LANCE R. LEFLEUR
DIRECTOR

ADEM
Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ■ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ■ FAX (334) 271-7950

KAY IVEY
GOVERNOR

APR 3 0 2025

MR BRIAN HOCUTT
GENERAL MANAGER
CHEROKEE NITROGEN, LLC
1080 INDUSTRIAL DRIVE
CHEROKEE, AL 35616-5414

RE: REVISED DRAFT PERMIT
NPDES PERMIT NUMBER AL0000418

Dear Mr. Hocutt:

Transmitted herein is a revised draft of the referenced permit.

We would appreciate your comments on the permit within **30 days** of the date of this letter. Please direct any comments of a technical or administrative nature to the undersigned.

By copy of this letter and the draft permit, we are also requesting comments within the same time frame from EPA.

Our records indicate that have utilized the Department's web-based electronic environmental (E2) reporting system for submittal of discharge monitoring reports (DMRs). The Department transitioned from the E2 Reporting System to the Alabama Environmental Permitting and Compliance System (AEPACS) for the submittal of DMRs on November 15, 2021. AEPACS is an electronic system that allows facilities to apply for and maintain permits as well as submit other required applications, registrations, and certifications. In addition, the system allows facilities to submit required compliance reports or other information to the Department. The Department has used the E2 User account information to set up a similar User Profile in AEPACS based on the following criteria:

1. The user has logged in to E2 since October 1, 2019; and
2. The E2 user account is set up using a unique email address.

E2 users that met the above criteria will only need to establish an ADEM Web Portal account (https://prd.adem.alabama.gov/awp) under the same email address as their E2 account to have the same permissions in AEPACS as they did in E2. They will also automatically be linked to the same facilities they were in E2.

The Alabama Department of Environmental Management encourages you to voluntarily consider pollution prevention practices and alternatives at your facility. Pollution Prevention may assist you in complying with effluent limitations, and possibly reduce or eliminate monitoring requirements.

If you have questions regarding this permit or monitoring requirements, please contact Theo Pinson by e-mail at **tpinson@adem.alabama.gov** or by phone at **(334) 274-4202.**

Sincerely,

Scott

Scott Jackson, Chief
Industrial Section
Industrial/Municipal Branch
Water Division

Enclosure: Revised Draft Permit

pc via website: Montgomery Field Office
EPA Region IV
U.S. Fish & Wildlife Service
AL Historical Commission
Advisory Council on Historic Preservation
Department of Conservation and Natural Resources

ADEM
Alabama Department of Environmental Management

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

PERMITTEE: CHEROKEE NITROGEN, LLC

FACILITY LOCATION: CHEROKEE NITROGEN, LLC
1080 INDUSTRIAL DRIVE
CHEROKEE, ALABAMA 35616
COLBERT COUNTY

PERMIT NUMBER: AL0000418

RECEIVING WATERS: DSN 001 UNNAMED TRIBUTARY TO THE TENNESSEE RIVER

In accordance with and subject to the provisions of the Federal Water Pollution Control Act, as amended, 33 U.S.C. §§1251-1388 (the "FWPCA"), the Alabama Water Pollution Control Act, as amended, Code of Alabama 1975, §§ 22-22-1 to 22-22-14 (the "AWPCA"), the Alabama Environmental Management Act, as amended, Code of Alabama 1975, §§22-22A-1 to 22-22A-17, and rules and regulations adopted thereunder, and subject further to the terms and conditions set forth in this permit, the Permittee is hereby authorized to discharge into the above-named receiving waters.

ISSUANCE DATE:

EFFECTIVE DATE:

EXPIRATION DATE:

DRAFT

Alabama Department of Environmental Management

Table of Contents

Table of Contents (continued)

PART I: DISCHARGE LIMITATIONS, CONDITIONS, AND REQUIREMENTS

A. DISCHARGE LIMITATIONS AND MONITORING REQUIREMENTS

DSN 0011: Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff 3/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency[2]	Sample Type[1]	Seasonal
Temperature, Water Deg. Fahrenheit (00011) Effluent Gross Value	*****	*****	*****	*****	98.0 Monthly Average	100.0 Maximum Daily	deg F	Continuous	Recorder	All Months
pH (00400) Effluent Gross Value	*****	*****	*****	6.0 Minimum Daily	*****	8.5 Maximum Daily	S.U.	Weekly	Grab	All Months
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Composite	All Months
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	10.0 Monthly Average	15.0 Maximum Daily	mg/l	Weekly	Grab	All Months
Nitrogen, Ammonia Total (As N) (00610) Effluent Gross Value	*****	*****	*****	*****	2.48 Monthly Average	3.72 Maximum Daily	mg/l	Weekly	Grab	All Months
Nitrogen, Kjeldahl Total (As N) (00625) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Grab	All Months
Nitrite Plus Nitrate Total 1 Det. (As N) (00630) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Grab	All Months
Phosphorus, Total (As P) (00665) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	(Report) Monthly Average	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Continuous	Totalizer	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.

2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.

3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.

DSN 0011 (Continued): Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff 3/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency[2]	Sample Type[1]	Seasonal
Chlorine, Total Residual 4/ (50060) Effluent Gross Value	*****	*****	*****	*****	0.011 Monthly Average	0.019 Maximum Daily	mg/l	Weekly	Grab	All Months
E. Coli (51040) Effluent Gross Value	*****	*****	*****	*****	126 Monthly Average	298 Maximum Daily	col/100mL	Weekly	Grab	May, Jun, Jul, Aug, Sep, Oct
E. Coli (51040) Effluent Gross Value	*****	*****	*****	*****	548 Monthly Average	2507 Maximum Daily	col/100mL	Monthly	Grab	Jan, Feb, Mar, Apr, Nov, Dec
BOD, Carbonaceous 05 Day, 20C (80082) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Grab	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.

2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.

3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.

4/ A measurement of Total Residual Chlorine below 0.05 mg/L shall be considered in compliance with the permit limitations and should be reported as *B on the electronic discharge monitoring report.

DSN 001T: Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff 3/ 4/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency[2]	Sample Type[1]	Seasonal
Toxicity, Ceriodaphnia Chronic (61426) Effluent Gross Value	0 Monthly Average	*****	pass=0;fail=1	*****	*****	*****	*****	Quarterly	24-Hr Composite	All Months
Toxicity, Pimephales Chronic (61428) Effluent Gross Value	0 Monthly Average	*****	pass=0;fail=1	*****	*****	*****	*****	Quarterly	24-Hr Composite	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.

2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.

3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.

4/ See Part IV.B for Effluent Toxicity Limitations and Biomonitoring Requirements.

DSN 01A1: Internal Outfall to DSN 001 to demonstrate compliance with categorical process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff 3/

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge from the outfall(s) listed above and described more fully in the Permittee's application. Such discharges shall be limited and monitored by the Permittee as specified below:

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency[2]	Sample Type[1]	Seasonal
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	30.0 Monthly Average	45.0 Weekly Average	mg/l	Monthly	Grab	All Months
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	10.0 Monthly Average	15.0 Maximum Daily	mg/l	Weekly	Grab	All Months
Nitrogen, Organic Total (As N) (00605) Effluent Gross Value	152.0 Monthly Average	284.0 Maximum Daily	lbs/day	*****	*****	*****	*****	Weekly	Composite	All Months
Nitrogen, Ammonia Total (As N) (00610) Effluent Gross Value	233.0 Monthly Average	526.0 Maximum Daily	lbs/day	*****	*****	*****	*****	Weekly	Composite	All Months
Nitrogen, Nitrate Total (As N) (00620) Effluent Gross Value	195.9 Monthly Average	461.6 Maximum Daily	lbs/day	*****	*****	*****	*****	Weekly	Composite	All Months
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	(Report) Monthly Average	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Continuous	Totalizer	All Months
BOD, Carbonaceous 05 Day, 20C (80082) Effluent Gross Value	*****	*****	*****	*****	25.0 Monthly Average	37.5 Weekly Average	mg/l	Monthly	Grab	All Months

THE DISCHARGE SHALL HAVE NO SHEEN, AND THERE SHALL BE NO DISCHARGE OF VISIBLE OIL, FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

1/ Samples collected to comply with the monitoring requirements specified above shall be collected at the following location: At the nearest accessible location just prior to discharge and after final treatment. Unless otherwise specified, composite samples shall be time composite samples collected using automatic sampling equipment or a minimum of eight (8) equal volume grab samples collected over equal time intervals. All composite samples shall be collected for the total period of discharge not to exceed 24 hours.

2/ If only one sampling event occurs during a month, the sample result shall be reported on the discharge monitoring report as both the monthly average and daily maximum value for all parameters with a monthly average limitation.

3/ See Part IV.A for Best Management Practices (BMP) Plan Requirements.

B. DISCHARGE MONITORING AND RECORD KEEPING REQUIREMENTS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge and shall be in accordance with the provisions of this permit.

2. Test Procedures

For the purpose of reporting and compliance, permittees shall use one of the following procedures:

a. For parameters with an EPA established Minimum Level (ML), report the measured value if the analytical result is at or above the ML and report "0" for values below the ML. Test procedures for the analysis of pollutants shall conform to 40 CFR Part 136 and guidelines published pursuant to Section 304(h) of the FWPCA, 33 U.S.C. Section 1314(h). If more than one method for analysis of a substance is approved for use, a method having a minimum level lower than the permit limit shall be used. If the minimum level of all methods is higher than the permit limit, the method having the lowest minimum level shall be used and a report of less than the minimum level shall be reported as zero and will constitute compliance; however, should EPA approve a method with a lower minimum level during the term of this permit the permittee shall use the newly approved method.

b. For pollutants parameters without an established ML, an interim ML may be utilized. The interim ML shall be calculated as 3.18 times the Method Detection Level (MDL) calculated pursuant to 40 CFR Part 136, Appendix B.

   Permittees may develop an effluent matrix-specific ML, where an effluent matrix prevents attainment of the established ML. However, a matrix specific ML shall be based upon proper laboratory method and technique. Matrix-specific MLs must be approved by the Department, and may be developed by the permittee during permit issuance, reissuance, modification, or during compliance schedule.

   In either case the measured value should be reported if the analytical result is at or above the ML and "0" reported for values below the ML.

c. For parameters without an EPA established ML, interim ML, or matrix-specific ML, a report of less than the detection limit shall constitute compliance if the detection limit of all analytical methods is higher than the permit limit using the most sensitive EPA approved method. For the purpose of calculating a monthly average, "0" shall be used for values reported less than the detection limit.

   The Minimum Level utilized for procedures A and B above shall be reported on the permittee's DMR. When an EPA approved test procedure for analysis of a pollutant does not exist, the Director shall approve the procedure to be used.

3. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The facility name and location, point source number, date, time and exact place of sampling;

b. The name(s) of person(s) who obtained the samples or measurements;

c. The dates and times the analyses were performed;

d. The name(s) of the person(s) who performed the analyses;

e. The analytical techniques or methods used, including source of method and method number; and

f. The results of all required analyses.

4. Records Retention and Production

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the above reports or the application for this permit, for a period of at least three years from the date of the sample measurement, report or application. This period may be extended by request of the Director at any time. If litigation or other enforcement action, under the AWPCA and/or the FWPCA, is ongoing which involves any of the above records, the records shall be kept until the litigation is resolved. Upon the written request of the Director or his designee, the permittee shall provide the Director with a copy of any record required to be retained by this paragraph. Copies of these records shall not be submitted unless requested.

All records required to be kept for a period of three years shall be kept at the permitted facility or an alternate location approved by the Department in writing and shall be available for inspection.

5. Monitoring Equipment and Instrumentation

All equipment and instrumentation used to determine compliance with the requirements of this permit shall be installed, maintained, and calibrated in accordance with the manufacturer's instructions or, in the absence of manufacturer's instructions, in accordance with accepted practices. The permittee shall develop and maintain quality assurance procedures to ensure proper operation and maintenance of all equipment and instrumentation. The quality assurance procedures shall include the proper use, maintenance, and installation, when appropriate, of monitoring equipment at the plant site.

C. DISCHARGE REPORTING REQUIREMENTS

1. Reporting of Monitoring Requirements

a. The permittee shall conduct the required monitoring in accordance with the following schedule:

MONITORING REQUIRED MORE FREQUENTLY THAN MONTHLY AND MONTHLY shall be conducted during the first full month following the effective date of coverage under this permit and every month thereafter.

QUARTERLY MONITORING shall be conducted at least once during each calendar quarter. Calendar quarters are the periods of January through March, April through June, July through September, and October through December. The permittee shall conduct the quarterly monitoring during the first complete calendar quarter following the effective date of this permit and is then required to monitor once during each quarter thereafter. Quarterly monitoring may be done anytime during the quarter, unless restricted elsewhere in this permit, but it should be submitted with the last DMR due for the quarter, i.e., (March, June, September and December DMR's).

SEMIANNUAL MONITORING shall be conducted at least once during the period of January through June and at least once during the period of July through December. The permittee shall conduct the semiannual monitoring during the first complete calendar semiannual period following the effective date of this permit and is then required to monitor once during each semiannual period thereafter. Semiannual monitoring may be done anytime during the semiannual period, unless restricted elsewhere in this permit, but it should be submitted with the last DMR for the month of the semiannual period, i.e. (June and December DMR's).

ANNUAL MONITORING shall be conducted at least once during the period of January through December. The permittee shall conduct the annual monitoring during the first complete calendar annual period following the effective date of this permit and is then required to monitor once during each annual period thereafter. Annual monitoring may be done anytime during the year, unless restricted elsewhere in this permit, but it should be submitted with the December DMR.

b. The permittee shall submit discharge monitoring reports (DMRs) on the forms provided by the Department and in accordance with the following schedule:

REPORTS OF MORE FREQUENTLY THAN MONTHLY AND MONTHLY TESTING shall be submitted on a **monthly** basis. The first report is due on the **28th day of (MONTH, YEAR).** The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

REPORTS OF QUARTERLY TESTING shall be submitted on a **quarterly** basis. The first report is due on the **28th day of [Month, Year].** The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

REPORTS OF SEMIANNUAL TESTING shall be submitted on a semiannual basis. The reports are due on the 28th day of JANUARY and the 28th day of JULY. The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

REPORTS OF ANNUAL TESTING shall be submitted on an annual basis. The first report is due on the 28th day of JANUARY. The reports shall be submitted so that they are received by the Department no later than the 28th day of the month following the reporting period.

c. Except as allowed by Provision I.C.1.c.(1) or (2), the permittee shall submit all Discharge Monitoring Reports (DMRs) required by Provision I.C.1.b electronically.

(1) If the permittee is unable to complete the electronic submittal of DMR data due to technical problems originating with the Department's electronic system (this could include entry/submittal issues with an entire set of DMRs or individual parameters), the permittee is not relieved of their obligation to submit DMR data to the Department by the date specified in Provision I.C.1.b, unless otherwise directed by the Department.

If the Department's electronic system is down on the 28th day of the month in which the DMR is due or is down for an extended period of time, as determined by the Department, when a DMR is required to be submitted, the permittee may submit the data in an alternate manner and format acceptable to the Department. Preapproved alternate acceptable methods include faxing, e-mailing, mailing, or hand-delivery of data such that they are received by the required reporting date. Within 5 calendar days of the Department's electronic system resuming operation, the permittee shall enter the data into the Department's electronic system, unless an alternate timeframe is approved by the Department. A comment should be included on the electronic DMR submittal verifying the original submittal date (date of the fax, copy of the dated e-mail, or hand-delivery stamped date), if applicable.

(2) The permittee may submit a request to the Department for a temporary electronic reporting waiver for DMR submittals. The waiver request should include the permit number; permittee name; facility/site name; facility address; name, address, and contact information for the responsible official or duly authorized representative; a detailed statement regarding the basis for requesting such a waiver; and the duration for which the waiver is requested. Approved electronic reporting waivers are not transferrable.

Permittees with an approved electronic reporting waiver for DMRs may submit hard copy DMRs for the period that the approved electronic reporting waiver request is effective. The permittee shall submit the Department-approved DMR forms to the address listed in Provision I.C.1.e.

(3) If a permittee is allowed to submit a hard copy DMR, the DMR must be legible and bear an original signature. Photo and electronic copies of the signature are not acceptable and shall not satisfy the reporting requirements of this permit.

(4) If the permittee, using approved analytical methods as specified in Provision I.B.2, monitors any discharge from a point source for a limited substance identified in Provision I.A. of this permit more frequently than required by this permit, the results of such monitoring shall be included in the calculation and reporting of values on the DMR and the increased frequency shall be indicated on the DMR.

(5) In the event no discharge from a point source identified in Provision I.A. of this permit and described more fully in the permittee's application occurs during a monitoring period, the permittee shall report "No Discharge" for such period on the appropriate DMR.

d. All reports and forms required to be submitted by this permit, the AWPCA and the Department's Rules, shall be electronically signed (or, if allowed by the Department, traditionally signed) by a "responsible official" of the permittee as defined in ADEM Administrative Code Rule 335-6-6-.09 or a "duly authorized representative" of such official as defined in ADEM Administrative Code Rule 335-6-6-.09 and shall bear the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

e. Discharge Monitoring Reports required by this permit, the AWPCA, and the Department's Rules that are being submitted in hard copy shall be addressed to:

Alabama Department of Environmental Management
Water Division
Office of Water Services
Post Office Box 301463
Montgomery, Alabama 36130-1463

Certified and Registered Mail containing Discharge Monitoring Reports shall be addressed to:

Alabama Department of Environmental Management
Water Division
Office of Water Services
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

f. All other correspondence and reports required to be submitted by this permit, the AWPCA, and the Department's Rules shall be addressed to:

Alabama Department of Environmental Management`
Water Division
Post Office Box 301463
Montgomery, Alabama 36130-1463

Certified and Registered Mail shall be addressed to:

Alabama Department of Environmental Management
Water Division
1400 Coliseum Boulevard
Montgomery, Alabama 36110-2400

g. If this permit is a re-issuance, then the permittee shall continue to submit DMRs in accordance with the requirements of their previous permit until such time as DMRs are due as discussed in Part I.C.1.b above.

2. Noncompliance Notification

a. 24-Hour Noncompliance Reporting

The permittee shall report to the Director, within 24-hours of becoming aware of the noncompliance, any noncompliance which may endanger health or the environment. This shall include but is not limited to the following circumstances:

(1) does not comply with any daily minimum or maximum discharge limitation for an effluent characteristic specified in Provision I. A. of this permit which is denoted by an "(X)";

(2) threatens human health or welfare, fish or aquatic life, or water quality standards;

(3) does not comply with an applicable toxic pollutant effluent standard or prohibition established under Section 307(a) of the FWPCA, 33 U.S.C. Section 1317(a);

(4) contains a quantity of a hazardous substance which has been determined may be harmful to public health or welfare under Section 311(b)(4) of the FWPCA, 33 U.S.C. Section 1321(b)(4);

(5) exceeds any discharge limitation for an effluent characteristic as a result of an unanticipated bypass or upset; and

(6) is an unpermitted direct or indirect discharge of a pollutant to a water of the state (unpermitted discharges properly reported to the Department under any other requirement are not required to be reported under this provision).

The permittee shall orally report the occurrence and circumstances of such discharge to the Director within 24-hours after the permittee becomes aware of the occurrence of such discharge. In addition to the oral report, the permittee shall submit to the Director or Designee a written report as provided in Part I.C.2.c no later than five (5) days after becoming aware of the occurrence of such discharge.

b. If for any reason, the permittee's discharge does not comply with any limitation of this permit, the permittee shall submit to the Director or Designee a written report as provided in Part I.C.2.c below, such report shall be submitted with the next Discharge Monitoring Report required to be submitted by Part I.C.1 of this permit after becoming aware of the occurrence of such noncompliance.

c. Any written report required to be submitted to the Director or Designee by Part I.C.2 a. or b. shall be submitted using a Noncompliance Notification Form (ADEM Form 421) available on the Department's website (http://adem.alabama.gov/DeptForms/Form421.pdf) and include the following information:

(1) A description of the discharge and cause of noncompliance;

(2) The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and

(3) A description of the steps taken and/or being taken to reduce or eliminate the noncomplying discharge and to prevent its recurrence.

D. OTHER REPORTING AND NOTIFICATION REQUIREMENTS

1. Anticipated Noncompliance

The permittee shall give the Director written advance notice of any planned changes or other circumstances regarding a facility which may result in noncompliance with permit requirements.

2. Termination of Discharge

The permittee shall notify the Director, in writing, when all discharges from any point source(s) identified in Provision I. A. of this permit have permanently ceased. This notification shall serve as sufficient cause for instituting procedures for modification or termination of the permit.

3. Updating Information

a. The permittee shall inform the Director of any change in the permittee's mailing address, telephone number or in the permittee's designation of a facility contact or office having the authority and responsibility to prevent and abate violations of the AWPCA, the Department's Rules, and the terms and conditions of this permit, in writing, no later than ten (10) days after such change. Upon request of the Director or his designee, the permittee shall furnish the Director with an update of any information provided in the permit application.

b. If the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information with a written explanation for the mistake and/or omission.

4. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director or his designee may request to determine whether cause exists for modifying, revoking and re-issuing, suspending, or terminating this permit, in whole or in part, or to determine compliance with this permit.

5. Cooling Water and Boiler Water Additives

a. The permittee shall notify the Director in writing not later than thirty (30) days prior to instituting the use of any biocide corrosion inhibitor or chemical additive in a cooling or boiler system, not identified in the application for this permit, from which discharge is allowed by this permit. Notification is not required for additives that do not contain a heavy metal(s) as an active ingredient and that pass through a wastewater treatment system prior to discharge nor is notification required for additives that should not reasonably be expected to cause the cooling water or boiler water to exhibit toxicity as determined by analysis of manufacturer's data or testing by the permittee. Such notification shall include:

(1) name and general composition of biocide or chemical;

(2) 96-hour median tolerance limit data for organisms representative of the biota of the waterway into which the discharge will ultimately reach;

(3) quantities to be used;

(4) frequencies of use;

(5) proposed discharge concentrations; and

(6) EPA registration number, if applicable.

b. The use of a biocide or additive containing tributyl tin, tributyl tin oxide, zinc, chromium or related compounds in cooling or boiler system(s), from which a discharge regulated by this permit occurs, is prohibited except as exempted below. The use of a biocide or additive containing zinc, chromium or related compounds may be used in special circumstances if (1) the permit contains limits for these substances, or (2) the applicant demonstrates during the application process that the use of zinc, chromium or related compounds as a biocide or additive will not pose a reasonable potential to violate the applicable State water quality standards for these substances. The use of any additive, not identified in this permit or in the application for this permit or not exempted from notification under this permit is prohibited, prior to a determination by the Department that permit modification to control discharge of the additive is not required or prior to issuance of a permit modification controlling discharge of the additive.

6. **Permit Issued Based on Estimated Characteristics**

   a. If this permit was issued based on estimates of the characteristics of a process discharge reported on an EPA NPDES Application Form 2D (EPA Form 3510-2D), the permittee shall complete and submit an EPA NPDES Application Form 2C (EPA Form 3510-2C) no later than two years after the date that discharge begins. Sampling required for completion of the Form 2C shall occur when a discharge(s) from the process(s) causing the new or increased discharge is occurring. If this permit was issued based on estimates concerning the composition of a stormwater discharge(s), the permittee shall perform the sampling required by EPA NPDES Application Form 2F (EPA Form 3510-2F) no later than one year after the industrial activity generating the stormwater discharge has been fully initiated.

   b. This permit shall be reopened if required to address any new information resulting from the completion and submittal of the Form 2C and or 2F.

E. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the discharge limitations specified in Provision I. A. in accordance with the following schedule:

COMPLIANCE SHALL BE ATTAINED ON THE EFFECTIVE DATE OF THIS PERMIT

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

PART II: OTHER REQUIREMENTS, RESPONSIBILITIES, AND DUTIES

A. Operational and Management Requirements

1. Facilities Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities only when necessary to achieve compliance with the conditions of the permit.

2. Best Management Practices

a. Dilution water shall not be added to achieve compliance with discharge limitations except when the Director or his designee has granted prior written authorization for dilution to meet water quality requirements.

b. The permittee shall prepare, implement, and maintain a Spill Prevention, Control and Countermeasures (SPCC) Plan in accordance with 40 C.F.R. Section 112 if required thereby.

c. The permittee shall prepare, submit for approval and implement a Best Management Practices (BMP) Plan for containment of any or all process liquids or solids, in a manner such that these materials do not present a significant potential for discharge, if so required by the Director or his designee. When submitted and approved, the BMP Plan shall become a part of this permit and all requirements of the BMP Plan shall become requirements of this permit.

3. Spill Prevention, Control, and Management

The permittee shall provide spill prevention, control, and/or management sufficient to prevent any spills of pollutants from entering a water of the state or a publicly or privately owned treatment works. Any containment system used to implement this requirement shall be constructed of materials compatible with the substance(s) contained and which shall prevent the contamination of groundwater and such containment system shall be capable of retaining a volume equal to 110 percent of the capacity of the largest tank for which containment is provided.

B. Other Responsibilities

1. Duty to Mitigate Adverse Impacts

The permittee shall promptly take all reasonable steps to mitigate and minimize or prevent any adverse impact on human health or the environment resulting from noncompliance with any discharge limitation specified in Provision I. A. of this permit, including such accelerated or additional monitoring of the discharge and/or the receiving waterbody as necessary to determine the nature and impact of the noncomplying discharge.

2. Right of Entry and Inspection

The permittee shall allow the Director, or an authorized representative, upon the presentation of proper credentials and other documents as may be required by law to:

a. enter upon the permittee's premises where a regulated facility or activity or point source is located or conducted, or where records must be kept under the conditions of the permit;

b. have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;

c. inspect any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under the permit; and

d. sample or monitor, for the purposes of assuring permit compliance or as otherwise authorized by the AWPCA, any substances or parameters at any location.

C. Bypass and Upset

1. Bypass

a. Any bypass is prohibited except as provided in b. and c. below:

b. A bypass is not prohibited if:

(1) It does not cause any discharge limitation specified in Provision I. A. of this permit to be exceeded;

(2) It enters the same receiving stream as the permitted outfall; and

(3) It is necessary for essential maintenance of a treatment or control facility or system to assure efficient operation of such facility or system.

c. A bypass is not prohibited and need not meet the discharge limitations specified in Provision I. A. of this permit if:

(1) It is unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime (this condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance); and

(3) The permittee submits a written request for authorization to bypass to the Director at least ten (10) days prior to the anticipated bypass (if possible), the permittee is granted such authorization, and the permittee complies with any conditions imposed by the Director to minimize any adverse impact on human health or the environment resulting from the bypass.

d. The permittee has the burden of establishing that each of the conditions of Provision II.C.1.b. or c. have been met to qualify for an exception to the general prohibition against bypassing contained in a. and an exemption, where applicable, from the discharge limitations specified in Provision I. A. of this permit.

2. Upset

a. A discharge which results from an upset need not meet the discharge limitations specified in Provision I. A. of this permit if:

(1) No later than 24-hours after becoming aware of the occurrence of the upset, the permittee orally reports the occurrence and circumstances of the upset to the Director or his designee; and

(2) No later than five (5) days after becoming aware of the occurrence of the upset, the permittee furnishes the Director with evidence, including properly signed, contemporaneous operating logs, or other relevant evidence, demonstrating that (i) an upset occurred; (ii) the permittee can identify the specific cause(s) of the upset; (iii) the permittee's facility was being properly operated at the time of the upset; and (iv) the permittee promptly took all reasonable steps to minimize any adverse impact on human health or the environment resulting from the upset.

b. The permittee has the burden of establishing that each of the conditions of Provision II. C.2.a. of this permit have been met to qualify for an exemption from the discharge limitations specified in Provision I.A. of this permit.

D. DUTY TO COMPLY WITH PERMIT, RULES, AND STATUTES

1. Duty to Comply

a. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the AWPCA and the FWPCA and is grounds for enforcement action, for permit termination, revocation and reissuance, suspension, modification; or denial of a permit renewal application.

b. The necessity to halt or reduce production or other activities in order to maintain compliance with the conditions of the permit shall not be a defense for a permittee in an enforcement action.

c. The discharge of a pollutant from a source not specifically identified in the permit application for this permit and not specifically included in the description of an outfall in this permit is not authorized and shall constitute noncompliance with this permit.

d. The permittee shall take all reasonable steps, including cessation of production or other activities, to minimize or prevent any violation of this permit or to minimize or prevent any adverse impact of any permit violation.

e. Nothing in this permit shall be construed to preclude and negate the permittee's responsibility or liability to apply for, obtain, or comply with other ADEM, Federal, State, or Local Government permits, certifications, licenses, or other approvals.

2. **Removed Substances**

Solids, sludges, filter backwash, or any other pollutant or other waste removed in the course of treatment or control of wastewaters shall be disposed of in a manner that complies with all applicable Department Rules.

3. **Loss or Failure of Treatment Facilities**

Upon the loss or failure of any treatment facilities, including but not limited to the loss or failure of the primary source of power of the treatment facility, the permittee shall, where necessary to maintain compliance with the discharge limitations specified in Provision I. A. of this permit, or any other terms or conditions of this permit, cease, reduce, or otherwise control production and/or all discharges until treatment is restored. If control of discharge during loss or failure of the primary source of power is to be accomplished by means of alternate power sources, standby generators, or retention of inadequately treated effluent, the permittee must furnish to the Director within six months a certification that such control mechanisms have been installed.

4. **Compliance with Statutes and Rules**

a. This permit has been issued under ADEM Administrative Code, Chapter 335-6-6. All provisions of this chapter, that are applicable to this permit, are hereby made a part of this permit. A copy of this chapter may be obtained for a small charge from the Office of General Counsel, Alabama Department of Environmental Management, 1400 Coliseum Blvd., Montgomery, AL 36130.

b. This permit does not authorize the noncompliance with or violation of any Laws of the State of Alabama or the United States of America or any regulations or rules implementing such laws. FWPCA, 33 U.S.C. Section 1319, and Code of Alabama 1975, Section 22-22-14.

E. PERMIT TRANSFER, MODIFICATION, SUSPENSION, REVOCATION, AND REISSUANCE

1. **Duty to Reapply or Notify of Intent to Cease Discharge**

a. If the permittee intends to continue to discharge beyond the expiration date of this permit, the permittee shall file a complete permit application for reissuance of this permit at least 180 days prior to its expiration. If the permittee does not intend to continue discharge beyond the expiration of this permit, the permittee shall submit written notification of this intent which shall be signed by an individual meeting the signatory requirements for a permit application as set forth in ADEM Administrative Code Rule 335-6-6-.09.

b. Failure of the permittee to apply for reissuance at least 180 days prior to permit expiration will void the automatic continuation of the expiring permit provided by ADEM Administrative Code Rule 335-6-6-.06 and should the permit not be reissued for any reason any discharge after expiration of this permit will be an unpermitted discharge.

2. **Change in Discharge**

a. The permittee shall apply for a permit modification at least 180 days in advance of any facility expansion, production increase, process change, or other action that could result in the discharge of additional pollutants or increase the quantity of a discharged pollutant such that existing permit limitations would be exceeded or that could result in an additional discharge point. This requirement applies to pollutants that are or that are not subject to discharge limitations in this permit. No new or increased discharge may begin until the Director has authorized it by issuance of a permit modification or a reissued permit.

b. The permittee shall notify the Director as soon as it is known or there is reason to believe:

(1) That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis, of any toxic pollutant which is not limited in this permit, if that discharge will exceed the highest of the following notification levels:

(i) one hundred micrograms per liter;

(ii) two hundred micrograms per liter for acrolein and acrylonitrile; five hundred micrograms per liter for 2,4-dinitrophenol and for 2-methyl-4,6-dini-trophenol; and one milligram per liter for antimony;

(iii) five times the maximum concentration value reported for that pollutant in the permit application; or

(2) That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

(i) five hundred micrograms per liter;

(ii) one milligram per liter for antimony;

(iii) ten times the maximum concentration value reported for that pollutant in the permit application.

3. Transfer of Permit

This permit may not be transferred or the name of the permittee changed without notice to the Director and subsequent modification or revocation and reissuance of the permit to identify the new permittee and to incorporate any other changes as may be required under the FWPCA or AWPCA. In the case of a change in name, ownership or control of the permittee's premises only, a request for permit modification in a format acceptable to the Director is required at least 30 days prior to the change. In the case of a change in name, ownership or control of the permittee's premises accompanied by a change or proposed change in effluent characteristics, a complete permit application is required to be submitted to the Director at least 180 days prior to the change. Whenever the Director is notified of a change in name, ownership or control, he may decide not to modify the existing permit and require the submission of a new permit application.

4. Permit Modification and Revocation

a. This permit may be modified or revoked and reissued, in whole or in part, during its term for cause, including but not limited to, the following:

(1) If cause for termination under Provision II. E. 5. of this permit exists, the Director may choose to revoke and reissue this permit instead of terminating the permit;

(2) If a request to transfer this permit has been received, the Director may decide to revoke and reissue or to modify the permit; or

(3) If modification or revocation and reissuance is requested by the permittee and cause exists, the Director may grant the request.

b. This permit may be modified during its term for cause, including but not limited to, the following:

(1) If cause for termination under Provision II. E. 5. of this permit exists, the Director may choose to modify this permit instead of terminating this permit;

(2) There are material and substantial alterations or additions to the facility or activity generating wastewater which occurred after permit issuance which justify the application of permit conditions that are different or absent in the existing permit;

(3) The Director has received new information that was not available at the time of permit issuance and that would have justified the application of different permit conditions at the time of issuance;

(4) A new or revised requirement(s) of any applicable standard or limitation is promulgated under Sections 301(b)(2)(C), (D), (E), and (F), and 307(a)(2) of the FWPCA;

(5) Errors in calculation of discharge limitations or typographical or clerical errors were made;

(6) To the extent allowed by ADEM Administrative Code, Rule 335-6-6-.17, when the standards or regulations on which the permit was based have been changed by promulgation of amended standards or regulations or by judicial decision after the permit was issued;

(7) To the extent allowed by ADEM Administrative Code, Rule 335-6-6-.17, permits may be modified to change compliance schedules;

(8) To agree with a granted variance under 30l(c), 30l(g), 30l(h), 30l(k), or 3l6(a) of the FWPCA or for fundamentally different factors;

(9) To incorporate an applicable 307(a) FWPCA toxic effluent standard or prohibition;

(10) When required by the reopener conditions in this permit;

(11) When required under 40 CFR 403.8(e) (compliance schedule for development of pretreatment program);

(12) Upon failure of the state to notify, as required by Section 402(b)(3) of the FWPCA, another state whose waters may be affected by a discharge permitted by this permit;

(13) When required to correct technical mistakes, such as errors in calculation, or mistaken interpretations of law made in determining permit conditions; or

(14) When requested by the permittee and the Director determines that the modification has cause and will not result in a violation of federal or state law, regulations or rules.

5. **Permit Termination**

This permit may be terminated during its term for cause, including but not limited to, the following:

a. Violation of any term or condition of this permit;

b. The permittee's misrepresentation or failure to disclose fully all relevant facts in the permit application or during the permit issuance process or the permittee's misrepresentation of any relevant facts at any time;

c. Materially false or inaccurate statements or information in the permit application or the permit;

d. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge;

e. The permittee's discharge threatens human life or welfare or the maintenance of water quality standards;

f. Permanent closure of the facility generating the wastewater permitted to be discharged by this permit or permanent cessation of wastewater discharge;

g. New or revised requirements of any applicable standard or limitation that is promulgated under Sections 301(b)(2)(C), (D), (E), and (F), and 307(a)(2) of the FWPCA that the Director determines cannot be complied with by the permittee; or

h. Any other cause allowed by the ADEM Administrative Code, Chapter 335-6-6.

6. **Permit Suspension**

This permit may be suspended during its term for noncompliance until the permittee has taken action(s) necessary to achieve compliance.

7. **Request for Permit Action Does Not Stay Any Permit Requirement**

The filing of a request by the permittee for modification, suspension or revocation of this permit, in whole or in part, does not stay any permit term or condition.

F. COMPLIANCE WITH TOXIC POLLUTANT STANDARD OR PROHIBITION

If any applicable effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the FWPCA, 33 U.S.C. Section 1317(a), for a toxic pollutant discharged by the permittee and such standard or prohibition is more stringent than any discharge limitation on the pollutant specified in Provision I. A. of this permit, or controls a pollutant not limited in Provision I. A. of this permit, this permit shall be modified to conform to the toxic pollutant effluent standard or prohibition and the permittee shall be notified of such modification. If this permit has not been modified to conform to the toxic pollutant effluent standard or prohibition before the effective date of such standard or prohibition, the permittee shall attain compliance with the requirements of the standard or prohibition within the time period required by the standard or prohibition and shall continue to comply with the standard or prohibition until this permit is modified or reissued.

G. DISCHARGE OF WASTEWATER GENERATED BY OTHERS

The discharge of wastewater, generated by any process, facility, or by any other means not under the operational control of the permittee or not identified in the application for this permit or not identified specifically in the description of an outfall in this permit is not authorized by this permit.

PART III: OTHER PERMIT CONDITIONS

A. Civil and Criminal Liability

1. Tampering

Any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained or performed under the permit shall, upon conviction, be subject to penalties as provided by the AWPCA.

2. False Statements

Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be subject to penalties as provided by the AWPCA.

3. Permit Enforcement

a. Any NPDES permit issued or reissued by the Department is a permit for the purpose of the AWPCA and the FWPCA and as such any terms, conditions, or limitations of the permit are enforceable under state and federal law.

b. Any person required to have a NPDES permit pursuant to ADEM Administrative Code Chapter 335-6-6 and who discharges pollutants without said permit, who violates the conditions of said permit, who discharges pollutants in a manner not authorized by the permit, or who violates applicable orders of the Department or any applicable rule or standard of the Department, is subject to any one or combination of the following enforcement actions under applicable state statutes.

  (1) An administrative order requiring abatement, compliance, mitigation, cessation, clean-up, and/or penalties;

  (2) An action for damages;

  (3) An action for injunctive relief; or

  (4) An action for penalties.

c. If the permittee is not in compliance with the conditions of an expiring or expired permit the Director may choose to do any or all of the following provided the permittee has made a timely and complete application for reissuance of the permit:

  (1) initiate enforcement action based upon the permit which has been continued;

  (2) issue a notice of intent to deny the permit reissuance. If the permit is denied, the owner or operator would then be required to cease the activities authorized by the continued permit or be subject to enforcement action for operating without a permit;

  (3) reissue the new permit with appropriate conditions; or

  (4) take other actions authorized by these rules and AWPCA.

4. Relief from Liability

Except as provided in Provision II.C.1 (Bypass) and Provision II.C.2 (Upset), nothing in this permit shall be construed to relieve the permittee of civil or criminal liability under the AWPCA or FWPCA for noncompliance with any term or condition of this permit.

B. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject under Section 311 of the FWPCA, 33 U.S.C. Section 1321.

C. Property and Other Rights

This permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to persons or property or invasion of other private rights, trespass, or any infringement of federal, state, or local laws or regulations, nor does it authorize or approve the construction of any physical structures or facilities or the undertaking of any work in any waters of the state or of the United States.

D. Availability of Reports

Except for data determined to be confidential under Code of Alabama 1975, Section 22-22-9(c), all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. Effluent data shall not be considered confidential.

E. Expiration of Permits for New or Increased Discharges

1. If this permit was issued for a new discharger or new source, this permit shall expire eighteen months after the issuance date if construction of the facility has not begun during the eighteen-month period.

2. If this permit was issued or modified to allow the discharge of increased quantities of pollutants to accommodate the modification of an existing facility and if construction of this modification has not begun during the eighteen month period after issuance of this permit or permit modification, this permit shall be modified to reduce the quantities of pollutants allowed to be discharged to those levels that would have been allowed if the modification of the facility had not been planned.

3. Construction has begun when the owner or operator has:

   a. begun, or caused to begin as part of a continuous on-site construction program:

      (1) any placement, assembly, or installation of facilities or equipment; or

      (2) significant site preparation work including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment; or

   b. entered into a binding contractual obligation for the purpose of placement, assembly, or installation of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under the paragraph. The entering into a lease with the State of Alabama for exploration and production of hydrocarbons shall also be considered beginning construction.

F. Compliance with Water Quality Standards

1. On the basis of the permittee's application, plans, or other available information, the Department has determined that compliance with the terms and conditions of this permit should assure compliance with the applicable water quality standards.

2. Compliance with permit terms and conditions notwithstanding, if the permittee's discharge(s) from point sources identified in Provision I. A. of this permit cause or contribute to a condition in contravention of state water quality standards, the Department may require abatement action to be taken by the permittee in emergency situations or modify the permit pursuant to the Department's Rules, or both.

3. If the Department determines, on the basis of a notice provided pursuant to this permit or any investigation, inspection or sampling, that a modification of this permit is necessary to assure maintenance of water quality standards or compliance with other provisions of the AWPCA or FWPCA, the Department may require such modification and, in cases of emergency, the Director may prohibit the discharge until the permit has been modified.

G. Groundwater

Unless specifically authorized under this permit, this permit does not authorize the discharge of pollutants to groundwater. Should a threat of groundwater contamination occur, the Director may require groundwater monitoring to properly assess the degree of the problem and the Director may require that the Permittee undertake measures to abate any such discharge and/or contamination.

H. Definitions

1. Average monthly discharge limitation - means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month (zero discharge days shall not be included in the number of "daily discharges" measured and a less than detectable test result shall be treated as a concentration of zero if the most sensitive EPA approved method was used).

2. Average weekly discharge limitation - means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week (zero discharge days shall not be included in the number of "daily discharges" measured and a less than detectable test result shall be treated as a concentration of zero if the most sensitive EPA approved method was used).

3. Arithmetic Mean – means the summation of the individual values of any set of values divided by the number of individual values.

4. AWPCA - means the Alabama Water Pollution Control Act.

5. BOD – means the five-day measure of the pollutant parameter biochemical oxygen demand.

6. Bypass - means the intentional diversion of waste streams from any portion of a treatment facility.

7. CBOD – means the five-day measure of the pollutant parameter carbonaceous biochemical oxygen demand.

8. Daily discharge - means the discharge of a pollutant measured during any consecutive 24-hour period in accordance with the sample type and analytical methodology specified by the discharge permit.

9. Daily maximum - means the highest value of any individual sample result obtained during a day.

10. Daily minimum - means the lowest value of any individual sample result obtained during a day.

11. Day - means any consecutive 24-hour period.

12. Department - means the Alabama Department of Environmental Management.

13. Director - means the Director of the Department.

14. Discharge - means "[t]he addition, introduction, leaking, spilling or emitting of any sewage, industrial waste, pollutant or other wastes into waters of the state". Code of Alabama 1975, Section 22-22-1(b)(8).

15. Discharge Monitoring Report (DMR) - means the form approved by the Director to accomplish reporting requirements of an NPDES permit.

16. DO – means dissolved oxygen.

17. 8HC – means 8-hour composite sample, including any of the following:

    a. The mixing of at least 5 equal volume samples collected at constant time intervals of not more than 2 hours over a period of not less than 8 hours between the hours of 6:00 a.m. and 6:00 p.m. If the sampling period exceeds 8 hours, sampling may be conducted beyond the 6:00 a.m. to 6:00 p.m. period.

    b. A sample continuously collected at a constant rate over period of not less than 8 hours between the hours of 6:00 a.m. and 6:00 p.m. If the sampling period exceeds 8 hours, sampling may be conducted beyond the 6:00 a.m. to 6:00 p.m. period.

18. EPA - means the United States Environmental Protection Agency.

19. FC – means the pollutant parameter fecal coliform.

20. Flow – means the total volume of discharge in a 24-hour period.

21. FWPCA - means the Federal Water Pollution Control Act.

22. Geometric Mean – means the Nth root of the product of the individual values of any set of values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered one (1).

23. Grab Sample – means a single influent or effluent portion which is not a composite sample. The sample(s) shall be collected at the period(s) most representative of the discharge.

24. Indirect Discharger – means a nondomestic discharger who discharges pollutants to a publicly owned treatment works or a privately owned treatment facility operated by another person.

25. Industrial User – means those industries identified in the Standard Industrial Classification manual, Bureau of the Budget 1967, as amended and supplemented, under the category "Division D – Manufacturing" and such other classes of significant waste producers as, by regulation, the Director deems appropriate.

26. MGD – means million gallons per day.

27. Monthly Average – means, other than for fecal coliform bacteria, the arithmetic mean of the entire composite or grab samples taken for the daily discharges collected in one month period. The monthly average for fecal coliform bacteria is the geometric mean of daily discharge samples collected in a one month period. The monthly average for flow is the arithmetic mean of all flow measurements taken in a one month period.

28. New Discharger – means a person, owning or operating any building, structure, facility or installation:

    a. from which there is or may be a discharge of pollutants;

    b. that did not commence the discharge of pollutants prior to August 13, 1979, and which is not a new source; and

    c. which has never received a final effective NPDES permit for dischargers at that site.

29. NH3-N – means the pollutant parameter ammonia, measured as nitrogen.

30. Permit application - means forms and additional information that is required by ADEM Administrative Code Rule 335-6-6-.08 and applicable permit fees.

31. Point source - means "any discernible, confined and discrete conveyance, including but not limited to any pipe, channel, ditch, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, . . . from which pollutants are or may be discharged." Section 502(14) of the FWPCA, 33 U.S.C. Section 1362(14).

32. Pollutant - includes for purposes of this permit, but is not limited to, those pollutants specified in Code of Alabama 1975, Section 22-22-1(b)(3) and those effluent characteristics specified in Provision I. A. of this permit.

33. Privately Owned Treatment Works – means any devices or system which is used to treat wastes from any facility whose operator is not the operator of the treatment works, and which is not a "POTW".

34. Publicly Owned Treatment Works – means a wastewater collection and treatment facility owned by the State, municipality, regional entity composed of two or more municipalities, or another entity created by the State or local authority for the purpose of collecting and treating municipal wastewater.

35. Receiving Stream – means the "waters" receiving a "discharge" from a "point source".

36. Severe property damage - means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

37. Significant Source – means a source which discharges 0.025 MGD or more to a POTW or greater than five percent of the treatment work's capacity, or a source which is a primary industry as defined by the U.S. EPA or which discharges a priority or toxic pollutant.

38. Solvent – means any virgin, used or spent organic solvent(s) identified in the F-Listed wastes (F001 through F005) specified in 40 CFR 261.31 that is used for the purpose of solubilizing other materials.

39. TKN – means the pollutant parameter Total Kjeldahl Nitrogen.

40. TON – means the pollutant parameter Total Organic Nitrogen.

41. TRC – means Total Residual Chlorine.

42. TSS – means the pollutant parameter Total Suspended Solids.

43. 24HC – means 24-hour composite sample, including any of the following:

    a. the mixing of at least 12 equal volume samples collected at constant time intervals of not more than 2 hours over a period of 24 hours;

    b. a sample collected over a consecutive 24-hour period using an automatic sampler composite to one sample. As a minimum, samples shall be collected hourly and each shall be no more than one twenty-fourth (1/24) of the total sample volume collected; or

    c. a sample collected over a consecutive 24-hour period using an automatic composite sampler composited proportional to flow.

44. Upset - means an exceptional incident in which there is an unintentional and temporary noncompliance with technology-based permit discharge limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

45. Waters - means "[a]ll waters of any river, stream, watercourse, pond, lake, coastal, ground or surface water, wholly or partially within the state, natural or artificial. This does not include waters which are entirely confined and retained completely upon the property of a single individual, partnership or corporation unless such waters are used in interstate commerce." Code of Alabama 1975, Section 22-22-1(b)(2). Waters "include all navigable waters" as defined in Section 502(7) of the FWPCA, 22 U.S.C. Section 1362(7), which are within the State of Alabama.

46. Week - means the period beginning at twelve midnight Saturday and ending at twelve midnight the following Saturday.

47. Weekly (7-day and calendar week) Average – is the arithmetic mean of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. The calendar week is defined as beginning on Sunday and ending on Saturday. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for the calendar week shall be included in the data for the month that contains the Saturday.18. EPA - means the United States Environmental Protection Agency.

I. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

PART IV: ADDITIONAL REQUIREMENTS, CONDITIONS, AND LIMITATIONS

A. Best Management Practices (BMP) Plan Requirements

1. BMP Plan

The permittee shall develop and implement a Best Management Practices (BMP) Plan which prevents, or minimizes the potential for, the release of pollutants from ancillary activities, including material storage areas; plant site runoff; in-plant transfer, process and material handling areas; loading and unloading operations, and sludge and waste disposal areas, to the waters of the State through plant site runoff; spillage or leaks; sludge or waste disposal; or drainage from raw material storage.

2. Plan Content

The permittee shall prepare and implement a best management practices (BMP) plan, which shall:

a. Establish specific objectives for the control of pollutants:

(1) Each facility component or system shall be examined for its potential for causing a release of significant amounts of pollutants to waters of the State due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.

(2) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g. precipitation), or circumstances to result in significant amounts of pollutants reaching surface waters, the plan should include a prediction of the direction, rate of flow, and total quantity of pollutants which could be discharged from the facility as a result of each condition or circumstance.

b. Establish specific best management practices to meet the objectives identified under paragraph a. of this section, addressing each component or system capable of causing a release of significant amounts of pollutants to the waters of the State, and identifying specific preventative or remedial measures to be implemented;

c. Establish a program to identify and repair leaking equipment items and damaged containment structures, which may contribute to contaminated stormwater runoff. This program must include regular visual inspections of equipment, containment structures and of the facility in general to ensure that the BMP is continually implemented and effective;

d. Prevent the spillage or loss of fluids, oil, grease, gasoline, etc. from vehicle and equipment maintenance activities and thereby prevent the contamination of stormwater from these substances;

e. Prevent or minimize stormwater contact with material stored on site;

f. Designate by position or name the person or persons responsible for the day to day implementation of the BMP;

g. Provide for routine inspections, on days during which the facility is manned, of any structures that function to prevent stormwater pollution or to remove pollutants from stormwater and of the facility in general to ensure that the BMP is continually implemented and effective;

h. Provide for the use and disposal of any material used to absorb spilled fluids that could contaminate stormwater;

i. Develop a solvent management plan, if solvents are used on site. The solvent management plan shall include as a minimum lists of the solvents on site; the disposal method of solvents used instead of dumping, such as reclamation, contract hauling; and the procedures for assuring that solvents do not routinely spill or leak into the stormwater;

j. Provide for the disposal of all used oils, hydraulic fluids, firefighting foams, solvent degreasing material, etc. in accordance with good management practices and any applicable state or federal regulations;

k. Include a diagram of the facility showing the locations where stormwater exits the facility, the locations of any structure or other mechanisms intended to prevent pollution of stormwater or to remove pollutants from stormwater, the locations of any collection and handling systems;

l. Provide control sufficient to prevent or control pollution of stormwater by soil particles to the degree required to maintain compliance with the water quality standard for turbidity applicable to the waterbody(s) receiving discharge(s) under this permit;

m. Provide spill prevention, control, and/or management sufficient to prevent or minimize contaminated stormwater runoff. Any containment system used to implement this requirement shall be constructed of materials compatible with the substance(s) contained and shall prevent the contamination of groundwater. The containment system shall also be capable of retaining a volume equal to 110 percent of the capacity of the largest tank for which containment is provided;

n. Provide and maintain curbing, diking or other means of isolating process areas to the extent necessary to allow segregation and collection for treatment of contaminated stormwater from process areas;

o. Be reviewed by plant engineering staff and the plant manager; and

p. Bear the signature of the plant manager.

3. Compliance Schedule

The permittee shall have reviewed (and revised if necessary) and fully implemented the BMP plan as soon as practicable but no later than six months after the effective date of this permit.

4. Department Review

a. When requested by the Director or his designee, the permittee shall make the BMP available for Department review.

b. The Director or his designee may notify the permittee at any time that the BMP is deficient and require correction of the deficiency.

c. The permittee shall correct any BMP deficiency identified by the Director or his designee within 30 days of receipt of notification and shall certify to the Department that the correction has been made and implemented.

5. Administrative Procedures

a. A copy of the BMP shall be maintained at the facility and shall be available for inspection by representatives of the Department.

b. A log of the routine inspection required above shall be maintained at the facility and shall be available for inspection by representatives of the Department. The log shall contain records of all inspections performed for the last three years and each entry shall be signed by the person performing the inspection.

c. The permittee shall provide training for any personnel required to implement the BMP and shall retain documentation of such training at the facility. This documentation shall be available for inspection by representatives of the Department. Training shall be performed prior to the date that implementation of the BMP is required.

d. BMP Plan Modification. The permittee shall amend the BMP plan whenever there is a change in the facility or change in operation of the facility which materially increases the potential for the ancillary activities to result in a discharge of significant amounts of pollutants.

e. BMP Plan Review. The permittee shall complete a review and evaluation of the BMP plan at least once every three years from the date of preparation of the BMP plan. Documentation of the BMP Plan review and evaluation shall be signed and dated by the Plant Manager.

B. EFFLUENT TOXICITY LIMITATIONS AND BIOMONITORING REQUIREMENTS

1. The permittee shall perform short-term chronic toxicity tests on the wastewater discharges required to be tested for chronic toxicity by Part I of this permit.

a. Test Requirements

(1) The tests shall be performed using undiluted effluent.

(2) Any test result that shows a statistically significant reduction in survival, growth, or reproduction between the control and the test at the 95% confidence level indicate chronic toxicity and constitute noncompliance with this permit.

b. General Test Requirements

(1) A minimum of three (3) 24-hour composite samples shall be obtained for use in the above biomonitoring tests and collected every other day so that the laboratory receives water samples on the first, third, and fifth day of the seven-day test period. The holding time for each composite sample shall not exceed 36 hours. The control water shall be a water prepared in the laboratory in accordance with the EPA procedure described in EPA 821-R-02-013 or the most current edition or another control water selected by the permittee and approved by the Department.

(2) Effluent toxicity tests in which the control survival is less than 80%, P. promelas dry weight per surviving control organism is less than 0.25 mg, Ceriodaphnia number of young per surviving control organism is less than 15, Ceriodaphnia reproduction where less than 60% of surviving control females produce three broods or in which the other requirements of the EPA Test Procedure are not met shall be unacceptable and the permittee shall rerun the tests as soon as practical within the monitoring period.

(3) In the event of an invalid test, upon subsequent completion of a valid test, the results of all tests, valid and invalid, are reported with an explanation of the tests performed and results.

c. Reporting Requirements

(1) The permittee shall notify the Department in writing within 48 hours after toxicity has been demonstrated by the scheduled test(s).

(2) Biomonitoring test results obtained during each monitoring period shall be summarized and reported using the appropriate Discharge Monitoring Report (DMR) form approved by the Department. In accordance with Section 2 of this part, an effluent toxicity report containing the information in Section 2 shall be included with the DMR. Two copies of the test results must be submitted to the Department no later than 28 days after the month in which the tests were performed.

d. Additional Testing Requirements

(1) If chronic toxicity is indicated (noncompliance with permit limit), the permittee shall perform two additional valid chronic toxicity tests in accordance with these procedures to determine the extent and duration of the toxic condition. The toxicity tests shall run consecutively beginning on the first calendar week following the date on which the permittee became aware of the permit noncompliance and the results of these tests shall be submitted no later than 28 days following the month in which the tests were performed.

(2) After evaluation of the results of the follow-up tests, the Department will determine if additional action is appropriate and may require additional testing and/or toxicity reduction measures. The permittee may be required to perform a Toxicity Identification Evaluation (TIE) and/or a Toxicity Reduction Evaluation (TRE). The TIE/TRE shall be performed in accordance with the most recent protocols/guidance outlined by EPA (e.g., EPA/600/2-88/062, EPA/600/R-92/080, EPA/600/R-91-003, EPA/600/R-92/081, EPA/833/B-99/022 and/or EPA/600/6-91/005F, etc.)

e. Test Methods

The tests shall be performed in accordance with the latest edition of the "EPA Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms". The Larval Survival and Growth Test, Methods 1000.0, shall be used for the fathead minnow (*Pimephales promelas*) test and the Survival and Reproduction Test, Method 1002.0, shall be used for the cladoceran (*Ceriodaphnia dubia*) test.

2. Effluent Toxicity Testing Reports

The following information shall be submitted with each discharge monitoring report unless otherwise directed by the Department. The Department may at any time suspend or reinstate these requirements or may decrease or increase the frequency of submittals.

a. Introduction

(1) Facility name, location, and county

(2) Permit number

(3) Toxicity testing requirements of permit

(4) Name of receiving water body

(5) Contract laboratory information (if tests are performed under contract)

(a) Name of firm

(b) Telephone number

(c) Address

(6) Objective of test

b. Plant Operation

(1) Discharge Operating schedule (if other than continuous)

(2) Volume of discharge during sample collection to include Mean daily discharge on sample collection dates (MGD, CFS, GPM)

(3) Design flow of treatment facility at time of sampling

c. Source of Effluent and Dilution Water

(1) Effluent samples

(a) Sampling point

(b) Sample collection dates and times (to include composite sample start and finish times)

(c) Sample collection method

(d) Physical and chemical data of undiluted effluent samples (water temperature, pH, alkalinity, hardness, specific conductance, total residual chlorine (if applicable), etc.)

(e) Lapsed time from sample collection to delivery

(f) Lapsed time from sample collection to test initiation

(g) Sample temperature when received at the laboratory

(2) Dilution Water

(a) Source

(b) Collection/preparation date(s) and time(s)

(c) Pretreatment (if applicable)

(d) Physical and chemical characteristics (water temperature, pH, alkalinity, hardness, specific conductance, etc.)

d. Test Conditions

(1) Toxicity test method utilized

(2) End point(s) of test

(3) Deviations from referenced method, if any, and reason(s)

(4) Date and time test started

(5) Date and time test terminated

(6) Type and volume of test chambers

(7) Volume of solution per chamber

(8) Number of organisms per test chamber

(9) Number of replicate test chambers per treatment

(10) Test temperature, pH, and dissolved oxygen as recommended by the method (to include ranges)

(11) Specify if aeration was needed

(12) Feeding frequency, amount, and type of food

(13) Specify if (and how) pH control measures were implemented

(14) Light intensity (mean)

e. Test Organisms

(1) Scientific name

(2) Life stage and age

(3) Source

(4) Disease(s) treatment (if applicable)

f. Quality Assurance

(1) Reference toxicant utilized and source

(2) Date and time of most recent chronic reference toxicant test(s), raw data and current control chart(s). The most recent chronic reference toxicant test shall be conducted within 30 days of the routine.

(3) Dilution water utilized in reference toxicant test

(4) Results of reference toxicant test(s) (NOEC, IC25, PASS/FAIL, etc.), report concentration response relationship and evaluate test sensitivity

(5) Physical and chemical methods utilized

g. Results

(1) Provide raw toxicity data in tabular form, including daily records of affected organisms in each concentration (including controls) and replicate

(2) Provide table of endpoints: NOECs, IC25s, PASS/FAIL, etc. (as required in the applicable NPDES permit)

(3) Indicate statistical methods used to calculate endpoints

(4) Provide all physical and chemical data required by method

(5) Results of test(s) (NOEC, IC25, PASS/FAIL, etc.), report concentration-response relationship (definitive test only), report percent minimum significant difference (PMSD) calculated for sub-lethal endpoints determined by hypothesis testing.

h. Conclusions and Recommendations

(1) Relationship between test endpoints and permit limits

(2) Actions to be taken

Adapted from "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms", Fourth Edition, October 2002 (EPA 821-R-02-013), Section 10, Report Preparation

C. Cooling Water Intake Structure (CWIS) Requirements

1. The cooling water intake structure used by the Permittee has been evaluated using available information. At this time, the Department has determined that the cooling water intake structure represents the best technology available (BTA) to minimize adverse environmental impact in accordance with Section 316(b) of the Federal Clean Water Act (33 U.S.C. section 1326).

2. The Permittee is required to operate and maintain the CWIS in a manner that minimizes impingement and entrainment levels. Documentation detailing the steps that have and are being taken to minimize the impingement and entrainment levels shall be maintained on site and made available upon request.

3. Nothing in this Permit authorizes take for the purposes of a facility compliance with the Endangered Species Act. Under the Endangered Species Act, take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct, of endangered or threatened species.

4. The Permittee shall submit the information required by the applicable provisions of 40 CFR 122.21(r) at least 180 days prior to permit expiration. The Permittee may request to reduce the information required, if conditions at the facility and in the waterbody remain substantially unchanged since the previous application so long as the relevant previously submitted information remains representative of current source water, intake structure, cooling water system, and operating conditions. Any habitat designated as critical or species listed as threatened or endangered after issuance of the current permit whose range of habitat or designated critical habit includes waters where a facility intake is located constitutes potential for a substantial change that must be addressed by the owner/operator in subsequent permit applications, unless the facility received an exemption pursuant to 16 U.S.C. 1536(o) or a permit pursuant to 16 U.S.C. 1539(a) or there is no reasonable expectation of take. The Permittee must submit its request for reduced cooling water intake structure and waterbody application information to the Director at least two years and six months prior to the expiration of the NPDES permit. The Permittee's request must identify each element that it determines has not substantially changed since the previous permit application and the basis for the determination. The Director has the discretion to accept or reject any part of the request.

5. The Permittee must keep records of all submissions that are part of the permit application pertaining to the CWIS until the subsequent permit is issued to the Permittee.

6. The Permittee's permit application must contain readily available information, at the time of permit application development, in identifying all Federally-listed threatened and endangered species and/or designated critical habitat that are or may be present in the action area.

7. The Permittee must conduct weekly visual inspections or employ remote monitoring devices during the period the cooling water intake structure is in operation. This condition is only applicable if control technologies are being employed to comply with BTA for impingement mortality.

8. The Permittee is required to submit an Annual Certification to the Department no later than January 28th of each year. The Annual Certification shall detail if any changes have been made to impact the operation of the CWIS structure.

D. 316(A) THERMAL VARIANCE CONTINUANCE

A variance request under CWA Section 316(a) for the thermal component of the discharge must be filed with the application for permit renewal in accordance with 40 CFR Part 125.70 Subpart H – Criteria for Determining Alternative Effluent Limitations Under Section 316(a) of the Act and 40 CFR 122.21(m)(6) Subpart B – Permit Application and Special NPDES Program Requirements, Variance Requests by Non-POTWs. The request to continue the variance must be received with the application for renewal of the NPDES permit 180 days prior to permit expiration. At a minimum, the application shall include necessary technical data and relevant information to include data collected within the life of the permit to support the request for a variance continuation.

The Permittee shall conduct a 316(a) study during the permit cycle. A 316(a) study plan shall be submitted to the Department for review within 180 days after the effective date of this permit and shall be revised as soon as practical based upon subsequent receipt of comments from the Department. After the study plan has been approved by the Department, the Permittee shall complete the study and submit the results to the Department at least 365 days prior to the expiration date of this permit.

The field study portion of the 316(a) study shall consider the following components:

1. Fish collection
2. Habitat evaluation
3. In-situ water quality
4. Water sample collection

The study shall be completed at the following stations that were utilized in the original 316(a) study unless otherwise approved by the Department:

- CN-UT (Cherokee Nitrogen Unnamed Tributary): This monitoring station is located downstream of the waterfall in the Cherokee Nitrogen discharge tributary and runs from the most downstream riffle upstream to the base (the toe) of the waterfall pool. This reach is approximately 500 feet long, maximum.

- MSB-1 – Moon Springs Branch: This monitoring station is located upstream of last riffle before the mouth of the Tennessee River and runs approximately 1000 feet upstream.

ADEM PERMIT RATIONALE

PREPARED DATE: November 9, 2023
REVISED DATE: December 28, 2023
REVISED DATE: April 16, 2025
PREPARED BY: Theo Pinson

Permittee Name: Cherokee Nitrogen, LLC

Facility Name: Cherokee Nitrogen, LLC

Permit Number: AL0000418

PERMIT IS A REISSUANCE DUE TO EXPIRATION

DISCHARGE SERIAL NUMBERS (DSN) & DESCRIPTIONS:

001	Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff
01A	Internal Outfall to DSN 001 to demonstrate compliance with categorical process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff

INDUSTRIAL CATEGORY: 40 CFR Part 418 - Fertilizer Manufacturing Point Source Category
Subpart B - Ammonia Subcategory
Subpart C - Urea Subcategory
Subpart D - Ammonium Nitrate Subcategory
Subpart E - Nitric Acid Subcategory

MAJOR: No

STREAM INFORMATION:

Receiving Stream:	Unnamed Tributary to the Tennessee River
Classification:	Fish and Wildlife
River Basin:	Tennessee
7Q10:	0 cfs
7Q2:	0 cfs
1Q10:	0 cfs
Annual Average Flow:	1.81 cfs
303(d) List:	No
Impairment:	Within 24-hour travel time to mercury impairment
TMDL:	No

DISCUSSION:

The facility manufactures nitrogen-based chemicals used predominately in agriculture. Production facilities include an ammonia plant, two nitric acid plants, a urea plant, and a nitrate plant. Raw materials include natural gas, air, purchased ammonia, and lubricants.

ADEM Administrative Rule 335-6-10-.12 requires applicants to new or expanded discharges to Tier II waters demonstrate that the proposed discharge is necessary for important economic or social development in the area in which the waters are located. The application submitted by the facility is not for a new or expanded discharge; therefore, the applicant is not required to demonstrate that the discharge is necessary for economic and social development.

DSN 0011: Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
Temperature, Water Deg. Fahrenheit (00011) Effluent Gross Value	*****	*****	*****	*****	98.0 Monthly Average	100.0 Maximum Daily	deg F	Continuous	Recorder	All Months	316(a)
pH (00400) Effluent Gross Value	*****	*****	*****	6.0 Minimum Daily	*****	8.5 Maximum Daily	S.U.	Weekly	Grab	All Months	WQBEL
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Composite	All Months	BPJ
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	10.0 Monthly Average	15.0 Maximum Daily	mg/l	Weekly	Grab	All Months	BPJ
Nitrogen, Ammonia Total (As N) (00610) Effluent Gross Value	*****	*****	*****	*****	2.48 Monthly Average	3.72 Maximum Daily	mg/l	Weekly	Grab	All Months	WQBEL
Nitrogen, Kjeldahl Total (As N) (00625) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Grab	All Months	BPJ
Nitrite Plus Nitrate Total 1 Det. (As N) (00630) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Grab	All Months	BPJ
Phosphorus, Total (As P) (00665) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Monthly	Grab	Apr, May, Jun, Jul, Aug, Sep,	BPJ
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	(Report) Monthly Average	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Continuous	Totalizer	All Months	BPJ
Chlorine, Total Residual (50060) Effluent Gross Value	*****	*****	*****	*****	0.011 Monthly Average	0.019 Maximum Daily	mg/l	Weekly	Grab	All Months	BPJ
E. Coli (51040) Effluent Gross Value	*****	*****	*****	*****	548 Monthly Average	2507 Maximum Daily	col/100mL	Monthly	Grab	Jan, Feb, Mar, Apr, Nov, Dec	WQBEL
E. Coli (51040) Effluent Gross Value	*****	*****	*****	*****	126 Monthly Average	298 Maximum Daily	col/100mL	Weekly	Grab	May, Jun, Jul, Aug, Sep, Oct	WQBEL
BOD, Carbonaceous 05 Day, 20C (80082) Effluent Gross Value	*****	*****	*****	*****	(Report) Monthly Average	(Report) Maximum Daily	mg/l	Weekly	Grab	All Months	BPJ

DSN 001T: Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
Toxicity, Ceriodaphnia Chronic (61426) Effluent Gross Value	0 Monthly Average	*****	pass=0;fail=1	*****	*****	*****	*****	Quarterly	24-Hr Composite	All Months	BPJ
Toxicity, Pimephales Chronic (61428) Effluent Gross Value	0 Monthly Average	*****	pass=0;fail=1	*****	*****	*****	*****	Quarterly	24-Hr Composite	All Months	BPJ

DSN 01A1: Internal Outfall to DSN 001 to demonstrate compliance with categorical process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff

Parameter	Quantity or Loading		Units	Quality or Concentration			Units	Sample Frequency	Sample Type	Seasonal	Basis
Solids, Total Suspended (00530) Effluent Gross Value	*****	*****	*****	*****	30.0 Monthly Average	45.0 Weekly Average	mg/l	Monthly	Grab	All Months	EGL
Oil & Grease (00556) Effluent Gross Value	*****	*****	*****	*****	10.0 Monthly Average	15.0 Maximum Daily	mg/l	Weekly	Grab	All Months	BPJ
Nitrogen, Organic Total (As N) (00605) Effluent Gross Value	152.0 Monthly Average	284.0 Maximum Daily	lbs/day	*****	*****	*****	*****	Weekly	Composite	All Months	EGL
Nitrogen, Ammonia Total (As N) (00610) Effluent Gross Value	233.0 Monthly Average	526.0 Maximum Daily	lbs/day	*****	*****	*****	*****	Weekly	Composite	All Months	EGL
Nitrogen, Nitrate Total (As N) (00620) Effluent Gross Value	195.9 Monthly Average	461.6 Maximum Daily	lbs/day	*****	*****	*****	*****	Weekly	Composite	All Months	EGL
Flow, In Conduit or Thru Treatment Plant (50050) Effluent Gross Value	(Report) Monthly Average	(Report) Maximum Daily	MGD	*****	*****	*****	*****	Continuous	Totalizer	All Months	EGL
BOD, Carbonaceous 05 Day, 20C (80082) Effluent Gross Value	*****	*****	*****	*****	25.0 Monthly Average	37.5 Weekly Average	mg/l	Monthly	Grab	All Months	EGL/BPJ

*Basis for Permit Limitation

- BPJ – Best Professional Judgment
- WQBEL – Water Quality Based Effluent Limits
- EGL – Federal Effluent Guideline Limitations
- 316(a) – Thermal Variance

Discussion

Categorical process wastewaters associated with the production of ammonia, nitric acid, urea, and ammonium nitrate in addition to non-categorical wastestreams including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff are discharged to the NPDES Treatment Pond. The Department has developed categorical effluent guideline limitations applied at Internal Outfall 01A which is the discharges from the NPDES Treatment Pond based on the applicable provisions of 40 CFR Part 418 - Fertilizer Manufacturing Point Source Category. Compliance with secondary treatment standards for sanitary wastewaters has been proposed at internal Outfal 01A. The discharges from the NPDES Treatment Pond (Internal Outfall 01A) combine with once through non-contact cooling waters and stormwater runoff before final discharge through Outfall 001. Water quality based effluent limitations have been proposed after combination of all wastestreams at Outfall 001.

The facility also operates an Irrigation Pond which receives waters from the ammonia, nitric acid, urea, and nitrate production processes. The water in the irrigation pond is monitored for nutrient content and balanced with non-contact cooling water and/or water from the NPDES Treatment Pond as needed for agricultural irrigation. Through an agreement with a local farmer, water from the Irrigation Pond is land applied on cropland surrounding the facility.

The Department's Water Quality Branch has determined that the receiving stream for Outfall 001 should be listed as an Unnamed Tributary of the Tennessee River instead of as directly to the Tennessee River. As a result, water quality calculations have been developed using the flow characteristics of the Unnamed Tributary.

Best Management Practices (BMPs) are believed to be the most effective way to control the contamination of stormwater from areas of industrial activities. This facility is required to maintain a BMP plan. The requirements of the BMP plan call for minimization of stormwater contact with waste materials, products and by-products, and for prevention of spills or loss of fluids from equipment maintenance activities. The effectiveness of the BMPs will be measured through the monitoring of the pollutants of concern.

The parameters of concern for this facility are based on the parameters of concern listed in the permit application and from the current permit. These parameters are consistent with similar facilities in the state and have been proven to be reflective of the operations at this facility. The proposed monitoring frequencies are based on a review of site specific conditions and an evaluation of similar facilities.

Outfall 001

Total facility discharge including non-contact cooling water, stormwater runoff, and Internal Outfall DSN01A - process wastewater discharges associated with the production of ammonia, nitric acid, urea, and ammonium nitrate including sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff.

Temperature

The proposed temperature limitations are based on a 316(a) thermal variance. The Permittee submitted a demonstration for proposal of a thermal variance following EPA's Section 316(a) regulations and guidance. Based on the information submitted by the Permittee, the Department has determined that a balanced and indigenous population (BIP) is being maintained in the Unnamed Tributary to the Tennessee River.

pH

ADEM Administrative Code, Division 6 Regulations, 335-6-10-.09(5)(e)(2) – Specific Water Quality Criteria for Fish and Wildlife classified streams states: "Sewage, industrial waste or other wastes shall not cause the pH to deviate more than one unit from then normal or natural pH, nor be less than 6.0, nor greater than 8.5 standard units."

Total Suspended Solids (TSS), Carbonaceous Biochemical Oxygen Demand (CBOD)

Monitoring is proposed to evaluate the effectiveness of the facility treatment system and the impact of the discharge on the receiving stream.

Oil & Grease

The Oil and Grease limitations are proposed to be continued from the previous permit based on BPJ and should prevent the occurrence of a visible sheen in the receiving stream. These limitations have been shown to be achievable through the use of proper BMPs.

Ammonia

The proposed Outfall 001 ammonia limitations were developed in consultation with the Department's Water Quality Branch based on ammonia toxicity.

Nutrients (Kjeldahl Nitrogen, Nitrite Plus Nitrate, Phosphorus)

The Department's Water Quality Branch has requested monitoring to provide information regarding the nutrient contribution of the discharge to the receiving stream and river basin.

Total Residual Chlorine (TRC)

The proposed TRC limitations are based on the United States Environmental Protection Agency's (EPA) recommended water quality standard. In accordance with a letter dated August 11, 1998 from EPA Headquarters and a 1991 memorandum from EPA Region 4's Environmental Services Division (ESD), due to testing and method detection limitations, a Total Residual Chlorine measurement below 0.05 mg/L shall be considered below detection for compliance purposes and should be reported as *B on the electronic discharge monitoring report.

E. Coli

E. Coli limitations are proposed due to the discharge of sanitary wastewaters and are based on ADEM Administrative Code, Division 6 Regulations, 335-6-10-.09(5)(e)(7) -Specific Water Quality Criteria for Fish and Wildlife classified streams.

Chronic Toxicity Biomonitoring

Monitoring is proposed at an IWC of 100% based on the receiving stream minimum 7-day low flow that occurs once in 10 years (7Q10).

Internal Outfall 01A

Internal Outfall 01A is located at the discharge from the NPDES Treatment Pond to Outfall DSN 001 to demonstrate compliance with categorical effluent guideline limitations associated with the production of ammonia, nitric acid, urea, and ammonium nitrate. Other non-categorical discharges to the NPDES Treatment Pond include sanitary wastewaters, boiler blowdown, water filter backwash, cooling tower blowdown, and stormwater runoff.

Federal Effluent Guideline Limitations (EGL)

Parameters based upon EGL have had effluent guidelines established under the 40 CFR40 CFR Part 418 - Fertilizer Manufacturing Point Source Category. Specifically Subpart B - Ammonia Subcategory, Subpart C - Urea Subcategory, Subpart D - Ammonium Nitrate Subcategory, and Subpart E - Nitric Acid Subcategory. Please see the attached guideline calculations.

Secondary Treatment Standards – TSS and CBOD

Compliance with secondary treatment standards for TSS and CBOD have been proposed at Internal Outfall 01A prior to comingling with once through cooling water and stormwater runoff. The sanitary wastewaters are pretreated in a dedicated sanitary treatment system and then routed to the NPDES Treatment Pond for final treatment prior to discharge through Internal Outfall 01A and ultimately final Outfall 001.

303(d) List of Impaired Waters/Total Maximum Daily Load (TMDL)

The discharge is within a 24-hour travel time to the Tennessee River which is listed on the 303(d) List of Impaired Waters for mercury. The discharge from the facility is not expected to contribute to the mercury impairment.

Stormwater Outfalls 002 and 003 (Removal)
Outfalls 002 and 003 have served as stormwater outfalls for discharges from the land application fields. The agricultural activities performed on the land application fields are conducted by a local farmer through an agreement with the Permittee. The land application waters have previously been deemed to be a fertilizer by The Alabama Department of Agriculture and Industries based on the nutrient content. The Department has determined that the stormwater discharges from the land application fields are not subject to NPDES permitting requirements based on the agricultural stormwater runoff exemption at 40 CFR Part 122.2.

Groundwater Monitoring (Removal)
The Department's Groundwater Branch has completed a review of the groundwater data submitted by the Permittee as required by NPDES Permit AL0000418. The review indicated consistent groundwater flow from the northwest to the southeast, towards Malone Creek and the Tennessee River. Additionally, elevated levels of nitrate plus nitrite nitrogen, as compared to the drinking water maximum contaminant level, were noted in several monitoring wells including the stated background wells. No drinking water wells were identified by the Groundwater Branch in the area.

Cooling Water Intake Structure (CWIS) Requirements
Section 316(b) of the Clean Water Act requires that facilities minimize adverse environmental impacts resulting from the operation of cooling water intake structures (CWIS) by using the "Best Technology Available" (BTA). All of those facilities including those not specifically addressed by rules, must be evaluated for 316(b) compliance. For those facilities not addressed in Phase I, II, or III rules, a BTA determination must be made using "Best Professional Judgment" (BPJ) under the authority of 40 CFR §§ 125 Subpart J and 401.14. Facilities that meet these criteria must submit the information described in 40 CFR 122.21(r)(2) through (r)(8) in order for the Department to make a BTA determination.

The Department has determined that the CWIS operated by the facility is subject to the 316(b) Phase II requirements. The CWIS withdrawals water from the Tennessee River utilizing three lift pumps for a maximum design flowrate of 45 MGD. Each pump has a design pump rate of 15 MGD. Two 84-inch diameter intake pipes extend horizontally from the riverbank approximately 100 feet into the navigation channel of the river. The intake pipes have 45° wye with dual opening ends facing downstream and perpendicular to the river that are fitted with 12-inch by 12 inch mesh, bar type screens. The intake water travels through the intake pipes into a stilling basin on the bank of the river. One of three pumps pulls water from the stilling basin through a traveling chain and basket steel screen with a vertical chain speed of 10 feet per minute. The average CWIS intake flowrate is less than 1% of the annual average flow of the Tennessee River. No entrainment mortality studies have been conducted for the CWIS.

40 CFR Part 125.94(c)(11) states, "In limited circumstances, rates of impingement may be so low at a facility that additional impingement controls may not be justified. The Director, based on review of site-specific data submitted under 40 CFR 122.21(r), may conclude that the documented rate of impingement at the cooling water intake is so low that no additional controls are warranted." Based on historical observations and recent documentation of impingement rates, the facility petitioned the Department to conduct a De Minimis Impingement Study to demonstrate that the rate of impingement does not warrant additional controls. Based on a review of the study findings, the Department determined that that additional impingement controls may not currently be justified. The facility must submit supporting information and demonstration for continuation of the De Minimis determination at least 180 days prior to expiration of the permit.

At this time, the Department has made a BTA determination that the CWIS represents the best technology available to minimize adverse environmental impact in accordance with Section 316(b) of the Federal Clean Water Act (33 U.S.C. section 1326). The facility is required to operate and maintain the CWIS in a manner that minimizes impingement and entrainment levels. Documentation detailing the steps that have and are being taken to minimize the impingement and entrainment levels shall be maintained on-site and made available upon request during inspections. The following conditions are proposed in the draft permit.

1. The CWIS used by the Permittee has been evaluated using available information. At this time, the Department has determined that the CWIS represents the best technology available (40 CFR 125.98(b)(6)) to minimize adverse environmental impact in accordance with Section 316(b) of the Federal Clean Water Act (33 U.S.C. section 1326).

2. The Permittee is required to operate and maintain the CWIS in a manner that minimizes impingement and entrainment levels. Documentation detailing the steps that have and are being taken to minimize the impingement and entrainment levels shall be maintained on site and made available upon request.

3. Nothing in this Permit authorizes take for the purposes of a facility compliance with the Endangered Species Act. Under the Endangered Species Act, take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct, of endangered or threatened species.

4. The Permittee shall submit the information required by the applicable provisions of 40 CFR 122.21(r) at least 180 days prior to permit expiration. The Permittee may request to reduce the information required, if conditions at the facility and in the waterbody remain substantially unchanged since the previous application so long as the relevant previously submitted information remains representative of current source water, intake structure, cooling water system, and operating conditions. Any habitat designated as critical or species listed as threatened or endangered after issuance of the current permit whose range of habitat or designated critical habit includes waters where a facility intake is located constitutes potential for a substantial change that must be addressed by the owner/operator in subsequent permit applications, unless the facility received an exemption pursuant to 16 U.S.C. 1536(o) or a permit pursuant to 16 U.S.C. 1539(a) or there is no reasonable expectation of take. **The Permittee must submit its request for reduced cooling water intake structure and waterbody application information to the Director at least two years and six months prior to the expiration of the NPDES permit.** The Permittee's request must identify each element that it determines has not substantially changed since the previous permit application and the basis for the determination. The Director has the discretion to accept or reject any part of the request.

5. The Permittee must keep records of all submissions that are part of the permit application pertaining to the CWIS until the subsequent permit is issued to the Permittee.

6. The Permittee's permit application must contain readily available information, at the time of permit application development, in identifying all Federally-listed threatened and endangered species and/or designated critical habitat that are or may be present in the action area.

7. The Permittee must conduct weekly visual inspections or employ remote monitoring devices during the period the cooling water intake structures are in operation. This condition is only applicable if control technologies are being employed to comply with final BTA for impingement mortality.

8. The Permittee is required to submit an Annual Certification to the Department no later than January 28th of each year. The Annual Certification shall detail if any changes have been made to impact the operation of the CWIS structure.

Revision December 28, 2023

The permit has been revised based on comments received from the Permittee. The Permittee requested a reduction in the proposed phosphorus monitoring requirements. The Permittee indicated the facility is a nitrogen-based fertilizer producer and does not produce any phosphorus-based products. The Department has reduced the proposed phosphorus monitoring requirements from weekly to monthly during the growing season.

The Permittee requested that the secondary treatment requirements for CBOD and TSS be applied at final Outfall 0011 instead of the newly proposed internal Outfall 01B. The sanitary wastewaters are pretreated in a dedicated sanitary treatment system and then routed to the NPDES Treatment Pond for final treatment prior to discharge through Internal Outfall 01A and ultimately final Outfall 001. Due to dilution provided by once through cooling waters, the Department has proposed the CBOD and TSS secondary treatment standards be applied at internal Outfall 01A which is after treatment but prior to comingling with the once through cooling water.

Revision April 16, 2025

The Department has revised the proposed draft permit based on comments received from the U.S. EPA concerning the proposed 316(a) Thermal Variance. The Department has proposed the following requirements in Permit Part IV.D:

The Permittee shall conduct a 316(a) study during the permit cycle. A 316(a) study plan shall be submitted to the Department for review within 180 days after the effective date of this permit and shall be revised as soon as practical based upon subsequent receipt of comments from the Department. After the study plan has been approved by the Department, the Permittee shall complete the study and submit the results to the Department at least 365 days prior to the expiration date of this permit.

The field study portion of the 316(a) study shall consider the following components:

1. Fish collection
2. Habitat evaluation
3. In-situ water quality
4. Water sample collection

The study shall be completed at the following stations that were utilized in the original 316(a) study unless otherwise approved by the Department:

- CN-UT (Cherokee Nitrogen Unnamed Tributary): This monitoring station is located downstream of the waterfall in the Cherokee Nitrogen discharge tributary and runs from the most downstream riffle upstream to the base (the toe) of the waterfall pool. This reach is approximately 500 feet long, maximum.

- MSB-1 – Moon Springs Branch: This monitoring station is located upstream of last riffle before the mouth of the Tennessee River and runs approximately 1000 feet upstream.

Cherokee Nitrogen, LLC
NPDES Permit Number AL0000418

40 CFR Part 418 Subpart B Ammonia Subcategory
40 CFR Part 418.23 BAT Effluent Limitations
Production = 1,090,919 lbs/day

	Guideline Factors (lbs/1,000 lbs of product)			Calculated Allocation in lbs/day	
Parameter	Mamimum	Average	Production in 1,000 lbs/day	Mamimum	Average
Ammonia	0.05	0.025	1,090.919	54.55	27.27

40 CFR Part 418 Subpart C Urea Subcategory
40 CFR Part 418.33(b) BAT Effluent Limitations
Production = 567,691 lbs/day

	Guideline Factors (lbs/1,000 lbs of product)			Calculated Allocation in lbs/day	
Parameter	Mamimum	Average	Production in 1,000 lbs/day	Mamimum	Average
Ammonia	0.53	0.27	567.691	300.88	153.28
Organic Nitrogen	0.86	0.46	567.691	488.21	261.14

40 CFR Part 418 Subpart D Ammonium Nitrate Subcategory
40 CFR Part 418.43(b) BAT Effluent Limitations

Production =			
	Ammonium Nitrate Solution	1,171,888	lbs/day
	Ammonium Nitrate Prill	0	lbs/day
	Urea Ammonuium Nitrate Solution	1,310,511	lbs/day
	Total	2,482,399	lbs/day

	Guideline Factors (lbs/1,000 lbs of product)			Calculated Allocation in lbs/day	
Parameter	Mamimum	Average	Production in 1,000 lbs/day	Mamimum	Average
Ammonia	0.08	0.04	2,482	198.59	99.30
Nitrate	0.12	0.07	2,482	297.89	173.77

40 CFR Part 418 Subpart E Nitric Acid Subcategory
40 CFR Part 418.53(b) BAT Effluent Limitations
Production = 962,736 lbs/day

	Guideline Factors (lbs/1,000 lbs of product)			Calculated Allocation in lbs/day	
Parameter	Mamimum	Average	Production in 1,000 lbs/day	Mamimum	Average
Ammonia	0.08	0.008	963	77.02	7.70
Nitrate	0.17	0.023	963	163.67	22.14

	Calculated Guideline Allocation in lbs/day			Existing Permit Limits in lbs/day	
Parameter	Mamimum	Average	Parameter	Mamimum	Average
Ammonia	631.03	287.55	Ammonia	526.0	233.0
Organic Nitrogen	488.21	261.14	Organic Nitrogen	284.0	152.0
Nitrate	461.55	195.91	Nitrate	563.0	199.0

	Proposed Draft Permit Limitations in lbs/day	
Parameter	Mamimum	Average
Ammonia	526.0	233.0
Organic Nitrogen	284.0	152.0
Nitrate	461.6	195.9

Facility Name: **Cherokee Nitrogen LLC**

NPDES No.: **AL0000418**

$$Q_d*C_d + Q_{d2}*C_{d2} + Q_s*C_s = Q_r*C_r$$

ID	Pollutant	Carcinogen "yes"	Type	Background from upstream source (C_{d2}) Daily Max	Background from upstream source (C_{d2}) Monthly Ave	Background Instream (C_s) Daily Max	Background Instream (C_s) Monthly Ave	**Enter** Max Daily Discharge as reported by Applicant (C_d) Max	**Enter** Avg Daily Discharge as reported by Applicant (C_d) Ave	Partition Coefficient (Stream / Lake)
				µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	
1	Antimony		Metals	0	0	0	0	0	0	-
2	**Arsenic*,****	YES	Metals	0	0	0	0	0	0	0.574
3	Berylium		Metals	0	0	0	0	0	0	-
4	Cadmium**		Metals	0	0	0	0	0	0	0.236
5	Chromium / Chromium III**		Metals	0	0	0	0	0	0	0.210
6	Chromium / Chromium VI**		Metals	0	0	0	0	0	0	
7	Copper**		Metals	0	0	0	0	0	0	0.388
8	Lead**		Metals	0	0	0	0	0	0	0.206
9	Mercury**		Metals	0	0	0	0	0	0	0.302
10	Nickel**		Metals	0	0	0	0	0	0	0.505
11	Selenium		Metals	0	0	0	0	0	0	-
12	Silver		Metals	0	0	0	0	0	0	-
13	Thallium		Metals	0	0	0	0	0	0	-
14	Zinc**		Metals	0	0	0	0	0	0	0.330
15	Cyanide		Metals	0	0	0	0	0	0	-
16	Total Phenolic Compounds		Metals	0	0	0	0	0	0	-
17	Hardness (As CaCO3)		Metals	0	0	0	0	0	0	-
18	Acrolein		VOC	0	0	0	0	0	0	-
19	**Acrylonitrile***	YES	VOC	0	0	0	0	0	0	-
20	**Aldrin**	YES	VOC	0	0	0	0	0	0	-
21	**Benzene***	YES	VOC	0	0	0	0	0	0	-
22	**Bromoform***	YES	VOC	0	0	0	0	0	0	-
23	**Carbon Tetrachloride***	YES	VOC	0	0	0	0	0	0	-
24	**Chlordane**	YES	VOC	0	0	0	0	0	0	-
25	Clorobenzene		VOC	0	0	0	0	0	0	-
26	**Chlorodibromo-Methane***	YES	VOC	0	0	0	0	0	0	-
27	Chloroethane		VOC	0	0	0	0	0	0	-
28	2-Chloro-Ethylvinyl Ether		VOC	0	0	0	0	0	0	-
29	**ChloroForm***	YES	VOC	0	0	0	0	0	0	-
30	**4,4'-DDD**	YES	VOC	0	0	0	0	0	0	-
31	**4,4'-DDE**	YES	VOC	0	0	0	0	0	0	-
32	**4.4'-DDT**	YES	VOC	0	0	0	0	0	0	-
33	**Dichlorobromo-Methane***	YES	VOC	0	0	0	0	0	0	-
34	1, 1-Dichloroethane		VOC	0	0	0	0	0	0	-
35	**1, 2-Dichloroethane***	YES	VOC	0	0	0	0	0	0	-
36	Trans-1, 2-Dichloro-Ethylene		VOC	0	0	0	0	0	0	-
37	**1, 1-Dichloroethylene***	YES	VOC	0	0	0	0	0	0	-
38	1, 2-Dichloropropane		VOC	0	0	0	0	0	0	-
39	1, 3-Dichloro-Propylene		VOC	0	0	0	0	0	0	-
40	**Dieldrin**	YES	VOC	0	0	0	0	0	0	-
41	Ethylbenzene		VOC	0	0	0	0	0	0	-
42	Methyl Bromide		VOC	0	0	0	0	0	0	-
43	Methyl Chloride		VOC	0	0	0	0	0	0	-
44	**Methylene Chloride***	YES	VOC	0	0	0	0	0	0	-
45	**1, 1, 2, 2-Tetrachloro-Ethane***	YES	VOC	0	0	0	0	0	0	-
46	**Tetrachloro-Ethylene***	YES	VOC	0	0	0	0	0	0	-
47	Toluene		VOC	0	0	0	0	0	0	-
48	**Toxaphene**	YES	VOC	0	0	0	0	0	0	-
49	**Tributyltine (TBT)**	YES	VOC	0	0	0	0	0	0	-
50	1, 1, 1-Trichloroethane		VOC	0	0	0	0	0	0	-
51	**1, 1, 2-Trichloroethane***	YES	VOC	0	0	0	0	0	0	-
52	**Trichlorethylene***	YES	VOC	0	0	0	0	0	0	-
53	**Vinyl Chloride***	YES	VOC	0	0	0	0	0	0	-
54	P-Chloro-M-Cresol		Acids	0	0	0	0	0	0	-
55	2-Chlorophenol		Acids	0	0	0	0	0	0	-
56	2, 4-Dichlorophenol		Acids	0	0	0	0	0	0	-
57	2, 4-Dimethylphenol		Acids	0	0	0	0	0	0	-
58	4, 6-Dinitro-O-Cresol		Acids	0	0	0	0	0	0	-
59	2, 4-Dinitrophenol		Acids	0	0	0	0	0	0	-
60	**4,6-Dintro-2-methylophenol**	YES	Acids	0	0	0	0	0	0	-
61	**Dioxin (2,3,7,8-TCDD)**	YES	Acids	0	0	0	0	0	0	-
62	2-Nitrophenol		Acids	0	0	0	0	0	0	-
63	4-Nitrophenol		Acids	0	0	0	0	0	0	-
64	**Pentachlorophenol***	YES	Acids	0	0	0	0	0	0	-
65	Phenol		Acids	0	0	0	0	0	0	-
66	**2, 4, 6-Trichlorophenol***	YES	Acids	0	0	0	0	0	0	-
67	Acenaphthene		Bases	0	0	0	0	0	0	-
68	Acenaphthylene		Bases	0	0	0	0	0	0	-
69	Anthracene		Bases	0	0	0	0	0	0	-
70	Benzidine		Bases	0	0	0	0	0	0	-
71	**Benzo(A)Anthracene***	YES	Bases	0	0	0	0	0	0	-
72	**Benzo(A)Pyrene***	YES	Bases	0	0	0	0	0	0	-
73	3, 4 Benzo-Fluoranthene		Bases	0	0	0	0	0	0	-
74	Benzo(GHI)Perylene		Bases	0	0	0	0	0	0	-
75	Benzo(K)Fluoranthene		Bases	0	0	0	0	0	0	-
76	Bis (2-Chloroethoxy) Methane		Bases	0	0	0	0	0	0	-
77	**Bis (2-Chloroethyl)-Ether***	YES	Bases	0	0	0	0	0	0	-
78	Bis (2-Chloroiso-Propyl) Ether		Bases	0	0	0	0	0	0	-
79	**Bis (2-Ethylhexyl) Phthalate***	YES	Bases	0	0	0	0	0	0	-
80	4-Bromophenyl Phenyl Ether		Bases	0	0	0	0	0	0	-
81	Butyl Benzyl Phthalate		Bases	0	0	0	0	0	0	-
82	2-Chloronaphthalene		Bases	0	0	0	0	0	0	-
83	4-Chlorophenyl Phenyl Ether		Bases	0	0	0	0	0	0	-
84	**Chrysene***	YES	Bases	0	0	0	0	0	0	-
85	Di-N-Butyl Phthalate		Bases	0	0	0	0	0	0	-
86	Di-N-Octyl Phthalate		Bases	0	0	0	0	0	0	-
87	**Dibenzo(A,H)Anthracene***	YES	Bases	0	0	0	0	0	0	-
88	1, 2-Dichlorobenzene		Bases	0	0	0	0	0	0	-
89	1, 3-Dichlorobenzene		Bases	0	0	0	0	0	0	-
90	1, 4-Dichlorobenzene		Bases	0	0	0	0	0	0	-
91	**3, 3-Dichlorobenzidine***	YES	Bases	0	0	0	0	0	0	-
92	Diethyl Phthalate		Bases	0	0	0	0	0	0	-
93	Dimethyl Phthalate		Bases	0	0	0	0	0	0	-
94	**2, 4-Dinitrotoluene***	YES	Bases	0	0	0	0	0	0	-
95	2, 6-Dinitrotoluene		Bases	0	0	0	0	0	0	-
96	1,2-Diphenylhydrazine		Bases	0	0	0	0	0	0	-
97	**Endosulfan (alpha)**	YES	Bases	0	0	0	0	0	0	-
98	**Endosulfan (beta)**	YES	Bases	0	0	0	0	0	0	-
99	**Endosulfan sulfate**	YES	Bases	0	0	0	0	0	0	-
100	**Endrin**	YES	Bases	0	0	0	0	0	0	-
101	**Endrin Aldeyhide**	YES	Bases	0	0	0	0	0	0	-
102	Fluoranthene		Bases	0	0	0	0	0	0	-
103	Fluorene		Bases	0	0	0	0	0	0	-
104	Heptochlor	YES	Bases	0	0	0	0	0	0	-
105	Heptachlor Epoxide	YES	Bases	0	0	0	0	0	0	-
106	**Hexachlorobenzene***	YES	Bases	0	0	0	0	0	0	-
107	**Hexachlorobutadiene***	YES	Bases	0	0	0	0	0	0	-
108	**Hexachlorocyclohexan (alpa)**	YES	Bases	0	0	0	0	0	0	-
109	**Hexachlorocyclohexan (beta)**	YES	Bases	0	0	0	0	0	0	-
110	**Hexachlorocyclohexan (gamma)**	YES	Bases	0	0	0	0	0	0	-
111	HexachlorocycloPentadiene		Bases	0	0	0	0	0	0	-
112	Hexachloroethane		Bases	0	0	0	0	0	0	-
113	**Indeno(1, 2, 3-CK)Pyrene***	YES	Bases	0	0	0	0	0	0	-
114	Isophorone		Bases	0	0	0	0	0	0	-
115	Naphthalene		Bases	0	0	0	0	0	0	-
116	Nitrobenzene		Bases	0	0	0	0	0	0	-
117	**N-Nitrosodi-N-Propylamine***	YES	Bases	0	0	0	0	0	0	-
118	**N-Nitrosodi-N-Methylamine***	YES	Bases	0	0	0	0	0	0	-
119	**N-Nitrosodi-N-Phenylamine***	YES	Bases	0	0	0	0	0	0	-
120	**PCB-1016**	YES	Bases	0	0	0	0	0	0	-
121	**PCB-1221**	YES	Bases	0	0	0	0	0	0	-
122	**PCB-1232**	YES	Bases	0	0	0	0	0	0	-
123	**PCB-1242**	YES	Bases	0	0	0	0	0	0	-
124	**PCB-1248**	YES	Bases	0	0	0	0	0	0	-
125	**PCB-1254**	YES	Bases	0	0	0	0	0	0	-
126	**PCB-1260**	YES	Bases	0	0	0	0	0	0	-
127	Phenanthrene		Bases	0	0	0	0	0	0	-
128	Pyrene		Bases	0	0	0	0	0	0	-
129	1, 2, 4-Trichlorobenzene		Bases	0	0	0	0	0	0	-

v. 041014jhl

22.924	**Enter** Q_d = wastewater discharge flow from facility (MGD)
35.4686776	Q_d = wastewater discharge flow (cfs) (this value is caluclated from the MGD)
0	**Enter flow from upstream discharge** Qd2 = background stream flow in MGD above point of discharge
0	Qd2 = background stream flow from upstream source (cfs)
0	**Enter 7Q10,** Q_s = background stream flow in cfs above point of discharge
0	**Enter or estimated, 1Q10,** Q_s = background stream flow in cfs above point of discharge (1Q10 estimated at 75% of 7Q10)
1.81	**Enter Mean Annual Flow**, Q_s = background stream flow in cfs above point of discharge
0	**Enter 7Q2**, Q_s = background stream flow in cfs above point of discharge (For LWF class streams)
Enter to Left	**Enter C_s** = background in-stream pollutant concentration in µg/l (assuming this is zero "0" unless there is data)
Q_d +Qd2+Q_s	Q_r = resultant in-stream flow, after discharge
Calculated on other	C_r = resultant in-stream pollutant concentration in µg/l in the stream (after complete mixing occurs)
100	**Enter**, Background Hardness above point of discharge (assumed 50 South of Birmingham and 100 North of Birmingham)
7.00 s.u.	**Enter**, Background pH above point of discharge
YES	**Enter**, Is discharge to a stream? "YES" Other option would be to a Lake. (This changes the partition coefficients for the metals)

** Using Partition Coefficients

April 30, 2025

Facility Name: **Cherokee Nitrogen LLC**

NPDES No.: **AL0000418**

Freshwater F&W classification.					Max Daily Discharge as reported by Applicant (C_{dmax})	Freshwater Acute (µg/l) Q_s =1Q10				Background from upstream source (Cd2) Monthly Ave	Avg Daily Discharge as reported by Applicant (C_{davg})	Freshwater Chronic (µg/l) Q_s = 7Q10				Human Health Consumption Fish only (µg/l) Carcinogen Q_s = Annual Average Non-Carcinogen Q_s = 7Q10			
ID	Pollutant	RP?	Carcinogen yes	Background from upstream source (Cd2) Daily Max		Water Quality Criteria (C_r)	Draft Permit Limit (C_{dmax})	20% of Draft Permit Limit	RP?			Water Quality Criteria (C_r)	Draft Permit Limit (C_{davg})	20% of Draft Permit Limit	RP?	Water Quality Criteria (C_r)	Draft Permit Limit (C_{davg})	20% of Draft Permit Limit	RP?
1	Antimony			0	0	-	-	-	-	0	0	-	-	-	-	3.73E+02	3.73E+02	7.47E+01	No
2	Arsenic		YES	0	0	592.334	592.334	118.467	No	0	0	261.324	261.324	52.265	No	3.03E-01	3.18E-01	6.37E-02	No
3	Berylium			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
4	Cadmium			0	0	8.533	8.533	1.707	No	0	0	1.042	1.042	0.208	No	-	-	-	-
5	Chromium/ Chromium III			0	0	2713.159	2713.159	542.632	No	0	0	352.926	352.926	70.585	No	-	-	-	-
6	Chromium/ Chromium VI			0	0	16.000	16.000	3.200	No	0	0	11.000	11.000	2.200	No	-	-	-	-
7	Copper			0	0	34.637	34.637	6.927	No	0	0	23.082	23.082	4.616	No	-	-	-	-
8	Lead			0	0	313.502	313.502	62.700	No	0	0	12.217	12.217	2.443	No	-	-	-	-
9	Mercury			0	0	2.400	2.400	0.480	No	0	0	0.012	0.012	0.002	No	4.24E-02	4.24E-02	8.48E-03	No
10	Nickel			0	0	927.200	927.200	185.440	No	0	0	102.983	102.983	20.597	No	9.93E+02	9.93E+02	1.99E+02	No
11	Selenium			0	0	20.000	20.000	4.000	No	0	0	5.000	5.000	1.000	No	2.43E+03	2.43E+03	4.86E+02	No
12	Silver			0	0	3.217	3.217	0.643	No	0	0	-	-	-	-	-	-	-	-
13	Thallium			0	0	-	-	-	-	0	0	-	-	-	-	2.74E-01	2.74E-01	5.47E-02	No
14	Zinc			0	0	355.092	355.092	71.018	No	0	0	357.997	357.997	71.599	No	1.49E+04	1.49E+04	2.98E+03	No
15	Cyanide			0	0	22.000	22.000	4.400	No	0	0	5.200	5.200	1.040	No	9.33E+03	9.33E+03	1.87E+03	No
16	Total Phenolic Compounds			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
17	Hardness (As CaCO3)			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
18	Acrolein			0	0	-	-	-	-	0	0	-	-	-	-	5.43E+00	5.43E+00	1.09E+00	No
19	Acrylonitrile		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.44E-01	1.51E-01	3.03E-02	No
20	Aldrin		YES	0	0	3.000	3.000	0.600	No	0	0	-	-	-	-	2.94E-05	3.09E-05	6.18E-06	No
21	Benzene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.55E+01	1.63E+01	3.25E+00	No
22	Bromoform		YES	0	0	-	-	-	-	0	0	-	-	-	-	7.88E+01	8.28E+01	1.66E+01	No
23	Carbon Tetrachloride		YES	0	0	-	-	-	-	0	0	-	-	-	-	9.57E-01	1.01E+00	2.01E-01	No
24	Chlordane		YES	0	0	2.400	2.400	0.480	No	0	0	0.0043	0.004	0.001	No	4.73E-04	4.97E-04	9.94E-05	No
25	Clorobenzene			0	0	-	-	-	-	0	0	-	-	-	-	9.06E+02	9.06E+02	1.81E+02	No
26	Chlorodibromo-Methane		YES	0	0	-	-	-	-	0	0	-	-	-	-	7.41E+00	7.79E+00	1.56E+00	No
27	Chloroethane			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
28	2-Chloro-Ethylvinyl Ether			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
29	ChloroForm		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.02E+02	1.07E+02	2.14E+01	No
30	4,4' - DDD		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.81E-04	1.91E-04	3.81E-05	No
31	4,4' - DDE		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.28E-04	1.35E-04	2.69E-05	No
32	4,4' - DDT		YES	0	0	1.100	1.100	0.220	No	0	0	0.001	0.001	0.000	No	1.28E-04	1.35E-04	2.69E-05	No
33	Dichlorobromo-Methane		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.00E+01	1.05E+01	2.11E+00	No
34	1, 1-Dichloroethane			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
35	1, 2-Dichloroethane		YES	0	0	-	-	-	-	0	0	-	-	-	-	2.14E+01	2.25E+01	4.49E+00	No
36	Trans-1, 2-Dichloro-Ethylene			0	0	-	-	-	-	0	0	-	-	-	-	5.91E+03	5.91E+03	1.18E+03	No
37	1, 1-Dichloroethylene		YES	0	0	-	-	-	-	0	0	-	-	-	-	4.17E+03	4.38E+03	8.76E+02	No
38	1, 2-Dichloropropane			0	0	-	-	-	-	0	0	-	-	-	-	8.49E+00	8.49E+00	1.70E+00	No
39	1, 3-Dichloro-Propylene			0	0	-	-	-	-	0	0	-	-	-	-	1.23E+01	1.23E+01	2.46E+00	No
40	Dieldrin		YES	0	0	0.240	0.240	0.048	No	0	0	0.056	0.056	0.011	No	3.12E-05	3.28E-05	6.56E-06	No
41	Ethylbenzene			0	0	-	-	-	-	0	0	-	-	-	-	1.24E+03	1.24E+03	2.49E+02	No
42	Methyl Bromide			0	0	-	-	-	-	0	0	-	-	-	-	8.71E+02	8.71E+02	1.74E+02	No
43	Methyl Chloride			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
44	Methylene Chloride		YES	0	0	-	-	-	-	0	0	-	-	-	-	3.46E+02	3.63E+02	7.27E+01	No
45	1, 1, 2, 2-Tetrachloro-Ethane		YES	0	0	-	-	-	-	0	0	-	-	-	-	2.33E+00	2.45E+00	4.90E-01	No
46	Tetrachloro-Ethylene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.92E+00	2.01E+00	4.03E-01	No
47	Toluene			0	0	-	-	-	-	0	0	-	-	-	-	8.72E+03	8.72E+03	1.74E+03	No
48	Toxaphene		YES	0	0	0.730	0.730	0.146	No	0	0	0.0002	0.000	0.000	No	1.62E-04	1.70E-04	3.40E-05	No
49	Tributyltin (TBT)		YES	0	0	0.460	0.460	0.092	No	0	0	0.072	0.072	0.014	No	-	-	-	-
50	1, 1, 1-Trichloroethane			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
51	1, 1, 2-Trichloroethane		YES	0	0	-	-	-	-	0	0	-	-	-	-	9.10E+00	9.56E+00	1.91E+00	No
52	Trichlorethylene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.75E+01	1.84E+01	3.67E+00	No
53	Vinyl Chloride		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.42E+00	1.50E+00	2.99E-01	No
54	P-Chloro-M-Cresol			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
55	2-Chlorophenol			0	0	-	-	-	-	0	0	-	-	-	-	8.71E+01	8.71E+01	1.74E+01	No
56	2, 4-Dichlorophenol			0	0	-	-	-	-	0	0	-	-	-	-	1.72E+02	1.72E+02	3.44E+01	No
57	2, 4-Dimethylphenol			0	0	-	-	-	-	0	0	-	-	-	-	4.98E+02	4.98E+02	9.95E+01	No
58	4, 6-Dinitro-O-Cresol			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
59	2, 4-Dinitrophenol			0	0	-	-	-	-	0	0	-	-	-	-	3.11E+03	3.11E+03	6.22E+02	No
60	4,6-Dinitro-2-methylphenol		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.65E+02	1.74E+02	3.48E+01	No
61	Dioxin (2,3,7,8-TCDD)		YES	0	0	-	-	-	-	0	0	-	-	-	-	2.67E-08	2.80E-08	5.61E-09	No
62	2-Nitrophenol			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
63	4-Nitrophenol			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
64	Pentachlorophenol		YES	0	0	8.723	8.723	1.745	No	0	0	6.693	6.693	1.339	No	1.77E+00	1.86E+00	3.72E-01	No
65	Phenol			0	0	-	-	-	-	0	0	-	-	-	-	5.00E+05	5.00E+05	1.00E+05	No
66	2, 4, 6-Trichlorophenol		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.41E+00	1.49E+00	2.97E-01	No
67	Acenaphthene			0	0	-	-	-	-	0	0	-	-	-	-	5.79E+02	5.79E+02	1.16E+02	No
68	Acenaphthylene			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
69	Anthracene			0	0	-	-	-	-	0	0	-	-	-	-	2.33E+04	2.33E+04	4.67E+03	No
70	Benzidine			0	0	-	-	-	-	0	0	-	-	-	-	1.16E-04	1.16E-04	2.32E-05	No
71	Benzo(A)Anthracene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.12E-02	2.24E-03	No
72	Benzo(A)Pyrene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.12E-02	2.24E-03	No
73	Benzo(b)fluoranthene			0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.07E-02	2.13E-03	No
74	Benzo(GHI)Perylene			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
75	Benzo(K)Fluoranthene			0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.07E-02	2.13E-03	No
76	Bis (2-Chloroethoxy) Methane			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
77	Bis (2-Chloroethyl)-Ether		YES	0	0	-	-	-	-	0	0	-	-	-	-	3.07E-01	3.23E-01	6.46E-02	No
78	Bis (2-Chloroiso-Propyl) Ether			0	0	-	-	-	-	0	0	-	-	-	-	3.78E+04	3.78E+04	7.56E+03	No
79	Bis (2-Ethylhexyl) Phthalate		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.28E+00	1.35E+00	2.69E-01	No
80	4-Bromophenyl Phenyl Ether			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
81	Butyl Benzyl Phthalate			0	0	-	-	-	-	0	0	-	-	-	-	1.13E+03	1.13E+03	2.25E+02	No
82	2-Chloronaphthalene			0	0	-	-	-	-	0	0	-	-	-	-	9.24E+02	9.24E+02	1.85E+02	No
83	4-Chlorophenyl Phenyl Ether			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
84	Chrysene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.12E-02	2.24E-03	No
85	Di-N-Butyl Phthalate			0	0	-	-	-	-	0	0	-	-	-	-	2.62E+03	2.62E+03	5.24E+02	No
86	Di-N-Octyl Phthalate			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
87	Dibenzo(A,H)Anthracene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.12E-02	2.24E-03	No
88	1, 2-Dichlorobenzene			0	0	-	-	-	-	0	0	-	-	-	-	7.55E+02	7.55E+02	1.51E+02	No
89	1, 3-Dichlorobenzene			0	0	-	-	-	-	0	0	-	-	-	-	5.62E+02	5.62E+02	1.12E+02	No
90	1, 4-Dichlorobenzene			0	0	-	-	-	-	0	0	-	-	-	-	1.12E+02	1.12E+02	2.25E+01	No
91	3, 3-Dichlorobenzidine		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.66E-02	1.75E-02	3.49E-03	No
92	Diethyl Phthalate			0	0	-	-	-	-	0	0	-	-	-	-	2.56E+04	2.56E+04	5.11E+03	No
93	Dimethyl Phthalate			0	0	-	-	-	-	0	0	-	-	-	-	6.48E+05	6.48E+05	1.30E+05	No
94	2, 4-Dinitrotoluene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.98E+00	2.08E+00	4.16E-01	No
95	2, 6-Dinitrotoluene			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
96	1,2-Diphenylhydrazine			0	0	-	-	-	-	0	0	-	-	-	-	1.17E-01	1.17E-01	2.34E-02	No
97	Endosulfan (alpha)		YES	0	0	0.22	0.220	0.044	No	0	0	0.056	0.056	0.011	No	5.19E+01	5.45E+01	1.09E+01	No
98	Endosulfan (beta)		YES	0	0	0.22	0.220	0.044	No	0	0	0.056	0.056	0.011	No	5.19E+01	5.45E+01	1.09E+01	No
99	Endosulfan sulfate		YES	0	0	-	-	-	-	0	0	-	-	-	-	5.19E+01	5.45E+01	1.09E+01	No
100	Endrin		YES	0	0	0.086	0.086	0.017	No	0	0	0.036	0.036	0.007	No	3.53E-02	3.71E-02	7.41E-03	No
101	Endrin Aldeyhde		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.76E-01	1.85E-01	3.71E-02	No
102	Fluoranthene			0	0	-	-	-	-	0	0	-	-	-	-	8.12E+01	8.12E+01	1.62E+01	No
103	Fluorene			0	0	-	-	-	-	0	0	-	-	-	-	3.11E+03	3.11E+03	6.22E+02	No
104	Heptachlor		YES	0	0	0.52	0.520	0.104	No	0	0	0.0038	0.004	0.001	No	4.63E-05	4.87E-05	9.73E-06	No
105	Heptachlor Epoxide		YES	0	0	0.52	0.520	0.104	No	0	0	0.0038	0.004	0.001	No	2.29E-05	2.41E-05	4.81E-06	No
106	Hexachlorobenzene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.68E-04	1.76E-04	3.53E-05	No
107	Hexachlorobutadiene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.08E+01	1.13E+01	2.26E+00	No
108	Hexachlorocyclohexan (alpha)		YES	0	0	-	-	-	-	0	0	-	-	-	-	2.85E-03	2.99E-03	5.99E-04	No
109	Hexachlorocyclohexan (beta)		YES	0	0	-	-	-	-	0	0	-	-	-	-	9.97E-03	1.05E-02	2.10E-03	No
110	Hexachlorocyclohexan (gamma)		YES	0	0	0.95	0.950	0.190	No	0	0	-	-	-	-	1.08E+00	1.13E+00	2.26E-01	No
111	HexachlorocycloPentadiene			0	0	-	-	-	-	0	0	-	-	-	-	6.45E+02	6.45E+02	1.29E+02	No
112	Hexachloroethane			0	0	-	-	-	-	0	0	-	-	-	-	1.92E+00	1.92E+00	3.84E-01	No
113	Indeno(1, 2, 3-CK)Pyrene		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.07E-02	1.12E-02	2.24E-03	No
114	Isophorone			0	0	-	-	-	-	0	0	-	-	-	-	5.61E+02	5.61E+02	1.12E+02	No
115	Naphthalene			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
116	Nitrobenzene			0	0	-	-	-	-	0	0	-	-	-	-	4.04E+02	4.04E+02	8.07E+01	No
117	N-Nitrosodi-N-Propylamine		YES	0	0	-	-	-	-	0	0	-	-	-	-	2.95E-01	3.10E-01	6.20E-02	No
118	N-Nitrosodimethylamine		YES	0	0	-	-	-	-	0	0	-	-	-	-	1.76E+00	1.85E+00	3.70E-01	No
119	N-Nitrosodiphenylamine		YES	0	0	-	-	-	-	0	0	-	-	-	-	3.50E+00	3.68E+00	7.36E-01	No
120	PCB-1016		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
121	PCB-1221		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
122	PCB-1232		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
123	PCB-1242		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
124	PCB-1248		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
125	PCB-1254		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
126	PCB-1260		YES	0	0	-	-	-	-	0	0	0.014	0.014	0.003	No	3.74E-05	3.93E-05	7.86E-06	No
127	Phenanthrene			0	0	-	-	-	-	0	0	-	-	-	-	-	-	-	-
128	Pyrene			0	0	-	-	-	-	0	0	-	-	-	-	2.33E+03	2.33E+03	4.67E+02	No
129	1, 2, 4-Trichlorobenzene			0	0	-	-	-	-	0	0	-	-	-	-	4.09E+01	4.09E+01	8.19E+00	No

Pinson, Theo

From: Bryce K. Smith <bksmith@lsbindustries.com>
Sent: Thursday, October 10, 2024 3:59 PM
To: Pinson, Theo
Cc: Keith Long
Subject: LSB Chemical - Bio Study Proposed Language (EPA Region IV) [NDES Permit No. AL0000418]
Attachments: CN 316a re-verification protocol-f.docx

Theo,

Good afternoon. I've attached a copy of LSB Chemical's proposed language to be included in its upcoming NPDES renewal permit for your review. I would like to schedule a call with you and your Supervisor to discuss any questions or concerns you may have regarding this proposed language to address EPA Region IV's concerns with the previous 316a study results. Please let me know when you and your Supervisor would be available next week for a call to discuss. The best time for LSB and Greg Phillips with Alliance would be Monday afternoon, Tuesday morning, Wednesday morning before 10:30 a.m., and Thursday anytime before 3 p.m. I look forward to discussing this with you and your staff and hopefully providing a favorable path forward resulting in the issuance of LSB Cherokee's NPDES renewal permit. Let me know if you have any questions.

Bryce K. Smith, CHMM, REM
Environmental Manager | LSB Chemical - Cherokee Facility|1080 Industrial Drive, Cherokee, AL 35616
M (580) 583-8354 | bksmith@lsbindustries.com|www.lsbindustries.com

LETS ALWAYS STRIVE TO BE SAFE, COMPLIANT, and PRECISE

Follow us on social media for our latest updates

CN 316a Re-verification Protocol

When – in the fall of the third year of the permitting cycle.

What - Complete a biological assessment with a focus on the fish community that would be comparable to the 2022 316a study (Alliance Technical Group, January 2023).

Method –

The field study portion of the 316(a) re-verification study will include the following components:

1. Fish collection
2. Habitat evaluation
3. In-situ water quality
4. Water sample collection

The study will be completed at two of the stations that were utilized in the original 316a study.

- CN-UT – Unnamed Tributary. This monitoring station is located downstream of the waterfall in the CN discharge tributary and runs from the most downstream riffle upstream to the base (the toe) of the waterfall pool. This reach is approximately 500 feet long, maximum.

- MSB-1 – Moon Springs Branch. Reach is upstream of last riffle before mouth of the river and runs approximately 1000 feet upstream.

The MSB-1 station was one of the reference streams used in the 316a study and will be used in this re-verification only if the fish community at CN-UT is significantly different to that of the original study. Should this be the case the MSB-1 fish community will be examined to see if it is also significantly different to that of the 2022 study, which would indicate the differences are climatic or regional in nature and not a result of the CN discharge.

Fish data, habitat analysis, in-situ and water quality sampling will be collected and handled in the same manner they were for the 2022 316a study (Alliance Technical Group, January 2023) and as described in the 2022 Protocol. Field collection will occur in one season, the fall, to be consistent with when fish were collected in the original 2022 study.

Evaluation-

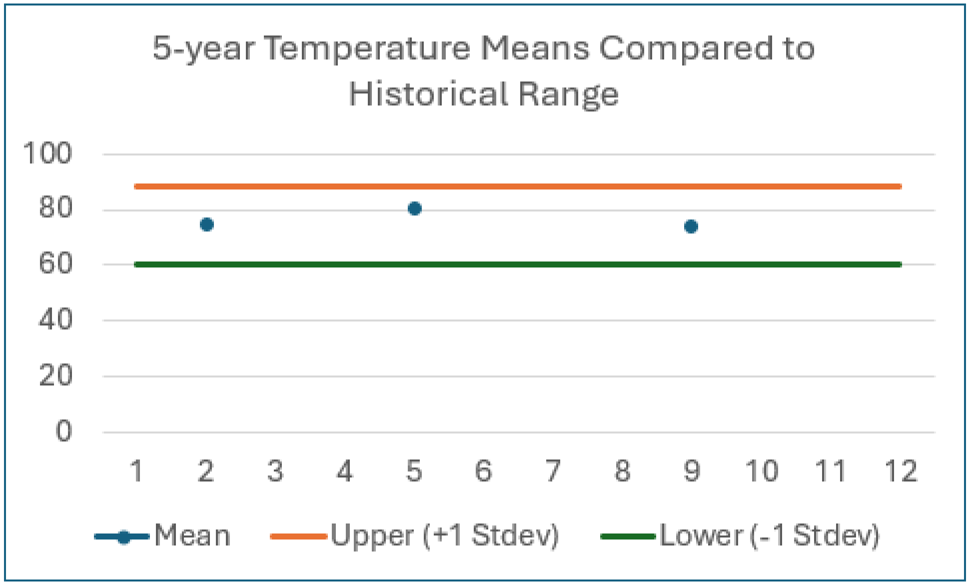
To support a re-verification of the temperature variance, according to the 316(a) guidance, the key factor that must be addressed/shown to be true in the receiving stream in question is documentation of no appreciable harm and the existence of an appropriate balanced and indigenous population (40CFR 122.1 and USEPA, 1974). The original bioassessment was designed for that purpose and the bioassessment for the re-verification will be focused on the same conditions with an emphasis on comparison to the 2022 collections and determination if they are similar or if the fish community has either improved or declined for some reason. To evaluate this condition, analysis of fish data collected during this study will again focus on community composition and balance to determine if the biotic community in the CN-UT is balanced and healthy (with no evident appreciable harm) consistent with its habitat and history (as compared to the 2022 collection and/or local control streams).

Pinson, Theo

From: Greg Phillips <Greg.Phillips@AllianceTG.com>
Sent: Thursday, September 12, 2024 11:24 AM
To: Pinson, Theo
Cc: Bryce K. Smith; Keith Long; Shon Simpson
Subject: Cherokee Nitrogen 316a re-verification

Theo,
I received your message. I have had this cued up to send all morning........As requested, we are providing you with an approach for Cherokee Nitrogen to show that their 316a variance is re-verified once every 5-year permitting cycle. We suggest this being a two-step re-verification:

1. Show compliance with permit limits for temperature. This will address mainly temperature maximums which we believe is the driver for effects on the biota.
2. Use a control chart approach to show that the average temperature is within +/-1 standard deviation of the mean. As long as the new five-year average mean temperature, for the five years leading up to the permit renewal, is in the bounds of the control parameters (+/- 1 Stdev) the 316a variance would be re-verified. An example is given below that is based on the previous 5(ish) years of temperature data. The three data points in the control charts, are the current temperature mean (first dot) and two fictional dots based on other possible data sets in the future. The control chart range is 60.4-88.7 (using a stdev of 14.2).



Since the biological assessment work completed to support the variance shows that the historical temperatures support a good aquatic life community, then as long as that temperature regime does not shift up significantly, there should be no adverse temperature effect on the biota. This is why we propose evaluation of the temperature permit limit compliance and the annual average temperature, both of which the biota experience full time. As long as these do not change (shift up) significantly one can assume there is no adverse biota impact due to temperature.

Please provide feedback when you have the time. And as always, feel free to reach out to me with questions. If you think this is good, I can package it more formally for a final submission to ADEM and EPA.

Thanks,

GBMc & ASSOCIATES NOW Alliance TECHNICAL GROUP
Greg Phillips
Principal/Senior Scientist
Office: 501-847-7077 | **Mobile:** 501-747-6239
Address: 219 Brown Ln, Bryant, AR 72022
www.alliancetg.com

December 08, 2023

SENT VIA CERTIFIED MAIL: 7017 1070 0000 8753 2895

Mr. Theo Pinson
Alabama Dept. of Environmental Management
1400 Coliseum Blvd.
Montgomery, Alabama 36110-2400

RECEIVED

DEC 13 2023

IND/MUN BRANCH

Via e-mail: tpinson@adem.alabama.gov

RE: Cherokee Nitrogen NPDES Permit No. AL0000418
Draft Permit Comments

Dear Mr. Pinson:

Thank you for providing a draft version of the NPDES permit for the Cherokee Nitrogen site. We appreciate your efforts to renew this permit for the site. We have reviewed the permit and have the following comments we would like to discuss.

Phosphorous

The Cherokee site is a nitrogen-based fertilizer producer. We do not produce any phosphorous products. Since we are not adding any phosphorous to any intake water we request that the monitoring of phosphorous be deleted from Outfall DSN0011. At a minimum, if there are other regulatory drivers that will not allow us to eliminate this requirement, we request that this data collection effort be reduced from a weekly grab to a monthly and that the timeframe be reduced to a year.

Internal Outfall DSN01B1

According to our sanitary system design, the effluent from the sanitary system is conveyed to our Effluent Pond. Due to the residence time in the Effluent Pond, we believe there is additional treatment occurring. The current draft of the NPDES permit requires that the site monitor the same two parameters, Total Suspended Solids and CBOD5, from Outfall DNS011.

If there is a regulatory requirement where these cannot be consolidated LSB requests that ADEM further consider that the DSN 01B1 numeric limits for total suspended solids (TSS) and Carbonaceous biochemical oxygen demand, 5-day ($CBOD_5$) are based on monthly sampling. Since the DSN 0011 requirements for TSS and $CBOD_5$ are report only, LSB requests that the sampling frequency for both the internal and final outfall be the same monthly sampling frequency.

Cooling Water Intake Structure

The site's cooling water intake structure does not use control technologies to comply with the Best Technology Available (BTA) requirement. Therefore, we wanted to clarify that the site will not be completing the weekly inspections described in Part IV C.7. We acknowledge and will comply with the Annual Certification requirement.

Please note that by the end of 2023 LSB Chemical, L.L.C. will be the new Cherokee Nitrogen name. Additionally, effective from the first part of January 2024 Mr. Howard Stevens will no longer be the General Manager (GM) at LSB Chemical- Cherokee facility. Mr. Stevens will be relocating to LSB Chemical's El Dorado, AR facility where he will be the GM. Therefore, beginning in the first part of January 2024 Mr. Brian Hocutt will be the LSB Chemical-Cherokee GM and subsequently the responsible official (RO) for signatory purposes related to regulatory submittals. We will be submitting the required ADEM forms to implement these changes. We would also like to request that Mr. Hocutt have an account set up in ADEM's AEPAC system for signing and submitting required discharge monitoring reports (DMRs). LSB Chemical-Cherokee will submit the required information for Mr. Hocutt's AEPAC account.

We would welcome the opportunity to discuss these comments at your convenience. If you have any questions or concerns about these comments, please contact Bryce K. Smith, Environmental Manager at 580-583-8354 or Howard Stevens, General Manager at 601-467-3526.

Best Regards,

Howard Stevens
General Manager

cc: Bryce K. Smith
Keith Long

RECEIVED

DEC 13 2023

IND/MUN BRANCH

LSB INDUSTRIES

RECEIVED

NOV 06 2023

IND/MUN BRANCH
WATER DIVISION

November 3, 2023

Mr. Theo Pinson
Alabama Dept. of Environmental Management
1400 Coliseum Blvd.
Montgomery, Alabama 36110-2400

Via e-mail: tpinson@adem.alabama.gov

RE: Cherokee Nitrogen NDES Permit No. AL0000418
Permit Renewal Application Forms

Dear Mr. Pinson:

Please find enclosed the requested supplemental forms for the Cherokee Nitrogen NPDES Permit Renewal. The following describes each form and recent edits.

Form 3510-1_rev

The information on Form 1 has been updated where needed.

Form 3510-2C

We have updated the information required on this form. We have conducted additional grab sampling of Outfall DSN001 for Table A pollutants – BOD5, COD, TOC, TSS and Ammonia (as N). The recorded effluent discharge flowrate on the sampling day was used with the constituent result to determine the lb/d loading. The Maximum Daily Discharge is reported as the maximum result from five (5) days of samples.

Form 3510-2C Addenda

Also attached are revised Addendum A – Facility Diagrams, B – Water Flow Diagram, and C – Production Data.

Form 187

We provide updates to Form 187, Form 187 Addendum B for LSB corporate Officers, and Form 187 Addendum D which summarizes the use of Corrosion Inhibitors and Biocides. We have also updated information, including but not limited to Section D water use, Cooling Water Intake Structure information, and Wastewater Flow Diagram.

The Form 187 Addendum D biocide and corrosion inhibitor concentrations are based on the following assumptions:

- Average product use
- Manufacturer reported product density
- 75% transformation of the active ingredients
- Dilution into the 16.8 MGD discharge

Stormwater Outfalls

As we have discussed, we are proposing to eliminate Stormwater Outfalls DSN002Q and DSN0003Q since there is no contribution from the manufacturing operation to these two outfalls. Please find attached a revised Site Location Map identifying the locations Outfalls DSN001 and DSN001A.

Should you have any questions or require additional information or this application, please contact Bryce K. Smith, Environmental Manager at 580-583-8354 or Howard Stevens, General Manager at 601-467-3526.

Best Regards,

Howard Stevens
General Manager

Attachments:

Form 3510-1_rev
Form 3510-2C
Form 3510-2C Addendum A – Facility Diagrams, B – Water Flow Diagram, C – Production Data
Form 187
Form 187 Addendum B and Addendum D

cc: Bryce K. Smith
Keith Long

Attachment:
Form 3510-1_rev

United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA Form 3510-1 Revised March 2019

Water Permits Division

EPA

Application Form 1
General Information

NPDES Permitting Program

Note: All applicants to the National Pollutant Discharge Elimination System (NPDES) permits program, with the exception of publicly owned treatment works and other treatment works treating domestic sewage, must complete Form 1. Additionally, all applicants must complete one or more of the following forms: 2B, 2C, 2D, 2E, or 2F. To determine the specific forms you must complete, consult the "General Instructions" for this form.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

Form 1 NPDES	EPA	U.S. Environmental Protection Agency Application for NPDES Permit to Discharge Wastewater **GENERAL INFORMATION**

SECTION 1. ACTIVITIES REQUIRING AN NPDES PERMIT (40 CFR 122.21(f) and (f)(1))

Activities Requiring an NPDES Permit

1.1	**Applicants *Not Required* to Submit Form 1**		
1.1.1	Is the facility a new or existing **publicly owned treatment works**? If yes, STOP. Do NOT complete Form 1. Complete Form 2A. ☑ No	1.1.2	Is the facility a new or existing **treatment works treating domestic sewage**? If yes, STOP. Do NOT complete Form 1. Complete Form 2S. ☑ No
1.2	**Applicants *Required* to Submit Form 1**		
1.2.1	Is the facility a **concentrated animal feeding operation** or a **concentrated aquatic animal production facility?** ☐ Yes → Complete Form 1 *and* Form 2B. ☑ No	1.2.2	Is the facility an **existing** manufacturing, commercial, mining, or silvicultural **facility** that **is currently discharging process wastewater**? ☑ Yes → Complete Form 1 *and* Form 2C. ☐ No
1.2.3	Is the facility a **new** manufacturing, commercial, mining, or silvicultural **facility** that has **not yet commenced to discharge**? ☐ Yes → Complete Form 1 *and* Form 2D. ☑ No	1.2.4	Is the facility a **new or existing** manufacturing, commercial, mining, or silvicultural **facility** that **discharges only nonprocess wastewater**? ☐ Yes → Complete Form 1 *and* Form 2E. ☑ No
1.2.5	Is the facility a **new or existing facility** whose discharge is composed entirely of **stormwater associated with industrial activity** or whose discharge is composed of **both stormwater and non-stormwater**? ☑ Yes → Complete Form 1 *and* Form 2F unless exempted by 40 CFR 122.26(b)(14)(x) or (b)(15). ☐ No		

SECTION 2. NAME, MAILING ADDRESS, AND LOCATION (40 CFR 122.21(f)(2))

Name, Mailing Address, and Location

2.1	**Facility Name**		
	Cherokee Nitrogen, LLC		
2.2	**EPA Identification Number**		
	110000589373		
2.3	**Facility Contact**		
	Name (first and last) Bryce K. Smith	Title Environmental Manager	Phone number (580) 583-8354
	Email address bksmith@lsbindustries.com		
2.4	**Facility Mailing Address**		
	Street or P.O. box 1080 Industrial Drive		
	City or town Cherokee	State AL	ZIP code 35616

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

Name, Mailing Address, and Location Continued	2.5	**Facility Location**		
		Street, route number, or other specific identifier 1080 Industrial Drive		
		County name Colbert	County code (if known) 20	
		City or town Cherokee	State AL	ZIP code 35616

SECTION 3. SIC AND NAICS CODES (40 CFR 122.21(f)(3))

SIC and NAICS Codes			
	3.1	**SIC Code(s)**	**Description** (optional)
		2873	Nitrogenous Fertilizers
		5191	Farm Supplies
	3.2	**NAICS Code(s)**	**Description** (optional)
		325311	Nitrogenous Fertilizer Manufacturing
		424910	Farm Supplies Merchant Wholesalers

SECTION 4. OPERATOR INFORMATION (40 CFR 122.21(f)(4))

Operator Information				
	4.1	**Name of Operator**		
		Cherokee Nitrogen, LLC		
	4.2	Is the name you listed in Item 4.1 also the owner? ☐ Yes ☑ No		
	4.3	**Operator Status**		
		☐ Public—federal ☑ Private	☐ Public—state ☐ Other (specify) ____________	☐ Other public (specify)____________
	4.4	**Phone Number of Operator**		
		(580) 583-8354		

Operator Information Continued				
	4.5	**Operator Address**		
		Street or P.O. Box 1080 Industrial Drive		
		City or town Cherokee	State AL	ZIP code 35616
		Email address of operator bksmith@lsbindustries.com		

SECTION 5. INDIAN LAND (40 CFR 122.21(f)(5))

Indian Land		
	5.1	Is the facility located on Indian Land? ☐ Yes ☑ No

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

SECTION 6. EXISTING ENVIRONMENTAL PERMITS (40 CFR 122.21(f)(6))

Existing Environmental Permits

6.1 **Existing Environmental Permits** (check all that apply and print or type the corresponding permit number for each)

☑ NPDES (discharges to surface water) AL0000418	☑ RCRA (hazardous wastes) ALD057803135	☐ UIC (underground injection of fluids)
☑ PSD (air emissions) 701-0013	☐ Nonattainment program (CAA)	☐ NESHAPs (CAA)
☐ Ocean dumping (MPRSA)	☐ Dredge or fill (CWA Section 404)	☐ Other (specify)

SECTION 7. MAP (40 CFR 122.21(f)(7))

Map

7.1 Have you attached a topographic map containing all required information to this application? (See instructions for specific requirements.)

☑ Yes ☐ No ☐ CAFO—Not Applicable (See requirements in Form 2B.)

SECTION 8. NATURE OF BUSINESS (40 CFR 122.21(f)(8))

Nature of Business

8.1 Describe the nature of your business.

Cherokee Nitrogen, LLC manufactures nitrogen-based chemicals used predominately in agriculture. The facility receives raw materials, which include natural gas, air, purchased ammonia, and lubricants. Production facilities include an ammonia plant, two nitric acid plants, a urea plant, and a nitrate plant.

Process wastewater from water treatment filter rinse, sewage treatment, boiler and cooling tower blowdown, #2 acid plant, and stormwater flows directly to the NPDES settling/holding pond. Oil is recovered via rope skimmer. Any spill that may occur within the plant is contained and neutralized or recovered prior to discharge at DSN001A. BMPs are utilized to minimize stormwater contact. Discharges from the NPDES settling/holding pond combine with once-through cooling water and stormwater runoff before final discharge through DSN001.

Plant process wastewater that contains small quantities of ammonium nitrate, urea, and ammonia is discharged to and stored in an agricultural irrigation pond. The water is monitored for nutrient content and balanced with non-contact cooling water as needed for agricultural irrigation. The agricultural irrigation water is applied to

SECTION 9. COOLING WATER INTAKE STRUCTURES (40 CFR 122.21(f)(9))

Cooling Water Intake Structures

9.1 Does your facility use cooling water?

☑ Yes ☐ No → SKIP to Item 10.1.

9.2 Identify the source of cooling water. (Note that facilities that use a cooling water intake structure as described at 40 CFR 125, Subparts I and J may have additional application requirements at 40 CFR 122.21(r). Consult with your NPDES permitting authority to determine what specific information needs to be submitted and when.)

Cooling water sources include municipal water supplied by Town of Cherokee Water and Gas Board and surface water intake from the Tennessee River/ Pickwick Lake. Municipal water intake is approximately 0.14 MGD and surface water intake is approximately 15 MGD. Approximately 96% of the intake water is used for cooling purposes.

SECTION 10. VARIANCE REQUESTS (40 CFR 122.21(f)(10))

Variance Requests

10.1 Do you intend to request or renew one or more of the variances authorized at 40 CFR 122.21(m)? (Check all that apply. Consult with your NPDES permitting authority to determine what information needs to be submitted and when.)

☐ Fundamentally different factors (CWA Section 301(n))
☐ Water quality related effluent limitations (CWA Section 302(b)(2))
☐ Non-conventional pollutants (CWA Section 301(c) and (g))
☐ Thermal discharges (CWA Section 316(a))
☑ Not applicable

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

SECTION 11. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

Checklist and Certification Statement

11.1 In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.

Column 1	Column 2
☑ Section 1: Activities Requiring an NPDES Permit	☐ w/ attachments
☑ Section 2: Name, Mailing Address, and Location	☐ w/ attachments
☑ Section 3: SIC Codes	☐ w/ attachments
☑ Section 4: Operator Information	☐ w/ attachments
☑ Section 5: Indian Land	☐ w/ attachments
☑ Section 6: Existing Environmental Permits	☐ w/ attachments
☑ Section 7: Map	☑ w/ topographic map ☐ w/ additional attachments
☑ Section 8: Nature of Business	☐ w/ attachments
☑ Section 9: Cooling Water Intake Structures	☐ w/ attachments
☑ Section 10: Variance Requests	☐ w/ attachments
☑ Section 11: Checklist and Certification Statement	☐ w/ attachments

11.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Howard Stevens	General Manager
Signature	Date signed 11-3-23

United States
Environmental Protection Agency

Office of Water
Washington, D.C.

EPA Form 3510-2C
Revised March 2019

Water Permits Division

EPA

Application Form 2C

Existing Manufacturing, Commercial, Mining, and Silvicultural Operations

NPDES Permitting Program

Note: Complete this form ***and*** Form 1 if your facility is an existing manufacturing, commercial, mining, or silvicultural facility that currently discharges process wastewater.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

Form 2C NPDES

EPA

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater

EXISTING MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURE OPERATIONS

SECTION 1. OUTFALL LOCATION (40 CFR 122.21(g)(1))

Outfall Location

1.1 Provide information on each of the facility's outfalls in the table below.

Outfall Number	Receiving Water Name	Latitude				Longitude			
DSN001	Tennessee River	34°	48′	31″	N	87°	56′	17″	W
DSN001A	Tennessee River	34°	48′	32″	N	87°	56′	16″	W
		°	′	″		°	′	″	

SECTION 2. LINE DRAWING (40 CFR 122.21(g)(2))

Line Drawing

2.1 Have you attached a line drawing to this application that shows the water flow through your facility with a water balance? (See instructions for drawing requirements. See Exhibit 2C–1 at end of instructions for example.)

☑ Yes ☐ No

SECTION 3. AVERAGE FLOWS AND TREATMENT (40 CFR 122.21(g)(3))

Average Flows and Treatment

3.1 For each outfall identified under Item 1.1, provide average flow and treatment information. Add additional sheets if necessary.

****Outfall Number**** 001

Operations Contributing to Flow

Operation	Average Flow
Non-contact cooling water and stormwater	11.46 mgd
	mgd
	mgd
	mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge
Impervious surface, erosion control, BMPs	4-A	N/A

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

Average Flows and Treatment Continued

3.1 cont.

****Outfall Number** 001A**

Operations Contributing to Flow

Operation	Average Flow
Treated sanitary waste/ filter rinse water	0.664 mgd
Boiler blowdown	0.144 mgd
Cooling water blowdown	0.612 mgd
Plant process water	0.180 mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge
Impervious surface, erosion control, sedimentation BMPs	1-T	Disposal/recycling of used oil
Rope oil skimmer	1-U	
	4-A	

****Outfall Number** ________**

Operations Contributing to Flow

Operation	Average Flow
	mgd
	mgd
	mgd
	mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge

System Users

3.2 Are you applying for an NPDES permit to operate a privately owned treatment works?

☐ Yes ☑ No → SKIP to Section 4.

3.3 Have you attached a list that identifies each user of the treatment works?

☐ Yes ☐ No

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

SECTION 4. INTERMITTENT FLOWS (40 CFR 122.21(g)(4))

Intermittent Flows

4.1 Except for storm runoff, leaks, or spills, are any discharges described in Sections 1 and 3 intermittent or seasonal?

☐ Yes ☑ No → SKIP to Section 5.

4.2 Provide information on intermittent or seasonal flows for each applicable outfall. Attach additional pages, if necessary.

Outfall Number	Operation (list)	Frequency		Flow Rate		Duration
		Average Days/Week	Average Months/Year	Long-Term Average	Maximum Daily	
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days

SECTION 5. PRODUCTION (40 CFR 122.21(g)(5))

Applicable ELGs

5.1 Do any effluent limitation guidelines (ELGs) promulgated by EPA under Section 304 of the CWA apply to your facility?

☑ Yes ☐ No → SKIP to Section 6.

5.2 Provide the following information on applicable ELGs.

ELG Category	ELG Subcategory	Regulatory Citation
Fertilizer Manufacturing	Ammonia, Urea, Ammonium Nitrate, and Nitric Acid	40 CFR 418, Subparts B-E

Production-Based Limitations

5.3 Are any of the applicable ELGs expressed in terms of production (or other measure of operation)?

☑ Yes ☐ No → SKIP to Section 6.

5.4 Provide an actual measure of daily production expressed in terms and units of applicable ELGs.

Outfall Number	Operation, Product, or Material	Quantity per Day	Unit of Measure
DSN001A	Ammonia (Subpart B)	1,090,919	lbs
DSN001A	Urea (Subpart C)	558,087	lbs
DSN001A	Ammonium Nitrate (Subpart D) / Nitric Acid (Subpart E)	997,190 / 951,721	lbs

SECTION 6. IMPROVEMENTS (40 CFR 122.21(g)(6))

Upgrades and Improvements

6.1 Are you presently required by any federal, state, or local authority to meet an implementation schedule for constructing, upgrading, or operating wastewater treatment equipment or practices or any other environmental programs that could affect the discharges described in this application?

☐ Yes ☑ No → SKIP to Item 6.3.

6.2 Briefly identify each applicable project in the table below.

Brief Identification and Description of Project	Affected Outfalls (list outfall number)	Source(s) of Discharge	Final Compliance Dates	
			Required	Projected

6.3 Have you attached sheets describing any additional water pollution control programs (or other environmental projects that may affect your discharges) that you now have underway or planned? *(optional item)*

☐ Yes ☐ No ☑ Not applicable

SECTION 7. EFFLUENT AND INTAKE CHARACTERISTICS (40 CFR 122.21(g)(7))

Effluent and Intake Characteristics

See the instructions to determine the pollutants and parameters you are required to monitor and, in turn, the tables you must complete. Not all applicants need to complete each table.

Table A. Conventional and Non-Conventional Pollutants

7.1 Are you requesting a waiver from your NPDES permitting authority for one or more of the Table A pollutants for any of your outfalls?

☐ Yes ☑ No → SKIP to Item 7.3.

7.2 If yes, indicate the applicable outfalls below. Attach waiver request and other required information to the application.

Outfall Number _____ Outfall Number _____ Outfall Number _____

7.3 Have you completed monitoring for all Table A pollutants at each of your outfalls for which a waiver has not been requested and attached the results to this application package?

☑ Yes ☐ No; a waiver has been requested from my NPDES permitting authority for all pollutants at all outfalls.

Table B. Toxic Metals, Cyanide, Total Phenols, and Organic Toxic Pollutants

7.4 Do any of the facility's processes that contribute wastewater fall into one or more of the primary industry categories listed in Exhibit 2C-3? (See end of instructions for exhibit.)

☐ Yes ☑ No → SKIP to Item 7.8.

7.5 Have you checked "Testing Required" for all toxic metals, cyanide, and total phenols in Section 1 of Table B?

☐ Yes ☐ No

7.6 List the applicable primary industry categories and check the boxes indicating the required GC/MS fraction(s) identified in Exhibit 2C-3.

Primary Industry Category	Required GC/MS Fraction(s) (Check applicable boxes.)			
	☐ Volatile	☐ Acid	☐ Base/Neutral	☐ Pesticide
	☐ Volatile	☐ Acid	☐ Base/Neutral	☐ Pesticide
	☐ Volatile	☐ Acid	☐ Base/Neutral	☐ Pesticide

Effluent and Intake Characteristics Continued	7.7	Have you checked "Testing Required" for all required pollutants in Sections 2 through 5 of Table B for each of the GC/MS fractions checked in Item 7.6? ☐ Yes ☐ No
	7.8	Have you checked "Believed Present" or "Believed Absent" for all pollutants listed in Sections 1 through 5 of Table B where testing is not required? ☑ Yes ☐ No
	7.9	Have you provided (1) quantitative data for those Section 1, Table B, pollutants for which you have indicated testing is required or (2) quantitative data or other required information for those Section 1, Table B, pollutants that you have indicated are "Believed Present" in your discharge? ☑ Yes ☐ No
	7.10	Does the applicant qualify for a small business exemption under the criteria specified in the instructions? ☐ Yes → Note that you qualify at the top of Table B, then SKIP to Item 7.12. ☑ No
	7.11	Have you provided (1) quantitative data for those Sections 2 through 5, Table B, pollutants for which you have determined testing is required or (2) quantitative data or an explanation for those Sections 2 through 5, Table B, pollutants you have indicated are "Believed Present" in your discharge? ☑ Yes ☐ No
	Table C. Certain Conventional and Non-Conventional Pollutants	
	7.12	Have you indicated whether pollutants are "Believed Present" or "Believed Absent" for all pollutants listed on Table C for all outfalls? ☑ Yes ☐ No
	7.13	Have you completed Table C by providing (1) quantitative data for those pollutants that are limited either directly or indirectly in an ELG and/or (2) quantitative data or an explanation for those pollutants for which you have indicated "Believed Present"? ☑ Yes ☐ No
	Table D. Certain Hazardous Substances and Asbestos	
	7.14	Have you indicated whether pollutants are "Believed Present" or "Believed Absent" for all pollutants listed in Table D for all outfalls? ☑ Yes ☐ No
	7.15	Have you completed Table D by (1) describing the reasons the applicable pollutants are expected to be discharged and (2) by providing quantitative data, if available? ☑ Yes ☐ No
	Table E. 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8-TCDD)	
	7.16	Does the facility use or manufacture one or more of the 2,3,7,8-TCDD congeners listed in the instructions, or do you know or have reason to believe that TCDD is or may be present in the effluent? ☐ Yes → Complete Table E. ☑ No → SKIP to Section 8.
	7.17	Have you completed Table E by reporting *qualitative* data for TCDD? ☐ Yes ☐ No

SECTION 8. USED OR MANUFACTURED TOXICS (40 CFR 122.21(g)(9))

Used or Manufactured Toxics	8.1	Is any pollutant listed in Table B a substance or a component of a substance used or manufactured at your facility as an intermediate or final product or byproduct? ☐ Yes ☑ No → SKIP to Section 9.		
	8.2	List the pollutants below.		
		1.	4.	7.
		2.	5.	8.
		3.	6.	9.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

SECTION 9. BIOLOGICAL TOXICITY TESTS (40 CFR 122.21(g)(11))

Biological Toxicity Tests

9.1 Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made within the last three years on (1) any of your discharges or (2) on a receiving water in relation to your discharge?

☑ Yes ☐ No → SKIP to Section 10.

9.2 Identify the tests and their purposes below.

Test(s)	Purpose of Test(s)	Submitted to NPDES Permitting Authority?	Date Submitted
Aquatic Toxicity - Acute	Pimephales promelas morbidity	☑ Yes ☐ No	04/12/2023
Aquatic Toxicity - Acute	Cerodaphnia dubia morbidity	☑ Yes ☐ No	04/12/2023
		☐ Yes ☐ No	

SECTION 10. CONTRACT ANALYSES (40 CFR 122.21(g)(12))

Contract Analyses

10.1 Were any of the analyses reported in Section 7 performed by a contract laboratory or consulting firm?

☐ Yes ☑ No → SKIP to Section 11.

10.2 Provide information for each contract laboratory or consulting firm below.

	Laboratory Number 1	Laboratory Number 2	Laboratory Number 3
Name of laboratory/firm			
Laboratory address			
Phone number			
Pollutant(s) analyzed			

SECTION 11. ADDITIONAL INFORMATION (40 CFR 122.21(g)(13))

Additional Information

11.1 Has the NPDES permitting authority requested additional information?

☐ Yes ☑ No → SKIP to Section 12.

11.2 List the information requested and attach it to this application.

1.	4.
2.	5.
3.	6.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110000589373	AL0000418	Cherokee Nitrogen, LLC	

SECTION 12. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

Checklist and Certification Statement

12.1 In Column 1 below, mark the sections of Form 2C that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to complete all sections or provide attachments.

Column 1	Column 2	
☑ Section 1: Outfall Location	☑ w/ attachments	
☑ Section 2: Line Drawing	☑ w/ line drawing	☐ w/ additional attachments
☑ Section 3: Average Flows and Treatment	☐ w/ attachments	☐ w/ list of each user of privately owned treatment works
☑ Section 4: Intermittent Flows	☐ w/ attachments	
☑ Section 5: Production	☑ w/ attachments	
☑ Section 6: Improvements	☐ w/ attachments	☐ w/ optional additional sheets describing any additional pollution control plans
☑ Section 7: Effluent and Intake Characteristics	☐ w/ request for a waiver and supporting information	☐ w/ explanation for identical outfalls
	☐ w/ small business exemption request	☐ w/ other attachments
	☑ w/ Table A	☑ w/ Table B
	☑ w/ Table C	☑ w/ Table D
	☑ w/ Table E	☐ w/ analytical results as an attachment
☑ Section 8: Used or Manufactured Toxics	☐ w/ attachments	
☑ Section 9: Biological Toxicity Tests	☐ w/ attachments	
☑ Section 10: Contract Analyses	☐ w/ attachments	
☑ Section 11: Additional Information	☐ w/ attachments	
☑ Section 12: Checklist and Certification Statement	☐ w/ attachments	

12.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Howard Stevens	General Manager
Signature	Date signed

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE A. CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(iii)) [1]

	Pollutant	Waiver Requested (if applicable)	Units (specify)		Effluent: Maximum Daily Discharge (required)	Effluent: Maximum Monthly Discharge (if available)	Effluent: Long-Term Average Daily Discharge (if available)	Effluent: Number of Analyses	Intake (Optional): Long-Term Average Value	Intake (Optional): Number of Analyses
☐	Check here if you have applied to your NPDES permitting authority for a waiver for *all* of the pollutants listed on this table for the noted outfall.									
1.	Biochemical oxygen demand (BOD_5)	☐	Concentration	mg/L	<2			5		
			Mass	lb/d	273			5		
2.	Chemical oxygen demand (COD)	☐	Concentration	mg/L	17			5		
			Mass	lb/d	2,321			5		
3.	Total organic carbon (TOC)	☐	Concentration	mg/L	2.4			5		
			Mass	lb/d	326			5		
4.	Total suspended solids (TSS)	☐	Concentration	mg/L	5.1			5		
			Mass	lb/d	644			5		
5.	Ammonia (as N)	☐	Concentration	mg/L	0.34			5		
			Mass	lb/d	43			5		
6.	Flow	☐	Rate	mgd	22.924		17.935	Continuous		
7.	Temperature (winter)	☐	°C	°C						
	Temperature (summer)	☐	°C	°C	33.9		30.4	26		
8.	pH (minimum)	☐	Standard units	s.u.	6.9			69		
	pH (maximum)	☐	Standard units	s.u.	8.8			69		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses

☐ Check here if you qualify as a small business per the instructions to Form 2C and, therefore, do not need to submit quantitative data for any of the organic toxic pollutants in Sections 2 through 5 of this table. Note, however, that you must still indicate in the appropriate column of this table if you believe any of the pollutants listed are present in your discharge.

Section 1. Toxic Metals, Cyanide, and Total Phenols

	Pollutant/Parameter	Testing Required	Believed Present	Believed Absent	Units		Maximum Daily Discharge	Maximum Monthly Discharge	Long-Term Average Daily Discharge	Number of Analyses	Intake Long-Term Average Value	Intake Number of Analyses
1.1	Antimony, total (7440-36-0)	☐	☐	☑	Concentration							
					Mass							
1.2	Arsenic, total (7440-38-2)	☐	☐	☑	Concentration							
					Mass							
1.3	Beryllium, total (7440-41-7)	☐	☐	☑	Concentration							
					Mass							
1.4	Cadmium, total (7440-43-9)	☐	☐	☑	Concentration							
					Mass							
1.5	Chromium, total (7440-47-3)	☐	☐	☑	Concentration							
					Mass							
1.6	Copper, total (7440-50-8)	☐	☐	☑	Concentration							
					Mass							
1.7	Lead, total (7439-92-1)	☐	☐	☑	Concentration							
					Mass							
1.8	Mercury, total (7439-97-6)	☐	☐	☑	Concentration							
					Mass							
1.9	Nickel, total (7440-02-0)	☐	☐	☑	Concentration							
					Mass							
1.10	Selenium, total (7782-49-2)	☐	☐	☑	Concentration							
					Mass							
1.11	Silver, total (7440-22-4)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
1.12	Thallium, total (7440-28-0)	☐	☐	☑	Concentration							
					Mass							
1.13	Zinc, total (7440-66-6)	☐	☐	☑	Concentration							
					Mass							
1.14	Cyanide, total (57-12-5)	☐	☐	☑	Concentration							
					Mass							
1.15	Phenols, total	☐	☐	☑	Concentration							
					Mass							
Section 2. Organic Toxic Pollutants (GC/MS Fraction—Volatile Compounds)												
2.1	Acrolein (107-02-8)	☐	☐	☑	Concentration							
					Mass							
2.2	Acrylonitrile (107-13-1)	☐	☐	☑	Concentration							
					Mass							
2.3	Benzene (71-43-2)	☐	☐	☑	Concentration							
					Mass							
2.4	Bromoform (75-25-2)	☐	☐	☑	Concentration							
					Mass							
2.5	Carbon tetrachloride (56-23-5)	☐	☐	☑	Concentration							
					Mass							
2.6	Chlorobenzene (108-90-7)	☐	☐	☑	Concentration							
					Mass							
2.7	Chlorodibromomethane (124-48-1)	☐	☐	☑	Concentration							
					Mass							
2.8	Chloroethane (75-00-3)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.9	2-chloroethylvinyl ether (110-75-8)	☐	☐	☑	Concentration							
					Mass							
2.10	Chloroform (67-66-3)	☐	☐	☑	Concentration							
					Mass							
2.11	Dichlorobromomethane (75-27-4)	☐	☐	☑	Concentration							
					Mass							
2.12	1,1-dichloroethane (75-34-3)	☐	☐	☑	Concentration							
					Mass							
2.13	1,2-dichloroethane (107-06-2)	☐	☐	☑	Concentration							
					Mass							
2.14	1,1-dichloroethylene (75-35-4)	☐	☐	☑	Concentration							
					Mass							
2.15	1,2-dichloropropane (78-87-5)	☐	☐	☑	Concentration							
					Mass							
2.16	1,3-dichloropropylene (542-75-6)	☐	☐	☑	Concentration							
					Mass							
2.17	Ethylbenzene (100-41-4)	☐	☐	☑	Concentration							
					Mass							
2.18	Methyl bromide (74-83-9)	☐	☐	☑	Concentration							
					Mass							
2.19	Methyl chloride (74-87-3)	☐	☐	☑	Concentration							
					Mass							
2.20	Methylene chloride (75-09-2)	☐	☐	☑	Concentration							
					Mass							
2.21	1,1,2,2- tetrachloroethane (79-34-5)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number	
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001	Form Approved 03/05/19 OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.22	Tetrachloroethylene (127-18-4)	☐	☐	☑	Concentration							
					Mass							
2.23	Toluene (108-88-3)	☐	☐	☑	Concentration							
					Mass							
2.24	1,2-trans-dichloroethylene (156-60-5)	☐	☐	☑	Concentration							
					Mass							
2.25	1,1,1-trichloroethane (71-55-6)	☐	☐	☑	Concentration							
					Mass							
2.26	1,1,2-trichloroethane (79-00-5)	☐	☐	☑	Concentration							
					Mass							
2.27	Trichloroethylene (79-01-6)	☐	☐	☑	Concentration							
					Mass							
2.28	Vinyl chloride (75-01-4)	☐	☐	☑	Concentration							
					Mass							
Section 3. Organic Toxic Pollutants (GC/MS Fraction—Acid Compounds)												
3.1	2-chlorophenol (95-57-8)	☐	☐	☑	Concentration							
					Mass							
3.2	2,4-dichlorophenol (120-83-2)	☐	☐	☑	Concentration							
					Mass							
3.3	2,4-dimethylphenol (105-67-9)	☐	☐	☑	Concentration							
					Mass							
3.4	4,6-dinitro-o-cresol (534-52-1)	☐	☐	☑	Concentration							
					Mass							
3.5	2,4-dinitrophenol (51-28-5)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)	Effluent				Intake (optional)	
			Believed Present	Believed Absent		Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
3.6	2-nitrophenol (88-75-5)	☐	☐	☑	Concentration						
					Mass						
3.7	4-nitrophenol (100-02-7)	☐	☐	☑	Concentration						
					Mass						
3.8	p-chloro-m-cresol (59-50-7)	☐	☐	☑	Concentration						
					Mass						
3.9	Pentachlorophenol (87-86-5)	☐	☐	☑	Concentration						
					Mass						
3.10	Phenol (108-95-2)	☐	☐	☑	Concentration						
					Mass						
3.11	2,4,6-trichlorophenol (88-05-2)	☐	☐	☑	Concentration						
					Mass						
Section 4. Organic Toxic Pollutants (GC/MS Fraction—Base /Neutral Compounds)											
4.1	Acenaphthene (83-32-9)	☐	☐	☑	Concentration						
					Mass						
4.2	Acenaphthylene (208-96-8)	☐	☐	☑	Concentration						
					Mass						
4.3	Anthracene (120-12-7)	☐	☐	☑	Concentration						
					Mass						
4.4	Benzidine (92-87-5)	☐	☐	☑	Concentration						
					Mass						
4.5	Benzo (a) anthracene (56-55-3)	☐	☐	☑	Concentration						
					Mass						
4.6	Benzo (a) pyrene (50-32-8)	☐	☐	☑	Concentration						
					Mass						

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.7	3,4-benzofluoranthene (205-99-2)	☐	☐	☑	Concentration							
					Mass							
4.8	Benzo (ghi) perylene (191-24-2)	☐	☐	☑	Concentration							
					Mass							
4.9	Benzo (k) fluoranthene (207-08-9)	☐	☐	☑	Concentration							
					Mass							
4.10	Bis (2-chloroethoxy) methane (111-91-1)	☐	☐	☑	Concentration							
					Mass							
4.11	Bis (2-chloroethyl) ether (111-44-4)	☐	☐	☑	Concentration							
					Mass							
4.12	Bis (2-chloroisopropyl) ether (102-80-1)	☐	☐	☑	Concentration							
					Mass							
4.13	Bis (2-ethylhexyl) phthalate (117-81-7)	☐	☐	☑	Concentration							
					Mass							
4.14	4-bromophenyl phenyl ether (101-55-3)	☐	☐	☑	Concentration							
					Mass							
4.15	Butyl benzyl phthalate (85-68-7)	☐	☐	☑	Concentration							
					Mass							
4.16	2-chloronaphthalene (91-58-7)	☐	☐	☑	Concentration							
					Mass							
4.17	4-chlorophenyl phenyl ether (7005-72-3)	☐	☐	☑	Concentration							
					Mass							
4.18	Chrysene (218-01-9)	☐	☐	☑	Concentration							
					Mass							
4.19	Dibenzo (a,h) anthracene (53-70-3)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.20	1,2-dichlorobenzene (95-50-1)	☐	☐	☑	Concentration							
					Mass							
4.21	1,3-dichlorobenzene (541-73-1)	☐	☐	☑	Concentration							
					Mass							
4.22	1,4-dichlorobenzene (106-46-7)	☐	☐	☑	Concentration							
					Mass							
4.23	3,3-dichlorobenzidine (91-94-1)	☐	☐	☑	Concentration							
					Mass							
4.24	Diethyl phthalate (84-66-2)	☐	☐	☑	Concentration							
					Mass							
4.25	Dimethyl phthalate (131-11-3)	☐	☐	☑	Concentration							
					Mass							
4.26	Di-n-butyl phthalate (84-74-2)	☐	☐	☑	Concentration							
					Mass							
4.27	2,4-dinitrotoluene (121-14-2)	☐	☐	☑	Concentration							
					Mass							
4.28	2,6-dinitrotoluene (606-20-2)	☐	☐	☑	Concentration							
					Mass							
4.29	Di-n-octyl phthalate (117-84-0)	☐	☐	☑	Concentration							
					Mass							
4.30	1,2-Diphenylhydrazine (as azobenzene) (122-66-7)	☐	☐	☑	Concentration							
					Mass							
4.31	Fluoranthene (206-44-0)	☐	☐	☑	Concentration							
					Mass							
4.32	Fluorene (86-73-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.33	Hexachlorobenzene (118-74-1)	☐	☐	☑	Concentration							
					Mass							
4.34	Hexachlorobutadiene (87-68-3)	☐	☐	☑	Concentration							
					Mass							
4.35	Hexachlorocyclopentadiene (77-47-4)	☐	☐	☑	Concentration							
					Mass							
4.36	Hexachloroethane (67-72-1)	☐	☐	☑	Concentration							
					Mass							
4.37	Indeno (1,2,3-cd) pyrene (193-39-5)	☐	☐	☑	Concentration							
					Mass							
4.38	Isophorone (78-59-1)	☐	☐	☑	Concentration							
					Mass							
4.39	Naphthalene (91-20-3)	☐	☐	☑	Concentration							
					Mass							
4.40	Nitrobenzene (98-95-3)	☐	☐	☑	Concentration							
					Mass							
4.41	N-nitrosodimethylamine (62-75-9)	☐	☐	☑	Concentration							
					Mass							
4.42	N-nitrosodi-n-propylamine (621-64-7)	☐	☐	☑	Concentration							
					Mass							
4.43	N-nitrosodiphenylamine (86-30-6)	☐	☐	☑	Concentration							
					Mass							
4.44	Phenanthrene (85-01-8)	☐	☐	☑	Concentration							
					Mass							
4.45	Pyrene (129-00-0)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.46	1,2,4-trichlorobenzene (120-82-1)	☐	☐	☑	Concentration							
					Mass							
Section 5. Organic Toxic Pollutants (GC/MS Fraction—Pesticides)												
5.1	Aldrin (309-00-2)	☐	☐	☑	Concentration							
					Mass							
5.2	α-BHC (319-84-6)	☐	☐	☑	Concentration							
					Mass							
5.3	β-BHC (319-85-7)	☐	☐	☑	Concentration							
					Mass							
5.4	γ-BHC (58-89-9)	☐	☐	☑	Concentration							
					Mass							
5.5	δ-BHC (319-86-8)	☐	☐	☑	Concentration							
					Mass							
5.6	Chlordane (57-74-9)	☐	☐	☑	Concentration							
					Mass							
5.7	4,4'-DDT (50-29-3)	☐	☐	☑	Concentration							
					Mass							
5.8	4,4'-DDE (72-55-9)	☐	☐	☑	Concentration							
					Mass							
5.9	4,4'-DDD (72-54-8)	☐	☐	☑	Concentration							
					Mass							
5.10	Dieldrin (60-57-1)	☐	☐	☑	Concentration							
					Mass							
5.11	α-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.12	β-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							
5.13	Endosulfan sulfate (1031-07-8)	☐	☐	☑	Concentration							
					Mass							
5.14	Endrin (72-20-8)	☐	☐	☑	Concentration							
					Mass							
5.15	Endrin aldehyde (7421-93-4)	☐	☐	☑	Concentration							
					Mass							
5.16	Heptachlor (76-44-8)	☐	☐	☑	Concentration							
					Mass							
5.17	Heptachlor epoxide (1024-57-3)	☐	☐	☑	Concentration							
					Mass							
5.18	PCB-1242 (53469-21-9)	☐	☐	☑	Concentration							
					Mass							
5.19	PCB-1254 (11097-69-1)	☐	☐	☑	Concentration							
					Mass							
5.20	PCB-1221 (11104-28-2)	☐	☐	☑	Concentration							
					Mass							
5.21	PCB-1232 (11141-16-5)	☐	☐	☑	Concentration							
					Mass							
5.22	PCB-1248 (12672-29-6)	☐	☐	☑	Concentration							
					Mass							
5.23	PCB-1260 (11096-82-5)	☐	☐	☑	Concentration							
					Mass							
5.24	PCB-1016 (12674-11-2)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number	Form Approved 03/05/19
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001	OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.25	Toxaphene (8001-35-2)	☐	☐	☑	Concentration							
					Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you believe all pollutants on Table C to be ***present*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.										
☐	Check here if you believe all pollutants on Table C to be ***absent*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.										
1.	Bromide (24959-67-9)	☐	☑	Concentration							
				Mass							
2.	Chlorine, total residual	☑	☐	Concentration	mg/L	0.01		0.009	69		
				Mass							
3.	Color	☐	☑	Concentration							
				Mass							
4.	Fecal coliform	☑	☐	Concentration	col/100ml	174		56	69		
				Mass							
5.	Fluoride (16984-48-8)	☐	☑	Concentration							
				Mass							
6	Nitrate-nitrite	☑	☐	Concentration							
				Mass							
7.	Nitrogen, total organic (as N)	☑	☐	Concentration							
				Mass							
8.	Oil and grease	☑	☐	Concentration	mg/L	8.1		2.1	69		
				Mass							
9.	Phosphorus (as P), total (7723-14-0)	☐	☑	Concentration							
				Mass							
10.	Sulfate (as SO_4) (14808-79-8)	☐	☑	Concentration							
				Mass							
11.	Sulfide (as S)	☐	☑	Concentration							
				Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number	Form Approved 03/05/19
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001	OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
12.	Sulfite (as SO_3) (14265-45-3)	☐	☑	Concentration							
				Mass							
13.	Surfactants	☐	☑	Concentration							
				Mass							
14.	Aluminum, total (7429-90-5)	☐	☑	Concentration							
				Mass							
15.	Barium, total (7440-39-3)	☐	☑	Concentration							
				Mass							
16.	Boron, total (7440-42-8)	☐	☑	Concentration							
				Mass							
17.	Cobalt, total (7440-48-4)	☐	☑	Concentration							
				Mass							
18.	Iron, total (7439-89-6)	☐	☑	Concentration							
				Mass							
19.	Magnesium, total (7439-95-4)	☐	☑	Concentration							
				Mass							
20.	Molybdenum, total (7439-98-7)	☐	☑	Concentration							
				Mass							
21.	Manganese, total (7439-96-5)	☐	☑	Concentration							
				Mass							
22.	Tin, total (7440-31-5)	☐	☑	Concentration							
				Mass							
23.	Titanium, total (7440-32-6)	☐	☑	Concentration							
				Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
24.	**Radioactivity**										
	Alpha, total	☐	☑	Concentration							
				Mass							
	Beta, total	☐	☑	Concentration							
				Mass							
	Radium, total	☐	☑	Concentration							
				Mass							
	Radium 226, total	☐	☑	Concentration							
				Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
1.	Asbestos	☐	☑		
2.	Acetaldehyde	☐	☑		
3.	Allyl alcohol	☐	☑		
4.	Allyl chloride	☐	☑		
5.	Amyl acetate	☐	☑		
6.	Aniline	☐	☑		
7.	Benzonitrile	☐	☑		
8.	Benzyl chloride	☐	☑		
9.	Butyl acetate	☐	☑		
10.	Butylamine	☐	☑		
11.	Captan	☐	☑		
12.	Carbaryl	☐	☑		
13.	Carbofuran	☐	☑		
14.	Carbon disulfide	☐	☑		
15.	Chlorpyrifos	☐	☑		
16.	Coumaphos	☐	☑		
17.	Cresol	☐	☑		
18.	Crotonaldehyde	☐	☑		
19.	Cyclohexane	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
20.	2,4-D (2,4-dichlorophenoxyacetic acid)	☐	☑		
21.	Diazinon	☐	☑		
22.	Dicamba	☐	☑		
23.	Dichlobenil	☐	☑		
24.	Dichlone	☐	☑		
25.	2,2-dichloropropionic acid	☐	☑		
26.	Dichlorvos	☐	☑		
27.	Diethyl amine	☐	☑		
28.	Dimethyl amine	☐	☑		
29.	Dintrobenzene	☐	☑		
30.	Diquat	☐	☑		
31.	Disulfoton	☐	☑		
32.	Diuron	☐	☑		
33.	Epichlorohydrin	☐	☑		
34.	Ethion	☐	☑		
35.	Ethylene diamine	☐	☑		
36.	Ethylene dibromide	☐	☑		
37.	Formaldehyde	☐	☑		
38.	Furfural	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
39.	Guthion	☐	☑		
40.	Isoprene	☐	☑		
41.	Isopropanolamine	☐	☑		
42.	Kelthane	☐	☑		
43.	Kepone	☐	☑		
44.	Malathion	☐	☑		
45.	Mercaptodimethur	☐	☑		
46.	Methoxychlor	☐	☑		
47.	Methyl mercaptan	☐	☑		
48.	Methyl methacrylate	☐	☑		
49.	Methyl parathion	☐	☑		
50.	Mevinphos	☐	☑		
51.	Mexacarbate	☐	☑		
52.	Monoethyl amine	☐	☑		
53.	Monomethyl amine	☐	☑		
54.	Naled	☐	☑		
55.	Naphthenic acid	☐	☑		
56.	Nitrotoluene	☐	☑		
57.	Parathion	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
58.	Phenolsulfonate	☐	☑		
59.	Phosgene	☐	☑		
60.	Propargite	☐	☑		
61.	Propylene oxide	☐	☑		
62.	Pyrethrins	☐	☑		
63.	Quinoline	☐	☑		
64.	Resorcinol	☐	☑		
65.	Strontium	☐	☑		
66.	Strychnine	☐	☑		
67.	Styrene	☐	☑		
68.	2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	☐	☑		
69.	TDE (tetrachlorodiphenyl ethane)	☐	☑		
70.	2,4,5-TP [2-(2,4,5-trichlorophenoxy) propanoic acid]	☐	☑		
71.	Trichlorofon	☐	☑		
72.	Triethanolamine	☐	☑		
73.	Triethylamine	☐	☑		
74.	Trimethylamine	☐	☑		
75.	Uranium	☐	☑		
76.	Vanadium	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
77.	Vinyl acetate	☐	☑		
78.	Xylene	☐	☑		
79.	Xylenol	☐	☑		
80.	Zirconium	☐	☑		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110000589373	AL0000418	Cherokee Nitrogen, LLC	DSN001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE E. 2,3,7,8 TETRACHLORODIBENZO P DIOXIN (2,3,7,8 TCDD) (40 CFR 122.21(g)(7)(viii))

Pollutant	TCDD Congeners Used or Manufactured	Presence or Absence (check one)		Results of Screening Procedure
		Believed Present	Believed Absent	
2,3,7,8-TCDD	☐	☐	☑	

Attachment:
Form 3510-2C

ADDENDUM C

Production Data

Unit	2018 Tons/Yr	2019 Tons/Yr	2020 Tons/Yr	2021 Tons/Yr	2022 Tons/Yr	Avg 5 years Lbs/Day	Average of 5 Yearly Max Months Over Last 5 years Lbs/Day	Maximum Monthly Production from 2022 Lbs/Day
Ammonia	147,149	174,104	181,539	155,183	160,717	896,706	1,090,919	1,109,645
Nitric Acid	121,134	131,634	132,648	141,178	128,024	716,997	951,721	962,736
Ammonium Nitrate Solution	117,279	124,514	130,376	139,746	149,432	724,366	997,190	1,171,888
Ammonium Nitrate Prill	0	0	0	0	0	0	0	0
Urea Ammonium Nitrate Solution (UAN)	167,807	192,838	187,374	166,205	187,584	987,741	1,290,786	1,310,511
Urea	69,948	83,326	90,272	76,648	82,843	441,443	558,087	567,691
Carbon Dioxide	173,146	204,377	214,448	184,372	189,472	1,057,848	1,264,076	1,281,247
Ammonium Hydroxide (Aqua Ammonia)	919	1,399	1,222	923	857	5,827	8,916	7,193

Attachment:
Form 3510-2C Addendum A – Facility Diagrams, B – Water Flow Diagram, C – Production Data

ADDENDUM A

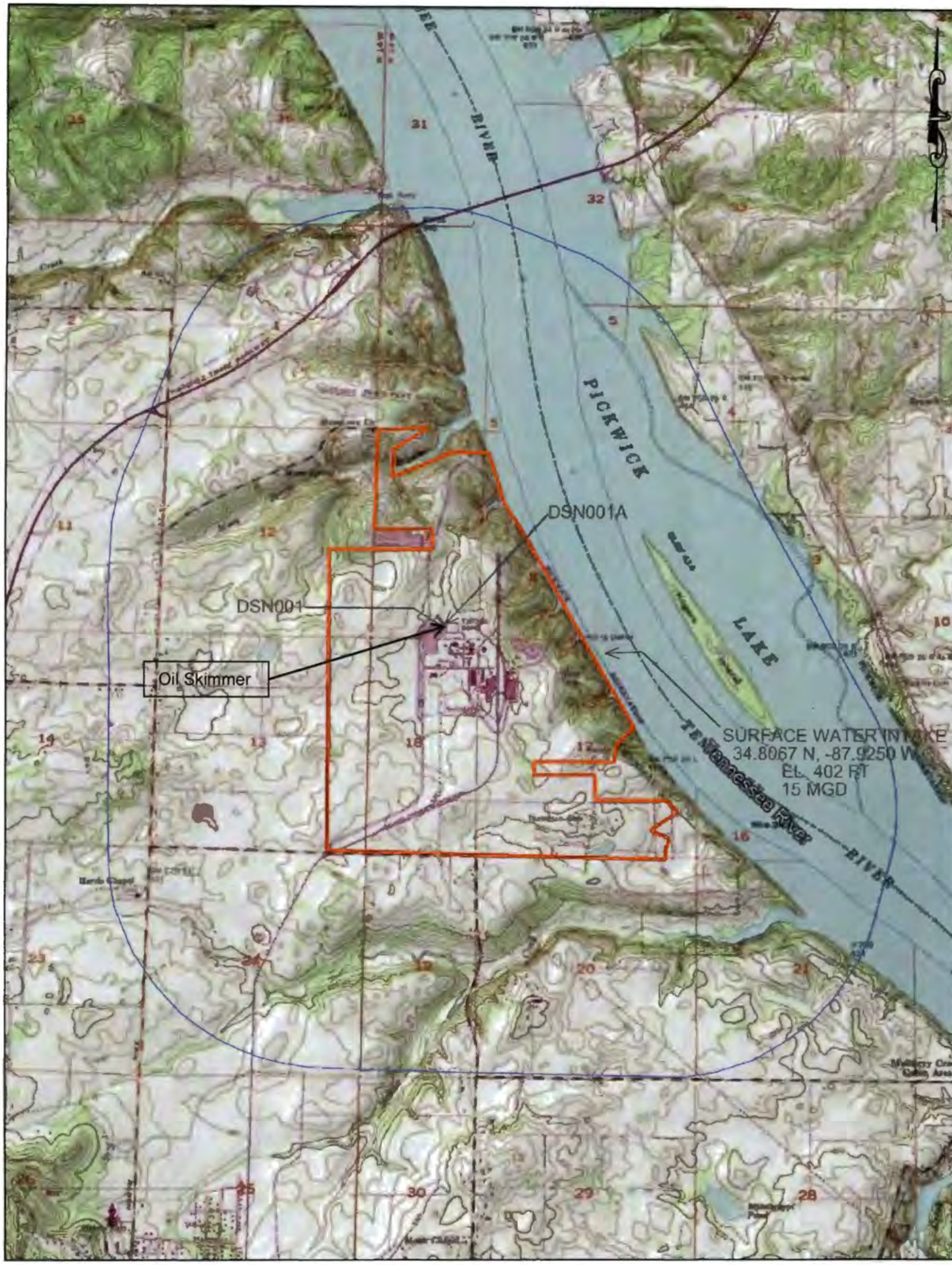
Facility Diagrams

FIGURE 1 - CHEROKEE NITROGEN, LLC

GOOGLE EARTH AERIAL PHOTOGRAPH

Scale: 1" = 1,060'
Job No: 23-090
Date: 05/24/2023
Drawn b : SAH

GSE, Inc.
3795 Gordon Terry Porkwoy
Trinity, AL 35673
Phone: (256) 350-9754
Fax: (256) 350-9768



SUBJECT SITE

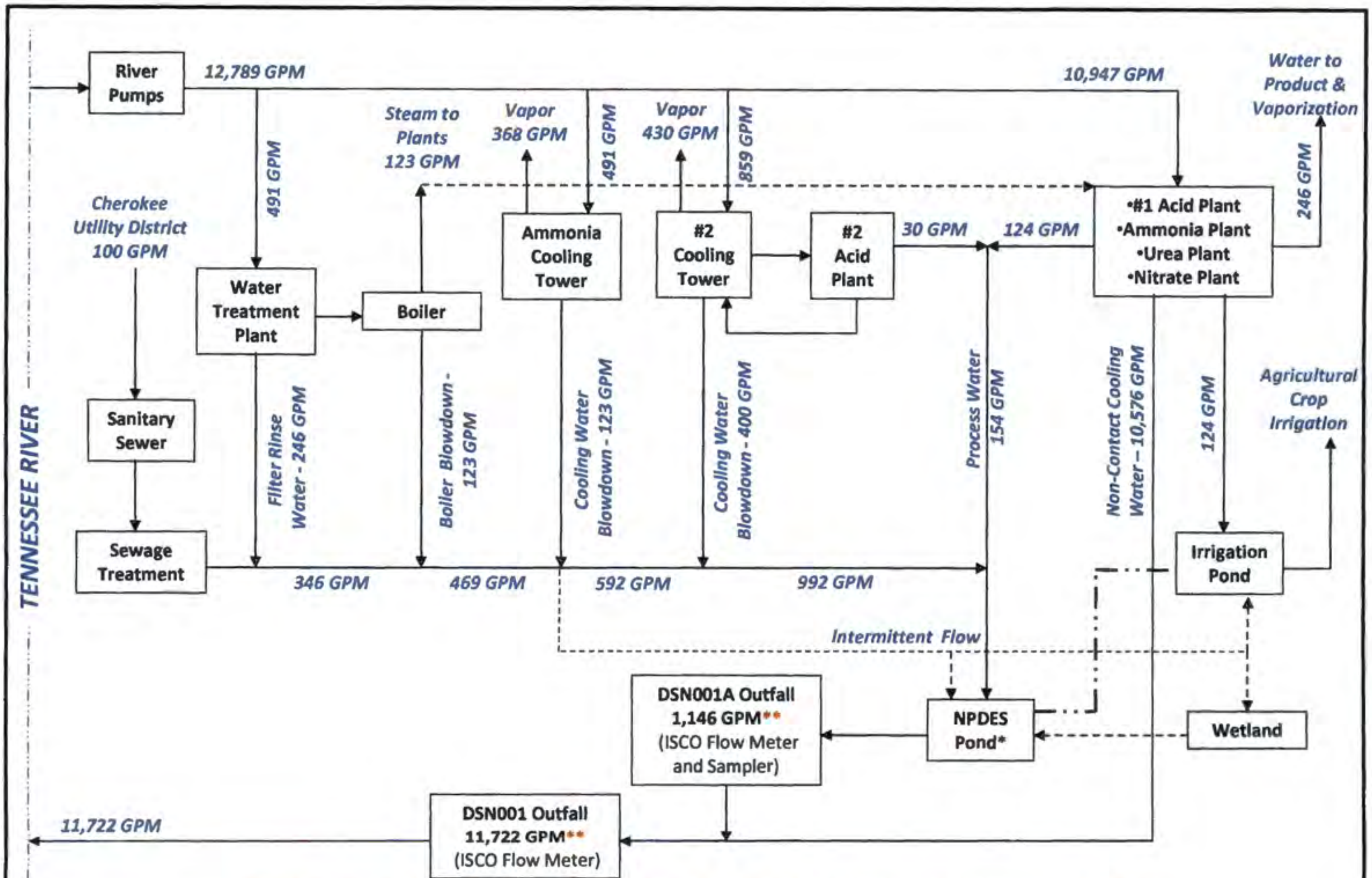
EXTENDED BOUNDARY

FIGURE 2 - SITE LOCATION MAP	Scale: 1:2000 Job No: 23-090
USGS 7.5' TOPOGRAPHIC MAP	Date: 05/26/2023 Drawn by: SAH

GSE, Inc.
3795 Gordon Terry Parkway
Trinity, AL 35673
Phone: (256) 350-9754
Fax: (256) 350-9768

ADDENDUM B

Water Flow Diagram



**NPDES Pond can be closed off and pumped to the Irrigation Pond, if needed, for crops or during an emergency situation.*
***River Water Intake, DSN001A, and DSN001 flows are based on recorded average flow data. Remaining flow data is estimated.*

Project:	Title:				
NPDES PERMIT RENEWAL APPLICATION CHEROKEE NITROGEN, LLC	SCHEMATIC OF WATER FLOW	GSE	Drawn: SAH	Checked: JKC	Figure
			Not to Scale		1

Attachment:
Form 187

Alabama Department of Environmental Management (ADEM)
NPDES Individual Permit Application
Supplementary Information for Industrial Facilities

Instructions: This form should be used to submit the required supplementary information for an application for an NPDES individual permit for industrial facilities. The completed application should be submitted to ADEM in duplicate. If insufficient space is available to address any item, please continue on an attached sheet of paper. Please mark "N/A" in the appropriate box when an item is not applicable to the applicant. **Please type or print legibly in blue or black ink.** Mail the completed application to:

ADEM-Water Division
Industrial Section
P O Box 301463
Montgomery, AL 36130-1463

PURPOSE OF THIS APPLICATION

☐ Initial Permit Application for New Facility*
☐ Initial Permit Application for Existing Facility*
☐ Modification of Existing Permit
■ Reissuance of Existing Permit
☐ Revocation & Reissuance of Existing Permit

* *An application for participation in the ADEM's Electronic Environmental (E2) Reporting must be submitted to allow permittee to electronically submit reports as required.*

SECTION A – GENERAL INFORMATION

1. Permittee Name: Cherokee Nitrogen, LLC
2. NPDES Permit Number: AL 0000418 (not applicable if initial permit application)
3. SID Permit Number (if applicable): IU
4. NPDES General Permit Number (if applicable): ALG
5. Facility Location (Front Gate): Latitude: 34.8057814 Longitude: -87.9385775
6. Responsible Official (as described on the last page of this application):

   Name: Howard Stevens Title: General Manager

   Address: 1080 Industrial Drive

   City: Cherokee State: AL Zip: 35616

   Phone Number: (256) 359-7222 Email Address: hstevens@lsbindustries.com
7. Designated Discharge Monitoring Report (DMR) Contact:

   Name: Bryce K. Smith Title: Environmental Manager

   Phone Number: (580) 583-8354 Email Address: bksmith@lsbindustries.com
8. Type of Business Entity:

   ☐ Corporation ☐ General Partnership ☐ Limited Partnership ☒ Limited Liability Company ☐ Sole Proprietorship
   ☐ Other (Please Specify)

8. Complete this section if the Applicant's business entity is a Corporation

   a) Location of Incorporation:

   Address: 3503 NW 63rd Street, Suite 500

   City: Oklahoma City County: Oklahoma State: Oklahoma Zip: 73116-2238

   b) Parent Corporation of Applicant:

   Name: LSB Industries, Inc.

   Address: 3503 NW 63rd Street, Suite 500

   City: Oklahoma City State: Oklahoma Zip: 73116-2238

c) Subsidiary Corporation(s) of Applicant:

Name: N/A

Address:

City: State: Zip:

d) Corporate Officers:

Name: See Addendum B

Address:

City: State: Zip:

Name:

Address:

City: State: Zip:

e) Agent designated by the corporation for purposes of service:

Name: Howard Stevens, General Manager

Address: 1080 Industrial Drive

City: Cherokee State: AL Zip: 35616

9. If the Applicant's business entity is a Partnership, please list the general partners.

Name: Name:

Address: Address:

City: State: Zip: City: State: Zip:

10. If the Applicant's business entity is a Proprietorship, please enter the proprietor's information.

Name:

Address:

City: State: Zip:

11. Identify all Administrative Complaints, Notices of Violation, Directives, Administrative Orders, or Litigation concerning water if any, against the Applicant, its parent corporation or subsidiary corporations within the State of Alabama within the past five years (attach additional sheets if necessary):

Facility Name	Permit Number	Type of Action	Date of Action
N/A			

SECTION B – BUSINESS ACTIVITY

If your facility conducts or will be conducting any of the processes listed below (regardless of whether they generate wastewater, waste sludge, or hazardous waste), place a check beside the category of business activity (check all that apply):

Industrial Categories

- ☐ Aluminum Forming
- ☐ Asbestos Manufacturing
- ☐ Battery Manufacturing
- ☐ Can Making
- ☐ Canned and Preserved Fruit and Vegetables
- ☐ Canned and Preserved Seafood
- ☐ Cement Manufacturing
- ☐ Centralized Waste Treatment
- ☐ Carbon Black
- ☐ Coal Mining
- ☐ Coil Coating
- ☐ Copper Forming
- ☐ Electric and Electronic Components Manufacturing
- ☐ Electroplating
- ☐ Explosives Manufacturing
- ☐ Feedlots
- ☐ Ferroalloy Manufacturing
- ☒ Fertilizer Manufacturing
- ☐ Foundries (Metal Molding and Casting)
- ☐ Glass Manufacturing
- ☐ Grain Mills
- ☐ Gum and Wood Chemicals Manufacturing
- ☐ Inorganic Chemicals
- ☐ Iron and Steel
- ☐ Leather Tanning and Finishing
- ☐ Metal Finishing
- ☐ Meat Products
- ☐ Metal Molding and Casting
- ☐ Metal Products
- ☐ Nonferrous Metals Forming
- ☐ Nonferrous Metals Manufacturing
- ☐ Oil and Gas Extraction
- ☐ Organic Chemicals Manufacturing
- ☐ Paint and Ink Formulating
- ☐ Paving and Roofing Manufacturing
- ☐ Pesticides Manufacturing
- ☐ Petroleum Refining
- ☐ Phosphate Manufacturing
- ☐ Photographic
- ☐ Pharmaceutical
- ☐ Plastic & Synthetic Materials
- ☐ Plastics Processing Manufacturing
- ☐ Porcelain Enamel
- ☐ Pulp, Paper, and Fiberboard Manufacturing
- ☐ Rubber
- ☐ Soap and Detergent Manufacturing
- ☐ Steam and Electric
- ☐ Sugar Processing
- ☐ Textile Mills
- ☐ Timber Products
- ☐ Transportation Equipment Cleaning
- ☐ Waste Combustion
- ☐ Other (specify)____________________

A facility with processes inclusive in these business areas may be covered by Environmental Protection (EPA) categorical standards. These facilities are termed "categorical users".

SECTION C – WASTEWATER DISCHARGE INFORMATION

1. Do you share an outfall with another facility? ☐ Yes ☒ No (If no, continue to C.2)

   For each shared outfall, provide the following:

Applicant's Outfall No.	Name of Other Permittee/Facility	NPDES Permit No.	Where is sample collected by Applicant?

2. Do you have, or plan to have, automatic sampling equipment or continuous wastewater flow metering equipment at this facility?

Current:	Flow Metering	☒ Yes	☐ No	☐ N/A
	Sampling Equipment	☒ Yes	☐ No	☐ N/A
Planned:	Flow Metering	☒ Yes	☐ No	☐ N/A
	Sampling Equipment	☒ Yes	☐ No	☐ N/A

If so, please attach a schematic diagram of the sewer system indicating the present or future location of this equipment and describe the equipment below:

ISCO Flow Meters located at DSN001 (present), DSN001A (present), and DSN001B (future-if required)
ISCO Sampling Units located at DSN001A (present) and DSN001B (future-if required)

3. Are any process changes or expansions planned during the next three years that could alter wastewater volumes or characteristics?

☐ Yes ☒ No (If no, continue to C.4)

Briefly describe these changes and their anticipated effects on the wastewater volume and characteristics:

4. List the trade name and chemical composition of all biocides and corrosion inhibitors used:

Trade Name	Chemical Composition
See Addendum D	

For each biocide and/or corrosion inhibitor used, please include the following information:

(1) 96-hour median tolerance limit data for organisms representative of the biota of the waterway into which the discharge will ultimately reach,
(2) quantities to be used,
(3) frequencies of use,
(4) proposed discharge concentrations, and
(5) EPA registration number, if applicable

SECTION D – WATER SUPPLY

Water Sources (check as many as are applicable):

☐ Private Well
■ Surface Water
■ Municipal Water Utility (Specify City):
☐ Other (Specify): ______

IF MORE THAN ONE WELL OR SURFACE INTAKE, PROVIDE DATA FOR EACH ON AN ATTACHMENT

City: 0.14 MGD* Well: ______ MGD* Well Depth: ______ Ft. Latitude: ______ Longitude: ______

Surface Intake Volume: 18.4 MGD* Intake Elevation in Relation to Bottom: ______ Ft.

Intake Elevation: 402 Ft. Latitude: 34.8067 Longitude: -87.9250

Name of Surface Water Source: Tennessee River/ Pickwick Lake

*** MGD – Million Gallons per Day**

Cooling Water Intake Structure Information

Complete D.1 and D.2 if your water supply is provided by an outside source and not by an onsite water intake structure? (e.g., another industry, municipality, etc…)

1. Does the provider of your source water operate a surface water intake? ■ Yes ☐ No
   (If yes, continue, if no, go to Section E.)

   a) Name of Provider: Town of Cherokee Water and Gas Board   b) Location of Provider: 3780 Old Lee Hwy, Cherokee, AL 35616

   c) Latitude: 34.79983   Longitude: -87.92357

2. Is the provider a public water system (defined as a system which provides water to the public for human consumption or which provides only <u>treated</u> water, not raw water)? ■ Yes ☐ No (If yes, go to Section E, if no, continue.)

Only to be completed if you have a cooling water intake structure or the provider of your water supply uses an intake structure and does not treat the raw water.

3. Is any water withdrawn from the source water used for cooling? ■ Yes ☐ No

4. Using the average monthly measurements over any 12-month period, approximately what percentage of water withdrawn is used exclusively for cooling purposes? 96 %

5. Does the cooling water consist of treated effluent that would otherwise be discharged? ☐ Yes ■ No
   (If yes, go to Section E, if no, complete D.6 – D.17)

6. a. Is the cooling water used in a once-through cooling system? ■ Yes ☐ No

   b. Is the cooling water used in a closed cycle cooling system? ☐ Yes ■ No

7. When was the intake installed? 1962
   (Please provide dates for all major construction/installation of intake components including screens)

8. What is the maximum intake volume? 59,000,000
   (maximum pumping capacity in gallons per day)

9. What is the average intake volume? 18,400,000
   (average intake pump rate in gallons per day average in any 30-day period)

10. What is the actual intake flow (AIF) as defined in 40 CFR §125.92(a)? 18.4 MGD

11. How is the intake operated? (e.g., continuously, intermittently, batch) Continuously

12. What is the mesh size of the screen on your intake? 3/8 in. square, open, 14 gauge

13. What is the intake screen flow-through area? 66 sqft

14. What is the through-screen design intake flow velocity? 1.0 ft/sec

15. What is the through-screen actual velocity (in ft/sec)? 0.84 ft/sec

16. What is the mechanism for cleaning the screen? (e.g., does it rotate for cleaning) Rotating

17. Do you have any additional fish detraction technology on your intake? ☐ Yes ■ No

18. Have there been any studies to determine the impact of the intake on aquatic organisms? ■ Yes ☐ No (If yes, please provide.)

19. Attach a site map showing the location of the water intake in relation to the facility, shoreline, water depth, etc.

SECTION E – WASTE STORAGE AND DISPOSAL INFORMATION

Provide a description of the location of all sites involved in the storage of solids or liquids that could be accidentally discharged to a water of the state, either directly or indirectly via such avenues as storm water drainage, municipal wastewater systems, etc., which are located at the facility for which the NPDES application is being made. Where possible, the location should be noted on a map and included with this application:

Description of Waste	Description of Storage Location
Used Oil	Rope Skimmer Collection Tank

SECTION F – COASTAL ZONE INFORMATION

Is the discharge(s) located within the 10-foot elevation contour and within the limits of Mobile or Baldwin County? ☐ Yes ☒ No
If yes, complete items F.1 – F.12:

		Yes	No
1.	Does the project require new construction?	☐	☐
2.	Will the project be a source of new air emissions?	☐	☐
3.	Does the project involve dredging and/or filling of a wetland area or water way?	☐	☐
	If Yes, has the Corps of Engineers (COE) permit been received? COE Project No. ________________	☐	☐
4.	Does the project involve wetlands and/or submersed grassbeds?	☐	☐
5.	Are oyster reefs located near the project site? If Yes, include a map showing project and discharge location with respect to oyster reefs	☐	☐
6.	Does the project involve the site development, construction and operation of an energy facility as defined in ADEM Admin. Code r. 335-8-1-.02(bb)?	☐	☐
7.	Does the project involve mitigation of shoreline or coastal area erosion?	☐	☐
8.	Does the project involve construction on beaches or dune areas?	☐	☐
9.	Will the project interfere with public access to coastal waters?	☐	☐
10.	Does the project lie within the 100-year floodplain?	☐	☐
11.	Does the project involve the registration, sale, use, or application of pesticides?	☐	☐
12.	Does the project propose or require construction of a new well or to alter an existing groundwater well to pump more than 50 gallons per day (GPD)?	☐	☐
	If yes, has the applicable permit for groundwater recovery or for groundwater well installation been obtained?	☐	☐

SECTION G – ANTI-DEGRADATION EVALUATION

In accordance with 40 CFR §131.12 and the ADEM Admin. Code r. 335-6-10-.04 for anti-degradation, the following information must be provided, if applicable. It is the applicant's responsibility to demonstrate the social and economic importance of the proposed activity. If further information is required to make this demonstration, attach additional sheets to the application.

1. Is this a new or increased discharge that began after April 3, 1991? ☐ Yes ☒ No
   If yes, complete G.2 below. If no, go to Section H.

2. Has an Anti-Degradation Analysis been previously conducted and submitted to the Department for the new or increased discharge referenced in G.1? ☐ Yes ☐ No

   If yes, do not complete this section. If no, and the discharge is to a Tier II waterbody as defined in ADEM Admin. Code r. 335-6-10-.12(4), complete G.2.A – G.2.F below and ADEM Forms 311 and 313 (attached). ADEM Form 313 must be provided for each alternative considered technically viable.

Information required for new or increased discharges to high quality waters:

A. What environmental or public health problem will the discharger be correcting?

B. How much will the discharger be increasing employment (at its existing facility or as the result of locating a new facility)?

C. How much reduction in employment will the discharger be avoiding?

D. How much additional state or local taxes will the discharger be paying?

E. What public service to the community will the discharger be providing?

F. What economic or social benefit will the discharger be providing to the community?

SECTION H – EPA Application Forms

All Applicants must submit EPA permit application forms. More than one application form may be required from a facility depending on the number and types of discharges or outfalls found. The EPA application forms are found on the Department's website at http://www.adem.alabama.gov/programs/water/waterforms.cnt . The EPA application forms must be submitted in duplicate as follows:

1. All applicants must submit Form 1.

2. Applicants for existing industrial facilities (including manufacturing facilities, commercial facilities, mining activities, and silvicultural activities) which discharge process wastewater must submit Form 2C.

3. Applicants for new industrial facilities which propose to discharge process wastewater must submit Form 2D.

4. Applicants for new and existing industrial facilities which discharge only non-process wastewater (i.e., non-contact cooling water and/or sanitary wastewater) must submit Form 2E.

5. Applicants for new and existing facilities whose discharge is composed entirely of storm water associated with industrial activity must submit Form 2F, unless exempted by § 122.26(c)(1)(ii). If the discharge is composed of storm water and non-storm water, the applicant must also submit Forms 2C, 2D, and/or 2E, as appropriate (in addition to Form 2F).

SECTION I – ENGINEERING REPORT/BMP PLAN REQUIREMENTS

See ADEM 335-6-6-.08(i) & (j)

SECTION J– RECEIVING WATERS

Outfall No.	Receiving Water(s)	303(d) Segment?		Included in TMDL?*	
DSN001	Tennessee River	☐ Yes	☒ No	☐ Yes	☒ No
DSN001A	Tennessee River	☐ Yes	☒ No	☐ Yes	☒ No
		☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No
		☐ Yes	☐ No	☐ Yes	☐ No

*If a TMDL Compliance Schedule is requested, the following should be attached as supporting documentation:

(1) Justification for the requested Compliance Schedule (e.g. time for design and installation of control equipment, etc.);

(2) Monitoring results for the pollutant(s) of concern which have not previously been submitted to the Department (sample collection dates, analytical results (mass and concentration), methods utilized, MDL/ML, etc. should be submitted as available);

(3) Requested interim limitations, if applicable;

(4) Date of final compliance with the TMDL limitations; and,

(5) Any other additional information available to support requested compliance schedule.

SECTION K – APPLICATION CERTIFICATION

The information contained in this form must be certified by a responsible official as defined in ADEM Administrative Code r. 335-6-6-.09 "signatories to permit applications and reports" (see below).

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations."

Signature of Responsible Official: [signature] Date Signed: 11-3-23

Name: Howard Stevens Title: General Manager

If the Responsible Official signing this application is not identified in Section A.7, provide the following information:

Mailing Address: __________

City: __________ State: __________ Zip: __________

Phone Number: __________ Email Address: __________

335-6-6-.09 SIGNATORIES TO PERMIT APPLICATIONS AND REPORTS.

(1) The application for an NPDES permit shall be signed by a responsible official, as indicated below:

(a) In the case of a corporation, by a principal executive officer of at least the level of vice president, or a manager assigned or delegated in accordance with corporate procedures, with such delegation submitted in writing if required by the Department, who is responsible for manufacturing, production, or operating facilities and is authorized to make management decisions which govern the operation of the regulated facility;

(b) In the case of a partnership, by a general partner;

(c) In the case of a sole proprietorship, by the proprietor; or

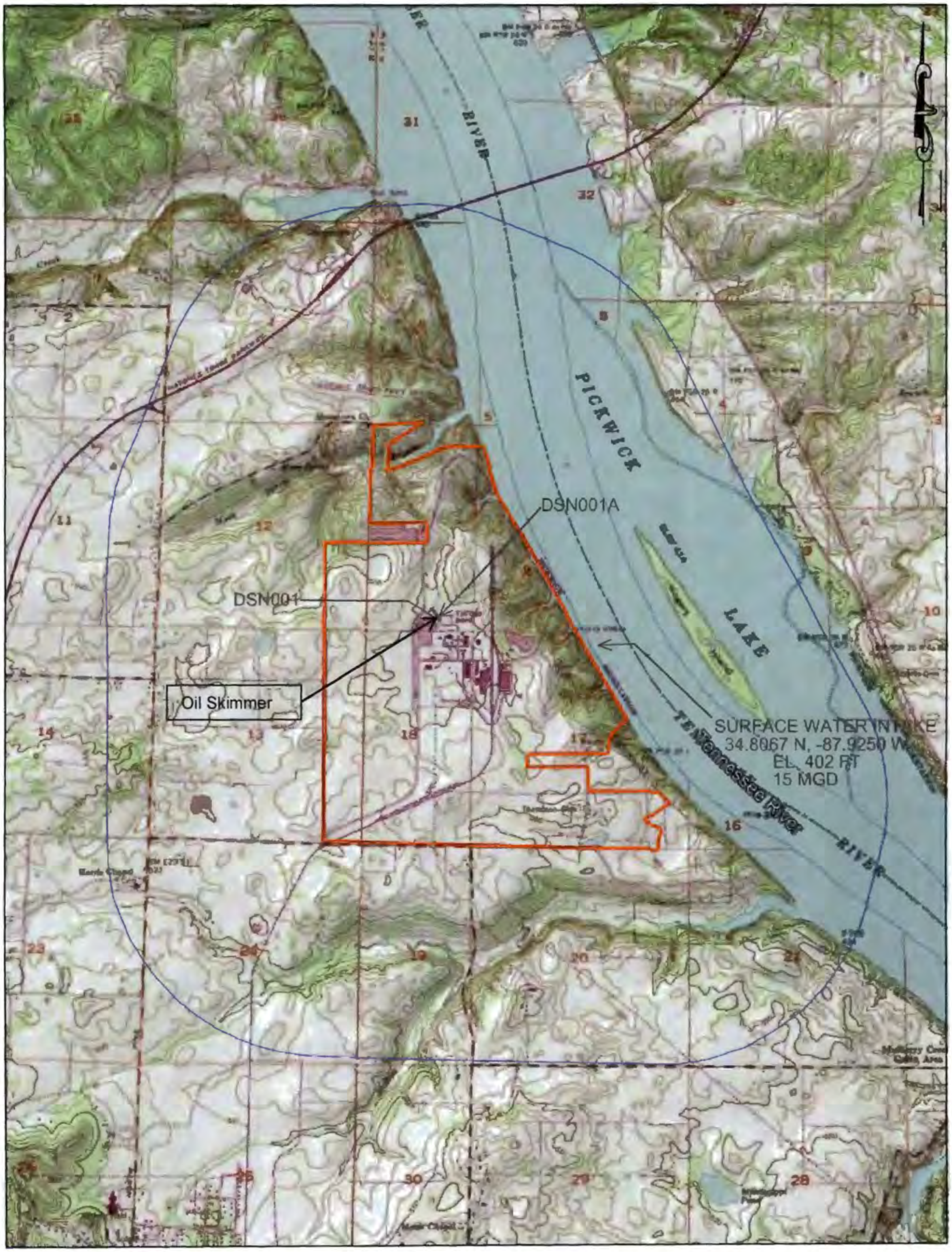
(d) In the case of a municipal, state, federal, or other public entity, by either a principal executive officer, or ranking elected official.

Attachment:
Form 187 Addendums A- F

ADDENDUM A

Facility Diagrams

FIGURE 1 - CHEROKEE NITROGEN, LLC	Scale: 1" = 1,060'	GSE, Inc. 3795 Gordon Terry Porkwoy Trinity, AL 35673 Phone: (256) 350-9754 Fax: (256) 350-9768
	Job No: 23-090	
GOOGLE EARTH AERIAL PHOTOGRAPH	Date: 05/24/2023	
	Drawn b : SAH	



SUBJECT SITE

EXTENDED BOUNDARY

FIGURE 2 - SITE LOCATION MAP	Scale: 1:2000 Job No: 23-090
USGS 7.5' TOPOGRAPHIC MAP	Date: 05/26/2023 Drawn by: SAH

GSE, Inc.
3795 Gordon Terry Parkway
Trinity, AL 35673
Phone: (256) 350-9754
Fax: (256) 350-9768

ADDENDUM B

Corporate Officers

Cherokee Nitrogen, LLC

Corporate Officers

Mark T. Behrman, President and Chief Executive Officer
3503 NW 63rd St, Suite 500
Oklahoma City, Oklahoma 73116

Cheryl Maguire, Executive Vice President, Chief Financial Officer
3503 NW 63rd St, Suite 500
Oklahoma City, Oklahoma 73116

Michael J. Foster, Executive Vice President, General Counsel and Secretary
3503 NW 63rd St, Suite 500
Oklahoma City, Oklahoma 73116

John Burns, Executive Vice President-Manufacturing
3503 NW 63rd St, Suite 500
Oklahoma City, Oklahoma 73116

Damien Renwick, Executive Vice President, Chief Commercial Officer
3503 NW 63rd St, Suite 500
Oklahoma City, Oklahoma 73116

Kristy Carver, Senior Vice President, Treasurer
3503 NW 63rd St, Suite 500
Oklahoma City, Oklahoma 73116

ADDENDUM C

Description of Operations

Cherokee Nitrogen, LLC

Description of Operations

Cherokee Nitrogen, LLC is located in Cherokee, Colbert County, Alabama. The plant lies north of Colbert County Road 25 and southwest of the Tennessee River. The plant occupies approximately 300 acres of land and contains approximately 270,000 square feet of buildings. Cherokee Nitrogen also owns approximately 1,000 acres of adjacent farmland. The facility is a manufacturing plant for nitrogen-based chemicals used predominately in agriculture. The facility receives raw materials which include natural gas, air, purchased ammonia, and lubricants. Production facilities include an ammonia plant, two nitric acid plants, a urea plant, and an ammonium nitrate plant.

Process wastewater from water treatment filter rinse, sewage treatment, boiler and cooling tower blowdown, #2 acid plant, and stormwater flows directly to the NPDES settling/holding pond. Oil is recovered via rope skimmer. Any spill that may occur within the plant is contained and neutralized or recovered prior to discharge at DSN001A. BMPs are utilized to minimize stormwater contact. Discharges from the NPDES settling/holding pond combine with once-through cooling water and stormwater runoff before final discharge through DSN001.

Plant process wastewater that contains small quantities of ammonium nitrate, urea, and ammonia is discharged to and stored in an agricultural irrigation pond. The water is monitored for nutrient content and balanced with non-contact cooling water as needed for agricultural irrigation. The agricultural irrigation water is applied to approximately 1,650 acres of crops (Bermuda grass, corn, cotton, etc.). BMPs are utilized to minimize stormwater contact. Irrigation activities are in accordance with the existing NPDES permit.

ADDENDUM D

Biocide and Corrosion Inhibitor Usage

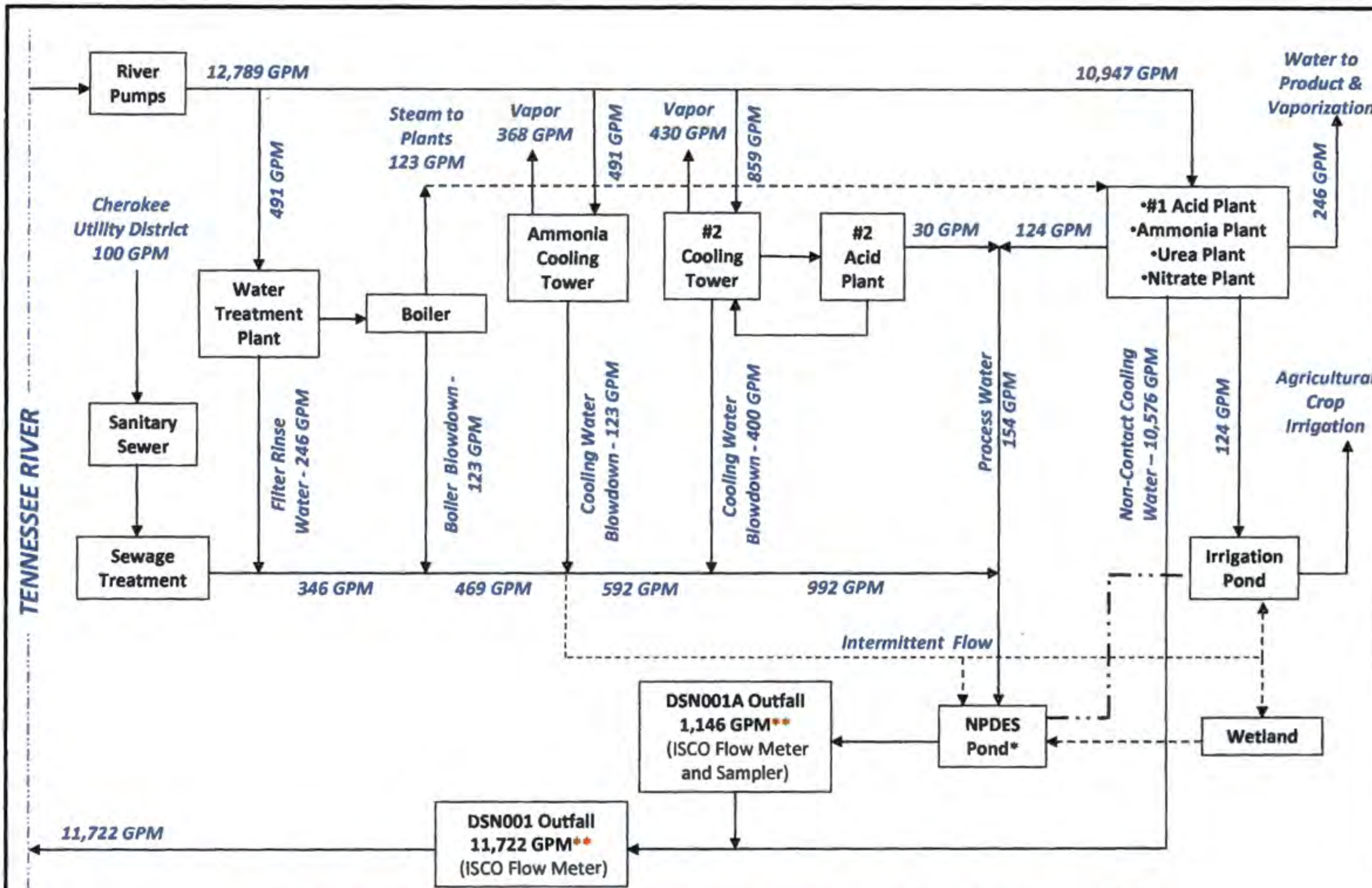
Form 187, Addendum D
Cherokee Nitrogen Biocide and Corrosion Inhibitor Product List

						96-hour median tolerance or available toxicity data							
Product Use	**Product Name**	**Manufacturer**	**Toxicity Based on Overall Product or Listed Constituent**	**CAS No.**	**Percent in Product (maximum, if given a range)**	**Toxicity Based on Overall Product or Listed Constituent**	**Toxicity to Algae (mg/L)**	**Toxicity to Fish (mg/L)**	**Toxicity to Invertebrates (mg/L)**	**Quantities to be Used (gallons on average)**	**Frequency of Use**	**Proposed Discharge Concentrations (ppm, assuming no transformation during use)**	**EPA Registration Number, if applicable**
Corrosion Inhibitor	3D TRASAR 3DT178	Nalco Canada ULC	Product			Overall Product		1,875	1,875 (48-hr)	10	Daily	0.21	N/A
			Tetrapotassium Pyrophosphate	7320-34-5	30					10	Daily	0.06	N/A
			Potassium Phosphate	16068-46-5	30					10	Daily	0.06	N/A
Corrosion Inhibitor	3D Trasar 3DT260	Nalco Canada ULC	Product			Overall Product	Benzotriazole 15.4 (72-hr EC50)	1,436	884 (48-hr)	0.3	Daily	0.005	N/A
			2-Phosphono-1,2,4-Butanetricarboxylic Acid	37971-36-1	5					0.3	Daily	0.0002	N/A
			Hydroxyethylidenediphosphonic Acid	2809-21-4	5					0.3	Daily	0.0002	N/A
			Benzotriazole	95-14-7	5					0.3	Daily	0.0002	N/A
Corrosion Inhibitor	3D Trasar 3DT397	Nalco Company	Product			Overall Product	104 (48-hr)	480	369 (48-hr)	1.5	Daily	0.02	N/A
			Modified benzimidazole salt	Proprietary	30					1.5	Daily	0.007	N/A
			Organic Sulfonic Acid	Proprietary	30					1.5	Daily	0.007	N/A
			Acetic Acid	64-19-7	5					1.5	Daily	0.001	N/A
			Alkano Sulfoxide	Proprietary	5					1.5	Daily	0.001	N/A
Corrosion Inhibitor	Trasar Trac100	Nalco Company	Product			Overall Product		10,000	7,752 (48-hr)	5	Week	0.09	N/A
			Sodium Metasilicate	6834-92-0	10					5	Week	0.009	N/A
			Sodium Tetraborate	1330-43-4	5		52.4 (72-hr EC50)			5	Week	0.005	N/A
Corrosion Inhibitor	CONQUOR CNOR3586	Nalco Company	Product			Overall Product	31 (72-hr EC50)	220	157 (48-hr)	2	Daily	0.03	N/A
			Methoxypropylamine	5332-73-0	30					2	Daily	0.008	N/A
			Cyclohexylamine	108-91-8	30					2	Daily	0.008	N/A
			Diethylhydroxylamine	3710-84-7	5					2	Daily	0.001	N/A
Corrosion Inhibitor	NexGuard 22310	Nalco Canada ULC	Product			Overall Product		2,861	1,650 (48-hr)	9	Daily	0.14	N/A
Corrosion Inhibitor	NITROSOLVE 220	Nalco Company	Sodium Petroleum-Sulphonate	68608-26-4	30	Sodium Petroleum-Sulphonate	>1,000 (72-hr EC50)	>10,000	>1,000 (48-hr EC 50)	18	Daily	0.09	N/A
			Dodecanoic Acid, potassium salt	10124-65-9	10	Dodecanoic Acid, potassium salt			5.7 (48-hr EC 50)	18	Daily	0.03	N/A
			Glycerol	56-81-5	30	Glycerol		855		18	Daily	0.09	N/A
Corrosion Inhibitor	SurGard 1700	Nalco Company	Product			Product		>1,000	>1,000 (48-hr)	5	Daily	0.08	N/A
			Diethylehtanolamine	100-37-8	10					5	Daily	0.01	N/A
Biocide	H-130 Microbiocide	Nalco Canada ULC	Didecyl-dimethyl-ammonium chloride	7137-51-5	50	Didecyl-dimethyl-ammonium chloride	0.026	0.19	0.19 (48-hr)	12	Weekly	0.01	N/A
			Ethanol	64-17-5	30					12	Weekly	0.01	N/A
Biocide	NALCO 77352NA	Nalco Company	Product			Overall Product	0.018 (EC50)	9.1	16.2 (48-hr)	5	Weekly	0.011	N/A
			Magnesium Nitrate	10377-60-3	5					5	Weekly	0.001	N/A
			5-Chloro-2-Methyl-4-Isothiazolin-3-one	26172-55-4	5					5	Weekly	0.001	N/A
			Magnesium Chloride	7786-30-3	5					5	Weekly	0.001	N/A
			2-Methyl-4-Isothiazolin-3-one	2682-20-4	1					5	Weekly	0.0001	N/A
Biocide	PURATE	Nalco Company	Sodium Chlorate	7775-90-9	40	Sodium Chlorate	>1,000 (72-hr EC50)	>1,000	>1,000 (48-hr EC)	50	Daily	1.03	N/A
			Hydrogen Peroxide	7722-84-1	10	Hydrogen Peroxide		16.4	2.4 (48-hr)	50	Daily	0.10	N/A
Biocide	Sodium Hypochlorite 12.5% NSF	Brenntag Pacific	Hypochlorous acid, sodium salt	7681-52-9	12.5	Hypochlorous acid, sodium salt		0.05 - 0.071	0.045-0.068 (48 hr)	3	Daily	0.01	N/A
Biocide	Stabrex ST70	Nalco Company	Product			Overall Product	3.66 (72-hr)	4.5	1.6 (48-hr)	0.5	Daily	0.01	N/A
			Sodium Bromide	7647-15-6	9.23					0.5	Daily	0.001	N/A
			Sodium Hypochlorite	7681-52-9	6.36					0.5	Daily	0.001	N/A
			Sodium Chloride	7647-14-5	5					0.5	Daily	0.0005	N/A
			Sodium Hydroxide	1310-73-2	5					0.5	Daily	0.0005	N/A

Proposed Discharge Concentration is based on: 1) higher range of average product use, 2) reported product density, 3) assuming 75% transformation during use, and 4) daily discharge volume of 11,721 gpm (equal to 16.8 MGD).

ADDENDUM E

Water Flow Diagram



**NPDES Pond can be closed off and pumped to the Irrigation Pond, if needed, for crops or during an emergency situation.*

***River Water Intake, DSN001A, and DSN001 flows are based on recorded average flow data. Remaining flow data is estimated.*

Project:	Title:				Figure
NPDES PERMIT RENEWAL APPLICATION CHEROKEE NITROGEN, LLC	SCHEMATIC OF WATER FLOW	GSE	Drawn	SAH	1
			Checked	JKC	
			Not to Scale		

ADDENDUM F

Production Data

Unit	2018 Tons/Yr	2019 Tons/Yr	2020 Tons/Yr	2021 Tons/Yr	2022 Tons/Yr	Avg 5 years Lbs/Day	Average of 5 Yearly Max Months Over Last 5 years Lbs/Day	Maximum Monthly Production from 2022 Lbs/Day
Ammonia	147,149	174,104	181,539	155,183	160,717	896,706	1,090,919	1,109,645
Nitric Acid	121,134	131,634	132,648	141,178	128,024	716,997	951,721	962,736
Ammonium Nitrate Solution	117,279	124,514	130,376	139,746	149,432	724,366	997,190	1,171,888
Ammonium Nitrate Prill	0	0	0	0	0	0	0	0
Urea Ammonium Nitrate Solution (UAN)	167,807	192,838	187,374	166,205	187,584	987,741	1,290,786	1,310,511
Urea	69,948	83,326	90,272	76,648	82,843	441,443	558,087	567,691
Carbon Dioxide	173,146	204,377	214,448	184,372	189,472	1,057,848	1,264,076	1,281,247
Ammonium Hydroxide (Aqua Ammonia)	919	1,399	1,222	923	857	5,827	8,916	7,193

From:	Greg Phillips <Greg.Phillips@AllianceTG.com>
Sent:	Wednesday, January 11, 2023 4:29 PM
To:	Pinson, Theo
Cc:	Keith Long; Andy Dolan; Nicki Johnson
Subject:	Submittal of 316(a) Study Report-Cherokee Nitrogen
Attachments:	CN-316a Study Report_1.11.2023.pdf

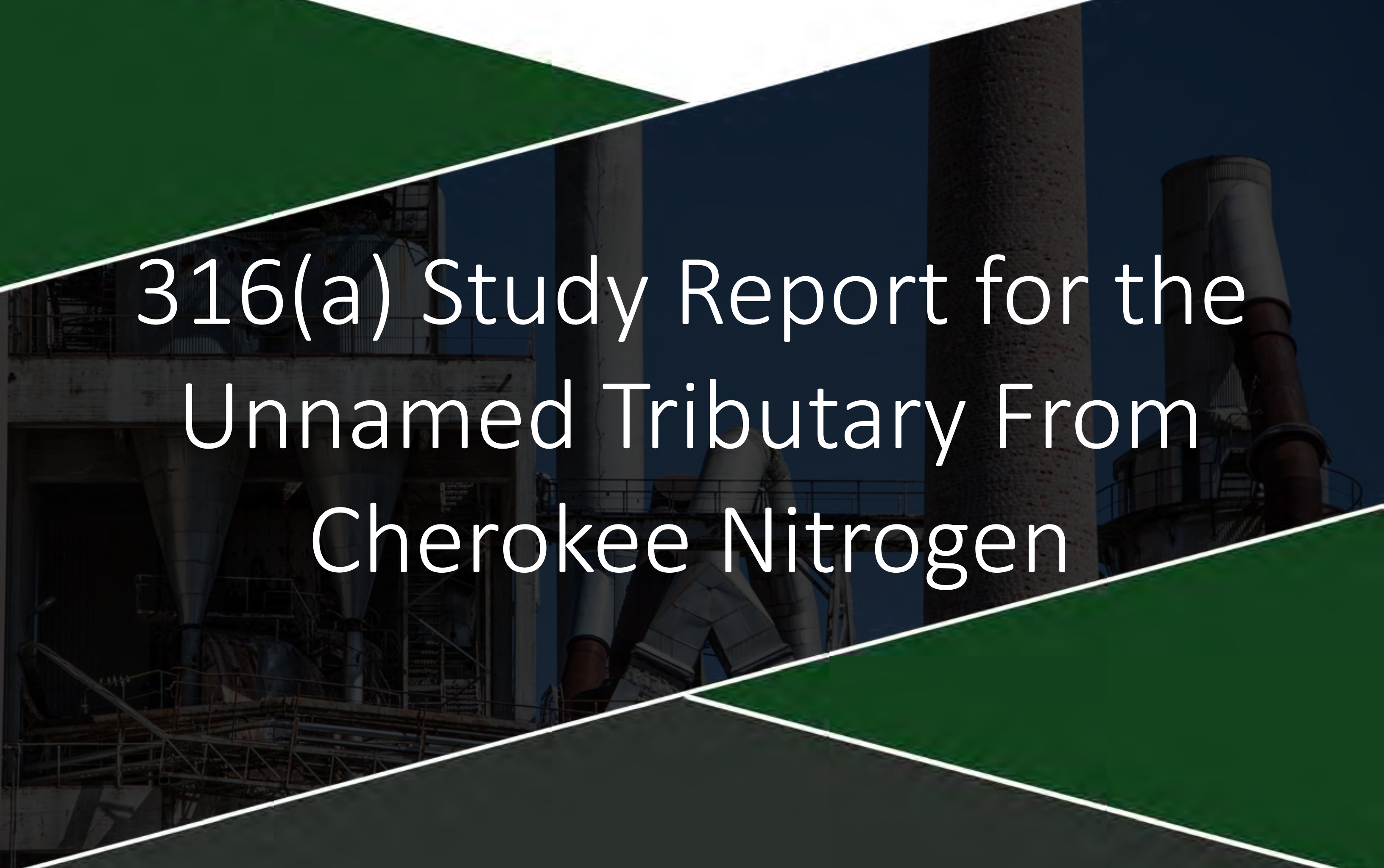
Hi Theo,
Hope all is well in Alabama!

On behalf of Cherokee Nitrogen, please find attached the 316(a) study report for their facility near Cherokee, AL. If you have any questions please let us know.
Please let me know that you have received this email.

Thanks,

GBMc & ASSOCIATES NOW Alliance TECHNICAL GROUP
Greg Phillips
Principal/Senior Scientist
Office: 501-847-7077 | **Mobile:** 501-747-6239
Address: 219 Brown Ln, Bryant, AR 72022
www.alliancetg.com

219 Brown Lane, Bryant, Arkansas
501-847-7077
www.alliancetg.com



316(a) Study Report for the Unnamed Tributary From Cherokee Nitrogen

THIS REPORT WAS CREATED BY THE ATG TEAM FOR Cherokee Nitrogen—January 10, 2023_

CONTENTS

1.0 INTRODUCTION

In 2018 the Alabama Department of Environmental Management (ADEM) completed a synoptic survey of the unnamed tributary to which Cherokee Nitrogen (CN) discharges treated wastewater and once through cooling water under NPDES Permit AL0000418. This survey resulted in the ADEM proposal to move the compliance point (where water quality standards apply) for the CN discharge from the Tennessee River to the waterfall on the unnamed tributary, about 0.2 miles upstream of the mouth of the river. This proposed change in compliance locations is anticipated to result in significant changes to current discharge limits, including temperature. The facility evaluated alternatives for over a year and elected to complete a 316(a) study, which had originally been suggested by ADEM, as a reasonable solution to address temperature. This report provides a synopsis of the study that was completed, including methodology, results, a review of historical effluent data and conclusions/recommendations for a temperature variance.

2.0 STUDY OBJECTIVE AND RATIONALE

The objective of this study was to evaluate whether the receiving stream is maintaining a balanced indigenous population (BIP) (EPA Memo, 2008 and CFR 125.71) consistent with its habitat and history and/or that there is an absence of prior appreciable harm (CFR 125.73). To accomplish this, a Type III 316(a) Demonstration was completed to document no appreciable harm to the stream system (USEPA, 1974 and USEPA, 1977). Type III demonstrations are usually completed when the situation is unique, and the usual information may not be available or not be applicable and warrants a special study that is less rigorous. The rationale for a Type III Demonstration is:

1. The effluent discharge temperature has not changed appreciably for years in the unnamed tributary, only the permitting of it has evolved.
2. The effluent discharge temperature predates the Clean Water Act.
3. 316(a) studies are traditionally completed on large water bodies rather than small first order streams like this case. There is unlikely to be a large body of data available on biota for such a small stream in this area, and likely none collected for this purpose.
4. The stream channel above the unnamed tributary waterfall is erosional in form (geomorphically) and would likely not exist or be a small ephemeral drain without the current NPDES outfall and the stormwater flows incurred from the industrial and agricultural land uses in its watershed over the past several decades.

5. The length of stream below the waterfall (where it becomes a water of the state) is less than 0.2 miles to the mouth of the Tennessee River and is highly influenced by the water levels of the River. Approximately 500 feet of channel exists between the most downstream riffle and the waterfall (where it is less affected by the river), making it the only representative sample reach and a very small one, with a limited amount of length for aquatic habitat.
6. The channel slope is steep and morphology changes from riffle-pool near the mouth to more step-pool near the waterfall. As such flow can be turbulent near the waterfall, further limiting stable habitat for fish and limiting fish passage in upper sections of the reach.
7. Due to all of the points noted above, the area may be classifiable as a "low potential impact" area (USEPA, 1977) under the Type III demonstration.

Therefore, a Type III study was completed to support the variance and document the occurrence of no appreciable harm and the existence of an appropriate (appropriate for reach size and habitat) balanced and indigenous population (community) (40CFR 122.1 and USEPA, 1974) in the stream. The components of this study are presented below and are largely based on a two-season bioassessment completed on the unnamed tributary and three local control streams.

3.0 SITE SELECTION AND WATERSHED CONTEXT

The Cherokee Nitrogen facility sets on the banks of the Tennessee River just north of Cherokee, Alabama, in the Tennessee River watershed (HUC 06030005). The site discharges to a small first order unnamed tributary that flows directly into the river. The watershed of the unnamed tributary is approximately 2.8 mi^2 in size and is dominated by agricultural land uses (cultivated crops primarily) at 62%, forest at 19% and developed land (primarily industrial) at 16% (figure 1). Slope in the watershed is low to moderate overall but becomes very steep near the river and in the tributary corridor.

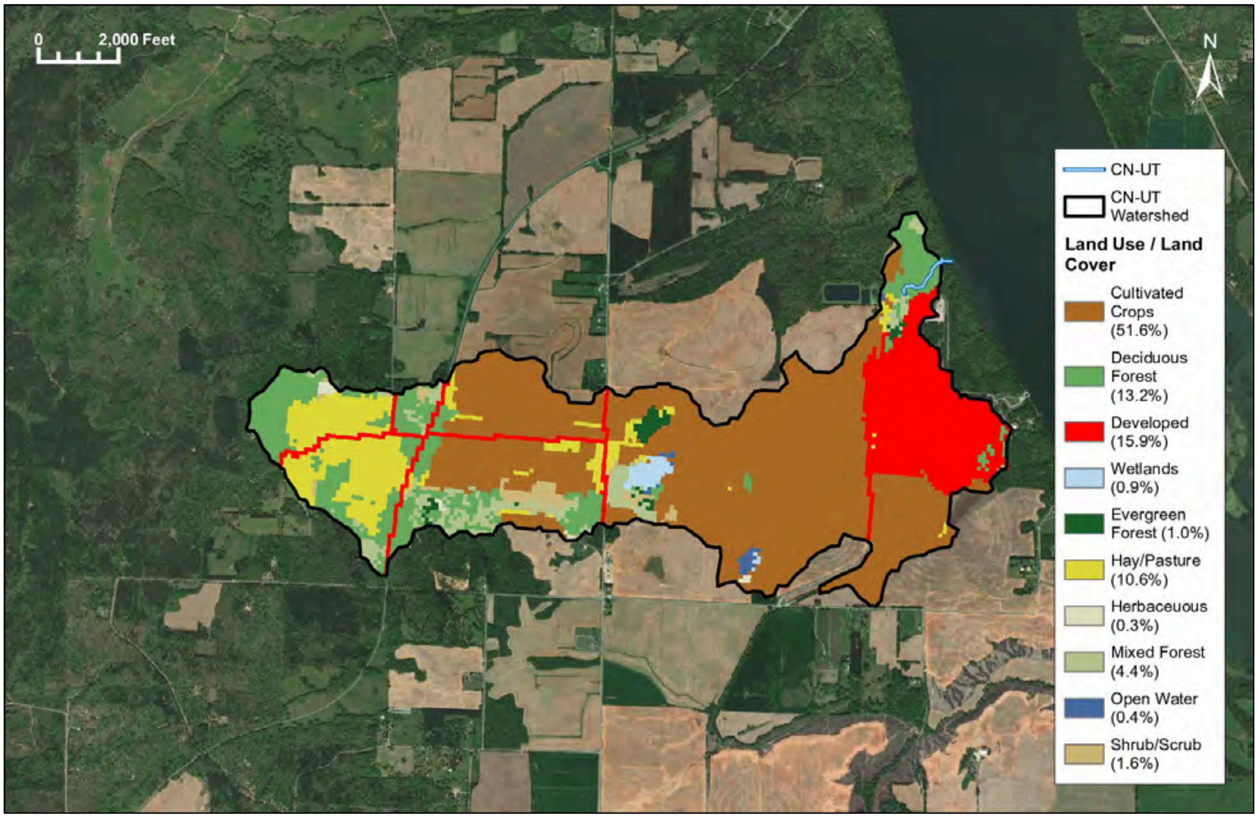


Figure 1. CN-UT watershed and LULC Map.

Site/Reference Stream Selection

Selection of the proper reference stream is an important factor in any bioassessment related study. Reference streams should be as similar to the test stream as possible and share similar geomorphic, flow and watershed land use characteristics. However, they should not have point source discharges or unusual and significant anthropogenic (non-point source) impacts. A desktop assessment was completed to match up nearby streams that drain into the Tennessee River that might serve as good references. Attributes evaluated included watershed size, %forested land use, %agricultural land use, local topography slope/gradient, etc. Information from the desktop assessment was submitted to ADEM in an email on September 2, 2021 for review. On September 13-14, 2021 GBMc & Associates (GBMc) assessed eight of the better candidate streams (nine different stream reaches) that had been previously evaluated using a desktop assessment methodology. The objective was to identify reference reaches that are as similar as possible to the subject test stream (CN-UT). The results of that analysis culminated in five possible reference locations that were recommended by GBMc and approved for use by ADEM through the Workplan review and approval process. Two of the five were primary locations (noted below with an *) that would be assessed and three were held in reserve as acceptable alternatives. The five reference streams approved for use were:

- CCN-1* (Colbert Creek North of River, most upstream reach)
- MC-1* (Mulberry Creek)
- CCN-2 (Colbert Creek North of River)
- MSB-1 (Moon Springs Branch)
- MC-1 (Malone Creek)

For the study, three reference streams were utilized, CCN-1, MC-1 and MSB-1. Each of these streams have watersheds that drain directly to the Tennessee River in proximity to Cherokee Nitrogen. Their watershed sizes generally approximate that of the CN-UT (though one is somewhat larger), and each of the streams appears to have some spring water influences. A map depicting each of their watersheds is provided in Figure 2, and a summary of their watershed characteristics is proved in Table 1.

Table 1. Summary of reference stream watershed attributes at the assessment reach.

Stream Identification	**Geology**	**WS Size (acres)**	**%Forest LULC**	**%Agri LULC**	**Topography adjacent to reach**
CN-UT	lime	1789	19	62	steep
Moon Springs Br	lime	1086	35	60	steep
Mulberry Ck	lime	4215	38	42	Flat-Moderate
Colbert Ck North of Lake	lime	2430	28	62	Flat-Moderate

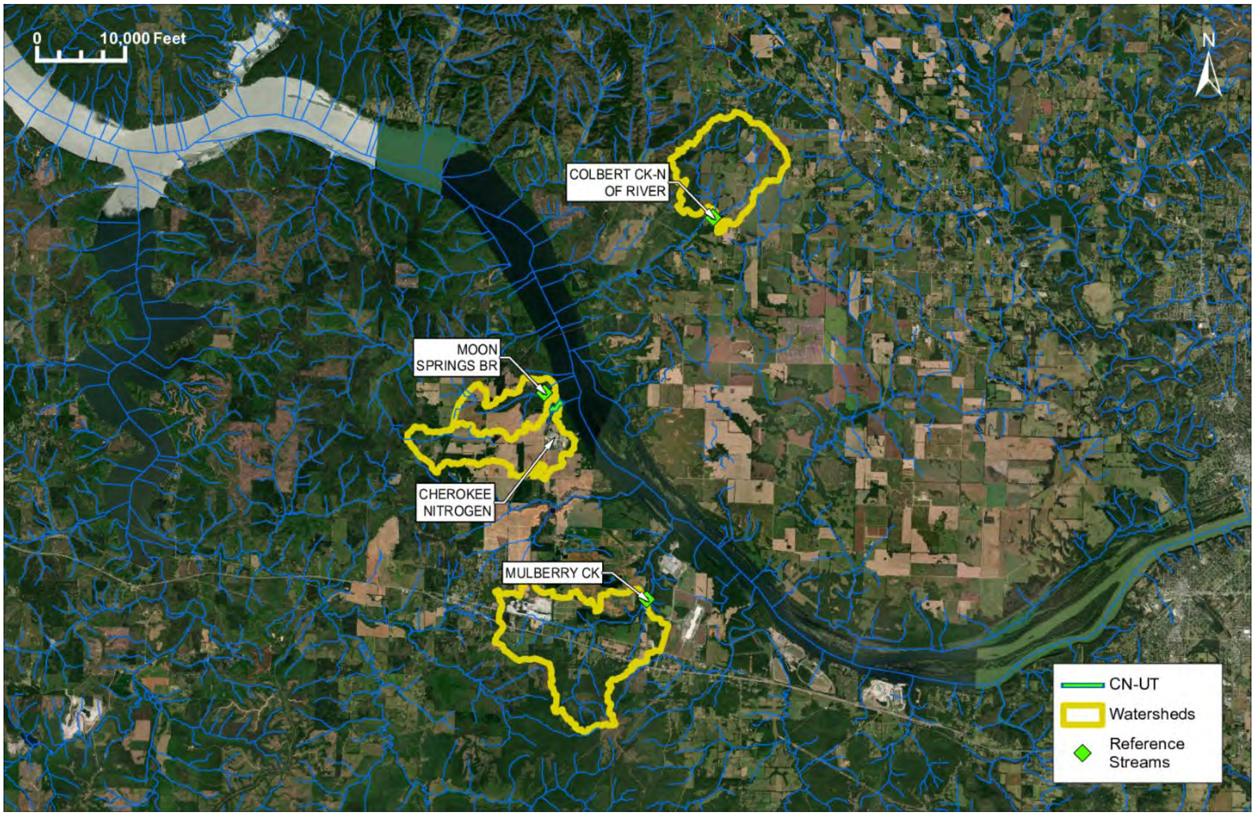


Figure 2. Watershed context for each stream reach/station assessed.

4.0 METHODOLOGY - WATER QUALITY EVALUATION AND BIOLOGICAL ASSESSMENT

This section describes the primary data collection efforts to support the variance application. The field study portion of the 316(a) study included the following components:

1. Fish collection
2. Macroinvertebrate collection
3. Habitat evaluation
4. In-situ water quality
5. Water sample collection
6. Ambient stream temperature monitoring

Components 1-5 were completed in all study reaches, including the CN-UT. Moon Springs Branch, which was considered an acceptable alternate reference location, was added to the studies bioassessment component to supplement the biological data with a stream in an adjacent valley but was not added to the ambient temperature monitoring program since it was added several months after the other in-stream probes were installed. Brief location descriptions of each of these monitoring stations follows (see Figure 3.)

- CN-UT – Unnamed Tributary. This monitoring station is located downstream of the large waterfall and runs from the most downstream riffle upstream to the base (the toe) of the waterfall pool. This reach is approximately 500 feet long, maximum. (34.816465°/-87.934687°)
- CCN-1 – Cobert Creek North of the River. Reach begins at the Waterloo Road crossing and runs upstream approximately 800 feet.
- MC-1 – Mulberry Creek. Reach begins at Mulberry Lane and runs upstream approximately 500 feet.
- MSB-1 – Moon Springs Branch. Reach is upstream of last riffle before mouth of the river and runs approximately 1000 feet upstream.

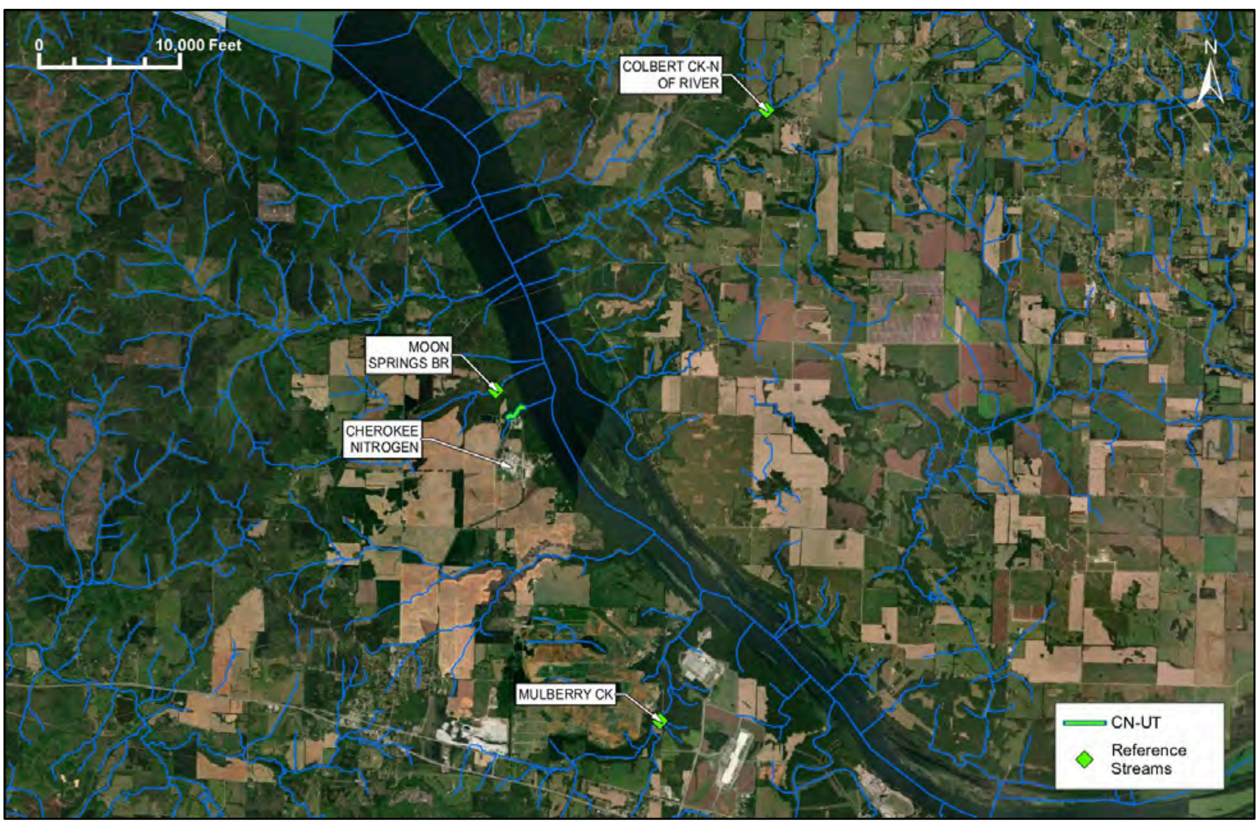


Figure 3. Monitoring stations for the 316(a) study.

Each study task described below may reference either an ADEM SOP and/or a GBMc SOP or both. Referenced SOPs were provided in the study Workplan (GBMc, 2021).

4.1 Fish

Fish were collected from each study reach using electrofishing techniques supplemented by block netting/seining as needed. Fish collection was completed following the ADEM SOP No. 6100 (Fish Index of Biotic Integrity Sample Collection Procedures for Wadable Streams).

Captured fish were placed in a water filled ice chest or bucket for holding prior to identification and were either identified on site and released or preserved as a voucher sample for later identification in the lab. Larger fish were typically identified onsite, measured and released. Released fish were tallied and representative photos taken as necessary for documentation. Sample reach lengths were chosen to typify the local stream system and to encompass all available habitat types (riffles, runs, pools, woody debris, boulders, etc.) while minimizing the amount of stream electro fished to the extent practicable. With the maximum sample reach in CN-UT being approximately 500 feet, care was taken to not oversample the references reaches, which will have much greater potential reach lengths, and thus potentially skew abundance and diversity metrics. Collections generally proceeded until the target of 30+2 “efforts” (ADEM SOP 6100) was achieved and/or a representative sample was collected.

4.2 Benthic Macroinvertebrates

Macroinvertebrates were collected at each station generally following the ADEM SOP No. 6000, *Aquatic Macroinvertebrate Community Wadable Multi-Habitat Bioassessment* protocol. Under this protocol certain habitat types are sampled when available in the sample reach, including:

- Riffle
- CPOM
- Rock/Log
- Root/Bank
- Macrophyte Beds
- Sand/Bottom

A 30-micron rectangular dip net was used for the collections at each station in each available habitat type. Available habitats as described in the ADEM protocol were preserved separately by habitat type, for later sorting and identification in the lab.

Macroinvertebrates were picked randomly from each sample using a canton sorting tray. Grids were picked according to ADEM SOP 6001 to achieve a target of approximately 100 organisms from each habitat type. Organisms were identified according to ADEM SOP No. 6002. Identification resolution was generally down to genus level, but some taxa were identified only to family/sub-family or order (i.e. Chironomidae, Oligochaeta). ADEM SOP 6002 states that Chironomidae should be identified to genus level. However, for the purposes of this study, and the level of community comparisons necessary, Chironomidae were identified to sub-family and Oligochaeta to family. Should additional resolution be required the analysis can be updated at a later time. All samples were treated with the same level of analysis rigor.

Macroinvertebrates were evaluated according to various community metrics and compared to the reference reaches. Metrics calculated include dominant taxa percentages, percentage of each ordinal group, functional feeding group percentages, species richness and species diversity and other metrics related to the Alabama IBI.

4.3 Habitat

While completing activities at each site, observations of habitat were made in order to complete the ADEM data forms for both *Physical Characterization* (SOP No. 6300) and *Wadeable Stream Habitat Survey* (SOP No. 6301). Each assessment was completed for each station by the field team. Flow was measured at each of the three stations using a flow velocity meter and following the velocity area method for cross sectional stream flow measurement (GBMc SOP No 5.0).

4.4 In-situ Water Quality

In-situ parameters were measured at each primary station during each study event (i.e. fall and spring assessments) and at MSB-1 during the fall event. In-situ parameters included:

1. Temperature (°C)
2. pH (s.u.)
3. Specific Conductance (µmhous)
4. Dissolved oxygen (mg/L)

5. Turbidity (ntu)

Field meters used for in-situ analysis were calibrated according to GBMc SOPs (which generally follow manufacturers recommendations) each day prior to field use.

4.5 Water Sample Collection

Water samples were collected from each of the three primary assessment stations, during each study event. Samples were not collected from MSB-1. Parameters for laboratory analysis were ammonia-N, CBOD5, nitrite-N, nitrite-nitrate-N, TKN and organic nitrogen. The PACE laboratory completed water sample analysis. Sample collection followed GBMc SOP No. 12.0. In summary, all samples were placed in the appropriate clean containers supplied by the laboratory. Each sample container was labeled with the sample I.D., date, time, and initials of collector(s). Samples were placed in ice chests and maintained at approximately 4º C for delivery conducive to maintenance of regulatory holding times. The fall samples experienced a delivery error with the overnight shipping company and arrived a day late with all ice melted. However, samples were analyzed anyway and results reported in Section 5.4. Chain of Custody (COC) forms included all required information and were checked for completeness prior to submission of samples to the laboratory. A field duplicate sample was also collected during one sample event.

A summary of the sample design for each task is provided in Table 2 and a summary of the sampling methods is provide in Table 3.

Table 2. Summary of Sample Design

Parameter	Bioassessment	In-Situ (Water)	Water Samples for Lab
Station I.D.	Parameters Being Analyzed		
CN-UT	Fish[1], Macroinvertebrates, Habitat	pH, temperature, dissolved oxygen, specific conductance, turbidity	ammonia-N, CBOD5, Nitrate-N, and organic nitrogen
CNN-1	Same as above	Same as above	Same as above
MC-1	Same as above	Same as above	Same as above
MSB-1	Same as above	Same as above[2]	n/a

[1]Fish were only collected during the fall season.

[2]In-situ parameters at MSB-1 were only collected during the fall event.

Table 3. Summary of Sampling Methods

Sample Type	GBMc QAP SOP Number	Sampling Equipment	ADEM SOP Number	Field Processing Protocol	Storage Vessel	Preservative	Record Sheet (Y / N)
Fish	SOP 10.0[1]	Electro Shocker, Seines	6100	Sort, ID and Tally, Preserve, Label, Store	Large PE Bottles/Buckets	Formalin	Y
Macroinvertebrates	SOP 9.0[1]	Aquatic Dip Net	6000, 6001, 6002	Condense, Label, Preserve, Store	Large PE Bottles/Buckets	70% Ethanol or Kaylee's Solution	Y
Habitat (incl. flow)	SOP 6.0, 5.0	Wading Rod, Tape Measure, Flow Meter	6300, 6301	Complete Field Notes	n/a	n/a	Y
Water	SOP 12.0	Sample Bottles	n/a	Label and Store in Ice Chest	Various Bottles	Various	Y
In-situ	SOP 1.0, 2.0, 3.0, 4.0, 14.0	Field Meters	n/a	Calibrate, Measure in Main Channel, Record	n/a	n/a	Y

[1]GBMc SOP utilized where ADEM SOP is not specific, otherwise ADEM SOP followed.

4.6 Ambient Stream Temperature Monitoring

Three continuous reading temperature probes (Hobo® style) were installed in the CN-UT. Temperature probes were also installed in each reference stream reach, with the exception of MSB-1, which was added after Workplan approval, for bioassessment purposes only. The locations temperature probes were installed are:

1. UT-B – At the wooden bridge, by Outfall 001. (34.809129°/-87.938111°)
2. UT-W – In the UT just upstream of the large waterfall. (34.815803°/-87.935223°)
3. UT-1 – In the UT at the last riffle prior to exiting into the Tennessee River. (34.816984°/-87.934265°)
4. CNN-1 – Just upstream of Waterloo Road bridge. (34.875379°/-87.877241°)
5. MC-1 – Just upstream of Mulberry Lane Bridge. (34.756123°/-87.900136°)

Probes were installed where they contact flowing water and are protected from large debris. Probes were installed on November 16, 2021, checked and downloaded during subsequent site visits and retrieved on December 1, 2022 for final download and analysis. All temperature probes were new, and factory calibrated. Each probe was checked against a calibrated field meter when installed to verify accuracy of temperature reading during deployment and during each maintenance site visit. Probes recorded temperature readings every 30 minutes (minimum) at each of the five stations.

5.0 STUDY RESULTS

Data collected during the 316(a) study, both new field data and historical data, were evaluated for completeness and accuracy (GBMc Workplan, 2021), and proven data were analyzed and used, as appropriate, to assess the feasibility of the proposed temperature variance. Following the Type III demonstration requirements, data was used primarily to provide evidence of maintenance of a balanced indigenous population and/or "...absence of prior appreciable harm…" to indigenous biological communities from the 60+ year old wastewater discharge.

Analysis of fish and macroinvertebrate data collected during this study focused on community composition and balance to determine if the biotic community in the CN-UT is balanced and healthy (with no evident appreciable harm) consistent with its represented habitat and history. Some differences in taxa (presence/absence) were anticipated due solely to the unique spring water dominated, cool water nature of the reference streams. Any spring water associated differences is noted in this report.

Tables are provided in Appendix A that include all fish and macroinvertebrates collected. Habitat forms and laboratory data are provided in Appendix B. Photographs of each site and select fish collected are provided in Appendix C.

5.1 Habitat Evaluation

Habitat was assessed during each bioassessment at the primary stations and at MSB-1 during the fall assessment. Habitat will always vary between assessments but is not anticipated to vary significantly between seasons as long as flow is maintained, and no extraordinary disturbances occur. Habitat at each station was adequate to sustain biological communities typical of small streams in the Tennessee River Valley. Some reaches had better habitat than others, and the collections, particularly in the case of macroinvertebrates, represent habitat that was prevalent in each reach. Stream CCN-1, which had only intermittent pools during the summer and fall 2022, had the lowest habitat score in the fall bioassessment of all stations and seasons assessed. This low score was the direct result of the low water level and lack of wetted habitat. A summary of the key habitat parameters is provided in Table 4. Scores that appear in

Table 4 have a maximum score of 20 for each category. Higher values indicate better quality features for that attribute.

Table 4. Summary of habitat assessment scores.

Stream Habitat Metrics[1]	CN-UT		CCN-1		MC-1		MSB-1	
	spring	fall	spring	fall	spring	fall	Spring[2]	fall
Instream Cover	15.5	15.5	14.5	3	18	17.5	--	4.5
Epifaunal Substrate	10	12.5	14.5	1	18	16	--	12.5
Embeddedness	3	10	7.5	13	11.5	12	--	11.5
Velocity/Depth Regime	11	12	7	2	11	13	--	12
Channel Alteration	9	13	16.5	16	8	15.5	--	16
Sediment Deposition	3.5	8.5	16.5	16.5	17.5	17	--	9.5
Channel Flow Status	15	13	12.5	1	11	10.5	--	10
Condition of Banks	6	6.5	8.5	9.5	7.5	15	--	12
Bank Vegetation Protection	12	6	11	2	14	12	--	13
Grazing or Other Disruptive Pressure	16	16	14	14	18	18	--	14
Riparian Vegetation Zone width	16	18	15	17	15	18	--	18
Riparian Veg. Zone Quality	18	17	14	18	18	17	--	17
Frequency of Riffle	19	19	9	0	14	12	--	1.5
Average of 13 Metrics	11.8	12.8	12.3	8.7	14.0	14.9	--	11.7

[1] 0-5 poor, 6-10 marginal, 11-15 suboptimal, 16-20 optimal.

[2] Habitat data was not collected (inadvertently) in the spring at MSB-1.

A brief summary of habitat at each site follows. Photographs are provided in Appendix C.

- CN-UT - This reach in the test stream is composed of approximately 50% riffle and 30% pool with short rocky runs (20%) transitioning between morphology types. The bankfull width is approximately 22 feet, with all areas wadeable. The riffles in this reach are steeper than in the reference reaches and contain a larger mean substrate size than do two of the three reference reaches, with coarse gravel and cobble common. The reach is largely shaded, and the water is almost always clear, but can be slightly opaque/turbid at times. There is some woody structure (fallen trees and logs) in this reach available for fish habitat along with moderate amounts of submerged root wad (small root masses) habitat. The frequency of cobble and a few boulder sized rocks also provide habitat for small fish. Due to the CN effluent discharge the water level on the day of collection came to near the toe of each bank slope. Riparian buffer is forested on both banks and in fairly good condition. It should be noted that this stream is extremely unstable (erodible) upstream of the waterfall, and that instability creates large sediment loads following rain events, that have been observed deposited in the lower sections of the CN-UT reach.

- CCN-1 – This reference stream assessment reach in Colbert Creek has the smallest channel size of the streams assessed (18 feet wide), but the most similar substrate (cobble abundance and angularity) to CN-UT of all the reference streams. When flowing the CCN-1 reach is composed of approximately 40% riffle, 20% run and 40% pool. However, during the fall assessment only shallow intermittent pools existed at this site. Substrates are mostly gravel and cobble. The reach is almost entirely shaded, and the water was clear in this reach. There is some woody structure (fallen trees and logs) and root balls in this reach available for fish habitat, but rocky substrates were the most prevalent habitat type, especially for macroinvertebrates. Riparian buffer is forested on both banks and in fairly good condition.

- MC-1 – Mulberry Creek is the most developed geomorphically of the stream sites assessed. As a result, it has more diverse and developed habitat and received the highest scores during the habitat assessments. It is composed of approximately 60% riffle and 30% pool with short rocky runs (10%) transitioning between morphology types. The bankfull width is approximately 25 feet wide. Substrates are mostly gravel and cobble with some small boulders. The reach is mostly shaded, and water was clear. There is some woody structure (fallen trees and logs) in this reach available for fish habitat as well as submerged root wads and small boulders. Flow was typical during each collection. Riparian buffer is forested on both banks and in fairly good condition, though the forested buffer is narrow on the right bank.

- MSB-1 – The Moon Springs Branch reach is composed of approximately 40% riffle and 50% pool with short rocky runs (10%) transitioning between morphology types. Substrate in this reach is mostly composed of gravel. The stream channel is approximately 20 feet wide with a strong meander pattern compared to the other streams assessed. Water is generally clear in this reach but during the fall 2022 assessment it was somewhat muddy and appeared to have received a recent wash of silt/sediment from the watershed. There is ample woody structure (fallen trees and logs) and rootballs/wads in this reach available for fish and invertebrate habitat. Riparian buffer is forested on both banks and in very good condition.

Overall, reach MC-1 had the better habitat, particularly in regard to riffle habitat for macroinvertebrates and riffle dwelling fish species such as darters. However, the other reaches all had sufficient habitat to support a healthy and diverse fish and macroinvertebrate community when flow is/was present.

5.2 Fish Community

Fish were collected during the fall bioassessment, were identified and a series of community metrics calculated. These metrics included general community metrics such as species richness, species diversity, trophic structure and percent of each represented family (Table 5). In addition, the ADEM Index of Biotic Integrity (IBI) metrics for fish were calculated.

Fish were abundant at each station with the exception of CCN-1 where only 10 fish were collected. The low number of fish are indicative of the lack of flow and limited habitat available during the fall season. Unlike, the other streams assessed, it appears that CCN-1 has limited spring influence during the hotter and dryer times of the year. Station CN-UT and MC-1 had the highest catch per unit effort (16.8 and 16.7) with almost identical values of total fish collected of 57 and 56, respectively (Table 5).

Table 5. General community fish metrics calculated for each station.

Parameter	**Station Identification**			
COMMUNITY MEASURES	CN-UT	MC-1	CCN-1	MSB-1
Richness (Total Number of Taxa)	10	8	2	9
Darter Richness (Number of Taxa)	0	2	0	0
Sunfish Richness (Number of Taxa)	5	2	2	4
% Pollution Tolerant Species*	54.4	57.1	100.0	51.2
% Unknown Tolerance*	45.6	42.9	0.0	48.8
% Pollution Intolerant Species*	0.0	0.0	0.0	0.0
Diversity Indices (Shannon-Wiener)	2.14	2.18	0.88	2.81
Abundance, fish collected/minute	3.4	3.3	1.7	2.8
Pedal down time (minutes)	16.8	16.7	5.8	15.1
TROPHIC STRUCTURE				
% Herbivores*	1.8	3.6	0.0	16.3
% Omnivores*	---	---	---	---
% Invertivores/Insectivores*	87.8	96.4	100	65.1
% Top Carnivores*	10.5	0.0	0.0	18.6
PERCENT OF 5 DOMINANT FAMILY GROUPS				
COTTIDAE	0.0	19.6	0.0	0.0
CYPRINIDAE	1.8	53.6	0.0	16.3
CATOSTOMIDAE	0.0	1.8	0.0	0.0

FUNDULIDAE	0.0	0.0	0.0	2.3
ICTALURIDAE	1.8	0.0	0.0	0.0
CENTRARCHIDAE	93.0	0.0	100.0	60.5
PERCIDAE	0.0	7.1	0.0	0.0
ATHERINIDAE	1.8	17.9	0.0	0.0
POECILIIDAE	1.8	0.0	0.0	20.9
Total % of 5 Dominant Groups	100	100	100	100

*As identified by ADEM SOP No. 6101

The fish community at each of the three reference stations varied as did the test stream CN-UT. Trophic structure was similar at all four stations being dominated overwhelming by insectivore/invertivores (>65% at all stations). Three of the four stations (CN-UT, CCN-1 and MSB-1) were dominated by centrachids (sunfish and bass) with the lowest portion being at MSB-1 with 61% (Figure 4.) The fourth station (MC-1) was dominated by cyprinids (minnows) at 54%. Darters (7%) and sculpins (20%) made up significant percentages of the collection at MC-1 and it was the only station in the study they were collected from. Likely a result of significant perennial spring influence which keeps water temperatures lower as preferred by these two fish families. The test reach, CN-UT, and two of the reference reaches (MC-1 and MSB-1) displayed similar species richness and species diversity (Figure 5.)

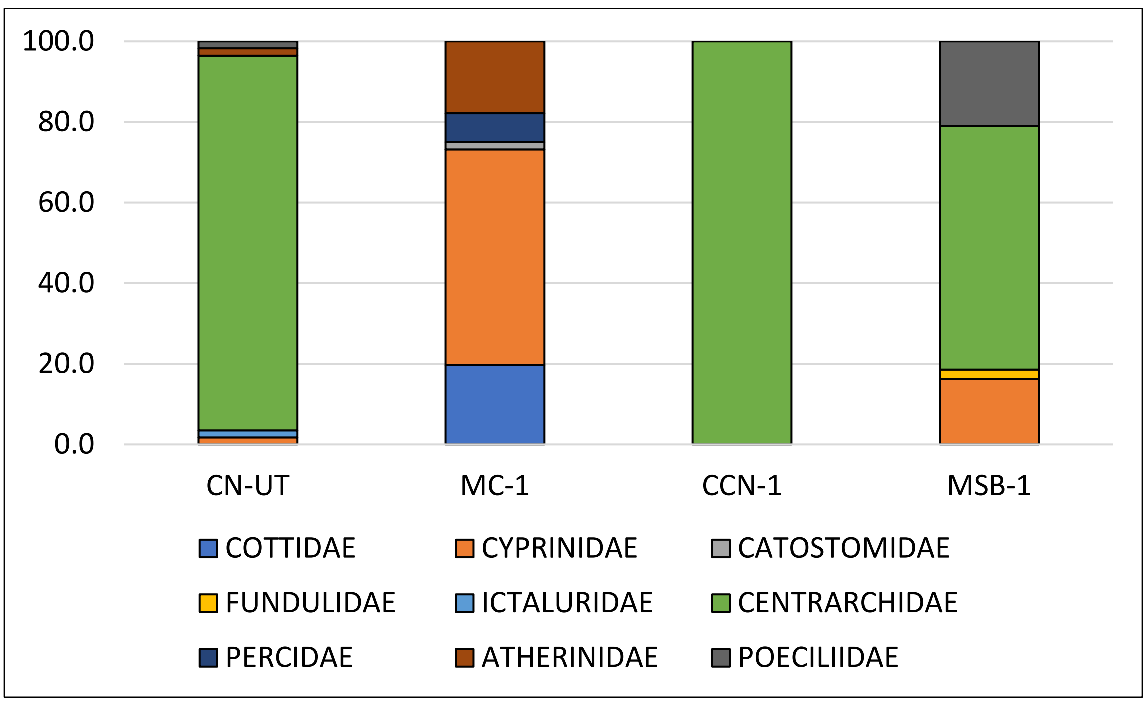


Figure 4. Fish dominant family community composition at each station.

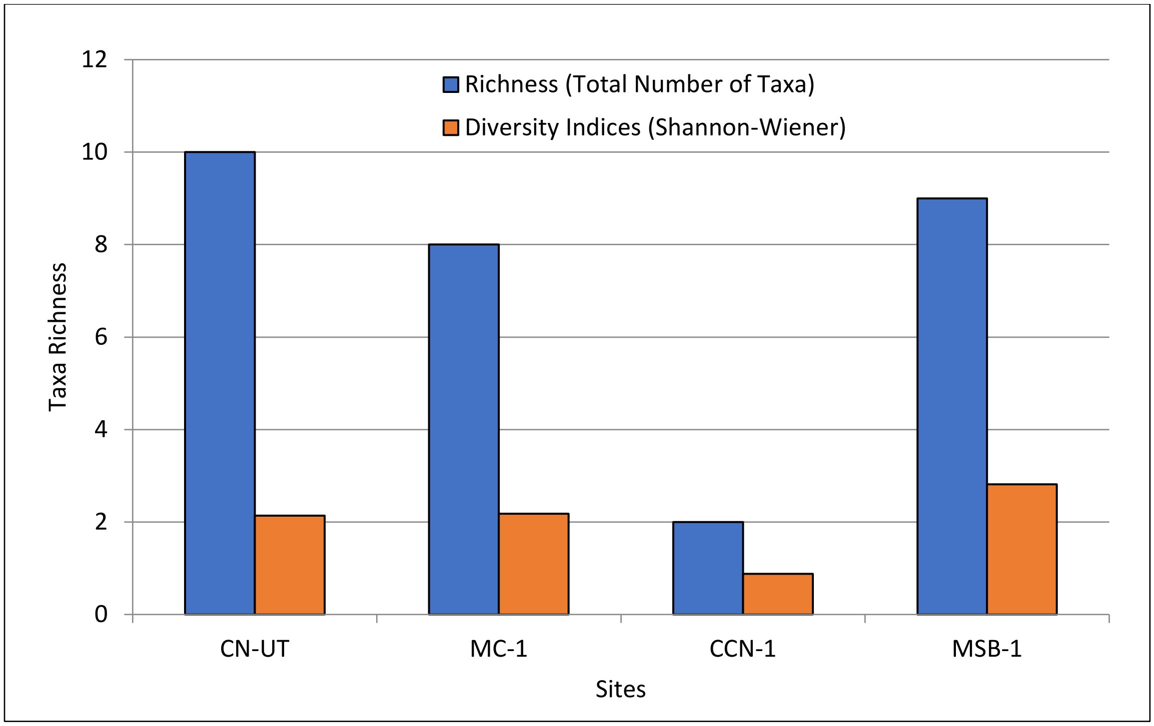


Figure 5. Fish community richness and Shannon-Wiener diversity index.

Fish IBI scores, which were calculated for each collection, ranged from 24-34 (Figure 6), with the CN-UT scoring a 28. Station MC-1 scored the highest at 34. The scoring system assigns a score of either 1, 3 or 5 for each metric. Higher scores indicate better quality. Maximum score possible for any site is 60 (12 metrics with a maximum score of 5 for each). Based on the ADEM score ratings Stations CN-UT and CCN-1 would rate “Poor” (scores of 22-28) and MC-1 and MSB-1 would rate “Fair” (scores of 29-40). The actual scoring difference between CN-UT and MSB-1 are inconsequential (i.e. a difference of only 2 points between MSB-1 and CN-UT is insufficient to delineate actual differences in the community). A summary of the scores for each IBI metric are included in Appendix A.

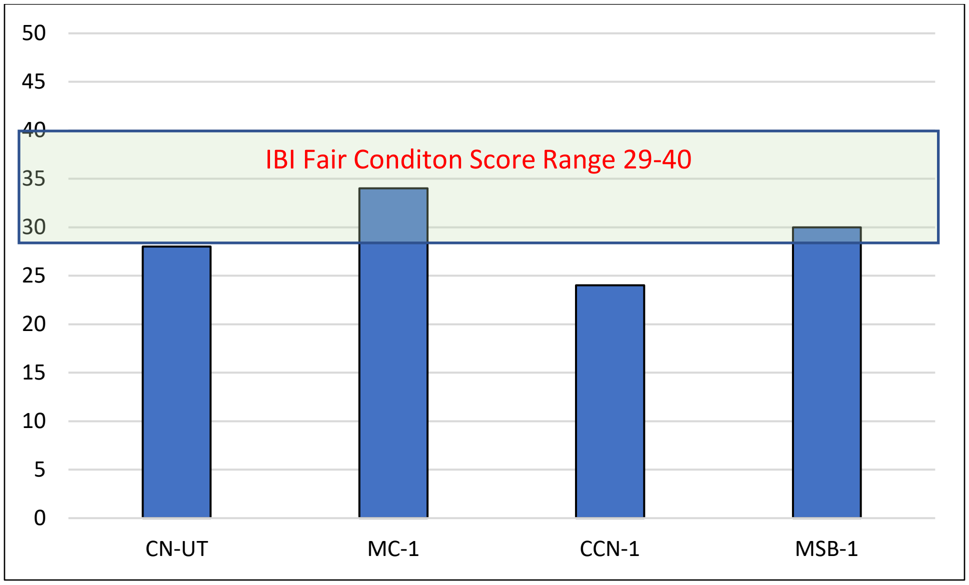


Figure 6. Comparison of fish IBI scores at each station.

5.3 Benthic Macroinvertebrates Community

Macroinvertebrates were abundant at all stations during the spring and fall sample events with the exception of the fall event at CCN-1, where abundance was reduced due to low flow levels and the associated reduced habitat availability. Most prominent habitats sampled in each reach during all events were:

- Rock/Log
- Coarse/Riffle
- Root/Bank

CPOM was also sampled during the fall event at CN-UT, MC-1 and MSB-1, while only coarse/riffle habitat was sampled at CCN-1 during the fall event. All habitat types sampled contained macroinvertebrates. Habitats with the most abundance and diversity were coarse/riffle and root/bank. The abundance at each station is typical for small streams with each reaches specific level of habitat development (i.e. riffle and root abundance and quality) and the streams watershed land uses (i.e. considerable agriculture).

A series of biometrics were calculated for each of the macroinvertebrate collections. Some general biometrics were calculated that include dominant taxa, percentage of each ordinal group, functional feeding group percentages, species richness and species diversity, etc. (Table 6.)

Table 6. Macroinvertebrate biometrics for each station.

Metric	CCN-1		MSB-1		MC-1		CN-UT	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Total Abundance:	14	350	290	271	488	319	485	322
Species Richness:	6	26	17	20	31	24	23	11
Shannon-Wiener Diversity Index	1.43	2.04	1.99	1.82	2.85	2.53	1.83	1.50
EPT Richness	0	8	2	6	9	8	4	4
% EPT	0	19	3	7	30	38	7	54
Biotic Index	6.48	6.13	6.83	6.46	5.53	5.92	6.76	5.43
Functional Feed Groups								
Collector-gatherers	50.0%	40.9%	79.3%	74.9%	35.7%	23.8%	40.8%	42.2%
Collector-filterers	0.0%	21.4%	3.1%	7.7%	16.4%	34.8%	7.2%	48.1%
Predators	35.7%	29.4%	14.8%	15.5%	10.7%	12.5%	30.7%	2.2%
Shredders	0.0%	0.6%	0.0%	1.1%	11.1%	14.1%	0.0%	7.1%
Scrapers	14.3%	7.7%	2.8%	0.7%	26.2%	14.7%	21.2%	0.3%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Dominant Ordinal Groups								
Amphipoda	0%	0%	0%	0%	11%	13%	0%	0%
Basommatophora	0%	0%	0%	0%	0%	8%	0%	0%
Coleoptera	14%	3%	3%	4%	12%	6%	2%	0%
Diptera	57%	71%	58%	58%	29%	33%	64%	42%
Ephemeroptera	0%	2%	0%	1%	12%	3%	0%	0%
Gastropoda	7%	4%	2%	0%	9%	1%	20%	0%
Hemiptera	21%	0%	0%	0%	2%	0%	0%	0%
Isopoda	0%	0%	28%	30%	0%	0%	0%	0%
Odonata	0%	1%	0%	0%	3%	1%	3%	0%
Oligochaeta	0%	0%	6%	1%	4%	0%	3%	2%
Trichoptera	0%	17%	3%	6%	18%	35%	7%	54%

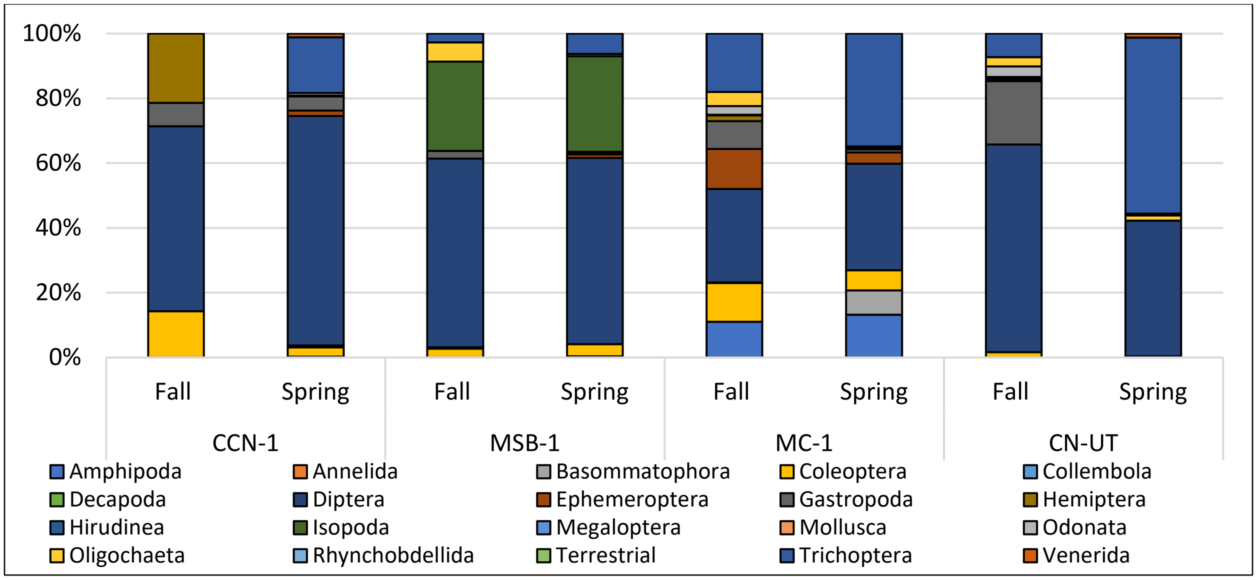


Figure 7. Community composition as a percent of macroinvertebrates in each ordinal group.

Community composition (Figure 7) displayed similarities in each reach assessed. The collection from each reach was dominated by dipterans (3 of 4 reaches) or trichopterans in all seasons, and in three of the reaches trichopterans were the second most dominant. The proportion of each functional feeding group (Figure 8) was similar at each station in the fall with collector-gatherers being dominant followed by predators at three stations and collector-filters at the fourth station (MC-1). In the spring season all stations were dominated by either collector-gatherers or collector-filterers.

Species richness and diversity were greatest during the fall at MC-1, but during the spring richness was greatest at CCN-1 and diversity greatest at MC-1. Hilsenhoff Biotic index was lowest at MC-1 in the fall and at CN-UT in the spring, indicating the collections from these two stations had a higher proportion of individuals/species sensitive to environmental perturbation compared to the other stations (Table 6). For the Hilsenhoff biotic index lower scores indicate more sensitivity to environmental perturbation. Consistent with the biotic index the two stations with the greatest percent of EPT taxa, which are generally considered more sensitive to perturbation, was CN-UT (54%) and MC-1 (38%) during the spring collection, while the fall collections resulted in the same two stations but in the reverse order, MC-1 (30%) and CN-UT (7%).

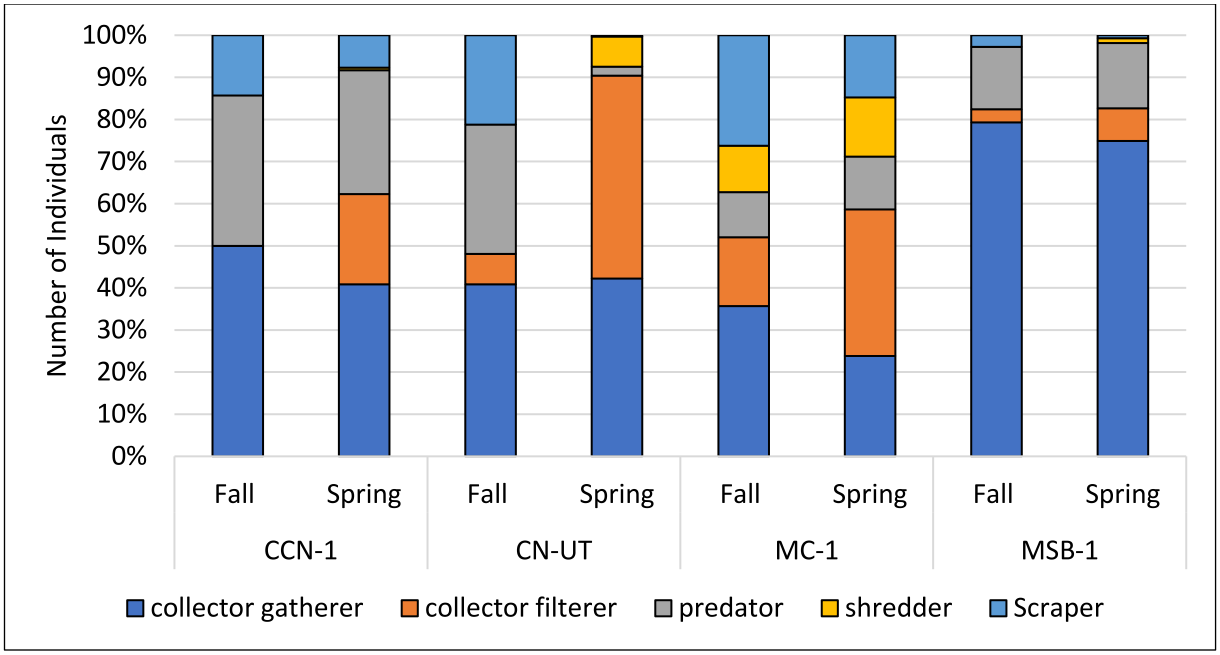


Figure 8. Comparison of functional feeding groups (trophic levels) at each station.

The six metrics that make up the ADEM Index of Biotic Integrity (IBI) for the Interior Plateau/Transition Hills (ADEM SOP No. 6004) were calculated (Table 7). Although the IBI was not a required metric calculation for this study, it does provide valuable information related to the ability of the unnamed tributary at Cherokee Nitrogen to sustain an acceptable level of aquatic life that compares reasonably well to other streams in the region as depicted by scores over 44 (a good rating). In the IBI, higher scores indicate higher quality communities.

Table 7. ADEM IBI biometrics and scores for the Interior Plateau/Transition Hills.

	CCN-1		**MSB-1**		**MC-1**		**CN-UT**	
ADEM IBI Metric	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**
EPT taxa	0.0	17.4	0.0	8.7	21.7	17.4	0.0	0.0
Non Insect Taxa	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Shannon	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0
EPTPctminusHB	0.0	100.0	16.1	42.9	100.0	100.0	76.3	100.0
Tolerant Taxa	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Predators Pct	5.1	23.7	28.4	14.4	19.1	33.0	47.0	19.1
Overall Score	34.2	56.9	40.7	44.3	58.0	58.4	53.9	53.2
Rating	Fair	Good	Fair	Good	Good	Good	Good	Good

5.4 Water Quality

A summary of in-situ and laboratory analysis are provided in the tables (8 and 9) below. The two in-situ data points that stand out are the low pH at CCN-1 during both seasons. This site always had the lowest flow and was reduced to only intermittent pools in the fall assessment when pH was lowest. Specific conductance appeared somewhat elevated at MC-1 and MSB-1 in the fall, even for spring dominated streams, but the levels were not out of possible ranges, nor were they elevated to levels of concern. Dissolved oxygen (D.O) levels were ≥60% saturation at all stations in all seasons, with the exception of CCN-1 in the fall, where there was no flow to keep the water oxygenated.

Table 8. In-situ data from each station collected during the bioassessments.

Station	Date:	Temp (°C)	DO (mg/L)	Sp. Cond. (uS)	pH (su)	Turb. (ntu)	Flow (cfs)
Spring 2022							
CCN-1	6/1/2022	19.4	5.6	35.8	5.9	6.54	0.14
CN-UT	6/1/2022	30.1	6.4	489	7.3	6.91	11.4
MC-1	6/1/2022	21.2	9.3	338.9	8.1	3.69	2.2
Fall 2022							
CN-UT	9/27/2022	28.7	6.1	329	7.7	5.28	16.7
CCN-1	9/28/2022	14.3	2.3	99	4.3	14	0.00
MC-1	9/28/2022	15.3	8.3	727	6.2	3.67	0.34
MSB	9/28/2022	15.8	9.2	682	7.5	118	0.50

The results from the laboratory analysis of water samples were unremarkable (Table 9).

Table 9. Laboratory results from sample collection.

Station ID	Date	Total Organic Nitrogen (mg/L)	TKN (mg/L)	Ammonia (mg/L)	NO2- NO3-N (mg/L)	Nitrite (mg/L)	CBOD5 (mg/L)
CCN-1	6/2/2022	0.29	0.29	ND	0.49	--	--
CN-UT	6/2/2022	0.76	0.97	0.21	5.3	--	--
MC-1	6/2/2022	0.33	0.33	ND	1.1	--	--
CCN-1	9/28/2022	1.6	1.8	0.27	ND	ND	5.5
CN-UT	9/28/2022	2.0	2.0	ND	1.2	ND	ND
CN-UT duplicate*	9/28/2022	ND	ND	ND	1.2	ND	ND
MC-1	9/28/2022	ND	ND	ND	0.74	ND	ND

*Note the field duplicate results for TON and TKN are suspect, but neither the sample result nor the duplicate indicates values of concern.

5.5 Temperature

Continuous recording probes (Hobo®) were installed in three locations in the CN-UT and in two of the reference streams (CNN-1 and MC-1). Data was recorded continuously for approximately one year. A summary of the result is provided in Table 10 and is represented in degrees Fahrenheit.

Table 10. Summary of temperature (deg F) recorded by continuous monitoring probes.

	Probes in the CN-UT (deg F)			References (deg F)	
Statistic	**At Facility (UT-B)**	**Top of Waterfall (UT-W)**	**UT-1 (downstream end of CN-UT)**	**MC-1**	**CCN-1**
min	41.9	41.6	42.1	42.1	22.3
max	98.8	97.2	95.2	80.6	95.1
stdev	14.6	8.9	13.1	8.7	11.8
avg	75.3	81.9	73.8	62.4	59.9
99^{th} percentile	97.1	96.1	93.9	78.4	82.3
95^{th} percentile	95.9	94.5	92.2	76.0	77.8

Some cooling was observed between the measurement location near the outfall (UT-B) and the most downstream site in the bioassessment reach (UT-1). On average the water cooled approximately 1.5 degrees F. However, seasonally (June-September, when the weather was warmest) the water cooled by 3.6 degrees F on average (Figure 9.) Weather (temperatures) in 2022 were in the normal range at the Huntsville, AL NOAA station.

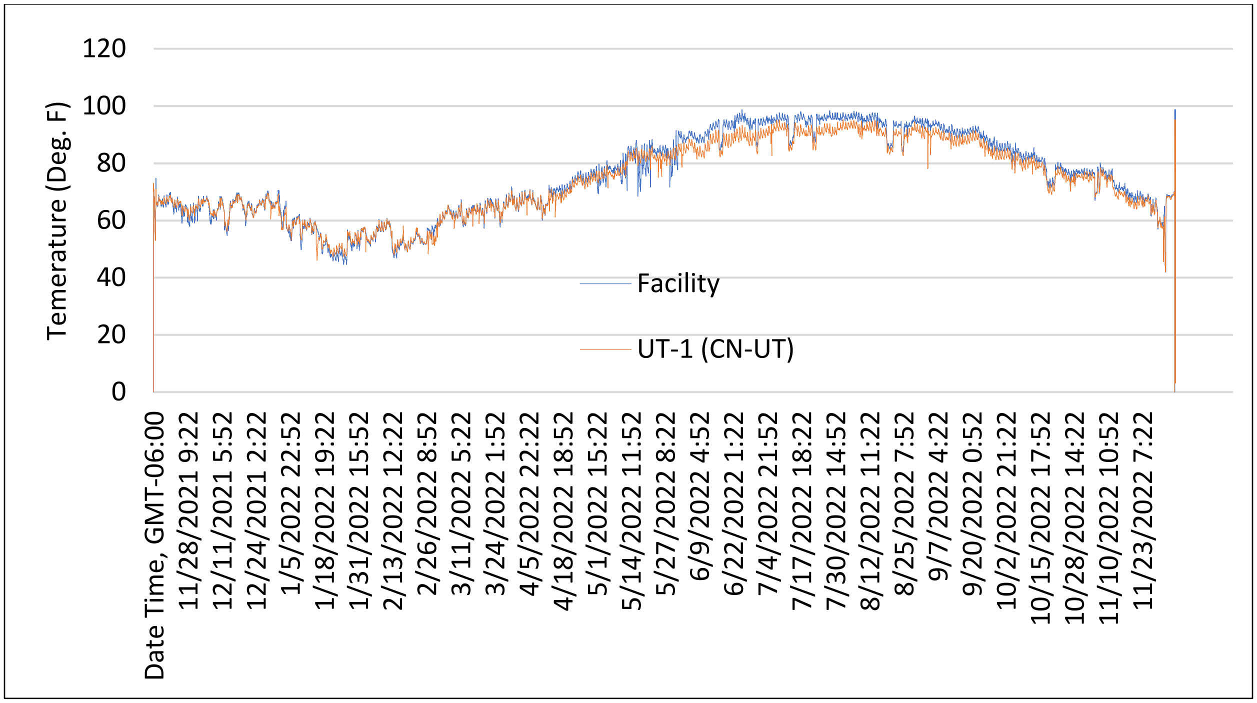


Figure 9. Temperature measured in the facility near the outfall versus in the bioassessment reach (CN-UT).

Temperatures in the two reference streams were cooler, on average, but did show less variance than expected, particularly in the cooler season of the year (Figure 10)

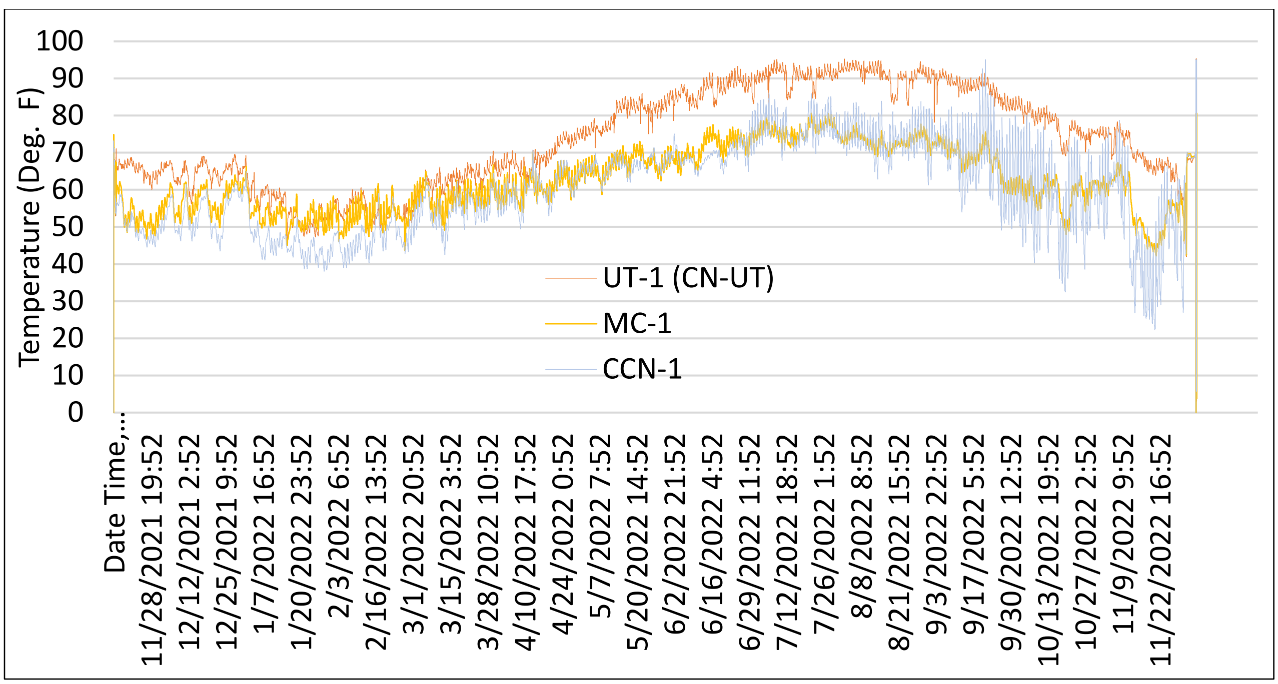


Figure 10. Comparison of temperatures in the CN-UT versus two reference streams.

6.0 HYDROLOGY AND ENGINEERING BASIS

As a part of the 316(a) study a hydrology analysis of the UT system and an engineering summary of the facility wastewater system was completed. The following information was compiled, analyzed and included in the final study report.

1) Background information on the wastewater system and outfall configuration.
2) Summary of past five years of DMR data and flow history.
3) Delineation of components of wastewater flow in the CN system and other flows (stormwater) entering the UT.
4) A summary of the latest CORMIX findings related to temperature in the TN River.

6.1 Wastewater System Configuration

See diagram in Appendix D.

6.2 DMR 5-Year Summary and Flow Analysis

Data from the facilities Discharge Monitoring Reports (DMR) was reviewed for the past 5 years (January 1, 2017 to December 4, 2022). The facility monitors flow and pH continuously and samples for all other chemical parameters on a weekly basis. A summary of the results for the internal process water Outfall (001A) are provided in Table 10. A summary of the results from the main outfall (001), which contains 001A and the once through cooling water from the river is provided in Table 11. Note, the summary of the five years of temperature monitoring data is consistent with the one year of continuous monitoring data recorded November 2021 to December 2022. A summary of the data is provided in Appendix D.

Table 10. Summary of DMR data from Outfall 001A (process water).

Statistic	Flow (mgd)	NH3-N (mg/L)	NH3-N (lbs/day)	NO3-N (mg/L)	NO3-N (lbs/day)	ORG-N (mg/L)	ORG-N (lbs/day)	O & G (mg/L)
min	0.00	0.30	3.6	0.40	7.0	0.00	1.0	0.10
avg	1.69	7.60	87.3	12.35	146.2	2.57	29.4	1.70
max	4.73	64.70	494.0	57.80	445.0	44.50	241.5	7.60

Table 11. Summary of Outfall 001 data, which includes the once through cooling water.

Statistic	pH (su)	Flow (mgd)	E-Coli (col/unit)	O & G (mg/L)	Temp. (Deg. F)	TRC (mg/L)
min	6.8	1.72	2.00	0.10	46.7	0.00
avg	8.0	13.04	47.09	1.60	74.5	0.01
max	8.9	27.97	212.00	10.20	97.2	0.02

Overall, the process water makes up, on average, approximately 13% of the total flow out to the river. The majority of the flow at Outfall 001 is once through cooling water, which will predominantly exhibit chemical characteristics of the Tennessee River at the cooling water intake.

6.3 Summary of CORMIX Results

In 2017 ADEM completed a CORMIX model of the Tennessee River using the mixing zone requirements for lakes (Memorandum to Theo Pinson from Russ Caton, May 1, 2017) in its modeling analysis of dispersion as it relates to temperature and overall effluent mixing. It was later agreed that the appropriate mixing zone requirement should be that of a river system, rather than a lake, due to constant velocity passing by the stream confluence, even during river low flow conditions (7Q10 = 7131 cfs). Taking this into consideration, the most recent approved CORMIX model for the River was completed in 2000 by CH2M Hill for Cherokee Nitrogen (LaRoche Industries, Inc at the time of the study). That study concluded that a temperature limit, at the outfall, should be 107 deg F monthly average and 109 deg. F daily maximum for a river flow of approximately 11,600 cfs and an effluent flow of 38 mgd. It concluded that these temperatures would not only satisfy the mixing zone requirements in the Tennessee River (i.e. maintain an 86 deg F temperature at the edge of the mixing zone) but that it does not consider any cooling that occurs in the unnamed tributary and should therefore be considered conservative.

To further evaluate the temperature limits, a CORMIX model was run by GBMc in 2018 using the ADEM inputs, including the lower 7Q10 of 7131 cfs, and riverine temperature criteria. Several modeling runs were completed and the most conservative run, resulted in a temperature limit of 99.5 deg F for the unnamed tributary entering the river. See model input/output for that run in Appendix E.

7.0 CONCLUSIONS AND RECOMMENDATIONS

To support a temperature variance according to the 316(a) guidance, the key factor that must be addressed/shown to be true in the receiving stream in question is documentation of no appreciable harm and the existence of an appropriate balanced and indigenous population (40CFR 122.1 and USEPA, 1974). The bioassessment designed for this study was purposed with assessing that condition (occurrence of no appreciable harm and the existence of an appropriate balanced and indigenous population) and the results from this study support that conclusion according to the following points:

1. Habitat was sufficient for macroinvertebrates at all stations during the spring season but was less available during the fall season at CCN-1.
2. Habitat was sufficient for fish at three of the four stations during the fall assessment. During the fall assessment, CCN-1 had a poor habitat quality due to lack of available habitat resulting from limited wetted area.
3. The fish community at all stations displayed similar dominant or sub-dominant families and similar trophic structure.
4. The fish community at CN-UT scored similar to or higher than the reference streams on key metrics such as species richness and diversity.
5. Though not a requirement of this study, the fish IBI was calculated, and the CN-UT scored a 28, compared to a range of 24-34 (30-34 when CCN-1 is excluded) from the reference streams, indicating it's scores are similar to the local streams assessed.
6. The macroinvertebrate community at each station shared top three dominant orders and the trophic structure (functional feeding groups) at each station were similar during the spring and fall collections.
7. Key biometrics at CN-UT either indicated a more sensitive community (such as the biotic index and %EPT in the spring) or were similar (within the range) to those of the reference streams (diversity index, richness, etc.)
8. The Alabama macroinvertebrate IBI was calculated for each of the streams assessed, and the CN-UT rated in the "good" category for both seasons with total scores in excess of (better than) or similar to the reference reaches.

Since the biological community observed during 2022 in the unnamed tributary (which is mostly composed of heated effluent) was shown to be sustaining an acceptable level of aquatic life a 316(a) temperature variance is a reasonable option for compliance.

To establish a new temperature limit for the variance, the historical data, including the continuous data collected in 2021-2022, was evaluated (Section 5.5). This data indicates that during the past five years the facility has recorded a maximum temperature of 97.2 deg F during DMR monitoring. The continuous monitoring devices installed near the outfall recorded a maximum temperature of 98.8 deg F. The 99th percentile value of the continuous monitoring data was 97.1 deg. F, and that of the DMR data was 96.2 deg. F, indicating that 99% of the time the temperature in the ditch and at the outfall are less than those values. Therefore, to ensure that the requested variance is sufficient to sustain routine compliance under current operating conditions, yet not be overly liberal, we recommend that a monthly average temperature of 98 deg F and a daily maximum temperature of 100 deg F[1] be established as the permit limits for the facility at the outfall 001 monitoring point.

[1] The 2000 CORMIX modeling by CH2M-Hill established a maximum daily limit as 2 Deg F above the monthly average limit set by the modeling.

8.0 REFERENCES CITED

Alabama Department of Environment
Various dates (see below). SOP’s ADEM , Montgomery, Alabama

6000; 3/11/2010
6001 ; 6/30/2016
6002 ; 10/6/2017
6100 ; 3/31/2014
6300 ; 1/13/2015
6301 ; 6/19/2018

GBMc & Associates. 2021. 316(a) Workplan. GBMc & Associates, Bryant, AR

GBMc & Associates. 2008. Quality Assurance Plan. GBMc & Associates, Bryant, AR

U.S. Environmental Protection Agency. 1977. *Interagency 316 (a) Technical Guidance Manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements*. Office of Water. Washington, D.C.

U.S. Environmental Protection Agency. 1974. Water Planning Division. *316 (a) Technical Guidance—Thermal Discharges.* Water Planning Division, Washington, D.C.

Appendix A

Fish and Macroinvertebrate Tables

Fish collection from each sample site in study area

Scientific Name	Common Name	CN-UT	MC-1	CCN-1	MSB-1
COTTIDAE	Sculpins				
Cottus carolinae	Banded Sculpin		11		
CYPRINIDAE	Minnows & Carps				
Campostoma oligolepis	Largescale Stoneroller	1			7
Pimephales notatus	Bluntnose Minnow		2		
Luxilus chrysocephalus	Striped Shiner		28		
CATOSTOMIDAE					
	Silver Redhorse		1		
FUNDULIDAE					
Fundulus olivaceus	Blackspotted Topminnow				1
ICTALURIDAE					
Ictalurus punctatus	Channel Catfish	1			
CENTRARCHIDAE					
Lepomis microlophus	Redear Sunfish	3			
Lepomis cyanellus	Green Sunfish	1	2	7	4
Lepomis humilis	Orangespotted Sunfish				4
Lepomis macrochirus	Bluegill Sunfish	29		3	9
Lepomis megalotis	Longear Sunfish	14	2		1
Lepomis auritus	Redbreasted sunfish	5			
Micropterus salmoides	Largemouth Bass	1			1
Micropterus salmoides	Spotted Bass				7
PERCIDAE	Perch				
Etheostoma duryi	Black Darter		3		
Etheostoma caeruleum	Rainbow Darter		7		
ATHERINIDAE	Silversides				
Labidesthes sicculus	Brook Silverside	1			
POECILIIDAE	Live Bearer				
Gambusia affinis	Western Mosquitofish	1			9
Total No. Taxa Collected		10.0	8.0	2.0	9.0
Total Fish Collected		57.0	56.0	10.0	43.0
Level of Effort (Minutes) PDT[3]		16.8	16.7	5.8	15.1
Catch per Minute, PDT		3.39	3.35	1.71	2.84
Shannon-Wiever Diversity Index		2.14	2.18	0.88	2.81

Summary of macroinvertebrates collected.

Season			Fall				Spring			
Order	**Family**	**Genus**	**CCN-1**	**MSB-1**	**MC-1**	**CN-UT**	**CCN-1**	**MSB-1**	**MC-1**	**CN-UT**
Amphipoda	Hyalellidae	Hyalella			54			1	42	
Annelida	Oligochaeta	Oligochaeta					1			
Basommatophora	Lymnaeidae	Lymnaeidae							24	
Coleoptera	Dytiscidae	Hydrodytes		2						
	Hydrodytes	Laccophilus	1			1	1			
	Elmidae	Ancyronyx							8	1
		Dubriaphia			6					
		Macronychus	1		5	3				
		Optioservus					6			
		Stenelmis		1	28	3	2		11	
	Gyrinidae	Gyretes		5				10		
	Helodidae	Helodidae					1			
	Psephenidae	Ectopria			19	1			1	
Collembola	Collembola	Collembola		1						
	Mackenziellidae	Mackenziella					2			
Decapoda	Cambaridae	Procambarus			1					
Diptera	Ceratopogonidae	Atrichopogon				1				
		Bezzia			3		1			
	Chironomidae	Chironomini	7	112	82	169	111	105	48	129
		Orthocladiinae		18	35	14	25	11	17	1
		Tanypodinae	1	29	13	126	95	26	19	5
	Culicidae	Anopheles						1		
	Culicidae	Mansonia		2						
	Culicidae	Wyeomyia					13		1	
	Dolichipodidae	Dolichipodidae		3						
	Empididae	Clinocera						3		
	Empididae	Dolichocephala						1		
	Empididae	hemerodromia							1	
	Pelecorhynchidae	Glutops		4			2			
	Simulidae	Simulium						8	18	
		Simulium		1	8					
	Stratiomyidae	Nemotelus						1		
	Stratiomyidae	Oxycera				1				
	Tipulidae	Tipula					1		1	
Ephemeroptera	Baetidae	Baetis			4					
		Paracloeodes			7		3		7	
		Pseudocloeon			11			3	3	
	Caenidae	Caenis			12		1			
	Heptageniidae	stenonema			26		1		1	
	Leptophlebiidae	Paraleptophlebia					1			
Gastropoda	Physidae	Physella	1	7		94	15		3	
	Planorbidae	Planorbis				1				
	Pleuroceridae	Pleurocera			42					
Hemiptera	Belostomatidae	Bellostoma				1				
	Colixidae	Sigara						1		
	Hebridae	Lipogomphus			1	1	1			
	Veliidae	Microvelia	3		5					
	Veliidae	Rhagovelia			3					
Hirudinea	Glossiphoniidae	Glossiphoniidae				2		1		
Isopoda	Asellidae	Caecidotea		46						
		Lirceus		34				80		
Megaloptera	Corydalidae	Corydalus			1	1				
Mollusca	Corbiculidae	Corbicula				1				
Odonata	Coenagrionidae	Amphiagrion			3	14				
		Chromagrion			1					
		Enallagma			4	2			1	
		Ischnura					1		1	
	Corduliidae	Somatochlora					2			
		Helocordulia			3					
		Somatochlora			2					
Oligochaeta	Lumbriculidae	Lumbriculidae		17	21	14		2		5
Rhynchobdellida	Glossiphoniidae	Glossiphoniidae							1	2
Terrestrial	Terrestrial	Terrestrial		0						
Trichoptera	Hydropsychidae	Cheumatopsyche		5	18	18	42	2	45	82
		Hydropsyche		3		5		10	45	69
		Macrostemum				11				
	Hydroptilidae	Hydroptila						2		1
		Oxyethira					1			
		Stactobiella						2	2	23
	Leptoceridae	Oecetis			9		1			
	Philopotamidae	Chimarra			54		16		2	
	Polycentropidae	Polycentropus			7	1				
	Polycentropodidae	Polycentropus							17	
	Rhyacophilidae	Rhyacophila						1		
Venerida	Cyrenidae	Corbicula					4			4
		Grand Total	14	290	488	485	350	271	319	322

7.2 **Interior Plateau/Transition Hills Index (Ecoregion 71 and 65j)** showing discrimination efficiency (DE) of each metric, trend with increasing stress, and scoring formulae. The formulae are shown as they should be typed into an excel spreadsheet. The text in the formula should be replaced with a reference to the cell with these metric results.

Metric	DE	Response	Score[a]
EPTTax	52.9	(-)	=max(0,min(100,100*(EPTTax-4)/23))
NonInsPTax	76.5	(+)	=max(0,min(100,100*(22.8-NonInsPTax)/20.3))
Shannon	58.8	(-)	=max(0,min(100,100*(Shannon-2.7)/2.15))
EPTPctminusHB	82.4	(-)	=max(0,min(100,100*(EPTPctminusHB-0.8)/44.8))
TolerantPTax	82.4	(+)	=max(0,min(100,100*(48.3-TolerantPTax)/33.5))
PredatorsPct	88.2	(-)	=max(0,min(100,100*(PredatorsPct-1.9)/21.5))

[a] min=minimum; max=maximum

IBI Metric Scores	Colbert Creek North		Moon Springs Branch		Mulberry Creek		Unnamed Tributary	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
EPT taxa	0.0	17.4	0.0	8.7	21.7	17.4	0.0	0.0
Non Insect Taxa	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Shannon	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0
EPTPctminusHB	0.0	100.0	16.1	42.9	100.0	100.0	76.3	100.0
Tolerant Taxa	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Predators Pct	5.1	23.7	28.4	14.4	19.1	33.0	47.0	19.1

IBI Ratings

Colbert Creek North		Moon Springs Branch		Mulberry Creek		Unnamed Tributary	
Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
34.2	56.9	40.7	44.3	58.0	58.4	53.9	53.2
Fair	Good	Fair	Good	Good	Good	Good	Good

Appendix B

Field Data Forms and Lab Results

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nitrogen *Station #* CN-UT
Visit Date 6/1/22 *Visit Time* 1200 *Collector Names* ENJ/DMB

Trip Comments:

STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O =)

ALAWADR/BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)

	Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
☐ Field Form: *Phys Char Form*		☐ Rep 1		☐ Activity Not Conducted
☐ Field Form: *Substrate Composition & Habitat Assessment Form*				☐ Activity Not Conducted
☐ Datalogger Import		☐ Rep 1		☐ Activity Not Conducted
☒ MB-I Inverts		☐ Rep 1		☐ Activity Not Conducted
☐ Peri Chl a		☐ Rep 1		☐ Activity Not Conducted
☐ Fish IBI		☐ Rep 1		☐ Activity Not Conducted

If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed ☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments
☐ Pictures Taken (Notes:)

RIPARIAN LANDUSE & VEGETATION

Land use at Reach (Check all): ☐ Pasture ☐ Fields ☒ Crops ☐ Residential ☒ Forest ☐ Commercial ☐ CAFO ☒ Industrial ☐ Mixed Urban ☐ silviculture

Dominant Riparian Vegetation Present Select Only One: ☒ Trees ☐ Herbaceous ☐ Shrubs ☐ Grasses

Canopy Cover: ☐ Open 0-20% ☐ Mostly Open 20-40% ☐ Est 50/50 40-60% ☒ Mostly Shaded 60-80% ☐ Shaded 80-100%
Type: ☐ Deciduous ☐ Coniferous ☒ Mixed

INSTREAM FEATURES

Stream Morphology Est.
Reach Length ___ ft
Stream Width 18 ft
Bank Height: High 15 ft, Low 2 ft
High Water Mark ___ ft
Channelized? ☐ Yes ☒ No

% of Total Reach (Must add up to 100%)
Riffle Habitat 35 %
Rootbank Habitat 10 %
Rock/log Habitat 35 %
CPOM Habitat 0 %
Sand Habitat 0 %
Macro Habitat Bedrock 0 %
Unsuitable Substrates 20 %

Stream Depth: Riffle 0.6 ft, Run 0.8 ft, Pool 3 ft
Proportion of: Riffle 60 %, Run 10 %, Pool 30 %

Dam Present ☒ No ☐ Yes
Relation to Reach: ☐ Above ☐ Below ☐ Within
Est. Gradient (Over 100ft): ☐ Low <1ft ☒ High >3ft ☐ Moderate 1-3 ft
If Yes, Kind? ☐ Beaver ☐ Debris ☐ Low-head ☐ Mill ☐ Culvert ☐ Hydropower

AQUATIC VEGETATION

Total % of wetted reach with aquatic vegetation present 0 % *For species list see plant guide of common species of AL*

Dominant Vegetation Type: (Select only one) ☐ Rooted Emergent ☐ Rooted Floating ☐ Rooted Submergent ☐ Attached Algae ☐ Floating Algae ☐ Free Floating

(Optional) Type	*% of Wetted Reach*	*Species*	*Type*	*% of Wetted Reach*	*Species*
Rooted Emergent	%		Attached Algae	%	
Rooted Floating	%		Floating Algae	%	
Rooted Submergent	%		Free Floating	%	

SEDIMENT / SUBSTRATE

Sediment Odors (Select One): ☒ None ☐ Chemical ☐ Sewage ☐ Anaerobic ☐ Petroleum ☐ Fishy
Oils (Select One): ☒ Absent ☐ Moderate ☐ Slight ☐ Profuse
Deposits (Select One): ☐ None ☐ Paper Fiber ☒ Silt ☐ Sand ☐ Gravel ☐ Sawdust ☐ Sludge ☐ Coal Fines
Looking at stones that are not deeply embedded, are the undersides black in color? ☒ Yes ☐ No ☐ N/A

WATER QUALITY INDICATORS

Water Odors (Select One): ☒ Normal/None ☐ Chemical ☐ Raw Sewage ☐ Treated Sewage ☐ Fishy ☐ Anaerobic ☐ Petroleum
Surface Oils: ☒ None ☐ Flecks ☐ Sheen ☐ Slick ☐ Globs
Water Color (Select One): ☒ Clear/No Color ☐ Grey ☐ Green ☐ Purple ☐ Brown (Mud) ☐ Red (Dye) ☐ Chalky White ☐ Blue ☐ Lt. Tannic ☐ Dk. Tannic
Biological Indicators (Select all): ☐ Mussels ☒ Fish ☐ Crayfish ☒ Snails ☐ Macroinvertebrates ☐ Fresh Beaver Sticks

FOD I-Form 13 Rev 02/13/2013

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☐ Yes - ADEM: Abbrev Meter (*cfs*) ☐ Yes - USGS: Gauge (*cfs*) ☐ Yes - Facility (*mgd*)	☐ No - Not wadeable (too deep) ☐ No - Flow conditions hazardous ☐ No - Visible but not measurable	☐ No - Not Required ☐ No - Flow not visible ☐ No - Braided/Swamp	☐ No - Meter Malfunctioned ☐ Data Collected but Lost or Corrupted
	USGS Gage # or Flow–Meter #:		Flow (*cfs*) or (*mgd*):	

Now	*Weather*	*Past 24 hrs*	*Flow Stage*	*Velocity*
☒	Clear / Cloudless	☒	☐ Flood (out of banks)	☐ Swift >3 ft / Sec
☐	Partly Cloudy	☐	☐ Above Normal	
☐	Mostly Cloudy	☐	☒ Normal	☐ Moderate 1.5 – 3 ft / Sec
☐	Cloudy	☐	☐ Low	
☐	Fog	☐		☐ Slow <1.5 ft / Sec
☐	Light Rain / Drizzle	☐		
☐	Rain	☐	*Heavy Rain in last 7 Days?*	
☐	Thunderstorms	☐		
☐	Freezing Precipitation	☐	☐ Yes ☒ No	

Parameter	*Value*	*Replicate*	*Unit*
Datalogger Serial#		N/A	#
Total Depth @ FM Pt			ft
Air Temp.		N/A	°C
Turbidity Meter #		N/A	#
Turbidity			NTU
Depth of Turbidity:	☐ Surface ☐ Mid-Depth ☐ ______ ft		

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		7	1/2
Hardpan Clay			1/2
Boulder	>10 in.		Yes
Cobble	2.5 - 10 in.	30	Yes
Gravel	0.1 - 2.5 in.	~~[illegible]~~ 60	Yes
Sand	Gritty		
Silt			
Clay	Slick		
Detritus	Stick/Wood	5	Yes
	CPOM		
Muck	Fine Org.		
	Total	100%	

	Name of Collector Riffle / Run HA	*Collector 1* Score (LB/RB)	*Collector 2* Score (LB/RB)
1	Instream Cover	15	16
2	Epifaunal surface	9	11
3	Embeddedness	7	4
4	Velocity/Depth	11	12
5	Channel Alteration	9	9
6	Sediment Deposition	4	3
7	Frequency of Riffles		
8	Channel Flow Status	15	15
9	Condition of Banks	6	6
10	Bank Veg. Protection	6 / 6	/
11	Disruptive Pressure	8 / 8	/
12	Riparian Veg. zone	8 / 8	/
13	Rip Veg Zone Quality	9 / 9	/

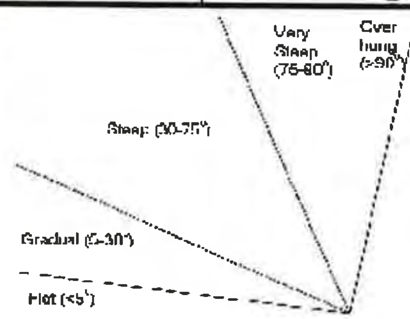
	Name of Collector Glide / Pool HA	*Collector 1* Score (LB/RB)	*Collector 2* Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

18

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

Check One for each Bank:

Left Bank Angle	☐ Flat	☒ Gradual	☐ Steep	☐ Very Steep	☐ Overhang
Right Bank Angle	☐ Flat	☒ Gradual	☐ Steep	☐ Very Steep	☐ Overhang



fast/sh

FOD I-Form 13 Rev 02/13/2013

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nutrien *Station #* MC-1
Visit Date 6/1/22 *Visit Time* 1506 *Collector Names* EN TD MB

Trip Comments:					
STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O =)				
ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)		Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
	☐ Field Form: *Phys Char Form*		☐ *Rep 1*		☐ Activity Not Conducted
	☐ Field Form: *Substrate Composition & Habitat Assessment Form*				☐ Activity Not Conducted
	☐ Datalogger Import		☐ *Rep 1*		☐ Activity Not Conducted
	☐ MB-I Inverts		☐ *Rep 1*		☐ Activity Not Conducted
	☐ Peri Chl *a*		☐ *Rep 1*		☐ Activity Not Conducted
	☐ Fish IBI		☐ *Rep 1*		☐ Activity Not Conducted
	If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed ☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments				
	☐ Pictures Taken (Notes:)				

RIPARIAN LANDUSE & VEGETATION	*Land use at Reach (Check all)*: ☒ Pasture ☐ Fields ☐ Crops ☒ Residential ☐ Forest ☐ Commercial	☐ CAFO ☐ Industrial ☐ Mixed Urban ☐ silviculture	*Dominant Riparian Vegetation Present Select Only One*: ☒ Trees ☐ Herbaceous ☐ Shrubs ☐ Grasses	*Canopy Cover:* ☐ Open 0-20% ☐ Mostly Open 20-40% ☐ Est 50/50 40-60% ☐ Mostly Shaded 60-80% ☒ Shaded 80-100%; *Type:* ☐ Deciduous ☐ Coniferous ☒ Mixed

INSTREAM FEATURES	*Stream Morphology Est.*	*% of Total Reach (Must add up to 100%)*	*Stream Depth*	*Dam Present* ☒ No ☐ Yes
	Reach Length ___ ft	*Riffle Habitat* 55 %	Riffle 0.4 ft	*Relation to Reach*: ☐ Above ☐ Below ☐ Within
	Stream Width 8 ft	*Rootbank Habitat* 25 %	Run 0.7 ft	*If Yes, Kind?*: ☐ Beaver ☐ Debris ☐ Low-head ☐ Mill ☐ Culvert ☐ Hydropower
	Bank Height: High 10 ft, Low 2 ft	*Rock/log Habitat* 15 %	Pool 2.5 ft	
	High Water Mark ___ ft	*CPOM Habitat* 0 %	*Proportion of*: Riffle 70 %	*Est. Gradient (Over 100ft)*: ☐ Low <1ft ☐ High >3ft ☒ Moderate 1-3 ft
	Channelized? ☐ Yes ☒ No	*Sand Habitat* 0 %	Run 10 %	
		Macro Habitat 0 %	Pool 20 %	
		Unsuitable Substrates 5 %		

AQUATIC VEGETATION	*Total % of wetted reach with aquatic vegetation present* 3 %	*For species list see plant guide of common species of AL*
	Dominant Vegetation Type: (Select only one) ☐ Rooted Emergent ☐ Rooted Floating ☐ Rooted Submergent ☒ Attached Algae ☐ Floating Algae ☐ Free Floating	
	(Optional) Type / % of Wetted Reach / Species: Rooted Emergent ___ % ___; Rooted Floating ___ % ___; Rooted Submergent ___ % ___	*Type / % of Wetted Reach / Species*: Attached Algae <5 % Filamentous; Floating Algae ___ % ___; Free Floating ___ % ___

SEDIMENT / SUBSTRATE	*Sediment Odors (Select One)*: ☒ None ☐ Chemical ☐ Sewage ☐ Anaerobic ☐ Petroleum ☐ Fishy	*Oils (Select One)*: ☒ Absent ☐ Moderate ☐ Slight ☐ Profuse	*Deposits (Select One)*: ☒ None ☐ Paper Fiber ☐ Silt ☐ Sand ☐ Gravel ☐ Sawdust ☐ Sludge ☐ Coal Fines	*Looking at stones that are not deeply embedded, are the undersides black in color?* ☒ Yes ☐ No ☐ N/A

WATER QUALITY INDICATORS	*Water Odors (Select One)*: ☒ Normal/None ☐ Chemical ☐ Raw Sewage ☐ Treated Sewage ☐ Fishy ☐ Anaerobic ☐ Petroleum	*Surface Oils*: ☒ None ☐ Flecks ☐ Sheen ☐ Slick ☐ Globs	*Water Color (Select One)*: ☒ Clear/No Color ☐ Grey ☐ Green ☐ Purple ☐ Brown (Mud) ☐ Red (Dye) ☐ Chalky White ☐ Blue ☐ Lt. Tannic ☐ Dk. Tannic	*Biological Indicators (Select all)*: ☐ Mussels ☒ Fish ☒ Crayfish ☒ Snails ☒ Macroinvertebrates ☐ Fresh Beaver Sticks

FOD I-Form 13 Rev 02/13/2013

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☐ Yes - ADEM: Abbrev Meter (cfs)	☐ No - Not wadeable (too deep)	☐ No - Not Required	☐ No - Meter Malfunctioned
	☐ Yes - USGS: Gauge (cfs)	☐ No - Flow conditions hazardous	☐ No - Flow not visible	☐ Data Collected but Lost or Corrupted
	☐ Yes - Facility (mgd)	☐ No - Visible but not measurable	☐ No - Braided/Swamp	
	USGS Gage # or Flow--Meter #:		Flow (cfs) or (mgd):	

Now	*Weather*	*Past 24 hrs*	*Flow Stage*	*Velocity*
X	Clear / Cloudless	X	☐ Flood (out of banks)	☐ Swift >3 ft / Sec
☐	Partly Cloudy	☐	☐ Above Normal	
☐	Mostly Cloudy	☐	X Normal	☐ Moderate 1.5 – 3 ft / Sec
☐	Cloudy	☐	☐ Low	
☐	Fog	☐		☐ Slow <1.5 ft / Sec
☐	Light Rain / Drizzle	☐		
☐	Rain	☐	*Heavy Rain in last 7 Days?*	
☐	Thunderstorms	☐		
☐	Freezing Precipitation	☐	☐ Yes X No	

Parameter	*Value*	*Replicate*	*Unit*
Datalogger Serial#		N/A	#
Total Depth @ FM Pt			ft
Air Temp.		N/A	°C
Turbidity Meter #		N/A	#
Turbidity			NTU
Depth of Turbidity:	☐ Surface		
	☐ Mid-Depth		
	☐ _______ ft		

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		18	1/2
Hardpan Clay			1/2
Boulder	>10 in.	20	Yes
Cobble	2.5 - 10 in.	20	Yes
Gravel	0.1 - 2.5 in.	35	Yes
Sand	Gritty		
Silt		5	
Clay	Slick		
Detritus	Stick/Wood	2	Yes
	CPOM		
Muck	Fine Org.		
Total		100%	

	Name of Collector	Collector 1	Collector 2
	Riffle / Run HA	Score (LB/RB)	Score (LB/RB)
1	Instream Cover	18	18
2	Epifaunal surface	18	18
3	Embeddedness	12	11
4	Velocity/Depth	9	13
5	Channel Alteration	10 9	8
6	Sediment Deposition	17	18
7	Frequency of Riffles	11	11
8	Channel Flow Status	11	11
9	Condition of Banks	7	8
10	Bank Veg. Protection	7 / 7	/
11	Disruptive Pressure	9 / 9	/
12	Riparian Veg. zone	7 / 8	/
13	Rip Veg Zone Quality	9 / 9	/

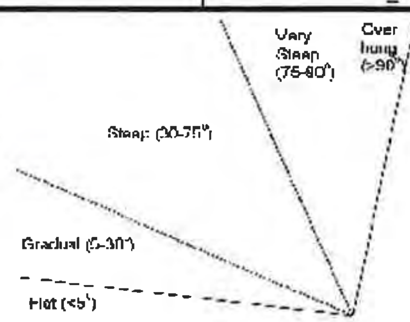
	Name of Collector	Collector 1	Collector 2
	Glide / Pool HA	Score (LB/RB)	Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

*Dani & I talked through #10-13 /8

Check One for each Bank:

Left Bank Angle	☐ Flat	☐ Gradual	X Steep	☐ Very Steep	☐ Overhung
Right Bank Angle	☐ Flat	X Gradual	☐ Steep	☐ Very Steep	☐ Overhung



FOD I-Form 13 Rev 02/13/2013

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nitrogen *Station #* CCN-1 Colbert Creek North
Visit Date 6/1/22 *Visit Time* 645 *Collector Names* ENJ/OMB

Trip Comments:

STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O =)

ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)	Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
□ Field Form: *Phys Char Form*		□ *Rep 1*		□ Activity Not Conducted
□ Field Form: *Substrate Composition & Habitat Assessment Form*				□ Activity Not Conducted
□ Datalogger Import		□ *Rep 1*		□ Activity Not Conducted
☒ MB-I Inverts	645	□ *Rep 1*		□ Activity Not Conducted
□ Peri Chl a		□ *Rep 1*		□ Activity Not Conducted
□ Fish IBI		□ *Rep 1*		□ Activity Not Conducted

If any activity is not conducted, Why? □ No Flow □ Intermittent Pools □ Too Deep □ Too Turbid □ Dry Streambed □ Equipment Malfunctioned □ Inaccessible □ Dangerous Flow □ Dangerous Weather □ Other: Note in Comments
□ Pictures Taken (Notes:)

RIPARIAN LANDUSE & VEGETATION

Land use at Reach (Check all): □ Pasture ☒ Fields □ Crops □ Residential □ Forest □ Commercial □ CAFO □ Industrial □ Mixed Urban □ silviculture
Dominant Riparian Vegetation Present Select Only One: ☒ Trees □ Herbaceous □ Shrubs □ Grasses
Canopy Cover: □ Open 0-20% □ Mostly Open 20-40% □ Est 50/50 40-60% □ Mostly Shaded 60-80% ☒ Shaded 80-100%
Type: □ Deciduous □ Coniferous □ Mixed

INSTREAM FEATURES

Stream Morphology Est.
Reach Length 6PS track ft
Stream Width 10 ft
Bank Height: High 6.5 ft Low <1 ft
High Water Mark 5 ft
Channelized? □ Yes ☒ No

% of Total Reach (Must add up to 100%)
Riffle Habitat 35 %
Rootbank Habitat 30 %
Rock/log Habitat 30 %
CPOM Habitat 0 %
Sand Habitat 6 %
Macro Habitat Depositional? 0 %
Unsuitable Substrates 5 %

Stream Depth: Riffle 0.3 ft Run 0.5 ft Pool 2.0 ft
Proportion of: Riffle 40 % Run 20 % Pool 40 %

Dam Present ☒ No □ Yes
Relation to Reach: □ Above □ Below □ Within
Est. Gradient (Over 100m): □ Low <1ft □ High >3ft ☒ Moderate 1-3 ft
If Yes, Kind? □ Beaver □ Debris □ Low-head □ Mill □ Culvert □ Hydropower

AQUATIC VEGETATION

Total % of wetted reach with aquatic vegetation present 5 % *For species list see plant guide of common species of AL*

Dominant Vegetation Type: (Select only one) □ Rooted Emergent □ Rooted Floating □ Rooted Submergent ☒ Attached Algae □ Floating Algae □ Free Floating

(Optional) Type	% of Wetted Reach	Species	Type	% of Wetted Reach	Species
Rooted Emergent	0 %		Attached Algae	10 %	filamentous
Rooted Floating	0 %		Floating Algae	%	
Rooted Submergent	6 %		Free Floating	%	

SEDIMENT / SUBSTRATE

Sediment Odors (Select One): ☒ None □ Chemical □ Sewage □ Anaerobic □ Petroleum □ Fishy
Oils (Select One): ☒ Absent □ Moderate □ Slight □ Profuse
Deposits (Select One): □ None □ Paper Fiber ☒ Silt □ Sand □ Gravel □ Sawdust □ Sludge □ Coal Fines
Looking at stones that are not deeply embedded, are the undersides black in color? ☒ Yes □ No □ N/A

WATER QUALITY INDICATORS

Water Odors (Select One): ☒ Normal/None □ Chemical □ Raw Sewage □ Treated Sewage □ Fishy □ Anaerobic □ Petroleum
Surface Oils: ☒ None □ Flecks □ Sheen □ Slick □ Globs
Water Color (Select One): ☒ Clear/No Color □ Grey □ Green □ Purple □ Brown (Mud) □ Red (Dye) □ Chalky White □ Blue □ Lt. Tannic □ Dk. Tannic
Biological Indicators (Select all): □ Mussels ☒ Fish □ Crayfish □ Snails ☒ Macroinvertebrates ☒ Fresh Beaver Sticks

FOD I-Form 13 Rev 02/13/2013

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

March McBirney

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☒ Yes - ADEM: Abbrev-Meter (cfs)	☐ No - Not wadeable (too deep)	☐ No - Not Required	☐ No - Meter Malfunctioned
	☐ Yes - USGS: Gauge (cfs)	☐ No - Flow conditions hazardous	☐ No - Flow not visible	☐ Data Collected but Lost or Corrupted
	☐ Yes - Facility (mgd)	☐ No - Visible but not measurable	☐ No - Braided/Swamp	
	USGS Gage # or Flow–Meter #:		Flow (cfs) or (mgd):	

Now	*Weather*	*Past 24 hrs*	*Flow Stage*	*Velocity*	*Parameter*	*Value*	*Replicate*	*Unit*
X	Clear / Cloudless	X	☐ Flood (out of banks)	☐ Swift >3 ft / Sec	Datalogger Serial#		N/A	#
☐	Partly Cloudy	☐	☐ Above Normal		Total Depth @ FM Pt			ft
☐	Mostly Cloudy	☐	☒ Normal	☐ Moderate 1.5 – 3 ft / Sec	Air Temp.		N/A	°C
☐	Cloudy	☐	☐ Low		Turbidity Meter #		N/A	#
☐	Fog	☐		☒ Slow <1.5 ft / Sec	Turbidity			NTU
☐	Light Rain / Drizzle	☐			Depth of Turbidity:	☐ Surface		
☐	Rain	☐	*Heavy Rain in last 7 Days?*			☐ Mid-Depth		
☐	Thunderstorms	☐				☐ ______ ft		
☐	Freezing Precipitation	☐	☐ Yes ☒ No					

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		10	1/2
Hardpan Clay			1/2
Boulder	>10 in.		Yes
Cobble	2.5 - 10 in.	30	Yes
Gravel	0.1 - 2.5 in.	35	Yes
Sand	Gritty		
Silt		20	No
Clay	Slick		
Detritus	Stick/Wood	5	Yes
	CPOM		
Muck	Fine Org.		
	Total	100%	

	Name of Collector / Riffle / Run HA	Collector 1 Score (LB/RB)	Collector 2 Score (LB/RB)
1	Instream Cover	14	15
2	Epifaunal surface	14	15
3	Embeddedness	18	17
4	Velocity/Depth	7	7
5	Channel Alteration	16	17
6	Sediment Deposition	16	17
7	Frequency of Riffles	12	13
8	Channel Flow Status	12	13
9	Condition of Banks	8	9
10	Bank Veg. Protection	6 / 5	/
11	Disruptive Pressure	7 / 7	/
12	Riparian Veg. zone	9 / 6	/
13	Rip Veg Zone Quality	9 / 6	/

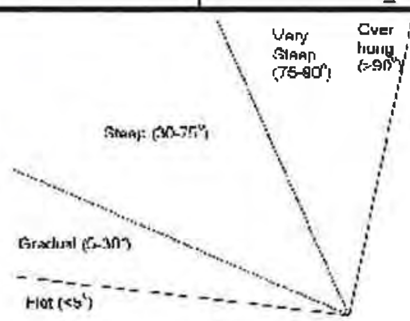
	Name of Collector / Glide / Pool HA	Collector 1 Score (LB/RB)	Collector 2 Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

10

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

Check One for each Bank:

Left Bank Angle	☐ Flat	☒ Gradual	☐ Steep	☐ Very Steep	☐ Overhang
Right Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhang



FOD I-Form 13 Rev 02/13/2013

CN-UT
Page 1

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nitrogen *Station #* CN-UT
Visit Date 9/27/22 *Visit Time* 1430 *Collector Names* ENJ/DMB/WHG

Trip Comments:

STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O = 7.0)

ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)	Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
[x] Field Form: *Phys Char Form*		☐ *Rep 1*		☐ Activity Not Conducted
☐ Field Form: *Substrate Composition & Habitat Assessment Form*				☐ Activity Not Conducted
[x] Datalogger Import		☐ *Rep 1*		☐ Activity Not Conducted
[x] MB-I Inverts		☐ *Rep 1*		☐ Activity Not Conducted
☐ Peri Chl a		☐ *Rep 1*		☐ Activity Not Conducted
[x] Fish IBI		☐ *Rep 1*		☐ Activity Not Conducted

If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed ☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments

☐ Pictures Taken (Notes:)

RIPARIAN LANDUSE & VEGETATION

Land use at Reach (Check all): ☐ Pasture ☐ Fields [x] Crops ☐ Residential [x] Forest ☐ Commercial ☐ CAFO [x] Industrial ☐ Mixed Urban ☐ silviculture

Dominant Riparian Vegetation Present Select Only One: [x] Trees ☐ Herbaceous ☐ Shrubs ☐ Grasses

Canopy Cover: ☐ Open 0-20% ☐ Mostly Open 20-40% ☐ Est 50/50 40-60% [x] Mostly Shaded 60-80% ☐ Shaded 80-100%
Type: ☐ Deciduous ☐ Coniferous ☐ Mixed

INSTREAM FEATURES

Stream Morphology Est.	*% of Total Reach (Must add up to 100%)*	*Stream Depth*
Reach Length ___ ft	*Riffle Habitat* 30 %	Riffle 0.8 ft
Stream Width 10/19 ft	*Rootbank Habitat* 20 %	Run 1.0 ft
Bank Height: High 12 ft	*Rock/log Habitat* 30 %	Pool 3 ft
Low 1 ft	*CPOM Habitat* 10 %	*Proportion of*
High Water Mark ___ ft	*Sand Habitat* 0 %	Riffle 35 %
Channelized? ☐ Yes [x] No	*Macro Habitat* 0 %	Run 50 %
	Unsuitable Substrates 0 %	Pool 15 %

Dam Present [x] No ☐ Yes
Relation to Reach: ☐ Above ☐ Below ☐ Within
Est. Gradient (Over 100m): ☐ Low <1ft [x] High >3ft ☐ Moderate 1-3 ft
If Yes, Kind? ☐ Beaver ☐ Debris ☐ Low-head ☐ Mill ☐ Culvert ☐ Hydropower

AQUATIC VEGETATION

Total % of wetted reach with aquatic vegetation present 0 % *For species list see plant guide of common species of AL*

Dominant Vegetation Type: (Select only one) ☐ Rooted Emergent ☐ Rooted Floating ☐ Rooted Submergent ☐ Attached Algae ☐ Floating Algae ☐ Free Floating

(Optional) Type	*% of Wetted Reach*	*Species*	*Type*	*% of Wetted Reach*	*Species*
Rooted Emergent	___ %		Attached Algae	___ %	
Rooted Floating	___ %		Floating Algae	___ %	
Rooted Submergent	___ %		Free Floating	___ %	

SEDIMENT / SUBSTRATE

Sediment Odors (Select One): [x] None ☐ Chemical ☐ Sewage ☐ Anaerobic ☐ Petroleum ☐ Fishy
Oils (Select One): [x] Absent ☐ Moderate ☐ Slight ☐ Profuse
Deposits (Select One): [x] None ☐ Paper Fiber ☐ Silt ☐ Sand ☐ Gravel ☐ Sawdust ☐ Sludge ☐ Coal Fines
Looking at stones that are not deeply embedded, are the undersides black in color? [x] Yes ☐ No ☐ N/A

WATER QUALITY INDICATORS

Water Odors (Select One): [x] Normal/None ☐ Chemical ☐ Raw Sewage ☐ Treated Sewage ☐ Fishy ☐ Anaerobic ☐ Petroleum
Surface Oils: [x] None ☐ Flecks ☐ Sheen ☐ Slick ☐ Globs
Water Color (Select One): [x] Clear/No Color ☐ Grey ☐ Green ☐ Purple ☐ Brown (Mud) ☐ Red (Dye) ☐ Chalky White ☐ Blue ☐ Lt. Tannic ☐ Dk. Tannic
Biological Indicators (Select all): ☐ Mussels [x] Fish [x] Crayfish ☐ Snails [x] Macroinvertebrates ☐ Fresh Beaver Sticks

FOD I-Form 13 Rev 03/13/2013

CN-UT
Page 2

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☒ Yes - ADEM: Abbrev Meter (cfs) ☐ Yes - USGS: Gauge (cfs) ☐ Yes - Facility (mgd)	☐ No - Not wadeable (too deep) ☐ No - Flow conditions hazardous ☐ No - Visible but not measurable	☐ No - Not Required ☐ No - Flow not visible ☐ No - Braided/Swamp	☐ No - Meter Malfunctioned ☐ Data Collected but Lost or Corrupted
	USGS Gage # or Flow–Meter #:		Flow (cfs) or (mgd):	

Now	Weather	Past 24 hrs
☒	Clear / Cloudless	☒
☐	Partly Cloudy	☐
☐	Mostly Cloudy	☐
☐	Cloudy	☐
☐	Fog	☐
☐	Light Rain / Drizzle	☐
☐	Rain	☐
☐	Thunderstorms	☐
☐	Freezing Precipitation	☐

Flow Stage
- ☐ Flood (out of banks)
- ☐ Above Normal
- ☒ Normal
- ☐ Low

Heavy Rain in last 7 Days? ☐ Yes ☒ No

Velocity
- ☐ Swift >3 ft / Sec
- ☐ Moderate 1.5 – 3 ft / Sec
- ☐ Slow <1.5 ft / Sec

Parameter	Value	Replicate	Unit
Datalogger Serial#		N/A	#
Total Depth @ FM Pt			ft
Air Temp.		N/A	°C
Turbidity Meter #		N/A	#
Turbidity			NTU
Depth of Turbidity:	☐ Surface ☐ Mid-Depth ☐ _______ ft		

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		2	1/2
Hardpan Clay			1/2
Boulder	>10 in.		Yes
Cobble	2.5 - 10 in.	20	Yes
Gravel	0.1 - 2.5 in.	60	Yes
Sand	Gritty		
Silt		15	
Clay	Slick		
Detritus	Stick/Wood		Yes
Detritus	CPOM	3	
Muck	Fine Org.	15	
	Total	100%	

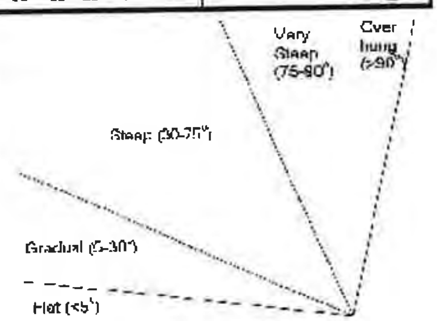
	Name of Collector / Riffle / Run HA	Collector 1 Score (LB/RB)	Collector 2 Score (LB/RB)
1	Instream Cover	15	16
2	Epifaunal surface	12	13
3	Embeddedness	11	9
4	Velocity/Depth	12	12
5	Channel Alteration	13	13
6	Sediment Deposition	9	8
7	Frequency of Riffles		
8	Channel Flow Status	13	17
9	Condition of Banks	7	6
10	Bank Veg. Protection	6	10
11	Disruptive Pressure	9	7
12	Riparian Veg. zone	9	9
13	Rip Veg Zone Quality	9	8

	Name of Collector / Glide / Pool HA	Collector 1 Score (LB/RB)	Collector 2 Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

Check One for each Bank:

Left Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhung
Right Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhung



FOD I-Form 13 Rev 02/13/2013

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nitrogen　　Station # MSB-1
Visit Date 9/28/22　　Visit Time ______　　Collector Names EMJ/WHG/DMB

Trip Comments:

STATION VISIT COMMENTS (REACH DESCRIPTION): (For COC Purposes: D.O =)

ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)

	Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
☐ Field Form: Phys Char Form		☐ Rep 1		☐ Activity Not Conducted
☐ Field Form: Substrate Composition & Habitat Assessment Form				☐ Activity Not Conducted
☐ Datalogger Import		☐ Rep 1		☐ Activity Not Conducted
☒ MB-I Inverts		☐ Rep 1		☐ Activity Not Conducted
☐ Peri Chl a		☐ Rep 1		☐ Activity Not Conducted
☒ Fish IBI		☐ Rep 1		☐ Activity Not Conducted

If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed ☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments
☐ Pictures Taken (Notes:)

RIPARIAN LANDUSE & VEGETATION

Land use at Reach (Check all): ☐ Pasture ☐ Fields ☐ Crops ☐ Residential ☒ Forest ☐ Commercial ☐ CAFO ☐ Industrial ☐ Mixed Urban ☐ silviculture
Dominant Riparian Vegetation Present (Select Only One): ☒ Trees ☐ Herbaceous ☐ Shrubs ☐ Grasses
Canopy Cover: ☐ Open 0-20% ☐ Mostly Open 20-40% ☐ Est 50/50 40-60% ☐ Mostly Shaded 60-80% ☒ Shaded 80-100%
Type: ☐ Deciduous ☐ Coniferous ☒ Mixed

INSTREAM FEATURES

Stream Morphology Est.: Reach Length ____ ft; Stream Width 6 ft; Bank Height: High 3 ft, Low 1 ft; High Water Mark ____ ft
Channelized? ☐ Yes ☐ No

% of Total Reach (Must add up to 100%): Riffle Habitat 40 %; Rootbank Habitat 20 %; Rock/log Habitat 20 %; CPOM Habitat 5 %; Sand Habitat 0 %; Macro Habitat 0 %; Unsuitable Substrates 15 %

Stream Depth: Riffle 0.3 ft; Run 0.4 ft; Pool 1.5 ft
Proportion of: Riffle 40 %; Run 10 %; Pool 50 %

Dam Present ☒ No ☐ Yes
Relation to Reach: ☐ Above ☐ Below ☐ Within
If Yes, Kind? ☐ Beaver ☐ Debris ☐ Low-head ☐ Mill ☐ Culvert ☐ Hydropower
Est. Gradient (Over 100ft): ☒ Low <1ft ☐ High >3ft ☐ Moderate 1-3 ft

AQUATIC VEGETATION

Total % of wetted reach with aquatic vegetation present 0 %　For species list see plant guide of common species of AL
Dominant Vegetation Type (Select only one): ☐ Rooted Emergent ☐ Rooted Floating ☐ Rooted Submergent ☐ Attached Algae ☐ Floating Algae ☐ Free Floating

(Optional) Type	% of Wetted Reach	Species	Type	% of Wetted Reach	Species
Rooted Emergent	%		Attached Algae	%	
Rooted Floating	%		Floating Algae	%	
Rooted Submergent	%		Free Floating	%	

SEDIMENT / SUBSTRATE

Sediment Odors (Select One): ☒ None ☐ Chemical ☐ Sewage ☐ Anaerobic ☐ Petroleum ☐ Fishy
Oils (Select One): ☒ Absent ☐ Moderate ☐ Slight ☐ Profuse
Deposits (Select One): ☐ None ☐ Paper Fiber ☒ Silt ☐ Sand ☐ Gravel ☐ Sawdust ☐ Sludge ☐ Coal Fines
Looking at stones that are not deeply embedded, are the undersides black in color? ☒ Yes ☐ No ☐ N/A

WATER QUALITY INDICATORS

Water Odors (Select One): ☒ Normal/None ☐ Chemical ☐ Raw Sewage ☐ Treated Sewage ☐ Fishy ☐ Anaerobic ☐ Petroleum
Surface Oils: ☒ None ☐ Flecks ☐ Sheen ☐ Slick ☐ Globs
Water Color (Select One): ☒ Clear/No Color ☐ Grey ☐ Green ☐ Purple ☐ Brown (Mud) ☐ Red (Dye) ☐ Chalky White ☐ Blue ☐ Lt. Tannic ☐ Dk. Tannic
Biological Indicators (Select all): ☐ Mussels ☒ Fish ☒ Crayfish ☐ Snails ☒ Macroinvertebrates ☐ Fresh Beaver Sticks

FOD I-Form 13 Rev 02/13/2013

MSB-1

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☒ Yes - ADEM: Abbrev Meter (cfs)	☐ No - Not wadeable (too deep)	☐ No - Not Required	☐ No - Meter Malfunctioned
	☐ Yes - USGS: Gauge (cfs)	☐ No - Flow conditions hazardous	☐ No - Flow not visible	☐ Data Collected but Lost or Corrupted
	☐ Yes - Facility (mgd)	☐ No - Visible but not measurable	☐ No - Braided/Swamp	
	USGS Gage # or Flow–Meter #:		Flow (cfs) or (mgd):	

Now	*Weather*	*Past 24 hrs*
☒	Clear / Cloudless	☒
☐	Partly Cloudy	☐
☐	Mostly Cloudy	☐
☐	Cloudy	☐
☐	Fog	☐
☐	Light Rain / Drizzle	☐
☐	Rain	☐
☐	Thunderstorms	☐
☐	Freezing Precipitation	☐

Flow Stage
- ☐ Flood (out of banks)
- ☐ Above Normal
- ☐ Normal
- ☒ Low

Heavy Rain in last 7 Days? ☐ Yes ☒ No

Velocity
- ☐ Swift >3 ft / Sec
- ☐ Moderate 1.5 – 3 ft / Sec
- ☒ Slow <1.5 ft / Sec

Parameter	*Value*	*Replicate*	*Unit*
Datalogger Serial#		N/A	#
Total Depth @ FM Pt			ft
Air Temp.		N/A	°C
Turbidity Meter #		N/A	#
Turbidity			NTU

Depth of Turbidity: ☐ Surface ☐ Mid-Depth ☐ _______ ft

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		0	1/2
Hardpan Clay		0	1/2
Boulder	>10 in.	0	Yes
Cobble	2.5 - 10 in.	10	Yes
Gravel	0.1 - 2.5 in.	50	Yes
Sand	Gritty	0	
Silt		0	
Clay	Slick	0	
Detritus	Stick/Wood	5	Yes
	CPOM	5	
Muck	Fine Org.	30	
	Total	100%	

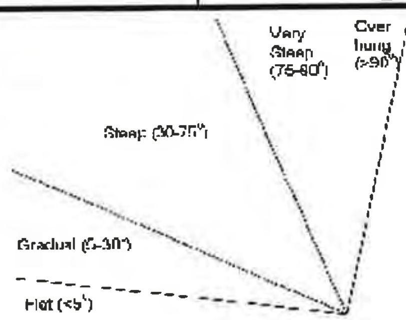
	Riffle / Run HA	*Collector 1* Score (LB/RB)	*Collector 2* Score (LB/RB)
	Name of Collector		
1	Instream Cover	5	4
2	Epifaunal surface	12	13
3	Embeddedness	11	12
4	Velocity/Depth	13	11
5	Channel Alteration	16	16
6	Sediment Deposition	9	10
7	Frequency of Riffles		
8	Channel Flow Status	10	10
9	Condition of Banks	12	12
10	Bank Veg. Protection	14	12
11	Disruptive Pressure	8	6
12	Riparian Veg. zone	9	9
13	Rip Veg Zone Quality	9	8

	Glide / Pool HA	*Collector 1* Score (LB/RB)	*Collector 2* Score (LB/RB)
	Name of Collector		
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)					
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35	

Check One for each Bank:

Left Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhung
Right Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhung



FOD I-Form 13 Rev 02/13/2013

MC-1
Page 1

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nitrogen   Station # MC-1
Visit Date 9/28/22   Visit Time ______   Collector Names ENT / WHG / DMB

Trip Comments:

STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O =)

ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)	Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
☐ Field Form: Phys Char Form		☐ Rep 1		☐ Activity Not Conducted
☐ Field Form: Substrate Composition & Habitat Assessment Form				☐ Activity Not Conducted
☐ Datalogger Import		☐ Rep 1		☐ Activity Not Conducted
☒ MB-I Inverts		☐ Rep 1		☐ Activity Not Conducted
☐ Peri Chl a		☐ Rep 1		☐ Activity Not Conducted
☒ Fish IBI		☐ Rep 1		☐ Activity Not Conducted

If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed ☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments

☐ Pictures Taken (Notes:)

RIPARIAN LANDUSE & VEGETATION

Land use at Reach (Check all): ☒ Pasture ☒ Fields ☐ Crops ☐ Residential ☒ Forest ☐ Commercial ☐ CAFO ☐ Industrial ☐ Mixed Urban ☐ silviculture

Dominant Riparian Vegetation Present Select Only One: ☒ Trees ☐ Herbaceous ☐ Shrubs ☐ Grasses

Canopy Cover: ☐ Open 0-20% ☐ Mostly Open 20-40% ☐ Est 50/50 40-60% ☐ Mostly Shaded 60-80% ☒ Shaded 80-100%
Type: ☐ Deciduous ☐ Coniferous ☒ Mixed

INSTREAM FEATURES

Stream Morphology Est.
Reach Length GPS ft
Stream Width 10 ft
Bank Height: High 10 ft, Low 2 ft
High Water Mark ____ ft
Channelized? ☐ Yes ☐ No

% of Total Reach (Must add up to 100%)

Riffle Habitat	50 %
Rootbank Habitat	10 %
Rock/log Habitat	35 %
CPOM Habitat	5 %
Sand Habitat	0 %
Macro Habitat	0 %
Unsuitable Substrates	0 %

Stream Depth: Riffle 0.4 ft, Run 0.7 ft, Pool 2.5 ft
Proportion of: Riffle 50 %, Run 10 %, Pool 40 %

Dam Present ☒ No ☐ Yes
Relation to Reach: ☐ Above ☐ Below ☐ Within
If Yes, Kind? ☐ Beaver ☐ Debris ☐ Low-head ☐ Mill ☐ Culvert ☐ Hydropower
Est. Gradient (Over 100ft): ☐ Low <1ft ☐ High >3ft ☒ Moderate 1-3 ft

AQUATIC VEGETATION

Total % of wetted reach with aquatic vegetation present 0 %   For species list see plant guide of common species of AL

Dominant Vegetation Type: (Select only one) ☐ Rooted Emergent ☐ Rooted Floating ☐ Rooted Submergent ☐ Attached Algae ☐ Floating Algae ☐ Free Floating

(Optional) Type	% of Wetted Reach	Species	Type	% of Wetted Reach	Species
Rooted Emergent	%		Attached Algae	%	
Rooted Floating	%		Floating Algae	%	
Rooted Submergent	%		Free Floating	%	

SEDIMENT / SUBSTRATE

Sediment Odors (Select One): ☒ None ☐ Chemical ☐ Sewage ☐ Anaerobic ☐ Petroleum ☐ Fishy
Oils (Select One): ☒ Absent ☐ Moderate ☐ Slight ☐ Profuse
Deposits (Select One): ☒ None ☐ Paper Fiber ☐ Silt ☐ Sand ☐ Gravel ☐ Sawdust ☐ Sludge ☐ Coal Fines
Looking at stones that are not deeply embedded, are the undersides black in color? ☒ Yes ☐ No ☐ N/A

WATER QUALITY INDICATORS

Water Odors (Select One): ☒ Normal/None ☐ Chemical ☐ Raw Sewage ☐ Treated Sewage ☐ Fishy ☐ Anaerobic ☐ Petroleum
Surface Oils: ☒ None ☐ Flecks ☐ Sheen ☐ Slick ☐ Globs
Water Color (Select One): ☒ Clear/No Color ☐ Grey ☐ Green ☐ Purple ☐ Brown (Mud) ☐ Red (Dye) ☐ Chalky White ☐ Blue ☐ Lt. Tannic ☐ Dk. Tannic
Biological Indicators (Select all): ☐ Mussels ☒ Fish ☒ Crayfish ☐ Snails ☒ Macroinvertebrates ☐ Fresh Beaver Sticks

FOD I-Form 13 Rev 02/13/2013

MC-1
Page 2

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?				
	☒ Yes - ADEM: Abbrev Meter (cfs)	☐ No - Not wadeable (too deep)	☐ No - Not Required	☐ No - Meter Malfunctioned
	☐ Yes - USGS: Gauge (cfs)	☐ No - Flow conditions hazardous	☐ No - Flow not visible	☐ Data Collected but Lost or Corrupted
	☐ Yes - Facility (mgd)	☐ No - Visible but not measurable	☐ No - Braided/Swamp	
	USGS Gage # or Flow—Meter #:		**Flow (cfs) or (mgd):**	

Now	*Weather*	*Past 24 hrs*	*Flow Stage*	*Velocity*
☒	Clear / Cloudless	☒	☐ Flood (out of banks)	☐ Swift >3 ft / Sec
☐	Partly Cloudy	☐	☐ Above Normal	☐ Moderate 1.5 – 3 ft / Sec
☐	Mostly Cloudy	☐	☒ Normal	☒ Slow ≤1.5 ft / Sec
☐	Cloudy	☐	☐ Low	
☐	Fog	☐		
☐	Light Rain / Drizzle	☐	*Heavy Rain in last 7 Days?*	
☐	Rain	☐	☐ Yes ☒ No	
☐	Thunderstorms	☐		
☐	Freezing Precipitation	☐		

Parameter	*Value*	*Replicate*	*Unit*
Datalogger Serial#		N/A	#
Total Depth @ FM Pt			ft
Air Temp.		N/A	°C
Turbidity Meter #		N/A	#
Turbidity			NTU
Depth of Turbidity:	☐ Surface ☐ Mid-Depth ☐ ______ ft		

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		10	1/2
Hardpan Clay			1/2
Boulder	>10 in.	20	Yes
Cobble	2.5 - 10 in.	20	Yes
Gravel	0.1 - 2.5 in.	35	Yes
Sand	Gritty		
Silt			
Clay	Slick		
Detritus	Stick/Wood	10	Yes
	CPOM	5	
Muck	Fine Org.		
	Total	100%	

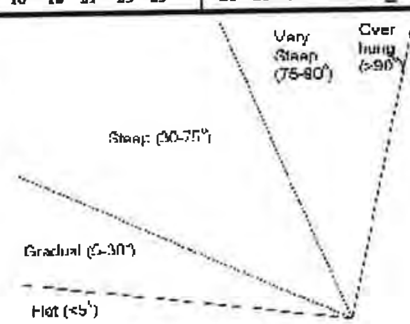
	Name of Collector Riffle / Run HA	*Collector 1* Score (LB/RB)	*Collector 2* Score (LB/RB)
1	Instream Cover	18	17
2	Epifaunal surface	16	16
3	Embeddedness	12	12
4	Velocity/Depth	13	13
5	Channel Alteration	16	15
6	Sediment Deposition	17	17
7	Frequency of Riffles		
8	Channel Flow Status	10	11
9	Condition of Banks	15	15
10	Bank Veg. Protection	6	6
11	Disruptive Pressure	9	9
12	Riparian Veg. zone	9	9
13	Rip Veg Zone Quality	8	9

	Name of Collector Glide / Pool HA	*Collector 1* Score (LB/RB)	*Collector 2* Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

Check One for each Bank:

Left Bank Angle	☐ Flat	☒ Gradual	☐ Steep	☐ Very Steep	☐ Overhung
Right Bank Angle	☐ Flat	☒ Gradual	☐ Steep	☐ Very Steep	☐ Overhung



FOD I-Form 13 Rev 02/13/2013

CCN-1
Page 1

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

Trip Name Cherokee Nitrogen *Station #* CCN-1
Visit Date 7/28/22 *Visit Time* ______ *Collector Names* ENJ/DMB/WHG

Trip Comments:	
STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O =)

ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (* ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)		Activity Time* (24hrs):		Replicate Time (24hrs):	Activity Conducted?
	☐ Field Form: *Phys Char Form*		☐ *Rep 1*		☐ Activity Not Conducted
	☐ Field Form: *Substrate Composition & Habitat Assessment Form*				☐ Activity Not Conducted
	☐ Datalogger Import		☐ *Rep 1*		☐ Activity Not Conducted
	☒ MB-I Inverts		☐ *Rep 1*		☐ Activity Not Conducted
	☐ Peri Chl a		☐ *Rep 1*		☐ Activity Not Conducted
	☒ Fish IBI		☐ *Rep 1*		☐ Activity Not Conducted
	If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed ☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments				
	☐ Pictures Taken (Notes:)				

RIPARIAN LANDUSE & VEGETATION	
Land use at Reach (Check all)	☒ Pasture ☒ Fields ☐ Crops ☐ Residential ☒ Forest ☐ Commercial ☐ CAFO ☐ Industrial ☐ Mixed Urban ☐ silviculture
Dominant Riparian Vegetation Present Select Only One	☒ Trees ☐ Herbaceous ☐ Shrubs ☐ Grasses
Canopy Cover:	☐ Open 0-20% ☐ Mostly Open 20-40% ☐ Est 50/50 40-60% ☐ Mostly Shaded 60-80% ☒ Shaded 80-100%
Type:	☒ Deciduous ☐ Coniferous ☐ Mixed

INSTREAM FEATURES			
Stream Morphology Est.	*% of Total Reach (Must add up to 100%)*	*Stream Depth*	*Dam Present* ☒ No ☐ Yes
Reach Length Isolated pools	*Riffle Habitat* 0 %	Riffle 0 ft	*Relation to Reach:* ☐ Above ☐ Below ☐ Within / *If Yes, Kind?* ☐ Beaver ☐ Debris ☐ Low-head ☐ Mill ☐ Culvert ☐ Hydropower
Stream Width ___ ft	*Rootbank Habitat* ___ %	Run 0 ft	
Bank Height: High 6.5 ft	*Rock/log Habitat* 95 %	Pool 3 ft	
Low 1 ft	*CPOM Habitat* ___ %	*Proportion of*	
High Water Mark 5 ft	*Sand Habitat* ___ %	Riffle 0 %	*Est. Gradient (Over 100ft)*
Channelized? ☐ Yes ☒ No	*Macro Habitat* ___ %	Run 0 %	☐ Low <1ft ☐ High >3ft ☒ Moderate 1-3 ft
	Unsuitable Substrates 5 %	Pool 100 %	

AQUATIC VEGETATION					
Total % of wetted reach with aquatic vegetation present 0 %			*For species list see plant guide of common species of AL*		
Dominant Vegetation Type: (Select only one)	☐ Rooted Emergent ☐ Rooted Floating	☐ Rooted Submergent ☐ Attached Algae	☐ Floating Algae ☐ Free Floating		
(Optional) Type	*% of Wetted Reach*	*Species*	*Type*	*% of Wetted Reach*	*Species*
Rooted Emergent	___ %		Attached Algae	___ %	
Rooted Floating	___ %		Floating Algae	___ %	
Rooted Submergent	___ %		Free Floating	___ %	

SEDIMENT / SUBSTRATE			
Sediment Odors (Select One) ☒ None ☐ Chemical ☐ Sewage ☐ Anaerobic ☐ Petroleum ☐ Fishy	*Oils (Select One)* ☒ Absent ☐ Moderate ☐ Slight ☐ Profuse	*Deposits (Select One)* ☒ None ☐ Paper Fiber ☐ Silt ☐ Sand ☐ Gravel ☐ Sawdust ☐ Sludge ☐ Coal Fines	*Looking at stones that are not deeply embedded, are the undersides black in color?* ☒ Yes ☐ No ☐ N/A

WATER QUALITY INDICATORS			
Water Odors (Select One) ☒ Normal/None ☐ Chemical ☐ Raw Sewage ☐ Treated Sewage ☐ Fishy ☐ Anaerobic ☐ Petroleum	*Surface Oils* ☒ None ☐ Flecks ☐ Sheen ☐ Slick ☐ Globs	*Water Color (Select One)* ☐ Clear/No Color ☐ Grey ☐ Green ☐ Purple ☐ Brown (Mud) ☐ Red (Dye) ☐ Chalky White ☐ Blue ☐ Lt. Tannic ☒ Dk. Tannic	*Biological Indicators (Select all)* ☐ Mussels ☒ Fish ☐ Crayfish ☐ Snails ☒ Macroinvertebrates ☐ Fresh Beaver Sticks

FOD F-Form 13 Rev 02/13/2013

CCN-1
Page 2

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☐ Yes - ADEM: Abbrev Meter (cfs)	☐ No - Not wadeable (too deep)	☐ No - Not Required	☐ No - Meter Malfunctioned
	☐ Yes - USGS: Gauge (cfs)	☐ No - Flow conditions hazardous	☒ No - Flow not visible	☐ Data Collected but Lost or Corrupted
	☐ Yes - Facility (mgd)	☐ No - Visible but not measurable	☐ No - Braided/Swamp	
	USGS Gage # or Flow–Meter #:		Flow (cfs) or (mgd):	

Now	Weather	Past 24 hrs	Flow Stage	Velocity
☒	Clear / Cloudless	☒	☐ Flood (out of banks)	☐ Swift >3 ft / Sec
☐	Partly Cloudy	☐	☐ Above Normal	
☐	Mostly Cloudy	☐	☐ Normal	☐ Moderate 1.5 – 3 ft / Sec
☐	Cloudy	☐	☒ Low	
☐	Fog	☐	None	☐ Slow <1.5 ft / Sec
☐	Light Rain / Drizzle	☐		
☐	Rain	☐	*Heavy Rain in last 7 Days?*	None
☐	Thunderstorms	☐		
☐	Freezing Precipitation	☐	☐ Yes ☒ No	

Parameter	Value	Replicate	Unit
Datalogger Serial#		N/A	#
Total Depth @ FM Pt			ft
Air Temp.		N/A	°C
Turbidity Meter #		N/A	#
Turbidity			NTU
Depth of Turbidity:	☐ Surface ☐ Mid-Depth ☐ ______ ft		

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock		10	1/2
Hardpan Clay			1/2
Boulder	>10 in.		Yes
Cobble	2.5 - 10 in.	50	Yes
Gravel	0.1 - 2.5 in.	20	Yes
Sand	Gritty		
Silt			
Clay	Slick		
Detritus	Stick/Wood	5	Yes
	CPOM	10	NO
Muck	Fine Org.		
	Total	100%	

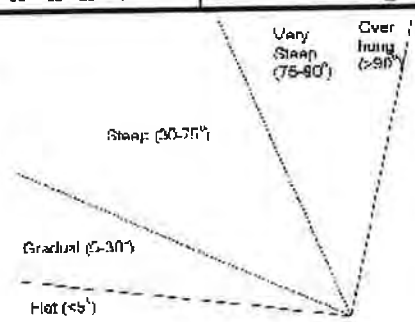
	Name of Collector Riffle / Run HA	Collector 1 Score (LB/RB)	Collector 2 Score (LB/RB)
1	Instream Cover	2	3
2	Epifaunal surface	1	1
3	Embeddedness	14	12
4	Velocity/Depth	2	2
5	Channel Alteration	16	16
6	Sediment Deposition	17	10
7	Frequency of Riffles	1	1
8	Channel Flow Status	1	1
9	Condition of Banks	10	9
10	Bank Veg. Protection	1	1
11	Disruptive Pressure	7	7
12	Riparian Veg. zone	9	8
13	Rip Veg Zone Quality	9	9

	Name of Collector Glide / Pool HA	Collector 1 Score (LB/RB)	Collector 2 Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

Check One for each Bank:

Left Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhung
Right Bank Angle	☐ Flat	☐ Gradual	☒ Steep	☐ Very Steep	☐ Overhung



FOD I-Form 13 Rev 02/13/2013

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

January 03, 2023

Nikki Johnson
GBMC Assoc
219 Brown Lane
Bryant, AR 72022

RE: Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Dear Nikki Johnson:

Enclosed are the analytical results for sample(s) received by the laboratory on September 29, 2022. The results relate only to the samples included in this report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - New Orleans

1/3/23 Revised report to give more complete report format.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Karen Brown

Karen Brown for
Suzanne Junkin
suzanne.junkin@pacelabs.com
(205)614-6630
Project Manager

Enclosures

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

CERTIFICATIONS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Pace Analytical Services New Orleans

Florida Department of Health (NELAC): E87595
Illinois Environmental Protection Agency: 0025721
Kansas Department of Health and Environment (NELAC): E-10266
Louisiana Dept. of Environmental Quality (NELAC/LELAP): 02006
Texas Commission on Env. Quality (NELAC): T104704405-09-TX
U.S. Dept. of Agriculture Foreign Soil Import: P330-10-00119

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

SAMPLE SUMMARY

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Lab ID	Sample ID	Matrix	Date Collected	Date Received
20257022001	**CCN-1**	Water	09/28/22 07:40	09/29/22 11:56
20257022002	**MC-1**	Water	09/28/22 09:00	09/29/22 11:56
20257022003	**CN-UT**	Water	09/28/22 10:00	09/29/22 11:56
20257022004	**CN-UT Dup**	Water	09/28/22 10:00	09/29/22 11:56

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

SAMPLE ANALYTE COUNT

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Lab ID	Sample ID	Method	Analysts	Analytes Reported
20257022001	**CCN-1**	SM 5210B	MEW	1
		TKN-NH3 Calculation	TAE	1
		EPA 351.2	TAE	1
		SM 4500-NH3 G	CDL	1
		SM 4500-NO3 F	DWR	1
		SM 4500-NO3 F	ABW	1
20257022002	**MC-1**	SM 5210B	MEW	1
		TKN-NH3 Calculation	TAE	1
		EPA 351.2	TAE	1
		SM 4500-NH3 G	CDL	1
		SM 4500-NO3 F	DWR	1
		SM 4500-NO3 F	ABW	1
20257022003	**CN-UT**	SM 5210B	MEW	1
		TKN-NH3 Calculation	TAE	1
		EPA 351.2	TAE	1
		SM 4500-NH3 G	CDL	1
		SM 4500-NO3 F	DWR	1
		SM 4500-NO3 F	ABW	1
20257022004	**CN-UT Dup**	SM 5210B	JMB	1
		TKN-NH3 Calculation	TAE	1
		EPA 351.2	TAE	1
		SM 4500-NH3 G	CDL	1
		SM 4500-NO3 F	DWR	1
		SM 4500-NO3 F	ABW	1

PASI-N = Pace Analytical Services - New Orleans

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

ANALYTICAL RESULTS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Sample: CCN-1 | **Lab ID: 20257022001** | Collected: 09/28/22 07:40 | Received: 09/29/22 11:56 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
5210B cBOD, 5 day	Analytical Method: SM 5210B Preparation Method: SM 5210B Pace Analytical Services - New Orleans							
Carbonaceous BOD, 5 day	**5.5**	mg/L	3.0	3	09/29/22 15:00	10/04/22 13:30		
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	**1.6**	mg/L	0.10	1		10/05/22 21:00		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**1.8**	mg/L	0.10	1	09/30/22 10:28	10/05/22 10:46	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	**0.27**	mg/L	0.10	1		10/07/22 15:52	7664-41-7	
SM4500NO2-B, Nitrite, unpres	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrite as N	ND	mg/L	0.050	1		09/29/22 12:49	14797-65-0	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	ND	mg/L	0.050	1		10/06/22 15:19		

Sample: MC-1 | **Lab ID: 20257022002** | Collected: 09/28/22 09:00 | Received: 09/29/22 11:56 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
5210B cBOD, 5 day	Analytical Method: SM 5210B Preparation Method: SM 5210B Pace Analytical Services - New Orleans							
Carbonaceous BOD, 5 day	ND	mg/L	3.0	3	09/29/22 15:28	10/04/22 13:57		
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	ND	mg/L	0.10	1		10/05/22 21:00		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.10	1	09/30/22 10:28	10/05/22 10:48	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		10/07/22 15:54	7664-41-7	

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

ANALYTICAL RESULTS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Sample: MC-1 | **Lab ID: 20257022002** | Collected: 09/28/22 09:00 | Received: 09/29/22 11:56 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
SM4500NO2-B, Nitrite, unpres	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrite as N	ND	mg/L	0.050	1		09/29/22 12:49	14797-65-0	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.74**	mg/L	0.050	1		10/06/22 15:20		

Sample: CN-UT | **Lab ID: 20257022003** | Collected: 09/28/22 10:00 | Received: 09/29/22 11:56 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
5210B cBOD, 5 day	Analytical Method: SM 5210B Preparation Method: SM 5210B Pace Analytical Services - New Orleans							
Carbonaceous BOD, 5 day	ND	mg/L	3.0	3	09/29/22 15:33	10/04/22 14:03		
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	**2.0**	mg/L	0.10	1		10/12/22 15:00		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**2.0**	mg/L	0.10	1	10/04/22 09:48	10/06/22 18:18	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		10/07/22 15:55	7664-41-7	
SM4500NO2-B, Nitrite, unpres	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrite as N	ND	mg/L	0.050	1		09/29/22 12:49	14797-65-0	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**1.2**	mg/L	0.050	1		10/06/22 15:22		

Sample: CN-UT Dup | **Lab ID: 20257022004** | Collected: 09/28/22 10:00 | Received: 09/29/22 11:56 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
5210B cBOD, 5 day	Analytical Method: SM 5210B Preparation Method: SM 5210B Pace Analytical Services - New Orleans							
Carbonaceous BOD, 5 day	ND	mg/L	3.0	3	09/30/22 07:49	10/05/22 06:25		

REPORT OF LABORATORY ANALYSIS

Pace Analytical
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

ANALYTICAL RESULTS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Sample: CN-UT Dup | **Lab ID: 20257022004** | Collected: 09/28/22 10:00 | Received: 09/29/22 11:56 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	ND	mg/L	0.10	1		10/05/22 21:00		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	ND	mg/L	0.10	1	09/30/22 10:28	10/05/22 10:48	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		10/07/22 15:57	7664-41-7	
SM4500NO2-B, Nitrite, unpres	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrite as N	ND	mg/L	0.050	1		09/29/22 12:49	14797-65-0	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**1.2**	mg/L	0.050	1		10/06/22 15:23		

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267120
QC Batch Method: SM 5210B
Analysis Method: SM 5210B
Analysis Description: 5210B cBOD, 5 day
Laboratory: Pace Analytical Services - New Orleans

Associated Lab Samples: 20257022001, 20257022002, 20257022003

METHOD BLANK: 1277278 Matrix: Water
Associated Lab Samples: 20257022001, 20257022002, 20257022003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Carbonaceous BOD, 5 day	mg/L	ND	0.20	10/04/22 13:16	

LABORATORY CONTROL SAMPLE: 1277280

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Carbonaceous BOD, 5 day	mg/L	198	171	86	85-115	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267153
QC Batch Method: SM 5210B
Analysis Method: SM 5210B
Analysis Description: 5210B cBOD, 5 day
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20257022004

METHOD BLANK: 1277526
Matrix: Water
Associated Lab Samples: 20257022004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Carbonaceous BOD, 5 day	mg/L	ND	0.20	10/05/22 06:18	

LABORATORY CONTROL SAMPLE: 1277528

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Carbonaceous BOD, 5 day	mg/L	198	179	90	85-115	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267160
QC Batch Method: EPA 351.2
Analysis Method: EPA 351.2
Analysis Description: 351.2 TKN
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20257022001, 20257022002, 20257022004

METHOD BLANK: 1277558 Matrix: Water
Associated Lab Samples: 20257022001, 20257022002, 20257022004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	ND	0.10	10/05/22 10:26	

LABORATORY CONTROL SAMPLE: 1277559

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	4.8	4.4	92	80-120	

MATRIX SPIKE SAMPLE: 1277561

Parameter	Units	20256854002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	24.7	2.5	29.0	174	75-125	M1

SAMPLE DUPLICATE: 1277560

Parameter	Units	20256854002 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	24.7	24.0	3	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267399
QC Batch Method: EPA 351.2
Analysis Method: EPA 351.2
Analysis Description: 351.2 TKN
Laboratory: Pace Analytical Services - New Orleans

Associated Lab Samples: 20257022003

METHOD BLANK: 1278971 Matrix: Water
Associated Lab Samples: 20257022003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	ND	0.10	10/07/22 08:57	

LABORATORY CONTROL SAMPLE: 1278972

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	4.8	4.4	92	80-120	

MATRIX SPIKE SAMPLE: 1278974

Parameter	Units	20257314002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.60	2.5	4.1	142	75-125	M1

SAMPLE DUPLICATE: 1278973

Parameter	Units	20257314002 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.60	0.73	19	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267830
QC Batch Method: SM 4500-NH3 G
Analysis Method: SM 4500-NH3 G
Analysis Description: 4500 Ammonia
Laboratory: Pace Analytical Services - New Orleans

Associated Lab Samples: 20257022001, 20257022002, 20257022003, 20257022004

METHOD BLANK: 1281414 Matrix: Water
Associated Lab Samples: 20257022001, 20257022002, 20257022003, 20257022004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Ammonia	mg/L	ND	0.10	10/07/22 15:47	

LABORATORY CONTROL SAMPLE: 1281415

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	5.1	5.0	98	90-110	

MATRIX SPIKE SAMPLE: 1281417

Parameter	Units	20256193021 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	ND	5	4.8	95	75-125	

SAMPLE DUPLICATE: 1281416

Parameter	Units	20256193021 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, Ammonia	mg/L	ND	ND		20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267110
QC Batch Method: SM 4500-NO3 F
Analysis Method: SM 4500-NO3 F
Analysis Description: SM4500NO3-F, Nitrite, unpres
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20257022001, 20257022002, 20257022003, 20257022004

METHOD BLANK: 1277142 Matrix: Water
Associated Lab Samples: 20257022001, 20257022002, 20257022003, 20257022004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrite as N	mg/L	ND	0.050	09/29/22 12:49	

LABORATORY CONTROL SAMPLE: 1277143

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	0.2	0.19	95	90-110	

MATRIX SPIKE SAMPLE: 1277145

Parameter	Units	20256931002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrite as N	mg/L	ND	0.25	0.24	94	80-120	

SAMPLE DUPLICATE: 1277144

Parameter	Units	20256931002 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrite as N	mg/L	ND	ND		20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

QC Batch: 267663
QC Batch Method: SM 4500-NO3 F
Analysis Method: SM 4500-NO3 F
Analysis Description: SM4500NO3-F, Nitrate, Preserved
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20257022001, 20257022002, 20257022003, 20257022004

METHOD BLANK: 1280602 Matrix: Water
Associated Lab Samples: 20257022001, 20257022002, 20257022003, 20257022004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	ND	0.050	10/06/22 15:03	

LABORATORY CONTROL SAMPLE: 1280603

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	19.9	18.9	95	90-110	

MATRIX SPIKE SAMPLE: 1280605

Parameter	Units	20255642001 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	ND	1	1.0	101	80-120	

SAMPLE DUPLICATE: 1280604

Parameter	Units	20255642001 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	ND	ND		20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALIFIERS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

ANALYTE QUALIFIERS

M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20257022

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
20257022001	**CCN-1**	SM 5210B	267120	SM 5210B	267367
20257022002	**MC-1**	SM 5210B	267120	SM 5210B	267367
20257022003	**CN-UT**	SM 5210B	267120	SM 5210B	267367
20257022004	**CN-UT Dup**	SM 5210B	267153	SM 5210B	267497
20257022001	**CCN-1**	TKN-NH3 Calculation	267491		
20257022002	**MC-1**	TKN-NH3 Calculation	267491		
20257022003	**CN-UT**	TKN-NH3 Calculation	267491		
20257022004	**CN-UT Dup**	TKN-NH3 Calculation	267491		
20257022001	**CCN-1**	EPA 351.2	267160	EPA 351.2	267633
20257022002	**MC-1**	EPA 351.2	267160	EPA 351.2	267633
20257022003	**CN-UT**	EPA 351.2	267399	EPA 351.2	267860
20257022004	**CN-UT Dup**	EPA 351.2	267160	EPA 351.2	267633
20257022001	**CCN-1**	SM 4500-NH3 G	267830		
20257022002	**MC-1**	SM 4500-NH3 G	267830		
20257022003	**CN-UT**	SM 4500-NH3 G	267830		
20257022004	**CN-UT Dup**	SM 4500-NH3 G	267830		
20257022001	**CCN-1**	SM 4500-NO3 F	267110		
20257022002	**MC-1**	SM 4500-NO3 F	267110		
20257022003	**CN-UT**	SM 4500-NO3 F	267110		
20257022004	**CN-UT Dup**	SM 4500-NO3 F	267110		
20257022001	**CCN-1**	SM 4500-NO3 F	267663		
20257022002	**MC-1**	SM 4500-NO3 F	267663		
20257022003	**CN-UT**	SM 4500-NO3 F	267663		
20257022004	**CN-UT Dup**	SM 4500-NO3 F	267663		

Pace

CHAIN-OF-CUSTODY / Analytical Request Doc

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be

Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at https://info.pacelabs

WO# : 20257022

20257022

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company: GBMC	Report To: Nikki Johnson	Attention:
Address: 219 Brown Lane	Copy To: njohnson@gbmcassoc.com	Company Name: GBMC
nt, AR 72022	opnillips@gbmcassoc.com	Address:
il:	Purchase Order #:	Pace Quote:
ne: (501)847-7077 Fax:	Project Name: Cherokee	Pace Project Manager: suzanne.junkin@pacelabs.com,
uested Due Date:	Project #:	Pace Profile #: 17452

Regulatory Agency

State / Location

MATRIX / CODE: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Other OT; Tissue TS

SAMPLE ID — One Character per box. (A-Z, 0-9 / , -) Sample Ids must be unique

SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED START DATE	START TIME	END DATE	END TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test Y/N	cBOD; 5 day	Ammonia, TON, N+N, TKN	Nitrate	Residual Chlorine (Y/N)
CCN-1	WT	G	9/27/22	740	—	—	14	3	X									X	X	X	
MC-1	WT	G	9/27/22	900	—	—	15	3	X									X	X	X	
CN-UT	WT	G	9/27/22	1000	—	—	21	3	X									X	X	X	
CN-UT Dup	WT	G	9/27/22	1020	—	—	21	3	X									X	X	X	

Requested Analysis Filtered (Y/N)

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
	Nikki Johnson	9/27/22	1050							
	FedEx	9-29-22	0845	J [illegible] / Pace	9-29-22	0845	0.4	Y	Y	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Nicki Johnson

SIGNATURE of SAMPLER: Nikki Johnson DATE Signed: 9/27/22

TEMP in C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

WO# : 20257022

PM: RST Due Date: 10/13/22
CLIENT: TU-GBMC

Pace
1000 Riverbend, Blvd., Suite F
St. Rose, LA 70087

Project #

Courier: ☐ Pace Courier ☐ Hired Courier ☑ Fed X ☐ UPS ☐ DHL ☐ USPS ☐ Customer ☐ Other

Custody Seal on Cooler/Box Present: ☑ YES ☐ NO **Custody Seals Intact:** ☑ YES ☐ NO

Samples on Ice: ☑ YES ☐ NO **Type of Ice:** Wet Blue None

Date and Initials of person examining contents: 9/29/22 [illegible]

Temp should be ≤6°C *Temp must be measured from Temperature blank when present

Cooler #1 Thermometer Used: 10 Cooler Temp °C: (Observed) 0.4 (CF) 0 (Actual) 0.4
Cooler #2 Thermometer Used:___ Cooler Temp °C: (Observed)___ (CF)___ (Actual)___
Cooler #3 Thermometer Used:___ Cooler Temp °C: (Observed)___ (CF)___ (Actual)___
Cooler #4 Thermometer Used:___ Cooler Temp °C: (Observed)___ (CF)___ (Actual)___

Tracking #: 5488 0746 7413

Temperature Blank Present*?	☑Yes ☐No ☐N/A	
Chain of Custody Present:	☑Yes ☐No ☐N/A	
Chain of Custody Complete:	☑Yes ☐No ☐N/A	
Chain of Custody Relinquished:	☑Yes ☐No ☐N/A	
Sampler Name & Signature on COC:	☑Yes ☐No ☐N/A	
Samples Arrived within Hold Time:	☑Yes ☐No ☐N/A	
Sufficient Volume:	☑Yes ☐No ☐N/A	
Correct Containers Used:	☑Yes ☐No ☐N/A	
Filtered vol. Rec. for Diss. tests	☐Yes ☐No ☑N/A	
Sample Labels match COC:	☑Yes ☐No ☐N/A	
All containers received within manafacture's precautionary and/or expiration dates.	☑Yes ☐No ☐N/A	
All containers needing chemical preservation have been checked (except VOA, coliform, & O&G).	☑Yes ☐No ☐N/A	If No, was preservative added? ☑Yes ☐No If added record lot #.:
All containers preservation checked found to be in compliance with EPA recommendation.	☐Yes ☑No ☐N/A	HNO3___ H2SO4 2280113 Date: 9/29 Time: 12:40
Headspace in VOA Vials (>6mm):	☐Yes ☐No ☑N/A	
Trip Blank Present:	☐Yes ☑No	

Client Notification/ Resolution:

Person Contacted:___ Date/Time:___

Comments/ Resolution:___

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

January 03, 2023

Nikki Johnson
GBMC Assoc
219 Brown Lane
Bryant, AR 72022

RE: Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Dear Nikki Johnson:

Enclosed are the analytical results for sample(s) received by the laboratory on June 06, 2022. The results relate only to the samples included in this report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - New Orleans

1/3/23 Revised report to give more complete report format.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Karen Brown

Karen Brown for
Suzanne Junkin
suzanne.junkin@pacelabs.com
(205)614-6630
Project Manager

Enclosures

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

CERTIFICATIONS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Pace Analytical Services New Orleans

Florida Department of Health (NELAC): E87595
Illinois Environmental Protection Agency: 0025721
Kansas Department of Health and Environment (NELAC): E-10266
Louisiana Dept. of Environmental Quality (NELAC/LELAP): 02006
Texas Commission on Env. Quality (NELAC): T104704405-09-TX
U.S. Dept. of Agriculture Foreign Soil Import: P330-10-00119

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

SAMPLE SUMMARY

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Lab ID	Sample ID	Matrix	Date Collected	Date Received
20245884001	**CCN-1**	Water	06/02/22 11:15	06/06/22 09:00
20245884002	**CN-UT**	Water	06/02/22 12:50	06/06/22 09:00
20245884003	**MC-1**	Water	06/02/22 13:20	06/06/22 09:00

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

SAMPLE ANALYTE COUNT

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Lab ID	Sample ID	Method	Analysts	Analytes Reported
20245884001	**CCN-1**	TKN-NH3 Calculation	NTG	1
		EPA 351.2	RVJ	1
		SM 4500-NH3 G	ABW	1
		SM 4500-NO3 F	ABW	1
20245884002	**CN-UT**	TKN-NH3 Calculation	NTG	1
		EPA 351.2	RVJ	1
		SM 4500-NH3 G	ABW	1
		SM 4500-NO3 F	ABW	1
20245884003	**MC-1**	TKN-NH3 Calculation	NTG	1
		EPA 351.2	RVJ	1
		SM 4500-NH3 G	ABW	1
		SM 4500-NO3 F	ABW	1

PASI-N = Pace Analytical Services - New Orleans

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

ANALYTICAL RESULTS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Sample: CCN-1 | **Lab ID: 20245884001** | Collected: 06/02/22 11:15 | Received: 06/06/22 09:00 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	**0.29**	mg/L	0.10	1		06/17/22 08:56		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.29**	mg/L	0.10	1	06/08/22 14:55	06/09/22 14:08	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		06/15/22 13:50	7664-41-7	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**0.49**	mg/L	0.050	1		06/16/22 12:47		

Sample: CN-UT | **Lab ID: 20245884002** | Collected: 06/02/22 12:50 | Received: 06/06/22 09:00 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	**0.76**	mg/L	0.10	1		06/17/22 08:56		
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.97**	mg/L	0.10	1	06/08/22 14:55	06/09/22 14:08	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	**0.21**	mg/L	0.10	1		06/15/22 13:51	7664-41-7	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**5.3**	mg/L	0.25	5		06/16/22 13:04		

Sample: MC-1 | **Lab ID: 20245884003** | Collected: 06/02/22 13:20 | Received: 06/06/22 09:00 | Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Total Organic Nitrogen Calc.	Analytical Method: TKN-NH3 Calculation Pace Analytical Services - New Orleans							
Total Organic Nitrogen	**0.33**	mg/L	0.10	1		06/17/22 08:56		

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

ANALYTICAL RESULTS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Sample: MC-1 **Lab ID: 20245884003** Collected: 06/02/22 13:20 Received: 06/06/22 09:00 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - New Orleans							
Nitrogen, Kjeldahl, Total	**0.33**	mg/L	0.10	1	06/08/22 14:55	06/09/22 14:10	7727-37-9	
4500 Ammonia Water	Analytical Method: SM 4500-NH3 G Pace Analytical Services - New Orleans							
Nitrogen, Ammonia	ND	mg/L	0.10	1		06/15/22 13:52	7664-41-7	
4500NO3-F, NO3-NO2	Analytical Method: SM 4500-NO3 F Pace Analytical Services - New Orleans							
Nitrogen, NO2 plus NO3	**1.1**	mg/L	0.050	1		06/16/22 12:50		

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

QC Batch: 257500 — Analysis Method: EPA 351.2
QC Batch Method: EPA 351.2 — Analysis Description: 351.2 TKN
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20245884001, 20245884002, 20245884003

METHOD BLANK: 1226943 — Matrix: Water
Associated Lab Samples: 20245884001, 20245884002, 20245884003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	ND	0.10	06/09/22 13:51	

LABORATORY CONTROL SAMPLE: 1226944

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	4.8	4.7	99	80-120	

MATRIX SPIKE SAMPLE: 1226946

Parameter	Units	20245850002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.63	2.5	4.2	143	75-125	M1

SAMPLE DUPLICATE: 1226945

Parameter	Units	20245850002 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, Kjeldahl, Total	mg/L	0.63	0.66	6	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

QC Batch: 258207 | Analysis Method: SM 4500-NH3 G
QC Batch Method: SM 4500-NH3 G | Analysis Description: 4500 Ammonia
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20245884001, 20245884002, 20245884003

METHOD BLANK: 1230547 | Matrix: Water
Associated Lab Samples: 20245884001, 20245884002, 20245884003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Ammonia	mg/L	ND	0.10	06/15/22 13:44	

LABORATORY CONTROL SAMPLE: 1230548

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	5.1	5.2	103	90-110	

MATRIX SPIKE SAMPLE: 1230550

Parameter	Units	20245883002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/L	0.17	5	5.2	101	75-125	

SAMPLE DUPLICATE: 1230549

Parameter	Units	20245883002 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, Ammonia	mg/L	0.17	0.17	4	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

QC Batch: 258234
QC Batch Method: SM 4500-NO3 F
Analysis Method: SM 4500-NO3 F
Analysis Description: SM4500NO3-F, Nitrate, Preserved
Laboratory: Pace Analytical Services - New Orleans
Associated Lab Samples: 20245884001, 20245884002, 20245884003

METHOD BLANK: 1230831   Matrix: Water
Associated Lab Samples: 20245884001, 20245884002, 20245884003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	ND	0.050	06/16/22 12:31	

LABORATORY CONTROL SAMPLE: 1230832

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	19.9	19.3	97	90-110	

MATRIX SPIKE SAMPLE: 1230834

Parameter	Units	20245850002 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	1.5	10	11.9	103	80-120	

SAMPLE DUPLICATE: 1230833

Parameter	Units	20245850002 Result	Dup Result	RPD	Max RPD	Qualifiers
Nitrogen, NO2 plus NO3	mg/L	1.5	1.5	2	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

Pace Analytical Services, LLC
1166 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALIFIERS

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

TNTC - Too Numerous To Count

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.

ANALYTE QUALIFIERS

M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

Pace Analytical Services, LLC
1168 Whigham Place
Tuscaloosa, AL 35405
(205) 614-6630

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Cherokee Nitrogen 316A Study
Pace Project No.: 20245884

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
20245884001	**CCN-1**	TKN-NH3 Calculation	258377		
20245884002	**CN-UT**	TKN-NH3 Calculation	258377		
20245884003	**MC-1**	TKN-NH3 Calculation	258377		
20245884001	**CCN-1**	EPA 351.2	257500	EPA 351.2	257670
20245884002	**CN-UT**	EPA 351.2	257500	EPA 351.2	257670
20245884003	**MC-1**	EPA 351.2	257500	EPA 351.2	257670
20245884001	**CCN-1**	SM 4500-NH3 G	258207		
20245884002	**CN-UT**	SM 4500-NH3 G	258207		
20245884003	**MC-1**	SM 4500-NH3 G	258207		
20245884001	**CCN-1**	SM 4500-NO3 F	258234		
20245884002	**CN-UT**	SM 4500-NO3 F	258234		
20245884003	**MC-1**	SM 4500-NO3 F	258234		

WO# : 20245884

20245884

GBMc

219 Brown Ln.
Bryant, AR 72022
(501) 847-7077 Fax (501) 847-7943

Chain of Custody

17452

CLIENT INFORMATION		BILLING INFORMATION	
Company:	GBMc & Associates	Bill To:	← Same
Project Name/No.:	Cherokee Nitrogen	Company:	
Send Report To:	njohnson@gbmcassoc.com	Address:	
Address:	219 Brown Ln		
	Bryant AR 72022	Phone No.:	
Phone/Fax No.:		Fax No.:	

SPECIAL INSTRUCTIONS/PRECAUTIONS:

Parameters for Analysis/Methods

Sample ID	Sample Description	Date	Time	Matrix S=Sed/Soil W=Water	Number of Containers	Composite or Grab	Nitrate-N	CBOD-5	Ammonia-N Organic Nitrogen							
CCN-1		6/2/22	1115	W	3	G	X	X	X							
CN-UT		6/2/22	1250	W	3	G	X	X	X							
MC-1		6/2/22	1320	W	3	G	X	X	X							
Preservative	(Sulfuric acid =S, Nitric acid =N, NaOH =B, Ice =I)						I	I	I, S	I	I	I	I			

Sampler(s): ENJ / DMB

Shipment Method: ~~Delivery~~ Fedex overnight

Turnaround Time Required: Normal

COC Completed by: ENJ Date: 6/2/22 Time: 1400

COC Checked by: DMB Date: 6/2/22 Time: 1405

Relinquished by: [signature] Date: 6/2/22 Time: 1410

Received by: FedEx Date: Time:

Relinquished by: FedEx Date: 6/6/22 Time: 9:00

Received in lab by: [signature] Pace Date: 6/6/22 Time: 9:00

LABORATORY USE ONLY: Samples Received On Ice?: YES or NO

Sample Temperature: 25.6°c

Ice Melted

WO#: 20245884

PM: RST Due Date: 06/20/22
CLIENT: TU-GBMC

Pace

1000 Riverbend. Blvd., Suite F
St. Rose, LA 70087

Project

Courier: ☐ Pace Courier ☐ Hired Courier ☒ Fed X ☐ UPS ☐ DHL ☐ USPS ☐ Customer ☐ Other

Custody Seal on Cooler/Box Present: ☒ YES ☐ NO **Custody Seals intact:** ☒ YES ☐ NO

Samples on ice: ☒ YES ☐ NO
Ice melted

Type of Ice: Wet Blue None

Date and Initials of person examining contents: 6/6/22 AE

Temp should be ≤6°C *Temp must be measured from Temperature blank when present

Cooler #1 Thermometer Used: 10	Cooler Temp °C: (Observed) 25.6	(CF) 0	(Actual) 25.6
Cooler #2 Thermometer Used:	Cooler Temp °C: (Observed)	(CF)	(Actual)
Cooler #3 Thermometer Used:	Cooler Temp °C: (Observed)	(CF)	(Actual)
Cooler #4 Thermometer Used:	Cooler Temp °C: (Observed)	(CF)	(Actual)

Tracking #: 2738 6034 3606

Temperature Blank Present*?	☐Yes ☒No ☐N/A	
Chain of Custody Present:	☒Yes ☐No ☐N/A	
Chain of Custody Complete:	☒Yes ☐No ☐N/A	
Chain of Custody Relinquished:	☒Yes ☐No ☐N/A	
Sampler Name & Signature on COC:	☒Yes ☐No ☐N/A	
Samples Arrived within Hold Time:	☐Yes ☒No ☐N/A	CBOD is out of hold. + Nitrite
Sufficient Volume:	☒Yes ☐No ☐N/A	
Correct Containers Used:	☒Yes ☐No ☐N/A	
Filtered vol. Rec. for Diss. tests	☐Yes ☐No ☒N/A	
Sample Labels match COC:	☒Yes ☐No ☐N/A	
All containers received within manafacture's precautionary and/or expiration dates.	☒Yes ☐No ☐N/A	
All containers needing chemical preservation have been checked (except VOA, coliform, & O&G).	☒Yes ☐No ☐N/A	If No, was preservative added? ☐Yes ☐No
All containers preservation checked found to be in compliance with EPA recommendation.	☒Yes ☐No ☐N/A	If added record lot #.: HNO3 ___ H2SO4 ___ Date: ___ Time: ___
~~Headspace in VOA Vials (>6mm):~~	☐Yes ☐No ☒N/A	
Trip Blank Present:	☐Yes ☒No	

Client Notification/ Resolution:

Person Contacted: Nikki Johnson Date/Time: 6/6/22

Comments/ Resolution:
The client said to run the samples that are in hold.

Appendix C

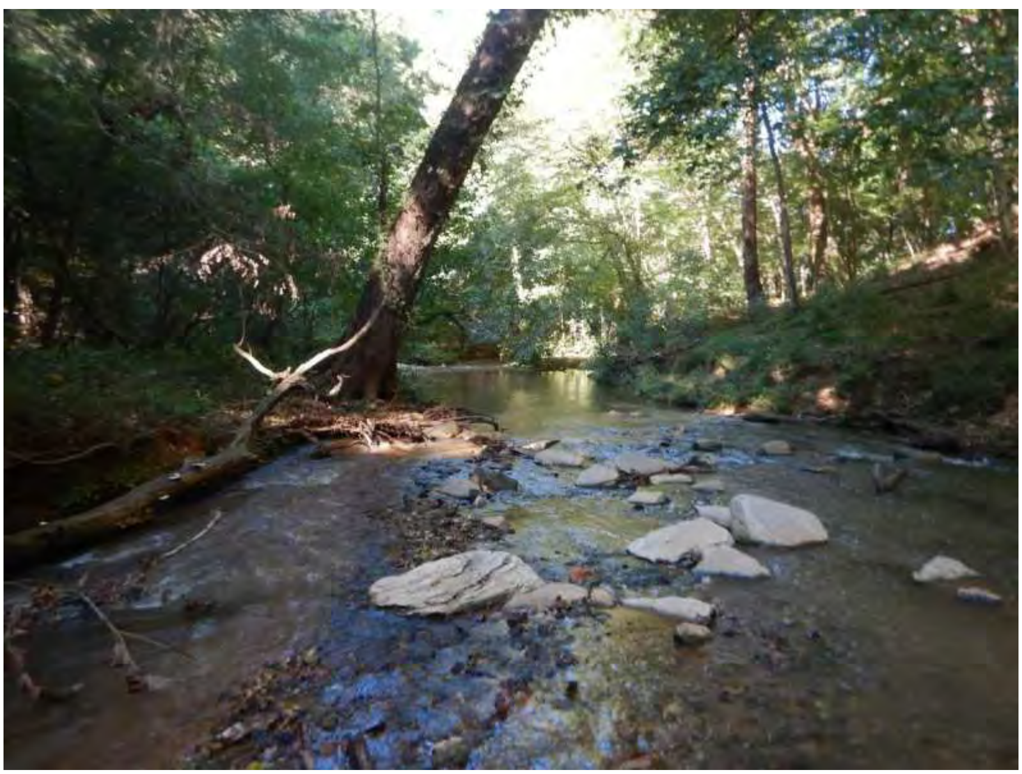
Photographs

Photos of the Streams Assessed

CN-UT Spring 2022

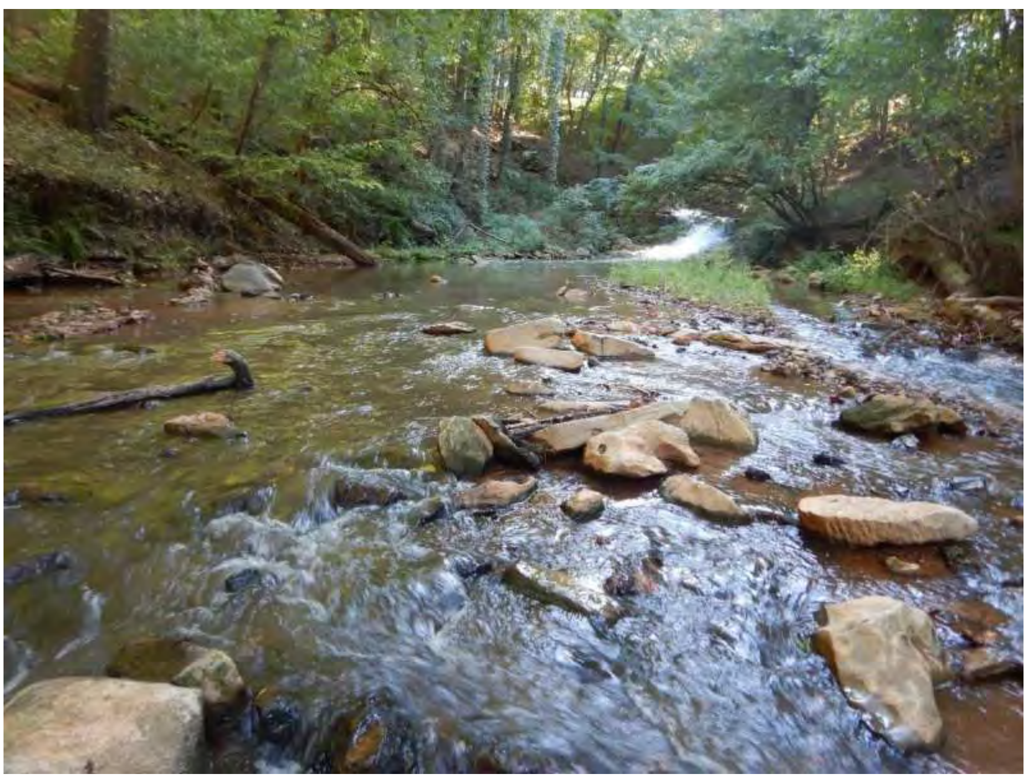
CN-UT spring 2022

CN-UT Fall 2022



CN-UT Fall 2022

Some fish collected from CN-UT Fall 2022



CN-UT

MSB-1 Spring 2022

MSB-1 Spring 2022

MSB-1 in Fall 2022

MSB-1 in Fall 2022

MSB-1 Fall 2022

CCN-1 Spring 2022

CCN-1 Spring 2022

CCN-1 Fall 2022

CCN-1 Fall 2022

MC-1 Spring 2022

MC-1 Spring 2022

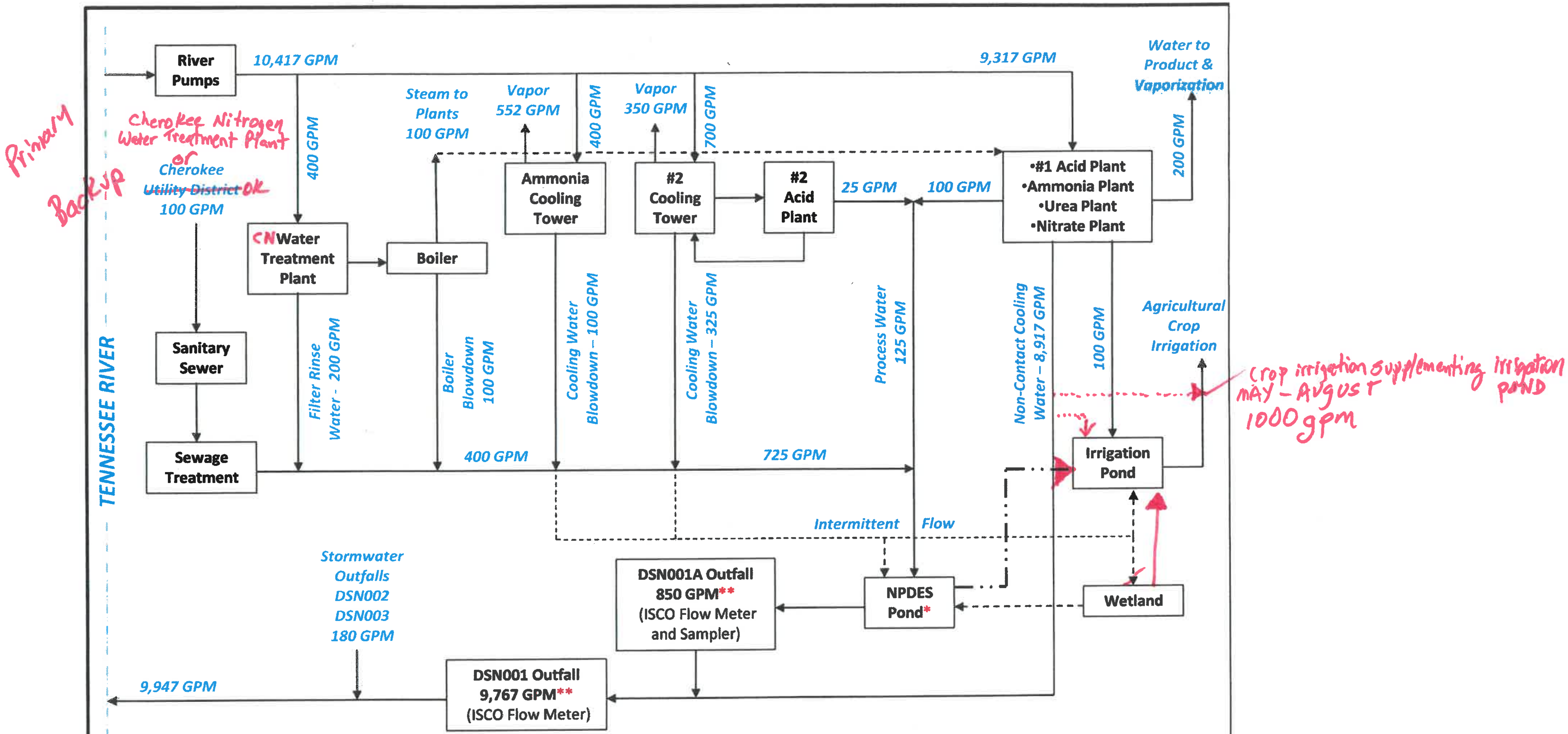
MC-1 Fall 2022

Sculpin collected from MC-1 Fall 2022

MC-1 Fall 2022

Appendix D

Wastewater System Information and Data



*NPDES Pond can be closed off and pumped to the Irrigation Pond, if needed, for crops or during an emergency situation.

**DSN001A and DSN001 flows are based on average recordable flow data. Remaining flow data is estimated..

Project: NPDES PERMIT RENEWAL APPLICATION CHEROKEE NITROGEN, LLC	Title: SCHEMATIC OF WATER FLOW	GSE	Drawn: SAH; Checked: JKC; Not to Scale	Figure 3

Outfall 001 Data

Date	pH	Flow	Rain	E-Coli	O & G	Temp.	TRC
1/1/2017	8.1	11.541	0.00				
1/2/2017	8.0	11.673	1.50				
1/3/2017	7.9	11.574	0.00				
1/4/2017	7.8	9.633	0.00				
1/5/2017	8.1	9.666	0.00	203	0.2	N/A	0.01
1/6/2017	8.6	10.014	0.00				
1/7/2017	8.7	7.712	0.00				
1/8/2017	8.0	9.393	0.00				
1/9/2017	8.0	10.882	0.00	34	0.5	N/A	0.01
1/10/2017	8.2	11.659	0.00				
1/11/2017	8.1	12.377	0.00				
1/12/2017	8.1	12.145	0.00				
1/13/2017	8.2	11.805	0.00				
1/14/2017	8.2	11.439	0.00				
1/15/2017	8.3	11.517	0.00				
1/16/2017	8.3	12.374	0.20	20	0.9	N/A	0.01
1/17/2017	8.1	12.060	0.20				
1/18/2017	8.3	11.887	0.18				
1/19/2017	7.9	12.888	2.10				
1/20/2017	8.3	12.038	0.00				
1/21/2017	8.2	12.246	0.00				
1/22/2017	8.1	12.068	1.30				
1/23/2017	8.0	11.579	0.00	95	0.4	N/A	0.01
1/24/2017	8.2	11.950	0.00				
1/25/2017	8.6	11.842	0.00				
1/26/2017	8.0	10.005	0.00				
1/27/2017	8.1	10.148	0.00				
1/28/2017	8.0	10.566	0.00				
1/29/2017	8.0	9.915	0.00				
1/30/2017	8.0	10.901	0.00				
1/31/2017	8.0	11.645	0.00				
2/1/2017	7.8	11.041	0.00	41	0.2	N/A	0.01
2/2/2017	8.0	10.742	0.10				
2/3/2017	8.2	10.163	0.00				
2/4/2017	8.1	10.755	0.00				
2/5/2017	8.0	11.005	0.50				
2/6/2017	8.0	11.838	0.00	17	1.4	N/A	0.01
2/7/2017	8.2	12.541	0.10				
2/8/2017	8.3	11.252	0.00				
2/9/2017	8.2	10.142	0.00				
2/10/2017	8.1	11.359	0.00				
2/11/2017	8.1	11.701	0.00				
2/12/2017	8.1	11.381	0.00				
2/13/2017	8.1	10.928	0.00	20	0.8	N/A	0.01
2/14/2017	8.2	10.981	0.35				
2/15/2017	8.2	10.487	0.00				
2/16/2017	8.5	10.838	0.00				
2/17/2017	8.3	11.621	0.00				
2/18/2017	8.1	11.398	0.00				
2/19/2017	8.0	11.462	0.00				
2/20/2017	7.9	11.677	0.00	5	0.1	N/A	0.01
2/21/2017	8.4	11.548	0.00				
2/22/2017	8.1	11.392	0.10				
2/23/2017	8.0	11.454	0.00				
2/24/2017	8.6	11.444	0.00				
2/25/2017	8.5	10.439	0.00				
2/26/2017	8.4	11.073	0.50				
2/27/2017	8.4	11.354	0.55	21	1.5	N/A	0.01
2/28/2017	8.2	12.091	0.15				
3/1/2017	8.2	12.006	0.30				
3/2/2017	8.2	10.613	0.00				
3/3/2017	8.5	10.481	0.00				
3/4/2017	8.5	10.763	0.00				
3/5/2017	8.4	10.663	0.00				
3/6/2017	8.2	11.721	1.15	17	1.0	NA	0.01
3/7/2017	8.0	10.750	0.00				
3/8/2017	8.0	10.662	0.75				
3/9/2017	8.3	11.766	0.00				
3/10/2017	8.0	10.087	0.00				
3/11/2017	8.0	9.620	0.00				
3/12/2017	8.8	9.857	0.40				
3/13/2017	7.9	9.914	0.00	20	1.0	NA	0.01
3/14/2017	8.1	9.026	0.00				
3/15/2017	8.2	9.393	0.00				
3/16/2017	7.9	12.847	0.00				
3/17/2017	7.9	13.563	0.50				
3/18/2017	7.9	13.239	0.00				
3/19/2017	8.1	13.169	0.00				
3/20/2017	8.1	13.636	0.00	26	1.4	NA	0.01
3/21/2017	8.2	13.474	0.05				
3/22/2017	8.3	13.286	0.00				
3/23/2017	8.5	14.046	0.00				
3/24/2017	8.3	13.883	0.00				
3/25/2017	8.1	13.540	0.20				
3/26/2017	8.1	12.987	0.00				
3/27/2017	7.9	14.663	1.15	15	1.9	NA	0.01
3/28/2017	7.9	13.244	0.00				
3/29/2017	7.7	13.074	0.00				
3/30/2017	8.0	13.405	0.20				
3/31/2017	8.0	13.079	0.00				
4/1/2017	8.2	13.307	0.00				
4/2/2017	8.2	14.417	1.68				
4/3/2017	8.1	14.462	0.15	31	0.3	N/A	0.01
4/4/2017	7.7	13.525	0.00				
4/5/2017	7.9	13.545	0.00				
4/6/2017	8.0	13.268	0.00				
4/7/2017	8.1	13.452	0.00				
4/8/2017	7.9	13.895	0.00				
4/9/2017	8.2	14.019	0.00				
4/10/2017	8.2	13.888	0.00	10	0.9	N/A	0.01
4/11/2017	8.1	14.083	0.00				
4/12/2017	8.0	13.511	0.00				
4/13/2017	8.1	12.373	0.00				
4/14/2017	8.2	10.908	0.00				
4/15/2017	8.1	11.060	0.00				
4/16/2017	8.2	11.287	0.00				
4/17/2017	8.3	11.332	0.40	18	0.4	N/A	0.01
4/18/2017	7.9	12.012	0.40				

4/19/2017	8.0	11.035	0.00				
4/20/2017	7.9	10.845	0.00				
4/21/2017	8.1	12.651	0.65				
4/22/2017	8.1	15.215	0.55				
4/23/2017	8.0	12.860	0.00				
4/24/2017	8.0	13.682	0.00	26	0.7	N/A	0.01
4/25/2017	8.3	13.017	0.00				
4/26/2017	7.8	13.219	0.78				
4/27/2017	7.9	13.516	0.00				
4/28/2017	8.0	13.815	0.00				
4/29/2017	7.6	13.369	0.00				
4/30/2017	7.8	14.320	0.45				
5/1/2017	7.8	13.649	0.00	11	0.8	84	0.01
5/2/2017	7.9	13.039	0.00				
5/3/2017	7.8	13.427	0.40				
5/4/2017	7.7	13.734	0.25				
5/5/2017	7.8	13.648	0.00				
5/6/2017	8.0	13.962	0.00				
5/7/2017	7.9	12.706	0.00				
5/8/2017	7.8	9.765	0.00	6	0.8	84	0.01
5/9/2017	7.6	9.131	0.00				
5/10/2017	8.0	8.641	0.00				
5/11/2017	8.0	9.132	0.20				
5/12/2017	7.9	10.796	0.00				
5/13/2017	8.1	10.245	0.00				
5/14/2017	8.2	8.814	0.00				
5/15/2017	8.1	7.624	0.00	16	0.4	89	0.01
5/16/2017	8.2	6.973	0.00				
5/17/2017	8.2	7.811	0.00				
5/18/2017	8.4	8.137	0.00				
5/19/2017	8.6	8.203	0.00				
5/20/2017	8.2	11.897	0.45				
5/21/2017	8.1	11.246	0.00				
5/22/2017	8.8	11.610	0.15	24	1.6	86.0	0.01
5/23/2017	8.4	10.975	0.10				
5/24/2017	8.4	13.528	0.30				
5/25/2017	8.0	13.077	0.00				
5/26/2017	7.9	11.292	0.00				
5/27/2017	8.1	12.135	1.60				
5/28/2017	8.1	12.127	0.00				
5/29/2017	7.9	12.572	0.45				
5/30/2017	7.8	10.409	0.00	23	0.4	86.8	0.01
5/31/2017	7.8	9.967	0.00				
6/1/2017	8.0	9.612	0.00				
6/2/2017	8.0	10.698	0.00				
6/3/2017	8.0	9.793	0.60				
6/4/2017	8.0	10.147	0.50				
6/5/2017	7.8	10.741	0.10	24	0.9	93.2	0.01
6/6/2017	7.9	10.038	0.00				
6/7/2017	8.2	11.563	0.00				
6/8/2017	8.6	10.321	0.00				
6/9/2017	8.3	9.148	0.00				
6/10/2017	8.1	8.895	0.00				
6/11/2017	8.1	8.984	0.00				
6/12/2017	8.2	8.910	0.00	25	0.4	91.0	0.01
6/13/2017	8.3	8.723	0.00				
6/14/2017	8.3	7.522	0.00				
6/15/2017	8.2	9.262	0.85				
6/16/2017	8.0	9.743	0.00				
6/17/2017	8.2	9.163	0.00				
6/18/2017	8.2	10.219	0.20				
6/19/2017	8.2	10.359	0.00	7	0.3	90.8	0.01
6/20/2017	8.0	8.937	0.00				
6/21/2017	8.3	9.854	0.40				
6/22/2017	8.2	11.799	0.20				
6/23/2017	8.3	11.292	0.40				
6/24/2017	8.1	11.148	0.00				
6/25/2017	8.2	10.349	0.00				
6/26/2017	8.4	9.341	0.00	11	0.2	91.0	0.01
6/27/2017	8.2	9.082	0.00				
6/28/2017	8.3	8.812	0.00				
6/29/2017	8.3	9.928	0.40				
6/30/2017	8.0	9.831	0.00				
7/1/2017	8.1	8.778	0.00				
7/2/2017	8.1	8.581	0.00				
7/3/2017	8.2	10.327	1.10	10	1.5	91.6	0.01
7/4/2017	8.0	10.415	0.60				
7/5/2017	8.1	11.123	0.35				
7/6/2017	8.3	11.194	0.00				
7/7/2017	8.2	10.427	0.00				
7/8/2017	8.3	10.915	0.00				
7/9/2017	8.7	8.508	0.00				
7/10/2017	8.5	8.710	0.00	21	1.2	94.1	0.01
7/11/2017	8.0	8.056	0.00				
7/12/2017	8.3	8.221	0.00				
7/13/2017	8.1	8.761	1.40				
7/14/2017	8.1	9.201	0.00				
7/15/2017	8.5	9.135	0.00				
7/16/2017	8.2	8.317	0.10				
7/17/2017	7.9	7.738	0.00	34	0.4	95.9	0.01
7/18/2017	8.1	8.231	0.00				
7/19/2017	8.5	8.196	0.00				
7/20/2017	8.2	8.253	0.00				
7/21/2017	8.6	8.061	0.00				
7/22/2017	8.5	8.817	0.00				
7/23/2017	8.3	10.386	0.23				
7/24/2017	8.0	12.292	0.00	94	0.2	96.1	0.01
7/25/2017	8.0	10.258	0.00				
7/26/2017	8.2	10.472	0.00.				
7/27/2017	8.0	10.660	1.10				
7/28/2017	8.3	16.187	1.60				
7/29/2017	7.8	13.012	0.00				
7/30/2017	7.8	12.724	0.00				
7/31/2017	8.2	12.636	0.00	31	0.8	95.9	0.01
8/1/2017	8.2	13.279	0.00				
8/2/2017	8.2	12.269	0.00				
8/3/2017	8.1	11.831	0.00				
8/4/2017	7.9	13.451	0.00				
8/5/2017	8.1	12.304	0.00				
8/6/2017	8.2	13.891	0.30				

8/7/2017	7.9	14.545	0.20	31	0.6	93.8	0.01
8/8/2017	7.8	13.583	0.00				
8/9/2017	7.8	14.656	0.00				
8/10/2017	7.8	13.151	0.00				
8/11/2017	7.8	12.531	0.00				
8/12/2017	7.9	9.553	0.00				
8/13/2017	7.9	10.110	0.70				
8/14/2017	8.0	14.994	0.28	30	3.5	94.6	0.01
8/15/2017	7.8	13.992	0.32				
8/16/2017	7.8	12.303	0.00				
8/17/2017	7.8	13.005	0.20				
8/18/2017	8.1	12.009	0.00				
8/19/2017	7.9	12.019	0.00				
8/20/2017	7.8	11.628	0.00				
8/21/2017	7.8	11.940	0.00	12	1.7	91.4	0.00
8/22/2017	8.0	12.436	0.60				
8/23/2017	7.7	14.006	0.00				
8/24/2017	8.1	13.704	0.00				
8/25/2017	8.0	13.727	0.00				
8/26/2017	8.5	13.905	0.00				
8/27/2017	8.1	13.910	0.00				
8/28/2017	7.9	14.554	0.00	29	0.3	97.2	0.01
8/29/2017	8.0	14.313	0.00				
8/30/2017	7.8	15.867	0.70				
8/31/2017	7.8	16.273	1.45				
9/1/2017	7.9	15.710	0.00				
9/2/2017	8.0	14.821	0.00				
9/3/2017	7.7	14.134	0.00				
9/4/2017	7.7	14.394	0.00	33	0.1	94.0	0.01
9/5/2017	7.8	15.716	0.00				
9/6/2017	7.8	15.634	0.00				
9/7/2017	7.7	16.272	0.00				
9/8/2017	8.1	16.129	0.00				
9/9/2017	7.8	15.690	0.00				
9/10/2017	7.8	15.504	0.00				
9/11/2017	8.0	15.138	1.75	18	10.2	90..9	0.01
9/12/2017	7.8	15.618	0.30				
9/13/2017	7.7	15.417	0.00				
9/14/2017	7.9	13.801	0.00				
9/15/2017	7.9	13.896	0.00				
9/16/2017	7.8	14.424	0.55				
9/17/2017	7.9	13.353	0.00				
9/18/2017	7.7	13.016	0.00	31	0.9	87.7	0.01
9/19/2017	7.8	13.114	0.00				
9/20/2017	7.9	12.807	0.00				
9/21/2017	8.0	13.353	0.00				
9/22/2017	7.7	13.137	0.00				
9/23/2017	7.7	12.780	0.00				
9/24/2017	7.7	12.941	0.00				
9/25/2017	7.7	13.192	0.00	10	0.6	91.2	0.01
9/26/2017	7.9	13.711	0.00				
9/27/2017	7.7	12.977	0.00				
9/28/2017	7.7	13.131	0.00				
9/29/2017	7.8	13.852	0.00				
9/30/2017	7.7	14.434	0.00				
10/1/2017	7.9	14.540	0.00				
10/2/2017	7.8	14.361	0.00	12	1.2	87.9	0.01
10/3/2017	8.1	13.918	0.00				
10/4/2017	8.1	13.829	0.00				
10/5/2017	8.0	13.352	0.00				
10/6/2017	7.9	13.949	0.00				
10/7/2017	8.0	14.935	0.00				
10/8/2017	7.8	14.568	0.15				
10/9/2017	7.9	14.075	0.40	15	0.5	87.9	0.01
10/10/2017	7.5	14.358	0.15				
10/11/2017	7.6	13.866	0.00				
10/12/2017	7.7	13.965	0.00				
10/13/2017	7.6	13.822	0.00				
10/14/2017	7.6	14.157	0.00				
10/15/2017	7.8	14.041	0.30				
10/16/2017	7.9	13.701	0.00	34	2.0	82.1	0.01
10/17/2017	7.8	12.828	0.00				
10/18/2017	8.0	12.786	0.00				
10/19/2017	8.4	12.964	0.00				
10/20/2017	8.3	13.516	0.00				
10/21/2017	8.1	14.139	0.00				
10/22/2017	8.0	18.803	3.75				
10/23/2017	8.0	13.805	0.00	93	0.4	86.5	0.01
10/24/2017	8.1	12.992	0.00				
10/25/2017	8.0	13.213	0.00				
10/26/2017	8.0	14.117	0.00				
10/27/2017	8.1	13.760	0.80				
10/28/2017	7.9	13.368	0.00				
10/29/2017	8.0	12.659	0.00				
10/30/2017	7.7	13.420	0.00	30	0.4	NA	0.01
10/31/2017	8.2	13.575	0.00				
11/1/2017	7.9	13.558	0.10				
11/2/2017	7.7	14.167	0.40				
11/3/2017	7.9	14.195	0.00				
11/4/2017	8.0	14.230	0.00				
11/5/2017	7.9	14.096	0.65				
11/6/2017	8.0	15.390	0.00	60	0.3	74.1	0.01
11/7/2017	8.0	14.062	0.35				
11/8/2017	8.0	13.236	0.00				
11/9/2017	8.2	13.229	0.00				
11/10/2017	8.1	12.766	0.00				
11/11/2017	8.1	13.724	0.00				
11/12/2017	8.0	13.811	0.10				
11/13/2017	8.2	13.446	0.00	49	0.9	71.0	0.01
11/14/2017	8.3	13.269	0.00				
11/15/2017	8.1	13.527	0.00				
11/16/2017	8.1	12.976	0.00				
11/17/2017	8.1	14.080	0.00				
11/18/2017	8.1	13.618	0.45				
11/19/2017	8.2	12.591	0.00				
11/20/2017	8.0	12.642	0.00	19	0.9	69.3	0.01
11/21/2017	8.1	12.669	0.00				
11/22/2017	8.1	12.663	0.00				
11/23/2017	8.0	12.611	0.00				
11/24/2017	8.1	12.973	0.00				

11/25/2017	8.2	13.151	0.00				
11/26/2017	8.6	12.899	0.00				
11/27/2017	8.5	12.917	0.00	70	0.2	68.7	0.01
11/28/2017	8.3	12.769	0.00				
11/29/2017	8.0	13.453	0.00				
11/30/2017	8.1	13.503	0.00				
12/1/2017	8.0	13.275	0.00				
12/2/2017	8.1	13.200	0.00				
12/3/2017	8.0	13.257	0.00				
12/4/2017	7.9	14.221	1.50	6	3.6	69.3	0.01
12/5/2017	7.6	13.689	0.35				
12/6/2017	7.9	13.345	0.00				
12/7/2017	8.1	12.267	0.00				
12/8/2017	7.9	12.122	0.00				
12/9/2017	8.3	12.900	0.00				
12/10/2017	8.0	12.178	0.00				
12/11/2017	8.1	13.366	0.00	14	1.0	66.8	0.01
12/12/2017	8.0	13.032	0.00				
12/13/2017	8.1	12.817	0.00				
12/14/2017	8.1	12.931	0.00				
12/15/2017	8.1	12.699	0.00				
12/16/2017	8.0	12.750	0.45				
12/17/2017	8.0	13.151	0.00				
12/18/2017	8.0	13.580	0.00	16	1.4	64.2	0.01
12/19/2017	7.7	14.559	1.70				
12/20/2017	7.9	14.755	0.25				
12/21/2017	7.7	13.991	0.00				
12/22/2017	7.9	14.770	1.10				
12/23/2017	8.0	13.677	0.00				
12/24/2017	7.9	12.414	0.00				
12/25/2017	7.9	11.856	0.00				
12/26/2017	8.0	12.148	0.00				
12/27/2017	8.1	13.010	0.00				
12/28/2017	8.1	14.113	0.00	96	0.3	48.7	0.01
12/29/2017	8.6	13.005	0.00				
12/30/2017	8.4	12.475	0.00				
12/31/2017	8.30	8.748	0.00				
1/1/2018	8.2	5.971	0.00				
1/2/2018	8.1	10.641	0.00	24	1.7	51	0.01
1/3/2018	8.3	13.368	0.00				
1/4/2018	8.2	7.744	0.00				
1/5/2018	8.0	12.685	0.00				
1/6/2018	8.2	12.716	0.00				
1/7/2018	8.1	12.108	0.30				
1/8/2018	8.1	13.062	0.38	15	3.5	52.8	0.01
1/9/2018	8.1	13.619	0.00				
1/10/2018	8.4	13.838	0.00				
1/11/2018	8.6	13.811	0.35				
1/12/2018	7.8	12.391	0.00				
1/13/2018	8.1	12.172	0.00				
1/14/2018	8.1	12.083	0.00				
1/15/2018	8.0	12.220	0.10	33	1.1	48	0.01
1/16/2018	8.0	6.674	0.00				
1/17/2018	8.0	5.197	0.00				
1/18/2018	8.7	7.936	0.00				
1/19/2018	7.5	12.408	0.00				
1/20/2018	7.8	13.955	0.00				
1/21/2018	8.0	13.985	0.35				
1/22/2018	8.1	13.813	0.00	29	0.2	52.7	0.01
1/23/2018	8.5	13.300	0.00				
1/24/2018	8.4	13.186	0.00				
1/25/2018	8.3	13.131	0.00				
1/26/2018	8.5	13.579	0.00				
1/27/2018	8.6	13.759	0.55				
1/28/2018	8.6	13.134	0.00				
1/29/2018	8.7	12.644	0.00	19	0.9	56	0.01
1/30/2018	8.5	12.914	0.00				
1/31/2018	8.6	13.649	0.00				
2/1/2018	8.7	12.959	0.15				
2/2/2018	8.4	12.137	0.00				
2/3/2018	8.6	13.138	0.00				
2/4/2018	8.7	13.711	0.00				
2/5/2018	8.8	13.544	0.00	47	1.4	53.1	0.01
2/6/2018	8.8	13.830	2.15				
2/7/2018	8.8	12.698	0.00				
2/8/2018	8.6	13.622	0.00				
2/9/2018	8.7	14.609	3.00				
2/10/2018	8.5	18.007	0.00				
2/11/2018	8.2	13.277	0.00				
2/12/2018	8.1	12.624	0.00	140	1.2	56.5	0.01
2/13/2018	8.1	14.091	1.75				
2/14/2018	8.0	15.676	0.60				
2/15/2018	7.8	14.962	0.00				
2/16/2018	7.8	14.134	0.00				
2/17/2018	7.8	14.276	0.50				
2/18/2018	7.8	14.397	0.00				
2/19/2018	7.8	15.212	0.00	35	0.7	62.1	0.01
2/20/2018	7.4	14.887	0.00				
2/21/2018	7.8	14.922	2.20				
2/22/2018	8.0	17.578	0.00				
2/23/2018	7.7	15.516	0.00				
2/24/2018	7.7	15.757	0.00				
2/25/2018	7.7	14.901	1.35				
2/26/2018	7.7	13.818	0.00	190	1.1	63.6	0.01
2/27/2018	7.6	16.044	1.80				
2/28/2018	8.1	16.527	1.10				
3/1/2018	7.7	15.693	0.15				
3/2/2018	7.7	13.793	0.00				
3/3/2018	7.7	13.988	0.00				
3/4/2018	7.8	15.454	0.20				
3/5/2018	7.8	15.187	0.00	190	0.2	65.7	0.01
3/6/2018	7.4	14.658	0.00				
3/7/2018	7.9	13.212	0.00				
3/8/2018	8.1	13.625	0.00				
3/9/2018	7.9	14.459	1.00				
3/10/2018	7.9	14.724	0.00				
3/11/2018	7.7	13.947	0.00				
3/12/2018	7.8	13.518	0.00				
3/13/2018	8.1	12.213	0.00	90	0.2	63	0.01
3/14/2018	8.0	12.057	0.00				

3/15/2018	8.1	13.396	0.00				
3/16/2018	7.8	12.545	0.00				
3/17/2018	7.9	12.605	0.00				
3/18/2018	8.0	12.505	0.30				
3/19/2018	8.0	14.269	0.50	29	0.4	58.9	0.01
3/20/2018	7.9	11.001	0.00				
3/21/2018	7.8	11.750	0.00				
3/22/2018	8.0	12.369	0.00				
3/23/2018	8.0	12.681	0.00				
3/24/2018	8.0	13.457	0.45				
3/25/2018	8.1	12.890	0.00				
3/26/2018	8.0	12.740	0.00	38.00	1.2	62.4	0.01
3/27/2018	8.0	13.236	0.00				
3/28/2018	8.1	15.190	2.60				
3/29/2018	8.1	14.010	0.00				
3/30/2018	8.0	12.396	0.25				
3/31/2018	7.8	12.565	0.00				
4/1/2018	8.0	13.721	0.00				
4/2/2018	7.7	13.430	0.00	27	0.2	67	0.01
4/3/2018	7.9	12.883	0.50				
4/4/2018	7.9	12.449	0.00				
4/5/2018	7.9	13.299	0.35				
4/6/2018	8.4	12.983	0.60				
4/7/2018	8.3	11.871	0.00				
4/8/2018	8.2	12.058	0.00				
4/9/2018	7.9	13.236	0.00	19	0.1	64.8	0.01
4/10/2018	8.0	12.805	0.00				
4/11/2018	8.0	13.112	0.00				
4/12/2018	8.3	13.711	0.00				
4/13/2018	8.4	13.740	1.25				
4/14/2018	7.7	13.577	1.30				
4/15/2018	7.8	12.641	0.00				
4/16/2018	7.7	11.588	0.00	75	1.1	58.2	0.01
4/17/2018	7.8	12.648	0.00				
4/18/2018	7.9	13.845	0.00				
4/19/2018	8.1	12.892	0.00				
4/20/2018	7.9	12.224	0.00				
4/21/2018	7.8	12.913	0.15				
4/22/2018	8.0	14.993	2.50				
4/23/2018	7.9	13.074	0.18	72	1.9		0.01
4/24/2018	7.7	12.927	0.00				
4/25/2018	7.8	13.190	0.70				
4/26/2018	7.6	13.153	0.90				
4/27/2018	7.6	13.248	0.00				
4/28/2018	7.8	12.721	0.00				
4/29/2018	8.0	12.785	0.00				
4/30/2018	7.8	13.040	0.00	39	1.5	74.2	0.01
5/1/2018	7.4	13.280	0.00				
5/2/2018	8.0	13.926	0.00				
5/3/2018	8.3	14.033	0.00				
5/4/2018	8.0	13.809	2.40				
5/5/2018	7.9	15.214	0.40				
5/6/2018	7.8	13.515	0.00				
5/7/2018	7.9	13.138	0.00	38	1.2	77.3	0.01
5/8/2018	7.8	10.174	0.00				
5/9/2018	8.0	10.243	0.00				
5/10/2018	8.0	10.168	0.00				
5/11/2018	7.9	9.973	0.00				
5/12/2018	8.0	10.030	0.00				
5/13/2018	7.8	10.683	0.00				
5/14/2018	8.0	10.115	0.00	35	0.5	89.6	0.01
5/15/2018	7.9	10.227	0.00				
5/16/2018	7.5	11.954	0.00				
5/17/2018	7.9	11.002	0.20				
5/18/2018	7.9	11.614	0.30				
5/19/2018	8.0	10.516	0.00				
5/20/2018	7.7	8.899	0.00				
5/21/2018	8.0	10.562	0.00	4	0.9	88.2	0.01
5/22/2018	8.3	11.528	0.00				
5/23/2018	8.2	7.809	0.00				
5/24/2018	7.9	9.148	0.00				
5/25/2018	8.0	9.422	0.20				
5/26/2018	8.1	9.913	0.00				
5/27/2018	8.1	12.970	2.50				
5/28/2018	7.9	12.790	0.15	150	0.6	90.3	0.01
5/29/2018	7.9	17.638	3.45				
5/30/2018	7.8	13.408	0.78				
5/31/2018	7.9	12.582	0.30				
6/1/2018	8.1	13.267	0.70				
6/2/2018	7.9	11.355	0.00				
6/3/2018	7.9	10.288	0.25				
6/4/2018	8.1	11.371	0.00				
6/5/2018	7.9	10.849	0.00				
6/6/2018	7.9	9.454	0.00	11	0.8	89.8	0.01
6/7/2018	8.0	8.303	0.00				
6/8/2018	8.3	7.295	0.00				
6/9/2018	8.1	7.921	0.00				
6/10/2018	8.2	9.156	0.00				
6/11/2018	8.1	8.712	0.00	22	0.4	90.9	0.01
6/12/2018	7.8	9.213	0.80				
6/13/2018	8.4	13.178	0.20				
6/14/2018	7.6	10.736	0.00				
6/15/2018	8.0	9.784	0.00				
6/16/2018	8.2	8.809	0.00				
6/17/2018	8.5	10.155	0.35				
6/18/2018	8.1	8.594	0.00	7	0.3	94.8	0.01
6/19/2018	8.2	10.574	0.00				
6/20/2018	8.2	12.940	0.98				
6/21/2018	7.9	12.914	0.70				
6/22/2018	7.7	13.486	0.90				
6/23/2018	7.8	13.846	0.75				
6/24/2018	7.7	11.334	0.00				
6/25/2018	7.9	10.754	0.00	4	0.4	96.8	0.01
6/26/2018	8.1	10.064	0.00				
6/27/2018	7.4	10.212	0.00				
6/28/2018	7.7	10.598	0.00				
6/29/2018	7.7	9.636	0.00				
6/30/2018	8.2	7.642	0.00				
7/1/2018	8.3	7.927	0.00				
7/2/2018	8.3	8.128	0.15	5	0.3	96.6	0.01

7/3/2018	8.5	7.893	0.00				
7/4/2018	8.3	7.076	0.70				
7/5/2018	8.1	11.510	0.10				
7/6/2018	8.1	11.808	0.50				
7/7/2018	8.4	11.734	0.00				
7/8/2018	8.1	12.310	0.00				
7/9/2018	7.7	10.751	0.00	5	2.9	94.6	0.01
7/10/2018	8.1	7.336	0.00				
7/11/2018	8.5	7.295	0.00				
7/12/2018	7.9	7.348	0.00				
7/13/2018	8.0	7.299	0.00				
7/14/2018	7.9	7.200	0.20				
7/15/2018	7.9	7.766	0.50				
7/16/2018	7.9	10.253	0.00	56	1.0	92.5	0.01
7/17/2018	7.5	12.163	0.00				
7/18/2018	7.7	10.627	0.00				
7/19/2018	8.2	7.353	0.00				
7/20/2018	8.5	6.481	0.00				
7/21/2018	8.4	6.737	0.00				
7/22/2018	8.4	1.891	0.00				
7/23/2018	7.8	5.674	0.00	46	0.1	87.8	0.01
7/24/2018	7.6	4.951	0.00				
7/25/2018	8.2	5.016	0.00				
7/26/2018	7.9	2.587	0.00				
7/27/2018	8.8	2.379	0.00				
7/28/2018	8.9	6.193	0.00				
7/29/2018	8.1	6.055	0.00				
7/30/2018	8.2	6.181	0.00	39	1.1	86.8	0.01
7/31/2018	8.2	7.575	1.70				
8/1/2018	8.5	9.630	0.00				
8/2/2018	7.9	9.183	0.00				
8/3/2018	8.4	11.228	0.00				
8/4/2018	8.2	9.960	0.00				
8/5/2018	8.6	8.509	0.00				
8/6/2018	8.9	9.021	0.30	66	1.1	86.1	0.01
8/7/2018	8.4	11.751	0.00				
8/8/2018	7.7	12.188	0.40				
8/9/2018	8.3	13.230	0.25				
8/10/2018	8.2	11.972	0.00				
8/11/2018	7.5	12.581	0.00				
8/12/2018	7.7	12.124	0.00				
8/13/2018	7.7	10.561	0.00	17	1.1	86.8	0.01
8/14/2018	7.5	10.839	0.00				
8/15/2018	7.6	12.824	0.00				
8/16/2018	7.8	13.305	0.00				
8/17/2018	7.7	12.944	0.10				
8/18/2018	7.8	12.779	0.00				
8/19/2018	7.8	7.399	0.00				
8/20/2018	7.6	9.970	0.15	9	0.9	88.1	0.01
8/21/2018	7.7	11.555	0.00				
8/22/2018	7.8	8.555	0.00				
8/23/2018	8.4	12.962	0.00				
8/24/2018	7.7	14.811	0.00				
8/25/2018	8.0	14.089	0.00				
8/26/2018	8.7	13.575	0.00				
8/27/2018	8.9	13.314	0.00				
8/28/2018	7.9	11.000	0.00				
8/29/2018	7.8	10.602	0.00	7	0.2	89.7	0.01
8/30/2018	7.6	14.408	0.21				
8/31/2018	7.2	15.123	0.00				
9/1/2018	7.1	14.316	0.00				
9/2/2018	7.6	14.212	0.00				
9/3/2018	8.0	14.649	0.00				
9/4/2018	8.2	13.006	0.00	180	1.7	88.2	0.01
9/5/2018	7.7	18.188	0.00				
9/6/2018	7.9	16.733	0.00				
9/7/2018	7.8	16.160	0.30				
9/8/2018	7.9	14.855	0.00				
9/9/2018	7.8	15.902	0.35				
9/10/2018	7.2	15.716	0.00	13	0.5	87.0	0.01
9/11/2018	7.5	15.531	0.00				
9/12/2018	7.5	14.085	0.00				
9/13/2018	7.6	15.785	0.00				
9/14/2018	7.7	15.255	0.20				
9/15/2018	7.8	15.434	0.00				
9/16/2018	7.8	15.403	0.00				
9/17/2018	7.8	15.475	0.00	11	0.2	87.7	0.01
9/18/2018	7.9	15.183	0.00				
9/19/2018	7.8	13.146	0.00				
9/20/2018	7.7	17.054	0.00				
9/21/2018	8.0	17.499	0.25				
9/22/2018	8.8	18.155	1.40				
9/23/2018	8.0	18.957	0.20				
9/24/2018	7.7	18.904	0.20	24	0.9	88.3	0.01
9/25/2018	7.7	18.664	1.00				
9/26/2018	7.7	18.812	0.30				
9/27/2018	7.8	17.123	0.20				
9/28/2018	7.8	17.075	0.00				
9/29/2018	8.3	17.350	0.00				
9/30/2018	8.3	17.175	0.00				
10/1/2018	8.0	18.118	0.00	35	2.1	89.4	0.01
10/2/2018	8.2	17.627	0.00				
10/3/2018	8.4	17.160	0.00				
10/4/2018	8.1	15.941	0.00				
10/5/2018	8.0	15.331	0.00				
10/6/2018	7.9	19.986	0.00				
10/7/2018	7.8	15.398	0.00				
10/8/2018	7.7	16.158	0.00	11	0.3	85.2	0.01
10/9/2018	7.8	16.209	0.00				
10/10/2018	7.8	16.035	0.30				
10/11/2018	7.8	15.731	0.00				
10/12/2018	7.6	16.020	0.00				
10/13/2018	7.7	15.410	0.00				
10/14/2018	7.8	14.970	0.00				
10/15/2018	7.6	16.891	0.00	3	0.8	81.3	0.01
10/16/2018	7.8	16.111	0.50				
10/17/2018	7.8	16.324	0.10				
10/18/2018	8.0	15.992	0.00				
10/19/2018	8.0	16.105	0.30				
10/20/2018	8.3	15.476	0.00				

10/21/2018	8.3	13.231	0.00				
10/22/2018	8.1	13.585	0.00	74	0.3	73.4	0.01
10/23/2018	8.0	14.279	0.00				
10/24/2018	7.9	17.739	0.05				
10/25/2018	7.9	17.232	1.10				
10/26/2018	7.8	15.956	0.20				
10/27/2018	7.8	15.274	0.00				
10/28/2018	7.9	15.361	0.00				
10/29/2018	7.8	15.732	0.00	4	0.5	71.9	0.01
10/30/2018	7.8	18.494	0.00				
10/31/2018	8.0	17.879	0.70				
11/1/2018	7.6	17.775	0.00				
11/2/2018	7.8	14.669	0.10				
11/3/2018	8.1	16.308	0.00				
11/4/2018	8.0	17.640	0.15				
11/5/2018	8.3	19.590	1.60	16	0.7	70.7	0.01
11/6/2018	8.2	17.484	0.00				
11/7/2018	8.1	15.304	0.20				
11/8/2018	8.2	15.954	0.40				
11/9/2018	7.9	14.097	0.00				
11/10/2018	8.0	14.929	0.00				
11/11/2018	8.0	15.451	1.05				
11/12/2018	8.1	15.502	0.80	55	1.6	61.8	0.01
11/13/2018	8.2	13.212	0.00				
11/14/2018	7.8	12.791	0.70				
11/15/2018	8.0	14.101	0.00				
11/16/2018	7.8	14.390	0.00				
11/17/2018	7.7	14.355	0.00				
11/18/2018	7.8	15.009	0.00				
11/19/2018	8.1	14.697	0.00	39	0.2	55.0	0.01
11/20/2018	7.9	14.700	0.00				
11/21/2018	7.8	14.642	0.00				
11/22/2018	7.6	14.478	0.00				
11/23/2018	7.8	15.021	0.40				
11/24/2018	7.7	15.832	0.00				
11/25/2018	7.7	14.930	0.00				
11/26/2018	7.7	14.106	0.00				
11/27/2018	7.5	10.657	0.00	28	0.4	59.9	0.01
11/28/2018	7.9	14.756	0.10				
11/29/2018	7.9	15.893	0.60				
11/30/2018	7.9	16.448	1.40				
12/1/2018	7.7	16.488	0.00				
12/2/2018	7.9	15.545	0.00				
12/3/2018	7.9	14.884	0.00	37	1.3	58.2	0.01
12/4/2018	7.9	14.928	1.50				
12/5/2018	7.8	12.762	0.35				
12/6/2018	8.4	15.019	0.00				
12/7/2018	8.0	14.277	0.00				
12/8/2018	8.0	14.290	0.00				
12/9/2018	8.2	13.377	0.00				
12/10/2018	8.0	14.170	0.00	125	0.3	54.5	0.01
12/11/2018	7.9	14.215	0.00				
12/12/2018	8.1	14.615	0.00				
12/13/2018	8.1	15.293	0.00				
12/14/2018	8.0	17.120	0.00				
12/15/2018	7.8	15.082	0.00				
12/16/2018	8.2	14.660	0.45				
12/17/2018	8.7	14.477	0.00	42	0.2	55.0	0.01
12/18/2018	8.7	13.788	0.00				
12/19/2018	8.3	14.990	1.70				
12/20/2018	8.4	14.552	0.25				
12/21/2018	8.1	13.644	0.00				
12/22/2018	8.3	15.048	1.10				
12/23/2018	8.3	14.317	0.00				
12/24/2018	8.3	13.516	0.00				
12/25/2018	8.0	14.315	0.00				
12/26/2018	7.6	15.710	0.15	8	1.8	55.9	0.01
12/27/2018	7.5	15.313	1.15				
12/28/2018	7.7	14.917	0.00				
12/29/2018	7.6	14.548	0.00				
12/30/2018	7.7	15.431	0.90				
12/31/2018	7.70	17.544	0.00				
1/1/2019	7.8	14.681	0.90				
1/2/2019	7.8	15.307	0.70	189	2.6	55.7	0.01
1/3/2019	7.8	15.499	0.40				
1/4/2019	8.6	15.011	0.15				
1/5/2019	7.7	14.669	0.00				
1/6/2019	7.6	15.851	0.00				
1/7/2019	7.8	17.215	0.00	56	1.9	55.2	0.01
1/8/2019	7.8	15.049	0.00				
1/9/2019	8.1	12.585	0.00				
1/10/2019	7.8	11.637	0.00				
1/11/2019	8.1	13.008	0.00				
1/12/2019	8.1	13.195	0.65				
1/13/2019	8.2	12.078	0.04				
1/14/2019	8.0	11.325	0.00	25	0.4	55.7	0.01
1/15/2019	8.1	12.494	0.00				
1/16/2019	7.9	13.472	0.30				
1/17/2019	7.8	14.177	0.18				
1/18/2019	7.8	14.023	1.15				
1/19/2019	7.9	13.124	0.50				
1/20/2019	8.1	13.167	0.00				
1/21/2019	7.9	16.869	0.00	111	0.3	51.9	0.01
1/22/2019	8.0	23.122	0.10				
1/23/2019	8.3	18.054	0.95				
1/24/2019	8.1	18.141	0.00				
1/25/2019	7.9	18.310	0.00				
1/26/2019	7.8	18.452	0.00				
1/27/2019	8.0	22.741	0.00				
1/28/2019	7.5	16.461	0.00	78	0.2	54.1	0.01
1/29/2019	7.6	13.262	0.00				
1/30/2019	7.9	16.228	0.00				
1/31/2019	7.9	15.881	0.00				
2/1/2019	8.0	16.174	0.00				
2/2/2019	8.1	14.713	0.00				
2/3/2019	8.0	15.776	0.20				
2/4/2019	7.8	15.199	0.00	10	1.1	55.2	0.01
2/5/2019	7.8	16.518	0.30				
2/6/2019	7.7	15.784	0.20				
2/7/2019	7.9	15.167	0.20				

2/8/2019	7.8	18.993	0.00				
2/9/2019	8.1	17.516	0.20				
2/10/2019	7.7	13.842	0.00				
2/11/2019	7.8	18.967	1.00	17	1.5	51	0.01
2/12/2019	8.4	16.536	0.00				
2/13/2019	8.3	15.184	0.00				
2/14/2019	8.4	21.636	0.00				
2/15/2019	7.8	13.829	0.50				
2/16/2019	8.1	14.287	0.20				
2/17/2019	8.0	24.590	0.75				
2/18/2019	8.0	21.013	0.25	212	0.6	55.4	0.01
2/19/2019	8.1	21.263	3.30				
2/20/2019	8.9	25.725	0.10				
2/21/2019	7.3	20.368	4.00				
2/22/2019	8.6	26.037	3.30				
2/23/2019	7.8	27.969	0.00				
2/24/2019	7.1	19.978	0.00				
2/25/2019	7.8	21.985	0.00				
2/26/2019	7.9	23.302	0.50	205	1.9	52.8	0.01
2/27/2019	7.6	24.715	0.10				
2/28/2019	7.9	22.564	0.00				
3/1/2019	7.9	21.053	0.80				
3/2/2019	8.8	20.962	0.70				
3/3/2019	8.8	18.823	0.70				
3/4/2019	8.2	19.235	0.00	180	2.5	51.4	0.01
3/5/2019	8.1	19.498	0.00				
3/6/2019	8.0	21.635	0.00				
3/7/2019	7.8	22.555	0.20				
3/8/2019	7.8	23.642	0.40				
3/9/2019	7.9	23.731	0.30				
3/10/2019	8.0	23.191	0.10				
3/11/2019	8.0	14.097	0.20	122	0.9	58.6	0.01
3/12/2019	7.8	15.013	0.00				
3/13/2019	7.8	17.380	0.00				
3/14/2019	8.0	16.143	0.15				
3/15/2019	7.8	13.307	0.00				
3/16/2019	8.2	13.552	0.00				
3/17/2019	8.2	13.920	0.00				
3/18/2019	7.8	13.489	0.00	28	0.4	61.7	0.01
3/19/2019	7.8	13.114	0.00				
3/20/2019	7.8	14.412	0.15				
3/21/2019	7.9	13.324	0.00				
3/22/2019	8.0	13.380	0.00				
3/23/2019	8.4	14.539	0.00				
3/24/2019	8.1	14.364	0.10				
3/25/2019	8.1	14.872	0.00	5	1.00	62.2	0.01
3/26/2019	8.2	14.589	0.00				
3/27/2019	8.1	15.528	0.00				
3/28/2019	8.0	16.337	0.00				
3/29/2019	8.2	16.371	0.00				
3/30/2019	8.0	15.336	0.60				
3/31/2019	8.0	13.944	0.00				
4/1/2019	8.2	15.203	0.00	9	2.3	61.5	0.01
4/2/2019	8.2	15.242	0.00				
4/3/2019	8.4	16.626	0.00				
4/4/2019	8.2	16.051	0.70				
4/5/2019	7.7	16.794	0.00				
4/6/2019	7.7	16.826	0.00				
4/7/2019	7.7	16.134	0.55				
4/8/2019	7.8	17.892	1.10	51	1.5	67.8	0.01
4/9/2019	8.0	16.374	0.00				
4/10/2019	7.9	16.132	0.00				
4/11/2019	8.1	15.865	0.10				
4/12/2019	8.0	14.924	0.50				
4/13/2019	8.0	16.221	1.65				
4/14/2019	8.1	14.742	0.00				
4/15/2019	7.8	15.017	0.00	55	1.1	65.4	0.01
4/16/2019	7.8	15.775	0.00				
4/17/2019	7.8	16.287	0.00				
4/18/2019	7.8	15.835	1.00				
4/19/2019	7.7	13.647	1.00				
4/20/2019	7.7	14.528	0.00				
4/21/2019	8.1	14.911	0.00				
4/22/2019	7.8	15.291	0.00	32	0.6	72.1	0.01
4/23/2019	7.9	14.235	0.00				
4/24/2019	8.0	16.327	0.00				
4/25/2019	7.8	14.893	0.15				
4/26/2019	7.7	12.987	0.00				
4/27/2019	7.9	14.989	0.00				
4/28/2019	8.0	14.112	0.00				
4/29/2019	8.0	14.509	0.00	7	0.6	74.6	0.01
4/30/2019	7.8	14.545	0.00				
5/1/2019	7.8	7.322	0.40				
5/2/2019	7.8	12.964	0.40				
5/3/2019	7.9	14.185	0.00				
5/4/2019	7.9	13.868	1.00				
5/5/2019	8.0	13.590	0.00				
5/6/2019	8.2	13.224	0.00	24	1.7	76.4	0.01
5/7/2019	8.1	13.921	0.00				
5/8/2019	8.2	12.974	1.35				
5/9/2019	7.8	12.736	0.00				
5/10/2019	7.8	12.906	0.20				
5/11/2019	7.8	12.895	0.20				
5/12/2019	7.8	12.542	0.00				
5/13/2019	7.7	12.644	0.00				
5/14/2019	7.9	12.767	0.00	18	0.4	78.2	0.01
5/15/2019	7.5	13.034	0.00				
5/16/2019	8.0	10.680	0.00				
5/17/2019	7.9	8.266	0.00				
5/18/2019	7.9	8.042	0.00				
5/19/2019	8.0	7.800	0.00				
5/20/2019	7.7	8.175	0.00	33	0.4	82.2	0.01
5/21/2019	7.8	9.836	0.00				
5/22/2019	7.8	11.196	0.00				
5/23/2019	7.9	10.114	0.00				
5/24/2019	7.8	9.792	0.00				
5/25/2019	7.3	8.097	0.00				
5/26/2019	7.3	9.077	0.00				
5/27/2019	7.5	7.753	0.00				
5/28/2019	7.9	5.944	0.00				

5/29/2019	7.6	8.916	0.00	2	2.1	87.2	0.01
5/30/2019	7.5	8.120	0.00				
5/31/2019	7.6	7.158	0.00				
6/1/2019	7.9	6.370	0.00				
6/2/2019	7.8	7.800	0.00	10	2.9	83.4	0.01
6/3/2019	7.8	8.088	0.00				
6/4/2019	7.7	7.597	0.00				
6/5/2019	7.8	8.143	0.10				
6/6/2019	7.9	8.295	0.70				
6/7/2019	7.9	11.318	0.10				
6/8/2019	8.0	11.809	0.00				
6/9/2019	8.0	11.166	0.00				
6/10/2019	8.2	7.407	0.00	9	0.6	89.7	0.01
6/11/2019	7.5	7.195	0.00				
6/12/2019	8.0	7.148	0.00				
6/13/2019	8.1	6.806	0.00				
6/14/2019	8.0	7.200	0.00				
6/15/2019	8.0	7.506	0.00				
6/16/2019	8.1	7.461	0.20				
6/17/2019	8.1	10.334	1.10				
6/18/2019	8.0	11.224	0.20	30	0.3	88.3	0.01
6/19/2019	7.9	10.566	0.15				
6/20/2019	7.9	8.967	0.00				
6/21/2019	7.8	11.137	0.00				
6/22/2019	7.8	11.067	0.00				
6/23/2019	8.2	9.295	0.40				
6/24/2019	8.3	11.543	0.00	38	0.9	88.7	0.01
6/25/2019	8.1	11.309	0.00				
6/26/2019	8.0	11.256	0.00				
6/27/2019	8.0	9.116	0.30				
6/28/2019	8.4	10.100	0.55				
6/29/2019	7.9	10.265	0.00				
6/30/2019	8.1	7.568	0.00				
7/1/2019	8.3	7.010	0.00	28	0.3	89.2	0.01
7/2/2019	8.6	7.219	0.00				
7/3/2019	8.3	7.098	0.00				
7/4/2019	8.4	7.104	0.00				
7/5/2019	8.4	6.722	0.00				
7/6/2019	8.7	6.869	0.00				
7/7/2019	8.0	10.732	1.20				
7/8/2019	8.2	10.173	0.00	29	1.7	89.9	0.01
7/9/2019	8.3	6.448	0.00				
7/10/2019	8.2	6.872	0.00				
7/11/2019	7.9	6.350	0.20				
7/12/2019	8.2	8.377	0.90				
7/13/2019	8.4	9.499	0.00				
7/14/2019	8.3	9.048	1.35				
7/15/2019	7.7	9.695	0.35	117	0.2	95.3	0.01
7/16/2019	8.0	9.711	2.20				
7/17/2019	8.0	11.614	0.00				
7/18/2019	7.8	9.102	0.00				
7/19/2019	7.9	9.041	0.00				
7/20/2019	8.2	9.442	0.65				
7/21/2019	8.0	9.219	0.00				
7/22/2019	7.9	9.731	0.75	34	0.2	91.2	0.01
7/23/2019	8.0	9.437	0.00				
7/24/2019	7.9	8.568	0.00				
7/25/2019	8.2	8.942	0.00				
7/26/2019	8.2	8.790	0.00				
7/27/2019	8.1	7.276	0.00				
7/28/2019	8.1	7.205	0.00				
7/29/2019	8.4	6.055	0.00	14	5.7	85.1	0.01
7/30/2019	8.3	6.447	0.00				
7/31/2019	8.3	8.578	0.00				
8/1/2019	8.5	7.459	0.00				
8/2/2019	8.3	12.426	0.00				
8/3/2019	8.0	6.163	0.00				
8/4/2019	8.1	7.076	0.30				
8/5/2019	8.1	7.993	0.00	12	0.5	87.6	0.01
8/6/2019	8.0	9.251	2.55				
8/7/2019	8.1	9.229	1.10				
8/8/2019	8.6	8.902	0.00				
8/9/2019	8.4	8.729	0.00				
8/10/2019	8.1	8.564	0.00				
8/11/2019	7.9	8.279	0.00				
8/12/2019	7.9	8.519	0.00	64	1.7	92.8	0.01
8/13/2019	8.0	7.646	1.15				
8/14/2019	7.9	9.136	0.00				
8/15/2019	7.8	8.172	0.00				
8/16/2019	7.8	7.729	0.00				
8/17/2019	7.8	8.521	0.00				
8/18/2019	7.8	8.775	0.00				
8/19/2019	8.0	8.897	0.00	57	3.2	91.5	0.01
8/20/2019	7.8	9.039	0.00				
8/21/2019	8.0	9.171	0.00				
8/22/2019	8.1	8.798	0.00				
8/23/2019	7.7	8.638	1.25				
8/24/2019	8.0	9.222	1.00				
8/25/2019	7.9	20.695	5.00				
8/26/2019	7.7	8.578	0.15				
8/27/2019	7.8	9.025	0.00	212	5.8	83.6	0.01
8/28/2019	7.8	8.776	0.00				
8/29/2019	7.7	8.869	0.00				
8/30/2019	8.1	8.579	0.00				
8/31/2019	8.6	8.405	0.00				
9/1/2019	8.3	8.220	0.00				
9/2/2019	8.2	8.736	0.00				
9/3/2019	8.0	8.935	0.00	93	2.9	92.8	0.01
9/4/2019	8.0	8.753	0.00				
9/5/2019	7.8	8.529	0.00				
9/6/2019	7.9	8.800	0.00				
9/7/2019	8.1	8.825	0.00				
9/8/2019	8.1	8.907	0.00				
9/9/2019	8.1	8.991	0.00	23	0.7	91.2	0.01
9/10/2019	8.2	8.904	0.00				
9/11/2019	8.1	8.897	0.00				
9/12/2019	8.1	8.873	0.00				
9/13/2019	8.1	8.828	0.00				
9/14/2019	7.8	8.827	0.00				
9/15/2019	7.9	8.626	0.00				

9/16/2019	8.1	8.575	0.00	14	4.9	93.3	0.01
9/17/2019	8.3	8.898	0.00				
9/18/2019	8.1	8.835	0.00				
9/19/2019	8.0	8.690	0.00				
9/20/2019	8.3	8.445	0.00				
9/21/2019	8.4	8.510	0.00				
9/22/2019	8.1	8.478	0.00				
9/23/2019	8.1	8.542	0.00	8	2.7	88.1	0.01
9/24/2019	8.1	8.526	0.00				
9/25/2019	8.0	8.365	0.00				
9/26/2019	7.9	8.720	0.00				
9/27/2019	7.7	8.754	0.00				
9/28/2019	8.0	8.753	0.00				
9/29/2019	8.0	8.808	0.00				
9/30/2019	7.8	9.025	0.00	30	2.2	87.9	0.01
10/1/2019	7.8	8.871	0.00				
10/2/2019	7.8	8.736	0.00				
10/3/2019	8.0	8.865	0.00				
10/4/2019	7.9	9.062	0.00				
10/5/2019	7.8	9.027	0.00				
10/6/2019	8.0	9.044	0.00				
10/7/2019	8.1	8.907	2.30	90	2.0	88.5	0.01
10/8/2019	7.6	9.120	0.10				
10/9/2019	7.9	9.128	0.00				
10/10/2019	7.7	8.813	0.00				
10/11/2019	7.9	8.939	0.00				
10/12/2019	7.9	8.661	0.25				
10/13/2019	8.1	8.067	0.00				
10/14/2019	8.0	8.794	0.00	15	0.4	80.6	0.01
10/15/2019	7.9	9.729	0.00				
10/16/2019	8.0	10.176	0.25				
10/17/2019	7.9	9.594	0.00				
10/18/2019	8.0	9.777	0.00				
10/19/2019	8.1	10.255	0.00				
10/20/2019	7.9	11.006	0.00				
10/21/2019	8.0	9.414	0.00	12	2.1	77.9	0.01
10/22/2019	7.9	8.308	0.70				
10/23/2019	7.9	7.876	0.00				
10/24/2019	8.0	7.631	0.00				
10/25/2019	8.1	8.459	0.05				
10/26/2019	7.9	8.477	2.60				
10/27/2019	8.0	8.719	0.20				
10/28/2019	7.9	8.315	0.00	4	2.0	74.4	0.01
10/29/2019	7.9	7.707	0.00				
10/30/2019	7.9	8.146	0.50				
10/31/2019	7.9	8.456	0.60				
11/1/2019	7.9	6.481	0.00				
11/2/2019	8.1	7.205	0.00				
11/3/2019	8.2	6.948	0.00				
11/4/2019	8.0	6.589	0.00	28	1.2	69.0	0.01
11/5/2019	8.1	6.526	0.00				
11/6/2019	8.0	7.996	0.00				
11/7/2019	8.2	8.381	0.00				
11/8/2019	7.8	7.125	0.25				
11/9/2019	8.1	6.925	0.00				
11/10/2019	8.1	6.870	0.00				
11/11/2019	8.0	7.125	0.00	62	1.3	68.5	0.01
11/12/2019	8.0	6.877	0.35				
11/13/2019	8.0	4.213	0.00				
11/14/2019	8.0	5.875	0.00				
11/15/2019	8.1	5.490	0.00				
11/16/2019	8.1	5.888	0.00				
11/17/2019	8.0	5.464	0.00				
11/18/2019	7.9	5.702	0.00				
11/19/2019	8.2	6.405	0.00	44	1.1	62.6	0.01
11/20/2019	8.2	6.565	0.00				
11/21/2019	8.2	6.686	0.00				
11/22/2019	8.1	7.100	0.50				
11/23/2019	8.0	7.614	1.80				
11/24/2019	8.0	6.699	0.00				
11/25/2019	8.0	6.075	0.00	48	0.9	57.2	0.01
11/26/2019	8.1	6.801	0.00				
11/27/2019	7.9	8.086	1.05				
11/28/2019	7.5	6.511	0.00				
11/29/2019	7.6	6.938	0.00				
11/30/2019	7.6	7.038	0.00				
12/1/2019	7.7	9.843	2.90				
12/2/2019	7.8	6.047	0.00				
12/3/2019	7.8	4.956	0.00	6	1.0	55.8	0.01
12/4/2019	7.9	6.184	0.00				
12/5/2019	8.0	6.312	0.00				
12/6/2019	8.1	7.067	0.00				
12/7/2019	7.9	7.025	0.00				
12/8/2019	8.0	6.624	0.00				
12/9/2019	8.0	7.558	0.00	60	1.1	60.4	0.01
12/10/2019	8.0	7.593	0.20				
12/11/2019	8.0	6.159	0.10				
12/12/2019	7.9	7.666	0.00				
12/13/2019	7.8	6.882	0.00				
12/14/2019	7.8	6.259	0.00				
12/15/2019	8.0	6.357	0.00				
12/16/2019	8.2	7.462	0.15	40	1.5	58.6	0.01
12/17/2019	7.9	7.398	1.10				
12/18/2019	7.8	6.809	0.00				
12/19/2019	7.9	7.675	0.00				
12/20/2019	8.1	8.565	0.00				
12/21/2019	8.2	6.917	0.00				
12/22/2019	8.2	6.609	0.00				
12/23/2019	8.1	6.211	1.50				
12/24/2019	7.7	6.643	0.00				
12/25/2019	7.8	6.878	0.00				
12/26/2019	7.9	7.307	0.00	51	2.2	50.9	0.01
12/27/2019	8.0	7.912	0.00				
12/28/2019	7.9	7.953	0.00				
12/29/2019	7.9	8.230	0.00				
12/30/2019	7.7	7.989	1.50	120	1.7	53.4	0.01
12/31/2019	7.6	6.889	0.00				
1/1/2020	7.5	6.721	0.00				
1/2/2020	7.5	7.460	0.20				
1/3/2020	7.5	7.520	2.25				

1/4/2020	8.2	8.760	0.30				
1/5/2020	7.7	8.064	0.00				
1/6/2020	7.9	7.451	0.00	120	1.2	52.7	0.01
1/7/2020	7.5	7.947	0.00				
1/8/2020	7.8	8.459	0.00				
1/9/2020	7.9	7.685	0.00				
1/10/2020	7.7	8.386	0.00				
1/11/2020	7.9	9.208	1.85				
1/12/2020	8.0	10.000	1.20				
1/13/2020	8.1	7.058	0.00	68	0.3	57.7	0.01
1/14/2020	8.3	9.295	1.60				
1/15/2020	8.2	10.240	0.00				
1/16/2020	7.9	8.284	0.30				
1/17/2020	7.7	7.088	0.00				
1/18/2020	7.8	8.156	0.10				
1/19/2020	7.8	7.609	0.40				
1/20/2020	8.0	6.831	0.00	70	1.6	57	0.01
1/21/2020	8.0	9.177	0.00				
1/22/2020	8.2	9.109	0.00				
1/23/2020	8.1	6.914	0.00				
1/24/2020	8.1	6.460	0.80				
1/25/2020	8.0	6.524	0.00				
1/26/2020	8.0	7.247	0.00				
1/27/2020	8.2	7.393	0.15	32	3.2	55	0.01
1/28/2020	7.9	7.114	0.00				
1/29/2020	7.9	7.537	0.00				
1/30/2020	7.9	7.262	0.00				
1/31/2020	8.1	7.534	0.10				
2/1/2020	8.2	7.721	0.00				
2/2/2020	8.2	6.995	0.00				
2/3/2020	8.3	8.453	0.00	15	0.5	55.9	0.01
2/4/2020	8.0	9.184	0.20				
2/5/2020	8.0	8.509	0.50				
2/6/2020	7.9	10.083	2.70				
2/7/2020	7.8	6.993	0.20				
2/8/2020	7.8	7.499	0.00				
2/9/2020	8.1	8.384	0.00				
2/10/2020	8.0	8.039	1.50	120	0.5	58.4	0.01
2/11/2020	7.9	10.773	1.70				
2/12/2020	7.9	8.470	0.25				
2/13/2020	8.0	9.062	1.60				
2/14/2020	8.6	8.654	0.00				
2/15/2020	8.9	9.006	0.00				
2/16/2020	8.0	8.618	0.00				
2/17/2020	7.7	6.919	0.00	115	0.4	57.3	0.01
2/18/2020	7.5	8.451	0.30				
2/19/2020	7.8	7.165	0.35				
2/20/2020	7.5	6.571	0.30				
2/21/2020	7.6	5.874	0.45				
2/22/2020	7.3	6.381	0.00				
2/23/2020	7.5	7.279	0.00				
2/24/2020	7.6	6.601	0.15				
2/25/2020	7.8	7.159	0.70	80	6	55.3	0.01
2/26/2020	7.8	7.435	0.00				
2/27/2020	8.1	6.732	0.00				
2/28/2020	8.5	6.825	0.00				
2/29/2020	8.6	6.978	0.00				
3/1/2020	8.1	7.913	0.00				
3/2/2020	8.0	8.201	0.45	27	0.4	60	0.01
3/3/2020	8.1	8.848	0.00				
3/4/2020	8.3	8.607	0.00				
3/5/2020	8.2	8.002	0.00				
3/6/2020	8.3	12.077	0.00				
3/7/2020	8.3	13.072	0.00				
3/8/2020	8.4	13.200	0.00				
3/9/2020	8.3	14.070	0.00	20	1.5	64	0.01
3/10/2020	8.1	14.285	0.30				
3/11/2020	8.2	14.106	0.00				
3/12/2020	8.0	14.586	0.45				
3/13/2020	8.0	15.033	0.40				
3/14/2020	8.1	14.451	0.00				
3/15/2020	8.2	15.629	2.85				
3/16/2020	7.7	14.717	0.00				
3/17/2020	7.7	14.336	0.00	80.00	1.3	60	0.01
3/18/2020	7.8	14.540	0.00				
3/19/2020	8.1	14.903	0.00				
3/20/2020	7.9	15.119	0.20				
3/21/2020	8.0	14.331	0.40				
3/22/2020	8.1	13.612	0.00				
3/23/2020	8.1	15.088	1.70	82	5.4	62	0.01
3/24/2020	8.0	15.887	0.85				
3/25/2020	8.1	15.569	0.60				
3/26/2020	8.2	14.802	0.00				
3/27/2020	8.1	15.329	0.00				
3/28/2020	7.9	15.533	0.00				
3/29/2020	7.9	15.469	0.70				
3/30/2020	7.8	14.775	0.00	190	1.5	71.3	0.01
3/31/2020	7.9	14.826	1.40				
4/1/2020	8.0	13.828	0.10				
4/2/2020	8.1	14.611	0.00				
4/3/2020	8.4	14.509	0.00				
4/4/2020	8.4	15.129	0.00				
4/5/2020	8.1	15.309	0.00				
4/6/2020	8.0	15.300	0.00	20	2.1	70	0.01
4/7/2020	8.0	15.644	0.00				
4/8/2020	7.9	15.451	0.00				
4/9/2020	7.8	15.737	0.75				
4/10/2020	7.9	15.111	0.00				
4/11/2020	8.1	13.911	0.00				
4/12/2020	8.4	15.787	2.00				
4/13/2020	8.2	17.419	1.50				
4/14/2020	8.0	13.666	0.00	80	1.1	68.7	0.01
4/15/2020	8.3	13.936	0.00				
4/16/2020	8.1	14.021	0.00				
4/17/2020	8.4	14.671	0.00				
4/18/2020	8.2	15.038	0.40				
4/19/2020	8.1	14.423	0.30				
4/20/2020	8.0	14.423	0.60	40	1.3	67.4	0.01
4/21/2020	8.0	14.939	0.00				
4/22/2020	8.0	14.826	0.00				

4/23/2020	7.4	15.148	1.00				
4/24/2020	8.3	15.639	0.10				
4/25/2020	8.3	15.805	0.30				
4/26/2020	8.3	14.768	0.00				
4/27/2020	8.3	14.731	0.00	19	2.9	67.4	0.01
4/28/2020	8.7	15.596	0.00				
4/29/2020	8.3	15.293	0.10				
4/30/2020	8.3	14.885	0.20				
5/1/2020	8.4	14.689	0.00				
5/2/2020	8.5	15.129	0.00				
5/3/2020	8.5	15.455	0.00				
5/4/2020	8.4	15.424	0.00	14	0.3	70.5	0.01
5/5/2020	8.4	15.594	0.00				
5/6/2020	8.3	15.166	0.00				
5/7/2020	8.4	13.942	0.00				
5/8/2020	8.7	15.192	0.50				
5/9/2020	8.4	12.514	0.10				
5/10/2020	8.6	14.322	0.00				
5/11/2020	8.8	14.813	0.00	5	0.9	72.5	0.01
5/12/2020	8.5	14.851	0.00				
5/13/2020	8.3	12.880	0.00				
5/14/2020	8.2	13.177	0.00				
5/15/2020	8.5	13.514	0.00				
5/16/2020	8.3	14.463	0.10				
5/17/2020	8.1	13.327	0.00				
5/18/2020	8.2	14.317	0.35	74	0.9	77.3	0.01
5/19/2020	8.2	15.626	0.00				
5/20/2020	8.2	15.258	0.00				
5/21/2020	8.1	15.123	0.00				
5/22/2020	8.0	13.099	0.00				
5/23/2020	8.1	15.852	0.85				
5/24/2020	8.2	16.483	0.00				
5/25/2020	8.4	16.450	0.10				
5/26/2020	8.2	16.082	0.10	43	1.6	81.8	0.01
5/27/2020	8.1	14.711	0.00				
5/28/2020	8.1	15.678	0.50				
5/29/2020	8.1	15.226	0.30				
5/30/2020	8.0	16.194	0.00				
5/31/2020	8.3	15.356	0.00				
6/1/2020	8.1	14.710	0.00	81	1.7	78.2	0.01
6/2/2020	8.0	12.842	0.00				
6/3/2020	8.4	11.830	0.00				
6/4/2020	8.2	12.044	0.30				
6/5/2020	8.2	12.414	0.00				
6/6/2020	7.8	13.780	0.50				
6/7/2020	8.4	15.461	0.00				
6/8/2020	8.1	13.520	0.00	28	2.2	85.1	0.01
6/9/2020	7.9	11.267	1.25				
6/10/2020	7.8	15.494	0.00				
6/11/2020	8.0	13.904	0.00				
6/12/2020	8.0	10.402	0.00				
6/13/2020	8.0	10.954	0.00				
6/14/2020	8.4	10.699	0.00				
6/15/2020	8.5	10.365	0.00	41	3.0	87.8	0.01
6/16/2020	8.5	10.632	0.00				
6/17/2020	8.4	10.528	0.00				
6/18/2020	8.6	11.023	0.00				
6/19/2020	8.6	10.131	0.00				
6/20/2020	8.6	10.110	0.00				
6/21/2020	8.8	10.599	0.00				
6/22/2020	8.5	10.212	0.00	13	7.5	87.6	0.01
6/23/2020	8.1	10.331	0.50				
6/24/2020	8.2	14.123	0.30				
6/25/2020	7.8	13.502	0.10				
6/26/2020	7.7	14.285	0.00				
6/27/2020	7.5	14.186	0.20				
6/28/2020	8.2	14.936	0.00				
6/29/2020	8.1	14.851	0.40	120	1.4	83.8	0.01
6/30/2020	8.4	18.391	2.20				
7/1/2020	7.9	15.616	2.50				
7/2/2020	8.5	16.396	0.80				
7/3/2020	8.0	14.022	0.00				
7/4/2020	7.9	14.153	0.00				
7/5/2020	7.8	14.182	0.50				
7/6/2020	7.7	11.446	0.00	61	0.4	88.2	0.01
7/7/2020	8.2	11.826	0.00				
7/8/2020	8.1	10.998	0.00				
7/9/2020	8.3	10.604	0.00				
7/10/2020	8.3	9.684	0.00				
7/11/2020	8.5	9.931	0.00				
7/12/2020	8.2	9.701	3.10				
7/13/2020	8.1	17.771	0.00	73	0.7	88.8	0.01
7/14/2020	7.9	14.063	0.00				
7/15/2020	7.8	13.778	0.00				
7/16/2020	8.1	9.857	0.00				
7/17/2020	8.2	9.654	0.00				
7/18/2020	8.5	9.758	0.00				
7/19/2020	8.1	11.327	0.00				
7/20/2020	8.1	9.978	0.00	51	3.9	92.1	0.01
7/21/2020	8.3	11.059	0.00				
7/22/2020	8.2	12.766	1.10				
7/23/2020	7.8	16.240	1.45				
7/24/2020	7.8	14.873	0.00				
7/25/2020	7.7	13.998	0.00				
7/26/2020	8.3	10.802	0.00				
7/27/2020	8.2	11.332	0.00				
7/28/2020	8.3	12.955	0.00				
7/29/2020	8.1	12.245	0.00	38	1.1	89.6	0.01
7/30/2020	7.6	10.973	0.00				
7/31/2020	7.8	11.204	0.00				
8/1/2020	8.1	11.322	0.00				
8/2/2020	8.1	13.081	0.00				
8/3/2020	8.1	13.081	0.25				
8/4/2020	8.2	11.207	0.00				
8/5/2020	8.2	11.004	0.00	32	5.3	90.1	0.01
8/6/2020	8.1	11.417	0.00				
8/7/2020	8.0	12.628	0.00				
8/8/2020	7.9	13.278	0.00				
8/9/2020	7.9	11.901	0.00				
8/10/2020	7.9	13.008	0.00				

8/11/2020	7.9	11.897	0.00				
8/12/2020	7.9	12.020	0.00	89	4.9	91.7	0.01
8/13/2020	8.0	10.472	0.00				
8/14/2020	8.0	12.598	1.10				
8/15/2020	7.8	13.685	0.40				
8/16/2020	7.8	13.355	0.00				
8/17/2020	7.0	14.110	0.00	92	5.5	92.3	0.01
8/18/2020	7.9	14.269	0.00				
8/19/2020	8.0	13.338	0.00				
8/20/2020	7.8	13.029	0.00				
8/21/2020	7.9	14.052	0.40				
8/22/2020	7.9	14.086	0.00				
8/23/2020	8.0	14.241	0.00				
8/24/2020	8.0	14.326	0.35				
8/25/2020	8.0	14.447	0.00	32	0.7	93.3	0.01
8/26/2020	8.0	14.227	1.65				
8/27/2020	8.1	13.843	0.00				
8/28/2020	7.7	12.832	0.80				
8/29/2020	7.3	13.761	1.65				
8/30/2020	7.4	13.818	0.00				
8/31/2020	7.6	13.753	0.30	62	0.8	89.6	0.01
9/1/2020	7.9	13.985	0.00				
9/2/2020	7.3	14.608	0.00				
9/3/2020	7.8	14.736	0.00				
9/4/2020	7.8	14.895	0.00				
9/5/2020	8.0	14.768	0.00				
9/6/2020	8.0	14.610	0.00				
9/7/2020	7.9	14.455	0.00				
9/8/2020	7.9	14.425	0.00				
9/9/2020	7.9	14.417	0.00				
9/10/2020	8.2	14.395	0.00	51	2.4	85.8	0.01
9/11/2020	8.1	14.373	0.00				
9/12/2020	8.2	14.290	0.00				
9/13/2020	8.2	14.278	0.00				
9/14/2020	8.1	14.389	1.30	105	3.2	89.6	0.01
9/15/2020	8.0	13.881	0.00				
9/16/2020	8.0	13.895	0.00				
9/17/2020	7.8	13.750	0.00				
9/18/2020	8.0	14.135	0.00				
9/19/2020	8.0	13.863	0.00				
9/20/2020	7.9	13.907	0.00				
9/21/2020	7.6	14.214	0.00				
9/22/2020	7.7	13.727	0.00				
9/23/2020	8.2	14.027	0.00	38	3.2	81.5	0.01
9/24/2020	8.0	13.468	1.70				
9/25/2020	7.8	13.892	0.15				
9/26/2020	7.8	14.102	0.00				
9/27/2020	7.8	13.962	0.00				
9/28/2020	7.8	13.361	0.00	27	1.3	80.7	0.01
9/29/2020	7.8	13.037	0.20				
9/30/2020	8.0	12.856	0.00				
10/1/2020	8.6	13.290	0.00				
10/2/2020	8.2	12.104	0.00				
10/3/2020	8.1	14.412	0.00				
10/4/2020	8.0	13.025	0.00				
10/5/2020	7.8	13.089	0.00				
10/6/2020	7.7	12.564	0.00	13	2.2	77.0	0.01
10/7/2020	7.8	12.504	0.00				
10/8/2020	7.8	14.443	0.00				
10/9/2020	7.8	14.061	0.00				
10/10/2020	7.7	13.416	0.80				
10/11/2020	7.8	13.861	0.50				
10/12/2020	8.0	13.771	0.00				
10/13/2020	8.0	13.367	0.00				
10/14/2020	8.0	12.557	0.00	14	0.5	80.2	0.01
10/15/2020	7.9	13.495	0.00				
10/16/2020	8.1	13.583	0.10				
10/17/2020	8.2	12.544	0.00				
10/18/2020	8.1	12.653	0.00				
10/19/2020	8.0	13.413	0.00	35	0.5	76.6	0.01
10/20/2020	7.7	14.119	0.00				
10/21/2020	8.0	14.209	0.00				
10/22/2020	7.9	14.293	0.00				
10/23/2020	7.7	14.358	0.00				
10/24/2020	8.2	15.080	0.00				
10/25/2020	8.0	13.235	1.50				
10/26/2020	8.0	13.350	0.00				
10/27/2020	7.8	13.039	0.00	43	1.4	74.8	0.01
10/28/2020	7.8	13.741	1.50				
10/29/2020	8.0	14.769	0.80				
10/30/2020	7.7	12.967	0.00				
10/31/2020	7.9	12.447	0.00				
11/1/2020	8.1	12.987	0.00				
11/2/2020	8.2	12.157	0.00				
11/3/2020	8.3	12.395	0.00	43	0.5	74.4	0.01
11/4/2020	8.0	12.231	0.00				
11/5/2020	8.2	12.049	0.00				
11/6/2020	8.2	11.972	0.00				
11/7/2020	8.1	12.562	0.00				
11/8/2020	8.0	13.472	0.00				
11/9/2020	7.9	13.564	0.00				
11/10/2020	8.0	14.841	0.00				
11/11/2020	8.0	13.351	0.10	48	3.2	72.0	0.01
11/12/2020	7.8	13.541	0.00				
11/13/2020	7.7	11.685	0.00				
11/14/2020	7.9	12.066	0.00				
11/15/2020	8.0	13.579	0.00				
11/16/2020	8.1	12.440	0.00				
11/17/2020	8.3	11.934	0.00	27	0.9	71.4	0.01
11/18/2020	8.0	11.635	0.00				
11/19/2020	8.3	12.056	0.00				
11/20/2020	8.1	12.453	0.00				
11/21/2020	8.1	12.617	0.00				
11/22/2020	8.2	12.703	0.00				
11/23/2020	8.3	11.860	0.00	12	0.3	68.3	0.01
11/24/2020	8.4	11.552	0.00				
11/25/2020	8.3	12.595	0.00				
11/26/2020	8.1	11.342	0.00				
11/27/2020	8.1	11.607	0.00				
11/28/2020	8.3	11.831	0.30				

11/29/2020	8.4	11.083	0.00				
11/30/2020	8.1	10.540	0.80	48	1.3	56.8	0.01
12/1/2020	8.1	11.232	0.00				
12/2/2020	8.3	8.683	0.00				
12/3/2020	8.1	13.711	0.00				
12/4/2020	8.2	11.416	0.80				
12/5/2020	7.9	13.521	0.00				
12/6/2020	8.1	13.782	0.00				
12/7/2020	8.0	12.443	0.00	45	1.3	60.4	0.01
12/8/2020	8.0	10.960	0.00				
12/9/2020	7.9	13.841	0.00				
12/10/2020	7.9	14.039	0.00				
12/11/2020	8.8	12.484	0.00				
12/12/2020	8.0	12.845	0.40				
12/13/2020	8.0	12.828	0.00				
12/14/2020	8.3	13.414	1.30				
12/15/2020	7.9	12.468	0.00				
12/16/2020	8.0	11.946	0.25				
12/17/2020	8.1	11.958	0.00	190	0.8	60.6	0.01
12/18/2020	8.3	11.205	0.00				
12/19/2020	8.5	13.792	0.00				
12/20/2020	8.1	12.036	0.35				
12/21/2020	8.0	11.559	0.15	38	1.2	58.6	0.01
12/22/2020	8.0	12.036	0.00				
12/23/2020	7.9	13.148	0.00				
12/24/2020	8.2	14.144	0.00				
12/25/2020	8.1	10.653	0.00				
12/26/2020	8.2	6.271	1.10				
12/27/2020	8.7	12.221	0.00				
12/28/2020	8.5	13.530	0.00	27	2.6	60.4	0.01
12/29/2020	8.2	12.337	0.00				
12/30/2020	8.0	11.745	0.00				
12/31/2020	8.1	13.269	0.40				
1/1/2021	8.0	12.948	0.70				
1/2/2021	8.6	11.943	0.00				
1/3/2021	8.5	12.612	0.00				
1/4/2021	8.5	12.289	0.00	63	4.4	51.9	0.01
1/5/2021	8.1	11.966	0.00				
1/6/2021	7.9	16.211	0.00				
1/7/2021	8.1	12.916	0.00				
1/8/2021	8.5	12.004	0.40				
1/9/2021	8.0	12.040	0.00				
1/10/2021	8.1	13.131	0.00				
1/11/2021	8.0	13.444	0.00	14	0.4	53	0.01
1/12/2021	7.9	13.879	0.00				
1/13/2021	7.9	13.661	0.00				
1/14/2021	7.9	13.019	0.00				
1/15/2021	8.0	12.460	0.00				
1/16/2021	8.3	10.425	0.00				
1/17/2021	8.2	10.092	0.00				
1/18/2021	8.2	12.113	0.00	3	1.7	52.2	0.01
1/19/2021	7.7	11.913	0.00				
1/20/2021	7.7	11.861	0.00				
1/21/2021	7.9	11.566	0.40				
1/22/2021	8.1	10.614	0.00				
1/23/2021	8.2	11.907	0.00				
1/24/2021	8.2	11.226	0.00				
1/25/2021	8.1	11.977	1.40				
1/26/2021	8.1	13.737	0.00				
1/27/2021	8.2	12.783	0.00	92	1	59.1	0.01
1/28/2021	8.3	11.535	0.00				
1/29/2021	8.3	12.402	0.00				
1/30/2021	8.2	11.529	0.00				
1/31/2021	8.1	11.813	0.30				
2/1/2021	8.0	10.963	0.00				
2/2/2021	7.8	11.249	0.00				
2/3/2021	8.0	11.978	0.00	21	1.7	57.3	0.01
2/4/2021	8.4	12.493	0.00				
2/5/2021	8.2	12.078	0.04				
2/6/2021	8.5	15.879	0.00				
2/7/2021	8.3	10.958	0.00				
2/8/2021	8.5	10.580	0.10	63	0.5	51.4	0.01
2/9/2021	8.5	11.115	0.00				
2/10/2021	8.4	11.839	0.00				
2/11/2021	7.9	12.448	0.35				
2/12/2021	8.1	11.299	0.50				
2/13/2021	8.0	13.370	0.00				
2/14/2021	8.1	13.693	0.00				
2/15/2021	8.0	12.235	0.35				
2/16/2021	7.9	12.198	0.30				
2/17/2021	7.7	12.198	0.30	47	3.0	53.4	0.01
2/18/2021	7.8	12.162	0.00				
2/19/2021	8.2	10.463	0.00				
2/20/2021	8.4	7.910	0.00				
2/21/2021	8.3	9.074	0.00				
2/22/2021	8.1	13.485	0.00				
2/23/2021	8.0	13.426	0.00				
2/24/2021	8.1	12.313	0.00	55	3.0	53.9	0.01
2/25/2021	8.2	13.247	0.00				
2/26/2021	7.7	12.448	0.70				
2/27/2021	7.5	13.630	0.00				
2/28/2021	7.8	13.308	0.00				
3/1/2021	7.8	13.043	0.90				
3/2/2021	7.7	11.261	0.00				
3/3/2021	7.8	11.959	0.00				
3/4/2021	7.7	13.335	0.00	142	3.5	56.8	0.01
3/5/2021	7.9	12.240	0.00				
3/6/2021	7.8	11.748	0.00				
3/7/2021	7.8	12.529	0.00				
3/8/2021	8.1	13.601	0.00	35	1	67.4	0.01
3/9/2021	7.7	12.892	0.00				
3/10/2021	8.1	13.452	0.00				
3/11/2021	7.9	13.585	0.00				
3/12/2021	8.1	13.328	0.00				
3/13/2021	7.8	13.548	0.00				
3/14/2021	7.9	13.305	0.00				
3/15/2021	8.0	13.578	0.00	18	0.3	66.5	0.01
3/16/2021	8.1	13.123	0.00				
3/17/2021	8.0	13.696	0.65				
3/18/2021	8.0	17.481	1.20				

3/19/2021	7.8	14.378	0.00				
3/20/2021	7.9	14.590	0.00				
3/21/2021	7.8	15.047	0.00				
3/22/2021	7.7	14.897	0.00				
3/23/2021	7.9	16.092	0.00	115	0.7	62.7	0.01
3/24/2021	7.6	15.737	0.30				
3/25/2021	7.8	16.435	1.45				
3/26/2021	7.6	17.061	0.60				
3/27/2021	7.9	14.650	0.16				
3/28/2021	7.8	18.244	2.50				
3/29/2021	7.5	16.065	0.00				
3/30/2021	7.5	16.041	0.00				
3/31/2021	7.5	16.781	1.10	161.00	1.4	63.5	0.01
4/1/2021	7.7	15.639	0.00				
4/2/2021	7.8	15.754	0.00				
4/3/2021	8.0	16.763	0.00				
4/4/2021	7.9	15.783	0.00				
4/5/2021	7.7	15.411	0.00	58	2.7	64.7	0.01
4/6/2021	7.5	15.737	0.00				
4/7/2021	7.7	17.206	0.00				
4/8/2021	7.8	16.810	0.90				
4/9/2021	7.2	15.455	0.00				
4/10/2021	8.3	16.179	0.75				
4/11/2021	7.8	15.556	0.00				
4/12/2021	8.0	15.108	0.00				
4/13/2021	7.6	16.141	0.00	150	1.1	72.1	0.01
4/14/2021	7.7	16.094	0.00				
4/15/2021	7.9	15.625	0.00				
4/16/2021	7.9	15.897	0.00				
4/17/2021	7.9	15.643	0.00				
4/18/2021	7.8	15.929	0.00				
4/19/2021	7.8	15.606	0.00	16	2.9	68.1	0.01
4/20/2021	7.7	16.096	0.00				
4/21/2021	7.7	16.553	0.01				
4/22/2021	7.8	16.053	0.00				
4/23/2021	7.7	15.669	0.00				
4/24/2021	7.8	15.800	0.00				
4/25/2021	7.8	16.107	0.50				
4/26/2021	7.8	15.985	0.00				
4/27/2021	8.0	15.621	0.00				
4/28/2021	7.8	18.007	0.00				
4/29/2021	7.9	15.881	0.10	25	0.4	69	0.01
4/30/2021	7.9	16.205	0.00				
5/1/2021	8.0	16.662	0.00	48	2.5	72.3	0.01
5/2/2021	7.9	16.625	0.00				
5/3/2021	7.9	15.997	0.45				
5/4/2021	8.2	16.913	1.45				
5/5/2021	8.2	17.942	0.36				
5/6/2021	7.9	16.899	0.00				
5/7/2021	8.0	16.187	0.00				
5/8/2021	7.8	16.456	0.00				
5/9/2021	8.2	16.022	0.00				
5/10/2021	8.1	16.300	0.00	24	1.6	72.3	0.01
5/11/2021	8.0	16.607	0.00				
5/12/2021	7.9	16.472	0.60				
5/13/2021	7.8	15.766	0.00				
5/14/2021	7.8	12.079	0.00				
5/15/2021	7.9	11.664	0.00				
5/16/2021	8.0	12.716	0.00				
5/17/2021	8.1	11.608	0.00				
5/18/2021	7.8	10.808	0.00	14	3.5	75	0.01
5/19/2021	8.0	11.965	0.00				
5/20/2021	7.8	12.349	0.00				
5/21/2021	8.1	12.660	0.00				
5/22/2021	8.1	11.575	0.00				
5/23/2021	8.1	12.551	0.00				
5/24/2021	8.6	12.437	0.00	25	3.3	80.6	0.01
5/25/2021	8.0	11.708	0.00				
5/26/2021	7.7	11.503	0.00				
5/27/2021	7.9	11.165	0.00				
5/28/2021	8.0	11.838	0.30				
5/29/2021	7.8	11.120	0.00				
5/30/2021	7.9	11.199	0.00				
5/31/2021	8.0	11.333	0.00				
6/1/2021	8.1	11.510	0.00				
6/2/2021	7.9	13.144	1.20	12	3.8	79.5	0.01
6/3/2021	7.8	16.677	0.60				
6/4/2021	7.7	15.419	0.00				
6/5/2021	7.6	15.705	0.00				
6/6/2021	7.6	15.849	0.70				
6/7/2021	7.8	15.849	0.75				
6/8/2021	7.7	16.694	0.50				
6/9/2021	7.7	17.097	1.40				
6/10/2021	7.8	16.791	0.35				
6/11/2021	7.8	15.504	0.00	14	0.6	82.5	0.01
6/12/2021	7.7	16.183	0.10				
6/13/2021	7.5	15.835	0.00				
6/14/2021	7.6	14.756	0.35	10	2.8	86.0	0.01
6/15/2021	7.8	12.225	0.00				
6/16/2021	8.0	12.246	0.00				
6/17/2021	8.2	11.595	0.00				
6/18/2021	7.9	11.708	0.00				
6/19/2021	7.6	11.599	0.00				
6/20/2021	7.9	11.518	0.00				
6/21/2021	7.8	11.018	0.00	20	1.7	87.2	0.01
6/22/2021	7.6	15.438	1.50				
6/23/2021	7.7	16.178	0.00				
6/24/2021	7.9	16.147	0.00				
6/25/2021	7.9	14.394	0.00				
6/26/2021	7.9	12.049	0.00				
6/27/2021	7.9	12.044	0.00				
6/28/2021	7.4	11.254	0.10	7	0.5	88.5	0.01
6/29/2021	7.7	14.196	0.00				
6/30/2021	6.8	17.171	0.90				
7/1/2021	7.6	16.333	0.00				
7/2/2021	7.6	17.024	0.15				
7/3/2021	7.8	17.041	0.00				
7/4/2021	8.1	17.030	0.00				
7/5/2021	7.7	14.701	0.00				
7/6/2021	7.7	12.913	0.00	4	3.2	83.8	0.01

7/7/2021	7.9	13.438	0.00				
7/8/2021	7.8	17.440	0.90				
7/9/2021	7.7	17.532	0.10				
7/10/2021	7.7	17.826	1.30				
7/11/2021	7.4	16.470	0.40				
7/12/2021	7.7	16.314	1.20	43	2.1	87.4	0.01
7/13/2021	7.8	16.260	0.00				
7/14/2021	7.7	17.399	0.70				
7/15/2021	7.9	17.621	0.00				
7/16/2021	8.1	14.741	0.00				
7/17/2021	7.7	13.121	0.10				
7/18/2021	7.8	14.126	0.00				
7/19/2021	7.6	14.417	0.10	20	0.3	88.5	0.01
7/20/2021	7.6	13.494	0.15				
7/21/2021	7.8	13.626	0.75				
7/22/2021	7.9	13.302	0.00				
7/23/2021	7.9	15.117	0.00				
7/24/2021	7.6	14.614	0.00				
7/25/2021	7.7	15.502	0.00				
7/26/2021	7.8	14.526	0.60				
7/27/2021	7.7	17.552	0.10				
7/28/2021	7.7	17.408	0.00	29	2.0	90.6	0.01
7/29/2021	7.6	15.893	0.00				
7/30/2021	8.1	16.992	0.00				
7/31/2021	7.5	16.082	0.30				
8/1/2021	7.6	14.193	0.00				
8/2/2021	7.6	16.382	0.15	79	1.8	82.9	0.01
8/3/2021	7.8	16.539	0.70				
8/4/2021	7.9	15.318	0.00				
8/5/2021	8.3	14.403	0.00				
8/6/2021	8.1	12.656	0.00				
8/7/2021	7.8	3.135	0.20				
8/8/2021	7.9	3.024	0.00				
8/9/2021	8.0	2.160	0.00				
8/10/2021	7.7	1.971	0.00				
8/11/2021	7.5	10.493	0.00	38	1.7	80.2	0.01
8/12/2021	7.7	12.694	0.00				
8/13/2021	7.8	10.297	0.08				
8/14/2021	8.4	10.343	0.00				
8/15/2021	7.7	13.335	0.00				
8/16/2021	7.8	11.018	1.20	92	3.6	80.6	0.01
8/17/2021	8.1	11.286	0.00				
8/18/2021	8.0	2.186	0.00				
8/19/2021	7.7	6.211	3.40				
8/20/2021	7.8	16.630	0.05				
8/21/2021	8.3	16.244	0.00				
8/22/2021	8.0	16.126	0.60				
8/23/2021	8.3	16.079	0.00	40	2.6	84.2	0.01
8/24/2021	8.0	14.966	0.00				
8/25/2021	8.1	7.785	0.00				
8/26/2021	7.9	2.452	0.00				
8/27/2021	8.0	13.486	0.00				
8/28/2021	7.7	16.488	0.00				
8/29/2021	7.7	16.401	0.00				
8/30/2021	7.8	16.308	0.00	20	4.7	78.6	0.01
8/31/2021	7.9	16.952	3.50				
9/1/2021	7.7	17.075	0.05				
9/2/2021	7.8	15.468	0.00				
9/3/2021	7.9	14.843	0.00				
9/4/2021	7.7	14.852	0.00				
9/5/2021	7.8	15.432	0.00				
9/6/2021	7.9	15.774	0.00				
9/7/2021	7.9	14.992	0.00	8	1.1	86.3	0.01
9/8/2021	7.9	14.396	0.00				
9/9/2021	8.0	14.999	0.00				
9/10/2021	7.8	14.419	0.00				
9/11/2021	8.0	14.457	0.00				
9/12/2021	8.0	14.993	0.00				
9/13/2021	8.0	15.365	0.00	15	1.1	89.0	0.01
9/14/2021	7.8	15.577	0.00				
9/15/2021	7.9	16.736	3.45				
9/16/2021	7.7	16.618	0.00				
9/17/2021	7.9	16.365	0.08				
9/18/2021	7.8	23.201	5.00		8.3		
9/19/2021	7.8	16.572	0.35				
9/20/2021	7.7	16.080	0.15				
9/21/2021	7.7	15.960	0.50				
9/22/2021	7.7	15.274	0.20	96	2.1	84.9	0.01
9/23/2021	7.8	13.473	0.00				
9/24/2021	7.9	13.159	0.00				
9/25/2021	7.9	13.653	0.00				
9/26/2021	7.6	13.885	0.00				
9/27/2021	7.6	13.506	0.00	37	3.9	82.2	0.01
9/28/2021	7.6	13.320	0.00				
9/29/2021	7.7	14.408	0.00				
9/30/2021	7.6	14.604	0.00				
10/1/2021	7.8	14.180	0.00				
10/2/2021	7.7	13.429	0.00				
10/3/2021	7.8	13.713	0.00				
10/4/2021	7.7	13.917	0.80				
10/5/2021	7.7	14.344	0.20	118	3.0	82.9	0.01
10/6/2021	7.7	14.298	1.20				
10/7/2021	7.7	14.166	0.10				
10/8/2021	7.7	13.218	0.00				
10/9/2021	7.7	13.724	0.00				
10/10/2021	7.8	14.596	0.00				
10/11/2021	7.8	14.130	0.00	31	3.4	83.4	0.01
10/12/2021	8.1	13.787	0.10				
10/13/2021	7.8	14.386	0.00				
10/14/2021	7.8	14.059	0.00				
10/15/2021	7.8	13.735	0.00				
10/16/2021	8.0	13.855	1.00				
10/17/2021	7.9	13.920	0.00				
10/18/2021	7.6	13.887	0.00	24	1.3	81.8	0.01
10/19/2021	7.8	14.233	0.00				
10/20/2021	7.8	16.130	0.00				
10/21/2021	7.8	15.624	0.00				
10/22/2021	7.9	15.831	0.40				
10/23/2021	7.9	15.804	0.00				
10/24/2021	7.8	16.072	0.00				

10/25/2021	7.8	15.896	0.30	20	0.8	78.2	0.01
10/26/2021	8.0	16.116	0.00				
10/27/2021	7.8	16.914	0.00				
10/28/2021	7.8	16.165	0.75				
10/29/2021	7.9	15.902	0.20				
10/30/2021	8.0	15.761	0.10				
10/31/2021	8.1	15.188	0.00				
11/1/2021	8.0	15.047	0.00	21	2.4	75.0	0.01
11/2/2021	7.9	14.839	0.00				
11/3/2021	8.1	14.651	0.00				
11/4/2021	8.1	13.790	0.00				
11/5/2021	8.0	14.975	0.00				
11/6/2021	8.2	14.664	0.00				
11/7/2021	8.2	14.966	0.00				
11/8/2021	8.2	14.845	0.00	9	1.5	70.5	0.01
11/9/2021	8.8	14.885	0.00				
11/10/2021	8.1	14.729	0.00				
11/11/2021	8.0	15.939	0.10				
11/12/2021	7.9	15.387	0.10				
11/13/2021	8.0	15.089	0.00				
11/14/2021	7.9	16.422	0.00				
11/15/2021	8.0	15.564	0.00	11	2.3		0.01
11/16/2021	8.0	15.605	0.00				
11/17/2021	8.0	15.645	0.00				
11/18/2021	7.8	16.134	0.22				
11/19/2021	8.0	15.248	0.22				
11/20/2021	8.0	15.404	0.00				
11/21/2021	8.2	14.219	0.00				
11/22/2021	8.3	16.283	0.40	64	0.9	65.1	0.01
11/23/2021	8.1	15.568	0.00				
11/24/2021	8.2	13.647	0.00				
11/25/2021	8.1	14.133	0.00				
11/26/2021	8.0	13.653	0.00				
11/27/2021	8.1	10.792	0.00				
11/28/2021	8.0	14.392	0.00				
11/29/2021	8.1	14.266	0.00	22	3.1	63.6	0.01
11/30/2021	8.0	15.299	0.00				
12/1/2021	8.1	14.594	0.00				
12/2/2021	8.1	14.156	0.00				
12/3/2021	8.2	13.943	0.00				
12/4/2021	8.1	14.957	0.20				
12/5/2021	8.1	16.493	0.00				
12/6/2021	7.9	15.230	0.70	53	2.2	65.8	0.01
12/7/2021	8.1	14.336	0.00				
12/8/2021	8.2	11.509	0.00				
12/9/2021	8.3	15.108	0.00				
12/10/2021	8.2	14.839	0.10				
12/11/2021	8.2	16.217	0.70				
12/12/2021	8.2	14.756	0.10				
12/13/2021	8.4	12.180	0.00	73	1.4	57.9	0.01
12/14/2021	8.3	14.505	0.00				
12/15/2021	8.0	14.129	0.00				
12/16/2021	8.2	15.415	0.00				
12/17/2021	8.3	15.528	0.40				
12/18/2021	8.2	15.423	0.00				
12/19/2021	8.2	14.385	0.00				
12/20/2021	8.4	14.728	0.00	65	0.6	62.7	0.01
12/21/2021	8.1	12.481	0.00				
12/22/2021	8.0	14.761	0.00				
12/23/2021	8.0	11.179	0.00				
12/24/2021	8.0	14.741	0.00				
12/25/2021	8.2	15.656	0.00				
12/26/2021	7.7	15.616	0.00				
12/27/2021	8.0	15.594	0.10	7	3.4	65.1	0.01
12/28/2021	8.0	15.261	0.00				
12/29/2021	8.2	15.819	0.00				
12/30/2021	8.2	15.610	1.80				
12/31/2021	8.1	15.610	0.00				
1/1/2022	8.1	15.610	0.05				
1/2/2022	8.2	15.610	2.70				
1/3/2022	8.4	15.363	0.25				
1/4/2022	8.2	15.486	0.00				
1/5/2022	8.3	15.295	0.00	72	0.7	52.7	0.01
1/6/2022	8.0	14.104	0.30				
1/7/2022	8.0	13.810	0.00				
1/8/2022	8.0	14.500	0.00				
1/9/2022	7.8	14.846	0.00				
1/10/2022	8.0	14.310	0.38	62	0.2	52.3	0.01
1/11/2022	8.5	14.019	0.00				
1/12/2022	7.8	14.755	0.00				
1/13/2022	7.9	14.838	0.00				
1/14/2022	8.1	15.065	0.00				
1/15/2022	8.0	14.965	0.00				
1/16/2022	8.0	14.961	0.00				
1/17/2022	7.8	15.171	2.50				
1/18/2022	7.8	14.105	0.00				
1/19/2022	8.5	14.977	0.05	174	5.6	53	0.01
1/20/2022	8.1	15.296	1.40				
1/21/2022	8.1	15.514	0.00				
1/22/2022	8.1	15.365	0.00				
1/23/2022	8.1	15.100	0.00				
1/24/2022	8.1	9.739	0.00	140			
1/25/2022	7.8	11.897	0.00		1.6	46.7	0.01
1/26/2022	8.0	12.037	0.00				
1/27/2022	7.9	9.591	0.00				
1/28/2022	7.8	12.912	0.00				
1/29/2022	8.1	8.872	0.00				
1/30/2022	8.2	12.311	0.00				
1/31/2022	8.2	10.983	0.00	20	0.6	50	0.01
2/1/2022	8.3	13.714	0.00				
2/2/2022	8.1	15.658	0.30				
2/3/2022	7.9	14.773	0.70				
2/4/2022	8.2	14.208	0.50				
2/5/2022	8.2	11.240	0.00				
2/6/2022	8.2	8.124	0.00				
2/7/2022	8.2	9.400	0.00	32	6.5	53.7	0.01
2/8/2022	8.3	10.623	0.00				
2/9/2022	8.3	15.204	0.00				
2/10/2022	8.4	15.767	0.00				
2/11/2022	8.2	16.279	0.00				

2/12/2022	8.1	16.035	0.1				
2/13/2022	8.3	12.162	0.00				
2/14/2022	8.3	9.928	0.00	21	0.1	48	0.01
2/15/2022	8.1	12.608	0.00				
2/16/2022	8.1	15.148	0.00				
2/17/2022	8.1	17.715	0.10				
2/18/2022	7.7	20.201	0.90				
2/19/2022	7.6	14.345	0.10				
2/20/2022	8.0	15.027	0.00				
2/21/2022	7.8	18.944	0.00	168	0.5	52.8	0.01
2/22/2022	7.8	18.535	1.00				
2/23/2022	7.9	19.113	1.10				
2/24/2022	7.8	17.691	0.38				
2/25/2022	7.7	17.044	0.10				
2/26/2022	7.7	18.545	0.00				
2/27/2022	8.0	18.129	1.00				
2/28/2022	7.7	18.785	0.00	130	5.0	54.5	0.01
3/1/2022	7.6	19.753	0.00				
3/2/2022	7.7	18.510	0.00				
3/3/2022	7.4	18.471	0.00				
3/4/2022	7.6	18.360	0.00				
3/5/2022	7.8	18.696	0.00				
3/6/2022	7.9	18.874	0.00				
3/7/2022	7.5	18.686	0.30	53	1.4	64.9	0.01
3/8/2022	7.9	17.908	0.10				
3/9/2022	7.7	17.393	0.70				
3/10/2022	7.9	17.363	0.00				
3/11/2022	7.8	17.755	0.00				
3/12/2022	7.8	18.507	0.00				
3/13/2022	8.0	9.867	0.00				
3/14/2022	8.0	16.921	0.00	149	2.1	62.6	0.01
3/15/2022	8.0	17.598	0.00				
3/16/2022	7.9	17.027	1.10				
3/17/2022	7.3	17.309	0.00				
3/18/2022	7.0	17.334	0.60				
3/19/2022	7.8	17.502	0.00				
3/20/2022	7.8	17.193	0.00				
3/21/2022	7.7	17.031	0.00	122.00	0.5	65.4	0.01
3/22/2022	7.8	17.630	0.00				
3/23/2022	8.0	17.760	0.90				
3/24/2022	7.9	16.852	0.00				
3/25/2022	8.0	16.595	0.00				
3/26/2022	8.0	16.566	0.00				
3/27/2022	7.6	16.707	0.00				
3/28/2022	8.1	16.600	0.00				
3/29/2022	8.0	17.176	0.00				
3/30/2022	7.5	17.018	0.00	30	1.4	65.1	0.01
3/31/2022	7.5	17.813	0.80				
4/1/2022	7.9	17.400	0.00				
4/2/2022	7.6	17.385	0.10				
4/3/2022	7.6	17.119	0.00				
4/4/2022	7.7	16.848	0.00	19	1.4	68	0.01
4/5/2022	7.6	17.357	0.70				
4/6/2022	7.8	16.988	0.08				
4/7/2022	7.9	16.929	0.00				
4/8/2022	7.8	17.013	0.00				
4/9/2022	8.2	16.727	0.00				
4/10/2022	8.0	17.458	0.00				
4/11/2022	8.1	17.385	0.30	9	2.7	65.6	0.01
4/12/2022	7.8	16.773	0.10				
4/13/2022	8.0	17.521	0.25				
4/14/2022	7.8	18.883	1.30				
4/15/2022	8.1	17.913	0.00				
4/16/2022	8.5	20.385	2.00				
4/17/2022	8.0	18.968	0.15				
4/18/2022	7.9	17.715	0.15				
4/19/2022	7.9	16.574	0.00	144	0.2	67.6	0.01
4/20/2022	8.1	17.545	0.00				
4/21/2022	7.9	17.968	0.10				
4/22/2022	7.5	17.805	0.00				
4/23/2022	7.4	18.188	0.00				
4/24/2022	7.7	17.678	0.00				
4/25/2022	8.1	18.757	0.00				
4/26/2022	7.6	17.958	0.20	18	3.9	74.8	0.01
4/27/2022	8.0	16.824	0.00				
4/28/2022	7.8	17.434	0.00				
4/29/2022	7.7	18.349	0.00				
4/30/2022	7.9	19.019	0.00				
5/1/2022	8.0	16.754	0.05				
5/2/2022	7.9	13.765	0.00	7	2.6	76.2	0.01
5/3/2022	7.8	12.572	0.02				
5/4/2022	8.1	13.190	0.00				
5/5/2022	7.8	13.818	0.00				
5/6/2022	7.5	16.421	0.75				
5/7/2022	8.0	17.840	0.10				
5/8/2022	8.0	17.447	0.00				
5/9/2022	7.9	18.537	0.00	10	3.2	77	0.01
5/10/2022	7.7	18.078	0.00				
5/11/2022	8.1	14.270	0.00				
5/12/2022	8.0	13.815	0.00				
5/13/2022	7.9	13.091	0.80				
5/14/2022	8.0	16.651	0.00				
5/15/2022	8.0	16.161	0.00				
5/16/2022	8.6	15.337	0.20	18	1.6	87.8	0.01
5/17/2022	8.4	15.692	0.00				
5/18/2022	7.7	12.114	0.00				
5/19/2022	7.7	11.675	0.00				
5/20/2022	7.6	10.910	0.00				
5/21/2022	7.7	10.405	0.00				
5/22/2022	7.8	11.924	0.48				
5/23/2022	7.9	15.783	0.10				
5/24/2022	7.9	15.585	0.00	24	1.7	80.6	0.01
5/25/2022	8.1	16.310	0.90				
5/26/2022	7.5	16.200	0.90				
5/27/2022	8.1	16.673	0.10				
5/28/2022	8.3	16.030	0.00				
5/29/2022	8.5	13.933	0.00				
5/30/2022	8.6	11.086	0.00				
5/31/2022	8.7	12.290	0.00	12	2.1	89	0.01
6/1/2022	8.1	11.375	0.00				

6/2/2022	8.1	12.477	0.30				
6/3/2022	7.7	12.736	0.55				
6/4/2022	7.7	16.809	0.00				
6/5/2022	7.8	17.138	0.00				
6/6/2022	7.9	17.589	0.00				
6/7/2022	7.7	17.395	0.15	8	0.1	89.7	0.01
6/8/2022	7.5	13.348	0.19				
6/9/2022	8.0	14.078	0.35				
6/10/2022	7.6	13.595	0.00				
6/11/2022	8.0	13.537	0.00				
6/12/2022	8.1	13.486	0.00				
6/13/2022	8.3	13.713	0.00	12	0.7	93.3	0.01
6/14/2022	8.2	14.723	0.00				
6/15/2022	8.0	14.624	0.00				
6/16/2022	7.6	15.259	0.00				
6/17/2022	7.6	8.318	0.00				
6/18/2022	7.7	15.233	0.00				
6/19/2022	7.8	14.846	0.00				
6/20/2022	8.0	13.923	0.00	25	0.7	89.7	0.01
6/21/2022	7.8	13.572	0.00				
6/22/2022	8.0	13.653	0.00				
6/23/2022	8.0	14.415	0.00				
6/24/2022	7.9	13.690	0.00				
6/25/2022	7.9	13.315	0.00				
6/26/2022	8.0	12.537	0.00				
6/27/2022	8.0	12.040	0.00				
6/28/2022	7.4	12.186	0.00	28	2.5	89.8	0.01
6/29/2022	8.1	12.331	0.00				
6/30/2022	7.8	12.445	0.00				
7/1/2022	8.0	13.237					
7/2/2022	8.4	13.775					
7/3/2022	8.5	13.360					
7/4/2022	8.5	13.060					
7/5/2022	8.7	12.692	0.10				
7/6/2022	7.5	1.716					
7/7/2022	7.6	8.053	1.85	143	8.1	93.2	0.01
7/8/2022	7.8	17.258					
7/9/2022	7.9	17.392					
7/10/2022	7.8	16.798					
7/11/2022	7.9	16.856	0.20				
7/12/2022	7.9	16.392		35	2.3	87.9	0.01
7/13/2022	7.8	16.367	1.00				
7/14/2022	7.3	17.838					
7/15/2022	7.9	17.283					
7/16/2022	7.9	16.744					
7/17/2022	8.0	11.958					
7/18/2022	8.0	11.728					
7/19/2022	7.5	12.084		50	0.8	89.0	0.01
7/20/2022	7.4	13.148					
7/21/2022	7.5	11.695					
7/22/2022	7.7	11.609					
7/23/2022	7.8	12.516					
7/24/2022	7.8	12.360					
7/25/2022	7.9	11.886					
7/26/2022	7.9	11.319		13	2.7	91.5	0.01
7/27/2022	8.0	13.245					
7/28/2022	7.9	13.083					
7/29/2022	8.0	10.477	0.10				
7/30/2022	7.9	11.210					
7/31/2022	7.8	11.490					
8/1/2022	7.8	15.129	0.35				
8/2/2022	7.5	16.538		120	2.8	89.9	0.01
8/3/2022	7.7	16.361					
8/4/2022	8.0	16.372					
8/5/2022	7.9	16.886					
8/6/2022	7.9	16.946					
8/7/2022	7.8	15.414					
8/8/2022	7.9	15.097					
8/9/2022	7.5	11.712	0.30	42	1.1	90.6	0.01
8/10/2022	7.7	16.274	0.40				
8/11/2022	7.6	16.156					
8/12/2022	7.6	16.383	0.20				
8/13/2022	7.7	15.908					
8/14/2022	7.8	15.757					
8/15/2022	7.9	15.841					
8/16/2022	7.5	15.322		60	1.2	79.7	0.01
8/17/2022	7.9	14.492					
8/18/2022	7.6	14.439					
8/19/2022	7.1	13.638					
8/20/2022	7.5	12.913					
8/21/2022	7.7	14.606					
8/22/2022	7.9	14.390	0.03				
8/23/2022	7.6	14.347		11	0.1	85.4	0.00
8/24/2022	7.7	15.394					
8/25/2022	8.1	15.121					
8/26/2022	7.7	12.719					
8/27/2022	7.6	13.094					
8/28/2022	7.6	12.317					
8/29/2022	7.6	13.133					
8/30/2022	7.7	13.082	0.50				
8/31/2022	7.7	13.476		45	0.8	90.1	0.01
9/1/2022	7.7	12.026					
9/2/2022	8.3	12.016					
9/3/2022	8.0	12.583					
9/4/2022	7.9	14.931					
9/5/2022	7.7	15.677					
9/6/2022	7.6	15.207	3.20				
9/7/2022	7.8	15.839	0.20	43	3.6	88.5	0.01
9/8/2022	7.6	15.735					
9/9/2022	7.7	14.822					
9/10/2022	7.6	15.717					
9/11/2022	7.5	15.894					
9/12/2022	7.4	15.149	0.10				
9/13/2022	7.5	14.124		86	1.5	83.0	0.00
9/14/2022	7.7	15.413					
9/15/2022	7.9	15.214					
9/16/2022	7.8	15.154					
9/17/2022	7.9	14.810					
9/18/2022	7.9	15.340					
9/19/2022	8.0	14.823					

9/20/2022	7.8	14.425		9	2.1	89.0	0.01
9/21/2022	7.8	15.044					
9/22/2022	7.8	16.247					
9/23/2022	8.0	16.298					
9/24/2022	7.9	16.413					
9/25/2022	7.8	17.350	1.40				
9/26/2022	7.7	16.944					
9/27/2022	7.5	16.344		19	1.5	80.9	0.01
9/28/2022	7.7	16.421					
9/29/2022	7.9	15.902					
9/30/2022	7.9	16.543					
10/1/2022	8.0	16.934					
10/2/2022	8.0	16.813					
10/3/2022	8.1	16.877					
10/4/2022	8.2	16.857		12	2.4	77.0	0.00
10/5/2022	7.6	16.051					
10/6/2022	7.5	15.982					
10/7/2022	7.6	16.801					
10/8/2022	7.6	17.181					
10/9/2022	7.5	16.941					
10/10/2022	7.5	16.645					
10/11/2022	7.8	16.413		23	2.3	75.5	0.01
10/12/2022	7.8	17.460					
10/13/2022	8.0	17.276	1.75				
10/14/2022	8.2	16.407					
10/15/2022	8.4	17.656					
10/16/2022	8.4	17.673					
10/17/2022	8.4	17.846	0.50				
10/18/2022	8.0	17.869		9	2.0	69.4	0.00
10/19/2022	7.8	21.524					
10/20/2022	8.0	14.478					
10/21/2022	8.0	18.043					
10/22/2022	7.9	18.043					
10/23/2022	7.8	18.087					
10/24/2022	7.8	17.757					
10/25/2022	7.6	18.000		23	1.8	76.4	0.01
10/26/2022	7.9	17.585	1.50				
10/27/2022	7.5	16.609	0.10				
10/28/2022	7.8	17.260					
10/29/2022	7.8	17.549					
10/30/2022	7.7	17.844					
10/31/2022	7.7	17.496	0.25				
11/1/2022	7.8	16.893	0.25	22	0.8	73.4	0.01
11/2/2022	8.1	17.891					
11/3/2022	7.9	17.325					
11/4/2022	7.5	17.494					
11/5/2022	7.6	17.625					
11/6/2022	7.5	13.469	0.75				
11/7/2022	7.6	17.535	0.25				
11/8/2022	7.9	18.513					
11/9/2022	8.1	17.351		9	3.2	71.3	0.02
11/10/2022	8.0	17.790	0.50				
11/11/2022	7.9	18.190					
11/12/2022	7.8	17.330					
11/13/2022	7.9	18.647					
11/14/2022	7.9	13.687					
11/15/2022	7.6	16.118	0.50				
11/16/2022	7.9	16.275		63	2.0	68.0	0.00
11/17/2022	8.0	15.104					
11/18/2022	8.1	9.716					
11/19/2022	8.1	12.375					
11/20/2022	8.0	10.406					
11/21/2022	8.0	9.865					
11/22/2022	7.8	13.989		18	6.0	64.9	0.00
11/23/2022	7.7	15.066					
11/24/2022	7.5	17.130					
11/25/2022	7.5	16.503	0.13				
11/26/2022	7.8	16.305					
11/27/2022	8.0	15.904					
11/28/2022	8.1	15.276	1.00				
11/29/2022	7.6	16.055		93	0.5	61.5	0.00
11/30/2022	7.6	17.118	3.50				
12/1/2022	7.4	13.861					
12/2/2022	8.1	16.210					
12/3/2022	7.8	15.890	0.63				
12/4/2022	7.7	15.906					

Outfall 001A Data

Date	pH	Flow	Calc. Flow	NH3-N Samp.-blank	NH3-N ppm	NH3-N lbs/day	NIT-N Samp.-blank	NIT-N ppm	NIT-N lbs/day	ORG-N Samp.-blank	ORG-N ppm	TON	ORG-N lbs/day	O & G
1/1/2017	8.4	1315	1.8936											
1/2/2017	8.2	1688	2.4307											
1/3/2017	8	1065	1.5336											
1/4/2017	8.4	443	0.6379											
1/5/2017	8.8	567	0.8165	9.5	22.2	151	8.8	20.6	140	6.2	36.3	14	96	0.5
1/6/2017	9.1	648	0.9331											
1/7/2017	8.9	648	0.9331											
1/8/2017	8.8	853	1.2283											
1/9/2017	8.8	898	1.2931											
1/10/2017	8.7	708	1.0195											
1/11/2017	8.5	960	1.3824	6.3	14.7	170	6.5	15.2	175	3.2	18.7	4	46	0.8
1/12/2017	8.6	944	1.3594											
1/13/2017	8.9	828	1.1923											
1/14/2017	8.8	394	0.5674											
1/15/2017	8.9	483	0.6955											
1/16/2017	8.9	919	1.3234	3.1	7.3	80	5.3	12.4	137	1.6	9.4	2.1	23	1
1/17/2017	8.7	921	1.3262											
1/18/2017	8.8	887	1.2773											
1/19/2017	8.7	1314	1.8922											
1/20/2017	8.7	829	1.1938											
1/21/2017	8.5	827	1.1909											
1/22/2017	8.3	834	1.201											
1/23/2017	8.2	950	1.368	9.2	21.5	246	10.9	25.5	291	3.7	21.7	0.1	1	0.6
1/24/2017	8.7	960	1.3824											
1/25/2017	9.1	980	1.4112											
1/26/2017	8.8	217	0.3125											
1/27/2017	8.9	463	0.6667											
1/28/2017	8.8	565	0.8136											
1/29/2017	8.2	474	0.6826											
1/30/2017	8.1	694	0.9994											
1/31/2017	8.4	984	1.417											
2/1/2017	7.8	960	1.3824	2.5	5.9	69	6.1	14.3	169	1.2	7	1.2	14	0.5
2/2/2017	8.7	850	1.224											
2/3/2017	9.1	612	0.8813											
2/4/2017	9	638	0.9187											
2/5/2017	8.9	703	1.0123											
2/6/2017	8.7	874	1.2586	3.6	8.4	88	5.5	12.9	135	1.5	8.8	0.4	4	1.2
2/7/2017	8.9	1351	1.9454											
2/8/2017	9.1	737	1.0613											
2/9/2017	9	605	0.8712											
2/10/2017	9.1	725	1.044											
2/11/2017	9	778	1.1203											
2/12/2017	9	744	1.0714											
2/13/2017	8.9	733	1.0555	5.4	12.6	111	5.7	13.3	117	3.2	18.7	6.1	54	0.9
2/14/2017	8.9	764	1.1002											
2/15/2017	8.9	780	1.1232											
2/16/2017	8.9	797	1.1477											
2/17/2017	8.8	859	1.237											
2/18/2017	8.4	831	1.1966											
2/19/2017	8	827	1.1909											
2/20/2017	7.6	817	1.1765	2.8	6.6	64	4.7	11	108	1.5	8.8	2.2	22	1
2/21/2017	8.7	804	1.1578											
2/22/2017	7.4	801	1.1534											
2/23/2017	7.3	771	1.1102											
2/24/2017	9	780	1.1232											
2/25/2017	8.9	654	0.9418											
2/26/2017	8	725	1.044	6.4	15	130	4.5	10.5	92	2.8	16.4	1.4	12	1.7
2/27/2017	8.8	771	1.1102											
2/28/2017	8.7	798	1.1491											
3/1/2017	8.4	1414	2.0362											
3/2/2017	8.7	941	1.355											
3/3/2017	9	783	1.1275											
3/4/2017	9	679	0.9778											
3/5/2017	9.1	235	0.3384	1.6	3.7	11	4.4	10.3	29	0.7	4.1	0.4	1	1.9
3/6/2017	7.7	1043	1.5019											
3/7/2017	8.2	843	1.2139											
3/8/2017	8.3	813	1.1707											
3/9/2017	8.6	1147	1.6517											
3/10/2017	8.4	398	0.5731											
3/11/2017	8.6	636	0.9158											
3/12/2017	9	701	1.0094	1.5	3.5	30	5	11.7	99	0.7	4.1	0.6	5	2.5
3/13/2017	8.8	692	0.9965											
3/14/2017	8.7	604	0.8698											
3/15/2017	8.8	608	0.8755											
3/16/2017	8.9	903	1.3003											
3/17/2017	8.9	943	1.3579											
3/18/2017	8.9	919	1.3234											
3/19/2017	8.9	866	1.247	2.2	5	52	6	13.5	140	1.1	6.2	1.2	13	1.9
3/20/2017	8.9	873	1.2571											
3/21/2017	8.9	879	1.2658											
3/22/2017	8.9	965	1.3896											
3/23/2017	9	1368	1.9699											
3/24/2017	8.7	1393	2.0059											

3/25/2017	8.6	1268	1.8259											
3/26/2017	8.9	762	1.0973	1	2.3	21	4	9	82	0.5	2.8	0.6	5	2
3/27/2017	8.8	1682	2.4221											
3/28/2017	8.3	710	1.0224											
3/29/2017	8.4	1022	1.4717											
3/30/2017	8.7	1042	1.5005											
3/31/2017	8.6	831	1.1966											
4/1/2017	8.9	885	1.2744											
4/2/2017	8.9	1460	2.1024	1.5	3.4	59	5.3	11.9	209	1	5.6	2.3	39	0.8
4/3/2017	8.3	1497	2.1557											
4/4/2017	8.4	708	1.0195											
4/5/2017	8.4	864	1.2442											
4/6/2017	8.7	859	1.237											
4/7/2017	8.9	872	1.2557											
4/8/2017	9	1089	1.5682											
4/9/2017	9	1097	1.5797	1.1	2.5	33	4	9	119	0.7	3.9	1.5	19	1.4
4/10/2017	9	1113	1.6027											
4/11/2017	8.9	1226	1.7654											
4/12/2017	8.8	1131	1.6286											
4/13/2017	8.9	1013	1.4587											
4/14/2017	8.9	1169	1.6834											
4/15/2017	8.9	853	1.2283											
4/16/2017	9	963	1.3867											
4/17/2017	9	1079	1.5538	1.1	2.5	32	4.8	10.8	140	0.6	3.4	0.9	12	0.6
4/18/2017	8.7	1598	2.3011											
4/19/2017	8.6	1538	2.2147											
4/20/2017	8.7	1008	1.4515											
4/21/2017	8.8	980	1.4112											
4/22/2017	8.6	2103	3.0283											
4/23/2017	8.5	562	0.8093	2.8	6.3	43	6.6	14.9	100	1.5	8.4	2.1	14	0.3
4/24/2017	8.7	922	1.3277											
4/25/2017	8.9	879	1.2658											
4/26/2017	8.8	906	1.3046											
4/27/2017	8.5	914	1.3162											
4/28/2017	8.6	948	1.3651											
4/29/2017	8.6	952	1.3709											
4/30/2017	8.6	1082	1.5581											
5/1/2017	8.4	852	1.2269	1.4	3.2	32	5.4	12.2	124	0.7	3.9	0.8	8	0.6
5/2/2017	8.6	871	1.2542											
5/3/2017	8.8	883	1.2715											
5/4/2017	8.6	1042	1.5005											
5/5/2017	8.4	1044	1.5034											
5/6/2017	8.5	1080	1.5552											
5/7/2017	8.5	576	0.8294	1.2	2.7	19	3.7	8.3	58	0.6	3.4	0.7	5	1.1
5/8/2017	8.7	711	1.0238											
5/9/2017	8.7	1102	1.5869											
5/10/2017	8.6	1331	1.9166											
5/11/2017	8.6	1094	1.5754											
5/12/2017	8.4	971	1.3982											
5/13/2017	8.5	975	1.404											
5/14/2017	8.5	1016	1.463	0.7	1.6	19	3.2	7.2	88	0.4	2.3	0.7	8	0.1
5/15/2017	8.6	1245	1.7928											
5/16/2017	8.8	1249	1.7986											
5/17/2017	8.8	1233	1.7755											
5/18/2017	9.1	1198	1.7251											
5/19/2017	9.2	1207	1.7381											
5/20/2017	8.8	1245	1.7928											
5/21/2017	8.8	1134	1.633	12	27	368	5.5	12.4	169	5	28.1	1.1	15	6.5
5/22/2017	9.4	1106	1.5926											
5/23/2017	9	1076	1.5494											
5/24/2017	9	1072	1.5437											
5/25/2017	8.5	1080	1.5552											
5/26/2017	8.5	1095	1.5768											
5/27/2017	8.7	1935	2.7864											
5/28/2017	8.3	1101	1.5854											
5/29/2017	8.4	989	1.4242											
5/30/2017	8.5	964	1.3882	2	4.5	52	5.2	11.7	136	1	5.6	1.1	13	0.6
5/31/2017	8.9	783	1.1275											
6/1/2017	9	1280	1.8432											
6/2/2017	8.6	1124	1.6186											
6/3/2017	8.4	985	1.4184											
6/4/2017	8.3	1036	1.4918	3	6.8	84	7.1	16	199	1.5	8.4	1.7	21	1.1
6/5/2017	8.1	1057	1.5221											
6/6/2017	8.4	1200	1.728											
6/7/2017	8.8	1085	1.5624											
6/8/2017	9.2	888	1.2787											
6/9/2017	9.1	796	1.1462											
6/10/2017	8.9	774	1.1146											
6/11/2017	8.7	1257	1.8101	0.8	1.8	27	3.8	8.6	129	0.6	3.4	1.6	24	1.1
6/12/2017	9.1	1244	1.7914											
6/13/2017	9.2	1304	1.8778											
6/14/2017	8.9	1221	1.7582											
6/15/2017	8.7	1230	1.7712											
6/16/2017	8.6	1156	1.6646											
6/17/2017	8.8	1060	1.5264											
6/18/2017	9.1	1063	1.5307	1	2.3	29	3.4	7.7	98	1	5.6	3.4	43	2.2
6/19/2017	9.3	1057	1.5221											
6/20/2017	9.2	604	0.8698											

6/21/2017	9.3	492	0.7085											
6/22/2017	8.9	1402	2.0189											
6/23/2017	8.8	1320	1.9008											
6/24/2017	8.6	789	1.1362											
6/25/2017	8.8	721	1.0382	1.4	3.2	27	4.4	9.9	86	0.6	3.4	0.2	2	0.5
6/26/2017	9	788	1.1347											
6/27/2017	9.1	807	1.1621											
6/28/2017	9.2	715	1.0296											
6/29/2017	9.1	716	1.031											
6/30/2017	8.9	998	1.4371											
7/1/2017	8.8	875	1.26											
7/2/2017	8.8	850	1.224	0.8	1.8	18	3	6.8	69	0.4	2.3	0.5	5	1.9
7/3/2017	9	899	1.2946											
7/4/2017	8.6	1313	1.8907											
7/5/2017	8.7	970	1.3968											
7/6/2017	9.1	954	1.3738											
7/7/2017	9.3	947	1.3637											
7/8/2017	9.4	917	1.3205											
7/9/2017	9.6	814	1.1722	0.5	1.1	11	5.1	11.5	112	0.6	3.4	2.3	22	0.7
7/10/2017	9.7	1181	1.7006											
7/11/2017	8.4	1166	1.679											
7/12/2017	9.1	1236	1.7798											
7/13/2017	8.9	1468	2.1139											
7/14/2017	8.9	1185	1.7064											
7/15/2017	9.2	1159	1.669											
7/16/2017	9.2	778	1.1203	0.9	2	19	4	9	84	0.4	2.2	0.2	2	0.8
7/17/2017	9.2	470	0.6768											
7/18/2017	9.5	1099	1.5826											
7/19/2017	9.4	1008	1.4515											
7/20/2017	9.3	968	1.3939											
7/21/2017	9.1	938	1.3507											
7/22/2017	9	1051	1.5134											
7/23/2017	9.3	1030	1.4832	1.6	3.6	44	4.9	11	136	1	5.6	2	25	0.3
7/24/2017	9.2	928	1.3363											
7/25/2017	9.2	717	1.0325											
7/26/2017	9.2	666	0.959											
7/27/2017	8.8	1318	1.8979											
7/28/2017	8.6	1755	2.5272											
7/29/2017	8.6	848	1.2211											
7/30/2017	8.7	936	1.3478	2.1	4.7	53	6.5	14.6	164	0.9	5.1	0.3	4	1.1
7/31/2017	9.1	861	1.2398											
8/1/2017	9.4	1277	1.8389											
8/2/2017	8.7	1229	1.7698											
8/3/2017	8.8	992	1.4285											
8/4/2017	8.8	957	1.3781											
8/5/2017	9.2	1140	1.6416											
8/6/2017	9.6	909	1.309	0.6	1.3	15	4	9	98	0.5	2.8	1.5	16	1.1
8/7/2017	9	809	1.165											
8/8/2017	8.9	823	1.1851											
8/9/2017	8.5	1775	2.556											
8/10/2017	8.7	891	1.283											
8/11/2017	8.9	770	1.1088											
8/12/2017	8.9	764	1.1002											
8/13/2017	8.9	710	1.0224	0.3	0.7	6	3.7	8.3	71	0.3	1.7	1	9	0.8
8/14/2017	8.9	1111	1.5998											
8/15/2017	8.5	1467	2.1125											
8/16/2017	8.6	1440	2.0736											
8/17/2017	8.8	1433	2.0635											
8/18/2017	8.9	797	1.1477											
8/19/2017	8.9	1024	1.4746											
8/20/2017	9	684	0.985	0.6	1.3	11	5	11.2	92	0.5	2.8	1.5	12	1.7
8/21/2017	9	822	1.1837											
8/22/2017	9.1	874	1.2586											
8/23/2017	8.6	1500	2.16											
8/24/2017	8.9	1024	1.4746											
8/25/2017	9	938	1.3507											
8/26/2017	9.3	313	0.4507											
8/27/2017	8.8	790	1.1376	8.1	18.2	173	6.5	14.6	138	3.4	19.1	0.9	9	1.5
8/28/2017	8.9	693	0.9979											
8/29/2017	8.8	1007	1.4501											
8/30/2017	8.6	1608	2.3155											
8/31/2017	8	1052	1.5149											
9/1/2017	8.2	1014	1.4602											
9/2/2017	8.4	913	1.3147											
9/3/2017	8.5	807	1.1621											
9/4/2017	8.7	799	1.1506	3.4	7.6	73	6.6	14.8	142	1.7	9.5	1.9	18	0.1
9/5/2017	9	735	1.0584											
9/6/2017	8.6	712	1.0253											
9/7/2017	8.6	1686	2.4278											
9/8/2017	8.7	1467	2.1125											
9/9/2017	8.5	1181	1.7006											
9/10/2017	8.4	1056	1.5206	1.6	3.6	46	3.3	7.4	94	0.7	3.9	0.3	4	4.4
9/11/2017	8.5	444	0.6394											
9/12/2017	8.1	1191	1.715											
9/13/2017	8.1	1201	1.7294											
9/14/2017	8.4	866	1.247											
9/15/2017	8.5	797	1.1477											
9/16/2017	8.6	1008	1.4515											

9/17/2017	8.6	885	1.2744	3.1	7	74	7.8	17.5	186	1.4	7.9	0.9	10	1.1
9/18/2017	8.1	809	1.165											
9/19/2017	8.2	777	1.1189											
9/20/2017	8.3	759	1.093											
9/21/2017	7.7	1107	1.5941											
9/22/2017	7.4	1102	1.5869											
9/23/2017	7.2	1092	1.5725											
9/24/2017	7.5	1057	1.5221	2.8	6.4	81	7.3	16.7	212	1.5	8.6	2.2	28	1.5
9/25/2017	7.5	1020	1.4688											
9/26/2017	8	995	1.4328											
9/27/2017	7.9	997	1.4357											
9/28/2017	7.7	984	1.417											
9/29/2017	7.7	989	1.4242											
9/30/2017	7.8	1339	1.9282											
10/1/2017	8.4	1226	1.7654	1	2.3	34	3.4	7.8	114	0.5	2.9	0.6	8	1.8
10/2/2017	8.6	958	1.3795											
10/3/2017	8.7	780	1.1232											
10/4/2017	8.7	759	1.093											
10/5/2017	8.6	798	1.1491											
10/6/2017	8.5	1381	1.9886											
10/7/2017	8.6	1383	1.9915											
10/8/2017	8.4	932	1.3421	1.4	3.2	36	3.6	8.2	92	0.6	3.4	0.2	3	3.6
10/9/2017	8.4	835	1.2024											
10/10/2017	8	812	1.1693											
10/11/2017	8.1	778	1.1203											
10/12/2017	8	803	1.1563											
10/13/2017	7.1	1221	1.7582											
10/14/2017	7.1	1308	1.8835											
10/15/2017	7.6	1076	1.5494	1.4	3.2	41	5.1	11.7	151	0.6	3.4	0.2	3	0.2
10/16/2017	8.1	999	1.4386											
10/17/2017	8.4	911	1.3118											
10/18/2017	8.5	756	1.0886											
10/19/2017	8.8	1076	1.5494											
10/20/2017	9	1086	1.5638											
10/21/2017	8.9	858	1.2355											
10/22/2017	8.8	2033	2.9275	5.2	11.9	290	6.2	14.2	346	2.2	12.6	0.7	17	0.2
10/23/2017	8.5	972	1.3997											
10/24/2017	8.6	766	1.103											
10/25/2017	8.6	850	1.224											
10/26/2017	8.5	918	1.3219											
10/27/2017	8.3	861	1.2398											
10/28/2017	7.8	983	1.4155											
10/29/2017	8.3	864	1.2442											
10/30/2017	8.6	928	1.3363											
10/31/2017	8.8	997	1.4357	3.4	7.8	93	3.5	8	96	1.5	8.6	0.8	10	2.3
11/1/2017	8.5	858	1.2355											
11/2/2017	8.3	816	1.175											
11/3/2017	8.5	832	1.1981											
11/4/2017	8.6	818	1.1779											
11/5/2017	8.5	749	1.0786	2.9	6.6	60	4.5	10.3	92	1.6	9.1	2.5	23	0.4
11/6/2017	8.3	1539	2.2162											
11/7/2017	8.4	1041	1.499											
11/8/2017	8.6	854	1.2298											
11/9/2017	8.6	671	0.9662											
11/10/2017	8.8	611	0.8798											
11/11/2017	8.7	1070	1.5408											
11/12/2017	8.8	1182	1.7021	3	6.9	97	4.6	10.5	149	1.4	8	1.1	16	0.9
11/13/2017	8.9	1045	1.5048											
11/14/2017	9	888	1.2787											
11/15/2017	8.8	770	1.1088											
11/16/2017	8.7	702	1.0109											
11/17/2017	8.7	1104	1.5898											
11/18/2017	8.6	1097	1.5797											
11/19/2017	8.6	837	1.2053	5.3	12.1	122	8	18.3	184	3.4	19.4	7.3	73	0.8
11/20/2017	8.6	928	1.3363											
11/21/2017	8.6	849	1.2226											
11/22/2017	8.8	835	1.2024											
11/23/2017	8.8	866	1.247											
11/24/2017	8.9	955	1.3752											
11/25/2017	8.7	968	1.3939											
11/26/2017	9.1	1112	1.6013	16.2	37	494	9.4	21.5	287	7.1	40.6	3.54	47.3	0.4
11/27/2017	9	1080	1.5552											
11/28/2017	9	926	1.3334											
11/29/2017	8.4	842	1.2125											
11/30/2017	8.5	818	1.1779											
12/1/2017	8.7	820	1.1808											
12/2/2017	8.7	955	1.3752											
12/3/2017	8.7	921	1.3262	3.3	7.4	82	6.6	14.9	164	1.4	7.9	0.45	5	1.2
12/4/2017	8.2	1262	1.8173											
12/5/2017	8.1	1682	2.4221											
12/6/2017	8.3	1498	2.1571											
12/7/2017	8.3	887	1.2773											
12/8/2017	7.9	752	1.0829											
12/9/2017	8.7	725	1.044											
12/10/2017	8.6	769	1.1074	5.7	12.8	119	7.5	16.9	156	2.8	15.8	2.93	27	1.7
12/11/2017	8.8	896	1.2902											
12/12/2017	8.4	821	1.1822											
12/13/2017	8.7	864	1.2442											

12/14/2017	8.7	851	1.2254											
12/15/2017	8.8	765	1.1016											
12/16/2017	8.8	859	1.237											
12/17/2017	8.6	919	1.3234	4.9	11	122	10.1	22.7	251	2.3	12.9	1.91	21.1	1.2
12/18/2017	8	975	1.404											
12/19/2017	8.4	1464	2.1082											
12/20/2017	8.1	1672	2.4077											
12/21/2017	8.3	1174	1.6906											
12/22/2017	8.3	1209	1.741											
12/23/2017	8.2	1054	1.5178											
12/24/2017	8.5	663	0.9547											
12/25/2017	8.5	623	0.8971											
12/26/2017	8.4	629	0.9058											
12/27/2017	8.4	574	0.8266	7	15.8	109	6.7	15.1	104	3.1	17.4	1.69	11.6	0.6
12/28/2017	8.4	598	0.8611											
12/29/2017	9.3	1316	1.895											
12/30/2017	9	945	1.3608											
12/31/2017	9	585	0.8424											
1/1/2018	8.9	453	0.6523											
1/2/2018	8.9	563	0.8107	4.4	9.9	67	4.9	11	74.6	1.8	10.1	0.2	1.5	2.6
1/3/2018	8.9	1128	1.6243											
1/4/2018	8.8	716	1.031											
1/5/2018	8.5	771	1.1102											
1/6/2018	8.8	714	1.0282											
1/7/2018	8.7	391	0.563	10.5	23.6	111	9.1	20.5	96.2	5.5	31	7.3	34.4	2.6
1/8/2018	8.8	1113	1.6027											
1/9/2018	8.8	1146	1.6502											
1/10/2018	8.7	807	1.1621											
1/11/2018	8.1	755	1.0872											
1/12/2018	8.6	430	0.6192											
1/13/2018	8.6	1045	1.5048											
1/14/2018	8.9	680	0.9792	8.1	18.2	148.9	8.5	19.1	156.3	4.5	25.3	7.1	57.9	1.3
1/15/2018	8.9	653	0.9403											
1/16/2018	8.9	379	0.5458											
1/17/2018	9	398	0.5731											
1/18/2018	9.4	474	0.6826											
1/19/2018	6.1	606	0.8726											
1/20/2018	7.2	1042	1.5005											
1/21/2018	8.1	860	1.2384	5.8	13.1	134.9	4.2	9.5	97.7	2.5	14.1	1	10.5	0.3
1/22/2018	8.5	1044	1.5034											
1/23/2018	8.7	1043	1.5019											
1/24/2018	8.7	858	1.2355											
1/25/2018	8.8	808	1.1635											
1/26/2018	8.9	826	1.1894											
1/27/2018	8.9	809	1.165											
1/28/2018	9	924	1.3306											
1/29/2018	9	918	1.3219	6.3	14.2	156.4	7.6	17.1	188.6	3.1	17.4	3.3	36	1.2
1/30/2018	8.9	866	1.247											
1/31/2018	9	1013	1.4587											
2/1/2018	9.1	858	1.2355											
2/2/2018	7.2	421	0.6062											
2/3/2018	7.8	474	0.6826											
2/4/2018	8.5	1140	1.6416											
2/5/2018	9	1070	1.5408	7.1	16	205.4	6.8	15.3	196.7	3.1	17.4	1.5	18.8	1.7
2/6/2018	9.1	1090	1.5696											
2/7/2018	8.8	1109	1.597											
2/8/2018	8.7	1113	1.6027											
2/9/2018	8.9	1199	1.7266											
2/10/2018	8.7	2746	3.9542											
2/11/2018	8.6	1032	1.4861											
2/12/2018	8.5	633	0.9115	2.4	5.4	41.1	5.3	11.9	90.7	1.2	6.8	1.4	10.3	1.5
2/13/2018	8.7	836	1.2038											
2/14/2018	8.5	1748	2.5171											
2/15/2018	8.2	1031	1.4846											
2/16/2018	7.9	941	1.355											
2/17/2018	8	1162	1.6733											
2/18/2018	8.1	834	1.201											
2/19/2018	8.1	1136	1.6358	3.3	7.4	101.4	5.6	12.6	172	1.7	9.6	2.1	29.2	0.5
2/20/2018	8.2	845	1.2168											
2/21/2018	7.4	1079	1.5538											
2/22/2018	8.1	1796	2.5862											
2/23/2018	8.1	1115	1.6056											
2/24/2018	8.1	1312	1.8893											
2/25/2018	8.1	1274	1.8346											
2/26/2018	8.1	861	1.2398											
2/27/2018	7.1	1602	2.3069											
2/28/2018	8.5	1819	2.6194	5.8	12.9	281.7	6	13.3	291.4	3	16.7	3.8	82.6	1
3/1/2018	8.2	1553	2.2363											
3/2/2018	8.3	538	0.7747											
3/3/2018	8.3	545	0.7848											
3/4/2018	8.3	1163	1.6747											
3/5/2018	8.2	1229	1.7698	2	4.4	66	7.1	15.8	233	0.9	5	0.6	8	0.4
3/6/2018	6.8	951	1.3694											
3/7/2018	8	824	1.1866											
3/8/2018	9	805	1.1592											
3/9/2018	8.9	908	1.3075											
3/10/2018	8.8	933	1.3435											
3/11/2018	8.2	893	1.2859											

3/12/2018	8.3	849	1.2226											
3/13/2018	8.8	867	1.2485	3.2	7.1	74	5.3	11.8	123	1.5	8.3	1.2	13	0.2
3/14/2018	8.8	887	1.2773											
3/15/2018	8.8	1761	2.5358											
3/16/2018	8.3	554	0.7978											
3/17/2018	8.3	535	0.7704											
3/18/2018	8.6	630	0.9072											
3/19/2018	8.6	1976	2.8454											
3/20/2018	8.4	520	0.7488	3.5	7.8	49	4.9	10.9	68	1.5	8.3	0.6	3	0.2
3/21/2018	8.4	869	1.2514											
3/22/2018	8.6	965	1.3896											
3/23/2018	8.7	1000	1.44											
3/24/2018	8.6	1354	1.9498											
3/25/2018	8.5	1066	1.535	3.3	7.3	94	4.8	10.7	137	1.6	8.9	1.6	20	0.8
3/26/2018	8.8	1023	1.4731											
3/27/2018	8.6	1145	1.6488											
3/28/2018	8.7	1865	2.6856											
3/29/2018	8.4	1677	2.4149											
3/30/2018	8.5	919	1.3234											
3/31/2018	8.6	1015	1.4616											
4/1/2018	8.6	1509	2.173	1.9	4.2	77	3.5	7.8	141	1.2	6.7	2.4	44	0.8
4/2/2018	8.8	1188	1.7107											
4/3/2018	8.7	869	1.2514											
4/4/2018	8.6	1120	1.6128											
4/5/2018	8.7	1624	2.3386											
4/6/2018	9	1597	2.2997											
4/7/2018	8.8	1308	1.8835											
4/8/2018	9	638	0.9187	7	15.6	119	6.8	15.1	116	3.2	17.8	2.2	17	0.8
4/9/2018	8.6	1318	1.8979											
4/10/2018	8.9	1130	1.6272											
4/11/2018	9	1241	1.787											
4/12/2018	9.1	1363	1.9627											
4/13/2018	9.1	1251	1.8014											
4/14/2018	7.7	1780	2.5632											
4/15/2018	7.7	1808	2.6035											
4/16/2018	8.1	849	1.2226	8.1	18	184	9.8	21.8	222	3.5	19.5	1.4	15	1.1
4/17/2018	7.5	738	1.0627											
4/18/2018	8	1521	2.1902											
4/19/2018	8.6	1209	1.741											
4/20/2018	8.9	669	0.9634											
4/21/2018	9	827	1.1909											
4/22/2018	9.1	2123	3.0571											
4/23/2018	8.7	1097	1.5797	7.3	16.2	214	7.8	17.3	228	3.1	17.2	1	13	1.4
4/24/2018	8.5	1046	1.5062											
4/25/2018	8.5	1043	1.5019											
4/26/2018	8.6	1327	1.9109											
4/27/2018	8.5	1181	1.7006											
4/28/2018	8.5	733	1.0555											
4/29/2018	8.5	996	1.4342	2.3	5.1	61	6.7	14.9	178	1.2	6.7	1.6	19	1.7
4/30/2018	8.4	1109	1.597											
5/1/2018	8.5	922	1.3277											
5/2/2018	8.7	1339	1.9282											
5/3/2018	9.2	1453	2.0923											
5/4/2018	9	1201	1.7294											
5/5/2018	8.4	1633	2.3515											
5/6/2018	8.2	1047	1.5077											
5/7/2018	8.4	1236	1.7798											
5/8/2018	8.5	871	1.2542											
5/9/2018	8.7	961	1.3838	3.4	7.6	87	8	17.8	205	1.5	8.3	0.8	9	1.3
5/10/2018	8.9	896	1.2902											
5/11/2018	8.8	728	1.0483											
5/12/2018	8.9	1699	2.4466											
5/13/2018	8.9	1335	1.9224											
5/14/2018	8.8	1334	1.921											
5/15/2018	8.7	1335	1.9224											
5/16/2018	8.6	1716	2.471											
5/17/2018	8.7	1230	1.7712	3.7	8.2	122	5.7	12.7	187	2	11.1	2.9	43	0.4
5/18/2018	8.6	1510	2.1744											
5/19/2018	8.4	1584	2.281											
5/20/2018	8.4	1008	1.4515	2.2	4.9	59	4.8	10.7	129	1.2	6.7	1.8	22	0.9
5/21/2018	8.7	1214	1.7482											
5/22/2018	8.9	1368	1.9699											
5/23/2018	8.9	1082	1.5581											
5/24/2018	8.3	1578	2.2723											
5/25/2018	8.8	1197	1.7237											
5/26/2018	8.9	1192	1.7165											
5/27/2018	8.8	2161	3.1118											
5/28/2018	8.4	1209	1.741	1.4	3.1	45	4.5	10	145	0.8	4.4	1.3	19	0.6
5/29/2018	8.3	2869	4.1314											
5/30/2018	8.2	1751	2.5214											
5/31/2018	8.2	1366	1.967											
6/1/2018	8.3	1138	1.6387											
6/2/2018	8.2	1004	1.4458											
6/3/2018	8.2	1157	1.6661											
6/4/2018	8.6	1318	1.8979											
6/5/2018	8.9	1211	1.7438											
6/6/2018	9	1225	1.764	3.4	7.6	111	5.6	12.5	184	1.6	8.9	1.3	20	0.6
6/7/2018	9.1	1134	1.633											

6/8/2018	9	1005	1.4472											
6/9/2018	9.1	1061	1.5278											
6/10/2018	9.1	1154	1.6618	3.8	8.5	117	4.2	9.4	130	2.5	13.9	5.5	76	0.5
6/11/2018	8.6	1350	1.944											
6/12/2018	8.4	1164	1.6762											
6/13/2018	8.8	1894	2.7274											
6/14/2018	7.2	1243	1.7899											
6/15/2018	9	1326	1.9094											
6/16/2018	9.1	1489	2.1442											
6/17/2018	9.5	1136	1.6358											
6/18/2018	8.8	1301	1.8734	2.2	4.9	77	3	6.7	104	1.3	7.2	2.3	37	0.5
6/19/2018	9.1	1493	2.1499											
6/20/2018	9.2	1716	2.471											
6/21/2018	8.6	1749	2.5186											
6/22/2018	8.2	1862	2.6813											
6/23/2018	8.2	2118	3.0499											
6/24/2018	8.2	1803	2.5963											
6/25/2018	8.6	1209	1.741											
6/26/2018	9.2	1083	1.5595	3.5	7.8	101	4	8.9	116	1.8	10	2.2	29	0.1
6/27/2018	8.8	1339	1.9282											
6/28/2018	8.1	1369	1.9714											
6/29/2018	8.2	1452	2.0909											
6/30/2018	8.8	1438	2.0707											
7/1/2018	8.9	1222	1.7597	2	4.5	65	3.4	7.6	111	1.4	7.8	3.3	49	1.1
7/2/2018	9.1	1343	1.9339											
7/3/2018	8.9	1334	1.921											
7/4/2018	8.7	709	1.021											
7/5/2018	8.6	1491	2.147											
7/6/2018	9	1315	1.8936											
7/7/2018	9.2	1283	1.8475											
7/8/2018	8.7	1539	2.2162	1.3	2.9	54	4.5	10	185	0.7	3.9	1	19	2.5
7/9/2018	8.6	1214	1.7482											
7/10/2018	8.6	1385	1.9944											
7/11/2018	9.2	1235	1.7784											
7/12/2018	9	1127	1.6229											
7/13/2018	9.1	1098	1.5811											
7/14/2018	9.1	946	1.3622											
7/15/2018	9	1374	1.9786	1.3	2.9	48	5.7	12.7	210	1.1	6.1	3.2	53	1.1
7/16/2018	8.4	2065	2.9736											
7/17/2018	8	1525	2.196											
7/18/2018	8	1032	1.4861											
7/19/2018	8.4	1145	1.6488											
7/20/2018	8.7	846	1.2182											
7/21/2018	8.7	899	1.2946											
7/22/2018	8.7	495	0.7128											
7/23/2018	9	265	0.3816	21.1	47	150	5.8	12.9	41	9.8	54.6	7.6	24	0.4
7/24/2018	8.9	362	0.5213											
7/25/2018	8.6	715	1.0296											
7/26/2018	7.8	663	0.9547											
7/27/2018	8.7	615	0.8856											
7/28/2018	9.1	526	0.7574											
7/29/2018	9.1	693	0.9979											
7/30/2018	9.2	747	1.0757	5	11.1	100	4.8	10.7	96	2.6	14.5	3.3	30	0.6
7/31/2018	9.3	1506	2.1686											
8/1/2018	8.8	1507	2.1701											
8/2/2018	8.6	666	0.959											
8/3/2018	9.4	1392	2.0045											
8/4/2018	9	1067	1.5365											
8/5/2018	9.4	1006	1.4486	4.7	10.5	127	0.6	1.3	16	2.2	12.3	1.8	22	0.7
8/6/2018	9.2	1095	1.5768											
8/7/2018	9.2	1177	1.6949											
8/8/2018	9	1197	1.7237											
8/9/2018	9.3	1202	1.7309											
8/10/2018	9	1203	1.7323											
8/11/2018	8.5	1246	1.7942											
8/12/2018	9.1	1483	2.1355											
8/13/2018	8.8	1409	2.029											
8/14/2018	8.2	1398	2.0131	0.3	0.7	11	0.2	0.4	7	0.2	1.1	0.4	7	1.1
8/15/2018	8	1900	2.736											
8/16/2018	8.1	1220	1.7568											
8/17/2018	8	1160	1.6704											
8/18/2018	8.1	1160	1.6704											
8/19/2018	8	997	1.4357	1.6	3.6	43	2.5	5.6	67	0.8	4.5	0.9	11	0.2
8/20/2018	8.1	1063	1.5307											
8/21/2018	8.2	1033	1.4875											
8/22/2018	8.5	1028	1.4803											
8/23/2018	7.6	1021	1.4702											
8/24/2018	8.6	1027	1.4789											
8/25/2018	8.9	1056	1.5206											
8/26/2018	9.6	650	0.936											
8/27/2018	9.9	244	0.3514											
8/28/2018	9.4	875	1.26											
8/29/2018	8.8	496	0.7142	8.7	19.4	116	3.3	7.4	44	3.9	21.7	2.3	13	0.2
8/30/2018	8.7	468	0.6739											
8/31/2018	8.6	321	0.4622											
9/1/2018	8.7	271	0.3902											
9/2/2018	8.9	255	0.3672											
9/3/2018	9.1	217	0.3125											

9/4/2018	9.3	529	0.7618	6.1	13.6	86	1.5	3.3	21	2.8	15.6	2	13	1.3
9/5/2018	8.9	587	0.8453											
9/6/2018	8.2	565	0.8136											
9/7/2018	8.8	513	0.7387											
9/8/2018	8.6	496	0.7142											
9/9/2018	8.2	900	1.296	1.9	4.2	46	5.1	11.4	123	1	5.6	1.3	14	3.2
9/10/2018	8.1	842	1.2125											
9/11/2018	8.3	940	1.3536											
9/12/2018	8.6	1076	1.5494											
9/13/2018	8.7	1112	1.6013											
9/14/2018	9.1	1125	1.62											
9/15/2018	9	1147	1.6517											
9/16/2018	8.2	1174	1.6906											
9/17/2018	8.7	1185	1.7064	1.5	3.3	48	4.3	9.6	136	0.9	5	1.7	24	0.3
9/18/2018	8.5	1229	1.7698											
9/19/2018	8.3	1247	1.7957											
9/20/2018	8.7	1126	1.6214											
9/21/2018	8.7	1398	2.0131											
9/22/2018	9.6	1181	1.7006											
9/23/2018	8.7	1304	1.8778											
9/24/2018	8.5	1314	1.8922	5.4	12	189	7.9	17.6	277	2.4	13.1	1.1	17	1.7
9/25/2018	8.2	1274	1.8346											
9/26/2018	8.4	1346	1.9382											
9/27/2018	7.8	403	0.5803											
9/28/2018	7.1	175	0.252											
9/29/2018	7.7	523	0.7531											
9/30/2018	8.7	876	1.2614	1.3	2.9	30	4.5	10	105	0.8	4.4	1.5	16	0.5
10/1/2018	8.9	907	1.3061											
10/2/2018	9.2	1228	1.7683											
10/3/2018	9.3	1275	1.836											
10/4/2018	9.3	1280	1.8432											
10/5/2018	9	1240	1.7856											
10/6/2018	8.6	1015	1.4616											
10/7/2018	7.9	836	1.2038	1.2	2.7	27	6.8	15.1	152	0.6	3.3	0.6	6	6.1
10/8/2018	8.3	1185	1.7064											
10/9/2018	8.1	903	1.3003											
10/10/2018	8	833	1.1995											
10/11/2018	7.5	1140	1.6416											
10/12/2018	8	1065	1.5336											
10/13/2018	8.3	463	0.6667											
10/14/2018	8	182	0.2621	29.1	64.7	141	26	57.8	126	20	109.2	44.5	97	1
10/15/2018	9.4	301	0.4334											
10/16/2018	9.4	185	0.2664											
10/17/2018	9.1	351	0.5054											
10/18/2018	8.8	963	1.3867											
10/19/2018	8.8	935	1.3464											
10/20/2018	9	1059	1.525											
10/21/2018	8.9	569	0.8194	7.4	16.5	112	3	6.7	46	3.5	19.5	3	21	0.4
10/22/2018	8.7	563	0.8107											
10/23/2018	8.5	1300	1.872											
10/24/2018	8.6	1636	2.3558											
10/25/2018	8.5	1302	1.8749											
10/26/2018	7.8	1091	1.571											
10/27/2018	7.5	1052	1.5149											
10/28/2018	8.3	1062	1.5293	3.4	7.6	96	7.4	16.5	210	1.5	8.3	0.8	10	0.1
10/29/2018	8.3	1032	1.4861											
10/30/2018	8.4	1245	1.7928											
10/31/2018	8.4	1218	1.7539											
11/1/2018	8.6	2312	3.3293											
11/2/2018	7.8	593	0.8539											
11/3/2018	8.6	1008	1.4515											
11/4/2018	8.8	1046	1.5062	2.1	4.7	59	2.2	4.9	61	1.2	6.7	2	25	1.3
11/5/2018	8.8	1573	2.2651											
11/6/2018	8.7	1325	1.908											
11/7/2018	8.7	926	1.3334											
11/8/2018	8.9	1183	1.7035											
11/9/2018	8.7	1101	1.5854											
11/10/2018	8.8	1039	1.4962											
11/11/2018	8.7	1114	1.6042											
11/12/2018	8.9	1499	2.1586											
11/13/2018	8.7	1267	1.8245	9	20	304	8.2	18.2	277	3.8	21.1	1.1	17	0.6
11/14/2018	8.6	1072	1.5437											
11/15/2018	8.7	939	1.3522											
11/16/2018	8.6	1039	1.4962											
11/17/2018	8.5	1063	1.5307											
11/18/2018	8.6	1082	1.5581											
11/19/2018	8.9	992	1.4285	4.7	10.4	124	5.2	11.6	138	2.1	11.7	1.2	15	0.9
11/20/2018	7.8	886	1.2758											
11/21/2018	8.1	846	1.2182											
11/22/2018	8	885	1.2744											
11/23/2018	8.1	1020	1.4688											
11/24/2018	8.1	1646	2.3702											
11/25/2018	7.3	922	1.3277	3.5	7.8	86	6.3	14	155	1.5	8.3	0.6	6	0.4
11/26/2018	7.8	934	1.345											
11/27/2018	7.5	1115	1.6056											
11/28/2018	7.8	1262	1.8173											
11/29/2018	8	1212	1.7453											
11/30/2018	7.9	1447	2.0837											

12/1/2018	7.5	1682	2.4221											
12/2/2018	7.7	1117	1.6085											
12/3/2018	8.7	1023	1.4731											
12/4/2018	8.5	921	1.3262	4.6	10.3	114	6.3	14.1	156	2.1	11.7	1.5	16	1.6
12/5/2018	8.4	1030	1.4832											
12/6/2018	9.3	1142	1.6445											
12/7/2018	8.9	1130	1.6272											
12/8/2018	8.8	1386	1.9958											
12/9/2018	8.8	1484	2.137											
12/10/2018	8.5	1058	1.5235											
12/11/2018	8.2	944	1.3594											
12/12/2018	8.7	895	1.2888	11.1	24.8	267	8.5	19	204	5	27.9	3.1	34	1.1
12/13/2018	8.7	1031	1.4846											
12/14/2018	8.6	1862	2.6813											
12/15/2018	8.5	872	1.2557											
12/16/2018	8.8	867	1.2485											
12/17/2018	9.1	949	1.3666											
12/18/2018	9.4	528	0.7603	17.6	39.3	249	9.3	20.8	132	8.7	48.6	9.3	59	0.4
12/19/2018	9.1	993	1.4299											
12/20/2018	9.2	949	1.3666											
12/21/2018	8.8	836	1.2038											
12/22/2018	8.8	935	1.3464											
12/23/2018	8.9	934	1.345											
12/24/2018	8.7	795	1.1448											
12/25/2018	8.3	795	1.1448											
12/26/2018	7.2	1183	1.7035	3.7	8.3	117	8.4	18.8	267	2.6	14.5	6.3	89	0.7
12/27/2018	7	1800	2.592											
12/28/2018	7.6	1198	1.7251											
12/29/2018	7.2	875	1.26											
12/30/2018	7.7	933	1.3435	4.3	9.6	108	7	15.6	175	2.1	11.7	2.1	24	1.4
12/31/2018	8.1	2175	3.132											
1/1/2019	8.1	569	0.8194											
1/2/2019	8.1	1422	2.0477											
1/3/2019	8.3	1482	2.1341											
1/4/2019	9	743	1.0699											
1/5/2019	8.3	176	0.2534											
1/6/2019	7.9	958	1.3795											
1/7/2019	8.3	1244	1.7914											
1/8/2019	7.6	1489	2.1442											
1/9/2019	8.7	776	1.1174	6.5	14.5	135.4	9.3	20.8	193.7	4.4	24.6	10.1	93.7	1.9
1/10/2019	7.7	143	0.2059											
1/11/2019	8.5	1101	1.5854											
1/12/2019	8.8	1294	1.8634											
1/13/2019	8.8	986	1.4198	6.2	13.9	164	7.1	15.9	187.9	3	16.8	2.9	34.4	0.6
1/14/2019	9	967	1.3925											
1/15/2019	9.1	900	1.296											
1/16/2019	8.9	1010	1.4544											
1/17/2019	8.6	1214	1.7482											
1/18/2019	8.6	1511	2.1758											
1/19/2019	8.5	1556	2.2406											
1/20/2019	8.4	1147	1.6517	5.4	12.1	166.2	6.7	15	206.2	2.3	12.8	0.8	10.8	1.2
1/21/2019	8.6	1194	1.7194											
1/22/2019	8.7	1495	2.1528											
1/23/2019	8.8	1532	2.2061											
1/24/2019	8.5	1047	1.5077											
1/25/2019	8.2	944	1.3594											
1/26/2019	7.9	1349	1.9426											
1/27/2019	8	1111	1.5998	5	11.2	149.1	6.4	14.3	190.8	2.8	15.6	4.5	59.6	0.3
1/28/2019	8.1	1136	1.6358											
1/29/2019	7.9	1143	1.6459											
1/30/2019	8.1	1197	1.7237											
1/31/2019	8.3	1376	1.9814											
2/1/2019	8.5	1447	2.0837											
2/2/2019	8.5	1303	1.8763											
2/3/2019	8.6	1065	1.5336	3.4	7.6	97.2	4.2	9.4	120	1.4	7.8	0.2	2.9	0.8
2/4/2019	8.5	1492	2.1485											
2/5/2019	8.4	1500	2.16											
2/6/2019	8.4	1715	2.4696											
2/7/2019	8.3	1124	1.6186											
2/8/2019	8.5	928	1.3363											
2/9/2019	9	1076	1.5494											
2/10/2019	7.9	1162	1.6733	5.3	11.8	165.3	4.8	10.7	149.7	2.6	14.5	2.7	37.4	1.9
2/11/2019	7.6	1716	2.471											
2/12/2019	8.7	1552	2.2349											
2/13/2019	8.8	1446	2.0822											
2/14/2019	8.9	994	1.4314											
2/15/2019	8.7	1336	1.9238											
2/16/2019	8.6	1636	2.3558											
2/17/2019	8.5	1657	2.3861											
2/18/2019	8.4	1351	1.9454	6.7	14.9	241.1	8	17.7	287.8	2.9	16.1	1.2	19.8	0.5
2/19/2019	8.6	1858	2.6755											
2/20/2019	9.1	2745	3.9528											
2/21/2019	7.1	1979	2.8498											
2/22/2019	8.9	3284	4.729											
2/23/2019	8.2	2412	3.4733											
2/24/2019	8.6	578	0.8323	6.1	13.5	93.9	6.2	13.7	95.4	3.3	18.3	4.8	33.1	1.4
2/25/2019	8.3	871	1.2542											
2/26/2019	8.4	1241	1.787											

2/27/2019	8.3	1413	2.0347											
2/28/2019	8.5	1343	1.9339											
3/1/2019	8.6	1142	1.6445											
3/2/2019	9.1	2602	3.7469											
3/3/2019	9.1	897	1.2917											
3/4/2019	8.8	1210	1.7424											
3/5/2019	8.8	989	1.4242	7.3	16.2	192.3	7.5	16.6	197.5	3.3	18.3	2.1	25	0.8
3/6/2019	8.7	991	1.427											
3/7/2019	8.5	1309	1.885											
3/8/2019	8.2	1385	1.9944											
3/9/2019	8.4	1358	1.9555											
3/10/2019	8.6	1047	1.5077	6.1	13.5	170.1	6.7	14.9	186.8	3	16.6	3.1	39	2.2
3/11/2019	8.6	990	1.4256											
3/12/2019	8.3	989	1.4242											
3/13/2019	8.4	1913	2.7547											
3/14/2019	8.8	1479	2.1298											
3/15/2019	8.6	1073	1.5451											
3/16/2019	8.9	1161	1.6718											
3/17/2019	8.3	988	1.4227	2.7	6	71	4.8	10.6	126.3	1.2	6.7	0.7	7.9	0.8
3/18/2019	8.6	1020	1.4688											
3/19/2019	8.5	1070	1.5408											
3/20/2019	9	1165	1.6776											
3/21/2019	9	1106	1.5926											
3/22/2019	9	1108	1.5955											
3/23/2019	9.2	1152	1.6589											
3/24/2019	9	543	0.7819	3.2	7.1	46.3	5.4	12	78.1	1.4	7.8	0.7	4.3	0.5
3/25/2019	8.8	1128	1.6243											
3/26/2019	8.9	1308	1.8835											
3/27/2019	8.8	1321	1.9022											
3/28/2019	8.9	1203	1.7323											
3/29/2019	9	1176	1.6934											
3/30/2019	8.9	1128	1.6243											
3/31/2019	8.6	1057	1.5221	2.9	6.4	81.6	5.8	12.9	163.3	1.4	7.8	1.3	16.9	1.9
4/1/2019	8.7	1102	1.5869											
4/2/2019	8.8	1223	1.7611											
4/3/2019	8.9	1287	1.8533											
4/4/2019	8.8	1291	1.859											
4/5/2019	8.5	1309	1.885											
4/6/2019	8.8	1171	1.6862											
4/7/2019	8.5	1160	1.6704											
4/8/2019	8.6	2174	3.1306											
4/9/2019	8.3	1414	2.0362	3.9	8.6	146.9	6.3	14	237.2	2.1	11.6	3	50.8	1.4
4/10/2019	8.5	1106	1.5926											
4/11/2019	8.7	1100	1.584											
4/12/2019	8.8	1700	2.448											
4/13/2019	8.4	1956	2.8166											
4/14/2019	7.7	2054	2.9578											
4/15/2019	8	1224	1.7626	3	6.7	97.8	5.5	12.2	179.3	1.6	8.9	2.2	32.6	0.9
4/16/2019	8.3	1510	2.1744											
4/17/2019	8.5	1844	2.6554											
4/18/2019	8.8	1696	2.4422											
4/19/2019	8.6	1579	2.2738											
4/20/2019	8.4	1850	2.664											
4/21/2019	8.6	1132	1.6301											
4/22/2019	8.7	1688	2.4307											
4/23/2019	8.8	1255	1.8072	1.8	4	60.2	5.6	12.4	187.2	1.3	7.2	3.2	48.5	1.1
4/24/2019	8.7	1923	2.7691											
4/25/2019	8.5	1575	2.268											
4/26/2019	8.4	498	0.7171											
4/27/2019	8.7	1247	1.7957											
4/28/2019	8.7	1192	1.7165	1.3	3	42.6	5.4	12.4	177.1	0.7	4	1	14.8	1.8
4/29/2019	8.7	1726	2.4854											
4/30/2019	8.6	1317	1.8965											
5/1/2019	8.3	999	1.4386											
5/2/2019	8.2	542	0.7805											
5/3/2019	8.2	1783	2.5675											
5/4/2019	8.3	1747	2.5157											
5/5/2019	8.2	1709	2.461											
5/6/2019	8.5	1108	1.5955	3.2	7.3	97.5	6	13.7	182.9	2.3	13.2	5.8	77.7	1
5/7/2019	8.6	1790	2.5776											
5/8/2019	8.9	916	1.319											
5/9/2019	8.7	1316	1.895											
5/10/2019	8.2	1364	1.9642											
5/11/2019	8.3	1389	2.0002											
5/12/2019	8.4	1495	2.1528											
5/13/2019	8.9	1443	2.0779											
5/14/2019	9.1	1300	1.872	1.7	3.9	60.8	5	11.5	178.8	0.8	4.6	0.7	10.7	0.4
5/15/2019	8.9	1540	2.2176											
5/16/2019	9.1	1270	1.8288											
5/17/2019	9.1	1399	2.0146											
5/18/2019	8.9	1607	2.3141											
5/19/2019	9	1083	1.5595	1.5	3.4	44.7	3.9	8.9	116.2	0.7	4	0.6	7.4	0.8
5/20/2019	8.8	1077	1.5509											
5/21/2019	8.5	1451	2.0894											
5/22/2019	8.3	2120	3.0528											
5/23/2019	8.7	1491	2.147											
5/24/2019	9.1	1336	1.9238											
5/25/2019	3.2	209	0.301											

5/26/2019	3.2	159	0.229											
5/27/2019	6.6	132	0.1901											
5/28/2019	7	118	0.1699											
5/29/2019	7.6	444	0.6394	0.9	2.1	11	6.3	14.4	76.9	0.7	4	1.9	10.4	1.5
5/30/2019	8	1485	2.1384											
5/31/2019	7.5	1085	1.5624											
6/1/2019	8.3	169	0.2434											
6/2/2019	8.3	1061	1.5278	1.5	3.4	43.8	3.5	8	102.1	0.7	4	0.6	7.3	2
6/3/2019	8.5	1358	1.9555											
6/4/2019	8.6	1366	1.967											
6/5/2019	8.5	1906	2.7446											
6/6/2019	8.5	1874	2.6986											
6/7/2019	8.4	1530	2.2032											
6/8/2019	8.6	1511	2.1758											
6/9/2019	8.7	1274	1.8346	1.4	3.2	49.1	2.8	6.4	98.1	0.9	5.2	1.9	29.8	0.9
6/10/2019	8.9	1474	2.1226											
6/11/2019	8.9	1542	2.2205											
6/12/2019	8.8	1690	2.4336											
6/13/2019	8.8	1637	2.3573											
6/14/2019	8.9	1324	1.9066											
6/15/2019	9	1342	1.9325											
6/16/2019	9.1	1339	1.9282											
6/17/2019	9.2	2173	3.1291	3	6.9	179.3	5.4	12.4	322.8	1.5	8.6	1.7	44.8	0.8
6/18/2019	8.4	1211	1.7438											
6/19/2019	8.2	1186	1.7078											
6/20/2019	8.3	1219	1.7554											
6/21/2019	8.5	1269	1.8274											
6/22/2019	8.9	1269	1.8274											
6/23/2019	9	1430	2.0592	2	4.6	78.7	3.5	8	137.7	1.1	6.3	1.7	29.5	0.4
6/24/2019	8.6	1740	2.5056											
6/25/2019	8.5	1408	2.0275											
6/26/2019	8.5	1401	2.0174											
6/27/2019	8.5	1389	2.0002											
6/28/2019	8.8	1473	2.1211											
6/29/2019	8.6	1801	2.5934											
6/30/2019	8.8	1417	2.0405	1.8	4.1	70.2	3.3	7.6	128.6	0.8	4.6	0.5	7.8	0.4
7/1/2019	9.2	1195	1.7208											
7/2/2019	9.6	1228	1.7683											
7/3/2019	9	1716	2.471											
7/4/2019	9.2	1677	2.4149											
7/5/2019	9.5	1463	2.1067											
7/6/2019	9.6	1192	1.7165											
7/7/2019	8.5	1740	2.5056											
7/8/2019	8.8	1636	2.3558											
7/9/2019	9	1689	2.4322	2.1	4.8	97.6	3.2	7.3	148.7	1.1	6.3	1.5	30.2	1.5
7/10/2019	9	1593	2.2939											
7/11/2019	8.6	1265	1.8216											
7/12/2019	9	1321	1.9022											
7/13/2019	9.2	1648	2.3731											
7/14/2019	8.9	1386	1.9958	3.6	8.2	137.2	5.9	13.5	224.9	1.8	10.3	2.1	34.3	0.5
7/15/2019	8.3	1997	2.8757											
7/16/2019	8.3	1922	2.7677											
7/17/2019	8.1	2305	3.3192											
7/18/2019	8.3	1170	1.6848											
7/19/2019	8.6	1122	1.6157											
7/20/2019	8.9	1563	2.2507											
7/21/2019	8.6	1396	2.0102											
7/22/2019	8.5	2009	2.893											
7/23/2019	8.3	1929	2.7778											
7/24/2019	8.6	1023	1.4731	3	6.9	84.4	4.2	9.6	118.2	1.6	9.2	2.3	28.1	4.5
7/25/2019	8.9	1349	1.9426											
7/26/2019	8.9	1335	1.9224											
7/27/2019	9	1349	1.9426											
7/28/2019	9.1	1368	1.9699	0.7	1.6	26.3	2.3	5.3	86.5	0.6	3.4	1.8	30.1	4.5
7/29/2019	9.2	1503	2.1643											
7/30/2019	9.2	1611	2.3198											
7/31/2019	9.2	1526	2.1974											
8/1/2019	8.9	1587	2.2853											
8/2/2019	8.8	1259	1.813											
8/3/2019	8.7	1298	1.8691											
8/4/2019	8.8	1284	1.849	2.4	5.5	84.8	2.3	5.3	81.2	1.6	9.2	3.7	56.5	2
8/5/2019	8.6	1302	1.8749											
8/6/2019	8.7	1968	2.8339											
8/7/2019	8.4	2255	3.2472											
8/8/2019	9	1888	2.7187											
8/9/2019	8.7	1799	2.5906											
8/10/2019	8.7	1764	2.5402											
8/11/2019	8.5	1114	1.6042	3.8	8.7	116.4	1.6	3.7	49	2	11.5	2.7	36.8	0.7
8/12/2019	8.5	1305	1.8792											
8/13/2019	8.6	2132	3.0701											
8/14/2019	8.3	1916	2.759											
8/15/2019	8.3	831	1.1966											
8/16/2019	7.8	279	0.4018											
8/17/2019	7.8	1143	1.6459											
8/18/2019	7.6	1503	2.1643											
8/19/2019	7.8	1432	2.0621	1.4	3.2	55.1	4	9.2	157.6	0.6	3.4	0.2	3.9	2.7
8/20/2019	8.4	1487	2.1413											
8/21/2019	8.7	1603	2.3083											

8/22/2019	8.5	1379	1.9858											
8/23/2019	7.2	1848	2.6611											
8/24/2019	8.4	1720	2.4768											
8/25/2019	8.5	1720	2.4768											
8/26/2019	7.6	1175	1.692											
8/27/2019	7.7	988	1.4227											
8/28/2019	8.1	776	1.1174	2.5	5.7	53.4	3.1	7.1	66.2	1.6	9.2	3.4	32	1.1
8/29/2019	8.1	1615	2.3256											
8/30/2019	8.7	1563	2.2507											
8/31/2019	9.3	1525	2.196											
9/1/2019	9	1143	1.6459											
9/2/2019	8.9	1463	2.1067											
9/3/2019	8.8	1487	2.1413	1	2.3	40.9	2.6	6	106.3	0.6	3.4	1.1	20.5	5.2
9/4/2019	8.6	1123	1.6171											
9/5/2019	8.5	1144	1.6474											
9/6/2019	8.6	1313	1.8907											
9/7/2019	8.7	1345	1.9368											
9/8/2019	8.7	1353	1.9483	1.4	3.2	52.1	2.7	6.2	100.5	1	5.7	2.5	40.9	1.6
9/9/2019	8.8	1433	2.0635											
9/10/2019	9	1388	1.9987											
9/11/2019	8.7	1507	2.1701											
9/12/2019	8.8	1427	2.0549											
9/13/2019	8.7	1412	2.0333											
9/14/2019	8.6	1393	2.0059											
9/15/2019	8.7	1190	1.7136	0.7	1.6	22.9	3.9	8.9	127.7	0.8	4.6	3	42.6	1.3
9/16/2019	9.3	1182	1.7021											
9/17/2019	9	1459	2.101											
9/18/2019	8.7	1427	2.0549											
9/19/2019	8.6	1344	1.9354											
9/20/2019	9	1384	1.993											
9/21/2019	8.9	1365	1.9656											
9/22/2019	8.9	1336	1.9238											
9/23/2019	9	1308	1.8835											
9/24/2019	8.9	1275	1.836	1.5	3.4	52.6	2.8	6.4	98.2	1.1	6.3	2.9	43.8	7.6
9/25/2019	8.9	1272	1.8317											
9/26/2019	8.9	1341	1.931											
9/27/2019	9	1362	1.9613											
9/28/2019	9.1	1362	1.9613											
9/29/2019	8.9	1358	1.9555											
9/30/2019	8.7	1369	1.9714	0.7	1.6	26.4	2.8	6.4	105.4	0.7	4	2.4	39.5	2.5
10/1/2019	8.9	1343	1.9339											
10/2/2019	8.7	1371	1.9742											
10/3/2019	9	1512	2.1773											
10/4/2019	8.7	1603	2.3083											
10/5/2019	8.2	1675	2.412											
10/6/2019	8.4	1510	2.1744											
10/7/2019	8.6	1339	1.9282	5	11.3	181.5	7.9	17.8	286.7	2.2	12.4	1.1	18.1	2.3
10/8/2019	7.8	2162	3.1133											
10/9/2019	8	2139	3.0802											
10/10/2019	8.2	1275	1.836											
10/11/2019	8.3	1244	1.7914											
10/12/2019	8.5	1230	1.7712											
10/13/2019	8.5	1329	1.9138											
10/14/2019	8.5	1230	1.7712	1.3	2.9	43.3	3.3	7.4	110	0.6	3.4	0.5	7.4	2.3
10/15/2019	8.6	1316	1.895											
10/16/2019	8.7	1366	1.967											
10/17/2019	8.4	1382	1.9901											
10/18/2019	8.6	1353	1.9483											
10/19/2019	8.6	1351	1.9454											
10/20/2019	8.4	1365	1.9656											
10/21/2019	8.5	1379	1.9858	1.2	2.7	44.7	2	4.5	74.5	0.7	4	1.3	21.5	3.1
10/22/2019	8.4	1623	2.3371											
10/23/2019	8.1	1540	2.2176											
10/24/2019	8.2	1350	1.944											
10/25/2019	8.3	1587	2.2853											
10/26/2019	8.3	1744	2.5114											
10/27/2019	8.5	1940	2.7936											
10/28/2019	8.2	1758	2.5315	3	6.8	143.6	5.7	12.9	272.3	1.5	8.5	1.7	35.9	2.4
10/29/2019	8.1	1282	1.8461											
10/30/2019	8.2	1407	2.0261											
10/31/2019	8.5	1452	2.0909											
11/1/2019	8.3	1267	1.8245											
11/2/2019	8.4	1399	2.0146											
11/3/2019	8.5	1240	1.7856											
11/4/2019	8.5	775	1.116	1.8	4.1	38	4	9	84	1	5.6	1.5	14	4.3
11/5/2019	8.6	1111	1.5998											
11/6/2019	8.6	1815	2.6136											
11/7/2019	8.6	1741	2.507											
11/8/2019	8.4	1487	2.1413											
11/9/2019	8.5	885	1.2744											
11/10/2019	8.3	1017	1.4645											
11/11/2019	7.9	1351	1.9454	2.4	5.4	88	5.9	13.3	216	1.3	7.3	1.9	31	2.5
11/12/2019	8	1288	1.8547											
11/13/2019	8	975	1.404											
11/14/2019	8.4	1105	1.5912											
11/15/2019	8.4	1210	1.7424											
11/16/2019	7.8	1152	1.6589											
11/17/2019	8.1	1155	1.6632											

11/18/2019	8.5	1169	1.6834											
11/19/2019	8.6	1388	1.9987	1.3	2.9	48	4.2	9.5	158	0.8	4.5	1.6	27	0.5
11/20/2019	8.9	1364	1.9642											
11/21/2019	8.8	1355	1.9512											
11/22/2019	8.6	1470	2.1168											
11/23/2019	8.2	1794	2.5834											
11/24/2019	8.5	2191	3.155											
11/25/2019	8.5	1343	1.9339	3.4	7.7	124	5.4	12.2	197	1.6	9	1.3	21	0.9
11/26/2019	8.3	1390	2.0016											
11/27/2019	8.4	1789	2.5762											
11/28/2019	7.2	2122	3.0557											
11/29/2019	7.6	1360	1.9584											
11/30/2019	7.8	1916	2.759											
12/1/2019	7.8	1514	2.1802											
12/2/2019	7.9	2778	4.0003											
12/3/2019	8	1433	2.0635	2	4.5	77	5.5	12.4	213	1.6	9	4.5	77.4	1.3
12/4/2019	8.2	1236	1.7798											
12/5/2019	8.5	1339	1.9282											
12/6/2019	8.8	1464	2.1082											
12/7/2019	8.8	1544	2.2234											
12/8/2019	8.8	1388	1.9987											
12/9/2019	8.8	1444	2.0794	1.7	3.8	65.9	3.2	7.2	124.9	1	5.6	1.8	31.2	1.9
12/10/2019	8.7	1210	1.7424											
12/11/2019	8.6	1181	1.7006											
12/12/2019	7.4	1240	1.7856											
12/13/2019	8.6	1285	1.8504											
12/14/2019	8.8	1265	1.8216											
12/15/2019	8.7	1290	1.8576											
12/16/2019	8.9	1361	1.9598	1.7	3.8	62	3.6	8.1	132	1.1	6.2	2.4	39	0.7
12/17/2019	8.4	1457	2.0981											
12/18/2019	8.3	1263	1.8187											
12/19/2019	8.6	1255	1.8072											
12/20/2019	8.9	1521	2.1902											
12/21/2019	8.9	1576	2.2694											
12/22/2019	8.8	1498	2.1571											
12/23/2019	8.8	470	0.6768											
12/24/2019	9.3	1497	2.1557											
12/25/2019	9.1	471	0.6782											
12/26/2019	9	685	0.9864											
12/27/2019	8.8	1506	2.1686	3.6	8.1	147	4.9	11.1	201	1.8	10.2	2.1	38	2.6
12/28/2019	8.6	1554	2.2378											
12/29/2019	8.6	1554	2.2378											
12/30/2019	7.9	1603	2.3083											
12/31/2019	7.9	1767	2.5445											
1/1/2020	8.2	1753	2.5243											
1/2/2020	8.3	1622	2.3357											
1/3/2020	8.4	1744	2.5114											
1/4/2020	8.6	1134	1.633	13.7	30.9	421	14.5	32.7	445	7.8	44	13.1	178	1.4
1/5/2020	8	1406	2.0246											
1/6/2020	8.2	1340	1.9296											
1/7/2020	8	1231	1.7726											
1/8/2020	8.1	1689	2.4322											
1/9/2020	8.6	836	1.2038	3.2	7.2	72.3	4.4	9.9	99.4	1.8	10.2	3	30.1	1.6
1/10/2020	8.4	1353	1.9483											
1/11/2020	8.2	1937	2.7893											
1/12/2020	8.6	2654	3.8218											
1/13/2020	8.7	1361	1.9598											
1/14/2020	8.6	2243	3.2299											
1/15/2020	8.5	2885	4.1544											
1/16/2020	8.6	931	1.3406											
1/17/2020	8.2	685	0.9864	4.6	10.4	85.6	5.7	12.2	100.4	2.1	11.8	1.4	11.5	1.6
1/18/2020	8.4	1400	2.016											
1/19/2020	8.6	1432	2.0621											
1/20/2020	8.6	629	0.9058	5.6	12.6	95.2	7	15.8	119.4	2.8	15.8	3.2	24.2	1.1
1/21/2020	8.6	728	1.0483											
1/22/2020	8.7	1510	2.1744											
1/23/2020	8.8	1310	1.8864											
1/24/2020	8.5	1380	1.9872											
1/25/2020	8.5	1436	2.0678											
1/26/2020	8.6	1530	2.2032											
1/27/2020	8.8	1509	2.173											
1/28/2020	8.6	906	1.3046	5.4	12.2	132.7	7.9	17.7	193.7	2.3	13	0.8	8.7	4
1/29/2020	8.9	789	1.1362											
1/30/2020	8.6	1319	1.8994											
1/31/2020	9	1371	1.9742											
2/1/2020	9.1	1346	1.9382											
2/2/2020	8.9	1247	1.7957											
2/3/2020	9	1548	2.2291											
2/4/2020	8.8	1627	2.3429											
2/5/2020	8.9	1037	1.4933	5.9	13.3	165.6	6.8	15.3	190.5	2.9	16.4	3.1	38.6	0.1
2/6/2020	8.8	1394	2.0074											
2/7/2020	8.4	1750	2.52											
2/8/2020	8.4	1752	2.5229											
2/9/2020	8.7	1593	2.2939											
2/10/2020	8.7	1084	1.561	4.9	11.1	144.5	7.6	17.2	223.9	2.1	11.8	0.7	9.1	0.6
2/11/2020	8.4	2949	4.2466											
2/12/2020	8.4	2244	3.2314											
2/13/2020	8.5	2444	3.5194											

2/14/2020	9.9	1784	2.569											
2/15/2020	9.4	1270	1.8288											
2/16/2020	8.8	1654	2.3818											
2/17/2020	8	1012	1.4573	3.6	8.1	99	6.6	14.9	181	3	16.9	8.8	107	0.6
2/18/2020	8.5	1660	2.3904											
2/19/2020	8.3	0	0											
2/20/2020	8.5	0	0											
2/21/2020	7.4	0	0											
2/22/2020	8.6	0	0											
2/23/2020	8.7	0	0											
2/24/2020	9	0	0											
2/25/2020	9	0	0											
2/26/2020	8.6	693	0.9979											
2/27/2020	9	1227	1.7669											
2/28/2020	9.2	357	0.5141	12.1	27.3	117.1	10.8	24.4	104.6	7.4	41.8	14.5	62.2	2
2/29/2020	8.8	710	1.0224											
3/1/2020	9.1	1173	1.6891											
3/2/2020	9.1	986	1.4198	6.3	14.2	168	4.9	11.1	131	3	16.9	2.7	32	0.6
3/3/2020	9.1	1378	1.9843											
3/4/2020	9	1212	1.7453											
3/5/2020	9	1064	1.5322											
3/6/2020	9.1	1216	1.751											
3/7/2020	9	1238	1.7827											
3/8/2020	9.1	1225	1.764											
3/9/2020	9.2	1160	1.6704	4.6	11	153	2.6	6.2	86	2.6	15.5	4.5	63	0.7
3/10/2020	8.8	1165	1.6776											
3/11/2020	8.9	1320	1.9008											
3/12/2020	8.7	1337	1.9253											
3/13/2020	8.8	1325	1.908											
3/14/2020	8.7	1435	2.0664											
3/15/2020	8.8	1755	2.5272											
3/16/2020	8.3	2301	3.3134											
3/17/2020	8.4	1535	2.2104											
3/18/2020	8.5	1088	1.5667	4.1	9.8	128	4.2	10	131	2.4	17.8	8	105	1.3
3/19/2020	8.8	1082	1.5581											
3/20/2020	9	1106	1.5926											
3/21/2020	8.8	1134	1.633											
3/22/2020	8.9	1415	2.0376											
3/23/2020	9.2	1403	2.0203	4	9.5	161	5.3	12.6	212	1.8	10.7	1.2	20	2.2
3/24/2020	8.6	2070	2.9808											
3/25/2020	8.8	1969	2.8354											
3/26/2020	8.9	1738	2.5027											
3/27/2020	8.9	1131	1.6286											
3/28/2020	8.8	1140	1.6416											
3/29/2020	8.6	1156	1.6646											
3/30/2020	8.6	1151	1.6574	4.8	11.5	159	4.8	11.5	159	2.2	13.1	1.6	22	2.2
3/31/2020	8.8	1473	2.1211											
4/1/2020	8.8	1844	2.6554											
4/2/2020	9	1594	2.2954											
4/3/2020	9.2	1282	1.8461											
4/4/2020	9.3	1244	1.7914											
4/5/2020	9	1270	1.8288											
4/6/2020	9.2	1273	1.8331	4.8	11.5	175.8	4.9	11.7	178.9	2.2	13.1	1.6	24.5	2.7
4/7/2020	9.1	1152	1.6589											
4/8/2020	9	1119	1.6114											
4/9/2020	9	1164	1.6762											
4/10/2020	8.7	1167	1.6805											
4/11/2020	8.9	1085	1.5624											
4/12/2020	9.1	1849	2.6626											
4/13/2020	8.5	2257	3.2501											
4/14/2020	8.6	1003	1.4443	6.6	15.7	189	7.9	18.8	227	4	23.9	8.2	99	3.8
4/15/2020	8.9	1423	2.0491											
4/16/2020	8.5	1435	2.0664											
4/17/2020	9.1	1345	1.9368											
4/18/2020	8.9	1246	1.7942											
4/19/2020	8.8	1298	1.8691											
4/20/2020	8.6	1298	1.8691											
4/21/2020	8	942	1.3565	4.9	11.7	132	7	16.7	189	2	11.9	0.2	2	1.3
4/22/2020	7.7	1212	1.7453											
4/23/2020	8.1	1415	2.0376											
4/24/2020	8.6	1457	2.0981											
4/25/2020	9.1	1300	1.872											
4/26/2020	9	1133	1.6315											
4/27/2020	9	1756	2.5286											
4/28/2020	9.3	1511	2.1758											
4/29/2020	9	1063	1.5307	4.1	9.8	125	5.8	13.8	176	2.4	14.3	4.5	58	0.9
4/30/2020	8.8	1096	1.5782											
5/1/2020	9	1323	1.9051											
5/2/2020	9.3	1156	1.6646											
5/3/2020	9.2	1090	1.5696											
5/4/2020	9.1	1074	1.5466											
5/5/2020	9	925	1.332	2.3	5.5	61	2.5	6	67	1.4	8.4	2.9	32	1.4
5/6/2020	8.9	1253	1.8043											
5/7/2020	9	1052	1.5149											
5/8/2020	9.3	10.8	0.0156											
5/9/2020	9	1103	1.5883											
5/10/2020	8.9	1019	1.4674											
5/11/2020	8.9	885	1.2744	1.8	4.3	46	1.9	4.5	48	0.9	5.4	1.1	12	1.5

5/12/2020	8.8	966	1.391											
5/13/2020	8.8	991	1.427											
5/14/2020	8.8	968	1.3939											
5/15/2020	9	973	1.4011											
5/16/2020	9.1	700	1.008											
5/17/2020	9.1	992	1.4285											
5/18/2020	9.2	1233	1.7755	1.1	2.6	39	2.7	6.4	95	0.5	3	0.4	6	6.7
5/19/2020	9.1	1175	1.692											
5/20/2020	8.8	1071	1.5422											
5/21/2020	8.7	636	0.9158											
5/22/2020	8.4	1006	1.4486											
5/23/2020	8.4	1101	1.5854											
5/24/2020	8.3	1478	2.1283											
5/25/2020	8.5	1298	1.8691											
5/26/2020	8.6	1240	1.7856											
5/27/2020	8.7	1244	1.7914	2.7	6.4	96	6.5	15.5	232	1.7	10.1	3.7	55	2
5/28/2020	8.3	1221	1.7582											
5/29/2020	8.4	904	1.3018											
5/30/2020	8.3	1618	2.3299											
5/31/2020	8.7	942	1.3565											
6/1/2020	8.4	1070	1.5408	1.5	3.6	46	5.3	12.6	162	0.7	4.2	0.6	7.7	2.7
6/2/2020	8.6	817	1.1765											
6/3/2020	9	852	1.2269											
6/4/2020	9.2	1032	1.4861											
6/5/2020	8.8	1251	1.8014											
6/6/2020	8.3	2098	3.0211											
6/7/2020	8.8	1195	1.7208											
6/8/2020	8.7	1120	1.6128	1.7	4.1	55	5.5	13.1	176	0.8	4.8	0.7	9	5.9
6/9/2020	8.6	1101	1.5854											
6/10/2020	8.2	1174	1.6906											
6/11/2020	8.4	1159	1.669											
6/12/2020	8.5	1312	1.8893											
6/13/2020	8.6	1199	1.7266											
6/14/2020	8.7	1150	1.656											
6/15/2020	9	873	1.2571	1.4	3.3	35	2.7	6.4	67	1.1	6.6	3.3	35	7.4
6/16/2020	8.9	842	1.2125											
6/17/2020	9	845	1.2168											
6/18/2020	8.8	1377	1.9829											
6/19/2020	9.3	1282	1.8461											
6/20/2020	9.4	1108	1.5955											
6/21/2020	9.1	1030	1.4832											
6/22/2020	8.4	914	1.3162	1.1	2.6	29	1.9	4.5	49	0.6	3.6	1	11	4.7
6/23/2020	8.6	923	1.3291											
6/24/2020	8.4	968	1.3939											
6/25/2020	8.4	939	1.3522											
6/26/2020	8.4	800	1.152											
6/27/2020	8.4	950	1.368											
6/28/2020	8.8	1429	2.0578											
6/29/2020	8.9	1299	1.8706	4.7	11.2	175	3.7	8.8	137	2.9	17.3	6.1	95	2.3
6/30/2020	8.6	2056	2.9606											
7/1/2020	8.3	1648	2.3731											
7/2/2020	8.8	3020	4.3488											
7/3/2020	8.2	1223	1.7611											
7/4/2020	8.3	1228	1.7683											
7/5/2020	8.5	1299	1.8706											
7/6/2020	8.2	1116	1.607	1.6	3.8	50.9	2.3	5.5	73.7	1.2	7.2	3.4	45.6	0.7
7/7/2020	8.8	1157	1.6661											
7/8/2020	9	1324	1.9066											
7/9/2020	9.1	1011	1.4558											
7/10/2020	9	979	1.4098											
7/11/2020	9.2	976	1.4054											
7/12/2020	8.9	1013	1.4587											
7/13/2020	8.3	2738	3.9427											
7/14/2020	8.1	1259	1.813	4.5	10.7	161.8	5.5	13.1	198.1	2.2	13.1	2.4	36.3	0.9
7/15/2020	8.3	1080	1.5552											
7/16/2020	8.6	1164	1.6762											
7/17/2020	8.9	1187	1.7093											
7/18/2020	9.2	1272	1.8317											
7/19/2020	8.8	1421	2.0462											
7/20/2020	8.6	1422	2.0477	0.9	2.2	38	2.6	6.2	106	0.8	4.8	2.6	44	2.7
7/21/2020	8.9	1393	2.0059											
7/22/2020	8.7	1382	1.9901											
7/23/2020	8.1	2284	3.289											
7/24/2020	8	1740	2.5056											
7/25/2020	8.1	1229	1.7698											
7/26/2020	8.7	1171	1.6862											
7/27/2020	9.1	1159	1.669											
7/28/2020	9.2	1133	1.6315	0.9	2.1	29	1.8	4.3	59	0.6	3.6	1.5	20	0.9
7/29/2020	8.8	161	0.2318											
7/30/2020	8.1	29	0.0418											
7/31/2020	7.9	27	0.0389											
8/1/2020	8.3	21	0.0302											
8/2/2020	8.3	17	0.0245											
8/3/2020	8.8	126	0.1814											
8/4/2020	8.8	1136	1.6358											
8/5/2020	8.7	1164	1.6762											
8/6/2020	8.8	1178	1.6963											
8/7/2020	8.6	1164	1.6762	1.3	3.1	43	2.5	6	84	0.7	4.2	1.1	15	1.8

8/8/2020	8.6	1542	2.2205											
8/9/2020	8.5	1348	1.9411											
8/10/2020	8.3	2510	3.6144											
8/11/2020	8.5	1646	2.3702											
8/12/2020	8.1	500	0.72	4.7	11.2	67	5.8	13.8	83	3.6	21.5	10.3	62	2.5
8/13/2020	8.4	593	0.8539											
8/14/2020	8.4	755	1.0872											
8/15/2020	8	836	1.2038											
8/16/2020	8.5	613	0.8827											
8/17/2020	8.7	1412	2.0333											
8/18/2020	8.3	1252	1.8029	1.5	3.6	54	2.2	5.3	80	0.9	5.4	1.8	27	2.1
8/19/2020	8.3	1326	1.9094											
8/20/2020	8.3	1307	1.8821											
8/21/2020	8.2	1355	1.9512											
8/22/2020	8.4	1330	1.9152											
8/23/2020	8.4	1319	1.8994											
8/24/2020	8.3	1355	1.9512	2.1	5	81	2.1	5	81	1.1	6.6	1.6	26	0.8
8/25/2020	8.5	1340	1.9296											
8/26/2020	8.6	1564	2.2522											
8/27/2020	8.5	1425	2.052											
8/28/2020	8.2	453	0.6523											
8/29/2020	7.7	1300	1.872											
8/30/2020	7.7	1219	1.7554											
8/31/2020	8.3	1056	1.5206	3.9	8.7	110	4.8	10.8	137	2	11.2	2.5	32	1.2
9/1/2020	8.4	986	1.4198											
9/2/2020	8.1	1190	1.7136											
9/3/2020	8.2	1330	1.9152											
9/4/2020	8.4	1362	1.9613											
9/5/2020	8.6	1370	1.9728											
9/6/2020	8.7	1350	1.944											
9/7/2020	8.7	1394	2.0074											
9/8/2020	8.7	1406	2.0246											
9/9/2020	8.8	1393	2.0059											
9/10/2020	8.7	1405	2.0232	1.7	3.8	64	4.8	10.8	182	0.7	3.9	0.1	2	3
9/11/2020	8.5	1457	2.0981											
9/12/2020	8.6	1560	2.2464											
9/13/2020	8.6	1623	2.3371											
9/14/2020	8.5	1992	2.8685											
9/15/2020	8.5	1402	2.0189	2.3	5.2	87.6	4.2	9.4	158.3	1.6	9	3.8	64	1.2
9/16/2020	8.4	1285	1.8504											
9/17/2020	8.2	1353	1.9483											
9/18/2020	8.3	1387	1.9973											
9/19/2020	8.6	1337	1.9253											
9/20/2020	8.5	1353	1.9483											
9/21/2020	8.6	1335	1.9224											
9/22/2020	8.4	1305	1.8792	3.3	7.4	116	4.4	9.9	155	2.1	11.8	4.4	69	2.6
9/23/2020	8.6	1311	1.8878											
9/24/2020	8.4	1341	1.931											
9/25/2020	8	1519	2.1874											
9/26/2020	8	1425	2.052											
9/27/2020	8	1362	1.9613											
9/28/2020	7.9	1355	1.9512	3.9	8.7	142	6.1	13.9	226	1.7	9.5	0.8	13	1.5
9/29/2020	7.9	1340	1.9296											
9/30/2020	8	1346	1.9382											
10/1/2020	8.9	1228	1.7683											
10/2/2020	8.4	429	0.6178											
10/3/2020	8.3	1364	1.9642											
10/4/2020	8.2	1412	2.0333											
10/5/2020	8.2	1345	1.9368											
10/6/2020	8.3	1020	1.4688	1.5	3.4	41.6	6	13.4	164.1	0.8	4.5	1.1	13.5	2.5
10/7/2020	8.1	709	1.021											
10/8/2020	8	2403	3.4603											
10/9/2020	8	1791	2.579											
10/10/2020	8.2	1393	2.0059											
10/11/2020	8.1	1703	2.4523											
10/12/2020	8.3	1458	2.0995											
10/13/2020	8.3	1128	1.6243											
10/14/2020	8.1	881	1.2686	1.1	2.5	26.5	7.4	16.6	175.6	0.6	3.4	0.9	9.5	0.1
10/15/2020	7.8	1287	1.8533											
10/16/2020	8.2	1403	2.0203											
10/17/2020	8.1	1438	2.0707											
10/18/2020	8.1	948	1.3651											
10/19/2020	7.8	841	1.211	1.5	3.4	34	5.6	12.5	126	0.8	4.5	1.1	11	0.2
10/20/2020	7.8	1318	1.8979											
10/21/2020	8	1392	2.0045											
10/22/2020	8	1600	2.304											
10/23/2020	7.6	1575	2.268											
10/24/2020	8.6	2228	3.2083											
10/25/2020	8	1673	2.4091											
10/26/2020	8	1104	1.5898											
10/27/2020	7.7	976	1.4054	2.2	4.9	57	6.9	15.5	182	1	5.6	0.7	8.2	1.4
10/28/2020	7.6	1697	2.4437											
10/29/2020	8.2	2285	3.2904											
10/30/2020	7.8	1904	2.7418											
10/31/2020	7.7	1459	2.101											
11/1/2020	7.8	1407	2.0261											
11/2/2020	8.4	1328	1.9123											
11/3/2020	8.3	1272	1.8317	1.2	2.7	41	6.2	13.9	212	0.6	3.4	0.7	11	0.5

11/4/2020	8	1296	1.8662											
11/5/2020	8.6	1281	1.8446											
11/6/2020	8.1	1126	1.6214											
11/7/2020	8	1152	1.6589											
11/8/2020	7.9	1166	1.679											
11/9/2020	7.8	1187	1.7093											
11/10/2020	8.2	2254	3.2458											
11/11/2020	8.3	1104	1.5898											
11/12/2020	8.3	1860	2.6784											
11/13/2020	8.5	607	0.8741	1.5	3.4	25	6.3	14.1	103	1.2	6.7	3.3	24	0.9
11/14/2020	8.5	1170	1.6848											
11/15/2020	8.6	1312	1.8893											
11/16/2020	8.5	1181	1.7006											
11/17/2020	8.7	947	1.3637											
11/18/2020	8.3	981	1.4126	1.8	4	47	6.1	13.7	161	1.2	6.7	2.7	32	1.8
11/19/2020	8.3	956	1.3766											
11/20/2020	7.9	1178	1.6963											
11/21/2020	8.1	1582	2.2781											
11/22/2020	8.4	1536	2.2118											
11/23/2020	8.6	1368	1.9699											
11/24/2020	8.9	1056	1.5206											
11/25/2020	8.3	1163	1.6747	1.7	3.8	53	7.2	16.1	225	1	5.6	1.8	25	0.3
11/26/2020	8.3	518	0.7459											
11/27/2020	8.5	1509	2.173											
11/28/2020	8.6	1031	1.4846											
11/29/2020	8.6	988	1.4227											
11/30/2020	8.3	988	1.4227	0.6	1.3	16	6.3	14.1	167	1.2	4.5	3.2	38	1.2
12/1/2020	8.4	978	1.4083											
12/2/2020	8.4	1266	1.823											
12/3/2020	8.1	1321	1.9022											
12/4/2020	8.5	1380	1.9872											
12/5/2020	8.4	1923	2.7691											
12/6/2020	8.7	1394	2.0074											
12/7/2020	8.4	1058	1.5235	1.6	3.6	46	6	13.4	170	0.8	4.5	0.9	11	0.8
12/8/2020	8.7	728	1.0483											
12/9/2020	8.3	721	1.0382											
12/10/2020	8.6	1813	2.6107											
12/11/2020	8.7	721	1.0382											
12/12/2020	8.8	920	1.3248											
12/13/2020	8.4	991	1.427											
12/14/2020	9	1669	2.4034											
12/15/2020	7.8	1218	1.7539											
12/16/2020	8.6	1089	1.5682											
12/17/2020	8.6	822	1.1837	3.3	7.4	73	7.8	17.5	173	2.1	11.8	4.4	43.4	0.3
12/18/2020	8.9	843	1.2139											
12/19/2020	9.2	900	1.296											
12/20/2020	8.8	1024	1.4746											
12/21/2020	8.7	967	1.3925	3.2	7.2	84	6.4	14.3	166	1.4	7.8	0.6	7	0.5
12/22/2020	8.7	994	1.4314											
12/23/2020	8.7	1001	1.4414											
12/24/2020	8.8	2008	2.8915											
12/25/2020	8.9	1420	2.0448											
12/26/2020	9	770	1.1088											
12/27/2020	9.3	263	0.3787											
12/28/2020	9.1	1574	2.2666	3.7	8.3	157	5.7	12.8	242	1.7	9.5	1.2	23	1.3
12/29/2020	8.8	1023	1.4731											
12/30/2020	8.8	958	1.3795											
12/31/2020	8.8	1322	1.9037											
1/1/2021	8.7	1485	2.1384											
1/2/2021	9.2	1282	1.8461											
1/3/2021	9.3	691	0.995											
1/4/2021	8.8	632	0.9101	6.6	14.8	112	8.2	18.4	140	3.1	17.4	2.6	20	2.7
1/5/2021	8.8	749	1.0786											
1/6/2021	8.8	1075	1.548											
1/7/2021	8.9	1143	1.6459											
1/8/2021	9.3	1068	1.5379											
1/9/2021	8.6	1017	1.4645											
1/10/2021	8.6	977	1.4069											
1/11/2021	8.3	901	1.2974	5.4	12.1	131	6.1	13.7	148	3.1	17.4	5.3	57	0.7
1/12/2021	8.3	841	1.211											
1/13/2021	7.8	946	1.3622											
1/14/2021	7.9	1275	1.836											
1/15/2021	8.1	1283	1.8475											
1/16/2021	9.1	598	0.8611											
1/17/2021	9	693	0.9979											
1/18/2021	8.9	757	1.0901	6.1	13.7	125	9.2	20.6	187	3.3	18.5	4.8	44	3
1/19/2021	6.8	799	1.1506											
1/20/2021	7.2	1125	1.62											
1/21/2021	7.7	1094	1.5754											
1/22/2021	8.3	1097	1.5797											
1/23/2021	8.9	1054	1.5178											
1/24/2021	9	1065	1.5336											
1/25/2021	8.7	1295	1.8648											
1/26/2021	8.5	2125	3.06											
1/27/2021	8.9	1767	2.5445											
1/28/2021	9	1021	1.4702	2.9	6.5	79.7	5.9	13.2	161.8	1.4	7.8	1.3	15.9	0.5
1/29/2021	9.3	769	1.1074											
1/30/2021	9	684	0.985											

1/31/2021	8.5	920	1.3248											
2/1/2021	7.6	871	1.2542	4.6	10.3	108	8	17.9	187	2.7	15.1	4.8	50	0.7
2/2/2021	6.9	806	1.1606											
2/3/2021	7.8	1298	1.8691											
2/4/2021	8.8	1605	2.3112											
2/5/2021	8.7	1468	2.1139											
2/6/2021	9.2	1218	1.7539											
2/7/2021	8.9	740	1.0656											
2/8/2021	9.3	700	1.008	2.9	6.5	55	5.8	13	109	1.9	10.6	4.1	35	1
2/9/2021	9.3	812	1.1693											
2/10/2021	9.2	916	1.319											
2/11/2021	8.4	1288	1.8547											
2/12/2021	8.2	1116	1.607											
2/13/2021	8.3	1406	2.0246											
2/14/2021	8.4	1326	1.9094											
2/15/2021	8.5	627	0.9029	2.4	5.4	41	7.8	17.5	132	1.3	7.3	1.9	14	2.7
2/16/2021	8	701	1.0094											
2/17/2021	7.4	775	1.116											
2/18/2021	8.1	922	1.3277											
2/19/2021	8.7	992	1.4285											
2/20/2021	8.8	1124	1.6186											
2/21/2021	8.8	1222	1.7597											
2/22/2021	8.7	1977	2.8469											
2/23/2021	8.4	1605	2.3112											
2/24/2021	8.7	754	1.0858	5.3	11.9	107.8	6.3	14.1	127.7	2.9	16.2	4.3	38.9	3
2/25/2021	8.4	1600	2.304											
2/26/2021	7.5	1133	1.6315											
2/27/2021	7.2	2271	3.2702											
2/28/2021	7.6	1157	1.6661											
3/1/2021	7.7	939	1.3522											
3/2/2021	7.8	1169	1.6834											
3/3/2021	7.8	1111	1.5998											
3/4/2021	8.1	1652	2.3789											
3/5/2021	8.5	922	1.3277	2	4.6	50.9	5.3	12.1	133.9	0.9	5.1	0.5	5.5	2.5
3/6/2021	8.4	1056	1.5206											
3/7/2021	8.5	1020	1.4688											
3/8/2021	8.6	1060	1.5264	1.3	3	38	3.8	8.7	111	0.9	5.1	2.1	27	1.2
3/9/2021	8.6	1019	1.4674											
3/10/2021	8.7	1881	2.7086											
3/11/2021	8.7	1649	2.3746											
3/12/2021	8.6	1332	1.9181											
3/13/2021	8.5	1331	1.9166											
3/14/2021	8.5	1330	1.9152											
3/15/2021	8.5	1356	1.9526	1.2	2.7	44	3.7	8.5	138	0.9	5.1	2.4	39	1
3/16/2021	8.4	1343	1.9339											
3/17/2021	8.1	1577	2.2709											
3/18/2021	8.4	3083	4.4395											
3/19/2021	8	1288	1.8547											
3/20/2021	7.9	1183	1.7035											
3/21/2021	8.1	1104	1.5898											
3/22/2021	8	816	1.175											
3/23/2021	8.6	1358	1.9555	2.4	5.5	90	4.7	10.7	175	1.3	7.4	1.9	31	2.6
3/24/2021	8.5	1402	2.0189											
3/25/2021	8.4	1723	2.4811											
3/26/2021	8.3	2412	3.4733											
3/27/2021	8.8	1427	2.0549											
3/28/2021	8	2058	2.9635											
3/29/2021	7.9	1859	2.677											
3/30/2021	7.8	1636	2.3558											
3/31/2021	7.7	1554	2.2378	3.1	7.1	132.5	6.3	14.4	268.7	1.4	8	0.9	16.8	1.5
4/1/2021	8.5	1712	2.4653											
4/2/2021	8.5	1306	1.8806											
4/3/2021	8.5	1235	1.7784											
4/4/2021	8.5	1193	1.7179											
4/5/2021	8.5	929	1.3378	1.6	3.7	41	3	6.9	77	0.8	4.6	0.9	10	1.9
4/6/2021	8.8	901	1.2974											
4/7/2021	8.4	1949	2.8066											
4/8/2021	8.4	2440	3.5136											
4/9/2021	8.1	1036	1.4918											
4/10/2021	8.7	2743	3.9499											
4/11/2021	8.3	1460	2.1024											
4/12/2021	8.5	643	0.9259											
4/13/2021	8.7	1200	1.728	10.9	24.9	359	5.3	12.1	174	5.3	30.3	5.4	78	1.8
4/14/2021	8.6	1377	1.9829											
4/15/2021	8.3	1226	1.7654											
4/16/2021	8.4	1166	1.679											
4/17/2021	8.7	1011	1.4558											
4/18/2021	8.3	972	1.3997											
4/19/2021	8	966	1.391	2	4.6	53	5.4	12.3	143	1.1	6.3	1.7	20	5.4
4/20/2021	8.2	1317	1.8965											
4/21/2021	8	1735	2.4984											
4/22/2021	8.3	1156	1.6646											
4/23/2021	8.5	1184	1.705											
4/24/2021	8.6	1248	1.7971											
4/25/2021	8.7	1267	1.8245											
4/26/2021	8.5	865	1.2456	2.8	6.4	67	7.2	16.5	171	1.7	9.7	3.3	34	1.3
4/27/2021	8.7	799	1.1506											
4/28/2021	8.1	2797	4.0277											

4/29/2021	8.5	1080	1.5552											
4/30/2021	8.6	1233	1.7755											
5/1/2021	8.6	1217	1.7525											
5/2/2021	8.6	1139	1.6402											
5/3/2021	8.4	690	0.9936	2.2	5	41	6.5	14.9	124	0.9	5.1	0.1	1	3.8
5/4/2021	8.4	802	1.1549											
5/5/2021	8.7	2278	3.2803											
5/6/2021	8.2	1570	2.2608											
5/7/2021	8.3	999	1.4386											
5/8/2021	8.6	1532	2.2061											
5/9/2021	8.5	1022	1.4717											
5/10/2021	8.5	1060	1.5264	1.8	4.1	52	5.7	13.1	167	1.3	7.5	3.4	43	2.3
5/11/2021	8.3	1416	2.039											
5/12/2021	8.6	1467	2.1125											
5/13/2021	8.5	995	1.4328											
5/14/2021	8.4	1138	1.6387											
5/15/2021	8.5	1257	1.8101											
5/16/2021	8.6	1189	1.7122											
5/17/2021	8.5	1081	1.5566											
5/18/2021	8.3	899	1.2946											
5/19/2021	8.2	951	1.3694	5	11.5	131.3	7.1	16.3	186.2	3.2	18.4	6.9	78.8	1.3
5/20/2021	8.2	1394	2.0074											
5/21/2021	8.2	1654	2.3818											
5/22/2021	8.2	750	1.08											
5/23/2021	8.2	1312	1.8893											
5/24/2021	8.2	898.8	1.2943											
5/25/2021	8.4	1392	2.0045											
5/26/2021	8.4	1232	1.7741	4.4	10.1	150	8.1	18.6	275	3.2	14.4	4.3	64	4.6
5/27/2021	8.7	753.1	1.0845											
5/28/2021	8.5	1156	1.6646											
5/29/2021	8.2	844	1.2154											
5/30/2021	8.4	1263	1.8187											
5/31/2021	8.5	1146	1.6502											
6/1/2021	8.5	880	1.2672											
6/2/2021	8.4	1706	2.4566											
6/3/2021	8.3	1876	2.7014											
6/4/2021	8	1027	1.4789	1.9	4.4	54	6.2	14.2	175	1	5.7	1.3	16	5.4
6/5/2021	7.9	565	0.8136											
6/6/2021	7.1	529	0.7618											
6/7/2021	7.6	1054	1.5178											
6/8/2021	7.9	1542	2.2205											
6/9/2021	7.7	1768	2.5459											
6/10/2021	7.9	1908	2.7475											
6/11/2021	8	1087	1.5653											
6/12/2021	8.2	822	1.1837	1.6	3.7	37	8	18.4	182	1.1	6.3	2.6	26	0.6
6/13/2021	6	1515	2.1816											
6/14/2021	7.4	1512	2.1773											
6/15/2021	8.7	1313	1.8907											
6/16/2021	8.7	1127	1.6229	0.6	1.4	19	6.2	14.2	192	0.3	1.7	0.3	4	1.5
6/17/2021	9.4	1645	2.3688											
6/18/2021	9	1752	2.5229											
6/19/2021	8.6	1579	2.2738											
6/20/2021	8.7	1736	2.4998											
6/21/2021	9	855	1.2312	0.6	1.4	14	5.4	12.4	127	0.5	2.9	1.5	15	0.8
6/22/2021	7.1	1543	2.2219											
6/23/2021	7.7	1704	2.4538											
6/24/2021	8.3	1857	2.6741											
6/25/2021	8.5	2038	2.9347											
6/26/2021	8.4	1851	2.6654											
6/27/2021	8.4	1818	2.6179											
6/28/2021	6.1	1020	1.4688											
6/29/2021	7.4	502	0.7229	1	2.3	14	10.6	24.3	147	0.7	4	1.7	10	0.8
6/30/2021	6.2	2191	3.155											
7/1/2021	6.6	900	1.296											
7/2/2021	7.5	1697	2.4437											
7/3/2021	8.6	1607	2.3141											
7/4/2021	9.2	1737	2.5013											
7/5/2021	9	1852	2.6669											
7/6/2021	9.1	1510	2.1744											
7/7/2021	8.1	1468	2.1139	0.3	0.7	12	4.4	10.1	178	0.4	2.3	1.6	28	6.5
7/8/2021	7.9	2089	3.0082											
7/9/2021	8.3	1973	2.8411											
7/10/2021	7.9	2214	3.1882											
7/11/2021	7.1	1401	2.0174											
7/12/2021	7.8	834	1.201											
7/13/2021	7.8	1254	1.8058	3.2	7.4	111	6.5	14.9	224	1.7	9.8	2.4	36	1.5
7/14/2021	7.7	1637	2.3573											
7/15/2021	8.3	1731	2.4926											
7/16/2021	8.8	1737	2.5013											
7/17/2021	7.9	1697	2.4437											
7/18/2021	8.4	1689	2.4322											
7/19/2021	7.9	1675	2.412											
7/20/2021	7.9	947	1.3637	2.1	4.8	55	6.2	14.2	162	1.1	6.3	1.5	17	1
7/21/2021	7.7	1333	1.9195											
7/22/2021	8.1	1534	2.209											
7/23/2021	8.1	1812	2.6093											
7/24/2021	8.1	1752	2.5229											
7/25/2021	7.8	1705	2.4552											

7/26/2021	8.2	1102	1.5869											
7/27/2021	8.2	1769	2.5474											
7/28/2021	8.3	1229	1.7698											
7/29/2021	8	1096	1.5782	2.7	6.2	82	6.2	14.2	187	1.7	9.8	3.6	47	5.8
7/30/2021	7.5	1298	1.8691											
7/31/2021	8	2572	3.7037											
8/1/2021	8.1	2264	3.2602											
8/2/2021	7.7	2393	3.4459											
8/3/2021	8	2406	3.4646	1.6	3.7	106.9	2.4	5.5	106.9	1.1	6.3	2.6	75.1	1.9
8/4/2021	8	2164	3.1162											
8/5/2021	8.7	1863	2.6827											
8/6/2021	8.3	1262	1.8173											
8/7/2021	8.1	282	0.4061											
8/8/2021	8	63	0.0907											
8/9/2021	7.8	9	0.013											
8/10/2021	7.7	22.9	0.033											
8/11/2021	7.7	517	0.7445											
8/12/2021	8	1747	2.5157	1.2	2.8	59	1.8	4.1	86	0.6	3.4	0.6	13	0.6
8/13/2021	8.6	1581	2.2766											
8/14/2021	9.1	1381	1.9886											
8/15/2021	8	1372	1.9757											
8/16/2021	7.8	1265	1.8216	2.6	6	91	2.8	6.4	97	1.2	6.9	0.9	14	6.3
8/17/2021	8.2	1340	1.9296											
8/18/2021	8.5	665	0.9576											
8/19/2021	8.4	1096	1.5782											
8/20/2021	8.4	1652	2.3789											
8/21/2021	9	1599	2.3026											
8/22/2021	8.8	1576	2.2694											
8/23/2021	9.1	1572	2.2637	6.1	14	264	2.6	6	113	3	17.2	3.2	60	1.1
8/24/2021	9	1483	2.1355											
8/25/2021	9	1013	1.4587											
8/26/2021	9	84	0.121											
8/27/2021	8.9	1007	1.4501											
8/28/2021	8.7	1171	1.6862											
8/29/2021	8.4	1051	1.5134											
8/30/2021	8.5	1002	1.4429	1.7	3.9	46.9	1.8	4.1	49.3	0.7	4	0.1	1.2	4.1
8/31/2021	8	2086	3.0038											
9/1/2021	8.4	2424	3.4906											
9/2/2021	8.8	1162	1.6733											
9/3/2021	8.9	1086	1.5638											
9/4/2021	9.1	509	0.733											
9/5/2021	8.8	744	1.0714											
9/6/2021	8.8	840	1.2096											
9/7/2021	8.9	855	1.2312											
9/8/2021	9	872	1.2557	2.1	4.8	50.3	3.7	8.5	89	1.2	6.9	2.1	22	0.7
9/9/2021	9.1	913	1.3147											
9/10/2021	8.9	1083	1.5595											
9/11/2021	9.3	1038	1.4947											
9/12/2021	9.2	979	1.4098											
9/13/2021	9.2	879	1.2658	0.6	1.4	15	3	6.9	73	1.3	2.3	0.7	7	0.7
9/14/2021	8.8	790	1.1376											
9/15/2021	8.3	1787	2.5733											
9/16/2021	7.6	1909	2.749											
9/17/2021	8.3	1480	2.1312											
9/18/2021	7.9	1523	2.1931											
9/19/2021	8.3	1566	2.255											
9/20/2021	7.8	1341	1.931											
9/21/2021	8.1	1214	1.7482											
9/22/2021	8.1	691	0.995											
9/23/2021	8.7	729	1.0498	6.5	14.9	131	5.6	12.9	113	2.7	15.5	0.6	5	2
9/24/2021	8.6	1203	1.7323											
9/25/2021	8.6	1627	2.3429											
9/26/2021	7.7	1382	1.9901											
9/27/2021	7.3	1424	2.0506											
9/28/2021	7.7	788	1.1347	4.3	9.9	94	11.2	25.7	243.2	2.4	13.8	3.9	37	1.9
9/29/2021	7.8	1251	1.8014											
9/30/2021	8	1101	1.5854											
10/1/2021	7.9	1185	1.7064											
10/2/2021	8	386	0.5558											
10/3/2021	8.1	607	0.8741											
10/4/2021	8.2	668	0.9619											
10/5/2021	8.4	1134	1.633											
10/6/2021	8.2	1223	1.7611	5.4	12.4	182.1	8	18.4	182.1	2.4	13.8	1.4	20.6	0.9
10/7/2021	8.3	1217	1.7525											
10/8/2021	8.3	1183	1.7035											
10/9/2021	8.1	1245	1.7928											
10/10/2021	8.4	2096	3.0182											
10/11/2021	8.7	1250	1.8	1.5	3.4	51	5.5	12.6	189.2	0.7	4	0.6	9	2.4
10/12/2021	8.7	878	1.2643											
10/13/2021	8.7	1485	2.1384											
10/14/2021	8.7	1317	1.8965											
10/15/2021	8.7	983	1.4155											
10/16/2021	8.5	1032	1.4861											
10/17/2021	8.5	1357	1.9541											
10/18/2021	7.8	583	0.8395	3.2	7.3	51	9.7	22.3	156.1	1.4	8	0.7	4.9	2.5
10/19/2021	8	1402	2.0189											
10/20/2021	8.2	617	0.8885											
10/21/2021	8.6	801	1.1534											

10/22/2021	8.7	859	1.237											
10/23/2021	8.7	1137	1.6373											
10/24/2021	8.7	1249	1.7986											
10/25/2021	8.6	663	0.9547	1.6	3.7	30	6.8	17.9	143	0.8	4.6	0.9	7	1.3
10/26/2021	8.6	950	1.368											
10/27/2021	8.3	1634	2.353											
10/28/2021	8.5	1248	1.7971											
10/29/2021	8.4	1529	2.2018											
10/30/2021	8.4	1820	2.6208											
10/31/2021	8.4	1332	1.9181											
11/1/2021	8.9	961	1.3838	3.1	7.1	82	7.2	16.5	190	1.5	8.6	1.5	17	0.4
11/2/2021	8.9	664	0.9562											
11/3/2021	9	873	1.2571											
11/4/2021	9	975	1.404											
11/5/2021	8.9	732	1.0541											
11/6/2021	8.9	1383	1.9915											
11/7/2021	8.9	943	1.3579											
11/8/2021	8.9	1118	1.6099	1.5	3.4	46	5.3	12.2	164	0.7	4	0.6	8	3.1
11/9/2021	9.3	1100	1.584											
11/10/2021	8.8	1076	1.5494											
11/11/2021	8.3	1094	1.5754											
11/12/2021	8.2	1338	1.9267											
11/13/2021	8.3	1006	1.4486											
11/14/2021	8.3	867	1.2485											
11/15/2021	8.6	786	1.1318	1.7	3.9	37	8.5	19.5	184	0.8	4.6	0.7	7	1.2
11/16/2021	8.4	869	1.2514											
11/17/2021	8.4	948	1.3651											
11/18/2021	8.4	951	1.3694											
11/19/2021	8.4	789	1.1362											
11/20/2021	8.7	745	1.0728											
11/21/2021	9	793	1.1419											
11/22/2021	8.9	1777	2.5589											
11/23/2021	8.8	795	1.1448	3.7	8.5	81	7	16.1	154	1.6	9.2	0.7	7	1
11/24/2021	8.8	679	0.9778											
11/25/2021	8.7	747	1.0757											
11/26/2021	8.7	353	0.5083											
11/27/2021	8.5	747	1.0757											
11/28/2021	8.4	1844	2.6554											
11/29/2021	8.2	724	1.0426	3	6.9	60	4.9	11.3	98	1.3	7.5	0.6	5	2.8
11/30/2021	8.6	658	0.9475											
12/1/2021	8.6	879	1.2658											
12/2/2021	8.7	733	1.0555											
12/3/2021	8.8	564	0.8122											
12/4/2021	8.8	1299	1.8706											
12/5/2021	9	1888	2.7187											
12/6/2021	8.5	663	0.9547	1.8	4.1	33	6	13.8	110	1.1	6.3	2.2	18	0.9
12/7/2021	9	480	0.6912											
12/8/2021	9	896	1.2902											
12/9/2021	9	919	1.3234											
12/10/2021	9	979	1.4098											
12/11/2021	8.8	1470	2.1168											
12/12/2021	8.8	1280	1.8432											
12/13/2021	9	1032	1.4861											
12/14/2021	8.9	786	1.1318	4	9.4	89	8.7	20.4	193	2.5	14.6	5.2	49	0.5
12/15/2021	9	879	1.2658											
12/16/2021	8.8	983	1.4155											
12/17/2021	9.1	983	1.4155											
12/18/2021	9	981	1.4126											
12/19/2021	9	959	1.381											
12/20/2021	9	839	1.2082											
12/21/2021	8.9	885	1.2744	3.4	8	85	7	16.4	174	1.6	9.4	1.4	15	1.1
12/22/2021	8.9	978	1.4083											
12/23/2021	8.9	1078	1.5523											
12/24/2021	8.9	1147	1.6517											
12/25/2021	9	1082	1.5581											
12/26/2021	7.2	1054	1.5178											
12/27/2021	8.5	975	1.404											
12/28/2021	8.9	576	0.8294	2.5	5.9	41	7.8	18.3	127	1.1	6.4	0.5	4	3.1
12/29/2021	9.2	981	1.4126											
12/30/2021	8.8	1234	1.777											
12/31/2021	8.7	1870	2.6928											
1/1/2022	8.6	1030	1.4832											
1/2/2022	8.9	2123	3.0571											
1/3/2022	8.9	1497	2.1557											
1/4/2022	8.8	1583	2.2795											
1/5/2022	8.9	1450	2.088											
1/6/2022	8.8	623	0.8971	6.3	14.8	110.7	6.5	15.2	113.7	2.9	17	2.2	16.5	0.5
1/7/2022	8.9	419	0.6034											
1/8/2022	8.8	898	1.2931											
1/9/2022	8.8	1138	1.6387											
1/10/2022	8.5	766	1.103	4	9.4	87	6.5	15.2	140	2.5	14.6	5.2	48	0.9
1/11/2022	8.6	564	0.8122											
1/12/2022	8.8	1075	1.548											
1/13/2022	8.8	1133	1.6315											
1/14/2022	9	1290	1.8576											
1/15/2022	8.9	1221	1.7582											
1/16/2022	9	1218	1.7539											
1/17/2022	8.7	1364	1.9642											

1/18/2022	8.6	624	0.8986											
1/19/2022	9.3	1283	1.8475											
1/20/2022	8.8	1451	2.0894	5.9	13.8	240.5	6.1	14.3	249.2	3.1	18.1	4.3	74.9	2
1/21/2022	8.7	1602	2.3069											
1/22/2022	8.7	1499	2.1586											
1/23/2022	8.7	1315	1.8936											
1/24/2022	8.9	983	1.4155	2.7	6.3	74	5.6	13.1	155	2.2	12.9	6.6	78	0.8
1/25/2022	8.4	846	1.2182											
1/26/2022	8.4	995	1.4328											
1/27/2022	8.3	1218	1.7539											
1/28/2022	8.8	875	1.26											
1/29/2022	9.1	809	1.165											
1/30/2022	9.1	1089	1.5682											
1/31/2022	9.2	1213	1.7467	2.7	6.8	99	5.4	12.6	184	1.3	7.6	0.8	12	0.6
2/1/2022	9.2	1175	1.692											
2/2/2022	9.2	1256	1.8086											
2/3/2022	8.8	1447	2.0837											
2/4/2022	8.8	1313	1.8907											
2/5/2022	9	453	0.6523											
2/6/2022	9.2	965	1.3896											
2/7/2022	8.9	1085	1.5624	3.1	7.3	95	4.7	11	143	1.6	9.4	2.1	27	5.5
2/8/2022	9.1	1148	1.6531											
2/9/2022	9.2	835	1.2024											
2/10/2022	9.3	943	1.3579											
2/11/2022	9	1093	1.5739											
2/12/2022	9.2	1156	1.6646											
2/13/2022	9.3	1306	1.8806											
2/14/2022	9	1164	1.6762	1.1	2.6	36	4.4	10.3	144	0.6	3.5	0.9	13	0.4
2/15/2022	8.8	1176	1.6934											
2/16/2022	8.6	1310	1.8864											
2/17/2022	8.4	1918	2.7619											
2/18/2022	8.3	3245	4.6728											
2/19/2022	8.6	2424	3.4906											
2/20/2022	8.6	988	1.4227											
2/21/2022	8.6	672	0.9677	2.1	4.9	40	3.3	7.7	62	0.9	5.3	0	3	2.5
2/22/2022	8.2	1828	2.6323											
2/23/2022	8.1	1809	2.605											
2/24/2022	8	1648	2.3731											
2/25/2022	8.1	838	1.2067											
2/26/2022	8.7	761	1.0958											
2/27/2022	8.7	1326	1.9094											
2/28/2022	8.5	1415	2.0376	3.6	8.4	142.7	4.8	11.2	190.3	1.6	9.4	1	17	3.9
3/1/2022	8.7	1318	1.8979											
3/2/2022	8.7	1342	1.9325											
3/3/2022	8.9	1328	1.9123											
3/4/2022	8.7	1286	1.8518											
3/5/2022	8.9	1244	1.7914											
3/6/2022	8.6	1222	1.7597											
3/7/2022	8.7	907	1.3061	0.6	1.4	15	4	9.4	102	0.5	2.9	1.5	16	3.1
3/8/2022	8.6	1830	2.6352											
3/9/2022	8.5	1568	2.2579											
3/10/2022	8.7	1291	1.859											
3/11/2022	8.5	1233	1.7755											
3/12/2022	8.6	927	1.3349											
3/13/2022	9	826	1.1894											
3/14/2022	9	825	1.188											
3/15/2022	8.7	1083	1.5595	1.5	3.5	46	5.1	11.9	155	0.7	4.1	0.6	8	1.4
3/16/2022	8.7	1363	1.9627											
3/17/2022	8.4	1427	2.0549											
3/18/2022	8.2	1220	1.7568											
3/19/2022	8.9	1787	2.5733											
3/20/2022	9	1167	1.6805											
3/21/2022	8.7	1110	1.5984	2.4	5.6	75	6.9	16.2	216	1.2	7	1.4	19	0.3
3/22/2022	8.7	1382	1.9901											
3/23/2022	8.8	1791	2.579											
3/24/2022	8.7	1560	2.2464											
3/25/2022	8.9	1362	1.9613											
3/26/2022	8.8	1209	1.741											
3/27/2022	8.7	1140	1.6416											
3/28/2022	8.7	1174	1.6906											
3/29/2022	8.4	1400	2.016											
3/30/2022	8.6	663	0.9547	2.3	5.4	43	6.3	14.8	118	1.4	8.2	2.8	22	0.7
3/31/2022	8.3	1157	1.6661											
4/1/2022	8.3	1474	2.1226											
4/2/2022	7.8	987	1.4213											
4/3/2022	8.2	1521	2.1902											
4/4/2022	8.3	896	1.2902	1.2	2.8	30.1	4.4	10.3	110.8	0.6	3.5	0.7	7.5	1.6
4/5/2022	8.8	997	1.4357											
4/6/2022	8.5	1044	1.5034											
4/7/2022	8.8	1057	1.5221											
4/8/2022	8.7	1210	1.7424											
4/9/2022	8.5	1565	2.2536											
4/10/2022	8.9	1005	1.4472											
4/11/2022	9	988	1.4227	2	4.7	56	4.7	11	131	1.2	7	2.3	27	2.1
4/12/2022	8.8	789	1.1362											
4/13/2022	8.8	1360	1.9584											
4/14/2022	8.5	1946	2.8022											
4/15/2022	8.7	1555	2.2392											

4/16/2022	8.8	2059	2.965											
4/17/2022	8.5	2155	3.1032											
4/18/2022	8.5	1610	2.3184											
4/19/2022	8.6	607	0.8741	2.8	6.6	47	7.9	18.5	135	2.1	12.3	5.7	42	0.4
4/20/2022	8.7	1263	1.8187											
4/21/2022	8.7	1151	1.6574											
4/22/2022	8.6	1032	1.4861											
4/23/2022	8.5	1027	1.4789											
4/24/2022	8.4	762	1.0973											
4/25/2022	8.9	1744	2.5114											
4/26/2022	8.1	1322	1.9037											
4/27/2022	9.1	854.7	1.2308	2.1	4.9	50	7.8	18.3	188	1	5.9	1	10	1.6
4/28/2022	8.9	1668	2.4019											
4/29/2022	8.6	1581	2.2766											
4/30/2022	8.7	1377	1.9829											
5/1/2022	8.7	1302	1.8749											
5/2/2022	8.6	992	1.4285	1.2	2.8	33.4	5.9	13.8	164.4	0.7	4.1	1.3	15.5	3.1
5/3/2022	8.6	719	1.0354											
5/4/2022	8.7	1384	1.993											
5/5/2022	8.9	595	0.8568											
5/6/2022	8.4	1020	1.4688											
5/7/2022	8.7	1474	2.1226											
5/8/2022	8.8	1232	1.7741											
5/9/2022	8.9	1073	1.5451											
5/10/2022	8.8	945	1.3608	1.1	2.6	30	4.2	9.8	111	0.6	3.5	0.9	10.2	2.4
5/11/2022	8.8	751	1.0814											
5/12/2022	9.1	1778	2.5603											
5/13/2022	8.8	1844	2.6554											
5/14/2022	8.9	1879	2.7058											
5/15/2022	8.7	1436	2.0678											
5/16/2022	8.9	723	1.0411	1.2	2.8	24	5.4	12.6	109	0.9	5.3	2.5	21.7	1.1
5/17/2022	8.4	1639	2.3602											
5/18/2022	9.4	1540	2.2176											
5/19/2022	9.1	1160	1.6704											
5/20/2022	9	1671	2.4062											
5/21/2022	8.9	1470	2.1168											
5/22/2022	8.8	1363	1.9627											
5/23/2022	8.7	1342	1.9325											
5/24/2022	8.7	1201	1.7294	3.3	7.7	111	4.8	11.2	162	1.4	8.1	0.4	6	0.9
5/25/2022	8.6	1713	2.4667											
5/26/2022	8.5	1725	2.484											
5/27/2022	8.6	2065	2.9736											
5/28/2022	8.7	1586	2.2838											
5/29/2022	8.9	1125	1.62											
5/30/2022	9.3	1158	1.6675											
5/31/2022	9.6	1836	2.6438	0.6	1.4	31	4	9.4	207	0.8	4.7	3.3	73	1.8
6/1/2022	9.2	1505	2.1672											
6/2/2022	9.1	1375	1.98											
6/3/2022	8.5	1426	2.0534											
6/4/2022	8.3	1463	2.1067											
6/5/2022	8.1	1449	2.0866											
6/6/2022	8	1418	2.0419											
6/7/2022	8.1	1229	1.7698	2	4.7	69.4	5.4	12.6	186	1.1	6.4	1.7	25	0.8
6/8/2022	8.2	1117	1.6085											
6/9/2022	8.6	2155	3.1032											
6/10/2022	8.5	1575	2.268											
6/11/2022	9	1448	2.0851											
6/12/2022	9.6	983	1.4155											
6/13/2022	9	960	1.3824	0.2	0.5	5.8	3	7	80.7	0.2	1.2	0.7	8.1	0.1
6/14/2022	9.6	1454	2.0938											
6/15/2022	9.2	1502	2.1629											
6/16/2022	7.8	1459	2.101											
6/17/2022	8.1	1430	2.0592											
6/18/2022	8.4	1484	2.137											
6/19/2022	8.6	1332	1.9181											
6/20/2022	8.8	1081	1.5566											
6/21/2022	8.4	754	1.0858	0.8	1.9	17.2	4	9.4	85.1	0.4	2.3	0.4	3.6	1.1
6/22/2022	8.8	865	1.2456											
6/23/2022	8.8	1186	1.7078											
6/24/2022	8.5	1062	1.5293											
6/25/2022	8.7	634	0.913											
6/26/2022	8.8	525	0.756											
6/27/2022	9.1	383	0.5515											
6/28/2022	10.2	1248	1.7971	0.3	0.9	13.5	2.2	6.5	97	0.5	3.7	2.8	42	6.7
6/29/2022	9.1	1362	1.9613											
6/30/2022	9	1320	1.9008											
7/1/2022	8.9	1079	1.5538											
7/2/2022	9.2	1702	2.4509											
7/3/2022	9.3	1253	1.8043											
7/4/2022	9.4	123	0.1771											
7/5/2022	9.5	1041	1.499											
7/6/2022	8.4	1432	2.0621											
7/7/2022	8.2	1193	1.7179	1.4	4.2	60.2	4.5	13.4	192	0.6	4.5	0.3	4.3	7.3
7/8/2022	8.4	1636	2.3558											
7/9/2022	8.7	1733	2.4955											
7/10/2022	8.9	1391	2.003											
7/11/2022	9	1400	2.016											
7/12/2022	9.3	1052	1.5149	0.3	0.9	11.4	2.4	7.1	89.7	0.2	1.5	0.6	7.6	1.9

7/13/2022	8.5	1500	2.16											
7/14/2022	8.6	1941	2.795											
7/15/2022	9	1360	1.9584											
7/16/2022	9.2	1298	1.8691											
7/17/2022	9.1	1239	1.7842											
7/18/2022	9.4	912.7	1.3143											
7/19/2022	9.5	972	1.3997	0.2	0.6	7	2.4	7.1	82.9	0.2	1.5	0.9	10.5	2.5
7/20/2022	8.8	1926	2.7734											
7/21/2022	8.9	976.7	1.4064											
7/22/2022	9	918.1	1.3221											
7/23/2022	8.9	1641	2.363											
7/24/2022	8.8	1552	2.2349											
7/25/2022	8.8	1313	1.8907											
7/26/2022	9.5	1006	1.4486	0.1	0.3	3.6	1.9	5.6	67.7	0.2	1.5	1.2	14.5	2.9
7/27/2022	9.4	1042	1.5005											
7/28/2022	8.9	956	1.3766											
7/29/2022	8.8	583	0.8395											
7/30/2022	8.8	1064	1.5322											
7/31/2022	8.7	1172	1.6877											
8/1/2022	8.7	1664	2.3962											
8/2/2022	8.7	1215	1.7496	1.8	5.4	78.8	4.3	12.8	186.8	1.2	8.8	3.5	51.1	6.1
8/3/2022	9.1	1074	1.5466											
8/4/2022	9.4	1089	1.5682											
8/5/2022	9.3	1567	2.2565											
8/6/2022	9	1780	2.5632											
8/7/2022	8.9	1349	1.9426											
8/8/2022	8.8	1494	2.1514											
8/9/2022	9.3	663.8	0.9559	1.4	4.2	33.5	4	11.9	94.9	0.8	5.9	1.7	13.6	3.1
8/10/2022	8.9	1467	2.1125											
8/11/2022	8.9	1513	2.1787											
8/12/2022	8.9	1681	2.4206											
8/13/2022	8.8	1500	2.16											
8/14/2022	8.7	1500	2.16											
8/15/2022	8.8	1344	1.9354											
8/16/2022	8.9	1308	1.8835	1.9	5.6	88.2	4	11.9	187.4	1.9	14.1	8.5	133.5	2.2
8/17/2022	8.8	1324	1.9066											
8/18/2022	9.2	1428	2.0563											
8/19/2022	8.6	1634	2.353											
8/20/2022	8.6	1470	2.1168											
8/21/2022	8.7	1429	2.0578											
8/22/2022	8.8	1414	2.0362											
8/23/2022	8.8	1135	1.6344	1.8	5.4	73.6	2.7	8	109.1	0.9	6.7	1.3	17.7	0.3
8/24/2022	8.9	1129	1.6258											
8/25/2022	9	1109	1.597											
8/26/2022	7.9	1240	1.7856											
8/27/2022	7.8	1262	1.8173											
8/28/2022	7.7	1232	1.7741											
8/29/2022	7.58	1296	1.8662											
8/30/2022	7.73	1750	2.52											
8/31/2022	7.04	1374	1.9786	4.9	14.6	240.9	3.8	11.3	186.5	2.9	21.6	7	115.5	0.8
9/1/2022	7.4	1343	1.9339											
9/2/2022	9	1439	2.0722											
9/3/2022	8.3	1596	2.2982											
9/4/2022	8.1	1745	2.5128											
9/5/2022	7.8	1691	2.435											
9/6/2022	7.7	1443	2.0779											
9/7/2022	7.9	1397	2.0117	3	8.9	149.3	4.6	13.7	229.9	1.4	10.4	1.5	25.2	4.8
9/8/2022	8.2	1661	2.3918											
9/9/2022	8.3	1721	2.4782											
9/10/2022	8.1	1419	2.0434											
9/11/2022	7.9	1324	1.9066											
9/12/2022	7.7	1373	1.9771											
9/13/2022	7.6	351.4	0.506	0.7	2.1	12.4	2.9	8.6	50.8	1	7.4	5.3	31.3	0.1
9/14/2022	8.4	1546	2.2262											
9/15/2022	8.9	1510	2.1744											
9/16/2022	8.7	1409	2.029											
9/17/2022	8.7	1111	1.5998											
9/18/2022	8.9	1082	1.5581											
9/19/2022	8.8	1110	1.5984											
9/20/2022	8.8	1137	1.6373	0.6	1.8	24.6	2.6	7.7	105.1	0.8	7.4	5.6	76.5	2.1
9/21/2022	8.9	1146	1.6502											
9/22/2022	8.9	1141	1.643											
9/23/2022	9	1092	1.5725											
9/24/2022	8.5	1150	1.656											
9/25/2022	8.3	1366	1.967											
9/26/2022	7.9	1563	2.2507											
9/27/2022	8.1	1483	2.1355	1.5	4.5	80.1	3.8	11.3	201.3	0.7	5.2	0.7	12.5	0.4
9/28/2022	7.8	1339	1.9282											
9/29/2022	8.5	796	1.1462											
9/30/2022	8.8	1110	1.5984											
10/1/2022	9	1400	2.016											
10/2/2022	9.1	1423	2.0491											
10/3/2022	9.1	1352	1.9469											
10/4/2022	9.1	1298	1.8691	0.1	0.3	4.7	1.5	4.5	70.1	0.1	0.7	0.4	6.2	2.4
10/5/2022	8.5	986	1.4198											
10/6/2022	7.8	1023	1.4731											
10/7/2022	7.2	1315	1.8936											
10/8/2022	7.8	1264	1.8202											

10/9/2022	8.4	1180	1.6992											
10/10/2022	8.7	1141	1.643											
10/11/2022	7.9	834	1.201	1.5	4.5	45.1	3	8.9	89.1	1.1	8.2	3.7	37.1	3.8
10/12/2022	7.4	1405	2.0232											
10/13/2022	9.2	1136	1.6358											
10/14/2022	8.9	739	1.0642											
10/15/2022	8.8	1380	1.9872											
10/16/2022	8.7	1365	1.9656											
10/17/2022	8.6	1339	1.9282											
10/18/2022	8.7	1329	1.9138	0.2	0.6	9.6	2.7	8	128.6	2.1	15.6	15	241.5	2.4
10/19/2022	8.8	1149	1.6546											
10/20/2022	8.8	1137	1.6373											
10/21/2022	8.8	1168	1.6819											
10/22/2022	8.4	1268	1.8259											
10/23/2022	8	1241	1.787											
10/24/2022	7.6	1162	1.6733											
10/25/2022	7.7	1202	1.7309	0.5	1.5	21.7	2.4	7.1	102.5	1.7	12.6	11.1	160.2	4
10/26/2022	8.3	1285	1.8504											
10/27/2022	6.5	1249	1.7986											
10/28/2022	7.5	1263	1.8187											
10/29/2022	7.6	1281	1.8446											
10/30/2022	7.6	1301	1.8734											
10/31/2022	7.8	1288	1.8547											
11/1/2022	8.3	902	1.2989	1.6	4.8	52	2.6	7.7	83.4	1.2	8.9	4.1	44.4	1.9
11/2/2022	8.3	1366	1.967											
11/3/2022	8.2	1400	2.016											
11/4/2022	7.4	1342	1.9325											
11/5/2022	7.5	949	1.3666											
11/6/2022	7.7	913	1.3147											
11/7/2022	7.7	1016	1.463											
11/8/2022	7.7	1938	2.7907											
11/9/2022	8	953	1.3723	3.4	10.1	115.6	5.3	15.8	180.8	3.8	28.2	18.1	207.2	2.2
11/10/2022	7.8	1383	1.9915											
11/11/2022	7.9	1854	2.6698											
11/12/2022	7.9	1209	1.741											
11/13/2022	8.1	1008	1.4515											
11/14/2022	8.1	910	1.3104											
11/15/2022	8.6	1024	1.4746											
11/16/2022	8.8	1023	1.4731	3.3	9.8	120.6	6.1	18.1	222.4	1.5	11.2	1.4	17.2	3
11/17/2022	8.9	991	1.427											
11/18/2022	8.5	1035	1.4904											
11/19/2022	8.4	1067	1.5365											
11/20/2022	8.3	1019	1.4674											
11/21/2022	8.3	972	1.3997											
11/22/2022	8.3	707	1.0181	1.8	5.4	45.9	4	11.9	101	1.5	11.2	5.8	49.2	6.1
11/23/2022	8.5	756	1.0886											
11/24/2022	8.4	1460	2.1024											
11/25/2022	8.4	1421	2.0462											
11/26/2022	8.6	1203	1.7323											
11/27/2022	8.7	1191	1.715											
11/28/2022	8.9	1170	1.6848											
11/29/2022	6.7	847	1.2197	1.4	4.2	42.7	4	11.9	121	1.1	8.2	4	40.7	1.2
11/30/2022	7.6	830	1.1952											
12/1/2022	8.3	1167	1.4832											
12/2/2022	8.7	1397	3.0571											
12/3/2022	8.8	1018	1.4659											
12/4/2022	8.7	941	1.355											

Appendix E

CORMIX Modeling (Draft)

Crit 7 (more conserv.)

```
CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                      CORMIX MIXING ZONE EXPERT SYSTEM
                          CORMIX Version 11.0GT
                      HYDRO3:Version-11.0.0.0  April,2018
SITE NAME/LABEL:                 Tennessee River
  DESIGN CASE:                   Cherokee Nitrogen Critical
  FILE NAME:                     D:\Models\cormix files\Cherokee-Crit7.prd
  Using subsystem CORMIX3:       Buoyant Surface Discharges
  Start of session:              02/22/2019--15:40:00
*****************************************************************************
SUMMARY OF INPUT DATA:
-----------------------------------------------------------------------------
AMBIENT PARAMETERS:
  Cross-section                          = bounded
  Width                          BS      = 1536 m
  Channel regularity             ICHREG  = 1
  Ambient flowrate               QA      = 201.80 m^3/s   - 7131 cfs
  Average depth                  HA      = 4.27 m
  Depth at discharge             HD      = 4 m
  Ambient velocity               UA      = 0.0308 m/s
  Darcy-Weisbach friction factor F       = 0.0435
    Calculated from Manning's n          = 0.03
  Wind velocity                  UW      = 2 m/s
  Stratification Type            STRCND  = U
  Surface temperature                    = 29 degC
  Bottom temperature                     = 29 degC
  Calculated FRESH-WATER DENSITY values:
  Surface density                RHOAS   = 995.9449 kg/m^3
  Bottom density                 RHOAB   = 995.9449 kg/m^3
-----------------------------------------------------------------------------
DISCHARGE PARAMETERS:            Surface Discharge
  Discharge located on                   = left bank/shoreline
  Discharge configuration                = flush discharge
  Distance from bank to outlet   DISTB   = 0 m
  Discharge angle                SIGMA   = 105 deg
  Depth near discharge outlet    HD0     = 0.82 m
  Bottom slope at discharge      SLOPE   = 0.17 deg
  Rectangular discharge:
    Discharge cross-section area A0      = 12.710000 m^2
    Discharge channel width      B0      = 15.5 m
    Discharge channel depth      H0      = 0.82 m
    Discharge aspect ratio       AR      = 0.052903
  Reduced discharge channel due to intrusion:
    Cross-section area           A0      = 7.0463 m^2
    Channel width                B0      = 15.5 m
    Channel depth                H0      = 0.45 m
    Aspect ratio                 AR      = 0.03
  Discharge flowrate             Q0      = 0.789 m^3/s
  Discharge velocity             U0      = 0.11 m/s
  Discharge temperature (freshwater)     = 37.5 degC   - 99.5°F
  Corresponding density          RHO0    = 993.1441 kg/m^3
  Density difference             DRHO    = 2.8008 kg/m^3
  Buoyant acceleration           GP0     = 0.0276 m/s^2
  Discharge concentration        C0      = 8.5 deg.C
  Surface heat exchange coeff.   KS      = 0.000006 m/s
  Coefficient of decay           KD      = 0 /s
-----------------------------------------------------------------------------
DISCHARGE/ENVIRONMENT LENGTH SCALES:
  LQ  = 2.65 m        Lm  = 3.66 m          Lbb = 747.02 m
  LM  = 1.10 m
-----------------------------------------------------------------------------
NON-DIMENSIONAL PARAMETERS:
  Densimetric Froude number      FR0    = 0.41 (based on LQ)
  Channel densimetric Froude no. FRCH   = 1 (based on H0)
  Velocity ratio                 R      = 3.64
-----------------------------------------------------------------------------
MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
  Toxic discharge                       = no
  Water quality standard specified      = yes
  Water quality standard         CSTD   = 1 deg.C
  Regulatory mixing zone                = yes
  Regulatory mixing zone specification  = distance
  Regulatory mixing zone value          = 740 m (m^2 if area)
  Region of interest                    = 16000 m
*****************************************************************************
HYDRODYNAMIC CLASSIFICATION:
  *------------------------*
  | FLOW CLASS    = PL1  |
  *------------------------*

  Limiting Dilution S = (QA/Q0)+ 1.0 = 256.8

*****************************************************************************
MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

-----------------------------------------------------------------------------
X-Y-Z Coordinate system:
Origin is located at WATER SURFACE and at centerline of discharge channel;
   0 m from the left bank/shore.
```

```
  Number of display steps NSTEP = 30 per module.
-----------------------------------------------------------------------------
NEAR-FIELD REGION (NFR) CONDITIONS :
Note: The NFR is the zone of strong initial mixing. It has no regulatory
  implication. However, this information may be useful for the discharge
  designer because the mixing in the NFR is usually sensitive to the
  discharge design conditions.
  Pollutant concentration at NFR edge  c = 2.9696 deg.C
  Dilution at edge of NFR              s = 2.9
  NFR Location:                        x = 599.39 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  NFR plume dimensions:  half-width (bh) = 470.88 m
                          thickness (bv) = 0.16 m
Cumulative travel time:       19407.5039 sec.
-----------------------------------------------------------------------------
Buoyancy assessment:
  The effluent density is less than the surrounding ambient water
  density at the discharge level.
  Therefore, the effluent is POSITIVELY BUOYANT and will tend to rise towards
  the surface.
-----------------------------------------------------------------------------
FAR-FIELD MIXING SUMMARY:
  Plume becomes vertically fully mixed at 5919.74 m downstream
  and laterally fully mixed at 4799.71 m downstream.
-----------------------------------------------------------------------------
PLUME BANK CONTACT SUMMARY:
  Plume in bounded section contacts nearest bank at -299.69 m downstream.
  Plume contacts second bank at 4799.71 m downstream.
********************** TOXIC DILUTION ZONE SUMMARY ***********************
No TDZ was specified for this simulation.
********************* REGULATORY MIXING ZONE SUMMARY *********************
The plume conditions at the boundary of the specified RMZ are as follows:
  Pollutant concentration              c = 2.534654  deg.C
  Corresponding dilution               s = 3.3
  Plume location:                      x = 740 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  Plume dimensions:      half-width (bh) = 535.08 m
                          thickness (bv) = 0.16 m
Cumulative travel time:       24039.7930 sec.

Note:
Plume concentration c and dilution s values are reported based on prediction
file values - assuming linear interpolation between predicted points just
before and just after the RMZ boundary has been detected.

Please ensure a small step size is used in the prediction file to account
for this linear interpolation. Step size can be controlled by increasing
(reduces the prediction step size) or decreasing (increases the prediction
step size) the - Output Steps per Module - in CORMIX input.

At this position, the plume is CONTACTING the LEFT bank.
However, the specified water quality standard has not been met
  within the RMZ. In particular:
The ambient water quality standard was encountered at the following
  plume position:
  Water quality standard                 = 1  deg.C
  Corresponding dilution               s = 8.2
  Plume location:                      x = 1381.84 m
    (centerline coordinates)           y = 0 m
                                       z = 0 m
  Plume dimensions:      half-width (bh) = 748.86 m
                          thickness (bv) = 0.28 m
********************* FINAL DESIGN ADVICE AND COMMENTS ********************

INTRUSION OF AMBIENT WATER into the discharge opening will occur!

For the present discharge/environment conditions the discharge densimetric Froude number is well below unity. This is an
UNDESIRABLE operating condition.

To prevent intrusion, change the discharge parameters (e.g. decrease the discharge opening area) in order to increase the
discharge Froude number.

In a future iteration, change the discharge parameters (e.g. decrease port diameter) in order to increase the Froude number.
-----------------------------------------------------------------------------
REMINDER:  The user must take note that HYDRODYNAMIC MODELING by any known
  technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
  CORMIX predictions on dilutions and concentrations (with associated
  plume geometries) are reliable for the majority of cases and are accurate
  to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges
  the design configuration as highly complex and uncertain for prediction.
```

```
CORMIX3 PREDICTION FILE:
33333333333333333333333333333333333333333333333333333333333333333333333333333333
                        CORMIX MIXING ZONE EXPERT SYSTEM
                 Subsystem CORMIX3: Buoyant Surface Discharges
                              CORMIX Version 11.0GT
                      HYDRO3 Version 11.0.0.0 April 2018
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   Tennessee River
 Design case:       Cherokee Nitrogen Critical
 FILE NAME:         D:\Models\cormix files\Cherokee-Crit7.prd
 Time stamp:        02/22/2019--15:40:00

ENVIRONMENT PARAMETERS (metric units)
 Bounded section
 BS    =   1536.00  AS    =   6558.72  QA    =    201.80  ICHREG= 1
 HA    =      4.27  HD    =      4.00
 UA    =     0.031  F     =     0.044 USTAR =0.2270E-02
 UW    =     2.000 UWSTAR=0.2198E-02
 Uniform density environment
 STRCND=  U         RHOAM =  995.9449

DISCHARGE PARAMETERS (metric units)
 BANK  =  LEFT      DISTB =      0.00  Configuration: flush discharge
 SIGMA =    105.00  HD0   =      0.82  SLOPE =    0.17 deg.
 Rectangular channel geometry:
 B0    =    15.500 H0    =     0.820 A0    =0.1271E+02  AR    =       0.053
 Reduced channel geometry due to intrusion:
 B0    =    15.500 H0    =     0.455 A0    =0.7046E+01  AR    =       0.029
 (All relevant parameters further below are based on this geometry.)
 U0    =     0.112 Q0    =     0.789        =0.7890E+00
 RHO0  =  993.1441  DRHO0 =0.2801E+01  GP0   =0.2758E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.5972E-05  KD    =0.0000E+00

FLUX VARIABLES (metric units)
 Q0    =0.7890E+00  M0    =0.8835E-01  J0    =0.2176E-01
 Associated length scales (meters)
 LQ    =      2.65  LM    =      1.10  Lm    =      9.66  Lb    =    747.02

NON-DIMENSIONAL PARAMETERS
 FR0   =      0.41  FRCH  =      1.00  R     =      3.64

FLOW CLASSIFICATION
 333333333333333333333333333333333333333333
 3  Flow class (CORMIX3)      =    PL1    3
 3  Applicable layer depth HS =     4.00  3
 3  Limiting Dilution S =QA/Q0=   256.77  3
 333333333333333333333333333333333333333333

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  1
 REGSPC=  1         XREG  =    740.00  WREG  =      0.00  AREG  =      0.00
 XINT  =  16000.00  XMAX  =  16000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the WATER SURFACE and at center of discharge
      channel/outlet:       0.00 m  from the LEFT  bank/shore.
    X-axis points downstream
    Y-axis points to left as seen by an observer looking downstream
    Z-axis points vertically upward (in CORMIX3, all values Z = 0.00)
NSTEP =  30 display intervals per module
--------------------------------------------------------------------------------

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S  = hydrodynamic dilutions, include buoyancy (heat) loss effects
   C  = corresponding temperature values (in "deg.C"!) include heat loss
--------------------------------------------------------------------------------
BEGIN MOD301: DISCHARGE MODULE

 Efflux conditions:
       X          Y          Z          S       C          BV        BH        UC         TT
     0.00       0.00       0.00       1.0 0.850E+01     0.45      7.75     0.112  .00000E+00

END OF MOD301: DISCHARGE MODULE
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
BEGIN MOD302: ZONE OF FLOW ESTABLISHMENT

  Control volume inflow:
       X          Y          Z          S       C          BV        BH        UC         TT
     0.00       0.00       0.00       1.0 0.850E+01     0.45      7.75     0.112  .00000E+00

 Profile definitions:
   BV = Gaussian 1/e (37%) vertical thickness
   BH = Gaussian 1/e (37%) horizontal half-width, normal to trajectory
```

```
   S  - hydrodynamic centerline dilution
   C  - centerline concentration (includes reaction efects, if any)
   Uc = Local centerline excess velocity (above ambient)
   TT = Cumulative travel time

 Control volume outflow:                                    SIGMAE=   257.16
      X         Y         Z          S         C        BV        BH       UC        TT
    -0.10     -0.40     0.00      1.0 0.850E+01   0.45      7.96    0.112  .36902E+01
 Cumulative travel time -            3.6902 sec  (    0.00 hrs)

END OF MOD302: ZONE OF FLOW ESTABLISHMENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD331: UPSTREAM INTRUDING PLUME

 Control volume inflow:
      X         Y         Z          S         C        BV        BH        TT
    -0.10     -0.40     0.00      1.0 0.850E+01   0.45      7.96 .36902E+01

 UPSTREAM INTRUSION PROPERTIES:
        Upstream intrusion length                   -      299.69 m
        X-position of upstream stagnation point    -     -299.69 m
        Thickness in intrusion region               -        0.16 m
        Half-width at downstream end                =      470.88 m
        Thickness at downstream end                 =        0.16 m

 In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times
   the local water depth.
 This may be caused by a very small ambient velocity, perhaps in
   combination with large discharge buoyancy.
 If the ambient conditions are strongly transient (e.g. tidal), then the
   CORMIX steady-state predictions of upstream intrusion are probably
   unrealistic.

 Profile definitions:
   BV - top-hat thickness,measured vertically
   BH - top-hat half-width, measured horizontally from bank/shoreline
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

      X         Y         Z          S         C        BV        BH        TT
  -299.69      0.00      0.00   9999.9 0.000E+00   0.00      0.00 .36902E+01
  -281.71      0.00      0.00      3.3 0.261E+01   0.05     66.59 .36902E+01
  -193.60      0.00      0.00      1.4 0.618E+01   0.11    161.75 .36902E+01
  -105.49      0.00      0.00      1.1 0.784E+01   0.14    218.84 .36902E+01
    17.38      0.00      0.00      1.0 0.848E+01   0.16    263.86 .36902E-01
    70.73      0.00      0.00      1.1 0.772E+01   0.16    302.24 .23055E+04
   158.84      0.00      0.00      1.5 0.584E+01   0.16    336.27 .51693E+04
   246.95      0.00      0.00      1.9 0.443E+01   0.16    367.16 .80328E+04
   335.06      0.00      0.00      2.3 0.365E+01   0.16    395.65 .10897E+05
   423.17      0.00      0.00      2.6 0.326E+01   0.16    422.22 .13760E+05
   511.28      0.00      0.00      2.8 0.308E+01   0.16    447.21 .16624E+05
   599.39      0.00      0.00      2.9 0.297E+01   0.16    470.88 .19488E+05
 Cumulative travel time =         19487.5039 sec  (    5.41 hrs)

END OF MOD331: UPSTREAM INTRUDING PLUME
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD341: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV - top-hat thickness,measured vertically
   BH - top-hat half-width, measured horizontally from bank/shoreline
   S  - hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)
   TT = Cumulative travel time

 Plume Stage 2 (bank attached):
      X         Y         Z          S         C        BV        BH        TT
   599.39      0.00      0.00      2.9 0.297E+01   0.16    469.96 .19488E+05
   739.40      0.00      0.00      3.3 0.254E+01   0.16    534.83 .24020E+05
 ** REGULATORY MIXING ZONE BOUNDARY **
 In this prediction interval the plume DOWNSTREAM distance meets or exceeds
 the regulatory value -    740.00 m.
 This is the extent of the REGULATORY MIXING ZONE.
   879.41      0.00      0.00      4.0 0.212E+01   0.17    589.95 .28553E+05
  1019.42      0.00      0.00      4.8 0.174E+01   0.19    638.79 .33086E+05
  1159.43      0.00      0.00      5.9 0.141E+01   0.22    683.45 .37619E+05
  1299.44      0.00      0.00      7.3 0.114E+01   0.26    725.26 .42151E+05
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
  1439.45      0.00      0.00      8.9 0.914E+00   0.30    765.07 .46684E+05
  1579.46      0.00      0.00     11.0 0.740E+00   0.35    803.40 .51217E+05
```

1719.47	0.00	0.00	13.4	0.602E+00	0.41	840.62	.55750E+05
1859.48	0.00	0.00	16.2	0.495E+00	0.47	876.96	.60283E+05
1999.50	0.00	0.00	19.5	0.410E+00	0.55	912.56	.64815E+05
2139.51	0.00	0.00	23.1	0.342E+00	0.62	947.54	.69348E+05
2279.52	0.00	0.00	27.3	0.289E+00	0.71	981.96	.73881E+05
2419.53	0.00	0.00	31.9	0.246E+00	0.80	1015.87	.78414E+05
2559.54	0.00	0.00	37.0	0.210E+00	0.90	1049.31	.82946E+05
2699.55	0.00	0.00	42.5	0.182E+00	1.00	1082.32	.87479E+05
2839.56	0.00	0.00	48.6	0.158E+00	1.11	1114.91	.92012E+05
2979.57	0.00	0.00	55.3	0.138E+00	1.23	1147.10	.96545E+05
3119.58	0.00	0.00	62.4	0.121E+00	1.35	1178.93	.10108E+06
3259.59	0.00	0.00	70.1	0.107E+00	1.48	1210.39	.10561E+06
3399.60	0.00	0.00	78.4	0.955E-01	1.61	1241.50	.11014E+06
3539.62	0.00	0.00	87.3	0.857E-01	1.75	1272.28	.11468E+06
3679.63	0.00	0.00	96.7	0.765E-01	1.90	1302.74	.11921E+06
3819.64	0.00	0.00	106.7	0.688E-01	2.05	1332.89	.12374E+06
3959.65	0.00	0.00	117.4	0.622E-01	2.20	1362.73	.12827E+06
4099.66	0.00	0.00	128.6	0.564E-01	2.36	1392.29	.13281E+06
4239.67	0.00	0.00	140.5	0.513E-01	2.52	1421.56	.13734E+06
4379.68	0.00	0.00	153.0	0.468E-01	2.69	1450.56	.14187E+06
4519.69	0.00	0.00	166.1	0.428E-01	2.87	1479.30	.14641E+06
4659.70	0.00	0.00	179.9	0.393E-01	3.05	1507.77	.15094E+06
4799.71	0.00	0.00	194.4	0.362E-01	3.23	1536.00	.15547E+06

Cumulative travel time = 155471.0625 sec (43.19 hrs)
Plume is LATERALLY FULLY MIXED at the end of the buoyant spreading regime.

END OF MOD341: BUOYANT AMBIENT SPREADING

BEGIN MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.241E-02 m^2/s
Horizontal diffusivity (initial value) = 0.301E-02 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to water depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y direction
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
TT = Cumulative travel time

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	TT
4799.71	0.00	0.00	194.4	0.362E-01	3.23	1536.00	.15547E+06
5173.06	0.00	0.00	214.8	0.322E-01	3.57	1536.00	.16756E+06
5546.40	0.00	0.00	239.9	0.283E-01	3.99	1536.00	.17964E+06

Plume interacts with BOTTOM.
The passive diffusion plume becomes VERTICALLY FULLY MIXED within this prediction interval.

X	Y	Z	S	C	BV	BH	TT
5919.74	0.00	0.00	256.8	0.260E-01	4.27	1536.00	.19172E+06

Effluent is FULLY MIXED over the entire channel cross-section.
Except for possible far-field decay or reaction processes, there are NO FURTHER CHANGES with downstream direction.

X	Y	Z	S	C	BV	BH	TT
6293.08	0.00	0.00	256.8	0.256E-01	4.27	1536.00	.20382E+06
6666.43	0.00	0.00	256.8	0.252E-01	4.27	1536.00	.21590E+06
7039.77	0.00	0.00	256.8	0.247E-01	4.27	1536.00	.22799E+06
7413.11	0.00	0.00	256.8	0.243E-01	4.27	1536.00	.24008E+06
7786.46	0.00	0.00	256.8	0.239E-01	4.27	1536.00	.25217E+06
8159.80	0.00	0.00	256.8	0.235E-01	4.27	1536.00	.26425E+06
8533.14	0.00	0.00	256.8	0.231E-01	4.27	1536.00	.27634E+06
8906.48	0.00	0.00	256.8	0.227E-01	4.27	1536.00	.28843E+06
9279.83	0.00	0.00	256.8	0.223E-01	4.27	1536.00	.30051E+06
9653.17	0.00	0.00	256.8	0.220E-01	4.27	1536.00	.31260E+06
10026.51	0.00	0.00	256.8	0.216E-01	4.27	1536.00	.32469E+06
10399.86	0.00	0.00	256.8	0.212E-01	4.27	1536.00	.33677E+06
10773.20	0.00	0.00	256.8	0.209E-01	4.27	1536.00	.34886E+06
11146.54	0.00	0.00	256.8	0.205E-01	4.27	1536.00	.36095E+06
11519.88	0.00	0.00	256.8	0.202E-01	4.27	1536.00	.37303E+06
11893.23	0.00	0.00	256.8	0.199E-01	4.27	1536.00	.38512E+06
12266.57	0.00	0.00	256.8	0.195E-01	4.27	1536.00	.39721E+06
12639.91	0.00	0.00	256.8	0.192E-01	4.27	1536.00	.40929E+06
13013.25	0.00	0.00	256.8	0.189E-01	4.27	1536.00	.42138E+06
13386.60	0.00	0.00	256.8	0.186E-01	4.27	1536.00	.43347E+06
13759.94	0.00	0.00	256.8	0.182E-01	4.27	1536.00	.44555E+06
14133.28	0.00	0.00	256.8	0.179E-01	4.27	1536.00	.45764E+06
14506.63	0.00	0.00	256.8	0.176E-01	4.27	1536.00	.46973E+06
14879.97	0.00	0.00	256.8	0.173E-01	4.27	1536.00	.48181E+06
15253.31	0.00	0.00	256.8	0.171E-01	4.27	1536.00	.49390E+06
15626.65	0.00	0.00	256.8	0.168E-01	4.27	1536.00	.50599E+06
16000.00	0.00	0.00	256.8	0.165E-01	4.27	1536.00	.51807E+06

Cumulative travel time = 518074.8125 sec (143.91 hrs)

Note:
CORMIX is a steady state model and assumes discharge and ambient conditions do not vary over time. The predicted plume cumulative travel time exceeds 48 hours at this trajectory distance. Keep in mind that ambient and discharge conditions are likely to vary over large space and time scales. Predictions at such large space and time scales may be inconsistent with CORMIX modeling assumptions.

```
Please carefully evaluate your simulation results and limit model interpretation to space
 and time scales consistent with steady state assumptions and ambient schematization.

 Simulation limit based on maximum specified distance =  16000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD361: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------
CORMIX3: Buoyant Surface Discharges                    End of Prediction File
33333333333333333333333333333333333333333333333333333333333333333333333333333333
```

219 BROWN LANE, BRYANT, AR
WWW.GBMcASSOC.COM
501-847-7077

LANCE R. LEFLEUR
DIRECTOR

KAY IVEY
GOVERNOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ▪ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ▪ FAX (334) 271-7950

December 6, 2021

MR STUART CARTER
GENERAL MANAGER
CHEROKEE NITROGEN
1080 INDUSTRIAL DRIVE
CHEROKEE ALABAMA 35616

RE: NPDES PERMIT NUMBER AL0000418
316(a) STUDY PLAN

Dear Mr. Carter:

The Department has evaluated the revised 316(a) Study Plan submitted on November 10, 2021. Based on our review, the Department has no comments at this time and hereby approves the plan.

If you have any questions or concerns, please contact Theo Pinson by phone at (334) 274-4202 or by email at tpinson@adem.alabama.gov.

Sincerely,

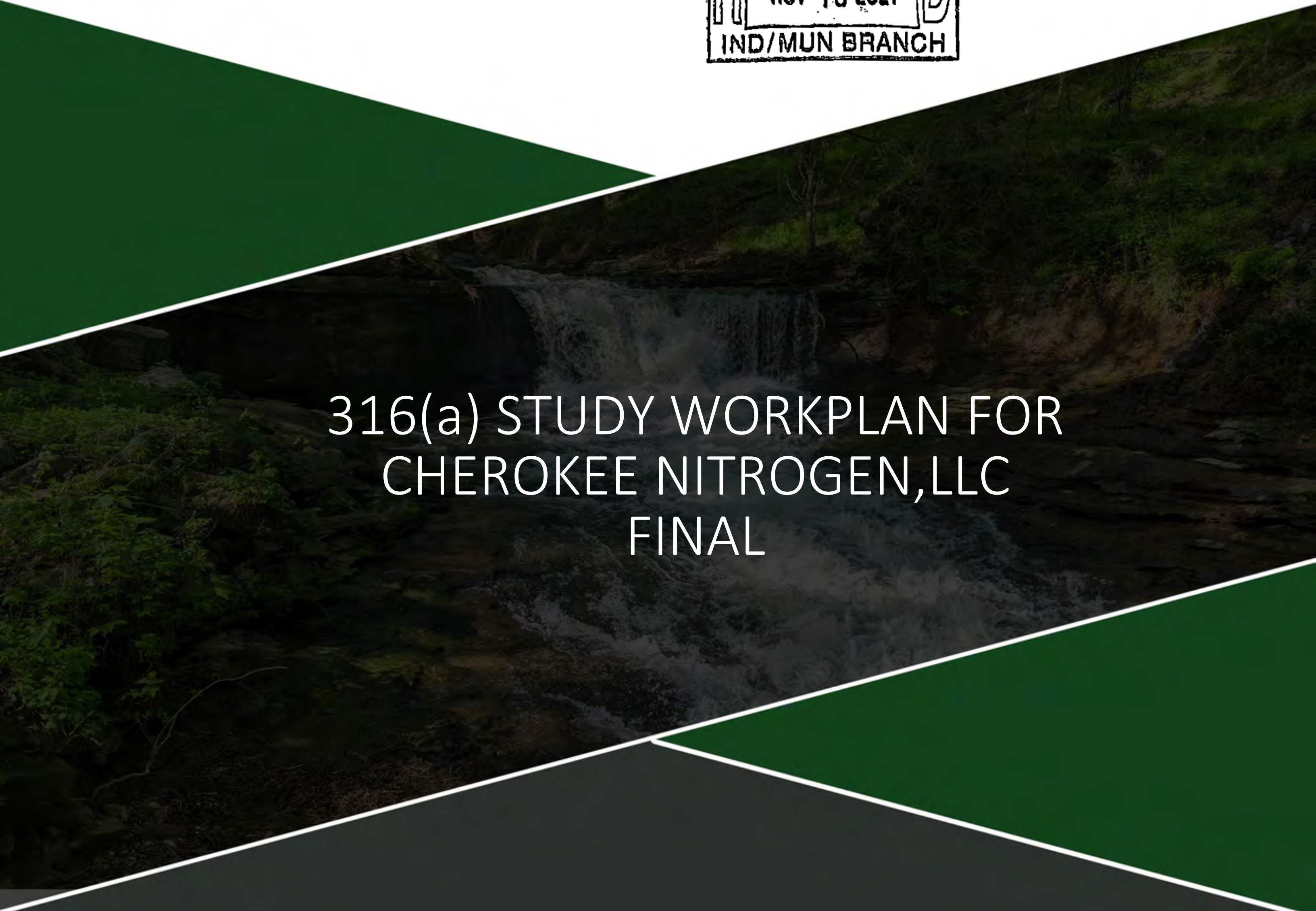
Scott Ramsey, Chief
Industrial Section
Industrial/Municipal Branch
Water Division

cc: Fred Leslie, ADEM Field Operations Division

GBMc
& ASSOCIATES

219 BROWN LANE, BRYANT, AR
WWW.GBMcASSOC.COM
501-847-7077

RECEIVED
NOV 10 2021
IND/MUN BRANCH



316(a) STUDY WORKPLAN FOR CHEROKEE NITROGEN,LLC FINAL

THIS REPORT WAS CREATED BY THE GBMc & ASSOCIATES TEAM FOR CHEROKEE NITROGEN, LLC ON NOVEMBER 8, 2021

316(a) STUDY WORKPLAN - FINAL

Prepared for:

Cherokee Nitrogen LLC
1080 Industrial Drive
Cherokee, Alabama 35616-0250

Prepared by:

GBMc & Associates
219 Brown Lane
Bryant, AR 72022

November 8, 2021 - Final

CONTENTS

APPENDICES

1.0 INTRODUCTION

In 2018 the Alabama Department of Environmental Management (ADEM) completed a synoptic survey of the unnamed tributary to which Cherokee Nitrogen (CN) discharges treated wastewater and once through cooling water under NPDES Permit AL0000418. This survey resulted in the ADEM proposal to move the compliance point for CN from the Tennessee River to the waterfall on the unnamed tributary, about 0.2 miles upstream of the mouth of the river. This proposed change in compliance locations is anticipated to result in significant changes to current discharge limits, including temperature. The facility has been evaluating alternatives for over a year and now proposes completing a 316(a) study, which was originally suggested by ADEM, as a reasonable solution to address temperature. This Workplan will lay out the basis for the study and provide details on the associated study tasks and quality assurance procedures to be utilized to ensure data used for the variance request is accurate and representative.

2.0 STUDY OBJECTIVE AND RATIONALE

The objective of this study is to evaluate whether the receiving stream is maintaining a balanced indigenous population (BIP) (EPA Memo, 2008 and CFR 125.71) consistent with its habitat and history and/or that there is an absence of prior appreciable harm (CFR 125.73). To accomplish this, we propose to complete a Type III 316(a) Demonstration to document no appreciable harm to the stream system (USEPA, 1974 and USEPA, 1977). Type III demonstrations are usually completed when the situation is unique, and the usual information may not be available or not be applicable and warrants a special study that is less rigorous. The rationale for a Type III Demonstration is:

1. The effluent discharge temperature has not changed appreciably for years, only the permitting of it has evolved.
2. The effluent discharge temperature predates the Clean Water Act.
3. 316(a) studies are traditionally completed on large water bodies rather than small first order streams like this case. There is unlikely to be a large body of data available on biota for such a small stream in this area, and likely none collected for this purpose.
4. The stream channel above the unnamed tributary waterfall is erosional in form (geomorphically) and would likely not exist or be a small ephemeral drain without the current NPDES outfall and the stormwater flows incurred from the industrial and agricultural land uses in its watershed over the past several decades.

5. The length of stream below the waterfall (where it becomes a water of the state) is less than 0.2 miles to the mouth of the Tennessee River and is highly influenced by the water levels of the River. Approximately 500 feet of channel exists between the most downstream riffle and the waterfall (where it is less affected by the river), making it the only representative sample reach and a very small one, with a limited amount of aquatic habitat for biota.
6. The channel slope is steep and morphology changes from riffle-pool near the mouth to more step-pool near the waterfall. As such flow can be turbulent near the waterfall, further limiting stable habitat for fish and limiting fish passage in upper sections of the reach.
7. Due to all of the points noted above, the area may be classifiable as a "low potential impact" area (EPA, 1977) under the Type III demonstration.

Therefore, a Type III study will be completed to support the variance and document the occurrence of no appreciable harm and the existence of an appropriate (appropriate for reach size and habitat) balanced and indigenous population (community) (40CFR 122.1 and USEPA, 1974) in the stream. The components of this study are presented below and will be largely based on a two-season bioassessment completed on the unnamed tributary and two local control streams.

3.0 WATERSHED CONTEXT

The Cherokee Nitrogen facility sets on the banks of the Tennessee River just north of Cherokee, Alabama, in the Tennessee River watershed (HUC 06030005). The site discharges to a small first order unnamed tributary that flows directly into the river. The watershed of the unnamed tributary is approximately 2.8 mi^2 in size and is dominated by agricultural land uses (cultivated crops primarily) at 62%, forest at 19% and developed land (primarily industrial) at 16% (figure 1). Slope in the watershed is low to moderate overall but becomes very steep near the river and in the tributary corridor.

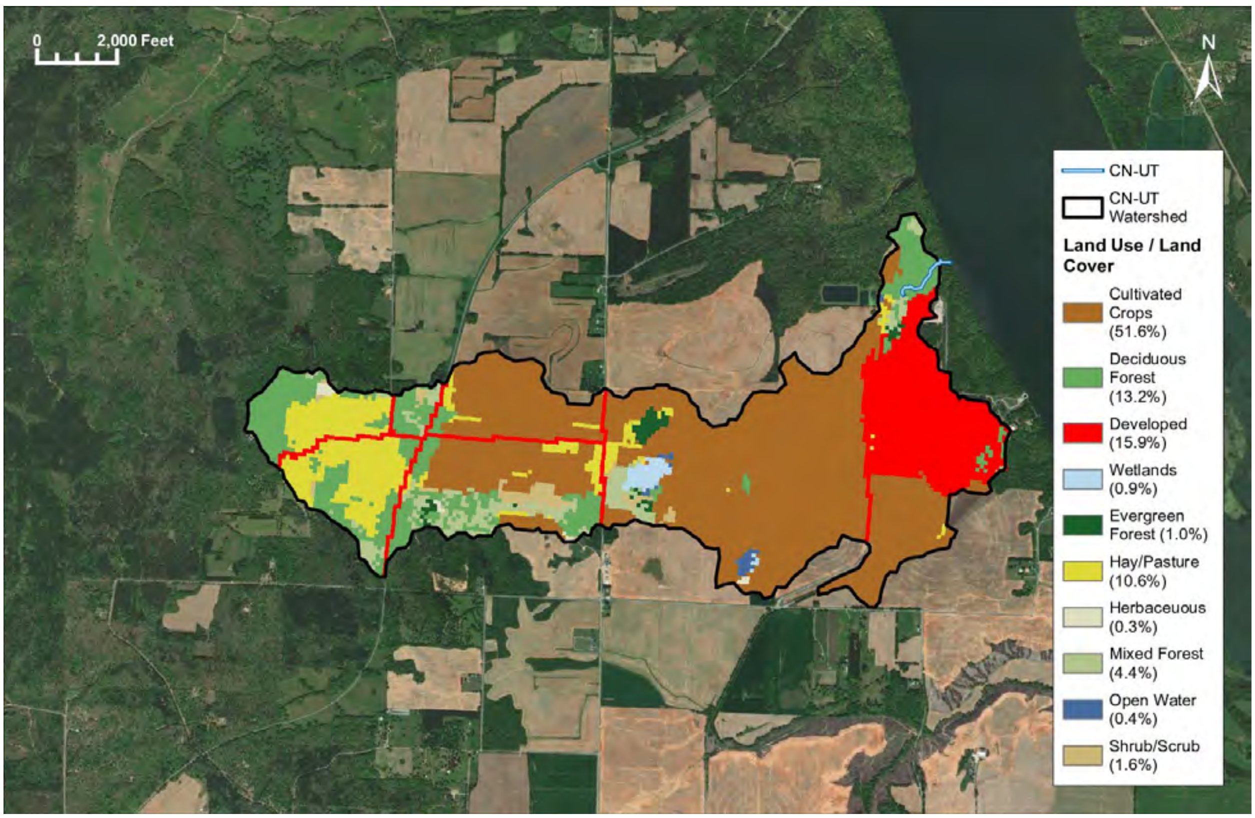


Figure 1. CN-UT watershed and LULC Map.

4.0 WATER QUALITY EVALUATION AND BIOLOGICAL ASSESSMENT

This section describes the primary data collection efforts to support the variance application. The field study portion of the 316(a) study will include the following components:

1. Fish collection
2. Macroinvertebrate collection
3. Habitat evaluation
4. In-situ water quality
5. Water sample collection
6. Ambient stream temperature monitoring

Components 1-6 will be completed in the three study reaches, which will be referred to as monitoring stations or reaches. One monitoring station will be in the unnamed tributary receiving treated effluent from CN, and the other two monitoring stations will be local reference reaches with as similar habitat and watershed characteristics to the UT as practicable. Brief location descriptions of each of these monitoring stations follows (see Figure 2.)

CN-UT – Unnamed Tributary. This monitoring station is located downstream of the large waterfall and runs from the most downstream riffle upstream to the base (the toe) of the waterfall pool. This reach is approximately 500 feet long, maximum. (34.816465°/-87.934687°)
CCN-1 – Cobert Creek North of the River. Reach begins at the Waterloo Road crossing.
MC-1 – Mulberry Creek. Reach begins at Mulberry Lane.

Alternatively, if one of these reference reaches is not usable at the time of the survey, for reasons such as no flow, having landowner access issues, etc, one of the following stream reaches will be utilized as a replacement:

CCN-2 – Colbert Creek North of River. A reach above Natchez Trace Parkway but downstream of Waterloo Road.
MSB-1 – Moon Springs Branch. Reach upstream of last riffle before mouth of the river.
MC-1 – Malone Creek. Reach at Moody Lane intersection with Creek.

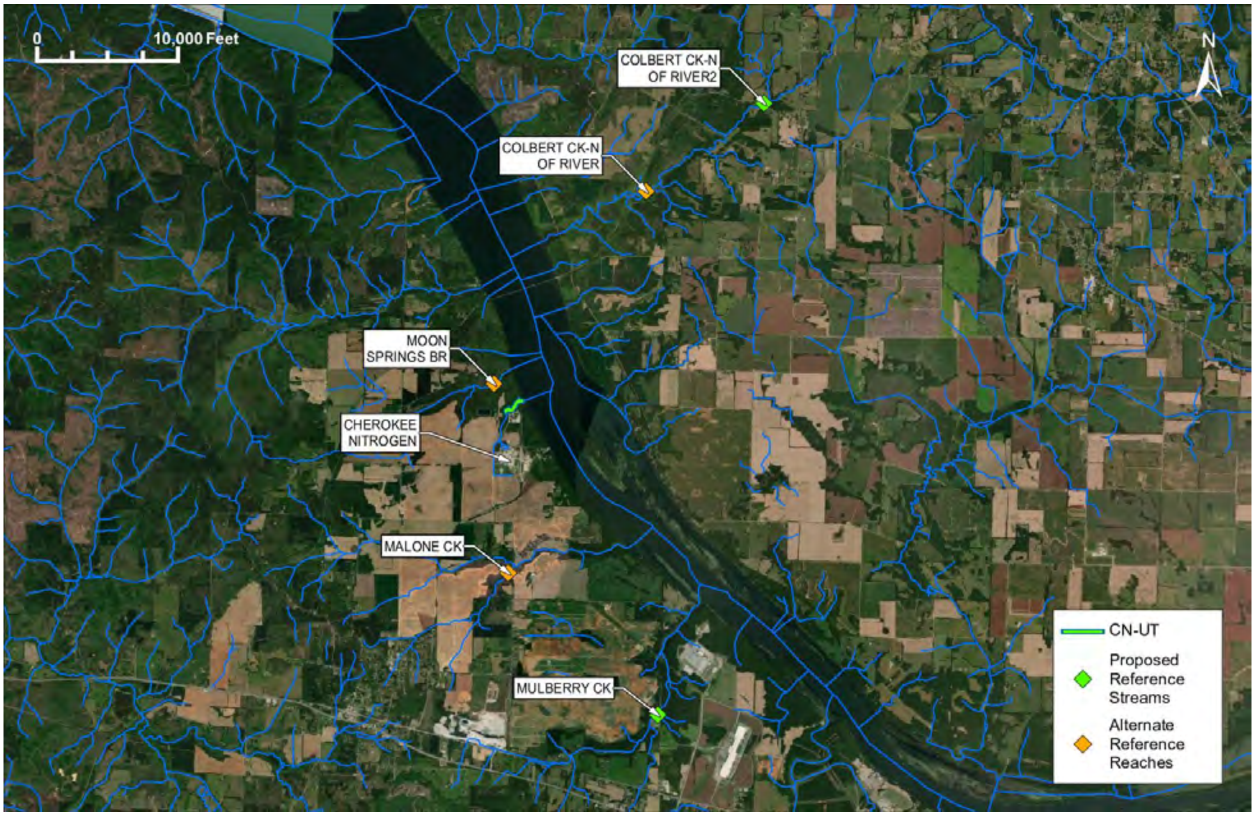


Figure 2. Monitoring stations for the 316(a) study.

Each study task described below may reference either and ADEM SOP or a GBMc SOP or both. Referenced SOPs are included in Appendix A. Data quality objectives and QA/QC efforts are provided in Section 7.

4.1 Fish

Fish will be collected from each study reach using electrofishing techniques supplemented by block netting/seining as needed. Fish collection will be completed following the ADEM SOP No. 6100 (Fish Index of Biotic Integrity Sample Collection Procedures for Wadable Streams).

Captured fish will be placed in a water filled ice chest or bucket for holding prior to identification and will either be identified on site and released or preserved as a voucher sample for later identification in the lab. Larger fish will typically be identified onsite, measured and released. Any released fish will be tallied and fish representing new species at a particular site will also be photographed as a voucher for that station. Sample reach lengths will be chosen to typify the local stream system and to encompass all available habitat types (riffles, runs, pools, woody debris, boulders, etc.) while minimizing the amount of stream electro fished to the extent practicable. With the maximum sample reach in CN-UT being approximately 500 feet, care will be taken to not oversample the references reaches, which will have much greater potential reach lengths, and thus potentially skew abundance and diversity metrics. Collection will generally proceed until the target of 30+2 “efforts” (ADEM SOP 6100) is achieved. Since available habitat could be limited in some reaches (i.e. CN-UT) the number of “efforts” will be recorded in each reach to factor into abundance and other associated community metrics.

4.2 Benthic Macroinvertebrates

Macroinvertebrates will be collected at each station generally following the ADEM SOP No. 6000, *Aquatic Macroinvertebrate Community Wadable Multi-Habitat Bioassessment* protocol. Under this protocol certain habitat types are sampled when available in the sample reach, including:

- Riffle
- CPOM
- Rock/Log
- Root/Bank
- Macrophyte Beds
- Sand/Bottom

A 30-micron rectangular dip net will be used for the collections at each station in each available habitat type. Available habitats as described in the ADEM protocol will be preserved separately by habitat type, for later sorting and identification in the lab.

Macroinvertebrates will be picked randomly from each sample using a canton sorting tray. Grids will be picked according to ADEM SOP 6001 to achieve a target of approximately 100 organisms from each habitat type. Organisms will be identified according to ADEM SOP No. 6002. Identification resolution will be generally down to genus level, but some taxa will be identified only to family/sub-family or order (i.e. Chironomidae, Oligochaeta). ADEM SOP 6002 states for Chironomidae to be identified to genus level. Should Chironomidae be one of the three dominant taxa groups in a given sample or should additional taxonomic resolution be needed to differentiate community condition then Chironomidae will be identified to genus level. Collections from all stations will receive the same level of taxonomic effort/resolution.

Macroinvertebrates will be evaluated according to various community metrics and will be compared to the reference reaches. Some of the general metrics that will be calculated include dominant taxa percentages, percentage of each ordinal group, functional feeding group percentages, species richness and species diversity. Other metrics, including those from the ADEM SOP No. 6004 may be utilized as appropriate to collection season and the comparative purpose/objective.

4.3 Habitat

While completing activities at each site, observations of habitat will be made in order to complete the Alabama Department of Environmental Management (ADEM) data forms for both Physical Characterization (SOP No. 6300) and *Wadeable Stream Habitat Survey* (SOP No. 6301). Each assessment will be completed for each station by the field team, consisting of three experienced ecologists and/or environmental scientists. Additional data will be collected at each station to supplement and support the habitat observations including wetted widths, approximate depths, top of bank and bankfull widths, approximate top of bank and bankfull depths/bank height and dominate substrate by morphology type. Flow will be measured at each of the three stations using a flow velocity meter and following the velocity area method for cross sectional stream flow measurement (GBMc SOP No 5.0).

4.4 In-situ Water Quality

In-situ parameters will be collected at each station during each study event (i.e. fall and spring assessments). In-situ parameters include:

1. Temperature (°C)
2. pH (s.u.)
3. Specific Conductance (µmhous)
4. Dissolved oxygen (mg/L)
5. Turbidity (ntu)

Field meters used for in-situ analysis will be calibrated according to GBMc SOPs (which generally follow manufacturers recommendations) each day prior to field use.

4.5 Water Sample Collection

Water samples will be collected from each of the three stations, during each study event. Parameters for laboratory analysis will be ammonia-N, CBOD5, Nitrate-N, and organic nitrogen. The PACE laboratory in Tuscaloosa, AL will complete water sample analysis. Sample collection will follow GBMc SOP No. 12.0. In summary, all samples will be placed in the appropriate clean containers supplied by the laboratory. Each sample container will be labeled with the sample I.D., date, time, and initials of collector(s). Samples will be placed in ice chests and maintained at approximately 4º C for delivery to the laboratory in a timely manner conducive to maintenance of regulatory holding times. Chain of Custody (COC) forms will include information that is labeled on each sample bottle and delivered with the sample's bottles to the laboratory for analysis. The COC form will include all required information and will be checked for completeness prior to submission of samples to the laboratory.

One field duplicate sample will be collected during one of the sample events (fall or spring). The handling of the field duplicate is discussed in Section 7.

A summary of the sample design for each task is provided in Table 1 and a summary of the sampling methods is provide in Table 2.

Table 1. Summary of Sample Design

Parameter	Bioassessment	In-Situ (Water)	Water Samples for Lab
Station I.D.	Parameters Being Analyzed		
CN-UT	Fish[1], Macroinvertebrates, Habitat	pH, temperature, dissolved oxygen, specific conductance, turbidity	ammonia-N, CBOD5, Nitrate-N, and organic nitrogen
CNN-1	Same as above	Same as above	Same as above
MC-1	Same as above	Same as above	Same as above

[1]Fish will only be collected during one season (most likely the fall).

Table 2. Summary of Sampling Methods

Sample Type	GBMc QAP SOP Number	Sampling Equipment	ADEM SOP Number	Field Processing Protocol	Storage Vessel	Preservative	Record Sheet (Y / N)
Fish	SOP 10.0[1]	Electro Shocker, Seines	6100	Sort, ID and Tally, Preserve, Label, Store	Large PE Bottles/Buckets	Formalin	Y
Macroinvertebrates	SOP 9.0[1]	Aquatic Dip Net	6000, 6001, 6002	Condense, Label, Preserve, Store	Large PE Bottles/Buckets	70% Ethanol or Kaylee's Solution	Y
Habitat (incl. flow)	SOP 6.0, 5.0	Wading Rod, Tape Measure, Flow Meter	6300, 6301	Complete Field Notes	n/a	n/a	Y
Water	SOP 12.0	Sample Bottles	n/a	Label and Store in Ice Chest	Various Bottles	Various	Y
In-situ	SOP 1.0, 2.0, 3.0, 4.0, 14.0	Field Meters	n/a	Calibrate, Measure in Main Channel, Record	n/a	n/a	Y

[1]GBMc SOP utilized where ADEM SOP is not specific, otherwise ADEM SOP followed.

4.6 Ambient Stream Temperature Monitoring

Three continuous reading temperature probes (Hobo® style) will be installed in the CN-UT. A temperature probe will also be installed in each reference stream reach. The locations for temperature probes are:

1. UT-B – At the wooden bridge, by outfall 001. (34.809129°/-87.938111°)
2. UT-W – In the UT just upstream of the large waterfall. (34.815803°/-87.935223°)
3. UT-1 – In the UT at the last riffle prior to exiting into the Tennessee River. (34.816984°/-87.934265°)
4. CNN-1 – Just upstream of Waterloo Road bridge. (34.875379°/-87.877241°)
5. MC-1 – Just upstream of Mulberry Lane Bridge. (34.756123°/-87.900136°)

Probes will be installed where they contact flowing water and are protected from large debris. Probes will be installed during the late fall 2021 and checked and downloaded during each site visit (Fall, spring) and retrieved in November 2022 for analysis. Temperature probes will be new, and factory calibrated. Each probe will be checked against a calibrated field meter to verify accuracy of temperature reading during deployment and during each maintenance site visit. Each probe will record temperature readings every 30 minutes (minimum) at each of the five stations.

5.0 HYDROLOGY AND ENGINEERING BASIS

As a part of the 316(a) study a hydrology analysis of the UT system and an engineering summary of the facility wastewater system will be provided. The following information will be compiled, analyzed and included in the final study report.

1) Background information on the wastewater system and outfall configuration.
2) Summary of past five years of DMR data and flow history.
3) Delineation of components of wastewater flow in the CN system and other flows (stormwater) entering the UT.
4) Provide a summary of the latest Commix findings related to temperature in the TN River.

6.0 DATA EVALUATION

Data collected during the 316(a) study, both new field data and historical data, will be evaluated for completeness and accuracy (Section 7), and the proven data will be used to assess the feasibility of a proposed temperature variance. Following the Type III demonstration requirements, the data will be used primarily to provide evidence of maintenance of a balanced indigenous population and/or "...absence of prior appreciable harm…" to indigenous biological communities from the 50+ year old wastewater discharge. Various data will be used in this process including but not limited to:

1) Fish collections
2) Macroinvertebrate collections
3) Habitat assessments
4) Local reference stream assessments/collections
5) Water quality data (new and historical)

Analysis of fish and macroinvertebrate data collected during this study will focus on community composition and balance to determine if the biotic community in the CN-UT is balanced and healthy (with no evident appreciable harm) consistent with its represented habitat and history. The focus of any comparisons to reference conditions will be on dominants in common (family, order, etc.), trophic structure, and overall make-up of species typical of the ecoregion. Some differences in taxa (presence/absence) are anticipated due solely to the unique spring water dominated, cool water nature of the reference streams. Any spring water associated differences will be noted in the final report.

In order to establish the appropriate allowable discharge temperature, under a temperature variance, the following data (and other appropriate data meeting the DQO) may be utilized:

1. Effluent DMR data.
2. Routine temperature data collected by the facility
3. Historical and newly collected temperature data from the unnamed tributary.

The temperature variance will be calculated following standard and accepted statistical principals and protocols. For example, data will be handled using statistical tests/procedures appropriate to data set variance and distribution. It is likely that if the biota found in the CN-UT are balanced and indigenous with no evidence of "…appreciable harm…" that the temperature variance request will be that of the current temperature limits in CN NPDES permit. However, should the data analysis support a lower or higher temperature value, that information will also be presented. The basis/rationale for any variance along with all data and calculations will be presented in the final report.

7.0 DATA QUALITY OBJECTIVES/QUALITY ASSURANCE/QUALITY CONTROL

This section provides a summary of the Data Quality Objectives (DQO) and quality assurance/ quality control practices followed for tasks in this study to provide accurate, representative, and precise data.

7.1 Data Quality Objectives

Sample collection techniques are based on those recommended by EPA for specific media types in various guidance documents. Use of accepted sampling methodology ensures that the results are comparable. The completeness criterion for this project is that 90% of the samples from each media will provide usable results. That is, the collection, handling, and analysis process allows that 10% of the samples (maximum) could be lost, contaminated, or rendered unusable due to field technician or laboratory error.

An overview of data quality objectives for the laboratory is provided in the table below. EPA approved methods will be utilized, and the laboratory will be certified in the State of Alabama and/or hold a NELAC/NELAR accreditation.

Table 3. Summary of Laboratory DQO.

Parameter	Source/Method[1]	Units	RL
Ammonia-N	SM 4500	mg/l	0.10
Nitrate-N	EPA 300.0/SM4500	mg/L	0.03
Organic nitrogen	SM4500	mg/L	0.03
CBOD5	SM5210	mg/L	2.0

[1]Alternate methods could be used consistent with 40 CFR Part 136

In-situ parameter measurement consisting of pH, temperature, dissolved oxygen, specific conductance, and turbidity is subject to the 90% usable result completeness criterion.

Ambient stream temperature probes will be deployed at each of the three sampling stations. Probes will log data every 30 minutes at minimum. The 90% completeness criterion is also applicable to this temperature data.

DMR and other facility data collection will also have been compiled, reviewed, and reported during this study as required by NPDES permit and discussed in Section 6. Use of quality assurance with the DMR requirements provides an adequate level of data quality for these parameters. The completeness criterion for the data evaluation of the project is that 90% of the data evaluated will provide usable results.

7.2 Quality Assurance/Control

Bioassessments

GBMc & Associates maintains a Quality Assurance Plan (QAP) for field data collection and data handling (GBMc & Associates, 2008) including for bioassessment tasks. Standard operating procedures (SOP's) from the QAP referenced in this report are provided in Appendix A.

Trained scientists will conduct the field sampling/assessments and other associated activities at each sample location. Notes will be kept in field notebooks and/or specific field data forms that record information collected during the study, unusual observations, and a log of daily activities. All data forms, calibration logs, field notes, and other study documentation will be reviewed by the Project Manager or Senior Scientist for completeness and accuracy. Concerns over field data collection success or required deviations to SOP will be reported to the project manager for review. Any deviations from the methodologies described in this Workplan will be recorded and presented, in detail (including an assessment of potential effect on data), in the final project report.

All taxonomic identifications of fish or macroinvertebrates will be completed by trained and experienced ecologist or environmental scientists. This quality assurance will include a minimum of 10% verifications by a senior level ecologist/taxonomist per the GBMc SOP No. 9.0 and 10.0.

Water Sampling

Duplicate samples for all constituents will be collected once during the study. Duplicate samples will vary by no more than 30% relative percent differences (RPD), or the sample results will be considered suspect. In the event an RPD exceeds 30%, the Project manager will investigate the incident to determine the cause of the exceedance and what action, if any, is necessary.

Representativeness

All measurements must be made so that the results are representative of the conditions being measured. The data quality objective is to take samples and perform analyses that depict the existing conditions as accurately as possible. The quantitative goal is to have 90% of the field duplicate samples be within the acceptance criteria, which is that 90% of the samples from each media will provide usable results.

Analytical Laboratory

The laboratory will validate analytical data by use of blanks, laboratory controls, spikes, and spike duplicates. Laboratory blanks measure the amount of each respective analyte contributed from the analytical procedure. A laboratory blank is considered out of control for a specific analyte if the value exceeds the higher of either the minimum detection limit (MDL) or 5% of the measured concentration in the sample. A laboratory control measures the ability of the laboratory to recover an analyte from a blank matrix. The laboratory spike sample is used to evaluate the laboratory's ability to recover an analyte in the sample matrix. The QC exceedance criteria for laboratory controls and spikes is based on upper and lower control limits derived from the laboratory's method specialized limits. The laboratory spike duplicate is used to evaluate the laboratory's precision (ability to attain similar analytical results from duplicate samples). A RPD is calculated for the spike and spike duplicate. The RPD is compared to method specialized limits to determine QC exceedance. Any significant excursion from one of the QC parameters will result in a repeat of the analysis in question following an investigation by the laboratory as to the cause of the QC excursion.

Precision and Bias (Analytical Laboratory)

Precision is the degree to which a set of observations, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. Bias is the systematic error that contributes to the difference between the mean of a significant number of test results and the accepted reference value. Precision and bias are determined for standard and non-standard methods. Precision and bias are determined through the performance of a Demonstration of Capability, laboratory control samples, matrix spikes, and sample duplicates.

Method Sensitivity (Analytical Laboratory)

Method sensitivity refers to the ability of the laboratory test method to measure concentration down to levels of concern for a particular purpose. In this study the laboratory methods are sufficiently sensitive to measure the parameters of interest at adequate concentrations.

Data Handling

All data collected during scientific studies will be checked by the team leader for completeness and accuracy. Field data forms will be complete and initialed by the completing scientist and the reviewing scientist. All field data sheets and logbooks will be kept at GBMc and maintained for a period of 5 years.

All field data will be entered to spreadsheets (or databases) or scanned into pdf files for electronic storage. Data will be stored electronically in project files on a secure network. The network is backed up twice daily. Data entry to spreadsheets and databases along with spreadsheet calculations will be checked for accuracy at a rate of 10% (minimum) of the entries and calculation cells. Copies of the checked data and spreadsheets will be initialed by the reviewer and retained. All calculations will be detailed in the body of written reports, shown on

GBMc & Associates Calculation Pages or the excel document where the calculations were completed can be provided.

GBMc & Associates are responsible for the compilation of all data (*in-situ*, flow, analytical, etc.) collected during the study. Analytical results as well as QA/QC results will be reported in electronic format to the Project Manager. This data will be stored on the GBMc & Associates network for a minimum of five years after the end of the project. All deliverables (scientific reports, QA/QC reports, etc.) developed as part of this study will be peer reviewed and/or reviewed by the Project Manager prior to being sent to Cherokee Nitrogen or ADEM.

8.0 REPORTING AND SCHEDULE

The final report will present methodologies, data collected (including fish and macroinvertebrate taxa lists, enumerations and habitat survey scores), a discussion of results and provide the basis and calculations of the recommended temperature variance consistent with the biological findings of the study. The study's findings will be summarized by GBMc & Associates in a final report suitable for submission to ADEM and EPA. The proposed project schedule is provided in Table 4.

Table 4. Proposed schedule

Task No.	Task Description	Start Date	Completion Date
1	Install Temperature probes	November 1, 2021	December 30, 2021
2	2022 Spring Bioassessment	April 15, 2022	June 30, 2022
3	2022 Fall Bioassessment	August 15, 2022	October 20, 2022
4	Data Evaluation	June 1, 2022	November 30, 2022
5	Draft Report	November 1, 2022	December 30, 2022
6	Final Report	Within 30 days of ADEM comment receipt	

9.0 REFERENCES CITED

Alabama Department of Environment
Various dates (see below). SOP's ADEM , Montgomery, Alabama

6000; 3/11/2010
6001 ; 6/30/2016
6002 ; 10/6/2017
6100 ; 3/31/2014
6300 ; 1/13/2015
6301 ; 6/19/2018

GBMc & Associates. 2008. Quality Assurance Plan. GBMc & Associates, Bryant, AR

U.S. Environmental Protection Agency. 1977. *Interagency 316 (a) Technical Guidance Manual and Guide for Thermal Effects Sections of Nuclear Facilities Environmental Impact Statements*. Office of Water. Washington, D.C.

U.S. Environmental Protection Agency. 1974. Water Planning Division. *316 (a) Technical Guidance—Thermal Discharges.* Water Planning Division, Washington, D.C.

APPENDIX A

FISH INDEX OF BIOTIC INTEGRITY
SAMPLE COLLECTION PROCEDURES
FOR WADEABLE STREAMS

SOP #6100

Rev. 2.0

VERSION DATE – 03/31/14

PREPARED BY:	Ruth Perry	**DATE**	04/01/2014
REVIEWED BY:	 **Branch or Division Chief**	**DATE**	03/31/14
APPROVED BY:	 **Quality Assurance Manager**	**DATE**	3/31/2014

Alabama Department of Environmental Management

1400 Coliseum Blvd Montgomery, AL	1350 Coliseum Blvd Montgomery, AL	2715 Sandlin Rd Decatur, AL	110 Vulcan Rd Birmingham, AL	2204 Perimeter Rd Mobile, AL

TABLE OF CONTENTS

PREFACE

This Standard Operating Procedures (SOP) Manual supersedes all Departmental SOPs relating to the methods addressed and is designed to be periodically reviewed and updated. The primary purpose of this document is to establish and maintain uniform operational and quality control guidance. The compliance with these procedures is essential to produce reliable data. Any deviation from this SOP must be documented and approved by the Project QA/QC Coordinator and/or project supervisor.

DISCLAIMER

This document has been prepared for use by the staff of the Alabama Department of Environmental Management (ADEM). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. No portion of this manual is intended to supersede any Departmental policy memorandum issued by the Director or Deputy Director.

NOTE

Any alpha suffix added to the version date indicates the incorporation of corrections for non-critical typographic errors or formatting, i.e., no methodology changes were incorporated.

FISH INDEX OF BIOTIC INTEGRITY SAMPLE COLLECTION PROCEDURES FOR WADEABLE STREAMS

1 SCOPE AND APPLICATION

1.1 This method describes sample collection procedures for freshwater fish communities in preparation for assessing biological condition of flowing, wadeable streams in Alabama using the Index of Biotic Integrity (IBI).

2 SUMMARY OF METHOD

2.1 Fish may be collected using a variety of methods depending on habitat type and depth of stream. Regardless of the method used, precautions should be taken to ensure that the sample collected is representative of the community as a whole. Collection efforts should be stratified over four habitat types (riffles, runs, pools, and shorelines). A minimum of 30 sampling efforts (i.e., 10 each to riffle, run, and pool habitats) and at least 2 shoreline efforts should be devoted to each stream collection in order to yield a sample compatible for use with the IBI.

3 DEFINITIONS

3.1 Net Set – The collector(s) sets the net by ensuring that the weighted edge of the seine is in as close contact with the bottom substrate as possible with both end poles at slightly greater than 60 degrees in order to avoid submersing the upper edge of the seine below water, resulting in loss of catch.

3.2 Pools – Topographic low areas of slower moving water usually characterized by accumulated finer sediment material.

3.3 Riffle – Topographic high areas created by accumulated coarse sediment material.

3.4 Runs – Transitional areas where, as one moves downstream from a pool to a riffle, depth decreases and velocity increases, and when exiting a riffle depth increases and velocity decreases.

3.5 Shoreline – Habitat found where the water surface interacts with the landscape resulting in a diverse array of microhabitats such as shallow shoals, deep holes, riparian cover (or lack of), log snags, weed beds, and undercut banks.

3.6 Seine Haul – The collector(s) complete the net set and both collectors move forward in unison to a designated position or a collector takes a stationary position as the second collector brings his brail to the completed position.

3.7 Pool - One sampling effort is defined as a seine haul through a pool for at least 20 feet.

3.8 Riffle – One sampling effort is equal to a net set in a riffle and sampled for at least 20 feet where fishes are shocked into the net.

3.9 Run – One sampling effort is equal to a net set in a run and sampled for at least 20 feet where fishes are shocked into the net.

3.10 Shoreline – One sampling effort is equal to a length of 150 linear feet of shoreline shocked for fishes.

3.11 External Anomalies – The presence of visible skin or subcutaneous disorders. More common anomalies include: Deformities, Eroded Fins, Lesions and Ulcers, Tumors, Anchor Worms, Black Spot, Leeches, Fungus, Ich (*Ichthyophthirus multifilis*), and Popeye.

3.12 Young of Year (YOY) – Juvenile fish, usually less than 20-25mm in total length.

3.13 Mean Stream Width (MSW) – Average of stream width from bank to bank.

3.14 Backpacker – Individual collector carrying the backpack shocker.

4 Health & Safety Warnings

4.1 General field health and safety warnings apply.

5 Interferences

5.1 Conditions with low conductivity may require a higher voltage output, while high conductivity may require voltage to be adjusted to a lower setting.

6 Personnel Qualifications

6.1 No employee shall conduct this technique until he/she has actual field experience and has successfully demonstrated the ability of conducting this technique under the supervision of a senior staff member.

6.2 All professional and paraprofessional Departmental employees shall have the equivalent of three months field experience before they are permitted to conduct any sampling efforts on their own. This field experience shall be gained by on-the-job training utilizing the "buddy" system.

6.3 Each new Departmental employee shall accompany an experienced field employee on as many field trips as possible to experience the differing types of field situations in which the new employee may be required to participate.

6.4 During the training period, the new employee will be permitted to perform all facets of field investigation, including sampling, under the direction and supervision of senior technical staff members.

6.5 Depending on the project for which the samples are collected, a 40 hour hazardous waste safety training course may be required along with the annual 8 hour updates.

7 Equipment and Supplies

Back Pack Electrofishing Unit (BPEF)	Clean Holding Bucket
Dip Nets	10% Formalin Solution for Preservation
Minnow Seines	Datasonde and Hand unit
Sample Collection Jugs	Waders
Labeling Tape	Pencil/Marking Pen
Chain-of-Custody Form(s)	Field Notebook
Clipboard	Field Data Sheet Printed on Rite-in-the-Rain Paper

8 Equipment Selection

8.1 Wadeable streams less than 10 meters in mean stream width (MSW) can generally be sampled effectively using only one BPEF.

8.2 Streams larger than 10 meters MSW may require additional BPEF units and/or tow barge.

8.3 Best professional judgment may be utilized by experienced collectors to determine the level of effort needed to adequately sample a site.

9 Sample Collection Considerations

9.1 Timeframe for season is predicated on water level and temperature. Streams should be wadeable with a flow that allows the collectors to move in an upstream direction at a steady pace.

9.2 Most sampling should occur during the summer months when water levels are generally lowest, fish populations tend to be most stable and sedentary, and pollution stresses are potentially the greatest.

9.3 Extra care should be exercised when sampling streams with elevated turbidity levels or excess fine bottom substrate (silt) should be avoided due to the reduced visibility of stunned fishes in these conditions.

9.4 Some habitats can support more diverse fish assemblages than others due to water depth, velocity and vegetative cover. Stream runs (between riffles and pools) are productive habitats. Other areas of focus should include vegetated shorelines along riffle margins, head areas where riffles start to break, and plunge pools where runs transition to pools.

9.5 A goal of ten efforts should be conducted for each of the run, riffle, and pool habitats with a minimum of two efforts conducted for shoreline per station.

10 Sample Collection Procedures

10.1 <u>General Procedures</u>

10.1.1 Collection efforts should be stratified over four habitat types (riffles, runs, pools, and shorelines). A minimum of 30 sampling efforts (10 each to riffle, run, and pool habitats) and at least 2 shoreline efforts should be devoted to each stream collection in order to yield a sample compatible for use with the IBI.

10.1.2 If all habitats are not found within the stream reach, sample available habitats proportionally to get an overall representative sample of the fish community. For example, if there is no pool habitat, sample 15 runs and 15 riffles. Do not forget to include at least 2 shoreline efforts as well.

10.1.3 If the available habitats are not equally represented in the reach, the number of sampling passes/habitat should reflect the general percentage of that habitat in the reach. For example, if there is more run habitat than riffle, sample 13 runs, 7 riffles, and 10 pools. Do not forget to include at least 2 shoreline efforts as well.

10.2 Riffle Habitat

10.2.1 Sample all microhabitats in riffles areas: the head, foot, middle and sides.

10.2.2 Set the net in a shallow, rocky area or deeper, swifter chute; the backpacker then enters the sampling area 15-20 feet upstream of sampling area, taking care not to disturb the sampling area while moving into position. The backpacker then proceeds to shock downstream through the riffle into the seine while disturbing the bottom.

10.2.3 The backpacker should continue shocking into the seine until the seine is ready to be lifted.

10.2.4 Additional crew member(s) may follow behind the backpacker disturbing the bottom to dislodge stunned fishes.

10.3 Run Habitat

10.3.1 Runs are sampled similarly to a riffle, by blocking off the downstream end of the area to be sampled with a seine. The backpacker then thoroughly shocks downstream into the seine for about 20 feet. At least one other person should walk behind the backpacker while disturbing the substrate to get stunned fish into the water column and picking up fish with a dip net. For runs, stunned fish may also be collected by either seining with the flow or by moving with the seine from bank to bank across the stream either alone or following the backpacker.

10.4 Pool Habitat

10.4.1 The use of seines in pools should be limited. Without the aid of the higher velocities (runs and riffles), seining in pools requires more effort. The lower velocities allow the fish a greater chance of evading the net, resulting in a decrease in collecting efficiency. Pools can be sampled either by following the backpacker with dip nets, shocking downstream into net sets, or by trapping fishes against the shore or in a slough by conducting seine hauls. A combination of these techniques can also ensure a representative sample from pool habitats based upon best professional judgment.

10.4.2 Deep pools with structure can be sampled by blocking the downstream end with the seine and working the upstream area with a shocker and dip nets.

10.5 Shoreline Habitat

10.5.1 Shoreline can be sampled by a crew member working with the backpack shocker upstream along the shoreline shocking around habitat structures. One or two field crew members follow closely scooping the stunned fishes with dip nets.

11 Sample Handling and Preservation

11.1 All collected individuals are detained until they are either field identified or preserved for lab identification. Fish identified in the field are identified, examined for external anomalies and immediately released.

11.2 Young-of-year (YOY) individuals should not be counted or identified for analytical purposes because large numbers of YOY may bias the IBI's usefulness as an indicator of aquatic ecosystem health (Karr et. al, 1986).

11.3 Specimens are preserved in 10 percent Formalin solution.

11.4 A field label should be placed inside every sample container returned to the laboratory. Labeling tape may also be placed on the outside of the container. The stream station name, date collected, and collectors' names should be included on the label.

11.5 Small individuals up to 5 inches in length can be adequately preserved by placing them directly in the Formalin solution. Larger individuals must first be fixed by injecting preservative into the body cavity. The body cavity of very large individuals must be cut open to allow adequate preservation.

11.6 Specimens saved for permanent storage at the lab must be rinsed with tap water three times to wash away the Formalin. To draw out the water, the specimens should be preserved in increasing concentrations of ethanol (20%, 40%, and 70%). The specimens should soak in each concentration for at least 3-5 days before moving up to the next concentration, beginning with 20% ethanol.

11.7 A label should be included with the specimens each time the solution changes, beginning with the 20% ethanol solution. The label should include the date the specimens were put into the solution and the current concentration.

11.8 For permanent retention in a reference collection, a label containing the station name, specific location information, date collected, county, any sample numbering code, collector, and the name of the person(s) who identified the species should be included on a water-proof label and placed inside the container.

12 Troubleshooting

12.1 Refer to applicable Manufacturer's Manual for backpack shocker and other equipment–specific problems.

13 Data Acquisition, Calculations, & Data Reduction Requirements

N/A

14 Data and Records Management

14.1 All samples must be fully identified and chain-of-custody maintained. See SOP #9040.

14.2 All sample collection activities shall be traceable, through field records or notes, to the person/crew collecting the sample.

14.3 All maintenance and calibration records for sampling equipment shall be kept so that they are similarly traceable.

14.4 A field collection form and fish habitat assessment form (*in development*) must be completed at every sample location.

15 Quality Control & Quality Assurance

15.1 Field Training

15.1.1 All personnel involved in sampling and identification of fish should be trained consistently according to the Departmental SOP.

15.1.2 Each site must be assigned a Station ID and it shall be attached to or retained within each sample from that site, so that each sample is traceable from collection, field identification, enumeration, field preservation, in-house identification and archiving or disposal.

15.2 Field Identification

15.2.1 Two experienced staff members must agree on fish species identification prior to release. If this cannot be accomplished with 100% confidence, the fish should be retained for in-house identification.

15.2.2 Only field-identified species are tabulated on the Fish Community IBI Survey Form (to prevent duplication if fish are counted from in-house ID and added back to field identification tally form).

15.2.3 Five (5%) of all stations will be subjected to quality assurance of field IDs through the use of a Quality Control Container (QCC). All field identified fish will be collected and preserved in the QCC unless special circumstances warrant otherwise (i.e. collection of endangered or threatened species).

15.3 QA In-House ID

15.3.1 All fish will be laboratory identified by experienced staff and recorded on the IBI Lab ID Sheet (Section 17).

15.3.2 Five to 10 percent (5-10%) of in-house identified species will be re-identified by a Secondary Identifier to confirm species identity.

15.3.3 An external taxonomic expert should be used to identify 5-10% of all species identified in the lab.

15.3.4 Any species that cannot be identified shall be sent to an external taxonomic expert for identification and will not be included as part of the internal QA procedure. All fish species identified by an external taxonomic expert will be re-identified to confirm the identity.

15.3.5 The numbers of fish for each Lab Identified species are added back to the final field numbers found on the Fish Community IBI Survey Form for that station.

16 Reference

ADEM. 2015 (as amended). Standard Operating Procedures #9040 Station, Sample Identification and Chain of Custody Pro0cedures. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

Georgia Department of Natural Resources, Environmental Protection Division. 2004. Standard operating procedures: freshwater macroinvertebrate biological assessment. Water Protection Branch, Atlanta, Georgia.

Ohio Environmental Protection Agency. 1987c. Biological criteria for the protection of aquatic life: volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Monitoring and Assessment, Columbus, Ohio.

O'Neil, P.E., and Shepard, T.E., 2000, Application of the index of biotic integrity for assessing biological condition of wadeable streams in the Black Warrior River system, Alabama: Alabama Geological Survey Bulletin 169, 71 p.

O'Neil, P.E., Shepard, T.E., and Cook, M.R., 2006, Habitat and biological assessment of the Terrapin Creek watershed and development of the index of biotic integrity for the Coosa and Tallapoosa River systems: Alabama Geological Survey Open-File report 0601, 210 p.

17 Tables, Diagrams, Flow Charts and Forms

IBI Lab ID Sheet Example

IBI LAB ID SHEET

STATION:______________________

DATE COLLECTED:______________________

DATE ID'D:______________________

1ST ID:______________________

2ND ID:______________________

#	COMMON NAME	SCIENTIFIC NAME	FAMILY

18 Change Tracking

Rev. Date (Review Date) Rev. #	Approved By:	Detail of Approved Change
02/12/2007 Rev. 0		Original Version
02/12/07 (7/18/08)	J. Miller	Annual Review—No Changes.
02/12/07 (03/03/10)	J. Miller	Periodic Review—No Changes.
04/02/12 Rev. 1.0	R. Young	Periodic review. Made non-critical formatting and grammatical changes. Modified the following sections: 7; 9.3; 10.3.1; 11.4; 11.6; 11.7; and 15.3.1. Added IBI form example to Sec. 17. Deleted Sec. 11.8.
03/31/14 Rev. 2.0	R. Perez	Periodic review. Made non-critical formatting and grammatical changes. Added the following sections: 10.1; 10.1.1; 10.1.2; and 10.1.3.
03/31/14 (05/23/16) Rev. 2.0	L. Huff	Periodic Review—No Changes.
03/31/14 (03/02/18) Rev. 2.0	L. Huff	Periodic Review—No Changes.

AQUATIC MACROINVERTEBRATE COMMUNITY
WADEABLE MULTI-HABITAT BIOASSESSMENT

SAMPLE COLLECTION

SOP #6000

Rev. 2.0

VERSION DATE – 03/11/10

PREPARED BY:		**DATE**	03/11/2010
REVIEWED BY:	**Branch or Division Chief**	**DATE**	03/12/10
APPROVED BY:	**Quality Assurance Manager**	**DATE**	3/11/2010

Alabama Department of Environmental Management

1400 Coliseum Blvd
Montgomery, AL

1350 Coliseum Blvd
Montgomery, AL

2715 Sandlin Rd
Decatur, AL

110 Vulcan Rd
Birmingham, AL

2204 Perimeter Rd
Mobile, AL

TABLE OF CONTENTS

PREFACE

This Standard Operating Procedures (SOP) Manual supercedes all Departmental SOPs relating to the methods addressed and is designed to be periodically reviewed and updated. The primary purpose of this document is to establish and maintain uniform operational and quality control guidance. The compliance with these procedures is essential to produce reliable data. Any deviation from this SOP must be documented and approved by the program/project QA/QC Coordinator and/or program/project supervisor.

DISCLAIMER

This document has been prepared for use by the staff of the Alabama Department of Environmental Management (ADEM). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. No portion of this manual is intended to supersede any Departmental policy memorandum issued by the Director or Deputy Director.

NOTE

Any alpha suffix added to the version date indicates the incorporation of corrections for non-critical typographic errors or formatting, i.e., no methodology changes were incorporated.

AQUATIC MACROINVERTEBRATE COMMUNITY WADEABLE MULTI-HABITAT BIOASSESSMENT SAMPLE COLLECTION

1 SCOPE AND APPLICATION

1.1 This method describes the aquatic macroinvertebrate collection procedures for ADEM's wadeable multi-habitat bioassessment (WMB-I) protocol.

2 SUMMARY OF METHOD

2.1 Bioassessment samples are collected from a variety of habitats depending on the characteristics of the water body. Precautions should be taken to ensure the samples collected are representative of the current conditions.

3 DEFINITIONS

CPOM: Coarse particulate organic matter. This is a composite collection of leaves, needles, twigs, bark or fragments of these.

Method Precision: A measure of the variability between duplicate samples. It is calculated as (100%-CV (Coefficient of Variation) between assessment scores from duplicate samples) where:

$$CV=\left(\frac{\text{Standard Deviation of assessment scores from duplicate samples}}{\text{Average of assessment scores from duplicate samples}}\right)*100$$

4 HEALTH & SAFETY WARNINGS

General field health and safety warnings apply.

5 INTERFERENCES

6 PERSONNEL QUALIFICATIONS

6.1 No employee shall conduct this technique until he/she has actual field experience and has successfully demonstrated the ability of conducting this technique under the supervision of a senior staff member.

6.2 Each new Field Operations employee shall accompany an experienced field employee on as many as possible of the differing types of sampling situations the employee may be called upon to conduct.

6.3 During this training period the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of senior technical staff members.

7 Equipment and Supplies

Plastic Sample Containers	2 #30 Sieve Buckets
Pencil and Permanent Marker	100% Denatured Ethanol
Chain-of-Custody Form(s)	Forceps
Kick Net	Brush
2 'A' Frame Nets	Plastic Elutriation Trays
White labeling tape	2 #30 Sieves

8 Sample Collection

8.1 Index Period

8.1.1 Benthic macroinvertebrate bioassessments are conducted during the period from late April through early July. Many fauna are present in the streams for relatively short periods, making the timing of sample collection more critical.

8.2 General

8.2.1 A survey of the site should be conducted to identify what habitats are available and typical of the stream reach. Replicate samples should reflect the variability in depth and current velocity of each habitat type.

8.2.2 Prior to leaving a site, thoroughly rinse and inspect all nets and other equipment to prevent transferring organisms from one site to the next.

8.2.3 Before sampling is conducted, an initial reconnaissance should, if feasible, be made to locate suitable sampling location(s) in the event that these locations are not identified in the QAPP or Plan of Study.

8.3 When not to collect a sample/conduct an assessment—Any situation that creates dangerous sampling conditions, unfavorable conditions that affect the ability of field personnel to collect a sample representative of current water quality or conditions that prevent field personnel from collecting a sample that meets the objectives of the study.

8.3.1 Non-flowing conditions

Current assessment guidelines are based on flowing conditions in least-impaired ecoregional reference streams. For that reason, bioassessments will not be conducted during periods of no-flow. These might include drought conditions or areas directly above or below a beaver dam.

8.3.2 Post-rain or flood event

High water conditions severely impair sampling efficiency by making some critical habitats inaccessible. High flows also scour substrates of organisms and habitat (CPOM). Increased turbidity and raised water level may make it difficult for field personnel to see and sample most habitat types.

Recent rains may mask what would other wise be non-flowing conditions. Prior flow conditions can be difficult to determine, but USGS flow data from nearby streams may be used to make the best determination possible.

8.4 Additional Information Required

8.4.1 A Habitat Assessment/Physical Characterization (HA/PC) datasheet, Field Parameters, and a stream flow measurement will always be completed in conjunction with an MB-I assessment. Other data may also be required, but will vary with study objective, station location, and program.

8.4.1.1 Field parameters and water quality samples will be collected at the downstream end of the sampling reach before the WMB-I sample collection begins to prevent stirring up bottom sediments and silt. (SOP #s 2040, 2041, 2042, 2043, 2044, 2045, 2061, 2062, 2063, 2064, 2066, 2065, 9021)

8.4.1.2 The habitat assessment/physical characterization datasheet will always be completed after the WMB-I sample collection (SOP #s 6300 and 6301).

8.4.1.3 Field parameters and flow data are transferred from the datasonde to the appropriate HA/PC datasheet as soon as possible.

8.4.1.4 If a periphyton bioassessment is conducted during the same site visit, it is completed before the collection of the WMB-I sample.

8.5 Collection of WMB-I Samples

Each of the following habitat types are sampled using the appropriate equipment and preserved separately with 100% denatured ethanol. The final concentration will be <100% due to dilution by water retained in the organic matter collected.

8.5.1 Riffle

8.5.1.1 A kick net is positioned upright and securely on the stream bed while a $1m^2$ area upstream is physically disrupted using feet and/or hands.

8.5.1.2 Two-one square meter ($1m^2$) riffle samples should be collected at each station. The two samples should reflect the variability in the riffle habitat (collect one from an area of fast current velocity and one from an area of slower current velocity or include both shady and sunny areas).

8.5.1.3 The two samples are washed down and composited in a large bucket sieve. Large debris can be rinsed, visually inspected, and removed at this time.

8.5.2 CPOM

8.5.2.1 A variety of CPOM forms should be collected, if they are available, from at least three (3) different areas. Potential sample sources include leaf packs caught on woody debris and rocks and from roots extending out into the stream. A portion of the sample may be collected from the shore area and from backwater areas.

8.5.2.2 The material collected should fill approximately ½ of a #30 sieve bucket. Care should be taken to avoid collecting recently deposited or fully decomposed leaf litter. Maximum shredder abundance is obtained when the CPOM material is about 50% decomposed. Elutriate the material using the plastic tray and #30 sieve.

8.5.3 Rock/Log

8.5.3.1 Five to six rocks and/or logs and sticks are washed into a large bucket sieve partially filled with water. The surfaces are vigorously brushed or rubbed to dislodge all attached fauna.

8.5.3.2 Any decaying logs are picked apart, especially logs with loose bark, and rinsed.

8.5.3.3 Larger rocks and logs are visually inspected for any associated invertebrates and hand picked with forceps. Chunks of clay are also broken apart to collect the burrowing organisms.

8.5.3.4 The net and buckets are visually inspected and hand picked with forceps to ensure that all organisms have been retrieved.

8.5.4 Root/Bank

8.5.4.1 Three (3) different areas of cut bank with exposed roots (each about one meter in length) are sampled at each site. The areas sampled should reflect the variability in root/bank habitat by differing current regimes and location on bank.

8.5.4.2 Using an 'A' frame net, the rootbank is physically disturbed and swept in an upstream motion. The captured material is rinsed well in the net to remove fine silt.

8.5.4.3 Large pieces of plant material are rinsed, visually inspected to remove attached organisms, and discarded.

8.5.5 Macrophyte Beds

8.5.5.1 Three one meter (1m) areas on the macrophyte bed are physically disturbed. They are then sampled using a sweeping motion with an 'A' frame net.

8.5.6 Sand/Bottom

8.5.6.1 If sand substrate is present, three areas are sampled. The areas sampled should be 1m long and in differing flow regimes.

8.5.6.2 Samples are collected using an 'A' frame net. It is shuffled along the bottom with a shaky, scooping action approximately two to three centimeters (2-3 cm) below the surface of the sand.

8.6 <u>Sample Labeling</u>

8.6.1 Each sample container returned to the lab should be appropriately labeled. Each sample container is pre-taped. When a container is used, it will be labeled with the following information:

- Station designation (AAAABBBB-YYMMDD, where A and B correspond to the pre-assigned station name and number and YYMMDD corresponds to the year (YY), month (MM), and day (DD) that the sample was collected),
- Sampling method – WMB-I
- Habitat type (i.e., riffle, R/B, R/L, CPOM, Sand, Macro)
- Collectors' name(s)/initial(s) (Circle the name/initials of the primary collector of the habitat)

- Collection time (optional)

8.7 Chain of Custody

8.7.1 Chain of custody of samples is maintained according to SOP #9040 and using the appropriate Chain-of-Custody form.

8.7.2 All members of the field crew are personally responsible for the care and custody of the samples collected until they are properly transferred to another person or facility.

8.7.3 After samples have been properly relinquished to the macroinvertebrate laboratory, the chain-of-custody sheets are stored in ADEM's *Macroinvertebrate Sample Log Binder* until all macroinvertebrate samples have been collected. The sheets should be kept in alphabetical order by station. These sheets are then bound into one document that serves as ADEM's annual sample logbook.

9 QUALITY CONTROL & QUALITY ASSURANCE

9.1 Quality Assurance Samples

9.1.1 Duplicate Multi-Crew Field Collections

Duplicate field collections will be performed once per year by separate field crews to "recalibrate" field personnel.

9.1.2 Replicate Field Collections

9.1.2.1 Duplicate field collections will be performed at 10% of the sites sampled in order to document reproducibility of the bioassessment technique at the site.

9.1.2.2 Each team leader should conduct duplicate field collections at approximately 10% of the sites they sample.

9.1.2.3 Duplicate field collections require two comparable stream reaches. The team leader should evaluate the appropriateness of a location for collection of duplicate samples during site reconnaissance, and collection of duplicate samples at these locations should be planned during the sampling season.

9.1.2.4 The location of the duplicate reach in reference to the primary reach should be specified.

- The duplicate reach should be as similar as possible to the primary reach.
- The duplicate reach may be located upstream of the primary reach; or, if the reach is very wide, it can be located along the opposite bank.
- If there is ample habitat, the duplicate sample can be collected within the primary reach, taking care not to sample the same location twice.

9.2 Method Precision

9.2.1 Comparison of WMB-I scores from duplicate samples should result in method precision of $\geq$95%.

9.2.2 If method precision is $\leq$85%, an evaluation will be made as to the cause of the discrepancy. Additional training and/or adjustments in equipment or methods used may be initiated.

After procedural corrections have been implemented, another QA sampling event will take place.

9.2.3 All results will be filed with the QC Coordinator annually to calculate and report the method precision obtained by each macroinvertebrate team leader.

10 Troubleshooting

10.1 Inspect all nets for tears before sampling.

11 Data Acquisition, Calculations, & Data Reduction Requirements

12 Data and Records Management

12.1 All samples collected must be fully identified and chain-of-custody maintained. See SOP #9040.

12.2 All sample collection activities shall be traceable, through field records or notes, to the person/crew collecting the sample. All maintenance and calibration records for sampling equipment shall be kept so that they are similarly traceable.

12.3 All records are retained as described in the Departmental Records Retention Policy.

13 Reference

ADEM. 2017 (as amended). Standard Operating Procedures #2040 Stream Flow Measurement by ADEM Abbreviated Stream Velocity Measurement Method. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (as amended). Standard Operating Procedures #2041 *In-Situ* Surface Water Quality Field Measurements: Temperature. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (as amended). Standard Operating Procedures #2042 *In-Situ* Surface Water Quality Field Measurements: pH. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (as amended). Standard Operating Procedures #2043 *In-Situ* Surface Water Quality Field Measurements: Conductivity. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2014 (as amended). Standard Operating Procedures #2044 Surface Water Quality Field Measurements: Turbidity. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (as amended). Standard Operating Procedures #2045 *In-Situ* Surface Water Quality Field Measurements: Dissolved Oxygen. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2018 (as amended). Standard Operating Procedures #2061 General Surface Water Sample Collection. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2012 (as amended). Standard Operating Procedures #2062 Dissolved Reactive Phosphorus (DRP) Surface Water Sample Collection and Processing. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2016 (as amended). Standard Operating Procedures #2063 Chlorophyll *a* Surface Water Sample Collection and Processing. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (as amended). Standard Operating Procedures #2064 Surface Water Sample Collection Fecal Coliform, Enterococcus, & E. coli. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2007 (as amended). Standard Operating Procedures #2065 Sediment Sample Collection. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2012 (as amended). Standard Operating Procedures #2066 Dissolved Metals Sample Collection and Processing. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2015 (as amended). Standard Operating Procedures #6300 Surface Water Quality Physical Characterization and Reach Selection. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2013 (as amended). Standard Operating Procedures #6301 Wadeable Stream Habitat Assessment. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (as amended). Standard Operating Procedures #9021 Field Quality Control: Measurements and Samples. Alabama Department of Environmental Management, Montgomery (ADEM), AL.

ADEM. 2017 (as amended). Standard Operating Procedures #9040 Station, Sample Identification and Chain of Custody Procedures. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

14 CHANGE TRACKING

Rev. Date (Review Date) Rev. #	Approved By:	Detail of Approved Change
04/02/2007 Rev. 0	L. Huff	Original Version
04/01/08 Rev 1.0	L. Huff	Annual Review. Updated equipment and supplies to include plastic elutriation trays. Deleted 8.2.1 as it was a duplicate of 8.3.
03/11/10 Rev. 2.0	S. Kumar	Periodic Review. Made non-critical grammatical and formatting changes. Modified the following sections: 7-added equipment; and 8.5.2.2-added last sentence.
03/11/10 (1/30/12) Rev. 2.0	A. Phillips	Periodic Review—No changes
03/11/10 (01/21/14) Rev. 2.0	H. Cox	Periodic Review—No changes
03/11/10 (01/13/16) Rev. 2.0	H. Cox	Periodic Review—No changes
03/11/10 (01/09/18) Rev. 2.0	B. Diggs	Periodic Review—No changes

AQUATIC MACROINVERTEBRATE COMMUNITY
WADEABLE MULTI-HABITAT BIOASSESSMENT

-SAMPLE PROCESSING-

SOP #6001

Rev. 5.0

VERSION DATE – 06/30/16

PREPARED BY:		**DATE**	06/30/2016
REVIEWED BY:	**Branch or Division Chief**	**DATE**	06/30/16
APPROVED BY:	**Quality Assurance Manager**	**DATE**	6/30/2016

Alabama Department of Environmental Management

1400 Coliseum Blvd Montgomery, AL	1350 Coliseum Blvd Montgomery, AL	2715 Sandlin Rd Decatur, AL	110 Vulcan Rd Birmingham, AL	2204 Perimeter Rd Mobile, AL

TABLE OF CONTENTS

PREFACE

This Standard Operating Procedures (SOP) Manual supersedes all Departmental SOPs relating to the methods addressed and is designed to be periodically reviewed and updated. The primary purpose of this document is to establish and maintain uniform operational and quality control guidance. Compliance with these procedures is essential to produce reliable data. Any deviation from this SOP must be documented and approved by the program/project QA coordinator and/or program/project supervisor.

DISCLAIMER

This document has been prepared for use by the staff of the Alabama Department of Environmental Management (ADEM). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. No portion of this manual is intended to supersede any Departmental policy memorandum issued by the Director or Deputy Director.

NOTE

Any alpha suffix added to the version date indicates the incorporation of corrections for non-critical typographic errors or formatting, i.e., no methodology changes were incorporated.

AQUATIC MACROINVERTEBRATE COMMUNITY WADEABLE MULTI-HABITAT BIOASSESSMENT—SAMPLE PROCESSING

1 SCOPE AND APPLICATION

This method describes the aquatic macroinvertebrate sample processing procedures for ADEM's wadeable multi-habitat bioassessment (WMB-I) protocol (ADEM SOP # 6000).

2 SUMMARY OF METHOD

2.1 This method describes the processing and sorting of habitat samples for a macroinvertebrate community bioassessment.

2.1.1 Sorting of the organisms includes estimating a general count of the organisms in the sample.

- If the count is believed to be $\leq$ 100 individuals, the picker processes 100% of the sample.
- If it is estimated that the sample contains more than 100 individuals, the sample is subsampled.

3 DEFINITIONS

3.1 Split Sample: A sample where the random subsample is conducted on only ½ or ¼ of the total sample.

3.2 Split Factor: Information recorded on the *Macroinvertebrate Chain-of-Custody and Sample Logsheets* (*Sample Logsheet*) which indicates how a sample was divided. The split factor for a normally processed sample is "1". If ½ of the sample is processed, the split factor is "2"; if ¼ is processed, the split factor is "4".

3.3 5′ Pick: A sorting process used to collect any large and/or rare organisms that were not picked during a random subsample.

3.4 EPT: Invertebrates that are classified in the families of Ephemeroptera, Plecoptera, and/or Trichoptera.

3.5 HA/PC: Habitat Assessment/Physical Characterization sheet. Field personnel complete this sheet during sample collection.

3.6 Chiros: A term used by sample processors to describe insects belonging to the family Chironomidae.

3.7 Non-Chiros: A term used by sample processors to describe all organisms that do not belong to the family Chironomidae.

4 HEALTH & SAFETY WARNINGS

General laboratory health and safety warnings apply.

5 INTERFERENCES

N/A

6 PERSONNEL QUALIFICATIONS

6.1 No employee shall conduct this technique until he/she has actual laboratory experience and has successfully demonstrated the ability of conducting this technique under the supervision of a senior staff member.

6.2 All professional and paraprofessional Departmental employees shall have laboratory experience before they are permitted to conduct any sample processing efforts on their own. This experience shall be gained by on-the-job training utilizing the "buddy" system.

6.3 During this training period, the new employee will be permitted to perform all facets of sample processing, including sample picking, under the direction and supervision of senior technical staff members.

7 EQUIPMENT AND SUPPLIES

Sample Containers	Pencil	Squirt Bottle
#30 Mesh Sieve	Glass Vials	100% Denatured Ethanol
Forceps	Vial Labels	Adjustable Fluorescent Light
Elutriating Pan	Laboratory Counter	Random HS Generator
30-Square Picking Pan		Laboratory Processing Tally Sheet (FOD I-Form 27)

8 EQUIPMENT SELECTION

N/A

9 SAMPLE HANDLING

9.1 Samples are collected using the methods set forth in SOP #6000, Aquatic Macroinvertebrate Community Wadeable Multi-habitat Bioassessment—Sample Collection.

9.2 Logging in Samples

9.2.1 Place samples to be processed on the appropriate labeled laboratory shelf. Change alcohol for these samples 2-3 days after the samples are returned to the laboratory.

9.2.2 After samples have been properly relinquished to the macroinvertebrate laboratory, the *Macroinvertebrate Chain-of-Custody and Sample Logsheets* (*Sample Logsheet*) are stored alphabetically by station in ADEM's *Macroinvertebrate Sample Log Binder* until all macroinvertebrate samples for the year have been collected. The sheets are then bound into one document that serves as ADEM's annual sample logbook.

9.2.3 Begin completing the "Processing Information" section of the *Sample Logsheets*.

9.2.4 Locate the individual station file folder for each logged-in sample. It should contain the following applicable forms:

- General Genus-Level Bench Sheet (FOD I - Form 21)
- Chironomidae Genus-Level Bench Sheet (FOD I - Form 22)

9.2.5 Unless otherwise requested by the study leader add the following forms and data to the file:

- Completed HA/PC form in the file making sure that the field parameter and flow measurements have been entered
- Flow Tracker datasheets
- Data sonde results
- Data sonde calibration report
- Copy of turbidity meter calibration check

9.2.6 Place each completed station file folder in the *In-Processed Stations* accordion file indicating that the samples are ready for picking or identification.

9.3 <u>Sample Processing</u>

9.3.1 Process all samples separately.

9.3.2 Use best professional judgment (for a biologist experienced in macroinvertebrate sample processing) on any deviations experienced in sample processing. Then document those deviations and their corresponding decisions on the S*ample Logsheet*.

9.3.3 Approximately two days after the samples are collected and preserved, for any samples containing large amounts of organic debris, decant the collection ethanol through a #30 sieve. Replace the decanted ethanol with ninety percent (90%) denatured ethanol to help prevent decay of the more fragile soft-bodied organisms.

9.3.3.1 Inspect the sieve for organisms that might have been fallen from the sample during the decanting process and return them to the sample.

9.3.3.2 Initial and date the sample label once the alcohol has been replaced.

9.4 <u>General Sample-Sort Preparation Procedures</u>

9.4.1 Select a WMB-I habitat sample jar from the shelf.

9.4.2 Find the Station File Folder in either the *Picking in Progress* tray, the *In-Processed Stations* accordion file (if picking for that station has not been started), or in the *IDs in Progress* Tray.

9.4.3 Thoroughly rinse the sample with water in a #30 mesh sieve to remove preservative. A stir and pour elutriation technique is used in conjunction with the sieve and elutriating pan to remove inorganic material.

9.4.3.1 After rinsing, visually inspect the inorganic material for any remaining large organisms or shells added to the main sample.

9.4.3.2 Rinse, visually inspect, and discard any large organic material (whole leaves, twigs, algal or macrophyte mats) not removed in the field.

9.4.3.3 Have a second experienced sample processor check the inorganic material before disposing into the waste bucket in the laboratory.

9.4.4 Soak the sample contents in water for about 15 minutes to hydrate the benthic organisms and prevent them from floating on the water surface during sorting.

9.4.5 Place the sample contents in a white, 8 x 10 x 2-inch pan that has the interior bottom marked with a numbered grid pattern (one to thirty) with each grid measuring 4 x 4 cm.

9.4.6 Add enough water to allow complete dispersion of the sample within the pan(s). (Refer to Section 9.4.11 for large samples.) Avoid an excessive amount of water as it will allow sample material to shift between squares during sorting.

9.4.7 Distribute sample material evenly between the squares. Use an adjustable fluorescent light and/or fiber optic light over the pan for lighting during sorting.

9.4.8 Prepare two or three glass vials to receive the sorted organisms.

9.4.8.1 Fill each vial with ninety percent (90%) denatured ethanol.

9.4.8.2 Place a label in each vial. The label should include:

- FRONT: Station designation, collector initials, date of collection, habitat type, and 100% Pick, if applicable.
- BACK: Initials of person processing, date of processing, and "Chiros", "Non-Chiros", or "5′ Pick".

9.4.9 A sample is 100% processed if it contains ≤ 100 organisms. If it is estimated that more than one hundred (100) organisms will be picked from the pan (> 4 organisms per square), the sample should be subsampled (Section 9.6).

9.4.10 If organisms are extremely abundant in a sample (≥ 100 organisms counted in 1 square), a *split sample* can be conducted to cut down on the time spent processing and identifying the sample (Section 9.6.3).

9.4.11 Samples that are too large to be effectively sorted in a single pan may be thoroughly mixed in a container with some water, and half of the homogenized sample placed in each of two gridded pans.

9.4.11.1 Sort the same squares from each pan in order to ensure a representative subsample (i.e., if square #6 is picked in pan A, then square #6 is also picked from pan B).

9.4.11.2 For the purposes of calculation, if 12 squares are picked from each pan, the number of squares picked is 12, not 24.

9.4.11.3 Count an organism in the square in which its head lies. Empty shells, cases, and portions of organisms that do not include the head are not counted in the subsample. They may be included in the subsample to aid with identification.

9.5 Picking the organisms

9.5.1 Use forceps to pick the organisms from the sample and place them into the proper vial. Place Chironomidae in the "chiro" vial and all other organisms in the "Non-Chiro" vial.

9.5.2 Use a laboratory counter to track the number of organisms picked. Count Chironomidae and "Non-Chiro" separately.

9.5.3 Once finished picking, have another person experienced with the technique (i.e., a QCer) re-check the sample removing and counting any organisms that may have been missed and placing them in the appropriate sample vial.

9.5.4 Ensure that the QCer initials and dates the appropriate spaces on the *Sample Logsheet* in the "Processing Information" section.

9.5.5 Discard the remaining matter from the pan into the proper waste bucket and clean the pan in preparation for processing of another sample.

9.6 Subsampling Procedures

9.6.1 Subsampling is divided into two parts: A) a random subsample (Section 9.6.2), or split sample (if necessary, Section 9.6.3) and B) a 5′ Pick, i.e., five-minute pick (Section 9.5.4).

9.6.2 Random Subsample

9.6.2.1 Evenly distribute the organisms over the grids using forceps.

9.6.2.2 Take care not to disturb the sample once the random subsample process has begun.

9.6.2.3 The total of Chironomidae and non-chiros should be ≥ 100. Do not include organisms picked during the 5′ Pick in this count.

9.6.2.4 Completely pick randomly numbered squares (numbers are generated using numbered chips drawn from a cup) until at least one hundred (100) organisms have been counted OR a minimum of 5 squares have been picked. Always finish any square started.

9.6.2.5 If ≥ 100 organisms have been counted after picking one square, pour the organisms back into the sample, and follow the procedures for a split sample (Section 9.6.3).

9.6.2.6 Count an organism in the square in which its head lies. For organisms without an identifiable head-end, consider the organism to be in the square containing the largest portion of its body.

9.6.3 Split Sample

9.6.3.1 Use sample splitting in situations where a particular organism is so abundant that picking of the sample is extremely difficult.

9.6.3.2 Use sample splitting if there are ≥ 100 organisms in one square.

9.6.3.3 Spread the entire sample as evenly as possible in a #30 mesh sieve or in a white pan without water.

9.6.3.4 Using fingers, forceps, and a squirt bottle, remove ½ of the sample and place it in a gridded white pan for random sampling or further splitting.

9.6.3.5 Process the sample and record the split factor (as defined in Section 3.2) on the *Sample Logsheet* in the "Processing Information Section".

9.6.4 5' Pick

9.6.4.1 Conduct this procedure after the random subsample (Section 9.6.2) or split sample (Section 9.6.3) is completed.

9.6.4.2 Place any large and/or rare (< 15 count) organisms **that were not picked** during the random subsampling in a sample vial for later identification.

9.6.4.3 Fill a vial with ninety percent (90%) denatured ethanol and label it with the following information:

- Front: Station designation, collector initials, date of collection, and habitat type.
- Back: Initials of person processing, date of processing, and "5' Pick".

9.6.4.4 Visually inspect the sample for large and/or rare organisms. Place these organisms into the proper vial.

9.7 Documenting Sample Processing

9.7.1 Initial and date the appropriate space in the *Sample Logsheets* and indicate whether a 5' pick was conducted or the sample was split or subsampled.

9.7.2 Complete the *Processing Information* section of the *Sample Logsheet*s and include the following:

- number of squares subsampled
- number of "non-chiros" and "chiros" picked from the subsample
- number of vials containing the "non-chiros", "chiros", and "5' Pick".

9.7.3 Place vials ready for identification into the appropriate pre-labeled box on the "Stations to be IDed" shelf.

9.7.4 Place the station folder in the *Samples Ready for ID* tray if all of the habitats for that sample have been processed; or if habitat samples remain to be picked, in the *Picking in Progress* tray.

10 TROUBLESHOOTING

If sample processing is done as directed, the "non-chiros" sample vial should contain less than or equal to 250 organisms. If such vial contains greater than 250 organisms, the ID personnel may perform another sub sample to reduce the number of IDs, which must be performed, closer to 100. Any randomly chosen square must be completely picked and numbers recorded in the log book (i.e., Final number of "non-chiros", 11 of 30 squares sub-sampled by "ID personnel initials" and "date").

11 DATA ACQUISITION, CALCULATION, & DATA REDUCTION REQUIREMENTS

N/A

12 DATA AND RECORDS MANAGEMENT

12.1 All samples shall be fully identified and sample chain-of-custody maintained for all samples processed (SOP #9040, Station, Sample Identification and Chain-of-Custody Procedures) using the ADEM Macroinvertebrate Chain-of-Custody and *Sample Logsheet* generated by the Macroinvertebrate ALAWADR database.

12.2 All sample processing activities shall be traceable through laboratory *Sample Logsheets* to the person(s) processing the sample(s).

12.3 All records will be archived according to the Department's records retention policy.

13 QUALITY CONTROL & QUALITY ASSURANCE

13.1 Two types of quality assurance are conducted to confirm that a minimum 90% picking efficiency and 90% subsampling accuracy for WMB-I samples are maintained by all personnel.

- To satisfactorily complete sample processing training requirements, the sample processor must maintain an average percent comparability for QC'd WMB-I samples of $\geq$ 90%.
- If this level of comparability cannot be met, the processor will go through an intensive training period. During this time, the processor is re-instructed on processing techniques by a senior sampling processor.

13.2 Picking Efficiency

13.2.1 The picking efficiency should be $\geq$ 0.9 (or 90%) to meet picking efficiency standards.

13.2.2 After the sample has been re-checked (Section 9.5.3), compare the number of organisms picked before and after the QC using the following equation:

$$\% \text{ efficiency} = \frac{\text{Total \# organisms - \# QC organisms}}{\text{Total \# organisms}} \times 100$$

13.2.3 Provide all picking efficiency results to the QA coordinator who utilizes them to monitor performance characteristics of the WMB-I method and to ensure that all personnel are processing samples accurately and consistently. The QA coordinator reports these results annually.

13.3 Subsampling Accuracy

13.3.1 As an annual measure of subsampling accuracy (representative of the sample as a whole), perform a 100% pick on 5% of all laboratory subsamples for the year after subsampling is complete.

13.3.2 Use a *Laboratory Processing Tally Sheet* (FOD I-Form 27, Appendix) to determine whether a 100% pick needs to be conducted.

13.3.2.1 Each time a sample is subsampled, record the sample on the *Tally Sheet*.

13.3.2.2 100% pick every 20th sample.

13.3.3 On the *Sample Logsheets*, check "yes" by "Is there a 100% pick after subsample?" Indicate the sample type (habitat) that was 100% picked.

13.3.4 Ensure that the same person(s) who picked the subsample conducts the 100% pick.

13.3.5 Calculate subsampling accuracy as the percent similarity (PS) of 'Composition of Taxa Groups – Percent Organisms'. To calculate PS, the number of organisms in each taxa group is converted into a percent for Sample A and Sample B. Sample A is the percentage of organisms picked from the original subsample (e.g., 5 squares of the pan), and Sample B consists of the percentage of organisms found in the remainder of pan. Percent Similarity is obtained by summing the minimum percent of each taxa group the two samples have in common (see example below).

	% Sample A	% Sample B	Minimum %
Mayfly	15	10	10
Stonefly	5	10	5
Caddisfly	50	40	40
Percent Similarity			55

13.3.6 Enter the 100% pick sample into the database as: XXXX-###z, where XXXX is Alpha portion of the station ID, the ### is numeric portion of the station ID, and z is suffix to identify the dataset as a generated from a 100% pick.

13.3.7 Using the metric report generated by the Macroinvertebrate ACCESS Database, calculate the Composition of Taxa Groups – Percent Organisms for both the subsample and 100% pick datasets.

13.3.8 Percent similarity between the expanded subsample and the 100% pick (subsample organisms + 100% pick organisms) should be $\geq$ 90%.

13.3.9 File all results with the QA coordinator who must then calculate and report QA results for all personnel.

13.4 Archiving Samples

13.4.1 All samples will be kept in the Macroinvertebrate Lab Sample Archive for a total of 5 years at which time the samples may be disposed of or donated to an interested school or laboratory.

14 References

ADEM. 2010 (as amended). Standard Operating Procedures #6000 Aquatic Macroinvertebrate Community Wadeable Multi-habitat Bioassessment—Sample Collection. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2018 (as amended). Standard Operating Procedures #9021 Field Quality Control: Measurements and Samples. Alabama Department of Environmental Management (ADEM), Montgomery, AL

ADEM. 2017 (as amended). Standard Operating Procedures #9040 Station, Sample Identification and Chain of Custody Procedures. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

15 APPENDIX

ADEM-FIELD OPERATIONS-AQUATIC ASSESSMENT UNIT
Laboratory Processing Tally Sheet

Used to determine whether an MB-I subsample should also be 100% picked

Enter all stations / Habitats subsampled Year: 20__

	Station Number	Habitat	100% Pick?
1			No
2			No
3			No
4			No
5			No
6			No
7			No
8			No
9			No
10			No
11			No
12			No
13			No
14			No
15			No
16			No
17			No
18			No
19			No
20			100 % Pick
21			No
22			No
23			No
24			No
25			No
26			No
27			No
28			No
29			No
30			No
31			No
32			No
33			No
34			No
35			No
36			No
37			No
38			No
39			No
40			100 % Pick

FOD I-Form 27 (Rev 04/03/07)

16 CHANGE TRACKING

Rev. Date (Review Date) Rev. #	Approved By:	Detail of Approved Change
06/13/07 Rev. 0	L. Huff	Original Version
06/09/08 Rev. 1.0	L. Huff	Annual review—added verbiage in Sec. 10 to indicate when samples should be split.
05/25/10 Rev. 2.0	L. Huff	Annual Review. Made non-critical formatting and grammatical changes. Modified Sec 9.4.9 to clarify subsampling numbers. Deleted Sec 9.6.3.3 as it conflicted with another section.
06/25/12 Rev. 3.0	L. Huff	Periodic review. Made non-critical formatting and grammatical changes. Modified Sec 12.1 to ALAWADR database.
06/06/14 Rev. 4.0	A. Phillips	Periodic review. Made non-critical formatting and grammatical changes. Deleted section 3.6. Added sections 3.6 and 3.7. Modified the following sections: 9.2.4; 9.2.5; 9.4.3; and 9.4.8.2.
06/30/16 Rev. 5.0	S. Kumar	Periodic review. Made grammatical changes. Replaced "others" by "non-chiros" in the text wherever necessary as it has changed in ALAWADR.
06/30/16 (06/19/18) Rev. 5.0	S. Kumar	Periodic review—no changes.

AQUATIC MACROINVERTEBRATE COMMUNITY
WADEABLE MULTI-HABITAT BIOASSESSMENT

ORGANISM IDENTIFICATION

SOP #6002

Rev. 4.0

VERSION DATE – 10/06/17

PREPARED BY:	Sreelatha Kumar	**DATE**	10/06/2017
REVIEWED BY:	**Branch or Division Chief**	**DATE**	10/10/17
APPROVED BY:	**Quality Assurance Manager**	**DATE**	10/6/2017

Alabama Department of Environmental Management

1400 Coliseum Blvd, Montgomery, AL | 1350 Coliseum Blvd, Montgomery, AL | 2715 Sandlin Rd, Decatur, AL | 110 Vulcan Rd, Birmingham, AL | 2204 Perimeter Rd, Mobile, AL

TABLE OF CONTENTS

PREFACE

This Standard Operating Procedures (SOP) Manual supersedes all Departmental SOPs relating to the methods addressed and is designed to be periodically reviewed and updated. The primary purpose of this document is to establish and maintain uniform operational and quality control guidance. The compliance with these procedures is essential to produce reliable data. Any deviation from this SOP must be documented and approved by the program/project QA/QC Coordinator and/or program/project supervisor.

DISCLAIMER

This document has been prepared for use by the staff of the Alabama Department of Environmental Management (ADEM). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. No portion of this manual is intended to supersede any Departmental policy memorandum issued by the Director or Deputy Director.

NOTE

Any alpha suffix added to the version date indicates the incorporation of corrections for non-critical typographic errors or formatting, i.e., no methodology changes were incorporated.

AQUATIC MACROINVERTEBRATE COMMUNITY WADEABLE MULTIHABITAT BIOASSESSMENT ORGANISM IDENTIFICATION

1 SCOPE AND APPLICATION

1.1 This method describes the aquatic macroinvertebrate identification procedures for ADEM's wadeable multi-habitat bioassessment (WMB-I) protocol.

2 SUMMARY OF METHOD

2.1 This method describes the identification of individual samples collected as part of a macroinvertebrate bioassessment of wadeable streams.

3 DEFINITIONS

N/A

4 HEALTH & SAFETY WARNINGS

4.1 General field health and safety warnings apply.

5 INTERFERENCES

N/A

6 PERSONNEL QUALIFICATIONS

6.1 No employee shall conduct this technique until he/she has actual laboratory experience and has successfully demonstrated the ability of conducting this technique under the supervision of a senior staff member.

6.2 All professional and paraprofessional Departmental employees shall have laboratory experience before they are permitted to conduct any sample processing efforts on their own. This experience shall be gained by on-the-job training utilizing the "buddy" system.

6.3 During this training period, the new employee will be permitted to perform all facets of sample processing, including sample picking, under the direction and supervision of senior technical staff members.

7 EQUIPMENT AND SUPPLIES

Sample Vials	Macroinvertebrate Keys (Appendix F)
Dissecting Microscope	Pencil
Fiber Optic Lights	Bench Sheets
Chironomidae Slide Identification Bench Sheet (FOD I –Form 20)	*Chironomidae Compilation Worksheet* (FOD I - Form 25)
**Chironomidae Bench Sheet* (FOD I - Form 22)	*Internal QA of Taxonomy Datasheet* (FOD I – Forms 18 & 19).
**Genus-Level Bench Sheet (FOD I – Form 21)*	*Macroinvertebrate Chain-of-Custody and Sample Logsheets (Sample Logsheet)*
Focerps	Petri dishes
Reagent alcohol	

*Forms 21 & 22 are found on the AAU Server.

8 Organism Identification—General

8.1 Most organisms are identified to genus level (or lowest possible level).

8.1.1 There are some exceptions where genus-level identifications are currently not practical for the ADEM Macroinvertebrate Laboratory.

8.1.2 Some genera contain multiple species that exhibit a wide range in pollution tolerance. These genera are identified to the species level for the purposes of calculating the NCBI.

8.2 The Chironomidae are usually the most abundant macroinvertebrate family in both numbers of taxa and individuals encountered in the majority of aquatic habitats.

8.2.1 Because of their size and similarity to some other Dipteran larvae, some Chironomids ("chiro") and "other" macroinvertebrates are easily misidentified during sample sorting.

8.2.2 The "other" and "chiro" vials should be checked and any necessary corrections made by the taxonomist identifying the "others".

9 Organism Identification—Chironomidae

9.1 Any samples containing more than 30 chironomids will be subsampled by either the Non-grouping or Grouping method.

9.2 The number to be subsampled is recorded on the *Macroinvertebrate Chain-of-Custody and Sample Logsheets* (*Sample Logsheet*) as "Chiros Subsamp" under the appropriate habitat.

9.3 The initials of the subsampler and date are also recorded on the *Sample Logsheet*.

Non-grouping Subsampling Method

9.3.1 This is a random subsample of the chironomids picked from each sample type (either 100% pick or subsampled).

9.3.2 This method requires no grouping or subfamily-level identification.

9.3.3 A minimum of 30 organisms or ten percent of the total number of organisms, whichever is greater, will be identified. Any deviations from these criteria are based on best professional judgment of an experienced taxonomist.

9.3.4 Calculating the number to be subsampled

- Project the number of chironomids in the whole unpicked sample by determining the ratio of the total number of squares in the pan to the number of squares picked.
- Multiply this number with the number of chironomids in the random subsample.
- Multiply this number by 10%. Subsample this number or 30 organisms, whichever value is greater. If this number is ≥60, conduct 2 separate 30-organism subsamples.
- Enter this value on the *Sample Logsheet* under "Chiro Subsamp".

  Example:

  89 chironomids picked from 6 squares of 30 total squares

  (30÷6)*89=445

  0.10*445=45

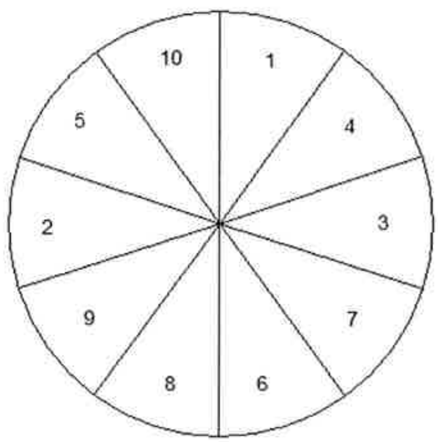
  45 is greater than 30; therefore 45 organisms are subsampled

- This figure is the estimated number of chironomids that will be slide mounted for identification. The number of slides needed to mount the entire chironomid sample should also be estimated and recorded on the *Sample Logsheet.*

9.3.5 *Subsampling*

- The chironomid sample to be subsampled is placed in a Petri dish divided into ten equal sized pie shapes.
- Using forceps, equally distribute the chironomids over the bottom of the dish.
- The organisms are subsampled starting at the center of the Petri dish and proceeding outward, picking any organism whose head is within the pie shape and counting until you reach 30 or the calculated number to be subsampled.
- Proceed from quadrant to quadrant in the following randomly generated order: 1, 8, 2, 3, 9, 5, 4, 6, 7, 10. If the Petri dish has already been randomly numbered, then proceed in from 1 to 10 in numerical order.

Figure 1. Petri Dish with Randomly numbered quadrants.



Grouping Method

9.3.6 Similar chironomid specimens are grouped together. Several of each group are then mounted as a representative specimen.

9.3.7 Many chironomids can be sorted to genus while still in fluid preservative. The characters used to do this are as follows:

- Shape of head capsule
- Color or markings of head capsule—look for stripes, spots, bars, or a darkened posterior margin of the head capsule
- Color of body—best seen in live or fresh specimens; some larvae may be white, cream, red, green, blue, or even purple
- General body appearance—look for length, density, and placement of body setae, and body shape (curved or the head distinctly bent)
- Tubules—presence, location, shape, and number of pairs
- Antennae—shape, length, presence of elongated base, ability to retract

- Size—although different taxa may differ in size, different instars of the same taxon will also differ in size

9.3.8 After the chironomids have been grouped, select several representative specimens from each group and mount them.

- A minimum of one organism and a maximum of 10% of the group should be mounted.
- Next to each representative specimen on the microscope slide, note the number of organisms that it represents. This will be the expansion factor for that particular identification.

Slide Labeling

9.3.9 Microscope slides are numbered by the type of study conducted.

- Arrange the *Sample Logsheets* for all WMB-I stations alphabetically by study type to estimate the number of slides that will be needed for each study type.
- The slide numbers increase from -001 for each study type.
- Label the slides using the following prefixes:

  Ambient Monitoring (Trends): T-XXX
  Special Studies: S-XXX
  Reference Reaches: R-XXX
  Quality Assurance: P-XXX (Sample Processing) or Q-XXX (Duplicate Sample)

- The slides should be labeled to include station designation and sample type.
- The last slide in each habitat is labeled "End" to signify that the next slide begins the organisms from a new habitat type.

Slide Identification Bench Sheets

9.3.10 The *Chironomidae Slide Identification Bench Sheet* (*Chiro Bench Sheet*) (FOD I – Form 20) that is used will depend on how many chironomids are mounted under a coverslip.

9.7.1.1 For most projects, two chironomids per coverslip is the most efficient method to use. (FOD I-Form 20)

9.3.11 The Chiro Bench Sheets must correspond with the slide numbers and labels.

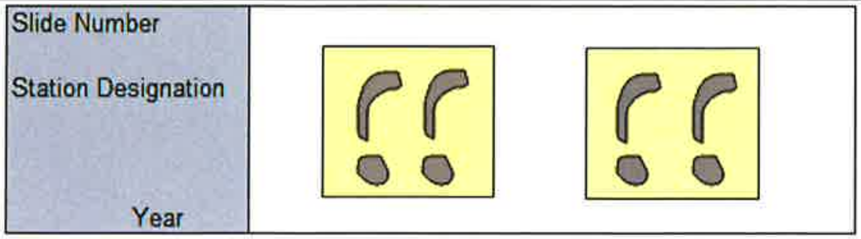
- Enter slide numbers and year on the top right corner of each *Chiro Bench Sheet.*
- Indicate the first slide for each sample by labeling with habitat type and station under the slide number.
- Indicate the last slide for each sample by labeling "End" or "Last".

Slide Mounting

9.3.12 Generally, four chironomids under two coverslips (2 per coverslip) are mounted on each slide.

9.3.13 For each coverslip, one drop of CMC-10 is placed on the slide (too much is better than too little).

9.3.14 Orient the head so that the ventral side is up and the mandibles are located toward the bottom of the slide.



9.8.3.1 The head can be removed from the body using a bevel needle. The body should be mounted next to the head.

9.3.15 Cover the heads and bodies with a plastic coverslip by gently placing one side of the coverslip down first, then releasing the slip to allow it to slowly settle over the larvae.

- Using forceps or the eraser end of a pencil, press the coverslip until the mandibles are opened, exposing the mentum.
- The S1 setae and pectin epipharyngis should also be visible. (This may require a good deal of pressure.)
- Orient the larvae by pushing or pressing on the coverslip.

9.3.16 Allow the slides to air dry in the slide (cardboard) boxes and clear for at least 24 hours before attempting identification.

9.3.17 Initial and date the *Sample Logsheet* under "Chiros Mounted".

Identification

9.3.18 Most chironomids are identified to genus level (or lowest possible level). However, depending on the objectives of the study and available resources, the chironomid genera that have multiple species exhibiting a wide range of pollution tolerance should be identified to species.

9.3.19 Use the abbreviations listed in the Classifications Table of the Macroinvertebrate ACCESS database to indicate the identified taxa on the *Chiro Bench Sheet*. This ensures that the identification entries will be correctly interpreted.

9.3.20 Initial and date the *Sample Logsheet* under "Chironomidae Identifications".

9.3.21 The identifications and numbers of organisms for each taxa identified are tallied on the *Chironomidae Compilation Worksheet* (Appendix A) and transferred to the *Chironomidae Bench Sheet* (FOD I – Form 22).

9.3.22 The identifications and numbers of organisms for each taxon are then entered into the Macroinvertebrate ALAWADR database.

10 Organism Identification—Non-Chironomid Organisms

10.1 For genera containing multiple species that exhibit a wide range in pollution tolerance, identification is carried to the species level.

10.1.1 If possible, the following genera should be identified to the species level: *Hydropsyche*, *Ephemerella*, *Stenonema*, *Acentrella*, and *Baetis*.

10.1.2 Appendix F summaries the primary taxonomic references for each taxon, the level to which each taxon should be identified, and the primary key for identification.

10.1.2.1 All taxonomists will use the same primary taxonomic key for each taxon to maintain consistence in identification and nomenclature.

10.2 Specimens are identified at to 80X magnification using a dissecting scope and fiber optic lights.

10.3 Select the first station from the "WMB-I samples to be ID'd" shelf. Find the corresponding station file folder in the "Picking Complete" tray or the "Others" to be ID'd tray.

10.3.1 The organisms will be identified on the *Genus-Level Bench Sheet (FOD I – Form 21).*

10.4 When the whole station is ID'd, place the completed benchsheets back in the Station File Folder, complete the File Tracking Sheet, and place the file in the *ID's Complete* tray.

10.5 Initial and date the sample on the station label and return the sample to the "WMB-I samples to be ID'd" shelf.

10.6 The taxonomist(s) must initial and date in appropriate spaces under Identification Information for that sample on the *Sample Logsheets*.

11 Archiving Samples

11.1 All samples are kept in the Macroinvertebrate Lab Sample Archive for a total of 5 years at which time the samples can be disposed of or donated to an interested school or laboratory.

12 Troubleshooting

N/A

13 Data Acquisition, Calculation, & Data Reduction Requirements

N/A

14 Data and Records Management

14.1 All samples shall be fully identified and sample chain-of-custody maintained for all samples processed (SOP #9040) using the ADEM Macroinvertebrate Chain-of-Custody and *Sample Logsheet* generated by the Macroinvertebrate ALAWADR database.

14.2 All sample processing activities shall be traceable through laboratory *Sample Logsheets* to the person(s) processing the sample(s).

14.3 All records will be archived according to the Department's records retention policy.

15 Quality Control & Quality Assurance

Training Taxonomists for WMB-I Sample Identifications

15.1.1 Taxonomists are considered to be in training until they have successfully completed two QC procedures.

- Each taxonomist, regardless of experience, will have every WMB-I sample verified by another taxonomist until they have satisfactorily completed initial taxonomic QC on a set of 5 samples (at least 5 samples with > 90% comparability).
- Once a taxonomist in training has satisfactorily completed his first QC, every 10^{th} sample will be verified by another taxonomist.

- To satisfactorily complete taxonomic training requirements, the taxonomist must maintain an average percent comparability for QC'd WMB-I samples of $\geq$ 90% for a minimum of 10 sets of QC samples (100 total samples identified).
- If this level of comparability cannot be met, the taxonomist will have every WMB-I sample verified by another taxonomist until they have satisfactorily completed a second round of initial taxonomic QC on a set of 5 samples (5 consecutive samples with > 90% comparability).
- A taxonomist will be required to complete a 2nd initial taxonomic QC of 5 samples if ANY QC comparison results in a comparability rating of $\leq$ 80%.

Continuing Taxonomic Quality Control Requirements

15.1.2 Once a taxonomist has successfully completed taxonomic training, 5% of the WMB-I samples ID'd are re-ID'd by a 2nd taxonomist to ensure that data quality requirements are consistently being met.

15.1.3 Samples to be QAed are randomly selected during or after completion of all IDs for a sampling season. The taxonomist must maintain an average percent similarity of $\geq$90% to be considered trained and experienced in WMB-I sample identification.

15.1.4 If average percent comparability is <90%, the taxonomist must successfully complete an initial taxonomic QC at the beginning of the next sampling season.

15.1.5 If any one QC comparison results in a comparability rating of $\leq$80%, 10 additional samples shall be randomly selected for QC. If average percent comparability is <90% OR any one QC comparison is $\leq$80%, the taxonomist will be considered to be in training. All of the WMB-I samples identified by that taxonomist will be re-identified by that taxonomist. These identifications will be QC'ed according to the procedures outlined in Section 15.1.1.

Taxonomic Quality Control Procedures

15.1.6 For the purposes of the WMB-I, comparability is defined as percent similarity between the primary and QC taxa lists of all non-chironomidae taxa.

15.1.7 Percent similarity is defined as the sum of the minimum percent contributed by each taxon.

15.1.8 QC identifications are recorded on a second bench sheet.

- Suspected identification errors and the % WMB-I ID Proficiency are recorded on the *Internal QA of Taxonomy Datasheet* (FOD I – Form 18) and noted on the *Sample Logsheet* "Identification Information" Section.
- Organisms that are incorrectly identified should be set aside in a separate vial for verification and training.

15.1.9 The taxonomist performing the QC will identify every organism in the sample, entering discrepancies in identifications on an *Internal QA of Taxonomy Datasheet* (FOD I – Form 18).

- Discrepancies are placed in separate vials for further review and discussion by the taxonomist and QAer.

15.1.10 Once verification is completed, both taxonomists will go over the *Internal QA of Taxonomy Datasheet*, as well as the vials with the organisms that were incorrectly identified.

- If an agreement cannot be reached after consultation with the reference collection, the specimen will be verified by another taxonomist in the laboratory (or, if possible, verified by an expert).
- Any agreed-upon changes will be made to the *Internal QA of Taxonomy Datasheet* and the QC bench sheets filed with the QC Officer.
- The QC bench sheets will be kept in the original file for entry into the Macroinvertebrate ALAWADR Database.

15.1.11 The taxonomist who verified the identifications must initial and date the *Sample Logsheet* in the "Identification Information" Section for that sample.

15.1.12 When the QC is complete, place the completed QC benchsheet back in the Station File Folder and place the File in the *Files Ready for DataBase Entry* tray.

16 Reference

ADEM 2017 (as amended). Standard Operating Procedures #9040 Station, Sample Identification and Chain of Custody Procedures. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

17 Appendix

Attachment A. Chironomidae Slide Identification Bench Sheet

ADEM-FIELD OPERATIONS-AQUATIC ASSESSMENT UNIT

Identified by:______________ Chironomidae Bench Sheet (Page 1 of 2) Slide # _______01 to _______50
Date Identified:______________ (4 chiros per slide) Year: 20____

1		14		27		40	
2		15		28		41	
3		16		29		42	
4		17		30		43	
5		18		31		44	
6		19		32		45	
7		20		33		46	
8		21		34		47	
9		22		35		48	
10		23		36		49	
11		24		37		50	
12		25		38			
13		26		39			

FOD I-Form 20 (Rev 4-3-07)

(Second page of this form contains spaces for slides 51-100)

Attachment B. Chironomidae Compilation data sheet.

ADEM-FIELD OPERATIONS-AQUATIC ASSESSMENT UNIT-----CHIRONOMIDAE COMPILATION

Station Number: *Date:*

	riffle	*rootbank*	*rocklog*	*cpom*	*sand*	
Ablabesmyia						
Brillia						
Chironomus						
Cladotanytarsus						
Corynoneura						
Cricotopus						
Cricotopus/Orthocl.						
Cryptochironomus						
Dicrotendipes						
Labrundinea						
Larsia						
Microtendipes						
Nanocladius						
Natarsia						
Nilothauma						
Paracladopelma						
Paralauterborniella						
Parametriocnemus						
Paratanytarsus						
Phaenopsectra						
Polypedilum						
Procladius						
Psectrocladius						
Pseudochironomus						
Rheocricotopus						
Rheotanytarsus						
Stempelinella						
Stenochironomus						
Stictochironomus						
Tanytarsus						
Thiene Grp						
Thienemaniella						
Tribelos						
Tvetnia						
Xylotopus						

FOD I-Form 25 (Rev 04/03/07)

Attachment C. Internal QA of Taxonomy for Non-Chironomidae

ADEM-FIELD OPERATIONS-AQUATIC ASSESSMENT UNIT
Internal QA of Taxonomy ---Non-Chironomidae

Station Number ______________
Identifier: ______________
QA'd By: ______________
Total Number of Taxa in Sample: ________

Taxa Incorrectly Identified		Corrected Taxa	
Name of Organism	Agreement X	Name of Organism	Agreement X
Total # of Taxa Incorrect			

Percent of Taxa ID'd Correctly = [(Total Taxa - Incorrect Taxa) / Total Taxa] *100

[(________ - ________) / ________] * 100 = ______ % Correctly Identified

Initials signify review by identifier being QA'd ☐

FOD I - Form 18 (Rev 3-3-07)

Attachment D. Internal QA of Taxonomy for Chironomidae

ADEM-FIELD OPERATIONS-AQUATIC ASSESSMENT UNIT
Internal QA of Taxonomy ---Chironomidae

Slide Box Number__________________
Identifier:
QA'd By: __________________
Total Number of Chironomidae Identified __________

Chironomidae Incorrectly Identified		Corrected Chironomidae	
Name of Organism	Agreement X	Name of Organism	Agreement X
Total # of Chironomide Incorrect			

Percent of Chironomidae ID'd Correctly = [(Total Org. - Incorrect Org) / Total Org.] *100

[(________ - ________) / ________] * 100 = ________ % Correctly Identified

Initials signify review by identifier being QA'd [ ]

FOD I - Form 19 (Rev 3-3-07)

Attachment E. Reference Collection Specimen Record

ADEM FIELD OPERATIONS-AQUATIC ASSESSMENT UNIT
REFERENCE COLLECTION SPECIMEN RECORD

Begin Month/Yr ____________

End Month/Yr ____________

Coll. D.B.	RL Bg	Order	Family	Genus	A/L	Identified Date	Identified By:	Verified Date	Verified By:	Station Number Locality	Sample Type & Method	# org. in lot	Collected Date	Collected By

FOD I-Form 26 (Rev 04/03/07)

Appendix F. Primary Taxonomic Keys by Taxon.

Taxon	***Level***	***Primary Key****
Ephemeroptera	Genus	Merritt & Cummins (2008) / Morse et al. 2017
Plecoptera	Genus	Stewart & Stark (2002) / Morse et al. 2017
Trichoptera	Genus	Merritt & Cummins (2008) / Morse et al. 2017
Amphipoda	Genus	Pennak (1992)
Decapoda	Family	Pennak (1992)
Isopoda	Genus	Pennak (1992)
Coleoptera	Genus	Merritt & Cummins (2008)
Diptera	Genus	Merritt & Cummins (2008)
Ceratopogonidae	Genus	Brigham et al. (1982)
Chironomidae	Genus	Epler (1995, 2001) /Wiederholm (1983)
Simuliidae	Genus	Adler et. al (2004)
Hemiptera	Genus	Merritt & Cummins (2008)
Megaloptera	Genus	Merritt & Cummins (2008)
Odonata	Genus	Merritt & Cummins (2008)
Corduliidae	Genus	Brigham et al. (1982) may be helpful
Libellulidae	Genus	Brigham et al. (1982) may be helpful
Gastropoda	Genus	Pennak (1992)
Pelecypoda	Genus	Pennak (1992)
Sphaeriidae	Family	Pennak (1992)
Hirudinea	Class	Pennak (1992)
Neuroptera	Genus	Merritt & Cummins (2008)
Lepidoptera	Genus	Merritt & Cummins (2008)
"Hydracarina"	group	Pennak (1992)
Ostracoda	Sub-Class	Pennak (1992)
Nematoda	Phylum	Pennak (1992)
Tricladida (Planaria)	Family	Pennak (1992)
Collembola	Class	Merritt & Cummins (2008)
Oligochaeta	Class	Pennak (1992)
Spongillidae	Family	Pennak (1992)
Cladocera	Order	Pennak (1992)
Nematomorpha	Phylum	Pennak (1992)

Taxonomic References*

Adler, P. H., Currie, D. C., and D. M Wood. 2004. The Black Flies (Simuliidae) of North America. Cornell University Press. 941 pp.

Berner, L. and M. L. Pescador. 1988. The Mayflies of Florida. Revised Edition. University Presses of Florida, Gainesville. 415 pp.

Brigham, A. R., W. U. Brigham, A. Gnilka. 1982. Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Ill., 800 pp.

Burch, J. B., 1982. Freshwater snails (Mollusca: Gastropoda) of North America. EPA-600/3-82-026. U.S. Government Printing Office, Washington, D.C. 294 pp.

Edmunds, George F., Jr., S. L. Jensen, and L. Berner. 1976. The mayflies of North and Central America. University of Minnesota Press, Minneapolis. 330 pp.

Epler, J. H., 1995. Identification Manual for the Larval Chironomidae (Diptera) of Florida (Revised Edition). Florida Department of Environmental Regulation, Central District, Orlando, FL. 319pp.

Epler, J.H., 2001. Identification Manual for the Larval Chironomidae (Diptera) of North and South Carolina.

Epler, J. H., 2010. Identification Manual for Water Beetles of Florida.

Epler, J.H., 2014. Identification Guide to the Larvae of the Tribe Tanytarsini (Diptera: Chironomidae) in Florida.

Harris, S. C. 1987. Aquatic Macroinvertebrates in the Warrior Coal Basin of Alabama. Geological Survey of Alabama, Bull. 127. 303 pp.

Heard, R. W. 1982. Guide to Common Tidal Marsh Invertebrates of the Northeastern Gulf of Mexico. Mississippi Alabama Sea Grant Consortium. MASGP-79-004. 82 pp.

Klemm, D. J. 1982. Leeches (Annelida: Hirudinea) of North America. EPA-600/3-82-025.

Merritt, T. W. and K. W. Cummins, 2008. An Introduction to the Aquatic Insects of North America. Fourth Edition. Kendall/Hunt Publ. Co., Dubuque, IA.. 1158 pp.

Morse, J. C., McCafferty, W. P., Stark, B. P., and Jacobus, L. M. (editors), 2017. Larvae of the Southeastern USA Mayfly, Stonefly, and Caddisfly Species (Ephemeroptera, Plecoptera, and Trichoptera).Needham, J. G. and M. J. Westfall, Jr. 1955. A Manual of the Dragonflies of North America (Anisoptera). Univ. California Press, Berkeley. 615 pp.

Pennak, R.W. 1989. Fresh-Water Invertebrates of the United States: Protozoa to Mollusca, Third Edition. John Wiley & Sons, Inc. New York, NY. 628pp.

Pescador, M. L. and A.R. Barton. 2004. Guide to the Mayfly (Ephemeroptera) Nymphs of Florida. Florida DEP. Div. of Water Resource Management. Tallahassee. 115 pp.

Richardson, J. S. 2003. Identification Manual for the Dragonfly Larvae (Anisoptera) of Florida.. Florida DEP Div. of Resource Assessment and Management. Tallahassee. 113 pp.

Sinclair, R. M., 1964. Water Quality Requirements for Elmid Beetles - with Larval and Adult Keys to the Eastern Genera. Tennessee Stream Pollution Control Board. Tennessee Department of Public Health, Nashville. 14 pp.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). 2nd Edition. The Caddis Press. 510 pp.

Tennessen, K., 2003. Odonata Larvae of the Southeastern U.S. An ID Manual for EPA Region 4.

Thompson, F. G. 1984. Freshwater Snails of Florida - a Manual for Identification. University Presses of Florida, Gainesville. 94 pp.

Westfall, M. J., Jr. and M. L. May. 2006. Damselflies of North America, Revised Edition. Scientific Publishers. 502 pp.

Wiederholm, T. ed. 1983, Chironomidae of the Holarctic Region Keys and Diagnoses. Part 1 - Larvae. Ent. Scand. Suppl. 19. 457 pp.

Wiggins, G. B., 1996. Larvae of the North American Caddisfly Genera (Trichoptera). 2nd Edition. University of Toronto Press, Toronto, Canada. 457 pp.

18 CHANGE TRACKING

Rev. Date (Review Date) Rev. #	Change Contact	Detail of Approved Change
10/17/07 Rev 0		Original Version
09/03/09 Rev. 1.0	H. Cox B. Diggs L. Huff	Annual review. Made non-critical formatting and grammatical changes. Modified Sec. 15.1.1, bullet 1-omitted second staff repicking a sample; sec. 15.2.1-changed 10% to 5% for QA percentage.
09/03/09 (09/28/11) Rev. 1.0	S. Kumar L. Huff	Annual review. No changes.
09/12/13 Rev.2.0	H. Cox	Periodic review. Made non-critical formatting and grammatical changes. Updated Appendix F and reference list.
09/28/15 Rev. 3.0	S. Kumar	Periodic review. Made non-critical formatting and grammatical changes. Added forceps, petri dishes, Reagent alcohol to Sec. 7, Equipments & Supplies. Grammatical change in 8.2.2— term changed from "OTHERS" to "NON CHIRONOMIDS" in sec. 9.8.3.1.
10/06/17 Rev. 4.0	S. Kumar	Periodic review. Made non-critical formatting and grammatical changes. Added two references as keys. Corrected the second last sentence in Slide labeling 9.3.9

SURFACE WATER QUALITY PHYSICAL CHARACTERIZATION AND REACH SELECTION

SOP #6300

Rev. 3.0

VERSION DATE: 01/13/15

PREPARED BY:		**DATE**	1/14/2015
REVIEWED BY:	Branch or Division Chief	**DATE**	01/13/15
APPROVED BY:	Quality Assurance Manager	**DATE**	1/13/2015

Alabama Department of Environmental Management

1400 Coliseum Blvd Montgomery, AL | 1350 Coliseum Blvd Montgomery, AL | 2715 Sandlin Rd Decatur, AL | 110 Vulcan Rd Birmingham, AL | 2204 Perimeter Rd Mobile, AL

TABLE OF CONTENTS

PREFACE

This Standard Operating Procedures (SOP) Manual supersedes all Departmental SOPs relating to the methods addressed and is designed to be periodically reviewed and updated. The primary purpose of this document is to establish and maintain uniform operational and quality control guidance. The compliance with these procedures is essential to produce reliable data. Any deviation from this SOP must be documented and approved by the Project QA/QC Coordinator and/or project supervisor.

DISCLAIMER

This document has been prepared for use by the staff of the Alabama Department of Environmental Management (ADEM). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. No portion of this manual is intended to supersede any Departmental policy memorandum issued by the Director or Deputy Director.

NOTE

Any alpha suffix added to the version date indicates the incorporation of corrections for non-critical typographic errors or formatting, i.e., no methodology changes were incorporated.

SURFACE WATER QUALITY
PHYSICAL CHARACTERIZATION AND REACH SELECTION

1 SCOPE AND APPLICATION

The combination of information requested on the two page ***Physical Characterization Field Data Sheet*** has been adapted to meet the data needs associated with surface water decisions, e.g., Total Maximum Daily Loads (TMDL). It accompanies biological sampling activities such as Wadeable Intensive Macroinvertebrate Bioassessments (WMB-I), fish Index of Biotic Integrity (IBI) assessments, and periphyton chlorophyll-*a* screening events. The sheet has been designed to fulfill data requirements set by ADEM's ALAWADR database.

2 SUMMARY OF METHOD

2.1 Whenever a Habitat Assessment is required as part of a site visit, a two-page physical characterization data sheets is also completed. Generally one person will complete the two page worksheet and then BEFORE leaving the site the field crew will discuss the selections and estimates to determine if any modifications are required.

2.2 The habitat assessments will be independently conducted by at least two trained personnel (See SOP #6301, Wadeable Stream Habitat Assessment).

2.3 After discussion of the results, the two sets of habitat assessment results will be transferred to the appropriate section on Page 2 of the worksheet.

3 MULTIPLE PHYSICAL HABITAT ASSESSMENTS FOR SINGLE STATION

3.1 When more than one HA/PC event is planned for a station over the length of a project it is recommended that on subsequent visits a copy of the previous HA/PCs be taken in the field and left in the vehicle.

3.2 Once the current HA/PC is completed and upon returning to the vehicle, make a quick comparison to see if anything changed drastically. If so, determine if it was an actual change or if an error occurred.

4 DEFINITIONS

N/A

5 HEALTH & SAFETY WARNINGS

General field health and safety warnings apply.

6 INTERFERENCES

N/A

7 PERSONNEL QUALIFICATIONS

7.1 No employee shall conduct this technique until he/she has actual field experience and has successfully demonstrated the ability of conducting this technique under the supervision of a senior staff member.

7.2 Each new Departmental employee shall accompany an experienced field employee on as many field trips as possible to experience the differing types of field situations to which the new employee may be required to participate.

7.3 During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of senior technical staff members.

8 Reach Selection

8.1 An approximately 300-foot wadeable reach representative of the stream should be selected to conduct the Habitat Assessment and Physical Characterization.

8.2 Whenever possible, the area should be at least 50 feet upstream from any road or bridge crossing to minimize its effect on stream velocity, depth, and overall habitat quality. There should be no major tributaries discharging to the stream within the selected reach.

8.3 A detailed description of the reach shall be entered in the Station Visit Comments Section on the two-page *Physical Characterization Field Data Sheet with Datalogger Import*, Page 1.

9 Form Completion Requirements

9.1 General

One form only should be used for each site visit. The following field explanations are included to summarize all required information on the two-page *Physical Characterization Field Data Sheet with Datalogger Import*.

9.2 Station Visit Essentials

9.2.1 TRIP NAME- pre-assigned trip designation by collector.

9.2.2 STATION NUMBER- number pre-assigned to the station in the study plan and should not be altered unless approval from the Project Coordinator.

9.2.3 VISIT DATE - Month, day, and year the assessment was completed.

9.2.4 VISIT TIME- in military time (e.g., 0700 = 7:00 AM)

9.2.5 COLLECTOR NAMES - USER ID or Initials of all persons contributing to the assessment.

9.2.6 TRIP COMMENTS- an additional line to add any pertinent information that applies to every station visit on the trip, i.e., “ongoing tornado” or “forgot thermometer”.

9.2.7 STATION VISIT COMMENTS- three line space for Reach Description and “other” reasons/explanations for not conducting any required activity.

9.3 ALAWADR/BIOWADR STATION VISIT ACTIVITIES (check all that apply)

This is the section where the collector checks all applicable activity boxes for a specific station and/or boxes that explain why any required activity was not conducted. Also, replicate activities are covered here. These responses correspond with entries in ALAWADR.

- FIELD FORM: PHYSICAL CHARACTERIZATION FORM: check if you filled out any parts of this form.

- FIELD FORM: SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM: check if you conducted a habitat assessment on this station
- DATA LOGGER IMPORT: check if you used a data logger to collect *in situ* measurements which will be imported directly into ALAWADR.
- MB-I INVERTS: check if you conducted a Wadeable Multi Habitat Macroinvertebrate Bioassessment at this station
- PERI CHL *a*: check if you conducted a Periphyton Chlorophyll *a* Assessment at this station.
- FISH IBI: check if you conducted a Fish Index of Biotic Integrity Assessment at this station.
- REP 1: check when Replicate Sampling Activities were conducted.

9.3.1 ACTIVITY NOT CONDUCTED—Reasons why you did not conduct a specific activity if that was the purpose of the visit.

- NO FLOW: No flow was detected either by visual examination or because velocity would not register on the instrument. Water may be stagnant and not representative of normal conditions.
- INTERMITTENT POOLS: Stream is a series of pools with dry streambed in between.
- TOO DEEP: Stream is not wadeable and therefore could not be entered.
- TOO TURBID: The in-stream bottom substrate has been rendered invisible due to dissolved and suspended solids in the water table.
- DRY STREAMBED: There is no water in the streambed.
- EQUIPMENT MALFUNCTION: Flow meter is not working or will not pass QA/QC test.
- INACCESSIBLE: Station is obstructed by debris, fallen trees, is fenced, or too steep to enter.
- DANGEROUS FLOW: Water velocities are such that stream cannot be entered safely.
- DANGEROUS WEATHER: Heavy rain, thunderstorms or tornadoes are occurring.
- OTHER: Note in Comments: Describe the reasons why activity was not conducted.

9.3.2 PICTURES TAKEN (Notes: Any information you might want to add to describe or clarify picture)

9.4 <u>RIPARIAN LANDUSE & VEGETATION.</u>

9.4.1 LAND USE AT REACH (check all that apply)

- PASTURE: Any grazing activities (cattle, horses)
- FIELDS: Broken soil for vegetable plantings, graded soil

- INDUSTRIAL: e.g., foundry, steel, or other manufacturing plants
- CROPS: Presence of row crops, such as cotton, corn, soy beans, peanuts
- RESIDENTIAL: Any kind of homestead or neighborhood
- MIXED URBAN: Urban or suburban settings with associated vehicle traffic and parking lots.
- FOREST: Mostly trees and shrubs with associated undercover growth
- COMMERCIAL: Any kind of business, e.g., car repair, shopping mall, stores
- SILVICULTURE: Logging and clear cutting activities associated with timber and pulp wood production.
- CAFO: Concentrated Animal Feed Operation, i.e., chicken houses, hog farms.

9.4.2 DOMINANT RIPARIAN VEGETATION (select one)

- TREES: Mostly mature trees
- SHRUBS: Mostly shrubs, e.g., Privet, Rhododendron, Mountain Laurel.
- HERBACEOUS: Mix of grasses, weeds, and wildflowers
- GRASSES: Grassy areas or lawns

9.4.3 CANOPY COVER (select one)

This is the estimation of the percent of shading over the sampling reach caused by overhanging branches. An exposed stream often experiences increased water temperature that may be limiting to some organisms and be favorable for nuisance algal blooms resulting in decreased minimum dissolved oxygen concentrations. A fully shaded stream can inhibit the growth and reproduction of aquatic and riparian plants, inhibit primary production, and reduce habitat.

- OPEN: 0-20% shaded
- MOSTLY OPEN: 20-40% shaded
- EST. 50/50 OR 60/40%: estimated to be half shaded and half open
- MOSTLY SHADED: 60-80% shaded
- SHADED: 80-100% shaded

9.4.4 CANOPY TYPE (select one)

- DECIDUOUS: Mostly hardwoods
- CONIFEROUS: Mostly pines or other needle bearers (e.g., cedar, cypress, firs, spruce)
- MIXED: Mixture of pines and hardwoods

9.5 <u>INSTREAM FEATURES</u>

9.5.1 STREAM MORPHOLOGY ESTIMATES

- REACH LENGTH is the distance actually included for assessment of habitat (target distance is 300 feet).

- STREAM WIDTH is the estimated average distance from shore to shore at a transect representative of the stream width in the area. This will likely differ from the width of the flow measurement transect.
- BANK HEIGHT is the estimated vertical distance from the top of a representative bank to the water surface. Both the High and Low bank height are recorded.
- HIGH WATER MARK is an estimate of the vertical distance from the water surface to the peak overflow level as indicated by debris hanging in bank or flood plain vegetation, and deposition of silt or soil. In instances where bank overflow is rare, a high water mark may not be evident. It is also important to consider how light vegetation (such as bushes, small trees) may be pushed over by high flows (entrapping debris near the top), and then straighten out when the flow drops. This may give the indication of much deeper water than was actually achieved.
- CHANNELIZED is the indication of whether the area included in the sampling reach has been altered by man, this includes straightening of the stream, bridge abutments and road crossings.

9.5.2 PERCENT HABITAT

This is the percentage estimate of available/sample-able habitat by type present at any defined reach (percentages must add up to 100%).

- % RIFFLE HABITAT: Boulder/cobble/gravel areas within the reach that can be sampled with a kick net.
- % ROOTBANK HABITAT: Areas of underwater tree roots that can be sampled with a dip net.
- % ROCK/LOG HABITAT: Available rocks and logs that can be washed into a sieve bucket.
- % CPOM HABITAT: Leaf packs and other available accumulations of small debris that can be collected in a sieve bucket.
- % SAND HABITAT: Silt covered shallow areas that can be sampled with a dip net.
- % MACRO HABITAT: Macrophytes growing within the reach that are available for sampling with a dip net.
- % UNSUITABLE SUBSTRATES: e.g., unbroken bedrock, hardpan clay, concrete, deep water sand areas.

9.5.3 STREAM DEPTH

This is the estimated vertical distance from water surface to stream bottom at a representative depth at each of the three habitat types, riffle, run and pool.

9.5.4 PROPORTION OF REACH

This is the percentage of the selected reach that is represented by the Riffle, Run, and Pool habitat types.

9.5.5 DAM PRESENT (select yes or no) is the indication of the presence of a dam at the sampling reach and the general type, such as a beaver dam, debris dam, low head dam, mill dam, culvert, or hydropower dam.

9.5.6 RELATION OF DAM TO REACH—What is the RELATION OF THE DAM to the sampling site? Above (upstream) or below (downstream) or within?

9.5.7 ESTIMATED GRADIENT (select one)

This is the amount of elevation loss, or drop in the stream bed over the entire reach length (300 ft).

- Low <1ft
- Moderate 1-3ft
- High >3ft

9.6 AQUATIC VEGETATION

9.6.1 TOTAL PERCENTAGE OF THE REACH'S WETTED SUBSTRATE WITH AQUATIC VEGETATION PRESENT - Make an estimate of this percentage (0% to 100%). Example: 100% = all surfaces covered by vegetation including algae; 50% = one-half of all surfaces covered by vegetation, etc.

9.6.2 DOMINANT VEGETATION TYPE (select only one)

Indicate the dominant type of in-stream vegetation present in the stream reach. In addition to being an indicator group that responds to disturbances, aquatic vegetation provides habitat and sustenance for aquatic life. (For common species list see Field Guide to Aquatic Plants of Alabama by ADCNR.)

- ROOTED EMERGENT: e.g., Water Willow, Smartweeds, Bullrushes, Cattails.
- ROOTED SUBMERGENT: e.g., Coontail, *Hydrilla*, Water milfoil, Pondweed, Eelgrass.
- FLOATING ALGAE: e.g., Green algae, Blue-green algae.
- ROOTED FLOATING: e.g., Water Lily, Spatterdock, Watershield.
- ATTACHED ALGAE: e.g., Filamentous algae.
- FREE FLOATING: e.g., Duckweed, Water Lettuce.

9.6.3 PERCENTAGE OF WETTED REACH BY VEGETATION TYPE (optional) – Estimate the percentage of the wetted reach with each of the vegetation types present (Note: The sum of these percentages may be greater than the *Total Percentage of the reach's wetted substrate with aquatic vegetation present* if multiple vegetation types cover the same wetted reach).

Example: Total = 50%; Rooted Emergent = 25%, Attached Algae =35%. You infer from this that 10% of the vegetated area is covered by both Rooted Emergent and Attached Algae.

9.6.4 DOMINANT SPECIES BY VEGETATION TYPE (optional) - List the dominant species (or common names) for each vegetation type, if known. (For common species list see Field Guide to Aquatic Plants of Alabama by ADCNR.)

9.7 SEDIMENT / SUBSTRATE

9.7.1 SEDIMENT ODORS (select one) - Disturb sediment in a pool or other depositional area in the sampling reach and note any odors that are associated with sediment.

- NONE-No odor present
- SEWAGE
- PETROLEUM
- CHEMICAL
- ANAEROBIC
- FISHY

9.7.2 SEDIMENT OILS (select one)—Describes the relative amount of any oils associated with the sediment observed in the sampling reach.

- ABSENT
- SLIGHT
- MODERATE
- PROFUSE

9.7.3 SEDIMENT DEPOSITS (select one)—Describes those deposits that are present in the sampling reach.

- NONE
- SILT
- GRAVEL
- SLUDGE
- PAPER FIBER
- SAND
- SAWDUST
- COAL FINES

9.7.4 LOOKING AT STONES THAT ARE NOT DEEPLY EMBEDDED, ARE THE UNDERSIDES BLACK IN COLOR?

This generally indicates low dissolved oxygen concentrations or anaerobic conditions in the water/sediment interface area. Option N/A is for use only when no rocks are available to view, as indicated in the Substrate Composition by the lack of boulder, cobble, gravel, etc.

9.8 WATER QUALITY INDICATORS

9.8.1 WATER ODORS (select one) that are associated with the water in the stream reach.

- NORMAL/NONE
- CHEMICAL
- RAW SEWAGE

- TREATED SEWAGE [WWTP DISCHARGE]
- FISHY
- ANAEROBIC
- PETROLEUM

9.8.2 WATER SURFACE OILS (select one)—Describe the relative amount of any oils present on the water surface.

- NONE
- FLECKS
- SHEEN
- SLICK
- GLOBS

9.8.3 WATER COLOR (select one)—Describes the apparent color of the water caused by planktonic algae and other natural causes as well as suspended solids, dyes, and chemical discharges.

- CLEAR/NO COLOR
- GREY
- GREEN
- PURPLE
- BROWN [MUD]
- RED [DYE]
- CHALKY WHITE
- BLUE
- LIGHT TANNIC
- DARK TANNIC

9.8.4 BIOLOGICAL INDICATORS—Groups seen while at the sampling reach. Check all that apply.

- MUSSELS
- FISH
- CRAYFISH
- SNAILS
- MACROINVERTEBRATES
- FRESH BEAVER STICKS

9.9 VISIT OBSERVATIONS AND MEASUREMENTS

9.9.1 WAS A STREAM FLOW MEASURED? Either measure a flow, record the flow from the USGS Website, or to indicate the reason that no flow was measured. (select one)

- YES-ADEM (Abbreviated method with meter),
- YES-USGS (gauge),
- YES–FACILITY (mgd),
- NO-NOT WADEABLE (too deep),
- NO-FLOW CONDITIONS HAZARDOUS,
- NO-VISIBLE BUT NOT MEASURABLE,
- NO-NOT REQUIRED,
- NO-FLOW NOT VISIBLE,
- NO, BRAIDED/SWAMP,
- NO-METER MALFUNCTIONED,
- DATA COLLECTED BUT LOST OR CORRUPTED.

9.9.2 USGS GAGE # or FLOW METER #—Record the number of the USGS gage used or the identifier number on the flow meter.

9.9.3 FLOW (CFS) or (MGD)—Record value of flow either from website or after downloading flow in the office.

9.9.4 WEATHER—Indicate the weather conditions at the time of sampling and those from the last 24 hrs. This information is important to interpret the effects of storm events on the sampling effort.

9.9.5 HAS THERE BEEN HEAVY RAIN IN THE LAST 7 DAYS? This can be determined from weather reports or from anecdotal information.

9.9.6 FLOW STAGE—What are the current flow conditions?

- FLOOD: Out of banks and onto the floodplain
- ABOVE NORMAL: Water levels appear to be above the normal level as indicated by grasses and shrubs on the banks being partially to totally submerged.
- NORMAL: Water Levels appear to be normal as indicated by the bank conditions.
- LOW: Water levels are lower than normal as indicated by exposed root/bank areas and stream substrates.

9.9.7 VELOCITY—Estimate the relative overall stream velocity in the reach

- SLOW: is estimated as moving at a speed less than 1.5 feet per second
- MODERATE: is estimated as moving at a speed between 1.5 and 3.0 feet per second
- FAST: is estimated as moving at a speed greater than 3.0 feet per second

9.9.8 FIELD MEASUREMENTS

- DATA LOGGER SERIAL #: Hydrolab ID number
- TOTAL DEPTH @ FM PT: This is the total depth at the location where the field measurement was made.
- AIR TEMPERATURE: Record air temperature in Celsius.
- TURBIDITY METER #: Record instrument identification number
- TURBIDITY: Record result in NTU here
- DEPTH AT WHICH TURBIDITY SAMPLE WAS TAKEN: Options are surface, Mid-Depth or measure depth in feet.

9.10 Substrate Composition & Habitat Assessment Form

9.10.1 INDEX TO USE (check one)-important for metrics selection

- HIGH GRADIENT: Usually Riffle/Run streams with moderate (1-3ft) to high (>3ft) elevation drop over 300 ft.
- LOW GRADIENT: Usually Glide/Pool streams with low (<1ft) elevation drop over 300ft.

9.10.2 ESTIMATED % SUBSTRATE COMPOSITION IN SAMPLING AREA— Percentages are assigned to the available substrate types. Percentages must add up to 100%. Inorganic and Organic Substrate Component Estimates are the visually estimated proportions for each of the substrate/particle types. Those substrates, which are usually considered stable, are indicated as such. Bedrock or Hardpan Clay are only considered about 50% stable for habitat quality purposes. Substrate types:

- BEDROCK: Solid rock substrate.
- HARDPAN CLAY: Solid clay substrate.
- BOULDER: Rock, pieces of bedrock or hardpan clay >10 inches in diameter.
- COBBLE: Rock, pieces of bedrock or hardpan clay between 2.5 to 10 inches in diameter
- GRAVEL: Rocks between 0.1 to 2.5 inches in diameter.
- SAND: Gritty particles
- SILT: Fine depositional materials that readily re-suspend into the water column
- CLAY: As in slicks or exposed banks
- DETRITUS: Sticks, wood (downed trees) and Coarse Particulate Organic Matter (CPOM), e.g., leaf packs.
- MUCK: fine organic deposits from decomposition

9.10.3 FREQUENCY OF RIFFLES/BENDS (Optional) (Distance between riffles/bends divided by stream width): This is a computer generated measurement added to sheet upon return to the office.

9.10.4 BANK ANGLES AT REACH are recorded separate for left and right banks. Estimated bank angle options are: flat (<5°), gradual (5-30°), steep (30-75°), very steep (75-90°), overhung (>90°).

9.11 Habitat Assessment Tally Forms

Enter the collector names and the individual parameter results of the applicable habitat assessment as determined following SOP #6301. One collector may use the HABITAT ASSESSMENT SUMMARY SHEET and then transfer the results into the appropriate location on the Tally Forms.

10 Troubleshooting

N/A

11 Acquisition, Calculations, & Data Reduction Requirements

N/A

12 Data and Records Management

12.1 Detailed field notes should be made regarding conditions at the site.

12.2 All records are retained as described in the Departmental Records Retention Policy (ADEM 2001).

13 Quality Control & Quality Assurance

13.1 Replicate measurements are entered into the blanks on the field sheet in the columns labeled "Replicate".

13.2 Replicate field measurement or sample times should be recorded at least one minute apart from first field measurement or sample collection time.

13.3 Refer to SOP #9021 Field Quality Control: Measurements and Samples for specific sampling and measurement QC activities.

14 Reference

ADEM. 2001. Functional Analysis & Records Disposition Authority. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2018 (as amended). Standard Operating Procedures #9021 Field Quality Control: Measurements and Samples. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2018 (as amended). Standard Operating Procedures #6301 Wadeable Stream – Habitat Assessment. Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADCNR. 2007 Field Guide to Aquatic Plants of Alabama. Alabama Department of Conservation and Natural Resources (ADCNR), Montgomery, AL.

15 ATTACHMENTS

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 1)

ADEM - FIELD OPERATIONS DIVISION
PHYSICAL CHARACTERIZATION FIELD DATA SHEET W/DATALOGGER IMPORT

*Trip Name*__________ *Station #*__________

*Visit Date*________ *Visit Time*________ *Collector Names*__________

Trip Comments:					
STATION VISIT COMMENTS (REACH DESCRIPTION)	(For COC Purposes: D.O =)				
ALAWADR/ BIOWADR STATION VISIT ACTIVITIES (*ACTIVITY TIMES ONLY NEEDED IF DIFFERENT FROM STATION VISIT TIME)		Activity Time* (*24hrs*):		Replicate Time (*24hrs*):	Activity Conducted?
	▫ Field Form: *Phys Char Form*		☐ *Rep 1*		☐ Activity Not Conducted
	▫ Field Form: *Substrate Composition & Habitat Assessment Form*				☐ Activity Not Conducted
	▫ Datalogger Import		☐ *Rep 1*		☐ Activity Not Conducted
	▫ MB-I Inverts		☐ *Rep 1*		☐ Activity Not Conducted
	▫ Peri Chl *a*		☐ *Rep 1*		☐ Activity Not Conducted
	▫ Fish IBI		☐ *Rep 1*		☐ Activity Not Conducted
	If any activity is not conducted, Why? ☐ No Flow ☐ Intermittent Pools ☐ Too Deep ☐ Too Turbid ☐ Dry Streambed				
	☐ Equipment Malfunctioned ☐ Inaccessible ☐ Dangerous Flow ☐ Dangerous Weather ☐ Other: Note in Comments				
	☐ Pictures Taken (Notes:)				

RIPARIAN LANDUSE & VEGETATION	*Land use at Reach(Check all)* ▫ CAFO	*Dominant Riparian Vegetation Present Select Only One*	*Canopy Cover:*	▫ Open 0-20%
	▫ Pasture ▫ Fields ▫ Industrial		▫ Mostly Open 20-40%	▫ Est 50/50 40-60%
	▫ Crops ▫ Residential ▫ Mixed Urban	▫ Trees ▫ Herbaceous	▫ Mostly Shaded 60-80%	▫ Shaded 80-100%
	▫ Forest ▫ Commercial ▫ silviculture	▫ Shrubs ▫ Grasses	*Type:* ▫ Deciduous ▫ Coniferous ▫ Mixed	

INSTREAM FEATURES	*Stream Morphology Est.*	% of Total Reach (Must add up to 100%)	*Stream Depth*	*Dam Present*	▫ No ▫ Yes
	Reach Length ____ ft	*Riffle Habitat* ____ %	Riffle ____ ft	*Relation to Reach*	*If Yes, Kind?*
	Stream Width ____ ft	*Rootbank Habitat* ____ %	Run ____ ft	▫ Above	▫ Beaver
	Bank Height: High____ ft	*Rock/log Habitat* ____ %	Pool ____ ft	▫ Below	▫ Debris
	Low ____ ft	*CPOM Habitat* ____ %	*Proportion of*	▫ Within	▫ Low-head
	High Water Mark ____ ft	*Sand Habitat* ____ %	Riffle ____ %	*Est. Gradient (Over 100M)*	▫ Mill
	Channelized?	*Macro Habitat* ____ %	Run ____ %	▫ Low <1ft ▫ High >3ft	▫ Culvert
	▫ Yes ▫ No	*Unsuitable Substrates* ____ %	Pool ____ %	▫ Moderate 1-3 ft	▫ Hydropower

AQUATIC VEGETATION	*Total % of wetted reach with aquatic vegetation present* ____ %			*For species list see plant guide of common species of AL*		
	Dominant Vegetation Type: (Select only one)	▫ Rooted Emergent	▫ Rooted Submergent	▫ Floating Algae		
		▫ Rooted Floating	▫ Attached Algae	▫ Free Floating		
	(Optional) Type	*% of Wetted Reach*	*Species*	*Type*	*% of Wetted Reach*	*Species*
	Rooted Emergent	____ %	____	Attached Algae	____ %	____
	Rooted Floating	____ %	____	Floating Algae	____ %	____
	Rooted Submergent	____ %	____	Free Floating	____ %	____

SEDIMENT / SUBSTRATE	*Sediment Odors* (Select One)	*Oils* (Select One)	*Deposits* (Select One)	*Looking at stones that are not deeply embedded, are the undersides black in color?*
	▫ None ▫ Chemical	▫ Absent ▫ Moderate	▫ None ▫ Paper Fiber	▫ Yes ▫ No ▫ N/A
	▫ Sewage ▫ Anaerobic	▫ Slight ▫ Profuse	▫ Silt ▫ Sand	
	▫ Petroleum ▫ Fishy		▫ Gravel ▫ Sawdust	
			▫ Sludge ▫ Coal Fines	

WATER QUALITY INDICATORS	*Water Odors* (Select One)	*Surface Oils*	*Water Color* (Select One)	*Biological Indicators* (Select all)
	☐ Normal/None ☐ Chemical	☐ None	☐ Clear/No Color ☐ Grey	☐ Mussels ☐ Fish
	☐ Raw Sewage ☐ Treated Sewage	☐ Flecks	☐ Green ☐ Purple	☐ Crayfish ☐ Snails
	☐ Fishy ☐ Anaerobic	☐ Sheen	☐ Brown (Mud) ☐ Red (Dye)	☐ Macroinvertebrates
	☐ Petroleum	☐ Slick	☐ Chalky White ☐ Blue	☐ Fresh Beaver Sticks
		☐ Globs	☐ Lt. Tannic ☐ Dk. Tannic	

FOD I-Form 13 Rev 02/13/2013

ATTACHMENT A – PHYSICAL CHARACTERIZATION FIELD DATA SHEET (PAGE 2)

VISIT OBSERVATIONS AND MEASUREMENTS

Was Flow Measured?	☐ Yes - ADEM: Abbrev Meter (*cfs*) ☐ Yes - USGS: Gauge (*cfs*) ☐ Yes - Facility (*mgd*)	☐ No - Not wadeable (too deep) ☐ No - Flow conditions hazardous ☐ No - Visible but not measurable	☐ No - Not Required ☐ No - Flow not visible ☐ No - Braided/Swamp	☐ No - Meter Malfunctioned ☐ Data Collected but Lost or Corrupted
	USGS Gage # or Flow–Meter #:		**Flow (*cfs*) or (*mgd*):**	

Now	*Weather*	*Past 24 hrs*	*Flow Stage*	*Velocity*
□	Clear / Cloudless	□	□ Flood (out of banks)	□ Swift >3 ft / Sec
□	Partly Cloudy	□	□ Above Normal	
□	Mostly Cloudy	□	□ Normal	□ Moderate 1.5 – 3 ft / Sec
□	Cloudy	□	□ Low	
□	Fog	□		□ Slow <1.5 ft / Sec
□	Light Rain / Drizzle	□		
□	Rain	□	*Heavy Rain in last 7 Days?*	
□	Thunderstorms	□		
□	Freezing Precipitation	□	□ Yes □ No	

Parameter	*Value*	*Replicate*	*Unit*
Datalogger Serial#		*N/A*	#
Total Depth @ FM Pt			ft
Air Temp.		*N/A*	°C
Turbidity Meter #		*N/A*	#
Turbidity			*NTU*
Depth of Turbidity:	□ Surface □ Mid-Depth □ ________ ft		

SUBSTRATE COMPOSITION & HABITAT ASSESSMENT FORM

Index To Use:
☐ High Gradient
☐ Low Gradient

Est. % Composition In Sampling Area

Type	Diameter	Percent	Stable
Bedrock			1/2
Hardpan Clay			1/2
Boulder	>10 in.		Yes
Cobble	2.5 - 10 in.		Yes
Gravel	0.1 - 2.5 in.		Yes
Sand	Gritty		
Silt			
Clay	Slick		
Detritus	Stick/Wood		Yes
	CPOM		
Muck	Fine Org.		
	Total	100%	

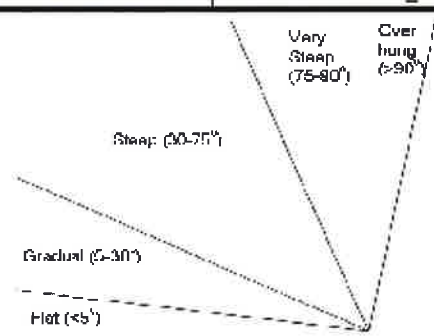
	Name of Collector	*Collector 1*	*Collector 2*
	Riffle / Run HA	Score (LB/RB)	Score (LB/RB)
1	Instream Cover		
2	Epifaunal surface		
3	Embeddedness		
4	Velocity/Depth		
5	Channel Alteration		
6	Sediment Deposition		
7	Frequency of Riffles		
8	Channel Flow Status		
9	Condition of Banks		
10	Bank Veg. Protection	/	/
11	Disruptive Pressure	/	/
12	Riparian Veg. zone	/	/
13	Rip Veg Zone Quality	/	/

	Name of Collector	*Collector 1*	*Collector 2*
	Glide / Pool HA	Score (LB/RB)	Score (LB/RB)
1	Instream Cover		
2	Pool Substrate Char.		
3	Pool Variability		
4	Channel Alteration		
5	Sediment Deposition		
6	Channel Sinuosity		
7	Channel Flow Status		
8	Condition of Banks		
9	Bank Veg. Protection	/	/
10	Disruptive Pressure	/	/
11	Riparian Veg. Zone	/	/
12	Rip Veg Zone Quality	/	/

Frequency of Riffles/ Bends (Distance between riffles/bends ÷ stream width)				
Computer Measurement	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥35

Check One for each Bank:

Left Bank Angle	□ Flat	□ Gradual	□ Steep	□ Very Steep	□ Overhung
Right Bank Angle	□ Flat	□ Gradual	□ Steep	□ Very Steep	□ Overhung



FOD I-Form 13 Rev 02/13/2013

ATTACHMENT B –HABITAT ASSESSMENT SUMMARY SHEET

Habitat Assessment Summary Sheet---For Use With Laminated HA Forms

Sta/Date ___________	Coll:_____	Sta/Date ___________	Coll:_____
Riffle Run	**Score (LB/RB)**	**Glide/Pool**	**Score (LB/RB)**
1 Instream Cover		1 Instream Cover	
2 Epifaunal surface		2 Pool Substrate Char.	
3 Embeddedness		3 Pool Variability	
4 Velocity/Depth		4 Channel Alteration	
5 Channel Alteration		5 Sediment Deposition	
6 Sediment Deposition		6 Channel Sinuosity	
7 Frequency of Riffles		7 Channel flow Status	
8 Channel flow Status		8 Condition of Banks	
9 Condition of Banks		9 Bank Veg Protection	/
10 Bank Veg Protection	/	10 disruptive pressure	/
11 Disruptive pressure	/	11 Riparian veg zone	/
12 Riparian veg zone	/	12 Riparian Zone Veg Quality	/
13 Riparian Zone Veg Quality	/		

Sta/Date ___________	Coll:_____	Sta/Date ___________	Coll:_____
Riffle Run	**Score (LB/RB)**	**Glide/Pool**	**Score (LB/RB)**
1 Instream Cover		1 Instream Cover	
2 Epifaunal surface		2 Pool Substrate Char.	
3 Embeddedness		3 Pool Variability	
4 Velocity/Depth		4 Channel Alteration	
5 Channel Alteration		5 Sediment Deposition	
6 Sediment Deposition		6 Channel Sinuosity	
7 Frequency of Riffles		7 Channel flow Status	
8 Channel flow Status		8 Condition of Banks	
9 Condition of Banks		9 Bank Veg Protection	/
10 Bank Veg Protection	/	10 disruptive pressure	/
11 Disruptive pressure	/	11 Riparian veg zone	/
12 Riparian veg zone	/	12 Riparian Zone Veg Quality	/
13 Riparian Zone Veg Quality	/		

Sta/Date ___________	Coll:_____	Sta/Date ___________	Coll:_____
Riffle Run	**Score (LB/RB)**	**Glide/Pool**	**Score (LB/RB)**
1 Instream Cover		1 Instream Cover	
2 Epifaunal surface		2 Pool Substrate Char.	
3 Embeddedness		3 Pool Variability	
4 Velocity/Depth		4 Channel Alteration	
5 Channel Alteration		5 Sediment Deposition	
6 Sediment Deposition		6 Channel Sinuosity	
7 Frequency of Riffles		7 Channel flow Status	
8 Channel flow Status		8 Condition of Banks	
9 Condition of Banks		9 Bank Veg Protection	/
10 Bank Veg Protection	/	10 disruptive pressure	/
11 Disruptive pressure	/	11 Riparian veg zone	/
12 Riparian veg zone	/	12 Riparian Zone Veg Quality	/
13 Riparian Zone Veg Quality	/		

ADEM/FOD/EIS FOD I - Form 16 (Rev. 02/13/2013)

16 CHANGE TRACKING

Rev. Date (Review Date) Rev. #	Approved By:	Detail of Approved Change
02/06/2006 Rev. 0		Original Version
02/21/2007 Rev. 1.0	S. Gibson	Annual review. Corrected non-critical typos and formatting un-related to methods addressed. Added "Note" in preface section. Deleted Section 7.1 referencing the 3 months experience requirement.
03/03/08 Rev. 1.0		Annual review—no changes
02/06/06 (05/18/09) Rev. 1.0	B. Diggs	Annual review—no changes
02/06/06 (02/09/11) Rev. 1.0	B. Diggs	Periodic Review—No Changes.
03/25/13 Rev. 2.0	H. Cox	Periodic Review. Complete Revision.
01/13/15 Rev. 3.0	B. Diggs	Periodic Review. Paragraph 8.2 changed 300 feet to 50 feet.
01/13/15 (02/08/17) Rev. 3.0	H. Cox	Periodic Review—No Changes.
01/13/15 (01/03/19) Rev. 3.0	B. Diggs	Periodic Review— Corrected non-critical typo un-related to methods addressed. Paragraph 9.5.2 bullet point '%Riffle Habitat' changed 'Bolder' to 'Boulder'.

WADEABLE STREAM
HABITAT SURVEY

SOP #6301

Revision 2.1

VERSION DATE – 06/19/18

PREPARED BY:	Ashley Lockwood	**DATE**	06/20/2018
REVIEWED BY:	**Branch or Division Chief**	**DATE**	06/22/18
APPROVED BY:	**Quality Assurance Manager**	**DATE**	6/20/2018

Alabama Department of Environmental Management

1400 Coliseum Blvd	1350 Coliseum Blvd	2715 Sandlin Rd	110 Vulcan Rd	2204 Perimeter Rd
Montgomery, AL	Montgomery, AL	Decatur, AL	Birmingham, AL	Mobile, AL

TABLE OF CONTENTS

PREFACE

This Standard Operating Procedures (SOP) Manual supersedes all Departmental SOPs relating to the methods addressed and is designed to be periodically reviewed and updated. The primary purpose of this document is to establish and maintain uniform operational and quality control guidance. The compliance with these procedures is essential to produce reliable data. Any deviation from this SOP must be documented and approved by the Project QA/QC Coordinator and/or project supervisor.

DISCLAIMER

This document has been prepared for use by the staff of the Alabama Department of Environmental Management (ADEM). Mention of trade names or commercial products does not constitute endorsement or recommendation for use. No portion of this manual is intended to supersede any Departmental policy memorandum issued by the Director or Deputy Director.

NOTE:

Any alpha suffix added to the version date indicates the incorporation of corrections for non-critical typographic errors or formatting, i.e., no methodology changes were incorporated.

WADEABLE STREAM - HABITAT SURVEY

1 SCOPE AND APPLICATION

Adequate habitat is related to overall aquatic life use and may be a potential source of limitation to aquatic biota. A survey of habitat quality can (1) identify obvious constraints on the attainable potential of the site to support healthy biological communities; (2) assist in the selection of appropriate comparable sampling sites; and (3) provide basic information to assist in the interpretation of biological community survey results.

2 SUMMARY OF METHOD

A minimum of two trained field personnel will individually conduct the habitat survey. At each station, the individual survey parameter scores are compared, and any differences between personnel discussed and modified as deemed appropriate. The individual survey scores for each parameter are averaged. The final survey score is calculated from these averages. The final score for each station is compared to a regional reference station or guideline developed from reference station data. The station is classified on the basis of its similarity to expected conditions (as represented by the reference station or guideline) and its apparent potential to support an acceptable level of biological health.

3 DEFINITIONS

3.1 RIFFLE RUN - High gradient streams (or riffle/run-dominated streams) are those in moderate-to-high gradient landscapes. Natural high gradient streams have substrates primarily composed of coarse sediment particles (gravel or larger) or frequent coarse particulate aggregations along stream reaches.

3.2 GLIDE POOL - Natural low gradient streams (or glide/pool-dominated streams) have substrates of fine sediment or infrequent aggregations of more coarse (gravel or larger) sediment particles along stream reaches.

4 HEALTH & SAFETY WARNINGS

General field, health and safety warnings apply.

5 INTERFERENCES

N/A

6 PERSONNEL QUALIFICATIONS

6.1 No employee shall conduct this technique until he/she has actual field experience and has successfully demonstrated the ability of conducting this technique under the supervision of a senior staff member.

6.2 Each new Departmental employee shall accompany an experienced field employee on as many field trips as possible to experience the differing types of field situations to which the new employee may be required to participate.

6.3 During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of senior technical staff members.

6.4 Depending on the project for which the samples are collected, a 40 hr hazardous waste safety training course may be required along with the annual 8 hr updates.

7 EQUIPMENT AND SUPPLIES

Glide/Pool Habitat Survey Field Data Sheet

Riffle/Run Habitat Survey Field Data Sheet

ADEM Page 1 and 2 Physical Characterization Field Data Sheet

Habitat Survey Summary Sheet

8 REACH SELECTION

8.1 The matrices used for the habitat survey are based on physical characteristics of the waterbody and surrounding landform and land uses.

8.2 The stream segment length or area assessed will vary with each site but a reach is generally defined as 100 meters.

8.3 The parameters are evaluated over the stream reach being assessed, but primarily in an upstream direction where conditions will have the greatest impact on the community being studied. Any deviations should be documented in the "Comments" section on the Field Data Sheet.

9 CONDUCTING THE HABITAT SURVEY

The following is an explanation of the habitat survey parameters used on each of the habitat surveys for Riffle/Run (RR) and Glide/Pool (GP) stream morphologies. Specific scoring criteria are located on the *Habitat Survey Field Data Sheets (Pages 7 - 9)*.

9.1 **Epifaunal Surface/Instream Cover (RR #1&#2, GP #1)** - Includes the relative quantity and variety of natural structures in the stream, such as cobble riffles, large rocks, fallen trees, logs and branches, and undercut banks, available for colonization by macroinvertebrates. Smooth bedrock or hardpan-clay substrates are generally not good habitat although they are stable. A general rule of thumb is that if there is at least some vegetation on the bedrock about 50% of the amount is considered stable.

9.1.1 Numerous types of insect larvae attach themselves to rocks, logs, branches or other submerged substrates. The greater the variety and number of available attachment sites, the greater the variety of macroinvertebrates in the stream. A wide variety and/or abundance of submerged structures in the stream provide macroinvertebrates and fish with a large number of niches, thus increasing habitat diversity.

9.1.2 As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases. Rocky bottom areas are critical for maintaining a healthy variety of insects in most high gradient streams. Snags and submerged logs (not including "new fall") are among the most productive habitat structures for macroinvertebrate colonization and fish refugia in low gradient streams.

9.2 **Embeddedness (RR #3)** - Refers to the extent to which rocks (gravel, cobble, and boulders) and snags 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 is decreased. Embeddedness is a result of large-scale sediment movement and deposition, and is a parameter evaluated in the riffles and run areas of high gradient streams. The rating of this parameter may be variable depending on where the observations are taken. To avoid confusion with sediment deposition (**RR #6, GP #5**) observations of embeddedness should be taken in the upstream portions of riffle and cobble substrate areas.

9.3 **Pool Substrate Characterization (GP #2) -** Evaluates the type and condition of bottom substrates found in pools. Firmer sediment types (e.g., gravel, sand) and rooted aquatic plants 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.

9.4 **Velocity/Depth Combinations (RR #4) -** Patterns of velocity and depth are included for high-gradient streams as an important feature of habitat diversity. The best streams in most high-gradient regions will have all four patterns present - 1) slow deep, 2) slow-shallow, 3) fast-deep, and 4) fast-shallow. The general guidelines are 0.5m depth (est. knee-deep) to separate shallow from deep, and 0.3m/sec to separate fast from slow. The occurrence of these four patterns relates to the stream's ability to provide and maintain a stable aquatic environment.

9.5 **Pool variability (GP #3) -** 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. (Rule of thumb - Large is > ½ the stream width, Deep is > 3 feet). A stream with many pool types will support a wide variety of aquatic species. Rivers with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community. General guidelines are any pool dimension (i.e., length, width, oblique) greater than half the cross-section of the stream for separating large from small and 1 m depth separating shallow and deep.

9.6 **Channel Alteration (RR #5, GP #4) -** Measurement 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 for flood control or irrigation purposes. Such streams have far fewer available habitats for fish, macroinvertebrates, and plants than do naturally meandering streams. Channel alteration is present when artificial embankments, riprap 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 changes have occurred. Scouring is often associated with channel alteration.

9.7 **Sediment Deposition (RR #6, GP #5) -** Measures 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 a meander that increase in size as the channel is diverted toward the outer bank) or shoals, or result in the filling_of pools. Usually deposition 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.

9.8 **Channel Sinuosity (GP #6, RR #7)** - Riffle/Run ratio is a way to measure the sequence of riffles and thus the heterogeneity 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 distinct riffles are uncommon, a run/bend ratio can be used as a measure of meandering or sinuosity. A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when the stream fluctuates as a result of storms. The ratios are calculated by dividing the distance between the riffles (riffle streams) or the bends (pool dominated streams) by the stream width.

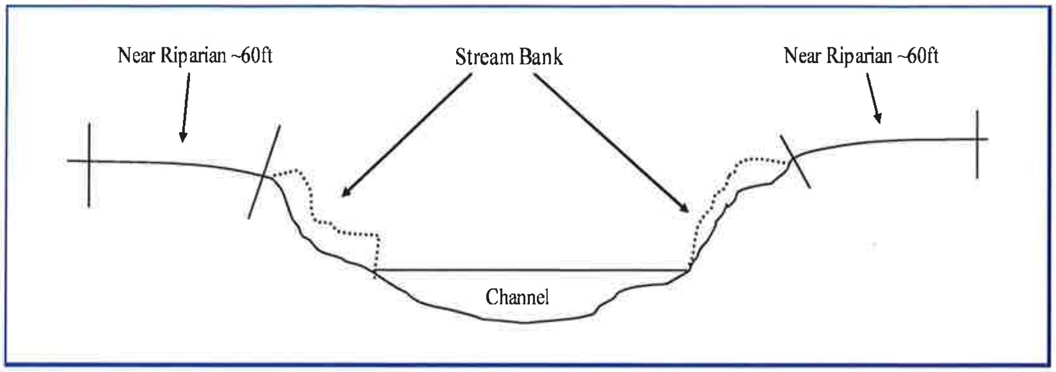
9.9 **Bank Stability/Condition of Banks (RR #9, GP #8)** - Measures whether the stream banks are eroded (or have the potential for erosion). Bedrock/large boulder stream banks are given a high score no matter what the slope. Steep banks are more likely to collapse and suffer from erosion than are gently sloping banks and are therefore considered unstable. Signs of erosion include - crumbling, un-vegetated banks, exposed tree roots, and exposed soil. Eroded banks indicate a problem of sediment movement and deposition, and suggest a scarcity of cover and organic input to streams.

9.10 **Bank Vegetative Protection/Grazing or Other Disruptive Pressure (RR #10&#11, GP #9&#10)** (See Figure 1) - Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone. 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 of in-stream 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. Adjustments should be made in areas with clay banks where steep, raw areas may not be as susceptible to erosion as other soil types. This parameter is made more effective by defining the natural vegetation for the region and stream type (i.e., shrubs, trees, etc.).

9.11 **Riparian Vegetative Zone Width (RR #12, GP #11)** (See Figure 1) - Measures the width of natural vegetation from the edge of the stream bank out through the riparian zone. A vegetated riparian zone serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports a robust stream system; narrow riparian zones occur when roads, parking lots, fields, lawns, bare soil, rocks, or buildings are near the stream bank. Residential developments, urban centers, golf courses, and rangeland are common causes of anthropogenic degradation of the riparian zone. The presence of 'old field' (i.e., previously developed fields not currently in use), paths and walkways in an otherwise undisturbed riparian zone may be judged inconsequential to the destruction of the riparian zone.

9.12 **Riparian Zone Vegetative Quality (RR #13)** (See Figure 1) - Estimates the presence (in percent) of normal/undisturbed expected plant community for given sunlight and habitat conditions.

Figure 1 – Stream and near-stream areas.



10 FORM COMPLETION REQUIREMENTS

10.1 Use a new field data sheet to record all of the data collected at the site visit (including HS scores). The form should be completed in its entirety prior to leaving each site.

10.2 A Xerox of the previous Field Data Sheet with HS scores taken into the field for *reference-only* is acceptable. Do not write on the XEROX sheet or check off the values as substitution for completing a new form.

11 TROUBLESHOOTING

N/A

12 DATA ACQUISITION, CALCULATIONS, & DATA REDUCTION REQUIREMENTS

N/A

13 DATA AND RECORDS MANAGEMENT

N/A

14 QUALITY CONTROL & QUALITY ASSURANCE

14.1 General

14.1.1 In visual-based habitat surveys, final conclusions are potentially subject to variability among field investigators. This limitation can be minimized by ensuring that an investigator is appropriately trained in the evaluation technique with periodic cross-checks conducted among investigators to promote consistency.

14.1.2 Consistency among parallel and independent physical habitat surveys can be evaluated by rank-order comparisons of the evaluated sites. Thus, comparing the score for each parameter is not as important as comparing the total score for each habitat survey which gives the rank order of the sites (their placement in the survey from good to bad) (U.S. EPA 1995).

14.2 Annual Field Validation

14.2.1 Annual field validation for all assigned field investigators for that year (March-March) will involve the following:

- Regional HS Sessions will be conducted for all appropriate staff (DEC/BHM, MGY & Mobile).
- At each session, two to four preliminary re-calibration sites will be evaluated preferably with previous HSs in the Excellent, Good, Fair and Poor categories.
- The HA Session for evaluation will include comparison of simultaneous independent habitat surveys of a test stream site. The surveys are compared to the surveys conducted by staff designated as "experts".
- Experienced staff will qualify as experts by completing three consecutive years of HS QA in their region and their scores consistently falling within three standard deviations of the Expert staff.

14.2.2 If any staff member's values fall outside of the above quality assurance guidelines of three standard deviations of the experts' averaged score, a corrective action will be initiated.

14.2.3 A corrective action will include an evaluation as to the cause of the discrepancy. Additional training/instruction or other appropriate corrective measures will be initiated followed by an additional field validation exercise. All results will be filed with the appropriate Quality Assurance Coordinator.

15 Reference

Plafkin, J.L., MT. Barber, K.D. Porter, S.K. Gross, R.M. Hughes. 1989 Rapid Bioassessment Protocols For Use In Streams And Rivers - Benthic Macroinvertebrates And Fish. Report No. EPA444/4-89-001, Office Of Water. U.S. EPA, Washington, D.C. 194p.

Barber, M.T., G.L. Gerritsen, B.D. Snyder, and J.B. Stribling. 1997 (Draft). Revision to Rapid bioassessment protocols for use in streams and rivers - Periphyton, benthic macroinvertebrates and fish. Report No. EPA 841-D-97-002. Office of Water. W.S. EPA. Washington D.C.

16 ATTACHMENTS

ATTACHMENT A

ADEM-FIELD OPERATIONS DIVISION
RIFFLE/RUN HABITAT SURVEY FIELD DATA SHEET

Habitat Parameter	Category: Optimal	Suboptimal	Marginal	Poor
1 **Instream Cover**	>50% mix of boulder, cobble, submerged logs, undercut banks, or other stable habitat.	50-30% mix of boulder, cobble, or other stable habitat; adequate habitat.	30-10% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable.	<10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2 **Epifaunal surface**	Well developed riffle and run; riffles as wide as stream and length is 2x the width of stream; abundance of cobble.	Riffle is as wide as stream, but length is <2 times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is <2 times the stream width, gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or run virtually non existent; large boulders and bedrock prevalent; cobble lacking.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3 **Embeddedness**	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are >75% surrounded by fine sediment.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 **Velocity/Depth Regimes**	All 4 velocity/depth regimes present (slow-deep, slow-shallow, fast-shallow, fast-deep).	Only 3 of 4 regimes present. (If fast-shallow is missing, score lower.)	Only 2 of 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 **Man-made Channel Alteration**	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; and 40 - 80% of stream reach is channelized and disrupted.	Banks shored with gabion or cement; >80% of the stream reach channelized and disrupted.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
6 **Sediment Deposition**	Little or no enlargement of islands or point bars and less than 5 % of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; > 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7 **Frequency of Riffles (Distance between riffles/ stream width)**	<5 5 6 7	8 9 11 13 15	16 18 21 23 25	26 28 30 32 34 ≥ 35
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 **Channel flow Status**	Water reaches base of both lower banks.	Water fills >75% of the available channel.	Water fills 75 - 25% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 **Condition of Banks**	Banks stable; no evidence (<5%) of erosion or bank failure.	Moderately stable, infrequent, small areas (5-30%) of erosion mostly healed over.	Moderately unstable; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent Along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score ______	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
10 **Bank Vegetative Protection**	>90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB) ______	10 9 8	7 6	5 4 3	2 1 0
Score (RB) ______	10 9 8	7 6	5 4 3	2 1 0
11 **Grazing or other disruptive pressure**	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; < 1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB) ______	10 9 8	7 6	5 4 3	2 1 0
Score (RB) ______	10 9 8	7 6	5 4 3	2 1 0
12 **Riparian vegetative zone (each bank)**	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB) ______	10 9 8	7 6	5 4 3	2 1 0
Score (RB) ______	10 9 8	7 6	5 4 3	2 1 0
13 **Riparian ZoneVegetative Quality (each bank)**	Over 80% of riparian surfaces consist of normal, expected plant community for given sunlight and habitat conditions (e.g., native plants, trees, understory shrubs, or nonwoody macrophytes). Minimal disturbance.	>50% to 80% of riparian zone is undisturbed (normal, expected plant community for given sunlight and habitat conditions). Some disruption of community observed.	25% to 50% of riparian zone is undisturbed (normal, expected plant community for given sunlight and habitat conditions). Disruption is obvious.	Less than 25% of riparian zone is undisturbed (normal, expected plant community for given sunlight and habitat conditions).
Score (LB) ______	10 9	8 7 6	5 4 3	2 1 0
Score (RB) ______	10 9	8 7 6	5 4 3	2 1 0

FOD I-Form 15 (6/01/18)

Attachment B

ADEM-FIELD OPERATIONS-MONTGOMERY BRANCH
GLIDE/POOL HABITAT SURVEY FIELD DATA SHEET

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1 **Instream Cover**	> 50% mix of snags, submerged logs, undercut banks, or other stable habitat; rubble, gravel may be present.	50-30% mix of stable habitat; adequate habitat for maintenance of populations.	30-10% mix of stable habitat; habitat availability less than desirable.	<10% stable habitat; lack of habitat is obvious.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
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 or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
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 pools absent.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4 **Man-made Channel Alteration**	No Channelization or dredging present.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 years) may be present, but not recent.	New embankments present on both banks; channelization may be extensive, usually in urban or agriculture lands; and > 80% of stream reach is channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5 **Sediment Deposition**	<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; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost 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 0
6 **Channel Sinuosity**	Bends in stream increase stream length 3 to 4 times longer than if it was in a straight line.	Bends in stream increase stream length 2 to 3 times longer than if it was in a straight line.	Bends in stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
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.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8 **Condition of Banks**	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; 30-60% of banks in reach have areas of erosion.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; on side slopes, 60-100% of bank has erosional scars.
Score ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
9 **Bank Vegetative Protection (each bank)**	> 90% of the stream bank surfaces covered by vegetation.	90-70% of the streambank surfaces covered by vegetation.	70-50% of the stream bank surfaces covered by vegetation.	<50% of the streambank surfaces covered by vegetation.
Score (LB)	10 9 8	7 6	5 4 3	2 1 0
Score (RB)	10 9 8	7 6	5 4 3	2 1 0
10 **Grazing or other disruptive pressure (each bank)**	Vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	Disruption evident but not affecting full plant growth potential to any great extent; >1/2 of the potential plant stubble height remaining.	Disruption obvious; patches of bare soil or closely cropped vegetation common; <1/2 of the potential plant stubble height remaining.	Disruption of stream bank vegetation is very high; vegetation has been removed to ≤ 2 inches average stubble height.
Score (LB)	10 9 8	7 6	5 4 3	2 1 0
Score (RB) ____	10 9 8	7 6	5 4 3	2 1 0
11 **Riparian vegetative zone Width (each bank)**	Width of riparian zone >60 feet; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 60 - 40 feet; human activities have impacted zone only minimally.	Width of riparian zone 40 - 20 feet; human activities have impacted zone a great deal.	Width of riparian zone <20 feet; little or no riparian vegetation due to human activities.
Score (LB) ____	10 9 8	7 6	5 4 3	2 1 0
Score (RB) ____	10 9 8	7 6	5 4 3	2 1 0
12 **Riparian ZoneVegetative Quality (each bank)**	Over 80% of riparian surfaces consist of normal, expected plant community for given sunlight and habitat conditions (e.g., native plants, trees, understory shrubs, or nonwoody macrophytes). Minimal disturbance.	>50% to 80% of riparian zone is undisturbed (normal, expected plant community for given sunlight and habitat conditions). Some disruption of community observed.	25% to 50% of riparian zone is undisturbed (normal, expected plant community for given sunlight and habitat conditions). Disruption is obvious.	Less than 25% of riparian zone is undisturbed (normal, expected plant community for given sunlight and habitat conditions).
Score (LB) ____	10 9	8 7 6	5 4 3	2 1 0
Score (RB) ____	10 9	8 7 6	5 4 3	2 1 0

rev 6/18

ATTACHMENT C

Habitat Survey Summary Sheet---For Use With Laminated HS Forms

Sta/Date ___________	Coll:_____	Sta/Date ___________	Coll:_____
Riffle Run	Score (LB/RB)	Glide/Pool	Score (LB/RB)
1 Instream Cover		1 Instream Cover	
2 Epifaunal surface		2 Pool Substrate Char.	
3 Embeddedness		3 Pool Variability	
4 Velocity/Depth		4 Channel Alteration	
5 Channel Alteration		5 Sediment Deposition	
6 Sediment Deposition		6 Channel Sinuosity	
7 Frequency of Riffles		7 Channel flow Status	
8 Channel flow Status		8 Condition of Banks	
9 Condition of Banks		9 Bank Veg Protection	/
10 Bank Veg Protection	/	10 disruptive pressure	/
11 Disruptive pressure	/	11 Riparian veg zone	/
12 Riparian veg zone	/	12 Riparian Zone Veg Quality	/
13 Riparian Zone Veg Quality	/		

Sta/Date ___________	Coll:_____	Sta/Date ___________	Coll:_____
Riffle Run	Score (LB/RB)	Glide/Pool	Score (LB/RB)
1 Instream Cover		1 Instream Cover	
2 Epifaunal surface		2 Pool Substrate Char.	
3 Embeddedness		3 Pool Variability	
4 Velocity/Depth		4 Channel Alteration	
5 Channel Alteration		5 Sediment Deposition	
6 Sediment Deposition		6 Channel Sinuosity	
7 Frequency of Riffles		7 Channel flow Status	
8 Channel flow Status		8 Condition of Banks	
9 Condition of Banks		9 Bank Veg Protection	/
10 Bank Veg Protection	/	10 disruptive pressure	/
11 Disruptive pressure	/	11 Riparian veg zone	/
12 Riparian veg zone	/	12 Riparian Zone Veg Quality	/
13 Riparian Zone Veg Quality	/		

Sta/Date ___________	Coll:_____	Sta/Date ___________	Coll:_____
Riffle Run	Score (LB/RB)	Glide/Pool	Score (LB/RB)
1 Instream Cover		1 Instream Cover	
2 Epifaunal surface		2 Pool Substrate Char.	
3 Embeddedness		3 Pool Variability	
4 Velocity/Depth		4 Channel Alteration	
5 Channel Alteration		5 Sediment Deposition	
6 Sediment Deposition		6 Channel Sinuosity	
7 Frequency of Riffles		7 Channel flow Status	
8 Channel flow Status		8 Condition of Banks	
9 Condition of Banks		9 Bank Veg Protection	/
10 Bank Veg Protection	/	10 disruptive pressure	/
11 Disruptive pressure	/	11 Riparian veg zone	/
12 Riparian veg zone	/	12 Riparian Zone Veg Quality	/
13 Riparian Zone Veg Quality	/		

ADEM/FOD/EIS FOD I - Form 18 (Rev. 06/01/2018)

17 Change Tracking

Rev. Date (Review Date) Rev. #	Approved By:	Detail of Approved Change
08/01/2006 Rev. 0		Added "14.2 Annual Field Validation" procedures and corrective action measures to 14. Quality Assurance section
02/22/2007 Rev. 1.0		Annual review. Corrected non-critical typos and formatting un-related to methods addressed. Added "Note" in preface section. Deleted Section 6.2 referencing the 3 months experience requirement. Updated forms to include internal ADEM form #.
03/03/08 Rev. 1.0		Annual review—no changes
02/22/07 (06/15/09) Rev. 1.0	B. Diggs	Annual Review—no changes.
02/22/07 (02/09/11) Rev. 1.0	B. Diggs	Periodic Review—No Changes.
02/14/13 Rev. 2.0	H. Cox	Periodic Review. Made non-critical formatting and grammatical changes. Attached updated forms and updated explanations in text accordingly.
02/14/13 (01/14/15) Rev. 2.0	H. Cox	Periodic Review—No Changes.
02/14/13 (02/08/17) Rev. 2.0	H. Cox	Periodic Review—No Changes.
06/19/18 Rev. 2.1	A. Lockwood	Made non-critical formatting and grammatical changes. Throughout the SOP, changed "assessment" to "survey". This includes the title. Revised text in Section 2. Attached updated forms.

1.0 pH METER CALIBRATION AND MEASUREMENT SOP

Purpose

This SOP describes the methods for calibration and use of portable pH meters (capable of 2-point calibration) such as the Orion® Star Series pH meter and YSI multi-parameter meters. Field forms used for meter calibration and measurement recording are attached to this SOP.

Troubleshooting: The pH millivolt value should be between -50 to 50 mV in pH buffer 7. If this is not the case, this could mean the probe needs to be cleaned. Clean the probe according to the manufacturer's recommendations and then recalibrate. If the pH millivolt reading is still not within the range specified above, the reference solution inside the probe might be too old or the probe may need to be replaced.

Calibration

Orion® Star Series (or similar pH meter)

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 owner's manual for help.

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

4. Remove the probe protection cap, rinse, and place the probe in pH buffer solution 7.00 submerging the end to at least 1 inch. Allow the meter to adjust to the buffer's pH.

5. Once the meter reading shows no significant change for approximately 30 seconds, press the Calibration button on the meter to begin the calibration process. The display should read "CAL.1" along with the pH reading.

6. When the meter has accepted the buffer, the pH will stop flashing. Press the Calibration button to accept the value and proceed to the next calibration point "CAL.2"

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 or 10.01, whichever best brackets the expected pH range to be measured and stir it gently.

9. When the meter has accepted the value, the pH will stop flashing as in step 6 above. Press "Store" 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 by rinsing the probe with distilled water and then placing it in the pH 7.00 buffer solution and taking a reading. Make sure the measured symbol is lit, if not press the "Measure" button to return to measurement mode. When the pH stops flashing record this reading on the pH Calibration Record form. If the reading is between 6.70 and 7.30 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. For all-day sampling events where the meter will measure several times, verification in the two-point standards used to calibrate to check for calibration drift. Meters reading pH outside of the 10% standard solution pH should be recalibrated and that calibration should be recorded on a form or field notebook. Most measurements in the natural world should be between the 6.0-9.0 range. Furthermore, if the battery or probe is ever disconnected from the meter during use, a new calibration would be required.

YSI 556

1. Be sure that the pH 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 owner's manual for help.

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

4. Press the on/off key to display the run screen then press the Escape key to display the Main Menu screen.

5. Use the arrow key to highlight the Calibrate selection and press Enter.

6. Use the arrow keys to highlight the pH selection and press Enter to display the pH calibration screen.

7. Select the 2-point option to calibrate the pH sensor using two calibration standards then press Enter. The pH Entry Screen is displayed.

8. Remove the transport/calibration cup from the end of the probe and place the probe in pH buffer solution 7.00 so that the sensor is completely immersed, approximately 30 mL.

9. Use the keypad to enter the calibration value of the buffer being used and press Enter. The pH calibration screen is displayed. Allow at least one minute for temperature equilibration before proceeding.

10. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted and prompt you to press Enter to Continue.

11. Press Enter. This returns you to the Specified pH Entry Screen. Rinse the probe module, transport/calibration cup, and sensors in distilled water.

12. Repeat steps 8 through 10 using the second pH buffer solution, 4.01 (pink), or 10.01 (blue), whichever best brackets the expected pH range to be measured.

13. Press Escape to return to Main Menu. Use the keypad and select Run.

14. 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 6.70 and 7.30 then the original calibration remains valid. If the measurement falls outside this range, then the meter should be recalibrated.

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

16. The pH meter should be calibrated once per day on days that it is used. For all-day sampling events where the meter will measure several times, verification in the two-point standards used to calibrate to check for calibration drift. Meters reading pH outside of the 10% standard solution pH should be recalibrated and that calibration

should be recorded on a form or field notebook. Most measurements in the natural world should be between the 6.0-9.0 range. Furthermore, if the battery or probe is ever disconnected from the meter during use, a new calibration would be required.

YSI Pro

1. Be sure that the pH 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 owner's manual for help.

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

4. Pour enough pH 7 standard into the calibration cup to immerse the pH bulb and the temperature sensor.

5. Press the Call button.

6. Highlight ISE1 pH, press enter.

7. The instrument will automatically recognize the standard value and will display it at the top of the screen. If the standard is incorrect scroll up to change it.

8. Once the meter reading shows no significant change for approximately 30 seconds, highlight accept calibration and press enter to accept the first calibration point.

9. Record after Calibration pH Reading in pH units and the post-calibration pH millivolts on the calibration sheet. This pH millivolt value should be between 165 mV and 180 mV below the pH 7 mV reading. If this is not the case, this could mean the probe needs to be cleaned. Clean the probe according to the manufacturer's recommendations (see the section on page 25 of this manual on sensor maintenance and cleaning) and then recalibrate. If the pH millivolt reading is still not within the range specified above, the reference solution inside the probe might be too old. The sensor may need further maintenance or to be replaced. The lifespan of reference solution inside pH sensors is only 1.5-2 years. Remove the calibration cup from the bulkhead and dispose of the pH 7 standard.

10. Pour enough pH standard into the calibration cup to immerse the pH bulb and the temperature sensor.

11. Once the pH and temperature readings stabilize, record the Before Calibration pH reading in pH units on the calibration worksheet. This value will display under actual readings.

12. The instrument will automatically recognize the standard value and will display it at the top of the screen. If the standard is incorrect scroll up to change it.

13. Once the meter reading shows no significant change for approximately 30 seconds, highlight Accept Calibration and press the Cal button to finish the pH calibration.

14. Record after calibration pH Reading in pH units and the post-calibration pH millivolts on the calibration sheet. If the pH millivolt reading is still not within the range specified above or in the manual, the reference solution inside the probe might be too old or the sensor may need further maintenance or to be replaced. The lifespan of reference solution inside pH sensors is only 1.5-2 years.

pH Measurements

Orion® Star Series (or similar pH meter)

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

2. Press the “Measure” button to begin. The measure symbol will flash until the reading is stable. When the pH stops flashing record the reading to the nearest tenth of a unit.

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

YSI 556 and YSI Pro

1. Power on the probe so that the main menu is on display.

2. With the probe sensor guard installed, completely immerse all sensors into the sample.

3. Allow the meter to stabilize and record the pH reading to the nearest tenth of a unit.

Meter Maintenance/Storage

1. Store the meter in a safe dry place. When coming back from the field, open pelican cases that meters are stored in to allow the meter and its parts to dry sufficiently.

2. Keep a clean moist sponge (use pH buffer 4.0 to keep the sponge moist) in the transport/calibration cup and keep sealed when not in use and between measurements. The probes should never be allowed to dry out.

3. A small piece of sponge soaked in pH buffer 4.00 should be placed 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.

Quality Assurance/Quality Control

1. Meters are calibrated bi-monthly (at a minimum) to ensure proper function and accuracy.

Calibration Field Form

Bubbled From:

Dissolved Oxygen Meter Air Calibration Record							
Calibrators Initials	Date	Time	Meter	100% Air Saturation (mg/l)	Altitude (ft)	Barometric Pressure (mm Hg)	Comments
			Pro Do (New)				
			YSI Pro #1				
			YSI Pro #2				
			YSI 556				

pH Meter Calibration Record								
Calibrators Initials	Date	Time	Meter	Standard	Slope	7.00 Buffer Check	4.00 Buffer Check	Comments
			Thermo Scientific #1					
			Thermo Scientific #2					
			Thermo Orion (Black)					
			YSI Pro #1					
			YSI Pro #2					
			YSI 556					

Conductivity						
Calibrators initials	Date	Time	Meter	Standard	Meter Cond:	Comments
			YSI 556			
			YSI Pro #1			
			YSI Pro #2			

Turbidity									
Calibrators initials	Date	Time	Gel Standard			Meter Reading			Comments
			0-10	0-100	0-1000	0-10	0-100	0-1000	

Temperature						
Calibrators initials	Date	Time	Meter	Thermometer Temperature °C	Meter Temperature °C	Comments

2.0 DISSOLVED OXYGEN (D.O.) METER CALIBRATION AND MEASUREMENT SOP

Purpose

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

Procedure

Important notes:

- For any DO calibrations using the YSI 556 or Pro, the meters should be turned on for 10-15 minutes for the probes to polarize.
- Membranes should be changed regularly and generally last 2-8 weeks depending on use and storage. Sponges should be changed since bacterial growth may consume oxygen and interfere with calibration.
- If DO will not calibrate correctly, check the conductivity sensor, ensure that it is calibrated, and reading correctly to obtain accurate DO mg/L (ppm) measurements.
- Typical causes of a calibration error message include an incorrect sensor, membrane, or port setup in the instrument, incorrect barometric pressure information, a bad membrane, or a sensor that needs to be reconditioned.

Calibration

YSI 556

1. Be sure that the D.O. 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 owner’s manual for help.
3. Record the proper information (date, time, etc.) on the Calibration Field Form (attached) or in a field notebook.

Perform an Air Calibration Procedure:

1. Press the on/off key to display the run screen then press the Escape key to display the Main Menu screen.

2. Use the arrow key to highlight the Calibrate selection and press Enter.

3. Use the arrow keys to highlight the Dissolved Oxygen selection and press Enter to display the DO calibration screen.

4. Highlight the DO % selection and press Enter. The DO Barometric Pressure Entry Screen is displayed.

5. Remove the transport/calibration cup to ensure the sponge is “dripping” wet and engage only 1 or 2 threads of the transport/calibration cup to the probe module to ensure the DO sensor is vented to the atmosphere. Make sure that the DO and temperature sensors are not immersed in the water.

6. Allow approximately 5-15 minutes for the air in the transport/calibration cup to become saturated.

7. Evaluate the barometric pressure. If the pressure needs to be calibrated, use the keypad to enter the current local barometric pressure either measured by the YSI 556 or from the NWS/NOAA for your area. Barometer readings from the NWS/NOAA are generally corrected to sea level and must be uncorrected before use. For field DO calibrations, use the following equation to correct National Weather Service & NOAA sea-level corrected barometric pressure to absolute barometric pressure:

   $$BP \sim SLBP - 2.5(A/100)$$

   SLBP = sea level BP
   A = altitude in feet above sea level

8. Press Enter. The DO % saturation calibration screen is displayed. Allow approximately ten minutes for the air in the transport/calibration cup to become saturated and for the temperature to equilibrate before proceeding.

9. Observe reading under DO %. When the reading shows no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted and prompt you to press Enter to Continue. Record the resulting % saturation value, which should be between 95% and 105%.

10. Press Enter to return to the DO calibration screen then press Escape to return to the calibrate menu.

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

YSI Pro

1. Be sure that the D.O. 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 owner’s manual for help.

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

Perform an Air Calibration Procedure:

1. Press the on/off key to display the run screen.

2. Remove the transport/calibration cup to ensure the sponge is “dripping” wet and engage only 1 or 2 threads of the transport/calibration cup to the probe module to ensure the DO sensor is vented to the atmosphere. Make sure the DO and temperature sensors are in an upright position and not immersed in the water.

3. Allow approximately 5-15 minutes for the air in the transport/calibration cup to become saturated.

4. Press the Cal key to display the Calibrate screen. Highlight the DO % selection and press Enter. The DO Barometric Pressure Entry Screen is displayed.

5. The instrument will use the internal barometer during calibration and will display this value in brackets at the top of the display. Highlight Barometer and press enter to adjust it if needed. If the barometer reading is incorrect, it is recommended that you calibrate the barometer.

6. Press Enter. The DO % saturation calibration screen is displayed.

7. Observe reading under DO %. When the reading shows no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted and prompt you to press Enter to Continue. Record the resulting % saturation value, which should be between 95% and 105%.

8. Press Enter to return to the DO calibration screen then press Escape to return to the calibrate menu.

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

YSI ODO

1. Remove the transport/calibration cup to ensure the sponge is “dripping” wet and engage only 1 or 2 threads of the transport/calibration cup to the probe module to ensure the DO sensor is vented to the atmosphere. Make sure the DO and temperature sensors in an upright position and are not immersed in the water. The sponge should be clean since bacterial growth may consume oxygen and interfere with the calibration.

2. Wait approximately 5 to 10 minutes for the storage container to become completely saturated and to allow the temperature and dissolved oxygen sensors to stabilize.

3. Press Calibration. Highlight DO and press enter.

4. Highlight DO % and press enter to confirm.

5. The instrument will use the value from the internal barometer during calibration and will display this value in brackets at the top of the display. Highlight the barometer value and press enter to adjust it if needed. If the barometer reading is incorrect, it is recommended that you calibrate your barometer.

6. Wait for the temperature and DO% values under “Actual Readings” to stabilize, then highlight Accept Calibration and press enter to calibrate.

7. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal to complete the calibration. The message line at the bottom of the screen will display “Calibrating Channel...” followed by “Calibration Successful”. Press Esc to cancel the calibration and the meter is ready for use.

   Note - the barometer should be reading “true” barometric pressure (see Barometer section in the manual for more information on “true” barometric pressure). If the value is acceptable, there is no need to change it or perform a barometer calibration.

D.O. Measurements

YSI 556

1. Press the on/off-key.

2. Make sure the probe sensor guard is installed.

3. Place the probe module in the sample. Be sure to completely immerse all the sensors.

4. Gently move the probe module through the sample to provide a fresh sample to the DO sensor.

5. Watch the readings on the display until they are stable. Once stabilized, record reading to the nearest tenth mg/L.

YSI Pro

1. Press the on/Off key. Install the sensor guard to protect the sensor and membrane.

2. Place the probe in the sample to be measured and give the probe a quick shake to release any air bubbles.

3. Allow the temperature readings to stabilize. Next, stir the probe in the sample to overcome the stirring dependence of the dissolved oxygen sensor.

4. Watch the readings on the display until they are stable. Once stabilized, record reading to the nearest tenth mg/L.

YSI ODO

1. To take readings, insert the probe into the sample.

2. Move the probe in the sample to release any air bubbles and to provide a fresh sample to the sensor cap. This movement is only necessary when first inserting the probe into the sample. Since the ProODO utilizes optical luminescent technology, continuous sample movement or stirring is not required.

3. The probe will fit into a 300 mL BOD bottle for taking initial and final BOD readings. For best results in a BOD bottle, a stirring device should be used to properly mix the sample and to keep solids from settling at the bottom.

4. Allow the temperature readings to stabilize and wait approximately 25-35 seconds for the DO readings to stabilize.

5. Record reading to the nearest tenth mg/L.

   Note - There is NO WARM-UP period associated with the ProODO sensor so you may wish to turn off the ProODO instrument between readings to conserve battery power.

Meter Maintenance/Storage

1. Store the meter in a safe dry place. When coming back from the field, open pelican cases that meters are stored in to allow the meter and its parts to dry sufficiently.

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

3. A small piece of clean sponge soaked in pH buffer 4.0 solution should be placed 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 approximately 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 bi-monthly (at a minimum) to ensure proper function and accuracy.

Calibration Field Form

Bubbled From:

Dissolved Oxygen Meter Air Calibration Record							
Calibrators Initials	Date	Time	Meter	100% Air Saturation (mg/l)	Altitude (ft)	Barometric Pressure (mm Hg)	Comments
			Pro Do (New)				
			YSI Pro #1				
			YSI Pro #2				
			YSI 556				

pH Meter Calibration Record								
Calibrators Initials	Date	Time	Meter	Standard	Slope	7.00 Buffer Check	4.00 Buffer Check	Comments
			Thermo Scientific #1					
			Thermo Scientific #2					
			Thermo Orion (Black)					
			YSI Pro #1					
			YSI Pro #2					
			YSI 556					

Conductivity						
Calibrators initials	Date	Time	Meter	Standard	Meter Cond:	Comments
			YSI 556			
			YSI Pro #1			
			YSI Pro #2			

Turbidity									
Calibrators initials	Date	Time	Gel Standard			Meter Reading			Comments
			0-10	0-100	0-1000	0-10	0-100	0-1000	

Temperature						
Calibrators initials	Date	Time	Meter	Thermometer Temperature °C	Meter Temperature °C	Comments

3.0 CONDUCTIVITY METER CALIBRATION AND MEASUREMENT SOP

Purpose

This SOP describes the methods for calibration and use of portable YSI 556 and ProPlus meters. Field forms used for meter calibration and measurement recording are attached to this SOP.

Important Notes

GBMc generally measures specific conductance in its field studies. The following are the modes of measurement:

Conductivity - the 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.

Conductivity Solution after opened is only good for 6 months. Be sure to label the bottle when opened and look at the date when calibrating.

Calibration

YSI 556

1. Press the on/off key to display the run screen.

2. Press the Escape key to display the main menu screen.

3. Use the arrow keys to highlight the Calibrate selection.

4. Use the arrow keys to highlight the Conductivity selection. Press Enter.

5. Place the conductivity standard into a clean, dry, or pre-rinsed transport/calibration cup.

6. Carefully immerse the sensor end of the probe module into the solution. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

7. Be sure to enter the value in mS/cm. Most conductivity standard solutions are in µg/L, so the conversion is important. For example, if the standard is 1,000 µg/L, you would enter 1 mS/L.

8. Allow at least one minute for temperature equilibration before proceeding.

9. When the reading shows no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted and prompt you to press Enter again to Continue.

10. Record the conductivity on the calibration form.

YSI Pro

1. Turn the meter on, press Cal on the meter, and from the main menu use the arrow keys to highlight the Conductivity selection.

2. Press Enter and then highlight the Specific Conductance selection, press Enter.

3. The conductivity calibration Entry Screen is displayed. Place enough conductivity standard to immerse the sensor into a dry or pre-rinsed transport/calibration cup.

4. Carefully immerse the sensor into the solution and gently rotate to remove any bubbles from the conductivity cell. Screw the transport/calibration and securely tighten.

5. Use the keypad to enter the calibration value of the standard being used. Be sure to enter the value in the correct units, press Enter.

6. The conductivity calibration Screen is displayed. Allow at least one minute for temperature equilibration before proceeding.

7. Observe the reading under Specific Conductance until no significant change or for approximately 30 seconds, press Enter. After calibration has been accepted, press Enter to continue.

8. Press Enter and then press Escape to return to calibrate the menu. Rinse probe and sensors with distilled water. Gently shake or rinse off excess liquid from the probe. The meter is now ready for use.

Measure with YSI 556 and YSI Pro

1. Ensure that the probe is securely connected to the meter and press the on/off button.
2. With the probe sensor guard installed, completely immerse all sensors into the sample.
3. Allow the meter to stabilize and record the Conductivity reading.

Meter Maintenance/Storage

1. Store the meter in a safe dry place. When coming back from the field, open pelican cases that meters are stored in to allow the meter and its parts to dry sufficiently.
2. Keep the probe cover on the probe when not in use and between measurements.
3. A small piece of clean sponge soaked in pH buffer 4.0 solution should be placed in the bottom of the probe cover to keep the probe surface moist. The probe should never be allowed to dry out.

Cleaning the conductivity cell

1. Dip the cell in a 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 bi-monthly (at a minimum) to ensure proper function and accuracy.

Calibration Field Form

Bubbled From:

Dissolved Oxygen Meter Air Calibration Record							
Calibrators Initials	Date	Time	Meter	100% Air Saturation (mg/l)	Altitude (ft)	Barometric Pressure (mm Hg)	Comments
			Pro Do (New)				
			YSI Pro #1				
			YSI Pro #2				
			YSI 556				

pH Meter Calibration Record								
Calibrators Initials	Date	Time	Meter	Standard	Slope	7.00 Buffer Check	4.00 Buffer Check	Comments
			Thermo Scientific #1					
			Thermo Scientific #2					
			Thermo Orion (Black)					
			YSI Pro #1					
			YSI Pro #2					
			YSI 556					

Conductivity						
Calibrators initials	Date	Time	Meter	Standard	Meter Cond:	Comments
			YSI 556			
			YSI Pro #1			
			YSI Pro #2			

Turbidity									
Calibrators initials	Date	Time	Gel Standard			Meter Reading			Comments
			0-10	0-100	0-1000	0-10	0-100	0-1000	

Temperature						
Calibrators initials	Date	Time	Meter	Thermometer Temperature °C	Meter Temperature °C	Comments

4.0 TEMPERATURE MEASUREMENT/CHECK AND CALIBRATION SOP

Purpose

This SOP describes the methods for the measurement of temperature using various instruments including the Orion Star Series pH meter(s), YSI Pro, and YSI 556 as well as other meters with temperature capability. Field forms used for meter calibration and measurement recording are attached to this SOP.

Procedure

Accuracy Check for all Instruments

1. Insert the probe into a container holding water, and allow the temperature reading to stabilize.

2. Record the temperature displayed on each respective instrument in the calibration logbook or field notebook along with date/time and individual performing the task.

3. Compare the actual temperature of the water measured with a 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 Star Series 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 readout is located in the upper left of the LCD on the meter.

YSI Pro

1. Turn the meter on.

2. Insert the probe into the solution to be measured.

3. The temperature readout is located in the lower right of the LCD on the meter.

YSI 556

1. Turn the meter on.

2. Insert the probe into the solution to be measured.

3. The temperature readout is located on the screen.

Meter Maintenance/Storage

1. Store the meter in a safe dry place. When coming back from the field, open pelican cases that meters are stored in to allow the meter and its parts to dry sufficiently.

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

3. A small piece of clean sponge soaked in pH buffer 4.0 solution should be placed in the bottom of the probe cover to keep the probe surface moist. The probe should never be allowed to dry out.

Quality Assurance/Quality Control

1. Meters are calibrated bi-monthly (at a minimum) to ensure proper function and accuracy.

Calibration Field Form

Bubbled From:

Dissolved Oxygen Meter Air Calibration Record							
Calibrators Initials	Date	Time	Meter	100% Air Saturation (mg/l)	Altitude (ft)	Barometric Pressure (mm Hg)	Comments
			Pro Do (New)				
			YSI Pro #1				
			YSI Pro #2				
			YSI 556				

pH Meter Calibration Record								
Calibrators Initials	Date	Time	Meter	Standard	Slope	7.00 Buffer Check	4.00 Buffer Check	Comments
			Thermo Scientific #1					
			Thermo Scientific #2					
			Thermo Orion (Black)					
			YSI Pro #1					
			YSI Pro #2					
			YSI 556					

Conductivity						
Calibrators initials	Date	Time	Meter	Standard	Meter Cond:	Comments
			YSI 556			
			YSI Pro #1			
			YSI Pro #2			

Turbidity									
Calibrators initials	Date	Time	Gel Standard			Meter Reading			Comments
			0-10	0-100	0-1000	0-10	0-100	0-1000	

Temperature						
Calibrators initials	Date	Time	Meter	Thermometer Temperature °C	Meter Temperature °C	Comments

5.0 TURBIDITY METER CALIBRATION AND MEASUREMENT SOP

Purpose

This SOP describes the methods for calibration and use of the portable HACH Model 2100P Turbidimeter. Most of the time, the turbidimeter just needs to be verified that it is within 10% of the StablCal® or Gelex® standards. Calibration should be completed annually or when the standards fall outside the acceptable range >± 10%.

Calibration

Procedure

1. Push the CALIBRATION key to enter the Calibration mode.

2. Follow the instructions on the display.

   Note: If using StablCal® standards gently invert each standard before inserting the standard.

3. Insert the 20 NTU StablCal Standard and close the lid.

   Note: The vials have arrows on the side, line the arrows up before entering into turbidimeter.

4. Push Read.

5. The display shows stabilizing and then shows the result.

6. Repeat Step 2 and 3 with the 100 NTU and 800 NTU Standards or similar concentrations.

   Note: Push Done to complete a 2-point calibration or continue to 3-point calibration.

7. Push Done to review the calibration details.

8. Push Store to save the results. After calibration is complete, the meter automatically goes into the Verify Cal mode.

Checking Meter Calibration

1. The standards should be used as a routine check for instrument calibration. If the standards do not read within 10% of the assigned value, the instrument should be recalibrated before use.

2. Place the instrument on a flat surface.

3. After turning the instrument on.

4. Clean the outside of the vial with a soft, lint-free cloth removing water spots and fingerprints.

5. Insert the 0-10 NTU standard into the cuvette compartment with the orientation (arrow) mark on the vial 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 via land compare the value on the band near the top of the vial with the recorded value. If the recorded value is within 10% of the value marked on the vial, continue to step 8. Otherwise, recalibrate the instrument.

8. Repeat steps 3 through 6 for the other two 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 the sample, taking care to prevent the formation of air bubbles.

2. Clean the outside of the cuvette with a soft, lint-free cloth removing water spots and fingerprints.

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. 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 standards should be stored in a clean state in the proper boxes in the portable carrying case.

Quality Assurance/Quality Control

1. Meters are calibrated bi-monthly (at a minimum) to ensure proper function and accuracy.

Calibration Field Form

Bubbled From:

Dissolved Oxygen Meter Air Calibration Record							
Calibrators Initials	Date	Time	Meter	100% Air Saturation (mg/l)	Altitude (ft)	Barometric Pressure (mm Hg)	Comments
			Pro Do (New)				
			YSI Pro #1				
			YSI Pro #2				
			YSI 556				

pH Meter Calibration Record								
Calibrators Initials	Date	Time	Meter	Standard	Slope	7.00 Buffer Check	4.00 Buffer Check	Comments
			Thermo Scientific #1					
			Thermo Scientific #2					
			Thermo Orion (Black)					
			YSI Pro #1					
			YSI Pro #2					
			YSI 556					

Conductivity						
Calibrators initials	Date	Time	Meter	Standard	Meter Cond:	Comments
			YSI 556			
			YSI Pro #1			
			YSI Pro #2			

Turbidity									
Calibrators initials	Date	Time	Gel Standard			Meter Reading			Comments
			0-10	0-100	0-1000	0-10	0-100	0-1000	

Temperature						
Calibrators initials	Date	Time	Meter	Thermometer Temperature °C	Meter Temperature °C	Comments

6.0 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 streamflow differences. The 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 2000 Flo-Mate 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 the 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, when possible. 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, or make note if the right bank is used as “zero”. 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) or make note if vice versa is completed.

4. Attach the velocity meter probe to the calibrated wading rod that indicates the 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 the manufacturer’s recommendations).

5. Divide the total wetted stream width into equally sized intervals. There should be a minimum of ten measurement locations, however, fifteen to twenty is preferred for the best resolution.

6. Stand downstream of the tape and to the side of the midpoint of the first interval.

7. Place the wading rod in the stream at the midpoint of the interval. Record the distance from the 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 streamflow. If the water depth is less than or equal to 2.5 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 2.5 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, and

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 Marsh-McBirney meter, use the lowest time constant scale setting on the meter that provides stable readings.

11. Move to 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 streamflow. 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 replicate should be averaged together for each spillway; use additional field measurement forms if necessary.

Neutrally Buoyant Object Procedure

In streams too shallow or too swift/high to wade the neutrally buoyant object method may be employed in place of the velocity-area method. 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 oranges (preferred), limes, large 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. In large systems, each of the three replicates should be placed at approximately ¼, center, and ¾ of channel width locations.

5. The 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 the 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 or a field computer. Any additional observations will be recorded in field notebooks. Calculations will be performed using excel spreadsheets to determine flow volume in cubic feet per second (cfs) by using either a field computer or entered upon return to the office. If the flow is not entered in a field computer, flow data should be entered into excel spreadsheet templates within 48-72 hours upon return to the office from the field.

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 2000). 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.

For comprehensive loading-based studies and/or hydraulic modeling 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.

Marsh McBirney meters should be sent to Hach approximately once a year to be certified calibrated.

Discharge/Flow Measurement Form

Station:		
Waterbody:		
Date:		
Crew:	Start Time:	Recorder:
	End Time:	GH. Change: ________________in
	Staff/Gage:	_______________hrs .
Width:	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/Observations:

V1.1 01/2012

(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)
TOTALS							

13.0 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.

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 and analyzed for chemicals of concern according to the project study plan or proposal. 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 and analyzed for chemicals of concern according to the project study plan or proposals. 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 if one has not been supplied by the laboratory, 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 each bottle per site and place the cap securely each bottle.

    When filling sample bottles be sure to choose a representative sample location that 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 protocol should be followed:

    a. record flow for each sample time on the COC form or field notebook
    b. include compositing instructions on the COC form for laboratory use
    c. or composite on-site prior to delivery to the lab

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 the sample holding times and make an effort to return samples to the 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 the 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 or scanned into a pdf and stored in the project file.

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.

GBM^c & Associates
219 Brown Ln.
Bryant, AR 72022
(501) 847-7077 Fax (501) 847-7943

Chain of Custody

Client/Billing Information		SPECIAL INSTRUCTIONS/PRECAUTIONS:
Contact:		
Company:		
Address:		
		Project Name / Number:
Phone No.:		
Fax No.:		

Sample ID	Sample Description	Date	Time	Matrix S=Sed/Soil W=Water	Number of Containers	Composite or Grab	Parameters for Analysis/Methods				
Preservative	(Sulfuric acid =S, Nitric acid =N, Hydrochloric acid= H, 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:________________

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. This form is utilized as part of habitat assessments and as the first form in unified stream assessments (USA). The information (apart from 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. Estimate or measure the gradient (under surface slope) and record on the form.

6. Hydrology

   Check the appropriate current flow status of the stream (low, moderate, high) and indicate if flow measurements will be taken. If slope and sinuosity were measured record on form.

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. Riparian Vegetation

   Record the dominant riparian vegetation and the average (typical) buffer width.

9. Stream Morphology

   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. Each collaborating biologist may initial the field form in this section if necessary for documentation.

10. Stream Disturbances

    Note any observed stream disturbances in the reach on the field form. Check appropriate observations related to channelization, erosion and chemical stability ("dynamics").

11. Water/Observations

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

12. 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. If this form is part of a USA, additional information is provided on the primary USA form on a Reach level basis.

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 reflect 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 is 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 are 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. This protocol typifies the methodology used in GBMc & Associates aquatic biologists. However, variations on this approach is commonly utilized to fit specific state monitoring program methodology, such that direct collection comparisons can be made.

Procedure

Pool Dominated Stream/Multihabitat Approach (Timed Method)

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 number of kicks, jabs or sweeps may be tallied to provide a measure of area sampled. That is, for every kick, jab or sweep approximately $0.25m^2$ is sampled, dependent on the size of the net and the approach utilized by the collector. The net is periodically emptied into a bucket for transport of the sample up and down the stream reach.

Riffle Dominated Stream Approach (Timed Method)

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 or raked 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. An area of approximately $1m^2$ should be kicked at each location sampled, and the total number of locations sampled should be tallied to provide an estimate of total sampled area.

Riffle Focused Multi-habitat Approach (Area Method)

An alternate sampling protocol for collection of macroinvertebrates in riffle dominated streams involves the collection of all dominant habitats with an emphasis in the riffles. In this protocol $5m^2$ of riffle habitat are sampled as described above and $5m^2$ of non-riffle, pool and run habitat (root wads, deposition, vegetation, etc.) are sampled as described in the pool dominated stream protocol. The two samples (riffle and non-riffle) are kept in separate buckets and processed separately so that analysis in the lab will provide a riffle collection and a run/pool collection.

Sample Processing

After collection, samples are initially sorted and concentrated using a series of U.S. standard sieves the smallest of which has a #35 mesh with an opening size of 500μm.

One of two processing methods may be utilized. Either method can be completed in the field.

1. Random Pick Method - 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.
2. Random sub-sampling – The sample collected is condensed and spread evenly in a sorting tray (caton style or similar). The tray is composed of several equal sized grids and random numbers are drawn (or rolled on dice) to determine which grid(s) is picked. The debris from selected grids is removed and placed in a tray. All organisms from the debris, from a single grid, are removed This process is continued until the appropriate sample size (100, 200 etc.) within ±10% is achieved. It may take one grid or several grids, dependent on organism abundance, to attain the

required sample size. A minimum of two grids should be picked to limit potential bias. Once picking of a grid begins all organisms must be removed regardless of surpassing the target sample size. As an alternative to the grided sorting tray a 4" ring (crochet style) may be tossed at random into a tray debris spread evenly. All the debris within the ring is removed and processed in the same manner as for a grid. This process is also repeated until the required sample size is attained.

The 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 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 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 (7-day maximum) 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), percent EPT, percentage of dominant ordinal groups, species diversity as determined by the Shannon-Wiener diversity Index, a biotic index (measure of species tolerance to perturbation) such as Hilsenhoff's Biotic Insex (HBI) and 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 either picked out individually or a grid may be used to random pick a specific amount of debris. 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 or 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 will be 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 or if the principal investigator determines that a representative collection has been obtained. 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 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, fish released 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 between 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 success 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, record the location, 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^{o} 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 GBM^c & 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.

GBMc & ASSOCIATES

219 BROWN LANE, BRYANT, AR
WWW.GBMcASSOC.COM
501-847-7077

GBMc & ASSOCIATES
STRATEGIC ENVIRONMENTAL CONSULTING

219 BROWN LANE, BRYANT, AR 72022
WWW.GBMcASSOC.COM
501-847-7077

July 2, 2021

Mr. Theo Pinson
Industrial Section, Industrial/Municipal Branch
Water Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, AL 36110-2400

RE: 316(a) Study Rationale - Cherokee Nitrogen LLC – NPDES Permit No. AL0000418
GBM[c] No. 2086-20-070

Dear Mr. Pinson,

This letter is a follow-up to previous conversations related to Cherokee Nitrogen's upcoming permit renewal. As you are aware the decision by ADEM to move the compliance point for Cherokee Nitrogen from the Tennessee River, upstream to the waterfall on the unnamed drain, is anticipated to bring more stringent limits for some parameters, including temperature. The facility has been evaluating these concerns and proposes completing a 316(a) study, as originally suggested by ADEM as a reasonable solution to address temperature.

We propose to complete a Type III 316(a) Demonstration to document no appreciable harm to the stream system (USEPA, 1974 and USEPA, 1977). Type III demonstrations are usually completed when the situation is unique, and the usual information may not be available or not be applicable and warrants a special study that is less rigorous. The rationale for a Type III Demonstration is:

1. The effluent discharge temperature has not changed appreciably for years, only the permitting of it has evolved.
2. The effluent discharge temperature predates the Clean Water Act.
3. 316(a) studies are traditionally completed on large water bodies rather than small first order streams like this case. There is unlikely to be a large body of data available on biota for such a small stream in this area, and likely none collected for this purpose.
4. The stream channel above the waterfall is erosional in form (geomorphically) and would likely not exist or be a small ephemeral drain without the current NPDES outfall and the stormwater flows incurred from the industrial and agricultural land uses in its watershed over the past several decades.
5. The length of stream below the waterfall (where it becomes a water of the state) is less than 0.2 miles to the mouth of the Tennessee River and is highly influenced by the water levels of the River. Approximately 500 feet of channel exists between the most downstream riffle and the waterfall (where it is less affected by the river), making it the only representative sample reach and a very small one, with a limited amount of aquatic habitat for biota.
6. Due to all of the points noted above, the area may be classifiable as a "low potential impact" area.

RECEIVED
JUL 0 2 2021
IND/MUN BRANCH

Therefore, we are proposing the following Type III study be completed to support the variance and document the existence of an appropriate (appropriate for reach size and habitat) balanced and indigenous population (community) (40CFR 122.1 and USEPA, 1974) in the stream. Once these study concepts (or variations thereof) are agreed upon with ADEM, Cherokee Nitrogen will develop and submit a detailed Workplan for approval prior to beginning field work. The goal is to begin the field study in October 2021 and have the entire 316(a) demonstration study completed and submitted to ADEM in the summer of 2022.

Study Outline

1. Background. Plant history, regulatory history and reason for variance request.
2. Biological study.
    a. Review any existing or local data from similar stream types in the ecoregion. Summarize findings.
    b. Collect fish and macroinvertebrates from the stream reach below the waterfall, during the fall and spring for macroinvertebrates (two collection events) and during the fall only for fish (one collection event). One fish collection was selected due to the small sample reach and the potential to affect the population from completing multiple sample events over a short time period. Fish and macroinvertebrates collected will be identified to the genus[1] or species level This data will be analyzed, and community metrics calculated. Goal is to show that the current discharge is allowing for a balance community of indigenous fish to thrive. A reference condition will not be used due to the unique nature of the discharge and the anticipated difficulty in finding a reference stream with similar geomorphology, habitat and history. This bioassessment will set a baseline for future monitoring should any be required.
    c. A thermal tolerance evaluation of species collected will be completed.
3. Summary of Hydrology and Engineering Basis. Discuss discharge configuration, provide summary of discharge parameters, flow history and sources, etc. Provide a calculation and/or modeling of estimated background flow from stormwater run-off and from the spring. Discuss plume modeling in river and attainment of temperature standard.
4. Request for Variance. Provide the specific temperature requested and the rational for this request, based on the data collected during the study. It will include calculation methods and calculations as appropriate.
5. References
6. Appendices with supporting documents and information

[1] Fish will be identified to species level and macroinvertebrates to genus level, with the exception of a select few representatives such as Chironomidae and oligochaete which will be to family or subfamily.

We greatly appreciate your consideration of this study rationale and are available to discuss the plan, actions and schedules proposed at your convenience.

Respectfully submitted on behalf of Cherokee Nitrogen,
GBMc & ASSOCIATES

Greg Phillips
Principal/Senior Scientist

cc: Keith Long – LSB Corporation
Andy Dolan – LSB-Cherokee Nitrogen

LANCE R. LEFLEUR
DIRECTOR

KAY IVEY
GOVERNOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ▪ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ▪ FAX (334) 271-7950

OCTOBER 22, 2019

MR BEN VAN VECKHOVEN
GENERAL MANAGER
CHEROKEE NITROGEN LLC
1080 INDUSTRIAL DRIVE
CHEROKEE ALABAMA 35616-0250

RE: 316(B) DE MINIMIS STUDY REPORT
NPDES PERMIT NUMBER AL0000418

Dear Mr. Van Veckhoven:

The Department has reviewed the 316(b) Compliance De Minimis Rate of Impingement Study Report received on July 3, 2019. The Department has no comments on the study report. The documented rate of impingement at the cooling water intake appears to warrant no additional controls at this time. If you have any questions regarding this determination, please contact Theo Pinson by e-mail at **tpinson@adem.alabama.gov** or by phone at **(334) 274-4202.**

Sincerely,

Scott Ramsey, Chief
Industrial Section
Industrial/Municipal Branch
Water Division

GBM^c

Cherokee Nitrogen L.L.C.
316(b) Compliance: De Minimis Rate of Impingement Study Report

July 3, 2019

GBM^c & Associates
Strategic Environmental Services

316(b) Compliance: De Minimis Rate of Impingement Study Report

Prepared for:

Cherokee Nitrogen L.L.C.
1080 Industrial Drive
Cherokee, Alabama 35616-0250

Prepared by:

GBM[c] & Associates
219 Brown Lane
Bryant, AR 72022

July 3, 2019

CONTENTS

TABLE

APPENDICES

1.0 INTRODUCTION

Cherokee Nitrogen L.L.C. (Cherokee Nitrogen) is operating under the National Pollutant Discharge Elimination System (NPDES) Permit No. AL0000418 and is currently going through the renewal process. During this NPDES permit renewal cycle, the Alabama Department of Environmental Management (ADEM) required additional information from the facility to comply with the Section 316(b) rule of the Clean Water Act. This additional 316(b) supporting documentation, detailed in 40 CFR 122.21(r)(2-8), was submitted to ADEM on March 15, 2017 and included a request/schedule for additional time to evaluate river withdraw flows through their cooling water intake structures (CWIS) [40 CFR 122.21(r)(5)] and (if necessary) compliance options associated with 40 CFR 122.21(r)(6).

The determination was made based on operational information that the facility is subject to the final 316(b) rule (August 15, 2014). The rule requires Cherokee Nitrogen to comply with one of seven Best Technology Available (BTA) compliance options for Impingement Mortality (IM). Additionally, the rule provides at 40 CFR 125.94(c)(11) that there may be cases where the rate of impingement is so low *(De Minimis)* that additional controls may not be justified. The rule states that "the Director, based on a review of site-specific data submitted under 40 CFR 122.21(r), may conclude that the documented rate of impingement at the cooling water intake is so low that no additional controls are warranted. For threatened or endangered species, all unauthorized take is prohibited by the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.)*. Notice of a determination that no additional impingement controls are warranted must be included in the draft or proposed permit and the Director's response to all comments on this determination must be included in the record for the final permit."

Following discussions and meetings with ADEM, Cherokee Nitrogen requested ADEM's approval to conduct a site-specific *De Minimis* impingement study based on their existing operational conditions and controls of the facility's Cooling Water Intake Structure (CWIS). This request for approval was submitted to ADEM through a study plan dated August 3, 2018. This study plan was reviewed and approved by ADEM via a letter dated November 30, 2018. Appendix A provides a copy of Cherokee Nitrogen's study plan as well as ADEM's approval letter.

This report provides the results of Cherokee Nitrogen's *De Minimis* rate of impingement study completed over seven months in five 1-week periods (December 2018, January 2019, April 2019, May 2019, and June 2019) to aid in the determination of the *De Minimis* applicability. The following sections of the report provide facility operational conditions during the study, sampling methods, study results, and discussions of Cherokee Nitrogen's *De Minimis* rate of impingement study.

2.0 OPERATIONAL CONDITIONS

Cherokee Nitrogen currently operates a CWIS located on the Tennessee River within the Pickwick Lake Reservoir. Appendix B provides area maps detailing the facility location and its CWIS system. The facility maintains three 10,417 gallons per minute (gpm) pumps that are primarily used for once-through cooling. However, only one pump is typically utilized at a time. The other two pumps were utilized historically but are now only used as backups. While there is no flow monitoring device located on the intake side of the CWIS, a good estimation of average flow through the facility can be shown with the average recordable flow data at Outfall DSN001 (9,767 gpm; schematic of water flow provided in the renewal application). Estimated through screen velocity can be calculated using one 10,417 gpm pump and the CWIS design drawing details. Drawings of both the CWIS and traveling water screen are provided in Appendix C of this report. The estimated through screen velocity with one operational pump is approximately 0.67 ft/sec and was consistent throughout the five 1-week study periods. Flow was estimated using withdrawal records calculated using Outfall 001 discharge records, cooling tower evaporation, water used through the facility (product + evaporation), and water pulled out for irrigation. The resulting estimated flow equals approximately 10,621 gpm on average. The average is very close to what the pump curve specifications are for one pump. Appendix D provides the daily flow numbers and estimated withdrawal flow documenting consistent and representative operations during all study weeks.

3.0 SAMPLING METHODS

Sampling was completed in accordance with the approved study plan (Appendix A) to assess the seasonal fish community potentially affected by Cherokee Nitrogen cooling water intake operations. Sampling took place during two winter events (12/17/18 – 12/24/18 and 1/9/19 – 1/16/19) to characterize cold-weather conditions and three spring events (4/9/19 – 4/16/19, 5/13/19 – 5/20/19, and 6/10/19 – 6/17/19) to coincide with the spawning season. Fish were collected from the CWIS system (traveling screens, fish return chute, and capture bucket) during each of the consecutive 7-day period by a Cherokee Nitrogen CWIS operator. The operator collected and froze all collected fish for later assessment by a GBM[c] & Associates (GBM[c]) biologist. The sample collection process was carried out as follows:

- Before each study week, the CWIS operator cleaned the traveling screen systems, the decks, debris reflector, fish return chute, and capture bucket of any debris and organisms.
- Daily, the screens, decks, debris reflector, fish return chute, and capture bucket were cleaned, and any fish captured were collected and preserved. Samples were frozen and stored on-site. CWIS operator observed and noted conditions within the stilling basin documenting any signs of active fish and/or fish mortality not associated with the intake screen system.

- On the 7th day, a GBMc' biologist observed the cleaning and collection process, and noted on-site conditions associated with the stilling basin, the screens, decks, debris reflector, fish return chute, and capture bucket. Any fish collected from Day-1 through Day-7 were assessed and documented.

4.0 SAMPLING RESULTS

During the five 1-week study periods, a total of 22 fish were collected from the CWIS system. The first study week (12/17/18 – 12/24/18) produced 20 fish and included 17 threadfin shad (*Dorosoma petenense*), one longear sunfish (*Lepomis megalotis*), one juvenile sunfish (*Lipomas Sp.*), and one gizzard shad (*Dorosoma cepedianum*). Week-2 (1/9/19 – 1/16/19) produced a single small freshwater drum (*Aplodinotus grunniens*) that was 10 cm in length. Week-3 (4/9/19 – 4/16/19) produced a single longear sunfish (*Lepomis megalotis).* No other fish were collected throughout the study. Appendix E provides detailed tables including observations, comments, fish identifications, size, and any lesions, parasites, or deformities from each sampling week. Due to the limited number of fish collected during the study, fish community ecology statistical metrics were not calculated. Table 1 provides a summary of fish numbers impinged throughout the study.

Table 1. Numbers of Impinged Fish Throughout Study.

Scientific Name	Common Name	Winter		Spring / Early Summer		
		Week-1	Week-2	Week-3	Week-4	Week-5
CLUPEIDAE						
Dorosoma petenense	Threadfin shad	17	--	--	--	--
Dorosoma cepedianum	Gizzard shad	1	--	--	--	--
CENTRARCHIDAE						
Lepomis megalotis	Longear sunfish	1	--	1	--	--
Lepomis Sp.	Juvenile sunfish	1	--	--	--	--
SCIAENIDAE						
Aplodinotus grunniens	Freshwater Drum	--	1	--	--	--

Appendix F contains the 3016(b) De Minimis Rate of Impingement Study photo log. This includes the CWIS, traveling screen, fish return chute, capture bucket, stilling basin, as well as all fish collected during the study.

5.0 CONCLUSIONS

The rates of impingement at Cherokee Nitrogen's CWIS were extremely low during the study period. A total of 22 fish impinged throughout the study, with 21 of those collected during the winter study weeks. Of those 21, 17 were threadfin shad collected during week-1 (12/17/18 – 12/24/18). This could be an indication of a possible shad kill (or stunned shad) due to the colder temperatures.

During the study period, the CWIS was operated normally. Observations made during the study period included sunfish species swimming in the stilling basin very near the traveling screens, which indicates currents are not strong enough to draw in healthy fish.

The very low impingement results of this study are consistent with facility personnel observations with regards to the number of fish impinged in the CWIS system historically.

Based on the results of the study at Cherokee Nitrogen, the rates of impingement were so low that they should be characterized as *De Minimis* per §125.94(c)(11) of the final 316(b) rule and no further additional controls to reduce impingement mortality at the CWIS are needed.

Appendix A

De Minimis Study Plan / ADEM Approval Letter

Cherokee Nitrogen L.L.C.
316(b) Compliance: De Minimis Rate of Impingement Study Plan

August 03, 2018

GBM^c & Associates
Strategic Environmental Services

316(b) Compliance: De Minimis Rate of Impingement Study Plan

Prepared for:

Cherokee Nitrogen L.L.C.
1080 Industrial Drive
Cherokee, Alabama 35616-0250

Prepared by:

GBM[c] & Associates
219 Brown Lane
Bryant, AR 72022

August 03, 2018

CONTENTS

1.0 BACKGROUND

The Cherokee Nitrogen L.L.C. (Cherokee Nitrogen) National Pollutant Discharge Elimination System (NPDES) Permit No. AL0000418 is currently going through the renewal process. Following the initial submittal of their application for permit renewal to Alabama Department of Environmental Management (ADEM), additional information was requested regarding the Clean Water Act Section 316(b) as detailed in 40 CFR 122.21(r)(2-8). This additional 316(b) supporting documentation was submitted on March 15, 2017 and included a request/schedule for additional time to evaluate river withdraw flows through their cooling water intake structures (CWIS) [40 CFR 122.21(r)(5)], and if required, evaluate potential compliance options associated with 40 CFR 122.21(r)(6).

Cherokee Nitrogen has performed an investigation of operational procedures and existing available flow data and is pursuing compliance with 40 CFR 122.21(r)(6) through a demonstration described in 40 CFR 125.94 (c)(11).

2.0 CHOSEN METHOD OF COMPLIANCE WITH IMPINGEMENT MORTALITY STANDARD

The final 316(b) rule (August 15, 2014) requires existing facilities that have an NPDES permit and operate a CWIS subject to the rule to comply with one of seven Best Technology Available (BTA) compliance options for Impingement Mortality (IM). The rule also provides at 40 CFR 125.94(c)(11) that there may be cases where the rate of impingement is so low *(De Minimis)* that additional controls may not be justified. The rule states that "the Director, based on a review of site-specific data submitted under 40 CFR 122.21(r), may conclude that the documented rate of impingement at the cooling water intake is so low that no additional controls are warranted. For threatened or endangered species, all unauthorized take is prohibited by the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.)*. Notice of a determination that no additional impingement controls are warranted must be included in the draft or proposed permit and the Director's response to all comments on this determination must be included in the record for the final permit."

Cherokee Nitrogen is requesting ADEM approval to conduct a *De Minimis* Impingement Study based on the current operational conditions of the facility's CWIS. This Study Plan has been developed to support Cherokee Nitrogen's collection of site-specific data to evaluate the rate of impingement and to determine if the *de minimis* provision is applicable. The results of this study will be submitted to ADEM to support the NPDES permitting process with respect to 316(b) BTA compliance.

3.0 OPERATIONAL CONDITIONS

Cherokee Nitrogen currently operates a CWIS located on the Tennessee River within the Pickwick Lake Reservoir. The facility maintains three 10,417 gallons per minute (gpm) pumps that are primarily used for once-through cooling. However, typically only one pump is utilized at a time. The other two are for higher demands, or as backup. While there is no flow monitoring device located on the intake side of the CWIS, a good estimation of average flow through the facility can be shown with the average recordable flow data at Outfall DSN001 (9,767 gpm; schematic of water flow provided in the renewal application). Estimated through screen velocity can be calculated using one 10,417 gpm pump and the CWIS design drawing details. Drawings of both the CWIS and traveling water screen were previously provided as Appendix B and Appendix C, respectively of the 316(b) supporting documentation submitted on March 15, 2017. The estimated through screen velocity with one operational pump is approximately 0.67 ft/sec.

4.0 SAMPLING PROTOCOL

Sampling will be conducted in Winter (December 2018 and January 2019) and Spring (April, May, and early June 2019) to assess the seasonal fish community potentially affected by Cherokee Nitrogen facility operations. Fish will be collected from the CWIS during a consecutive 7-day period by the Cherokee Nitrogen CWIS operator when cleaning the traveling screen system. The operator will collect and freeze the fish for later assessment by a GBM[c] & Associates (GBM[c]) biologist. The sample collection process will proceed as follows, with guidance and coordination provided by the GBM[c] biologist:

- Before the study begins (at the beginning of the first week of collection), the CWIS operator will clean the traveling screen systems, the decks, and debris reflector of any debris and organisms. The CWIS operator will then empty the debris trough.
- Daily (after the initial cleanout), the screens, decks and debris reflector will again be cleaned into the debris trough. All organisms in the debris trough will be emptied into sample coolers. The samples will be frozen and stored onsite in coolers by staff. Observations will be made within the stilling basin prior to the traveling screen for any signs of fish mortality not associated with the intake screen system (e.g. shad kill during the two winter sampling periods).
- On the 7th day, the biologist will observe the intake screen washing process and assess the impinged organisms, in addition to assessing the previously collected (Days 1-6) organisms. All organisms impinged on the intake screen will be assessed if possible.
- After the sample assessment is completed, the organisms will be discarded in a manner consistent with typical intake screen maintenance operations.

5.0 METHOS OF ANALYSIS

All fish collected in the hoppers during the 7-day sample period will be enumerated and identified to the lowest taxonomic extent practical. In addition, detailed notes on length, weight, and external anomalies for each individual will be collected to ascertain species health, age classes, and general mass composition of the community. For species with high abundance, a minimum of 30 individual organisms will be assessed. Photo documentation of each species will be conducted by GBM[c] during processing to further aid in species verification. Data will be recorded on a data sheet that includes abundance and external anomalies of the species collected along with detailed notes on general conditions of habitat and the source waterbody.

6.0 DATA EVALUATION AND REPORTING

The results of the 5 sampling events will be documented in a summary report and used to estimate a baseline impingement rate for the CWIS and determine whether the *de minimis* rate of impingement provision might be applicable. Fish community ecology statistics including species abundance, the range of sizes and age classes, and species mass for each of the sampling events will be presented. The report will be provided to ADEM for review and consideration for the NPDES permit renewal, within 6 weeks after the fifth sampling event has been completed.

7.0 SCHEDULE

The proposed schedule for the field operations for each sampling event is provided in the following table:

Date	Task at CWIS	Responsibility
Sample Event Start – Day 1	Initial traveling screen cleaning. Decks cleaned. Debris reflector cleaned. Debris trough emptied into the trash.	Cherokee Nitrogen
Days 2 - Day 6	Traveling screen cleaning. Remaining organisms on decks and debris reflector collected. Debris trough is emptied, and all organisms collected placed into coolers and frozen.	Cherokee Nitrogen
Day 7	Traveling screen cleaning. Remaining organisms on decks and debris reflector collected. Debris trough is emptied, and all organisms collected placed into coolers and frozen.	Cherokee Nitrogen/GBM[c]
Sample Event Complete – Day 7	Samples assessed.	GBM[c]

The five sample events will take place as follows:

Sample Event	Date
1	December 2018
2	January 2019
3	April 2019
4	May 2019
5	Early June 2019

LANCE R. LEFLEUR
DIRECTOR

KAY IVEY
GOVERNOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ▪ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ▪ FAX (334) 271-7950

NOVEMBER 30, 2018

MR BEN VAN VECKHOVEN
GENERAL MANAGER
CHEROKEE NITROGEN LLC
1080 INDUSTRIAL DRIVE
CHEROKEE ALABAMA 35616-0250

RE: 316(B) COMPLIANCE DE MINIMIS STUDY PLAN
NPDES PERMIT NUMBER AL0000418

Dear Mr. Van Veckhoven:

The Department has reviewed the 316(b) Compliance De Minimis Rate of Impingement Study Plan dated August 3, 2018. At this time, the Department has no comments on the plan as proposed. If you have any questions regarding this determination, please contact Mr. Theo Pinson by e-mail at **tpinson@adem.alabama.gov** or by phone at **(334) 274-4202.**

Sincerely,

Scott Ramsey, Chief
Industrial Section
Industrial/Municipal Branch
Water Division

Appendix B

Area Maps

SKH	GBMc		316b DE MINIMIS	2086-17-050	
SKH		OVERALL AERIAL MAP	RATE OF IMPINGEMENT STUDY	06/27/2019	
SKH			CHEROKEE NITROGEN, INC.	SHOWN	S1
ALB			COLBERT COUNTY, ALABAMA		

NO	DATE	REVISION	BY	CK.	APPR.

NO	DATE	REVISION	BY	CK.	APPR.

SKH
SKH
SKH
ALB

GBMc

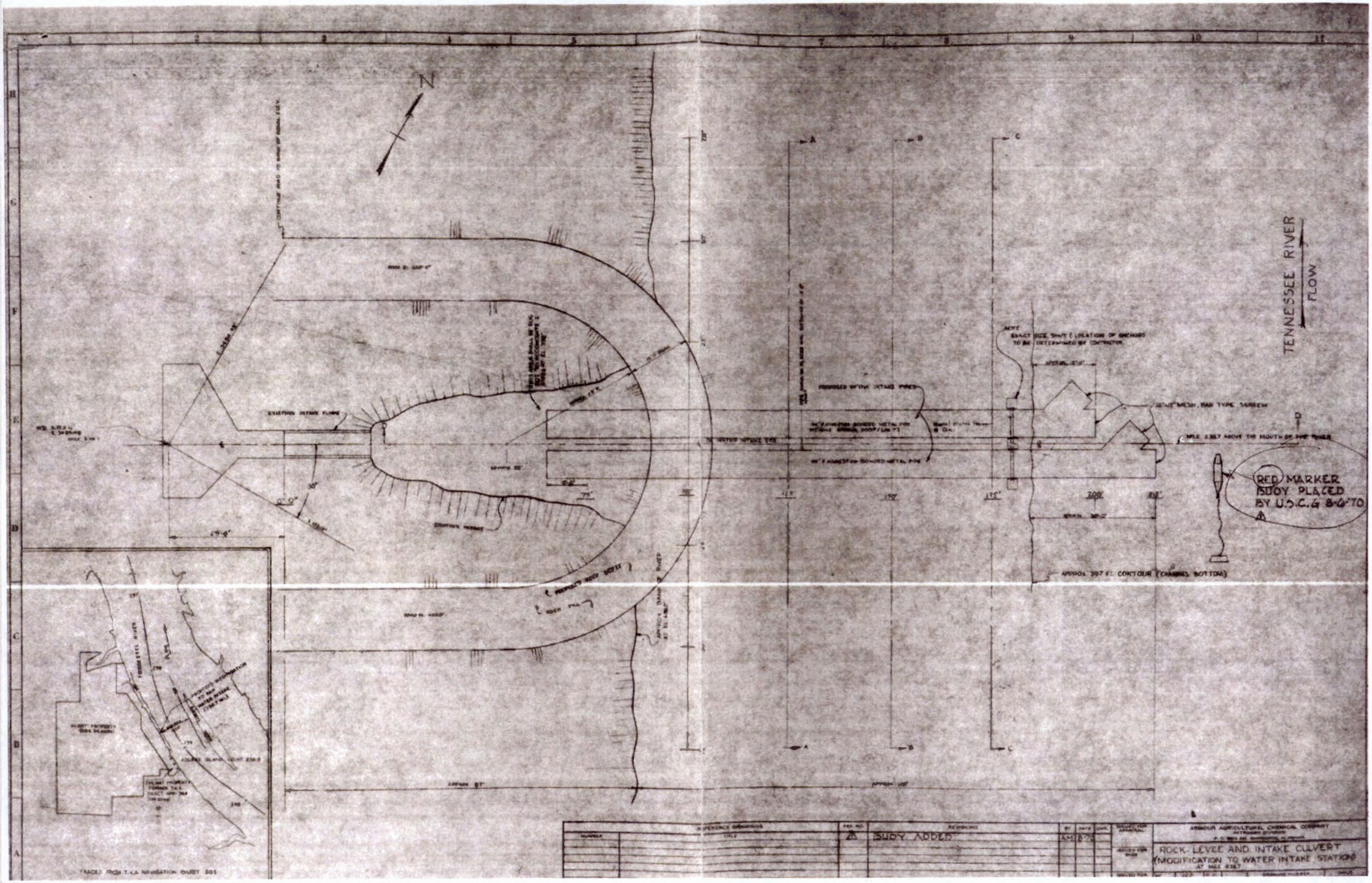
AERIAL DETAIL MAP

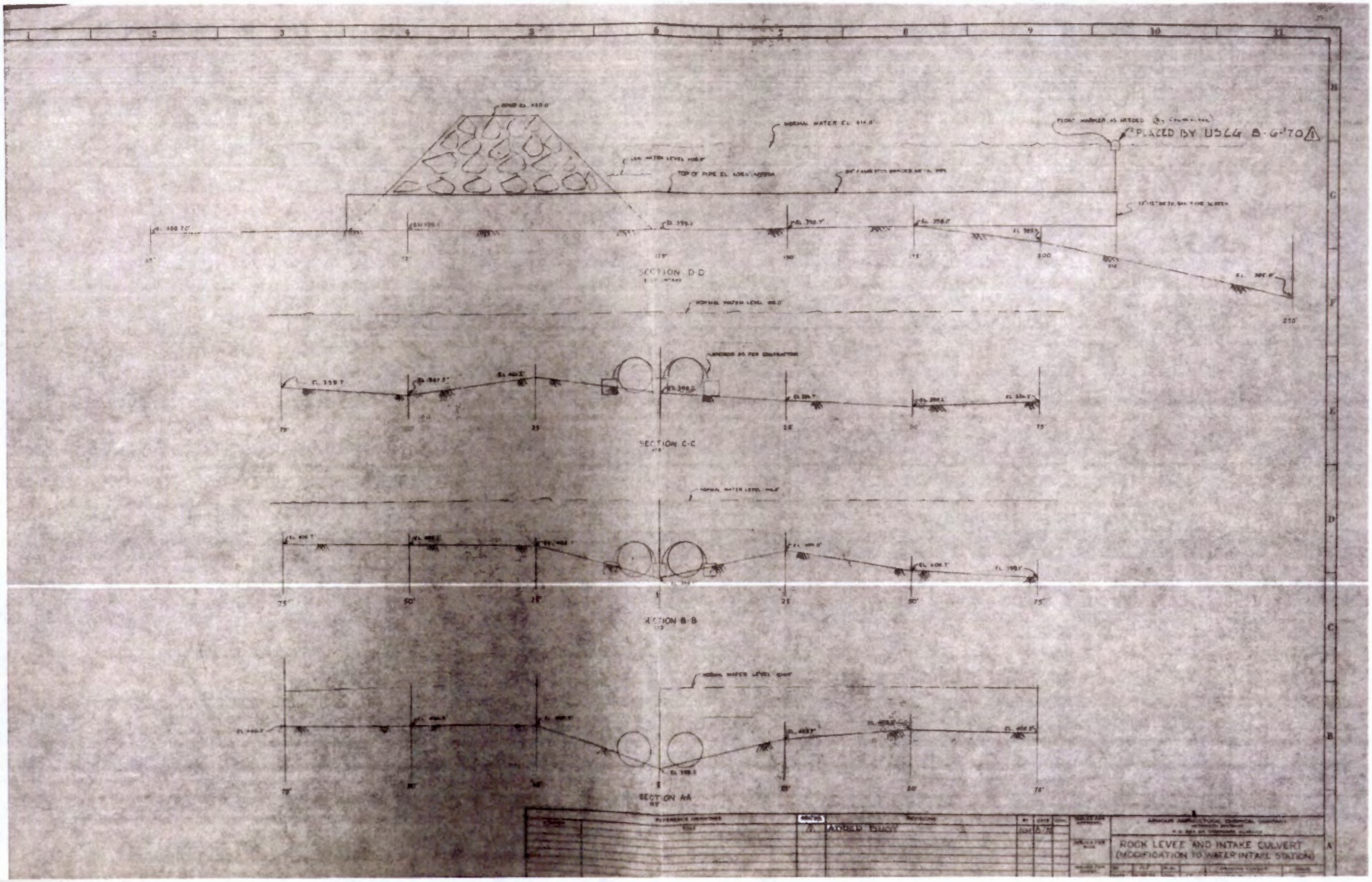
316b DE MINIMIS
RATE OF IMPINGEMENT STUDY
CHEROKEE NITROGEN, INC.
COLBERT COUNTY, ALABAMA

2086-17-050
06/27/2013
SHOWN
S2

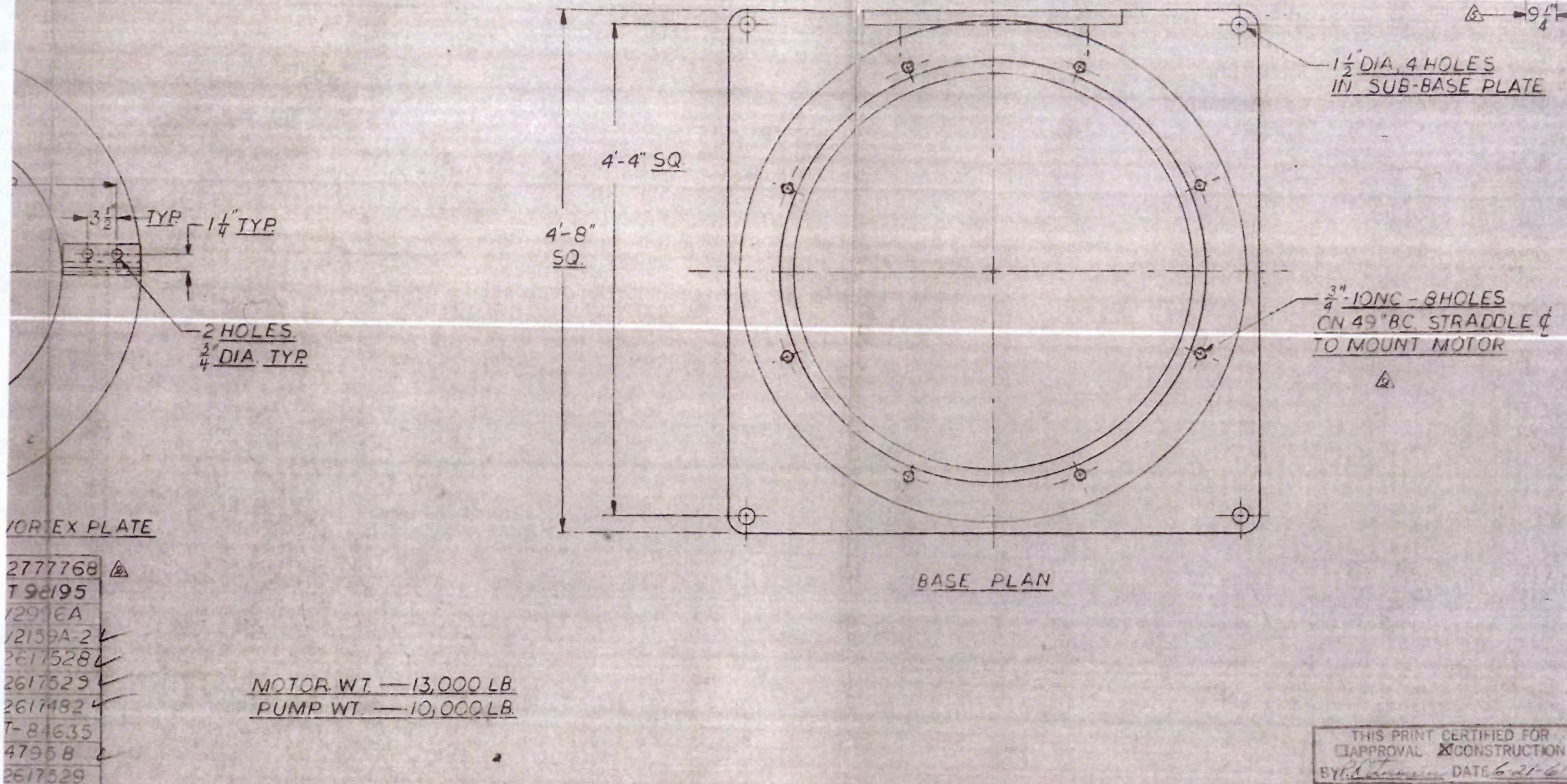
Appendix C

CWIS Design Drawings / Traveling Screen Design Drawing


N
TENNESSEE RIVER
FLOW
RED MARKER
BUOY PLACED
BY U.S.C.G 8-6-70
BUOY ADDED
ARMOUR AGRICULTURAL CHEMICAL COMPANY
ROCK LEVEE AND INTAKE CULVERT
(MODIFICATION TO WATER INTAKE STATION)



NORMAL WATER EL. 414.0'
FLOAT MARKER AS NEEDED (BY CONTRACTOR)
REPLACED BY USCG 8-6-'70
SECTION D-D
SECTION C-C
SECTION B-B
SECTION A-A
ADDED BUOY
ROCK LEVEE AND INTAKE CULVERT
(MODIFICATION TO WATER INTAKE STATION)



THIS PRINT CERTIFIED FOR ☐ APPROVAL ☒ CONSTRUCTION
BY [illegible] DATE 6-21-61

ITEM NO. 2701 - Ja - Jb - Jc

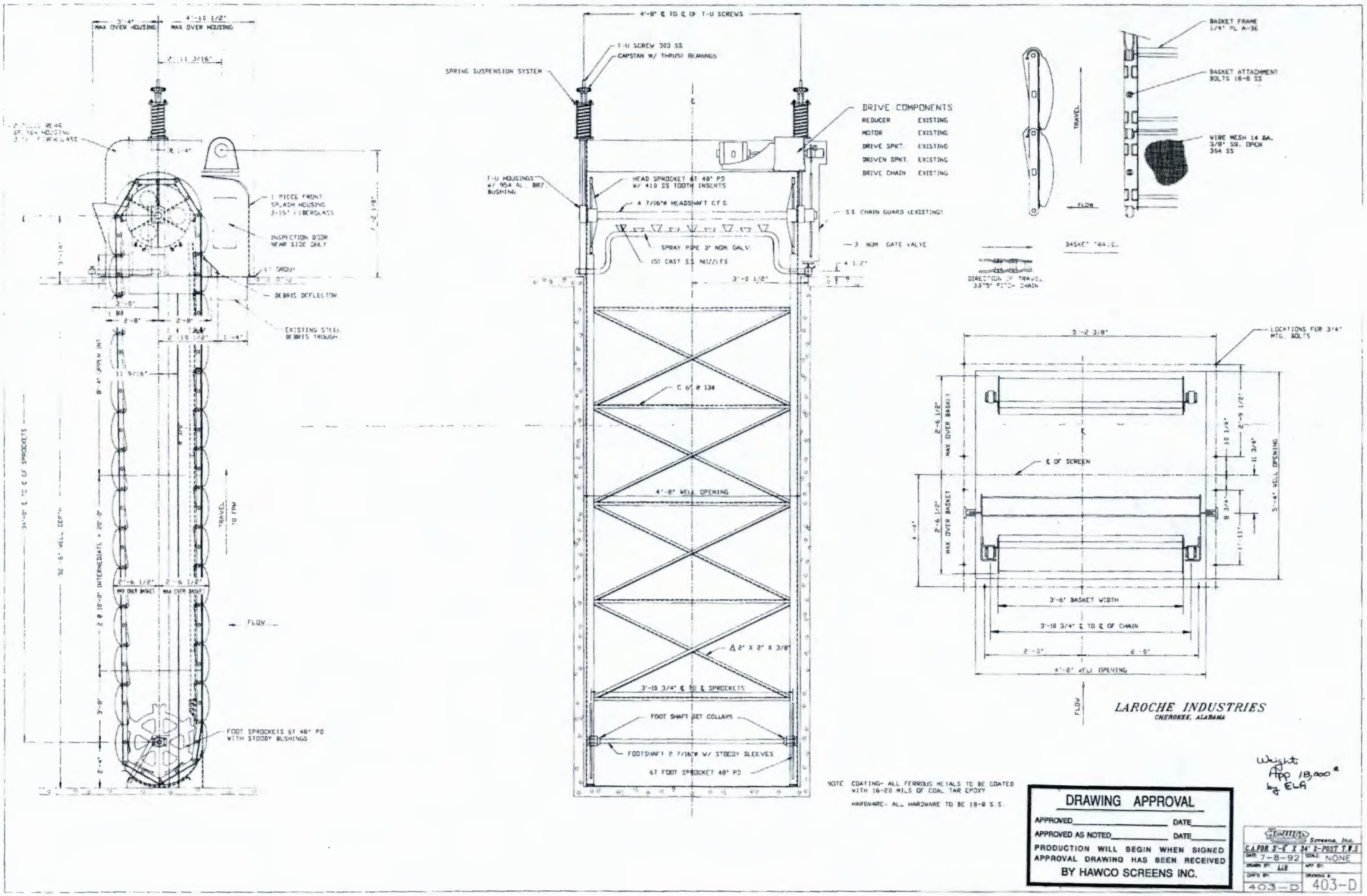
CUSTOMER M.W. KELLOGG CO. CUST. ORDER NO. 5032-S-J30-14

FOR TOWN OF CHEROKEE CONTRACT NO.

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
LOS ANGELES, CALIFORNIA INDIANAPOLIS, INDIANA

JOB NO.	PUMP NO.	TYPE PUMP	SIZE PUMP	NO. STAGES	CAPACITY G. P. M.	NET HEAD	SPEED R. P. M.	ROTATION	H. P.	FRAME NO.	TYPE OF DRIVE
88164-V	138446 -8	HXB	28	2	12,500	243'	1180	C.C.W.	900	—	ALLIS CHALMER

DRAWN BY Br DATE 5-8-61
APPROVED BY [illegible] DATE [illegible]
DRAWING NO. 2777725



DRIVE COMPONENTS
REDUCER EXISTING
MOTOR EXISTING
DRIVE SPKT. EXISTING
DRIVEN SPKT. EXISTING
DRIVE CHAIN EXISTING
SPRING SUSPENSION SYSTEM
T-U SCREW 303 SS
CAPSTAN W/ THRUST BEARINGS
4'-8" ℄ TO ℄ OF T-U SCREWS
HEAD SPROCKET 6T 48" PD W/ 410 SS TOOTH INSERTS
4 7/16"Ø HEADSHAFT C.F.S.
SPRAY PIPE 3" NOM. GALV.
(5) CAST S.S. NOZZLES
S.S. CHAIN GUARD (EXISTING)
3" NOM. GATE VALVE
4'-0" WELL OPENING
3'-10 3/4" ℄ TO ℄ SPROCKETS
FOOT SHAFT SET COLLARS
FOOTSHAFT 2 7/16"Ø W/ STOODY SLEEVES
6T FOOT SPROCKET 48" PD
FOOT SPROCKETS 6T 48" PD WITH STOODY BUSHINGS
1 PIECE FRONT SPLASH HOUSING 3/16" FIBERGLASS
INSPECTION DOOR NEAR SIDE ONLY
DEBRIS DEFLECTOR
EXISTING STEEL DEBRIS TROUGH
MAX OVER HOUSING
MAX OVER BASKET
FLOW
TRAVEL 10 FPM
BASKET FRAME 1/4" PL A-36
BASKET ATTACHMENT BOLTS 18-8 SS
WIRE MESH 14 GA. 3/8" SQ. OPEN 304 SS
DIRECTION OF TRAVEL 3.075" PITCH CHAIN
BASKET TRAVEL
LOCATIONS FOR 3/4" MTG. BOLTS
℄ OF SCREEN
3'-6" BASKET WIDTH
3'-10 3/4" ℄ TO ℄ OF CHAIN
4'-0" WELL OPENING
5'-4" WELL OPENING
LAROCHE INDUSTRIES
CHEROKEE, ALABAMA
NOTE: COATING- ALL FERROUS METALS TO BE COATED WITH 16-20 MILS OF COAL TAR EPOXY
HARDWARE- ALL HARDWARE TO BE 18-8 S.S.
DRAWING APPROVAL
APPROVED DATE
APPROVED AS NOTED DATE
PRODUCTION WILL BEGIN WHEN SIGNED APPROVAL DRAWING HAS BEEN RECEIVED BY HAWCO SCREENS INC.
Weight App 18,000# by ELA
Hawco Screens, Inc.
C.A.FOR 3'-6" X 34' 2-POST T.W.S
DATE 7-8-92
SCALE NONE
DRAWN BY LLB
403-D
403-D

Appendix D

Daily CWIS Withdrawal Flows

Cherokee Nitrogen L.L.C. - 316(b) De Minimis Rate of Impingement Study - Estimated CWIS Withdrawal

Date	Outfall 001 Discharge (MGD)	Est. CWIS Withdrawal (MGD)	Est. CWIS Withdrawal (GPM)	Rainfall (Inches)	Irrigation Water Used (MGD)
12/17/2018	14.477	16.064	11156	0	0
12/18/2018	13.788	15.375	10677	0	0
12/19/2018	14.990	14.027	9741	1.7	0
12/20/2018	14.552	15.764	10947	0.25	0
12/21/2018	13.644	15.231	10577	0	0
12/22/2018	15.048	14.985	10406	1.1	0
12/23/2018	14.317	15.904	11044	0	0
12/24/2018	13.516	15.103	10488	0	0
Week 1 Averages	NA	15.307	10630	NA	NA
1/9/2019	12.585	14.172	9842	0	0
1/10/2019	11.637	13.224	9183	0	0
1/11/2019	13.008	14.595	10135	0	0
1/12/2019	13.195	13.807	9588	0.65	0
1/13/2019	12.078	13.605	9448	0.04	0
1/14/2019	11.325	12.912	8967	0	0
1/15/2019	12.494	14.081	9778	0	0
1/16/2019	13.472	14.609	10145	0.3	0
Week 2 Averages	NA	13.876	9636	NA	NA
4/9/2019	16.374	17.961	12473	0	0
4/10/2019	16.132	17.719	12305	0	0
4/11/2019	15.865	17.452	12119	0	0
4/12/2019	14.924	15.761	10945	0.5	0
4/13/2019	16.221	15.333	10648	1.65	0
4/14/2019	14.742	16.329	11340	0	0
4/15/2019	15.017	16.604	11531	0	0
4/16/2019	15.775	17.362	12057	0	0
Week 3 Averages	NA	16.815	11677	NA	NA
5/13/2019	12.644	14.231	9883	0	0
5/14/2019	12.767	14.354	9968	0	0
5/15/2019	13.034	14.621	10153	0	0
5/16/2019	10.680	15.867	11019	0	3.600
5/17/2019	8.266	16.045	11142	0	6.192
5/18/2019	8.042	15.821	10987	0	6.192
5/19/2019	7.800	15.579	10819	0	6.192
5/20/2019	8.175	15.954	11079	0	6.192
Week 4 Averages	NA	15.309	10631	NA	NA
6/10/2019	7.407	15.186	10546	0	6.192
6/11/2019	7.195	14.974	10399	0	6.192
6/12/2019	7.148	14.927	10366	0	6.192
6/13/2019	6.806	14.585	10128	0	6.192
6/14/2019	7.200	14.979	10402	0	6.192
6/15/2019	7.506	15.285	10615	0	6.192
6/16/2019	7.461	14.940	10375	0.2	6.192
6/17/2019	10.334	16.463	11433	1.1	6.192
Week 5 Averages	NA	15.167	10533	NA	NA

Appendix E

Weekly Detailed Study Tables

Cherokee Nitrogen L.L.C. - 316(b) De Minimis Rate of Impingement - Study Week #1 (12/17/18 - 12/24/18)

Day No.	Start		End		Stilling Basin Observation	Total Fish Collected	Fish ID	Common Name	Scientific Name	Length (cm)	Lesions, Parasites or Deformities Y/N	Comments
1	12/17/2018	11:30 AM	12/18/2018	11:30 AM	Clean water, No fish observed	0	--	--	--	--	--	
2	12/18/2018	12:00 PM	12/19/2018	12:00 PM	Clean water, No fish observed	2	W1-D2-1	Threadfin Shad	*Dorosoma petenense*	6.8	N	
							W1-D2-2	Threadfin Shad	*Dorosoma petenense*	6.0	N	
3	12/19/2018	12:10 PM	12/20/2019	12:10 PM	Clean water, No fish obsereved	5	W1-D3-1	Threadfin Shad	*Dorosoma petenense*	8.0	N	
							W1-D3-2	Threadfin Shad	*Dorosoma petenense*	6.5	N	
							W1-D3-3	Threadfin Shad	*Dorosoma petenense*	6.3	N	
							W1-D3-4	Threadfin Shad	*Dorosoma petenense*	6.5	N	
							W1-D3-5	Threadfin Shad	*Dorosoma petenense*	7.3	N	
4	12/20/2018	12:20 PM	12/21/2018	12:20 PM	Clean water, No fish observed	2	W1-D4-1	Threadfin Shad	*Dorosoma petenense*	5.5	N	
							W1-D4-2	Threadfin Shad	*Dorosoma petenense*	6.0	N	
5	12/21/2018	12:30 PM	12/22/2018	12:20 PM	Clean water, No fish observed	7	W1-D5-1	Threadfin Shad	*Dorosoma petenense*	7.0	N	
							W1-D5-2	Threadfin Shad	*Dorosoma petenense*	6.0	N	
							W1-D5-3	Threadfin Shad	*Dorosoma petenense*	6.0	N	large amount of Hydrilla observed and collected on intake screens, fish return chute, and capture bucket. Fish appear to have gotten caught up the the Hydrilla.
							W1-D5-4	Threadfin Shad	*Dorosoma petenense*	6.5	N	
							W1-D5-5	Threadfin Shad	*Dorosoma petenense*	6.5	N	
							W1-D5-6	Juvenile Sunfish Species (unidentifiable)	*Lipomas Sp.*	5.5	N	
							W1-D5-7	Longer Sunfish (Appeared to be decaying. Had sections of body missing. Was entangled in hydrilla that never went down return chute and into trap/screen)	*Lepomis megalotis*	9.0	N	
6	12/22/2018	12:30 PM	12/23/2018	12:30 PM	Clean water, No fish observed	0	--	--	--	--	--	
7	12/23/2018	12:40 PM	12/24/2018	12:40 PM	Clean water, No fish observed	4	W1-D7-1	Threadfin Shad	*Dorosoma petenense*	6.5	N	
							W1-D7-2	Threadfin Shad	*Dorosoma petenense*	6.0	N	
							W1-D7-3	Threadfin Shad	*Dorosoma petenense*	6.0	N	
							W1-D7-4	Gizzard Shad (Appeared to be slightly decaying)	*Dorosoma cepedianum*	26.0	N	

Note: All notes and comments were made by the CWIS operator (Day-1 - Day7).

Cherokee Nitrogen L.L.C. - 316(b) De Minimis Rate of Impingement - Study Week #2 (1/9/19 - 1/10/19)

Day No.	Start		End		Stilling Basin Observation	Total Fish Collected	Fish ID	Common Name	Scientific Name	Length (cm)	Lesions, Parasites or Deformities Y/N	Comments
1	1/9/2019	11:50 AM	1/10/2019	11:50 AM	Clean water, No fish observed	0	--	--	--	--	--	large amount of Hydrilla collected on intake screens, fish return chute, and capture bucket
2	1/10/2019	12:10 PM	1/11/2019	12:10 PM	Clean water, No fish observed	1	W2-D2-1	Freshwater Drum	*Aplodinotus grunniens*	10.0	N	
3	1/11/2019	12:20 PM	1/12/2019	12:20 PM	Clean water, No fish observed	0	--	--	--	--	--	
4	1/12/2019	12:40 PM	1/13/2019	1:00 PM	Clean water, No fish observed	0	--	--	--	--	--	
5	1/13/2019	1:00 PM	1/14/2019	1:00 PM	Clean water, No fish observed	0	--	--	--	--	--	
6	1/14/2019	1:00 PM	1/15/2019	1:00 PM	Clean water, No fish observed	0	--	--	--	--	--	
7	1/15/2019	1:20 PM	1/16/2019	1:20 PM	Clean water, No fish observed	0	--	--	--	--	--	

Note: Notes and comments were made by both the CWIS operator (Day-1 - Day-6) and GBMc biologist (Day-7).

Cherokee Nitrogen L.L.C. - 316(b) De Minimis Rate of Impingement - Study Week #3 (4/9/19 - 4/15/19)

Day No.	Start		End		Stilling Basin Observation	Total Fish Collected	Fish ID	Common Name	Scientific Name	Length (cm)	Lesions, Parasites or Deformities Y/N	Comments
1	4/9/2019	8:00 AM	4/10/2019	8:00 AM	No fish observed	0	--	--	--	--	--	Intake screens clean of debis. Small amount of debris collected in caputre bucket.
2	4/10/2019	8:30 AM	4/11/2019	8:30 AM	No fish observed	0	--	--	--	--	--	
3	4/11/2019	9:00 AM	4/12/2019	9:00 AM	No fish observed	0	--	--	--	--	--	
4	4/12/2019	9:30 AM	4/13/2019	9:30 AM	No fish observed	0	--	--	--	--	--	
5	4/13/2019	9:55 AM	4/14/2019	9:55 AM	No fish observed	1	W3-D5-1	Longer Sunfish	*Lepomis megalotis*	12.8	N	
6	4/14/2019	10:00 AM	4/15/2019	10:00 AM	Basin muddy, small amount of leafy & small woody debris	0	--	--	--	--	--	Small amount of leafy debris collected on intake screen, fish return chute, and capture bucket
7	4/15/2019	10:30 AM	4/16/2019	10:30 AM	Few fish observed swimming in basin very near intake screen. small amount of leafy and small woody debris	0	--	--	--	--	--	

Note: Notes and comments were made by both the CWIS operator (Day-1 - Day-6) and GBMc biologist (Day-7).

Cherokee Nitrogen L.L.C. - 316(b) De Minimis Rate of Impingement - Study Week #4 (5/13/19 - 5/20/19)

Day No.	Start		End		Stilling Basin Observation	Total Fish Collected	Fish ID	Common Name	Scientific Name	Length (cm)	Lesions, Parasites or Deformities Y/N	Comments
1	5/13/2019	11:45 AM	5/14/2019	11:45 AM	No fish observed	0	--	--	--	--	--	Small amounts of Hydrilla collected in capute bucket.
2	5/14/2019	11:55 AM	5/15/2019	11:55AM	No fish observed	0	--	--	--	--	--	
3	5/15/2019	12:05 PM	5/16/2019	12:05 PM	No fish observed	0	--	--	--	--	--	
4	5/16/2019	12:15 PM	5/17/2019	12:15 PM	No fish observed	0	--	--	--	--	--	
5	5/17/2019	12:30 PM	5/18/2019	12:30 PM	No fish observed	0	--	--	--	--	--	
6	5/18/2019	12:35 PM	5/19/2019	12:35 PM	No fish observed	0	--	--	--	--	--	
7	5/19/2019	12:40 PM	5/20/2019	12:40 PM	Turtles and sunfish observed swimming in basin.	0	--	--	--	--	--	

Note: Notes and comments were made by both the CWIS operator (Day-1 - Day-6) and GBMc biologist (Day-7).

Cherokee Nitrogen L.L.C. - 316(b) De Minimis Rate of Impingement - Study Week #5 (6/10/19 - 6/17/19)

Day No.	Start		End		Stilling Basin Observation	Total Fish Collected	Fish ID	Common Name	Scientific Name	Length (cm)	Lesions, Parasites or Deformities Y/N	Comments
1	6/10/2019	11:45 AM	6/11/2019	11:45 AM	Few fish observed	0	--	--	--	--	--	Small amounts of Hydrilla collected in capture bucket.
2	6/11/2019	12:00 PM	6/12/2019	12:00 PM	Few fish observed	0	--	--	--	--	--	
3	6/12/2019	12:15 PM	6/13/2019	12:15 PM	Few fish observed	0	--	--	--	--	--	
4	6/13/2019	12:30 PM	6/14/2019	12:30 PM	No fish observed	0	--	--	--	--	--	
5	6/14/2019	12:45 PM	6/15/2019	12:45 PM	No fish observed	0	--	--	--	--	--	
6	6/15/2019	1:00 PM	6/16/2019	1:00 PM	No fish observed	0	--	--	--	--	--	
7	6/16/2019	1:15 PM	6/17/2019	1:15 PM	Basin clear, Hydrilla growing in basin, Observed sunfish and turtles in basin. Sunfish appear to be spawing in basin.	0	--	--	--	--	--	

Note: Notes and comments were made by both the CWIS operator (Day-1 - Day-6) and GBMc biologist (Day-7).

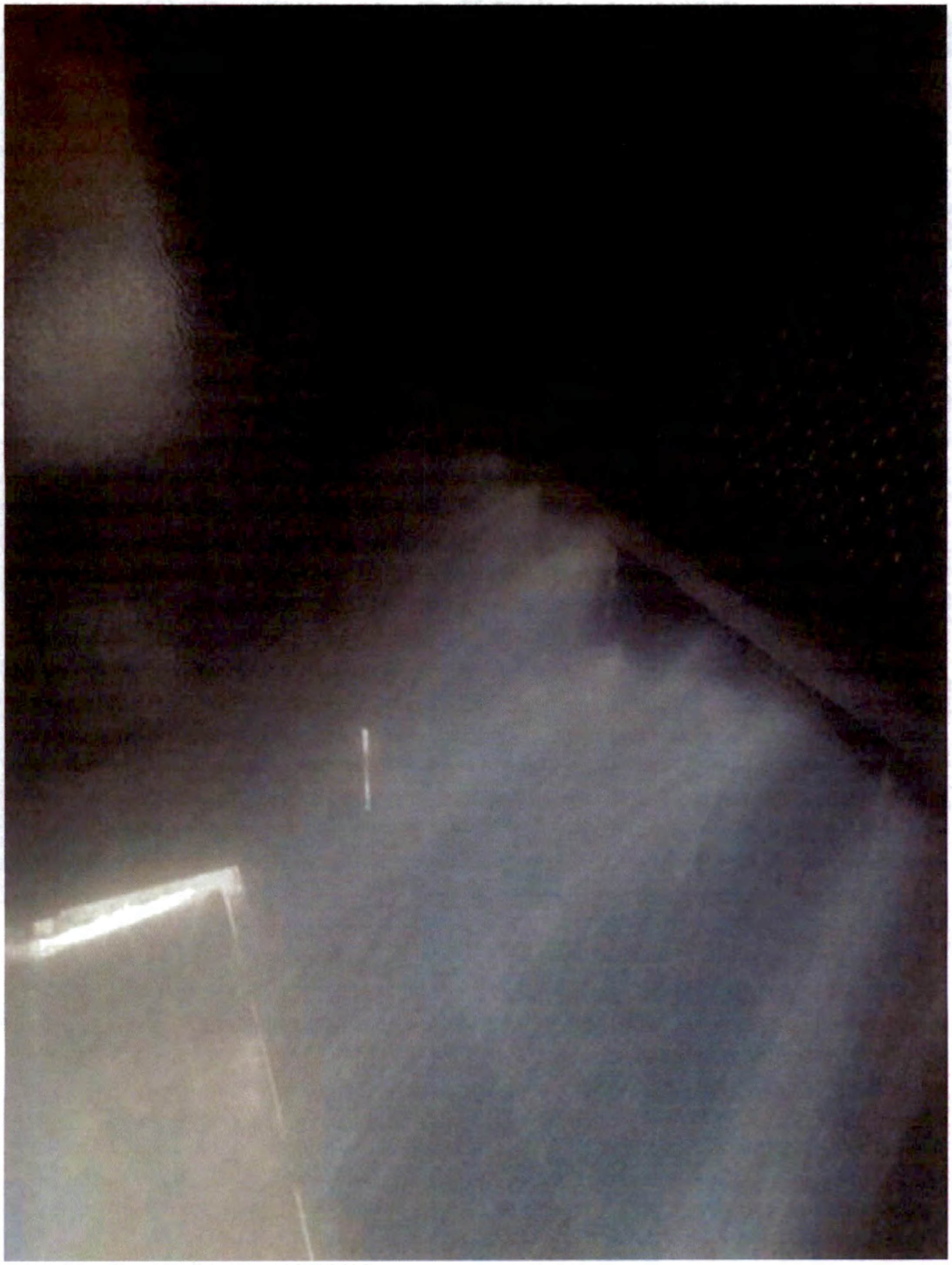
Appendix F

Photographic Log


CWIS – 1/17/19


Stilling Basin – 6/18/19


Traveling Screen, Debris Deflector, and Return Chute – 6/18/19

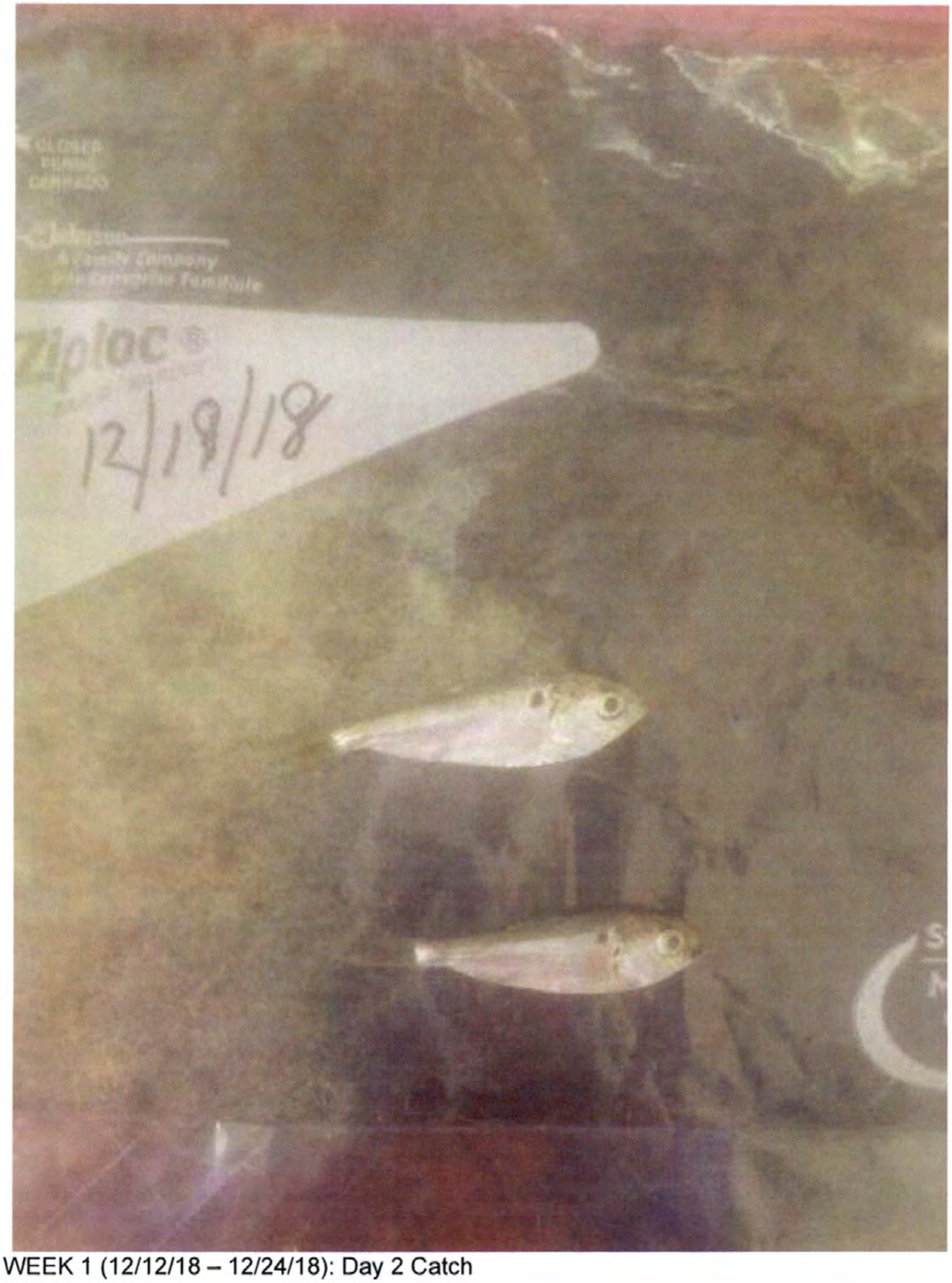

Traveling Screen Rinse – 12/18/18

Return Chute Following Screen Rinse – 12/18/18


Return Chute – 6/18/19


Fish Return Chute and Capture Bucket – 1/17/19


Capture Bucket – 6/18/19



WEEK 1 (12/12/18 – 12/24/18): Day 2 Catch

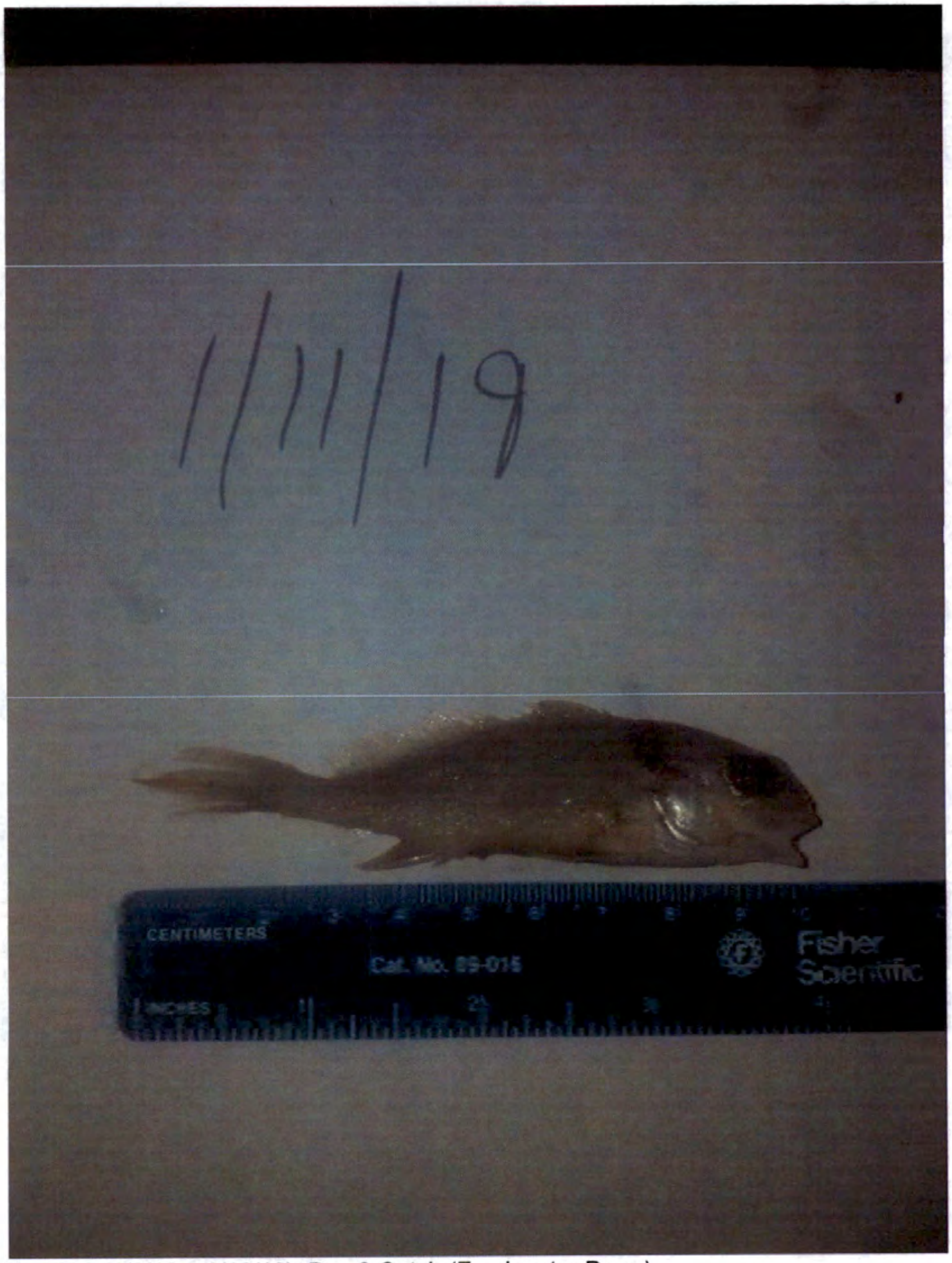
WEEK 1 (12/12/18 – 12/24/18): Day 3 Catch

WEEK 1 (12/12/18 – 12/24/18): Day 4 Catch (Top Left)

WEEK 1 (12/12/18 – 12/24/18): Day 5 Catch

WEEK 1 (12/12/18 – 12/24/18): Day 7 Catch (Gizzard Shad)

WEEK 1 (12/12/18 – 12/24/18): Day 7 Catch (Threadfin Shad)



WEEK 2 (1/9/19 – 1/16/19): Day 2 Catch (Freshwater Drum)

Spawning Sunfish in Stilling Basin – 6/18/19

LANCE R. LEFLEUR
DIRECTOR

KAY IVEY
GOVERNOR

Alabama Department of Environmental Management
adem.alabama.gov
1400 Coliseum Blvd. 36110-2400 ▪ Post Office Box 301463
Montgomery, Alabama 36130-1463
(334) 271-7700 ▪ FAX (334) 271-7950

NOVEMBER 30, 2018

MR BEN VAN VECKHOVEN
GENERAL MANAGER
CHEROKEE NITROGEN LLC
1080 INDUSTRIAL DRIVE
CHEROKEE ALABAMA 35616-0250

RE: 316(B) COMPLIANCE DE MINIMIS STUDY PLAN
NPDES PERMIT NUMBER AL0000418

Dear Mr. Van Veckhoven:

The Department has reviewed the 316(b) Compliance De Minimis Rate of Impingement Study Plan dated August 3, 2018. At this time, the Department has no comments on the plan as proposed. If you have any questions regarding this determination, please contact Mr. Theo Pinson by e-mail at **tpinson@adem.alabama.gov** or by phone at **(334) 274-4202.**

Sincerely,

SR

Scott Ramsey, Chief
Industrial Section
Industrial/Municipal Branch
Water Division

Cherokee Nitrogen L.L.C.
316(b) Compliance: De Minimis Rate of Impingement Study Plan

August 03, 2018

GBMc & Associates
Strategic Environmental Services

316(b) Compliance: De Minimis Rate of Impingement Study Plan

Prepared for:

Cherokee Nitrogen L.L.C.
1080 Industrial Drive
Cherokee, Alabama 35616-0250

Prepared by:

GBM[c] & Associates
219 Brown Lane
Bryant, AR 72022

August 03, 2018

CONTENTS

1.0 BACKGROUND

The Cherokee Nitrogen L.L.C. (Cherokee Nitrogen) National Pollutant Discharge Elimination System (NPDES) Permit No. AL0000418 is currently going through the renewal process. Following the initial submittal of their application for permit renewal to Alabama Department of Environmental Management (ADEM), additional information was requested regarding the Clean Water Act Section 316(b) as detailed in 40 CFR 122.21(r)(2-8). This additional 316(b) supporting documentation was submitted on March 15, 2017 and included a request/schedule for additional time to evaluate river withdraw flows through their cooling water intake structures (CWIS) [40 CFR 122.21(r)(5)], and if required, evaluate potential compliance options associated with 40 CFR 122.21(r)(6).

Cherokee Nitrogen has performed an investigation of operational procedures and existing available flow data and is pursuing compliance with 40 CFR 122.21(r)(6) through a demonstration described in 40 CFR 125.94 (c)(11).

2.0 CHOSEN METHOD OF COMPLIANCE WITH IMPINGEMENT MORTALITY STANDARD

The final 316(b) rule (August 15, 2014) requires existing facilities that have an NPDES permit and operate a CWIS subject to the rule to comply with one of seven Best Technology Available (BTA) compliance options for Impingement Mortality (IM). The rule also provides at 40 CFR 125.94(c)(11) that there may be cases where the rate of impingement is so low *(De Minimis)* that additional controls may not be justified. The rule states that "the Director, based on a review of site-specific data submitted under 40 CFR 122.21(r), may conclude that the documented rate of impingement at the cooling water intake is so low that no additional controls are warranted. For threatened or endangered species, all unauthorized take is prohibited by the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.).* Notice of a determination that no additional impingement controls are warranted must be included in the draft or proposed permit and the Director's response to all comments on this determination must be included in the record for the final permit."

Cherokee Nitrogen is requesting ADEM approval to conduct a *De Minimis* Impingement Study based on the current operational conditions of the facility's CWIS. This Study Plan has been developed to support Cherokee Nitrogen's collection of site-specific data to evaluate the rate of impingement and to determine if the *de minimis* provision is applicable. The results of this study will be submitted to ADEM to support the NPDES permitting process with respect to 316(b) BTA compliance.

3.0 OPERATIONAL CONDITIONS

Cherokee Nitrogen currently operates a CWIS located on the Tennessee River within the Pickwick Lake Reservoir. The facility maintains three 10,417 gallons per minute (gpm) pumps that are primarily used for once-through cooling. However, typically only one pump is utilized at a time. The other two are for higher demands, or as backup. While there is no flow monitoring device located on the intake side of the CWIS, a good estimation of average flow through the facility can be shown with the average recordable flow data at Outfall DSN001 (9,767 gpm; schematic of water flow provided in the renewal application). Estimated through screen velocity can be calculated using one 10,417 gpm pump and the CWIS design drawing details. Drawings of both the CWIS and traveling water screen were previously provided as Appendix B and Appendix C, respectively of the 316(b) supporting documentation submitted on March 15, 2017. The estimated through screen velocity with one operational pump is approximately 0.67 ft/sec.

4.0 SAMPLING PROTOCOL

Sampling will be conducted in Winter {December 2018 and January 2019) and Spring (April, May, and early June 2019) to assess the seasonal fish community potentially affected by Cherokee Nitrogen facility operations. Fish will be collected from the CWIS during a consecutive 7-day period by the Cherokee Nitrogen CWIS operator when cleaning the traveling screen system. The operator will collect and freeze the fish for later assessment by a GBM[c] & Associates (GBM[c]) biologist. The sample collection process will proceed as follows, with guidance and coordination provided by the GBM[c] biologist:

- Before the study begins (at the beginning of the first week of collection), the CWIS operator will clean the traveling screen systems, the decks, and debris reflector of any debris and organisms. The CWIS operator will then empty the debris trough.
- Daily (after the initial cleanout), the screens, decks and debris reflector will again be cleaned into the debris trough. All organisms in the debris trough will be emptied into sample coolers. The samples will be frozen and stored onsite in coolers by staff. Observations will be made within the stilling basin prior to the traveling screen for any signs of fish mortality not associated with the intake screen system (e.g. shad kill during the two winter sampling periods).
- On the 7th day, the biologist will observe the intake screen washing process and assess the impinged organisms, in addition to assessing the previously collected (Days 1-6) organisms. All organisms impinged on the intake screen will be assessed if possible.
- After the sample assessment is completed, the organisms will be discarded in a manner consistent with typical intake screen maintenance operations.

5.0 METHOS OF ANALYSIS

All fish collected in the hoppers during the 7-day sample period will be enumerated and identified to the lowest taxonomic extent practical. In addition, detailed notes on length, weight, and external anomalies for each individual will be collected to ascertain species health, age classes, and general mass composition of the community. For species with high abundance, a minimum of 30 individual organisms will be assessed. Photo documentation of each species will be conducted by GBM[c] during processing to further aid in species verification. Data will be recorded on a data sheet that includes abundance and external anomalies of the species collected along with detailed notes on general conditions of habitat and the source waterbody.

6.0 DATA EVALUATION AND REPORTING

The results of the 5 sampling events will be documented in a summary report and used to estimate a baseline impingement rate for the CWIS and determine whether the *de minimis* rate of impingement provision might be applicable. Fish community ecology statistics including species abundance, the range of sizes and age classes, and species mass for each of the sampling events will be presented. The report will be provided to ADEM for review and consideration for the NPDES permit renewal, within 6 weeks after the fifth sampling event has been completed.

7.0 SCHEDULE

The proposed schedule for the field operations for each sampling event is provided in the following table:

Date	Task at CWIS	Responsibility
Sample Event Start – Day 1	Initial traveling screen cleaning. Decks cleaned. Debris reflector cleaned. Debris trough emptied into the trash.	Cherokee Nitrogen
Days 2 - Day 6	Traveling screen cleaning. Remaining organisms on decks and debris reflector collected. Debris trough is emptied, and all organisms collected placed into coolers and frozen.	Cherokee Nitrogen
Day 7	Traveling screen cleaning. Remaining organisms on decks and debris reflector collected. Debris trough is emptied, and all organisms collected placed into coolers and frozen.	Cherokee Nitrogen/GBM[c]
Sample Event Complete – Day 7	Samples assessed.	GBM[c]

The five sample events will take place as follows:

Sample Event	Date
1	December 2018
2	January 2019
3	April 2019
4	May 2019
5	Early June 2019