EXHIBIT E

CROOKED CREEK
USE ATTAINABILITY ANALYSIS – HARRISON AND YELLEVILLE, ARKANSAS

ftn Associates Ltd.
water resources / environmental consultants

USE ATTAINABILITY ANALYSIS REPORT
CROOKED CREEK
BOONE AND MARION COUNTIES, ARKANSAS

REVISED
JUNE 8, 2015

USE ATTAINABILITY ANALYSIS REPORT
CROOKED CREEK
BOONE AND MARION COUNTIES, ARKANSAS

Prepared for

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EXECUTIVE SUMMARY AND CONCLUSIONS

ES.1 Summary

The City of Harrison, Arkansas, discharges treated wastewater to Crooked Creek under authority of its National Pollutant Discharge Elimination System (NPDES) permit for the Harrison Waste Water Treatment Plant (HWWTP). The HWWTP discharge enters Crooked Creek approximately 73.4 miles upstream of its confluence with the White River. This permit was scheduled for renewal in October 2012. The Arkansas Department of Environmental Quality (ADEQ) is considering future permit limits for dissolved minerals (total dissolved solids [TDS], sulfate, and chloride) in Harrison's permit when it is renewed. A segment of Crooked Creek upstream and downstream of the HWWTP (reach 11010003-049) was listed as impaired for TDS, chloride, and sulfate on the Arkansas 2008 303(d) list (which is the latest EPA-approved list) due to unknown sources. The Arkansas draft 2012 303(d) list also lists the suspected sources of the TDS, chloride, and sulfate impairments as unknown.

Under the authority of its NPDES permit, the City of Yellville, Arkansas, discharges treated wastewater from its WWTP (YWWTP) to Crooked Creek approximately 22.5 miles upstream of its confluence with the White River. The NPDES permit (No. AR0034037) is scheduled for renewal in March 2015. A segment of Crooked Creek downstream of the HWWTP and upstream and downstream of the YWWTP discharge (stream segment 11010003-048) was listed as impaired for TDS, chloride, and sulfate on the Arkansas 2008 303(d) list due to unknown sources. The Arkansas draft 2012 303(d) list also list the suspected sources of the TDS, chloride, and sulfate impairments as unknown.

An analysis of discharge TDS, sulfate, and chloride concentrations for HWWTP and YWWTP revealed that both discharges meet current sulfate and chloride criteria for Crooked Creek (20 mg/L for both sulfate and chloride); however, neither discharge meets the current TDS criterion of 200 mg/L. However, further analysis showed that if permit limits for either city were set to instream criteria for sulfate or chloride due to the impairment listings, neither city would consistently meet such limits. Accordingly, Harrison and Yellville undertook a use attainability analysis (UAA) to evaluate alternatives for meeting anticipated permit limits for minerals.

ES.2 Alternative Evaluations

UAA guidance requires that a technical and economic evaluation be made of possible alternatives to direct discharge of the water. Based on a number of similar evaluations in previous UAAs, the alternatives for management of effluents with elevated dissolved minerals are limited. Three alternatives that have been reviewed for similar applications include: (1) reverse osmosis (RO) treatment of the wastewater, (2) pumping the wastewater to a larger stream that holds the potential for dilution of the minerals, and (3) treatment using a constructed wetland. FTN completed the alternatives evaluation based on previous experience, information from published literature, and from data provided by the city.

Treatment using a constructed wetlands was dismissed for both facilities due the fact that constructed wetlands could only be used to reduce sulfate in the discharges, but not TDS or chloride. A reduction in sulfate would result in the production of bicarbonate in place of sulfate (Hedin et al. 1989), resulting in no net reduction in TDS. In addition, wetland treatment would have no effect on TDS as calcium, sodium, bicarbonate, or chloride (Hedin et al. 1989), which comprise, on average, 54% of the HWWTP discharge TDS (see Section 4.3). Similarly, calcium, sodium, bicarbonate, and chloride comprise an average of 79% of the TDS of the YWWTP discharge and would be virtually unaffected by wetland treatment.

The remaining analysis focused (1) RO treatment to remove or reduce dissolved minerals; and (2) pumping the wastewater to a larger stream that holds the potential for dilution of the minerals. Tables ES.1 and ES.2 provide cost estimates for the direct discharge option and the two alternative options for the HWWTP and YWWTP, respectively.

Table ES.1. Summary of capital, operating, and implementation costs for various options to attain compliance with permit limits for the Harrison WWTP.

Option Description	Estimated Capital Cost	Estimated Annual Operating Cost	Implementation Cost
Discharge to Crooked Creek	--	--	$150,000
RO Treatment	$5,600,000	$5,950,000	--
Pipeline to White River	$24,000,000	$150,000	--

Table ES.2. Summary of capital, operating, and implementation costs for various options to attain compliance with permit limits for the Yellville WWTP.

Option Description	Estimated Capital Cost	Estimated Annual Operating Cost	Implementation Cost
Discharge to Crooked Creek	--	--	$150,000
RO Treatment	$2,250,000	$375,000	--
Pipeline to White River	$3,400,000	$100,000	--

The capital costs and annual operating costs associated with both alternative options are prohibitively expensive, indicating that the most cost-effective option for the HWWTP and YWWTP discharges is direct discharge. Implementing this option, however, will require modified water quality standards for TDS, sulfate, and chloride in Crooked Creek. Section 8.0 provides more information with regard to the alternatives analysis.

ES.3 Use Analysis

The use attainability analysis indicated that the existing mineral regime is supporting the primary contact recreation, secondary contact recreation, drinking water supply, industrial water supply, and agricultural water supply designated uses. With regard to the fisheries (aquatic life) use, the results of the analysis of biological communities can be summarized as follows:

1. Both outfalls have a minor impact on downstream TDS, sulfate, and chloride concentrations;
2. Habitat evaluations indicated very similar habitat upstream and downstream of the YWWTP. Discharge data collected in the immediate vicinity of the macroinvertebrate sampling locations also show similar depths and velocities upstream and downstream. Based on the habitat evaluations, Wolman pebble counts, and flow transect data, it was concluded that habitat is not a likely cause of the observed impairment of the downstream macroinvertebrate assemblage compared to the upstream assemblage and to least-disturbed ecoregion reference conditions;
3. There is no discernible adverse impact on fish communities in Crooked Creek due to the presence of the HWWTP. Because the impact of the YWWTP on downstream water quality is similar to that of the HWWTP, it is likely that the YWWTP water quality has a similarly negligible adverse impact on the downstream fish communities;

4. Spring samples upstream versus downstream of the discharges show no significant impairment to moderate impairment of the benthic community in the downstream reaches (see Table 7.7). However, the magnitude and timing of the TDS, sulfate, and chloride increases downstream of the discharges are not commensurate with the downstream changes in the benthic macroinvertebrate communities;

5. A total of five independent biological samples (two macrobenthic samples with two duplicates, and one fish sample) were collected in the upstream and downstream reaches of the HWWTP. Three of the five (two macrobenthic and the fish sample) showed no impairment, and the remaining two showed slight downstream impairment. These results are consistent with similar habitat characteristics in the upstream and downstream reaches. For example, percent algal cover, which would be expected to respond to differences in water quality due to the discharges, did not change from upstream to downstream. Therefore, the HWWTP has only minimal effects on the biology in the downstream reach; and

6. TDS concentrations exceed the Crooked Creek site-specific criterion at all locations, including those upstream of the HWWTP and YWWTP discharges. Based on data collected during the study, sulfate and chloride values rarely exceeded the Crooked Creek criteria. Benthic macroinvertebrate communities show moderate to slight impairment when compared to communities in least-disturbed streams. TDS concentrations in the least-disturbed streams considered in this study were similar or higher and also exceeded the Crooked Creek site-specific criterion. Therefore, the existing minerals concentrations in Crooked Creek, including those due to input from the HWWTP and YWWTP, can be expected to support Ozark Highland ecoregion least-disturbed benthic macroinvertebrate communities.

These findings demonstrate conclusively that the modest increases in TDS, sulfate, and chloride concentrations downstream of the HWWTP and YWWTP outfalls do not cause adverse impacts to aquatic life, and also demonstrate that the existing TDS concentrations in the Crooked Creek reaches upstream and downstream of the HWWTP and YWWTP do not limit benthic macroinvertebrate communities and can be expected to support the Ozark Highland fisheries designated use.

ES.4 Proposed Criteria

Proposed criteria are based on existing mineral conditions in Crooked Creek. Existing conditions were based on available monitoring data from ADEQ ambient monitoring of Crooked Creek. Because the 2008 Arkansas 303(d) list is the latest EPA-approved list (which evaluated data from the 2002 to 2007 date range), data from the past 10 years were examined for each of the ADEQ monitoring stations shown on Figure ES.1. Appendix G provides the ADEQ historical monitoring data for those monitoring stations. Ninety-fifth percentile values for each of the ADEQ monitoring stations are provided in Table ES.3.

Table ES.3. Ninety-fifth percentile values of ADEQ historical monitoring data for dissolved minerals in Crooked Creek.

	95th Percentile Values at ADEQ Monitoring Station (mg/L)					
Parameter	**WHI0200**	**WHI0067**	**WHI0066**	**WHI0048A/ WHI0193[a]**	**WHI0048B**	**WHI0048C**
TDS	226	233	269	226	221	238
Sulfate	11.6	9.4	24.4	9.4	7.6	10.2
Chloride	8.3	11.3	22.6	10.7	7.6	7.9
Period of Record[b]	11/28/2011 07/30/2013[c]	08/05/2003 07/30/2013[d]	08/05/2003 07/30/2013[d]	08/19/2003 07/09/2013[d]	12/09/2003 06/04/2013[d]	12/09/2003 06/04/2013[d]

Notes:

(a) ADEQ discontinued monitoring at WHI0048A and moved the sampling point upstream from Yellville to WHI0193.

(b) Date range queried was from August 1, 2003, to July 31, 2013, on ADEQ surface water quality monitoring data search page (http://www.adeq.state.ar.us/techsvs/water_quality/water_quality_station.asp, accessed August 20, 2013).

(c) Represents the full period of record for this station.

(d) Actual date range of data obtained from the search query for this station.

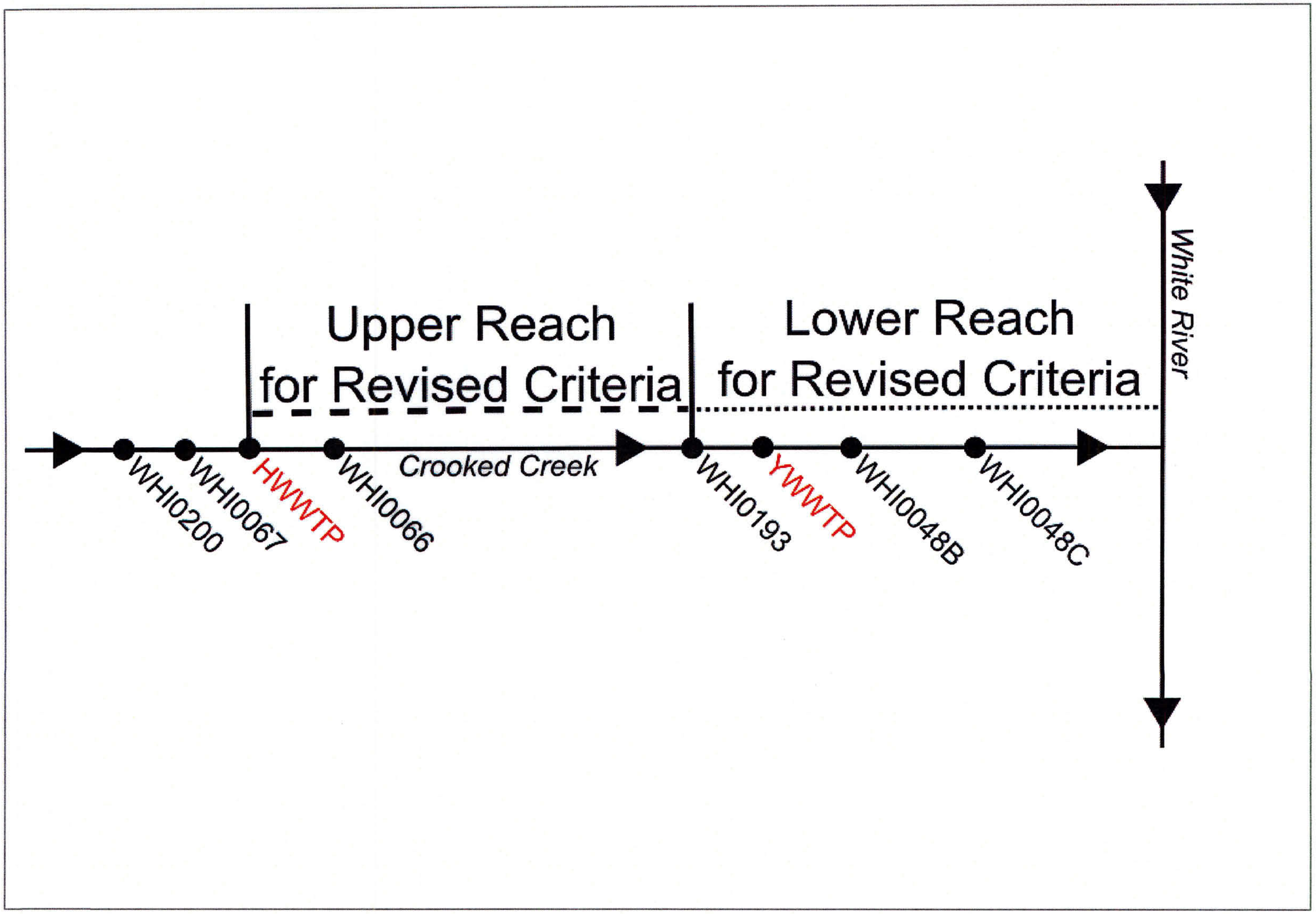

Figure ES.1. Schematic diagram of outfalls, ADEQ monitoring stations, and upper and lower reaches for revised criteria.

The proposed revised site-specific criteria (Table ES.4) are based on the values in Table ES.3 as described below for the following two reaches of Crooked Creek:

1. Upper Reach (Figure ES.1): From the HWWTP to ADEQ monitoring station WHI0193. The proposed revised TDS, sulfate, and chloride criteria for this reach (Table ES.4) are the highest of the 95th percentile values from stations WHI0066 and WHI0193 (Table ES.3).
2. Lower Reach (Figure ES.1): From ADEQ monitoring station WHI0193 to the mouth of Crooked Creek at the White River. The proposed revised TDS criterion for this reach (Table ES.4) is the highest of the 95th percentile values from stations WHI0048B and WHI0048C (Table ES.3). There are no proposed changes to the sulfate and chloride criteria in the lower reach.

Table ES.4. Proposed criteria for dissolved minerals in Crooked Creek.

Stream Reach	Existing Criteria			Proposed Criteria		
	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Upstream reach (from HWWTP to WHI0193)	20	20	200	22.6	24.4	269
Downstream reach (from WHI0193 to mouth of Crooked Creek)	20	20	200	No change	No change	238

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Photo A.4. HWWTP Outfall 001 on April 2, 2013.

Photo A.5. CC-1 on September 19, 2012.

Photo A.6. CC-1 on April 2, 2013.

Photo A.7. CC-2 on September 19, 2012.

Photo A.8. CC-2 on April 3, 2013.

Photo A.9. YWWTP Outfall 001 on September 19, 2012.

Photo A.10. YWWTP Outfall 001 on April 3, 2013.

Photo A.11. CC-3 on April 3, 2013.

APPENDIX B

Biweekly Sampling Data

Table B.1. Biweekly sampling results from Highway 65 bridge (upstream of HWWTP).

Sampling Date	Alkalinity (as $CaCO_3$) (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Bicarbonate (mg/L)	Total Ca (mg/L)	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Hardness (as $CaCO_3$) (mg/L)
5/10/2012	177	266	7.44	4.41	106.00	71.6	1.76	3.41	1.24	179
5/21/2012		207	6.45	3.97						
6/5/2012		242	6.52	3.95						
6/21/2012		250	6.54	4.08						
7/5/2012		232	7.07	4.43						
7/17/2012	160	244	6.45	4.08	97	67.2	1.84	3.14	1.36	168
7/31/2012		213	6.82	4.62						
8/16/2012		197	7.55	4.74						
8/30/2012		182	7.89	4.81						
9/11/2012	159	179	6.89	4.84	96	66.8	1.97	3.47	1.27	167
9/24/2012		207	7.59	5.93						
10/8/2012		227	7.68	5.14						
10/22/2012		205	7.31	4.97						
11/5/2012		208	7.04	5.13						
11/20/2012	166	182	7.42	4.72	100	71.4	1.94	3.79	1.46	178
12/3/2012		215	7.72	5.21						
12/18/2012		219	8.12	5.37						
1/3/2013	210	210	8.64	5.26						
1/14/2012	146	188	6.93	4.93	88	66.4	1.86	3.84	1.32	166
1/28/2013		188	7.94	6.9						
2/11/2013		196	6.79	7.08						
2/28/2013		155	7.2	9.61						
3/13/2013		160	6.59	8.45						
3/26/2013	109	147	6.57	9.79	66	52.4	1.85	3.63	1.18	131
4/11/2013		184	7.5	8.49						
4/23/2013		196	6.51	8.17						

Table B.2. Biweekly sampling results from HWWTP discharge.

Sampling Date	Alkalinity (as $CaCO_3$) (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Bicarbonate (mg/L)	Total Ca (mg/L)	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Hardness (as $CaCO_3$) (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	NO_3+ NO_2 (mg/L)
5/10/2012*	174	294	9.03	6.31	105	71.6	1.77	3.89	1.31	186			
5/21/2012*		220	6.71	4.1									
6/5/2012*		263	7.46	4.51									
6/21/2012*		242	6.97	4.52									
7/5/2012*		216	7.5	4.92									
7/17/2012*	155	244	6.81	4.46	94	65.4	1.79	3.71	1.46	171			
7/31/2012		411	54.2	59.7									
8/16/2012		373	59	63.3									
8/30/2012		387	68	77.8									
9/11/2012	40	338	57.6	42.8	24	42.9	2.84	40.7	13.5	119			
9/24/2012		417	59.9	54									
10/8/2012		438	59.3	58.4									
10/22/2012		324	55.5	41.4							22.5	0.142	22.6
11/5/2012		352	61	56.6							20.7	<0.100	20.7
11/20/2012	31	331	57.7	60.8	19	43.3	3.58	62.1	12.7	123	22.3	<0.100	22.3
12/3/2012		382	63.8	73									
12/18/2012		350	61.4	53.2									
1/3/2013	210	334	56.6	42.6							18.6	<0.1	18.6
1/14/2013	37	297	47.5	43.9	22	40.8	3.22	44.6	10.1	115	15.2	<0.100	15.2
1/28/2013		315	59	63							15.4	<0.100	15.4
2/11/2013		235	41.4	35.4							15.2	<0.100	15.2
2/28/2013		267	42.7	37.4							3.38	0.26	3.64
3/13/2013		265	36.9	49.9							5.6	0.142	5.74
3/26/2013	69	288	40.4	46	42	45.9	2.91	40.5	8.07	127	12.2	<0.100	12.2
4/11/2013		349	54.8	77.9							7.16	<0.100	7.16
4/23/2013		301	45.9	55.6							1.47	0.501	1.97

* Samples collected from instream and not included in statistical summaries.

Table B.3. Biweekly sampling results from Silver Valley Bridge (downstream of HWWTP).

Sampling Date	Alkalinity (as $CaCO_3$) (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Bicarbonate (mg/L)	Total Ca (mg/L)	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Hardness (as $CaCO_3$) (mg/L)
5/10/2012	173	242	10.7	8.51	104.00	69.2	1.80	6.05	1.68	165.55
5/21/2012		230	9.44	7.14						
6/5/2012		268	10.9	7.62						
6/21/2012		243	9.5	8.05						
7/5/2012		227	10.1	9.27						
7/17/2012	148	255	9.56	7.42	89	63.1	1.94	7.44	2.22	
7/31/2012		252	15.7	14.4						
8/16/2012		232	16.8	14.9						
8/30/2012		228	19.2	18.6						
9/11/2012	149	213	10.6	7.63	90	63.5	1.99	6.32	2.07	166.754
9/24/2012		249	18.1	15.7						
10/8/2012		251	14	14						
10/22/2012		219	13	9.12						
11/5/2012		213	11.3	9.47						
11/20/2012	156	216	12.1	8.99	94	70	2.11	7.96	2.27	183.479
12/3/2012		222	13.4	12.1						
12/18/2012		223	13.2	9.81						
1/3/2013	210	246	13.8	8.14						
1/14/2013	129	196	12.3	9.62	78	58.4	1.91	8.52	2.3	153.69
1/28/2013		209	12.4	11.2						
2/11/2013		204	9.76	9.06						
2/28/2013		162	10.2	10.9						
3/13/2013		163	8.65	9.97						
3/26/2013	113	165	9.49	11.8	68	55.1	1.97	6.17	1.62	145.697
4/11/2013		197	10.7	11.4						
4/23/2013		207	9.89	10.9						

Table B.4. Biweekly sampling results from Arkansas Highway 14 bridge (upstream of YWWTP).

Sampling Date	Alkalinity (as $CaCO_3$) (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Bicarbonate (mg/L)	Total Ca (mg/L)	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Hardness (as $CaCO_3$) (mg/L)
9/24/2012		-	-	-						
10/8/2012		-	-	-						
10/19/2012		179	8.63	7.78						
11/5/2012		-	-	-						
11/19/2012		-	-	-						
12/3/2012		-	-	-						
12/17/2012		-	-	-						
1/2/2013		183	9.1	8.82						
1/14/2013	161	194	8.16	9.23	97	56.7	10.1	4.05	1.59	183.172
1/29/2013		207	8.46	9.11						
2/11/2013		210	6.51	8.94						
2/26/2013		170	5.75	7.72						
3/11/2013		157	5.12	6.91						
3/25/2013	167	207	6.12	7.42	101	64.3	9.48	3.28	1.33	199.596
4/8/2013		210	6.18	7.61						

*Note: Consistent flow was not observed in this reach of Crooked Creek until January 2013.

Table B.5. Biweekly sampling results from YWWTP.

Sampling Date	Alkalinity (as $CaCO_3$) (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Bicarbonate (mg/L)	Total Ca (mg/L)	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Hardness (as $CaCO_3$) (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	NO_3+ NO_2 (mg/L)
9/24/2012		328	36.9	23.1									
10/8/2012		347	38.6	19									
10/19/2012		307	28.9	21.7									
11/5/2012		254	39.3	20.2									
11/19/2012	181	293	39.2	19.2	110	44.6	18	25.1	7.82	185			
12/3/2012		276	43.1	18.7									
12/17/2012		292	42.4	22.3							0.723	<0.100	0.723
1/2/2013		280	43.2	26.5							1.35	<0.100	1.35
1/14/2013	217	309	39.7	26	132	51.7	20.6	30.2	9.67	214	0.601	<0.100	0.601
1/29/2013		312	39.3	24.5							0.405	<0.100	0.405
2/11/2013		301	18.6	30							<0.100	<0.100	<0.100
2/26/2013		261	22.4	27.1							1.86	<0.100	1.86
3/11/2013		256	17.1	24.2							0.973	<0.100	0.973
3/25/2013	227	293	21.3	27.4	138	60.3	29.3	15.1	4.23	271	0.6	<0.100	0.6
4/8/2013		336	30.3	24.6							0.176	<0.100	0.176

Table B.6. Biweekly sampling results from Oxford property (downstream of YWWTP).

Sampling Date	Alkalinity (as $CaCO_3$) (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Bicarbonate (mg/L)	Total Ca (mg/L)	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Hardness (as $CaCO_3$) (mg/L)
9/24/2012		-	-	-						
10/8/2012		-	-	-						
10/19/2012		-	-	-						
11/5/2012		-	-	-						
11/19/2012		-	-	-						
12/3/2012		-	-	-						
12/17/2012		-	-	-						
1/2/2013		-	-	-						
1/14/2013	165	203	7.5	10.6	97	55.7	13.3	3.84	1.6	193.852
1/29/2013		-	-	-						
2/11/2013		215	6.28	9.69						
2/26/2013		175	5.67	8.63						
3/11/2013		174	5.09	7.24						
3/25/2013	171	205	6.02	7.46	104	66.1	10.8	3.19	1.31	209.526
4/8/2013		223	6.21	7.65						

*Note: Consistent flow was not observed in this reach of Crooked Creek until February 2013.

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1.0 INTRODUCTION

1.1 Background

The City of Harrison, Arkansas (Harrison), discharges treated wastewater under authority of its National Pollutant Discharge Elimination System (NPDES) permit (No. AR0034321) for the Harrison Waste Water Treatment Plant (HWWTP). This permit was scheduled for renewal in October 2012. The discharge enters Crooked Creek, which flows approximately 73.4 miles to the White River at the Marion-Baxter county line in Arkansas (Figure 1.1). The Arkansas Department of Environmental Quality (ADEQ) is considering future permit limits for dissolved minerals (total dissolved solids [TDS], sulfate, and chloride) in Harrison's permit when it is renewed. In the Arkansas 2008 303(d) list, stream segment 11010003-049 (located on Crooked Creek upstream and downstream of the HWWTP discharge) was listed as impaired due to exceedances of the Arkansas TDS, chloride, sulfate, and beryllium water quality standards (WQS). The suspected source of the TDS, chloride, sulfate, and beryllium noted on the Arkansas 2008 303(d) list was unknown. The Arkansas draft 2012 303(d) list proposes removing beryllium as a cause of impairment. The suspected source of the TDS, chloride, and sulfate noted on the Arkansas draft 2012 303(d) list is unknown.

The City of Yellville, Arkansas (Yellville) discharges treated wastewater under authority of its NPDES permit (No. AR0034037) for the Yellville Waste Water Treatment Plant (YWWTP). This permit is scheduled for renewal in March 2015. The discharge enters Crooked Creek, which flows approximately 22.5 miles to the White River at the Marion-Baxter county line in Arkansas (Figure 1.1). In the Arkansas 2008 303(d) list, stream segment 11010003-048 (located on Crooked Creek downstream of the HWWTP and upstream and downstream of the YWWTP discharge) was listed as impaired due to exceedances of the WQS for temperature, TDS, sulfate, and chloride. The suspected source of the temperature noted on the Arkansas 2008 303(d) list was resource extraction. The suspected sources of the dissolved minerals noted on the Arkansas 2008 303(d) list were unknown. The Arkansas draft 2012 303(d) list proposes removing temperature as a cause of impairment. The suspected sources of the dissolved minerals noted on the Arkansas draft 2012 303(d) list are unknown.

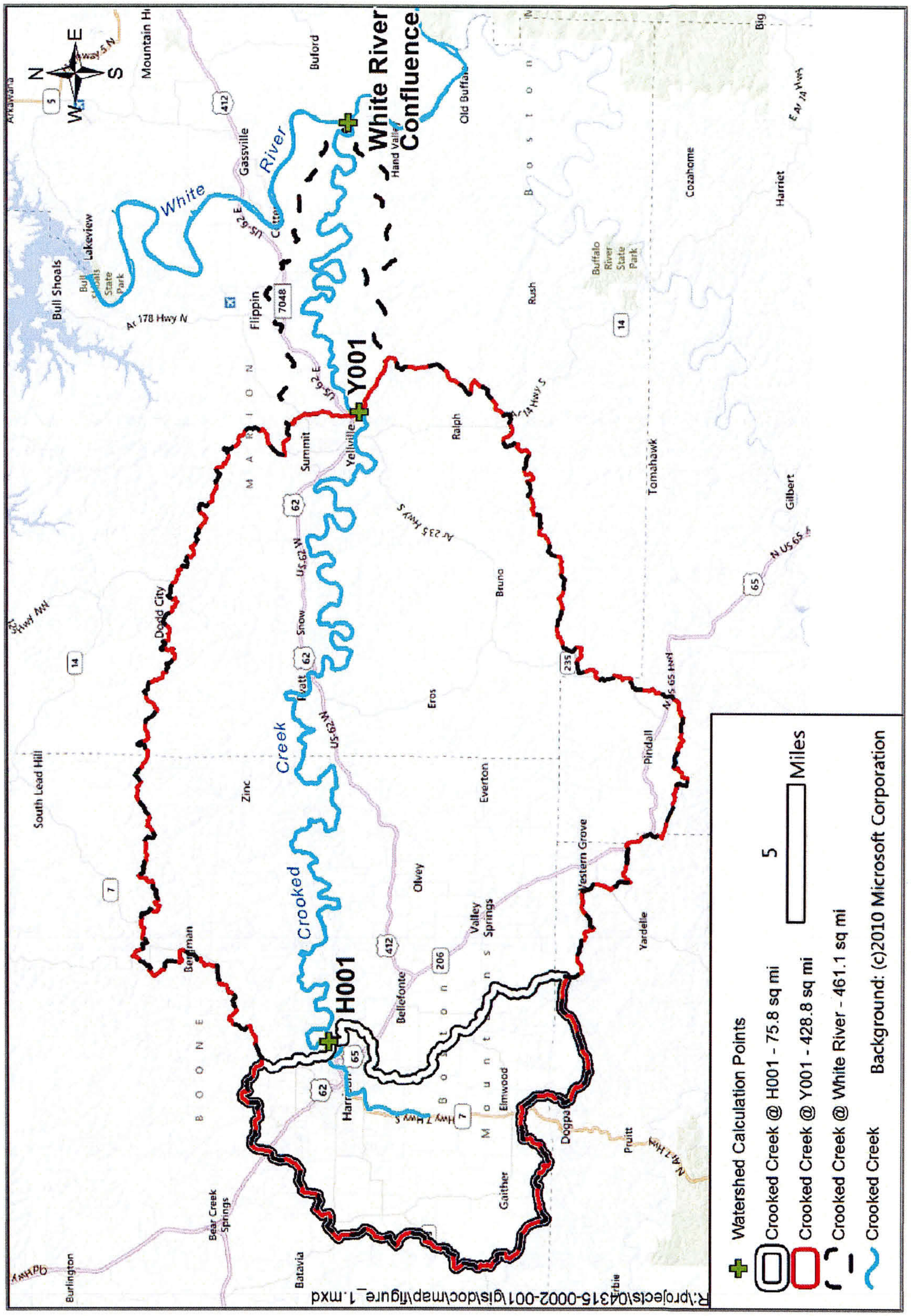


Figure 1.1. Map of stream locations, watershed boundaries, and watershed areas.

An analysis of discharge TDS, sulfate, and chloride concentrations for HWWTP and YWWTP revealed that both discharges meet the current sulfate and chloride criteria for Crooked Creek (20 mg/L for both sulfate and chloride); however, neither discharge could meet the current TDS limits based on the current TDS criterion (200 mg/L). Further analysis showed that if permit limits for either city were set to instream criteria for sulfate or chloride due to the impairment listings, neither city would consistently meet such limits. Accordingly, Harrison and Yellville undertook a use attainability analysis (UAA) to evaluate alternatives for meeting anticipated permit limits for minerals.

1.2 UAA Objectives

The UAA study reported herein was conducted with the following objectives:

1. Determine existing and attainable uses in waterbodies downstream of the HWWTP and YWWTP discharges (Crooked Creek, White River);
2. Determine if the existing direct discharges from the HWWTP and YWWTP support existing and attainable uses in downstream waterbodies; and
3. Evaluate options for permit compliance, including treatment, alternative discharge locations, and site-specific minerals criteria.

1.3 UAA Approach

Preliminary evaluation of water quality near the HWWTP and YWWTP discharges indicated the following:

- TDS concentrations routinely exceed the Crooked Creek site-specific criterion upstream and downstream of both discharges,
- A discharge limitation on TDS in the NPDES permits will not prevent exceedances of the site-specific TDS criterion in Crooked Creek downstream of the respective outfalls due to the fact that the TDS criterion is exceeded upstream of both outfalls, and
- Sulfate and chloride concentrations rarely exceed the Crooked Creek site-specific criteria upstream or downstream of either discharge based on the UAA study data, but ADEQ historical data from Crooked Creek show exceedances of criteria in approximately 10% of the measurements for both parameters.

Therefore, in addition to the evaluation of treatment and alternative discharge locations, this UAA includes an evaluation of site-specific TDS, sulfate, and chloride criteria and modification of the Crooked Creek site-specific criteria.

This proposal is in accordance with §2.303 and §2.308 of Regulation No. 2 (APCEC 2014), which allow the development of site-specific criteria using scientifically defensible methods that fully protect and maintain existing uses, meet the requirements for public participation per the *State of Arkansas Continuing Planning Process* (CPP) (ADEQ 2000), and allow for consideration of controls that would result in substantial and widespread economic and social impact.

The following were components of the approach to address these issues:

1. A waterbody survey to document current water quality and biological conditions in waterbodies receiving the discharges and on other area streams;
2. Analysis of the toxicity of the effluent discharges;
3. An evaluation of the technical, environmental, and economic feasibility of treatment to reduce TDS, sulfate, and chloride; and
4. An evaluation of the technical, environmental, and economic feasibility of moving the discharges to an alternate location.

Development of the UAA approach followed applicable guidance in the following documents:

1. The US Environmental Protection Agency (EPA) *Water Quality Standards Handbook: Second Edition* (EPA 1994);
2. The EPA Technical Support Document for Waterbody Surveys and Assessments for Conducting UAAs (EPA 1983);
3. The Water Environment Research Foundation's (WERF) reports "Suggested Framework for Conducting UAAs and Interpreting Results" (WERF 1997a) and "A Comprehensive UAA Technical Reference" (WERF 1997b);
4. The *State of Arkansas Continuing Planning Process* (ADEQ 2000);
5. APCEC Regulation No. 2, including §2.306 (2014); and
6. 40 CFR 131.10(a) through (k).

The UAA process included development of a UAA study plan to document the various strategies and planned tasks for ADEQ and EPA review. The revised plan (November 12, 2012) incorporated comments from ADEQ. As part of this process, ADEQ indicated conceptual agreement with the proposed UAA approach.

1.4 Facility Process Description

The treatment process for the HWWTP consists of a bar screen, a primary clarifier followed by two parallel oxidation ditches, ultraviolet treatment, and an aeration cascade. The design flow is 2.6 million gallons per day (mgd).

The treatment process for the YWWTP consists of extended action aeration and activated sludge followed by clarification, UV, and post-aeration. The design flow is 0.75 mgd.

2.0 SAMPLING STATIONS

2.1 Field Surveys

Sampling stations were chosen by FTN and ADEQ to characterize aquatic life in Crooked Creek upstream and downstream of the HWWTP and YWWTP discharges. The locations of the FTN sampling stations are indicated on Figure 2.1, illustrated schematically on Figure 2.2, and described in Tables 2.1 and 2.2. A reference stream location was not chosen, as no comparable stream was located within the near vicinity. Photographs of selected locations from the fall 2012 and spring 2013 sampling are provided in Appendix A. Sampling upstream and downstream of the YWWTP was not possible during the fall due to lack of stream flow.

2.2 Routine Biweekly Sampling

During May 2012 through April 2013, Harrison and Yellville personnel collected biweekly grab samples from the outfalls and from Crooked Creek locations upstream and downstream of the respective outfalls. In general, these locations (Figures 2.3 and 2.4, Table 2.3) were different from the aquatic life sampling locations. Due to a lack of consistent flow, samples were not collected consistently at the sampling locations upstream and downstream of the YWWTP until January and February 2013, respectively.

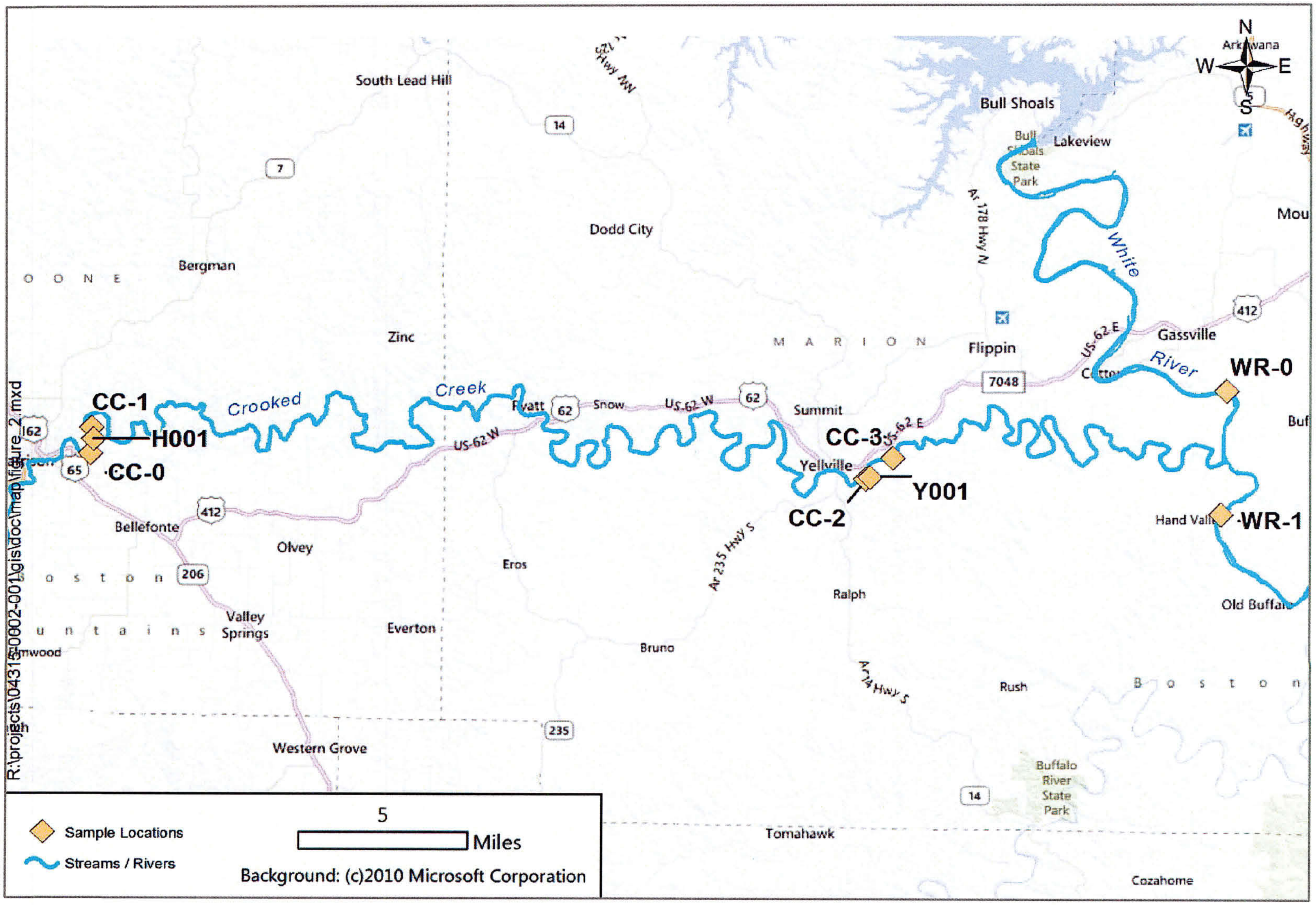


Figure 2.1. Map of waterbodies sampled during the study and locations of sampling stations.

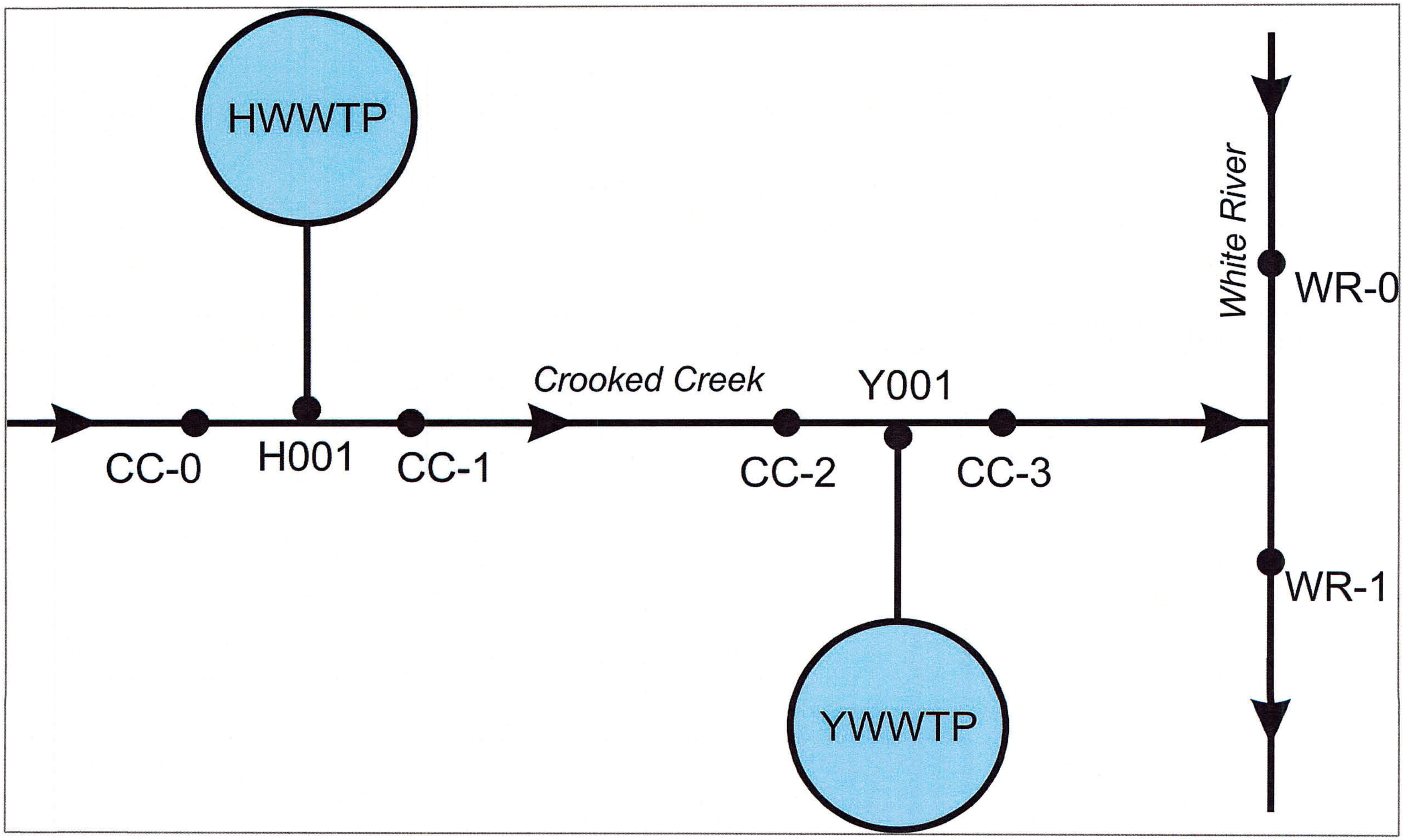


Figure 2.2. Schematic diagram of discharge sources and receiving streams.

Table 2.1. Description of sampling locations and information collected during the fall 2012 field surveys.

Station ID	Description	GPS Coordinates		Water Quality	Flow	Fish	Benthos	Habitat
		Latitude	Longitude					
CC-0	Crooked Creek upstream of HWWTP	36.23164	-93.07636	X	X	X	X	X
H001	HWWTP Outfall 001	36.23792	-93.07446	X	X			
CC-1	Crooked Creek downstream of HWWTP	36.24304	-93.07551	X	X	X	X	X
CC-2	Crooked Creek upstream of YWWTP	36.21989	-92.66565					
Y001	YWWTP Outfall 001	36.22049	-92.66333	X	X			
CC-3	Crooked Creek downstream of YWWTP	36.22920	-92.65119					
WR-0	White River upstream of mouth of Crooked Creek	36.25771	-92.47438	X				
WR-1	White River downstream of mouth of Crooked Creek	36.20376	-92.47803	X				

Table 2.2. Description of sampling locations and information collected during the spring 2013 field survey.

Station ID	Description	GPS Coordinates		Water Quality	Flow	Fish	Benthos	Habitat
		Latitude	Longitude					
CC-0	Crooked Creek upstream of HWWTP	36.23164	-93.07636	X	X		X	
H001	HWWTP Outfall 001	36.23792	-93.07446	X	X			
CC-1	Crooked Creek downstream of HWWTP	36.24304	-93.07551	X	X		X	
CC-2	Crooked Creek upstream of YWWTP	36.21989	-92.66565	X	X		X	
Y001	YWWTP Outfall 001	36.22049	-92.66333	X	X			
CC-3	Crooked Creek downstream of YWWTP	36.22920	-92.65119	X	X		X	
WR-0	White River upstream of mouth of Crooked Creek	36.25771	-92.47438	X				
WR-1	White River downstream of mouth of Crooked Creek	36.20376	-92.47803	X				

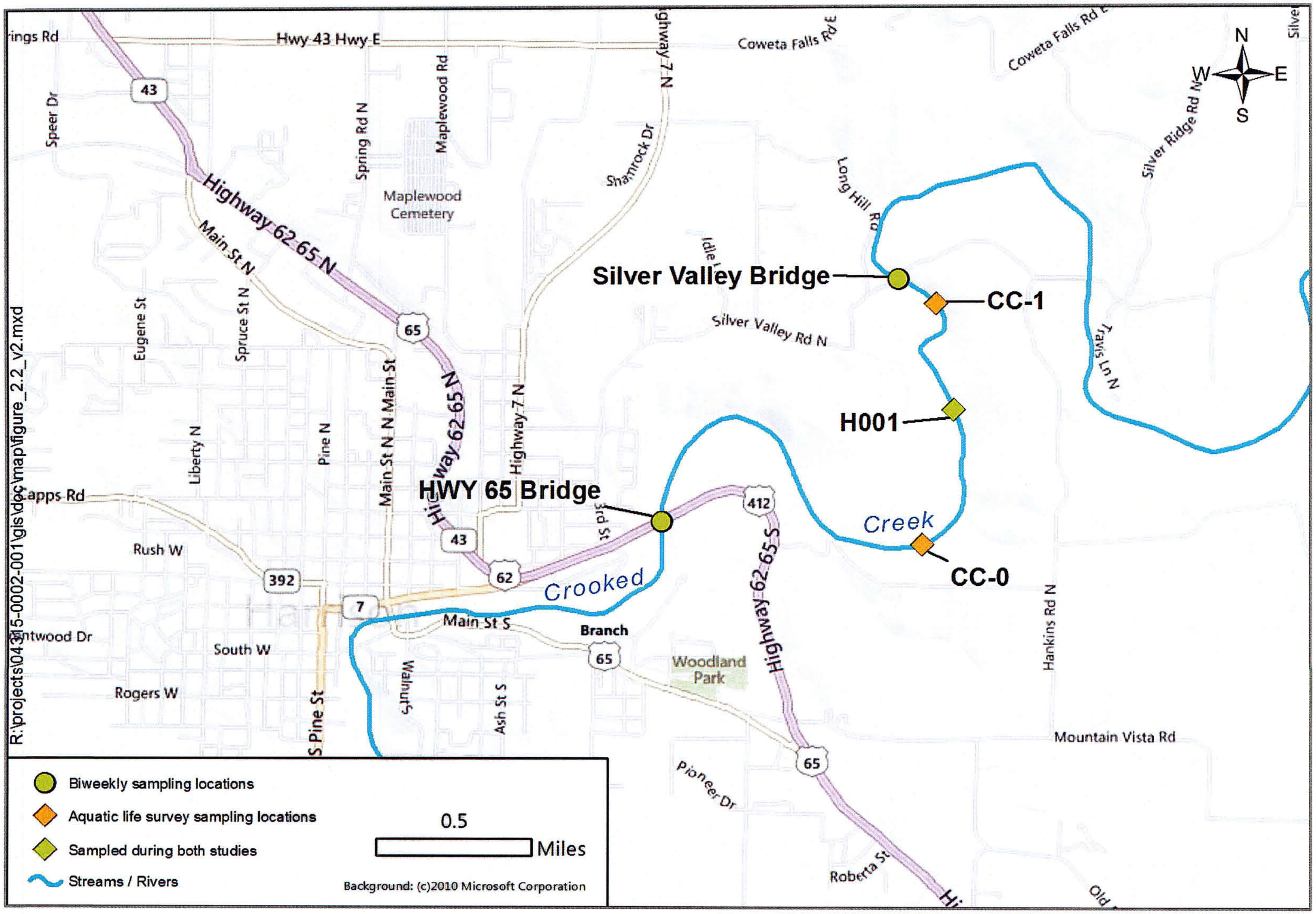


Figure 2.3. Aquatic life and biweekly sampling stations for Crooked Creek near the Harrison WWTP.

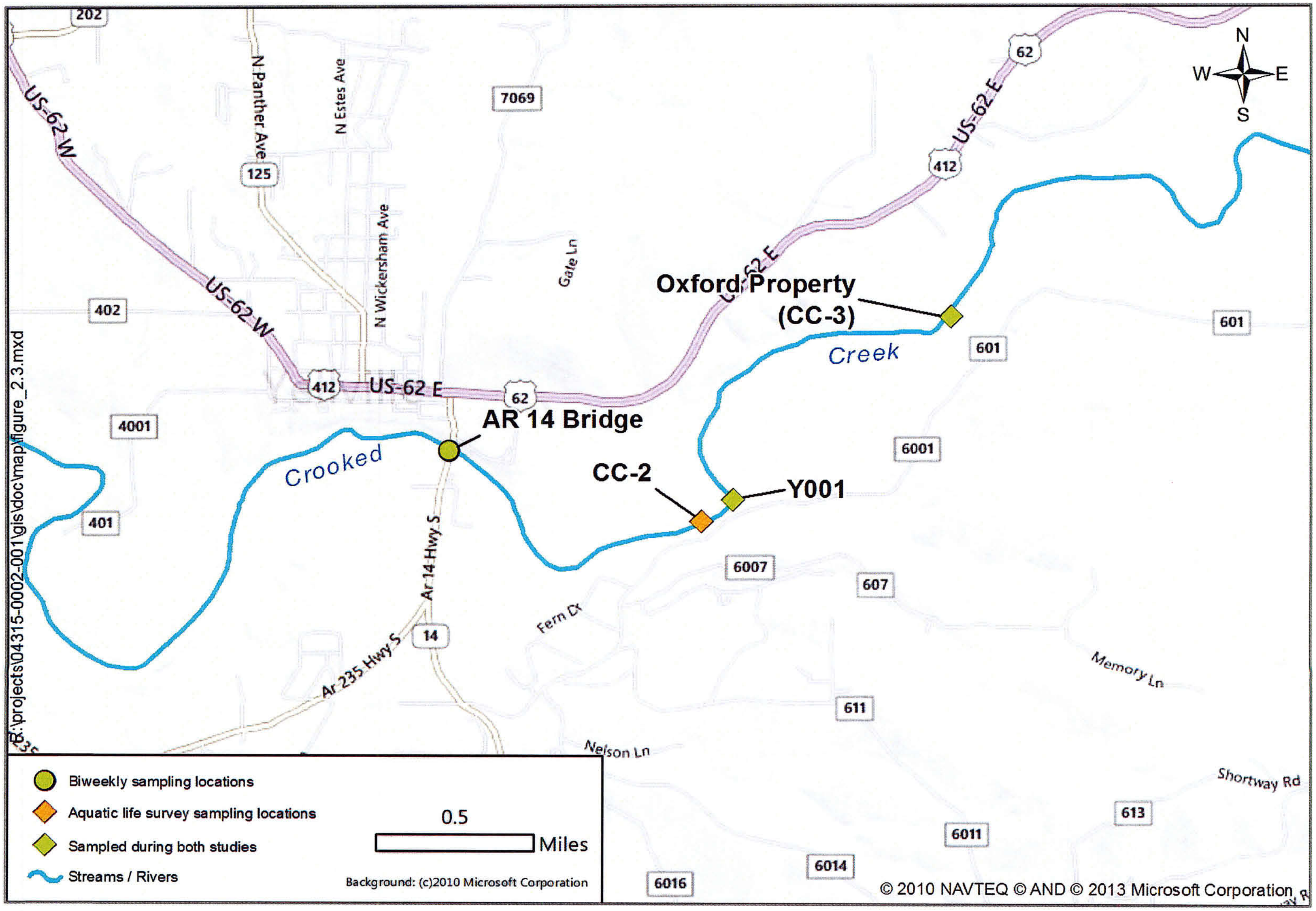


Figure 2.4. Aquatic life and biweekly sampling stations for Crooked Creek near the Yellville WWTP.

Table 2.3. Description of sampling locations and information collected during the routine biweekly sampling.

Station ID	Description	GPS Coordinates		Water Quality
		Latitude	Longitude	
US-65 bridge	Crooked Creek upstream of HWWTP	36.23270	-93.09133	X
H001	HWWTP Outfall 001	36.23792	-93.07446	X
Silver Valley Road bridge	Crooked Creek downstream of HWWTP	36.24432	-93.07771	X
AR-14 bridge	Crooked Creek upstream of YWWTP	36.22281	-92.67928	X
Y001	YWWTP Outfall 001	36.22049	-92.66333	X
Oxford property	Crooked Creek one mile downstream of YWWTP*	36.22920	-92.65119	X

*Same location as CC-3.

3.0 APPLICABLE ARKANSAS WATER QUALITY STANDARDS (APCEC REGULATION NO. 2)

Potentially affected waterbodies (Crooked Creek and White River) are located in the Ozark Highlands ecoregion. Table 3.1 summarizes default designated uses and mineral criteria applicable to waterbodies downstream of the HWWTP and YWWTP discharges. Stream locations, watershed boundaries and watershed areas are provided on Figure 1.1.

Table 3.1. Summary of default designated uses and mineral criteria applicable to waterbodies downstream of the HWWTP and YWWTP discharges.

Waterbody	Designated Uses	Applicable Mineral Criteria (mg/L)		
		Chloride	Sulfate	TDS
Crooked Creek from HWWTP Outfall 001 to YWWTP Outfall 001	Primary Contact Recreation Secondary Contact Recreation Perennial Ozark Highlands Fishery Domestic Water Supply Industrial Water Supply Agricultural Water Supply	20	20	200
Crooked Creek from YWWTP Outfall 001 to confluence with White River	Primary Contact Recreation Secondary Contact Recreation Perennial Ozark Highlands Fishery Domestic Water Supply Industrial Water Supply Agricultural Water Supply	20	20	200
White River downstream of confluence with Crooked Creek	Primary Contact Recreation Secondary Contact Recreation Trout Fishery Perennial Ozark Highlands Fishery Domestic Water Supply Industrial Water Supply Agricultural Water Supply Other Uses	20	20	180

4.0 DISCHARGE AND RECEIVING STREAM WATER QUALITY CHARACTERISTICS

4.1 Water Quality and Flow Sampling

4.1.1 Water Quality and Flow Sampling During Aquatic Life Surveys

During the fall 2012 and spring 2013 aquatic life surveys, FTN collected grab samples at the sampling locations described in Tables 2.1 and 2.2 according to FTN sampling protocols. Samples were taken from mid-surface from flowing portions of the stream using a clean plastic jug. The sample was then split into aliquots and placed into sample containers containing preservative appropriate for the analysis of selected parameters (Table 4.1). Samples were placed on ice immediately upon collection and delivered to American Interplex Corporation Laboratories (AIC), which is certified by ADEQ for the selected analyses.

Table 4.1. Analytes and analytical methods for analysis of outfall and receiving stream samples.

Analyte	Method (or equivalent)
Chloride (Cl^-)	EPA 300.0
Sulfate (SO_4^{-2})	EPA 300.0
Calcium (Ca^{+2})	EPA 200.7
Magnesium (Mg^{+2})	EPA 200.7
Sodium (Na^+)	EPA 200.7
Potassium (K^+)	EPA 200.7
Total Alkalinity	SM 2320B
Hardness	EPA 200.7
TDS	SM 2540C

Stream flow was measured within each sampling reach indicated. Flows were measured by measuring stream width, depth and current velocity per US Geological Survey protocols (1982) using a calibrated wading rod and a Marsh-McBirney (Flow Mate Model 2000) flow meter. All flow measurements were made concurrently with grab sample collection.

In situ measurements of temperature (°C), dissolved oxygen (DO; mg/L), pH (standard units), and specific conductance (conductivity; µS) were taken using Hydrolab Minisonde Multiprobe water quality monitors. Instruments were calibrated on the day of use or deployment.

Calibration of the DO function on all instruments was performed using air calibration. Calibration of conductivity and pH functions was performed using standard buffers (pH) and calibration standards (conductivity). Calibration was checked upon completion of each day's measurements by comparing instrument readings with readings in standard buffers, calibration standards or saturated air, as appropriate. All calibration information was documented and retained as part of the project records. Discreet in situ measurements were taken in mid-current at mid-depth concurrently with grab samples.

4.1.2 Biweekly Sampling

At the request of ADEQ, Harrison and Yellville personnel collected biweekly water quality data in Crooked Creek upstream and downstream of their WWTP discharges, flow permitting, at the sampling locations described in Section 2.2 (Table 2.3). Samples were collected from May 10, 2012, through April 23, 2013, at the HWWTP. Consistent flow was not achieved in Crooked Creak upstream of YWWTP until approximately January 2, 2013, or in Crooked Creek downstream of the YWWTP until approximately February 11, 2013 (around 40 days after consistent flow was established at the upstream site); thus sampling was intermittent during that time and generally spanned from October 2012 to April 2013. Note that the biweekly sampling locations were not the same as those used for the aquatic life survey (see Tables 2.1 through 2.3). Samples were routinely analyzed for TDS, sulfate, and chloride (Table 4.1). On selected dates, samples were analyzed for additional analytes (calcium, magnesium, sodium, potassium, and alkalinity). Bicarbonate ion concentrations were estimated based on measured total alkalinity and assumed pH values of 8.0 su for receiving stream samples and 7.5 su for outfall samples. Samples were shipped overnight to Environmental Testing and Consulting, Inc.[1] (ETC), which is certified by ADEQ for these analyses.

4.2 Water Quality and Flow Measurement Results and Discussion

Results of flow, in situ, and dissolved minerals measurements collected by FTN during the aquatic life surveys are presented in Tables 4.2 through 4.4 for the September 2012 (fall),

[1] Environmental Testing and Consulting, Inc., 2790 Whitten Road, Memphis, TN 38133

November 2012 (fall), and April 2013 (spring) sampling, respectively. Samples collected in fall 2012 showed TDS in excess of the Crooked Creek site-specific criterion of 200 mg/L upstream and downstream of the HWWTP. Additionally, sulfate and chloride concentrations were in excess of the Crooked Creek site-specific criteria of 20 mg/L downstream of the HWWTP. Water quality samples were not collected upstream and downstream of the YWWTP during the fall 2012 sampling due to lack of surface flow. Samples collected in spring 2013 showed TDS in excess of the Crooked Creek site-specific criterion downstream of the YWWTP.

Table 4.2. Summary of results of flow, water chemistry analyses of grab samples, and in situ measurements taken concurrently with biological sampling on September 19 and 20, 2012.

Parameter	Station							
	CC-0	**H001**	**CC-1**	**CC-2**	**Y001**	**CC-3**	**WR-0**	**WR-1**
Date [(a)]	9/20	9/20	9/19	NM	9/19	NM	9/20	9/20
Time [(a)] (24 h)	1823	1908	1930	NM	1015	NM	2132	2213
Flow (gpm)	6,934	2,083	8,074	NM	128	NM	NM	5.74×10^{5} [(c)]
Temperature (°C)	20.63	23.49	20.51	NM	23.62	NM	18.86	18.04
DO (mg/L)	9.70	6.80	9.61	NM	5.13	NM	10.86	NM
pH (su)	7.17	6.80	7.47	NM	7.37	NM	7.93	7.93
Specific Conductance (μS)	356.1	619.2	377.9	NM	573.7	NM	277.2	273.5
TDS (mg/L)	**220**	410	**230**	NM	340	NM	160	150
Sulfate (mg/L)	5.6	53	11	NM	25	NM	6.7	6.5
Chloride (mg/L)	8.3	55	13	NM	36	NM	5.5	5.1

Notes: Bold entries indicate values not meeting site-specific water quality criteria; NM = not measured.
(a) Date and time of sample collection and in situ measurements.
(b) HWWTP and YWWTP outfalls flows obtained from the cities.
(c) White River flows obtained from USGS gage near Norfork (http://waterdata.usgs.gov/ar/nwis/uv?site_no=07057370)

Samples collected at the White River stations downstream of Crooked Creek showed mineral concentrations well below site-specific criteria. One sample collected on the White River upstream of Crooked Creek exceeded sulfate and TDS criteria (Table 4.4).

Flow measurements taken during the aquatic life surveys are summarized in Table 4.5 to provide an indication of the contribution of the discharges to the total downstream flow.

Table 4.3. Summary of results of flow, water chemistry analyses of grab samples, and in situ measurements taken concurrently with biological sampling on November 27 and 28, 2012.

Parameter	Station							
	CC-0	H001	CC-1	CC-2	Y001	CC-3	WR-0	WR-1
Date [(a)]	11/28	11/28	11/28	NM	11/28	NM	11/27	11/27
Time [(a)] (24 h)	0840	1600	1213	NM	1710	NM	1723	1655
Flow (gpm)	4,566	1,736	5,024	NM	120	NM	NM	$1.80x10^6$ [(c)]
Temperature (°C)	8.30	13.85	10.69	NM	13.25	NM	NM	NM
DO (mg/L)	9.96	9.14	9.80	NM	10.98	NM	NM	NM
pH (su)	7.46	7.26	7.89	NM	7.67	NM	NM	NM
Specific Conductance (μS)	377	669	417	NM	477	NM	NM	NM
TDS (mg/L)	**230**	430	**280**	NM	270	NM	150	170
Sulfate (mg/L)	6.2	110	**29**	NM	21	NM	7.0	6.5
Chloride (mg/L)	8.9	65	**21**	NM	41	NM	6.1	5.6

Notes: Bold entries indicate values not meeting site-specific water quality criteria; NM = not measured.
(a) Date and time of sample collection and in situ measurements.
(b) HWWTP and YWWTP outfalls flows obtained from the cities.
(c) White River flows obtained from USGS gage near Norfork (http://waterdata.usgs.gov/ar/nwis/uv?site_no=07057370)

Table 4.4. Summary of results of flow, water chemistry analyses of grab samples, and in situ measurements taken concurrently with biological sampling on April 2 and 3, 2013.

Parameter	Station							
	CC-0	H001	CC-1	CC-2	Y001	CC-3	WR-0	WR-1
Date [(a)]	4/2	4/2	4/2	4/3	4/3	4/3	4/2	4/2
Time [(a)] (24 h)	1552	1200	1445	0907	0826	1149	2002	2037
Flow (gpm)	17,782	3,194	19,059	88,493	224	72,464	NM	$1.88x10^6$ [(c)]
Temperature (°C)	12.95	14.30	12.69	9.57	11.47	10.54	10.98	8.92
DO (mg/L)	10.21	8.28	10.21	9.39	8.24	9.54	8.34	10.78
pH (su)	7.50	7.70	7.64	7.98	7.67	8.06	7.22	7.77
Specific Conductance (μS)	320	587	329	335	530	329	544	297
TDS (mg/L)	160	340	200	190	320	**240**	**220**	78
Sulfate (mg/L)	5.8	66	8.8	7.8	25	7.0	**56**	7.7
Chloride (mg/L)	6.9	51	7.8	5.3	23	5.7	4.9	4.7

Notes: Bold entries indicate values not meeting site-specific water quality criteria; NM = not measured.
(a) Date and time of sample collection and in situ measurements.
(b) HWWTP and YWWTP outfalls flows obtained from the cities.
(c) White River flows obtained from USGS gage near Norfork (http://waterdata.usgs.gov/ar/nwis/uv?site_no=07057370)

Table 4.5. Summary of Crooked Creek flows expressed as the proportion of flow upstream of the discharges to the flow downstream of discharges.

Location	September 2012	November 2012	April 2013
HWWTP	0.859	0.909	0.933
YWWTP	No flow	No flow	0.997*

*Calculated as the upstream flow divided by sum of the effluent flow and upstream flow.

Results of biweekly measurements of TDS, sulfate and chloride in samples collected by Harrison and Yellville upstream and downstream of their WWTP outfalls are summarized in Tables 4.6 and 4.7, respectively, and presented in their entirety in Appendix B (laboratory reports for all analytical testing are provided in Appendix C). These tabular summaries do not include data collected during the fall 2012 and spring 2013 aquatic life survey sampling events because the biweekly sampling and aquatic life sampling were performed at different locations on Crooked Creek.

Biweekly samples showed TDS in excess of the Crooked Creek site-specific criterion upstream and downstream of the HWWTP on a routine basis with over 50% of the measured values upstream of the discharge exceeding the 200-mg/L criterion. Biweekly samples did not show sulfate or chloride values exceeding the Crooked Creek site-specific criteria upstream or downstream of the HWWTP; however, FTN sampling in November 2012 as part of the aquatic life field survey showed exceedances in sulfate and chloride values downstream of the HWWTP. The 95th percentile of the biweekly sulfate and chloride values did not exceed the Crooked Creek site-specific criteria during the monitoring period.

Biweekly samples collected also showed TDS in excess of the Crooked Creek site-specific criterion upstream and downstream of the YWWTP, with over 25% of the measured values upstream of the discharge exceeding the 200-mg/L criterion. Biweekly samples collected by Yellville and FTN did not show sulfate or chloride values exceeding the Crooked Creek site-specific criteria upstream or downstream of the YWWTP during the monitoring period.

Table 4.6. Summary of TDS, sulfate, and chloride concentrations from biweekly sampling of Crooked Creek upstream and downstream[1] of the HWWTP (May 10, 2012, through April 23, 2013).

Ion	Summary Statistic		Concentration (mg/L)			Downstream Increase	
			Upstream	Effluent[2]	Downstream	mg/L	%
TDS	Percentile	25th	185	300	208	7	3
		50th	206	336	223	14	7
		75th	218	375	243	32	16
		95th	249	418	254	41	20
	Minimum		147	235	162	-24	-9
	Mean		204	338	220	17	9
	Maximum		266	438	268	46	25
Sulfate	Percentile	25th	4.6	43.6	8.6	2.9	55.5
		50th	5.1	54.8	9.7	4.1	84.1
		75th	6.7	61.4	11.7	4.8	106.3
		95th	9.3	77.8	15.5	10.1	213.7
	Minimum		4.0	35.4	7.1	1.3	13.4
	Mean		5.7	54.6	10.6	4.9	96.0
	Maximum		9.8	77.9	18.6	13.8	286.7
Chloride	Percentile	25th	6.6	47.1	9.9	3.1	44.6
		50th	7.1	57.1	11.1	4.3	57.9
		75th	7.6	59.5	13.4	5.6	76.5
		95th	8.1	64.0	17.8	10.2	136.4
	Minimum		6.5	36.9	8.7	2.1	31.3
	Mean		7.2	54.1	12.1	4.9	67.3
	Maximum		8.6	68.0	19.2	11.3	143.3

Notes:
1. See Table 2.3 for biweekly sampling locations.
2. Effluent summary statistics exclude sampling dates from May 10, 2012, to July 17, 2012 (period of record begins July31, 2012, and continues through April 23, 2013). The "effluent" data collected prior to July 31, 2012, were collected from instream and are not representative of the outfall.

Table 4.7. Summary of TDS, sulfate, and chloride concentrations from biweekly sampling of Crooked Creek upstream and downstream[1] of the YWWTP (September 24, 2012, through April 8, 2013).

Ion	Summary Statistic		Concentration (mg/L)			Downstream Change	
			Upstream[2]	Effluent	Downstream[3]	mg/L	%
TDS	Percentile	25th	179	278	182	5	3
		50th	194	293	204	7	4
		75th	207	311	213	12	6
		95th	210	339	221	16	10
	Minimum		157	256	174	-2	-1
	Mean		194	295	199	8	4
	Maximum		210	336	223	17	11
Sulfate	Percentile	25th	7.6	21.0	7.5	0.1	1.6
		50th	7.8	24.2	8.1	0.5	6.6
		75th	8.9	26.3	9.4	0.9	10.9
		95th	9.2	28.2	10.4	1.3	14.1
	Minimum		6.9	24.2	7.2	0.0	0.5
	Mean		8.1	26.3	8.5	0.6	6.8
	Maximum		9.2	30.0	10.6	1.4	14.8
Chloride	Percentile	25th	6.1	25.7	5.8	-0.2	-3.1
		50th	6.5	38.6	6.1	-0.1	-1.5
		75th	8.5	39.5	6.3	0.0	-0.8
		95th	8.9	43.1	7.2	0.0	0.2
	Minimum		5.1	17.1	5.1	-0.7	-8.1
	Mean		6.6	27.0	6.1	-0.2	-2.5
	Maximum		8.5	39.7	7.5	0.0	0.5

Notes:
1. See Table 2.3 for biweekly sampling locations.
2. Consistent flows were not observed in this reach of Crooked Creek until January 2, 2013.
3. Consistent flows were not observed in this reach of Crooked Creek until February 11, 2013.

The average percent increase in TDS due to the discharges was 9% and 4% for the HWWTP and YWWTP, respectively (Tables 4.6 and 4.7). These percent increases represent TDS concentration increases of 17 mg/L and 8 mg/L for the HWWTP and YWWTP, respectively. The average sulfate increase due to the HWWTP discharge is 96%, but this only represents a 4.9-mg/L increase in sulfate concentration. At the YWWTP, the average downstream increase in sulfate concentrations is 6.8%, but only 0.6 mg/L. Average increases in chloride concentrations downstream of the HWWTP are similar to sulfate, 4.9 mg/L (67.3%). The YWWTP dilutes chloride levels in Crooked Creek; all downstream values are equal to or lower than the upstream values. These results indicate that the discharges have a relatively minor impact on the ionic strength of Crooked Creek. These effects are also illustrated on Figure 4.1 for TDS; visual inspection suggests that upstream-to-downstream differences are typically less than monthly or biweekly differences.

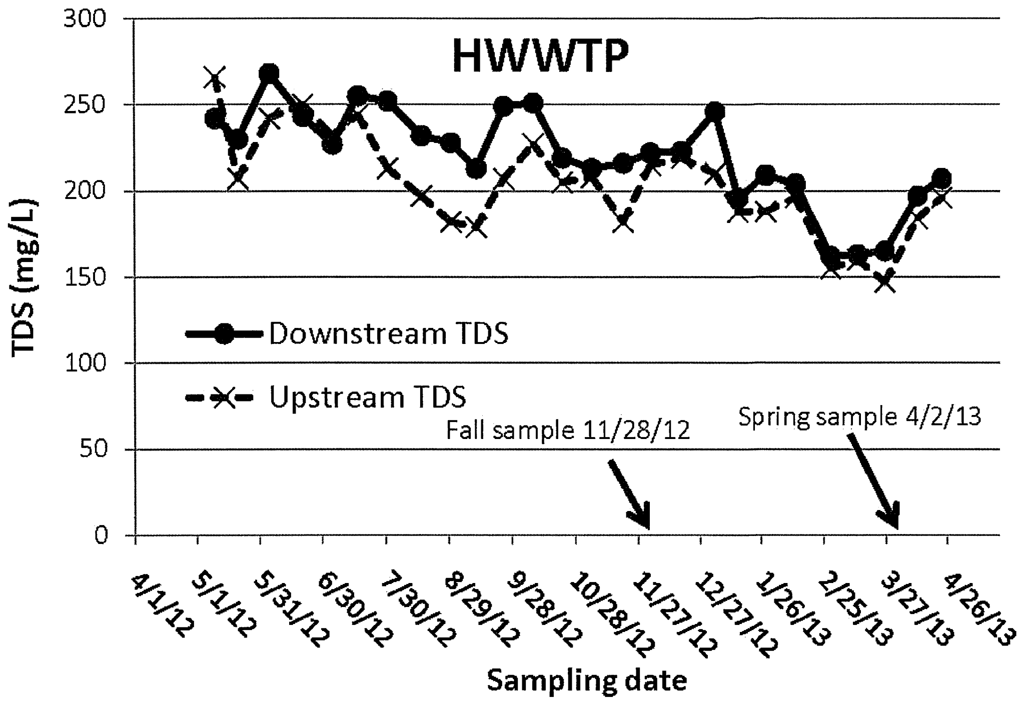
The flow summary provided in Table 4.5 clearly shows that the discharges contribute a relatively minor portion to the total downstream flow. The summary also indicates that flows during September 2012 were near critical low-flows[2]. This information supports the biweekly sampling data showing that the discharges have a relatively minor impact on the water quality of Crooked Creek.

4.3 Ionic Composition of Effluents and Receiving Streams

Concentrations and proportions of major cations and anions (TDS, sulfate, chloride, bicarbonate, calcium, magnesium, sodium, potassium) from selected samples collected during the biweekly sampling are summarized in Tables 4.8 and 4.9 and presented in their entirety in Appendix B.

Tables 4.8 indicates that, as expected, the discharges differ from Crooked Creek by having higher concentrations of virtually all ions. Table 4.8 also shows that as suggested by upstream versus downstream differences in flows and minerals concentrations (see previous section), there is relatively little increase in the ion concentrations downstream of the discharges.

[2] The critical low-flow effluent dilution per NPDES permit number AR0034321 for the HWWTP is 84%.



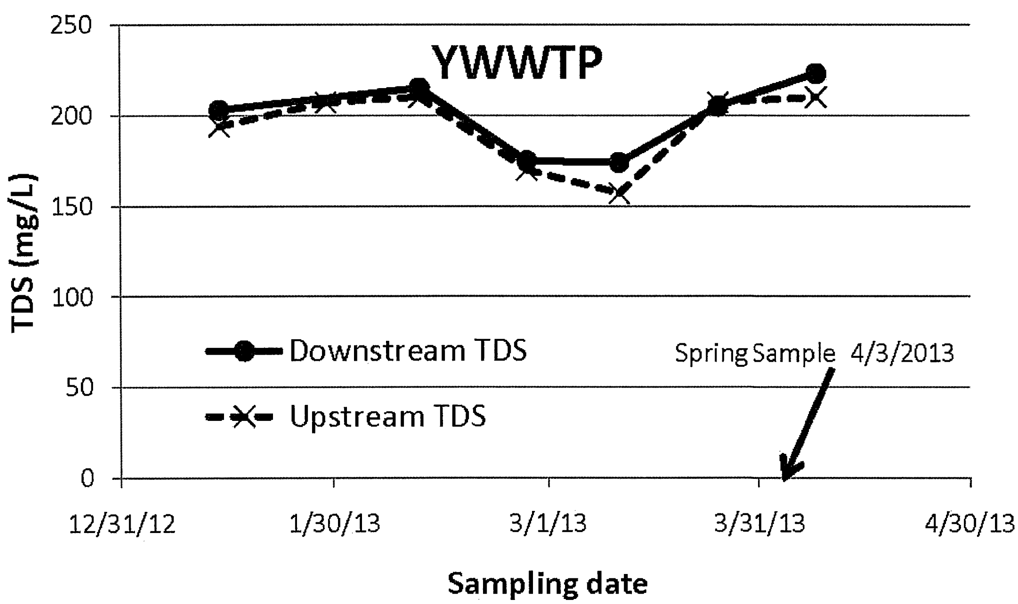


Figure 4.1. Time-series plots of TDS concentrations in Crooked Creek upstream and downstream of HWWTP and YWWTP discharges.

Table 4.8. Average concentrations of major cations and anions from the discharges and from Crooked Creek upstream and downstream of the discharges.

Analyte	HWWTP			YWWTP		
	Upstream of Discharge	Discharge	Downstream of Discharge	Upstream of Discharge*	Discharge	Downstream of Discharge*
TDS (mg/L)	174	314	198	201	298	204
Chloride (mg/L)	6.95	50.8	11.1	7.14	33.4	6.76
Sulfate (mg/L)	6.07	48.4	9.51	8.33	24.2	9.03
Bicarbonate (mg/L)	87.5	26.8	82.5	99.0	127	101
Total Calcium (mg/L)	64.3	43.2	61.8	60.5	52.2	60.9
Total Magnesium (mg/L)	1.91	3.14	2.00	9.79	22.6	12.1
Total Sodium (mg/L)	3.68	47.0	7.24	3.67	23.5	3.51
Total Potassium (mg/L)	1.31	11.1	2.07	1.46	7.24	1.45
Hardness (mg/L)	168	121	162	191	224	202
Number of samples	4	4	4	2	3	2
Sampling Dates	09/11/2012, 11/20/2012, 01/14/2013, 03/26/2013			11/19/2012, 01/14/2013, 03/25/2013		

*Consistent flow was not observed in the reach of Crooked Creek upstream of the YWWTP until January 2013 and in the reach downstream of the YWWTP until February 2013; therefore there were no samples on November 19, 2012, for either of those reaches.

Table 4.9. Average proportion of major cations and anions from the discharges and from Crooked Creek upstream and downstream of the discharges.

Analyte	Upstream of Discharge		Effluent		Downstream of Discharge	
	Harrison	Yellville	Harrison	Yellville	Harrison	Yellville
Chloride	0.04	0.04	0.16	0.11	0.06	0.03
Sulfate	0.04	0.04	0.15	0.08	0.05	0.04
Bicarbonate	0.50	0.49	0.09	0.42	0.42	0.49
Total Calcium	0.37	0.30	0.14	0.18	0.31	0.30
Total Magnesium	0.01	0.05	0.01	0.08	0.01	0.06
Total Sodium	0.02	0.02	0.15	0.08	0.04	0.02
Total Potassium	0.01	0.01	0.04	0.02	0.01	0.01
Proportion of TDS as measured ions	0.99	0.95	0.76	0.97	0.89	0.95
Proportion of TDS as Ca, Mg, HCO_3	0.88	0.84	0.24	0.68	0.74	0.85

Table 4.9 shows that the HWWTP and YWWTP effluents are substantially different in terms of ionic composition. The ionic composition of the HWWTP effluent is somewhat evenly distributed among sodium, sulfate, calcium, and chloride, which account for 60% of the total ionic makeup. In contrast, the calcium and bicarbonate ions dominate the ionic composition of the YWWTP effluent, accounting for 60% of the total ionic composition. Although the two discharges have substantially different ionic makeup, the ionic makeup of Crooked Creek upstream versus downstream of the discharges is relatively unaffected (Table 4.9) with calcium and bicarbonate dominating the ionic composition of Crooked Creek upstream and downstream of both discharges.

4.4 Discharge and Receiving Stream Water Quality Characteristics Conclusions

The primary findings of the UAA water quality survey included the following:

- Sulfate and chloride are only minor components of TDS in the Crooked Creek reaches upstream and downstream of the discharges. In contrast, calcium and bicarbonate dominate the TDS composition. Therefore, overall TDS was the primary focus of the evaluation of the designated use attainment. For the purpose of establishing criteria, appropriate sulfate and chloride concentrations should reflect concentrations that are consistent with protective TDS criteria.
- Background concentrations of TDS near Harrison and Yellville routinely exceed the Crooked Creek site-specific criterion.
- Concentrations of sulfate and chloride downstream of Harrison occasionally exceed the Crooked Creek site-specific criteria.
- The HWWTP and YWWTP discharges have a minimal effect on flows, TDS, sulfate, and chloride concentrations and on ionic composition of Crooked Creek downstream of the outfalls.
- Applicable (ecoregion) criteria are not exceeded in the White River downstream of the mouth of Crooked Creek.

5.0 TOXICITY EVALUATION

The Clean Water Act (CWA) prohibits toxic discharges. The potential toxicity of TDS in a discharge will depend on the ionic composition characteristic of the discharge, which can be evaluated three different ways:

1. Direct toxicity testing of the effluent through routine monitoring or special sampling,
2. Simulated toxicity testing using empirical models, and
3. Toxicity testing on effluent spiked with inorganic salts to mimic elevated TDS levels.

In general, the preferred approach is to test on effluent spiked with inorganic salts to mimic elevated TDS levels because it provides a direct measurement of the toxic threshold of TDS of a particular ionic composition. In the case of the HWWTP and YWWTP discharges, the actual ionic strength of the discharges is well below published toxic thresholds (Davies and Hall 2007; Elphick et al. 2011; Lasier and Hardin 2010; Mount et al. 1997; Soucek and Kennedy 2007; Soucek 2007, Soucek et al. 2011, van Dam et al. 2010) for the types of ions present, and the discharges have a relatively minor impact on the ionic strength and composition of the receiving stream. Therefore, evaluation of effluent toxicity tests and simulation using empirical models (Mount et al. 1997; Lasier and Hardin 2010) should provide sufficient information to evaluate the potential for toxicity to occur in whole effluent toxicity (WET) testing on the discharges.

5.1 Literature-Based Evaluation

This evaluation used empirical models developed by Mount et al. (1997) and Lasier and Hardin (2010) to estimate the chronic threshold of chloride and sulfate in the HWWTP and YWWTP discharges. Mount et al. (1997) developed empirical equations to predict percent survival in 48-hour acute toxicity tests on aqueous solutions made of calcium, magnesium, sodium, chloride, sulfate, and bicarbonate. Lasier and Hardin developed acute-to-chronic ratios

(ACRs) for *Ceriodaphnia dubia* in aqueous solutions dominated by chloride, sulfate, and bicarbonate. The approach used herein was to estimate the acute toxicity threshold of chloride and sulfate for *C. dubia* using equations developed by Mount et al. (1997) by "adding" chloride and sulfate as sodium chloride and sodium sulfate to a "simulated effluent" having the ionic composition of the HWWTP and YWWTP discharges indicated in Table 4.8.[3] Successively more concentrated solutions were simulated until the predicted survival was 50%. The chloride, sulfate, and TDS concentrations that predicted 50% survival provided an estimate of the acute toxic threshold (LC50). This value was then multiplied by the ACRs reported by Lasier and Hardin (2010) for chloride (4.6) and sulfate (2.3) to estimate the chronic thresholds chloride and sulfate. An ACR of 3.0 was assumed for TDS.

Table 5.1 provides ion concentrations used for input to the Mount et al. (1997) model to return an estimated survival of 50% for the two discharges. Table 5.2 provides the estimated IC25 concentrations (concentration inhibiting *C. dubia* reproduction by 25%) based on model predictions per Mount et al. (1997) and the ACRs from Lasier and Hardin (2010). A comparison of these IC25 values with the maximum TDS, chloride and sulfate values from the biweekly sampling (Tables 4.6 and 4.7) is also presented in Table 5.2. The values summarized in Table 5.2 indicate that the estimated chronic toxicity thresholds exceed maximum mineral concentrations in the effluent by factors of two or more.

5.2 Effluent Testing

Only the HWWTP is required to conduct routine quarterly biomonitoring as a permit requirement. HWWTP has conducted quarterly biomonitoring from the third quarter of 2007 to the first quarter of 2011, at which point the frequency was reduced to semi-annual. When the permit expired in 2012, the biomonitoring frequency returned to quarterly. Between 2007 and the first quarter of 2013, there has been one WET test failure, which occurred during the first quarter of 2008. No lethal or sublethal toxicity was observed in the subsequent monthly retesting

[3] For this simulation, we assumed that hardness and alkalinity in the discharges result from properties of the source water which are, in turn, the result of geologic features of the ecoregion. In contrast, anthropogenic inputs to the discharges were assumed to result in additional chloride and sulfate primarily as sodium salts. Accordingly, alkalinity and hardness were held constant in these "simulated effluents."

conducted as required by the permit. None of the 16 subsequent routine tests have shown lethal or sub-lethal toxicity at the critical dilution (84%).

Table 5.1. Ion concentrations used for input to the model by Mount et al. 1997 to return an estimated survival of 50% in a 48-hour acute toxicity test using *C. dubia*.

Ion Concentration (mg/L)	**Effluent Source**	
	HWWTP	**YWWTP**
Sodium	1,010	801
Potassium	11.1	7.24
Calcium	43.2	52.2
Magnesium	3.14	22.6
Chloride	907	719
Sulfate	864	685
Bicarbonate[4]	54.0	208
TDS	2,892	2,342
Cation/anion	1.05	1.02

Table 5.2. Estimated IC25 (concentration inhibiting *C. dubia* reproduction by 25%) concentrations based on model predictions per Mount et al. (1997) and the ACRs from Lasier and Hardin (2010).

	Effluent Source					
	HWWTP			**YWWTP**		
Ion (ACR)	**LC50[(a)] (mg/L)**	**IC25[(b)] (mg/L)**	**IC25÷[max[(c)]]**	**LC50[(a)] (mg/L)**	**IC25[(b)] (mg/L)**	**IC25÷[max[(c)]]**
Chloride (4.6)	907	197	2.9	719	156	3.9
Sulfate (2.3)	864	376	4.8	685	298	9.9
TDS (3.0)	2,892	964	2.2	2,342	781	2.3

Notes:
(a) From Table 5.1.
(b) Based on ACR.
(c) Highest concentration from biweekly sampling.

Effluent samples from HWWTP and YWWTP were collected on November 28, 2012, and April 2, 2013, and tested for chronic toxicity to *C. dubia* in undiluted effluent per EPA (2002). The sample collected on November 28, 2012, was submitted to AIC for testing. The

[4] Bicarbonate values in this table differ from those given in Tables 4.6 and 4.7 because Mount et al. (1997) calculated bicarbonates based on APHA (1989).

sample collected on April 2, 2013, was submitted to Huther and Associates, Inc. (HAI; 1156 North Bonnie Brae, Denton, TX 76201) for testing. HAI is certified by ADEQ for this type of testing. For each sampling date, the two effluents were tested concurrently with a common control. TDS, sulfate, and chloride concentrations were measured in each sample. Results are summarized in Table 5.3. Both samples submitted to AIC showed sub-lethal toxicity while neither sample submitted to HAI showed toxicity. Although the level of toxicity correlated with mineral concentrations with the tests performed by AIC, this was not the case with the data set as a whole. For example, the TDS concentration for the YWWTP sample tested by HAI was higher than the YWWTP TDS concentration tested by AIC, but the YWWTP sample tested by AIC showed sub-lethal toxicity while the YWWTP sample tested by HAI did not.

Table 5.3. Results of chronic toxicity tests on HWWTP and YWWTP samples.

	Sample Collected 11/28/2012					**Sample Collected 04/02/2013**				
Sample	**S100[a]**	**R100[b]**	**Chloride (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**	**S100**	**R100**	**Chloride (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**
Control	100	18.2	NM	NM	NM	100	21.7	NM	NM	NM
HWWTP	100	12.9[c]	65	110	430	100	23.5	51	66	340
YWWTP	100	14.9[c]	41	21	270	100	22.8	23	25	320

Notes: NM=not measured
(a) S100 = percent survival (n=10) in undiluted sample
(b) R100 = average number of neonates per female in undiluted sample
(c) Significantly less than the control ($p = 0.05$)

Table 5.4 compares mineral concentrations in the effluent samples collected from HWWTP and YWWTP on November 28, 2012, and April 2, 2013, to chronic toxicity thresholds developed in the previous section (Table 5.2). This comparison demonstrates that the estimated chronic toxicity thresholds are well above the measured ion concentrations from the effluent samples.

These results suggest that the toxicity observed in the samples collected on November 28, 2012, is not due to dissolved minerals.

Table 5.4. Comparison of estimated chronic toxicity thresholds (IC25 concentrations; see Table 5.2) with measured mineral concentrations from HWWTP and YWWTP samples collected November 28, 2012, and April 2, 2013 (see Table 5.3).

Sampling Date	Ion	Effluent Source					
		HWWTP			YWWTP		
		IC25* (mg/L)	Measured Concentration	IC25 ÷ [measured]	IC25* (mg/L)	Measured Concentration	IC25 ÷ [measured]
11/28/2012	Chloride	197	65	3.0	156	41	3.8
	Sulfate	376	110	3.4	298	21	14.2
	TDS	964	430	2.2	781	270	2.9
04/02/2013	Chloride	197	51	3.9	156	23	6.8
	Sulfate	376	66	5.7	298	25	11.9
	TDS	964	340	2.8	781	320	2.4

* Value from Table 5.2.

5.3 Toxicity Evaluation Conclusions

This evaluation of potential ion toxicity indicated the following:

1. The HWWTP effluent routinely passes NPDES biomonitoring tests;
2. TDS, sulfate, and chloride concentrations in the HWWTP and YWWTP samples showing sub-lethal toxicity effluent were well below chronic toxicity thresholds derived from published ion-toxicity relationships; and
3. TDS, sulfate and chloride concentrations from biweekly sampling of the HWWTP and YWWTP are well below chronic toxicity thresholds indicated by published ion-toxicity relationships.

This evaluation demonstrates that there is a very low potential for episodes of toxicity in routine WET testing due to current mineral concentrations.

6.0 ATTAINABLE USES

This section evaluates attainable uses in Crooked Creek in the presence of the HWWTP and YWWTP discharges.

6.1 Primary and Secondary Contact Recreation

Mineral content of surface water is not typically a relevant parameter used to consider the attainability of contact recreation uses. Therefore, current concentrations of dissolved minerals should have no effect on the attainability of these uses.

6.2 Domestic Water Supply

Current concentrations of TDS are well below secondary drinking water standards for TDS, sulfate, and chloride of 500, 250, and 250 mg/L, respectively. Therefore, the current mineral regime in the receiving streams will support this use.

6.3 Industrial Water Supply

Current concentrations of dissolved minerals do not affect the attainability of this use.

6.4 Agricultural Water Supply: Crops

The most commonly used guideline for salinity tolerance of crops is Ayers and Westcot (1985). In this document, yield potentials for a number of crops are associated with soil and water salinity values measured as electrical conductance. Salinity values associated with yield potentials for cotton, soybeans, and rice are summarized in Table 6.1. The water salinity (ECw) values reported in Ayers and Westcot (1985) have been calculated from the soil salinity (ECe) values reported (ECw = ECe/1.5). TDS values shown in Table 6.1 were calculated from the conductivity values (TDS = 650*conductivity). The average TDS concentration for Crooked Creek downstream of the HWWTP (220 mg/L; see Table 4.6) is well below the calculated irrigation water TDS values summarized in Table 6.1, thus indicating that effluent TDS would not be expected to negatively affect crop productivity. The US Salinity Laboratory

(US Department of Agriculture, Agricultural Research Services) has calculated linear regressions of irrigation water salinity (measured as the conductivity) to relative rice yield measurements based on experiments conducted in the late 1990s (Zeng and Shannon 2000). These relationships are based on the response of rice to sodium chloride (NaCl) solutions of various strengths that were used for irrigation in the experiments. Table 6.2 shows irrigation water conductivities for relative yields of grain weight per panicle and grain weight per plant that correspond to the yield potentials that are shown in Table 6.1. These values were calculated using Zeng and Shannon's (2000) linear regression equations. TDS values in Table 6.2 are calculated using the same equation as Table 6.1 values. The linear regression relationships developed by the US Salinity Laboratory indicate that a TDS concentration (due primarily to NaCl) of 1,000 mg/L could reduce rice productivity by about 10%. Tacker et al. (2001) also report that irrigation water with conductivity greater than 1.2 dS/m (approximately 780 mg/L TDS) is borderline for use on rice. The University of Arkansas Cooperative Extension Service reports that TDS levels greater than 770 parts per million (ppm) in irrigation water for rice are cause for concern.

Table 6.1. Influence of soil salinity (ECe) and irrigation water salinity (ECw) on crop tolerance and yield potential of selected crops (Ayers and Westcot 1985).

		100% yield		90% yield		75% yield		50% yield		0% yield	
Crop	**Parameter**	**ECe**	**ECw**	**ECe**	**ECw**	**ECe**	**ECw**	**ECe**	**ECw**	**ECe**	**ECw**
Cotton	Cond, dS/m	7.7	5.1	9.6	6.4	13	8.4	17	12	27	18
	TDS, mg/L	--	3,315	--	4,160	--	5,460	--	7,800	--	11,700
Rice	Cond, dS/m	3	2	3.8	2.6	5.1	3.4	7.2	4.8	11	7.6
	TDS, mg/L	--	1,300	--	1,690	--	2,210	--	3,120	--	4,940
Soybean	Cond, dS/m	5	3.3	5.5	3.7	6.3	4.2	7.5	5	10.	6.7
	TDS, mg/L	--	2,145	--	2,405	--	2,730	--	3,250	--	4,355

Table 6.2. Irrigation water salinity for selected relative rice yield measurements calculated using US Salinity Laboratory linear regression equations (Zeng and Shannon 2000).

Yield Measurement	Parameter	Percent Yield				
		100	90	75	50	0
Grain weight per panicle [a]	Conductance (dS/m)	0.49	1.71	3.54	6.59	12.68
	TDS (mg/L)	317	1,110	2,299	4,280	8,244
Grain weight per plant [b]	Conductance (dS/m)	0.46	1.52	3.12	5.78	11.10
	TDS (mg/L)	297	989	2,026	3,755	7,212

Notes:
(a) ECw = (1.040 – relative yield)/0.082, r^2=0.87
(b) ECw = (1.043 – relative yield)/0.094, r^2=0.83

This information indicates that Crooked Creek is suitable for irrigation, and the mineral concentrations in Crooked Creek will not affect the attainability of the agricultural water supply use.

6.5 Agricultural Water Supply: Livestock

There are no published guidelines for salinity/TDS in pasture irrigation water (personal communication, Bryce Baldridge, University of Arkansas Extension Agent, Lawrence County, University of Arkansas Extension Service, Walnut Ridge, Arkansas). However, field observations indicate that the land adjacent to Crooked Creek is used extensively as cattle pasture. This information indicates that these aspects of the agricultural water supply use are currently attained in Crooked Creek.

6.6 Aquatic Life

To evaluate the attainability of aquatic life uses (perennial Ozark Highlands fishery) water quality and biological surveys were conducted during the fall of 2012 (September 19 and 20 and November 27 and 28) and spring of 2013 (April 2 and 3). The purpose of the field surveys was as follows:

1. To establish the range of chemical, physical, habitat and biological conditions present in Crooked Creek upstream and downstream of the HWWTP and YWWTP outfalls; and

2. To evaluate factors (habitat, pollutants) that could potentially limit aquatic life in downstream stream reaches affected by the HWWTP and YWWTP discharges.

Attainability of the aquatic life use is addressed in Section 7 of this document.

7.0 AQUATIC LIFE ATTAINMENT EVALUATION

The evaluation of attainable aquatic life uses included a field survey of benthic macroinvertebrates, fish, and habitat upstream and downstream of the HWWTP during the dry season (September and November 2012) flow conditions and a field survey of benthic macroinvertebrates and habitat upstream and downstream of the HWWTP and YWWTP during the wet season (April 2013) flow conditions.

One objective of the analysis of biological communities was to evaluate the effects of elevated minerals due to the HWWTP and YWWTP discharges. Accordingly, this evaluation involved comparisons between upstream and downstream communities. Because sulfate and chloride are only minor components of TDS in the Crooked Creek reaches upstream and downstream of the discharges (Section 4.3), overall TDS was the primary focus of the evaluation of the designated use attainment. Monitoring data presented in Section 4.0 demonstrate that TDS concentrations at both the upstream and downstream sites in both reaches exceed the Crooked Creek TDS criterion of 200 mg/L. Therefore, upstream versus downstream comparisons of biological communities do not address potential effects on aquatic life due to the fact that TDS concentrations also exceed the criterion upstream of the outfall. Evaluation of potential effects due to TDS concentrations that exceed criteria must be based on comparisons with reference locations that do not exceed TDS criteria. Therefore, the comparisons of primary interest were as follows:

1. CC-0 versus CC-1 to assess potential effects on Crooked Creek due to the HWWTP discharge,
2. CC-2 versus CC-3 to assess potential effects on Crooked Creek due to the YWWTP discharge, and
3. All Crooked Creek locations versus least-disturbed Ozark Highland ecoregion reference streams to document potential differences in biological communities resulting from the existing minerals regime in Crooked Creek.

Comparisons with reference streams used available data from ADEQ's routine biological monitoring of least-disturbed waterbodies. An advantage of this type of comparison is that it can account for variability among sites with information from several reference sites and comparison sites. A disadvantage of this approach is that the comparison is somewhat biased because Crooked Creek is not a least-disturbed system in the reaches upstream and downstream of the HWWTP and YWWTP discharges. Therefore, a certain level of impairment due to factors other than minerals (e.g., urbanization and other land uses) should be expected in those reaches.

Based on conversations with ADEQ staff, this approach used benthic macroinvertebrate and water quality collections from Yocum Creek (YC) and Long Creek (LC) at two locations on each stream (YC-1, YC-2, LC-1 and LC-2). Basic information for these sites is provided in Table 7.1. Both spring and fall macrobenthos collections were available from one or two sites on both reference streams. Field sampling methods used in ADEQ's routine biological monitoring (timed single-habitat collections from riffles) as well as sample sorting and taxonomic identification protocols were comparable to those used for this study.

Table 7.1. Basic information for least-disturbed reference sites used in the analysis of benthic macroinvertebrate communities.

Stream Name	Drainage Area (mi^2)	Latitude	Longitude	Sample Date	ADEQ Sample Reference Number
Yocum Creek 1	55	36.41444	-93.3829	06/07/2001	ADEQ4k-50
				11/01/2000	ADEQ4k-3
Yocum Creek 2	55	36.41439	-93.3862	*N/A*	*N/A*
				11/01/2000	ADEQ4k-4
Long Creek 1	190	36.38808	-93.3116	06/07/2001	ADEQ4k-48
				10/31/2000	ADEQ4k-1
Long Creek 2	190	36.38793	-93.3116	06/07/2001	ADEQ4k-49
				10/31/2000	ADEQ4k-2

Sampling of the Crooked Creek biological communities involved the following efforts:

- Fall 2012: Fish and benthic macroinvertebrate sampling upstream and downstream of the HWWTP (locations CC-0 and CC-1, respectively), and
- Spring 2013: Benthic macroinvertebrate sampling upstream and downstream of HWWTP (CC-0 and CC-1, respectively) and YWWTP (CC-2 and CC-3, respectively).

Fall sampling in the YWWTP reach was not conducted because surface flow was absent, as is normal for that reach during that season. An examination of the results of the fall sampling of the HWWTP reach and consultation with ADEQ staff indicated that there would be no need for additional fish sampling during the spring 2013 and that an adequate assessment of effects on the biota due to mineral discharges could be made based on the fall benthic macroinvertebrate and fish sampling of the HWWTP reach and spring macroinvertebrate sampling of both the HWWTP and YWWTP reaches.

The approach to evaluating differences in communities using multiple reference and comparison sites was to compute the overall percent similarity for each pair-wise combination of reference and Crooked Creek sites. The magnitude and consistency of differences between reference and Crooked Creek sites were compared by examining the average and range of percent similarity across all pair-wise comparisons in light of differences in water quality (i.e., minerals).

7.1 Habitat Evaluation

Comparisons between upstream and downstream fish communities require that habitat is at least roughly equivalent between comparison reaches or that the confounding effects of habitat can be resolved based on habitat preferences of the biota. Benthic macroinvertebrate collection was conducted in a single habitat (riffle) within each reach so that habitat would have less potential to confound comparisons with the macroinvertebrate communities. Habitat characterization followed high-gradient stream habitat assessment procedures per Barbour et al. (1999). The characterization included visual evaluation of physical habitat and a scoring methodology that allowed a rough comparison of habitat quality among sites.

Physical variables assessed included the following:

1. Canopy cover,
2. Substrate type,
3. Sediment characteristics,
4. Dominant aquatic vegetation,
5. Proportion of reach with aquatic vegetation,

6. Pool/riffle ratio,
7. Average depth, width, current velocity,
8. Dominant riparian vegetation, and
9. Watershed features.

Scored habitat variables included the following:

10. Epifaunal substrate/available cover,
11. Embeddedness,
12. Velocity/depth regime,
13. Sediment deposition,
14. Channel flow status,
15. Channel alteration,
16. Frequency of riffles or bends,
17. Bank stability,
18. Vegetative protection, and
19. Riparian vegetative zone width.

Assessment of physical and habitat characteristics was conducted upstream (CC-0) and downstream (CC-1) of the HWWTP during September and November 2012 and April 2013, as well as upstream and downstream of YWWTP during April 2013, to identify potential habitat differences between the comparison reaches. The same FTN field personnel performed the evaluations of the upstream and downstream reaches.

7.1.1 Habitat Characteristics: Results and Discussion

Results of the assessment of physical characteristics and habitat variables upstream (CC-0) and downstream (CC-1) of the HWWTP for the fall 2012 sampling are presented in Tables 7.2 and 7.3. Results of the assessment of upstream and downstream locations for the spring 2013 sampling are presented in Tables 7.4 and 7.5. Completed habitat forms are provided in Appendix D. Nonpoint runoff from urbanization and pasture habitat within the immediate vicinity potentially affected both upstream and downstream locations of both reaches. Neither of the stream reaches was channelized.

Crooked Creek habitat was comparable upstream and downstream of the HWWTP and was comprised of pools, riffles, and runs dominated by cobble and gravel with a small percentage of organic substrate components. Scored habitat variables (Tables 7.2 and 7.4) can be used to evaluate relative habitat quality. Although they are somewhat subjective and subject to investigator bias, they are useful for evaluating general trends and relationships and for detecting large differences in habitat. A given difference in total habitat scores can be due to small consistent differences among most or all parameters, or large differences among a few. In general, differences in total habitat scores of approximately 20 points or more can be considered to indicate an actual difference in habitat quality. By this criterion, the assessment indicated similar habitat quality of optimal condition in the reaches upstream and downstream of the HWWTP and the YWWTP (Tables 7.2 and 7.4).

Comparison of physical habitat variables (Tables 7.3 and 7.5) also indicated similar conditions upstream and downstream of both discharges. One notable seasonal difference was higher substrate coverage with attached algae in the reaches upstream and downstream of HWWTP in the spring sampling (up to 80% in both reaches; see Table 7.5) compared to the fall sampling (0% to 1%; see Table 7.3). Discharge data collected in the immediate vicinity of the macroinvertebrate sampling locations show similar depths and velocities in the upstream and downstream macroinvertebrate sampling locations. The downstream location was approximately 0.1 ft deeper and 0.14 ft/sec slower than the upstream location.

Table 7.2. Summary of habitat evaluation performed September 19 and 20, 2012.

Category	CC-0	CC-1*
Epifaunal Substrate/Available Cover	18	18
Embeddedness	18	17.5
Velocity/Depth Regime	19	17
Sediment Deposition	15	16
Channel Flow Status	14	16.5
Channel Alteration	20	20
Frequency of riffles	20	19
Bank Stability	7/9	6.5/7
Vegetative Protection	7/9	8.5/9
Riparian Vegetative Zone Width	3/10	6/9.5
Total Habitat Score	169	170.5

* The score reported is the average of scores from two separate sections of the reach scored independently.

Table 7.3. Summary of physical and habitat characteristics evaluation performed September 19 and 20, 2012.

Category		CC-0	CC-1
Canopy cover		Partly open	Partly open
Inorganic substrate (% coverage)	Bedrock	10	10
	Boulder	5	10
	Cobble	35	25
	Gravel	50	50
	Sand	0	2
	Silt	0	3
	Clay	0	0
Organic substrate (% composition)	CPOM	<5	5
	FPOM	<1	<5
	Shell	0	0
Dominant aquatic vegetation		None	Rooted emergent
Percent of reach with aquatic vegetation		0	1
Pool/riffle ratio		1:2	1:3
Average stream depth (m)		0.4	0.3
Average stream width (m)		10	12.5
Average current velocity (m/s)		0.2	0.2
Substrate odors		Normal	Normal
Substrate oils		None	None
Substrate deposits		None	None
Embedded stones black on underside?		No	No
Dominant riparian vegetation		Trees (RB)/grasses (LB)	Trees (RB)/grasses (LB)
Watershed features	Land use	Forest/field/pasture	Forest/field/pasture
	Pollution sources	Yes	Yes
	Erosion	Minimal	Minimal
Weather		Clear/sunny	Clear/sunny

Table 7.4. Summary of habitat evaluation performed April 2 and 3, 2013.

Category	CC-0	CC-1*	CC-2	CC-3
Epifaunal Substrate/Available Cover	19	17.5	16	19
Embeddedness	18	17	18	17
Velocity/Depth Regime	19	19	19	20
Sediment Deposition	19	16.5	18	18
Channel Flow Status	19	19	19	19
Channel Alteration	20	20	20	17
Frequency of Riffles (or bends)	20	19	13	19
Bank Stability (LB)	6	5.5	7	8
Bank Stability (RB)	9	7.5	9	9
Vegetative Protection (LB)	5	6.5	9	9
Vegetative Protection (RB)	10	8.5	10	9
Riparian Vegetative Zone Width (LB)	3	6.5	9	10
Riparian Vegetative Zone Width (RB)	10	9	10	9
Total Habitat Score	177	171.5	177	183

* The score reported is the average of scores from two separate sections of the reach scored independently.

Table 7.5. Summary of physical and habitat characteristics evaluation performed April 2 and 3, 2013.

Category		CC-0	CC-1 (upstream portion)*	CC-1 (downstream portion)*	CC-2	CC-3
Canopy cover		Partly open	Partly open	Partly open	Partly open	Partly open
Inorganic substrate (% coverage)	Bedrock	10	10	10	0	0
	Boulder	5	10	10	< 1	5
	Cobble	40	35	30	50	45
	Gravel	45	45	50	50	50
	Sand	0	0	0	0	0
	Silt	0	0	0	0	0
	Clay	0	0	0	0	0
Organic substrate (% composition)	CPOM	10	5	< 5	0	0
	FPOM	0	0	0	0	0
	Shell	0	0	0	0	0
Dominant aquatic vegetation		Attached algae	Attached algae	Rooted & attached algae	None	None
Percent of reach with aquatic vegetation		80	80	5	0	0
Pool/riffle ratio		1:1	1:1	1:2	4:1	4:1
Average stream depth (m)		NR	NR	NR	NR	NR
Average stream width (m)		10	NR	10	25	25
Average current velocity (m/s)		NR	NR	NR	NR	NR
Substrate odors		Normal	Normal	Normal	Normal	Normal
Substrate oils		Absent	Absent	Absent	Absent	Absent
Substrate deposits		None	None	None	None	None
Embedded stones black on underside?		No	No	No	No	No
Dominant riparian vegetation		Trees, grasses	Trees, grasses	Trees	Trees	Trees
Watershed features	Land use	Forest, field, pasture	Forest, field, pasture	Forest, field, pasture	Forest, field pasture	Forest, field pasture
	Pollution sources	Yes	Yes	Yes	Yes	Yes
	Erosion	Moderate	Moderate	Moderate	Moderate	Moderate
Weather		Rain	Rain	Rain	Cloudy	Rain

*Upstream and downstream portions of CC-1 refer to upstream and downstream portions of the reach in which sampling site CC-1 is located.

Substrate composition among the Crooked Creek sampling locations (where macroinvertebrate sampling was conducted) and the reference stream locations is summarized on Figure 7.1.

Both fall and spring sampling included the collection of a duplicate riffle sample from the location downstream of the HWWTP (CC-1). Differences between the duplicate samples were within the expected range of variability.

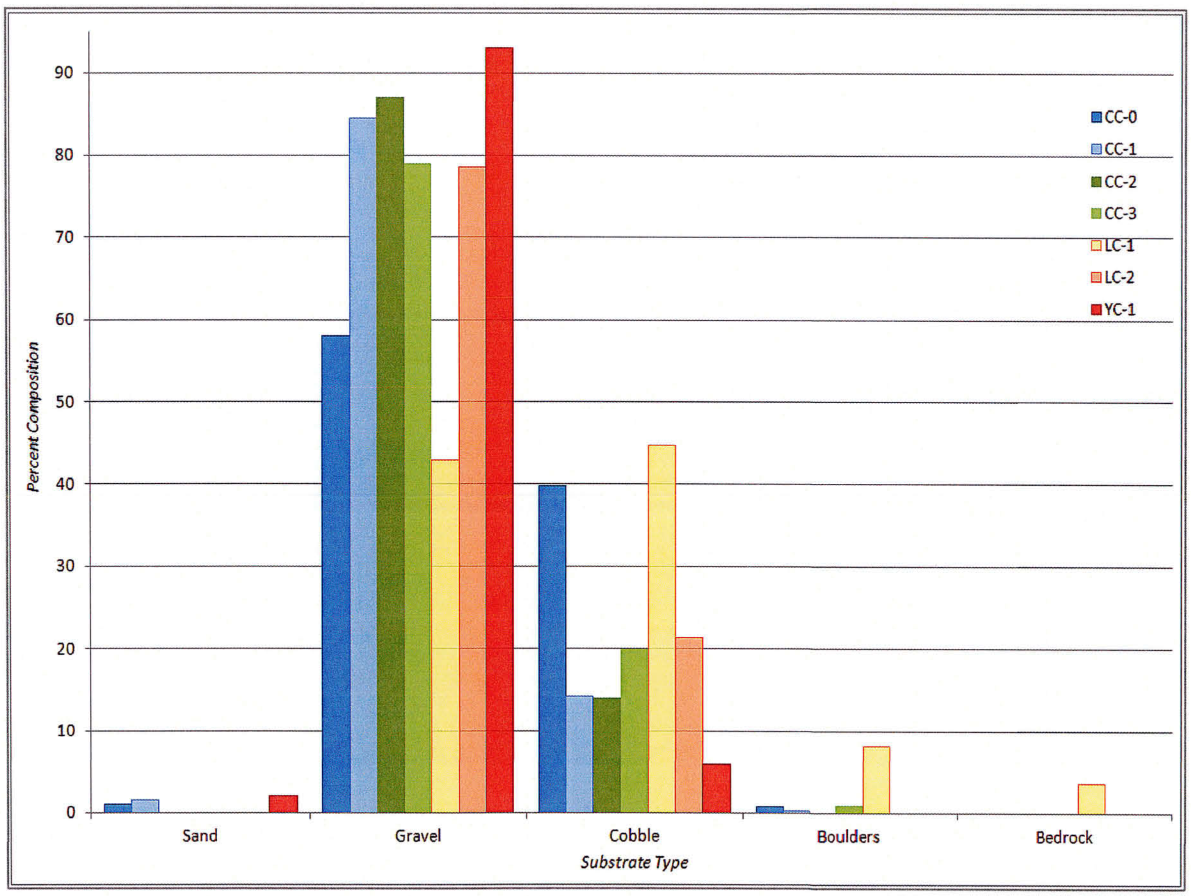


Figure 7.1. Substrate composition in Crooked Creek and the reference streams.

7.1.2 Habitat Characteristics: Conclusions

Habitat assessments indicated that within the study area, Crooked Creek is a waterbody with generally coarse substrates and land use dominated by forest and pasture. No differences in habitat quality upstream (CC-0) and downstream (CC-1) of the HWWTP were indicated by the assessment, including variables that could be affected by water quality such as an abundance of filamentous algae. Habitat evaluations indicated very similar habitat overall upstream and downstream of the YWWTP. The procedure classified habitat at both reaches as "optimal." The abundance and diversity of fish is expected to follow the same general pattern as habitat quality. Large deviations from this expectation indicate the influence of other limiting factors such as water quality.

Visual evaluation of Figure 7.1 indicates that (1) gravel and cobble substrates dominate all Crooked Creek and reference locations, and (2) the range of percent gravel and cobble composition at the sampling sites is within the range of percent gravel and cobble composition at the reference stream locations. This comparison shows that substrate composition was generally comparable between upstream and downstream sampling locations in Crooked Creek and between the reference stream locations and Crooked Creek sampling locations. None of the sites contained fine or embedded substrates that might be expected to impair benthic macroinvertebrate communities.

7.2 Biological Community Survey Methodology

7.2.1 Benthic Macroinvertebrate Field and Laboratory Methods

Invertebrate sampling was conducted using the five-minute traveling kick method (ADEQ 2010). Invertebrates were sampled using a D-frame kick net with 0.5-mm mesh net. Two riffles within each reach were sampled for a combined time of five minutes. Each riffle was sampled by starting at a downstream corner of the riffle and kicking the substrate along a diagonal path upstream through the riffle for 2.5 minutes. The two riffle samples were combined into one composite sample. After removal and washing of large debris, the entire content of the net was washed into wide-mouth plastic jars and immediately preserved with 70% ethanol.

Both fall and spring sampling included the collection of a duplicate riffle sample from the location downstream of the HWWTP (CC-1).

Samples were sorted in the laboratory by dispensing the entire sample onto a Caton grid. All organisms were sorted from randomly selected grids, one grid at a time, until a minimum of 250 organisms were collected. All individuals were counted in the selected grid. If one grid yielded greater than 250 organisms, the sub-sampling was considered complete. Some samples yielded large numbers of organisms in the first grid (e.g., the CC-1 duplicate yielded greater than 700 individuals). Sorted organisms were transferred to 70% ethanol in glass vials. To assure thorough removal of specimens from the sample, the sorted residue was retained and examined by a second biological technician. If the second sorting produced fewer than 10% of the number of organisms found in the initial sorting, the sorting of that sample was considered complete. If the second sorting produced more than 10% of the number of organisms found in the initial sorting, the sample was resorted until the 10% goal was reached.

Taxonomic identifications were carried out to the lowest practical taxon according to Merritt and Cummins (1996), Thorp and Covich (2001) and Houston (1980). In general, macroinvertebrates were identified to genus except for bivalve mollusks, gastropods, dipteran larvae, and decapod shrimp, which were identified to family. A voucher collection of invertebrate taxa collected at the sites was retained for further reference. Taxonomic identifications in the voucher collection were verified by a second taxonomist and identification discrepancies were resolved.

7.2.2 Benthic Macroinvertebrate Data Analysis

Benthic invertebrate data were evaluated following the bioassessment III protocols outlined in Plafkin et al. (1989) as modified by ADEQ (ADEQ personal communication). Appendix E provides a detailed description of this methodology as applied to this study for two types of comparisons: (1) locations downstream of the HWWTP and YWWTP discharges using upstream sites as a reference (CC-1 versus CC-0 for the HWWTP reach and CC-3 versus CC-2 for the YWWTP reach); and (2) all Crooked Creek stations versus least-disturbed waterbodies (LC-1, LC-2, YC-1, and YC-2).

7.2.3 Fish Sampling Methods

Prior to sampling each stream reach, the upper and lower ends of the reach were cordoned off using block nets. Fish sampling was conducted using a Smith-Root LR-24 DC current backpack electroshocker. Sampling of each reach was conducted by probing all available habitat beginning at the downstream end of the reach, and proceeding upstream. Two sampling passes were performed on each reach. Stunned fish were collected in a plastic bucket and maintained with aeration until processed. Each individual captured was identified in the field to species according to Robison and Buchanan (1988). Physical anomalies were documented. Individuals not positively identified in the field were killed, preserved in formalin, and identified in the laboratory. After processing, all living fish were returned to the sampling reach.

Fish data were evaluated using the fish community biocriteria for Ozark Highland streams (Table 7.6) established by ADEQ (personal communication). Total scores of 37 to 45 identify the stream as fully supporting the designated use, 25 to 36 as generally supporting, 13 to 24 as impaired, and 0 to 12 as not supporting.

Table 7.6. Fish community biocriteria for Ozark Highlands streams.

Metric	Score		
	5	**3**	**1**
% Sensitive Individuals	>31	31 – 20	<20
% Cyprinidae (Minnows)	48 – 64	39 – 47 or 65 – 73	<39 or >73
% Ictaluridae (Catfishes)	>2[a]	1 – 2[a]	<1 or >3% bullheads
% Centrarchidae (Sunfishes)	4 – 15[b]	<4 or 15 – 20[b]	>20 or >2% green sunfish
% Percidae (Darters)	>11	5 – 11	<5
% Primary Feeders	<42	42 – 49	>49
% "Key" Individuals	>23	23 – 16	<16
Diversity*	>2.77	2.77 – 2.37	<2.37
# Species	>WA*0.034+16.45	WA*0.034+16.45 to WA*0.034+12.26	<WA*0.034+12.26

Notes: WA = watershed area (mi^2)
(a) No more than 7% bullheads.
(b) No more than 12% green sunfish.

7.3 Biological Characteristics Results and Discussion

7.3.1 Benthic Macroinvertebrates

Upstream versus Downstream of HWWTP and YWWTP Outfalls

Table 7.7 summarizes the percent similarity of benthic macroinvertebrate communities upstream versus downstream of the HWWTP and YWWTP. Appendix E provides a detailed description of how Table 7.7 was compiled. The fall samples indicated slight to no significant impairment at the location downstream of the HWWTP (CC-1 and CC-1 duplicate) relative to the upstream location (CC-0). The spring samples indicated slight to no significant impairment at the location downstream of the HWWTP and moderate impairment at the location downstream of the YWWTP.

Table 7.7. Summary of upstream versus downstream comparisons of benthic macroinvertebrate communities in Crooked Creek.

Season	Downstream Station	Percent Similarity with Reference (Upstream)	Interpretation
Fall	CC-1 (HWWTP)	68.8%	Slight impairment
	CC-1 duplicate (HWWTP)	93.8%	No significant impairment
Spring	CC-1 (HWWTP)	75.0%	Slight impairment
	CC-1 duplicate (HWWTP)	87.5%	No significant impairment
	CC-3 (YWWTP)	33.3%	Moderate impairment

One of the potential underlying mechanisms that may affect assemblage structure is the presence of stressors such as elevated mineral concentrations, which is the focus of this study. As shown in Section 4.0, the outfalls have a minor influence on downstream TDS concentrations at both locations. Average TDS, sulfate, and chloride concentrations increased by 17 mg/L, 4.9 mg/L, and 4.9 mg/L, respectively, in Crooked Creek below the HWWTP outfall (Table 4.6). This corresponded to a minimal change in the macroinvertebrate community downstream as represented by duplicate samples (no significant impairment to slight impairment; see Table 7.7). Upstream to downstream differences in TDS concentrations in both reaches are typically less than monthly or biweekly differences (Figure 4.1). It is not clear whether a cause and effect relationship would be expected to exist between small changes such as these. The YWWTP reaches showed the largest upstream to downstream assemblage differences (Table 7.7) but showed the smallest upstream to downstream mineral differences in both absolute and relative terms, where average TDS and sulfate concentrations increased by 8 mg/L and 0.6 mg/L, respectively, downstream of the YWWTP outfall (Table 4.7). This result shows that the magnitude of the minerals increase downstream of the discharge is not commensurate with the downstream change in the benthic macroinvertebrate communities. If the macroinvertebrate assemblages are responding to the modest upstream to downstream increases in mineral concentrations (i.e., a less than 10% difference in upstream versus downstream 95th percentile TDS values), then the greatest upstream to downstream mineral differences (observed at the HWWTP) should cause the greatest upstream to downstream assemblage differences. The opposite was observed. Accordingly, there must be other underlying mechanisms affecting assemblage structure. These underlying factors do not appear to be related to physical habitat or substrate because those factors do not vary appreciably between upstream and downstream locations.

Crooked Creek Locations versus Least-Disturbed Reference Streams

Overall similarity values for each pair-wise combination of a Crooked Creek location versus a least-disturbed reference location are provided in Table 7.8 and summarized in Table 7.9. Appendix E provides a detailed description of how Tables 7.8 and 7.9 were compiled. Table 7.9 demonstrates that depending on the season and the particular sites that are compared, sites upstream or downstream of the HWWTP or YWWTP were slightly to moderately impaired relative to least-disturbed reference sites.

Table 7.8. Comparison matrix of overall percent similarity between least-disturbed reference streams and Crooked Creek sites.

Season	Site	YC-1	YC-2	LC-1	LC-2
Fall	CC-0	52.9%	66.7%	46.7%	60.0%
	CC-1	41.2%	66.7%	53.3%	60.0%
	CC-1 Dup	47.1%	86.7%	60.0%	73.3%
Spring	CC-0	47.1%	No data	44.4%	50.0%
	CC-1	41.2%	No data	44.4%	44.4%
	CC-1 Dup	41.2%	No data	38.9%	44.4%
	CC-2	58.8%	No data	66.7%	66.7%
	CC-3	29.4%	No data	27.8%	27.8%

Table 7.9. Summary of overall percent similarity between least-disturbed reference and Crooked Creek sites.

Season	Summary Statistic	Percent Similarity	Interpretation
Fall	Minimum	41.2%	Moderate Impairment
	Mean	59.5%	Slight Impairment
	Maximum	86.7%	No Significant Impairment
Spring	Minimum	27.8%	Moderate Impairment
	Mean	44.9%	Moderate Impairment
	Maximum	66.7%	Slight Impairment

A summary of TDS, chloride and sulfate concentrations from ten sampling events on Yocum Creek and Long Creek during the same general time period as the biological sample collection (2001 through 2004 for the water quality sampling versus 2000 and 2001 for the biological sampling), and during multiple seasons, shows an average TDS concentration of 228 mg/L (14% greater than the Crooked Creek criterion), with all measurements in excess of the Crooked Creek TDS criterion of 200 mg/L (Table 7.10). Sulfate and chloride values were all less than the current Crooked Creek criteria.

Table 7.10. Summary of mineral concentrations from ADEQ sampling of Long Creek and Yocum Creek least-disturbed streams.

Location	Sampling Date	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)
Long Creek (ADEQ WHI0071)	10/10/2000	238	7.8	15.6
	11/07/2000	226	7.9	14.5
	09/12/2000	227	6.9	14.0
	05/29/2001	229	9.7	17.0
	06/26/2001	226	9.2	17.0
Yocum Creek (ADEQ WHI0137)	10/27/2003	235	5.9	12.2
	01/12/2004	236	7.5	12.6
	03/22/2004	233	6.9	12.8
	05/17/2004	207	5.7	9.9
Minimum		207	5.7	9.9
Mean		228	7.5	14.0
Maximum		238	9.7	17.0

These TDS concentrations exceed Crooked Creek criteria by similar or greater magnitudes than concentrations from biweekly monitoring of the Crooked Creek locations during this study. This result demonstrates that TDS concentrations similar to the existing Crooked Creek concentrations, including those influenced by the discharges, will support a least-disturbed benthic macroinvertebrate community. This would also suggest that the slight changes in TDS upstream and downstream of the HWWTP do not cause the observed differences in the benthic macroinvertebrate community in that reach. Chloride and sulfate concentrations are higher in Crooked Creek than in the least-disturbed streams (though still generally lower than ecoregion criteria). As discussed in Section 4.3, chloride and sulfate are a minor part of the ionic makeup of Crooked Creek, with most TDS present as calcium and bicarbonate (Table 4.9). This is likely the case for Ozark Highland ecoregion streams in general. Therefore, for the purposes of aquatic life protection in this case, it is appropriate to focus on TDS.

7.3.2 Fish

Relative species abundances for the September 2012 collections are presented in Table 7.11. Biocriteria metrics and metric values (Ozark Highlands streams) for the September 2012 collection in the HWWTP reach are presented in Table 7.12.

Cyprinids dominated fish communities in terms of species composition and numbers of individuals in Crooked Creek upstream (CC-0) and downstream (CC-1) of the HWWTP (Table 7.11). *Campostoma oligolepis* was the most common cyprinid at both locations followed by *Luxilus pilsbryi*. In addition, the most common species by family at both sites were *Hypentelium nigricans* (Catostomidae), *Noturus exilis* (Ictaluridae), *Ambloplites constellatus* (Centrarchidae), *Etheostoma caeruleum* (Percidae), and *Cottus carolinae* (Cottidae). All dominant species by family, with the exception of *Campostoma oligolepis* and *Cottus carolinae* are key species in the Ozark Highlands. *Cottus carolinae* is an indicator species in the Ozark Highlands.

The fish communities upstream and downstream of the HWWTP were very similar with respect to the total taxa, relative abundances, and biocriteria metric values for the Ozark Highlands streams (Tables 7.11 and 7.12). The fish community IBI scores indicate that Crooked Creek "generally supports" Ozark Highland fish communities upstream of the HWWTP (CC-0) and "fully supports" those communities downstream of the HWWTP (CC-1).

Table 7.11. Summary of fish collections (as percent relative abundance) conducted September 19 and 20, 2012.

Family	Species	Sampling Location	
		CC-0	**CC-1**
Cyprinidae	*Campostoma oligolepis*	52.1	48.6
	Luxilus chrysocephalus	0.3	0.3
	*Luxilus pilsbryi**	14.0	11.7
	Nocomis biguttatus	1.0	0.5
	*Notropis nubilus***	4.3	5.1
	Notropis rubellus	1.3	1.4
	Pimephales notatus	0.6	0.4
	Semotilus atromaculatus	0.0	0.2
Catostomidae	*Hypentelium nigricans**	1.2	0.9
	Moxostoma duquesnii	0.5	0.5
Ictaluridae	*Ameiurus natalis*	0.0	0.2
	*Noturus exilis**	3.2	1.8
Fundulidae	*Fundulus catenatus*	0.0	0.1
	Fundulus olivaceus	0.0	0.1
Poeciliidae	*Gambusia affinis*	0.2	0.1
Centrarchidae	*Ambloplites constellatus**	2.3	2.8
	Lepomis cyanellus	0.1	0.0
	Lepomis megalotis	0.8	1.0
	*Micropterus dolomieu**	0.4	0.5
	Micropterus salmoides	0.1	0.1
Percidae	*Etheostoma blennioides*	0.7	1.1
	*Etheostoma caeruleum**	14.1	18.6
	Etheostoma zonale	0.4	1.1
Cottidae	*Cottus carolinae***	2.4	3.0
Total Taxa		**20**	**23**
Total Number		**1,078**	**1,681**

* Ozark Highlands ecoregion key species
** Ozark Highlands ecoregion indicator species

Table 7.12. Summary of fish community biocriteria metrics for sampling conducted September 19 through 20, 2012.

Biocriteria Metric	Sampling Location			
	CC-0		CC-1	
	Metric Score	Metric Value	Metric Score	Metric Value
% Sensitive Individuals	5	41.56	5	43.96
% Cyprinidae	1	73.56	3	68.23
% Ictaluridae	5	3.25	5	2.02
(% bullheads)		0.00		0.18
% Centrarchidae	3	3.71	5	4.34
(% Green sunfish)		0.09		0.00
% Percidae	5	15.21	5	20.70
% Primary Feeders	1	56.96	1	54.07
% Key Individuals	5	35.25	5	36.29
Diversity	3	2.43	3	2.53
# Species	3	15-20*	5	15-20*
Total Score	31		37	

*Metric value was calculated using a watershed size of 76 square miles.

7.4 Additional Factors Potentially Affecting Use Attainability

ADEQ's review of the draft UAA report requested evaluation of causal variables that might contribute to the impairment observed in the macrobenthic community downstream of YWWTP in the spring sampling, such as habitat variables (see Sections 7.1.1 and 7.1.2), timeliness of sampling efforts downstream of the YWWTP after consistent flow was re-established, and other water quality parameters such as nutrients.

7.4.1 Timeliness of Sampling Efforts

As discussed in Section 4.1.2, the sampling site downstream of YWWTP did not achieve consistent flow until approximately 40 days after consistent flow was achieved at the upstream sampling site. The biological sampling effort occurred in Crooked Creek approximately 90 and 50 days after consistent flow was achieved at the YWWTP upstream and downstream sites, respectively. The extent to which this difference could account for the observed differences in the macroinvertebrate communities is unclear. Differences in the time available for colonization might be expected to affect diversity measures such as taxa richness and community loss. The score for the upstream versus downstream comparison of taxa richness was zero for the YWWTP reach in spring 2013 (see Table E.7 in Appendix E), which is consistent with this expectation. However, the comparison for the community loss metric (score = 4) does not support this expectation. It is unclear how time of colonization might affect the remaining metrics in Table E.7.

7.4.2 Other Water Quality Variables

FTN deployed data loggers upstream and downstream on the YWWTP in the spring of 2013 to monitor diel changes in dissolved oxygen, pH, conductivity, and temperature. However, the upstream logger malfunctioned during deployment, which precluded an upstream versus downstream comparison of those factors.

Biweekly sampling of the receiving streams and discharges included analyses of major anions and cations in selected samples, which demonstrated that the discharges have minimal effects on ion composition in Crooked Creek (Tables 4.8 and 4.9). However, the data set did not include upstream versus downstream measurements of nutrients, so nutrients cannot be evaluated as a potential factor. However, it should be noted that ADEQ stated in its comments on the draft UAA report that changes in the benthic macroinvertebrate community are consistent with effects due to nutrients.

7.5 Aquatic Life Use Attainability

Results of the analysis of biological communities with respect to existing mineral concentrations can be summarized as follows:

1. Both outfalls have a minor impact on downstream TDS, sulfate, and chloride concentrations;
2. Habitat evaluations indicated very similar habitat upstream and downstream of the YWWTP. Discharge data collected in the immediate vicinity of the macroinvertebrate sampling locations also show similar depths and velocities upstream and downstream. Based on the habitat evaluations, Wolman pebble counts, and flow transect data, it was concluded that habitat is not a likely cause of the observed impairment of the downstream macroinvertebrate assemblage compared to the upstream assemblage and to least-disturbed ecoregion reference conditions;

3. There is no discernible adverse impact on fish communities in Crooked Creek due to the presence of the HWWTP. Because the impact of the YWWTP on downstream water quality is similar to that of the HWWTP, it is likely that the YWWTP water quality has a similarly negligible adverse impact on the downstream fish communities;

4. Spring samples upstream versus downstream of the discharges show no significant impairment to moderate impairment of the benthic community in the downstream reaches. However, the magnitude and timing of the TDS, sulfate, and chloride increases downstream of the discharges are not commensurate with the downstream changes in the benthic macroinvertebrate communities;

5. A total of five independent biological samples (two macrobenthic samples with two duplicates, and one fish sample) were collected in the upstream and downstream reaches of the HWWTP. Three of the five (two macrobenthic and the fish sample) showed no impairment, and the remaining two showed slight downstream impairment. These results are consistent with similar habitat characteristics in the upstream and downstream reaches. For example, percent algal cover, which would be expected to respond to differences in water quality due to the discharges, did not change from upstream to downstream. Therefore, the HWWTP has only minimal effects on the biology in the downstream reach; and

6. TDS concentrations exceed the Crooked Creek site-specific criterion at all locations, including those upstream of the HWWTP and YWWTP discharges. Based on data collected during the study, sulfate and chloride values rarely exceeded the Crooked Creek criteria. Benthic macroinvertebrate communities show moderate to slight impairment when compared to communities in least-disturbed streams. TDS concentrations in the least-disturbed streams considered in this study were similar or higher and also exceeded the Crooked Creek site-specific criterion. Therefore, the existing minerals concentrations in Crooked Creek, including those due to input from the HWWTP and YWWTP, can be expected to support Ozark Highland ecoregion least-disturbed benthic macroinvertebrate communities.

These findings demonstrate conclusively that the modest increases in TDS, sulfate, and chloride concentrations downstream of the HWWTP and YWWTP outfalls do not cause adverse impacts to aquatic life, and also demonstrate that the existing TDS concentrations in the Crooked Creek reaches upstream and downstream of the HWWTP and YWWTP do not limit benthic macroinvertebrate communities and can be expected to support the Ozark Highland fisheries designated use.

8.0 EVALUATION OF ALTERNATIVES

UAA guidance requires that an evaluation be made of the alternatives to the direct discharge of the water. These alternatives are evaluated for technical and economic considerations. Based on a number of similar evaluations in previous UAAs, the alternatives for management of effluents with elevated dissolved minerals are limited. Three alternatives that have been reviewed for similar applications include: (1) reverse osmosis (RO) treatment of the wastewater, (2) pumping the wastewater to a larger stream that holds the potential for dilution of the minerals, and (3) treatment using a constructed wetland. FTN has completed this evaluation of alternatives based on previous experience, information from published literature, and from data provided by the city. The evaluation was primarily completed by Rex Robbins, PE, of FTN.

Based on preliminary screening of these three options, the use of a constructed wetland can be dismissed for both facilities. Constructed wetlands can only be used to reduce sulfate, which results in the production of bicarbonate in place of sulfate (Hedin et al. 1989). Sulfate makes up an average of 15% of the TDS of the HWWTP (Table 4.9). Therefore, although a constructed wetland could, in principle, reduce sulfate in the HWWTP discharge, the resulting TDS concentration would not be decreased (due to the replacement of the sulfate ions with bicarbonate ions) and no net benefit would be obtained. In addition, wetland treatment will have no effect on TDS as calcium, sodium, bicarbonate, or chloride (Hedin et al. 1989), which comprise, on average, 54% of the HWWTP discharge TDS (Table 4.9). Similarly, calcium, sodium, bicarbonate, and chloride comprise an average of 79% of the TDS of the YWWTP discharge and would be virtually unaffected by wetland treatment.

Accordingly, the following sections evaluate two alternatives for achieving compliance with the Arkansas water quality criteria:

- RO treatment to remove or reduce dissolved minerals; and
- Pumping the wastewater to a larger stream that holds the potential for dilution of the minerals.

These two alternatives will be compared with the anticipated cost of implementing revised site-specific criteria for dissolved minerals in Crooked Creek. The evaluation of these alternatives follows.

8.1 TDS Treatment Through Reverse Osmosis

Wastewater technologies, such as conventional precipitation, can efficiently remove the heavy metals from wastewater to meet the effluent requirements. However, these systems do not remove the dissolved compounds like sulfate and TDS. As a result, the effluent flow from the treatment plant is limited by the dilution of the flow in the receiving stream to reduce these constituents to acceptable concentrations.

RO is an advanced water/wastewater treatment process capable of removing dissolved contaminants such as TDS, sulfate, and chloride. It is essentially an extension of a filtration process in which highly pressurized feed water flows across a membrane, with a portion of the flow, identified as "permeate," going through the membrane. The rest of the feed is called "concentrate" because it carries off the concentrated contaminants rejected by the membrane. The concentrate amount depends on many factors and can vary between 10% to 30% of the feed. Depending on the size of the pores in the membrane, the process results in different classes of separation. For the removal of dissolved solids, a membrane capable of rejecting elemental particles must be utilized.

8.1.1 Technical Considerations

Based on the preliminary information available from equipment manufacturers, RO is a possible alternative treatment for effluent to meet the limits for TDS and sulfate. The RO permeate would be of high quality and meet downstream Arkansas WQS in this process.

The most common problems with RO involve the tendency for fouling problems when applied to concentrated waste streams and the cost of operation (i.e., electricity, membrane cleaning, etc.).

The disposal of the concentrated brine generated by this process is a larger problem. This issue generally becomes the controlling factor in the selection of RO for many applications. RO separates the contaminants from water, but it does not chemically change them to other non-polluting compounds. This concentrate would require disposal by other methods.

8.1.2 Concentrate Disposal Options

The brine solution may be (1) solidified and disposed onsite, (2) transported offsite for stabilization prior to landfilling, or (3) transported offsite to a municipal or industrial wastewater treatment system. The waste brine solution is not a hazardous waste in Arkansas, but disposal in neighboring states may be restricted to industrial or hazardous waste facilities. Transportation will be a critical factor for two of the three options.

8.1.2.1 Onsite Stabilization

The concentrate could be stabilized onsite, using a cementitious element such as Portland cement or fly ash. This would require the construction of a mixing facility, purchase of the cementitious agent, crews, and equipment to mix the waste solution, regulatory authority to dispose of the waste onsite, and engineering support for selection and operation of a disposal area. The critical and unknown costs for this option are the mixing ratio for the waste solution/stabilization agent, and any required environmental protection controls for the disposal area. The mixing ratio determines the tonnage necessary for purchase of the stabilizing agent, and the environmental protection controls could range from open disposal on land adjacent to the facility or the installation of a landfill with liners and caps.

8.1.2.2 Offsite Treatment

The wastewater could be transported offsite by truck to an industrial or municipal wastewater treatment facility. It would be necessary to provide waste profile information to each facility to obtain cost information. For treatment and discharge, the treatment facility would need to be located at a site with capabilities for discharging to a large waterbody or to an underground disposal well. The critical cost component would be the cost of transportation and the cost per disposal on a per-gallon basis.

8.1.2.3 Offsite Stabilization

The wastewater could be transported to an industrial or municipal landfill for stabilization and disposal. Offsite disposal offers several advantages. The site earthwork balance does not have to account for onsite disposal, and there is a minimum of regulatory approval required when the waste is removed to an offsite facility. For local landfills, the costs may be lower than for landfills dedicated to industrial or hazardous waste, but the environmental control can differ from cell to cell, requiring more oversight of disposal operations.

8.1.3 Economic Considerations for the Harrison WWTP

For the Harrison WWTP, a set of conditions was chosen to provide a basis for sizing equipment and estimating operating costs. The water analysis and the design flow requirements are primary considerations in the sizing and cost of the equipment. Pumps and piping that are associated with the RO process would be required along with controls, building, utilities, etc.

The basic assumptions used in the analysis of costs for the HWWTP are shown below:

1. A design flow of approximately 2.6 mgd (1,800 gallons per minute [gpm]) is the basis for sizing the RO system.
2. An average flow rate of 2.6 mgd (1,800 gpm) is the basis for calculating operating costs.
3. To reduce the amount of brine requiring disposal, the system will consist of a minimum of three RO units in series, and a holding tank to facilitate disposal of the concentrate. Each pass will have a reject rate of 20%.
4. Approximately 8.3 million gallons per year at 5% solids will be generated as brine solution reject from the RO treatment system and will require disposal.
5. The treated effluent will be discharged to waters of the United States.
6. The waste brine solution would be about 5% solids.

The following cost information is based upon a three-stage RO system, able to sequentially concentrate the reject water to about 1/100 of its original volume. The concentrate could then be stored in an onsite holding tank.

The capital costs of installing an RO treatment system have been estimated by the US Army Corps of Engineers (USACE) to range from $1.44 to $2.13 per gallon per day. This is for a single-stage RO unit. For a three-stage RO unit, it is estimated that the costs would increase by a factor of 1.5. The costs were developed by USACE for a typical brackish water application in Florida. These values are widely cited in the literature, and although dated, are still considered adequate for a comparison of alternatives. Over this time period (since the mid-1990s), the cost of RO membranes has been reduced. However, the cost of ancillary equipment (i.e., equipment housing, pumping, piping) has increased. Therefore, the costs are considered valid for the intended use. For purposes of this discussion, the costs for installing an RO system are estimated at $2.16 per gallon per day. This provides an estimated capital cost of the treatment system of approximately $5,600,000.

USACE further estimated the operating costs of an RO system (less the costs of brine disposal) at about $0.001 per gallon for a large-scale treatment system. This cost would translate to an annual operating cost of about $950,000.

The above costs are based on generic estimates. However, these estimates provide a method for comparison between the different alternatives that are available. As stated above, the costs of disposal of the concentrate actually becomes the controlling factor with this application.

For the disposal of the concentrate, the critical cost components for offsite treatment or disposal are the cost of transportation and the per-ton disposal fee for the waste. Typical haul and disposal costs for a similar project have been shown to be about $1.00 per gallon for transport and disposal at an Oklahoma facility. The use of a local landfill or a deep well disposal site in Louisiana, if acceptance of the waste can be obtained, may lower that cost to about $0.60 per gallon. Even at this lower cost, the annual costs associated with disposal would be about $5,000,000 per year. It is possible that, given these high costs, an evaporator or other means for drying the solids would be feasible. However, there would still be a dried product requiring disposal. The cost of installing and operating the drying equipment is not expected to be significantly lower than shown above for hauling and disposal.

Therefore, based on these preliminary calculations, RO treatment would have a capital cost of about $5.6 million and an annual operating cost of about $5,950,000.

8.1.4 Economic Considerations for the Yellville WWTP

For the Yellville WWTP, a set of conditions was chosen to provide a basis for sizing equipment and estimating operating costs. The water analysis and the design flow requirements are primary considerations in the sizing and cost of the equipment. Pumps and piping that are associated with the RO process would be required along with controls, building, utilities, etc.

The basic assumptions used in the analysis of costs for the YWWTP are shown below:

1. A design flow of approximately 0.75 mgd (520 gpm) is the basis for sizing the RO system.
2. An average flow rate of 0.29 mgd (200 gpm) will be the basis for calculating operating costs.
3. To reduce the amount of brine requiring disposal, the system will consist of a minimum of three RO units in series, and a holding tank to facilitate disposal of the concentrate. Each pass will have a reject rate of 20%.
4. Approximately 441,500 gallons per year at 5% solids will be generated as brine solution reject from the RO treatment system and will require disposal.
5. The treated effluent will be discharged to waters of the United States.
6. The waste brine solution would be about 5% solids.

The following cost information is based upon a three-stage RO system, able to sequentially concentrate the reject water to about 1/100 of its original volume. The concentrate could then be stored in an onsite holding tank awaiting disposal.

The capital costs of installing an RO treatment system have been estimated by USACE to range from $1.44 to $2.13 per gallon per day. This is for a single-stage RO unit. For a three-stage RO unit, it is estimated that the costs would increase by a factor of 1.5. For purposes of this discussion, the costs for installing an RO system are estimated at $3 per gallon per day. This provides an estimated capital cost of the treatment system of approximately $2,250,000.

USACE further estimated the operating costs of an RO system (less the costs of brine disposal) at about $0.001 per gallon for a large-scale treatment system. This cost would translate to an annual operating cost of about $110,000.

For both the capital and operating costs, the factors provided by USACE may be low due to the relative size of this application. However, the cost estimates should provide a method for comparison. Also, as stated above, the costs of disposal of the concentrate actually becomes the controlling factor with this application.

For the disposal of the concentrate, the critical cost components for offsite treatment or disposal are the cost of transportation and the per ton disposal fee for the waste. Typical haul and disposal costs for a similar project have been shown to be about $1.00 per gallon for transport and disposal at an Oklahoma facility. The use of a local landfill or at a deep well disposal site in Louisiana, if acceptance of the waste can be obtained, may lower that cost to about $0.60 per gallon. Even at this lower cost, the annual costs associated with disposal would be about $265,000. It is possible that, given these high costs, an evaporator or other means for drying the solids would be feasible. However, there would still be a dried product requiring disposal. The cost of installing and operating the drying equipment is not expected to be significantly lower than shown above for hauling and disposal.

Therefore, based on these preliminary calculations, RO treatment would have a capital cost of about $2,250,000 and an annual operating cost of about $375,000.

8.2 Pipeline

This alternative is not attractive for either facility because there is not a waterbody nearby that could serve as an appropriate receiving stream. The only large river that could possibly serve as a receiving stream would be the White River, which is over 30 miles away from the HWWTP and 8 miles away from the YWWTP.

The estimated cost of building a pipeline from the HWWTP to the White River would be over $24,000,000, including the purchase of right-of-way. The cost of pumping and maintenance would add another $150,000 annually to the cost of this option for the HWWTP.

The estimated cost of building a pipeline from the YWWTP to the White River would be about $3,400,000, including the purchase of right-of-way. The cost of pumping and maintenance would add another $100,000 annually to the cost of this option for the YWWTP.

8.3 Summary of Costs

The three available options for management of the mineral concentrations from the facilities are as follows:

1. Direct discharge under modified dissolved minerals criteria;
2. Installation of an RO treatment system; or
3. Installation of a pipeline to the White River.

Tables 8.1 and 8.2 summarize the estimated costs with each option for each facility. Any capital and operating costs associated with the direct discharge option (e.g., effluent monitoring) would also be required in the other options, and therefore were not added to the cost estimates. The implementation costs for the direct discharge refer to costs for the UAA study and consulting and legal costs to support the rule-making process to modify the dissolved minerals criteria.

Table 8.1. Summary of capital, operating, and implementation costs for various options to attain compliance with permit limits for the Harrison WWTP.

Option Description	Estimated Capital Cost	Estimated Annual Operating Cost	Implementation Cost
Discharge to Crooked Creek	--	--	$150,000
RO Treatment	$5,600,000	$5,950,000	--
Pipeline to White River	$24,000,000	$150,000	--

Table 8.2. Summary of capital, operating, and implementation costs for various options to attain compliance with permit limits for the Yellville WWTP.

Option Description	Estimated Capital Cost	Estimated Annual Operating Cost	Implementation Cost
Discharge to Crooked Creek	--	--	$150,000
RO Treatment	$2,250,000	$375,000	--
Pipeline to White River	$3,400,000	$100,000	--

8.4 Alternatives Analysis Conclusions

The information presented in this section indicates that the most cost-effective option for the HWWTP and YWWTP discharges is direct discharge. Implementing this option, however, will require modified dissolved minerals criteria in Crooked Creek, the current receiving stream.

9.0 PROPOSED SITE-SPECIFIC CRITERIA

9.1 Synopsis of Supporting Information

As mentioned in Section 1.0, the reaches of Crooked Creek upstream and downstream of the HWWTP and YWWTP outfalls (stream segments 11010003-049 and 11010003-048, respectively) are listed on the 2008 303(d) list as impaired for TDS, sulfate, and chloride due to due to exceedances of existing site-specific minerals criteria for Crooked Creek. Because of these impairment listings, permit limits for dissolved minerals for the HWWTP and YWWTP could be set equal to the instream criteria for those reaches of Crooked Creek. This UAA proposes site-specific criteria that are similar to Ozark Highland ecoregion criteria. The observations and reasoning in support of the proposed criteria are as follows:

1. The UAA demonstrated that although the sulfate, chloride, and TDS concentrations in the HWWTP and YWWTP effluents exceed instream criteria, the discharges only have a minor effect on the mineral concentrations of Crooked Creek (Sections 4.2 and 4.3).
2. In the UAA study reaches, sulfate and chloride are minor components of the TDS, which is primarily composed of calcium and bicarbonate (Section 4.3). Therefore, under existing conditions, overall TDS should be the primary focus of minerals criteria, and site-specific TDS criteria should be based on TDS concentrations that protect the Ozark Highland fisheries designated use. Sulfate and chloride criteria should reflect concentrations that are consistent with protective TDS criteria.
3. The slight increase in mineral concentrations downstream of the HWWTP corresponded to a minimal change in the macroinvertebrate community (no significant impairment to slight impairment). It is not clear whether a cause and effect relationship would be expected to exist between small changes such as these. The YWWTP reaches showed the largest upstream to downstream assemblage differences and the smallest upstream to downstream mineral differences in both absolute and relative terms. If the macroinvertebrate assemblages are responding to the modest upstream to downstream increases in mineral concentrations (i.e., a less than 10% difference in upstream versus downstream 95^{th} percentile TDS values), then the greatest upstream to downstream mineral differences (observed at the HWWTP) should cause the greatest upstream to downstream assemblage differences. The opposite was observed. This result shows that, when considering both discharges, the magnitude of the mineral increase downstream of the discharges is not commensurate with the downstream change in the benthic macroinvertebrate

communities. Accordingly, there must be underlying factors other than habitat or minerals affecting assemblage structure.

4. Evaluations of mineral concentrations and biological communities in least-disturbed streams demonstrates that TDS concentrations similar to the existing Crooked Creek concentrations, including those influenced by the discharges, will support least-disturbed benthic macroinvertebrate communities (Sections 7.3 and 7.5).

Mineral concentrations similar to ecoregion criteria will support the Ozark Highland fisheries designated use provided that sulfate and chloride continue to have a minor contribution to TDS as indicated by existing conditions.

9.2 Proposed Criteria

Proposed criteria are based on existing mineral conditions in Crooked Creek. Existing conditions were based on available monitoring data from ADEQ ambient monitoring of Crooked Creek. Because the 2008 Arkansas 303(d) list is the latest EPA-approved list (which evaluated data from the 2002 to 2007 date range), data from the past 10 years were examined for each of the ADEQ monitoring stations shown on Figure 9.1. Appendix G provides the ADEQ historical monitoring data for those monitoring stations. Ninety-fifth percentile values for each of the ADEQ monitoring stations are provided in Table 9.1. The proposed revised site-specific criteria (Table 9.2) are based on the values in Table 9.1 as described below for the following two reaches of Crooked Creek:

1. Upper Reach (Figure 9.1): From the HWWTP to ADEQ monitoring station WHI0193. The proposed revised TDS, sulfate, and chloride criteria for this reach (Table 9.2) are the highest of the 95th percentile values from stationsWHI0066 and WHI0193 (Table 9.1).
2. Lower Reach (Figure 9.1): From ADEQ monitoring station WHI0193 to the mouth of Crooked Creek at the White River. The proposed revised TDS criterion for this reach (Table 9.2) is the highest of the 95th percentile values from stations WHI0048B and WHI0048C (Table 9.1). There are no proposed changes to the sulfate and chloride criteria in this reach.

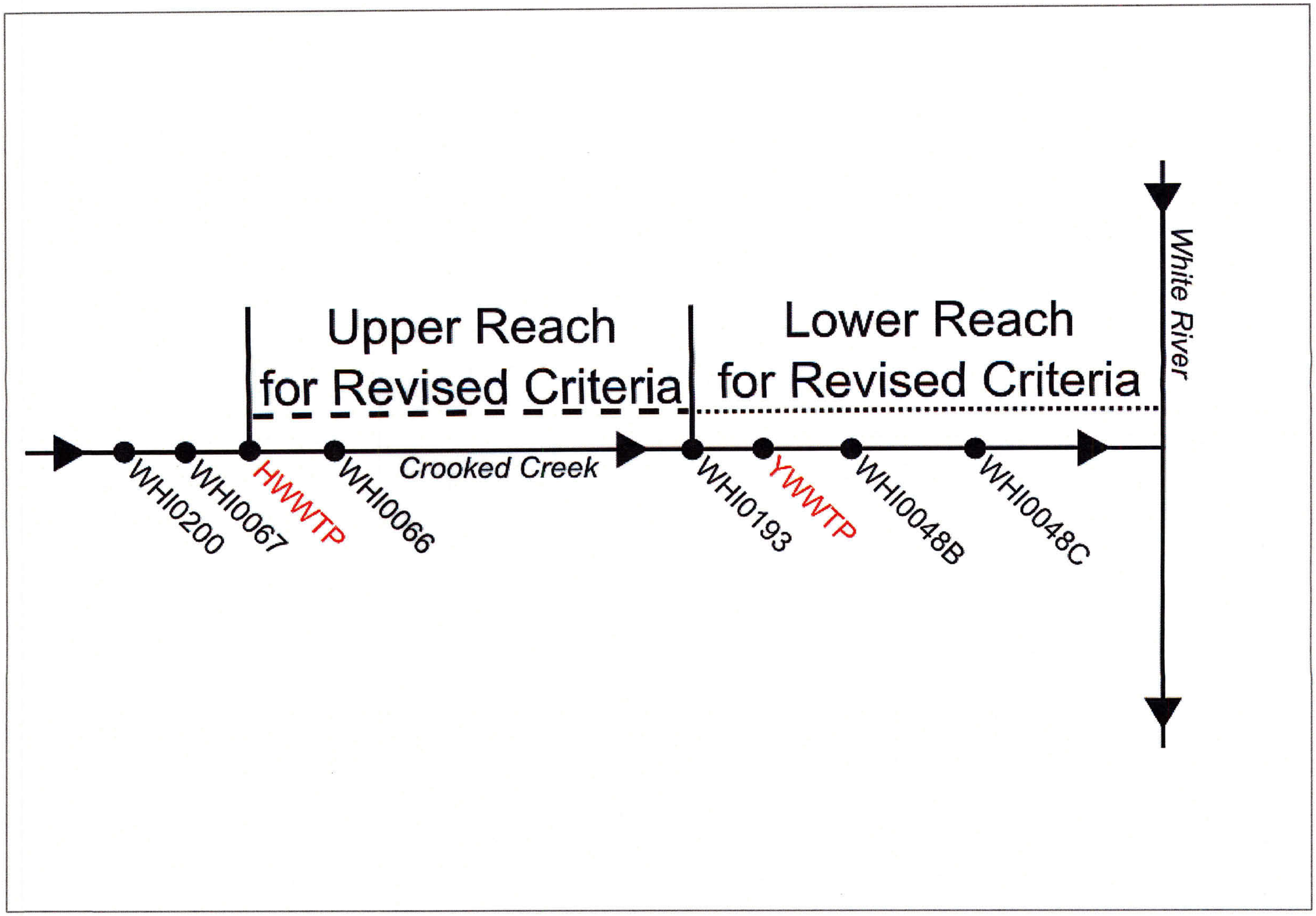


Figure 9.1. Schematic diagram of outfalls, ADEQ monitoring stations, and upper and lower reaches for revised criteria.

Table 9.1. Ninety-fifth percentile values of ADEQ historical monitoring data for dissolved minerals in Crooked Creek.

Parameter	95th Percentile Values at ADEQ Monitoring Station (mg/L)					
	WHI0200	WHI0067	WHI0066	WHI0048A/ WHI0193[a]	WHI0048B	WHI0048C
TDS	226	233	269	226	221	238
Sulfate	11.6	9.4	24.4	9.4	7.6	10.2
Chloride	8.3	11.3	22.6	10.7	7.6	7.9
Period of Record[b]	11/28/2011 07/30/2013[c]	08/05/2003 07/30/2013[d]	08/05/2003 07/30/2013[d]	08/19/2003 07/09/2013[d]	12/09/2003 06/04/2013[d]	12/09/2003 06/04/2013[d]

Notes:

(a) ADEQ discontinued monitoring at WHI0048A and moved the sampling point upstream from Yellville to WHI0193.

(b) Date range queried was from August 1, 2003, to July 31, 2013, on ADEQ surface water quality monitoring data search page (http://www.adeq.state.ar.us/techsvs/water_quality/water_quality_station.asp, accessed August 20, 2013).

(c) Represents the full period of record for this station.

(d) Actual date range of data obtained from the search query for this station.

Table 9.2. Proposed criteria for dissolved minerals in Crooked Creek.

Stream Reach	Existing Criteria			Proposed Criteria		
	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Upstream reach (from HWWTP to WHI0193)	20	20	200	22.6	24.4	269
Downstream reach (from WHI0193 to mouth of Crooked Creek)	20	20	200	No change	No change	238

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APPENDIX C

Laboratory Reports

Aquatic Life Survey Water Quality Sampling

AMERICAN INTERPLEX CORPORATION
LABORATORIES

FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
3 Innwood Circle, Suite 220
Little Rock, AR 72211

This report contains the analytical results and supporting information for samples submitted on July 27, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

John Overbey
Laboratory Director

This document has been distributed to the following:

PDF cc: FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
jtm@ftn-assoc.com

FTN Associates, Ltd.
ATTN: Mr. Pat Downey
pjd@ftn-assoc.com

FTN Associates, Ltd.
ATTN: Mr. Jeremy Rigsby
jmr@ftn-assoc.com

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

SAMPLE INFORMATION

Project Description:

Seven (7) water sample(s) received on July 27, 2012
4315-050
Harrison UAA

Receipt Details:

A Chain of Custody was provided. The samples were delivered in one (1) ice chest.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

Sample Identification:

Laboratory ID	Client Sample ID	Sampled Date/Time	Notes
159725-1	H001 25JUL12 1030	25-Jul-2012 1030	
159725-2	HWWTP DS 25JUL12 1200	25-Jul-2012 1200	
159725-3	Y001 25JUL12 1503	25-Jul-2012 1503	
159725-4	Clear Cr Ref 26JUL12 1300	26-Jul-2012 1300	
159725-5	Crooked Cr US 26JUL12 1545	26-Jul-2012 1545	
159725-6	Crooked Cr HWY 7 26JUL12 1600	26-Jul-2012 1600	
159725-7	HWY 65 26JUL12 1610	26-Jul-2012 1610	

Qualifiers:

D Result is from a secondary dilution factor

References:

"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 21st edition.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

AMERICAN INTERPLEX CORPORATION LABORATORIES

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

ANALYTICAL RESULTS

AIC No. 159725-1
Sample Identification: H001 25JUL12 1030

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**390**	10	**mg/l**	
SM 2540 C	Prep: 31-Jul-2012 1502 by 285	Analyzed: 02-Aug-2012 1132 by 285		Batch: W40586	
Chloride		**65**	2	**mg/l**	D
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1200 by 07		Batch: S32860	Dil: 10
Sulfate		**99**	2	**mg/l**	D
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1200 by 07		Batch: S32860	Dil: 10

AIC No. 159725-2
Sample Identification: HWWTP DS 25JUL12 1200

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**250**	10	**mg/l**	
SM 2540 C	Prep: 31-Jul-2012 1502 by 285	Analyzed: 02-Aug-2012 1132 by 285		Batch: W40586	
Chloride		**19**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1250 by 07		Batch: S32860	
Sulfate		**21**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1250 by 07		Batch: S32860	

AIC No. 159725-3
Sample Identification: Y001 25JUL12 1503

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**330**	10	**mg/l**	
SM 2540 C	Prep: 31-Jul-2012 1502 by 285	Analyzed: 02-Aug-2012 1132 by 285		Batch: W40586	
Chloride		**82**	2	**mg/l**	D
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1523 by 07		Batch: S32860	Dil: 10
Sulfate		**24**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1315 by 07		Batch: S32860	

AIC No. 159725-4
Sample Identification: Clear Cr Ref 26JUL12 1300

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**160**	10	**mg/l**	
SM 2540 C	Prep: 02-Aug-2012 1205 by 285	Analyzed: 06-Aug-2012 1332 by 285		Batch: W40605	
Chloride		**7.9**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1340 by 07		Batch: S32860	
Sulfate		**5.0**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1340 by 07		Batch: S32860	

AMERICAN INTERPLEX CORPORATION LABORATORIES

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

ANALYTICAL RESULTS

AIC No. 159725-5
Sample Identification: Crooked Cr US 26JUL12 1545

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**210**	10	**mg/l**	
SM 2540 C	Prep: 02-Aug-2012 1205 by 285	Analyzed: 06-Aug-2012 1332 by 285		Batch: W40605	
Chloride		**9.0**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1408 by 07		Batch: S32860	
Sulfate		**5.6**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1408 by 07		Batch: S32860	

AIC No. 159725-6
Sample Identification: Crooked Cr HWY 7 26JUL12 1600

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**170**	10	**mg/l**	
SM 2540 C	Prep: 02-Aug-2012 1205 by 285	Analyzed: 06-Aug-2012 1332 by 285		Batch: W40605	
Chloride		**6.6**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1703 by 07		Batch: S32860	
Sulfate		**3.2**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1703 by 07		Batch: S32860	

AIC No. 159725-7
Sample Identification: HWY 65 26JUL12 1610

Analyte		Result	RL	Units	Qualifier
Total Dissolved Solids		**200**	10	**mg/l**	
SM 2540 C	Prep: 02-Aug-2012 1205 by 285	Analyzed: 06-Aug-2012 1332 by 285		Batch: W40605	
Chloride		**7.9**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1728 by 07		Batch: S32860	
Sulfate		**5.1**	0.2	**mg/l**	
EPA 300.0	Prep: 27-Jul-2012 1458 by 07	Analyzed: 30-Jul-2012 1728 by 07		Batch: S32860	

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DUPLICATE RESULTS

Analyte		AIC No.	Result	RPD	RPD Limit	Preparation Date	Analysis Date	Dil	Qual
Total Dissolved Solids		159669-1	42 mg/l			31Jul12 1502 by 285	02Aug12 1132 by 285		
	Batch: W40586	Duplicate	40 mg/l	4.88	10.0	31Jul12 1502 by 285	02Aug12 1132 by 285		
Total Dissolved Solids		159725-4	160 mg/l			02Aug12 1205 by 285	06Aug12 1332 by 285		
	Batch: W40605	Duplicate	160 mg/l	1.23	10.0	02Aug12 1205 by 285	06Aug12 1332 by 285		

LABORATORY CONTROL SAMPLE RESULTS

Analyte	Spike Amount	%	Limits	RPD	Limit	Batch	Preparation Date	Analysis Date	Dil	Qual
Chloride	20 mg/l	98.5	90.0-110			S32860	27Jul12 1459 by 07	30Jul12 1044 by 07		
Sulfate	20 mg/l	99.9	90.0-110			S32860	27Jul12 1459 by 07	30Jul12 1044 by 07		

MATRIX SPIKE SAMPLE RESULTS

Analyte	Sample	Spike Amount	%	Limits	Batch	Preparation Date	Analysis Date	Dil	Qual
Chloride	159725-1	20 mg/l	98.4	80.0-120	S32860	27Jul12 1459 by 07	30Jul12 1109 by 07		
	159725-1	20 mg/l	105	80.0-120	S32860	27Jul12 1459 by 07	30Jul12 1135 by 07		
	Relative Percent Difference:		4.61	10.0	S32860				
Sulfate	159725-1	20 mg/l	100	80.0-120	S32860	27Jul12 1459 by 07	30Jul12 1109 by 07		
	159725-1	20 mg/l	103	80.0-120	S32860	27Jul12 1459 by 07	30Jul12 1135 by 07		
	Relative Percent Difference:		1.83	10.0	S32860				

LABORATORY BLANK RESULTS

Analyte	Result	RL	PQL	QC Sample	Preparation Date	Analysis Date	Qual
Total Dissolved Solids	< 10 mg/l	10	10	W40586-1	31Jul12 1502 by 285	02Aug12 1132 by 285	
Total Dissolved Solids	< 10 mg/l	10	10	W40605-1	02Aug12 1205 by 285	06Aug12 1332 by 285	
Chloride	< 0.2 mg/l	0.2	0.2	S32860-1	27Jul12 1459 by 07	30Jul12 1019 by 07	
Sulfate	< 0.2 mg/l	0.2	0.2	S32860-1	27Jul12 1459 by 07	30Jul12 1019 by 07	

ftn

159725

Date	Project Name	Project No.	Project Manager (Print)	Page 1 of 1
27 JUL 12	Harrison UAA	4315-050	Jim Malcolm	

Laboratory Name: American Interplex Laboratories

Phone:

Submitted by:
FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211
(501) 225-7779 • Fax (501) 225-6738

Sampler Signature(s)

Recorded By (Print) Jeremy Rigsby

Lab Turn-Around-Time
- ☐ 24 Hours
- ☐ 48 Hours
- ☒ Normal
- ☐ Other: Due: __/__/__

SAMPLE DESCRIPTION

	Sample Identification	Date	Time	Matrix* W	Matrix* S	Matrix* O	No. of Containers	Comp	Grab	TDS, Sulfate, Chloride	Parameters (Method Number)							Laboratory Notes
1	H001	25 JUL 12	1030	X			1		X	X								
2	HWWTP DS	25 JUL 12	1200	X			1		X	X								
3	Y001	25 JUL 12	1503	X			1		X	X								
4	Clear Cr Ref	26 JUL 12	1300	X			1		X	X								
5	Crooked Cr US	26 JUL 12	1545	X			1		X	X								
6	Crooked Cr HWY 7	26 JUL 12	1600	X			1		X	X								
7	HWY 65	26 JUL 12	1610	X			1		X	X								
									Container Type	P								
									Preservative	NO								

* Matrix: W = Water S = Soil O = Other

G = Glass P= Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = None S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Relinquished By (Signature)	Print Name	Date	Time	Received By (Signature)	Print Name	Date	Time
	Jeremy Rigsby	27 JUL 12	1132				
Relinquished By (Signature)	Print Name	Date	Time	Received By Laboratory (Signature)	Print Name	Date	Time
					Jennifer Bradford	7-27-12	1132

Please email results to jtm@ftn-assoc.com, pjd@ftn-assoc.com, and jmr@ftn-assoc.com

Laboratory Remarks:

2°c

Revision Date 11/22/02

AMERICAN INTERPLEX CORPORATION LABORATORIES

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FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
3 Innwood Circle, Suite 220
Little Rock, AR 72211

This report contains the analytical results and supporting information for samples submitted on September 21, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

John Overbey
Laboratory Director

This document has been distributed to the following:

PDF cc: FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
jtm@ftn-assoc.com

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

SAMPLE INFORMATION

Project Description:
Six (6) water sample(s) received on September 21, 2012
4315-050
Crooked Creek UAA

Receipt Details:
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

Sample Identification:

Laboratory ID	Client Sample ID	Sampled Date/Time	Notes
161161-1	Y001 19SEP12 1015	19-Sep-2012 1015	
161161-2	CC-1 19SEP12 1930	19-Sep-2012 1930	
161161-3	CC-0 20SEP12 1823	20-Sep-2012 1823	
161161-4	H001 20SEP12 1908	20-Sep-2012 1908	
161161-5	WR-0 20SEP12 2132	20-Sep-2012 2132	
161161-6	WR-1 20SEP12 2213	20-Sep-2012 2213	

Qualifiers:
D Result is from a secondary dilution factor

References:
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 21st edition.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

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ANALYTICAL RESULTS

AIC No. 161161-1
Sample Identification: Y001 19SEP12 1015

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**3.3**	1	**mg/l**	
EPA 351.2	Prep: 24-Sep-2012 1527 by 93	Analyzed: 26-Sep-2012 1310 by 93		Batch: W41131	
Total Dissolved Solids		**340**	10	**mg/l**	
SM 2540 C	Prep: 24-Sep-2012 0931 by 285	Analyzed: 25-Sep-2012 1138 by 285		Batch: W41121	
Total Phosphorus		**1.2**	0.1	**mg/l**	D
SM 4500-P B,F	Prep: 25-Sep-2012 1444 by 306	Analyzed: 27-Sep-2012 0932 by 306		Batch: W41138	Dil: 5
Chloride		**36**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 1918 by 07		Batch: S33187	
Nitrate + Nitrite as N		**< 0.5**	0.5	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 22-Sep-2012 0104 by 07		Batch: S33187	Dil: 10
Sulfate		**25**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 1918 by 07		Batch: S33187	

AIC No. 161161-2
Sample Identification: CC-1 19SEP12 1930

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**1.7**	1	**mg/l**	
EPA 351.2	Prep: 24-Sep-2012 1527 by 93	Analyzed: 26-Sep-2012 1324 by 93		Batch: W41131	
Total Dissolved Solids		**230**	10	**mg/l**	
SM 2540 C	Prep: 24-Sep-2012 0931 by 285	Analyzed: 25-Sep-2012 1138 by 285		Batch: W41121	
Total Phosphorus		**0.27**	0.02	**mg/l**	
SM 4500-P B,F	Prep: 25-Sep-2012 1444 by 306	Analyzed: 27-Sep-2012 1036 by 306		Batch: W41138	
Chloride		**13**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 1944 by 07		Batch: S33187	
Nitrate + Nitrite as N		**3.0**	0.5	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 22-Sep-2012 0130 by 07		Batch: S33187	Dil: 10
Sulfate		**11**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 1944 by 07		Batch: S33187	

AIC No. 161161-3
Sample Identification: CC-0 20SEP12 1823

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 24-Sep-2012 1527 by 93	Analyzed: 26-Sep-2012 1325 by 93		Batch: W41131	
Total Dissolved Solids		**220**	10	**mg/l**	
SM 2540 C	Prep: 24-Sep-2012 0931 by 285	Analyzed: 25-Sep-2012 1138 by 285		Batch: W41121	
Total Phosphorus		**< 0.02**	0.02	**mg/l**	
SM 4500-P B,F	Prep: 25-Sep-2012 1444 by 306	Analyzed: 27-Sep-2012 0853 by 306		Batch: W41138	
Chloride		**8.3**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 2010 by 07		Batch: S33187	

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ANALYTICAL RESULTS

AIC No. 161161-3 (Continued)
Sample Identification: CC-0 20SEP12 1823

Analyte		Result	RL	Units	Qualifier
Nitrate + Nitrite as N		**1.1**	0.5	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 22-Sep-2012 0156 by 07		Batch: S33187	Dil: 10
Sulfate		**5.6**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 2010 by 07		Batch: S33187	

AIC No. 161161-4
Sample Identification: H001 20SEP12 1908

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**1.9**	1	**mg/l**	
EPA 351.2	Prep: 24-Sep-2012 1527 by 93	Analyzed: 26-Sep-2012 1326 by 93		Batch: W41131	
Total Dissolved Solids		**410**	10	**mg/l**	
SM 2540 C	Prep: 24-Sep-2012 0931 by 285	Analyzed: 25-Sep-2012 1138 by 285		Batch: W41121	
Total Phosphorus		**2.8**	0.1	**mg/l**	D
SM 4500-P B,F	Prep: 25-Sep-2012 1444 by 306	Analyzed: 27-Sep-2012 0933 by 306		Batch: W41138	Dil: 5
Chloride		**55**	2	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 2035 by 07		Batch: S33187	Dil: 10
Nitrate + Nitrite as N		**22**	0.5	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 22-Sep-2012 0222 by 07		Batch: S33187	Dil: 10
Sulfate		**53**	2	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 2035 by 07		Batch: S33187	Dil: 10

AIC No. 161161-5
Sample Identification: WR-0 20SEP12 2132

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 24-Sep-2012 1527 by 93	Analyzed: 26-Sep-2012 1327 by 93		Batch: W41131	
Total Dissolved Solids		**160**	10	**mg/l**	
SM 2540 C	Prep: 24-Sep-2012 0931 by 285	Analyzed: 25-Sep-2012 1138 by 285		Batch: W41121	
Total Phosphorus		**< 0.02**	0.02	**mg/l**	
SM 4500-P B,F	Prep: 25-Sep-2012 1444 by 306	Analyzed: 27-Sep-2012 0857 by 306		Batch: W41138	
Chloride		**5.5**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 2127 by 07		Batch: S33187	
Nitrate + Nitrite as N		**< 0.5**	0.5	**mg/l**	D
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 22-Sep-2012 0405 by 07		Batch: S33187	Dil: 10
Sulfate		**6.7**	0.2	**mg/l**	
EPA 300.0	Prep: 21-Sep-2012 1452 by 07	Analyzed: 21-Sep-2012 2127 by 07		Batch: S33187	

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ANALYTICAL RESULTS

AIC No. 161161-6
Sample Identification: WR-1 20SEP12 2213

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 24-Sep-2012 1527 by 93	**< 1** Analyzed: 26-Sep-2012 1329 by 93	1	**mg/l** Batch: W41131	
Total Dissolved Solids SM 2540 C	Prep: 24-Sep-2012 0931 by 285	**150** Analyzed: 25-Sep-2012 1138 by 285	10	**mg/l** Batch: W41121	
Total Phosphorus SM 4500-P B,F	Prep: 25-Sep-2012 1444 by 306	**< 0.02** Analyzed: 27-Sep-2012 0858 by 306	0.02	**mg/l** Batch: W41138	
Chloride EPA 300.0	Prep: 21-Sep-2012 1452 by 07	**5.1** Analyzed: 21-Sep-2012 2153 by 07	0.2	**mg/l** Batch: S33187	
Nitrate + Nitrite as N EPA 300.0	Prep: 21-Sep-2012 1452 by 07	**< 0.5** Analyzed: 22-Sep-2012 0431 by 07	0.5	**mg/l** Batch: S33187	D Dil: 10
Sulfate EPA 300.0	Prep: 21-Sep-2012 1452 by 07	**6.5** Analyzed: 21-Sep-2012 2153 by 07	0.2	**mg/l** Batch: S33187	

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DUPLICATE RESULTS

Analyte		AIC No.	Result	RPD	RPD Limit	Preparation Date	Analysis Date	Dil	Qual
Total Dissolved Solids		161118-1	1300 mg/l			24Sep12 0931 by 285	25Sep12 1138 by 285		
	Batch: W41121	Duplicate	1400 mg/l	0.592	10.0	24Sep12 0931 by 285	25Sep12 1138 by 285		
Total Dissolved Solids		161162-1	940 mg/l			24Sep12 0931 by 285	25Sep12 1138 by 285		
	Batch: W41121	Duplicate	950 mg/l	0.955	10.0	24Sep12 0931 by 285	25Sep12 1138 by 285		

LABORATORY CONTROL SAMPLE RESULTS

Analyte	Spike Amount	%	Limits	RPD	Limit	Batch	Preparation Date	Analysis Date	Dil	Qual
Total Kjeldahl Nitrogen	5 mg/l	107	80.0-120			W41131	24Sep12 1528 by 93	26Sep12 1309 by 93		
Total Phosphorus	0.5 mg/l	107	85.0-115			W41138	25Sep12 1445 by 306	27Sep12 0832 by 306		
Chloride	20 mg/l	100	90.0-110			S33187	21Sep12 1452 by 07	21Sep12 1643 by 07		
Nitrate + Nitrite as N	8 mg/l	99.4	90.0-110			S33187	21Sep12 1452 by 07	21Sep12 1643 by 07		
Sulfate	20 mg/l	100	90.0-110			S33187	21Sep12 1452 by 07	21Sep12 1643 by 07		

MATRIX SPIKE SAMPLE RESULTS

Analyte	Sample	Spike Amount	%	Limits	Batch	Preparation Date	Analysis Date	Dil	Qual
Total Kjeldahl Nitrogen	161161-1	5 mg/l	111	80.0-120	W41131	24Sep12 1528 by 93	26Sep12 1311 by 93		
	161161-1	5 mg/l	110	80.0-120	W41131	24Sep12 1528 by 93	26Sep12 1313 by 93		
	Relative Percent Difference:		0.787	25.0	W41131				
Total Phosphorus	161169-1	0.5 mg/l	105	80.0-120	W41138	25Sep12 1445 by 306	27Sep12 1037 by 306	5	D
	161169-1	0.5 mg/l	108	80.0-120	W41138	25Sep12 1445 by 306	27Sep12 1038 by 306	5	D
	Relative Percent Difference:		1.90	10.0	W41138				D
Chloride	161161-1	20 mg/l	97.2	80.0-120	S33187	21Sep12 1452 by 07	21Sep12 1800 by 07		
	161161-1	20 mg/l	98.5	80.0-120	S33187	21Sep12 1452 by 07	21Sep12 1826 by 07		
	Relative Percent Difference:		1.15	10.0	S33187				
Nitrate + Nitrite as N	161161-1	8 mg/l	99.4	80.0-120	S33187	21Sep12 1452 by 07	21Sep12 1800 by 07		
	161161-1	8 mg/l	101	80.0-120	S33187	21Sep12 1452 by 07	21Sep12 1826 by 07		
	Relative Percent Difference:		1.27	10.0	S33187				
Sulfate	161161-1	20 mg/l	99.0	80.0-120	S33187	21Sep12 1452 by 07	21Sep12 1800 by 07		
	161161-1	20 mg/l	101	80.0-120	S33187	21Sep12 1452 by 07	21Sep12 1826 by 07		
	Relative Percent Difference:		1.97	10.0	S33187				

LABORATORY BLANK RESULTS

Analyte	Result	RL	PQL	QC Sample	Preparation Date	Analysis Date	Qual
Total Kjeldahl Nitrogen	< 1 mg/l	1	1	W41131-1	24Sep12 1528 by 93	26Sep12 1307 by 93	
Total Dissolved Solids	< 10 mg/l	10	10	W41121-1	24Sep12 0931 by 285	25Sep12 1138 by 285	
Total Phosphorus	< 0.02 mg/l	0.02	0.02	W41138-1	25Sep12 1445 by 306	27Sep12 0831 by 306	
Chloride	< 0.2 mg/l	0.2	0.2	S33187-1	21Sep12 1452 by 07	21Sep12 1517 by 07	
Nitrate + Nitrite as N	< 0.05 mg/l	0.05	0.05	S33187-1	21Sep12 1452 by 07	21Sep12 1517 by 07	
Sulfate	< 0.2 mg/l	0.2	0.2	S33187-1	21Sep12 1452 by 07	21Sep12 1517 by 07	

ftn

161161

Date	Project Name	Project No.	Project Manager (Print)	Page
21 SEP 12	Crooked Creek UAA	4315-050	Jim Malcolm	Page 1 of 1

Laboratory Name: American Interplex Laboratories

Phone:

Submitted by:
FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211
(501) 225-7779 • Fax (501) 225-6738

Sampler Signature(s):

Recorded By (Print): Jeremy Rigsby

Lab Turn-Around-Time:
- ☐ 24 Hours
- ☐ 48 Hours
- ☒ Normal
- ☐ Other: Due: __/__/__

SAMPLE DESCRIPTION

Parameters (Method Number)

	Sample Identification	Date	Time	Matrix* W	Matrix* S	Matrix* O	No. of Containers	Comp	Grab	TDS, SO4, CL	TKN, NO3+NO2N, TP						Laboratory Notes
1	Y001	19 SEP 12	1015	X			2		X	X	X						
2	CC-1	19 SEP 12	1930	X			2		X	X	X						
3	CC-0	20 SEP 12	1823	X			2		X	X	X						
4	H001	20 SEP 12	1908	X			2		X	X	X						
5	WR-0	20 SEP 12	2132	X			2		X	X	X						
6	WR-1	20 SEP 12	2213	X			2		X	X	X						
								Container Type									
								Preservative									

* Matrix: W = Water S = Soil O = Other

G = Glass P= Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = None S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Relinquished By (Signature)	Print Name	Date	Time	Received By (Signature)	Print Name	Date	Time
	Jeremy Rigsby	21 SEP 12	1423				
Relinquished By (Signature)	Print Name	Date	Time	Received By Laboratory (Signature)	Print Name	Date	Time
				Eugene Hampton	Eugene Hampton	9-21-12	1423

Laboratory Remarks:
2° C

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FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
3 Innwood Circle, Suite 220
Little Rock, AR 72211

This report contains the analytical results and supporting information for samples submitted on November 29, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

John Overbey
Laboratory Director

This document has been distributed to the following:

PDF cc: FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
jtm@ftn-assoc.com

FTN Associates, Ltd.
ATTN: Mr. Pat Downey
pjd@ftn-assoc.com

FTN Associates, Ltd.
ATTN: Mr. Jeremy Rigsby
jmr@ftn-assoc.com

AMERICAN INTERPLEX CORPORATION LABORATORIES

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

SAMPLE INFORMATION

Project Description:
Six (6) water sample(s) received on November 29, 2012
Crooked Creek UAA
4315-050

Receipt Details:
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

Sample Identification:

Laboratory ID	Client Sample ID	Sampled Date/Time	Notes
162806-1	WR-1 27NOV12 1655	27-Nov-2012 1655	
162806-2	WR-0 27NOV12 1723	27-Nov-2012 1723	
162806-3	CC-0 28NOV12 0840	28-Nov-2012 0840	
162806-4	CC-1 28NOV12 1213	28-Nov-2012 1213	
162806-5	H001 28NOV12 1600	28-Nov-2012 1600	
162806-6	Y001 28NOV12 1710	28-Nov-2012 1710	

Qualifiers:
D Result is from a secondary dilution factor

References:
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 21st edition.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

AMERICAN INTERPLEX CORPORATION LABORATORIES

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3 Innwood Circle, Suite 220
Little Rock, AR 72211

ANALYTICAL RESULTS

AIC No. 162806-1
Sample Identification: WR-1 27NOV12 1655

Analyte	Prep	Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 29-Nov-2012 1545 by 93	**< 1** Analyzed: 03-Dec-2012 1654 by 93	1	**mg/l** Batch: W41814	
Total Dissolved Solids SM 2540 C	Prep: 29-Nov-2012 1500 by 306	**170** Analyzed: 30-Nov-2012 1406 by 306	10	**mg/l** Batch: W41812	
Total Phosphorus SM 4500-P B,F	Prep: 29-Nov-2012 1547 by 306	**< 0.02** Analyzed: 03-Dec-2012 1214 by 306	0.02	**mg/l** Batch: W41815	
Chloride EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**5.6** Analyzed: 29-Nov-2012 1228 by 07	0.2	**mg/l** Batch: S33563	
Nitrate + Nitrite as N EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**0.59** Analyzed: 29-Nov-2012 1510 by 07	0.5	**mg/l** Batch: S33563	D Dil: 10
Sulfate EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**6.5** Analyzed: 29-Nov-2012 1228 by 07	0.2	**mg/l** Batch: S33563	

AIC No. 162806-2
Sample Identification: WR-0 27NOV12 1723

Analyte	Prep	Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 29-Nov-2012 1545 by 93	**< 1** Analyzed: 03-Dec-2012 1659 by 93	1	**mg/l** Batch: W41814	
Total Dissolved Solids SM 2540 C	Prep: 29-Nov-2012 1500 by 306	**150** Analyzed: 30-Nov-2012 1406 by 306	10	**mg/l** Batch: W41812	
Total Phosphorus SM 4500-P B,F	Prep: 29-Nov-2012 1547 by 306	**< 0.02** Analyzed: 03-Dec-2012 1356 by 306	0.02	**mg/l** Batch: W41815	
Chloride EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**6.1** Analyzed: 29-Nov-2012 1254 by 07	0.2	**mg/l** Batch: S33563	
Nitrate + Nitrite as N EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**< 0.5** Analyzed: 29-Nov-2012 1536 by 07	0.5	**mg/l** Batch: S33563	D Dil: 10
Sulfate EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**7.0** Analyzed: 29-Nov-2012 1254 by 07	0.2	**mg/l** Batch: S33563	

AIC No. 162806-3
Sample Identification: CC-0 28NOV12 0840

Analyte	Prep	Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 29-Nov-2012 1545 by 93	**< 1** Analyzed: 03-Dec-2012 1701 by 93	1	**mg/l** Batch: W41814	
Total Dissolved Solids SM 2540 C	Prep: 29-Nov-2012 1500 by 306	**230** Analyzed: 30-Nov-2012 1406 by 306	10	**mg/l** Batch: W41812	
Total Phosphorus SM 4500-P B,F	Prep: 29-Nov-2012 1547 by 306	**< 0.02** Analyzed: 03-Dec-2012 1217 by 306	0.02	**mg/l** Batch: W41815	
Chloride EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**8.9** Analyzed: 29-Nov-2012 1320 by 07	0.2	**mg/l** Batch: S33563	

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ANALYTICAL RESULTS

AIC No. 162806-3 (Continued)
Sample Identification: CC-0 28NOV12 0840

Analyte		Result	RL	Units	Qualifier
Nitrate + Nitrite as N		**1.5**	0.5	**mg/l**	D
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1719 by 07		Batch: S33563	Dil: 10
Sulfate		**6.2**	0.2	**mg/l**	
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1320 by 07		Batch: S33563	

AIC No. 162806-4
Sample Identification: CC-1 28NOV12 1213

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 29-Nov-2012 1545 by 93	Analyzed: 03-Dec-2012 1702 by 93		Batch: W41814	
Total Dissolved Solids		**280**	10	**mg/l**	
SM 2540 C	Prep: 29-Nov-2012 1500 by 306	Analyzed: 30-Nov-2012 1406 by 306		Batch: W41812	
Total Phosphorus		**0.58**	0.02	**mg/l**	
SM 4500-P B,F	Prep: 29-Nov-2012 1547 by 306	Analyzed: 03-Dec-2012 1244 by 306		Batch: W41815	
Chloride		**21**	0.2	**mg/l**	
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1346 by 07		Batch: S33563	
Nitrate + Nitrite as N		**4.9**	0.5	**mg/l**	D
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1745 by 07		Batch: S33563	Dil: 10
Sulfate		**29**	0.2	**mg/l**	
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1346 by 07		Batch: S33563	

AIC No. 162806-5
Sample Identification: H001 28NOV12 1600

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**2.3**	1	**mg/l**	
EPA 351.2	Prep: 29-Nov-2012 1545 by 93	Analyzed: 03-Dec-2012 1703 by 93		Batch: W41814	
Total Dissolved Solids		**430**	10	**mg/l**	
SM 2540 C	Prep: 29-Nov-2012 1500 by 306	Analyzed: 30-Nov-2012 1406 by 306		Batch: W41812	
Total Phosphorus		**2.5**	0.1	**mg/l**	D
SM 4500-P B,F	Prep: 29-Nov-2012 1547 by 306	Analyzed: 03-Dec-2012 1245 by 306		Batch: W41815	Dil: 5
Chloride		**65**	2	**mg/l**	D
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1438 by 07		Batch: S33563	Dil: 10
Nitrate + Nitrite as N		**17**	0.5	**mg/l**	D
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1811 by 07		Batch: S33563	Dil: 10
Sulfate		**110**	2	**mg/l**	D
EPA 300.0	Prep: 29-Nov-2012 1104 by 07	Analyzed: 29-Nov-2012 1438 by 07		Batch: S33563	Dil: 10

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ANALYTICAL RESULTS

AIC No. 162806-6
Sample Identification: Y001 28NOV12 1710

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 29-Nov-2012 1545 by 93	**< 1** Analyzed: 03-Dec-2012 1708 by 93	1	**mg/l** Batch: W41814	
Total Dissolved Solids SM 2540 C	Prep: 29-Nov-2012 1500 by 306	**270** Analyzed: 30-Nov-2012 1406 by 306	10	**mg/l** Batch: W41812	
Total Phosphorus SM 4500-P B,F	Prep: 29-Nov-2012 1547 by 306	**1.8** Analyzed: 03-Dec-2012 1246 by 306	0.1	**mg/l** Batch: W41815	D Dil: 5
Chloride EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**41** Analyzed: 29-Nov-2012 1503 by 07	0.2	**mg/l** Batch: S33563	
Nitrate + Nitrite as N EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**1.1** Analyzed: 29-Nov-2012 1837 by 07	0.5	**mg/l** Batch: S33563	D Dil: 10
Sulfate EPA 300.0	Prep: 29-Nov-2012 1104 by 07	**21** Analyzed: 29-Nov-2012 1503 by 07	0.2	**mg/l** Batch: S33563	

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DUPLICATE RESULTS

Analyte		AIC No.	Result	RPD	RPD Limit	Preparation Date	Analysis Date	Dil	Qual
Total Dissolved Solids		162806-1	170 mg/l			29Nov12 1500 by 306	30Nov12 1406 by 306		
	Batch: W41812	Duplicate	160 mg/l	7.09	10.0	29Nov12 1500 by 306	30Nov12 1406 by 306		

LABORATORY CONTROL SAMPLE RESULTS

Analyte	Spike Amount	%	Limits	RPD	Limit	Batch	Preparation Date	Analysis Date	Dil	Qual
Total Kjeldahl Nitrogen	5 mg/l	100	80.0-120			W41814	29Nov12 1546 by 93	03Dec12 1652 by 93		
Total Phosphorus	0.5 mg/l	103	85.0-115			W41815	29Nov12 1548 by 306	03Dec12 1207 by 306		
Chloride	20 mg/l	96.9	90.0-110			S33563	29Nov12 0946 by 07	29Nov12 1131 by 07		
Nitrate + Nitrite as N	8 mg/l	94.4	90.0-110			S33563	29Nov12 0946 by 07	29Nov12 1131 by 07		
Sulfate	20 mg/l	95.9	90.0-110			S33563	29Nov12 0946 by 07	29Nov12 1131 by 07		

MATRIX SPIKE SAMPLE RESULTS

Analyte	Sample	Spike Amount	%	Limits	Batch	Preparation Date	Analysis Date	Dil	Qual
Total Kjeldahl Nitrogen	162806-1	5 mg/l	99.8	80.0-120	W41814	29Nov12 1546 by 93	03Dec12 1655 by 93		
	162806-1	5 mg/l	97.4	80.0-120	W41814	29Nov12 1546 by 93	03Dec12 1656 by 93		
	Relative Percent Difference:		2.28	25.0	W41814				
Total Phosphorus	162825-1	0.5 mg/l	108	80.0-120	W41815	29Nov12 1548 by 306	03Dec12 1210 by 306	5	D
	162825-1	0.5 mg/l	113	80.0-120	W41815	29Nov12 1548 by 306	03Dec12 1211 by 306	5	D
	Relative Percent Difference:		2.29	10.0	W41815				D
Chloride	162797-1	20 mg/l	94.3	80.0-120	S33563	29Nov12 0946 by 07	29Nov12 1157 by 07		
	162797-1	20 mg/l	96.8	80.0-120	S33563	29Nov12 0946 by 07	29Nov12 1327 by 07		
	Relative Percent Difference:		2.31	10.0	S33563				
Nitrate + Nitrite as N	162797-1	8 mg/l	92.6	80.0-120	S33563	29Nov12 0946 by 07	29Nov12 1157 by 07		
	162797-1	8 mg/l	96.3	80.0-120	S33563	29Nov12 0946 by 07	29Nov12 1327 by 07		
	Relative Percent Difference:		3.89	10.0	S33563				
Sulfate	162797-1	20 mg/l	92.8	80.0-120	S33563	29Nov12 0946 by 07	29Nov12 1157 by 07		
	162797-1	20 mg/l	94.3	80.0-120	S33563	29Nov12 0946 by 07	29Nov12 1327 by 07		
	Relative Percent Difference:		1.56	10.0	S33563				

LABORATORY BLANK RESULTS

Analyte	Result	RL	PQL	QC Sample	Preparation Date	Analysis Date	Qual
Total Kjeldahl Nitrogen	< 1 mg/l	1	1	W41814-1	29Nov12 1546 by 93	03Dec12 1651 by 93	
Total Dissolved Solids	< 10 mg/l	10	10	W41812-1	29Nov12 1500 by 306	30Nov12 1406 by 306	
Total Phosphorus	< 0.02 mg/l	0.02	0.02	W41815-1	29Nov12 1548 by 306	03Dec12 1206 by 306	
Chloride	< 0.2 mg/l	0.2	0.2	S33563-1	29Nov12 0946 by 07	29Nov12 1105 by 07	
Nitrate + Nitrite as N	< 0.05 mg/l	0.05	0.05	S33563-1	29Nov12 0946 by 07	29Nov12 1105 by 07	
Sulfate	< 0.2 mg/l	0.2	0.2	S33563-1	29Nov12 0946 by 07	29Nov12 1105 by 07	

162806

ftn

Date	Project Name	Project No.	Project Manager (Print)	Page
29 NOV 12	Crooked Creek UAA	4315-050	Jim Malcolm	Page 1 of 1

Laboratory Name:
American Interplex Laboratories

Phone:

Submitted by:

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211
(501) 225-7779 • Fax (501) 225-6738

Sampler Signature(s)

Recorded By (Print)
Jeremy Rigsby

Lab Turn-Around-Time

- ☐ 24 Hours
- ☐ 48 Hours
- ☒ Normal
- ☐ Other: Due: __/__/__

SAMPLE DESCRIPTION

Parameters (Method Number)

	Sample Identification	Date	Time	Matrix* W	Matrix* S	Matrix* O	No. of Containers	Comp	Grab	TDS, SO4, CL	TKN, NO3+NO2N, TP						Laboratory Notes
1	WR-1	27 NOV 12	1655	X			2		X	X	X						
2	WR-0	27 NOV 12	1723	X			2		X	X	X						
3	CC-0	28 NOV 12	0840	X			2		X	X	X						
4	CC-1	28 NOV 12	1213	X			2		X	X	X						
5	H001	28 NOV 12	1600	X			2		X	X	X						
6	Y001	28 NOV 12	1710	X			2		X	X	X						
									Container Type	P	P						
									Preservative	NO	S						

* Matrix: W = Water S = Soil O = Other

G = Glass P= Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = None S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Relinquished By (Signature)	Print Name	Date	Time	Received By (Signature)	Print Name	Date	Time
	Jeremy Rigsby	29 NOV 12	1004				

Relinquished By (Signature)	Print Name	Date	Time	Received By Laboratory (Signature)	Print Name	Date	Time
					Eugene Hampton	11-29-12	1004

Please email results to jtm@ftn-assoc.com, pjd@ftn-assoc.com, and jmr@ftn-assoc.com

Laboratory Remarks:
2°C

Revision Date 11/22/02

AMERICAN INTERPLEX CORPORATION
LABORATORIES

FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
3 Innwood Circle, Suite 220
Little Rock, AR 72211

This report contains the analytical results and supporting information for samples submitted on April 4, 2013. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

John Overbey
Laboratory Director

This document has been distributed to the following:

PDF cc: FTN Associates, Ltd.
ATTN: Mr. Jim Malcolm
jtm@ftn-assoc.com

FTN Associates, Ltd.
ATTN: Mr. Pat Downey
pjd@ftn-assoc.com

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ATTN: Mr. Jeremy Rigsby
jmr@ftn-assoc.com

AMERICAN INTERPLEX CORPORATION
LABORATORIES

FTN Associates, Ltd.
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Little Rock, AR 72211

SAMPLE INFORMATION

Project Description:
Eight (8) water sample(s) received on April 4, 2013
04315-0002-001
Crooked Creek UAA

Receipt Details:
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

Sample Identification:

Laboratory ID	Client Sample ID	Sampled Date/Time	Notes
166277-1	H001 02APR13 1200	02-Apr-2013 1200	
166277-2	CC-1 02APR13 1445	02-Apr-2013 1445	
166277-3	CC-0 02APR13 1552	02-Apr-2013 1552	
166277-4	WR-0 02APR13 2002	02-Apr-2013 2002	
166277-5	WR-1 02APR13 2037	02-Apr-2013 2037	
166277-6	Y001 03APR13 0826	03-Apr-2013 0826	
166277-7	CC-2 03APR13 0907	03-Apr-2013 0907	
166277-8	CC-3 03APR13 1149	03-Apr-2013 1149	

Qualifiers:
D Result is from a secondary dilution factor
Q Analyte is not within quality control limits

Case Narrative:
The matrix spike recovery for Total Kjeldahl Nitrogen failed to meet acceptance criteria due to matrix interference.

References:
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 21st edition.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

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ANALYTICAL RESULTS

AIC No. 166277-1
Sample Identification: H001 02APR13 1200

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 04-Apr-2013 1507 by 93	**1.6** Analyzed: 05-Apr-2013 1652 by 93	1	**mg/l** Batch: W43108	
Total Dissolved Solids SM 2540 C	Prep: 04-Apr-2013 1509 by 302	**340** Analyzed: 05-Apr-2013 1609 by 302	10	**mg/l** Batch: W43109	
Phosphorus EPA 200.7	Prep: 04-Apr-2013 1023 by 271	**0.76** Analyzed: 04-Apr-2013 1628 by 305	0.02	**mg/l** Batch: S34349	
Chloride EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**51** Analyzed: 04-Apr-2013 2333 by 270	2	**mg/l** Batch: S34355	D Dil: 10
Nitrate + Nitrite as N EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**12** Analyzed: 05-Apr-2013 1410 by 270	0.5	**mg/l** Batch: S34355	D Dil: 10
Sulfate EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**66** Analyzed: 04-Apr-2013 2333 by 270	2	**mg/l** Batch: S34355	D Dil: 10

AIC No. 166277-2
Sample Identification: CC-1 02APR13 1445

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 04-Apr-2013 1507 by 93	**< 1** Analyzed: 05-Apr-2013 1602 by 93	1	**mg/l** Batch: W43108	
Total Dissolved Solids SM 2540 C	Prep: 04-Apr-2013 1509 by 302	**200** Analyzed: 05-Apr-2013 1609 by 302	10	**mg/l** Batch: W43109	
Phosphorus EPA 200.7	Prep: 04-Apr-2013 1023 by 271	**0.34** Analyzed: 04-Apr-2013 1633 by 305	0.02	**mg/l** Batch: S34349	
Chloride EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**7.8** Analyzed: 04-Apr-2013 2359 by 270	2	**mg/l** Batch: S34355	D Dil: 10
Nitrate + Nitrite as N EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**1.7** Analyzed: 05-Apr-2013 1619 by 270	0.5	**mg/l** Batch: S34355	D Dil: 10
Sulfate EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**8.8** Analyzed: 04-Apr-2013 2359 by 270	2	**mg/l** Batch: S34355	D Dil: 10

AIC No. 166277-3
Sample Identification: CC-0 02APR13 1552

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen EPA 351.2	Prep: 04-Apr-2013 1507 by 93	**< 1** Analyzed: 05-Apr-2013 1604 by 93	1	**mg/l** Batch: W43108	
Total Dissolved Solids SM 2540 C	Prep: 04-Apr-2013 1509 by 302	**160** Analyzed: 05-Apr-2013 1609 by 302	10	**mg/l** Batch: W43109	
Phosphorus EPA 200.7	Prep: 04-Apr-2013 1023 by 271	**0.33** Analyzed: 04-Apr-2013 1652 by 305	0.02	**mg/l** Batch: S34349	
Chloride EPA 300.0	Prep: 04-Apr-2013 1551 by 270	**6.9** Analyzed: 05-Apr-2013 0025 by 270	2	**mg/l** Batch: S34355	D Dil: 10

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ANALYTICAL RESULTS

AIC No. 166277-3 (Continued)
Sample Identification: CC-0 02APR13 1552

Analyte		Result	RL	Units	Qualifier
Nitrate + Nitrite as N		**1.5**	0.5	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 1725 by 270		Batch: S34355	Dil: 10
Sulfate		**5.8**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0025 by 270		Batch: S34355	Dil: 10

AIC No. 166277-4
Sample Identification: WR-0 02APR13 2002

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 04-Apr-2013 1507 by 93	Analyzed: 05-Apr-2013 1605 by 93		Batch: W43108	
Total Dissolved Solids		**220**	10	**mg/l**	
SM 2540 C	Prep: 04-Apr-2013 1509 by 302	Analyzed: 05-Apr-2013 1609 by 302		Batch: W43109	
Phosphorus		**0.30**	0.02	**mg/l**	
EPA 200.7	Prep: 04-Apr-2013 1023 by 271	Analyzed: 04-Apr-2013 1656 by 305		Batch: S34349	
Chloride		**4.9**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0051 by 270		Batch: S34355	Dil: 10
Nitrate + Nitrite as N		**0.71**	0.5	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 1811 by 270		Batch: S34355	Dil: 10
Sulfate		**56**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0051 by 270		Batch: S34355	Dil: 10

AIC No. 166277-5
Sample Identification: WR-1 02APR13 2037

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 04-Apr-2013 1507 by 93	Analyzed: 05-Apr-2013 1606 by 93		Batch: W43108	
Total Dissolved Solids		**78**	10	**mg/l**	
SM 2540 C	Prep: 04-Apr-2013 1509 by 302	Analyzed: 05-Apr-2013 1609 by 302		Batch: W43109	
Phosphorus		**0.26**	0.02	**mg/l**	
EPA 200.7	Prep: 04-Apr-2013 1023 by 271	Analyzed: 04-Apr-2013 1700 by 305		Batch: S34349	
Chloride		**4.7**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0117 by 270		Batch: S34355	Dil: 10
Nitrate + Nitrite as N		**< 0.5**	0.5	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 1834 by 270		Batch: S34355	Dil: 10
Sulfate		**7.7**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0117 by 270		Batch: S34355	Dil: 10

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Little Rock, AR 72211

ANALYTICAL RESULTS

AIC No. 166277-6
Sample Identification: Y001 03APR13 0826

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 04-Apr-2013 1507 by 93	Analyzed: 05-Apr-2013 1608 by 93		Batch: W43108	
Total Dissolved Solids		**320**	10	**mg/l**	
SM 2540 C	Prep: 04-Apr-2013 1509 by 302	Analyzed: 05-Apr-2013 1609 by 302		Batch: W43109	
Phosphorus		**1.1**	0.02	**mg/l**	
EPA 200.7	Prep: 04-Apr-2013 1023 by 271	Analyzed: 04-Apr-2013 1703 by 305		Batch: S34349	
Chloride		**23**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0143 by 270		Batch: S34355	Dil: 10
Nitrate + Nitrite as N		**0.54**	0.5	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 1856 by 270		Batch: S34355	Dil: 10
Sulfate		**25**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0143 by 270		Batch: S34355	Dil: 10

AIC No. 166277-7
Sample Identification: CC-2 03APR13 0907

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 04-Apr-2013 1507 by 93	Analyzed: 05-Apr-2013 1612 by 93		Batch: W43108	
Total Dissolved Solids		**190**	10	**mg/l**	
SM 2540 C	Prep: 04-Apr-2013 1509 by 302	Analyzed: 05-Apr-2013 1609 by 302		Batch: W43109	
Phosphorus		**0.32**	0.02	**mg/l**	
EPA 200.7	Prep: 04-Apr-2013 1023 by 271	Analyzed: 04-Apr-2013 1708 by 305		Batch: S34349	
Chloride		**5.3**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0208 by 270		Batch: S34355	Dil: 10
Nitrate + Nitrite as N		**1.4**	0.5	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 1920 by 270		Batch: S34355	Dil: 10
Sulfate		**7.8**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0208 by 270		Batch: S34355	Dil: 10

AIC No. 166277-8
Sample Identification: CC-3 03APR13 1149

Analyte		Result	RL	Units	Qualifier
Total Kjeldahl Nitrogen		**< 1**	1	**mg/l**	
EPA 351.2	Prep: 04-Apr-2013 1507 by 93	Analyzed: 05-Apr-2013 1613 by 93		Batch: W43108	
Total Dissolved Solids		**240**	10	**mg/l**	
SM 2540 C	Prep: 04-Apr-2013 1509 by 302	Analyzed: 05-Apr-2013 1609 by 302		Batch: W43109	
Phosphorus		**0.32**	0.02	**mg/l**	
EPA 200.7	Prep: 04-Apr-2013 1023 by 271	Analyzed: 04-Apr-2013 1712 by 305		Batch: S34349	
Chloride		**5.7**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0234 by 270		Batch: S34355	Dil: 10

AMERICAN INTERPLEX
CORPORATION
LABORATORIES

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

ANALYTICAL RESULTS

AIC No. 166277-8 (Continued)
Sample Identification: CC-3 03APR13 1149

Analyte		Result	RL	Units	Qualifier
Nitrate + Nitrite as N		**1.1**	0.5	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 2104 by 270		Batch: S34355	Dil: 10
Sulfate		**7.0**	2	**mg/l**	D
EPA 300.0	Prep: 04-Apr-2013 1551 by 270	Analyzed: 05-Apr-2013 0234 by 270		Batch: S34355	Dil: 10

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

DUPLICATE RESULTS

Analyte		AIC No.	Result	RPD	RPD Limit	Preparation Date	Analysis Date	Dil	Qual
Total Dissolved Solids		166277-1	340 mg/l			04Apr13 1509 by 302	05Apr13 1609 by 302		
	Batch: W43109	Duplicate	350 mg/l	2.90	10.0	04Apr13 1509 by 302	05Apr13 1609 by 302		

LABORATORY CONTROL SAMPLE RESULTS

Analyte	Spike Amount	%	Limits	RPD	Limit	Batch	Preparation Date	Analysis Date	Dil	Qual
Total Kjeldahl Nitrogen	5 mg/l	110	80.0-120			W43108	04Apr13 1509 by 93	05Apr13 1557 by 93		
Phosphorus	5 mg/l	105	85.0-115			S34349	04Apr13 1024 by 271	04Apr13 1515 by 305		
Chloride	20 mg/l	96.8	90.0-110			S34355	04Apr13 1552 by 270	04Apr13 1828 by 270		
Nitrate + Nitrite as N	8 mg/l	99.8	90.0-110			S34355	04Apr13 1552 by 270	04Apr13 1828 by 270		
Sulfate	20 mg/l	95.4	90.0-110			S34355	04Apr13 1552 by 270	04Apr13 1828 by 270		

MATRIX SPIKE SAMPLE RESULTS

Analyte	Sample	Spike Amount	%	Limits	Batch	Preparation Date	Analysis Date	Dil	Qual
Total Kjeldahl Nitrogen	166277-1	5 mg/l	72.2	80.0-120	W43108	04Apr13 1509 by 93	05Apr13 1653 by 93		Q
	166277-1	5 mg/l	77.9	80.0-120	W43108	04Apr13 1509 by 93	05Apr13 1654 by 93		Q
	Relative Percent Difference:		5.29	25.0	W43108				
Phosphorus	166259-1	5 mg/l	102	75.0-125	S34349	04Apr13 1024 by 271	04Apr13 1519 by 305		
	166259-1	5 mg/l	102	75.0-125	S34349	04Apr13 1024 by 271	04Apr13 1522 by 305		
	Relative Percent Difference:		0.468	20.0	S34349				
Chloride	166292-1	20 mg/l	96.7	80.0-120	S34355	04Apr13 1552 by 270	04Apr13 1853 by 270		
	166292-1	20 mg/l	96.6	80.0-120	S34355	04Apr13 1552 by 270	04Apr13 1919 by 270		
	Relative Percent Difference:		0.0501	10.0	S34355				
Nitrate + Nitrite as N	166292-1	8 mg/l	99.2	80.0-120	S34355	04Apr13 1552 by 270	04Apr13 1853 by 270		
	166292-1	8 mg/l	99.2	80.0-120	S34355	04Apr13 1552 by 270	04Apr13 1919 by 270		
	Relative Percent Difference:		0.00	10.0	S34355				
Sulfate	166292-1	20 mg/l	97.2	80.0-120	S34355	04Apr13 1552 by 270	04Apr13 1853 by 270		
	166292-1	20 mg/l	97.3	80.0-120	S34355	04Apr13 1552 by 270	04Apr13 1919 by 270		
	Relative Percent Difference:		0.0299	10.0	S34355				

LABORATORY BLANK RESULTS

Analyte	Result	RL	PQL	QC Sample	Preparation Date	Analysis Date	Qual
Total Kjeldahl Nitrogen	< 1 mg/l	1	1	W43108-1	04Apr13 1509 by 93	05Apr13 1555 by 93	
Total Dissolved Solids	< 10 mg/l	10	10	W43109-1	04Apr13 1509 by 302	05Apr13 1609 by 302	
Phosphorus	< 0.02 mg/l	0.02	0.02	S34349-1	04Apr13 1024 by 271	04Apr13 1534 by 305	
Chloride	< 0.2 mg/l	0.2	0.2	S34355-1	04Apr13 1552 by 270	04Apr13 1804 by 270	
Nitrate + Nitrite as N	< 0.05 mg/l	0.05	0.05	S34355-1	04Apr13 1552 by 270	04Apr13 1804 by 270	
Sulfate	< 0.2 mg/l	0.2	0.2	S34355-1	04Apr13 1552 by 270	04Apr13 1804 by 270	

ftn

166277

Date	Project Name	Project No.	Project Manager (Print)	Page
04 APR 13	Crooked Creek UAA	04315-0002-001	Jim Malcolm	Page 1 of 1

Laboratory Name: American Interplex Laboratories

Phone:

Submitted by:
FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211
(501) 225-7779 • Fax (501) 225-6738

Sampler Signature(s):

Recorded By (Print): Jeremy Rigsby

Lab Turn-Around-Time:
- ☐ 24 Hours
- ☐ 48 Hours
- ☒ Normal
- ☐ Other: Due: __/__/__

SAMPLE DESCRIPTION

Sample Identification	Date	Time	Matrix* W	Matrix* S	Matrix* O	No. of Containers	Comp	Grab	TDS, SO4, CL	TKN, NO3N+NO2N, TP						Laboratory Notes
H001	02 APR 13	1200	X			2		X	X	X						
CC-1	02 APR 13	1445	X			2		X	X	X						
CC-0	02 APR 13	1552	X			2		X	X	X						
WR-0	02 APR 13	2002	X			2		X	X	X						
WR-1	02 APR 13	2037	X			2		X	X	X						
Y001	03 APR 13	0826	X			2		X	X	X						
CC-2	03 APR 13	0907	X			2		X	X	X						
CC-3	03 APR 13	1149	X			2		X	X	X						
								Container Type	P	P						
								Preservative	NO	S						

* Matrix: W = Water S = Soil O = Other

G = Glass P= Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = None S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Relinquished By (Signature)	Print Name	Date	Time	Received By (Signature)	Print Name	Date	Time
	Jeremy Rigsby	04 APR 13	0836				

Relinquished By (Signature)	Print Name	Date	Time	Received By Laboratory (Signature)	Print Name	Date	Time
				Shana Purchase	Shana Purchase	4-4-13	0836

Please email results to jim@ftn-assoc.com, pjd@ftn-assoc.com, and jmr@ftn-assoc.com

Laboratory Remarks:

2-C

Revision Date 11/22/02

Biweekly Sampling Data from HWWTP

ETC Environmental Testing & Consulting, Inc.
www.etcmemphis.com 2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

5/21/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-132-0213
Client Project Description: Bi-weekly Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received 3 sample(s) on 5/11/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

ETC
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Environmental Testing & Consulting, Inc.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Bi-weekly Sampling

Report Date : 5/21/2012

Report Number : **12-132-0213**

REPORT OF ANALYSIS

Received : 5/11/2012

Lab No : **93305**
Sample ID : **Silver Valley Bridge (Downstream)**

Matrix: **Aqueous**
Sampled: **5/10/2012 8:20**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**173**	mg/L	1	1	05/17/12 09:12	EWB	2320B
Chloride	**10.7**	mg/L	0.400	1	05/19/12 01:15	RQE	EPA-300.0
Total Dissolved Solids	**242**	mg/L	10	1	05/15/12 08:30	NRT	2540C
Total Calcium	**69.2**	mg/L	0.100	1	05/15/12 02:42	BKN	EPA-200.7
Total Magnesium	**1.80**	mg/L	0.100	1	05/15/12 02:42	BKN	EPA-200.7
Total Potassium	**1.68**	mg/L	0.100	1	05/15/12 02:42	BKN	EPA-200.7
Total Sodium	**6.05**	mg/L	0.500	1	05/15/12 02:42	BKN	EPA-200.7
Total Sulfate (SO4)	**8.51**	mg/L	1.00	1	05/19/12 01:15	RQE	EPA-300.0

Lab No : **93306**
Sample ID : **Hwy 62/65 Bridge (Upstream)**

Matrix: **Aqueous**
Sampled: **5/10/2012 8:05**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**177**	mg/L	1	1	05/17/12 09:12	EWB	2320B
Chloride	**7.44**	mg/L	0.400	1	05/19/12 01:32	RQE	EPA-300.0
Total Dissolved Solids	**266**	mg/L	10	1	05/15/12 08:30	NRT	2540C
Total Calcium	**71.6**	mg/L	0.100	1	05/15/12 03:09	BKN	EPA-200.7
Total Magnesium	**1.76**	mg/L	0.100	1	05/15/12 03:09	BKN	EPA-200.7
Total Potassium	**1.24**	mg/L	0.100	1	05/15/12 03:09	BKN	EPA-200.7
Total Sodium	**3.41**	mg/L	0.500	1	05/15/12 03:09	BKN	EPA-200.7
Total Sulfate (SO4)	**4.41**	mg/L	1.00	1	05/19/12 01:32	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Bi-weekly Sampling

Report Date : 5/21/2012

Report Number : **12-132-0213**

REPORT OF ANALYSIS

Received : 5/11/2012

Lab No : **93307**
Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**
Sampled: **5/10/2012 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**174**	mg/L	1	1	05/17/12 09:12	EWB	2320B
Chloride	**9.03**	mg/L	0.400	1	05/19/12 00:57	RQE	EPA-300.0
Total Dissolved Solids	**294**	mg/L	10	1	05/15/12 08:30	NRT	2540C
Total Calcium	**71.6**	mg/L	0.100	1	05/15/12 03:16	BKN	EPA-200.7
Total Magnesium	**1.77**	mg/L	0.100	1	05/15/12 03:16	BKN	EPA-200.7
Total Potassium	**1.31**	mg/L	0.100	1	05/15/12 03:16	BKN	EPA-200.7
Total Sodium	**3.89**	mg/L	0.500	1	05/15/12 03:16	BKN	EPA-200.7
Total Sulfate (SO4)	**6.31**	mg/L	1.00	1	05/19/12 00:57	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-132-0213**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 05/11/2012 09:55:12

City Of Harrison

12-132-0213
03322
2012-05-11
09:54:51

Harrison Wastewater Treatment Plant
Bi-weekly Sampling

Chain of Custody

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily	Monthly Quarterly Semi-Annual

FID#

Purchase Order #

ted

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	TOTAL ALKALINITY					
5/10/2012	8:20AM	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X	X					
5/10/2012	8:20AM	Silver Valley Bridge (Downstream)	water	plastic	1	1	G	X	X	X	X									
5/10/2012	8:05AM	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X	X					
5/10/2012	8:05AM	HWY 62-65 Bridge (Upstream)	water	plastic	1	1	G	X	X	X	X									
5/10/2012	8:30AM	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X	X					
5/10/2012	8:30AM	WWTP DISCHARGE POINT	water	plastic	1	1	G	X	X	X	X									

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	5-10-2012/9:00AM	[illegible]	5/11/12-0914

Rec'd at Lab By:		Rec'd Date / Time:	Comments:
Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

5/24/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-143-0208
Client Project Description: Bi-weekly Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received 3 sample(s) on 5/22/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Bi-weekly Sampling

Report Date : 5/24/2012

Report Number : **12-143-0208**

REPORT OF ANALYSIS

Received : 5/22/2012

Lab No : **95030** Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)** Sampled: **5/21/2012 9:10**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**9.44**	mg/L	0.400	1	05/23/12 13:04	RQE	EPA-300.0
Total Dissolved Solids	**230**	mg/L	10	1	05/23/12 07:00	NRT	2540C
Total Sulfate (SO4)	**7.14**	mg/L	1.00	1	05/23/12 13:04	RQE	EPA-300.0

Lab No : **95031** Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)** Sampled: **5/21/2012 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.45**	mg/L	0.400	1	05/23/12 13:22	RQE	EPA-300.0
Total Dissolved Solids	**207**	mg/L	10	1	05/23/12 07:00	NRT	2540C
Total Sulfate (SO4)	**3.97**	mg/L	1.00	1	05/23/12 13:22	RQE	EPA-300.0

Lab No : **95032** Matrix: **Aqueous**
Sample ID : **WWTP Effluent** Sampled: **5/21/2012 9:20**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.71**	mg/L	0.400	1	05/23/12 13:39	RQE	EPA-300.0
Total Dissolved Solids	**220**	mg/L	10	1	05/23/12 07:00	NRT	2540C
Total Sulfate (SO4)	**4.10**	mg/L	1.00	1	05/23/12 13:39	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-143-0208**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Question			
Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 05/22/2012 10:22:08

City Of Harrison

12-143-0208
03322
2012-05-22
10:21:38
Harrison Wastewater Treatment Plant
Bi-weekly Sampling

# of Custody

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily	Monthly Quarterly Semi-Annual

Projec

FID#
Purchase Order #

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
5/21/2012	9:10AM	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X
5/21/2012	9:00AM	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X
5/21/2012	9:20AM	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments: 1°C

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
T. Holt	Tim Holt/City of Harrison	5-21-2012/9:45AM	R Ross MBS	5-22-12 09:29

Rec'd at Lab By: R Ross MBS
Rec'd Date / Time: 5-22-12 09:29
Comments: 1°C

Shipped Via: UPS | ICED | NEXT DAY AIR

ETC ENVIRONMENTAL TESTING & CONSULTING, INC.
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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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6/13/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-158-0231
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 6/6/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 6/13/2012

Report Number : **12-158-0231**

REPORT OF ANALYSIS

Received : 6/6/2012

Lab No : **97483**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **6/5/2012 9:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**10.9**	mg/L	0.400	1	06/13/12 04:15	RQE	EPA-300.0
Total Dissolved Solids	**268**	mg/L	10	1	06/08/12 07:30	NRT	2540C
Total Sulfate (SO4)	**7.62**	mg/L	1.00	1	06/13/12 04:15	RQE	EPA-300.0

Lab No : **97484**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **6/5/2012 9:50**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.52**	mg/L	0.400	1	06/13/12 04:32	RQE	EPA-300.0
Total Dissolved Solids	**242**	mg/L	10	1	06/08/12 07:30	NRT	2540C
Total Sulfate (SO4)	**3.95**	mg/L	1.00	1	06/13/12 04:32	RQE	EPA-300.0

Lab No : **97485**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **6/5/2012 9:20**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.46**	mg/L	0.400	1	06/13/12 04:50	RQE	EPA-300.0
Total Dissolved Solids	**263**	mg/L	10	1	06/08/12 07:30	NRT	2540C
Total Sulfate (SO4)	**4.51**	mg/L	1.00	1	06/13/12 04:50	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-158-0231**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 06/06/2012 10:02:27

City Of Harrison

Chain of Custody

12-158-0231
03322
2012-06-06
10:01:53
Harrison Wastewater Treatment Plant
Bi-weekly Sampling

Client	City of Harrison	Project Number	Analysis R
Address	1508 Silver Valley Road Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily Bi-Weekly Monthly Quarterly Semi-Annual			

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
6/5/2012	9:.35am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
6/5/2012	9:50am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
6/5/2012	9:20am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

NEXT DAY AIR A.R.S. TRACKING NUMBER 1Z 373 E20 27 1030 1863
REF #/ DATE CCS 6-5-2012

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments: 1°C

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	6/5/2012 10:05am		

Rec'd at Lab By: [illegible] Rec'd Date / Time: 6-6-12 09:16 Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

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6/28/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-174-0218
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 6/22/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 6/28/2012

Report Number : **12-174-0218**

REPORT OF ANALYSIS

Received : 6/22/2012

Lab No : **89914**
Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)**
Sampled: **6/21/2012 7:05**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**9.50**	mg/L	0.400	1	06/25/12 09:16	RQE	EPA-300.0
Total Dissolved Solids	**243**	mg/L	10	1	06/26/12 14:00	NRT	2540C
Sulfate	**8.05**	mg/L	1.00	1	06/25/12 09:16	RQE	EPA-300.0

Lab No : **89915**
Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Sampled: **6/21/2012 7:13**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.54**	mg/L	0.400	1	06/25/12 09:33	RQE	EPA-300.0
Total Dissolved Solids	**250**	mg/L	10	1	06/26/12 14:00	NRT	2540C
Sulfate	**4.08**	mg/L	1.00	1	06/25/12 09:33	RQE	EPA-300.0

Lab No : **89916**
Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point**
Sampled: **6/21/2012 6:54**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.97**	mg/L	0.400	1	06/25/12 09:51	RQE	EPA-300.0
Total Dissolved Solids	**242**	mg/L	10	1	06/26/12 14:00	NRT	2540C
Sulfate	**4.52**	mg/L	1.00	1	06/25/12 09:51	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-174-0218**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 06/22/2012 10:34:27

City Of Harrison

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

12-174-0218
03322
2012-06-22
10 33 55

ain of Custody

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily Monthly Quarterly Semi-Annual	

FID#

Purchase Order #

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
6/21/2012	7:05am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
6/21/2012	7:13am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
6/21/2012	6:54am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	6/21/2012	B8GTUG	

Rec'd at Lab By: B8GTUG Rec'd Date / Time: 6-22-12 09:27 Comments:

Shipped Via: UPS ICED NEXT DAY AIR

UPR 1°C

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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7/17/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-188-0220
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 7/6/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 7/17/2012

Report Number : **12-188-0220**

REPORT OF ANALYSIS

Received : 7/6/2012

Lab No : **92478**
Sample ID : **Silver Valley Bridge**
Matrix: **Aqueous**
Sampled: **7/5/2012 7:55**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**10.1**	mg/L	0.400	1	07/11/12 11:00	RQE	EPA-300.0
Total Dissolved Solids	**227**	mg/L	10	1	07/12/12 15:00	NRT	2540C
Sulfate	**9.27**	mg/L	1.00	1	07/11/12 11:00	RQE	EPA-300.0

Lab No : **92479**
Sample ID : **Hwy 62/65 Bridge**
Matrix: **Aqueous**
Sampled: **7/5/2012 8:10**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.07**	mg/L	0.400	1	07/09/12 11:30	RQE	EPA-300.0
Total Dissolved Solids	**232**	mg/L	10	1	07/12/12 15:00	NRT	2540C
Sulfate	**4.43**	mg/L	1.00	1	07/11/12 10:26	RQE	EPA-300.0

Lab No : **92480**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **7/5/2012 7:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.50**	mg/L	0.400	1	07/09/12 11:47	RQE	EPA-300.0
Total Dissolved Solids	**216**	mg/L	10	1	07/12/12 15:00	NRT	2540C
Sulfate	**4.92**	mg/L	1.00	1	07/11/12 10:43	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-188-0220**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 07/06/2012 10:10:21

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

12-188-0220
03322
2012-07-06
10 10.10

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
Mr. Tim Holt	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Silver Valley Bridge	Plastic - Pint	7-5-12 7:55	1	NONE		Aqueous	SO4/TDS/Cl
Hwy 62-65 Bridge	Plastic - Pint	7-5-12 8:10	1	NONE		Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	7-5-12 7:45	1	NONE		Aqueous	SO4/TDS/Cl

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
		1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		[signature]	7/6/12-0946

1/1

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

7/26/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-200-0214
Client Project Description: Bi-monthly

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 7/18/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Bi-monthly

Report Date : 7/26/2012

Report Number : **12-200-0214**

REPORT OF ANALYSIS

Received : 7/18/2012

Lab No : **94872**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **7/17/2012 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**148**	mg/L	1	1	07/25/12 09:30	EWB	2320B
Chloride	**9.56**	mg/L	0.400	1	07/20/12 11:10	RQE	EPA-300.0
Total Dissolved Solids	**255**	mg/L	10	1	07/24/12 10:30	NRT	2540C
Total Calcium	**63.1**	mg/L	0.100	1	07/23/12 22:03	BKN	EPA-200.7
Total Magnesium	**1.94**	mg/L	0.100	1	07/22/12 22:30	BKN	EPA-200.7
Total Potassium	**2.22**	mg/L	0.100	1	07/23/12 22:03	BKN	EPA-200.7
Total Sodium	**7.44**	mg/L	0.500	1	07/22/12 22:30	BKN	EPA-200.7
Sulfate	**7.42**	mg/L	1.00	1	07/20/12 11:10	RQE	EPA-300.0
Carbonate	<2	mg/L	2	1	07/25/12 09:30	EWB	2320B
Bicarbonate (as CaCO3)	**148**	mg/L	1	1	07/25/12 09:30	EWB	2320B

Lab No : **94873**
Sample ID : **Hwy 62-65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **7/17/2012 8:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**160**	mg/L	1	1	07/25/12 09:30	EWB	2320B
Chloride	**6.45**	mg/L	0.400	1	07/20/12 11:28	RQE	EPA-300.0
Total Dissolved Solids	**244**	mg/L	10	1	07/24/12 10:30	NRT	2540C
Total Calcium	**67.2**	mg/L	0.100	1	07/23/12 22:10	BKN	EPA-200.7
Total Magnesium	**1.84**	mg/L	0.100	1	07/22/12 22:51	BKN	EPA-200.7
Total Potassium	**1.36**	mg/L	0.100	1	07/23/12 22:10	BKN	EPA-200.7
Total Sodium	**3.14**	mg/L	0.500	1	07/24/12 11:10	BKN	EPA-200.7
Sulfate	**4.08**	mg/L	1.00	1	07/20/12 11:28	RQE	EPA-300.0
Carbonate	<2	mg/L	2	1	07/25/12 09:30	EWB	2320B
Bicarbonate (as CaCO3)	**160**	mg/L	1	1	07/25/12 09:30	EWB	2320B

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

ETC
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Environmental Testing & Consulting, Inc.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Bi-monthly

Report Date : 7/26/2012

Report Number : **12-200-0214**

REPORT OF ANALYSIS

Received : 7/18/2012

Lab No : **94874**
Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**
Sampled: **7/17/2012 8:40**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**155**	mg/L	1	1	07/25/12 09:30	EWB	2320B
Chloride	**6.81**	mg/L	0.400	1	07/24/12 00:50	RQE	EPA-300.0
Total Dissolved Solids	**244**	mg/L	10	1	07/24/12 10:30	NRT	2540C
Total Calcium	**65.4**	mg/L	0.100	1	07/23/12 22:17	BKN	EPA-200.7
Total Magnesium	**1.79**	mg/L	0.100	1	07/22/12 22:58	BKN	EPA-200.7
Total Potassium	**1.46**	mg/L	0.100	1	07/23/12 22:17	BKN	EPA-200.7
Total Sodium	**3.71**	mg/L	0.500	1	07/24/12 11:17	BKN	EPA-200.7
Sulfate	**4.46**	mg/L	1.00	1	07/24/12 00:50	RQE	EPA-300.0
Carbonate	<2	mg/L	2	1	07/25/12 09:30	EWB	2320B
Bicarbonate (as CaCO3)	**155**	mg/L	1	1	07/25/12 09:30	EWB	2320B

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-200-0214**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 07/18/2012 09:48:25

City Of Harrison

12-200-0214
03322
2012-07-18
09:47:26
Harrison Wastewater Treatment Plant
Bi-monthly

y

Client	City of Harrison	Project Number	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily Bi-Weekly Bi-Monthly Quarterly Semi-Annual			

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	TOTAL ALKALINITY
7/17/2012	8:30AM	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X	X
7/17/2012	8:30AM	Silver Valley Bridge (Downstream)	water	plastic	1	1	G	X	X	X	X				
7/17/2012	8:15AM	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X	X
7/17/2012	8:15AM	HWY 62-65 Bridge (Upstream)	water	plastic	1	1	G	X	X	X	X				
7/17/2012	8:40AM	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X	X
7/17/2012	8:40AM	WWTP DISCHARGE POINT	water	plastic	1	1	G	X	X	X	X				

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	7-17-2012/9:00AM		
			BRCO	7/18/12 0925

Rec'd at Lab By: | Rec'd Date / Time: | Comments:

Shipped Via | UPS | ICED ✓ | NEXT DAY AIR | UPS

10C

ETC **Environmental Testing & Consulting, Inc.**
www.etcmemphis.com
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"A Laboratory Management Partner"

8/10/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-214-0210
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 8/1/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 8/10/2012

Report Number : **12-214-0210**

REPORT OF ANALYSIS

Received : 8/1/2012

Lab No : **97429**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **7/31/2012 12:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**15.7**	mg/L	0.400	1	08/09/12 12:13	RQE	EPA-300.0
Total Dissolved Solids	**252**	mg/L	10	1	08/09/12 13:15	NRT	2540C
Sulfate	**14.4**	mg/L	1.00	1	08/09/12 12:13	RQE	EPA-300.0

Lab No : **97430**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **7/31/2012 12:20**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.82**	mg/L	0.400	1	08/09/12 12:30	RQE	EPA-300.0
Total Dissolved Solids	**213**	mg/L	10	1	08/09/12 13:15	NRT	2540C
Sulfate	**4.62**	mg/L	1.00	1	08/09/12 12:30	RQE	EPA-300.0

Lab No : **97431**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **7/31/2012 12:40**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**54.2**	mg/L	2.00	5	08/09/12 13:26	RQE	EPA-300.0
Total Dissolved Solids	**411**	mg/L	10	1	08/09/12 13:15	NRT	2540C
Sulfate	**59.7**	mg/L	5.00	5	08/09/12 13:26	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

ETC www.etcmemphis.com

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**

Customer Name: **Harrison Wastewater Treatment Plant**

Report Number: **12-214-0210**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)

☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 08/01/2012 10:32:32

City Of Harrison

Chain of Custody

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily Monthly Quarterly Semi-Annual	

Project Number

FID#

Purchase Order #

Analysis Requested

12-214-0210
03322
2012-08-01
10:32:09
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
7/31/2012	12:30pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
7/31/2012	12:20pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
7/31/2012	12:40pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Randy Reese	Randy Reese/City of Harrison	7-31-2012/1:00pm		
			RBa 8/1/12-0924	

Rec'd at Lab By:

Rec'd Date / Time:

Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

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www.etcmemphis.com
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"A Laboratory Management Partner"

8/24/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-230-0212
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 8/17/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

ENVIRONMENTAL TESTING & CONSULTING, INC.
www.etcmemphis.com
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 8/24/2012

Report Number : **12-230-0212**

REPORT OF ANALYSIS

Received : 8/17/2012

Lab No : **90174**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **8/16/2012 13:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**16.8**	mg/L	0.400	1	08/21/12 01:19	RQE	EPA-300.0
Total Dissolved Solids	**232**	mg/L	10	1	08/22/12 07:15	NRT	2540C
Sulfate	**14.9**	mg/L	1.00	1	08/21/12 01:19	RQE	EPA-300.0

Lab No : **90175**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **8/16/2012 13:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.55**	mg/L	0.400	1	08/21/12 19:19	RQE	EPA-300.0
Total Dissolved Solids	**197**	mg/L	10	1	08/22/12 07:15	NRT	2540C
Sulfate	**4.74**	mg/L	1.00	1	08/21/12 19:19	RQE	EPA-300.0

Lab No : **90176**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **8/16/2012 13:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**59.0**	mg/L	2.00	5	08/23/12 19:39	RQE	EPA-300.0
Total Dissolved Solids	**373**	mg/L	10	1	08/22/12 07:15	NRT	2540C
Sulfate	**63.3**	mg/L	5.00	5	08/23/12 19:39	RQE	EPA-300.0

Qualifiers/ Definitions

* Outside QC limit
MQL Method Quantitation Limit
DF Dilution Factor

ETC
www.etcmemphis.com

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road   Memphis, Tennessee 38133   (901) 213-2400   Fax (901) 213-2440

"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**

Customer Name: **Harrison Wastewater Treatment Plant**

Report Number: **12-230-0212**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)

☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 08/17/2012 09:33:13

City Of Harrison

12-230-0212
03322
2012-08-17
09:30:14
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	Project Number	Analysis R
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily Bi-Weekly	Monthly Quarterly Semi-Annual		

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
8/16/2012	1:15pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
8/16/2012	1:00pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
8/16/2012	1:25pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	8/16/2012		

Rec'd at Lab By: BRo Rec'd Date / Time: 8/17/12 - 0909 Comments: 1°C

Shipped Via	UPS	ICED	NEXT DAY AIR

ETC Environmental Testing & Consulting, Inc.
www.etcmemphis.com 2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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9/10/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-244-0221
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 8/31/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 9/10/2012

Report Number : **12-244-0221**

REPORT OF ANALYSIS

Received : 8/31/2012

Lab No : **92503**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **8/30/2012 12:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**19.2**	mg/L	0.400	1	08/31/12 14:22	RQE	EPA-300.0
Total Dissolved Solids	**228**	mg/L	10	1	09/05/12 14:15	NRT	2540C
Sulfate	**18.6**	mg/L	1.00	1	08/31/12 14:22	RQE	EPA-300.0

Lab No : **92504**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **8/30/2012 12:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.89**	mg/L	0.400	1	08/31/12 14:39	RQE	EPA-300.0
Total Dissolved Solids	**182**	mg/L	10	1	09/05/12 14:15	NRT	2540C
Sulfate	**4.81**	mg/L	1.00	1	08/31/12 14:39	RQE	EPA-300.0

Lab No : **92505**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **8/30/2012 12:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**68.0**	mg/L	2.00	5	09/04/12 15:23	RQE	EPA-300.0
Total Dissolved Solids	**387**	mg/L	10	1	09/05/12 14:15	NRT	2540C
Sulfate	**77.8**	mg/L	5.00	5	09/04/12 15:23	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-244-0221**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 08/31/2012 10:39:00

City Of Harrison

Chain of Custody

12-244-0221
03322
2012-08-31
10:31:31
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily	Monthly Quarterly Semi-Annual

Project Number

FID#

Purchase Order #

Analysis R

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
8/30/2012	12:25pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
8/30/2012	12:15pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
8/30/2012	12:35pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	8/30/2012/1:00pm		

Rec'd at Lab By: BBOTCFO

Rec'd Date / Time: 8-31-12 0932

Comments: 1°C

Shipped Via: UPS ICED NEXT DAY AIR

9/21/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-256-0252
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 9/12/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 9/21/2012

Report Number : **12-256-0252**

REPORT OF ANALYSIS

Received : 9/12/2012

Lab No : **94539**
Sample ID : **Silver Valley Bridge (Downstream) Plus**

Matrix: **Aqueous**
Sampled: **9/11/2012 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**149**	mg/L	1	1	09/18/12 10:43	EWB	2320B
Chloride	**10.6**	mg/L	0.400	1	09/14/12 11:43	RQE	EPA-300.0
Total Dissolved Solids	**213**	mg/L	10	1	09/17/12 13:40	NRT	2540C
Total Calcium	**63.5**	mg/L	0.100	1	09/18/12 18:07	JTR	EPA-200.7
Total Magnesium	**1.99**	mg/L	0.100	1	09/18/12 18:07	JTR	EPA-200.7
Total Potassium	**2.07**	mg/L	0.100	1	09/18/12 18:07	BKN	EPA-200.7
Total Sodium	**6.32**	mg/L	0.500	1	09/18/12 18:07	BKN	EPA-200.7
Sulfate	**7.63**	mg/L	1.00	1	09/14/12 11:43	RQE	EPA-300.0

Lab No : **94540**
Sample ID : **Hwy 62/65 Bridge (Upstream) plus**

Matrix: **Aqueous**
Sampled: **9/11/2012 8:40**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**159**	mg/L	1	1	09/18/12 10:43	EWB	2320B
Chloride	**6.89**	mg/L	0.400	1	09/14/12 12:01	RQE	EPA-300.0
Total Dissolved Solids	**179**	mg/L	10	1	09/17/12 13:40	NRT	2540C
Total Calcium	**66.8**	mg/L	0.100	1	09/18/12 18:27	JTR	EPA-200.7
Total Magnesium	**1.97**	mg/L	0.100	1	09/18/12 18:27	JTR	EPA-200.7
Total Potassium	**1.27**	mg/L	0.100	1	09/18/12 18:27	BKN	EPA-200.7
Total Sodium	**3.47**	mg/L	0.500	1	09/18/12 18:27	BKN	EPA-200.7
Sulfate	**4.84**	mg/L	1.00	1	09/14/12 12:01	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 9/21/2012

Report Number : **12-256-0252**

REPORT OF ANALYSIS

Received : 9/12/2012

Lab No : **94541**

Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**

Sampled: **9/11/2012 9:10**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**40**	mg/L	1	1	09/18/12 10:43	EWB	2320B
Chloride	**57.6**	mg/L	2.00	5	09/14/12 14:20	RQE	EPA-300.0
Total Dissolved Solids	**338**	mg/L	10	1	09/17/12 13:40	NRT	2540C
Total Calcium	**42.9**	mg/L	0.100	1	09/18/12 18:33	JTR	EPA-200.7
Total Magnesium	**2.84**	mg/L	0.100	1	09/18/12 18:33	JTR	EPA-200.7
Total Potassium	**13.5**	mg/L	0.100	1	09/18/12 18:33	BKN	EPA-200.7
Total Sodium	**40.7**	mg/L	0.500	1	09/18/12 18:33	BKN	EPA-200.7
Sulfate	**42.8**	mg/L	1.00	1	09/14/12 12:18	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-256-0252**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 09/12/2012 13:01:16

City Of Harrison

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

12-256-0252
03322
2012-09-12
12 55 17

dy

Client	City of Harrison	Project Number
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	
Phone No.	870-741-4426	FID#
FAX No.	870-741-5022	Purchase Order #
Project:	CROOKED CREEK SAMPLING	
Project Manager	Tim Holt	
Type of Event:		
Single Daily Bi-Weekly	Quarterly Semi-Annual	

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	TOTAL ALKALINITY
9/11/2012	9:00am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X	X
9/11/2012	9:00am	Silver Valley Bridge (Downstream)	water	plastic	1	1	G	X	X	X	X				
9/11/2012	8:40am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X	X
9/11/2012	8:40am	HWY 62-65 Bridge (Upstream)	water	plastic	1	1	G	X	X	X	X				
9/11/2012	9:10am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X	X
9/11/2012	9:10am	WWTP DISCHARGE POINT	water	plastic	1	1	G	X	X	X	X				

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	9-11-2012/9;30am	BHolt	9-12-12

Rec'd at Lab By: BHolt	Rec'd Date / Time: 9-12-12 10:03	Comments: 1°C	
Shipped Via	UPS	ICED	NEXT DAY AIR

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

10/1/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-269-0230
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 9/25/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 10/1/2012

Report Number : **12-269-0230**

REPORT OF ANALYSIS

Received : 9/25/2012

Lab No : **97265** Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)** Sampled: **9/24/2012 12:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**18.1**	mg/L	0.400	1	09/25/12 20:57	RQE	EPA-300.0
Total Dissolved Solids	**249**	mg/L	10	1	09/28/12 14:00	NRT	2540C
Sulfate	**15.7**	mg/L	1.00	1	09/25/12 20:57	RQE	EPA-300.0

Lab No : **97266** Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)** Sampled: **9/24/2012 12:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.59**	mg/L	0.400	1	09/25/12 21:14	RQE	EPA-300.0
Total Dissolved Solids	**207**	mg/L	10	1	09/28/12 14:00	NRT	2540C
Sulfate	**5.93**	mg/L	1.00	1	09/25/12 21:14	RQE	EPA-300.0

Lab No : **97267** Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point** Sampled: **9/24/2012 12:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**59.9**	mg/L	2.00	5	09/26/12 10:37	RQE	EPA-300.0
Total Dissolved Solids	**417**	mg/L	10	1	09/28/12 14:00	NRT	2540C
Sulfate	**54.0**	mg/L	5.00	5	09/26/12 10:37	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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www.etcmemphis.com
Environmental Testing & Consulting, Inc.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-269-0230**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 09/25/2012 10:19:31

City Of Harrison

12-269-0230
00022
2012-09-25
10 18 47
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	Project Number	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily Monthly Quarterly Semi-Annual			

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
9/24/2012	12:15pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
9/24/2012	12:25pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
9/24/2012	12:35pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
	Tim Holt/City of Harrison	9-24/2012/1:00pm		

Rec'd at Lab By:

Rec'd Date / Time: 9-25-12

Comments: 09:33

Shipped Via: UPS | ICED | NEXT DAY AIR

1°C

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10/16/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-283-0211
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 10/9/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 10/16/2012

Report Number : **12-283-0211**

REPORT OF ANALYSIS

Received : 10/9/2012

Lab No : **89148**
Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)**
Sampled: **10/8/2012 10:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**14.0**	mg/L	0.400	1	10/10/12 18:31	RQE	EPA-300.0
Total Dissolved Solids	**251**	mg/L	10	1	10/12/12 14:20	NRT	2540C
Sulfate	**14.0**	mg/L	1.00	1	10/10/12 18:31	RQE	EPA-300.0

Lab No : **89149**
Matrix: **Aqueous**
Sample ID : **Hwy 62-65 Bridge (Upstream)**
Sampled: **10/8/2012 10:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.68**	mg/L	0.400	1	10/10/12 18:49	RQE	EPA-300.0
Total Dissolved Solids	**227**	mg/L	10	1	10/12/12 14:20	NRT	2540C
Sulfate	**5.14**	mg/L	1.00	1	10/10/12 18:49	RQE	EPA-300.0

Lab No : **89150**
Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point**
Sampled: **10/8/2012 10:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**59.3**	mg/L	2.00	5	10/12/12 10:56	RQE	EPA-300.0
Total Dissolved Solids	**438**	mg/L	10	1	10/12/12 14:20	NRT	2540C
Sulfate	**58.4**	mg/L	5.00	5	10/12/12 10:56	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-283-0211**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 10/09/2012 09:47:33

City Of Harrison

12-283-0211
03322
2012-10-09
09:43:08
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	**Project Number**	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net	FID#	
Phone No.	870-741-4426	Purchase Order #	
FAX No.	870-741-5022		
Project:	CROOKED CREEK SAMPLING		
Project Manager	Randy Reese		
Type of Event:			
Single Daily	Monthly Quarterly Semi-Annual		

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
10/8/2012	10:25a.m	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
10/8/2012	10:15a.m	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
10/8/2012	10:35a.m	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Randy Reese	Randy Reese/City of Harrison	10-8-2012/10:45 a.m	[illegible]	10/9/12-0932

Rec'd at Lab By:

Rec'd Date / Time:

Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

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10/31/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-297-0221
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 10/23/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 10/31/2012

Report Number : **12-297-0221**

REPORT OF ANALYSIS

Received : 10/23/2012

Lab No : **91592**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **10/22/2012 9:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**13.0**	mg/L	0.400	1	10/24/12 18:34	RQE	EPA-300.0
Total Dissolved Solids	**219**	mg/L	10	1	10/29/12 10:15	NRT	2540C
Sulfate	**9.12**	mg/L	1.00	1	10/30/12 16:58	RQE	EPA-300.0

Lab No : **91593**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **10/22/2012 9:20**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.31**	mg/L	0.400	1	10/24/12 18:51	RQE	EPA-300.0
Total Dissolved Solids	**205**	mg/L	10	1	10/29/12 10:15	NRT	2540C
Sulfate	**4.97**	mg/L	1.00	1	10/30/12 16:40	RQE	EPA-300.0

Lab No : **91594**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **10/22/2012 9:10**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**55.5**	mg/L	4.00	10	10/23/12 15:53	RQE	EPA-300.0
Nitrate (NO3-N)	**22.5**	mg/L	1.00	10	10/23/12 15:53	RQE	EPA-300.0
Nitrite (NO2-N)	**0.142**	mg/L	0.100	1	10/23/12 15:35	RQE	EPA-300.0
Nitrate+Nitrite-N	**22.6**	mg/L	0.100	1	10/23/12 15:35		EPA-300.0
Total Dissolved Solids	**324**	mg/L	10	1	10/29/12 10:15	NRT	2540C
Sulfate	**41.4**	mg/L	1.00	1	10/23/12 15:35	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-297-0221**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 10/23/2012 10:44:56

City Of Harrison

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

12-297-0221
03322
2012-10-23
10:44:39

Chain of Custody

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily	Monthly Quarterly Semi-Annual

FID#

Purchase Order #

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
10/22/2012	9:30 AM	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
10/22/2012	9:20 AM	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
10/22/2012	9:10 AM	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
[signature]	Randy Reese	10-22-12 / 9:50 AM		

Rec'd at Lab By: [signature] Rec'd Date / Time: 10-23-12 09:28 Comments:

Shipped Via: UPS ICED NEXT DAY AIR

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11/13/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-311-0214
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 11/6/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 11/13/2012

Report Number : **12-311-0214**

REPORT OF ANALYSIS

Received : 11/6/2012

Lab No : **93872** Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)** Sampled: **11/5/2012 8:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**11.3**	mg/L	0.400	1	11/06/12 13:08	RQE	EPA-300.0
Total Dissolved Solids	**213**	mg/L	10	1	11/08/12 08:00	NRT	2540C
Sulfate	**9.47**	mg/L	1.00	1	11/06/12 13:08	RQE	EPA-300.0

Lab No : **93873** Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)** Sampled: **11/5/2012 8:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.04**	mg/L	0.400	1	11/06/12 13:25	RQE	EPA-300.0
Total Dissolved Solids	**208**	mg/L	10	1	11/08/12 08:00	NRT	2540C
Sulfate	**5.13**	mg/L	1.00	1	11/06/12 13:25	RQE	EPA-300.0

Lab No : **93874** Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point** Sampled: **11/5/2012 8:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**61.0**	mg/L	4.00	10	11/08/12 10:49	RQE	EPA-300.0
Nitrate (NO3-N)	**20.7**	mg/L	1.00	10	11/08/12 10:49	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	11/06/12 11:23	RQE	EPA-300.0
Nitrate+Nitrite-N	**20.7**	mg/L	0.100	1	11/06/12 11:23		EPA-300.0
Total Dissolved Solids	**352**	mg/L	10	1	11/08/12 08:00	NRT	2540C
Sulfate	**56.6**	mg/L	10.0	10	11/08/12 10:49	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-311-0214**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments: Add NO3, NO2 to WWTP Discharge Point sample per client.

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 11/06/2012 10:20:14

City Of Harrison

Chain of Custody

Client	City of Harrison	Project Number
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	
Phone No.	870-741-4426	FID#
FAX No.	870-741-5022	Purchase Order #
Project:	CROOKED CREEK SAMPLING	
Project Manager	Randy Reese	
Type of Event:		
Single Daily	Monthly Quarterly Semi-Annual	

Analysis Requested

12-311-0214
03322
2012-11-06
10:19:05
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3, NO2
11-5-12	8:15 a.m	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X	
11-5-12	8:25 a.m	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X	
11-5-12	8:35 a.m	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Randy Reese	Randy Reese/City of Harrison	11-5-12 / 9:00 a.m		
		11/6/12 0946	R Ross	R.Ross

Rec'd at Lab By:	Rec'd Date / Time:	Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

ETC **Environmental Testing & Consulting, Inc.**
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12/5/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-326-0233
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 11/21/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randall H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 12/5/2012

Report Number : **12-326-0233**

REPORT OF ANALYSIS

Received : 11/21/2012

Lab No : **96804**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **11/20/2012 8:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**156**	mg/L	1	1	11/28/12 11:05	EWB	2320B
Chloride	**12.1**	mg/L	0.400	1	11/29/12 20:54	RQE	EPA-300.0
Total Dissolved Solids	**216**	mg/L	10	1	11/26/12 14:30	NRT	2540C
Total Calcium	**70.0**	mg/L	0.100	1	12/01/12 05:45	BKN	EPA-200.7
Total Magnesium	**2.11**	mg/L	0.100	1	12/01/12 05:45	BKN	EPA-200.7
Total Potassium	**2.27**	mg/L	0.100	1	12/04/12 13:42	JTR	EPA-200.7
Total Sodium	**7.96**	mg/L	0.500	1	12/04/12 13:42	JTR	EPA-200.7
Sulfate	**8.99**	mg/L	1.00	1	11/29/12 20:54	RQE	EPA-300.0

Lab No : **96805**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **11/20/2012 8:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**166**	mg/L	1	1	11/28/12 11:05	EWB	2320B
Chloride	**7.42**	mg/L	0.400	1	11/29/12 21:12	RQE	EPA-300.0
Total Dissolved Solids	**182**	mg/L	10	1	11/26/12 14:30	NRT	2540C
Total Calcium	**71.4**	mg/L	0.100	1	12/01/12 05:52	BKN	EPA-200.7
Total Magnesium	**1.94**	mg/L	0.100	1	12/01/12 05:52	BKN	EPA-200.7
Total Potassium	**1.46**	mg/L	0.100	1	12/04/12 13:44	JTR	EPA-200.7
Total Sodium	**3.79**	mg/L	0.500	1	12/04/12 13:44	JTR	EPA-200.7
Sulfate	**4.72**	mg/L	1.00	1	11/29/12 21:12	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 12/5/2012

Report Number : **12-326-0233**

REPORT OF ANALYSIS

Received : 11/21/2012

Lab No : **96806**

Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**

Sampled: **11/20/2012 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**31**	mg/L	1	1	11/28/12 11:05	EWB	2320B
Chloride	**57.7**	mg/L	4.00	10	11/21/12 12:30	RQE	EPA-300.0
Nitrate (NO3-N)	**22.3**	mg/L	1.00	10	11/21/12 12:30	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	11/21/12 11:20	RQE	EPA-300.0
Nitrate+Nitrite-N	**22.3**	mg/L	0.100	1	11/21/12 11:20		EPA-300.0
Total Dissolved Solids	**331**	mg/L	10	1	11/26/12 14:30	NRT	2540C
Total Calcium	**43.3**	mg/L	0.100	1	12/01/12 05:58	BKN	EPA-200.7
Total Magnesium	**3.58**	mg/L	0.100	1	12/01/12 05:58	BKN	EPA-200.7
Total Potassium	**12.7**	mg/L	0.500	5	12/04/12 13:49	JTR	EPA-200.7
Total Sodium	**62.1**	mg/L	2.50	5	12/04/12 13:49	JTR	EPA-200.7
Sulfate	**60.8**	mg/L	10.0	10	11/21/12 12:30	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-326-0233**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 11/21/2012 10:03:50

City Of Harrison

Harrison Wastewater Treatment Plant
Crooked Creek Sampling
12-326-0233
03022
2012-11-21
10:03:01

Client	City of Harrison	Project Number
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	FID#
Phone No.	870-741-4426	Purchase Order #
FAX No.	870-741-5022	
Project:	CROOKED CREEK SAMPLING	
Project Manager	Tim Holt	
Type of Event:		
Single Daily Bi-Weekly Quarterly Semi-Annual		

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	Nitrate & Nitrite
11/20/2012	8:35am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X	
					1	1		X	X	X					
11/20/2012	8:45am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X	
					1	1		X	X	X					
11/20/2012	9:00am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X	X
					1	1		X	X	X					

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	11-20-2012/9:45am		

Rec'd at Lab By: BHoug Rec'd Date / Time: 11-21-12/0919 Comments:

Shipped Via: UPS ICED NEXT DAY AIR

1°C

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12/12/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-339-0216
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 12/4/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

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Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 12/12/2012

Report Number : **12-339-0216**

REPORT OF ANALYSIS

Received : 12/4/2012

Lab No : **98669** Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)** Sampled: **12/3/2012 7:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**13.4**	mg/L	0.400	1	12/10/12 18:26	RQE	EPA-300.0
Total Dissolved Solids	**222**	mg/L	10	1	12/05/12 13:00	NRT	2540C
Sulfate	**12.1**	mg/L	1.00	1	12/10/12 18:26	RQE	EPA-300.0

Lab No : **98670** Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)** Sampled: **12/3/2012 7:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.72**	mg/L	0.400	1	12/10/12 18:44	RQE	EPA-300.0
Total Dissolved Solids	**215**	mg/L	10	1	12/05/12 13:00	NRT	2540C
Sulfate	**5.21**	mg/L	1.00	1	12/10/12 18:44	RQE	EPA-300.0

Lab No : **98671** Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point** Sampled: **12/3/2012 7:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**63.8**	mg/L	2.00	5	12/11/12 22:48	RQE	EPA-300.0
Total Dissolved Solids	**382**	mg/L	10	1	12/05/12 13:00	NRT	2540C
Sulfate	**73.0**	mg/L	5.00	5	12/11/12 22:48	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-339-0216**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 12/04/2012 09:55:12

City Of Harrison

12-339-0216
03322
2012-12-04
09:54:41
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	Project Number
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	
Phone No.	870-741-4426	FID#
FAX No.	870-741-5022	Purchase Order #
Project:	CROOKED CREEK SAMPLING	
Project Manager	Tim Holt	
Type of Event:		
Single Daily	Monthly Quarterly Semi-Annual	

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE
12/3/2012	7:30am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X
12/3/2012	7:00am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X
12/3/2012	7:15am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	12-3-2012/8:45am		
		12/4/12-0933	RRo	RROSS

Rec'd at Lab By: Rec'd Date / Time: Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

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1/2/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-354-0214
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 12/19/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 1/2/2013

Report Number : **12-354-0214**

REPORT OF ANALYSIS

Received : 12/19/2012

Lab No : **91183**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **12/18/2012 7:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**13.2**	mg/L	0.400	1	12/28/12 23:41	RQE	EPA-300.0
Total Dissolved Solids	**223**	mg/L	10	1	12/21/12 09:45	NRT	2540C
Sulfate	**9.81**	mg/L	1.00	1	12/28/12 23:41	RQE	EPA-300.0

Lab No : **91184**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **12/18/2012 7:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**8.12**	mg/L	0.400	1	12/28/12 23:58	RQE	EPA-300.0
Total Dissolved Solids	**219**	mg/L	10	1	12/21/12 09:45	NRT	2540C
Sulfate	**5.37**	mg/L	1.00	1	12/28/12 23:58	RQE	EPA-300.0

Lab No : **91185**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **12/18/2012 7:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**61.4**	mg/L	4.00	10	12/31/12 16:37	RQE	EPA-300.0
Total Dissolved Solids	**350**	mg/L	10	1	12/21/12 09:45	NRT	2540C
Sulfate	**53.2**	mg/L	10.0	10	12/31/12 16:37	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-354-0214**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 12/19/2012 10:16:42

City Of Harrison

Chain of Custody

12-354-0214
03322
2012-12-19
10:16:14

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	Project Number	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily	Monthly Quarterly Semi-Annual		

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	N02
12/18/2012	7:15am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
12/18/2012	7:30am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
12/18/2012	7:00am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	12-18-2012/8:15am		
		12/19/12-0945	RRo	RRoss

Rec'd at Lab By:

Rec'd Date / Time:

Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

ETC www.etcmemphis.com
ENVIRONMENTAL TESTING & CONSULTING, INC.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

1/11/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-004-0222
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 1/4/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 1/11/2013

Report Number : **13-004-0222**

REPORT OF ANALYSIS

Received : 1/4/2013

Lab No : **93088** Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)** Sampled: **1/3/2013 9:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**13.8**	mg/L	0.400	1	01/07/13 14:46	RQE	EPA-300.0
Total Dissolved Solids	**246**	mg/L	10	1	01/08/13 14:00	NRT	2540C
Sulfate	**8.14**	mg/L	1.00	1	01/07/13 14:46	RQE	EPA-300.0

Lab No : **93089** Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)** Sampled: **1/3/2013 9:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**8.64**	mg/L	0.400	1	01/07/13 15:03	RQE	EPA-300.0
Total Dissolved Solids	**210**	mg/L	10	1	01/08/13 14:00	NRT	2540C
Sulfate	**5.26**	mg/L	1.00	1	01/07/13 15:03	RQE	EPA-300.0

Lab No : **93090** Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point** Sampled: **1/3/2013 9:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**56.6**	mg/L	4.00	10	01/04/13 14:34	RQE	EPA-300.0
Nitrate (NO3-N)	**18.6**	mg/L	1.00	10	01/04/13 14:34	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	01/04/13 13:25	RQE	EPA-300.0
Nitrate+Nitrite-N	**18.6**	mg/L	0.100	1	01/04/13 13:25		EPA-300.0
Total Dissolved Solids	**334**	mg/L	10	1	01/08/13 14:00	NRT	2540C
Sulfate	**42.6**	mg/L	1.00	1	01/04/13 13:25	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-004-0222**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 01/04/2013 10:37:14

City Of Harrison

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

13-004-0222
03322
2013-01-04
10:35:14

Chain of Custody

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	
Single Daily Bi-Weekly Monthly Quarterly Semi-Annual	

FID#

Purchase Order #

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	NO2
1/3/2013	9:25am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
1/3/2013	9:35am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
1/3/2013	9:15am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	1-3-2013/10:00am		
		1/4/13-1000	RRoss	RRoss-EIC

Rec'd at Lab By:

Rec'd Date / Time:

Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

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1/24/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-015-0223
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 1/15/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 1/24/2013

Report Number : **13-015-0223**

REPORT OF ANALYSIS

Received : 1/15/2013

Lab No : **94746**
Sample ID : **Silver Valley Bridge (Downstream) Plus**
Matrix: **Aqueous**
Sampled: **1/14/2013 12:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**129**	mg/L	1	1	01/16/13 09:13	EWB	2320B
Chloride	**12.3**	mg/L	0.400	1	01/15/13 17:16	RQE	EPA-300.0
Total Dissolved Solids	**196**	mg/L	10	1	01/21/13 14:00	NRT	2540C
Total Calcium	**58.4**	mg/L	0.100	1	01/17/13 21:27	BKN	EPA-200.7
Total Magnesium	**1.91**	mg/L	0.100	1	01/17/13 21:27	BKN	EPA-200.7
Total Potassium	**2.30**	mg/L	0.100	1	01/19/13 00:39	JTR	EPA-200.7
Total Sodium	**8.52**	mg/L	0.500	1	01/19/13 00:39	JTR	EPA-200.7
Sulfate	**9.62**	mg/L	1.00	1	01/15/13 17:16	RQE	EPA-300.0

Lab No : **94747**
Sample ID : **Hwy 62/65 Bridge (Upstream) plus**
Matrix: **Aqueous**
Sampled: **1/14/2013 12:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**146**	mg/L	1	1	01/16/13 09:13	EWB	2320B
Chloride	**6.93**	mg/L	0.400	1	01/15/13 17:33	RQE	EPA-300.0
Total Dissolved Solids	**188**	mg/L	10	1	01/21/13 14:00	NRT	2540C
Total Calcium	**66.4**	mg/L	0.100	1	01/17/13 21:34	BKN	EPA-200.7
Total Magnesium	**1.86**	mg/L	0.100	1	01/17/13 21:34	BKN	EPA-200.7
Total Potassium	**1.32**	mg/L	0.100	1	01/19/13 00:59	JTR	EPA-200.7
Total Sodium	**3.84**	mg/L	0.500	1	01/19/13 00:59	JTR	EPA-200.7
Sulfate	**4.93**	mg/L	1.00	1	01/15/13 17:33	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 1/24/2013

Report Number : **13-015-0223**

REPORT OF ANALYSIS

Received : 1/15/2013

Lab No : **94748**
Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**
Sampled: **1/14/2013 12:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**37**	mg/L	1	1	01/16/13 09:13	EWB	2320B
Chloride	**47.5**	mg/L	4.00	10	01/15/13 11:22	RQE	EPA-300.0
Nitrate (NO3-N)	**15.2**	mg/L	1.00	10	01/15/13 11:22	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	01/15/13 10:42	RQE	EPA-300.0
Nitrate+Nitrite-N	**15.2**	mg/L	0.100	1	01/15/13 10:42		EPA-300.0
Total Dissolved Solids	**297**	mg/L	10	1	01/21/13 14:00	NRT	2540C
Total Calcium	**40.8**	mg/L	0.100	1	01/17/13 21:40	BKN	EPA-200.7
Total Magnesium	**3.22**	mg/L	0.100	1	01/17/13 21:40	BKN	EPA-200.7
Total Potassium	**10.1**	mg/L	0.100	1	01/19/13 01:06	JTR	EPA-200.7
Total Sodium	**44.6**	mg/L	0.500	1	01/19/13 01:06	JTR	EPA-200.7
Sulfate	**43.9**	mg/L	1.00	1	01/15/13 10:42	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**

Customer Name: **Harrison Wastewater Treatment Plant**

Report Number: **13-015-0223**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Question			
Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)

☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 01/15/2013 09:57:02

City Of Harrison

...dy

13-015-0223
03322
2013-01-15
09:56:52
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	**Project Number**	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily Bi-Weekly Quarterly Semi-Annual			

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	Nitrate & Nitrite
1/14/2013	12:15pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X	
					1	1		X	X	X					
1/14/2013	12:25pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X	
					1	1		X	X	X					
1/14/2013	12:00pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X	X
					1	1		X	X	X					

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	1-14-2013/12:45pm		
		1/15/13 0931	BRoss	BRoss

Rec'd at Lab By: | *Rec'd Date / Time:* | *Comments:*

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

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www.etcmemphis.com 2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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2/1/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-029-0230
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 1/29/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 2/1/2013

Report Number : **13-029-0230**

REPORT OF ANALYSIS

Received : 1/29/2013

Lab No : **97510**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **1/28/2013 9:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**12.4**	mg/L	0.400	1	01/29/13 15:52	RQE	EPA-300.0
Total Dissolved Solids	**209**	mg/L	10	1	01/30/13 14:00	NRT	2540C
Sulfate	**11.2**	mg/L	1.00	1	01/31/13 22:03	RQE	EPA-300.0

Lab No : **97511**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **1/28/2013 9:35**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.94**	mg/L	0.400	1	01/29/13 16:45	RQE	EPA-300.0
Total Dissolved Solids	**188**	mg/L	10	1	01/30/13 14:00	NRT	2540C
Sulfate	**6.90**	mg/L	1.00	1	01/31/13 22:20	RQE	EPA-300.0

Lab No : **97512**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **1/28/2013 9:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**59.0**	mg/L	4.00	10	01/29/13 11:49	RQE	EPA-300.0
Nitrate (NO3-N)	**15.4**	mg/L	1.00	10	01/29/13 11:49	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	01/29/13 11:31	RQE	EPA-300.0
Nitrate+Nitrite-N	**15.4**	mg/L	0.100	1	01/29/13 11:31		EPA-300.0
Total Dissolved Solids	**315**	mg/L	10	1	01/30/13 14:00	NRT	2540C
Sulfate	**63.0**	mg/L	10.0	10	01/29/13 11:49	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-029-0230**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Susan Simpson

Date & Time: 01/29/2013 10:25:40

City Of Harrison

Harrison Wastewater Treatment Plant
Crooked Creek Sampling
13-029-0230
03322
2013-01-29
10:23:10

Client	City of Harrison	Project Number
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	
Phone No.	870-741-4426	FID#
FAX No.	870-741-5022	Purchase Order #
Project:	CROOKED CREEK SAMPLING	
Project Manager	Tim Holt	
Type of Event:		
Single Daily	Monthly Quarterly Semi-Annual	

Analys...

Date	Time	Sample Identification	Matrix	Type	No.	Pres	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	N02
1/28/2013	9:25am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
1/28/2013	9:35am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
1/28/13												
(SAS) ~~1/8/2013~~	9:15am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments: 1°C

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	1-28-2013/10:00am	S. Simpson	Susan A Simpson/ETC
		1/29/13 09:20		

Rec'd at Lab By: | Rec'd Date / Time: | Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

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www.etcmemphis.com 2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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2/18/2013

Harrison Wastewater Treatment Plant
Mr. Tim Holt
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-043-0216
Client Project Description: Crooked Creek Sampling

Dear Mr. Tim Holt:

Environmental Testing and Consulting, Inc. received sample(s) on 2/12/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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03322
Harrison Wastewater Treatment Plant
Mr. Tim Holt
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 2/18/2013

Report Number : **13-043-0216**

REPORT OF ANALYSIS

Received : 2/12/2013

Lab No : **89707**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **2/11/2013 12:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**9.76**	mg/L	0.400	1	02/14/13 21:08	RQE	EPA-300.0
Total Dissolved Solids	**204**	mg/L	10	1	02/13/13 14:30	NRT	2540C
Sulfate	**9.06**	mg/L	1.00	1	02/14/13 21:08	RQE	EPA-300.0

Lab No : **89708**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **2/11/2013 12:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.79**	mg/L	0.400	1	02/14/13 21:25	RQE	EPA-300.0
Total Dissolved Solids	**196**	mg/L	10	1	02/13/13 14:30	NRT	2540C
Sulfate	**7.08**	mg/L	1.00	1	02/14/13 21:25	RQE	EPA-300.0

Lab No : **89709**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **2/11/2013 12:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**41.4**	mg/L	4.00	10	02/13/13 10:03	RQE	EPA-300.0
Nitrate (NO3-N)	**15.2**	mg/L	1.00	10	02/13/13 10:03	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	02/12/13 17:05	RQE	EPA-300.0
Nitrate+Nitrite-N	**15.2**	mg/L	0.100	1	02/12/13 17:05		EPA-300.0
Total Dissolved Solids	**235**	mg/L	10	1	02/13/13 14:30	NRT	2540C
Sulfate	**35.4**	mg/L	1.00	1	02/12/13 17:05	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-043-0216**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Susan Simpson

Date & Time: 02/12/2013 09:56:03

City Of Harrison

13-043-0216
03322
2013-02-12
09:54:43
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	Project Number	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily	Monthly Quarterly Semi-Annual		

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	NO2
2/11/2013	12:15pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
2/11/2013	12:30pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
2/11/2013	12:00pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	2-11-2013/1:00pm		

Rec'd at Lab By: S Simpson | Rec'd Date / Time: 2/12/13 0924 | Comments: 1.0°C

Shipped Via	UPS	ICED	NEXT DAY AIR

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3/7/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-060-0225
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 3/1/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 3/7/2013

Report Number : **13-060-0225**

REPORT OF ANALYSIS

Received : 3/1/2013

Lab No : **93237** Matrix: **Aqueous**
Sample ID : **Silver Valley Bridge (Downstream)** Sampled: **2/28/2013 9:40**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**10.2**	mg/L	0.400	1	03/01/13 12:05	RQE	EPA-300.0
Total Dissolved Solids	**162**	mg/L	10	1	03/05/13 10:00	NRT	2540C
Sulfate	**10.9**	mg/L	1.00	1	03/01/13 12:05	RQE	EPA-300.0

Lab No : **93238** Matrix: **Aqueous**
Sample ID : **Hwy 62/65 Bridge (Upstream)** Sampled: **2/28/2013 9:55**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.20**	mg/L	0.400	1	03/01/13 13:15	RQE	EPA-300.0
Total Dissolved Solids	**155**	mg/L	10	1	03/05/13 10:00	NRT	2540C
Sulfate	**9.61**	mg/L	1.00	1	03/01/13 13:15	RQE	EPA-300.0

Lab No : **93239** Matrix: **Aqueous**
Sample ID : **WWTP Discharge Point** Sampled: **2/28/2013 9:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**42.7**	mg/L	4.00	10	03/01/13 14:07	RQE	EPA-300.0
Nitrate (NO3-N)	**3.38**	mg/L	0.100	1	03/01/13 13:50	RQE	EPA-300.0
Nitrite (NO2-N)	**0.260**	mg/L	0.100	1	03/01/13 13:50	RQE	EPA-300.0
Nitrate+Nitrite-N	**3.64**	mg/L	0.100	1	03/01/13 13:50		EPA-300.0
Total Dissolved Solids	**267**	mg/L	10	1	03/05/13 10:00	NRT	2540C
Sulfate	**37.4**	mg/L	1.00	1	03/01/13 13:50	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-060-0225**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 03/01/2013 09:54:34

City Of Harrison

dy

13-060-0225
03322
2013-03-01
09:54:00
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	**Project Number**	
Address	1508 Silver Valley Road		
	Harriosn, AR 72601		
email address	hwwtp2@windstream.net		
Phone No.	870-741-4426	FID#	
FAX No.	870-741-5022	Purchase Order #	
Project:	CROOKED CREEK SAMPLING		
Project Manager	Tim Holt		
Type of Event:			
Single Daily	Monthly Quarterly Semi-Annual		

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	NO2
2/28/2013	9:40am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
2/28/2013	9:55am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
2/28/2013	9:25am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	2-28-2013/10:00am		
			[illegible] 3/1/13-0929	

Rec'd at Lab By:		Rec'd Date / Time:	Comments:
Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

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3/25/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-073-0220
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 3/14/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 3/25/2013

Report Number : **13-073-0220**

REPORT OF ANALYSIS

Received : 3/14/2013

Lab No : **96269**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **3/13/2013 9:40**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**8.65**	mg/L	0.400	1	03/14/13 12:56	RQE	EPA-300.0
Total Dissolved Solids	**163**	mg/L	10	1	03/20/13 14:30	NRT	2540C
Sulfate	**9.97**	mg/L	1.00	1	03/14/13 12:56	RQE	EPA-300.0

Lab No : **96270**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **3/13/2013 9:55**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.59**	mg/L	0.400	1	03/14/13 13:14	RQE	EPA-300.0
Total Dissolved Solids	**160**	mg/L	10	1	03/20/13 14:30	NRT	2540C
Sulfate	**8.45**	mg/L	1.00	1	03/14/13 13:14	RQE	EPA-300.0

Lab No : **96271**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **3/13/2013 9:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**36.9**	mg/L	4.00	10	03/21/13 14:05	RQE	EPA-300.0
Nitrate (NO3-N)	**5.60**	mg/L	0.100	1	03/14/13 13:31	RQE	EPA-300.0
Nitrite (NO2-N)	**0.142**	mg/L	0.100	1	03/14/13 13:31	RQE	EPA-300.0
Nitrate+Nitrite-N	**5.74**	mg/L	0.100	1	03/14/13 13:31		EPA-300.0
Total Dissolved Solids	**265**	mg/L	10	1	03/20/13 14:30	NRT	2540C
Sulfate	**49.9**	mg/L	1.00	1	03/14/13 13:31	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-073-0220**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 03/14/2013 10:24:11

City Of Harrison

13-073-0220
03322
2013-03-14
10:23:34
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison	Project Number
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	
Phone No.	870-741-4426	FID#
FAX No.	870-741-5022	Purchase Order #
Project:	CROOKED CREEK SAMPLING	
Project Manager	Tim Holt	
Type of Event:		
Single Daily	Monthly Quarterly Semi-Annual	

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	N02
3/13/2013	9:40am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
3/13/2013	9:55am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
3/13/2013	9:25am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	3/13/2013/10:30am		
			[illegible] 3/14/13 0935	

Rec'd at Lab By: Rec'd Date / Time: Comments:

Shipped Via	UPS	ICED	NEXT DAY AIR

1°C

ETC www.etcmemphis.com
Environmental Testing & Consulting, Inc.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

4/10/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-086-0222
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 3/27/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 4/10/2013

Report Number : **13-086-0222**

REPORT OF ANALYSIS

Received : 3/27/2013

Lab No : **98784**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **3/26/2013 12:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**113**	mg/L	1	1	04/01/13 11:15	EWB	2320B
Chloride	**9.49**	mg/L	0.400	1	03/27/13 15:34	RQE	EPA-300.0
Total Dissolved Solids	**165**	mg/L	10	10	03/29/13 13:30	NRT	2540C
Total Calcium	**55.1**	mg/L	0.100	1	04/05/13 22:14	BKN	EPA-200.7
Total Magnesium	**1.97**	mg/L	0.100	1	04/05/13 22:14	BKN	EPA-200.7
Total Potassium	**1.62**	mg/L	0.100	1	04/10/13 13:48	JTR	EPA-200.7
Total Sodium	**6.17**	mg/L	0.500	1	04/10/13 13:48	JTR	EPA-200.7
Sulfate	**11.8**	mg/L	1.00	1	03/27/13 15:34	RQE	EPA-300.0

Lab No : **98785**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **3/26/2013 12:25**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**109**	mg/L	1	1	04/01/13 11:15	EWB	2320B
Chloride	**6.57**	mg/L	0.400	1	03/27/13 15:51	RQE	EPA-300.0
Total Dissolved Solids	**147**	mg/L	10	1	03/29/13 13:30	NRT	2540C
Total Calcium	**52.4**	mg/L	0.100	1	04/05/13 22:21	BKN	EPA-200.7
Total Magnesium	**1.85**	mg/L	0.100	1	04/05/13 22:21	BKN	EPA-200.7
Total Potassium	**1.18**	mg/L	0.100	1	04/10/13 13:51	JTR	EPA-200.7
Total Sodium	**3.63**	mg/L	0.500	1	04/10/13 13:51	JTR	EPA-200.7
Sulfate	**9.79**	mg/L	1.00	1	03/27/13 15:51	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 4/10/2013

Report Number : **13-086-0222**

REPORT OF ANALYSIS

Received : 3/27/2013

Lab No : **98786**

Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**

Sampled: **3/26/2013 12:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**69**	mg/L	1	1	04/01/13 11:15	EWB	2320B
Chloride	**40.4**	mg/L	4.00	10	03/27/13 11:48	RQE	EPA-300.0
Nitrate (NO3-N)	**12.2**	mg/L	1.00	10	03/27/13 11:48	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	03/27/13 11:30	RQE	EPA-300.0
Nitrate+Nitrite-N	**12.2**	mg/L	0.100	1	03/27/13 11:30		EPA-300.0
Total Dissolved Solids	**288**	mg/L	10	1	03/29/13 13:30	NRT	2540C
Total Calcium	**45.9**	mg/L	0.100	1	04/05/13 22:28	BKN	EPA-200.7
Total Magnesium	**2.91**	mg/L	0.100	1	04/05/13 22:28	BKN	EPA-200.7
Total Potassium	**8.07**	mg/L	0.100	1	04/10/13 13:55	JTR	EPA-200.7
Total Sodium	**40.5**	mg/L	0.500	1	04/10/13 13:55	JTR	EPA-200.7
Sulfate	**46.0**	mg/L	1.00	1	03/27/13 11:30	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-086-0222**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 03/27/2013 10:02:05

City Of Harrison

13-086-0222
03322
03-27-2013
09:46:16
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Client	City of Harrison
Address	1508 Silver Valley Road
	Harriosn, AR 72601
email address	hwwtp2@windstream.net
Phone No.	870-741-4426
FAX No.	870-741-5022
Project:	CROOKED CREEK SAMPLING
Project Manager	Tim Holt
Type of Event:	Single Daily Bi-Weekly Quarterly Semi-Annual

Project Number

FID#

Purchase Order #

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	Nitrate & Nitrite
3/26/2013	12:15pm	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G					X	X	X	
					1	1		X	X	X					
3/26/2013	12:25pm	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G					X	X	X	
					1	1		X	X	X					
3/26/2013	12:00pm	WWTP DISCHARGE POINT	water	plastic	1	NONE	G					X	X	X	X
					1	1		X	X	X					

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	3-26-2013/12:45pm		
		3/27/13 0935	RRoss	RRo

Rec'd at Lab By:

Rec'd Date / Time:

Comments:

Shipped Via UPS ICED NEXT DAY AIR

1°C

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4/19/2013

Harrison Wastewater Treatment Plant
Mr. Tim Holt
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-102-0236
Client Project Description: Crooked Creek Sampling

Dear Mr. Tim Holt:

Environmental Testing and Consulting, Inc. received sample(s) on 4/12/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Mr. Tim Holt
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 4/19/2013

Report Number : **13-102-0236**

REPORT OF ANALYSIS

Received : 4/12/2013

Lab No : **91949**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **4/11/2013 6:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**10.7**	mg/L	0.400	1	04/16/13 14:37	ACS	EPA-300.0
Total Dissolved Solids	**197**	mg/L	10	1	04/15/13 14:00	NRT	2540C
Sulfate	**11.4**	mg/L	1.00	1	04/16/13 14:37	ACS	EPA-300.0

Lab No : **91950**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **4/11/2013 7:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**7.50**	mg/L	0.400	1	04/16/13 14:55	ACS	EPA-300.0
Total Dissolved Solids	**184**	mg/L	10	1	04/15/13 14:00	NRT	2540C
Sulfate	**8.49**	mg/L	1.00	1	04/16/13 14:55	ACS	EPA-300.0

Lab No : **91951**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **4/11/2013 7:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**54.8**	mg/L	0.800	2	04/12/13 22:46	ACS	EPA-300.0
Nitrate (NO3-N)	**7.16**	mg/L	0.100	1	04/12/13 13:46	ACS	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	04/12/13 13:46	ACS	EPA-300.0
Nitrate+Nitrite-N	**7.16**	mg/L	0.100	1	04/12/13 13:46		EPA-300.0
Total Dissolved Solids	**349**	mg/L	10	1	04/15/13 14:00	NRT	2540C
Sulfate	**77.9**	mg/L	2.00	2	04/12/13 22:46	ACS	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-102-0236**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 04/12/2013 11:30:52

City Of Harrison

Chain of Custody

13-102-0236
03322
04-12-2013
11:29:58
Harrison Wastewater Treatment Plant
Crooked Creek Sampling or

Client	City of Harrison	Project Number			
Address	1508 Silver Valley Road				
	Harriosn, AR 72601				
email address	hwwtp2@windstream.net				
Phone No.	870-741-4426	FID#			
FAX No.	870-741-5022	Purchase Order #			
Project:	CROOKED CREEK SAMPLING				
Project Manager	Tim Holt				
Type of Event:					
Single Daily	Monthly Quarterly Semi-Annual				

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	N02									
4/11/2013	6:45am	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X											
4/11/2013	7:30am	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X											
4/11/2013	7:00am	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X									

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
Tim Holt	Tim Holt/City of Harrison	4-11-2013/9:00am		

Rec'd at Lab By:		Rec'd Date / Time:	4-12-13 0920	Comments:	
Shipped Via	UPS	ICED	NEXT DAY AIR		

1°C

13-114-0225
03322
04-24-2013
10:44:43
Harrison Wastewater Treatment Plant
Crooked Creek Sampling

City Of Harrison

Client	City of Harrison	**Project Number**
Address	1508 Silver Valley Road	
	Harriosn, AR 72601	
email address	hwwtp2@windstream.net	FID#
Phone No.	870-741-4426	Purchase Order #
FAX No.	870-741-5022	
Project:	CROOKED CREEK SAMPLING	
Project Manager	Tim Holt	
Type of Event:		
Single Daily	Monthly Quarterly Semi-Annual	

Analysis

Date	Time	Sample Identification	Matrix	Type	No.	Pres.	(G)rab or (C)omposite	SULFATE	TOTAL DISSOLVED SOLIDS	CHLORIDE	NO3	NO2
4-23-13	9:00 a.m	Silver Valley Bridge (Downstream)	water	plastic	1	NONE	G	X	X	X		
4-23-13	9:10 a.m	HWY 62-65 Bridge (Upstream)	water	plastic	1	NONE	G	X	X	X		
4-23-13	8:50 a.m	WWTP DISCHARGE POINT	water	plastic	1	NONE	G	X	X	X	X	X

Preservatives: (1) Nitric Acid(NH03) (2)Hydrochloric Acid(HCL) (3) Sodium Thiosulfate(Na2S203) (4) Sodium Hydroxide(Na03)

Client Remarks/Comments:

Relinquished By (Sign)	Print Name / Company	Date / Time	Received By (Sign)	Print Name / Company
	Randy Reese/City of Harrison	4-23-13 / 9:20 a.m		

Rec'd at Lab By:

Rec'd Date / Time: 4/24/13 1015

Comments:

Shipped Via	UPS	ICED 1°	NEXT DAY AIR

Biweekly Sampling Data from YWWTP

ETC Environmental Testing & Consulting, Inc.
www.etcmemphis.com
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"A Laboratory Management Partner"

10/1/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-269-0231
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 9/25/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 10/1/2012

Report Number : **12-269-0231**

REPORT OF ANALYSIS

Received : 9/25/2012

Lab No : **97268**

Sample ID : **WWTP Effluent**

Matrix: **Aqueous**

Sampled: **9/24/2012 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**36.9**	mg/L	0.400	1	09/25/12 21:49	RQE	EPA-300.0
Total Dissolved Solids	**328**	mg/L	10	1	09/28/12 14:00	NRT	2540C
Sulfate	**23.1**	mg/L	1.00	1	09/25/12 21:49	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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ENVIRONMENTAL TESTING & CONSULTING, INC.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-269-0231**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Brooke Shoup

Date & Time: 09/25/2012 10:21:07

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
Yellville Sampling
12-269-0231
03322
2012-09-25
10:20:48

0000015984

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling		

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
Mr. Tim Holt	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic Pint	NO WATER	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	NO WATER	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	9-24-2012 9:00AM	1	NONE	G	Aqueous	SO4/TDS/Cl

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXFORD	UPS - ICED NEXT DAY	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford			

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time

Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		BHarp	9-25-12 0933

1/1

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10/16/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-283-0212
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 10/9/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 10/16/2012

Report Number : **12-283-0212**

REPORT OF ANALYSIS

Received : 10/9/2012

Lab No : **89151**
Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**
Sampled: **10/8/2012 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**38.6**	mg/L	0.400	1	10/10/12 19:23	RQE	EPA-300.0
Total Dissolved Solids	**347**	mg/L	10	1	10/12/12 14:20	NRT	2540C
Sulfate	**19.0**	mg/L	1.00	1	10/10/12 19:23	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-283-0212**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 10/09/2012 09:49:59

ETC

Environmental Testing & Consulting, Inc.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

12-283-0212
03322
2012-10-09
09:49:28

Harrison Wastewater Treatment Plant
Yellville Sampling

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	N/A	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	N/A	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	10-8 2012 9 am	1	NONE	G	Aqueous	SO4/TDS/Cl
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART Oxford	UPS Next Day	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	9:00 Am 10-8-2012		
		Received by Lab (sign)	10/9/12-0932

1/1

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10/29/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-296-0259
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 10/22/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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Non-Compliance Login Summary Report

Incident Date: 10-22-2012 12:51 pm
Report number: 12-296-0259 Lab Number(s): 91347-91348
Customer number: 03322
Customer Name: Harrison Wastewater Treatment Plant
Contact Name: Harrison Wastewater Treatment P
Project ID: Harrison - Bi-weekly

This Non-Compliance Report has been generated because proper EPA protocol was not followed for the above referenced sample(s). This means that the data generated from the analysis of this project may not be suitable for Regulatory compliance.

This report should be included with any data submitted to a Regulatory Agency. The actual problems encountered are listed below.

Description of Login Non-Compliance

☑ **Sample Temperature Non-compliant**
Cooler Temperature: 14 degrees Celsius
Required Temperature: 2-6 degrees Celsius

☐ **Sample Received in Improper Container**
Analysis:
Received Container:
Required Container:

☐ **Sample Improperly Preserved**
Analysis:
Received Preservative:
Required Preservative:

☐ **Sample Received Outside Holding Time** Date Received: 10-22-2012 00:00
Analysis:
Sampled Date and Time:
Required Holding Time:

Other:

Corrective Action

Client Notified: ● Yes ○ No Date Client Notified: 10/22/12 Contact Name: Kathryn Catlin
Client Directive:
Approval to analyze samples per Kathryn Catlin.

Initiated By: Rebekah Ross Project manager: Randall Thomas QAO: Richard Medina

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 10/29/2012

Report Number : **12-296-0259**

REPORT OF ANALYSIS

Received : 10/22/2012

Lab No : **91347**
Sample ID : **Upstream**

Matrix: **Aqueous**
Sampled: **10/19/2012 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**8.63**	mg/L	0.400	1	10/25/12 20:53	RQE	EPA-300.0
Total Dissolved Solids	**179**	mg/L	10	1	10/24/12 14:30	NRT	2540C
Sulfate	**7.78**	mg/L	1.00	1	10/25/12 20:53	RQE	EPA-300.0

Lab No : **91348**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **10/19/2012 8:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**28.9**	mg/L	0.400	1	10/25/12 21:11	RQE	EPA-300.0
Total Dissolved Solids	**307**	mg/L	10	1	10/24/12 14:30	NRT	2540C
Sulfate	**21.7**	mg/L	1.00	1	10/25/12 21:11	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-296-0259**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	○ Yes	● No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments: Cooler temp = 14 degrees C upon receipt.

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 10/22/2012 10:32:53

ETC

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
Yellville Sampling

12-296-0259
03322
2012-10-22
10:30:00

UUUUU18477

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	10-19-2012 9:00 Am	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	no water	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	10-19-2012 8:45 Am	1	NONE	G	Aqueous	SO4/TDS/Cl
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Approval to analyze per K. Catlin.
RP 10/22

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXford	UPS next day	14°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford			
Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		RPSO	10/22/12 0919

1/1

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11/13/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-311-0215
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 11/6/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 11/13/2012

Report Number : **12-311-0215**

REPORT OF ANALYSIS

Received : 11/6/2012

Lab No : **93875**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **11/5/2012 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**39.3**	mg/L	0.400	1	11/06/12 13:43	RQE	EPA-300.0
Total Dissolved Solids	**254**	mg/L	10	1	11/08/12 08:00	NRT	2540C
Sulfate	**20.2**	mg/L	1.00	1	11/06/12 13:43	RQE	EPA-300.0

Qualifiers/ Definitions	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-311-0215**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 11/06/2012 10:23:07

ETC

Environmental Testing & Consulting, Inc.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
Yellville Sampling

12-311-0215
03322
2012-11-06
10:22:13

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	NO water	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	NO water	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	11-5-2012 8:30 AM.	1	NONE	G	Aqueous	SO4/TDS/Cl
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXFORD		1 °C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	11-5-2012 9:30 A.M.		
Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		[signature]	11/6/12-0946

1/1

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11/30/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-325-0213
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 11/20/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 11/30/2012

Report Number : **12-325-0213**

REPORT OF ANALYSIS

Received : 11/20/2012

Lab No : **96553**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **11/19/2012 9:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**181**	mg/L	1	1	11/28/12 11:05	EWB	2320B
Chloride	**39.2**	mg/L	0.400	1	11/27/12 23:34	RQE	EPA-300.0
Total Dissolved Solids	**293**	mg/L	10	1	11/26/12 14:30	NRT	2540C
Total Calcium	**44.6**	mg/L	0.100	1	11/29/12 01:16	BKN	EPA-200.7
Total Magnesium	**18.0**	mg/L	0.100	1	11/29/12 01:16	BKN	EPA-200.7
Total Potassium	**7.82**	mg/L	0.100	1	11/30/12 12:01	JTR	EPA-200.7
Total Sodium	**25.1**	mg/L	0.500	1	11/29/12 01:16	BKN	EPA-200.7
Sulfate	**19.2**	mg/L	1.00	1	11/28/12 12:40	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-325-0213**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 11/20/2012 09:53:31

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

12-325-0213
03322
2012-11-20
09:53:01

Harrison Wastewater Treatment Plant
Yellville Sampling

Remarks					
Company Name Harrison Wastewater Treatment Plant	Cust No 03322	Kit ID 0000018487	Telephone (870) 741-5527	RUSH	ICE
Site Name Yellville Sampling	Project Comment Every 2 Months			FID Number	
Project Harrison - Bi-weekly - Crooked Creek Sampling	Project Number	PO Number			
Project Manager / Contact City of YellvilleC/O Mr. Stuart Oxford	E-mail hwwtp2@windstream.net				

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	NO water	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk
Upstream	Plastic - Pint	NO water	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg
Downstream	Plastic - Pint	NO water	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk
Downstream	Plastic - Pint	NO water	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg
WWTP Effluent	Plastic - Pint	11-19-2012 9:15 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk
WWTP Effluent	Plastic - Pint	11-19-2012 9:15 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg

Sampled By STUART OXFORD	Method of Shipment ~~Fed Ex~~ UPS Aerton Iced	Blank / Cooler Temperature 1°C	
Relinquished By (sign) Stuart Oxford	Date / Time 11-19-2012 9:15 AM	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	~~Received by~~ Lab (sign) [signature]	Date / Time 11/20/12-0922

1/10

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12/12/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-339-0214
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 12/4/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 12/12/2012

Report Number : **12-339-0214**

REPORT OF ANALYSIS

Received : 12/4/2012

Lab No : **98667**
Sample ID : **WWTP Discharge Point**

Matrix: **Aqueous**
Sampled: **12/3/2012 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**43.1**	mg/L	2.00	5	12/11/12 21:38	RQE	EPA-300.0
Total Dissolved Solids	**276**	mg/L	10	1	12/05/12 13:00	NRT	2540C
Sulfate	**18.7**	mg/L	1.00	1	12/10/12 18:09	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**

Customer Name: **Harrison Wastewater Treatment Plant**

Report Number: **12-339-0214**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)

☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 12/04/2012 09:51:56

ETC ENVIRONMENTAL TESTING & CONSULTING, INC.

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Harrison Wastewater Treatment Plant
Yellville Sampling

12-339-0214
03322
2012-12-04
09 51 33

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly - Crooked Creek Sampling		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	NoWaTer	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	no waTer	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	12-3-2012 8:30AM	1	NONE	G	Aqueous	SO4/TDS/Cl
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXford	UPS next Day	1C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	12-3-2012 8:30 Am		
		Received by Lab (sign)	12/4/12-0933

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12/20/2012

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 12-353-0211
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 12/18/2012 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 12/20/2012

Report Number : **12-353-0211**

REPORT OF ANALYSIS

Received : 12/18/2012

Lab No : **90956**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **12/17/2012 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**42.4**	mg/L	4.00	10	12/18/12 14:41	RQE	EPA-300.0
Nitrate (NO3-N)	**0.723**	mg/L	0.100	1	12/18/12 11:51	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	12/18/12 11:51	RQE	EPA-300.0
Nitrate+Nitrite-N	**0.723**	mg/L	0.100	1	12/18/12 11:51		EPA-300.0
Total Dissolved Solids	**292**	mg/L	10	1	12/19/12 14:00	NRT	2540C
Sulfate	**22.3**	mg/L	1.00	1	12/18/12 11:51	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **12-353-0211**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Question			
Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 12/18/2012 10:10:22

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

12-353-0211
03322
2012-12-18
10:06:27

Harrison Wastewater Treatment Plant
Yellville Sampling

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly - Crooked Creek Sampling		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	NO water	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	NO water	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	12-17-2012 8:30 Am.	1	NONE	G	Aqueous	SO4/TDS/Cl/NO2/NO3
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXford	UPS next Day	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	9:00Am 12-17-2012		
		BRo	12/18/12-0943

1/1

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1/8/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-003-0225
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 1/3/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 1/8/2013

Report Number : **13-003-0225**

REPORT OF ANALYSIS

Received : 1/3/2013

Lab No : **92861**
Sample ID : **Upstream**
Matrix: **Aqueous**
Sampled: **1/2/2013 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**9.10**	mg/L	0.400	1	01/04/13 10:14	RQE	EPA-300.0
Total Dissolved Solids	**183**	mg/L	10	1	01/04/13 14:00	NRT	2540C
Sulfate	**8.82**	mg/L	1.00	1	01/04/13 10:14	RQE	EPA-300.0

Lab No : **92862**
Sample ID : **WWTP Effluent**
Matrix: **Aqueous**
Sampled: **1/2/2013 8:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**43.2**	mg/L	2.00	5	01/04/13 18:05	RQE	EPA-300.0
Nitrate (NO3-N)	**1.35**	mg/L	0.100	1	01/03/13 13:41	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	01/03/13 13:41	RQE	EPA-300.0
Nitrate+Nitrite-N	**1.35**	mg/L	0.100	1	01/03/13 13:41		EPA-300.0
Total Dissolved Solids	**280**	mg/L	10	1	01/04/13 14:00	NRT	2540C
Sulfate	**26.5**	mg/L	1.00	1	01/03/13 13:41	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-003-0225**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 01/03/2013 09:44:22

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
Yellville Sampling

13-003-0225
03322
2013-01-03
09:35:45

Remarks

Company Name	Cust No	Kit ID	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	0000018996	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly - Crooked Creek Sampling		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	1-2-13 9:00 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	NO WATER	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	1-2-13 8:45 AM	1	NONE	G	Aqueous	SO4/TDS/Cl / NO2 / NO3
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	
STUART OXFORD	~~Fed Ex~~ UPS	1°C	
Relinquished By (sign)	**Date / Time**	**Received By (sign)**	**Date / Time**
Stuart Oxford	1-2-2013 9:00 AM		
Relinquished By (sign)	**Date / Time**	**Received By (sign)**	**Date / Time**
Relinquished By (sign)	**Date / Time**	**Received by Lab (sign)**	**Date / Time**
		[signature]	1/3/13 0937

7/20

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1/24/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-015-0222
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 1/15/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 1/24/2013

Report Number : **13-015-0222**

REPORT OF ANALYSIS

Received : 1/15/2013

Lab No : **94742**
Sample ID : **Upstream**
Matrix: **Aqueous**
Sampled: **1/14/2013 8:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**161**	mg/L	1	1	01/16/13 09:13	EWB	2320B
Chloride	**8.16**	mg/L	0.400	1	01/15/13 16:41	RQE	EPA-300.0
Total Dissolved Solids	**194**	mg/L	10	1	01/21/13 14:00	NRT	2540C
Total Calcium	**56.7**	mg/L	0.100	1	01/17/13 20:54	BKN	EPA-200.7
Total Magnesium	**10.1**	mg/L	0.100	1	01/17/13 20:54	BKN	EPA-200.7
Total Potassium	**1.59**	mg/L	0.100	1	01/19/13 00:20	JTR	EPA-200.7
Total Sodium	**4.05**	mg/L	0.500	1	01/19/13 00:20	JTR	EPA-200.7
Sulfate	**9.23**	mg/L	1.00	1	01/15/13 16:41	RQE	EPA-300.0

Lab No : **94743**
Sample ID : **Downstream**
Matrix: **Aqueous**
Sampled: **1/14/2013 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**165**	mg/L	1	1	01/16/13 09:13	EWB	2320B
Chloride	**7.50**	mg/L	0.400	1	01/15/13 16:58	RQE	EPA-300.0
Total Dissolved Solids	**203**	mg/L	10	1	01/21/13 14:00	NRT	2540C
Total Calcium	**55.7**	mg/L	0.100	1	01/17/13 21:01	BKN	EPA-200.7
Total Magnesium	**13.3**	mg/L	0.100	1	01/17/13 21:01	BKN	EPA-200.7
Total Potassium	**1.60**	mg/L	0.100	1	01/19/13 00:26	JTR	EPA-200.7
Total Sodium	**3.84**	mg/L	0.500	1	01/19/13 00:26	JTR	EPA-200.7
Sulfate	**10.6**	mg/L	1.00	1	01/15/13 16:58	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 1/24/2013

Report Number : **13-015-0222**

REPORT OF ANALYSIS

Received : 1/15/2013

Lab No : **94744**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **1/14/2013 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**217**	mg/L	1	1	01/16/13 09:13	EWB	2320B
Chloride	**39.7**	mg/L	4.00	10	01/15/13 11:04	RQE	EPA-300.0
Nitrate (NO3-N)	**0.601**	mg/L	0.100	1	01/15/13 10:25	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	01/15/13 10:25	RQE	EPA-300.0
Nitrate+Nitrite-N	**0.601**	mg/L	0.100	1	01/15/13 10:25		EPA-300.0
Total Dissolved Solids	**309**	mg/L	10	1	01/21/13 14:00	NRT	2540C
Total Calcium	**51.7**	mg/L	0.100	1	01/17/13 21:07	BKN	EPA-200.7
Total Magnesium	**20.6**	mg/L	0.100	1	01/17/13 21:07	BKN	EPA-200.7
Total Potassium	**9.67**	mg/L	0.100	1	01/19/13 00:33	JTR	EPA-200.7
Total Sodium	**30.2**	mg/L	0.500	1	01/19/13 00:33	JTR	EPA-200.7
Sulfate	**26.0**	mg/L	1.00	1	01/15/13 10:25	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-015-0222**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 01/15/2013 09:54:39

ETC ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten R... mphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

13-015-0222
03322
2013-01-15
09 54 24

Harrison Wastewater Treatment Plant
Yellville Sampling

Company Name		Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant		03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling - Every 2 Months	Every 2 Months	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses	
Upstream	Plastic - Pint	1-14-2013 8:45 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk	
Upstream	Plastic - Pint	1-14-2013 8:45 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg	
Downstream	Plastic - Pint	1-14-2013 9:00 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk	
Downstream	Plastic - Pint	1-14-2013 9:00 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg	
WWTP Effluent	Plastic - Pint	1-14-13 8:30 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk/NO3/NO2	NO2 NO3
WWTP Effluent	Plastic - Pint	1-14-13 8:30 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg	
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label	

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXford	UPS NEXT DAY	1 °C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	1-14-2013 9:30 Am		
Relinquished By (sign)	**Date / Time**	**Received By (sign)**	**Date / Time**
Relinquished By (sign)	**Date / Time**	**Received by Lab (sign)**	**Date / Time**
		BBa	1/15/13 0934

1/1

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2/7/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-030-0220
Client Project Description: City of Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 1/30/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : City of Yellville Sampling

Report Date : 2/7/2013

Report Number : **13-030-0220**

REPORT OF ANALYSIS

Received : 1/30/2013

Lab No : **97632**
Sample ID : **Upstream**

Matrix: **Aqueous**
Sampled: **1/29/2013 9:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**8.46**	mg/L	0.400	1	02/05/13 16:25	RQE	EPA-300.0
Total Dissolved Solids	**207**	mg/L	10	1	02/01/13 14:30	NRT	2540C
Sulfate	**9.11**	mg/L	1.00	1	02/05/13 16:25	RQE	EPA-300.0

Lab No : **97633**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **1/29/2013 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**39.3**	mg/L	0.400	1	01/30/13 15:06	RQE	EPA-300.0
Nitrate (NO3-N)	**0.405**	mg/L	0.100	1	01/30/13 15:06	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	01/30/13 15:06	RQE	EPA-300.0
Nitrate+Nitrite-N	**0.405**	mg/L	0.100	1	01/30/13 15:06		EPA-300.0
Total Dissolved Solids	**312**	mg/L	10	1	02/01/13 14:30	NRT	2540C
Sulfate	**24.5**	mg/L	1.00	1	01/30/13 15:06	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-030-0220**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Question			
Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Question		
Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Susan Simpson

Date & Time: 01/30/2013 09:53:51

ENVIRONMENTAL TESTING & CONSULTING, INC.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
City of Yellville Sampling

13-030-0220
03322
2013-01-30
09:53:23

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	930/1-29-13	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	NO WATER	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	9:00 Am/1-29-13	1	NONE	G	Aqueous	SO4/TDS/Cl/NO3/NO2
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXFord	UPS next Day	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	1-29-2013 10:00 AM		
		Received by Lab (sign) Thompson	1/30/13 0935

1/1

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"A Laboratory Management Partner"

2/18/2013

Harrison Wastewater Treatment Plant
Mr. Stuart Oxford
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-043-0217
Client Project Description: Yellville Sampling

Dear Mr. Stuart Oxford:

Environmental Testing and Consulting, Inc. received sample(s) on 2/12/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Mr. Stuart Oxford
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 2/18/2013

Report Number : **13-043-0217**

REPORT OF ANALYSIS

Received : 2/12/2013

Lab No : **89711**
Sample ID : **Upstream**
Matrix: **Aqueous**
Sampled: **2/11/2013 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.51**	mg/L	0.400	1	02/14/13 21:43	RQE	EPA-300.0
Total Dissolved Solids	**210**	mg/L	10	1	02/13/13 14:30	NRT	2540C
Sulfate	**8.94**	mg/L	1.00	1	02/14/13 21:43	RQE	EPA-300.0

Lab No : **89712**
Sample ID : **Downstream**
Matrix: **Aqueous**
Sampled: **2/11/2013 8:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.28**	mg/L	0.400	1	02/14/13 22:00	RQE	EPA-300.0
Total Dissolved Solids	**215**	mg/L	10	1	02/13/13 14:30	NRT	2540C
Sulfate	**9.69**	mg/L	1.00	1	02/14/13 22:00	RQE	EPA-300.0

Lab No : **89713**
Sample ID : **WWTP Effluent**
Matrix: **Aqueous**
Sampled: **2/11/2013 8:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**18.6**	mg/L	0.400	1	02/12/13 12:44	RQE	EPA-300.0
Nitrate (NO3-N)	<0.100	mg/L	0.100	1	02/12/13 12:44	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	02/12/13 12:44	RQE	EPA-300.0
Nitrate+Nitrite-N	<0.100	mg/L	0.100	1	02/12/13 12:44		EPA-300.0
Total Dissolved Solids	**301**	mg/L	10	1	02/13/13 14:30	NRT	2540C
Sulfate	**30.0**	mg/L	1.00	1	02/12/13 12:44	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-043-0217**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Susan Simpson

Date & Time: 02/12/2013 10:00:27

ENVIRONMENTAL TESTING & CONSULTING, INC.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
Yellville Sampling

13-043-0217
03322
2013-02-12
09:59:09

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	2-11-2013 8:30 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	2-11-2013 8:45 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	2-11-2013 8:15 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/NO3/NO2
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUARTOXFord	UPS NEXT DAY	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	2-11-2013 9:30 A.M.		
		SASimpson	2/12/13 0924

1/1

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ENVIRONMENTAL TESTING & CONSULTING, INC.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

3/6/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-058-0225
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 2/27/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

nelac

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"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 3/6/2013

Report Number : **13-058-0225**

REPORT OF ANALYSIS

Received : 2/27/2013

Lab No : **92768**
Sample ID : **Upstream**
Matrix: **Aqueous**
Sampled: **2/26/2013 8:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**5.75**	mg/L	0.400	1	03/04/13 12:53	RQE	EPA-300.0
Total Dissolved Solids	**170**	mg/L	10	1	03/04/13 13:35	NRT	2540C
Sulfate	**7.72**	mg/L	1.00	1	03/04/13 12:53	RQE	EPA-300.0

Lab No : **92769**
Sample ID : **Downstream**
Matrix: **Aqueous**
Sampled: **2/26/2013 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**5.67**	mg/L	0.400	1	03/04/13 13:11	RQE	EPA-300.0
Total Dissolved Solids	**175**	mg/L	10	1	03/04/13 13:35	NRT	2540C
Sulfate	**8.63**	mg/L	1.00	1	03/04/13 13:11	RQE	EPA-300.0

Lab No : **92770**
Sample ID : **WWTP Effluent**
Matrix: **Aqueous**
Sampled: **2/26/2013 8:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**22.4**	mg/L	0.400	1	02/27/13 11:31	RQE	EPA-300.0
Nitrate (NO3-N)	**1.86**	mg/L	0.100	1	02/27/13 11:31	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	02/27/13 11:31	RQE	EPA-300.0
Nitrate+Nitrite-N	**1.86**	mg/L	0.100	1	02/27/13 11:31		EPA-300.0
Total Dissolved Solids	**261**	mg/L	10	1	03/04/13 13:35	NRT	2540C
Sulfate	**27.1**	mg/L	1.00	1	02/27/13 11:31	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-058-0225**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Susan Simpson

Date & Time: 02/27/2013 10:32:57

ETC Environmental Testing & Consulting, Inc.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

Harrison Wastewater Treatment Plant
Yellville Sampling

13-058-0225
03322
2013-02-27
10:31 17

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	8:15 AM 2-26-2013	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	8:30 AM 2-26-2013	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	2-26-2013 8:00 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/NO3/NO2
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART Oxford	UPS next Day 2-26-2013	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	9:45 Am 2-26-2013		

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time

Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		S Simpson	2/27/13 0935

1/1

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3/20/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-071-0211
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 3/12/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 3/20/2013

Report Number : **13-071-0211**

REPORT OF ANALYSIS

Received : 3/12/2013

Lab No : **95570**
Sample ID : **Upstream**
Matrix: **Aqueous**
Sampled: **3/11/2013 8:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**5.12**	mg/L	0.400	1	03/19/13 10:52	RQE	EPA-300.0
Total Dissolved Solids	**157**	mg/L	10	1	03/13/13 16:00	NRT	2540C
Sulfate	**6.91**	mg/L	1.00	1	03/19/13 10:52	RQE	EPA-300.0

Lab No : **95571**
Sample ID : **Downstream**
Matrix: **Aqueous**
Sampled: **3/11/2013 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**5.09**	mg/L	0.400	1	03/19/13 11:10	RQE	EPA-300.0
Total Dissolved Solids	**174**	mg/L	10	1	03/13/13 16:00	NRT	2540C
Sulfate	**7.24**	mg/L	1.00	1	03/19/13 11:10	RQE	EPA-300.0

Lab No : **95572**
Sample ID : **WWTP Effluent**
Matrix: **Aqueous**
Sampled: **3/11/2013 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**17.7**	mg/L	0.400	1	03/12/13 12:01	RQE	EPA-300.0
Nitrate (NO3-N)	**0.973**	mg/L	0.100	1	03/12/13 12:01	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	03/12/13 12:01	RQE	EPA-300.0
Nitrate+Nitrite-N	**0.973**	mg/L	0.100	1	03/12/13 12:01		EPA-300.0
Total Dissolved Solids	**256**	mg/L	10	1	03/13/13 16:00	NRT	2540C
Sulfate	**24.2**	mg/L	1.00	1	03/12/13 12:01	RQE	EPA-300.0

Qualifiers/ Definitions				
	*	Outside QC limit	DF	Dilution Factor
	MQL	Method Quantitation Limit		

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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-071-0211**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 03/12/2013 10:06:51

ETC

Environmental Testing & Consulting, Inc.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

13-071-0211
03322
2013-03-12
10:06:25
Harrison Wastewater Treatment Plant
Yellville Sampling

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	3-11-2013 8:45 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	3-11-2013 9:00 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	3-11-2013 8:30 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/NO3/NO2
UPS Next Day Label	NA	Next Day 3-	1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART Oxford	UPS Next Day	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	3-11-2013 9:30 AM		
		Received by Lab (sign): [signature]	3/12/13-0954

1/1

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"A Laboratory Management Partner"

4/11/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-085-0231
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 3/26/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 4/11/2013

Report Number : **13-085-0231**

REPORT OF ANALYSIS

Received : 3/26/2013

Lab No : **98507**
Sample ID : **Upstream**

Matrix: **Aqueous**
Sampled: **3/25/2013 8:15**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**167**	mg/L	1	1	04/01/13 11:15	EWB	2320B
Chloride	**6.12**	mg/L	0.400	1	03/26/13 18:07	RQE	EPA-300.0
Total Dissolved Solids	**207**	mg/L	10	1	03/28/13 14:00	NRT	2540C
Total Calcium	**64.3**	mg/L	0.100	1	04/06/13 05:54	BKN	EPA-200.7
Total Magnesium	**9.48**	mg/L	0.100	1	04/06/13 05:54	BKN	EPA-200.7
Total Potassium	**1.33**	mg/L	0.100	1	04/10/13 15:49	JTR	EPA-200.7
Total Sodium	**3.28**	mg/L	0.500	1	04/10/13 15:49	JTR	EPA-200.7
Sulfate	**7.42**	mg/L	1.00	1	03/26/13 18:07	RQE	EPA-300.0

Lab No : **98508**
Sample ID : **Downstream**

Matrix: **Aqueous**
Sampled: **3/25/2013 8:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**171**	mg/L	1	1	04/01/13 11:15	EWB	2320B
Chloride	**6.02**	mg/L	0.400	1	03/26/13 18:24	RQE	EPA-300.0
Total Dissolved Solids	**205**	mg/L	10	1	03/28/13 14:00	NRT	2540C
Total Calcium	**66.1**	mg/L	0.100	1	04/06/13 06:01	BKN	EPA-200.7
Total Magnesium	**10.8**	mg/L	0.100	1	04/06/13 06:01	BKN	EPA-200.7
Total Potassium	**1.31**	mg/L	0.100	1	04/10/13 15:52	JTR	EPA-200.7
Total Sodium	**3.19**	mg/L	0.500	1	04/10/13 15:52	JTR	EPA-200.7
Sulfate	**7.46**	mg/L	1.00	1	03/26/13 18:24	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Report Date : 4/11/2013

Report Number : **13-085-0231**

REPORT OF ANALYSIS

Received : 3/26/2013

Lab No : **98509**
Sample ID : **WWTP Effluent**

Matrix: **Aqueous**
Sampled: **3/25/2013 8:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Alkalinity (as CaCO3)	**227**	mg/L	1	1	04/01/13 11:15	EWB	2320B
Chloride	**21.3**	mg/L	0.400	1	03/26/13 12:54	RQE	EPA-300.0
Nitrate (NO3-N)	**0.600**	mg/L	0.100	1	03/26/13 12:54	RQE	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	03/26/13 12:54	RQE	EPA-300.0
Nitrate+Nitrite-N	**0.600**	mg/L	0.100	1	03/26/13 12:54		EPA-300.0
Total Dissolved Solids	**293**	mg/L	10	1	03/28/13 14:00	NRT	2540C
Total Calcium	**60.3**	mg/L	0.100	1	04/06/13 06:29	BKN	EPA-200.7
Total Magnesium	**29.3**	mg/L	0.100	1	04/06/13 06:29	BKN	EPA-200.7
Total Potassium	**4.23**	mg/L	0.100	1	04/10/13 15:55	JTR	EPA-200.7
Total Sodium	**15.1**	mg/L	0.500	1	04/10/13 15:55	JTR	EPA-200.7
Sulfate	**27.4**	mg/L	1.00	1	03/26/13 12:54	RQE	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-085-0231**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 03/26/2013 10:16:17

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road   Memphis, Tennessee 38133   (901) 213-2400   Fax (901) 213-2440

13-085-0231
03322
03-26-2013
10:16:04

Harrison Wastewater Treatment Plant
Crooked Creek Sampling

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling - Every 2 Months	Every 2 Months	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	3-25-2013 8:15AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk
Upstream	Plastic - Pint	3-25-2013 8:15 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg
Downstream	Plastic - Pint	3-25-2013 8:30 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk
Downstream	Plastic - Pint	3-25-2013 8:30 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg
WWTP Effluent	Plastic - Pint	3-25-2013 8:00AM	1	NONE	G	Aqueous	SO4/TDS/Cl/Alk/NO3/NO2
WWTP Effluent	Plastic - Pint	3-25-2013 8:00 AM	1	HNO3 - Nitric Acid	G	Aqueous	Na/K/Ca/Mg
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXford	UPS next Day	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	3-25-2013 9:30 AM.		
Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		[signature]	3/26/13-0935

1/1

ETC ENVIRONMENTAL TESTING & CONSULTING, INC.
www.etcmemphis.com 2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

5/6/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-099-9220
Client Project Description: Yellville Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 4/9/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

Environmental Testing & Consulting, Inc.
www.etcmemphis.com
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

Client: Harrison Wastewater Treatment Plant
Project: Yellville Sampling
Lab Report Number: 13-099-9220
Date: 5/6/2013

CASE NARRATIVE

Revised report due to correction of sample names.

ETC
ENVIRONMENTAL TESTING & CONSULTING, INC.
www.etcmemphis.com 2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Yellville Sampling

Revised Report Date: 5/6/2013

Report Number : **13-099-9220**

REPORT OF ANALYSIS

Received : 4/9/2013

Lab No : **91134**
Sample ID : **Upstream**
Matrix: **Aqueous**
Sampled: **4/8/2013 9:45**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.18**	mg/L	0.400	1	04/09/13 13:04	ACS	EPA-300.0
Total Dissolved Solids	**210**	mg/L	10	1	04/10/13 14:00	NRT	2540C
Sulfate	**7.61**	mg/L	1.00	1	04/09/13 13:04	ACS	EPA-300.0

Lab No : **91135**
Sample ID : **Downstream**
Matrix: **Aqueous**
Sampled: **4/8/2013 10:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.21**	mg/L	0.400	1	04/09/13 13:22	ACS	EPA-300.0
Total Dissolved Solids	**223**	mg/L	10	1	04/10/13 14:00	NRT	2540C
Sulfate	**7.65**	mg/L	1.00	1	04/09/13 13:22	ACS	EPA-300.0

Lab No : **91136**
Sample ID : **WWTP Effluent**
Matrix: **Aqueous**
Sampled: **4/8/2013 9:30**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**30.3**	mg/L	0.400	1	04/09/13 09:38	ACS	EPA-300.0
Nitrate (NO3-N)	**0.176**	mg/L	0.100	1	04/09/13 09:38	ACS	EPA-300.0
Nitrite (NO2-N)	<0.100	mg/L	0.100	1	04/09/13 09:38	ACS	EPA-300.0
Nitrate+Nitrite-N	**0.176**	mg/L	0.100	1	04/09/13 09:38		EPA-300.0
Total Dissolved Solids	**336**	mg/L	10	1	04/10/13 14:00	NRT	2540C
Sulfate	**24.6**	mg/L	1.00	1	04/09/13 09:38	ACS	EPA-300.0

Qualifiers/ Definitions DF Dilution Factor MQL Method Quantitation Limit

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-099-0220**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included? ○ Yes ● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Rebekah Ross

Date & Time: 04/09/2013 09:16:32

ENVIRONMENTAL TESTING & CONSULTING, INC.

2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440

13-099-0220
03322
04-09-2013
09:16:21

Harrison Wastewater Treatment Plant
Yellville Sampling

Company Name	Customer Number	Telephone	RUSH	ICE
Harrison Wastewater Treatment Plant	03322	(870) 741-5527		

Site Name	Project Comment	FID Number
Yellville Sampling	Every 2 Weeks	

Project	Project Number	PO Number
Harrison - Bi-weekly		

Project Manager / Contact	E-mail
City of YellvilleC/O Mr. Stuart Oxford	hwwtp2@windstream.net

Sample ID	Container Type	Collected Date / Time	# Cont	Preservative	Grab / Comp	Matrix	Analyses
Upstream	Plastic - Pint	4-8-2013 9:45 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
Downstream	Plastic - Pint	4-8-2013 10:00 AM	1	NONE	G	Aqueous	SO4/TDS/Cl
WWTP Effluent	Plastic - Pint	4-8-2013 9:30 AM	1	NONE	G	Aqueous	SO4/TDS/Cl/NO3/NO2
UPS Next Day Label	NA		1	NONE		Aqueous	UPS Return Label

Sampled By	Method of Shipment	Blank / Cooler Temperature	Remarks
STUART OXford	UPS NEXT Day	1°C	

Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Stuart Oxford	4-8-2013 11:00 AM		
Relinquished By (sign)	Date / Time	Received By (sign)	Date / Time
Relinquished By (sign)	Date / Time	Received by Lab (sign)	Date / Time
		RRo	4/9/13 0905

1/1

APPENDIX D

Aquatic Life Survey Field Sheets and Data Forms

September 2012

CROOKED CREEK UAA 19 SEP 12 JMR/BJG

Y001 @ 1015

Temp 23.62 SpC 573.7

pH 7.37 DO 5.13

Grab sample from effluent pipe

36.22059 photos 1124-1127

-92.66341

Crooked Creek at Y001 is dry except for minor ponding at outfall location

36.22115 photos 1128-1131

-92.66458

Hydrolab FTN#7 SN 45796 deployed at 1145 immediately upstream of the CC-0 reach

36.23188 photos 1132-1133

-93.07860

Hydrolab FTN#8 SN 48171 deployed at 1200 immediately upstream of the CC-1 reach

36.24157 photos 1134-1135

-93.07613

CC-1 @ 1930

Temp 20.51 SpC 377.9

pH 7.47 DO 9.61

36.24179

-93.07558

Grab sample and flow taken at this location

Rite in the Rain

CROOKED CREEK UAA 20 SEP 12 JMR/BJG

CC-0 @ 1853

Temp 20.63 SpC 356.1

pH 7.17 DO 9.70

36.23187

-93.07815

Grab sample and flow taken at this location

Hydrolab pulled from CC-0 @ 1847

H001 @ 1908

Temp 23.49 SpC 619.2

pH 6.80 DO 6.80

36.23804 photo 1151

-93.074698

Hydrolab pulled from CC-1 @ 1926

WR-0 @ 2132

Temp 18.86 SpC 277.2

pH 7.93 DO 10.86

36.25787

-92.47450

WR-1 @ 2213

Temp 18.04 SpC 273.5

pH 7.93 DO

36.203810

-92.47800

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR/BJG	
FORM COMPLETED BY JMR/BJG	DATE 20 SEP 12 TIME 0800 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ____ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ____ End Time ____ Duration 1892 sec. **Stream width (in meters)** Max ____ Mean ____
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other (____) ____%
GENERAL COMMENTS	Pass 1 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					D	E	F	L	M	S	T	Z
largescale stoneroller *Campostoma oligolepis*	156													X
rainbow darter *Etheostoma caeruleum*	52													X
banded sculpin *Cottus carolinae*	13													X
duskystripe shiner *Luxilus pilsbryi*	39													X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
Ozark minnow Notropis nubilus	14													
slender madtom Noturus exilis	7													
black redhorse Moxostoma duquesnii	3													X
northern hog sucker Hypentelium nigricans	1													X
smallmouth bass Micropterus dolomieu	1													X
Ozark bass Ambloplites constellatus	17													X
bluntnose minnow Pimephales notatus	2													X
rosyface shiner Notropis rubellus	6													X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 20 SEP 12 TIME 0800 (AM) PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______
	Block nets used? ☒ Yes ☐ No
	Sampling Duration Start Time ______ End Time ______ Duration 1892 sec.
	Stream width (in meters) Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 1 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					D	E	F	L	M	S	T	Z
blackspotted topminnow Fundulus olivaceus	1													
longear sunfish Lepomis megalotis	2													X
striped shiner Luxilus chrysocephalus	2													X
banded darter Etheostoma zonale	1													X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES							
							D	E	F	L	M	S	T	Z
	2													X
greenside darter Etheostoma blennioides														

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR/BJG	DATE 20 SEP 12 TIME 1000 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 1498 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 2 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
largescale stoneroller Campostoma oligolepis	172													X
Ozark minnow Notropis nubilus	7													
rainbow darter Etheostoma caeruleum	77													X
duskystripe shiner Luxilus pilsbryi	35													X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	D	E	F	L	M	S	T	Z
rosyface shiner / Notropis rubellus	5									X
hornyhead chub / Nocomis biguttatus	4									X
northern studfish / Fundulus catenatus	1									
longear sunfish / Lepomis megalotis	6									X
Ozark bass / Ambloplites constellatus	5									X
black redhorse / Moxostoma duquesnii	4									X
northern hog sucker / Hypentelium nigricans	2									X
creek chub / Semotilus atromaculatus	3									X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)
STATION #______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 20 SEP 12 TIME 1000 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 1498 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 2 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	D	E	F	L	M	S	T	Z
banded darter Etheostoma zonale	4									X
mosquitofish Gambusia affinis	1									
banded sculpin Cottus carolinae	6									X
slender madtom Noturus exilis	5									

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SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES							
							D	E	F	L	M	S	T	Z
	1													X
greenside darter Etheostoma blennioides														

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (downstream portion)
STATION #______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR/ BJG	
FORM COMPLETED BY JMR/ BJG	DATE 19 SEP 12 TIME 1345 AM PM (PM circled) — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 2008 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 1 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	D	E	F	L	M	S	T	Z
largescale stoneroller Campostoma oligolepis	264									X
		☒☒☒☒☒☒☒☒☒☒ ☒☒☒☒☒☒☒☒☒☒ ☒☒☒☒☒☒ : :								
rainbow darter Etheostoma caeruleum	101									X
		☒☒☒☒☒☒☒☒☒☒ •								
northern hog sucker Hypentelium nigricans	9									X
		☑								
longear sunfish Lepomis megalotis	9									X
		☑								

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	ANOMALIES D	E	F	L	M	S	T	Z
greenside darter *Etheostoma blennioides*	14									X
ozark bass *Ambloplites constellatus*	18									X
Creek chub *Semotilus atromaculatus*	1									X
smallmouth bass *Micropterus dolomieu*	5									X
hornyhead chub *Nocomis biguttatus*	3									X
banded sculpin *Cottus carolinae*	13									X
slender madtom *Noturus exilis*	15									
yellow bullhead *Ameiurus natalis*	3									

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (downstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR/BJG	DATE 19SEP12 TIME 1345 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 2008 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 1 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
banded darter Etheostoma zonale	3						:·							X
bluntnose minnow Pimephales notatus	3						:·							X
striped shiner Luxilus chrysocephalus	2						:							X
duskystripe shiner Luxilus pilsbryi	52						☒ ☒ ☒ ☒ ☒ :							X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
black redhorse Moxostoma duquesnii	1													X
Ozark minnow Notropis nubilus	38													
rosyface shiner Notropis rubellus	3													X
largemouth bass Micropterus salmoides	1													X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (downstream portion)
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 19 SEP 12 TIME 1730 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ____ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ____ End Time ____ Duration 1744 sec. **Stream width (in meters)** Max ____ Mean ____
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 2 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	D	E	F	L	M	S	T	Z
largescale stoneroller Campostoma oligolepis	225									X
rainbow darter Etheostoma caeruleum	82									X
duskystripe shiner Luxilus pilsbryi	71									X
Ozark minnow Notropis nubilus	27									

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SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	ANOMALIES D	E	F	L	M	S	T	Z
rosyface shiner Notropis rubellus	9									X
blackspotted topminnow Fundulus olivaceus	1									
banded sculpin Cottus carolinae	19									X
bluntnose minnow Pimephales notatus	1									X
northern hog sucker Hypentelium nigricans	3									X
Ozark bass Ambloplites constellatus	7									X
striped shiner Luxilus chrysocephalus	1									X
black redhorse Moxostoma duquesnii	1									X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (downstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 19 SEP 12 TIME 1730 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☐ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☐ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration ______ **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other (______) ____%
GENERAL COMMENTS	Pass 2 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	D	E	F	L	M	S	T	Z
hornyhead chub Nocomis biguttatus	2									X
slender madtom Noturus exilis	4									
smallmouth bass Micropterus dolomieu	2									X
banded darter Etheostoma zonale	10									X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
	1													X
greenside darter Etheostoma blennioides														

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0 (reference)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR/BJG	DATE 20 SEP 12 TIME 1530 AM PM — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 2348 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other (____) ____%
GENERAL COMMENTS	Pass 1 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
largescale stoneroller Campostoma oligolepis	335													X
duskystripe shiner Luxilus pilsbryi	103													X
rainbow darter Etheostoma caeruleum	73													X
Ozark minnow Notropis nubilus	39													X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
banded sculpin / Cottus carolinae	15													
black redhorse / Moxostoma duquesnii	4													X
northern hog sucker / Hypentelium nigricans	11													X
smallmouth bass / Micropterus dolomieu	4													X
Ozark bass / Ambloplites constellatus	19													X
longear sunfish / Lepomis megalotis	8													X
bluntnose minnow / Pimephales notatus	5													X
striped shiner / Luxilus chrysocephalus	3													X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0 (reference)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR/BJG	
FORM COMPLETED BY JMR/BJG	DATE 20 SEP 12 TIME 1530 AM (PM) — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 2348 sec **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ___% ☐ Pools ___% ☐ Runs ___ ☐ Snags ___% ☐ Submerged Macrophytes ___% ☐ Other ( ) ___%
GENERAL COMMENTS	Pass 1 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
hornyhead chub Nocomis biguttatus	6													X
rosyface shiner Notropis rubellus	9													
mosquitofish Gambusia affinis	2													
slender madtom Noturus exilis	18													

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
greenside darter / Etheostoma blennioides	3													X
banded darter / Etheostoma zonale	2													X
largemouth bass / Micropterus salmoides	1													X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0 (reference)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 20 SEP 12 TIME 1800 AM (PM) — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 1887 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 2 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					D	E	F	L	M	S	T	Z
	227													X
largescale stoneroller Campostoma oligolepis														
	79													X
rainbow darter Etheostoma caeruleum														
	7													X
Ozark minnow Notropis nubilus														
	48													X
duskystripe shiner Luxilus pilsbryi														

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES D	E	F	L	M	S	T	Z
slender madtom Noturus exilis	17													
greenside darter Etheostoma blennioides	5													X
black redhorse Moxostoma duquesnii	1													X
banded sculpin Cottus carolinae	11													
rosyface shiner Notropis rubellus	5													
Ozark bass Ambloplites constellatus	6													X
bluntnose minnow Pimephales notatus	1													X
banded darter Etheostoma zonale	2													X

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FISH SAMPLING FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0 (reference)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 20 SEP 12 TIME 1800 AM (PM) — REASON FOR SURVEY UAA

SAMPLE COLLECTION	**How were the fish captured?** ☒ back pack ☐ tote barge ☐ other ______ **Block nets used?** ☒ Yes ☐ No **Sampling Duration** Start Time ______ End Time ______ Duration 1887 sec. **Stream width (in meters)** Max ______ Mean ______
HABITAT TYPES	**Indicate the percentage of each habitat type present** ☐ Riffles ____% ☐ Pools ____% ☐ Runs ____ ☐ Snags ____% ☐ Submerged Macrophytes ____% ☐ Other ( ) ____%
GENERAL COMMENTS	Pass 2 Anomaly Z = blackspot

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)	ANOMALIES D	E	F	L	M	S	T	Z
northern hog sucker Hypentelium nigricans	2		:							X
longear sunfish Lepomis megalotis	1		•							X
green sunfish Lepomis cyanellus	1		•							X
hornyhead chub Nocomis biguttatus	5		1 :							X

SPECIES	TOTAL (COUNT)	OPTIONAL: LENGTH (mm)/WEIGHT (g) (25 SPECIMENT MAX SUBSAMPLE)					ANOMALIES							
							D	E	F	L	M	S	T	Z

ANOMALY CODES: D=deformities; E=eroded fins; F=fungus; L=lesions; M=multiple DELT anomalies; S=emaciated; Z=other

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time	20 SEP 12 1730	Stream	Crooked Creek
Observer	JMA/BJG	Transect No.	CC-0
Project No.	4315-050	Picture No.	

II. In-Situ Data

Dissolved Oxygen, mg/L	9.70
Temperature, C	20.63
Conductivity, uhmos	356.1
pH, su	7.17
ORP, mv	

III. Physical Characterization

Stream Width, ft	25.5		
Channel Width, ft			
Pool		Length, ft	
Riffle/Run		Length, ft	
Tape Down (ft)			

GPS
36.23187
-93.07815

Transect Reading	Tape Reading from LB/RB (ft)	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	29	0.10			0.00		
2	28	0.20			0.00		
3	27	0.20			-0.09		
4	26	0.25			-0.06		
5	25	0.30			0.00		
6	24	0.30			-0.01		
7	23	0.40			0.05		
8	22	0.30			0.02		
9	21	0.50			0.09		
10	20	0.60			0.23		
11	19	0.90			0.50		
12	18	0.90			0.77		
13	17	1.10			1.51		
14	16	1.20			1.74		
15	15	1.30			1.79		
16	14	1.40			1.89		
17	13	1.40			1.42		
18	12	1.40			1.27		
19	11	1.40			0.72		
20	10	1.35			0.35		
21	9	1.20			0.19		
22	8	0.90			0.04		
23	7	1.00			0.04		
24	6	0.90			-0.11		
25	5	0.60			-0.06		
26	4	0.20			-0.03		
27	3.5	0.00			0.00		LB @ 3.5 ft
Totals	0		0			0.000	cfs
						0	gpm

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time 19 SEP 12 1910
Observer JMR/ BJG
Project No. 4315-050
Stream Crooked Creek
Transect No. CC - 1
Picture No.

II. In-Situ Data

Dissolved Oxygen, mg/L 9.61
Temperature, C 20.51
Conductivity, uhmos 377.9
pH, su 7.47
ORP, mv

III. Physical Characterization

Stream Width, ft 23.5 ft
Channel Width, ft
Pool Length, ft
Riffle/Run Length, ft
Tape Down (ft)
GPS
36.24179
-93.07558

Transect Reading	Tape Reading from LB/RB (ft)	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	7.5	0.00			0.00		
2	8	0.10			0.03		
3	9	0.45			-0.09		
4	10	0.60			0.29		
5	11	0.80			0.83		
6	12	0.80			1.09		
7	13	0.70			1.73		
8	14	0.70			1.69		
9	15	0.90			1.83		
10	16	0.55			2.12		
11	17	0.80			2.45		
12	18	0.80			2.52		
13	19	0.80			1.84		
14	20	0.80			1.81		
15	21	0.60			1.32		
16	22	0.70			1.52		
17	23	0.60			1.66		
18	24	0.60			0.71		
19	25	0.55			0.80		
20	26	0.40			0.51		
21	27	0.35			0.37		
22	28	0.20			0.47		
23	29	0.20			0.34		
24	30	0.00			0.00		
25	31	0.00			0.00		
26							
27							
Totals	0		0			0.000	cfs
						0	gpm

LB @ 31 ft

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-D
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR	
FORM COMPLETED BY JMR	DATE 20 SEP 12 TIME 1819 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 2 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 168

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR BJG	
FORM COMPLETED BY BJG	DATE 20Sept2012 TIME 1819 AM PM REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 4 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 171

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0
STATION #________ RIVERMILE________	STREAM CLASS
LAT ____________ LONG ____________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR/ BJG Combined	DATE 20 SEP 12 TIME 1819 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 7 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (~~LB~~) RB	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 3 (~~RB~~) LB	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 169

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)	
STATION #______ RIVERMILE______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS JMR		
FORM COMPLETED BY JMR	DATE 20 SEP 12 TIME 1100 AM PM	REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable babitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 166

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CCI DS1 - upstream portion
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR BJG	
FORM COMPLETED BY BJG	DATE 20Sept2012 TIME 11:00 AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 174

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)
STATION #________ RIVERMILE________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG Combined	DATE 20 SEP 12 TIME 1100 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable babitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 171

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (downstream portion)
STATION #______ RIVERMILE______	STREAM CLASS
LAT______ LONG______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR	
FORM COMPLETED BY JMR	DATE 19 SEP 12 TIME 1900 AM (PM) — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 170

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 DS - 2 - downstream portion
STATION # ________ RIVERMILE ________	STREAM CLASS
LAT ________ LONG ________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS SMR BSG	
FORM COMPLETED BY BSG	DATE 14 Sept 2017 TIME 1900 AM (PM) REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 169

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (downstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG Combined	DATE 19 SEP 12 TIME 1900 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 170

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-O
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT 36.23187 LONG -93.07856	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR	DATE 20 SEP 12 TIME 1819 AM (PM) — REASON FOR SURVEY UAA

WEATHER CONDITIONS

Now		Past 24 Hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☒ 30 %
☒	clear/sunny	☐

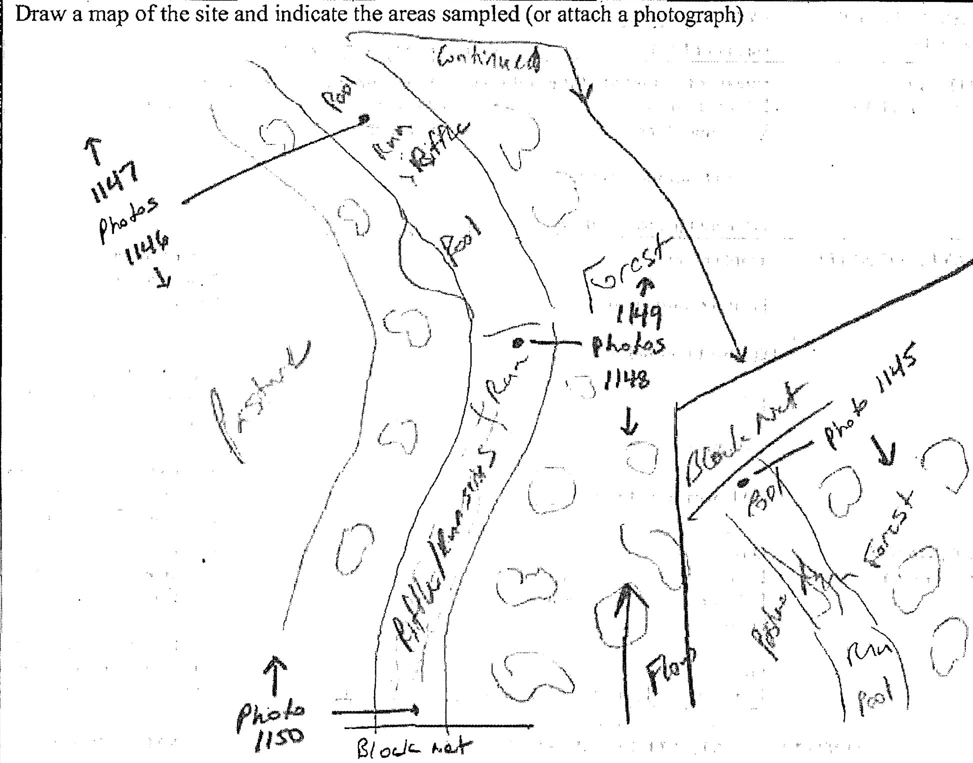
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 75 °C

Other ______

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☒ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other______

Catchment Area ______ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ____ ☐ Residential	**Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** minimal ☒ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees RB ☐ Shrubs ☒ Grasses LB ☐ Herbaceous **dominant species present** ____	
INSTREAM FEATURES	**Estimated Reach Length** 400 m **Estimated Stream Width** 10 m **Sampling Reach Area** ____ m^2 **Area in km^2 (m^2x1000)** ____ km^2 **Estimated Stream Depth** 0.4 m **Surface Velocity (at thalweg)** 0.2 m/sec	**Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.5 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 30 % 30 ☐ Run 40 % 40 ☐ Pool 30 % 30 – consulted w/ BJG **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** ____ m^2 Present **Density of LWD** ____ m^2/km^2 **(LWD/reach area)**	
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae dominant species present none Portion of the reach with aquatic vegetation 0 %	
WATER QUALITY	**Temperature** ____ °C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ see field notes	**Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ____ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ____
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ____ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse	**Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	<5
Boulder	> 256 mm (10")	5			
Cobble	64-256 mm (2.5" – 10")	35	Muck-Mud	Black, very fine organic (FPOM)	<1
Gravel	2-64 mm (0.1" – 2.5")	50			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

consulted w/ BJG

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 DS-2
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT 36.24380 LONG -93.07640	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR/BJG	
FORM COMPLETED BY JMR	DATE 19 SEP 12 TIME 1900 AM PM (PM circled) · REASON FOR SURVEY UAA

WEATHER CONDITIONS

Now		Past 24 Hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
___% ☐	%cloud cover	☐ ___%
☒	clear/sunny	☒

Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 65 °C

Other ______

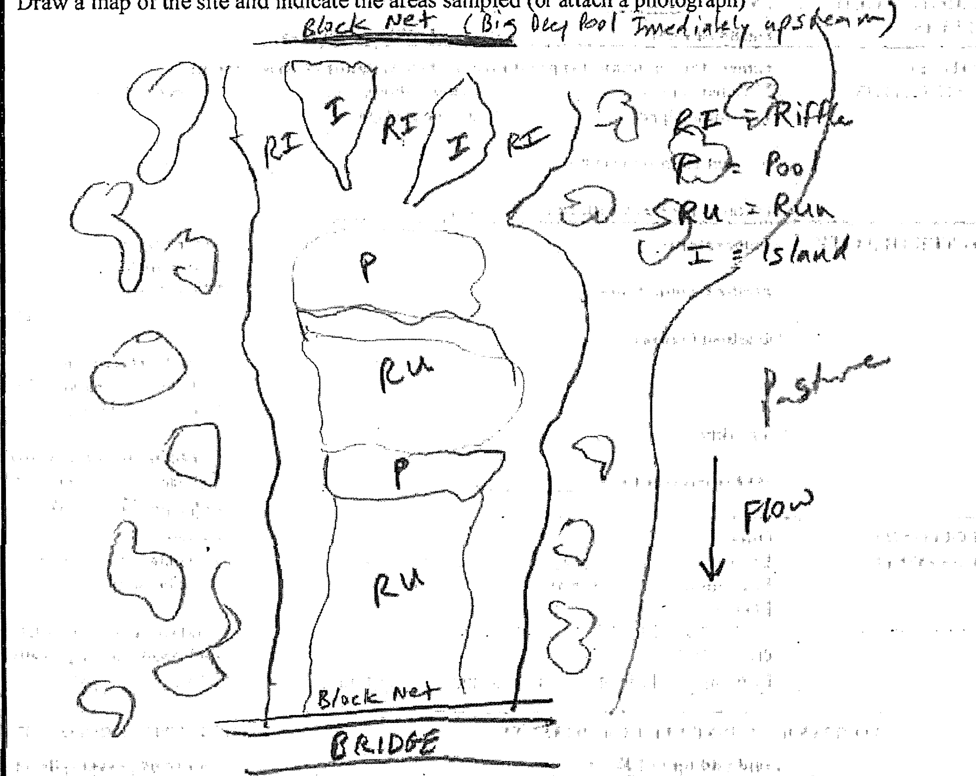
SITE LOCATION/MAP

photo #5

1136 · 1140 · 1141 · Flow · 1139 · 1138 · 1137

photos at cclus2 36.24380 -93.07639

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☒ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ______

Catchment Area ______ km²

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ____ ☐ Residential **Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☒ None ☐ Moderate ☐ Heavy — minimal
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees RB ☐ Shrubs ☒ Grasses LB ☐ Herbaceous **dominant species present** ____
INSTREAM FEATURES	**Estimated Reach Length** 150 m **Estimated Stream Width** 10 m **Sampling Reach Area** ____ m^2 **Area in km^2 (m^2x1000)** ____ km^2 **Estimated Stream Depth** 0.3 m **Surface Velocity (at thalweg)** 0.2 m/sec **Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.3 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 20 % ☐ Run 70 % ☐ Pool 10 % — consulted w/ BJG **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** ____ m^2 **Density of LWD** ____ m^2/km^2 **(LWD/reach area)**
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae dominant species present None Portion of the reach with aquatic vegetation 0 %
WATER QUALITY	**Temperature** ____ °C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ See field notes **Water Odors** ☐ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☒ Other ____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ____ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ____
SEDIMENT/ SUBSTRATE	**Odors** ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☒ None ☐ Other ____ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	<5
Boulder	> 256 mm (10")	10			
Cobble	64-256 mm (2.5" – 10")	25	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	51			
Sand	0.06 – 2mm (gritty)	2	Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm	2			
Clay	<0.004 mm (slick)	0			

consulted w/ BJG

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 DS1
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT 36.24158 LONG -93.07609	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR	DATE 20 SEP 12 TIME 1100 AM PM (AM circled) — REASON FOR SURVEY UAA

WEATHER CONDITIONS

Now		Past 24 Hours
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
30 % ☒	%cloud cover	☐ ___%
☐	clear/sunny	☒

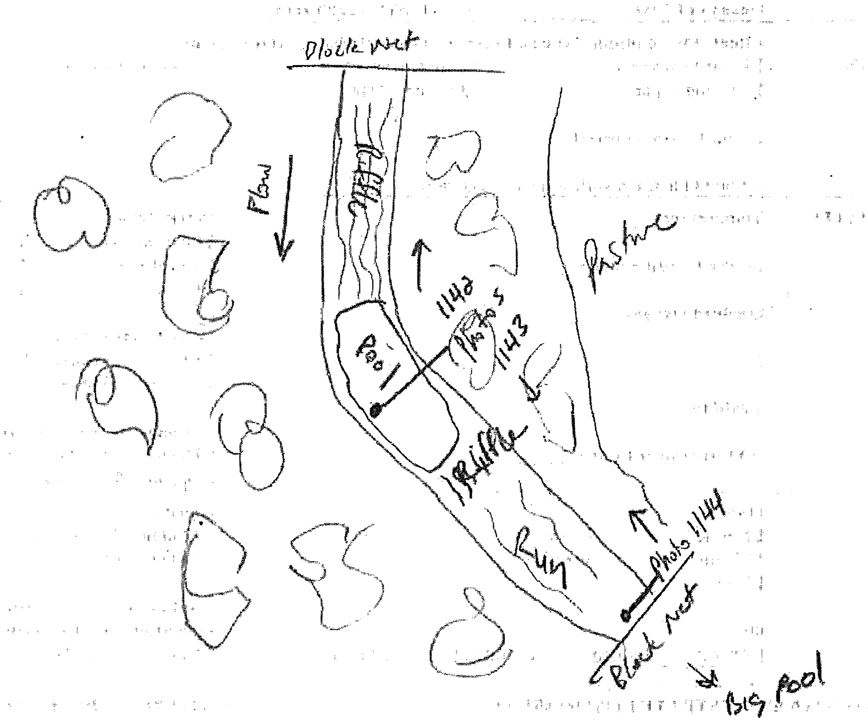
Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No

Air Temperature 65 °C

Other ____

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☒ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other____

Catchment Area ____ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
- [x] Forest
- [x] Field/Pasture
- [ ] Agricultural
- [ ] Residential
- [ ] Commercial
- [ ] Industrial
- [ ] Other ________

Local Watershed
- [ ] No evidence
- [x] Some potential sources
- [ ] Obvious sources

Local Watershed Erosion minimal
- [x] None
- [ ] Moderate
- [ ] Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
- [x] Trees RB
- [ ] Shrubs
- [x] Grasses LB
- [ ] Herbaceous

dominant species present ________

INSTREAM FEATURES

Estimated Reach Length 250 m

Estimated Stream Width 15 m

Sampling Reach Area ____ m^2

Area in km^2 (m^2x1000) ____ km^2

Estimated Stream Depth 0.3 m

Surface Velocity (at thalweg) 0.2 m/sec

Canopy Cover
- [x] Partly open
- [ ] Partly shaded
- [ ] Shaded

High Water Mark 0.5 m

Proportion of Reach Represented by Stream Morphology Types
- [ ] Riffle 35 %
- [ ] Run 34 %
- [ ] Pool 33 %

consulted w/ BSG

Channelized [ ] Yes [x] No

Dam Present [ ] Yes [x] No

LARGE WOODY DEBRIS

LWD ____ m^2 Present

Density of LWD ________ m^2/km^2 (LWD/reach area)

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
- [x] Rooted emergent
- [ ] Rooted submergent
- [ ] Rooted Floating
- [ ] Free floating
- [ ] Floating Algae
- [ ] Attached Algae

dominant species present ________

Portion of the reach with aquatic vegetation 1 %

WATER QUALITY

Temperature ____ °C

Specific Conductance ________

Dissolved Oxygen ________

pH ________

Turbidity ________

WQ Instrument Used ________

see field notes

Water Odors
- [x] Normal/None
- [ ] Sewage
- [ ] Petroleum
- [ ] Chemical
- [ ] Fishy
- [ ] Other ________

Water Surface Oils
- [ ] Slick
- [ ] Sheen
- [ ] Globs
- [ ] Flecks
- [x] None
- [ ] Other ________

Turbidity (if not measured)
- [x] Clear
- [ ] Slightly turbid
- [ ] Turbid
- [ ] Opaque
- [ ] Stained
- [ ] Other ________

SEDIMENT/ SUBSTRATE

Odors
- [x] Normal
- [ ] Sewage
- [ ] Petroleum
- [ ] Chemical
- [ ] Anaerobic
- [ ] None
- [ ] Other ________

Oils
- [x] Absent
- [ ] Slight
- [ ] Moderate
- [ ] Profuse

Deposits
- [ ] Sludge
- [ ] Sawdust
- [ ] Paper fiber
- [ ] Sand
- [ ] Relict shells
- [ ] Other ________

Looking at stones which are not deeply embedded, are the undersides black in color?
- [ ] Yes
- [x] No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		10
Boulder	> 256 mm (10")	10
Cobble	64-256 mm (2.5" – 10")	25
Gravel	2-64 mm (0.1" – 2.5")	50
Sand	0.06 – 2mm (gritty)	<1
Silt	0.004-0.06 mm	5
Clay	<0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	Sticks, wood, coarse plant materials (CPOM)	5-10
Muck-Mud	Black, very fine organic (FPOM)	<5
Marl	Grey, shell fragments	0

consulted w/ BSG

November 2012

27 Nov 2012 Harrison OA1 2

* Minisonde #4 deployed upstream → CC-0
@ 15:11 Clear Cool. Only scattered
light rain over last few days
- same location as september
sample

* Minisonde #5 deployed downstream → CC-1
@ 15:25
- same location as september sample
* WR-0 @ 17:23
* WR-1 @ 16:55

28 Nov 12

* Upstream sample → CC-0 collected @ 8:40
at same location as flow measurement
- Temp: 8.30
pH: 7.46
spc: 377
LDO: 9.96

Rite in the Rain

CC-1 Sample @ 1213 (Harrison DS)
- Same location as flow
Temp 16.69 SpC 417
pH 7.89 LDO 9.80
@ 14:50

* From FTN # 38352 Just upstream of sample location

- CC-1 Hydrolab pulled @ 15:45

Harison → H001 outfall @ 16:00
Temp 13.85 pH 7.26
SpC 669 DO 9.14

* Y001 @ 17:10

Temp 13.25
pH 7.67
SpC 477
DO 10.98

WR-0, WR-1, & CC-0 in situs collected w/
Hydrolab SN 45796
CC-1, H001, & Y001 in situs collected w/
Hydrolab SN 38352

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time 28 NOV 12 0915
Observer JMR / BJG
Project No. 4315-050

Stream Crooked Creek
Transect No. CC-0
Picture No.

II. In-Situ Data

Dissolved Oxygen, mg/L 9.96
Temperature, C 8.30
Conductivity, uhmos 377
pH, su 7.46
ORP, mv

III. Physical Characterization

Stream Width, ft 27.5
Channel Width, ft
Pool Length, ft
Riffle/Run Length, ft
Tape Down (ft)
GPS

Transect Reading	Tape Reading from LB/RB (ft)	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	35	0.06			0.00		
2	34.1	0.1			0.00		
3	33	0.1			-0.02		
4	32	0.1			0.17		
5	31	0.2			0.24		
6	30	0.2			0.58		
7	29	0.2			0.57		
8	28	0.35			0.12		
9	27	0.4			0.31		
10	26	0.3			0.22		
11	25	0.4			0.72		
12	24	0.5			0.89		
13	23	0.6			0.69		
14	22	0.6			1.49		
15	21	0.9			1.40		
16	20	0.9			1.35		
17	19	0.9			1.50		
18	18	1.0			1.07		
19	17	1.0			1.62		
20	16	0.9			0.80		
21	15	0.8			0.62		
22	14	0.8			0.50		
23	13	0.7			0.16		
24	12	0.5			-0.05		
25	11	0.4			-0.05		
26	10	0.0			0.00		
27	9	0.2			0.05		
Totals	0		0			0.000	cfs
	8	0.05			0.00	0	gpm
	7.5	0.00			0.00		LB @ 7.5 ft

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time 28 NOV 12 1313
Observer JMR / BJG
Project No. 4315-050

Stream Crooked Creek
Transect No. CC-1
Picture No.

II. In-Situ Data

Dissolved Oxygen, mg/L 9.80
Temperature, C 16.69
Conductivity, uhmos 417
pH, su 7.89
ORP, mv

III. Physical Characterization

Stream Width, ft 20.9
Channel Width, ft
Pool Length, ft
Riffle/Run Length, ft
Tape Down (ft)
GPS

Transect Reading	(ft) Tape Reading from LB/RB	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	5.8	0.00			0.00		
2	6	0.1			-0.18		
3	7	0.2			0.26		
4	8	0.4			0.14		
5	9	0.5			0.60		
6	10	0.7			0.67		
7	11	0.8			0.90		
8	12	0.9			1.41		
9	13	0.8			1.23		
10	14	0.9			0.81		
11	15	0.9			0.87		
12	16	0.9			1.01		
13	17	0.8			1.59		
14	18	0.8			1.22		
15	19	0.8			0.85		
16	20	0.8			0.80		
17	21	0.6			1.08		
18	22	0.6			0.80		
19	23	0.4			0.33		
20	24	0.35			0.29		
21	25	0.2			0.02		
22	26	0.1			0.00		
23	26.7	0.00			0.00		LB @ 26.7 ft
24							
25							
26							
27							
Totals	0		0			0.000	cfs
						0	gpm

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek		LOCATION CC-0	
STATION #	RIVERMILE	STREAM CLASS	
LAT	LONG	RIVER BASIN	
STORET #		AGENCY	
INVESTIGATORS JMR			
FORM COMPLETED BY JMR		DATE 28 NOV 12 TIME 0934 AM PM	REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 2 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 170

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS BSG/JMR	
FORM COMPLETED BY BSG	DATE 25 Nov 2012 TIME 09:34 AM PM / REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___(RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-O
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG Combined	DATE 28 NOV 12 TIME 0934 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 3 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 172

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Upstream Portion)
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR	
FORM COMPLETED BY JMR	DATE 28 NOV 12 TIME 1330 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 171

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS BJG / JMR	
FORM COMPLETED BY BJG	DATE 28 Nov 2012 TIME 1330 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Upstream Portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG Combined	DATE 28 NOV 12 TIME 1330 AM PM · REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 9 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 172

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Downstream Portion)
STATION #________ RIVERMILE________	STREAM CLASS
LAT________ LONG________	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR	
FORM COMPLETED BY JMR	DATE 28 NOV 12 TIME 1500 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 168

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Downstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS BSG/JMR	
FORM COMPLETED BY BSG	DATE 28Aug2013 TIME 15:00 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ________

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Downstream Portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR/ BJG Combined	DATE 28 NOV 12 TIME 1500 AM PM — REASON FOR SURVEY UAA

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category: Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 20	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE 19	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 168

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-0	
STATION #______ RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS JMR/BJG		
FORM COMPLETED BY JMR	DATE 28 NOV 12 TIME 0934 (AM) PM	REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now		Past 24 Hours	Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No
	☐	storm (heavy rain)	☐	
	☐	rain (steady rain)	☐	Air Temperature 36°F ~~°C~~
	☐	showers (intermittent)	☐	
	____% ☐	%cloud cover	☐ ____%	Other______
	☒	clear/sunny	☒	

SITE LOCATION/MAP	Draw a map of the site and indicate the areas sampled (or attach a photograph) See map on 20 Sep 12 data sheet
STREAM CHARACTERIZATION	**Stream Subsystem** ☒ Perennial ☐ Intermittent ☐ Tidal **Stream Type** ☐ Coldwater ☒ Warmwater **Stream Origin** ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☒ Mixture of origins ☐ Swamp and bog ☐ Other______ **Catchment Area**________km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest ☐ Commercial
☒ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ________
☐ Residential

Local Watershed
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous
dominant species present ________

INSTREAM FEATURES

Estimated Reach Length 400 m
Estimated Stream Width 10 m
Sampling Reach Area ____ m^2
Area in km^2 (m^2x1000) ____ km^2
Estimated Stream Depth ____ m
Surface Velocity (at thalweg) ____ m/sec

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded

High Water Mark 0.5 m

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 30 % ☐ Run 40 %
☐ Pool 30 %

Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

LARGE WOODY DEBRIS

LWD 10 m^2
Density of LWD ________ m^2/km^2 **(LWD/reach area)**

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating
☐ Floating Algae ☐ Attached Algae

dominant species present None

Portion of the reach with aquatic vegetation 0 %

WATER QUALITY

Temperature ______ °C
Specific Conductance ________
Dissolved Oxygen ________
pH ________
Turbidity ________
WQ Instrument Used ________

see field notes

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other ________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other ________

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other ________

SEDIMENT/ SUBSTRATE

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ________

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☒ Sand
☐ Relict shells ☐ Other ________

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			**ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)**		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	15-20
Boulder	> 256 mm (10")	5			
Cobble	64-256 mm (2.5" – 10")	35	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	50			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

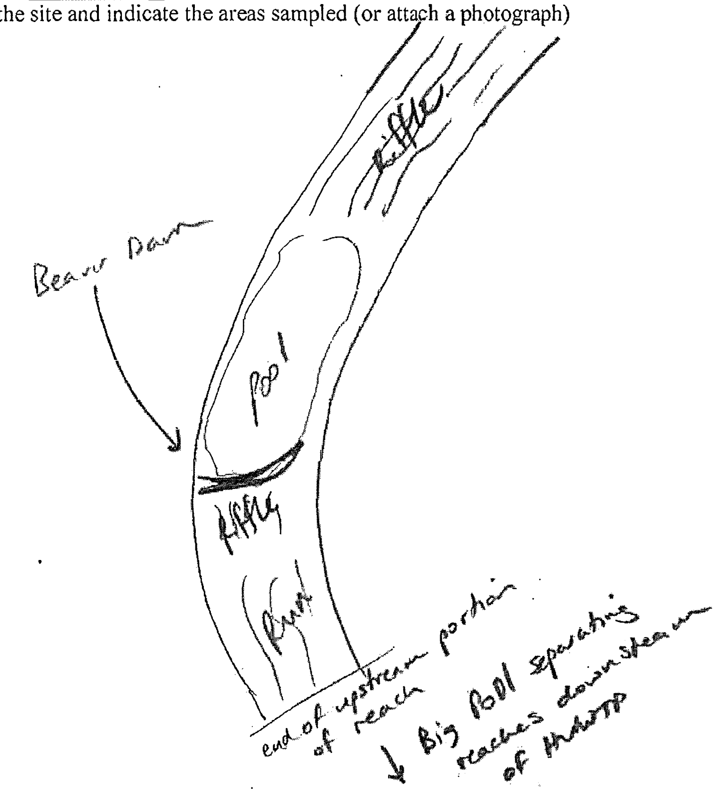
PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Upstream portion)
STATION # ______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR / BJG	DATE 28 NOV 12 TIME 1330 AM PM (circled) — REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now		Past 24 Hours	Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No
	☐	storm (heavy rain)	☐	
	☐	rain (steady rain)	☐	Air Temperature 52°F ~~°C~~
	☐	showers (intermittent)	☐	
	___% ☐	%cloud cover	☐ ___%	Other______
	☒	clear/sunny	☒	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other______

Catchment Area______ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ______ ☐ Residential	**Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☐ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☒ Grasses ☒ Herbaceous dominant species present ______	
INSTREAM FEATURES	**Estimated Reach Length** 250 m **Estimated Stream Width** ____m **Sampling Reach Area** ____m^2 **Area in km^2 (m^2x1000)** ____km^2 **Estimated Stream Depth** ____m **Surface Velocity (at thalweg)** ____m/sec	**Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.5 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 33 % ☐ Run 34 % ☐ Pool 33 % **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** 20 m^2 **Density of LWD** ______m^2/km^2 (LWD/reach area)	
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae dominant species present None Portion of the reach with aquatic vegetation 30 %	
WATER QUALITY	**Temperature** ____°C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ see field notes	**Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ______ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other____
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ______ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse	**Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ______ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			**ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)**		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	15
Boulder	> 256 mm (10")	10			
Cobble	64-256 mm (2.5" – 10")	30	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	50			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 downstream reach
STATION #______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / BJG	
FORM COMPLETED BY JMR/BJG	DATE 28 NOV 12 TIME 1500 AM (PM) — REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now / Past 24 Hours: ☐ storm (heavy rain) ☐; ☐ rain (steady rain) ☐; ☐ showers (intermittent) ☐; ___% ☐ %cloud cover ☐ ___%; ☒ clear/sunny ☒ Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No Air Temperature 54°F ~~°C~~ Other______
SITE LOCATION/MAP	Draw a map of the site and indicate the areas sampled (or attach a photograph) See map on 20 Sep 12 data sheet
STREAM CHARACTERIZATION	**Stream Subsystem** ☒ Perennial ☐ Intermittent ☐ Tidal **Stream Type** ☐ Coldwater ☒ Warmwater **Stream Origin** ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☒ Mixture of origins ☐ Swamp and bog ☐ Other______ **Catchment Area**______ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ______ ☐ Residential	**Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☐ None ☒ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☒ Herbaceous **dominant species present** ______	
INSTREAM FEATURES	**Estimated Reach Length** 150 m **Estimated Stream Width** 10 m **Sampling Reach Area** ____ m^2 **Area in km^2 (m^2x1000)** ____ km^2 **Estimated Stream Depth** ____ m **Surface Velocity (at thalweg)** ____ m/sec	**Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.4 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle ___% ☐ Run ___% ☐ Pool ___% **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** 3 m^2 **Density of LWD** ______ m^2/km^2 **(LWD/reach area)**	
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae dominant species present None Portion of the reach with aquatic vegetation 0 %	
WATER QUALITY	**Temperature** ____ °C **Specific Conductance** ______ **Dissolved Oxygen** ______ **pH** ______ **Turbidity** ______ **WQ Instrument Used** ______ see field notes	**Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ______ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ______
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ______ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse	**Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ______ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		10
Boulder	> 256 mm (10")	10
Cobble	64-256 mm (2.5" – 10")	30
Gravel	2-64 mm (0.1" – 2.5")	50
Sand	0.06 – 2mm (gritty)	<1
Silt	0.004-0.06 mm	
Clay	<0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	Sticks, wood, coarse plant materials (CPOM)	15
Muck-Mud	Black, very fine organic (FPOM)	0
Marl	Grey, shell fragments	0

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION
INVESTIGATOR(S) JMR / BJB	STREAM CLASS CC-0 (upstream riffle)
LAT	LONG
DATE 28 NOV 12	TIME 1055 AM PM
FORM COMPLETED BY JMR / BJB	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		128	51		90
2		128	52		16
3		128	53		64
4		128	54		64
5		180	55		128
6		64	56		180
7		64	57		128
8		11	58		90
9		16	59		90
10		45	60		90
11		45	61		11
12		32	62		16
13		2	63		90
14		64	64		180
15		45	65		90
16		32	66		16
17		45	67		90
18		45	68		45
19		64	69		8
20		128	70		64
21		64	71		180
22		180	72		45
23		128	73		90
24		90	74		180
25		2.8	75		128
26		90	76		90
27		32	77		22.6
28		32	78		64
29		128	79		90
30		180	80		22.6
31		128	81		16
32		11	82		11
33		11	83		32
34		64	84		45
35		90	85		90
36		128	86		11
37		90	87		90
38		64	88		90
39		128	89		22.6
40		90	90		4
41		64	91		128
42		90	92		128
43		11	93		90
44		45	94		180
45		11	95		128
46		180	96		8
47		8	97		32
48		180	98		45
49		11	99		16
50		128	100		64

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-0 (DS Riffle)
INVESTIGATOR(S) JMR / BJG	STREAM CLASS
LAT	LONG
DATE 28 NOV 12	TIME 1030 AM PM
FORM COMPLETED BY JMR / BJG	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		45	51		90
2		5.6	52		64
3		64	53		128
4		90	54		90
5		90	55		90
6		45	56		90
7		90	57		330 #
8		90	58		45
9		180	59		22.6
10		128	60		11
11		128	61		90
12		16	62		64
13		64	63		32
14		8	64		45
15		32	65		64
16		180	66		22.6
17		90	67		128
18		16	68		22.6
19		11	69		90
20		45	70		45
21		220 #	71		64
22		11	72		22.6
23		64	73		2
24		22.6	74		90
25		280 #	75		16
26		11	76		220 #
27		270	77		64
28		90	78		32
29		90	79		16
30		8	80		4
31		180	81		64
32		16	82		32
33		45	83		64
34		230 #	84		8
35		32	85		4
36		210	86		32
37		230 #	87		11
38		240 #	88		64
39		22.6	89		180
40		32	90		32
41		64	91		90
42		22.6	92		45
43		64	93		45
44		45	94		45
45		90	95		64
46		64	96		32
47		128	97		32
48		180	98		45
49		230	99		180
50		90	100		128

ETC Environmental Testing & Consulting, Inc.
www.etcmemphis.com
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

4/30/2013

Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison, AR, 72601

Ref: Analytical Testing
ETC Report Number: 13-114-0225
Client Project Description: Crooked Creek Sampling

Dear Ms. Kathryn Catlin:

Environmental Testing and Consulting, Inc. received sample(s) on 4/24/2013 for the analyses presented in the following report.

The above referenced project has been analyzed per your instructions. The analyses were performed in accordance with the applicable analytical method.

The analytical data has been validated using standard quality control measures performed as required by the analytical method. Quality Assurance, method validations, instrumentation maintenance and calibration for all parameters (NELAP and non-NELAP) were performed in accordance with guidelines established by the USEPA and NELAC unless otherwise indicated. Any parameter for which the laboratory is not officially NELAP accredited is indicated by a '~' symbol. These are not included in the scope because NELAP accreditation is either not available or has not been applied for. Additional certifications may be held/are available for parameters, where NELAP accreditation is not required or applicable. A full list of certifications is available upon request.

The results are shown on the attached Report of Analysis(s). Results for solid matrices are reported on an as-received basis unless otherwise indicated. This report shall not be reproduced except in full and relates only to the samples included in this report.

Please do not hesitate to contact me or client services if you have any questions or need additional information.

Sincerely,

Randell H. Thomas

Randy Thomas
Project Manager

Laboratory's liability in any claim relating to analyses performed shall be limited to, at laboratory's option, repeating the analysis in question at laboratory's expense, or the refund of the charges paid for performance of said analysis.

Alabama	#40750	Louisiana	#04015	VA NELAP	#460181	Texas	#T104704180-11-6	Arkansas	#88-0650
Mississippi		California	#09267CA	NC	#415	Oklahoma	#9311	Virginia	#00106
Kentucky	#90047	Tennessee	#TN02027	EPA	#TN00012	Kentucky UST	#41	Kansas	#E-10396

ETC
www.etcmemphis.com
ENVIRONMENTAL TESTING & CONSULTING, INC.
2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
"A Laboratory Management Partner"

03322
Harrison Wastewater Treatment Plant
Ms. Kathryn Catlin
PO Box 1715
Harrison , AR 72601

Project Information : Crooked Creek Sampling

Report Date : 4/30/2013

Report Number : **13-114-0225**

REPORT OF ANALYSIS

Received : 4/24/2013

Lab No : **93982**
Sample ID : **Silver Valley Bridge (Downstream)**
Matrix: **Aqueous**
Sampled: **4/23/2013 9:00**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**9.89**	mg/L	0.400	1	04/30/13 04:21	ACS	EPA-300.0
Total Dissolved Solids	**207**	mg/L	10	1	04/25/13 14:00	NRT	2540C
Sulfate	**10.9**	mg/L	1.00	1	04/30/13 04:21	ACS	EPA-300.0

Lab No : **93983**
Sample ID : **Hwy 62/65 Bridge (Upstream)**
Matrix: **Aqueous**
Sampled: **4/23/2013 9:10**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**6.51**	mg/L	0.400	1	04/30/13 04:39	ACS	EPA-300.0
Total Dissolved Solids	**196**	mg/L	10	1	04/25/13 14:00	NRT	2540C
Sulfate	**8.17**	mg/L	1.00	1	04/30/13 04:39	ACS	EPA-300.0

Lab No : **93984**
Sample ID : **WWTP Discharge Point**
Matrix: **Aqueous**
Sampled: **4/23/2013 8:50**

Test	Results	Units	MQL	DF	Date / Time Analyzed	By	Analytical Method
Chloride	**45.9**	mg/L	4.00	10	04/25/13 01:20	ACS	EPA-300.0
Nitrate (NO3-N)	**1.47**	mg/L	0.100	1	04/24/13 14:19	ACS	EPA-300.0
Nitrite (NO2-N)	**0.501**	mg/L	0.100	1	04/24/13 14:19	ACS	EPA-300.0
Nitrate+Nitrite-N	**1.97**	mg/L	0.100	1	04/24/13 14:19		EPA-300.0
Total Dissolved Solids	**301**	mg/L	10	1	04/25/13 14:00	NRT	2540C
Sulfate	**55.6**	mg/L	10.0	10	04/25/13 19:33	ACS	EPA-300.0

Qualifiers/ Definitions

*	Outside QC limit	DF	Dilution Factor
MQL	Method Quantitation Limit		

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2790 Whitten Road Memphis, Tennessee 38133 (901) 213-2400 Fax (901) 213-2440
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Cooler Receipt Form

Customer Number: **03322**
Customer Name: **Harrison Wastewater Treatment Plant**
Report Number: **13-114-0225**

Shipping Method

○ Fed Ex ● UPS ○ US Postal ○ Client ○ Lab ○ Courier ○ Other :

Shipping container/cooler uncompromised?	● Yes	○ No	
Custody seals intact on shipping container/cooler?	○ Yes	○ No	● Not Required
Custody seals intact on sample bottles?	○ Yes	○ No	● Not Required
Chain of Custody (COC) present?	● Yes	○ No	
COC agrees with sample label(s)?	● Yes	○ No	
COC properly completed	● Yes	○ No	
Samples in proper containers?	● Yes	○ No	
Sample containers intact?	● Yes	○ No	
Sufficient sample volume for indicated test(s)?	● Yes	○ No	
All samples received within holding time?	● Yes	○ No	
Cooler temperature in compliance?	● Yes	○ No	
Cooler/Samples arrived at the laboratory on ice. Samples were considered acceptable as cooling process had begun.	● Yes	○ No	
Water - Sample containers properly preserved	● Yes	○ No	○ N/A
Water - VOA vials free of headspace	○ Yes	○ No	● N/A
Trip Blanks received with VOAs	○ Yes	○ No	● N/A
Soil VOA method 5035 – compliance criteria met	○ Yes	○ No	● N/A

☐ High concentration container (48 hr) ☐ Low concentration EnCore samplers (48 hr)
☐ High concentration pre-weighed (methanol -14 d) ☐ Low conc pre-weighed vials (Sod Bis -14 d)

Special precautions or instructions included?	○ Yes	● No

Comments:

Any regulatory non-compliance issues will be recorded on non-compliance report.

Signature: Susan Simpson

Date & Time: 04/24/2013 10:45:55

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-1 (upstream Riffle)
INVESTIGATOR(S) JMR / BJG	STREAM CLASS
LAT	LONG
DATE 28 NOV 12	TIME 1340 AM PM
FORM COMPLETED BY JMR / BJG	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		8	51		11
2		128	52		32
3		32	53		5.6
4		5.6	54		64
5		64	55		45
6		64	56		45
7		22.6	57		32
8		4	58		90
9		128	59		2.8
10		64	60		90
11		11	61		90
12		45	62		128
13		22.6	63		22.6
14		90	64		64
15		45	65		90
16		128	66		90
17		128	67		22.6
18		45	68		22.6
19		2	69		22.6
20		2	70		11
21		16	71		32
22		11	72		32
23		32	73		128
24		16	74		32
25		5.6	75		32
26		64	76		64
27		128	77		32
28		180	78		45
29		90	79		16
30		45	80		16
31		64	81		11
32		45	82		11
33		16	83		45
34		128	84		45
35		16	85		22.6
36		32	86		16
37		16	87		11
38		11	88		22.6
39		32	89		22.6
40		128	90		16
41		90	91		8
42		90	92		16
43		32	93		32
44		64	94		22.6
45		45	95		32
46		2.8	96		5.6
47		11	97		2
48		22.6	98		32
49		16	99		32
50		45	100		16

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-1 (Downstream reach)
INVESTIGATOR(S) JMR / BTG	STREAM CLASS
LAT	LONG
DATE 28 NOV 12	TIME 1515 AM PM
FORM COMPLETED BY JMR / BTG	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		22.6	51		16
2		64	52		64
3		22.6	53		64
4		8	54		45
5		16	55		11
6		32	56		45
7		22.6	57		4
8		22.6	58		16
9		16	59		22.6
10		22.6	60		64
11		45	61		11
12		1000 #	62		8
13		32	63		64
14		16	64		32
15		22.6	65		16
16		64	66		22.6
17		45	67		32
18		45	68		8
19		4	69		16
20		8	70		16
21		64	71		32
22		16	72		8
23		8	73		16
24		32	74		32
25		22.6	75		45
26		32	76		8
27		22.6	77		32
28		16	78		16
29		11	79		2
30		16	80		16
31		64	81		16
32		11	82		16
33		90	83		22.6
34		22.6	84		16
35		64	85		45
36		16	86		4
37		16	87		32
38		32	88		45
39		64	89		64
40		16	90		11
41		16	91		64
42		45	92		22.6
43		8	93		5.6
44		16	94		64
45		32	95		32
46		32	96		90
47		64	97		22.6
48		16	98		45
49		5.6	99		64
50		32	100		11

April 2013

Crooked Creek UAA 02 APR 13 JMR/JJR

Hydrolab deployed @ Yellville US @ 0957 (CC-2)
Hydrolab deployed @ Yellville DS @ 1013 (CC-3)
Outfall insitu @ 1025 ← Toxicity Only

Temp	12.32
pH	6.89
SpC	582
DO	8.23

Y001 sample collected @ 1030
Hydrolab deployed @ Harrison DS @ 1129 (CC-1)
Hydrolab deployed @ Harrison US @ 1147 (CC-0)

H001 Outfall Sample @ 1200

temp	14.30
pH	7.70
SpC	587
DO	8.28

CC-1 Sample @ 1445

temp	12.69
pH	7.64
SpC	329
DO	10.21

CC-0 Sample @ 1552

temp	12.95	SpC	320
pH	7.50	DO	10.21

WR-0 Sample @ 2002

Temp	10.98	SpC	544
pH	7.22	DO	8.34

WR-1 Sample @ 2037

Temp	8.92	SpC	297
pH	7.77	DO	10.78

03 APR 13

Y001 Sample @ 0826

Temp	11.47	SpC	530
pH	7.67	DO	8.24

CC-2 Sample @ 0907

Temp	9.57	SpC	335
pH	7.98	DO	9.39

CC-3 Sample @ 1149

Temp	10.54	SpC	329
pH	8.06	DO	9.54

Hydrolabs pulled @ Yellville @ 1315 (CC-2 & CC-3)
Hydrolab pulled @ Harrison DS @ 1415 (CC-1)
Hydrolab pulled @ Harrison US @ 1440 (CC-0)

Rite in the Rain

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time 02 APR 13 1555
Observer JMR / JJR
Project No. R04315-0002-001

Stream Crooked Creek
Transect No. CC-0
Picture No.

II. In-Situ Data

Dissolved Oxygen, mg/L
Temperature, C
Conductivity, uhmos
pH, su
ORP, mv

III. Physical Characterization

Stream Width, ft
Channel Width, ft
Pool Length, ft
Riffle/Run Length, ft
Tape Down (ft)
GPS

Transect Reading	Tape Reading from LB/RB	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	8	0.33			0.04		
2	9	0.2			0.09		
3	10	0.3			0.64		
4	11	0.2			0.26		
5	12	0.2			0.51		
6	13	0.3			0.40		
7	14	0.4			0.48		
8	15	0.3			0.76		
9	16	0.4			1.01		
10	17	0.2			1.27		
11	18	0.5			1.49		
12	19	0.65			1.01		
13	20	0.7			1.39		
14	21	0.6			1.62		
15	22	1.0			1.46		
16	23	1.0			1.72		
17	24	1.05			2.38		
18	25	1.15			2.46		
19	26	1.3			2.03		
20	27	1.3			2.82		
21	28	1.4			2.93		
22	29	1.8			2.94		
23	30	1.8			2.21		
24	31	1.8			1.74		
25	32	1.6			1.32		
26	33	1.5			1.07		
27	34	1.35			-0.08		
Totals	0		0			0.000	cfs
	35	1.15			0.03	0	gpm
	36	0.9			-0.07		
	37	0.75			-0.18		
	38	0.5			-0.12		
	39	0.1			0.0		LB @ 39.0 ft

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time: 02 APR 13 1450
Observer: JMR/JJR
Project No.: R04315-0002-001
Stream: Crooked Creek
Transect No.: CC-1
Picture No.:

II. In-Situ Data

Dissolved Oxygen, mg/L:
Temperature, C:
Conductivity, uhmos:
pH, su:
ORP, mv:

III. Physical Characterization

Stream Width, ft:
Channel Width, ft:
Pool: Length, ft:
Riffle/Run: Length, ft:
Tape Down (ft):
GPS

Transect Reading	Tape Reading from LB/RB	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	6.75	0			0.00		
2	7	0.2	0.		0.21		
3	8	0.3			1.02		
4	9	0.6			1.14		
5	10	0.7			1.66		
6	11	0.9			1.68		
7	12	0.9			1.35		
8	13	1.05			1.90		
9	14	1.00			2.59		
10	15	0.95			2.90		
11	16	1.1			2.79		
12	17	1.1			2.71		
13	18	1.0			3.17		
14	19	1.1			2.91		
15	20	1.2			3.05		
16	21	1.0			2.64		
17	22	0.9			2.15		
18	23	1.0			2.44		
19	24	0.85			1.74		
20	25	0.75			2.51		
21	26	0.7			2.00		
22	27	0.55			1.89		
23	28	0.3			1.46		
24	29	0.5			0.99		
25	30	0.35			0.59		
26	31	0.35			0.47		
27	32	0.2			0.09		
Totals	0		0			0.000	cfs
	33	0.1			0.00	0	gpm

~~34~~
~~35~~
~~36~~

LB @ 33.0 ft

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time 03 APR 13 1153
Observer JMR / JJR
Project No. R04315-0002-001

Stream Crooked Creek
Transect No. CC-2
Picture No.

II. In-Situ Data

Dissolved Oxygen, mg/L
Temperature, C
Conductivity, uhmos
pH, su
ORP, mv

III. Physical Characterization

Stream Width, ft
Channel Width, ft
Pool Length, ft
Riffle/Run Length, ft
Tape Down (ft)
GPS

Transect Reading	Tape Reading from LB/RB	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	86	0.0		0.0	0.00		
2	83	0.15		0.30	0.09		
3	80	0.45	ft/sec	1.51	0.46	m/s	
4	77	0.65		2.33	0.71		
5	74	0.9		2.85	0.87		
6	71	1.05		3.22	0.98		
7	68	1.2		2.99	0.91		
8	65	1.4			3.89	← f/s	starting here
9	62	1.6			3.36		
10	59	1.75			3.51		
11	56	1.7			3.64		
12	53	1.55			3.54		
13	50	1.4			2.91		
14	47	1.3			2.97		
15	44	1.4			2.21		
16	41	1.6			3.01		
17	38	~~3~~ 1.5			2.39		
18	35	1.45			1.55		
19	32	1.9			0.32		
20	29	2.0			0.28		
21	26	2.05			0.17		
22	23	2.1			0.14		
23	20	2.1			0.20		
24	17	2.3			0.21		
25	14	2.5			0.15		
26	11	2.45			0.07		
27	8	2.05			0.16		
Totals	0		0			0.000	cfs
	5	1.55			0.03	0	gpm
	RB - 2	0.25			-0.03		

RB @ 2.0 ft

FTN Associates, LTD.
Physical Characterization - Worksheet

I. General

Date/Time	03 APR 13 1205	Stream	Crooked Creek
Observer	JMR / JTR	Transcect No.	CC-3
Project No.	R04315-0002-001	Picture No.	

II. In-Situ Data

Dissolved Oxygen, mg/L
Temperature, C
Conductivity, uhmos
pH, su
ORP, mv

III. Physical Characterization

Stream Width, ft
Channel Width, ft
Pool Length, ft
Riffle/Run Length, ft
Tape Down (ft)
GPS

Transect Reading	Tape Reading from LB/RB	Depth (ft)	Section Length (ft)	Area (ft2)	Velocity (fs)	Area Flow (cfs)	Comments
1	74	0.0			0.00		
2	71	0.25			0.25		
3	68	0.6			0.41		
4	65	0.9			0.48		
5	62	1.1			1.13		
6	59	1.3			1.45		
7	56	1.35			1.52		
8	53	1.25			1.77		
9	50	1.4			1.56		
10	47	1.4			2.01		
11	44	1.5			2.00		
12	41	1.5			2.33		
13	38	1.95			1.84		
14	35	2.1			2.49		
15	32	2.3			1.98		
16	29	2.35			2.72		
17	26	2.3			2.09		
18	23	2.05			2.32		
19	20	1.75			1.77		
20	17	1.8			0.35		
21	14	2.3			0.47		
22	11	2.5			0.16		
23	8	2.7			-0.11		
24	5	1.55			-0.04		
25	3.5	0.0			0.00		RB @ 3.5 ft
26							
27							
Totals	0		0			0.000	cfs
						0	gpm

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-O
STATION #_____ RIVERMILE _____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMK / JJR	
FORM COMPLETED BY JMK	DATE 02 APR 13 TIME 1630 AM PM / REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now / Past 24 Hours: ☐ / ☐ storm (heavy rain); ☒ / ☒ rain (steady rain); ☐ / ☐ showers (intermittent); 100 % ☐ / ☐ ___ % %cloud cover; ☐ / ☐ clear/sunny. Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No. Air Temperature 35 °C. Other_____
SITE LOCATION/MAP	Draw a map of the site and indicate the areas sampled (or attach a photograph) See notes from previous visit
STREAM CHARACTERIZATION	**Stream Subsystem** ☒ Perennial ☐ Intermittent ☐ Tidal **Stream Type** ☐ Coldwater ☒ Warmwater **Stream Origin** ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☒ Mixture of origins ☐ Swamp and bog ☐ Other_____ **Catchment Area**_____ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** [X] Forest ☐ Commercial [X] Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ________ ☐ Residential **Local Watershed** ☐ No evidence [X] Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☐ None [X] Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** [X] Trees ☐ Shrubs [X] Grasses ☐ Herbaceous **dominant species present** ________
INSTREAM FEATURES	**Estimated Reach Length** 400 m **Estimated Stream Width** 10 m **Sampling Reach Area** ____ m^2 **Area in km^2 (m^2x1000)** ____ km^2 **Estimated Stream Depth** ____ m **Surface Velocity (at thalweg)** ____ m/sec **Canopy Cover** [X] Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.3 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 30 % ☐ Run 40 % ☐ Pool 30 % **Channelized** ☐ Yes [X] No **Dam Present** ☐ Yes [X] No
LARGE WOODY DEBRIS	**LWD** 15 m^2 **Density of LWD** ________ m^2/km^2 (LWD/reach area)
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae [X] Attached Algae dominant species present ________ Portion of the reach with aquatic vegetation 40 %
WATER QUALITY	**Temperature** ____ °C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ see field notes **Water Odors** [X] Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks [X] None ☐ Other ____ **Turbidity (if not measured)** [X] Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ____
SEDIMENT/ SUBSTRATE	**Odors** [X] Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ________ **Oils** [X] Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes [X] No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	10
Boulder	> 256 mm (10")	5			
Cobble	64-256 mm (2.5" – 10")	40	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	45			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Upstream Portion of Reach)
STATION # ____ RIVERMILE ____	STREAM CLASS
LAT ____ LONG ____	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / JTR	
FORM COMPLETED BY JMR	DATE 02 APR 13 TIME 1450 AM PM — REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now / Past 24 Hours ☐ storm (heavy rain) ☐ ☒ rain (steady rain) ☒ ☐ showers (intermittent) ☐ 100 % ☒ %cloud cover ☐ ____ % ☐ clear/sunny ☐ Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No Air Temperature 36 °C Other ____
SITE LOCATION/MAP	Draw a map of the site and indicate the areas sampled (or attach a photograph) see previous field notes - Beaver dam no longer present
STREAM CHARACTERIZATION	**Stream Subsystem** ☒ Perennial ☐ Intermittent ☐ Tidal **Stream Type** ☐ Coldwater ☒ Warmwater **Stream Origin** ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☒ Mixture of origins ☐ Swamp and bog ☐ Other ____ **Catchment Area** ____ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ______ ☐ Residential	**Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☐ None ☒ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous dominant species present ______	
INSTREAM FEATURES	**Estimated Reach Length** ____m **Estimated Stream Width** ____m **Sampling Reach Area** ____m^2 **Area in km^2 (m^2x1000)** ____km^2 **Estimated Stream Depth** ____m **Surface Velocity (at thalweg)** ____m/sec	**Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.3 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 33 % ☐ Run 34 % ☐ Pool 33 % **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** 5 m^2 **Density of LWD** ____ m^2/km^2 (LWD/reach area)	
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae dominant species present ______ Portion of the reach with aquatic vegetation 80 %	
WATER QUALITY	**Temperature** ____°C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ see field notes	**Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ____ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other____
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ____ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse	**Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	5
Boulder	> 256 mm (10")	10			
Cobble	64-256 mm (2.5" – 10")	35	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	45			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-1 (Downstream Reach)
STATION #______ RIVERMILE ______	STREAM CLASS
LAT ______ LONG ______	RIVER BASIN
STORET #	AGENCY
INVESTIGATORS JMR / JJR	
FORM COMPLETED BY JMR	DATE 02 APR 13 TIME 1321 AM PM (circled: PM) — REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now / Past 24 Hours ☐ / ☐ storm (heavy rain) ☒ / ☒ rain (steady rain) ☐ / ☐ showers (intermittent) 100 % ☐ / ☐ ___ % %cloud cover ☐ / ☐ clear/sunny Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No Air Temperature 36 °F °C Other______
SITE LOCATION/MAP	Draw a map of the site and indicate the areas sampled (or attach a photograph) See field notes from previous visit
STREAM CHARACTERIZATION	**Stream Subsystem** ☒ Perennial ☐ Intermittent ☐ Tidal **Stream Type** ☐ Coldwater ☒ Warmwater **Stream Origin** ☐ Glacial ☐ Spring-fed ☐ Non-glacial montane ☒ Mixture of origins ☐ Swamp and bog ☐ Other______ **Catchment Area**______ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ________ ☐ Residential	**Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☐ None ☒ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous dominant species present ________	
INSTREAM FEATURES	**Estimated Reach Length** 150 m **Estimated Stream Width** 10 m **Sampling Reach Area** ____ m^2 **Area in km^2 (m^2x1000)** ____ km^2 **Estimated Stream Depth** ____ m **Surface Velocity (at thalweg)** ____ m/sec	**Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 0.3 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 20 % ☐ Run 70 % ☐ Pool 10 % **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** ________ m^2 **Density of LWD** ________ m^2/km^2 (LWD/reach area)	
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☒ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☒ Attached Algae dominant species present ________ Portion of the reach with aquatic vegetation 5 %	
WATER QUALITY	**Temperature** ____ °C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ see field notes	**Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ________ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ________ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ________
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ________ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse	**Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ________ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		10	Detritus	Sticks, wood, coarse plant materials (CPOM)	<5
Boulder	> 256 mm (10")	10			
Cobble	64-256 mm (2.5" – 10")	30	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	50			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

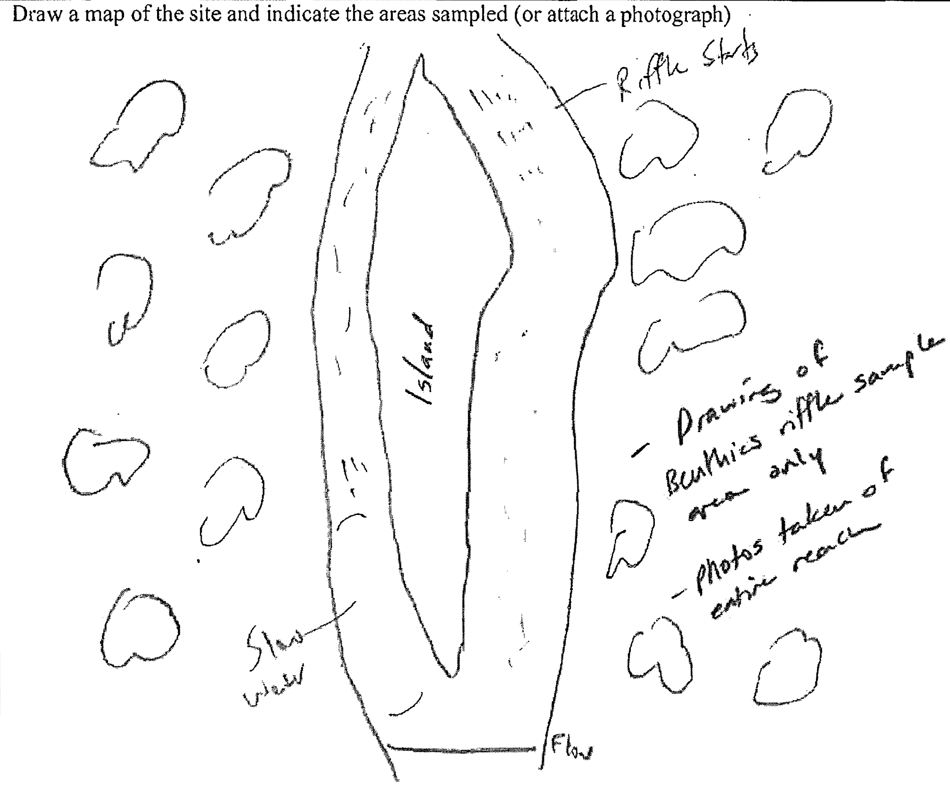
PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-2	
STATION # ______ RIVERMILE ______	STREAM CLASS	
LAT ______ LONG ______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS JMR / JJR		
FORM COMPLETED BY JMR	DATE 03 APR 13 TIME 0915 AM PM (AM circled)	REASON FOR SURVEY

WEATHER CONDITIONS	Now		Past 24 Hours	Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No	
	☐	storm (heavy rain)	☐		
	☐	rain (steady rain)	☐	Air Temperature 40 °C	
	☐	showers (intermittent)	☒		
	100 % ☐	%cloud cover	☐ ____%	Other______	
	☐	clear/sunny	☐		

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other______

Catchment Area ______ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☐ Agricultural ☐ Other ______ ☐ Residential **Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☒ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous **dominant species present** ______
INSTREAM FEATURES	**Estimated Reach Length** ___ m **Estimated Stream Width** 25 m **Sampling Reach Area** ___ m^2 **Area in km^2 (m^2x1000)** ___ km^2 **Estimated Stream Depth** ___ m **Surface Velocity (at thalweg)** ___ m/sec **Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 1.5 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle ___ % 15 ☐ Run ___ % 25 ☐ Pool ___ % 60 **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** 0 m^2 **Density of LWD** ______ m^2/km^2 **(LWD/reach area)**
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae dominant species present ______ Portion of the reach with aquatic vegetation 0 %
WATER QUALITY	**Temperature** ___ °C **Specific Conductance** ______ **Dissolved Oxygen** ______ **pH** ______ **Turbidity** ______ **WQ Instrument Used** ______ see field notes **Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ______ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ______ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ______
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ______ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ______ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock		0	Detritus	Sticks, wood, coarse plant materials (CPOM)	0
Boulder	> 256 mm (10")	>1			
Cobble	64-256 mm (2.5" – 10")	50	Muck-Mud	Black, very fine organic (FPOM)	0
Gravel	2-64 mm (0.1" – 2.5")	50			
Sand	0.06 – 2mm (gritty)		Marl	Grey, shell fragments	0
Silt	0.004-0.06 mm				
Clay	<0.004 mm (slick)				

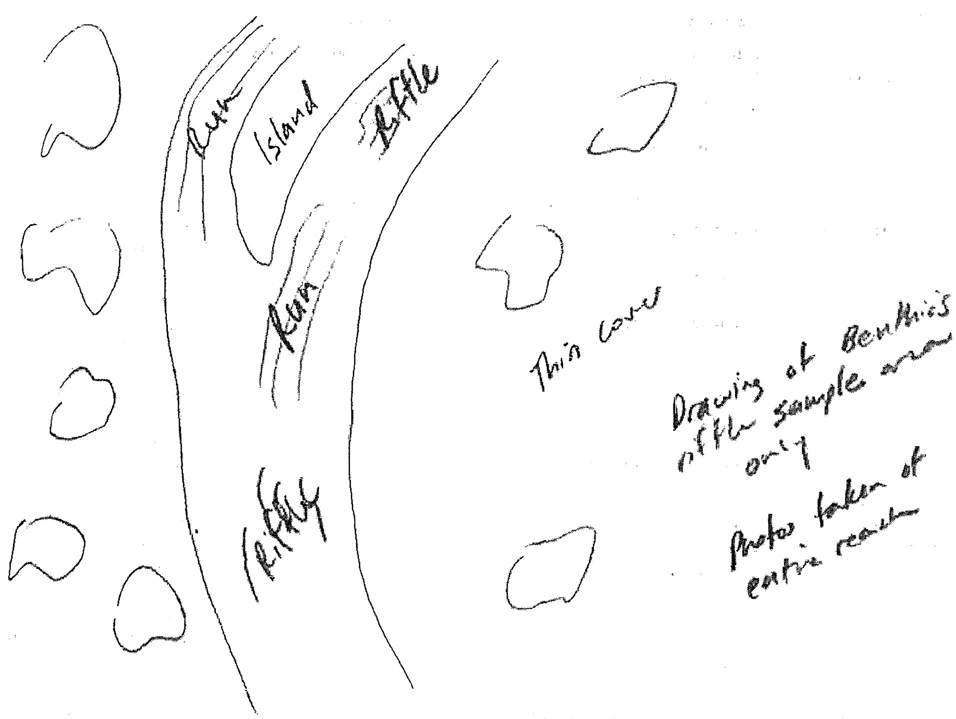
PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME Crooked Creek	LOCATION CC-3	
STATION #_____ RIVERMILE _____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS JMR / JJR		
FORM COMPLETED BY JMK	DATE 03 APR 13 TIME 1240 AM PM	REASON FOR SURVEY UAA

WEATHER CONDITIONS	Now		Past 24 Hours	Has there been a heavy rain in the last 7 days? ☒ Yes ☐ No
	☐	storm (heavy rain)	☐	
	☐	rain (steady rain)	☒	Air Temperature 40 °C
	☐	showers (intermittent)	☒	
	100 % ☐	%cloud cover	☐ _____ %	Other_____
	☐	clear/sunny	☐	

SITE LOCATION/MAP

Draw a map of the site and indicate the areas sampled (or attach a photograph)



STREAM CHARACTERIZATION

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other_____

Catchment Area_____ km^2

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ☒ Forest ☐ Commercial ☒ Field/Pasture ☐ Industrial ☒ Agricultural ☐ Other ____ ☐ Residential **Local Watershed** ☐ No evidence ☒ Some potential sources ☐ Obvious sources **Local Watershed Erosion** ☒ None ☐ Moderate ☐ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous dominant species present ____
INSTREAM FEATURES	**Estimated Reach Length** ____m **Estimated Stream Width** 25 m **Sampling Reach Area** ____m^2 **Area in km^2 (m^2x1000)** ____km^2 **Estimated Stream Depth** ____m **Surface Velocity (at thalweg)** ____m/sec **Canopy Cover** ☒ Partly open ☐ Partly shaded ☐ Shaded **High Water Mark** 1.5 m **Proportion of Reach Represented by Stream Morphology Types** ☐ Riffle 15 % ☐ Run 25 % ☐ Pool 60 % **Channelized** ☐ Yes ☒ No **Dam Present** ☐ Yes ☒ No
LARGE WOODY DEBRIS	**LWD** 0 m^2 **Density of LWD** ____m^2/km^2 **(LWD/reach area)**
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating ☐ Floating Algae ☐ Attached Algae dominant species present ____ Portion of the reach with aquatic vegetation 0 %
WATER QUALITY	**Temperature** ____°C **Specific Conductance** ____ **Dissolved Oxygen** ____ **pH** ____ **Turbidity** ____ **WQ Instrument Used** ____ see field notes **Water Odors** ☒ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other ____ **Water Surface Oils** ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☒ None ☐ Other ____ **Turbidity (if not measured)** ☒ Clear ☐ Slightly turbid ☐ Turbid ☐ Opaque ☐ Stained ☐ Other ____
SEDIMENT/ SUBSTRATE	**Odors** ☒ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other ____ **Oils** ☒ Absent ☐ Slight ☐ Moderate ☐ Profuse **Deposits** ☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand ☐ Relict shells ☐ Other ____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ☐ Yes ☒ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**
Bedrock		0
Boulder	> 256 mm (10")	5
Cobble	64-256 mm (2.5" – 10")	45
Gravel	2-64 mm (0.1" – 2.5")	50
Sand	0.06 – 2mm (gritty)	
Silt	0.004-0.06 mm	
Clay	<0.004 mm (slick)	

ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Characteristic**	**% Composition in Sampling Area**
Detritus	Sticks, wood, coarse plant materials (CPOM)	0
Muck-Mud	Black, very fine organic (FPOM)	0
Marl	Grey, shell fragments	0

FedEx Express **NEW** Package US Airbill

FedEx Tracking Number 8022 1516 4095

Form ID No. 0200

Sender's Copy

From *Please print and press hard.*

Date 4-2-13 Sender's FedEx Account Number 1024-1514-0

Sender's Name Jeremy Rigsby Phone (501) 225-7779

Company FTN Associated, Ltd.

Address 3 Innwood Circle, Suite 220 Dept./Floor/Suite/Room

City Little Rock State AR ZIP 72211

Your Internal Billing Reference
First 24 characters will appear on invoice.

To

Recipient's Name Bruce Huther Phone (940) 387-1025

Company Huther and Associates, Inc.

Address 1156 North Bonnie Brae Dept./Floor/Suite/Room
We cannot deliver to P.O. boxes or P.O. ZIP codes.

☐ HOLD Weekday — FedEx location address REQUIRED. NOT available for FedEx First Overnight.

☐ HOLD Saturday — FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Address
Use this line for the HOLD location address or for continuation of your shipping address.

City Denton State TX ZIP 76201

Easy new Peel-and-Stick airbill. No pouch needed.
Apply airbill directly to your package. See directions on back.

4 Express Package Service * To most locations.
NOTE: Service order has changed. Please select carefully.

Packages up to 150 lbs.
For packages over 150 lbs., use the new FedEx Express Freight US Airbill.

Next Business Day

- ☐ FedEx First Overnight — Earliest next business morning delivery to select locations. Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☒ FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.

2 or 3 Business Days

- ☐ FedEx 2Day A.M. — Second business morning.* Saturday Delivery NOT available.
- ☐ FedEx 2Day — Second business afternoon.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

5 Packaging * Declared value limit $500.

☐ FedEx Envelope* ☐ FedEx Pak* ☐ FedEx Box ☐ FedEx Tube ☒ Other

6 Special Handling and Delivery Signature Options

☐ SATURDAY Delivery — NOT available for FedEx Standard Overnight, FedEx 2Day A.M., or FedEx Express Saver.

☐ No Signature Required — Package may be left without obtaining a signature for delivery.
☐ Direct Signature — Someone at recipient's address may sign for delivery. *Fee applies.*
☒ Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. *Fee applies.*

Does this shipment contain dangerous goods?
One box must be checked.

☒ No ☐ Yes As per attached Shipper's Declaration. ☐ Yes Shipper's Declaration not required. ☐ Dry Ice Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

☐ Cargo Aircraft Only

7 Payment *Bill to:*

Enter FedEx Acct. No. or Credit Card No. below.

☒ Sender Acct. No. in Section 1 will be billed. ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

FedEx Acct. No. Credit Card No. Exp. Date

Total Packages	Total Weight	Total Declared Value†
1	64 lbs	$ 100 .00

†Our liability is limited to US$100 unless you declare a higher value. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

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WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-0 (Upstream Reach)
INVESTIGATOR(S) JMR / JJR	STREAM CLASS
LAT	LONG
DATE 02 APR 13	TIME 1530 AM (PM)
FORM COMPLETED BY JMR / JJR	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		16	51		16
2		64	52		90
3		11	53		128
4		16	54		64
5		90	55		22.6
6		16	56		90
7		90	57		64
8		90	58		16
9		8	59		32
10		16	60		90
11		90	61		5.6
12		128	62		64
13		32	63		90
14		90	64		8
15		128	65		4
16		5.6	66		45
17		64	67		16
18		32	68		32
19		16	69		64
20		180	70		11
21		45	71		64
22		90	72		45
23		11	73		11
24		128	74		5 6
25		128	75		22.6
26		45	76		32
27		32	77		16
28		32	78		128
29		64	79		16
30		45	80		90
31		90	81		90
32		45	82		90
33		180	83		180
34		45	84		90
35		128	85		180
36		128	86		5.6
37		128	87		90
38		32	88		8
39		32	89		280
40		128	90		4
41		8	91		90
42		2	92		128
43		4	93		32
44		45	94		22.6
45		128	95		64
46		32	96		5.6
47		90	97		64
48		64	98		5.6
49		90	99		45
50		11	100		90

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME	Crooked Creek	LOCATION	CC-0 DS Riffle
INVESTIGATOR(S)	JMR / JJR	STREAM CLASS	
LAT		LONG	
DATE	02 APR 13	TIME	1605 AM (PM)
FORM COMPLETED BY	JMR / JJR	REASON FOR SURVEY	UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		8	51		90
2		16	52		90
3		16	53		64
4		16	54		90
5		16	55		90
6		45	56		64
7		64	57		45
8		64	58		64
9		90	59		16
10		90	60		16
11		90	61		290 *
12		90	62		32
13		90	63		64
14		90	64		90
15		90	65		90
16		90	66		90
17		90	67		128
18		90	68		180
19		90	69		128
20		128	70		90
21		128	71		220 *
22		128	72		45
23		180	73		32
24		200 *	74		11
25		400 *	75		190
26		800 *	76		45
27		64	77		90
28		64	78		45
29		32	79		22.6
30		45	80		8
31		64	81		22.6
32		45	82		32
33		16	83		32
34		45	84		45
35		32	85		22.6
36		32	86		45
37		16	87		90
38		16	88		45
39		5.6	89		90
40		64	90		64
41		22.6	91		64
42		90	92		5.6
43		128	93		128
44		128	94		90
45		180	95		90
46		5.6	96		90
47		64	97		45
48		64	98		22.6
49		32	99		45
50		5.6	100		8

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-1 (Upstream)
INVESTIGATOR(S) JMR / JJR	STREAM CLASS
LAT	LONG
DATE 02 APR 13	TIME 1430 AM PM
FORM COMPLETED BY JMR / JJR	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		128	51		11
2		90	52		90
3		11	53		64
4		45	54		5.6
5		128	55		4
6		64	56		90
7		64	57		180
8		90	58		8
9		45	59		8
10		32	60		45
11		16	61		5.6
12		128	62		64
13		128	63		64
14		128	64		90
15		64	65		22.6
16		90	66		11
17		11	67		64
18		45	68		45
19		64	69		22.6
20		128	70		128
21		64	71		32
22		64	72		32
23		90	73		64
24		22.6	74		128
25		45	75		64
26		45	76		128
27		32	77		5.6
28		16	78		32
29		32	79		22.6
30		64	80		32
31		90	81		90
32		90	82		45
33		32	83		64
34		64	84		90
35		32	85		4
36		45	86		22.6
37		90	87		8
38		5.6	88		45
39		32	89		45
40		90	90		128
41		90	91		128
42		2	92		90
43		4	93		128
44		4	94		64
45		11	95		90
46		45	96		11
47		32	97		45
48		90	98		32
49		4	99		32
50		11	100		22.6

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME	Crooked Creek	LOCATION	CC-1 (Downstream Riffle)
INVESTIGATOR(S)	JMR / JJR	STREAM CLASS	
LAT		LONG	
DATE	02 APR 13	TIME	1345 AM (PM)
FORM COMPLETED BY	JMR / JJR	REASON FOR SURVEY	UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		64	51		16
2		45	52		32
3		22.6	53		22.6
4		32	54		64
5		32	55		64
6		16	56		16
7		32	57		45
8		45	58		90
9		16	59		64
10		11	60		32
11		32	61		16
12		64	62		16
13		22.6	63		90
14		32	64		64
15		22.6	65		64
16		64	66		22.6
17		22.6	67		45
18		64	68		11
19		11	69		5.6
20		64	70		32
21		45	71		16
22		32	72		90
23		90	73		32
24		16	74		22.6
25		8	75		5.6
26		32	76		5.6
27		32	77		45
28		45	78		11
29		45	79		32
30		45	80		22.6
31		45	81		11
32		32	82		32
33		45	83		32
34		16	84		45
35		8	85		45
36		32	86		32
37		45	87		11
38		22.6	88		45
39		64	89		32
40		16	90		32
41		32	91		11
42		90	92		11
43		64	93		32
44		22.6	94		64
45		16	95		64
46		11	96		90
47		32	97		45
48		16	98		45
49		16	99		45
50		32	100		64

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME	Crooked Creek	LOCATION	CC-2 (Upstream behind of Riffle)
INVESTIGATOR(S)	JMR / JJR	STREAM CLASS	
LAT		LONG	
DATE	03 APR 13	TIME	0815 AM PM
FORM COMPLETED BY	JMR / JJR	REASON FOR SURVEY	JMR

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		16	51		64
2		22.6	52		16
3		64	53		128
4		32	54		180
5		22.6	55		32
6		64	56		32
7		45	57		32
8		32	58		45
9		64	59		128
10		11	60		90
11		11	61		64
12		22.6	62		90
13		16	63		32
14		128	64		32
15		64	65		32
16		64	66		64
17		64	67		64
18		45	68		45
19		16	69		22.6
20		22.6	70		8
21		11	71		64
22		45	72		32
23		32	73		64
24		45	74		32
25		32	75		16
26		22.6	76		22.6
27		16	77		64
28		22.6	78		22.6
29		32	79		64
30		45	80		45
31		128	81		90
32		64	82		90
33		45	83		64
34		90	84		8
35		32	85		8
36		64	86		45
37		64	87		32
38		90	88		64
39		128	89		45
40		90	90		90
41		128	91		64
42		32	92		45
43		45	93		32
44		90	94		45
45		8	95		45
46		64	96		45
47		45	97		45
48		45	98		64
49		45	99		90
50		22.6	100		16

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-2 (Downstream Portion of Riffle)
INVESTIGATOR(S) JMR / JJR	STREAM CLASS
LAT	LONG
DATE 03 APR 13	TIME 0845 AM PM
FORM COMPLETED BY JMR / JJR	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		32	51		45
2		22.6	52		16
3		22.6	53		45
4		90	54		32
5		45	55		16
6		32	56		11
7		45	57		5.6
8		32	58		64
9		45	59		16
10		22.6	60		22.6
11		8	61		22.6
12		64	62		45
13		64	63		22.6
14		45	64		45
15		45	65		32
16		22.6	66		11
17		45	67		64
18		45	68		22.6
19		90	69		32
20		64	70		64
21		22.6	71		16
22		45	72		45
23		32	73		22.6
24		64	74		45
25		45	75		32
26		64	76		16
27		32	77		16
28		64	78		45
29		45	79		45
30		180	80		32
31		45	81		128
32		90	82		16
33		90	83		45
34		32	84		22.6
35		45	85		22.6
36		64	86		32
37		45	87		90
38		32	88		45
39		16	89		32
40		22.6	90		32
41		32	91		32
42		45	92		90
43		64	93		45
44		11	94		64
45		11	95		22.6
46		16	96		90
47		32	97		90
48		45	98		45
49		22.6	99		45
50		45	100		45

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-3 Upstream Riffle
INVESTIGATOR(S) JMR / JJR	STREAM CLASS
LAT	LONG
DATE 03 APR 13	TIME 1155 AM PM
FORM COMPLETED BY JMR / JJR	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		8	51		90
2		8	52		22.6
3		22.6	53		45
4		32	54		45
5		45	55		32
6		45	56		128
7		45	57		45
8		45	58		64
9		45	59		8
10		45	60		32
11		45	61		32
12		64	62		90
13		90	63		45
14		64	64		128
15		90	65		45
16		64	66		22.6
17		32	67	300	~~300~~
18		128	68		180
19		45	69		32
20		32	70		45
21		45	71		64
22		11	72		16
23		45	73		22.6
24		128	74		11
25		90	75		32
26		22.6	76		22.6
27		32	77		32
28		64	78		32
29		64	79		45
30		45	80		32
31		45	81		45
32		22.6	82		64
33		22.6	83		64
34		45	84		90
35		90	85		90
36		64	86		64
37		64	87		45
38		64	88		64
39		45	89		90
40		90	90		64
41		22.6	91		16
42		64	92		64
43		64	93		5.6
44		45	94		45
45		11	95		22.6
46		90	96		64
47		45	97		45
48		32	98		45
49		8	99		64
50		22.6	100		45

WOLMAN PEBBLE COUNT FIELD DATA SHEET

STREAM NAME Crooked Creek	LOCATION CC-3 (Downstream ~~[illegible]~~ Riffle)
INVESTIGATOR(S) JMR / JJR	STREAM CLASS
LAT	LONG
DATE 03 APR 13	TIME 1220 AM PM
FORM COMPLETED BY JMR / JJR	REASON FOR SURVEY UAA

Pebble ID	Measurement (mm)	Size Class	Pebble ID	Measurement (mm)	Size Class
1		180	51		11
2		128	52		32
3		90	53		45
4		90	54		64
5		90	55		128
6		128	56		32
7		90	57		180
8		64	58		90
9		64	59		45
10		45	60		32
11		64	61		32
12		32	62		22.6
13		32	63		45
14		~~32~~ 45	64		22.6
15		45	65		22.6
16		45	66		16
17		64	67		16
18		90	68		16
19		45	69		45
20		64	70		45
21		32	71		16
22		22.6	72		90
23		22.6	73	350	
24		45	74		45
25		16	75		32
26		16	76		64
27		22.6	77		64
28		45	78		128
29		45	79		90
30		64	80		45
31		22.6	81		45
32		16	82		32
33		45	83		128
34		32	84		64
35		32	85		180
36		22.6	86		90
37		32	87		128
38		32	88		64
39		45	89		90
40		16	90		90
41		32	91		32
42		90	92		64
43		90	93		90
44		90	94		45
45		64	95		32
46		64	96		16
47		45	97		16
48		45	98		45
49		64	99		45
50		45	100		32

APPENDIX E

Benthic Macroinvertebrate Assessment Methodology, Results, and Conclusions

BENTHIC MACROINVERTEBRATE ASSESSMENT METHODOLOGY, RESULTS, & CONCLUSIONS

This appendix provides the detailed evaluation of benthic macroinvertebrate communities upstream versus downstream of the Harrison wastewater treatment plant (HWWTP) and the Yellville WWTP (YWWTP) outfalls. The basic methodology follows the bioassessment III protocols outline in Pflakin et al. (1987), as modified by the Arkansas Department of Environmental Quality (ADEQ) (personal communication with Nathan Wentz, ADEQ, March 30, 2013). This modified methodology is as follows.

1.1 Modified Methodology

A multi-metric RBA score is computed based on the metrics given in Table E.1. The metric values for the reference (e.g., upstream or least-disturbed) are compared to the comparison site as indicated in the footnotes of Table E.1. A biological condition score of 0, 2, 4, or 6 is then assigned based on each comparison. The scores for the comparison site are then summed to give a composite score. The scores for the reference (i.e., upstream or least-disturbed, as appropriate) are given a value of "6" for all metrics except "% Contribution of Dominant Taxa." For this metric, the value in the table is the actual percent contribution, not a comparison to the reference. Therefore, the composite score for the reference is 5 times 6 plus the score for percent dominance[1]. Finally, comparability between the reference and the comparison site is based on the composite score of the comparison site divided by the composite score of the reference site and expressed as a percent. This percentage is then compared to Table E.2 to evaluate impairment status of the comparison site relative to the reference.

Both fall and spring sampling included the collection of a duplicate riffle sample from the location downstream of the HWWTP (CC-1). Differences between the duplicate samples were within the expected range of variability.

[1] For example, if "% Contribution of Dominant Taxa" for the reference was 32%, its score would = 2 and the reference composite score for comparing to the comparison site would be 30 + 2 = 32.

Table E.1. Method for scoring selected metric values relative to a reference site.

Metric	Biological Condition Scoring Criteria 6	4	2	0
Taxa Richness[(a)]	>80%	60%-80%	40%-60%	<40%
Hilsenhoff Biotic Index (HBI)[(b)]	>85%	70%-85%	50%-70%	<50%
Ratio of EPT to Chironomid Abundance[(a)]	>75%	50%-75%	25%-50%	<25%
% Contribution of Dominant Taxa[(c)]	<20%	20%-30%	30%-40%	>40%
EPT Index[(a)]	>90%	80%-90%	70%-80%	<70%
Community Loss Index[(d,e)]	<0.5	0.5-1.5	1.5-4.0	>4.0

Notes:
(a) Row entry is the metric value of the comparison site ÷ the metric value of the reference site X 100.
(b) Row entry is the metric value of the reference site ÷ the metric value of the comparison site X 100.
(c) Row entry is actual percent contribution, not percent comparability to reference site.
(d) Range of values obtained. A comparison to the reference site is incorporated in these indices.
(e) Community loss index = (x-y)/z, where x = # taxa present in reference site, y = # taxa common to both samples, and z = # taxa in comparison site. Value ranges from 0 to infinity.

Table E.2. Impairment categories based on composite scores of the comparison site expressed as a percentage of the reference site.

Impairment Status	% of Reference	Intepretation
No Significant Impairment	≥83%	Comparable to the best situation to be expected. Balanced trophic structure and optimum community structure present.
Slight Impairment	54%-79%	Community structure less than expected. Taxa richness lower than expected. Some intolerant taxa loss. Percent contribution of tolerant forms may increase.
Moderate Impairment	21%-50%	Obvious decline in taxa richness due to the loss of intolerant forms. Reduction in the EPT index.
Severe Impairment	<20%	Few taxa present and normally dominated by one or two taxa.

1.2 Analysis of Crooked Creek Data

The analysis of the Crooked Creek macroinvertebrate data involved two types of comparisons. The first type of comparison used the upstream sites as a reference (CC-0 versus CC-1 for the HWWTP reach and CC-2 versus CC-3 for the YWWTP reach). The second type involved comparisons of the Crooked Creek stations with least-disturbed waterbodies. Because sulfate and chloride are only minor components of TDS in the Crooked Creek reaches upstream and downstream of the discharges (see Section 4.3 of the UAA report), TDS was the primary focus of the evaluation of the designated use attainment.

1.2.1 Upstream vs. Downstream Comparisons: Macrobenthos, Fall 2012

No biological sampling was conducted at CC-2 or CC-3 during the fall 2012 sampling due to absence of flow in that reach. Metric values for the HWWTP reach comparisons are provided in Table E.3. Separate comparisons were performed for CC-0 versus CC-1 and CC-0 versus CC-1 duplicate. Comparisons for each metric and the overall comparisons are provided in Table E.4. The downstream station samples for CC-1 and CC-1 duplicate were 68.8% and 93.8% comparable, respectively, to the upstream station (CC-0). These results indicate a "slight impairment" to "no significant impairment" at the downstream station due to the presence of the HWWTP discharge.

Table E.3. Summary of macroinvertebrate metrics for the fall 2012 sampling.

Location		Metric				
		Total Taxa	HBI	Ratio of EPT to Chironomidae	Percent Contribution of Dominant Taxa	EPT Index
HWWTP	CC-0*	15	3.78	19	35%	5
	CC-1**	11	3.44	74	68%	3
	CC-1 duplicate**	13	3.57	83	64%	6

* Upstream stations
**Downstream stations

1.2.1 Upstream vs. Downstream Comparisons: Macrobenthos, Spring 2013

Samples were collected at all four stations as well as at the duplicate sampling station for CC-1 during the spring 2013 sampling. Metric values for the comparisons are provided in Table E.5. As with the fall data, separate comparisons were performed for the CC-0 versus CC-1 and CC-0 versus CC-1 duplicate. Comparisons for each metric and the overall comparisons are provided in Tables E.6 and E.7 for the HWWTP and YWWTP, respectively.

Table E.4. Upstream (CC-0) versus downstream (CC-1, CC-1 duplicate) comparison of macroinvertebrate metrics for the HWWTP reach during fall 2012 sampling.

Metric Comparison	Sites	Comparison with Reference	Score
Taxa Richness	CC-0 versus CC-1	73%	4
	CC-0 versus CC-1 duplicate	87%	6
HBI	CC-0 versus CC-1	110%	6
	CC-0 versus CC-1 duplicate	106%	6
EPT/Chironomidae	CC-0 versus CC-1	389%	6
	CC-0 versus CC-1 duplicate	437%	6
% Dominant	CC-0	35%	2
	CC-1	68%	0
	CC-1 duplicate	64%	0
EPT Index	CC-0 versus CC-1	60%	0
	CC-0 versus CC-1 duplicate	120%	6
Community Loss	CC-0 versus CC-1	0.45	6
	CC-0 versus CC-1 duplicate	0.23	6
Overall Sum of Scores		**Percent of Reference (upstream)**	**Interpretation**
CC-0	32	NA	NA
CC-1	22	68.8%	Slight impairment
CC-1 duplicate	30	93.8%	No significant impairment

Table E.5. Summary of macroinvertebrate metrics for the spring 2013 sampling.

Location		Metric				
		Total Taxa	HBI	Ratio of EPT to Chironomidae	Percent Contribution of Dominant Taxa	EPT Index
HWWTP	CC-0*	17	3.91	4.0	36%	6
	CC-1**	15	4.69	1.5	36%	5
	CC-1 duplicate **	14	4.50	2.6	35%	5
YWWTP	CC-2*	17	3.94	16	43%	9
	CC-3**	6	4.72	1.8	34%	4

* Upstream stations
**Downstream stations

Table E.6. Upstream (CC-0) versus downstream (CC-1, CC-1 duplicate) comparison of macroinvertebrate metrics for the HWWTP reach, spring 2013.

Metric Comparison	Sites	Comparison with Reference	Score
Taxa Richness	CC-0 versus CC-1	88%	6
	CC-0 versus CC-1 duplicate	82%	6
HBI	CC-0 versus CC-1	83%	4
	CC-0 versus CC-1 duplicate	87%	6
EPT/Chironomidae	CC-0 versus CC-1	37%	2
	CC-0 versus CC-1 duplicate	65%	4
% Dominant	CC-0	36%	2
	CC-1	36%	2
	CC-1 duplicate	35%	2
EPT Index	CC-0 versus CC-1	83%	4
	CC-0 versus CC-1 duplicate	83%	4
Community Loss	CC-0 versus CC-1	0.27	6
	CC-0 versus CC-1 duplicate	0.43	6
Overall Sum of Scores		**Percent of Reference (upstream)**	**Interpretation**
CC-0	32	NA	NA
CC-1	24	75.0%	Slight impairment
CC-1 duplicate	28	87.5%	No significant impairment

Table E.7. Upstream (CC-2) versus downstream (CC-3) comparison of macroinvertebrate metrics for the YWWTP reach, spring 2013.

Metric Comparison	Sites	Comparison with Reference	Score
Taxa Richness	CC-2 versus CC-3	35%	0
HBI	CC-2 versus CC-3	84%	4
EPT/Chironomidae	CC-2 versus CC-3	11%	0
% Dominant	CC-2	43%	0
	CC-3	34%	2
EPT Index	CC-2 versus CC-3	44%	0
Community Loss	CC-2 versus CC-3	1.3	4
Overall Sum of Scores		**Percent of Reference (upstream)**	**Interpretation**
CC-2	30	NA	NA
CC-3	10	33.3%	Moderate impairment

For the HWWTP reach, downstream station samples, CC-1 and CC-1 duplicate were 75.0% and 87.5% comparable, respectively, to the upstream station (Table E.6). These results indicate a "slight impairment" to "no significant impairment" at the downstream station due to the presence of the HWWTP discharge.

For the YWWTP reach, the downstream station sample (CC-3) was 33.3% comparable to the upstream station (Table E.7). This result indicates a "moderate impairment" at the downstream station due to the presence of the YWWTP discharge.

For ease of comparison, the results presented in Tables E.5 through E.7 are summarized in Table E.8.

Table E.8. Summary of upstream versus downstream comparisons of benthic macroinvertebrate communities in Crooked Creek.

Season	Downstream Station	Percent Similarity with Reference (Upstream)	Interpretation
Fall	CC-1 (HWWTP)	68.8%	Slight impairment
	CC-1 duplicate (HWWTP)	93.8%	No significant impairment
Spring	CC-1 (HWWTP)	75.0%	Slight impairment
	CC-1 duplicate (HWWTP)	87.5%	No significant impairment
	CC-3 (YWWTP)	33.3%	Moderate impairment

1.2.2 Upstream vs. Downstream: TDS Concentrations

Total dissolved solids (TDS) concentrations upstream and downstream of the HWWTP and YWWTP are plotted on Figure E.1 and summarized in Tables E.9 and E.10, respectively.

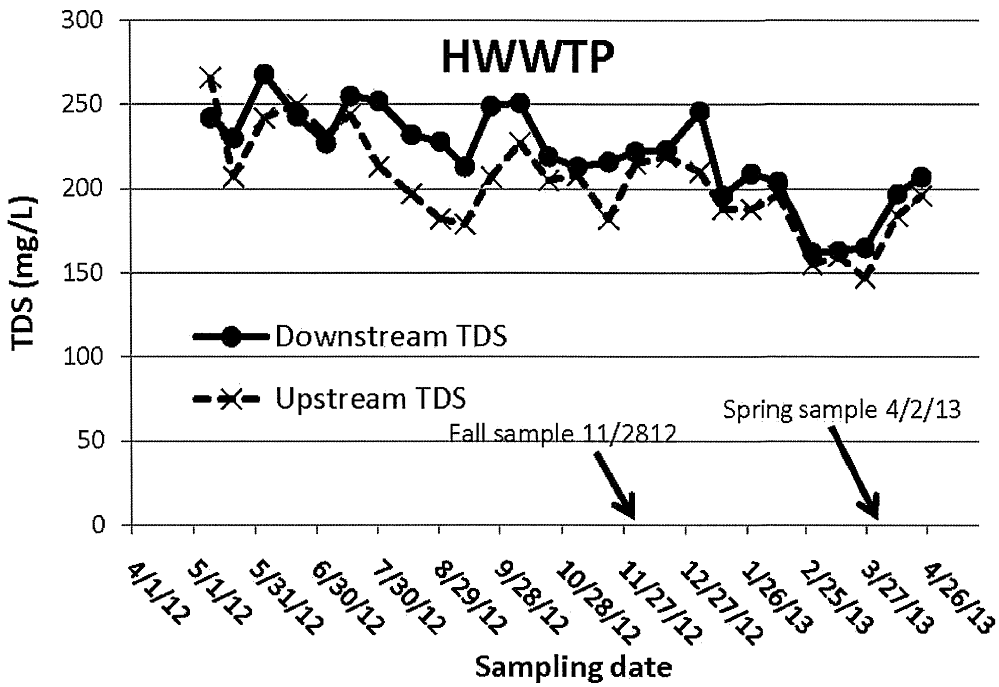
Table E.9. Summary of TDS concentrations from biweekly sampling of Crooked Creek upstream (US-65 bridge) and downstream (Silver Valley Road bridge) of the HWWTP (May 10, 2012, through April 23, 2013).

Summary Statistic		Upstream (mg/L)	Downstream (mg/L)	Downstream Change Concentration (mg/L)	Downstream Change Percent
Percentile	25th	185	208	7	3%
	50th	206	223	14	7%
	75th	218	243	32	16%
	95th	249	254	41	20%
Minimum		147	162	-24	-9%
Mean		204	220	17	9%
Maximum		266	268	46	25%

Table E.10. Summary of TDS concentrations from biweekly sampling of Crooked Creek upstream (AR-14 bridge) and downstream (Oxford property) of the YWWTP (September 24, 2012, through April 8, 2013).

Summary Statistic		Upstream[(a)] (mg/L)	Downstream[(b)] (mg/L)	Downstream Increase Concentration (mg/L)	Downstream Increase Percent
Percentile	25th	179	182	5	3%
	50th	194	204	7	4%
	75th	207	213	12	6%
	95th	210	221	16	10%
Minimum		157	174	-2	-1%
Mean		194	199	8	4%
Maximum		210	223	17	11%

Notes:
(a) Consistent flows were not observed in this reach of Crooked Creek until January 2, 2013.
(b) Consistent flows were not observed in this reach of Crooked Creek until February 11, 2013.



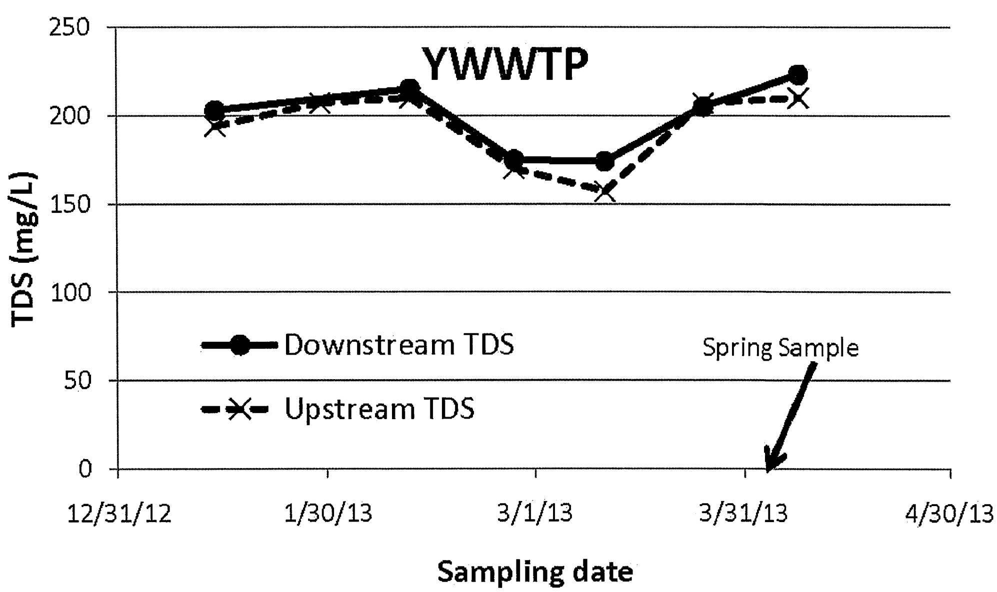


Figure E.1. Time-series plots of TDS in Crooked Creek upstream and downstream of HWWTP and YWWTP outfalls.

Visual examination of the TDS summaries and plots indicates that the outfalls have a minor influence on downstream TDS concentrations at both locations. TDS concentrations increased by an average of 9% and 4% in Crooked Creek below the HWWTP and YWWTP outfalls, respectively (Tables E.9 and E.10.) This corresponded to a minimal change in the macroinvertebrate community downstream as represented by duplicate samples (no significant impairment to slight impairment; Table E.8). Upstream to downstream differences in both reaches are typically less than monthly or biweekly differences (Figure E.1). It is not clear whether a cause and effect relationship would be expected to exist between small changes such as these. The YWWTP reaches showed the largest upstream to downstream assemblage differences (Table E.8) but showed the smallest upstream to downstream mineral differences in both absolute and relative terms, where the average TDS concentration increased by 8 mg/L downstream of the YWWTP outfall (Table E.10). This result shows that the magnitude of the minerals increase downstream of the discharge is not commensurate with the downstream change in the benthic macroinvertebrate communities. If the macroinvertebrate assemblages are responding to the modest upstream to downstream increases in mineral concentrations (i.e., a less than 10% difference in upstream versus downstream 95th percentile TDS values), then the greatest upstream to downstream mineral differences (observed at the HWWTP) should cause the greatest upstream to downstream assemblage differences. The opposite was observed. Accordingly, there must be other underlying mechanisms affecting assemblage structure. These underlying factors do not appear to be related to physical habitat or substrate because those factors do not vary appreciably between upstream and downstream locations.

1.3 Comparisons with Least-Disturbed Waterbodies

TDS concentrations at both the upstream and downstream sites in both reaches exceed the Crooked Creek TDS criterion of 200 mg/L. Therefore, upstream versus downstream comparisons of macrobenthos communities do not address potential effects on aquatic life due to the fact that TDS concentrations also exceed criteria upstream of the outfall. Evaluation of potential effects due to TDS concentrations that exceed criteria must be based on comparisons with reference locations that do not exceed TDS criteria. Therefore, the second type of comparison evaluated macroinvertebrate and water quality data of the Crooked Creek locations versus available data from ADEQ's routine biological monitoring of least-disturbed waterbodies. An advantage of this type of comparison is that it can account for variability among sites with information from several reference sites and comparison sites. A disadvantage of this approach is that the comparison is somewhat biased, because Crooked Creek is not a least-disturbed system in the reaches upstream and downstream of the HWWTP and YWWTP discharges. Therefore, a certain level of impairment due to factors other than minerals (e.g., urbanization and other land uses) should be expected in those reaches.

Based on conversations with ADEQ staff, this approach used biological and water quality collections from Yocum Creek (YC) and Long Creek (LC) at two locations on each stream (YC-1, YC-2, LC-1 and LC-2). Basic information on these sites is provided in Table E.11. Both spring and fall macrobenthos collections were available from one or two sites on both reference streams. Field sampling methods used for the ADEQ routine biological monitoring (timed single-habitat collections from riffles) as well as sample sorting and taxonomic identification protocols were comparable to those used for this study.

The approach to incorporating multiple reference and comparison sites was to compute the overall percent similarity as described in Section 1.1 for each pair-wise combination of reference and Crooked Creek site within each reach the pair-wise combinations for each season are provided in Table E.12. The metric values for the least-disturbed reference streams (Table E.13) were used along with data provided in Tables E.3 and E.4 to compute percent similarity values for all pair-wise combinations of reference versus Crooked Creek sites for each metric (Tables E.14 and E.15).

Table E.11. Basic information for least-disturbed reference sites used in the analysis of benthic macroinvertebrate communities.

Stream Name	Drainage Area (mi^2)	Latitude	Longitude	Sample Date	ADEQ Sample Reference Number
Yocum Creek 1	55	36.41444	-93.3829	06/07/2001	ADEQ4k-50
				11/01/2000	ADEQ4k-3
Yocum Creek 2	55	36.41439	-93.3862	*N/A*	*N/A*
				11/01/2000	ADEQ4k-4
Long Creek 1	190	36.38808	-93.3116	06/07/2001	ADEQ4k-48
				10/31/2000	ADEQ4k-1
Long Creek 2	190	36.38793	-93.3116	06/07/2001	ADEQ4k-49
				10/31/2000	ADEQ4k-2

Table E.12. Matrix of possible pair-wise comparisons of least-disturbed reference sites versus Crooked Creek sites for fall and spring macrobenthos samples.

	YC-1	YC-2	LC-1	LC-2
CC-0	Fall and spring	Fall only	Fall and spring	Fall and spring
CC-1	Fall and spring	Fall only	Fall and spring	Fall and spring
CC-1 duplicate	Fall and spring	Fall only	Fall and spring	Fall and spring
CC-2	Spring only	No comparison	Spring only	Spring only
CC-3	Spring only	No comparison	Spring only	Spring only

NC = no comparison

Table E.13. Metric values for least-disturbed reference streams.

Season	Location	Metric				
		Total Taxa	HBI	Ratio of EPT to Chironomidae	Percent Contribution of Dominant Taxa	EPT Index
Fall	YC-1	16	3.71	379	20.1%	9
	YC-2	14	3.31	79	50.0%	8
	LC-1	27	3.87	87	45.6%	11
	LC-2	20	3.32	65	46.7%	8
Spring	YC-1	26	4.55	21	21.7%	13
	LC-1	25	4.51	19	13.7%	11
	LC-2	22	4.58	15	15.8%	11

Table E.14. Comparison matrices of percent similarity/IBI scores for each metric for all pair-wise combinations of least-disturbed reference streams with Crooked Creek sites sampled during fall 2012.

Metric Comparison	Crooked Creek (Comparison) Site	Least-Disturbed Reference Site (percent similarity / IBI score)			
		YC-1	YC-2	LC-1	LC-2
Taxa Richness	CC-0	94% / 6	107% / 6	56% / 2	75% / 4
	CC-1	69% / 4	79% / 4	41% / 2	55% / 2
	CC-1 duplicate	81% / 6	93% / 6	48% / 2	65% / 4
HBI	CC-0	98% / 6	88% / 6	102% / 6	88% / 6
	CC-1	108% / 6	96% / 6	112% / 6	97% / 6
	CC-1 duplicate	104% / 6	93% / 6	108% / 6	93% / 6
EPT/ Chironomidae	CC-0	5% / 0	24% / 0	22% / 0	29% / 2
	CC-1	20% / 0	94% / 6	86% / 6	114% / 6
	CC-1 duplicate	22% / 0	106% / 6	96% / 6	129% / 6
% Contribution of Dominant Taxa	CC-0	35% / 2			
	CC-1	68% / 0			
	CC-1 duplicate	64% / 0			
	YC-1	20% / 4			
	YC-2	50% / 0			
	LC-1	46% / 0			
	LC-2	47% / 0			
EPT Index	CC-0	56% / 0	63% / 0	45% / 0	63% / 0
	CC-1	33% / 0	38% / 0	27% / 0	38% / 0
	CC-1 duplicate	67% / 0	75% / 2	55% / 0	75% / 2
Community Loss Index	CC-0	0.53 / 4	0.33 / 6	1.20 / 4	0.67 / 4
	CC-1	0.91 / 4	0.73 / 4	1.73 / 2	1.09 / 4
	CC-1 duplicate	0.62 / 4	0.46 / 6	1.38 / 4	0.77 / 4

Table E.15. Comparison matrices of percent similarity/IBI scores for each metric for all pair-wise combinations of least-disturbed reference streams versus Crooked Creek sites sampled during spring 2013.

Metric Comparison	Crooked Creek (Comparison) Site	Least-Disturbed Reference Site (percent similarity/IBI score)		
		YC-1	LC-1	LC-2
Taxa Richness	CC-0	65% / 4	68% / 4	77% / 4
	CC-1	58% / 2	60% / 4	68% / 4
	CC-1 duplicate	54% / 2	56% / 2	64% / 4
	CC-2	65% / 4	68% / 4	77% / 4
	CC-3	23% / 0	24% / 0	27% / 0
HBI	CC-0	116% / 6	115% / 6	117% / 6
	CC-1	97% / 6	96% / 6	98% / 6
	CC-1 duplicate	101% / 6	100% / 6	102% / 6
	CC-2	115% / 6	114% / 6	116% / 6
	CC-3	96% / 6	96% / 6	97% / 6
EPT/Chironomidae	CC-0	19% / 0	21% / 0	27% / 2
	CC-1	7% / 0	8% / 0	10% / 0
	CC-1 duplicate	12% / 0	14% / 0	17% / 0
	CC-2	78% / 6	87% / 6	108% / 6
	CC-3	8% / 0	9% / 0	12% / 0
% Contribution of Dominant Taxa	CC-0	36% / 2		
	CC-1	36% / 2		
	CC-1 duplicate	35% / 2		
	CC-2	43% / 0		
	CC-3	34% / 2		
	YC-1	22% / 4		
	LC-1	14% / 6		
	LC-2	16% / 6		
EPT Index	CC-0	46% / 0	55% / 0	55% / 0
	CC-1	38% / 0	45% / 0	45% / 0
	CC-1 duplicate	38% / 0	45% / 0	45% / 0
	CC-2	69% / 0	82% / 4	82% / 4
	CC-3	31% / 0	36% / 0	36% / 0
Community Loss Index	CC-0	0.88 / 4	0.71 / 4	0.59 / 4
	CC-1	1.07 / 4	0.80 / 4	0.73 / 4
	CC-1 duplicate	1.07 / 4	0.86 / 4	0.79 / 4
	CC-2	1.00 / 4	0.94 / 4	0.82 / 4
	CC-3	3.17 / 2	3.00 / 2	2.50 / 2

Overall similarity values for each pair-wise comparison are provided in Table E.16 and summarized in Table E.17. The summary presented in Table E.17 indicates that depending on the season and the particular sites that are compared, sites upstream or downstream of the HWWTP or YWWTP were slightly to moderately impaired relative to least-disturbed reference sites. A summary of TDS, chloride and sulfate concentrations from ten sampling events on Yocum Creek and Long Creek during the same general time period as the biological sampling (2001 through 2004 for the water quality sampling versus 2000 and 2001 for the biological sampling) and during multiple seasons shows an average TDS concentration of 228 mg/L, with all measurements in excess of the Crooked Creek TDS criterion of 200 mg/L (Table E.18). This result demonstrates that TDS concentrations that exceed 200 mg/L will support a least-disturbed benthic macroinvertebrate community.

Table E.16. Comparison matrix of overall percent similarity between least-disturbed reference and Crooked Creek sites.

Season	Crooked Creek (Comparison) Site	Least-Disturbed Reference Site			
		YC-1	YC-2	LC-1	LC-2
Fall	CC-0	52.9%	66.7%	46.7%	60.0%
	CC-1	41.2%	66.7%	53.3%	60.0%
	CC-1 duplicate	47.1%	86.7%	60.0%	73.3%
Spring	CC-0	47.1%	No data	44.4%	50.0%
	CC-1	41.2%	No data	44.4%	44.4%
	CC-1 duplicate	41.2%	No data	38.9%	44.4%
	CC-2	58.8%	No data	66.7%	66.7%
	CC-3	29.4%	No data	27.8%	27.8%

Table E.17. Summary of overall percent similarity between least-disturbed reference and Crooked Creek sites.

Season	Summary Statistic	Percent Similarity	Interpretation
Fall	Minimum	41.2%	Moderate Impairment
	Mean	59.5%	Slight Impairment
	Maximum	86.7%	No Significant Impairment
Spring	Minimum	27.8%	Moderate Impairment
	Mean	44.9%	Moderate Impairment
	Maximum	66.7%	Slight Impairment

Table E.18. Summary of mineral concentrations from ADEQ sampling of Long Creek and Yocum Creek least-disturbed streams.

Location	Sampling Date	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)
Long Creek (ADEQ WHI0071)	10/10/2000	238	7.8	15.6
	11/07/2000	226	7.9	14.5
	09/12/2000	227	6.9	14.0
	05/29/2001	229	9.7	17.0
	06/26/2001	226	9.2	17.0
Yocum Creek (ADEQ WHI0137)	10/27/2003	235	5.9	12.2
	01/12/2004	236	7.5	12.6
	03/22/2004	233	6.9	12.8
	05/17/2004	207	5.7	9.9
Minimum		207	5.7	9.9
Mean		228	7.5	14.0
Maximum		238	9.7	17.0

1.4 Findings and Conclusions

The benthic macroinvertebrate communities downstream of the HWWTP and YWWTP showed discernible effects relative to the upstream locations, ranging from moderate impairment to no significant impairment depending on the season and location. Biweekly monitoring of TDS revealed only minor increases (9% and 4% downstream of HWWTP and YWWTP, respectively) in TDS in Crooked Creek due to the wastewater discharges. These comparisons suggest that downstream TDS increases are not of sufficient magnitude and timing to be considered as a likely cause of downstream changes in the macrobenthos community.

The benthic macroinvertebrate communities in Crooked Creek showed discernible differences relative to the least-disturbed streams, ranging from moderate to no significant impairment depending on season and location. TDS concentrations in the least-disturbed reference streams averaged 228 mg/L, with all measurements in excess of the Crooked Creek TDS criterion of 200 mg/L. This result demonstrates that TDS concentrations that exceed 200 mg/L will support a least-disturbed benthic macroinvertebrate community.

This analysis shows that variability in benthic macroinvertebrate communities of Crooked Creek is not attributable to variability in TDS concentrations and that current TDS concentrations in Crooked Creek upstream and downstream of HWWTP and YWWTP will support Ozark Highland ecoregion least-disturbed aquatic life.

1.5 Literature Cited

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. *Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish* [EPA 440-4-89-001]. Washington, DC: US Environmental Protection Agency, Office of Water Regulations and Standards.

APPENDIX F

Benthic Macroinvertebrate Taxa and Abundance for Crooked Creek Stations and Least-Disturbed Streams

Table F.1. Benthic macroinvertebrate counts from fall 2012 sampling.

Class	Order	Family	Genus	TV	FFG	CC-0	CC-1	CC-1 Dup	YC-2	YC-1	LC-1	LC-2
Hirudinea				3	PA				1			
Bivalvia				8	FC	2	2	3				
Bivalvia	Corbicula			6	FC							
Crustacea	Decapoda	Cambaridae		6	GC	3	1	2	3	4	1	1
Gastropoda	Architaenioglossa	Viviparidae		4	SC					3	1	
Gastropoda	Basommatophora	Ancylidae	Ferrissia	6.9	SC						1	
Gastropoda	Basommatophora	Planorbidae		7	SC							
Gastropoda	Neotanenioglossa	Pleuroceridae		7	SC						1	1
Insecta	Coleoptera	Elmidae	Dubiraphia	6.4	SC	1						
Insecta	Coleoptera	Elmidae	Macronychus	4.7	GC	5	4	2				
Insecta	Coleoptera	Elmidae	Optioservus	2.7	SC	126	65	106	11	41	3	7
Insecta	Coleoptera	Elmidae	Stenelmis	5.4	SC	1	4	12			4	1
Insecta	Coleoptera	Gyrinidae	Dineutus	5.5	PR							
Insecta	Coleoptera	Gyrinidae	Gyretes	5	PR							
Insecta	Coleoptera	Lutrochus	Lutrochus	2.9								
Insecta	Coleoptera	Psephenidae	Ectopria	4	SC						1	
Insecta	Coleoptera	Psephenidae	Psephenus	2	SC	6		1	3	4	3	2
Insecta	Diptera	Chironomidae		6	GC	18	3	6			1	6
Insecta	Diptera	Empididae	Hemerodromia	6	PR							
Insecta	Diptera	Simulidae	Simulium	4.4	FC							
Insecta	Diptera	Tabanidae	Silvius	8	PR							
Insecta	Diptera	Tipulidae	Hexatoma	4.7	PR							
Insecta	Diptera	Tipulidae	Tipula	7.7	SH						2	
Insecta	Ephemeroptera	Ameletidae	Ameletus	2.1	GC				3		2	2
Insecta	Ephemeroptera	Baetidae	Baetis	3.1	GC			1		94	1	9
Insecta	Ephemeroptera	Caenidae	Caenis	7.6	GC	5		3	1			
Insecta	Ephemeroptera	Ephemerida	Ephemera	2.2	GC						1	2
Insecta	Ephemeroptera	Heptageniidae	Leurocuta	1	SC				4			
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	4	SC							
Insecta	Ephemeroptera	Heptageniidae		4	SC	3*		30*				
Insecta	Ephemeroptera	Heptageniidae	Stenacron	3.1	SC				1	1	4	
Insecta	Ephemeroptera	Heptageniidae	Stenonema	3.3	SC	186	256	455	51	92	93	226
Insecta	Ephemeroptera	Isonychiidae	Isonychia	2	SC	70	18	32	14	76	29	147
Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes	4	GC							
Insecta	Ephemeroptera	Leptohyphiidae	Leptophlebia	6.4	GC							
Insecta	Ephemeroptera	Leptohyphiidae	Tricorythodes	5.4	GC						33	53
Insecta	Ephemeroptera	Leptohyphiidae	Paraleptophlebia	1.2	GC					1		
Insecta	Ephemeroptera	Polymitarcyidae	Ephoron	2	GC							
Insecta	Hemiptera	Veliidae	Microvelia	6	PR							
Insecta	Hemiptera	Veliidae	Rhagavelia	6	PR							
Insecta	Lepidoptera	Pyralidae	Petrophila	2.5	SC							
Insecta	Lepidoptera	Schoenobiinae	Cambrinae	6	SH	2						
Insecta	Megaloptera	Corydalidae	Corydalus	5.6	PR	4	1		2	5	2	6

*Not included in taxa count.

Table F.1. Benthic macroinvertebrate counts from fall 2012 sampling.

Class	Order	Family	Genus	TV	FFG	CC-0	CC-1	CC-1 Dup	YC-2	YC-1	LC-1	LC-2
Insecta	Odonata	Coenagrionidae	Argia	5.1	PR		2					
Insecta	Odonata	Coenagrionidae	Enallagma	9	PR						2	3
Insecta	Odonata	Gomphidae	Dromogomphus	6.3	PR							
Insecta	Odonata	Gomphidae	Gomphus	4.9	PR							
Insecta	Odonata	Gomphidae	Ophiogomphus	6.2	PR						1	
Insecta	Plecoptera	Taeniopterygidae	Strophopteryx	2.5	SH						2	3
Insecta	Plecoptera	Taeniopterygidae	Taniopteryx	6.3	SH							2
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	6.6	FC	95	23	61	4	60	3	9
Insecta	Trichoptera	Hydropsychidae	Heliopsyche	3	SC					4	1	
Insecta	Trichoptera	Hydropsychidae	Hydropchyche	4	FC					6	3	
Insecta	Trichoptera	Limnephilidae	Manophylax								1	
Insecta	Trichoptera	Philopotamoidae	Chimarra	2.8	FC	4		2	1	45		1
Malacostraca	Amphipoda	Gammaridae	Gammarus	6.9	GC					1		
Malacostraca	Isopoda	Asellidae	Lirceus	7.7	SH				3	31	7	2
Oligochaeta				10	GC						1	1

Note: All of the individuals in FTN's 2012 and 2013 Crooked Creek collection identified the taxa marked in red as Maccaffertium. In the latest edition of Merrit, Cummins and Berg, the genus Stenonema was split into Stenonema and Maccaffertium. This edition postdates the collection of the ADEQ samples. Therefore the ADEQ samples probably contained what would now be identified as Maccaffertium. Accordingly, for purposes of comparability we have classified the Maccaffertium individuals in the FTN collection as Stenonema.

*Not included in taxa count.

Table F.2. Benthic macroinvertebrate counts from spring 2013 sampling.

Class	Order	Family	Genus	TV	FFG	CC-0	CC-1	CC-1 Dup	CC-2	CC-3	YC-1	LC-1	LC-2
Hirudinea				3	PA								
Bivalvia				8	FC	9	7	16	1				
Bivalvia			Corbicula	6	FC								
Crustacea	Decapoda	Cambaridae		6	GC			1			1	1	1
Gastropoda	Architaenioglossa	Viviparidae		4	SC							1	2
Gastropoda	Basommatophora	Ancylidae	Ferrissia	6.9	SC							1	
Gastropoda	Basommatophora	Physidae		8	SC				3		1		
Gastropoda	Basommatophora	Planorbidae		7	SC								1
Gastropoda	Neotanenioglossa	Pleuroceridae		7	SC				1				
Insecta	Coleoptera	Dryopidae	Helichus	5.4									
Insecta	Coleoptera	Elmidae	Dubiraphia	6	SC								
Insecta	Coleoptera	Elmidae	Macronychus	4.7	GC		1	6					
Insecta	Coleoptera	Elmidae	Optioservus	2.7	SC	49	24	38			30	1	1
Insecta	Coleoptera	Elmidae	Stenelmis	5.4	SC	16	91	91			2	6	24
Insecta	Coleoptera	Gyrinidae	Dineutus	5.5	PR								
Insecta	Coleoptera	Gyrinidae	Gyretes	5	PR						1	2	1
Insecta	Coleoptera	Hydrophilinae	Berosus	8.6									
Insecta	Coleoptera	Lutrochus	Lutrochus	2.9									
Insecta	Coleoptera	Psephenidae	Ectopria	4	SC								
Insecta	Coleoptera	Psephenidae	Psephenus	2	SC	14	2				8	4	4
Insecta	Diptera			7		2*	10*	6*	6*	13*		1*	
Insecta	Diptera	Athericidae	Atherix	2	PR	2			1	3			
Insecta	Diptera	Chironomidae		6	GC	59	137	66	14	117	7	5	11
Insecta	Diptera	Empididae	Hemerodromia	6	PR						1		1
Insecta	Diptera	Simulidae	Simulium	4.4	FC	3	2		52			1	2
Insecta	Diptera	Tabanidae	Silvius	8	PR								
Insecta	Diptera	Tipulidae	Hexatoma	4.7	PR								
Insecta	Diptera	Tipulidae	Tipula	7.7									
Insecta	Ephemeroptera	Ameletidae	Ameletus	2.1	GC						3		
Insecta	Ephemeroptera	Baetidae	Baetis	3.1	GC				134	106	26	5	9
Insecta	Ephemeroptera	Baetidae	Procloeon	4	GC						2		
Insecta	Ephemeroptera	Caenidae	Caenis	7.6	GC	24	11	4			14	4	18
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella	2.9	GC				2	6			
Insecta	Ephemeroptera	Heptageniidae	Heptagenia	2.8									
Insecta	Ephemeroptera	Heptageniidae	Leurocuta	1	SC							1	
Insecta	Ephemeroptera	Heptageniidae	Maccaffertium	4	SC								
Insecta	Ephemeroptera	Heptageniidae	Stenacron	3.1	SC						3	1	
Insecta	Ephemeroptera	Heptageniidae	Stenonema	3.3	SC	143	174	143	20	4	16	16	26
Insecta	Ephemeroptera	Isonychiidae	Isonychia	2	SC	44	6	7	1		6	12	31
Insecta	Ephemeroptera	Leptophlebiidae	Choroterpes	4	GC								1
Insecta	Ephemeroptera	Leptohyphiidae	Leptophlebia	6.4	GC								
Insecta	Ephemeroptera	Leptohyphiidae	Tricorythodes	5.4	GC						8	16	34
Insecta	Ephemeroptera	Polymitarcyidae	Ephoron	2	GC								2
Insecta	Hemiptera	Veliidae	Microvelia	6	PR						3		
Insecta	Hemiptera	Veliidae	Rhagavelia	6	PR							1	

*Not included in taxa count.

Table F.2. Benthic macroinvertebrate counts from spring 2013 sampling.

Class	Order	Family	Genus	TV	FFG	CC-0	CC-1	CC-1 Dup	CC-2	CC-3	YC-1	LC-1	LC-2
Insecta	Lepidoptera	Crambidae		6	SH		1	1	1				
Insecta	Lepidoptera	Pyralidae	Petrophila	2.5	SC								
Insecta	Lepidoptera	Schoenobiinae	Cambrinae	6	SH	2							
Insecta	Megaloptera	Corydalidae	Corydalus	5.6	PR	2					2	2	1
Insecta	Odonata	Coenagrionidae	Argia	5.1	PR	1	1	1				1	
Insecta	Odonata	Coenagrionidae	Enallagma	9									
Insecta	Odonata	Gomphidae	Dromogomphus	6.3	PR								
Insecta	Odonata	Gomphidae	Gomphus	4.9	PR						2	1	
Insecta	Plecoptera	Capniidae		1	SH				1				
Insecta	Plecoptera	Perlidae	Acroneuria	0									
Insecta	Plecoptera	Perlidae	Agnetina	2	PR						5		
Insecta	Plecoptera	Perlidae	Neoperla	1.6	PR				9				
Insecta	Plecoptera	Perlidae	Isoperla	2	PR				1				
Insecta	Plecoptera	Perlidae	Perlesta	4.9					60	92			
Insecta	Plecoptera	Taeniopterygidae	Strophopteryx	2.5	SH						2	1	
Insecta	Trichoptera					2*							
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	6.6	FC						46	17	21
Insecta	Trichoptera	Hydropsychidae	Heliopsyche	3	SC	23	11	18				7	5
Insecta	Trichoptera	Hydropsychidae	Hydropchyche	4	FC	1	2	1			11	14	17
Insecta	Trichoptera	Philopotamoidae	Chimarra	2.8	FC	1					5		2
Insecta	Trichoptera	Psychomyiidae	Lype	4.3	SC				1				
Malacostraca	Isopoda	Asellidae	Lirceus	7.7	SH	1	3	5	2		6	2	
Oligochaeta				10	GC						1		

Note: All of the individuals in FTN's 2012 and 2013 Crooked Creek collection identified the taxa marked in red as Maccaffertium. In the latest edition of Merrit, Cummins and Berg, the genus Stenonema was split into Stenonema and Maccaffertium. This edition postdates the collection of the ADEQ samples. Therefore the ADEQ samples probably contained what would now be identified as Maccaffertium. Accordingly, for purposes of comparability we have classified the Maccaffertium individuals in the FTN collection as Stenonema.

*Not included in taxa count.

APPENDIX G

ADEQ Historical Monitoring Data

ADEQ Historical Monitoring Data for TDS at **Station WHI0200** (Crooked Creek at Hudson Road).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0200	2013-2679	7/30/2013	TDS	202
WHI0200	2013-2275	6/25/2013	TDS	209
WHI0200	2013-1905	5/28/2013	TDS	189
WHI0200	2013-1314	4/22/2013	TDS	141
WHI0200	2013-0892	3/25/2013	TDS	127
WHI0200	2013-0347	2/5/2013	TDS	168
WHI0200	2013-0126	1/15/2013	TDS	217
WHI0200	2012-3818	12/10/2012	TDS	225
WHI0200	2012-3579	11/13/2012	TDS	226
WHI0200	2012-3373	10/23/2012	TDS	233
WHI0200	2012-3019	9/25/2012	TDS	197
WHI0200	2012-2650	8/28/2012	TDS	195
WHI0200	2012-2232	7/24/2012	TDS	188
WHI0200	2012-1912	6/26/2012	TDS	196
WHI0200	2012-1335	5/1/2012	TDS	187
WHI0200	2012-1271	4/24/2012	TDS	193
WHI0200	2012-0927	3/27/2012	TDS	164
WHI0200	2012-0574	2/28/2012	TDS	159
WHI0200	2012-0273	1/30/2012	TDS	139
WHI0200	2011-3643	11/28/2011	TDS	142

ADEQ Historical Monitoring Data for TDS at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2013-2677	7/30/2013	TDS	193
WHI0067	2013-2273	6/25/2013	TDS	209
WHI0067	2013-1903	5/28/2013	TDS	207
WHI0067	2013-1312	4/22/2013	TDS	177
WHI0067	2013-0890	3/26/2013	TDS	159
WHI0067	2013-0345	2/5/2013	TDS	190
WHI0067	2013-0124	1/15/2013	TDS	194
WHI0067	2012-3816	12/10/2012	TDS	243
WHI0067	2012-3577	11/13/2012	TDS	204
WHI0067	2012-3371	10/23/2012	TDS	223
WHI0067	2012-3017	9/25/2012	TDS	208
WHI0067	2012-2648	8/28/2012	TDS	207
WHI0067	2012-2230	7/24/2012	TDS	210
WHI0067	2012-1910	6/26/2012	TDS	209
WHI0067	2012-1333	5/1/2012	TDS	200
WHI0067	2012-1269	4/24/2012	TDS	210
WHI0067	2012-0925	3/27/2012	TDS	180
WHI0067	2012-0572	2/28/2012	TDS	192
WHI0067	2012-0271	1/30/2012	TDS	174
WHI0067	2011-3934	12/12/2011	TDS	206
WHI0067	2011-3540	11/15/2011	TDS	217
WHI0067	2011-3270	10/18/2011	TDS	188
WHI0067	2011-2909	8/20/2011	TDS	215
WHI0067	2011-2525	8/16/2011	TDS	219
WHI0067	2011-2145	7/18/2011	TDS	212
WHI0067	2011-1784	6/14/2011	TDS	185
WHI0067	2011-1419	5/17/2011	TDS	183
WHI0067	2011-1151	4/26/2011	TDS	137
WHI0067	2011-0823	3/29/2011	TDS	198
WHI0067	2011-0482	2/22/2011	TDS	219
WHI0067	2011-0250	1/25/2011	TDS	226
WHI0067	2010-3936	12/28/2010	TDS	216
WHI0067	2010-3647	11/21/2010	TDS	230
WHI0067	2010-3407	10/26/2010	TDS	218
WHI0067	2010-3047	9/21/2010	TDS	223
WHI0067	2010-2356	8/10/2010	TDS	200
WHI0067	2010-1972	7/20/2010	TDS	205
WHI0067	2010-1540	6/16/2010	TDS	214
WHI0067	2010-1106	5/4/2010	TDS	210
WHI0067	2010-0909	4/13/2010	TDS	204
WHI0067	2010-0673	3/16/2010	TDS	205

ADEQ Historical Monitoring Data for TDS at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2010-0485	2/23/2010	TDS	167
WHI0067	2010-0095	1/12/2010	TDS	212
WHI0067	2009-3178	12/1/2009	TDS	212
WHI0067	2009-2974	11/3/2009	TDS	187
WHI0067	2009-2730	10/13/2009	TDS	162
WHI0067	2009-2420	9/15/2009	TDS	166
WHI0067	2009-2078	8/10/2009	TDS	250
WHI0067	2009-1833	7/21/2009	TDS	166
WHI0067	2009-1567	6/23/2009	TDS	205
WHI0067	2009-0908	4/7/2009	TDS	195
WHI0067	2009-0433	2/17/2009	TDS	194
WHI0067	2009-0102	1/13/2009	TDS	217
WHI0067	2008-3497	12/9/2008	TDS	205
WHI0067	2008-3352	11/24/2008	TDS	225
WHI0067	2008-3070	10/21/2008	TDS	227
WHI0067	2008-2762	9/16/2008	TDS	196
WHI0067	2008-2514	8/19/2008	TDS	215
WHI0067	2008-2171	7/15/2008	TDS	190
WHI0067	2008-1936	6/17/2008	TDS	217
WHI0067	2008-1515	5/13/2008	TDS	169
WHI0067	2008-1197	4/1/2008	TDS	124
WHI0067	2009-0674	3/17/2008	TDS	206
WHI0067	2008-0949	3/3/2008	TDS	108
WHI0067	2008-0803	2/19/2008	TDS	168
WHI0067	2008-0126	1/15/2008	TDS	222
WHI0067	2007-3030	12/4/2007	TDS	217
WHI0067	2007-2853	11/13/2007	TDS	226
WHI0067	2007-2529	10/2/2007	TDS	203
WHI0067	2007-2342	9/5/2007	TDS	216
WHI0067	2007-2085	7/17/2007	TDS	199
WHI0067	2007-1853	6/19/2007	TDS	203
WHI0067	2007-1545	5/15/2007	TDS	186
WHI0067	2007-1135	4/10/2007	TDS	206
WHI0067	2007-1014	3/27/2007	TDS	211
WHI0067	2007-0753	2/27/2007	TDS	189
WHI0067	2007-0378	1/16/2007	TDS	161
WHI0067	2006-3203	12/12/2006	TDS	216
WHI0067	2006-2870	10/31/2006	TDS	234
WHI0067	2006-2690	10/10/2006	TDS	233
WHI0067	2006-2483	9/12/2006	TDS	224
WHI0067	2006-2296	8/15/2006	TDS	226

ADEQ Historical Monitoring Data for TDS at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2006-2081	7/18/2006	TDS	222
WHI0067	2006-1839	6/20/2006	TDS	216
WHI0067	2006-1088	5/16/2006	TDS	199
WHI0067	2006-0877	4/18/2006	TDS	207
WHI0067	2006-0572	3/7/2006	TDS	208
WHI0067	2006-0236	1/31/2006	TDS	213
WHI0067	2006-0010	1/3/2006	TDS	218
WHI0067	2005-3489	12/13/2005	TDS	225
WHI0067	2005-3334	11/15/2005	TDS	194
WHI0067	2005-3098	10/18/2005	TDS	219
WHI0067	2005-2617	9/13/2005	TDS	228
WHI0067	2005-2263	8/16/2005	TDS	211
WHI0067	2005-2031	7/26/2005	TDS	215
WHI0067	2005-1481	6/14/2005	TDS	215
WHI0067	2005-1249	5/17/2005	TDS	209
WHI0067	2005-0919	4/12/2005	TDS	158
WHI0067	2005-0581	3/15/2005	TDS	215
WHI0067	2005-0310	2/8/2005	TDS	194
WHI0067	2005-0105	1/11/2005	TDS	192
WHI0067	2004-3175	12/14/2004	TDS	206
WHI0067	2004-3031	11/16/2004	TDS	205
WHI0067	2004-2782	10/19/2004	TDS	223
WHI0067	2004-2584	9/28/2004	TDS	230
WHI0067	2004-2324	8/24/2004	TDS	217
WHI0067	2004-1942	7/27/2004	TDS	224
WHI0067	2004-1563	6/22/2004	TDS	235
WHI0067	2004-1409	5/25/2004	TDS	217
WHI0067	2004-1168	4/27/2004	TDS	194
WHI0067	2004-0802	3/30/2004	TDS	213
WHI0067	2004-0536	2/24/2004	TDS	200
WHI0067	2004-0287	1/27/2004	TDS	206
WHI0067	2003-3086	12/16/2003	TDS	215
WHI0067	2003-2917	11/18/2003	TDS	206
WHI0067	2003-2653	10/21/2003	TDS	246
WHI0067	2003-2354	9/9/2003	TDS	237
WHI0067	2003-2067	8/5/2003	TDS	222

ADEQ Historical Monitoring Data for TDS at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2013-2678	7/30/2013	TDS	217
WHI0066	2013-2274	6/25/2013	TDS	222
WHI0066	2013-1904	5/28/2013	TDS	217
WHI0066	2013-1313	4/22/2013	TDS	185
WHI0066	2013-0891	3/26/2013	TDS	168
WHI0066	2013-0346	2/5/2013	TDS	195
WHI0066	2013-0125	1/15/2013	TDS	205
WHI0066	2012-3817	12/10/2012	TDS	224
WHI0066	2012-3578	11/13/2012	TDS	231
WHI0066	2012-3372	10/23/2012	TDS	251
WHI0066	2012-3018	9/25/2012	TDS	250
WHI0066	2012-2649	8/28/2012	TDS	244
WHI0066	2012-2231	7/24/2012	TDS	246
WHI0066	2012-1911	6/26/2012	TDS	240
WHI0066	2012-1334	5/1/2012	TDS	217
WHI0066	2012-1270	4/24/2012	TDS	220
WHI0066	2012-0926	3/27/2012	TDS	193
WHI0066	2012-0573	2/28/2012	TDS	206
WHI0066	2012-0272	1/30/2012	TDS	177
WHI0066	2011-3935	12/12/2011	TDS	217
WHI0066	2011-3541	11/15/2011	TDS	222
WHI0066	2011-3271	10/18/2011	TDS	229
WHI0066	2011-2910	8/20/2011	TDS	215
WHI0066	2011-2526	8/16/2011	TDS	210
WHI0066	2011-2146	7/18/2011	TDS	228
WHI0066	2011-1785	6/14/2011	TDS	181
WHI0066	2011-1420	5/17/2011	TDS	183
WHI0066	2011-1152	4/26/2011	TDS	145
WHI0066	2011-0824	3/29/2011	TDS	203
WHI0066	2011-0483	2/22/2011	TDS	241
WHI0066	2011-0251	1/25/2011	TDS	252
WHI0066	2010-3937	12/28/2010	TDS	211
WHI0066	2010-3648	11/21/2010	TDS	250
WHI0066	2010-3408	10/26/2010	TDS	228
WHI0066	2010-3048	9/21/2010	TDS	225
WHI0066	2010-2357	8/10/2010	TDS	227
WHI0066	2010-1973	7/20/2010	TDS	208
WHI0066	2010-1541	6/16/2010	TDS	222
WHI0066	2010-1107	5/4/2010	TDS	198
WHI0066	2010-0910	4/13/2010	TDS	206
WHI0066	2010-0674	3/16/2010	TDS	205

ADEQ Historical Monitoring Data for TDS at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2010-0486	2/23/2010	TDS	170
WHI0066	2010-0096	1/12/2010	TDS	220
WHI0066	2009-3179	12/1/2009	TDS	213
WHI0066	2009-2975	11/3/2009	TDS	192
WHI0066	2009-2731	10/13/2009	TDS	165
WHI0066	2009-2419	9/15/2009	TDS	199
WHI0066	2009-2077	8/10/2009	TDS	232
WHI0066	2009-1834	7/21/2009	TDS	151
WHI0066	2009-1568	6/23/2009	TDS	204
WHI0066	2009-1281	5/19/2009	TDS	197
WHI0066	2009-0909	4/7/2009	TDS	194
WHI0066	2009-0434	2/17/2009	TDS	196
WHI0066	2009-0103	1/13/2009	TDS	209
WHI0066	2008-3498	12/9/2008	TDS	202
WHI0066	2008-3353	11/24/2008	TDS	240
WHI0066	2008-3071	10/21/2008	TDS	242
WHI0066	2008-3068	10/21/2008	TDS	189
WHI0066	2008-2763	9/16/2008	TDS	204
WHI0066	2008-2515	8/19/2008	TDS	226
WHI0066	2008-2172	7/15/2008	TDS	199
WHI0066	2008-1935	6/17/2008	TDS	208
WHI0066	2008-1516	5/13/2008	TDS	176
WHI0066	2008-1198	4/1/2008	TDS	138
WHI0066	2009-0675	3/17/2008	TDS	221
WHI0066	2008-0950	3/3/2008	TDS	112
WHI0066	2008-0804	2/19/2008	TDS	178
WHI0066	2008-0127	1/15/2008	TDS	244
WHI0066	2007-3031	12/4/2007	TDS	266
WHI0066	2007-2854	11/13/2007	TDS	261
WHI0066	2007-2530	10/2/2007	TDS	257
WHI0066	2007-2343	9/5/2007	TDS	258
WHI0066	2007-2086	7/17/2007	TDS	213
WHI0066	2007-1854	6/19/2007	TDS	235
WHI0066	2007-1546	5/15/2007	TDS	210
WHI0066	2007-1136	4/10/2007	TDS	227
WHI0066	2007-1015	3/27/2007	TDS	218
WHI0066	2007-0754	2/27/2007	TDS	194
WHI0066	2007-0379	1/16/2007	TDS	168
WHI0066	2006-3204	12/12/2006	TDS	213
WHI0066	2006-2871	10/31/2006	TDS	250
WHI0066	2006-2691	10/10/2006	TDS	287

ADEQ Historical Monitoring Data for TDS at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2006-2484	9/12/2006	TDS	219
WHI0066	2006-2297	8/15/2006	TDS	288
WHI0066	2006-2082	7/18/2006	TDS	272
WHI0066	2006-1840	6/20/2006	TDS	261
WHI0066	2006-1089	5/16/2006	TDS	213
WHI0066	2006-0878	4/18/2006	TDS	228
WHI0066	2006-0573	3/7/2006	TDS	256
WHI0066	2006-0237	1/31/2006	TDS	230
WHI0066	2006-0011	1/3/2006	TDS	274
WHI0066	2005-3490	12/13/2005	TDS	257
WHI0066	2005-3335	11/15/2005	TDS	204
WHI0066	2005-3099	10/18/2005	TDS	269
WHI0066	2005-2618	9/13/2005	TDS	267
WHI0066	2005-2264	8/16/2005	TDS	260
WHI0066	2005-2032	7/26/2005	TDS	265
WHI0066	2005-1482	6/14/2005	TDS	239
WHI0066	2005-1250	5/17/2005	TDS	225
WHI0066	2005-0920	4/12/2005	TDS	164
WHI0066	2005-0582	3/15/2005	TDS	228
WHI0066	2005-0311	2/8/2005	TDS	210
WHI0066	2005-0106	1/11/2005	TDS	200
WHI0066	2004-3176	12/14/2004	TDS	219
WHI0066	2004-3032	11/16/2004	TDS	213
WHI0066	2004-2783	10/19/2004	TDS	244
WHI0066	2004-2585	9/28/2004	TDS	274
WHI0066	2004-2325	8/24/2004	TDS	247
WHI0066	2004-1943	7/27/2004	TDS	234
WHI0066	2004-1564	6/22/2004	TDS	229
WHI0066	2004-1410	5/25/2004	TDS	226
WHI0066	2004-1169	4/27/2004	TDS	204
WHI0066	2004-0803	3/30/2004	TDS	230
WHI0066	2004-0537	2/24/2004	TDS	216
WHI0066	2004-0288	1/27/2004	TDS	217
WHI0066	2003-3087	12/16/2003	TDS	234
WHI0066	2003-2918	11/18/2003	TDS	212
WHI0066	2003-2654	10/21/2003	TDS	270
WHI0066	2003-2355	9/9/2003	TDS	265
WHI0066	2003-2068	8/5/2003	TDS	239

ADEQ Historical Monitoring Data for TDS at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2013-2444	7/9/2013	TDS	158
WHI0193	2013-2054	6/4/2013	TDS	200
WHI0193	2013-1552	5/7/2013	TDS	194
WHI0193	2013-0971	4/2/2013	TDS	195
WHI0193	2013-0640	3/5/2013	TDS	190
WHI0193	2013-0470	2/19/2013	TDS	200
WHI0193	2013-0068	1/8/2013	TDS	200
WHI0193	2012-3781	12/4/2012	TDS	173
WHI0193	2012-3485	11/5/2012	TDS	165
WHI0193	2012-3199	10/9/2012	TDS	160
WHI0193	2012-2836	9/11/2012	TDS	141
WHI0193	2012-2390	8/7/2012	TDS	141
WHI0193	2012-2038	7/10/2012	TDS	147
WHI0193	2012-1786	6/12/2012	TDS	152
WHI0193	2012-1558	5/22/2012	TDS	144
WHI0193	2012-1086	4/10/2012	TDS	189
WHI0193	2012-0795	3/13/2012	TDS	196
WHI0193	2012-0439	2/14/2012	TDS	200
WHI0193	2012-0097	1/10/2012	TDS	192
WHI0193	2011-3732	12/5/2011	TDS	207
WHI0193	2011-3434	11/1/2011	TDS	166
WHI0193	2011-3116	10/4/2011	TDS	139
WHI0193	2011-2785	9/6/2011	TDS	145
WHI0193	2011-2749	8/30/2011	TDS	136
WHI0193	2011-2020	7/5/2011	TDS	160
WHI0193	2011-1625	6/7/2011	TDS	176
WHI0193	2011-1236	5/3/2011	TDS	168
WHI0193	2011-0951	4/5/2011	TDS	201
WHI0193	2011-0512	3/1/2011	TDS	184
WHI0193	2011-0333	2/7/2011	TDS	203
WHI0193	2011-0099	1/18/2011	TDS	197
WHI0193	2010-3792	12/7/2010	TDS	199
WHI0193	2010-3615	11/16/2010	TDS	191
WHI0193	2010-3320	10/19/2010	TDS	177
WHI0193	2010-3117	9/28/2010	TDS	176
WHI0193	2010-2556	8/17/2010	TDS	167
WHI0193	2010-1781	7/6/2010	TDS	234
WHI0193	2010-1462	6/8/2010	TDS	191
WHI0193	2010-1184	5/11/2010	TDS	174
WHI0193	2010-0816	4/6/2010	TDS	192
WHI0193	2010-0525	3/2/2010	TDS	196

ADEQ Historical Monitoring Data for TDS at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2010-0385	2/16/2010	TDS	207
WHI0193	2010-0147	1/19/2010	TDS	216
WHI0193	2009-3279	12/8/2009	TDS	204
WHI0193	2009-3043	11/17/2009	TDS	206
WHI0193	2009-2786	10/20/2009	TDS	236
WHI0193	2009-2303	9/1/2009	TDS	184
WHI0193	2009-2148	8/19/2009	TDS	205
WHI0193	2009-1879	7/28/2009	TDS	201
WHI0193	2009-1445	6/9/2009	TDS	208
WHI0193	2009-1126	5/5/2009	TDS	197
WHI0193	2009-1054	4/28/2009	TDS	209
WHI0193	2009-0602	3/10/2009	TDS	202
WHI0193	2009-0408	2/10/2009	TDS	209
WHI0193	2009-0220	1/20/2009	TDS	193
WHI0193	2008-3517	12/9/2008	TDS	204
WHI0193	2008-3273	11/18/2008	TDS	201
WHI0193	2008-2934	10/7/2008	TDS	215
WHI0193	2008-2700	9/9/2008	TDS	226
WHI0193	2008-2436	8/12/2008	TDS	188
WHI0193	2008-2115	7/8/2008	TDS	189
WHI0193	2008-1858	6/10/2008	TDS	203
WHI0193	2008-1595	5/20/2008	TDS	182
WHI0193	2008-1314	4/15/2008	TDS	192
WHI0193	2008-1008	3/11/2008	TDS	217
WHI0193	2008-0298	2/4/2008	TDS	200
WHI0193	2008-0033	1/8/2008	TDS	207
WHI0193	2007-3131	12/11/2007	TDS	211
WHI0193	2007-2933	11/27/2007	TDS	210
WHI0193	2007-2618	10/16/2007	TDS	178
WHI0193	2007-2409	9/18/2007	TDS	179
WHI0193	2007-2260	8/7/2007	TDS	184
WHI0193	2007-1998	7/10/2007	TDS	183
WHI0193	2007-1699	6/5/2007	TDS	197
WHI0193	2007-1387	5/1/2007	TDS	189
WHI0193	2007-1074	4/3/2007	TDS	196
WHI0193	2007-0821	3/13/2007	TDS	195
WHI0193	2007-0547	2/6/2007	TDS	210
WHI0193	2007-0421	1/23/2007	TDS	204
WHI0193	2006-3281	12/19/2006	TDS	228
WHI0193	2006-3064	11/28/2006	TDS	221
WHI0193	2006-2752	10/17/2006	TDS	145

ADEQ Historical Monitoring Data for TDS at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2006-2549	9/19/2006	TDS	186
WHI0193	2006-2237	8/8/2006	TDS	173
WHI0048A	2006-1993	7/11/2006	TDS	166
WHI0048A	2006-1737	6/6/2006	TDS	205
WHI0048A	2006-1000	5/2/2006	TDS	198
WHI0048A	2006-0759	4/4/2006	TDS	192
WHI0048A	2006-0516	2/28/2006	TDS	209
WHI0048A	2006-0328	2/7/2006	TDS	204
WHI0048A	2006-0077	1/10/2006	TDS	198
WHI0048A	2005-3398	12/6/2005	TDS	210
WHI0048A	2005-3270	11/8/2005	TDS	190
WHI0048A	2005-2911	10/4/2005	TDS	185
WHI0048A	2005-1702	7/5/2005	TDS	175
WHI0048A	2005-1431	6/7/2005	TDS	206
WHI0048A	2005-1206	5/10/2005	TDS	212
WHI0048A	2005-0809	4/5/2005	TDS	199
WHI0048A	2005-0485	3/1/2005	TDS	213
WHI0048A	2005-0264	2/1/2005	TDS	226
WHI0048A	2005-0027	1/4/2005	TDS	169
WHI0048A	2004-3088	12/7/2004	TDS	218
WHI0048A	2004-2884	11/2/2004	TDS	201
WHI0048A	2004-2077	8/10/2004	TDS	164
WHI0048A	2004-1661	7/6/2004	TDS	188
WHI0048A	2004-1468	6/8/2004	TDS	205
WHI0048A	2004-1259	5/11/2004	TDS	343
WHI0048A	2004-0872	4/6/2004	TDS	210
WHI0048A	2004-0634	3/9/2004	TDS	212
WHI0048A	2004-0332	2/3/2004	TDS	221
WHI0048A	2004-0130	1/13/2004	TDS	226
WHI0048A	2003-3030	12/9/2003	TDS	190
WHI0048A	2003-2750	11/4/2003	TDS	201
WHI0048A	2003-2559	10/14/2003	TDS	189
WHI0048A	2003-2374	9/16/2003	TDS	184
WHI0048A	2003-2165	8/19/2003	TDS	163

ADEQ Historical Monitoring Data for TDS at **Station WHI0048B** (Crooked Creek 2 miles south of Flippin, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048B	2013-2050	6/4/2013	TDS	198
WHI0048B	2013-1548	5/7/2013	TDS	199
WHI0048B	2013-0967	4/2/2013	TDS	194
WHI0048B	2013-0636	3/5/2013	TDS	190
WHI0048B	2013-0466	2/19/2013	TDS	196
WHI0048B	2012-1082	4/10/2012	TDS	187
WHI0048B	2012-0791	3/13/2012	TDS	186
WHI0048B	2012-0435	2/14/2012	TDS	198
WHI0048B	2012-0093	1/10/2012	TDS	192
WHI0048B	2011-3728	12/5/2011	TDS	208
WHI0048B	2011-1621	6/7/2011	TDS	176
WHI0048B	2011-1232	5/3/2011	TDS	164
WHI0048B	2011-0947	4/5/2011	TDS	188
WHI0048B	2011-0508	3/1/2011	TDS	191
WHI0048B	2010-1457	6/8/2010	TDS	186
WHI0048B	2010-1179	5/11/2010	TDS	175
WHI0048B	2010-0811	4/6/2010	TDS	187
WHI0048B	2010-0520	3/2/2010	TDS	199
WHI0048B	2010-0380	2/16/2010	TDS	208
WHI0048B	2010-0142	1/19/2010	TDS	215
WHI0048B	2009-3274	12/8/2009	TDS	206
WHI0048B	2009-3038	11/17/2009	TDS	209
WHI0048B	2009-2781	10/20/2009	TDS	231
WHI0048B	2009-2143	8/19/2009	TDS	167
WHI0048B	2009-1874	7/28/2009	TDS	194
WHI0048B	2009-1440	6/9/2009	TDS	212
WHI0048B	2009-1121	5/5/2009	TDS	200
WHI0048B	2009-1049	4/28/2009	TDS	208
WHI0048B	2009-0597	3/10/2009	TDS	192
WHI0048B	2009-0403	2/10/2009	TDS	201
WHI0048B	2008-2929	10/7/2008	TDS	208
WHI0048B	2008-2695	9/9/2008	TDS	227
WHI0048B	2008-2431	8/12/2008	TDS	185
WHI0048B	2008-2110	7/8/2008	TDS	188
WHI0048B	2008-1853	6/10/2008	TDS	197
WHI0048B	2008-1590	5/20/2008	TDS	176
WHI0048B	2008-1309	4/15/2008	TDS	193
WHI0048B	2008-1003	3/11/2008	TDS	212
WHI0048B	2007-1993	7/10/2007	TDS	176
WHI0048B	2007-1382	5/1/2007	TDS	186
WHI0048B	2007-1069	4/3/2007	TDS	171

ADEQ Historical Monitoring Data for TDS at **Station WHI0048B** (Crooked Creek 2 miles south of Flippin, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048B	2007-0816	3/13/2007	TDS	195
WHI0048B	2007-0542	2/6/2007	TDS	207
WHI0048B	2007-0416	1/23/2007	TDS	211
WHI0048B	2006-1001	5/2/2006	TDS	199
WHI0048B	2005-1207	5/10/2005	TDS	197
WHI0048B	2005-0810	4/5/2005	TDS	200
WHI0048B	2005-0486	3/1/2005	TDS	212
WHI0048B	2005-0265	2/1/2005	TDS	221
WHI0048B	2005-0028	1/4/2005	TDS	194
WHI0048B	2004-3089	12/7/2004	TDS	218
WHI0048B	2004-2885	11/2/2004	TDS	183
WHI0048B	2004-1662	7/6/2004	TDS	168
WHI0048B	2004-1469	6/8/2004	TDS	180
WHI0048B	2004-1260	5/11/2004	TDS	225
WHI0048B	2004-0873	4/6/2004	TDS	200
WHI0048B	2004-0635	3/9/2004	TDS	220
WHI0048B	2004-0333	2/3/2004	TDS	221
WHI0048B	2003-3031	12/9/2003	TDS	196

ADEQ Historical Monitoring Data for TDS at **Station WHI0048C** (Crooked Creek at Hwy 101, 2 miles north of Rea Valley, AR).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048C	2013-2051	6/4/2013	TDS	193
WHI0048C	2013-1549	5/7/2013	TDS	193
WHI0048C	2013-0968	4/2/2013	TDS	180
WHI0048C	2013-0637	3/5/2013	TDS	193
WHI0048C	2013-0467	2/19/2013	TDS	214
WHI0048C	2012-1083	4/10/2012	TDS	180
WHI0048C	2012-0792	3/13/2012	TDS	185
WHI0048C	2012-0436	2/14/2012	TDS	216
WHI0048C	2012-0094	1/10/2012	TDS	189
WHI0048C	2011-3729	12/5/2011	TDS	190
WHI0048C	2011-1622	6/7/2011	TDS	174
WHI0048C	2011-1233	5/3/2011	TDS	157
WHI0048C	2011-0948	4/5/2011	TDS	218
WHI0048C	2011-0509	3/1/2011	TDS	195
WHI0048C	2010-3113	9/28/2010	TDS	159
WHI0048C	2010-1777	7/6/2010	TDS	159
WHI0048C	2010-1458	6/8/2010	TDS	178
WHI0048C	2010-1180	5/11/2010	TDS	179
WHI0048C	2010-0812	4/6/2010	TDS	186
WHI0048C	2010-0521	3/2/2010	TDS	191
WHI0048C	2010-0381	2/16/2010	TDS	206
WHI0048C	2010-0143	1/19/2010	TDS	212
WHI0048C	2009-3275	12/8/2009	TDS	195
WHI0048C	2009-3039	11/17/2009	TDS	201
WHI0048C	2009-2782	10/20/2009	TDS	238
WHI0048C	2009-2299	9/1/2009	TDS	166
WHI0048C	2009-2144	8/19/2009	TDS	174
WHI0048C	2009-1875	7/28/2009	TDS	162
WHI0048C	2009-1441	6/9/2009	TDS	197
WHI0048C	2009-1122	5/5/2009	TDS	197
WHI0048C	2009-1050	4/28/2009	TDS	198
WHI0048C	2009-0598	3/10/2009	TDS	180
WHI0048C	2009-0404	2/10/2009	TDS	193
WHI0048C	2008-2930	10/7/2008	TDS	194
WHI0048C	2008-2696	9/9/2008	TDS	230
WHI0048C	2008-2432	8/12/2008	TDS	176
WHI0048C	2008-2111	7/8/2008	TDS	176
WHI0048C	2008-1854	6/10/2008	TDS	186
WHI0048C	2008-1591	5/20/2008	TDS	177
WHI0048C	2008-1310	4/15/2008	TDS	198
WHI0048C	2008-1004	3/11/2008	TDS	215

ADEQ Historical Monitoring Data for TDS at **Station WHI0048C** (Crooked Creek at Hwy 101, 2 miles north of Rea Valley, AR).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048C	2007-1994	7/10/2007	TDS	192
WHI0048C	2007-1383	5/1/2007	TDS	178
WHI0048C	2007-1070	4/3/2007	TDS	189
WHI0048C	2007-0817	3/13/2007	TDS	196
WHI0048C	2007-0543	2/6/2007	TDS	207
WHI0048C	2007-0417	1/23/2007	TDS	213
WHI0048C	2006-1738	6/6/2006	TDS	202
WHI0048C	2006-1002	5/2/2006	TDS	197
WHI0048C	2006-0760	4/4/2006	TDS	221
WHI0048C	2006-0329	2/7/2006	TDS	245
WHI0048C	2005-1432	6/7/2005	TDS	189
WHI0048C	2005-1208	5/10/2005	TDS	192
WHI0048C	2005-0811	4/5/2005	TDS	194
WHI0048C	2005-0487	3/1/2005	TDS	198
WHI0048C	2005-0266	2/1/2005	TDS	229
WHI0048C	2005-0029	1/4/2005	TDS	219
WHI0048C	2004-3090	12/7/2004	TDS	225
WHI0048C	2004-2886	11/2/2004	TDS	178
WHI0048C	2004-1663	7/6/2004	TDS	145
WHI0048C	2004-1470	6/8/2004	TDS	169
WHI0048C	2004-1261	5/11/2004	TDS	233
WHI0048C	2004-0874	4/6/2004	TDS	237
WHI0048C	2004-0636	3/9/2004	TDS	208
WHI0048C	2004-0334	2/3/2004	TDS	244
WHI0048C	2004-0131	1/13/2004	TDS	169
WHI0048C	2003-3032	12/9/2003	TDS	281

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0200** (Crooked Creek at Hudson Road).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0200	2013-2679	7/30/2013	Sulfate	3.64
WHI0200	2013-2275	6/25/2013	Sulfate	4.61
WHI0200	2013-1905	5/28/2013	Sulfate	7.52
WHI0200	2013-1314	4/22/2013	Sulfate	11.3
WHI0200	2013-0892	3/25/2013	Sulfate	11.4
WHI0200	2013-0347	2/5/2013	Sulfate	10.6
WHI0200	2013-0126	1/15/2013	Sulfate	14.6
WHI0200	2012-3818	12/10/2012	Sulfate	5.25
WHI0200	2012-3579	11/13/2012	Sulfate	4.44
WHI0200	2012-3373	10/23/2012	Sulfate	6.54
WHI0200	2012-3019	9/25/2012	Sulfate	3.38
WHI0200	2012-2650	8/28/2012	Sulfate	3.12
WHI0200	2012-2232	7/24/2012	Sulfate	2.86
WHI0200	2012-1912	6/26/2012	Sulfate	3.4
WHI0200	2012-1335	5/1/2012	Sulfate	4.55
WHI0200	2012-1271	4/24/2012	Sulfate	5
WHI0200	2012-0927	3/27/2012	Sulfate	5.61
WHI0200	2012-0574	2/28/2012	Sulfate	7.02
WHI0200	2012-0273	1/30/2012	Sulfate	6.59
WHI0200	2011-3643	11/28/2011	Sulfate	6.85

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2013-2677	7/30/2013	Sulfate	4.55
WHI0067	2013-2273	6/25/2013	Sulfate	4.41
WHI0067	2013-1903	5/28/2013	Sulfate	5.71
WHI0067	2013-1312	4/22/2013	Sulfate	8.98
WHI0067	2013-0890	3/26/2013	Sulfate	9.57
WHI0067	2013-0345	2/5/2013	Sulfate	8
WHI0067	2013-0124	1/15/2013	Sulfate	5.3
WHI0067	2012-3816	12/10/2012	Sulfate	19.1
WHI0067	2012-3577	11/13/2012	Sulfate	4.82
WHI0067	2012-3371	10/23/2012	Sulfate	5.27
WHI0067	2012-3017	9/25/2012	Sulfate	5.84
WHI0067	2012-2648	8/28/2012	Sulfate	4.65
WHI0067	2012-2230	7/24/2012	Sulfate	4.36
WHI0067	2012-1910	6/26/2012	Sulfate	4.4
WHI0067	2012-1333	5/1/2012	Sulfate	4.23
WHI0067	2012-1269	4/24/2012	Sulfate	4.17
WHI0067	2012-0925	3/27/2012	Sulfate	5.11
WHI0067	2012-0572	2/28/2012	Sulfate	5.54
WHI0067	2012-0271	1/30/2012	Sulfate	5.66
WHI0067	2011-3934	12/12/2011	Sulfate	7.14
WHI0067	2011-3540	11/15/2011	Sulfate	6.89
WHI0067	2011-3270	10/18/2011	Sulfate	5.09
WHI0067	2011-2909	8/20/2011	Sulfate	5.06
WHI0067	2011-2525	8/16/2011	Sulfate	4.42
WHI0067	2011-2145	7/18/2011	Sulfate	3.94
WHI0067	2011-1784	6/14/2011	Sulfate	4.3
WHI0067	2011-1419	5/17/2011	Sulfate	4.96
WHI0067	2011-1151	4/26/2011	Sulfate	5.9
WHI0067	2011-0823	3/29/2011	Sulfate	6.3
WHI0067	2011-0482	2/22/2011	Sulfate	10.7
WHI0067	2011-0250	1/25/2011	Sulfate	4.95
WHI0067	2010-3936	12/28/2010	Sulfate	19.5
WHI0067	2010-3647	11/21/2010	Sulfate	4.1
WHI0067	2010-3407	10/26/2010	Sulfate	4.23
WHI0067	2010-3047	9/21/2010	Sulfate	5.22
WHI0067	2010-2356	8/10/2010	Sulfate	3.79
WHI0067	2010-1972	7/20/2010	Sulfate	5.13
WHI0067	2010-1540	6/16/2010	Sulfate	4.33
WHI0067	2010-1106	5/4/2010	Sulfate	9.22
WHI0067	2010-0909	4/13/2010	Sulfate	U
WHI0067	2010-0673	3/16/2010	Sulfate	5.78

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2010-0485	2/23/2010	Sulfate	6.79
WHI0067	2010-0095	1/12/2010	Sulfate	5.66
WHI0067	2009-3178	12/1/2009	Sulfate	5.05
WHI0067	2009-2974	11/3/2009	Sulfate	5.09
WHI0067	2009-2730	10/13/2009	Sulfate	4.44
WHI0067	2009-2420	9/15/2009	Sulfate	3.58
WHI0067	2009-2078	8/10/2009	Sulfate	14
WHI0067	2009-1833	7/21/2009	Sulfate	3.57
WHI0067	2009-1567	6/23/2009	Sulfate	4.92
WHI0067	2009-0908	4/7/2009	Sulfate	6.27
WHI0067	2009-0433	2/17/2009	Sulfate	6.02
WHI0067	2009-0102	1/13/2009	Sulfate	9.37
WHI0067	2008-3497	12/9/2008	Sulfate	4.13
WHI0067	2008-3352	11/24/2008	Sulfate	4.34
WHI0067	2008-3070	10/21/2008	Sulfate	3.8
WHI0067	2008-2762	9/16/2008	Sulfate	4.57
WHI0067	2008-2514	8/19/2008	Sulfate	5.13
WHI0067	2008-2171	7/15/2008	Sulfate	4.78
WHI0067	2008-1936	6/17/2008	Sulfate	9.43
WHI0067	2008-1515	5/13/2008	Sulfate	5.6
WHI0067	2008-1197	4/1/2008	Sulfate	5.42
WHI0067	2009-0674	3/17/2008	Sulfate	5.51
WHI0067	2008-0949	3/3/2008	Sulfate	6.46
WHI0067	2008-0803	2/19/2008	Sulfate	7.81
WHI0067	2008-0126	1/15/2008	Sulfate	6.87
WHI0067	2007-3030	12/4/2007	Sulfate	5.07
WHI0067	2007-2853	11/13/2007	Sulfate	5.23
WHI0067	2007-2529	10/2/2007	Sulfate	4.7
WHI0067	2007-2342	9/5/2007	Sulfate	4.7
WHI0067	2007-2085	7/17/2007	Sulfate	5.77
WHI0067	2007-1853	6/19/2007	Sulfate	4.85
WHI0067	2007-1545	5/15/2007	Sulfate	6.48
WHI0067	2007-1135	4/10/2007	Sulfate	5.19
WHI0067	2007-1014	3/27/2007	Sulfate	5.3
WHI0067	2007-0753	2/27/2007	Sulfate	6.06
WHI0067	2007-0378	1/16/2007	Sulfate	5.81
WHI0067	2006-3203	12/12/2006	Sulfate	7.85
WHI0067	2006-2870	10/31/2006	Sulfate	6.02
WHI0067	2006-2690	10/10/2006	Sulfate	6.08
WHI0067	2006-2483	9/12/2006	Sulfate	5.85
WHI0067	2006-2296	8/15/2006	Sulfate	5.22

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2006-2081	7/18/2006	Sulfate	5.02
WHI0067	2006-1839	6/20/2006	Sulfate	4.65
WHI0067	2006-1088	5/16/2006	Sulfate	5.52
WHI0067	2006-0877	4/18/2006	Sulfate	8.29
WHI0067	2006-0572	3/7/2006	Sulfate	7.06
WHI0067	2006-0236	1/31/2006	Sulfate	5.49
WHI0067	2006-0010	1/3/2006	Sulfate	5.52
WHI0067	2005-3489	12/13/2005	Sulfate	5.73
WHI0067	2005-3334	11/15/2005	Sulfate	3.84
WHI0067	2005-3098	10/18/2005	Sulfate	5.4
WHI0067	2005-2617	9/13/2005	Sulfate	4.72
WHI0067	2005-2263	8/16/2005	Sulfate	4.51
WHI0067	2005-2031	7/26/2005	Sulfate	4.44
WHI0067	2005-1481	6/14/2005	Sulfate	4.62
WHI0067	2005-1249	5/17/2005	Sulfate	4.84
WHI0067	2005-0919	4/12/2005	Sulfate	6.28
WHI0067	2005-0581	3/15/2005	Sulfate	6.03
WHI0067	2005-0310	2/8/2005	Sulfate	6.74
WHI0067	2005-0105	1/11/2005	Sulfate	5.7
WHI0067	2004-3175	12/14/2004	Sulfate	5.62
WHI0067	2004-3031	11/16/2004	Sulfate	6.91
WHI0067	2004-2782	10/19/2004	Sulfate	7.33
WHI0067	2004-2584	9/28/2004	Sulfate	4.93
WHI0067	2004-2324	8/24/2004	Sulfate	4.8
WHI0067	2004-1942	7/27/2004	Sulfate	5.13
WHI0067	2004-1563	6/22/2004	Sulfate	8.27
WHI0067	2004-1409	5/25/2004	Sulfate	4.5
WHI0067	2004-1168	4/27/2004	Sulfate	6.07
WHI0067	2004-0802	3/30/2004	Sulfate	8.79
WHI0067	2004-0536	2/24/2004	Sulfate	7.08
WHI0067	2004-0287	1/27/2004	Sulfate	8.57
WHI0067	2003-3086	12/16/2003	Sulfate	7.92
WHI0067	2003-2917	11/18/2003	Sulfate	4.38
WHI0067	2003-2653	10/21/2003	Sulfate	6.15
WHI0067	2003-2354	9/9/2003	Sulfate	5.43
WHI0067	2003-2067	8/5/2003	Sulfate	5.29

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2013-2678	7/30/2013	Sulfate	10.3
WHI0066	2013-2274	6/25/2013	Sulfate	10.8
WHI0066	2013-1904	5/28/2013	Sulfate	8.5
WHI0066	2013-1313	4/22/2013	Sulfate	10.4
WHI0066	2013-0891	3/26/2013	Sulfate	10.4
WHI0066	2013-0346	2/5/2013	Sulfate	9.06
WHI0066	2013-0125	1/15/2013	Sulfate	10.7
WHI0066	2012-3817	12/10/2012	Sulfate	21.2
WHI0066	2012-3578	11/13/2012	Sulfate	13.1
WHI0066	2012-3372	10/23/2012	Sulfate	12.9
WHI0066	2012-3018	9/25/2012	Sulfate	16.6
WHI0066	2012-2649	8/28/2012	Sulfate	15.2
WHI0066	2012-2231	7/24/2012	Sulfate	22.2
WHI0066	2012-1911	6/26/2012	Sulfate	11.6
WHI0066	2012-1334	5/1/2012	Sulfate	6.99
WHI0066	2012-1270	4/24/2012	Sulfate	6.83
WHI0066	2012-0926	3/27/2012	Sulfate	5.79
WHI0066	2012-0573	2/28/2012	Sulfate	8.01
WHI0066	2012-0272	1/30/2012	Sulfate	6.24
WHI0066	2011-3935	12/12/2011	Sulfate	11.1
WHI0066	2011-3541	11/15/2011	Sulfate	10.5
WHI0066	2011-3271	10/18/2011	Sulfate	12.6
WHI0066	2011-2910	8/20/2011	Sulfate	9.61
WHI0066	2011-2526	8/16/2011	Sulfate	9
WHI0066	2011-2146	7/18/2011	Sulfate	8.5
WHI0066	2011-1785	6/14/2011	Sulfate	7.12
WHI0066	2011-1420	5/17/2011	Sulfate	6.98
WHI0066	2011-1152	4/26/2011	Sulfate	5.93
WHI0066	2011-0824	3/29/2011	Sulfate	8.89
WHI0066	2011-0483	2/22/2011	Sulfate	17.8
WHI0066	2011-0251	1/25/2011	Sulfate	12.9
WHI0066	2010-3937	12/28/2010	Sulfate	11.7
WHI0066	2010-3648	11/21/2010	Sulfate	13.3
WHI0066	2010-3408	10/26/2010	Sulfate	9
WHI0066	2010-3048	9/21/2010	Sulfate	7.27
WHI0066	2010-2357	8/10/2010	Sulfate	8.37
WHI0066	2010-1973	7/20/2010	Sulfate	10.4
WHI0066	2010-1541	6/16/2010	Sulfate	10.1
WHI0066	2010-1107	5/4/2010	Sulfate	5.98
WHI0066	2010-0910	4/13/2010	Sulfate	8.12
WHI0066	2010-0674	3/16/2010	Sulfate	7.34

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2010-0486	2/23/2010	Sulfate	7.85
WHI0066	2010-0096	1/12/2010	Sulfate	7.1
WHI0066	2009-3179	12/1/2009	Sulfate	6.24
WHI0066	2009-2975	11/3/2009	Sulfate	6.08
WHI0066	2009-2731	10/13/2009	Sulfate	4.76
WHI0066	2009-2419	9/15/2009	Sulfate	6.77
WHI0066	2009-2077	8/10/2009	Sulfate	4.34
WHI0066	2009-1834	7/21/2009	Sulfate	4.67
WHI0066	2009-1568	6/23/2009	Sulfate	7.86
WHI0066	2009-1281	5/19/2009	Sulfate	6.23
WHI0066	2009-0909	4/7/2009	Sulfate	7.31
WHI0066	2009-0434	2/17/2009	Sulfate	8.5
WHI0066	2009-0103	1/13/2009	Sulfate	5.86
WHI0066	2008-3498	12/9/2008	Sulfate	11.4
WHI0066	2008-3353	11/24/2008	Sulfate	9.97
WHI0066	2008-3068	10/21/2008	Sulfate	7.6
WHI0066	2008-3071	10/21/2008	Sulfate	8.93
WHI0066	2008-2763	9/16/2008	Sulfate	5.57
WHI0066	2008-2515	8/19/2008	Sulfate	8.62
WHI0066	2008-2172	7/15/2008	Sulfate	7.85
WHI0066	2008-1935	6/17/2008	Sulfate	5.04
WHI0066	2008-1516	5/13/2008	Sulfate	7.57
WHI0066	2008-1198	4/1/2008	Sulfate	6.06
WHI0066	2009-0675	3/17/2008	Sulfate	11
WHI0066	2008-0950	3/3/2008	Sulfate	8.29
WHI0066	2008-0804	2/19/2008	Sulfate	10
WHI0066	2008-0127	1/15/2008	Sulfate	13.7
WHI0066	2007-3031	12/4/2007	Sulfate	19.5
WHI0066	2007-2854	11/13/2007	Sulfate	15.3
WHI0066	2007-2530	10/2/2007	Sulfate	17.2
WHI0066	2007-2343	9/5/2007	Sulfate	20.9
WHI0066	2007-2086	7/17/2007	Sulfate	11.2
WHI0066	2007-1854	6/19/2007	Sulfate	21.3
WHI0066	2007-1546	5/15/2007	Sulfate	15.3
WHI0066	2007-1136	4/10/2007	Sulfate	16.6
WHI0066	2007-1015	3/27/2007	Sulfate	9.58
WHI0066	2007-0754	2/27/2007	Sulfate	9.48
WHI0066	2007-0379	1/16/2007	Sulfate	6.28
WHI0066	2006-3204	12/12/2006	Sulfate	5.79
WHI0066	2006-2871	10/31/2006	Sulfate	11.7
WHI0066	2006-2691	10/10/2006	Sulfate	23.9

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2006-2484	9/12/2006	Sulfate	14.8
WHI0066	2006-2297	8/15/2006	Sulfate	37.7
WHI0066	2006-2082	7/18/2006	Sulfate	27.7
WHI0066	2006-1840	6/20/2006	Sulfate	29.6
WHI0066	2006-1089	5/16/2006	Sulfate	7.23
WHI0066	2006-0878	4/18/2006	Sulfate	20.7
WHI0066	2006-0573	3/7/2006	Sulfate	24.2
WHI0066	2006-0237	1/31/2006	Sulfate	13.3
WHI0066	2006-0011	1/3/2006	Sulfate	31.1
WHI0066	2005-3490	12/13/2005	Sulfate	17.1
WHI0066	2005-3335	11/15/2005	Sulfate	9.96
WHI0066	2005-3099	10/18/2005	Sulfate	19.8
WHI0066	2005-2618	9/13/2005	Sulfate	18.2
WHI0066	2005-2264	8/16/2005	Sulfate	28.8
WHI0066	2005-2032	7/26/2005	Sulfate	29.1
WHI0066	2005-1482	6/14/2005	Sulfate	15.2
WHI0066	2005-1250	5/17/2005	Sulfate	10.2
WHI0066	2005-0920	4/12/2005	Sulfate	7.06
WHI0066	2005-0582	3/15/2005	Sulfate	10.1
WHI0066	2005-0311	2/8/2005	Sulfate	8.59
WHI0066	2005-0106	1/11/2005	Sulfate	6.68
WHI0066	2004-3176	12/14/2004	Sulfate	8.23
WHI0066	2004-3032	11/16/2004	Sulfate	10
WHI0066	2004-2783	10/19/2004	Sulfate	13.3
WHI0066	2004-2585	9/28/2004	Sulfate	21.9
WHI0066	2004-2325	8/24/2004	Sulfate	14.5
WHI0066	2004-1943	7/27/2004	Sulfate	13.5
WHI0066	2004-1564	6/22/2004	Sulfate	4.34
WHI0066	2004-1410	5/25/2004	Sulfate	5.92
WHI0066	2004-1169	4/27/2004	Sulfate	6.62
WHI0066	2004-0803	3/30/2004	Sulfate	9.6
WHI0066	2004-0537	2/24/2004	Sulfate	11.3
WHI0066	2004-0288	1/27/2004	Sulfate	9.95
WHI0066	2003-3087	12/16/2003	Sulfate	10.4
WHI0066	2003-2918	11/18/2003	Sulfate	6.79
WHI0066	2003-2654	10/21/2003	Sulfate	13.3
WHI0066	2003-2355	9/9/2003	Sulfate	14.5
WHI0066	2003-2068	8/5/2003	Sulfate	9.99

ADEQ Historical Monitoring Data for Sulfate at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2013-2444	7/9/2013	Sulfate	5.03
WHI0193	2013-2054	6/4/2013	Sulfate	5.81
WHI0193	2013-1552	5/7/2013	Sulfate	6.62
WHI0193	2013-0971	4/2/2013	Sulfate	7.29
WHI0193	2013-0640	3/5/2013	Sulfate	7.11
WHI0193	2013-0470	2/19/2013	Sulfate	8.06
WHI0193	2013-0068	1/8/2013	Sulfate	8.69
WHI0193	2012-3781	12/4/2012	Sulfate	8.12
WHI0193	2012-3485	11/5/2012	Sulfate	7.6
WHI0193	2012-3199	10/9/2012	Sulfate	7.16
WHI0193	2012-2836	9/11/2012	Sulfate	6.14
WHI0193	2012-2390	8/7/2012	Sulfate	5.76
WHI0193	2012-2038	7/10/2012	Sulfate	5.01
WHI0193	2012-1786	6/12/2012	Sulfate	5.26
WHI0193	2012-1558	5/22/2012	Sulfate	5.1
WHI0193	2012-1086	4/10/2012	Sulfate	4.75
WHI0193	2012-0795	3/13/2012	Sulfate	5.29
WHI0193	2012-0439	2/14/2012	Sulfate	5.49
WHI0193	2012-0097	1/10/2012	Sulfate	6.64
WHI0193	2011-3732	12/5/2011	Sulfate	6.8
WHI0193	2011-3434	11/1/2011	Sulfate	6.59
WHI0193	2011-3116	10/4/2011	Sulfate	6.32
WHI0193	2011-2785	9/6/2011	Sulfate	5.52
WHI0193	2011-2749	8/30/2011	Sulfate	5.33
WHI0193	2011-2020	7/5/2011	Sulfate	5.62
WHI0193	2011-1625	6/7/2011	Sulfate	5.01
WHI0193	2011-1236	5/3/2011	Sulfate	4.76
WHI0193	2011-0951	4/5/2011	Sulfate	6.99
WHI0193	2011-0512	3/1/2011	Sulfate	8.38
WHI0193	2011-0333	2/7/2011	Sulfate	8.32
WHI0193	2011-0099	1/18/2011	Sulfate	9.14
WHI0193	2010-3792	12/7/2010	Sulfate	7.19
WHI0193	2010-3615	11/16/2010	Sulfate	6.03
WHI0193	2010-3320	10/19/2010	Sulfate	6.04
WHI0193	2010-3117	9/28/2010	Sulfate	5.4
WHI0193	2010-2556	8/17/2010	Sulfate	5.13
WHI0193	2010-1781	7/6/2010	Sulfate	5.44
WHI0193	2010-1462	6/8/2010	Sulfate	5.1
WHI0193	2010-1184	5/11/2010	Sulfate	4.33
WHI0193	2010-0816	4/6/2010	Sulfate	4.73
WHI0193	2010-0525	3/2/2010	Sulfate	5.26

ADEQ Historical Monitoring Data for Sulfate at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2010-0385	2/16/2010	Sulfate	5.21
WHI0193	2010-0147	1/19/2010	Sulfate	6.1
WHI0193	2009-3279	12/8/2009	Sulfate	5.16
WHI0193	2009-3043	11/17/2009	Sulfate	4.85
WHI0193	2009-2786	10/20/2009	Sulfate	5.35
WHI0193	2009-2303	9/1/2009	Sulfate	5.79
WHI0193	2009-2148	8/19/2009	Sulfate	6.76
WHI0193	2009-1879	7/28/2009	Sulfate	5.72
WHI0193	2009-1445	6/9/2009	Sulfate	5.24
WHI0193	2009-1126	5/5/2009	Sulfate	5.2
WHI0193	2009-1054	4/28/2009	Sulfate	5.51
WHI0193	2009-0602	3/10/2009	Sulfate	6.57
WHI0193	2009-0408	2/10/2009	Sulfate	5.65
WHI0193	2009-0220	1/20/2009	Sulfate	7.24
WHI0193	2008-3517	12/9/2008	Sulfate	6.13
WHI0193	2008-3273	11/18/2008	Sulfate	5.29
WHI0193	2008-2934	10/7/2008	Sulfate	5.17
WHI0193	2008-2700	9/9/2008	Sulfate	4.45
WHI0193	2008-2436	8/12/2008	Sulfate	4.65
WHI0193	2008-2115	7/8/2008	Sulfate	4.9
WHI0193	2008-1858	6/10/2008	Sulfate	5.96
WHI0193	2008-1595	5/20/2008	Sulfate	4.87
WHI0193	2008-1314	4/15/2008	Sulfate	5.23
WHI0193	2008-1008	3/11/2008	Sulfate	6.63
WHI0193	2008-0298	2/4/2008	Sulfate	10.9
WHI0193	2008-0033	1/8/2008	Sulfate	9.3
WHI0193	2007-3131	12/11/2007	Sulfate	9.42
WHI0193	2007-2933	11/27/2007	Sulfate	9.33
WHI0193	2007-2618	10/16/2007	Sulfate	8.17
WHI0193	2007-2409	9/18/2007	Sulfate	8.92
WHI0193	2007-2260	8/7/2007	Sulfate	6.67
WHI0193	2007-1998	7/10/2007	Sulfate	5.38
WHI0193	2007-1699	6/5/2007	Sulfate	6.63
WHI0193	2007-1387	5/1/2007	Sulfate	6.15
WHI0193	2007-1074	4/3/2007	Sulfate	6.33
WHI0193	2007-0821	3/13/2007	Sulfate	6.43
WHI0193	2007-0547	2/6/2007	Sulfate	6.04
WHI0193	2007-0421	1/23/2007	Sulfate	5.83
WHI0193	2006-3281	12/19/2006	Sulfate	6.56
WHI0193	2006-3064	11/28/2006	Sulfate	6.26
WHI0193	2006-2752	10/17/2006	Sulfate	5.22

ADEQ Historical Monitoring Data for Sulfate at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2006-2549	9/19/2006	Sulfate	9.74
WHI0193	2006-2237	8/8/2006	Sulfate	6.46
WHI0048A	2006-1993	7/11/2006	Sulfate	6.51
WHI0048A	2006-1737	6/6/2006	Sulfate	5.77
WHI0048A	2006-1000	5/2/2006	Sulfate	5.67
WHI0048A	2006-0759	4/4/2006	Sulfate	7.19
WHI0048A	2006-0516	2/28/2006	Sulfate	10
WHI0048A	2006-0328	2/7/2006	Sulfate	9.4
WHI0048A	2006-0077	1/10/2006	Sulfate	9.75
WHI0048A	2005-3398	12/6/2005	Sulfate	8.39
WHI0048A	2005-3270	11/8/2005	Sulfate	8.19
WHI0048A	2005-2911	10/4/2005	Sulfate	7.65
WHI0048A	2005-1702	7/5/2005	Sulfate	7.07
WHI0048A	2005-1431	6/7/2005	Sulfate	5.57
WHI0048A	2005-1206	5/10/2005	Sulfate	5.52
WHI0048A	2005-0809	4/5/2005	Sulfate	5.34
WHI0048A	2005-0485	3/1/2005	Sulfate	5.85
WHI0048A	2005-0264	2/1/2005	Sulfate	5.89
WHI0048A	2005-0027	1/4/2005	Sulfate	4.69
WHI0048A	2004-3088	12/7/2004	Sulfate	5.56
WHI0048A	2004-2884	11/2/2004	Sulfate	5.95
WHI0048A	2004-2077	8/10/2004	Sulfate	6.69
WHI0048A	2004-1661	7/6/2004	Sulfate	5.79
WHI0048A	2004-1468	6/8/2004	Sulfate	5.01
WHI0048A	2004-1259	5/11/2004	Sulfate	19.3
WHI0048A	2004-0872	4/6/2004	Sulfate	6.45
WHI0048A	2004-0634	3/9/2004	Sulfate	6.85
WHI0048A	2004-0332	2/3/2004	Sulfate	7.59
WHI0048A	2004-0130	1/13/2004	Sulfate	8.74
WHI0048A	2003-3030	12/9/2003	Sulfate	7.35
WHI0048A	2003-2750	11/4/2003	Sulfate	8.08
WHI0048A	2003-2559	10/14/2003	Sulfate	7.73
WHI0048A	2003-2374	9/16/2003	Sulfate	6.43
WHI0048A	2003-2165	8/19/2003	Sulfate	6.13

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0048B** (Crooked Creek 2 miles south of Flippin, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048B	2013-2050	6/4/2013	Sulfate	5.93
WHI0048B	2013-1548	5/7/2013	Sulfate	6.88
WHI0048B	2013-0967	4/2/2013	Sulfate	7.54
WHI0048B	2013-0636	3/5/2013	Sulfate	7.49
WHI0048B	2013-0466	2/19/2013	Sulfate	8.5
WHI0048B	2012-1082	4/10/2012	Sulfate	4.85
WHI0048B	2012-0791	3/13/2012	Sulfate	5.36
WHI0048B	2012-0435	2/14/2012	Sulfate	5.58
WHI0048B	2012-0093	1/10/2012	Sulfate	6.88
WHI0048B	2011-3728	12/5/2011	Sulfate	7.51
WHI0048B	2011-1621	6/7/2011	Sulfate	4.84
WHI0048B	2011-1232	5/3/2011	Sulfate	4.74
WHI0048B	2011-0947	4/5/2011	Sulfate	7.14
WHI0048B	2011-0508	3/1/2011	Sulfate	8.77
WHI0048B	2010-1457	6/8/2010	Sulfate	4.99
WHI0048B	2010-1179	5/11/2010	Sulfate	4.54
WHI0048B	2010-0811	4/6/2010	Sulfate	4.81
WHI0048B	2010-0520	3/2/2010	Sulfate	5.37
WHI0048B	2010-0380	2/16/2010	Sulfate	5.32
WHI0048B	2010-0142	1/19/2010	Sulfate	5.92
WHI0048B	2009-3274	12/8/2009	Sulfate	5.16
WHI0048B	2009-3038	11/17/2009	Sulfate	4.85
WHI0048B	2009-2781	10/20/2009	Sulfate	5
WHI0048B	2009-2143	8/19/2009	Sulfate	5.32
WHI0048B	2009-1874	7/28/2009	Sulfate	5.46
WHI0048B	2009-1440	6/9/2009	Sulfate	5.25
WHI0048B	2009-1121	5/5/2009	Sulfate	5.19
WHI0048B	2009-1049	4/28/2009	Sulfate	5.62
WHI0048B	2009-0597	3/10/2009	Sulfate	6.63
WHI0048B	2009-0403	2/10/2009	Sulfate	5.82
WHI0048B	2008-2929	10/7/2008	Sulfate	5.14
WHI0048B	2008-2695	9/9/2008	Sulfate	4.47
WHI0048B	2008-2431	8/12/2008	Sulfate	4.42
WHI0048B	2008-2110	7/8/2008	Sulfate	4.96
WHI0048B	2008-1853	6/10/2008	Sulfate	5.54
WHI0048B	2008-1590	5/20/2008	Sulfate	4.96
WHI0048B	2008-1309	4/15/2008	Sulfate	5.26
WHI0048B	2008-1003	3/11/2008	Sulfate	6.7
WHI0048B	2007-1993	7/10/2007	Sulfate	5.63
WHI0048B	2007-1382	5/1/2007	Sulfate	6.12
WHI0048B	2007-1069	4/3/2007	Sulfate	6.39

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0048B** (Crooked Creek 2 miles south of Flippin, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048B	2007-0816	3/13/2007	Sulfate	6.51
WHI0048B	2007-0542	2/6/2007	Sulfate	6.16
WHI0048B	2007-0416	1/23/2007	Sulfate	5.89
WHI0048B	2006-1001	5/2/2006	Sulfate	5.88
WHI0048B	2005-1207	5/10/2005	Sulfate	5.43
WHI0048B	2005-0810	4/5/2005	Sulfate	5.42
WHI0048B	2005-0486	3/1/2005	Sulfate	5.96
WHI0048B	2005-0265	2/1/2005	Sulfate	5.88
WHI0048B	2005-0028	1/4/2005	Sulfate	5.49
WHI0048B	2004-3089	12/7/2004	Sulfate	5.73
WHI0048B	2004-2885	11/2/2004	Sulfate	5.83
WHI0048B	2004-1662	7/6/2004	Sulfate	5.71
WHI0048B	2004-1469	6/8/2004	Sulfate	5
WHI0048B	2004-1260	5/11/2004	Sulfate	5.27
WHI0048B	2004-0873	4/6/2004	Sulfate	6.55
WHI0048B	2004-0635	3/9/2004	Sulfate	7.1
WHI0048B	2004-0333	2/3/2004	Sulfate	7.47
WHI0048B	2003-3031	12/9/2003	Sulfate	7.81

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0048C** (Crooked Creek at Hwy 101, 2 miles north of Rea Valley, AR).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048C	2013-2051	6/4/2013	Sulfate	5.24
WHI0048C	2013-1549	5/7/2013	Sulfate	6.76
WHI0048C	2013-0968	4/2/2013	Sulfate	7.62
WHI0048C	2013-0637	3/5/2013	Sulfate	7.57
WHI0048C	2013-0467	2/19/2013	Sulfate	10.7
WHI0048C	2012-1083	4/10/2012	Sulfate	4.83
WHI0048C	2012-0792	3/13/2012	Sulfate	5.42
WHI0048C	2012-0436	2/14/2012	Sulfate	5.56
WHI0048C	2012-0094	1/10/2012	Sulfate	7.11
WHI0048C	2011-3729	12/5/2011	Sulfate	6.62
WHI0048C	2011-1622	6/7/2011	Sulfate	5.02
WHI0048C	2011-1233	5/3/2011	Sulfate	4.69
WHI0048C	2011-0948	4/5/2011	Sulfate	10.3
WHI0048C	2011-0509	3/1/2011	Sulfate	9.4
WHI0048C	2010-3113	9/28/2010	Sulfate	7
WHI0048C	2010-1777	7/6/2010	Sulfate	3.59
WHI0048C	2010-1458	6/8/2010	Sulfate	4.78
WHI0048C	2010-1180	5/11/2010	Sulfate	4.43
WHI0048C	2010-0812	4/6/2010	Sulfate	4.8
WHI0048C	2010-0521	3/2/2010	Sulfate	5.35
WHI0048C	2010-0381	2/16/2010	Sulfate	5.3
WHI0048C	2010-0143	1/19/2010	Sulfate	5.5
WHI0048C	2009-3275	12/8/2009	Sulfate	5.01
WHI0048C	2009-3039	11/17/2009	Sulfate	4.9
WHI0048C	2009-2782	10/20/2009	Sulfate	4.98
WHI0048C	2009-2299	9/1/2009	Sulfate	4.56
WHI0048C	2009-2144	8/19/2009	Sulfate	4.07
WHI0048C	2009-1875	7/28/2009	Sulfate	5.03
WHI0048C	2009-1441	6/9/2009	Sulfate	5.13
WHI0048C	2009-1122	5/5/2009	Sulfate	5.18
WHI0048C	2009-1050	4/28/2009	Sulfate	5.5
WHI0048C	2009-0598	3/10/2009	Sulfate	6.19
WHI0048C	2009-0404	2/10/2009	Sulfate	5.72
WHI0048C	2008-2930	10/7/2008	Sulfate	4.69
WHI0048C	2008-2696	9/9/2008	Sulfate	4.47
WHI0048C	2008-2432	8/12/2008	Sulfate	4.37
WHI0048C	2008-2111	7/8/2008	Sulfate	4.59
WHI0048C	2008-1854	6/10/2008	Sulfate	4.24
WHI0048C	2008-1591	5/20/2008	Sulfate	5.04
WHI0048C	2008-1310	4/15/2008	Sulfate	5.32
WHI0048C	2008-1004	3/11/2008	Sulfate	6.78

ADEQ Historical Monitoring Data for Sulfate at **Station WHI0048C** (Crooked Creek at Hwy 101, 2 miles north of Rea Valley, AR).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048C	2007-1994	7/10/2007	Sulfate	5.43
WHI0048C	2007-1383	5/1/2007	Sulfate	6.22
WHI0048C	2007-1070	4/3/2007	Sulfate	5.93
WHI0048C	2007-0817	3/13/2007	Sulfate	5.92
WHI0048C	2007-0543	2/6/2007	Sulfate	5.95
WHI0048C	2007-0417	1/23/2007	Sulfate	5.89
WHI0048C	2006-1738	6/6/2006	Sulfate	3.86
WHI0048C	2006-1002	5/2/2006	Sulfate	5.75
WHI0048C	2006-0760	4/4/2006	Sulfate	9.52
WHI0048C	2006-0329	2/7/2006	Sulfate	18.4
WHI0048C	2005-1432	6/7/2005	Sulfate	3.88
WHI0048C	2005-1208	5/10/2005	Sulfate	5.23
WHI0048C	2005-0811	4/5/2005	Sulfate	5.45
WHI0048C	2005-0487	3/1/2005	Sulfate	6.18
WHI0048C	2005-0266	2/1/2005	Sulfate	6.2
WHI0048C	2005-0029	1/4/2005	Sulfate	10.1
WHI0048C	2004-3090	12/7/2004	Sulfate	6.61
WHI0048C	2004-2886	11/2/2004	Sulfate	5.33
WHI0048C	2004-1663	7/6/2004	Sulfate	5.92
WHI0048C	2004-1470	6/8/2004	Sulfate	5.1
WHI0048C	2004-1261	5/11/2004	Sulfate	5.33
WHI0048C	2004-0874	4/6/2004	Sulfate	7.12
WHI0048C	2004-0636	3/9/2004	Sulfate	7.15
WHI0048C	2004-0334	2/3/2004	Sulfate	9.9
WHI0048C	2004-0131	1/13/2004	Sulfate	9.02
WHI0048C	2003-3032	12/9/2003	Sulfate	36.5

ADEQ Historical Monitoring Data for Chloride at **Station WHI0200** (Crooked Creek at Hudson Road).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0200	2013-2679	7/30/2013	Chloride	6.3
WHI0200	2013-2275	6/25/2013	Chloride	6.99
WHI0200	2013-1905	5/28/2013	Chloride	6.52
WHI0200	2013-1314	4/22/2013	Chloride	5.82
WHI0200	2013-0892	3/25/2013	Chloride	5.67
WHI0200	2013-0347	2/5/2013	Chloride	6.78
WHI0200	2013-0126	1/15/2013	Chloride	8.09
WHI0200	2012-3818	12/10/2012	Chloride	8.09
WHI0200	2012-3579	11/13/2012	Chloride	8.26
WHI0200	2012-3373	10/23/2012	Chloride	8.1
WHI0200	2012-3019	9/25/2012	Chloride	8.03
WHI0200	2012-2650	8/28/2012	Chloride	7.92
WHI0200	2012-2232	7/24/2012	Chloride	7.92
WHI0200	2012-1912	6/26/2012	Chloride	8.66
WHI0200	2012-1335	5/1/2012	Chloride	6.74
WHI0200	2012-1271	4/24/2012	Chloride	6.75
WHI0200	2012-0927	3/27/2012	Chloride	5.18
WHI0200	2012-0574	2/28/2012	Chloride	6.42
WHI0200	2012-0273	1/30/2012	Chloride	5.65
WHI0200	2011-3643	11/28/2011	Chloride	6.14

ADEQ Historical Monitoring Data for Chloride at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2013-2677	7/30/2013	Chloride	6.72
WHI0067	2013-2273	6/25/2013	Chloride	7.87
WHI0067	2013-1903	5/28/2013	Chloride	8.11
WHI0067	2013-1312	4/22/2013	Chloride	7.34
WHI0067	2013-0890	3/26/2013	Chloride	7.28
WHI0067	2013-0345	2/5/2013	Chloride	8.12
WHI0067	2013-0124	1/15/2013	Chloride	8.11
WHI0067	2012-3816	12/10/2012	Chloride	19.1
WHI0067	2012-3577	11/13/2012	Chloride	7.71
WHI0067	2012-3371	10/23/2012	Chloride	8.54
WHI0067	2012-3017	9/25/2012	Chloride	9.01
WHI0067	2012-2648	8/28/2012	Chloride	8.29
WHI0067	2012-2230	7/24/2012	Chloride	7.91
WHI0067	2012-1910	6/26/2012	Chloride	8.46
WHI0067	2012-1333	5/1/2012	Chloride	6.84
WHI0067	2012-1269	4/24/2012	Chloride	6.77
WHI0067	2012-0925	3/27/2012	Chloride	5.6
WHI0067	2012-0572	2/28/2012	Chloride	6.96
WHI0067	2012-0271	1/30/2012	Chloride	6.08
WHI0067	2011-3934	12/12/2011	Chloride	7.59
WHI0067	2011-3540	11/15/2011	Chloride	9.84
WHI0067	2011-3270	10/18/2011	Chloride	8.94
WHI0067	2011-2909	8/20/2011	Chloride	8.43
WHI0067	2011-2525	8/16/2011	Chloride	8.64
WHI0067	2011-2145	7/18/2011	Chloride	7.77
WHI0067	2011-1784	6/14/2011	Chloride	7.73
WHI0067	2011-1419	5/17/2011	Chloride	7.26
WHI0067	2011-1151	4/26/2011	Chloride	5.19
WHI0067	2011-0823	3/29/2011	Chloride	9.18
WHI0067	2011-0482	2/22/2011	Chloride	15.9
WHI0067	2011-0250	1/25/2011	Chloride	10.3
WHI0067	2010-3936	12/28/2010	Chloride	16.9
WHI0067	2010-3647	11/21/2010	Chloride	7.21
WHI0067	2010-3407	10/26/2010	Chloride	7.69
WHI0067	2010-3047	9/21/2010	Chloride	8.1
WHI0067	2010-2356	8/10/2010	Chloride	7.32
WHI0067	2010-1972	7/20/2010	Chloride	7.71
WHI0067	2010-1540	6/16/2010	Chloride	7.34
WHI0067	2010-1106	5/4/2010	Chloride	9.17
WHI0067	2010-0909	4/13/2010	Chloride	6.89
WHI0067	2010-0673	3/16/2010	Chloride	7.28

ADEQ Historical Monitoring Data for Chloride at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2010-0485	2/23/2010	Chloride	7.22
WHI0067	2010-0095	1/12/2010	Chloride	7.11
WHI0067	2009-3178	12/1/2009	Chloride	6.42
WHI0067	2009-2974	11/3/2009	Chloride	6.75
WHI0067	2009-2730	10/13/2009	Chloride	4.58
WHI0067	2009-2420	9/15/2009	Chloride	4.25
WHI0067	2009-2078	8/10/2009	Chloride	11.6
WHI0067	2009-1833	7/21/2009	Chloride	4.8
WHI0067	2009-1567	6/23/2009	Chloride	6.83
WHI0067	2009-0908	4/7/2009	Chloride	6.51
WHI0067	2009-0433	2/17/2009	Chloride	7.55
WHI0067	2009-0102	1/13/2009	Chloride	10.3
WHI0067	2008-3497	12/9/2008	Chloride	6.55
WHI0067	2008-3352	11/24/2008	Chloride	6.96
WHI0067	2008-3070	10/21/2008	Chloride	6.46
WHI0067	2008-2762	9/16/2008	Chloride	5.69
WHI0067	2008-2514	8/19/2008	Chloride	7
WHI0067	2008-2171	7/15/2008	Chloride	6.6
WHI0067	2008-1936	6/17/2008	Chloride	11.8
WHI0067	2008-1515	5/13/2008	Chloride	5.99
WHI0067	2008-1197	4/1/2008	Chloride	3.9
WHI0067	2009-0674	3/17/2008	Chloride	7.68
WHI0067	2008-0949	3/3/2008	Chloride	2.85
WHI0067	2008-0803	2/19/2008	Chloride	7.95
WHI0067	2008-0126	1/15/2008	Chloride	8.92
WHI0067	2007-3030	12/4/2007	Chloride	8.25
WHI0067	2007-2853	11/13/2007	Chloride	8.7
WHI0067	2007-2529	10/2/2007	Chloride	7.67
WHI0067	2007-2342	9/5/2007	Chloride	8.56
WHI0067	2007-2085	7/17/2007	Chloride	7.7
WHI0067	2007-1853	6/19/2007	Chloride	7.56
WHI0067	2007-1545	5/15/2007	Chloride	7.23
WHI0067	2007-1135	4/10/2007	Chloride	7.84
WHI0067	2007-1014	3/27/2007	Chloride	7.86
WHI0067	2007-0753	2/27/2007	Chloride	8.22
WHI0067	2007-0378	1/16/2007	Chloride	6.56
WHI0067	2006-3203	12/12/2006	Chloride	10.2
WHI0067	2006-2870	10/31/2006	Chloride	8.7
WHI0067	2006-2690	10/10/2006	Chloride	8.95
WHI0067	2006-2483	9/12/2006	Chloride	7.89
WHI0067	2006-2296	8/15/2006	Chloride	9.33

ADEQ Historical Monitoring Data for Chloride at **Station WHI0067** (Crooked Creek above Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0067	2006-2081	7/18/2006	Chloride	8.57
WHI0067	2006-1839	6/20/2006	Chloride	7.89
WHI0067	2006-1088	5/16/2006	Chloride	7.22
WHI0067	2006-0877	4/18/2006	Chloride	9.07
WHI0067	2006-0572	3/7/2006	Chloride	11.3
WHI0067	2006-0236	1/31/2006	Chloride	8.87
WHI0067	2006-0010	1/3/2006	Chloride	8.79
WHI0067	2005-3489	12/13/2005	Chloride	8.33
WHI0067	2005-3334	11/15/2005	Chloride	6.58
WHI0067	2005-3098	10/18/2005	Chloride	8.76
WHI0067	2005-2617	9/13/2005	Chloride	8.45
WHI0067	2005-2263	8/16/2005	Chloride	7.52
WHI0067	2005-2031	7/26/2005	Chloride	8.34
WHI0067	2005-1481	6/14/2005	Chloride	7.73
WHI0067	2005-1249	5/17/2005	Chloride	7.78
WHI0067	2005-0919	4/12/2005	Chloride	5.55
WHI0067	2005-0581	3/15/2005	Chloride	8.07
WHI0067	2005-0310	2/8/2005	Chloride	8.04
WHI0067	2005-0105	1/11/2005	Chloride	8.2
WHI0067	2004-3175	12/14/2004	Chloride	7.65
WHI0067	2004-3031	11/16/2004	Chloride	8.19
WHI0067	2004-2782	10/19/2004	Chloride	9.14
WHI0067	2004-2584	9/28/2004	Chloride	8.34
WHI0067	2004-2324	8/24/2004	Chloride	8.36
WHI0067	2004-1942	7/27/2004	Chloride	8.05
WHI0067	2004-1563	6/22/2004	Chloride	11.4
WHI0067	2004-1409	5/25/2004	Chloride	7.29
WHI0067	2004-1168	4/27/2004	Chloride	7.42
WHI0067	2004-0802	3/30/2004	Chloride	7.39
WHI0067	2004-0536	2/24/2004	Chloride	8.91
WHI0067	2004-0287	1/27/2004	Chloride	9.18
WHI0067	2003-3086	12/16/2003	Chloride	10.1
WHI0067	2003-2917	11/18/2003	Chloride	7.19
WHI0067	2003-2653	10/21/2003	Chloride	10.1
WHI0067	2003-2354	9/9/2003	Chloride	9.5
WHI0067	2003-2067	8/5/2003	Chloride	8.26

ADEQ Historical Monitoring Data for Chloride at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2013-2678	7/30/2013	Chloride	12.7
WHI0066	2013-2274	6/25/2013	Chloride	13.9
WHI0066	2013-1904	5/28/2013	Chloride	12.9
WHI0066	2013-1313	4/22/2013	Chloride	10.1
WHI0066	2013-0891	3/26/2013	Chloride	9.14
WHI0066	2013-0346	2/5/2013	Chloride	10.7
WHI0066	2013-0125	1/15/2013	Chloride	14.4
WHI0066	2012-3817	12/10/2012	Chloride	21.3
WHI0066	2012-3578	11/13/2012	Chloride	18.4
WHI0066	2012-3372	10/23/2012	Chloride	19.4
WHI0066	2012-3018	9/25/2012	Chloride	20.2
WHI0066	2012-2649	8/28/2012	Chloride	20.6
WHI0066	2012-2231	7/24/2012	Chloride	18.6
WHI0066	2012-1911	6/26/2012	Chloride	16.5
WHI0066	2012-1334	5/1/2012	Chloride	10.5
WHI0066	2012-1270	4/24/2012	Chloride	10
WHI0066	2012-0926	3/27/2012	Chloride	6.26
WHI0066	2012-0573	2/28/2012	Chloride	9.73
WHI0066	2012-0272	1/30/2012	Chloride	7.64
WHI0066	2011-3935	12/12/2011	Chloride	11.9
WHI0066	2011-3541	11/15/2011	Chloride	14.1
WHI0066	2011-3271	10/18/2011	Chloride	16.5
WHI0066	2011-2910	8/20/2011	Chloride	11.5
WHI0066	2011-2526	8/16/2011	Chloride	13
WHI0066	2011-2146	7/18/2011	Chloride	10.9
WHI0066	2011-1785	6/14/2011	Chloride	9.49
WHI0066	2011-1420	5/17/2011	Chloride	8.45
WHI0066	2011-1152	4/26/2011	Chloride	5.24
WHI0066	2011-0824	3/29/2011	Chloride	14.2
WHI0066	2011-0483	2/22/2011	Chloride	21.6
WHI0066	2011-0251	1/25/2011	Chloride	24
WHI0066	2010-3937	12/28/2010	Chloride	15.2
WHI0066	2010-3648	11/21/2010	Chloride	13.7
WHI0066	2010-3408	10/26/2010	Chloride	14.3
WHI0066	2010-3048	9/21/2010	Chloride	9.93
WHI0066	2010-2357	8/10/2010	Chloride	12.1
WHI0066	2010-1973	7/20/2010	Chloride	9.28
WHI0066	2010-1541	6/16/2010	Chloride	10.3
WHI0066	2010-1107	5/4/2010	Chloride	6.88
WHI0066	2010-0910	4/13/2010	Chloride	8.24
WHI0066	2010-0674	3/16/2010	Chloride	9.9

ADEQ Historical Monitoring Data for Chloride at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2010-0486	2/23/2010	Chloride	8.81
WHI0066	2010-0096	1/12/2010	Chloride	9.76
WHI0066	2009-3179	12/1/2009	Chloride	8.1
WHI0066	2009-2975	11/3/2009	Chloride	6.6
WHI0066	2009-2731	10/13/2009	Chloride	4.55
WHI0066	2009-2419	9/15/2009	Chloride	7.4
WHI0066	2009-2077	8/10/2009	Chloride	7.14
WHI0066	2009-1834	7/21/2009	Chloride	5.29
WHI0066	2009-1568	6/23/2009	Chloride	8.59
WHI0066	2009-1281	5/19/2009	Chloride	8.64
WHI0066	2009-0909	4/7/2009	Chloride	7.76
WHI0066	2009-0434	2/17/2009	Chloride	8.82
WHI0066	2009-0103	1/13/2009	Chloride	7.09
WHI0066	2008-3498	12/9/2008	Chloride	13.1
WHI0066	2008-3353	11/24/2008	Chloride	12
WHI0066	2008-3071	10/21/2008	Chloride	9.25
WHI0066	2008-3068	10/21/2008	Chloride	5.99
WHI0066	2008-2763	9/16/2008	Chloride	6.62
WHI0066	2008-2515	8/19/2008	Chloride	9.64
WHI0066	2008-2172	7/15/2008	Chloride	8.5
WHI0066	2008-1935	6/17/2008	Chloride	7.35
WHI0066	2008-1516	5/13/2008	Chloride	7.56
WHI0066	2008-1198	4/1/2008	Chloride	4.29
WHI0066	2009-0675	3/17/2008	Chloride	10.6
WHI0066	2008-0950	3/3/2008	Chloride	3.16
WHI0066	2008-0804	2/19/2008	Chloride	11.2
WHI0066	2008-0127	1/15/2008	Chloride	19.3
WHI0066	2007-3031	12/4/2007	Chloride	25.6
WHI0066	2007-2854	11/13/2007	Chloride	23.2
WHI0066	2007-2530	10/2/2007	Chloride	19.3
WHI0066	2007-2343	9/5/2007	Chloride	20.6
WHI0066	2007-2086	7/17/2007	Chloride	11.1
WHI0066	2007-1854	6/19/2007	Chloride	14.6
WHI0066	2007-1546	5/15/2007	Chloride	11
WHI0066	2007-1136	4/10/2007	Chloride	13.8
WHI0066	2007-1015	3/27/2007	Chloride	11.2
WHI0066	2007-0754	2/27/2007	Chloride	10.1
WHI0066	2007-0379	1/16/2007	Chloride	7.36
WHI0066	2006-3204	12/12/2006	Chloride	8.94
WHI0066	2006-2871	10/31/2006	Chloride	15.4
WHI0066	2006-2691	10/10/2006	Chloride	22.4

ADEQ Historical Monitoring Data for Chloride at **Station WHI0066** (Crooked Creek below Harrison, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0066	2006-2484	9/12/2006	Chloride	12.9
WHI0066	2006-2297	8/15/2006	Chloride	26.6
WHI0066	2006-2082	7/18/2006	Chloride	21.7
WHI0066	2006-1840	6/20/2006	Chloride	17.1
WHI0066	2006-1089	5/16/2006	Chloride	9.39
WHI0066	2006-0878	4/18/2006	Chloride	16.9
WHI0066	2006-0573	3/7/2006	Chloride	23.2
WHI0066	2006-0237	1/31/2006	Chloride	15.9
WHI0066	2006-0011	1/3/2006	Chloride	21.3
WHI0066	2005-3490	12/13/2005	Chloride	21.1
WHI0066	2005-3335	11/15/2005	Chloride	10.6
WHI0066	2005-3099	10/18/2005	Chloride	21.5
WHI0066	2005-2618	9/13/2005	Chloride	25.2
WHI0066	2005-2264	8/16/2005	Chloride	17.3
WHI0066	2005-2032	7/26/2005	Chloride	21.5
WHI0066	2005-1482	6/14/2005	Chloride	17.2
WHI0066	2005-1250	5/17/2005	Chloride	12.3
WHI0066	2005-0920	4/12/2005	Chloride	6.47
WHI0066	2005-0582	3/15/2005	Chloride	11.8
WHI0066	2005-0311	2/8/2005	Chloride	10.8
WHI0066	2005-0106	1/11/2005	Chloride	9.86
WHI0066	2004-3176	12/14/2004	Chloride	10.5
WHI0066	2004-3032	11/16/2004	Chloride	11.4
WHI0066	2004-2783	10/19/2004	Chloride	16.7
WHI0066	2004-2585	9/28/2004	Chloride	21.9
WHI0066	2004-2325	8/24/2004	Chloride	18.2
WHI0066	2004-1943	7/27/2004	Chloride	14
WHI0066	2004-1564	6/22/2004	Chloride	7.2
WHI0066	2004-1410	5/25/2004	Chloride	10.7
WHI0066	2004-1169	4/27/2004	Chloride	8.15
WHI0066	2004-0803	3/30/2004	Chloride	12.2
WHI0066	2004-0537	2/24/2004	Chloride	14.9
WHI0066	2004-0288	1/27/2004	Chloride	12.8
WHI0066	2003-3087	12/16/2003	Chloride	17.4
WHI0066	2003-2918	11/18/2003	Chloride	11.3
WHI0066	2003-2654	10/21/2003	Chloride	22.6
WHI0066	2003-2355	9/9/2003	Chloride	20
WHI0066	2003-2068	8/5/2003	Chloride	16.2

ADEQ Historical Monitoring Data for Chloride at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2013-2444	7/9/2013	Chloride	8.32
WHI0193	2013-2054	6/4/2013	Chloride	6.28
WHI0193	2013-1552	5/7/2013	Chloride	4.96
WHI0193	2013-0971	4/2/2013	Chloride	6.3
WHI0193	2013-0640	3/5/2013	Chloride	6.58
WHI0193	2013-0470	2/19/2013	Chloride	7.4
WHI0193	2013-0068	1/8/2013	Chloride	10.3
WHI0193	2012-3781	12/4/2012	Chloride	10.3
WHI0193	2012-3485	11/5/2012	Chloride	10.3
WHI0193	2012-3199	10/9/2012	Chloride	10.2
WHI0193	2012-2836	9/11/2012	Chloride	9.48
WHI0193	2012-2390	8/7/2012	Chloride	9.41
WHI0193	2012-2038	7/10/2012	Chloride	8.37
WHI0193	2012-1786	6/12/2012	Chloride	7.85
WHI0193	2012-1558	5/22/2012	Chloride	7.19
WHI0193	2012-1086	4/10/2012	Chloride	5.42
WHI0193	2012-0795	3/13/2012	Chloride	4.24
WHI0193	2012-0439	2/14/2012	Chloride	5.31
WHI0193	2012-0097	1/10/2012	Chloride	6.9
WHI0193	2011-3732	12/5/2011	Chloride	5.8
WHI0193	2011-3434	11/1/2011	Chloride	9.16
WHI0193	2011-3116	10/4/2011	Chloride	9
WHI0193	2011-2785	9/6/2011	Chloride	9.86
WHI0193	2011-2749	8/30/2011	Chloride	9.02
WHI0193	2011-2020	7/5/2011	Chloride	7.78
WHI0193	2011-1625	6/7/2011	Chloride	6.85
WHI0193	2011-1236	5/3/2011	Chloride	3.44
WHI0193	2011-0951	4/5/2011	Chloride	8.26
WHI0193	2011-0512	3/1/2011	Chloride	8.97
WHI0193	2011-0333	2/7/2011	Chloride	9.95
WHI0193	2011-0099	1/18/2011	Chloride	9.84
WHI0193	2010-3792	12/7/2010	Chloride	8.28
WHI0193	2010-3615	11/16/2010	Chloride	8.55
WHI0193	2010-3320	10/19/2010	Chloride	8.26
WHI0193	2010-3117	9/28/2010	Chloride	7.5
WHI0193	2010-2556	8/17/2010	Chloride	7.76
WHI0193	2010-1781	7/6/2010	Chloride	7.75
WHI0193	2010-1462	6/8/2010	Chloride	5.8
WHI0193	2010-1184	5/11/2010	Chloride	4.18
WHI0193	2010-0816	4/6/2010	Chloride	4.71
WHI0193	2010-0525	3/2/2010	Chloride	5.98

ADEQ Historical Monitoring Data for Chloride at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2010-0385	2/16/2010	Chloride	5.68
WHI0193	2010-0147	1/19/2010	Chloride	6.43
WHI0193	2009-3279	12/8/2009	Chloride	5.44
WHI0193	2009-3043	11/17/2009	Chloride	5.07
WHI0193	2009-2786	10/20/2009	Chloride	4.96
WHI0193	2009-2303	9/1/2009	Chloride	7.61
WHI0193	2009-2148	8/19/2009	Chloride	7.07
WHI0193	2009-1879	7/28/2009	Chloride	6.16
WHI0193	2009-1445	6/9/2009	Chloride	6.41
WHI0193	2009-1126	5/5/2009	Chloride	4.06
WHI0193	2009-1054	4/28/2009	Chloride	5.58
WHI0193	2009-0602	3/10/2009	Chloride	6.87
WHI0193	2009-0408	2/10/2009	Chloride	5.61
WHI0193	2009-0220	1/20/2009	Chloride	8.16
WHI0193	2008-3517	12/9/2008	Chloride	8.32
WHI0193	2008-3273	11/18/2008	Chloride	7.46
WHI0193	2008-2934	10/7/2008	Chloride	6.14
WHI0193	2008-2700	9/9/2008	Chloride	4.63
WHI0193	2008-2436	8/12/2008	Chloride	4.5
WHI0193	2008-2115	7/8/2008	Chloride	5.16
WHI0193	2008-1858	6/10/2008	Chloride	6.77
WHI0193	2008-1595	5/20/2008	Chloride	5.32
WHI0193	2008-1314	4/15/2008	Chloride	5.09
WHI0193	2008-1008	3/11/2008	Chloride	7.08
WHI0193	2008-0298	2/4/2008	Chloride	10.7
WHI0193	2008-0033	1/8/2008	Chloride	10
WHI0193	2007-3131	12/11/2007	Chloride	10.4
WHI0193	2007-2933	11/27/2007	Chloride	11.9
WHI0193	2007-2618	10/16/2007	Chloride	10.7
WHI0193	2007-2409	9/18/2007	Chloride	10.4
WHI0193	2007-2260	8/7/2007	Chloride	10.1
WHI0193	2007-1998	7/10/2007	Chloride	5.61
WHI0193	2007-1699	6/5/2007	Chloride	7.83
WHI0193	2007-1387	5/1/2007	Chloride	5.97
WHI0193	2007-1074	4/3/2007	Chloride	7.86
WHI0193	2007-0821	3/13/2007	Chloride	7.33
WHI0193	2007-0547	2/6/2007	Chloride	7.06
WHI0193	2007-0421	1/23/2007	Chloride	6.52
WHI0193	2006-3281	12/19/2006	Chloride	8
WHI0193	2006-3064	11/28/2006	Chloride	7.54
WHI0193	2006-2752	10/17/2006	Chloride	4.23

ADEQ Historical Monitoring Data for Chloride at **Stations WHI0048A/WHI0193** (Crooked Creek west of Yellville at Kelly's Slab).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0193	2006-2549	9/19/2006	Chloride	11.9
WHI0193	2006-2237	8/8/2006	Chloride	10.2
WHI0048A	2006-1993	7/11/2006	Chloride	8.3
WHI0048A	2006-1737	6/6/2006	Chloride	7.65
WHI0048A	2006-1000	5/2/2006	Chloride	4.59
WHI0048A	2006-0759	4/4/2006	Chloride	8.18
WHI0048A	2006-0516	2/28/2006	Chloride	10.5
WHI0048A	2006-0328	2/7/2006	Chloride	9.64
WHI0048A	2006-0077	1/10/2006	Chloride	10.5
WHI0048A	2005-3398	12/6/2005	Chloride	10.3
WHI0048A	2005-3270	11/8/2005	Chloride	11.8
WHI0048A	2005-2911	10/4/2005	Chloride	9.37
WHI0048A	2005-1702	7/5/2005	Chloride	9.72
WHI0048A	2005-1431	6/7/2005	Chloride	7.78
WHI0048A	2005-1206	5/10/2005	Chloride	6.96
WHI0048A	2005-0809	4/5/2005	Chloride	5.97
WHI0048A	2005-0485	3/1/2005	Chloride	6.31
WHI0048A	2005-0264	2/1/2005	Chloride	7.11
WHI0048A	2005-0027	1/4/2005	Chloride	3.77
WHI0048A	2004-3088	12/7/2004	Chloride	5.7
WHI0048A	2004-2884	11/2/2004	Chloride	5.41
WHI0048A	2004-2077	8/10/2004	Chloride	9.45
WHI0048A	2004-1661	7/6/2004	Chloride	7.33
WHI0048A	2004-1468	6/8/2004	Chloride	7.34
WHI0048A	2004-1259	5/11/2004	Chloride	36.1
WHI0048A	2004-0872	4/6/2004	Chloride	7.48
WHI0048A	2004-0634	3/9/2004	Chloride	6.83
WHI0048A	2004-0332	2/3/2004	Chloride	7.83
WHI0048A	2004-0130	1/13/2004	Chloride	8.76
WHI0048A	2003-3030	12/9/2003	Chloride	7.5
WHI0048A	2003-2750	11/4/2003	Chloride	11.2
WHI0048A	2003-2559	10/14/2003	Chloride	10
WHI0048A	2003-2374	9/16/2003	Chloride	9.4
WHI0048A	2003-2165	8/19/2003	Chloride	10.3

ADEQ Historical Monitoring Data for Chloride at **Station WHI0048B** (Crooked Creek 2 miles south of Flippin, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048B	2013-2050	6/4/2013	Chloride	6.38
WHI0048B	2013-1548	5/7/2013	Chloride	4.71
WHI0048B	2013-0967	4/2/2013	Chloride	6.23
WHI0048B	2013-0636	3/5/2013	Chloride	6.59
WHI0048B	2013-0466	2/19/2013	Chloride	7.42
WHI0048B	2012-1082	4/10/2012	Chloride	5.38
WHI0048B	2012-0791	3/13/2012	Chloride	4.29
WHI0048B	2012-0435	2/14/2012	Chloride	5.36
WHI0048B	2012-0093	1/10/2012	Chloride	6.84
WHI0048B	2011-3728	12/5/2011	Chloride	6.01
WHI0048B	2011-1621	6/7/2011	Chloride	6.05
WHI0048B	2011-1232	5/3/2011	Chloride	3.38
WHI0048B	2011-0947	4/5/2011	Chloride	7.71
WHI0048B	2011-0508	3/1/2011	Chloride	9.18
WHI0048B	2010-1457	6/8/2010	Chloride	5.85
WHI0048B	2010-1179	5/11/2010	Chloride	4.58
WHI0048B	2010-0811	4/6/2010	Chloride	4.51
WHI0048B	2010-0520	3/2/2010	Chloride	6.09
WHI0048B	2010-0380	2/16/2010	Chloride	5.66
WHI0048B	2010-0142	1/19/2010	Chloride	6.33
WHI0048B	2009-3274	12/8/2009	Chloride	5.68
WHI0048B	2009-3038	11/17/2009	Chloride	5.3
WHI0048B	2009-2781	10/20/2009	Chloride	4.85
WHI0048B	2009-2143	8/19/2009	Chloride	6.9
WHI0048B	2009-1874	7/28/2009	Chloride	6.06
WHI0048B	2009-1440	6/9/2009	Chloride	6.36
WHI0048B	2009-1121	5/5/2009	Chloride	4.47
WHI0048B	2009-1049	4/28/2009	Chloride	6.21
WHI0048B	2009-0597	3/10/2009	Chloride	6.87
WHI0048B	2009-0403	2/10/2009	Chloride	5.79
WHI0048B	2008-2929	10/7/2008	Chloride	6.26
WHI0048B	2008-2695	9/9/2008	Chloride	4.64
WHI0048B	2008-2431	8/12/2008	Chloride	4.3
WHI0048B	2008-2110	7/8/2008	Chloride	5.04
WHI0048B	2008-1853	6/10/2008	Chloride	6.6
WHI0048B	2008-1590	5/20/2008	Chloride	5.16
WHI0048B	2008-1309	4/15/2008	Chloride	5.26
WHI0048B	2008-1003	3/11/2008	Chloride	6.62
WHI0048B	2007-1993	7/10/2007	Chloride	4.84
WHI0048B	2007-1382	5/1/2007	Chloride	6.01
WHI0048B	2007-1069	4/3/2007	Chloride	7.55

ADEQ Historical Monitoring Data for Chloride at **Station WHI0048B** (Crooked Creek 2 miles south of Flippin, Arkansas).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048B	2007-0816	3/13/2007	Chloride	7.32
WHI0048B	2007-0542	2/6/2007	Chloride	7.02
WHI0048B	2007-0416	1/23/2007	Chloride	6.44
WHI0048B	2006-1001	5/2/2006	Chloride	4.51
WHI0048B	2005-1207	5/10/2005	Chloride	6.99
WHI0048B	2005-0810	4/5/2005	Chloride	6
WHI0048B	2005-0486	3/1/2005	Chloride	6.3
WHI0048B	2005-0265	2/1/2005	Chloride	7
WHI0048B	2005-0028	1/4/2005	Chloride	5.2
WHI0048B	2004-3089	12/7/2004	Chloride	5.34
WHI0048B	2004-2885	11/2/2004	Chloride	4.86
WHI0048B	2004-1662	7/6/2004	Chloride	7.17
WHI0048B	2004-1469	6/8/2004	Chloride	7.36
WHI0048B	2004-1260	5/11/2004	Chloride	6.04
WHI0048B	2004-0873	4/6/2004	Chloride	7.49
WHI0048B	2004-0635	3/9/2004	Chloride	6.89
WHI0048B	2004-0333	2/3/2004	Chloride	7.84
WHI0048B	2003-3031	12/9/2003	Chloride	7.15

ADEQ Historical Monitoring Data for Chloride at **Station WHI0048C**
(Crooked Creek at Hwy 101, 2 miles north of Rea Valley, AR).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048C	2013-2051	6/4/2013	Chloride	5.56
WHI0048C	2013-1549	5/7/2013	Chloride	4.95
WHI0048C	2013-0968	4/2/2013	Chloride	6.07
WHI0048C	2013-0637	3/5/2013	Chloride	6.5
WHI0048C	2013-0467	2/19/2013	Chloride	6.23
WHI0048C	2012-1083	4/10/2012	Chloride	5.36
WHI0048C	2012-0792	3/13/2012	Chloride	4.39
WHI0048C	2012-0436	2/14/2012	Chloride	5.26
WHI0048C	2012-0094	1/10/2012	Chloride	6.54
WHI0048C	2011-3729	12/5/2011	Chloride	5.41
WHI0048C	2011-1622	6/7/2011	Chloride	6
WHI0048C	2011-1233	5/3/2011	Chloride	3.5
WHI0048C	2011-0948	4/5/2011	Chloride	6.86
WHI0048C	2011-0509	3/1/2011	Chloride	9.68
WHI0048C	2010-3113	9/28/2010	Chloride	6.98
WHI0048C	2010-1777	7/6/2010	Chloride	6.2
WHI0048C	2010-1458	6/8/2010	Chloride	5.62
WHI0048C	2010-1180	5/11/2010	Chloride	4.13
WHI0048C	2010-0812	4/6/2010	Chloride	4.5
WHI0048C	2010-0521	3/2/2010	Chloride	6
WHI0048C	2010-0381	2/16/2010	Chloride	5.81
WHI0048C	2010-0143	1/19/2010	Chloride	6.06
WHI0048C	2009-3275	12/8/2009	Chloride	5.41
WHI0048C	2009-3039	11/17/2009	Chloride	5.08
WHI0048C	2009-2782	10/20/2009	Chloride	4.88
WHI0048C	2009-2299	9/1/2009	Chloride	6.38
WHI0048C	2009-2144	8/19/2009	Chloride	5.91
WHI0048C	2009-1875	7/28/2009	Chloride	5.45
WHI0048C	2009-1441	6/9/2009	Chloride	6.33
WHI0048C	2009-1122	5/5/2009	Chloride	3.9
WHI0048C	2009-1050	4/28/2009	Chloride	6.09
WHI0048C	2009-0598	3/10/2009	Chloride	6.71
WHI0048C	2009-0404	2/10/2009	Chloride	5.81
WHI0048C	2008-2930	10/7/2008	Chloride	6.36
WHI0048C	2008-2696	9/9/2008	Chloride	4.63
WHI0048C	2008-2432	8/12/2008	Chloride	4.38
WHI0048C	2008-2111	7/8/2008	Chloride	4.71
WHI0048C	2008-1854	6/10/2008	Chloride	6.08
WHI0048C	2008-1591	5/20/2008	Chloride	5.13
WHI0048C	2008-1310	4/15/2008	Chloride	5.13
WHI0048C	2008-1004	3/11/2008	Chloride	6.82

ADEQ Historical Monitoring Data for Chloride at **Station WHI0048C** (Crooked Creek at Hwy 101, 2 miles north of Rea Valley, AR).

Station ID	ADEQ Lab Number	Date Sampled	Parameter	Concentration (mg/L)
WHI0048C	2007-1994	7/10/2007	Chloride	1.81
WHI0048C	2007-1383	5/1/2007	Chloride	6.42
WHI0048C	2007-1070	4/3/2007	Chloride	7.48
WHI0048C	2007-0817	3/13/2007	Chloride	7.21
WHI0048C	2007-0543	2/6/2007	Chloride	7.37
WHI0048C	2007-0417	1/23/2007	Chloride	6.35
WHI0048C	2006-1738	6/6/2006	Chloride	7.07
WHI0048C	2006-1002	5/2/2006	Chloride	4.61
WHI0048C	2006-0760	4/4/2006	Chloride	8.07
WHI0048C	2006-0329	2/7/2006	Chloride	6.53
WHI0048C	2005-1432	6/7/2005	Chloride	7.02
WHI0048C	2005-1208	5/10/2005	Chloride	6.58
WHI0048C	2005-0811	4/5/2005	Chloride	5.99
WHI0048C	2005-0487	3/1/2005	Chloride	6.37
WHI0048C	2005-0266	2/1/2005	Chloride	7.09
WHI0048C	2005-0029	1/4/2005	Chloride	11.7
WHI0048C	2004-3090	12/7/2004	Chloride	5.58
WHI0048C	2004-2886	11/2/2004	Chloride	4.1
WHI0048C	2004-1663	7/6/2004	Chloride	6.26
WHI0048C	2004-1470	6/8/2004	Chloride	6.56
WHI0048C	2004-1261	5/11/2004	Chloride	6.08
WHI0048C	2004-0874	4/6/2004	Chloride	7.55
WHI0048C	2004-0636	3/9/2004	Chloride	6.71
WHI0048C	2004-0334	2/3/2004	Chloride	7.53
WHI0048C	2004-0131	1/13/2004	Chloride	8.59
WHI0048C	2003-3032	12/9/2003	Chloride	7.36