload Allocation, which is the allowable loading of pollutants into the stream from KPDES-permitted sources, such as surface and subsurface mines.
Mining-WLA: the allowable loading for current KPDES-permitted mining sources which discharge the pollutants of concern, whether or not they have a permit limit for the pollutants of concern.
Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new mining permits, new discharges under existing mining permits as further permitted acreage is mined and discharges from mines under reclamation by the Kentucky Division of Abandoned Mine Lands (AML). Also includes the allocation for the KPDES-permitted sources that existed but were not known at the time the TMDL was written.
LA: the Load Allocation, which is the allowable loading of pollutants into the stream from sources not permitted by KPDES, such as formerly permitted mines, prelaw mines, and from natural background.
Seasonality: yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.
Critical Condition: the time period when the pollutant conditions are expected to be at their worst.
Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment.
Load: concentration * flow * conversion factor.
Concentration: milligrams per liter (iron, alkalinity, acidity), micrograms per liter (cadmium, nickel, zinc) or standard units (pH).
Flow (i.e., stream discharge): cubic feet per second (cfs).

Table S.6 TMDLs and Allocations by Impaired Segment

Pollutant	Units	TMDL(1)	MOS(2)	Mining-WLA(3)	Future Growth - WLA(4)	LA(5)
Caney Creek 0.0 to 8.2						
pH(6)	standard units	$6.0 \leq pH \leq 9.0$	Implicit	$6.0 \leq pH \leq 9.0$	$6.0 \leq pH \leq 9.0$	$6.0 \leq pH \leq 9.0$
Alkalinity, Acidity(7)	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Copper Creek 0.0 to 2.7						
pH(6)	standard units	$6.0 \leq pH \leq 9.0$	Implicit	$6.0 \leq pH \leq 9.0$	$6.0 \leq pH \leq 9.0$	$6.0 \leq pH \leq 9.0$
Alkalinity, Acidity(7)	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Iron Chronic(8)	pounds/ day	$Q_S \times 5.3938$	Implicit	$Q_M \times 5.3938$	$Q_{FG} \times 5.3938$	$Q_{LA} \times 5.3938$
Iron Acute	pounds/ day	$Q_S \times 21.575$	Implicit	$Q_M \times 21.575$	$Q_{FG} \times 21.575$	$Q_{LA} \times 21.575$
Zinc Acute and Chronic(9)	pounds/ day	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{FG} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{LA} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
Copperas Creek 0.0 to 3.6						
pH(6)	standard units	$6.0 \leq pH \leq 9.0$	Implicit	$6.0 \leq pH \leq 9.0$	$6.0 \leq pH \leq 9.0$	$6.0 \leq pH \leq 9.0$
Alkalinity, Acidity(7)	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Cadmium Chronic	pounds/ day	$Q_S \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$	$Q_{FG} \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$	$Q_{LA} \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$
Cadmium Acute	pounds/ day	$Q_S \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$	Implicit	$Q_M \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$	$Q_{FG} \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$	$Q_{LA} \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$
Iron Chronic(8)	pounds/ day	$Q_S \times 5.3938$	Implicit	$Q_M \times 5.3938$	$Q_{FG} \times 5.3938$	$Q_{LA} \times 5.3938$

Total Maximum Daily Load (TMDL) Synopsis

Pollutant	Units	TMDL[1]	MOS[2]	Mining-WLA[3]	Future Growth - WLA[4]	LA[5]
Copperas Creek 0.0 to 3.6						
Iron Acute	pounds/ day	$Q_S \times 21.575$	Implicit	$Q_M \times 21.575$	$Q_{FG} \times 21.575$	$Q_{LA} \times 21.575$
Nickel Chronic	pounds/ day	$Q_S \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$	$Q_{FG} \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$	$Q_{LA} \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$
Nickel Acute	pounds/ day	$Q_S \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$	$Q_{FG} \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$	$Q_{LA} \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$
Zinc Acute and Chronic[9]	pounds/ day	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{FG} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{LA} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
Fox Run 0.0 to 1.1						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Hurricane Creek 0.0 to 1.8						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Iron Chronic[8]	pounds/ day	$Q_S \times 5.3938$	Implicit	$Q_M \times 5.3938$	$Q_{FG} \times 5.3938$	$Q_{LA} \times 5.3938$
Iron Acute	pounds/ day	$Q_S \times 21.575$	Implicit	$Q_M \times 21.575$	$Q_{FG} \times 21.575$	$Q_{LA} \times 21.575$
Zinc Acute and Chronic[9]	pounds/ day	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{FG} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{LA} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6						
pH[6]	Standard Units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$

Total Maximum Daily Load (TMDL) Synopsis

Pollutant	Units	TMDL[(1)]	MOS[(2)]	Mining-WLA[(3)]	Future Growth - WLA[(4)]	LA[(5)]
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6						
Alkalinity, Acidity[(7)]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0

(1) TMDLs for metals are expressed as the flow in the stream, Q_S in ft^3/s, multiplied by the WQC in mg/L or µg/L and the appropriate conversion factor to convert the multiple of flow and the WQC into to units of load (pounds/day). The conversion factors are:

1. 5.3938 for a WQC in units of mg/L (i.e., for iron).
2. 0.005394 for a WQC in units of µg/L (i.e., for zinc, cadmium and nickel).

Also, pH must remain between 6.0 and 9.0 standard units, inclusive.

(2) The MOS is implicit: When in compliance, KPDES-permitted sources seldom discharge at their allowable limits for the pollutants addressed by this TMDL.

(3) The Mining-WLA is expressed as the flow in the stream due to KPDES-permitted sources with permit limits for the pollutants addressed by this TMDL, Q_M, in ft^3/s, multiplied by the WQC and the appropriate conversion factor. All dischargers must meet both the chronic and acute criteria for pollutants whose WQCs are expressed in both chronic and acute terms.

(4) The Future Growth-WLA is expressed as the flow in the stream due to future KPDES-permitted sources with permit limits for the pollutants addressed by this TMDL, Q_{FG}, in ft^3/s, multiplied by the WQC and the appropriate conversion factor. All dischargers must meet both the chronic and acute criteria for pollutants whose WQCs are expressed in both chronic and acute terms.

(5) The LA is expressed as the flow in the stream due to legal but non-KPDES-permitted sources of the pollutants addressed by this TMDL, Q_{LA}, in ft^3/s, multiplied by the WQC and the appropriate conversion factor. The LA includes mining sources in operation prior to May 3, 1978 and any natural background concentrations of the pollutants addressed by this TMDL.

(6) pH can be converted to a range of allowable loads of hydrogen ions in units of g/day; a pH of 6.0 represents a maximum allowable load of hydrogen ions equal to $Q_S \times 2.067$ g/day, and a pH of 9.0 represents a minimum allowable load of $Q_S \times 2.067E\text{-}3$ g/day, where Q_S is the flow in the stream in ft^3/s. The TMDL can then be allocated to the Mining-WLA, the Future Growth-WLA and the LA based on the fraction of the streamflow each contributes.

(7) Net alkalinity is defined as the alkalinity in mg/L as $CaCO_3$ minus the calculated acidity; the calculated acidity is determined using the following equation: Calculated Acidity, mg/L as $CaCO_3 = 50 \times ((10^{(3\text{-pH})}) + (3 \times \text{Fe mg/L}/55.8) + (2 \times \text{Mn mg/L}/54.9) + (3 \times \text{Al mg/L}/27))$. Monitoring and reporting of net alkalinity will be required both instream and at outfalls at the same frequency as iron and manganese are monitored and reported. Aluminum must be added to KPDES mining permits as report-only in order to determine the calculated acidity. Net alkalinity must be greater than or equal to zero (in both mg/L and pounds/day) in order to buffer metals hydrolysis which can lower pH below acceptable levels.

(8) The chronic iron WQC is 3.5 mg/L where there are no demonstrated impacts to aquatic life, and 1.0 mg/L where there are demonstrated impacts. This means for any WAH-impaired stream, the iron limit is 1.0 mg/L. Because all segments addressed by this document are WAH-impaired, the chronic iron TMDL is based on 1.0 mg/L as opposed to 3.5 mg/L. The acute WQC for iron is not dependent on impacts to aquatic life; it is 4.0 mg/L in all streams.

(9) The chronic and acute WQCs for zinc are identical.

Translation of WLAs into Permit Limits

Mining facilities must meet the discharge limits set in their KPDES permits, see Section 5.2.5.2, Coal General Permits, and 5.2.5.3, Coal Individual Permits. Pre-SMCRA facilities were not required to treat AMD subsequent to the cessation of mining.

The following changes to KPDES mining permits are required by this TMDL:

1. Permittees must report alkalinity in mg/L as $CaCO_3$ and aluminum in units of mg/L whenever and wherever iron and manganese are reported. However, for aluminum this report-only, no discharge limit is established. See below for alkalinity.

2. There must be sufficient net alkalinity present to buffer metals hydrolysis whenever and wherever iron and manganese are reported. Net alkalinity is defined as the alkalinity of the discharge water minus the calculated acidity, which must be greater than or equal to zero. The calculated acidity will be determined using Equation S.3, from Hedin et al. (1991), which conservatively assumes iron is in the form of Fe^{+3}:

$$\text{Calculated Acidity, mg/L as } CaCO_3 = 50 \times ((10^{(3\text{-pH})}) + (3 \times \text{Fe mg/L}/55.8) + (2 \times \text{Mn mg/L}/54.9) + (3 \times \text{Al mg/L}/27.0))$$

Equation S.3

If the net alkalinity is below zero, then a violation has occurred. See Section 6.2 for further explanation.

These changes will be made to the single existing mining permit in the watershed, the Don Bowles Corporation St. Charles Prep Plant/Can Do #1 Mine, KY0067121, when its permit is renewed. The facility's current permit is valid until 2017. These requirements will also apply to any future mining permits.

1.0 Introduction

Section 303(d) of the Clean Water Act requires states to identify waterbodies within their boundaries that have been assessed and are not currently meeting their designated uses (401 KAR 10:026 and 10:031) and that require the development of a Total Maximum Daily Load (TMDL). States must establish a priority ranking for such waters, taking into account their intended uses and the severity of the pollutant. Section 303(d) also requires that states provide a list of this information called the 303(d) list. This list is submitted to the Environmental Protection Agency (EPA) during even-numbered years and each submittal replaces the previous list. The 2010-303(d) information for Kentucky can be found in the 2012 *Integrated Report to Congress on the Condition of Water Resources in Kentucky Volume II. 303(d) List of Surface Waters* (Kentucky Division of Water (KDOW), 2012) and can be obtained at: http://water.ky.gov.

States are also required to develop TMDLs for the pollutants that cause each waterbody to fail to meet its designated uses. The TMDL process establishes the allowable amount (i.e. “load”) of the pollutant the waterbody can naturally assimilate while continuing to meet the water quality criteria (WQC) for each designated use. The pollutant load must be established at a level necessary to implement the applicable WQC with seasonal variations and a Margin of Safety (MOS) that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. This load is then divided among different sources of the pollutant in a watershed. Information from EPA on TMDLs can be found at: http://www.epa.gov/owow/tmdl.

2.0 Problem Definition

The TMDL watersheds are located in the United States Geological Survey (USGS) hydrologic unit code (HUC) 05140205, in Hopkins County, southwest of Madisonville; they are located along Interstate 69 and U.S. 62, see Figure 2.1.

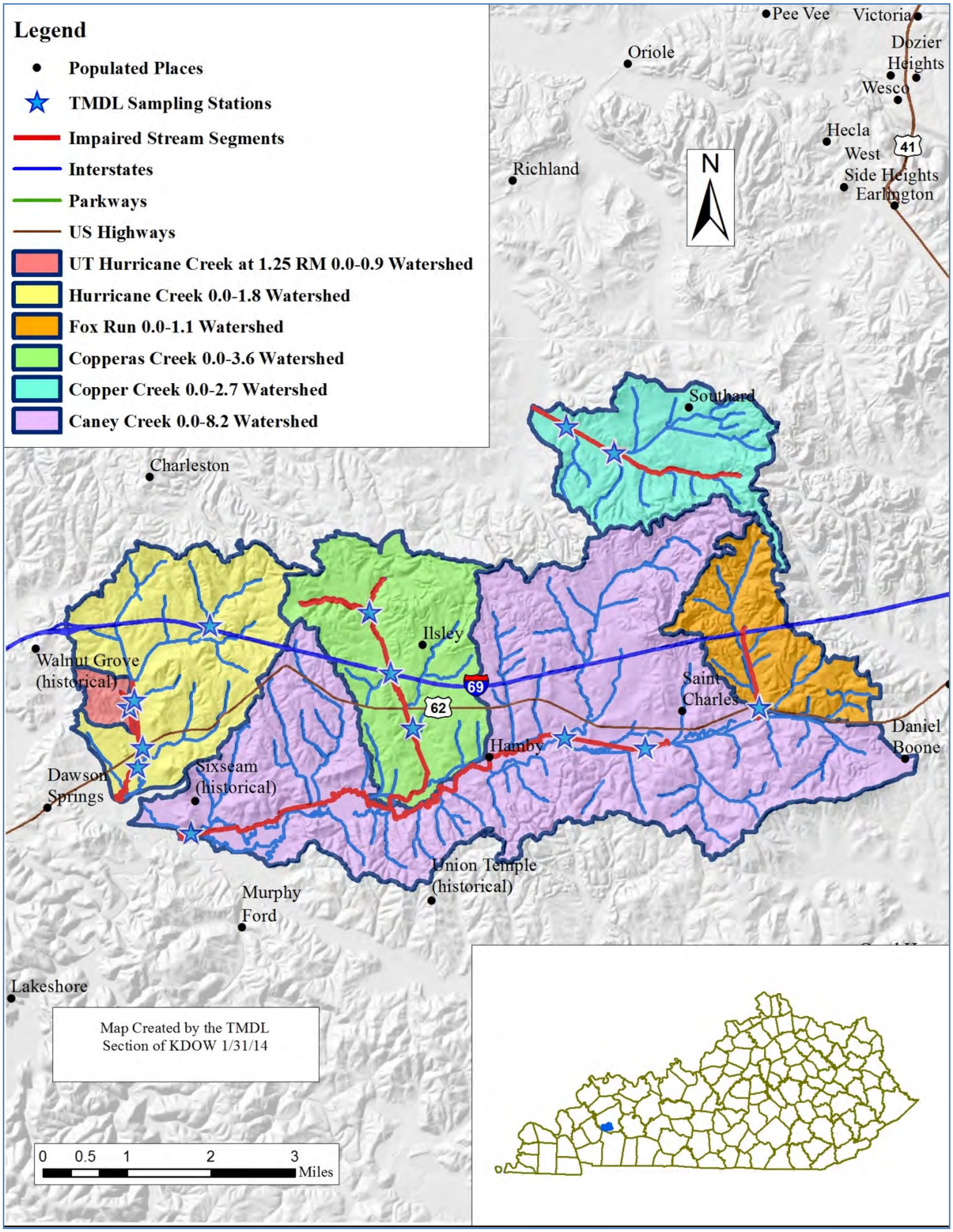


Figure 2.1 Location of the TMDL Watershed

2.1 303(d) Listing History

Legacy Listings. Four segments within the TMDL watershed were listed on KDOW's 2004 303(d) list of impaired waters, see Table 2.1.1.

Table 2.1.1 Legacy 303(d) Listings

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources
Caney Creek 0.0 to 8.8	pH	Hopkins	KY488837_01	Acid Mine Drainage; Surface Mining
Copper Creek 0.0 to 1.1	pH, Iron, Zinc	Hopkins	KY490078_01	Source Unknown
Copperas Creek 0.0 to 3.1	pH, Cadmium, Iron, Nickel, Zinc	Hopkins	KY490083_01	Source Unknown
Hurricane Creek 0.7 to 2.2	pH, Iron, Zinc	Hopkins	KY494821_01	Source Unknown

KDOW is unable to locate the listing data associated with these segments, which will be referred to as the legacy listings or legacy segments within this document.

Modern Listings. The KDOW TMDL program resampled the legacy segments and two additional tributaries from 5/17/2006 through 3/22/2007. KDOW biologists sampled 12 sites (or sampling stations) throughout the watershed collecting monthly water chemistry and habitat data. Eight of the 12 sites were also sampled for aquatic life. See Section 4.0 for further information.

This sampling design collected approximately one year's worth of monthly data. While KDOW normally uses three years worth of data to assess segments for metals impairment (KDOW, 2010), all listing decisions are made on a case-by-case basis, and for segments upstream of a known impairment, less data may be required. This allowed KDOW to list two additional segments on the 2008 303(d) list that had biology, pH and metals concentrations data which mirrored that of existing downstream pH- and metal-impaired segments. These were the Unnamed Tributary (UT) to Hurricane Creek and Fox Run, both of which are tributaries to segments with legacy impairments. This data threshold is also why no delisting decisions were made with regard to metals (i.e., due to the size of the dataset), even though some segments showed levels of zinc below the WQC (Copper Creek and Hurricane Creek), see Section 8.0 for results. Likewise, KDOW did not assess the legacy segments as impaired for additional metals as a result of this study although some concentrations of metals were above the WQC (e.g., arsenic, nickel) at certain stations, see Section 8.0 for a discussion of sampling results for each impaired segment.

In general, legacy segments in Kentucky have not always been listed with the same level of data rigor as that outlined in assessment guidance (EPA, 1997); because of this, in instances where overwhelming evidence existed, KDOW has often been able to obtain EPA approval to delist impaired segments using the same or a greater level of data rigor as that used for the initial listing decision. However, because the listing data associated with the legacy segments cannot be located, KDOW instead included these segments in the TMDL. All segments with an approved TMDL are placed in Category 4A in Kentucky's biannual Integrated Reports to Congress on Water Quality. If in the future segments with an approved TMDL are found to no longer be impaired for the pollutant addressed by the TMDL, they will be placed in Category 2C. This is a category for waterbodies with an approved TMDL which are now fully supporting the designated use for which the TMDL was written.

The impairments assessed as a result of this study were listed (or updated, in the case of the four legacy segments) on the 2008 303(d) List of Impaired Waters. In addition to the water chemistry and biological data collected by the TMDL Section, general watershed data, available from the Kentucky Geography Network (http://kygeonet.ky.gov) was also analyzed in a geographic information systems (GIS) framework. For the legacy segments, suspected sources were updated and river miles changed as a result of more accurate map information obtained through the GIS map data layer, NHD River Miles; however, the physical stream segments are the same. Currently, suspected sources of impairment include acid mine drainage, surface mining and coal mining. The TMDL stream segments addressed in this document are listed in Table 2.1.2 and illustrated in Figure 2.1.

Table 2.1.2 Impaired Waterbodies Addressed in this TMDL Document

Waterbody Name	Pollutant	County	GNIS Number	Suspected Sources	Impaired Use (Support Status)
Caney Creek 0.0 to 8.2	pH	Hopkins	KY488837_01	Acid Mine Drainage; Surface Mining	WAH, PCR, SCR (not supporting)
Copper Creek 0.0 to 2.7	pH, Iron, Zinc	Hopkins	KY490078_01	Coal Mining	WAH, PCR, SCR (not supporting)
Copperas Creek 0.0 to 3.6	pH, Cadmium, Iron, Nickel, Zinc	Hopkins	KY490083_01	Coal Mining	WAH, PCR, SCR (not supporting)
Fox Run 0.0 to 1.1	pH	Hopkins	KY492415_01	Coal Mining	WAH, PCR, SCR (not supporting)
Hurricane Creek 0.0 to 1.8	pH, Iron, Zinc	Hopkins	KY494821_01	Coal Mining	WAH, PCR, SCR (not supporting)
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6	pH, Iron, Zinc	Hopkins	KY494821-0.3_01	Coal Mining	WAH, PCR, SCR (not supporting)

3.0 Physical Setting

The TMDL watershed is located entirely within Hopkins County, approximately five miles southwest of the city of Madisonville. It is bisected by Interstate 69 and US 62. All streams in the watershed flow either into tributaries to the Tradewater River, or directly into the Tradewater River, which discharges to the Ohio River after generally traveling northwest. The area of the TMDL watershed is approximately 34.97 square miles. Watershed areas were determined using the USGS Stream Reach Drainage Polygons (USGS, ftp://ftp.kymartian.ky.gov/usgs/kyhydropolys.zip).

3.1 Geology

The TMDL watershed lies within the Western Coal Field ecoregion of the Interior River Valleys and Hills Level III ecoregion (Woods, et al. 2002). It is underlain primarily by the Carbondale formation of Middle Pennsylvanian age, the Tradewater Formation of Middle- to Lower Pennsylvanian age, and the Shelburn Formation of Upper Pennsylvanian age, with small areas of Quaternary alluvium (KGS, 2004), see Figure 3.1.1. Coal beds in the watershed include the Herrin (also known as the Western Kentucky Coal Bed Number 11, or WKY#11), Davis (WKY#6), WKY #5, Coiltown (WKY#14), Springfield (WKY#9), DeKoven (WKY#7) Houchin Creek (WKY#8b), Paradise (WKY#12), and the Mannington, Mining City, and Lewisport beds. Coal beds are separated by numbered seams; seams mined in the watershed include 585, 590, 600, 620, 625 and 655, with 600 predominating (KGS, 2009). See Figures 3.1.2 and 3.1.3.

The sulfur content of coal, mostly from pyrite, is responsible for the production of sulfuric acid once the spoils are exposed to water and oxygen; sulfuric acid is the predominant acid type in Acid Mine Drainage (AMD), although not all coal mining produces AMD impacts to streams, see Section 5.1. The sulfur content of coal usually varies spatially, but any coal with average sulfur content of greater than or equal to 2.5% is considered to be high sulfur (Jacobsen, 1993). The sulfur contents of the coal seams mined within the TMDL watershed are shown in Table 3.1.1.

Table 3.1.1 Average Total Sulfur Percentages for Coal Beds in the TMDL Watershed

Coal Bed	Average Total Sulfur, %	Source
Mannington, Mining City, and Lewisport	3.01	Greb, Williams, Williamson (1992)
Springfield (WKY#9)	3.3	Greb, Williams, Williamson (1992)
Herrin (WKY#11)	3.98	Greb, Williams, Williamson (1992)
Davis (WKY#6)	2.9	Greb, Williams, Williamson (1992)
Coiltown (WKY#14)	3.2	Greb, Williams, Williamson (1992)
DeKoven (WKY#7)	3.7	Jacobsen (1993)
Paradise (WKY#12)	3.3	KGS (Proximate Analysis Downloaded 4/17/2014)
Houchin Creek (WKY#8b)	4.96	KGS (Proximate Analysis Downloaded 4/17/2014)

No information was found for the WKY#5 coal bed, although Greb, et al. (1992) state “the coal of the Western Kentucky Coal Field is characterized as high-sulfur coal. Although coal with medium to even low sulfur contents occurs in the coal field, the majority of the coal produced is high in sulfur content. The average sulfur contents of the seven coal beds with the largest resources are all more than 3 percent.”

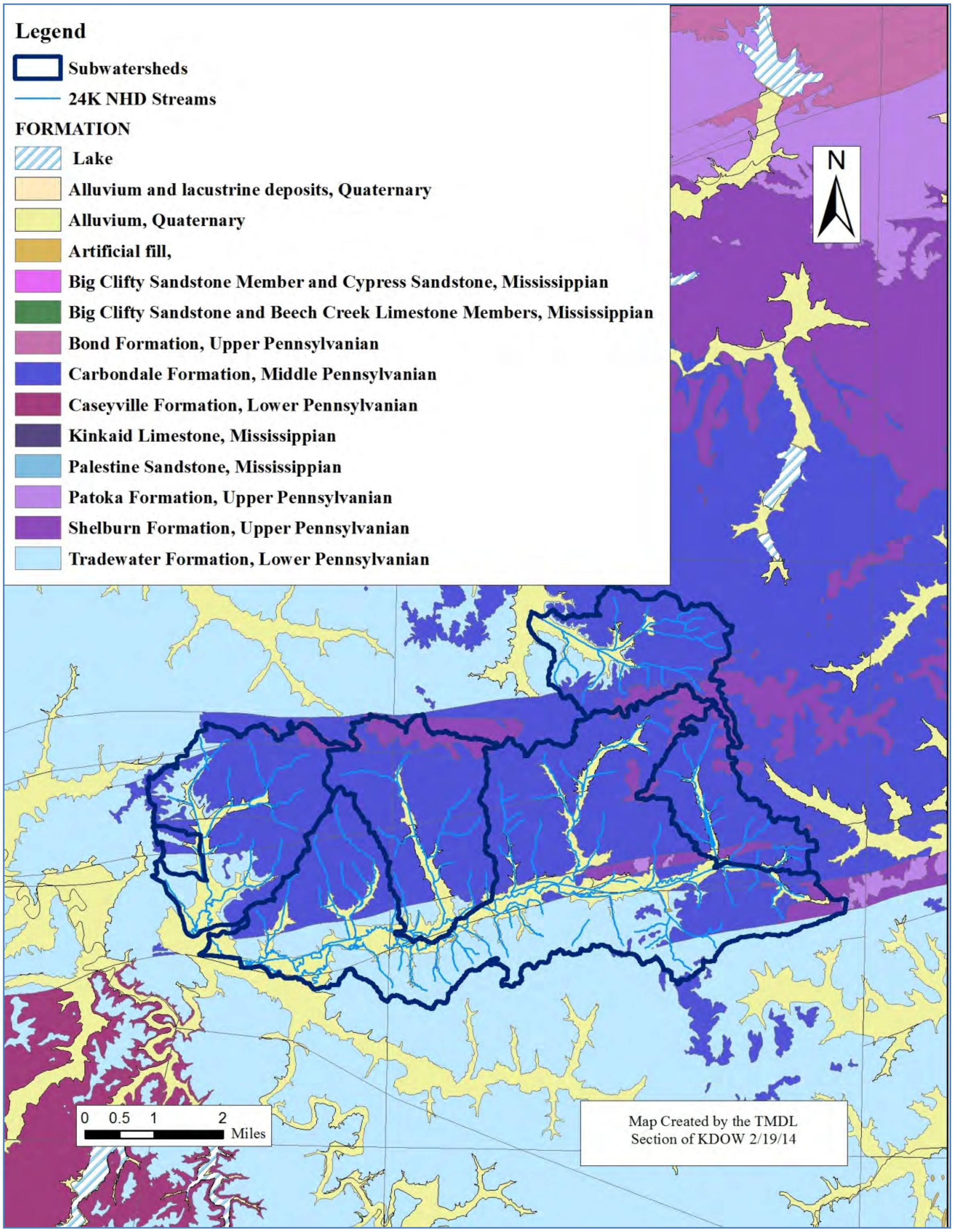


Figure 3.1.1 Generalized Geologic Map of the TMDL Watershed

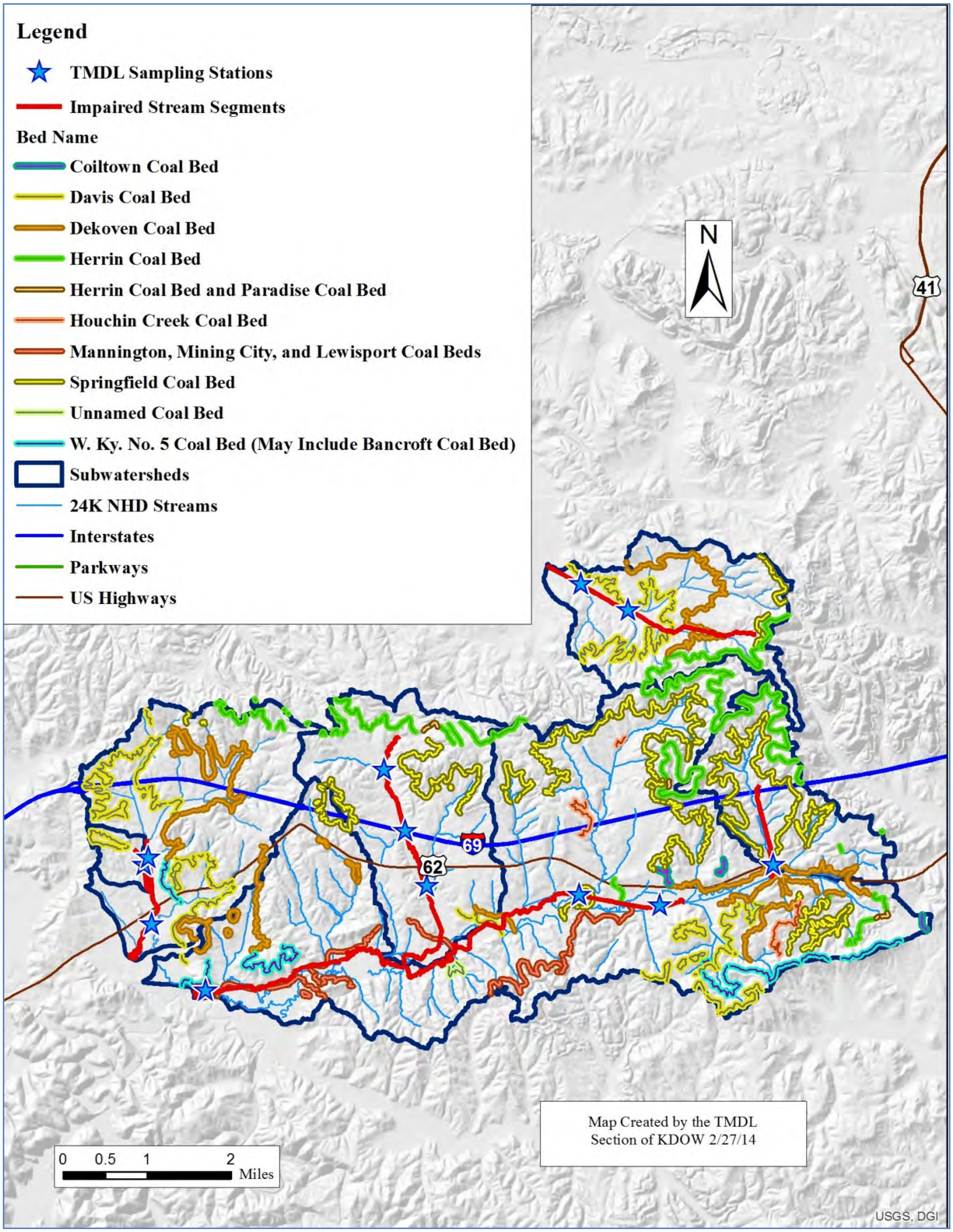
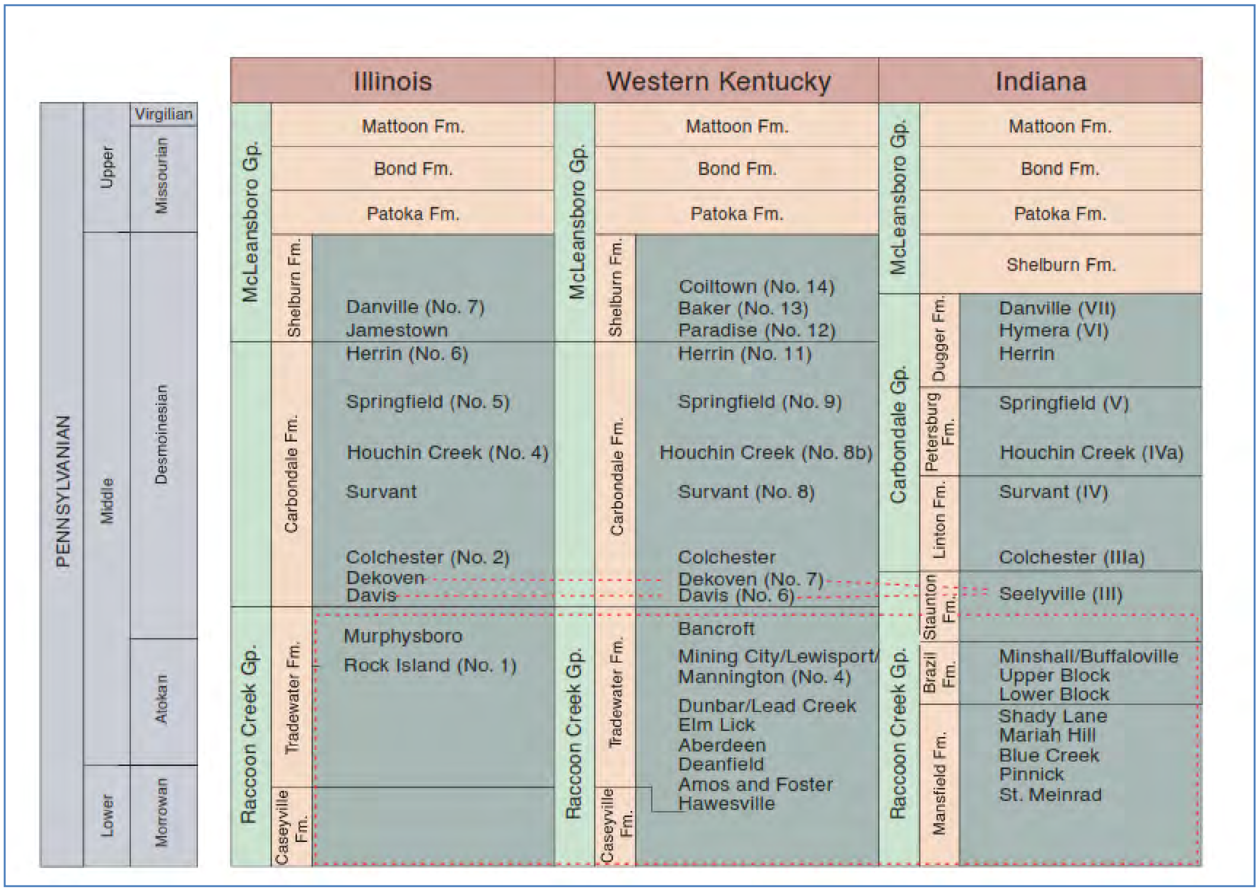


Figure 3.1.2 Mapped Coal Beds Within the TMDL Watershed



Fm. = formation, Gp. = group, dashed lines indicate problematic coal correlations

Figure 3.1.3 Stratigraphic Chart of Pennsylvanian Coal Geology (Hatch and Affolter, 2002)

3.2 Hydrology

Streams were mapped using the 1:24,000 National Hydrography Dataset (NHD, USGS, 2003). Copper Creek is a third-order stream which flows northwest into Richland Creek which discharges to Clear Creek, which then flows west to the Tradewater River. All the other streams in the TMDL watersheds empty into either Caney Creek or Hurricane Creek, both of which directly discharge south or southwest to the Tradewater River. Fox Run is a fourth-order stream which discharges to Caney Creek. Copperas Creek is a third-order stream that discharges to Caney Creek. Caney Creek is a fourth-order stream at its discharge to the Tradewater River. The UT to Hurricane Creek at 1.2 is a first order stream. Hurricane Creek is a third-order stream at its discharge to the Tradewater River. Stream order was determined using the Strahler (1952) method. These streams are generally low-gradient with wetlands along portions of their lengths.

Due to the lack of environmental controls during the period prior to the passage of the 1977 Surface Mining Control and Reclamation Act (SMCRA, see Section 5.2.3), watershed areas must be considered approximate wherever coal operations exist from this era, as often large portions of watersheds had their drainage rerouted, and mapped boundaries may therefore be incorrect (Personal Communication, Mark Meade, 2014). Current mining permits require the return of the area mined to the Approximate Original Contour (AOC), reducing or eliminating the impact on watershed boundaries.

3.3 Landcover Distribution

The 2006 National Land Cover Dataset (NLCD) was overlain with individual Stream Reach Drainage Polygons within a GIS framework to determine landcover in the watersheds. The landcover is largely comprised of forests, followed by pasture and row crops. Reclaimed mine land can appear as Scrub/Shrub landcover, which was aggregated into the Forest landcover. Current mining operations can appear in the Barren landcover. Figure 3.3.1 shows the landcover and Table 3.3.1 summarizes the land cover by percentage and square miles within the watershed. Further discussion of landcover classification is found in Appendix C.

Table 3.3.1 Summary of Landcover within the TMDL Watershed

Land Use	% of Total Area	Square Miles
Forest	71.8%	25.10
Agriculture (total)	13.0%	4.55
Pasture	7.6%	2.65
Row Crop	5.4%	1.90
Developed	4.5%	1.57
Natural Grassland	5.4%	1.90
Wetland	4.2%	1.46
Barren	0.2%	0.08

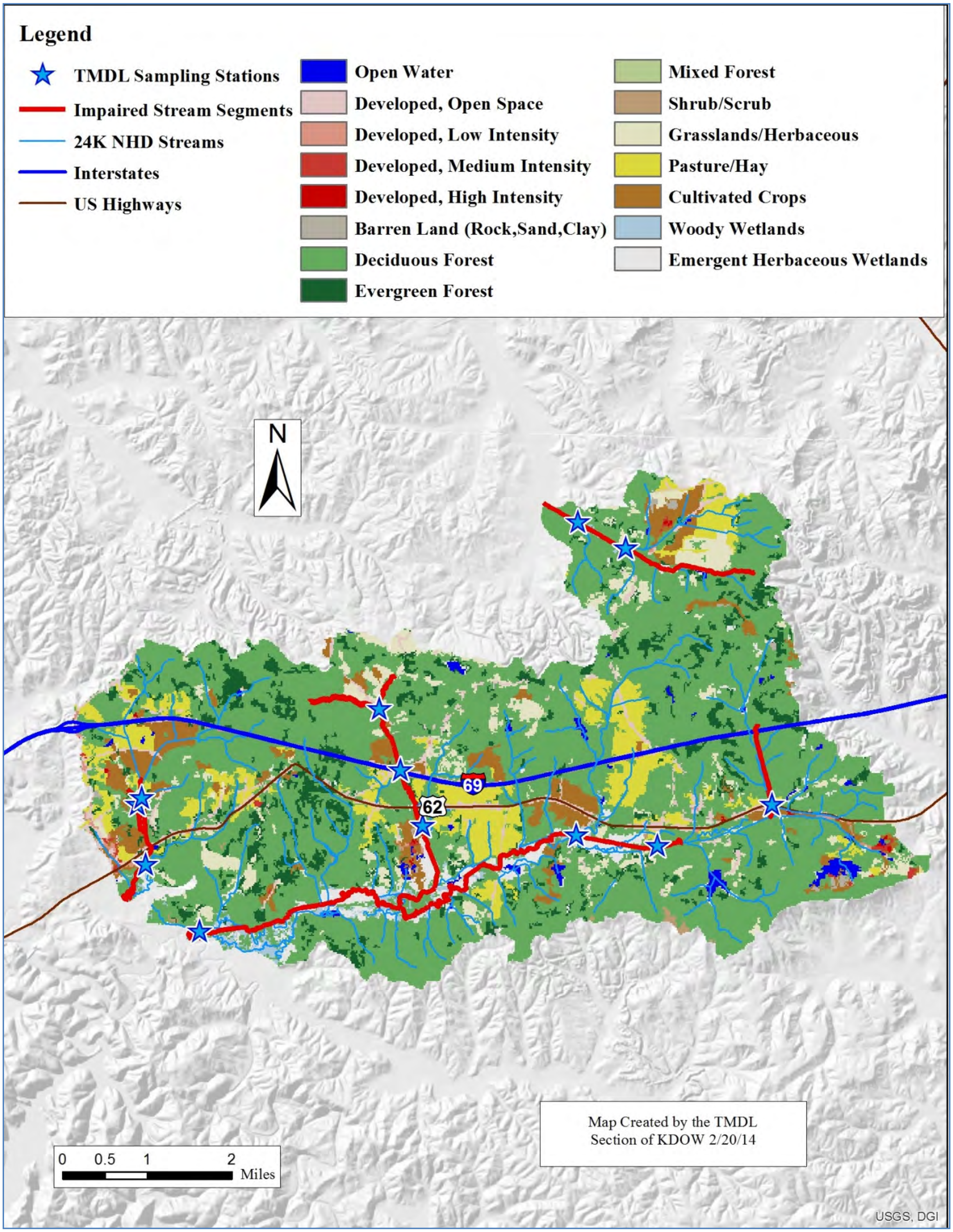


Figure 3.3.1 Landcover within the TMDL Watershed (NLCD 2006)

4.0 Monitoring

4.1 KDOW TMDL Monitoring

As stated, KDOW biologists sampled 12 sites throughout the watershed collecting water chemistry and habitat data from 5/17/2006 through 3/22/2007. Eight of the 12 sites were also sampled for aquatic life, specifically for macroinvertebrates; this sampling design collected approximately one year's worth of monthly data. Parameters included physical parameters (dissolved oxygen, pH, specific conductance and temperature), a full suite of metals, hardness and flow among others; see Section 8.2 and Appendix A. Table 4.1.1 gives the location of KDOW's sampling stations, as does Figure 4.1.1. Table 4.1.2 gives the narrative or categorical results of the biology samples collected by KDOW.

Some of the biology samples collected could not be processed using KDOW's standard operating procedures; KDOW normally uses what is called a 'full pick,' which consists of individually extracting all the macroinvertebrates from the collected sample (which may include rocks, sticks, silt, etc.) and identifying each one (KDOW, 2009). However, 5 of the 7 samples consisted of a very high number of monoculture chironomids, which are often an indicator of poor water quality, as was the absence of other organisms. Therefore, instead of a full pick, KDOW performed a subsample. Thus the numerical Macroinvertebrate Bioassessment Index (MBI) score generated would likely change somewhat if the sample had been fully processed, but KDOW is confident of the categorical score for these sites, none of which supported the WAH designated use.

Table 4.1.1 KDOW TMDL Sampling Locations (5/16/2006 thru 3/22/2007)

Station ID	Stream Name	Location	River Mile	Latitude	Longitude
DOW10009001	Copper Creek 0.0 to 2.7	Off private drive; ~0.3 mi above mouth	0.45	37.235000	-87.582100
DOW10009003	Copper Creek 0.0 to 2.7	Above Copper Creek Rd. bridge	1.11	37.230668	-87.571687
DOW10014007	Hurricane Creek 0.0 to 1.8	At Maple Swamp Rd.; above railroad bridge	0.80	37.174732	-87.673269
DOW10014009	UT to Hurricane Creek at 1.2 RM 0.0 to 0.6	At Tradewater Airport	0.35	37.185000	-87.675300
DOW10014010	Hurricane Creek 0.0 to 1.8	At Tradewater Airport	1.65	37.186200	-87.674300
DOW10014012	Caney Creek 0.0 to 8.2	Near mouth; off Maple Swamp Road	0.35	37.163500	-87.661400
DOW10014013	Caney Creek 0.0 to 8.2	At Rialto Mine Rd. bridge	6.80	37.181300	-87.581100

Station ID	Stream Name	Location	River Mile	Latitude	Longitude
DOW10014014	Caney Creek 0.0 to 8.2	At Buttermilk Rd. bridge (CR1268)	7.80	37.179700	-87.563700
DOW10014015	Fox Run 0.0 to 1.1	Below US62 bridge	0.15	37.187163	-87.539300
DOW10014016	Copperas Creek 0.0 to 3.6	~0.25 mi. below US62 bridge; below large drainage ditch from underground mine	1.40	37.182348	-87.614014
DOW10014017	Copperas Creek 0.0 to 3.6	Above Ilsley Rd. culvert	2.20	37.191800	-87.619000
DOW10014018	Copperas Creek 0.0 to 3.6	At Racetrack Rd. bridge	3.07	37.202240	-87.623790

Table 4.1.2 KDOW TMDL Biological Sampling Events

Waterbody Name	Biological Sampling Date	Sampling Station	Assemblage	Narrative Result
Caney Creek 0.0 to 8.2	6/28/06	DOW10014014	MBI(1)	Poor(2)
Caney Creek 0.0 to 8.2	No sample	DOW10014012	No sample	No sample
Caney Creek 0.0 to 8.2	No sample	DOW10014013	No sample	No sample
Copper Creek 0.0 to 2.7	5/18/06	DOW10009001	MBI(1)	Very Poor(2)
Copper Creek 0.0 to 2.7)	5/18/06	DOW10009003	MBI(1)	Very Poor
Copperas Creek 0.0 to 3.6	5/17/06	DOW10014016	MBI(1)	Very Poor(2)
Copperas Creek 0.0 to 3.6	5/17/06	DOW10014017	MBI(1)	Very Poor(2)
Copperas Creek 0.0 to 3.6	5/17/06	DOW10014018	MBI(1)	Very Poor(2)
Fox Run 0.0 to 1.1	6/17/06	DOW10014015	MBI(1)	Poor
Hurricane Creek 0.0 to 1.8	No sample	DOW10014007	No sample	No sample
Hurricane Creek 0.0 to 1.8	No sample	DOW10014010	No sample	No sample
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6	5/17/06	DOW10014009	MBI(1)	Very Poor(2)

(1) MBI = Macroinvertebrate Bioassessment Index.
(2) Use numerical results with caution, but the categorical score is correct.

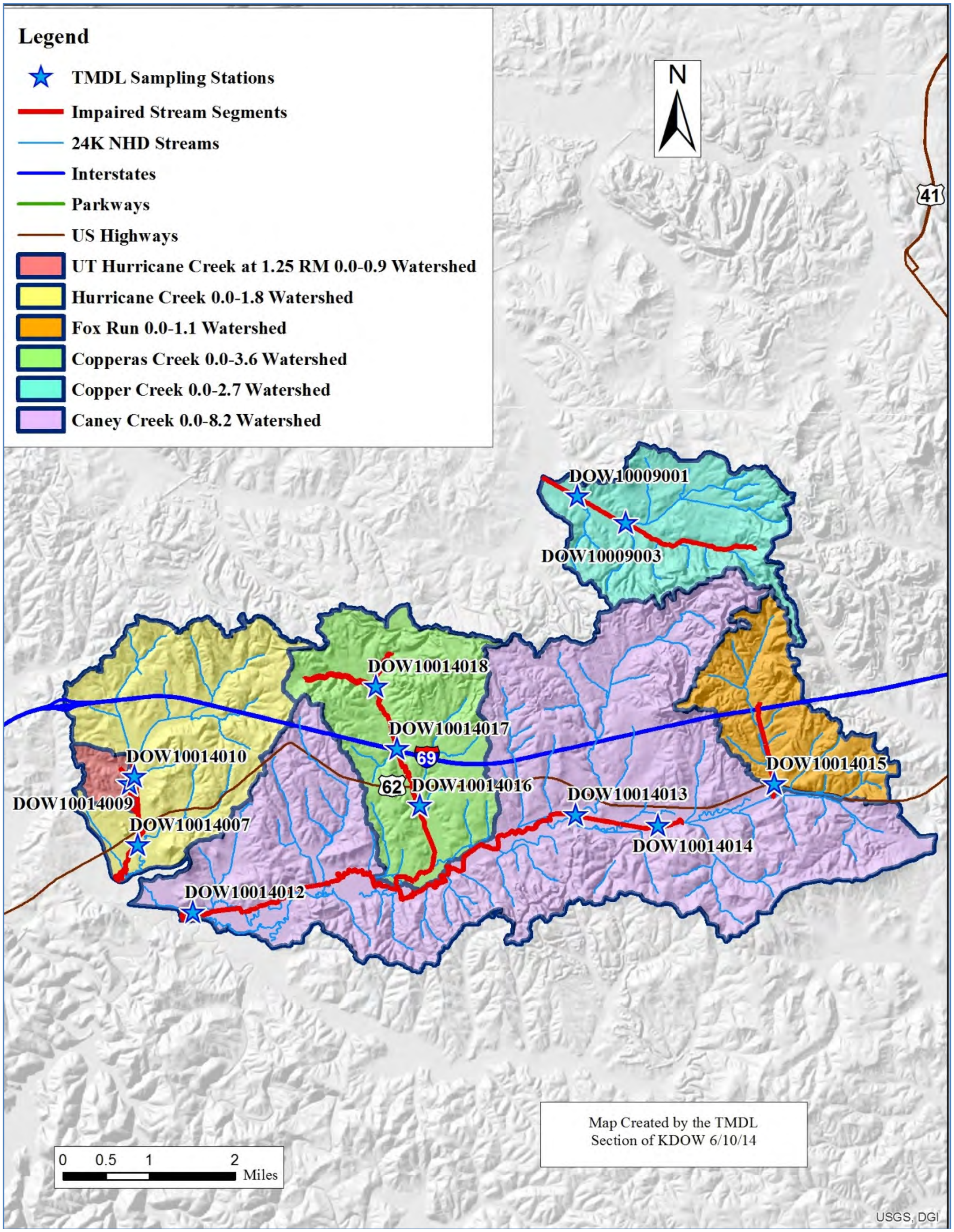


Figure 4.1.1 Locations of KDOW Sampling Sites and Assessed Stream Segments within the TMDL Watershed

4.2 Department for Natural Resources Division of Mine Permits Cumulative Hydraulic Impact Assessment (CHIA) Data

Kentucky's Division of Mine Permits (DMP) performs mining-related data collection of surface water, groundwater and sometimes other media as part of their Cumulative Hydrologic Impact Assessment (CHIA) program, see http://kentucky.gov/Newsroom/eppc_dnr/CHIA20110127.htm. Maps and data are available at http://minepermits.ky.gov/Pages/CHIA.aspx. The data are stored in the Surface Mining Information System (SMIS). The maps cover HUC12s; however the TMDL watershed crosses the border between two HUC12s, so acquiring complete data for the TMDL watershed required two downloads, numbered 051402050201 which includes Copper Creek, and 051402050105 which includes Caney Creek, its tributaries (Copperas and Fox Run) and Hurricane Creek. KDOW created a map from these downloads that shows the SMIS surface water sampling stations within the TMDL watershed, see Figure 4.2.1. In this figure, some stations overlap, these are labeled with a comma between the different station names. SMIS surface water data were downloaded on 12/16/2013 (051402050105) and 1/3/2014 (051402050201). See Appendix B for SMIS sampling data; data were available from 2006-2011. Additional results from 1983 were not included.

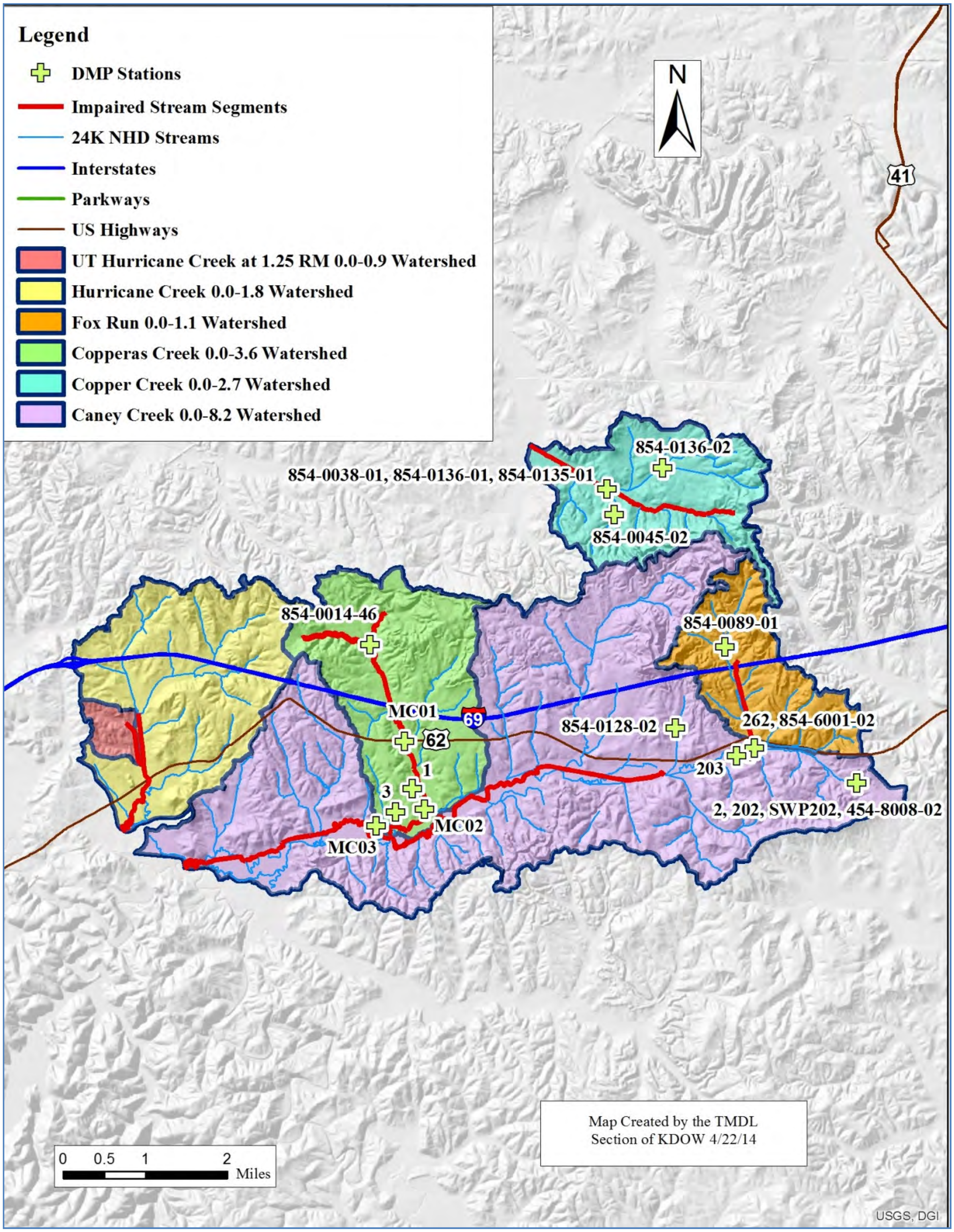


Figure 4.2.1 DMP Sampling Locations

5.0 Source Identification

5.1 Coal Mining Sources

There is an extensive amount of coal mining in the watershed. According to EPA (2014a), "coal mining employs basically the same traditional mining techniques used in hard rock mining - underground and surface ("strip") mining....[Strip mining] is analogous to the open pit mining techniques used in hard rock mining whereby the soil and rock above the coal seam are removed to expose the seam. The seam is then blasted and the coal is scooped up by huge front end loaders or electric shovels and transported to a coal processing plant. These coal preparation plants use a variety of physical (e.g., screening) and chemical (e.g., flotation using high gravity liquids) methods to separate the raw coal from all of the non-combustible waste rock and minerals (e.g., pyrite). The coarser waste rock is piled up adjacent to the mined out area and the finer coal tailings coming from the preparation plant are discharged as a thick slurry into a man-made impoundment. After coal mining operations have ceased, the mine is reclaimed by dumping the waste rock into the pit, regrading the area to approximate the original contours of the land and then replanting the area using native grasses and trees."

While not all mine runoff is acidic, coal mining can produce AMD as rainwater percolates through mine spoils and the porous strata of underground mines. EPA (2014b) characterizes AMD as "…the formation and movement of highly acidic water rich in heavy metals. This acidic water forms through the chemical reaction of surface water (rainwater, snowmelt, pond water) and shallow subsurface water with rocks that contain sulfur-bearing minerals, resulting in sulfuric acid. Heavy metals can be leached from rocks that come in contact with the acid, a process that may be substantially enhanced by bacterial action. The resulting fluids may be highly toxic and, when mixed with groundwater, surface water and soil, may have harmful effects on humans, animals and plants." AMD discharges were common to mining prior to the passage of SMCRA, see Section 5.2.3 for further discussion.

5.2 Coal Mining Permitting and Recordkeeping/Source Mapping

While KDOW permits mining discharges to surface water under the 1972 Clean Water Act through issuance of KPDES permits, other state agencies keep records and/or issue permits for coal mines, and some of these agencies generate maps of mines that were used to locate potential sources within this TMDL. However, the main source of mining-related pollutants, pre-law mines, were poorly represented within these data sources, due to lack of recordkeeping during that time period.

5.2.1 Kentucky Revenue Cabinet

Mining records have been kept for property tax purposes by the Kentucky Revenue Cabinet (KRC) since 1884. While requirements have evolved over time, currently KRC requires submittal of mapping information on owned or leased coal properties, including coal seam information, and including an outline of any area permitted for mining by DMP, the type of mining operation, and an outline of any mined-out areas. Much of this information is confidential and is not released to the public.

5.2.2 Division of Mine Safety

The Kentucky Division of Mine Safety (DMS, formerly the Office of Mine Safety and Licensing) licenses all mines, surface and underground, to operate from a safety as opposed to a revenue or environmental perspective. License renewal is required annually. DMS issues a 4-digit license number, and each annual renewal generates a new number. DMS also collects mine map data similar to that collected by KRC, including information on mined-out areas. Starting in 1953, DMS began organizing licenses under the umbrella of a State File Number (SFN) system, formerly referred to as a Kentucky Department of Mines and Minerals (KDMM) file number, which is a 5-digit number that may be followed by a dash and one or two additional digits. A SFN is assigned to each mine (i.e., each ground disturbance), and is permanent to that mine: while the mine may change ownership, and each owner may work the mine for multiple years generating multiple 4-digit (safety) license numbers, the SFN does not change, although the added digits after the first 5 digits and a dash can denote a change of mine ownership. Each SFN can be associated not only with multiple DMS licenses, but multiple DMP permits and thus with multiple KPDES permits; the SFN system was not created to track KPDES permit information, and it predates the CWA. SFN numbers are created using a 'one-up' system, where the date of creation of the file is reflected in the file number: Files with numbers less than 10,000 were generally created before the passage of SMCRA, and files on currently operating mines (as of January of 2014) generally have numbers in the 18,800-18,900 range (personal communication, Tom Schubert, 2014).

DMS began scanning their available maps of mined-out areas in 2004, and sent the files to KRC, which joined the scanned polygons with confidential tax return information in a Spatial Data Engine (SDE) database and created GIS layer files (a form of electronic map); DMS then extracted the polygon data minus the confidential information, and maintains the layer files, which are available on the Kentucky Geoportal (KyGeoportal) at http://kygisserver.ky.gov/geoportal/catalog/main/home.page.

DMS has also made their mined-out area maps available as electronic files and as interactive maps in a GIS framework on the Kentucky Mine Mapping Information System, http://minemaps.ky.gov/MineSearch.aspx. Users can search by SFN, location, company name, nearby stream, and other variables. While each entry contains a mine map, sometimes the Mine Mapping Information System also contains links to reports for individual SFNs, reports which give basic location information and the tonnage of coal produced, along with the associated four-digit DMS license number(s) and the DMP permit number(s). However, the DMP permit information is not always associated with the mined-out area maps, some of which predate SMCRA and the CWA, and thus they often cannot be tied to individual KPDES permits. Despite this data gap, the mined-out area maps were reproduced in Section 8 as they represent potential sources of the pollutants associated with this TMDL.

5.2.3 Kentucky Division of Mine Permits

Coal mining in Kentucky requires a permit from the State's Division of Mine Permits (DMP) in the Department for Natural Resources (DNR) as mandated by Title V of the 1977 SMCRA, for which Kentucky has primacy, or primary responsibility for regulation of surface coal mining, the surface effects of underground mining, as well as mine reclamation. Prior to SMCRA, there were no environmental requirements for mines relative to earth disturbance. SMCRA requirements were phased in beginning in 1978: KDOW et al., (2003) states "Mining permits [as opposed to KPDES permits] in Kentucky are classified on the basis of whether the original permit was issued prior to May 3, 1978 (pre-law permit), after January 18, 1983 (post-Kentucky primacy) or in-between these dates (interim period)." Under SMCRA the regulatory standards for issuance of a permit require that the operation be designed to prevent adverse changes in downstream water quantity or quality sufficient to cause material damage (401 KAR 8:10, Section 14, (3)). The permit review is designed to place burden on the applicant to either demonstrate that no potential source of degradation will be associated with operations or that operations have been designed to appropriately treat or remediate any adverse impact.

A SMCRA permit allows the earth disturbance associated with mining, requires measures to preclude offsite impacts during mining, and requires land reclamation at the conclusion of mining, but by itself does not allow the discharge of mine wastewater to waters of the Commonwealth; this requires a separate KPDES permit, see Section 5.2.5. Although DMP permits mines from an environmental perspective, the permit also requires safe mine operation.

Under SMCRA, DMP cannot issue permits for mining operations that will knowingly create AMD. The primary goal is to identify and isolate potential acid-producing materials and target them for special handling to prevent acid production. Permit reviews conduct acid-base accounting of the levels of potential acidity and the neutralization potential of each stratum from submitted corehole data to prevent the production of AMD. All runoff from coal mining performed under SMCRA (excepting small areas qualifying for exemption or alternate controls) is captured in a pond where it is monitored. Where the monitoring reflects the presence of AMD despite these controls, the runoff is treated then discharged to surface water, see Section 5.2.5.

Environmental monitoring is also a requirement. SMCRA permit applicants must submit 6 water quality samples collected throughout a one-year period that capture both high and low flow events. SMCRA permittees must also collect quarterly water quality monitoring results (surface and ground water) beginning when mining commences through complete bond release. Depending on affected stream assessments, permittees may also be required to conduct benthic macroinvertebrate and/or fish surveys and calculate appropriate biological indices, such as the MBI and Kentucky Index of Biotic Integrity (KIBI) for fish. This sampling is independent of that required under the facility's KPDES permit.

Also, SMCRA permits regulate the production of coal to minimize environmental impacts following cessation of mining activities. Coal spoils or leavings that are expected to produce AMD when exposed to water and oxygen must be addressed by special handling plans: examples include burying spoils below the permanent water table, or encapsulating them within the mine backfill. For these reasons, KDOW believes most of the pollution in the watershed is due to mining operations that existed prior to the passage of SMCRA, or 'pre-law' mines.

As stated, DMP issues permits related to earth disturbance and reclamation, and DMP's permit numbers are 7-digit numbers in the format XXX-XXXX; these are commonly known as the

DNR permit number, see Appendix D for additional information. Each DNR permit number is typically associated with one KPDES permit. DMP maintains archived paper files by permit number, each file contains information relative to a single permit, including the application, final permit, reclamation plans, bond information, and associated data and maps. Any enforcement activity is also included. While the information in these files has historically been submitted and stored on paper, DMP now requires new submissions to be made electronically. Information specific to DMP permitting can be obtained from the Surface Mining Information System (SMIS), at http://minepermits.ky.gov/Pages/SurfaceMiningInformationSystem.aspx. Using the information in SMIS, DMP publishes and maintains two types of GIS layerfiles of permitted coal mining areas available on the KyGeoportal (http://kygisserver.ky.gov/geoportal/catalog/main/home.page); one layerfile shows all permitted areas, active and inactive, and the other shows only the active permits. While the KPDES permit numbers associated with the DNR permit numbers are not included in the layers, within KDOW the KPDES permit number is normally associated with the DMP permit number within the TEMPO database. The layers of active and inactive mines are shown by watershed in Section 8.

5.2.4 Division of Mine Reclamation and Enforcement

The Division of Mine Reclamation and Enforcement (DMRE) within DNR is responsible for mine inspection, enforcement, and bond release/forfeiture. KDOW et al., (2003) also state, "All permits are secured through reclamation bonds. A reclamation bond is a financial document submitted to the DNR prior to mine permit issuance. A bond guarantees mining and reclamation operations will be conducted by mining companies according to regulations and the terms of the approved permit. If a coal company cannot comply with these conditions, the bond is "forfeited" (paid to the DNR) for eventual use by the Division of Abandoned Mine Lands in reclaiming the mined area. Reclamation bonds may be submitted in the forms of cash, certificate of deposit, letter of credit or surety (insurance policy).

A reclamation bond may be returned to a coal company by either of two methods: administrative or phase (on-ground reclamation). Administrative releases occur when new bonds are substituted for the original bonds. Administrative releases are also given for areas of a mine site that are permitted but never disturbed by mining or for areas that are included under a second more recently issued permit.

Phase releases occur in three stages and according to specific reclamation criteria: Phase One – all mining is complete, and backfilling, grading and initial seeding of mined areas has occurred. Phase Two – a minimum of two years of growth on vegetated areas since initial seeding, the vegetation is of sufficient thickness to prevent erosion and pollution of areas outside the mine area with mine soils, and any permanent water impoundments have met specifications for future maintenance by the landowner. Phase Three – a minimum of five years of vegetative growth since initial seeding and the successful completion of reclamation operations in order for the mined area to support the approved postmining land use. Up to 60 percent of the original bond amount is released at phase one. An additional 25 percent is returned at phase two, with the remainder of the reclamation bond released at phase three. Once a permit is released and the reclamation bond returned, the state cannot require additional remediation action by the mining company unless it is determined that fraudulent documentation was submitted as part of the remediation process." Bonds are not released if the water quality does not meet WQCs.

5.2.5 WLA Mining Sources

Prior to the beginning of operation, mining facilities must obtain a KPDES permit, either a Coal General or an Individual Permit. Facilities with a current KPDES permit are placed in the Wasteload Allocation (WLA). KPDES permits require monitoring of effluent quality and submittal of Discharge Monitoring Report (DMR) data monthly or quarterly to DNR. Some basic facility data is available on EPA's Integrated Compliance Information System (ICIS), which are available to the public at http://www.epa.gov/enviro/facts/pcs-icis/search.html, but currently DMR data must be requested through DNR. In the future, DMR data will be available through ICIS, and DMRs will be submitted to KDOW instead of DNR. Further information on KPDES permitting information can be found at http://water.ky.gov/permitting/Pages/Mining.aspx.

Mining facilities, unlike many industrial and wastewater facilities, do not have permitted design flows, and while they monitor flow, flow limits are not a condition of their permits. This is because mining sources generally discharge from impoundments or ponds in response to precipitation events, although the impoundments do have retention time requirements built in as necessary to treat the influent.

While active facilities with a KPDES permit are placed in the WLA, other sources are placed in the Load Allocation, see Sections 5.2.6 and 5.2.7, or are illegal, see Section 5.2.8.

5.2.5.1 Reasonable Potential Analysis

For new and expanded mining sources, when a facility submits an electronic Notice of Intent (eNOI, which is an application to receive a KPDES permit), the first step is a Reasonable Potential Analysis (RPA) to determine whether a general permit or an individual permit will be issued. The requirements for the RPA are found in KPDES Form C for mining permits, located at http://water.ky.gov/permitting/Pages/WastewaterDischarge.aspx. Where possible, the entity is required to collect data from an already existing and representative operation, i.e., an operation that mines using the same technique and mines the same coal seam as proposed in the new or expanded eNOI. The applicant must sample each existing discharge; analytical requirements include a full suite of metals, total suspended solids, sulfate, flow, temperature, phenols, cyanide, arsenic, specific conductance, hardness and pH. KDOW determines what type of permit will be issued based on the data collected for the RPA. If no representative operation exists from which to collect data, estimates are used instead. Within two years of commencing discharge, new operations shall submit actual discharge data to KDOW for the pollutants listed in the eNOI.

5.2.5.2 Coal General Permits

KDOW has two general coal mining permits, KYGE4XXXX for mines in eastern Kentucky and KYGW4XXXX for mines in western Kentucky. Under these permits, permittees have limits for pH, total suspended solids, iron and manganese. They are also required to report flow and specific conductance. Table 5.2.5.2.1 shows the effluent limits taken from the current KYGE4XXXX and KYGW4XXXX General Permits.

Table 5.2.5.2.1 Coal General Permit Limits and Reporting

Effluent Characteristics	Reported Discharge		Proposed Limits		Applicable Water Quality Criteria and/or Effluent Guidelines
	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	
Flow (MGD)	Variable	Variable	Report	Report	401 KAR 5:065, Section 2(4)
Specific Conductance (µS/cm)	Variable	Variable	Report	Report	401 KAR 5:070, Section 3
Total Recoverable Iron	Variable	Variable	3.0 mg/l	4.0 mg/l	401 KAR 10:031, Section 4, 401 KAR 5:065, Section 2(4), and 2(9)
Total Recoverable Manganese	Variable	Variable	2.0 mg/l	4.0 mg/l	401 KAR 5:065, Sections 2(4), and2(9)
Total Suspended Solids	Variable	Variable	35mg/l	70mg/l	401 KAR 5:065, Sections 2(4) and 2(9)
pH[1] Standard Units	Variable	Variable	6.0 (min.)	9.0 (max.)	401 KAR 10:031, Section 4 401 KAR 5:065, Sections 2(4) and 2(9)

[1] These types of discharges shall not cause the pH of the receiving stream to fluctuate more that 1.0 standard unit over a period of 24 hours.

5.2.5.3 Individual Permits

Individual Permits are given to the following types of applicants:

1. Those whose RPA indicates the likelihood of discharging pollutants beyond those covered in the General Permit.
2. Those who plan to discharge to an Outstanding National Resource Water.
3. Those who plan to discharge to an Outstanding State Resource Water due to its support of a federally listed Threatened or Endangered Species.
4. Those who plan to discharge to a Coldwater Aquatic Habitat (CAH), which is a designated use for some streams affected by coal discharges in Eastern Kentucky.
5. Those who plan to discharge to a stream with an EPA-approved TMDL for one or more mining-related pollutants.
6. Those who plan to discharge within five miles upstream of an existing listed domestic water supply intake.

General and Individual Permits require monthly monitoring for the effluent characteristics in Table 5.2.5.2.1, instream biological and physiochemical monitoring, Whole Effluent Toxicity (WET) testing, and the submission of a Pre-Mining Survey Map for the following types of sources:

1. New and expanded active surface mining areas draining to an instream or continuous discharge sediment control structure in the eastern coal field;
2. New and expanded coal preparation plants in the eastern coal field;
3. New or expanded underground mines in the eastern coal field; and
4. Instream or continuous discharge outfalls in the western coal field.

Whole Effluent Toxicity Testing. WET testing is performed by exposing live representative macroinvertebrates or fishes to effluent water in a laboratory setting to determine the toxic effects of the effluent on aquatic life, if any. WET testing is done quarterly. The Acute WET test requirements consists of two 48-hour static non-renewal toxicity tests (the same test water is used throughout) with water flea (Ceriodaphnia dubia, Daphnia magna, or Daphnia pulex) and two 48-hour static non-renewal toxicity tests with fathead minnow (Pimephales promelas) performed on discrete grab samples of 100% effluent, including maintaining control organisms which are not exposed to the effluent. Methods must comply with Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA-821-R-02-012 (5^{th} edition), the most recently published edition of this publication, or another method approved in advance by KDOW.

Pre-Mining Survey Map (PMSM). Prior to submission of the permit application, the applicant submits a PMSM form and map which outlines the scope of the pre-mining survey that will determine background conditions. The applicant must use the PMSM form found on the DEP forms library at http://dep.ky.gov/formslibrary/Pages/default.aspx for this submission. One purpose of the PMSM is to establish the location of the instream monitoring points necessary to determine background physical, chemical and biological conditions for the affected receiving waters. The PMSM also provides documentation that data collection and analysis will be performed in accordance with acceptable standards and the persons performing the collection and analysis meet the necessary qualifications.

Pre-Mining Survey: The pre-mining survey involves collecting initial physiochemical and biological samples before discharge begins to determine background conditions for each waterbody that will be affected by the discharge. Biology is represented by collecting the macroinvertebrate assemblage and calculating the MBI. The MBI score from the pre-mining survey determines an instream biological category (i.e., excellent, good, fair, poor or very poor), which is the minimum limit for that waterbody which shall not be lowered through the actions of the permittee. Initial physiochemical monitoring parameters are shown in Table 5.2.5.3.1.

Table 5.2.5.3.1 Pre-Mining Survey Instream Monitoring

BACKGROUND PHYSICAL\CHEMICAL CONDITIONS			
Instream Characteristic	**STORET Code**	**Units**	**Value**
Flow	00061	MGD	XX
Total Suspended Solids	00530	mg/l	XX
Specific Conductance	00095	µS/cm	XX
Total Sulfate (as SO_4)	00945	mg/l	XX
Total Recoverable Iron	00980	mg/l	XX
Total Recoverable Selenium	00981	µg/l	XX
pH	00400	SU	XX
Turbidity	00070	NTU	XX
Alkalinity (as $CaCO_3$)	00410	mg/l	XX
Dissolved Oxygen	00300	mg/l	XX
Temperature	00011	^{o}F	XX
Total Hardness (as $CaCO_3$)	00900	mg/l	XX

Trend Sampling. After discharge commences, additional annual physiochemical and biological sampling is required to determine trends; this sampling continues through Phase III bond release, see Section 5.2.4. Trend sampling involves both quarterly and annual monitoring, see Tables 5.3.5.3.2 and 5.3.5.3.3.

Table 5.2.5.3.2 Quarterly Instream Monitoring Frequency and Limitations

Instream Characteristic	Units	Minimum	Monthly Average	Daily Maximum	Maximum	Frequency	Sample Type
Flow	MGD	N/A	Report	Report	N/A	1/Quarter	Instantaneous
Total Suspended Solids	mg/l	N/A	Report	Report	N/A	1/Quarter	Grab
Specific Conductance	µS/cm	N/A	Report	Report	N/A	1/Quarter	Grab
Total Sulfate (as SO_4)	mg/l	N/A	Report	Report	N/A	1/Quarter	Grab

Table 5.2.5.3.3 Annual Instream Monitoring Frequency and Limitations

INSTREAM MONITORING REQUIREMENTs							MONITORING REQUIREMENTS	
Instream Characteristic	**STORE T Code**	**Units**	**Minim um**	**Monthly Average**	**Daily Maximu m**	**Maximu m**	**Freque ncy**	**Sample Type**
Flow	00061	MGD	N/A	Report	Report	N/A	1/Year	Instantan-eous
Total Suspended Solids	00530	mg/l	N/A	Report	Report	N/A	1/Year	Grab
Total Recoverable Iron	00980	mg/l	N/A	Report	Report	N/A	1/Year	Grab
pH	00400	SU	Report	N/A	N/A	Report	1/Year	Grab
Specific Conductance	00095	µS/cm	N/A	Report	Report	N/A	1/Year	Grab
Total Sulfate (as SO_4)	00945	mg/l	N/A	Report	Report	N/A	1/Year	Grab

INSTREAM MONITORING REQUIREMENTs							MONITORING REQUIREMENTS	
Instream Characteristic	**STORE T Code**	**Units**	**Minim um**	**Monthly Average**	**Daily Maximu m**	**Maximu m**	**Freque ncy**	**Sample Type**
Total Recoverable Selenium	00981	µg/l	N/A	Report	Report	N/A	1/Year	Grab
Turbidity	00070	NTU	N/A	Report	Report	N/A	1/Year	Grab
Alkalinity (as $CaCO_3$)	00410	mg/l	N/A	Report	Report	N/A	1/Year	Grab
Dissolved Oxygen	00300	mg/l	Report	N/A	N/A	N/A	1/Year	Grab
Temperature	00011	^{o}F	N/A	Report	Report	N/A	1/Year	Grab
Total Hardness (as $CaCO_3$)	00900	mg/l	N/A	Report	Report	N/A	1/Year	Grab
Biological Index Score[1]		None	XX[2]	Report	Report	N/A	1/Year	Grab
[1]See Section 7.5 of the permit for more information regarding this stream characteristic and the sampling requirement. [2]Category minimum (See the Background Biological Conditions Table of the permit)								

Effluent Monitoring. Each discharge is subject to effluent monitoring. Effluent monitoring parameters are determined by the type of discharge; mine drainage (influent) to the treatment system (ponds) can be either acid or alkaline. 401 KAR 5:065, Section 2(9) and 40 CFR 434.11 define alkaline drainage as having pH ≥6.0 and total recoverable iron less than or equal to 10.0 mg/L. However, within the KPDES permitting program, the default assumption is that discharge consists of acid mine drainage, which has pH<6.0 or total recoverable iron greater than 10.0 mg/L. Table 5.2.5.3.4 shows the Effluent Limitations and Monitoring Requirements for underground workings, coal preparation plants and associated areas in the eastern coal field, and non-reclamation areas in the western coal field.

Table 5.2.5.3.4 Effluent Limitations and Monitoring Requirements

KPDES Outfalls								
EFFLUENT LIMITATIONS							**MONITORING REQUIREMENTS**	
Effluent Characteristic	**STORET Code**	**Units**	**Mini mum**	**Monthly Average**	**Daily Maximum**	**Maxi mum**	**Frequency**	**Sample Type**
Flow	50050	MGD	N/A	Report	Report	N/A	2/Month	Instantaneous
Total Suspended Solids[1]	00530	mg/l	N/A	35	70	N/A	2/Month	Grab
Total Recoverable Iron	00980	mg/l	N/A	3.0	4.0	N/A	2/Month	Grab
Total Recoverable Manganese[1]	11123	mg/l	N/A	2.0	4.0	N/A	2/Month	Grab
pH	00400	SU	6.0	N/A	N/A	9.0	2/Month	Grab
Acute WET[2]	TS000	TU_A	N/A	N/A	N/A	1.00	1/Quarter	([2])
Specific Conductance	00095	µS/cm	N/A	Report	Report	N/A	2/Month	Grab
Total Sulfate (as SO_4)	00945	mg/l	N/A	Report	Report	N/A	2/Month	Grab
Total Recoverable Selenium	00981	µg/l	N/A	5.0[3]	20	N/A	2/Month	Grab

KPDES Outfalls								
EFFLUENT LIMITATIONS							**MONITORING REQUIREMENTS**	
Effluent Characteristic	**STORET Code**	**Units**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**	**Frequency**	**Sample Type**
Total Recoverable Selenium (Fish Tissue)	01148	mg/Kg dry weight	N/A	N/A	N/A	8.6	([3])	([3])
Precipitation Volume	79777	Inches	N/A	N/A	N/A	Report	([4])	Grab

[1]See Section 4 of the permit for alternate monitoring and effluent limitations available for a qualifying precipitation event (for subsurface mines, this applies only to combined flows, which are those combining two or more types of drainage, i.e., groundwater discharge with surface water discharge).
[2]See Section 3 of the permit for additional requirements related to Whole Effluent Toxicity (WET) Testing including sampling requirements.
[3]Should the monthly average concentration of total recoverable selenium exceed 5.0 µg/l; see Section 2. 9 of the permit for additional requirements.
[4]Precipitaton volume required only when applying for an Alternate Precipitation Effluent Limits (APELs), which are authorized by the coal effluent limit guidelines (ELGs) and are alternate limits and monitoring requirements on manganese and total suspended solids effective during high precipitation events; APELs will be considered on a case-by-case basis for surface mines and underground mines with comingled discharge).

Table 5.2.5.3.5 shows the Effluent Limitations and Monitoring Requirements for instream or continuous flow sediment control structures in the eastern and western coal fields.

Table 5.2.5.3.5 Effluent Limitations and Monitoring Requirements

KPDES Outfalls								
EFFLUENT LIMITATIONS							**MONITORING REQUIREMENTS**	
Effluent Characteristic	**STORET Code**	**Units**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**	**Frequency**	**Sample Type**
Flow	50050	MGD	N/A	Report	Report	N/A	2/Month	Instantaneous
Total Suspended Solids[1]	00530	mg/l	N/A	35	70	N/A	2/Month	Grab
Total Recoverable Iron	00980	mg/l	N/A	3.0	4.0	N/A	2/Month	Grab
Total Recoverable Manganese[1]	11123	mg/l	N/A	2.0	4.0	N/A	2/Month	Grab
pH	00400	SU	6.0	N/A	N/A	9.0	2/Month	Grab
Chronic WET[2]	TT000	TU_C	N/A	N/A	N/A	1.00	1/Quarter	([2])
Specific Conductance	00095	µS/cm	N/A	Report	Report	N/A	2/Month	Grab
Total Sulfate (as SO_4)	00945	mg/l	N/A	Report	Report	N/A	2/Month	Grab
Total Recoverable Selenium	00981	µg/l	N/A	5.0[3]	20	N/A	2/Month	Grab
Total Recoverable Selenium (Fish Tissue)	01148	mg/Kg dry weight	N/A	N/A	N/A	8.6	([3])	([3])
Precipitation Volume	79777	Inches	N/A	N/A	N/A	Report	([4])	Grab

[1]See Section 4 of the permit for alternate monitoring and effluent limitations available for a qualifying precipitation

KPDES Outfalls								
EFFLUENT LIMITATIONS							MONITORING REQUIREMENTS	
Effluent Characteristic	STORET Code	Units	Minimum	Monthly Average	Daily Maximum	Maximum	Frequency	Sample Type
event (for subsurface mines, this applies only to combined flows, which are those combining two or more types of drainage, i.e., groundwater discharge with surface water discharge). [2]See Section 3 of the permit for additional requirements related to Whole Effluent Toxicity (WET) Testing including sampling requirements. [3]Should the monthly average concentration of total recoverable selenium exceed 5.0 µg/l; see Section 2.6 of the permit for additional requirements. [4]Precipitaton volume required only when applying for an Alternate Precipitation Effluent Limits (APELs), which are authorized by the coal effluent limit guidelines (ELGs) and are alternate limits and monitoring requirements on manganese and total suspended solids effective during high precipitation events; APELs will be considered on a case-by-case basis for surface mines and underground mines with comingled discharge).								

Table 5.2.5.3.6 shows the Effluent Limitations and Monitoring Requirements for bench sediment control structures in the eastern coal field.

Table 5.2.5.3.6 Effluent Limitations and Monitoring Requirements

KPDES Outfalls								
EFFLUENT LIMITATIONS							MONITORING REQUIREMENTS	
Effluent Characteristic	STORET Code	Units	Minimum	Monthly Average	Daily Maximum	Maximum	Frequency	Sample Type
Flow	50050	MGD	N/A	Report	Report	N/A	2/Month	Instantaneous
Total Suspended Solids[1]	00530	mg/l	N/A	35	70	N/A	2/Month	Grab
Total Recoverable Iron	00980	mg/l	N/A	3.0	4.0	N/A	2/Month	Grab
Total Recoverable Manganese[1]	11123	mg/l	N/A	2.0	4.0	N/A	2/Month	Grab
pH	00400	SU	6.0	N/A	N/A	9.0	2/Month	Grab
Specific Conductance	00095	µS/cm	N/A	Report	Report	N/A	2/Month	Grab
Total Sulfate (as SO_4)	00945	mg/l	N/A	Report	Report	N/A	2/Month	Grab
Precipitation Volume	79777	Inches	N/A	N/A	N/A	Report	([2])	Grab
[1]See Section 4 of the permit for alternate monitoring and effluent limitations available for a qualifying precipitation event (for subsurface mines, this applies only to combined flows, which are those combining two or more types of drainage, i.e., groundwater discharge with surface water discharge). [2]Precipitaton volume required only when applying for an Alternate Precipitation Effluent Limits (APELs), which are authorized by the coal effluent limit guidelines (ELGs) and are alternate limits and monitoring requirements on manganese and total suspended solids effective during high precipitation events; APELs will be considered on a case-by-case basis for surface mines and underground mines with comingled discharge).								

Table 5.2.5.3.7 shows the Effluent Limitations and Monitoring Requirements reclamation areas in the western coal field.

Table 5.2.5.3.7 Effluent Limitations and Monitoring Requirements

KPDES Outfalls								
EFFLUENT LIMITATIONS							MONITORING REQUIREMENTS	
Effluent Characteristic	STORET Code	Units	Minimum	Monthly Average	Daily Maximum	Maximum	Frequency	Sample Type
Flow	50050	MGD	N/A	Report	Report	N/A	2/Month	Instantaneous
Settleable Solids[1]	00530	mg/l	N/A	N/A	N/A	0.5	2/Month	Grab
pH	00400	SU	6.0	N/A	N/A	9.0	2/Month	Grab
Specific Conductance	00095	µS/cm	N/A	Report	Report	N/A	2/Month	Grab
Total Sulfate (as SO_4)	00945	mg/l	N/A	Report	Report	N/A	2/Month	Grab
Precipitation Volume	79777	Inches	N/A	N/A	N/A	Report	([2])	Grab

[1]See Section 4 of the permit for alternate monitoring and effluent limitations available for a qualifying precipitation event (for subsurface mines, this applies only to combined flows, which are those combining two or more types of drainage, i.e., groundwater discharge with surface water discharge).
[2]Precipitaton volume required only when applying for an Alternate Precipitation Effluent Limits (APELs), which are authorized by the coal effluent limit guidelines (ELGs) and are alternate limits and monitoring requirements on manganese and total suspended solids effective during high precipitation events; APELs will be considered on a case-by-case basis for surface mines and underground mines with comingled discharge).

Active Dischargers. There is currently one active KPDES-permitted source within the TMDL watershed: This is the Don Bowles Corporation in the Caney Creek Watershed, see Table 5.2.5.3.8 and Section 8.2.1 for a map of its location. The KPDES permit and DMR information for this facility are available through a Freedom of Information Act (FOIA) request (http://eec.ky.gov/Pages/OpenRecords.aspx). Inactive sources are listed in Section 8.0.

Table 5.2.5.3.8 Active KPDES Mining Permit Information

Facility Name[(1)]	TEMPO AI ID	KPDES Permit Number	KPDES Effective Date	DNR Permit Number	DNR Effective Date	KPDES Facility Lat/Long
Don Bowles Coal No 1 LLC—St. Charles Prep Plant/Can Do #1 Mine	1873	KY0067121	1/1/2012	854-8011	1/8/2002	37.176389/ -87.525

[(1)] For brevity will be referred to in this document as the Don Bowles Corporation Can Do Mine.

5.2.6 LA Mining Sources

Mining facilities in operation prior to May 3, 1978, were not regulated by SMCRA. They are known as “pre-law” mines, and as such they are part of the LA. As stated, much of the mining in the watershed is pre-law, but inadequate recordkeeping means maps of pre-law mines are often unavailable.

5.2.7 LA Natural Background

Mining-related pollutants can all be present in surface water under natural background conditions. pH normally varies from a value of 7.0, and trace amounts of cadmium, zinc and nickel may be present. Iron may be present at higher than trace amounts; some streams in Western Kentucky have high levels of naturally occurring iron (Powell, 1988). Natural background levels for pH and metals were not established for this report. Any natural background is part of the LA.

5.2.8 Illegal Sources.

Illegal sources include mining without an approved KPDES permit, or discharging outside of an approved KDPES permit. They receive no allocation within the TMDL process. There are currently no known illegal sources in the TMDL watershed.

6.0 Water Quality Criteria

6.1 Water Quality Criteria

The Clean Water Act requires states to designate uses for surface waters within their jurisdiction. The designated uses assigned to waterbodies in Kentucky can be found in 401 KAR 10:026. Designated uses impaired in the waterbodies addressed by this TMDL include Warmwater Aquatic Habitat (WAH), Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR), whose definitions are found in 401 KAR 10:001:

1. WAH waters are those with surface water and associated substrate capable of supporting indigenous warm water aquatic life. WAH can be impaired by metals, pH and reduced alkalinity in addition to other pollutants. WAH criteria are in effect year-round.
2. PCR waters are those designated for full body contact recreation (e.g., swimming). PCR criteria are in effect during the recreation season of May 1 through October 31.
3. SCR waters are those designated for partial immersion (e.g., wading or boating). SCR criteria are in effect year-round.

The term *limit* is often used interchangeably with the terms *WQC* and *criterion*. WQCs are found in 401 KAR 10:031. Below are the WQCs for metals, pH, alkalinity and limits on the relative concentration of alkalinity and acidity:

6.1.1 pH

The pH of water may result in impairment for WAH, PCR and SCR. The pH shall not be less than six and zero-tenths (6.0) nor more than nine and zero-tenths (9.0) standard units and shall not fluctuate more than one and zero-tenths (1.0) pH unit over a period of twenty-four (24) hours.

6.1.2 Metals

Metals impair for WAH. Metals WQCs are given in terms of chronic and acute limits. The chronic criterion is the highest instream concentration of a toxic substance or an effluent to which organisms are able to be exposed for ninety-six (96) hours without causing an unacceptable harmful effect. The acute criterion is the highest instream concentration of a toxic substance or an effluent to which an organism can be exposed for one (1) hour without causing an unacceptable harmful effect.

6.1.2.1 Non-Hardness-Dependent Metals (Iron)

The WQCs for iron are not hardness-dependent. The chronic iron limit is 3.5 mg/L where aquatic life has not been shown to be adversely affected and 1.0 mg/L where aquatic life has been adversely affected. The chronic limit of 1.0 mg/L was used to set the TMDL for all iron-impaired segments in this document. The acute iron limit is 4.0 mg/L for all streams. Iron is the only metal whose chronic criterion varies depending on whether aquatic life has been adversely affected. Iron WQCs are shown in Table 6.1.2.1.1.

Table 6.1.2.1.1 Iron WQCs

Limit Type	Iron WQC, mg/L
Chronic–aquatic life is adversely affected	1.0
Chronic–aquatic life has not been shown to be adversely affected	3.5
Acute	4.0

6.1.2.2 Hardness-Dependent Metals (Cadmium, Nickel, Zinc)

It has been demonstrated that a number of elements that are metals, including cadmium, nickel and zinc, are less toxic to aquatic life as water hardness increases (EPA, 1986). Hardness refers to the dissolved mineral content of water. In residential plumbing, these minerals cause scale development. They also interfere with foam formation from soap—the soap forms a solid precipitate instead of a lather and it loses its surfactant property; this makes it 'hard' to clean clothing (Hach, 2014). When minerals constituting hardness dissolve in water they form a cation (with positive charge) and an anion (with negative charge). More specifically, hardness is the presence of multivalent cations (i.e., those with a charge of 2+ or greater) (Wikipedia, 2014a). Mostly hardness comes from calcium and magnesium ions, but other metals can contribute, including barium, iron, manganese, strontium and zinc (WHO, 2003). The two most important anions associated with the cations that cause hardness are bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}), see alkalinity, below. These ions normally originate in limestone or dolomite rock made more acidic by the incorporation of atmospheric carbon dioxide into rainwater (EPA, 1986). Even though hardness indicates only the presence of cations, it is measured in mg/L of calcium carbonate ($CaCO_3$). However, this does not mean calcium is the only cation being measured; other cations contribute to hardness as described above: but for measurement purposes, all contributors are reported as an equivalent molecular weight of $CaCO_3$.

Excess hardness may lower the toxicity of certain metals to aquatic organisms by combining with the metals to form less toxic compounds. Also cations (likely calcium, perhaps others) may have an antagonistic effect on the metals in question by taking up binding sites on ion-regulating proteins, possibly in the organism's gills, which interferes with the uptake of metals. Several researchers suggest that both alkalinity and the associated cations synergistically contribute to the reduction in toxicity (Wurts and Perschbacher, 1994). Because of the variable toxicity of these metals, unlike most other WQCs the limits are not fixed, but vary as the hardness varies. Therefore the WQC equations employ the natural log of hardness, or ln(hardness), where hardness is in units of mg/L as $CaCO_3$, and e, which is an irrational number (i.e., it has an infinite number of digits to the right of the decimal point) referred to as Euler's number; e is approximately equal to 2.71828. Of the hardness-dependent metals included in this TMDL, zinc is the only metal with an identical chronic and acute criterion. Tables 6.1.2.2.1 through 6.1.2.2.3 show the WQCs for these metals.

Table 6.1.2.2.1 Cadmium WQC

Limit Type	Cadmium WQC, µg/L
Chronic	$e^{(0.7409*(\ln(hardness))-4.719)}$
Acute	$e^{(1.0166*(\ln(hardness))-3.924)}$

Table 6.1.2.2.2 Nickel WQC

Limit Type	Nickel WQC, µg/L
Chronic	$e^{(0.846*(\ln(hardness))+0.0584)}$
Acute	$e^{(0.846*(\ln(hardness))+2.255)}$

Table 6.1.2.2.3 Zinc WQC

Limit Type	Zinc WQC, µg/L
Chronic	$e^{(0.8473*(\ln(hardness))+0.884)}$
Acute	$e^{(0.8473*(\ln(hardness))+0.884)}$

6.1.2.3 Alkalinity

Lowered alkalinity can impair for WAH. Alkalinity is the ability to neutralize an acid, and is quantified by titration; titration in this case is the iterative additions of an acid to the sample until a pH endpoint of 4.5 is reached (standard method 2320, APHA et al., 2012). This is because below a pH of 4.5, carbonate alkalinity is neutralized: Carbonate alkalinity is the primary species present in natural systems, although other types, such as phosphorus or nitrogen species can also exist.

Alkalinity can also be thought of as a measurement of the buffering capacity of water, or its ability to resist change in pH. Unlike hardness, which is the presence of mineral cations, alkalinity is the presence of anions, mainly carbonate, bicarbonate and hydroxide but also potentially including borate, phosphate, silicate, nitrate, dissolved ammonia, sulfide, and the conjugate bases of organic acids, minus free hydrogen ions. Alkalinity in water is divided into two anion fractions based on the presence of the carbonate and bicarbonate anions; these fractions are known as carbonate and non-carbonate, although as stated the carbonate fraction contributes the majority of alkalinity, especially in limestone-dominated systems (Wikipedia, 2014b). These anions resist lowering pH by taking up free hydrogen ions (Alabama Water Watch, 2014). Alkalinity, like hardness, is measured as an equivalent molecular weight of $CaCO_3$. 401 KAR 10:031 states the instream alkalinity cannot be reduced by more that 25%, unless the natural alkalinity is 20 mg/L as $CaCO_3$ or less, in which case it shall not be reduced at all. While the streams addressed by this TMDL have not been assessed for alkalinity impairment, KPDES Individual Permits are written to require instream alkalinity monitoring, and alkalinity is needed to buffer (i.e., neutralize) metals hydrolysis, see Section 6.2.

6.1.2.4 Acidity

Acidity does not have a specific limit set under 401 KAR 10:031. Acidity is the ability to neutralize a base and is quantified by titration, which in this case is the iterative additions of a base to the sample until a pH endpoint is reached; the endpoint may vary based on the constituents contributing to acidity, but is normally 3.7 to 8.3 (standard method 2310B, APHA et al., 2012). Acidity is increased by the presence of dissolved carbon dioxide and carbonic acid (H_2CO_3), metals undergoing hydrolysis (see Section 6.2) and free hydrogen ions, among other constituents. Sulfide molecules such as pyrite in contact with air and water release hydrogen ions (MicrobeWiki, 2015) increasing acidity, see Section 5.1 for further discussion. Acidity, like alkalinity and hardness, is measured as an equivalent molecular weight of $CaCO_3$. Acidity can cause lowering of pH depending on other factors such as the presence of a buffer (i.e., alkalinity), but acidity and pH are not identical, see Section 6.2; this section also describes the specific application of standard method 2310B to AMD.

6.2 Metals Hydrolysis

Metallic cations in AMD, including zinc, copper, iron, aluminum and manganese, are precipitated during treatment. This process involves the free ionic (or dissolved) form of the metal binding to hydroxides (the OH^- molecule) provided by treating the runoff with a chemical alkaline addition or from hydrolysis if the pH in the receiving water is high enough. Hydrolysis means the breaking of chemical bonds by the addition of water; the water molecule itself may also have its molecular bonds broken during the process (Wikipedia, 2015).

The metal hydroxides form insoluble compounds that then precipitate from the water. This process of precipitation is represented in the following equation using manganese, where the metal hydroxide (i.e., the manganese bound to an OH molecule through hydrolysis) forms the insoluble compound, manganese hydroxide, which then precipitates:

$$Mn^{+2} + 2H_2O \dashrightarrow Mn(OH)_2 + 2H^+$$

The hydrolysis reaction releases hydrogen ions, which can decrease pH (which is defined as the presence of hydrogen ions) if not enough excess hydroxide is present in the system to buffer the reaction. Other metals besides manganese undergo a similar reaction. This phenomenon makes it problematic to rely on pH as a sole indicator of the acidity of AMD, as treated mine effluent which meets the acceptable pH range of 6.0 to 9.0 standard units can be unstable (Kirby and Cravotta, 2005), and the final pH can fall below this range after discharge if not enough alkalinity is available in the water to buffer the total acidity.

This instability means special methods are needed to measure the acidity of AMD. To enhance metal precipitation in the laboratory, especially during titrations, heat and oxidation are used to speed up the reaction. More specifically, the addition of stronger bases like NaOH, and the use of heat and oxidation can improve the efficiency and speed of metal precipitation. For AMD, the determination of acidity by titration (2310B in Standard Methods, 2012) mandates that a hot peroxide treatment be employed (2310B.4*a*), called hot acidity or digested acidity.

In the environment, the primary metals of concern for AMD treatment are aluminum, iron and manganese. This is because other metals associated with AMD, including copper, nickel, and zinc normally drop out of solution in the process of properly treating AMD for iron and manganese. AMD generally has a low pH, and as the pH in the treatment pond is increased through addition of lime or limestone, the metals begin precipitating in the following order: ferric iron (i.e., Fe^{+3}) precipitates at a pH 3.0 to 3.5; aluminum precipitates at a pH of around 4.5, while copper and zinc precipitate at a pH of 7.0 to 8.0. Ferrous iron (i.e., Fe^{+2}) precipitates at around 8.0 to 8.5, but most treatment operations treat ferrous iron more quickly and economically by aerating the water to convert ferrous iron to ferric iron, and in this way a pH of only 3.0 to 4.0 is needed to precipitate the iron. Manganese precipitates at a much higher pH of 9.0 to 10.5, although the final numbers for these metals can vary based on field conditions and ionic composition. Because manganese precipitates last it is an indicator of the completeness of precipitation of other metals; this is the reason there is an effluent limit for manganese. However, aluminum can re-enter solution after initial precipitation at a pH of around 9.0 and thus can contribute hydrogen ions via hydrolysis even though it was initially removed earlier in the treatment process (Personal Communications, Dr. Jeffry Skousen, 4/16/14, 5/15/14, and 5/19/14; West Virginia University, 2014; Balintova and Petrilakova, 2011; Balintova et al., 2012).

The potential drop in pH due to hydrolysis reactions with metals can be calculated using the following equations (Personal Communication, Dr. Kelley Pennell, 2014), which use the acute permitted discharge limits of iron and manganese, which are both 4.0 mg/L as stated in Table 6.2:

$$(\text{Iron, 4.0 mg/L}) \times (1/55.845\text{ g/mol}) \times (1\text{ g}/1000\text{ mg}) = 7.1627\text{E-5 mol/L}$$
Equation 1.

$$(\text{Manganese, 4.0 mg/L}) \times (1/54.938\text{ g/mol}) \times (1\text{ g}/1000\text{ mg}) = 7.2809\text{E-5 mol/L}$$
Equation 2.

As stated, any aluminum present contributes hydrogen ions as well. In the treatment pond system, iron is more often in the form Fe^{+3} unless conditions are anaerobic, and most AMD treatment ponds are designed as aerobic environments (Personal Communication, Dr. Jeffry Skousen, 5/19/14). Manganese is solely in the form Mn^{+2}. The amount of hydrogen ions generated during metal hydrolysis is therefore equal to the results of Equations 1 and 2 multiplied by the valence number of the metals, or 3 for iron and 2 for manganese, then summing these results. This figure is 3.60499E-4 mol/L of H+. Since pH is defined specifically as the negative logarithm of the concentration of H+ ions in solution in units of mol/L, the resultant pH is equal to 3.44, which is far lower than the acceptable pH range of 6.0 to 9.0 standard units. If aluminum was also present, the potential pH drop would be even larger.

Metals hydrolysis can be countered by adding alkalinity to the solution. The amount of alkalinity necessary to neutralize the acidity generated by aluminum, iron and manganese at a specific pH can be calculated by the following equation, from Hedin, et al. (1991), which conservatively assumes all iron is in the form of Fe^{+3}:

$$\text{Calculated Acidity, mg/L as } CaCO_3 = 50 \times ((10^{(3-pH)}) + (3 \times \text{Fe mg/L}/55.8) + (2 \times \text{Mn mg/L}/54.9) + (3 \times \text{Al mg/L}/27.0))$$

Equation 3.

Solving Equation 3 gives the net alkalinity which must be present in solution to buffer metals hydrolysis (i.e., net alkalinity is defined as the alkalinity present in solution minus the calculated acidity). Three of the variables, pH, iron and manganese, have effluent limits. Aluminum does not have an effluent limit, so it must be reported when the other constituents are reported: The calculated acidity will then be determined and compared to the alkalinity present in solution. The alkalinity must equal or exceed the calculated acidity, or in other words the net alkalinity must be greater than or equal to zero.

7.0 Total Maximum Daily Load

EPA defines a TMDL as "a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Water quality standards are set by States, Territories, and Tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality. The Clean Water Act, Section 303, establishes the water quality standards and TMDL programs (EPA, 2008)."

7.1 TMDL Equation and Definitions

A TMDL calculation is performed as follows:

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

Equation 4.

The WLA has two components:

$$\text{WLA} = \text{Mining-WLA} + \text{Future Growth-WLA}$$

Equation 5.

Where:
TMDL: the WQC, expressed as a load.
MOS: the Margin of Safety, which can be an implicit or explicit additional reduction applied to sources of pollutants that accounts for uncertainties in the relationship between effluent limits and water quality. For this TMDL, the MOS is implicit.
TMDL Target: the TMDL minus the MOS.
WLA: the Wasteload Allocation, which is the allowable loading of pollutants into the stream from KPDES-permitted sources, such as surface and subsurface mines.
Mining-WLA: the allowable loading for current KPDES-permitted mining sources which discharge the pollutants of concern, whether or not they have a permit limit for the pollutants of concern.
Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new mining permits, new discharges under existing mining permits as further permitted acreage is mined and discharges from mines under reclamation by the Kentucky Division of Abandoned Mine Lands (AML). Also includes the allocation for the KPDES-permitted sources that existed but were not known at the time the TMDL was written.
LA: the Load Allocation, which is the allowable loading of pollutants into the stream from sources not permitted by KPDES, such as formerly permitted mines, and from natural background.
Seasonality: yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.

Critical Condition: the time period when the pollutant conditions are expected to be at their worst.
Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment.
Load: concentration * flow * conversion factor.
Concentration: milligrams per liter (iron, alkalinity, acidity), micrograms per liter (cadmium, nickel, zinc) or standard units (pH).
Flow (i.e., stream discharge): cubic feet per second (cfs).

7.2 TMDLs by Pollutant

The following sections set the loading associated with each pollutant addressed by the TMDL. The MOS, which is implicit, is discussed in Section 7.3. TMDLS are allocated to sources in Section 7.7.

7.2.1 pH

The acceptable range for pH is $6.0 \leq pH \leq 9.0$ standard units. In order to express this as a range of loads, pH can be converted to hydrogen ion concentration and then into load, where a pH of 6.0 equals a hydrogen ion concentration of 1.00E-6 mol/L and a pH of 9.0 equals a hydrogen ion concentration of 1.00E-9 mol/L (Milanco, 2014). Because the molecular weight of a hydrogen ion is 1.0 g/mol, the concentration of hydrogen ions in mol/L is the same as its concentration in g/L, or 1.0. Using the following equation, these hydrogen ion concentrations can be turned into load for any value of streamflow, Q_S:

$$(Q_S\ ft^3/s) \times (1E\text{-}6\ g/L) \times (86{,}400\ s/day) \times (28.31685\ L/ft^3) = \text{pH TMDL Load (hydrogen ions g/day)}$$

Equation 6 (pH = 6.0).

$$(Q_S\ ft^3/s) \times (1E\text{-}9\ g/L) \times (86{,}400\ s/day) \times (28.31685\ L/ft^3) = \text{pH TMDL Load (hydrogen ions g/day)}$$

Equation 7 (pH = 9.0).

Equation 6 simplifies to a TMDL Load for pH of $Q_S \times 2.44657$ g/day of hydrogen ions. Equation 7 simplifies to $Q_S \times 2.44657E\text{-}3$ g/day of hydrogen ions. However, the activity of hydrogen ions has been shown to decrease with increasing ionic strength of the water the hydrogen ions are dissolved in, or source water. This is because other ions limit the mobility of the hydrogen ions based on their charge and concentration. According to Snoeyink and Jenkins (1980), the ionic strength μ can be determined using the specific conductance (SC, also known as conductivity) of the source water in units of microSiemens per centimeter ($\mu S/cm$) with the following equation:

$$\mu = 1.6E\text{-}5 \times SC$$

Equation 8.

Ionic strength can be converted to an associated activity coefficient γ using the relationship shown in Figure 7.2.1.1.

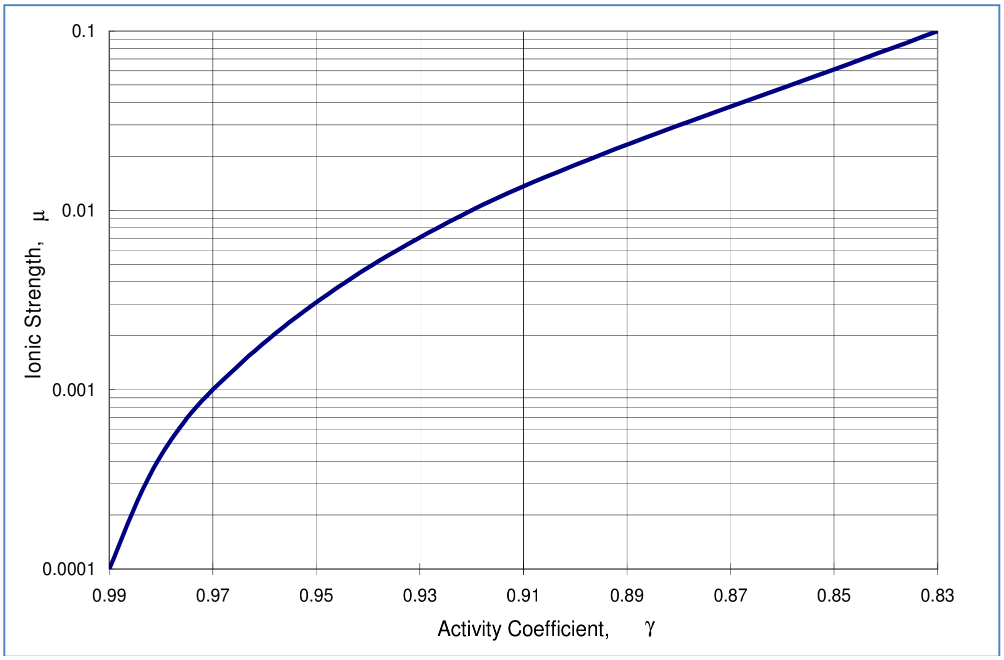


Figure 7.2.1.1 Ionic Strength vs. Activity Coefficient of H+ Ions

Using the maximum SC measured in the watershed, which is 4060 μS/cm recorded on 7/19/2006 at DOW10009003 on Copper Creek, yields an ionic strength μ of approximately 0.065. Using Figure 7.2.1.1, the activity coefficient γ is approximately 0.845. Measured hydrogen ion activity and actual hydrogen ion concentration are related by the following equation:

$$\{H+\} = [H+] \times \gamma$$

Equation 9.

Where {H+} is measured activity in moles/liter and [H+] is actual ionic concentration in moles/liter. The measured activity was used as the target instead of the actual concentration because KDOW regulates pH by the hydrogen ion activity as read by a pH meter. Therefore the range of hydrogen ion loads between a pH of 6.0 and 9.0 is derived by multiplying the result of Equations 6 and 7 by γ, or 0.845. This leaves the TMDL load range shown in Table 7.2.2.1:

Table 7.2.2.1 Range of Hydrogen Ion TMDL Loads Corresponding to a pH Range of 6.0 to 9.0 Standard Units

pH WQC, pH standard units	TMDL Load, Hydrogen Ions, g/day(1)
6.0 (upper limit of hydrogen ion loading)	$Q_S \times 2.067$
9.0 (lower limit of hydrogen ion loading)	$Q_S \times 2.067E\text{-}3$

(1) QS is the flow in the stream in ft^3/s.

7.2.2 Metals

Since both the acute and chronic criteria must be met, TMDL loads for metals are set using both the chronic and acute WQCs. For metals whose WQCs are given in mg/L, their concentration is converted to load in pounds per day using the following equation:

$$(\text{WQC mg/L}) \times (Q_S \text{ ft}^3/\text{s}) \times (1 \text{ lb}/453{,}592.4 \text{ mg}) \times (86{,}400 \text{ s/day}) \times (28.31685 \text{ L/ft}^3) = \text{TMDL Load (pounds/day)}$$

Equation 10.

The conversion factor for Equation 10 simplifies to the 5.3938.

For metals whose WQC is given in µg/L, the concentration is converted to load in pounds per day using the following equation:

$$(\text{WQC } \mu\text{g/L}) \times (1 \text{ mg}/1000\mu\text{g}) \times (Q_S \text{ ft}^3/\text{s}) \times (1 \text{ lb}/453{,}592.4 \text{ mg}) \times (86{,}400 \text{ s/day}) \times (28.31685 \text{ L/ft}^3) = \text{TMDL Load (pounds/day)}$$

Equation 11.

The conversion factor for Equation 11 simplifies to 0.005394.

Metals are divided into two categories, those whose toxicity is not hardness-dependent, and those whose toxicity is hardness-dependent.

7.2.2.1 Non-Hardness-Dependent Metals

Iron. Since the WQCs for iron are given in concentrations of mg/L, the following loads were derived from Equation 10:

Table 7.2.2.1.1 Iron WQCs and TMDL Load

Limit Type	Iron WQC, mg/L	Iron TMDL Load, pounds/day[1]
Chronic–aquatic life is adversely affected	1.0	$Q_S \times 5.3938$
Acute	4.0	$Q_S \times 21.575$

[1] QS is the flow in the stream in ft^3/s.

7.2.2.2 Hardness-Dependent Metals

Cadmium, Nickel, Zinc. The WQCs for hardness-dependent metals are given in µg/L instead of mg/L, so the TMDL loads were derived using Equation 11. As stated, zinc is the only metal whose chronic and acute criteria are identical.

Table 7.2.2.2.1 Cadmium WQC and TMDL Load

Limit Type	Cadmium WQC, µg/L[1]	Cadmium TMDL Load, pounds/day[2]
Chronic	$e^{(0.7409*(\ln(\text{hardness}))-4.719)}$	$Q_S \times 0.005394 \times e^{(0.7409*(\ln(\text{hardness}))-4.719)}$
Acute	$e^{(1.0166*(\ln(\text{hardness}))-3.924)}$	$Q_S \times 0.005394 \times e^{(1.0166*(\ln(\text{hardness}))-3.924)}$

[1] Hardness is in units of mg/L.
[2] QS is the flow in the stream in ft^3/s.

Table 7.2.2.2.2 Nickel WQC and TMDL Load

Limit Type	Nickel WQC, µg/L[1]	Nickel TMDL Load, pounds/day[2]
Chronic	$e^{(0.846*(\ln(\text{hardness}))+0.0584)}$	$Q_S \times 0.005394 \times e^{(0.846*(\ln(\text{hardness}))+0.0584)}$
Acute	$e^{(0.846*(\ln(\text{hardness}))+2.255)}$	$Q_S \times 0.005394 \times e^{(0.846*(\ln(\text{hardness}))+2.255)}$

(1) Hardness is in units of mg/L as $CaCO_3$.
(2) QS is the flow in the stream in ft^3/s.

Table 7.2.2.2.3 Zinc WQC and TMDL Load

Limit Type	Zinc WQC, µg/L[1]	Zinc TMDL Load, pounds/day[2]
Chronic	$e^{(0.8473*(\ln(\text{hardness}))+0.884)}$	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(\text{hardness}))+0.884)}$
Acute	$e^{(0.8473*(\ln(\text{hardness}))+0.884)}$	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(\text{hardness}))+0.884)}$

(1) Hardness is in units of mg/L.
(2) QS is the flow in the stream in ft^3/s.

However, despite the requirement that all pollutants be expressed as a load with a TMDL (D.C. Cir, 2006), KDOW and DNR expect metals and pH compliance to be evaluated in terms of concentration, not load.

7.2.3 Net Alkalinity

As stated in Section 6.2, net alkalinity, or the alkalinity minus the calculated acidity, must be equal to or greater than zero to buffer metals hydrolysis. This concentration can be converted into a load as follows:

$$(\text{Net Alkalinity, mg/L as } CaCO_3) \times (Q_S\ ft^3/s) \times (1\ lb/453{,}592.4\ mg) \times (86{,}400\ s/day) \times (28.31685\ L/ft^3) = \text{TMDL Load (pounds/day)}$$

Equation 12.

This simplifies to a target load equal to or greater than zero pounds/day of net alkalinity as $CaCO_3$, which must be met at all times. Like metals and pH, KDOW expects compliance to be evaluated in terms of concentration, not load.

7.3 Margin of Safety

The MOS can be an implicit (using conservative assumptions) or explicit (a reserved portion) additional reduction applied to the WLA, LA or to both types of sources that accounts for uncertainties in the relationship between effluent limits and water quality. Leaving aside natural background, KPDES dischargers are the only legal dischargers of mining-related pollutants into surface water, and the alkaline treatment pond system normally over-treats the AMD before discharge, both in terms of precipitating metals by raising pH and leaving adequate alkalinity in the system as a buffer (personal communication, Larry Sowder, 2014; EPA, 1982). Therefore mine operators normally discharge below their permitted effluent limits as a result of the need to retain adequate alkalinity. In addition, conservative assumptions have been used to determine hydrogen ion load limits and net alkalinity, see Sections 7.2.1 and 6.2. Therefore the MOS for this TMDL is implicit for all pollutants.

7.4 Allocations

The TMDL load is divided up among the Mining-WLA (for current KDPES permitted sources), the Future Growth-WLA (for future sources, expansion of existing sources and any existing source that was not known at the time the TMDL was written) and the LA (including natural background and any source in operation prior to May 3, 1978). These sources receive allocations proportional to the flow each contributes to the surface water system at any given point. The instream flow can be divided among the various sources as follows:

$$Q_S = Q_M + Q_{FG} + Q_{LA}$$

Equation 13.

Where Q_S is the flow in the stream, Q_M is the mining-related flow, Q_{FG} is the flow from future growth sources, and Q_{LA} is the flow from LA sources. All units are cfs. The flow of each source is proportional to its individual allocation. However allocations, like the TMDL itself, must be presented in terms of load. The TDML was already expressed in terms of load in Tables 7.2.2.1 through 7.2.2.2.3 for pH and metals, and in Section 7.2.3 for a net alkalinity. The flows for each source in Equation 13 were expressed in terms of allocated load by multiplying all the flows by the WQC for each pollutant (or target, in terms of net alkalinity) and by a conversion factor, i.e., using the same procedure that generated the TMDL loads found in Tables 7.2.2.1 through 7.2.2.2.3 and Section 7.2.3. Table 7.7.1 shows the final allocations for all impaired segments in the TMDL watershed.

Expressing the TMDL allocations using variables for flow and hardness means that each source must achieve the WQCs for their portion of the instream flow at all times, under all flow conditions and all conditions of hardness. With all sources meeting their individual allocations, the TMDL will also be met at all times, under all flow conditions and all conditions of hardness, including the critical condition, see Sections 7.6 and 8.2.

7.5 Seasonality

Seasonality is defined as yearly factors such as temporal variations on source behavior and stream loading than can affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses. Since the WQCs for pH and metals and the target for net alkalinity are in effect year round, this TMDL's limits apply year round.

7.6 Critical Condition

As stated in Section 5.2.5, permitted mining sources generally discharge in response to precipitation events, but treatment ponds are built to achieve a certain retention time, thus discharge may not immediately follow rain events. Section 8.2 describes how the critical condition was determined for each impaired segment.

7.7 TMDL Allocations

Table 7.7.1 gives TMDL allocations for all pollutants for all impaired waterbodies addressed by this TMDL.

Table 7.7.1 TMDLs and Allocations by Impaired Segment

Pollutant	Units	TMDL[1]	MOS[2]	Mining-WLA[3]	Future Growth - WLA[4]	LA[5]
Caney Creek 0.0 to 8.2						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Copper Creek 0.0 to 2.7						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Iron Chronic[8]	pounds/ day	$Q_S \times 5.3938$	Implicit	$Q_M \times 5.3938$	$Q_{FG} \times 5.3938$	$Q_{LA} \times 5.3938$
Iron Acute	pounds/ day	$Q_S \times 21.575$	Implicit	$Q_M \times 21.575$	$Q_{FG} \times 21.575$	$Q_{LA} \times 21.575$
Zinc Acute and Chronic[9]	pounds/ day	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{FG} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{LA} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
Copperas Creek 0.0 to 3.6						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Cadmium Chronic	pounds/ day	$Q_S \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$	$Q_{FG} \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$	$Q_{LA} \times 0.005394 \times e^{(0.7409*(\ln(hardness))-4.719)}$
Cadmium Acute	pounds/ day	$Q_S \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$	Implicit	$Q_M \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$	$Q_{FG} \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$	$Q_{LA} \times 0.005394 \times e^{(1.0166*(\ln(hardness))-3.924)}$
Iron Chronic[8]	pounds/ day	$Q_S \times 5.3938$	Implicit	$Q_M \times 5.3938$	$Q_{FG} \times 5.3938$	$Q_{LA} \times 5.3938$

Pollutant	Units	TMDL[1]	MOS[2]	Mining-WLA[3]	Future Growth - WLA[4]	LA[5]
Copperas Creek 0.0 to 3.6						
Iron Acute	pounds/ day	$Q_S \times 21.575$	Implicit	$Q_M \times 21.575$	$Q_{FG} \times 21.575$	$Q_{LA} \times 21.575$
Nickel Chronic	pounds/ day	$Q_S \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$	$Q_{FG} \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$	$Q_{LA} \times 0.005394 \times e^{(0.846*(\ln(hardness))+0.0584)}$
Nickel Acute	pounds/ day	$Q_S \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$	$Q_{FG} \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$	$Q_{LA} \times 0.005394 \times e^{(0.846*(\ln(hardness))+2.255)}$
Zinc Acute and Chronic[9]	pounds/ day	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{FG} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{LA} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
Fox Run 0.0 to 1.1						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Hurricane Creek 0.0 to 1.8						
pH[6]	standard units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$
Alkalinity, Acidity[7]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0
Iron Chronic[8]	pounds/ day	$Q_S \times 5.3938$	Implicit	$Q_M \times 5.3938$	$Q_{FG} \times 5.3938$	$Q_{LA} \times 5.3938$
Iron Acute	pounds/ day	$Q_S \times 21.575$	Implicit	$Q_M \times 21.575$	$Q_{FG} \times 21.575$	$Q_{LA} \times 21.575$
Zinc Acute and Chronic[9]	pounds/ day	$Q_S \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	Implicit	$Q_M \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{FG} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$	$Q_{LA} \times 0.005394 \times e^{(0.8473*(\ln(hardness))+0.884)}$
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6						
pH[6]	Standard Units	$6.0 \le pH \le 9.0$	Implicit	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$	$6.0 \le pH \le 9.0$

Pollutant	Units	TMDL[(1)]	MOS[(2)]	Mining-WLA[(3)]	Future Growth - WLA[(4)]	LA[(5)]
UT to Hurricane Creek at 1.2 RM 0.0 to 0.6						
Alkalinity, Acidity[(7)]	mg/L as $CaCO_3$	Net Alkalinity ≥ 0	Implicit	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0	Net Alkalinity ≥ 0

(1) TMDLs for metals are expressed as the flow in the stream, Q_S in ft^3/s, multiplied by the WQC in mg/L or µg/L and the appropriate conversion factor to convert the multiple of flow and the WQC into to units of load (pounds/day). The conversion factors are:

1. 5.3938 for a WQC in units of mg/L (i.e., for iron).
2. 0.005394 for a WQC in units of µg/L (i.e., for zinc, cadmium and nickel).

Also, pH must remain between 6.0 and 9.0 standard units, inclusive.

(2) The MOS is implicit: When in compliance, KPDES-permitted sources seldom discharge at their allowable limits for the pollutants addressed by this TMDL.

(3) The Mining-WLA is expressed as the flow in the stream due to KPDES-permitted sources with permit limits for the pollutants addressed by this TMDL, Q_M, in ft^3/s, multiplied by the WQC and the appropriate conversion factor. All dischargers must meet both the chronic and acute criteria for pollutants whose WQCs are expressed in both chronic and acute terms.

(4) The Future Growth-WLA is expressed as the flow in the stream due to future KPDES-permitted sources with permit limits for the pollutants addressed by this TMDL, Q_{FG}, in ft^3/s, multiplied by the WQC and the appropriate conversion factor. All dischargers must meet both the chronic and acute criteria for pollutants whose WQCs are expressed in both chronic and acute terms.

(5) The LA is expressed as the flow in the stream due to legal but non-KPDES-permitted sources of the pollutants addressed by this TMDL, Q_{LA}, in ft^3/s, multiplied by the WQC and the appropriate conversion factor. The LA includes mining sources in operation prior to May 3, 1978 and any natural background concentrations of the pollutants addressed by this TMDL.

(6) pH can be converted to a range of allowable loads of hydrogen ions in units of g/day; a pH of 6.0 represents a maximum allowable load of hydrogen ions equal to $Q_S \times 2.067$ g/day, and a pH of 9.0 represents a minimum allowable load of $Q_S \times 2.067E\text{-}3$ g/day, where Q_S is the flow in the stream in ft^3/s. The TMDL can then be allocated to the Mining-WLA, the Future Growth-WLA and the LA based on the fraction of the streamflow each contributes.

(7) Net alkalinity is defined as the alkalinity in mg/L as $CaCO_3$ minus the calculated acidity; the calculated acidity is determined using the following equation: Calculated Acidity, mg/L as $CaCO_3 = 50 \times ((10^{(3\text{-pH})}) + (3 \times \text{Fe mg/L}/55.8) + (2 \times \text{Mn mg/L}/54.9) + (3 \times \text{Al mg/L}/27))$. Monitoring and reporting of net alkalinity will be required both instream and at outfalls at the same frequency as iron and manganese are monitored and reported. Aluminum must be added to KPDES mining permits as report-only in order to determine the calculated acidity. Net alkalinity must be greater than or equal to zero (in both mg/L and pounds/day) in order to buffer metals hydrolysis which can lower pH below acceptable levels.

(8) The chronic iron WQC is 3.5 mg/L where there are no demonstrated impacts to aquatic life, and 1.0 mg/L where there are demonstrated impacts. This means for any WAH-impaired stream, the iron limit is 1.0 mg/L. Because all segments addressed by this document are WAH-impaired, the chronic iron TMDL is based on 1.0 mg/L as opposed to 3.5 mg/L. The acute WQC for iron is not dependent on impacts to aquatic life; it is 4.0 mg/L in all streams.

(9) The chronic and acute WQCs for zinc are identical.

8.0 Impaired Segments

This section presents data collected by the TMDL Section and includes an individual analysis of each impaired stream segment.

8.1 Data Validation

Data validation was performed on the TMDL Section's data as follows:

- Only samples collected from a flowing stream were considered in analysis.
- J-flagged data, which are those results above the detection limit but below the limit of quantitation, were reported verbatim.
- Non-detect samples were reported at their detection limit when necessary to complete the critical condition analysis, see below.

As stated in Sections 2.1 and 7.4, the data were used to assess the streams for mining-related impairments but not used to set a unique TMDL for any segment. This is because the TMDL is constructed using variables for flow and hardness; this means the TMDL is valid at all times, under all flow conditions and all conditions of hardness, including the critical condition for each segment.

8.2 Individual Stream Segment Analysis

Sampling Results. Results from the watershed sampling event in 2006-2007 are discussed for each segment, which are presented alphabetically. Only data for the pollutants that impair a given segment are shown in this section; additional data can be found in Appendix A.

For pH and iron, the concentrations were presented without further analysis beyond flagging for exceedances of the WQCs (i.e., pH below 6.0 standard units, and iron above the chronic or acute criterion). However, for the hardness-dependent metals, further columns were added. These include the hardness, the WQC, which was calculated based on the hardness, and another column showing the amount by which the instream metal concentration exceeded the WQC. This last column was included because knowing the concentration of the metal by itself often gives little to no understanding of its toxicity at the time the sample was collected; on a day with low hardness, a low concentration of the metal may pose more of a risk to aquatic life than a higher concentration of the metal on a day with significantly higher hardness. This is because hardness mitigates the toxicity of these metals, as described in Section 6.1.2.2. The amount by which the concentration of the hardness-dependent metal exceeded the WQC will be referred to as 'the (zinc/cadmium/nickel) difference' in places to avoid repetition. It is presented as a negative number when the concentration of the metal did not exceed the WQC for purposes of plotting the metal concentrations vs. flow to aid in determining the critical condition, see below. As stated in Section 2.1, some segments impaired for a given metal did not show any exceedances of that metal during TMDL sampling: While it may seem counterintuitive to assign a critical condition when the observed data did not show an exceedance of the WQC, EPA TMDL requirements mandate a discussion of the critical condition, so the same procedure was applied at all sites, whether or not KDOW's data showed an exceedance for a specific metal.

Critical Condition. A discussion of the critical condition is included for each impaired segment. The critical condition for each site was evaluated by plotting the pollutant(s) impairing the stream against flow to determine if precipitation-driven runoff was the cause of increasing pollutant loads, or if pollutants were associated with lower flows instead. For pH and iron, the concentration was plotted vs. flow. For hardness-dependent metals, the amount by which the concentration exceeded the WQC was plotted vs. flow, as this is the appropriate indicator of the potential toxicity of the metal when that sample was taken. Negative numbers were retained for this analysis as they improved the understanding of the relationship between flow and the toxicity of the metal. Linear trendlines were added to quantify the relationship between flow and the pollutant; an 'R^2' value was calculated and displayed on the plots, along with the equation describing the trendline. The term R^2 is constrained between 1.0 and 0.0, and indicates the strength of the effect of an independent variable (in this case flow) on a dependent variable (in this case pH or metals). An R^2 value of 1.0 indicates that all of the change seen in the concentration of the pollutant is due to flow, and a R^2 value of zero indicates that none of the change in the pollutant is due to flow. R^2 values are calculated along with a p-value, which denotes the significance of the relationship. A p-value of 0.05 or less indicates a significant relationship, a p-value higher means the data are not significant, and no conclusions should be drawn. However, all R^2 and p-values were shown, even where the data did not show a significant relationship. In order to plot the pollutant values vs. flow for cadmium, non-detects were used at their detection limit.

This analysis of the critical condition required the availability of flow data. However, no flow data were available for Site DOW10014007 on Hurricane Creek or for Sites DOW10014012 or DOW10014013 on Caney Creek. However, flow data were available for Sites DOW10014010 on Hurricane Creek and DOW10014014 on Caney Creek, so analysis was performed for all impaired stream segments, if not all sites.

The sampling period for the TMDL data was 5/16/2006 through 3/22/2007. Based on analysis of the precipitation data downloaded from the Dawson Springs meteorological station USC00152072 from the National Climate Data Center (http://www.ncdc.noaa.gov/cdo-web/search), which returned precipitation data from 1940 through 2012 (see Figure 8.1.1), the sampling period contained a mix of wetter-than-normal months and drier-than-normal months. This variance possibly aided the critical condition analysis by providing a mix of low-flow and high-flow conditions; however, as seen in the remainder of Section 8.0, most of the p-values did not show a significant relationship, and many of the R^2 values were fair or poor. This is likely due in part to the size of the dataset. However, in the case of pH on Copperas creek, the p-value showed significance for all three stations; the flow-pollutant relationships showed good and fair R^2 values, and the pH consistently decreased with decreasing flow at all three stations, therefore the critical condition for this impaired segment was described in terms of flow, although the date of the minimum pH value was also given as additional information. In all other cases, the critical condition was described as the date when pollutant concentrations were at their maximum, or their maximum difference for hardness-dependent metals.

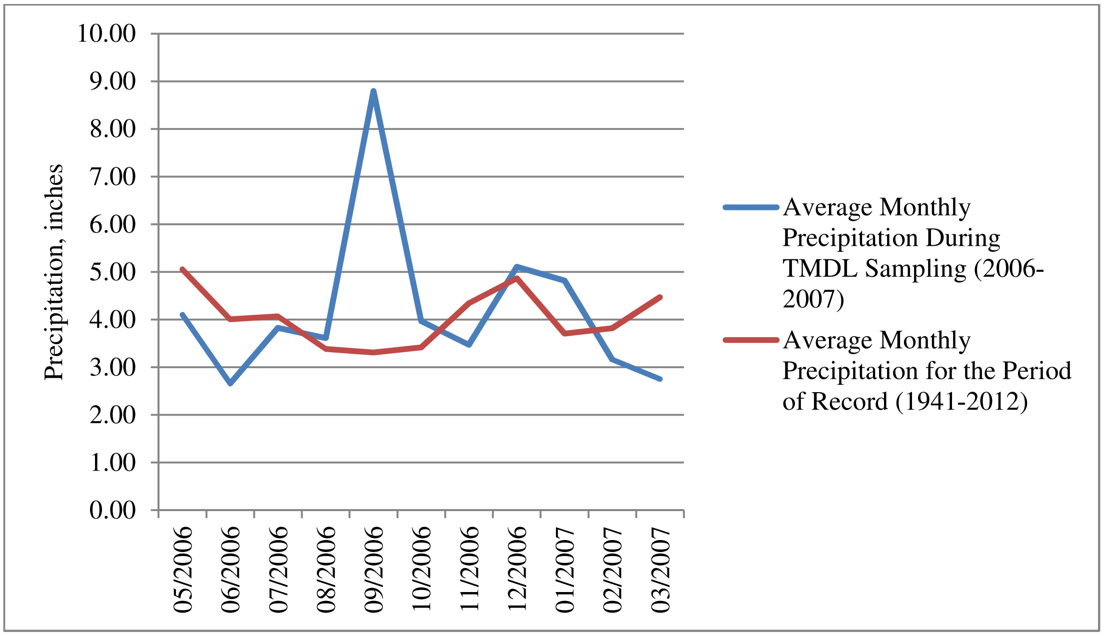


Figure 8.1.1 Average Monthly Precipitation Data for the Period of Record vs. Monthly Precipitation Data During TMDL Sampling at the Dawson Springs Meteorological Station, USC00152072

GIS Information Including Mining Sources. Data analysis was carried out for each impaired stream segment and its associated drainage area within a GIS framework. Most of the GIS data collected for the development of this document can be accessed and downloaded from the Kentucky Geography Network (http://kygeonet.ky.gov). Each segment has a map showing the DMS mined out areas, and a map showing the DNR mine permit boundaries, with the exception of UT to Hurricane Creek, which returned no mine permit boundaries within its watershed area. These maps do not reflect active mining facilities; only one active mining facility is present, the Don Bowles Corporation Can Do Mine in the far eastern portion of the Caney Creek watershed; an additional map was included to show this facility. Lists of inactive facilities were included using the data tables associated with the DMS mined out areas layer and the DNR mine permit boundaries layer.

8.2.1 Caney Creek of Tradewater River 0.0 to 8.2

Caney Creek is impaired for pH. TMDL sampling data indicate the stream was still impaired for pH at the time of data collection, see Tables 8.2.1.1 through 8.2.1.3. Only one iron sample was collected, which showed an exceedance of the acute limit, see Appendix A. No other metals samples showed exceedances. Flow was present at the upper two sampling stations, DOW10014012 and DOW10014013, but could not be measured at these stations due to the wide flow channel and the presence of vegetation that produced small flow velocities. However, flow was observed to be present so the data were included in the TMDL. Flow was measurable at the downstream station, DOW10014014. Figure 8.2.1.1 relates pH to flow to assist in determining the critical condition. There is one active mining permittee in the watershed, the Don Bowles Corporation Can Do Mine, KPDES permit number KY0067121, see Table 5.2.5.3.8 and Figure 8.2.1.2. Figure 8.2.1.3 shows the DMS mined out areas, and Figure 8.2.1.4 shows the DNR mine permit boundaries. Tables 8.2.1.4 and 8.2.1.5 list both types of potential sources.

Table 8.2.1.1 pH Data Collected for DOW10014012 Caney Creek of Tradewater River 0.0 to 8.2, RM 0.35

Date	pH, standard units	Flow, cfs
7/18/2006	6.68	*
8/9/2006	6.96	*
9/27/2006	6.31	*
10/17/2006	6.50	*
11/28/2006	7.03	*
1/11/2007	5.46	*
2/20/2007	6.01	*
3/21/2007	5.49	*
	Exceeds the pH limit	
* Flow was present but too low to measure		

Table 8.2.1.2 pH Data Collected for DOW10014013 Caney Creek of Tradewater River 0.0 to 8.2, RM 6.80

Date	pH, standard units	Flow, cfs
7/18/2006	6.78	*
8/9/2006	6.46	*
9/27/2006	5.91	*
10/17/2006	6.04	*
11/28/2006	6.53	*
1/11/2007	5.22	*
2/20/2007	5.75	*
3/21/2007	6.49	*
	Exceeds the pH limit	
* Flow was present but too low to measure		

Table 8.2.1.3 pH and Flow Data Collected for DOW10014014 Caney Creek of Tradewater River 0.0 to 8.2, RM 7.80

Date	pH, standard units	Flow, cfs
6/28/2006	5.59	0.848
7/18/2006	5.61	0.185
9/27/2006	5.87	2.667
10/17/2006	6.12	4.833
11/28/2006	5.27	2.840
1/11/2007	4.87	10.070
2/20/2007	5.86	6.837
3/21/2007	6.51	15.024
	Exceeds the pH limit	

Critical Condition. pH was plotted against flow at Site DOW10014014 and shown in Figure 8.2.1.1, since flow data were not available for the other sites. The plot showed a slight tendency towards decreasing pH at lower flows, but with a poor R^2 value. However, despite this slight trend, the lowest pH value of 4.87 standard units was observed on 1/11/2007 at a flow of 10.07 cfs, which is the second-highest flow value recorded for this site. This is therefore the critical condition for this impaired segment.

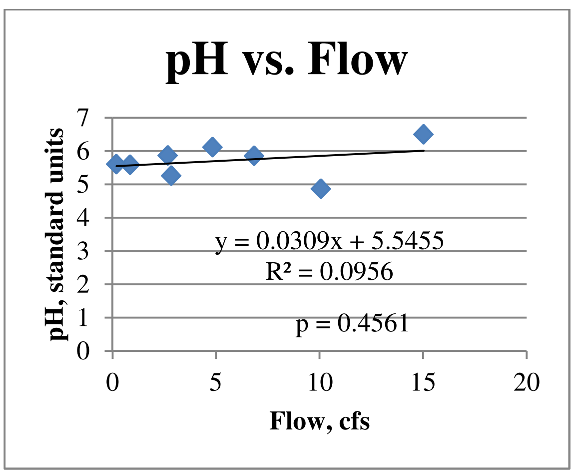


Figure 8.2.1.1 pH vs. Flow at Caney Creek Site DOW10014014, RM 7.80

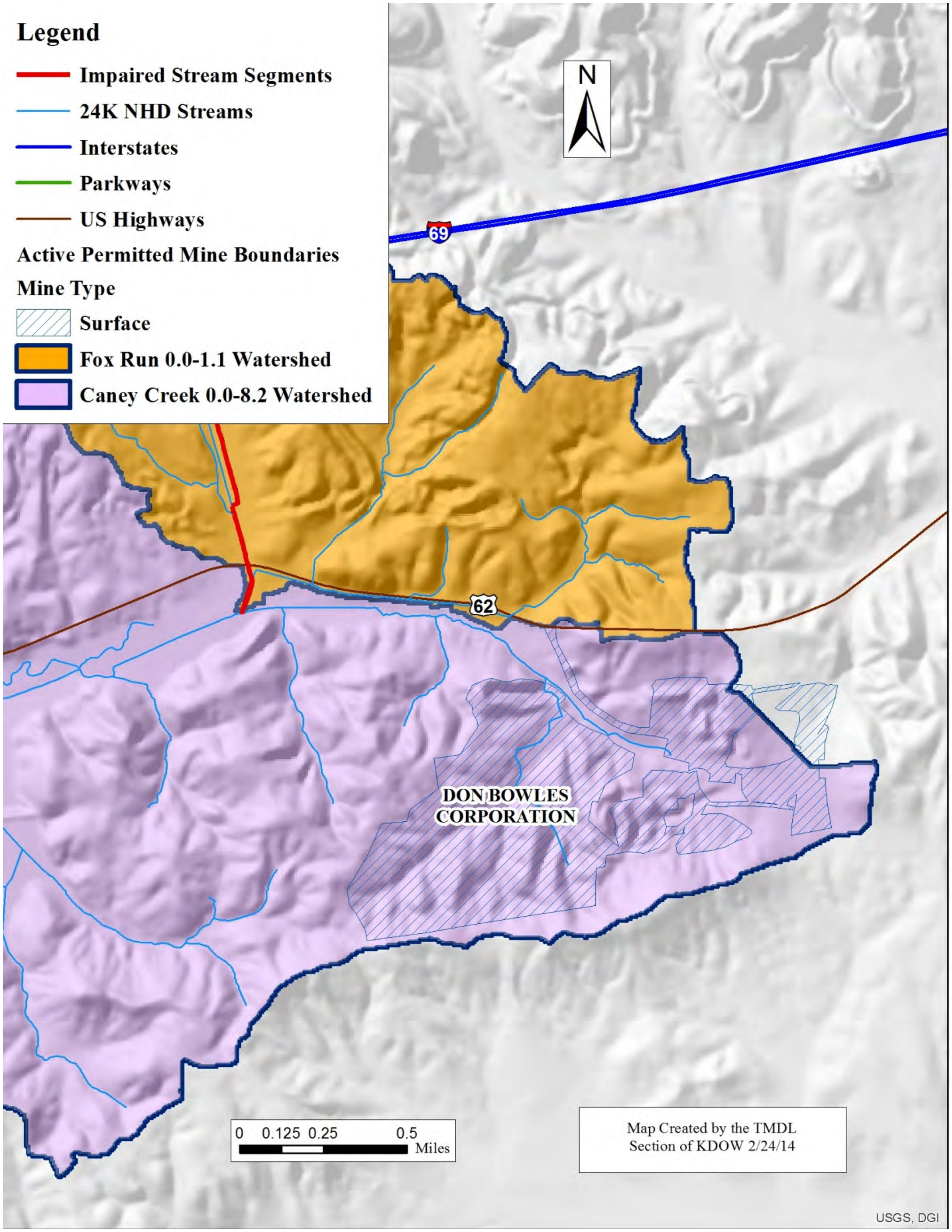


Figure 8.2.1.2 Location of the Don Bowles Corporation Can Do Mine, KPDES 0067121

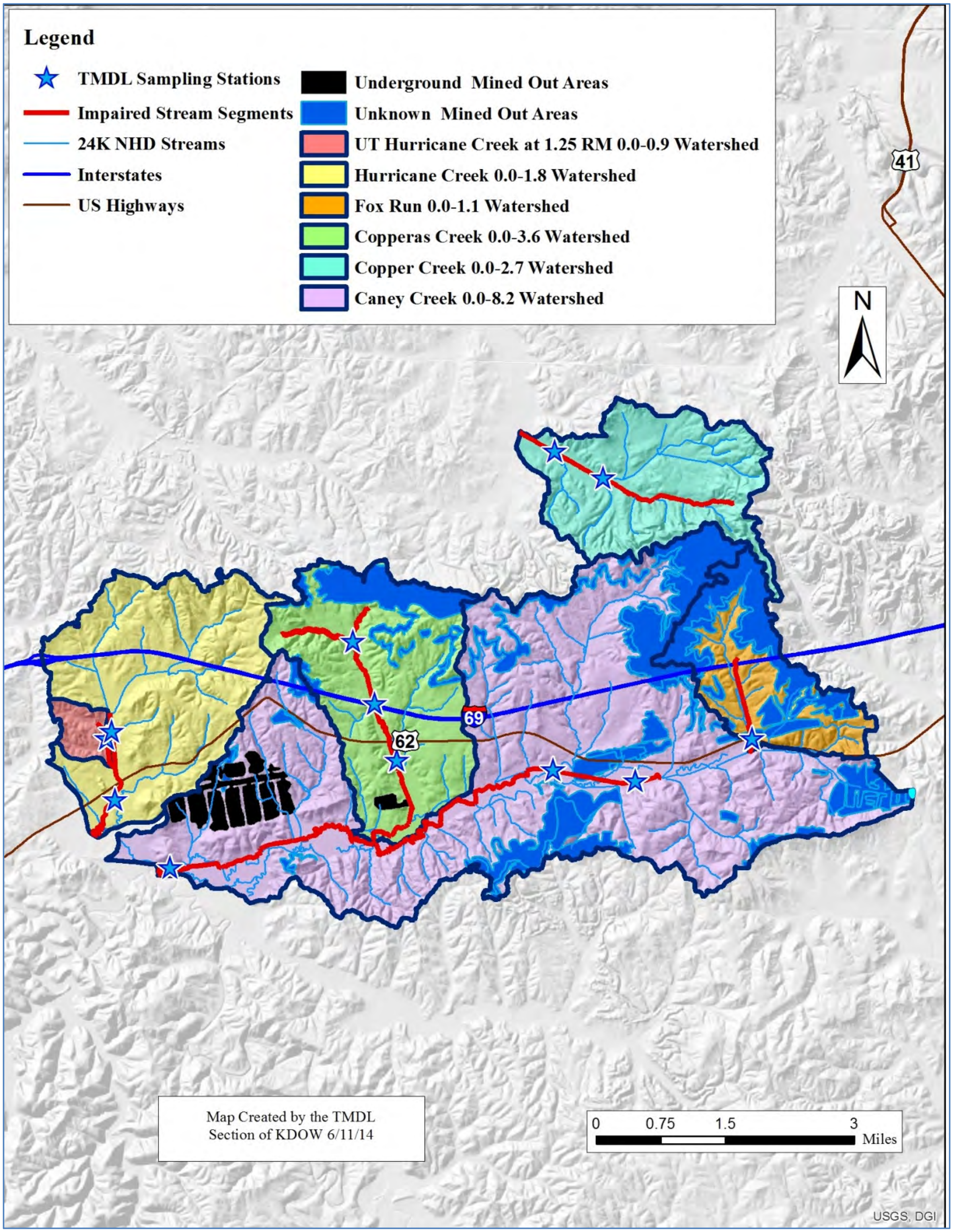


Figure 8.2.1.3 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Caney Creek Watershed

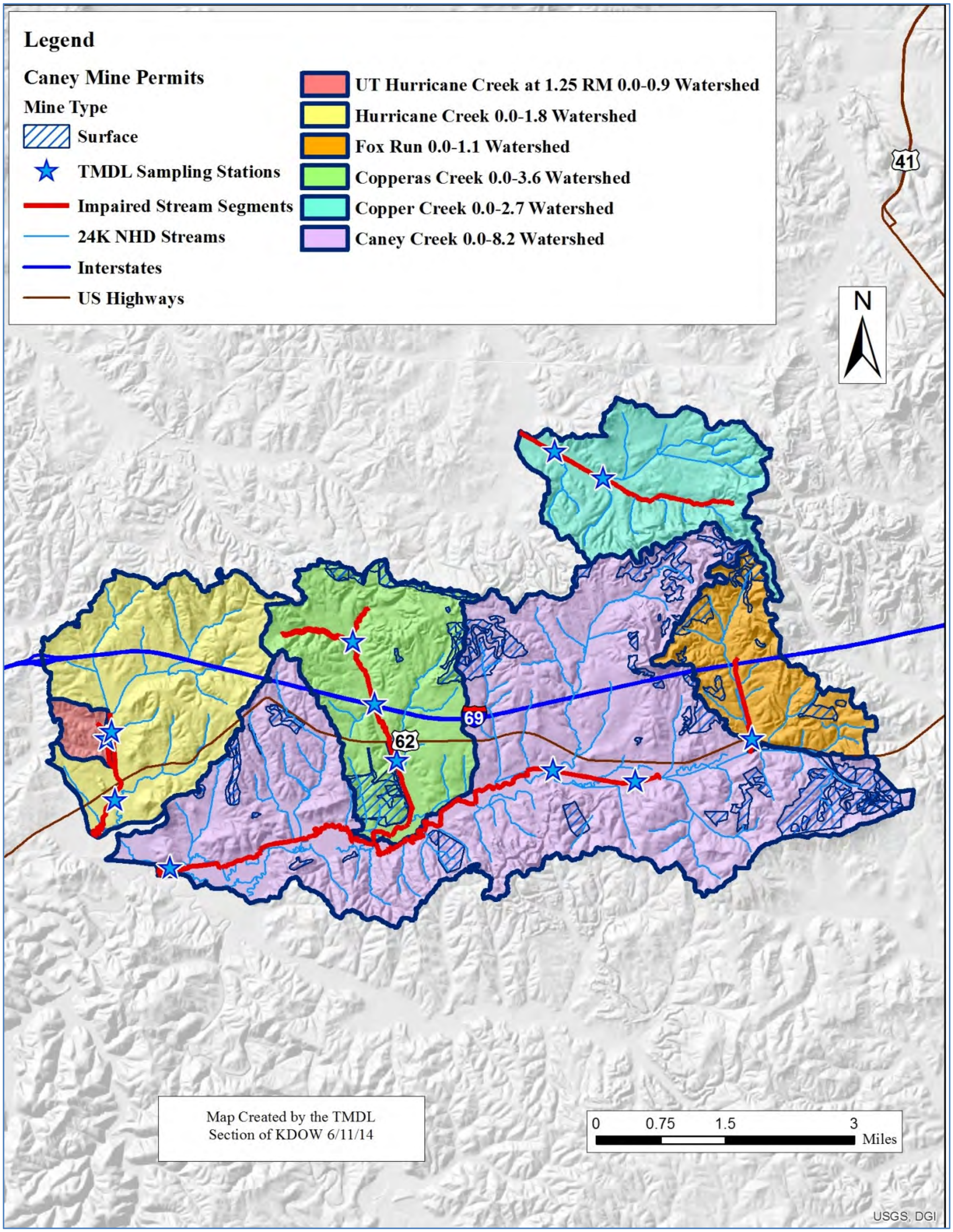


Figure 8.2.1.4 Data from the Department for Natural Resources on Licensed Mine Areas in the Caney Creek Watershed

Table 8.2.1.4 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Caney Creek Watershed

State File Number	Seam	Mine Type	Surface/Subsurface	Status
	585	UNKNOWN	Unknown	Abandoned
15159	565	STRIP TRUCK COAL	Surface	Abandoned
11415	565	UNKNOWN	Unknown	Abandoned
	585	UNKNOWN	Unknown	Abandoned
	585	UNKNOWN	Unknown	Abandoned
	585	UNKNOWN	Unknown	Abandoned
	585	UNKNOWN	Unknown	Abandoned
	585	UNKNOWN	Unknown	Abandoned
01641	585	UNKNOWN	Unknown	Abandoned
03482	590	UNKNOWN	Unknown	Abandoned
04965	590	UNKNOWN	Unknown	Abandoned
00445	600	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
10033	590	UNKNOWN	Unknown	Abandoned
10033	590	UNKNOWN	Unknown	Abandoned
02057	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
01641	590	UNKNOWN	Unknown	Abandoned
94315	590	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
90041	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
00445	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
00445	600	UNKNOWN	Unknown	Abandoned
10562-1	600	UNKNOWN	Unknown	Abandoned

State File Number	Seam	Mine Type	Surface/Subsurface	Status
06843-3	600	UNKNOWN	Unknown	Abandoned
06843-4	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
10562	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
95100	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
09972-7	600	UNKNOWN	Unknown	Abandoned
08286-1	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
00445	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
09108	620	UNKNOWN	Unknown	Abandoned
11415-1	620	UNKNOWN	Unknown	Abandoned
	620	UNKNOWN	Unknown	Abandoned
	625	UNKNOWN	Unknown	Abandoned
07081	655	UNKNOWN	Unknown	Abandoned
92803	655	UNKNOWN	Unknown	Abandoned
00308	655	UNKNOWN	Unknown	Abandoned
18024-2	655	UNDERGROUND TRUCK COAL	Underground	Abandoned
08146	655	UNKNOWN	Unknown	Abandoned
	655	UNKNOWN	Unknown	Abandoned
07745-3	655	UNKNOWN	Unknown	Abandoned
	655	UNKNOWN	Unknown	Abandoned
	655	UNKNOWN	Unknown	Abandoned

State File Number	Seam	Mine Type	Surface/Subsurface	Status
18040	655	UNDERGROUND TRUCK COAL	Underground	Abandoned
00454	655	UNDERGROUND RAIL COAL	Underground	Abandoned
	655	UNKNOWN	Unknown	Abandoned
08146	655	UNKNOWN	Unknown	Abandoned
07745-3	655	UNKNOWN	Unknown	Abandoned

Table 8.2.1.5 Data from the Department of Natural Resources on Licensed Mine Areas in the Caney Creek Watershed

DNR Permit	Mine Status(1)	Permit Name	Active/Inactive	Date Issued	Permit Type	Original Permit
0540034	RC	KIRKWOOD EXCAVATING INC	Released	7/27/1979	INTERIM	540034
0540071	RC	TERRY DARNELL MINES	Released	5/22/1980	INTERIM	540071
0540080	RC	MIRACLE MINING CO	Released	1/14/1981	INTERIM	540080
0540084	RC	MAGIC COLLERIES INC	Released	3/12/1981	INTERIM	540084
0540101	RC	MAGIC COLLERIES INC	Released	4/3/1981	INTERIM	540101
0540103	RC	MAGIC COLLERIES INC	Released	5/28/1981	INTERIM	540103
0540121	RC	KIRKWOOD EXCAVATING INC	Released	1/27/1982	INTERIM	540121
0540130	RC	DCLE COAL CORP	Released	1/29/1982	INTERIM	540130
0540134	RC	CHAROLAIS CORPORATION	Released	3/2/1982	INTERIM	540134
0540137	RC	ROMAR MINING INC	Released	4/14/1982	INTERIM	540137
0540140	RC	KIRKWOOD EXCAVATING INC	Released	7/8/1982	INTERIM	540140
0540142	RC	CHAROLAIS CORPORATION	Released	6/21/1982	INTERIM	540142
0540143	RC	CHRISTIAN COAL CORP	Released	6/30/1982	INTERIM	540143
0540144	RC	SOUTHERN INDIANA ENERGY INC	Released	7/13/1982	INTERIM	540144
0540147	RC	MIRACLE MINING CO	Released	7/30/1982	INTERIM	540147
0540151	RC	THOROUGHFARE COAL CORP	Released	7/15/1982	INTERIM	540151
0540158	RC	MIRACLE MINING CO	Released	8/4/1982	INTERIM	540158
4548008	RC	CHAROLAIS CORPORATION	Released	8/6/1984	PERMANENT	548008

DNR Permit	Mine Status(1)	Permit Name	Active/Inactive	Date Issued	Permit Type	Original Permit
8548011	A1	DON BOWLES CORPORATION	Active	1/8/2002	PERMANENT	548008
269271X						
100267X						
411475X	FF	INTERNATIONAL ENERGY CORP	Released	7/28/1975	PRE LAW	411475X
2540372	FF	JELLIKOHL MINE CO INC	Released	4/17/1978	INTERIM	2540372
291873X	FF	WALKER MINES	Released	8/13/1973	PRE LAW	291873X
321474X	RC	EDRO CO	Released	7/2/1974	PRE LAW	321474X
340274X	RC	ED BENNETT COAL CO	Released	10/17/1974	PRE LAW	340274X
423175X	RC	JIM SMITH CONTRACTING COMPANY INC	Released	9/15/1975	PRE LAW	423175X
441575X	RC	C N COAL CO	Released	2/5/1976	PRE LAW	441575X
210369X						
211569X						
248570X						
271373X						
277272						
296073X						
297373X						
297374X						
438875X						
603877X	RC	MARGARITA FUELS INC	Released	7/27/1977	PRE LAW	603877X
631177X	RC	ROYAL RESOURCES INC	Released	10/14/1977	PRE LAW	631177X
703577X	RC	VALLEY MINING CO	Released	4/5/1978	PRE LAW	703577X
8540014	RC	KIRKWOOD EXCAVATING INC	Released	9/18/1984	PERMANENT	8540014
8540247	RC	CHAROLAIS CORPORATION	Released	1/24/2002	PERMANENT	8540053
8540060	RC	EMERALD ENERGY CORPORATION	Released	7/18/1984	PERMANENT	8540060
8540062	RC	TERRY DARNELL MINES	Released	9/20/1984	PERMANENT	8540062
8540068	RC	H & G CONSTRUCTION CO INC	Released	5/20/1985	PERMANENT	8540068
8540112	RC	H & G CONSTRUCTION CO INC	Released	10/11/1986	PERMANENT	8540089
8540126	RC	WESTERN CARBON CORPORATION	Released	5/25/1989	PERMANENT	8540126
8540128	RC	HERRING CONSTRUCTION CO	Released	8/24/1988	PERMANENT	8540128

DNR Permit	Mine Status[1]	Permit Name	Active/Inactive	Date Issued	Permit Type	Original Permit
8544002	RC	HERRING CONSTRUCTION CO	Released	6/1/1987	PERMANENT	8544002
8545014	RC	MAGIC COAL COMPANY	Released	5/16/1991	PERMANENT	8545014
606077X						
82465						
8540159	FF	LONNIE ABBOTT	Released	3/1/1991	PERMANENT	8540126
8540230	RC	ISLAND FORK CONSTRUCTION LTD	Released	1/6/2000	PERMANENT	8540228
8545035	FF	MAGIC COAL COMPANY	Released	11/18/2003	PERMANENT	8545014
8548012	RC	DON BOWLES CORPORATION	Released	1/9/2002	PERMANENT	8546001
8545035	FF	MAGIC COAL COMPANY	Released	11/18/2003	PERMANENT	8545014
8545037	FF	AMERICAN MINING WEST LLC	Released	5/3/2006	PERMANENT	8545018
8545037	FF	AMERICAN MINING WEST LLC	Released	5/3/2006	PERMANENT	8545018
89563						
93771						
93965						
93966						
93972						

[1] Mine Status Codes:

FF = Final Forfeiture.

A1 = Active, Currently Being Mined.

RC = Permit Completely Released (Result of Transfer or Phase III Bond Release).

8.2.2 Copper Creek of Richland Creek 0.0 to 2.7

Copper Creek is impaired for pH, iron and zinc. TMDL sampling data indicate the stream was still impaired for pH at the time of data collection. Likewise iron showed all exceedances of the acute limit, but zinc showed no exceedances, see Tables 8.2.2.1 and 8.2.2.2. However, as stated in Section 2.1, the zinc impairment will not be reassessed without additional data. Other metals did not show exceedances, with the exception of mercury, which showed one exceedance of the fish consumption limit of 0.051 µg/L at station DOW10009001, see Appendix A. Figures 8.2.2.1 through 8.2.2.6 relate pollutant concentrations to flow to assist in determining the critical condition. Figure 8.2.2.7 shows the DMS mined out areas, and Figure 8.2.2.8 shows the DNR mine permit boundaries. Tables 8.2.2.3 and 8.2.2.4 list both types of potential sources.

Table 8.2.2.1 pH, Hardness, Iron, Zinc and Flow Data Collected for DOW10009001 Copper Creek of Richland Creek 0.0 to 2.7, RM 0.45

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L	Flow, cfs
5/18/2006	3.22	790	7.43	309	-381.4	690.4	690.4	2.953
7/19/2006	2.55	1940	42.6	755	-723.0	1478.0	1478.0	0.855
8/10/2006	2.73	1850	42.6 D	752	-667.7	1419.7	1419.7	0.689
9/28/2006	3.46	1000 (1050)	6.34 (6.33)	307 (307)	-585.7	892.7	892.7	1.724
10/18/2006	3.08	1250 (1280)	10.9 (11.0)	332 D (338 D)	-686.4	1018.4	1018.4	1.411
11/29/2006	3.37	1300	13.6	326 D	-726.8	1052.8	1052.8	2.119
1/10/2007	3.32	866	19.8	291 D	-455.2	746.2	746.2	5.236
2/22/2007	3.29	970	21.7 D	308 D	-513.5	821.5	821.5	3.715
3/22/2007	3.84	715	12.2	251 D	-383.4	634.4	634.4	4.283
	Exceeds the pH limit							
	Exceeds the acute limit							

Table 8.2.2.2 pH, Hardness, Iron, Zinc and Flow Data Collected for DOW10009003 Copper Creek of Richland Creek 0.0 to 2.7, RM 1.11

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L	Flow, cfs
5/18/2006	2.75	930	26.7	474	-318.7	792.7	792.7	1.551
7/19/2006	2.42	1950	61.5	965 D	-519.4	1484.4	1484.4	0.240
8/10/2006	2.64	1880	62.9 D	896 D	-543.2	1439.2	1439.2	0.194
9/28/2006	2.95	1380	28.5 D	519	-588.5	1107.5	1107.5	0.744
10/18/2006	2.76	1630	36.3 D	556 D	-719.3	1275.3	1275.3	0.387
11/29/2006	4.34	1390	28.6 D	421 D	-693.3	1114.3	1114.3	0.981
1/10/2007	2.77	1090	39.1 D	385 D	-521.8	906.8	906.8	2.232
2/22/2007	2.98	1470	49.1 D	538 D	-630.4	1168.4	1168.4	1.844
3/22/2007	2.80	1380	41.4 D	581 D	-526.5	1107.5	1107.5	2.035
(yellow)	Exceeds the pH limit							
(orange)	Exceeds the acute limit							

Critical Condition (pH). For Site DOW10009001, pH decreased with flow, with a fair R^2 value, see Figure 8.2.2.1. For Site DOW10009003, no trend was observed, see Figure 8.2.2.2. This may indicate different sources are influencing the two stations. The lowest pH value was 2.42 observed at Site DOW10009003 on 7/19/2006, which is therefore the critical condition for pH for this impaired segment.

Critical Condition (Iron). For Site DOW10009001, iron decreased slightly with flow, although the R^2 value was low, see Figure 8.2.2.3. Similar results were obtained at Site DOW10009003, a decreasing trend with flow but a low R^2 value, see Figure 8.2.2.4. The highest iron value was 62.9 mg/L observed at Site DOW10009003 on 8/10/2006, which is therefore the critical condition for iron for this impaired segment.

Critical Condition (Zinc). For Site DOW10009001, the difference between the zinc concentration and the chronic zinc WQC decreased with flow, with a fair R^2 value, see Figure 8.2.2.5. A similar but less pronounced trend was observed at Site DOW10009003, with a poor R^2 value, see Figure 8.2.2.6. The highest zinc difference was -318.7 mg/L observed at Site DOW10009003 on 5/18/2006, which is therefore the critical condition for zinc for this impaired segment.

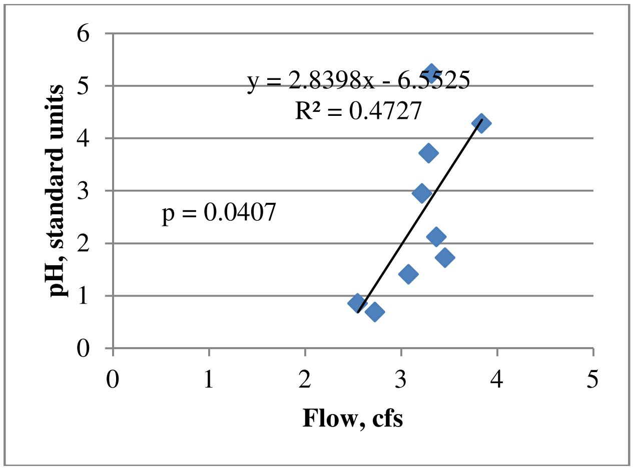


Figure 8.2.2.1 pH vs. Flow at Copper Creek Site DOW10009001, RM 0.45

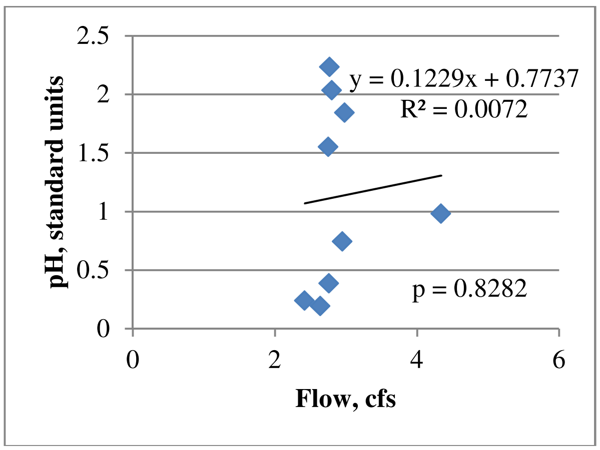


Figure 8.2.2.2 pH vs. Flow at Copper Creek Site DOW100019003, RM 1.11

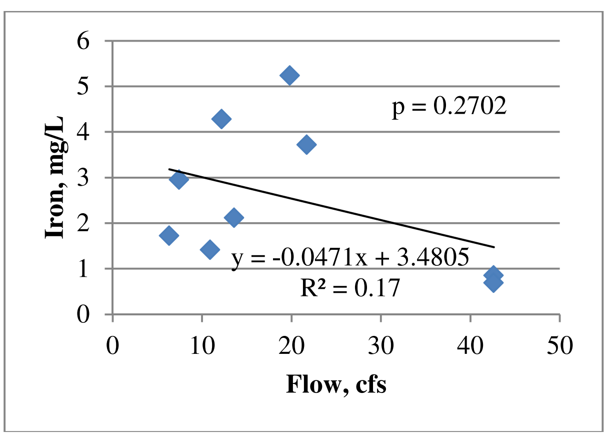


Figure 8.2.2.3 Iron vs. Flow at Copper Creek Site DOW10009001, RM 0.45

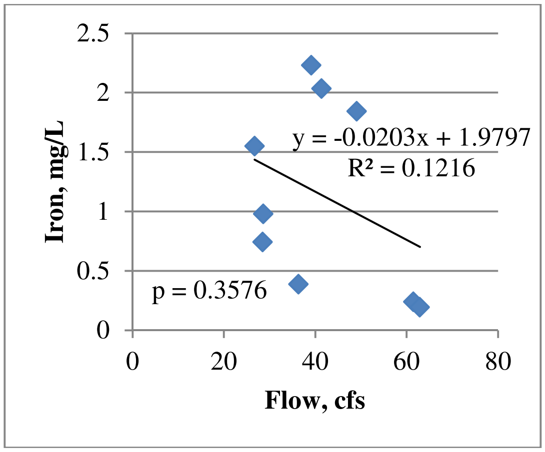


Figure 8.2.2.4 Iron vs. Flow at Copper Creek Site DOW10009003, RM 1.11

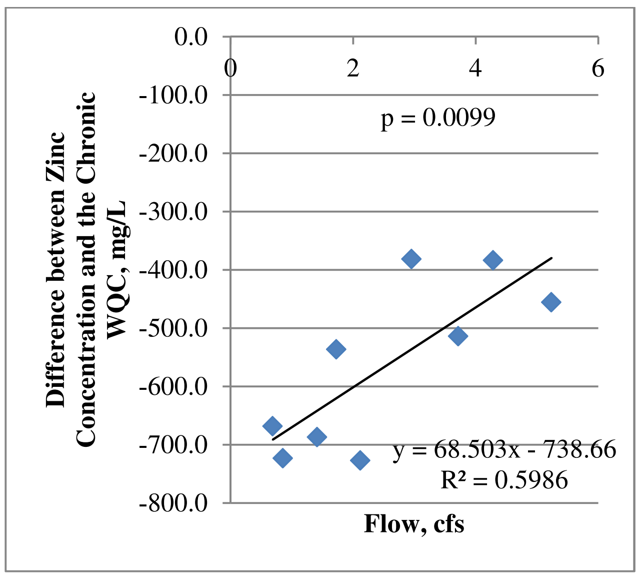


Figure 8.2.2.5 Zinc Difference vs. Flow at Copper Creek Site DOW10009001, RM 0.45

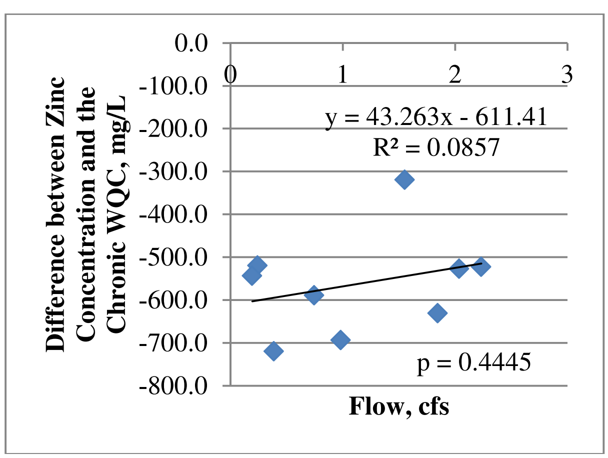


Figure 8.2.2.6 Zinc Difference vs. Flow at Copper Creek Site DOW10009003, RM 1.11

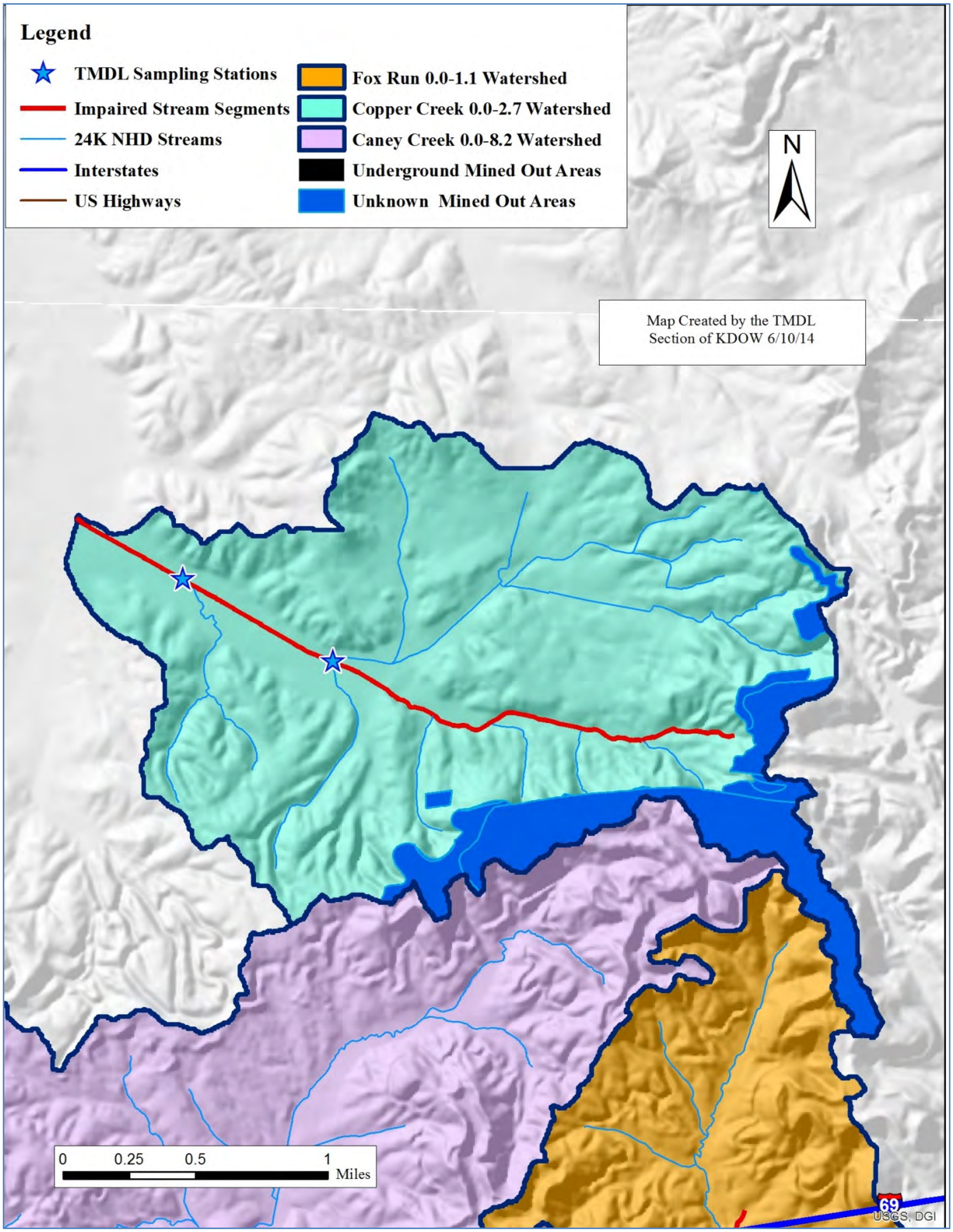


Figure 8.2.2.7 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Copper Creek Watershed

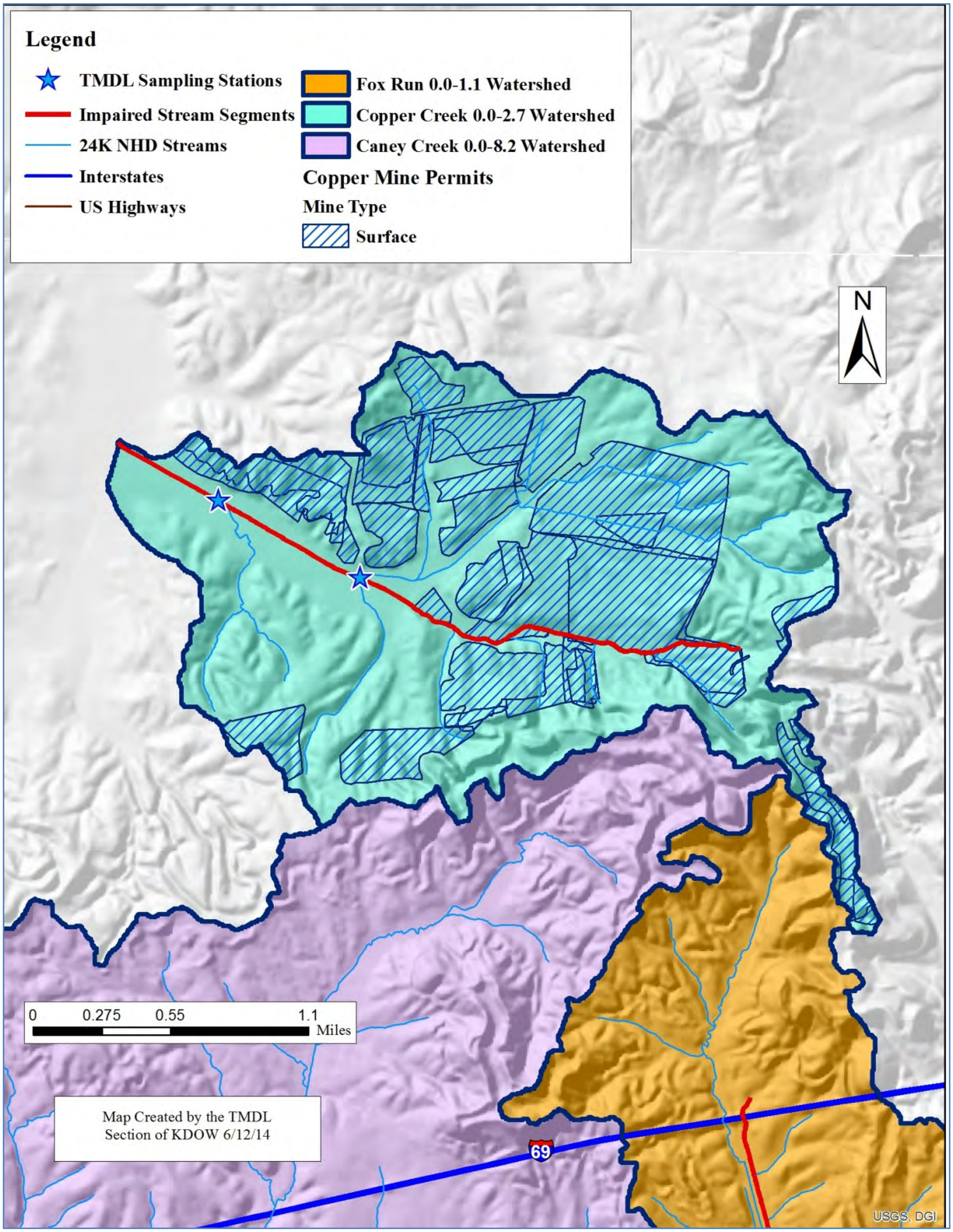


Figure 8.2.2.8 Data from the Department for Natural Resources on Licensed Mine Areas in the Copper Creek Watershed

Table 8.2.2.3 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Copper Creek Watershed

State File Number	Seam	Mine Type	Surface/Subsurface	Status
09218	600	UNKNOWN	Unknown	Abandoned
01641	585	UNKNOWN	Unknown	Abandoned
01641	590	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
10092	600	UNKNOWN	Unknown	Abandoned
10773-3	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned

Table 8.2.2.4 Data from the Department for Natural Resources on Licensed Mine Areas in the Copper Creek Watershed

DNR Permit	Mine Status(1)	Permit Name	Active/ Inactive	Date Issued	Permit Type	Original Permit
0540094	RC	T D C INC	Released	12/2/1980	INTERIM	540094
0540095	RC	KENTUCKY MINERALS INC	Released	12/18/1980	INTERIM	540095
0540099	RC	JIM SMITH CONTRACTING COMPANY INC	Released	2/11/1981	INTERIM	540099
0540143	RC	CHRISTIAN COAL CORP	Released	6/30/1982	INTERIM	540143
456275X						
100267X						
321475X	RC	WESTCO INC	Released	7/10/1975	PRE LAW	321475X
423175X	RC	JIM SMITH CONTRACTING COMPANY INC	Released	9/15/1975	PRE LAW	423175X
4540094	RC	T D C INC	Released	8/6/1984	PERMANENT	540094
8540131	RC	COSTAIN COAL INC	Released	11/17/1988	PERMANENT	4540099
457975X	RC	WESTCO INC	Released	5/13/1976	PRE LAW	457975X
480476X	RC	THUNDERBIRD COAL CO	Released	8/5/1976	PRE LAW	480476X
537376X	RC	WESTCO INC	Released	1/26/1977	PRE LAW	537376X
539176X	RC	EDRO CO	Released	1/28/1977	PRE LAW	539176X
541176X	RC	WESTCO INC	Released	2/3/1977	PRE LAW	541176X
561976X	RC	BELL & WALKER INC	Released	4/15/1977	PRE LAW	561976X
201068X						
451575X						
593877X	RC	WESTCO INC	Released	7/6/1977	PRE LAW	593877X
663477X	RC	WESTCO INC	Released	1/11/1980	PRE LAW	663477X
714777X	RC	WESTCO INC	Released	5/2/1977	PRE LAW	714777X
8540133	RC	LODESTAR ENERGY INC	Released	11/29/1988	PERMANENT	8540016

DNR Permit	Mine Status[1]	Permit Name	Active/ Inactive	Date Issued	Permit Type	Original Permit
8540135	VF	LODESTAR ENERGY INC	Released	11/17/1988	PERMANENT	8540038
8540045	RC	CHRISTIAN COAL CORP	Released	5/9/1984	PERMANENT	8540045
8540056	RC	CHRISTIAN COAL CORP	Released	1/15/1985	PERMANENT	8540056
8540136	VF	LODESTAR ENERGY INC	Released	11/16/1988	PERMANENT	8540082
8540126	RC	WESTERN CARBON CORPORATION	Released	5/25/1989	PERMANENT	8540126
8540159	FF	LONNIE ABBOTT	Released	3/1/1991	PERMANENT	8540126
8540230	RC	ISLAND FORK CONSTRUCTION LTD	Released	1/6/2000	PERMANENT	8540228
93771						
93972						

[1] Mine Status Codes:

FF = Final Forfeiture.
RC = Permit Completely Released (Result of Transfer or Phase III Bond Release)
VF = Voluntary Forfeiture.

8.2.3 Copperas Creek of Caney Creek 0.0 to 3.6

Copperas Creek is impaired for pH, cadmium, iron, nickel and zinc. TMDL sampling data indicate the stream was still impaired for pH at the time of data collection, with all samples from the three sites below the limit of 6.0 standard units. Iron showed exceedances of the acute limit in all samples at all three sites as well. Zinc showed almost all exceedances of the acute and chronic limit (which are the same), 22 out of 25 samples. Nickel showed 17 out of 25 exceedances of the chronic limit. Cadmium showed 2 exceedances of the chronic limit and 17 of the acute limit, see Tables 8.2.3.1 through 8.2.3.9. Of the other metals, arsenic showed two exceedances, selenium two, and mercury one, see Appendix A. Figures 8.2.3.1 through 8.2.3.15 relate pollutant concentrations to flow to assist in determining the critical condition. Figure 8.2.3.16 shows the DMS mined out areas, and Figure 8.2.3.17 shows the DNR mine permit boundaries. Tables 8.2.3.10 and 8.2.3.11 list both types of potential sources.

Table 8.2.3.1 pH, Hardness, Iron and Zinc Data Collected for DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6, RM 1.40

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L
5/17/2006	4.00	188	17.0	303	98.4	204.6	204.6
7/18/2006	2.69	457	21.2	790 D	355.8	434.2	434.2
9/27/2006	3.03	342	31.7	620	280.4	339.6	339.6
10/17/2006	3.03	378	32.2 D	115 D	-254.7	369.7	369.7
11/28/2006	3.36	359	32.3 D	766 D	412.1	353.9	353.9
1/11/2007	3.30	229	19.7 D	453 D	211.2	241.8	241.8
2/20/2007	3.66	281	25.1 D	350 D	62.5	287.5	287.5
3/21/2007	3.64	265	16.7	452 D	178.4	273.6	273.6
	Exceeds the pH limit						
	Exceeds the acute limit						
n/d = non detect							

Table 8.2.3.2 Nickel and Flow Data Collected for DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6, RM 1.40

Date	Nickel, µg/L	Nickel Chronic Limit, µg/L	Nickel Acute Limit, µg/L	Difference between the Nickel Concentration and the Nickel Chronic Limit, µg/L	Flow
5/17/2006	90.7	89.0	800.3	1.7	3.83
7/18/2006	206.0	188.6	1696.8	17.4	0.03
9/27/2006	188.0	147.6	1327.8	40.4	1.50
10/17/2006	33.8 D	160.7	1445.1	-126.9	1.60
11/28/2006	182.0	153.8	1383.4	28.2	1.44
1/11/2007	121.0	105.1	945.7	15.9	3.96
2/20/2007	123.0	125.0	1124.4	-2.0	3.47
3/21/2007	122.0	119.0	1070.0	3.0	4.67
	Exceeds the chronic limit				

Table 8.2.3.3 Cadmium Data Collected for DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6, RM 1.40

Date	Cadmium µg/L	Cadmium Chronic Limit, µg/L	Cadmium Acute Limit, µg/L	Difference between the Cadmium Concentration and the Cadmium Chronic Limit, µg/L
5/17/2006	4.33 J	0.4	4.1	3.9
7/18/2006	6.83 JD	0.8	10.0	6.0
9/27/2006	10.80	0.7	7.4	10.1
10/17/2006	n/d @ 4 D	0.7	8.2	
11/28/2006	15.9 JD	0.7	7.8	15.2
1/11/2007	6.42	0.5	5.0	5.9
2/20/2007	7.8 D	0.6	6.1	7.2
3/21/2007	8.42 D	0.6	5.7	7.9
	Exceeds the chronic limit			
	Exceeds the acute limit			
n/d = non detect				

Table 8.2.3.4 pH, Hardness, Iron and Zinc Data Collected for DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6, RM 2.20

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L
5/17/2006	3.11	272.0	6.4	472	192.3	279.7	279.7
7/18/2006	2.55	674.0	20.0	25.2 D	-578.2	603.4	603.4
9/27/2006	2.97	375.0	16.8	599	231.8	367.2	367.2
10/17/2006	2.92	482.0	17.9	651	196.8	454.2	454.2
11/28/2006	3.24	393.0	17.1	760 D	377.9	382.1	382.1
1/11/2007	3.83	254.0	12.1	504 D	240.0	264.0	264.0
2/20/2007	3.69	305.0	13.6	353 D	44.8	308.2	308.2
3/21/2007	3.66	305.0	8.8	428	119.8	308.2	308.2
	Exceeds the pH limit						
	Exceeds the acute limit						
n/d = non detect							

Table 8.2.3.5 Nickel and Flow Data Collected for DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6, RM 2.20

Date	Nickel, µg/L	Nickel Chronic Limit, µg/L	Nickel Acute Limit, µg/L	Difference between the Nickel Concentration and the Nickel Chronic Limit, µg/L	Flow
5/17/2006	137	121.6	1093.9	15.4	1.469
7/18/2006	283	262.1	2357.1	20.9	0.032
9/27/2006	198	159.6	1435.4	38.4	0.762
10/17/2006	189	197.3	1775.0	-8.3	0.730
11/28/2006	179	166.0	1493.4	13.0	0.893
1/11/2007	125	114.8	1032.3	10.2	2.868
2/20/2007	122	134.0	1205.2	-12.0	2.207
3/21/2007	119	134.0	1205.2	-15.0	2.734
	Exceeds the chronic limit				

Table 8.2.3.6 Cadmium Data Collected for DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6, RM 2.20

Date	Cadmium µg/L	Cadmium Chronic Limit, µg/L	Cadmium Acute Limit, µg/L	Difference between the Cadmium Concentration and the Cadmium Chronic Limit, µg/L
5/17/2006	n/d @ 10	0.6	5.9	
7/18/2006	n/d @ 0.8 D	1.1	14.8	
9/27/2006	11.60	0.7	8.2	10.9
10/17/2006	n/d @ 4.0	0.9	10.6	
11/28/2006	14.3 D	0.7	8.6	13.6
1/11/2007	7.82	0.5	5.5	7.3
2/20/2007	9.28 D	0.6	6.6	8.7
3/21/2007	6.8 J	0.6	6.6	6.2
	Exceeds the chronic limit			
	Exceeds the acute limit			
n/d = non detect				

Table 8.2.3.7 pH, Hardness, Iron and Zinc Data Collected for DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6, RM 3.07

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L
5/17/2006	2.72	500	48.5	1180	711.5	468.5	468.5
7/18/2006	2.29	931	140	38.9 D	-754.5	793.4	793.4
8/10/2006	2.49	1130	166 D	1440	505.0	935.0	935.0
9/27/2006	2.91	463	33.7 D	847	408.0	439.0	439.0
10/17/2006	2.89	646	36.4 D	946	363.9	582.1	582.1
11/28/2006	3.28	589	52 D	1210 D	671.7	538.3	538.3
1/11/2007	3.13	428	32.2 D	886 D	475.3	410.7	410.7
2/20/2007	3.29	512	43.2 D	891 D	412.9	478.1	478.1
3/21/2007	3.39	479	24.2 D	697	245.2	451.8	451.8
	Exceeds the pH limit						
	Exceeds the acute limit						
n/d = non detect							

Table 8.2.3.8 Nickel and Flow Data Collected for DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6, RM 3.07

Date	Nickel, µg/L	Nickel Chronic Limit, µg/L	Nickel Acute Limit, µg/L	Difference between the Nickel Concentration and the Nickel Chronic Limit, µg/L
5/17/2006	312	203.6	1830.9	108.4
7/18/2006	406	344.4	3097.9	61.6
8/10/2006	387	405.8	3649.5	-18.8
9/27/2006	252	190.7	1715.6	61.3
10/17/2006	274	252.8	2274.0	21.2
11/28/2006	297	233.8	2103.1	63.2
1/11/2007	225	178.5	1605.2	46.5
2/20/2007	229	207.7	1868.0	21.3
3/21/2007	187	196.3	1765.6	-9.3
	Exceeds the chronic limit			

Table 8.2.3.9 Cadmium Data Collected for DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6, RM 3.07

Date	Cadmium µg/L	Cadmium Chronic Limit, µg/L	Cadmium Acute Limit, µg/L	Difference between the Cadmium Concentration and the Cadmium Chronic Limit, µg/L
5/17/2006	17.6	0.9	11.0	16.7
7/18/2006	n/d @ 2.0 D	1.4	20.6	
8/10/2006	12.6	1.6	25.1	11.0
9/27/2006	15.7	0.8	10.1	14.9
10/17/2006	n/d @ 4	1.1	14.2	
11/28/2006	23 D	1.0	12.9	22.0
1/11/2007	14.1 D	0.8	9.4	13.3
2/20/2007	15.9 D	0.9	11.2	15.0
3/21/2007	12.5	0.9	10.5	11.6
	Exceeds the chronic limit			
	Exceeds the acute limit			
n/d = non detect				

Critical Condition (pH). For Site DOW10014016, pH decreased with flow, with a good R^2 value, see Figure 8.2.3.1. For Site DOW10014017, a similar trend was observed with a good R^2 value, except the trendline had a much steeper slope, see Figure 8.2.3.2. Site DOW10014018 also showed pH decreasing with flow, with a fair R^2 value, see Figure 8.2.3.3. Copperas Creek therefore has a low-flow critical condition for pH. The lowest pH value was 2.29 observed at Site DOW10014018 on 7/18/2006.

Critical Condition (Iron). For Site DOW10014016, iron decreased with flow with a fair R^2 value, see Figure 8.2.3.4. Site DOW10014017 also showed a decreasing trend with flow with a fair R^2 value, see Figure 8.2.3.5. Site DOW10014018 also showed iron decreasing with flow, but with a poor R^2 value, see Figure 8.2.3.6. The highest iron value was 166 mg/L observed at Site DOW10014018 on 8/10/2006, which is therefore the critical condition for iron for this impaired segment.

Critical Condition (Zinc). For Site DOW10014016, the difference between the zinc concentration and the chronic zinc WQC decreased with flow, but with a poor R^2 value, see Figure 8.2.3.7. An opposite trend was observed at Site DOW10014017, zinc slightly increasing with flow, with a poor R^2 value, see Figure 8.2.3.8. Site DOW10014018 showed zinc slightly increasing with flow, with a poor R^2 value, see Figure 8.2.3.9. It appears that zinc's critical condition is not limited to either high or low flow. The highest zinc difference was 711.5 mg/L observed at Site DOW10014018 on 5/17/2006, which is therefore the critical condition for zinc for this impaired segment.

Critical Condition (Nickel). For Site DOW10014016, the difference between the nickel concentration and the nickel WQC decreased with flow, but with a poor R^2 value, see Figure 8.2.3.10. An opposite trend was observed at Site DOW10014017 and DOW10014018, nickel slightly decreasing with flow, but also with poor R^2 values, see Figures 8.2.3.11 and 8.2.3.12. The highest nickel difference was 108.4 mg/L observed at Site DOW10014018 on 5/17/2006, which is therefore the critical condition for nickel for this impaired segment.

Critical Condition (Cadmium). For Site DOW10014016, the difference between the cadmium concentration and the chronic cadmium WQC decreased very slightly with flow, but with a poor R^2 value, see Figure 8.2.3.13. An opposite trend was observed at Sites DOW10014017 and DOW10014018, cadmium slightly increasing with flow, but also with poor R^2 values, see Figures 8.2.3.14 and 8.2.3.15. The highest cadmium difference was 22.0 mg/L observed at Site DOW10014018 on 11/28/2006, which is therefore the critical condition for cadmium for this impaired segment.

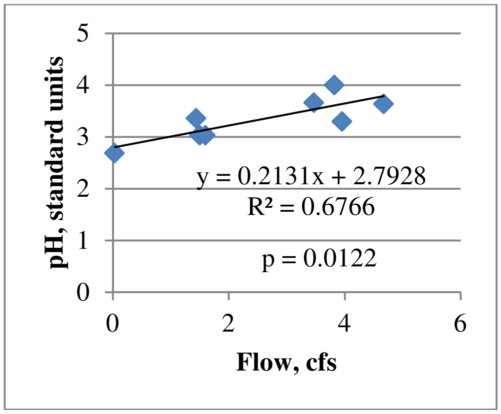


Figure 8.2.3.1 pH vs. Flow at Copperas Creek Site DOW10014016, RM 1.40

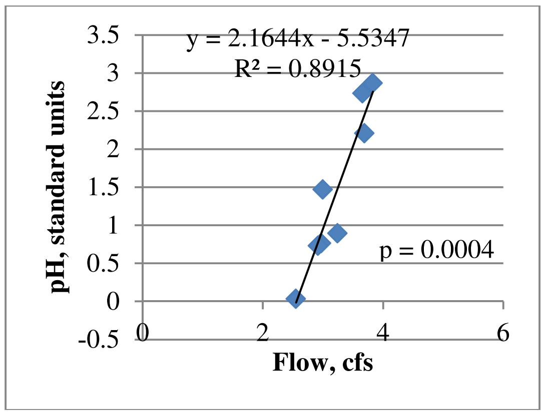


Figure 8.2.3.2 pH vs. Flow at Copperas Creek Site DOW10014017, RM 2.20

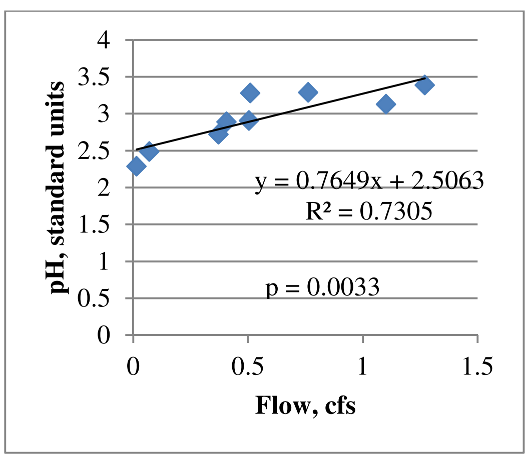


Figure 8.2.3.3 pH vs. Flow at Copperas Creek Site DOW10014018, RM 3.07

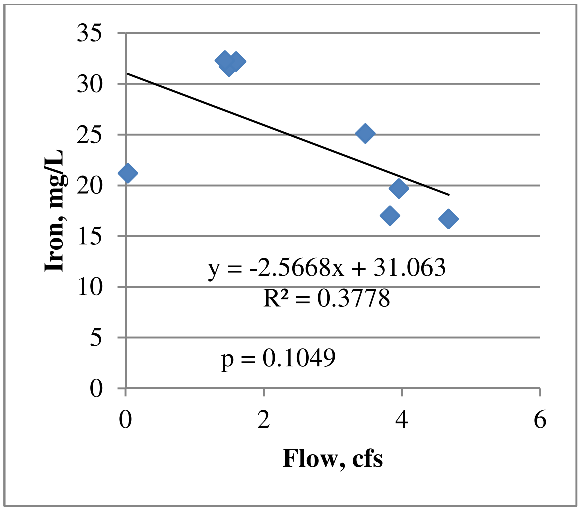


Figure 8.2.3.4 Iron vs. Flow at Copperas Creek Site DOW10014016, RM 1.40

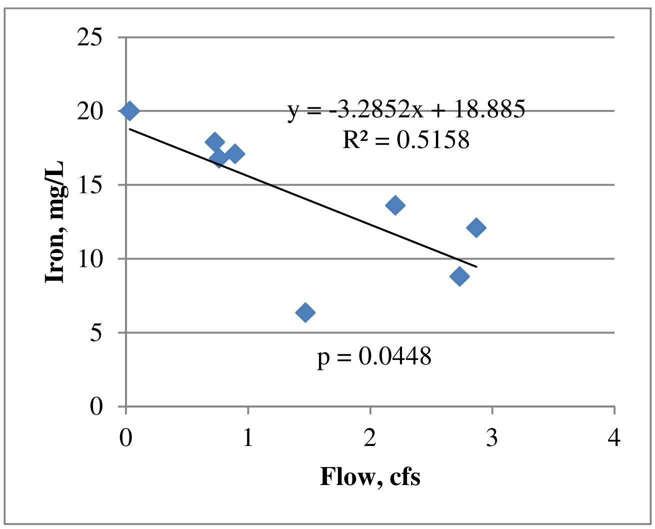


Figure 8.2.3.5 Iron vs. Flow at Copperas Creek Site DOW10014017, RM 2.20

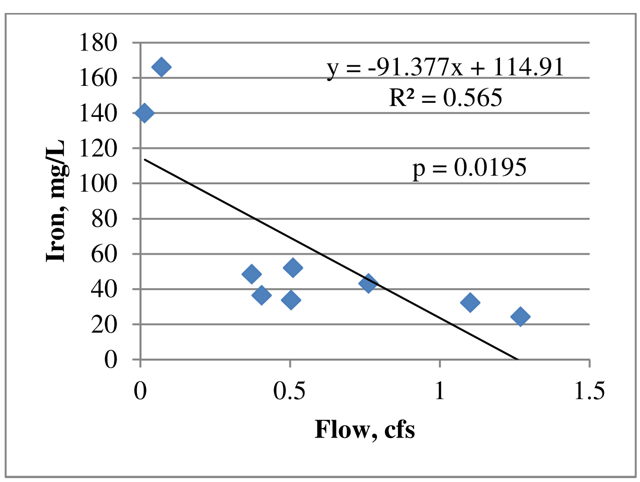


Figure 8.2.3.6 Iron vs. Flow at Copperas Creek Site DOW10014018, RM 3.07

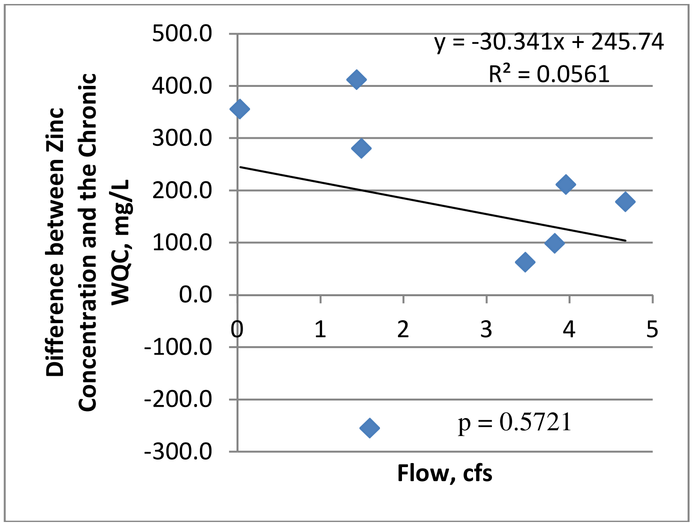


Figure 8.2.3.7 Zinc Difference vs. Flow at Copperas Creek Site DOW10014016, RM 1.40

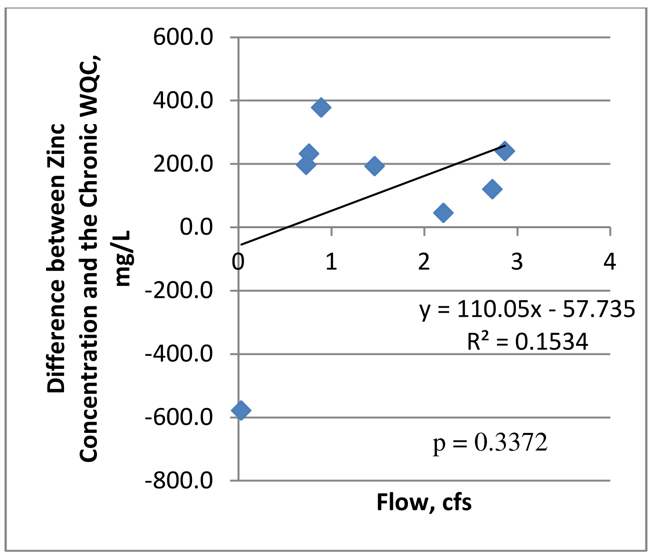


Figure 8.2.3.8 Zinc Difference vs. Flow at Copperas Creek Site DOW10014017, RM 2.20

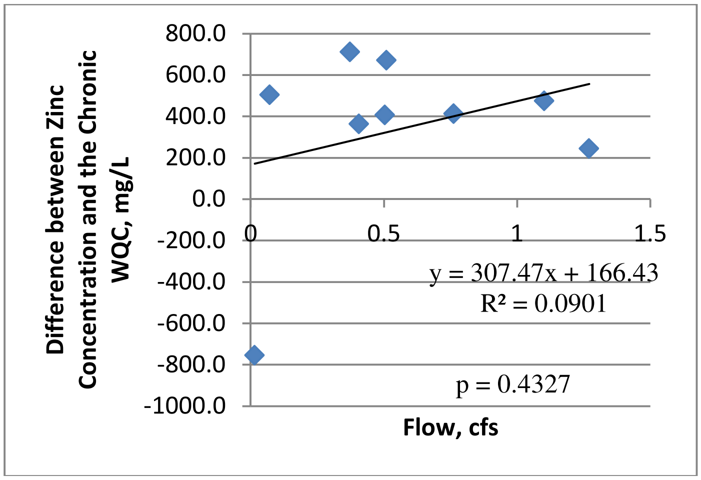


Figure 8.2.3.9 Zinc Difference vs. Flow at Copperas Creek Site DOW10014018, RM 3.07

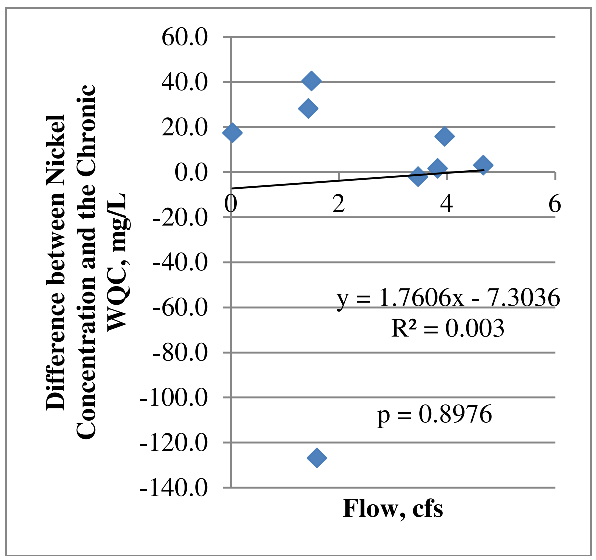


Figure 8.2.3.10 Nickel Difference vs. Flow at Copperas Creek Site DOW10014016, RM 1.40

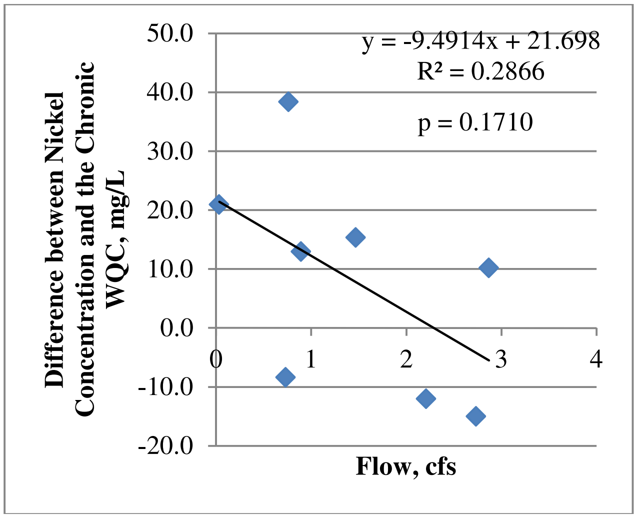


Figure 8.2.3.11 Nickel Difference vs. Flow at Copperas Creek Site DOW10014017, RM 2.20

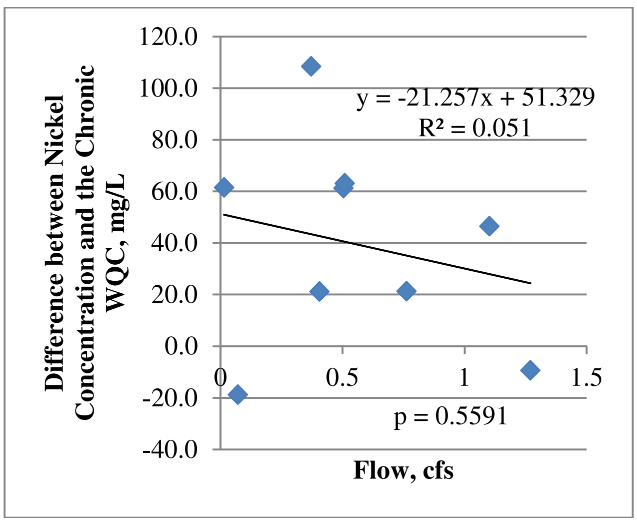


Figure 8.2.3.12 Nickel Difference vs. Flow at Copperas Creek Site DOW10014018, RM 3.07

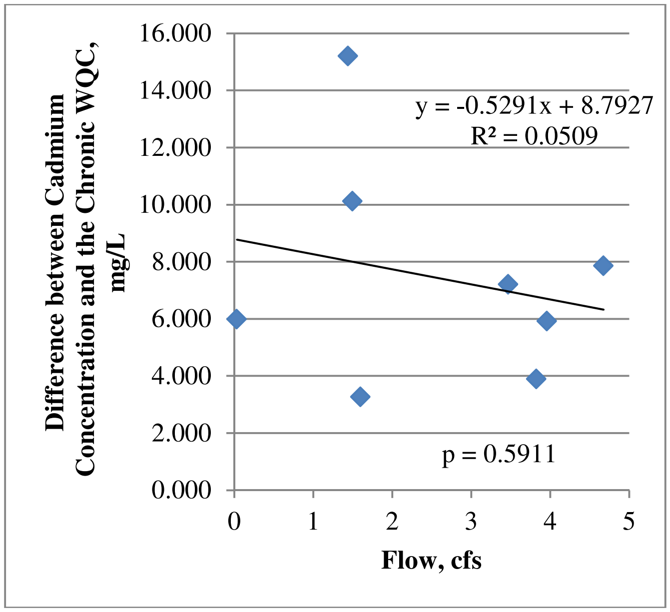


Figure 8.2.3.13 Cadmium Difference vs. Flow at Copperas Creek Site DOW10014016, RM 1.40

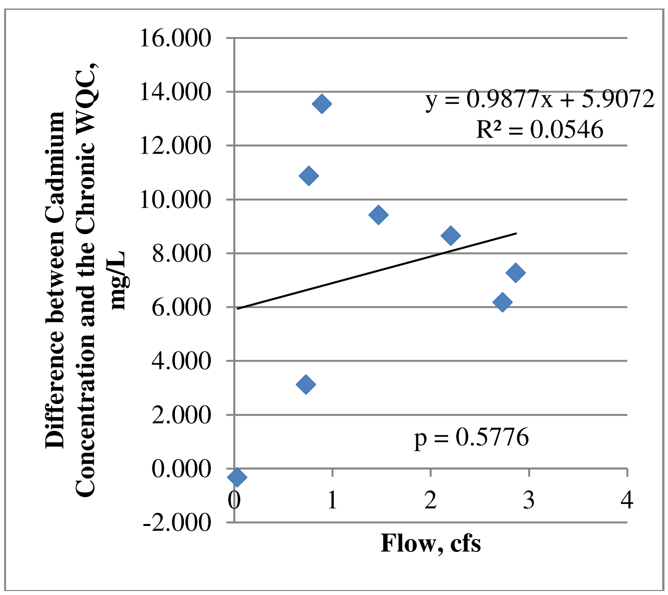


Figure 8.2.3.14 Cadmium Difference vs. Flow at Copperas Creek Site DOW10014017, RM 2.20

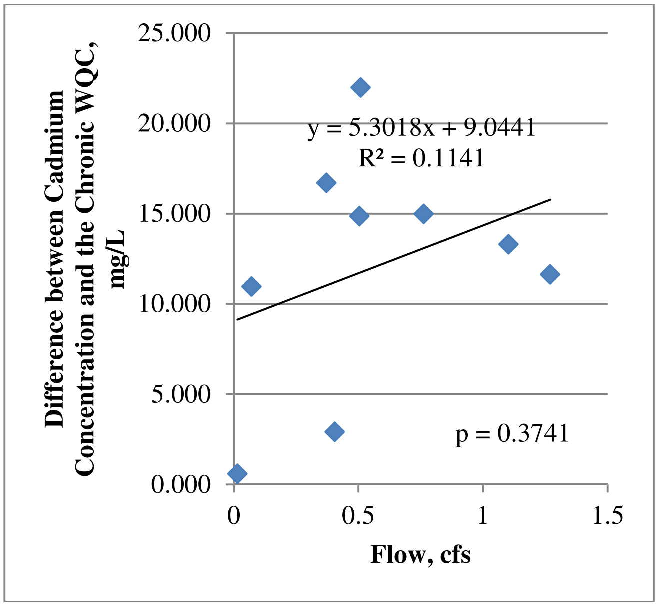


Figure 8.2.3.15 Cadmium Difference vs. Flow at Copperas Creek Site DOW10014018, RM 3.07

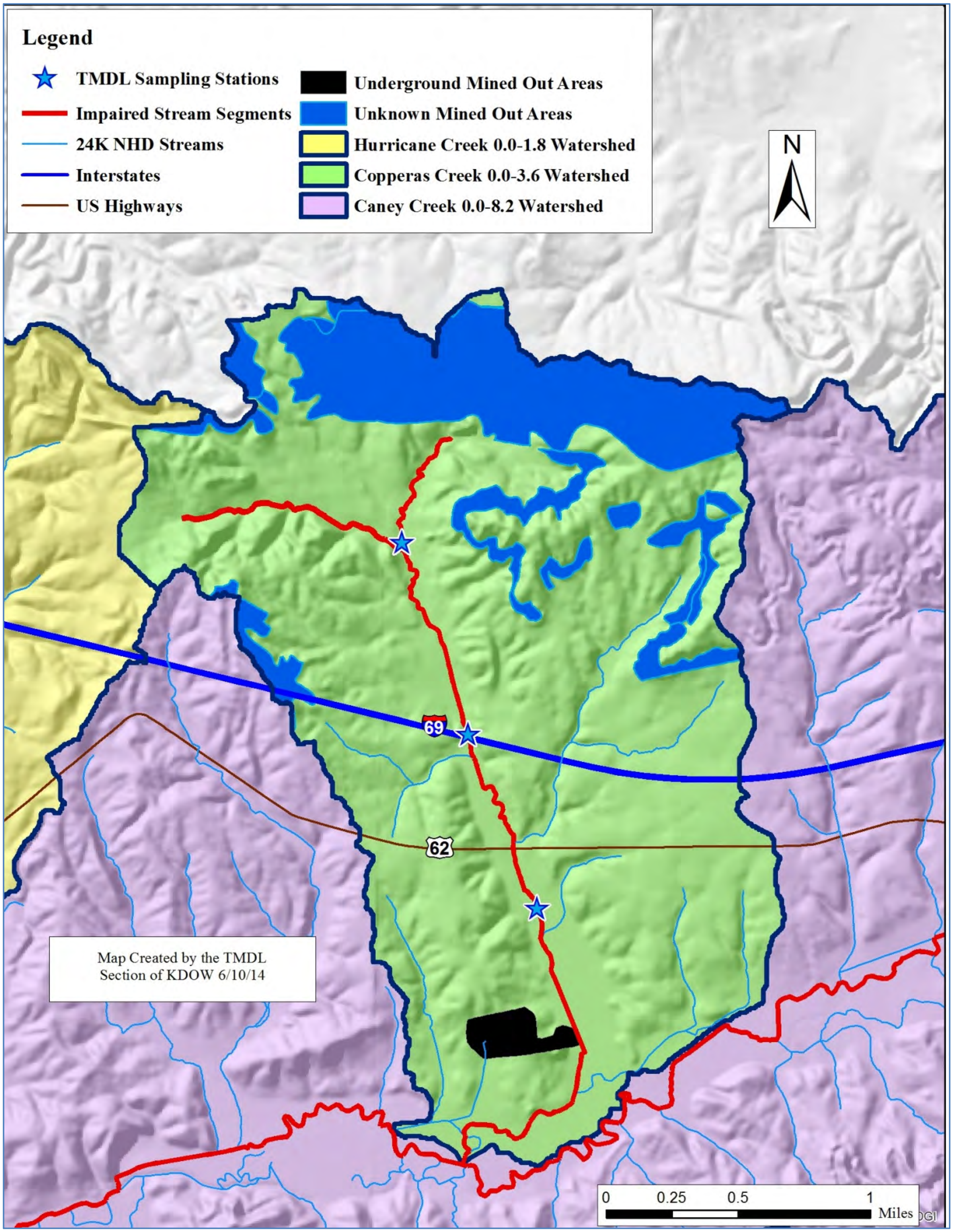


Figure 8.2.3.16 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Copperas Creek Watershed

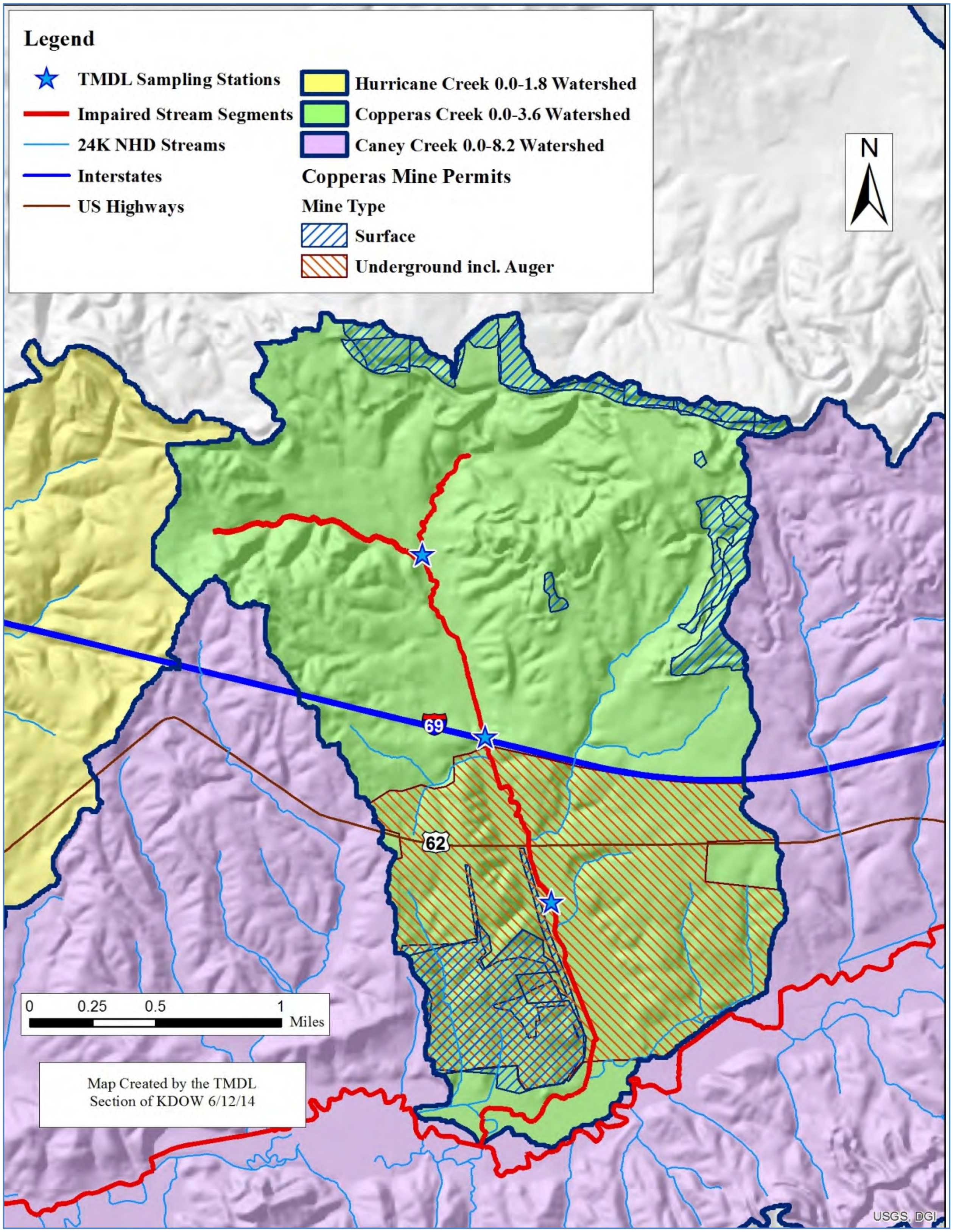


Figure 8.2.3.17 Data from the Department for Natural Resources on Licensed Mine Areas in the Copperas Creek Watershed

Table 8.2.3.10 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Copperas Creek Watershed

State File Number	Seam	Mine Type	Surface/Subsurface	Status
	585	UNKNOWN	Unknown	Abandoned
03482	590	UNKNOWN	Unknown	Abandoned
04965	590	UNKNOWN	Unknown	Abandoned
00445	600	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
90041	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
00445	600	UNKNOWN	Unknown	Abandoned
10562-1	600	UNKNOWN	Unknown	Abandoned
06843-3	600	UNKNOWN	Unknown	Abandoned
06843-4	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
10562	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
92803	655	UNKNOWN	Unknown	Abandoned
18040	655	UNDERGROUND TRUCK COAL	Underground	Abandoned

Table 8.2.3.11 Data from the Department for Natural Resources on Licensed Mine Areas in the Copperas Creek Watershed

DNR Permit	Mine Status(1)	Permit Name	Active/Inactive	Date Issued	Permit Type	Original Permit
0540034	RC	KIRKWOOD EXCAVATING INC	Released	7/27/1979	INTERIM	540034
0540071	RC	TERRY DARNELL MINES	Released	5/22/1980	INTERIM	540071
0540121	RC	KIRKWOOD EXCAVATING INC	Released	1/27/1982	INTERIM	540121
0540140	RC	KIRKWOOD EXCAVATING INC	Released	7/8/1982	INTERIM	540140
0540158	RC	MIRACLE MINING CO	Released	8/4/1982	INTERIM	540158
411475X	FF	INTERNATIONAL ENERGY CORP	Released	7/28/1975	PRE LAW	411475X
211569X						
248570X						
297373X						
603877X	RC	MARGARITA FUELS INC	Released	7/27/1977	PRE LAW	603877X
8540014	RC	KIRKWOOD EXCAVATING INC	Released	9/18/1984	PERMANENT	8540014
8540062	RC	TERRY DARNELL MINES	Released	9/20/1984	PERMANENT	8540062
8545014	RC	MAGIC COAL COMPANY	Released	5/16/1991	PERMANENT	8545014
606077X						
8545035	FF	MAGIC COAL COMPANY	Released	11/18/2003	PERMANENT	8545014
8545035	FF	MAGIC COAL COMPANY	Released	11/18/2003	PERMANENT	8545014

(1) Mine Status Codes:

FF = Final Forfeiture.

RC = Permit Completely Released (Result of Transfer or Phase III Bond Release).

8.2.4 Fox Run of Caney Creek 0.0 to 1.1

Fox Run is impaired for pH. TMDL sampling data indicate the stream was still impaired for pH at the time of data collection, with all samples from Site DOW10014015 below the limit of 6.0 standard units, see Table 8.2.4.1. There were no exceedances of the acute or chronic limit for any of the metals, although the sampling performed for Site DOW10014015 was far more limited than it was for most other stations with only one metal sample collected, see Appendix A. Figure 8.2.4.1 relates pH to flow to assist in determining the critical condition. Figure 8.2.4.2 shows the DMS mined out areas, and Figure 8.2.4.3 shows the DNR mine permit boundaries. Tables 8.2.4.2 and 8.2.4.3 list both types of potential sources.

Table 8.2.4.1 pH Data Collected for DOW10014015 Fox Run of Caney Creek 0.0 to 1.1, RM 0.15

Date	pH, standard units
5/17/2006	3.52
7/18/2006	3.55
8/9/2006	3.68
9/27/2006	5.05
10/17/2006	3.37
11/28/2006	5.23
1/11/2007	4.98
2/20/2007	5.86
3/21/2007	4.15
	Exceeds the pH limit

Critical Condition. For Site DOW10014015, pH was fairly consistent over the range of flows (neither increasing nor decreasing with flow), showing a poor R^2 value, see Figure 8.2.4.1. The lowest pH value was 3.37 on 10/17/2006, which is therefore the critical condition for this impaired segment.

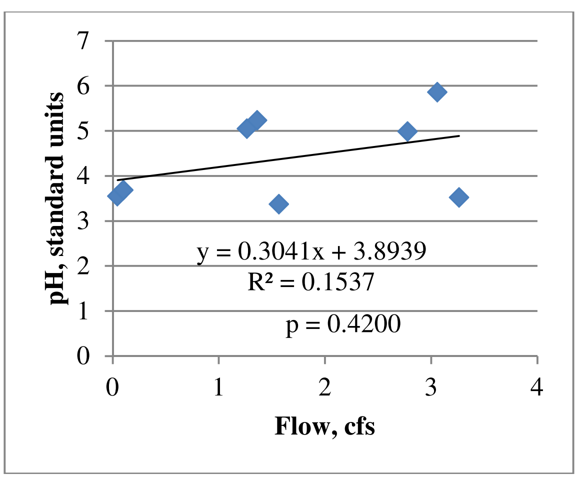


Figure 8.2.4.1 pH vs. Flow at Fox Run Site DOW10014015, RM 0.15

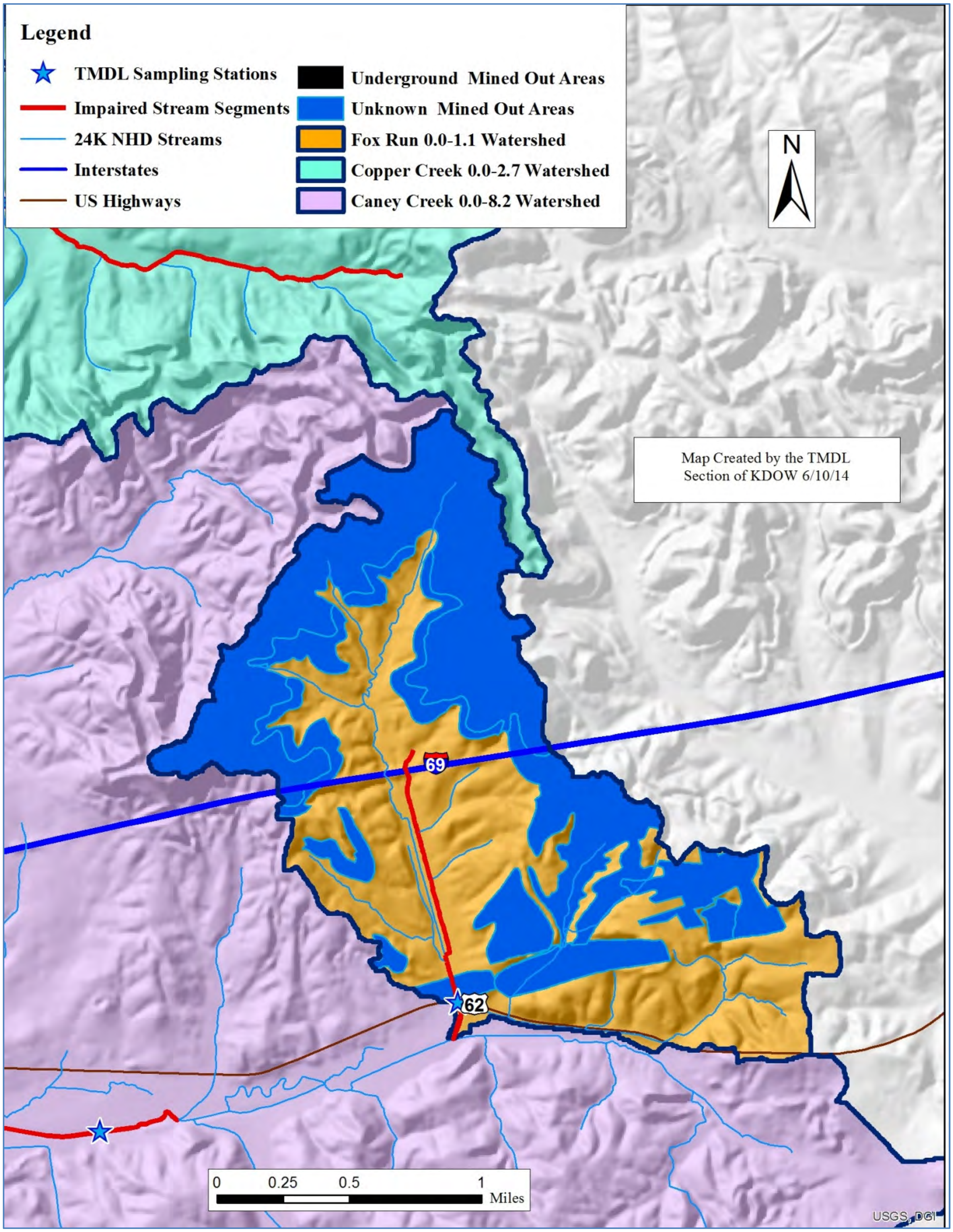


Figure 8.2.4.2 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Fox Run Watershed

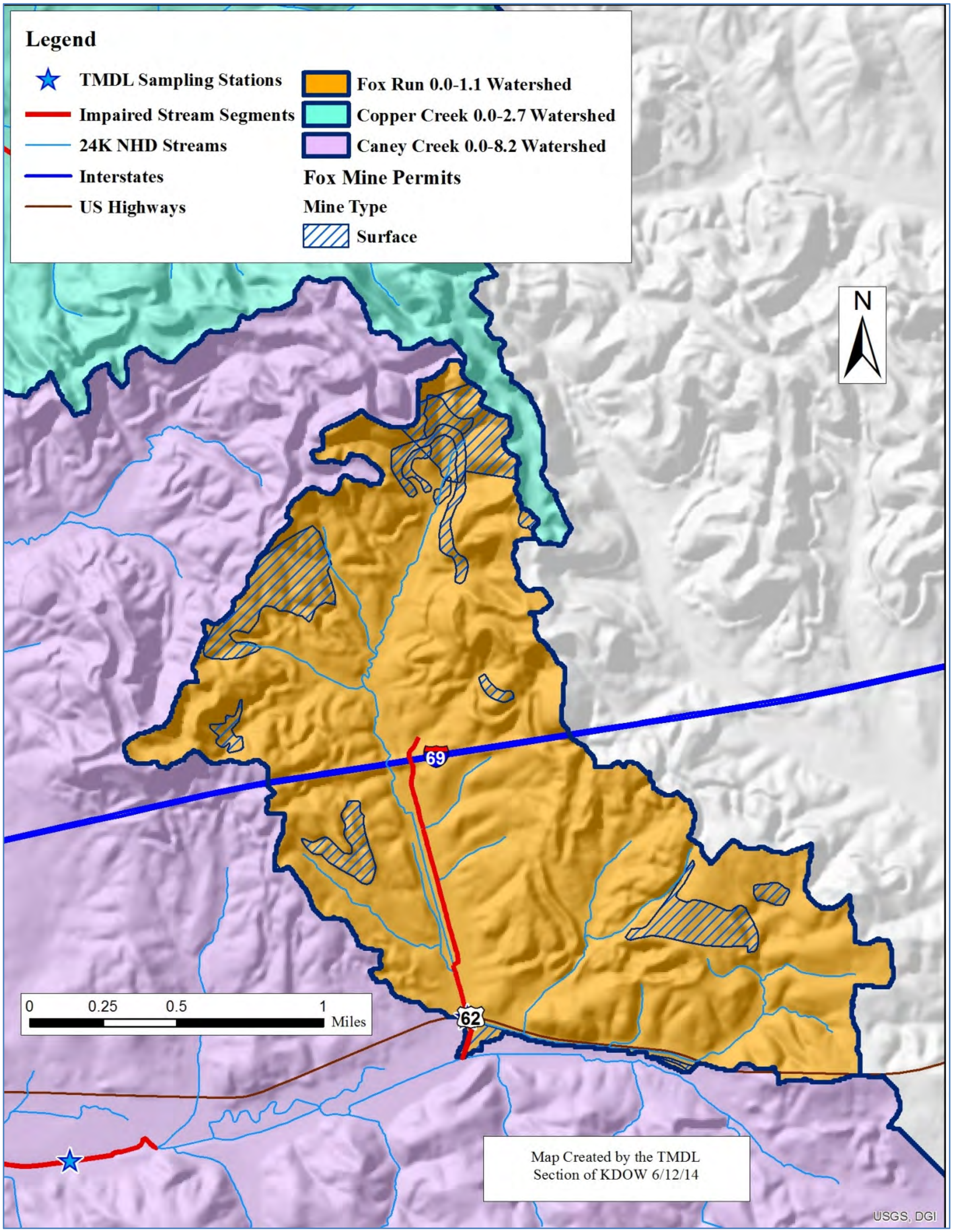


Figure 8.2.4.3 Data from the Department for Natural Resources on Licensed Mine Areas in the Fox Run Watershed

Table 8.2.4.2 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Fox Run Watershed

State File Number	Seam	Mine Type	Surface/Subsurface	Status
	585	UNKNOWN	Unknown	Abandoned
	585	UNKNOWN	Unknown	Abandoned
01641	585	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
10033	590	UNKNOWN	Unknown	Abandoned
10033	590	UNKNOWN	Unknown	Abandoned
01641	590	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
09218	600	UNKNOWN	Unknown	Abandoned
95100	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned

Table 8.2.4.3 Data from the Department for Natural Resources on Licensed Mine Areas in the Fox Run Watershed

DNR Permit	Mine Status[1]	Permit Name	Active/ Inactive	Date Issued	Permit Type	Original Permit
0540101	RC	MAGIC COLLERIES INC	Released	4/3/1981	INTERIM	540101
297374 X						
8540068	RC	H & G CONSTRUCTION CO INC	Released	5/20/1985	PERMANENT	8540068
8540112	RC	H & G CONSTRUCTION CO INC	Released	10/11/1986	PERMANENT	8540089
8540126	RC	WESTERN CARBON CORPORATION	Released	5/25/1989	PERMANENT	8540126
8540159	FF	LONNIE ABBOTT	Released	3/1/1991	PERMANENT	8540126
8540230	RC	ISLAND FORK CONSTRUCTION LTD	Released	1/6/2000	PERMANENT	8540228
8548012	RC	DON BOWLES CORPORATION	Released	1/9/2002	PERMANENT	8546001
93771						
93966						
93972						

[1] Mine Status Codes:

FF = Final Forfeiture.

RC = Permit Completely Released (Result of Transfer or Phase III Bond Release).

8.2.5 Hurricane Creek of Tradewater River 0.0 to 1.8

Hurricane Creek is impaired for pH, iron and zinc. TMDL sampling showed 4 out of 17 observations were below the acceptable limit for pH. There were no exceedances for iron at the upstream station, DOW10014010, but the reverse was true at the downstream station, DOW10014007, which showed eight exceedances of the chronic limit and one exceedance of the acute limit out of nine samples. There were no exceedances of the zinc WQCs, but as stated in Section 2.1, the zinc impairment will not be reassessed without additional data. No flow data were available at the downstream station, DOW10014007, due to the very low gradient of the stream near its discharge to the Tradewater River. See Tables 8.2.5.1 and 8.2.5.2 for sampling data. Of the other metals, arsenic showed 16 out of 17 exceedances, and cadmium showed 12 out of 17 exceedances, see Appendix A. Figures 8.2.5.1 through 8.2.5.3 relate pollutant concentrations to flow to assist in determining the critical condition. Figure 8.2.5.4 shows the DMS mined out areas, and Figure 8.2.5.5 shows the DNR mine permit boundaries. Tables 8.2.5.3 and 8.2.5.4 list both types of potential sources.

Table 8.2.5.1 pH, Hardness, Iron and Zinc Data Collected for DOW10014010 Hurricane Creek of Tradewater River 0.0 to 1.8, RM 1.65

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L
5/17/2006	5.66	164	0.49	42.70	-139.5	182.2	182.2
7/19/2006	7.09	637	0.20	7.22	-568.0	575.3	575.3
9/28/2006	6.90	362	0.49	54.40	-598.9	356.4	356.4
10/18/2006	6.91	525	0.37	38.70	-449.6	488.3	488.3
11/29/2006	6.45	508	0.10	69.6	-405.3	474.9	474.9
1/10/2007	6.47	237	0.15	91.70	-157.2	248.9	248.9
2/22/2007	6.40	319	0.22	82.00	-238.2	320.2	320.2
3/22/2007	5.51	327	0.24	66.80	-260.2	327.0	327.0
	Exceeds the pH limit						

Table 8.2.5.2 pH, Hardness, Iron and Zinc Data Collected for DOW10014007 Hurricane Creek of Tradewater River 0.0 to 1.8, RM 0.80

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L
5/17/2006	6.22	119	1.58	27.5	-111.3	138.8	138.8
7/19/2006	6.07	334	2.45	46.8	-286.1	332.9	332.9
8/10/2006	6.59	383	1.80	22.7	-351.1	373.8	373.8
9/28/2006	3.29	288	3.24	59.9	-233.7	293.6	293.6
10/18/2006	5.17	692	11.40	136 D	-481.1	617.1	617.1
11/29/2006	6.73	440 (467)	3.92 (8.02)	83.4 (80.2)	-337.0	420.4	420.4
1/10/2007	6.07	175	2.19	62.3	-130.2	192.5	192.5
2/22/2007	6.58	232	2.10	67.8	-176.7	244.5	244.5
3/22/2007	6.42	269	1.66	56.4	-220.7	277.1	277.1
	Exceeds the pH limit						
	Exceeds the chronic limit						
	Exceeds the acute limit						

Critical Condition (pH). For Site DOW10014010, pH decreased with flow, with a good R^2 value, see Figure 8.2.5.1. The lowest pH value was 3.29 observed at Site DOW10014007 on 9/28/2006, which is therefore the critical condition for pH for this impaired segment.

Critical Condition (Iron). For Site DOW10014010, iron increased slightly with flow, although the R^2 value was poor, see Figure 8.2.5.2. The highest iron value was 11.40 mg/L observed at Site DOW10014007 on 10/18/2006, which is therefore the critical condition for iron for this impaired segment.

Critical Condition (Zinc). For Site DOW10014010, the difference between the zinc concentration and the chronic zinc WQC increased with flow, with a fair R^2 value, see Figure 8.2.5.3. The highest zinc difference was -111.3 mg/L observed at Site DOW10014007 on 5/17/2006, which is therefore the critical condition for zinc for this impaired segment.

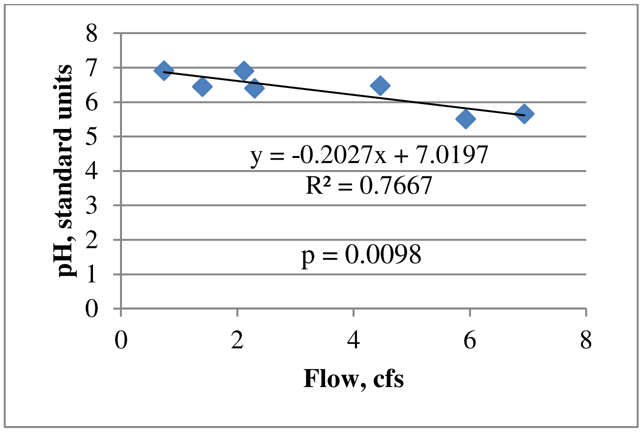


Figure 8.2.5.1 pH vs. Flow at Hurricane Creek Site DOW10014010, RM 1.65

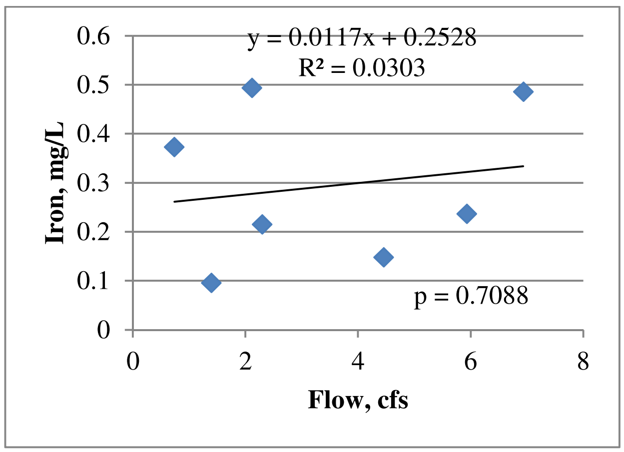


Figure 8.2.5.2 Iron vs. Flow at Hurricane Creek Site DOW10014010, RM 1.65

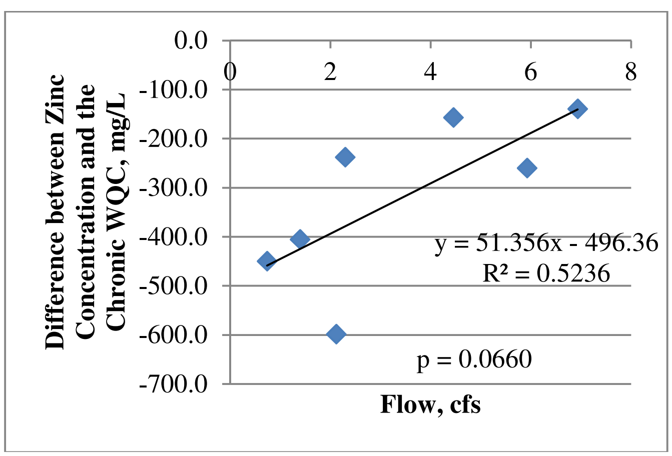


Figure 8.2.5.3 Zinc Difference vs. Flow at Hurricane Creek Site DOW10014010, RM 1.65

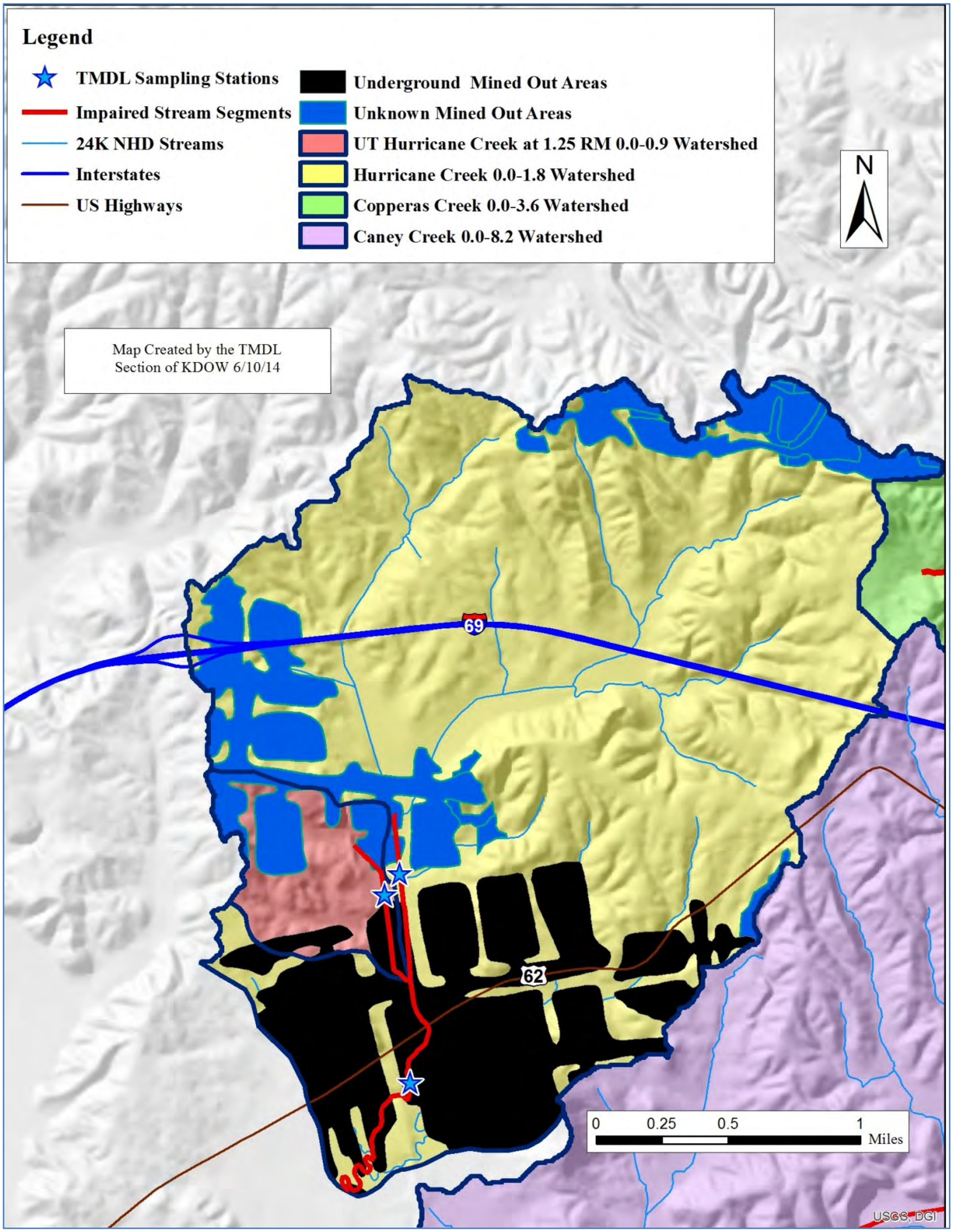


Figure 8.2.5.4 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Hurricane Creek Watershed

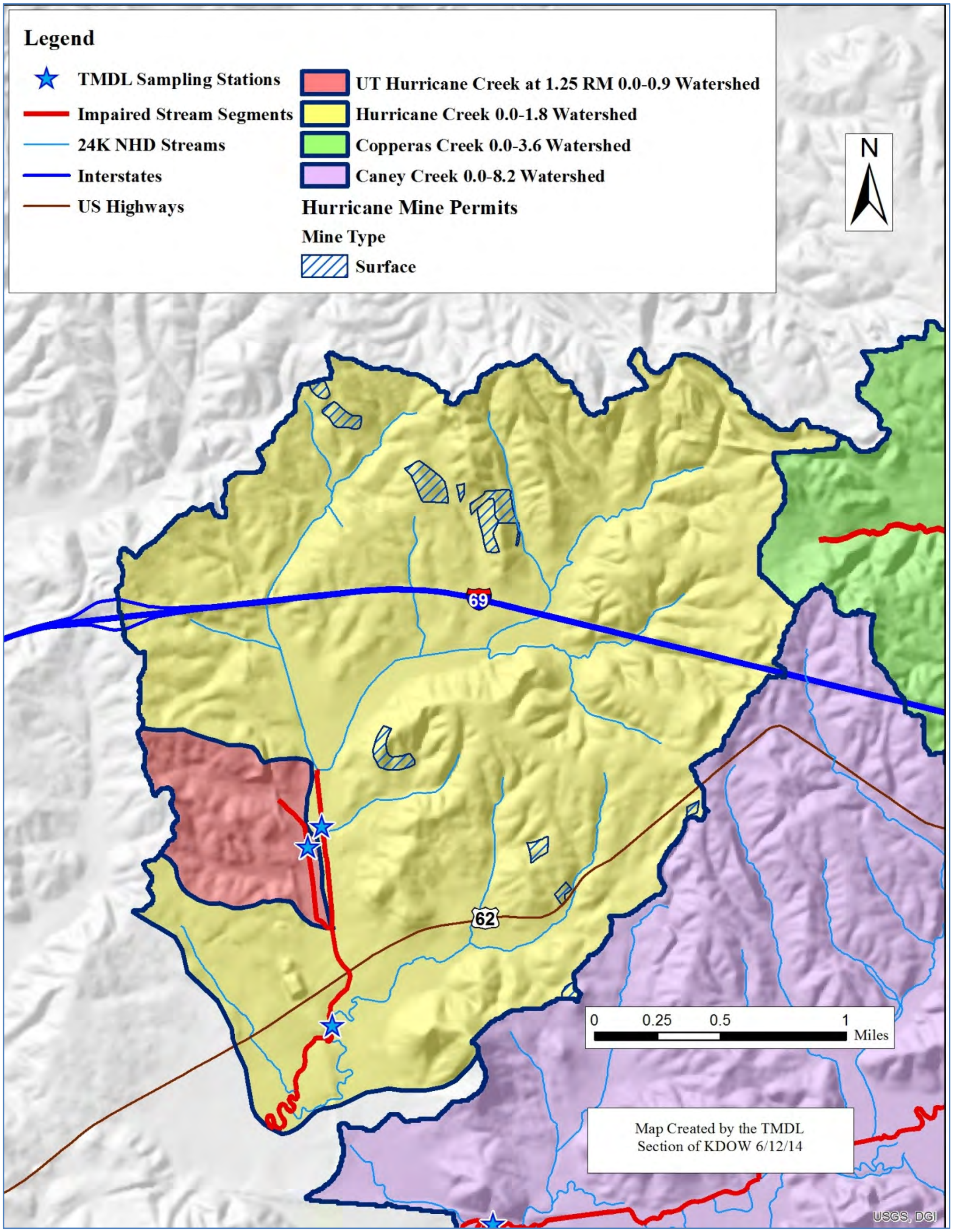


Figure 8.2.5.5 Data from the Department for Natural Resources on Licensed Mine Areas in the Hurricane Creek Watershed

Table 8.2.5.3 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the Hurricane Creek Watershed

State File Number	Seam	Mine Type	Surface/Subsurface	Status
	590	UNKNOWN	Unknown	Abandoned
03482	590	UNKNOWN	Unknown	Abandoned
04965	590	UNKNOWN	Unknown	Abandoned
	590	UNKNOWN	Unknown	Abandoned
02102	590	UNKNOWN	Unknown	Abandoned
90041	600	UNKNOWN	Unknown	Abandoned
	600	UNKNOWN	Unknown	Abandoned
09108	620	UNKNOWN	Unknown	Abandoned
10972	620	UNKNOWN	Unknown	Abandoned
10158-3	620	UNKNOWN	Unknown	Abandoned
00454	655	UNDERGROUND RAIL COAL	Underground	Abandoned
00684	655	UNKNOWN	Unknown	Abandoned

Table 8.2.5.4 Data from the Department for Natural Resources on Licensed Mine Areas in the Hurricane Creek Watershed

DNR Permit	Mine Status[1]	Permit Name	Active/ Inactive	Date Issued	Permit Type	Original Permit
0540010	RC	TOWER RESOURCES INC	Released	6/18/1979	INTERIM	540010
0540044	RC	TERRY DARNELL MINES	Released	4/4/1979	INTERIM	540044
269271X						
291873X	FF	WALKER MINES	Released	8/13/1973	PRE LAW	291873X
340274X	RC	ED BENNETT COAL CO	Released	10/17/1974	PRE LAW	340274X
210369X						
248570X						
253171X						
454275X						
653377X	FF	R E BIVINS	Released	12/13/1977	PRE LAW	653377X
679977X	RC	4 M COAL & ENERGY	Released	2/2/1978	PRE LAW	679977X
705177X	FF	JIM WHITAKER & SONS INC	Released	4/11/1978	PRE LAW	705177X
8540086	RC	EDWARD SIMONS	Released	5/1/1986	PERMANENT	8540086

[1] Mine Status Codes:

FF = Final Forfeiture.

RC = Permit Completely Released (Result of Transfer or Phase III Bond Release).

8.2.6 UT to Hurricane Creek at 1.2 RM 0.0 to 0.6

UT to Hurricane Creek at 1.2 is impaired for pH, iron and zinc. TMDL sampling showed all seven observations were below the acceptable limit for pH. Likewise, all seven iron observations were above the acute iron WQC. Five out of seven zinc observations were above the chronic and acute zinc limits, which are the same, see Table 8.2.6.1. Of the other metals, two out of seven copper observations exceeded the chronic WQC, three out of seven nickel observations exceeded the chronic WQC, and two out of seven selenium observations exceeded the chronic WQC, see Appendix A. Figures 8.2.6.1 through 8.2.6.3 relate pollutant concentrations to flow to assist in determining the critical condition. Figure 8.2.6.4 shows the DMS mined out areas. As stated, there were no DNR mine permit boundaries so no map of these was included. Tables 8.2.6.2 lists the potential sources associated with the mined out areas map.

Table 8.2.6.1 pH, Hardness, Iron and Zinc Data Collected for DOW10014009 UT to Hurricane Creek at 1.2 RM 0.0 to 0.6, Site RM 0.35

Date	pH, standard units	Hardness, Total mg/L	Iron, mg/L	Zinc, µg/L	Difference between the Zinc Concentration and the Zinc Chronic Limit, µg/L	Zinc Chronic Limit, µg/L	Zinc Acute Limit, µg/L
5/17/2006	3.21	287	111	339	46.3	292.7	292.7
9/28/2006	2.92	632	129 D	953	381.6	571.4	571.4
10/18/2006	2.77	668	69	n/d @ 100	-598.9	598.9	598.9
11/29/2006	2.82	605	188 D	548 D	-2.7	550.7	550.7
1/10/2007	2.66	368	138 D	366 D	4.6	361.4	361.4
2/22/2007	2.90	426	120 D	646 D	236.9	409.1	409.1
3/22/2007	2.65	503	126 D	539 D	68.1	470.9	470.9
(yellow)	Exceeds the pH limit						
(orange)	Exceeds the acute limit						
n/d = non detect							

Critical Condition (pH). pH increased very slightly with flow, with a poor R^2 value, see Figure 8.2.6.1. The lowest pH value was 2.65 observed on 3/22/2007, which is therefore the critical condition for pH for this impaired segment.

Critical Condition (Iron). Iron decreased very slightly with flow, with a poor R^2 value, see Figure 8.2.6.2. The highest iron value was 188 observed on 11/29/2006, which is therefore the critical condition for iron for this impaired segment.

Critical Condition (Zinc). The difference between the zinc concentration and the chronic zinc WQC increased very slightly with flow, but with a poor R^2 value, see Figure 8.2.6.3. The highest zinc difference was 381.6 mg/L observed on 9/28/2006, which is therefore the critical condition for zinc for this impaired segment.

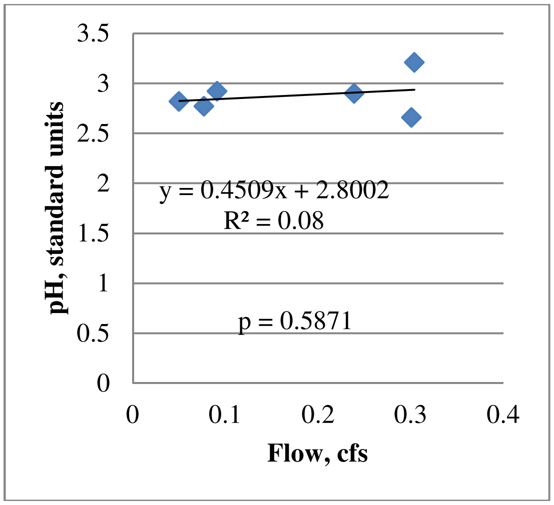


Figure 8.2.6.1 pH vs. Flow at UT to Hurricane Creek Site DOW10014009, RM 0.35

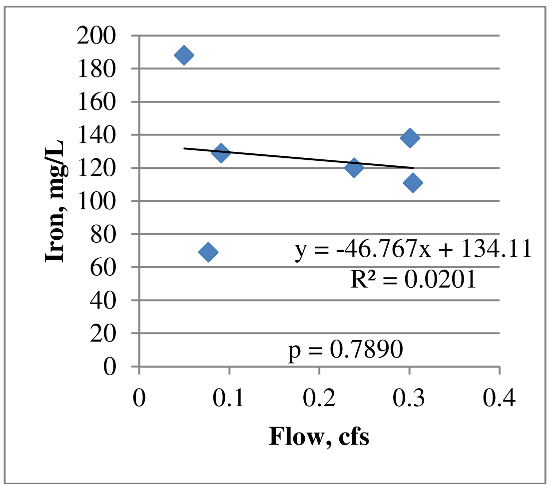


Figure 8.2.6.2 Iron vs. Flow at UT to Hurricane Creek Site DOW10014009, RM 0.35

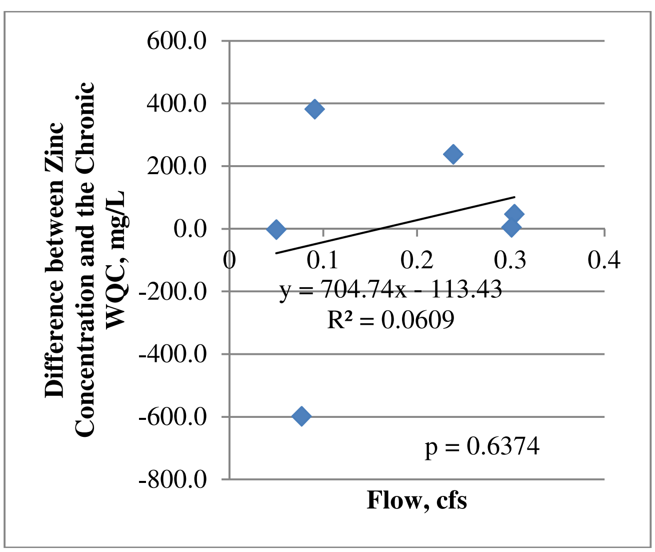


Figure 8.2.6.3 Zinc vs. Flow at UT to Hurricane Creek Site DOW10014009, RM 0.35

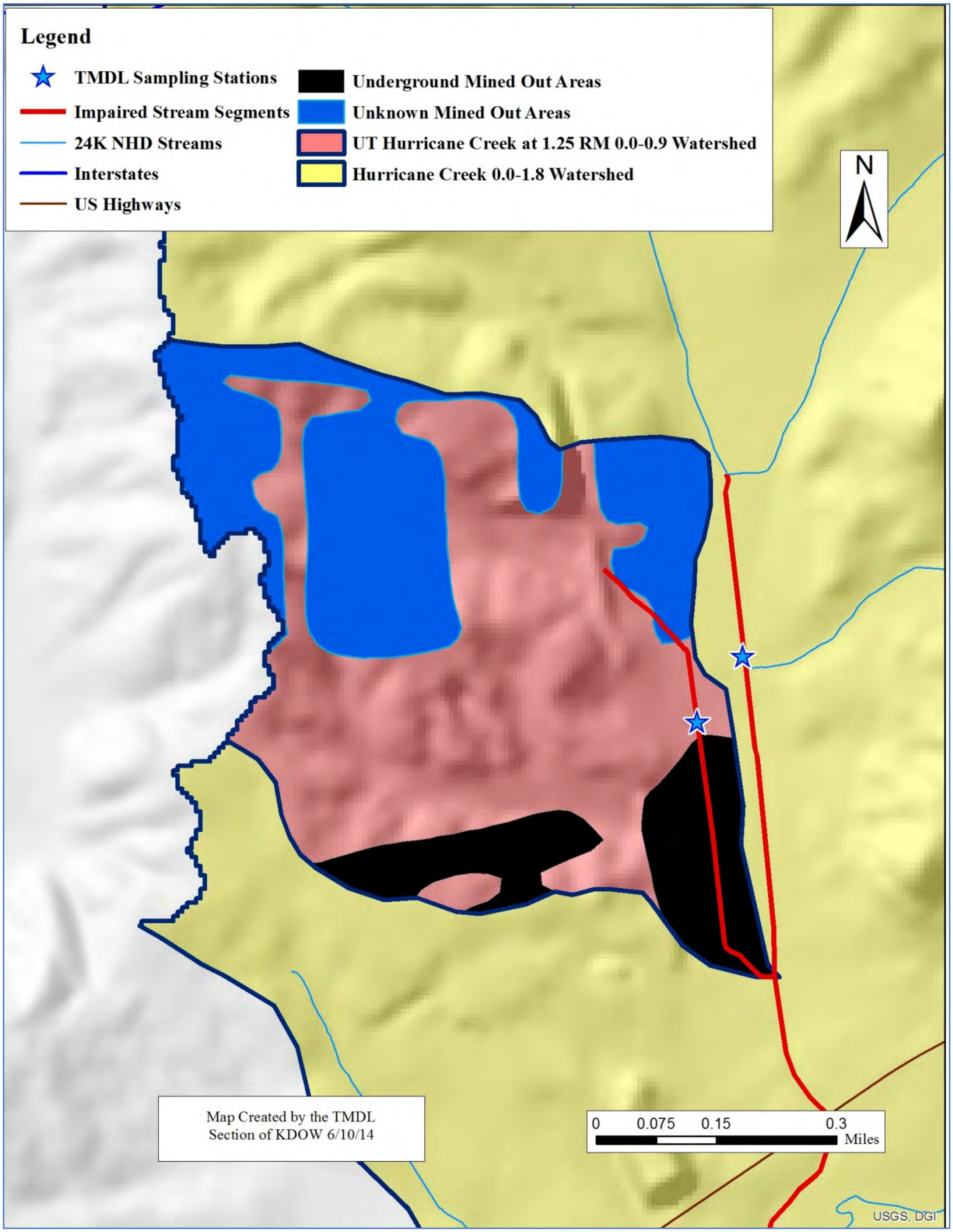


Figure 8.2.6.4 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the UT to Hurricane Creek Watershed

Table 8.2.6.2 Data from the Office of Mine Safety and Licensing on Mined Out Areas in the UT to Hurricane Creek Watershed

State File Number	Seam	Mine Type	Surface/Subsurface	Status
00454	655	UNDERGROUND RAIL COAL	Underground	Abandoned
00684	655	UNKNOWN	Unknown	Abandoned

9.0 Implementation

9.1 Abandoned Mine Lands

The Kentucky Division of Abandoned Mine Lands (AML) within DNR is charged with reclaiming land affected by mining before the passage of SMCRA. SMCRA Title IV authorized a reclamation fee which is charged on every ton of coal mined in the United States since 1977 and continuing through 2021. The money collected is kept in an account called the Abandoned Mine Reclamation Fund. SMCRA Title IV sets priorities for reclamation: Priority 1 and 2 are related to human health and safety. Priority 3 is AMD. The universe of AML projects also includes those post-SMCRA projects funded by forfeit bond money.

AML projects can involve responding to emergencies such as threats to human health or imminent loss of property, often from landslides or subsidences. However, AML funds are also spent on water line extensions to provide drinking water to communities whose groundwater supply has been impacted by mining (Personal Communication, Ernie Ellison, 2014). Other projects include closing mine openings, and all facets of work concerning AMD, which may include covering refuse (i.e., rejected coal), installing treatment ponds, eliminating rills and gullies, armoring channels, liming and revegetation (Personal Communication, Mark Meade, 2014). There are 12 completed AML projects in the TMDL watershed, Table 9.1.1 gives the acreage of each and reclamation dollars spent, and Figure 9.1.1 shows their locations. Bond forfeiture sites are not shown.

Table 9.1.1 Abandoned Mine Lands Projects

Project Name	Cost, Thousands	Acres
Ilsley Coke Ovens	323	21
Cany Black Gold	558	108
St. Charles Refuse Loadout	58	9
St. Charles Tipple	68	6
Homestead Refuse	590	40
Dawson Daylight Refuse	159	33
Russell Ridge	245	52
Crabtree Mine	239	63
Bunt Sisk Hills	218	23
Dawson Springs	423	70
J.O. Burge	233	50
Ilsley Highwall	24	3

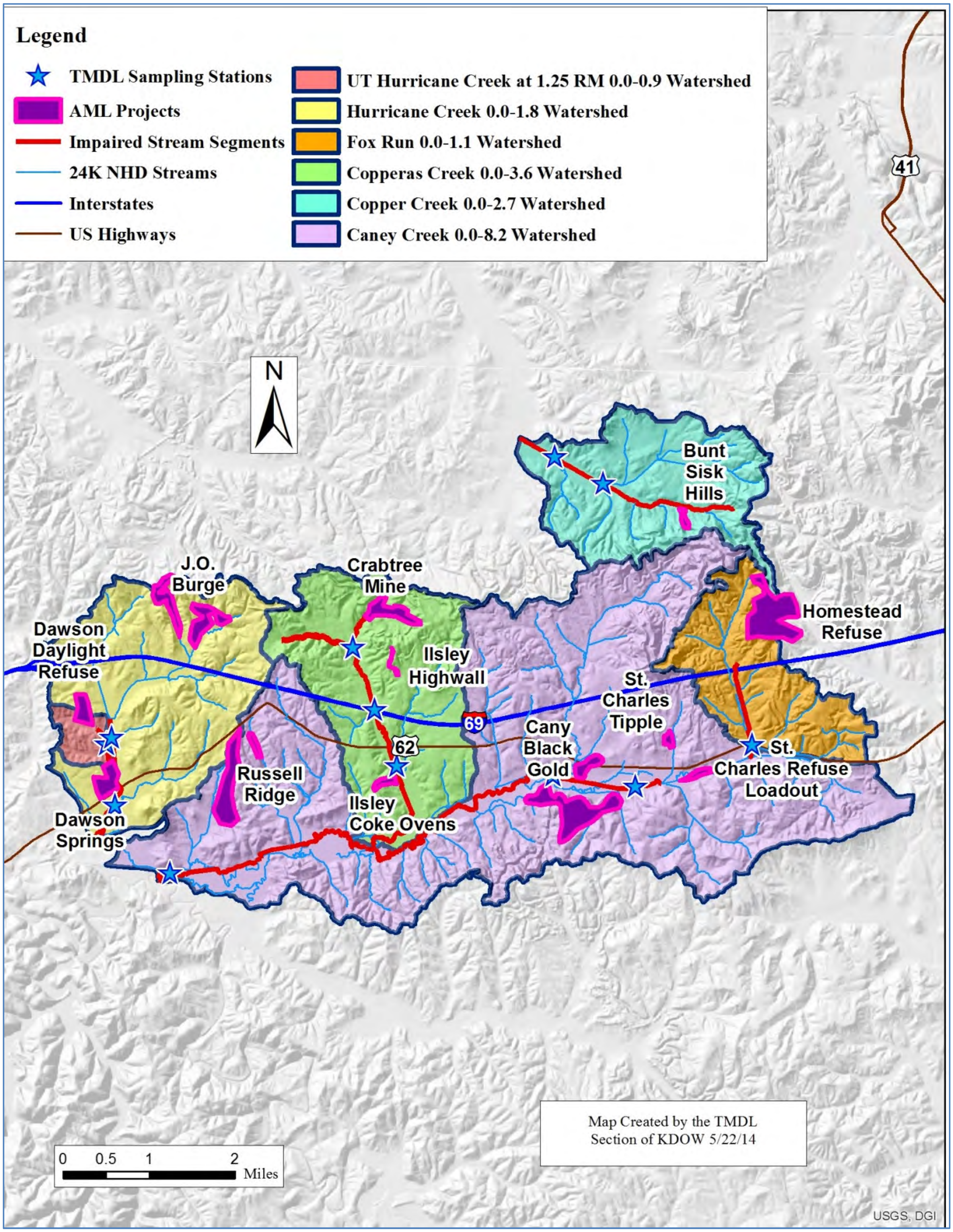


Figure 9.1.1 Abandoned Mine Lands Projects in the TMDL Watershed

10.0 Public Participation

This TMDL was published for a 30-day public comment beginning April 17th, 2015 and ending May 18th, 2015. A notification was sent to all newspapers in the Commonwealth of Kentucky and an advertisement was purchased in the Hopkinsville *Kentucky New Era* and the Madisonville *Messenger*, which are the newspapers of widest circulation in the area. Additionally, the public notice was distributed electronically through the 'Nonpoint Source Pollution Control' mailing list (http://water.ky.gov/nsp/Pages/MailingList.aspx) of persons interested in water quality issues, and emailed to the TMDL Listserv, which is a list of persons interested in TMDL-related issues.

Comments received during the public notice period have been incorporated into the administrative record for this TMDL. Revisions were made to the final TMDL report and a response was emailed to EPA, which was the only commenter.

11.0 References

33 U.S.C. § 1251, Section 303(d). Clean Water Act. 1972.

30 U.S.C. §§ 1234–1328. Surface Mining Control and Reclamation Act. 1977.

40 CFR 434.11. General Definitions. 2013.

401 KAR 5:065. Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water. 2005.

401 KAR 10:001. Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water. 2005.

401 KAR 10:026. Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water. 2005.

401 KAR 10:031. Natural Resources and Environmental Protection Cabinet, Department for Environmental Protection, Division of Water. 2005.

American Public Health Association, American Waterworks Association, Water Environment Federation. 2012. Standard Methods for the Examination of Water and Wastewater, 22nd Edition, Laura Bridgewater, Editor. American Public Health Association. Washington, DC.

Alabama Water Watch. 2014. Chemistry FAQs: What is the Difference Between Hardness and Alkalinity? Accessed 2/5/14 at http://www.alabamawaterwatch.org/resources/chemistry_faqs.html/title/what-is-the-difference-between-hardness-and-alkalinity-.

Balintova, Magdalena, Aneta Petrilakova. 2011. Study of pH Influence on Selective Precipitation of Heavy Metals from Acid Mine Drainage (Unpublished). Technical University of Kosice, Kosice, Slovakia. Accessed at http://www.nt.ntnu.no/users/skoge/prost/proceedings/pres2011-and-icheap10/PRES11/217Balintova.pdf.

Balintova, Magdalena, Aneta Petrilakova, Eva Singovszka. 2012. Study of Metals Distribution Between Water and Sediment in the Smolnik Creek (Slovakia) Contaminated by Acid Mine Drainage. Chemical Engineering Transactions, Vol. 28, 2012. The Italian Association of Chemical Engineering. Accessed at http://www.aidic.it/cet/12/28/013.pdf.

Friends of the Earth, Inc., v. EPA, et al. No 05-5015 (D.C. Cir 2006). Decision on the Anacostia River TMDL.

Fry, J., G. Xian, S. Jin, J. Dewitz, C. Homer, L. Yang, C. Barnes, N. Herold, and J. Wickham. 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States. PE&RS, Vol. 77(9):858-864.

Greb, Stephen F., Williams, David A., Williamson, Allen D. 1992. Geology and Stratigraphy of the Western Kentucky Coal Field. Bulletin 2, Series XI, Kentucky Geological Survey. ISSN 0075-559. University of Kentucky. Lexington, KY.

Hach. 2014. Application – Water Hardness Guide. Accessed 1/24/14 at http://www.hach.com/hardnessguide.

Hatch, J.R., and R.H. Affolter. 2002. Resource Assessment of the Springfield, Herrin, Danville and Baker Coals in the Illinois Basin. U.S. Geological Survey Professional Paper 1625-D. U.S. Department of the Interior. Accessed at http://162.114.39.10:8888/progress?pages&id=117949264&sp2&fileName=Q2hhcHRlcl9DLnBkZg==&url=aHR0cDovL3B1YnMudXNncy5nb3YvcHAvcDE2MjVkL0NoYXB0ZXJfQy5wZGY=&serv=5&foo=5.

Hedin, R.S., D.H. Dvorak, S.L. Gustafson, D.M. Hyman, P.E. McIntire, R.W. Naim, R.C. Neupert, A.C. Woods, H.M. Edenborn. 1991. Final Report: Use of a Constructed Wetland for the Treatment of Acid Mine Drainage at the Friendship Hill National Historic Site, Fayette County, Pennsylvania. US. Bureau of Mines. Pittsburgh, Pennsylvania.

Homer, C. C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, Vol. 70, No. 7, July 2004, pp. 829-840. www.mrlc.gov.

Jacobsen, Russell L. 1993. Coal Resources of the Dekoven and Davis Members (Carbondale Formation) in Gallatin and Saline Counties, Southeastern Illinois. Illinois State Geological Survey. Department of Energy and Natural Resources. Champaign, IL. Accessed at http://www.academia.edu/4965416/Coal_resources_of_the_Dekoven_and_Davis_Members_Carbondale_Formation_in_Gallatin_and_Saline_Counties_southeastern_Illinois.

Kentucky Division of Water. 2003. Total Maximum Daily Load pH (H+ Ion Mass), Craborchard Creek Watershed. TMDL Section, Frankfort, Kentucky. December, 2003.

Kentucky Division of Water. 2009. Benthic Macroinvertebrates Processing and Identification Standard Operating Procedures. Water Quality Branch, Frankfort, Kentucky.

Kentucky Division of Water. 2012. 2012 303(d) List of Impaired Waters; 2010 Integrated Reports to Congress on Water Quality in Kentucky. Water Quality Branch, Frankfort, Kentucky.

Kentucky Geologic Survey. 2004. kyvector.SDE.KGS_GQ_FORMATIONS_24K shapefile. Kentucky Geological Survey, Geospatial Analysis Section, Digital Mapping Team. Sparks, Thomas N., Crawford, Matt M.

Kentucky Geologic Survey. 2009. KGS_Coal_Beds shapefile. Kentucky Geological Survey, Geospatial Analysis Section, Digital Mapping Team. Sparks, Thomas N., Crawford, Matt M.

Kentucky Geological Survey. 2014. Coal Quality Database. Accessed 2/14/2014 at http://kgs.uky.edu/kgsweb/DataSearching/coalsearch.asp.

Kirby, Carl S., Charles A. Cravotta III. 2005. Net Alkalinity and Net Acidity 2: Practical Considerations. Applied Geochemistry 20 (2005) 1941-1964. Elsevier Press, available at http://mine-drainage.usgs.gov/pubs/cravotta/ApGeoch_1941-1964.pdf.

MicrobeWiki. Acid Mine Drainage. Viewed 3/16/2015 at http://microbewiki.kenyon.edu/index.php/Acid_mine_drainage.

Milanco Industrial Chemicals, Fundamentals of pH. 2014. Accessed 4/15/2014 at http://www.milanco.com/training/fundamen.htm.

Personal Communication, Ernie Ellison (Kentucky Division of Abandoned Mine Lands, Frankfort, Kentucky) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). June 18th, 2014.

Personal Communication, Mark Meade (Assistant Director, Kentucky Division of Abandoned Mine Lands, Frankfort Kentucky) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). May 22nd, 2014.

Personal Communication, James Seay (Kentucky Division of Water, Frankfort, Kentucky) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). March 29th, 2006.

Personal Communication, Larry Sowder (Contract Employee, Surface Water Permits Branch, Kentucky Division of Water, Frankfort, Kentucky) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). March 11th, 2014.

Personal Communication via Telephone, Dr. Jeffrey G. Skousen (Extension Specialist and Professor of Soil Science, West Virginia University. Morgantown, West Virginia) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). April 16th, 2014.

Personal Communication via Email, Dr. Jeffrey G. Skousen (Extension Specialist and Professor of Soil Science, West Virginia University. Morgantown, West Virginia) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). May 15th, 2014.

Personal Communication via Email, Dr. Jeffrey G. Skousen (Extension Specialist and Professor of Soil Science, West Virginia University. Morgantown, West Virginia) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). May 19th, 2014.

Personal Communication via Email, Dr. Kelley Pennell (Professor of Civil Engineering, University of Kentucky. Lexington, Kentucky) and Eric Liebenauer (Kentucky Division of Water, Frankfort, Kentucky). May 5th, 2014.

Powell, John D. 1988. Origin and Influence of Coal Mine Drainage on Streams of the United States. Environmental Geology and Water Sciences. April 1988, Volume 11, Issue 2, pp 141-15.

Snoeyink, V.L., D. Jenkins 1980. Water Chemistry. Wiley, Inc. New York.

Strahler, A. N. 1952. Hypsometric (Area-Altitude) Analysis of Erosional Topology. Geological Society of America Bulletin 63 (11): 1117–1142.

United States Environmental Protection Agency (EPA). 1986. Quality Criteria for Water. Office of Water Regulations and Standards. Washington, DC.

United States Environmental Protection Agency. 1982. Development Document for Final Effluent Limitations Guidelines and Standards for the Coal Mining Point Source Category. Effluent Guidelines Division. Office of Water. EPA WH-552. Washington, DC.

United States Environmental Protection Agency. 1997. Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Report Contents. Assessment and Watershed Protection Division (4503F), Office of Wetlands, Oceans, and Watersheds, Office of Water. U.S. Environmental Protection Agency, Washington, D.C.

United States Environmental Protection Agency. 2008. Introduction to Total Maximum Daily Loads. Accessed at http://www.epa.gov/owow/tmdl/intro.html.

U.S. Environmental Protection Agency (EPA). 2014a. NPDES Glossary. Accessed 1/30/2014 at http://cfpub.epa.gov/npdes/glossary.cfm#M.

U.S. Environmental Protection Agency (EPA). 2014b. Abandoned Mine Drainage. Accessed 1/30/2014 at http://water.epa.gov/polwaste/nps/acid_mine.cfm.

United States Geological Survey in cooperation with the U.S. Environmental Protection Agency. 2003. National Hydrography Dataset.

United States Geological Survey. Unpublished. Kentucky Stream Reach Drainage Polygons shapefile. USGS - Kentucky Water Science Center. Available at ftp://ftp.kymartian.ky.gov/usgs/kyhydropolys.zip.

West Virginia University. 2014. Overview of Acid Mine Drainage Treatment With Chemicals. Morgantown, West Virginia. Accessed at http://anr.ext.wvu.edu/land_reclamation/acid-mine-drainage/chemical_treatment.

Wikipedia. 2014a. Hard Water. Viewed 1/24/14 at http://en.wikipedia.org/wiki/Hard_water.

Wikipedia. 2014b. Alkalinity. Viewed 2/5/14 at http://en.wikipedia.org/wiki/Alkalinity.

Wikipedia. 2015. Hydrolysis. Viewed 3/17/15 at http://en.wikipedia.org/wiki/Hydrolysis.

World Health Organization. 2003. Hardness in Drinking Water. Available at http://www.who.int/water_sanitation_health/dwq/chemicals/en/hardness.pdf.

Woods, A. J., J. M. Omernik, W. H. Martin, G. J. Pond, W.M Andrews, S. M. Call, J.A Comstock, and D. D. Taylor. 2002. Ecoregions of Kentucky (2 sided color poster with map, descriptive text, summary tables, and photographs): Reston, VA, US Geological Survey (map scale 1:1,000,000).

Wurts, William A., and Peter W. Perschbacher. Effects of Bicarbonate Alkalinity and Calcium on the Acute Toxicity of Copper to Juvenile Channel Catfish. Aquaculture 125 (1994) 73-79. Elsevier Press, available at http://www2.ca.uky.edu/wkrec/AlkalinityCopperToxicity.pdf.

Appendix A TMDL Data

This appendix presents the data collected by the TMDL Section by site number, lowest to highest. No measurement or analysis was done for blank cells. Results from duplicate samples are shown in parentheses. Cells showing exceedances of the WQC are shaded. Non-detect samples are reported at their detection limit using the "@" symbol, if the detection limit was available; otherwise the reporting limit, or the limit of quantitation is shown instead of the detection limit. Results already presented in Section 8.0 (e.g., metals, pH, hardness) are not reproduced here. The following data flags are found in the Appendix A tables:

Flag	Flag Description
B	B = Analyte In Method Blank
D	D = Analyzed at a Higher Dilution
H	H = Exceeded Prep Hold Time
J	J = Estimated Value
Q	Q = QC Limits Exceeded
T	T = Exceeded Holding Time
X	X = See Case Narrative

Case narratives are not provided in this appendix, but the X-flag is shown.

DOW10009001 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**	**Arsenic, µg/L**	**Barium, µg/L**
5/18/2006	1200	64.5	n/d @ 5.0	n/d @ 5	n/d @ 5.0	4540	0.590	n/d @ 5.0	n/d @ 95.0
7/19/2006	1300	371 Q	n/d @ 5.0	n/d @ 5	n/d @ 5.0	16400		n/d @ 3.0	8.78
8/10/2006	1125	366 D	n/d @ 5.0	n/d @ 5	n/d @ 5.0	16300		0.676	8.40
9/28/2006	1410	81.6 (71.5)	n/d @ 5.0 (n/d @ 5.0)	n/d @ 5.0 (n/d @ 5.0)	n/d @ 5.0 (n/d @ 5.0)	6710 (6370)		4.2 J (3.92)	16 (16.9)
10/18/2006	1335	122 (123)	n/d @ 5.0 (n/d @ 5.0)	n/d @ 5.0 (n/d @ 5.0)	n/d @ 5.0 (n/d @ 5.0)	7960 D (8040 D)		n/d @ 2.0 D (n/d @ 2.0 D)	14 D (12.9 D)
11/29/2006	1155	105	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	6600 D		n/d @ 3.2 D	12.9
1/10/2007	1320	73	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	4590 D		0.484 JD	12.1
2/22/2007	1335	64	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	4240 D		n/d @ 4.0 D	17.0
3/22/2007	1110	54	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	4090 D		n/d @ 2.0 D (n/d @ 2.0 D)	25.4
Results of duplicate samples shown in parentheses n/d = non detect									

DOW10009001 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Bromide, mg/L**	**Cadmium, µg/L**	**Calcium, mg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**	**Fluoride, mg/L**	**Lead, µg/L**	**Magnesium, mg/L**
5/18/2006		n/d @ 10.0	255	n/d @ 5.0	n/d @ 5.0	21.8 J		n/d @ 95.0	83.5
7/19/2006		n/d @ 6.0	482	n/d @ 5.0	2.95	6.40		2.89	179.0
8/10/2006		0.92	467 D	n/d @ 5.0	3.06	5.43		2.64	165.0
9/28/2006		n/d @ 6.0 (n/d @ 6.0)	241 D (265)	n/d @ 5.0 (n/d @ 5.0)	0.764 (0.868)	2.97 (3.16)		1.03 (1.02)	97.4 (96.3)
10/18/2006	0.0391 D (0.0334 J)	n/d @ 4.0 D (nd @ 4.0 D)	293 D (299 D)	4.68 (4.67)	n/d @ 2.0 D (n/d @ 2.0 D)	n/d @ 5.0 D (n/d @ 5.0 D)	0.858	n/d @ 2.0 D (n/d @ 2.0 D)	126 (130.0)
11/29/2006	0.0523 D	n/d @ 6.4 D	328 D	4.34	n/d @ 3.2 D	n/d @ 8.0 D	0.755	0.706	117.0
1/10/2007	0.0429 J	n/d @ 2.0	214 D	3.64	0.386 J	2.74	0.648	0.357 J	80.6
2/22/2007	0.0265 J	n/d @ 8.0 D	243 D	3.46	0.749	2.91	0.464	0.517	88.2
3/22/2007	n/d @ 0.025	n/d @ 4.0 D (n/d @ 4.0 D)	178	3.55	0.658	1.90	0.535	0.526	65.6
Results of duplicate samples shown in parentheses n/d = non detect									

DOW10009001 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**	**Phosphorus, Total, mg/L**	**Potassium, mg/L**
5/18/2006	7560	n/d @ 0.02	121	0.197		2.05		0.0128 J	5.50
7/19/2006	12900	n/d @ 0.02	238						12.2
8/10/2006	12500	n/d @ 0.02	224						11.4
9/28/2006	6780 (6560)	n/d @ 0.02 (n/d @ 0.02)	96.8 (105.0)						7.56 (7.40)
10/18/2006	7560 D (7540 D)	n/d @ 0.02	128 D (127.0 D)	n/d @ 0.01 TX (n/d @ 0.01 TX)	n/d @ 0.01 TX (n/d @ 0.01 TX)		n/d @ 1.5 TX (n/d @ 1.5 TX)		9.50 (9.88)
11/29/2006	7020 D	0.07	132 D	n/d @ 0.01 TD	n/d @ 0.01 TQ		n/d @ 1.5 TD		8.44
1/10/2007	5800 D	n/d @ 0.02	117	0.312 T	n/d @ 0.01 T		n/d @ 0.5 TD		5.33
2/22/2007	5670 D	n/d @ 0.02	122	0.265 T	n/d @ 0.01 T		n/d @ 0.25 TD		5.97
3/22/2007	4590 D	n/d @ 0.02	93.1	0.168 TQ	n/d @ 0.01 T		n/d @ 2.5 TD		4.58

Results of duplicate samples shown in parentheses

Exceeds the mercury fish consumption limit

n/d = non detect

DOW10009001 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**
5/18/2006	n/d @ 13.0	n/d @ 5.0	22.8	859	1320	0.932 Q		9.71	98.2
7/19/2006	n/d @ 8.0	n/d @ 3.0	38.8	2330	3200			8.51	106.7
8/10/2006	n/d @ 0.5	n/d @ 0.2	35.4	2540	3040			8.41	104.1
9/28/2006	n/d @ 8.0 (n/d @ 8.0)	n/d @ 3.0 (n/d @ 3.0)	28 (28.0)	1340 D (1360)	1690 (338)			9.51	99.3
10/18/2006	n/d @ 5.0 D (n/d @ 5.0 D)	n/d @ 2.0 D (n/d @ 2.0 D)	27.4 (27.6)	1440 D (1460 D)	592 (854)		3 (4)	8.35	87.7
11/29/2006	n/d @ 8.0 D	n/d @ 3.2 D	30.0	1530 D	224		17	9.03	89.4
1/10/2007	2.69 JD	n/d @ 1.0 D	20.3	1010 D	940		31	12.94	99.7
2/22/2007	n/d @ 10.0 D	n/d @ 4.0 D	22.9	856 D	354		34	11.20	99.3
3/22/2007	n/d @ 5.0 D (n/d @ 5.0 D)	n/d @ 2.0 D (n/d @ 2.0 D)	17.8	649 D	804		35	10.12	99.1
Results of duplicate samples shown in parentheses n/d = non detect									

DOW10009001 Copper Creek of Richland Creek 0.0 to 2.7			
Date	**Temperature, °C**	**Specific Conductance, µmhos/cm**	**Flow**
5/18/2006	15.68	1598	2.953
7/19/2006	26.59	3697	0.855
8/10/2006	26.10	3705	0.689
9/28/2006	17.27	2007	1.724
10/18/2006	16.93	2375	1.411
11/29/2006	14.46	2440	2.119
1/10/2007	4.36	1632	5.236
2/22/2007	9.73	1915	3.715
3/22/2007	14.64	820	4.283

DOW10009003 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**	**Arsenic, µg/L**	**Barium, µg/L**
5/18/2006	915	162	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8410	0.791	n/d @ 5.0	n/d @ 94.8
7/19/2006	1415	504 Q	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	21600		n/d @ 1.0 D	6.89
8/10/2006	1245	481	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	19700		n/d @ 3.0 D	6.58
9/28/2006	1505	227	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	13200		4.38 J	14.60
10/18/2006	1430	266	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	15600 D		n/d @ 2.0 D	11.1 D
11/29/2006	1245	236	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	10400 D		n/d @ 1.0 D	13.00
1/10/2007	1245	175	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8290 D		n/d @ 1.0 D	10.40
2/22/2007	1405	218	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8370 D		n/d @ 3.0 D	8.27
3/22/2007	1140	208	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	9810 D		n/d @ 4.0 D	10.30
n/d = non detect									

DOW10009003 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Bromide, mg/L**	**Cadmium, µg/L**	**Calcium, mg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**	**Fluoride, mg/L**	**Lead, µg/L**	**Magnesium, mg/L**
5/18/2006		n/d @ 10.0	274	n/d @ 5.0	n/d @ 5.0	21 J		n/d @ 94.8	104
7/19/2006		n/d @ 2.0 D	476	n/d @ 5.0	3.42	4.87		2.07	186
8/10/2006		n/d @ 6.0 D	460	n/d @ 5.0	3.55	4.87		2.08	177
9/28/2006		n/d @ 6.0	326 D	n/d @ 5.0	1.77	4.07		1.78	129
10/18/2006	0.0371 J	n/d @ 4.0 D	368 D	3.93	n/d @ 2.0 D	5.72 D	1.040	n/d @ 2.0 D	172
11/29/2006	n/d @ 0.025 Q	n/d @ 2.0 D	356 D	3.69	1.67	3.56	0.923	1.39	121
1/10/2007	0.0405 J	n/d @ 2.0 D	266 D	3.17	0.98	3.33	0.805	0.486 J	103
2/22/2007	n/d @ 0.025	n/d @ 6.0 D	366 D	n/d @ 50.0 D	1.16	4.03	n/d @ 2.5	0.750	136
3/22/2007	0.0469 J	n/d @ 8.0 D	340 D	3.64	1.09	2.94	1.090	0.703	130
n/d = non detect									

DOW10009003 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**	**Phosphorus, Total, mg/L**	**Potassium, mg/L**
5/18/2006	8680	n/d @ 0.02	172	n/d @ 0.01		2.49		0.02	5.59
7/19/2006	16300	0.035 J	296						10.90
8/10/2006	15200	n/d @ 0.02	275						10.60
9/28/2006	11300	n/d @ 0.02	170						7.85
10/18/2006	11900 D	n/d @ 0.02	224 D	n/d @ 0.01 TX	n/d @ 0.01 TX		n/d @ 5.0 TX		9.46
11/29/2006	9090 D	n/d @ 0.02	157	n/d @ 0.01 TD	n/d @ 0.01 TQ		n/d @ 12.5 TD		7.41
1/10/2007	7740 D	n/d @ 0.02	141	0.0893 T	n/d @ 0.01 T		n/d @ 1.5 TD		5.69
2/22/2007	10800 D	n/d @ 0.02	208	n/d @ 0.01 T	n/d @ 0.01 T		n/d @ 2.5 TD		7.72
3/22/2007	9520 D	n/d @ 0.02	197	0.0452 TQ	n/d @ 0.01 T		n/d @ 25 TD		7.19
n/d = non detect									

DOW10009003 Copper Creek of Richland Creek 0.0 to 2.7									
Date	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**
5/18/2006	n/d @ 13.0	n/d @ 5.0	14.4	1220	1730	1.22 Q		10.44	
7/19/2006	n/d @ 2.5 D	n/d @ 1.0 D	23.5	2530	3310			8.44	109.9
8/10/2006	n/d @ 8.0 D	n/d @ 3.0 D	23.9	2530	3350			8.22	106.2
9/28/2006	n/d @ 8.0	n/d @ 3.0	18.0	2000 D	2150			9.68	101.8
10/18/2006	n/d @ 5.0 D	n/d @ 2.0 D	18.6	1790 D	388		3	8.65	92.7
11/29/2006	n/d @ 2.0 D	n/d @ 1.0 D	17.9	1850 D	866		9	10.12	99.4
1/10/2007	2.82 JD	n/d @ 1.0 D	14.7	1370 D	670		27	12.21	104.1
2/22/2007	n/d @ 7.5 D	n/d @ 3.0 D	17.2	1390 D	884		26	10.75	97.7
3/22/2007	n/d @ 10.0 D	n/d @ 4.0 D	16.9	1340 D	1250		18	10.07	100.5
n/d = non detect									

DOW10009003 Copper Creek of Richland Creek 0.0 to 2.7			
Date	**Temperature, °C**	**Specific Conductance, µmhos/cm**	**Flow**
5/18/2006	15.20	2237	1.551
7/19/2006	28.67	4060	0.240
8/10/2006	28.31	4055	0.194
9/28/2006	17.64	2500	0.744
10/18/2006	17.87	3090	0.387
11/29/2006	15.59	2210	0.981
1/10/2007	5.46	2026	2.232
2/22/2007	10.81	2486	1.844
3/22/2007	15.20	2617	2.035

DOW10014007 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	Time	Acidity (digested) ($CaCO_3$), mg/L	Alkalinity ($CaCO_3$), mg/L	Alkalinity, Bicarbonate ($CaCO_3$), mg/L	Alkalinity, Carbonate ($CaCO_3$), mg/L	Aluminum, µg/L	Ammonia, mg/L	Arsenic, µg/L
5/17/2006	1120	15.9	22.6	22.6	n/d @ 5.0	1580		0.852
7/19/2006	855	13.3 Q	25.9	25.9	n/d @ 5.0	519		0.941
8/10/2006	952	n/d @ 10	72.5	72.5	n/d @ 5.0	584		2.120
9/28/2006	905	36.4	7.7	7.7	n/d @ 5.0	410		0.871
10/18/2006	950	96.4	n/d @ 5	n/d @ 5.0	n/d @ 5.0	2250 D		n/d @ 2.0 D
11/29/2006	915	18.4 (23.5)	14.8 (14.5)	14.8 (14.5)	n/d @ 5.0 (n/d @ 5.0)	717 (2160 D)		0.665 (2.03)
1/10/2007	925	34.9	13.3	13.3	n/d @ 5.0	341		0.479 J
2/22/2007	925	36.7	8.0	8.0	n/d @ 5.0	372		0.590
3/22/2007	900	28.0	9.8	9.8	n/d @ 5.0	222		0.296 J

(yellow) Exceeds the chronic limit

(orange) Exceeds the acute limit

Results of duplicate sample shown in parentheses

n/d = non detect

DOW10014007 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	**Barium, µg/L**	**Bromide, mg/L**	**Cadmium, µg/L**	**Calcium, mg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**	**Lead, µg/L**
5/17/2006	27.3		n/d @ 0.4	28.4	5.73	1.12	2.44	1.14
7/19/2006	29.6		n/d @ 0.4	83.2	10.30	0.25 J	4.28	0.506
8/10/2006	25.8		n/d @ 0.4	98.0	9.02	0.622	3.66	1.42
9/28/2006	28.8		1.1	66.7	6.24	0.461 J	3.16	0.236 J
10/18/2006	31.3 D	0.0585	n/d @ 4.0 D	162.0	8.92	n/d @ 2.0	10.30	n/d @ 2.0
11/29/2006	30.6 (27.5)	n/d @ 0.025 Q (n/d @ 0.025 Q)	1.41 (1.36)	95.6 (102)	5.75 (5.97)	n/d @ 0.2 D (0.249 J)	2.1 D (2.78)	n/d @ 0.2 D (n/d @ 0.2)
1/10/2007	24.4	n/d @ 0.025	0.9	39.4	3.91	n/d @ 0.2	1.38	0.208 J
2/22/2007	26.0	n/d @ 0.025	1.2	52.3	9.62	n/d @ 0.2	1.07	n/d @ 0.2
3/22/2007	28.0	n/d @ 0.025	1.1	60.6	7.24	n/d @ 0.2	1.63	n/d @ 0.2
	Exceeds the chronic limit							
Results of duplicate sample shown in parentheses								
n/d = non detect								

DOW10014007 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**
5/17/2006	11.6	593	n/d @ 0.02	13.8				
7/19/2006	30.7	1980	n/d @ 0.02	17.5				
8/10/2006	33.6	895	n/d @ 0.02	8.2				
9/28/2006	29.4	1510	n/d @ 0.02	30.7				
10/18/2006	69.9	2260 D	n/d @ 0.02	41.5	0.678 TX	n/d @ 0.01 TX		n/d @ 0.25 TX
11/29/2006	48.9 (51.6)	1680 D (1620 D)	n/d @ 0.02 (n/d @ 0.02)	42.1 D (40.0)	0.649 T (0.695 T)	n/d @ 0.01 TQ (n/d @ 0.01 TQ)		n/d @ 0.15 TD (n/d @ 0.15 TD)
1/10/2007	18.5	690	n/d @ 0.02	27.4	0.325 T	n/d @ 0.01 T		n/d @ 0.025 T
2/22/2007	24.7	1190 D	0.0280 J	31.6	0.47 T	n/d @ 0.01 T		n/d @ 0.025 T
3/22/2007	28.5	1200 D	n/d @ 0.02	32.5	0.386 TQ	n/d @ 0.01 T		n/d @ 2.5 TD
Results of duplicate sample shown in parentheses n/d = non detect								

DOW10014007 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**
5/17/2006		2.41 (3.01)	n/d @ 0.5	n/d @ 0.2	7.9	120	200	
7/19/2006		5.00	n/d @ 0.5	n/d @ 0.2	13.0	294	496	
8/10/2006		4.16 B	1.32	n/d @ 0.2	13.3	330	554	
9/28/2006		3.40	0.660 J	n/d @ 0.2	9.3	326 D	476	
10/18/2006		5.77	n/d @ 5.0 D	n/d @ 2.0	12.2	772 D	972	
11/29/2006		2.97 B (3.01 B)	1 (0.828 J)	n/d @ 0.2 D (n/d @ 0.2)	11.3 (11.5)	452 D (474 D)	392 (410)	
1/10/2007		1.85 B	0.545 J	n/d @ 0.2	7.6	155 D	266	
2/22/2007		2.01 B	n/d @ 0.5	n/d @ 0.2	11.1	242 D	318	
3/22/2007		2.14 B	n/d @ 0.5	n/d @ 0.2	10.9	223 D	426	
Results of duplicate sample shown in parentheses n/d = non detect								

DOW10014007 Hurricane Creek of Tradewater River 0.0 to 1.8						
Date	Total Suspended Solids, mg/L	Dissolved Oxygen, mg/L	Dissolved Oxygen %Saturation	Temperature, °C	Specific Conductance, µmhos/cm	Flow
5/17/2006		7.7		14.1	314.6	*
7/19/2006		3.8	46.7	26.6	730.3	*
8/10/2006		5.3	69.5	27.0	1355.0	*
9/28/2006		2.4	24.5	17.6	1402.0	*
10/18/2006	64.0	5.0	49.4	14.0	1269.0	*
11/29/2006	4.5 (3.5)	7.3	65.6	10.9	937.0	*
1/10/2007	5.0	11.5	86.4	3.6	423.9	*
2/22/2007	6.5	10.1	85.6	7.4	572.4	*
3/22/2007	4.5	8.5	83.4	14.7	644.7	*
	Exceeds the dissolved oxygen limit					
* Flow was present but too low to measure						

DOW10014009 UT to Hurricane Creek at RM 1.2, 0.0 to 0.6								
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**	**Arsenic, µg/L**
5/17/2006	930	339	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	26000	5.98	10.2
9/28/2006	1020	849	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	78400		11.2 J
10/18/2006	1035	660	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	33900		n/d @ 10.0
11/29/2006	945	876	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	80800 D		29.8 DJ
1/10/2007	1010	475	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	37800 D		19.6 D
2/22/2007	1005	488	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	50000 D		14.2 D
3/22/2007	925	615	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	52500 D		9.74 D
n/d = non detect								

DOW10014009 UT to Hurricane Creek at RM 1.2, 0.0 to 0.6								
Date	**Barium, µg/L**	**Bromide, mg/L**	**Cadmium, µg/L**	**Calcium, mg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**	**Fluoride, mg/L**
5/17/2006	21	21.0		n/d @ 7.6	5.85	3	21.4	
9/28/2006	15.2	15.2		n/d @ 10.0	n/d	6.76	50.3	
10/18/2006	n/d	n/d @ 10.0	n/d @ 0.025	n/d @ 20.0	3.97	n/d @10.0	n/d @ 25.0	0.604
11/29/2006	10.9	10.9	n/d @ 0.025 Q	n/d @ 32.0 D	4.17	9.71	48 D	0.614
1/10/2007	17.6	17.6	n/d @ 0.025	n/d @ 4.0 D	3.15	4.24	16.8	0.225
2/22/2007	13.2	13.2	n/d @ 0.025	n/d @ 8.0 D	5.64	4.52	28.8	0.278
3/22/2007	13.6	13.6	n/d @ 0.025	n/d @ 4.0 D	5.98	4.28	37.7	0.466
	Exceeds the chronic limit							
n/d = non detect								

DOW10014009 UT to Hurricane Creek at RM 1.2, 0.0 to 0.6								
Date	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**
5/17/2006	1.81	30.4	5900	n/d @ 0.02	146.0	10.0		3.44
9/28/2006	2.84	57.1	18500	n/d @ 0.02	275.0			
10/18/2006	n/d @ 10.0	52.5	7570	n/d @ 0.02	n/d @ 10.0	9.67 TXD	0.186 TX	
11/29/2006	2.82	52.9	13500 D	n/d @ 0.02	294 D	13.3 TQ	0.401 TD	
1/10/2007	2.03	29.0	6040 D	n/d @ 0.02	139.0	8.42 T	0.146 T	
2/22/2007	2.30	36.1	9970 D	0.0	172.0	9.29 T	0.273 T	
3/22/2007	2.44	39.6	9450 D	n/d @ 0.02	192.0	6.35 TD	n/d @ 0.01 T	
	Exceeds the chronic limit							
n/d = non detect								

DOW10014009 UT to Hurricane Creek at RM 1.2, 0.0 to 0.6								
Date	**Ortho-phosphorus, mg/L**	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**
5/17/2006			3.17	n/d @ 9.5	n/d @ 3.8	12.1	708	1020
9/28/2006			4.75	15.8 J	n/d @ 5.0	13.3	1740 D	2250
10/18/2006	n/d @ 1.5 TX		4.04	n/d @ 25.0	n/d @ 10.0	14.5	1290 D	1050
11/29/2006	n/d @ 1.5		4.57	n/d @ 40.0 D	n/d @ 16.0 D	15.4	1560 D	446
1/10/2007	n/d @ 0.25 TD		3.07	n/d @ 5.0 D	n/d @ 2.0 D	10.2	164 D	1240
2/22/2007	n/d @ 0.5 TD		3.17 B	5.86 D	n/d @ 4.0 D	12.8	941 D	306
3/22/2007	n/d @ 2.5 TD		3.58	n/d @ 5.0 D	n/d @ 2.0 D	14.4	1200 D	1750
	Exceeds the chronic limit							
n/d = non detect								

DOW10014009 UT to Hurricane Creek at RM 1.2, 0.0 to 0.6							
Date	TKN, mg/L	Total Suspended Solids, mg/L	Dissolved Oxygen, mg/L	Dissolved Oxygen %Saturation	Temperature, °C	Specific Conductance, µmhos/cm	Flow
5/17/2006	8.25 Q		8.4		Jan-00	1311	0.304
9/28/2006		n/d @ 1.5	7.7	84.7	Jan-00	2464	0.091
10/18/2006		4.5	8.4	93.2	Jan-00	2324	0.077
11/29/2006		25.5	6.7	70.1	Jan-00	2670	0.050
1/10/2007			12.3	85.8	Jan-00	1488	0.301
2/22/2007		43.0	10.3	94.6	Jan-00	1720	0.239
n/d = non detect							

DOW10014010 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	Time	Acidity (digested) ($CaCO_3$), mg/L	Alkalinity ($CaCO_3$), mg/L	Alkalinity, Bicarbonate ($CaCO_3$), mg/L	Alkalinity, Carbonate ($CaCO_3$), mg/L	Aluminum, µg/L	Ammonia, mg/L	Arsenic, µg/L
5/17/2006	1015	8.08	30.3	30.3		1310	0.0251 J	0.535
7/19/2006	1015	n/d @ 10	68.4	68.4	n/d @ 5.0	592		0.587
9/28/2006	1115	n/d @ 10	45.2	45.2	n/d @ 5.0	798		0.617
10/18/2006	1100	n/d @ 10	46.3	46.3	n/d @ 5.0	627		0.437 J
11/29/2006	1015	n/d @ 10	51.7	51.7	n/d @ 5.0	547		0.341 J
1/10/2007	1050	n/d @ 10	27.5	27.5	n/d @ 5.0	889		0.325 J
2/22/2007	1030	n/d @ 10	30.3	30.3	n/d @ 5.0	788		0.547
3/22/2007	950	n/d @ 10	32.3	32.3	n/d @ 5.0	1150		0.335 J
	Exceeds the chronic limit							
	Exceeds the acute limit							
n/d = non detect								

DOW10014010 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	Barium, µg/L	Bromide, mg/L	Cadmium, µg/L	Calcium, mg/L	Chloride, mg/L	Chromium, µg/L	Copper, µg/L	Lead, µg/L
5/17/2006	32.2		0.692 J	35.4	7.19	1.43	1.94	0.861
7/19/2006	30.9		n/d @ 0.4	140.0	8.94	0.669	1.71	0.295 J
9/28/2006	25.4		1.33	80.1	6.96	0.971	2.48	0.503
10/18/2006	31.7	0.0534	1.08	117.0	11.7	0.548	1.76	0.298 J
11/29/2006	28.0	0.0497 Q	1.66	109.0	5.88	n/d @ 0.2	1.85	n/d @ 0.2
1/10/2007	25.1	n/d @ 0.025	1.79	51.8	3.99	0.201 J	1.80	n/d @ 0.2
2/22/2007	26.3	n/d @ 0.025	1.80	68.9	9.46	0.987	1.24	n/d @ 0.2
3/22/2007	32.1	n/d @ 0.025	1.52	71.4	6.93	0.750	1.93	0.669
	Exceeds the chronic limit							
n/d = non detect								

DOW10014010 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	Magnesium, mg/L	Manganese, µg/L	Mercury, µg/L	Nickel, µg/L	Nitrate, mg/L	Nitrite, mg/L	Organic Carbon, mg/L	Ortho-phosphorus, mg/L
5/17/2006	17.2	628	n/d @ 0.02	21.1	0.122		3.5	
7/19/2006	69.7	124	n/d @ 0.02	4.13				
9/28/2006	39.3	751	n/d @ 0.02	32.1				
10/18/2006	56.5	482	0.03 J	31.4	0.0298 TX	n/d @ 0.01 TX		n/d @ 0.15 TX
11/29/2006	57.3	1050 D	n/d @ 0.02	38.4	0.0895 T	n/d @ 0.01 TQ		n/d @ 0.15 TD
1/10/2007	26.1	843	n/d @ 0.02	39.8	0.137 T	n/d @ 0.01 T		n/d @ 0.025 T
2/22/2007	35.7	843	n/d @ 0.02	35.8	0.132 T	n/d @ 0.01 T		n/d @ 0.075 TD
3/22/2007	36.2	901 D	0.024 J	34.0	0.0753 TQ	n/d @ 0.01 T		n/d @ 2.5 TD
n/d = non detect								

DOW10014010 Hurricane Creek of Tradewater River 0.0 to 1.8								
Date	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**
5/17/2006	0.046	1.81	n/d @ 13.0	n/d @ 5.0	9.1	154	240	0.352 Q
7/19/2006		4.75 B	1.13	n/d @ 0.2	12.8	529	896	
9/28/2006		3.36	0.821 J	n/d @ 0.2	10.7	364 D	594	
10/18/2006		4.62	0.965 J	n/d @ 0.2	14.8	431 D	430	
11/29/2006		2.91 B	0.952 J	n/d @ 0.2	11.0	485 D	486	
1/10/2007		1.75 B	0.9 J	n/d @ 0.2	7.5	208 D	392	
2/22/2007		1.55	n/d @ 0.5	n/d @ 0.2	11.4	274 D	444	
3/22/2007		2.08 B	n/d @ 0.5	n/d @ 0.2	10.6	240 D	490	
n/d = non detect								

DOW10014010 Hurricane Creek of Tradewater River 0.0 to 1.8						
Date	**Total Suspended Solids, mg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**	**Temperature, °C**	**Specific Conductance, µmhos/cm**	**Flow**
5/17/2006		9.3	88.9	13.5	374.7	6.935
7/19/2006		6.5	77.8	24.0	1173.0	
9/28/2006		9.0	93.7	17.0	759.2	2.116
10/18/2006	3.5	7.7	78.1	15.2	915.6	0.736
11/29/2006	4.5	8.7	82.1	12.9	1009.0	1.396
1/10/2007	8.5	13.3	98.6	3.3	491.9	4.456
2/22/2007	7.5	12.2	97.6	6.8	616.5	2.297
3/22/2007	30.0	10.3	99.2	13.6	686.9	5.930

DOW10014012 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**	**Arsenic, µg/L**	**Barium, µg/L**
7/18/2006	1225	n/d @ 10.0	98.8	98.8	n/d @ 5.0	204		1.18	19.4
8/9/2006	1112	n/d @ 10.0	199.0	199.0	n/d @ 5.0				
9/27/2006	947	n/d @ 10.0	45.3	45.3	n/d @ 5.0				
10/17/2006	935	n/d @ 10.0	47.8	47.8	n/d @ 5.0				
11/28/2006	955	26.6	9.9	9.88	n/d @ 5.0				
1/11/2007	855	33.0							
2/20/2007	1025	32.5							
3/21/2007	1015	41.2	n/d @ 5	n/d @ 5.0	n/d @ 5.0				
n/d = non detect									

DOW10014012 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Bromide, mg/L**	**Cadmium, µg/L**	**Calcium, mg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**	**Fluoride, mg/L**	**Hardness, Total mg/L**	**Iron, mg/L**
7/18/2006		n/d @ 0.4	51.20	n/d @ 5.0	0.424 J	0.884 J		251	2.44
8/9/2006				n/d @ 5.0					
9/27/2006				n/d @ 5.0					
10/17/2006	0.0392 J			2.09			0.217		
11/28/2006	n/d @ 0.025 Q			2.41			0.284		
1/11/2007									
2/20/2007									
3/21/2007	0.036 J			2.68			0.304		
	Exceeds the chronic limit								
n/d = non detect									

DOW10014012 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**
7/18/2006	0.284 J	30.0	4250	n/d @ 0.02	7.94				
8/9/2006									
9/27/2006									
10/17/2006						0.042 TX	n/d @ 0.01 TX		n/d @ 0.025 T
11/28/2006						0.0102 T	n/d @ 0.01 TQ		n/d @ 0.025 T
1/11/2007									
2/20/2007									
3/21/2007						n/d @ 0.01 T	n/d @ 0.01 T		n/d @ 0.5 TD
n/d = non detect									

DOW10014012 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**
7/18/2006		3.74	n/d @ 0.5	n/d @ 0.2	9.33	190	380		
8/9/2006						160	438 T		
9/27/2006						194	342		
10/17/2006						197 D	288		44.0
11/28/2006						225 D	292		6.5
1/11/2007									
2/20/2007									
3/21/2007						357 D	558		19.0
n/d = non detect									

DOW10014012 Caney Creek of Tradewater River 0.0 to 8.2						
Date	**Zinc, µg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**	**Temperature, °C**	**Specific Conductance, µmhos/cm**	**Flow**
7/18/2006	7.46	3.5	30.0	24.17	586.6	*
8/9/2006		2.01	23.8	23.93	680.6	*
9/27/2006		2.61	27.4	17.79	438.3	*
10/17/2006		1.69	16.1	13.01	469.1	*
11/28/2006		5.81	48.4	8.03	511	*
1/11/2007		8.07	65.1	6.46	506.4	*
2/20/2007		8.49	68.7	6.22	622.5	*
3/21/2007		5.93	58.1	14.53	754.1	*
* Flow was present but too low to measure						

DOW10014013 Caney Creek of Tradewater River 0.0 to 8.2									
Date	Time	Acidity (digested) ($CaCO_3$), mg/L	Alkalinity ($CaCO_3$), mg/L	Alkalinity, Bicarbonate ($CaCO_3$), mg/L	Alkalinity, Carbonate ($CaCO_3$), mg/L	Aluminum, µg/L	Ammonia, mg/L	Arsenic, µg/L	Barium, µg/L
7/18/2006	1700	n/d @ 10	90.9	90.9	n/d @ 5.0				
8/9/2006	1147	n/d @ 10	62.6	62.6	n/d @ 5.0				
9/27/2006	1125	33.50	6.0	6.0	n/d @ 5.0				
10/17/2006	1045	22.80	11.1	11.1	n/d @ 5.0				
11/28/2006	1120	19.20	21.8	21.8	n/d @ 5.0				
1/11/2007	1025	52.40							
2/20/2007	1140	35.00							
3/21/2007	1120	30.00	9.93	9.93	n/d @ 5.0				
n/d = non detect									

DOW10014013 Caney Creek of Tradewater River 0.0 to 8.2									
Date	Bromide, mg/L	Cadmium, µg/L	Calcium, mg/L	Chloride, mg/L	Chromium, µg/L	Copper, µg/L	Fluoride, mg/L	Hardness, Total mg/L	Iron, mg/L
7/18/2006				n/d @ 5.0					
8/9/2006				5.01					
9/27/2006				n/d @ 5.0					
10/17/2006	0.0446 J			4.15			0.474		
11/28/2006	n/d @ 0.025 Q			4.04			0.188		
1/11/2007									
2/20/2007									
3/21/2007	0.0335 J			4.29			0.244		
n/d = non detect									

DOW10014013 Caney Creek of Tradewater River 0.0 to 8.2										
Date	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**
7/18/2006									
8/9/2006									
9/27/2006									
10/17/2006						n/d @ 0.01 TX	n/d @ 0.01 TX		n/d @ 0.5
11/28/2006						0.0393 T	n/d @ 0.01 TQ		n/d @ 0.025 T
1/11/2007									
2/20/2007									
3/21/2007						0.0721 TQ	n/d @ 0.01 T		n/d @ 0.5 TD
n/d = non detect									

DOW10014013 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**
7/18/2006						722	1200		
8/9/2006						1000	1450 T		
9/27/2006						776 D	1100		
10/17/2006						966 D	804		6.5
11/28/2006						303	420		104
1/11/2007									
2/20/2007									
3/21/2007						377 D	402		8.0
n/d = non detect									

DOW10014013 Caney Creek of Tradewater River 0.0 to 8.2						
Date	**Zinc, µg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**	**Temperature, °C**	**Specific Conductance, µmhos/cm**	**Flow**
7/18/2006		5.51	73.7	31.11	1532	*
8/9/2006		3.07	33.7	25.86	1861	*
9/27/2006		7.89	83.5	18.05	1202	*
10/17/2006		7.82	74.9	12.73	1594	*
11/28/2006		9.19	80.3	9.71	720	*
1/11/2007		12.14	93	4.23	825.4	*
2/20/2007		11.7	92.6	5.33	1008	*
3/21/2007		9.32	89.1	13.5	807.6	*
* Flow was present but too low to measure						

DOW10014014 Caney Creek of Tradewater River 0.0 to 8.2									
Date	Time	Acidity (digested) ($CaCO_3$), mg/L	Alkalinity ($CaCO_3$), mg/L	Alkalinity, Bicarbonate ($CaCO_3$), mg/L	Alkalinity, Carbonate ($CaCO_3$), mg/L	Aluminum, µg/L	Ammonia, mg/L	Arsenic, µg/L	Barium, µg/L
6/28/2006	1245	43.4	n/d @ 5	n/d @ 5.0	n/d @ 5.0		0.116		
7/18/2006	1705	36.5 Q	n/d @ 5	n/d @ 5.0	n/d @ 5.0				
9/27/2006	1055	31.3	6.38	6.38	n/d @ 5.0				
10/17/2006	1105	23.6	n/d @ 5	n/d @ 5.0	n/d @ 5.0				
11/28/2006	1155	55.6	n/d @ 5	n/d @ 5.0	n/d @ 5.0				
1/11/2007	1045	63.0							
2/20/2007	1200	25.1							
3/21/2007	1140	29.1	10.50	10.50	n/d @ 5.0				
n/d = non detect									

DOW10014014 Caney Creek of Tradewater River 0.0 to 8.2									
Date	Bromide, mg/L	Cadmium, µg/L	Calcium, mg/L	Chloride, mg/L	Chromium, µg/L	Copper, µg/L	Fluoride, mg/L	Hardness, Total mg/L	Iron, mg/L
6/28/2006				n/d @ 5.0					
7/18/2006				n/d @ 5.0					
9/27/2006				n/d @ 5.0					
10/17/2006	0.0369 J			5.05			0.456		
11/28/2006	n/d @ 0.025 Q			3.90			0.613		
1/11/2007									
2/20/2007									
3/21/2007	n/d @ 0.025			3.48			0.246		
n/d = non detect									

DOW10014014 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**
6/28/2006						0.137		1.55	
7/18/2006									
9/27/2006									
10/17/2006						0.0802 TX	n/d @ 0.01 TX		n/d @ 0.5
11/28/2006						0.0678 T	n/d @ 0.01 TQ		n/d @ 0.025 TD
1/11/2007									
2/20/2007									
3/21/2007						0.088 TQ	n/d @ 0.01 T		n/d @ 0.5 TD
n/d = non detect									

DOW10014014 Caney Creek of Tradewater River 0.0 to 8.2									
Date	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**
6/28/2006	0.0114 J					1000	1680	0.441 J	
7/18/2006						1370	1680		
9/27/2006						899 D	1170		
10/17/2006						938 D	558		4
11/28/2006						732 D	456		3
1/11/2007									
2/20/2007									
3/21/2007						434 D	236		14
n/d = non detect									

DOW10014014 Caney Creek of Tradewater River 0.0 to 8.2						
Date	Zinc, µg/L	Dissolved Oxygen, mg/L	Dissolved Oxygen %Saturation	Temperature, °C	Specific Conductance, µmhos/cm	Flow
6/28/2006		7.5		20.42	1808	0.848
7/18/2006		7.47	94.7	27.37	1964	0.185
9/27/2006		5.83	53.6	18.36	1319	2.667
10/17/2006		7.5	75.5	15.06	1523	4.833
11/28/2006		9.69	84.1	10.19	1417	2.84
1/11/2007		12.11	94.4	4.9	908.1	10.07
2/20/2007		7.8	63.4	6.43	1142	6.837
3/21/2007		10.06	96.4	13.6	901.8	15.024

DOW10014015 Fox Run of Caney Creek 0.0 to 1.1									
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**	**Arsenic, µg/L**	**Barium, µg/L**
5/17/2006	1745	-8.36	20.4	20.4	n/d @ 5.0	3100	0.0468 J	5.44 J	n/d @ 95.0
7/18/2006	1745	45.7 Q	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0				
8/9/2006	1243	49.7 Q	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0				
9/27/2006	1235	51.2	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0				
10/17/2006	1145	63.7	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0				
11/28/2006	1245	60.9	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0				
1/11/2007	1110	68.1 (66.1)							
2/20/2007	1225	55.1							
3/21/2007	1210	61.7	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0				
Results of duplicate sample shown in parentheses n/d = non detect									

DOW10014015 Fox Run of Caney Creek 0.0 to 1.1									
Date	**Bromide, mg/L**	**Calcium, mg/L**	**Cadmium, µg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**	**Fluoride, mg/L**	**Hardness, Total mg/L**	**Iron, mg/L**
5/17/2006		168.0	n/d @ 10.0	n/d @ 5.0	5.92 J	26.60		705	0.662
7/18/2006				n/d @ 5.0					
8/9/2006				n/d @ 5.0					
9/27/2006				n/d @ 5.0					
10/17/2006	0.0343 J			3.50			0.685		
11/28/2006	n/d @ 0.025 Q			3.39			0.736		
1/11/2007									
2/20/2007									
3/21/2007	n/d @ 0.025			3.64			0.578		
n/d = non detect									

DOW10014015 Fox Run of Caney Creek 0.0 to 1.1									
Date	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nickel, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**
5/17/2006	n/d @ 95.0	76.9	2690.0	n/d @ 0.02	85.5	0.0556		1.4	
7/18/2006									
8/9/2006									
9/27/2006									
10/17/2006						n/d @ 0.01 TX	n/d @ 0.01 TX		6.22 TX
11/28/2006						0.0292 T	n/d @ 0.01 TQ		n/d @ 1.25 TD
1/11/2007									
2/20/2007									
3/21/2007						0.0592 TQ	n/d @ 0.01 T		n/d @ 2.5 TD
n/d = non detect									

DOW10014015 Fox Run of Caney Creek 0.0 to 1.1									
Date	Phosphorus, Total, mg/L	Potassium, mg/L	Selenium, µg/L	Silver, µg/L	Sodium, mg/L	Sulfate, mg/L	Total Dissolved Solids, mg/L	TKN, mg/L	Total Suspended Solids, mg/L
5/17/2006	0.0106 J	3.54	n/d @ 13.0	n/d @ 5.0	10.9	672	1090	0.204 JTX	
7/18/2006						1330	1710		
8/9/2006						1290	1800 T		
9/27/2006						1340 D	1510		
10/17/2006						1230 D	368		n/d @ 1.5
11/28/2006						1090 D	248		3.5
1/11/2007									
2/20/2007									
3/21/2007						703 D	250		6.5
n/d = non detect									

DOW10014015 Fox Run of Caney Creek 0.0 to 1.1						
Date	**Zinc, µg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**	**Temperature, °C**	**Specific Conductance, µmhos/cm**	**Flow**
5/17/2006		9.3		60.4	1514	3.263
7/18/2006		8.6	98.8	72.1	1942	0.046
8/9/2006		8.4	97.3	72.4	1998	0.103
9/27/2006		9.1	95.5	63.9	1701	1.265
10/17/2006		8.6	86.6	58.8	1988	1.568
11/28/2006		11.3	100.8	55.0	1748	1.361
1/11/2007		11.6	96.6	45.6	1446	2.780
2/20/2007		9.8	96.8	45.5	1577	3.060
3/21/2007		9.8	96.8	58.7	1449	3.438

DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6.							
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**
5/17/2006	1200	66.4	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	5290	0.155
7/18/2006	1345	240 Q	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	18400 D	
9/27/2006	1029	195	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	17100	
10/17/2006	1010	196	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	178 D	
11/28/2006	1025	169	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	14700 D	
1/11/2007	930	93.2	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8200 D	
2/20/2007	1020	101.0	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8840 D	
3/21/2007	1040	75.3	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	6740 D	
n/d = non detect							

DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6.							
Date	**Arsenic, µg/L**	**Barium, µg/L**	**Bromide, mg/L**	**Calcium, mg/L**	**Chloride, mg/L**	**Chromium, µg/L**	**Copper, µg/L**
5/17/2006	n/d @ 2.0	25.1		53.5	6.98	n/d @ 2.0	18.50
7/18/2006	n/d @ 3.0 D	25.7		125.0	6.36	2.00	7.98
9/27/2006	2.41 J	22.0		91.8	n/d @ 5.0	1.52	8.35
10/17/2006	n/d @ 2.0 D	15.7 D	0.0358 J	107.0	11.90	n/d @ 2.0 D	n/d @ 5.0 D
11/28/2006	n/d @ 6.71	23.3	n/d @ 0.025 Q	89.4	5.19	1.30	7.24
1/11/2007	1.62	22.4	n/d @ 0.025	57.0	4.18	0.823	5.36
2/20/2007	0.984 JD	21.8	n/d @ 0.025	69.9	7.26	1.06	4.78
3/21/2007	1.95 JD	25.2	n/d @ 0.025	67.0	4.74	0.502	4.82
	Exceeds the acute limit						
n/d = non detect							

DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6.							
Date	**Fluoride, mg/L**	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**
5/17/2006		n/d @ 2.0	18.9	2030	n/d @ 0.02	0.181	
7/18/2006		3.14	35.3	6020 D	n/d @ 0.02		
9/27/2006		1.18	27.3	5720	n/d @ 0.02		
10/17/2006	0.663	n/d @ 2.0 D	26.9	1540 D	n/d @ 0.02	0.382 TX	n/d @ 0.01 TX
11/28/2006	0.705	0.714	32.9	4160	n/d @ 0.02	0.161 T	n/d @ 0.01 TQ
1/11/2007	0.418	0.412 J	21.0	2570 D	n/d @ 0.02	0.182 T	n/d @ 0.01 T
2/20/2007	0.391	0.420 J	25.9	2620 D	n/d @ 0.02	0.143 TD	n/d @ 0.01
3/21/2007	0.380	0.449 J	23.8	2320 D	n/d @ 0.02	0.0736 TQ	n/d @ 0.01 T
n/d = non detect							

DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**
5/17/2006	2.19		0.0195 J	2.30	n/d @ 5.0	n/d @ 2.0	10.4
7/18/2006				5.48	n/d @ 8.0 D	n/d @ 3.0 D	14.3
9/27/2006				3.83 B	5.56 J	n/d @ 2.0	10.9
10/17/2006		n/d @ 0.5 TX		6.18	n/d @ 5.0 D	n/d @ 2.0 D	15.6
11/28/2006		n/d @ 0.025 T		3.09 B	n/d @ 16.8 D	n/d @ 6.71 D	11.0
1/11/2007		n/d @ 0.025 T		2.01 B	1.13	n/d @ 0.2	7.63
2/20/2007		n/d @ 0.025		1.71	n/d @ 1.0	n/d @ 0.4	10.0
3/21/2007		n/d @ 0.5 TD		2.21 B	n/d @ 2.5 D	n/d @ 1.0 D	8.72
	Exceeds the chronic limit						

DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**	**Temperature, °C**
5/17/2006	227	346	0.455 JQ		8.09		14.14
7/18/2006	820	1060			7.09	94.0	30.14
9/27/2006	610	820			8.12	82.2	16.04
10/17/2006	589 D	432		15.5	7.83	73.0	14.39
11/28/2006	54.4	214		11.0	10.39	90.6	9.57
1/11/2007	328	446		13.0	9.55	77.9	5.97
2/20/2007	407 D	444		6.5	11.78	95.5	6.36
3/21/2007	363 D	538		10.5	10.64	100.1	12.31

DOW10014016 Copperas Creek of Caney Creek 0.0 to 3.6		
Date	**Specific Conductance, µmhos/cm**	**Flow**
5/17/2006	580.5	3.825
7/18/2006	1638	0.033
9/27/2006	1146	1.498
10/17/2006	1199	1.598
11/28/2006	1138	1.439
1/11/2007	1591	3.957
2/20/2007	749.8	3.469
3/21/2007	708.3	4.674

DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	Time	Acidity (digested) ($CaCO_3$), mg/L	Alkalinity ($CaCO_3$), mg/L	Alkalinity, Bicarbonate ($CaCO_3$), mg/L	Alkalinity, Carbonate ($CaCO_3$), mg/L	Aluminum, µg/L	Ammonia, mg/L
5/17/2006	1400	86.6	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	7790	0.066
7/18/2006	1510	303 Q	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	30800	
9/27/2006	1415	185	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	15400	
10/17/2006	1420	189	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	14600	
11/28/2006	1345	156	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	14600 D	
1/11/2007	1145	75.7	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8040 D	
2/20/2007	1340	70.7	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	8680 D	
3/21/2007	1320	61.8	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	6620 D	
n/d = non detect							

DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	Arsenic, µg/L	Barium, µg/L	Bromide, mg/L	Calcium, mg/L	Chloride, mg/L	Chromium, µg/L	Copper, µg/L
5/17/2006	n/d @ 5.0	24.9		76.5	6.80	n/d @ 2.0	18.8 J
7/18/2006	n/d @ 0.4 D	13.0		194.0	5.28	3.73	10.9
9/27/2006	2.09 J	15.7		103.0	n/d @ 5.0	1.53	7.72
10/17/2006	n/d @ 2.0	24.0	0.0327 J	137.0	9.39	n/d @ 2.0	n/d @ 5.0
11/28/2006	n/d @ 1.0 D	22.2	n/d @ 0.025 Q	102.0	4.43	1.18	6.90
1/11/2007	n/d @ 0.2	21.1	n/d @ 0.025	64.3	3.50	0.708	5.79
2/20/2007	0.536 JD	22.1	n/d @ 0.025	76.0	7.09	3.20	5.13
3/21/2007	n/d @ 0.2	23.1	n/d @ 0.025	78.0	3.61	n/d @ 0.2	4.74
n/d = non detect							

DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Fluoride, mg/L**	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nitrate, mg/L**	**Nitrite, mg/L**
5/17/2006		n/d @ 2.0	27.3	2870	n/d @ 0.02	0.180	
7/18/2006		2.05	46.0	8370	n/d @ 0.02		
9/27/2006		1.12	28.6	5150	n/d @ 0.02		
10/17/2006	0.845	n/d @ 2.0	34.0	4410	n/d @ 0.02	0.34 TX	n/d @ 0.01 TX
11/28/2006	0.843	0.713	33.7	3990 D	n/d @ 0.02	0.164 T	n/d @ 0.01 TQ
1/11/2007	0.504	0.376 J	22.6	2490 D	n/d @ 0.02	0.18 T	n/d @ 0.01 T
2/20/2007	0.468	0.448 J	28.0	2560 D	n/d @ 0.02	0.149 TD	n/d @ 0.01
3/21/2007	0.475	n/d @ 0.2	26.8	2180 D	n/d @ 0.02	0.0726 TQ	n/d @ 0.01 T
n/d = non detect							

DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**	**Sodium, mg/L**
5/17/2006	1.44	0.020	0.020	2.35	n/d @ 13.0	n/d @ 5.0	10.6
7/18/2006				5.93	n/d @ 1.0 D	n/d @ 0.4 D	16.6
9/27/2006				3.87 B	n/d @ 5.0	n/d @ 2.0	9.7
10/17/2006		n/d @ 0.25		6.19	n/d @ 5.0	n/d @ 5.0	14.1
11/28/2006		n/d @ 0.025 T		2.98 B	n/d @ 2.5 D	n/d @ 1.0 D	10.0
1/11/2007		n/d @ 0.075 TD		1.96 B	1.22	n/d @ 0.2	7.1
2/20/2007		n/d @ 0.025		1.68	n/d @ 1.0	n/d @ 0.4	9.7
3/21/2007		n/d @ 2.5 TD		2.07 B	n/d @ 0.5	n/d @ 0.2	8.2
n/d = non detect							

DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Sulfate, mg/L**	**Total Dissolved Solids, mg/L**	**TKN, mg/L**	**Total Suspended Solids, mg/L**	**Dissolved Oxygen, mg/L**	**Dissolved Oxygen %Saturation**	**Temperature, °C**
5/17/2006	317	508	0.4 JQ		8.34		15.69
7/18/2006	1120	1380			8.44	102.6	25.38
9/27/2006	610 D	924			8.10	87.9	19.26
10/17/2006	664 D	410		2.5	7.80	79.5	15.51
11/28/2006	50.8 D	436		8.5	9.84	89.1	11.11
1/11/2007	339	412		14	12.04	95.6	5.77
2/20/2007	388 D	316		13	11.22	94.9	7.97
3/21/2007	285 D	518		10.5	9.84	100.1	16.33

DOW10014017 Copperas Creek of Caney Creek 0.0 to 3.6		
Date	**Specific Conductance, µmhos/cm**	**Flow**
5/17/2006	837.8	1.469
7/18/2006	1992	0.032
9/27/2006	1245	0.762
10/17/2006	1351	0.730
11/28/2006	1184	0.893
1/11/2007	652.2	2.868
2/20/2007	741.4	2.207
3/21/2007	716.7	2.734

DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Time**	**Acidity (digested) ($CaCO_3$), mg/L**	**Alkalinity ($CaCO_3$), mg/L**	**Alkalinity, Bicarbonate ($CaCO_3$), mg/L**	**Alkalinity, Carbonate ($CaCO_3$), mg/L**	**Aluminum, µg/L**	**Ammonia, mg/L**
5/17/2006	1530	300	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	22500	0.532
7/18/2006	1606	851 Q	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	61600	
8/10/2006	1430	n/d @ 10	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	143000 D	
9/27/2006	1500	249	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	21800	
10/17/2006	1500	250	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	21300	
11/28/2006	1425	274	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	25300 D	
1/11/2007	1240	166	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	15000 D	
2/20/2007	1340	171	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	18600 D	
3/21/2007	1320	123	n/d @ 5.0	n/d @ 5.0	n/d @ 5.0	12100 D	
n/d = non detect							

DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	Arsenic, µg/L	Barium, µg/L	Bromide, mg/L	Cadmium, µg/L	Calcium, mg/L	Chloride, mg/L	Chromium, µg/L
5/17/2006	n/d @ 5.0	15.70		17.6 JL	159	n/d @ 5.0	n/d @ 5.0
7/18/2006	n/d @ 1.0 D	6.54		n/d @ 2.0 D	259	n/d @ 5.0	3.89
8/10/2006	n/d @ 3.0 D	5.67		12.6	328 D	n/d @ 5.0	8.36
9/27/2006	2.46 J	12.40		15.7	128	n/d @ 5.0	1.59
10/17/2006	n/d @ 2.0	24.00	0.0331 J	n/d @ 4	185	4.81	n/d @ 2.0
11/28/2006	n/d @ 1.0 D	16.80	n/d @ 0.025 Q	23 D	157	3.51	2.18
1/11/2007	n/d @ 0.4 D	16.20	n/d @ 0.025	14.1 D	116	3.13	1.74
2/20/2007	0.444 JD	16.80	n/d @ 0.025	15.9 D	138	3.46	2.09
3/21/2007	n/d @ 0.2	18.60	n/d @ 0.025	12.5	131	2.70	0.703

(orange) Exceeds the acute limit

(yellow) Exceeds the chronic limit

n/d = non detect

DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Copper, µg/L**	**Fluoride, mg/L**	**Lead, µg/L**	**Magnesium, mg/L**	**Manganese, µg/L**	**Mercury, µg/L**	**Nitrate, mg/L**
5/17/2006	23 J		n/d @ 95.0	44.3	5970	n/d @ 0.02	0.045
7/18/2006	7.41		1.41	69.0	13100	n/d @ 0.02	
8/10/2006	13.4		1.50	76.0	13200	n/d @ 0.02	
9/27/2006	8.44		0.922	34.9	6520	n/d @ 0.02	
10/17/2006	n/d @ 5.0	1.10	n/d @ 2.0	44.7	5320	n/d @ 0.02	0.08 TX
11/28/2006	11.60	1.30	0.863	47.8	6410 D	0.07	0.0641 T
1/11/2007	9.82	0.851	0.505	33.6	3750 D	n/d @ 0.02	0.0888 T
2/20/2007	10.40	0.805	0.602	40.6	4470 D	n/d @ 0.02	0.117 TD
3/21/2007	7.72	0.723	0.272 J	37.0	3160 D	n/d @ 0.02	0.046 TQ
	Exceeds the mercury fish consumption limit						
n/d = non detect							

DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	**Nitrite, mg/L**	**Organic Carbon, mg/L**	**Ortho-phosphorus, mg/L**	**Phosphorus, Total, mg/L**	**Potassium, mg/L**	**Selenium, µg/L**	**Silver, µg/L**
5/17/2006		1.75		0.0299	3.85	n/d @ 13.0	n/d @ 5.0
7/18/2006					7.61	n/d @ 2.5 D	n/d @ 1.0 D
8/10/2006					6.69	n/d @ 8.0 D	n/d @ 3.0 D
9/27/2006					4.20	5.16 J	n/d @ 2.0
10/17/2006	n/d @ 0.01 TX		n/d @ 0.25 TX		6.04	n/d @ 5.0	n/d @ 2.0
11/28/2006	n/d @ 0.01 TQ		n/d @ 1.25 TD		4.18	n/d @ 2.5 D	n/d @ 1.0 D
1/11/2007	n/d @ 0.01 T		n/d @ 0.25 TD		2.82 B	1.61 D	n/d @ 0.4 D
2/20/2007	n/d @ 0.01		n/d @ 0.5 D		2.78	n/d @ 1.0	n/d @ 0.4
3/21/2007	n/d @ 0.01 T		n/d @ 2.5 TD		2.77 B	n/d @ 0.5	n/d @ 0.2
	Exceeds the chronic limit						

DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6							
Date	Sodium, mg/L	Sulfate, mg/L	Total Dissolved Solids, mg/L	TKN, mg/L	Total Suspended Solids, mg/L	Dissolved Oxygen, mg/L	Dissolved Oxygen %Saturation
5/17/2006	12.70	76	1120	0.84 Q		8.91	92.4
7/18/2006	22.30	2180	2580			8.06	102.4
8/10/2006	25.40	2160	3290			9.75	123.4
9/27/2006	9.79	818 D	1080			8.10	89.0
10/17/2006	14.40	850 D	764		26.5	8.26	84.3
11/28/2006	11.20	988 D	796		24.5	10.11	91.6
1/11/2007	7.78	603 D	464		25.5	12.25	97.8
2/20/2007	9.56	743 D	480		47.0	11.17	95.2
3/21/2007	8.30	481 D	816		36.0	9.96	101.0
n/d = non detect							

DOW10014018 Copperas Creek of Caney Creek 0.0 to 3.6			
Date	Temperature, °C	Specific Conductance, µmhos/cm	Flow
5/17/2006	16.75	1512	0.372
7/18/2006	27.35	3251	0.015
8/10/2006	26.85	3775	0.071
9/27/2006	19.68	1461	0.504
10/17/2006	15.68	1617	0.406
11/28/2006	11.00	1011	0.510
1/11/2007	5.51	1081	1.102
2/20/2007	8.20	1230	0.762
3/21/2007		16.29	1.270

Appendix B SMIS Surface Water Data

Data downloaded from SMIS includes station names and latitude/longitude location information, but did not include the name of the waterbody from which the data were taken, and the waterbody could not always be definitively determined from the latitude/longitude information. Therefore, when flagging exceedances of the WQCs, KDOW did not differentiate which samples were collected from impaired waterbodies and which were not. This affects the coding of iron samples, which have different chronic WQCs depending on whether or not the waterbody is impaired for WAH. Any iron sample with a concentration greater than 1.0 mg/L up to and including 4.0 mg/L was therefore coded as a possible exceedance of the chronic WQC.

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8545037	SWP202	9/11/2006	Alkalinity	30	mg/L $CaCO_3$	514020505
8545037	SWP202	12/18/2006	SO4	360	mg/L	514020505
8545037	SWP202	9/11/2006	pH	7.14	standard units	514020505
8545037	SWP202	9/11/2006	Acidity	10	mg/L $CaCO_3$	514020505
8545037	SWP202	9/11/2006	TSS	19	mg/L	514020505
8545037	SWP202	9/11/2006	SO4	290	mg/L	514020505
8545037	SWP202	9/11/2006	Iron, Total	1.81	mg/L	514020505
8545037	SWP202	9/11/2006	Manganese, Total	1.3	mg/L	514020505
8545037	SWP202	12/18/2006	TSS	22	mg/L	514020505
8545037	SWP202	12/18/2006	pH	7.07	standard units	514020505
8545037	SWP202	12/18/2006	Acidity	10	mg/L $CaCO_3$	514020505
8545037	SWP202	12/18/2006	Iron, Total	1.73	mg/L	514020505
8545037	SWP202	12/18/2006	SPCON	1410	µS/cm	514020505
8545037	SWP202	12/18/2006	Alkalinity	30	mg/L $CaCO_3$	514020505
8545037	SWP202	12/18/2006	Manganese, Total	1.21	mg/L	514020505
8545037	SWP202	9/11/2006	SPCON	1330	µS/cm	514020505
8545035	MC03	11/16/2006	SPCON	710	µS/cm	514020505
8545035	MC03	11/16/2006	pH	6.08	standard units	514020505
8545035	MC03	11/16/2006	Acidity	100	mg/L $CaCO_3$	514020505
8545035	MC03	11/16/2006	Manganese, Total	0.91	mg/L	514020505
8545035	MC03	11/16/2006	TSS	13	mg/L	514020505
8545035	MC03	11/16/2006	SO4	270	mg/L	514020505
8545035	MC03	11/16/2006	Iron, Total	0.44	mg/L	514020505
8545035	MC03	11/16/2006	Alkalinity	20	mg/L $CaCO_3$	514020505
8545035	MC02	11/16/2006	SPCON	1120	µS/cm	514020505
8545035	MC02	11/16/2006	pH	4.31	standard units	514020505

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8545035	MC02	11/16/2006	Acidity	740	mg/L $CaCO_3$	514020505
8545035	MC02	11/16/2006	Alkalinity	5	mg/L $CaCO_3$	514020505
8545035	MC02	11/16/2006	TSS	16	mg/L	514020505
8545035	MC02	11/16/2006	SO4	680	mg/L	514020505
8545035	MC02	11/16/2006	Iron, Total	27.1	mg/L	514020505
8545035	MC02	11/16/2006	Manganese, Total	4.44	mg/L	514020505
8545035	MC02	2/8/2007	SPCON	1270	µS/cm	514020505
8545035	MC02	2/8/2007	pH	6.4	standard units	514020505
8545035	MC02	2/8/2007	Acidity	204	mg/L $CaCO_3$	514020505
8545035	MC02	2/8/2007	Alkalinity	1	mg/L $CaCO_3$	514020505
8545035	MC02	2/8/2007	TSS	3	mg/L	514020505
8545035	MC02	2/8/2007	SO4	531	mg/L	514020505
8545035	MC02	2/8/2007	Iron, Total	43.1	mg/L	514020505
8545035	MC02	2/8/2007	Manganese, Total	4.53	mg/L	514020505
8545035	MC02	5/10/2007	SPCON	1210	µS/cm	514020505
8545035	MC02	5/10/2007	pH	6	standard units	514020505
8545035	MC02	5/10/2007	Acidity	180	mg/L $CaCO_3$	514020505
8545035	MC02	5/10/2007	Alkalinity	2	mg/L $CaCO_3$	514020505
8545035	MC02	5/10/2007	TSS	16	mg/L	514020505
8545035	MC02	5/10/2007	SO4	605	mg/L	514020505
8545035	MC02	5/10/2007	Iron, Total	18.8	mg/L	514020505
8545035	MC02	5/10/2007	Manganese, Total	3.73	mg/L	514020505
8545035	MC02	10/31/2007	SPCON	1270	µS/cm	514020505
8545035	MC02	10/31/2007	pH	6	standard units	514020505
8545035	MC02	10/31/2007	Acidity	210	mg/L $CaCO_3$	514020505
8545035	MC02	10/31/2007	Alkalinity	1	mg/L $CaCO_3$	514020505
8545035	MC02	10/31/2007	TSS	3	mg/L	514020505
8545035	MC02	10/31/2007	SO4	684	mg/L	514020505
8545035	MC02	10/31/2007	Iron, Total	47.8	mg/L	514020505
8545035	MC02	10/31/2007	Manganese, Total	4.65	mg/L	514020505
8545035	MC01	11/16/2006	SPCON	1090	µS/cm	514020505
8545035	MC01	10/31/2007	Manganese, Total	3.69	mg/L	514020505
8545035	MC01	11/16/2006	Acidity	720.3	mg/L $CaCO_3$	514020505
8545035	MC01	11/16/2006	Alkalinity	5	mg/L $CaCO_3$	514020505
8545035	MC01	11/16/2006	TSS	26	mg/L	514020505
8545035	MC01	11/16/2006	SO4	610	mg/L	514020505
8545035	MC01	11/16/2006	Iron, Total	16.5	mg/L	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8545035	MC01	11/16/2006	Manganese, Total	3.44	mg/L	514020505
8545035	MC01	2/8/2007	SPCON	1050	µS/cm	514020505
8545035	MC01	2/8/2007	pH	6.4	standard units	514020505
8545035	MC01	2/8/2007	Acidity	120	mg/L $CaCO_3$	514020505
8545035	MC01	2/8/2007	Alkalinity	2	mg/L $CaCO_3$	514020505
8545035	MC01	2/8/2007	TSS	10	mg/L	514020505
8545035	MC01	2/8/2007	SO4	536	mg/L	514020505
8545035	MC01	2/8/2007	Iron, Total	18.8	mg/L	514020505
8545035	MC01	2/8/2007	Manganese, Total	3.64	mg/L	514020505
8545035	MC01	5/10/2007	SPCON	1070	µS/cm	514020505
8545035	MC01	5/10/2007	pH	5.8	standard units	514020505
8545035	MC01	5/10/2007	Acidity	102	mg/L $CaCO_3$	514020505
8545035	MC01	5/10/2007	Alkalinity	2	mg/L $CaCO_3$	514020505
8545035	MC01	5/10/2007	TSS	6	mg/L	514020505
8545035	MC01	5/10/2007	SO4	536	mg/L	514020505
8545035	MC01	5/10/2007	Iron, Total	4.94	mg/L	514020505
8545035	MC01	5/10/2007	Manganese, Total	3.35	mg/L	514020505
8545035	MC01	10/31/2007	Alkalinity	1	mg/L $CaCO_3$	514020505
8545035	MC01	10/31/2007	SPCON	1050	µS/cm	514020505
8545035	MC01	10/31/2007	pH	6.2	standard units	514020505
8545035	MC01	10/31/2007	Acidity	130	mg/L $CaCO_3$	514020505
8545035	MC01	10/31/2007	TSS	5	mg/L	514020505
8545035	MC01	10/31/2007	SO4	642	mg/L	514020505
8545035	MC01	10/31/2007	Iron, Total	22.5	mg/L	514020505
8545035	MC01	11/16/2006	pH	4.55	standard units	514020505
8546001	854-6001-02	6/19/1987	Manganese, Total	2.07	mg/L	514020505
8546001	854-6001-02	6/19/1987	Iron, Total	0.03	mg/L	514020505
8546001	854-6001-02	7/6/1987	pH	4.5	standard units	514020505
8546001	854-6001-02	7/6/1987	Acidity	133	mg/L $CaCO_3$	514020505
8546001	854-6001-02	7/6/1987	TSS	29	mg/L	514020505
8546001	854-6001-02	7/6/1987	SO4	916	mg/L	514020505
8546001	854-6001-02	7/6/1987	Iron, Total	1.04	mg/L	514020505
8546001	854-6001-02	7/6/1987	Manganese, Total	5.04	mg/L	514020505
8546001	854-6001-02	9/29/1987	SPCON	3377	µS/cm	514020505
8546001	854-6001-02	9/29/1987	pH	4.5	standard units	514020505
8546001	854-6001-02	9/29/1987	Acidity	166	mg/L $CaCO_3$	514020505
8546001	854-6001-02	9/29/1987	TSS	78	mg/L	514020505
8546001	854-6001-02	9/29/1987	SO4	2328	mg/L	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8546001	854-6001-02	9/29/1987	Iron, Total	2	mg/L	514020505
8546001	854-6001-02	9/29/1987	Manganese, Total	5.03	mg/L	514020505
8546001	854-6001-02	11/30/1987	SPCON	1844	µS/cm	514020505
8546001	854-6001-02	11/30/1987	pH	5.1	standard units	514020505
8546001	854-6001-02	11/30/1987	Acidity	170	mg/L $CaCO_3$	514020505
8546001	854-6001-02	11/30/1987	Alkalinity	14	mg/L $CaCO_3$	514020505
8546001	854-6001-02	11/30/1987	TSS	8	mg/L	514020505
8546001	854-6001-02	11/30/1987	SO4	1365	mg/L	514020505
8546001	854-6001-02	11/30/1987	Iron, Total	4.07	mg/L	514020505
8546001	854-6001-02	11/30/1987	Manganese, Total	7.03	mg/L	514020505
8546001	854-6001-02	12/28/1987	SPCON	729	µS/cm	514020505
8546001	854-6001-02	12/28/1987	pH	5.5	standard units	514020505
8546001	854-6001-02	12/28/1987	Acidity	41	mg/L $CaCO_3$	514020505
8546001	854-6001-02	12/28/1987	Alkalinity	6	mg/L $CaCO_3$	514020505
8546001	854-6001-02	12/28/1987	TSS	26	mg/L	514020505
8546001	854-6001-02	12/28/1987	SO4	373	mg/L	514020505
8546001	854-6001-02	12/28/1987	Iron, Total	1.05	mg/L	514020505
8546001	854-6001-02	12/28/1987	Manganese, Total	2.06	mg/L	514020505
8546001	854-6001-02	3/25/1987	TSS	1	mg/L	514020505
8546001	854-6001-02	3/25/1987	SPCON	1644	µS/cm	514020505
8546001	854-6001-02	3/25/1987	pH	5	standard units	514020505
8546001	854-6001-02	3/25/1987	Acidity	34	mg/L $CaCO_3$	514020505
8546001	854-6001-02	3/25/1987	SO4	1392	mg/L	514020505
8546001	854-6001-02	3/25/1987	Iron, Total	0.004	mg/L	514020505
8546001	854-6001-02	3/25/1987	Manganese, Total	4.02	mg/L	514020505
8546001	854-6001-02	6/19/1987	SPCON	836	µS/cm	514020505
8546001	854-6001-02	6/19/1987	pH	6	standard units	514020505
8546001	854-6001-02	6/19/1987	Alkalinity	21	mg/L $CaCO_3$	514020505
8546001	854-6001-02	6/19/1987	TSS	32	mg/L	514020505
8546001	854-6001-02	6/19/1987	SO4	295	mg/L	514020505
8546001	854-6001-02	7/6/1987	SPCON	1505	µS/cm	514020505
8540128	854-0128-02	7/12/1984	pH	4.7	standard units	514020505
8540128	854-0128-02	7/12/1984	Acidity	200	mg/L $CaCO_3$	514020505
8540128	854-0128-02	7/12/1984	TSS	5	mg/L	514020505
8540128	854-0128-02	7/12/1984	SO4	1250	mg/L	514020505
8540128	854-0128-02	7/12/1984	Iron, Dissolved	1.03	mg/L	514020505
8540128	854-0128-02	7/12/1984	Iron, Total	1.03	mg/L	514020505
8540128	854-0128-02	7/12/1984	Manganese, Dissolved	9.03	mg/L	514020505

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540128	854-0128-02	7/12/1984	Manganese, Total	9.03	mg/L	514020505
8540128	854-0128-02	8/15/1984	SPCON	1550	µS/cm	514020505
8540128	854-0128-02	8/15/1984	pH	4.5	standard units	514020505
8540128	854-0128-02	8/15/1984	Acidity	140	mg/L $CaCO_3$	514020505
8540128	854-0128-02	8/15/1984	TSS	1	mg/L	514020505
8540128	854-0128-02	8/15/1984	SO4	937.05	mg/L	514020505
8540128	854-0128-02	8/15/1984	Iron, Dissolved	0.04	mg/L	514020505
8540128	854-0128-02	8/15/1984	Iron, Total	0.04	mg/L	514020505
8540128	854-0128-02	8/15/1984	Manganese, Dissolved	14	mg/L	514020505
8540128	854-0128-02	8/15/1984	Manganese, Total	15	mg/L	514020505
8540128	854-0128-02	9/20/1984	SPCON	1232	µS/cm	514020505
8540128	854-0128-02	9/20/1984	pH	4	standard units	514020505
8540128	854-0128-02	9/20/1984	TSS	1	mg/L	514020505
8540128	854-0128-02	9/20/1984	SO4	635	mg/L	514020505
8540128	854-0128-02	9/20/1984	Iron, Dissolved	1.09	mg/L	514020505
8540128	854-0128-02	9/20/1984	Iron, Total	1.09	mg/L	514020505
8540128	854-0128-02	9/20/1984	Manganese, Dissolved	5.05	mg/L	514020505
8540128	854-0128-02	9/20/1984	Manganese, Total	5.05	mg/L	514020505
8540128	854-0128-02	12/14/1984	SPCON	1360	µS/cm	514020505
8540128	854-0128-02	12/14/1984	pH	3.8	standard units	514020505
8540128	854-0128-02	12/14/1984	Acidity	130	mg/L $CaCO_3$	514020505
8540128	854-0128-02	12/14/1984	TSS	514	mg/L	514020505
8540128	854-0128-02	12/14/1984	SO4	1040	mg/L	514020505
8540128	854-0128-02	12/14/1984	Iron, Dissolved	0.04	mg/L	514020505
8540128	854-0128-02	12/14/1984	Iron, Total	4.03	mg/L	514020505
8540128	854-0128-02	12/14/1984	Manganese, Dissolved	17	mg/L	514020505
8540128	854-0128-02	12/14/1984	Manganese, Total	17	mg/L	514020505
8540128	854-0128-02	1/14/1985	SPCON	658	µS/cm	514020505
8540128	854-0128-02	1/14/1985	pH	4.1	standard units	514020505
8540128	854-0128-02	1/14/1985	Acidity	55	mg/L $CaCO_3$	514020505
8540128	854-0128-02	1/14/1985	TSS	17	mg/L	514020505
8540128	854-0128-02	1/14/1985	SO4	345	mg/L	514020505
8540128	854-0128-02	1/14/1985	Iron, Dissolved	0.05	mg/L	514020505
8540128	854-0128-02	1/14/1985	Iron, Total	0.05	mg/L	514020505
8540128	854-0128-02	1/14/1985	Manganese, Dissolved	2.04	mg/L	514020505
8540128	854-0128-02	1/14/1985	Manganese, Total	2.09	mg/L	514020505
8540128	854-0128-02	4/19/1988	SPCON	299	µS/cm	514020505
8540128	854-0128-02	4/19/1988	pH	5.9	standard units	514020505

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540128	854-0128-02	4/19/1988	Acidity	18	mg/L $CaCO_3$	514020505
8540128	854-0128-02	4/19/1988	Alkalinity	22	mg/L $CaCO_3$	514020505
8540128	854-0128-02	4/19/1988	TSS	19	mg/L	514020505
8540128	854-0128-02	4/19/1988	SO4	84	mg/L	514020505
8540128	854-0128-02	4/19/1988	Iron, Total	0.05	mg/L	514020505
8540128	854-0128-02	4/19/1988	Manganese, Total	1.09	mg/L	514020505
8540128	854-0128-02	11/12/1984	TSS	1	mg/L	514020505
8540128	854-0128-02	11/12/1984	SPCON	1100	µS/cm	514020505
8540128	854-0128-02	11/12/1984	pH	3.5	standard units	514020505
8540128	854-0128-02	11/12/1984	Acidity	200	mg/L $CaCO_3$	514020505
8540128	854-0128-02	11/12/1984	SO4	690	mg/L	514020505
8540128	854-0128-02	11/12/1984	Iron, Dissolved	0.07	mg/L	514020505
8540128	854-0128-02	11/12/1984	Iron, Total	1.01	mg/L	514020505
8540128	854-0128-02	11/12/1984	Manganese, Dissolved	5.08	mg/L	514020505
8540128	854-0128-02	11/12/1984	Manganese, Total	5.08	mg/L	514020505
8540128	854-0128-02	7/12/1984	SPCON	1425	µS/cm	514020505
8540089	854-0089-01	5/16/1985	TSS	70	mg/L	514020505
8540089	854-0089-01	7/9/1985	Manganese, Total	6.07	mg/L	514020505
8540089	854-0089-01	5/16/1985	pH	3.4	standard units	514020505
8540089	854-0089-01	5/16/1985	Acidity	328	mg/L $CaCO_3$	514020505
8540089	854-0089-01	5/16/1985	SO4	1875	mg/L	514020505
8540089	854-0089-01	5/16/1985	Iron, Dissolved	1.09	mg/L	514020505
8540089	854-0089-01	5/16/1985	Iron, Total	33	mg/L	514020505
8540089	854-0089-01	5/16/1985	Manganese, Dissolved	5.02	mg/L	514020505
8540089	854-0089-01	5/16/1985	Manganese, Total	5.02	mg/L	514020505
8540089	854-0089-01	2/21/1985	SPCON	2250	µS/cm	514020505
8540089	854-0089-01	2/21/1985	pH	3	standard units	514020505
8540089	854-0089-01	2/21/1985	Acidity	1195	mg/L $CaCO_3$	514020505
8540089	854-0089-01	2/21/1985	TSS	96	mg/L	514020505
8540089	854-0089-01	2/21/1985	SO4	1525	mg/L	514020505
8540089	854-0089-01	2/21/1985	Iron, Dissolved	22	mg/L	514020505
8540089	854-0089-01	2/21/1985	Iron, Total	61	mg/L	514020505
8540089	854-0089-01	2/21/1985	Manganese, Dissolved	7.02	mg/L	514020505
8540089	854-0089-01	2/21/1985	Manganese, Total	7.02	mg/L	514020505
8540089	854-0089-01	3/29/1985	SPCON	2675	µS/cm	514020505
8540089	854-0089-01	3/29/1985	pH	3.4	standard units	514020505
8540089	854-0089-01	3/29/1985	Acidity	190	mg/L $CaCO_3$	514020505
8540089	854-0089-01	3/29/1985	TSS	54	mg/L	514020505

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540089	854-0089-01	3/29/1985	SO4	1900	mg/L	514020505
8540089	854-0089-01	3/29/1985	Iron, Dissolved	2.04	mg/L	514020505
8540089	854-0089-01	3/29/1985	Iron, Total	25	mg/L	514020505
8540089	854-0089-01	3/29/1985	Manganese, Dissolved	4.09	mg/L	514020505
8540089	854-0089-01	3/29/1985	Manganese, Total	5.01	mg/L	514020505
8540089	854-0089-01	4/23/1985	SPCON	2350	µS/cm	514020505
8540089	854-0089-01	4/23/1985	pH	3.5	standard units	514020505
8540089	854-0089-01	4/23/1985	Acidity	160	mg/L $CaCO_3$	514020505
8540089	854-0089-01	4/23/1985	TSS	52	mg/L	514020505
8540089	854-0089-01	4/23/1985	SO4	2000	mg/L	514020505
8540089	854-0089-01	4/23/1985	Iron, Dissolved	1	mg/L	514020505
8540089	854-0089-01	4/23/1985	Iron, Total	21	mg/L	514020505
8540089	854-0089-01	4/23/1985	Manganese, Dissolved	5.05	mg/L	514020505
8540089	854-0089-01	4/23/1985	Manganese, Total	6.07	mg/L	514020505
8540089	854-0089-01	6/27/1985	SPCON	2675	µS/cm	514020505
8540089	854-0089-01	6/27/1985	pH	3.3	standard units	514020505
8540089	854-0089-01	6/27/1985	Acidity	190	mg/L $CaCO_3$	514020505
8540089	854-0089-01	6/27/1985	TSS	80	mg/L	514020505
8540089	854-0089-01	6/27/1985	SO4	1775	mg/L	514020505
8540089	854-0089-01	6/27/1985	Iron, Dissolved	1.09	mg/L	514020505
8540089	854-0089-01	6/27/1985	Iron, Total	34	mg/L	514020505
8540089	854-0089-01	6/27/1985	Manganese, Dissolved	6.02	mg/L	514020505
8540089	854-0089-01	6/27/1985	Manganese, Total	7.03	mg/L	514020505
8540089	854-0089-01	7/9/1985	SPCON	2461	µS/cm	514020505
8540089	854-0089-01	7/9/1985	pH	3.5	standard units	514020505
8540089	854-0089-01	7/9/1985	Acidity	250	mg/L $CaCO_3$	514020505
8540089	854-0089-01	7/9/1985	TSS	36	mg/L	514020505
8540089	854-0089-01	7/9/1985	SO4	1725	mg/L	514020505
8540089	854-0089-01	7/9/1985	Iron, Dissolved	1	mg/L	514020505
8540089	854-0089-01	7/9/1985	Iron, Total	15	mg/L	514020505
8540089	854-0089-01	7/9/1985	Manganese, Dissolved	5.06	mg/L	514020505
8540089	854-0089-01	5/16/1985	SPCON	2220	µS/cm	514020505
8540014	854-0014-06	7/29/1982	Alkalinity	720	mg/L $CaCO_3$	514020505
8540014	854-0014-06	7/29/1982	SPCON	2420	µS/cm	514020505
8540014	854-0014-06	7/29/1982	pH	6.5	standard units	514020505
8540014	854-0014-06	7/29/1982	Acidity	520	mg/L $CaCO_3$	514020505
8540014	854-0014-06	7/29/1982	TSS	9	mg/L	514020505
8540014	854-0014-06	7/29/1982	TDS	2694	mg/L	514020505

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540014	854-0014-06	7/29/1982	Iron, Dissolved	0.18	mg/L	514020505
8540014	854-0014-06	7/29/1982	Iron, Total	0.21	mg/L	514020505
8540014	854-0014-06	7/29/1982	Manganese, Total	2.27	mg/L	514020505
8540014	854-0014-06	2/17/1982	TSS	35	mg/L	514020505
8540014	854-0014-06	2/17/1982	SPCON	2180	µS/cm	514020505
8540014	854-0014-06	2/17/1982	pH	6	standard units	514020505
8540014	854-0014-06	2/17/1982	Alkalinity	125	mg/L $CaCO_3$	514020505
8540014	854-0014-06	2/17/1982	TDS	2606	mg/L	514020505
8540014	854-0014-06	2/17/1982	Iron, Dissolved	0.12	mg/L	514020505
8540014	854-0014-06	2/17/1982	Iron, Total	1.66	mg/L	514020505
8540014	854-0014-06	2/17/1982	Manganese, Total	7.92	mg/L	514020505
8540014	854-0014-06	3/16/1982	SPCON	2160	µS/cm	514020505
8540014	854-0014-06	3/16/1982	pH	7.9	standard units	514020505
8540014	854-0014-06	3/16/1982	Alkalinity	105	mg/L $CaCO_3$	514020505
8540014	854-0014-06	3/16/1982	TSS	65	mg/L	514020505
8540014	854-0014-06	3/16/1982	TDS	2480	mg/L	514020505
8540014	854-0014-06	4/17/1982	SPCON	990	µS/cm	514020505
8540014	854-0014-06	4/17/1982	pH	6.4	standard units	514020505
8540014	854-0014-06	4/17/1982	Acidity	17	mg/L $CaCO_3$	514020505
8540014	854-0014-06	4/17/1982	Alkalinity	35	mg/L $CaCO_3$	514020505
8540014	854-0014-06	4/17/1982	TSS	23	mg/L	514020505
8540014	854-0014-06	4/17/1982	TDS	934	mg/L	514020505
8540014	854-0014-06	4/17/1982	Iron, Dissolved	0.83	mg/L	514020505
8540014	854-0014-06	4/17/1982	Iron, Total	0.83	mg/L	514020505
8540014	854-0014-06	4/17/1982	Manganese, Total	7.43	mg/L	514020505
8540014	854-0014-06	9/14/1982	SPCON	2070	µS/cm	514020505
8540014	854-0014-06	9/14/1982	pH	6	standard units	514020505
8540014	854-0014-06	9/14/1982	Alkalinity	130	mg/L $CaCO_3$	514020505
8540014	854-0014-06	9/14/1982	TSS	24	mg/L	514020505
8540014	854-0014-06	9/14/1982	TDS	297	mg/L	514020505
8540014	854-0014-06	9/14/1982	Iron, Dissolved	0.27	mg/L	514020505
8540014	854-0014-06	9/14/1982	Iron, Total	0.75	mg/L	514020505
8540014	854-0014-06	9/14/1982	Manganese, Total	0.84	mg/L	514020505
8540014	854-0014-06	10/18/1982	SPCON	1700	µS/cm	514020505
8540014	854-0014-06	10/18/1982	pH	7	standard units	514020505
8540014	854-0014-06	10/18/1982	Alkalinity	55	mg/L $CaCO_3$	514020505
8540014	854-0014-06	10/18/1982	TSS	16	mg/L	514020505
8540014	854-0014-06	10/18/1982	TDS	1934	mg/L	514020505

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8540014	854-0014-06	10/18/1982	SO4	950	mg/L	514020505
8540014	854-0014-06	10/18/1982	Iron, Dissolved	0.33	mg/L	514020505
8540014	854-0014-06	10/18/1982	Iron, Total	0.45	mg/L	514020505
8540014	854-0014-06	10/18/1982	Manganese, Total	0.84	mg/L	514020505
8540014	854-0014-06	3/9/1983	SPCON	1850	µS/cm	514020505
8540014	854-0014-06	3/9/1983	pH	9.5	standard units	514020505
8540014	854-0014-06	3/9/1983	Alkalinity	75	mg/L $CaCO_3$	514020505
8540014	854-0014-06	3/9/1983	TSS	34	mg/L	514020505
8540014	854-0014-06	3/9/1983	SO4	135	mg/L	514020505
8540014	854-0014-06	3/9/1983	Iron, Dissolved	0.47	mg/L	514020505
8540014	854-0014-06	3/9/1983	Iron, Total	1.82	mg/L	514020505
8540014	854-0014-06	3/9/1983	Manganese, Dissolved	0.38	mg/L	514020505
8540014	854-0014-06	3/9/1983	Manganese, Total	0.84	mg/L	514020505
8540014	854-0014-06	6/9/1983	SPCON	2400	µS/cm	514020505
8540014	854-0014-06	6/9/1983	pH	7.5	standard units	514020505
8540014	854-0014-06	6/9/1983	Alkalinity	170	mg/L $CaCO_3$	514020505
8540014	854-0014-06	6/9/1983	TSS	9	mg/L	514020505
8540014	854-0014-06	6/9/1983	SO4	1500	mg/L	514020505
8540014	854-0014-06	6/9/1983	Iron, Dissolved	0.15	mg/L	514020505
8540014	854-0014-06	6/9/1983	Iron, Total	1.16	mg/L	514020505
8540014	854-0014-06	6/9/1983	Manganese, Dissolved	1.75	mg/L	514020505
8540014	854-0014-06	6/9/1983	Manganese, Total	1.96	mg/L	514020505
4548008	454-8008-02	4/19/1984	Alkalinity	145	mg/L $CaCO_3$	514020505
4548008	454-8008-02	4/19/1984	TSS	44	mg/L	514020505
4548008	454-8008-02	4/19/1984	SO4	2413	mg/L	514020505
4548008	454-8008-02	4/19/1984	Iron, Dissolved	0.04	mg/L	514020505
4548008	454-8008-02	4/19/1984	Iron, Total	0.04	mg/L	514020505
4548008	454-8008-02	4/19/1984	Manganese, Dissolved	0.8	mg/L	514020505
4548008	454-8008-02	4/19/1984	Manganese, Total	0.8	mg/L	514020505
4548008	454-8008-02	3/9/1982	TSS	4	mg/L	514020505
4548008	454-8008-02	3/9/1982	SPCON	260	µS/cm	514020505
4548008	454-8008-02	3/9/1982	pH	7.5	standard units	514020505
4548008	454-8008-02	3/9/1982	Alkalinity	50	mg/L $CaCO_3$	514020505
4548008	454-8008-02	3/9/1982	TDS	196	mg/L	514020505
4548008	454-8008-02	3/9/1982	Iron, Dissolved	0.07	mg/L	514020505
4548008	454-8008-02	3/9/1982	Iron, Total	0.07	mg/L	514020505
4548008	454-8008-02	3/9/1982	Manganese, Total	0.02	mg/L	514020505
4548008	454-8008-02	9/17/1981	SPCON	2120	µS/cm	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
4548008	454-8008-02	9/17/1981	pH	3.5	standard units	514020505
4548008	454-8008-02	9/17/1981	Acidity	570	mg/L $CaCO_3$	514020505
4548008	454-8008-02	9/17/1981	TSS	8	mg/L	514020505
4548008	454-8008-02	9/17/1981	TDS	2614	mg/L	514020505
4548008	454-8008-02	9/17/1981	Iron, Dissolved	27.1	mg/L	514020505
4548008	454-8008-02	9/17/1981	Iron, Total	42.8	mg/L	514020505
4548008	454-8008-02	9/17/1981	Manganese, Total	43.5	mg/L	514020505
4548008	454-8008-02	11/17/1981	SPCON	2100	µS/cm	514020505
4548008	454-8008-02	11/17/1981	pH	3.4	standard units	514020505
4548008	454-8008-02	11/17/1981	Acidity	770	mg/L $CaCO_3$	514020505
4548008	454-8008-02	11/17/1981	TSS	10	mg/L	514020505
4548008	454-8008-02	11/17/1981	TDS	2478	mg/L	514020505
4548008	454-8008-02	11/17/1981	Iron, Dissolved	6.25	mg/L	514020505
4548008	454-8008-02	11/17/1981	Iron, Total	9.6	mg/L	514020505
4548008	454-8008-02	11/17/1981	Manganese, Total	51.7	mg/L	514020505
4548008	454-8008-02	1/8/1982	SPCON	132	µS/cm	514020505
4548008	454-8008-02	1/8/1982	pH	7.4	standard units	514020505
4548008	454-8008-02	1/8/1982	Acidity	5	mg/L $CaCO_3$	514020505
4548008	454-8008-02	1/8/1982	Alkalinity	30	mg/L $CaCO_3$	514020505
4548008	454-8008-02	1/8/1982	TSS	42	mg/L	514020505
4548008	454-8008-02	1/8/1982	TDS	163	mg/L	514020505
4548008	454-8008-02	1/8/1982	Iron, Dissolved	0.73	mg/L	514020505
4548008	454-8008-02	1/8/1982	Iron, Total	0.73	mg/L	514020505
4548008	454-8008-02	1/8/1982	Manganese, Total	0.04	mg/L	514020505
4548008	454-8008-02	4/9/1982	SPCON	179	µS/cm	514020505
4548008	454-8008-02	4/9/1982	pH	6.8	standard units	514020505
4548008	454-8008-02	4/9/1982	Alkalinity	45	mg/L $CaCO_3$	514020505
4548008	454-8008-02	4/9/1982	TSS	19	mg/L	514020505
4548008	454-8008-02	4/9/1982	TDS	166	mg/L	514020505
4548008	454-8008-02	4/9/1982	Iron, Dissolved	0.39	mg/L	514020505
4548008	454-8008-02	1/24/1984	pH	6.8	standard units	514020505
4548008	454-8008-02	4/9/1982	Iron, Total	0.39	mg/L	514020505
4548008	454-8008-02	4/9/1982	Manganese, Total	0.12	mg/L	514020505
4548008	454-8008-02	1/24/1984	SPCON	1850	µS/cm	514020505
4548008	454-8008-02	1/24/1984	Acidity	10	mg/L $CaCO_3$	514020505
4548008	454-8008-02	1/24/1984	Alkalinity	75	mg/L $CaCO_3$	514020505
4548008	454-8008-02	1/24/1984	TSS	230	mg/L	514020505
4548008	454-8008-02	1/24/1984	SO4	675	mg/L	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
4548008	454-8008-02	1/24/1984	Iron, Dissolved	0.13	mg/L	514020505
4548008	454-8008-02	1/24/1984	Iron, Total	4	mg/L	514020505
4548008	454-8008-02	1/24/1984	Manganese, Dissolved	5.68	mg/L	514020505
4548008	454-8008-02	1/24/1984	Manganese, Total	5.77	mg/L	514020505
4548008	454-8008-02	4/5/1984	SPCON	2400	µS/cm	514020505
4548008	454-8008-02	4/5/1984	pH	8.2	standard units	514020505
4548008	454-8008-02	4/5/1984	Acidity	5	mg/L $CaCO_3$	514020505
4548008	454-8008-02	4/5/1984	Alkalinity	105	mg/L $CaCO_3$	514020505
4548008	454-8008-02	4/5/1984	TSS	124	mg/L	514020505
4548008	454-8008-02	4/5/1984	SO4	1625	mg/L	514020505
4548008	454-8008-02	4/5/1984	Iron, Dissolved	0.04	mg/L	514020505
4548008	454-8008-02	4/5/1984	Iron, Total	0.93	mg/L	514020505
4548008	454-8008-02	4/5/1984	Manganese, Dissolved	0.69	mg/L	514020505
4548008	454-8008-02	4/5/1984	Manganese, Total	0.7	mg/L	514020505
4548008	454-8008-02	4/19/1984	SPCON	3200	µS/cm	514020505
4548008	454-8008-02	4/19/1984	pH	8.3	standard units	514020505
4548008	454-8008-02	4/19/1984	Acidity	30	mg/L $CaCO_3$	514020505
8548012	262	2/20/2008	Alkalinity	9	mg/L $CaCO_3$	514020505
8548012	262	2/20/2008	TSS	29	mg/L	514020505
8548012	262	2/20/2008	SO4	1260	mg/L	514020505
8548012	262	2/20/2008	Iron, Total	1.01	mg/L	514020505
8548012	262	2/20/2008	Manganese, Total	3.29	mg/L	514020505
8548012	262	12/30/2008	Alkalinity	15	mg/L $CaCO_3$	514020505
8548012	262	12/30/2008	SPCON	1230	µS/cm	514020505
8548012	262	12/30/2008	pH	5.67	standard units	514020505
8548012	262	12/30/2008	Acidity	51	mg/L $CaCO_3$	514020505
8548012	262	12/30/2008	TSS	13	mg/L	514020505
8548012	262	12/30/2008	SO4	761	mg/L	514020505
8548012	262	12/30/2008	Iron, Total	0.89	mg/L	514020505
8548012	262	12/30/2008	Manganese, Total	3.83	mg/L	514020505
8548012	262	3/31/2009	SPCON	493	µS/cm	514020505
8548012	262	3/31/2009	pH	6.41	standard units	514020505
8548012	262	3/31/2009	Acidity	1	mg/L $CaCO_3$	514020505
8548012	262	3/31/2009	Alkalinity	75	mg/L $CaCO_3$	514020505
8548012	262	3/31/2009	TSS	9	mg/L	514020505
8548012	262	3/31/2009	SO4	210	mg/L	514020505
8548012	262	3/31/2009	Iron, Total	0.11	mg/L	514020505
8548012	262	3/31/2009	Manganese, Total	0.002	mg/L	514020505

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8548012	262	6/23/2009	Alkalinity	86	mg/L $CaCO_3$	514020505
8548012	262	6/23/2009	SPCON	1410	µS/cm	514020505
8548012	262	6/23/2009	pH	6.37	standard units	514020505
8548012	262	6/23/2009	Acidity	1	mg/L $CaCO_3$	514020505
8548012	262	6/23/2009	TSS	3	mg/L	514020505
8548012	262	6/23/2009	SO4	833	mg/L	514020505
8548012	262	6/23/2009	Iron, Total	0.02	mg/L	514020505
8548012	262	6/23/2009	Manganese, Total	0.056	mg/L	514020505
8548012	262	9/29/2009	SPCON	1500	µS/cm	514020505
8548012	262	9/29/2009	pH	6.33	standard units	514020505
8548012	262	9/29/2009	Acidity	1	mg/L $CaCO_3$	514020505
8548012	262	9/29/2009	Alkalinity	308	mg/L $CaCO_3$	514020505
8548012	262	9/29/2009	TSS	8	mg/L	514020505
8548012	262	9/29/2009	SO4	1100	mg/L	514020505
8548012	262	9/29/2009	Iron, Total	0.03	mg/L	514020505
8548012	262	9/29/2009	Manganese, Total	0.248	mg/L	514020505
8548012	262	3/30/2006	SPCON	1560	µS/cm	514020505
8548012	262	3/30/2006	pH	7.3	standard units	514020505
8548012	262	3/30/2006	Acidity	22	mg/L $CaCO_3$	514020505
8548012	262	3/30/2006	Alkalinity	35	mg/L $CaCO_3$	514020505
8548012	262	3/30/2006	TSS	22	mg/L	514020505
8548012	262	3/30/2006	Iron, Total	2.1	mg/L	514020505
8548012	262	3/30/2006	Manganese, Total	3.33	mg/L	514020505
8548012	262	12/17/2007	Alkalinity	24	mg/L $CaCO_3$	514020505
8548012	262	12/17/2007	SPCON	20.8	µS/cm	514020505
8548012	262	12/17/2007	pH	6.18	standard units	514020505
8548012	262	12/17/2007	Acidity	1	mg/L $CaCO_3$	514020505
8548012	262	12/17/2007	TSS	9	mg/L	514020505
8548012	262	12/17/2007	SO4	2.61	mg/L	514020505
8548012	262	12/17/2007	Iron, Total	0.04	mg/L	514020505
8548012	262	12/17/2007	Manganese, Total	0.019	mg/L	514020505
8548012	262	6/30/2006	Alkalinity	31	mg/L $CaCO_3$	514020505
8548012	262	6/30/2006	SPCON	1542	µS/cm	514020505
8548012	262	6/30/2006	pH	5.26	standard units	514020505
8548012	262	6/30/2006	Acidity	62	mg/L $CaCO_3$	514020505
8548012	262	9/28/2006	SPCON	2276	µS/cm	514020505
8548012	262	6/30/2006	TSS	17	mg/L	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8548012	262	6/30/2006	Iron, Total	0.621	mg/L	514020505
8548012	262	6/30/2006	Manganese, Total	1.87	mg/L	514020505
8548012	262	9/28/2006	pH	6.08	standard units	514020505
8548012	262	9/28/2006	Acidity	1	mg/L $CaCO_3$	514020505
8548012	262	9/28/2006	Alkalinity	167	mg/L $CaCO_3$	514020505
8548012	262	9/28/2006	TSS	13	mg/L	514020505
8548012	262	9/28/2006	Iron, Total	0.131	mg/L	514020505
8548012	262	9/28/2006	Manganese, Total	0.045	mg/L	514020505
8548012	262	12/29/2006	SPCON	1106	µS/cm	514020505
8548012	262	12/29/2006	pH	5.6	standard units	514020505
8548012	262	12/29/2006	Acidity	64	mg/L $CaCO_3$	514020505
8548012	262	12/29/2006	Alkalinity	19	mg/L $CaCO_3$	514020505
8548012	262	12/29/2006	TSS	18	mg/L	514020505
8548012	262	12/29/2006	Iron, Total	1.74	mg/L	514020505
8548012	262	12/29/2006	Manganese, Total	2.95	mg/L	514020505
8548012	262	3/26/2007	SPCON	1247	µS/cm	514020505
8548012	262	3/26/2007	pH	5.93	standard units	514020505
8548012	262	3/26/2007	Acidity	63	mg/L $CaCO_3$	514020505
8548012	262	3/26/2007	Alkalinity	20	mg/L $CaCO_3$	514020505
8548012	262	3/26/2007	TSS	25	mg/L	514020505
8548012	262	3/26/2007	Iron, Total	1.36	mg/L	514020505
8548012	262	3/26/2007	Manganese, Total	3.21	mg/L	514020505
8548012	262	2/20/2008	SPCON	1350	µS/cm	514020505
8548012	262	2/20/2008	pH	7.81	standard units	514020505
8548012	262	2/20/2008	Acidity	29	mg/L $CaCO_3$	514020505
8548011	203	6/16/2011	pH	6.51	standard units	514020505
8548011	203	6/16/2011	Acidity	0	mg/L $CaCO_3$	514020505
8548011	203	6/16/2011	TSS	25	mg/L	514020505
8548011	203	6/16/2011	SO4	1220	mg/L	514020505
8548011	203	6/16/2011	Iron, Total	0.02	mg/L	514020505
8548011	203	6/16/2011	Manganese, Total	11.3	mg/L	514020505
8548011	203	12/29/2006	SPCON	590	µS/cm	514020505
8548011	203	12/29/2006	pH	8.2	standard units	514020505
8548011	203	12/29/2006	Acidity	1	mg/L $CaCO_3$	514020505
8548011	203	12/29/2006	Alkalinity	116	mg/L $CaCO_3$	514020505
8548011	203	12/29/2006	TSS	12	mg/L	514020505
8548011	203	12/29/2006	Iron, Total	0.614	mg/L	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8548011	203	12/29/2006	Manganese, Total	0.278	mg/L	514020505
8548011	203	11/27/2007	SPCON	618	µS/cm	514020505
8548011	203	11/27/2007	pH	6.73	standard units	514020505
8548011	203	11/27/2007	Acidity	1	mg/L $CaCO_3$	514020505
8548011	203	11/27/2007	Alkalinity	100	mg/L $CaCO_3$	514020505
8548011	203	11/27/2007	TSS	28	mg/L	514020505
8548011	203	11/27/2007	SO4	375	mg/L	514020505
8548011	203	11/27/2007	Iron, Total	0.76	mg/L	514020505
8548011	203	11/27/2007	Manganese, Total	0.258	mg/L	514020505
8548011	203	2/20/2008	SPCON	668	µS/cm	514020505
8548011	203	2/20/2008	pH	6.29	standard units	514020505
8548011	203	2/20/2008	Acidity	149	mg/L $CaCO_3$	514020505
8548011	203	2/20/2008	Alkalinity	1	mg/L $CaCO_3$	514020505
8548011	203	2/20/2008	TSS	16	mg/L	514020505
8548011	203	2/20/2008	SO4	461	mg/L	514020505
8548011	203	2/20/2008	Iron, Total	2.59	mg/L	514020505
8548011	203	2/20/2008	Manganese, Total	4.23	mg/L	514020505
8548011	203	12/19/2011	pH	7.57	standard units	514020505
8548011	203	12/19/2011	SPCON	477	µS/cm	514020505
8548011	203	12/19/2011	Acidity	0	mg/L $CaCO_3$	514020505
8548011	203	12/19/2011	Alkalinity	55	mg/L $CaCO_3$	514020505
8548011	203	12/19/2011	TSS	10	mg/L	514020505
8548011	203	12/19/2011	SO4	214	mg/L	514020505
8548011	203	12/19/2011	Iron, Total	0.9	mg/L	514020505
8548011	203	12/19/2011	Manganese, Total	0.087	mg/L	514020505
8548011	203	6/16/2011	Alkalinity	60	mg/L $CaCO_3$	514020505
8548011	203	6/16/2011	SPCON	1780	µS/cm	514020505
8548011	202	12/29/2006	SPCON	593	µS/cm	514020505
8548011	202	12/19/2011	Manganese, Total	0.079	mg/L	514020505
8548011	202	12/29/2006	Acidity	1	mg/L $CaCO_3$	514020505
8548011	202	12/29/2006	Alkalinity	121	mg/L $CaCO_3$	514020505
8548011	202	12/29/2006	TSS	12	mg/L	514020505
8548011	202	12/29/2006	Iron, Total	0.531	mg/L	514020505
8548011	202	12/29/2006	Manganese, Total	0.246	mg/L	514020505
8548011	202	11/27/2007	SPCON	630	µS/cm	514020505
8548011	202	11/27/2007	pH	6.91	standard units	514020505
8548011	202	11/27/2007	Acidity	1	mg/L $CaCO_3$	514020505

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8548011	202	11/27/2007	Alkalinity	99	mg/L $CaCO_3$	514020505
8548011	202	11/27/2007	TSS	37	mg/L	514020505
8548011	202	11/27/2007	SO4	376	mg/L	514020505
8548011	202	11/27/2007	Iron, Total	0.69	mg/L	514020505
8548011	202	11/27/2007	Manganese, Total	0.267	mg/L	514020505
8548011	202	2/20/2008	SPCON	736	µS/cm	514020505
8548011	202	2/20/2008	Acidity	1	mg/L $CaCO_3$	514020505
8548011	202	2/20/2008	pH	6.34	standard units	514020505
8548011	202	2/20/2008	Alkalinity	59	mg/L $CaCO_3$	514020505
8548011	202	2/20/2008	TSS	2	mg/L	514020505
8548011	202	2/20/2008	SO4	857	mg/L	514020505
8548011	202	2/20/2008	Iron, Total	0.1	mg/L	514020505
8548011	202	2/20/2008	Manganese, Total	0.564	mg/L	514020505
8548011	202	12/19/2011	SPCON	474	µS/cm	514020505
8548011	202	12/19/2011	pH	7.42	standard units	514020505
8548011	202	12/19/2011	Acidity	0	mg/L $CaCO_3$	514020505
8548011	202	12/19/2011	Alkalinity	69	mg/L $CaCO_3$	514020505
8548011	202	12/19/2011	TSS	11	mg/L	514020505
8548011	202	12/19/2011	SO4	213	mg/L	514020505
8548011	202	12/19/2011	Iron, Total	0.84	mg/L	514020505
8548011	202	12/29/2006	pH	8.1	standard units	514020505
8548011	2	11/27/2007	Alkalinity	99	mg/L $CaCO_3$	514020505
8548011	2	11/27/2007	SPCON	630	µS/cm	514020505
8548011	2	2/26/2004	Manganese, Total	0.0274	mg/L	514020505
8548011	2	2/26/2004	Iron, Total	0.63	mg/L	514020505
8548011	2	2/26/2004	SO4	77	mg/L	514020505
8548011	2	2/26/2004	TSS	7	mg/L	514020505
8548011	2	2/26/2004	Acidity	1	mg/L $CaCO_3$	514020505
8548011	2	2/26/2004	pH	7.62	standard units	514020505
8548011	2	12/29/2006	Manganese, Total	0.246	mg/L	514020505
8548011	2	11/27/2007	pH	6.91	standard units	514020505
8548011	2	11/27/2007	Acidity	1	mg/L $CaCO_3$	514020505
8548011	2	11/27/2007	TSS	37	mg/L	514020505
8548011	2	11/27/2007	SO4	376	mg/L	514020505
8548011	2	11/27/2007	Iron, Total	0.69	mg/L	514020505
8548011	2	11/27/2007	Manganese, Total	0.267	mg/L	514020505
8548011	2	6/23/2009	SPCON	1400	µS/cm	514020505
8548011	2	6/23/2009	pH	6.38	standard units	514020505

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8548011	2	6/23/2009	Acidity	1	mg/L $CaCO_3$	514020505
8548011	2	6/23/2009	Alkalinity	93	mg/L $CaCO_3$	514020505
8548011	2	6/23/2009	TSS	4	mg/L	514020505
8548011	2	6/23/2009	SO4	835	mg/L	514020505
8548011	2	6/23/2009	Iron, Total	0.02	mg/L	514020505
8548011	2	6/23/2009	Manganese, Total	0.042	mg/L	514020505
8548011	2	3/31/2009	SPCON	252	µS/cm	514020505
8548011	2	3/31/2009	pH	6.31	standard units	514020505
8548011	2	3/31/2009	Acidity	1	mg/L $CaCO_3$	514020505
8548011	2	3/31/2009	Alkalinity	63	mg/L $CaCO_3$	514020505
8548011	2	3/31/2009	TSS	5	mg/L	514020505
8548011	2	3/31/2009	SO4	46.4	mg/L	514020505
8548011	2	3/31/2009	Iron, Total	0.1	mg/L	514020505
8548011	2	3/31/2009	Manganese, Total	0.002	mg/L	514020505
8548011	2	2/20/2008	SPCON	736	µS/cm	514020505
8548011	2	2/20/2008	pH	6.34	standard units	514020505
8548011	2	2/20/2008	Acidity	1	mg/L $CaCO_3$	514020505
8548011	2	2/20/2008	Alkalinity	59	mg/L $CaCO_3$	514020505
8548011	2	2/20/2008	TSS	2	mg/L	514020505
8548011	2	2/20/2008	SO4	857	mg/L	514020505
8548011	2	2/20/2008	Iron, Total	0.1	mg/L	514020505
8548011	2	2/20/2008	Manganese, Total	0.564	mg/L	514020505
8548011	2	12/29/2006	SPCON	593	µS/cm	514020505
8548011	2	12/29/2006	pH	8.1	standard units	514020505
8548011	2	12/29/2006	Acidity	1	mg/L $CaCO_3$	514020505
8548011	2	12/29/2006	Alkalinity	121	mg/L $CaCO_3$	514020505
8548011	2	12/29/2006	TSS	12	mg/L	514020505
8548011	2	12/29/2006	SO4	241	mg/L	514020505
8548011	2	12/29/2006	Iron, Total	0.531	mg/L	514020505
8545035	3	9/11/2006	TSS	13	mg/L	514020505
8545035	3	9/11/2006	Alkalinity	20	mg/L $CaCO_3$	514020505
8545035	3	9/11/2006	Acidity	100	mg/L $CaCO_3$	514020505
8545035	3	9/11/2006	pH	6.08	standard units	514020505
8545035	3	9/11/2006	SPCON	710	µS/cm	514020505
8545035	3	9/11/2006	Iron, Total	0.44	mg/L	514020505
8545035	3	9/11/2006	SO4	270	mg/L	514020505
8545035	3	9/11/2006	Manganese, Total	0.91	mg/L	514020505

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8545035	2	9/11/2006	Acidity	740	mg/L $CaCO_3$	514020505
8545035	2	9/11/2006	Alkalinity	5	mg/L $CaCO_3$	514020505
8545035	2	9/11/2006	TSS	16	mg/L	514020505
8545035	2	9/11/2006	SO4	680	mg/L	514020505
8545035	2	9/11/2006	Iron, Total	27.1	mg/L	514020505
8545035	2	9/11/2006	Manganese, Total	4.44	mg/L	514020505
8545035	2	9/11/2006	SPCON	1120	µS/cm	514020505
8545035	2	9/11/2006	pH	4.31	standard units	514020505
8545035	1	9/11/2006	SPCON	1090	µS/cm	514020505
8545035	1	9/11/2006	pH	4.55	standard units	514020505
8545035	1	9/11/2006	Acidity	720.3	mg/L $CaCO_3$	514020505
8545035	1	9/11/2006	Manganese, Total	3.44	mg/L	514020505
8545035	1	9/11/2006	TSS	26	mg/L	514020505
8545035	1	9/11/2006	SO4	610	mg/L	514020505
8545035	1	9/11/2006	Iron, Total	16.5	mg/L	514020505
8545035	1	9/11/2006	Alkalinity	5	mg/L $CaCO_3$	514020505
8540136	854-0136-02	6/14/1983	SPCON	780	µS/cm	514020501
8540136	854-0136-02	5/28/1985	Manganese, Total	2	mg/L	514020501
8540136	854-0136-02	6/14/1983	Acidity	10	mg/L $CaCO_3$	514020501
8540136	854-0136-02	6/14/1983	Alkalinity	20	mg/L $CaCO_3$	514020501
8540136	854-0136-02	6/14/1983	TSS	1	mg/L	514020501
8540136	854-0136-02	6/14/1983	SO4	375	mg/L	514020501
8540136	854-0136-02	6/14/1983	Iron, Total	0.01	mg/L	514020501
8540136	854-0136-02	6/14/1983	Manganese, Total	3.09	mg/L	514020501
8540136	854-0136-02	11/23/1983	pH	4.4	standard units	514020501
8540136	854-0136-02	11/23/1983	Acidity	35	mg/L $CaCO_3$	514020501
8540136	854-0136-02	11/23/1983	Alkalinity	2	mg/L $CaCO_3$	514020501
8540136	854-0136-02	11/23/1983	TSS	194	mg/L	514020501
8540136	854-0136-02	11/23/1983	TDS	478	mg/L	514020501
8540136	854-0136-02	11/23/1983	SO4	400	mg/L	514020501
8540136	854-0136-02	11/23/1983	Iron, Total	6	mg/L	514020501
8540136	854-0136-02	11/23/1983	Manganese, Total	5	mg/L	514020501
8540136	854-0136-02	12/12/1983	SPCON	849	µS/cm	514020501
8540136	854-0136-02	12/12/1983	pH	4.8	standard units	514020501
8540136	854-0136-02	12/12/1983	Acidity	34	mg/L $CaCO_3$	514020501
8540136	854-0136-02	12/12/1983	Alkalinity	5	mg/L $CaCO_3$	514020501
8540136	854-0136-02	12/12/1983	TSS	7	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540136	854-0136-02	12/12/1983	SO4	435	mg/L	514020501
8540136	854-0136-02	12/12/1983	Iron, Total	0.06	mg/L	514020501
8540136	854-0136-02	12/12/1983	Manganese, Total	7	mg/L	514020501
8540136	854-0136-02	4/30/1985	SPCON	395	µS/cm	514020501
8540136	854-0136-02	4/30/1985	pH	6	standard units	514020501
8540136	854-0136-02	4/30/1985	Acidity	77	mg/L $CaCO_3$	514020501
8540136	854-0136-02	4/30/1985	Alkalinity	83	mg/L $CaCO_3$	514020501
8540136	854-0136-02	4/30/1985	TSS	8.01	mg/L	514020501
8540136	854-0136-02	4/30/1985	SO4	205	mg/L	514020501
8540136	854-0136-02	4/30/1985	Iron, Total	10	mg/L	514020501
8540136	854-0136-02	4/30/1985	Manganese, Total	3	mg/L	514020501
8540136	854-0136-02	5/28/1985	SPCON	310	µS/cm	514020501
8540136	854-0136-02	5/28/1985	pH	7.2	standard units	514020501
8540136	854-0136-02	5/28/1985	Acidity	216	mg/L $CaCO_3$	514020501
8540136	854-0136-02	5/28/1985	Alkalinity	263	mg/L $CaCO_3$	514020501
8540136	854-0136-02	5/28/1985	TSS	1	mg/L	514020501
8540136	854-0136-02	5/28/1985	SO4	500	mg/L	514020501
8540136	854-0136-02	5/28/1985	Iron, Total	2	mg/L	514020501
8540136	854-0136-02	6/14/1983	pH	6.8	standard units	514020501
8540136	854-0136-01	5/28/1985	SPCON	1895	µS/cm	514020501
8540136	854-0136-01	5/28/1985	pH	3.1	standard units	514020501
8540136	854-0136-01	5/28/1985	TSS	2.01	mg/L	514020501
8540136	854-0136-01	5/28/1985	SO4	660	mg/L	514020501
8540136	854-0136-01	5/28/1985	Iron, Total	62	mg/L	514020501
8540136	854-0136-01	5/28/1985	Manganese, Total	10	mg/L	514020501
8540136	854-0136-01	6/11/1985	SPCON	1150	µS/cm	514020501
8540136	854-0136-01	6/11/1985	pH	3.3	standard units	514020501
8540136	854-0136-01	6/11/1985	Acidity	234	mg/L $CaCO_3$	514020501
8540136	854-0136-01	6/11/1985	TSS	11	mg/L	514020501
8540136	854-0136-01	6/11/1985	SO4	950	mg/L	514020501
8540136	854-0136-01	6/11/1985	Iron, Total	28	mg/L	514020501
8540136	854-0136-01	6/11/1985	Manganese, Total	8	mg/L	514020501
8540136	854-0136-01	7/17/1985	SPCON	600	µS/cm	514020501
8540136	854-0136-01	7/17/1985	pH	6.4	standard units	514020501
8540136	854-0136-01	7/17/1985	Acidity	93	mg/L $CaCO_3$	514020501
8540136	854-0136-01	7/17/1985	Alkalinity	159	mg/L $CaCO_3$	514020501
8540136	854-0136-01	7/17/1985	TSS	1	mg/L	514020501
8540136	854-0136-01	7/17/1985	SO4	265	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540136	854-0136-01	7/17/1985	Iron, Total	2	mg/L	514020501
8540136	854-0136-01	7/17/1985	Manganese, Total	2	mg/L	514020501
8540136	854-0136-01	6/10/1983	SPCON	3300	µS/cm	514020501
8540136	854-0136-01	6/10/1983	pH	2.8	standard units	514020501
8540136	854-0136-01	6/10/1983	Acidity	1500	mg/L $CaCO_3$	514020501
8540136	854-0136-01	6/10/1983	TSS	8	mg/L	514020501
8540136	854-0136-01	6/10/1983	SO4	1825	mg/L	514020501
8540136	854-0136-01	6/10/1983	Iron, Dissolved	132	mg/L	514020501
8540136	854-0136-01	6/10/1983	Iron, Total	182	mg/L	514020501
8540136	854-0136-01	6/10/1983	Manganese, Dissolved	14	mg/L	514020501
8540136	854-0136-01	6/10/1983	Manganese, Total	164	mg/L	514020501
8540136	854-0136-01	9/26/1983	SPCON	4200	µS/cm	514020501
8540136	854-0136-01	9/26/1983	pH	2.6	standard units	514020501
8540136	854-0136-01	9/26/1983	Acidity	3450	mg/L $CaCO_3$	514020501
8540136	854-0136-01	9/26/1983	TSS	2	mg/L	514020501
8540136	854-0136-01	9/26/1983	SO4	3675	mg/L	514020501
8540136	854-0136-01	9/26/1983	Iron, Dissolved	198	mg/L	514020501
8540136	854-0136-01	9/26/1983	Iron, Total	211	mg/L	514020501
8540136	854-0136-01	9/26/1983	Manganese, Dissolved	21	mg/L	514020501
8540136	854-0136-01	9/26/1983	Manganese, Total	21	mg/L	514020501
8540136	854-0136-01	4/30/1985	SPCON	800	µS/cm	514020501
8540136	854-0136-01	4/30/1985	pH	3.8	standard units	514020501
8540136	854-0136-01	4/30/1985	Acidity	52	mg/L $CaCO_3$	514020501
8540136	854-0136-01	4/30/1985	TSS	11	mg/L	514020501
8540136	854-0136-01	4/30/1985	SO4	480	mg/L	514020501
8540136	854-0136-01	4/30/1985	Iron, Total	16	mg/L	514020501
8540136	854-0136-01	5/28/1985	Acidity	516	mg/L $CaCO_3$	514020501
8540136	854-0136-01	4/30/1985	Manganese, Total	5	mg/L	514020501
8540135	854-0135-01	1/6/1981	Manganese, Total	24	mg/L	514020501
8540135	854-0135-01	2/17/1981	SPCON	1030	µS/cm	514020501
8540135	854-0135-01	2/17/1981	pH	3.8	standard units	514020501
8540135	854-0135-01	2/17/1981	Acidity	310	mg/L $CaCO_3$	514020501
8540135	854-0135-01	2/17/1981	TSS	270	mg/L	514020501
8540135	854-0135-01	2/17/1981	TDS	836	mg/L	514020501
8540135	854-0135-01	2/17/1981	Iron, Dissolved	4	mg/L	514020501
8540135	854-0135-01	2/17/1981	Iron, Total	14	mg/L	514020501
8540135	854-0135-01	2/17/1981	Manganese, Total	5	mg/L	514020501
8540135	854-0135-01	4/20/1981	SPCON	1080	µS/cm	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540135	854-0135-01	4/20/1981	pH	3.5	standard units	514020501
8540135	854-0135-01	4/20/1981	SO4	533	mg/L	514020501
8540135	854-0135-01	4/20/1981	Acidity	590	mg/L $CaCO_3$	514020501
8540135	854-0135-01	4/20/1981	TSS	270	mg/L	514020501
8540135	854-0135-01	4/20/1981	TDS	858	mg/L	514020501
8540135	854-0135-01	4/20/1981	Iron, Dissolved	1.05	mg/L	514020501
8540135	854-0135-01	4/20/1981	Iron, Total	10.02	mg/L	514020501
8540135	854-0135-01	4/20/1981	Manganese, Total	5.08	mg/L	514020501
8540135	854-0135-01	6/10/1981	SPCON	3560	µS/cm	514020501
8540135	854-0135-01	10/18/1982	TSS	11	mg/L	514020501
8540135	854-0135-01	10/18/1982	TDS	5594	mg/L	514020501
8540135	854-0135-01	10/18/1982	SO4	2900	mg/L	514020501
8540135	854-0135-01	10/18/1982	Iron, Dissolved	175	mg/L	514020501
8540135	854-0135-01	10/18/1982	Iron, Total	175	mg/L	514020501
8540135	854-0135-01	10/18/1982	Manganese, Total	23	mg/L	514020501
8540135	854-0135-01	2/7/1983	SPCON	1850	µS/cm	514020501
8540135	854-0135-01	2/7/1983	pH	4.8	standard units	514020501
8540135	854-0135-01	2/7/1983	Acidity	460	mg/L $CaCO_3$	514020501
8540135	854-0135-01	2/7/1983	TSS	107	mg/L	514020501
8540135	854-0135-01	2/7/1983	SO4	1325	mg/L	514020501
8540135	854-0135-01	2/7/1983	Iron, Dissolved	7.04	mg/L	514020501
8540135	854-0135-01	2/7/1983	Iron, Total	44	mg/L	514020501
8540135	854-0135-01	2/7/1983	Manganese, Dissolved	10	mg/L	514020501
8540135	854-0135-01	2/7/1983	Manganese, Total	11	mg/L	514020501
8540135	854-0135-01	4/17/1981	TSS	1	mg/L	514020501
8540135	854-0135-01	4/17/1981	SPCON	2690	µS/cm	514020501
8540135	854-0135-01	4/17/1981	pH	3.3	standard units	514020501
8540135	854-0135-01	4/17/1981	Acidity	755	mg/L $CaCO_3$	514020501
8540135	854-0135-01	4/17/1981	TDS	2686	mg/L	514020501
8540135	854-0135-01	4/17/1981	Iron, Dissolved	54	mg/L	514020501
8540135	854-0135-01	4/17/1981	Iron, Total	76	mg/L	514020501
8540135	854-0135-01	4/17/1981	Manganese, Total	14	mg/L	514020501
8540135	854-0135-01	10/31/1980	SPCON	4690	µS/cm	514020501
8540135	854-0135-01	10/31/1980	pH	2.6	standard units	514020501
8540135	854-0135-01	10/31/1980	Acidity	1074	mg/L $CaCO_3$	514020501
8540135	854-0135-01	10/31/1980	TSS	53	mg/L	514020501
8540135	854-0135-01	10/31/1980	TDS	4630	mg/L	514020501
8540135	854-0135-01	10/31/1980	SO4	4650	mg/L	514020501

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8540135	854-0135-01	10/31/1980	Iron, Dissolved	200	mg/L	514020501
8540135	854-0135-01	10/31/1980	Iron, Total	221	mg/L	514020501
8540135	854-0135-01	10/31/1980	Manganese, Total	27	mg/L	514020501
8540135	854-0135-01	1/6/1981	SPCON	4700	µS/cm	514020501
8540135	854-0135-01	1/6/1981	Acidity	1070	mg/L $CaCO_3$	514020501
8540135	854-0135-01	1/6/1981	TSS	49	mg/L	514020501
8540135	854-0135-01	1/6/1981	TDS	4550	mg/L	514020501
8540135	854-0135-01	1/6/1981	Iron, Dissolved	186	mg/L	514020501
8540135	854-0135-01	1/6/1981	Iron, Total	230	mg/L	514020501
8540135	854-0135-01	6/10/1981	pH	2.6	standard units	514020501
8540135	854-0135-01	6/10/1981	Acidity	400	mg/L $CaCO_3$	514020501
8540135	854-0135-01	6/10/1981	TSS	28	mg/L	514020501
8540135	854-0135-01	6/10/1981	TDS	3320	mg/L	514020501
8540135	854-0135-01	6/10/1981	SO4	1770	mg/L	514020501
8540135	854-0135-01	6/10/1981	Iron, Dissolved	5	mg/L	514020501
8540135	854-0135-01	6/10/1981	Iron, Total	96	mg/L	514020501
8540135	854-0135-01	6/10/1981	Manganese, Dissolved	13	mg/L	514020501
8540135	854-0135-01	6/10/1981	Manganese, Total	13	mg/L	514020501
8540135	854-0135-01	7/9/1981	SPCON	3700	µS/cm	514020501
8540135	854-0135-01	7/9/1981	pH	2.7	standard units	514020501
8540135	854-0135-01	7/9/1981	Acidity	5000	mg/L $CaCO_3$	514020501
8540135	854-0135-01	7/9/1981	TSS	5	mg/L	514020501
8540135	854-0135-01	7/9/1981	TDS	63.08	mg/L	514020501
8540135	854-0135-01	7/9/1981	Iron, Dissolved	1.09	mg/L	514020501
8540135	854-0135-01	7/9/1981	Iron, Total	205	mg/L	514020501
8540135	854-0135-01	7/9/1981	Manganese, Total	2.03	mg/L	514020501
8540135	854-0135-01	8/27/1981	SPCON	3960	µS/cm	514020501
8540135	854-0135-01	8/27/1981	pH	2	standard units	514020501
8540135	854-0135-01	8/27/1981	Acidity	4290	mg/L $CaCO_3$	514020501
8540135	854-0135-01	8/27/1981	TSS	6	mg/L	514020501
8540135	854-0135-01	8/27/1981	TDS	4986	mg/L	514020501
8540135	854-0135-01	8/27/1981	Iron, Dissolved	161	mg/L	514020501
8540135	854-0135-01	8/27/1981	Iron, Total	175	mg/L	514020501
8540135	854-0135-01	8/27/1981	Manganese, Total	157	mg/L	514020501
8540135	854-0135-01	9/14/1982	SPCON	3500	µS/cm	514020501
8540135	854-0135-01	9/14/1982	pH	3.5	standard units	514020501
8540135	854-0135-01	9/14/1982	Acidity	2035	mg/L $CaCO_3$	514020501
8540135	854-0135-01	9/14/1982	TSS	1	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540135	854-0135-01	9/14/1982	TDS	4630	mg/L	514020501
8540135	854-0135-01	9/14/1982	Iron, Dissolved	121	mg/L	514020501
8540135	854-0135-01	6/10/1983	SPCON	3300	µS/cm	514020501
8540135	854-0135-01	6/10/1983	pH	4.5	standard units	514020501
8540135	854-0135-01	6/10/1983	Acidity	1500	mg/L $CaCO_3$	514020501
8540135	854-0135-01	6/10/1983	TSS	8	mg/L	514020501
8540135	854-0135-01	6/10/1983	SO4	1825	mg/L	514020501
8540135	854-0135-01	6/10/1983	Iron, Dissolved	132	mg/L	514020501
8540135	854-0135-01	6/10/1983	Iron, Total	182	mg/L	514020501
8540135	854-0135-01	6/10/1983	Manganese, Dissolved	14	mg/L	514020501
8540135	854-0135-01	6/10/1983	Manganese, Total	164	mg/L	514020501
8540135	854-0135-01	9/14/1982	Iron, Total	125	mg/L	514020501
8540135	854-0135-01	9/14/1982	Manganese, Total	22	mg/L	514020501
8540135	854-0135-01	10/18/1982	SPCON	4200	µS/cm	514020501
8540135	854-0135-01	10/18/1982	pH	2.5	standard units	514020501
8540135	854-0135-01	10/18/1982	Acidity	5000	mg/L $CaCO_3$	514020501
8540045	854-0045-02	6/10/1983	SPCON	3150	µS/cm	514020501
8540045	854-0045-02	6/10/1983	pH	4.5	standard units	514020501
8540045	854-0045-02	6/10/1983	Acidity	710	mg/L $CaCO_3$	514020501
8540045	854-0045-02	6/10/1983	TSS	1	mg/L	514020501
8540045	854-0045-02	6/10/1983	Iron, Dissolved	56.7	mg/L	514020501
8540045	854-0045-02	6/10/1983	Iron, Total	79	mg/L	514020501
8540045	854-0045-02	6/10/1983	Manganese, Dissolved	11.04	mg/L	514020501
8540045	854-0045-02	6/10/1983	Manganese, Total	11.4	mg/L	514020501
8540045	854-0045-02	9/12/1983	SPCON	3550	µS/cm	514020501
8540045	854-0045-02	9/12/1983	pH	2.4	standard units	514020501
8540045	854-0045-02	9/12/1983	Acidity	850	mg/L $CaCO_3$	514020501
8540045	854-0045-02	9/12/1983	TSS	2	mg/L	514020501
8540045	854-0045-02	9/12/1983	Iron, Dissolved	41.2	mg/L	514020501
8540045	854-0045-02	9/12/1983	Iron, Total	41.2	mg/L	514020501
8540045	854-0045-02	9/12/1983	Manganese, Dissolved	13.7	mg/L	514020501
8540045	854-0045-02	9/12/1983	Manganese, Total	13.7	mg/L	514020501
8540045	854-0045-02	11/15/1983	pH	5.8	standard units	514020501
8540045	854-0045-02	11/15/1983	Acidity	352	mg/L $CaCO_3$	514020501
8540045	854-0045-02	11/15/1983	TSS	16	mg/L	514020501
8540045	854-0045-02	11/15/1983	TDS	3420	mg/L	514020501
8540045	854-0045-02	11/15/1983	Iron, Dissolved	50	mg/L	514020501
8540045	854-0045-02	11/15/1983	Iron, Total	114	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540045	854-0045-02	11/15/1983	Manganese, Dissolved	13	mg/L	514020501
8540045	854-0045-02	11/15/1983	Manganese, Total	13	mg/L	514020501
8540045	854-0045-02	2/17/1982	SPCON	1430	µS/cm	514020501
8540045	854-0045-02	2/17/1982	pH	3.4	standard units	514020501
8540045	854-0045-02	2/17/1982	Acidity	325	mg/L $CaCO_3$	514020501
8540045	854-0045-02	2/17/1982	TSS	35	mg/L	514020501
8540045	854-0045-02	2/17/1982	TDS	1274	mg/L	514020501
8540045	854-0045-02	2/17/1982	Iron, Dissolved	3.95	mg/L	514020501
8540045	854-0045-02	2/17/1982	Iron, Total	17.9	mg/L	514020501
8540045	854-0045-02	2/17/1982	Manganese, Total	4.9	mg/L	514020501
8540045	854-0045-02	3/16/1982	SPCON	1300	µS/cm	514020501
8540045	854-0045-02	3/16/1982	pH	3.3	standard units	514020501
8540045	854-0045-02	3/16/1982	Acidity	590	mg/L $CaCO_3$	514020501
8540045	854-0045-02	3/16/1982	TSS	29	mg/L	514020501
8540045	854-0045-02	3/16/1982	TDS	970	mg/L	514020501
8540045	854-0045-02	3/16/1982	Iron, Dissolved	1.43	mg/L	514020501
8540045	854-0045-02	3/16/1982	Iron, Total	11.5	mg/L	514020501
8540045	854-0045-02	3/16/1982	Manganese, Total	3.62	mg/L	514020501
8540045	854-0045-02	4/17/1982	SPCON	2400	µS/cm	514020501
8540045	854-0045-02	4/17/1982	pH	3	standard units	514020501
8540045	854-0045-02	4/17/1982	Acidity	290	mg/L $CaCO_3$	514020501
8540045	854-0045-02	4/17/1982	TSS	1	mg/L	514020501
8540045	854-0045-02	4/17/1982	TDS	2284	mg/L	514020501
8540045	854-0045-02	4/17/1982	Iron, Dissolved	19	mg/L	514020501
8540045	854-0045-02	4/17/1982	Iron, Total	26	mg/L	514020501
8540045	854-0045-02	4/17/1982	Manganese, Total	9.05	mg/L	514020501
8540045	854-0045-02	7/29/1982	SPCON	2980	µS/cm	514020501
8540045	854-0045-02	7/29/1982	pH	3	standard units	514020501
8540045	854-0045-02	7/29/1982	Acidity	30	mg/L $CaCO_3$	514020501
8540045	854-0045-02	10/18/1982	SPCON	3300	µS/cm	514020501
8540045	854-0045-02	10/18/1982	pH	2.6	standard units	514020501
8540045	854-0045-02	10/18/1982	Acidity	650	mg/L $CaCO_3$	514020501
8540045	854-0045-02	10/18/1982	TSS	7	mg/L	514020501
8540045	854-0045-02	10/18/1982	TDS	3810	mg/L	514020501
8540045	854-0045-02	10/18/1982	Iron, Dissolved	35.1	mg/L	514020501
8540045	854-0045-02	10/18/1982	Iron, Total	35.1	mg/L	514020501
8540045	854-0045-02	10/18/1982	Manganese, Total	13	mg/L	514020501
8540045	854-0045-02	7/29/1982	TSS	12	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540045	854-0045-02	7/29/1982	TDS	3440	mg/L	514020501
8540045	854-0045-02	7/29/1982	Iron, Dissolved	17.1	mg/L	514020501
8540045	854-0045-02	7/29/1982	Iron, Total	17.1	mg/L	514020501
8540045	854-0045-02	7/29/1982	Manganese, Total	10.9	mg/L	514020501
8540045	854-0045-02	9/2/1982	SPCON	3000	µS/cm	514020501
8540045	854-0045-02	9/2/1982	pH	3	standard units	514020501
8540045	854-0045-02	9/2/1982	Acidity	430	mg/L $CaCO_3$	514020501
8540045	854-0045-02	9/2/1982	TSS	114.5	mg/L	514020501
8540045	854-0045-02	9/2/1982	TDS	3408	mg/L	514020501
8540045	854-0045-02	9/2/1982	Iron, Dissolved	10.2	mg/L	514020501
8540045	854-0045-02	9/2/1982	Iron, Total	21	mg/L	514020501
8540045	854-0045-02	9/2/1982	Manganese, Total	11.2	mg/L	514020501
8540045	854-0045-02	9/14/1982	SPCON	2800	µS/cm	514020501
8540045	854-0045-02	9/14/1982	pH	3.2	standard units	514020501
8540045	854-0045-02	9/14/1982	Acidity	455	mg/L $CaCO_3$	514020501
8540045	854-0045-02	9/14/1982	TSS	1	mg/L	514020501
8540045	854-0045-02	9/14/1982	TDS	3358	mg/L	514020501
8540045	854-0045-02	9/14/1982	Iron, Dissolved	21.7	mg/L	514020501
8540045	854-0045-02	9/14/1982	Iron, Total	23.5	mg/L	514020501
8540045	854-0045-02	9/14/1982	Manganese, Total	11.7	mg/L	514020501
8540045	854-0045-02	3/9/1983	SPCON	1370	µS/cm	514020501
8540045	854-0045-02	3/9/1983	pH	4.5	standard units	514020501
8540045	854-0045-02	3/9/1983	Acidity	280	mg/L $CaCO_3$	514020501
8540045	854-0045-02	3/9/1983	TSS	39	mg/L	514020501
8540045	854-0045-02	3/9/1983	Iron, Dissolved	5.01	mg/L	514020501
8540045	854-0045-02	3/9/1983	Iron, Total	14.8	mg/L	514020501
8540045	854-0045-02	3/9/1983	Manganese, Dissolved	4.47	mg/L	514020501
8540045	854-0045-02	3/9/1983	Manganese, Total	4.47	mg/L	514020501
8540038	854-0038-01	10/18/1982	TDS	5594	mg/L	514020501
8540038	854-0038-01	10/18/1982	TSS	11	mg/L	514020501
8540038	854-0038-01	10/18/1982	Iron, Dissolved	175	mg/L	514020501
8540038	854-0038-01	10/18/1982	Iron, Total	175	mg/L	514020501
8540038	854-0038-01	10/18/1982	Manganese, Total	23	mg/L	514020501
8540038	854-0038-01	6/10/1983	SPCON	2300	µS/cm	514020501
8540038	854-0038-01	6/10/1983	pH	4.5	standard units	514020501
8540038	854-0038-01	6/10/1983	Acidity	999.99	mg/L $CaCO_3$	514020501
8540038	854-0038-01	6/10/1983	TSS	8	mg/L	514020501
8540038	854-0038-01	6/10/1983	SO4	1825	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8540038	854-0038-01	6/10/1983	Iron, Dissolved	132	mg/L	514020501
8540038	854-0038-01	6/10/1983	Iron, Total	182	mg/L	514020501
8540038	854-0038-01	6/10/1983	Manganese, Dissolved	14.1	mg/L	514020501
8540038	854-0038-01	6/10/1983	Manganese, Total	164	mg/L	514020501
8540038	854-0038-01	8/27/1981	SPCON	3960	µS/cm	514020501
8540038	854-0038-01	8/27/1981	pH	2	standard units	514020501
8540038	854-0038-01	8/27/1981	Acidity	999.99	mg/L $CaCO_3$	514020501
8540038	854-0038-01	8/27/1981	TSS	6	mg/L	514020501
8540038	854-0038-01	8/27/1981	TDS	4968	mg/L	514020501
8540038	854-0038-01	8/27/1981	Iron, Dissolved	161	mg/L	514020501
8540038	854-0038-01	8/27/1981	Iron, Total	175	mg/L	514020501
8540038	854-0038-01	8/27/1981	Manganese, Total	157	mg/L	514020501
8540038	854-0038-01	2/7/1983	TSS	107	mg/L	514020501
8540038	854-0038-01	2/7/1983	SPCON	1850	µS/cm	514020501
8540038	854-0038-01	2/7/1983	pH	4.7	standard units	514020501
8540038	854-0038-01	2/7/1983	Acidity	460	mg/L $CaCO_3$	514020501
8540038	854-0038-01	2/7/1983	SO4	1325	mg/L	514020501
8540038	854-0038-01	2/7/1983	Iron, Dissolved	7.43	mg/L	514020501
8540038	854-0038-01	2/7/1983	Iron, Total	44.4	mg/L	514020501
8540038	854-0038-01	2/7/1983	Manganese, Dissolved	10.2	mg/L	514020501
8540038	854-0038-01	2/7/1983	Manganese, Total	11.5	mg/L	514020501
8540038	854-0038-01	4/17/1982	SPCON	2690	µS/cm	514020501
8540038	854-0038-01	4/17/1982	pH	3.3	standard units	514020501
8540038	854-0038-01	4/17/1982	Acidity	755	mg/L $CaCO_3$	514020501
8540038	854-0038-01	4/17/1982	TSS	1	mg/L	514020501
8540038	854-0038-01	4/17/1982	TDS	2686	mg/L	514020501
8540038	854-0038-01	4/17/1982	Iron, Dissolved	54	mg/L	514020501
8540038	854-0038-01	4/17/1982	Iron, Total	76	mg/L	514020501
8540038	854-0038-01	4/17/1982	Manganese, Total	14	mg/L	514020501
8540038	854-0038-01	9/14/1982	SPCON	3500	µS/cm	514020501
8540038	854-0038-01	9/14/1982	pH	2.7	standard units	514020501
8540038	854-0038-01	9/14/1982	Acidity	999.99	mg/L $CaCO_3$	514020501
8540038	854-0038-01	9/14/1982	TSS	1	mg/L	514020501
8540038	854-0038-01	9/14/1982	TDS	4630	mg/L	514020501
8540038	854-0038-01	9/14/1982	Iron, Dissolved	121.5	mg/L	514020501
8540038	854-0038-01	9/14/1982	Iron, Total	125.7	mg/L	514020501
8540038	854-0038-01	9/14/1982	Manganese, Total	22	mg/L	514020501
8540038	854-0038-01	10/18/1982	SPCON	4200	µS/cm	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540038	854-0038-01	10/18/1982	pH	2.5	standard units	514020501
8540038	854-0038-01	10/18/1982	Acidity	999.99	mg/L $CaCO_3$	514020501
8540038	854-0038-01	10/18/1982	SO4	2900	mg/L	514020501
8545015	203	3/31/2001	TSS	6	mg/L	514020501
8545015	203	3/31/2001	TDS	820	mg/L	514020501
8545015	203	3/31/2001	SO4	540	mg/L	514020501
8545015	203	3/31/2001	Iron, Total	0.12	mg/L	514020501
8545015	203	3/31/2001	Manganese, Total	0.09	mg/L	514020501
8545015	203	4/10/2001	SPCON	846	µS/cm	514020501
8545015	203	4/10/2001	pH	6.7	standard units	514020501
8545015	203	4/10/2001	Acidity	11	mg/L $CaCO_3$	514020501
8545015	203	4/10/2001	Alkalinity	46	mg/L $CaCO_3$	514020501
8545015	203	4/10/2001	TSS	3	mg/L	514020501
8545015	203	4/10/2001	TDS	311	mg/L	514020501
8545015	203	4/10/2001	SO4	340	mg/L	514020501
8545015	203	4/10/2001	Iron, Total	0.15	mg/L	514020501
8545015	203	4/10/2001	Manganese, Total	0.14	mg/L	514020501
8545015	203	1/23/1988	Alkalinity	11	mg/L $CaCO_3$	514020501
8545015	203	1/23/1988	SPCON	1179	µS/cm	514020501
8545015	203	1/23/1988	pH	4.72	standard units	514020501
8545015	203	1/23/1988	Acidity	56	mg/L $CaCO_3$	514020501
8545015	203	1/23/1988	TSS	86	mg/L	514020501
8545015	203	1/23/1988	SO4	679	mg/L	514020501
8545015	203	1/23/1988	Iron, Total	0.52	mg/L	514020501
8545015	203	1/23/1988	Manganese, Total	3.13	mg/L	514020501
8545015	203	8/15/1987	SPCON	2201	µS/cm	514020501
8545015	203	8/15/1987	pH	6.55	standard units	514020501
8545015	203	8/15/1987	Alkalinity	52	mg/L $CaCO_3$	514020501
8545015	203	8/15/1987	TSS	15	mg/L	514020501
8545015	203	8/15/1987	SO4	1077	mg/L	514020501
8545015	203	8/15/1987	Iron, Total	0.1	mg/L	514020501
8545015	203	8/15/1987	Manganese, Total	0.09	mg/L	514020501
8545015	203	9/15/1987	SPCON	2301	µS/cm	514020501
8545015	203	9/15/1987	pH	6.94	standard units	514020501
8545015	203	9/15/1987	Alkalinity	137	mg/L $CaCO_3$	514020501
8545015	203	9/15/1987	TSS	6	mg/L	514020501
8545015	203	9/15/1987	SO4	1246	mg/L	514020501
8545015	203	9/15/1987	Iron, Total	0.35	mg/L	514020501

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8545015	203	9/15/1987	Manganese, Total	2.22	mg/L	514020501
8545015	203	10/31/1987	SPCON	2640	µS/cm	514020501
8545015	203	10/31/1987	pH	7.19	standard units	514020501
8545015	203	10/31/1987	Alkalinity	148	mg/L $CaCO_3$	514020501
8545015	203	10/31/1987	TSS	82	mg/L	514020501
8545015	203	10/31/1987	SO4	1415	mg/L	514020501
8545015	203	10/31/1987	Iron, Total	0.19	mg/L	514020501
8545015	203	10/31/1987	Manganese, Total	0.06	mg/L	514020501
8545015	203	5/14/1990	SPCON	1037	µS/cm	514020501
8545015	203	5/14/1990	pH	4.1	standard units	514020501
8545015	203	5/14/1990	Acidity	48	mg/L $CaCO_3$	514020501
8545015	203	5/14/1990	TSS	20	mg/L	514020501
8545015	203	5/14/1990	SO4	626	mg/L	514020501
8545015	203	5/14/1990	Iron, Total	0.04	mg/L	514020501
8545015	203	5/14/1990	Manganese, Total	4.55	mg/L	514020501
8545015	203	6/2/1990	SPCON	1294.4	µS/cm	514020501
8545015	203	6/2/1990	pH	6.64	standard units	514020501
8545015	203	6/2/1990	Acidity	35	mg/L $CaCO_3$	514020501
8545015	203	6/2/1990	Alkalinity	44	mg/L $CaCO_3$	514020501
8545015	203	6/2/1990	TSS	14	mg/L	514020501
8545015	203	6/2/1990	SO4	680	mg/L	514020501
8545015	203	6/2/1990	Iron, Total	0.26	mg/L	514020501
8545015	203	6/2/1990	Manganese, Total	3.35	mg/L	514020501
8545015	203	3/31/1992	SPCON	300	µS/cm	514020501
8545015	203	3/31/1992	pH	6.8	standard units	514020501
8545015	203	3/31/1992	Alkalinity	87	mg/L $CaCO_3$	514020501
8545015	203	3/31/1992	TSS	5	mg/L	514020501
8545015	203	3/31/1992	SO4	21	mg/L	514020501
8545015	203	3/31/1992	Iron, Total	0.28	mg/L	514020501
8545015	203	3/31/1992	Manganese, Total	0.97	mg/L	514020501
8545015	203	12/6/2000	SPCON	2210	µS/cm	514020501
8545015	203	12/6/2000	pH	6	standard units	514020501
8545015	203	12/6/2000	Acidity	4	mg/L $CaCO_3$	514020501
8545015	203	12/6/2000	Alkalinity	38.93	mg/L $CaCO_3$	514020501
8545015	203	12/6/2000	TSS	11	mg/L	514020501
8545015	203	12/6/2000	TDS	810	mg/L	514020501
8545015	203	12/6/2000	SO4	1504	mg/L	514020501
8545015	203	12/6/2000	Iron, Total	0.14	mg/L	514020501

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8545015	203	12/6/2000	Manganese, Total	0.01	mg/L	514020501
8545015	203	3/31/2001	SPCON	2246	µS/cm	514020501
8545015	203	3/31/2001	pH	6.58	standard units	514020501
8545015	203	3/31/2001	Acidity	12	mg/L $CaCO_3$	514020501
8545015	203	3/31/2001	Alkalinity	45.18	mg/L $CaCO_3$	514020501
8540217	3	1/19/2004	Manganese, Total	0.239	mg/L	514020501
8540217	3	1/19/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	1/19/2004	Alkalinity	48	mg/L $CaCO_3$	514020501
8540217	3	2/12/2004	Iron, Total	2.22	mg/L	514020501
8540217	3	2/12/2004	Flow	0.005	cfs	514020501
8540217	3	2/12/2004	pH	6.9	standard units	514020501
8540217	3	2/12/2004	TSS	13	mg/L	514020501
8540217	3	2/12/2004	Manganese, Total	0.181	mg/L	514020501
8540217	3	2/12/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	2/12/2004	Alkalinity	43	mg/L $CaCO_3$	514020501
8540217	3	3/8/2004	Flow	0.001	cfs	514020501
8540217	3	3/8/2004	pH	6.15	standard units	514020501
8540217	3	3/8/2004	TSS	7	mg/L	514020501
8540217	3	11/7/2006	Manganese, Total	0.152	mg/L	514020501
8540217	3	11/7/2006	Acidity	21	mg/L $CaCO_3$	514020501
8540217	3	11/7/2006	Alkalinity	46	mg/L $CaCO_3$	514020501
8540217	3	1/22/2007	Flow	0.00576	cfs	514020501
8540217	3	1/22/2007	pH	7.5	standard units	514020501
8540217	3	1/22/2007	TSS	10	mg/L	514020501
8540217	3	1/22/2007	Iron, Total	0.602	mg/L	514020501
8540217	3	1/22/2007	Manganese, Total	0.24	mg/L	514020501
8540217	3	1/22/2007	Acidity	34	mg/L $CaCO_3$	514020501
8540217	3	1/22/2007	Alkalinity	36	mg/L $CaCO_3$	514020501
8540217	3	3/10/2008	Flow	0.00288	cfs	514020501
8540217	3	3/10/2008	pH	6.45	standard units	514020501
8540217	3	3/10/2008	TSS	7	mg/L	514020501
8540217	3	3/10/2008	Iron, Total	0.15	mg/L	514020501
8540217	3	3/10/2008	Manganese, Total	0.526	mg/L	514020501
8540217	3	3/10/2008	Acidity	13	mg/L $CaCO_3$	514020501
8540217	3	3/10/2008	Alkalinity	64	mg/L $CaCO_3$	514020501
8540217	3	4/1/2008	Flow	0.0216	cfs	514020501
8540217	3	4/1/2008	pH	5.86	standard units	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	3	4/1/2008	TSS	21	mg/L	514020501
8540217	3	4/1/2008	Iron, Total	0.72	mg/L	514020501
8540217	3	4/1/2008	Manganese, Total	0.72	mg/L	514020501
8540217	3	4/1/2008	Acidity	43	mg/L $CaCO_3$	514020501
8540217	3	4/1/2008	Alkalinity	51	mg/L $CaCO_3$	514020501
8540217	3	12/26/2008	Flow	0.00144	cfs	514020501
8540217	3	12/26/2008	pH	7.76	standard units	514020501
8540217	3	12/26/2008	TSS	6	mg/L	514020501
8540217	3	12/26/2008	SS	0.2	mg/L	514020501
8540217	3	12/26/2008	Iron, Total	0.29	mg/L	514020501
8540217	3	12/26/2008	Manganese, Total	0.355	mg/L	514020501
8540217	3	12/26/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	12/26/2008	Alkalinity	113	mg/L $CaCO_3$	514020501
8540217	3	4/1/2003	Flow	0.001	cfs	514020501
8540217	3	4/1/2003	pH	5.87	standard units	514020501
8540217	3	4/1/2003	TSS	5	mg/L	514020501
8540217	3	4/1/2003	Iron, Total	0.38	mg/L	514020501
8540217	3	4/1/2003	Manganese, Total	0.936	mg/L	514020501
8540217	3	4/1/2003	Acidity	6	mg/L $CaCO_3$	514020501
8540217	3	4/1/2003	Alkalinity	20	mg/L $CaCO_3$	514020501
8540217	3	5/5/2003	Flow	0.007	cfs	514020501
8540217	3	5/5/2003	pH	6.67	standard units	514020501
8540217	3	5/5/2003	TSS	13	mg/L	514020501
8540217	3	5/5/2003	Iron, Total	0.56	mg/L	514020501
8540217	3	5/5/2003	Manganese, Total	1.09	mg/L	514020501
8540217	3	5/5/2003	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	5/5/2003	Alkalinity	35	mg/L $CaCO_3$	514020501
8540217	3	5/19/2003	Flow	0.002	cfs	514020501
8540217	3	5/19/2003	pH	6.92	standard units	514020501
8540217	3	5/19/2003	TSS	14	mg/L	514020501
8540217	3	5/19/2003	Iron, Total	0.803	mg/L	514020501
8540217	3	5/19/2003	Manganese, Total	0.417	mg/L	514020501
8540217	3	5/19/2003	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	5/19/2003	Alkalinity	37	mg/L $CaCO_3$	514020501
8540217	3	1/5/2004	Flow	0.036	cfs	514020501
8540217	3	1/5/2004	pH	6.68	standard units	514020501
8540217	3	1/5/2004	TSS	29	mg/L	514020501

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8540217	3	1/5/2004	Iron, Total	3	mg/L	514020501
8540217	3	1/5/2004	Manganese, Total	0.204	mg/L	514020501
8540217	3	1/5/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	1/5/2004	Alkalinity	59	mg/L $CaCO_3$	514020501
8540217	3	1/19/2004	Flow	0.014	cfs	514020501
8540217	3	1/19/2004	pH	6.41	standard units	514020501
8540217	3	1/19/2004	TSS	15	mg/L	514020501
8540217	3	1/19/2004	Iron, Total	1.74	mg/L	514020501
8540217	3	5/4/2009	Flow	0.0432	cfs	514020501
8540217	3	5/4/2009	pH	7.35	standard units	514020501
8540217	3	5/4/2009	TSS	5	mg/L	514020501
8540217	3	5/4/2009	SS	0.2	mg/L	514020501
8540217	3	5/4/2009	Iron, Total	0.07	mg/L	514020501
8540217	3	5/4/2009	Manganese, Total	0.054	mg/L	514020501
8540217	3	5/4/2009	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	5/4/2009	Alkalinity	100	mg/L $CaCO_3$	514020501
8540217	3	5/19/2009	Flow	0.02	cfs	514020501
8540217	3	5/19/2009	pH	7.68	standard units	514020501
8540217	3	5/19/2009	TSS	12	mg/L	514020501
8540217	3	5/19/2009	SS	0.2	mg/L	514020501
8540217	3	5/19/2009	Iron, Total	0.18	mg/L	514020501
8540217	3	5/19/2009	Manganese, Total	0.095	mg/L	514020501
8540217	3	5/19/2009	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	5/19/2009	Alkalinity	87	mg/L $CaCO_3$	514020501
8540217	3	10/6/2009	Flow	0.00144	cfs	514020501
8540217	3	10/6/2009	pH	6.89	standard units	514020501
8540217	3	10/6/2009	TSS	1	mg/L	514020501
8540217	3	10/6/2009	SS	0.2	mg/L	514020501
8540217	3	10/6/2009	Iron, Total	0.02	mg/L	514020501
8540217	3	10/6/2009	Manganese, Total	0.003	mg/L	514020501
8540217	3	10/6/2009	Acidity	20	mg/L $CaCO_3$	514020501
8540217	3	10/6/2009	Alkalinity	9	mg/L $CaCO_3$	514020501
8540217	3	10/15/2009	Flow	0.00144	cfs	514020501
8540217	3	10/15/2009	pH	6.54	standard units	514020501
8540217	3	10/15/2009	TSS	5	mg/L	514020501
8540217	3	10/15/2009	SS	0.2	mg/L	514020501
8540217	3	10/15/2009	Iron, Total	0.02	mg/L	514020501
8540217	3	10/15/2009	Manganese, Total	0.152	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8540217	3	10/15/2009	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	10/15/2009	Alkalinity	87	mg/L $CaCO_3$	514020501
8540217	3	3/8/2004	Iron, Total	0.85	mg/L	514020501
8540217	3	3/8/2004	Manganese, Total	0.622	mg/L	514020501
8540217	3	3/8/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	3/8/2004	Alkalinity	32	mg/L $CaCO_3$	514020501
8540217	3	12/7/2004	Flow	0.0072	cfs	514020501
8540217	3	12/7/2004	pH	6.56	standard units	514020501
8540217	3	12/7/2004	TSS	13	mg/L	514020501
8540217	3	12/7/2004	Iron, Total	0.96	mg/L	514020501
8540217	3	12/7/2004	Manganese, Total	0.28	mg/L	514020501
8540217	3	12/7/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	3	12/7/2004	Alkalinity	28	mg/L $CaCO_3$	514020501
8540217	3	3/13/2006	Flow	0.0216	cfs	514020501
8540217	3	3/13/2006	pH	6.6	standard units	514020501
8540217	3	3/13/2006	TSS	32	mg/L	514020501
8540217	3	3/13/2006	Iron, Total	1.6	mg/L	514020501
8540217	3	1/30/2006	Flow	0.00144	cfs	514020501
8540217	3	3/13/2006	Manganese, Total	0.352	mg/L	514020501
8540217	3	3/13/2006	Acidity	21	mg/L $CaCO_3$	514020501
8540217	3	3/13/2006	Alkalinity	32	mg/L $CaCO_3$	514020501
8540217	3	1/30/2006	pH	7.14	standard units	514020501
8540217	3	1/30/2006	TSS	27	mg/L	514020501
8540217	3	1/30/2006	Iron, Total	0.845	mg/L	514020501
8540217	3	1/30/2006	Manganese, Total	0.045	mg/L	514020501
8540217	3	2/6/2006	Flow	0.00288	cfs	514020501
8540217	3	2/6/2006	pH	6.14	standard units	514020501
8540217	3	2/6/2006	TSS	19	mg/L	514020501
8540217	3	2/6/2006	Iron, Total	0.384	mg/L	514020501
8540217	3	2/6/2006	Manganese, Total	0.045	mg/L	514020501
8540217	3	11/7/2006	Flow	0.036	cfs	514020501
8540217	3	11/7/2006	pH	6.78	standard units	514020501
8540217	3	11/7/2006	TSS	11	mg/L	514020501
8540217	3	11/7/2006	Iron, Total	1.01	mg/L	514020501
8540217	2	12/13/2004	Flow	0.004	cfs	514020501
8540217	2	12/13/2004	pH	7.31	standard units	514020501
8540217	2	12/13/2004	TSS	12	mg/L	514020501
8540217	2	12/13/2004	Iron, Total	0.7839	mg/L	514020501

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8540217	2	12/13/2004	Manganese, Total	0.422	mg/L	514020501
8540217	2	12/13/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	12/13/2004	Alkalinity	129	mg/L $CaCO_3$	514020501
8540217	2	3/6/2006	Flow	0.00036	cfs	514020501
8540217	2	3/6/2006	pH	6.93	standard units	514020501
8540217	2	3/6/2006	TSS	5	mg/L	514020501
8540217	2	3/6/2006	Iron, Total	0.444	mg/L	514020501
8540217	2	3/6/2006	Manganese, Total	0.132	mg/L	514020501
8540217	2	3/6/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	3/6/2006	Alkalinity	123	mg/L $CaCO_3$	514020501
8540217	2	3/13/2006	Flow	0.036	cfs	514020501
8540217	2	3/13/2006	pH	6.55	standard units	514020501
8540217	2	3/13/2006	TSS	40	mg/L	514020501
8540217	2	3/13/2006	Iron, Total	1.7	mg/L	514020501
8540217	2	3/13/2006	Manganese, Total	0.176	mg/L	514020501
8540217	2	4/1/2003	Manganese, Total	0.0976	mg/L	514020501
8540217	2	4/1/2003	Flow	0.007	cfs	514020501
8540217	2	4/1/2003	pH	7.29	standard units	514020501
8540217	2	4/1/2003	TSS	4	mg/L	514020501
8540217	2	4/1/2003	Iron, Total	0.772	mg/L	514020501
8540217	2	4/1/2003	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/1/2003	Alkalinity	123	mg/L $CaCO_3$	514020501
8540217	2	4/21/2003	Flow	0.0007	cfs	514020501
8540217	2	4/21/2003	pH	6.84	standard units	514020501
8540217	2	4/21/2003	TSS	2	mg/L	514020501
8540217	2	4/21/2003	Iron, Total	0.698	mg/L	514020501
8540217	2	4/21/2003	Manganese, Total	0.466	mg/L	514020501
8540217	2	4/21/2003	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/21/2003	Alkalinity	130	mg/L $CaCO_3$	514020501
8540217	2	5/5/2003	Flow	0.021	cfs	514020501
8540217	2	5/5/2003	pH	7.23	standard units	514020501
8540217	2	5/5/2003	TSS	9	mg/L	514020501
8540217	2	5/5/2003	Iron, Total	0.535	mg/L	514020501
8540217	2	5/5/2003	Manganese, Total	0.364	mg/L	514020501
8540217	2	5/5/2003	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/5/2003	Alkalinity	117	mg/L $CaCO_3$	514020501
8540217	2	5/19/2003	Flow	0.005	cfs	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	2	5/19/2003	pH	7.17	standard units	514020501
8540217	2	5/19/2003	TSS	8	mg/L	514020501
8540217	2	5/19/2003	Iron, Total	0.934	mg/L	514020501
8540217	2	10/2/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	10/2/2006	Alkalinity	140	mg/L $CaCO_3$	514020501
8540217	2	11/7/2006	Flow	0.0864	cfs	514020501
8540217	2	11/7/2006	pH	6.74	standard units	514020501
8540217	2	11/7/2006	TSS	12	mg/L	514020501
8540217	2	11/7/2006	Iron, Total	1.2	mg/L	514020501
8540217	2	11/7/2006	Manganese, Total	0.204	mg/L	514020501
8540217	2	11/7/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	11/7/2006	Alkalinity	107	mg/L $CaCO_3$	514020501
8540217	2	11/20/2006	Flow	0.006	cfs	514020501
8540217	2	11/20/2006	pH	6.28	standard units	514020501
8540217	2	11/20/2006	TSS	9	mg/L	514020501
8540217	2	11/20/2006	Iron, Total	1.09	mg/L	514020501
8540217	2	11/20/2006	Manganese, Total	0.249	mg/L	514020501
8540217	2	11/20/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	11/20/2006	Alkalinity	110	mg/L $CaCO_3$	514020501
8540217	2	12/4/2006	Flow	0.00576	cfs	514020501
8540217	2	12/4/2006	pH	6.74	standard units	514020501
8540217	2	12/4/2006	TSS	11	mg/L	514020501
8540217	2	5/19/2003	Manganese, Total	0.38	mg/L	514020501
8540217	2	5/19/2003	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/19/2003	Alkalinity	139	mg/L $CaCO_3$	514020501
8540217	2	3/1/2004	Iron, Total	0.707	mg/L	514020501
8540217	2	3/1/2004	Flow	0.003	cfs	514020501
8540217	2	3/1/2004	pH	7.52	standard units	514020501
8540217	2	3/1/2004	TSS	5	mg/L	514020501
8540217	2	3/1/2004	Manganese, Total	0.34	mg/L	514020501
8540217	2	3/1/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	3/1/2004	Alkalinity	125	mg/L $CaCO_3$	514020501
8540217	2	1/5/2004	Flow	0.158	cfs	514020501
8540217	2	1/5/2004	pH	6.87	standard units	514020501
8540217	2	1/5/2004	TSS	48	mg/L	514020501
8540217	2	1/5/2004	Iron, Total	3.81	mg/L	514020501
8540217	2	1/5/2004	Manganese, Total	0.527	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	2	1/5/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	1/5/2004	Alkalinity	107	mg/L $CaCO_3$	514020501
8540217	2	1/19/2004	Flow	0.021	cfs	514020501
8540217	2	1/19/2004	pH	7.01	standard units	514020501
8540217	2	1/19/2004	TSS	21	mg/L	514020501
8540217	2	1/19/2004	Iron, Total	2.61	mg/L	514020501
8540217	2	1/19/2004	Manganese, Total	0.463	mg/L	514020501
8540217	2	1/19/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	1/19/2004	Alkalinity	124	mg/L $CaCO_3$	514020501
8540217	2	2/12/2004	Flow	0.011	cfs	514020501
8540217	2	2/12/2004	pH	6.69	standard units	514020501
8540217	2	2/12/2004	TSS	9	mg/L	514020501
8540217	2	2/12/2004	Iron, Total	2.77	mg/L	514020501
8540217	2	2/12/2004	Manganese, Total	1.25	mg/L	514020501
8540217	2	2/12/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	2/12/2004	Alkalinity	130	mg/L $CaCO_3$	514020501
8540217	2	3/8/2004	Flow	0.007	cfs	514020501
8540217	2	3/8/2004	pH	7.345	standard units	514020501
8540217	2	3/8/2004	TSS	10	mg/L	514020501
8540217	2	3/8/2004	Iron, Total	1.77	mg/L	514020501
8540217	2	3/8/2004	Manganese, Total	0.72	mg/L	514020501
8540217	2	3/8/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	3/8/2004	Alkalinity	139	mg/L $CaCO_3$	514020501
8540217	2	12/7/2004	Iron, Total	1.73	mg/L	514020501
8540217	2	12/7/2004	Flow	0.0173	cfs	514020501
8540217	2	12/7/2004	pH	6.63	standard units	514020501
8540217	2	12/7/2004	TSS	35	mg/L	514020501
8540217	2	12/7/2004	Manganese, Total	0.246	mg/L	514020501
8540217	2	12/7/2004	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	12/7/2004	Alkalinity	86	mg/L $CaCO_3$	514020501
8540217	2	3/5/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	3/19/2007	Flow	0.00144	cfs	514020501
8540217	2	3/19/2007	pH	6.75	standard units	514020501
8540217	2	3/19/2007	TSS	4	mg/L	514020501
8540217	2	3/19/2007	Iron, Total	0.319	mg/L	514020501
8540217	2	3/19/2007	Manganese, Total	0.108	mg/L	514020501
8540217	2	3/19/2007	Acidity	1	mg/L $CaCO_3$	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	2	3/19/2007	Alkalinity	114	mg/L $CaCO_3$	514020501
8540217	2	4/2/2007	Flow	0.01728	cfs	514020501
8540217	2	4/2/2007	pH	6.65	standard units	514020501
8540217	2	4/2/2007	TSS	15	mg/L	514020501
8540217	2	4/2/2007	Iron, Total	0.876	mg/L	514020501
8540217	2	4/2/2007	Manganese, Total	1.37	mg/L	514020501
8540217	2	4/2/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/2/2007	Alkalinity	86	mg/L $CaCO_3$	514020501
8540217	2	4/9/2007	Flow	0.00144	cfs	514020501
8540217	2	4/9/2007	pH	6.93	standard units	514020501
8540217	2	4/9/2007	TSS	4	mg/L	514020501
8540217	2	4/9/2007	Iron, Total	0.615	mg/L	514020501
8540217	2	3/13/2006	Acidity	12	mg/L $CaCO_3$	514020501
8540217	2	3/13/2006	Alkalinity	76	mg/L $CaCO_3$	514020501
8540217	2	1/26/2006	Flow	0.00432	cfs	514020501
8540217	2	1/26/2006	pH	6.67	standard units	514020501
8540217	2	1/26/2006	TSS	17	mg/L	514020501
8540217	2	1/26/2006	Iron, Total	1.29	mg/L	514020501
8540217	2	1/26/2006	Manganese, Total	0.224	mg/L	514020501
8540217	2	2/6/2006	Flow	0.00864	cfs	514020501
8540217	2	2/6/2006	pH	6.26	standard units	514020501
8540217	2	2/6/2006	TSS	11	mg/L	514020501
8540217	2	2/6/2006	Iron, Total	0.631	mg/L	514020501
8540217	2	2/6/2006	Manganese, Total	0.202	mg/L	514020501
8540217	2	9/25/2006	Iron, Total	1.51	mg/L	514020501
8540217	2	9/25/2006	Flow	0.01152	cfs	514020501
8540217	2	9/25/2006	pH	6.58	standard units	514020501
8540217	2	9/25/2006	TSS	46	mg/L	514020501
8540217	2	9/25/2006	Manganese, Total	0.564	mg/L	514020501
8540217	2	9/25/2006	Acidity	27	mg/L $CaCO_3$	514020501
8540217	2	9/25/2006	Alkalinity	93	mg/L $CaCO_3$	514020501
8540217	2	4/3/2006	Iron, Total	0.409	mg/L	514020501
8540217	2	4/3/2006	Flow	0.00036	cfs	514020501
8540217	2	4/3/2006	pH	7.1	standard units	514020501
8540217	2	4/3/2006	TSS	7	mg/L	514020501
8540217	2	4/3/2006	Manganese, Total	1.44	mg/L	514020501
8540217	2	4/3/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/3/2006	Alkalinity	139	mg/L $CaCO_3$	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	2	5/1/2006	Flow	0.0072	cfs	514020501
8540217	2	5/1/2006	pH	7.06	standard units	514020501
8540217	2	5/1/2006	TSS	9	mg/L	514020501
8540217	2	5/1/2006	Iron, Total	0.294	mg/L	514020501
8540217	2	5/1/2006	Manganese, Total	0.138	mg/L	514020501
8540217	2	5/1/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/1/2006	Alkalinity	93	mg/L $CaCO_3$	514020501
8540217	2	5/11/2006	Flow	0.00864	cfs	514020501
8540217	2	5/11/2006	pH	7.19	standard units	514020501
8540217	2	5/11/2006	TSS	18	mg/L	514020501
8540217	2	5/11/2006	Iron, Total	0.805	mg/L	514020501
8540217	2	5/11/2006	Manganese, Total	0.496	mg/L	514020501
8540217	2	5/11/2006	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/11/2006	Alkalinity	112	mg/L $CaCO_3$	514020501
8540217	2	10/2/2006	Flow	0.00036	cfs	514020501
8540217	2	10/2/2006	pH	7.31	standard units	514020501
8540217	2	10/2/2006	TSS	6	mg/L	514020501
8540217	2	10/2/2006	Iron, Total	0.426	mg/L	514020501
8540217	2	10/2/2006	Manganese, Total	0.181	mg/L	514020501
8540217	2	2/5/2008	Flow	0.01152	cfs	514020501
8540217	2	2/5/2008	pH	6.85	standard units	514020501
8540217	2	2/5/2008	TSS	6	mg/L	514020501
8540217	2	2/5/2008	Iron, Total	0.33	mg/L	514020501
8540217	2	2/5/2008	Manganese, Total	0.227	mg/L	514020501
8540217	2	2/5/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	2/5/2008	Alkalinity	84	mg/L $CaCO_3$	514020501
8540217	2	2/25/2008	Flow	0.01152	cfs	514020501
8540217	2	2/25/2008	pH	6.42	standard units	514020501
8540217	2	2/25/2008	TSS	12	mg/L	514020501
8540217	2	2/25/2008	Iron, Total	0.96	mg/L	514020501
8540217	2	2/25/2008	Manganese, Total	0.213	mg/L	514020501
8540217	2	2/25/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	2/25/2008	Alkalinity	75	mg/L $CaCO_3$	514020501
8540217	2	3/3/2008	Flow	0.00576	cfs	514020501
8540217	2	3/3/2008	pH	6.96	standard units	514020501
8540217	2	3/3/2008	TSS	5	mg/L	514020501
8540217	2	3/3/2008	Iron, Total	0.31	mg/L	514020501
8540217	2	3/3/2008	Manganese, Total	0.127	mg/L	514020501

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8540217	2	12/4/2006	Iron, Total	0.919	mg/L	514020501
8540217	2	12/4/2006	Manganese, Total	0.174	mg/L	514020501
8540217	2	12/4/2006	Acidity	28	mg/L $CaCO_3$	514020501
8540217	2	12/4/2006	Alkalinity	98	mg/L $CaCO_3$	514020501
8540217	2	12/18/2006	Flow	0.003	cfs	514020501
8540217	2	12/18/2006	pH	6.54	standard units	514020501
8540217	2	12/18/2006	TSS	5	mg/L	514020501
8540217	2	12/18/2006	Iron, Total	0.602	mg/L	514020501
8540217	2	12/18/2006	Manganese, Total	0.172	mg/L	514020501
8540217	2	12/18/2006	Acidity	30	mg/L $CaCO_3$	514020501
8540217	2	12/18/2006	Alkalinity	108	mg/L $CaCO_3$	514020501
8540217	2	1/2/2007	Iron, Total	1.1	mg/L	514020501
8540217	2	1/2/2007	Flow	0.00576	cfs	514020501
8540217	2	1/2/2007	pH	6.23	standard units	514020501
8540217	2	1/2/2007	TSS	6	mg/L	514020501
8540217	2	1/2/2007	Manganese, Total	0.339	mg/L	514020501
8540217	2	1/2/2007	Acidity	14	mg/L $CaCO_3$	514020501
8540217	2	1/2/2007	Alkalinity	118	mg/L $CaCO_3$	514020501
8540217	2	1/22/2007	Flow	0.0864	cfs	514020501
8540217	2	1/22/2007	pH	6.21	standard units	514020501
8540217	2	1/22/2007	TSS	23	mg/L	514020501
8540217	2	1/22/2007	Iron, Total	1.93	mg/L	514020501
8540217	2	1/22/2007	Manganese, Total	0.323	mg/L	514020501
8540217	2	1/22/2007	Acidity	19	mg/L $CaCO_3$	514020501
8540217	2	1/22/2007	Alkalinity	87	mg/L $CaCO_3$	514020501
8540217	2	2/6/2007	Flow	0.00288	cfs	514020501
8540217	2	2/6/2007	pH	6.97	standard units	514020501
8540217	2	2/6/2007	TSS	4	mg/L	514020501
8540217	2	2/6/2007	Iron, Total	0.291	mg/L	514020501
8540217	2	2/6/2007	Manganese, Total	0.634	mg/L	514020501
8540217	2	2/6/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	2/6/2007	Alkalinity	144	mg/L $CaCO_3$	514020501
8540217	2	2/19/2007	Flow	0.009	cfs	514020501
8540217	2	2/19/2007	pH	6.9	standard units	514020501
8540217	2	2/19/2007	TSS	14	mg/L	514020501
8540217	2	2/19/2007	Iron, Total	1.5	mg/L	514020501
8540217	2	2/19/2007	Manganese, Total	0.306	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[(1)]	Result	Units	CHIA Report No.
8540217	2	2/19/2007	Acidity	38	mg/L $CaCO_3$	514020501
8540217	2	2/19/2007	Alkalinity	122	mg/L $CaCO_3$	514020501
8540217	2	3/5/2007	Flow	0.00432	cfs	514020501
8540217	2	3/5/2007	pH	7.2	standard units	514020501
8540217	2	3/5/2007	TSS	13	mg/L	514020501
8540217	2	3/5/2007	Alkalinity	106	mg/L $CaCO_3$	514020501
8540217	2	3/5/2007	Iron, Total	0.716	mg/L	514020501
8540217	2	3/5/2007	Manganese, Total	0.093	mg/L	514020501
8540217	2	6/16/2008	TSS	2	mg/L	514020501
8540217	2	6/16/2008	SS	0.2	mg/L	514020501
8540217	2	6/16/2008	Iron, Total	0.4	mg/L	514020501
8540217	2	6/16/2008	Manganese, Total	0.182	mg/L	514020501
8540217	2	6/16/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	6/16/2008	Alkalinity	87	mg/L $CaCO_3$	514020501
8540217	2	12/26/2008	Flow	0.00144	cfs	514020501
8540217	2	12/26/2008	pH	7.53	standard units	514020501
8540217	2	12/26/2008	TSS	6	mg/L	514020501
8540217	2	12/26/2008	SS	0.2	mg/L	514020501
8540217	2	12/26/2008	Iron, Total	0.43	mg/L	514020501
8540217	2	12/26/2008	Manganese, Total	0.35	mg/L	514020501
8540217	2	12/26/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	12/26/2008	Alkalinity	97	mg/L $CaCO_3$	514020501
8540217	2	5/4/2009	Flow	0.0432	cfs	514020501
8540217	2	5/4/2009	pH	7.6	standard units	514020501
8540217	2	5/4/2009	TSS	16	mg/L	514020501
8540217	2	5/4/2009	SS	0.2	mg/L	514020501
8540217	2	5/4/2009	Iron, Total	0.41	mg/L	514020501
8540217	2	4/9/2007	Manganese, Total	0.119	mg/L	514020501
8540217	2	4/9/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/9/2007	Alkalinity	90	mg/L $CaCO_3$	514020501
8540217	2	5/7/2007	Flow	0.00288	cfs	514020501
8540217	2	5/7/2007	pH	6.84	standard units	514020501
8540217	2	5/7/2007	TSS	5	mg/L	514020501
8540217	2	5/7/2007	Iron, Total	0.946	mg/L	514020501
8540217	2	5/7/2007	Manganese, Total	1.98	mg/L	514020501
8540217	2	5/7/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/7/2007	Alkalinity	122	mg/L $CaCO_3$	514020501

Permit Number	Station	Sample Date	Parameter(1)	Result	Units	CHIA Report No.
8540217	2	11/26/2007	Flow	0.036	cfs	514020501
8540217	2	11/26/2007	pH	6.46	standard units	514020501
8540217	2	11/26/2007	TSS	8	mg/L	514020501
8540217	2	11/26/2007	Iron, Total	0.58	mg/L	514020501
8540217	2	11/26/2007	Manganese, Total	0.637	mg/L	514020501
8540217	2	11/26/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	11/26/2007	Alkalinity	108	mg/L $CaCO_3$	514020501
8540217	2	12/3/2007	Flow	0.0576	cfs	514020501
8540217	2	12/3/2007	pH	6.53	standard units	514020501
8540217	2	12/3/2007	TSS	22	mg/L	514020501
8540217	2	12/3/2007	Iron, Total	1.08	mg/L	514020501
8540217	2	12/3/2007	Manganese, Total	0.425	mg/L	514020501
8540217	2	12/3/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	12/3/2007	Alkalinity	98	mg/L $CaCO_3$	514020501
8540217	2	12/17/2007	Flow	0.036	cfs	514020501
8540217	2	12/17/2007	pH	6.44	standard units	514020501
8540217	2	12/17/2007	TSS	11	mg/L	514020501
8540217	2	12/17/2007	Iron, Total	0.7	mg/L	514020501
8540217	2	12/17/2007	Manganese, Total	0.204	mg/L	514020501
8540217	2	12/17/2007	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	12/17/2007	Alkalinity	66	mg/L $CaCO_3$	514020501
8540217	2	1/7/2008	Iron, Total	0.47	mg/L	514020501
8540217	2	1/7/2008	Flow	0.00432	cfs	514020501
8540217	2	1/7/2008	pH	6.53	standard units	514020501
8540217	2	1/7/2008	TSS	5	mg/L	514020501
8540217	2	1/7/2008	Manganese, Total	0.43	mg/L	514020501
8540217	2	1/7/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	1/7/2008	Alkalinity	100	mg/L $CaCO_3$	514020501
8540217	2	1/22/2008	Flow	0.00432	cfs	514020501
8540217	2	1/22/2008	pH	6.57	standard units	514020501
8540217	2	1/22/2008	TSS	10	mg/L	514020501
8540217	2	1/22/2008	Iron, Total	0.3	mg/L	514020501
8540217	2	1/22/2008	Manganese, Total	0.269	mg/L	514020501
8540217	2	1/22/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	1/22/2008	Alkalinity	150	mg/L $CaCO_3$	514020501
8540217	2	5/4/2009	Manganese, Total	0.599	mg/L	514020501
8540217	2	5/4/2009	Acidity	1	mg/L $CaCO_3$	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	2	5/4/2009	Alkalinity	206	mg/L $CaCO_3$	514020501
8540217	2	5/19/2009	Flow	0.014	cfs	514020501
8540217	2	5/19/2009	pH	7.62	standard units	514020501
8540217	2	5/19/2009	TSS	35	mg/L	514020501
8540217	2	5/19/2009	SS	0.2	mg/L	514020501
8540217	2	5/19/2009	Iron, Total	0.34	mg/L	514020501
8540217	2	5/19/2009	Manganese, Total	0.208	mg/L	514020501
8540217	2	5/19/2009	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/19/2009	Alkalinity	87	mg/L $CaCO_3$	514020501
8540217	2	7/7/2009	Flow	0.00144	cfs	514020501
8540217	2	7/7/2009	pH	6.37	standard units	514020501
8540217	2	7/7/2009	TSS	111	mg/L	514020501
8540217	2	7/7/2009	SS	0.2	mg/L	514020501
8540217	2	7/7/2009	Iron, Total	0.38	mg/L	514020501
8540217	2	7/7/2009	Manganese, Total	2.45	mg/L	514020501
8540217	2	7/7/2009	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	7/7/2009	Alkalinity	160	mg/L $CaCO_3$	514020501
8540217	2	3/3/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	3/3/2008	Alkalinity	95	mg/L $CaCO_3$	514020501
8540217	2	3/10/2008	Flow	0.0864	cfs	514020501
8540217	2	3/10/2008	pH	6.79	standard units	514020501
8540217	2	3/10/2008	TSS	10	mg/L	514020501
8540217	2	3/10/2008	Iron, Total	0.6	mg/L	514020501
8540217	2	3/10/2008	Manganese, Total	0.44	mg/L	514020501
8540217	2	3/10/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	3/10/2008	Alkalinity	99	mg/L $CaCO_3$	514020501
8540217	2	4/1/2008	Flow	0.18	cfs	514020501
8540217	2	4/1/2008	pH	7.11	standard units	514020501
8540217	2	4/1/2008	TSS	25	mg/L	514020501
8540217	2	4/1/2008	Iron, Total	2.22	mg/L	514020501
8540217	2	4/1/2008	Manganese, Total	0.306	mg/L	514020501
8540217	2	4/1/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/1/2008	Alkalinity	108	mg/L $CaCO_3$	514020501
8540217	2	4/7/2008	pH	6.43	standard units	514020501
8540217	2	4/7/2008	TSS	5	mg/L	514020501
8540217	2	4/7/2008	Iron, Total	0.51	mg/L	514020501
8540217	2	4/7/2008	Manganese, Total	0.452	mg/L	514020501

Permit Number	Station	Sample Date	Parameter[1]	Result	Units	CHIA Report No.
8540217	2	4/7/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/7/2008	Alkalinity	112	mg/L $CaCO_3$	514020501
8540217	2	4/22/2008	Flow	0.00432	cfs	514020501
8540217	2	4/22/2008	pH	6.46	standard units	514020501
8540217	2	4/22/2008	TSS	3	mg/L	514020501
8540217	2	4/22/2008	Iron, Total	0.28	mg/L	514020501
8540217	2	4/22/2008	Manganese, Total	0.506	mg/L	514020501
8540217	2	4/22/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	4/22/2008	Alkalinity	92	mg/L $CaCO_3$	514020501
8540217	2	5/6/2008	Flow	0.0072	cfs	514020501
8540217	2	5/6/2008	pH	7.09	standard units	514020501
8540217	2	5/6/2008	TSS	4	mg/L	514020501
8540217	2	5/6/2008	Iron, Total	0.2	mg/L	514020501
8540217	2	5/6/2008	Manganese, Total	0.243	mg/L	514020501
8540217	2	5/6/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/6/2008	Alkalinity	93	mg/L $CaCO_3$	514020501
8540217	2	5/12/2008	Flow	0.036	cfs	514020501
8540217	2	5/12/2008	pH	6.53	standard units	514020501
8540217	2	5/12/2008	TSS	4	mg/L	514020501
8540217	2	5/12/2008	Iron, Total	0.32	mg/L	514020501
8540217	2	5/12/2008	Manganese, Total	0.433	mg/L	514020501
8540217	2	5/12/2008	Acidity	1	mg/L $CaCO_3$	514020501
8540217	2	5/12/2008	Alkalinity	114	mg/L $CaCO_3$	514020501
8540217	2	6/16/2008	Flow	0.00144	cfs	514020501
8540217	2	6/16/2008	pH	6.75	standard units	514020501
8540217	1	5/4/2009	SS	0.2	mg/L	514020501
8540217	1	5/4/2009	Flow	0.0288	cfs	514020501
8540217	1	5/4/2009	pH	7.2	standard units	514020501
8540217	1	5/4/2009	Alkalinity	212	mg/L $CaCO_3$	514020501
8540217	1	5/4/2009	Iron, Total	0.62	mg/L	514020501
8540217	1	5/4/2009	Manganese, Total	0.593	mg/L	514020501
8540217	1	5/4/2009	Acidity	1	mg/L $CaCO_3$	514020501
8540217	1	5/4/2009	TSS	14	mg/L	514020501

Exceeds the chronic WQC for iron.

Exceeds the acute WQC iron.

Iron between 1.0 and 3.5 mg/L--Exceeds the WQC only if discharging to an impaired segment.

Exceeds the pH range of $6.0 \le pH \le 9.0$ standard units.

[1] SO4 = sulfate, SPCON = specific conductance, TDS = total dissolved solids, TSS = total suspended solids.

Appendix C Land Cover Analysis

The landcovers generated by the 2006 NLCD were consolidated for presentation purposes within the report. All forested land (deciduous, evergreen and mixed) and shrubbery was aggregated and reported as one category. Further, all residential landcover area was aggregated and reported as one category; developed land. The NLCD returned small but positive values for three types of residential landcovers—Developed Open Space, Low-Intensity Residential, and High-Intensity Residential. Developed Open Space is a term applied to differing types of landcover; within urban areas it is the designation given to parkland and other green areas. However, in rural watersheds such as the watersheds under study, it denotes residential areas with insufficient density to be classified as Low-Intensity Residential and is mainly composed of single family residences on large lots (James Seay, 2006, Personal Communication). Further descriptions of the NLCD classifications are provided below.

National Land Cover Database Class Descriptions (Homer et al., 2004)

(11) Open Water - All areas of open water, generally with less than 25% cover of vegetation or soil.

(21) Developed, Open Space - Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

(22) Developed, Low Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-49 percent of total cover. These areas most commonly include single-family housing units.

(23) Developed, Medium Intensity - Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-79 percent of the total cover. These areas most commonly include single-family housing units.

(24) Developed, High Intensity - Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100 percent of the total cover.

(31) Barren Land (Rock/Sand/Clay) - Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.

(41) Deciduous Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.

(42) Evergreen Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.

(43) Mixed Forest - Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.

(52) Shrub/Scrub - Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.

(71) Grassland/Herbaceous - Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

(81) Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.

(82) Cultivated Crops - Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.

(90) Woody Wetlands - Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

(95) Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

Appendix D Division of Mine Permits Numbering System

XXXX-XX Permit issued prior to May 3, 1978. Ex. 1357-76. The first four numbers represent the mine number. The last two numbers represent the year of issuance.

XXX-XXXX Permit issued after May 3, 1978. The first three numbers indicate the location of the mine by county and the timing of the original permit issuance (Ex. Hopkins County = 54).

If the first three numbers correspond to the county number, the permit was originally issued during the interim program.

If 200 has been added to the county number, the permit was originally issued prior to May 3, 1978, and carried through into the interim program. Ex. 254 (Hopkins).

If 400 has been added to the county number the permit was issued prior to the Permanent Program and was to remain active after January 18, 1983. Ex. 454 or 654 (Hopkins).

If 800 has been added to the county number: (1) the application is for a permit after January 18, 1983 or (2) two or more previously permitted areas have been combined into a single permit. Ex. 854 (Hopkins).

The last four numbers indicate the type of mining activity being permitted:

COAL

0000-4999	Surface Mining
5000-5999	Underground Mine
6000-6999	Crush/Load Facility
7000-7999	Haul Road Only
8000-8999	Preparation Plant
9000-9399	Refuse Disposal

NON COAL

9400-9499	Limestone
9500-9599	Clay
9600-9699	Sand/Gravel
9700-9799	Oil Shale
9800-9899	Flourspar