Loutre Creek – Section 2.306 Site Specific Water Quality Study

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1.0 INTRODUCTION

1.1 Background

This report presents the documentation developed in support of a proposed third-party rule making to address the existing final permit limits for dissolved minerals in the Lion Oil Company's (Lion Oil) NPDES permit (AR0000647). The documentation was developed in accordance with the project study plan developed for the aquatic life field study and as submitted to ADEQ for their review and comment (Appendix A). This documentation is required by Section 2.306 of the Arkansas Water Quality Standards (WQS) in support of the proposed modifications of designated but non-existing and unattainable domestic water supply use and associated water quality criteria for dissolved minerals (sulfates, SO_4; chlorides, Cl^- and total dissolved solids, TDS). This report also addresses the requirements of the 1994 Administrative Guidance Document of the ADEQ, which clarifies the Section 2.306 documentation process.

In addition, this report provides documentation regarding the attainability of the domestic water supply use from the perspective of the 40 CFR 131.10(g) rationale for use removal. The requirement for providing 40 CFR 131.10(g) documentation is to fulfill USEPA Region 6 requests for inclusion of use attainability information in the third party rule making process.

Lion Oil has operated an oil refinery, storage, and distribution center in, El Dorado, Arkansas, Union County since 1922 (Figure 1.1). Current refinery capacity is approximately 70,000 barrels per day (bpd). Recent increases in waste water effluent dissolved solids (especially SO_4 and TDS) have resulted from environmental improvements directed at air emissions control as mandated by EPA and ADEQ. In 2003, Lion Oil entered in to a Consent Decree jointly signed by ADEQ and EPA. The Decree required Lion Oil to install a wet scrubber on the facility's Cat Cracker to reduce SO_2 air emissions. That emissions control equipment was added and functional by March 2004. The scrubber uses sodium hydroxide and an oxidation system to ultimately convert the SO_2 to sodium sulfate (Na_2SO_4) in a water solution. The resulting Na_2SO_4 (dissolved minerals) is captured in the process waste water. Since the waste water treatment is not designed to remove dissolved minerals (and there is no economical treatment technology available for the removal of dissolved minerals), the resulting impact is an increase of approximately 1500-2000 ppm TDS to the Outfall 001 discharge, primarily in the form of Na_2SO_4.

In addition, Lion Oil has recently installed a new diesel hydrotreater and a gasoline hydrotreater to meet the new and more stringent sulfur standards for Tier 2 fuels. These regulatory required modifications also contribute additional TDS to the process waste water.

1.2 Report Focus and Objective

The focus of this report are the discharges from the treated process wastewater outfall (Outfall 001) and the storm water outfalls (002, 003, 004, 005, & 006/007) covered under their current NPDES permit. Each outfall discharges into Loutre Creek within a ½ mile stretch that dissects the manufacturing facility and the storage/distribution areas.

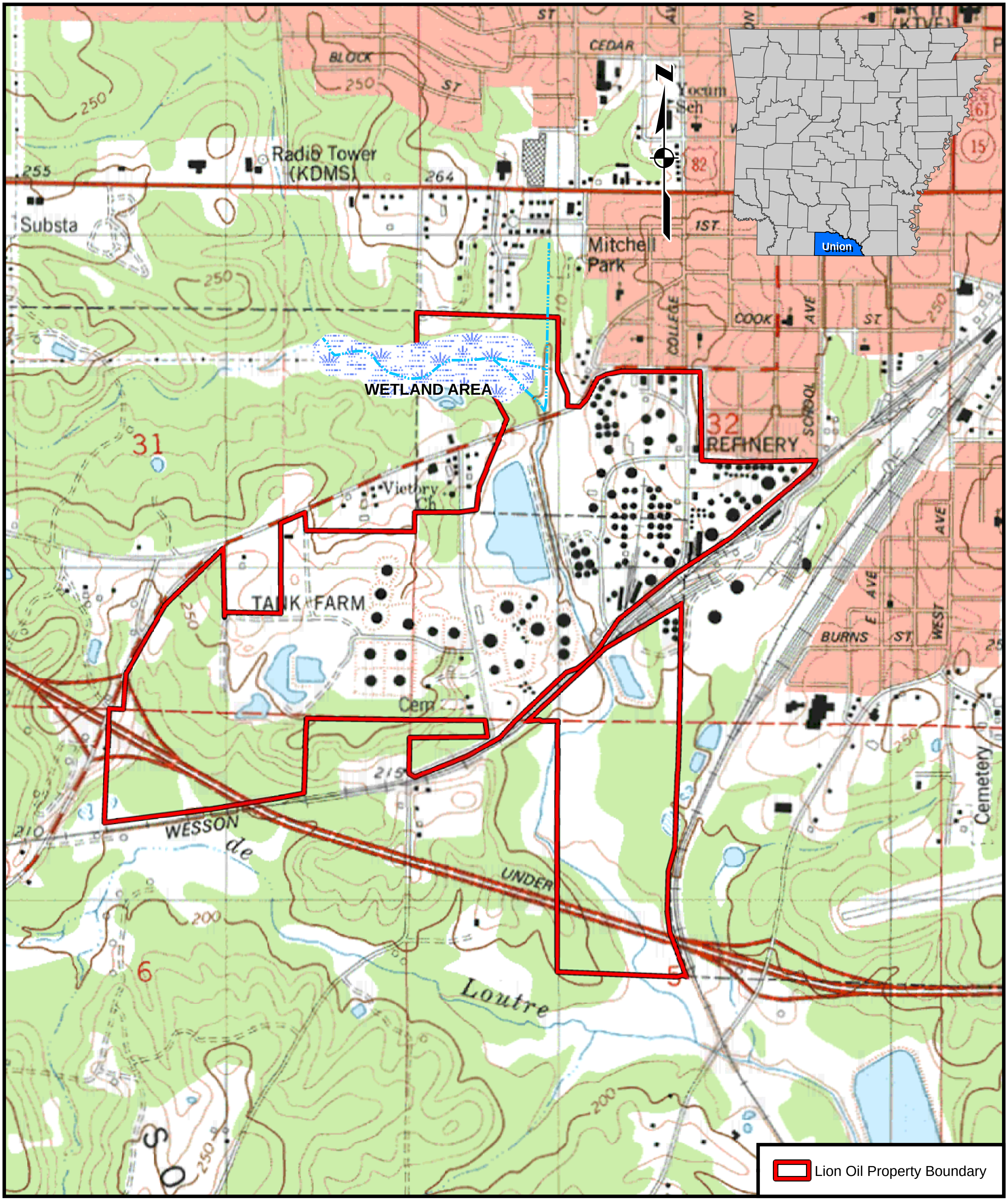

Figure 1.1. Location of Lion Oil, Loutre Creek and Bayou de Loutre. Lion Oil Section 2.306 documentation. September 2006.

Due to the close proximity of the outfalls with one another, all the outfalls are treated as one with regards to instream minerals concentrations and the proposed rule making changes for Loutre Creek and Bayou de Loutre. Each outfall discharge contains or potentially contains concentrations of chloride (Cl), sulfate (SO_4), and total dissolved solids (TDS) that are in excess of the existing ecoregion specific water quality criteria. These ecoregion criteria were developed based on characteristics of "least disturbed" Gulf Coastal streams that do not reflect the site specific conditions existing in the Bayou de Loutre watershed.

The primary report objectives are to:

- provide the required documentation to support a third-party rulemaking in accordance with Section 2.306 to remove the designated and unattainable domestic water supply use (DWSU) from Loutre Creek and Bayou de Loutre, from the mouth of Loutre Creek downstream to the mouth of Gum Creek. (Figure 1.2). As documented in the Arkansas water quality standards (ADEQ, 2001), the domestic water supply use for Bayou de Loutre has been removed from the mouth of Gum Creek downstream to the state line. In addition, the domestic water supply use for Bayou de Loutre above the mouth of Loutre Creek is being proposed for removal via pending 3rd party rule making for Great Lakes Chemical Company. (This 3rd party rule making was initiated during the September, 2006 ADEQ Commission meeting).

- propose site-specific water quality criteria for dissolved minerals (Cl, SO_4, and TDS) that:

    - ➢ reflect the current discharge concentrations which have increased as a result of recent improvements in air emissions control equipment. These increases overshadow reductions in mineral concentrations related to site improvements, and other pollution prevention activities.

    - ➢ are shown to support the designated seasonal fishery use in Loutre Creek downstream of the discharge and the supporting biotic communities to maintain that use.

This documentation summarizes significant findings and provides recommendations (Section 2.0), provides a summary of the site's background information (Section 3.0), documents the physical, chemical, and biological characteristics of tributaries that receive the permitted discharges from the targeted outfalls (Section 4.0), and presents the mass balance modeling results (Section 5.0). Section 6.0 provides a review of alternatives to meet the existing ecoregion criteria or stream criteria for dissolved minerals as well as the attainability of the domestic water supply use of Loutre Creek and Bayou de Loutre, respectively. Section 7.0 provides the citation for documents referenced in this report.

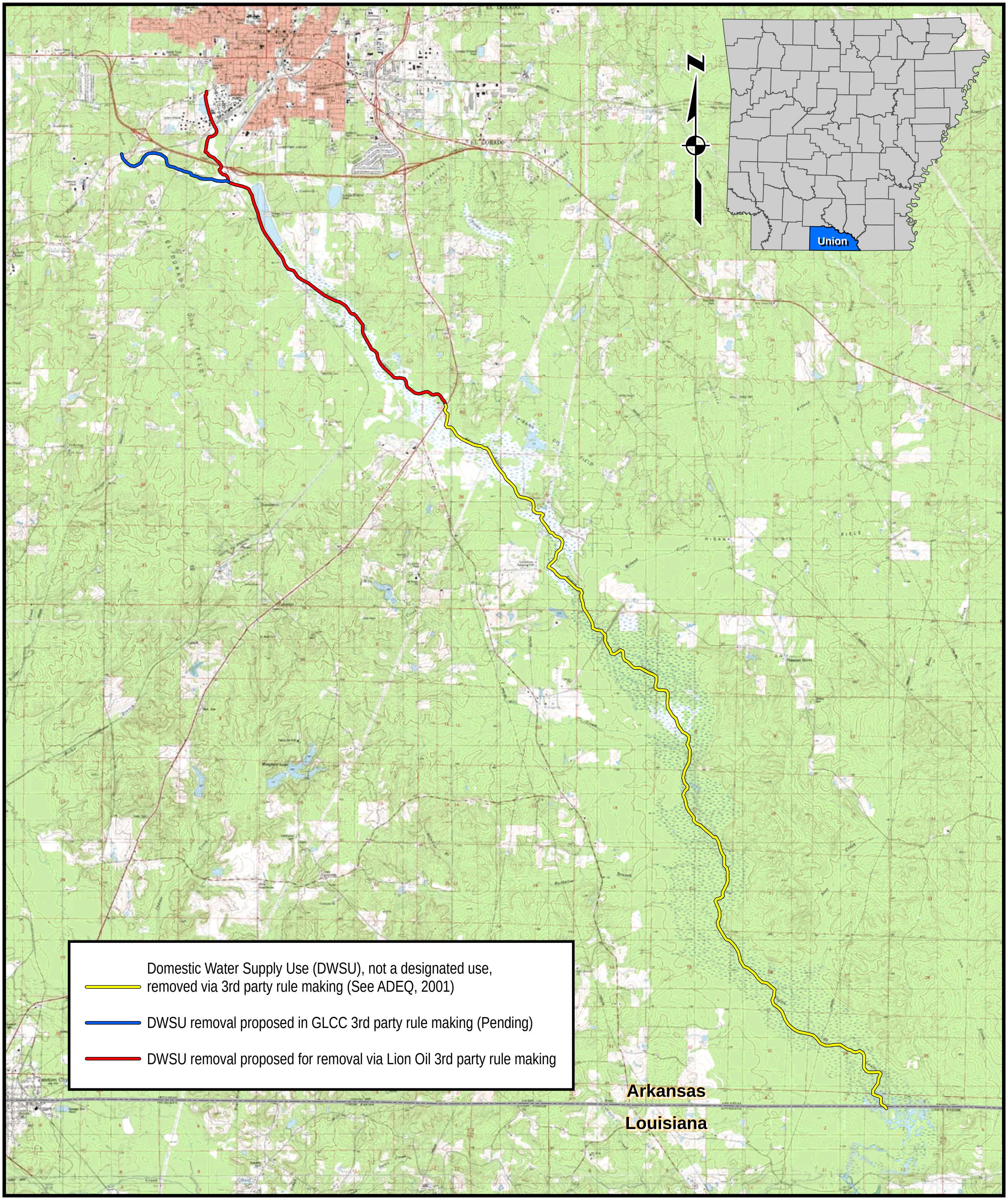

Figure 1.2. Status of the Domestic Water Supply Use designation in the Bayou de Loutre watershed. Lion Oil Section 2.306 documentation. September 2006.

2.0 SIGNIFICANT FINDINGS AND RECOMMENDATIONS

2.1 Significant Findings

The following findings are based on the information developed as part of the documentation in support of the proposed rule making and as directed by the aquatic life field survey (Appendix A).

1. Recent process and air emission control equipment have been added to the facility in response to a Consent Decree jointly signed by ADEQ and EPA to control air emissions. These scrubbers (air emission control equipment) have been responsible for recent increase in sulfates and TDS in the treated waste water discharged through Outfall 001.
2. The facility manages water discharges under the NPDES permit AR0000647.
3. The NPDES permit allows treated waste water discharge and the existing discharges have final dissolved mineral limitations based on ecoregion reference water quality criteria.
4. The historical and existing discharges have, on occasion, exceeded the water quality based ecoregion mineral criterion.
5. The facility certifies that it maintains a Storm Water Pollution Prevention Plan and a Spill Prevention Control and Countermeasure Plan.
6. All outfalls (treated waste water and storm water) discharge directly to Loutre Creek.
7. The water shed size at the mouth of Loutre Creek is less than 5 sq. miles (Figure 2.1).
8. Loutre Creek was found to maintain an existing fishery, and a designated aquatic life use to the degree allowed by the watershed size and the existing habitat
9. According to state resource agencies (ADH&HS and ADNR) the domestic water supply is use is not an existing use, nor is it an attainable use on Loutre Creek, and
10. Modification to the mineral criteria will not preclude the attainment of the other designated and attainable uses.

2.2 Recommendations

Based on the documentation presented herein, it is recommended that the designated domestic water supply use be removed from the following locations:

- Loutre Creek from Hwy 15 South (upstream terminus) to its confluence with Bayou de Loutre (see Figure 6.1).
- Bayou de Loutre from the mouth of Loutre Creek to the mouth of Gum Creek (Figure 1.2). As presented in the background information, the domestic water supply use for Bayou de Loutre downstream of the mouth of Gum Creek has been removed by previous rule making (ADEQ, 2004).

In addition to the domestic water supply use being removed, an increase in the water quality criteria for Cl, SO4, and TDS for the following locations are proposed to support the continued historical discharge from Lion Oil (see Section 6.6 for additional detail):

- Chloride, SO4, and TDS criteria for Loutre Creek from Hwy 15 South (upstream terminus) to its confluence of Bayou de Loutre for Chloride, SO4 and TDS in Bayou de Loutre from the mouth of Loutre Creek, downstream to the discharge from the City of El Dorado south waste water treatment facility.
- Sulfate and TDS in Bayou de Loutre from the City's discharge, then downstream to the mouth of Boggy Creek. and
- Sulfate in Bayou de Loutre from the mouth of Gum Creek down stream to the state line.

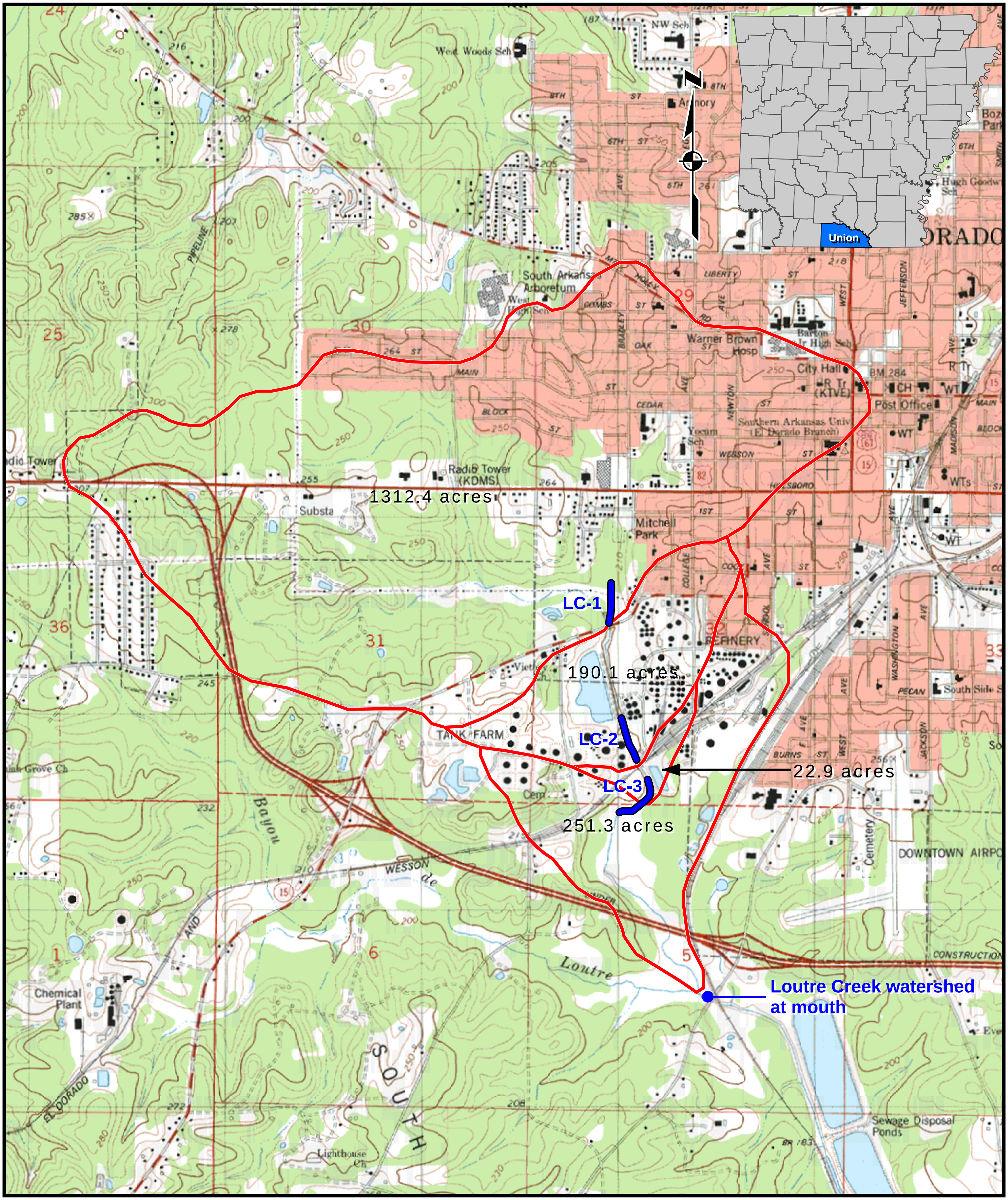

Figure 2.1. Study reaches, watershed boundaries and sizes of Loutre Creek sub-watersheds. Lion Oil Section 2.306 documentation. September 2006.

Table 2.1 summarizes the recommended changes to designated uses and the water quality criteria for Cl, SO_4 and TDS of individual streams segments evaluated.

Table 2.1. Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006.

Loutre Creek – from Hwy 15 South to the confluence of Bayou de Loutre	**Bayou de Loutre – from Loutre Creek to the discharge for the City of El Dorado South facility**	**Bayou de Loutre – from the discharge from the City of El Dorado-South downstream to the mouth of Gum Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria:	**Instream Criteria:**	**Instream Criteria:**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 256 mg/L; Sulfate from 31 mg/L to 997 mg/L. & TDS from 123 mg/L to 1756 mg/L	Amend stream dissolved minerals criteria: Chloride from 250 mg/L to 264, Sulfate from 90 mg/L to 635 mg/L & TDS from 500 mg/L to 1236 mg/L	Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 431 mg/L & TDS from 500 mg/L to 966 mg/L

Table 2.1 (cont.) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006.

Bayou de Loutre – from the mouth of Gum Creek downstream to the mouth of Boggy Creek	**Bayou de Loutre – from the mouth of Boggy Creek downstream to the mouth of Hibank Creek**	**Bayou de Loutre – from the mouth of Hibank Creek downstream to the mouth of Mill Creek**
No change in uses	No change in uses	No change in uses
Instream Criteria:	**Instream Criteria:**	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 345 mg/L and TDS from 750 mg/L to 780 mg/L	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 296 mg/L& TDS: NO CHANGE	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 263 mg/L & TDS: NO CHANGE

Table 2.1 (cont.) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006

Bayou de Loutre – from the mouth of Mill Creek downstream to the mouth of Buckaloo Branch	**Bayou de Loutre – from the mouth of Buckaloo Branch downstream to the mouth of Bear Creek**
No change in uses	**No change in uses**
Instream Criteria:	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 237 mg/L & TDS : NO CHANGE	Amend stream dissolved minerals criteria: Chloride : NO Change Sulfate from 90 mg/L to 216 mg/L & TDS: NO CHAMGE

Table 2.1 (cont.) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006

Bayou de Loutre - from the mouth of Bear Creek to the final segment of Bayou de Loutre.	**Bayou de Loutre (Final Segment) to the Arkansas/Louisiana State Line**
No change in uses	**No change in uses**
Instream Criteria:	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 198 mg/L & TDS: NO CHANGE	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 171 mg/L TDS: NO CHANGE.

3.0 BACKGROUND

3.1 Introduction

Lion Oil operates an oil refinery, storage and distribution facility in Union county on the south side of El Dorado, Arkansas. The facility's one treated process wastewater outfall (Outfall 001) and six storm water outfalls (Outfalls 002, 003, 004, 005, 006/007) discharge to Loutre Creek (Figure 3.1). A detailed description of each outfall and the individual discharge characteristics are provided in Sections 3.2 and following. Three storm water only outfalls 002, 003, and 004 discharge on a regular basis during storm events. However, three outfalls (005, 006, & 007) contain storm water commingled with treated process wastewater. Two outfalls are emergency overflow outfalls (005 & 006) from holding ponds located in the facility and contain storm water commingled with process wastewater. Outfall 005 is an emergency overflow outfall as designated in the Spill Prevention Control Countermeasure (SPCC) Pond and Outfall 006 is an emergency overflow outfall on the Main Holding Pond (Main Pond). Outfall 007 is a controlled storm water discharge from the Main Pond, which has the potential to discharge storm water commingled with process wastewater.

The Arkansas Water Quality Standards - Regulation No. 2 (WQS) (ADEQ, 2004) allows modification of water quality standards under various conditions. Specifically, Section 2.306 of the WQS allows the removal of a designated use other than a fishable or swimmable use, and for establishment of less stringent water quality criteria without affecting fishable or swimmable uses. This project report documents the information required to amend Reg. 2 through third party rulemaking. The study areas and discharges described above are depicted in Figure 3.2.

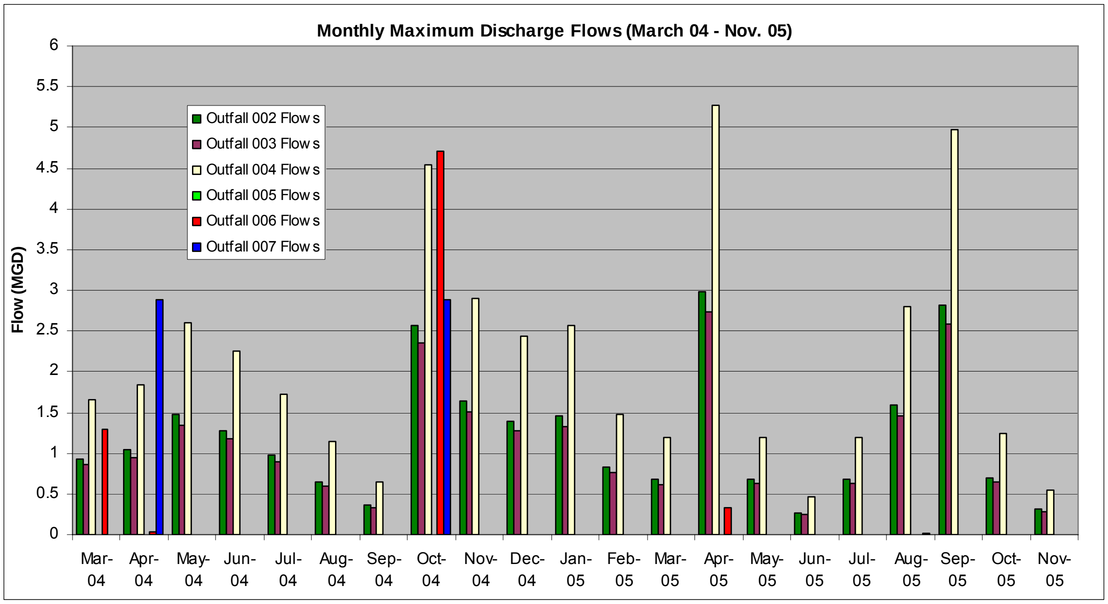

Figure 3.1 Relative frequency of discharge from storm water discharges from Lion Oil for period of 24 months.

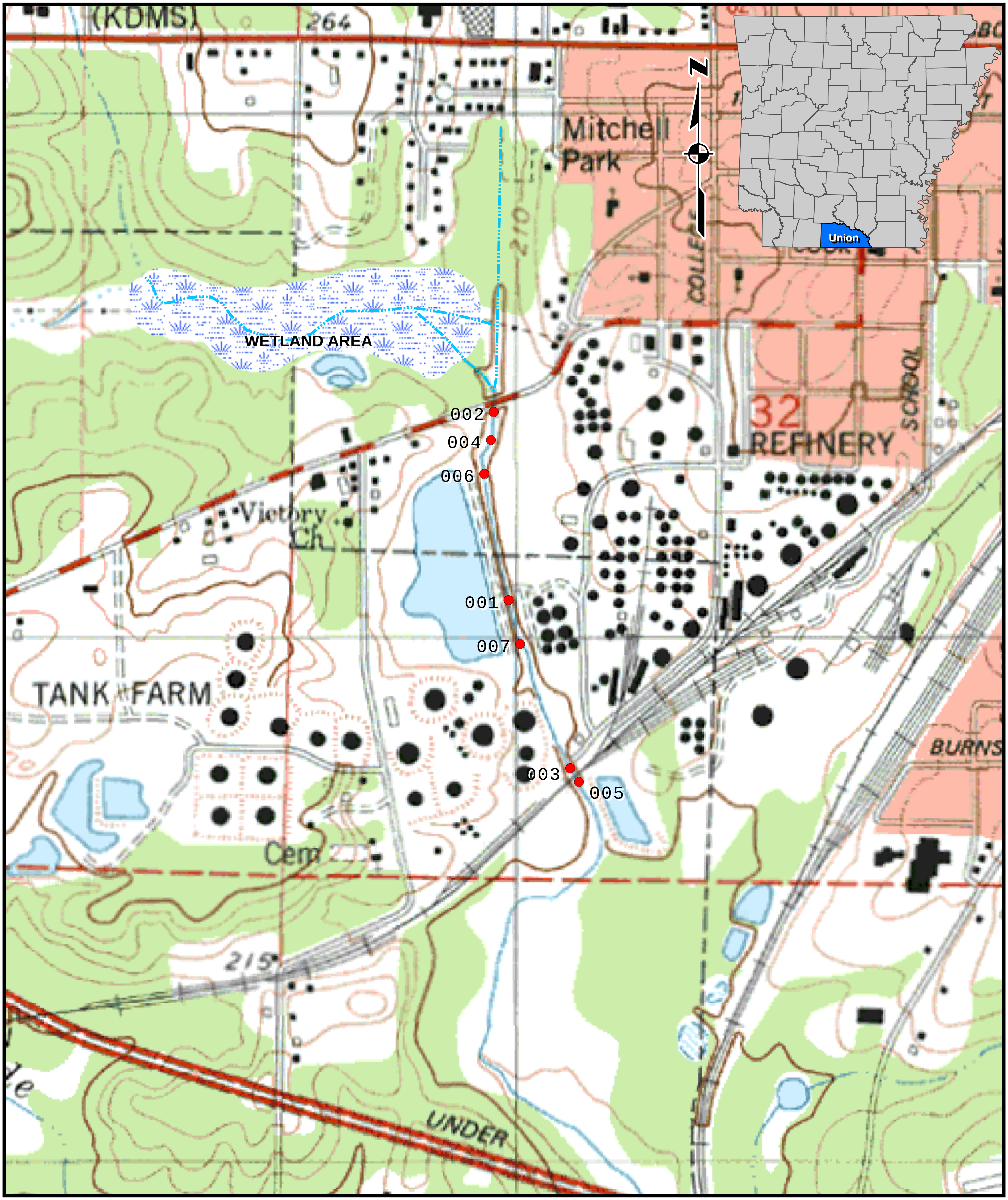

Figure 3.2. Lion Oil primary treated waste water discharge (Outfall 001) and the storm water discharges. Lion Oil Section 2.306 documentation. September 2006.

3.2 Designated Uses

The designated uses for Loutre Creek and Bayou de Loutre are those listed in the WQS for Gulf Coastal Plain streams with watersheds less than 10 mi^2. The designated uses for Loutre Creek and Bayou de Loutre are listed below. They are as follows:

Loutre Creek

- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery
- Seasonal Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Bayou de Loutre (above Gum Creek)

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Bayou de Loutre (below Gum Creek)

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Perennial Gulf Coastal Fishery
- Industrial Water Supply, and
- Agricultural Water Supply.

3.3 Domestic Water Supply Use

Based upon documentation provided by the Arkansas Department of Health and Human Services (ADHHS), Loutre Creek and Bayou de Loutre (above Gum Creek) are neither an existing or planned public water supply source. In addition, the Arkansas Natural Resource Commission (ANRC) has documented that the removal of the designated domestic water supply use from these water sources does not conflict with the Arkansas Water Plan. The letters from the ADHHS and ANRC are provided in Appendix B. As documented in ADEQ's Regulation No. 2, the domestic water supply use does not exist for Bayou de Loutre below the mouth of Gum Creek.

3.4 Outfall Characteristics

3.4.1. Discharge characteristics

Figure 3.1 (and Appendix C) provides a summary of the discharge characteristics for the targeted outfalls over the recent 2 year period. During the last two year period, Outfall 001 has discharged continually, Outfalls 002, 003, 004 have discharges in response to storm frequency (discharged 21 of 24 months), and discharges from Outfalls 005, 006 and 007 have been limited and in response to large storm events (006 discharged during 4 or the 24 months, 007 discharged during 3 of 24 months, and 005 did not discharge during that period, or since.

However, when outfalls 006 and 007 discharge, the volume typically equals or exceeds the volume from other discharges (Figure 3.2).

3.4.2 Effluent Dissolved Mineral Characteristics

Table 3.1 and 3.2 present the effluent characteristics of treated wastewater and storm water discharged through Outfalls 001, 002, 003, 004, 005, 006/007. This data represents available recent data. The actual period of record is variable depending on the parameter (CL, SO_4 or TDS), however the period of record represents recent operational condition ranging from March 2004-May 2006.). Documentation for the 95th percentile value is presented in Section 5.0. The percentile concentration values were statistically calculated based on methodologies outlined in *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987) which will be discussed in detail in Section 5.2.2.

Table 3.1. Summary of targeted mineral constituents in Outfall 001 discharge from Lion Oil facility.

Statistic*	**Chloride (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**
(Data Characterization)	N=33	N=26	N=26
Maximum	420	1775	2871
Minimum	204	372	760
Average	283	1027	2143
95th percentile	414	1639	2850
Median	250	984	2130

Table 3.2. Summary of targeted mineral constituents in storm water discharges from Lion Oil facility.

Statistic	**Chloride (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**
(Data Characterization)	N=7	N=7	N=7
Maximum	242	857	1864
Minimum	8.16	13.0	86.0
Average	58	192	478
95th percentile	242	857	1864
Median	31.2	99.0	358

3.5 Description of Pollution Prevention Practices

Areas where storm water and/or spills may leave the facility and enter the receiving stream are identified in the facility's Spill Prevention Control and Countermeasures (SPCC) and Storm Water Pollution Prevention Plan (SWPPP) plans. Best Management Practices (BMP's) as well as other secondary containment and treatments have been implemented to reduce contamination of storm water and prevent spill release. The SPCC and SWPPP provide the policies and procedures to limit storm water exposure to process waters and provides for the routine management of storm waters. Lion Oil has installed pollution prevention practices at the facility designed to reduce the potential of storm water contamination and to prevent spills from entering waters of the state. The following section describes on an outfall by outfall basis current BMP's and/or other treatments.

Lion Oil currently discharges treated process wastewater through Outfall 001 into Loutre Creek in the same reach that receives the storm water discharges. Within the last four year period, Lion Oil has implemented numerous production modifications in response to energy conservation goals, process optimization and environmental control projects in an effort to produce cleaner fuels with reduced sulfur in on-road diesel and ultra low sulfur gasoline. Lion Oil is currently evaluating alternatives to the continued discharge of the treated process wastewater into Loutre Creek.

3.5.1 Outfall 001

Outfall 001 discharges process wastewater after treatment through aggressive tertiary biological treatment. In addition, BMPs for wastewater treatment discharge includes strict controls on treatment chemicals, policies for storage, spill control, waste minimization, and clean up of wastewater treatment chemicals.

3.5.2 Outfall 002

Diked areas and tank water drains within the Outfall 002 drainage area are routed to the API separator. All other areas within the drainage area are non-process. The storm waters from non-process waters that fall within the Outfall 002 defined basin are discharged during the storm event and are not retained.

3.5.3 Outfall 003

Tank water drains are routed to the Intercept Station from which they are pumped to the API separator for treatment. Storage tanks are provided with firewalls for secondary containment of spills. Tank firewall valves are routinely closed and sealed per the SPCC and SWPPP. During a rainfall event, water within each tank firewall will be visually inspected prior to release through Outfall 003. The storm waters from non-process areas that fall within the Outfall 003 sub-basin are discharged during the storm event and are not retained.

3.5.4 Outfall 004

Tank water draws are routed to the API separator for treatment. Storage tanks are provided with firewalls for secondary containment of spills. Tank firewall valves are typically closed and sealed as specified in the SPCC and SWPPP. During a rainfall event, water within each tank firewall may be released through Outfall 004 after visual inspection. The storm waters from non-process areas that fall within the Outfall 004 sub-basin are discharged during the storm event and are not retained.

3.5.5 Outfall 005

Dry weather process flow and first flush storm water are pumped from the Intercept Station to the API separator for treatment. Storm water flows in excess of the Intercept Station pumping capacity flows to the SPCC Pond from which it is pumped to the Main Holding Pond. Any storm water flow in excess of the Intercept Station pumping capacity and the SPCC Pond storage capacity is released through Outfall 005 as an emergency discharge. As indicated in Section 3.4.1, this outfall has not discharged during the last 8 years. The combined pumping capacity has not been exceeded during the last 8 years and therefore there has not been a discharge from Outfall 005 during that period.

3.5.6 Outfall 006/007

Dry weather process flow and first flush storm water flows are collected and pumped to Equalization Tanks, and thence to the WWTP. Storm water flow in excess of the API separator lift pumps' capacity will flow to the Main Holding Pond. From the Main Holding Pond the storm water can be pumped to the Equalization Tanks on a controlled basis and processed through the WWTP as capacity becomes available. If WWTP capacity is fully utilized for process water treatment, the Main Holding Pond storm water can be tested for compliance with permit parameters and released through Outfall 007 as necessary.

Outfall 006 serves as an emergency discharge outfall for Outfall 007 (the Main Holding Pond) and is designed to protect the integrity of the dike system. Although the discharge frequency is reduced when compared to Outfalls 002, 003 and 004, discharges from 007 and 006 have occurred in conjunction with discharge from other outfalls and on those occasions the volume from 006 /007 have equaled or exceeded the discharge from the other outfalls.

3.6 Current NPDES Permit Status

3.6.1 NPDES Permit Compliance

Lion Oil's current NPDES permit (Permit No. AR00000647) became effective on March 1, 2004. The permit remains in effect until midnight, February 28, 2009.

3.6.1.1 Discharge and Monitoring Requirements

Lion Oil is currently under interim effluent limitations at Outfall 001. Sulfate (SO_4) and Total Dissolved Solids (TDS) fall under monitor and report limitations until the final permit limitations take effect March 1st, 2007. Currently, no dissolved minerals discharge limitations have been placed on Lion Oil’s storm water outfalls. However, the potential for mineral concentrations to exceed ecoregion instream WQS in Loutre Creek and the stream WQS in Bayou de Loutre is possible during normal discharge operations (Outfall 001) and/or storm water runoff events. The instream dissolved minerals WQS in Loutre Creek and Bayou de Loutre are based on the maintenance of the designated, but non-existing and unattainable domestic water supply use for Loutre Creek and Bayou de Loutre (upstream of Gum Creek). However, Bayou de Loutre (downstream of Gum Creek) has an instream WQS based on standards provided in ADEQ’s Regulation No. 2. The final discharge limitations and monitoring requirements for Lion Oil storm water outfall’s are summarized in Tables 3.3 through 3.6.

Table 3.3. Current Final Discharge Limitations for Lion Oil, Outfall 001.

Effluent Characteristic	**Monthly Average**	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Frequency of Analysis**
Flow (MGD)	N/A	NA	Report	Report	Daily*
Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) June – Sept. Oct. - May	223 lbs/day 534 lbs/day	400 lbs/day 958 lbs/day	10 mg/L 24 mg/L	18 mg/L 43 mg/L	once/week once/week
Chemical Oxygen Demand (COD)	3891 lbs/day	7598 lbs/day	175 mg/L	341 mg/L	once/week
Total Suspended Solids (TSS)	453 lbs/day	709 lbs/day	20 mg/L	32 mg/L	once/week
Ammonia Nitrogen (NH_3-N) June – Sept. Oct. - May	45 lbs/day 200 lbs/day	89 lbs/day 401 lbs/day	2.0 mg/L 9.0 mg/L	4.0 mg/L 18 mg/L	once/week
Dissolved Oxygen	N/A	N/A	7.0 inst. Min		once/week
Phenolic Compounds	4.0 lbs day	8.0 lbs/day	0.18 mg/L	0.36 mg/L	once/week
Sulfide	2.0 lbs/day	4.0 lbs/day	0.09 mg/L	0.18 mg/L	once/week
Sulfates (SO_4)	1514 lbs/day	2271 lbs/day	68 mg/L	102 mg/L	once/week
Total Dissolved Solids (TDS)	1915 lbs/day	2872 lbs/day	207 mg/L	310 mg/L	once/week
Temperature	N/A	N/A	86°F inst. Max		once/week
Total Chromium	6.0 lbs/day	14 lbs/day	0.27 mg/L	0.63 mg/L	once/month
Hexavalent Chromium	0.27 lbs/day	0.53 lbs/day	0.012 mg/L	0.024 mg/L	once/month
Selenium, Total Recoverable	0.13 lbs/day	0.26 lbs/day	5.8 µg/L	11.65 µg/L	once/month
Zinc, Total Recoverable	2.63 lbs/day	5.28 lbs/day	118 µg/L	237 µg/L	once/month
Oil and Grease (O&G)	166 lbs/day	316 lbs/day	7.0 mg/L	14.0 mg/L	once/week
pH (SU)	N/A	NA	*	*	continuous
Whole Effluent Lethality	Daily Avg. Min. - not < 96%		7-day Min. - not < 96%		once quarter
** pH shall not be less than 6.0 standard units nor greater that 9.0 standard units					

Table 3.4. Current Final Discharge Limitations for Lion Oil, Outfalls 002, 003, & 004.

Effluent Characteristic	Monthly Average	Daily Maximum	Frequency of Analysis
Flow (MGD)	N/A	NA	Daily*
Total Organic Carbon (TOC)	N/A	110 mg/L	Daily*
Oil and Grease	10 mg/L	15 mg/L	Daily*
pH (SU)	*	*	Daily*
* When Discharging ** pH shall not be less than 6.0 standard units nor greater that 9.0 standard units			

Table 3.5. Current Final Discharge Limitations for Lion Oil, Outfall 005.

Effluent Characteristic	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Frequency of Analysis
Flow (MGD)	N/A	NA	Report	Report	Daily*
Biochemical Oxygen Demand (BOD_5)	1555 lbs/day	2827 lbs/day	Report	Report	Daily*
Chemical Oxygen Demand (COD)	10602 lbs/day	21205 lbs/day	Report	Report	Daily*
Total Suspended Solids (TSS)	1272 lbs/day	1979 lbs/day	Report	Report	Daily*
Phenolic Compounds	9.9 lbs day	20.5 lbs/day	Report	Report	Daily*
Total Chromium	12.7 lbs/day	35.5 lbs/day	Report	Report	Daily*
Hexavalent Chromium	1.6 lbs/day	3.7 lbs/day	Report	Report	Daily*
Oil and Grease	474 lbs/day	919 lbs/day	10 mg/L	15 mg/L	Daily*
pH (SU)	N/A	NA	**	**	Daily*
* When Discharging ** pH shall not be less than 6.0 standard units nor greater that 9.0 standard units					

Table 3.6. Current Final Discharge Limitations for Lion Oil, Outfalls 006 & 007.

Effluent Characteristic	**Monthly Average**	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Frequency of Analysis**
Flow (MGD)	N/A	NA	Report	Report	Daily*
Biochemical Oxygen Demand (BOD_5)	1555 lbs/day	2827 lbs/day	Report	Report	Daily*
Chemical Oxygen Demand (COD)	10602 lbs/day	21205 lbs/day	Report	Report	Daily*
Total Suspended Solids (TSS)	1272 lbs/day	1979 lbs/day	Report	Report	Daily*
Phenolic Compounds	9.9 lbs day	20.5 lbs/day	Report	Report	Daily*
Total Chromium	12.7 lbs/day	35.5 lbs/day	Report	Report	Daily*
Hexavalent Chromium	1.6 lbs/day	3.7 lbs/day	Report	Report	Daily*
Lead, Total Recoverable	0.14 lbs/day	0.28 lbs/day	3.9 µg/L	7.8 µg/L	Daily*
Zinc, Total Recoverable	4.2 lbs/day	8.4 lbs/day	117 µg/L	235 µg/L	Daily*
Oil and Grease	474 lbs/day	919 lbs/day	10 mg/L	15 mg/L	Daily*
pH (SU)	N/A	NA	**	**	Daily*
* When Discharging ** pH shall not be less than 6.0 standard units nor greater that 9.0 standard units					

3.6.1.2 Dissolved Minerals

Dissolved minerals data from Outfall 001 (SO_4 and TDS) has been collected and monitored weekly since March, 2004, as required by the current NPDES interim permit. Prior to that time, there were no requirements to monitor and report dissolved minerals. The mineral data from the non-retained storm water outfalls (002, 003 and 004) and/or the Main Pond (Outfall 006 and 007) and SPCC Pond (Outfall 005) were collected in December 2005. Table 3.7 summarizes the dissolved mineral concentration typical of the storm water discharge from Lion Oil. Due to the close proximity of the storm water outfalls on Lion Oil property, (approximately ½ mile), the dissolved mineral data is treated as coming from a single discharge for mass balance modeling. Table 3.8 summarizes the dissolved mineral concentration typical of Lion Oil outfall 001. Both the storm water dissolved minerals and Outfall 001 dissolved mineral concentrations were used in the mass balance modeling to determine the proposed instream criteria. Additional chloride, sulfate and TDS information is provided in Section 5.0.

Table 3.7. Dissolved mineral data from Lion Oil storm water outfalls. December 2005.

Location / Date	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Outfall 002/12/24/05	9.1	13.0	86.0
Outfall 003/12/24/05	9.61	15.8	104
Outfall 004/12/24/05	8.16	15.5	88.0
Outfall 007/12/25/05	47.3	146.6	384
Outfall 007/12/26/05	58.1	194.8	462
Main Pond 006/12/15/05^A	242	857	1864
South Pond 005/12/15/05^A	31.2	98.6	358
Summary Statistics			
Maximum	242	857	1864
Minimum	8.16	13.0	86.0
Average	58	192	478
95th percentile*	242	857	1864
Median	31.2	99.0	358

* See section 5.0

A: Collected from retained storm waters to represent waters that maybe discharged through the respective outfalls

Table 3.8. Dissolved mineral data from Lion Oil Outfall 001. March 2004 - December 2005.

Date	Chloride (mg/L)	Sulfate Monthly Average (mg/L)	TDS Monthly Average (mg/L)
3/12/1986	296	--	--
5/12/1986	420	--	--
6/16/1986	312	--	--
7/28/1986	250	--	--
8/15/1986	234	--	--
Mar-04	--	372	760
Apr-04	--	941	1885
May-04	--	968	1989
Jun-04	--	807	1565
Jul-04	--	1121	2141
Aug-04	--	1270	2683
Sep-04	--	1386	2667
Oct-04	--	1068	2593
Nov-04	--	789	1513
Dec-04	--	999	1776
Jan-05	--	820	1667
Feb-05	--	827	1959
Mar-05	--	883	2120
Apr-05	--	812	1832
May-05	--	862	2246
Jun-05	--	758	2052
Jul-05	--	1107	2303
Aug-05	--	924	1913
Sep-05	--	1033	1530
Oct-05	--	955	2281
Nov-05	--	1149	2393
Dec-05	--	1162	2871
Jan-06	--	1775	2800
Feb-06	--	1322	2811
Mar-06	--	1383	2653

Table 3.8 (cont.). Dissolved mineral data from Lion Oil Outfall 001. March 2004 - December 2005.

Date	**Chloride (mg/L)**	**Sulfate Monthly Average (mg/L)**	**TDS Monthly Average (mg/L)**
Apr-06	--	1213	2727
4/29/2006	411.3	–	--
4/30/2006	329.6	–	--
5/01/2006	223.7	–	--
5/02/2006	249.6	–	--
5/03/2006	391.4	–	--
5/04/2006	341.3	–	--
5/06/2006	315.6	–	--
5/07/2006	282.4	–	--
5/08/2006	248.6	–	--
5/09/2006	217.3	–	--
5/10/2006	220.1	–	--
5/11/2006	235.9	–	--
5/12/2006	207.5	–	--
5/13/2006	213.6	–	--
5/14/2006	211.0	–	--
5/15/2006	213.2	–	--
5/16/2006	231.8	–	--
5/17/2006	234.3	–	--
5/18/2006	222.7	–	--
5/19/2006	222.7	–	--
5/20/2006	203.8	–	--
5/21/2006	270.0	–	--
5/22/2006	387.7	–	--
5/23/2006	398.8	–	--
5/24/2006	406.2	–	--
5/25/2006	377	–	--
5/26/2006	326	–	--
Summary Statistics			
Maximum	420	1775	2871
Minimum	204	372	760
Average	283	1027	2143
95th percentile*	414	1639	2850
Median	250	984	2130

* See section 5.0

As indicated in Table 3.3 (summary of Outfall 001 permit monitoring requirements), there is no permit requirement to monitor and report chloride concentration in the final Outfall 001 discharge. Since the is no long term history for chloride in the discharge, the chloride concentration was characterized using daily data from April 29 through May 24, 2006 (Appendix C).

Table 3.9 Chloride data from Outfall 001. POR 4/29-5/24, 2006 Lion Oil Company. El Dorado, AR.

DATE	CHLORIDES	DATE	CHLORIDES
4/29/2006	411.3 mg/L	5/12/2006	207.5 mg/L
4/30/2006	329.6 mg/L	5/13/2006	213.6 mg/L
5/1/2006	223.7 mg/L	5/14/2006	211.0 mg/L
5/2/2006	249.6 mg/L	5/15/2006	213.2 mg/L
5/3/2006	391.4 mg/L	5/16/2006	231.8 mg/L
5/4/2006	341.3 mg/L	5/17/2006	234.3 mg/L
5/5/2006	315.6 mg/L	5/18/2006	222.7 mg/L
5/6/2006	282.4 mg/L	5/19/2006	222.7 mg/L
5/7/2006	248.6 mg/L	5/20/2006	203.8 mg/L
5/8/2006	217.3 mg/L	5/21/2006	270.0 mg/L
5/9/2006	220.1 mg/L	5/22/2006	387.7 mg/L
5/10/2006	235.9 mg/L	5/23/2006	398.8 mg/L
5/11/2006	218.9 mg/L	5/24/2006	406.2 mg/L

3.6.2 Toxicity Testing

3.6.2.1 Outfall 001 Biomonitoring

Toxicity testing has been completed on Lion Oil's primary discharge (Outfall I001) for over 10 years. A summary of the last five year period of record for the biomonitoring is provided in Appendix D-1. The summary demonstrates that Outfall 001 consistently passed the lethality endpoints at the applicable critical dilution (72% or 96% effluent depending on the test period). The Outfall 001 effluent has passed 98% of the biomonitoring tests lethality endpoint over the last 5 years. No water flea chronic test failed the lethality endpoint and only one fathead minnow test (December 2001) failed the chronic lethality endpoint, over the last 5 year period of record. The water flea passed 74% and the fathead minnow passed almost 90 % of the sub-lethal test endpoints over the last 5 year period of record.

The upgrades to waster water treatment and improvements other pollution control activities are reflected in the historical biomonitoring activities. Figure 3.3 and 3.4 demonstrate the benefits of improved treatment and process modifications by the reduced variability in the chronic biomonitoring results. These test have consistently passed the lethality NOEC at or above the critical dilution during the last two year period of record.

This biomonitoring history demonstrates that the treated effluent is not toxic even under the critical dilutions reflective of critical Q 7-10 flow concentrations. The only endpoint that has demonstrated sporadic statistical difference during the most recent 2 year period of record is sub-lethal response of the water flea (*Ceriodaphnia dubia*). Although there were sporadic incidences of statistical differences between the control and the water flea sub-lethal end-point (e.g. reproduction) of the water flea, there does not appear to be a specific relationship to the estimated TDS concentration.

As presented in the summary of results in Appendix D-1, the test conductivity and the calculated TDS do not present a direct relationship with increased conductivity/TDS and sub-lethal response in the chronic biomonitoring tests. On occasion when the conductivity/calculated TDS values are elevated, there is no significant difference between the control and the exposure. Conversely, on occasions when there is a significant difference, the conductivity/TDS is less than other tests where there were no statistical significance. The biomonitoring results seen to indicate that there may be some constituent that impacts the reproduction response in the routine biomonitoring. There are many issues related to the reproductive response that may impact test significance, including organism health, culture techniques and even the application of the statistical approach to determining relative significance. However there is not sufficient information to implicate dissolve minerals as the cause of the test failure related to reproductive endpoint.

In summary, the Outfall 001 effluent has consistently passed the lethality endpoints at the applicable critical dilution (72 % or 96% effluent depending on the test period). The Outfall 001 effluent has passed 98% of the biomonitoring tests lethality endpoint over the last 5 years. No water flea chronic test failed the lethality endpoint and only one fathead minnow test (December 2001) failed the chronic lethality endpoint, over the last 5 year period of record.

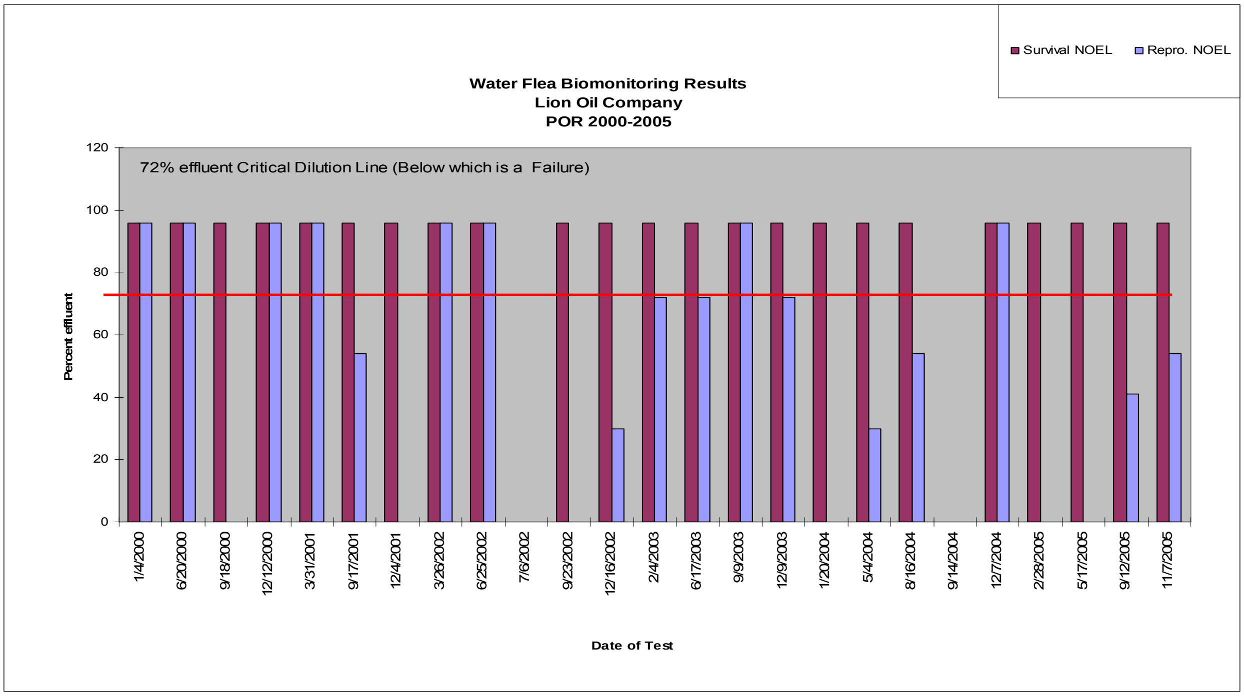

Figure 3.3 Summary of water flea (Ceriodaphnia dubia) biomonitoring performance. Period of record January 2000-December 2005.

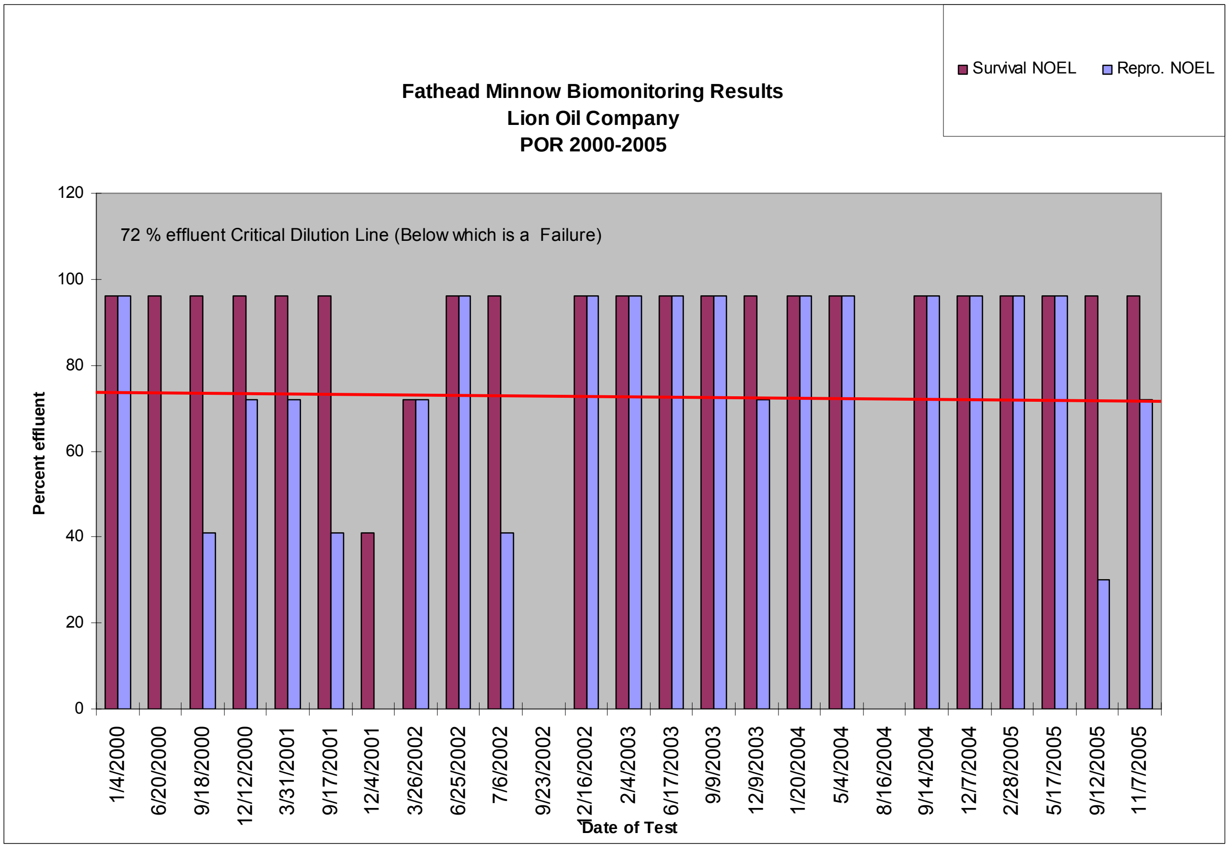

Figure 3.4. Summary of fathead minnow (Pimephales promelas) biomonitoring performance. Period of record January 2000-December 2005.

3.6.2.1 Outfall 001 Microtox

In addition to the permit required biomonitoring, Lion Oil utilizes a Microtox toxicity system to routinely monitor internal waste streams. The internal monitoring is completed as an early warning system to notify facility personnel to potentially atypical conditions that could result in permit non-compliance. Microtox tests are typically conducted daily on internal process waste water effluent stream. However on occasion, this frequency may be increased or decreased depending on operations and internal results. Should the Microtox indicate atypical results, additional testing maybe used to identify the cause and/or source of the upset condition prior to it becoming an issue with the waste water treatment facility or in the final effluent.

The Microtox typically demonstrates a range of response for 3 separate timed exposures (e.g. 1, 10, and 15 minutes). This response is reported as percent of light transmitted above and below established baseline for each timed test exposure period. Lion Oil has established a site specific reaction threshold as 20% effect. Any response that indicated greater than 20% response generated by bacteria exposed to 100% effluent is considered as an significant response and may generate additional monitoring and/or other internal actions to evaluate the potential cause of the change in response. Any response less than 20% is considered as acceptable. This 20% response criteria is loosely based on the 80% rule used in the routine biomonitoring where controls must maintain 80% level of performance. Details of the actual data and the previous 5 year period is provided in Appendix D-2 (Microtox history).

Figures 3.5, 3.6 and 3.7 plots the most recent Microtox results at 15, 5 and 30 minute response intervals, respectively. There is a slightly greater response indicated by the 5 minute test response where approximately 25 daily test exceeded the 20 % response. The 15 and 30 minute tests indicated less than 10 and 15 tests, respectively. However, the trend line for each test interval is decreasing indicating the effluent is having less effect over the last year.

3.6.2.2 Storm Water Outfalls

Toxicity testing on Lion Oil's storm water outfalls has not been required during the past 5 plus years. According to facility records, previous biomonitoring history (48 hour acute tests) on storm water did not indicate a potential for toxicity in the storm water discharges.

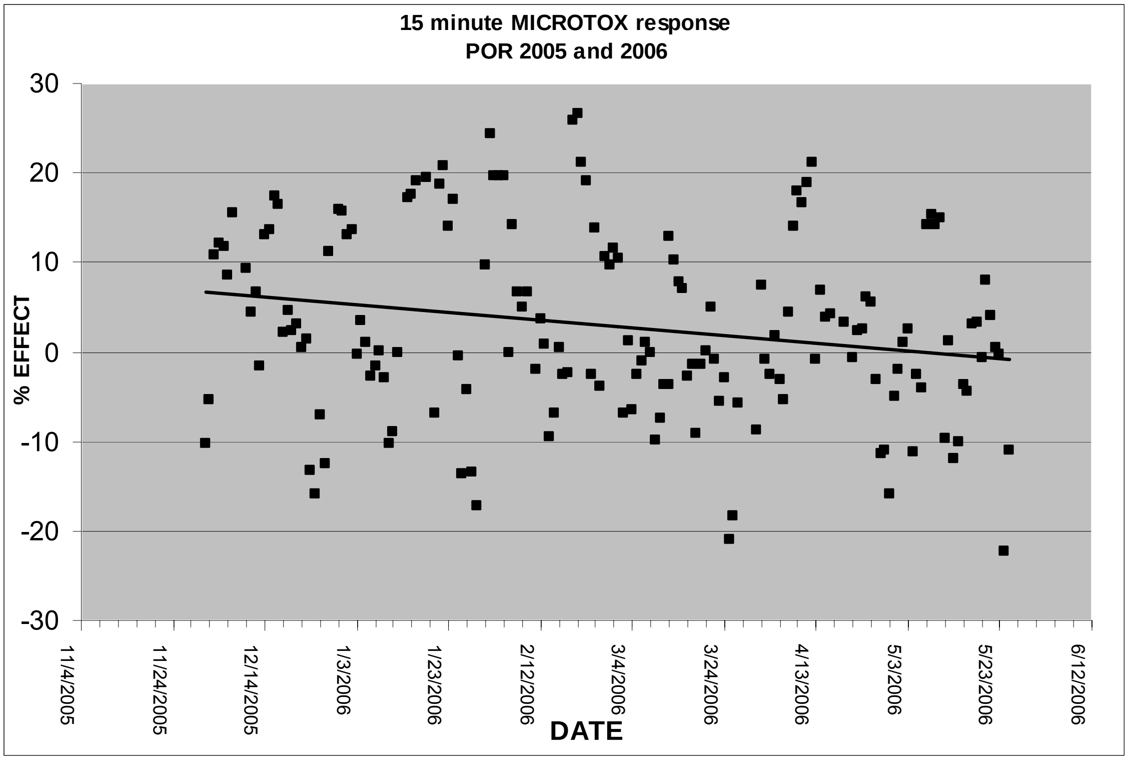

Figure 3.5 Summary of Microtox response to 15 minute exposure. Lion Oil POR 12/05 to 6/06. Note, decreasing trend line indication reduction in overall negative response.

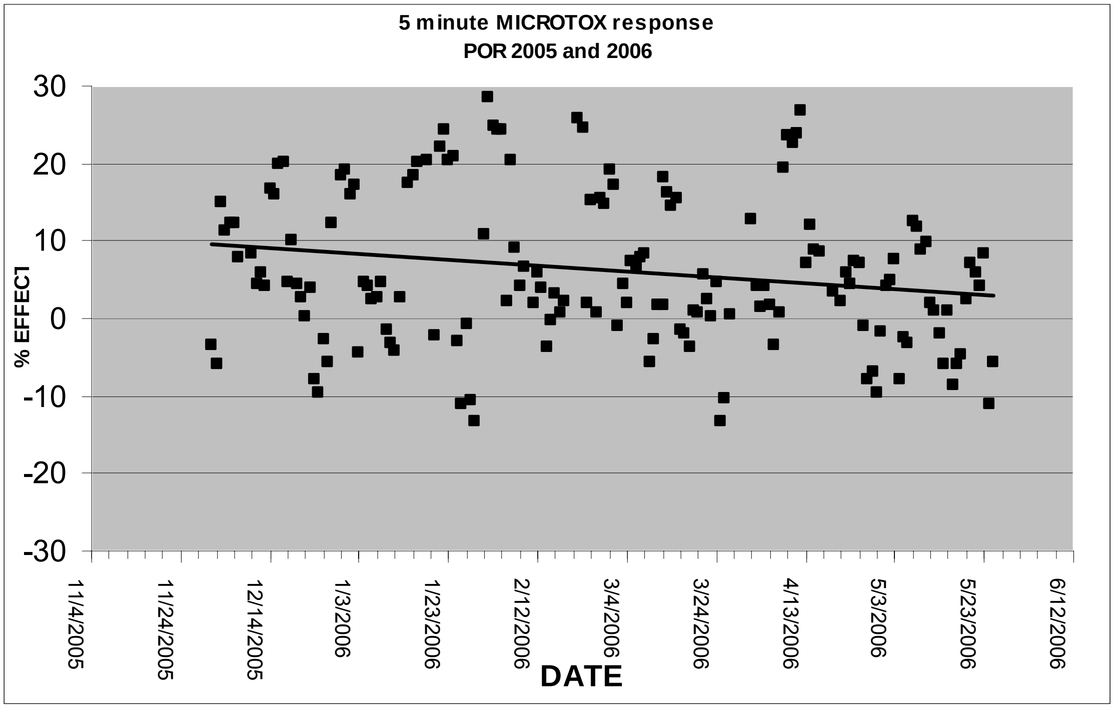

Figure 3.6. Summary of Microtox response to 5 minute exposure. Lion Oil POR 12/05 to 6/06. Note, decreasing trend line indication reduction in overall negative response.

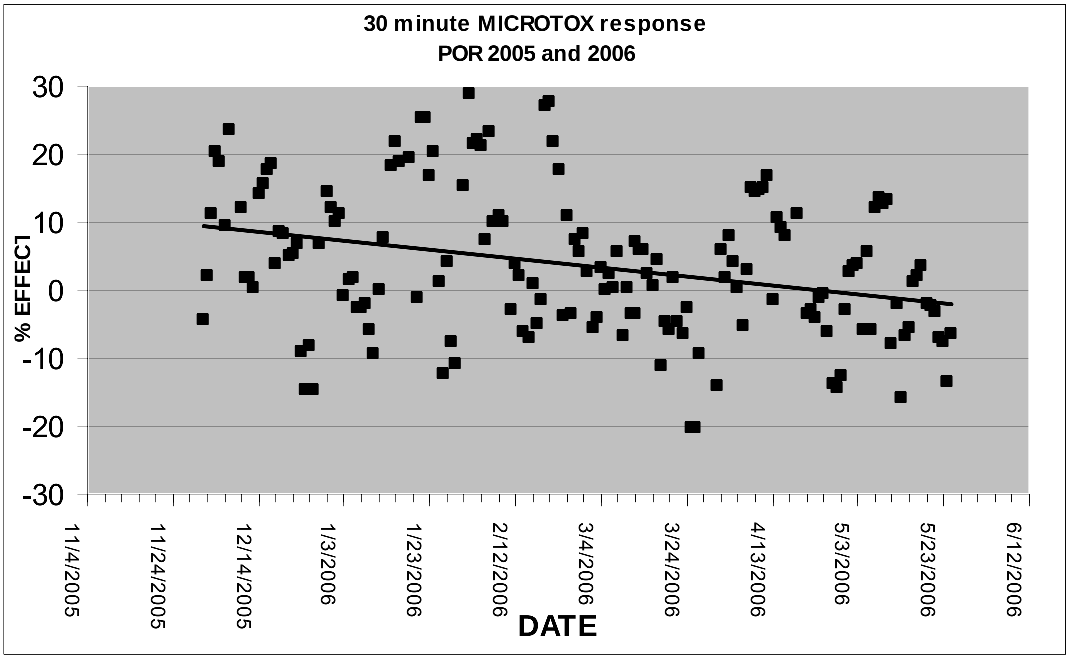

Figure 3.7. Summary of Microtox response to 30 minute exposure. Lion Oil POR 12/05 to 6/06. Note, decreasing trend line indication reduction in overall negative response.

4.0 AQUATIC LIFE FIELD STUDY

4.1 Introduction

The objective of the aquatic life field study was to document whether the designated aquatic life use was being maintained in Loutre Creek and if the permitted discharges from Lion Oil are beneficial or detrimental to the maintenance of those uses. The aquatic life field study was designed and proposed in accordance with the ADEQ Mineral Implementation Policy as provided in the Water Divisions CPP. In accordance with that Policy, the aquatic life field study focused on Loutre Creek above and below the discharge location(s). The following stream segments on Loutre Creek were assessed during this study: LC-1, Loutre Creek upstream of any Lion Oil influence (reference site), LC-2, Loutre Creek below outfalls 002, 004, 006/007, as well as Outfall 001, and LC-3, Loutre Creek below all Lion Oil outfall discharge influences (Figure 4.1). The watershed of Loutre Creek at each outfall is provided in Table 4.1. Loutre Creek is designated as supporting a seasonal Gulf Coastal Fishery in the Arkansas Water Quality standards (Section 3.2).

Table 4.1. Watershed size of Loutre Creek at each study reach. Lion Oil Section 2.306 study.

Study Reach	Watershed Size
LC-1	2.0 sq. miles
LC-2	2.6 sq. miles
LC-3	2.8 sq. miles

To accomplish the study objective, the aquatic life field study included evaluations of the habitat conditions, water quality, aquatic macroinvertebrate community, and fish community assemblages. Studies reaches for the aquatic life field study are as follows:

- Reach LC-1,
- Reach LC-2, and
- Reach LC3.

The evaluations were conducted during May, 2005. A summary of the aquatic life field study is presented in the following sections. Appendix E provides the field data sheets, analytical results, biological lab sheets and biometric scoring sheets.

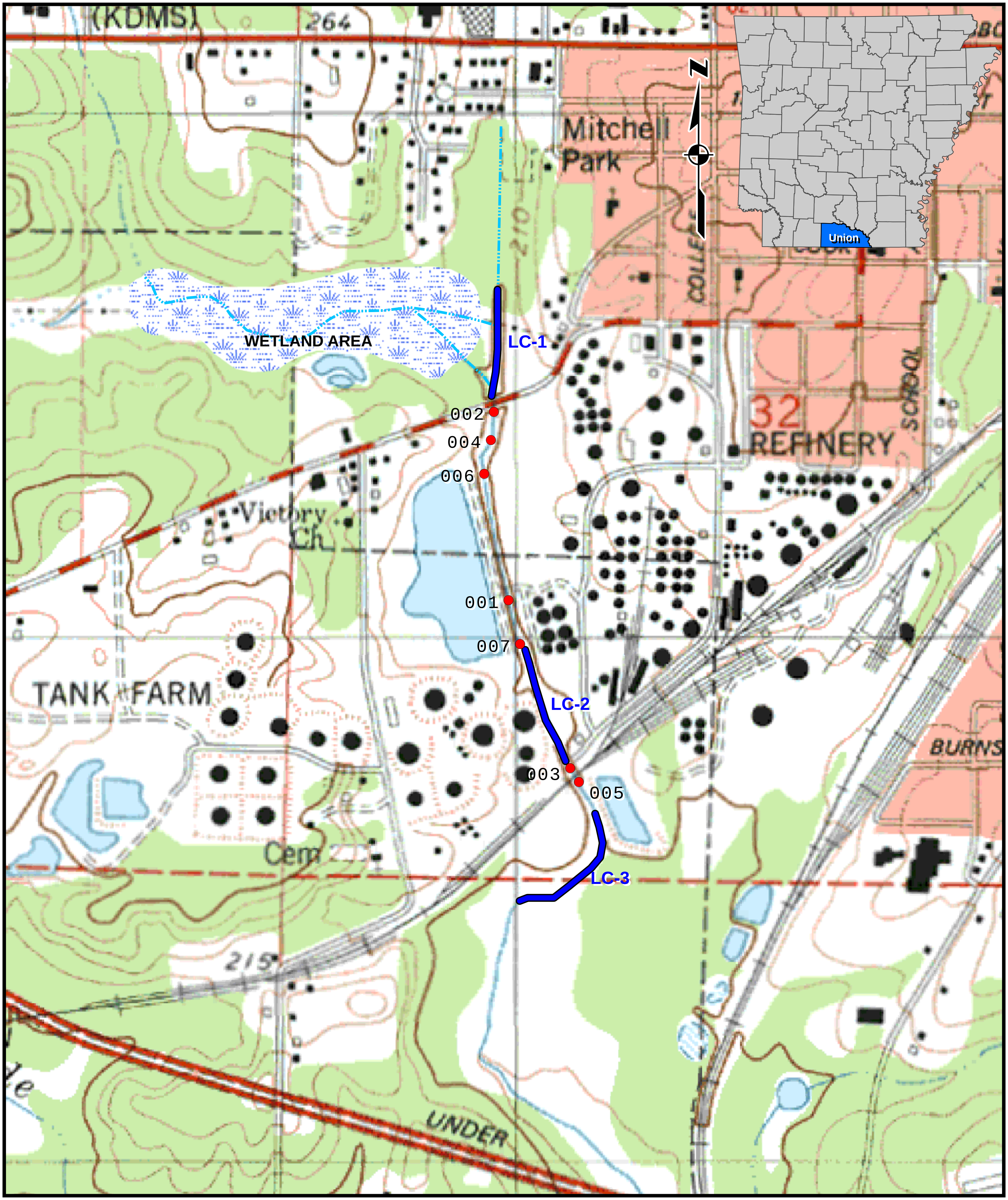

Figure 4.1. Aquatic life field study reaches. May 2005.

4.2 Habitat Characterization

4.2.1 Introduction

Physical habitat in streams includes all those physical attributes that influence or provide sustenance to biological attributes, both botanical and zoological, within the stream. Stream physical habitat varies naturally, as do biological characteristics; thus, habitat conditions differ even in the absence of point and anthropogenic non-point disturbance. Within a given ecoregion, stream drainage area, stream gradient and the geology are likely to be strong natural determinants of many aspects of stream habitat, because of their influence on discharge, flood stage, and stream energy (both static and kinetic). Kaufmann (1993) identified seven general physical habitat attributes important in influencing stream ecology and the maintenance of biological integrity:

1) channel dimensions,
2) channel gradient,
3) channel substrate size and type,
4) habitat complexity and cover,
5) riparian vegetation cover and structure,
6) anthropogenic alterations, and
7) channel-riparian interaction.

Land use activities can directly or indirectly alter any and/or all of these attributes. Nevertheless, the trends for each attribute will naturally vary with stream size (drainage area) and overall gradient. The relationships of specific physical habitat measurements described in this section to these seven attributes are discussed by Kaufmann (1993). Although they are actually biological measures, aquatic macrophytes, riparian vegetation, instream habitat and canopy cover are included in this and other physical habitat assessments because of their role in habitat structure and light inputs

The objectives of a habitat characterization are to:

1) assess the availability and quality of habitat for the development and maintenance of benthic invertebrate and fish communities, and
2) evaluate the role of habitat quality in relation to the attainment of designated uses and biological integrity.

There are three main headings for the components of the physical habitat characterization each with several categories. Measurements for each of the components (14 categories total) are recorded on copies of a two-page field form entitled Stream Habitat Assessment (Semi-Quantitative), and include:

1) Channel Morphology
    a) Reach Length Determination,
    b) Riffle-Pool Sequence, and
    c) Depth and Width Regime

2) Instream Structure
    a) Epifaunal substrate,
    b) Instream Habitat,
    c) Substrate Characterization,
    d) Sediment Deposition, and
    e) Aquatic Macrophytes and Periphyton

3) Riparian Characteristics
    a) Canopy Cover,
    b) Bank Stability and Slope,
    c) Vegetative Protection, and
    d) Riparian Vegetative Zone Width.

Field physical habitat measurements from a field habitat characterization are used in conjunction with water chemistry, temperature, macroinvertebrate and vertebrate (typically fish) community analyses, and other data sources to determine the status of the target streams attainment of designated uses and the water quality required to maintain those uses.

These procedures are intended for evaluating physical habitat in wadeable streams, but may be adapted for use in larger streams as necessary. The field procedures applied to this characterization are most efficiently applied during low flow conditions and during times when terrestrial vegetation is active, but can also be applied during spring seasonal conditions with higher base flows. This collection of procedures is designed for monitoring applications where robust, quantitative or semi-quantitative descriptions of habitat are desired. This semi-quantitative habitat procedure is usually used in conjunction with the *General Physical Habitat Characterization* and the *Qualitative Habitat Assessment* to provide a detailed view of the streams habitat condition.

The habitat characterization protocol provided herein differs from other rapid habitat assessment approaches (e.g., Plafkin et al., 1989, Rankin, 1995) by employing a, systematic spatial sampling that minimizes bias in the placement and positioning of measurements. Measures are taken over defined channel areas and these sampling areas are placed systematically at spacing that is proportional to the length of the entire study reach. This systematic sampling design provides resolution appropriate to the length of the study reach. The habitat assessment protocol summarized in this SOP is based on those of USEPA in their EMAP and RBP procedures (Lazorchak, 1998 and Barbour, 1999), USGS NAWQA program (Fitzpatrick, 1998) and Missouri Department of Natural Resources ESP (Sarver, 2000).

The procedures are employed on a sampling reach of length equal to 20 times the bankfull width. The semi-quantitative habitat sampling reach length should coincide as much as possible with that of the fish and macroinvertebrate collection reaches. Measurements are taken in each of 10 sub-reaches, which are systematically placed at intervals equal to approximately one tenth (1/10) the length of the represented study reach. Measurements and observations for each habitat characteristic are made in each of the sub-reaches as the assessment team moves along the stream channel. An average or total of the scores for each of the 10 sub-reaches is then calculated resulting in a mean value for each characteristic for the entire reach.

4.2.2 Methods

The habitat assessment was conducted within (or to the extent possible) the stream reach from which the benthic and fish communities are to be characterized. The physical habitat was characterized from measurements and observations of stream attributes made within 10 sub-reaches. The team assessing habitat moved along the stream channel (near the thalwag) observing habitat characteristics within each sub-reach. A description of and the rational for measuring each of the attributes are provided below. The details of how these attributes are recorded/evaluated are also described below in the following sections.

4.2.2.1 Channel Morphology

Channel morphology (or geomorphology) is a characterization of the shape of the stream channel including measurements and/or visual estimates of channel dimensions and riffle-pool sequences (i.e. a measure of the amount of riffles, runs and pools that occur in a given reach).

The channel observed includes that portion of the stream between the base flow wetted area and the top of the normal high water channel often referred to as the bankfull stage (Figure 1). The "bankfull" or "active" channel is defined as the channel that is filled by moderate-sized flood events that typically occur every one or two years. Such flow levels are on the verge of entering the flood plain and are believed to control channel dimensions in most streams.

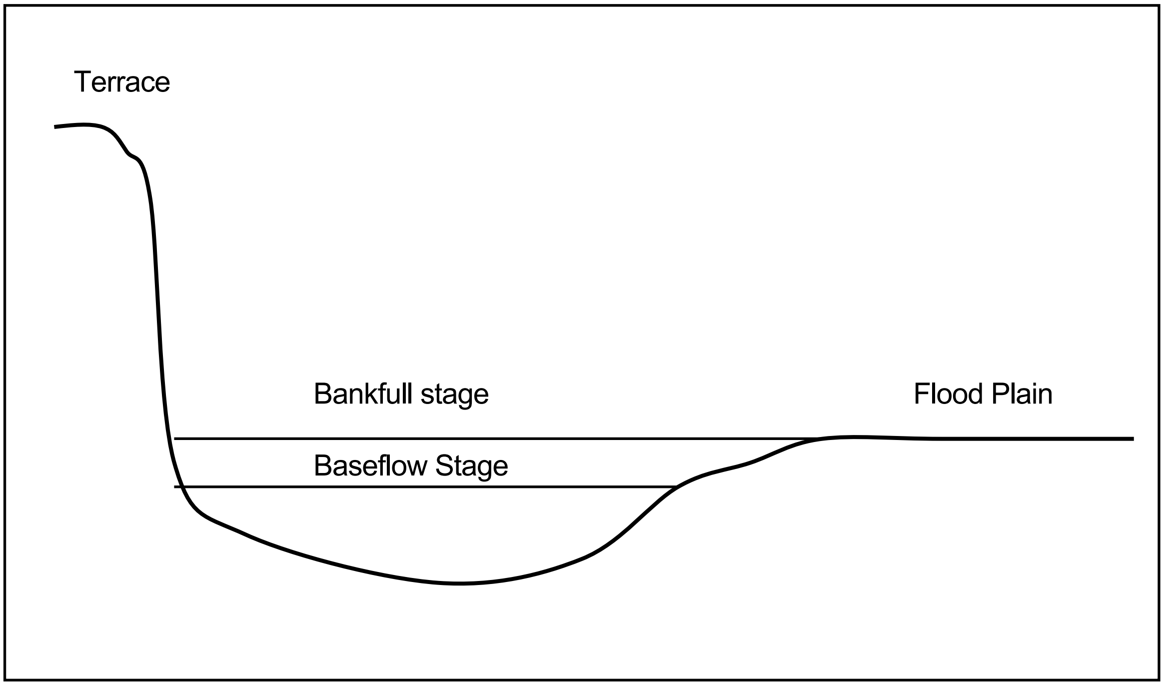

Figure 4.2. Stream channel depicting bankfull stage.

1) Reach Length Determination

First, bankfull depth (depth from stream bottom in thalwag to bankfull stage on the bank) was identified in at least two separate riffles (or alternatively runs in streams not exhibiting riffle morphology) in each study reach. Then bankfull depth and width was determined from 5 stream transects and recorded on the record sheet. Transect locations was selected to include each prominent morphology type represented in the stream. Bankfull depths were measured to the nearest 1/10 foot and bankfull widths were measured to the nearest foot using a wading rod and tape measure, respectively. An average of the 5 bankfull widths was then calculated and multiplied times 20 to arrive at the total reach length for assessment. This total length was then divided by ten to determine the length of each of the ten sub-reaches. Analysis of the first sub-reach began at the head of a given stream morphology (i.e. riffle, run or pool).

2) Riffle-Pool Sequence

Stream morphology refers to the abundance and placement (sequencing) of riffles, runs, and pools in a stream system. This sequencing is an indicator of a streams hydrological regime and stability as well as a determinant of its potential to sustain diverse aquatic communities. Beginning at the head of a morphological type (riffle, run or pool) the length of each morphological type in the stream reach was measured using a tape measure and recorded on the record sheet. The sequence of each morphological type was depicted on the record sheet using the provided notations so as to create a map to the location of each riffle, run or pool. The resulting measurements provided a quantitative measure of the percent of the study reach representing each stream morphological type (i.e. 40% riffle, 30% run, 30% pool, etc).

3) Depth and Width Regime

The average stream depth and width were estimated in riffles and pools in each sub-reach. Depths were measured along a transect, similar to that depicted in Figure 2, in a representative section of each riffle and pool in the sub-reach. Depths were generally taken in the thalwag (deepest area in stream channel) and approximately half way between the thalwag and the left and right banks. An estimated average depth for riffles and pools occurring in a sub-reach was derived from the cross-sectional depth measurements and recorded on the record sheet to the nearest 1/10 foot. Once completed for all 10 sub-reaches this provided an accurate semi-quantitative measurements of riffle and pool average depth and depth variability across the entire stream reach.

Stream wetted widths were measured along a transect, in a representative section of each riffle and pool in the sub-reach. An estimated average width for each morphological type in a sub-reach was recorded on the record sheet to the nearest foot. Once completed for all 10 sub-reaches this provided accurate semi-quantitative measurements of riffle and pool widths across the entire stream reach.

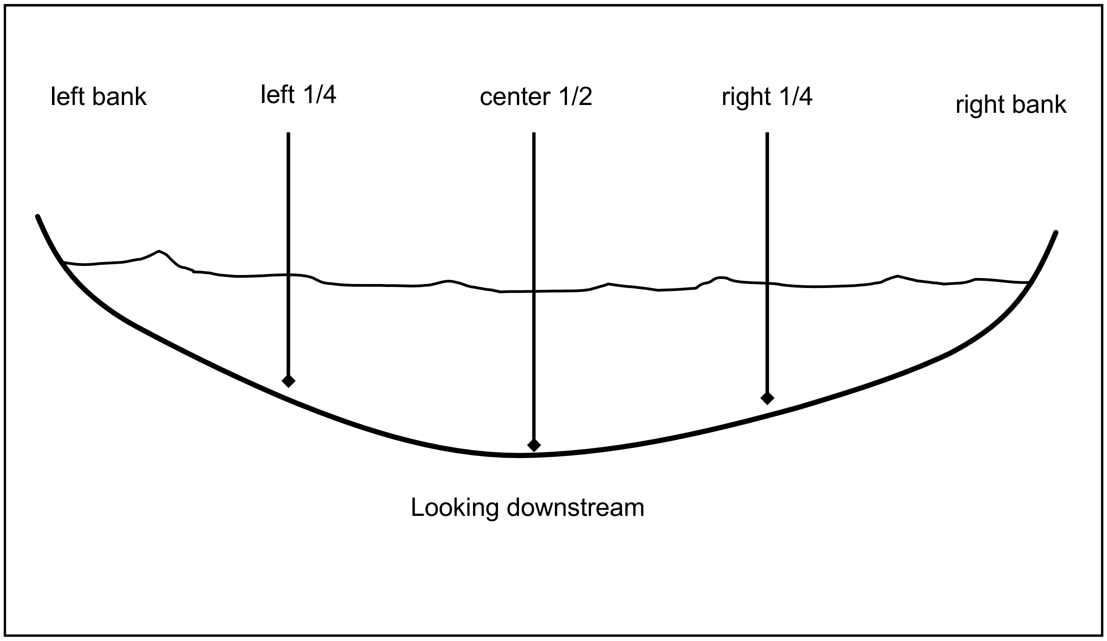

Figure 4.3. Approximate position of measurements across transect.

4.2.2.2 Instream Structure

Instream structure describes the characteristics of the stream within the wetted perimeter that makes up the habitat suitable for colonization of aquatic biota. This includes information about natural substrates (gravel, boulders, etc), aquatic plants and algae and debris that has been washed into or fallen into the stream, such as logs, leaves, etc. A stream capable of sustaining diverse aquatic communities will contain a variety of instream structure including some that is permanent and some that is mobile during high flow events.

4) Epifaunal Substrate (Macroinvertebrates)

   Epifaunal substrate refers to the area on the bottom of the stream (entire wetted perimeter) where macroinvertebrates inhabit. This attribute is scored as a percentage of the stream bottom in a sub-reach which contains substrates suitable for macroinvertebrate colonization. Scoring for this attribute should rely heavily on the stability of the substrate, the size of the interstitial spaces, and the cleanliness (not covered in thick algae or sediment deposits) of the substrate. Cobbles and coarse gravel will score higher percentages as they contain larger interstitial spaces for colonization, while sand and silt would score lower since they provide little spaces. In addition, root wads along the bank would score higher as they are more stable features than would depositional areas or small woody debris.

5) Instream Habitat (Fish)

   Instream habitat refers to the habitat features within the wetted perimeter of the stream sub-reach which are available for fish colonization. This attribute is scored as the percentage of the stream bottom (wetted perimeter) in a sub-reach which is covered with fish habitat. As with the epifaunal substrate attribute substrates composed of cobbles, coarse gravels and boulders score higher for fish cover as they provide better spaces for colonization. Other habitats that score high are large woody debris (individual logs with diameter >4 inches or complex woody structures composed of rootwads, logs, or limbs with diameter of 1.5 ft. or greater) and undercut banks. While habitats that score lower are those such as depositional areas, leaf packs, and fine sediments or sand.

6) Substrate Characterization

The dominant stream substrate size classification for riffles and pools within each sub-reach will be recorded on the record sheet. Only substrates within the wetted perimeter are evaluated. This information will be used to characterize the similarities and or differences in substrate structure and complexity in the riffles and pools of the study reach as it relates to the development and maintenance of the systems biological integrity.

Particle are classified into one of the size classes listed on the Semi-Quantitative Habitat Assessment Field Form based on the size of the intermediate axis (median dimension) of its length, width, and depth. This "median" dimension is the sieve size through which the particle can pass.

Bedrock	smooth or rough
Boulder	>25 cm
Cobble	6-25 cm
Coarse Gravel	1.6 – 6 cm
Fine Gravel	0.2 – 1.6 cm
Sand	<0.2 cm
Silt/Mud/Clay	fine, not gritty

Notations are made for unusual substrates such as concrete or asphalt and denote these artificial substrates as "other" and describe them in the comments section of the field data form. Code and describe other artificial (such as large appliances, tires, car bodies, etc.) substrates in the same manner.

7) Sediment Deposition

The sediment deposition attribute refers to the amount of stream bottom (in the wetted perimeter) that is covered by fine sediments and/or particulate organic matter. This attribute is scored as a percentage of the bottom in each sub-reach which is covered by such loose materials.

8) Aquatic Macrophytes and Periphyton Coverage

An estimate of the percentage of area covered by macrophytes and periphyton in a sub-reach is made and recorded both for riffles and pools. Macrophytes refers to aquatic plants that grow in the stream (both emergent and submerged), and periphyton refers to algae that grows on fixed surfaces. This attribute helps biologists determine stream productivity from a nutrient enrichment perspective and also for the availability of food sources for aquatic biota.

4.2.2.3 Riparian Characteristics

The riparian area includes the area from the stream bank in a direction away from the stream into the upland areas. It is these streamside riparian zones that ultimately help shape the stream and provide organic material as nutrients to the aquatic system. A well developed riparian area protects stream banks from erosion, provides shading, inputs nutrients, provides materials as habitat (instream structure) and filters runoff entering the stream. In the absence of well developed riparian zones the stream is more impacted by encroaching land-uses.

10) Canopy Cover

    Canopy cover (percent stream shading) over the stream was determined for each of the sub-reaches. Estimates of cover are made by looking into the canopy over the stream channel. Estimates were made from mid-channel and each quarter channel to determine the average percent canopy cover for the width of the stream in the sub-reach. Percent canopy at each measurement point was estimated visually.

11) Bank Stability and Slope

    Bank stability is an important attribute that is an indication of a stream reaches overall hydrologic equilibrium. A bank's stability also determines its ability to provide stable habitat for biota and its propensity to release large sediment yields to the stream, which ultimately cause high turbidity and deposition in downstream reaches. The right and left banks are classified according to the following categories:

    Score 9-10 = Stable, little evidence of erosion, < 5% bank eroding
    Score 6-8 = Moderately stable, some evidence of new erosion, 5-29% bank eroding
    Score 3-5 = Moderately unstable, obvious new erosion, 30-59% bank eroding
    Score 1-2 = Unstable, most of bank actively eroding, 60-100% bank eroding

    Banks composed of sands and gravels are much less stable than banks composed of silt/mud/clay or cobbles. The density of well rooted (more permanent) vegetation and root structure also help to improve a banks stability.

    Average bank slope (in degrees) in a sub-reach, was recorded for each bank (left and right). Bank slope affects the stability of a bank and is an indicator of past erosion. A gentle slope may average 30° while a steep or undercut bank may average 90° or 100°, respectively.

12) Vegetative Protection

    Bank vegetative protection was measured as a percent of the bank surface area which is covered by stable riparian vegetation and their associated roots in a sub-reach. Each bank (right and left) was assessed separately and the value recorded on the record sheet. Banks was assessed from the edge of the water to the top of the first terrace or normal top of bank.

13) Riparian Vegetative Zone Width

Riparian zone encompasses the area from the top of the normal stream bank outwards into the upland area. The broader the riparian vegetative zone width the more protected the stream banks are from alteration, the fewer pollutants will enter the stream from runoff, and the more available food sources there are to be deposited into the stream from the surrounding forest. Riparian zone width is scored for each bank in a sub-reach according to the following scale:

Score 9-10 = Riparian Zone Width > 18 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 1-2 = Riparian Zone Width < 6 meters

4.2.3 Scoring and Analysis of Habitat Assessment Data

Scores from the Semi-Quantitative Habitat Assessment was utilized in two different ways. First, data collected for each attribute (assessment category) was used independently to describe the study reach collectively. This method results in information such as: average riffle depth, average pool width, % riffle in entire reach, average bank stability, average (median) substrate size class in pools and riffles, mean % canopy cover, etc. Second, the data collected during the assessment was used in conjunction with the Qualitative Habitat Assessment procedure to score each of the ten "qualitative" indices with near quantitative accuracy (semi-quantitative). A combination of the two methodologies was incorporated into this intensive aquatic biota field study. The following sections outline the scoring of the qualitative habitat indices using the semi-quantitative data.

1) Epifaunal Substrate/Available Fish Cover

Average values from semi-quantitative categories 4 (Epifaunal Substrate) and 5 (Instream habitat) are combined into an overall average percent coverage are used to score this metric.

The following table presents the scoring criteria:

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Coverage	>70%	40%-70%	20%-39%	<20%
Score	20 -16	15 -11	10 - 6	5 - 1

2) Pool Substrate Characterization

Using the Substrate Characterization data from the semi-quantitative assessment (category 6) and the aquatic vegetation assessment (category 9) the following table may be used to score this metric.

Rank	Optimal		Sub-Optimal	Marginal	Poor
Substrate	Cobble or Gravel		Sand/Silt/Clay	Sand/Silt/Clay	Bedrock or Clay Only
Macrophytes Present	Yes	No	Yes	No	No
Score	20 - 18	17 - 16	15 - 11	10 - 6	5 - 1

3) Pool Variability

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) are used to help score this metric. Use the following table to determine pool variability.

Pool Characteristic	Large-Deep	Large-Shallow	Small-Deep	Small-Shallow
Size	Length ≥ Width	Length ≥ Width	Length < Width	Length < Width
Depth	≥3.2 feet	< 3.2 feet	≥3.2 feet	< 3.2 feet

An equal balance of all four pool types achieves higher scores. A prevalence of shallow pools scores lower.

4) Channel Alteration

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

5) Sediment Deposition

Reach average percent bottom affected by deposition (from category 8) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Bottom Affected	<5%	5%-30%	31%-50%	>50%
Score	20 -16	15 -11	10 - 6	5 - 1

Utilize the lower end of each scale to represent reaches where recent sediment bar formation is evident.

6) Channel Sinuosity (replacement for Frequency of Riffles)

This metric is assessed separately from the semi-quantitative data. It can be estimated in the field, measured during a longitudinal survey or calculated from current aerial photographs.

7) Channel Flow Status

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

8) Bank Stability

The average bank stability score for each represented bank from the semi-quantitative assessment (category 11) is directly applied to the qualitative assessment scoring for this metric (i.e. an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

9) Vegetative Protection

Reach average percent bank protected (from category 12 of the semi-quantitative record sheet) is used directly to score this metric for the right and left bank.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Protected	>90%	70% - 90%	50% - 69%	<50%
Score	20 -16	15 -11	10 - 6	5 - 1

10) Riparian Vegetative Zone Width

The average riparian zone width score for each represented bank from the semi-quantitative assessment (category 13) is directly applied to the qualitative assessment scoring for this metric (i.e. an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such).

4.2.4 Results and Discussion

4.2.4.1 Habitat Quality

The field study was completed on April 28, 2005 during seasonal stream conditions. A summary of the physical attributes of all stations where physical data was collected is presented in Table 4.2. Each study reach was generally characteristic of Gulf Coastal Plain streams and/or seasonal wet-weather tributaries with small watersheds. Field sheets and the raw habitat data are provided in Appendix E.

4.2.4.2 Reach LC-1

As identified in Section 4.1, Reach LC-1 was used to represent an upstream reference condition. This reach is located upstream of any discharge from Lion Oil. The upstream terminus of the reach LC-1 was a large wetland area that was developed and maintained as a result of beaver activity. The source of the flow in reach LC-1 was seepage from the beaver dam. The reference reach differed from the other two study reaches in four primary characteristics.

Table 4.2. Habitat characteristics of study reaches during seasonal flow conditions.

Observation	Study Locations		
	LC-1	LC-2	LC-3
Date	4/28/2005	4/28/2005	4/28/2005
General Stream Characteristics:			
Upstream Watershed Size, mi^2	2.0	2.6	2.8
Total Habitat Reach Length, ft	254	424	338
Average Bankfull Width, ft	12.7	21.2	16.9
Average Bankfull Depth, ft[1]	1.4	2.2	1.95
Average Velocity, fps	0.25	0.78	0.86
Flow, cfs	0.48	4.19	4.45
Morphology Regime			
% Pool	74.7	100	65
% Riffle	25.3	--	8.8
% Run	--	--	27
Depth and Width Regime			
Average Riffle Depth, ft.	0.3	--	0.6
Average Riffle Wetted Width, ft	5	--	9
Average Pool Depth, ft.	1.7	1.0	1.5
Average Pool Wetted Width, ft	8.8	19.9	15.7
Instream Habitat (Percent Stable Habitat)			
Epifaunal Substrate, Macroinvertebrates	45	15	24
Instream Cover, Fish	48	14	29
Substrate Characterization (Dominate Substrate)			
Pool	sand	sand	clay/silt, sand
Riffle	sand	--	sand
Run	--	--	clay/silt, sand
Sediment Deposition			
Average Percent of Bottom Affected	38	55	27
Aquatic Macrophytes and Periphyton (Percent Coverage)			
Pool Macrophytes	2.9	4.5	4.4
Pool Periphyton	0	1	7.2
Riffle Macrophytes	0	--	2.5
Riffle Periphyton	0	--	22.5
Run Macrophytes	--	--	5
Run Periphyton	--	--	5
Canopy Cover (Percent Stream Shading)			
Stream Shading	85	0	13
Bank Stability and Slope			
Average Left Bank Stability	mod. stable	mod. unstable	unstable
Average Left Bank Slope (degrees)	79	76	87
Average Right Bank Stability	mod. unstable	mod. unstable	mod. unstable
Average Right Bank Slope (degrees)	70	67	77
Bank Vegetative Protection			
Average Left Bank Protection (percent)	54	54.5	40
Average Right Bank Protection (percent)	45	61	57
Riparian Vegetative Zone Width			
Left Bank Riparian Width, meters	12 - 18	0	12 – 18
Right Bank Riparian Width, meters	12 - >18	0	6 - 11

[1] Average bankfull depth is calculated on riffles only

- **Flow:** the flow in LC-1 was approximately one-tenth (0,1) of the flow at the other two reaches.
- **Canopy Cover:** Cover in LC-1 was 80-100% compared to less than 20% for the other two reaches,
- **In stream Habitat**: The habitat of LC-1 was almost double that at the other study reaches. This was in the form of woody debris, which originated from the canopy and/or stream bank habitat.
- **Riffle/Pool Complex:** LC-1 also demonstrated a distinct pool/riffle complex that was absent in the downstream reaches.

These characteristics (Appendix F, Figures F.1-3) provided a greater diversity of habitats for the development of the benthic and fish community, however the limited flow overshadowed the diversity and resulted in a reduced benthic diversity and limited fish community development (See Sections 4.4 and 4.5).

The LC-1 reach was approximately 254 feet in length with a bankfull width (the point at which the stream enters its active floodplain) of 12.7 feet, and was composed of approximately 75% shallow pools and 25% riffles (Appendix F, Figures F.1-3). The stream reach had an average wetted riffle depth and width of 0.3 ft and 5.0 ft, respectively. The average wetted pool depth and width was 1.7 ft and 8.8 ft, respectively. Average velocity was 0.25 fps, while the flow recorded at this station was 0.48 cfs (See Appendix E).

Instream habitat (fish cover) was composed of logs and woody debris, and covered approximately 48% of the reach. The epifaunal substrate (macroinvertebrate habitat) was available in approximately 45% of the reach. The stream substrate composed mostly of sand in riffles and in pools. Sediment found in this reach was at about 38% of the bottom affected. Very few aquatic macrophytes were found along this stream segment (2.9%) and were restricted to pool margins. Stream shading along the reach was high at 85% canopy. Bank stability was scored on a left and right bank basis, the left bank scored in the moderately stable category, while the right bank scored moderately unstable. Bank vegetative protection covered approximately 45 -54% of the reach, while riparian vegetative zone averaged 12 to >18 meters.

4.2.4.3 Reach LC-2

This reach is located wholly within the managed area of the Lion Oil facility (Figures C-4 - 5). The stream course is channalized with containment dikes on both sides of the entire reach. The reach was classified as a single long pool with no riffles or runs (e.g. areas with increased velocities) and little variability in substrate (100% sand). The physical constraints would indicate that the biotic communities should have been limited when compared to both the upstream reference and downstream reaches (See Section 4.4 and 4.5).

Reach LC-2 (424 feet) was composed of 100% shallow pools. Table 4.2 (See Appendix C – Field data sheets). The average bankfull width was 21.2 ft. The average stream wetted depth and width was 1.0 ft and 19.9 ft, respectively. Note, the average wetted width was only 9% of the bankfull width in this reach, compared to 54% in Reach LC-1. This reduced ratio also reflective of the managed stream corridor as Loutre Creek dissects the facility. Average velocity at LC-2 was 0.78 fps, while the flow recorded at this station was 4.19 cfs (Appendix C).

Fish cover and macroinvertebrate habitat both covered approximately 15% of the area surveyed and were limited due to historical stream modification. The reach's substrate was dominated by sand. Heavy amounts of sediments were found in LC-2 at approximately 55% of the bottom affected. Stream shading along this reach was 0% reflecting the historical riparian disruption. Few aquatic macrophytes were found along this stream segment and covered less than 5% of the available stream-bank interface. This macrophytes community was restricted to watercress along the stream margins with grasses and forbs at the aquatic interface. Both left and right bank stability scored in the moderately unstable category, while the bank slopes were approximately 76° and 67° for left and right bank, respectively. Bank vegetative protection was adequate and covered approximately 55% and 61% for left and right bank, respectively. However, the bank vegetation was predominately grasses, which has very little protective characteristics. The riparian zone was also very minimal and was only protected by grasses, the actual score for the riparian zone width was zero.

4.2.4.4 Reach LC-3

Reach LC-3 is located downstream of all storm water discharges (Figure 4.1). The watershed was slightly larger than LC-2, however the stream width and depth was less than LC-2, again reflecting the managed habitat of LC-2. Reach LC-3 demonstrated a greater degree of stream morphology development and a wider variety and density of instream vegetation than any other reach (Appendix F, Figure F 6-9).

Reach LC-3 (338 feet) was composed of approximately 65% shallow pools, 27% runs, and approximately 9% riffles (Appendix C). The average bankfull width was measured at 16.9 ft, while the bankfull depth was measured at approximately 2.0 ft. The average wetted riffle depth and width was 0.6 ft and 9.0 ft, respectively. The average wetted pool depth and width was 1.5 ft and 15.7 ft, respectively. Average velocity at LC-3 was 0.86 fps, while the flow recorded at this station was 4.45 cfs (Table 4.2 and Appendix C).

Within the study reach, the fish cover and macroinvertebrate habitat covered approximately 25% and 30%, respectively. Stream shading within the reach was sparse with 13% canopy. The aquatic macrophytes within the reach were found in each morphology regime between 2.5% and 5.0%. Periphyton covered approximately 22.5% of available riffle substrate. Average bank stability along LC-3 was unstable (left bank) and moderately unstable (right bank). Bank slope was very steep at 87% and 77% for left bank and right bank, respectively. Bank vegetative protection was moderate and averaged between 40% and 57%. The riparian vegetative zone average was 12 – 18 meters for the left bank, while the right bank's average was 6 – 11 meters.

4.2.5 Habitat Potential

A qualitative assessment of habitat potential was completed at study reaches LC-1, LC-2, and LC-3. The assessment placed reaches LC-1 and LC-3 in the sub-optimal category with mean scores of 14.2 and 11.4, respectively and reach LC-2 in the marginal category with a mean score of 7.8 (Table 4.3). Differences in the scores between reaches were demonstrated most significantly by differences in epifaunal substrate, channel alteration, channel sinuosity, and riparian vegetative zone width.

The results of the qualitative habitat assessment indicate the presence of favorable habitat for fish and macroinvertebrates at study reaches LC-1 and LC-3. While study reach LC-2 scored less favorably for fish and macroinvertebrate habitat due to disturbances both instream and along side the stream, as well as alterations to the channel. The individual scoring forms are provided in Appendix E.

Table 4.3. Qualitative habitat potential summary of study reaches, April 2005.

	Reach		
Parameters	LC-1	LC-2	LC-3
1. Epifaunal Substrate	14	4	10
2. Pool Substrate	10	11	13
3. Pool Variability	13	10	15
4. Channel Alteration	18	2	10
5. Sediment Deposition	14	8	13
6. Channel Sinuosity	13	2	9
7. Channel Flow Status	17	16	16
8. Bank Stability			
Left Bank	8	5	3
Right Bank	7	5	5
9. Vegetative Protection			
Left Bank	7	6	5
Right Bank	5	7	6
10. Riparian Vegetative Zone Width			
Left Bank	8	1	6
Right Bank	8	1	3
Score (Total)	142	78	114
Score Average	14.2	7.8	11.4
Ranking	S	M	S

Ranking	Range
Optimal (O)	16-20
Sub-optimal (S)	11-15
Marginal (M)	6-10
Poor (P)	0-5

4.2.6 Habitat Conclusions

The habitat evaluation indicated that:

1. The habitat of Loutre Creek provides some minimum level of form and function to support a limited biotic community.
2. Loutre Creek does not demonstrate the habitat potential for the development of a characteristic Gulf Coastal Seasonal biotic community. The limiting factors vary from study reach to study reach.
3. The flow (minimum even during the spring seasonal period) and stream morphology (no deep pools) of the reference reach (LC-1) limits the biotic community development.
4. The flows provided by the current discharge condition from Lion Oil provides a constant source of flow to allow increased community development when compared to upstream reference conditions.

4.3 Water Quality

4.3.1 Chemical Characteristics

This section presents the methods and results of the water quality characterization for *in-situ* and minerals analysis in Loutre Creek upstream (LC-1) and downstream (LC-2 & LC-3) of Lion Oil storm water outfall discharge influences. The analytical methods used followed procedures outlined in Standard Methods for the Examination of Water and Wastewater and appropriate EPA published methods.

4.3.2 Methods

The water quality analysis was conducted during April 2005 to characterize instream conditions during spring seasonal period. Water quality analyses were taken within each study reach during the time of biological assessment. Water quality analyses consisted of *in-situ* measurements and grab samples for laboratory analysis of chloride, sulfate, and TDS. *In-situ* measurements for water temperature, dissolved oxygen (DO), and specific conductance were measured using a YSI Model 85 digital meter. The pH was measured using an Orion model 230A pH meter that was calibrated using the standard two point method. Turbidity was measured using a Hach 2100P turbidimeter. Grab samples were collected and preserved on ice for laboratory analysis of chloride, sulfate, and TDS. All field meters were calibrated the morning prior to use in the field. Calibration records, analytical results and chain of custodies are provided in E- Field Data Sheets.

4.3.3 Results and Discussion

The *in-situ* water quality data is presented in Table 4.4. DO ranged from 3.7 mg/L to 5.2 mg/L in the sampling reaches. The pH ranged between 6.7 and 7.9 s.u. along the three reaches evaluated. Specific conductivity was a magnitude higher at LC-2 (2,876 μmhos) and LC-3 (2,788 μmhos) verses LC-1 (295 μmhos). These increases reflect a result of residual effects from storm water outfalls, as well as current effects of Outfall 001 discharge. The chloride, sulfate, and TDS concentrations were also higher at LC-2 and LC-3 than at LC-1, likely for the same reason.

Table 4.4. Water quality data measured/sampled in April 2005.

Parameter	LC-1	LC-2	LC-3
Date	4/28/2005	4/28/2005	4/28/2005
Time	1410	1045	0800
Temperature, C^o	21.1	26.8	23.6
Dissolved Oxygen, mg/L	3.7	5.2	4.4
Specific Conductance, uS	295	2876	2788
pH, su	6.7	7.9	7.5
Turbidity, ntu	13.3	24.0	22.0
Total Dissolved solids mg/L	190	1800	1800
Chloride mg/L	70	220	220
Sulfate mg/L	4.4	960	950

4.3.4 Conclusions

1) The *in-situ* parameters measured during the study indicate that water quality supports the attainment of the designated aquatic life use and the development and maintenance of the biological integrity in stream bodies.

2) Upstream dissolved oxygen did not maintain the water quality standard for primary season Gulf Coast minimums.
3) The water quality of Loutre Creek is dominated by the discharge from the facility.

4.4 Benthic Macroinvertebrate Community

4.4.1 Introduction

The benthic macroinvertebrate community reflects the effects of habitat availability, and the long term exposure to physical and chemical properties of the water in which it develops and lives. The presence and diversity of the benthic macroinvertebrate community reflects a water body's biological integrity.

4.4.2 Methods

An assessment of the benthic macroinvertebrate community was performed using rapid bioassessment (RBA) techniques as detailed in ADEQ, 1988. The methods were modified to sample in pool habitats. As indicated in Section 1.2, three sampling stations associated with the discharges were evaluated. LC-1 was on Loutre Creek upstream of any contribution from the Lion Oil facility, either treated process or storm water. Reach LC-2 was sampled to represent conditions downstream of Outfall 001 (treated process discharge) and Reach LC-3 was sampled to characterize Loutre Creek downstream of all discharge for the facility (Figure 4.1).

Macroinvertebrates were sampled using a Turtox Indestructible® dip net. Each station was sampled for three minutes according to the RBA protocol. The three minute sample period included time spent actively sampling the selected microhabitat and did not include time moving from microhabitat to microhabitat and/or sorting large debris particles from the sample to be processed.

Each sample was placed in a bucket and condensed using multiple washings into a standard #30 sieve. The samples were preserved in the field and transported to the lab for further processing, sub-sampling, identification and enumeration. In the lab, each of the field preserved samples were sub-sampled at random, placed on a grid, white sorting tray from which the macroinvertebrates sub-sample was collected. The white tray, with a 10 X 10 grid, was used to randomly select a 100 organism sub-sample from the qualifiedly collected benthic sample. Numbered grids were selected at random, from which all insects were collected and ultimately identified. Collections from individual grids continued until 100 organisms were collected. The 100 organism sub-samples were preserved in Kaylee's solution or 70% ethanol as a voucher for verification. The remainder of the original sample was concentrated, large particles removed, preserved in Kaylee's 'solution and retained as a voucher for the sample picking techniques used. These voucher samples will be held at GBM^c for a period of 24 months or until the project is completed. After project completion the samples may be contributed to a university zoological collection.

The macroinvertebrate assemblages from each station were analyzed according to several benthic community biometrics. These include richness (number of different taxa), EPT richness (number of different taxa represented in the orders Ephemeroptera, Plecoptera, and Trichoptera), and species diversity as determined by the Shannon-Wiener diversity Index. The analysis also included the seven biometrics used by the State of Arkansas (ADPCE, 1988) in their RBA scoring system. This scoring system places a value (1 to 4, 1=excessive differences, 4=no differences) on each of the seven biometrics to achieve a final mean score. The field data sheets and biometric score forms are provided in Appendix E.

4.4.3 Results and Discussion

4.4.3.1 Overview

The species diversity was greatest (3.73) at the downstream most station (LC-3), and lowest (3.10) in the reference reach above the Lion Oil facility, indicating that the benthic community was improved, and more diverse, both taxonomically and functionally, downstream of the storm water discharges of the Lion Oil facility than they were upstream of those contributions. This measure of invertebrate community development reflects the impact of the urban disturbances and the limited watershed size upstream of the facility. In addition, the continuous flow augmented by the treated discharge from Outfall 001 (in the middle of Reach 2) maintains a constant wetted habitat. A summary of the benthic macroinvertebrate community assemblages of Loutre Creek collected during the spring seasonal aquatic field study is presented in Table 4.4. A total of 18 taxa (i.e., community richness) were identified from all reaches sampled from Loutre Creek (Table 4.5).

The representative communities of each sample reach shared 3 of 5 dominant ordinal groups (Diptera, Annelida, Pelecypoda). However, Reach LC-3 demonstrated the most even distribution on an ordinal level with 7 orders comprising approximately 10 percent of the benthic sub-sample, and included mayflies with 9.6 percent of the assemblage. The LC-3 diversity was further demonstrated in that the five dominant taxa comprised only 58 percent of the sample compared to 89 and 82 percent at LC-1 and LC-2, respectively.

The functional assemblage changed from LC-1 to LC-3. The LC-1 functional assemblage was dominated by collectors over predators, by a 2:1 ratio. This ratio moderated at LC-2 to about 1:1 and was reversed at LC-3 to almost 1:2, collectors to predators. Typically, the collectors functional group would dominate gulf coastal streams with watersheds of 10 square mile or less, as demonstrated by LC-1, the reference condition. However the elevated flows and the persistent velocity resulting from the discharges, and the changes these two physical conditions bring about on the stream channel (clay hardpan, deeply incised stream bad, etc.), and the absence of a canopy at LC-3 functionally reflect conditions characteristic of much larger watersheds. The shift in the functional assemblage from collector to predator dominated communities is in response to these physical changes.

4.4.3.2 Reach LC-1

The upstream community (LC-1) was dominated by representatives from the order Diptera (true flies) and Annelida (aquatic worms), which comprised 77.3 percent of the assemblage. Only the introduced Asiatic clam (Corbicula), was collected from LC-1 and not collected from either LC-2 or LC-3.

4.4.3.3 Reach LC-2

The invertebrate community of Reach LC-2 was also dominated by order Diptera (true flies) and Annelida (aquatic worms), but comprised only 60 percent of the assemblage. Other dominates included damselflies which comprised 12 percent of the assemblage. The trophic structure of LC-2 was more closely divided between collectors and predators. There was no individual taxa collected from LC-2 that was not also collected from either LC-1 or LC-3 community was composed mostly of collectors.

4.4.3.4 Reach LC-3

The invertebrate community of Reach LC-3 community was also dominated by diptera, which comprised 41% of the assemblage. There was no clear sub-dominant with six orders approximating 10% of the community. The trophic structure of community was dominated by predators. Mayflies and additional crustaceans were collected from LC-3 that were not present in the other study reaches.

4.4.3.5 Biometric Score Comparisons

Although there were some specific taxonomic differences in the species collected, the biometric scores calculated for the comparison of the assemblages collected at LC-1, LC-2 and LC-3 were 2.9, 3.4, and 3.6, indicating only minimal differences between the benthic community assemblages. The most notable difference between the representative communities upstream and downstream of the storm water outfalls is in their trophic structure (Figure 4.4).

This structure demonstrates a shift from a collection dominated community to a predator dominated assemblage. Several factors could account for this including, habital differences, hydraulic modification due to storm flows, or the changes in water quality. Typically, collectors would dominate benthic assemblages of small gulf coastal streams. However, the hydraulics created by the storm water and treated process discharge result are characteristic of much larger watersheds.

Table 4.5 Summary of Benthic Community metrics from Loutre Creek as sampled May 2005.

Parameter	**Reach Designation**		
COMMUNITY MEASURES	**LC-1**	**LC-2**	**LC-3**
Total number of Taxa (Richness)	18	18	18
EPT Richness	0	0	1
EPT % Abundance	0	0	9.6
Diversity Indices (Shannon-Wiener)	3.0	3.4	3.9
Total % of 5 Dominant Taxa	89	72	58
Dominant Orders			
Ephemeroptera	0	0	9.6
Annelida	27.3	12.7	10.6
Odonata	5	11.8	9.6
Pelecypoda	12	0	0
Crustacea	3.6	6.9	10.6
Hemiptera	0	4.9	10.6
Diptera	48.	56	41.3
Functional Assemblage			
Shredders	9	11	10
Scrapers	0	1	0
Collectors, Filtering	26.4	29.4	14
Collectors, Gathering	28.2	14.7	23
Collectors, total	54.6	44.1	37.5
Predators	35.5	44	52
Biometric Score:	**3.4**		**3.6**

Table 4.6 Summary of Benthic Community taxa collected from Loutre Creek using the RBA techniques. May 2005.

Taxa/Station I.D.	**Trophic Group**	**STUDY REACHES**		
		LC-1	**LC-2**	**LC-3**
COLLEMBOLA				
Podura	PR	---	---	2
ANNELIDA				
Oligochaeta	GC	29	13	11
Helobdella	PA	1	---	---
PELECYPODA				
Corbicula	FC	13	---	---
CRUSTACEA				
Cambarinae	SH	3	7	8
Amphipoda	GC	1	---	---
Isopoda	GC	---	---	3
Palaemonetes	FC	---	---	2
EPHEMEROPTERA				
Caenis	GC	---	---	10
ODONATA				
Argia	PR	1	3	4
Enallagma	PR	---	8	6
Libellula	PR	3	---	---
Perithemis	PR	1	1	---
HEMIPTERA				
Belostoma	PR	1	1	---
Corixidae	PR	---	4	11
MEGALOPTERA				
Sialis	PR	---	---	3
COLEOPTERA				
Curculionidae	PR	---	---	2
Dineutus (larvae)	PR	1	---	---
Dytiscus	SC	---	1	---
Hydrocanthus	SH	---	1	---
Hydrochus	SH	---	1	---
Peltodytes	SH	1	---	---
Uvarus	PR	---	3	3
DIPTERA				
Anopheles	FC	1	2	---
Bittacomorpha	SH	1	---	---
Probezzia	GC	1	2	---
Chironominae	FC	15	28	15
Tanypodinae	PR	25	14	11
Tanytarsini	PR	7	9	4
Hexatoma	PR	---	2	2
Psychoda	PR	---	---	8
Tipula	SH	5	2	3
Sum of Percentages		100	100	100
Total Abundance:		110	102	108
Species Richness:		18	18	18
Shannon-Wiener Diversity Index		3.1	3.4	3.86

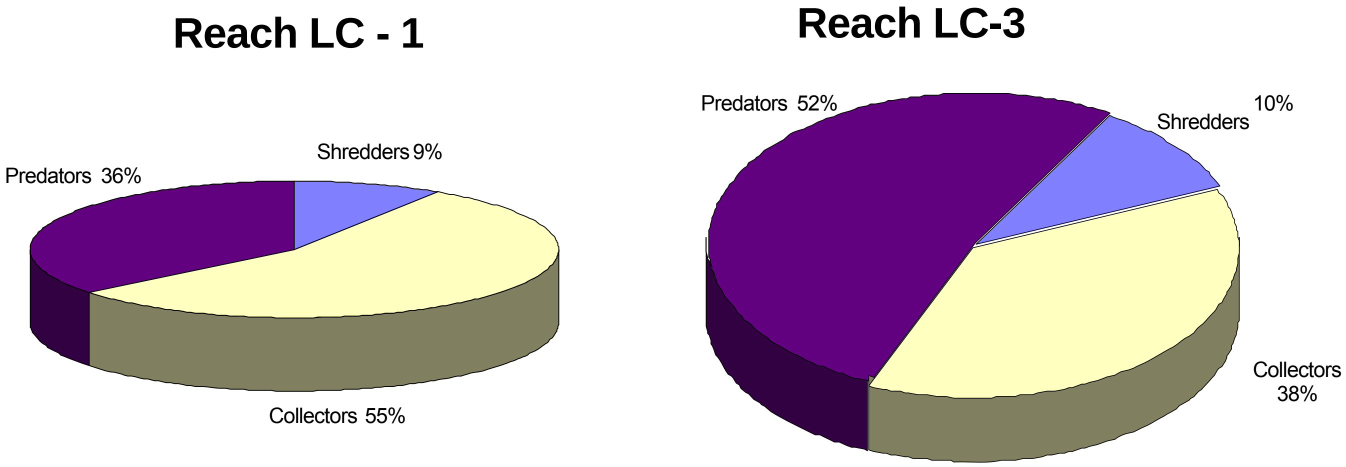

Figure 4.4. Comparison of trophic structure of benthic community upstream and downstream of outfalls. Collector dominated to Predator dominated.

4.4.4 Conclusions

Based on the analysis of the macroinvertebrate collection from Loutre Creek, the following conclusions are provided:

1) The macroinvertebrate communities observed at all study reaches are similar in the development of taxonomic diversity.
2) Biometric comparisons indicate that there are minimal differences in the benthic communities.
3) The community structure (form and function) demonstrated minimal differences which could be attributed to differences in physical conditions of the stream reach evaluated.
4) The macroinvertebrate communities observed at the Loutre Creek reaches are similar in structure and composition to Gulf Coastal Plain ecoregion conditions for small watersheds. However, the complexity of the community was limited when compared to least disturbed streams, even in the reference site on Loutre Creek.
5) The minimal differences actually reflect an improved benthic community at LC-3 downstream when compared to LC-1. The improvement is likely a response to increased flow and the improved habitat diversity indicated in the qualitative habitat assessment.
6) The macroinvertebrate community is being fully maintained downstream of the effluent discharge, as is the designated aquatic life use.
7) The biological integrity of Loutre Creek is being supported by the existing discharge conditions, which include elevated dissolved mineral concentrations resulting for the application of the air emission control equipment.

4.5 Fish Community

4.5.1 Introduction

The fish community supported in a stream is in direct response to available habitat, food sources, and water quality of that particular stream. The presence of a certain level of species richness and diversity along with a community structure similar to that expected in typical streams of a ecoregion are indicators of aquatic ecosystem health.

The objective of the fish community characterization is to collect and identify a representative sample of all except very rare species in the assemblage reflective of the relative abundance within the community. Backpack electrofishing equipment is used as the principal sampling gear supplemented by block netting and seining in habitats where flow, substrate and structure affect the capture of fish species. Other methods of fish sampling may be implemented when conditions are not adequate for backpack eletrofishing or seining; these may include, using boat electrofishing equipment and/or hook and line sampling equipment. Usually 2 – 4 team members will make up the sampling team involved in collecting the aquatic vertebrates.

Major factors that influence collecting include flows, water depth, instream obstructions, water turbidity, temperature and conductivity. The primary tool utilized in the fish collections was a Smith-Root backpack electroshocker. However, seines and block nets were utilized as necessary to adequately characterize a sampling reach. The shocker is equipped with an automated timing mechanism which records the amount of time that electricity is actually being applied, or “pedal down time” (PDT).

Sampling fish species to determine their proportionate abundance will be conducted after all water quality parameters and/or samples are collected but prior to the collection of the macroinvertebrate sample and habitat data.

Shocked fish were captured with hand held dip nets and held in buckets while the sampling continued. The entire stream width within the sampling reach will be sampled. PDT time will continue for not less than 30 minutes unless the wetted habitat of any reach limits the PDT. In addition to the PDT, the total collection time will be recorded.

Unless specified in a project specific sampling analysis plan (SAP), there will not be a maximum time limit for the collection period, however the collections may be terminated when in the opinion of the principal investigator determines that a representative collection has been obtained. Sampling information is recorded on the Fish Community Collection Form, general comments (perceived fishing efficiency, missed fish, and gear operation suggestions) will be recorded on the lines provided on this form.

An effort to search for and collect fish will be completed at all reaches, even if the stream is extremely small, and it appears that sampling may not collect any specimens. If no specimens are collected, the "NONE COLLECTED" field on the Fish Collection Form will be completed and will provide an explanation in the comments section of the form.

4.5.2 Methods

An assessment of the fish community in Loutre Creek (LC-1, LC-2, and LC-3) was performed. During the spring of 2005, each reach was sampled using a Smith-Root backpack electroshocker. The shocker includes an automated timing mechanism which records the amount of time that electricity is actually being applied, or “pedal down time” (PDT).

Shocked fish were captured with hand held dip nets and held in buckets while the sampling continued. At the end of each sampling effort fish from both reaches were preserved in formalin for later identification in the lab. Fish identifications were made according to the Fishes of Arkansas (Robison, 1988) and The Fishes of Missouri (Pflieger, 1975) to species level where possible.

The fish collections at each reach were compared according to several biometrics including: species richness (number of taxa); sunfish richness; species diversity; abundance; dominant family groups; percent of tolerant species; trophic structure; percent of hybrids; percent of diseased fish; and key and indicator species as listed in Reg. No. 2. In addition, the fish community was assessed using a Biocriteria method developed by ADEQ. This Biocriteria uses a scoring system by which the assemblage collected is compared to a reference stream in the same ecoregion using eight different metrics. The metric scores are totaled and the resulting sum is used to assess if a stream reach is in support of its assigned designated uses.

4.5.3 Results and Discussion

4.5.3.1 Reach Comparisons

Species richness and diversity demonstrated little differences between the three study reaches. Species richness and diversity were 12 and 1.53 for LC-1, 12 and 1.64 for LC-2, and 12 and 1.43 for LC-3. Each study reach was dominated by sunfish which comprised 58% (LC-1) and 74% (LC-2 & LC-3) of the community (Table 4.7). The fish assemblages from each reach shared the two dominant species represented in the samples. The differences were in the sub-dominant group found at each study reach, which comprised the majority of each reaches' collection (Table 4.8). Trophically, the communities were dominated by insectivores, which accounted for 97.9% to 99.3% of each community. The remaining community trophic structure comprised of 1.6%, and 0.7% omnivores at LC-1 and LC-2, respectively and 1.4% and 0.7% piscivores at LC-2 and LC-3, respectively.

A summary of the fish collected from the three reaches is provided in Table 4.8. The fish assemblages collected from study reaches LC-1, LC-2, and LC-3 included a PDT of 28.2 minutes, 38.4 minutes, and 37.8 minutes, respectively. This equates to abundance of the fish observed during the collection and is expressed as fish caught per minute of shocking time or pedal down time (PDT). The number of fish caught per minute of PDT is 4.43 at LC-1, 3.67 at LC-2, and 3.68 at LC-3. The field data sheets and bio-criteria determination sheets are provided in Appendix E.

4.5.3.2 Biometric assessment

The primary factor in evaluating the biocriteria scoring for this application demonstrates that the downstream reach fish community was equal to that of the upstream reference reach (LC-1) fish community. This demonstrates that the storm water discharges are not causing an adverse effect on the fish community's development.

The biometric scoring evaluates a fish community as it is compared to a least disturbed Gulf Coastal stream. Important considerations in the application of the biometric assessment and the comparison of fish communities relates to the watershed size and the condition of the watershed. Both of these attributes, the watershed size and watershed condition, of the upstream reference site on Loutre Creek (LC-1) is a lower value when compared to those used In the biocriteria development.

The biometric assessment resulted in a total of 8 points at LC-1, a total of 8 points at LC-2, and 6 points at LC-3 out of 32 possible points. The low scores when compared to a least disturbed reference, are a result of sensitive, catfishes, darters, and key species rarity, as well as an over abundance of sunfish representatives and low species diversity through out the study reaches.

However, all 3 reaches, including the upstream reference reach scored the same, indicating that the storm water discharges are not preventing the attainable use as indicated by the upstream reference condition. Scores from each reach on Loutre Creek place them in the “not supporting” use support category, when compared to the least disturbed condition. However, the biocriteria scoring matrix was developed for streams with watersheds of around 10 mi^2 and does not account for seasonal streams with very small (<3 mi^2) watersheds.

Table 4.7. Fish community structural analysis for Lion Oil, El Dorado, AR, April 2005.

Parameter	LC-1	LC-2	LC-3
COMMUNITY MEASURES			
Richness (Total Number of Taxa)	12	12	12
Darter Richness (Number of Taxa)	--	--	--
Sunfish Richness (Number of Taxa)	5	5	5
% Pollution Tolerant Species	2.4	4.96	5.04
% Pollution Intermediate Species	96.8	95.04	94.96
% Pollution Intolerant Species	0.80	--	--
% Diseased	--	4.3	2.2
Number of Key & Indicator Species (Taxa)	2.0	2.0	3.0
Number of Key & Indicator Species (Individuals)	4.0	10.0	6.0
% Key & Indicator Species numbers of total fish	3.2	7.1	4.3
Diversity Indices (Shannon-Wiever)	1.53	1.64	1.43
Abundance, fish collected/minute	4.43	3.67	3.68
TROPHIC STRUCTURE			
% Herbivores	--	--	--
% Omnivores	1.60	0.71	--
% Insectivores	98.4	97.9	99.3
% Piscivores	--	1.42	0.72
PERCENT OF 5 DOMINANT FAMILY GROUPS			
Cyprinidae	2.4	0.7	--
Poeciliidae	36.8	24.8	25.2
Cyprinodontidae	2.4	--	--
Esocidae	--	--	0.7
Aphredoderidae	0.8	--	--
Ictaluridae	--	0.7	--
Centrarchidae	57.6	73.8	74.1
Total % of 5 Dominant Groups	100.0	100.0	100.0

* Total of 12 key and indicator species possible.

Table 4.8. Fish community for Lion Oil, El Dorado, AR, April 2005.

Scientific Name	Common Name	LC-1	LC-2	LC-3
		4/28/2005	4/28/2005	4/28/2005
CYPRINIDAE				
Notemigonus crysoleucas	golden shiner	2	1	0
Opsopoeodus emiliae	pugnose minnow	1	0	0
POECILIIDAE				
Gambusia affinis	mosquitofish	46	35	35
CYPRINODONTIDAE				
Fundulus chrysotus	golden topminnow	3	0	0
ESOCIDAE				
Esox americanus[1]	grass pickerel	0	0	1
APHREDODERIDAE				
Aphredoderus sayanus[2]	pirate perch	1	0	0
ICTALURIDAE				
Ameiurus melas	black bullhead	0	1	0
CENTRARCHIDAE				
Lepomis cyanellus	green sunfish	1	6	7
Lepomis gulosus[1]	warmouth	0	2	1
Lepomis punctatus[2]	spotted sunfish	3	8	6
Lepomis megalotis	longear sunfish	68	86	89
Micropterus salmoides	largemouth bass	0	2	0
Total No. Taxa Collected		12	12	12
Total Fish Collected		125	141	139
Level of Effort (Minutes) PDT[3]		28.2	38.4	37.8
Catch per Minute, PDT		4.43	3.67	3.68
Shannon-Wiever Diversity Index		1.53	1.64	1.43

[1] Typical Gulf Coastal Ecoregion Key Species

[2] Typical Gulf Coastal Ecoregion Indicator Species

[3] Pedal Down Time

4.5.4 Conclusions

Based on the results of the fish collections, the following conclusions are provided:

1) The fish assemblages collected at all study reaches, upstream and downstream of the storm water discharges, are similar in structure and function indicating that the biological integrity required to maintain the attainable seasonal fishery is being supported.
2) The communities at all reaches (LC-1, LC-2, and LC-3) during the seasonal study period were found to be dominated by sunfish.
3) The communities were similar to those expected in a Gulf Coastal Plain stream of similar watershed size. Therefore, the seasonal fishery downstream from the discharges is being maintained, as is the designated aquatic life use.
4) The numbers of fish and diversity collected downstream during the seasonal study exceeds and/or equals those collected upstream. The downstream reach was found to contain three of the key and indicator species as well. (ADEQ, 2004)

5) Comparisons to least disturbed gulf coastal streams indicated non-attainment of the perennial fishery use.
6) The fish communities characterized as part of the aquatic life field study indicates that Loutre Creek, downstream of the existing Lion Oil discharges is maintaining the designated aquatic life use and while not as diverse as a typical least disturbed fishery, is more typical of a Gulf Coastal Plain stream than is the reference reach above the discharges.

4.6 Summary

Based on the aquatic life field study, the designated aquatic life use (seasonal fishery) and the biological integrity of Loutre Creek is maintained downstream of the existing discharges from the Lion Oil facility. In fact, the augmentation of flow from the discharges serve to enhance the potential for community development as illustrated by the comparisons between the upstream reference condition and the downstream study reaches.

5.0 EXISTING LOADINGS OF DISSOLVED MINERALS

5.1 Chloride, Sulfate, and TDS Water Quality Criteria

Currently Loutre Creek's minerals water quality criteria is ecoregion numbers, while Bayou de Loutre has stream based water quality criteria for minerals. The current ecoregion based chloride, sulfate and TDS water quality criteria for Loutre Creek (Figure 5.1) is 14 mg/L, 31 mg/L, and 123 mg/L respectively. The existing stream based chloride, sulfate and TDS for Bayou de Loutre upstream of Gum Creek is 200 mg/L, 90 mg/L, and 500 mg/L respectively and 200 mg/L, 90 mg/L, and 750 mg/L downstream of Gum Creek. Utilizing the applicable flows, background concentrations provided in the WQS and the applying the methods stipulated in the Continuous Planning Process (CPP), Outfall 001's discharge from the Lion Oil facility will not maintain the existing ecoregion dissolved minerals criteria in Loutre Creek or sections of Bayou de Loutre.

In addition to ecoregion water quality criteria, the domestic water supply use designation for Loutre Creek and Bayou de Loutre (upstream of Gum Creek) results in numeric criteria of 250 mg/L, 250 mg/L and 500 mg/L for chloride, sulfate and TDS, respectively. As discussed in Sections 3.2 and 3.3, the domestic water supply use is a designated, but not an existing use for Loutre Creek or Bayou de Loutre. Additionally, there are no plans to utilize either stream as a domestic water supply use.

In order to determine appropriate chloride, sulfate, and TDS criteria for Loutre Creek and Bayou de Loutre, mass balances were developed as described in the following sections.

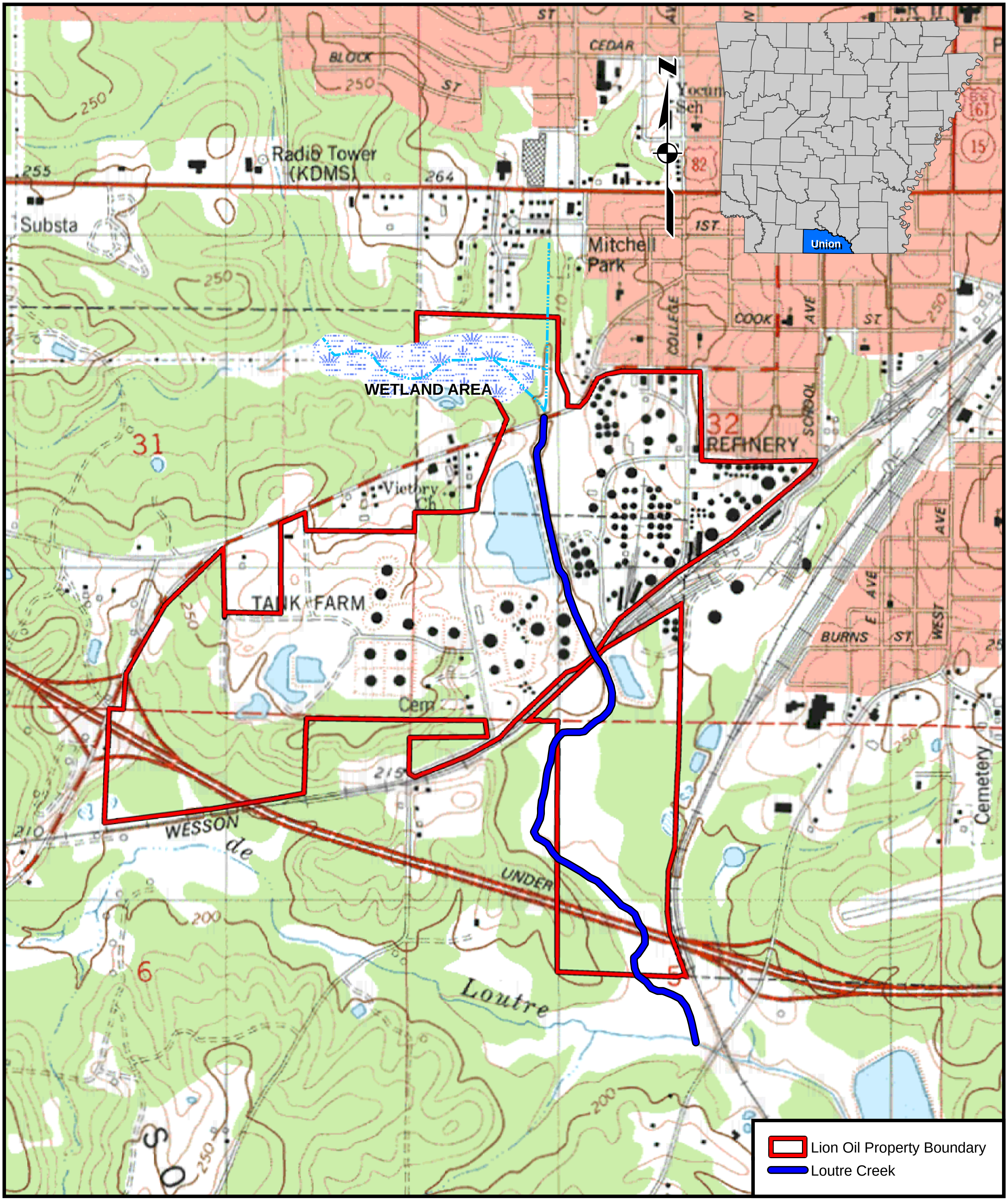

Figure 5.1. Lion Oil and Loutre Creek reach proposed for 3rd party rule making.

5.2 Mass Balance

The following mass balance equation was used to calculate instream waste concentrations (IWC) for chloride, sulfate, and TDS:

$$IWC = [(Qb \times Cb) + (Qe \times Ce)] / (Qb + Qe)$$

Where:

Qb = The background flow of the receiving stream
Cb = The background concentration of chloride, sulfate, or TDS in the receiving stream
Qe = The discharge flow of the effluent
Ce = The effluent concentration of chloride, sulfate, or TDS

5.2.1 Methods

The procedure for evaluating instream concentrations and developing permit limits for dissolved minerals can be found in *ADEQ Discharge Permit, Toxic Control Implementation Procedure* in Arkansas' 1995 Continuing Planning Process (CPP). The value used for the background concentration in Loutre Creek and Bayou de Loutre of chloride (5 mg/L), sulfate (13 mg/L), and TDS (67 mg/L) was the mean concentration for the Gulf Coastal Plain Ecoregion. The background values are listed in the CPP in Attachment XII, *Mineral Permitting Strategy*, for streams in the Gulf Coastal Plain with a 7Q-10 of less than 100 cfs. A background flow of 4 cfs was used in each stream, as allowed for determining instream mineral concentrations in the WQS. Outfall 001 effluent concentrations for chloride were derived from historical data and data collected during April and May 2006, while storm water data was collected in December 2005 from each storm water outfall and/or each of the two holding ponds that discharge through outfall 005, 006, and 007. Effluent concentrations for sulfate and TDS were derived from data collected from March, 2004 through April, 2006 from Outfall 001. Instream concentrations were calculated for Loutre Creek and Bayou de Loutre.

5.2.2 Computations for Loutre Creek

The Gulf Coastal Plain ecoregion background concentrations for chloride, sulfate, and TDS are 5 mg/L, 13 mg/L, and 67 mg/L, respectively. Lion Oil's reported highest monthly average flow for Outfall 001 from January 2004 through December 2005 is 2.62 mgd (4.06 cfs). The flow value used in the computations as the effluent flow at Outfall 001 selected as directed by Section D of *ADEQ Discharge Permit, Toxic Control Implementation Procedure* in the CPP. A concentration of 503 mg/L chloride, 1967 mg/L sulfate, and 3420 mg/L TDS were used as the effluent concentrations. Each of these values is the 95th percentile plus 20% of its respective data set. Due to the limited number of data points, a clear normal distribution verses non-normal distribution determination was unable to be made. Therefore, the chloride, sulfate, and TDS 95th percentiles were calculated according to a non-parametric (the data set was analyzed using a non-normal distribution) The non-parametric statistical technique as outlined in *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987) was used for each data set. Additionally, frequency histograms were prepared for each data set so a visual check of its normality distribution could be made. The chloride, sulfate, and TDS data visually appeared to have a non-normal distribution. Therefore, the 95th percentile for the chloride, sulfate, and TDS data was calculated using a nonparametric technique (Gilbert, 1987) presented below:

k = p(n=1)

where: k = the ranked order number from the chloride data set (values of k that are not integers are interpolated for using the two values that k falls between).
p = desired percentile
n = number of data points

This method returns a k value of 32.3 for chloride and 25.65 for sulfate and TDS. The chloride data set has an n = 33, while the sulfate and TDS data sets has an n = 26. Therefore, the values ranked in the data set as "32.3" for chloride and "25.65" for sulfate and TDS was (414 mg/L, 1639 mg/L, and 2850 mg/L, respectively). These "ranked" values are equal to the 95th percentile. Utilizing all the aforementioned data the IWC for chloride, sulfate, and TDS are calculated below. The summary of the mass balance data inputs are provided in Table 5.1 for Loutre Creek.

$IWC_{chloride}$ =
[(4.0 cfs x 5.0 mg/L) + (4.06 cfs x 503 mg/L)] / (4.0 cfs + 4.06 cfs) = 256 mg/L

$IWC_{sulfate}$ =
[(4.0 cfs x 13 mg/L) + (4.06 cfs x 1967 mg/L)] / (4.0 cfs + 4.06 cfs) = 997 mg/L

IWC_{TDS} =
[(4.0 cfs x 67 mg/L) + (4.06 cfs x 3420 mg/L)] / (4.0 cfs + 4.06 cfs) = 1756 mg/L

Table 5.1. Instream Waste Concentration (IWC) Calculation for Loutre Creek.

Parameters	Chloride	Sulfate	TDS
Ce, mg/L (projected 95th %tile + 20%)	503	1967	3420
Cb, mg/L	5.0	13.0	67.0
Qe, cfs	4.06	4.06	4.06
Qb, cfs	4.0	4.0	4.0
Projected IWC (mg/L)	256	997	1756

Appendix C. provides a schematic of the 95th percentiles, flows, and IWC computations for the individual dissolved minerals and TDS.

5.2.3 Computations for Bayou de Loutre (from Loutre Creek to the discharge of the City of El Dorado South facility)

The IWC computations for chloride, sulfate, and TDS for this reach of Bayou de Loutre (from the mouth of Loutre Creek to the discharge of the City of El Dorado South facility) were preformed utilizing the previously calculated IWCs and flows from Loutre Creek (Section 5.2.2 above) for each respective mineral.

The following inputs were used to determine the IWC for each relevant mineral in this reach of Bayou de Loutre. The "effluent concentration" was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Chemtura 002, Chemtura 004, and Lion 001.

While the “effluent flow” was the total of each outfall’s (Chemtura 002, Chemtura 004, and Lion 001) reported highest monthly average flows. The resulting “effluent flow” was 4.94 cfs. The background watershed flow used for this reach came from background flow from Loutre Creek (4 cfs) and Bayou de Loutre (4 cfs) for a total of 8.0 cfs. The projected IWC were 264 mg/L, 635 mg/L, and 1236 mg/L for chloride, sulfate, and TDS, respectively. The IWC schematics detailing the model inputs and IWC projections are provided in Appendix C. The calculated IWC for chloride, sulfate, and TDS indicated higher concentrations than the current stream based water quality criteria for Bayou de Loutre. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.2.

$IWC_{chloride}$ =
[(8.0 cfs x 5.0 mg/L) + (4.94 cfs x 684 mg/L)] / (8.0 cfs + 4.94 cfs) = 264 mg/L

$IWC_{sulfate}$ =
[(8.0 cfs x 13.0 mg/L) + (4.94 cfs x 1643 mg/L)] / (8.0 cfs + 4.94 cfs) = 635 mg/L

IWC_{TDS} =
[(8.0 cfs x 67 mg/L) + (4.94 cfs x 3128 mg/L)] / (8.0 cfs + 4.94 cfs) = 1236 mg/L

Table 5.2. Instream Waste Concentration (IWC) Calculation

Parameters	Chloride	Sulfate	TDS
Ce, mg/L	684	1643	3128
Cb, mg/L	5.0	13	67
Qe, cfs	4.94	4.94	4.94
Qb, cfs	8.0	8.0	8.0
Projected IWC (mg/L)	264	635	1236

5.2.4 Computations for Bayou de Loutre (from the discharge of the City of El Dorado South facility to the mouth of Gum Creek)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from the discharge of the City of El Dorado South facility to the mouth of Gum Creek) were determined utilizing the previously calculated IWCs and flows from Bayou de Loutre (Section 5.2.3 above) for each respective mineral. The calculated IWC for sulfate and TDS indicated higher concentrations than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride projects lower than the current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride in Bayou de Loutre (from the discharge of the City of El Dorado South facility to the mouth of Gum Creek) is not being requested at this time.

The following inputs were used to determine the IWC for each relevant mineral in this reach of Bayou de Loutre. The “effluent concentration” was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from GLCC-Central 002, GLCC-Central 004, Lion 001, and City of El Dorado South facility 001. While the “effluent flow” was the total of each outfall’s (GLCC-Central 002, GLCC-Central 004, Lion 001, and City of El Dorado South 001) reported highest monthly average flows. The resulting “effluent flow” was 12.37 cfs. The background watershed flow used for this reach came from background flow from Loutre Creek (4 cfs) and Bayou de Loutre (4 cfs) for a total of 8.0 cfs. The projected IWC were 220 mg/L, 431 mg/L, and

966 mg/L for chloride (no change needed), sulfate, and TDS, respectively. The IWC schematics detailing the model inputs and IWC projections are provided in Appendix C. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.3.

$IWC_{sulfate}$ =
[(8.0 cfs x 13.0 mg/L) + (12.37 cfs x 702 mg/L)] / (8.0 cfs + 12.37 cfs) = 431 mg/L

IWC_{TDS} =
[(8.0 cfs x 67 mg/L) + (12.37 cfs x 1548 mg/L)] / (8.0 cfs + 12.37 cfs) = 966 mg/L

Table 5.3. Instream Waste Concentration (IWC) Calculation for Bayou de Loutre.

Parameters	Sulfate	TDS
Ce, mg/L	702	1548
Cb, mg/L	13	67
Qe, cfs	12.37	12.37
Qb, cfs	8.0	8.0
Projected IWC (mg/L)	431	966

5.2.5 Computations for Bayou de Loutre (from Gum Creek to the mouth of Boggy Creek)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from Gum Creek to the mouth of Boggy Creek) were determined utilizing the previously calculated IWCs and flows from section 5.2.4 above with the addition of two more facility sources (via Gum Creek) that are included in this section for each respective mineral. The calculated IWC for sulfate and TDS indicated higher concentrations than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride projects lower than the current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride in this reach of Bayou de Loutre (from Gum Creek to the mouth of Boggy Creek) is not being requested at this time.

The following calculations were used to determine the IWC for each relevant mineral in this reach of Bayou de Loutre. The resulting "effluent concentration" following the addition of GLCC South – 001 and Georgia Pacific – 004 (chloride - 335 mg/L, sulfate – 636 mg/L, & TDS – 1406 mg/L) was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, and Georgia Pacific El Dorado Mill – 004. The resulting "effluent flow" (combined total of all contributing sources) was 13.68 cfs. Table 5.4 provides a complete list of point source discharges and applicable flow and minerals data utilized for computations. Any facility minerals data not available through DMR reporting was replaced in the calculations with ecoregion background number for that respective mineral. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), and Gum Creek (4 cfs) for a total of 12.0 cfs. The projected IWC were 181 mg/L, 345 mg/L, and 780 mg/L for chloride (no change needed), sulfate, and TDS, respectively. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.5.

Table 5.4. Summary of sources contributors to Bayou de Loutre watershed.

Facility Name	Outfall #	Flow (cfs)	Cl^- (mg/L)	SO_4^{-2} (mg/L)	TDS (mg/L)
Cooper Tire	002	N/A	N/A	N/A	N/A
Lion Oil	001	4.06	504	1967	3420
GLCC - South	001	0.75	181	13	67
GLCC - Central	002	0.24	1029	380	1376
GLCC - Central	004	0.64	1702	63.7	1932
City - South	001	7.43	142	76	497
GP -El Dorado	004	0.56	5	13	67

$IWC_{sulfate}$ =
[(12.0 cfs x 13.0 mg/L) + (13.68 cfs x 636 mg/L)] / (12.0 cfs + 13.68 cfs) = 345 mg/L

IWC_{TDS} =
[(12.0 cfs x 67 mg/L) + (13.68 cfs x 1406 mg/L)] / (12.0 cfs + 13.68 cfs) = 780 mg/L

Table 5.5. Instream Waste Concentration (IWC) Calculations.

Parameters	Sulfate	TDS
Ce, mg/L	636	1406
Cb, mg/L	13	67
Qe, cfs	13.68	13.68
Qb, cfs	12.0	12.0
Projected IWC (mg/L)	345	780

5.2.6 Computations for Bayou de Loutre (from Boggy Creek to the mouth of Hibank Creek)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from Boggy Creek to the mouth of Hibank Creek) were determined utilizing the previously calculated IWCs and flows from section 5.2.5 above with the addition of one more facility source (via Boggy Creek) that is included in this section for each respective mineral. The calculated IWC for sulfate indicated a higher concentration than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride and TDS projects lower than current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride and TDS in this reach of Bayou de Loutre (from Boggy Creek to the mouth of Hibank Creek) is not being requested at this time.

The following calculations were used to determine the IWC for the relevant mineral in this reach of Bayou de Loutre. The resulting “effluent concentration” following the addition of Teris - 009 004 (chloride - 332 mg/L, sulfate – 619 mg/L, & TDS – 1381 mg/L) was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, Georgia Pacific El Dorado Mill – 004, and Teris -009. The resulting “effluent flow” (combined total of all contributing sources) was 14.07 cfs. Table 5.6 provides the final list of point source discharges and applicable flow and minerals data utilized for computations. Any facility minerals data not available through DMR reporting was replaced in the calculations with ecoregion background number for that respective mineral. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), Gum Creek (4 cfs), and Boggy

Creek (4 cfs) for a total of 16.0 cfs. The projected IWC were 158 mg/L, 296 mg/L, and 682 mg/L for chloride (no change needed), sulfate, and TDS (no change needed), respectively. The IWC schematics detailing the model inputs and IWC projections are provided in Appendix C. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.7.

Table 5.6. Summary of final sources contributors to Bayou de Loutre watershed.

Facility Name	Outfall #	Flow (cfs)	Cl^- (mg/L)	SO_4^{-2} (mg/L)	TDS (mg/L)
Cooper Tire	002	N/A	N/A	N/A	N/A
Lion Oil	001	4.06	504	1967	3420
GLCC - South	001	0.75	181	13	67
GLCC - Central	002	0.24	1029	380	1376
GLCC - Central	004	0.64	1702	63.7	1932
City - South	001	7.43	142	76	497
GP –El Dorado	004	0.56	5	13	67
Teris	009	0.39	228	13	526

$IWC_{sulfate}$ =
[(16.0 cfs x 13.0 mg/L) + (14.07 cfs x 619 mg/L)] / (16.0 cfs + 14.07 cfs) = 296 mg/L

Table 5.7. Instream Waste Concentration (IWC) Calculations.

Parameters	Sulfate
Ce, mg/L	619
Cb, mg/L	13
Qe, cfs	14.07
Qb, cfs	16.0
Projected IWC (mg/L)	296

5.2.7 Computations for Bayou de Loutre (from Hibank Creek to the mouth of Mill Creek)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from Hibank Creek to the mouth of Mill Creek) were determined utilizing the previously calculated IWCs and flows from section 5.2.6 above for each respective mineral. The calculated IWC for sulfate indicated a higher concentration than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride and TDS projects lower than current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride and TDS in this reach of Bayou de Loutre (from Hibank Creek to the mouth of Mill Creek) is not being requested at this time.

The following calculations were used to determine the IWC for the relevant mineral in this reach of Bayou de Loutre. The resulting "effluent concentration", for each respective mineral, (chloride - 332 mg/L, sulfate – 619 mg/L, & TDS – 1381 mg/L), was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, Georgia Pacific El Dorado Mill – 004, and Teris -009. The resulting "effluent flow" (combined total of all contributing sources) was 14.07 cfs. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), Gum Creek (4 cfs), Boggy Creek (4 cfs), and Hibank Creek (4 cfs) for a total of 20.0 cfs. The projected IWC were 140 mg/L, 263 mg/L, and 610 mg/L for chloride (no change needed), sulfate, and TDS (no change needed), respectively. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.8.

$IWC_{sulfate}$ =
[(20.0 cfs x 13.0 mg/L) + (14.07 cfs x 619 mg/L)] / (20.0 cfs + 14.07 cfs) = 263 mg/L

Table 5.8. Instream Waste Concentration (IWC) Calculations.

Parameters	Sulfate
Ce, mg/L	619
Cb, mg/L	13
Qe, cfs	14.07
Qb, cfs	20.0
Projected IWC (mg/L)	263

5.2.8 Computations for Bayou de Loutre (from Mill Creek to the mouth of Buckaloo Branch)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from Mill Creek to the mouth of Buckaloo Branch) were determined utilizing the previously calculated IWCs and flows from section 5.2.7 above for each respective mineral. The calculated IWC for sulfate indicated a higher concentration than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride and TDS projects lower than current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride and TDS in this reach of Bayou de Loutre (from Mill Creek to the mouth of Buckaloo Branch) is not being requested at this time.

The following calculations were used to determine the IWC for the relevant mineral in this reach of Bayou de Loutre. The resulting “effluent concentration”, for each respective mineral, (chloride - 332 mg/L, sulfate – 619 mg/L, & TDS – 1381 mg/L), was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, Georgia Pacific El Dorado Mill – 004, and Teris -009. The resulting “effluent flow” (combined total of all contributing sources) was 14.07 cfs. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), Gum Creek (4 cfs), Boggy Creek (4 cfs), Hibank Creek (4 cfs), and Mill Creek (4 cfs) for a total of 24.0 cfs. The projected IWC were 126 mg/L, 237 mg/L, and 553 mg/L for chloride (no change needed), sulfate, and TDS (no change needed), respectively. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.9.

$IWC_{sulfate}$ =
[(24.0 cfs x 13.0 mg/L) + (14.07 cfs x 619 mg/L)] / (24.0 cfs + 14.07 cfs) = 237 mg/L

Table 5.9. Instream Waste Concentration (IWC) Calculations

Parameters	Sulfate
Ce, mg/L	619
Cb, mg/L	13
Qe, cfs	14.07
Qb, cfs	24.0
Projected IWC (mg/L)	237

5.2.9 Computations for Bayou de Loutre (from Buckaloo Branch to the mouth of Bear Creek)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from Buckaloo Branch to the mouth of Bear Creek) were determined utilizing the previously calculated IWCs and flows from section 5.2.8 above for each respective mineral. The calculated IWC for sulfate indicated a higher concentration than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride and TDS projects lower than current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride and TDS in this reach of Bayou de Loutre (from Buckaloo Branch to the mouth of Bear Creek) is not being requested at this time.

The following calculations were used to determine the IWC for the relevant mineral in this reach of Bayou de Loutre. The resulting "effluent concentration", for each respective mineral, (chloride - 332 mg/L, sulfate – 619 mg/L, & TDS – 1381 mg/L), was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, Georgia Pacific El Dorado Mill – 004, and Teris -009. The resulting "effluent flow" (combined total of all contributing sources) was 14.07 cfs. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), Gum Creek (4 cfs), Boggy Creek (4 cfs), Hibank Creek (4 cfs), Mill Creek (4 cfs), and Buckaloo Branch (4 cfs) for a total of 28.0 cfs. The projected IWC were 114 mg/L, 216 mg/L, and 507 mg/L for chloride (no change needed), sulfate, and TDS (no change needed), respectively. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.10.

$IWC_{sulfate}$ =
[(28.0 cfs x 13.0 mg/L) + (14.07 cfs x 619 mg/L)] / (28.0 cfs + 14.07 cfs) = 216 mg/L

Table 5.10. Instream Waste Concentration (IWC) Calculations

Parameters	Sulfate
Ce, mg/L	619
Cb, mg/L	13
Qe, cfs	14.07
Qb, cfs	28.0
Projected IWC (mg/L)	216

5.2.10 Computations for Bayou de Loutre (from Bear Creek to the top of the final segment of Bayou de Loutre)

IWC computations for chloride, sulfate, and TDS in Bayou de Loutre (from Bear Creek to the top of the final segment of Bayou de Loutre) were determined utilizing the previously calculated IWCs and flows from section 5.2.9 above for each respective mineral. The calculated IWC for sulfate indicated a higher concentration than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride and TDS projects lower than current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride and TDS in this reach of Bayou de Loutre (from Bear Creek to the top of the final segment of Bayou de Loutre) is not being requested at this time.

The following calculations were used to determine the IWC for the relevant mineral in this reach of Bayou de Loutre. The resulting "effluent concentration", for each respective mineral, (chloride - 332 mg/L, sulfate – 619 mg/L, & TDS – 1381 mg/L), was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, Georgia Pacific El Dorado Mill – 004, and Teris -009. The resulting "effluent flow" (combined total of all contributing sources) was 14.07 cfs. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), Gum Creek (4 cfs), Boggy Creek (4 cfs), Hibank Creek (4 cfs), Mill Creek (4 cfs), Buckaloo Branch (4 cfs), and Bear Creek (4 cfs) for a total of 32.0 cfs. The projected IWC were 105 mg/L, 198 mg/L, and 468 mg/L for chloride (no change needed), sulfate, and TDS (no change needed), respectively. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.11.

$\text{IWC}_{\text{sulfate}} =$
$[(32.0 \text{ cfs} \times 13.0 \text{ mg/L}) + (14.07 \text{ cfs} \times 619 \text{ mg/L})] / (32.0 \text{ cfs} + 14.07 \text{ cfs}) = 198 \text{ mg/L}$

Table 5.11. Instream Waste Concentration (IWC) Calculations

Parameters	Sulfate
Ce, mg/L	619
Cb, mg/L	13
Qe, cfs	14.07
Qb, cfs	32.0
Projected IWC (mg/L)	198

5.2.11 Computations for the final segment of Bayou de Loutre to the Arkansas/Louisiana Stateline

IWC computations for chloride, sulfate, and TDS in the last segment Bayou de Loutre prior to the Arkansas / Louisiana state line were determined utilizing the previously calculated IWCs and flows from section 5.2.10 above for each respective mineral. The calculated IWC for sulfate indicated a higher concentration than the current stream based water quality criteria for Bayou de Loutre. The calculated IWC for chloride and TDS projects lower than current stream based water quality criteria and shows no toxic reasonable potential at this time. Therefore, change in the water quality criteria for chloride and TDS in this final reach of Bayou de Loutre is not being requested at this time.

The following calculations were used to determine the IWC for the relevant mineral in this reach of Bayou de Loutre. The resulting "effluent concentration", for each respective mineral, (chloride - 332 mg/L, sulfate – 619 mg/L, & TDS – 1381 mg/L), was derived from a mass balance calculation utilizing the flow weighted mixed concentrations from Lion Oil 001, GLCC – South 001, GLCC – Central 002, GLCC – Central 004, City of El Dorado South facility 001, Georgia Pacific El Dorado Mill – 004, and Teris -009. The resulting "effluent flow" (combined total of all contributing sources) was 14.07 cfs. The background watershed flow used for this reach came from the watersheds of Loutre Creek (4 cfs), Bayou de Loutre (4 cfs), Gum Creek (4 cfs), Boggy Creek (4 cfs), Hibank Creek (4 cfs), Mill Creek (4 cfs), Buckaloo Branch (4 cfs), Bear Creek (4 cfs), Bayou de Loutre lower "main stem" (4 cfs), and all the unnamed tributaries along Bayou de Loutre (4 cfs) for a total of 40.0 cfs. The projected IWC were 90 mg/L, 171 mg/L, and 409 mg/L for chloride (no change needed), sulfate, and TDS (no change needed), respectively. Utilizing all the aforementioned data, the IWC is calculated below are summarized in Table 5.12.

$IWC_{sulfate}$ =
[(40.0 cfs x 13.0 mg/L) + (14.07 cfs x 619 mg/L)] / (40.0 cfs + 14.07 cfs) = 171 mg/L

Table 5.12. Instream Waste Concentration (IWC) Calculations

Parameters	Sulfate
Ce, mg/L	619
Cb, mg/L	13
Qe, cfs	14.07
Qb, cfs	40.0
Projected IWC (mg/L)	171

5.2.12 Computations for increased capacity.

In response to the increasing need for domestic fuel supplies and limited refinery capacity, Lion Oil anticipates an upgrade in the refinery capacity from 70,000 bpd to 85,000 bpd. This 20% production increase would also result in the proportional increase the TDS. The sources of the TDS increases would be from two primary sources, one; the air emission control equipment capturing and conversing of the SO_2 emissions into NA_2SO_4 and two; sodium chloride from the Crude Unit Desalter, which is the major source of chlorides. As part of the upgrade, it is anticipated that the Cat Cracker capacity will be expanded from the current capacity of 20,000 bpd to 25,000 bpd, and therefore it is likely that the Sulfate/TDS from the scrubber will go up proportionately. In order to account for these increases, the instream criteria are being proposed as the 95 percentile of the historical data set plus twenty percent.

Table 5.13. Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006.

Loutre Creek – from Hwy 15 South to the confluence of Bayou de Loutre	**Bayou de Loutre – from Loutre Creek to the discharge for the City of El Dorado South facility**	**Bayou de Loutre – from the discharge from the City of El Dorado-South downstream to the mouth of Gum Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria:	**Instream Criteria:**	**Instream Criteria:**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 256 mg/L; Sulfate from 31 mg/L to 997 mg/L. & TDS from 123 mg/L to 1756 mg/L	Amend stream dissolved minerals criteria: Chloride from 250 mg/L to 264, Sulfate from 90 mg/L to 635 mg/L & TDS from 500 mg/L to 1236 mg/L	Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 431 mg/L & TDS from 500 mg/L to 966 mg/L

Table 5.13. (con't) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006.

Bayou de Loutre – from the mouth of Gum Creek downstream to the mouth of Boggy Creek	**Bayou de Loutre – from the mouth of Boggy Creek downstream to the mouth of Hibank Creek**	**Bayou de Loutre – from the mouth of Hibank Creek downstream to the mouth of Mill Creek**
No change in uses	No change in uses	No change in uses
Instream Criteria:	**Instream Criteria:**	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 345 mg/L and TDS from 750 mg/L to 780 mg/L	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 296 mg/L& TDS: NO CHANGE	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 263 mg/L & TDS: NO CHANGE

Table 5.13. (con't) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006

Bayou de Loutre – from the mouth of Mill Creek downstream to the mouth of Buckaloo Branch	**Bayou de Loutre – from the mouth of Buckaloo Branch downstream to the mouth of Bear Creek**
No change in uses	No change in uses
Instream Criteria:	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 237 mg/L & TDS : NO CHANGE	Amend stream dissolved minerals criteria: Chloride : NO Change Sulfate from 90 mg/L to 216 mg/L & TDS: NO CHAMGE

Table 5.13. (con't) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006

Bayou de Loutre - from the mouth of Bear Creek to the final segment of Bayou de Loutre.	**Bayou de Loutre (Final Segment) to the Arkansas/Louisiana State Line**
No change in uses	No change in uses
Instream Criteria:	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 198 mg/L & TDS: NO CHANGE	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 171 mg/L TDS: NO CHANGE.

5.2.13 Comparison with the dissolved mineral standard for Louisiana

The proposed third party rule making was considered in light of the state of Louisiana's water quality standards (LWQS). The current Arkansas criteria for sulfate and TDS in Bayou de Loutre are 90 mg/L and 750 mg/L, respectively. The current Louisiana criteria are 45 mg/L and 500 mg/L respectively. Therefore, the existing Arkansas criteria already exceed the existing LA criteria. This proposed third party rule making modifies only the existing sulfate criteria and does not propose modifications to the existing Arkansas criteria for Chlorides of TDS in Bayou de Loutre downstream of the Mouth of Gum Creek (Figure 5.2). As specified in the LWQS, the sulfate criteria for Bayou de Loutre is 45 mg/L, which is ½ the existing Arkansas criteria. In Louisiana, this criterion applies at the long term average flow condition. This flow condition is different from the flow condition at which the mineral criteria are applied as specified by Arkansas' WQS.

In order to determine the potential effect of the proposed rule making on the Louisiana sulfate standard, the long term flow condition for Bayou de Loutre was determined, then applied to the projected facility loadings with consideration of background concentrations.

After review of available flow data, there was no long term period of record flows for Bayou de Loutre within Arkansas. Little Cornie Bayou (LCB) is the watershed adjacent to Bayou de Loutre, to the west. The LCB watershed has similar topography, is in the same ecoregion and presented a relatively undisturbed watershed with very limited point source discharges. The USGS maintains a flow gauging station on LCB (USGS Station 07366200) near Lillie, LA. At this location, the watershed is similar in size to Bayou de Loutre watershed at the state line. The data from the USGS Lillie gauge was used to compute a long-term average flow for Bayou de Loutre. Little Cornie Bayou (USGS Station 07366200) near Lillie, LA has flow data for more than the last 50 years. Due to improvements in flow monitoring and recording, the flow to watershed size ratio was complied for LCB using flow data from the last 21 years. This flow to watershed size ratio was then applied to the watershed size for Bayou de Loutre at the state line to estimate the compliance with the current LA sulfate standard of 45mg/l based on a long term average flow condition.

This method utilized an average flow calculated from the last 21 years (7/1/1985 – 6/30/2006) of the daily flow data at USGS gauging station on Little Cornie Bayou near Lillie, LA (Station No. 07366200). (Appendix F) The average flow (250.2 cfs) was then used, along with the station's watershed size (208.0 mi^2), to calculate a flow to watershed size ratio. The ratio (1.20 cfs / mi^2) was then applied to Bayou de Loutre at the state line (watershed size of 125.4 mi^2). Using the 1.20 cfs / mi^2 ratio this equates to an average background flow at the state line on Bayou de Loutre of approximately 152 cfs. Utilizing the minerals and flow data from the source contributors, and the allowable ecoregion background concentration number for sulfate – 13 mg/L, an IWC was projected for sulfate. The projected IWCs for Bayou de Loutre from at the Arkansas / Louisiana state line equals 45 mg/L and is projected to maintain the state standard at the prorated long term average flow. The basis for the projected IWCs calculations are provided in Appendix F.

During the preparation of this documentation, water quality staff of Louisiana Department of Environmental Quality (LDEQ) was briefed on the upcoming proposed rule making. Information was exchanged and additional information was provided by Lion Oil to LDEQ at their request. During this consultation, LDEQ staff provided documentation that supported Bayou de Loutre's compliance with the Louisiana's existing dissolved mineral standard. This compliance record includes recent monitoring data collected after Lion Oil installed the air emission control equipment in March 2004 (e.g. includes discharges from Lion Oil characteristic of the sulfate and TDS concentrations resulting from the air emissions control equipment installed by Lion Oil). Based on the information presented, LDEQ staff indicated that there was no reason to expect the proposed rule making would have a negative impact on the continued compliance with the dissolved mineral standard.

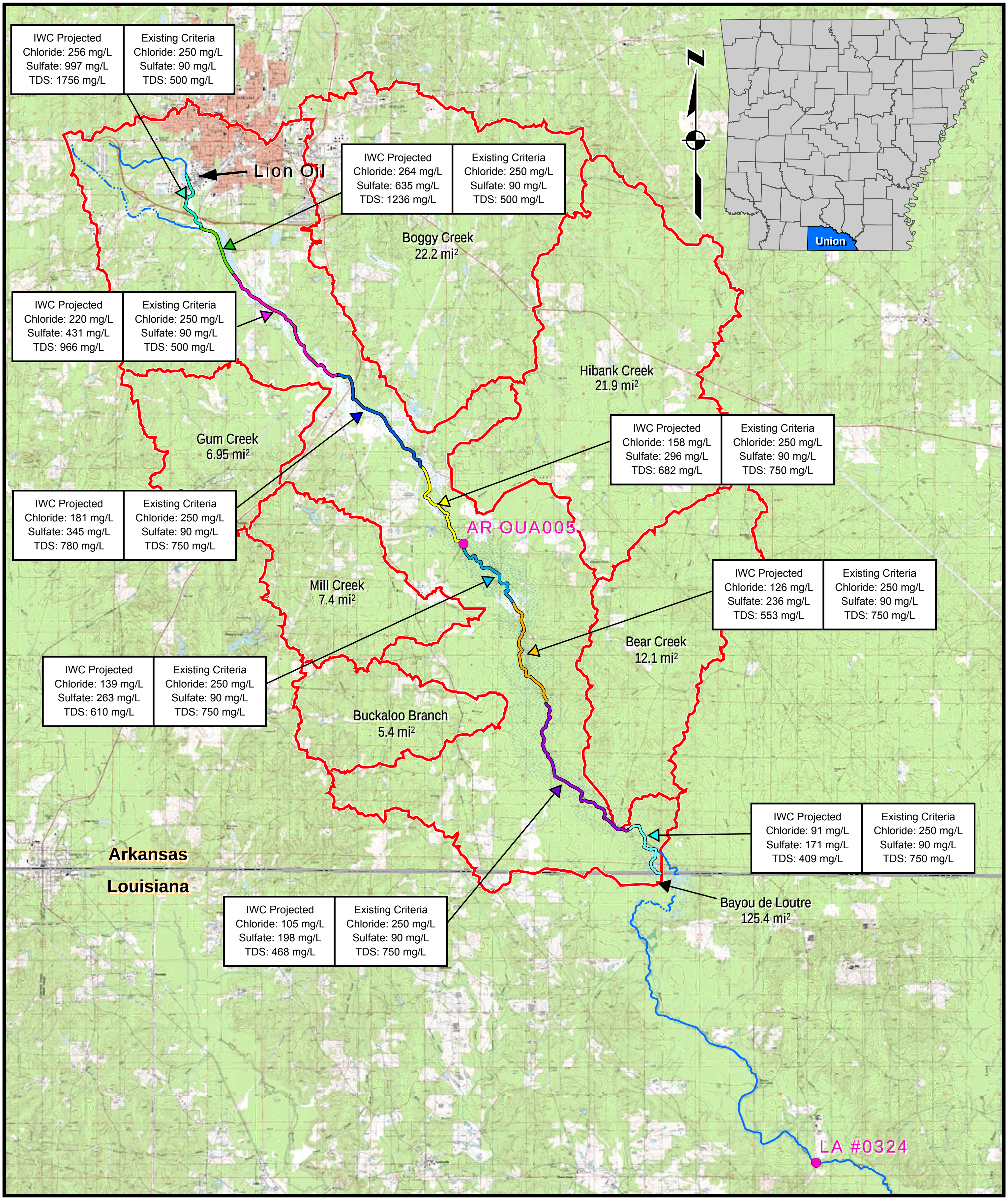

Figure 5.2 Existing and Proposed dissolved mineral criteria for stream segments in Bayou de Loutre watershed. Lion Oil Section 2.306 documentation. September 2006.

In summary, the existing chloride and TDS criteria for the lower reach of Bayou de Loutre are not being modified as part of this rule making. The rule making proposes to increase the existing sulfate criteria from 90 mg/L to 171 mg/L. Although this exceeds the existing LA stream standard, the differences in the applicable flows at which the criteria are applied indicated this modification will not result in compliance issues in Bayou de Loutre for the State of LA.

6.0 ALTERNATIVE ANALYSES

This section summarizes the analyses of alternatives for the Lion Oil facility to maintain the WQS for Loutre Creek and Bayou de Loutre. As seen in Section 5.0, the discharges from Lion Oil maintains protective criteria related to the existing uses; however, it does not maintain the protective criteria for chloride, sulfate, and TDS related to the designated (but not existing) Domestic Water Supply uses assigned to Loutre Creek and Bayou de Loutre (upstream of Gum Creek). In addition, the current concentration of dissolved minerals is projected to cause instream exceedences under critical flow conditions.

Six alternatives were identified to address designated uses and the protective criteria for chloride and TDS. They are as follows:

1) no action,
2) no discharge,
3) hydrograph controlled release,
4) treatment
5) source reduction/Pollution Prevention
6) Water Quality Standards modification.

6.1 No Action

This alternative would maintain the current discharge situation. However, the chloride, sulfate, and TDS effluent concentrations would be exceeded at such time a permit limit is established to maintain the designated but non-existing, domestic water supply use. In addition, it is projected that instream exceedences of the ecoregion chloride, sulfate and TDS criteria will occur under critical conditions if there no additional alternative is pursued. The potential for non-compliance with the proposed final permit limits is not an acceptable alternative for Lion Oil or ADEQ.

6.2 No Discharge

The no discharge alternative is not economically feasible. Although the Lion Oil facility operates a process wastewater outfall (Outfall 001), the cost and added volume of including all storm water runoff collected throughout the facility would ultimately make it economically infeasible to continue operations.

Lion Oil employs approximately 500 employees with an annual payroll estimated at approximately $30 million dollars. Lion Oil is a significant employer in Union County. The Company’s annual impact on the local economy exceeds $200 million dollars. In addition, Lion Oil pays approximately $2.25 million in local and state taxes.

In addition, in order to meet the increasing need for gas and low sulfur diesel fuels, Lion Oil anticipates an upgrade to the refinery capacity from 70,000 bpd to 85,000 bpd. This increase in production capacity will result in additional jobs and taxes to the local and state economy. In addition, due to limited production capacity elsewhere in the United States, any increase in capacity is beneficial to the product supply.

The no discharge alternative would require the cessation of operations at Lion Oil, an action which would greatly affect the local economy and place increased burden on the US fuel supply. This alternative is considered infeasible due to the socioeconomic effects to the local area and the effect on the domestic fuel supply should the Lion Oil facility close.

6.3 Hydrograph Controlled Release (HCR)

The feasibility of a HCR was examined as an alternative for minimizing the impact of Lion Oil's discharges with elevated mineral concentrations. In Lion Oil's situation, an HCR system would not achieve compliance with the ecoregion dissolved minerals water quality criterion because the hydrology of the Loutre Creek is impacted by limited watershed size (<3 mi^2) at the downstream most storm water outfall location. The small watershed size and the urban development in the watershed, has made storm water flows through the Loutre Creek watershed highly variable with flash increases in response to storm events. In addition the Lion Oil facility comprises a large percent of the Loutre Creek watershed, further reducing the applicability for an HCR system to manage the dissolved minerals discharge for the facility. The timing of storm runoff, the development within the watershed upstream of the facility storm water discharges, and the proportion of facility storm water to watershed waters limits the application of an HCR system. The HCR discharge operational scenario is not considered to be feasible.

A runoff model was developed to determine the upstream flow required to allow the discharge through Outfall 001, with the existing dissolved mineral concentrations that will meet the existing Loutre Creek criteria. The model applied the highest monthly flow from Outfall 001 (POR January 2004-December 2005), during typical ambient conditions (neither wet or dry conditions) and a background concentration as stipulated in the ADEQ CPP for Gulf Coastal streams. The model projected that it would take a 15 inch storm event to generate sufficient background flow to allow the discharge from Outfall 001 maintain the existing instream standard. According to the Rainfall Frequency and Magnitude Atlas for the South Central United States (SRCC Technical Report 97-1), the 100 year 24 hour storm event is approximately 10 inches for this area of Arkansas. This further demonstrates that an HCR approach to permit compliance with the dissolved mineral final permit limits is not feasible . The calculations are provided in Appendix G-1.

6.4 Treatment

EPA has no Best Available Technology (BAT) for removal of chloride, sulfate, or TDS from waste streams. While ion exchange (anion) and reverse osmosis treatment technologies exist, these methods currently are not cost effective on a large scale and are not typically recommended for treatment of waters prior to discharge. Also, the concentrated reject streams generated from such processes present their own unique set of potential environmental risks which can be much greater than the storm waters from which the minerals were extracted. In addition this advanced treatment places large burdens on the cost effectiveness of the facility and goods produced.

The technical limitations and uncertain environmental effects of concentrated waste streams generated from ion exchange and reverse osmosis treatment make the treatment alternative infeasible when other alternatives are considered.

Despite these limitations, Lion Oil has investigated the capital and annual operating costs to install advanced treatment for reduction of TDS in the effluent. Specifically, the treatment process includes ultra-filtration, reverse osmosis, and concentration/crystallization of the system effluent in addition to ancillary storage and equipment. Information on the treatment system is provided in Appendix G-2.

The estimated capital cost ($43,375,000) and annual operating cost ($5,746,000) would be overly burdensome and place the facility at a significant competitive disadvantage. Thus, treatment is infeasible in consideration of other alternatives.

6.5 Source Reduction/Pollution Prevention

The dissolved minerals in the storm water outfalls are primarily contributed from collected storm water from the site. Recent facility improvements to conserve energy resources, to produce ultra-low sulfur fuels, to reduce sulfur in air emissions, and water conservation efforts have contributed to the increase in dissolved minerals, in both the process wastewater and the storm water. The facility has completed numerous site modifications and prevention activities to reduce storm water contamination as discussed in Section 3.5. Although there may be some additional incrementally small reductions in other pollutants, the efforts at continued cleaner fuels and continued reductions in resource conservation will ultimately result in increased dissolved mineral concentration in both treated process wastewaters and untreated storm waters.

6.6 WQS Modifications

Discussions concerning the WQS Modification alternative are contained in the following sections.

6.6.1 Designated Uses

As discussed in Section 3.2, the following designated uses have been assigned to Loutre Creek and Bayou de Loutre in the AWQS.

Loutre Creek
- Primary Contact Recreation,
- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Bayou de Loutre (upstream of Gum Creek)
- Primary Contact Recreation,
- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Bayou de Loutre (downstream of Gum Creek)
- Primary Contact Recreation,

- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Industrial Water Supply, and
- Agricultural Water Supply.

6.6.2 Existing Uses

The documented existing fishery use in Loutre Creek and Bayou de Loutre is a Seasonal Gulf Coastal Fishery.

The primary contact recreation use was not documented as an existing use. The uses of agricultural and industrial water supply were also not documented as existing and may be limited due to water volume, but are not precluded due to water quality.

6.6.3 Attainability of the Domestic Water Supply Use

As previously noted based on the documentation provided by ADH, Loutre Creek and Bayou de Loutre (upstream of Gum Creek) is not existing or planned public water supply source. Bayou de Loutre (downstream of Gum Creek) has already had its domestic water supply use removed. In addition, the ASWCC has documented that the removal of the designated domestic water supply use from Loutre Creek or Bayou de Loutre (upstream of Gum Creek) does not conflict with the Arkansas Water Plan.

In addition to an evaluation of the existing and planned use of Loutre Creek and Bayou de Loutre (upstream of Gum Creek) as a domestic water supply, the USEPA Region 6 has requested that information concerning the attainability of the domestic water supply use on the basis of the regulatory criteria contained at 40 CFR 131.10(g) be included in use removal request documentation. Review of the project documentation considering the 40 CFR 131.10(g) criteria demonstrates that removing the designated, but not existing domestic water supply use is appropriate because the use is not attainable based on two of the 40 CFR 131.10(g) criteria. The first of these is criterion No. 2, which states:

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

The Loutre Creek watershed is approximately 5 mi^2 in size, the stream is intermittent in nature and does not have consistent base flows required to supply the volume of water necessary for the development and operation of a domestic water supply. In addition, because of the intermittent nature of the discharge from Lion Oil’s storm water outfalls the increased flow supplied sporadically through effluent discharge is not sufficient to compensate for the small watershed size of Loutre Creek. Neither the stream system nor the discharge provides the consistent flow volume required for feasible attainment of a domestic water supply use.

The second applicable 40 CFR 131.10 (g) criterion is No. 5, which states:

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

As demonstrated in the documentation, the physical characteristics of Loutre Creek, consist primarily of shallow pools and run areas, will not support intake and storage areas necessary for the development of a domestic water supply system. As such, the extensive physical modifications required to develop intake and storage areas would result in the removal of riparian habitat and modification of Gulf Coastal fisheries habitats. Such modifications would impact the existing aquatic life use.

Based upon the previous analyses, the following modifications to the WQS are recommended:

6.7 Selected Alternative

Based on the historical discharge presented, the historical biomonitoring record, the results of the aquatic life field assessment, the mass balance modeling and the assessment of alternatives presented above, the selected alternative is to remove the domestic water supply use from sections of Loutre Creek and Bayou De Loutre (Figure 6.1) and modify the WQS for dissolved minerals as summarized in the following tables.

Table 6.1. Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006.

Loutre Creek – from Hwy 15 South to the confluence of Bayou de Loutre	**Bayou de Loutre – from Loutre Creek to the discharge for the City of El Dorado South facility**	**Bayou de Loutre – from the discharge from the City of El Dorado-South downstream to the mouth of Gum Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria:	**Instream Criteria:**	**Instream Criteria:**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 256 mg/L; Sulfate from 31 mg/L to 997 mg/L. & TDS from 123 mg/L to 1756 mg/L	Amend stream dissolved minerals criteria: Chloride from 250 mg/L to 264, Sulfate from 90 mg/L to 635 mg/L & TDS from 500 mg/L to 1236 mg/L	Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 431 mg/L & TDS from 500 mg/L to 966 mg/L

Table 6.1 (cont.) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006.

Bayou de Loutre – from the mouth of Gum Creek downstream to the mouth of Boggy Creek	**Bayou de Loutre – from the mouth of Boggy Creek downstream to the mouth of Hibank Creek**	**Bayou de Loutre – from the mouth of Hibank Creek downstream to the mouth of Mill Creek**
No change in uses	No change in uses	No change in uses
Instream Criteria:	**Instream Criteria:**	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 345 mg/L and TDS from 750 mg/L to 780 mg/L	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 296 mg/L& TDS: NO CHANGE	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 263 mg/L & TDS: NO CHANGE

Table 6.1 (cont.) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006

Bayou de Loutre – from the mouth of Mill Creek downstream to the mouth of Buckaloo Branch	**Bayou de Loutre – from the mouth of Buckaloo Branch downstream to the mouth of Bear Creek**
No change in uses	**No change in uses**
Instream Criteria:	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 237 mg/L & TDS : NO CHANGE	Amend stream dissolved minerals criteria: Chloride : NO Change Sulfate from 90 mg/L to 216 mg/L & TDS: NO CHAMGE

Table 6.1 (cont.) Summary of Proposed WQS Modifications. Lion Oil 3rd party rulemaking. October 2006

Bayou de Loutre - from the mouth of Bear Creek to the final segment of Bayou de Loutre.	**Bayou de Loutre (Final Segment) to the Arkansas/Louisiana State Line**
No change in uses	**No change in uses**
Instream Criteria:	**Instream Criteria:**
Amend stream dissolved minerals criteria: Chloride : NO CHANGE Sulfate from 90 mg/L to 198 mg/L & TDS: NO CHANGE	Amend stream dissolved minerals criteria: Chloride: NO CHANGE Sulfate from 90 mg/L to 171 mg/L TDS: NO CHANGE.

These proposed modifications are supported by the documentation which meets the requirements of WQS Section 2.306 as implemented by the Administrative Guidance Document.

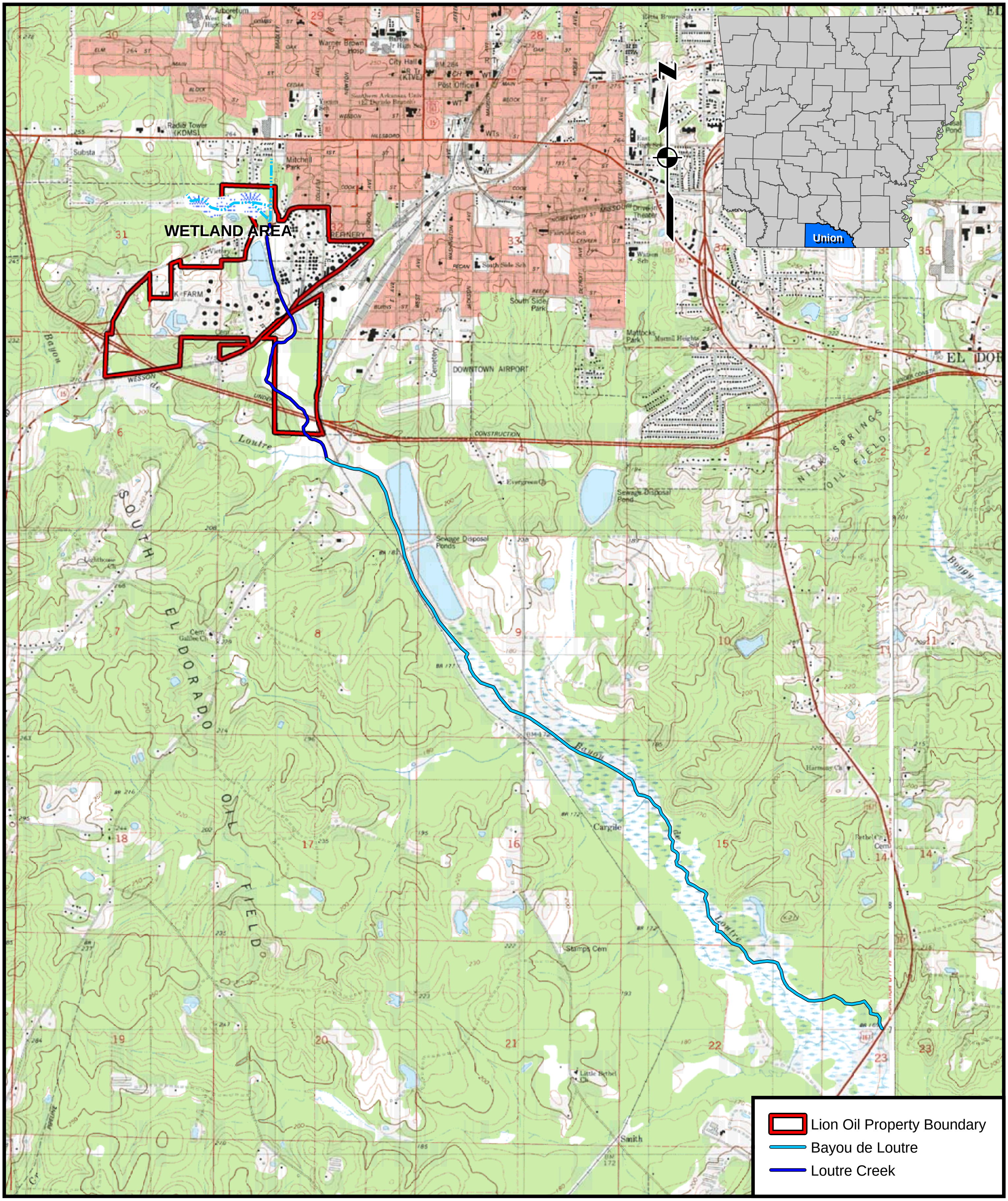

Figure 6.1. Loutre Creek and Bayou de Loutre downstream to the mouth of Gum Creek. Stream reaches proposed for use removal.

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Appendix A

Aquatic Life Field Study

Section 2.306 [formerly 4(g)] Field Study Plan

Prepared for:

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April 18, 2005

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1.0 Introduction

1.1 Background

A third-party rule making is being developed to address the existing final permit limits for dissolved minerals in the Lion Oil Company (Lion Oil) El Dorado Refinery's NPDES permit (AR0000647). The current interim permit limits are monitor and report only. During the interim period, these parameters have been demonstrated to exceed the final permit limitations. In addition, storm water discharges from Outfalls 002, 003, and 004, may not maintain the ecoregion mineral criteria stipulated for the unnamed tributaries of the Gulf Coastal Plain ecoregion in Regulation No. 2. Although Outfalls 005 and 006 are emergency overflow and rarely discharge, any release from these outfalls will also exceed the ecoregion criteria as they currently exist. Currently, Outfall 007 is a controlled storm water/process wastewater release that is discharged on an intermittent basis after testing demonstrates compliance with existing permit limitations. Although there are no existing permit limits on Outfall 007 for minerals, the intermittent discharge from discharge from Outfall 007 could exceed the current ecoregion criteria for dissolved minerals of 14 mg/L (chloride), 31 mg/L (sulfate) and 123 mg/L (total dissolved solids, TDS). These criteria were developed using an ecoregion approach and were developed on a water body specific basis.

Currently, the dissolved solids discharged through Outfall 001 (sulfate and TDS), will not consistently meet the final permit limits of 68 mg/L and 102 mg/L for monthly average and 86 mg/L and 129 mg/L for the daily maximum, respectively. Outfall 001 discharges directly to Loutre Creek (Figure 1.1) and includes process water as well as storm water.

The final permit limits are scheduled to become effective on January 2007, unless they are modified through the third-party rule making provision of the Arkansas Water Quality Standards (Regulation No. 2). The current final dissolved mineral permit limits were developed based on a long term average background flow of 4 CFS and are being implemented to protect the designated but non-existing and unattainable drinking water uses through the application of criteria of 250 mg/L, 250mg/L, and 500 mg/L for chloride, sulfate and TDS, respectively.

The ADEQ recognizes that the application of the dissolved mineral criteria using long term average flows (rather than Q7-10 flows) do not necessarily preclude other designated uses (fishable/swimmable) and have provided for the application of long-term flows to determine site specific instream criteria once the drinking water uses are removed. This third-party rule making is accomplished through the application of Section 2.306 [formerly 4(g)] in Regulation No. 2.

1.2 Study Objective

The objective of the study plan is to complete the field documentation required to support a third-party rulemaking in accordance with Section 2.306 to remove the

Lion Oil has developed and implemented best management practices (BMPs) to address and control storm water discharges and limit exposure of storm water. The facility is located on Highway 15 within the city limits of El Dorado, AR (Figure 1.1). Lion Oil is authorized to discharge treated process waste water, storm water and other non-process waters under National Pollutant Discharge Elimination System (NPDES) permit no. AR0000647 into Loutre Creek. Loutre Creek watershed is approximately 2.2 mi^2 at the location of Outfall 001 (Figure 1.2)

2.0 Quality Assurance/Quality Control

A complete and thorough Quality Assurance (QA) program with defined data quality objectives (DQO) is an essential part of any biological field study. The degree to which the study data meets the DQO dictates the quality and representativeness of the overall project.

2.1 Quality Control

The DQOs of this study are to attain data that meets the following quality control (QC) criteria:

1) Precision is a gauge of the ability of a measurement to be repeated acquiring similar results. The *in-situ* and analytical data will be checked for precision by use of duplicate samples at a minimum rate of 10%. An acceptable level of data precision will be based on the relative percent difference (RPD) between duplicate samples not to exceed 20%. The habitat, fish and macroinvertebrate portion of the study cannot be easily duplicated. Standard collection procedures will be used at each collection station to achieve the greatest degrees of reproducibility possible.
2) Representativeness is a gauge of the degree to which a measurement is representative of the true condition. Sampling reaches have been carefully selected as to best represent the conditions in that segment of the stream.
3) Comparability is a gauge of the ability of the resulting data to compare to data from similar measurements performed in the same study and in other studies. An effort to use standardized techniques based on EPA accepted methodologies was made to maximize comparability. Also, only experienced and trained personnel are performing the various measurements.
4) Completeness is a measure of the degrees of validity of the data collected. Completeness is evaluated by ongoing review of project data by team members to assure that all the necessary data will be collected and is reasonable.

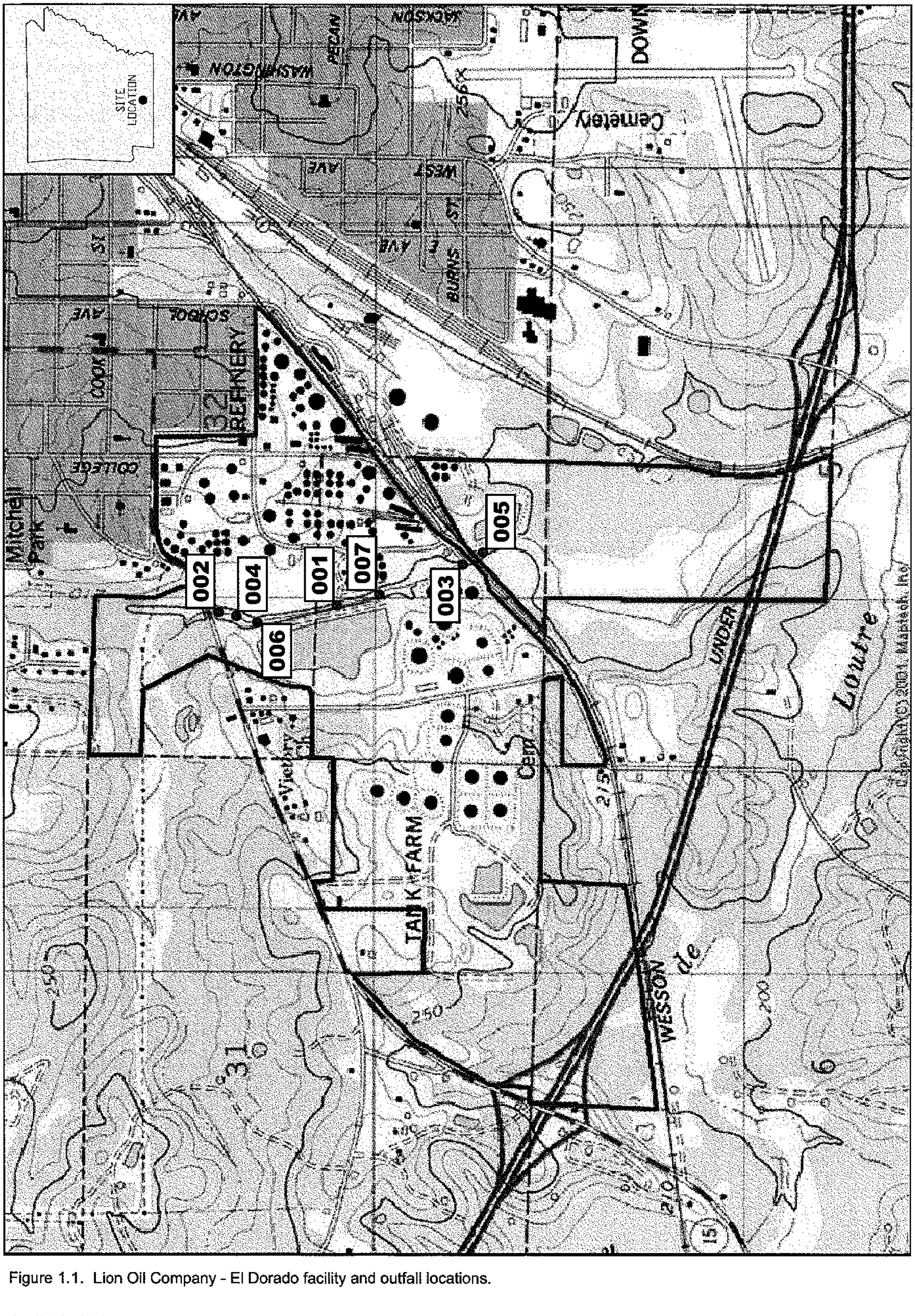

Figure 1.1. Lion Oil Company - El Dorado facility and outfall locations.

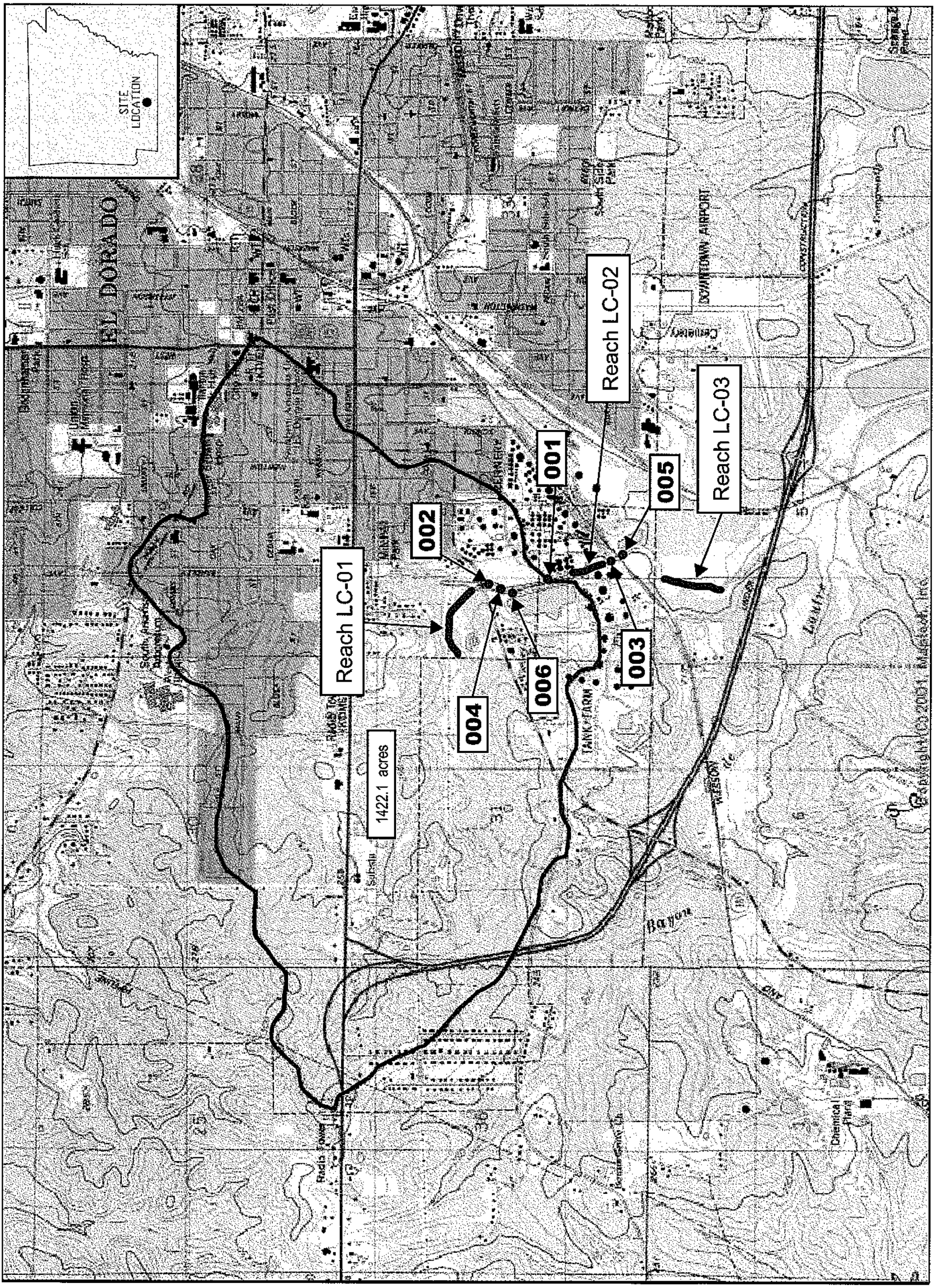

Figure 1.2. Lion Oil outfall 001 watershed boundary, outfall locations and proposed study reaches.

5) Accuracy is a gauge of the degree of agreement between the measured value and the real value. Proper instrument calibrations and reference solution checks assure accuracy of *in-situ* data. All field equipment will be utilized and calibrated according to manufacturer's directions. Calibrations will be conducted daily prior to use. If any equipment fails to conform to known QA/QC manufacturers' specifications, the equipment will be replaced with duplicate equipment that will meet the specifications. Accuracy for biological collections/assessments is not quantifiable, since the true value is not known.
6) A chain of custody will be executed whenever samples are to be transferred between separate entities (e.g., water quality samples).

2.2 Field Method QC

The quality of data collected during this study will be further assured by the following QC measures:

1) A Field Equipment Checklist will be maintained and followed for all field trips. Use of the checklist helps ensure that all field equipment and forms are prepared and available for use in the field.
2) All methodologies used during this study will be based on approved and widely accepted EPA methodologies. An effort is continuously made to keep abreast of the most current methodologies and to adjust our program so as to be more comparable, representative and accurate.
3) Field data sheets are designed for each type of measurement (i.e., *in-situ,* benthos, fish, habitat, etc.). Field sheets contain the necessary information along with space to note anomalies or variances from standard procedures.
4) Trained and experienced field biologists will conduct the study. All crucial team members hold college level degrees in biological sciences or related fields. Continuing education is encouraged through short courses, scientific journal review, conference attendance, and readings in current text and manuals to assure up-to-date knowledge of the field.
5) Fish and aquatic macroinvertebrates will be identified to the lowest taxonomic level practicable. Taxonomic references will be those widely accepted in the scientific community. Identification checks will be made randomly by the project manager or other senior level scientists to verify the accuracy and of the identifications. This check will occur at a rate of approximately 10%.
6) Where analyses are quantifiable EPA approved test methods will be utilized. In these quantifiable cases MDLs will be established and adhered to along with all pertinent QC procedures (i.e., blanks, controls, spikes, and spike duplicates).

2.3 Data Review and Validation

It is necessary to establish QC guidelines for reviewing, validating, and if necessary correcting data following its measurement and analysis in the field or laboratory. This is accomplished by following the steps listed below.

1) All field record sheets, taxonomic identifications, community metrics, and analytical results will be reviewed for precision, representativeness, comparability, completeness, and accuracy.
2) When data quality problems are discovered the project manager and/or the senior scientist will determine the level of the problem and the corrective action, if any, necessary to eliminate the problem.
3) Corrective actions will vary along with the type of QC problem and the degree of the problem. Corrective action for a duplicate sample returning an RPD greater than 20% might result in a repeat of the analysis or even a repeat of the sampling event. Corrective action for a field record sheet being incomplete would likely result in a team meeting to facilitate the missing parameters being filled in correctly.

2.4 QA/QC Checks Following Each Stream Visit

Following the conclusion of all activities at each sample reach, the sample team will review all completed data forms and sample labels for accuracy, completeness, and legibility, and will conduct a final inspection of samples collected. If information is missing from the forms or labels, the team leader will make any corrections prior to proceeding to the next sample reach. The team leader will initial all data forms after review. Other team members will inspect and clean sampling equipment, inventory field supplies, prepare samples for shipment or storage as needed.

3.0 Watershed Characterization

3.1 Study Reaches

The watershed of the Loutre Creek originates to the northwest of the Lion Oil Refinery but within the city limits and urban development of El Dorado (Figure 1.2). The watershed size at the site of the discharge of Outfall 001 is approximately 2.2 mi^2. The total watershed of Loutre Creek is less than 4 mi^2 at its confluence with Bayou de Loutre. Loutre Creek bi-sects the Lion Oil facility and has been altered within the refinery boundaries since established in the early 1920's. As part of this third-party rulemaking, stream reaches on Loutre Creek, both upstream and downstream of the refinery and the various discharges will be evaluated. As indicated by Figure 1.2, at a minimum, the individual reaches will include:

1. LC 001 Loutre Creek, the receiving stream into which Outfall 001 discharges and upstream of Hwy 15 and any storm water discharge from Lion Oil;
2. LC 002 Loutre Creek just downstream of the discharge from Outfall 001 but on Lion Oil property and upstream from the storm water Outfalls 003 and 005; and
3. LC 003 Loutre Creek, downstream of all discharges from Lion Oil.

Physical, chemical, and biological data will be collected at each of these reaches in accordance with the following schedule.

3.2 Period of Study

Due to the limited watershed size (less than 10 mi^2) and the nature of the respective discharges (exclusively or primarily storm water), data collection for the third-party rule making will occur during the spring seasonal period of the year during steady state flow conditions. It is currently proposed that field activities be completed during the last week of April or the first week of May.

4.0 Physical Habitat Characterization

4.1 Purpose

Physical habitat in streams includes all those physical attributes that influence or provide sustenance to biological attributes, both botanical and zoological, within the stream. Stream physical habitat varies naturally, as do biological characteristics; thus, habitat conditions differ even in the absence of point and anthropogenic non-point disturbance. Within a given ecoregion, stream drainage area, stream gradient and the geology are likely to be strong natural determinants of many aspects of stream habitat, because of their influence on discharge, flood stage, and stream energy (both static and kinetic). Kaufmann (1993) identified seven general physical habitat attributes important in influencing stream ecology and the maintenance of biological integrity:

1) channel dimensions,
2) channel gradient,
3) channel substrate size and type,
4) habitat complexity and cover,
5) riparian vegetation cover and structure,
6) anthropogenic alterations, and
7) channel - riparian interaction.

Land use activities can directly or indirectly alter any and/or all of these attributes. Nevertheless, the trends for each attribute will naturally vary with stream size (drainage area) and overall gradient. The relationships of specific physical habitat measurements described in this section to these seven attributes are discussed by Kaufmann (1993). Although they are actually biological measures, aquatic macrophytes, riparian vegetation, instream habitat and canopy cover are included in this and other physical habitat assessments because of their role in habitat structure and light inputs.

The objectives of a habitat characterization are to:

1) assess the availability and quality of habitat for the development and maintenance of benthic invertebrate and fish communities, and
2) evaluate the role of habitat quality in relation to the attainment of designated uses and biological integrity.

There are three main headings for the components of the physical habitat characterization each with several categories. Measurements for each of the components (14 categories total) are recorded on copies of a two-page field form entitled Stream Habitat Assessment-Semi-Quantitative (Appendix A) and include:

1) Channel Morphology
    a) Reach Length Determination
    b) Riffle-Pool Sequence
    c) Depth and Width Regime
2) Instream Structure
    a) Epifaunal Substrate
    b) Instream Habitat
    c) Substrate Characterization
    d) Embeddedness
    f) Sediment Deposition
    g) Aquatic Macrophytes and Periphyton
3) Riparian Characteristics
    a) Canopy Cover
    b) Bank Stability and Slope
    c) Vegetative Protection
    d) Riparian Vegetative Zone Width
    e) Land-use Stream Impacts

Field physical habitat measurements from a field habitat characterization are used in conjunction with water chemistry, temperature, macroinvertebrate and vertebrate (typically fish) community analyses, and other data sources to determine the status of the target streams attainment of designated uses and the water quality required to maintain those uses. The documentation of existing conditions are systematically tabulated using a variety of field data forms. Examples of the forms utilized are provided in Appendix B.

These procedures are intended for evaluating physical habitat in wadeable streams. The field procedures will be applied during spring seasonal conditions with steady base flows. This semi-quantitative habitat procedure will be applied in conjunction with the *General Physical Habitat Characterization* and the *Qualitative Habitat Assessment* to provide a detailed view of the streams habitat condition.

The habitat characterization protocol differs from other rapid habitat assessment approaches (e.g., Plafkin et al., 1989, Rankin, 1995) by employing a, systematic spatial sampling that minimizes bias in the placement and positioning of measurements. Measures are taken over defined channel areas and these sampling areas are placed systematically at spacing that is proportional to the length of the entire study reach. This systematic sampling design provides resolution appropriate to the length of the study reach. The habitat assessment protocol is based on those of USEPA in their EMAP and RBP procedures (Lazorchak, 1998 and Barbour, 1999), USGS NAWQA program (Fitzpatrick, 1998) and Missouri Department of Natural Resources ESP (Sarver, 2000). The protocol is objective and repeatable and employs previously developed methods to produce repeatable measures of physical habitat in place of estimation techniques wherever possible.

Two people will complete the specified assessment, including stream flow. The actual time required to complete the habitat characterization at each monitoring location can vary considerably with channel characteristics.

The procedures are employed on a sampling reach of length equal to 20 times the bankfull width, or at least 100 yards of instream distance. The semi-quantitative habitat sampling reach length will include to the extent possible the fish and macroinvertebrate collection reaches. Measurements will be taken in each of 10 sub-reaches, which are systematically placed, at intervals equal to approximately one tenth (1/10) the length of the represented study reach. Measurements and observations for each habitat characteristic are made in each of the sub-reaches as the assessment team moves along the stream channel. An average or total of the scores for each of the 10 sub-reaches is then calculated resulting in a mean value for each characteristic for the entire reach.

4.2 Procedure

The habitat assessment will be conducted within (or to the extent possible) the stream reach from which the benthic and fish communities are to be characterized. The physical habitat will be characterized from measurements and observations of stream attributes made within 10 sub-reaches. The field team assessing habitat should move along the stream channel (near the thalwag) observing habitat characteristics within each sub-reach. A description of and the rational for measuring each of the attributes are provided below. The details of how these attributes are recorded/evaluated are also described in the GBM^c QAP.

4.2.1 Channel Morphology

Channel morphology (or geomorphology) is a characterization of the shape of the stream channel including measurements and/or visual estimates of channel dimensions and riffle-pool sequences (i.e., a measure of the amount of riffles, runs and pools that occur in a given reach).

The channel observed includes that portion of the stream between the base flow wetted area and the top of the normal high water channel often referred to as the bankfull stage (Figure 4.1). The "bankfull" or "active" channel is defined as the channel that is filled by moderate-sized flood events that typically occur every one or two years. Such flow levels are on the verge of entering the flood plain and are believed to control channel dimensions in most streams.

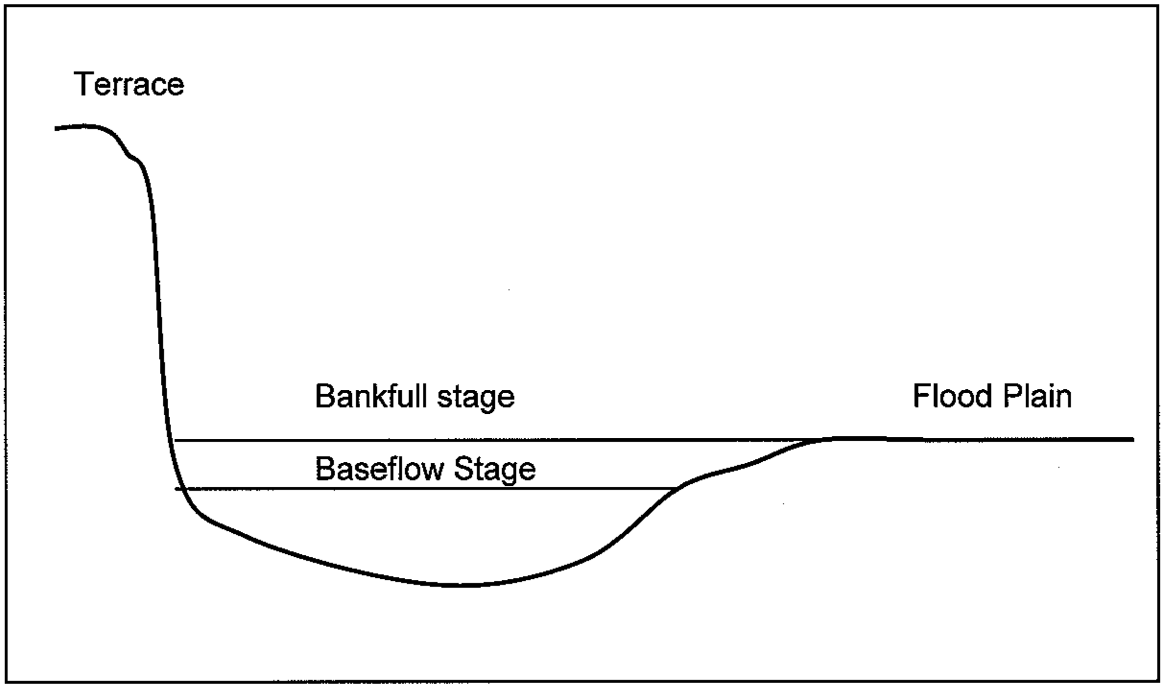

Figure 4.1. Stream channel depicting bankfull stage.

1) Reach Length Determination

First, bankfull depth (depth from stream bottom in thalwag to bankfull stage on the bank) is identified in at least two separate riffles (or alternatively runs in streams not exhibiting riffle morphology) in the study reach. Then bankfull depth and width is determined from five (5) stream transects and recorded on the record sheet. Transect locations should be selected to include each prominent morphology type represented in the stream. Bankfull depths are measured to the nearest 1/10 foot and bankfull widths are measured to the nearest foot using a wading rod and tape measure/range finder, respectively. An average of the 5 bankfull widths is then calculated and multiplied times 20 to arrive at the total reach length for assessment. This total length is then divided by ten to determine the length of each of the ten sub-reaches. Analysis of the first sub-reach should begin at the head of a given stream morphology (i.e., riffle, run or pool).

2) Riffle-Pool Sequence

Stream morphology refers to the abundance and placement (sequencing) of riffles, runs, and pools in a stream system. This sequencing is an indicator of a streams hydrological regime and stability as well as a determinant of its potential to sustain diverse aquatic communities. Beginning at the head of a morphological type (riffle, run or pool) the length of each morphological type in the stream reach should be measured using a range finder or tape measure and recorded on the record sheet. The sequence of each morphological type should be depicted on the record sheet using the provided notations so as to create a map to the location of each riffle, run or pool. The resulting measurements should provide a quantitative measure of the percent of the study reach representing each stream morphological type (i.e., 40% riffle, 30% run, 30% pool, etc.).

3) Depth and Width Regime

The average stream depth and width will be estimated in riffles (or runs in the absence of riffles) and pools in each sub-reach. Depths will be measured along a transect, similar to that depicted in Figure 4.2, in a representative section of each riffle and pool in the sub-reach. Depths are generally taken in the thalwag (deepest area in stream channel) and approximately half way between the thalwag and the left and right banks. An estimated average depth for riffles and pools occurring in a sub-reach is derived from the cross-sectional depth measurements and recorded on the record sheet to the nearest 1/10 foot. Once completed for all 10 sub-reaches this should provide accurate semi-quantitative measurements of riffle and pool average depth and depth variability across the entire stream reach.

Stream wetted widths will be measured along a transect, in a representative section of each riffle and pool in the sub-reach. An estimated average width for each morphological type in a sub-reach should be recorded on the record sheet to the nearest foot. Once completed for all 10 sub-reaches this should provide accurate semi-quantitative measurements of riffle and pool widths across the entire stream reach.

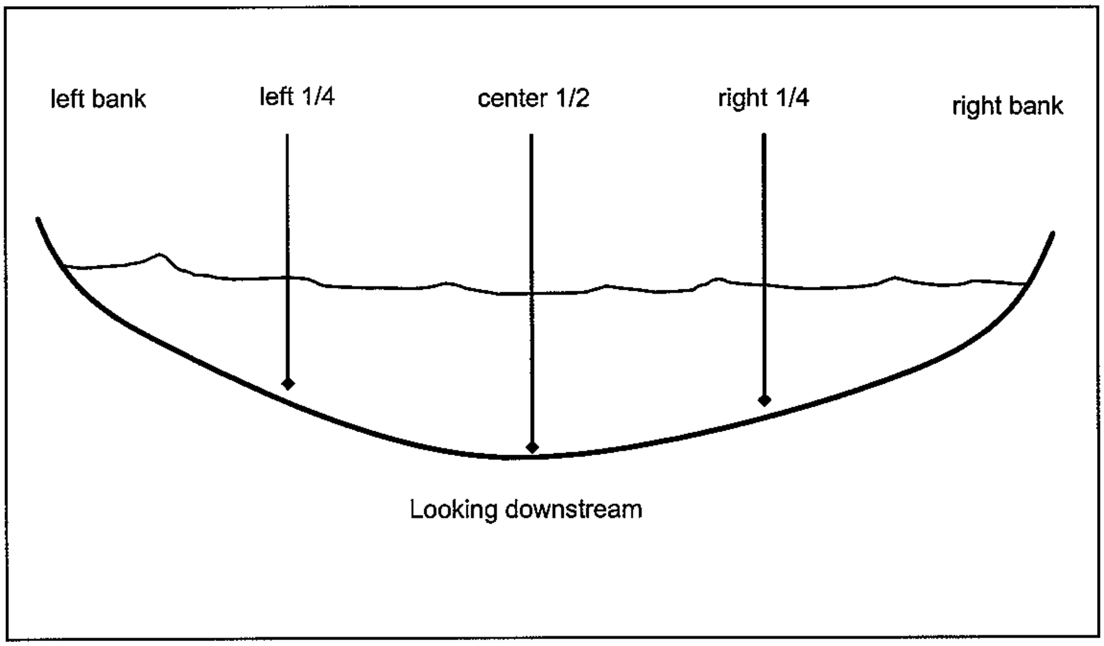

Figure 4.2. Approximate position of measurements across transect.

4.2.2 Instream Structure

Instream structure describes the characteristics of the stream within the wetted perimeter that makes up the habitat suitable for colonization of aquatic biota. This includes information about natural substrates (gravel, boulders, etc), aquatic plants and algae and debris that has been washed into or fallen into the stream, such as logs, leaves, etc. A stream capable of sustaining diverse aquatic communities will contain a variety of instream structure including some that is permanent and some that is mobile during high flow events.

4) Epifaunal Substrate (Macroinvertebrates)

Epifaunal substrate refers to the area on the bottom of the stream (entire wetted perimeter) where macroinvertebrates inhabit. This attribute is scored as a percentage of the stream bottom in a sub-reach which contains substrates suitable for macroinvertebrate colonization. Scoring for this attribute should rely heavily on the stability of the substrate, the size of the interstitial spaces, and the cleanliness (not covered in thick algae or sediment deposits) of the substrate. Cobbles and coarse gravel will score higher percentages as they contain larger interstitial spaces for colonization, while sand and silt would score lower since they provide little spaces. In addition, root wads along the bank would score higher as they are more stable features than would depositional areas or small woody debris.

5) Instream Habitat (Fish)

Instream habitat refers to the habitat features within the wetted perimeter of the stream sub-reach which are available for fish colonization. This attribute is scored as the percentage of the stream bottom (wetted perimeter) in a sub-reach which is covered with fish habitat. As with the epifaunal substrate attribute substrates composed of cobbles, coarse gravels and boulders score higher for fish cover as they provide better spaces for colonization. Other habitats that score high are large woody debris (individual logs with diameter >4 inches or complex woody structures composed of rootwads, logs, or limbs with diameter of 1.5 ft. or greater)and undercut banks. While habitats that score lower are those such as depositional areas, leaf packs, and fine sediments or sand.

6) Substrate Characterization

The dominant stream substrate size classification for riffles and pools within each sub-reach will be recorded on the record sheet. Only substrates within the wetted perimeter are evaluated. This information will be used to characterize the similarities and or differences in substrate structure and complexity in the riffles and pools of the study reach as it relates to the development and maintenance of the systems biological integrity.

Classify the particle into one of the size classes listed on the Semi-Quantitative Habitat Assessment Field Form based on the size of the intermediate axis (median dimension) of its length, width, and depth. This "median" dimension is the sieve size through which the particle can pass.

Bedrock	smooth or rough
Boulder	>25 cm
Cobble	6-25 cm
Coarse Gravel	1.6 – 6 cm
Fine Gravel	0.2 – 1.6 cm
Sand	<0.2 cm
Silt/Mud/Clay	fine, not gritty

Always make notations for unusual substrates such as concrete or asphalt and denote these artificial substrates as "other" and describe them in the comments section of the field data form. Code and describe other artificial (such as large appliances, tires, car bodies, etc.) substrates in the same manner.

7) Embeddedness

Embeddedness is the fraction of a particle's surface that is surrounded by (embedded in) sand or finer sediments on the stream bottom. By definition, the embeddedness of sand, silt, clay, and muck is 100 percent and the embeddedness of hardpan and bedrock is 0 percent.

For this attribute estimations are not made per sub-reach but for the entire stream reach as a whole. An estimation of the "percent embedded" is recorded for coarse riffle substrates in the study reach. This is accomplished by removing 12 pieces of cobble, gravel, or small boulders in at least two different riffles (three maximum) and recording the percent embedded for each. Percent embedded can be visually observed as the darkened portion of the coarse substrate that was buried in the streams fine bed material. If the darkened area covers half the coarse substrates height than the percent embedded is 50%, etc. (Figure 4.3).

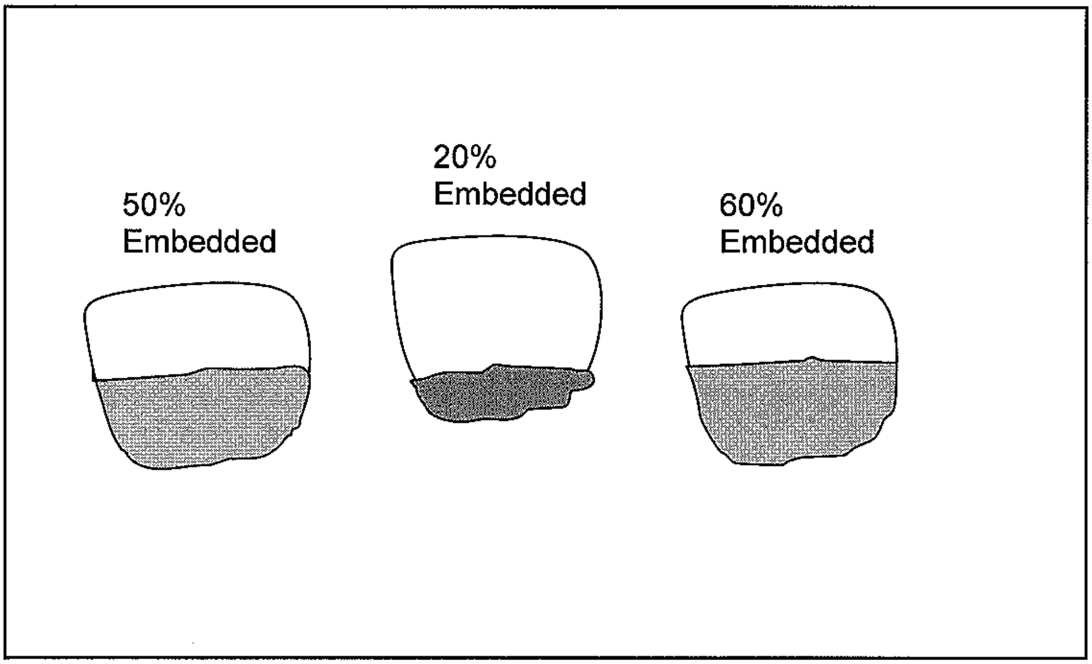

Figure 4.3. Depiction of percent embedded characteristics.

8) Sediment Deposition

The sediment deposition attribute refers to the amount of stream bottom (in the wetted perimeter) that is covered by fine sediments and/or particulate organic matter. This attribute is scored as a percentage of the bottom in each sub-reach which is covered by such loose materials.

9) Aquatic Macrophytes and Periphyton Coverage

An estimate of the percentage of area covered by macrophytes and periphyton in a sub-reach is made and recorded both for riffles and pools. Macrophytes refers to aquatic plants that grow in the stream (both emergent and submerged), and periphyton refers to algae that grows on fixed surfaces. This attribute helps biologists determine stream productivity from a nutrient enrichment perspective and also for the availability of food sources for aquatic biota.

4.2.4 Riparian Characteristics

The riparian area includes the area from the stream bank in a direction away from the stream into the upland areas. It is these stream-side riparian zones that ultimately help shape the stream and provide organic material as nutrients to the aquatic system. A well developed riparian area protects stream banks form erosion, provides shading, inputs nutrients, provides materials as habitat (instream structure) and filters runoff entering the stream. In the absence of well developed riparian zones the stream is more impacted by encroaching land-uses.

10) Canopy Cover

Canopy cover (percent stream shading) over the stream is determined for each of the sub-reaches. Estimates of cover are made by looking into the canopy over the stream channel. Estimates are made from mid-channel and each quarter channel to determine the average percent canopy cover for the width of the stream in the sub-reach. Percent canopy at each measurement point can be estimated visually or by use of a spherial densiometer.

11) Bank Stability and Slope

Bank stability is an important attribute that is an indication of a stream reaches overall hydrologic equilibrium. A bank's stability also determines its ability to provide stable habitat for biota and its propensity to release large sediment yields to the stream, which ultimately cause high turbidity and deposition in downstream reaches. The right and left banks are classified according to the following categories:

Score 9-10 = Stable, little evidence of erosion, < 5% bank eroding
Score 6-8 = Moderately stable, some evidence of new erosion, 5-29% bank eroding
Score 3-5 = Moderately unstable, obvious new erosion, 30-59% bank eroding
Score 1-2 = Unstable, most of bank actively eroding, 60-100% bank eroding

Banks composed of sands and gravels are much less stable than banks composed of silt/mud/clay or cobbles. The density of well rooted (more permanent) vegetation and root structure also help to improve a banks stability.

Average bank slope (in degrees) in a sub-reach, is recorded for each bank (left and right). Bank slope affects the stability of a bank and is an indicator of past erosion. A gentle slope may average 30° while a steep or undercut bank may average 90° or 100°, respectively.

12) Vegetative Protection

Bank vegetative protection is measured as a percent of the bank surface area which is covered by stable riparian vegetation and their associated roots in a sub-reach. Each bank (right and left) is assessed separately and the value recorded on the record sheet. Banks are assessed from the edge of the water to the top of the first terrace or normal top of bank.

13) Riparian Vegetative Zone Width

Riparian zone with encompasses the area from the top of the normal stream bank outwards into the upland area. The broader the riparian vegetative zone width the more protected the stream banks are from alteration, the fewer pollutants will enter the stream from runoff, and the more available food sources there are to be deposited into the stream from the surrounding forest. Riparian zone width is scored for each bank in a sub-reach according to the following scale:

Score 9-10 = Riparian Zone Width > 18 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 1-2 = Riparian Zone Width < 6 meters

14) Land-Use Stream Impacts

Significant Alteration of the land-uses in the immediate riparian area can have detrimental affects on the stream habitat and biota. Urban and agricultural activities are often considered the more prominent of those land-uses that may impact a stream. These impacts are assessed by indicting a specific land-use impact associated with a sub-reach (on either bank) on the record sheet and assigning a degree of impact score to the land-use. The following land-use categories and impact scoring system are provided:

Land-uses:
C = Cattle
R = Row crops
U = Urban encroachment
I = Industrial encroachment
O = Other (noted on field form)

Scoring:
0 = no land-use impacts
1 = minor impacts
2 = moderate impacts
3 = major impacts

4.3 Scoring and Analysis of Habitat Assessment Data

Scores from the Semi-Quantitative Habitat Assessment can be utilized in two different ways. First, data collected for each attribute (assessment category) can be used independently to describe the study reach collectively. This method results in information such as: average riffle depth, average pool width, percent riffle in entire reach, average bank stability, average (median) substrate size class in pools and riffles, mean percent canopy cover, etc. Second, the data collected during the assessment can be used in conjunction with the Qualitative Habitat Assessment procedure to score each of the ten “qualitative” indices with near quantitative accuracy (semi-quantitative). A combination of the two methodologies should be incorporated into all intensive aquatic biota field studies where habitat assessment accuracy and repeatability is critical. The following sections outline the scoring of the qualitative habitat indices using the semi-quantitative data.

4.3.1 High Gradient (riffle-pool stream complexes)

1) Epifaunal Substrate / Available Fish Cover

Average values from semi-quantitative categories 4 (Epifaunal Substrate) and 5 (Instream Habitat) are combined into an overall average percent coverage and used to score this metric.

The following table presents the scoring criteria:

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Coverage	>70%	40%-70%	20%-39%	<20%
Score	20 -16	15 -11	10 - 6	5 - 1

2) Embeddedness

Reach average percent embedded (from category 7) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Embedded	<25%	25%-50%	49%-75%	>75%
Score	20 -16	15 -11	10 - 6	5 - 1

3) Velocity / Depth Regime

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) along with flow and velocity data collected in the reach is used to score this metric. Use the following table to determine which regimes are present:

Rank	Slow-deep	Slow-shallow	Fast deep	Fast shallow
Velocity	<1 fps	<1 fps	>1 fps	>1 fps
Depth Regime	>1.6 feet	<1.6 feet	>1.6 feet	<1.6 feet
Typical Morphology	Deep pool	Shallow pool	run	riffle

If a reach has deep and shallow pools, and distinctive run and riffle morphology, then you have at least three regimes and possible all four regimes. Score each rank lower if shallow regimes are the missing regimes. Scoring is applied as per the following table.

Rank	Optimal	Sub-Optimal	Marginal	Poor
No. Regimes	Four regimes present	Three regimes present	Two regimes present	One regime present
Score	20 -16	15 -11	10 - 6	5 - 1

4) Channel Alteration

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

5) Sediment Deposition

Reach average percent bottom affected by deposition (from category 8) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Bottom Affected	<5%	5%-30%	31%-50%	>50%
Score	20 -16	15 -11	10 - 6	5 - 1

Utilize the lower end of each scale to represent reaches where recent sediment bar formation is evident.

6) Frequency of Riffles

Using semi-quantitative category 3 (Depth and Width Regime) the average width of the stream is determined as the average of riffle and pool widths combined. Using category 2 (Riffle-Pool Sequence) the distance between riffles can be calculated using the sequencing notations and the morphological lengths. The table presented below should be used to develop scores for this metric.

Example: a reach with an average width of 18 feet, with 4 riffles separated by a 50 foot pool, a 20 foot run, and a 100 foot pool would result in an average distance between riffles of 57 feet. Therefore, the ratio = 57/18 = 3.2 and would rank as Optimal (score @ 18).

Rank	Optimal	Sub-Optimal	Marginal	Poor
Ratio (distance between riffles : stream width)	<7 : 1	7 – 15 : 1	16 -25 : 1	>25 : 1
Score	20 -16	15 -11	10 - 6	5 - 1

In continuous riffle streams the consistent placement of boulders and logs provides scores in the highest range of the optimal category.

7) Channel Flow Status

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

8) Bank Stability

The average bank stability score for each represented bank from the semi-quantitative assessment (category 11) is directly applied to the qualitative assessment scoring for this metric (i.e., an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

9) Vegetative Protection

Reach average percent bank protected (from category 12 of the semi-quantitative record sheet) is used directly to score this metric for the right and left bank.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Protected	>90%	70% - 90%	50% - 69%	<50%
Score	20 -16	15 -11	10 - 6	5 - 1

10) Riparian Vegetative Zone Width

The average riparian zone width score for each represented bank from the semi-quantitative assessment (category 13) is directly applied to the qualitative assessment scoring for this metric (i.e., an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

4.3.2 Alternative Metrics for Low Gradient Streams (pool dominated complexes)

The individual metrics with alternatives for pool dominated stream complexes includes 2, 3, and 6, and are described as follows:

2) Pool Substrate Characterization (replacement for Embeddedness)

Using the Substrate Characterization data from the semi-quantitative assessment (category 6) and the aquatic vegetation assessment (category 9) the following table may be used to score this metric.

Rank	Optimal		Sub-Optimal	Marginal	Poor
Substrate	Cobble or Gravel		Sand/Silt/Clay	Sand/Silt/Clay	Bedrock or Clay Only
Macrophytes Present	Yes	No	Yes	No	No
Score	20 - 18	17 - 16	15 - 11	10 - 6	5 - 1

3) Pool Variability (replacement for Velocity/Depth Regime)

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) are used to help score this metric. Use the following table to determine pool variability.

Pool Characteristic	Large-Deep	Large-Shallow	Small-Deep	Small-Shallow
Size	Length ≥ Width	Length ≥ Width	Length < Width	Length < Width
Depth	≥3.2 feet	< 3.2 feet	≥3.2 feet	< 3.2 feet

An equal balance of all four pool types achieves higher scores. A prevalence of shallow pools scores lower.

6) Channel Sinuosity (replacement for Frequency of Riffles)

This metric is assessed separately from the semi-quantitative data. It can be estimated in the field, measured during a longitudinal survey or calculated from current aerial photographs.

5.0 Water Quality

During the field study, water quality will be documented through *in-situ* measurements and sampling for laboratory analyses at each of the study reaches as identified in Section 3.1. The following sections present the parameters and documentation methods.

5.1 *In-situ* Measurements

The following parameters will be monitored at each of the study reaches:

1) temperature, C°
2) dissolved oxygen, mg/L
3) conductivity, µS
4) pH, su
5) flow, cfs

In accordance with Section 2.0 calibration will be performed and documented according to the manufacturer's recommendations. Details of the methods and procedures utilized are provided in Appendix A.

The *in-situ* measurements are recorded on the second page of the Field Data Form. Other information recorded on the Field Data Forms will include:

1) general station location information,
2) the field crew completing the assessment,
3) current hydrologic conditions,
4) antecedent moisture conditions, and
5) identification of the meters utilized.

5.2 Water Chemistry

Grab samples for laboratory analysis of chloride, sulfate and TDS will be collected at each sample reach at the same time as *in-situ* measurements are obtained. Analytical results from the laboratory will be retained for use in project documentation. The instream mineral concentrations will also be utilized in the development of the site specific water quality criteria for each discharge.

6.0 Benthic Macroinvertebrate Community

6.1 Introduction

The benthic macroinvertebrate protocol utilized in these field studies is intended to evaluate the biological integrity of wadeable streams for the purpose of detecting stresses on community structure, assessing the relative severity of these stresses, and determining the maintenance of the designated uses. The approach is based on the "Rapid Bioassessment Protocol III – Multi Habitat approach using an aquatic dip net as published by the U.S. Environmental Protection Agency (Barbour, M.I. et al., 1999) as adapted for use in pool dominated streams of the Gulf Coastal Plain Ecoregion. The details of the benthic characterization are provided in Section 9.0 of Appendix A.

The one-man protocol is the preferred macroinvertebrate collecting method for pool dominated streams (a second person can be used for water safety and to keep time and record information on the field forms). The U.S. Geological Survey utilizes the one-man approach for their National Water-Quality Assessment Program (NAWQA; Cuffney et al., 1993).

During this Project, the benthic community of the following reaches will be evaluated:

4. LC 001 Loutre Creek, the receiving stream into which Outfall 001 discharges and upstream of Hwy 15 and any storm water discharge from Lion Oil;
5. LC 002 Loutre Creek just downstream of the discharge from Outfall 001 but on Lion Oil property and upstream from the storm water Outfalls 003 and 005; and
6. LC 003 Loutre Creek, downstream of all discharges from Lion Oil.

6.2 Methods

Qualitative samples of the benthic macroinvertebrate assemblage will be collected over a predetermined period of time using an aquatic dip net and sampling all available microhabitats present within the stream reach.

Each station will be sampled for three minutes according to the RBA protocol. Each sample will be placed in a bucket and condensed with a series of washings through a series of sieves, the smallest of which will be a U.S. Standard #30 sieve.

6.3 Sample Processing

Random sub-samples of the concentrated sample will be then placed on a white sorting tray from which the macroinvertebrates will be removed. A 100 organism sub-sample will be randomly picked (according to the RBA procedures) from the tray and field identified to the lowest possible taxon.

The 100 organism sub-samples will be preserved in 70% ethanol or Kayles solution for lab verification of field identifications and as a voucher to be used if more detailed analysis becomes necessary. Laboratory verification will be accomplished using general keys including but not limited to Merritt & Cummings, (1996); Pennak, (1989), and Unsinger (1963). In addition more taxa specific keys such as Mayflies of North and Central America (Edmunds et. al., 1976), Dragonflies of North America, (Needham & Westfall, 1975) or keys developed specifically for Arkansas may be utilized for the laboratory verification of the field identifications.

After the 100 organism random sample is collected, labeled and preserved, the larger debris items (e.g., leaves, sticks, rocks, etc.) in the collected sample will be examined for clinging benthic macroinvertebrates. Any organisms will be removed prior to the larger debris being discarded. The remainder of the original sample not utilized in the selection of the 100-organism sub-sample will be concentrated and retained as a voucher for the sample picking techniques used. The voucher samples will be preserved with 70% ethanol or Kayles solution. These voucher samples will be held at GBM^c for a period of 24 months following the conclusion of the third party rulemaking at which time the samples may be submitted to an academic zoological collection. The macroinvertebrate assemblages from each station will be analyzed according to several benthic community biometrics. These will include richness (number of different taxa), EPT richness (number of different taxa represented in the orders Ephemeroptera, Plecoptera, and Trichoptera), and species diversity as determined by the Shannon-Wiener Diversity Index.

The analysis will also include the seven biometrics used by the State of Arkansas (ADPCE, 1988) in their RBA scoring system. This scoring system places a value (1 to 4, 1 = excessive differences, 4 = no differences) on each of the seven biometrics to achieve a final mean score. The biometric scoring will indicate the impacts to a benthic community when compared to the benthic community of different reaches, to demonstrate effects of point and or non-point source contributions between reaches.

For each study site, a complete tabulation of taxa, numbers of individuals and their percent composition will be included on the two-page field data sheets – Benthic Macroinvertebrates. The first page of the two-page data form will include general information identifying the sample reach and investigators as well as site observations to include:

1) time sampled,
2) relative abundance of aquatic tropic level communities,
3) percent of major habitats sampled,
4) percent of specific microhabitats sampled, and
5) relative abundance of the ordinal groups observed during sample collection.

The second page provides for the listing of the taxa comprising the 100 organism sub-sample and the field identifications and the numbers of each. Also included on page 2 are the general reach identifiers and preliminary summary sections to be used in the application of selected biometric scoring criteria.

7.0 Fish Community

7.1 Introduction

The fish community supported in a stream is in direct response to available habitat, food sources, and water quality of that particular stream. The presence of a certain level of species richness and diversity along with a community structure similar to that expected in typical streams of the ecoregion are indicators of aquatic ecosystem health.

The objective of the fish community characterization is to collect and identify a representative sample of all except very rare species in the assemblage reflective of the relative abundance within the community assemblage. Backpack electrofishing equipment will be used as the principal sampling gear supplemented by block netting and seining in habitats where flow, substrate and structure affect capture of benthic species. All team personnel will be involved in collecting fish.

Although most of the receiving streams into which the discharges occur are a fraction of the 10 square mile threshold for perennial fish community maintenance, the fish community of the following reaches will be evaluated during this project:

1. LC 001 Loutre Creek, the receiving stream into which Outfall 001 discharges and upstream of Hwy 15 and any storm water discharge from Lion Oil;
2. LC 002 Loutre Creek just downstream of the discharge from Outfall 001 but on Lion Oil property; and upstream of Storm water discharges 003 and 005; and
3. LC 003 Loutre Creek, downstream all discharges from Lion Oil.

7.2 Methods

Major factors that influence collecting include flows, water depth, instream obstructions, water turbidity, temperature and conductivity. The primary tool utilized in the fish collections will be a Smith-Root backpack electroshocker. However, seines and block nets may be utilized as necessary to adequately characterize the reaches indicated.

Sampling fish species to determine their proportionate abundance will be conducted after all water quality parameters and/or samples are collected but prior to the collection of the benthic and habitat data as described in Sections 4 and 5.

Shocked fish will be captured with hand held dip nets and held in buckets while the sampling continues throughout the reach. The entire channel within the sampling reach will be sampled. Actual shocking time will continue for not less than 30 minutes unless the wetted habitat area of any reach is too small for 30 minutes of shocking time. The shocker is equipped with an automated timing mechanism which records the amount of time that electricity is actually being applied, or "pedal down time" (PDT). In addition to PDT, the total collection time will be recorded. There will not be a maximum time limit for the collection period, however the collections may be terminated when the principal investigator determines that additional collection time will not likely result in additional fish species. Sampling information will be recorded on the Field Data Sheets - Fish. General comments (perceived fishing efficiency, missed fish, and gear operation suggestions) will be recorded on the lines provided on the form.

An effort to search for and collect fish will be completed at all reaches, even if the stream is extremely small, and it appears that sampling may not collect any specimens.

7.3 Sample Processing

Following collection, each sample of fish from a reach will be preserved in formalin for later processing. Sample processing will involve tallying and identifying fish, examining individual specimens for external anomalies, preparing voucher specimens for taxonomic confirmation and archival at a museum.

For each study site, a complete tabulation of taxa, numbers of individuals and their percent composition will be included on the two-page Field Data Sheets – Fish. The first page of the two-page data form will include general information identifying the sample reach and investigators as well as site observations to include:

1) time sampled,
2) Pedal Down Time (PDT),
3) relative abundance of aquatic tropic level communities,
4) percent of major habitats sampled,
5) percent of specific microhabitats sampled, and
6) relative abundance and scoring of substrate.

Ultimately, the fish identification will be verified in the lab using keys in the Fishes of Arkansas (Robison and Buchanan, 1988) and the Fishes of Missouri (Pflieger, 1975) to species level where possible.

The fish collections at each reach will be compared according to several biometrics including: species richness (number of taxa); sunfish richness; species diversity; abundance; dominant ordinal groups; percent of tolerant species; trophic structure; percent of hybrids; percent of diseased fish; and key indicator species as listed in Regulation No. 2 of the ADEQ.

In addition, the fish assemblage will be evaluated utilizing the fish community biocriteria and a comparison to typical Gulf Coastal Ecoregion least disturbed streams. The fish community biocriteria scoring was developed by the ADEQ and uses eight metrics to determine use support status.

8.0 Field Study Schedule

The spring seasonal biotic characterizations will be completed during April/ May 2005. This period corresponds to the seasonal fishery period as stipulated in ADEQ seasonal fishery designation. Due to the storm water nature of the discharge and the small watershed size, a perennial fishery use does not apply to the unnamed tributaries into which Outfall 001 discharges.

9.0 References

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1.0 pH Meter Calibration SOP

Purpose

This SOP describes the methods for calibration and use of the portable Orion® 200 series pH meters. Field forms used for meter calibration and measurement recording are attached to this SOP.

Procedure

Calibration

1. Be sure that the electrode (probe) is properly attached and that a good battery is installed.

2. Turn the meter on and check the read-out for any warning messages ("Low Bat.", etc.) If problems occur refer to the owners manual for help.

3. Record the proper information (date, time, etc.) on the Calibration Field Form (attached) or in a field logbook.

4. Remove the probe protection cap and place the probe in pH buffer solution 7.00 (yellow in color) submerging the end to ***at least 1 inch***. Allow the meter to adjust to the buffers pH for approximately 1 minute.

5. Press the "Cal" button on the meter to begin the calibration process. The display should read "calibration" and "P1" along with the pH reading.

6. When the meter has accepted the buffer it will beep and "ready" will be displayed. Press "Yes" to accept the value. Record this number on the pH Calibration Record sheet. The display should now read "P2" at the screen's bottom.

7. Remove the probe from the 7.00 buffer and rinse with distilled water to remove any excess buffer solution.

8. Place the probe in the second buffer solution, 4.01 (pink) or 10.01 (blue), whichever best brackets the expected pH range to be measured, and stir it gently.

9. When the meter has accepted the value it will beep and the "ready" sign will be displayed as in step 6 above. Press "Yes" to accept this value. Record this number on the pH Calibration Record sheet.

10. The display will immediately show the slope, a number that should be between 92% and 102%. Record this number on the pH Calibration Record sheet. If the slope is larger or smaller than this range the meter should be recalibrated.

11. A calibration check should be done once the meter is calibrated. This is done simply by placing the probe in the pH 7.00 buffer solution and taking a reading. Record this reading on the pH Calibration Record form. If the reading is between 6.90 and 7.10 then the original calibration remains valid. If the measurement falls outside this range then the meter should be recalibrated.

12. Gently shake or rinse off excess liquid from the probe. The meter is now ready for use.

13. The pH meter should be calibrated once per day on days that it is used. The pH meter should have its calibration checked once for each sampling trip or once every 5 samples whichever is greater. This is done simply by placing the probe in the pH 7.00 buffer solution and taking a reading. Record this reading on the pH Calibration Record form. If the reading is between 6.90 and 7.10 then the original calibration remains valid. If the measurement falls outside this range then the meter should be recalibrated. Furthermore, if the battery or probe is ever disconnected from the meter during use, a new calibration would be required.

pH Measurements

1. Place the probe in the liquid to be analyzed and stir it gently. The probe should be submerged ***at least 1 inch*** into the liquid.

2. Allow the meter to stabilize on a reading (may take up to 4 minutes). The meter will respond with "ready" when it has properly stabilized. Record the reading. If the meter will not indicate "ready" after several minutes and the pH value displayed is not fluctuating greatly then a value may be recorded without the meter indicating "ready."

3. Be sure to turn off the meter when the final pH measurement has been taken and recorded.

Meter Maintenance/Storage

1. Store the meter in a safe dry place.

2. Keep the probe cover on the probe when not in use and between measurements.

3. A small piece of paper towel soaked in pH buffer 7.00 should be place in the bottom of the probe cover to keep the probe surface wetted with the buffer. The probe should **never** be allowed to dry out.

4. Use only "Low Maintenance Triode" ATC probes with the 200 series pH meters (model # 9107BN or equivalent.)

Quality Assurance/Quality Control

1. Meters are calibrated biweekly (at a minimum) to ensure proper function and accuracy.
2. Values measured during biweekly calibrations are compared between meters to verify accuracy.
3. Duplicate measurements should be taken at a rate of 10% (minimum) of samples analyzed.

2.0 Dissolved Oxygen (D.O.) Meter Calibration SOP

Purpose

This SOP describes the methods for calibration and use of the portable YSI Model 58 and Model 85 D.O. meters. Field forms used for meter calibration and measurement recording are attached to this SOP.

Procedure

Calibration

Model 58

1. Be sure that the oxygen probe is properly attached to the meter and that the end of the probe is affixed in storage bottle containing a piece of wet sponge or towel to keep the probe moist, and to provide a water-saturated air environment.

2. Turn the meter on and check the read-out for the "LOBAT" warning, and for the normally observed display readings. If problems occur refer to the owners manual for help.

3. Record the proper information (date, time, etc.) on the Dissolved Oxygen Calibration Record sheet or in a field logbook.

4. Set the D.O. meter to "ZERO" and use the "O2 ZERO" knob to adjust the display to 0.0. If the meter will not adjust to zero refer to the owners manual for guidance.

5. Perform a Calibration according to one of the following procedures:

   Winkler Titration (verification calibration)

   a) Fill a container with at least 500 mL distilled water (or tap water if distilled not available) and allow it to acclimate. It can be aerated overnight to achieve 100% oxygen saturation if desired.
   b) Fill each of two BOD bottles with the water from the container by gently submerging them into the container.
   c) Add one each of the HACH manganous sulfate and alkaline iodide-azide powder pillows to each bottle. Cap the bottles and invert them 15-20 times to mix the solution thoroughly.
   d) Allow the bottles to settle until a precipitate appears in the bottom half of the bottle. This will usually take 3-5 minutes.
   e) Add one HACH sulfamic acid powder pillow to each BOD bottle. Invert the bottles until all the precipitate has been dissolved.

f) Using a graduated cylinder measure and place 200 mL of the solution into a flask.
g) Add 1 mL of HACH starch indicator to the flask. The solution should turn black.
h) Using a burette filled with sodium thiosulfate (at room temperature) titrate the solution in the flask drop-wise until the solution turns clear.
i) Record the starting and ending volumes from the burette.
j) Repeat this titration (steps f-I) for a second flask filled with fresh solution.
k) Subtract ending volumes from starting volumes to arrive at the volume used for each titration. The volume used is equivalent to the dissolved oxygen content of the water in mg/L.
l) If the D.O. values from the two titrations differ by more than 5%RPD then the titrations should be repeated.
m) Remove the D.O probe from the storage bottle and place it in the container holding the water. It must be submerged at least 1 inch below the waters surface. Set the meter to the "0.1 mg/l" measurement mode.. Swirl the probe gently and slowly in the water.
n) Calibrate the meter to the average of the two dissolved oxygen measurements by turning the "O2 CALIB" knob until the display reads the corresponding D.O. concentration. Record the final calibrated value.

Air Calibration (Standard Calibration)

a) Set the meter to the temperature measurement mode ("TEMP...").
b) Record the temperature of the probe in the storage bottle on the record form or in a field logbook.
c) Refer to the attached table presenting Solubility of Oxygen in Water values (also on back of meter) and find the solubility of oxygen at the corresponding temperature.
d) Record the appropriate barometric pressure or altitude (use pressure when available).
e) Refer to the attached table presenting Calibration Values at Various Pressures and Altitudes (also on back of meter) and record the "CALIB VALUE" in % saturation at the corresponding pressure or altitude.
f) Using the solubility of oxygen value and the % saturation value as a decimal calculate the calibration value by multiplication (i.e. at an altitude Of 1413 ft. and a temperature of 20°C the calibration value would be 8.64 mg/L or 8.6 mg/L).
g) Set the meter to the D.O. measurement mode ("0.1 mg/l") and adjust the display using the "O2 CALIB" knob to read the calibration value as calculated.
h) Record the final calibrated value on the record form or in a field logbook.

Model 85

1. Turn on the meter and make sure the meter is in the D.O. mode (will display mg/L).

2. Wet the sponge in the calibration/storage chamber and insert the probe into the chamber.

3. Allow the D.O. and Temperature readings to stabilize (up to 15 minutes).

4. Press the up arrow and down arrow buttons simultaneously.

5. When prompted to do so, enter the local altitude in hundreds of feet by scrolling up or down with the up or down arrow buttons.

6. Press enter when the correct altitude is displayed. Base altitude on barometric pressure when possible, as it will have an affect on the calibration. See "Air Calibration" above for details.

7. When the percent reading is stable, press enter. Save will be displayed on the screen for a few seconds, then the meter will return to the normal operation mode.

NOTE: Each time either of the meters is turned off they should be recalibrated.

D.O. Measurements

Model 58 and 85

1. Set the meter to the D.O. measurement mode. Place the probe in the liquid to be analyzed and stir it gently and slowly to keep water passing over the probe membrane. The probe should be submerged ***at least 1 inch*** into the liquid.

2. Allow the meter to stabilize on a reading (should take less than one minute). Once the meter has stabilized record the reading.

3. If the meter will not stabilize check the probe for air bubbles. If bubbles are found shake the probe firmly but not violently a couple of times and re-measure. If problems still occur probe maintenance is necessary.

4. The meter should be placed in the "ZERO" mode between measurements to conserve battery life. Be sure to turn off the meter when the final D.O. measurement has been taken and recorded.

Meter Maintenance/Storage

1. Store the meter in a safe dry place.

2. Keep the probe cover on the probe when not in use and between measurements.

3. A small piece of sponge or paper towel soaked in clean water should be place in the bottom of the probe cover to keep the probe surface moist. The probe should **never** be allowed to dry out.

4. The probe membrane should be replaced at a minimum every 6 months or whenever the meter fails to perform to standard.

5. Use only YSI replacement parts and probes with the meter.

Quality Assurance/Quality Control

1. Meters are calibrated biweekly (at a minimum) to ensure proper function and accuracy.
2. Values measured during biweekly calibrations are compared between meters to verify accuracy.
3. Duplicate measurements should be taken at a rate of 10% (minimum) of samples analyzed.

3.0 Conductivity Meter Calibration and Measurement SOP

Purpose

This SOP describes the methods for calibration and use of portable YSI conductivity meters. Field forms used for meter calibration and measurement recording are attached to this SOP.

Procedure

Calibration

Calibration of YSI conductivity meters is performed by the manufacturer and is rarely needed. However, the accuracy of the meter should be monitored bi-weekly and before each use. The bi-weekly monitoring of accuracy should be recorded in the calibration log book, along with date/time performed and name of person performing task.

1. Turn the instrument on and allow it to complete its self test procedure.
2. Bi-weekly the instrument should be checked for accuracy using a standard of 80 uS/cm. The meter should be set to measure specific conductance. The steps listed below under "Conductivity Measurements" should be followed for checking conductivity accuracy. This standard check should be recorded in the calibration log book.
3. YSI conductivity meters are calibrated a minimum of once a year or when there is reason to believe the instrument is reading incorrectly (outside the range of 80±10 uS/cm during the accuracy check).
4. To calibrate, select a calibration solution, which is most similar to the sample you will be measuring. The following should serve as a guideline:

   for sea water choose a 50 mS/cm conductivity standard,
   for fresh water choose a 1 mS/cm conductivity standard, and
   for brackish water choose a 10 mS/cm conductivity standard.

5. Place at least 3 inches of solution in a clean glass beaker.
6. Insert the probe into the beaker deep enough to completely cover the oval shaped hole on the side of the probe. Do not rest the probe on the bottom of the container -- suspend it above the bottom at least 1/4 inch.

7. Allow at least 60 seconds for the temperature reading to become stable.

8. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.

9. Press and release the up and down keys (Λ,V) at the same time. The CAL symbol will appear at the bottom left of the display to indicate that the instrument is now in Calibration Mode.

10. Use the up or down arrow key to adjust the reading on the display until it matches the value of the calibration solution you are using.

11. Once the display reads the exact value of the calibration solution being used press the ENTER key once. The word "SAVE" will flash across the display for a second indicating that the calibration has been accepted.

Conductivity Measurements

1. Press the "ON/OFF" button to turn the meter on. The meter will go through a self-test procedure, which will last for several seconds. The cell constant will be displayed when the self-test is finished. Consult the Operations Manual if an error is displayed during the self-test.

2. Select the mode of measurement on the meter by pressing and releasing the "MODE" button on the meter. GBM^C generally measures specific conductance in its field studies. The following are the modes of measurement capable of the YSI 30 meter:

   Conductivity - measurement of the conductive material in the liquid sample without regard to temperature. Displayed when the large numbers on the display will be followed by the respective units, and the temperature units will not be flashing.

   Specific Conductance - temperature compensated conductivity which automatically adjusts the reading to a calculated value which would have been read if the sample had been at 25°C. Displayed when the large numbers on the display will be followed by the respective units, and the temperature units will be flashing.

   Salinity - A calculation done by the instrument electronics, based upon the conductivity and temperature readings. Displayed when large numbers on the display will be followed by ppt.

3. Insert the probe into the solution being measured for conductivity, making sure that the probe is inserted deep enough to cover the hole located on its side. If possible,

refrain from touching any solid located in the solution, and hold the probe at least 1/4 inch from the bottom and sides of any container used to hold the sample. The probe should also be vigorously shaken in the solution to dislodge any air bubbles, which may be adhered.

NOTE: The YSI meters are factory calibrated, and retain the last calibration conducted. This means that once batteries are installed, or when the meter is turned on, you are ready to begin taking measurements.

Meter Maintenance/Storage

Always rinse the conductivity cell with clean water after each use.

Cleaning the conductivity cell

1. Dip the cell in cleaning solution of 1:1 isopropyl alcohol and 10N HCl, and agitate for two to three minutes.

2. Remove the cell from the cleaning solution.

3. Use a nylon brush to dislodge any contaminants from inside the electrode chamber.

4. Repeat steps one and two until the cell is completely clean. Rinse the cell thoroughly in deionized water.

5. Store the conductivity cell in the meter storage chamber.

Quality Assurance/Quality Control

1. Meters are calibrated biweekly (at a minimum) to ensure proper function and accuracy.
2. Values measured during biweekly calibrations are compared between meters to verify accuracy.
3. Duplicate measurements should be taken at a rate of 10% (minimum) of samples analyzed.

4.0 Temperature Measurement/Check SOP

Purpose

This SOP describes the methods for the measurement of temperature using the Orion MODEL 230 A pH meter, Hach MODEL 50050 pH meter, YSI MODEL 58 DO meter, YSI MODEL 30 conductivity meter, and YSI MODEL 85 combination meter. Field forms used for meter calibration and measurement recording are attached to this SOP.

Procedure

Accuracy Check for all Instruments

1. Insert the probe for the corresponding instrument into a container holding water, and allow the temperature reading to stabilize.
2. Record the temperature displayed on each respective instrument in the calibration log book along with date/time and individual performing the task.
3. Compare the actual temperature of the water measured with a certified calibrated thermometer to the temperature measured by the respective instruments.
4. If the temperature relative percent difference exceeds 20%, then do not use that particular meter for temperature analysis.

Temperature Measurement

Orion Model 230 A pH meter

1. Connect the combination pH/temperature electrode to the meter.
2. Turn the meter on, and allow it to go through its self-test.
3. Insert the probe into the solution to be measured.
4. The temperature read out is located in the lower left of the LCD on the meter.

HACH EC10 pH/mV/temperature meter

1. Connect the combination pH/temperature electrode to the meter.
2. Turn the meter on, and allow it to go through its self-test.
3. Insert the probe into the solution to be measured.
4. The temperature read out is located in the prompt line followed by ATC.

YSI Model 30 Conductivity meter and YSI Model 85 Combination meter

1. Turn the meter on.
2. Insert the probe into the solution to be measured.
3. The temperature read out is located in the lower right of the LCD on the meter.

YSI Model 58 Dissolved Oxygen meter

1. Turn the meter to temperature mode.
2. Insert the probe into the solution to be measured.
3. The temperature read out is located on the screen.

Quality Assurance/Quality Control

1. Meters are calibrated biweekly (at a minimum) to ensure proper function and accuracy.
2. Values measured during biweekly calibrations are compared between meters to verify accuracy.
3. Duplicate measurements should be taken at a rate of 10% (minimum) of samples analyzed.

5.0 Flow Measurements SOP

Purpose

This SOP describes the procedure used in the determination of water flow, which is necessary for the calculation of water volume passing through a given water body.

No single method for measuring discharge is applicable to all types of stream channels. The preferred procedure for obtaining discharge data is based on "velocity-area" methods (e.g., Rantz and others, 1982; Linsley et al., 1982). For streams that are too small or too shallow to use the equipment required for the velocity-area procedure, two alternative procedures are presented.

Stream discharge is equal to the product of the mean current velocity and vertical cross sectional area of flowing water. Discharge measurements are critical for assessing pollutant loading and reaeration rates used for dissolved oxygen modeling, as well as, other characteristics that are very sensitive to stream flow differences. Discharge will be measured at a suitable location within the sample reach that is as close as possible to the location where chemical samples are collected so that these data correspond. Field data forms for recording measurements are attached to this SOP.

Procedure

Velocity Area Procedure

Because velocity and depth typically vary greatly across a stream, accuracy in field measurements is achieved by measuring the mean velocity and flow cross-sectional area of many increments across a channel. Each increment gives a subtotal of the stream discharge, and the whole is calculated as the sum of these parts.

A Marsh McBirney Model 201 Portable Water Current Meter will be used whenever conditions allow. The site selected for flow measurements will be chosen on the basis of the most uniform streambed cross-section. This facilitates the best measurements since non-uniform streambeds may cause errors in velocity and depth. Manmade structures (bridges and culverts) may be used as flow measurement sites, but are not ideal.

Discharge measurements are generally made at only one carefully chosen channel cross section within the sampling reach. It is important to choose a channel cross section that is as much like a canal as possible, void of obstructions, as this provides the best conditions for measuring discharge by the velocity-area method. Rocks and other obstructions may be removed to improve the cross-section before any measurements are made. However, because removing obstacles from one part of a cross-section affects adjacent water velocities, you must not change the cross-section once you commence collecting the set of velocity and depth measurements.

The procedure for obtaining depth and velocity measurements is outlined below:

1) Locate a cross-section of the stream channel for discharge determination that exhibits as many of these qualities as possible: Segment of stream above and below cross-section is straight, depths mostly greater than .5 feet, and velocities mostly greater than 0.5 feet/second. Do not measure discharge in a pool. Flow should be relatively uniform, with no eddies, backwaters, or excessive turbulence.

2) Stretch a tape measure across the stream perpendicular to its flow, with the "zero" end of the rod or tape on the left bank, as viewed when looking downstream. Tightly suspend the measuring tape across the stream, approximately one-foot above water level and secure at both ends.

3) Record the total wetted distance indicated by the tape from the left descending bank (LDB) to the right descending bank (RDB).

4) Attach the velocity meter probe to the calibrated wading rod that indicates depth and holds the flow probe at 60% depth. Check to ensure the meter is functioning properly and the correct calibration value is displayed. If necessary the meter and probe can be calibrated according to the instructions in the QA/QC section of this SOP (which is based on manufacturers recommendations).

5) Divide the total wetted stream width into equally sized intervals, generally one foot wide (minimum of ten measurement locations, but never less than 1/2 foot increments).

6) Stand downstream of the tape and to the side of the midpoint of the first interval (closest to the LDB).

7) Place the wading rod in the stream at the midpoint of the interval. Record the distance from the left bank (in feet) and the depth indicated on the wading rod (in tenths of a foot) on the Flow Measurement Form.

8) Stand downstream of the probe to avoid disrupting the stream flow. If the water depth is less than 3 ft., adjust the position of the probe on the wading rod so it is at 60% of the measured depth below the surface of the water (Meador et al., 1993). The probe is set at the 60% depth by adjusting the foot scale on the sliding rod with the tenth scale on the depth gauge rod. If the water depth is greater than 3 ft., take measurements at 20% and 80% of the depth from the water surface. The average of these two readings is considered the water velocity for the respective measurement point. To set the probe at the 20% depth, first multiply the water depth by two, then use the calculated number to line up the foot scale as with the

60% depth. The same method is used for the 80% depth, except the calculated value is the water depth divided by two.

9) Face the probe upstream at a right angle to the cross-section. Do not adjust the angle of the probe, even if local flow eddies hit at oblique angles to the cross-section.

10) Wait 20 seconds to allow the meter to equilibrate then measure the velocity. Record the value on the Flow Measurement Form. For the electromagnetic current meter (e.g., Marsh-McBirney), use the lowest time constant scale setting on the meter that provides stable readings.

11) Move to the midpoint of the next interval and repeat Steps 6 through 8. Continue until depth and velocity measurements have been recorded for all intervals.

12) Record the data from each measurement on the Discharge Flow Recording form.

Timed Filling Procedure

In channels too "small" for the velocity-area method, discharge can be determined directly by measuring the time it takes to fill a container of known volume. "Small" is defined as a channel so shallow that the current velocity probe cannot be placed in the water, or where the channel is broken up and irregular due to rocks and debris, and suitable cross-section for using the velocity area procedure is not available. This can be an extremely precise and accurate method, but requires a natural or constructed spillway of free-falling water. If obtaining data by this procedure will result in a lot of channel disturbance or stir up a lot of sediment, wait until after all biological and chemical measurements and sampling activities have been completed.

Choose a cross-section of the stream that contains one or more natural spillways or plunges that collectively include the entire stream flow. A temporary spillway can also be constructed using a portable V-notch weir, plastic sheeting, or other materials that are available onsite. Choose a location within the sampling reach that is narrow and easy to block when using a portable weir. Position the weir in the channel so that the entire flow of the stream is completely rerouted through its notch. Impound the flow with the weir, making sure that water is not flowing beneath or around the side of the weir. Use mud or stones and plastic sheeting to get a good waterproof seal. The notch must be high enough to create a small spillway as water flows over its sharp crest.

Make sure that the entire flow of the spillway is going into the bucket. Record the time it takes to fill a measured volume on the Field Measurement Form. Repeat the procedure five times. If the cross-section contains multiple spillways, you will need to do separate determinations for each spillway. If so, clearly indicate which time and volume data replicates should be averaged together for each spillway; use additional field measurement forms if necessary.

Neutrally-Buoyant Object Procedure

In streams too shallow to use the velocity-area method the neutrally-buoyant object method may be employed. This procedure involves measuring the time it takes a floating object to pass a known stream distance. This is done using buoyant objects that float low in the water such as key limes, sticks, or small rubber balls. The following steps should always be followed to ensure accurate results.

1. Mark off on the stream bank the starting and ending points. These should be far enough apart to allow at least 10 seconds of drift time between them. Record the distance between the two points in feet to the nearest 0.1 foot.
2. Place the buoyant object in the water upstream of the starting point and begin timing on a stopwatch when the object reaches the start line.
3. Record the elapsed time till the object crosses the end line, in seconds to the nearest 0.1 seconds.
4. Repeat steps two and three at least three times to develop an average time of passage in seconds.
5. Average velocity is equal to distance divided by average elapsed time.
6. Measure cross sectional depths and width in the middle of the flow path to acquire a cross sectional wetted area. This can be used along with the average velocity to determine flow in cubic feet per second.

Observations and Calculations

Discharge is usually determined after collecting water chemistry samples. Although discharge is part of the physical habitat indicator, it is presented as a separate section.

Flow data will be recorded on the Discharge Flow Recording forms. Any additional observations will be recorded in field notebooks. Calculations will be performed using hand held calculators to determine flow volume in CFS. The calculated volume will be evaluated for reasonableness and may be repeated if there are questions regarding the flow accuracy. A sketch of the stream cross section should be added to the flow form, especially if there were critical conditions that may have impacted the flow measurement.

The following calculations are used to calculate flow/discharge:

a. Calculate Area (A) by multiplying Width (W) X Depth (D).
b. Calculate discharge (Q) by multiplying Velocity (V) by Area (A).
c. Calculate total Area (A) and Discharge (Q) in each respective column.

d. Calculate average Velocity (V) by dividing summed Discharge (Q) by summed area or by taking an average of each velocity measurement.

QA/QC Stream flow Current Velocity Meters

Field teams will be using an electromagnetic type meter (e.g., Marsh McBirney Model 201 D). General guidelines regarding performance checks and inspection of current meters are presented below. If required the operating manual for the specific meter will be referenced for information as necessary.

Periodically or prior to field studies, the meter is calibrated to a zero value using a bucket of quiescent water and the following routine. The probe is placed in the bucket and allowed to sit for 30 minutes with no disturbance. The velocity value obtained should be 0.0 ± 0.1. The meter is adjusted to zero if the value is outside this range.

Duplicate flow measurements are taken for at least one in ten sites where flow is measured. A relative percent difference (RPD) is calculated, and must be less than 20% to be within control parameters. Any values exceeding 20% are investigated to determine the cause and the need for corrective action. When possible flow measurement values are compared to gauging station data or data from fixed flow meters as a QA check

6.0 General Physical Characterization SOP

Purpose

The physical characteristics of an entire watershed are important components of an overall biological assessment of an individual stream. Watershed features and uses have a great affect on the development of a stream morphology and its biota.

Physical characterization includes documentation of weather conditions before and during the survey, description of stream origin and type, flow status, watershed features (landuse, etc), instream morphological features, water observations, and sediment observations. These parameters provide a general overview of the stream system in which a study is occurring.

Procedure

A General Physical Characterization Field Form (attached) should be completed for each stream reach in a study. The information (apart form general headings) provided below is included on the field form. A brief explanation of how to complete the information under each parameter heading is provided below.

Parameter:

1. Stream Name
2. Latitude/Longitude
3. River Basin (basin the stream is a part of)
4. Weather Conditions

   Check the appropriate box for the current weather conditions and the weather conditions in the past 24 hours. If there is cloud cover provide an approximation of the percent coverage. Indicate if there has been significant rain in the past 7 days. Provide an estimate (or measure) of air temperature.

5. Stream Attributes

   Check the box indicating if the stream is perennial, intermittent, or tidal. Check if the stream is a coldwater habitat (trout) or a warmwater habitat (bass). Mark the correct stream geological origin (glacial, montane, swamp, etc.) Estimate or measure, on a topographic map, the catchment size and record on the field form.

6. Hydrology

Check the appropriate current flow status of the stream (low, moderate, high) and indicate if flow measurements will be taken.

7. Watershed Features

Check the appropriate boxes concerning dominant land uses (pasture, industrial, etc.) in the area of the stream. Mark appropriate boxes concerning potential non-point source (NPS) pollution contributions. Note watershed erosion evidence observed.

8. Instream Features

Assess what portion of the stream reach can be characterized by the three morphological types (riffle, run, pool). Make an effort to assess the entire reach accurately and rank each morphological type as a percentage of the whole reach (i.e. 30% riffle, 50% run, 20% pool). Complete this parameter by having each participating field biologist collaborate in the ratings. Have each collaborating biologist initial the field form in this section. Note if any channelization or dams are present.

9. Water/Observations

Assess the water for odors, turbidity, and surface sheen's and mark the appropriate descriptor listed on the field form.

10. Sediment/Observations

Assess the sediment for odor and deposits and mark the appropriate descriptor on the field form.

Make additional notes and observations for each category directly on the field form or provide a code to reference comments written in a separate field notebook.

7.0 Semi-Quantitative Habitat Assessment SOP

Purpose

Physical habitat in streams includes all those physical attributes that influence or provide sustenance to biological attributes, both botanical and zoological, within the stream. Stream physical habitat varies naturally, as do biological characteristics; thus, habitat conditions differ even in the absence of point and anthropogenic non-point disturbance. Within a given ecoregion, stream drainage area, stream gradient and the geology are likely to be strong natural determinants of many aspects of stream habitat, because of their influence on discharge, flood stage, and stream energy (both static and kinetic). Kaufmann (1993) identified seven general physical habitat attributes important in influencing stream ecology and the maintenance of biological integrity:

1) channel dimensions,
2) channel gradient,
3) channel substrate size and type,
4) habitat complexity and cover,
5) riparian vegetation cover and structure,
6) anthropogenic alterations, and
7) channel-riparian interaction.

Land use activities can directly or indirectly alter any and/or all of these attributes. Nevertheless, the trends for each attribute will naturally vary with stream size (drainage area) and overall gradient. The relationships of specific physical habitat measurements described in this section to these seven attributes are discussed by Kaufmann (1993). Although they are actually biological measures, aquatic macrophytes, riparian vegetation, in-stream habitat and canopy cover are included in this and other physical habitat assessments because of their role in habitat structure and light inputs

The objectives of a habitat characterization are to:

1) assess the availability and quality of habitat for the development and maintenance of benthic invertebrate and fish communities, and
2) evaluate the role of habitat quality in relation to the attainment of designated uses and biological integrity.

There are three main headings for the components of the physical habitat characterization each with several categories. Measurements for each of the components (14 categories total) are recorded on copies of a two-page field form entitled Stream Habitat Assessment (Semi-Quantitative), and include:

1) Channel Morphology
    a) Reach Length Determination
    b) Riffle-Pool Sequence
    c) Depth and Width Regime

2) In-Stream Structure
    a) Epifaunal substrate
    b) In-Stream Habitat
    c) Substrate Characterization
    d) Embeddedness
    e) Sediment Deposition
    f) Aquatic Macrophytes and Periphyton
3) Riparian Characteristics
    a) Canopy Cover
    b) Bank Stability and slope
    c) Vegetative Protection
    d) Riparian Vegetative Zone Width
    e) Land-use Stream Impacts

Field physical habitat measurements from a field habitat characterization are used in conjunction with water chemistry, temperature, macroinvertebrate and vertebrate (typically fish) community analyses, and other data sources to determine the status of the target streams attainment of designated uses and the water quality required to maintain those uses.

These procedures are intended for evaluating physical habitat in wadeable streams, but may be adapted for use in larger streams as necessary. The field procedures applied to this characterization are most efficiently applied during low flow conditions and during times when terrestrial vegetation is active, but can also be applied during spring seasonal conditions with higher base flows. This collection of procedures is designed for monitoring applications where robust, quantitative or semi-quantitative descriptions of habitat are desired. This semi-quantitative habitat procedure is usually used in conjunction with the *General Physical Habitat Characterization* and the *Qualitative Habitat Assessment* to provide a detailed view of the streams habitat condition.

The habitat characterization protocol provided herein differs from other rapid habitat assessment approaches (e.g., Plafkin et al., 1989, Rankin, 1995) by employing a, systematic spatial sampling that minimizes bias in the placement and positioning of measurements. Measures are taken over defined channel areas and these sampling areas are placed systematically at spacing that is proportional to the length of the entire study reach. This systematic sampling design provides resolution appropriate to the length of the study reach. The habitat assessment protocol summarized in this SOP is based on those of USEPA in their EMAP and RBP procedures (Lazorchak, 1998 and Barbour, 1999), USGS NAWQA program (Fitzpatrick, 1998) and Missouri Department of Natural Resources ESP (Sarver, 2000).

We strive to make the protocol objective and repeatable by using previously developed methods to produce repeatable measures of physical habitat in place of estimation techniques wherever possible.

Two people typically complete the specified assessment, including stream flow measurements, in about two hours of field time. However, the time required can vary considerably with channel characteristics.

The procedures are employed on a sampling reach of length equal to 20 times the bankfull width, or at least 100 yards of in-stream distance. The semi-quantitative habitat sampling reach length should coincide as much as possible with that of the fish and macroinvertebrate collection reaches. Measurements are taken in each of 10 sub-reaches, which are systematically placed, at intervals equal to approximately one tenth (1/10) the length of the represented study reach. Measurements and observations for each habitat characteristic are made in each of the sub-reaches as the assessment team moves along the stream channel. An average or total of the scores for each of the 10 sub-reaches is then calculated resulting in a mean value for each characteristic for the entire reach.

Procedure

The habitat assessment will be conducted within (or to the extent possible) the stream reach from which the benthic and fish communities are to be characterized. The physical habitat will be characterized from measurements and observations of stream attributes made within 10 sub-reaches. The team assessing habitat should move along the stream channel (near the thalwag) observing habitat characteristics within each sub-reach. A description of and the rational for measuring each of the attributes are provided below. The details of how these attributes are recorded/evaluated are also described below in the following sections.

Channel Morphology

Channel morphology (or geomorphology) is a characterization of the shape of the stream channel including measurements and/or visual estimates of channel dimensions and riffle-pool sequences. i.e. a measure of the amount of riffles, runs and pools that occur in a given reach.

The channel observed includes that portion of the stream between the base flow wetted area and the top of the normal high water channel often referred to as the bankfull stage (Figure 1.) The "bankfull" or "active" channel is defined as the channel that is filled by moderate-sized flood events that typically occur every one or two years. Such flow levels are on the verge of entering the flood plain and are believed to control channel dimensions in most streams.

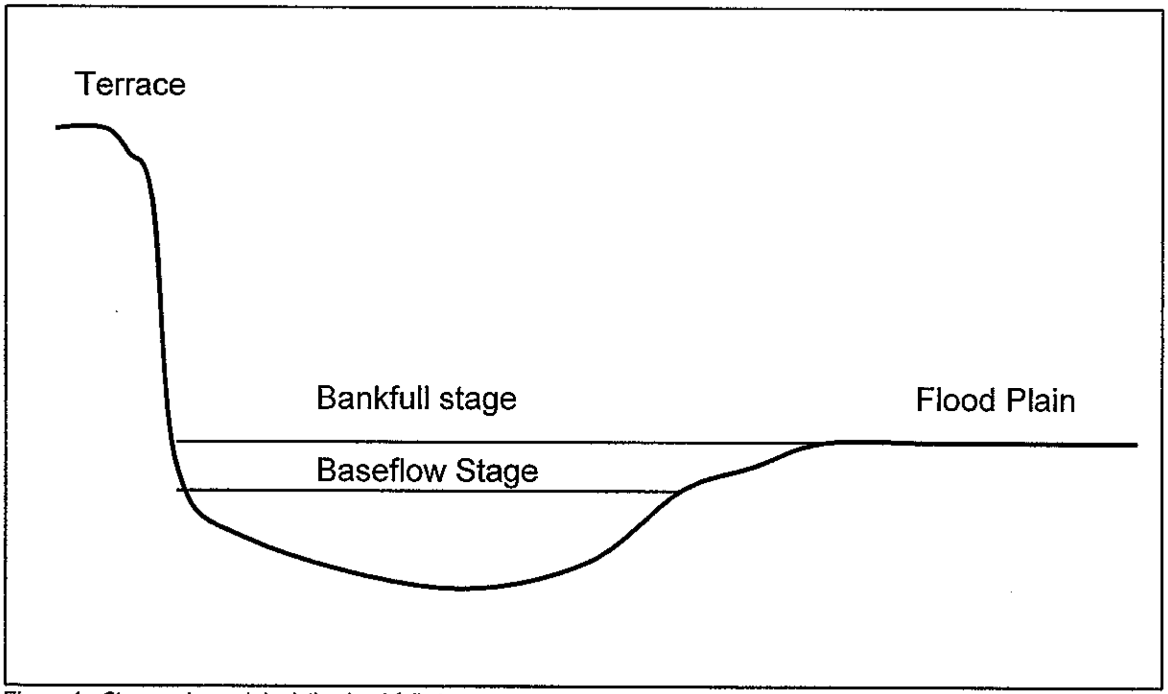

Figure 1. Stream channel depicting bankfull stage.

1) Reach Length Determination

First, bankfull depth (depth from stream bottom in thalwag to bankfull stage on the bank) is identified in at least two separate riffles (or alternatively runs in streams not exhibiting riffle morphology) in the study reach. Then bankfull depth and width is determined from 5 stream transects and recorded on the record sheet. Transect locations should be selected to include each prominent morphology type represented in the stream. Bankfull depths are measured to the nearest 1/10 foot and bankfull widths are measured to the nearest foot using a wading rod and tape measure/range finder, respectively. An average of the 5 bankfull widths is then calculated and multiplied times 20 to arrive at the total reach length for assessment. This total length is then divided by ten to determine the length of each of the ten sub-reaches. Analysis of the first sub-reach should begin at the head of a given stream morphology (i.e. riffle, run or pool).

2) Riffle-Pool Sequence

Stream morphology refers to the abundance and placement (sequencing) of riffles, runs, and pools in a stream system. This sequencing is an indicator of a streams hydrological regime and stability as well as a determinant of its potential to sustain diverse aquatic communities. Beginning at the head of a morphological type (riffle, run or pool) the length of each morphological type in the stream reach should be measured using a range finder or tape measure and recorded on the record sheet. The sequence of each morphological type should be depicted on the record sheet using the provided notations so as to create a map to the location of each riffle, run or pool. The resulting measurements should provide a quantitative measure of the percent of the study reach representing each stream morphological type (i.e. 40% riffle, 30% run, 30% pool, etc).

3) Depth and Width Regime

The average stream depth and width will be estimated in riffles (or runs in the absence of riffles) and pools in each sub-reach. Depths will be measured along a transect, similar to that depicted in Figure 2, in a representative section of each riffle and pool in the sub-reach. Depths are generally taken in the thalwag (deepest area in stream channel) and approximately half way between the thalwag and the left and right banks. An estimated average depth for riffles and pools occurring in a sub-reach is derived from the cross-sectional depth measurements and recorded on the record sheet to the nearest 1/10 foot. Once completed for all 10 sub-reaches this should provide accurate semi-quantitative measurements of riffle and pool average depth and depth variability across the entire stream reach.

Stream wetted widths will be measured along a transect, in a representative section of each riffle and pool in the sub-reach. An estimated average width for each morphological type in a sub-reach should be recorded on the record sheet to the nearest foot. Once completed for all 10 sub-reaches this should provide accurate semi-quantitative measurements of riffle and pool widths across the entire stream reach.

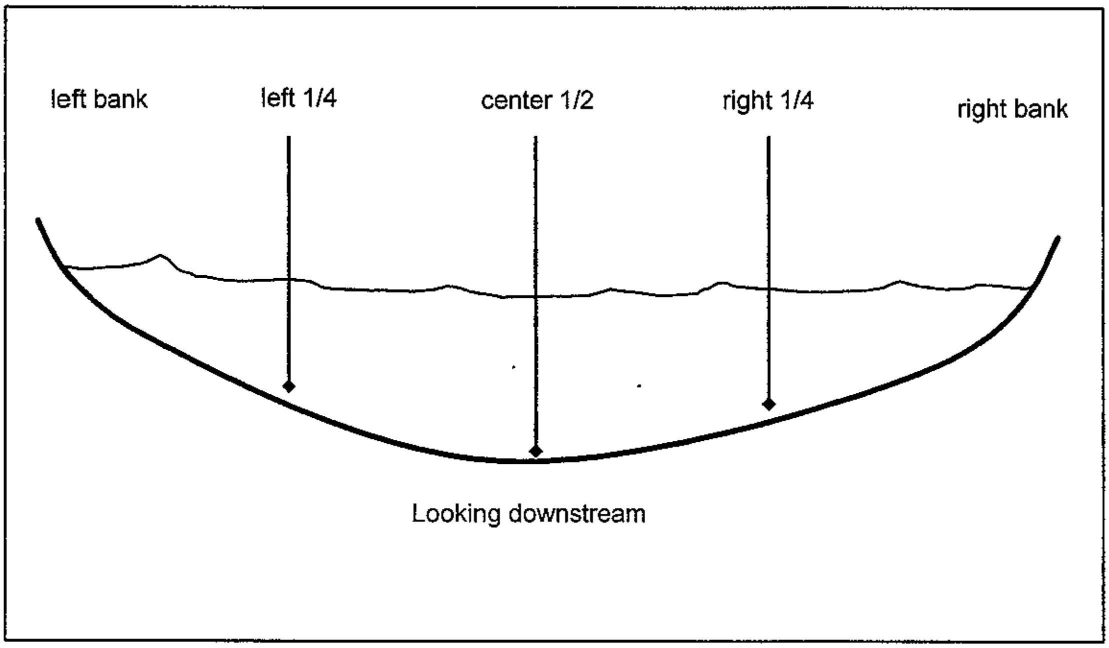

Figure 2. Approximate position of measurements across transect.

In-Stream Structure

In-stream structure describes the characteristics of the stream within the wetted perimeter that makes up the habitat suitable for colonization of aquatic biota. This includes information about natural substrates (gravel, boulders, etc), aquatic plants and algae and debris that has been washed into or fallen into the stream, such as logs, leaves, etc. A stream capable of sustaining diverse aquatic communities will contain a variety of in-stream structure including some that is permanent and some that is mobile during high flow events.

4) Epifaunal Substrate (Macroinvertebrates)

   Epifaunal substrate refers to the area on the bottom of the stream (entire wetted perimeter) where macroinvertebrates inhabit. This attribute is scored as a percentage of the stream bottom in a sub-reach which contains substrates suitable for macroinvertebrate colonization. Scoring for this attribute should rely heavily on the stability of the substrate, the size of the interstitial spaces, and the cleanliness (not covered in thick algae or sediment deposits) of the substrate. Cobbles and coarse gravel will score higher percentages as they contain larger interstitial spaces for colonization, while sand and silt would score lower since they provide little spaces. In addition, root wads along the bank would score higher as they are more stable features than would depositional areas or small woody debris.

5) In-Stream Habitat (Fish)

   In-stream habitat refers to the habitat features within the wetted perimeter of the stream sub-reach which are available for fish colonization. This attribute is scored as the percentage of the stream bottom (wetted perimeter) in a sub-reach which is covered with fish habitat. As with the epifaunal substrate attribute substrates composed of cobbles, coarse gravels and boulders score higher for fish cover as they provide better spaces for colonization. Other habitats that score high are large woody debris (individual logs with diameter >4 inches or complex woody structures composed of rootwads, logs, or limbs with diameter of 1.5 ft. or greater)and undercut banks. While habitats that score lower are those such as depositional areas, leaf packs, and fine sediments or sand.

6) Substrate Characterization

The dominant stream substrate size classification for riffles and pools within each sub-reach will be recorded on the record sheet. Only substrates within the wetted perimeter are evaluated. This information will be used to characterize the similarities and or differences in substrate structure and complexity in the riffles and pools of the study reach as it relates to the development and maintenance of the systems biological integrity.

Classify the particle into one of the size classes listed on the Semi-Quantitative Habitat Assessment Field Form based on the size of the intermediate axis (median dimension) of its length, width, and depth. This "median" dimension is the sieve size through which the particle can pass.

Bedrock	smooth or rough
Boulder	>25 cm
Cobble	6-25 cm
Coarse Gravel	1.6 – 6 cm
Fine Gravel	0.2 – 1.6 cm
Sand	<0.2 cm
Silt/Mud/Clay	fine, not gritty

Always make notations for unusual substrates such as concrete or asphalt and denote these artificial substrates as "other" and describe them in the comments section of the field data form. Code and describe other artificial (such as large appliances, tires, car bodies, etc.) substrates in the same manner.

7) Embeddedness

Embeddedness is the fraction of a particle's surface that is surrounded by (embedded in) sand or finer sediments on the stream bottom. By definition, the embeddedness of sand, silt, clay, and muck is 100 percent and the embeddedness of hardpan and bedrock is 0 percent.

For this attribute estimations are not made per sub-reach but for the entire stream reach as a whole. An estimation of the "percent embedded" is recorded for coarse riffle substrates in the study reach. This is accomplished by removing 12 pieces of cobble, gravel, or small boulders in at least two different riffles (three maximum) and recording the percent embedded for each. Percent embedded can be visually observed as the darkened portion of the coarse substrate that was buried in the streams fine bed material. If the darkened area covers half the coarse substrates height than the percent embedded is 50%, etc (Figure 3.)

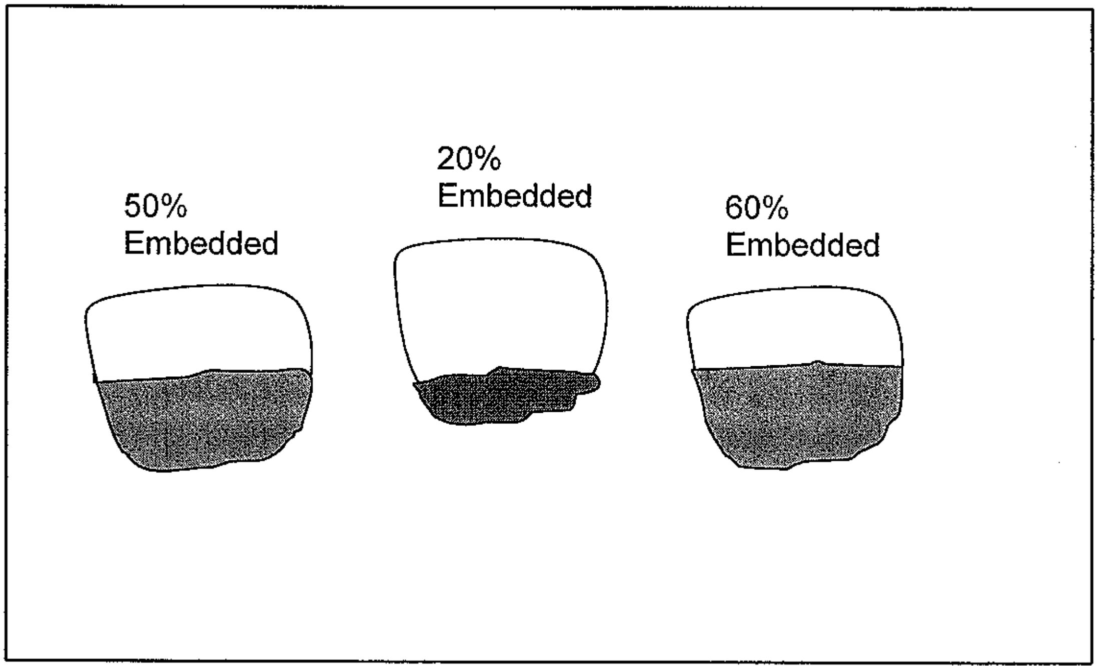

Figure 3. Depiction of percent embedded characteristics.

8) Sediment Deposition

The sediment deposition attribute refers to the amount of stream bottom (in the wetted perimeter) that is covered by fine sediments and/or particulate organic matter. This attribute is scored as a percentage of the bottom in each sub-reach which is covered by such loose materials.

9) Aquatic Macrophytes and Periphyton Coverage

An estimate of the percentage of area covered by macrophytes and periphyton in a sub-reach is made and recorded both for riffles and pools. Macrophytes refers to aquatic plants that grow in the stream (both emergent and submerged), and periphyton refers to algae that grows on fixed surfaces. This attribute helps biologists determine stream productivity from a nutrient enrichment perspective and also for the availability of food sources for aquatic biota.

Riparian Characteristics

The riparian area includes the area from the stream bank in a direction away from the stream into the upland areas. It is these stream-side riparian zones that ultimately help shape the stream and provide organic material as nutrients to the aquatic system. A well developed riparian area protects stream banks form erosion, provides shading, inputs nutrients, provides materials as habitat (in-stream structure) and filters run-off entering the stream. In the absence of well developed riparian zones the stream is more impacted by encroaching land-uses.

10) Canopy Cover

Canopy cover (percent stream shading) over the stream is determined for each of the sub-reaches. Estimates of cover are made by looking into the canopy over the stream channel. Estimates are made from mid-channel and each quarter channel to determine the average percent canopy cover for the width of the stream in the sub-reach. Percent canopy at each measurement point can be estimated visually or by use of a spherial densiometer.

11) Bank Stability and Slope

Bank stability is an important attribute that is an indication of a stream reaches overall hydrologic equilibrium. A bank's stability also determines its ability to provide stable habitat for biota and its propensity to release large sediment yields to the stream, which ultimately cause high turbidity and deposition in downstream reaches. The right and left banks are classified according to the following categories:

Score 9-10 = Stable, little evidence of erosion, < 5% bank eroding
Score 6-8 = Moderately stable, some evidence of new erosion, 5-29% bank eroding
Score 3-5 = Moderately unstable, obvious new erosion, 30-59% bank eroding
Score 1-2 = Unstable, most of bank actively eroding, 60-100% bank eroding

Banks composed of sands and gravels are much less stable than banks composed of silt/mud/clay or cobbles. The density of well rooted (more permanent) vegetation and root structure also help to improve a banks stability.

Average bank slope (in degrees) in a sub-reach, is recorded for each bank (left and right). Bank slope affects the stability of a bank and is an indicator of past erosion. A gentle slope may average 30° while a steep or undercut bank may average 90° or 100°, respectively.

12) Vegetative Protection

Bank vegetative protection is measured as a percent of the bank surface area which is covered by stable riparian vegetation and their associated roots in a sub-reach. Each bank (right and left) is assessed separately and the value recorded on the record sheet. Banks are assessed from the edge of the water to the top of the first terrace or normal top of bank.

13) Riparian Vegetative Zone Width

Riparian zone with encompasses the area from the top of the normal stream bank outwards into the upland area. The broader the riparian vegetative zone width the more protected the stream banks are from alteration, the fewer pollutants will enter the stream from run-off, and the more available food sources there are to be deposited into the stream from the surrounding forest. Riparian zone width is scored for each bank in a sub-reach according to the following scale:

Score 9-10 = Riparian Zone Width > 18 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 1-2 = Riparian Zone Width < 6 meters

14) Land-Use Stream Impacts

Significant Alteration of the land-uses in the immediate riparian area can have detrimental affects on the stream habitat and biota. Urban and agricultural activities are often considered the more prominent of those land-uses that may impact a stream. These impacts are assessed by indicting a specific land-use impact associated with a sub-reach (on either bank) on the record sheet and assigning a degree of impact score to the land-use. The following land-use categories and impact scoring system are provided:

Land-uses:
C = Cattle,
R = Row Crops,
U = Urban encroachment,
I = Industrial Encroachment, and
O = Other (noted on field form)

Scoring:
0 = no land-use impacts,
1 = minor impacts,
2 = moderate impacts, and
3 = major impacts

Scoring and Analysis of Habitat Assessment Data

Scores from the Semi-Quantitative Habitat Assessment can be utilized in two different ways. First, data collected for each attribute (assessment category) can be used independently to describe the study reach collectively. This method results in information such as: average riffle depth, average pool width, %riffle in entire reach, average bank stability, average (median) substrate size class in pools and riffles, mean %canopy cover, etc. Second, the data collected during the assessment can be used in conjunction with the Qualitative Habitat Assessment procedure to score each of the ten "qualitative" indices with near quantitative accuracy (semi-quantitative). A combination of the two methodologies should be incorporated into all intensive aquatic biota field studies where habitat assessment accuracy and repeatability is critical. The following sections outline the scoring of the qualitative habitat indices using the semi-quantitative data.

High Gradient (riffle-pool stream complexes)

1) Epifaunal Substrate / Available Fish Cover

Average values from semi-quantitative categories 4 (Epifaunal Substrate) and 5 (In-Stream habitat) are combined into an overall average percent coverage and used to score this metric.

The following table presents the scoring criteria:

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Coverage	>70%	40%-70%	20%-39%	<20%
Score	20 -16	15 -11	10 - 6	5 - 1

2) Embeddedness

Reach average percent embedded (from category 7) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Embedded	<25%	25%-50%	49%-75%	>75%
Score	20 -16	15 -11	10 - 6	5 - 1

3) Velocity / Depth Regime

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) along with flow and velocity data collected in the reach is used to score this metric. Use the following table to determine which regimes are present:

Rank	Slow-deep	Slow-shallow	Fast deep	Fast shallow
Velocity	<1 fps	<1 fps	>1 fps	>1 fps
Depth Regime	>1.6 feet	<1.6 feet	>1.6 feet	<1.6 feet
Typical Morphology	Deep pool	Shallow pool	run	riffle

If a reach has deep and shallow pools, and distinctive run and riffle morphology, then you have at least three regimes and possible all four regimes. Score each rank lower if shallow regimes are the missing regimes. Scoring is applied as per the following table.

Rank	Optimal	Sub-Optimal	Marginal	Poor
No. Regimes	Four regimes present	Three regimes present	Two regimes present	One regime present
Score	20 -16	15 -11	10 - 6	5 - 1

4) Channel Alteration

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

5) Sediment Deposition

Reach average percent bottom affected by deposition (from category 8) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Bottom Affected	<5%	5%-30%	31%-50%	>50%
Score	20 -16	15 -11	10 - 6	5 - 1

Utilize the lower end of each scale to represent reaches where recent sediment bar formation is evident.

6) Frequency of Riffles

Using semi-quantitative category 3 (Depth and Width Regime) the average width of the stream is determined as the average of riffle and pool widths combined. Using category 2 (Riffle-Pool Sequence) the distance between riffles can be calculated using the sequencing notations and the morphological lengths. The table presented below should be used to develop scores for this metric.

Example: a reach with an average width of 18 feet, with 4 riffles separated by a 50 foot pool, a 20 foot run, and a 100 foot pool would result in an average distance between riffles of 57 feet. Therefore, the ratio = 57/18 = 3.2 and would rank as Optimal (score @ 18).

Rank	Optimal	Sub-Optimal	Marginal	Poor
Ratio (distance between riffles : stream width)	<7 : 1	7 – 15 : 1	16 -25 : 1	>25 : 1
Score	20 -16	15 -11	10 - 6	5 - 1

In continuous riffle streams the consistent placement of boulders and logs provides scores in the highest range of the optimal category.

7) Channel Flow Status

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

8) Bank Stability

The average bank stability score for each represented bank from the semi-quantitative assessment (category 11) is directly applied to the qualitative assessment scoring for this metric (i.e. an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

9) Vegetative Protection

Reach average percent bank protected (from category 12 of the semi-quantitative record sheet) is used directly to score this metric for the right and left bank.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Protected	>90%	70% - 90%	50% - 69%	<50%
Score	20 -16	15 -11	10 - 6	5 - 1

10) Riparian Vegetative Zone Width

The average riparian zone width score for each represented bank from the semi-quantitative assessment (category 13) is directly applied to the qualitative assessment scoring for this metric (i.e. an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

Alternative Metrics for Low Gradient Streams (pool dominated complexes)

2) Pool Substrate Characterization (replacement for Embeddedness)

Using the Substrate Characterization data from the semi-quantitative assessment (category 6) and the aquatic vegetation assessment (category 9) the following table may be used to score this metric.

Rank	Optimal		Sub-Optimal	Marginal	Poor
Substrate	Cobble or Gravel		Sand/Silt/Clay	Sand/Silt/Clay	Bedrock or Clay Only
Macrophytes Present	Yes	No	Yes	No	No
Score	20 - 18	17 - 16	15 - 11	10 - 6	5 - 1

3) Pool Variability (replacement for Velocity/Depth Regime)

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) are used to help score this metric. Use the following table to determine pool variability.

Pool Characteristic	Large-Deep	Large-Shallow	Small-Deep	Small-Shallow
Size	Length ≥ Width	Length ≥ Width	Length < Width	Length < Width
Depth	≥3.2 feet	< 3.2 feet	≥3.2 feet	< 3.2 feet

An equal balance of all four pool types achieves higher scores. A prevalence of shallow pools scores lower.

6) Channel Sinuosity (replacement for Frequency of Riffles)

This metric is assessed separately from the semi-quantitative data. It can be estimated in the field, measured during a longitudinal survey or calculated from current aerial photographs.

8.0 Qualitative Habitat Assessment (Habitat Potential) SOP

Purpose/Objective

After all other samples and field data have been collected, the field team conducts an overall habitat assessment of the stream, makes a general visual assessment of the stream, and performs a final check of the data forms and samples before leaving the stream site. The habitat assessment protocol used is adapted from EPA's "Rapid Bioassessment Protocols..." (Barbour et al, 1999), and has been refined from various applications across the country. The approach focuses on integrating information from specific parameters on the structure of the physical habitat.

The objective of the visual stream assessment is to record field team observations of catchment and stream characteristics that are useful for data validation, future data interpretation, ecological value assessment, development of associations, and verification of stressor data. The observations and impressions of field teams are extremely valuable. Thus, it is important that these observations about stream characteristics be recorded for future data interpretation and, validation. The assessment form is designed as a template for recording pertinent field observations. It is by no means comprehensive and any additional observations should be recorded in the Comments section of the form.

Based on the perception gained from collecting samples and measurements from throughout the sampling reach, the reach will be classified as either "Riffle/run" or "Pool/glide" prevalent based on visual impressions of the dominant habitat type. The prevalent habitat type will be based on which habitat type occupies the majority of the length of the sampling reach. A different field data form is completed depending upon the prevalent habitat type.

For each prevalent habitat type, ten characteristics (termed "parameters") of habitat are considered and evaluated as part of the rapid habitat assessment. These parameters are described below. Most of the parameters are evaluated similarly for both types of prevalent (Riffle/run and Pool/glide) habitats. In four cases, the same parameter is evaluated differently, or a different, but ecologically equivalent, parameter is evaluated in riffle/run prevalent streams versus pool/glide prevalent streams. Epifaunal substrates are evaluated differently in riffle/run and pool/glide prevalent streams. Substrate embeddedness is evaluated in riffle/run prevalent streams, while pool substrate composition is evaluated in pool/glide prevalent streams. The presence of four potential types of microhabitat types based on combinations of depth and current velocity is evaluated in riffle/run prevalent streams, while the presence of four potential types of pool microhabitat based on depth and area are evaluated in pool/glide prevalent streams. The frequency of riffles is evaluated in riffle/run prevalent streams, while channel sinuosity is evaluated in pool/glide prevalent streams.

Procedure

For each of the ten parameters, rate the overall quality of the sampling reach on a scale of 0 to 20. Scores for each parameter are recorded on the pool/glide or riffle/run version of the Qualitative Habitat Assessment Field Form. If the stream is classified as a pool/glide prevalent stream, record your scores for each parameter on the pool/glide version of the Qualitative Habitat Assessment Field Form. Transfer the scores assigned for each parameter to the box in the left-hand column of the form. Sum the scores for each parameter and record the total score in the box at the bottom of page 2 of the form. Divide the total score by ten to arrive at a reach average score.

The following parameters are used for the evaluation:

1. epifaunal substrate/available cover,
2. (a)embededdness, or
   (b)pool substrate characterization,
3. (a)velocity and depth regimens, or
   (b)pool variability,
4. channel alteration,
5. sediment deposition,
6. (a)frequency of riffles, or
   (b)channel sinuosity,
7. channel flow status,
8. bank stability,
9. vegetative protection, and
10. riparian vegetative zone width.

Each reach will be evaluated by two to four experienced field biologists who ranked each attribute independently and summed them for a total score. The scores were then averaged to produce the overall ranking. Calculated scores placed the reach into a habitat category of optimal (16-20), suboptimal (11-15), marginal (6-10), or poor (1-5). The distinction within the four (4) categories may be subjective. (e.g., a large patch of clear cut logging on a hill overlooking the stream would be rated high within the poor category [a rating of 5] while limited logging activity right on the stream bank would be rated low within the poor category [a rating of 1]). When assessing reach characteristics, the entire sampling reach is considered a third level evaluation.

Complete the assessment form after all other sampling and measurement activities have been completed. Take into account all observations the sampling team has made while at the site. The assessment includes the following components:

Parameter	Description and Rationale
1. Epifaunal Substrate/Available Cover	Essentially the amount of niche space or hard substrates (gravel, cobble) for macroinvertebrate colonization and the amount of available cover (logs, branches) for fish refugia. Numerous types of insect larvae attach themselves to rocks, logs, branches, or other submerged substrates. The greater the variety and number of available niches, and cover the greater the variety of insects and fishes in the stream. Rocky bottom areas are critical for maintaining a healthy variety of insects in most high gradient stream. Woody cover is critical in developing a well-balanced fish community. The abundance, distribution, and quality of substrate and other stable colonizing surfaces and cover (e.g., old logs, snags, and aquatic vegetation) maximize the potential for colonization by fish and insects.
2a. Embeddedness (high gradient)	The extent to which rocks (gravel, cobble, and boulders) are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish for shelter, spawning, and egg incubation is decreased. To estimate the percent of embeddedness, observe the amount of silt or finer sediments overlying and surrounding the rocks. If kicking does not dislodge the rocks or cobble, they may be greatly embedded. It is useful to observe the extent of the dark area on their underside of a few rocks.
2b. Pool Substrate Characterization (low gradient)	Gravel or firm vegetated pool substrates support a wider variety of organisms than a pool substrate dominated by mud or bedrock and no plants. In addition, a stream that has a uniform substrate in its pools will support far fewer types of organisms than a stream that has a variety of substrate types.

3a. Velocity and Depth Regimens (high gradient)	There are four primary current and depth combinations: (1)slow-deep, (2)slow-shallow, (3)fast-deep, and (4)fast-shallow. The best streams in high gradient regions will have all four combinations present. The presence or availability of these four habitats relates to the ability of the stream to provide and maintain a stable aquatic environment. In general use a depth of 0.5 m to separate shallow from deep and a current velocity of 0.3 m/sec to separate fast from slow.
3b. Pool Variability (low gradient)	Rates the overall mixture of pool types found in streams, according to size and depth. The four basic types of pools are large-shallow, large-deep, small-shallow, and small-deep. A stream with many pool types will support a wide variety of aquatic species. Rivers with sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. As a general guideline, consider a pool deep if it is greater than 1 m deep, and large if its length, width, or oblique dimension is greater than half the stream width.
4. Channel Alteration	Basically a measure of large-scale changes in the shape of the stream channel. Many streams in urban and agricultural areas have been straightened, deepened or diverted into concrete channels, often for flood control purposes. Such streams have far fewer natural habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when the stream runs through a concrete channel; when artificial embankments, rip-rap, and other forms of artificial bank stabilization or structures are present; when the stream is very straight for significant distances; when dams and bridges are present; and when other such changes have occurred.

5. Sediment Deposition	The amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of the deposition. Deposition occurs from large-scale movement of sediment caused by watershed erosion. Sediment deposition may cause the formation of islands, point bars (areas of increased deposition usually at the beginning of meanders that increase in size as the channel is diverted toward the outer bank) or shoals or result in the filling of pools. Increased sedimentation also results in increased deposition. Usually this is evident in areas that are obstructed by natural or man-made debris and areas where the stream flow decreases, such as bends. High levels of sediment deposition create an unstable and continually changing environment that becomes unsuitable for many organisms.
6a. Frequency of Riffles (high gradient)	The sequence of riffles occurring in a stream. Riffles are a source of high-quality habitat and diverse fauna; therefore, an increased frequency of occurrence greatly enhances the diversity of the stream community. For areas where riffles are uncommon, a run/bend ratio can be used as a measure of sinuosity. A large degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle the high-energy flows that result from storms than are relatively straight streams.
6b. Channel Sinuosity (low gradient)	Evaluates the meandering or relative frequency of bends of for aquatic organisms, whereas straight stream segments are characterized by monotonous habitats that are prone to flooding. A high degree of sinuosity creates a variety of pools and reduces the energy from surges when the stream flow fluctuates. The absorption of this energy by bends protects the stream from excessive erosion and flooding. In "ox bow" streams of coastal areas and deltas, meanders are highly exaggerated and transient. Natural conditions are shifting channels and bends. Alteration of these streams is usually in the form of flow regulation and diversion.

7. Channel Flow Status	The degree to which the channel is filled with water. The flow status will change as the channel enlarges or as flow decreases as a result of dams and other obstructions, diversions for irrigation, or drought. When water does not cover much of the streambed, the amount of useable substrate for aquatic organisms is limited.
8. Bank Stability	The stream banks are eroded (or have the potential for erosion). Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered to be unstable. Signs of erosion include crumbling, unvegetated banks, exposed tree roots, and exposed soil
9. Vegetative Protection	The amount of the stream bank and near-stream riparian area that is covered by vegetation. The root systems of plants growing on stream banks help hold soil in place, thereby reducing the amount of erosion that is likely to occur. This parameter supplies information on the ability of the bank to resist erosion, as well as some additional information on the uptake of nutrients by the plants, the control on instream scouring, and stream shading. Banks that have full, natural plant growth are better for fish and macroinvertebrates than are banks without vegetative protection or those shored up with concrete or riprap.
10. Riparian Vegetated Zone Width	The width of natural vegetation from the edge of the stream bank (riparian buffer zone). The riparian vegetative zone serves as a buffer zone to pollutants entering a stream from runoff, controls erosion, and provides stream habitat and nutrient input into the stream. A relatively undisturbed riparian zone reflects a healthy stream system; narrow, far less useful riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. The presence of "old fields" (i.e., a previously developed field allowed to convert to natural conditions) will rate higher than fields in continuous or periodic use. Paths and walkways in an otherwise undisturbed riparian zone may be judged to be Inconsequential to destruction of the riparian zone.

9.0 Benthic Macroinvertebrate Protocol SOP

Purpose

Benthic invertebrates inhabit the sediment or live on the bottom substrates of streams. The diversity and the presence of an expected level of benthic community reflects the maintenance of a systems biological integrity. Monitoring these assemblages is useful in assessing the status of the water body and detecting trends in ecological condition. Benthic communities respond to a wide array of stressors in different ways so that it is often possible to determine the type of stress that has affected a macroinvertebrate community (e.g., Klemm et al., 1990). Because many macroinvertebrates have relatively long life cycles of a year or more and are relatively immobile, macroinvertebrate community structure can be a function of present or past conditions. The benthic invertebrate community also reflects the effects of habitat availability, and the long-term exposure to physical and chemical properties of the water in which they develop and live.

The benthic macroinvertebrate protocol is intended to evaluate the biological integrity of wadeable streams for the purpose of detecting stresses on community structure, assessing the relative severity of these stresses, and determine the maintenance of the designated uses. The approach are based on the *Rapid Bioassessment Protocols for Wadeable Streams and Rivers* published by the U.S. Environmental Protection Agency (Barbour, 1999). Variations of the approach is utilized by the U.S. Geological Survey for their National Water-Quality Assessment Program (NAWQA; Cuffney et al., 1993) and by the EPA in their Environmental Monitoring and Assessment Program (EMAP, Lazorchak, 1998). The protocol requires only one person and is the preferred macroinvertebrate collecting method where habitat is variable (a second person can be used for water safety and to keep time and record information on the field forms). The methodology used by GBMc & Associates is a modification of the EPA "Multi-habitat Approach" (Barbour, 1999) designed to better assess pool dominated streams and riffle dominated streams using similar but different collection techniques. The approach can be generally considered a semi-quantitative methodology, in that there is some measure of abundance on a per sample basis and data is comparable to other collections.

Procedure

Pool Dominated Stream/Multihabitat Approach

An aquatic dip net is used to sample all available microhabitats present within the stream reach. Sampling is conducted using kicking, jabbing, and sweeping techniques. Kicking involves placing the net on the substrate and kicking the substrate upstream of the net allowing the dislodged invertebrates and debris to float into the net. Jabbing involves quick jabs of the net into submerged or exposed habitat types (macrophytes, root wads, branches, etc.) in an effort to dislodge invertebrates for capture. Sweeping entails sweeping the net through or above a habitat type to dislodge and capture invertebrates. Sweeping is often done above sandy and silty areas and root wads so as to capture as little debris as possible but still dislodge organisms. Sampling effort is timed on a stopwatch for a total of three minutes. Only time actually spent kicking, jabbing, or sweeping is allowed to accrue on the timer. The net is periodically emptied into a bucket for transport of the sample up and down the stream reach.

Riffle Dominated Stream

An aquatic dip net (generally the rectangular sort at least 16" wide) is used to sample the riffle habitat in a stream. The net is placed on the stream bottom and the substrate upstream of the net is vigorously kicked by the sampler to dislodge invertebrates allowing them to drift into the net. Sampling is conducted in this manner at different riffle locations throughout the study reach for a total kick time of 5 minutes. It may be useful to sweep the net through the dislodged and drifting debris in an effort to pick up as many invertebrates as possible. Kick time is monitored with a stop watch allowing time to accrue only during kicking and subsequent drift time. The net contents are placed in a bucket for holding after each riffle sample is collected.

Sample Processing

After collection, samples are initially sorted and concentrated using a series of U.S. standard sieves the smallest of which has a #30 mesh with an opening size of 600µm. Random sub-samples of the concentrated sample will be placed on a white sorting tray from which the macroinvertebrates will be removed. A 100 organism sub-sample will be randomly picked from the tray and field identified to the lowest possible taxon. A representative amount of the concentrated sample is picked to be sure that each type of debris (i.e. leafs, algal mats, sediment, etc.) have been checked for macroinvertebrates. The 100 organism sub-samples will be preserved in Kaylee's Solution (a fixative, 15 pts. ethanol, 6 pts. formalin, 1 pt. glacial acetic acid, 30 pts. deionized water) or 70% ethanol for lab verification of field identifications and as a voucher to be used if more detailed analysis becomes necessary. If the sample is placed in Kaylee's solution it is removed and placed in 70% ethanol within 7-days. Each sample is labeled inside with a waterproof label and outside with laboratory tape containing the following information:

- station I.D.,
- location (waterbody, county, state),
- project number,
- date/time,
- initials of collector, and
- collection method/duration.

After the 100 organism random sample is collected, labeled and preserved, the larger debris items (e.g. leaves, sticks, rocks etc.) in the collected sample will be examined for clinging benthic macroinvertebrates. Any organisms will be removed prior to the debris being discarded. The remainder of the original sample not utilized in the selection of the 100-organism sub-sample will be concentrated and retained as a voucher for the sample picking (sub-sampling) techniques used. The voucher samples will be preserved in either Kaylee's Solution or 70 % ethanol. Voucher samples will be held at GBM^c for a period of 24 months, from the conclusion of the study at which time the samples may be submitted to an academic zoological collection.

For each study site, a complete tabulation of taxa, numbers of individuals and their percent composition will be included on the Benthic Macroinvertebrates Field Data Form (attached). The first page of the form will include general information identifying the sample reach and investigators as well as site observations to include:

1. time sampled,
2. relative abundance of aquatic trophic level communities (periphyton, macrophytes, etc.),
3. percent of major habitats sampled,
4. percent of specific microhabitats sampled, and
5. relative abundance of the ordinal groups observed during sample collection.

The second page provides for the listing of the taxa comprising the 100 organism sub-sample and the field identifications and the numbers of each. Also included on page 2 are the general reach identifiers and preliminary summary sections to be used in the application of selected biometric scoring criteria.

All macroinvertebrate identifications shall be verified in the laboratory by experienced invertebrate biologists. Laboratory verification will be accomplished using general keys including but not limited to Merritt & Cummings, (1996); and Pennak, (1989). In addition more taxa specific keys such as Mayflies of North and Central America (Edmunds et, al, 1976), Dragonflies of North America, (Needham & Westfall, 1975) or species specific keys developed for a state or region will be utilized for the laboratory verification of the field identifications.

Community Biometric Analysis

The qualitative samples are used to taxonomically characterize the aquatic community, identify indicator taxa and determine relative abundance of taxa and ecological types. The macroinvertebrate assemblages from each station are analyzed according to several benthic community biometrics. These will include richness (number of different taxa), EPT richness (number of different taxa represented in the orders Ephemeroptera, Plecoptera, and Trichoptera), percentage of dominant ordinal groups, species diversity as determined by the Shannon-Wiener diversity Index, and functional feeding group assessment. The analysis may also include the seven biometrics used by the State of Arkansas (ADPC&E, 1988) in their RBA scoring system, as well as other state specific biotic indexes. The biometric scoring activity will indicate the impacts to a benthic community when compared to the benthic community of different reaches, to demonstrate effects of point and or non-point source contributions between reaches.

Alternative Sampling and Processing Methodologies

An alternative processing technique may be used for the macroinvertebrate samples collected using the preceding RBA protocols. This technique involves concentrating the entire sample in the field and preserving it for transport to the laboratory. No on-site picking occurs. Once in the lab the sample is further concentrated and sorted to size using standard sieves. The sample is then placed into white sorting trays. Every macroinvertebrate in the sample is picked out and placed in a sample container. Once the entire sample has been picked and all organisms are in a single container the macroinvertebrates are poured onto a gridded and numbered sorting tray and swirled to distribute them randomly and as evenly as possible throughout the tray. Random numbers are then drawn that correspond to a given grid. All of the macroinvertebrates found in that grid are then removed and tallied. This process continues until a sample of sufficient size has been achieved, usually 100, 200, or 300 macroinvertebrates. The final sample size is dependant on the level of random error that is acceptable in the study. The macroinvertebrates are then identified to the lowest taxonomic level possible and the assemblage is analyzed as outlined above.

In addition to the semi-quantitative sampling protocols described in the preceding sections other semi-quantitative and quantitative methodology may be utilized where circumstances require a more detailed and precise assessment of the macroinvertebrate community. Quantitative and semi-quantitative protocols utilize sampling devices where a known area of substrate is sampled (i.e. 1.0 ft^2, 0.1 m^2, etc.) such as with a Surber Sampler or a Hester-Dendy , respectively. Quantitative techniques require processing of the entire sample collected to remove all macroinvertebrates captured. Macroinvertebrates are identified to the lowest possible taxonomic level, enumerated, and calculations of density per unit area are completed at varying taxonomic levels. Biometric analysis can then be completed using the same metrics as in the semi-quantitative assessment.

Quality Control

Field teams collecting macroinvertebrates are led by experienced aquatic biologists and ecologists. Field forms designed specifically for macroinvertebrate collection studies and set up to include all pertinent field data are completed for each sample site. All field forms are reviewed at the end of the study for completeness and accuracy. Identification of macroinvertebrates is verified in the laboratory by an experienced invertebrate biologist. Periodic spot checks to verify laboratory identifications are made by a qualified biologist on the team. Efforts are made to remain abreast of current research in macroinvertebrate biology and identification techniques through scientific journals and conferences. In addition, EPA document updates and new information on macroinvertebrate community assessment is tracked via the internet.

Macroinvertebrate duplicate samples are collected at one of ten study sites. In years where less than ten sites are sampled a minimum of one duplicate sample should be collected at a given site. Duplicate samples are treated the same way as the base sample for processing and identification. A similarity index is calculated for the duplicate and base samples. Index results indicating similarity less than 65% are considered out of control. In the case of an "out of control" condition the organism identifications will be assessed as will the collection techniques. Corrective action will be determined by the project manager and/or the senior biologist and could include adjustments to techniques or a re-sampling of the sites in question.

10.0 Fish Collection Protocol SOP

Purpose/Objective

The fish community supported in a stream is in direct response to available habitat, food sources, and water quality of that particular stream. The presence of a certain level of species richness and diversity along with a community structure similar to that expected in typical streams of a ecoregion are indicators of aquatic ecosystem health.

The objective of the fish community characterization is to collect and identify a representative sample of all except very rare species in the assemblage reflective of the relative abundance within the community. Backpack electrofishing equipment is used as the principal sampling gear supplemented by block netting and seining in habitats where flow, substrate and structure affect the capture of fish species. Other methods of fish sampling may be implemented when conditions are not adequate for backpack eletrofishing or seining; these may include, using boat electrofishing equipment and/or hook and line sampling equipment. Usually 2 – 4 team members will make up the sampling team involved in collecting the aquatic vertebrates.

Major factors that influence collecting include flows, water depth, in-stream obstructions, water turbidity, temperature and conductivity. The primary tool utilized in the fish collections will be a Smith-Root backpack electroshocker. However, seines and block nets may be utilized as necessary to adequately characterize a sampling reach. The shocker is equipped with an automated timing mechanism which records the amount of time that electricity is actually being applied, or "pedal down time" (PDT).

Sampling fish species to determine their proportionate abundance will be conducted after all water quality parameters and/or samples are collected but prior to the collection of the macroinvertebrate sample and habitat data.

Shocked fish were captured with hand held dip nets and held in buckets while the sampling continued. The entire stream width within the sampling reach will be sampled. PDT time will continue for not less than 30 minutes unless the wetted habitat of any reach limits the PDT. In addition to the PDT, the total collection time will be recorded.

Unless specified in a project specific sampling analysis plan (SAP), there will not be a maximum time limit for the collection period, however the collections may be terminated when in the opinion of the principal investigator determines that a representative collection has been obtained. Sampling information is recorded on the Fish Community Collection Form, general comments (perceived fishing efficiency, missed fish, and gear operation suggestions) will be recorded on the lines provided on this form.

An effort to search for and collect fish will be completed at all targeted reaches, even if the stream is extremely small, and it appears that sampling may not collect any specimens. If no specimens are collected, complete the "NONE COLLECTED" field on the Fish Collection Form. Provide an explanation in the comments section of the form.

Procedure

Electroshocking

The procedure to sample with the backpack electrofisher unit is presented below:

Initially a decision will have to be made on what type of current to be used, alternating current (AC) or direct current (DC). AC flows from the anode and the cathode with an alternating direction of current flow. This alternating flow of current causes the fish to have strong muscle contractions, resulting in immobilization. AC has the highest electrofishing sucsess rate but also poses the highest risk of permanent injury to the fish (particularly to larger specimens). DC is the direct flow of electrical current from the cathode to the anode. DC causes the fishes muscles to contract in such a way that the fish swim towards the anode probe. Muscle contractions occur until the fish is so close to the probe that the higher level of electricity stuns the fish. DC pulse length and duration can be adjusted with the shocking unit mode switches to more efficiently apply electricity that will draw fish to the probe without causing injury.

Make sure that the unit is full of properly mixed gas and oil (100:1), attach cathode (cable tail that drags behind operator, and anode (actual shocking probe with thumb switch to control electricity current)

Select the initial voltage based on the measured conductivity of the stream. For high conductivity water (300 - 1200 μS) use a voltage setting of 100 - 400 volts. For medium conductivity water (100 – 300 μS) use a voltage setting of 500 - 800 volts. For low conductivity water (10 – 100 μS) use a voltage setting of 900 - 1100 volts.

Select the initial frequency and/or wavelength based on the expected size of fish. Find a setting, using the number dial (1 – 16) and the letter dial (A – P), that will allow you to have maximum amperage output without overloading the unit, typically 0.7 – 1.9 amps. Start with a setting of I-6 and adjust letters then numbers to find your setting. A higher mode setting provides more amperage as does a higher voltage setting. Typical setting used by GBMc & Associates are I (5-7) and J (5-7) at a voltage of 100-300 volts.

Record the latitude and longitude of the starting location and the starting time for electrofishing. Start the electrofisher, place the generator on the 300VA position for full generator output, set the timer to zero, and depress the switch to begin fishing. Starting at the bottom of the reach, fish in an upstream direction. **Adjust voltage and waveform output according to sampling effectiveness and incidental mortality to specimens.** The backpack unit is equipped with an audio alarm that sounds when the output voltage exceeds 30 V. It also serves as an input current indicator for pulse cycles greater than 5Hz. It begins as a strong continuous tone and begins to beep slowly at currents of 1.25 amps. It beeps faster as input current increases. In case of an overload (in excess of 3 amps), the beep becomes very rapid and the overload indicator comes on. Release the anode switch and adjust voltage and waveform and continue fishing.

When fishing, slowly sweep the anode wand from side to side in the water in riffles and pools. Sample available cut-bank and snag habitat areas as well as riffles and pools. Move the wand in and out of large snags or deep cuts or release the electrode switch, move the wand away slightly, depress the switch again and sweep the wand away from the cover to draw fish out into open. In fast, shallow water, it may be more effective to use a seine or a couple of handheld nets as a block net; sweep the anode and fish downstream into the net.

In streams wider than can be effectively sampled during a single pass (generally 5 ft or more), it may be necessary to work from the midline of the stream channel to the banks. Be sure that deep, shallow, fast, slow, complex, and simple habitats are all sampled. In stretches with deep pools, fish the margins of the pool as much as possible, being extremely careful not to step into deep water.

One or two netters follow along beside or slightly behind the person operating the electrofisher (on the anode side). Each netter uses an insulated dip net to retrieve stunned individual fish, which are then deposited into a bucket carried by one of the netters for later processing

At the completion of electrofishing, note the PDT, total sampling time, the total distance sampled, and information obtained while sampling. Record this information on the Fish Collection Form or in a team member's field notebook.

Electrofishing Precautions

Because fishes and amphibians are collected using portable electrofishing units, safety procedures must be followed meticulously at all times. Primary responsibility for safety while electrofishing rests with the principal investigator. Electrofishing units have a high voltage output and may deliver a dangerous electrical shock. While electrofishing, avoid contact with the water unless sufficiently insulated against electrical shock. Use chest waders and rubber gloves to prevent the chance of electric shock
Avoid contact with the anode and cathode at all times due to the potential shock hazard. While electrofishing avoid reaching into the water. If it is necessary for a team member to reach into the water to pick up a fish or something that has been dropped, do so only after the electrical current has been interrupted and the anode is removed from the water. Do not resume electrofishing until all individuals are clear of the electroshock hazard. The electrofishing equipment is equipped with a 45° tilt switch that interrupts the current and may shut off the unit completely in the event the person carrying the unit falls. Do not make any modifications to the electrofishing unit that would bypass the unit's automatic shutoff features.

Electrofishing equipment will not be utilized near unprotected people, pets, or livestock. Activity will be discontinued during thunderstorms or heavy rain.

Seining

Seining may be used in conjunction with electrofishing to ensure sampling of those species which may otherwise be under presented by an electrofishing survey alone (e.g., darters, madtoms, and benthic cyprinids). Seining may also be used in sites where the stream is too deep for electrofishing to be conducted safely or in turbid, simple, soft-bottomed streams where it is more effective.

Depending on the particular use (block netting vs. active seining) and the habitat, different sizes of seines are used. In riffle habitats, the seine is held stationary while team members disturb the substrate immediately upstream of the net. In pools, the seine is pulled back and forth across the pool, using the shore and other natural habitat breaks as barriers, or pulled rapidly downstream through the pool and then swept toward the shore. Block nets may be used in very large pools to limit escape or as seines. Large nets are typically deployed parallel to the current and swept to shore.

Proceed upstream through the reach, allocating the seining effort among habitat areas (riffles and pools) so that the entire reach is sampled. Deposit fish collected by seining into a bucket for later processing. It is not necessary to segregate the fish collected via electroshocking or seining. However the number of seine hauls and the time expanded in seining will be recorded on the Fish Field Data Sheet. At the completion of sampling activities (electrofishing and/or seining), record the total fishing time on the Fish Field Data Sheets.

Sample Processing

Sample processing involves tallying and identifying fish, examining individual specimens for external anomalies, preparing voucher specimens for taxonomic confirmation and archival at GBM^c.

Unless otherwise specified in a project specific SAP, at the end of each sampling effort fish from the entire reach are preserved in formalin for identification in the lab. For each study site, a complete tabulation of taxa, numbers of individuals and their percent composition will be included on the 2 page Field Data Sheets – Fish (attached). The first page of the 2-page data form will include general information identifying the sample reach and investigators as well as site observations to include:

time sampled,
pedal down time (PDT),
relative abundance of aquatic trophic level communities,
percent of major habitats sampled,
percent of specific microhabitats sampled, and
relative abundance and scoring of substrate.

The second page provides for the listing of the taxa (field identification) and the numbers of each. Also included on page 2 are the general reach identifiers.
Ultimately, the fish identification will be verified in the lab using keys in the Fishes of Arkansas (Robison, 1988) and the Fishes of Missouri (Pflieger, 1975) to species level where possible.

The fish collections at each reach will be compared according to several biometrics which may include: species richness (number of taxa); sunfish richness; species diversity; abundance; dominant ordinal groups; percent of tolerant species; trophic structure; percent of hybrids; and percent of diseased fish. The analysis may also include the eight biometrics used by the State of Arkansas in their RBA scoring system. This scoring system places a value of 0, 2, or 4 on each of the eight biometrics to achieve a final mean score. The final mean score (0 to 32, 0-8=not supporting, 9-16=impaired, 17-24=generally supporting, 25-32=fully supporting) will indicate the impacts to a fish community when compared to the fish community of different reaches, to demonstrate effects of point and or non-point source contributions between reaches.

Sample Maintenance

At the conclusion of all identifications, all fish collections are placed in 40% - 50% isopropyl alcohol for permanent preservation. The fish collections are maintained at GBMc & Associates for a period of three years after the completion of the project. An archive list of all fish collections is on file at GBMc & Associates. After the three year time period is up preserved fish may be offered to a scholastic institution or museum, discarded in an appropriate manner, or remain in storage at GBMc & Associates.

Quality Control

Field teams collecting fish are led by experienced aquatic biologists. A team of qualified personnel using proven sampling techniques makes field collections. Sampling equipment is routinely inspected to maintain and ensure proper working order prior to a sampling trip. Adjustment in the field to the equipment and/or techniques can be made in the field by the sampling team to improve the collection results. All aspects of the fish collection are documented in team members' personal field books, as well as specific field forms. The field forms are designed specifically for fish collection studies and are set up to include all pertinent field data. Field forms are completed for each sample site. All field forms are reviewed at the end of the study for completeness and accuracy.

Identification of the collected fish starts in the field and is conducted by one or more experienced aquatic biologists that were involved in the collection effort. Field identifications are later verified in the laboratory by an experienced aquatic biologist. Laboratory identifications are then confirmed by a senior biologist to ensure completeness and accuracy. Efforts are made to remain abreast of current research in fisheries biology and identification techniques through scientific journals and conferences. In addition, EPA document updates and new information on fish assessment is tracked via the internet.

12.0 Sample Collection and Custody

Purpose

This SOP describes the materials and methods necessary for the routine collection of water and wastewater samples for the analysis of various conventional and unconventional pollutants. It also gives guidance for the completion of the COC forms necessary for each set of samples collected for laboratory analysis. This SOP provides general guidance and should not be substituted for a study specific work plan and/or Sampling and Analysis Plan.

Procedures

Sample Collection

1. Fill out an Equipment Checklist for each sampling trip, checking (✓) all the necessary gear for sample completion.

2. Clean sample bottles should be supplied by the laboratory or a reputable scientific supply company. Be sure to have an extra set of sample bottles on hand on each field trip.

3. Check all bottles prepared by the lab to ensure the proper analyses are covered with the correct type of preservation. (Table 1)

4. A duplicate sample for a given analyte shall be taken, 1 for every 10 samples collected. That is, a duplicate sample will be collected 10% of the time. A duplicate sample is simply a second sample taken from the same location immediately following the original sample. The duplicate sample serves as a quality control check for the sample sources (stream water, etc.) variability, and the sampling methodology repeatability.

5. A field blank shall be collected 10% of the time (1 in 10 samples) when metals or organic chemicals are being analyzed. A field blank is simply a sample bottle filled with deionized water (blank water) on-site at the study location to represent any potential contamination present at the site or in the sampling techniques.

6. A trip blank should be collected at the rate of 1 per 10 samples when metals or organic chemicals are being analyzed. A trip blank is a bottle filled in the lab with deionized water to verify blank water and sample bottle purity.

7. Use appropriate safety precautions while collecting the samples (i.e., wear latex gloves, Tyvek® suits, etc.) as necessary.

8. Place a label on the sample bottle, prior to collecting the samples, and record the following information on the label using a permanent marker (e.g., Sharpie®):

   a. sample identification,
   b. date of collection,
   c. time of collection,
   d. initials of collectors, and

    e. parameters to be analyzed (NH_3-N, Total Cu, etc.)

9. Fill one bottle per site completely, and place the cap securely on the bottle.

   When filling sample bottles be sure to choose a representative sample location which is accessible in a manner as to prevent bottom and/or attached solid materials from entering the sample bottle. Samples should be taken in flowing water where possible. Samples should be taken from below the water surface if depth allows.

10. Place the bottle in an ice filled ice chest to keep the sample cool (4°C±2). If the ice chest(s) will be shipped to a laboratory, ice should be placed in a plastic bag(s) to prevent possible sample contamination from melting.

11. Record sample information on the Field Data Form or in a field notebook, along with any pertinent observations. If available, record instantaneous flow at the time of sample collection. This is important if the samples are from an NPDES discharge or other regulatory monitored system.

12. If samples are to be composited according to flow (flow-weighted) the following protoccol should be followed:

    a) record a flow for each sample time on the COC form
    b) include compositing instructions on the COC form for laboratory use

13. Measure any necessary in-situ parameters (pH, temperature, dissolved oxygen, specific conductivity) and record on the appropriate field form or in a field notebook.

14. When sampling is complete a COC form should be completed.

15. Take note of sample holding times (Table 1) and make an effort to return samples to lab as soon as possible.

Chain of Custody (COC)

1. A COC form (attached) must be filled out for all samples submitted to the laboratory for analysis.

2. The COC form must be filled out with a ballpoint pen, and signed in the appropriate locations by each individual receiving the sample(s).

3. The following information ***must be completed*** on each COC form:

    a. company/facility,
    b. contact name,
    c. address,
    d. phone number,
    e. sample id,
    f. sample description (where taken),
    g. date (from sample bottle),
    h. time (from sample bottle),

i. number of containers,
j. preservative,
k. parameters to analyze at lab,
l. sampler(s),
m. shipment method,
n. turnaround time required,
o. coc form completed by,
p. coc form checked by, and
q. relinquished by.

4. Each completed COC form shall be photocopied and the copy filed.

5. If shipping ice chests to a laboratory, the original COC form should be placed in a ziplock bag and then taped to the inside top of the ice chest for shipment.

6. At the lab the COC form will be received and signed. A copy of the COC form should be returned by the lab, along with the analysis results, when completed.

14.0 Turbidity Meter Calibration SOP

Purpose

This SOP describes the methods for calibration and use of the portable HACH Model 2100P Turbidimeter.

Calibration

Procedure

1. Prepare formazin 20, 100, and 800 NTU calibration dilutions immediately before calibrating. The solutions are made with a well mixed 4000 NTU stock solution and high quality dilution water (<0.5 NTU) as follows:

   Dilution water--Deionized water. The deionized water should have a turbidity reading <0.5 NTU.

   20 NTU--Add 0.5 mL stock solution to a 100 mL volumetric flask and bring to volume.
   100 NTU--Add 2.5 mL stock solution to a 100 mL volumetric flask and bring to volume.
   800 NTU--Add 20 mL stock solution to a 100mL volumetric flask and bring to volume.
   (The 4000 NTU solution is stable for up to a year, but dilutions deteriorate more rapidly.)

2. Use the same sample cuvette for each different dilution reading. Rinse the clean cuvette with dilution water three times; then fill to the line with dilution water.

3. Place the instrument on a flat surface. Then insert the sample cuvette into the cuvette compartment with the orientation mark on the cuvette aligned with the mark on the front of the compartment. Close the lid and press I/O.

4. Turn the signal average off by pressing the Signal Average key until off is indicated. Then press calibrate (CAL). CAL and S0 should be displayed on the screen along with the value for the S0 standard for the last calibration.

5. Press READ. After the count down is completed, the blank value will be displayed, then the display will advance to the next standard. Remove the sample cuvette. (In case of error, refer to manual.)

6. S1 and 20 NTU will be displayed on the screen.

7. Rinse the sample cuvette 3 times with the well mixed, 20 NTU standard. Then fill the cuvette to the line with the 20 NTU standard.

8. Clean the outside of the cuvette with a soft, lint-free cloth removing water spots and fingerprints. Then apply a thin film of silicone oil and spread the oil evenly over the outside surface with a soft cloth.

9. Insert the sample cuvette into the cuvette compartment with the orientation mark on the cuvette aligned with the mark on the front of the compartment.

10. Close the lid and press READ. After the count down is completed, the standard value will be displayed, then the display will advance to the next standard. Remove the sample cuvette.

11. Repeat steps 6 through 10 for the S2 and S3 samples (100 and 800 NTU, respectively.)

12. After S3 has been read, the display will show S0. Remove the sample cuvette. Press CAL to accept the calibration.

13. Once the calibration has been accepted, the instrument will automatically proceed to measurement mode.

    (If any errors occur during calibration, revert to manual for explanation.)

Calibration Verification

The 2100P Turbidimeter does not require calibration before every measurement. Gelex® Standards are used for routine calibration checks. Routine calibration checks should be performed bi-monthly. If the Gelex® standards read more than 5% from their recorded value, the meter should be recalibrated.

Procedure

Assigning values to the Gelex® standards

1. Calibrate the meter as described above.

2. Select the automatic range mode using the RANGE key.

3. Turn the signal average off by pressing the SIGNAL AVERAGE key until SIG AVG is not displayed on the screen.

4. Clean the outside of the Gelex® vile with a soft, lint-free cloth removing water spots and fingerprints. Then apply a thin film of silicone oil and spread the oil evenly over the outside surface with a soft cloth.

5. Insert the 0-10 NTU Gelex® standard into the cuvette compartment with the orientation mark on the vile aligned with the mark on the front of the compartment. Close the compartment lid.

6. Press READ and record the displayed value after the lamp signal is no longer displayed on the screen.

7. Remove the vile and mark the value on the band near the top of the vile with a permanent marker.

8. Repeat steps 3 through 6 for the other Gelex® standards.

9. The values for each Gelex® standard should be reassigned each time a new calibration is performed.

Checking meter calibration

1. The Gelex® standards should be used as a routine check for instrument calibration. If the standards do not read within 5% of the assigned value, the instrument should be recalibrated before use, and new values assigned to the Gelex® standards.

2. Place the instrument on a flat surface.

3. After turning the instrument on, select the automatic range mode using the RANGE key.

4. Turn the signal average off by pressing the SIGNAL AVERAGE key until SIG AVG is not displayed on the screen.

5. Clean the outside of the Gelex® vile with a soft, lint-free cloth removing water spots and fingerprints. Then apply a thin film of silicone oil and spread the oil evenly over the outside surface with a soft cloth.

6. Insert the 0-10 NTU Gelex® standard into the cuvette compartment with the orientation mark on the vile aligned with the mark on the front of the compartment. Close the compartment lid.

7. Press READ and record the displayed value after the lamp signal is no longer displayed on the screen.

8. Remove the vile and compare the value on the band near the top of the vile with the recorded value. If the recorded value is within 5% of the value marked on the vile, continue to step 8. Otherwise recalibrate the instrument.

9. Repeat steps 3 through 6 for the other Gelex® standards.

Turbidity Measurements

Procedure

1. Collect a representative sample of the liquid to be analyzed in a clean container. Rinse the clean sample cuvette three times with the sample water and fill to the line with sample, taking care to prevent the formation of air bubbles and not leave fingerprints on the sides of the cuvette.

2. Clean the outside of the cuvette with a soft, lint-free cloth removing water spots and fingerprints. Then apply a thin film of silicone oil and spread the oil evenly over the outside surface with a soft cloth.

3. Place the instrument on a flat surface and turn it on by pressing I/O.

4. Insert the sample cuvette into the cuvette compartment with the orientation mark on the cuvette aligned with the mark on the front of the compartment and close the lid.

5. Select automatic range by pressing the RANGE key until AUTO RNG is displayed.

6. Turn the signal average off by pressing the SIGNAL AVERAGE key until SIG AVG is not displayed on the screen.

7. Press READ and record the turbidity value after the lamp symbol is no longer displayed on the screen.

Meter Maintenance/Storage

1. Store the meter in the designated portable carrying case.

2. The meter should not be stored or left in a "dirty" condition.

3. The sample cuvette, silicone oil, and Gelex® standards should be stored in clean state in the proper boxes in the portable carrying case.

4. The 4000 NTU stock solution should be stored in a refrigerator at 5^0 C.

Quality Assurance/Quality Control

1. Meters are calibrated biweekly (at a minimum) to ensure proper function and accuracy.

2. Duplicate measurements should be taken at a rate of 10% (minimum) of samples analyzed.

Page ____ of ______

Field Data Form

FIELD MEASUREMENT RECORD (Date__________________) **REVIEWED BY:__________________**

Station/Depth	Date	Time	Field Crew	Temp C°	DO mg/l	Sp. Cond. uS	pH su	Sample # of Containers		Notes
								S=Sed.	W=Wat.	

* Indicates calibration check was made

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Calibration Field Form

Dissolved Oxygen Meter Air Calibration Record

Date/Time:	Calibrators Initials:	Meter:	100 % Air Saturation (mg/l)	Altitude (ft)	Barometric Pressure (mm Hg)	Comments:

pH Meter Calibration Record

Date/Time:	Calibrators Initials:	Meter:	Standard (4, 7, 10):	Slope:	7.00 Buffer Check	Comments:

Conductivity Meter Calibration Record

Date/Time:	Calibrators Initials :	Meter:	Standard:	Meter Cond:	Comments:

Turbidity Meter Calibration Record

Date/Time:	Calibrators Initials :	Meter:	Gel Standard:			Meter Reading			Comments:
			0-10	0-100	0-1000	0-10	0-100	0-1000	

Temperature Meter Calibration Record

Date/Time:	Calibrators Initials:	Meter:	Thermometer Temperature °C:	Meter Temperature °C:	Comments:

FIELD EQUIPMENT CHECKLIST

Project No:_______________ **Crew:**____________________

Field Instruments

_____ Battery Charger
_____ D.O. Meter (calibration kit, batts)
_____ D.O. Water Saturation Kit (air pump, tubing, jar)
_____ pH Meter (stds, bottle batts)
_____ Conductivity Meter (batteries)
_____ Depth (chart, probe, batts)
_____ Hach Kit (batts, methods, chems, stds)
_____ Flow (batts, meter, rod, calc, forms, waders, tape/tag line)
_____ Isco (instruments, bottles, batts, tubing, strainers, clamps)
_____ Turbidity Meter/Kit
_____ Range finder
_____ GPS

Miscellaneous

_____ Cash advance
_____ Credit card
_____ Pens
_____ Camera/film
_____ Small recorder
_____ Rubber boots
_____ Waders
_____ Rain suits
_____ Flashlight
_____ Knife, scissors
_____ Tape measure(s)
_____ Rope
_____ Tool box
_____ Backpack
_____ Wash bottles
_____ Crest gages
_____ Alconox/brush
_____ Trash bags
_____ Duct tape
_____ 5 gal. Bottle
_____ DI/tap water
_____ Flagging
_____ Keys (gate, gage, etc.)
_____ Extra vehicle key

Aquatic Life Surveys

_____ Tag line/Tape measure (Habitat)
_____ Aquatic Dip net
_____ Seine
_____ Fish nets
_____ Containers
_____ Preservative (alcohol, Kaylees, formaldehyde)
_____ Sieves
_____ Sorting trays (picking, gridded)
_____ Forceps
_____ Electroshocker (pig tail, extra probe, extra conductors, rubber gloves, generator gas/mix, spark plugs)

Ground Water Sample Collection

_____ Water level indicator
_____ Pumps/batteries
_____ Tubing
_____ Turbidmeter
_____ Bailers (disp./other)
_____ Hexane
_____ Field forms
_____ 0.45 µm Filter apparatus
_____ Water level detector

Boat Usage

_____ Life jackets
_____ Paddles
_____ Boat cushions
_____ Anchor
_____ Motor battery
_____ Motor oil
_____ Gas tanks
_____ Trolling motor
_____ Depth finder (graph)
_____ Spare tire

Field Forms/Documentation

_____ Field forms - Habitat
_____ Field forms - Fish/Bugs
_____ Field forms - Chemistry
_____ Field log book
_____ COC forms
_____ Ziplock bags
_____ Maps
_____ Sampling plan
_____ Pens/pencils
_____ Clipboards

Safety

_____ Hard hats
_____ Safety glasses
_____ Face shields
_____ Eye wash bottle
_____ Gloves
_____ Steel toe boots
_____ Hazcomm materials
_____ Tyvex suits
_____ Sun protection
_____ Bug spray
_____ Water, drinks
_____ Soap, alcohol, bandages
_____ 2-way radios

Sample Collection (General)

_____ Sample bottles
_____ Extra sample bottles
_____ Sharpies, pens
_____ Clear tape/dispenser
_____ Bucket(s)/rope
_____ Ice chests/ice
_____ Horizontal water bottle
_____ Sediment spoons/bowls
_____ Dredge (hoist)
_____ Core sampler (handle, extensions, body, tips, cap, slip wrench, sleeves/caps)
_____ DI water
_____ Extra labels
_____ Decon. Equipment

Wetlands Delineation

_____ Soil Probe
_____ Spade/shovel
_____ α,α-dipyridal
_____ Plant press
_____ Plant field books
_____ ACOE Data Forms
_____ Wetland Assessment Forms
_____ Munsell soil color charts
_____ Machete
_____ Magnifier loop

Hydraulic Studies

_____ Rhodamine WT dye
_____ Fluorometer/accessories
_____ Power inverter
_____ Auto samplers/batteries, bottles
_____ Sample vials
_____ 5 gal. glass container
_____ Graduated cylinder
_____ Dye standards
_____ Labeling tape
_____ Pipettes
_____ Beakers (600 mL)
_____ Water level Loggers
_____ Logger Data Retrieval (Palm / laptop)
_____ PVC Pipe for Installations
_____ Mounting Anchors
_____ Logger Manuals

Lake Studies

_____ Horizontal Water Bottle
_____ Secchi Disk
_____ Chlorophyll a equipment (filter, membrane filters, flask, graduated cylinder, MgCO3, pipettes, aspirator, aluminum foil)
_____ Whirl Paks
_____ Plankton Net
_____ 3% Formalin
_____ Macrophyte Gear

V1.2-08/04

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D:
LOCATION:
STREAM NAME:
RIVER BASIN:
LAT: **LONG:**
PROJECT:
INVESTIGATORS:
DATE/TIME:
FORM CHECKED BY:

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__%☐	% cloud cover	☐_____%
☐	clear/sunny	☐

Heavy rain in the last 7 days? ☐ Yes ☐ No
Air Temperature___________°C/°F
Other________________________

STREAM ATTRIBUTES

Stream Subsystem
☐ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☐ Mixture of origins
☐ Swamp and bog ☐ Other _______________

Catchment Area: _________mi^2
Stream Order: ___________

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☐ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☐ Low ☐ None

Flows Measured?
☐ Yes ☐ No

Reach: Slope & Sinuosity
________ft/mi ________

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ____% ☐ Sub-Urban
☐ Pasture ____% ☐ Commercial____%
☐ Row Crops ____% ☐ Industrial ____%
☐ Urban ____% ☐ Other _______________%

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☐ Mature Forest ____% ☐ Shrub/Sapling ____% ☐ Herbs/Grasses ____% ☐ Turf ____%

STREAM MORPHOLOGY

☐ Riffle ______% ☐ Run ______% ☐ Pool ______%

STREAM DISTURBANCES

☐ Roads ☐ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other ______________

Channelized: ☐ Yes ☐ Some ☐ No
Local Watershed Erosion: ☐ None ☐ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☐ Degrading ☐ Widening ☐ Headcutting

WATER/ OBSERVATIONS

Water Odors
☐ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other___________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☐ None ☐ Other___________

Turbidity/Water Clarity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_____________

SEDIMENT/ OBSERVATIONS

Sediment Odor
☐ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other_________________

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☐ Sand ☐ Relict shells
☐ Other__________________

Quantitative Habitat Characterization Field Form

Station I.D:		**Transect # (circle):** 1 2 3 4 5 - (6 7 8 9 10)
Stream Name:	**Client:**	**Date/Time:**
Location:	**Investigators:**	**Reason For Survey:**
Lat: **Long:**	**Form Completed By:**	**Form Checked By (date/time):**

Stream Morphological Type (For Entire Reach):	**Riffle** ☐ Number:		**Run** ☐ Number:		**Pool** ☐ Number:	
Total Reach length, ft:	Length, ft:	% =	Length, ft:	% =	Length, ft:	% =

Transect I.D. & Width (ft.)		Measurement Number & Position	Depth (ft)	Stream Habitat (Fish Cover)								%Stream Substrate (row total = 100%)											%Canopy Cover
				Type & Abundance								Type										%Embedded	
				Depressions	Woody Debris, large (>.3m)	Woody Debris, small (<.3m)	Aquatic Vegetation	Leafy Debris	Overhanging Vegetation	Boulders / Outcroppings	Devoid	Bedrock (smooth)	Bedrock (rough)	Boulder (>25cm)	Cobble (6-25cm)	Coarse Gravel (1.6-6.0cm)	Fine Gravel (0.2-6.0cm)	Sand (<0.2cm, gritty)	Silt/Mud/Clay (not gritty)	Hardpan (firm/consolidated)	Organic Matter (ground)		
Transect No:	Width:	1. (lft. Bank)																					
		2. (lft. ¼)																					
		3. (center ½)																					
		4. (rt. ¼)																					
		5. (rt. Bank)																					
		Average:																					
Transect No:	Width:	1. (lft. Bank)																					
		2. (lft. ¼)																					
		3. (center ½)																					
		4. (rt. ¼)																					
		5. (rt. Bank)																					
		Average:																					

Stream Reach Habitat Summary:

Substrate Type Reach Summary (% Occurrence):

Key to Habitat and Other Categorical Measures: 0 = Devoid (0%) 1 = Sparse (<10%) 2 = Moderate (10%-40%) 3 = Heavy (40%-75%) 4 = Very Heavy (>75%)

Quantitative Habitat Characterization Field Form cont.

Station I.D:

Transect # (circle): 1 2 3 4 5 - (6 7 8 9 10)

<table>
<tr><td>Stream Characteristics:</td><td colspan="6">Transect No:</td><td colspan="6">Transect No:</td></tr>
<tr><td>Stream Wetted Width, ft:</td><td colspan="6"></td><td colspan="6"></td></tr>
<tr><td>Channel Width, ft:</td><td colspan="6"></td><td colspan="6"></td></tr>
<tr><td>Left Bank Height, ft</td><td colspan="6"></td><td colspan="6"></td></tr>
<tr><td>Right Bank Height, ft:</td><td colspan="6"></td><td colspan="6"></td></tr>
<tr><td>Distance From Last Transect, ft:</td><td colspan="6"></td><td colspan="6"></td></tr>
<tr><td rowspan="2">Transect Stream Morphological Type:</td><td colspan="6">Riffle ☐ Run ☐ Pool ☐ (check one)</td><td colspan="6">Riffle ☐ Run ☐ Pool ☐ (check one)</td></tr>
<tr><td colspan="6">Length, ft:</td><td colspan="6">Length, ft:</td></tr>
<tr><td rowspan="2">Periphyton Coverage:</td><td colspan="3">On Substrate</td><td colspan="3">On Habitat</td><td colspan="3">On Substrate</td><td colspan="3">On Habitat</td></tr>
<tr><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td></tr>
<tr><td>Bank Cover/Habitat:</td><td colspan="3">Left Bank (LB)</td><td colspan="3">Right Bank (RB)</td><td colspan="3">Left Bank (LB)</td><td colspan="3">Right Bank (RB)</td></tr>
<tr><td>Roots:</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td></tr>
<tr><td>Brush:</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td></tr>
<tr><td>Undercut Bank:</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td></tr>
<tr><td>Vegetation:</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td></tr>
<tr><td>Devoid:</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td><td colspan="3">0 1 2 3 4</td></tr>
<tr><td rowspan="3">Bank Slope:
(check appropriate box)
Flat (<8°), Mod(9-30°), Steep (>30°)</td><td colspan="3">Left Bank (LB)</td><td colspan="3">Right Bank (RB)</td><td colspan="3">Left Bank (LB)</td><td colspan="3">Right Bank (RB)</td></tr>
<tr><td>Flat</td><td>Mod.</td><td>Steep</td><td>Flat</td><td>Mod.</td><td>Steep</td><td>Flat</td><td>Mod.</td><td>Steep</td><td>Flat</td><td>Mod.</td><td>Steep</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Bank Stability:
(check appropriate box)</td><td>Stable</td><td>Mod.</td><td>Unstab</td><td>Stable</td><td>Mod.</td><td>Unstab</td><td>Stable</td><td>Mod.</td><td>Unstab.</td><td>Stable</td><td>Mod.</td><td>Unstab</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Riparian Ground Cover:</td><td colspan="3">Left Bank (LB)</td><td colspan="3">Right Bank (RB)</td><td colspan="3">Left Bank (LB)</td><td colspan="3">Right Bank (RB)</td></tr>
<tr><td>% Herbs/Grasses</td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>% Shrubs/Trees</td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>% Soil/Sand</td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>% Rock</td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Riparian Canopy Cover: (%)</td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Canopy Tree Type: (circle one)</td><td colspan="3">Decid. – Conif. - Mixed</td><td colspan="3">Decid. – Conif. - Mixed</td><td colspan="3">Decid. – Conif. - Mixed</td><td colspan="3">Decid. – Conif. - Mixed</td></tr>
<tr><td>Riparian Land-use: (circle one)</td><td colspan="3">Past. - Crops – Ind. – Resid. – Forest – Silvi. – Other</td><td colspan="3">Past - Crops – Ind – Resid – Forest – Silvi – Other</td><td colspan="3">Past - Crops – Ind – Resid – Forest – Silvi – Other</td><td colspan="3">Past - Crops – Ind – Resid – Forest – Silvi – Other</td></tr>
</table>

Stream Habitat Assessment

Date:	Analyst:	Station #: Sample #:	Location:

Reach Length Determination

Parameter	Measurement Number					Average	Total Reach Length[1] (ft)	Sub-Reach Length[2] (ft)
	1	2	3	4	5			
Bankfull Width								
Bankfull Depth							na	na

[1]Average width times 20

[2] Total Length divided by 10

Riffle-Pool Sequence

Morph. Type:	Reach Number - Length in Feet									
	1	2	3	4	5	6	7	8	9	10
Riffle										
Run										
Pool										
Total										
Sequence[1]										

[1]Riffle=”xxx”, Run=”ooo“, Pool=”-----”

Epifaunal Substrate/Available Cover

Section	1	2	3	4	5	6	7	8	9	10	Average
%											

Substrate Characterization

Morph. Type	Reach No. - Dominant substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle											
Pool											

BR=Bedrock, BLD=Boulder, COB=Cobble, CG=Coarse Gravel, FG=Fine Gravel, S=Sand, SC=Silt/Clay

Embeddedness

Cobble	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
% Emb.																
Cat.																

Category I = 0-25% Embedded

Category II = 25.1-50% Embedded

Category III = 50.1-75% Embedded

Category IV = > 75% Embedded

Predominant Category ______________

Sediment Deposition

Section	1	2	3	4	5	6	7	8	9	10	Average
%											

Depth Regime

Morph. Type	Reach No. - Average Depth (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle											
Pool											

Canopy Cover (Stream Shading)

	Reach No. - Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading											

Bank Stability

LB Section	1	2	3	4	5	6	7	8	9	10	Predominant Category
Category											
RB Section	1	2	3	4	5	6	7	8	9	10	Predominant Category
Category											

Category I = Stable. < 5% bank affected.
Category II = Moderately stable. 5-29.9% of bank reach has erosion.
Category III = Moderately unstable. 30-59.9% of bank reach has erosion.
Category IV = Unstable. Many eroded areas; 60-100% of bank reach has erosion.

Vegetative Protection

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%											
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%											

Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Predominant Category
Category											
RB Section	1	2	3	4	5	6	7	8	9	10	Predominant Category
Category											

Category I = > 18 meters
Category II = 17.9-12 meters
Category III = 11.9-6 meters
Category IV = < 6 meters

In-Stream Habitat (Available Fish Cover, bkf-bkf)

	Reach No. - Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
Score											

Scoring: 20-16 Optimal, 15-11 Sub-optimal, 10-6 Marginal, 5-0 Poor

Aquatic Macrophytes and Periphyton

Morph. Type		Reach No. - Abundance										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes											
	Periphyton											
Pool	Macrophytes											
	Periphyton											

Abundance: 0-4, (0=none 4=abundant)

Stream Habitat Assessment (Semi-Quantitative)

Station #:	Stream:	Date/Time:	Analyst:
	Location:		

1. Reach Length Determination

Parameter	Measurement Number					Average	Total Reach Length[1] (ft)	Sub-Reach Length[2] (ft)
	1	2	3	4	5			
Bankfull Width								
Bankfull Depth							na	na

[1]Average width times 20 [2] Total Length divided by 10

2. Riffle-Pool Sequence

Morph. Type:	Reach Number - Length in Feet										
	1	2	3	4	5	6	7	8	9	10	Total
Riffle											
Run											
Pool											
Total											
Sequence[1]											

[1]Riffle="xxx", Run="-----", Pool="~~~"

3. Depth and Width Regime

Morph. Type	Reach No. - Average Depth (ft) / Width (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth											
Riffle Width											
Pool Depth											
Pool Width											

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area											

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

	Reach No. – Availability and Quality of Fish Habitat										
Section	1	2	3	4	5	6	7	8	9	10	Average
% Area											

6. Substrate Characterization (Dominant Substrate)

Morph. Type	Reach No. - Dominant substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle											
Pool											

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	11	12	Average
% Embedded													

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%											

Stream Habitat Assessment (Semi-Quantitative)

Station #:	Date/Time:	Initials:

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph. Type		Reach No. – Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes											
	Periphyton											
Pool	Macrophytes											
	Periphyton											

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. – Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading											

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score											
Slope (°)											
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score											
Slope (°)											

Score 9-10 = Stable, < 5% bank affected.

Score 6-8 = Moderately stable, 5-29% of bank eroding

Score 3-5 = Moderately unstable, 30-59% bank eroding.

Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%											
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%											

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score											
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score											

Score 9-10 = Riparian Zone Width > 18 meters

Score 6-8 = Riparian Zone Width 18 - 12 meters

Score 3-5 = Riparian Zone Width 11 - 6 meters

Score 1-2 = Riparian Zone Width < 6 meters

14. Land-Use Stream Impacts

Section	Reach No. – Impact Score										
	1	2	3	4	5	6	7	8	9	10	Average
Impact											

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other ____________

Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Stream Habitat Assessment

Reach Length Determination

Parameter	Measurement Number					Average	Total Reach Length[1] (ft)	Sub-Reach Length[2] (ft)
	1	2	3	4	5			
Bankfull Width								
Bankfull Depth							na	na

[1] Average width times 20

[2] Total Length divided by 10

Riffle-Pool Sequence

Morph. Type:	Reach Number - Length in Feet									
	1	2	3	4	5	6	7	8	9	10
Riffle										
Run										
Pool										
Total										
Sequence[1]										

[1] Riffle=”xxx”, Run=”-----“, Pool=”ooo”

Substrate Characterization

Morph. Type	Reach No. - Dominant substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle											
Pool											

BR=Bedrock, BLD=Boulder, COB=Cobble, CG=Coarse Gravel, FG=Fine Gravel, S=Sand, SC=Silt/Clay

Depth Regime

Morph. Type	Reach No. - Average Depth (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle											
Pool											

Canopy Cover (Stream Shading)

	Reach No. - Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading											

In-Stream Habitat (Available Fish Cover, bkf-bkf)

	Reach No. - Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
Score											

Scoring: 20-16 Optimal, 15-11 Sub-optimal, 10-6 Marginal, 5-0 Poor

Aquatic Macrophytes and Periphyton

Morph. Type		Reach No. - Abundance										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes											
	Periphyton											
Pool	Macrophytes											
	Periphyton											

Abundance: 0-4, (0=none 4=abundant)

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D:	Client:
Stream name:	Date/Time:
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam 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
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D:	Date/Time:
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE _____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE _____ LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE _____ RB	Right Bank 10 9	8 7 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE _____ LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE _____ RB	Right Bank 10 9	8 7 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE _____ LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE _____ RB	Right Bank 10 9	8 7 6	5 4 3	2 1

TOTAL SCORE: __________
AVERAGE SCORE: __________

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

Habitat Assessment Field Data Sheet (Low Gradient)

Floodplain Characterization[1]:

Station I.D:	Date/Time:
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter flood plain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter flood plain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter flood plain. Stream not deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest.	Predominant floodplain vegetation type is young forest.	Predominant floodplain vegetation type is shrub or old field.	Predominant floodplain vegetation type is turf or crop land.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water.	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water.	Either all wetland or non-wetland habitats, evidence of standing/ponded water.	Either all wetland or non-wetland habitats, no evidence of standing/ponded water.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures.	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function.	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function.	Significant floodplain encroachment (i.e., fill material, land development, or manmade structures). Significant effect on floodplain function.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Floodplain Total Score:_______________ **Floodplain Average Score:**_____________

[1] Modified from *Unified Stream Assessment: A Users Manual*, (Kitchell & Schuller, 2004)

GBMc

219 Brown Ln.
Bryant, AR 72022
(501) 847-7077 Fax (501) 847-7943

Chain of Custody

LIENT INFORMATION		BILLING INFORMATION		SPECIAL INSTRUCTIONS/PRECAUTIONS:
Company:		Bill To:		
Project Name/No.:		Company:		
Send Report To:		Address:		
Address:				Parameters for Analysis/Methods
		Phone No.:		
Phone/Fax No.:		Fax No.:		

Sample ID	Sample Description	Date	Time	Matrix S=Sed/Soil W=Water	Number of Containers	Composite or Grab										
Preservative (Sulfuric acid =S, Nitric acid =N, NaOH =B, Ice =I)																

Sampler(s):

Shipment Method:

Turnaround Time Required:

COC Completed by:__________ Date: ________ Time: ______

COC Checked by:__________ Date:________ Time:______

Relinquished by:__________ Date:________ Time:______

Received by: __________ Date:________ Time:______

Relinquished by:__________ Date:________ Time:______

Received in lab by:__________ Date:________ Time:______

LABORATORY USE ONLY: **Samples Received On Ice?: YES or NO** **Sample Temperature:________**

V1.2 04/15/05

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name:____________________.
Client:____________________.
Project no:____________________.
Investigators: __________. __________.
__________. __________.
Date Sample Collected: ____________________.
Habitat Forms Completed: yes / no

Location: ____________________.
Ecoregion: ____________________.
Weather: ____________________.
____________________.
Form Completed By: ______________.
Form Checked By: ______________.
Fish Sampling Completed: yes / no

Collection Site Observations		
	Above Station	Below Station
Total Time Sampled:		
Relative Abundance of Aquatic Biota		
Periphyton:	0 1 2 3 4	0 1 2 3 4
Filamentous Algae:	0 1 2 3 4	0 1 2 3 4
Macrophytes:	0 1 2 3 4	0 1 2 3 4
Slimes:	0 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4
Fish:	0 1 2 3 4	0 1 2 3 4
Other__________:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:		
Shallow Pool:		
Deep Pool:		
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:		
Emergent Vegatation:		
Submerged Vegetation:		
Depositional Area:		
Overhanging Veg:		
Root Wads:		
Undercut Banks:		
Filamentous algae:		
Leafy Debris:		
Other__________:		

Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		
R=Rare, C=Common, A=Abundant, D=Dominant Rare<3, Common 3-9, Abundant>10, Dominant>50		

Site Description and Observations:

Rapid Bioassessment Field Sheet

Point Source ______________________ Date ____________

Collector ____________ Sample Technique ____________ Sediment ____________

Habitat Description: ABOVE ______________________

BELOW ______________________

MACROINVERTEBRATE COMMUNITY

ABOVE Station #			BELOW Station #		
Cnt.	Taxa	Tally	Cnt.	Taxa	Tally
	:TOTAL:			:TOTAL:	

Community Structure

	ABOVE	BELOW		ABOVE	BELOW
% Ephem.			% Odon.		
% Plecop.			% Cole.		
% Trichop.			% Crustacea		
% EPT					
% Chir.			# of Taxa:		
% Diptera			Biotic Score:		

Comments:

BIOMETRIC SCORE SHEET

Station: Above ________ Below________ NPDES Permit #______________

Habitat Sampled ____________ Date/Time ________________ Biometric Score

Biometric (1) Dominants-In Common ________

DIC = __________

Dominants Above	%	Dominants Below	%	If DIC	Score
1.____________	____	1.____________	____	4-5	4
2.____________	____	2.____________	____	3	3
3.____________	____	3.____________	____	2	2
4.____________	____	4.____________	____	0-1	1
5.____________	____	5.____________	____		
Total % of Dom:	____	Total % of Dom:	____		

Biometric (2) Common Taxa Index ________

CTI: = __________ [TIC/MAX (T_a or T_b)]

If CTI	Score	If CTI	Score
> .70	4	0.30-.49	2
0.50-0.70	3	<0.29	1

Biometric (3) Quantitative Similarity Index ________

QSI: = __________ [Σ min (pi_a, pi_b)]

If QSI	Score	If QSI	Score
> 65	4	45-55	2
56-65	3	< 45	1

Biometric (4) Taxa Richness ________

# of Taxa Above = ______

# of Taxa Below = ______

% difference = ______

If % Diff.	Score	If % Diff.	Score
≤ 10%	4	31-45%	2
11-30%	3	> 45%	1

Biometric (5) Indicator Assemblage Index ________

	% EPT	%CA
Above		
Below		
IAI =		

IAI = 0.50 [($\%EPT_b/\%EPT_a$) + ($\%CA_a/\%CA_b$)]

If IAI	Score	If IAI	Score
> .80	4	0.50 - 0.64	2
0.65 - 0.80	3	<0.50	1

Biometric (6) Missing EPT Genera ________

Comments

If Missing	Score	If Missing	Score
≤ 1	4	2 from 2	2
2	3	>2 from 2	1

Biometric (7) Functional Group Percent Similarity ________

FG = Σ min ($\%Sh_a$, $\%Sh_b$ + $\%SC_a$, SC_b, + % CO_a, CO_b, + % PR_a, PR_b)

	Above	Below
% Shredders	______	______
% Scrapers	______	______
% Collectors	______	______
% Predators	______	______

If %	Score
> 85	4
75 – 85	3
65 – 74	2
< 65	1

FG % Similarity = ________

TOTAL BIOMETRIC SCORE = ________

MEAN BIOMETRIC SCORE = ________

AQUATIC LIFE USE STATUS ________________

POTENTIAL GENERIC CAUSE ________________

FIELD DATA SHEETS - FISH

Waterbody Name:____________________.
Client:__________________.
Project no:________________.
Investigators: ________. ________.
________. ________.
Date Sample Collected:________________________.
Habitat Forms Completed: yes / no

Location:__________________________.
Ecoregion:________________________.
Weather:__________________________.
__________________________.
Form Completed By:______________.
Form Checked By:______________.
Fish Sampling Completed: yes / no

Collection Site Observations			
	Above Station	Below Station	Additional Observations:
Total Time Sampled:			
Relative Abundance of Aquatic Biota			
Periphyton:	0 1 2 3 4	0 1 2 3 4	
Filamentous Algae:	0 1 2 3 4	0 1 2 3 4	
Macrophytes:	0 1 2 3 4	0 1 2 3 4	
Slimes:	0 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4	
Fish:	0 1 2 3 4	0 1 2 3 4	
Other____________:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:			
Shallow Pool:			
Deep Pool:			
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:			
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:			
Overhanging Veg:			
Root Wads:			
Undercut Banks:			
Filamentous algae:			
Leafy debris:			
Substrate Type and Scoring			
Substrate	Score	Adj. Score	
Bedrock:	X 0.1		
Lg. Boulder:	X 1.0		
Boulders:	X 1.0		
Rubble:	X 1.0		
Gravel:	X 0.5		
Sand:	X 0.1		
Mud/Silt:	X 0.1		
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

Sampling Gear Type: Electrofishing Seine Gill nets

Unit of Effort: Above: ______ Below: ______

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: ______

Below Station: ______

Fish Species Observed

Above Station #	Below Station #

FISH COMMUNITY BIOCRITERIA

Gulf Coastal-Typical Streams

	Reference Conditions			Scores by Station ID	
METRIC	**4**	**2**	**0**		
% Sensitive Individuals	>1	1-0.5	<0.5		
% Cyprinidae (minnows)	5-35	<5 or 36-45	>45		
% Ictaluridae (Catfishes)	>1[1]	0.5-1[1]	<0.5 or >8 bullheads		
% Centrarchidae (Sunfishes)	28-47[2]	18-28 or 47-57[2]	<18 or >57 or >8 Green sunfish		
% Percidae (darters)	>10	6-10	<6		
% Primary Feeders	<15	15-22	>22		
% "Key" Individuals	>19	13-19	<13		
Diversity	>3.89	3.89-3.65	<3.65		
			TOTAL		
			IMPAIRMENT STATUS		

[1] no more than 8% bullheads
[2] no more than 8% Green sunfish

Impairment Status
Total Score:

25-32	Fully Supporting
24-17	Slightly Impaired
16-9	Moderately Impaired
0-8	Not Supporting

Appendix B

Agency documentation

Arkansas Department of Health and Human Services
Division of Health
Paul K. Halverson, DrPH, Director
Engineering Section – Environmental Health Branch – Center for Local Public Health
Postal Address P. O. Box 1437, Slot H-37 Little Rock, AR 72203-1437 1-501-661-2623 TDD: 1-800-234-4399
Physical Address for UPS or Fedex 4815 West Markham St., Slot H-37 Little Rock, AR 72205 Fax: 1-501-661-2032

December 6, 2005

Mr. Vince Blubaugh
GBMc & Associates
219 Brown Lane
Bryant, AR 72022

Re: Domestic Water Supply Determination
Unnamed Tributaries of Little Cornie Bayou and Bayou De Loutre
Union County, AR

Dear Mr. Blubaugh,

In response to your letter of October 27, 2005 regarding the above streams, please be advised that these water bodies are not currently used as a source of supply for a public water system, nor are we aware of their being considered for such use.

We have no information regarding their use as a private or individual water supply. By copy of this letter, if the County Sanitarian is aware of such use, he/she is requested to respond to you in writing.

Should you have any questions in this regard, feel free to contact our office. We apologize for the delay in responding.

Sincerely,

Bob Makin, P.E., Assistant Director
Engineering Section

Cc: Martin Maner, ADEQ Water Division
Union County Sanitarian

Arkansas Natural Resources Commission

J. Randy Young, PE
Executive Director

101 East Capitol, Suite 350
Little Rock, Arkansas 72201
http://www.anrc.arkansas.gov/

Phone: (501) 682-1611
Fax: (501) 682-3991
E-mail: anrc@arkansas.gov

Mike Huckabee
Governor

November 8, 2005

Mr. Vince Blubaugh
Principal, CBM^{c} & Associates
219 Brown Lane
Bryant, Arkansas 72022

RE: Review and Comments
Removal of Designated Domestic Water Supply Use from Loutre Creek

Dear Mr. Blubaugh:

Thank you for the opportunity to review and comment on the removal of the Designated Domestic Water Supply Use from Loutre Creek near El Dorado in Union County, Arkansas. The downstream most coordinates for the reach under review are Latitude 33°11'33.08" and Longitude 92°40'42.39".

The removal of the Designated Domestic Water Supply Use from this reach of Loutre Creek would not conflict with the Arkansas State Water Plan. If you need any further assistance, or have any questions, please contact Steve Loop at (501)-682-3959.

Sincerely,

Earl T Smith

Earl T. Smith, P.E., Chief
Water Resources Division

Appendix C

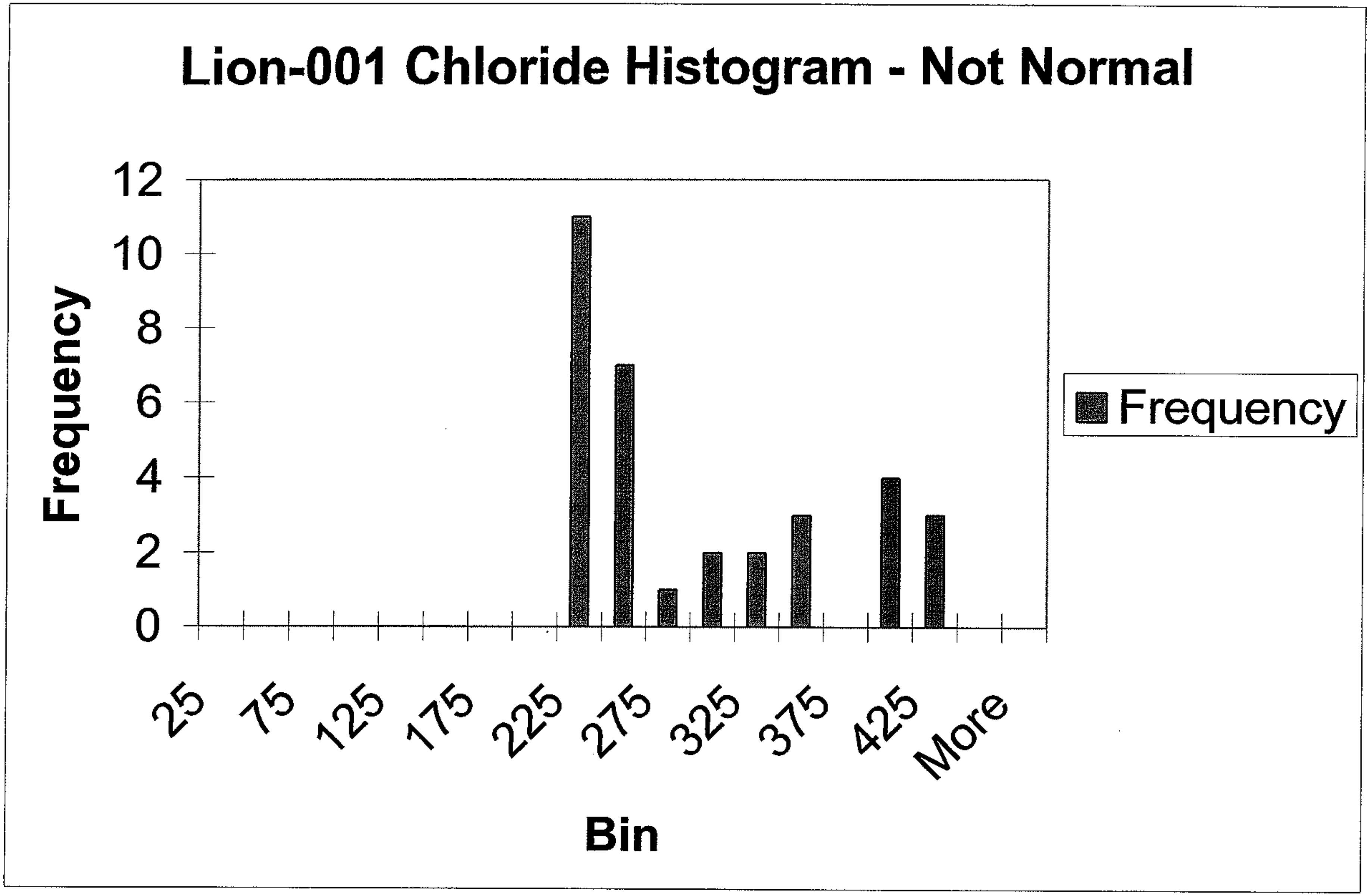
Facility and DMR Dissolved Mineral Data

Summary of Lion Oil's Outfall 001 values for Chloride, Sulfate, and TDS for Lion Oil.

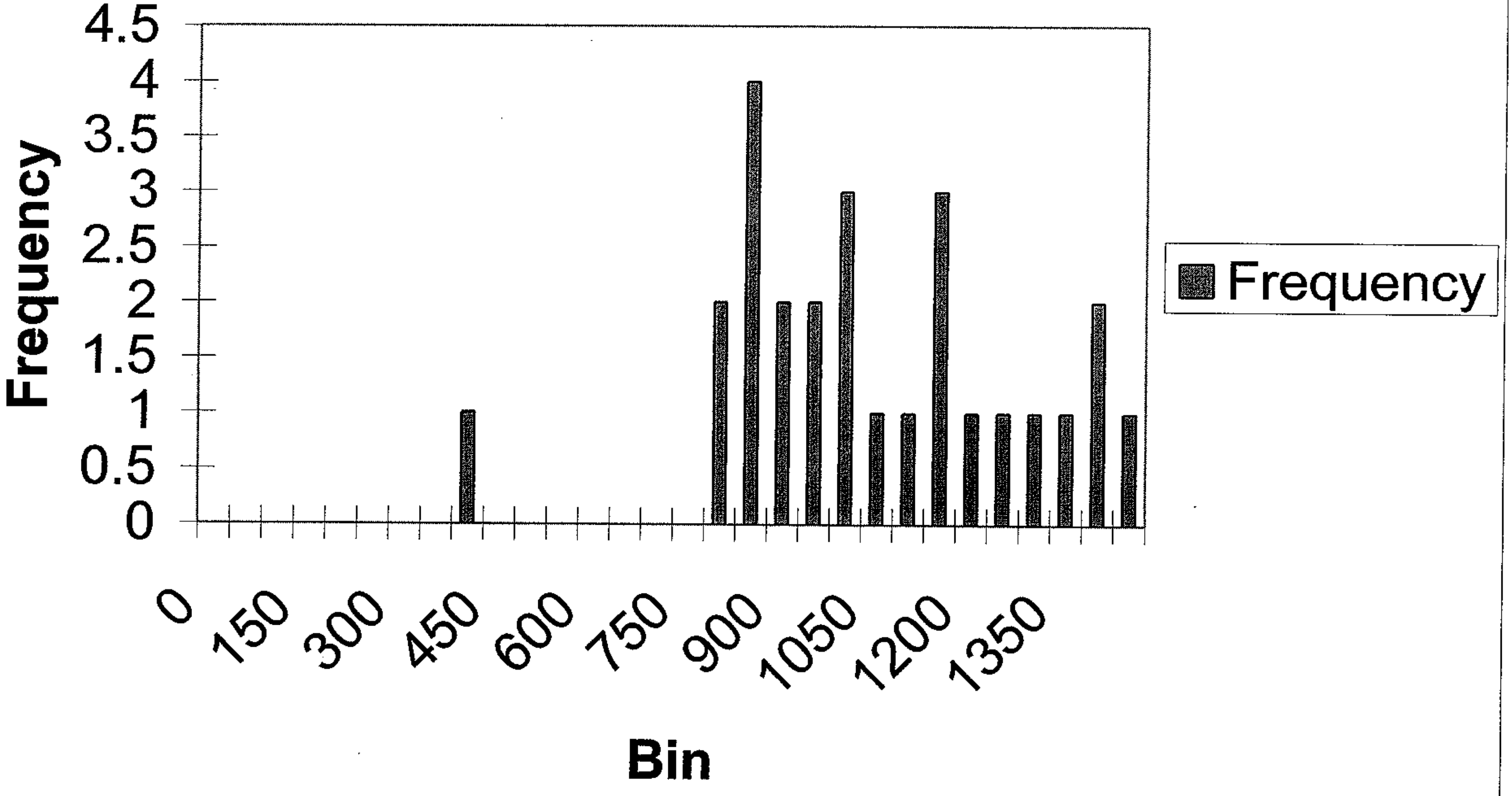
Location / Date	Chloride (mg/L)		Mo Average Sulfate (mg/L)		Mo Average TDS (mg/L)
3/12/1986	296				
5/12/1986	420				
6/16/1986	312				
7/28/1986	250				
8/15/1986	234				
Mar-04			372		760
Apr-04			941		1885
May-04			968		1989
Jun-04			807		1565
Jul-04			1121		2141
Aug-04			1270		2683
Sep-04			1386		2667
Oct-04			1068		2593
Nov-04			789		1513
Dec-04			999		1776
Jan-05			820		1667
Feb-05			827		1959
Mar-05			883		2120
Apr-05			812		1832
May-05			862		2246
Jun-05			758		2052
Jul-05			1107		2303
Aug-05			924		1913
Sep-05			1033		1530
Oct-05			955		2281
Nov-05			1149		2393
Dec-05			1162		2871
Jan-06			1775		2800
Feb-06			1322		2811
Mar-06			1383		2653
Apr-06			1213		2727
4/29/2006	411.3				
4/30/2006	329.6				
5/1/2006	223.7				
5/2/2006	249.6				
5/3/2006	391.4				
5/4/2006	341.3				
5/5/2006	315.6				
5/6/2006	282.4				

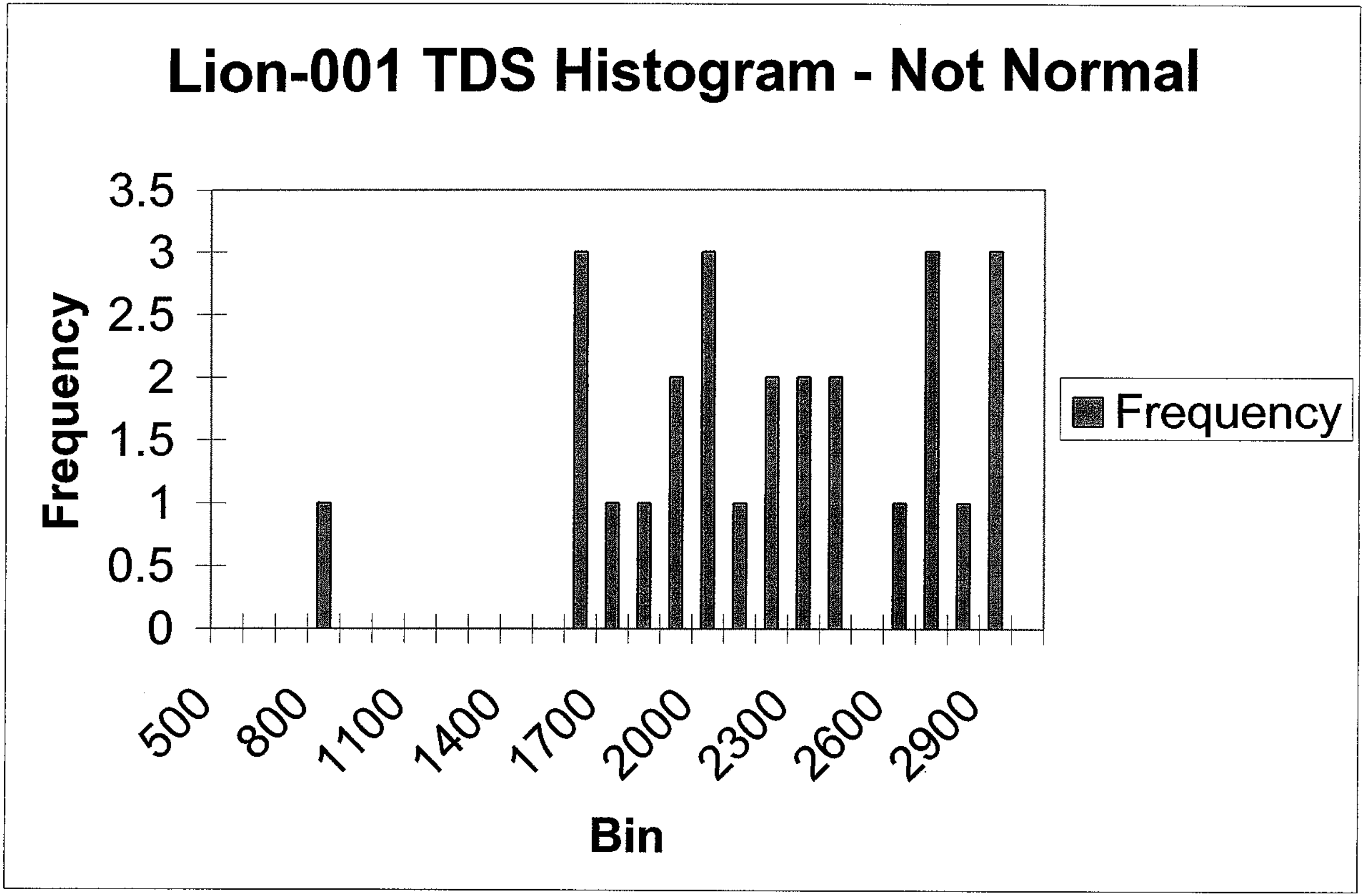
5/7/2006	248.6				
5/8/2006	217.3				
5/9/2006	220.1				
5/10/2006	235.9				
5/11/2006	218.9				
5/12/2006	207.5				
5/13/2006	213.6				
5/14/2006	211				
5/15/2006	213.2				
5/16/2006	231.8				
5/17/2006	234.3				
5/18/2006	222.7				
5/19/2006	222.7				
5/20/2006	203.8				
5/21/2006	270				
5/22/2006	387.7				
5/23/2006	398.8				
5/24/2006	406.2				
5/25/2006	377				
5/26/2006	326				

Statistics	**Chloride (mg/l)**	**Sulfate (mg/l)**	**TDS (mg/l)**
Data Characterization			
99th%tile	417	1678	2856
95th%tile	403	1385	2808
average	283	1027	2143
maximum	420	1775	2871
minimum	204	372	760
median	260	984	2130
count	33	26	26
standard deviation	72	272	512
CV	0.26	0.27	0.24
Pn	0.87	0.84	0.84
99%	0.99	0.99	0.99
95%	0.95	0.95	0.95
Z for 99 %tile	2.33	2.33	2.33
Z for 95 %tile	1.64	1.64	1.64
99% Value	420	1776	2871
95% Value	414	1689	2860
	ORDER STATS	**ORDER STATS**	**ORDER STATS**


Lion-001 Chloride Histogram - Not Normal
Frequency
12
10
8
6
4
2
0
25
75
125
175
225
275
325
375
425
More
Bin
Frequency

Lion-001 SO4 Histogram - Not Normal




Lion-001 TDS Histogram - Not Normal
Frequency
3.5
3
2.5
2
1.5
1
0.5
0
500
800
1100
1400
1700
2000
2300
2600
2900
Bin
Frequency

Lion Oil's DMR Flow Summary 1/04 - 12/05

	Flow (MGD)	Flow (MGD)
Date	Mo Maximum	Mo Average
Jan-04	1.917	1.616
Feb-04	2.871	2.379
Mar-04	2.816	2.622
Apr-04	2.901	2.447
May-04	2.844	2.453
Jun-04	2.784	2.566
Jul-04	3.153	2.551
Aug-04	3.005	2.262
Sep-04	2.295	1.847
Oct-04	2.542	1.880
Nov-04	2.562	2.179
Dec-04	2.615	2.193
Jan-05	2.583	2.233
Feb-05	2.352	2.139
Mar-05	2.524	2.135
Apr-05	2.659	2.380
May-05	2.518	2.192
Jun-05	2.569	2.206
Jul-05	2.553	2.111
Aug-05	2.424	2.037
Sep-05	2.721	2.139
Oct-05	2.489	1.610
Nov-05	2.397	1.885
Dec-05	2.438	2.029
Totals (MGD)		
Average	2.606	2.170
Maximum	3.153	2.622
Minimum	1.917	1.610
Number	24	24

Totals (cfs)		
Average	4.031	3.358
Maximum	4.878	[redacted]
Minimum	2.966	2.491

Outfall 002 Flows		
Date	Daily Max (MGD)	Monthly Average (MGD)
30-Nov-05	0.312	0.204
31-Oct-05	0.704	0.704
30-Sep-05	2.817	1.521
31-Aug-05	1.585	0.504
31-Jul-05	0.68	0.416
30-Jun-05	0.264	0.264
31-May-05	0.68	0.518
30-Apr-05	2.986	1.041
31-Mar-05	0.672	0.179
28-Feb-05	0.832	0.153
31-Jan-05	1.457	0.708
31-Dec-04	1.385	0.789
30-Nov-04	1.641	0.678
31-Oct-04	2.577	1.157
30-Sep-04	0.368	0.368
31-Aug-04	0.648	0.472
31-Jul-04	0.977	0.532
30-Jun-04	1.281	0.433
31-May-04	1.473	0.739
30-Apr-04	1.041	0.516
31-Mar-04	0.936	0.546
Average	**1.21**	**0.59**
Maximum	**2.99**	**1.52**
Number	**21**	**21**

Highest Monthly Average Flow		
Site	MGD	cfs
002	1.52	2.35
003	1.39	2.15
004	2.68	4.15
005	NO DISCHARGE	
006	2.22	3.43
007	2.89	4.47
Average	2.14	3.31

Outfall 003 Flows		
Date	Daily Max (MGD)	Monthly Average (MGD)
30-Nov-05	0.286	0.187
31-Oct-05	0.645	0.645
30-Sep-05	2.581	1.393
31-Aug-05	1.452	0.462
31-Jul-05	0.623	0.381
30-Jun-05	0.242	0.242
31-May-05	0.623	0.474
30-Apr-05	2.735	0.953
31-Mar-05	0.616	0.164
28-Feb-05	0.762	0.141
31-Jan-05	1.334	0.649
31-Dec-04	1.268	0.723
30-Nov-04	1.503	0.621
31-Oct-04	2.361	1.06
30-Sep-04	0.337	0.337
31-Aug-04	0.594	0.433
31-Jul-04	0.894	0.487
30-Jun-04	1.173	0.396
31-May-04	1.349	0.677
30-Apr-04	0.953	0.473
31-Mar-04	0.858	0.534
Average	**1.10**	**0.54**
Maximum	**2.74**	**1.39**
Number	**21**	**21**

Outfall 004 Flows		
Date	**Daily Max (MGD)**	**Monthly Average (MGD)**
30-Nov-05	0.551	0.36
31-Oct-05	1.242	1.242
30-Sep-05	4.97	2.683
31-Aug-05	2.796	0.89
31-Jul-05	1.2	0.734
30-Jun-05	0.466	0.466
31-May-05	1.2	0.913
30-Apr-05	5.266	1.836
31-Mar-05	1.186	0.315
28-Feb-05	1.468	0.271
31-Jan-05	2.57	1.25
31-Dec-04	2.443	1.392
30-Nov-04	2.894	1.196
31-Oct-04	4.546	2.041
30-Sep-04	0.649	0.649
31-Aug-04	1.144	0.833
31-Jul-04	1.723	0.938
30-Jun-04	2.259	0.763
31-May-04	2.598	1.304
30-Apr-04	1.836	0.911
31-Mar-04	1.652	1.028
Average	**2.13**	**1.05**
Maximum	**5.27**	**2.68**
Number	**21**	**21**

Outfall 005 Flows		
Date	**Daily Max (MGD)**	**Monthly Average (MGD)**
30-Nov-05	NO DISCHARGE	
31-Oct-05	NO DISCHARGE	
30-Sep-05	NO DISCHARGE	
31-Aug-05	NO DISCHARGE	
31-Jul-05	NO DISCHARGE	
30-Jun-05	NO DISCHARGE	
31-May-05	NO DISCHARGE	
30-Apr-05	NO DISCHARGE	
31-Mar-05	NO DISCHARGE	
28-Feb-05	NO DISCHARGE	
31-Jan-05	NO DISCHARGE	
31-Dec-04	NO DISCHARGE	
30-Nov-04	NO DISCHARGE	
31-Oct-04	NO DISCHARGE	
30-Sep-04	NO DISCHARGE	
31-Aug-04	NO DISCHARGE	
31-Jul-04	NO DISCHARGE	
30-Jun-04	NO DISCHARGE	
31-May-04	NO DISCHARGE	
30-Apr-04	NO DISCHARGE	
31-Mar-04	NO DISCHARGE	
Average	**#DIV/0!**	**#DIV/0!**
Maximum	**0.00**	**0.00**
Number	**0**	**0**

005	NO DISCHARGE	NO DISCHARGE

Outfall 006 Flows		
Date	Daily Max (MGD)	Monthly Average (MGD)
30-Nov-05	NO DISCHARGE	
31-Oct-05	NO DISCHARGE	
30-Sep-05	NO DISCHARGE	
31-Aug-05	NO DISCHARGE	
31-Jul-05	NO DISCHARGE	
30-Jun-05	NO DISCHARGE	
31-May-05	NO DISCHARGE	
30-Apr-05	0.328	0.328
31-Mar-05	NO DISCHARGE	
28-Feb-05	NO DISCHARGE	
31-Jan-05	NO DISCHARGE	
31-Dec-04	NO DISCHARGE	
30-Nov-04	NO DISCHARGE	
31-Oct-04	4.704	2.216
30-Sep-04	NO DISCHARGE	
31-Aug-04	NO DISCHARGE	
31-Jul-04	NO DISCHARGE	
30-Jun-04	NO DISCHARGE	
31-May-04	NO DISCHARGE	
30-Apr-04	0.041	0.04
31-Mar-04	1.3	0.36
Average	**1.59**	**0.74**
Maximum	**4.70**	**2.22**
Number	**4**	**4**

Outfall 007 Flows		
Date	Daily Max (MGD)	Monthly Average (MGD)
30-Nov-05	NO DISCHARGE	
31-Oct-05	NO DISCHARGE	
30-Sep-05	NO DISCHARGE	
31-Aug-05	0.014	0.014
31-Jul-05	NO DISCHARGE	
30-Jun-05	NO DISCHARGE	
31-May-05	NO DISCHARGE	
30-Apr-05	NO DISCHARGE	
31-Mar-05	NO DISCHARGE	
28-Feb-05	NO DISCHARGE	
31-Jan-05	NO DISCHARGE	
31-Dec-04	NO DISCHARGE	
30-Nov-04	NO DISCHARGE	
31-Oct-04	2.88	2.88
30-Sep-04	NO DISCHARGE	
31-Aug-04	NO DISCHARGE	
31-Jul-04	NO DISCHARGE	
30-Jun-04	NO DISCHARGE	
31-May-04	NO DISCHARGE	
30-Apr-04	2.89	2.89
31-Mar-04	NO DISCHARGE	
Average	**1.93**	**1.93**
Maximum	**2.89**	**2.89**
Number	**3**	**3**

IWC Calculations (10-1-06) - CHLORIDE by Segment

	Watershed	**Flow**		**Conc**	**Load**	**IWC**
Source	**(mi^2)**	**cfs**	**mgd**	**mg/L**	**lb/day**	
Loutre Creek above Lion Oil	4.78	4	2.584	5	107.7528	5
Loutre Creek below Lion Oil - 0utfall 001	**Point Source**	**4.06**	**2.62276**	**504**	**11024.40447**	**256**
GLCC - Outfall 002 via Bayou de Loutre	Point Source	0.24	0.15504	1029	1330.531574	
GLCC - Outfall 004 via Bayou de Loutre	Point Source	0.64	0.41344	1702	5868.648499	
B de L below Loutre Creek	**4.13**	**4**	**2.584**	**5**	**107.7528**	**264**
B de L below City South - Outfall 001 [1]	**Point Source**	**7.43**	**4.79978**	**142**	**5684.283458**	**220**
GLCC South - 001 via Gum Creek[2]	Point Source	0.75	0.4845	181	731.37213	
Georgia Pacific - 004 via Gum Creek[2]	Point Source	0.56	0.36176	5	15.085392	
B de L Below Gum Creek	**6.95**	**4**	**2.584**	**5**	**107.7528**	**181**
Teris - 009 via Boggy Creek[2]	Point Source	0.39	0.25194	228	479.0689488	
B de L Below Boggy Creek	**22.17**	**4**	**2.584**	**5**	**107.7528**	**158**
B de L Below Hibank Creek	**21.89**	**4**	**2.584**	**5**	**107.7528**	**140**
B de L Below Mill Creek	**7.4**	**4**	**2.584**	**5**	**107.7528**	**126**
B de L Below Buckaloo Branch	**5.4**	**4**	**2.584**	**5**	**107.7528**	**114**
B de L Below Bear Creek	**12.1**	**4**	**2.584**	**5**	**107.7528**	**105**
B de L final segment composite (main stem 19.17mi2 =4 cfs & unnamed tribs 21.17 mi2 = 4 cfs)	**40.58**	**8**	**5.168**	**5**	**215.5056**	**90**
Totals	**125.4**	**54.07**	**34.92922**		**26210.92248**	**90**

[1] El Darado Water Utilities North & South Plants NPDES Permit Documentation (3/8/01).

[2] Flows and Chloride concentrations (GLCC - South & Teris) are LTA from facility data set

IWC Calculations (10-1-06) - SULFATE by Segment

	Watershed	Flow		Conc	Load	IWC
Source		**cfs**	**mgd**	**mg/L**	**lb/day**	
Loutre Creek above Lion Oil	4.78	4	2.584	13	280.15728	13
Loutre Creek below Lion Oil - 0utfall 001	**Point Source**	**4.06**	**2.62276**	**1967**	**43025.80079**	**997**
GLCC - Outfall 002 via Bayou de Loutre	Point Source	0.24	0.15504	380	491.352768	
GLCC - Outfall 004 via Bayou de Loutre	Point Source	0.64	0.41344	63.7	219.6433075	
B de L below Loutre Creek	**4.13**	**4**	**2.584**	**13**	**280.15728**	**635**
B de L below City South - Outfall 001 [1]	**Point Source**	**7.43**	**4.79978**	**76**	**3042.292555**	**431**
GLCC South - 001 via Gum Creek[2]	Point Source	0.75	0.4845	13	52.52949	
Georgia Pacific - 004 via Gum Creek[2]	Point Source	0.56	0.36176	13	39.2220192	
B de L Below Gum Creek	**6.95**	**4**	**2.584**	**13**	**280.15728**	**345**
Teris - 009 via Boggy Creek[2]	Point Source	0.39	0.25194	13	27.3153348	
B de L Below Boggy Creek	**22.17**	**4**	**2.584**	**13**	**280.15728**	**296**
B de L Below Hibank Creek	**21.89**	**4**	**2.584**	**13**	**280.15728**	**263**
B de L Below Mill Creek	**7.4**	**4**	**2.584**	**13**	**280.15728**	**237**
B de L Below Buckaloo Branch	**5.4**	**4**	**2.584**	**13**	**280.15728**	**216**
B de L Below Bear Creek	**12.1**	**4**	**2.584**	**13**	**280.15728**	**198**
B de L final segment composite (main stem 19.17mi2 =4 cfs & unnamed tribs 21.17 mi2 = 4 cfs)	**40.58**	**8**	**5.168**	**13**	**560.31456**	**171**
Totals	**125.4**	**54.07**	**34.92922**		**49699.72907**	**171**

[1] El Darado Water Utilities North & South Plants NPDES Permit Documentation (3/8/01).

[2] Flows are LTA from facility data set

IWC Calculations (10-1-06) - TDS by Segment

	Watershed	Flow		Conc	Load	IWC
Source		cfs	mgd	mg/L	lb/day	
Loutre Creek above Lion Oil	4.78	4	2.584	67	1443.88752	67
Loutre Creek below Lion Oil - 0utfall 001	**Point Source**	**4.06**	**2.62276**	**3420**	**74808.45893**	**1756**
GLCC - Outfall 002 via Bayou de Loutre	Point Source	0.24	0.15504	1376	1779.214234	
GLCC - Outfall 004 via Bayou de Loutre	Point Source	0.64	0.41344	1932	6661.709107	
B de L below Loutre Creek	**4.13**	**4**	**2.584**	**67**	**1443.88752**	**1236**
B de L below City South - Outfall 001 [1]	**Point Source**	**7.43**	**4.79978**	**497**	**19894.9921**	**966**
GLCC South - 001 via Gum Creek [2]	Point Source	0.75	0.4845	67	270.72891	
Georgia Pacific - 004 via Gum Creek [2]	Point Source	0.56	0.36176	67	202.1442528	
B de L Below Gum Creek	**6.95**	**4**	**2.584**	**67**	**1443.88752**	**780**
Teris - 009 via Boggy Creek[2]	Point Source	0.39	0.25194	526	1105.22047	
B de L Below Boggy Creek	**22.17**	**4**	**2.584**	**67**	**1443.88752**	**682**
B de L Below Hibank Creek	**21.89**	**4**	**2.584**	**67**	**1443.88752**	**610**
B de L Below Mill Creek	**7.4**	**4**	**2.584**	**67**	**1443.88752**	**553**
B de L Below Buckaloo Branch	**5.4**	**4**	**2.584**	**67**	**1443.88752**	**507**
B de L Below Bear Creek	**12.1**	**4**	**2.584**	**67**	**1443.88752**	**468**
B de L final segment composite (main stem 19.17mi2 =4 cfs & unnamed tribs 21.17 mi2 = 4 cfs)	**40.58**	**8**	**5.168**	**67**	**2887.77504**	**409**
Totals	**125.4**	**54.07**	**34.92922**		**119161.3432**	**409**

[1] El Darado Water Utilities North & South Plants NPDES Permit Documentation (3/8/01).

[2] Flows and TDS concentration (Teris) are LTA from facility data set

Mass Balance Calcs - Source Contributors to Bayou de Loutre down to Boggy Creek.

Chloride

	Flow		Conc	Load	mixed conc
Source	cfs	mgd	mg/L	lb/day	
GLCC Central - Outfall 002	0.24	0.15504	1029	1330.531574	
GLCC Central - Outfall 004	0.64	0.41344	1702	5868.648499	
Lion - Outfall 001	4.06	2.62276	504	11024.40447	
City of ElDo - South	7.43	4.79978	142	5684.283458	
GLCC South - 001*	0.75	0.4845	181	731.37213	
Georgia Pacific - 004*	0.56	0.36176	5	15.085392	
Totals	13.68	8.83728		24654.32553	**335**

* Flows and/or concentration are LTA form outfall data set

Sulfate

	Flow		Conc	Load	mixed conc
Source	cfs	mgd	mg/L	lb/day	
GLCC Central - Outfall 002	0.24	0.15504	380	491.352768	
GLCC Central - Outfall 004	0.64	0.41344	63.7	219.6433075	
Lion - Outfall 001	4.06	2.62276	1967	43025.80079	
City of ElDo - South	7.43	4.79978	76	3042.292555	
GLCC South - 001*	0.75	0.4845	13	52.52949	
Georgia Pacific - 004*	0.56	0.36176	13	39.2220192	
Totals	13.68	8.83728		46870.84093	**636**

* Flows are LTA form outfall data set

TDS

	Flow		Conc	Load	mixed conc
Source	cfs	mgd	mg/L	lb/day	
GLCC Central - Outfall 002	0.24	0.15504	1376	1779.214234	
GLCC Central - Outfall 004	0.64	0.41344	1932	6661.709107	
Lion - Outfall 001	4.06	2.62276	3420	74808.45893	
City of ElDo - South	7.43	4.79978	497	19894.9921	
GLCC South - 001*	0.75	0.4845	67	270.72891	
Georgia Pacific - 004*	0.56	0.36176	67	202.1442528	
Totals	13.68	8.83728		103617.2475	**1406**

* Flows and/or concentration are LTA form outfall data set

Mass Balance Calcs - Source Contributors to Bayou de Loutre down to AR/LA State Line

Chloride

	Flow		Conc	Load	mixed conc
Source	cfs	mgd	mg/L	lb/day	
GLCC Central - Outfall 002	0.24	0.15504	1029	1330.531574	
GLCC Central - Outfall 004	0.64	0.41344	1702	5868.648499	
Lion - Outfall 001	4.06	2.62276	504	11024.40447	
City of ElDo - South	7.43	4.79978	142	5684.283458	
GLCC South - 001*	0.75	0.4845	181	731.37213	
Georgia Pacific - 004*	0.56	0.36176	5	15.085392	
Taris - 009*	0.39	0.25194	228	479.3421021	
Totals	14.07	9.08922		25133.66763	**332**

* Flows and/or concentration are LTA form outfall data set

Sulfate

	Flow		Conc	Load	mixed conc
Source	cfs	mgd	mg/L	lb/day	
GLCC Central - Outfall 002	0.24	0.15504	380	491.352768	
GLCC Central - Outfall 004	0.64	0.41344	63.7	219.6433075	
Lion - Outfall 001	4.06	2.62276	1967	43025.80079	
City of ElDo - South	7.43	4.79978	76	3042.292555	
GLCC South - 001*	0.75	0.4845	13	52.52949	
Georgia Pacific - 004*	0.56	0.36176	13	39.2220192	
Taris - 009*	0.39	0.25194	13	27.3153348	
Totals	14.07	9.08922		46898.15627	**619**

* Flows are LTA form outfall data set

TDS

	Flow		Conc	Load	mixed conc
Source	cfs	mgd	mg/L	lb/day	
GLCC Central - Outfall 002	0.24	0.15504	1376	1779.214234	
GLCC Central - Outfall 004	0.64	0.41344	1932	6661.709107	
Lion - Outfall 001	4.06	2.62276	3420	74808.45893	
City of ElDo - South	7.43	4.79978	497	19894.9921	
GLCC South - 001*	0.75	0.4845	67	270.72891	
Georgia Pacific - 004*	0.56	0.36176	67	202.1442528	
Taris - 009*	0.39	0.25194	526	1105.22047	
Totals	14.07	9.08922		104722.468	**1381**

* Flows and/or concentration are LTA form outfall data set

Minerals IWC Calculations for Loutre Creek (Below Lion Oil) - 6/20/06

20% increase over historical 95%

95th Percentile + 20% - w/ Outfall 001

Chloride - 95th Percentile Value - Outfall 001

((4 cfs * 5 mg/L) + (4.06 cfs * **503**)) / (4 cfs + 4.06 cfs)

20	2042	8.06	
2062	8.06		502.8
256			

Sulfate - 95th Percentile Value - Outfall 001

((4 cfs * 13 mg/L) + (4.06 cfs * **1967**)) / (4 cfs + 4.06 cfs)

52	7986	8.06	
8038	8.06		1967
997			

TDS - 95th Percentile Value - Outfall 001

((4 cfs * 67 mg/L) + (4.06 cfs * **3420**)) / (4 cfs + 4.06 cfs)

268	13885	8.06	
14153	8.06		3420
1756			

[illegible]				
((4 cfs * 67 mg/L) + (4.06 cfs * **1918**)) / (4 cfs + 4.06 cfs)				
268	7787	8.06		
8055	8.06			
[illegible]				

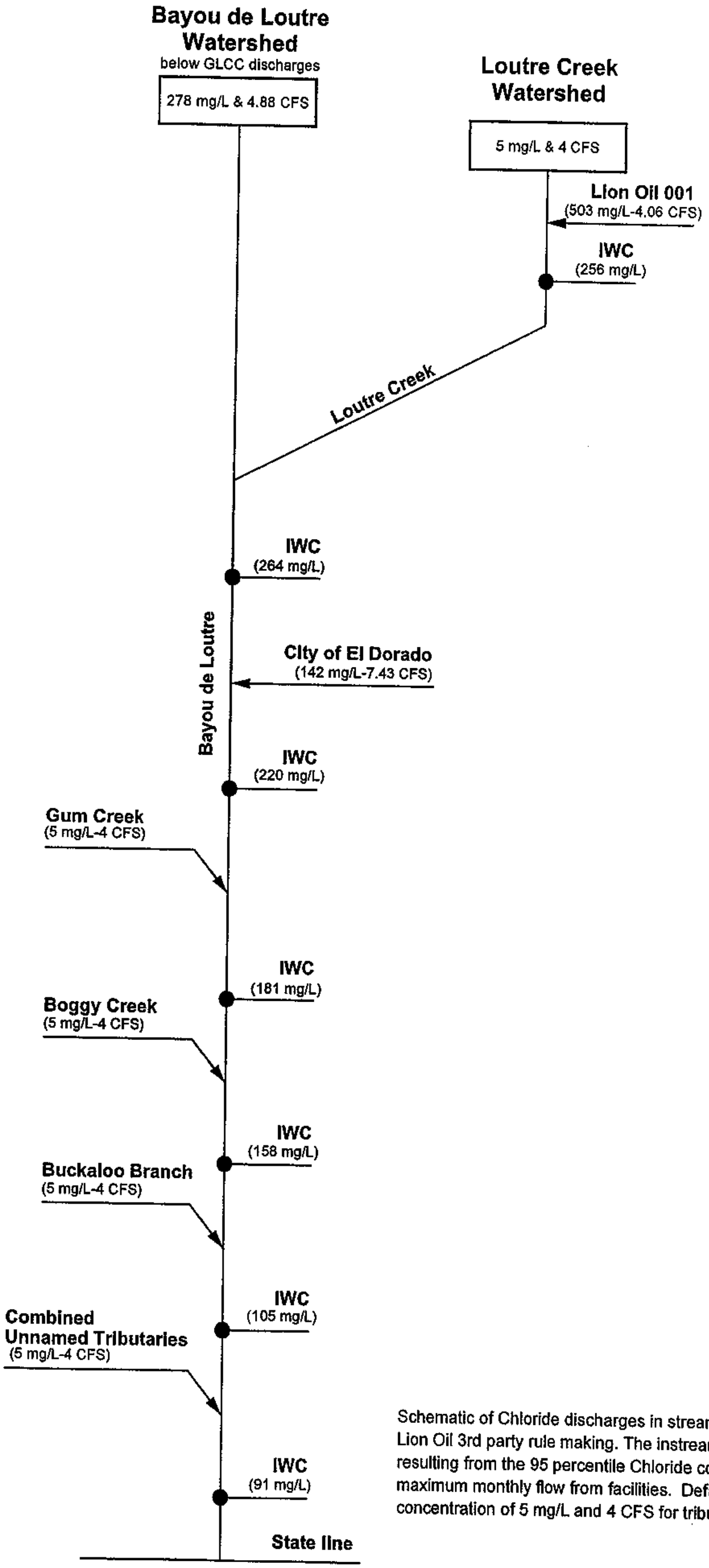
IWC = [(Qb x Cb) + (Qe x Ce)] / (Qb + Qe)

Where:

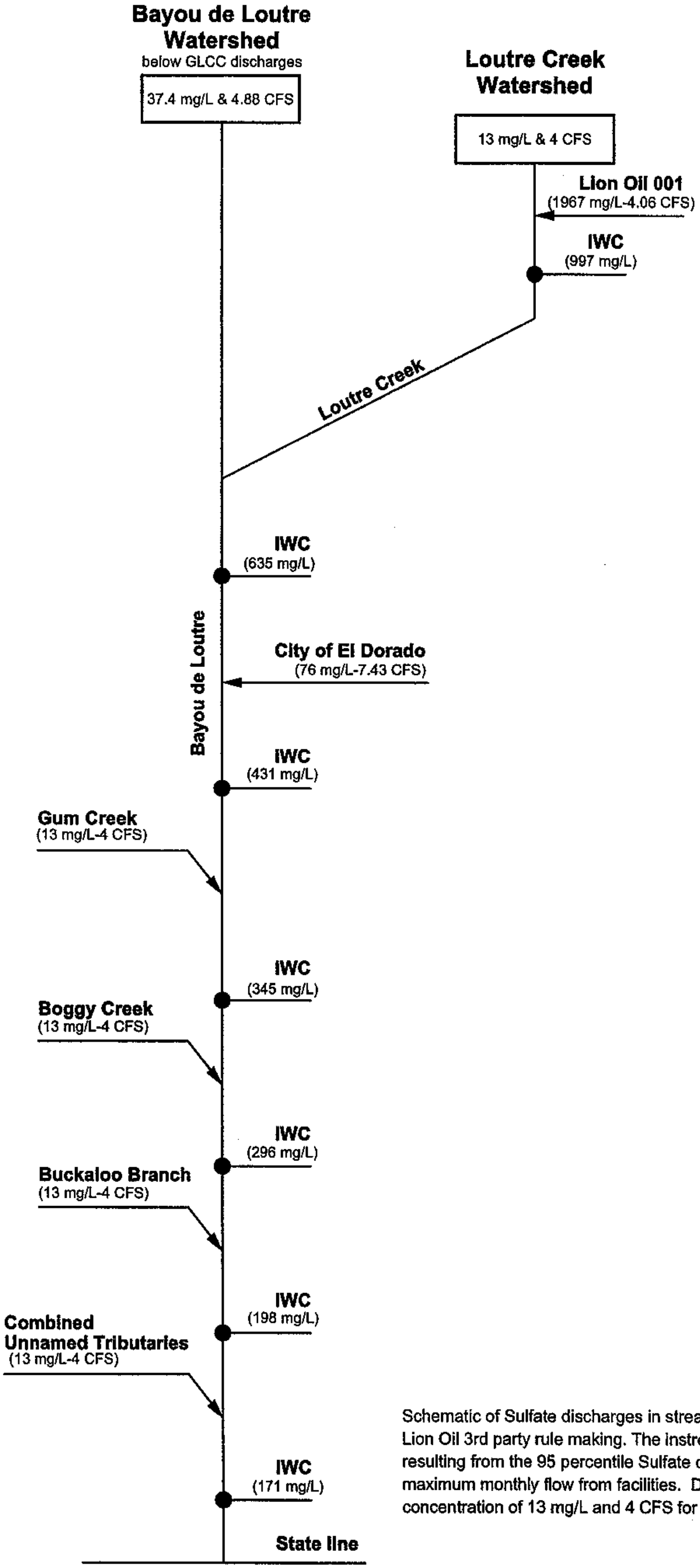
Qb = The background flow of the receiving stream
Cb = The background concentration of chloride, sulfate or TDS in the receiving stream
Qe = The discharge flow of the effluent
Ce = The effluent concentration of chloride, sulfate or TDS

Highest Monthly Average Flow		
Site	**MGD**	**cfs**
001	2.622	4.06

Highest Monthly Average Flow		
Site	**MGD**	**cfs**
002	1.52	2.35
003	1.39	2.15
004	2.68	4.15
005	NO DISCHARGE	
006	2.22	3.43
007	2.89	4.47
Average	2.14	3.31



Schematic of Chloride discharges in stream segments as projected for Lion Oil 3rd party rule making. The instream waste concentration resulting from the 95 percentile Chloride concentration and the mean maximum monthly flow from facilities. Default background mineral concentration of 5 mg/L and 4 CFS for tributaries.



Schematic of Sulfate discharges in stream segments as projected for Lion Oil 3rd party rule making. The instream waste concentration resulting from the 95 percentile Sulfate concentration and the mean maximum monthly flow from facilities. Default background mineral concentration of 13 mg/L and 4 CFS for tributaries.

Appendix D

Summary of Toxicity Testing Data

Appendix D-1

Chronic Summary

Outfall 001 Lion Facility Toxicity Summary (7-day chronic toxicity test) POR 1/4/2000 through 2005

	Ceriodaphnia dubia (Water Flea)						Pimephales promelas (Fathead Minnow)								
Date Test Initated	Survival CNTL	Survival 96%	Survival NOEL	Repro. CNTL	Repro. 72%	Repro. NOEL	Survival CNTL	Survival 96%	Survival NOEL	Growth CNTL	Growth 72%	Growth NOEL		TRC	Hardness
1/4/2000	100	100	96	18.4	19.7	96	87.5	85	96	0.355	0.293	96		0.01	79
6/20/2000	100	100	96	17	24.3	96	100	97.5	96	0.683	0.395	0		0.01	128
9/18/2000	100	90	96	18.4	14.7	0	97.5	97.5	96	0.663	0.44	41		0.01	104
12/12/2000	100	100	96	17.4	15	96	100	100	96	0.617	0.538	72		0.01	72
3/31/2001	100	100	96	19.9	19	96	90	87.5	96	0.446	0.292	72		0.01	84
9/17/2001	90	100	96	22.8	12.5	54	97.5	100	96	0.658	0.489	41		0.01	92
12/4/2001	100	90	96	20.5	0	0	97.5	55	41	0.728	0.403	0		0.01	96
3/26/2002	90	100	96	19.8	18.4	96	100	62.5	72	0.632	0.36	72		0.01	120
6/25/2002	80	100	96	26.6	16.1	96	92.5	92.5	96	0.453	0.505	96		0.01	64
7/6/2002	na	na	na	na	na	na	100	90	96	0.783	0.5	41		0.1	68
9/23/2002	100	100	96	18	7.1	0	na	na	na	na	na	na			
12/16/2002	100	100	96	22.1	11.4	30	87.5	100	96	0.81	0.848	96		0.01	52
2/4/2003	100	90	96	17	22.9	72	100	60	96	0.633	0.328	96	<	0.1	156
6/17/2003	100	100	96	23	22.9	72	82	96	96	0.932	1	96	<	0.01	112
9/9/2003	100	100	96	17.5	17.5	96	92.5	97.5	96	0.49	0.45	96	<	0.01	60
12/9/2003	80	80	96	16.4	17	72	100	90	96	0.405	0.415	72	<	0.01	156
1/20/2004	100	100	96	26.6	21.9	0	97.5	92.5	96	0.495	0.418	96	<	0.01	112
5/4/2004	100	100	96	28.9	14.7	30	92.5	97.5	96	0.44	0.585	96	<	0.01	80
8/16/2004	100	90	96	24.6	14.9	54	na	na	na	na	na	na	<	0.01	84
9/14/2004	--	–	–	--	–	–	97.5	100	96	0.588	0.793	96	<	0.1	76
12/7/2004	100	100	96	25.2	24.1	96	97.5	97.5	96	0.845	0.853	96	<	0.1	92
2/28/2005	90	100	96	33.6	25.3	0	100	100	96	0.555	0.53	96	<	0.01	72
5/17/2005	100	70	96	26	17.7	0	87.5	90	96	0.46	0.41	96	<	0.01	156
9/12/2005	100	100	96	24.5	16.9	41	97.5	92.5	96	0.793	0.605	30	<	0.01	92
11/7/2005	100	100	96	23.7	14.8	54	95	82.5	96	0.87	0.62	72	<	0.01	92

▨ = Note worthy data

Appendix D-2

Microtox Summary

Summary of	1999 Microtox Data.	
DATE	% EFFECT	% EFFECT
	5 MIN	15 MIN
7/14/1999	22.95	27.32
7/15/1999	36.69	52.88
7/16/1999	71.08	81.96
7/19/1999	20.35	18.91
7/20/1999	4.62	6.262
7/21/1999	7.39	10.69
7/22/1999	6.72	9.93
7/23/1999	3.44	0.8
7/26/1999	21.92	27.63
7/28/1999	4.44	6.76
7/29/1999	2.36	5.86
7/30/1999	21.36	27.89
7/31/1999	17.75	16.47
8/1/1999	15.25	13.53
8/2/1999	5.9	4.86
8/3/1999	10.4	7.6
8/4/1999	67.57	78.53
8/5/1999	70.37	79.9
8/6/1999	46.7	61.64
8/7/1999	9.04	0.16
8/8/1999	-10.72	0
8/9/1999	2.77	9.89
8/10/1999	2.44	1.44
8/11/1999	0.95	0.09
8/12/1999	7.46	6.85
8/13/1999	13.2	12.6
8/14/1999	9.26	5.57
8/15/1999	6.61	3.56
8/16/1999	-2.34	-5.75
8/17/1999	3.55	-0.28
8/18/1999	4.16	2.82
8/19/1999	4.21	0.63
8/20/1999	9.4	9.43
8/21/1999	12.67	10.96
8/22/1999	15.46	15.15
8/23/1999	15.78	9.6
8/24/1999	2.12	3.11
8/25/1999	27.38	29.54
8/26/1999	11.4	10.8
8/27/1999	17.54	13.19
8/28/1999	16.44	16.17
8/29/1999	16.08	20.31
8/30/1999	4.48	10.7
8/31/1999	3.45	-1.37
9/1/1999	15.7	14.3
9/2/1999	-12.9	-16.34
9/3/1999	-8.24	-15.42
9/4/1999	8.8	1.22
9/5/1999	27.62	24.11
9/6/1999	8.81	4.3
9/7/1999	6.57	1.53
9/8/1999	-10.91	-15.6
9/9/1999	8.66	2.45
9/10/1999	4.29	3.24
9/11/1999	0.91	1.56
9/12/1999	-2	-8.04
9/13/1999	-9.8	-14.3
9/14/1999	-12.2	-14.31
9/15/1999	2.35	1.99

9/16/1999	1.09	0.37
9/17/1999	6.4	3.88
9/18/1999	2.49	0.9
9/19/1999	42.7	41.6
9/20/1999	12.56	11.7
9/21/1999	2.66	3.2
9/22/1999	3.6	4.1
9/23/1999	-21.9	-25.09
9/24/1999	-16.05	-19.89
9/25/1999	4.8	0.77
9/26/1999	-3.27	-11.68
9/27/1999	-13.06	-18.05
9/28/1999	-5.98	-10.88
9/29/1999	-9.2	-12.19
9/30/1999	0.024	-1.66
10/1/1999	10.14	8.13
10/2/1999	55.25	68.15
10/3/1999	47.25	50.79
10/4/1999	14	16.24
10/5/1999	21.01	31.8
10/6/1999	8.08	6.7
10/7/1999	1.13	-4.65
10/8/1999	5.2	1.4
10/9/1999	6.4	5.3
10/10/1999	7.7	5.2
10/11/1999	1.5	0.8
10/12/1999	-1.41	1.15
10/13/1999	3.26	2.59
10/14/1999	1.33	0.02
10/15/1999	1.7	-6.02
10/16/1999	34.91	33.15
10/17/1999	2.67	0.7
10/18/1999	-5.4	-4.2
10/19/1999	5.2	-2.9
10/20/1999	-0.02	0.5
10/21/1999	-3.18	-8.4
10/22/1999	-6.02	
10/23/1999	-7.36	-14
10/24/1999	41.25	35.07
10/25/1999	39.06	30.3
10/26/1999	-1.8	-7.08
10/27/1999	-2.56	-6.77
10/28/1999	-6.02	-5.66
10/29/1999	0.27	-3.49
10/30/1999	-1.02	-9.43
10/31/1999	9.06	11.44
11/1/1999	-0.88	-12.26
11/2/1999	2.51	-0.97
11/3/1999	6.62	0.36
11/4/1999	11.95	7.23
11/5/1999	6.73	5.56
11/6/1999	52.47	46.3
11/7/1999	38.5	24.21
11/8/1999	-8.1	-19.7
11/9/1999	13.6	7.71
11/10/1999	-9.66	-9.44
11/11/1999	-10.89	-8.45
11/12/1999	-7.6	-11.1
11/13/1999	3.03	-3.9
11/14/1999	8.09	-1.67
11/15/1999	8.56	-1.5
11/16/1999	2.71	5.89
11/17/1999	3.98	0.35

11/18/1999	3.17	0.11
11/19/1999	27.22	23.63
11/20/1999	30.11	30.11
11/21/1999	9.31	4.07
11/22/1999	1.75	0.68
[redacted]	[redacted]	[redacted]
12/3/1999	-21.62	-4.08
12/4/1999	10.34	24.39
12/5/1999	16.7	30.55
12/6/1999	-2.82	7.33
12/7/1999	-14.4	-12.95
12/8/1999	2.81	5.55
12/9/1999	2.81	5.56
12/10/1999	-9.986	-7.81
12/11/1999	-6.896	-9.22
12/12/1999	-13.13	-11.65
12/13/1999	-15.59	-10.92
12/14/1999	1.744	-6.14
12/15/1999	1.74	-4.37
12/16/1999	0.019	-0.075
12/17/1999	-6.06	-9.16
12/18/1999	-3.6	0.7
12/19/1999	-5.79	-1.77
12/20/1999	-5	14.95
12/21/1999	-2.3	-10
12/22/1999	-1.03	-5.88
12/23/1999	-7.24	-0.26
12/24/1999	-1.97	1.99
12/25/1999	1.27	4.11
12/26/1999	-0.46	-3.22
12/27/1999	1.68	3.75
12/28/1999	0.79	3.16
12/29/1999	-2.25	-14.19
12/30/1999	-7.9	-15.44
12/31/1999	2.07	-0.79

Microtox 2000 Summary

DATE	% EFFECT 5 MIN	% EFFECT 15 MIN
1/1/2000	-5.53	5.49
1/2/2000	-3.75	9
1/3/2000	-6.13	4.44
1/4/2000	-3.19	-3.38
1/5/2000	-4.01	-4.07
1/6/2000	-0.21	-3.45
1/7/2000	1.2	1.26
1/8/2000	-5.67	-6.5
1/9/2000	-11.74	-9.77
1/10/2000	-10.17	-4.12
1/11/2000	1.85	1.43
1/12/2000	7.75	5.73
1/13/2000	-0.07	-1.57
1/14/2000	4.32	3.46
1/15/2000	-2.46	-13.46
1/16/2000	-9.8	-16.62
1/17/2000	24.23	30.03
1/18/2000	67.12	72.93
1/19/2000	60.55	69.32
1/20/2000	12.43	16.43
1/21/2000	-2.7	-11.4
1/22/2000	11.01	7.81
1/23/2000	-0.035	3.66
1/24/2000	-24.3	-22.9
1/25/2000	-14.56	-23.74
1/26/2000	-14.49	-30.8
1/27/2000	-8.35	-22.39
1/28/2000	-17.53	-35.8
1/29/2000	-1.02	-1.95
1/30/2000	-4.84	-12.6
1/31/2000	-8.95	-17.99
2/1/2000	-3.96	-4.91
2/2/2000	10.86	16.02
2/3/2000	-0.3	3.7
2/4/2000	3.44	6.78
2/5/2000	2.49	3.84
2/6/2000	6.64	9.12
2/7/2000	4.45	7.46
2/8/2000	-2.48	-8.75
2/9/2000	4.93	11.56
2/10/2000	-2.31	2.14
2/11/2000	-3.42	1.49
2/12/2000	6.99	8.83
2/13/2000	3.19	0.24
2/14/2000	-3.6	-9.58
2/15/2000	7.53	21.83
2/16/2000	-12.27	0.52
2/17/2000	-20.36	-11.39

2/18/2000	-18.27	-12.61
2/19/2000	-10.13	-14.33
2/20/2000	-7.31	-8.05
2/21/2000	-5.46	-0.88
2/22/2000	-0.4	4.72
2/23/2000	-3.7	5
2/24/2000	-0.64	11.19
2/25/2000	8.34	22.57
2/26/2000	10.27	17.96
2/27/2000	-0.22	4.11
2/28/2000	-2.67	0.06
2/29/2000	0.51	1.56
3/1/2000	-3.9	-4.3
3/2/2000	-4.47	-4.86
3/3/2000	-5.67	-4.01
3/4/2000	-0.62	-9.8
3/5/2000	-0.58	-3.61
3/6/2000	-0.23	-2.67
3/7/2000	-3.56	-5.8
3/8/2000	-4.62	-3.2
3/9/2000	-4.89	-4.2
3/11/2000	1.22	3.847
3/12/2000	6.34	9.033
3/13/2000	14.69	17.48
3/14/2000	10.44	13.5
3/15/2000	7.428	10.85
3/16/2000	4.625	7.688
3/17/2000	4.647	7.753
3/18/2000	5.752	5.834
3/19/2000	14.51	11.88
3/20/2000	14.22	7.918
3/21/2000	9.154	9.004
3/22/2000	6.492	6.09
3/23/2000	2.045	4.309
3/24/2000	-2.862	-0.4529
3/25/2000	7.945	8.589
3/26/2000	6.406	5.577
3/27/2000	6.325	10.78
3/28/2000	4.976	6.469
3/29/2000	11.49	21.61
3/30/2000	4.991	15.51
3/31/2000	-0.0086	11.77
4/1/2000	8.688	12.63
4/2/2000	9.546	8.636
4/3/2000	7.057	6.839
4/4/2000	1.683	-8.735
4/5/2000	0.2339	0.0046
4/6/2000	1.009	4.501
4/7/2000	-4.816	-5.443
4/8/2000	-19.82	-27.37
4/9/2000	-20.12	-25.85
4/10/2000	-11.41	-14.49

4/11/2000	0.8855	0.5442
4/12/2000	4.027	6.159
4/13/2000	7.419	13.33
4/14/2000	-1.265	5.422
4/15/2000	-8.359	-5.896
4/16/2000	-7.653	-0.9644
4/17/2000	-10.72	-2.684
4/18/2000	10.81	7.424
4/19/2000	16.08	13.62
4/20/2000	16.76	15.14
4/21/2000	19	16.52
4/22/2000	14.86	16.24
4/23/2000	16.34	20.11
4/24/2000	12.01	16.32
4/25/2000	13.75	18.11
4/26/2000	14.89	18.43
4/28/2000	15.64	18.41
4/29/2000	16.69	17.12
4/30/2000	10.15	11.86
5/1/2000	5.78	9.573
5/2/2000	13.79	18.21
5/3/2000	18.17	23.23
5/4/2000	15.44	19.59
5/5/2000	13.19	14.66
5/6/2000	12.22	10.67
5/7/2000	8.08	8.423
5/8/2000	7.578	6.318
5/9/2000	10.36	9.793
5/10/2000	7.291	10.64
5/12/2000	6.075	7.047
5/13/2000	4.725	5.775
5/14/2000	1.085	-0.165
5/15/2000	-0.1973	0.7301
5/16/2000	5.3	9.8
5/17/2000	1.77	9.61
5/18/2000	11.54	11.53
5/19/2000	8.517	7.439
5/20/2000	12.2	12.86
5/21/2000	5.529	7.187
5/22/2000	4.947	8.502
5/24/2000	4.979	7.305
5/25/2000	3.25	5.811
5/26/2000	3.893	6.873
5/27/2000	3.724	8.726
5/28/2000	2.803	6.58
5/29/2000	-0.1431	4.73
5/30/2000	4.063	11.29
5/31/2000	4.176	6.487
6/1/2000	1.941	2.632
6/2/2000	-3.321	-1.515
6/3/2000	4.531	4.328
6/4/2000	4.153	5.517

6/5/2000	3.216	3.087
6/6/2000	-2.332	-2.6
6/7/2000	-4.217	-2.523
6/8/2000	4.567	7.073
6/9/2000	8.63	6.194
6/10/2000	8.986	8.774
6/11/2000	10.76	12.26
6/12/2000	4.772	9.631
6/13/2000	-1.244	-0.467
6/14/2000	2.527	3.596
6/15/2000	-0.6572	0.8189
6/16/2000	3.228	8.695
6/17/2000	-0.9489	0.9144
6/18/2000	-2.717	3.898
6/19/2000	-3.471	3.967
6/20/2000	7.263	6.076
6/21/2000	8.145	6.83
6/22/2000	9.169	9.198
6/23/2000	7.894	8.993
6/24/2000	6.381	8.537
6/25/2000	2.172	4.657
6/26/2000	3.214	5.585
6/27/2000	6.41	7.878
6/28/2000	5.184	6.339
6/29/2000	4.427	7.32
6/30/2000	-1.672	1.845
7/1/2000	3.491	4.697
7/2/2000	7.487	5.972
7/3/2000	7.972	6.427
7/4/2000	-1.34	1.21
7/5/2000	0.0064	1.351
7/6/2000	-2.343	0.1314
7/7/2000	7.949	11.98
7/8/2000	4.987	10.57
7/9/2000	5.573	8.599
7/10/2000	9.463	8.965
7/12/2000	6.019	5.888
7/13/2000	6.218	6.498
7/14/2000	-0.5927	1.449
7/15/2000	4.58	5.517
7/16/2000	8.799	7.12
7/17/2000	6.349	4.356
7/18/2000	6.881	13.48
7/19/2000	4.342	11.77
7/20/2000	3.611	12.11
7/21/2000	1.639	9.134
7/24/2000	8.402	12.36
7/25/2000	0.9149	2.149
7/26/2000	-3.4	1.596
7/27/2000	-5.129	-0.9551
7/28/2000	-7.006	-1.338
7/29/2000	2.147	3.675

7/30/2000	-1.571	0.9958
7/31/2000	-4.774	0.6202
8/1/2000	4.607	8.227
8/2/2000	7.012	10.72
8/4/2000	2.434	7.264
8/5/2000	10.74	13.83
8/6/2000	11.44	18.44
8/7/2000	8.972	17.19
8/9/2000	2.298	3.513
8/10/2000	8.542	11.89
8/11/2000	7.412	12.61
8/12/2000	10.29	8.389
8/13/2000	6.137	6.298
8/14/2000	4.354	7.247
8/15/2000	3.827	3.957
8/16/2000	-2.546	5.273
8/17/2000	-4.311	6.561
8/18/2000	-3.749	6.933
8/19/2000	8.556	8.316
8/20/2000	13.23	10.64
8/21/2000	7.378	4.689
8/22/2000	3.1	4.977
8/25/2000	5.901	7.762
8/26/2000	13.1	13.35
8/27/2000	8.656	6.536
8/28/2000	6.035	5.882
8/29/2000	3.323	6.404
8/30/2000	4.327	7.999
8/31/2000	3.264	13.44
9/1/2000	6.288	15.54
9/2/2000	14.39	18.49
9/3/2000	16.68	21.47
9/4/2000	11.9	16.38
9/5/2000	3.029	7.954
9/6/2000	2.497	3.818
9/7/2000	2.791	8.664
9/8/2000	8.343	12.38
9/9/2000	3.667	3.257
9/10/2000	5.949	13.34
9/11/2000	4.061	14.57
9/12/2000	24.65	32.19
9/13/2000	23.1	33.77
9/14/2000	14.7	24.1
9/15/2000	4.653	13.08
9/16/2000	9.316	13.24
9/17/2000	6.309	8.457
9/18/2000	-1.572	2.33
9/19/2000	5.8	7.047
9/20/2000	7.808	5.423
9/21/2000	7.366	6.103
9/22/2000	5.554	1.838
9/23/2000	1.337	8.929

9/24/2000	-2.699	6.447
9/25/2000	-6.521	3.65
9/26/2000	4.185	7.175
9/28/2000	10.76	14.96
9/29/2000	11.25	17.67
9/30/2000	13.56	15.71
10/1/2000	10.84	13.09
10/2/2000	10.83	12.99
10/3/2000	12.14	11.34
10/4/2000	11.07	11.9
10/5/2000	5.652	7.685
10/6/2000	0.8074	6.643
10/7/2000	8.732	13.21
10/8/2000	2.252	1.288
10/9/2000	-0.6422	-1.356
10/10/2000	7.425	11.88
10/11/2000	2.41	5.296
10/12/2000	2.557	6.004
10/13/2000	-1.073	1.939
10/14/2000	9.625	15.15
10/15/2000	-0.9224	2.842
10/16/2000	-2.231	1.515
10/17/2000	7.045	8.658
10/18/2000	2.674	4.17
10/19/2000	-4.992	-6.673
10/20/2000	-3.405	1.742
10/21/2000	-1.324	4.196
10/22/2000	-6.11	-4.485
10/23/2000	-12.08	-6.524
10/24/2000	4.388	3.8
10/25/2000	9.662	10.8
10/26/2000	6.731	8.903
10/27/2000	6.984	11.35
10/28/2000	8.544	11.78
10/29/2000	9.3	11
10/30/2000	-0.1682	-0.6373
10/31/2000	8.428	11.36
11/1/2000	7.176	5.032
11/2/2000	4.138	5.264
11/3/2000	-2.084	1.534
11/4/2000	8.579	11.94
11/5/2000	6.569	5.572
11/6/2000	6.584	10.77
11/7/2000	6.969	9.189
11/8/2000	9.464	8.573
11/9/2000	8.502	10.94
11/10/2000	4.447	7.891
11/11/2000	9.829	12.21
11/12/2000	5.379	5.343
11/13/2000	-0.7618	-1.834
11/14/2000	4.186	6.239
11/15/2000	-0.6936	-6.863

11/16/2000	-3.057	-7.548
11/17/2000	-7.789	-13.99
11/18/2000	1.493	-0.4657
11/19/2000	3.703	-1.447
11/20/2000	-4.523	-4.98
11/21/2000	-4.339	-3.836
11/22/2000	-2.011	0.3722
11/23/2000	6.873	6.882
11/24/2000	7.866	6.189
11/25/2000	2.931	1.292
11/26/2000	2.78	0.5492
11/27/2000	25.13	35.85
11/28/2000	3.755	4.842
11/29/2000	3.643	5.349
11/30/2000	3.276	5.677
12/1/2000	-1.641	3.034
12/2/2000	3.504	7.954
12/3/2000	9.043	8.131
12/4/2000	2.222	5.578
12/5/2000	1.458	0.0683
12/6/2000	-7.731	-2.527
12/7/2000	-9.476	-4.253
12/9/2000	7.28	7.51
12/10/2000	11.09	8.11
12/11/2000	13.05	10.3
12/12/2000	7.632	5.7
12/13/2000	5.207	5.516
12/14/2000	5.375	9.763
12/15/2000	7.63	10.73
12/16/2000	5.18	11.43
12/17/2000	4.557	7.488
12/18/2000	4.097	10.87
12/20/2000	10.69	12.75
12/21/2000	6.846	9.386
12/22/2000	35.79	39.99
12/23/2000	5.038	7.409
12/24/2000	-1.135	4.01
12/25/2000	0.2561	-0.3672
12/26/2000	-2.998	-1.717
12/27/2000	-0.67	5.312
12/28/2000	4.69	7.056
12/29/2000	9.509	11.17
12/30/2000	0.34	5.1
12/31/2000	2.6	7.02

Microtox Summary 2001

1/1/2001	6.96	10.69
1/2/2001	-0.75	1.47
1/3/2001	8.62	3.95
1/4/2001	9.42	0.32
1/5/2001	0.1378	-0.0469
1/6/2001	-4.007	-2.355
1/7/2001	-9.379	-8.386
1/8/2001	-11.84	-10.83
1/9/2001	-3.892	-0.7014
1/10/2001	-2.481	-3.232
1/11/2001	-6.899	-3.565
1/12/2001	-8.733	-5.312
1/13/2001	7.28	3.55
1/14/2001	15.28	10.44
1/15/2001	16.4	9.7
1/16/2001	9.62	5.19
1/17/2001	12.81	10.09
1/18/2001	12.93	10.36
1/19/2001	10.35	10.69
1/20/2001	6.07	3.68
1/21/2001	6.29	
1/22/2001	8.5	
1/23/2001	-6.1	-9.41
1/24/2001	-2.949	-8.085
1/25/2001	1.56	-3
1/26/2001	-1.4	-6.222
1/27/2001	2.19	0.33
1/28/2001	16.26	19.99
1/29/2001	11.71	11.42
1/30/2001	6.86	5.75
1/31/2001	-2.6	-5.7
2/1/2001	1.45	-1.4
2/2/2001	-0.34	-4.1
2/3/2001	0.93	-2.96
2/4/2001	4.76	2.78
2/5/2001	5.96	3.45
2/6/2001	1.63	-0.31
2/8/2001	4.08	4.98
2/10/2001	2.8	0.6
2/11/2001	6	2.99
2/12/2001	2.09	3.09
2/13/2001	15.31	9.08
2/17/2001	-4.94	-10.52
2/18/2001	24.98	15.89
2/19/2001	3.68	-2.94
2/21/2001	3.62	-2.12
2/22/2001	-8.3	-12.32
2/23/2001	-9.88	-17.93
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Microtox 2002 Summary

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11/6/2002	-7.62	-3.29	-0.34
11/7/2002	-16.19	-14.25	-15.1
11/8/2002	-5.54	-1.55	2.17
11/9/2002	8.97	7.36	4.72
11/10/2002	28.24	28.07	25.11
11/11/2002	26.38	26.48	26.69
11/12/2002	25.96	26.12	24.77
11/13/2002	24.46	22.22	17.86
11/14/2002	6.88	8.15	9.66
11/15/2002	17.05	20.17	20.34
11/16/2002	15.55	16.64	15.06
11/17/2002	16.82	17.21	16.36
11/18/2002	16.42	18.7	16.61
11/19/2002	-3.22	-2.66	-1.53
11/20/2002	12.09	12.22	9.49
11/21/2002	-5.24	-12.42	-14.97
11/22/2002	8.36	2.06	0.43
11/24/2002	7.03	-0.96	-5.15
11/25/2002	5.51	-1.86	-5.82
11/26/2002	5.06	-1.83	-7.93
11/27/2002	1.05	4.17	6.88
11/28/2002	0.41	-2.51	-8.11
11/29/2002	1.54	-1.3	-5.09
11/30/2002	-0.97	-4.99	-7.52
12/1/2002	3.28	-1.28	-5.87
12/2/2002	1.31	-3.63	-9.63
12/4/2002	2.14	1.66	11.72
12/5/2002	7.13	0.27	-3.71
12/6/2002	19.88	16.61	10.56

12/8/2002	21.41	13.31	0.85
12/9/2002	19.19	15.52	7.62
12/10/2002	16.29	13.47	4.62
12/11/2002	19.97	15.65	19.56
12/12/2002	3.21	-4.23	-5.62
12/13/2002	1.95	-4.33	-6.34
12/14/2002	8.72	6.6	5.99
12/15/2002	6.82	3.2	0.98
12/16/2002	5.16	3.87	3.39
12/17/2002	0.08	-1.83	-4.69
12/18/2002	1.71	-0.3	17.11
12/19/2002	0.4	-11.15	-16.63
12/20/2002	7.91	-2.13	-1.5
12/21/2002	2.81	1.79	2
12/22/2002	17.76	12.73	5.12
12/23/2002	11.02	6.05	-3.78
12/24/2002	11.94	5.88	-3.77
12/25/2002	14.37	8.38	-0.53
12/26/2002	-7.04	-6.36	-2.71
12/27/2002	-11.96	-10.13	-4.96
12/28/2002	-16.07	-25.99	-29.52
12/29/2002	-2.09	-13.09	-20.32
12/30/2002	-6.6	-18.72	-26.3
12/31/2002	-6.72	-17.63	-25.68

Summary or Microtox for 2003

	5 MIN	15 MIN	30 MIN
11/1/2002	14.87	10.79	5.43
11/2/2002	12	6.44	1.74
11/3/2002	15	11.41	5.05
11/4/2002	18.01	14.19	7.15
11/5/2002	-0.94	2.4	3.92
11/6/2002	-7.62	-3.29	-0.34
11/7/2002	-16.19	-14.25	-15.1
11/8/2002	-5.54	-1.55	2.17
11/9/2002	8.97	7.36	4.72
11/10/2002	28.24	28.07	25.11
11/11/2002	26.38	26.48	26.69
11/12/2002	25.96	26.12	24.77
11/13/2002	24.46	22.22	17.86
11/14/2002	6.88	8.15	9.66
11/15/2002	17.05	20.17	20.34
11/16/2002	15.55	16.64	15.06
11/17/2002	16.82	17.21	16.36
11/18/2002	16.42	18.7	16.61
11/19/2002	-3.22	-2.66	-1.53
11/20/2002	12.09	12.22	9.49
11/21/2002	-5.24	-12.42	-14.97
11/22/2002	8.36	2.06	0.43
11/24/2002	7.03	-0.96	-5.15
11/25/2002	5.51	-1.86	-5.82
11/26/2002	5.06	-1.83	-7.93
11/27/2002	1.05	4.17	6.88
11/28/2002	0.41	-2.51	-8.11
11/29/2002	1.54	-1.3	-5.09
11/30/2002	-0.97	-4.99	-7.52
12/1/2002	3.28	-1.28	-5.87
12/2/2002	1.31	-3.63	-9.63
12/4/2002	2.14	1.66	11.72
12/5/2002	7.13	0.27	-3.71
12/6/2002	19.88	16.61	10.56
12/8/2002	21.41	13.31	0.85
12/9/2002	19.19	15.52	7.62
12/10/2002	16.29	13.47	4.62
12/11/2002	19.97	15.65	19.56
12/12/2002	3.21	-4.23	-5.62
12/13/2002	1.95	-4.33	-6.34
12/14/2002	8.72	6.6	5.99
12/15/2002	6.82	3.2	0.98
12/16/2002	5.16	3.87	3.39
12/17/2002	0.08	-1.83	-4.69
12/18/2002	1.71	-0.3	17.11
12/19/2002	0.4	-11.15	-16.63
12/20/2002	7.91	-2.13	-1.5
12/21/2002	2.81	1.79	2

12/22/2002	17.76	12.73	5.12
12/23/2002	11.02	6.05	-3.78
12/24/2002	11.94	5.88	-3.77
12/25/2002	14.37	8.38	-0.53
12/26/2002	-7.04	-6.36	-2.71
12/27/2002	-11.96	-10.13	-4.96
12/28/2002	-16.07	-25.99	-29.52
12/29/2002	-2.09	-13.09	-20.32
12/30/2002	-6.6	-18.72	-26.3
12/31/2002	-6.72	-17.63	-25.68
1/1/2003	-0.03	-11.61	-20.56
1/2/2003	-9.01	-27.87	-39.9
1/3/2003	-4.92	-19.64	-24.64
1/4/2003	-2.48	-14.89	-22.25
1/5/2003	-2.96	-15.72	-23.28
1/6/2003	-3.91	-19.83	-27.48
1/7/2003	-2.96	-3.65	-6.48
1/8/2003	8.39	-1.23	-2.94
1/9/2003	-3.04	-7.91	-6.47
1/10/2003	-4	-9.83	-14.8
1/11/2003	-1.5	-8.87	-15.75
1/13/2003	0.93	-5.82	-12.8
1/14/2003	0.93	-6.7	-14.38
1/15/2003	4.7	-6.31	-10.43
1/16/2003	11.47	-1.09	-10.44
1/17/2003	8.8	-2.17	-7.66
1/18/2003	-0.49	-10.69	-15.23
1/20/2003	8.4	-3.11	-12.87
1/21/2003	-12.61	-14.19	-15.04
1/22/2003	-3.88	-2.76	1.24
1/23/2003	-1.5	-5.27	-5.93
1/24/2003	10.9	8.01	6.46
1/27/2003	12.65	8.46	6.51
1/28/2003	9.33	5.16	2.86
1/29/2003	12.62	8.73	6.84
1/30/2003	-1.21	-7.81	-10.78
1/31/2003	4.01	-7.56	-8.95
2/1/2003	-0.63	-2.37	-2.82
2/2/2003	13.65	8.29	10.96
2/3/2003	16.06	8.38	7.09
2/4/2003	-4.9	-15.06	-17.37
2/5/2003	0.94	-2.94	-1.62
2/6/2003	-14.2	-20.55	-22.44
2/7/2003	-14.23	-4.13	-2.36
2/8/2003	-9.74	-15.95	-17.47
2/9/2003	1.44	-8.5	-7.04
2/10/2003	2.07	-9.43	-8.93
2/11/2003	5.86	-1.65	-4.41
2/12/2003	-4.32	-4.63	-5.76
2/13/2003	5.74	-4.05	-4.73
2/14/2003	-3.76	0.1	9.8
2/15/2003	18.47	19.1	26.49

2/16/2003	19.67	21.44	29.68
2/17/2003	19.41	20.68	30.07
2/18/2003	20.48	24.19	31.31
2/19/2003	12.89	16.9	26.11
2/20/2003	12.65	23.7	30.06
2/21/2003	14.57	24.15	31.74
2/22/2003	14.37	26.2	34.41
2/23/2003	11.04	25.4	34.4
2/24/2003	14.4	16.09	20.48
2/25/2003	14.96	18.93	25.07
2/26/2003	14.64	17.5	24.59
2/27/2003	10.54	3.92	0.95
2/28/2003	22.2	15.04	10.35
3/3/2003	18.37	11	4.75
3/8/2003	8.95	6	2.68
3/9/2003	10.76	9.53	5.6
3/10/2003	14.64	11.53	5.94
3/11/2003	12.31	9.68	3.64
3/12/2003	16.2	13.43	8.25
3/13/2003	4.37	8.18	8.82
3/14/2003	11.8	14.96	16.73
3/15/2003	12.61	11.83	9.72
3/16/2003	21.83	19.98	14.63
3/17/2003	22.46	20.78	14.27
3/18/2003	17.94	16.72	11.5
3/19/2003	14.88	14.85	10.25
3/20/2003	11.91	17.46	25.58
3/21/2003	1.68	-0.97	
3/22/2003	9.48	4.37	
3/23/2003	16.04	9.48	
3/24/2003	16.61	11.24	
3/25/2003	15.2	11.54	
3/27/2003	12.24	12.28	13.85
3/28/2003	22.56	22.93	20.6
3/29/2003	23.93	23.34	20.24
3/30/2003	22.16	22.52	20.42
3/31/2003	22.49	22.54	18.28
4/1/2003	5.33	4.85	5.68
4/2/2003	13.29	14.56	13.3
4/3/2003	0.79	0.8	-0.03
4/4/2003	3.79	2.84	5.5
4/5/2003	4.67	5.04	6.8
4/6/2003	3	4.9	6.96
4/7/2003	7.12	9.78	13.06
4/8/2003	-1.64	5.1	9.99
4/9/2003	-3.16	3.56	10.15
4/10/2003	8.16	4.8	2.24
4/11/2003	19.09	15.83	11.27
4/12/2003	21.94	18.71	13.25
4/13/2003	21.37	17.77	12.54
4/14/2003	21.73	18.9	12.64
4/15/2003	-6.19	-5.81	-1.43

4/16/2003	-1.78	0.36	2.21
4/17/2003	-3.95	-2.85	-1.7
4/18/2003	-1.21	-5.13	-5.68
4/19/2003	8.25	5.78	5.1
4/20/2003	6.76	4.67	2.87
4/21/2003	7.59	5.45	2.49
4/22/2003	3.69	1.03	-3.78
4/23/2003	11.3	4.39	-0.21
4/24/2003	28.15	25.15	20.16
4/25/2003	33.11	32.47	29.38
4/26/2003	34.73	34.14	29.17
4/27/2003	43.3	47.52	48.7
4/28/2003	26.3	35.63	44.89
4/29/2003	22.61	31.02	41.91
4/30/2003	15.26	20.07	23.32
5/1/2003	19.97	19.37	14.57
5/2/2003	5.87	3.2	-1.91
5/3/2003	5.61	1.09	-2.88
5/4/2003	8.32	3.64	0.07
5/5/2003	5.59	2.99	-2.19
5/6/2003	8.65	7.89	7.03
5/7/2003	35.3	35.7	38.6
5/8/2003	32.6	31.9	33.8
5/9/2003	34.1	32.6	33.7
5/10/2003	20.37	24.95	27.61
5/11/2003	20.68	26.14	29.6
5/12/2003	9.38	12.21	12.37
5/13/2003	8.44	12.74	12.74
5/14/2003	15.37	18.7	20.59
5/15/2003	8.58	10.23	11.46
5/16/2003	19.37	12.31	16.74
5/17/2003	21.5	2.2	2.64
5/18/2003	22.97	3.54	2.96
5/19/2003	21.18	-1.67	-0.63
5/20/2003	22.36	3.86	2.19
5/21/2003	-8.68	-4.4	-2.7
5/22/2003	1.41	-4.62	-8.91
5/23/2003	6.15	0.78	-2.46
5/24/2003	4.28	-1.66	-4.3
5/25/2003	5.88	0.91	-4.13
5/26/2003	16.96	16.82	15.64
5/27/2003	-5.39	-9.1	-10.54
5/28/2003	-2.86	-3.07	-3.57
5/29/2003	2.11	0.08	-4.22
5/30/2003	8.98	8.09	4.42
5/31/2003	10.43	10.07	6.65
6/1/2003	10.61	11.55	7.06
6/2/2003	8.72	9.13	4.71
6/3/2003	-3.93	-4.37	-7.77
6/4/2003	0.23	0.72	-2.02
6/5/2003	-1.26	0.19	-2.55
6/6/2003	-5.12	-6.38	-5.37

6/7/2003	-2.78	-8.76	-8.16
6/8/2003	-4.38	-9.55	-9.25
6/9/2003	-3.65	-10.24	-11.73
6/10/2003	-3.54	-4.93	-8.44
6/11/2003	5.17	2.16	1.25
6/12/2003	2.41	-1.4	-1.4
6/13/2003	4.17	0.9	0.47
6/14/2003	-7.58	-9.69	-6.85
6/15/2003	-6.58	-10.23	-7.61
6/16/2003	-4.24	-11.71	-7.38
6/17/2003	7.46	-0.25	-4.6
6/18/2003	27.04	14.36	12.06
6/19/2003	-0.94	-4.22	-7.73
6/20/2003	5.31	-3.42	2.9
6/21/2003	9.76	3.63	3.52
6/22/2003	19.23	5.67	0.23
6/23/2003	18.65	6.42	-1.13
6/24/2003	23.36	11.94	4.62
6/25/2003	28.27	16.15	5.27
6/26/2003	-7.47	-12.15	-25.57
6/27/2003	-3.86	-1.82	-6.67
6/28/2003	-15.69	-15.06	
6/29/2003	-11.57	-10.32	
6/30/2003	-15.09	-14.27	
7/1/2003	-11.81	-6.72	
7/2/2003	-5.05	-6.71	
7/3/2003	8.26	1.58	-1.62
7/4/2003	1.31	-3.63	-9.15
7/5/2003	6.34	0.56	-3.86
7/6/2003	7.56	3.59	-3.62
7/7/2003	4.68	4.35	-6.24
7/8/2003	-3.89	-6.25	-6.62
7/9/2003	-5.26	-6.3	-0.44
7/10/2003	-3.43	-1.77	0.91
7/12/2003	11.22	4.1	-11.08
7/13/2003	12.6	6.46	-9.99
7/14/2003	10.84	5.86	-14.28
7/15/2003	12.18	8	-12.6
7/16/2003	4	1.92	0.99
7/17/2003	9.07	6.88	6.69
7/18/2003	6.67	4.25	4.62
7/19/2003	-9.34	-15.67	-10.1
7/20/2003	-3.47	-18.54	-16.51
7/21/2003	-7.14	-22.42	-14.11
7/22/2003	-3.34	-16.54	-11.73
7/23/2003	-0.51	-11.62	-0.2
7/24/2003	1.34	1.04	-1.28
7/25/2003	2.26	0.3	-1.19
7/26/2003	3.4	5.02	1.91
7/27/2003	7.39	9.82	8.61
7/28/2003	2.25	3.38	5.34
7/29/2003	-11.54	-8.46	-6.54

7/30/2003	-5.45	-2.54	5.28
7/31/2003	-9.47	-6.24	0.11
8/1/2003	3.47	-1.42	-2.5
8/2/2003	22.48	17.58	14.5
8/3/2003	20.95	16.17	14.66
8/4/2003	20.44	15.39	16.31
8/5/2003	20.53	15.42	12.53
8/6/2003	-2.37	-8.71	-12.36
8/7/2003	1.95	-3.33	-3.89
8/8/2003	18.97	14.98	4.47
8/9/2003	21.69	18.39	8.01
8/10/2003	22.62	18.16	5.53
8/11/2003	21.54	16.7	1.37
8/12/2003	-4.14	-6.56	-7.14
8/13/2003	1.04	0.06	-3.15
8/14/2003	-5.86	-6.95	-13.31
8/15/2003	-3.76	-5.14	-12.24
8/16/2003	-6.08	-4.69	-12.16
8/17/2003	-8.13	-7.74	-14.73
8/18/2003	-9.12	-5.77	-11.36
8/19/2003	-16.16	-14.72	-14.74
8/20/2003	-12.63	-13.17	-11.29
8/21/2003	3.08	-3.97	-3.64
8/22/2003	1.31	-8.03	0.24
8/23/2003	2.13	-5.49	2.19
8/24/2003	0.09	-7.19	-0.03
8/25/2003	6.87	-0.25	4.82
8/26/2003	-7.21	-12.55	-12.01
8/27/2003	1.68	-3.1	-1.82
8/28/2003	-1.42	-7.89	-24.02
8/29/2003	7.07	-15.83	-22.08
8/30/2003	11.5	-13.36	-19.21
8/31/2003	13.82	-13.93	-19.68
9/1/2003	17.34	-8.21	-9
9/2/2003	-5.55	-6.79	-12.18
9/3/2003	-21.27	-8.98	-3.24
9/4/2003	-21.79	-6.78	-3.35
9/5/2003	6.2	2.82	-0.39
9/6/2003	-0.08	-3.32	-2.12
9/7/2003	5.52	5.11	2.94
9/8/2003	7.12	3.44	2.86
9/9/2003	9.43	6.16	3.62
9/10/2003	15.15	8.96	4.43
9/11/2003	23.17	24.95	25.91
9/12/2003	5.12	9.26	
9/13/2003	10.56	8.53	
9/14/2003	7.45	9.48	
9/15/2003	6.31	7.64	
9/16/2003	6.38	1.82	-1.01
9/17/2003	-0.68	-3.02	-3.95
9/18/2003	6.61	4.05	2.27
9/19/2003	4.08	0.29	-1.96

9/20/2003	0.24	-5.33	-4.72
9/21/2003	10.58	2.75	2.38
9/22/2003	11.73	3.36	3.72
9/23/2003	14.47	10.93	11.08
9/24/2003	14.64	6.2	5.87
9/25/2003	0.138	1.05	4.21
9/26/2003	1.94	1.42	7.28
9/27/2003	-1.45	-3.01	2.58
9/28/2003	-3.28	-4.96	0.94
9/29/2003	-3.96	-6.05	-0.74
9/30/2003	-1.2	1.86	5.97
10/1/2003	0.53	0.89	5.69
10/2/2003	0.93	2.59	-0.21
10/3/2003	11.12	11.09	5.2
10/4/2003	8.69	13.98	8.67
10/5/2003	7.71	12.31	7.97
10/6/2003	4.88	9.66	5.1
10/8/2003	0.57	-1.43	-1.97
10/9/2003	1.6	-1.06	0.13
10/10/2003	0.96	-1.72	0.14
10/11/2003	-1.94	-1.82	-1.58
10/12/2003	-4.05	-4.46	-3.34
10/13/2003	-8.66	-8.68	-8.2
10/14/2003	-11.3	-9.88	-9.72
10/15/2003	-3.53	0.91	-0.89
10/16/2003	9.17	8.83	7.99
10/17/2003	5.54	6.98	3.65
10/18/2003	5.22	5.58	2.5
10/19/2003	-1.33	4.2	-6.3
10/20/2003	-0.62	5.22	-0.76
10/21/2003	-0.27	2.64	-5.46
10/22/2003	4.62	3.35	-0.64
10/23/2003	1.83	2.73	-4.13
10/24/2003	4.97	6	-2.45
10/25/2003	3.49	5.34	-3.7
10/26/2003	13.78	22.59	20.61
10/27/2003	4.22	4.23	9.39
10/28/2003	1.94	-5.39	-8.42
10/29/2003	-0.55	-4.46	-4.83
10/30/2003	1.42	-4.33	-4.36
10/31/2003	1.05	-4.34	-2.56
11/1/2003	-4.75	-11.81	-9.26
11/2/2003	-3.71	-13.02	-12.98
11/3/2003	-9.62	-9.2	-12.1
11/4/2003	0.29	-3.1	-6.04
11/5/2003	-1.93	-6.4	-9.61
11/6/2003	6.89	3.11	-0.84
11/7/2003	7.92	3.05	1.57
11/8/2003	7.43	5.81	2.49
11/9/2003	10.54	7.73	2.55
11/10/2003	-3.96	-7.57	-6.7
11/11/2003	-0.85	-1.9	-1.88

11/12/2003	6.94	2.86	-1.08
11/13/2003	7.47	8.11	7.43
11/14/2003	4.2	4.61	2.18
11/15/2003	5.17	5.73	3.6
11/16/2003	5.58	6.39	1.85
11/17/2003	-8.14	-8.26	-8.88
11/18/2003	5.28	-1.34	-3.69
11/19/2003	-3.34	-11.07	-9.85
11/20/2003	-3.25	-9.34	-8.11
11/21/2003	-4	-6.8	-5.33
11/22/2003	-1.83	-6.51	-7.73
11/23/2003	-4.12	-5.96	-5.73
11/24/2003	-2.54	-6.18	-2.27
11/25/2003	-0.82	-1.78	3.1
11/26/2003	3.24	-0.48	-3.75
11/27/2003	8.06	3.19	-2.38
11/28/2003	7.24	0.93	-4.5
11/29/2003	9.08	4.02	-0.73
11/30/2003	9.64	4.17	-0.68
12/1/2003	-4.46	-5.28	-7.41
12/2/2003	-0.58	1.5	-1.61
12/3/2003	-8.95	-9.94	-12.16
12/4/2003	9.05	9.72	15.85
12/5/2003	17.86	15.96	21.72
12/6/2003	18.09	16.86	21.54
12/7/2003	20.2	20.22	23.4
12/8/2003	18.22	16.97	21.28
12/9/2003	8.77	6	5.81
12/10/2003	9.54	5.09	8.88
12/11/2003	3.59	-0.45	-3.69
12/12/2003	0.2	-5.59	-10.1
12/13/2003	5.89	3.67	-0.42
12/14/2003	13.99	10.52	9.27
12/15/2003	11.96	9.12	5.71
12/16/2003	11.59	8.28	3.78
12/17/2003	14.04	10	6.27
12/18/2003	9.3	4	0.65
12/19/2003	13.95	7.54	-1.14
12/20/2003	11.71	8.29	-2.39
12/21/2003	12.76	10.42	1.14
12/22/2003	12.18	8.83	-1.44
12/24/2003	6.6	3.08	
12/26/2003	11.84	9.32	
12/27/2003	11.96	7.6	
12/28/2003	10.38	5.78	
12/29/2003	10.46	8.2	
12/30/2003	-0.06	-3.44	-2.88
12/31/2003	4.56	3.26	-1.72

Summary of Microtox 2004 Data

	5 MIN	15 MIN	30 MIN
12/1/2003	-4.46	-5.28	-7.41
12/2/2003	-0.58	1.5	-1.61
12/3/2003	-8.95	-9.94	-12.16
12/4/2003	9.05	9.72	15.85
12/5/2003	17.86	15.96	21.72
12/6/2003	18.09	16.86	21.54
12/7/2003	20.2	20.22	23.4
12/8/2003	18.22	16.97	21.28
12/9/2003	8.77	6	5.81
12/10/2003	9.54	5.09	8.88
12/11/2003	3.59	-0.45	-3.69
12/12/2003	0.2	-5.59	-10.1
12/13/2003	5.89	3.67	-0.42
12/14/2003	13.99	10.52	9.27
12/15/2003	11.96	9.12	5.71
12/16/2003	11.59	8.28	3.78
12/17/2003	14.04	10	6.27
12/18/2003	9.3	4	0.65
12/19/2003	13.95	7.54	-1.14
12/20/2003	11.71	8.29	-2.39
12/21/2003	12.76	10.42	1.14
12/22/2003	12.18	8.83	-1.44
12/24/2003	6.6	3.08	
12/26/2003	11.84	9.32	
12/27/2003	11.96	7.6	
12/28/2003	10.38	5.78	
12/29/2003	10.46	8.2	
12/30/2003	-0.06	-3.44	-2.88
12/31/2003	4.56	3.26	-1.72
1/1/2004	7.87	4.5	0.64
1/2/2004	9.49	10.08	5.71
1/3/2004	4.2	4.09	2.2
1/4/2004	12.33	10.12	7.84
1/7/2004	3.89	1.92	-0.65
1/8/2004	2.85	1.73	7.65
1/9/2004	-1.04	-4.73	-7.37
1/10/2004	3.2	3.93	0.84
1/11/2004	3.5	2.46	1.44
1/12/2004	1.24	1.55	-0.02
1/13/2004	-1.59	1.24	-1.38
1/14/2004	-0.25	0.83	4.03
1/15/2004	1.47	3.55	4.45
1/16/2004	3.52	3.78	1.76
1/17/2004	6.85	5.08	4.64
1/18/2004	10.11	8.9	8.3
1/19/2004	6.07	5.56	5.36
1/20/2004	6.48	5.02	5.23
1/21/2004	16.89	12.26	16.14

1/22/2004	11.36	9.92	7.29
1/23/2004	9.33	8.38	3.7
1/25/2004	4.55	2.26	2.15
1/26/2004	7.52	7.46	6.52
1/27/2004	10.96	11.89	13.32
1/28/2004	9.04	9.57	10.18
1/29/2004	7.18	6.64	3.83
1/30/2004	7.95	8.31	6.43
1/31/2004	6.41	3.23	3.41
2/1/2004	8.88	1.45	5.01
2/2/2004	7.48	2.86	4.48
2/4/2004	12.98	14.37	7.48
2/5/2004	9.48	10.92	4.23
2/6/2004	7.58	4.1	1.46
2/7/2004	15.9	12.33	11.15
2/8/2004	18.87	15.91	13.46
2/9/2004	16.23	10.08	9.37
2/10/2004	19.67	16.74	17.46
2/11/2004	-6.47	-4.37	-1.15
2/12/2004	-3.03	-5.38	-2.13
2/14/2004	-5.8	-6.79	-12.25
2/15/2004	0.29	0.11	-5.53
2/16/2004	1.53	5.94	2.9
2/17/2004	-0.79	5.25	2.11
2/18/2004	0.51	5.87	2.45
2/19/2004	4.36	7.36	14.74
2/20/2004	4.95	10.78	21.44
2/21/2004	4.54	8.43	15.29
2/23/2004	8.94	10.33	17.89
2/24/2004	7.4	12.31	19.52
2/25/2004	5	9.03	14.76
2/26/2004	2.22	10.74	17.1
2/27/2004	10.54	12.38	14.26
3/1/2004	22.97	27.54	28.3
3/2/2004	24.65	28.68	29.67
3/3/2004	2.61	6.56	11.1
3/4/2004	11.77	12.54	17.12
3/5/2004	7.9	8.11	7.74
3/8/2004	7.09	7.11	9.18
3/9/2004	5.35	6.31	7.84
3/10/2004	7.1	8.97	9.14
3/11/2004	7.07	10.14	11.44
3/15/2004	8.14	6.04	9.66
3/16/2004	8.35	8.48	14.15
3/17/2004	13.26	14.32	15.28
3/19/2004	13.66	14.08	18.12
3/21/2004	18.16	18.05	18.45
3/22/2004	9.66	9.47	10.98
3/23/2004	10.2	9.99	9.74
3/24/2004	10.43	7.35	9.54
3/25/2004	30.9	28.54	26.46
3/26/2004	30.5	28.97	27.19

3/27/2004	31.52	30.7	28.23
3/28/2004	29.6	28.6	26.68
3/29/2004	3.12	2.23	-0.96
3/30/2004	18.8	16.4	13.14
3/31/2004	18.42	17.95	14.58
4/2/2004	4.32	-2.44	-7.4
4/3/2004	20.49	12.98	12.36
4/4/2004	27.53	25.79	23.6
4/5/2004	29.9	24.82	24.21
4/6/2004	21.41	15.48	16.45
4/7/2004	3.11	4.51	10.84
4/8/2004	5.11	5.93	9.06
4/9/2004	0.32	2.75	5.52
4/10/2004	6.79	-0.74	-3.42
4/11/2004	19.81	8.15	7.71
4/12/2004	23.61	14.77	14.49
4/13/2004	21.36	13.99	12.3
4/14/2004	22.79	15.75	15.39
4/15/2004	0.82	-0.2	2.6
4/16/2004	0.58	3.58	2.82
4/17/2004	2.29	-6.11	-2.29
4/18/2004	6.32	-0.65	-2.32
4/19/2004	10.32	6.27	6.14
4/20/2004	13.79	11.22	10.82
4/21/2004	9.78	5.98	6.13
4/22/2004	1.41	3.64	8.82
4/23/2004	7.96	5.19	4.51
4/24/2004	6.92	3.32	1.02
4/25/2004	7.58	2.26	2.63
4/26/2004	5.96	-0.47	-0.03
4/27/2004	5.87	2	3.98
4/28/2004	6.53	3.15	2.25
4/29/2004	0.81	1.24	3.78
4/30/2004	2.3	-2.67	-3.88
5/1/2004	23.59	23.13	20.48
5/2/2004	13.67	15.23	16.61
5/3/2004	11.87	12.55	12.67
5/4/2004	8.06	5.17	5.31
5/5/2004	16.09	10.73	12.67
5/6/2004	13.06	8.7	7.51
5/7/2004	8.54	2.81	1.46
5/8/2004	10	6.46	4.95
5/9/2004	15.75	13.27	11.95
5/10/2004	15.74	15.68	12.67
5/11/2004	13.89	12.83	9.04
5/12/2004	17.62	16.32	13.02
5/13/2004	2.11	-3.3	-10.53
5/14/2004	6.51	4.19	1.88
5/15/2004	25.03	21.55	19.19
5/16/2004	23.13	19.87	18.56
5/17/2004	24.06	21.55	20.31
5/18/2004	23.44	20.26	19

5/19/2004	-2.75	-5.14	-3.83
5/20/2004	1.15	3.7	6.26
5/21/2004	6.89	4.51	2.57
5/22/2004	9.99	7.94	5.54
5/23/2004	7.51	5.77	4.79
5/24/2004	9.17	7.63	6
5/25/2004	8.39	6.2	4.25
5/26/2004	2.36	-2.81	-10.98
5/27/2004	4.76	0.097	-4.43
5/28/2004	9.91	3.51	-2.08
5/29/2004	21.54	16.6	17.76
5/30/2004	22.36	19.78	18.65
5/31/2004	23.26	18.1	19.38
6/1/2004	20.11	15.71	17.04
6/2/2004	0.17	-0.52	2.75
6/3/2004	2.06	-0.94	4.32
6/4/2004	8.75	6.79	4.04
6/5/2004	19.86	18.09	17.67
6/6/2004	16.97	13.92	12.23
6/7/2004	17.95	15.78	14.44
6/8/2004	17.76	17.14	17.11
6/9/2004	3.59	3.42	3.57
6/10/2004	3.46	1.64	-3.15
6/11/2004	3.34	0.12	-0.28
6/12/2004	21.07	18.06	17.57
6/13/2004	18.63	16.61	14.6
6/15/2004	20.69	17.74	15.67
6/16/2004	15.03	14.63	27.09
6/17/2004	-1.82	-3.25	3.42
6/19/2004	-0.9	-4.44	-1.55
6/20/2004	-0.69	-2.86	0.25
6/21/2004	-2.35	-2.69	-2.52
6/22/2004	-2.33	-1.25	7.91
6/23/2004	1.12	0.29	-1.85
6/24/2004	0.21	5.52	20.95
6/25/2004	-1.88	-2.92	17.4
6/26/2004	17.09	13.26	12.15
6/27/2004	12.69	9.86	13.24
6/28/2004	9.7	23.68	50.62
6/29/2004	13.51	27.77	52.29
6/30/2004	2.43	1.19	2.71
7/1/2004	2.32	1.67	1.85
7/2/2004	8.43	10.99	6.2
7/3/2004	6.7	10.14	5.37
7/4/2004	5.91	10.16	5.64
7/5/2004	0.81	7.75	2.77
7/6/2004	2.39	1.13	1.42
7/7/2004	5.24	9.79	7.35
7/8/2004	4.96	8.62	7.01
7/9/2004	1.71	-0.49	-0.75
7/10/2004	4.53	-0.65	1.83
7/11/2004	5.18	-1.74	-1.07

7/12/2004	2.58	-3.17	-0.14
7/13/2004	-0.96	-6.54	1.49
7/14/2004	-2.66	-1.79	12.48
7/15/2004	4.28	5.89	17.48
7/16/2004	3.25	-3.91	-2.34
7/17/2004	21.49	12.81	14.74
7/18/2004	22.57	15.64	15.3
7/19/2004	21.36	17.1	16.37
7/20/2004	19.32	13.91	12.73
7/21/2004	1.37	-5.12	-7.04
7/22/2004	14.35	12.44	11.05
7/23/2004	5.14	2.25	0.1
7/24/2004	16.1	13.35	13.03
7/25/2004	18.51	16.72	15.45
7/26/2004	23.09	22.29	18.97
7/27/2004	20.54	19.96	16.62
7/28/2004	-2.97	-1.56	0.51
7/29/2004	-2.3	-1.06	1.73
7/30/2004	2.71	2.1	9.17
7/31/2004	8.32	5	9.79
8/1/2004	7.52	4.17	7.61
8/2/2004	6.76	2.48	5.36
8/3/2004	5.21	1.32	2.27
8/4/2004	-0.94	-4.37	-3.23
8/5/2004	1.71	0.43	-0.8
8/6/2004	8.24	4.88	5.46
8/7/2004	22.89	18.88	19.84
8/8/2004	22.76	20.97	19.74
8/9/2004	24.49	23.54	22.3
8/10/2004	22.5	22.82	20.64
8/11/2004	-7.23	-10.11	-10.44
8/12/2004	-3.6	-3.09	-2.09
8/13/2004	2.58	-2.99	-2.38
8/14/2004	-2.89	-6.88	-6.87
8/15/2004	-0.62	-2.52	-1.04
8/16/2004	-4.93	-4.29	-3.98
8/17/2004	2.79	-2.44	1.1
8/18/2004	12.91	7.97	7.43
8/19/2004	-2.86	-4.69	-2.45
8/20/2004	-2.01	-3.01	-2.28
8/21/2004	2.93	-2.85	-0.23
8/22/2004	18.24	17.25	17.24
8/23/2004	26.12	23.58	22.11
8/24/2004	18.89	16.82	15.78
8/25/2004	23.23	22.32	21.28
8/26/2004	-1.43	-6.59	-6.76
8/27/2004	8.03	1.39	0.57
8/28/2004	7.88	2.34	2
8/29/2004	6.84	1.81	0.79
8/30/2004	3.28	-0.51	0.1
8/31/2004	-7.54	-8.28	-10.82
9/1/2004	-15.35	2.23	-1.02

9/2/2004	7.49	-0.09	-0.53
9/3/2004	24.79	19.24	19.59
9/4/2004	24.23	20.76	18.72
9/5/2004	23.58	18.76	16.94
9/6/2004	24.43	23.24	21.26
9/7/2004	-8.74	-5.93	-4.71
9/8/2004	-13.58	-9.35	-7.37
9/9/2004	-1.07	-2.95	-5.31
9/10/2004	3.18	0.6	-1.34
9/11/2004	3.95	3.17	1.97
9/12/2004	2.1	2.55	-1.24
9/13/2004	0.01	1.12	-3.45
9/14/2004	3.59	-1.6	0.21
9/15/2004	23.94	20.88	20.4
9/16/2004	8.56	4.01	3.58
9/17/2004	22.89	18.72	18.4
9/18/2004	2.32	-1.56	0.73
9/19/2004	9.3	4.83	5.3
9/20/2004	10.03	5.11	3.85
9/21/2004	5.62	2.46	3.11
9/22/2004	5.38	0.22	3.03
9/23/2004	0.37	-6.2	-3.97
9/24/2004	3.86	-0.54	5.73
9/25/2004	5.83	2.26	7.13
9/26/2004	2.28	1.4	5.92
9/27/2004	2.8	3.63	7.76
9/28/2004	1.9	-1.77	3
9/29/2004	12.8	9.95	10.73
9/30/2004	2.29	-5.34	1.32
10/1/2004	10.22	3.89	8.56
10/2/2004	11.79	7.86	9.29
10/3/2004	17.05	11.98	7.8
10/4/2004	11.21	8.93	9.08
10/5/2004	-9.57	-4.07	3.91
10/6/2004	-15.36	-9.32	-7.46
10/7/2004	-5.16	-9.71	-8.17
10/8/2004	2.03	-0.91	-3.35
10/9/2004	-0.41	-0.75	-2.66
10/10/2004	1.68	3.95	0.86
10/11/2004	-0.41	2.4	1.28
10/12/2004	6.63	3.98	6.45
10/13/2004	15.57	12.27	16.83
10/14/2004	9.33	6.5	10.38
10/15/2004	8.17	7.09	6.91
10/16/2004	6.02	4.8	4.22
10/17/2004	8.97	8.16	7.15
10/18/2004	2.78	3.78	3.91
10/19/2004	4.58	-1.96	0.4
10/20/2004	20.85	13.99	16.71
10/21/2004	18.73	12.29	14.35
10/22/2004	19.81	13.8	16.03
10/23/2004	-15.68	-16.41	

10/24/2004	-13.84	-8.531	
10/26/2004	-13.09	-8.61	
10/27/2004	-19.04	-9.32	
10/28/2004	0.58	1.16	
10/29/2004	3.68	4.27	2.77
10/30/2004	9.12	12.4	8.21
10/31/2004	4.47	5.31	2.24
11/1/2004	14.51	14.89	10.65
11/2/2004	14.5	16.31	10.76
11/4/2004	-1.78	9.27	-0.74
11/5/2004	13.6	10.97	9.88
11/6/2004	19.11	18.2	16.67
11/7/2004	19.16	18.52	16.15
11/8/2004	9.03	16.77	33.44
11/9/2004	13.71	18.95	36.87
11/10/2004	4.69	0.94	10.79
11/11/2004	12.32	2.68	18.4
11/12/2004	1.64	0.12	3.4
11/13/2004	5.19	2.4	5.26
11/14/2004	2.49	0.36	3.04
11/15/2004	1.17	-0.46	2.97
11/16/2004	-2.51	-1.76	9.25
11/17/2004	-2.43	-4.78	-0.71
11/18/2004	2.33	2.15	3.94
11/19/2004	3.54	5.03	7.43
11/20/2004	1.84	-3.12	-1.97
11/21/2004	8.06	3.75	5.74
11/22/2004	6.19	2.83	5.18
11/24/2004	8.07	5.83	5.98
11/25/2004	-1.39	-5.56	-4.45
11/26/2004	-1.17	-3.3	1.82
11/27/2004	3.61	4.35	6.83
11/28/2004	4.78	4.2	4.06
11/29/2004	1.77	2.7	2.64
11/30/2004	-2.68	-2.07	2.8
12/1/2004	5.23	9.56	15.26
12/2/2004	4.08	7.36	13.36
12/3/2004	-1.39	-5.33	-4.32
12/4/2004	8.66	5.08	3.23
12/5/2004	8.21	4.63	3.29
12/6/2004	9.18	6.24	5.71
12/7/2004	-4.29	-8.91	-8.67
12/8/2004	5.07	3.32	0.85
12/9/2004	3.84	0.46	-0.47
12/10/2004	19.76	16.53	16.78
12/11/2004	17.56	14.69	14.93
12/12/2004	16.78	14.39	14.75
12/13/2004	18.04	16.27	16.1
12/14/2004	-0.41	-6.1	-5.88
12/15/2004	1.71	-0.99	-2.59
12/16/2004	0.63	-3.86	-6.25
12/17/2004	-2.03	-5.27	-3.93

12/17/2004	-2.01	-5.3	-4.64
12/21/2004	-6.2	-8.22	1.76
12/22/2004	-1.87	-2.15	4.52
12/23/2004	0.14	-0.66	6.29
12/24/2004	2.75	4.18	13.39
12/25/2004	4.29	6.94	11.4
12/26/2004	-7.34	-2.26	5.3
12/27/2004	-7.86	7.2	15.45
12/28/2004	-10.54	10.2	15.2
12/29/2004	-6.65	-5.16	5.37
12/30/2004	-2.91	-1.96	9.04
12/31/2004	-4.16	-1.96	6.8

Summary of 2005-2006 Microtox Results

	5 MIN	15 MIN	30 MIN
12/1/2005	-3.39	-10.2	-4.47
12/2/2005	-5.85	-5.29	2.15
12/3/2005	14.92	10.74	11.22
12/4/2005	11.39	12.14	20.23
12/5/2005	12.34	11.76	18.9
12/6/2005	12.31	8.49	9.4
12/7/2005	7.94	15.48	23.44
12/10/2005	8.38	9.39	12.14
12/11/2005	4.34	4.35	1.86
12/12/2005	5.99	6.6	1.77
12/13/2005	4.11	-1.67	0.38
12/14/2005	16.73	13.16	14.07
12/15/2005	16.08	13.71	15.45
12/16/2005	20	17.44	17.72
12/17/2005	20.16	16.49	18.43
12/18/2005	4.67	2.1	3.69
12/19/2005	10.06	4.68	8.52
12/20/2005	4.36	2.3	8.38
12/21/2005	2.59	3.14	4.95
12/22/2005	0.36	0.56	5.21
12/23/2005	4.05	1.41	6.74
12/24/2005	-7.86	-13.27	-9.01
12/25/2005	-9.65	-15.82	-14.59
12/26/2005	-2.6	-7.11	-8.17
12/27/2005	-5.69	-12.5	-14.8
12/28/2005	12.23	11.22	6.62
12/30/2005	18.47	15.87	14.47
12/31/2005	19.08	15.72	12.16
1/1/2006	15.96	13.15	9.94
1/2/2006	17.22	13.72	11.27
1/3/2006	-4.44	-0.24	-0.82
1/4/2006	4.7	3.46	1.4
1/5/2006	4.29	1.06	1.67
1/6/2006	2.42	-2.73	-2.79
1/7/2006	2.8	-1.51	-2.64
1/8/2006	4.64	0.1	-1.98
1/9/2006	-1.58	-2.83	-5.98
1/10/2006	-3.18	-10.23	-9.54
1/11/2006	-4.13	-8.88	0.07
1/12/2006	2.59	-0.18	7.66
1/14/2006	17.45	17.16	18.19
1/15/2006	18.45	17.51	21.69
1/16/2006	20.1	19.14	18.71
1/18/2006	20.31	19.52	19.46
1/20/2006	-2.21	-6.85	-1.05
1/21/2006	22.03	18.63	25.24
1/22/2006	24.38	20.76	25.21
1/23/2006	20.3	13.98	16.85
1/24/2006	20.97	17.04	20.37

1/25/2006	-3.03	-0.39	1.16
1/26/2006	-11.03	-13.59	-12.32
1/27/2006	-0.76	-4.24	4.09
1/28/2006	-10.6	-13.47	-7.76
1/29/2006	-13.35	-17.13	-10.75
1/31/2006	10.92	9.62	15.38
2/1/2006	28.44	24.44	28.78
2/2/2006	24.82	19.69	21.48
2/3/2006	24.28	19.69	22.03
2/4/2006	24.36	19.67	21.27
2/5/2006	2.24	-0.11	7.29
2/6/2006	20.53	14.21	23.36
2/7/2006	9.02	6.72	9.87
2/8/2006	4.2	4.98	10.87
2/9/2006	6.74	6.63	9.97
2/11/2006	2.01	-1.97	-2.8
2/12/2006	5.8	3.58	3.87
2/13/2006	3.84	0.87	1.95
2/14/2006	-3.64	-9.53	-6.23
2/15/2006	-0.32	-6.92	-7
2/16/2006	3.08	0.49	0.83
2/17/2006	0.67	-2.45	-5.01
2/18/2006	2.12	-2.26	-1.59
2/19/2006	30.45	25.86	27.06
2/20/2006	31.21	26.7	27.54
2/21/2006	25.72	21.16	21.71
2/22/2006	24.55	19.04	17.57
2/23/2006	1.98	-2.57	-3.95
2/24/2006	15.33	13.76	10.96
2/25/2006	0.86	-3.92	-3.48
2/26/2006	15.37	10.6	7.5
2/27/2006	14.86	9.72	5.57
2/28/2006	19.13	11.48	8.2
3/1/2006	17.24	10.43	2.63
3/2/2006	-0.91	-6.81	-5.73
3/3/2006	4.35	1.28	-3.99
3/4/2006	2.04	-6.57	3.17
3/5/2006	7.48	-2.62	0.02
3/6/2006	6.57	-1.02	2.24
3/7/2006	7.76	1.02	0.15
3/8/2006	8.25	-0.16	5.48
3/9/2006	-5.63	-9.85	-6.82
3/10/2006	-2.8	-7.41	0.44
3/11/2006	1.65	-3.63	-3.5
3/12/2006	1.65	-3.63	-3.5
3/12/2006	18.09	12.82	7.01
3/13/2006	16.2	10.2	5.77
3/14/2006	14.4	7.82	5.84
3/15/2006	15.37	7.07	2.4
3/16/2006	-1.49	-2.82	0.56
3/17/2006	-1.96	-1.39	4.52
3/18/2006	-3.81	-9.18	-11.15

3/19/2006	1.08	-1.34	-4.84
3/20/2006	0.84	0.11	-5.99
3/21/2006	5.73	4.93	1.73
3/22/2006	2.34	-0.93	-4.61
3/23/2006	0.21	-5.58	-6.42
3/24/2006	4.64	-2.88	-2.6
3/25/2006	-13.21	-20.9	-20.31
3/26/2006	-10.28	-18.43	-20.25
3/27/2006	0.47	-5.66	-9.35
3/31/2006		-8.73	-14.09
4/1/2006	12.82	7.48	5.77
4/2/2006	4.07	-0.8	1.75
4/3/2006	1.37	-2.63	7.89
4/4/2006	4.17	1.75	4.07
4/5/2006	1.65	-3.04	0.16
4/6/2006	-3.36	-5.45	-5.42
4/7/2006	0.83	4.43	3.05
4/8/2006	19.51	14.06	15.04
4/9/2006	23.5	17.9	14.45
4/10/2006	22.64	16.66	14.7
4/11/2006	23.97	18.81	15.04
4/12/2006	26.83	21.09	16.87
4/13/2006	7.16	-0.77	-1.39
4/14/2006	12.01	6.81	10.47
4/15/2006	8.73	3.81	9.2
4/16/2006	8.63	4.28	7.9
4/19/2006	3.35	3.29	11.25
4/21/2006	2.1	-0.57	-3.67
4/22/2006	5.92	2.32	-2.9
4/23/2006	4.4	2.48	-4.06
4/24/2006	7.39	6.11	-1.03
4/25/2006	7.05	5.62	-0.62
4/26/2006	-1.03	-3.09	-6.32
4/27/2006	-7.9	-11.42	-13.9
4/28/2006	-6.97	-11.04	-14.53
4/29/2006	-9.57	-15.84	-12.74
4/30/2006	-1.8	-4.97	-3.07
5/1/2006	4.24	-1.97	2.51
5/2/2006	4.94	1.01	3.39
5/3/2006	7.7	2.53	3.68
5/4/2006	-7.82	-11.12	-5.74
5/5/2006	-2.54	-2.52	5.56
5/6/2006	-3.1	-4.13	-5.97
5/7/2006	12.53	14.13	12.03
5/8/2006	11.73	15.26	13.46
5/9/2006	8.96	14.21	12.71
5/10/2006	9.73	14.94	13.28
5/11/2006	1.96	-9.73	-7.96
5/12/2006	1.06	1.23	-2
5/13/2006	-2.03	-11.9	-15.8
5/14/2006	-5.87	-10.1	-6.84
5/15/2006	0.87	-3.73	-5.45

5/16/2006	-8.56	-4.34	1.19
5/17/2006	-6.01	3.05	2.05
5/18/2006	-4.61	3.23	3.59
5/19/2006	2.37	-0.57	-2.01
5/20/2006	7.22	7.98	-2.49
5/21/2006	5.88	4.11	-3.23
5/22/2006	4.25	0.51	-7.16
5/23/2006	8.32	-0.26	-7.71
5/24/2006	-11.17	-22.36	-13.42
5/25/2006	-5.77	-11.01	-6.39

Appendix E

Field Data Sheets

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: LC-1
LOCATION: U/S of Lion O.I
STREAM NAME: Loutre Creek
RIVER BASIN: Ouachita
LAT: 33 12 5.4 **LONG:** 92,43,1
PROJECT: Lion O.I UAA
INVESTIGATORS: SMH/OB
DATE/TIME: 4/28/05
FORM CHECKED BY:

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__%☐	% cloud cover	☐ __%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☒ Yes ☐ No
Air Temperature______ °C/°F
Other______

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal
Stream Type
☐ Coldwater ☒ Warmwater
Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☐ Mixture of origins
☐ Swamp and bog ☐ Other______
Catchment Area: ______ mi²
Stream Order: ______
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

Flows
☐ High ☐ Moderate ☒ Low ☐ None
Flows Measured? ☒ Yes ☐ No
Reach: Slope ______ ft/mi **& Sinuosity** ______

Predominant Surrounding Landuse
☒ Forest 50 %
☐ Pasture ____%
☐ Row Crops ____%
☒ Urban 50 %
☐ Sub-Urban
☐ Commercial____%
☐ Industrial ____%
☐ Other ______%

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☒ Urban/Sub-Urban Storm Water

☒ Mature Forest 10 % ☒ Shrub/Sapling 90 % ☐ Herbs/Grasses ____% ☐ Turf ____%

☒ Riffle 25.3% ☐ Run ____% ☒ Pool 74.7%

☒ Roads ☒ Bridges ☐ Pipelines ☒ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☒ Other Wet land

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☐ Degrading ☐ Widening ☐ Headcutting

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other______

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☐ None ☐ Other______

Turbidity/Water Clarity (If not measured) 13.3 NTU
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☒ Other Silt/Dirt

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D. LC-1
LOCATION Union, AK; Eldorado
STREAM NAME Loutre Creek
RIVER BASIN Ouachita
LAT
LONG
CLIENT Lion Oil
INVESTIGATORS BJP/KSM/SKH/JB
FORM COMPLETED BY BJP / JB
DATE 4/28/05
TIME 1500
REASON FOR SURVEY

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 80 °C/[✓ F]

Other ____________

STREAM ATTRIBUTES

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☑ Mixture of origins
☐ Other ____________

Catchment Area ________ mi²

HYDROLOGY

Flows
☐ High ☐ Moderate ☑ Low ☐ None

Flows Measured?
☑ Yes ☐ No

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☐ Commercial
☐ Industrial
☐ Other ____________

Local Watershed NPS Pollution
☐ No evidence
☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

INSTREAM FEATURES

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 30 %
☐ Run 20 %
☐ Pool 50 %

Channelized ☐ Yes ☐ Some ☑ No

Dam Present ☐ Yes ☐ Some ☑ No

WATER/ OBSERVATIONS

Water Odors
☑ Normal/None
☐ Petroleum
☐ Fishy
☐ Sewage
☐ Chemical
☐ Other ____________

Water Surface Oils
☐ Slick
☐ Flecks
☑ Sheen – organic / Fe oxide
☐ None
☐ Globs
☐ Other ____________

Turbidity (if not measured)
☐ Clear
☐ Opaque
☑ Slightly turbid
☑ Stained
☐ Turbid
☐ Other ____________

SEDIMENT/ OBSERVATIONS

Sediment Odor
☑ Normal
☐ Chemical
☐ Other ____________
☐ Sewage
☐ Anaerobic
☐ Petroleum
☐ None

Sediment Deposits
☐ Sludge
☑ Sand
☑ Other organic
☐ Sawdust
☐ Relict shells
☐ Oils

Discharge/Flow Measurement Form

Station: LC-1

Waterbody: Louthin Creek

Date: 2/28/05

Crew: SKH / JJB

Start Time: 1555

Recorder: SKH

End Time: 1605

GH. Change: ______ in

______ hrs.

Staff/Gage:

Width: 5.0

Area:

Velocity:

Disch/Flow:

Method:

No Secs:

Meter No:

Max Vel:

Min Vel:

ORIENTATION:

Wading, Boat, Upstream, Downstream, Side Bridge ______ ft/mi, above, below gage, and ______

Measurement rated: excellent good fair poor based on the following conditions: Cross section ______

Flow ______ Weather ______

Other ______ Air ______ °F @ ______

Gage ______ Water ______ °F @ ______

Observer ______

Control ______

Remarks ______

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, [✓ 0.6] or 0.8)	(5) Area (A)	(6) Discharge (Q)
0.5	0.5	0.2		ND			
1.0		0.5		0.19			
1.5		0.5		0.31			
2.0		0.5		0.51			
2.5		0.4		0.47			
3.0		0.3		0.40			
3.5		0.3		0.29			
4.0		0.1		0.1			
~~4.5~~							
5.0	1.0	0.0		ND			
TOTALS							

V1.0 1096

Completed By______ Checked by______ Reviewed by______

Lion Oil date 4/28/2005

Start 1555
Stop 1605

Station: LC-1
Waterbody: Loutre Creek
Crew: BJP/SKH

Width (ft):	5.0	Area:	1.5	Max Vel:	0.51
Disc/Flow (cfs):	0.48	Velocity:	0.25	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
0.5	0.5	0.2	0	0.1	0
1.0	0.5	0.5	0.19	0.25	0.0475
1.5	0.5	0.5	0.31	0.25	0.0775
2.0	0.5	0.5	0.51	0.25	0.1275
2.5	0.5	0.4	0.47	0.2	0.094
3.0	0.5	0.4	0.4	0.2	0.08
3.5	0.5	0.3	0.29	0.15	0.0435
4.0	0.5	0.1	0.1	0.05	0.005
5.0	1.0	0	0	0	0
Total	5.00	2.90	2.27	1.45	0.48
Average	0.56	0.32	0.25	0.16	0.05

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-1	Date/Time: 4/28/05	Initials: SKY/JB

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Riffle	Macrophytes	—	—	0	0	—	—	6	0	—		0
	Periphyton	—	—	0	—	—	—	0	6	—		0
Pool	Macrophytes	15	5	0	0	0	0	0	—	0		2.9
	Periphyton	0	0	0	0	0	0	0	—	0		0

10. Canopy Cover (Percent Stream Shading)

Shading	80	80	90	90	90	90	90	90	90	90	85

11. Bank Stability (Score) and Slope (Degrees)

Score	8	6	7	8	8	8	8	8	8	6	7.5
Slope (°)	80°	90°	70°	90	85	80	60	70	80	80	79
Score	8	7	7	6	6	8	8	8	8	7	7.3
Slope (°)	80°	70°	80	50	60	70	60	70	70	80	70

Score 9-10 = Stable, < 5% bank affected.
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

%	80	60	20	60	60	50	40	60	70	40	54
%	80	40	10	35	35	50	40	60	50	40	45

13. Riparian Vegetative Zone Width

Score	7	8	8	9	8	8	8	8	8	8	8
Score	8	8	8	9	8	8	8	8	8	8	8.1

Score 9-10 = Riparian Zone Width > 18 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 1-2 = Riparian Zone Width < 6 meters

14. Land-Use Stream Impacts

Impact	u,1	u,1	u,1	u,1	u,1					u,1

C= Cattle R = Row Crops U = Urban/Encroachment I = Industrial Encroachment O = Other ______
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Page 2 of 2
V2.1

Stream Habitat Assessment (Semi-Quantitative)

2nd

Station #: LC-1	Stream: Lortin Creek Location: Upper Lortin East Fork	Date/Time: 4/28/05 1430 –	Analyst: SW/UTB

1. Reach Length Determination

1/2 Width

Bankfull Width	10.5	11.5	10.6	~~13.8~~ 12.5	18.5	12.7	254	25.4'
Bankfull Depth	1.8	2.6	2.8	~~2.4~~ 1.4	4.5	1.4	na	na

¹Average width times 20 ²Total Length divided by 10

1.2

1.9

Camo GPS (353) u/s Lat 33.51 Lng 33,129 92 40 43.5

(852)

d/s Lat: 37°12'5.4" Lng: 92°43'1.0"

2. Riffle-Pool Sequence

Riffle											
Run			7 13.4				25.4	25.4			64.2
Pool	25.4	25.4	12	25.4	25.4	25.4					
Total									25.4	25.4	189.8
Sequence¹	∼∼∼	∼∼∼	∼∼xx	∼∼∼	∼∼∼	xxxx	xxxx	xxxx	∼∼∼	∼∼∼	

25.

74.

¹Riffle="xxx", Run="-----", Pool="∼∼∼"

Trib from Bear Break

3. Depth and Width Regime

Riffle Depth	—	—	0.4	1.1	—	[illegible]	0.2	0.2	—	—	[illegible]
Riffle Width	—	—	5	10	—	—	5.0	5.0	—	—	[illegible]
Pool Depth	1.8	1.1	0.4	[illegible]	2.5	1.8	—	[illegible]	1.4	1.3	1.7
Pool Width	11.0	12.0	10	[illegible]	14.0	11.0	—	[illegible]	11.0	9.0	8.8

2.5 Shallow / no Deep

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

% Area	60	40	30	35	70	[illegible]	20	20	40	60	44.5

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

% Area	70	50	30	40	70	70	20	20	50	60	480

6. Substrate Characterization (Dominant Substrate)

Riffle	—										
Pool	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

%	30	40	50	25	50	70	20	20	20	50	37.5

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: LC-1	Date/Time:
Stream name: Lowtre Creek	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 8 LB	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 7 LB	Left Bank 10 9	8 [✓ 7] 6	5 4 3	2 1
SCORE 5 RB	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 8 LB	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1
SCORE 8 RB	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1

TOTAL SCORE: 142

AVERAGE SCORE: 14.2

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D.: LC-1	Client: Lion Oil
Stream name: Loutre Creek	Date/Time: 4/28/05
Location:	Form Completed By: JBB/SKH

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 ~~8 7~~ 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 18	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1

?

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FIELD DATA SHEETS - FISH

Waterbody Name: Loutre Creek (LC-1)
Client: Lion Oil
Project no: 2160-05-070.
Investigators: BJP. KEM.
Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: Union, AR: Eldorado
Ecoregion: Gulf Coastal Plain
Weather: Clear, windy.
~80°F
Form Completed By: BJP/KEM
Form Checked By:
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations			
	Above Station	Below Station	Additional Observations:
Total Time Sampled			
Relative Abundance of Aquatic Biota			
Periphyton:	0 [✓ 1] 2 3 4	0 1 2 3 4	
Filamentous Algae:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Macrophytes:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 [✓ 3] 4	0 1 2 3 4	
Fish:	0 1 2 [✓ 3] 4	0 1 2 3 4	
Other___:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Macrohabitats Sampled (%)			
[✓ Riffle]/Run:	10		
Shallow Pool:	70		
Deep Pool:	20		
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	50		
Emergent Vegatation:	–		
Submerged Vegetation:	–		
Depositional Area:	10		
Overhanging Veg:	–		
Root Wads:	30		
Undercut Banks:	10		
Filamentous algae:	–		
Leafy debris:	–		
Substrate Type and Scores			
Substrate	Score	Adj. Score	
Bedrock:	– X 0.1		
Lg. Boulder:	– X 1.0		
Boulders:	– X 1.0		
Rubble:	– X 1.0		
Gravel:	– X 0.5		
Sand:	60 X 0.1		
Mud/Silt: 20/20	40 X 0.1		
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

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Sampling Gear Type: [✓ Electrofishing] Seine Gill nets

Unit of Effort: Above PDT ~~2~~-1692 ~~Below:~~

Quantity of Available Fish Cover:

Above Station: [✓ Very Abundant,] Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: Canopy cover prolific; sediment deposition abundant

Below Station:

5/18/05 (5/14) AB checks

Fish Species Observed

Release

Above Station # LC-1	Below Station #
(68) — Long ear 卌 卌 卌 卌 卌	卌 卌 卌 卌 卌 卌 卌 卌 卌
(46) — Gambusia 卌 卌 卌 卌 卌	卌 卌 卌 II
② — Golden shiner II	
(3) — Golden top minnow III	
Pirate Perch	(1)
~~Blue gill~~ I Not Found	
1 — Notropis I Notropis emiliae	(Pugnose Minnow)
(3) — Spotted sunfish III	
① — Green I	

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FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Loutre Creek (LC-1)

Client: Lion Oil

Project no: 2160-05-070

Investigators: BJP REM

Date Sample Collected: 4/28/05

Habitat Forms Completed: [✓ yes] / no

Location: Union Co. AR. Eldorado

Ecoregion: Gulf Coastal Plain

Weather: Clear, windy ~80°F

Form Completed By: BJP/REM

Form Checked By: ____________

Fish Sampling Completed: [✓ yes] / no

Collection Site Observations

	Above Station	Below Station
[illegible]		
Relative Abundance of Aquatic Biota		
Periphyton:	0 [✓ 1] 2 3 4	0 1 2 3 4
Filamentous Algae:	[✓ 0] 1 2 3 4	0 1 2 3 4
Macrophytes:	[✓ 0] 1 2 3 4	0 1 2 3 4
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 2 [✓ 3] 4	0 1 2 3 4
Fish:	0 1 2 [✓ 3] 4	0 1 2 3 4
Other__________:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
[✓ Riffle]/Run:	10 riffs	
Shallow Pool:	70	
Deep Pool:	20	
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:	50	
Emergent Vegatation:	0	
Submerged Vegetation:	0	
Depositional Area:	10	
Overhanging Veg:	0	
Root Wads:	30	
Undercut Banks:	10	
Filamentous algae:	-	
Leafy Debris:	-	
Other__________:		

Macroinvertebrate Qualitative Sample List

Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant
Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

Rapid Bioassessment Field Sheet

Point Source Reach LC-1 (Coutre Creek - u/s of Line 0.1 Date 5/5/05

Collector ______ Sample Technique ______ Sediment ? ______

Habitat Description: ABOVE Reach LC-1

BELOW Reach LC-2

MACROINVERTEBRATE COMMUNITY

ABOVE Station # LC-1

Cnt.	Taxa	Tally
29	Oligochaetae	𝍸𝍸𝍸𝍸𝍸||||
1	Leeche (moorblelle)	|
3	Cambarine	|||
1	Amphipoda	|
13	Corbicula	𝍸𝍸|||
1	Belostoma	|
1	Argia	|
3	Libellulia	|||
	~~[illegible]~~ REW	
1	Anopheles	|
1	Bittacomorpha	|
1	Perithemis	|
	Chironomidae	
15	Chironominae	𝍸𝍸𝍸
25	Tanypodinae	𝍸𝍸𝍸𝍸𝍸
7	Tanytarsini	𝍸||
1	Probezzia	|
1	Dineutus	|
1	Peltodytes	|
5	Tipula	𝍸
	:TOTAL:	

BELOW Station # LC-2

Cnt.	Taxa	Tally
13	Oligo.	𝍸𝍸|||
7	Crayfish	𝍸||
1	Belostoma	|
3	Argia	|||
1	Libellula	|
2	Hexatoma	||
2	mosquito	||
4	Corixidae	||||
~~1~~	~~Perithemis~~	~~1~~ RE
8	Enallagma	𝍸|||
28	Chironomidae	𝍸𝍸𝍸𝍸𝍸|||
14	Tanypodinae	𝍸𝍸||||
9	Tanytarsini	𝍸||||
	~~Corixidae~~	~~||||~~
2	Probezzia	||
	~~Hexatoma~~	
2	Tipula	||
1	Dytiscus	|
1	Hydrocanthus	|
1	Hydrochus	|
3	Uvarus	|||
	:TOTAL:	

Community Structure

	ABOVE	BELOW
% Ephem.		
% Plecop.		
% Trichop.		
% EPT		
% Chir.		
% Diptera		

	ABOVE	BELOW
% Odon.		
% Cole.		
% Crustacea		
# of Taxa:		
Biotic Score:		

Comments:

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: LC-2
LOCATION: Lion Oil
STREAM NAME: Loutre Creek
RIVER BASIN: Ouachita River
LAT: **LONG:**
PROJECT: Lion Oil WAA
INVESTIGATORS: SKH/JB
DATE/TIME: 4/28/05
FORM CHECKED BY:

Now / **Past 24-hr**
☐ storm (heavy rain) ☐
☐ rain (steady rain) ☐
☐ showers (intermittent) ☐
__%☐ % cloud cover ☐____%
☒ clear/sunny ☒

Heavy rain in the last 7 days? ☒ Yes ☐ No
Air Temperature________°C/°F
Other________

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other ________

Catchment Area: ________mi²
Stream Order: ________

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured?
☒ Yes ☐ No

Reach: Slope & Sinuosity
________ft/mi ________

Predominant Surrounding Landuse
☐ Forest ____% ☐ Sub-Urban
☐ Pasture ____% ☐ Commercial____%
☐ Row Crops ____% ☒ Industrial 100%
☐ Urban ____% ☐ Other ________%

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☒ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

☐ Mature Forest ____% ☐ Shrub/Sapling ____% ☒ Herbs/Grasses 100% ☐ Turf ____%

☒ Riffle 1 % ☐ Run ____% ☒ Pool 99 %

☒ Roads ☒ Bridges ☒ Pipelines ☐ Beaver Dams ☒ Point Source
☒ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other ________

Channelized: ☒ Yes ☐ Some ☐ No
Local Watershed Erosion: ☐ None ☐ Minimal ☒ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☒ Degrading ☐ Widening ☐ Headcutting

Water Odors
☐ Normal/None ☐ Sewage
☒ Petroleum ☒ Chemical
☐ Fishy ☐ Other________

Water Surface Oils
☐ Slick ☒ Sheen ☒ Globs
☒ Flecks ☐ None ☐ Other________

Turbidity/Water Clarity (if not measured)
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other________

24.0 NTU

Sediment Odor
☐ Normal ☐ Sewage ☒ Petroleum
☒ Chemical ☐ Anaerobic ☐ None
☐ Other________

Sediment Deposits
☐ Sludge ☐ Sawdust ☒ Oils
☒ Sand ☐ Relict shells
☒ Other Silts/Dirt

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D. LC-2	LOCATION Union, AR; Eldorado
STREAM NAME Loutre Creek	RIVER BASIN Ouachita
LAT LONG	CLIENT Lion Oil
INVESTIGATORS BJP/RCM/SKH/JB	
FORM COMPLETED BY BJP / JB	DATE 4/28/05 TIME 1400
	REASON FOR SURVEY

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 ~80 °C/[✓ °F]

Other____________

STREAM ATTRIBUTES

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 ________mi²

HYDROLOGY

Flows
☐ High ☑ Moderate ☐ Low ☐ None

Flows Measured?
☑ Yes ☐ No

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☐ Field/Pasture ☑ Industrial
☐ Agricultural ☐ Other ____________
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☑ Heavy

INSTREAM FEATURES

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle______%
☐ Run___70___%
☐ Pool___30___%

Channelized ☑ Yes ☐ Some ☐ No

Dam Present ☑ Yes ☐ Some ☐ No

WATER/ OBSERVATIONS

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/ OBSERVATIONS

Sediment Odor
☐ Normal ☐ Sewage ☑ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Sediment Deposits
☐ Sludge ☐ Sawdust ☑ Oils
☐ Sand ☐ Relict shells
☐ Other______________

Discharge/Flow Measurement Form

Station: LC-2

Waterbody: Louton Creek

Date: 4/28/

Crew: SKH/JB

Start Time: 1220

Recorder: SKH

End Time: 1230

GH. Change: ______ in ______ hrs.

Staff/Gage:

Width: 17.0'

Area:

Velocity:

Disch/Flow:

Method:

No Secs:

Meter No:

Max Vel:

Min Vel:

ORIENTATION:

[✓ Wading], Boat, [✓ Upstream], Downstream, Side Bridge ______ ft/mi, above, below gage, and ______

Measurement rated: excellent [✓ good] fair poor based on the following conditions: Cross section ______

Flow ______ Weather ______

Other ______ Air ______ °F @ ______

Gage ______ Water ______ °F @ ______

Observer ______

Control ______

Remarks ______

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
2.0	2.0	0.3		0.82			
4.0	2.0	0.3		0.92			
6.0	2.0	0.3		0.89			
8.0	2.0	0.3		1.01			
10.0	2.0	0.3		0.78			
12.0	2.0	0.3		0.80			
14.0	2.0	0.3		0.96			
16.0	2.0	0.3		0.80			
17	1.0	0.3		ND			
TOTALS							

Concrete Bottom (Flat)

V1.0 1096

Completed By______ Checked by______ Reviewed by______

Lion Oil		date	4/28/2005	Start	1220
				Stop	1230
Station:	LC-2				
Waterbody:	Loutre Creek				
Crew:	BJP/SKH				
Width (ft):	17.0	Area:	5.1	Max Vel:	1.01
Disc/Flow (cfs):	4.19	Velocity:	0.78	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Avg velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
2.0	2.0	0.3	0.82	0.6	0.492
4.0	2.0	0.3	0.92	0.6	0.552
6.0	2.0	0.3	0.89	0.6	0.534
8.0	2.0	0.3	1.01	0.6	0.606
10.0	2.0	0.3	0.78	0.6	0.468
12.0	2.0	0.3	0.8	0.6	0.48
14.0	2.0	0.3	0.96	0.6	0.576
16.0	2.0	0.3	0.8	0.6	0.48
17.0	1.0	0.3	0	0.3	0
Total	17.00	2.70	6.98	5.10	4.19
Average	1.89	0.30	0.78	0.57	0.47

Stream Habitat Assessment (Semi-Quantitative)

d/s Lat: 33 ..
Lng: 92 40 38.6

Station #: LC2	Stream: Locke Creek	Date/Time: 4/28/05	Analyst: SKH/GB
	Location: Union County	1050-1205	

Run/Pool

Camo GPS u/s Lat: 33 11 46.8
Long: 92 40 40.3, d/s Lat:
Long:

1. Reach Length Determination

						Average		
Bankfull Width	17.0	25.6	23.4	20.0	~~8~~ 19.9	21.2	424	42.4
Bankfull Depth	2.2	3.1'	3.6	2.2	2.1	2.2	na	na
H2O	0.9	1.6	2.0'	1.2	1.1			

[1]Average width times 20 [2]Total Length divided by 10

2. Riffle-Pool Sequence

	1	2	3	4	5	6	7	8	9	10	Total
Riffle											
Run											
Pool	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	
Total											
Sequence[1]	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	

[1]Riffle="xxx", Run="-----", Pool="~~~"

Most of Stream is Channelized Pool/Run

NOTE: Stream Had 1 Riffle, Concrete ~~Flat~~, w/ Broken Concrete, just u/s of Ship Hatch

3. Depth and Width Regime

	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth	—	—	—	—	—	—					
Riffle Width	—	—	—	—	—	—					
Pool Depth	1.5	1.1	0.9	0.7	1.2	1.0	0.8	0.9	0.7	1.1	.99
Pool Width	28.0'	20'	17	18	20	18	21	18	20	19	19.9

Shallow pools, no Deep

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

	1	2	3	4	5	6	7	8	9	10	Average
% Area	10	15	15	10	10	15	20	15	15	20	14.5

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

	1	2	3	4	5	6	7	8	9	10	Average
% Area	10	15	15	10	10	10	20	15	15	20	14

6. Substrate Characterization (Dominant Substrate)

	1	2	3	4	5	6	7	8	9	10	Average
Riffle	—	—	—	—	—	—	—	—	—	—	
Pool	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	(S) 2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

	1	2	3	4	5	6	7	8	9	10	Average
% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

	1	2	3	4	5	6	7	8	9	10	Average
%	20	25	20	30	60	90	80	60	40	80	54.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-2	Date/Time: 4/28/05	Initials: SKH/OB

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Riffle	Macrophytes	–	–	–	–	–	–	–	–	–	–	
	Periphyton	–	–	–	–	–	–	–	–	–	–	
Pool	Macrophytes	5	5	5	0	5	5	5	0	5	10	4.5
	Periphyton	5	5	0	0	0	0	0	0	0	0	1

10. Canopy Cover (Percent Stream Shading)

Shading	0										0

11. Bank Stability (Score) and Slope (Degrees)

Score	4	5	5	5	6	5	6	4	5	2	4.7
Slope (°)	75°	85	70	70	70	80	80	70	70	85	76

Score	5	5	6	6	4	6	3	5	5	7	5.2
Slope (°)	80°	70	70°	60	70	80	80	60	50	50	67

Score 9-10 = Stable, < 5% bank affected.
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

%	30	60	60	60	70	60	70	60	40	15	54.5

%	60	80	60	60	50	70	40	70	50	65	60.5

13. Riparian Vegetative Zone Width

Score	0										0

Score	0										0

Score 9-10 = Riparian Zone Width > 18 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 1-2 = Riparian Zone Width < 6 meters

14. Land-Use Stream Impacts

Impact	I, 3										

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other ______
Score O = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: LC-2	Client:
Stream name:	Date/Time:
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 [✓ 4] 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 2	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: LC-2	Date/Time:
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 2	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 5 LB	Left Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
SCORE 5 RB	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 6 LB	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 1 LB	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1]
SCORE 1 RB	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1]

TOTAL SCORE: 78
AVERAGE SCORE: 7.8

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

FIELD DATA SHEETS - FISH

Waterbody Name: Loutre Creek

Client: Lion Oil

Project no: 2160-05-070

Investigators: BJM REM

Date Sample Collected: 4/28/05

Habitat Forms Completed: [✓ yes] / no

Location: Union County AR Eldorado

Ecoregion: Gulf Coastal

Weather: Clear - upper 70s

Form Completed By: BJP/REM

Form Checked By:

Fish Sampling Completed: [✓ yes] / no

Collection Site Observations			
	Above Station	Below Station	Additional Observations:
Total Time Sampled:	LC-2		
Relative Abundance of Aquatic Biota			
Periphyton:	BJM ~~0~~ [✓ 1] 2 3 4	0 1 2 3 4	
Filamentous Algae:	~~0~~ [✓ 1] 2 3 4	0 1 2 3 4	
Macrophytes:	0 [✓ 1] 2 3 4	0 1 2 3 4	
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 [✓ 2 3] 4	0 1 2 3 4	
Fish:	0 1 [✓ 2 3] 4	0 1 2 3 4	
Other_________:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:	5		
Shallow Pool:	70		
Deep Pool:	25		
Backwaters:			
Chanelized:	* 100%		
Microhabitats Sampled (%)			
Woody debris:	5		
Emergent Vegatation:	20		
Submerged Vegetation:	10		
Depositional Area:	0		
Overhanging Veg:	BJP ~~65~~ 55		
Root Wads:	5		
Undercut Banks:	5		
Filamentous algae:			
Leafy debris:			

Substrate Type and Scoring

Substrate	Score	Adj. Score
Bedrock:	X 0.1	
Lg. Boulder:	X 1.0	
Boulders:	X 1.0	
Rubble:	5 X 1.0	
Gravel:	5 X 0.5	
Sand:	70 X 0.1	
Mud/Silt:	15 mud / 5 silt X 0.1	

Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0

Sampling Gear Type: [✓ Electrofishing] Seine Gill nets

Unit of Effort: Above: ~~2201~~ 2301 ~~Below:~~ N/A ~~1049~~ 1045-1135

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, [✓ Sparse,] Absent

~~Below Station: Very Abundant~~, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: channelized sand substrate, overhanging non woody vegetation, some woody debris

Below Station:

[illegible] (SPA) Check 5/1/[illegible]

Fish Species Observed

	Above Station # LC-2	Below Station #	Releas-
		卌 卌 卌 卌	
(86) – Longear	卌 卌 卌 卌 卌	卌 卌 卌 卌 卌 卌 卌 卌	22
(2) – Warmouth	II	← III 2 warmouth w/ Internal parasites	
(6) – Green sunfish	卌 I	2 w/ Internal parasites	
(2) – Large m. bass	II	1 w/ Fin Rot	/
(1) Golden Shiner			/
(35) Gamb	卌 卌 卌 卌 卌 II		
(1) B. bullhead	I	1 w/ Fin Rot	
(8) spotted sun	卌 III		

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GBM© & Assoc. Doc. 1
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FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Loutre Creek
Client: Lion Oil
Project no: 2160-05-070
Investigators: REM, BJP
Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: Union County AR Eldorado
Ecoregion: Coastal Plain
Weather: Clear ~80°
Form Completed By: BJP/REM
Form Checked By:
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations

	Above Station	Below Station
Total Reps Sampled	LC-2	
Relative Abundance of Aquatic Biota		
Periphyton:	0 [✓ 1] 2 3 4	0 1 2 3 4
Filamentous Algae:	0 [✓ 1] 2 3 4	0 1 2 3 4
Macrophytes:	0 [✓ 1] 2 3 4	0 1 2 3 4
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 [✓ 2 3] 4	0 1 2 3 4
Fish:	0 1 [✓ 2 3] 4	0 1 2 3 4
Other________:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:	5	
Shallow Pool:	70	
Deep Pool:	25	
Backwaters:		
Chanelized:	100%	
Microhabitats Sampled (%)		
Woody Debris:		
Emergent Vegatation:	50	
Submerged Vegetation:		
Depositional Area:		
Overhanging Veg:	50	
Root Wads:		
Undercut Banks:		
Filamentous algae:		
Leafy Debris:		
Other________:		

Macroinvertebrate Qualitative Sample List

Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant
Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: LC-3	**LOCATION:** Union County
STREAM NAME: Loutre Creek	**RIVER BASIN:** Ouachita River
LAT: 33 11 34.8 **LONG:** 92 40 38.1	**PROJECT:** Lion OIMAA
INVESTIGATORS: SKM/BOP **DATE/TIME:** 4/28/05 (0955)	**FORM CHECKED BY:**

Now / **Past 24-hr**
☐ storm (heavy rain) ☐
☐ rain (steady rain) ☐
☐ showers (intermittent) ☐
__%☐ % cloud cover ☐____%
☒ clear/sunny ☒

Heavy rain in the last 7 days? ☒Yes ☐ No
Air Temperature 65 °C/[✓ F]
Other____________

Stream Subsystem
☒Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒Mixture of origins
☐ Swamp and bog ☐ Other____________

Catchment Area: ________mi²
Stream Order: ________

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

Flows
☐ High ☐ Moderate ☒Low ☐ None

Flows Measured? ☒Yes ☐ No

Reach: Slope & Sinuosity
________ft/mi ________

Predominant Surrounding Landuse
☒Forest 10 %
☒ Pasture 40 %
☐ Row Crops ____%
☐ Urban ____%
☐ Sub-Urban
☐ Commercial____%
☒ Industrial ~~40~~ 10 % Conc
☒Other 40 (Thicket)%

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

☐ Mature Forest ____% ☒Shrub/Sapling 60 % ☒Herbs/Grasses 40% ☐ Turf ____%

☒Riffle 8.8 % ☒Run 26.6 % ☒ Pool 44.6%

☐ Roads ☐ Bridges ☒Pipelines ☐ Beaver Dams ☒Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☒Other ____________

Channelized: ☐ Yes ☒Some ☐ No
Local Watershed Erosion: ☐ None ☐ Minimal ☒Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☒Degrading ☐ Widening ☐ Headcutting

Water Odors
☐ Normal/None ☐ Sewage
☒Petroleum ☒Chemical
☐ Fishy ☐ Other____________

Water Surface Oils
☐ Slick ☒ Sheen ☒Globs
☒Flecks ☐ None ☐ Other____________

Turbidity/Water Clarity (if not measured)
☐ Clear ☒Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other 22.0

Sediment Odor
☐ Normal ☐ Sewage ☒Petroleum
☒ Chemical ☐ Anaerobic ☐None
☐ Other____________

Sediment Deposits
☐ Sludge ☐ Sawdust ☒Oils
☒ Sand ☐ Relict shells
☒Other Silt/Dirt

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GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D. LC-3	**LOCATION** Union, AR, Eldorado
STREAM NAME Loutre Creek	**RIVER BASIN** Ouachita
LAT **LONG**	**CLIENT** Lion Oil
INVESTIGATORS BM/KEM/JB/SKH	
FORM COMPLETED BY BPP/JB	**DATE** 4/28/05 **TIME** 0800
	REASON FOR SURVEY

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/[✓ F]

Other ____________

STREAM ATTRIBUTES

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 ________ mi^2

HYDROLOGY

Flows
☐ High ☑ Moderate ☐ Low ☐ None

Flows Measured?
☑ Yes ☐ No

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☑ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other ____________
☐ Residential

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

INSTREAM FEATURES

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 20 %
☐ Run 30 %
☐ Pool 50 %

Channelized ☐ Yes ☐ Some ☑ No

Dam Present ☐ Yes ☐ Some ☑ No

WATER/ OBSERVATIONS

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/ OBSERVATIONS

Sediment Odor
☐ Normal ☐ Sewage ☑ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other ____________

Sediment Deposits
☐ Sludge ☐ Sawdust ☑ Oils
☐ Sand ☐ Relict shells
☐ Other ____________

Discharge/Flow Measurement Form

Station: LC-3

Waterbody: Louhm Creek

Date: 4/28/05

Crew: SKH/BJT

Start Time: 1000

Recorder: SKH

End Time: 1010

GH. Change: ______ in

______ hrs.

Staff/Gage:

Width: 9.5

Area:

Velocity:

Disch/Flow:

Method:

No Secs:

Meter No:

Max Vel:

Min Vel:

ORIENTATION:

Wading, Boat, Upstream, Downstream, Side Bridge ______ ft/mi, above, below gage, and ______

Measurement rated: excellent good fair poor based on the following conditions: Cross section ______

Flow ______ Weather ______

Other ______ Air ______ °F @ ______

Gage ______ Water ______ °F @ ______

Observer ______

Control ______

Remarks ______

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
1.0	1.0	0.4	*	ND			
2.0	1.0	0.5		0.5			
3.0	1.0	0.6		1.17			
4.0	1.0	0.6		0.57			
5.0	1.0	0.5		1.46			
6.0	1.0	0.5		1.0			
7.0	1.0	0.5		1.58			
8.0	1.0	0.5		1.78			
9.0	1.0	0.5		0.5			
9.5	0.5	0.4		ND			
TOTALS							

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Completed By______ Checked by______ Reviewed by______

Lion Oil		date	4/28/2005	Start	1000
				Stop	1010
Station:	LC-3				
Waterbody:	Loutre Creek				
Crew:	BJP/SKH				
Width (ft):	9.5	Area:	4.7	Max Vel:	1.78
Disc/Flow (cfs):	4.45	Velocity:	0.86	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Avg Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
1.0	1.0	0.4	0	0.4	0
2.0	1.0	0.5	0.5	0.5	0.25
3.0	1.0	0.6	1.17	0.6	0.702
4.0	1.0	0.6	0.57	0.6	0.342
5.0	1.0	0.5	1.46	0.5	0.73
6.0	1.0	0.5	1	0.5	0.5
7.0	1.0	0.5	1.58	0.5	0.79
8.0	1.0	0.5	1.78	0.5	0.89
9.0	1.0	0.5	0.5	0.5	0.25
9.5	0.5	0.1	0	0.05	0
Total	9.50	4.70	8.56	4.65	4.45
Average	0.95	0.47	0.86	0.47	0.45

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-3	Stream: Loutre Creek Location: Union County	Date/Time: 4/28/05 0810 – 0950	Analyst: SKH/BJP

1. Reach Length Determination

ph for Coro GPS 348 d/s Lat: 33 11 34.8 Long: 92 40 38.1 349 u/s Lat: 33 11 37. Long: 92 40 35.

						Average		
Bankfull Width	16.7	16.4	19.7	13.0	19.6	16.9	338'	33.8'
Bankfull Depth	2.0	1.1	3.5	2.5	2.3	1.95	na	na

[1]Average width times 20 [2]Total Length divided by 10

H2O 0.9 | 0.9 | 2.1 | 1.2 | 1.2

2. Riffle-Pool Sequence

Riffle	10+7.8	[illegible]						12.0	—	—	29.8	8.8
Run	16	27					33.8	13.0	—	—	89.8	26.(
Pool		6.8	33.8	33.8	33.8	33.8		8.8	33.8	33.8	218.4	64.(
Total												
Sequence[1]	xxx-----xxx	-----~~	~~~~	~~~~	~~~~	~~~~	-----	-----xxx~~	~~~~	~~~~		

[1]Riffle="xxx", Run="-----", Pool="~~~"

3. Depth and Width Regime

	1	2	3	4	5	6	7	8	9	10	Average	Run
Riffle Depth	0.7	0.9	—	—	—	—	0.7	0.5	—	—	.6	.8
Riffle Width	8.0	6.5	—	—	—	—	6.0	10.0	—	—	9.0	5.75
Pool Depth	1.1	1.5	1.2	2.0	2.0	2.5	—	0.8	1.3	1.5	1.54	
Pool Width	14.0	10.0	18.0	20	15.0	18.0	—	11.0	20	15	15.7	

[illegible] – shallow pools, no Deep

Run/Pool

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	25	15	10	20	20	25	35	40	30	20	24

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	30	20	15	30	40	40	30	30	30	25	29

6. Substrate Characterization (Dominant Substrate)

	1	2	3	4	5	6	7	8	9	10	Average	Run
Riffle	S(2)	~~6~~ SC(1)	—	—	—	—	S(1)	GF(3)	—	—	2	1.5
Pool	SC(1)	SC(1)	SC(1)	SC(1)	S(1) [illegible]	S(1)	—	S(1)	S(2)	S(2)	1.4	

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

NOTE: Riffle #1 & 2 were packed w/ Hard Clay "washed" clean. Run/Pool

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Low

Section	1	2	3	4	5	6	7	8	9	10	Average
% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	30	10	15	30	20	40	30	20	30	40	26.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-3	Date/Time: 4/28/05	Initials: SKH/BJP

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Riffle	Macrophytes	0	0	—	—	—	—	10	5	—	—	2.5
	Periphyton	50	30	—	—	—	—	5	5	—	—	22.5
Pool	Macrophytes	0	0	5	5	5	10	—	5	5	5	4.4
	Periphyton	20	10	5	5	5	5	—	5	5	5	7.2

Run
5
5

moss type

Run/Pool

10. Canopy Cover (Percent Stream Shading)

Shading	20	10	10	10	20	10	20	10	10	10	13

11. Bank Stability (Score) and Slope (Degrees)

Score	5	2	2	2	2	1	3	3	2	2	2.4
Slope (°)	80°	90°	90°	90°	90	90	80	80	85°	90	86.5

Score	7	8	4	2	4	7	2	5	4	3	4.7
Slope (°)	65°	60°	80°	90°	75	80	90	70	80	90	77

Score 9-10 = Stable, < 5% bank affected.

Score 3-5 = Moderately unstable, 30-59% bank eroding.

Score 6-8 = Moderately stable, 5-29% of bank eroding

Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

%	60	50	30	40	35	20	60	45	40	20	40

%	75	85	50	40	55	75	40	55	70	25	57

13. Riparian Vegetative Zone Width

Score	*7	*7	*7	*7	*7	8	7	5	4	5	6.4

Score	2	2	2	2	3	3	3	3	5	5	3.0

Score 9-10 = Riparian Zone Width > 18 meters

Score 3-5 = Riparian Zone Width 11 - 6 meters

Score 6-8 = Riparian Zone Width 18 - 12 meters

Score 1-2 = Riparian Zone Width < 6 meters

* LB Riparian is a cane thicket

14. Land-Use Stream Impacts

Impact	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other ______

Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: LC-3	Client:
Stream name:	Date/Time:
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: LL-3	Date/Time:
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 3 LB	Left Bank 10 9	8 7 6	5 4 [✓ 3]	2 1
SCORE 5 RB	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 5 LB	Left Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
SCORE 6 RB	Right Bank 10 9	8 7 [✓ 6]	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 6 LB	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1
SCORE 3 RB	Right Bank 10 9	8 7 6	5 4 [✓ 3]	2 1

TOTAL SCORE: 114

AVERAGE SCORE: 11.4

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

FIELD DATA SHEETS - FISH

Waterbody Name: Louter Creek

Client: Lion oil

Project no: 2[illegible]60-05-070

Investigators: REM BJP SKH JB

Date Sample Collected: 4/28/05

Habitat Forms Completed: [✓ yes] / no

Location: LC3

Ecoregion: Gulf Coastal

Weather: Sunny Clear Mild

Form Completed By: REM/JB

Form Checked By:

Fish Sampling Completed: [✓ yes] / no

Collection Site Observations			
	Above Station	LC3 Below Station	Additional Observations:
Location Sample			
Relative Abundance of Aquatic Biota			
Periphyton:	0 1 2 3 4	0 1 [✓ 2] 3 4	
Filamentous Algae:	0 1 2 3 4	[✓ 0] 1 2 3 4	
Macrophytes:	0 1 2 3 4	0 1 [✓ 2] 3 4	
Slimes:	0 1 2 3 4	[✓ 0] 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 [✓ 2] 3 4	
Fish:	0 1 2 3 4	0 1 2 [✓ 3] 4	
Other____________:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:		5/25	
Shallow Pool:		60	
Deep Pool:		15	
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:		15	
Emergent Vegatation:		10	
Submerged Vegetation:			
Depositional Area:		20	
Overhanging Veg:		5	
Root Wads:		20	
Undercut Banks:		30	
Filamentous algae:			
Leafy debris:			
Substrate Type and Scoring			
Substrate	Score	Adj. Score	
Bedrock:	X 0.1		
Lg. Boulder:	X 1.0		
Boulders:	X 1.0		
Rubble:	X 1.0		
Gravel:	X 0.5	10	
Sand:	X 0.1	10	
Mud/Silt:	X 0.1	80 (old tar deposits)	
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

Sampling Gear Type: [✓ Electrofishing] Seine Gill nets

Unit of Effort: Above: ______ Below: 2267 PDT

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, [✓ Sparse] Absent

Site Description & Notes:

Above Station: ______

Below Station: Loutre Creek

(SKH)

LAB checked 5/19/05

Fish Species Observed

~~Above Station #~~ LC3	Below Station #
㉟ – Gambasia 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	
~~Yellow Sunfish~~	
(89) – Longear Sunfish 𝍸 𝍸 𝍸 𝍸 𝍸	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
① – Grass Pickerel |	㊵ - ㊾
⑥ – Spotted Sunfish 𝍸 𝍸 ||||	
⑦ – Green Sunfish 𝍸 ||	– 3 w/ internal parasites
~~Bluegill~~ — Not Found |	
① – Warmouth |	

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GBM© & Assoc. Doc. 1
Page 2 of 2

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Loutre Creek

Client: Lion oil

Project no: 2160-05-070

Investigators: REM, BJP, SKH, JB

Date Sample Collected: 4/28/05

Habitat Forms Completed: [✓ yes] / no

Location: LC 3

Ecoregion: Gulf Coastal

Weather: Sunny Clear, Mild

Form Completed By: REM/JB

Form Checked By: ____

Fish Sampling Completed: yes / no

Collection Site Observations		
	LC 2 ~~Above Station~~	LC-3 Below Station
[illegible]		
Relative Abundance of Aquatic Biota		
Periphyton:	0 1 2 3 4	0 [✓ 1] 2 3 4
Filamentous Algae:	0 1 2 3 4	[✓ 0] 1 2 3 4
Macrophytes:	0 1 2 3 4	0 1 [✓ 2] 3 4
Slimes:	0 1 2 3 4	[✓ 0] 1 2 3 4
Macroinvertebrates:	0 1 2 3 4	0 1 [✓ 2] [✓ 3] 4
Fish:	0 1 2 3 4	0 1 [✓ 2] 3 4
Other____:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:		15/35
Shallow Pool:		50
Deep Pool:		
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:		
Emergent Vegatation:		40
Submerged Vegetation:		
Depositional Area:		20
Overhanging Veg:		
Root Wads:		20
Undercut Banks:		20
Filamentous algae:		
Leafy Debris:		
Other____:		

Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	LC-3 Below Station
Annelida		
Decapoda		A
Gastropoda		
Pelecypoda		
Hemiptera		A
Coleoptera		
Lepidoptera		
Odonata		P/C
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		P/C

R=Rare, C=Common, A=Abundant, D=Dominant

Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

Rapid Bioassessment Field Sheet

Point Source Pesch LC-3

Collector ______ Sample Technique ______ Sediment ? ______ Date ______

Habitat Description: ABOVE ______

BELOW ______

MACROINVERTEBRATE COMMUNITY

ABOVE Station # ______

Cnt.	Taxa	Tally
11	Oligochaeta	𝍸𝍸|
8	Cambarinae	𝍸|||
3	Isopoda	|||
2	Palaemonetes	||
10	Caenis	𝍸𝍸
11	Corixidae	𝍸𝍸|
2	Columbella	||
4	Argia	||||
6	Enallagma	𝍸|
3	Sialis	|||
2	Hexatoma	||
2	Weevil	||
3	Uvarus	|||
3	Tipula	|||
15	Chironomidae	𝍸𝍸𝍸
11	Tanypodinae	𝍸𝍸|
4	Tanytarsini	||||
8	Psycoda	𝍸|||
	:TOTAL:	

BELOW Station # ______

Cnt.	Taxa	Tally
	:TOTAL:	

Community Structure

	ABOVE	BELOW
% Ephem.		
% Plecop.		
% Trichop.		
% EPT		
% Chir.		
% Diptera		

	ABOVE	BELOW
% Odon.		
% Cole.		
% Crustacea		
# of Taxa:		
Biotic Score:		

Comments:

Page 1 of 1

Field Data Form

FIELD MEASUREMENT RECORD (Date 4/27- /05)

REVIEWED BY: ______

Station/Depth	Date	Time	Field Crew	Temp C°	DO mg/l	Sp. Cond. uS	pH su	Turb. (ntu)	Sample # of Containers		Notes
									S=Sed.	W=Wat.	
UTA-2	4/27/05	0755- ~~0745~~	BJP/SKH	14.9°C	75.2% 7.5	475	6.5	12.7	—	1	sample collected @0740 Cl, Sulfate, TDS
UTA-4	4/27/05	1140	BJP/SKH	16.5°C	34% 3.5mg/L	4299	5.6	21.2	—	1	WQ samples collected Cl, SO4, TDS
UTA-3	4/27/05	1505	SKH/BJP	17.4°C	70.5% 7.5mg/L	495	6.4	17.0	—	1	"
LC-3	4/28/05	0800	SKH/BJP	23.6°C	53.0% 4.4mg/L	2788	7.5	22.0	—	1	"
LC-2	4/28/05	1045	SKH/JB	26.8°C	66.6% 5.2mg/L	2874	7.9	24.0	—	1	"
LC-1	4/28/05	1410	SKH/DB	21.1°C	41.0% 3.7mg/L	295	6.7	13.3	—	1	"

* Indicates calibration check was made

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Bryant, AR 72022

CASE NARRATIVE

SAMPLE RECEIPT

Received Temperature: 1°C

Receipt Verification:	Complete Chain of Custody	Y
	Sample ID on Sample Labels	Y
	Date and Time on Sample Labels	Y
	Proper Sample Containers	Y
	Within Holding Times	Y
	Adequate Sample Volume	Y
	Sample Integrity	Y
	Proper Temperature	Y
	Proper Preservative	Y

QUALIFIERS

AIC Sample No.	Qualifiers	Definition
89880-2	D	Result is from a secondary dilution factor
89880-3	D	Result is from a secondary dilution factor
89880-5	D	Result is from a secondary dilution factor
89880-6	D	Result is from a secondary dilution factor

erences:

"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", 20th edition, 1998.

"American Society for Testing and Materials" (ASTM).

"Association of Analytical Chemists" (AOAC).

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Bryant, AR 72022

ANALYTICAL RESULTS

AIC No. 89880-1
Sample Identification: UTA-2 4-27-05 (0740)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	280	10	mg/l	W13814	
Chloride	EPA 300.0	79	0.2	mg/l	S15746	
Sulfate	EPA 300.0	12	0.2	mg/l	S15746	

AIC No. 89880-2
Sample Identification: UTA-3 4-27-05 (1505)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	300	10	mg/l	W13814	
Chloride	EPA 300.0	100	2	mg/l	S15746	D
Sulfate	EPA 300.0	15	0.2	mg/l	S15746	

AIC No. 89880-3
Sample Identification: UTA-4 4-27-05 (1140)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	2000	10	mg/l	W13814	
Chloride	EPA 300.0	1200	20	mg/l	S15746	D
Sulfate	EPA 300.0	11	0.2	mg/l	S15746	

AIC No. 89880-4
Sample Identification: LC-1 4-28-05 (1410)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	190	10	mg/l	W13817	
Chloride	EPA 300.0	70	0.2	mg/l	S15746	
Sulfate	EPA 300.0	4.4	0.2	mg/l	S15746	

AIC No. 89880-5
Sample Identification: LC-2 4-28-05 1045

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	1800	10	mg/l	W13817	
Chloride	EPA 300.0	220	2	mg/l	S15746	D
Sulfate	EPA 300.0	960	2	mg/l	S15746	D

AIC No. 89880-6
Sample Identification: LC-3 4-28-05 (0800)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	1800	10	mg/l	W13817	
Chloride	EPA 300.0	220	2	mg/l	S15746	D
Sulfate	EPA 300.0	950	2	mg/l	S15746	D

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SAMPLE PREPARATION REPORT

AIC No. 89880-1

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814	
Chloride	29APR05 1557 252	29APR05 2116 252		S15746	
Sulfate	29APR05 1557 252	29APR05 2116 252		S15746	

AIC No. 89880-2

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814	
Chloride	29APR05 1557 252	29APR05 2132 252	10	S15746	D
Sulfate	29APR05 1557 252	29APR05 2148 252		S15746	

AIC No. 89880-3

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814	
Chloride	29APR05 1557 252	02MAY05 0956 252	100	S15746	D
Sulfate	29APR05 1557 252	29APR05 2219 252		S15746	

AIC No. 89880-4

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 1246 223		W13817	
Chloride	29APR05 1557 252	29APR05 2345 252		S15746	
Sulfate	29APR05 1557 252	29APR05 2345 252		S15746	

AIC No. 89880-5

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 1246 223		W13817	
Chloride	29APR05 1557 252	30APR05 0001 252	10	S15746	D
Sulfate	29APR05 1557 252	30APR05 0001 252	10	S15746	D

AIC No. 89880-6

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 1246 223		W13817	
Chloride	29APR05 1557 252	30APR05 0032 252	10	S15746	D
Sulfate	29APR05 1557 252	30APR05 0032 252	10	S15746	D

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LABORATORY CONTROL SAMPLE RESULTS

Analyte	Spike Amount	% Recovery	% Recovery Limits	RPD	RPD Limit	Batch	Qualifier
Total Dissolved Solids	250 mg/l	101/102	85-115	0.791	10	W13814	
Total Dissolved Solids	250 mg/l	104/103	85-115	0.193	10	W13817	
Chloride	10 mg/l	97.1/95.2	90-110	2.01	10	S15746	
Sulfate	30 mg/l	99.8/100	90-110	0.180	10	S15746	

MATRIX SPIKE SAMPLE RESULTS

Analyte	Spike Amount	% Recovery	% Recovery Limits	RPD	RPD Limit	Batch	Qualifier
Chloride	10 mg/l	94.5/97.5	80-120	2.64	10	S15746	
Sulfate	30 mg/l	97.9/98.2	80-120	0.322	10	S15746	

LABORATORY BLANK RESULTS

Analyte	Method	Result	Units	RL	QC Sample	Qualifier
tal Dissolved Solids	EPA 160.1	< 10	mg/l	10	W13814-1	
l Dissolved Solids	EPA 160.1	< 10	mg/l	10	W13817-1	
C oride	EPA 300.0	< 0.2	mg/l	0.2	S15746-1	
Sulfate	EPA 300.0	< 0.2	mg/l	0.2	S15746-1	

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QUALITY CONTROL PREPARATION REPORT

LABORATORY CONTROL SAMPLES

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	QC Sample	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814-2	
Total Dissolved Solids	-	03MAY05 0926 223		W13814-3	
Total Dissolved Solids	-	03MAY05 1246 223		W13817-2	
Total Dissolved Solids	-	03MAY05 1246 223		W13817-3	
Chloride	29APR05 1132 252	29APR05 1333 252		S15746-2	
Chloride	29APR05 1132 252	29APR05 1400 252		S15746-3	
Sulfate	29APR05 1132 252	29APR05 1333 252		S15746-2	
Sulfate	29APR05 1132 252	29APR05 1400 252		S15746-3	

MATRIX SPIKE SAMPLES

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	QC Sample	Qualifier
Chloride	29APR05 1132 252	29APR05 1427 252		S15746-4	
Chloride	29APR05 1132 252	29APR05 1459 252		S15746-5	
Sulfate	29APR05 1132 252	29APR05 1427 252		S15746-4	
Sulfate	29APR05 1132 252	29APR05 1459 252		S15746-5	

LABORATORY BLANKS

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	QC Sample	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814-1	
Total Dissolved Solids	-	03MAY05 1246 223		W13817-1	
Chloride	29APR05 1132 252	29APR05 1319 252		S15746-1	
Sulfate	29APR05 1132 252	29APR05 1319 252		S15746-1	

GBM

GBM^c & Associates
Strategic Environmental Services
219 Brown Ln.
Bryant, AR 72022 X

(501) 847-7077 Fax (501) 847-7943

Chain of Custody

89880

CLIENT INFORMATION

Company: GBM^c & Associates
Project Name/No.: 2160-~~05~~-070 / 2072-05-070
Send Report To: ~~Roland~~ McDaniel
Address: 21~~9~~ ~~Brown~~ Lane
Bryant AR 72022
Phone/Fax No.:

BILLING INFORMATION

Bill To:
Company: See
Address: Client
Information
Phone No.:
Fax No.:

SPECIAL INSTRUCTIONS/PRECAUTIONS

Contact Brad Phillips or Kyle Hathcoti with any questions @ 501-847-7077

Parameters for Analysis/Methods

	Sample ID	Sample Description	Date	Time	Matrix S=Sed/Soil W=Water	Number of Containers	Composite or Grab	Cl, SO4, TDS									
①	UTA-2		4/27/05	0740	W	1	G	X									
②	UTA-3		4/27/05	1565	W	1	G	X									
③	UTA-4		4/27/05	1140	W	1	G	X									
④	LC-1		4/28/05	1410	W	1	G	X									
⑤	LC-2		4/28/05	1045	W	1	G	X									
⑥	LC-3		4/28/05	0800	W	1	G	X									
	Preservative	(Sulfuric acid =S, Nitric acid =N, NaOH =B, Ice =I)						I									

Sampler(s): BJP/SKH/JB
Shipment Method: GBM^c Delivery
Turnaround Time Required: Normal
COC Completed by: Date: 4/29/05 Time: 1230
COC Checked by: Date: 4/29/05 Time: 1235
Relinquished by: Date: 4/29/05 Time: 1315
Received by: Date: Time:
Relinquished by: Date: Time:
Received in lab by: Date: 4-29-05 Time: 1315

LABORATORY USE ONLY Samples Received on Ice? YES or NO Sample temperature

V1.3 04/14/04

Appendix E

Field Data Sheets

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: LC-1
LOCATION: u/s of Lion 0.1
STREAM NAME: Loutre Creek
RIVER BASIN: Ouachita
LAT: 33 12 5.4 **LONG:** 92 43 1
PROJECT: Lion 0.1 UAA
INVESTIGATORS: SMH/DB
DATE/TIME: 4/28/05
FORM CHECKED BY:

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☒ Yes ☐ No
Air Temperature __________ °C/°F
Other __________

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☐ Mixture of origins
☐ Swamp and bog ☐ Other __________

Catchment Area: __________ mi²
Stream Order: __________

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope ______ ft/mi **& Sinuosity** ______

Predominant Surrounding Landuse
☒ Forest 50 %
☐ Pasture ____%
☐ Row Crops ____%
☒ Urban 50 %
☐ Sub-Urban
☐ Commercial ____%
☐ Industrial ____%
☐ Other __________%

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☒ Urban/Sub-Urban Storm Water

☒ Mature Forest 10 % ☒ Shrub/Sapling 90 % ☐ Herbs/Grasses ____% ☐ Turf ____%

☒ Riffle 23.3% ☐ Run ______% ☒ Pool 74.7%

☒ Roads ☒ Bridges ☐ Pipelines ☒ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☒ Other Wet land

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☐ Degrading ☐ Widening ☐ Headcutting

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other __________

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☐ None ☐ Other __________

Turbidity/Water Clarity (if not measured) 13.3 NTU
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other __________

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other __________

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☒ Other Silt/Dirt

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D. LC-1
LOCATION Union, AK; Eldorado
STREAM NAME Loutre Creek
RIVER BASIN Ouachita
LAT **LONG**
CLIENT Lion Oil
INVESTIGATORS BJP/KSM/BKH/JB
FORM COMPLETED BY BJP/JB
DATE 4/28/05
TIME 1500
REASON FOR SURVEY

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 80 °C/[✓ F]
Other

STREAM ATTRIBUTES

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☑ Mixture of origins
☐ Other

Catchment Area ______ mi²

HYDROLOGY

Flows
☐ High ☐ Moderate ☑ Low ☐ None

Flows Measured?
☑ Yes ☐ No

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☐ Commercial
☐ Industrial
☐ Other

Local Watershed NPS Pollution
☐ No evidence ☑ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

INSTREAM FEATURES

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 30 %
☐ Run 20 %
☐ Pool 50 %

Channelized ☐ Yes ☐ Some ☑ No

Dam Present ☐ Yes ☐ Some ☑ No

WATER/ OBSERVATIONS

Water Odors
☑ Normal/None
☐ Petroleum
☐ Fishy
☐ Sewage
☐ Chemical
☐ Other

Water Surface Oils
☐ Slick ☑ Sheen – organic / Fe oxide ☐ Globs
☐ Flecks ☐ None ☐ Other

Turbidity (if not measured)
☐ Clear
☐ Opaque
☑ Slightly turbid
☑ Stained
☐ Turbid
☐ Other

SEDIMENT/ OBSERVATIONS

Sediment Odor
☑ Normal
☐ Chemical
☐ Other
☐ Sewage
☐ Anaerobic
☐ Petroleum
☐ None

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☑ Sand ☐ Relict shells
☑ Other organic

Discharge/Flow Measurement Form

Station: LC-1

Waterbody: Louthn Creek

Date: 2/28/05

Crew: SKH / JTB	Start Time: 1555	Recorder: SKH
	End Time: 1605	GH. Change: ____ in
	Staff/Gage:	____ hrs.
Width: 5.0	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

Wading, Boat, Upstream, Downstream, Side Bridge ____ ft/mi, above, below gage, and ____

Measurement rated: excellent good fair poor based on the following conditions: Cross section ____

Flow ____ Weather ____

Other ____ Air ____ °F @ ____

Gage ____ Water ____ °F @ ____

Observer ____

Control ____

Remarks ____

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, [✓ 0.6] or 0.8)	(5) Area (A)	(6) Discharge (Q)
0.5	0.5	0.2		ND			
1.0		0.5		0.19			
1.5		0.5		0.31			
2.0		0.5		0.51			
2.5		0.4		0.47			
3.0		0.3		0.40			
3.5		0.3		0.29			
4.0		0.1		0.1			
~~4.5~~	~~0.5~~						
5.0	1.0	0.0		ND			
TOTALS							

V1.0 1096

Completed By____ Checked by____ Reviewed by____

Lion Oil		date	4/28/2005	Start	1555
				Stop	1605

Station: LC-1
Waterbody: Loutre Creek
Crew: BJP/SKH

Width (ft):	5.0	Area:	1.5	Max Vel:	0.51
Disc/Flow (cfs):	0.48	Velocity:	0.25	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
0.5	0.5	0.2	0	0.1	0
1.0	0.5	0.5	0.19	0.25	0.0475
1.5	0.5	0.5	0.31	0.25	0.0775
2.0	0.5	0.5	0.51	0.25	0.1275
2.5	0.5	0.4	0.47	0.2	0.094
3.0	0.5	0.4	0.4	0.2	0.08
3.5	0.5	0.3	0.29	0.15	0.0435
4.0	0.5	0.1	0.1	0.05	0.005
5.0	1.0	0	0	0	0
Total	5.00	2.90	2.27	1.45	0.48
Average	0.56	0.32	0.25	0.16	0.05

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-1	Date/Time: 4/28/05	Initials: SKY/JB

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Riffle	Macrophytes	—	—	0	0	—	—	6	0	—		0
	Periphyton	—	—	0	—	—	—	0	6	—		0
Pool	Macrophytes	15	5	0	0	0	0	~~0~~	—	0		2.9
	Periphyton	0	0	0	0	0	0	~~0~~	—	0		0

10. Canopy Cover (Percent Stream Shading)

Shading	80	80	90	90	90	90	90	90	90	90	85

11. Bank Stability (Score) and Slope (Degrees)

Score	8	6	7	8	8	8	8	8	8	6	7.5
Slope (°)	80°	90°	70°	90	85	80	60	70	80	80	79
Score	8	7	7	6	6	8	8	8	8	7	7.3
Slope (°)	80°	70°	80	50	60	80	60	70	70	80	70

Score 9-10 = Stable, < 5% bank affected.
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

%	80	60	20	60	60	50	40	60	70	40	54
%	80	40	10	35	35	50	40	60	50	40	45

13. Riparian Vegetative Zone Width

Score	7	8	8	9	8	8	8	8	8	8	8
Score	8	8	8	9	8	8	8	8	8	8	8.1

Score 9-10 = Riparian Zone Width > 18 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 1-2 = Riparian Zone Width < 6 meters

14. Land-Use Stream Impacts

Impact	u,~~2~~1	u,1	u,1	u,1	u,1						u,1

C= Cattle R = Row Crops U = Urban/Encroachment I = Industrial Encroachment O = Other ________
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-1	Stream: Lortrie Creek	Date/Time: 4/28/05	Analyst: SPH/UCB
	Location: Upper Lortrie East Fork	1430 –	

1. Reach Length Determination

Bankfull Width	10.5	11.5	10.6	~~13.8~~ 12.5	18.5	12.7	254	25.4'
Bankfull Depth	1.8	2.6	2.8	~~2.4~~ 1.4	4.5	1.4	na	na

[1]Average width times 20 1.2 1.9 [2]Total Length divided by 10

Cano GPS (353) u/s Lat 33.51 Lng 33,129 92 40 43.5 (852) d/s Lat: 37°12'5.4" Lng: 92°43'1.0"

2. Riffle-Pool Sequence

Riffle											
Run			13.4				25.4	25.4			64.2
Pool	25.4	25.4	12	25.4	25.4	25.4					
Total									25.4	25.4	189.8
Sequence[1]	~~~	~~~	~~xx	~~~	~~~	~~~	xxx	xxx	~~~	~~~	

25.
74.

[1]Riffle="xxx", Run="-----", Pool="~~~"

Trib from Bear Break

3. Depth and Width Regime

Riffle Depth	—	—	0.4	1.1	–	~~X~~	0.2	0.2	—	—	~~[illegible]~~ .27
Riffle Width	—	—	5	10	—	~~—~~	5.0	5.0 ~~5.5~~	—	–	~~[illegible]~~
Pool Depth	1.8	1.1	0.4	~~[illegible]~~	2.5	1.8	~~[illegible]~~ –	~~.7~~	1.4	1.3	~~[illegible]~~ .5 1.7
Pool Width	11.0	12.0	10	~~[illegible]~~	14.0	11.0	~~[illegible]~~ –	~~50~~	11.0	9.0	8.8

2.5 Shallow / no Deep

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

% Area	60	40	30	35	70	~~[illegible]~~	20	20	40	60	44.5

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

% Area	70	50	30	40	70	70	20	20	50	60	480

6. Substrate Characterization (Dominant Substrate)

Riffle	—										
Pool	S(2)	S(2)	S(2)	S(2	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)	S(2)

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

%	30	40	50	25	50	70	20	20	20	50	37.5

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: LC-1	Date/Time:
Stream name: Lowtre Creek	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 8 LB	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 7 LB	Left Bank 10 9	8 [✓ 7] 6	5 4 3	2 1
SCORE 5 RB	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 8 LB	Left Bank 10 9	[✓ 8] 7 6	5 4 3	2 1
SCORE 8 RB	Right Bank 10 9	[✓ 8] 7 6	5 4 3	2 1

TOTAL SCORE: 142
AVERAGE SCORE: 14.2

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: LC-1	Client: Lion Oil
Stream name: Loutre Creek	Date/Time: 4/28/05
Location:	Form Completed By: JBB/SKH

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 14	20 19 18 17 16	15 14 13 12 11	10 9 [illegible] 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 18	20 19 [✓ 18] 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 14	20 19 18 17 16	15 [✓ 14] 13 12 11	10 9 8 7 6	5 4 3 2 1

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FIELD DATA SHEETS - FISH

Waterbody Name: Loutre Creek (LC-1)
Client: Lion Oil
Project no: 2160-05-070.
Investigators: BJP. REM.
Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: Union, AR: Eldorado
Ecoregion: Gulf Coastal Plain
Weather: Clear, windy
~80° F
Form Completed By: BJP/REM
Form Checked By:
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations			
	Above Station	Below Station	Additional Observations:
Total Time Sampled			
Relative Abundance of Aquatic Biota			
Periphyton:	0 [✓ 1] 2 3 4	0 1 2 3 4	
Filamentous Algae:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Macrophytes:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 [✓ 3] 4	0 1 2 3 4	
Fish:	0 1 2 [✓ 3] 4	0 1 2 3 4	
Other______:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Macro Habitat Sampled (%)			
[✓ Riffle]/Run:	10		
Shallow Pool:	70		
Deep Pool:	20		
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	50		
Emergent Vegatation:	–		
Submerged Vegetation:	–		
Depositional Area:	10		
Overhanging Veg:	–		
Root Wads:	30		
Undercut Banks:	10		
Filamentous algae:	–		
Leafy debris:	–		
Substrate Type and Scoring			
Substrate	Score	Adj. Score	
Bedrock:	– X 0.1		
Lg. Boulder:	– X 1.0		
Boulders:	– X 1.0		
Rubble:	– X 1.0		
Gravel:	– X 0.5		
Sand:	60 X 0.1		
Mud/Silt: 20/20	40 X 0.1		
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

Sampling Gear Type: [✓ Electrofishing] Seine Gill nets

Unit of Effort: Above PDT 8-1692 ~~Below:~~

Quantity of Available Fish Cover:

Above Station: [✓ Very Abundant] Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: Canopy cover prolific; sediment deposition abundant

Below Station:

5/18/05 (5/19)
AB Checks

Fish Species Observed

Release

Above Station # LC-1	Below Station #
(68) — Long ear 卌 卌 卌 卌 卌	卌 卌 卌 卌 卌 卌 卌 卌 卌
㊻ — Gambusia 卌 卌 卌 卌 卌	卌 卌 卌 II
② — Golden shiner II	
③ — Golden top minnow III	
Pirate Perch	①
~~Blue gill~~ I Not	Found
1 — Notropis 1 Notropis emiliae	(Pugnose Minnow)
③ — Spotted sunfish III	
① — Green 1	

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Loutre Creek (LC-1)
Client: Lion Oil
Project no: 2160-05-070
Investigators: BJP , REM
Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: Union Co. AR. Eldorado
Ecoregion: Gulf Coastal Plain
Weather: Clear, windy ~80°F
Form Completed By: BJP/REM
Form Checked By:
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations	Above Station	Below Station
Day Time Sampled		
Relative Abundance of Aquatic Biota		
Periphyton:	0 [✓ 1] 2 3 4	0 1 2 3 4
Filamentous Algae:	[✓ 0] 1 2 3 4	0 1 2 3 4
Macrophytes:	[✓ 0] 1 2 3 4	0 1 2 3 4
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 2 [✓ 3] 4	0 1 2 3 4
Fish:	0 1 2 [✓ 3] 4	0 1 2 3 4
Other________:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
[✓ Riffle]/Run:	10 riff	
Shallow Pool:	70	
Deep Pool:	20	
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:	50	
Emergent Vegatation:	0	
Submerged Vegetation:	0	
Depositional Area:	10	
Overhanging Veg:	0	
Root Wads:	30	
Undercut Banks:	10	
Filamentous algae:	-	
Leafy Debris:	-	
Other________:		

Macroinvertebrate Qualitative Sample List

Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant
Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

Rapid Bioassessment Field Sheet

Point Source Reach LC-1 (Coutre Creek - u/s of Low O.1) Date 5/5/05

Collector ________ Sample Technique ________ Sediment ? ________

Habitat Description: ABOVE Reach LC-1

BELOW Reach LC-2

MACROINVERTEBRATE COMMUNITY

ABOVE Station # LC-1

Cnt.	Taxa	Tally
29	Oligochaetae	卌 卌 卌 卌 卌 ||||
1	Leeche (moorbille)	|
3	Cambarus	|||
1	Amphipoda	|
13	Corbicula	卌 卌 |||
1	Belostoma	|
1	Argia	|
3	Libellulia	|||
	~~[illegible]~~ REW	
1	Anopheles	|
1	Bittacomorpha	|
1	Perithemis	|
	Chironomidae	
15	Chironominae	卌 卌 卌
25	Tanypodinae	卌 卌 卌 卌 卌
7	Tanytarsini	卌 ||
1	Probezzia	|
1	Dineutus	|
1	Peltodytes	|
5	Tipula	卌
	:TOTAL:	

BELOW Station # LC-2

Cnt.	Taxa	Tally
13	Oligo.	卌 卌 |||
7	Crayfish	卌 ||
1	Belostoma	|
3	Argia	|||
1	Libellula	|
2	Hexatoma	||
2	mosquito	||
4	Corixidae	||||
~~1~~	~~Perithemis~~	~~| RE~~
8	Enallagma	卌 |||
28	Chironomidae	卌 卌 卌 卌 卌 |||
14	Tanypodinae	卌 卌 ||||
9	Tanytarsini	卌 ||||
	~~Corixidae~~	~~卌~~
2	Probezzia	||
	~~Hexatoma~~	
2	Tipula	||
1	Dytiscus	|
1	Hydrocanthus	|
1	Hydrochus	|
3	Uvarus	|||
	:TOTAL:	

Community Structure

	ABOVE	BELOW
% Ephem.		
% Plecop.		
% Trichop.		
% EPT		
% Chir.		
% Diptera		

	ABOVE	BELOW
% Odon.		
% Cole.		
% Crustacea		
# of Taxa:		
Biotic Score:		

Comments:

1.1 6/99

Page 2 of 3

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: LC-2
LOCATION: Lion Oil
STREAM NAME: Loutre Creek
RIVER BASIN: Ouachita River
LAT: **LONG:**
PROJECT: Lion Oil WAA
INVESTIGATORS: SKH/JB
DATE/TIME: 4/28/05
FORM CHECKED BY:

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☒ Yes ☐ No
Air Temperature__________°C/°F
Other____________________

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____________

Catchment Area: __________mi²
Stream Order: __________

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope ________ft/mi **& Sinuosity** ________

Predominant Surrounding Landuse
☐ Forest ____% ☐ Sub-Urban
☐ Pasture ____% ☐ Commercial____%
☐ Row Crops ____% ☒ Industrial 100%
☐ Urban ____% ☐ Other ______________%

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☒ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

☐ Mature Forest ____% ☐ Shrub/Sapling ____% ☒ Herbs/Grasses 100% ☐ Turf ____%

☒ Riffle 1 % ☐ Run ______% ☒ Pool 99 %

☒ Roads ☒ Bridges ☒ Pipelines ☐ Beaver Dams ☒ Point Source
☒ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other ____________

Channelized: ☒ Yes ☐ Some ☐ No
Local Watershed Erosion: ☐ None ☐ Minimal ☒ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☒ Degrading ☐ Widening ☐ Headcutting

Water Odors
☐ Normal/None ☐ Sewage
☒ Petroleum ☒ Chemical
☐ Fishy ☐ Other__________

Water Surface Oils
☐ Slick ☒ Sheen ☒ Globs
☒ Flecks ☐ None ☐ Other__________

Turbidity/Water Clarity (if not measured)
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

24.0 NTU

Sediment Odor
☐ Normal ☐ Sewage ☒ Petroleum
☒ Chemical ☐ Anaerobic ☐ None
☐ Other______________

Sediment Deposits
☐ Sludge ☐ Sawdust ☒ Oils
☒ Sand ☐ Relict shells
☒ Other Silts/Dirt

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D. LC-2
LOCATION Union, AR; Eldorado
STREAM NAME Loutre Creek
RIVER BASIN Ouachita
LAT **LONG**
CLIENT Lion Oil
INVESTIGATORS BJP/RCM/SKH/JB
FORM COMPLETED BY BJP/JB
DATE 4/28/05
TIME 1400
REASON FOR SURVEY

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 ~80 °C/[✓ °F]

Other ____________

STREAM ATTRIBUTES

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☑ Mixture of origins
☐ Other ____________

Catchment Area ________ mi²

HYDROLOGY

Flows
☐ High ☑ Moderate ☐ Low ☐ None

Flows Measured?
☑ Yes ☐ No

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest
☐ Field/Pasture
☐ Agricultural
☐ Residential
☐ Commercial
☑ Industrial
☐ Other ____________

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☐ Moderate ☑ Heavy

INSTREAM FEATURES

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle ______%
☐ Run 70 %
☐ Pool 30 %

Channelized ☑ Yes ☐ Some ☐ No

Dam Present ☑ Yes ☐ Some ☐ No

WATER/ OBSERVATIONS

Water Odors
☐ Normal/None
☑ Petroleum
☐ Fishy
☐ Sewage
☐ Chemical
☐ Other ____________

Water Surface Oils
☐ Slick ☑ Sheen ☑ Globs
☑ Flecks ☐ None ☐ Other ____________

Turbidity (if not measured)
☐ Clear
☐ Opaque
☑ Slightly turbid
☑ Stained
☐ Turbid
☐ Other ____________

SEDIMENT/ OBSERVATIONS

Sediment Odor
☐ Normal
☐ Chemical
☐ Other ____________
☐ Sewage
☐ Anaerobic
☑ Petroleum
☐ None

Sediment Deposits
☐ Sludge ☐ Sawdust ☑ Oils
☐ Sand ☐ Relict shells
☐ Other ____________

Discharge/Flow Measurement Form

Station: LC-2

Waterbody: Louden Creek

Date: 4/28/

Crew: SKH/JB

Start Time: 1220

End Time: 1230

Staff/Gage:

Recorder: SKH

GH. Change: ______ in

______ hrs.

Width: 17.0'

Area:

Velocity:

Disch/Flow:

Method:

No Secs:

Meter No:

Max Vel:

Min Vel:

ORIENTATION:

[✓ Wading], Boat, [✓ Upstream], Downstream, Side Bridge ______ ft/mi,

above, below gage, and ______

Measurement rated: excellent [✓ good] fair poor based on the following

conditions: Cross section ______

Flow ______ Weather ______

Other ______ Air ______ °F @ ______

Gage ______ Water ______ °F @ ______

Observer ______

Control ______

Remarks ______

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
2.0	2.0	0.3		0.82			
4.0	2.0	0.3		0.92			
6.0	2.0	0.3		0.89			
8.0	2.0	0.3		1.01			
10.0	2.0	0.3		0.78			
12.0	2.0	0.3		0.80			
14.0	2.0	0.3		0.96			
16.0	2.0	0.3		0.80			
17	1.0	0.3		ND			
TOTALS							

Concrete Bottom (Flat)

V1.0 1096

Completed By______ Checked by______ Reviewed by______

Lion Oil		date	4/28/2005	Start	1220
				Stop	1230
Station:	LC-2				
Waterbody:	Loutre Creek				
Crew:	BJP/SKH				
Width (ft):	17.0	Area:	5.1	Max Vel:	1.01
Disc/Flow (cfs):	4.19	Velocity:	0.78	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Avg Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
2.0	2.0	0.3	0.82	0.6	0.492
4.0	2.0	0.3	0.92	0.6	0.552
6.0	2.0	0.3	0.89	0.6	0.534
8.0	2.0	0.3	1.01	0.6	0.606
10.0	2.0	0.3	0.78	0.6	0.468
12.0	2.0	0.3	0.8	0.6	0.48
14.0	2.0	0.3	0.96	0.6	0.576
16.0	2.0	0.3	0.8	0.6	0.48
17.0	1.0	0.3	0	0.3	0
Total	17.00	2.70	6.98	5.10	4.19
Average	1.89	0.30	0.78	0.57	0.47

d/s Lat: 33 ..
Lng: 92 40 38.6

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC2	Stream: Locke Creek	Date/Time: 4/28/05	Analyst: SKH/OB
	Location: Union County	1050- 1205	

Run/Pool Camo GPS u/s Lat: 33 11 46.8 u/s Long: 92 40 40.3, d/s Lat: d/s Long:

1. Reach Length Determination

Bankfull Width	17.0	25.6	23.4	20.0	~~8~~ 19.9	21.2	424	42.4
Bankfull Depth	2.2	3.1'	3.6'	2.2	2.1	2.2	na	na

[1]Average width times 20 [2]Total Length divided by 10

H2O 0.9 | 1.6 | 2.0' | 1.2 | 1.1 |

2. Riffle-Pool Sequence

Riffle											
Run											
Pool	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	
Total											
Sequence[1]	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	~~~	

[1]Riffle="xxx", Run="-----", Pool="~~~"

Most of Stream is Channelized Pool/Run NOTE: Stream Had 1 Riffle, Concrete Flat, w/ Broken Concrete, just u/s of Ship Wash

3. Depth and Width Regime

	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth	—	—	—	—	—	—					
Riffle Width	—	—	—	—	—	—					
Pool Depth	1.5	1.1	0.9	0.7	1.2	1.0	0.8	0.9	0.7	1.1	.99
Pool Width	28.0'	20'	17	18	20	18	21	18	20	19	19.9

Shallow pools, no Deep

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

	1	2	3	4	5	6	7	8	9	10	Average
% Area	10	15	15	10	10	15	20	15	15	20	14.5

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

	1	2	3	4	5	6	7	8	9	10	Average
% Area	10	15	15	10	10	10	20	15	15	20	14

6. Substrate Characterization (Dominant Substrate)

	1	2	3	4	5	6	7	8	9	10	Average
Riffle	—	—	—	—	—	—	—	—	—	—	
Pool	5(2)	5(2)	5(2)	5(2)	5(2)	5(2)	5(2)	5(2)	5(2)	5(2)	(5) 2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

low

	1	2	3	4	5	6	7	8	9	10	Average
% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

	1	2	3	4	5	6	7	8	9	10	Average
%	20	25	20	30	60	90	80	60	40	80	54.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-2

Date/Time: 4/28/05

Initials: SKH/GB

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Riffle	Macrophytes	—	—	—	—	—	—	—	—	—	—	
	Periphyton	—	—	—	—	—	—	—	—	—	—	
Pool	Macrophytes	5	5	5	0	5	5	5	0	5	10	4.5
	Periphyton	5	5	0	0	0	0	0	0	0	0	1

10. Canopy Cover (Percent Stream Shading)

Shading	0										0

11. Bank Stability (Score) and Slope (Degrees)

Score	4	5	5	5	6	5	6	4	5	2	4.7
Slope (°)	75°	85	70	70	70	80	80	70	70	85	76

Score	5	5	6	6	4	6	3	5	5	7	5.2
Slope (°)	80°	70	70°	60	70	80	80	60	50	50	67

Score 9-10 = Stable, < 5% bank affected.

Score 3-5 = Moderately unstable, 30-59% bank eroding.

Score 6-8 = Moderately stable, 5-29% of bank eroding

Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

%	30	60	60	60	70	60	70	60	40	15	54.5

%	60	80	60	60	50	70	40	70	50	65	60.5

13. Riparian Vegetative Zone Width

Score	0										0

Score	0										0

Score 9-10 = Riparian Zone Width > 18 meters

Score 3-5 = Riparian Zone Width 11 - 6 meters

Score 6-8 = Riparian Zone Width 18 - 12 meters

Score 1-2 = Riparian Zone Width < 6 meters

14. Land-Use Stream Impacts

Impact	I, 3										

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other

Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: LC-2	Client:
Stream name:	Date/Time:
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 [✓ 4] 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 11	20 19 18 17 16	15 14 13 12 [✓ 11]	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 2	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 [✓ 8] 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: LC-2
Stream name:
Date/Time:
Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 2	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 [✓ 2] 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 5 LB	Left Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
SCORE 5 RB	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 6 LB	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 [✓ 7] 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 1 LB	Left Bank 10 9	8 7 6	5 4 3	2 [✓ 1]
SCORE 1 RB	Right Bank 10 9	8 7 6	5 4 3	2 [✓ 1]

TOTAL SCORE: 78
AVERAGE SCORE: 7.8

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

FIELD DATA SHEETS - FISH

Waterbody Name: Loutre Creek
Client: Lion Oil
Project no: 2160-05-070
Investigators: BJP REM

Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: Union County AR Eldorado
Ecoregion: Gulf Coastal
Weather: Clear - upper 70s

Form Completed By: BJP/REM
Form Checked By:
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations

	Above Station	Below Station	Additional Observations:
Total Time Sampled	LC-2		
Relative Abundance of Aquatic Biota			
Periphyton:	BJP ~~0~~ [✓ 1] 2 3 4	0 1 2 3 4	
Filamentous Algae:	~~0~~ [✓ 1] 2 3 4	0 1 2 3 4	
Macrophytes:	0 [✓ 1] 2 3 4	0 1 2 3 4	
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 [✓ 2 3] 4	0 1 2 3 4	
Fish:	0 1 [✓ 2 3] 4	0 1 2 3 4	
Other________:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Macro-Habitat Sampled (%)			
Riffle/Run:	5		
Shallow Pool:	70		
Deep Pool:	25		
Backwaters:			
Chanelized:	* 100%		
Microhabitats Sampled (%)			
Woody debris:	5		
Emergent Vegatation:	20		
Submerged Vegetation:	10		
Depositional Area:	0		
Overhanging Veg:	BJP ~~65~~ 55		
Root Wads:	5		
Undercut Banks:	5		
Filamentous algae:			
Leafy debris:			

Substrate Type and Scoring

Substrate	Score		Adj. Score
Bedrock:		X 0.1	
Lg. Boulder:		X 1.0	
Boulders:		X 1.0	
Rubble:	5	X 1.0	
Gravel:	5	X 0.5	
Sand:	70	X 0.1	
Mud/Silt:	15 mud / 5 silt	X 0.1	

Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0

Sampling Gear Type: [✓ Electrofishing] Seine Gill nets

Unit of Effort: Above: ~~0201~~ 2301 ~~Below:~~ N/A ~~1049~~ 1045-1135

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, [✓ Sparse], Absent

~~Below Station: Very Abundant~~, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: channelized sand substrate, overhanging non woody vegetation, some woody debris

Below Station:

SK
MB Check 5/1/[illegible]

Fish Species Observed

	Above Station #	LC-2	~~Below Station #~~ 𝍸 𝍸 𝍸 𝍸	Releas
86	Longear	𝍸 𝍸 𝍸 𝍸 𝍸	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	22
2	Warmouth	||	||| 2 warmouth w/ Internal parasites	
6	Green sunfish	𝍸 |	2 w/ Internal parasites	
2	Large m. bass	||	1 w/ Fin Rot	1
1	Golden Shiner			1
35	Gamb	𝍸 𝍸 𝍸 𝍸 𝍸 ||		
1	B. bullhead	|	1 w/ Fin Rot	
8	spotted sun	𝍸 |||		

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GBM© & Assoc. Doc. 1
Page 2 of 2

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Loutre Creek
Client: Lion Oil
Project no: 2160-05-070
Investigators: REM, BJP

Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: Union County, AR Eldorado
Ecoregion: Coastal Plain
Weather: Clear ~80°

Form Completed By: BJP/REM
Form Checked By: ______
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations

	Above Station	Below Station
Site Rep Sampled	LC-2	
Relative Abundance of Aquatic Biota		
Periphyton:	0 [✓ 1] 2 3 4	0 1 2 3 4
Filamentous Algae:	0 [✓ 1] 2 3 4	0 1 2 3 4
Macrophytes:	0 [✓ 1] 2 3 4	0 1 2 3 4
Slimes:	[✓ 0] 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 [✓ 2 3] 4	0 1 2 3 4
Fish:	0 1 [✓ 2 3] 4	0 1 2 3 4
Other______:	0 1 2 3 4	0 1 2 3 4

0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant

	Above Station	Below Station
Major Habitat Sampled (%)		
Riffle/Run:	5	
Shallow Pool:	70	
Deep Pool:	25	
Backwaters:		
Chanelized:	100%	
Microhabitats Sampled (%)		
Woody Debris:		
Emergent Vegatation:	50	
Submerged Vegetation:		
Depositional Area:		
Overhanging Veg:	50	
Root Wads:		
Undercut Banks:		
Filamentous algae:		
Leafy Debris:		
Other______:		

Macroinvertebrate Qualitative Sample List

Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant
Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: LC-3
LOCATION: Union County
STREAM NAME: Loutre Creek
RIVER BASIN: Ouachita River
LAT: 33 11 34.8 **LONG:** 92 40 38.1
PROJECT: Lion OIMAA
INVESTIGATORS: SLM/BDP
DATE/TIME: 4/28/05 (0955)
FORM CHECKED BY:

Now / **Past 24-hr**
☐ storm (heavy rain) ☐
☐ rain (steady rain) ☐
☐ showers (intermittent) ☐
__%☐ % cloud cover ☐ ____%
☒ clear/sunny ☒

Heavy rain in the last 7 days? ☒ Yes ☐ No
Air Temperature 65 °C/[✓ °F]
Other ______

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other ______

Catchment Area: ______ mi^2
Stream Order: ______

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope & Sinuosity
______ft/mi ______

Predominant Surrounding Landuse
☒ Forest 10 % ☐ Sub-Urban
☒ Pasture 40 % ☐ Commercial____%
☐ Row Crops ____% ☒ Industrial 10 % Cme
☐ Urban ____% ☒ Other 40 (Thicket) %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

☐ Mature Forest ____% ☒ Shrub/Sapling 60 % ☒ Herbs/Grasses 40% ☐ Turf ____%

☒ Riffle 8.8 % ☒ Run 26.6 % ☒ Pool 64.6%

☐ Roads ☐ Bridges ☒ Pipelines ☐ Beaver Dams ☒ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☒ Other ______

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☐ Minimal ☒ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☒ Degrading ☐ Widening ☐ Headcutting

Water Odors
☐ Normal/None ☐ Sewage
☒ Petroleum ☒ Chemical
☐ Fishy ☐ Other______

Water Surface Oils
☐ Slick ☒ Sheen ☒ Globs
☒ Flecks ☐ None ☐ Other______

Turbidity/Water Clarity (if not measured)
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other 22.0

Sediment Odor
☐ Normal ☐ Sewage ☒ Petroleum
☒ Chemical ☐ Anaerobic ☐ None
☐ Other______

Sediment Deposits
☐ Sludge ☐ Sawdust ☒ Oils
☒ Sand ☐ Relict shells
☒ Other Silt/Dirt

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D. LC-3	**LOCATION** Union, AR, Eldorado	
STREAM NAME Loutre Creek	**RIVER BASIN** Ouachita	
LAT **LONG**	**CLIENT** Lion Oil	
INVESTIGATORS BM/KEM/JB/SKR		
FORM COMPLETED BY BRP/JB	**DATE** 4/28/05 **TIME** 0800	**REASON FOR SURVEY**

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/[✓ °F]

Other________

STREAM ATTRIBUTES

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial
☐ Non-glacial montane
☐ Swamp and bog
☐ Spring-fed
☑ Mixture of origins
☐ Other ________

Catchment Area ______ mi²

HYDROLOGY

Flows
☐ High ☑ Moderate ☐ Low ☐ None

Flows Measured?
☑ Yes ☐ No

WATERSHED FEATURES

Predominant Surrounding Landuse
☐ Forest
☑ Field/Pasture
☐ Agricultural
☐ Residential
☐ Commercial
☐ Industrial
☐ Other ________

Local Watershed NPS Pollution
☐ No evidence ☐ Some potential sources
☑ Obvious sources

Local Watershed Erosion
☐ None ☑ Moderate ☐ Heavy

INSTREAM FEATURES

Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 20 %
☐ Run 30 %
☐ Pool 50 %

Channelized ☐ Yes ☐ Some ☑ No

Dam Present ☐ Yes ☐ Some ☑ No

WATER/ OBSERVATIONS

Water Odors
☐ Normal/None
☑ Petroleum
☐ Fishy
☐ Sewage
☐ Chemical
☐ Other________

Water Surface Oils
☐ Slick ☑ Sheen ☐ Globs
☑ Flecks ☐ None ☐ Other________

Turbidity (if not measured)
☐ Clear
☐ Opaque
☑ Slightly turbid
☑ Stained
☐ Turbid
☐ Other________

SEDIMENT/ OBSERVATIONS

Sediment Odor
☐ Normal
☐ Chemical
☐ Other________
☐ Sewage
☐ Anaerobic
☑ Petroleum
☐ None

Sediment Deposits
☐ Sludge ☐ Sawdust ☑ Oils
☐ Sand ☐ Relict shells
☐ Other________

Discharge/Flow Measurement Form

Station: LC-3
Waterbody: Loutn Creek
Date: 4/28/05
Crew: SKH/BJT
Start Time: 1000
Recorder: SKH
End Time: 1010
GH. Change: ________ in
________ hrs.
Staff/Gage:
Width: 9.5
Area:
Velocity:
Disch/Flow:
Method:
No Secs:
Meter No:
Max Vel:
Min Vel:

ORIENTATION:
Wading, Boat, Upstream, Downstream, Side Bridge ________ ft/mi, above, below gage, and ____________

Measurement rated: excellent good fair poor based on the following conditions: Cross section ____________
Flow ____________ Weather ____________
Other ____________ Air ________ °F @ ________
Gage ____________ Water ________ °F @ ________

Observer ____________

Control ____________

Remarks ____________

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
1.0	1.0	0.4	*	ND			
2.0	1.0	0.5		0.5			
3.0	1.0	0.6		1.17			
4.0	1.0	0.6		0.57			
5.0	1.0	0.5		1.46			
6.0	1.0	0.5		1.0			
7.0	1.0	0.5		1.58			
8.0	1.0	0.5		1.78			
9.0	1.0	0.5		0.5			
9.5	0.5	0.4		ND			
TOTALS							

V1.0 1096

Completed By________ Checked by__________ Reviewed by__________

Lion Oil date 4/28/2005

Start 1000
Stop 1010

Station: LC-3
Waterbody: Loutre Creek
Crew: BJP/SKH

Width (ft):	9.5	Area:	4.7	Max Vel:	1.78
Disc/Flow (cfs):	4.45	Velocity:	0.86	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Avg Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
1.0	1.0	0.4	0	0.4	0
2.0	1.0	0.5	0.5	0.5	0.25
3.0	1.0	0.6	1.17	0.6	0.702
4.0	1.0	0.6	0.57	0.6	0.342
5.0	1.0	0.5	1.46	0.5	0.73
6.0	1.0	0.5	1	0.5	0.5
7.0	1.0	0.5	1.58	0.5	0.79
8.0	1.0	0.5	1.78	0.5	0.89
9.0	1.0	0.5	0.5	0.5	0.25
9.5	0.5	0.1	0	0.05	0
Total	9.50	4.70	8.56	4.65	4.45
Average	0.95	0.47	0.86	0.47	0.45

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-3	Stream: Loutre Creek	Date/Time: 4/28/05	Analyst: SKH/BJP
	Location: Union Count	0810 – 0950	

for Coro GPS (348) d/s Lat: 33 11 34.8 Long: 92 40 38.1 (349) u/s Lat: 33 11 37. Long: 92 40 35.

1. Reach Length Determination

Bankfull Width	16.7	16.4	19.7	13.0	19.6	16.9	338'	33.8'
Bankfull Depth	2.0	1.7	3.5	2.5	2.3	1.95	na	na
H2O	0.9	0.9	2.1	1.2	1.2			

[1]Average width times 20 [2]Total Length divided by 10

2. Riffle-Pool Sequence

Riffle	10+7.8	[illegible]						12.0	—	—	29.8	8.8
Run	16	27					33.8	13.0	—	—	89.8	26.(
Pool		6.8	33.8	33.8	33.8	33.8		8.8	33.8	33.8	218.4	64.(
Total												
Sequence[1]	xxx-----xxx	------~~~	~~~~~	~~~~~	~~~~~	~~~~~	------	---~~~	~~~~	~~~~		

[1]Riffle="xxx", Run="----", Pool="~~~"

3. Depth and Width Regime

												Run
Riffle Depth	0.7	0.9	—	—	—	—	0.7	0.5	—	—	.6	.8
Riffle Width	8.0	6.5	—	—	—	—	6.0	10.0	—	—	9.0	5.75
Pool Depth	1.1	1.5	1.2	2.0	2.0	2.5	—	0.8	1.3	1.5	1.54	
Pool Width	14.0	10.0	18.0	20	15.0	18.0	—	11.0	20	15	15.7	

Quafed — shallow pools, no Deep

Run/pool

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

% Area	25	15	10	20	20	25	35	40	30	20	24

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

% Area	30	20	15	30	40	40	30	30	30	25	29

6. Substrate Characterization (Dominant Substrate)

												Run
Riffle	S(2)	SC(1)	—	—	—	—	S(1)	GF(3)	—	—	2	1.5
Pool	SC(1)	SC(1)	SC(1)	SC(1)	S(2)	S(1)	—	S(2)	S(2)	S(2)	1.4	

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

NOTE: Riffle #1 & 2 were packed w/ Hard Clay "washed" clean. Run/Pool

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Low

% Embedded										

8. Sediment Deposition (Percent of Bottom Affected)

%	30	10	15	30	20	40	30	20	30	40	26.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: LC-3	Date/Time: 4/28/05	Initials: SKH/BJP

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Riffle	Macrophytes	0	0	—	—	—	—	10	5	—	—	2.5
	Periphyton	50	30	—	—	—	—	5	5	—	—	22.5
Pool	Macrophytes	0	0	5	5	5	10	—	5	5	5	4.4
	Periphyton	20	10	5	5	5	5	—	5	5	5	7.2

Rw
5
5

Moss type

Rw/Pool

10. Canopy Cover (Percent Stream Shading)

Shading	20	10	10	10	20	10	20	10	10	10	13

11. Bank Stability (Score) and Slope (Degrees)

Score	5	2	2	2	2	1	3	3	2	2	2.4
Slope (°)	80°	90°	90°	90°	90	90	80	80	85°	90	86.5
Score	7	8	4	2	4	7	2	5	4	3	4.7
Slope (°)	65°	60°	80°	90°	75	80	90	70	80	90	77

Score 9-10 = Stable, < 5% bank affected.
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

%	60	50	30	40	35	20	60	45	40	20	40
%	75	85	50	40	55	75	40	35	70	25	57

13. Riparian Vegetative Zone Width

Score	*7	*7	*7	*7	*7	8	7	5	4	5	6.4
Score	2	2	2	2	3	3	3	3	5	5	3.0

Score 9-10 = Riparian Zone Width > 18 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 1-2 = Riparian Zone Width < 6 meters

* LB Riparian is a cane thicket

14. Land-Use Stream Impacts

Impact	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1	I, 1

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other ______
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: LC-3	Client:
Stream name:	Date/Time:
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 15	20 19 18 17 16	[✓ 15] 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 10	20 19 18 17 16	15 14 13 12 11	[✓ 10] 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 13	20 19 18 17 16	15 14 [✓ 13] 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: LL-3	Date/Time:
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 [✓ 9] 8 7 6	5 4 3 2 1
7. 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
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 3 LB	Left Bank 10 9	8 7 6	5 4 [✓ 3]	2 1
SCORE 5 RB	Right Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	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 streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 5 LB	Left Bank 10 9	8 7 6	[✓ 5] 4 3	2 1
SCORE 6 RB	Right Bank 10 9	8 7 [✓ 6]	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, 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 a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 6 LB	Left Bank 10 9	8 7 [✓ 6]	5 4 3	2 1
SCORE 3 RB	Right Bank 10 9	8 7 6	5 4 [✓ 3]	2 1

TOTAL SCORE: 114

AVERAGE SCORE: 11.4

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

FIELD DATA SHEETS - FISH

Waterbody Name: Louter Creek
Client: Lion Oil
Project no: 2[illegible]60-05-070
Investigators: REM, BJP, SKH, JB
Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: LC3
Ecoregion: Gulf Coastal
Weather: Sunny Clear Mild
Form Completed By: REM/JB
Form Checked By:
Fish Sampling Completed: [✓ yes] / no

Collection Site Observations			
	Above Station	LC3 Below Station	Additional Observations:
Location Sample			
Relative Abundance of Aquatic Biota			
Periphyton:	0 1 2 3 4	0 1 [✓ 2] 3 4	
Filamentous Algae:	0 1 2 3 4	[✓ 0] 1 2 3 4	
Macrophytes:	0 1 2 3 4	0 1 [✓ 2] 3 4	
Slimes:	0 1 2 3 4	[✓ 0] 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 [✓ 2] 3 4	
Fish:	0 1 2 3 4	0 1 2 [✓ 3] 4	
Other________:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:		5/25	
Shallow Pool:		60	
Deep Pool:		15	
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:		15	
Emergent Vegatation:		10	
Submerged Vegetation:			
Depositional Area:		20	
Overhanging Veg:		5	
Root Wads:		20	
Undercut Banks:		30	
Filamentous algae:			
Leafy debris:			

Substrate Type and Scoring		
Substrate	Score	Adj. Score
Bedrock:	X 0.1	
Lg. Boulder:	X 1.0	
Boulders:	X 1.0	
Rubble:	X 1.0	
Gravel:	X 0.5	10
Sand:	X 0.1	10
Mud/Silt:	X 0.1	80 (old tar deposits)

Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0

Sampling Gear Type: [✓ Electrofishing] Seine Gill nets

Unit of Effort: Above: Below: 2267 PDT

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, [✓ Sparse] Absent

Site Description & Notes:

Above Station:

Below Station: Loutre Creek

SKH

LAB checked

5/19/03

Fish Species Observed

~~Above Station #~~ LC3	Below Station #
35 – Gambusia 卌 卌 卌 卌 卌 卌 卌	
~~Yellow Sunfish~~	
89 – Longear Sunfish 卌 卌 卌 卌 卌	卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 40-49
1 – Grass Pickerel |	
6 – Spotted Sunfish 卌 卌 ||||	
7 – Green Sunfish 卌 ||	– 3 w/ internal parasites
~~Bluegill~~ – Not Found |	
1 – Warmouth |	

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Loutre Creek
Client: Lion Oil
Project no: 2160-05-070
Investigators: REM, BJP, SKH, JB
Date Sample Collected: 4/28/05
Habitat Forms Completed: [✓ yes] / no

Location: LC 3
Ecoregion: Gulf Coastal
Weather: Sunny Clear Mild
Form Completed By: REM/JB
Form Checked By:
Fish Sampling Completed: yes / no

Collection Site Observations	LC 2 ~~Above Station~~	LC-3 Below Station
[illegible]		
Relative Abundance of Aquatic Biota		
Periphyton:	0 1 2 3 4	0 [✓ 1] 2 3 4
Filamentous Algae:	0 1 2 3 4	[✓ 0] 1 2 3 4
Macrophytes:	0 1 2 3 4	0 1 [✓ 2] 3 4
Slimes:	0 1 2 3 4	[✓ 0] 1 2 3 4
Macroinvertebrates:	0 1 2 3 4	0 1 [✓ 2] [✓ 3] 4
Fish:	0 1 2 3 4	0 1 [✓ 2] 3 4
Other_________:	0 1 2 3 4	0 1 2 3 4

0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant

Macrohabitat Sampled (%)		
Riffle/Run:		15/85
Shallow Pool:		50
Deep Pool:		
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:		
Emergent Vegatation:		40
Submerged Vegetation:		
Depositional Area:		20
Overhanging Veg:		
Root Wads:		20
Undercut Banks:		20
Filamentous algae:		
Leafy Debris:		
Other_________:		

Macroinvertebrate Qualitative Sample List

Taxa	Above Station	LC-3 Below Station
Annelida		
Decapoda		A
Gastropoda		
Pelecypoda		
Hemiptera		A
Coleoptera		
Lepidoptera		
Odonata		P/c
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		P/c

R=Rare, C=Common, A=Abundant, D=Dominant
Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

Rapid Bioassessment Field Sheet

Point Source Resch LC-3

Collector _____ Sample Technique _____ Sediment ? _____ Date _____

Habitat Description: ABOVE _____

BELOW _____

MACROINVERTEBRATE COMMUNITY

ABOVE Station # _____

Cnt.	Taxa	Tally
11	Oligochaeta	𝍸𝍸 |
8	Cambarinae	𝍸 |||
3	Isopoda	|||
2	Palaemonetes	||
10	Caenis	𝍸𝍸
11	Corixidae	𝍸𝍸 |
2	Columbella	||
4	Argia	||||
6	Enallagma	𝍸 |
3	Sialis	|||
2	Hexatoma	||
2	Weevil	||
3	Uvarus	|||
3	Tipula	|||
15	Chironomidae	𝍸𝍸𝍸
11	Tanypodinae	𝍸𝍸 |
4	Tanytarsini	||||
8	Psychoda	𝍸 |||
	:TOTAL:	

BELOW Station # _____

Cnt.	Taxa	Tally
	:TOTAL:	

Community Structure

	ABOVE	BELOW
% Ephem.		
% Plecop.		
% Trichop.		
% EPT		
% Chir.		
Diptera		

	ABOVE	BELOW
% Odon.		
% Cole.		
% Crustacea		
# of Taxa:		
Biotic Score:		

nments:

Page 1 of 1

Field Data Form

FIELD MEASUREMENT RECORD (Date 4/27- /05)

REVIEWED BY: ____________

Station/Depth	Date	Time	Field Crew	Temp C°	DO mg/l	Sp. Cond. uS	pH su	Turb. (ntu)	Sample # of Containers S=Sed.	W=Wat.	Notes
UTA-2	4/27/05	0755- ~~0745~~	ms R.u BJP/SKH	14.9°C	75.2% 7.5	475	6.5	12.7	—	1	sample collected @0740 Cl, Sulfate, TDS
UTA-4	4/27/05	1140	BJP/SKH	16.5°C	34% 3.5 mg/L	4299	5.6	21.2	—	1	WQ samples collected Cl, SO4, TDS
UTA-3	4/27/05	1505	SKH/BJP	17.4°C	70.5% 7.5 mg/L	495	6.4	17.0	—	1	"
LC-3	4/28/05	0800	SKH/BJP	23.6°C	53.0% 4.4 mg/L	2788	7.5	22.0	—	1	"
LC-2	4/28/05	1045	SKH/JB	26.8°C	66.6% 5.2 mg/L	2874	7.9	24.0	—	1	"
LC-1	4/28/05	1410	SKH/JB	21.1°C	41.0% 3.7 mg/L	295	6.7	13.3	—	1	"

* Indicates calibration check was made

V1.2 04/18/2004

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Brown Lane
Bryant, AR 72022

CASE NARRATIVE

SAMPLE RECEIPT

Received Temperature: 1°C

Receipt Verification:		
	Complete Chain of Custody	Y
	Sample ID on Sample Labels	Y
	Date and Time on Sample Labels	Y
	Proper Sample Containers	Y
	Within Holding Times	Y
	Adequate Sample Volume	Y
	Sample Integrity	Y
	Proper Temperature	Y
	Proper Preservative	Y

QUALIFIERS

AIC Sample No.	Qualifiers	Definition
89880-2	D	Result is from a secondary dilution factor
89880-3	D	Result is from a secondary dilution factor
89880-5	D	Result is from a secondary dilution factor
89880-6	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", 20th edition, 1998.

"American Society for Testing and Materials" (ASTM).

"Association of Analytical Chemists" (AOAC).

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ANALYTICAL RESULTS

AIC No. 89880-1
Sample Identification: UTA-2 4-27-05 (0740)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	280	10	mg/l	W13814	
Chloride	EPA 300.0	79	0.2	mg/l	S15746	
Sulfate	EPA 300.0	12	0.2	mg/l	S15746	

AIC No. 89880-2
Sample Identification: UTA-3 4-27-05 (1505)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	300	10	mg/l	W13814	
Chloride	EPA 300.0	100	2	mg/l	S15746	D
Sulfate	EPA 300.0	15	0.2	mg/l	S15746	

AIC No. 89880-3
Sample Identification: UTA-4 4-27-05 (1140)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	2000	10	mg/l	W13814	
Chloride	EPA 300.0	1200	20	mg/l	S15746	D
Sulfate	EPA 300.0	11	0.2	mg/l	S15746	

AIC No. 89880-4
Sample Identification: LC-1 4-28-05 (1410)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	190	10	mg/l	W13817	
Chloride	EPA 300.0	70	0.2	mg/l	S15746	
Sulfate	EPA 300.0	4.4	0.2	mg/l	S15746	

AIC No. 89880-5
Sample Identification: LC-2 4-28-05 1045

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	1800	10	mg/l	W13817	
Chloride	EPA 300.0	220	2	mg/l	S15746	D
Sulfate	EPA 300.0	960	2	mg/l	S15746	D

AIC No. 89880-6
Sample Identification: LC-3 4-28-05 (0800)

Analyte	Method	Result	RL	Units	Batch	Qualifier
Total Dissolved Solids	EPA 160.1	1800	10	mg/l	W13817	
Chloride	EPA 300.0	220	2	mg/l	S15746	D
Sulfate	EPA 300.0	950	2	mg/l	S15746	D

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SAMPLE PREPARATION REPORT

AIC No. 89880-1

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814	
Chloride	29APR05 1557 252	29APR05 2116 252		S15746	
Sulfate	29APR05 1557 252	29APR05 2116 252		S15746	

AIC No. 89880-2

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814	
Chloride	29APR05 1557 252	29APR05 2132 252	10	S15746	D
Sulfate	29APR05 1557 252	29APR05 2148 252		S15746	

AIC No. 89880-3

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814	
Chloride	29APR05 1557 252	02MAY05 0956 252	100	S15746	D
Sulfate	29APR05 1557 252	29APR05 2219 252		S15746	

AIC No. 89880-4

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 1246 223		W13817	
Chloride	29APR05 1557 252	29APR05 2345 252		S15746	
Sulfate	29APR05 1557 252	29APR05 2345 252		S15746	

AIC No. 89880-5

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 1246 223		W13817	
Chloride	29APR05 1557 252	30APR05 0001 252	10	S15746	D
Sulfate	29APR05 1557 252	30APR05 0001 252	10	S15746	D

AIC No. 89880-6

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	Batch	Qualifier
Total Dissolved Solids	-	03MAY05 1246 223		W13817	
Chloride	29APR05 1557 252	30APR05 0032 252	10	S15746	D
Sulfate	29APR05 1557 252	30APR05 0032 252	10	S15746	D

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LABORATORY CONTROL SAMPLE RESULTS

Analyte	Spike Amount	% Recovery	% Recovery Limits	RPD	RPD Limit	Batch	Qualifier
Total Dissolved Solids	250 mg/l	101/102	85-115	0.791	10	W13814	
Total Dissolved Solids	250 mg/l	104/103	85-115	0.193	10	W13817	
Chloride	10 mg/l	97.1/95.2	90-110	2.01	10	S15746	
Sulfate	30 mg/l	99.8/100	90-110	0.180	10	S15746	

MATRIX SPIKE SAMPLE RESULTS

Analyte	Spike Amount	% Recovery	% Recovery Limits	RPD	RPD Limit	Batch	Qualifier
Chloride	10 mg/l	94.5/97.5	80-120	2.64	10	S15746	
Sulfate	30 mg/l	97.9/98.2	80-120	0.322	10	S15746	

LABORATORY BLANK RESULTS

Analyte	Method	Result	Units	RL	QC Sample	Qualifier
tal Dissolved Solids	EPA 160.1	< 10	mg/l	10	W13814-1	
al Dissolved Solids	EPA 160.1	< 10	mg/l	10	W13817-1	
Chloride	EPA 300.0	< 0.2	mg/l	0.2	S15746-1	
Sulfate	EPA 300.0	< 0.2	mg/l	0.2	S15746-1	

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QUALITY CONTROL PREPARATION REPORT

LABORATORY CONTROL SAMPLES

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	QC Sample	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814-2	
Total Dissolved Solids	-	03MAY05 0926 223		W13814-3	
Total Dissolved Solids	-	03MAY05 1246 223		W13817-2	
Total Dissolved Solids	-	03MAY05 1246 223		W13817-3	
Chloride	29APR05 1132 252	29APR05 1333 252		S15746-2	
Chloride	29APR05 1132 252	29APR05 1400 252		S15746-3	
Sulfate	29APR05 1132 252	29APR05 1333 252		S15746-2	
Sulfate	29APR05 1132 252	29APR05 1400 252		S15746-3	

MATRIX SPIKE SAMPLES

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	QC Sample	Qualifier
Chloride	29APR05 1132 252	29APR05 1427 252		S15746-4	
Chloride	29APR05 1132 252	29APR05 1459 252		S15746-5	
Sulfate	29APR05 1132 252	29APR05 1427 252		S15746-4	
Sulfate	29APR05 1132 252	29APR05 1459 252		S15746-5	

LABORATORY BLANKS

Analyte	Date/Time Prepared By	Date/Time Analyzed By	Dilution	QC Sample	Qualifier
Total Dissolved Solids	-	03MAY05 0926 223		W13814-1	
Total Dissolved Solids	-	03MAY05 1246 223		W13817-1	
Chloride	29APR05 1132 252	29APR05 1319 252		S15746-1	
Sulfate	29APR05 1132 252	29APR05 1319 252		S15746-1	

GBMc & Associates
Strategic Environmental Services
219 Brown Ln.
Bryant, AR 72022 X

(501) 847-7077 Fax (501) 847-7943

Chain of Custody

89880

CLIENT INFORMATION

Company: GBMc & Associates
Project Name/No.: 2160-05-070 / 2072-05-070
Send Report To: ~~Roland~~ McDaniel
Address: 219 Brown Lane
Bryant AR 72022
Phone/Fax No.:

BILLING INFORMATION

Bill To:
Company: See
Address: Client
Information
Phone No.:
Fax No.:

SPECIAL INSTRUCTIONS/PRECAUTIONS

Contact Brad Phillips or Kyle Hathcote with any questions @ 501-847-7077

	Sample ID	Sample Description	Date	Time	Matrix S=Sed/Soil W=Water	Number of Containers	Composite or Grab	Cl, SO_4, TDS
①	UTA-2		4/27/05	0740	W	1	G	X
②	UTA-3		4/27/05	1505	W	1	G	X
③	UTA-4		4/27/05	1140	W	1	G	X
④	LC-1		4/28/05	1410	W	1	G	X
⑤	LC-2		4/28/05	1045	W	1	G	X
⑥	LC-3		4/28/05	0800	W	1	G	X
Preservative	(Sulfuric acid =S, Nitric acid =N, NaOH =B, Ice =I)							I

Parameters for Analysis/Methods

Sampler(s): BJP/SKH/JB
Shipment Method: GBMc Delivery
Turnaround Time Required: Normal

COC Completed by: B Phillips Date: 4/29/05 Time: 1230
COC Checked by: Date: 4/29/05 Time: 1235

Relinquished by: Bradley J Phillips Date: 4/29/05 Time: 1315
Received by: Date: Time:

Relinquished by: Date: Time:
Received in lab by: Date: 4-29-05 Time: 1315

LABORATORY USE ONLY Samples Received on Ice? YES or NO Sample temperature

V1.3 04/14/04

Appendix F

LA Data

Appendix F-1

USGS Flow Data

07366200 LITTLE CORNEY BAYOU NEAR LILLIE, LA

LOCATION.--Lat 32°55'45", long 92°37'58", in NW ¼ sec.1, T.22 N., R.3 W., Union Parish, Hydrologic Unit 08040206, left bank on downstream side of bridge on State Highway 15, 1.4 mi east of Lillie, and 2.6 mi upstream from mouth.

DRAINAGE AREA.--208 mi².

PERIOD OF RECORD.--October 1955 to current year.

REVISED RECORDS.--WDR LA-79-1: 1978(M).

GAGE.--Water-stage recorder. Datum of gage is 91.48 ft above sea level. October 1955 to Jan. 26, 1956, nonrecording gage, Jan. 27, 1956 to May 31, 1978, water-stage recorder, at site 500 ft downstream at same datum.

REMARKS.--Records good above 100 cfs, fair between 100 cfs and 50 cfs, and poor below, except for estimated record, which is poor. Satellite telemetry at station.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 1,200 ft³/s and maximum (*):

Date	Time	Discharge (ft³/s)	Gage height (ft)	Date	Time	Discharge (ft³/s)	Gage height (ft)
Oct 12	1100	2,070	8.06	Dec 25	0900	2,550	8.42
Nov 5	0000	1,850	7.90	Jan 10	1200	1,480	7.63
Nov 25	2000	1,440	7.60	Jan 15	0800	1,890	7.93
Dec 2	1200	1,400	7.57	Feb 10	1500	1,690	7.46
Dec 10	0000	2,440	8.34	Apr 13	0900	*4,020	*9.88

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.73	159	1,300	114	1,100	189	120	39	176	4.6	0.37	0.51
2	0.72	381	1,370	116	1,110	125	84	33	56	4.2	0.31	0.35
3	0.64	653	1,350	118	1,140	104	66	29	42	3.7	0.25	0.24
4	0.59	1,300	1,070	110	1,100	117	56	27	35	3.8	0.21	0.16
5	0.53	1,700	728	101	995	117	49	26	27	3.8	0.19	0.11
6	0.46	1,140	618	110	793	106	67	26	22	10	0.17	0.10
7	0.52	693	889	287	637	98	87	26	22	19	0.14	0.11
8	3.3	428	1,170	710	767	128	85	27	22	13	0.11	0.10
9	91	188	2,040	1,010	1,060	164	95	31	24	7.2	0.09	0.09
10	403	66	2,280	1,420	1,600	193	84	36	21	6.3	0.08	0.07
11	885	58	1,610	1,090	1,310	174	173	34	20	5.0	0.07	0.06
12	1,960	63	953	673	809	135	1,100	30	20	4.9	0.06	0.05
13	1,610	60	640	656	540	100	3,640	27	18	4.5	0.05	0.05
14	1,010	57	453	994	347	76	2,100	24	17	3.3	0.04	0.04
15	603	53	279	1,820	239	61	1,050	26	17	2.6	0.04	0.04
16	302	47	140	1,570	197	53	598	28	15	2.5	0.03	0.03
17	74	42	98	900	159	49	308	34	15	5.6	0.03	0.04
18	41	73	86	541	128	46	103	33	17	5.8	0.02	0.03
19	34	245	80	333	109	44	61	e28	19	3.4	0.02	0.03
20	30	325	74	187	104	46	49	25	18	2.5	0.01	0.02
21	30	482	69	134	117	55	43	23	17	1.8	0.01	0.02
22	27	752	132	115	121	291	40	20	15	1.3	0.05	0.02
23	28	796	530	99	144	431	37	21	13	1.1	0.04	0.01
24	33	885	1,120	84	310	415	33	23	11	0.87	0.04	0.25
25	37	1,320	2,380	75	381	348	30	50	9.6	0.70	0.04	2.3
26	34	1,310	1,480	71	402	194	36	28	8.7	0.56	0.03	12
27	37	1,030	786	68	406	108	55	20	7.8	0.60	0.04	12
28	80	812	505	128	331	183	76	23	7.0	0.64	0.05	8.1
29	137	604	327	443	—	207	85	75	6.0	0.52	0.67	4.6
30	234	805	197	567	---	222	56	475	4.9	0.40	0.97	3.5
31	311	—	133	813	---	190	---	517	---	0.35	0.72	---
TOTAL	8,038.49	16,527	24,887	15,457	16,456	4,769	10,466	1,864	723.0	124.54	4.95	45.03
MEAN	259	551	803	499	588	154	349	60.1	24.1	4.02	0.16	1.50
MAX	1,960	1,700	2,380	1,820	1,600	431	3,640	517	176	19	0.97	12
MIN	0.46	42	69	68	104	44	30	20	4.9	0.35	0.01	0.01
AC-FT	15,940	32,780	49,360	30,660	32,640	9,460	20,760	3,700	1,430	247	9.8	89
CFSM	1.25	2.65	3.86	2.40	2.83	0.74	1.68	0.29	0.12	0.02	0.00	0.01
IN.	1.44	2.96	4.45	2.76	2.94	0.85	1.87	0.33	0.13	0.02	0.00	0.01

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1956 - 2005, BY WATER YEAR (WY)

MEAN	56.0	149	297	344	430	403	394	236	156	70.8	28.2	38.5
MAX	660	977	1,333	1,140	1,256	1,222	2,764	852	1,391	985	202	464
(WY)	(1985)	(1958)	(2002)	(1974)	(1975)	(2001)	(1991)	(1991)	(1974)	(1989)	(1996)	(1974)
MIN	0.14	8.88	20.7	34.4	45.4	48.3	49.8	11.5	3.40	1.19	0.16	0.00
(WY)	(2001)	(1996)	(1957)	(2000)	(2000)	(1966)	(1981)	(1988)	(1966)	(1988)	(2005)	(2000)

USGS Station 07366200 - Little Corney Bayou near Lillie, LA
Daily Mean Flow Data - (7/1/1985 - 6/30/2006)

208.00 square miles
A = Approved for publication -- Processing and review completed.
P = Provisional data subject to revision.
e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
7/1/1985	2.7	A
7/2/1985	2.3	A
7/3/1985	4.3	A
7/4/1985	8.3	A
7/5/1985	9.8	A
7/6/1985	11	A
7/7/1985	11	A
7/8/1985	7.9	A
7/9/1985	7.5	A
7/10/1985	6.7	A
7/11/1985	5.3	A
7/12/1985	4.2	A
7/13/1985	3.7	A
7/14/1985	4.8	A
7/15/1985	3.4	A
7/16/1985	5.2	A
7/17/1985	28	A
7/18/1985	24	A
7/19/1985	27	A
7/20/1985	16	A
7/21/1985	11	A
7/22/1985	13	A
7/23/1985	51	A
7/24/1985	73	A
7/25/1985	51	A
7/26/1985	26	A
7/27/1985	22	A
7/28/1985	17	A
7/29/1985	15	A
7/30/1985	11	A
7/31/1985	8.5	A
8/1/1985	6.3	A
8/2/1985	5	A
8/3/1985	4	A
8/4/1985	3.7	A
8/5/1985	3.2	A
8/6/1985	4.3	A
8/7/1985	4.7	A
8/8/1985	4.6	A
8/9/1985	4.9	A
8/10/1985	5	A

USGS Station 07366200 - Little Corney Bayou near Lillie, LA
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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
8/11/1985	5.8	A
8/12/1985	6.2	A
8/13/1985	5.3	A
8/14/1985	5	A
8/15/1985	6.7	A
8/16/1985	7.8	A
8/17/1985	8.7	A
8/18/1985	8.8	A
8/19/1985	9.5	A
8/20/1985	15	A
8/21/1985	19	A
8/22/1985	21	A
8/23/1985	16	A
8/24/1985	12	A
8/25/1985	9.5	A
8/26/1985	8.5	A
8/27/1985	7.6	A
8/28/1985	6.8	A
8/29/1985	6.6	A
8/30/1985	6.2	A
8/31/1985	5.2	A
9/1/1985	4.9	A
9/2/1985	4.3	A
9/3/1985	7.1	A
9/4/1985	12	A
9/5/1985	25	A
9/6/1985	29	A
9/7/1985	25	A
9/8/1985	17	A
9/9/1985	13	A
9/10/1985	16	A
9/11/1985	33	A
9/12/1985	46	A
9/13/1985	30	A
9/14/1985	20	A
9/15/1985	15	A
9/16/1985	12	A
9/17/1985	9.6	A
9/18/1985	7	A
9/19/1985	5.9	A
9/20/1985	5	A

USGS Station 07366200 - Little Corney Bayou near Lillie, LA
Daily Mean Flow Data - (7/1/1985 - 6/30/2006)

208.00 square miles
A = Approved for publication -- Processing and review completed.
P = Provisional data subject to revision.
e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
9/21/1985	4.5	A
9/22/1985	4	A
9/23/1985	4.3	A
9/24/1985	4.2	A
9/25/1985	4.3	A
9/26/1985	4.4	A
9/27/1985	4.5	A
9/28/1985	6	A
9/29/1985	8	A
9/30/1985	15	A
10/1/1985	21	A
10/2/1985	17	A
10/3/1985	12	A
10/4/1985	9	A
10/5/1985	8	A
10/6/1985	6	A
10/7/1985	4	A
10/8/1985	3.5	A
10/9/1985	3.1	A
10/10/1985	3.5	A
10/11/1985	4	A
10/12/1985	5	A
10/13/1985	7	A
10/14/1985	7.4	A
10/15/1985	6.6	A
10/16/1985	6	A
10/17/1985	7	A
10/18/1985	13	A
10/19/1985	24	A
10/20/1985	50	A
10/21/1985	86	A
10/22/1985	353	A
10/23/1985	882	A
10/24/1985	566	A
10/25/1985	280	A
10/26/1985	65	A
10/27/1985	35	A
10/28/1985	42	A
10/29/1985	149	A
10/30/1985	478	A
10/31/1985	710	A

USGS Station 07366200 - Little Corney Bayou near Lillie, LA
Daily Mean Flow Data - (7/1/1985 - 6/30/2006)

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Date	Flow (cfs)	Qualification
	All	Code
11/1/1985	692	A
11/2/1985	730	A
11/3/1985	772	A
11/4/1985	626	A
11/5/1985	393	A
11/6/1985	166	A
11/7/1985	57	A
11/8/1985	41	A
11/9/1985	34	A
11/10/1985	30	A
11/11/1985	29	A
11/12/1985	29	A
11/13/1985	31	A
11/14/1985	31	A
11/15/1985	33	A
11/16/1985	35	A
11/17/1985	43	A
11/18/1985	121	A
11/19/1985	209	A
11/20/1985	270	A
11/21/1985	298	A
11/22/1985	248	A
11/23/1985	127	A
11/24/1985	125	A
11/25/1985	265	A
11/26/1985	423	A
11/27/1985	1160	A
11/28/1985	1050	A
11/29/1985	763	A
11/30/1985	548	A
12/1/1985	424	A
12/2/1985	349	A
12/3/1985	285	A
12/4/1985	337	A
12/5/1985	480	A
12/6/1985	422	A
12/7/1985	278	A
12/8/1985	137	A
12/9/1985	90	A
12/10/1985	78	A
12/11/1985	264	A

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Date	Flow (cfs)	Qualification
	All	Code
12/12/1985	871	A
12/13/1985	2010	A
12/14/1985	1960	A
12/15/1985	1120	A
12/16/1985	757	A
12/17/1985	558	A
12/18/1985	400	A
12/19/1985	279	A
12/20/1985	160	A
12/21/1985	109	A
12/22/1985	91	A
12/23/1985	84	A
12/24/1985	80	A
12/25/1985	74	A
12/26/1985	68	A
12/27/1985	64	A
12/28/1985	65	A
12/29/1985	64	A
12/30/1985	63	A
12/31/1985	61	A
1/1/1986	61	A
1/2/1986	60	A
1/3/1986	58	A
1/4/1986	58	A
1/5/1986	58	A
1/6/1986	57	A
1/7/1986	56	A
1/8/1986	58	A
1/9/1986	59	A
1/10/1986	60	A
1/11/1986	58	A
1/12/1986	57	A
1/13/1986	55	A
1/14/1986	52	A
1/15/1986	51	A
1/16/1986	49	A
1/17/1986	49	A
1/18/1986	52	A
1/19/1986	60	A
1/20/1986	72	A
1/21/1986	72	A

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Date	Flow (cfs)	Qualification
	All	Code
1/22/1986	65	A
1/23/1986	57	A
1/24/1986	51	A
1/25/1986	65	A
1/26/1986	116	A
1/27/1986	106	A
1/28/1986	81	A
1/29/1986	65	A
1/30/1986	59	A
1/31/1986	53	A
2/1/1986	50	A
2/2/1986	50	A
2/3/1986	51	A
2/4/1986	260	A
2/5/1986	767	A
2/6/1986	1190	A
2/7/1986	1520	A
2/8/1986	1000	A
2/9/1986	719	A
2/10/1986	616	A
2/11/1986	478	A
2/12/1986	338	A
2/13/1986	244	A
2/14/1986	192	A
2/15/1986	167	A
2/16/1986	139	A
2/17/1986	118	A
2/18/1986	105	A
2/19/1986	95	A
2/20/1986	86	A
2/21/1986	78	A
2/22/1986	69	A
2/23/1986	68	A
2/24/1986	60	A
2/25/1986	55	A
2/26/1986	53	A
2/27/1986	53	A
2/28/1986	51	A
3/1/1986	47	A
3/2/1986	46	A
3/3/1986	46	A

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Date	Flow (cfs)	Qualification
	All	Code
3/4/1986	46	A
3/5/1986	45	A
3/6/1986	44	A
3/7/1986	42	A
3/8/1986	40	A
3/9/1986	38	A
3/10/1986	39	A
3/11/1986	38	A
3/12/1986	165	A
3/13/1986	408	A
3/14/1986	652	A
3/15/1986	698	A
3/16/1986	782	A
3/17/1986	659	A
3/18/1986	483	A
3/19/1986	435	A
3/20/1986	392	A
3/21/1986	299	A
3/22/1986	224	A
3/23/1986	128	A
3/24/1986	79	A
3/25/1986	64	A
3/26/1986	57	A
3/27/1986	53	A
3/28/1986	50	A
3/29/1986	49	A
3/30/1986	46	A
3/31/1986	44	A
4/1/1986	40	A
4/2/1986	38	A
4/3/1986	36	A
4/4/1986	35	A
4/5/1986	37	A
4/6/1986	39	A
4/7/1986	41	A
4/8/1986	45	A
4/9/1986	68	A
4/10/1986	69	A
4/11/1986	62	A
4/12/1986	347	A
4/13/1986	701	A

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Date	Flow (cfs)	Qualification
	All	Code
4/14/1986	539	A
4/15/1986	404	A
4/16/1986	341	A
4/17/1986	191	A
4/18/1986	68	A
4/19/1986	55	A
4/20/1986	283	A
4/21/1986	443	A
4/22/1986	429	A
4/23/1986	566	A
4/24/1986	546	A
4/25/1986	314	A
4/26/1986	92	A
4/27/1986	53	A
4/28/1986	51	A
4/29/1986	51	A
4/30/1986	42	A
5/1/1986	187	A
5/2/1986	544	A
5/3/1986	223	A
5/4/1986	68	A
5/5/1986	44	A
5/6/1986	34	A
5/7/1986	29	A
5/8/1986	24	A
5/9/1986	20	A
5/10/1986	18	A
5/11/1986	16	A
5/12/1986	17	A
5/13/1986	20	A
5/14/1986	23	A
5/15/1986	26	A
5/16/1986	26	A
5/17/1986	33	A
5/18/1986	60	A
5/19/1986	61	A
5/20/1986	51	A
5/21/1986	41	A
5/22/1986	34	A
5/23/1986	28	A
5/24/1986	27	A

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Date	Flow (cfs)	Qualification
	All	Code
5/25/1986	33	A
5/26/1986	105	A
5/27/1986	197	A
5/28/1986	498	A
5/29/1986	263	A
5/30/1986	146	A
5/31/1986	69	A
6/1/1986	45	A
6/2/1986	36	A
6/3/1986	28	A
6/4/1986	26	A
6/5/1986	24	A
6/6/1986	40	A
6/7/1986	74	A
6/8/1986	91	A
6/9/1986	239	A
6/10/1986	346	A
6/11/1986	343	A
6/12/1986	323	A
6/13/1986	223	A
6/14/1986	58	A
6/15/1986	28	A
6/16/1986	17	A
6/17/1986	11	A
6/18/1986	6.6	A
6/19/1986	4	A
6/20/1986	2.4	A
6/21/1986	3.4	A
6/22/1986	4.8	A
6/23/1986	6	A
6/24/1986	13	A
6/25/1986	17	A
6/26/1986	23	A
6/27/1986	42	A
6/28/1986	349	A
6/29/1986	5270	A
6/30/1986	5040	A
7/1/1986	2170	A
7/2/1986	1010	A
7/3/1986	579	A
7/4/1986	268	A

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Date	Flow (cfs)	Qualification
	All	Code
7/5/1986	62	A
7/6/1986	39	A
7/7/1986	29	A
7/8/1986	23	A
7/9/1986	19	A
7/10/1986	16	A
7/11/1986	13	A
7/12/1986	12	A
7/13/1986	9.8	A
7/14/1986	7.9	A
7/15/1986	6.9	A
7/16/1986	6.3	A
7/17/1986	4.9	A
7/18/1986	3.2	A
7/19/1986	1.6	A
7/20/1986	1.6	A
7/21/1986	1.6	A
7/22/1986	2.2	A
7/23/1986	2.2	A
7/24/1986	4.4	A
7/25/1986	6.9	A
7/26/1986	7.7	A
7/27/1986	11	A
7/28/1986	11	A
7/29/1986	8.2	A
7/30/1986	5	A
7/31/1986	2.8	A
8/1/1986	2.6	A
8/2/1986	2.7	A
8/3/1986	2	A
8/4/1986	1.1	A
8/5/1986	0.56	A
8/6/1986	0.32	A
8/7/1986	0.23	A
8/8/1986	0.23	A
8/9/1986	0.27	A
8/10/1986	0.26	A
8/11/1986	2	A
8/12/1986	3	A
8/13/1986	0.66	A
8/14/1986	2.7	A

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Date	Flow (cfs)	Qualification
	All	Code
8/15/1986	2.6	A
8/16/1986	5.5	A
8/17/1986	13	A
8/18/1986	11	A
8/19/1986	9.2	A
8/20/1986	14	A
8/21/1986	14	A
8/22/1986	13	A
8/23/1986	15	A
8/24/1986	35	A
8/25/1986	35	A
8/26/1986	28	A
8/27/1986	9	A
8/28/1986	2.6	A
8/29/1986	2.8	A
8/30/1986	1.7	A
8/31/1986	1.9	A
9/1/1986	1.2	A
9/2/1986	1.2	A
9/3/1986	12	A
9/4/1986	20	A
9/5/1986	15	A
9/6/1986	27	A
9/7/1986	38	A
9/8/1986	32	A
9/9/1986	17	A
9/10/1986	10	A
9/11/1986	4.8	A
9/12/1986	3.8	A
9/13/1986	2.8	A
9/14/1986	2.9	A
9/15/1986	2.4	A
9/16/1986	2.1	A
9/17/1986	2.1	A
9/18/1986	16	A
9/19/1986	36	A
9/20/1986	18	A
9/21/1986	9.3	A
9/22/1986	35	A
9/23/1986	71	A
9/24/1986	59	A

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Date	Flow (cfs)	Qualification
	All	Code
9/25/1986	31	A
9/26/1986	17	A
9/27/1986	11	A
9/28/1986	7	A
9/29/1986	6.4	A
9/30/1986	10	A
10/1/1986	8.7	A
10/2/1986	8.3	A
10/3/1986	7.2	A
10/4/1986	6.1	A
10/5/1986	13	A
10/6/1986	21	A
10/7/1986	17	A
10/8/1986	19	A
10/9/1986	64	A
10/10/1986	92	A
10/11/1986	79	A
10/12/1986	70	A
10/13/1986	116	A
10/14/1986	141	A
10/15/1986	143	A
10/16/1986	125	A
10/17/1986	63	A
10/18/1986	35	A
10/19/1986	22	A
10/20/1986	15	A
10/21/1986	13	A
10/22/1986	12	A
10/23/1986	34	A
10/24/1986	341	A
10/25/1986	596	A
10/26/1986	986	A
10/27/1986	1100	A
10/28/1986	756	A
10/29/1986	476	A
10/30/1986	171	A
10/31/1986	61	A
11/1/1986	45	A
11/2/1986	38	A
11/3/1986	31	A
11/4/1986	42	A

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Date	Flow (cfs)	Qualification
	All	Code
11/5/1986	167	A
11/6/1986	295	A
11/7/1986	442	A
11/8/1986	854	A
11/9/1986	2440	A
11/10/1986	3020	A
11/11/1986	1420	A
11/12/1986	853	A
11/13/1986	616	A
11/14/1986	468	A
11/15/1986	384	A
11/16/1986	327	A
11/17/1986	211	A
11/18/1986	130	A
11/19/1986	100	A
11/20/1986	69	A
11/21/1986	80	A
11/22/1986	94	A
11/23/1986	440	A
11/24/1986	1900	A
11/25/1986	3420	A
11/26/1986	3600	A
11/27/1986	2440	A
11/28/1986	1690	A
11/29/1986	1080	A
11/30/1986	717	A
12/1/1986	630	A
12/2/1986	386	A
12/3/1986	254	A
12/4/1986	173	A
12/5/1986	135	A
12/6/1986	109	A
12/7/1986	100	A
12/8/1986	264	A
12/9/1986	539	A
12/10/1986	741	A
12/11/1986	1110	A
12/12/1986	1430	A
12/13/1986	903	A
12/14/1986	617	A
12/15/1986	485	A

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Date	Flow (cfs)	Qualification
	All	Code
12/16/1986	451	A
12/17/1986	436	A
12/18/1986	436	A
12/19/1986	490	A
12/20/1986	522	A
12/21/1986	479	A
12/22/1986	423	A
12/23/1986	420	A
12/24/1986	459	A
12/25/1986	448	A
12/26/1986	452	A
12/27/1986	491	A
12/28/1986	466	A
12/29/1986	349	A
12/30/1986	218	A
12/31/1986	153	A
1/1/1987	124	A
1/2/1987	112	A
1/3/1987	166	A
1/4/1987	459	A
1/5/1987	551	A
1/6/1987	608	A
1/7/1987	765	A
1/8/1987	651	A
1/9/1987	474	A
1/10/1987	372	A
1/11/1987	290	A
1/12/1987	263	A
1/13/1987	253	A
1/14/1987	215	A
1/15/1987	167	A
1/16/1987	146	A
1/17/1987	143	A
1/18/1987	339	A
1/19/1987	517	A
1/20/1987	515	A
1/21/1987	576	A
1/22/1987	659	A
1/23/1987	526	A
1/24/1987	352	A
1/25/1987	226	A

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Date	Flow (cfs)	Qualification
	All	Code
1/26/1987	185	A
1/27/1987	175	A
1/28/1987	173	A
1/29/1987	155	A
1/30/1987	132	A
1/31/1987	119	A
2/1/1987	112	A
2/2/1987	285	A
2/3/1987	445	A
2/4/1987	550	A
2/5/1987	849	A
2/6/1987	746	A
2/7/1987	715	A
2/8/1987	689	A
2/9/1987	722	A
2/10/1987	730	A
2/11/1987	588	A
2/12/1987	423	A
2/13/1987	266	A
2/14/1987	167	A
2/15/1987	372	A
2/16/1987	1330	A
2/17/1987	1910	A
2/18/1987	1990	A
2/19/1987	1060	A
2/20/1987	823	A
2/21/1987	1090	A
2/22/1987	1160	A
2/23/1987	1490	A
2/24/1987	1050	A
2/25/1987	769	A
2/26/1987	689	A
2/27/1987	1600	A
2/28/1987	2460	A
3/1/1987	2690	A
3/2/1987	2010	A
3/3/1987	1390	A
3/4/1987	807	A
3/5/1987	568	A
3/6/1987	413	A
3/7/1987	278	A

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Date	Flow (cfs)	Qualification
	All	Code
3/8/1987	205	A
3/9/1987	185	A
3/10/1987	166	A
3/11/1987	144	A
3/12/1987	121	A
3/13/1987	107	A
3/14/1987	104	A
3/15/1987	102	A
3/16/1987	99	A
3/17/1987	110	A
3/18/1987	170	A
3/19/1987	200	A
3/20/1987	229	A
3/21/1987	240	A
3/22/1987	188	A
3/23/1987	140	A
3/24/1987	275	A
3/25/1987	340	A
3/26/1987	356	A
3/27/1987	365	A
3/28/1987	332	A
3/29/1987	168	A
3/30/1987	108	A
3/31/1987	115	A
4/1/1987	131	A
4/2/1987	122	A
4/3/1987	123	A
4/4/1987	116	A
4/5/1987	107	A
4/6/1987	95	A
4/7/1987	87	A
4/8/1987	77	A
4/9/1987	74	A
4/10/1987	67	A
4/11/1987	64	A
4/12/1987	59	A
4/13/1987	57	A
4/14/1987	60	A
4/15/1987	60	A
4/16/1987	59	A
4/17/1987	54	A

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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
4/18/1987	50	A
4/19/1987	46	A
4/20/1987	44	A
4/21/1987	41	A
4/22/1987	37	A
4/23/1987	35	A
4/24/1987	32	A
4/25/1987	29	A
4/26/1987	27	A
4/27/1987	26	A
4/28/1987	26	A
4/29/1987	25	A
4/30/1987	23	A
5/1/1987	20	A
5/2/1987	19	A
5/3/1987	18	A
5/4/1987	33	A
5/5/1987	37	A
5/6/1987	32	A
5/7/1987	48	A
5/8/1987	50	A
5/9/1987	69	A
5/10/1987	76	A
5/11/1987	60	A
5/12/1987	44	A
5/13/1987	37	A
5/14/1987	44	A
5/15/1987	42	A
5/16/1987	38	A
5/17/1987	47	A
5/18/1987	66	A
5/19/1987	64	A
5/20/1987	50	A
5/21/1987	36	A
5/22/1987	27	A
5/23/1987	22	A
5/24/1987	44	A
5/25/1987	46	A
5/26/1987	36	A
5/27/1987	28	A
5/28/1987	22	A

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208.00 square miles
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P = Provisional data subject to revision.
e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
5/29/1987	20	A
5/30/1987	18	A
5/31/1987	16	A
6/1/1987	21	A
6/2/1987	24	A
6/3/1987	20	A
6/4/1987	27	A
6/5/1987	34	A
6/6/1987	25	A
6/7/1987	16	A
6/8/1987	12	A
6/9/1987	10	A
6/10/1987	8.4	A
6/11/1987	7.8	A
6/12/1987	6.9	A
6/13/1987	21	A
6/14/1987	64	A
6/15/1987	72	A
6/16/1987	58	A
6/17/1987	46	A
6/18/1987	38	A
6/19/1987	27	A
6/20/1987	22	A
6/21/1987	17	A
6/22/1987	15	A
6/23/1987	14	A
6/24/1987	44	A
6/25/1987	84	A
6/26/1987	38	A
6/27/1987	22	A
6/28/1987	15	A
6/29/1987	12	A
6/30/1987	8.4	A
7/1/1987	21	A
7/2/1987	73	A
7/3/1987	107	A
7/4/1987	73	A
7/5/1987	38	A
7/6/1987	26	A
7/7/1987	20	A
7/8/1987	15	A

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Date	Flow (cfs)	Qualification
	All	Code
7/9/1987	12	A
7/10/1987	15	A
7/11/1987	17	A
7/12/1987	15	A
7/13/1987	12	A
7/14/1987	9.5	A
7/15/1987	7.5	A
7/16/1987	6.2	A
7/17/1987	5.3	A
7/18/1987	4.7	A
7/19/1987	4.1	A
7/20/1987	3.6	A
7/21/1987	3.1	A
7/22/1987	2.8	A
7/23/1987	2.7	A
7/24/1987	3.9	A
7/25/1987	14	A
7/26/1987	17	A
7/27/1987	13	A
7/28/1987	9.3	A
7/29/1987	6.4	A
7/30/1987	4.7	A
7/31/1987	3.8	A
8/1/1987	3.9	A
8/2/1987	4.6	A
8/3/1987	3.7	A
8/4/1987	3.6	A
8/5/1987	4.2	A
8/6/1987	6.5	A
8/7/1987	13	A
8/8/1987	7.2	A
8/9/1987	5.1	A
8/10/1987	4.1	A
8/11/1987	7.4	A
8/12/1987	26	A
8/13/1987	22	A
8/14/1987	11	A
8/15/1987	6.9	A
8/16/1987	3.9	A
8/17/1987	2.8	A
8/18/1987	2	A

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Date	Flow (cfs)	Qualification
	All	Code
8/19/1987	1.6	A
8/20/1987	1.3	A
8/21/1987	1.1	A
8/22/1987	0.87	A
8/23/1987	0.84	A
8/24/1987	0.69	A
8/25/1987	0.58	A
8/26/1987	0.52	A
8/27/1987	0.46	A
8/28/1987	0.38	A
8/29/1987	0.34	A
8/30/1987	0.31	A
8/31/1987	0.28	A
9/1/1987	0.29	A
9/2/1987	0.24	A
9/3/1987	0.28	A
9/4/1987	0.28	A
9/5/1987	0.24	A
9/6/1987	0.23	A
9/7/1987	0.2	A
9/8/1987	0.18	A
9/9/1987	0.17	A
9/10/1987	0.2	A
9/11/1987	0.17	A
9/12/1987	0.16	A
9/13/1987	0.14	A
9/14/1987	0.2	A
9/15/1987	0.49	A
9/16/1987	0.4	A
9/17/1987	0.28	A
9/18/1987	0.29	A
9/19/1987	0.4	A
9/20/1987	2	A
9/21/1987	2.4	A
9/22/1987	1.4	A
9/23/1987	1.1	A
9/24/1987	1	A
9/25/1987	0.92	A
9/26/1987	0.77	A
9/27/1987	0.64	A
9/28/1987	0.5	A

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Date	Flow (cfs)	Qualification
	All	Code
9/29/1987	0.39	A
9/30/1987	0.25	A
10/1/1987	0.26	A
10/2/1987	0.25	A
10/3/1987	0.15	A
10/4/1987	0.1	A
10/5/1987	0.06	A
10/6/1987	0.04	A
10/7/1987	0.03	A
10/8/1987	0.02	A
10/9/1987	0.01	A
10/10/1987	NA	A
10/11/1987	NA	A
10/12/1987	NA	A
10/13/1987	NA	A
10/14/1987	NA	A
10/15/1987	NA	A
10/16/1987	NA	A
10/17/1987	NA	A
10/18/1987	NA	A
10/19/1987	NA	A
10/20/1987	NA	A
10/21/1987	NA	A
10/22/1987	NA	A
10/23/1987	0.01	A
10/24/1987	0.03	A
10/25/1987	0.14	A
10/26/1987	0.59	A
10/27/1987	2.6	A
10/28/1987	2.6	A
10/29/1987	2.4	A
10/30/1987	2.3	A
10/31/1987	2.3	A
11/1/1987	3	A
11/2/1987	4.1	A
11/3/1987	4.4	A
11/4/1987	4.6	A
11/5/1987	5.7	A
11/6/1987	7	A
11/7/1987	8.8	A
11/8/1987	10	A

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Date	Flow (cfs)	Qualification
	All	Code
11/9/1987	17	A
11/10/1987	67	A
11/11/1987	101	A
11/12/1987	107	A
11/13/1987	104	A
11/14/1987	78	A
11/15/1987	47	A
11/16/1987	117	A
11/17/1987	333	A
11/18/1987	509	A
11/19/1987	499	A
11/20/1987	438	A
11/21/1987	463	A
11/22/1987	410	A
11/23/1987	190	A
11/24/1987	71	A
11/25/1987	76	A
11/26/1987	170	A
11/27/1987	264	A
11/28/1987	304	A
11/29/1987	326	A
11/30/1987	318	A
12/1/1987	228	A
12/2/1987	108	A
12/3/1987	67	A
12/4/1987	53	A
12/5/1987	48	A
12/6/1987	46	A
12/7/1987	58	A
12/8/1987	75	A
12/9/1987	73	A
12/10/1987	65	A
12/11/1987	54	A
12/12/1987	48	A
12/13/1987	44	A
12/14/1987	48	A
12/15/1987	53	A
12/16/1987	56	A
12/17/1987	53	A
12/18/1987	50	A
12/19/1987	48	A

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Date	Flow (cfs)	Qualification
	All	Code
12/20/1987	83	A
12/21/1987	89	A
12/22/1987	110	A
12/23/1987	118	A
12/24/1987	105	A
12/25/1987	83	A
12/26/1987	186	A
12/27/1987	1090	A
12/28/1987	1920	A
12/29/1987	2670	A
12/30/1987	1650	A
12/31/1987	1040	A
1/1/1988	759	A
1/2/1988	585	A
1/3/1988	440	A
1/4/1988	360	A
1/5/1988	319	A
1/6/1988	288	A
1/7/1988	285	A
1/8/1988	261	A
1/9/1988	214	A
1/10/1988	169	A
1/11/1988	136	A
1/12/1988	125	A
1/13/1988	173	A
1/14/1988	245	A
1/15/1988	280	A
1/16/1988	314	A
1/17/1988	365	A
1/18/1988	423	A
1/19/1988	492	A
1/20/1988	1200	A
1/21/1988	1510	A
1/22/1988	1290	A
1/23/1988	893	A
1/24/1988	619	A
1/25/1988	436	A
1/26/1988	295	A
1/27/1988	178	A
1/28/1988	124	A
1/29/1988	105	A

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Date	Flow (cfs)	Qualification
	All	Code
1/30/1988	91	A
1/31/1988	86	A
2/1/1988	90	A
2/2/1988	154	A
2/3/1988	249	A
2/4/1988	276	A
2/5/1988	323	A
2/6/1988	351	A
2/7/1988	305	A
2/8/1988	205	A
2/9/1988	134	A
2/10/1988	108	A
2/11/1988	97	A
2/12/1988	99	A
2/13/1988	109	A
2/14/1988	124	A
2/15/1988	194	A
2/16/1988	270	A
2/17/1988	222	A
2/18/1988	246	A
2/19/1988	500	A
2/20/1988	631	A
2/21/1988	739	A
2/22/1988	814	A
2/23/1988	636	A
2/24/1988	451	A
2/25/1988	303	A
2/26/1988	171	A
2/27/1988	113	A
2/28/1988	94	A
2/29/1988	84	A
3/1/1988	77	A
3/2/1988	75	A
3/3/1988	104	A
3/4/1988	171	A
3/5/1988	196	A
3/6/1988	203	A
3/7/1988	166	A
3/8/1988	198	A
3/9/1988	747	A
3/10/1988	704	A

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Date	Flow (cfs)	Qualification
	All	Code
3/11/1988	560	A
3/12/1988	570	A
3/13/1988	492	A
3/14/1988	371	A
3/15/1988	273	A
3/16/1988	203	A
3/17/1988	142	A
3/18/1988	125	A
3/19/1988	154	A
3/20/1988	156	A
3/21/1988	151	A
3/22/1988	130	A
3/23/1988	105	A
3/24/1988	109	A
3/25/1988	151	A
3/26/1988	292	A
3/27/1988	451	A
3/28/1988	626	A
3/29/1988	652	A
3/30/1988	642	A
3/31/1988	594	A
4/1/1988	604	A
4/2/1988	704	A
4/3/1988	693	A
4/4/1988	564	A
4/5/1988	522	A
4/6/1988	518	A
4/7/1988	419	A
4/8/1988	281	A
4/9/1988	145	A
4/10/1988	90	A
4/11/1988	72	A
4/12/1988	70	A
4/13/1988	75	A
4/14/1988	74	A
4/15/1988	66	A
4/16/1988	56	A
4/17/1988	49	A
4/18/1988	52	A
4/19/1988	78	A
4/20/1988	102	A

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Date	Flow (cfs)	Qualification
	All	Code
4/21/1988	119	A
4/22/1988	132	A
4/23/1988	108	A
4/24/1988	69	A
4/25/1988	46	A
4/26/1988	36	A
4/27/1988	27	A
4/28/1988	22	A
4/29/1988	18	A
4/30/1988	15	A
5/1/1988	14	A
5/2/1988	13	A
5/3/1988	12	A
5/4/1988	10	A
5/5/1988	9.2	A
5/6/1988	7.8	A
5/7/1988	7.9	A
5/8/1988	6.9	A
5/9/1988	6.3	A
5/10/1988	7.3	A
5/11/1988	15	A
5/12/1988	15	A
5/13/1988	14	A
5/14/1988	13	A
5/15/1988	11	A
5/16/1988	7.3	A
5/17/1988	5.2	A
5/18/1988	3.9	A
5/19/1988	3.5	A
5/20/1988	3.1	A
5/21/1988	2.6	A
5/22/1988	5.2	A
5/23/1988	31	A
5/24/1988	38	A
5/25/1988	33	A
5/26/1988	23	A
5/27/1988	14	A
5/28/1988	9.1	A
5/29/1988	5.9	A
5/30/1988	4.4	A
5/31/1988	3.5	A

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Date	Flow (cfs)	Qualification
	All	Code
6/1/1988	2.5	A
6/2/1988	2.1	A
6/3/1988	3.1	A
6/4/1988	14	A
6/5/1988	23	A
6/6/1988	16	A
6/7/1988	8.6	A
6/8/1988	4.8	A
6/9/1988	3.2	A
6/10/1988	2.6	A
6/11/1988	2	A
6/12/1988	1.7	A
6/13/1988	1.5	A
6/14/1988	1.5	A
6/15/1988	1.4	A
6/16/1988	1.3	A
6/17/1988	1.3	A
6/18/1988	1.3	A
6/19/1988	1.3	A
6/20/1988	1.1	A
6/21/1988	1.1	A
6/22/1988	1.3	A
6/23/1988	1.3	A
6/24/1988	1.3	A
6/25/1988	1.4	A
6/26/1988	1.4	A
6/27/1988	1.4	A
6/28/1988	1.3	A
6/29/1988	1.2	A
6/30/1988	1.1	A
7/1/1988	0.95	A
7/2/1988	0.84	A
7/3/1988	0.77	A
7/4/1988	0.53	A
7/5/1988	0.3	A
7/6/1988	0.26	A
7/7/1988	0.36	A
7/8/1988	1.2	A
7/9/1988	3.6	A
7/10/1988	2.6	A
7/11/1988	1.8	A

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Date	Flow (cfs)	Qualification
	All	Code
7/12/1988	1.4	A
7/13/1988	1	A
7/14/1988	1.1	A
7/15/1988	1.1	A
7/16/1988	1.2	A
7/17/1988	0.96	A
7/18/1988	0.95	A
7/19/1988	0.85	A
7/20/1988	0.78	A
7/21/1988	0.71	A
7/22/1988	0.91	A
7/23/1988	0.77	A
7/24/1988	0.6	A
7/25/1988	0.48	A
7/26/1988	0.53	A
7/27/1988	1.1	A
7/28/1988	2.6	A
7/29/1988	2.5	A
7/30/1988	2.2	A
7/31/1988	1.9	A
8/1/1988	1.6	A
8/2/1988	1.4	A
8/3/1988	1.2	A
8/4/1988	1.2	A
8/5/1988	1.3	A
8/6/1988	1	A
8/7/1988	0.65	A
8/8/1988	0.55	A
8/9/1988	0.65	A
8/10/1988	0.71	A
8/11/1988	0.76	A
8/12/1988	0.77	A
8/13/1988	0.74	A
8/14/1988	0.71	A
8/15/1988	0.78	A
8/16/1988	0.93	A
8/17/1988	0.68	A
8/18/1988	0.71	A
8/19/1988	0.8	A
8/20/1988	0.69	A
8/21/1988	0.89	A

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Date	Flow (cfs)	Qualification
	All	Code
8/22/1988	21	A
8/23/1988	38	A
8/24/1988	17	A
8/25/1988	34	A
8/26/1988	36	A
8/27/1988	21	A
8/28/1988	10	A
8/29/1988	4.9	A
8/30/1988	2.9	A
8/31/1988	2.6	A
9/1/1988	2.7	A
9/2/1988	2.3	A
9/3/1988	2.3	A
9/4/1988	2.3	A
9/5/1988	11	A
9/6/1988	11	A
9/7/1988	6	A
9/8/1988	3.5	A
9/9/1988	2.6	A
9/10/1988	2.1	A
9/11/1988	2.2	A
9/12/1988	16	A
9/13/1988	34	A
9/14/1988	25	A
9/15/1988	14	A
9/16/1988	7.7	A
9/17/1988	5.2	A
9/18/1988	4.5	A
9/19/1988	4	A
9/20/1988	3.6	A
9/21/1988	3.2	A
9/22/1988	3	A
9/23/1988	3	A
9/24/1988	2.9	A
9/25/1988	2.2	A
9/26/1988	2.1	A
9/27/1988	2	A
9/28/1988	1.7	A
9/29/1988	1.7	A
9/30/1988	10	A
10/1/1988	35	A

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Date	Flow (cfs)	Qualification
	All	Code
10/2/1988	37	A
10/3/1988	34	A
10/4/1988	24	A
10/5/1988	15	A
10/6/1988	9.5	A
10/7/1988	6.2	A
10/8/1988	4.8	A
10/9/1988	4.6	A
10/10/1988	6.8	A
10/11/1988	6.9	A
10/12/1988	6.3	A
10/13/1988	5	A
10/14/1988	5.2	A
10/15/1988	10	A
10/16/1988	5.6	A
10/17/1988	3.5	A
10/18/1988	3.6	A
10/19/1988	24	A
10/20/1988	50	A
10/21/1988	63	A
10/22/1988	66	A
10/23/1988	57	A
10/24/1988	45	A
10/25/1988	33	A
10/26/1988	22	A
10/27/1988	21	A
10/28/1988	36	A
10/29/1988	45	A
10/30/1988	49	A
10/31/1988	51	A
11/1/1988	55	A
11/2/1988	49	A
11/3/1988	43	A
11/4/1988	33	A
11/5/1988	23	A
11/6/1988	16	A
11/7/1988	12	A
11/8/1988	13	A
11/9/1988	14	A
11/10/1988	22	A
11/11/1988	42	A

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Date	Flow (cfs)	Qualification
	All	Code
11/12/1988	49	A
11/13/1988	101	A
11/14/1988	139	A
11/15/1988	158	A
11/16/1988	164	A
11/17/1988	146	A
11/18/1988	102	A
11/19/1988	78	A
11/20/1988	71	A
11/21/1988	59	A
11/22/1988	65	A
11/23/1988	73	A
11/24/1988	68	A
11/25/1988	56	A
11/26/1988	69	A
11/27/1988	143	A
11/28/1988	213	A
11/29/1988	306	A
11/30/1988	682	A
12/1/1988	714	A
12/2/1988	497	A
12/3/1988	268	A
12/4/1988	109	A
12/5/1988	70	A
12/6/1988	55	A
12/7/1988	49	A
12/8/1988	50	A
12/9/1988	65	A
12/10/1988	118	A
12/11/1988	137	A
12/12/1988	129	A
12/13/1988	113	A
12/14/1988	98	A
12/15/1988	84	A
12/16/1988	74	A
12/17/1988	62	A
12/18/1988	54	A
12/19/1988	49	A
12/20/1988	47	A
12/21/1988	89	A
12/22/1988	199	A

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Date	Flow (cfs)	Qualification
	All	Code
12/23/1988	294	A
12/24/1988	735	A
12/25/1988	896	A
12/26/1988	639	A
12/27/1988	460	A
12/28/1988	391	A
12/29/1988	367	A
12/30/1988	409	A
12/31/1988	470	A
1/1/1989	602	A
1/2/1989	644	A
1/3/1989	548	A
1/4/1989	470	A
1/5/1989	408	A
1/6/1989	301	A
1/7/1989	187	A
1/8/1989	147	A
1/9/1989	161	A
1/10/1989	206	A
1/11/1989	229	A
1/12/1989	428	A
1/13/1989	1380	A
1/14/1989	2530	A
1/15/1989	2950	A
1/16/1989	2230	A
1/17/1989	1470	A
1/18/1989	993	A
1/19/1989	692	A
1/20/1989	519	A
1/21/1989	384	A
1/22/1989	253	A
1/23/1989	167	A
1/24/1989	133	A
1/25/1989	148	A
1/26/1989	179	A
1/27/1989	240	A
1/28/1989	264	A
1/29/1989	256	A
1/30/1989	488	A
1/31/1989	1070	A
2/1/1989	1540	A

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Date	Flow (cfs)	Qualification
	All	Code
2/2/1989	1150	A
2/3/1989	651	A
2/4/1989	718	A
2/5/1989	529	A
2/6/1989	429	A
2/7/1989	403	A
2/8/1989	383	A
2/9/1989	316	A
2/10/1989	221	A
2/11/1989	169	A
2/12/1989	168	A
2/13/1989	310	A
2/14/1989	499	A
2/15/1989	737	A
2/16/1989	1310	A
2/17/1989	1620	A
2/18/1989	1300	A
2/19/1989	1030	A
2/20/1989	1070	A
2/21/1989	1820	A
2/22/1989	1470	A
2/23/1989	1080	A
2/24/1989	802	A
2/25/1989	633	A
2/26/1989	494	A
2/27/1989	370	A
2/28/1989	309	A
3/1/1989	335	A
3/2/1989	373	A
3/3/1989	443	A
3/4/1989	529	A
3/5/1989	582	A
3/6/1989	686	A
3/7/1989	705	A
3/8/1989	698	A
3/9/1989	654	A
3/10/1989	569	A
3/11/1989	439	A
3/12/1989	293	A
3/13/1989	198	A
3/14/1989	155	A

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Date	Flow (cfs)	Qualification
	All	Code
3/15/1989	133	A
3/16/1989	116	A
3/17/1989	103	A
3/18/1989	96	A
3/19/1989	92	A
3/20/1989	94	A
3/21/1989	465	A
3/22/1989	787	A
3/23/1989	570	A
3/24/1989	441	A
3/25/1989	355	A
3/26/1989	262	A
3/27/1989	417	A
3/28/1989	524	A
3/29/1989	682	A
3/30/1989	1030	A
3/31/1989	992	A
4/1/1989	949	A
4/2/1989	608	A
4/3/1989	439	A
4/4/1989	279	A
4/5/1989	213	A
4/6/1989	212	A
4/7/1989	212	A
4/8/1989	162	A
4/9/1989	112	A
4/10/1989	93	A
4/11/1989	85	A
4/12/1989	80	A
4/13/1989	83	A
4/14/1989	102	A
4/15/1989	108	A
4/16/1989	106	A
4/17/1989	98	A
4/18/1989	89	A
4/19/1989	84	A
4/20/1989	78	A
4/21/1989	70	A
4/22/1989	61	A
4/23/1989	54	A
4/24/1989	47	A

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Date	Flow (cfs)	Qualification
	All	Code
4/25/1989	43	A
4/26/1989	40	A
4/27/1989	39	A
4/28/1989	48	A
4/29/1989	79	A
4/30/1989	161	A
5/1/1989	199	A
5/2/1989	202	A
5/3/1989	286	A
5/4/1989	1310	A
5/5/1989	1940	A
5/6/1989	1850	A
5/7/1989	1170	A
5/8/1989	739	A
5/9/1989	528	A
5/10/1989	304	A
5/11/1989	134	A
5/12/1989	181	A
5/13/1989	301	A
5/14/1989	323	A
5/15/1989	408	A
5/16/1989	708	A
5/17/1989	1000	Ae
5/18/1989	1300	Ae
5/19/1989	1790	A
5/20/1989	1880	A
5/21/1989	1000	Ae
5/22/1989	700	Ae
5/23/1989	500	Ae
5/24/1989	350	Ae
5/25/1989	250	Ae
5/26/1989	180	Ae
5/27/1989	120	Ae
5/28/1989	85	Ae
5/29/1989	60	Ae
5/30/1989	52	Ae
5/31/1989	49	A
6/1/1989	40	A
6/2/1989	35	A
6/3/1989	32	A
6/4/1989	39	A

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Date	Flow (cfs)	Qualification
	All	Code
6/5/1989	82	A
6/6/1989	201	A
6/7/1989	368	A
6/8/1989	1630	A
6/9/1989	1410	A
6/10/1989	1790	A
6/11/1989	1310	A
6/12/1989	742	A
6/13/1989	485	A
6/14/1989	335	A
6/15/1989	571	A
6/16/1989	637	A
6/17/1989	482	A
6/18/1989	495	A
6/19/1989	491	A
6/20/1989	300	A
6/21/1989	103	A
6/22/1989	61	A
6/23/1989	47	A
6/24/1989	39	A
6/25/1989	33	A
6/26/1989	29	A
6/27/1989	56	A
6/28/1989	405	A
6/29/1989	827	A
6/30/1989	1750	A
7/1/1989	3120	A
7/2/1989	4720	A
7/3/1989	3900	A
7/4/1989	2330	A
7/5/1989	1480	A
7/6/1989	1230	A
7/7/1989	1840	A
7/8/1989	1610	A
7/9/1989	1160	A
7/10/1989	711	A
7/11/1989	477	A
7/12/1989	265	A
7/13/1989	139	A
7/14/1989	192	A
7/15/1989	246	A

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Date	Flow (cfs)	Qualification
	All	Code
7/16/1989	437	A
7/17/1989	1250	A
7/18/1989	1850	A
7/19/1989	1110	A
7/20/1989	743	A
7/21/1989	533	A
7/22/1989	387	A
7/23/1989	209	A
7/24/1989	99	A
7/25/1989	75	A
7/26/1989	69	A
7/27/1989	85	A
7/28/1989	84	A
7/29/1989	75	A
7/30/1989	67	A
7/31/1989	55	A
8/1/1989	48	A
8/2/1989	45	A
8/3/1989	51	A
8/4/1989	63	A
8/5/1989	55	A
8/6/1989	51	A
8/7/1989	40	A
8/8/1989	35	A
8/9/1989	30	A
8/10/1989	26	A
8/11/1989	22	A
8/12/1989	21	A
8/13/1989	17	A
8/14/1989	16	A
8/15/1989	15	A
8/16/1989	14	A
8/17/1989	22	A
8/18/1989	32	A
8/19/1989	40	A
8/20/1989	50	A
8/21/1989	34	A
8/22/1989	24	A
8/23/1989	18	A
8/24/1989	17	A
8/25/1989	17	A

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Date	Flow (cfs)	Qualification
	All	Code
8/26/1989	21	A
8/27/1989	20	A
8/28/1989	19	A
8/29/1989	16	A
8/30/1989	27	A
8/31/1989	36	A
9/1/1989	30	A
9/2/1989	26	A
9/3/1989	20	A
9/4/1989	16	A
9/5/1989	14	A
9/6/1989	13	A
9/7/1989	13	A
9/8/1989	12	A
9/9/1989	11	A
9/10/1989	10	A
9/11/1989	15	A
9/12/1989	30	A
9/13/1989	28	A
9/14/1989	24	A
9/15/1989	24	A
9/16/1989	25	A
9/17/1989	21	A
9/18/1989	17	A
9/19/1989	15	A
9/20/1989	14	A
9/21/1989	13	A
9/22/1989	11	A
9/23/1989	10	A
9/24/1989	12	A
9/25/1989	9.9	A
9/26/1989	9.2	A
9/27/1989	9.1	A
9/28/1989	9.7	A
9/29/1989	11	A
9/30/1989	15	A
10/1/1989	20	A
10/2/1989	23	A
10/3/1989	22	A
10/4/1989	20	A
10/5/1989	15	A

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Date	Flow (cfs)	Qualification
	All	Code
10/6/1989	13	A
10/7/1989	12	A
10/8/1989	12	A
10/9/1989	14	A
10/10/1989	16	A
10/11/1989	16	A
10/12/1989	14	A
10/13/1989	13	A
10/14/1989	12	A
10/15/1989	12	A
10/16/1989	14	A
10/17/1989	32	A
10/18/1989	37	A
10/19/1989	33	A
10/20/1989	28	A
10/21/1989	23	A
10/22/1989	22	A
10/23/1989	20	A
10/24/1989	20	A
10/25/1989	19	A
10/26/1989	19	A
10/27/1989	19	A
10/28/1989	17	A
10/29/1989	16	A
10/30/1989	16	A
10/31/1989	21	A
11/1/1989	30	A
11/2/1989	33	A
11/3/1989	29	A
11/4/1989	26	A
11/5/1989	23	A
11/6/1989	36	A
11/7/1989	93	A
11/8/1989	99	A
11/9/1989	104	A
11/10/1989	126	A
11/11/1989	101	A
11/12/1989	65	A
11/13/1989	49	A
11/14/1989	42	A
11/15/1989	41	A

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Date	Flow (cfs)	Qualification
	All	Code
11/16/1989	41	A
11/17/1989	40	A
11/18/1989	37	A
11/19/1989	35	A
11/20/1989	35	A
11/21/1989	33	A
11/22/1989	50	A
11/23/1989	116	A
11/24/1989	141	A
11/25/1989	116	A
11/26/1989	80	A
11/27/1989	64	A
11/28/1989	55	A
11/29/1989	47	A
11/30/1989	42	A
12/1/1989	37	A
12/2/1989	37	A
12/3/1989	37	A
12/4/1989	34	A
12/5/1989	32	A
12/6/1989	32	A
12/7/1989	34	A
12/8/1989	43	A
12/9/1989	44	A
12/10/1989	46	A
12/11/1989	46	A
12/12/1989	42	A
12/13/1989	39	A
12/14/1989	37	A
12/15/1989	35	A
12/16/1989	35	A
12/17/1989	33	A
12/18/1989	33	A
12/19/1989	38	A
12/20/1989	44	A
12/21/1989	44	Ae
12/22/1989	45	Ae
12/23/1989	44	Ae
12/24/1989	42	Ae
12/25/1989	37	A
12/26/1989	35	A

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Date	Flow (cfs)	Qualification
	All	Code
12/27/1989	45	A
12/28/1989	52	A
12/29/1989	58	A
12/30/1989	82	A
12/31/1989	231	A
1/1/1990	361	A
1/2/1990	410	A
1/3/1990	379	A
1/4/1990	378	A
1/5/1990	466	A
1/6/1990	546	A
1/7/1990	579	A
1/8/1990	518	A
1/9/1990	403	A
1/10/1990	268	A
1/11/1990	165	A
1/12/1990	112	A
1/13/1990	89	A
1/14/1990	75	A
1/15/1990	69	A
1/16/1990	69	A
1/17/1990	84	A
1/18/1990	318	A
1/19/1990	670	A
1/20/1990	1160	A
1/21/1990	1460	A
1/22/1990	1160	A
1/23/1990	778	A
1/24/1990	579	A
1/25/1990	449	A
1/26/1990	326	A
1/27/1990	234	A
1/28/1990	171	A
1/29/1990	328	A
1/30/1990	536	A
1/31/1990	606	A
2/1/1990	714	A
2/2/1990	1580	A
2/3/1990	2420	A
2/4/1990	4470	A
2/5/1990	4430	A

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Date	Flow (cfs)	Qualification
	All	Code
2/6/1990	2070	A
2/7/1990	972	A
2/8/1990	657	A
2/9/1990	553	A
2/10/1990	1500	A
2/11/1990	1080	A
2/12/1990	927	A
2/13/1990	823	A
2/14/1990	646	A
2/15/1990	513	A
2/16/1990	622	A
2/17/1990	539	A
2/18/1990	371	A
2/19/1990	283	A
2/20/1990	220	A
2/21/1990	174	A
2/22/1990	393	A
2/23/1990	637	A
2/24/1990	660	A
2/25/1990	766	A
2/26/1990	618	A
2/27/1990	439	A
2/28/1990	275	A
3/1/1990	188	A
3/2/1990	233	A
3/3/1990	308	A
3/4/1990	301	A
3/5/1990	267	A
3/6/1990	216	A
3/7/1990	195	A
3/8/1990	912	A
3/9/1990	3630	A
3/10/1990	5210	A
3/11/1990	2080	A
3/12/1990	950	A
3/13/1990	637	A
3/14/1990	501	A
3/15/1990	538	A
3/16/1990	561	A
3/17/1990	671	A
3/18/1990	661	A

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Date	Flow (cfs)	Qualification
	All	Code
3/19/1990	536	A
3/20/1990	401	A
3/21/1990	255	A
3/22/1990	162	A
3/23/1990	130	A
3/24/1990	117	A
3/25/1990	108	A
3/26/1990	109	A
3/27/1990	148	A
3/28/1990	182	A
3/29/1990	336	A
3/30/1990	1410	A
3/31/1990	3370	A
4/1/1990	3270	A
4/2/1990	1590	A
4/3/1990	1170	A
4/4/1990	752	A
4/5/1990	524	A
4/6/1990	596	A
4/7/1990	710	A
4/8/1990	869	A
4/9/1990	1060	A
4/10/1990	710	A
4/11/1990	583	A
4/12/1990	479	A
4/13/1990	429	A
4/14/1990	456	A
4/15/1990	496	A
4/16/1990	469	A
4/17/1990	444	A
4/18/1990	438	A
4/19/1990	358	A
4/20/1990	211	A
4/21/1990	137	A
4/22/1990	113	A
4/23/1990	103	A
4/24/1990	94	A
4/25/1990	85	A
4/26/1990	89	A
4/27/1990	105	A
4/28/1990	201	A

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Date	Flow (cfs)	Qualification
	All	Code
4/29/1990	258	A
4/30/1990	222	A
5/1/1990	138	A
5/2/1990	90	A
5/3/1990	75	A
5/4/1990	91	A
5/5/1990	110	A
5/6/1990	98	A
5/7/1990	75	A
5/8/1990	60	A
5/9/1990	56	A
5/10/1990	56	A
5/11/1990	52	A
5/12/1990	106	A
5/13/1990	567	A
5/14/1990	1090	A
5/15/1990	1520	A
5/16/1990	847	A
5/17/1990	673	A
5/18/1990	3800	A
5/19/1990	2910	A
5/20/1990	1120	A
5/21/1990	724	A
5/22/1990	688	A
5/23/1990	977	A
5/24/1990	1020	A
5/25/1990	668	A
5/26/1990	449	A
5/27/1990	269	A
5/28/1990	234	A
5/29/1990	291	A
5/30/1990	261	A
5/31/1990	268	A
6/1/1990	525	A
6/2/1990	770	A
6/3/1990	1110	A
6/4/1990	1720	A
6/5/1990	3300	A
6/6/1990	1770	A
6/7/1990	800	A
6/8/1990	492	A

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Date	Flow (cfs)	Qualification
	All	Code
6/9/1990	281	A
6/10/1990	109	A
6/11/1990	68	A
6/12/1990	56	A
6/13/1990	49	A
6/14/1990	43	A
6/15/1990	39	A
6/16/1990	38	A
6/17/1990	35	A
6/18/1990	32	A
6/19/1990	29	A
6/20/1990	27	A
6/21/1990	23	A
6/22/1990	21	A
6/23/1990	21	A
6/24/1990	26	A
6/25/1990	22	A
6/26/1990	37	A
6/27/1990	36	A
6/28/1990	38	A
6/29/1990	30	A
6/30/1990	24	A
7/1/1990	19	A
7/2/1990	16	A
7/3/1990	13	A
7/4/1990	12	A
7/5/1990	11	A
7/6/1990	10	A
7/7/1990	9.3	A
7/8/1990	8.9	A
7/9/1990	9.2	A
7/10/1990	9.1	A
7/11/1990	8.3	A
7/12/1990	12	A
7/13/1990	14	A
7/14/1990	13	A
7/15/1990	13	A
7/16/1990	13	A
7/17/1990	12	A
7/18/1990	13	A
7/19/1990	14	A

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Date	Flow (cfs)	Qualification
	All	Code
7/20/1990	14	A
7/21/1990	14	A
7/22/1990	14	A
7/23/1990	14	A
7/24/1990	25	A
7/25/1990	31	A
7/26/1990	27	A
7/27/1990	21	A
7/28/1990	16	A
7/29/1990	11	A
7/30/1990	7.8	A
7/31/1990	15	A
8/1/1990	42	A
8/2/1990	53	A
8/3/1990	102	A
8/4/1990	287	A
8/5/1990	263	A
8/6/1990	147	A
8/7/1990	50	A
8/8/1990	28	A
8/9/1990	20	A
8/10/1990	15	A
8/11/1990	12	A
8/12/1990	11	A
8/13/1990	10	A
8/14/1990	11	A
8/15/1990	14	A
8/16/1990	12	A
8/17/1990	10	A
8/18/1990	9	A
8/19/1990	8.3	A
8/20/1990	6.7	A
8/21/1990	5.8	A
8/22/1990	7.3	A
8/23/1990	6.5	A
8/24/1990	5.6	A
8/25/1990	5.8	A
8/26/1990	6	A
8/27/1990	6.5	A
8/28/1990	7.6	A
8/29/1990	5.7	A

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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
8/30/1990	4.3	A
8/31/1990	3.9	A
9/1/1990	2.8	A
9/2/1990	2.5	A
9/3/1990	3.3	A
9/4/1990	2.4	A
9/5/1990	3.4	A
9/6/1990	3.1	A
9/7/1990	2.6	A
9/8/1990	2.5	A
9/9/1990	4.6	A
9/10/1990	40	A
9/11/1990	53	A
9/12/1990	43	A
9/13/1990	36	A
9/14/1990	31	A
9/15/1990	27	A
9/16/1990	25	A
9/17/1990	19	A
9/18/1990	15	A
9/19/1990	11	A
9/20/1990	9.6	A
9/21/1990	17	A
9/22/1990	34	A
9/23/1990	26	A
9/24/1990	19	A
9/25/1990	14	A
9/26/1990	11	A
9/27/1990	9	A
9/28/1990	8.3	A
9/29/1990	7.8	A
9/30/1990	7.4	A
10/1/1990	6.4	A
10/2/1990	6	A
10/3/1990	5.9	A
10/4/1990	7.5	A
10/5/1990	15	A
10/6/1990	14	A
10/7/1990	12	A
10/8/1990	10	A
10/9/1990	12	A

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Date	Flow (cfs)	Qualification
	All	Code
10/10/1990	17	A
10/11/1990	23	A
10/12/1990	22	A
10/13/1990	19	A
10/14/1990	17	A
10/15/1990	14	A
10/16/1990	14	A
10/17/1990	13	A
10/18/1990	16	A
10/19/1990	27	A
10/20/1990	22	A
10/21/1990	25	A
10/22/1990	70	A
10/23/1990	112	A
10/24/1990	125	A
10/25/1990	123	A
10/26/1990	70	A
10/27/1990	36	A
10/28/1990	28	A
10/29/1990	24	A
10/30/1990	22	A
10/31/1990	23	A
11/1/1990	21	A
11/2/1990	21	A
11/3/1990	23	A
11/4/1990	25	A
11/5/1990	31	A
11/6/1990	40	A
11/7/1990	44	A
11/8/1990	43	A
11/9/1990	97	A
11/10/1990	232	A
11/11/1990	311	A
11/12/1990	319	A
11/13/1990	300	A
11/14/1990	263	A
11/15/1990	123	A
11/16/1990	56	A
11/17/1990	45	A
11/18/1990	38	A
11/19/1990	32	A

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Date	Flow (cfs)	Qualification
	All	Code
11/20/1990	29	A
11/21/1990	28	A
11/22/1990	29	A
11/23/1990	42	A
11/24/1990	52	A
11/25/1990	51	A
11/26/1990	48	A
11/27/1990	51	A
11/28/1990	105	A
11/29/1990	227	A
11/30/1990	291	A
12/1/1990	334	A
12/2/1990	339	A
12/3/1990	272	A
12/4/1990	202	A
12/5/1990	124	A
12/6/1990	73	A
12/7/1990	56	A
12/8/1990	50	A
12/9/1990	45	A
12/10/1990	42	A
12/11/1990	40	A
12/12/1990	39	A
12/13/1990	47	A
12/14/1990	47	A
12/15/1990	45	A
12/16/1990	43	A
12/17/1990	57	A
12/18/1990	114	A
12/19/1990	193	A
12/20/1990	222	A
12/21/1990	248	A
12/22/1990	391	A
12/23/1990	507	A
12/24/1990	436	A
12/25/1990	366	A
12/26/1990	324	A
12/27/1990	389	A
12/28/1990	592	A
12/29/1990	701	A
12/30/1990	820	A

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Date	Flow (cfs)	Qualification
	All	Code
12/31/1990	840	A
1/1/1991	695	A
1/2/1991	510	A
1/3/1991	383	A
1/4/1991	279	A
1/5/1991	158	A
1/6/1991	103	A
1/7/1991	153	A
1/8/1991	260	A
1/9/1991	288	A
1/10/1991	539	A
1/11/1991	1140	A
1/12/1991	1290	A
1/13/1991	1370	A
1/14/1991	884	A
1/15/1991	811	A
1/16/1991	1100	A
1/17/1991	1060	A
1/18/1991	1300	A
1/19/1991	866	A
1/20/1991	593	A
1/21/1991	424	A
1/22/1991	288	A
1/23/1991	192	A
1/24/1991	135	A
1/25/1991	107	A
1/26/1991	93	A
1/27/1991	85	A
1/28/1991	83	A
1/29/1991	78	A
1/30/1991	76	A
1/31/1991	74	A
2/1/1991	72	A
2/2/1991	64	A
2/3/1991	60	A
2/4/1991	58	A
2/5/1991	81	A
2/6/1991	178	A
2/7/1991	252	A
2/8/1991	290	A
2/9/1991	324	A

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Date	Flow (cfs)	Qualification
	All	Code
2/10/1991	295	A
2/11/1991	164	A
2/12/1991	92	A
2/13/1991	79	A
2/14/1991	71	A
2/15/1991	62	A
2/16/1991	56	A
2/17/1991	58	A
2/18/1991	578	A
2/19/1991	4920	A
2/20/1991	4120	A
2/21/1991	2680	A
2/22/1991	2040	A
2/23/1991	1580	A
2/24/1991	1310	A
2/25/1991	1450	A
2/26/1991	921	A
2/27/1991	608	A
2/28/1991	442	A
3/1/1991	384	A
3/2/1991	481	A
3/3/1991	751	A
3/4/1991	1100	A
3/5/1991	789	A
3/6/1991	536	A
3/7/1991	377	A
3/8/1991	240	A
3/9/1991	155	A
3/10/1991	116	A
3/11/1991	97	A
3/12/1991	89	A
3/13/1991	89	A
3/14/1991	86	A
3/15/1991	80	A
3/16/1991	74	A
3/17/1991	75	A
3/18/1991	86	A
3/19/1991	83	A
3/20/1991	78	A
3/21/1991	77	A
3/22/1991	79	A

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Date	Flow (cfs)	Qualification
	All	Code
3/23/1991	75	A
3/24/1991	70	A
3/25/1991	65	A
3/26/1991	61	A
3/27/1991	63	A
3/28/1991	83	A
3/29/1991	647	A
3/30/1991	1040	A
3/31/1991	1200	A
4/1/1991	1100	A
4/2/1991	705	A
4/3/1991	469	A
4/4/1991	285	A
4/5/1991	191	A
4/6/1991	214	A
4/7/1991	242	A
4/8/1991	361	A
4/9/1991	451	A
4/10/1991	775	A
4/11/1991	730	A
4/12/1991	632	A
4/13/1991	1450	A
4/14/1991	4620	A
4/15/1991	6840	A
4/16/1991	5460	A
4/17/1991	2130	A
4/18/1991	1040	A
4/19/1991	744	A
4/20/1991	778	A
4/21/1991	817	A
4/22/1991	1270	A
4/23/1991	1390	A
4/24/1991	972	A
4/25/1991	1080	A
4/26/1991	857	A
4/27/1991	783	A
4/28/1991	11400	A
4/29/1991	19300	A
4/30/1991	13800	A
5/1/1991	7180	A
5/2/1991	1860	A

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Date	Flow (cfs)	Qualification
	All	Code
5/3/1991	917	A
5/4/1991	1370	A
5/5/1991	2520	A
5/6/1991	3600	A
5/7/1991	1970	A
5/8/1991	1330	A
5/9/1991	856	A
5/10/1991	655	A
5/11/1991	517	A
5/12/1991	421	A
5/13/1991	364	A
5/14/1991	294	A
5/15/1991	201	A
5/16/1991	154	A
5/17/1991	157	A
5/18/1991	154	A
5/19/1991	140	A
5/20/1991	129	A
5/21/1991	133	A
5/22/1991	134	A
5/23/1991	125	A
5/24/1991	123	A
5/25/1991	114	A
5/26/1991	211	A
5/27/1991	281	A
5/28/1991	205	A
5/29/1991	173	A
5/30/1991	128	A
5/31/1991	94	A
6/1/1991	87	A
6/2/1991	91	A
6/3/1991	70	A
6/4/1991	58	A
6/5/1991	49	A
6/6/1991	44	A
6/7/1991	42	A
6/8/1991	42	A
6/9/1991	38	A
6/10/1991	36	A
6/11/1991	38	A
6/12/1991	56	A

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Date	Flow (cfs)	Qualification
	All	Code
6/13/1991	70	A
6/14/1991	50	A
6/15/1991	41	A
6/16/1991	75	A
6/17/1991	143	A
6/18/1991	179	A
6/19/1991	125	A
6/20/1991	66	A
6/21/1991	45	A
6/22/1991	36	A
6/23/1991	31	A
6/24/1991	33	A
6/25/1991	51	A
6/26/1991	46	A
6/27/1991	36	A
6/28/1991	31	A
6/29/1991	35	A
6/30/1991	43	A
7/1/1991	32	A
7/2/1991	27	A
7/3/1991	23	A
7/4/1991	49	A
7/5/1991	51	A
7/6/1991	64	A
7/7/1991	53	A
7/8/1991	37	A
7/9/1991	28	A
7/10/1991	24	A
7/11/1991	23	A
7/12/1991	19	A
7/13/1991	16	A
7/14/1991	14	A
7/15/1991	12	A
7/16/1991	11	A
7/17/1991	11	A
7/18/1991	9.8	A
7/19/1991	11	A
7/20/1991	15	A
7/21/1991	17	A
7/22/1991	30	A
7/23/1991	24	A

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Date	Flow (cfs)	Qualification
	All	Code
7/24/1991	17	A
7/25/1991	14	A
7/26/1991	13	A
7/27/1991	13	A
7/28/1991	15	A
7/29/1991	27	A
7/30/1991	51	A
7/31/1991	55	A
8/1/1991	32	A
8/2/1991	21	A
8/3/1991	15	A
8/4/1991	14	A
8/5/1991	14	A
8/6/1991	13	A
8/7/1991	19	A
8/8/1991	28	A
8/9/1991	22	A
8/10/1991	26	A
8/11/1991	38	A
8/12/1991	32	A
8/13/1991	24	A
8/14/1991	20	A
8/15/1991	19	A
8/16/1991	17	A
8/17/1991	17	A
8/18/1991	17	A
8/19/1991	22	A
8/20/1991	23	A
8/21/1991	19	A
8/22/1991	14	A
8/23/1991	13	A
8/24/1991	13	A
8/25/1991	14	A
8/26/1991	11	A
8/27/1991	9.6	A
8/28/1991	11	A
8/29/1991	12	A
8/30/1991	17	A
8/31/1991	84	A
9/1/1991	151	A
9/2/1991	130	A

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Date	Flow (cfs)	Qualification
	All	Code
9/3/1991	168	A
9/4/1991	138	A
9/5/1991	137	A
9/6/1991	120	A
9/7/1991	86	A
9/8/1991	56	A
9/9/1991	43	A
9/10/1991	116	A
9/11/1991	125	A
9/12/1991	81	A
9/13/1991	42	A
9/14/1991	31	A
9/15/1991	25	A
9/16/1991	21	A
9/17/1991	20	A
9/18/1991	20	A
9/19/1991	33	A
9/20/1991	28	A
9/21/1991	21	A
9/22/1991	17	A
9/23/1991	16	A
9/24/1991	31	A
9/25/1991	200	A
9/26/1991	385	A
9/27/1991	367	A
9/28/1991	178	A
9/29/1991	60	A
9/30/1991	38	A
10/1/1991	29	A
10/2/1991	24	A
10/3/1991	20	A
10/4/1991	21	A
10/5/1991	19	A
10/6/1991	20	A
10/7/1991	21	A
10/8/1991	17	A
10/9/1991	16	A
10/10/1991	16	A
10/11/1991	18	A
10/12/1991	19	A
10/13/1991	19	A

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Date	Flow (cfs)	Qualification
	All	Code
10/14/1991	20	A
10/15/1991	20	A
10/16/1991	17	A
10/17/1991	16	A
10/18/1991	18	A
10/19/1991	19	A
10/20/1991	19	A
10/21/1991	20	A
10/22/1991	22	A
10/23/1991	18	Ae
10/24/1991	18	Ae
10/25/1991	20	Ae
10/26/1991	25	Ae
10/27/1991	30	Ae
10/28/1991	55	Ae
10/29/1991	100	Ae
10/30/1991	169	A
10/31/1991	391	A
11/1/1991	518	A
11/2/1991	606	A
11/3/1991	512	A
11/4/1991	383	A
11/5/1991	204	A
11/6/1991	88	A
11/7/1991	65	A
11/8/1991	58	A
11/9/1991	56	A
11/10/1991	54	A
11/11/1991	52	A
11/12/1991	49	A
11/13/1991	47	A
11/14/1991	47	A
11/15/1991	49	A
11/16/1991	48	A
11/17/1991	46	A
11/18/1991	68	A
11/19/1991	100	A
11/20/1991	207	A
11/21/1991	331	A
11/22/1991	330	A
11/23/1991	320	A

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Date	Flow (cfs)	Qualification
	All	Code
11/24/1991	268	A
11/25/1991	124	A
11/26/1991	75	A
11/27/1991	67	A
11/28/1991	70	A
11/29/1991	70	A
11/30/1991	70	A
12/1/1991	211	A
12/2/1991	1290	A
12/3/1991	2830	A
12/4/1991	2630	A
12/5/1991	1560	A
12/6/1991	934	A
12/7/1991	643	A
12/8/1991	438	A
12/9/1991	438	A
12/10/1991	1290	A
12/11/1991	1010	A
12/12/1991	752	A
12/13/1991	591	A
12/14/1991	494	A
12/15/1991	385	A
12/16/1991	304	A
12/17/1991	243	A
12/18/1991	177	A
12/19/1991	136	A
12/20/1991	118	A
12/21/1991	115	A
12/22/1991	146	A
12/23/1991	344	A
12/24/1991	429	A
12/25/1991	399	A
12/26/1991	392	A
12/27/1991	381	A
12/28/1991	276	A
12/29/1991	175	A
12/30/1991	140	A
12/31/1991	124	A
1/1/1992	112	A
1/2/1992	109	A
1/3/1992	125	A

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Date	Flow (cfs)	Qualification
	All	Code
1/4/1992	120	A
1/5/1992	115	A
1/6/1992	107	A
1/7/1992	98	A
1/8/1992	101	A
1/9/1992	147	A
1/10/1992	138	A
1/11/1992	115	A
1/12/1992	223	A
1/13/1992	478	A
1/14/1992	524	A
1/15/1992	496	A
1/16/1992	476	A
1/17/1992	431	A
1/18/1992	363	A
1/19/1992	425	A
1/20/1992	479	A
1/21/1992	460	A
1/22/1992	460	A
1/23/1992	452	A
1/24/1992	390	A
1/25/1992	317	A
1/26/1992	252	A
1/27/1992	216	A
1/28/1992	301	A
1/29/1992	357	A
1/30/1992	374	A
1/31/1992	374	A
2/1/1992	329	A
2/2/1992	235	A
2/3/1992	169	A
2/4/1992	141	A
2/5/1992	300	A
2/6/1992	614	A
2/7/1992	677	A
2/8/1992	776	A
2/9/1992	729	A
2/10/1992	531	A
2/11/1992	332	A
2/12/1992	559	A
2/13/1992	3490	A

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Date	Flow (cfs)	Qualification
	All	Code
2/14/1992	4150	A
2/15/1992	3640	A
2/16/1992	1630	A
2/17/1992	947	A
2/18/1992	675	A
2/19/1992	514	A
2/20/1992	388	A
2/21/1992	273	A
2/22/1992	203	A
2/23/1992	203	A
2/24/1992	259	A
2/25/1992	408	A
2/26/1992	1530	A
2/27/1992	2280	A
2/28/1992	2190	A
2/29/1992	1140	A
3/1/1992	703	A
3/2/1992	487	A
3/3/1992	371	A
3/4/1992	556	A
3/5/1992	930	A
3/6/1992	1170	A
3/7/1992	1310	A
3/8/1992	945	A
3/9/1992	681	A
3/10/1992	1540	A
3/11/1992	2900	A
3/12/1992	2020	A
3/13/1992	1060	A
3/14/1992	661	A
3/15/1992	464	A
3/16/1992	328	A
3/17/1992	241	A
3/18/1992	332	A
3/19/1992	537	A
3/20/1992	598	A
3/21/1992	787	A
3/22/1992	690	A
3/23/1992	484	A
3/24/1992	329	A
3/25/1992	246	A

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Date	Flow (cfs) All	Qualification Code
3/26/1992	263	A
3/27/1992	248	A
3/28/1992	221	A
3/29/1992	183	A
3/30/1992	151	A
3/31/1992	134	A
4/1/1992	123	A
4/2/1992	109	A
4/3/1992	99	A
4/4/1992	92	A
4/5/1992	85	A
4/6/1992	85	A
4/7/1992	102	A
4/8/1992	113	A
4/9/1992	108	A
4/10/1992	94	A
4/11/1992	84	A
4/12/1992	75	A
4/13/1992	66	A
4/14/1992	61	A
4/15/1992	56	A
4/16/1992	54	A
4/17/1992	56	A
4/18/1992	52	A
4/19/1992	54	A
4/20/1992	71	A
4/21/1992	126	A
4/22/1992	105	A
4/23/1992	79	A
4/24/1992	61	A
4/25/1992	65	A
4/26/1992	155	A
4/27/1992	199	A
4/28/1992	229	A
4/29/1992	154	A
4/30/1992	205	A
5/1/1992	282	A
5/2/1992	299	A
5/3/1992	274	A
5/4/1992	157	A
5/5/1992	69	A

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Date	Flow (cfs) All	Qualification Code
5/6/1992	46	A
5/7/1992	36	A
5/8/1992	31	A
5/9/1992	28	A
5/10/1992	27	A
5/11/1992	26	A
5/12/1992	39	A
5/13/1992	76	A
5/14/1992	76	A
5/15/1992	59	A
5/16/1992	46	A
5/17/1992	42	A
5/18/1992	38	A
5/19/1992	38	A
5/20/1992	51	A
5/21/1992	98	A
5/22/1992	183	A
5/23/1992	242	A
5/24/1992	242	A
5/25/1992	210	A
5/26/1992	148	A
5/27/1992	166	A
5/28/1992	198	A
5/29/1992	179	A
5/30/1992	193	A
5/31/1992	162	A
6/1/1992	168	A
6/2/1992	264	A
6/3/1992	493	A
6/4/1992	2280	A
6/5/1992	2640	A
6/6/1992	1410	A
6/7/1992	783	A
6/8/1992	558	A
6/9/1992	646	A
6/10/1992	517	A
6/11/1992	284	A
6/12/1992	169	A
6/13/1992	97	A
6/14/1992	69	A
6/15/1992	64	A

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Date	Flow (cfs) All	Qualification Code
6/16/1992	76	A
6/17/1992	70	A
6/18/1992	57	A
6/19/1992	44	A
6/20/1992	36	A
6/21/1992	34	A
6/22/1992	31	A
6/23/1992	27	A
6/24/1992	24	A
6/25/1992	21	A
6/26/1992	24	A
6/27/1992	50	A
6/28/1992	55	A
6/29/1992	44	A
6/30/1992	193	A
7/1/1992	368	A
7/2/1992	313	A
7/3/1992	129	A
7/4/1992	51	A
7/5/1992	40	A
7/6/1992	30	A
7/7/1992	24	A
7/8/1992	19	A
7/9/1992	17	A
7/10/1992	14	A
7/11/1992	12	A
7/12/1992	12	A
7/13/1992	11	A
7/14/1992	9.7	A
7/15/1992	8.8	A
7/16/1992	8.8	A
7/17/1992	8.2	A
7/18/1992	13	A
7/19/1992	18	A
7/20/1992	16	A
7/21/1992	20	A
7/22/1992	23	A
7/23/1992	42	A
7/24/1992	55	A
7/25/1992	55	A
7/26/1992	49	A

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Date	Flow (cfs) All	Qualification Code
7/27/1992	29	A
7/28/1992	25	A
7/29/1992	62	A
7/30/1992	160	A
7/31/1992	276	A
8/1/1992	405	A
8/2/1992	378	A
8/3/1992	194	A
8/4/1992	63	A
8/5/1992	123	A
8/6/1992	289	A
8/7/1992	230	A
8/8/1992	218	A
8/9/1992	242	A
8/10/1992	210	A
8/11/1992	73	A
8/12/1992	36	A
8/13/1992	38	A
8/14/1992	47	A
8/15/1992	37	A
8/16/1992	28	A
8/17/1992	23	A
8/18/1992	19	A
8/19/1992	16	A
8/20/1992	14	A
8/21/1992	14	A
8/22/1992	14	A
8/23/1992	13	A
8/24/1992	12	A
8/25/1992	13	A
8/26/1992	13	A
8/27/1992	11	A
8/28/1992	11	A
8/29/1992	13	A
8/30/1992	12	A
8/31/1992	11	A
9/1/1992	11	A
9/2/1992	19	A
9/3/1992	25	A
9/4/1992	39	A
9/5/1992	38	A

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Date	Flow (cfs)	Qualification
	All	Code
9/6/1992	35	A
9/7/1992	26	A
9/8/1992	20	A
9/9/1992	16	A
9/10/1992	13	A
9/11/1992	40	A
9/12/1992	61	A
9/13/1992	31	A
9/14/1992	21	A
9/15/1992	16	A
9/16/1992	13	A
9/17/1992	12	A
9/18/1992	12	A
9/19/1992	10	A
9/20/1992	10	A
9/21/1992	12	A
9/22/1992	41	A
9/23/1992	93	A
9/24/1992	91	A
9/25/1992	60	A
9/26/1992	41	A
9/27/1992	31	A
9/28/1992	26	A
9/29/1992	19	A
9/30/1992	15	A
10/1/1992	12	P
10/2/1992	16	P
10/3/1992	12	P
10/4/1992	14	P
10/5/1992	15	P
10/6/1992	11	P
10/7/1992	11	P
10/8/1992	11	P
10/9/1992	12	P
10/10/1992	11	P
10/11/1992	12	P
10/12/1992	13	P
10/13/1992	13	P
10/14/1992	15	P
10/15/1992	17	P
10/16/1992	22	P

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Date	Flow (cfs)	Qualification
	All	Code
10/17/1992	32	P
10/18/1992	27	P
10/19/1992	25	P
10/20/1992	23	P
10/21/1992	23	P
10/22/1992	24	P
10/23/1992	28	P
10/24/1992	27	P
10/25/1992	27	P
10/26/1992	28	P
10/27/1992	32	P
10/28/1992	53	P
10/29/1992	47	P
10/30/1992	43	P
10/31/1992	86	P
11/1/1992	81	P
11/2/1992	68	P
11/3/1992	68	P
11/4/1992	92	P
11/5/1992	89	P
11/6/1992	53	P
11/7/1992	38	P
11/8/1992	30	P
11/9/1992	27	P
11/10/1992	29	P
11/11/1992	28	P
11/12/1992	33	P
11/13/1992	54	P
11/14/1992	54	P
11/15/1992	50	P
11/16/1992	46	P
11/17/1992	40	P
11/18/1992	35	P
11/19/1992	33	P
11/20/1992	50	P
11/21/1992	157	P
11/22/1992	312	P
11/23/1992	474	P
11/24/1992	560	P
11/25/1992	491	P
11/26/1992	400	P

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Date	Flow (cfs)	Qualification
	All	Code
11/27/1992	250	P
11/28/1992	98	P
11/29/1992	60	P
11/30/1992	51	P
12/1/1992	48	P
12/2/1992	43	P
12/3/1992	39	P
12/4/1992	38	P
12/5/1992	39	P
12/6/1992	42	P
12/7/1992	47	P
12/8/1992	48	P
12/9/1992	60	P
12/10/1992	163	P
12/11/1992	193	P
12/12/1992	191	P
12/13/1992	168	P
12/14/1992	112	P
12/15/1992	153	P
12/16/1992	444	P
12/17/1992	657	P
12/18/1992	627	P
12/19/1992	657	P
12/20/1992	753	P
12/21/1992	851	P
12/22/1992	703	P
12/23/1992	623	P
12/24/1992	661	P
12/25/1992	639	P
12/26/1992	533	P
12/27/1992	456	P
12/28/1992	378	P
12/29/1992	276	P
12/30/1992	165	P
12/31/1992	148	P
1/1/1993	140	P
1/2/1993	133	P
1/3/1993	117	P
1/4/1993	121	P
1/5/1993	236	P
1/6/1993	355	P

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Date	Flow (cfs)	Qualification
	All	Code
1/7/1993	401	P
1/8/1993	475	P
1/9/1993	534	P
1/10/1993	517	P
1/11/1993	519	P
1/12/1993	520	P
1/13/1993	531	P
1/14/1993	478	P
1/15/1993	361	P
1/16/1993	259	P
1/17/1993	172	P
1/18/1993	261	P
1/19/1993	681	P
1/20/1993	1130	P
1/21/1993	1730	P
1/22/1993	1520	P
1/23/1993	1040	P
1/24/1993	823	P
1/25/1993	657	P
1/26/1993	491	P
1/27/1993	404	P
1/28/1993	374	P
1/29/1993	314	P
1/30/1993	213	P
1/31/1993	150	P
2/1/1993	124	P
2/2/1993	110	P
2/3/1993	100	P
2/4/1993	91	P
2/5/1993	84	P
2/6/1993	81	P
2/7/1993	79	P
2/8/1993	74	P
2/9/1993	72	P
2/10/1993	70	P
2/11/1993	89	P
2/12/1993	112	P
2/13/1993	110	P
2/14/1993	95	P
2/15/1993	102	P
2/16/1993	378	P

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Date	Flow (cfs)	Qualification
	All	Code
2/17/1993	564	P
2/18/1993	480	P
2/19/1993	413	P
2/20/1993	363	P
2/21/1993	243	P
2/22/1993	150	P
2/23/1993	116	P
2/24/1993	94	P
2/25/1993	100	P
2/26/1993	245	P
2/27/1993	325	P
2/28/1993	320	P
3/1/1993	314	P
3/2/1993	600	P
3/3/1993	853	P
3/4/1993	765	P
3/5/1993	873	P
3/6/1993	750	P
3/7/1993	491	P
3/8/1993	289	P
3/9/1993	162	P
3/10/1993	121	P
3/11/1993	98	P
3/12/1993	109	P
3/13/1993	186	P
3/14/1993	173	P
3/15/1993	148	P
3/16/1993	191	P
3/17/1993	462	P
3/18/1993	635	P
3/19/1993	716	P
3/20/1993	770	P
3/21/1993	666	P
3/22/1993	503	P
3/23/1993	502	P
3/24/1993	619	P
3/25/1993	561	P
3/26/1993	463	P
3/27/1993	372	P
3/28/1993	437	P
3/29/1993	529	P

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Date	Flow (cfs)	Qualification
	All	Code
3/30/1993	427	P
3/31/1993	278	P
4/1/1993	187	P
4/2/1993	139	P
4/3/1993	114	P
4/4/1993	98	P
4/5/1993	129	P
4/6/1993	152	P
4/7/1993	194	P
4/8/1993	1370	P
4/9/1993	2610	P
4/10/1993	2940	P
4/11/1993	1500	P
4/12/1993	813	P
4/13/1993	532	P
4/14/1993	392	P
4/15/1993	1060	P
4/16/1993	1660	P
4/17/1993	1890	P
4/18/1993	1200	P
4/19/1993	698	P
4/20/1993	461	P
4/21/1993	306	P
4/22/1993	189	P
4/23/1993	131	P
4/24/1993	92	P
4/25/1993	74	P
4/26/1993	112	P
4/27/1993	129	P
4/28/1993	135	P
4/29/1993	135	P
4/30/1993	202	P
5/1/1993	209	P
5/2/1993	188	P
5/3/1993	193	P
5/4/1993	246	P
5/5/1993	426	P
5/6/1993	700	P
5/7/1993	540	P
5/8/1993	267	P
5/9/1993	82	P

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Date	Flow (cfs)	Qualification
	All	Code
5/10/1993	77	P
5/11/1993	121	P
5/12/1993	189	P
5/13/1993	367	P
5/14/1993	508	P
5/15/1993	364	P
5/16/1993	214	P
5/17/1993	100	P
5/18/1993	53	P
5/19/1993	46	P
5/20/1993	60	P
5/21/1993	76	P
5/22/1993	73	P
5/23/1993	47	P
5/24/1993	36	P
5/25/1993	35	P
5/26/1993	48	P
5/27/1993	82	P
5/28/1993	83	P
5/29/1993	57	P
5/30/1993	40	P
5/31/1993	33	P
6/1/1993	30	P
6/2/1993	30	P
6/3/1993	28	P
6/4/1993	25	P
6/5/1993	22	P
6/6/1993	19	P
6/7/1993	18	P
6/8/1993	17	P
6/9/1993	16	P
6/10/1993	14	P
6/11/1993	12	P
6/12/1993	11	P
6/13/1993	14	P
6/14/1993	28	P
6/15/1993	27	P
6/16/1993	21	P
6/17/1993	29	P
6/18/1993	33	P
6/19/1993	23	P

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Date	Flow (cfs)	Qualification
	All	Code
6/20/1993	23	P
6/21/1993	322	P
6/22/1993	2160	P
6/23/1993	3180	P
6/24/1993	2210	P
6/25/1993	1090	P
6/26/1993	765	P
6/27/1993	508	P
6/28/1993	233	P
6/29/1993	83	P
6/30/1993	51	P
7/1/1993	37	P
7/2/1993	30	P
7/3/1993	26	P
7/4/1993	23	P
7/5/1993	19	P
7/6/1993	17	P
7/7/1993	16	P
7/8/1993	14	P
7/9/1993	13	P
7/10/1993	13	P
7/11/1993	26	P
7/12/1993	23	P
7/13/1993	19	P
7/14/1993	19	P
7/15/1993	15	P
7/16/1993	13	P
7/17/1993	13	P
7/18/1993	12	P
7/19/1993	10	P
7/20/1993	9	P
7/21/1993	7.5	P
7/22/1993	7.2	P
7/23/1993	6.7	P
7/24/1993	6.2	P
7/25/1993	6.4	P
7/26/1993	6.2	P
7/27/1993	5.6	P
7/28/1993	5	P
7/29/1993	4.9	P
7/30/1993	4.8	P

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Date	Flow (cfs)	Qualification
	All	Code
7/31/1993	5.3	P
8/1/1993	6.2	P
8/2/1993	5.7	P
8/3/1993	16	P
8/4/1993	35	P
8/5/1993	31	P
8/6/1993	28	P
8/7/1993	68	P
8/8/1993	126	P
8/9/1993	59	P
8/10/1993	28	P
8/11/1993	19	P
8/12/1993	14	P
8/13/1993	12	P
8/14/1993	9.9	P
8/15/1993	8.3	P
8/16/1993	10	P
8/17/1993	6.5	P
8/18/1993	5.2	P
8/19/1993	4.8	P
8/20/1993	4.7	P
8/21/1993	4.4	P
8/22/1993	6.8	P
8/23/1993	4.2	P
8/24/1993	2.5	P
8/25/1993	2.2	P
8/26/1993	2.1	P
8/27/1993	2.1	P
8/28/1993	2.1	P
8/29/1993	2	P
8/30/1993	2.5	P
8/31/1993	2.5	P
9/1/1993	2.6	P
9/2/1993	2.3	P
9/3/1993	2	P
9/4/1993	1.9	P
9/5/1993	1.9	P
9/6/1993	1.9	P
9/7/1993	1.7	P
9/8/1993	1.4	P
9/9/1993	1.3	P

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Date	Flow (cfs)	Qualification
	All	Code
9/10/1993	1.3	P
9/11/1993	1	P
9/12/1993	0.79	P
9/13/1993	0.69	P
9/14/1993	1.3	P
9/15/1993	1.3	P
9/16/1993	1.1	P
9/17/1993	1	P
9/18/1993	0.96	P
9/19/1993	1.1	P
9/20/1993	1.7	P
9/21/1993	2	P
9/22/1993	2.2	P
9/23/1993	2.3	P
9/24/1993	2.2	P
9/25/1993	2.9	P
9/26/1993	17	P
9/27/1993	65	P
9/28/1993	72	P
9/29/1993	44	P
9/30/1993	24	P
10/1/1993	17	P
10/2/1993	14	P
10/3/1993	16	P
10/4/1993	38	P
10/5/1993	36	P
10/6/1993	26	P
10/7/1993	20	P
10/8/1993	16	P
10/9/1993	14	P
10/10/1993	15	P
10/11/1993	16	P
10/12/1993	17	P
10/13/1993	21	P
10/14/1993	60	P
10/15/1993	60	P
10/16/1993	44	P
10/17/1993	31	P
10/18/1993	25	P
10/19/1993	28	P
10/20/1993	31	P

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	All	Code
10/21/1993	68	P
10/22/1993	102	P
10/23/1993	99	P
10/24/1993	62	P
10/25/1993	38	P
10/26/1993	29	P
10/27/1993	25	P
10/28/1993	22	P
10/29/1993	20	P
10/30/1993	25	P
10/31/1993	35	P
11/1/1993	33	P
11/2/1993	33	P
11/3/1993	31	P
11/4/1993	31	P
11/5/1993	30	P
11/6/1993	29	P
11/7/1993	28	P
11/8/1993	25	P
11/9/1993	23	P
11/10/1993	22	P
11/11/1993	24	P
11/12/1993	22	P
11/13/1993	22	P
11/14/1993	33	P
11/15/1993	139	P
11/16/1993	261	P
11/17/1993	364	P
11/18/1993	456	P
11/19/1993	460	P
11/20/1993	391	P
11/21/1993	286	P
11/22/1993	134	P
11/23/1993	68	P
11/24/1993	54	P
11/25/1993	52	P
11/26/1993	52	P
11/27/1993	56	P
11/28/1993	56	P
11/29/1993	53	P
11/30/1993	49	P

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Date	Flow (cfs)	Qualification
	All	Code
12/1/1993	45	P
12/2/1993	43	P
12/3/1993	50	P
12/4/1993	131	P
12/5/1993	242	P
12/6/1993	315	P
12/7/1993	389	P
12/8/1993	441	P
12/9/1993	367	P
12/10/1993	161	P
12/11/1993	88	P
12/12/1993	75	P
12/13/1993	77	P
12/14/1993	174	P
12/15/1993	222	P
12/16/1993	247	P
12/17/1993	230	P
12/18/1993	155	P
12/19/1993	92	P
12/20/1993	71	P
12/21/1993	77	P
12/22/1993	80	P
12/23/1993	76	P
12/24/1993	69	P
12/25/1993	63	P
12/26/1993	57	P
12/27/1993	51	P
12/28/1993	50	P
12/29/1993	53	P
12/30/1993	52	P
12/31/1993	50	P
1/1/1994	53	P
1/2/1994	95	P
1/3/1994	152	P
1/4/1994	268	P
1/5/1994	318	P
1/6/1994	322	P
1/7/1994	291	P
1/8/1994	184	P
1/9/1994	127	P
1/10/1994	93	P

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Date	Flow (cfs)	Qualification
	All	Code
1/11/1994	85	P
1/12/1994	151	P
1/13/1994	212	P
1/14/1994	280	P
1/15/1994	330	P
1/16/1994	340	P
1/17/1994	319	P
1/18/1994	355	P
1/19/1994	405	P
1/20/1994	447	P
1/21/1994	416	P
1/22/1994	294	P
1/23/1994	154	P
1/24/1994	106	P
1/25/1994	87	P
1/26/1994	139	P
1/27/1994	946	P
1/28/1994	4080	P
1/29/1994	4340	P
1/30/1994	2870	P
1/31/1994	1300	P
2/1/1994	773	P
2/2/1994	518	P
2/3/1994	358	P
2/4/1994	229	P
2/5/1994	232	P
2/6/1994	278	P
2/7/1994	228	P
2/8/1994	176	P
2/9/1994	152	P
2/10/1994	550	P
2/11/1994	1610	P
2/12/1994	1660	P
2/13/1994	1700	P
2/14/1994	1710	P
2/15/1994	1420	P
2/16/1994	1040	P
2/17/1994	762	P
2/18/1994	564	P
2/19/1994	422	P
2/20/1994	319	P

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Date	Flow (cfs)	Qualification
	All	Code
2/21/1994	304	P
2/22/1994	478	P
2/23/1994	876	P
2/24/1994	1130	P
2/25/1994	1300	P
2/26/1994	1050	P
2/27/1994	699	P
2/28/1994	478	P
3/1/1994	457	P
3/2/1994	818	P
3/3/1994	1080	P
3/4/1994	1280	P
3/5/1994	1080	P
3/6/1994	768	P
3/7/1994	562	P
3/8/1994	437	P
3/9/1994	519	P
3/10/1994	803	P
3/11/1994	785	P
3/12/1994	863	P
3/13/1994	817	P
3/14/1994	609	P
3/15/1994	438	P
3/16/1994	315	P
3/17/1994	213	P
3/18/1994	155	P
3/19/1994	127	P
3/20/1994	112	P
3/21/1994	103	P
3/22/1994	94	P
3/23/1994	86	P
3/24/1994	84	P
3/25/1994	80	P
3/26/1994	71	P
3/27/1994	91	P
3/28/1994	276	P
3/29/1994	376	P
3/30/1994	425	P
3/31/1994	663	P
4/1/1994	611	P
4/2/1994	403	P

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Date	Flow (cfs)	Qualification
	All	Code
4/3/1994	215	P
4/4/1994	121	P
4/5/1994	91	P
4/6/1994	97	P
4/7/1994	91	P
4/8/1994	79	P
4/9/1994	75	P
4/10/1994	67	P
4/11/1994	65	P
4/12/1994	238	P
4/13/1994	486	P
4/14/1994	515	P
4/15/1994	478	P
4/16/1994	539	P
4/17/1994	437	P
4/18/1994	296	P
4/19/1994	195	P
4/20/1994	118	P
4/21/1994	74	P
4/22/1994	89	P
4/23/1994	80	P
4/24/1994	53	P
4/25/1994	46	P
4/26/1994	45	P
4/27/1994	42	P
4/28/1994	38	P
4/29/1994	35	P
4/30/1994	36	P
5/1/1994	76	P
5/2/1994	57	P
5/3/1994	266	P
5/4/1994	500	P
5/5/1994	473	P
5/6/1994	380	P
5/7/1994	254	P
5/8/1994	108	P
5/9/1994	64	P
5/10/1994	64	P
5/11/1994	57	P
5/12/1994	53	P
5/13/1994	49	P

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Date	Flow (cfs)	Qualification
	All	Code
5/14/1994	76	P
5/15/1994	322	P
5/16/1994	647	P
5/17/1994	764	P
5/18/1994	576	P
5/19/1994	391	P
5/20/1994	162	P
5/21/1994	65	P
5/22/1994	46	P
5/23/1994	38	P
5/24/1994	35	P
5/25/1994	32	P
5/26/1994	30	P
5/27/1994	31	P
5/28/1994	37	P
5/29/1994	40	P
5/30/1994	46	P
5/31/1994	54	P
6/1/1994	62	P
6/2/1994	106	P
6/3/1994	103	P
6/4/1994	59	P
6/5/1994	42	P
6/6/1994	37	P
6/7/1994	35	P
6/8/1994	50	P
6/9/1994	77	P
6/10/1994	55	P
6/11/1994	58	P
6/12/1994	52	P
6/13/1994	51	P
6/14/1994	48	P
6/15/1994	41	P
6/16/1994	35	P
6/17/1994	31	P
6/18/1994	27	P
6/19/1994	27	P
6/20/1994	27	P
6/21/1994	28	P
6/22/1994	24	P
6/23/1994	25	P

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Date	Flow (cfs)	Qualification
	All	Code
6/24/1994	47	P
6/25/1994	79	P
6/26/1994	66	P
6/27/1994	41	P
6/28/1994	28	P
6/29/1994	21	P
6/30/1994	18	P
7/1/1994	23	P
7/2/1994	30	P
7/3/1994	58	P
7/4/1994	62	P
7/5/1994	35	P
7/6/1994	23	P
7/7/1994	16	P
7/8/1994	13	P
7/9/1994	10	P
7/10/1994	8.1	P
7/11/1994	8.3	P
7/12/1994	9.3	P
7/13/1994	16	P
7/14/1994	26	P
7/15/1994	51	P
7/16/1994	38	P
7/17/1994	23	P
7/18/1994	18	P
7/19/1994	24	P
7/20/1994	29	P
7/21/1994	24	P
7/22/1994	31	P
7/23/1994	80	P
7/24/1994	146	P
7/25/1994	187	P
7/26/1994	171	P
7/27/1994	69	P
7/28/1994	60	P
7/29/1994	49	P
7/30/1994	31	P
7/31/1994	25	P
8/1/1994	20	P
8/2/1994	19	P
8/3/1994	16	P

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Date	Flow (cfs)	Qualification
	All	Code
8/4/1994	21	P
8/5/1994	25	P
8/6/1994	28	P
8/7/1994	29	P
8/8/1994	26	P
8/9/1994	23	P
8/10/1994	19	P
8/11/1994	18	P
8/12/1994	14	P
8/13/1994	12	P
8/14/1994	11	P
8/15/1994	8.8	P
8/16/1994	8	P
8/17/1994	7.1	P
8/18/1994	6.1	P
8/19/1994	7.6	P
8/20/1994	24	P
8/21/1994	64	P
8/22/1994	149	P
8/23/1994	168	P
8/24/1994	104	P
8/25/1994	36	P
8/26/1994	23	P
8/27/1994	19	P
8/28/1994	16	P
8/29/1994	17	P
8/30/1994	16	P
8/31/1994	14	P
9/1/1994	13	P
9/2/1994	12	P
9/3/1994	13	P
9/4/1994	13	P
9/5/1994	11	P
9/6/1994	10	P
9/7/1994	9.6	P
9/8/1994	16	P
9/9/1994	18	P
9/10/1994	15	P
9/11/1994	12	P
9/12/1994	10	P
9/13/1994	6	P

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Date	Flow (cfs)	Qualification
	All	Code
9/14/1994	6.2	P
9/15/1994	5.3	P
9/16/1994	4.7	P
9/17/1994	5.1	P
9/18/1994	5	P
9/19/1994	4.5	P
9/20/1994	3.6	P
9/21/1994	2.9	P
9/22/1994	2.8	P
9/23/1994	2.9	P
9/24/1994	3.3	P
9/25/1994	4.2	P
9/26/1994	3.5	P
9/27/1994	3.3	P
9/28/1994	2.9	P
9/29/1994	2.3	P
9/30/1994	2.1	P
10/1/1994	1.9	A
10/2/1994	2.1	A
10/3/1994	2.5	A
10/4/1994	2.7	A
10/5/1994	2.3	A
10/6/1994	2.3	A
10/7/1994	2.1	A
10/8/1994	2	A
10/9/1994	2.6	A
10/10/1994	4.8	A
10/11/1994	7.4	A
10/12/1994	17	A
10/13/1994	26	A
10/14/1994	27	A
10/15/1994	19	A
10/16/1994	75	A
10/17/1994	336	A
10/18/1994	481	A
10/19/1994	518	A
10/20/1994	540	A
10/21/1994	511	A
10/22/1994	513	A
10/23/1994	458	A
10/24/1994	380	A

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Date	Flow (cfs)	Qualification
	All	Code
10/25/1994	358	A
10/26/1994	364	A
10/27/1994	297	A
10/28/1994	248	A
10/29/1994	224	A
10/30/1994	109	A
10/31/1994	58	A
11/1/1994	43	A
11/2/1994	34	A
11/3/1994	30	A
11/4/1994	33	A
11/5/1994	45	A
11/6/1994	122	A
11/7/1994	129	A
11/8/1994	155	A
11/9/1994	169	A
11/10/1994	163	A
11/11/1994	159	A
11/12/1994	135	A
11/13/1994	130	A
11/14/1994	116	A
11/15/1994	95	A
11/16/1994	77	A
11/17/1994	69	A
11/18/1994	70	A
11/19/1994	82	A
11/20/1994	75	A
11/21/1994	68	A
11/22/1994	66	A
11/23/1994	66	A
11/24/1994	60	A
11/25/1994	51	A
11/26/1994	46	A
11/27/1994	46	A
11/28/1994	77	A
11/29/1994	61	A
11/30/1994	66	A
12/1/1994	55	A
12/2/1994	49	A
12/3/1994	47	A
12/4/1994	47	A

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Date	Flow (cfs)	Qualification
	All	Code
12/5/1994	47	A
12/6/1994	48	A
12/7/1994	48	A
12/8/1994	66	A
12/9/1994	172	A
12/10/1994	308	A
12/11/1994	539	A
12/12/1994	690	A
12/13/1994	889	A
12/14/1994	1020	A
12/15/1994	994	A
12/16/1994	1530	A
12/17/1994	2260	A
12/18/1994	2420	A
12/19/1994	1560	A
12/20/1994	992	A
12/21/1994	698	A
12/22/1994	524	A
12/23/1994	399	A
12/24/1994	295	A
12/25/1994	219	A
12/26/1994	155	A
12/27/1994	116	A
12/28/1994	98	A
12/29/1994	102	A
12/30/1994	146	A
12/31/1994	152	A
1/1/1995	134	A
1/2/1995	114	A
1/3/1995	96	A
1/4/1995	91	A
1/5/1995	86	A
1/6/1995	97	A
1/7/1995	198	A
1/8/1995	266	A
1/9/1995	297	A
1/10/1995	315	A
1/11/1995	323	A
1/12/1995	247	A
1/13/1995	175	A
1/14/1995	254	A

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Date	Flow (cfs)	Qualification
	All	Code
1/15/1995	354	A
1/16/1995	419	A
1/17/1995	442	A
1/18/1995	1100	A
1/19/1995	2710	A
1/20/1995	3260	A
1/21/1995	2470	A
1/22/1995	1260	A
1/23/1995	793	A
1/24/1995	592	A
1/25/1995	444	A
1/26/1995	367	A
1/27/1995	402	A
1/28/1995	478	A
1/29/1995	523	A
1/30/1995	662	A
1/31/1995	678	A
2/1/1995	535	A
2/2/1995	401	A
2/3/1995	282	A
2/4/1995	189	A
2/5/1995	133	A
2/6/1995	104	A
2/7/1995	90	A
2/8/1995	81	A
2/9/1995	76	A
2/10/1995	76	A
2/11/1995	81	A
2/12/1995	81	A
2/13/1995	79	A
2/14/1995	81	A
2/15/1995	95	A
2/16/1995	249	A
2/17/1995	316	A
2/18/1995	323	A
2/19/1995	274	A
2/20/1995	189	A
2/21/1995	128	A
2/22/1995	98	A
2/23/1995	83	A
2/24/1995	82	A

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Date	Flow (cfs)	Qualification
	All	Code
2/25/1995	84	A
2/26/1995	78	A
2/27/1995	91	A
2/28/1995	430	A
3/1/1995	1040	A
3/2/1995	1070	A
3/3/1995	1010	A
3/4/1995	782	A
3/5/1995	676	A
3/6/1995	619	A
3/7/1995	1330	A
3/8/1995	2620	A
3/9/1995	2910	A
3/10/1995	2090	A
3/11/1995	1070	A
3/12/1995	682	A
3/13/1995	486	A
3/14/1995	389	A
3/15/1995	363	A
3/16/1995	357	A
3/17/1995	382	A
3/18/1995	371	A
3/19/1995	342	A
3/20/1995	310	A
3/21/1995	263	A
3/22/1995	188	A
3/23/1995	143	A
3/24/1995	121	A
3/25/1995	109	A
3/26/1995	105	A
3/27/1995	110	A
3/28/1995	124	A
3/29/1995	103	A
3/30/1995	103	A
3/31/1995	99	A
4/1/1995	89	A
4/2/1995	78	A
4/3/1995	69	A
4/4/1995	67	A
4/5/1995	77	A
4/6/1995	81	A

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Date	Flow (cfs)	Qualification
	All	Code
4/7/1995	87	A
4/8/1995	81	A
4/9/1995	72	A
4/10/1995	63	A
4/11/1995	408	A
4/12/1995	830	A
4/13/1995	687	A
4/14/1995	825	A
4/15/1995	787	A
4/16/1995	506	A
4/17/1995	241	A
4/18/1995	106	A
4/19/1995	77	A
4/20/1995	84	A
4/21/1995	138	A
4/22/1995	264	A
4/23/1995	738	A
4/24/1995	1090	A
4/25/1995	1380	A
4/26/1995	1520	A
4/27/1995	858	A
4/28/1995	523	A
4/29/1995	258	A
4/30/1995	112	A
5/1/1995	85	A
5/2/1995	81	A
5/3/1995	75	A
5/4/1995	108	A
5/5/1995	180	A
5/6/1995	179	A
5/7/1995	164	A
5/8/1995	156	A
5/9/1995	203	A
5/10/1995	241	A
5/11/1995	243	A
5/12/1995	219	A
5/13/1995	133	A
5/14/1995	77	A
5/15/1995	61	A
5/16/1995	54	A
5/17/1995	48	A

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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
5/18/1995	45	A
5/19/1995	92	A
5/20/1995	135	A
5/21/1995	123	A
5/22/1995	76	A
5/23/1995	50	A
5/24/1995	40	A
5/25/1995	34	A
5/26/1995	31	A
5/27/1995	29	A
5/28/1995	28	A
5/29/1995	31	A
5/30/1995	61	A
5/31/1995	277	A
6/1/1995	222	A
6/2/1995	216	A
6/3/1995	138	A
6/4/1995	74	A
6/5/1995	51	A
6/6/1995	40	A
6/7/1995	34	A
6/8/1995	30	A
6/9/1995	27	A
6/10/1995	25	A
6/11/1995	25	A
6/12/1995	32	A
6/13/1995	38	A
6/14/1995	34	A
6/15/1995	29	A
6/16/1995	25	A
6/17/1995	22	A
6/18/1995	21	A
6/19/1995	19	A
6/20/1995	18	A
6/21/1995	17	A
6/22/1995	16	A
6/23/1995	16	A
6/24/1995	15	A
6/25/1995	15	A
6/26/1995	15	A
6/27/1995	14	A

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Date	Flow (cfs)	Qualification
	All	Code
6/28/1995	14	A
6/29/1995	13	A
6/30/1995	13	A
7/1/1995	14	A
7/2/1995	22	A
7/3/1995	23	A
7/4/1995	20	A
7/5/1995	28	A
7/6/1995	76	A
7/7/1995	105	A
7/8/1995	116	A
7/9/1995	84	A
7/10/1995	35	A
7/11/1995	18	A
7/12/1995	13	A
7/13/1995	9.7	A
7/14/1995	7.5	A
7/15/1995	6.3	A
7/16/1995	5.4	A
7/17/1995	4.8	A
7/18/1995	4.8	A
7/19/1995	4.9	A
7/20/1995	5.7	A
7/21/1995	8.5	A
7/22/1995	6.4	A
7/23/1995	5	A
7/24/1995	4.2	A
7/25/1995	3.4	A
7/26/1995	3.3	A
7/27/1995	2.9	A
7/28/1995	2.6	A
7/29/1995	2.5	A
7/30/1995	2.3	A
7/31/1995	2.3	A
8/1/1995	2.5	A
8/2/1995	2.3	A
8/3/1995	3.1	A
8/4/1995	4.3	A
8/5/1995	5.3	A
8/6/1995	6	A
8/7/1995	9.4	A

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Date	Flow (cfs)	Qualification
	All	Code
8/8/1995	21	A
8/9/1995	13	A
8/10/1995	8.7	A
8/11/1995	6.7	A
8/12/1995	5.6	Ae
8/13/1995	4.5	Ae
8/14/1995	3.7	Ae
8/15/1995	3.1	Ae
8/16/1995	2.6	Ae
8/17/1995	2.2	Ae
8/18/1995	1.9	Ae
8/19/1995	1.6	Ae
8/20/1995	1.4	Ae
8/21/1995	1.2	Ae
8/22/1995	1.1	Ae
8/23/1995	1	Ae
8/24/1995	0.9	Ae
8/25/1995	0.8	Ae
8/26/1995	0.72	Ae
8/27/1995	0.64	Ae
8/28/1995	0.58	Ae
8/29/1995	0.52	Ae
8/30/1995	0.46	Ae
8/31/1995	0.39	Ae
9/1/1995	0.34	Ae
9/2/1995	0.3	Ae
9/3/1995	0.26	Ae
9/4/1995	0.22	A
9/5/1995	0.18	A
9/6/1995	0.13	A
9/7/1995	0.09	A
9/8/1995	0.06	A
9/9/1995	0.04	A
9/10/1995	0.03	A
9/11/1995	0.01	A
9/12/1995	0.01	A
9/13/1995	0.04	A
9/14/1995	0.03	A
9/15/1995	0.04	A
9/16/1995	0.13	A
9/17/1995	0.56	A

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Date	Flow (cfs)	Qualification
	All	Code
9/18/1995	1.2	A
9/19/1995	4	A
9/20/1995	13	A
9/21/1995	21	A
9/22/1995	17	A
9/23/1995	13	Ae
9/24/1995	10	Ae
9/25/1995	7	Ae
9/26/1995	5.8	Ae
9/27/1995	4.6	Ae
9/28/1995	3.8	Ae
9/29/1995	3.2	Ae
9/30/1995	2.9	Ae
10/1/1995	13	P
10/2/1995	15	P
10/3/1995	15	P
10/4/1995	16	P
10/5/1995	16	P
10/6/1995	16	P
10/7/1995	16	P
10/8/1995	16	P
10/9/1995	16	P
10/10/1995	16	P
10/11/1995	16	P
10/12/1995	16	P
10/13/1995	15	P
10/14/1995	15	P
10/15/1995	14	P
10/16/1995	14	P
10/17/1995	14	P
10/18/1995	14	P
10/19/1995	14	P
10/20/1995	12	P
10/21/1995	11	P
10/22/1995	11	P
10/23/1995	11	P
10/24/1995	10	P
10/25/1995	11	P
10/26/1995	11	P
10/27/1995	11	P
10/28/1995	10	P

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Date	Flow (cfs)	Qualification
	All	Code
10/29/1995	11	P
10/30/1995	11	P
10/31/1995	9.7	P
11/1/1995	10	P
11/2/1995	16	P
11/3/1995	16	P
11/4/1995	14	P
11/5/1995	12	P
11/6/1995	10	P
11/7/1995	10	P
11/8/1995	12	P
11/9/1995	11	P
11/10/1995	10	P
11/11/1995	9	P
11/12/1995	9	P
11/13/1995	9.3	P
11/14/1995	8.5	P
11/15/1995	7.9	P
11/16/1995	7	P
11/17/1995	7	P
11/18/1995	8.1	P
11/19/1995	5.9	P
11/20/1995	5.1	P
11/21/1995	5.2	P
11/22/1995	5.8	P
11/23/1995	5.8	P
11/24/1995	6.2	P
11/25/1995	6.7	P
11/26/1995	7.4	P
11/27/1995	7.6	P
11/28/1995	7.8	P
11/29/1995	7.8	P
11/30/1995	8.2	P
12/1/1995	9.1	P
12/2/1995	9.7	P
12/3/1995	10	P
12/4/1995	11	P
12/5/1995	8.1	P
12/6/1995	5.2	P
12/7/1995	4	P
12/8/1995	12	P

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Date	Flow (cfs)	Qualification
	All	Code
12/9/1995	25	P
12/10/1995	20	P
12/11/1995	12	P
12/12/1995	6.4	P
12/13/1995	4.7	P
12/14/1995	4	P
12/15/1995	11	P
12/16/1995	52	P
12/17/1995	62	P
12/18/1995	215	P
12/19/1995	264	P
12/20/1995	288	P
12/21/1995	224	P
12/22/1995	118	P
12/23/1995	58	P
12/24/1995	42	P
12/25/1995	36	P
12/26/1995	32	P
12/27/1995	30	P
12/28/1995	28	P
12/29/1995	29	P
12/30/1995	30	P
12/31/1995	38	P
1/1/1996	60	P
1/2/1996	114	P
1/3/1996	122	P
1/4/1996	93	P
1/5/1996	69	P
1/6/1996	46	P
1/7/1996	39	P
1/8/1996	35	P
1/9/1996	33	P
1/10/1996	32	P
1/11/1996	31	P
1/12/1996	30	P
1/13/1996	28	P
1/14/1996	27	P
1/15/1996	28	P
1/16/1996	25	P
1/17/1996	27	P
1/18/1996	41	P

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Date	Flow (cfs)	Qualification
	All	Code
1/19/1996	48	P
1/20/1996	47	P
1/21/1996	44	P
1/22/1996	39	P
1/23/1996	62	P
1/24/1996	184	P
1/25/1996	249	P
1/26/1996	213	P
1/27/1996	133	P
1/28/1996	84	P
1/29/1996	66	P
1/30/1996	61	P
1/31/1996	59	P
2/1/1996	58	P
2/2/1996	61	P
2/3/1996	60	P
2/4/1996	56	P
2/5/1996	53	P
2/6/1996	62	P
2/7/1996	75	P
2/8/1996	85	P
2/9/1996	94	P
2/10/1996	100	P
2/11/1996	86	P
2/12/1996	68	P
2/13/1996	55	P
2/14/1996	49	P
2/15/1996	45	P
2/16/1996	42	P
2/17/1996	40	P
2/18/1996	39	P
2/19/1996	53	P
2/20/1996	79	P
2/21/1996	73	P
2/22/1996	65	P
2/23/1996	56	P
2/24/1996	49	P
2/25/1996	44	P
2/26/1996	42	P
2/27/1996	43	P
2/28/1996	46	P

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Date	Flow (cfs)	Qualification
	All	Code
2/29/1996	47	P
3/1/1996	43	P
3/2/1996	40	P
3/3/1996	38	P
3/4/1996	36	P
3/5/1996	36	P
3/6/1996	50	P
3/7/1996	72	P
3/8/1996	65	P
3/9/1996	62	P
3/10/1996	52	P
3/11/1996	46	P
3/12/1996	45	P
3/13/1996	46	P
3/14/1996	44	P
3/15/1996	40	P
3/16/1996	39	P
3/17/1996	43	P
3/18/1996	83	P
3/19/1996	141	P
3/20/1996	152	P
3/21/1996	147	P
3/22/1996	103	P
3/23/1996	65	P
3/24/1996	147	P
3/25/1996	462	P
3/26/1996	610	P
3/27/1996	507	P
3/28/1996	448	P
3/29/1996	448	P
3/30/1996	388	P
3/31/1996	209	P
4/1/1996	134	P
4/2/1996	111	P
4/3/1996	111	P
4/4/1996	76	P
4/5/1996	88	P
4/6/1996	157	P
4/7/1996	188	P
4/8/1996	178	P
4/9/1996	137	P

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Date	Flow (cfs)	Qualification
	All	Code
4/10/1996	80	P
4/11/1996	54	P
4/12/1996	55	P
4/13/1996	149	P
4/14/1996	185	P
4/15/1996	168	P
4/16/1996	130	P
4/17/1996	142	P
4/18/1996	163	P
4/19/1996	165	P
4/20/1996	140	P
4/21/1996	287	P
4/22/1996	308	P
4/23/1996	201	P
4/24/1996	156	P
4/25/1996	116	P
4/26/1996	66	P
4/27/1996	45	P
4/28/1996	37	P
4/29/1996	63	P
4/30/1996	98	P
5/1/1996	142	P
5/2/1996	134	P
5/3/1996	81	P
5/4/1996	42	P
5/5/1996	30	P
5/6/1996	24	P
5/7/1996	21	P
5/8/1996	18	P
5/9/1996	15	P
5/10/1996	13	P
5/11/1996	15	P
5/12/1996	19	P
5/13/1996	16	P
5/14/1996	17	P
5/15/1996	16	P
5/16/1996	15	P
5/17/1996	12	P
5/18/1996	9.6	P
5/19/1996	11	P
5/20/1996	7.3	P

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Date	Flow (cfs)	Qualification
	All	Code
5/21/1996	5.3	P
5/22/1996	4.2	P
5/23/1996	3.5	P
5/24/1996	2.9	P
5/25/1996	2.6	P
5/26/1996	2.1	P
5/27/1996	1.9	P
5/28/1996	2.1	P
5/29/1996	3.1	P
5/30/1996	2.4	P
5/31/1996	2.3	P
6/1/1996	4.7	P
6/2/1996	14	P
6/3/1996	14	P
6/4/1996	12	P
6/5/1996	10	P
6/6/1996	8.8	P
6/7/1996	11	P
6/8/1996	18	P
6/9/1996	19	P
6/10/1996	14	P
6/11/1996	11	P
6/12/1996	15	P
6/13/1996	91	P
6/14/1996	185	P
6/15/1996	176	P
6/16/1996	152	P
6/17/1996	72	P
6/18/1996	31	P
6/19/1996	25	P
6/20/1996	46	P
6/21/1996	66	P
6/22/1996	104	P
6/23/1996	101	P
6/24/1996	44	P
6/25/1996	30	P
6/26/1996	26	P
6/27/1996	18	P
6/28/1996	16	P
6/29/1996	12	P
6/30/1996	11	P

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Date	Flow (cfs)	Qualification
	All	Code
7/1/1996	9.4	P
7/2/1996	8	P
7/3/1996	6.3	P
7/4/1996	6.5	P
7/5/1996	7	P
7/6/1996	7.5	P
7/7/1996	7	P
7/8/1996	7.3	P
7/9/1996	7.1	P
7/10/1996	6.8	P
7/11/1996	8.6	P
7/12/1996	8.9	P
7/13/1996	9.1	P
7/14/1996	11	P
7/15/1996	22	P
7/16/1996	47	P
7/17/1996	40	P
7/18/1996	40	P
7/19/1996	42	P
7/20/1996	33	P
7/21/1996	24	P
7/22/1996	17	P
7/23/1996	14	P
7/24/1996	13	P
7/25/1996	33	P
7/26/1996	43	P
7/27/1996	65	P
7/28/1996	147	P
7/29/1996	204	P
7/30/1996	256	P
7/31/1996	308	P
8/1/1996	367	P
8/2/1996	304	P
8/3/1996	449	P
8/4/1996	801	P
8/5/1996	591	P
8/6/1996	368	P
8/7/1996	306	P
8/8/1996	224	P
8/9/1996	85	P
8/10/1996	62	P

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Date	Flow (cfs)	Qualification
	All	Code
8/11/1996	58	P
8/12/1996	64	P
8/13/1996	114	P
8/14/1996	69	P
8/15/1996	83	P
8/16/1996	62	P
8/17/1996	31	P
8/18/1996	23	P
8/19/1996	16	P
8/20/1996	13	P
8/21/1996	12	P
8/22/1996	13	P
8/23/1996	10	P
8/24/1996	8.4	P
8/25/1996	7.1	P
8/26/1996	6.4	P
8/27/1996	6.7	P
8/28/1996	15	P
8/29/1996	120	P
8/30/1996	688	P
8/31/1996	1300	P
9/1/1996	1230	P
9/2/1996	896	P
9/3/1996	526	P
9/4/1996	172	P
9/5/1996	47	P
9/6/1996	32	P
9/7/1996	28	P
9/8/1996	24	P
9/9/1996	20	P
9/10/1996	16	P
9/11/1996	13	P
9/12/1996	11	P
9/13/1996	9.5	P
9/14/1996	8.8	P
9/15/1996	8.3	P
9/16/1996	8.7	P
9/17/1996	8.5	P
9/18/1996	9.3	P
9/19/1996	8.6	P
9/20/1996	8.7	P

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Date	Flow (cfs)	Qualification
	All	Code
9/21/1996	87	P
9/22/1996	329	P
9/23/1996	152	P
9/24/1996	30	P
9/25/1996	29	P
9/26/1996	34	P
9/27/1996	1130	P
9/28/1996	1760	P
9/29/1996	1310	P
9/30/1996	1140	P
10/1/1996	795	P
10/2/1996	503	P
10/3/1996	190	P
10/4/1996	58	P
10/5/1996	40	P
10/6/1996	33	P
10/7/1996	28	P
10/8/1996	25	P
10/9/1996	23	P
10/10/1996	20	P
10/11/1996	20	P
10/12/1996	18	P
10/13/1996	14	P
10/14/1996	13	P
10/15/1996	13	P
10/16/1996	13	P
10/17/1996	12	P
10/18/1996	31	P
10/19/1996	60	P
10/20/1996	40	P
10/21/1996	30	P
10/22/1996	44	P
10/23/1996	140	P
10/24/1996	158	P
10/25/1996	204	P
10/26/1996	303	P
10/27/1996	373	P
10/28/1996	194	P
10/29/1996	88	P
10/30/1996	62	P
10/31/1996	51	P

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Date	Flow (cfs)	Qualification
	All	Code
11/1/1996	55	P
11/2/1996	135	P
11/3/1996	140	P
11/4/1996	100	P
11/5/1996	80	P
11/6/1996	88	P
11/7/1996	100	P
11/8/1996	270	P
11/9/1996	330	P
11/10/1996	292	P
11/11/1996	285	P
11/12/1996	244	P
11/13/1996	125	P
11/14/1996	79	P
11/15/1996	65	P
11/16/1996	65	P
11/17/1996	52	P
11/18/1996	62	P
11/19/1996	75	P
11/20/1996	92	P
11/21/1996	99	P
11/22/1996	86	P
11/23/1996	73	P
11/24/1996	70	P
11/25/1996	274	P
11/26/1996	473	P
11/27/1996	566	P
11/28/1996	736	P
11/29/1996	808	P
11/30/1996	739	P
12/1/1996	766	P
12/2/1996	910	P
12/3/1996	1090	P
12/4/1996	878	P
12/5/1996	648	P
12/6/1996	435	P
12/7/1996	232	P
12/8/1996	140	P
12/9/1996	112	P
12/10/1996	96	P
12/11/1996	83	P

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Date	Flow (cfs)	Qualification
	All	Code
12/12/1996	76	P
12/13/1996	71	P
12/14/1996	68	P
12/15/1996	64	P
12/16/1996	133	P
12/17/1996	332	P
12/18/1996	392	P
12/19/1996	386	P
12/20/1996	384	P
12/21/1996	366	P
12/22/1996	239	P
12/23/1996	144	P
12/24/1996	147	P
12/25/1996	186	P
12/26/1996	209	P
12/27/1996	394	P
12/28/1996	565	P
12/29/1996	625	Pe
12/30/1996	700	Pe
12/31/1996	500	Pe
1/1/1997	380	Pe
1/2/1997	280	Pe
1/3/1997	220	Pe
1/4/1997	170	Pe
1/5/1997	210	Pe
1/6/1997	335	P
1/7/1997	459	P
1/8/1997	670	P
1/9/1997	1110	P
1/10/1997	1340	P
1/11/1997	1390	P
1/12/1997	1130	P
1/13/1997	684	P
1/14/1997	424	P
1/15/1997	269	P
1/16/1997	293	P
1/17/1997	297	P
1/18/1997	289	P
1/19/1997	277	P
1/20/1997	213	P
1/21/1997	168	P

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Date	Flow (cfs)	Qualification
	All	Code
1/22/1997	180	P
1/23/1997	211	P
1/24/1997	946	P
1/25/1997	1600	P
1/26/1997	1660	P
1/27/1997	1280	P
1/28/1997	830	P
1/29/1997	601	P
1/30/1997	435	P
1/31/1997	319	P
2/1/1997	221	P
2/2/1997	160	P
2/3/1997	129	P
2/4/1997	133	P
2/5/1997	158	P
2/6/1997	190	P
2/7/1997	338	P
2/8/1997	723	P
2/9/1997	788	P
2/10/1997	956	P
2/11/1997	864	P
2/12/1997	717	P
2/13/1997	1910	P
2/14/1997	2520	P
2/15/1997	2670	P
2/16/1997	1610	P
2/17/1997	841	P
2/18/1997	547	P
2/19/1997	367	P
2/20/1997	256	P
2/21/1997	499	P
2/22/1997	738	P
2/23/1997	650	P
2/24/1997	658	P
2/25/1997	603	P
2/26/1997	478	P
2/27/1997	562	P
2/28/1997	609	P
3/1/1997	696	P
3/2/1997	5330	P
3/3/1997	6820	P

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Date	Flow (cfs)	Qualification
	All	Code
3/4/1997	4580	P
3/5/1997	2360	P
3/6/1997	1830	P
3/7/1997	931	P
3/8/1997	763	P
3/9/1997	731	P
3/10/1997	549	P
3/11/1997	407	P
3/12/1997	313	P
3/13/1997	415	P
3/14/1997	673	P
3/15/1997	710	P
3/16/1997	836	P
3/17/1997	722	P
3/18/1997	523	P
3/19/1997	390	P
3/20/1997	333	P
3/21/1997	356	P
3/22/1997	512	P
3/23/1997	461	P
3/24/1997	305	P
3/25/1997	195	P
3/26/1997	258	P
3/27/1997	325	P
3/28/1997	355	P
3/29/1997	302	P
3/30/1997	202	P
3/31/1997	124	P
4/1/1997	91	P
4/2/1997	80	P
4/3/1997	68	P
4/4/1997	147	P
4/5/1997	3490	P
4/6/1997	8210	P
4/7/1997	4420	P
4/8/1997	1690	P
4/9/1997	819	P
4/10/1997	511	P
4/11/1997	314	P
4/12/1997	191	P
4/13/1997	173	P

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Date	Flow (cfs)	Qualification
	All	Code
4/14/1997	161	P
4/15/1997	142	P
4/16/1997	111	P
4/17/1997	93	P
4/18/1997	80	P
4/19/1997	70	P
4/20/1997	63	P
4/21/1997	59	P
4/22/1997	134	P
4/23/1997	295	P
4/24/1997	298	P
4/25/1997	294	P
4/26/1997	482	P
4/27/1997	792	P
4/28/1997	1740	P
4/29/1997	1880	P
4/30/1997	1390	P
5/1/1997	1070	P
5/2/1997	895	P
5/3/1997	1390	P
5/4/1997	932	P
5/5/1997	1150	P
5/6/1997	1000	P
5/7/1997	582	P
5/8/1997	311	P
5/9/1997	145	P
5/10/1997	96	P
5/11/1997	77	P
5/12/1997	64	P
5/13/1997	55	P
5/14/1997	49	P
5/15/1997	44	P
5/16/1997	41	P
5/17/1997	39	P
5/18/1997	38	P
5/19/1997	38	P
5/20/1997	39	P
5/21/1997	72	P
5/22/1997	162	P
5/23/1997	160	P
5/24/1997	111	P

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Date	Flow (cfs)	Qualification
	All	Code
5/25/1997	98	P
5/26/1997	178	P
5/27/1997	524	P
5/28/1997	749	P
5/29/1997	459	P
5/30/1997	224	P
5/31/1997	307	P
6/1/1997	967	P
6/2/1997	1890	P
6/3/1997	1170	P
6/4/1997	605	P
6/5/1997	284	P
6/6/1997	150	P
6/7/1997	181	P
6/8/1997	214	P
6/9/1997	174	P
6/10/1997	398	P
6/11/1997	485	P
6/12/1997	264	P
6/13/1997	154	P
6/14/1997	133	P
6/15/1997	109	P
6/16/1997	78	P
6/17/1997	68	P
6/18/1997	103	P
6/19/1997	129	P
6/20/1997	96	P
6/21/1997	62	P
6/22/1997	46	P
6/23/1997	37	P
6/24/1997	32	P
6/25/1997	27	P
6/26/1997	31	P
6/27/1997	68	P
6/28/1997	42	P
6/29/1997	64	P
6/30/1997	62	P
7/1/1997	68	P
7/2/1997	51	P
7/3/1997	35	P
7/4/1997	28	P

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Date	Flow (cfs)	Qualification
	All	Code
7/5/1997	23	P
7/6/1997	20	P
7/7/1997	20	P
7/8/1997	24	P
7/9/1997	24	P
7/10/1997	21	P
7/11/1997	19	P
7/12/1997	17	P
7/13/1997	16	P
7/14/1997	15	P
7/15/1997	14	P
7/16/1997	14	P
7/17/1997	14	P
7/18/1997	13	P
7/19/1997	12	P
7/20/1997	15	P
7/21/1997	16	P
7/22/1997	13	P
7/23/1997	12	P
7/24/1997	11	P
7/25/1997	11	P
7/26/1997	12	P
7/27/1997	11	P
7/28/1997	10	P
7/29/1997	9.9	P
7/30/1997	15	P
7/31/1997	20	P
8/1/1997	15	P
8/2/1997	14	P
8/3/1997	14	P
8/4/1997	12	P
8/5/1997	11	P
8/6/1997	10	P
8/7/1997	9.5	P
8/8/1997	10	P
8/9/1997	17	P
8/10/1997	27	P
8/11/1997	41	P
8/12/1997	61	P
8/13/1997	113	P
8/14/1997	218	P

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Date	Flow (cfs)	Qualification
	All	Code
8/15/1997	410	P
8/16/1997	176	P
8/17/1997	71	P
8/18/1997	40	P
8/19/1997	29	P
8/20/1997	25	P
8/21/1997	23	P
8/22/1997	22	P
8/23/1997	29	P
8/24/1997	34	P
8/25/1997	30	P
8/26/1997	27	P
8/27/1997	24	P
8/28/1997	21	P
8/29/1997	18	P
8/30/1997	16	P
8/31/1997	15	P
9/1/1997	17	P
9/2/1997	76	P
9/3/1997	57	P
9/4/1997	31	P
9/5/1997	22	P
9/6/1997	18	P
9/7/1997	16	P
9/8/1997	15	P
9/9/1997	16	P
9/10/1997	18	P
9/11/1997	18	P
9/12/1997	16	P
9/13/1997	14	P
9/14/1997	13	P
9/15/1997	14	P
9/16/1997	13	P
9/17/1997	12	P
9/18/1997	12	P
9/19/1997	11	P
9/20/1997	11	P
9/21/1997	10	P
9/22/1997	8.7	Pe
9/23/1997	7.6	Pe
9/24/1997	6.5	Pe

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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
9/25/1997	5.7	Pe
9/26/1997	5	Pe
9/27/1997	5.6	Pe
9/28/1997	4.7	Pe
9/29/1997	3.9	Pe
9/30/1997	3	Pe
10/1/1997	2.5	Ae
10/2/1997	1.9	Ae
10/3/1997	1.4	Ae
10/4/1997	1	Ae
10/5/1997	0.8	Ae
10/6/1997	0.6	Ae
10/7/1997	0.45	Ae
10/8/1997	0.35	Ae
10/9/1997	0.85	Ae
10/10/1997	1.7	Ae
10/11/1997	4	Ae
10/12/1997	8.5	Ae
10/13/1997	19	Ae
10/14/1997	29	A
10/15/1997	17	A
10/16/1997	12	A
10/17/1997	7.6	A
10/18/1997	7	A
10/19/1997	5.2	A
10/20/1997	4.6	A
10/21/1997	5.6	A
10/22/1997	23	A
10/23/1997	23	A
10/24/1997	80	A
10/25/1997	139	A
10/26/1997	188	A
10/27/1997	189	A
10/28/1997	68	A
10/29/1997	33	A
10/30/1997	18	A
10/31/1997	14	A
11/1/1997	31	A
11/2/1997	24	A
11/3/1997	17	A
11/4/1997	13	A

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208.00 square miles
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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
11/5/1997	22	A
11/6/1997	91	A
11/7/1997	92	A
11/8/1997	76	A
11/9/1997	62	A
11/10/1997	40	A
11/11/1997	30	A
11/12/1997	29	A
11/13/1997	59	A
11/14/1997	106	A
11/15/1997	107	A
11/16/1997	100	A
11/17/1997	86	A
11/18/1997	58	A
11/19/1997	40	A
11/20/1997	31	A
11/21/1997	27	A
11/22/1997	25	A
11/23/1997	23	A
11/24/1997	23	A
11/25/1997	22	A
11/26/1997	18	A
11/27/1997	18	A
11/28/1997	25	A
11/29/1997	173	A
11/30/1997	307	A
12/1/1997	249	A
12/2/1997	194	A
12/3/1997	210	A
12/4/1997	237	A
12/5/1997	160	A
12/6/1997	94	A
12/7/1997	75	A
12/8/1997	144	A
12/9/1997	276	A
12/10/1997	245	A
12/11/1997	202	A
12/12/1997	177	A
12/13/1997	111	A
12/14/1997	64	A
12/15/1997	49	A

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Date	Flow (cfs)	Qualification
	All	Code
12/16/1997	41	A
12/17/1997	36	A
12/18/1997	35	A
12/19/1997	33	A
12/20/1997	29	A
12/21/1997	163	A
12/22/1997	391	A
12/23/1997	442	A
12/24/1997	1030	A
12/25/1997	1680	A
12/26/1997	1260	A
12/27/1997	1220	A
12/28/1997	753	A
12/29/1997	415	A
12/30/1997	222	A
12/31/1997	109	A
1/1/1998	73	A
1/2/1998	58	A
1/3/1998	52	A
1/4/1998	51	A
1/5/1998	65	A
1/6/1998	262	A
1/7/1998	1100	A
1/8/1998	1600	A
1/9/1998	1850	A
1/10/1998	1590	A
1/11/1998	960	A
1/12/1998	768	A
1/13/1998	723	A
1/14/1998	637	A
1/15/1998	990	A
1/16/1998	776	A
1/17/1998	532	A
1/18/1998	390	A
1/19/1998	324	A
1/20/1998	257	A
1/21/1998	181	A
1/22/1998	267	A
1/23/1998	417	A
1/24/1998	490	A
1/25/1998	617	A

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Date	Flow (cfs)	Qualification
	All	Code
1/26/1998	669	A
1/27/1998	561	A
1/28/1998	432	A
1/29/1998	402	A
1/30/1998	472	A
1/31/1998	410	A
2/1/1998	270	A
2/2/1998	247	A
2/3/1998	249	A
2/4/1998	233	A
2/5/1998	246	A
2/6/1998	207	A
2/7/1998	136	A
2/8/1998	100	A
2/9/1998	84	A
2/10/1998	81	A
2/11/1998	154	A
2/12/1998	198	A
2/13/1998	198	A
2/14/1998	230	A
2/15/1998	231	A
2/16/1998	361	A
2/17/1998	560	A
2/18/1998	666	A
2/19/1998	763	A
2/20/1998	725	A
2/21/1998	566	A
2/22/1998	431	A
2/23/1998	390	A
2/24/1998	339	A
2/25/1998	310	A
2/26/1998	391	A
2/27/1998	589	A
2/28/1998	580	A
3/1/1998	643	A
3/2/1998	699	A
3/3/1998	514	A
3/4/1998	306	A
3/5/1998	166	A
3/6/1998	156	A
3/7/1998	314	A

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P = Provisional data subject to revision.
e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
3/8/1998	1220	A
3/9/1998	1300	A
3/10/1998	1540	A
3/11/1998	1300	A
3/12/1998	745	A
3/13/1998	465	A
3/14/1998	283	A
3/15/1998	181	A
3/16/1998	209	A
3/17/1998	786	A
3/18/1998	1130	A
3/19/1998	1750	A
3/20/1998	1250	A
3/21/1998	726	A
3/22/1998	485	A
3/23/1998	327	A
3/24/1998	205	A
3/25/1998	154	A
3/26/1998	132	A
3/27/1998	125	A
3/28/1998	116	A
3/29/1998	105	A
3/30/1998	95	A
3/31/1998	118	A
4/1/1998	210	A
4/2/1998	243	A
4/3/1998	287	A
4/4/1998	262	A
4/5/1998	162	A
4/6/1998	109	A
4/7/1998	89	A
4/8/1998	79	A
4/9/1998	91	A
4/10/1998	95	A
4/11/1998	95	A
4/12/1998	83	A
4/13/1998	71	A
4/14/1998	63	A
4/15/1998	61	A
4/16/1998	57	A
4/17/1998	60	A

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Date	Flow (cfs)	Qualification
	All	Code
4/18/1998	58	A
4/19/1998	101	A
4/20/1998	107	A
4/21/1998	100	A
4/22/1998	81	A
4/23/1998	66	A
4/24/1998	58	A
4/25/1998	49	A
4/26/1998	44	A
4/27/1998	77	A
4/28/1998	621	A
4/29/1998	520	A
4/30/1998	195	A
5/1/1998	91	A
5/2/1998	61	A
5/3/1998	59	A
5/4/1998	64	A
5/5/1998	65	A
5/6/1998	70	A
5/7/1998	52	A
5/8/1998	46	A
5/9/1998	41	A
5/10/1998	37	A
5/11/1998	38	A
5/12/1998	37	A
5/13/1998	30	A
5/14/1998	27	A
5/15/1998	27	A
5/16/1998	27	A
5/17/1998	26	A
5/18/1998	24	A
5/19/1998	22	A
5/20/1998	22	A
5/21/1998	21	A
5/22/1998	20	A
5/23/1998	19	A
5/24/1998	16	A
5/25/1998	17	A
5/26/1998	18	A
5/27/1998	24	A
5/28/1998	29	A

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Date	Flow (cfs)	Qualification
	All	Code
5/29/1998	28	A
5/30/1998	30	A
5/31/1998	35	A
6/1/1998	30	A
6/2/1998	26	A
6/3/1998	22	A
6/4/1998	19	A
6/5/1998	18	A
6/6/1998	18	A
6/7/1998	19	A
6/8/1998	25	A
6/9/1998	26	A
6/10/1998	24	A
6/11/1998	16	Ae
6/12/1998	6.5	Ae
6/13/1998	3	Ae
6/14/1998	1.6	Ae
6/15/1998	2.3	Ae
6/16/1998	3.8	Ae
6/17/1998	4.2	Ae
6/18/1998	2.8	Ae
6/19/1998	3.6	Ae
6/20/1998	2.5	Ae
6/21/1998	1.7	Ae
6/22/1998	1.1	Ae
6/23/1998	0.7	Ae
6/24/1998	1.1	Ae
6/25/1998	2	Ae
6/26/1998	1.3	Ae
6/27/1998	1	Ae
6/28/1998	0.7	Ae
6/29/1998	0.5	Ae
6/30/1998	0.39	Ae
7/1/1998	0.3	Ae
7/2/1998	0.25	Ae
7/3/1998	0.23	Ae
7/4/1998	0.2	Ae
7/5/1998	0.3	Ae
7/6/1998	0.2	Ae
7/7/1998	0.1	Ae
7/8/1998	NA	A

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P = Provisional data subject to revision.
e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
7/9/1998	NA	A
7/10/1998	0.1	Ae
7/11/1998	0.25	Ae
7/12/1998	NA	A
7/13/1998	NA	A
7/14/1998	NA	A
7/15/1998	NA	A
7/16/1998	NA	A
7/17/1998	NA	A
7/18/1998	NA	A
7/19/1998	NA	A
7/20/1998	NA	A
7/21/1998	NA	A
7/22/1998	NA	A
7/23/1998	NA	A
7/24/1998	0.85	Ae
7/25/1998	25	A
7/26/1998	29	A
7/27/1998	22	A
7/28/1998	15	A
7/29/1998	14	A
7/30/1998	19	A
7/31/1998	20	A
8/1/1998	14	A
8/2/1998	9.1	A
8/3/1998	6.5	A
8/4/1998	9.2	A
8/5/1998	21	A
8/6/1998	26	A
8/7/1998	28	A
8/8/1998	24	A
8/9/1998	22	A
8/10/1998	20	A
8/11/1998	19	A
8/12/1998	26	A
8/13/1998	64	A
8/14/1998	99	A
8/15/1998	184	A
8/16/1998	272	A
8/17/1998	165	A
8/18/1998	73	A

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P = Provisional data subject to revision.
e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
8/19/1998	43	A
8/20/1998	32	A
8/21/1998	26	A
8/22/1998	25	A
8/23/1998	24	A
8/24/1998	22	A
8/25/1998	21	A
8/26/1998	21	A
8/27/1998	21	A
8/28/1998	20	A
8/29/1998	19	A
8/30/1998	19	A
8/31/1998	18	A
9/1/1998	17	A
9/2/1998	17	A
9/3/1998	17	A
9/4/1998	16	A
9/5/1998	16	A
9/6/1998	15	A
9/7/1998	14	A
9/8/1998	12	A
9/9/1998	6.8	A
9/10/1998	7.1	A
9/11/1998	8.3	A
9/12/1998	30	A
9/13/1998	135	A
9/14/1998	167	A
9/15/1998	203	A
9/16/1998	292	A
9/17/1998	282	A
9/18/1998	255	A
9/19/1998	177	A
9/20/1998	77	A
9/21/1998	43	A
9/22/1998	35	A
9/23/1998	30	A
9/24/1998	27	A
9/25/1998	26	A
9/26/1998	25	A
9/27/1998	24	A
9/28/1998	22	A

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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
9/29/1998	21	A
9/30/1998	20	A
10/1/1998	21	A
10/2/1998	20	A
10/3/1998	21	A
10/4/1998	27	A
10/5/1998	38	A
10/6/1998	42	A
10/7/1998	94	A
10/8/1998	82	A
10/9/1998	86	A
10/10/1998	106	A
10/11/1998	86	A
10/12/1998	51	A
10/13/1998	37	A
10/14/1998	32	A
10/15/1998	29	A
10/16/1998	27	A
10/17/1998	25	A
10/18/1998	26	A
10/19/1998	26	A
10/20/1998	29	A
10/21/1998	32	A
10/22/1998	32	A
10/23/1998	33	A
10/24/1998	31	A
10/25/1998	29	A
10/26/1998	27	A
10/27/1998	27	A
10/28/1998	27	A
10/29/1998	27	A
10/30/1998	27	A
10/31/1998	27	A
11/1/1998	28	A
11/2/1998	43	A
11/3/1998	44	A
11/4/1998	38	A
11/5/1998	37	A
11/6/1998	35	A
11/7/1998	34	A
11/8/1998	40	A

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Date	Flow (cfs)	Qualification
	All	Code
11/9/1998	47	A
11/10/1998	49	A
11/11/1998	52	A
11/12/1998	54	A
11/13/1998	86	A
11/14/1998	145	A
11/15/1998	212	A
11/16/1998	151	A
11/17/1998	120	A
11/18/1998	105	A
11/19/1998	91	A
11/20/1998	119	A
11/21/1998	188	A
11/22/1998	148	A
11/23/1998	95	A
11/24/1998	75	A
11/25/1998	64	A
11/26/1998	55	A
11/27/1998	55	A
11/28/1998	53	A
11/29/1998	48	A
11/30/1998	54	A
12/1/1998	97	A
12/2/1998	81	A
12/3/1998	68	A
12/4/1998	65	A
12/5/1998	68	A
12/6/1998	70	A
12/7/1998	69	A
12/8/1998	276	A
12/9/1998	378	A
12/10/1998	323	A
12/11/1998	503	A
12/12/1998	806	A
12/13/1998	858	A
12/14/1998	1020	A
12/15/1998	862	A
12/16/1998	676	A
12/17/1998	510	A
12/18/1998	343	A
12/19/1998	242	A

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Date	Flow (cfs)	Qualification
	All	Code
12/20/1998	247	A
12/21/1998	243	A
12/22/1998	392	A
12/23/1998	683	A
12/24/1998	753	A
12/25/1998	766	A
12/26/1998	690	A
12/27/1998	589	A
12/28/1998	501	A
12/29/1998	419	A
12/30/1998	338	A
12/31/1998	265	A
1/1/1999	259	A
1/2/1999	1860	A
1/3/1999	2890	A
1/4/1999	2600	A
1/5/1999	1640	A
1/6/1999	908	A
1/7/1999	636	A
1/8/1999	488	A
1/9/1999	406	A
1/10/1999	379	A
1/11/1999	374	A
1/12/1999	363	A
1/13/1999	300	A
1/14/1999	226	A
1/15/1999	175	A
1/16/1999	159	A
1/17/1999	142	A
1/18/1999	128	A
1/19/1999	115	A
1/20/1999	108	A
1/21/1999	117	A
1/22/1999	409	A
1/23/1999	1300	A
1/24/1999	972	A
1/25/1999	814	A
1/26/1999	661	A
1/27/1999	521	A
1/28/1999	369	A
1/29/1999	1760	A

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Date	Flow (cfs)	Qualification
	All	Code
1/30/1999	5100	A
1/31/1999	6790	A
2/1/1999	4170	A
2/2/1999	2270	A
2/3/1999	1190	A
2/4/1999	773	A
2/5/1999	562	A
2/6/1999	418	A
2/7/1999	316	A
2/8/1999	245	A
2/9/1999	220	A
2/10/1999	218	A
2/11/1999	208	A
2/12/1999	231	A
2/13/1999	261	A
2/14/1999	212	A
2/15/1999	190	A
2/16/1999	171	A
2/17/1999	152	A
2/18/1999	144	A
2/19/1999	135	A
2/20/1999	122	A
2/21/1999	114	A
2/22/1999	106	A
2/23/1999	99	A
2/24/1999	95	A
2/25/1999	90	A
2/26/1999	89	A
2/27/1999	91	A
2/28/1999	86	A
3/1/1999	90	A
3/2/1999	94	A
3/3/1999	170	A
3/4/1999	150	A
3/5/1999	114	A
3/6/1999	97	A
3/7/1999	86	A
3/8/1999	80	A
3/9/1999	103	A
3/10/1999	137	A
3/11/1999	151	A

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Date	Flow (cfs)	Qualification
	All	Code
3/12/1999	142	A
3/13/1999	548	A
3/14/1999	944	A
3/15/1999	1170	A
3/16/1999	1320	A
3/17/1999	911	A
3/18/1999	595	A
3/19/1999	388	A
3/20/1999	227	A
3/21/1999	163	A
3/22/1999	141	A
3/23/1999	134	A
3/24/1999	130	A
3/25/1999	152	A
3/26/1999	189	A
3/27/1999	176	A
3/28/1999	164	A
3/29/1999	151	Ae
3/30/1999	143	Ae
3/31/1999	183	Ae
4/1/1999	198	Ae
4/2/1999	190	Ae
4/3/1999	179	Ae
4/4/1999	750	Ae
4/5/1999	3100	Ae
4/6/1999	3670	A
4/7/1999	2380	A
4/8/1999	1450	A
4/9/1999	847	A
4/10/1999	553	A
4/11/1999	352	A
4/12/1999	188	A
4/13/1999	122	A
4/14/1999	99	A
4/15/1999	120	A
4/16/1999	155	A
4/17/1999	174	A
4/18/1999	151	A
4/19/1999	105	A
4/20/1999	79	A
4/21/1999	67	A

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Date	Flow (cfs)	Qualification
	All	Code
4/22/1999	60	A
4/23/1999	54	A
4/24/1999	50	A
4/25/1999	48	A
4/26/1999	47	A
4/27/1999	61	A
4/28/1999	62	A
4/29/1999	56	A
4/30/1999	52	A
5/1/1999	43	A
5/2/1999	39	A
5/3/1999	37	A
5/4/1999	37	A
5/5/1999	53	A
5/6/1999	54	A
5/7/1999	45	A
5/8/1999	55	A
5/9/1999	51	A
5/10/1999	41	A
5/11/1999	37	A
5/12/1999	35	A
5/13/1999	42	A
5/14/1999	40	A
5/15/1999	36	A
5/16/1999	33	A
5/17/1999	29	A
5/18/1999	45	A
5/19/1999	79	A
5/20/1999	74	A
5/21/1999	57	A
5/22/1999	42	A
5/23/1999	35	A
5/24/1999	32	A
5/25/1999	30	A
5/26/1999	35	A
5/27/1999	33	A
5/28/1999	29	A
5/29/1999	26	A
5/30/1999	26	A
5/31/1999	36	A
6/1/1999	72	A

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Date	Flow (cfs)	Qualification
	All	Code
6/2/1999	69	A
6/3/1999	74	A
6/4/1999	52	A
6/5/1999	40	A
6/6/1999	33	A
6/7/1999	28	A
6/8/1999	25	A
6/9/1999	23	A
6/10/1999	21	A
6/11/1999	20	A
6/12/1999	19	A
6/13/1999	23	A
6/14/1999	37	A
6/15/1999	33	A
6/16/1999	31	A
6/17/1999	24	A
6/18/1999	20	A
6/19/1999	18	A
6/20/1999	16	A
6/21/1999	15	A
6/22/1999	15	A
6/23/1999	16	A
6/24/1999	23	A
6/25/1999	93	A
6/26/1999	369	A
6/27/1999	561	A
6/28/1999	677	A
6/29/1999	655	A
6/30/1999	513	A
7/1/1999	257	A
7/2/1999	63	A
7/3/1999	37	A
7/4/1999	28	A
7/5/1999	23	A
7/6/1999	19	A
7/7/1999	17	A
7/8/1999	16	A
7/9/1999	17	A
7/10/1999	15	A
7/11/1999	22	A
7/12/1999	57	A

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Date	Flow (cfs)	Qualification
	All	Code
7/13/1999	72	A
7/14/1999	72	A
7/15/1999	44	A
7/16/1999	30	A
7/17/1999	23	A
7/18/1999	19	A
7/19/1999	16	A
7/20/1999	14	A
7/21/1999	12	A
7/22/1999	10	A
7/23/1999	8.9	A
7/24/1999	8	A
7/25/1999	8.6	A
7/26/1999	12	A
7/27/1999	16	A
7/28/1999	11	A
7/29/1999	8.6	A
7/30/1999	7.7	A
7/31/1999	6.8	A
8/1/1999	5.4	A
8/2/1999	4.7	A
8/3/1999	4.1	A
8/4/1999	3.6	A
8/5/1999	3.3	A
8/6/1999	3.3	A
8/7/1999	4	A
8/8/1999	4	A
8/9/1999	3.6	A
8/10/1999	3.1	A
8/11/1999	2.6	A
8/12/1999	2.3	A
8/13/1999	1.9	A
8/14/1999	1.6	A
8/15/1999	1.5	A
8/16/1999	1.4	A
8/17/1999	1.3	A
8/18/1999	1.2	A
8/19/1999	1.1	A
8/20/1999	1	A
8/21/1999	0.94	A
8/22/1999	0.83	A

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Date	Flow (cfs)	Qualification
	All	Code
8/23/1999	0.79	A
8/24/1999	0.76	A
8/25/1999	0.73	A
8/26/1999	0.68	A
8/27/1999	0.96	A
8/28/1999	0.88	A
8/29/1999	0.76	A
8/30/1999	0.85	A
8/31/1999	1.1	A
9/1/1999	1.2	A
9/2/1999	1.3	A
9/3/1999	1	A
9/4/1999	1.4	A
9/5/1999	1.4	A
9/6/1999	1.3	A
9/7/1999	1	A
9/8/1999	1.9	A
9/9/1999	5.2	A
9/10/1999	4.4	A
9/11/1999	2.9	A
9/12/1999	2.1	A
9/13/1999	1.6	A
9/14/1999	1.4	A
9/15/1999	1.1	A
9/16/1999	0.78	A
9/17/1999	0.67	A
9/18/1999	0.65	A
9/19/1999	0.52	A
9/20/1999	0.55	A
9/21/1999	0.46	A
9/22/1999	0.41	A
9/23/1999	0.4	A
9/24/1999	0.25	A
9/25/1999	0.19	A
9/26/1999	0.18	A
9/27/1999	0.18	A
9/28/1999	0.18	A
9/29/1999	0.18	A
9/30/1999	0.15	A
10/1/1999	0.13	A
10/2/1999	0.12	A

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Date	Flow (cfs)	Qualification
	All	Code
10/3/1999	0.1	A
10/4/1999	0.09	A
10/5/1999	0.07	A
10/6/1999	0.06	A
10/7/1999	0.07	A
10/8/1999	0.12	A
10/9/1999	0.21	A
10/10/1999	6.2	A
10/11/1999	8.2	A
10/12/1999	6.5	A
10/13/1999	5.3	A
10/14/1999	4.9	A
10/15/1999	6.7	A
10/16/1999	7.9	A
10/17/1999	8.2	A
10/18/1999	7.5	A
10/19/1999	6.5	A
10/20/1999	6.8	A
10/21/1999	7.1	A
10/22/1999	8.1	A
10/23/1999	9.6	A
10/24/1999	9.7	A
10/25/1999	9.6	A
10/26/1999	9.6	A
10/27/1999	10	A
10/28/1999	11	A
10/29/1999	11	A
10/30/1999	11	A
10/31/1999	13	A
11/1/1999	18	A
11/2/1999	20	A
11/3/1999	20	A
11/4/1999	19	A
11/5/1999	20	A
11/6/1999	20	A
11/7/1999	18	A
11/8/1999	18	A
11/9/1999	20	A
11/10/1999	20	A
11/11/1999	21	A
11/12/1999	22	A

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Date	Flow (cfs)	Qualification
	All	Code
11/13/1999	24	A
11/14/1999	24	A
11/15/1999	24	A
11/16/1999	24	A
11/17/1999	23	A
11/18/1999	23	A
11/19/1999	24	A
11/20/1999	26	A
11/21/1999	30	A
11/22/1999	26	A
11/23/1999	23	A
11/24/1999	27	A
11/25/1999	16	A
11/26/1999	18	A
11/27/1999	16	A
11/28/1999	13	A
11/29/1999	15	A
11/30/1999	17	A
12/1/1999	18	A
12/2/1999	20	A
12/3/1999	23	A
12/4/1999	27	A
12/5/1999	51	A
12/6/1999	63	A
12/7/1999	48	A
12/8/1999	37	A
12/9/1999	30	A
12/10/1999	33	A
12/11/1999	35	A
12/12/1999	36	A
12/13/1999	70	A
12/14/1999	76	A
12/15/1999	67	A
12/16/1999	51	A
12/17/1999	38	A
12/18/1999	32	A
12/19/1999	28	A
12/20/1999	26	A
12/21/1999	24	A
12/22/1999	22	A
12/23/1999	22	A

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Date	Flow (cfs)	Qualification
	All	Code
12/24/1999	22	A
12/25/1999	24	A
12/26/1999	23	A
12/27/1999	22	A
12/28/1999	21	A
12/29/1999	21	A
12/30/1999	22	A
12/31/1999	22	A
1/1/2000	21	A
1/2/2000	22	A
1/3/2000	22	A
1/4/2000	22	A
1/5/2000	21	A
1/6/2000	20	A
1/7/2000	23	A
1/8/2000	38	A
1/9/2000	79	A
1/10/2000	70	A
1/11/2000	60	A
1/12/2000	46	A
1/13/2000	37	A
1/14/2000	30	A
1/15/2000	28	A
1/16/2000	28	A
1/17/2000	26	A
1/18/2000	25	A
1/19/2000	25	A
1/20/2000	26	A
1/21/2000	25	A
1/22/2000	23	A
1/23/2000	23	A
1/24/2000	23	A
1/25/2000	21	A
1/26/2000	21	A
1/27/2000	23	A
1/28/2000	43	A
1/29/2000	62	A
1/30/2000	64	A
1/31/2000	69	A
2/1/2000	69	A
2/2/2000	68	A

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Date	Flow (cfs)	Qualification
	All	Code
2/3/2000	65	A
2/4/2000	62	A
2/5/2000	58	A
2/6/2000	54	A
2/7/2000	48	A
2/8/2000	42	A
2/9/2000	38	A
2/10/2000	35	A
2/11/2000	32	A
2/12/2000	30	A
2/13/2000	28	A
2/14/2000	27	A
2/15/2000	25	A
2/16/2000	25	A
2/17/2000	25	A
2/18/2000	25	A
2/19/2000	30	A
2/20/2000	35	A
2/21/2000	32	A
2/22/2000	29	A
2/23/2000	28	A
2/24/2000	27	A
2/25/2000	26	A
2/26/2000	31	A
2/27/2000	72	A
2/28/2000	109	A
2/29/2000	142	A
3/1/2000	128	A
3/2/2000	71	A
3/3/2000	45	A
3/4/2000	36	A
3/5/2000	31	A
3/6/2000	29	A
3/7/2000	27	A
3/8/2000	25	A
3/9/2000	24	A
3/10/2000	28	A
3/11/2000	118	A
3/12/2000	214	A
3/13/2000	198	A
3/14/2000	123	A

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Date	Flow (cfs)	Qualification
	All	Code
3/15/2000	70	A
3/16/2000	141	A
3/17/2000	251	A
3/18/2000	252	A
3/19/2000	336	A
3/20/2000	371	A
3/21/2000	261	A
3/22/2000	170	A
3/23/2000	145	A
3/24/2000	84	A
3/25/2000	58	A
3/26/2000	56	A
3/27/2000	88	A
3/28/2000	144	A
3/29/2000	173	A
3/30/2000	294	A
3/31/2000	347	A
4/1/2000	321	A
4/2/2000	1150	A
4/3/2000	1980	A
4/4/2000	1190	A
4/5/2000	952	A
4/6/2000	868	A
4/7/2000	702	A
4/8/2000	526	A
4/9/2000	335	A
4/10/2000	155	A
4/11/2000	91	A
4/12/2000	115	A
4/13/2000	203	A
4/14/2000	214	A
4/15/2000	189	A
4/16/2000	154	A
4/17/2000	104	A
4/18/2000	72	A
4/19/2000	55	A
4/20/2000	44	A
4/21/2000	38	A
4/22/2000	30	A
4/23/2000	28	A
4/24/2000	25	A

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Date	Flow (cfs)	Qualification
	All	Code
4/25/2000	27	A
4/26/2000	38	A
4/27/2000	67	A
4/28/2000	56	A
4/29/2000	38	A
4/30/2000	28	A
5/1/2000	24	A
5/2/2000	22	A
5/3/2000	22	A
5/4/2000	79	A
5/5/2000	316	A
5/6/2000	491	A
5/7/2000	688	A
5/8/2000	668	A
5/9/2000	537	A
5/10/2000	430	A
5/11/2000	259	A
5/12/2000	73	A
5/13/2000	80	A
5/14/2000	148	A
5/15/2000	151	A
5/16/2000	147	A
5/17/2000	94	A
5/18/2000	51	A
5/19/2000	60	A
5/20/2000	437	A
5/21/2000	924	A
5/22/2000	912	A
5/23/2000	790	A
5/24/2000	599	A
5/25/2000	347	A
5/26/2000	85	A
5/27/2000	45	A
5/28/2000	62	A
5/29/2000	141	A
5/30/2000	197	A
5/31/2000	251	A
6/1/2000	123	A
6/2/2000	44	A
6/3/2000	30	A
6/4/2000	26	A

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e = Value has been estimated.

Date	Flow (cfs)	Qualification
	All	Code
6/5/2000	56	A
6/6/2000	94	A
6/7/2000	85	A
6/8/2000	53	A
6/9/2000	35	A
6/10/2000	27	A
6/11/2000	24	A
6/12/2000	21	A
6/13/2000	17	A
6/14/2000	14	A
6/15/2000	12	A
6/16/2000	11	A
6/17/2000	13	A
6/18/2000	38	A
6/19/2000	62	A
6/20/2000	50	A
6/21/2000	48	A
6/22/2000	76	A
6/23/2000	144	A
6/24/2000	92	A
6/25/2000	45	A
6/26/2000	28	A
6/27/2000	21	A
6/28/2000	21	A
6/29/2000	32	A
6/30/2000	50	A
7/1/2000	48	A
7/2/2000	38	A
7/3/2000	33	A
7/4/2000	35	A
7/5/2000	26	A
7/6/2000	19	A
7/7/2000	14	A
7/8/2000	12	A
7/9/2000	9.5	A
7/10/2000	8.1	A
7/11/2000	7.3	A
7/12/2000	7.8	A
7/13/2000	8.8	A
7/14/2000	9.4	A
7/15/2000	19	A

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Date	Flow (cfs)	Qualification
	All	Code
7/16/2000	22	A
7/17/2000	16	A
7/18/2000	12	A
7/19/2000	9.3	A
7/20/2000	7.5	A
7/21/2000	6	A
7/22/2000	4.6	A
7/23/2000	3	A
7/24/2000	2.4	A
7/25/2000	1.8	A
7/26/2000	1.9	A
7/27/2000	1.3	A
7/28/2000	1.1	A
7/29/2000	0.99	A
7/30/2000	1.7	A
7/31/2000	3	A
8/1/2000	9	A
8/2/2000	8.9	A
8/3/2000	7.3	A
8/4/2000	5.4	A
8/5/2000	3.5	A
8/6/2000	2.4	A
8/7/2000	1.7	A
8/8/2000	1.4	A
8/9/2000	0.89	A
8/10/2000	0.77	A
8/11/2000	0.78	A
8/12/2000	0.74	A
8/13/2000	0.65	A
8/14/2000	0.54	A
8/15/2000	0.46	A
8/16/2000	0.41	A
8/17/2000	0.43	A
8/18/2000	0.36	A
8/19/2000	0.32	A
8/20/2000	0.29	A
8/21/2000	0.23	A
8/22/2000	0.18	A
8/23/2000	0.13	A
8/24/2000	0.08	A
8/25/2000	0.04	A

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Date	Flow (cfs)	Qualification
	All	Code
8/26/2000	0.03	A
8/27/2000	0.02	A
8/28/2000	0.01	A
8/29/2000	0.01	A
8/30/2000	NA	A
8/31/2000	NA	A
9/1/2000	NA	A
9/2/2000	NA	A
9/3/2000	NA	A
9/4/2000	NA	A
9/5/2000	NA	A
9/6/2000	NA	A
9/7/2000	NA	A
9/8/2000	NA	A
9/9/2000	NA	A
9/10/2000	NA	A
9/11/2000	NA	A
9/12/2000	NA	A
9/13/2000	NA	A
9/14/2000	NA	A
9/15/2000	NA	A
9/16/2000	NA	A
9/17/2000	NA	A
9/18/2000	NA	A
9/19/2000	NA	A
9/20/2000	NA	A
9/21/2000	NA	A
9/22/2000	NA	A
9/23/2000	NA	A
9/24/2000	NA	A
9/25/2000	NA	A
9/26/2000	NA	A
9/27/2000	NA	A
9/28/2000	NA	A
9/29/2000	NA	A
9/30/2000	NA	A
10/1/2000	NA	A
10/2/2000	NA	A
10/3/2000	NA	A
10/4/2000	NA	A
10/5/2000	NA	A

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Date	Flow (cfs)	Qualification
	All	Code
10/6/2000	NA	A
10/7/2000	NA	A
10/8/2000	NA	A
10/9/2000	0.88	A
10/10/2000	1.1	A
10/11/2000	0.53	A
10/12/2000	0.37	A
10/13/2000	0.34	A
10/14/2000	0.4	A
10/15/2000	0.38	A
10/16/2000	0.24	A
10/17/2000	0.19	A
10/18/2000	0.05	A
10/19/2000	0.02	A
10/20/2000	0.01	A
10/21/2000	NA	A
10/22/2000	NA	A
10/23/2000	NA	A
10/24/2000	NA	A
10/25/2000	NA	A
10/26/2000	NA	A
10/27/2000	NA	A
10/28/2000	NA	A
10/29/2000	NA	A
10/30/2000	NA	A
10/31/2000	NA	A
11/1/2000	NA	A
11/2/2000	1.2	A
11/3/2000	2.1	A
11/4/2000	11	A
11/5/2000	23	A
11/6/2000	22	A
11/7/2000	19	A
11/8/2000	52	A
11/9/2000	90	A
11/10/2000	60	A
11/11/2000	46	A
11/12/2000	39	A
11/13/2000	34	A
11/14/2000	34	A
11/15/2000	30	A

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Date	Flow (cfs)	Qualification
	All	Code
11/16/2000	28	A
11/17/2000	32	A
11/18/2000	31	A
11/19/2000	29	A
11/20/2000	29	A
11/21/2000	27	A
11/22/2000	24	A
11/23/2000	24	A
11/24/2000	484	A
11/25/2000	1050	A
11/26/2000	834	A
11/27/2000	620	A
11/28/2000	709	A
11/29/2000	643	A
11/30/2000	427	A
12/1/2000	188	A
12/2/2000	88	A
12/3/2000	66	A
12/4/2000	54	A
12/5/2000	46	A
12/6/2000	41	A
12/7/2000	38	A
12/8/2000	36	A
12/9/2000	35	A
12/10/2000	33	A
12/11/2000	33	A
12/12/2000	33	A
12/13/2000	59	A
12/14/2000	235	A
12/15/2000	352	A
12/16/2000	728	A
12/17/2000	1060	A
12/18/2000	985	A
12/19/2000	761	A
12/20/2000	612	A
12/21/2000	509	A
12/22/2000	354	A
12/23/2000	165	A
12/24/2000	93	A
12/25/2000	81	A
12/26/2000	113	A

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Date	Flow (cfs)	Qualification
	All	Code
12/27/2000	1550	A
12/28/2000	3390	A
12/29/2000	3540	A
12/30/2000	2770	A
12/31/2000	1570	A
1/1/2001	935	A
1/2/2001	629	A
1/3/2001	439	A
1/4/2001	292	A
1/5/2001	211	A
1/6/2001	164	A
1/7/2001	143	A
1/8/2001	131	A
1/9/2001	115	A
1/10/2001	100	A
1/11/2001	104	A
1/12/2001	140	A
1/13/2001	152	A
1/14/2001	170	A
1/15/2001	177	A
1/16/2001	165	A
1/17/2001	299	A
1/18/2001	1600	A
1/19/2001	3580	A
1/20/2001	3920	A
1/21/2001	2530	A
1/22/2001	1540	A
1/23/2001	955	A
1/24/2001	676	A
1/25/2001	504	A
1/26/2001	366	A
1/27/2001	254	A
1/28/2001	178	A
1/29/2001	286	A
1/30/2001	586	A
1/31/2001	600	A
2/1/2001	559	A
2/2/2001	575	A
2/3/2001	563	A
2/4/2001	438	A
2/5/2001	276	A

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Date	Flow (cfs)	Qualification
	All	Code
2/6/2001	153	A
2/7/2001	110	A
2/8/2001	95	A
2/9/2001	91	A
2/10/2001	96	A
2/11/2001	108	A
2/12/2001	371	A
2/13/2001	742	A
2/14/2001	855	A
2/15/2001	1350	A
2/16/2001	2050	A
2/17/2001	3570	A
2/18/2001	4430	A
2/19/2001	2520	A
2/20/2001	1230	A
2/21/2001	771	A
2/22/2001	575	A
2/23/2001	445	A
2/24/2001	356	A
2/25/2001	302	A
2/26/2001	254	A
2/27/2001	340	A
2/28/2001	1850	A
3/1/2001	6370	A
3/2/2001	5250	A
3/3/2001	3250	A
3/4/2001	2680	A
3/5/2001	2120	A
3/6/2001	1430	A
3/7/2001	1020	A
3/8/2001	730	A
3/9/2001	599	A
3/10/2001	556	A
3/11/2001	469	A
3/12/2001	497	A
3/13/2001	790	A
3/14/2001	1240	A
3/15/2001	2180	A
3/16/2001	1830	A
3/17/2001	1240	A
3/18/2001	1140	A

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Date	Flow (cfs)	Qualification
	All	Code
3/19/2001	759	A
3/20/2001	536	A
3/21/2001	385	A
3/22/2001	266	A
3/23/2001	181	A
3/24/2001	166	A
3/25/2001	298	A
3/26/2001	340	A
3/27/2001	312	A
3/28/2001	329	A
3/29/2001	356	A
3/30/2001	398	A
3/31/2001	364	A
4/1/2001	360	A
4/2/2001	357	A
4/3/2001	353	A
4/4/2001	307	A
4/5/2001	218	A
4/6/2001	149	A
4/7/2001	116	A
4/8/2001	96	A
4/9/2001	81	A
4/10/2001	70	A
4/11/2001	61	A
4/12/2001	58	A
4/13/2001	132	A
4/14/2001	207	A
4/15/2001	239	A
4/16/2001	544	A
4/17/2001	711	A
4/18/2001	653	A
4/19/2001	522	A
4/20/2001	398	A
4/21/2001	223	A
4/22/2001	92	A
4/23/2001	66	A
4/24/2001	65	A
4/25/2001	59	A
4/26/2001	55	A
4/27/2001	46	A
4/28/2001	38	A

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Date	Flow (cfs)	Qualification
	All	Code
4/29/2001	32	A
4/30/2001	28	A
5/1/2001	27	A
5/2/2001	25	A
5/3/2001	23	A
5/4/2001	20	A
5/5/2001	19	A
5/6/2001	20	A
5/7/2001	165	A
5/8/2001	960	A
5/9/2001	1590	A
5/10/2001	1360	A
5/11/2001	978	A
5/12/2001	818	A
5/13/2001	347	A
5/14/2001	111	A
5/15/2001	50	A
5/16/2001	38	A
5/17/2001	32	A
5/18/2001	29	A
5/19/2001	28	A
5/20/2001	54	A
5/21/2001	180	A
5/22/2001	86	A
5/23/2001	35	A
5/24/2001	26	A
5/25/2001	22	A
5/26/2001	20	A
5/27/2001	17	A
5/28/2001	16	A
5/29/2001	17	A
5/30/2001	17	A
5/31/2001	47	A
6/1/2001	124	A
6/2/2001	151	A
6/3/2001	144	A
6/4/2001	165	A
6/5/2001	164	A
6/6/2001	91	A
6/7/2001	80	A
6/8/2001	94	A

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Date	Flow (cfs)	Qualification
	All	Code
6/9/2001	100	A
6/10/2001	202	A
6/11/2001	206	A
6/12/2001	86	A
6/13/2001	44	A
6/14/2001	31	A
6/15/2001	30	A
6/16/2001	41	A
6/17/2001	36	A
6/18/2001	29	A
6/19/2001	23	A
6/20/2001	18	A
6/21/2001	14	A
6/22/2001	12	A
6/23/2001	13	A
6/24/2001	18	A
6/25/2001	37	A
6/26/2001	30	A
6/27/2001	23	A
6/28/2001	26	A
6/29/2001	34	A
6/30/2001	50	A
7/1/2001	84	A
7/2/2001	59	A
7/3/2001	51	A
7/4/2001	49	A
7/5/2001	44	A
7/6/2001	28	A
7/7/2001	22	A
7/8/2001	17	A
7/9/2001	14	A
7/10/2001	12	A
7/11/2001	9.7	A
7/12/2001	7.9	A
7/13/2001	6.7	A
7/14/2001	6.5	A
7/15/2001	7.4	A
7/16/2001	6.5	A
7/17/2001	5.5	A
7/18/2001	4.9	A
7/19/2001	4.6	A

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Date	Flow (cfs)	Qualification
	All	Code
7/20/2001	4.2	A
7/21/2001	5.8	A
7/22/2001	5.9	A
7/23/2001	4.8	A
7/24/2001	3.5	A
7/25/2001	2.8	A
7/26/2001	2.4	A
7/27/2001	2.3	A
7/28/2001	2.3	A
7/29/2001	2.3	A
7/30/2001	2.3	A
7/31/2001	2.3	A
8/1/2001	2.1	A
8/2/2001	1.9	A
8/3/2001	2.8	A
8/4/2001	5.3	A
8/5/2001	5.2	A
8/6/2001	6.4	A
8/7/2001	5.1	A
8/8/2001	4	A
8/9/2001	3.1	A
8/10/2001	2.6	A
8/11/2001	2.3	A
8/12/2001	2	A
8/13/2001	1.9	A
8/14/2001	1.8	A
8/15/2001	3	A
8/16/2001	3.5	A
8/17/2001	3.2	A
8/18/2001	7.3	A
8/19/2001	11	A
8/20/2001	8	A
8/21/2001	5.4	A
8/22/2001	4.5	A
8/23/2001	3.7	A
8/24/2001	3.2	A
8/25/2001	2.8	A
8/26/2001	2.3	A
8/27/2001	1.9	A
8/28/2001	2	A
8/29/2001	2.6	A

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Date	Flow (cfs)	Qualification
	All	Code
8/30/2001	4.8	A
8/31/2001	13	A
9/1/2001	24	A
9/2/2001	37	A
9/3/2001	41	A
9/4/2001	43	A
9/5/2001	34	Ae
9/6/2001	26	Ae
9/7/2001	19	A
9/8/2001	12	A
9/9/2001	12	A
9/10/2001	20	A
9/11/2001	15	A
9/12/2001	11	A
9/13/2001	6	A
9/14/2001	5.4	A
9/15/2001	3.9	A
9/16/2001	3	A
9/17/2001	2.4	A
9/18/2001	2	A
9/19/2001	2.2	A
9/20/2001	2.4	A
9/21/2001	3.7	A
9/22/2001	6	A
9/23/2001	5.4	A
9/24/2001	4.1	A
9/25/2001	4.1	A
9/26/2001	3.5	A
9/27/2001	2.8	A
9/28/2001	2.2	A
9/29/2001	1.9	A
9/30/2001	2	A
10/1/2001	1.9	A
10/2/2001	2.4	A
10/3/2001	2.8	A
10/4/2001	2.8	A
10/5/2001	3	A
10/6/2001	5.4	A
10/7/2001	5.5	A
10/8/2001	5.3	A
10/9/2001	5.2	A

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Date	Flow (cfs)	Qualification
	All	Code
10/10/2001	4.7	A
10/11/2001	22	A
10/12/2001	64	A
10/13/2001	134	A
10/14/2001	238	A
10/15/2001	228	A
10/16/2001	207	A
10/17/2001	246	A
10/18/2001	298	A
10/19/2001	231	A
10/20/2001	61	A
10/21/2001	20	A
10/22/2001	14	A
10/23/2001	11	A
10/24/2001	9.6	A
10/25/2001	8.8	A
10/26/2001	9.9	A
10/27/2001	9	A
10/28/2001	8	A
10/29/2001	8.5	A
10/30/2001	8.6	A
10/31/2001	8.9	A
11/1/2001	11	A
11/2/2001	14	A
11/3/2001	17	A
11/4/2001	20	A
11/5/2001	21	A
11/6/2001	21	A
11/7/2001	22	A
11/8/2001	22	A
11/9/2001	22	A
11/10/2001	23	A
11/11/2001	24	A
11/12/2001	24	A
11/13/2001	25	A
11/14/2001	26	A
11/15/2001	26	A
11/16/2001	26	A
11/17/2001	25	A
11/18/2001	25	A
11/19/2001	26	A

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Date	Flow (cfs)	Qualification
	All	Code
11/20/2001	26	A
11/21/2001	27	A
11/22/2001	28	A
11/23/2001	28	A
11/24/2001	31	A
11/25/2001	35	A
11/26/2001	36	A
11/27/2001	67	A
11/28/2001	343	A
11/29/2001	2310	A
11/30/2001	2820	A
12/1/2001	2440	A
12/2/2001	2090	A
12/3/2001	1240	A
12/4/2001	709	A
12/5/2001	449	A
12/6/2001	257	A
12/7/2001	110	A
12/8/2001	96	A
12/9/2001	190	A
12/10/2001	239	A
12/11/2001	277	A
12/12/2001	2330	A
12/13/2001	5000	A
12/14/2001	5450	A
12/15/2001	4640	A
12/16/2001	3080	A
12/17/2001	2930	A
12/18/2001	1880	A
12/19/2001	2990	A
12/20/2001	1780	A
12/21/2001	677	A
12/22/2001	546	A
12/23/2001	372	A
12/24/2001	261	A
12/25/2001	191	A
12/26/2001	180	A
12/27/2001	200	A
12/28/2001	199	A
12/29/2001	139	A
12/30/2001	92	A

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Date	Flow (cfs)	Qualification
	All	Code
12/31/2001	75	A
1/1/2002	66	A
1/2/2002	60	A
1/3/2002	56	A
1/4/2002	54	A
1/5/2002	61	A
1/6/2002	156	A
1/7/2002	214	A
1/8/2002	225	A
1/9/2002	241	A
1/10/2002	236	A
1/11/2002	187	A
1/12/2002	113	A
1/13/2002	82	A
1/14/2002	69	A
1/15/2002	60	A
1/16/2002	55	A
1/17/2002	52	A
1/18/2002	54	A
1/19/2002	72	A
1/20/2002	169	A
1/21/2002	261	A
1/22/2002	372	A
1/23/2002	547	A
1/24/2002	578	A
1/25/2002	712	A
1/26/2002	1500	A
1/27/2002	1460	A
1/28/2002	1040	A
1/29/2002	630	A
1/30/2002	402	A
1/31/2002	273	A
2/1/2002	226	A
2/2/2002	207	A
2/3/2002	173	A
2/4/2002	126	A
2/5/2002	98	A
2/6/2002	189	A
2/7/2002	316	A
2/8/2002	336	A
2/9/2002	355	A

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Date	Flow (cfs)	Qualification
	All	Code
2/10/2002	376	A
2/11/2002	327	A
2/12/2002	220	A
2/13/2002	123	A
2/14/2002	84	A
2/15/2002	70	A
2/16/2002	63	A
2/17/2002	58	A
2/18/2002	55	A
2/19/2002	114	Ae
2/20/2002	201	Ae
2/21/2002	327	A
2/22/2002	328	A
2/23/2002	376	A
2/24/2002	397	A
2/25/2002	288	A
2/26/2002	144	A
2/27/2002	77	A
2/28/2002	60	A
3/1/2002	56	A
3/2/2002	66	A
3/3/2002	117	A
3/4/2002	116	A
3/5/2002	101	A
3/6/2002	80	A
3/7/2002	65	A
3/8/2002	58	A
3/9/2002	60	A
3/10/2002	74	A
3/11/2002	90	A
3/12/2002	407	A
3/13/2002	642	A
3/14/2002	1180	A
3/15/2002	998	A
3/16/2002	742	A
3/17/2002	487	A
3/18/2002	342	A
3/19/2002	270	A
3/20/2002	887	A
3/21/2002	2620	A
3/22/2002	1530	A

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Date	Flow (cfs)	Qualification
	All	Code
3/23/2002	1250	A
3/24/2002	896	A
3/25/2002	551	A
3/26/2002	390	A
3/27/2002	366	A
3/28/2002	411	A
3/29/2002	364	A
3/30/2002	323	A
3/31/2002	1120	A
4/1/2002	1440	A
4/2/2002	1710	A
4/3/2002	1460	A
4/4/2002	736	A
4/5/2002	432	A
4/6/2002	260	A
4/7/2002	138	A
4/8/2002	325	A
4/9/2002	762	A
4/10/2002	772	A
4/11/2002	944	A
4/12/2002	758	A
4/13/2002	470	A
4/14/2002	277	A
4/15/2002	145	A
4/16/2002	86	A
4/17/2002	67	A
4/18/2002	56	A
4/19/2002	49	A
4/20/2002	45	A
4/21/2002	42	A
4/22/2002	38	A
4/23/2002	36	A
4/24/2002	33	A
4/25/2002	31	A
4/26/2002	29	A
4/27/2002	31	A
4/28/2002	32	A
4/29/2002	33	A
4/30/2002	32	A
5/1/2002	29	A
5/2/2002	27	A

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Date	Flow (cfs)	Qualification
	All	Code
5/3/2002	25	A
5/4/2002	49	A
5/5/2002	76	A
5/6/2002	77	A
5/7/2002	62	A
5/8/2002	41	A
5/9/2002	31	A
5/10/2002	28	A
5/11/2002	26	A
5/12/2002	27	A
5/13/2002	30	A
5/14/2002	39	A
5/15/2002	33	A
5/16/2002	27	A
5/17/2002	25	A
5/18/2002	34	A
5/19/2002	38	A
5/20/2002	41	A
5/21/2002	29	A
5/22/2002	23	A
5/23/2002	19	A
5/24/2002	16	A
5/25/2002	16	A
5/26/2002	15	A
5/27/2002	17	A
5/28/2002	19	A
5/29/2002	28	A
5/30/2002	130	A
5/31/2002	200	A
6/1/2002	191	A
6/2/2002	161	A
6/3/2002	162	A
6/4/2002	83	A
6/5/2002	29	A
6/6/2002	22	A
6/7/2002	19	A
6/8/2002	21	A
6/9/2002	20	A
6/10/2002	19	A
6/11/2002	24	A
6/12/2002	23	A

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Date	Flow (cfs)	Qualification
	All	Code
6/13/2002	19	A
6/14/2002	17	A
6/15/2002	14	A
6/16/2002	12	Ae
6/17/2002	11	Ae
6/18/2002	15	A
6/19/2002	16	A
6/20/2002	16	A
6/21/2002	16	A
6/22/2002	16	A
6/23/2002	15	A
6/24/2002	14	A
6/25/2002	14	A
6/26/2002	17	A
6/27/2002	26	A
6/28/2002	26	A
6/29/2002	28	A
6/30/2002	26	A
7/1/2002	26	A
7/2/2002	25	A
7/3/2002	24	A
7/4/2002	26	A
7/5/2002	27	A
7/6/2002	26	A
7/7/2002	31	A
7/8/2002	27	A
7/9/2002	23	A
7/10/2002	20	A
7/11/2002	18	A
7/12/2002	18	A
7/13/2002	19	A
7/14/2002	27	A
7/15/2002	43	A
7/16/2002	54	A
7/17/2002	53	A
7/18/2002	39	A
7/19/2002	31	A
7/20/2002	37	A
7/21/2002	34	A
7/22/2002	26	A
7/23/2002	22	A

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Date	Flow (cfs)	Qualification
	All	Code
7/24/2002	19	A
7/25/2002	18	A
7/26/2002	18	A
7/27/2002	19	A
7/28/2002	19	A
7/29/2002	16	A
7/30/2002	15	A
7/31/2002	14	A
8/1/2002	13	A
8/2/2002	13	A
8/3/2002	13	A
8/4/2002	13	A
8/5/2002	12	A
8/6/2002	11	A
8/7/2002	10	A
8/8/2002	9.8	A
8/9/2002	9.2	A
8/10/2002	8.8	A
8/11/2002	8.5	A
8/12/2002	8.3	A
8/13/2002	8	A
8/14/2002	8.6	A
8/15/2002	9.6	A
8/16/2002	22	A
8/17/2002	85	A
8/18/2002	72	A
8/19/2002	31	A
8/20/2002	27	A
8/21/2002	18	A
8/22/2002	13	A
8/23/2002	10	A
8/24/2002	8.2	A
8/25/2002	7.4	A
8/26/2002	6.2	A
8/27/2002	6.3	A
8/28/2002	6.1	A
8/29/2002	5.5	A
8/30/2002	5	A
8/31/2002	4.7	A
9/1/2002	4.3	A
9/2/2002	3.9	A

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Date	Flow (cfs)	Qualification
	All	Code
9/3/2002	3.5	A
9/4/2002	3.4	A
9/5/2002	3.8	A
9/6/2002	4.3	A
9/7/2002	5.2	A
9/8/2002	6	A
9/9/2002	6.7	A
9/10/2002	6.9	A
9/11/2002	6.6	A
9/12/2002	6.1	A
9/13/2002	5.2	A
9/14/2002	4.4	A
9/15/2002	4.6	A
9/16/2002	6.9	A
9/17/2002	7	A
9/18/2002	6.5	A
9/19/2002	6.4	A
9/20/2002	6.9	A
9/21/2002	17	A
9/22/2002	15	A
9/23/2002	12	A
9/24/2002	9.9	Ae
9/25/2002	8.6	Ae
9/26/2002	8.5	Ae
9/27/2002	10	Ae
9/28/2002	15	Ae
9/29/2002	12	Ae
9/30/2002	10	Ae
10/1/2002	13	Ae
10/2/2002	12	Ae
10/3/2002	13	Ae
10/4/2002	25	Ae
10/5/2002	28	Ae
10/6/2002	21	Ae
10/7/2002	17	Ae
10/8/2002	16	Ae
10/9/2002	16	A
10/10/2002	17	Ae
10/11/2002	18	Ae
10/12/2002	18	Ae
10/13/2002	17	Ae

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Date	Flow (cfs)	Qualification
	All	Code
10/14/2002	14	Ae
10/15/2002	12	A
10/16/2002	10	A
10/17/2002	11	A
10/18/2002	9.9	A
10/19/2002	13	A
10/20/2002	27	A
10/21/2002	29	A
10/22/2002	25	A
10/23/2002	17	A
10/24/2002	13	A
10/25/2002	15	A
10/26/2002	23	A
10/27/2002	27	A
10/28/2002	37	A
10/29/2002	42	A
10/30/2002	48	A
10/31/2002	36	A
11/1/2002	25	A
11/2/2002	17	A
11/3/2002	15	A
11/4/2002	21	A
11/5/2002	84	A
11/6/2002	177	A
11/7/2002	194	A
11/8/2002	184	A
11/9/2002	164	A
11/10/2002	92	A
11/11/2002	48	A
11/12/2002	33	A
11/13/2002	27	A
11/14/2002	25	A
11/15/2002	26	A
11/16/2002	25	A
11/17/2002	26	A
11/18/2002	25	A
11/19/2002	25	A
11/20/2002	25	A
11/21/2002	25	A
11/22/2002	26	A
11/23/2002	26	A

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Date	Flow (cfs)	Qualification
	All	Code
11/24/2002	26	A
11/25/2002	27	A
11/26/2002	36	A
11/27/2002	69	A
11/28/2002	72	A
11/29/2002	74	A
11/30/2002	65	A
12/1/2002	47	A
12/2/2002	38	A
12/3/2002	33	A
12/4/2002	90	A
12/5/2002	213	A
12/6/2002	257	A
12/7/2002	257	A
12/8/2002	262	A
12/9/2002	226	A
12/10/2002	107	A
12/11/2002	54	A
12/12/2002	44	A
12/13/2002	69	A
12/14/2002	143	A
12/15/2002	162	A
12/16/2002	179	A
12/17/2002	163	A
12/18/2002	152	A
12/19/2002	435	A
12/20/2002	2280	A
12/21/2002	4320	A
12/22/2002	2420	A
12/23/2002	1400	A
12/24/2002	1800	A
12/25/2002	1570	A
12/26/2002	1330	A
12/27/2002	1350	A
12/28/2002	998	A
12/29/2002	637	A
12/30/2002	416	A
12/31/2002	444	A
1/1/2003	604	A
1/2/2003	639	A
1/3/2003	644	A

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Date	Flow (cfs)	Qualification
	All	Code
1/4/2003	908	A
1/5/2003	631	A
1/6/2003	406	A
1/7/2003	207	A
1/8/2003	108	A
1/9/2003	83	A
1/10/2003	74	A
1/11/2003	66	A
1/12/2003	60	A
1/13/2003	55	A
1/14/2003	53	A
1/15/2003	51	A
1/16/2003	50	A
1/17/2003	49	A
1/18/2003	47	A
1/19/2003	46	A
1/20/2003	46	A
1/21/2003	47	A
1/22/2003	48	A
1/23/2003	46	A
1/24/2003	43	A
1/25/2003	41	A
1/26/2003	41	A
1/27/2003	41	A
1/28/2003	41	A
1/29/2003	43	A
1/30/2003	50	A
1/31/2003	52	A
2/1/2003	51	A
2/2/2003	48	A
2/3/2003	48	A
2/4/2003	48	A
2/5/2003	47	A
2/6/2003	59	A
2/7/2003	150	A
2/8/2003	192	A
2/9/2003	221	A
2/10/2003	273	A
2/11/2003	283	A
2/12/2003	234	A
2/13/2003	230	A

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Date	Flow (cfs)	Qualification
	All	Code
2/14/2003	216	A
2/15/2003	144	A
2/16/2003	201	A
2/17/2003	535	A
2/18/2003	1800	A
2/19/2003	1580	A
2/20/2003	1020	A
2/21/2003	1410	A
2/22/2003	3020	A
2/23/2003	5870	A
2/24/2003	3950	A
2/25/2003	2290	A
2/26/2003	1690	A
2/27/2003	1630	A
2/28/2003	1630	A
3/1/2003	1620	A
3/2/2003	1440	A
3/3/2003	1110	A
3/4/2003	796	A
3/5/2003	598	A
3/6/2003	460	A
3/7/2003	357	A
3/8/2003	275	A
3/9/2003	225	A
3/10/2003	176	A
3/11/2003	137	A
3/12/2003	113	A
3/13/2003	116	A
3/14/2003	136	A
3/15/2003	128	A
3/16/2003	123	Ae
3/17/2003	113	Ae
3/18/2003	102	A
3/19/2003	179	A
3/20/2003	317	A
3/21/2003	515	A
3/22/2003	1140	A
3/23/2003	893	A
3/24/2003	545	A
3/25/2003	270	A
3/26/2003	148	A

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Date	Flow (cfs)	Qualification
	All	Code
3/27/2003	224	A
3/28/2003	243	A
3/29/2003	217	A
3/30/2003	193	A
3/31/2003	119	A
4/1/2003	86	A
4/2/2003	72	A
4/3/2003	64	A
4/4/2003	61	A
4/5/2003	61	A
4/6/2003	373	A
4/7/2003	2260	A
4/8/2003	1800	A
4/9/2003	1240	A
4/10/2003	1140	A
4/11/2003	792	A
4/12/2003	481	A
4/13/2003	196	A
4/14/2003	96	A
4/15/2003	72	A
4/16/2003	60	A
4/17/2003	54	A
4/18/2003	50	A
4/19/2003	47	A
4/20/2003	46	A
4/21/2003	47	A
4/22/2003	45	A
4/23/2003	41	A
4/24/2003	38	A
4/25/2003	41	A
4/26/2003	50	A
4/27/2003	64	A
4/28/2003	56	A
4/29/2003	45	A
4/30/2003	38	A
5/1/2003	33	A
5/2/2003	31	A
5/3/2003	78	A
5/4/2003	266	A
5/5/2003	339	A
5/6/2003	194	A

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Date	Flow (cfs)	Qualification
	All	Code
5/7/2003	152	A
5/8/2003	523	A
5/9/2003	770	A
5/10/2003	875	A
5/11/2003	555	A
5/12/2003	145	A
5/13/2003	64	A
5/14/2003	82	A
5/15/2003	205	A
5/16/2003	392	A
5/17/2003	512	A
5/18/2003	493	A
5/19/2003	324	A
5/20/2003	227	A
5/21/2003	205	A
5/22/2003	95	A
5/23/2003	57	A
5/24/2003	45	A
5/25/2003	39	A
5/26/2003	35	A
5/27/2003	37	A
5/28/2003	44	A
5/29/2003	39	A
5/30/2003	33	A
5/31/2003	28	A
6/1/2003	24	A
6/2/2003	21	A
6/3/2003	21	A
6/4/2003	22	A
6/5/2003	21	A
6/6/2003	21	A
6/7/2003	23	A
6/8/2003	26	A
6/9/2003	28	A
6/10/2003	29	A
6/11/2003	30	A
6/12/2003	37	A
6/13/2003	58	A
6/14/2003	65	A
6/15/2003	71	A
6/16/2003	62	A

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Date	Flow (cfs)	Qualification
	All	Code
6/17/2003	50	A
6/18/2003	49	A
6/19/2003	51	A
6/20/2003	45	A
6/21/2003	45	A
6/22/2003	40	A
6/23/2003	35	A
6/24/2003	31	A
6/25/2003	28	A
6/26/2003	27	A
6/27/2003	54	A
6/28/2003	115	A
6/29/2003	130	A
6/30/2003	71	A
7/1/2003	39	A
7/2/2003	31	A
7/3/2003	28	A
7/4/2003	24	A
7/5/2003	24	A
7/6/2003	55	A
7/7/2003	88	A
7/8/2003	51	A
7/9/2003	33	A
7/10/2003	25	A
7/11/2003	20	A
7/12/2003	16	A
7/13/2003	14	A
7/14/2003	30	A
7/15/2003	33	A
7/16/2003	19	A
7/17/2003	14	A
7/18/2003	11	A
7/19/2003	10	A
7/20/2003	10	A
7/21/2003	11	A
7/22/2003	11	A
7/23/2003	10	A
7/24/2003	9.6	A
7/25/2003	9.2	A
7/26/2003	8.9	A
7/27/2003	7.3	A

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Date	Flow (cfs)	Qualification
	All	Code
7/28/2003	6.2	A
7/29/2003	5.5	A
7/30/2003	5.5	A
7/31/2003	7.8	A
8/1/2003	12	A
8/2/2003	14	A
8/3/2003	11	A
8/4/2003	8.5	A
8/5/2003	6.9	A
8/6/2003	6.4	A
8/7/2003	10	A
8/8/2003	10	A
8/9/2003	7.2	A
8/10/2003	5.9	A
8/11/2003	5.7	A
8/12/2003	5.1	A
8/13/2003	8	A
8/14/2003	5.5	A
8/15/2003	4.6	A
8/16/2003	4.5	A
8/17/2003	4.7	A
8/18/2003	4.9	A
8/19/2003	4.6	A
8/20/2003	4.8	A
8/21/2003	6	A
8/22/2003	4.7	A
8/23/2003	3.6	A
8/24/2003	4.2	A
8/25/2003	4.2	A
8/26/2003	3.4	A
8/27/2003	3.1	A
8/28/2003	5.3	A
8/29/2003	3.8	A
8/30/2003	2.7	A
8/31/2003	2.4	A
9/1/2003	2.2	A
9/2/2003	3.3	A
9/3/2003	6.4	A
9/4/2003	6.4	A
9/5/2003	5.3	A
9/6/2003	3.9	A

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Date	Flow (cfs)	Qualification
	All	Code
9/7/2003	2.6	A
9/8/2003	2.4	A
9/9/2003	3	A
9/10/2003	2.4	A
9/11/2003	1.5	A
9/12/2003	1.3	A
9/13/2003	4.4	A
9/14/2003	6.2	A
9/15/2003	4.1	A
9/16/2003	2.7	A
9/17/2003	1.7	A
9/18/2003	1.1	A
9/19/2003	0.73	A
9/20/2003	0.48	A
9/21/2003	0.6	A
9/22/2003	3.8	A
9/23/2003	4.9	A
9/24/2003	3.8	A
9/25/2003	2.4	A
9/26/2003	1.4	A
9/27/2003	0.86	A
9/28/2003	0.84	A
9/29/2003	0.82	A
9/30/2003	0.74	A
10/1/2003	0.65	A
10/2/2003	0.55	A
10/3/2003	0.52	A
10/4/2003	0.49	A
10/5/2003	0.59	A
10/6/2003	0.61	A
10/7/2003	0.53	A
10/8/2003	0.73	A
10/9/2003	0.93	A
10/10/2003	1.1	A
10/11/2003	1.5	A
10/12/2003	1.9	A
10/13/2003	2.2	A
10/14/2003	2.5	A
10/15/2003	2.6	A
10/16/2003	2.4	A
10/17/2003	2.2	A

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Date	Flow (cfs)	Qualification
	All	Code
10/18/2003	1.9	Ae
10/19/2003	1.7	A
10/20/2003	1.6	A
10/21/2003	1.7	A
10/22/2003	1.7	A
10/23/2003	1.6	A
10/24/2003	1.5	A
10/25/2003	1.5	A
10/26/2003	3.7	A
10/27/2003	5.4	A
10/28/2003	4.6	A
10/29/2003	3.8	A
10/30/2003	3.3	A
10/31/2003	3.2	A
11/1/2003	3.4	A
11/2/2003	3.1	A
11/3/2003	3.3	A
11/4/2003	4	A
11/5/2003	3.6	A
11/6/2003	3.2	A
11/7/2003	3.2	A
11/8/2003	3.4	A
11/9/2003	3.5	A
11/10/2003	4	A
11/11/2003	4.4	A
11/12/2003	5.2	A
11/13/2003	4.3	A
11/14/2003	3.8	A
11/15/2003	3.9	A
11/16/2003	4.1	A
11/17/2003	11	A
11/18/2003	31	A
11/19/2003	61	A
11/20/2003	80	A
11/21/2003	68	A
11/22/2003	48	A
11/23/2003	40	A
11/24/2003	40	A
11/25/2003	43	A
11/26/2003	40	A
11/27/2003	42	A

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Date	Flow (cfs)	Qualification
	All	Code
11/28/2003	42	A
11/29/2003	39	A
11/30/2003	37	A
12/1/2003	35	A
12/2/2003	33	A
12/3/2003	32	A
12/4/2003	31	A
12/5/2003	31	A
12/6/2003	31	A
12/7/2003	31	A
12/8/2003	31	A
12/9/2003	33	A
12/10/2003	41	A
12/11/2003	47	A
12/12/2003	46	A
12/13/2003	47	A
12/14/2003	55	A
12/15/2003	54	A
12/16/2003	50	A
12/17/2003	46	A
12/18/2003	42	A
12/19/2003	39	A
12/20/2003	36	A
12/21/2003	34	A
12/22/2003	33	A
12/23/2003	33	A
12/24/2003	36	A
12/25/2003	42	A
12/26/2003	44	A
12/27/2003	42	A
12/28/2003	39	A
12/29/2003	38	A
12/30/2003	45	A
12/31/2003	54	A
1/1/2004	52	A
1/2/2004	46	A
1/3/2004	42	A
1/4/2004	40	A
1/5/2004	43	A
1/6/2004	44	A
1/7/2004	39	A

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Date	Flow (cfs)	Qualification
	All	Code
1/8/2004	37	A
1/9/2004	37	A
1/10/2004	39	A
1/11/2004	39	A
1/12/2004	37	A
1/13/2004	35	A
1/14/2004	34	A
1/15/2004	34	A
1/16/2004	33	A
1/17/2004	34	A
1/18/2004	41	A
1/19/2004	42	A
1/20/2004	41	A
1/21/2004	39	A
1/22/2004	37	A
1/23/2004	34	A
1/24/2004	38	A
1/25/2004	156	A
1/26/2004	242	A
1/27/2004	252	A
1/28/2004	238	A
1/29/2004	215	A
1/30/2004	114	A
1/31/2004	60	A
2/1/2004	49	A
2/2/2004	44	A
2/3/2004	44	A
2/4/2004	43	A
2/5/2004	331	A
2/6/2004	671	A
2/7/2004	737	A
2/8/2004	593	A
2/9/2004	576	A
2/10/2004	537	A
2/11/2004	432	A
2/12/2004	557	A
2/13/2004	772	A
2/14/2004	1010	A
2/15/2004	1490	A
2/16/2004	1290	A
2/17/2004	886	A

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Date	Flow (cfs)	Qualification
	All	Code
2/18/2004	776	A
2/19/2004	727	A
2/20/2004	578	A
2/21/2004	386	A
2/22/2004	181	A
2/23/2004	95	A
2/24/2004	89	A
2/25/2004	246	A
2/26/2004	670	A
2/27/2004	764	A
2/28/2004	736	A
2/29/2004	798	A
3/1/2004	1330	A
3/2/2004	1990	A
3/3/2004	4970	A
3/4/2004	2930	A
3/5/2004	1720	A
3/6/2004	1260	A
3/7/2004	1040	A
3/8/2004	1100	A
3/9/2004	886	A
3/10/2004	602	A
3/11/2004	370	A
3/12/2004	165	A
3/13/2004	99	A
3/14/2004	95	A
3/15/2004	155	A
3/16/2004	178	A
3/17/2004	186	A
3/18/2004	201	A
3/19/2004	186	A
3/20/2004	128	A
3/21/2004	136	A
3/22/2004	215	A
3/23/2004	275	A
3/24/2004	333	A
3/25/2004	297	A
3/26/2004	143	A
3/27/2004	88	A
3/28/2004	75	A
3/29/2004	239	A

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Date	Flow (cfs)	Qualification
	All	Code
3/30/2004	380	A
3/31/2004	417	A
4/1/2004	441	A
4/2/2004	435	A
4/3/2004	288	A
4/4/2004	104	A
4/5/2004	70	A
4/6/2004	58	A
4/7/2004	52	A
4/8/2004	52	A
4/9/2004	57	A
4/10/2004	83	A
4/11/2004	146	A
4/12/2004	264	A
4/13/2004	279	A
4/14/2004	260	A
4/15/2004	247	A
4/16/2004	244	A
4/17/2004	177	A
4/18/2004	63	A
4/19/2004	58	A
4/20/2004	48	A
4/21/2004	44	A
4/22/2004	41	A
4/23/2004	38	A
4/24/2004	36	A
4/25/2004	42	A
4/26/2004	61	A
4/27/2004	84	A
4/28/2004	120	A
4/29/2004	152	A
4/30/2004	112	A
5/1/2004	236	A
5/2/2004	517	A
5/3/2004	701	A
5/4/2004	833	A
5/5/2004	738	A
5/6/2004	584	A
5/7/2004	289	A
5/8/2004	66	A
5/9/2004	43	A

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Date	Flow (cfs)	Qualification
	All	Code
5/10/2004	37	A
5/11/2004	37	A
5/12/2004	136	A
5/13/2004	345	A
5/14/2004	409	A
5/15/2004	534	A
5/16/2004	1070	A
5/17/2004	862	A
5/18/2004	576	A
5/19/2004	279	A
5/20/2004	81	A
5/21/2004	52	A
5/22/2004	43	A
5/23/2004	37	A
5/24/2004	33	A
5/25/2004	29	A
5/26/2004	26	A
5/27/2004	23	A
5/28/2004	21	A
5/29/2004	27	A
5/30/2004	37	A
5/31/2004	397	A
6/1/2004	726	A
6/2/2004	665	A
6/3/2004	1440	A
6/4/2004	1400	A
6/5/2004	996	A
6/6/2004	729	A
6/7/2004	609	A
6/8/2004	433	A
6/9/2004	213	A
6/10/2004	153	A
6/11/2004	160	A
6/12/2004	171	A
6/13/2004	100	A
6/14/2004	55	A
6/15/2004	43	A
6/16/2004	63	A
6/17/2004	97	A
6/18/2004	88	A
6/19/2004	58	A

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Date	Flow (cfs)	Qualification
	All	Code
6/20/2004	120	A
6/21/2004	183	A
6/22/2004	94	A
6/23/2004	146	A
6/24/2004	263	A
6/25/2004	614	A
6/26/2004	967	A
6/27/2004	1470	A
6/28/2004	1500	A
6/29/2004	1140	A
6/30/2004	1390	A
7/1/2004	2190	A
7/2/2004	1510	A
7/3/2004	930	A
7/4/2004	611	A
7/5/2004	486	A
7/6/2004	347	A
7/7/2004	127	A
7/8/2004	55	A
7/9/2004	42	A
7/10/2004	35	A
7/11/2004	30	A
7/12/2004	26	A
7/13/2004	24	A
7/14/2004	21	A
7/15/2004	18	A
7/16/2004	16	A
7/17/2004	18	A
7/18/2004	22	A
7/19/2004	20	A
7/20/2004	18	A
7/21/2004	17	A
7/22/2004	15	A
7/23/2004	14	A
7/24/2004	12	A
7/25/2004	12	A
7/26/2004	43	A
7/27/2004	120	A
7/28/2004	135	A
7/29/2004	60	A
7/30/2004	38	A

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Date	Flow (cfs)	Qualification
	All	Code
7/31/2004	41	A
8/1/2004	108	A
8/2/2004	98	A
8/3/2004	44	A
8/4/2004	27	A
8/5/2004	20	A
8/6/2004	15	A
8/7/2004	11	A
8/8/2004	8.2	A
8/9/2004	6.5	A
8/10/2004	5.1	A
8/11/2004	6	A
8/12/2004	7.6	A
8/13/2004	11	A
8/14/2004	15	A
8/15/2004	13	A
8/16/2004	8.9	A
8/17/2004	7.7	A
8/18/2004	8.3	A
8/19/2004	9.3	A
8/20/2004	10	A
8/21/2004	14	A
8/22/2004	25	A
8/23/2004	38	A
8/24/2004	72	A
8/25/2004	96	A
8/26/2004	51	A
8/27/2004	30	A
8/28/2004	29	A
8/29/2004	21	A
8/30/2004	14	A
8/31/2004	11	A
9/1/2004	9	A
9/2/2004	7	A
9/3/2004	5.7	A
9/4/2004	4.9	A
9/5/2004	4.3	A
9/6/2004	4.1	A
9/7/2004	4.2	A
9/8/2004	4.3	A
9/9/2004	3.9	A

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Date	Flow (cfs)	Qualification
	All	Code
9/10/2004	3.5	A
9/11/2004	2.8	A
9/12/2004	2.6	A
9/13/2004	2.1	A
9/14/2004	1.8	A
9/15/2004	1.5	A
9/16/2004	1.3	A
9/17/2004	1	A
9/18/2004	0.91	A
9/19/2004	0.77	A
9/20/2004	0.56	A
9/21/2004	0.47	A
9/22/2004	0.37	A
9/23/2004	0.3	A
9/24/2004	0.34	A
9/25/2004	0.33	A
9/26/2004	0.39	A
9/27/2004	0.34	A
9/28/2004	0.4	A
9/29/2004	0.68	A
9/30/2004	0.7	A
10/1/2004	0.73	A
10/2/2004	0.72	A
10/3/2004	0.64	A
10/4/2004	0.59	A
10/5/2004	0.53	A
10/6/2004	0.46	A
10/7/2004	0.52	A
10/8/2004	3.3	A
10/9/2004	91	A
10/10/2004	403	A
10/11/2004	885	A
10/12/2004	1960	A
10/13/2004	1610	A
10/14/2004	1010	A
10/15/2004	603	A
10/16/2004	302	A
10/17/2004	74	A
10/18/2004	41	A
10/19/2004	34	A
10/20/2004	30	A

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Date	Flow (cfs)	Qualification
	All	Code
10/21/2004	30	A
10/22/2004	27	A
10/23/2004	28	A
10/24/2004	33	A
10/25/2004	37	A
10/26/2004	34	A
10/27/2004	37	A
10/28/2004	80	A
10/29/2004	137	A
10/30/2004	234	A
10/31/2004	311	A
11/1/2004	159	A
11/2/2004	381	A
11/3/2004	653	A
11/4/2004	1300	A
11/5/2004	1700	A
11/6/2004	1140	A
11/7/2004	693	A
11/8/2004	428	A
11/9/2004	188	A
11/10/2004	66	A
11/11/2004	58	A
11/12/2004	63	A
11/13/2004	60	A
11/14/2004	57	A
11/15/2004	53	A
11/16/2004	47	A
11/17/2004	42	A
11/18/2004	73	A
11/19/2004	245	A
11/20/2004	325	A
11/21/2004	482	A
11/22/2004	752	A
11/23/2004	796	A
11/24/2004	885	A
11/25/2004	1320	A
11/26/2004	1310	A
11/27/2004	1030	A
11/28/2004	812	A
11/29/2004	604	A
11/30/2004	805	A

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Date	Flow (cfs)	Qualification
	All	Code
12/1/2004	1300	A
12/2/2004	1370	A
12/3/2004	1350	A
12/4/2004	1070	A
12/5/2004	728	A
12/6/2004	618	A
12/7/2004	889	A
12/8/2004	1170	A
12/9/2004	2040	A
12/10/2004	2280	A
12/11/2004	1610	A
12/12/2004	953	A
12/13/2004	640	A
12/14/2004	453	A
12/15/2004	279	A
12/16/2004	140	A
12/17/2004	98	A
12/18/2004	86	A
12/19/2004	80	A
12/20/2004	74	A
12/21/2004	69	A
12/22/2004	132	A
12/23/2004	530	A
12/24/2004	1120	A
12/25/2004	2380	A
12/26/2004	1480	A
12/27/2004	786	A
12/28/2004	505	A
12/29/2004	327	A
12/30/2004	197	A
12/31/2004	133	A
1/1/2005	114	A
1/2/2005	116	A
1/3/2005	118	A
1/4/2005	110	A
1/5/2005	101	A
1/6/2005	110	A
1/7/2005	287	A
1/8/2005	710	A
1/9/2005	1010	A
1/10/2005	1420	A

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	All	Code
1/11/2005	1090	A
1/12/2005	673	A
1/13/2005	656	A
1/14/2005	994	A
1/15/2005	1620	A
1/16/2005	1570	A
1/17/2005	900	A
1/18/2005	541	A
1/19/2005	333	A
1/20/2005	187	A
1/21/2005	134	A
1/22/2005	115	A
1/23/2005	99	A
1/24/2005	84	A
1/25/2005	75	A
1/26/2005	71	A
1/27/2005	68	A
1/28/2005	128	A
1/29/2005	443	A
1/30/2005	567	A
1/31/2005	813	A
2/1/2005	1100	A
2/2/2005	1110	A
2/3/2005	1140	A
2/4/2005	1100	A
2/5/2005	995	A
2/6/2005	793	A
2/7/2005	637	A
2/8/2005	767	A
2/9/2005	1060	A
2/10/2005	1600	A
2/11/2005	1310	A
2/12/2005	809	A
2/13/2005	540	A
2/14/2005	347	A
2/15/2005	239	A
2/16/2005	197	A
2/17/2005	159	A
2/18/2005	128	A
2/19/2005	109	A
2/20/2005	104	A

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	All	Code
2/21/2005	117	A
2/22/2005	121	A
2/23/2005	144	A
2/24/2005	310	A
2/25/2005	381	A
2/26/2005	402	A
2/27/2005	406	A
2/28/2005	331	A
3/1/2005	189	A
3/2/2005	125	A
3/3/2005	104	A
3/4/2005	117	A
3/5/2005	117	A
3/6/2005	106	A
3/7/2005	98	A
3/8/2005	128	A
3/9/2005	164	A
3/10/2005	193	A
3/11/2005	174	A
3/12/2005	135	A
3/13/2005	100	A
3/14/2005	76	A
3/15/2005	61	A
3/16/2005	53	A
3/17/2005	49	A
3/18/2005	46	A
3/19/2005	44	A
3/20/2005	46	A
3/21/2005	55	A
3/22/2005	291	A
3/23/2005	431	A
3/24/2005	415	A
3/25/2005	348	A
3/26/2005	194	A
3/27/2005	108	A
3/28/2005	183	A
3/29/2005	207	A
3/30/2005	222	A
3/31/2005	190	A
4/1/2005	120	A
4/2/2005	84	A

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Date	Flow (cfs)	Qualification
	All	Code
4/3/2005	66	A
4/4/2005	56	A
4/5/2005	49	A
4/6/2005	67	A
4/7/2005	67	A
4/8/2005	85	A
4/9/2005	95	A
4/10/2005	84	A
4/11/2005	173	A
4/12/2005	1100	A
4/13/2005	3640	A
4/14/2005	2100	A
4/15/2005	1050	A
4/16/2005	598	A
4/17/2005	308	A
4/18/2005	103	A
4/19/2005	61	A
4/20/2005	49	A
4/21/2005	43	A
4/22/2005	40	A
4/23/2005	37	A
4/24/2005	33	A
4/25/2005	30	A
4/26/2005	36	A
4/27/2005	55	A
4/28/2005	76	A
4/29/2005	65	A
4/30/2005	56	A
5/1/2005	39	A
5/2/2005	33	A
5/3/2005	29	A
5/4/2005	27	A
5/5/2005	26	A
5/6/2005	26	A
5/7/2005	26	A
5/8/2005	27	A
5/9/2005	31	A
5/10/2005	36	A
5/11/2005	34	A
5/12/2005	30	A
5/13/2005	27	A

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Date	Flow (cfs)	Qualification
	All	Code
5/14/2005	24	A
5/15/2005	26	A
5/16/2005	28	A
5/17/2005	34	A
5/18/2005	33	A
5/19/2005	28	Ae
5/20/2005	25	A
5/21/2005	23	A
5/22/2005	20	A
5/23/2005	21	A
5/24/2005	23	A
5/25/2005	50	A
5/26/2005	28	A
5/27/2005	20	A
5/28/2005	23	A
5/29/2005	75	A
5/30/2005	475	A
5/31/2005	517	A
6/1/2005	176	A
6/2/2005	56	A
6/3/2005	42	A
6/4/2005	35	A
6/5/2005	27	A
6/6/2005	22	A
6/7/2005	22	A
6/8/2005	22	A
6/9/2005	24	A
6/10/2005	21	A
6/11/2005	20	A
6/12/2005	20	A
6/13/2005	18	A
6/14/2005	17	A
6/15/2005	17	A
6/16/2005	15	A
6/17/2005	15	A
6/18/2005	17	A
6/19/2005	19	A
6/20/2005	18	A
6/21/2005	17	A
6/22/2005	15	A
6/23/2005	13	A

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Date	Flow (cfs)	Qualification
	All	Code
6/24/2005	11	A
6/25/2005	9.6	A
6/26/2005	8.7	A
6/27/2005	7.8	A
6/28/2005	7	A
6/29/2005	6	A
6/30/2005	4.9	A
7/1/2005	4.6	A
7/2/2005	4.2	A
7/3/2005	3.7	A
7/4/2005	3.8	A
7/5/2005	3.8	A
7/6/2005	10	A
7/7/2005	19	A
7/8/2005	13	A
7/9/2005	7.2	A
7/10/2005	6.3	A
7/11/2005	5	A
7/12/2005	4.9	A
7/13/2005	4.5	A
7/14/2005	3.3	A
7/15/2005	2.6	A
7/16/2005	2.5	A
7/17/2005	5.6	A
7/18/2005	5.8	A
7/19/2005	3.4	A
7/20/2005	2.5	A
7/21/2005	1.8	A
7/22/2005	1.3	A
7/23/2005	1.1	A
7/24/2005	0.87	A
7/25/2005	0.7	A
7/26/2005	0.56	A
7/27/2005	0.6	A
7/28/2005	0.64	A
7/29/2005	0.52	A
7/30/2005	0.4	A
7/31/2005	0.35	A
8/1/2005	0.37	A
8/2/2005	0.31	A
8/3/2005	0.25	A

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Date	Flow (cfs)	Qualification
	All	Code
8/4/2005	0.21	A
8/5/2005	0.19	A
8/6/2005	0.17	A
8/7/2005	0.14	A
8/8/2005	0.11	A
8/9/2005	0.09	A
8/10/2005	0.08	A
8/11/2005	0.07	A
8/12/2005	0.06	A
8/13/2005	0.05	A
8/14/2005	0.04	A
8/15/2005	0.04	A
8/16/2005	0.03	A
8/17/2005	0.03	A
8/18/2005	0.02	A
8/19/2005	0.02	A
8/20/2005	0.01	A
8/21/2005	0.01	A
8/22/2005	0.05	A
8/23/2005	0.04	A
8/24/2005	0.04	A
8/25/2005	0.04	A
8/26/2005	0.03	A
8/27/2005	0.04	A
8/28/2005	0.05	A
8/29/2005	0.67	A
8/30/2005	0.97	A
8/31/2005	0.72	A
9/1/2005	0.51	A
9/2/2005	0.35	A
9/3/2005	0.24	A
9/4/2005	0.16	A
9/5/2005	0.11	A
9/6/2005	0.1	A
9/7/2005	0.11	A
9/8/2005	0.1	A
9/9/2005	0.09	A
9/10/2005	0.07	A
9/11/2005	0.06	A
9/12/2005	0.05	A
9/13/2005	0.05	A

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Date	Flow (cfs)	Qualification
	All	Code
9/14/2005	0.04	A
9/15/2005	0.04	A
9/16/2005	0.03	A
9/17/2005	0.04	A
9/18/2005	0.03	A
9/19/2005	0.03	A
9/20/2005	0.02	A
9/21/2005	0.02	A
9/22/2005	0.02	A
9/23/2005	0.01	A
9/24/2005	0.25	A
9/25/2005	2.3	A
9/26/2005	12	A
9/27/2005	12	A
9/28/2005	8.1	A
9/29/2005	4.6	A
9/30/2005	3.5	A
10/1/2005	3.2	P
10/2/2005	2.8	P
10/3/2005	2.4	P
10/4/2005	2.3	P
10/5/2005	2.3	P
10/6/2005	2.3	P
10/7/2005	2.3	P
10/8/2005	2.2	P
10/9/2005	2.2	P
10/10/2005	2.2	P
10/11/2005	2	P
10/12/2005	1.9	P
10/13/2005	1.7	P
10/14/2005	1.6	P
10/15/2005	1.4	P
10/16/2005	1	P
10/17/2005	0.91	P
10/18/2005	1	P
10/19/2005	1.1	P
10/20/2005	1.2	P
10/21/2005	1.2	P
10/22/2005	1.2	P
10/23/2005	1.2	P
10/24/2005	1.2	P

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Date	Flow (cfs)	Qualification
	All	Code
10/25/2005	1.1	P
10/26/2005	1.1	P
10/27/2005	1.1	P
10/28/2005	1.1	P
10/29/2005	1.1	P
10/30/2005	1.1	P
10/31/2005	1.1	P
11/1/2005	1.6	P
11/2/2005	3.8	P
11/3/2005	3.9	P
11/4/2005	3.6	P
11/5/2005	3.6	P
11/6/2005	3.9	P
11/7/2005	4.3	P
11/8/2005	4.4	P
11/9/2005	4.2	P
11/10/2005	4.2	P
11/11/2005	4.3	P
11/12/2005	4.4	P
11/13/2005	4.5	P
11/14/2005	4.9	P
11/15/2005	6.5	P
11/16/2005	6.2	P
11/17/2005	6.3	P
11/18/2005	6.6	P
11/19/2005	7.1	P
11/20/2005	7.2	P
11/21/2005	8.2	P
11/22/2005	12	P
11/23/2005	11	P
11/24/2005	10	P
11/25/2005	10	P
11/26/2005	12	P
11/27/2005	14	P
11/28/2005	16	P
11/29/2005	19	P
11/30/2005	17	P
12/1/2005	16	P
12/2/2005	16	P
12/3/2005	16	P
12/4/2005	17	P

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Date	Flow (cfs)	Qualification
	All	Code
12/5/2005	17	P
12/6/2005	18	P
12/7/2005	18	P
12/8/2005	20	P
12/9/2005	23	P
12/10/2005	25	P
12/11/2005	24	P
12/12/2005	24	P
12/13/2005	24	P
12/14/2005	25	P
12/15/2005	31	P
12/16/2005	30	P
12/17/2005	25	P
12/18/2005	22	P
12/19/2005	19	P
12/20/2005	17	P
12/21/2005	15	P
12/22/2005	14	P
12/23/2005	14	P
12/24/2005	14	P
12/25/2005	17	P
12/26/2005	20	P
12/27/2005	18	P
12/28/2005	19	P
12/29/2005	18	P
12/30/2005	17	P
12/31/2005	16	P
1/1/2006	17	P
1/2/2006	18	P
1/3/2006	18	P
1/4/2006	17	P
1/5/2006	18	P
1/6/2006	18	P
1/7/2006	16	P
1/8/2006	11	P
1/9/2006	12	P
1/10/2006	15	P
1/11/2006	21	P
1/12/2006	20	P
1/13/2006	18	P
1/14/2006	17	P

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Daily Mean Flow Data - (7/1/1985 - 6/30/2006)

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Date	Flow (cfs)	Qualification
	All	Code
1/15/2006	15	P
1/16/2006	16	P
1/17/2006	63	P
1/18/2006	95	P
1/19/2006	64	P
1/20/2006	26	P
1/21/2006	14	P
1/22/2006	31	P
1/23/2006	176	P
1/24/2006	284	P
1/25/2006	257	P
1/26/2006	173	P
1/27/2006	86	P
1/28/2006	27	P
1/29/2006	23	P
1/30/2006	26	P
1/31/2006	20	P
2/1/2006	15	P
2/2/2006	67	P
2/3/2006	207	P
2/4/2006	208	P
2/5/2006	136	P
2/6/2006	76	P
2/7/2006	37	P
2/8/2006	22	P
2/9/2006	14	P
2/10/2006	18	P
2/11/2006	98	P
2/12/2006	149	P
2/13/2006	134	P
2/14/2006	90	P
2/15/2006	48	P
2/16/2006	23	P
2/17/2006	17	P
2/18/2006	16	P
2/19/2006	18	P
2/20/2006	16	P
2/21/2006	15	P
2/22/2006	15	P
2/23/2006	15	P
2/24/2006	14	P

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Daily Mean Flow Data - (7/1/1985 - 6/30/2006)

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Date	Flow (cfs)	Qualification
	All	Code
2/25/2006	44	P
2/26/2006	169	P
2/27/2006	208	P
2/28/2006	188	P
3/1/2006	143	P
3/2/2006	67	P
3/3/2006	25	P
3/4/2006	14	P
3/5/2006	11	P
3/6/2006	8.2	P
3/7/2006	7.1	P
3/8/2006	6.7	P
3/9/2006	8.3	P
3/10/2006	49	P
3/11/2006	89	P
3/12/2006	64	P
3/13/2006	23	P
3/14/2006	20	P
3/15/2006	18	P
3/16/2006	10	P
3/17/2006	7.5	P
3/18/2006	14	P
3/19/2006	195	P
3/20/2006	951	P
3/21/2006	1840	P
3/22/2006	1600	P
3/23/2006	1030	P
3/24/2006	656	P
3/25/2006	384	P
3/26/2006	209	P
3/27/2006	84	P
3/28/2006	36	P
3/29/2006	25	P
3/30/2006	18	P
3/31/2006	15	P
4/1/2006	12	P
4/2/2006	10	P
4/3/2006	9.2	P
4/4/2006	7.5	P
4/5/2006	5.9	P
4/6/2006	5.4	P

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Date	Flow (cfs)	Qualification
	All	Code
4/7/2006	5.3	P
4/8/2006	17	P
4/9/2006	62	P
4/10/2006	107	P
4/11/2006	84	P
4/12/2006	21	P
4/13/2006	8	P
4/14/2006	4.9	P
4/15/2006	3.9	P
4/16/2006	3.2	P
4/17/2006	2.8	P
4/18/2006	2.3	P
4/19/2006	2.2	P
4/20/2006	2.4	P
4/21/2006	8.9	P
4/22/2006	91	P
4/23/2006	153	P
4/24/2006	137	P
4/25/2006	57	P
4/26/2006	38	P
4/27/2006	68	P
4/28/2006	60	P
4/29/2006	38	P
4/30/2006	114	P
5/1/2006	179	P
5/2/2006	161	P
5/3/2006	85	P
5/4/2006	26	P
5/5/2006	70	P
5/6/2006	192	P
5/7/2006	168	P
5/8/2006	118	P
5/9/2006	128	P
5/10/2006	139	P
5/11/2006	96	P
5/12/2006	39	P
5/13/2006	12	P
5/14/2006	5.3	P
5/15/2006	3.6	P
5/16/2006	2.8	P
5/17/2006	2.4	P

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Date	Flow (cfs)	Qualification
	All	Code
5/18/2006	2.1	P
5/19/2006	2.2	P
5/20/2006	2	P
5/21/2006	2.3	P
5/22/2006	2.1	P
5/23/2006	2.7	P
5/24/2006	2.3	P
5/25/2006	2	P
5/26/2006	1.8	P
5/27/2006	1.9	P
5/28/2006	1.7	P
5/29/2006	2.3	P
6/30/2006	2.5	P
5/31/2006	2.6	P
6/1/2006	3.7	P
6/2/2006	4.3	P
6/3/2006	3.7	P
6/4/2006	3.4	P
6/5/2006	3.1	P
6/6/2006	2.8	P
6/7/2006	2.6	P
6/8/2006	2.5	P
6/9/2006	2.4	P
6/10/2006	2.4	P
6/11/2006	2.2	P
6/12/2006	1.9	P
6/13/2006	1.6	P
6/14/2006	1.4	P
6/15/2006	1.3	P
6/16/2006	1.2	P
6/17/2006	1.5	P
6/18/2006	2.1	P
6/19/2006	4.1	P
6/20/2006	5.7	P
6/21/2006	4.7	P
6/22/2006	4	P
6/23/2006	3.3	P
6/24/2006	6.8	P
6/25/2006	6.3	P
6/26/2006	4.5	P
6/27/2006	3.9	P

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Date	Flow (cfs)	Qualification
	All	Code
6/28/2006	3	P
6/29/2006	2.6	P
6/30/2006	2.4	P
[illegible]		
Average	250	
Minimum	0.01	
Maximum	19300	
Median	51.0	
Count	7590	
Harmonic Mean	2.10	

Appendix F-2

LDEQ Monitoring Data
Bayou de Loutre Dissolved Mineral
POR January 1995-March 2006

***Data provides by LDEQ to demonstrate compliance with existing dissolved mineral Criteria**

B. de L'outre Data

SITE	DESCRIPTION	DATE	PCODE	RESULT	UNITS	PARAMETER
0324	Bayou De L'Outre north of Farmerville	1/10/1995	515	226	MG/L	T.D.S.
0324	Louisiana	3/14/1995	515	198	MG/L	T.D.S.
0324	Louisiana	5/9/1995	515	270	MG/L	T.D.S.
0324	Louisiana	7/11/1995	515	450	MG/L	T.D.S.
0324	Louisiana	9/12/1995	515	652	MG/L	T.D.S.
0324	Louisiana	11/14/95	515	430	MG/L	T.D.S.
0324	Louisiana	1/9/1996	515	92	MG/L	T.D.S.
0324	Louisiana	3/12/1996	515	294	MG/L	T.D.S.
0324	Louisiana	5/14/1996	515	154	MG/L	T.D.S.
0324	Louisiana	7/9/1996	515	286	MG/L	T.D.S.
0324	Louisiana	9/10/1996	515	264	MG/L	T.D.S.
0324	Louisiana	11/19/1996	515	248	MG/L	T.D.S.
0324	Louisiana	1/7/1997	515	194	MG/L	T.D.S.
0324	Louisiana	3/11/1997	515	150	MG/L	T.D.S.
0324	Louisiana	5/13/1997	515	182	MG/L	T.D.S.
0324	Louisiana	7/15/1997	515	230	MG/L	T.D.S.
0324	Louisiana	9/9/1997	515	188	MG/L	T.D.S.
0324	Louisiana	11/18/1997	515	348	MG/L	T.D.S.
0324	Louisiana	1/13/1998	515	174	MG/L	T.D.S.
0324	Louisiana	3/10/1998	515	90	MG/L	T.D.S.
0324	Bayou De L'Outre north of Farmerville	5/12/1998	515	158	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	10/26/1999	515	266	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	11/23/1999	515	284	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	12/14/1999	515	252	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe	1/5/2004	515	167	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	2/2/2004	515	127	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	3/8/2004	515	93.3	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	4/5/2004	515	104	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	5/3/2004	515	161	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	6/1/2004	515	107	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	6/28/2004	515	103	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	7/26/2004	515	102	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	8/23/2004	515	123	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	10/4/2004	515	125	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	10/18/2004	515	159	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	11/15/2004	515	103	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	1/9/2006	515	336	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	2/13/2006	515	155	MG/L	T.D.S.
0072	Bayou De L'Outre near Monroe, Louisiana	3/13/2006	515	161	MG/L	T.D.S.

0324	Bayou De L'Outre north of Farmerville	1/9/1996	940	111	MG/L	CL, TOTAL
0324	Louisiana	3/12/1996	940	122	MG/L	CL, TOTAL
0324	Louisiana	5/14/1996	940	89.8	MG/L	CL, TOTAL
0324	Louisiana	7/9/1996	940	101	MG/L	CL, TOTAL
0324	Louisiana	9/10/1996	940	84	MG/L	CL, TOTAL
0324	Louisiana	11/19/1996	940	76.9	MG/L	CL, TOTAL

B. de L'outre Data

0324	Louisiana	1/7/1997	940		54.5	MG/L	CL, TOTAL
0324	Louisiana	3/11/1997	940		17.7	MG/L	CL, TOTAL
0324	Louisiana	5/13/1997	940		33.4	MG/L	CL, TOTAL
0324	Louisiana	7/15/1997	940		57.8	MG/L	CL, TOTAL
0324	Louisiana	9/9/1997	940		51	MG/L	CL, TOTAL
0324	Louisiana	11/18/1997	940		73.4	MG/L	CL, TOTAL
0324	Louisiana	1/13/1998	940		23.3	MG/L	CL, TOTAL
0324	Louisiana	3/10/1998	940		22.6	MG/L	CL, TOTAL
0324	Bayou De L'Outre north of Farmerville	5/12/1998	940		51.9	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	4/27/1999	940		16.1	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	5/25/1999	940		37.1	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	6/22/1999	940		53.5	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	7/27/1999	940		45.2	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	8/24/1999	940		58.2	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	9/28/1999	940		62.2	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	10/26/1999	940		61.8	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	11/23/1999	940		64.6	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	12/14/1999	940		49.7	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	1/5/2004	940		62.5	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	2/2/2004	940		38.8	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	3/8/2004	940		16.6	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	4/5/2004	940		23.9	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	5/3/2004	940		31.5	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	6/1/2004	940		21.6	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	6/28/2004	940		18.5	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	7/26/2004	940		14.3	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	8/23/2004	940		3.2	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	10/4/2004	940		33.8	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	10/18/2004	940		34.9	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	11/15/2004	940		11.5	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	1/9/2006	940		88.5	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	2/13/2006	940		38.2	MG/L	CL, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	3/13/2006	940		46.9	MG/L	CL, TOTAL

0324	Bayou De L'Outre north of Farmerville	1/9/1996	945		54.8	SO4	SO4, TOTAL
0324	Louisiana	3/12/1996	945		41.7	SO4	SO4, TOTAL
0324	Louisiana	5/14/1996	945		15.9	SO4	SO4, TOTAL
0324	Louisiana	7/9/1996	945		26.3	SO4	SO4, TOTAL
0324	Louisiana	9/10/1996	945		24.5	SO4	SO4, TOTAL
0324	Louisiana	11/19/1996	945		26.4	SO4	SO4, TOTAL
0324	Louisiana	1/7/1997	945		18	SO4	SO4, TOTAL
0324	Louisiana	3/11/1997	945		8.6	SO4	SO4, TOTAL
0324	Louisiana	5/13/1997	945		9.6	SO4	SO4, TOTAL
0324	Louisiana	7/15/1997	945		36	SO4	SO4, TOTAL
0324	Louisiana	9/9/1997	945		30	SO4	SO4, TOTAL
0324	Louisiana	11/18/1997	945		35.2	SO4	SO4, TOTAL
0324	Louisiana	1/13/1998	945		8.5	SO4	SO4, TOTAL

B. de L'outre Data

0324	Louisiana	3/10/1998	945		7	SO4	SO4, TOTAL
0324	Louisiana	5/12/1998	945		25.4	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	2/23/1999	945		4.5	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	3/23/1999	945		9.4	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	4/27/1999	945		3.5	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	5/25/1999	945		9.5	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	6/22/1999	945		15.4	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	7/27/1999	945		7.8	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	8/24/1999	945		6.3	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	9/28/1999	945		93.1	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	10/26/1999	945		87.2	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	11/23/1999	945		82.6	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	12/14/1999	945		52	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	1/5/2004	945		26.2	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	2/2/2004	945		19.9	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	3/8/2004	945		6.9	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	4/5/2004	945		6.1	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	5/3/2004	945		8.3	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	6/1/2004	945		6.9	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	6/28/2004	945		5.8	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	7/26/2004	945		9	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	8/23/2004	945		1.3	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	10/4/2004	945		8.5	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	10/18/2004	945		38.4	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	11/15/2004	945		8.5	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	1/9/2006	945		85.8	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	2/13/2006	945		22.7	SO4	SO4, TOTAL
0072	Bayou De L'Outre near Monroe, Louisiana	3/13/2006	945		21.9	SO4	SO4, TOTAL

Appendix G

Alternative Analysis

Appendix G-1

Hydrograph Model

GBM^{c} & Associates
219 Brown Lane
Bryant, AR 72022

Sheet No. 1 **of** 1
Date July 12, 2006
By AAS
Chkd MSR **Date** 7/12/06
Project No. 2160-05-070

SUBJECT: Stream Flow Calculations

The following calculations demonstrate the amount of flow required in Loutre Creek at Lion Oil's Outfall 001 discharge location to reach the specified in-stream concentrations.

Gulf Costal Ecoregion Stream Quality Data (ADEQ CPP)
Sulfate = 13 mg/L
Chloride = 5 mg/L
TDS = 67 mg/L

Proposed Effluent Concentrations
Sulfate = 1,967 mg/L
Chloride = 503 mg/L
TDS = 3,240 mg/L

Target In-Stream Concentrations
Sulfate = 68 mg/L
TDS = 86 mg/L

Lion Oil Effluent Flow Rate
2.62 MGD (Highest monthly average flow rate recorded Jan. 2004 through Dec. 2005)

Required Stream Flow Calculations

<u>Sulfate</u>

$(Q_s \times 13 \text{ mg/L}) + (2.62 \text{ MGD} \times 1{,}967 \text{ mg/L}) = (Q_s + 2.62 \text{ MGD}) \times 68 \text{ mg/L}$

$Q_s = 90.5 \text{ MGD} = 140 \text{ CFS}$

<u>TDS</u>

$(Q_s \times 67 \text{ mg/L}) + (2.62 \text{ MGD} \times 3{,}240 \text{ mg/L}) = (Q_s + 2.62 \text{ MGD}) \times 86 \text{ mg/L}$

$Q_s = 434.9 \text{ MGD} = 673 \text{ CFS}$

Resulting In-Stream Chloride Concentration

$(434.9 \text{ MGD} \times 5 \text{ mg/L}) + (2.62 \text{ MGD} \times 503 \text{ mg/L}) = (434.9 \text{ MGD} + 2.62 \text{ MGD}) \times C_{Cl}$

$C_{Cl} = 8.0 \text{ mg/L}$

Loutre Creek

RUN-OFF MODEL

	NORMAL	DRY	WET
CN (CURVE NUMBER) =	74	54.02	89.54
AMC (ANTESEDENT COND. FACT.) =	1	0.73	1.21
P (AMT. OF RAINFALL) =	15.1		
AREA (sq. mi.) =	2.157		
AREA (ACRES) =	1380.48		
S =	3.51	8.51	1.17
Q =	11.59616	8.21318	13.80722
RUN-OFF (ACRE-FT) =	1334.02	944.84	1588.38
RUN-OFF (MGD) =	434.76	307.92	517.65
RUN-OFF (CFS) =	673.00	476.66	801.32

NOTE: All run-off flow rates and rainfall events based on 24-hour period (run-off assummed to be complete in 24-hours)

Each Box Self Calculates

Reference: Ward and Trimble, 2004

Curve Number Adjustments

CN (AMCII)	AMCI (dry)	AMCIII (wet)
10	0.4	2.22
15	0.43	2.04
20	0.45	1.85
25	0.48	1.8
30	0.5	1.67
35	0.53	1.59
40	0.55	1.5
45	0.59	1.45
50	0.62	1.4
55	0.65	1.35
60	0.67	1.3
65	0.7	1.26
70	0.73	1.21
75	0.76	1.18
80	0.79	1.14
85	0.83	1.11
90	0.87	1.07
95	0.94	1.04
100	1	1

Appendix G-2

Treatment Estimate

Memorandum

DATE: July 7, 2006

TO: Chuck Campbell, PE, REM
GBM^c & Associates

FROM: Aaron Stallmann, PE
GBM^c & Associates

RE: Lion Oil Company
Sand Filter Cost Estimate

GBM^c No. 2160-05-070

The following table summarizes the items with estimated capital and annual costs associated with the construction and operation a sand filter treatment unit at Lion Oil Company in El Dorado, Arkansas.

Item	Estimated Cost
Capital	
Dual Media Filter (Two Units – each 32' x 32', includes filter media, concrete construction, piping, fittings, backwash blower, and backwash pump).	$200,000
Surge Storage (One 1.2 MMgal epoxy coated carbon steel tank with concrete foundation, includes piping and fittings).	$325,000
Diversion Storage (Three 1.2 MMgal epoxy coated carbon steel tank with concrete foundation, includes piping and fittings).	$950,000
Total	$1,475,000
Operating and Maintenance (includes electricity to pump to the filters, polymer, manpower, and annualized replacement for pumps and blowers).	$95,000

GBMc & Associates
219 Brown Lane
Bryant, AR 72022

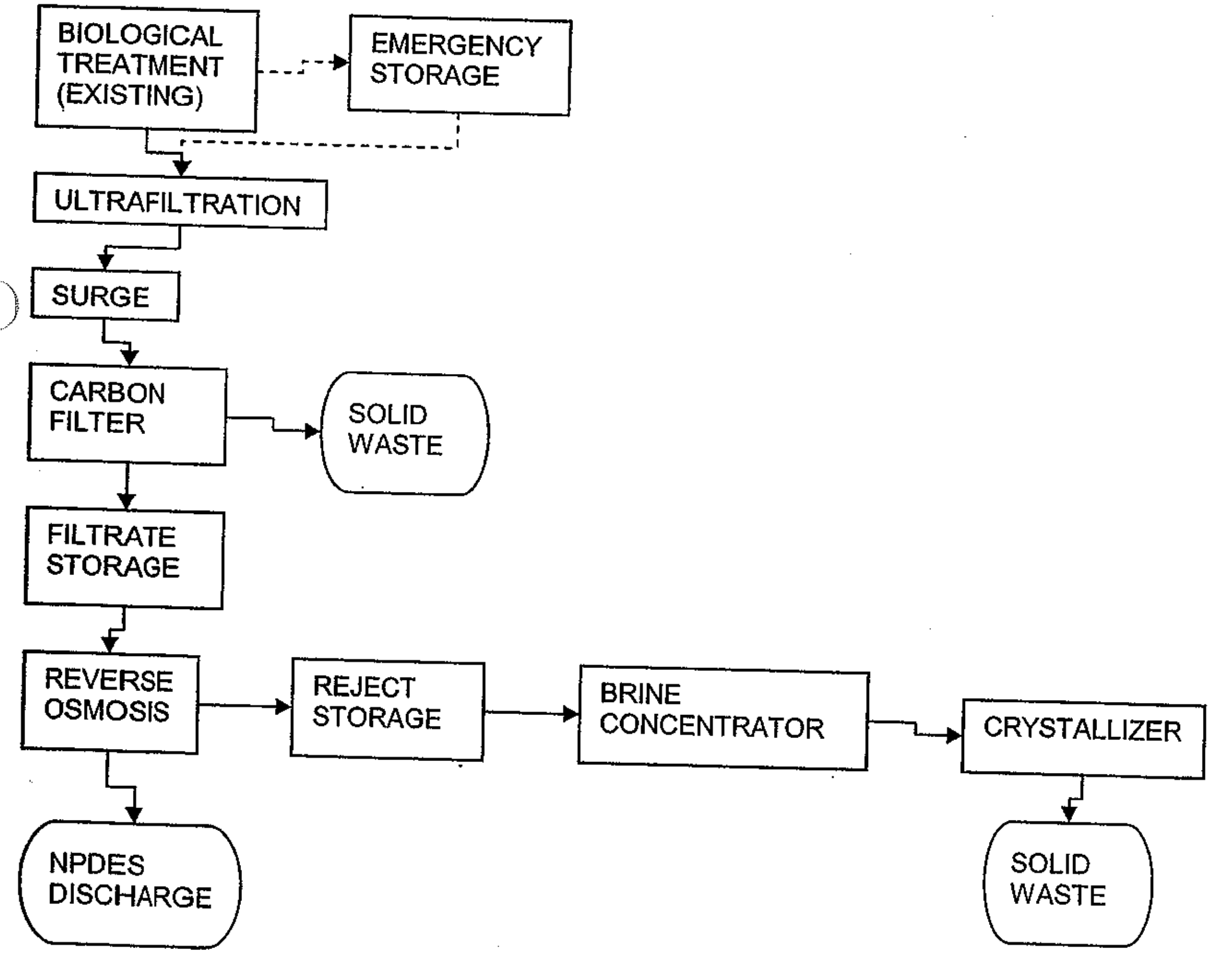
Sheet No. 1 **of** 2
Date 07/17/06
By CDC
Chkd MSR **Date** 07/17/06
Project No. 2160-05-070

SUBJECT: ESTIMATION OF TDS TREATMENT CAPITAL & OPERATING COSTS

BASIS OF DESIGN ESTIMATE:

Waste Flow = 2.67 MGD
Effluent TDS = 3,420 mg/l
Discharge Max = 165 mg/l (NPDES Limit = 207 mg/l)
R.O. Reject = 500 GPM

PROCESS FLOW:



GBM^c & Associates
219 Brown Lane
Bryant, AR 72022

Sheet No. 2 **of** 2
Date 07/17/06
By CDC
Chkd MSR **Date** 07/17/06
Project No. 2160-05-070

SUBJECT: ESTIMATION OF TDS TREATMENT CAPITAL & OPERATING COSTS

CAPITAL COST:

CAPITAL	
UF+Carbon+RO	$17,025,000
Storage tanks	$2,550,000
Evaporative crystallization system	$23,800,000
TOTAL CAPITAL[1]	**$43,375,000**

[1] Includes Engineering Design, Equipment, Site Work, Structural, Installation, and Permitting

ANNUAL OPERATING COST:

ANNUAL OPERATING	
Filtration	$250,000
RO	$1,795,000
Crystallization	$1,834,000
Annualized capital replacement	$1,867,000
TOTAL OPERATING[2]	**$5,746,000**

[2] Includes Electric Power, Maintenance, Membrane Replacement, Consumables/Chemicals, Labor, Waste Disposal (10,000 ton/yr), Annualized Capital Equipment Replacement (20-year life)

Capital and Operating Cost Estimate Sources: Bill Heinz and Jason Dejournett, GE Water; Perry's Chemical Engineering Handbook, 7th Edition p.22-52; Implicit Price Deflators 1995-2006, US Dept. Commerce; Lion Oil Company.

Appendix H

Photos of Study Reaches

Reach LC-1

Figure F-1. Reach LC-1: Note shallow and narrow stream and canopy cover. May 2005.

Figure F-2. Reach LC-1. Largest pool upstream of Highway 15 right-of-way

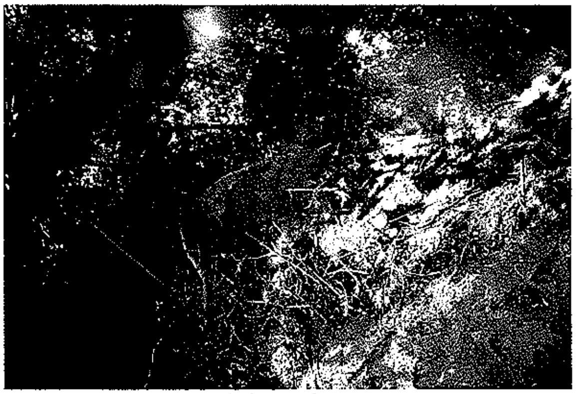


Figure F-3 Reach LC-1. Substrate and instream cover along right descending bank.May 2005.

Reach LC-2

Figure F-4. Reach LC-2. View from downstream terminus of Reach. View upstream. Note primary channel (vegetated) and containment levees on east side.

Figure F-5. Reach LC-2. Note downstream control and clay banks. Flow not storm flow related. May 2005.

Figure F-6. Reach LC-3. Downstream terminals of reach View looking upstream. Note depth of incised channel.

Reach LC-3

Figure F-7. Reach LC-3. Mid-reach. Note degree of channel incision and some instream habitat. Pool depth >7 ft.

Figure F-8. Reach LC-3. View of upper 1/3 of reach downstream right descending bank. Note shallow run with exposed clay shelf along left descending bank.

Figure F-9. Reach LC-3. Upper terminus of reach. Note rail yard in background. View from right descending bank looking upstream.