Related Documents

Colon Mine Site Structural Fill

Charah, Inc.

Sanford, NC

November 2014
Revised December 2014

NPDES Permit NCG020854, December 2014
Riverbend TCLP Report, Sept 2014
Wetlands Determination, August 2014
Threatened/Endangered Study, August 2014
Archeological Study, August 2014
SWPPP, April 2014
Application for Mining Permit, March 2014
Colon Mine Drawings, February 2014
Sutton TCLP Report, June 2012
NCDENR Mine Permit Mod 53-05, April 2005
NCDENR Mine Permit 53-05, March 2004

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North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

December 16, 2014

Mr. Charles E. Price
Green Meadow, LLC
12601 Plantside Drive
Louisville, NC 40299

Subject: NPDES General Permit NCG020854
Green Meadow, LLC
Formerly General Shale Brick, Inc.
Certificate of Coverage NCG020854
Lee County

Dear Mr. Price:

Division personnel received your request to revise your stormwater permit Certificate of Coverage to accurately reflect your new company and/or facility name.

Please find enclosed the revised Certificate of Coverage. The terms and conditions contained in the General Permit remain unchanged and in full effect. This revised Certificate of Coverage is issued under the requirements of North Carolina General Statutes 143-215.1 and the Memorandum of Agreement between North Carolina and the U.S. Environmental Protection Agency.

If you have any questions or need further information, please contact the Stormwater Permitting Program at (919) 707-9220.

Sincerely,

for Tracy E. Davis, P.E., CPM, Director
Division of Energy, Mineral and Land Resources

cc: Raleigh Regional Office
Stormwater Permitting Program Files
Central Files

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES

GENERAL PERMIT NO. NCG020000
CERTIFICATE OF COVERAGE No. NCG020854

STORMWATER DISCHARGES

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provision of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

Green Meadow, LLC

is hereby authorized to discharge stormwater from a facility located at:

Colon Mine
1604 Colon Road
Sanford
Lee County

to receiving waters designated as Roberts Creek, a class WS-IV water in the Cape Fear River Basin, in accordance with the effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, III, and IV of General Permit No. NCG020854 as attached.

This certificate of coverage shall become effective December 16, 2014.

This Certificate of Coverage shall remain in effect for the duration of the General Permit.

Signed this day December 16, 2014.

Ken Pickle

for Tracy E. Davis, P.E., Director
Division of Energy, Mineral, and Land Resources
By the Authority of the Environmental Management Commission

Analytical Laboratory

13339 Hagers Ferry Road
Huntersville, NC 28078-7929
McGuire Nuclear Complex - MG03A2
Phone: 980-875-5245 Fax: 980-875-4349

Order Summary Report

Order Number: **J14090369**

Project Name:

Customer Name(s): Robert Wylie, Sean DeNeale, Andy Tinsley

Customer Address: 175 Steam Plant Rd
Mail Code: Riverbend Steam Station
Mt Holly, NC 28120

Lab Contact: Jason C Perkins Phone: 980-875-5348

Report Authorized By: (Signature)  **Date:** 9/30/2014

Jason C Perkins

Program Comments:

Please contact the Program Manager (Jason C Perkins) with any questions regarding this report.

Data Flags & Calculations:

Any analytical tests or individual analytes within a test flagged with a Qualifier indicate a deviation from the method quality system or quality control requirement. The qualifier description is found at the end of the Certificate of Analysis (sample results) under the qualifiers heading. All results are reported on a dry weight basis unless otherwise noted. Subcontracted data included on the Duke Certificate of Analysis is to be used as information only. Certified vendor results can be found in the subcontracted lab final report. Duke Energy Analytical Laboratory subcontracts analyses to other vendor laboratories that have been qualified by Duke Energy to perform these analyses except where noted.

Data Package:

This data package includes analytical results that are applicable only to the samples described in this narrative. An estimation of the uncertainty of measurement for the results in the report is available upon request. This report shall not be reproduced, except in full, without the written consent of the Analytical Laboratory. Please contact the Analytical laboratory with any questions. The order of individual sections within this report is as follows:

Job Summary Report, Sample Identification, Technical Validation of Data Package, Analytical Laboratory Certificate of Analysis, Analytical Laboratory QC Reports, Sub-contracted Laboratory Results, Customer Specific Data Sheets, Reports & Documentation, Customer Database Entries, Test Case Narratives, Chain of Custody (COC)

Certification:

The Analytical Laboratory holds the following State Certifications : North Carolina (DENR) Certificate #248, South Carolina (DHEC) Laboratory ID # 99005. Contact the Analytical Laboratory for definitive information about the certification status of specific methods.

Sample ID's & Descriptions:

Sample ID	Plant/Station	Collection Date and Time	Collected By	Sample Description
2014027417	RIVERBEND	05-Aug-14	ILLEGIBLE	B-101 (17-27, 27-37)
2014027418	RIVERBEND	06-Aug-14	ILLEGIBLE	B-101 (43.5, 47-57)
2014027419	RIVERBEND	07-Aug-14	ILLEGIBLE	B-102 (3.5-7)
2014027420	RIVERBEND	07-Aug-14	ILLEGIBLE	B-102 (14-17, 17-27)
2014027421	RIVERBEND	07-Aug-14	ILLEGIBLE	B-102 (39)
2014027422	RIVERBEND	07-Aug-14	ILLEGIBLE	B-116 (3.5-7)
2014027423	RIVERBEND	07-Aug-14	ILLEGIBLE	B-116 (7-17)
2014027424	RIVERBEND	07-Aug-14	ILLEGIBLE	B-117 (6-7, 7-17)
2014027425	RIVERBEND	07-Aug-14	ILLEGIBLE	B-117 (24.6)
2014027426	RIVERBEND	08-Aug-14	ILLEGIBLE	B-119 (7-17)
2014027427	RIVERBEND	08-Aug-14	ILLEGIBLE	B-119 (17-27)

11 Total Samples

Technical Validation Review

Checklist:

COC and .pdf report are in agreement with sample totals and analyses (compliance programs and procedures).	☑ Yes	☐ No
All Results are less than the laboratory reporting limits.	☐ Yes	☑ No
All laboratory QA/QC requirements are acceptable.	☑ Yes	☐ No

Report Sections Included:

- ☑ Job Summary Report
- ☑ Sample Identification
- ☑ Technical Validation of Data Package
- ☑ Analytical Laboratory Certificate of Analysis
- ☐ Analytical Laboratory QC Report
- ☑ Sub-contracted Laboratory Results
- ☐ Customer Specific Data Sheets, Reports, & Documentation
- ☐ Customer Database Entries
- ☑ Chain of Custody
- ☑ Electronic Data Deliverable (EDD) Sent Separately

Reviewed By: DBA Account Date: 9/30/2014

Certificate of Laboratory Analysis

Order # J14090369

Site: B-101 (17-27, 27-37) **Sample #: 2014027417**

Collection Date: 05-Aug-14 Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-101 (43.5, 47-57) **Sample #: 2014027418**

Collection Date: 06-Aug-14 Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-102 (3.5-7)
Collection Date: 07-Aug-14

Sample #: **2014027419**
Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-102 (14-17, 17-27) **Sample #: 2014027420**

Collection Date: 07-Aug-14 Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-102 (39) **Sample #: 2014027421**

Collection Date: 07-Aug-14 Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-116 (3.5-7)
Collection Date: 07-Aug-14

Sample #: **2014027422**
Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-116 (7-17)
Collection Date: 07-Aug-14

Sample #: **2014027423**
Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-117 (6-7, 7-17)
Collection Date: 07-Aug-14

Sample #: **2014027424**
Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-117 (24.6)
Collection Date: 07-Aug-14

Sample #: **2014027425**
Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-119 (7-17)
Collection Date: 08-Aug-14

Sample #: **2014027426**
Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

Certificate of Laboratory Analysis

Order # J14090369

Site: B-119 (17-27) **Sample #: 2014027427**

Collection Date: 08-Aug-14 Matrix: RCRA

Analyte	Result	Units	Qualifiers	RDL	DF	Method	Analysis Date/Time	Analyst
Miscellaneous Tests by a Vendor Laboratory - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
METALS ANALYSIS BY VENDOR LAB - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America
PCBS - (Analysis Performed by Test America)								
PCB	**Complete**							V_T. America
RCRA TCLP Metals by Vendor - (Analysis Performed by Test America)								
Vendor Parameter	**Complete**							V_T. America

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Nashville
2960 Foster Creighton Drive
Nashville, TN 37204
Tel: (615)726-0177

TestAmerica Job ID: 490-61841-1
Client Project/Site: Riverbend Dry Stack Ash J14090369

For:
Duke Energy Corporation
13339 Hagers Ferry Road
Huntersville, North Carolina 28078

Attn: Lab Customer

Authorized for release by:
9/30/2014 11:04:23 AM

Shali Brown, Project Manager II
(615)301-5031
shali.brown@testamericainc.com

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Sample Summary

Client: Duke Energy Corporation
Project/Site: Riverbend Dry Stack Ash J14090369

TestAmerica Job ID: 490-61841-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
490-61841-1	B-101 (17-27, 27-37)	Solid	08/05/14 01:01	09/19/14 08:30
490-61841-2	B-101 (43.5, 47-57)	Solid	08/06/14 01:01	09/19/14 08:30
490-61841-3	B-102 (3.5-7)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-4	B-102 (14-17, 17-27)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-5	B-102 (3a)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-6	B-116 (3.5-7)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-7	B-116 (7-17)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-8	B-117 (6-7, 7-17)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-9	B-117 (24.6)	Solid	08/07/14 01:01	09/19/14 08:30
490-61841-10	B-119 (7-17)	Solid	08/08/14 01:01	09/19/14 08:30
490-61841-11	B-119 (17-27)	Solid	08/08/14 01:01	09/19/14 08:30

Job ID: 490-61841-1

Laboratory: TestAmerica Nashville

Narrative

CASE NARRATIVE

Client: Duke Energy Corporation

Project: Riverbend Dry Stack Ash J14090369

Report Number: 490-61841-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica Nashville attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 09/19/2014; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 21.5 C.

Except:

The following sample(s) was received outside of holding time for Mercury: B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (14-17, 17-27) (490-61841-4), B-102 (3.5-7) (490-61841-3), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (24.6) (490-61841-9), B-117 (6-7, 7-17) (490-61841-8), B-119 (17-27) (490-61841-11), B-119 (7-17) (490-61841-10).

The following sample(s) was received at the laboratory outside the required temperature criteria for Mercury and Anions: B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (14-17, 17-27) (490-61841-4), B-102 (3.5-7) (490-61841-3), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (24.6) (490-61841-9), B-117 (6-7, 7-17) (490-61841-8), B-119 (17-27) (490-61841-11), B-119 (7-17) (490-61841-10). The client was contacted regarding this issue, and the laboratory was instructed to <<CHOOSE ONE>> proceed with/cancel analysis.

POLYCHLORINATED BIPHENYLS (PCBS)

Samples B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (3.5-7) (490-61841-3), B-102 (14-17, 17-27)

Job ID: 490-61841-1 (Continued)

Laboratory: TestAmerica Nashville (Continued)

(490-61841-4), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (6-7, 7-17) (490-61841-8), B-117 (24.6) (490-61841-9), B-119 (7-17) (490-61841-10) and B-119 (17-27) (490-61841-11) were analyzed for polychlorinated biphenyls (PCBs) in accordance with EPA SW-846 Method 8082. The samples were prepared on 09/23/2014 and analyzed on 09/25/2014.

Surrogates are added during the extraction process prior to dilution. When the sample dilution is 5X or greater, surrogate recoveries are diluted out and no corrective action is required.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TCLP METALS (ICP)

Samples B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (3.5-7) (490-61841-3), B-102 (14-17, 17-27) (490-61841-4), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (6-7, 7-17) (490-61841-8), B-117 (24.6) (490-61841-9), B-119 (7-17) (490-61841-10) and B-119 (17-27) (490-61841-11) were analyzed for TCLP metals (ICP) in accordance with EPA SW-846 Method 1311/6010C. The samples were leached on 09/23/2014 and 09/24/2014, prepared on 09/24/2014 and 09/25/2014 and analyzed on 09/24/2014, 09/25/2014 and 09/26/2014.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TCLP MERCURY

Samples B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (3.5-7) (490-61841-3), B-102 (14-17, 17-27) (490-61841-4), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (6-7, 7-17) (490-61841-8), B-117 (24.6) (490-61841-9) and B-119 (7-17) (490-61841-10) were analyzed for TCLP mercury in accordance with EPA SW-846 Methods 1311/7470A. The samples were leached on 09/23/2014, prepared on 09/24/2014 and analyzed on 09/25/2014.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ANIONS

Samples B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (3.5-7) (490-61841-3), B-102 (14-17, 17-27) (490-61841-4), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (6-7, 7-17) (490-61841-8), B-117 (24.6) (490-61841-9), B-119 (7-17) (490-61841-10) and B-119 (17-27) (490-61841-11) were analyzed for anions in accordance with EPA SW-846 Method 9056A. The samples were leached on 09/23/2014 and analyzed on 09/25/2014 and 09/26/2014.

Sample B-117 (24.6) (490-61841-9)[100X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

PERCENT SOLIDS

Samples B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (3.5-7) (490-61841-3), B-102 (14-17, 17-27) (490-61841-4), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (6-7, 7-17) (490-61841-8), B-117 (24.6) (490-61841-9), B-119 (7-17) (490-61841-10) and B-119 (17-27) (490-61841-11) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 09/22/2014.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ORGANIC PREP

Method(s) 1311: Insufficient sample was provided to perform the leaching procedure with the required 100g for the following sample(s): B-101 (17-27, 27-37) (490-61841-1), B-101 (43.5, 47-57) (490-61841-2), B-102 (14-17, 17-27) (490-61841-4), B-102 (3.5-7) (490-61841-3), B-102 (3a) (490-61841-5), B-116 (3.5-7) (490-61841-6), B-116 (7-17) (490-61841-7), B-117 (24.6) (490-61841-9), B-117 (6-7, 7-17) (490-61841-8), B-119 (7-17) (490-61841-10). The volume of leaching fluid was adjusted proportionally to maintain a 20:1 ratio of leaching fluid to weight of sample. Reporting limits (RLs) are not affected.

Method(s) 1311: Insufficient sample was provided to perform the leaching procedure with the required 100g for the following sample(s): B-119 (17-27) (490-61841-11). The volume of leaching fluid was adjusted proportionally to maintain a 20:1 ratio of leaching fluid to weight of sample. Reporting limits (RLs) are not affected.

Job ID: 490-61841-1 (Continued)

Laboratory: TestAmerica Nashville (Continued)

SUBCONTRACT WORK - ASBESTOS

Method Asbestos: This method was subcontracted to EMLab P&K Fort Lauderdale. The subcontract laboratory certification is different from that of the facility issuing the final report.

Definitions/Glossary

Client: Duke Energy Corporation
Project/Site: Riverbend Dry Stack Ash J14090369

TestAmerica Job ID: 490-61841-1

Qualifiers

Metals

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Client Sample ID: B-101 (17-27, 27-37)

Date Collected: 08/05/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-1

Matrix: Solid
Percent Solids: 78.1

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1
PCB-1221	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1
PCB-1232	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1
PCB-1242	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1
PCB-1248	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1
PCB-1254	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1
PCB-1260	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 12:50	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*65*		*20 - 150*	*09/23/14 16:56*	*09/25/14 12:50*	*1*
Tetrachloro-m-xylene	*51*		*19 - 147*	*09/23/14 16:56*	*09/25/14 12:50*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**296**		12.9		mg/Kg	☼		09/25/14 01:11	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:05	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:05	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:05	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:05	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:03	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:05	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:03	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:28	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**22**		0.10		%			09/22/14 18:28	1
Percent Solids	**78**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-101 (43.5, 47-57)

Date Collected: 08/06/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-2

Matrix: Solid
Percent Solids: 75.2

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1
PCB-1221	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1
PCB-1232	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1
PCB-1242	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1
PCB-1248	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1
PCB-1254	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1
PCB-1260	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 13:59	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*77*		*20 - 150*	*09/23/14 16:56*	*09/25/14 13:59*	*1*
Tetrachloro-m-xylene	*57*		*19 - 147*	*09/23/14 16:56*	*09/25/14 13:59*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**539**		13.1		mg/Kg	☼		09/25/14 01:31	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:28	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:28	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:28	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:28	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:25	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:28	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:25	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:29	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**25**		0.10		%			09/22/14 18:28	1
Percent Solids	**75**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-102 (3.5-7)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-3

Matrix: Solid
Percent Solids: 78.0

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1
PCB-1221	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1
PCB-1232	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1
PCB-1242	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1
PCB-1248	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1
PCB-1254	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1
PCB-1260	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 14:22	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*70*		*20 - 150*	*09/23/14 16:56*	*09/25/14 14:22*	*1*
Tetrachloro-m-xylene	*62*		*19 - 147*	*09/23/14 16:56*	*09/25/14 14:22*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**65.7**		12.6		mg/Kg	☼		09/25/14 01:51	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:31	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:31	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:31	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:31	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:28	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:31	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:28	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:34	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**22**		0.10		%			09/22/14 18:28	1
Percent Solids	**78**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-102 (14-17, 17-27)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-4

Matrix: Solid
Percent Solids: 76.9

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1
PCB-1221	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1
PCB-1232	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1
PCB-1242	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1
PCB-1248	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1
PCB-1254	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1
PCB-1260	ND		0.0326		mg/Kg	☼	09/23/14 16:56	09/25/14 14:45	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*78*		*20 - 150*	*09/23/14 16:56*	*09/25/14 14:45*	*1*
Tetrachloro-m-xylene	*60*		*19 - 147*	*09/23/14 16:56*	*09/25/14 14:45*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**315**		12.9		mg/Kg	☼		09/25/14 02:51	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:35	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:35	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:35	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:35	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:32	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:35	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:32	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:36	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**23**		0.10		%			09/22/14 18:28	1
Percent Solids	**77**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-102 (3a)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-5

Matrix: Solid
Percent Solids: 76.2

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1
PCB-1221	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1
PCB-1232	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1
PCB-1242	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1
PCB-1248	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1
PCB-1254	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1
PCB-1260	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 15:55	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*84*		*20 - 150*	*09/23/14 16:56*	*09/25/14 15:55*	*1*
Tetrachloro-m-xylene	*64*		*19 - 147*	*09/23/14 16:56*	*09/25/14 15:55*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**255**		13.1		mg/Kg	☼		09/25/14 03:11	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:38	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:38	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:38	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:38	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:35	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:38	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:35	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:37	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**24**		0.10		%			09/22/14 18:28	1
Percent Solids	**76**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-116 (3.5-7)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-6

Matrix: Solid
Percent Solids: 77.4

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1
PCB-1221	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1
PCB-1232	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1
PCB-1242	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1
PCB-1248	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1
PCB-1254	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1
PCB-1260	ND		0.0332		mg/Kg	☼	09/23/14 16:56	09/25/14 16:18	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*82*		*20 - 150*	*09/23/14 16:56*	*09/25/14 16:18*	*1*
Tetrachloro-m-xylene	*68*		*19 - 147*	*09/23/14 16:56*	*09/25/14 16:18*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**105**		13.1		mg/Kg	☼		09/25/14 03:31	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:42	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:42	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:42	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:42	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:39	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:42	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:39	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:38	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**23**		0.10		%			09/22/14 18:28	1
Percent Solids	**77**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-116 (7-17)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-7

Matrix: Solid
Percent Solids: 74.8

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1
PCB-1221	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1
PCB-1232	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1
PCB-1242	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1
PCB-1248	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1
PCB-1254	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1
PCB-1260	ND		0.0330		mg/Kg	☼	09/23/14 16:56	09/25/14 16:41	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*85*		*20 - 150*	*09/23/14 16:56*	*09/25/14 16:41*	*1*
Tetrachloro-m-xylene	*71*		*19 - 147*	*09/23/14 16:56*	*09/25/14 16:41*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**198**		13.3		mg/Kg	☼		09/25/14 03:51	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:45	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:45	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:45	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:45	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:42	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:45	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:42	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:40	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**25**		0.10		%			09/22/14 18:28	1
Percent Solids	**75**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-117 (6-7, 7-17)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-8

Matrix: Solid
Percent Solids: 74.1

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1
PCB-1221	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1
PCB-1232	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1
PCB-1242	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1
PCB-1248	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1
PCB-1254	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1
PCB-1260	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:04	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*82*		*20 - 150*	*09/23/14 16:56*	*09/25/14 17:04*	*1*
Tetrachloro-m-xylene	*68*		*19 - 147*	*09/23/14 16:56*	*09/25/14 17:04*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**89.6**		13.3		mg/Kg	☼		09/25/14 04:11	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:49	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:49	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:49	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:49	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:46	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:49	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:46	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:41	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**26**		0.10		%			09/22/14 18:28	1
Percent Solids	**74**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-117 (24.6)

Date Collected: 08/07/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-9

Matrix: Solid
Percent Solids: 86.2

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1
PCB-1221	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1
PCB-1232	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1
PCB-1242	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1
PCB-1248	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1
PCB-1254	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1
PCB-1260	ND		0.0333		mg/Kg	☼	09/23/14 16:56	09/25/14 17:27	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*80*		*20 - 150*	*09/23/14 16:56*	*09/25/14 17:27*	*1*
Tetrachloro-m-xylene	*65*		*19 - 147*	*09/23/14 16:56*	*09/25/14 17:27*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**15700**		1170		mg/Kg	☼		09/26/14 17:29	100

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:52	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:52	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:52	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:52	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 13:49	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:52	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 13:49	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:43	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**14**		0.10		%			09/22/14 18:28	1
Percent Solids	**86**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-119 (7-17)

Date Collected: 08/08/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-10

Matrix: Solid
Percent Solids: 75.3

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1
PCB-1221	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1
PCB-1232	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1
PCB-1242	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1
PCB-1248	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1
PCB-1254	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1
PCB-1260	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 17:50	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*90*		*20 - 150*	*09/23/14 16:56*	*09/25/14 17:50*	*1*
Tetrachloro-m-xylene	*77*		*19 - 147*	*09/23/14 16:56*	*09/25/14 17:50*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**570**		13.1		mg/Kg	☼		09/25/14 04:51	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:56	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 22:56	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 22:56	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:56	1
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 14:04	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 22:56	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 14:04	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/24/14 09:17	09/25/14 10:44	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**25**		0.10		%			09/22/14 18:28	1
Percent Solids	**75**		0.10		%			09/22/14 18:28	1

Client Sample ID: B-119 (17-27)

Date Collected: 08/08/14 01:01
Date Received: 09/19/14 08:30

Lab Sample ID: 490-61841-11

Matrix: Solid
Percent Solids: 71.0

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1
PCB-1221	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1
PCB-1232	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1
PCB-1242	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1
PCB-1248	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1
PCB-1254	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1
PCB-1260	ND		0.0331		mg/Kg	☼	09/23/14 16:56	09/25/14 18:13	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*95*		*20 - 150*	*09/23/14 16:56*	*09/25/14 18:13*	*1*
Tetrachloro-m-xylene	*78*		*19 - 147*	*09/23/14 16:56*	*09/25/14 18:13*	*1*

Method: 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	**415**		14.1		mg/Kg	☼		09/25/14 05:11	1

Method: 6010C - Metals (ICP) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/25/14 10:31	09/25/14 21:20	1
Barium	ND		10.0		mg/L		09/25/14 10:31	09/25/14 21:20	1
Cadmium	ND		0.100		mg/L		09/25/14 10:31	09/25/14 21:20	1
Chromium	ND		0.500		mg/L		09/25/14 10:31	09/25/14 21:20	1
Silver	ND		0.500		mg/L		09/25/14 10:31	09/25/14 21:20	1
Lead	ND		0.500		mg/L		09/25/14 10:31	09/25/14 21:20	1
Selenium	ND		0.100		mg/L		09/25/14 10:31	09/26/14 13:54	1

Method: 7470A - Mercury (CVAA) - TCLP

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND	H	0.00200		mg/L		09/25/14 11:11	09/25/14 11:23	1

General Chemistry

Analyte	Result	Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	**29**		0.10		%			09/22/14 18:28	1
Percent Solids	**71**		0.10		%			09/22/14 18:28	1

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Lab Sample ID: MB 490-192666/1-A
Matrix: Solid
Analysis Batch: 193067

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 192666

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1
PCB-1221	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1
PCB-1232	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1
PCB-1242	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1
PCB-1248	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1
PCB-1254	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1
PCB-1260	ND		0.0333		mg/Kg		09/23/14 16:56	09/25/14 10:54	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*87*		*20 - 150*	*09/23/14 16:56*	*09/25/14 10:54*	*1*
Tetrachloro-m-xylene	*94*		*19 - 147*	*09/23/14 16:56*	*09/25/14 10:54*	*1*

Lab Sample ID: LCS 490-192666/2-A
Matrix: Solid
Analysis Batch: 193067

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 192666

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
PCB-1016			0.167	0.1524		mg/Kg		91	65 - 125		
PCB-1260			0.167	0.1535		mg/Kg		92	52 - 150		

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
DCB Decachlorobiphenyl (Surr)	*86*		*20 - 150*
Tetrachloro-m-xylene	*66*		*19 - 147*

Lab Sample ID: 490-61841-1 MS
Matrix: Solid
Analysis Batch: 193067

Client Sample ID: B-101 (17-27, 27-37)
Prep Type: Total/NA
Prep Batch: 192666

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
PCB-1016	ND		0.210	0.1755		mg/Kg	☼	83	42 - 140		
PCB-1260	ND		0.210	0.1746		mg/Kg	☼	83	37 - 159		

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
DCB Decachlorobiphenyl (Surr)	*73*		*20 - 150*
Tetrachloro-m-xylene	*60*		*19 - 147*

Lab Sample ID: 490-61841-1 MSD
Matrix: Solid
Analysis Batch: 193067

Client Sample ID: B-101 (17-27, 27-37)
Prep Type: Total/NA
Prep Batch: 192666

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
PCB-1016	ND		0.211	0.1784		mg/Kg	☼	84	42 - 140	2	50
PCB-1260	ND		0.211	0.1694		mg/Kg	☼	80	37 - 159	3	50

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
DCB Decachlorobiphenyl (Surr)	*73*		*20 - 150*
Tetrachloro-m-xylene	*49*		*19 - 147*

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 490-192629/1-A
Matrix: Solid
Analysis Batch: 192913

Client Sample ID: Method Blank
Prep Type: Soluble

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	ND		10.1		mg/Kg			09/24/14 21:10	1

Lab Sample ID: LCS 490-192629/2-A
Matrix: Solid
Analysis Batch: 192913

Client Sample ID: Lab Control Sample
Prep Type: Soluble

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Sulfate			493	576.1		mg/Kg		117	80 - 120		

Lab Sample ID: LCSD 490-192629/3-A
Matrix: Solid
Analysis Batch: 192913

Client Sample ID: Lab Control Sample Dup
Prep Type: Soluble

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sulfate			499	568.4		mg/Kg		114	80 - 120	1	20

Lab Sample ID: 490-61390-A-1-B MS
Matrix: Solid
Analysis Batch: 192913

Client Sample ID: Matrix Spike
Prep Type: Soluble

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Sulfate	13.3		624	720.1		mg/Kg	☼	113	80 - 120		

Lab Sample ID: 490-61390-A-1-C MSD
Matrix: Solid
Analysis Batch: 192913

Client Sample ID: Matrix Spike Duplicate
Prep Type: Soluble

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sulfate	13.3		606	705.0		mg/Kg	☼	114	80 - 120	2	20

Lab Sample ID: MB 490-192629/1-A
Matrix: Solid
Analysis Batch: 193424

Client Sample ID: Method Blank
Prep Type: Soluble

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	ND		10.1		mg/Kg			09/26/14 16:28	1

Lab Sample ID: LCS 490-192629/2-A
Matrix: Solid
Analysis Batch: 193424

Client Sample ID: Lab Control Sample
Prep Type: Soluble

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Sulfate			493	536.8		mg/Kg		109	80 - 120		

Lab Sample ID: LCSD 490-192629/3-A
Matrix: Solid
Analysis Batch: 193424

Client Sample ID: Lab Control Sample Dup
Prep Type: Soluble

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sulfate			499	527.2		mg/Kg		106	80 - 120	2	20

Method: 6010C - Metals (ICP)

Lab Sample ID: MB 490-192760/1-A
Matrix: Solid
Analysis Batch: 193047

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 192760

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 21:55	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 21:55	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 21:55	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 21:55	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 21:55	1

Lab Sample ID: MB 490-192760/1-A
Matrix: Solid
Analysis Batch: 193262

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 192760

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 12:53	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 12:53	1

Lab Sample ID: MB 490-192760/1-A
Matrix: Solid
Analysis Batch: 193309

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 192760

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 16:29	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 16:29	1

Lab Sample ID: LCS 490-192760/3-A
Matrix: Solid
Analysis Batch: 193047

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 192760

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	2.00	2.011		mg/L		101	80 - 120
Barium	20.0	20.11		mg/L		101	80 - 120
Cadmium	2.00	1.969		mg/L		98	80 - 120
Chromium	10.0	9.734		mg/L		97	80 - 120
Lead	10.0	10.66		mg/L		107	80 - 120

Lab Sample ID: LCS 490-192760/3-A
Matrix: Solid
Analysis Batch: 193262

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 192760

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Silver	2.00	1.921		mg/L		96	80 - 120
Selenium	2.00	2.049		mg/L		102	80 - 120

Lab Sample ID: LCS 490-192760/3-A
Matrix: Solid
Analysis Batch: 193309

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 192760

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Silver	2.00	1.988		mg/L		99	80 - 120
Selenium	2.00	2.239		mg/L		112	80 - 120

Method: 6010C - Metals (ICP) (Continued)

Lab Sample ID: MB 490-193131/1-A
Matrix: Solid
Analysis Batch: 193350

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 193131

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/25/14 10:30	09/25/14 20:16	1
Barium	ND		10.0		mg/L		09/25/14 10:30	09/25/14 20:16	1
Cadmium	ND		0.100		mg/L		09/25/14 10:30	09/25/14 20:16	1
Chromium	ND		0.500		mg/L		09/25/14 10:30	09/25/14 20:16	1
Silver	ND		0.500		mg/L		09/25/14 10:30	09/25/14 20:16	1
Lead	ND		0.500		mg/L		09/25/14 10:30	09/25/14 20:16	1

Lab Sample ID: MB 490-193131/1-A
Matrix: Solid
Analysis Batch: 193538

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 193131

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.100		mg/L		09/25/14 10:30	09/26/14 13:00	1

Lab Sample ID: LCS 490-193131/4-A
Matrix: Solid
Analysis Batch: 193350

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 193131

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Arsenic			2.00	2.063		mg/L		103	80 - 120		
Barium			20.0	20.30		mg/L		102	80 - 120		
Cadmium			2.00	2.047		mg/L		102	80 - 120		
Chromium			10.0	10.33		mg/L		103	80 - 120		
Silver			2.00	1.892		mg/L		95	80 - 120		
Lead			10.0	11.02		mg/L		110	80 - 120		

Lab Sample ID: LCS 490-193131/4-A
Matrix: Solid
Analysis Batch: 193538

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 193131

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Selenium			2.00	2.058		mg/L		103	80 - 120		

Lab Sample ID: LB 490-192582/1-C
Matrix: Solid
Analysis Batch: 193047

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 192760

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/24/14 09:51	09/24/14 21:59	1
Barium	ND		10.0		mg/L		09/24/14 09:51	09/24/14 21:59	1
Cadmium	ND		0.100		mg/L		09/24/14 09:51	09/24/14 21:59	1
Chromium	ND		0.500		mg/L		09/24/14 09:51	09/24/14 21:59	1
Lead	ND		0.500		mg/L		09/24/14 09:51	09/24/14 21:59	1

Method: 6010C - Metals (ICP) (Continued)

Lab Sample ID: LB 490-192582/1-C — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193262 — **Prep Batch: 192760**

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Silver	ND		0.500		mg/L		09/24/14 09:51	09/25/14 12:56	1
Selenium	ND		0.100		mg/L		09/24/14 09:51	09/25/14 12:56	1

Lab Sample ID: 490-61841-1 MS — **Client Sample ID: B-101 (17-27, 27-37)**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193047 — **Prep Batch: 192760**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	ND		2.00	2.087		mg/L		99	75 - 125
Barium	ND		20.0	20.58		mg/L		93	75 - 125
Cadmium	ND		2.00	1.929		mg/L		96	75 - 125
Chromium	ND		10.0	9.160		mg/L		92	75 - 125
Lead	ND		10.0	10.27		mg/L		103	75 - 125

Lab Sample ID: 490-61841-1 MS — **Client Sample ID: B-101 (17-27, 27-37)**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193262 — **Prep Batch: 192760**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Silver	ND		2.00	1.885		mg/L		94	75 - 125
Selenium	ND		2.00	2.087		mg/L		102	75 - 125

Lab Sample ID: 490-61841-1 MSD — **Client Sample ID: B-101 (17-27, 27-37)**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193047 — **Prep Batch: 192760**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	ND		2.00	2.293		mg/L		110	75 - 125	9	20
Barium	ND		20.0	22.66		mg/L		103	75 - 125	10	20
Cadmium	ND		2.00	2.107		mg/L		105	75 - 125	9	20
Chromium	ND		10.0	10.22		mg/L		102	75 - 125	11	20
Lead	ND		10.0	11.28		mg/L		113	75 - 125	9	20

Lab Sample ID: 490-61841-1 MSD — **Client Sample ID: B-101 (17-27, 27-37)**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193262 — **Prep Batch: 192760**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Silver	ND		2.00	2.013		mg/L		101	75 - 125	7	20
Selenium	ND		2.00	2.253		mg/L		110	75 - 125	8	20

Lab Sample ID: LB 490-192854/1-B — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193350 — **Prep Batch: 193131**

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.500		mg/L		09/25/14 10:31	09/25/14 20:23	1
Barium	ND		10.0		mg/L		09/25/14 10:31	09/25/14 20:23	1
Cadmium	ND		0.100		mg/L		09/25/14 10:31	09/25/14 20:23	1

Method: 6010C - Metals (ICP) (Continued)

Lab Sample ID: LB 490-192854/1-B — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193350 — **Prep Batch: 193131**

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Chromium	ND		0.500		mg/L		09/25/14 10:31	09/25/14 20:23	1
Silver	ND		0.500		mg/L		09/25/14 10:31	09/25/14 20:23	1
Lead	ND		0.500		mg/L		09/25/14 10:31	09/25/14 20:23	1

Lab Sample ID: LB 490-192854/1-B — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193538 — **Prep Batch: 193131**

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.100		mg/L		09/25/14 10:31	09/26/14 13:07	1

Lab Sample ID: 490-62081-A-1-C MS — **Client Sample ID: Matrix Spike**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193350 — **Prep Batch: 193131**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	ND		2.00	2.407		mg/L		120	75 - 125
Barium	ND		20.0	21.60		mg/L		107	75 - 125
Cadmium	0.249		2.00	2.564		mg/L		116	75 - 125
Chromium	ND		10.0	10.79		mg/L		108	75 - 125
Silver	ND		2.00	2.054		mg/L		103	75 - 125
Lead	ND		10.0	12.30		mg/L		120	75 - 125

Lab Sample ID: 490-62081-A-1-C MS — **Client Sample ID: Matrix Spike**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193538 — **Prep Batch: 193131**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Selenium	ND		2.00	2.344		mg/L		117	75 - 125

Lab Sample ID: 490-62081-A-1-D MSD — **Client Sample ID: Matrix Spike Duplicate**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193350 — **Prep Batch: 193131**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	ND		2.00	2.260		mg/L		113	75 - 125	6	20
Barium	ND		20.0	20.12		mg/L		99	75 - 125	7	20
Cadmium	0.249		2.00	2.375		mg/L		106	75 - 125	8	20
Chromium	ND		10.0	10.04		mg/L		100	75 - 125	7	20
Silver	ND		2.00	1.919		mg/L		96	75 - 125	7	20
Lead	ND		10.0	11.38		mg/L		111	75 - 125	8	20

Lab Sample ID: 490-62081-A-1-D MSD — **Client Sample ID: Matrix Spike Duplicate**
Matrix: Solid — **Prep Type: TCLP**
Analysis Batch: 193538 — **Prep Batch: 193131**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Selenium	ND		2.00	2.210		mg/L		111	75 - 125	6	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 490-192746/1-A
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 192746

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00200		mg/L		09/24/14 09:17	09/25/14 09:44	1

Lab Sample ID: LCS 490-192746/4-A
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 192746

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury			0.0200	0.02046		mg/L		102	80 - 120		

Lab Sample ID: MB 490-192747/1-A
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 192747

Analyte	MB Result	MB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00200		mg/L		09/24/14 09:20	09/25/14 09:31	1

Lab Sample ID: LCS 490-192747/3-A
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 192747

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury			0.0200	0.01971		mg/L		99	80 - 120		

Lab Sample ID: LB 490-192343/1-C
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 192746

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00200		mg/L		09/24/14 09:17	09/25/14 09:46	1

Lab Sample ID: 490-61889-B-1-H MS
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 192746

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury	ND		0.0200	0.02073		mg/L		104	75 - 125		

Lab Sample ID: 490-61889-B-1-I MSD
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 192746

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	ND		0.0200	0.01998		mg/L		100	75 - 125	4	20

Lab Sample ID: LB 490-192582/1-B
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Method Blank
Prep Type: TCLP
Prep Batch: 192747

Analyte	LB Result	LB Qualifier	RL		Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00200		mg/L		09/24/14 09:20	09/25/14 09:32	1

Lab Sample ID: 490-62014-B-2-E MS
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Matrix Spike
Prep Type: TCLP
Prep Batch: 192747

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury	ND		0.0200	0.01950		mg/L		98	75 - 125		

Lab Sample ID: 490-62014-B-2-F MSD
Matrix: Solid
Analysis Batch: 193183

Client Sample ID: Matrix Spike Duplicate
Prep Type: TCLP
Prep Batch: 192747

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	ND		0.0200	0.01910		mg/L		95	75 - 125	2	20

Method: Moisture - Percent Moisture

Lab Sample ID: 490-61841-1 DU
Matrix: Solid
Analysis Batch: 192382

Client Sample ID: B-101 (17-27, 27-37)
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Percent Moisture	22			22		%				0.8	20
Percent Solids	78			78		%				0.2	20

GC Semi VOA

Prep Batch: 192666

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	Total/NA	Solid	3550C	
490-61841-1 MS	B-101 (17-27, 27-37)	Total/NA	Solid	3550C	
490-61841-1 MSD	B-101 (17-27, 27-37)	Total/NA	Solid	3550C	
490-61841-2	B-101 (43.5, 47-57)	Total/NA	Solid	3550C	
490-61841-3	B-102 (3.5-7)	Total/NA	Solid	3550C	
490-61841-4	B-102 (14-17, 17-27)	Total/NA	Solid	3550C	
490-61841-5	B-102 (3a)	Total/NA	Solid	3550C	
490-61841-6	B-116 (3.5-7)	Total/NA	Solid	3550C	
490-61841-7	B-116 (7-17)	Total/NA	Solid	3550C	
490-61841-8	B-117 (6-7, 7-17)	Total/NA	Solid	3550C	
490-61841-9	B-117 (24.6)	Total/NA	Solid	3550C	
490-61841-10	B-119 (7-17)	Total/NA	Solid	3550C	
490-61841-11	B-119 (17-27)	Total/NA	Solid	3550C	
LCS 490-192666/2-A	Lab Control Sample	Total/NA	Solid	3550C	
MB 490-192666/1-A	Method Blank	Total/NA	Solid	3550C	

Analysis Batch: 193067

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	Total/NA	Solid	8082A	192666
490-61841-1 MS	B-101 (17-27, 27-37)	Total/NA	Solid	8082A	192666
490-61841-1 MSD	B-101 (17-27, 27-37)	Total/NA	Solid	8082A	192666
490-61841-2	B-101 (43.5, 47-57)	Total/NA	Solid	8082A	192666
490-61841-3	B-102 (3.5-7)	Total/NA	Solid	8082A	192666
490-61841-4	B-102 (14-17, 17-27)	Total/NA	Solid	8082A	192666
490-61841-5	B-102 (3a)	Total/NA	Solid	8082A	192666
490-61841-6	B-116 (3.5-7)	Total/NA	Solid	8082A	192666
490-61841-7	B-116 (7-17)	Total/NA	Solid	8082A	192666
490-61841-8	B-117 (6-7, 7-17)	Total/NA	Solid	8082A	192666
490-61841-9	B-117 (24.6)	Total/NA	Solid	8082A	192666
490-61841-10	B-119 (7-17)	Total/NA	Solid	8082A	192666
490-61841-11	B-119 (17-27)	Total/NA	Solid	8082A	192666
LCS 490-192666/2-A	Lab Control Sample	Total/NA	Solid	8082A	192666
MB 490-192666/1-A	Method Blank	Total/NA	Solid	8082A	192666

HPLC/IC

Leach Batch: 192629

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61390-A-1-B MS	Matrix Spike	Soluble	Solid	DI Leach	
490-61390-A-1-C MSD	Matrix Spike Duplicate	Soluble	Solid	DI Leach	
490-61841-1	B-101 (17-27, 27-37)	Soluble	Solid	DI Leach	
490-61841-2	B-101 (43.5, 47-57)	Soluble	Solid	DI Leach	
490-61841-3	B-102 (3.5-7)	Soluble	Solid	DI Leach	
490-61841-4	B-102 (14-17, 17-27)	Soluble	Solid	DI Leach	
490-61841-5	B-102 (3a)	Soluble	Solid	DI Leach	
490-61841-6	B-116 (3.5-7)	Soluble	Solid	DI Leach	
490-61841-7	B-116 (7-17)	Soluble	Solid	DI Leach	
490-61841-8	B-117 (6-7, 7-17)	Soluble	Solid	DI Leach	
490-61841-9	B-117 (24.6)	Soluble	Solid	DI Leach	
490-61841-10	B-119 (7-17)	Soluble	Solid	DI Leach	

HPLC/IC (Continued)

Leach Batch: 192629 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-11	B-119 (17-27)	Soluble	Solid	DI Leach	
LCS 490-192629/2-A	Lab Control Sample	Soluble	Solid	DI Leach	
LCSD 490-192629/3-A	Lab Control Sample Dup	Soluble	Solid	DI Leach	
MB 490-192629/1-A	Method Blank	Soluble	Solid	DI Leach	

Analysis Batch: 192913

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61390-A-1-B MS	Matrix Spike	Soluble	Solid	9056A	192629
490-61390-A-1-C MSD	Matrix Spike Duplicate	Soluble	Solid	9056A	192629
490-61841-1	B-101 (17-27, 27-37)	Soluble	Solid	9056A	192629
490-61841-2	B-101 (43.5, 47-57)	Soluble	Solid	9056A	192629
490-61841-3	B-102 (3.5-7)	Soluble	Solid	9056A	192629
490-61841-4	B-102 (14-17, 17-27)	Soluble	Solid	9056A	192629
490-61841-5	B-102 (3a)	Soluble	Solid	9056A	192629
490-61841-6	B-116 (3.5-7)	Soluble	Solid	9056A	192629
490-61841-7	B-116 (7-17)	Soluble	Solid	9056A	192629
490-61841-8	B-117 (6-7, 7-17)	Soluble	Solid	9056A	192629
490-61841-10	B-119 (7-17)	Soluble	Solid	9056A	192629
490-61841-11	B-119 (17-27)	Soluble	Solid	9056A	192629
LCS 490-192629/2-A	Lab Control Sample	Soluble	Solid	9056A	192629
LCSD 490-192629/3-A	Lab Control Sample Dup	Soluble	Solid	9056A	192629
MB 490-192629/1-A	Method Blank	Soluble	Solid	9056A	192629

Analysis Batch: 193424

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-9	B-117 (24.6)	Soluble	Solid	9056A	192629
LCS 490-192629/2-A	Lab Control Sample	Soluble	Solid	9056A	192629
LCSD 490-192629/3-A	Lab Control Sample Dup	Soluble	Solid	9056A	192629
MB 490-192629/1-A	Method Blank	Soluble	Solid	9056A	192629

Metals

Leach Batch: 192343

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61889-B-1-H MS	Matrix Spike	TCLP	Solid	1311	
490-61889-B-1-I MSD	Matrix Spike Duplicate	TCLP	Solid	1311	
LB 490-192343/1-C	Method Blank	TCLP	Solid	1311	

Leach Batch: 192582

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	TCLP	Solid	1311	
490-61841-1 MS	B-101 (17-27, 27-37)	TCLP	Solid	1311	
490-61841-1 MSD	B-101 (17-27, 27-37)	TCLP	Solid	1311	
490-61841-2	B-101 (43.5, 47-57)	TCLP	Solid	1311	
490-61841-3	B-102 (3.5-7)	TCLP	Solid	1311	
490-61841-4	B-102 (14-17, 17-27)	TCLP	Solid	1311	
490-61841-5	B-102 (3a)	TCLP	Solid	1311	
490-61841-6	B-116 (3.5-7)	TCLP	Solid	1311	
490-61841-7	B-116 (7-17)	TCLP	Solid	1311	
490-61841-8	B-117 (6-7, 7-17)	TCLP	Solid	1311	

Metals (Continued)

Leach Batch: 192582 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-9	B-117 (24.6)	TCLP	Solid	1311	
490-61841-10	B-119 (7-17)	TCLP	Solid	1311	
490-62014-B-2-E MS	Matrix Spike	TCLP	Solid	1311	
490-62014-B-2-F MSD	Matrix Spike Duplicate	TCLP	Solid	1311	
LB 490-192582/1-B	Method Blank	TCLP	Solid	1311	
LB 490-192582/1-C	Method Blank	TCLP	Solid	1311	

Prep Batch: 192746

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	TCLP	Solid	7470A	192582
490-61841-2	B-101 (43.5, 47-57)	TCLP	Solid	7470A	192582
490-61841-3	B-102 (3.5-7)	TCLP	Solid	7470A	192582
490-61841-4	B-102 (14-17, 17-27)	TCLP	Solid	7470A	192582
490-61841-5	B-102 (3a)	TCLP	Solid	7470A	192582
490-61841-6	B-116 (3.5-7)	TCLP	Solid	7470A	192582
490-61841-7	B-116 (7-17)	TCLP	Solid	7470A	192582
490-61841-8	B-117 (6-7, 7-17)	TCLP	Solid	7470A	192582
490-61841-9	B-117 (24.6)	TCLP	Solid	7470A	192582
490-61841-10	B-119 (7-17)	TCLP	Solid	7470A	192582
490-61889-B-1-H MS	Matrix Spike	TCLP	Solid	7470A	192343
490-61889-B-1-I MSD	Matrix Spike Duplicate	TCLP	Solid	7470A	192343
LB 490-192343/1-C	Method Blank	TCLP	Solid	7470A	192343
LCS 490-192746/4-A	Lab Control Sample	Total/NA	Solid	7470A	
MB 490-192746/1-A	Method Blank	Total/NA	Solid	7470A	

Prep Batch: 192747

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-11	B-119 (17-27)	TCLP	Solid	7470A	192854
490-62014-B-2-E MS	Matrix Spike	TCLP	Solid	7470A	192582
490-62014-B-2-F MSD	Matrix Spike Duplicate	TCLP	Solid	7470A	192582
LB 490-192582/1-B	Method Blank	TCLP	Solid	7470A	192582
LCS 490-192747/3-A	Lab Control Sample	Total/NA	Solid	7470A	
MB 490-192747/1-A	Method Blank	Total/NA	Solid	7470A	

Prep Batch: 192760

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	TCLP	Solid	3010A	192582
490-61841-1 MS	B-101 (17-27, 27-37)	TCLP	Solid	3010A	192582
490-61841-1 MSD	B-101 (17-27, 27-37)	TCLP	Solid	3010A	192582
490-61841-2	B-101 (43.5, 47-57)	TCLP	Solid	3010A	192582
490-61841-3	B-102 (3.5-7)	TCLP	Solid	3010A	192582
490-61841-4	B-102 (14-17, 17-27)	TCLP	Solid	3010A	192582
490-61841-5	B-102 (3a)	TCLP	Solid	3010A	192582
490-61841-6	B-116 (3.5-7)	TCLP	Solid	3010A	192582
490-61841-7	B-116 (7-17)	TCLP	Solid	3010A	192582
490-61841-8	B-117 (6-7, 7-17)	TCLP	Solid	3010A	192582
490-61841-9	B-117 (24.6)	TCLP	Solid	3010A	192582
490-61841-10	B-119 (7-17)	TCLP	Solid	3010A	192582
LB 490-192582/1-C	Method Blank	TCLP	Solid	3010A	192582
LCS 490-192760/3-A	Lab Control Sample	Total/NA	Solid	3010A	
MB 490-192760/1-A	Method Blank	Total/NA	Solid	3010A	

Metals (Continued)

Leach Batch: 192854

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-11	B-119 (17-27)	TCLP	Solid	1311	
490-62081-A-1-C MS	Matrix Spike	TCLP	Solid	1311	
490-62081-A-1-D MSD	Matrix Spike Duplicate	TCLP	Solid	1311	
LB 490-192854/1-B	Method Blank	TCLP	Solid	1311	

Analysis Batch: 193047

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	TCLP	Solid	6010C	192760
490-61841-1 MS	B-101 (17-27, 27-37)	TCLP	Solid	6010C	192760
490-61841-1 MSD	B-101 (17-27, 27-37)	TCLP	Solid	6010C	192760
490-61841-2	B-101 (43.5, 47-57)	TCLP	Solid	6010C	192760
490-61841-3	B-102 (3.5-7)	TCLP	Solid	6010C	192760
490-61841-4	B-102 (14-17, 17-27)	TCLP	Solid	6010C	192760
490-61841-5	B-102 (3a)	TCLP	Solid	6010C	192760
490-61841-6	B-116 (3.5-7)	TCLP	Solid	6010C	192760
490-61841-7	B-116 (7-17)	TCLP	Solid	6010C	192760
490-61841-8	B-117 (6-7, 7-17)	TCLP	Solid	6010C	192760
490-61841-9	B-117 (24.6)	TCLP	Solid	6010C	192760
490-61841-10	B-119 (7-17)	TCLP	Solid	6010C	192760
LB 490-192582/1-C	Method Blank	TCLP	Solid	6010C	192760
LCS 490-192760/3-A	Lab Control Sample	Total/NA	Solid	6010C	192760
MB 490-192760/1-A	Method Blank	Total/NA	Solid	6010C	192760

Prep Batch: 193131

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-11	B-119 (17-27)	TCLP	Solid	3010A	192854
490-62081-A-1-C MS	Matrix Spike	TCLP	Solid	3010A	192854
490-62081-A-1-D MSD	Matrix Spike Duplicate	TCLP	Solid	3010A	192854
LB 490-192854/1-B	Method Blank	TCLP	Solid	3010A	192854
LCS 490-193131/4-A	Lab Control Sample	Total/NA	Solid	3010A	
MB 490-193131/1-A	Method Blank	Total/NA	Solid	3010A	

Analysis Batch: 193183

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	TCLP	Solid	7470A	192746
490-61841-2	B-101 (43.5, 47-57)	TCLP	Solid	7470A	192746
490-61841-3	B-102 (3.5-7)	TCLP	Solid	7470A	192746
490-61841-4	B-102 (14-17, 17-27)	TCLP	Solid	7470A	192746
490-61841-5	B-102 (3a)	TCLP	Solid	7470A	192746
490-61841-6	B-116 (3.5-7)	TCLP	Solid	7470A	192746
490-61841-7	B-116 (7-17)	TCLP	Solid	7470A	192746
490-61841-8	B-117 (6-7, 7-17)	TCLP	Solid	7470A	192746
490-61841-9	B-117 (24.6)	TCLP	Solid	7470A	192746
490-61841-10	B-119 (7-17)	TCLP	Solid	7470A	192746
490-61841-11	B-119 (17-27)	TCLP	Solid	7470A	192747
490-61889-B-1-H MS	Matrix Spike	TCLP	Solid	7470A	192746
490-61889-B-1-I MSD	Matrix Spike Duplicate	TCLP	Solid	7470A	192746
490-62014-B-2-E MS	Matrix Spike	TCLP	Solid	7470A	192747
490-62014-B-2-F MSD	Matrix Spike Duplicate	TCLP	Solid	7470A	192747
LB 490-192343/1-C	Method Blank	TCLP	Solid	7470A	192746
LB 490-192582/1-B	Method Blank	TCLP	Solid	7470A	192747

Metals (Continued)

Analysis Batch: 193183 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 490-192746/4-A	Lab Control Sample	Total/NA	Solid	7470A	192746
LCS 490-192747/3-A	Lab Control Sample	Total/NA	Solid	7470A	192747
MB 490-192746/1-A	Method Blank	Total/NA	Solid	7470A	192746
MB 490-192747/1-A	Method Blank	Total/NA	Solid	7470A	192747

Analysis Batch: 193262

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	TCLP	Solid	6010C	192760
490-61841-1 MS	B-101 (17-27, 27-37)	TCLP	Solid	6010C	192760
490-61841-1 MSD	B-101 (17-27, 27-37)	TCLP	Solid	6010C	192760
490-61841-2	B-101 (43.5, 47-57)	TCLP	Solid	6010C	192760
490-61841-3	B-102 (3.5-7)	TCLP	Solid	6010C	192760
490-61841-4	B-102 (14-17, 17-27)	TCLP	Solid	6010C	192760
490-61841-5	B-102 (3a)	TCLP	Solid	6010C	192760
490-61841-6	B-116 (3.5-7)	TCLP	Solid	6010C	192760
490-61841-7	B-116 (7-17)	TCLP	Solid	6010C	192760
490-61841-8	B-117 (6-7, 7-17)	TCLP	Solid	6010C	192760
490-61841-9	B-117 (24.6)	TCLP	Solid	6010C	192760
490-61841-10	B-119 (7-17)	TCLP	Solid	6010C	192760
LB 490-192582/1-C	Method Blank	TCLP	Solid	6010C	192760
LCS 490-192760/3-A	Lab Control Sample	Total/NA	Solid	6010C	192760
MB 490-192760/1-A	Method Blank	Total/NA	Solid	6010C	192760

Analysis Batch: 193309

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 490-192760/3-A	Lab Control Sample	Total/NA	Solid	6010C	192760
MB 490-192760/1-A	Method Blank	Total/NA	Solid	6010C	192760

Analysis Batch: 193350

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-11	B-119 (17-27)	TCLP	Solid	6010C	193131
490-62081-A-1-C MS	Matrix Spike	TCLP	Solid	6010C	193131
490-62081-A-1-D MSD	Matrix Spike Duplicate	TCLP	Solid	6010C	193131
LB 490-192854/1-B	Method Blank	TCLP	Solid	6010C	193131
LCS 490-193131/4-A	Lab Control Sample	Total/NA	Solid	6010C	193131
MB 490-193131/1-A	Method Blank	Total/NA	Solid	6010C	193131

Analysis Batch: 193538

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-11	B-119 (17-27)	TCLP	Solid	6010C	193131
490-62081-A-1-C MS	Matrix Spike	TCLP	Solid	6010C	193131
490-62081-A-1-D MSD	Matrix Spike Duplicate	TCLP	Solid	6010C	193131
LB 490-192854/1-B	Method Blank	TCLP	Solid	6010C	193131
LCS 490-193131/4-A	Lab Control Sample	Total/NA	Solid	6010C	193131
MB 490-193131/1-A	Method Blank	Total/NA	Solid	6010C	193131

General Chemistry

Analysis Batch: 192382

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
490-61841-1	B-101 (17-27, 27-37)	Total/NA	Solid	Moisture	
490-61841-1 DU	B-101 (17-27, 27-37)	Total/NA	Solid	Moisture	
490-61841-2	B-101 (43.5, 47-57)	Total/NA	Solid	Moisture	
490-61841-3	B-102 (3.5-7)	Total/NA	Solid	Moisture	
490-61841-4	B-102 (14-17, 17-27)	Total/NA	Solid	Moisture	
490-61841-5	B-102 (3a)	Total/NA	Solid	Moisture	
490-61841-6	B-116 (3.5-7)	Total/NA	Solid	Moisture	
490-61841-7	B-116 (7-17)	Total/NA	Solid	Moisture	
490-61841-8	B-117 (6-7, 7-17)	Total/NA	Solid	Moisture	
490-61841-9	B-117 (24.6)	Total/NA	Solid	Moisture	
490-61841-10	B-119 (7-17)	Total/NA	Solid	Moisture	
490-61841-11	B-119 (17-27)	Total/NA	Solid	Moisture	

Client Sample ID: B-101 (17-27, 27-37)

Lab Sample ID: 490-61841-1

Date Collected: 08/05/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 78.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 12:50	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 01:11	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:05	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:03	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:28	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-101 (43.5, 47-57)

Lab Sample ID: 490-61841-2

Date Collected: 08/06/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 75.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 13:59	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 01:31	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:28	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:25	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:29	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-102 (3.5-7)

Lab Sample ID: 490-61841-3

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 78.0

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 14:22	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 01:51	CLN	TAL NSH

Client Sample ID: B-102 (3.5-7)

Lab Sample ID: 490-61841-3

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:31	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:28	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:34	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-102 (14-17, 17-27)

Lab Sample ID: 490-61841-4

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 76.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 14:45	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 02:51	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:35	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:32	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:36	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-102 (3a)

Lab Sample ID: 490-61841-5

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 76.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 15:55	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 03:11	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:38	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH

Client Sample ID: B-102 (3a)

Lab Sample ID: 490-61841-5

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:35	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:37	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-116 (3.5-7)

Lab Sample ID: 490-61841-6

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 77.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 16:18	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 03:31	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:42	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:39	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:38	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-116 (7-17)

Lab Sample ID: 490-61841-7

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 74.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 16:41	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 03:51	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:45	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:42	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH

Client Sample ID: B-116 (7-17)

Lab Sample ID: 490-61841-7

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
TCLP	Analysis	7470A		1	193183	09/25/14 10:40	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-117 (6-7, 7-17)

Lab Sample ID: 490-61841-8

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 74.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 17:04	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 04:11	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:49	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:46	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:41	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-117 (24.6)

Lab Sample ID: 490-61841-9

Date Collected: 08/07/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 86.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 17:27	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		100	193424	09/26/14 17:29	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:52	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 13:49	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:43	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-119 (7-17)

Lab Sample ID: 490-61841-10

Date Collected: 08/08/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 75.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 17:50	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 04:51	CLN	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193047	09/24/14 22:56	LTB	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	3010A			192760	09/24/14 09:51	TDP	TAL NSH
TCLP	Analysis	6010C		1	193262	09/25/14 14:04	NLI	TAL NSH
TCLP	Leach	1311			192582	09/23/14 13:08	SJM	TAL NSH
TCLP	Prep	7470A			192746	09/24/14 09:17	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 10:44	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Client Sample ID: B-119 (17-27)

Lab Sample ID: 490-61841-11

Date Collected: 08/08/14 01:01

Matrix: Solid

Date Received: 09/19/14 08:30

Percent Solids: 71.0

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3550C			192666	09/23/14 16:56	LDC	TAL NSH
Total/NA	Analysis	8082A		1	193067	09/25/14 18:13	HMT	TAL NSH
Soluble	Leach	DI Leach			192629	09/23/14 15:43	CLN	TAL NSH
Soluble	Analysis	9056A		1	192913	09/25/14 05:11	CLN	TAL NSH
TCLP	Leach	1311			192854	09/24/14 12:55	SJM	TAL NSH
TCLP	Prep	3010A			193131	09/25/14 10:31	ADN	TAL NSH
TCLP	Analysis	6010C		1	193350	09/25/14 21:20	LTB	TAL NSH
TCLP	Leach	1311			192854	09/24/14 12:55	SJM	TAL NSH
TCLP	Prep	3010A			193131	09/25/14 10:31	ADN	TAL NSH
TCLP	Analysis	6010C		1	193538	09/26/14 13:54	LTB	TAL NSH
TCLP	Leach	1311			192854	09/24/14 12:55	SJM	TAL NSH
TCLP	Prep	7470A			192747	09/25/14 11:11	AAS	TAL NSH
TCLP	Analysis	7470A		1	193183	09/25/14 11:23	AAS	TAL NSH
Total/NA	Analysis	Moisture		1	192382	09/22/14 18:28	AJK	TAL NSH

Laboratory References:

EMLab Fort = EMLab P&K Fort Lauderdale, 6301 NW 5th Way, Suite 2850, Fort Lauderdale, FL 33309, TEL (954)776-8400

TAL NSH = TestAmerica Nashville, 2960 Foster Creighton Drive, Nashville, TN 37204, TEL (615)726-0177

Method Summary

Client: Duke Energy Corporation
Project/Site: Riverbend Dry Stack Ash J14090369

TestAmerica Job ID: 490-61841-1

Method	Method Description	Protocol	Laboratory
8082A	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	SW846	TAL NSH
9056A	Anions, Ion Chromatography	SW846	TAL NSH
6010C	Metals (ICP)	SW846	TAL NSH
7470A	Mercury (CVAA)	SW846	TAL NSH
Moisture	Percent Moisture	EPA	TAL NSH
Asbestos	Asbestos in Soils	NONE	EMLab Fort

Protocol References:

EPA = US Environmental Protection Agency

NONE = NONE

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EMLab Fort = EMLab P&K Fort Lauderdale, 6301 NW 5th Way, Suite 2850, Fort Lauderdale, FL 33309, TEL (954)776-8400

TAL NSH = TestAmerica Nashville, 2960 Foster Creighton Drive, Nashville, TN 37204, TEL (615)726-0177

Certification Summary

Client: Duke Energy Corporation
Project/Site: Riverbend Dry Stack Ash J14090369

TestAmerica Job ID: 490-61841-1

Laboratory: TestAmerica Nashville

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
A2LA	A2LA		NA: NELAP & A2LA	12-31-15
A2LA	ISO/IEC 17025		0453.07	12-31-15
Alaska (UST)	State Program	10	UST-087	10-31-14
Arizona	State Program	9	AZ0473	05-05-15
Arkansas DEQ	State Program	6	88-0737	04-25-15
California	NELAP	9	1168CA	10-31-14 *
Connecticut	State Program	1	PH-0220	12-31-15
Florida	NELAP	4	E87358	06-30-15
Illinois	NELAP	5	200010	12-09-14
Iowa	State Program	7	131	04-01-16
Kansas	NELAP	7	E-10229	10-31-14 *
Kentucky (UST)	State Program	4	19	06-30-15
Louisiana	NELAP	6	30613	06-30-15
Maryland	State Program	3	316	03-31-15
Massachusetts	State Program	1	M-TN032	06-30-15
Minnesota	NELAP	5	047-999-345	12-31-14
Mississippi	State Program	4	N/A	06-30-15
Montana (UST)	State Program	8	NA	02-24-20
Nevada	State Program	9	TN00032	07-31-15
New Hampshire	NELAP	1	2963	10-09-14 *
New Jersey	NELAP	2	TN965	06-30-15
New York	NELAP	2	11342	03-31-15
North Carolina (WW/SW)	State Program	4	387	12-31-14
North Dakota	State Program	8	R-146	06-30-14 *
Ohio VAP	State Program	5	CL0033	10-16-15
Oklahoma	State Program	6	9412	08-31-15
Oregon	NELAP	10	TN200001	04-29-15
Pennsylvania	NELAP	3	68-00585	06-30-15
Rhode Island	State Program	1	LAO00268	12-30-14
South Carolina	State Program	4	84009 (001)	02-28-15
South Carolina (DW)	State Program	4	84009 (002)	02-23-17
Tennessee	State Program	4	2008	02-23-17
Texas	NELAP	6	T104704077	08-31-15
USDA	Federal		S-48469	10-30-16
Utah	NELAP	8	TN00032	07-31-15
Virginia	NELAP	3	460152	06-14-15
Washington	State Program	10	C789	07-19-15
West Virginia DEP	State Program	3	219	02-28-15
Wisconsin	State Program	5	998020430	08-31-15
Wyoming (UST)	A2LA	8	453.07	12-31-15

* Certification renewal pending - certification considered valid.

EMLab P&K
A TestAmerica Company

Report for:

Ms. Shali Brown
TestAmerica-Nashville, TN
2960 Foster Creighton Drive
Nashville, TN 37204

Regarding: Project: 49002157; Riverbend Dry Stack Ash J14090369
EML ID: 1265721

Approved by:

Approved Signatory
Baluswamy Krishnan

Dates of Analysis:
Asbestos PLM: 09-26-2014

Service SOPs: Asbestos PLM (EPA Methods 600/R-93/116 & 600/M4-82-020, SOP EM-AS-S-1267)

EMLab P&K
6301 NW 5th Way, Suite 2850, Ft. Lauderdale, FL 33309
(877) 711-8400 Fax (954) 776-8485 www.emlab.com

Client: TestAmerica-Nashville, TN
C/O: Ms. Shali Brown
Re: 49002157; Riverbend Dry Stack Ash J14090369

Date of Sampling: 08-05-2014
Date of Receipt: 09-23-2014
Date of Report: 09-26-2014

ASBESTOS PLM REPORT: EPA-600/M4-82-020 & EPA METHOD 600/R-93-116

Total Samples Submitted:	11
Total Samples Analysed:	11
Total Samples with Layer Asbestos Content > 1%:	0

Location: B-101 (17-27, 27-37) Lab ID-Version‡: 5760539-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Moderate

Location: B-101 (43.5, 47-57) Lab ID-Version‡: 5760540-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Location: B-102 (3.5-7) Lab ID-Version‡: 5760541-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Location: B-102 (14-17, 17-27) Lab ID-Version‡: 5760542-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Inhomogeneous samples are separated into homogeneous subsamples and analyzed individually. ND means no fibers were detected. When detected, the minimum detection and reporting limit is less than 1% unless point counting is performed. Floor tile samples may contain large amounts of interference material and it is recommended that the sample be analyzed by gravimetric point count analysis to lower the detection limit and to aid in asbestos identification.
‡ A "Version" indicated by -"x" after the Lab ID# with a value greater than 1 indicates a sample with amended data. The revision number is reflected by the value of "x".

EMLab P&K
6301 NW 5th Way, Suite 2850, Ft. Lauderdale, FL 33309
(877) 711-8400 Fax (954) 776-8485 www.emlab.com

Client: TestAmerica-Nashville, TN
C/O: Ms. Shali Brown
Re: 49002157; Riverbend Dry Stack Ash J14090369

Date of Sampling: 08-05-2014
Date of Receipt: 09-23-2014
Date of Report: 09-26-2014

ASBESTOS PLM REPORT: EPA-600/M4-82-020 & EPA METHOD 600/R-93-116

Location: B-102 (3a) Lab ID-Version‡: 5760543-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Moderate

Location: B-116 (3.5-7) Lab ID-Version‡: 5760544-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Location: B-116 (7-17) Lab ID-Version‡: 5760545-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Location: B-117 (6-7, 7-17) Lab ID-Version‡: 5760546-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Inhomogeneous samples are separated into homogeneous subsamples and analyzed individually. ND means no fibers were detected. When detected, the minimum detection and reporting limit is less than 1% unless point counting is performed. Floor tile samples may contain large amounts of interference material and it is recommended that the sample be analyzed by gravimetric point count analysis to lower the detection limit and to aid in asbestos identification.
‡ A "Version" indicated by -"x" after the Lab ID# with a value greater than 1 indicates a sample with amended data. The revision number is reflected by the value of "x".

EMLab P&K
6301 NW 5th Way, Suite 2850, Ft. Lauderdale, FL 33309
(877) 711-8400 Fax (954) 776-8485 www.emlab.com

Client: TestAmerica-Nashville, TN
C/O: Ms. Shali Brown
Re: 49002157; Riverbend Dry Stack Ash J14090369

Date of Sampling: 08-05-2014
Date of Receipt: 09-23-2014
Date of Report: 09-26-2014

ASBESTOS PLM REPORT: EPA-600/M4-82-020 & EPA METHOD 600/R-93-116

Location: B-117 (24.6) Lab ID-Version‡: 5760547-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Location: B-119 (7-17) Lab ID-Version‡: 5760548-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Location: B-119 (17-27) Lab ID-Version‡: 5760549-1

Sample Layers	Asbestos Content
Dark Gray Non-Fibrous Material	ND
Sample Composite Homogeneity:	Good

Inhomogeneous samples are separated into homogeneous subsamples and analyzed individually. ND means no fibers were detected. When detected, the minimum detection and reporting limit is less than 1% unless point counting is performed. Floor tile samples may contain large amounts of interference material and it is recommended that the sample be analyzed by gravimetric point count analysis to lower the detection limit and to aid in asbestos identification.
‡ A "Version" indicated by -"x" after the Lab ID# with a value greater than 1 indicates a sample with amended data. The revision number is reflected by the value of "x".

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
Nashville, TN

COOLER RECEIPT FORM

490-61841 Chain of Custody

Le008
2806

Cooler Received/Opened On 9/19/2014 @ 0830

1. Tracking # 8887 (last 4 digits, FedEx)

Courier: Fed Ex IR Gun ID 17960358

2. Temperature of rep. sample or temp blank when opened: 21.5 *Degrees Celsius*

3. If Item #2 temperature is 0°C or less, was the representative sample or temp blank frozen? YES NO..(NA)

4. Were custody seals on outside of cooler? (YES)...NO...NA

If yes, how many and where: front

5. Were the seals intact, signed, and dated correctly? (YES)...NO...NA

6. Were custody papers inside cooler? (YES)..NO...NA

I certify that I opened the cooler and answered questions 1-6 (intial) CM

7. Were custody seals on containers: YES (NO) and Intact YES...NO..(NA)

Were these signed and dated correctly? YES...NO..(NA)

8. Packing mat'l used? Bubblewrap (Plastic bag) Peanuts Vermiculite Foam Insert Paper Other None

9. Cooling process: Ice Ice-pack Ice (direct contact) Dry Ice Other (None)

10. Did all containers arrive in good condition (unbroken)? (YES)...NO...NA

11. Were all container labels complete (#, date, signed, pres., etc)? (YES)...NO...NA

12. Did all container labels and tags agree with custody papers? (YES)...NO...NA

13a. Were VOA vials received? YES..(NO)..NA

b. Was there any observable headspace present in any VOA vial? YES...NO..(NA)

14. Was there a Trip Blank in this cooler? YES...NO...(NA) If multiple coolers, sequence # NA

I certify that I unloaded the cooler and answered questions 7-14 (intial) D

15a. On pres'd bottles, did pH test strips suggest preservation reached the correct pH level? YES..NO..(NA)

b. Did the bottle labels indicate that the correct preservatives were used YES...NO...(NA)

16. Was residual chlorine present? YES...NO...(NA)

I certify that I checked for chlorine and pH as per SOP and answered questions 15-16 (intial) D

17. Were custody papers properly filled out (ink, signed, etc)? (YES)...NO...NA

18. Did you sign the custody papers in the appropriate place? (YES)...NO...NA

19. Were correct containers used for the analysis requested? (YES)...NO...NA

20. Was sufficient amount of sample sent in each container? (YES)...NO...NA

I certify that I entered this project into LIMS and answered questions 17-20 (intial) M

I certify that I attached a label with the unique LIMS number to each container (intial) M

21. Were there Non-Conformance issues at login? (YES)..NO Was a NCM generated? (YES)..NO...# 140553 140554

BIS = Broken in shipment
Cooler Receipt Form.doc

LF-1
End of Form

Revised 11/28/12

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

DUKE ENERGY®

Analytical Laboratory Services
Mail Code MGO3A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(980) 875-5245
Fax: (980) 875-4349

Analytical Laboratory Use Only

Work Order: J1409369 | Matrix: | Samples Originating From: NC___ SC___ OH___
Logged by: DM | Date & Time: 9/18/14 1145
Ven: Test America | LDD
PO: PO #658489
SAMPLE PROGRAM: Ground Water ___ NPDES ___ Other ___ Plant ___ RCRA Waste ___

Page 1 of 1
DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

Customer must Complete

1)Project Name: Riverbend Dry Stack Ash		2)Phone No:
3)Client: Robert Wylie, Sean DeNeale, Andy Tinsley		4)Fax No:
5)Business Unit:	6)Project ID:	7)Mail Code:
8) Operating Unit:	9)Activity ID:	10)Process ID

Important: When **specific accounting** has been established enter that accounitng above. If specific accounting has not established we can work with just the Operating Unit and Process ID. **THANKS!**

15)Preserv.: 1=HCl 2=H_2SO_4 3=HNO_3 4=Ice 5=None

LOOK... Customer to complete all appropriate areas.

Loc: 490
61841

LAB USE ONLY 11)Lab ID	12)Chem Desktop No.	13)Sample Description or ID	14)Collection Information Date	Time	Signature	16)Analyses Required 17)Comp.	18)Grab	5	5	5	5	Methods used must be SCDHEC certified	20)Total # of Containers
								8 RCRA Metals TCLP	PCB	Sulfate, Total	Asbestos		
2414527 417		B-101 (17-27, 27-37)	8/5/14	NA				X	X	X	X		
418		B-101 (43.5, 47-57)	8/6/14					X	X	X	X		
419		B-102 (3.5-7)	8/7/14					X	X	X	X		
420		B-102 (14-17, 17-27)	8/7/14					X	X	X	X		
421		B-102 (39)	8/7/14					X	X	X	X		
422		B-116 (3.5-7)	8/7/14					X	X	X	X		
423		B-116 (7-17)	8/7/14					X	X	X	X		
424		B-117 (6-7, 7-17)	8/7/14					X	X	X	X		
425		B-117 (24.6)	8/7/14					X	X	X	X		
426		B-119 (7-17)	8/8/14					X	X	X	X		
427		B-119 (17-27)	8/8/14					0	X	4	X		

Customer to complete appropriate columns to right

21)Relinquished By	Date/Time 9/18/14 1030	Accepted By:	Date/Time 3/15 10:30 am 9/18/14
Relinquished By	Date/Time	Accepted By:	Date/Time 9/18/14 1225
Relinquished By	Date/Time 9/18/14	Accepted By:	Date/Time
Sealed/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time 9/18/14 1140

24)Comments: Samples collected in soil Jars/bags & transferred to Lab bottles on 9/18/14

IAN 9/19/14 0820 21.5

22)Requested Turnaround
14 Days 9/29/14
48 Hr ___
Other ___ 24 Hr ___ Add. Cost Will Apply

TestAmerica Nashville
2960 Foster Creighton Drive
Nashville, TN 37204
Phone (615) 726-0177 Fax (615) 726-3404

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Brown, Shali	Carrier Tracking No(s):	COC No: 490-23647.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: shali.brown@testamericainc.com		Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc				Job #: 490-61841-1
Address: 6301 NW 5th Way, Suite 2850,	Due Date Requested: 9/24/2014	Analysis Requested		Preservation Codes:
City: Fort Lauderdale	TAT Requested (days):			
State, Zip: FL, 33309				
Phone: 954-776-8400(Tel) 954-xxx-xxxx(Fax)	PO #:			
Email:	WO #:			
Project Name: Riverbend Dry Stack Ash J14090369	Project #: 49002157			
Site:	SSOW#:			Other:

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2SO3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - ph 4-5, Z - other (specify)

001265721

Sample Identification - Client ID	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD	SUB (Asbestos)/ Asbestos	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
B-101 (17-27, 27-37)	8/5/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-101 (43.5, 47-57)	8/6/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-102 (3.5-7)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-102 (14-17, 17-27)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-102 (9a)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-116 (3.5-7)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-116 (7-17)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-117 (6-7, 7-17)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-117 (24.6)	8/7/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-119 (7-17)	8/8/14	01:01 Eastern		Solid			X		Asbestos; due 9/26
B-119 (17-27)	8/8/14	01:01 Eastern		Solid			X		Asbestos; due 9/26

Possible Hazard Identification
Foreign Soil
Deliverable Requested: I, II, III, IV, Other (specify)

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ☐ Archive For Months
Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:	
Relinquished by: [signature]	Date/Time: 9/22/14 16:03	Company: Nashville	Received by: [signature]	Date/Time: 9/23/14 9:50	Company: Em Lab PN
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No | Custody Seal No.: | Cooler Temperature(s) °C and Other Remarks:

Login Sample Receipt Checklist

Client: Duke Energy Corporation

Job Number: 490-61841-1

Login Number: 61841

List Source: TestAmerica Nashville

List Number: 1

Creator: Buckingham, Paul

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	False	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	False	
Residual Chlorine Checked.	N/A	

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

Page 1 of 1

DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

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Analytical Laboratory Services
Mail Code MGO3A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(980) 875-5245
Fax: (980) 875-4349

Analytical Laboratory Use Only

Work Order: J1409369 | Matrix: | Samples Originating From: NC ___ SC ___ OH ___

Logged by: DM | Date & Time: 9/18/14 1145

Ven: Test America | PO: PO #658489

SAMPLE PROGRAM: Ground Water ___ NPDES ___ Other ___ Plant ___ RCRA Waste ___

Customer must Complete

1)Project Name	Riverbend Dry Stack Ash	2)Phone No:
3)Client	Robert Wylie, Sean DeNeale, Andy Tinsley	4)Fax No:
5)Business Unit:	6)Project ID:	7)Mail Code:
8) Operating Unit:	9)Activity ID:	10)Process ID

Important: When specific accounting has been established enter that accounitng above. If specific accounting has not established we can work with just the Operating Unit and Process ID. THANKS!

LOOK... Customer to complete all appropriate areas.

[15]Preserv.: 1=HCl 2=H_2SO_4 3=HNO_3 4=Ice 5=None

[16]Analyses Required

LAB USE ONLY [11]Lab ID	[12]Chem Desktop No.	[13]Sample Description or ID	[14]Collection Information Date	Time	Signature	[17]Comp.	[18]Grab	8 RCRA Metals TCLP (5)	PCB (5)	Sulfate, Total (5)	Asbestos (5)	Methods used must be SCDHEC certified	[20]Total # of Containers
1409369 417		B-101 (17-27, 27-37)	8/5/14	NA				X	X	X	X		
418		B-101 (43.5, 47-57)	8/6/14					X	X	X	X		
419		B-102 (3.5-7)	8/7/14					X	X	X	X		
420		B-102 (14-17, 17-27)	8/7/14					X	X	X	X		
421		B-102 (39)	8/7/14					X	X	X	X		
422		B-116 (3.5-7)	8/7/14					X	X	X	X		
423		B-116 (7-17)	8/7/14					X	X	X	X		
424		B-117 (6-7, 7-17)	8/7/14					X	X	X	X		
425		B-117 (24.6)	8/7/14					X	X	X	X		
426		B-119 (7-17)	8/8/14					X	X	X	X		
427		B-119 (17-27)	8/8/14					X	X	X	X		

Customer to complete appropriate columns to right

21)Relinquished By	Date/Time 9/18/14 1030	Accepted By:	Date/Time 3/15 10:30 am 9/18/14
Relinquished By	Date/Time	Accepted By:	Date/Time 9/18/14 1125
Relinquished By	Date/Time 9/18/14	Accepted By:	Date/Time
Sealed/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time 9/18/14 1140

24)Comments: Samples collected in soil Jars/bags & transferred to Lab bottles on 9/18/14

[22]Requested Turnaround
14 Days 9/29/14
48 Hr ___
*Other 24 Hr
* Add. Cost Will Apply

ClearWater Environmental Consultants, Inc.
www.cwenv.com

August 8, 2014

Mr. Norman Divers
Charah, Inc.
P.O. Box 287
Belmont, NC 28012

RE: Jurisdictional Determination
Colon Mine (+/- 408 AC)
Lee County, North Carolina

Dear Mr. Divers,

ClearWater Environmental Consultants, Inc. (CEC) is pleased to provide the following discussion of jurisdictional waters and wetlands at the Colon Mine in Lee County, North Carolina. The subject property totals approximately 408 acres and is accessed from Brickyard Road. A site vicinity map and USGS topographic map have been attached for review (Figures 1 and 2). CEC made field visits on July 21-24 and 30-31, 2014 to examine potential jurisdictional waters and wetlands within the delineation boundary. The locations of waters and wetlands have been flagged and approximate locations of jurisdictional areas are shown on the attached delineation map (Figure 3). Jurisdictional waters and wetlands identified on this map have been located within sub-meter accuracy utilizing a Trimble mapping grade Global Positioning System (GPS) and the subsequent differential correction of that data. GPS points may demonstrate uncorrectable errors due to topography, vegetative cover, and/or multipath signal error.

Jurisdictional Features

Open Water
The Colon Mine property contains many open water features. It is the opinion of CEC that these features are a result of past mining activity or installation of stormwater controls.

As stated in the "preamble" for 33 CFR, Sections 320-330, "waterfilled depressions created in dry land incidental to construction activity and pits excavated in dry land for the purpose of obtaining fill, sand, or gravel unless and until the construction or excavation operation is abandoned and the resulting body of water meets the definition of waters of the United States" are not jurisdictional. However, the Corps reserves the right on a case-by-case basis to determine that a particular waterbody in the above category is jurisdictional. Additionally, excavation of land through a jurisdictional water body, such as a stream, does not negate

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jurisdiction of the resultant feature (i.e. an excavated stream channel and resulting impoundment may both be jurisdictional). The permit applicant would need to provide substantive evidence that excavation originally occurred in high ground (outside of all jurisdictional waters) and that the subject mine is still active.

The "preamble" also states that "waste treatment systems" and "artificial lakes or ponds created by excavating and/or diking dry land to collect and retain water and which are used exclusively for such purposed as…settling basins" are not jurisdictional. The permit applicant would need to provide copies of approved Stormwater Management Plans to validate the presence of basins as stormwater controls.

Although CEC is confident in our assessment of open waters at the site, the US Army Corps of Engineers (Corps) is the only agency that can make final decisions regarding jurisdictional wetland and waters of the US delineations. Therefore, all preliminary determinations are subject to change until written verification is obtained. CEC strongly recommends that written verification be obtained from the Corps prior to closing on the property, beginning any site work, or making any legal reliance on this determination. The delineation map provided (Figure 3) is for informational purposes only and should not be used to determine precise boundaries, roadways, property boundary lines, nor legal descriptions. The map shall not be construed to be an official survey of any data depicted.

Streams

The Colon Mine property contains perennial and intermittent streams throughout the tract (Figure 3). One named stream, Roberts Creek, is identified as a "blue-line" stream on the USGS topographic map (Figure 2). Other tributaries on site (some also identified as "blue-line" streams) are unnamed tributaries to Roberts Creek. Some of these tributaries are also identified on the most recent published Soil Survey of Lee County, North Carolina (September 1989) (Attached soils maps Figures 4a and 4b).

Channel determinations are based primarily on the definition of "waters of the US" found in 33 CFR, Section 328. The jurisdictional extent is considered the upper limits of the ordinary high water mark as identified in the field. The Corps District Office has provided additional regional guidance for jurisdictional designations on drainage features. Only those channels with adequate groundwater discharge to maintain intermittent or perennial flow are found to be jurisdictional.

Unnamed tributaries on site hold the same stream classification as the named tributary into which they flow. Roberts Creek and unnamed tributaries on site are classified as class "C" and "WS-IV" waters by the NC Division of Water Resources (DWR).

- **Class "C" Waters** are those waters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture and other uses suitable for class "C". Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development or types of discharges.

- **Class "WS-IV" Waters** are those waters protected as water supplies for drinking, culinary, or food-processing purposes which are generally in moderately to highly developed watersheds or protected areas and meet average watershed development density levels specified by the DWR. Nonpoint source and stormwater pollution that would adversely impact the waters for use as water supply or any other designated use will not be permissible. A stormwater management plan will be required for all drainage areas within projects that have, or are anticipated to have, impervious surface cover of equal to or greater than 24%. At a minimum, the stormwater management plan should remove 85% Total Suspended Solids (TSS) and be designed in accordance with the most recent published version of the *NC Division of Water Quality's Stormwater Best Management Practices (BMP) Manual*. In watersheds that are classified as "WS" by the DWR, 30% Total Phosphorus and 30% Total Nitrogen removal will be required. BMPs must also remove fecal coliform and heavy metals. In watersheds that are classified as "WS-IV", stormwater requirements are determined by the density option chosen by the applicant: high or low. A project is considered low density if the built upon area is 24% or less; or the applicant proposes one, single family residential dwelling on lots greater than or equal to 1/2 acre. Development areas that are outside of "critical areas" and absent a curb and gutter street system will be allowed 36% built upon area or three, single family residential dwellings per acre. In general, stormwater management plans will be approved for the low density option provided stormwater runoff is transported primarily by vegetated conveyances and a 30-foot wide vegetated buffer is established along stream segments. For high density developments, the DWR will require that control systems be designed to control runoff from all surfaces generated by one inch of rainfall. High density developments will not exceed 70% built upon area and a 100-foot wide vegetated buffer must be maintained adjacent to all perennial waters.

Wetlands

Potential wetland areas within the project boundary are evaluated for the presence or absence of three wetland criteria outlined in the *Corps of Engineers Wetlands Delineation Manual* (1987 Manual). All of following criteria must be met for a subject area to be considered a jurisdictional wetland: presence of hydric soil and hydrophytic vegetation; and evidence of wetland hydrology and connectivity. Indicators of hydrology include, but are not limited to, saturation in the upper 12 inches of the soil profile, drift lines, water marks, and sediment deposits. Findings of a hydrological connection can be supported through the existence of soils defined as hydric. Hydric soils are defined by the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (July 2010). Vegetation holding a "FAC", "FACW", or "OBL" designation are considered to be hydrophytic. Plant communities in subject areas must include dominant hydrophytic vegetation at a proportion of at least 50 percent to meet the hydrophytic vegetation criteria.

Waters of the US in the form of wetlands were observed throughout the site (Figure 3).

Summary

Jurisdictional waters and wetlands were identified on the site. The Corps should be contacted for a site visit and verification of jurisdictional areas. Although CEC is confident in our assessment of the site, the Corps is the only entity that can make a final decision regarding the presences or absence of jurisdictional waters and wetlands on a site. CEC strongly recommends that written verification be obtained from the Corps prior to closing on the property, beginning any site work, or making any legal reliance on this determination. CEC will arrange a site visit with the Corps for verification of the delineation if requested. The Raleigh Regulatory Field Office of the Corps of Engineers Wilmington District verifies wetland and stream delineations in central North Carolina.

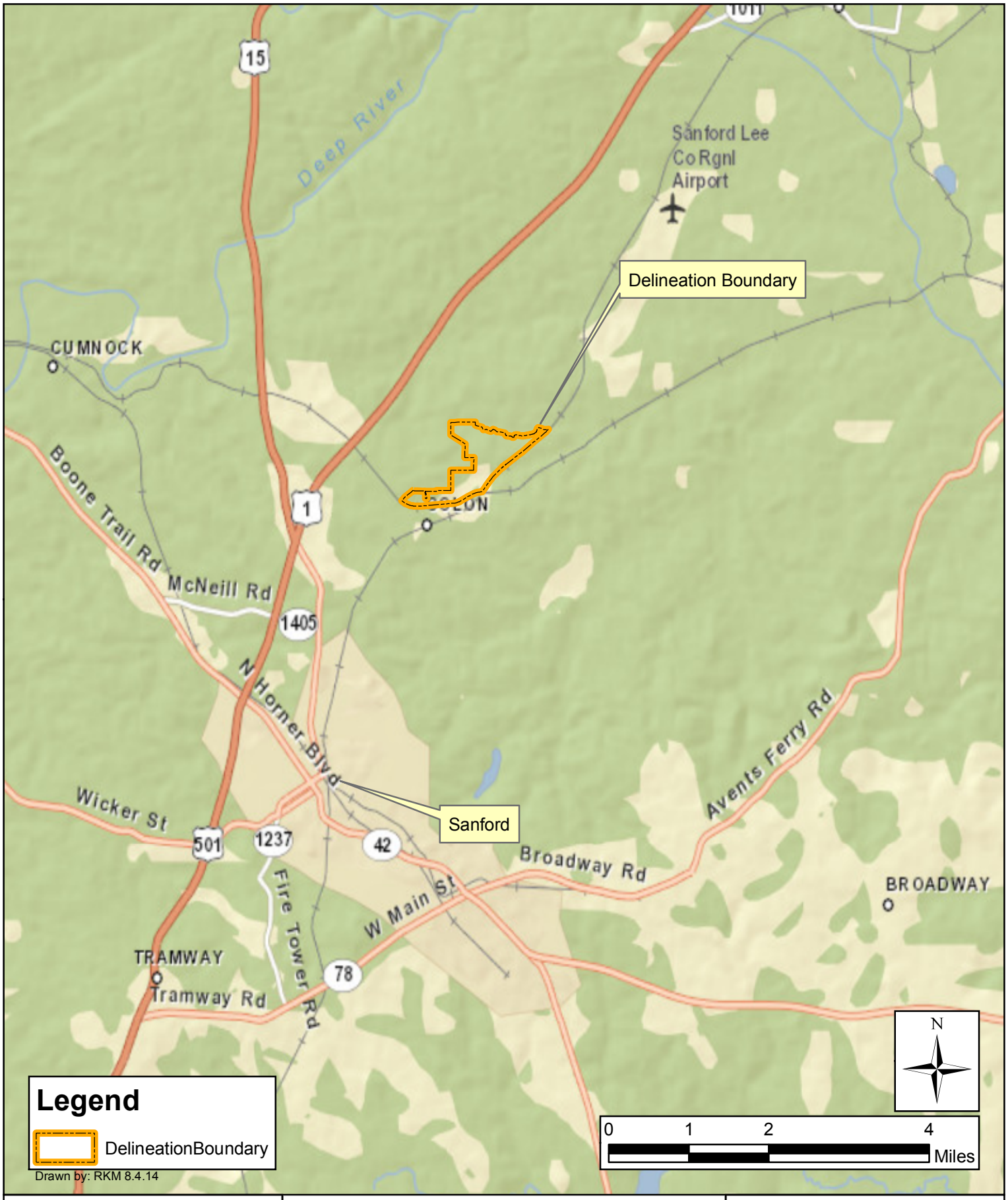
We appreciate the opportunity to provide this information to you. If you have any questions or comments concerning this letter please do not hesitate to contact me at 828-698-9800.

Sincerely,

Rebekah L. Newton
Project Biologist

R. Clement Riddle, P.W.S.
Principal

Colon Mine (+/-408 AC)



Lee County,
North Carolina

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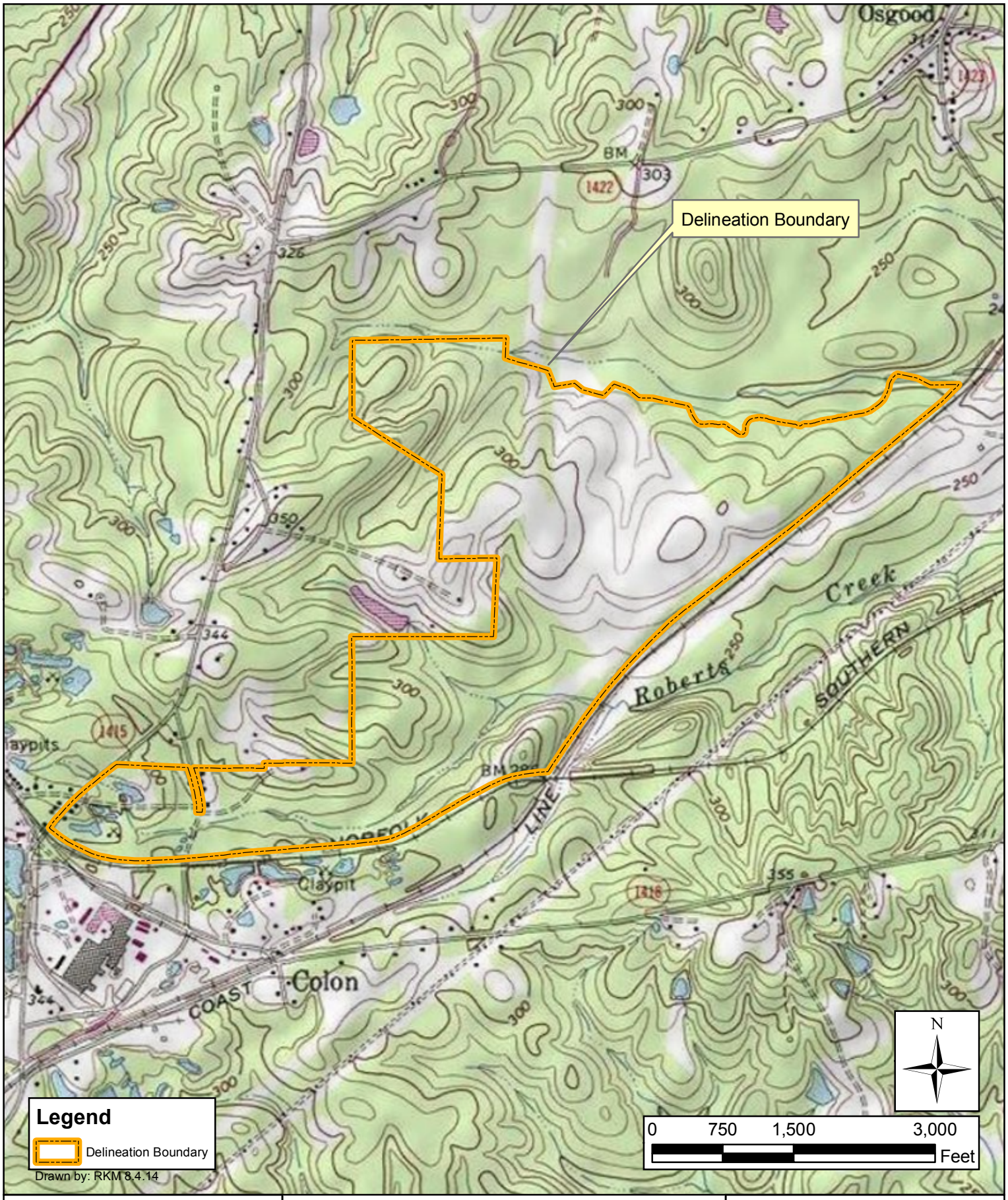
Site Vicinity
Figure 1

Colon Mine (+/-408 AC)



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North Carolina

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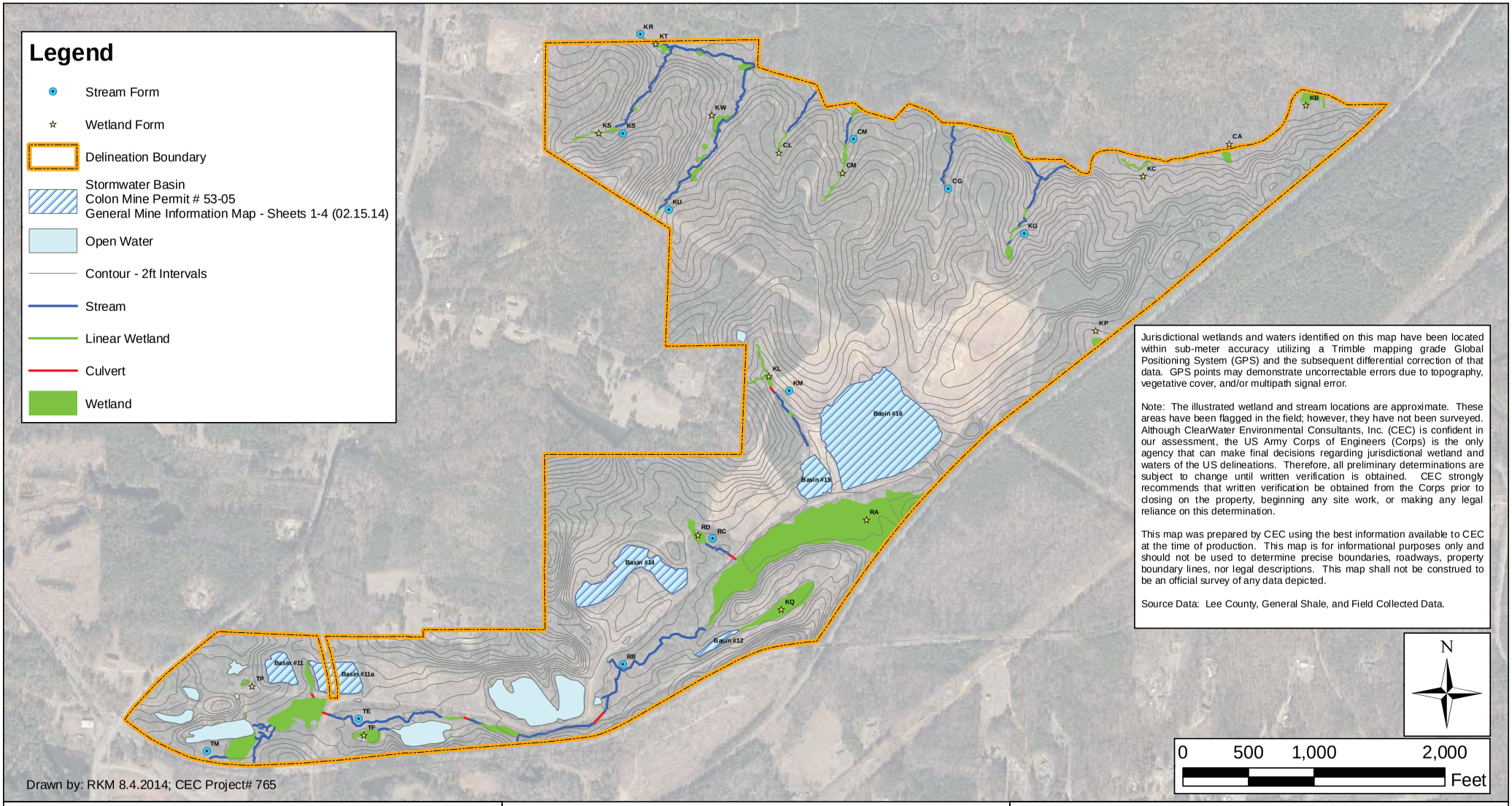
USGS Topographic Map
Colon Quad
Figure 2

Colon Mine (+/- 408 AC)



Lee County,
North Carolina

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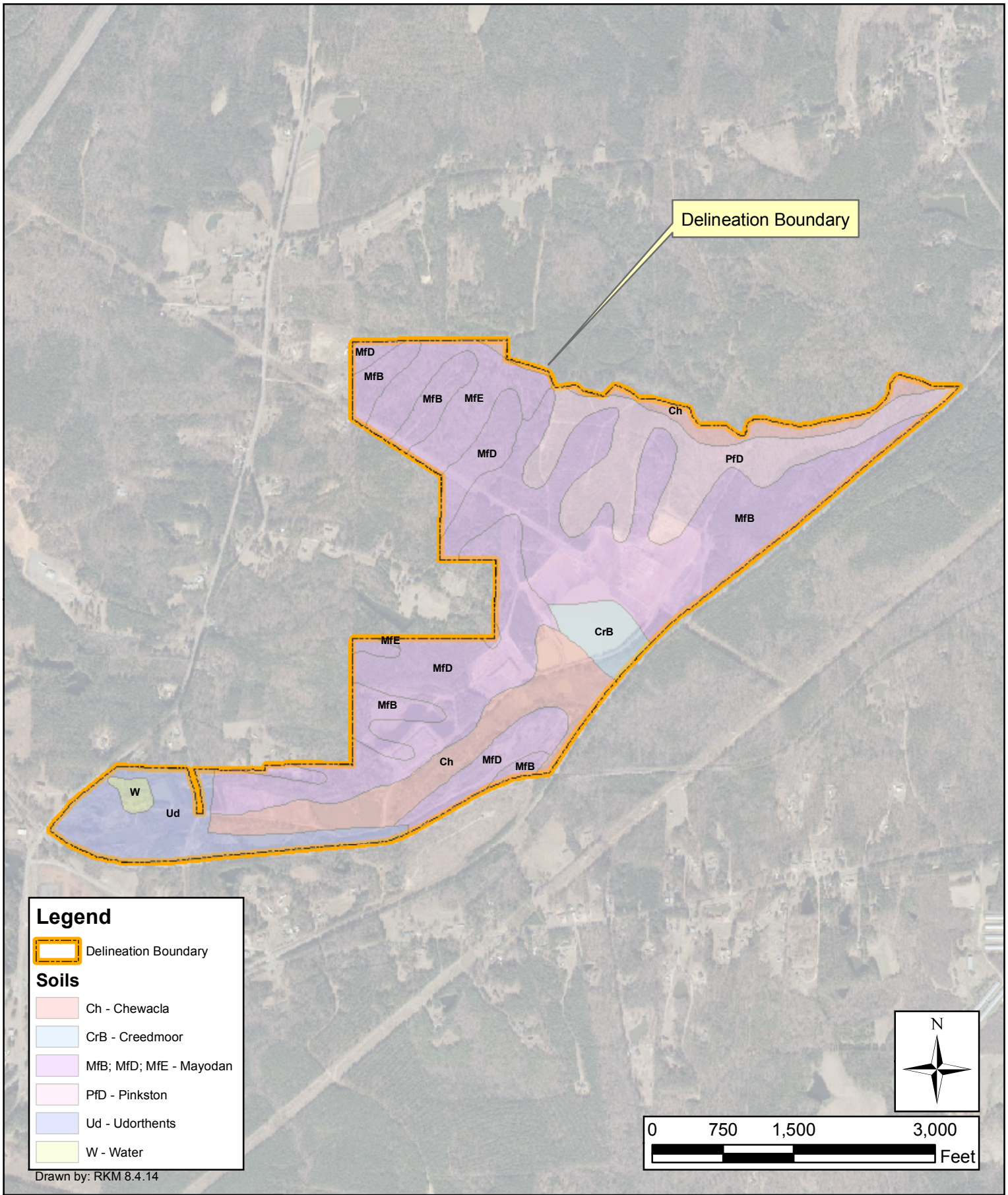
Figure 3
Stream and Wetland Delineation Map
Delineated: July 21, 22, 23, 24, 30, & 31, 2014.

Colon Mine (+/-408 AC)



Drawn by: RKM 8.4.14

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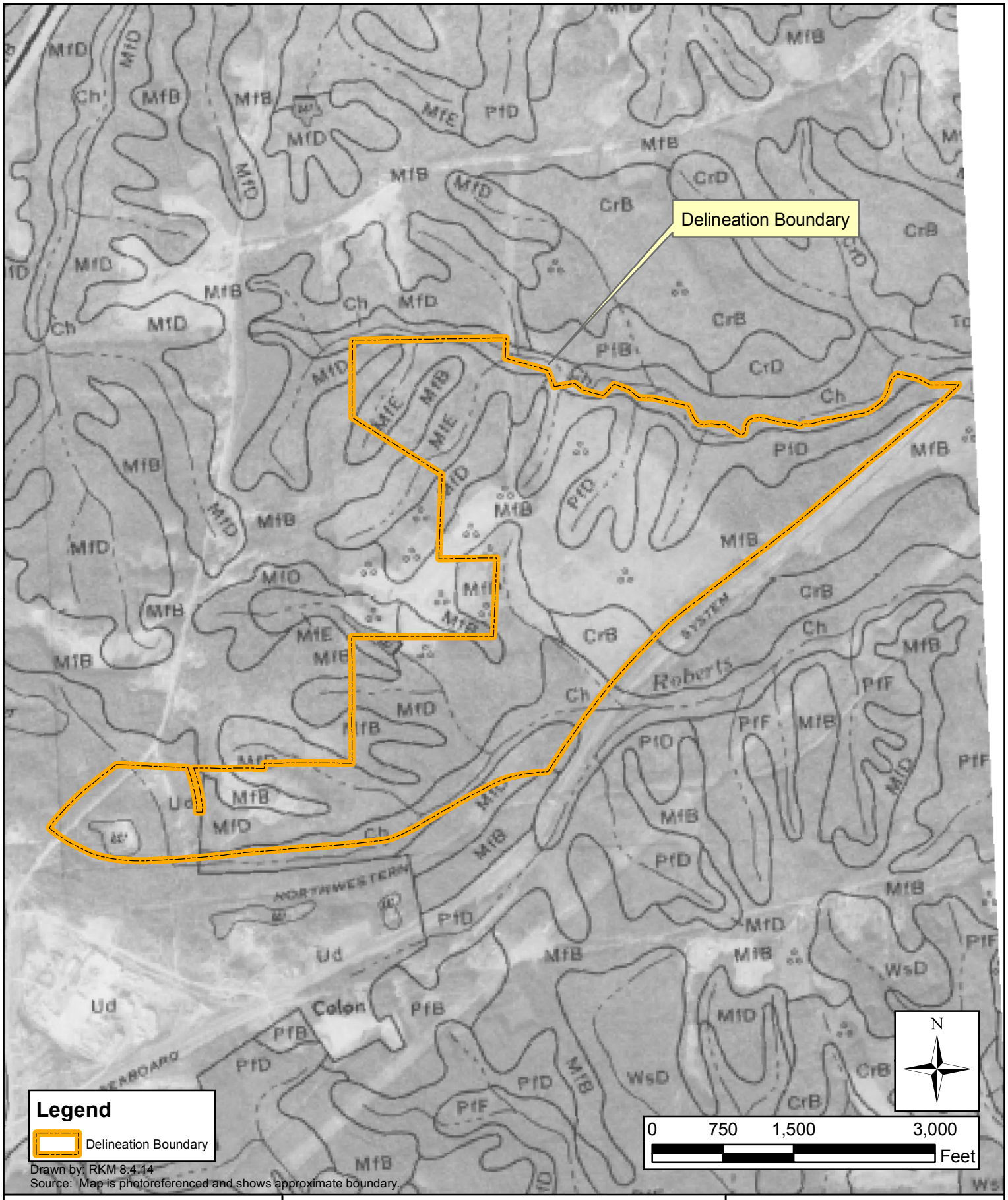
USDA Soils
Figure 4a

Colon Mine (+/-408 AC)



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North Carolina

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USDA Soils
Lee County Soils Suvey 1989
Figure 4b

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Colon Mine
Approximately 408 Acres
Lee County, NC

Threatened and Endangered Species Review and Habitat Assessment

Prepared For
Charah Inc.
12601 Plantside Drive
Louisville, KY 40299

Prepared By
ClearWater Environmental Consultants, Inc.
224 South Grove Street, Suite F
Hendersonville, NC 28792

August 8, 2014

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Appendices

Appendix A: US Fish and Wildlife Service County Database Information and NC Natural Heritage Program Data

1.0 INTRODUCTION

The following report includes methods used and results for a threatened and endangered species survey and habitat assessment for the proposed approximately 408 acre project known as the Colon Mine. The project is located off Colon Road in Sanford, Lee County, North Carolina (Figures 1-2). The site ranges in elevation from 334 feet to 230 feet above mean sea level.

The threatened and endangered species survey was conducted to determine the occurrence of or the potential for existence of federally listed threatened and endangered animal and plant species on the proposed site. Completion of this survey was directed by and complies with three current state and federal regulations: the Federal Endangered Species Act of 1973 (16 USC 1531-1543), the North Carolina Endangered Species Act (N.C.G.S. Sect. 113 article 25), and the North Carolina Plant Protection and Conservation Act of 1979 (N.C.G.S. Sect. 19b 106: 202.12-22).

2.0 METHODOLOGY

The protected species survey and habitat assessment was conducted on July 21-24 and July 30-31 2014 on the 408 acre project by ClearWater Environmental Consultants, Inc. (CEC) to determine the potential for occurrences of animal and plant species listed as endangered or threatened by current federal regulations.

A database search from the US Fish and Wildlife Service (FWS) dated July 14, 2014 provided existing data concerning the presence or potential occurrence of threatened or endangered species in Lee County, North Carolina (Appendix A). The FWS lists the following four federally threatened and endangered species as occurring or potentially occurring in Lee County, N.C. The species listed below were included in the surveys and assessment.

Table 1. Federally threatened and endangered species listed as occurring or potentially occurring.

Common Name	Scientific Name	Status
Red-cockaded woodpecker	*Picoides borealis*	Endangered
Cape Fear shiner	*Notropis mekistocholas*	Endangered
Harperella	*Ptilimnium viviparum*	Endangered
Northern long-eared bat	*Myotis septentrionalis*	Proposed

A database search from the NC Natural Heritage Program (NHP) dated July 14, 2014 provided existing data concerning the presence or potential occurrences of federal listed species in Lee County, North Carolina within five miles of the site (Appendix A).

The NHP indicates a documented occurrence of the Cape Fear shiner approximately 3.3 miles from the project in the lower Deep River subbasin.

The protected species survey consisted of a pedestrian survey by CEC staff. During field surveys, site habitats were identified and compared with recognized habitats for each of the four species potentially occurring on the site. Potential flora were identified to the

taxonomic unit level necessary to determine if the observed specimen was a protected species.

3.0 HABITAT CLASSIFICATION

During our site visits on July 21-24 and July 30-31, Clement Riddle, Kevin Mitchell, and Rebekah Newton with CEC identified seven habitats: ruderal corridors, early successional field, stream bank and riparian, mixed pine/hardwood forest, oak hickory forest, loblolly pine forest, and wetland.

3.1 Ruderal Corridors

The ruderal habitat consists of road edges and power line rights-of way. It is considered a disturbed and/or transitional community type. These areas are dominated by early successional saplings, shrubs, and herbaceous plants. Species observed include baccharis (*Baccharis sp.*), wax myrtle (*Morella cerifera*), lespedeza (*Lespedeza sp.*), blackberry (*Rubus sp*), dog fennel (*Eupatorium capillifolium*), goldenrod (*Solidago*), and switchgrass (*Panicum virgatum*). Other species observed include southern red oak (*Quercus falcata*), blackjack oak (*Quercus marilandica*), persimmon (*Diospyros virginiana*), and poison ivy (*Toxicodendron radicans*).

3.2 Early Successional Field

This habitat includes old abandoned fields dominated by baccharis, lespedeza, blackberry, and goldenrod. Other early successional saplings and shrubs include loblolly pine (*Pinus taeda*), sweetgum (*Liquidambar styraciflua*), and winged sumac (*Rhus copallinum*).

3.3 Stream Bank and Riparian

These freshwater habitats include the streambeds and banks and immediate riparian areas of Roberts Creek and unnamed tributaries to Roberts Creek. Nearly all of Roberts Creek has been affected (ditched, rerouted, impounded, etc.) by historic mining operations. Permanently rooted aquatic plants are practically non-existent in on-site streams. The unnamed tributaries are narrow systems varying from 2-6 feet wide. Dominant overstory species include red maple (*Acer rubrum*), sweetgum, water oak (*Quercus nigra*), willow oak (*Qercus phellos*), black gum (*Nyssa sylvatica*) and loblolly pine. Tag alder (*Alnus serrulata*), black willow (*Salix nigra*), and sourwood (*Oxydendron arboretum*) dominate the understory. Herbaceous species include bracken fern (*Pteridium aquilinum*), sensitive fern (*Onoclea sensibilis*), netted chain fern (*Woodwardia areolata*), cinnamon fern (*Osmundastrum cinnamomeum*), possum haw (*Vibernum nudum*), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy. Less dominant species include tulip poplar (*Liridodendron tulipifera*), American holly (*Ilex opaca*), northern red oak (*Quercus*

rubra), royal fern (*Osmunda regalis*), running cedar (*Lycopodium*), and sassafras (*Sassafras albidum*).

3.4 Mixed Pine/Hardwood Forest

The mixed pine/hardwood is dominated by 15-20 year old loblolly pine, sweetgum, sourwood, and black cherry (*Prunus serotina*). The dense understory is comprised of saplings and blackberry.

3.5 Oak Hickory Forest

This habitat consists of predominately oak species and hickory. Species include white oak (*Quercus alba*), southern red oak, northern red oak, mockernut hickory (*Carya tomentosa*), tulip poplar, sweetgum, sourwood, red maple, and a few scattered loblolly pines. The understory consists of sassafras, blueberry (*Vaccinium sp.*), dogwood (*Cornus florida*), winterberry (*Ilex verticillata*), grapevine (*Vitis sp.*), and (*Hexastylis spp.*).

3.6 Loblolly Pine Forest

This community is dominated by 10-25 year old Loblolly pine stands. The understory is dense and other species observed include tulip poplar, sweetgum, sourwood, red maple, and water oak. The herbaceous layer consists of Japanese honeysuckle (*Lonicera japonica*), greenbrier (*Smilax rotundifolia*), bracken fern, blackberry, and poison ivy.

3.7 Wetland

Wetlands on the northern end of the project are seepage and stream-flow driven systems adjacent to or at the head of perennial and intermittent streams. Dominant overstory species include black willow, red maple, sweetgum, black gum, willow oak, loblolly pine and water oak. In addition to saplings of the above trees, species observed in the shrub layer include elderberry, tag alder, and possumhaw. The herbaceous layer consists of cinnamon fern, sensitive fern, royal fern, sedges, and rushes.

Beaver activity and mining operations have also influenced wetland development along Roberts Creek on the southern end of the project. These open marsh wetland habitats are dominated by herbaceous plants and shrubs. Dominant species include black willow, tag alder, woolgrass (*Scirpus cyperinus*), lizard's tail (*Saururus cernuus*), cattail (*Typha latifolia*), and tearthumb (*Polygonum sagittatum*). Other species observed include elderberry (*Sambucus canadensis*), pickerelweed (*Pontederia cordata*), black gum, wax myrtle, button bush (*Cephalathus occidentalis*), red maple, and sweetgum.

3.8 Soils

Soils mapped by the Natural Resources Conservation Service (NRCS) Lee County Soil Survey for the site include: Chewacla silt loam (Ch) 0-2 percent slopes, Creedmoor fine sandy loam (CrB) 2-8 percent slopes, Myodon fine sandy loam (MfB, MfD, MfE) 2-25 percent slopes, and Pinkston silt loam (PfD) 8-15 percent slopes, Udorthents loamy, and Water (Figure 3) (NRCS 2014).

4.0 PROTECTED SPECIES

The following is a brief description of each federally listed species included in the survey, its recognized habitat, and comments regarding survey results for that species.

4.1 Red-cockaded woodpecker

The Red-cockaded woodpecker (RCW) (*Picoides borealis)* is a small bird measuring about 7 inches in length. Identifiable by its white cheek patch and black and white barred back, the males have a few red feathers, or "cockade". These red feathers usually remain hidden underneath black feathers between the black crown and white cheek patch unless the male is disturbed or excited. Female RCWs lack the red cockade. Juvenile males have a red patch in the center of their black crown. This patch disappears during the fall of their first year at which time their red-cockades appear.

Red-cockaded woodpecker habitat includes forests with trees old enough for roosting, generally at least 60-120 years old, depending on the species of pine. The most prominent adaptation of RCWs is their use of living pines for cavity excavation.

For nesting and roosting habitat, red-cockaded woodpeckers need open stands of pine containing trees 60 years old and older. RCWs need live, large older pines in which to excavate their cavities. Longleaf pines (*Pinus palustris*) are preferred, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods, or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 30 years old or older with foraging preference for pine trees 10 inches or larger in diameter. In good, moderately-stocked, pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres.

Suitable habitat for the red-cockaded woodpecker does not exist within the proposed project boundary. Pine stands are too dense and 15-35 years old. It is the opinion of CEC that the proposed project is not likely to adversely affect the red-cockaded woodpecker.

4.2 Cape Fear shiner

The Cape Fear shiner (*Notropis mekistocholas*) was first described as a new species in 1971. It is a small (approximately 2 inches long), yellowish minnow with a black band along the sides of its body. The shiner's fins are yellow and somewhat pointed. It has a black upper lip, and the lower lip bears a thin black bar along its margin.

The Cape Fear shiner is generally associated with gravel, cobble, and boulder substrates, and has been observed in slow pools, riffles, and slow runs. These areas occasionally support water willow (*Justicia americana*), which may be used as cover or protection from predators (e.g. flathead catfish (*Pylodictis olivaris*), bass (*Micropterus spp.*) and crappie (*Pomoxis spp.*)). The Cape Fear shiner can be found swimming in schools of other minnow species but is never the most abundant species. During the spawning season, May through July, the Cape Fear shiner adults move to slower flowing pools to lay eggs on the rocky substrate. Juveniles are often found in slack water, among large rock outcrops of the midstream, and in flooded side channels and pools.

Suitable habitat for the Cape Fear shiner does not exist within the proposed project boundary. The streams on site are dominated by silt and sand substrate. It is the opinion of CEC that the proposed project is not likely to adversely affect the Cape Fear shiner.

4.3 Harperella

Harperella in North Carolina (described as *Ptilimnium viviparum*) is a perennial herb that grows to a height of 6 - 36 inches (in) (0.15 - 1.0 meter; m). The leaves are reduced to hollow, quill-like structures. The small, white flowers occur in heads, or umbels, reminiscent of a small Queen Anne's lace (*Daucus carota*) flower head. Flowers have five regular parts and are bisexual or unisexual, each umbel containing both perfect and male florets. Seeds are elliptical and laterally compressed, measuring 0.06 – 0.08 in (1.5 - 2.0 millimeters; mm) in length. In pond habitats, flowering begin in May, while riverine populations flower much later, beginning in late June or July and continuing until frost.

Harperella in North Carolina typically occurs on rocky or gravel shoals and sandbars and along the margins of clear, swift-flowing stream sections. Harperella is known from only two locations in North Carolina. One population occurs in the Tar River in Granville County. Another population was reintroduced to the Deep River recently after the original population known from that area disappeared. This population occurs in Chatham County, but the river serves as the divide between Chatham and Lee counties.

Suitable habitat for the Harperella does not exist within the project boundary. It is the opinion of CEC that the proposed project is not likely to adversely affect the Harperella.

4.4 Northern long-eared bat

The Northern long-eared bat (*Myotis septentrionalis*) has been proposed to be federally listed as an endangered species. Currently there are no regulations protecting this species and no development constraints due to its potential presence; however, the listing decision is expected to be finalized in April of 2015.

Summer habitat for the Northern long-eared bat consists of the cavities, hollows, cracks, or loose bark of live or dead trees typically greater than three inches DBH (diameter at breast height). Suitable summer habitat for the Northern long-eared bat does exist within the proposed site and permanent removal of forested habitat may adversely affect this species. The timing of tree clearing activities at the site may be affected once the final listing decision is made. Once listed, a moratorium on tree cutting could go into effect from approximately May 15th to August 15th. Final dates of the tree cutting moratorium will not be known until the FWS makes a final listing decision.

5.0 CONCLUSION AND RECOMMENDATIONS

During completion of threatened and endangered species habitat assessments for the Colon Mine, CEC observed suitable summer habitat for the Northern long-eared bat. Currently there are no regulations protecting this species and no development constraints due to its potential presence; however, the listing decision is expected to be finalized in April of 2015.

As such, development of the Colon Mine is not likely to adversely affect federally threatened or endangered species. Because of the transitory nature of some of the listed threatened and endangered species and the particular flower/fruiting periods of some plants; it is possible that endangered species populations and locations may change over time. Therefore, any potential findings at a later date should be fully investigated and coordinated with appropriate agencies to prevent potential adverse impacts.

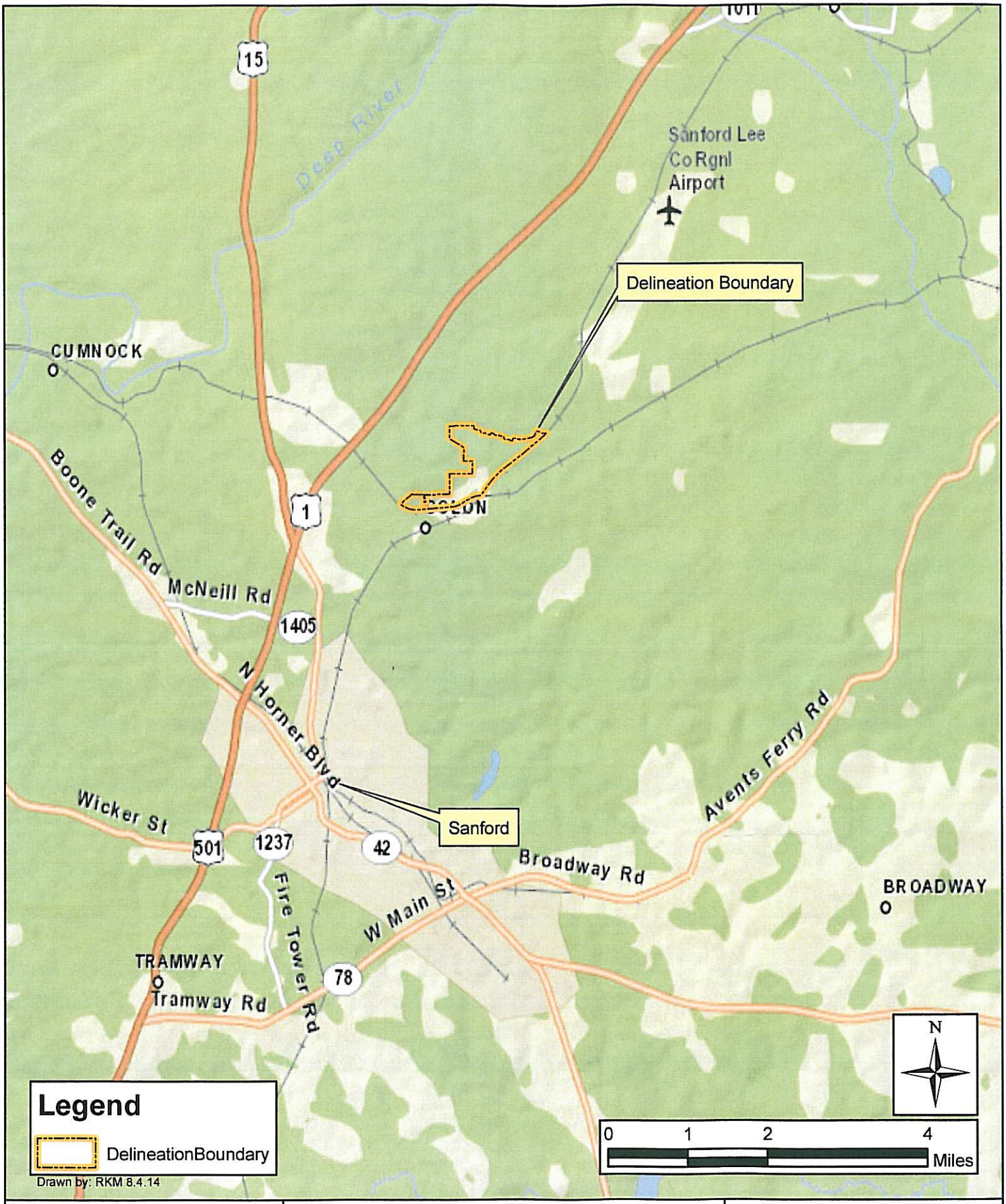
6.0 REFERENCES

NCNHP (North Carolina Natural Heritage Program Database). 2014. http://portal.ncdenr.org/web/nhp/database-search; accessed July 2014.

NRCS (Natural Resources Conservation Service). 2010. Web Soil Survey for Lee County. http://websoilsurvey.sc.egov.usda.gov; Accessed July 2014.

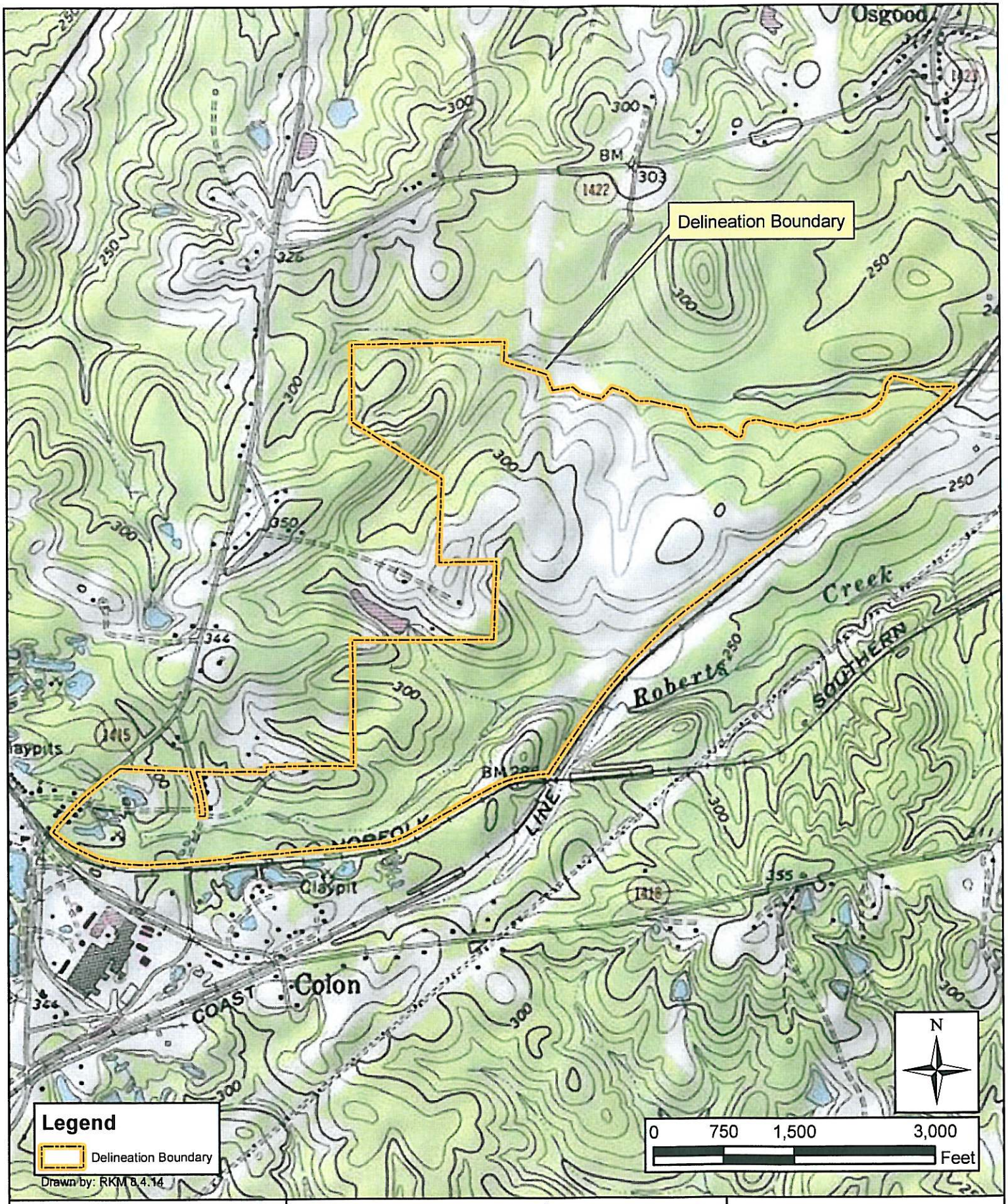
USFWS (United States Fish and Wildlife Service Database). 2014. http//www.fws.gov/Raleigh/species/cntylist/nc_counties.html. accessed July 2014.

Colon Mine (+/-408 AC)



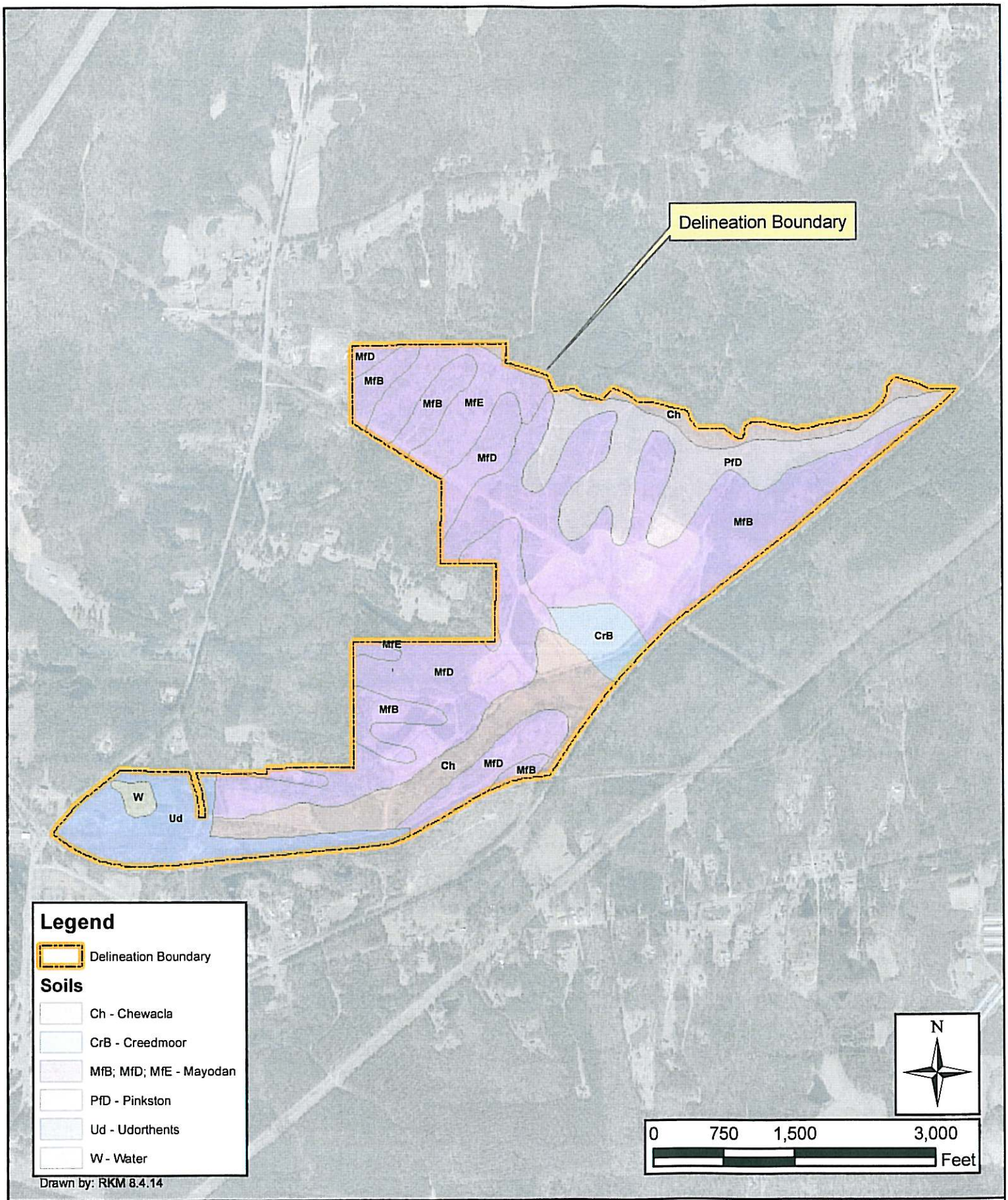
Lee County, North Carolina	ClearWater 224 South Grove Street, Suite F Hendersonville, North Carolina 28792	Site Vicinity Figure 1

Colon Mine (+/-408 AC)



Lee County, North Carolina	ClearWater 224 South Grove Street, Suite F Hendersonville, North Carolina 28792	USGS Topographic Map Colon Quad Figure 2

Colon Mine (+/-408 AC)



Lee County,
North Carolina

ClearWater

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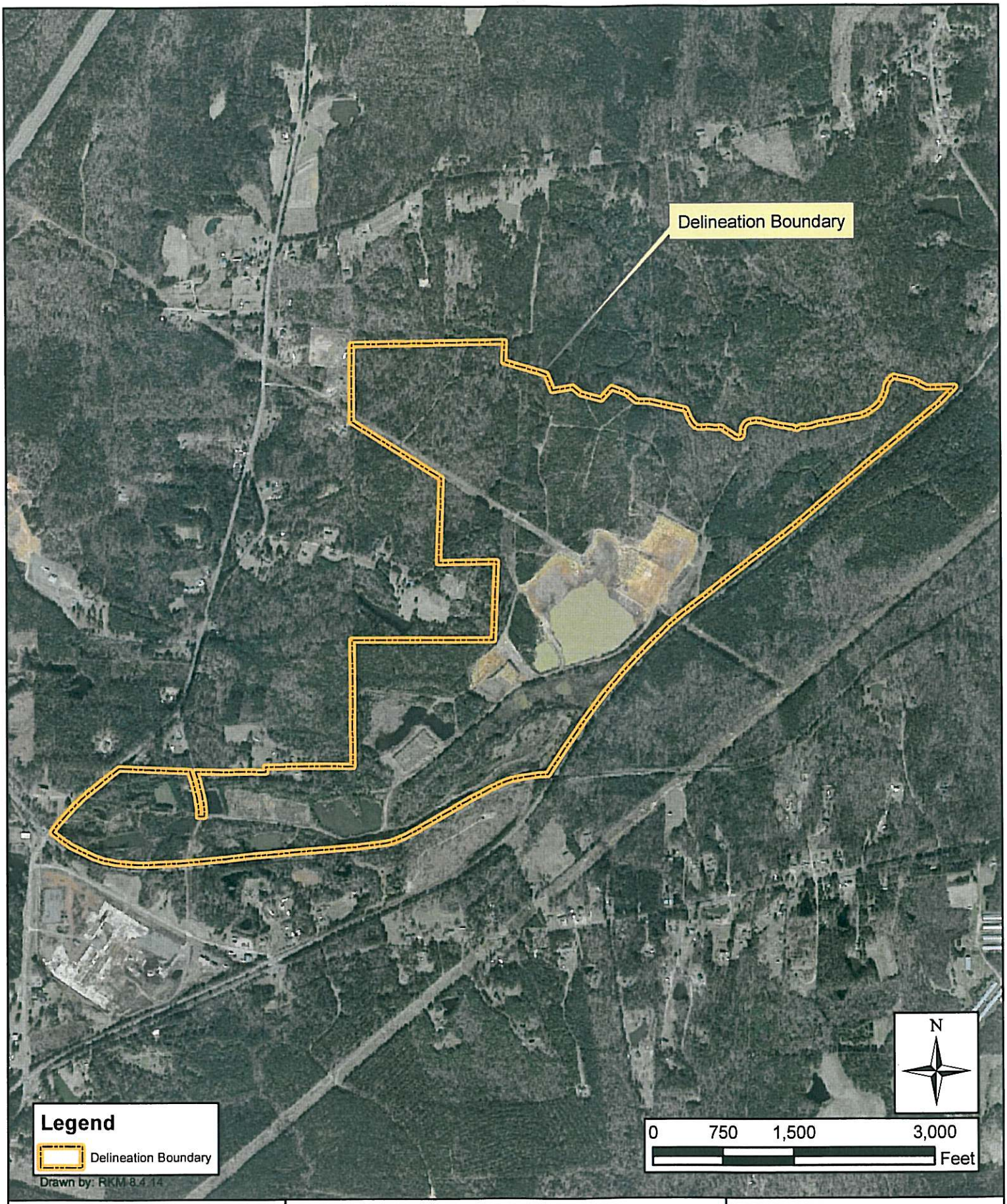
USDA Soils
Figure 3

Colon Mine (+/-408 AC)



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Aerial (2010)
NCCGIA
Figure 4

Appendix A

Database Information July 14, 2014

US Fish and Wildlife Service

&

North Carolina Natural Heritage Program

U.S. Fish & Wildlife Service

Endangered Species, Threatened Species,Federal Species of Concern, and Candidate Species,

Lee County, North Carolina

Updated: 1-22-2014

Critical Habitat Designations:

Cape Fear shiner - *Notropis mekistocholas* - Approximately 0.5river mile of Bear Creek, from Chatham County Road 2156 Bridge downstream to the Rocky River, then downstream in the Rocky River (approximately 4.2river miles) to the Deep River, then downstream in the Deep River (approximately 2.6river miles) to a point 0.3river mile below the Moncure, North Carolina, U.S.Geological Survey Gaging Station. Constituent elements include clean streams with gravel, cobble, and boulder substrates with pools, riffles, shallow runs and slackwater areas with large rock outcrops and side channels and pools with water of good quality with relatively low silt loads.
Federal Register Reference: September 25, 1987, Federal Register, 2: 36034-36039.

Common Name	Scientific name	Federal Status	Record Status
Vertebrate:			
American eel	*Anguilla rostrata*	FSC	Current
Cape Fear shiner	*Notropis mekistocholas*	E	Current
Carolina redhorse	*Moxostoma* sp. *2*	FSC	Current
Northern long-eared bat	*Myotis septentrionalis*	P	Current
Red-cockaded woodpecker	*Picoides borealis*	E	Historic
Invertebrate:			
Septima's clubtail	*Gomphus septima*	FSC	Current

Vascular Plant:

Bog spicebush	*Lindera subcoriacea*	FSC	Current
Buttercup phacelia	*Phacelia covillei*	FSC	Current
Carolina grass-of-parnassus	*Parnassia caroliniana*	FSC	Historic
Georgia lead-plant	*Amorpha georgiana* var. *georgiana*	FSC	Current
Harperella	*Ptilimnium nodosum*	E	Historic
Sandhills bog lily	*Lilium pyrophilum*	FSC	Current

Nonvascular Plant:

Lichen:

Definitions of Federal Status Codes:

E = endangered. A taxon "in danger of extinction throughout all or a significant portion of its range."
T = threatened. A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
C = candidate. A taxon under consideration for official listing for which there is sufficient information to support listing. (Formerly "C1" candidate species.)
BGPA =Bald and Golden Eagle Protection Act. See below.
FSC = federal species of concern. A species under consideration for listing, for which there is insufficient information to support listing at this time. These species may or may not be listed in the future, and many of these species were formerly recognized as "C2" candidate species.
T(S/A) = threatened due to similarity of appearance. A taxon that is threatened due to similarity of appearance with another listed species and is listed for its protection. Taxa listed as T(S/A) are not biologically endangered or threatened and are not subject to Section 7 consultation. See below.
EXP = experimental population. A taxon listed as experimental (either essential or nonessential). Experimental, nonessential populations of endangered species (e.g., red wolf) are treated as threatened species on public land, for consultation purposes, and as species proposed for listing on private land.
P = proposed. Taxa proposed for official listing as endangered or threatened will be noted as "PE" or "PT", respectively.

Bald and Golden Eagle Protection Act (BGPA):

In the July 9, 2007 Federal Register(72:37346-37372), the bald eagle was declared recovered, and removed (de-listed) from the Federal List of Threatened and Endangered wildlife. This delisting took effect August 8,2007. After delisting, the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668-668d) becomes the primary law protecting bald eagles. The Eagle Act prohibits take of bald and golden eagles and provides a statutory definition of "take" that includes "disturb". The USFWS has developed National Bald Eagle Management Guidelines to provide guidance to land managers, landowners, and others as to how to avoid disturbing bald eagles. For mor information, visit http://www.fws.gov/migratorybirds/baldeagle.htm

Threatened due to similarity of appearance(T(S/A)):

In the November 4, 1997 Federal Register (55822-55825), the northern population of the bog turtle (from New York south to Maryland) was listed as T (threatened), and the southern population (from Virginia south to

Georgia) was listed as T(S/A) (threatened due to similarity of appearance). The T(S/A) designation bans the collection and interstate and international commercial trade of bog turtles from the southern population. The T(S/A) designation has no effect on land management activities by private landowners in North Carolina, part of the southern population of the species. In addition to its official status as T(S/A), the U.S. Fish and Wildlife Service considers the southern population of the bog turtle as a Federal species of concern due to habitat loss.

Definitions of Record Status:

Current - the species has been observed in the county within the last 50 years.
Historic - the species was last observed in the county more than 50 years ago.
Obscure - the date and/or location of observation is uncertain.
Incidental/migrant - the species was observed outside of its normal range or habitat.
Probable/potential - the species is considered likely to occur in this county based on the proximity of known records (in adjacent counties), the presence of potentially suitable habitat, or both.

SCI_NAME	COM_NAME	SURVEYDATE
Gomphus septima	Septima's Clubtail	2013-04-15
Gomphus septima	Septima's Clubtail	2002-04-27
Phacelia covillei	Buttercup Phacelia	1984
Phacelia covillei	Buttercup Phacelia	1985
Phacelia covillei	Buttercup Phacelia	2004-05-09
Notropis mekistocholas	Cape Fear Shiner	2012-04-12

LAST_OBS	FIRST_OBS	EO_STATUS	NC_STATUS	USA_STATUS	S_RANK	G_RANK	TYPE
2013-04-15	1965	Current	SR	FSC	S2	G2	Aquatic
2002-04-27	1987-05-03	Current	SR	FSC	S2	G2	Aquatic
1984	1951-04	Current	SR-T	FSC	S3	G3	Upland
1985	1951-04	Current	SR-T	FSC	S3	G3	Upland
2004-05-09	2004-05-09	Current	SR-T	FSC	S3	G3	Upland
2012-04-12	1971-06-09	Current	E	E	S1	G1	Aquatic

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August 8, 2014

Mr. Clement Riddle
Clearwater Environmental Consultants
224 South Grove Street #F
Hendersonville, North Carolina 28792

RE: Management Summary, Archaeological Survey at the Sanford Mine, Lee County, North Carolina

Dear Mr. Riddle:

TRC Environmental Corporation (TRC) has completed the archaeological survey at the Sanford Mine in Lee County, North Carolina. The field investigations were accomplished from July 17th through August 7th, 2014, under the direction of Brooke Kenline. Paul Webb served as Principal Investigator.

PROJECT DEFINITION

The archaeological survey included a total of 5 parcels (PIN#s 9655-81-9374-00, 9655-62-2672-00, 9654-68-2373-00, 9654-58-2312-00, and 9654-38-3247-00) totaling approximately 250 acres of potentially undisturbed land and situated east of Colon Road and north of both Brickyard and Post Office roads. The work included shovel test excavations and surface surveys in areas where 50% or more of the ground surface was visible. All shovel tests were described in terms of depth, stratigraphy, and artifact recovery, and the texture and Munsell soil color of representative soils were recorded. The location of all shovel tests and surface surveys were plotted on a project map. Standard procedures were followed when archaeological sites were located to gather data on site size, location, integrity, and cultural affiliation. These procedures include intensive surface inspection and/or the excavation of additional shovel tests at 10-m to 15-m intervals within project boundaries. The location and limits of the site were recorded and a sketch map showing the location of all shovel tests was generated. The sites were photographed, general notes were taken concerning site location and condition, and GPS readings were taken.

FIELDWORK RESULTS

The survey fieldwork included the excavation of 594 shovel tests and the surface survey of approximately 3,980 linear meters of dirt roads/logging trails with surface visibility greater than 50%. Twenty five of the excavated shovel tests produced prehistoric or historic period artifacts and eight surface collections were made.

The survey identified a total of 12 archaeological sites, including seven low to moderate density prehistoric lithic artifact scatters on eroded upland landforms, one isolated prehistoric artifacts, three late 19th to the late 20th century historic homesteads with low to moderate artifact densities, and one early to mid-20th century historic cemetery (Figure 1; Table 1).

Table 1. Archaeological Sites Identified by the Sanford Mine Phase I Survey.

FS#	Component(s)	Shovel Tests			Features	Artifacts (including surface)				NRHP Recommendation
		Excavated	Prehistoric	Historic		Lithics	Ceramics	Historic	Total	
1	Prehistoric: Unknown Lithic Scatter	14	2	0	0	2	0	0	2	Not Eligible
2	Prehistoric: Unknown Lithic Scatter	9	1	0	0	1	0	0	1	Not Eligible
3	Prehistoric: Unknown Middle/Late Archaic	21	1	0	0	100	0	0	100	Not Eligible
4	Prehistoric: Unknown Lithic Scatter	22	6	0	0	12	0	0	12	Not Eligible
5	Prehistoric: Unknown Lithic Scatter	20	1	0	0	131	0	0	131	Not Eligible
6	Prehistoric: Unknown Lithic Scatter	14	1	0	0	3	0	0	3	Not Eligible
7	Prehistoric: Unknown Lithic Scatter	30	6	0	0	11	0	0	11	Not Eligible
8	Historic: Early 20th Century	25	0	5	3	0	0	13	13	Not Eligible
9	Historic: Late 19th- Mid 20th Century	15	0	1	1	0	0	3	3	Not Eligible
10	Prehistoric: Unknown Lithic Scatter	14	2	0	0	2	0	1	3	Not Eligible
11	Historic; Early-Mid 20th Century Cemetery	0	0	0	4+	0	0	0	0	Not Eligible
12	Historic: Mid-Late 20th Century	0	0	0	0	0	0	0	0	Not Eligible

No diagnostic artifacts were recovered from seven of the eight prehistoric sites (Field Sites 1, 2, 4, 5, 6, 7, and 10); the remaining site (Field Site 6) produced a rhyolite Savannah River projectile point and dates to the Middle to Late Archaic period (ca. 5000 to 1000 B.C.). No prehistoric ceramics were recovered and no features were identified at these sites. These eight sites lack integrity and the potential to provide meaningful information concerning the prehistory of the area, and are recommended not eligible for the National Register of Historic Places (National Register).

Historic sites identified within the project area vary in regard to integrity, occupation periods, and function. Field Site 8 is an early 20th century farmstead with several features including a brick chimney fall, surface refuse accumulation, and a possible well. Subsurface artifact density at the site is low. Field Site 9 is a late 19th to mid-20th century farmstead site with a standing outbuilding with wood plank siding. This site appears to be part of the agricultural hub of the farmstead and straddles the project boundary at the southeastern border of parcel #9655-62-2672-00. Field Site 12 is a mid to late 20th century domestic site located on Colon Road. Although the remains of a brick chimney or structure are present, the site appears to be severely disturbed and lacks research potential. None of these three sites possess research potential, and all are recommended not eligible for the National Register.

The final site (Field Site 11) is an early to mid-20th century cemetery associated with the early 20th century farmstead identified as Field Site 8. Although only one headstone and three metal markers were located during fieldwork, the cemetery is believed to contain at least eight to twelve burials due to the presence of rectangular depressions most likely associated with subsurface coffin collapse. The single headstone is marked "MCKINLEY JOHNSON/DELAWARE/PVT 811 PIONEER INF/AUGUST 31, 1932." Archival research has identified a 1932 application for this military headstone, indicated that Mr. Johnson was interred in Zion Hill Cemetery. This cemetery is currently not listed in the on-line Lee County cemetery survey (http://cemeterycensus.com/nc/lee/index.htm). This cemetery is not considered eligible for the National Register, but is protected by state statutes, as discussed below.

SUMMARY

The archaeological investigations at Sanford Mine have been completed in accordance with the project proposal, and have identified a total of 12 archaeological sites within the project area. Laboratory analysis and reporting are now in progress.

All 12 of the sites are recommended not eligible for the National Register, and no additional archaeological investigations should be required prior to development of the property. The presumed Zion Hill Cemetery (Field Site 11) is protected by North Carolina state statutes, however, minimally including G.S. 14-148 (*Defacing or desecrating grave sites*), 14-149 (*Desecrating, plowing over or covering up graves; desecrating human remains*), and Chapter 70, Article 3 (*The Unmarked Human Burial and Human Skeletal Remains Protection Act*) (see attached).

As the cemetery likely contains both marked and unmarked graves, it is recommended that no ground-disturbing activities be allowed within its boundaries, and that cemetery location and a surrounding 50-foot buffer be marked in the field and shown on any pertinent property maps. In the event that any disturbances are planned within the buffer area, additional investigations are recommended to ensure that no graves are present in that area. In the event that the cemetery cannot be preserved in place, it should be removed in accordance with North Carolina statutes.

Thank you for the opportunity to complete this work. Please do not hesitate to contact us at 919 530-8446 or via email at bkenline@trcsolutions.com or pwebb@trcsolutions.com if you have any questions or would like any additional information prior to completion of the full report.

Sincerely,

Brooke Kenline
Field Director

Paul Webb
Principal Investigator/Project Manager

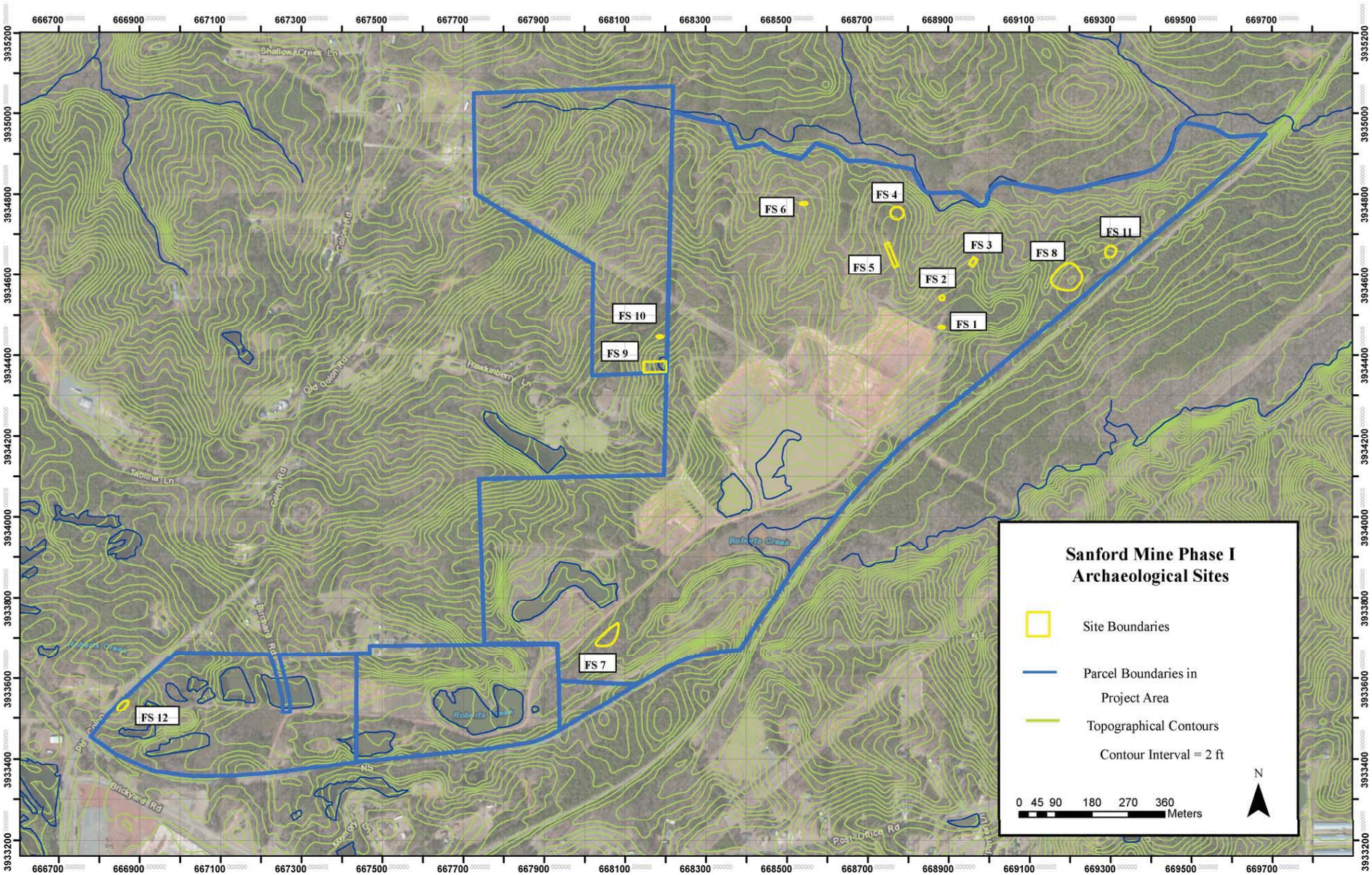

Figure 1. Archaeological Sites Identified within Project Area.

APPENDIX A. SELECTED NORTH CAROLINA GENERAL STATUTES RELATING TO CEMETERIES

§ 14-148. Defacing or desecrating grave sites.

(a) It is unlawful to willfully:

(1) Throw, place or put any refuse, garbage or trash in or on any cemetery.

(2) Take away, disturb, vandalize, destroy or change the location of any stone, brick, iron or other material or fence enclosing a cemetery without authorization of law or consent of the surviving spouse or next of kin of the deceased.

(3) Take away, disturb, vandalize, destroy, or tamper with any shrubbery, flowers, plants or other articles planted or placed within any cemetery to designate where human remains are interred or to preserve and perpetuate the memory and name of any person, without authorization of law or the consent of the surviving spouse or next of kin.

(b) The provisions of this section shall not apply to:

(1) Ordinary maintenance and care of a cemetery by the owner, caretaker, or other person acting to facilitate cemetery operations by keeping the cemetery free from accumulated debris or other signs of neglect.

(2) Conduct that is punishable under G.S. 14-149.

(3) A professional archaeologist as defined in G.S. 70-28(4) acting pursuant to the provisions of Article 3 of Chapter 70 of the General Statutes.

(c) Violation of this section is a Class I felony if the damage caused by the violation is one thousand dollars ($1,000) or more. Any other violation of this section is a Class 1 misdemeanor. In passing sentence, the court shall consider the appropriateness of restitution or reparation as a condition of probation under G.S. 15A-1343(b)(9) as an alternative to actual imposition of a fine, jail term, or both. (1840, c. 6; R.C., c. 34, s. 102; Code, s. 1088; Rev., s. 3680; C.S., s. 4320; 1969, c. 987; 1981, c. 752, s. 1; c. 853, s. 4; 1993, c. 539, s. 87; 1994, Ex. Sess., c. 24, s. 14(c); 2007-122, s. 1.)

§ 14-149. Desecrating, plowing over or covering up graves; desecrating human remains.

(a) It is a Class I felony, without authorization of law or the consent of the surviving spouse or next of kin of the deceased, to knowingly and willfully:

(1) Open, disturb, destroy, remove, vandalize or desecrate any casket or other repository of any human remains, by any means including plowing under, tearing up, covering over or otherwise obliterating or removing any grave or any portion thereof.

(2) Take away, disturb, vandalize, destroy, tamper with, or deface any tombstone, headstone, monument, grave marker, grave ornamentation, or grave artifacts erected or placed within any cemetery to designate the place where human remains are interred or to preserve and perpetuate the memory and the name of any person. This subdivision shall not apply to the ordinary maintenance and care of a cemetery.

(3) Repealed by Session Laws 2007-122, s. 2, effective December 1, 2007, and applicable to offenses committed on or after that date.

(a1) It is a Class H felony, without authorization of law or the consent of the surviving spouse or next of kin of the deceased, to knowingly and willfully disturb, destroy, remove, vandalize, or desecrate any human remains that have been interred in a cemetery.

(b) The provisions of this section shall not apply to a professional archaeologist as defined in G.S. 70-28(4) acting pursuant to the provisions of Article 3 of Chapter 70 of the General Statutes. (1889, c. 130; Rev., s. 3681; 1919, c. 218; C.S., s. 4321; 1981, c. 752, s. 2; c. 853, s. 5; 2007-122, s. 2.)

Chapter 65.
Cemeteries.

Article 12.
Abandoned and Neglected Cemeteries.
Part 1. General.

§ 65-85. Definitions.

As used in this Article, the following terms mean:

(1) Abandoned. – Ceased from maintenance or use by the person with legal right to the real property with the intent of not again maintaining the real property in the foreseeable future.
(2) Cemetery. – A tract of land used for burial of multiple graves.
(3) Department. – The Department of Cultural Resources.
(4) Grave. – A place of burial for a single decedent.
(5) Neglected. – Left unattended or uncared for through carelessness or intention and lacking a caretaker.
(6) Public cemetery. – A cemetery for which there is no qualification to purchase, own, or come into possession of a grave in that cemetery. (2007-118, s. 1.)

Part 3. Access to and Maintenance of Abandoned or Neglected Cemeteries.

§ 65-101. Entering public or private property to maintain or visit with consent.

Any of the following persons, with the consent of the public or private landowner, may enter the property of another to discover, restore, maintain, or visit a grave or abandoned public cemetery:

(1) A descendant of the person whose remains are reasonably believed to be interred in the grave or abandoned public cemetery.
(2) A descendant's designee.
(3) Any other person who has a special personal interest in the grave or abandoned public cemetery. (1987, c. 686, s. 1; 1991, c. 36, s. 1; 2007-118, s. 1.)

§ 65-102. Entering public or private property to maintain or visit without consent.

(a) If the consent of the landowner cannot be obtained, any person listed in G.S. 65-101(1), (2), or (3) may commence a special proceeding by petitioning the clerk of superior court of the county in which the petitioner has reasonable grounds to believe the grave or abandoned public cemetery is located for an order allowing the petitioner to enter the property to discover, restore, maintain, or visit the grave or abandoned public cemetery. The petition shall be verified. The special proceeding shall be in accordance with the provisions of Articles 27A and 33 of Chapter 1 of the General Statutes. The clerk shall issue an order allowing the petitioner to enter the property if the clerk finds all of the following:

(1) There are reasonable grounds to believe that the grave or abandoned public cemetery is located on the property or it is reasonably necessary to enter or cross the landowner's property to reach the grave or abandoned public cemetery.
(2) The petitioner, or the petitioner's designee, is a descendant of the deceased, or the petitioner has a legitimate historical, genealogical, or governmental interest in the grave or abandoned public cemetery.
(3) The entry on the property would not unreasonably interfere with the enjoyment of the property by the landowner.

(b) The clerk's order may state one or more of the following:

(1) Specify the dates and the daylight hours that the petitioner may enter and remain on the property.
(2) Grant the petitioner the right to enter the landowner's property periodically, as specified in the order, after the time needed for initial restoration of the grave or abandoned public cemetery.
(3) Specify a reasonable route from which the petitioner may not deviate in all entries and exits from the property. (1987, c. 686, s. 1; 1991, c. 36, s. 1; 1999-216, s. 12; 2007-118, s. 1.)

Part 4. Removal of Graves.

§ 65-106. Removal of graves; who may disinter, move, and reinter; notice; certificate filed; reinterment expenses; due care required.

(a) The State of North Carolina and any of its agencies, public institutions, or political subdivisions, the United States of America or any agency thereof, any church, electric power or lighting company, or any person, firm, or corporation may effect the disinterment, removal, and reinterment of graves as follows:

(1) By the State of North Carolina or any of its agencies, public institutions, or political subdivisions, the United States of America or any agency thereof, when it shall determine and certify to the board of county commissioners in the county from which the bodies are to be disinterred that such removal is reasonably necessary to perform its governmental functions and the duties delegated to it by law.

(2) By any church authority in order to erect a new church, parish house, parsonage, or any other facility owned and operated exclusively by such church; in order to expand or enlarge an existing church facility; or better to care for and maintain graves not located in a regular cemetery for which such church has assumed responsibility of care and custody.

(3) By an electric power or lighting company when it owns land on which graves are located, and the land is to be used as a reservoir.

(4) By any person, firm, or corporation who owns land on which an abandoned cemetery is located after first securing the consent of the governing body of the municipality or county in which the abandoned cemetery is located.

(b) The party effecting the disinterment, removal, and reinterment of a grave containing a decedent's remains under the provisions of this Part shall, before disinterment, give 30 days' written notice of such intention to the next of kin of the decedent, if known or subject to being ascertained by reasonable search and inquiry, and shall cause notice of such disinterment, removal, and reinterment to be published at least once per week for four successive weeks in a newspaper of general circulation in the county where such grave is located, and the first publication shall be not less than 30 days before disinterment. Any remains disinterred and removed hereunder shall be reinterred in a suitable cemetery.

(c) The party removing or causing the removal of all such graves shall, within 30 days after completion of the removal and reinterment, file with the register of deeds of the county from which the graves were removed and with the register of deeds of the county in which reinterment is made, a written certificate of the removal facts. Such certificate shall contain the full name, if known or reasonably ascertainable, of each decedent whose grave is moved, a precise description of the site from which such grave was removed, a precise description of the site and specific location where the decedent's remains have been reinterred, the full and correct name of the party effecting the removal, and a brief description of the statutory basis or bases upon which such removal or reinterment was effected. If the full name of any decedent cannot reasonably be ascertained, the removing party shall set forth all additional reasonably ascertainable facts about the decedent including birth date, death date, and family name.

The fee for recording instruments in general, as provided in G.S. 161-10(a)(1), for registering a certificate of removal facts shall be paid to the register of deeds of each county in which such certificate is filed for registration.

(d) All expenses of disinterment, removal, and acquisition of the new burial site and reinterment shall be borne by the party effecting such disinterment, removal, and reinterment, including the actual reasonable expense of one of the next of kin incurred in attending the same, not to exceed the sum of two hundred dollars ($200.00).

(e) The Office of Vital Records of North Carolina shall promulgate regulations affecting the registration and indexing of the written certificate of the removal facts, including the form of that certificate.

(f) The party effecting the disinterment, removal, and reinterment of a decedent's remains under the provisions of this Part shall ensure that the site in which reinterment is accomplished shall be of such suitable dimensions to accommodate the remains of that decedent only and that such site shall be reasonably accessible to all relatives of that decedent, provided that the remains may be reinterred in a common grave where written consent is obtained from the next of kin. If under the authority of this Part, disinterment, removal, and reinterment are effected by the State of North Carolina or any of its agencies, public institutions, or political subdivisions, the United States of America or any agency thereof, any electric power or lighting company, then such disinterment, removal, and reinterment shall be performed by a funeral director duly licensed as a "funeral director" or a "funeral service licensee" under the provisions of Article 13A of Chapter 90 of the General Statutes.

(g) All disinterment, removal, and reinterment under the provisions of this Part shall be made under the supervision and direction of the county board of commissioners or other appropriate official, including the local health director, appointed by such board for the county where the disinterment, removal, and reinterment take place.

If reinterment is effected in a county different from the county of disinterment with the consent of the next of kin of the deceased whose remains are disinterred, then the disinterment and removal shall be made under the supervision and direction of the county board of commissioners or other appropriate official, including the local health director, appointed by such board for the county of the disinterment, and the reinterment shall be made under the supervision and direction of the county board of commissioners or other appropriate official, including the local health director, appointed by such board for the county of reinterment.

Due care shall be taken to do said work in a proper and decent manner, and, if necessary, to furnish suitable coffins or boxes for reinterring such remains. Due care shall also be taken to remove, protect, and replace all tombstones or other markers, so as to leave such tombstones or other markers in as good condition as that prior to disinterment. Provided that in cases where the remains are to be moved to a perpetual care cemetery or other cemetery where upright tombstones are not permitted, a suitable replacement marker shall be provided.

(h) Nothing contained in this Part shall be construed to grant or confer the power or authority of eminent domain, or to impair the right of the next of kin of a decedent to remove or cause the removal, at his or their expense, of the remains or grave of such decedent. (1919, c. 245; C.S., ss. 5030, 5030(a); Ex. Sess. 1920, c. 46; 1927, c. 23, s. 1; c. 175, s. 1; 1937, c. 3; 1947, cc. 168, 576; 1961, c. 457; 1963, c. 915, s. 1; 1965, c. 71; 1971, c. 797, s. 1; 1977, c. 311, s. 1; 2001-390, s. 3; 2007-118, s. 1.)

Chapter 70.
Indian Antiquities, Archaeological Resources and Unmarked Human Skeletal Remains Protection.

Article 3.
Unmarked Human Burial and Human Skeletal Remains Protection Act.

§ 70-26. Short title.

This Article shall be known as "The Unmarked Human Burial and Human Skeletal Remains Protection Act." (1981, c. 853, s. 2.)

§ 70-27. Findings and purpose.

(a) The General Assembly finds that:

(1) Unmarked human burials and human skeletal remains are subject to vandalism and inadvertent destruction at an ever-increasing rate;

(2) Existing State laws do not provide adequate protection to prevent damage to and destruction of these remains;

(3) There is a great deal of scientific information to be gained from the proper excavation, study and analysis of human skeletal remains recovered from such burials; and

(4) There has been no procedure for descendants or other interested individuals to make known their concerns regarding disposition of these remains.

(b) The purpose of this Article is (i) to provide adequate protection from vandalism for unmarked human burials and human skeletal remains, (ii) to provide adequate protection for unmarked human burials and human skeletal remains not within the jurisdiction of the medical examiner pursuant to G.S. 130A-383 that are encountered during archaeological excavation, construction, or other ground disturbing activities, found anywhere within the State except on federal land, and (iii) to provide for adequate skeletal analysis of remains removed or excavated from unmarked human burials if the analysis would result in valuable scientific information. (1981, c. 853, s. 2; 2007-484, s. 11(a).)

§ 70-28. Definitions.

As used in this Article:

(1) "State Archaeologist" means the head of the Office of State Archaeology section of the Office of Archives and History, Department of Cultural Resources.

(2) "Executive Director" means the Executive Director of the North Carolina Commission of Indian Affairs.

(3) "Human skeletal remains" or "remains" means any part of the body of a deceased human being in any stage of decomposition.

(4) "Professional archaeologist" means a person having (i) a postgraduate degree in archaeology, anthropology, history, or another related field with a specialization in archaeology, (ii) a minimum of one year's experience in conducting basic archaeological field research, including the excavation and removal of human skeletal remains, and (iii) designed and

executed an archaeological study and presented the written results and interpretations of such study.

(5) "Skeletal analyst" means any person having (i) a postgraduate degree in a field involving the study of the human skeleton such as skeletal biology, forensic osteology or other relevant aspects of physical anthropology or medicine, (ii) a minimum of one year's experience in conducting laboratory reconstruction and analysis of skeletal remains, including the differentiation of the physical characteristics denoting cultural or biological affinity, and (iii) designed and executed a skeletal analysis, and presented the written results and interpretations of such analysis.

(6) "Unmarked human burial" means any interment of human skeletal remains for which there exists no grave marker or any other historical documentation providing information as to the identity of the deceased. (1981, c. 853, s. 2; 2002-159, s. 35(a); 2007-484, s. 10(a).)

§ 70-29. Discovery of remains and notification of authorities.

(a) Any person knowing or having reasonable grounds to believe that unmarked human burials or human skeletal remains are being disturbed, destroyed, defaced, mutilated, removed, or exposed, shall notify immediately the medical examiner of the county in which the remains are encountered.

(b) If the unmarked human burials or human skeletal remains are encountered as a result of construction or agricultural activities, disturbance of the remains shall cease immediately and shall not resume without authorization from either the county medical examiner or the State Archaeologist, under the provisions of G.S. 70-30(c) or 70-30(d).

(c) (1) If the unmarked human burials or human skeletal remains are encountered by a professional archaeologist, as a result of survey or test excavations, the remains may be excavated and other activities may resume after notification, by telephone or registered letter, is provided to the State Archaeologist. The treatment, analysis and disposition of the remains shall come under the provisions of G.S. 70-34 and 70-35.

(2) If a professional archaeologist directing long-term (research designed to continue for one or more field seasons of four or more weeks' duration) systematic archaeological research sponsored by any accredited college or university in North Carolina, as a part of his research, recovers Native American skeletal remains, he may be exempted from the provisions of G.S. 70-30, 70-31, 70-32, 70-33, 70-34 and 70-35(c) of this Article so long as he:

a. Notifies the Executive Director within five working days of the initial discovery of Native American skeletal remains;

b. Reports to the Executive Director, at agreed upon intervals, the status of the project;

c. Curates the skeletal remains prior to ultimate disposition; and

d. Conducts no destructive skeletal analysis without the express permission of the Executive Director.

Upon completion of the project fieldwork, the professional archaeologist, in consultation with the skeletal analyst and the Executive Director, shall determine the schedule for the completion of the skeletal analysis. In the event of a disagreement, the time for completion of the skeletal analysis shall not exceed four years. The Executive Director shall have authority concerning the ultimate disposition of the Native American skeletal remains after analysis is completed in accordance with G.S. 70-35(a) and 70-36(b) and (c).

(d) The State Archaeologist shall notify the Chief, Medical Examiner Section, Division of Health Services, Department of Health and Human Services, of any reported human skeletal remains discovered by a professional archaeologist. (1981, c. 853, s. 2; 1997-443, s. 11A.118(a); 2007-484, s. 10(b).)

§ 70-30. Jurisdiction over remains.

(a) Subsequent to notification of the discovery of an unmarked human burial or human skeletal remains, the medical examiner of the county in which the remains were encountered shall determine as soon as possible whether the remains are subject to the provisions of G.S. 130A-383.

(b) If the county medical examiner determines that the remains are subject to the provisions of G.S. 130A-383, the county medical examiner will immediately proceed with the investigation.

(c) If the county medical examiner determines that the remains are not subject to the provisions of G.S. 130A-383, the county medical examiner shall so notify the Chief Medical Examiner. The Chief Medical Examiner

shall notify the State Archaeologist of the discovery of the human skeletal remains and the findings of the county medical examiner. The State Archaeologist shall immediately take charge of the remains.

(d) Subsequent to taking charge of the human skeletal remains, the State Archaeologist shall have 48 hours to make arrangements with the landowner for the protection or removal of the unmarked human burial or human skeletal remains. The State Archaeologist shall have no authority over the remains at the end of the 48-hour period and may not prohibit the resumption of the construction or agricultural activities without the permission of the landowner. (1981, c. 853, s. 2; 2007-484, ss. 10(c), 11(b).)

§ 70-31. Archaeological investigation of human skeletal remains.

(a) If an agreement is reached with the landowner for the excavation of the human skeletal remains, the State Archaeologist shall either designate a member of his staff or authorize another professional archaeologist to excavate or supervise the excavation.

(b) The professional archaeologist excavating human skeletal remains shall report to the State Archaeologist, either in writing or by telephone, his opinion on the cultural and biological characteristics of the remains. This report shall be transmitted as soon as possible after the commencement of excavation, but no later than two full business days after the removal of a burial.

(c) The State Archaeologist, in consultation with the professional archaeologist excavating the remains, shall determine where the remains shall be held subsequent to excavation, pending other arrangements according to G.S. 70-32 or 70-33.

(d) The Department of Cultural Resources may obtain administrative inspection warrants pursuant to the provisions of Chapter 15, Article 4A of the General Statutes to enforce the provisions of this Article, provided that prior to the requesting of the administrative warrant, the Department shall contact the affected landowners and request their consent for access to their land for the purpose of gathering such information. If consent is not granted, the Department shall give reasonable notice of the time, place and before whom the administrative warrant will be requested so that the owner or owners may have an opportunity to be heard. (1981, c. 853, s. 2; 2007-484, s. 10(d).)

§ 70-32. Consultation with the Native American Community.

(a) If the professional archaeologist determines that the human skeletal remains are Native American, the State Archaeologist shall immediately notify the Executive Director of the North Carolina Commission of Indian Affairs. The Executive Director shall notify and consult with the Eastern Band of Cherokee or other appropriate tribal group or community.

(b) Within four weeks of the notification, the Executive Director shall communicate in writing to the State Archaeologist, the concerns of the Commission of Indian Affairs and an appropriate tribal group or community with regard to the treatment and ultimate disposition of the Native American skeletal remains.

(c) Within 90 days of receipt of the concerns of the Commission of Indian Affairs, the State Archaeologist and the Executive Director, with the approval of the principal tribal official of an appropriate tribe, shall prepare a written agreement concerning the treatment and ultimate disposition of the Native American skeletal remains. The written agreement shall include the following:

(1) Designation of a qualified skeletal analyst to work on the skeletal remains;

(2) The type of analysis and the specific period of time to be provided for analysis of the skeletal remains;

(3) The timetable for written progress reports and the final report concerning the skeletal analysis to be provided to the State Archaeologist and the Executive Director by the skeletal analyst; and

(4) A plan for the ultimate disposition of the Native American remains subsequent to the completion of adequate skeletal analysis.

If no agreement is reached within 90 days, the Archaeological Advisory Committee shall determine the terms of the agreement. (1981, c. 853, s. 2; 2007-484, s. 10(e).)

§ 70-33. Consultation with other individuals.

(a) If the professional archaeologist determines that the human skeletal remains are other than Native American, the State Archaeologist shall publish notice that excavation of the remains has occurred, at least once per week for four successive weeks in a newspaper of general circulation in the county where the burials or skeletal remains were situated, in an effort to determine the identity or next of kin or both of the deceased.

(b) If the next of kin are located, within 90 days the State Archaeologist in consultation with the next of kin shall prepare a written agreement concerning the treatment and ultimate disposition of the skeletal remains. The written agreement shall include:

(1) Designation of a qualified skeletal analyst to work on the skeletal remains;

(2) The type of analysis and the specific period of time to be provided for analysis of the skeletal remains;

(3) The timetable for written progress reports and the final report concerning the skeletal analysis to be provided to the State Archaeologist and the next of kin by the skeletal analyst; and

(4) A plan for the ultimate disposition of the skeletal remains subsequent to the completion of adequate skeletal analysis.

If no agreement is reached, the remains shall be handled according to the wishes of the next of kin. (1981, c. 853, s. 2; 2007-484, s. 10(f).)

§ 70-34. Skeletal analysis.

(a) Skeletal analysis conducted under the provisions of this Article shall only be accomplished by persons having those qualifications expressed in G.S. 70-28(5).

(b) Prior to the execution of the written agreements outlined in G.S. 70-32(c) and 70-33(b), the State Archaeologist shall consult with both the professional archaeologist and the skeletal analyst investigating the remains.

(c) The professional archaeologist and the skeletal analyst shall submit a proposal to the State Archaeologist within the 90-day period set forth in G.S. 70-32(c) and 70-33(b), including:

(1) Methodology and techniques to be utilized;

(2) Research objectives;

(3) Proposed time schedule for completion of the analysis; and

(4) Proposed time intervals for written progress reports and the final report to be submitted.

(d) If the terms of the written agreement are not substantially met, the Executive Director or the next of kin, after consultation with the State Archaeologist, may take possession of the skeletal remains. In such case, the State Archaeologist may ensure that appropriate skeletal analysis is conducted by another qualified skeletal analyst prior to ultimate disposition of the skeletal remains. (1981, c. 853, s. 2; 2007-484, s. 10(g).)

§ 70-35. Disposition of human skeletal remains.

(a) If the skeletal remains are Native American, the Executive Director, after consultation with an appropriate tribal group or community, shall determine the ultimate disposition of the remains after the analysis.

(b) If the skeletal remains are other than Native American and the next of kin have been identified, the next of kin shall have authority concerning the ultimate disposition of the remains after the analysis.

(c) If the State Archaeologist has received no information or communication concerning the identity or next of kin of the deceased, the skeletal remains shall be transferred to the State Archaeologist and permanently curated according to standard museum procedures after adequate skeletal analysis. (1981, c. 853, s. 2; 2007-484, s. 10(h).)

§ 70-36. Financial responsibility.

(a) The provisions of this Article shall not require that the owner of the land on which the unmarked human burials or human skeletal remains are found, bear the cost of excavation, removal, analysis or disposition.

(b) If a determination is made by the Executive Director, in consultation with an appropriate tribal group or community, that Native American skeletal remains shall be reinterred following the completion of skeletal analysis, an appropriate tribal group or community may provide a suitable burial location. If it elects not to do so, it shall be the responsibility of the North Carolina Commission of Indian Affairs to provide a suitable burial location.

(c) The expense of transportation of Native American remains to the reburial location shall be borne by the party conducting the excavation and removal of the skeletal remains. The reburial ceremony may be provided by an appropriate tribal group or community. If it elects not to do so, the reburial ceremony shall be the responsibility of the Commission of Indian Affairs. (1981, c. 853, s. 2.)

§ 70-37. Prohibited acts.

(a) No person, unless acting under the provisions of G.S. 130-198 through G.S. 130-201, shall:

(1) Knowingly acquire any human skeletal remains removed from unmarked burials in North Carolina after October 1, 1981, except in accordance with the provisions of this Article;

(2) Knowingly exhibit or sell any human skeletal remains acquired from unmarked burials in North Carolina; or

(3) Knowingly retain human skeletal remains acquired from unmarked burials in North Carolina after October 1, 1981, for scientific analysis beyond a period of time provided for such analysis pursuant to the provisions of G.S. 70-32, 70-33 and 70-34, with the exception of those skeletal remains curated under the provisions of G.S. 70-35.

(b) Other provisions of criminal law concerning vandalism of unmarked human burials or human skeletal remains may be found in G.S. 14-149. (1981, c. 853, s. 2.)

§ 70-40. Penalties.

(a) Violation of the provisions of G.S. 70-29 is a Class 1 misdemeanor.

(b) Violation of the provisions of G.S. 70-37(a) is a Class H felony. (1981, c. 853, s. 2; 1993, c. 539, s. 543; 1994, Ex. Sess., c. 24, s. 14(c).)

GENERAL SHALE
SANFORD, NC

COLON MINE

STORMWATER PERMIT NO. NCG020854

STORM WATER POLLUTION PREVENTION PLAN

DECEMBER 2013
UPDATED APRIL 2014

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Storm Water Pollution Prevention Team

Introduction

The purpose of this Storm Water Pollution Prevention Plan is to prevent storm water run-off from polluting the area lakes and streams. This plan is designed to fulfill the requirements of OUR NPDES General Permit for active and inactive mining sites (NCG020854).

Approval and 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 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.

Plan prepared by:
Steve W. Wyse, Environmental Engineer, General Shale Brick, Inc.

S. W. Wyse _____ Date: 4/17/14

Plan reviewed by:
Gregory Bowles, Director of Environment, General Shale Brick, Inc.

_____ Date: 4/17/14

Plan approved by:
Kevin Ham, Vice President, General Shale Brick, Inc.

Kevin Ham _____ Date: 4/17/14

Site Plan (Description of Activities and Potential Pollutant Sources)

Colon Mine is a former shale mining operation owned and operated by General Shale Brick, Inc. This mine supplied General Shale's brick manufacturing plant in Sanford, NC. This mine is currently in the process of being reclaimed. This includes relocating the stockpile to a General Shale brick plant in Moncure, NC.

The location map in Appendix A shows the facility and the surrounding features. A site map indicating the drainage area, locations of potential pollution sources, flow directions, and the outfall locations is also available in Appendix A.

The activities which may be potential sources of significant amounts of pollutants to storm water, the exposed materials associated with these activities, and their pollutants of concern are listed below.

1) Areas of Excavation – outdoor processing activities (mine is currently in reclamation)
   - Location – Northeast portion of mine.
   - Exposed Materials – Shale and clay
   - Management Practices – Proper contouring of excavated areas to drain stormwater into BMPs and sediment control basins.
   - Risk to Stormwater – Suspended Solids
   - Pollutant Control Measures – BMPs including check dams, revegetation of drainage areas, and berms to control erosion.
   - Storm Water Treatment – Sediment control basins

2) Stock Pile (loading and outdoor storage)
   - Location – Center portion of mine area.
   - Exposed Materials – Shale and clay
   - Management Practices – Placement of stockpile to reduce erosion. Compaction of crown and cutting of wingwalls
   - Risk to Stormwater – Suspended Solids
   - Pollutant Control Measures – Placement of stockpile where drainage flows to sediment control basin(s).
   - Storm Water Treatment – Sediment control basins

3) Fuel Tanks
   - Location – There are currently no fuel tanks at this location.
   - Exposed Materials – Diesel fuel and oil.
   - Management Practices – lock tanks to prevent vandalism, place tanks in secondary containment dikes
   - Risk to Stormwater – oil/fuel
   - Pollutant Control Measures – Secondary containment dike and SPCC plan
   - Storm Water Treatment – none

Spills

Appendix B is a list of significant spills that have occurred in the past three years

Evaluation of Outfalls for Presence of Non-Stormwater

An evaluation of the outfalls shall be completed once a year to look for the presence of non-stormwater discharges. An annual certification statement on the inspection form (Appendix C) is to be signed by the inspector. The inspector has authorization to certify the outfalls by the approval of this plan.

Erosion and Sedimentation Control

Vegetation is the primary tool for controlling erosion at this site. BMPs such as check dams and containment berms are also used to reduce runoff velocity and prevent stormwater from running on to disturbed areas.

Erosion and sediment controls shall be visually inspected for compliance with the mining permit. Structural storm water management measures, erosion control measures, and other structural pollution prevention measures identified in this plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement this plan, such as spill response equipment, will be made. The reports summarizing these evaluations are attached in Appendix D.

Stormwater Management Plan

- Management of Runoff - Runoff is directed into sediment control basins using berms, ditches, and sediment fences.

- BMP Inspections – Inspections will be completed weekly by the Mine Supervisor. Basically the inspections will cover 1) the integrity of the storm water sediment and erosion controls, 2) the status of the sediment control basins and the need to clean them out, 3) the best management practices associated with the stockpile area, 4) the condition of any fuel tanks, and 5) observations of visible sedimentation leaving the property. Appendix D is the inspection form.

- Secondary Containment – A table listing storage tanks at the mine and their associated secondary containment is located in Appendix E. The aboveground tanks are placed in dikes to contain spills.

Spill Prevention and Response

This site does not use fuel, oil, or hazardous substances in bulk storage. Fuels used for reclamation equipment are not stored on site and are brought to the mine by a fuel truck. Spill prevention and response for these fuels are explained in the preventive maintenance and housekeeping sections.

Preventive Maintenance

Inspect heavy equipment for hose or line leaks and replace as needed. By doing preventive maintenance, spills and leaks from these sources can be reduced. Preventive maintenance is also used on the swales, ditches, and containment basins, to ensure proper drainage and settling capabilities.

Good Housekeeping

Keeping the site neat and orderly is the responsibility of every employee and proper disposal of trash is required. All used oil is collected and recycled. Sediment basins are to be cleaned out when the Sediment load is at 50% capacity. The water truck is used to suppress dust as needed. Significant spills are recovered with the contaminated dirt and contained for disposal or placed in the covered stockpile at the plant.

Employee Training

Storm water management training will be required yearly for all employees that have an impact on the storm water and will include: spill response, good housekeeping, the best management practices needed to control runoff, mining and reclamation plans, monitoring requirements, the preventative maintenance of equipment required to prevent discharges to storm water, and the annual site compliance evaluation.

Pollution Prevention Team

The storm water pollution prevention team is responsible for the implementation, maintenance, and revision of this plan. Appendix F is a list of the team members and their responsibilities under this plan.

Plan Amendment

This plan shall be amended when there is a change in the design, construction, operation, or maintenance that has a significant effect on the potential for discharge of pollutants to surface water. This plan is to be reviewed as part of the annual evaluation of the site.

Recordkeeping and Internal Reporting

Records of spills, inspections, maintenance activities, and corrected BMPs will be kept as part of this plan. This data will be kept for five (5) years after the report or data are generated and will include:

- Storm Water Pollution Prevention Plan
- Permit
- Site Inspections
- Preventative Maintenance Records
- Notice of Intent
- Sampling data
- Training Records
- Spill Reports

.

Analytical Monitoring Requirements

The storm water monitoring required for this plant is summarized as follows:

Pollutants of Concern	Units	Benchmark Value	Frequency	Sample Type
Setteable Solids	ml/l	0.1 ml/l	Semi-Annual	Grab
Total Suspended Solids	mg/l	100 mg/l	Semi-Annual	Grab
Turbidity	NTU	N/A	Semi-Annual	Grab
Total Rainfall*	inches		Semi-Annual	Measure
Event Duration	minutes		Semi-Annual	Estimate
Total Flow	MG		Semi-Annual	Estimate

* On-site rain gauge or local rain gauge

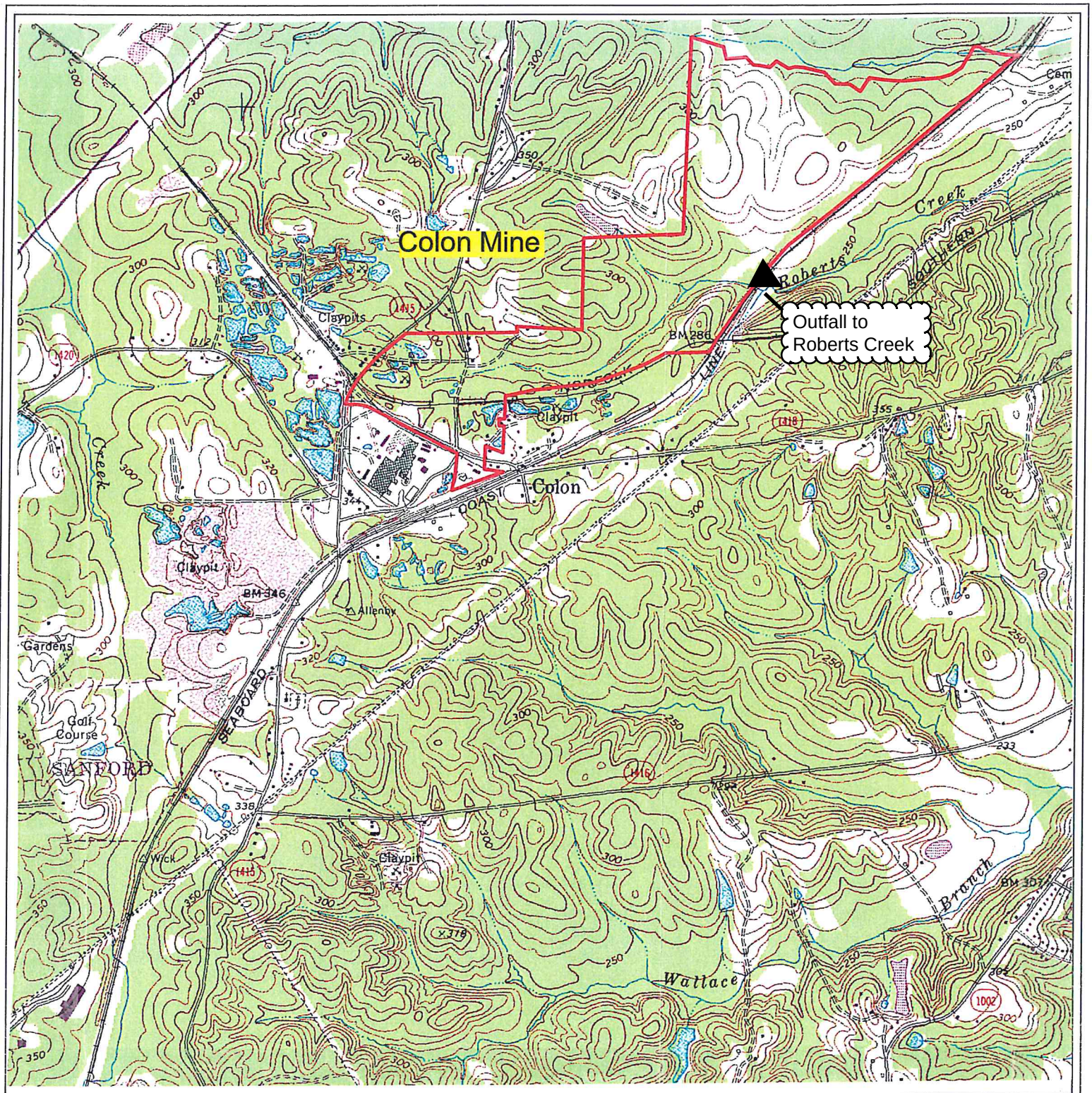
The following information will be recorded at the sample time: date, place sampled, and person sampling. The analytical results shall be submitted to the Division Central office no later than **March 1** of the following permit year. The general permit provides the specific requirements for collecting and analyzing the sample, reporting the results, and when sampling waivers are applicable. All sampling results are to be kept with this plan.

Appendix A

Location Map

Site Map

LOCATION MAP: General Shale, Colon Mine, Lee County



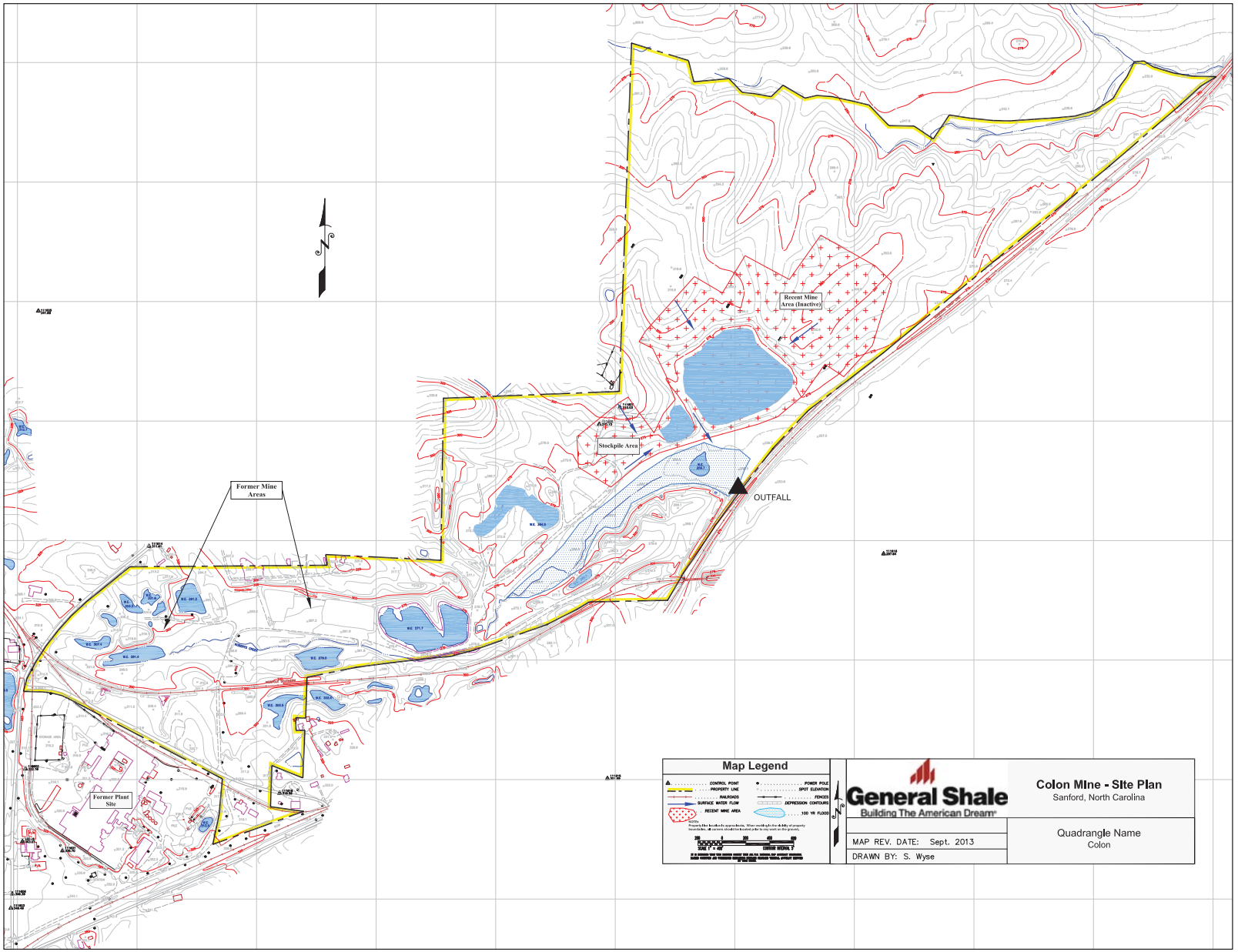
Latitude: 35°32'05.3" N
Longitude: -79°09'35.3" W
County: Lee
Stream Class: WS-IV
Receiving Stream: Roberts Creek
Sub-basin: 03-06-07 (Cape Fear River Basin)

NCG020854
General Shale, Inc.
Colon Mine

North

Facility Location

Not to Scale


Former Mine Areas
Recent Mine Area (Inactive)
Stockpile Area
OUTFALL
Former Plant Site
Map Legend
CONTROL POINT
PROPERTY LINE
RAILROADS
SURFACE WATER FLOW
RECENT MINE AREA
POWER POLE
SPOT ELEVATION
FENCES
DEPRESSION CONTOURS
100 YR FLOOD
General Shale
Building The American Dream®
Colon Mine - Site Plan
Sanford, North Carolina
MAP REV. DATE: Sept. 2013
DRAWN BY: S. Wyse
Quadrangle Name
Colon

Appendix B

Significant Spills and Leaks

Date	Location/Source	Material Spilled	Amount Spilled	Reason

Appendix C

Annual Evaluation of the Outfalls and the SWPPP

Colon Mine

Annual Evaluation of the Outfalls and The SWPPP

- ☐ The stormwater outfall has been evaluated for the presence of non-stormwater
  - ☐ Outfall functioning properly
  - ☐ Non-stormwater found

- ☐ Significant spills last year (list)

  _____

  _____

- ☐ No spills occurred

- ☐ BMPs effective
- ☐ BMPs require repair

- ☐ SWPPP requires updating

Date: _____ Inspector: _____

Appendix D
BMP Inspection Checklist

BMP and Controls Inspection

General Shale Brick, Inc.
Colon Mine
NCG020854

Date: _____

Inspected by: _____

□ If examination cannot be completed due to adverse weather (flood, tornado, severe storm) or lack of runoff (drought, frozen conditions) Check here and note in comments below.

Inspection

BMPs:
□ check dams OK, □ vegetation maintained, □ silt fences/berms maintained

Sediment basins:
□ sediment less than 50% capacity, □ no oil sheen, □ spillway in good condition,
□ discharge is clear,

Stockpile & Equipment:
□ runoff flows to a sediment basin, □ equipment maintained

Visible Sedimentation:

□ Sediment leaving the property

Comments: _____

_____

Appendix E

Storage Tanks and Secondary Containment

Tank Number	Tank Contents	Tank Construction	Dike Construction
None			

Appendix F

Storm Water Pollution Prevention Team

Colon Mine

Title	Responsibility	Name and Phone
Plant Manager	• Team Leader • Employee Training • Plan Implementation • Ensure that reports and monitoring efforts are completed	Larry Cockerill
Assistant Plant Manager	• Recognize non-compliance situations • Assist in employee training • Preventative maintenance • Maintain settling basins and BMPs	Jeff Magee
Environmental Engineer	• Site Inspection • Stormwater Sampling • Report to State • Assist in the annual compliance evaluation • Plan development, implementation, and revision	Warren Paschal Steve Wyse

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APPLICATION FOR A MINING PERMIT

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

LAND QUALITY SECTION

APPLICATION FOR A MINING PERMIT

(PLEASE PRINT OR TYPE)

1. Name of Mine Colon Mine County Lee

   River Basin Cape Fear

   Latitude (decimal degrees to four places) 35.5348

   Longitude (decimal degrees to four places) -79.1598

2. Name of Applicant* General Shale Brick, Inc.

3. Permanent address for receipt of official mail** 300 Brick Plant Rd., Moncure, NC 27559

   Telephone (919)774-6533 ext. 221 Alternate No. N/A

4. Mine Office Address N/A

   Telephone ( )

5. Mine Manager Warren Paschal

We hereby certify that all details contained in this Permit Application are true and correct to the best of our knowledge. We fully understand that any willful misrepresentation of facts will be cause for permit revocation.

***Signature Warren Paschal Date 3/21/14

Print Name Warren Paschal

Title Environmental Compliance Manager

* This will be the name that the mining permit will be issued to and the name that must be indicated on the reclamation bond (security) that corresponds to this site.

** The Land Quality Section must be notified of any changes in the permanent address or telephone number.

*** Signature of company officer required.

G.S. 74-51 provides that the Department shall grant or deny an application for a permit within 60 days of receipt of a complete application or, if a public hearing is held, within 30 days following the hearing and the filing of any supplemental information required by the Department. **All questions must be addressed and all required maps provided before this application can be considered complete. Attach additional sheets as needed.**

APPLICATION FOR A MINING PERMIT

NOTE: All of the following questions must be thoroughly answered regarding your mining operation for the intended life of the mine. All responses must be clearly conveyed on a corresponding, detailed mine map.

A. GENERAL CHARACTERISTICS OF THE MINE

1. Answer all of the following that apply:

☐ If this is an application for a **NEW** permit, indicate the total acreage at the site to be covered by the permit (this is the acreage that the "new permit" fee will be based upon):_____

Of this acreage, how much is owned and how much is leased? Acres owned:_____
Acres leased:_____ Property owner if leased:_____

☒ If this is an application for **RENEWAL** of a mining permit, indicate the mining permit number and the total (overall) acreage covered by the existing permit: Mining Permit No.: 53-05
Total permitted acreage (this is the acreage that the "renewal" fee will be based upon): 371

☐ If this is an application for a **MODIFICATION** to a mining permit, indicate the mining permit number and the total (overall) acreage covered by the existing permit.
Mining Permit No.:_____ Total permitted acreage:_____

Does the modification involve acreage within the previously approved permitted boundary?
Yes ☐ No ☐. If yes, indicate the acreage to be covered by this modification (this is the acreage that the "major modification" fee will be based upon):_____

Does the modification involve acreage outside the previously approved permitted boundary?
Yes ☐ No ☐. If yes, indicate the additional acreage to be covered by this modification:_____. (NOTE: you must complete all of Section F. of this application form entitled Notification of Adjoining Landowners).

Of this acreage to be added to the permit, will any portion of this acreage be affected (i.e.: disturbed, ground cover removed) by the mining operation? Yes ☐ No ☐ (If no, a "minor modification" fee of $100.00 is required, despite the "undisturbed" acreage to be added). If yes, indicate the acreage to be affected within the acreage to be added to the permit (the total acreage to be added to the permit is the acreage that the "major modification" fee will be based upon):_____

☐ If this is an application for **TRANSFER** of a mining permit, indicate the mining permit number and the total (overall) acreage covered by the existing permit.
Mining Permit No.:_____ Total permitted acreage:_____

SEE THE FEE SCHEDULE AT THE END OF THIS FORM FOR THE PROPER FEE AMOUNT TO BE PAID FOR THE REQUESTED PERMIT ACTION(S) AND CORRESPONDING ACREAGE NOTED ABOVE

2. Name of all materials mined: Brick Clay

3. Mining method:
☐ Hydraulic Dredge ☒ Front-end Loader & Truck ☒ Shovel & Truck
☐ Dragline & Truck ☒ Self-loading Scraper

Other (explain): _____

4. a. Expected maximum depth of mine (feet) 50'

Depth is relative to what benchmark? (e.g., natural ground level, mean sea level, road elevation, etc.)
Natural ground level

b. Expected average depth of mine (feet) 30'

APPLICATION FOR A MINING PERMIT

5. Has any area(s) at this site been mined in the past? Yes ☒ No ☐
If yes, when and by whom was this activity conducted? General Shale Brick Inc./Cherokee Sanford has mined the site since 1972

6. Number of years for which the permit is requested (10 years maximum): 10

B. MAPS

1. Clearly mark and label the location of your mining operation on **six (6) copies** of a 7.5-minute quadrangle and a county highway map. These maps, in addition to **six (6) copies** of all mine maps and reclamation maps, must be submitted with each permit application.

   7.5-minute quadrangles may be obtained from the N.C. Geological Survey:

   Mailing Address:
   1612 Mail Service Center
   Raleigh, North Carolina 27699-1612
   (919) 733-2423
   http://portal.ncdenr.org/web/lr/geological_home

   OR

   Physical Address:
   512 North Salisbury Street, 5th Floor
   Raleigh, North Carolina 27604

   County highway maps may be obtained from the N.C. Department of Transportation:

   North Carolina Department of Transportation – Geographic Information Systems (GIS)

   Mailing Address:
   NCDOT GIS Unit
   1587 Mail Service Center
   Raleigh, North Carolina 27699-1587

   Physical Address:
   NCDOT GIS Unit
   3401 Carl Sandburg Court
   Raleigh, North Carolina 27610
   (919) 212-6000
   http://www.ncdot.org/it/gis/

2. Mine maps must be accurate and appropriately scaled drawings, aerial photographs or enlarged topographic maps of the entire mine site. **All aspects of the mine site must be clearly labeled on the maps along with their corresponding (approximate) acreage. As a reminder, mining permits can only be issued for up to 10 years; thus, all mine and reclamation maps must only denote those activities that are intended to be conducted during the life of the mining permit.** All maps must be of a scale sufficient (see minimum requirements listed below) to clearly illustrate the following, **at a minimum:**

   a. Property lines of the tract or tracts of land on which the proposed mining activity is to be located including easements and rights-of-way.
   b. Existing or proposed permit boundaries.
   c. Initial and ultimate limits of clearing and grading.
   d. Outline and width of all buffer zones (both undisturbed and unexcavated).
   e. Outline and acreage of all pits/excavations.
   f. Outline and acreage of all stockpile areas.
   g. Outline and acreage of all temporary and/or permanent overburden disposal areas.
   h. Location and acreage of all processing plants (processing plants may be described as to location and distance from mine if sufficiently far removed).
   i. Locations and names of all streams, rivers and lakes.
   j. Outline and acreage of all settling and/or processing wastewater ponds.
   k. Location and acreage of all planned and existing access roads and on-site haul roads.
   l. Location of planned and existing on-site buildings.
   m. Location and dimensions of all proposed sediment and erosion control measures.
   n. Location of 100-year floodplain limits and wetland boundaries.
   o. Names of owners of record, both public and private, of all tracts of land that are adjoining the mining permit boundary; if an adjoining tract is owned or leased by the applicant or is owned by the lessor of the mine tract, names of owners of record of tracts adjoining these tracts, that are within 1,000 feet of the mining permit boundary, must be provided on the mine map.

p. Names of owners of record, both public and private, of all tracts of land that are adjoining the mining permit boundary which lie directly across and are contiguous to any highway, creek, stream, river, or other watercourse, railroad track, or utility or other public right-of-way. If an adjoining tract is owned or leased by the applicant or is owned by the lessor of the mine tract, names of owners of record of tracts adjoining these tracts, that are within 1,000 feet of the mining permit boundary, must be provided on the mine map(s). NOTE: "Highway" means a road that has four lanes of travel or less and is not designated as an Interstate Highway.

q. Map legend:

1. Name of applicant
2. Name of mine
3. North arrow
4. County
5. Scale
6. Symbols used and corresponding names
7. Date prepared and revised
8. Name and title of person preparing map

Map scales should meet the following guidelines:

PERMITTED ACREAGE	MAP SCALE
0-49 Acres	1 inch = 50 feet
50-199 Acres	1 inch = 100 feet
200+ Acres	1 inch = 200 feet

(NOTE: Smaller scaled maps may be acceptable if they clearly illustrate the above items)

A table/chart must be provided on the mine map that clearly lists the approximate acreage of tailings/sediment ponds, stockpiles, wastepiles, processing area/haul roads, mine excavation and any other major aspect of the mining operation that is proposed to be affected/disturbed during the life of the mining permit. A table/chart similar to the following will be acceptable:

CATEGORY	AFFECTED ACREAGE
Tailings/Sediment Ponds	28.5
Stockpiles	7.4
Wastepiles	5.0
Processing Area/Haul Roads	17.5
Mine Excavation	290.6
Other (Explain)	0
Total Disturbed Acreage	349.0

NOTE:
IN ADDITION TO THE ABOVE, THE MAPS MUST ALSO INCLUDE ANY SITE-SPECIFIC INFORMATION THAT IS PROVIDED IN THE ANSWERS TO THE FOLLOWING QUESTIONS IN THIS APPLICATION FORM (*PLEASE NOTE THE ITALICIZED QUESTIONS/STATEMENTS THROUGHOUT THE FORM*). THIS APPLICATION WILL NOT BE CONSIDERED COMPLETE WITHOUT ALL RELEVANT ITEMS BEING ADEQUATELY ADDRESSED ON THE MINE MAPS.

APPLICATION FOR A MINING PERMIT

C. PROTECTION OF NATURAL RESOURCES

1. Describe in detail the sequence of events for the development and operation of the mine and *reference the sequence to the mine map(s).* Attach additional sheets as needed.

Mining will continue as permitted. Basins 17 through 21 have not yet been installed. These basins will be installed before mining is conducted in the area of these basins. These basins were originally designed to discharge at brick bat outlet sections, but have been redesigned as wet retention basins. The proposed riser design will dewater slowly from the two (2) 2" holes provided at the permanent pool depth.

2. Describe specific erosion control measures to be installed prior to land disturbing activities and during mining to prevent offsite sedimentation *(include specific plans for sediment and erosion control for mine excavation(s), waste piles, access/mine roads and process areas)*, and give a detailed sequence of installation and schedule for maintenance of the measures. *Locate and label all sediment and erosion control measures on the mine map(s) and provide typical cross-sections/construction details of each measure.* Engineering designs and calculations are required to justify the adequacy of any proposed measures.

Erosion control is provided by the large bodies of water that were created by the excavation activities. Some areas require diversion berms and brickbat outlet sections to ensure storm-water runoff are directed to the sediment basins. The basins are designed to contain the runoff from the 10-year rain event. The basin outlets consisting of brickbat are designed to pass the 25-year rain event. Many of the mine excavation will extend below the outlet and pumping is required. The water is discharged to an adjacent mine excavation/sediment basin. The discharge pump has a maximum flow rate of 1500 gpm.

3. a. Will the operation involve washing the material mined, recycling process water, or other waste water handling? Yes ☐ No ☒. If yes, briefly describe all such processes including any chemicals to be used.

b. Will the operation involve discharging fresh or waste water from the mine or plant as a point discharge to the waters of the State? Yes ☒ No ☐. *If yes, briefly describe the nature of the discharge and locate all proposed discharge points (along with their method of stabilization) on your mine map(s).*

Discharges by gravity through sediment basins occur for storm-water runoff from the mine.

c. Will any part of the proposed mine excavation(s) extend below the water table? Yes ☒ No ☐.
If yes, do you intend to dewater the excavation(s)? Yes ☒ No ☐.
If yes, what impact, if any, will mine dewatering have on neighboring wells? Estimated withdrawal rate in gallons per day: 5,000. *Locate all existing wells on the mine map(s) that lie within 500 feet of the proposed excavation area.* Provide data to support any conclusions or statements made, including any monitoring well data, well construction data and current water withdrawal rates. Indicate whether the proposed mine locale is served by a public water system or private wells.

No water supply wells are within 500-ft of the mine. Groundwater removal is minimal and less than 5,000 gallons/day. The majority of water removed is surface water accumulation in the mine excavation.

d. If you answered yes to any of the above questions, provide evidence that you have applied for or obtained the appropriate water quality permit(s) (i.e., non-discharge, NPDES, Stormwater, etc.) from the Division of Water Quality, Water Quality Section. In addition, the applicant is required to register water use with the Division of Water Resources if the operation withdraws more than 10,000 gallons per day and needs a capacity use permit from the Division of Water Resources if the operation lies in a capacity use area and withdraws more than 100,000 gallons per day.

General Shale Brick Inc. has a stormwater permit that covers these discharges. (Permit No. NCG 070154)

4. a. Will the operation involve crushing or any other air contaminant emissions? Yes ☐ No ☒.
If yes, indicate evidence that you have applied for or obtained an air quality permit issued by the Division of Air Quality or local governing body.

b. How will dust from stockpiles, haul roads, etc., be controlled?

The natural moisture of the materials stockpiled will prevent dusting from stockpiles. Haul roads are wetted as needed to prevent dusting.

APPLICATION FOR A MINING PERMIT

5. a. A buffer will be required between any mining activity and any mining permit boundary or right-of-way. It may be an unexcavated buffer (no excavation, but roadways, berms and erosion & sedimentation control measures may be installed within it), an undisturbed buffer (no disturbance within the buffer whatsoever), or a combination of the two, depending upon the site conditions. Note that all buffers must be located within the mining permit boundaries.

   How wide a buffer will be maintained between any mining activity and any mining permit boundary or right-of-way at this site? A minimum buffer of 25 feet is recommended, although a wider buffer may be needed depending on site conditions. *Show all buffer locations and widths on the mine map(s).*

Buffers are at least 50ft from property lines, permit limits, and right-of-ways. The majority of the buffers are undisturbed. Along a portion of Colon Road, at least a 50-ft unexcavated buffer will be provided. A berm for visual screening will be installed.

   b. A minimum 50 foot wide undisturbed buffer will be required between any land disturbing activities within the mining permit boundaries and any natural watercourses and wetlands unless smaller undisturbed buffers can be justified. Depending on site conditions, a buffer wider than 50 feet may be needed.

   How wide an undisturbed buffer will be maintained between any land disturbing activities within the mining permit boundaries and any natural watercourses and wetlands at this site? *Show all buffer locations and widths on the mine map(s).*

At least a 50-ft undisturbed buffer is provided between the mine and wetlands, streams, and other natural bodies of water. However, along a portion of Roberts Creek, the buffer is at least 100-ft. Except at a 0.25 ac. area where the excavation is conducted to remove a peak formed by mining.

6. a. Describe methods to prevent landslide or slope instability adjacent to adjoining permit boundaries during mining. Minimum 2 horizontal to 1 vertical slopes or flatter for clayey material and minimum 3 horizontal to 1 vertical slopes or flatter for sandy material are generally required, unless technical justification can be provided to allow steeper slopes.

A 2:1 (H:V) slope is maintained along exterior slopes.

b. *Provide a cross-section on the mine map(s) for all fill slopes (berms, wastepiles, overburden disposal areas, etc.), clearly indicating the intended side slope gradient, installation of any benches and/or slope drains (with supporting design information) if needed, and the method of final stabilization.*

c. In excavation(s) of unconsolidated (non-rock) materials, specify the angle of all cut slopes including specifications for benching and sloping. *Cross-sections for all cut slopes must be provided on the mine map(s).*

No benching will be conducted. Cut slopes will be 2:1 (H:V) along the exterior of the mine.

d. In hardrock excavations, specify proposed bench widths and heights in feet. *Provide cross-sections of the mine excavation clearly noting the angles of the cut slopes, widths of all safety benches and mine benches, and the expected maximum depth of the excavation.*

N/A

7. Describe other methods to be taken during mining to prevent physical hazard to any neighboring dwelling house, public road, public, commercial or industrial building from any mine excavation. *Locate all such structures on the mine map if they are within 300 feet of any proposed excavation.*

N/A

8. Describe what kind of barricade will be used to prevent inadvertent public access along any high wall area and when it will be implemented. Vegetated earthen berms, appropriate fencing and adequate boulder barriers may be acceptable high wall barricades. *A construction detail/cross-section and location of each type of barricade to be used must be indicated on the mine map(s).*

N/A

APPLICATION FOR A MINING PERMIT

9. Are acid producing minerals or soils present? Yes ☐ No ☒.
If yes, how will acid water pollution from the excavation, stockpiles and waste areas be controlled?

10. a. Describe specific plans (including a schedule of implementation) for screening the operation from public view such as maintaining or planting trees, bushes or other vegetation, building berms or other measures. *Show the location of all visual screening on the mine map(s) and provide cross-sections through all proposed berms or proposed spacing, sizes and species for tree plantings.*

The majority of the mine is screened by the wooded areas. For a portion of Colon Road, a berm will be constructed for screening purposes. A culvert will need to be added to pass stormwater through the berm.

b. Could the operation have a significantly adverse effect on the purposes of a publicly owned park, forest or recreation area? If so, how will such effects (i.e., noise, visibility, etc.) be mitigated?

No

11. Will explosives be used? Yes ☐ No ☒.
If yes, specify the types of explosive(s) and describe what precaution(s) will be used to prevent physical hazard to persons or neighboring property from flying rocks or excessive air blasts or ground vibrations. Depending on the mine's location to nearby structures, more detailed technical information may be required on the blasting program (such as a third-party blasting study). *Locate the nearest offsite occupied structure(s) to the proposed excavation(s) on the mine map and indicate its approximate distance to the proposed excavation.*

12. Will fuel tanks, solvents, or other chemical reagents be stored on-site? Yes ☒ No ☐.
If yes, describe these materials, how they will be stored and method of containment in case of spill. Indicate the location(s) of all storage facilities on the mine map(s).

Motor oil and other products required for equipment maintenance are stored in two of the on-site facility storage buildings. Above ground petroleum tanks have secondary containment systems.

APPLICATION FOR A MINING PERMIT

D. RECLAMATION PLAN

1. Describe your intended plan for the final reclamation and subsequent use of all affected lands and indicate the sequence and general methods to be used in reclaiming this land. This must include the method of reclamation of settling ponds and/or sediment control basins and the method of restoration or establishment of any permanent drainage channels to a condition minimizing erosion, siltation and other pollution. *This information must be illustrated on a reclamation map and must correspond directly with the information provided on the mine map(s). In addition, design information, including typical cross-sections, of any permanent channels to be constructed as part of the reclamation plan and the location(s) of all permanent channels must be indicated on the reclamation map.*

The land will be revegetated in grass. The majority of the areas mined will be under water upon completion of mining. Land above the water will be sloped to drain by gravity to the water bodies formed by the excavation.

2. Is an excavated or impounded body of water to be left as a part of the reclamation? Yes ☒ No ☐.
If yes, illustrate the location of the body(s) of water on the reclamation map and provide a scaled cross-section(s) through the proposed body(s) of water. The minimum water depth must be at least 4 feet, measured from the normal low water table elevation, unless information is provided to indicate that a more shallow water body will be productive and beneficial at this site.

   Will the body(s) of water be stocked with fish? Yes ☒ No ☐.
   If yes, specify species.

The lakes will be stockpiled with bass, bream, and other species of fish native to the area.

3. Describe provisions for safety to persons and to adjoining property in all completed excavations in rock including what kind of permanent barricade will be left. Acceptable permanent barricades are appropriate fencing, large boulders placed end-to-end, etc. *Construction details and locations of all permanent barricades must be shown on the reclamation map.*

NA

APPLICATION FOR A MINING PERMIT

4. Indicate the method(s) of reclamation of overburden, refuse, spoil banks or other such on-site mine waste areas, including specifications for benching and sloping. *Final cross-sections and locations for such areas must be provided on the reclamation map.*

Overburden, refuse, and spoil banks are minimal for a clay mine. Such stockpiles will be spread on the ground to allow positive drainage and revegetated.

5. a. Describe reclamation of processing facilities, stockpile areas, and on-site roadways.

Associated ditches and storm drains are stable within the plant area. The stockpile areas will be graded for positive drainage before revegetation. The haul roads in the mine will remain in place. These roadways are flush with the ground or are located on embankment fill.

b. Will any on-site roadways be left as part of the reclamation? Yes ☒ No ☐.
If yes, identify such roadways on the reclamation map and provide details on permanent road and ditch line stabilization.

6. Describe the method of control of contaminants and disposal of scrap metal, junk machinery, cables, or other such waste products of mining. (Note definition of refuse in The Mining Act of 1971.)

No off-site generated waste shall be disposed of on the mine site without prior written approval from the NC Department of Environment and Natural Resources, Land Quality Section and either the Division of Waste Management (DWM) or local governing body. If a disposal permit has been issued by DWM for the site, a copy of said permit must be attached to this application. *All temporary and permanent refuse disposal areas must be clearly delineated on the mine map(s) and reclamation map, along with a list of items to be disposed in said areas.*

No scrap metal or other debris will be left on-site.

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7. Describe your plan for revegetation or other surface treatment of the affected areas. This plan must include recommendations for year-round seeding, including the time of seeding and the amount and type of seed, fertilizer, lime and mulch per acre. The recommendations must include general seeding instructions for both permanent and temporary revegetation. Revegetation utilizing only tree plantings is not acceptable. Recommendations can be sought from:

   a. Authorized representatives of the local Soil and Water Conservation District;
   b. Authorized representatives of the Division of Forest Resources, Department of Environment and Natural Resources;
   c. Authorized county representatives of the North Carolina Cooperative Extension Service, specialists and research faculty with the Colleges of Agriculture and Life Sciences and Forest Resources at North Carolina State University;
   d. North Carolina licensed landscape architects;
   e. Private consulting foresters referred by the Division of Forest Resources, Department of Environment and Natural Resources;
   f. N.C. Erosion and Sedimentation Control Planning and Design Manual;
   g. N.C. Surface Mining Manual: A Guide for Permitting, Operation and Reclamation;
   h. Others as may be approved by the Department.

LIME - RATE OF APPLICATION (tons/acre):

FERTILIZER - ANALYSIS AND RATE OF APPLICATION (pounds/acre):

SEED - TYPE(S) AND RATE(S) OF APPLICATION INCLUDING **YEAR-ROUND** SEEDING SCHEDULE (pounds/acre): [NOTE: Include Legumes]

Seed Types:	**Seeding Dates:**	**Seeding Rates:**

~~SEE MINE~~ MAPS
See following two pages

MULCH - TYPE AND RATE OF APPLICATION (pounds/acre) AND METHOD OF ANCHORING:

OTHER VEGETATIVE COVERS – TYPE (S) AND RATE (S) OF APPLICATION INCLUDING SEEDING SCHEDULE (pounds/acre, trees/acre, spacing of trees/shrubs, etc):

Revegetation and/or reforestation plan approved by:

Signature T Patrick Shillington Date 03/25/14

Print Name T. Patrick Shillington, P.E.

Title President

Agency Engineering & Environmental Science Co.

Vegetation Plan

1. Spread topsoil over disturbed areas and leave surface reasonably smooth and uniform.

2. Scarify surface to prepare a seedbed four to six inches deep. Use such equipment as tilling, disking, tracing, Or the teeth on a front end loader.

3. Mix lime and fertilizer with the soil during seedbed preparation.

4. Seed on freshly prepared seedbed following the application rates for the appropriate season.

3. Mulch all seeded areas immediately.

5. Tack mulch on slopes 3:1 (Horizontal: Vertical) or steeper by spraying with emulsified asphalt. Use an Anchoring tool such as a farming disc set in a vertical position on slopes less than 3:1. Mulch netting may Also be used on slopes.

4. Inspect seeded areas and make repairs within the planting season. If vegetation is over 60% damaged, Repeat steps 2 through 5.

8. Permanent revegetation shall be accomplished at the specified times of the year. Temporary vegetation shall be applied outside of the optimal times for establishment of permanent vegetation

9. Seeding Schedule.

TEMPORARY SEEDING SCHEDULE

Seeding Date: August 15 to December 15

Seed Type	Rate
Rye (grain)	120 lbs. /acre
10-10-10 Fertilizer	1,000 lbs. /acre
Lime	2,000 lbs. /acre
Mulch	4,000 lbs. /acre

Seeding Date: January 1 to May 1

Seed Type	Rate
Rye (grain)	120 lbs. /acre
Lime	2,000 lbs. /acre
10-10-10 Fertilizer	750 lbs. /acre
Mulch	4,000 lbs. /acre

Seeding Date: May 1 to August 15

Seed Type	Rate
German Millet	40 lbs. /acre
10-10-10 Fertilizer	750 lbs. /acre
Lime	2,000 lbs. /acre
Mulch	4,000 lbs. /acre

PERMANENT SEEDING SCHEDULE

Seeding Date:	Best	Possible
	Fall: August 25- September 15	August 20- October 25
	Late Winter: February 15- March 21	February 1- April 15

Seed Type	Rate
Tall Fescue	100 lbs. /acre
Serica Lespedeza	30 lbs. /acre
Kobe Lespedeza	10 lbs. /acre
10-10-10 Fertilizer	1,000 lbs. /acre
Lime	3,000 lbs. /acre
Mulch	4,000 lbs. /acre

Note 1: Fertilizer and lime application rates may deviate from above if soils are analyzed for optimum rates.

Note 2: Mulch shall be tacked with emulsified asphalt at rate of 14 to 28 gallons/1,000 sq. ft. on slopes of 3:1 (H: V) or steeper.

Note 3: After August 15, use Unscarified Sericea seed for permanent seeding period.

Revegetation plan approved by:

Signature: T. Patton Slayton Date: 03/25/14

Note: Permanent and Temporary revegetation plan based on guidelines in Erosion and Sediment Control Planning and Design Manual.

APPLICATION FOR A MINING PERMIT

E. DETERMINATION OF AFFECTED ACREAGE AND BOND

The following bond calculation worksheet is to be used to establish an appropriate bond (based upon a range of $500 to $5,000 per affected acre) for each permitted mine site based upon the acreage approved by the Department to be affected during the life of the mining permit. Please insert the approximate acreage, for each aspect of the mining operation, that you intend to affect during the life of this mining permit (in addition, please insert the appropriate reclamation cost/acre for each category from the Schedule of Reclamation Costs provided with this application form) OR you can defer to the Department to calculate your bond for you based upon your maps and standard reclamation costs:

CATEGORY	AFFECTED ACREAGE		RECLAMATION COST/ACRE*		RECLAMATION COST
Tailings/Sediment Ponds:	28.5 Ac.	X	$ 1000 /Ac.	=	$ 28,500
Stockpiles:	7.4 Ac.	X	$ 2500 /Ac.	=	$ 18,500
Wastepiles:	5.0 Ac.	X	$ 5000 /Ac.	=	$ 25,000
Processing Area/Haul Roads:	17.5 Ac.	X	$ 5000 /Ac.	=	$ 87,500
Mine Excavation:	290.6 Ac.	X	$ 2000 /Ac.	=	$ 581,200
Other:	_____ Ac.	X	$ _____ /Ac.	=	$ _____

TOTAL AFFECTED AC.: 349.0 Ac.

(TOTAL PERMITTED AC.: 371.0 Ac.)

Temporary & Permanent Sedimentation & Erosion Control Measures:
Divide the **TOTAL AFFECTED AC.** above into the following two categories: a) affected acres that drain into proposed/existing excavation and/or b) affected acres that will be graded for positive drainage where measures will be needed to prevent offsite sedimentation and sedimentation to onsite watercourses and wetlands.

a) Internal Drainage _____ Ac.

b) Positive Drainage 349 Ac. X $1,500.00 = $ 525,500.00

SUBTOTAL COST: $ 1,266,200.00

Inflation Factor:

0.02 X SUBTOTAL COST: $ 1,266,200.00 X Permit Life (1 to 10 years)

INFLATION COST: $ 253,240.00

TOTAL COST = SUBTOTAL COST + INFLATION COST = $ 1,519,440.00

Total Reclamation Bond Cost: $ 1,519,400.00
(round down to the nearest $100.00)

APPLICATION FOR A MINING PERMIT

G. LAND ENTRY AGREEMENT

We hereby grant to the Department or its appointed representatives the right of entry and travel upon our lands or operation during regular business hours for the purpose of making necessary field inspections or investigations as may be reasonably required in the administration of the Mining Act of 1971 pursuant to G.S. 74-56.

We further grant to the Department or its appointed representatives the right to make whatever entries on the land as may be reasonably necessary and to take whatever actions as may be reasonably necessary in order to carry out reclamation which the operator has failed to complete in the event a bond forfeiture is ordered pursuant to G.S. 74-59.

LANDOWNER:

Signature: Warren Pashcal

Print Name: General Shale Brick Inc.
(Title, if applicable)

Company General Shale Brick Inc.
(If applicable)

Address: _____

_____

Telephone: (919) 774-6533(221)

Date Signed: 3/21/14

APPLICANT:

Signature:* Warren Pashcal

Print Name: Warren Pashcal

Title: Environmental Compliance Manager

Company: General Shale Brick Inc.

Mine Name: Colon Mine

Telephone: (919) 774-6533(221)

Date Signed: 3/21/14

*Signature must be the same as the individual who signed Page 1 of this application.

One original and five (5) copies of the completed application, six (6) copies of all location maps, mine maps and reclamation maps, and the appropriate processing fee (see next page for fee schedule) in the form a check or money order payable to the North Carolina Department of Environment and Natural Resources must be sent to the Land Quality Section Central Office at the address listed on the front cover of this application form.

Inquiries regarding the status of the review of this application should be directed to the Mining Program staff at (919) 707-9220.

APPLICATION FOR A MINING PERMIT

MINING FEE SCHEDULE

A nonrefundable permit application processing fee when filing for a new mining permit, a major permit modification or a renewal permit is required as follows:

	0-25 acres	26+acres
New Permit Applications	$3,750.00	$5,000.00
Permit Modifications	$750.00	$1,000.00
Permit Renewals	$750.00	$1,000.00
Transfers/Minor Modifications*	$100.00	$100.00

*** A nonrefundable $100.00 permit application processing fee is required for minor permit modifications. Minor permit modifications include ownership transfers, name changes, bond substitutions and permit renewals where the mine is inactive and fully stabilized. A minor permit modification also includes lands added to a permitted area, outside of the minimum permit buffer zone requirements, where no plans for mining related disturbance of the added lands have been approved. All other changes are considered major permit modifications.**

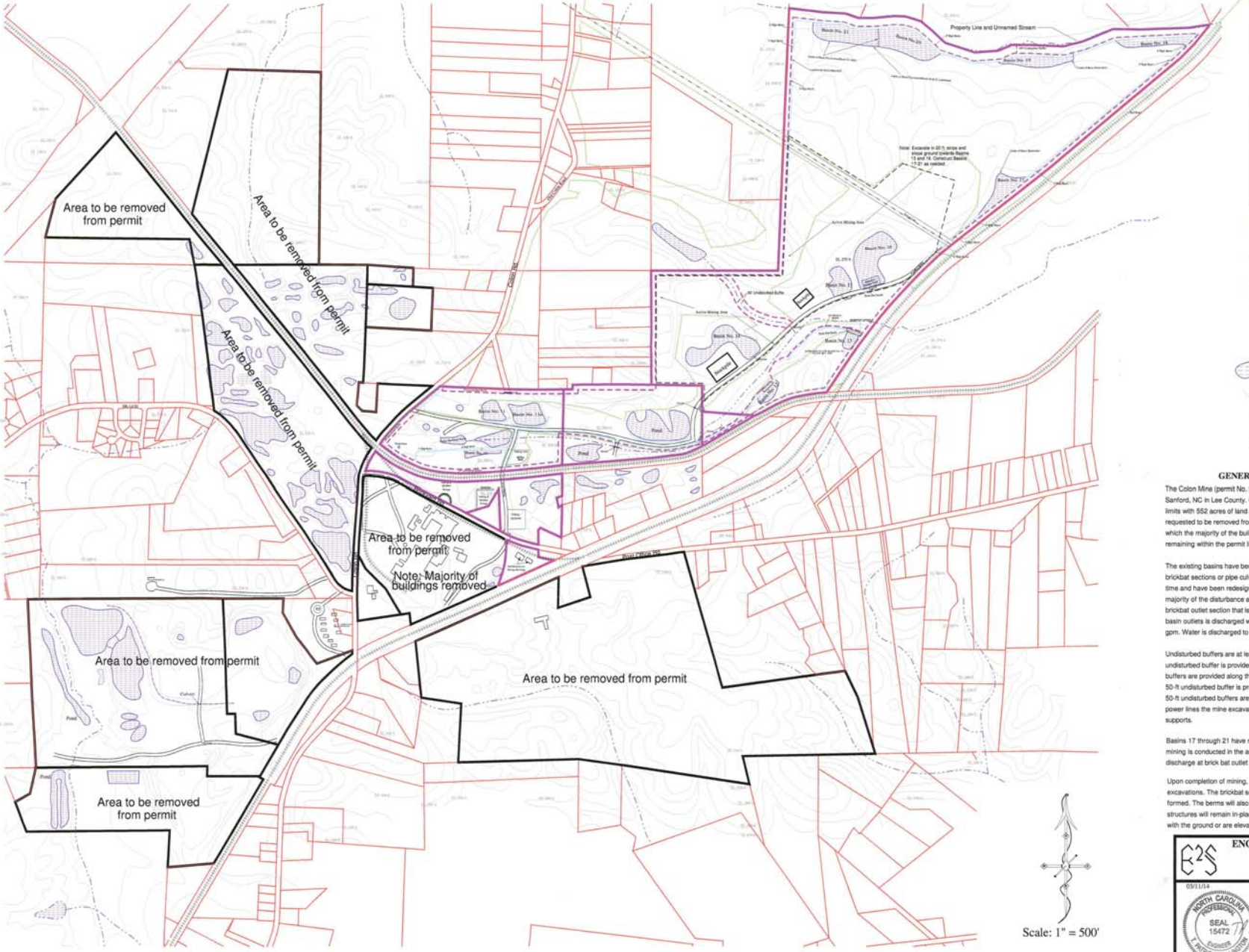
Acres for new permits and renewal permits means the total acreage at the site. Acres for major modification of permits means that area of land affected by the modification within the permitted mine area, or any additional land that is to be disturbed and added to an existing permitted area, or both.

SCHEDULE OF RECLAMATION COSTS
(Based upon range of $500 - $5,000 per affected acre)

COMMODITY CODES: **SG** = Sand and/or Gravel, **GS** = Gemstone, **Borrow** = Borrow/fill dirt, **CS** = Crushed Stone, **DS** = Dimension Stone, **FS** = Feldspar, **MI** = Mica, **LI** = Lithium, **PF** = Pyrophyllite, **OL** = Olivine, **KY** = Kyanite/Sillimanite/Andalusite, **PH** = Phosphate, **CL** = Clay/Shale, **PE** = Peat, **AU** = Gold, **TI** = Titanium, and **OT** = Other

Type	T/S Ponds	S.piles	W.piles	P.area/H.R.	Mine Excav.
SG, GS, Borrow	$500/ac.(L) 1500(FI)	$1800/ac.	$2000/ac.	$1800/ac.	$500/ac.(L) $2000(PD)
CS, DS, FS, MI, LI, PF, OL, KY	500(L) 1500(FI)	1800	2000	2000	500(L) 2500(PD)
PH	1000(L) 2500(FI)	2500	5000	5000	2000(L) 5000(PD)
CL	1000(L) 2500(FI)	2500	5000	5000	2000(L) 3700(PD)
PE, AU, TI, OT	1000(L) 2500(FI)	2500	3000	3500	2000(L) 5000(PD)

(L) = reclamation to a lake and revegetating sideslopes
(FI) = reclamation by filling in and revegetating
(PD) = reclamation by grading for positive drainage & revegetating



Legend

- Property Line and Mine Permit Limits
- Property Line for Areas to be Removed from Permit
- Adjacent Property Line
- Intermintent or Perenial Stream per USDA Lee Co. Soil Survey or USGS Map
- 10-Yr Limits of Disturbance
- Haul Road
- Building
- Brickbat Section
- Soil Berm/Roadway
- Water Accumulation in Basins and Mine Excavations
- Topographic Lines with Designated Elevation
- Railroad Tracks
- Active Mine Disturbance
- Tree Line

GENERAL MINE INFORMATION

The Colon Mine (permit No. 53-05) is located on Colon Road about 3 miles North of Sanford, NC in Lee County. Currently 1088 acres of land are within the mine permit limits with 552 acres of land allowed to be disturbed. Approximately 717 acres of land is requested to be removed from the mine permit. These areas include the plant area in which the majority of the buildings have been demolished. This will result in 371 acres remaining within the permit limits with 349 acres allowed for disturbance.

The existing basins have been formed by mine excavation and the outlets consist of brickbat sections or pipe culverts. However, five (5) basins have not been installed at this time and have been redesigned as wet retention basin with level spreader outlets. At the majority of the disturbance areas, excavation extends below the lowest level of the brickbat outlet section that is provided for these basins. The water accumulated below the basin outlets is discharged with an irrigation pump with a maximum capacity of 1500 gpm. Water is discharged to an adjacent mine/basin area.

Undisturbed buffers are at least 100-ft along the majority of Robert's Creek. A 50-ft undisturbed buffer is provided along the upper reach of the creek. Undisturbed 100-ft buffers are provided along the unnamed stream that is along the north property line. A 50-ft undisturbed buffer is provided along one of the tributaries to Robert's Creek. Also, 50-ft undisturbed buffers are provided along roadway and railroad right-of-ways. At power lines the mine excavation is maintained at least 50 ft. from the power line supports.

Basins 17 through 21 have not yet been installed. These basins will be installed before mining is conducted in the area of these basins. These basins were originally designed to discharge at brick bat outlet sections, but have been redesigned as wet retention basins.

Upon completion of mining, it is anticipated that lakes will be formed at the mine excavations. The brickbat sections (when present) will be leveled with a broad outlet formed. The berms will also be removed. For the wet retention basins, the outlet structures will remain in-place. All haul roads will be left in-place. Roadways are flush with the ground or are elevated above natural ground by embankment fill.

E2S
ENGINEERING & ENVIRONMENTAL SCIENCE COMPANY
3008 Anderson Drive
Raleigh, NC 27609
(919) 781-7798

03/11/14
NORTH CAROLINA PROFESSIONAL SEAL 15472 ENGINEER R. PATRICK SHILLINGTON

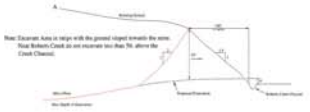
General Mine Information
Colon Mine
Permit No. 53-05
Lee County, NC

General Shale Brick, Inc.
300 Brick Plant Rd.
Moncure, NC 27559

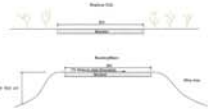
DATE: 11/13/03
DRAWN: JDC
REVISED: 2/5/14
SCALE: See Drawing
Sheet No. 1 of 4

↑SEE SHEET 3↑

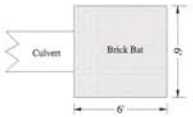
CROSS SECTION A-A'
(NTS)



TYPICAL ROADWAY
CROSS-SECTION
(NTS)



CULVERT OUTLET PLAN VIEW



Legend

- Property Line and Mine Permit Limits
- Property Line for Previously Permitted Areas
- Adjacent Property Line
- Intermittent or Perennial Stream per USDA Lee Co. Soil Survey or USGS Map
- 10-Yr Limits of Disturbance
- Haul Road
- Building
- Brickbat Section
- Soil Berm/Roadway
- Water Accumulation in Basins and Mine Excavations
- Topographic Lines with Designated Elevation
- Railroad Tracks
- Active Mine Disturbance
- Tree Line

Scale: 1" = 200'

MAINTENANCE CONSIDERATIONS

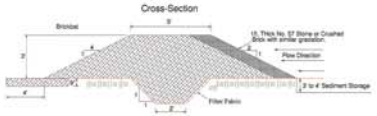
1. All erosion and sediment control practices shall be checked for stability and operation following every runoff-producing rainfall, but in no case should it be done less than once weekly. Any needed repairs will be made immediately to maintain all practices as designed.

2. The sediment basins will be cleaned out when the three to four foot deep storage areas fill up.

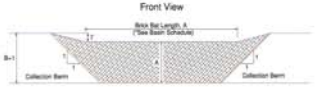
3. Replace fine brickbat filter section when clogged with fines.

Brick Bat Section
(NTS)

Cross-Section



Front View



Brick Bat Section Schedule

Basin No.	Basin Excavation Area, ft²	Brick Bat Length B (A)	Brick Bat Depth, B (B)	Sediment Storage Dimensions
Pump Discharge Basin	5,000	25'	4.5'	50' x 100' x 1' deep
11, 11A	72,215	42'	5'	69' x 138' x 3' deep
12	7,200 (60' by 120')	37'	4'	34' x 68' x 3' deep
13	18,525 (95' by 195')	65'	3.5'	49' x 98' x 3' deep
14	(1)	(1)	(1)	(1)

(1) Basin No. 14 Excavation will result in stormwater collection with no gravity drainage. Construct Pump Discharge Basin for water discharge from the mine area. Excavated area should be at least 3.0 acres flush or below the base of the downslope berm. The berm shall be at least 3.5' high, 1' diameter culvert installed through the berm for drainage when the basin is not actively mined.

BRICK BAT SECTION SPECIFICATIONS

1. Remove topsoil from area of brick bat section and place brick bats directly on the filter fabric. However, for the horizontal mat that extends 4 ft. downstream of the check dam toe, soil shall be removed to accommodate the 9 inch thick section so it is flush with existing ground level.

2. Construct check dam to dimensions specified in check dam details. The top of the check dam (crest level) should be maintained at constant level for the full length. Where the check dam meets the soil berm, the brick shall extend at least 1.0 ft. above the crest level.

Soil Berm Cross-Section

Collection Berm Specifications

1. Construct berm by placement of overburden.
2. Prior to placement of materials for berm formation, cut vegetation nearly flush with ground (if applicable).
3. Compact materials in 15. lifts by construction traffick
4. At a minimum, vegetate the crest and outside slopes the same day of contraction.

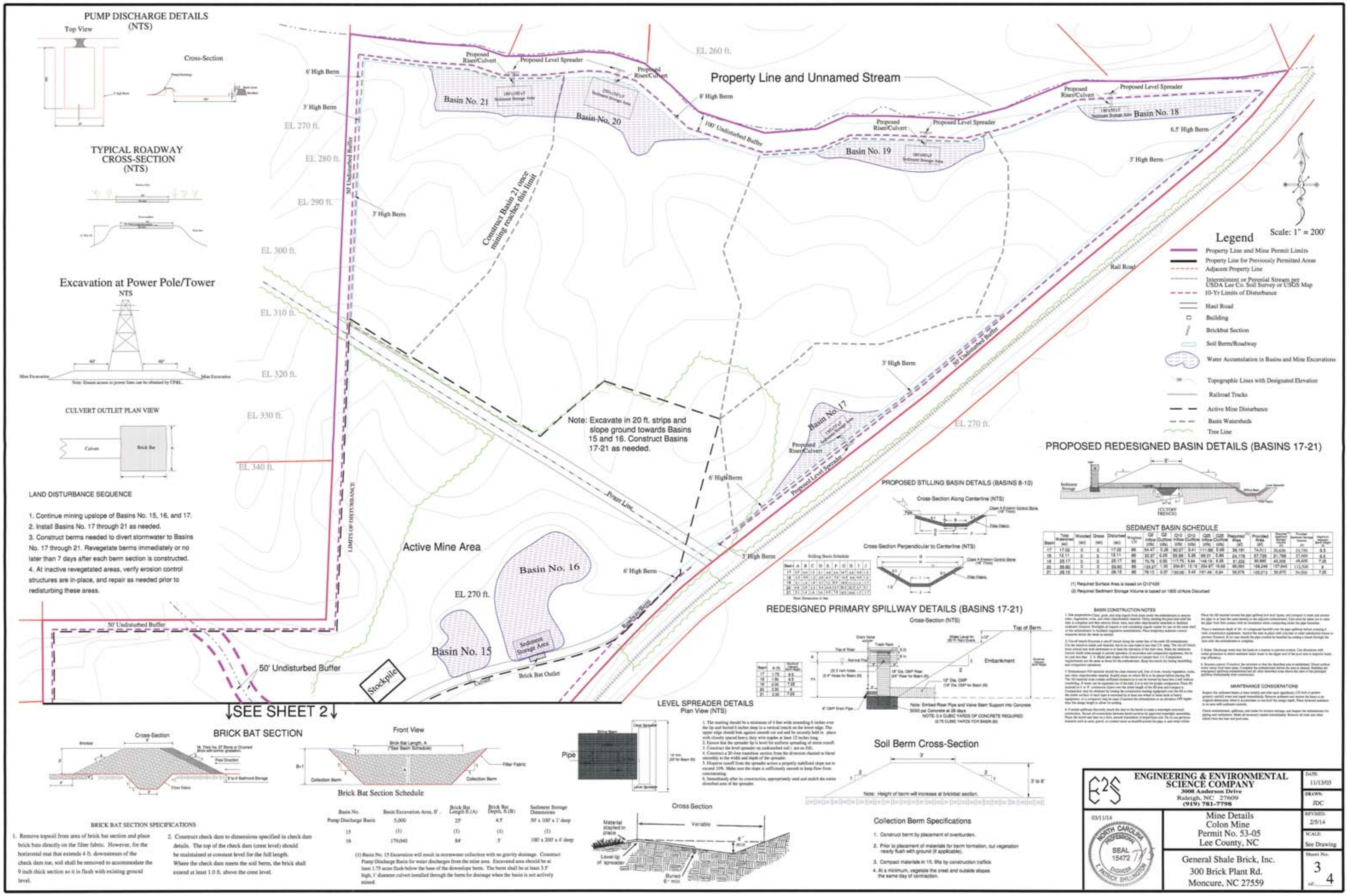
ENGINEERING & ENVIRONMENTAL SCIENCE COMPANY
3008 Anderson Drive
Raleigh, NC 27609
(919) 781-7798

DATE: 11/13/03
DRAWN: JDC
REVISED: 2/5/14
SCALE: See Drawing
Sheet No. 2 of 4

03/11/14
NORTH CAROLINA PROFESSIONAL SEAL 15472 ENGINEER F. PATRICK SHILLINGTON

Mine Details
Colon Mine
Permit No. 53-05
Lee County, NC

General Shale Brick, Inc.
300 Brick Plant Rd.
Moncure, NC 27559


PUMP DISCHARGE DETAILS
(NTS)
Top View
Cross-Section
TYPICAL ROADWAY CROSS-SECTION
(NTS)
Excavation at Power Pole/Tower
NTS
CULVERT OUTLET PLAN VIEW
Culvert
Brick Bat
LAND DISTURBANCE SEQUENCE
1. Continue mining upslope of Basins No. 15, 16, and 17.
2. Install Basins No. 17 through 21 as needed.
3. Construct berms needed to divert stormwater to Basins No. 17 through 21. Revegetate berms immediately or no later than 7 days after each berm section is constructed.
4. At inactive revegetated areas, verify erosion control structures are in-place, and repair as needed prior to redisturbing these areas.
Property Line and Unnamed Stream
Basin No. 21
Basin No. 20
Basin No. 19
Basin No. 18
Basin No. 17
Basin No. 16
Basin No. 15
Proposed Riser/Culvert
Proposed Level Spreader
6' High Berm
3' High Berm
6.5' High Berm
100' Undisturbed Buffer
50' Undisturbed Buffer
50' Undisturbed Buffer
Construct Basin 21 once mining reaches this limit
LIMITS OF DISTURBANCE
EL 260 ft.
EL 270 ft.
EL 280 ft.
EL 290 ft.
EL 300 ft.
EL 310 ft.
EL 320 ft.
EL 330 ft.
EL 340 ft.
Note: Excavate in 20 ft. strips and slope ground towards Basins 15 and 16. Construct Basins 17-21 as needed.
Power Line
Rail Road
Active Mine Area
Sediment Storage Area
Brick Bat Outlet
Culvert
Stockpile
↓SEE SHEET 2↓
Legend
Scale: 1" = 200'
Property Line and Mine Permit Limits
Property Line for Previously Permitted Areas
Adjacent Property Line
Intermittent or Perenial Stream per USDA Lee Co. Soil Survey or USGS Map
10-Yr Limits of Disturbance
Haul Road
Building
Brickbat Section
Soil Berm/Roadway
Water Accumulation in Basins and Mine Excavations
Topographic Lines with Designated Elevation
Railroad Tracks
Active Mine Disturbance
Basin Watersheds
Tree Line
PROPOSED REDESIGNED BASIN DETAILS (BASINS 17-21)
SEDIMENT BASIN SCHEDULE
PROPOSED STILLING BASIN DETAILS (BASINS 8-10)
Cross-Section Along Centerline (NTS)
Cross-Section Perpendicular to Centerline (NTS)
REDESIGNED PRIMARY SPILLWAY DETAILS (BASINS 17-21)
Cross-Section (NTS)
Top of Berm
Embankment
LEVEL SPREADER DETAILS
Plan View (NTS)
Pipe
Cross Section
Variable
6" min
Buried 6" min
Soil Berm Cross-Section
3'
3' to 8'
Note: Height of berm will increase at brickbat section.
Collection Berm Specifications
1. Construct berm by placement of overburden.
2. Prior to placement of materials for berm formation, cut vegetation nearly flush with ground (if applicable).
3. Compact materials in 1ft. lifts by construction traffick.
4. At a minimum, vegetate the crest and outside slopes the same day of contraction.
BRICK BAT SECTION
Cross-Section
Front View
Brick Bat Section Schedule
BRICK BAT SECTION SPECIFICATIONS
ENGINEERING & ENVIRONMENTAL SCIENCE COMPANY
3008 Anderson Drive
Raleigh, NC 27609
(919) 781-7798
Mine Details
Colon Mine
Permit No. 53-05
Lee County, NC
General Shale Brick, Inc.
300 Brick Plant Rd.
Moncure, NC 27559
DATE: 11/13/03
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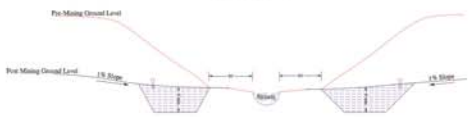
REVISED: 2/5/14
SCALE: See Drawing
Sheet No. 3 of 4

CROSS SECTION A-A'



CROSS SECTION B-B'

BROAD SWALE AT
BRICKBAT OUTLETS
CROSS SECTION

Scale: 1" = 400'

Legend

- Property Line and Mine Permit Limits
- Property Line for Previously Permitted Areas
- Adjacent Property Line
- Intermittent or Perenial Stream per USDA Lee Co. Soil Survey or USGS Map
- 10-Yr Limits of Disturbance
- Haul Road
- Building
- Brickbat Section
- Soil Berm/Roadway
- Water Accumulation in Basins and Mine Excavations
- Topographic Lines with Designated Elevation
- Railroad Tracks

RECLAMATION CONSIDERATIONS

1. Maintain 50' undisturbed buffer zone from adjacent property lines, railroad right-of-ways, and roadway right-of-ways. However, along a portion of Colon Road a 50-ft unexcavated buffer will have a 15+/- high berm. A 50ft to 100ft buffer zone shall generally be maintained from Roberts Creek and the unnamed stream along the north property line. Along a portion of Roberts Creek near Basin No. 12, excavation will be within 15ft. of the stream bank.

2. All perimeter mine excavation slopes shall be at least 2:1 (H:V) or flatter.

3. Remove all soil berms, brickbat sections, and pump discharge basins, which will create a broad swale for the outlet of the various lakes formed. These activities should be conducted after revegetating areas that will not be submerged in water.

4. Revegetate as per recommendations in the existing Mine Permit.

E2S ENGINEERING & ENVIRONMENTAL SCIENCE COMPANY
3008 Anderson Drive
Raleigh, NC 27609
(919) 781-7798

DATE: 11/13/03
DRAWN: JDC
REVISED: 2/5/14
SCALE: See Drawing
Sheet No. 4 of 4

03/11/14
NORTH CAROLINA PROFESSIONAL SEAL 15472 ENGINEER J. PATRICK SHILLINGTON

Mine Reclamation Plan
Colon Mine
Permit No. 53-05
Lee County, NC

General Shale Brick, Inc.
300 Brick Plant Rd.
Moncure, NC 27559

envirochem

ANALYTICAL & CONSULTING CHEMISTS

Environmental Chemists, Inc.

6602 Windmill Way • Wilmington, NC 28405
(910) 392-0223 (Lab) • (910) 392-4424 (Fax)
710 Bowsertown Road • Manteo, NC 27954
(252) 473-5702

NCDENR: DWQ CERTIFICATE #94. DLS CERTIFICATE #37729

Progress Energy - L.V. Sutton Plant
801 Sutton Plant Road
Wilmington NC 28401
Attention: R. Kent Tyndall

Date of Report: Jun 28, 2012
Customer PO #:
Report #: 2012-06128
Report to: R. Kent Tyndall
Project ID:

Lab ID	Sample ID:	Collect Date/Time	Matrix	Sampled by
12-14940	**Site:** Ash Sample	6/8/2012 2:00 PM	Solid/Sludge	Greg Brown

Test	Method	Results	Date Analyzed
Total Solids (%)	SM 2540 B	61.2 %	06/12/2012
Chlordane	SW 846 Method 8081B/3510	<0.0005 mg/L	06/21/2012
Endrin	SW 846 Method 8081B/3510	<0.00015 mg/L	06/21/2012
Heptachlor	SW 846 Method 8081B/3510	<0.00015 mg/L	06/21/2012
Heptachlor epoxide	SW 846 Method 8081B/3510	<0.00015 mg/L	06/21/2012
Lindane	SW 846 Method 8081B/3510	<0.00015 mg/L	06/21/2012
Methoxychlor	SW 846 Method 8081B/3510	<0.00015 mg/L	06/21/2012
Toxaphene	SW 846 Method 8081B/3510	<0.0005 mg/L	06/21/2012
1,4-Dichlorobenzene (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
2,4,5-Trichlorophenol (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
2,4,6-Trichlorophenol (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
2,4-Dinitrotoluene (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
Cresol (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
Hexachloro-1,3-butadiene (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
Hexachlorobenzene (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
Hexachloroethane (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
m + p-Cresol (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
Nitrobenzene (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
o-Cresol (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
Pentachlorophenol (TCLP)	SW 846 method 8270/3510	<0.025 mg/L	06/11/2012
Pyridine (TCLP)	SW 846 method 8270/3510	<0.005 mg/L	06/11/2012
2,4,5-TP	SW846 Method 8151A	<0.00333 mg/L	06/25/2012
2,4-D	SW846 Method 8151A	<0.0133 mg/L	06/25/2012
1,1-Dichloroethylene	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
1,2-Dichloroethane	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
Benzene	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
Carbon Tetrachloride	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012

envirochem (SM)

ANALYTICAL & CONSULTING CHEMISTS

Environmental Chemists, Inc.

6602 Windmill Way • Wilmington, NC 28405
(910) 392-0223 (Lab) • (910) 392-4424 (Fax)
710 Bowsertown Road • Manteo, NC 27954
(252) 473-5702

NCDENR: DWQ CERTIFICATE #94. DLS CERTIFICATE #37729

Progress Energy - L.V. Sutton Plant
801 Sutton Plant Road
Wilmington NC 28401
Attention: R. Kent Tyndall

Date of Report: Jun 28, 2012
Customer PO #:
Report #: 2012-06128
Report to: R. Kent Tyndall
Project ID:

Chlorobenzene	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
Chloroform	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
Methyl ethyl ketone	SW846 Method 8260/5030	< 0.05 mg/L	6/19/2012
Tetrachloroethylene	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
Trichloroethylene	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
Vinyl Chloride	SW846 Method 8260/5030	< 0.01 mg/L	6/19/2012
TCLP Metals			
Arsenic	EPA 200.7	<0.100 mg/L	06/14/2012
Barium	EPA 200.7	3.00 mg/L	06/14/2012
Cadmium	EPA 200.7	<0.100 mg/L	06/14/2012
Chromium	EPA 200.7	<0.100 mg/L	06/14/2012
Lead	EPA 200.7	<0.100 mg/L	06/14/2012
Selenium	EPA 200.7	<0.100 mg/L	06/14/2012
Silver	EPA 200.7	<0.100 mg/L	06/14/2012
Mercury	EPA 245.1	<0.002 mg/L	06/28/2012

Comment:
Reviewed by: Jim Price / Amy Lee

ATTACH PGN
USINESS
ARD
ERE)

ENVIRONMENTAL CHEMISTS, INC

Analytical & Consulting Chemists

Sample Collection and Chain of Custody

NCDENR: DWQ Certificate #94, DLS Certificate #37729

6602 Windmill Way
Wilmington, NC 28405
Phone: (910) 392-0223
Fax: (910) 392-4424
Email: EchemW@aol.com

Report No: 12-6128

Client: Progress Energy-Sutton Plant, 801 Sutton Steam Plant Rd, Wilmington, NC 28401

Collected By: Greg Brown

Sample Type: I = Influent, E = Effluent, W = Well, ST = Stream, SO = Soil, SL = Sludge Other:

Sample Identification	Collection DATE	TIME	TEMP	Sample Type	Composite or Grab	Container (P or G)	Chlorine mg/L	LAB ID NUMBER	PRESERVATION NONE	HCL	H_2SO_4	HNO_3	NaOH	THIO	OTHER	ANALYSIS REQUESTED
ash					C	P										
Sample	6/8/12	2pm	—		G	G		14940	X							See attached email for analysis requested
(Invoice this test separately from all others)					C	P										
					G	G										
					C	P										
					G	G										
					C	P										
					G	G										8 RCRA Metal TCLP
					C	P										
					G	G										
					C	P										
					G	G										8 RCRA Metal TCLP (** RUSH **)
					C	P										
					G	G										8 RCRA Metal TCLP (** RUSH **)
					C	P										
					G	G										8 RCRA Metal TCLP (** RUSH **)
					C	P										
					G	G										8 RCRA Metal TCLP (** RUSH **)
					C	P										
					G	G										
					C	P										
					G	G										

NOTICE – DECHLORINATION: Samples for Ammonia, TKN, Cyanide, Phenol, and Bacteria must be dechlorinated (0.2 ppm or less) in the field at the time of collection. See reverse side for instructions.

Transfer	Relinquished By:	Date/Time	Received By:	Date/Time
1.	Kent Tyndall	6/8/12 3:30 pm		
2.				

Temperature when Received: _____ Accepted: ✓ Rejected: _____ Resample Requested: _____

Delivered By: Kent Tyndall Received By: _____ Date: 6/8/12 Time: 1555

Comments: full TCLP analysis by SW-846 1311, 8260, 8270, 8081, 8151, and RCRA-8 metals

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NCDENR
North Carolina Department of Environment and Natural Resources
Division of Land Resources
Land Quality Section

James D. Simons, PG, PE
Director and State Geologist

Michael F. Easley, Governor
William G. Ross Jr., Secretary

April 6, 2005

Mr. Warren Paschal
General Shale Brick, Inc.
1600 Colon Road
Sanford, North Carolina 27330

RE: Permit No. 53-05
Colon Mine
Lee County
Cape Fear River Basin

Dear Mr. Paschal:

Your recent request to have the above referenced mining permit modified has been approved. The modification is to change the corporate name from Cherokee Sanford Group LLC to General Shale Brick, Inc. I have enclosed a revised permit cover page.

Please attach this approval letter and permit cover page to your existing mining permit for future reference. The expiration date, mine name and permit number on the permit document shall remain the same as before this modification.

The issuance of a mining permit and/or any modification to it does not supersede local zoning regulations. The responsibility of compliance with any applicable zoning regulations lies with you.

As a reminder, your permitted acreage at this site is 1088.17 acres and the amount of land you are approved to disturb is 551.97 acres.

Please advise this office at (919) 733-4574 should you have any questions concerning this matter.

Sincerely,

Floyd R. Williams, PG, CPG, CPESC
State Mining Specialist
Land Quality Section

FRW/jw
cc: Mr. John Holley, PE
Ms. Shannon Deaton-WRC
Mr. Bradley Bennett-DWQ

1612 Mail Service Center, Raleigh, North Carolina 27699-1612 • 919-733-4574 / FAX: 919-733-2876
512 North Salisbury Street, Raleigh, North Carolina, 27604

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF LAND RESOURCES

LAND QUALITY SECTION

PERMIT

For the operation of a mining activity

In accordance with the provisions of G.S. 74-46 through 68, " The Mining Act of 1971," Mining Permit Rule 15A NCAC 5 B, and other applicable laws, rules and regulations

Permission is hereby granted to:

General Shale Brick, Inc.

Colon Mine

Lee County – Permit No. 53-05

for the operation of a

Clay Mine

Which shall provide that the usefulness, productivity, and scenic values of all lands and waters affected by this mining operation will receive the greatest practical degree of protection and restoration.

MINING PERMIT EXPIRATION DATE: March 22, 2014

North Carolina Department of Environment and Natural Resources
Division of Land Resources
Land Quality Section

James D. Simons, P.G., P.E.
Director and State Geologist

Michael F. Easley, Governor
William G. Ross Jr., Secretary

March 22, 2004

Mr. Warren Paschal
Cherokee Sanford Group, LLC
1600 Colon Road
Sanford, North Carolina 27330

RE: Permit No. 53-05
Colon Mine
Lee County
Cape Fear River Basin

Dear Mr. Paschal:

Your application for renewal of the above referenced mining permit has been approved. A copy of the renewed permit is enclosed. The new expiration date is March 22, 2014.

The conditions in the permit renewal were based primarily upon the initial application. Modifications were made as indicated by the renewal request and as required to insure compliance with The Mining Act of 1971. I would like to draw your particular attention to the following conditions where minor additions or changes were made: Operating Condition Nos. 3C and 4D and Reclamation Condition Nos. 2G and 3.

As a reminder, your permitted acreage at this site is 1088.17 acres and the amount of land you are approved to disturb is 551.97 acres.

Please review the renewed permit and contact Ms. Judy Wehner, Assistant State Mining Specialist, at (919) 733-4574 should you have any questions concerning this matter.

Sincerely,

Floyd R. Williams, PG, CPG, CPESC
State Mining Specialist
Land Quality Section

FRW/jw
Enclosures
cc: Mr. John Holley, PE
Ms. Shannon Deaton-WRC, w/enclosures
Mr. Bradley Bennett-DWQ, w/enclosures
Mr. William Gerringer-DOL, Mine and Quarry Bureau, w/o enclosures

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF LAND RESOURCES

LAND QUALITY SECTION

PERMIT

For the operation of a mining activity

In accordance with the provisions of G.S. 74-46 through 68, " The Mining Act of 1971," Mining Permit Rule 15A NCAC 5 B, and other applicable laws, rules and regulations

Permission is hereby granted to:

Cherokee Sanford Group, LLC

Colon Mine

Lee County – Permit No. 53-05

for the operation of a

Clay Mine

Which shall provide that the usefulness, productivity, and scenic values of all lands and waters affected by this mining operation will receive the greatest practical degree of protection and restoration.

MINING PERMIT EXPIRATION DATE: March 22, 2014

In accordance with the application for this mining permit, which is hereby approved by the Department of Environment and Natural Resources, hereinafter referred to as the Department, and in conformity with the approved Reclamation Plan attached to and incorporated as part of this permit, provisions must be made for the protection of the surrounding environment and for reclamation of the land and water affected by the permitted mining operation. This permit is expressly conditioned upon compliance with all the requirements of the approved Reclamation Plan. However, completed performance of the approved Reclamation Plan is a separable obligation, secured by the bond or other security on file with the Department, and may survive the expiration, revocation, or suspension of this permit.

This permit is not transferable by the permittee with the following exception: If another operator succeeds to the interest of the permittee in the permitted mining operation, by virtue of a sale, imposed upon him by the conditions of his permit and by the Mining act with reference to the permitted operation, and transfer the permit to the successor operator, provided that both operators have complied with the requirements of the Mining Act and that the successor operator agrees to assume the duties of the permittee with reference to reclamation of the affected land and posts a suitable bond or other security.

In the event that the Department determines that the permittee or permittee's successor is not complying with the Reclamation Plan or other terms and conditions of this permit, or is failing to achieve the purposes and requirements of the Mining Act, the Department may give the operator written notice of its intent to modify, revoke or suspend the permit, or its intent to modify the Reclamation Plan as incorporated in the permit. The operator shall have right to a hearing at the designated time and place on any proposed modification, revocation or suspension by the Department. Alternatively and in addition to the above, the Department may institute other enforcement procedures authorized by law.

Definitions

Whenever used or referred to in this permit, unless the context clearly indicates otherwise, terms shall have the same meaning as supplied by the Mining Act, N.C.G.S. 74-49.

Modifications

November 4, 1988: This permit has been modified to change the company name from Sanford Brick and Tile Corporation to Cherokee Sanford Group.

April 10, 1992: This permit has been modified to allow mining on 52 acres and on-site disposal of petroleum contaminated soils as per the Mine expansion Map Erosion and Sediment Control Plan dated November 18, 1991.

July 21, 1992: This permit has been modified to allow crushed brick to be substituted for #57 washed stone on the upstream faces of all rock check dams.

February 13, 1995: This permit modified to increase the permitted acreage to 1093.18 acres and the affected acreage to 340 acres as indicated on the mine modification maps, sheets 1-4 dated May 25, 1994 and sealed September 12, 1994.

August 2, 1996: This permit has been modified to change the corporate name from Cherokee Sanford Group, Inc. to Cherokee Sanford Group, LLC.

October 24, 1997: This permit has been modified to revise the sediment and erosion control plan as indicated on the Site Layout Mine Map dated September 22, 1997 and supplemental information dated September 17, 1997 to more accurately reflect the field conditions, increase the maximum depth of the mine to 50 feet, allow the dewatering of the pit and allow two lake areas to be left at the time of final reclamation.

September 22, 1999: This permit has been modified to add approximately 211.37 acres of mine area that increases the affected acreage from 340.6 acres to 551.97 acres. This modification includes expanding the mine area in three areas and the associated sediment and erosion control measures as indicated on the General Mine Information Map dated June 21, 1999 and the Mine Modification Details Map last revised September 10, 1999, including the supplemental information dated June 21, 1999 and August 25, 1999.

April 25, 2000: A partial release has been granted, reducing the permitted acreage at this site by 5.01 undisturbed acres to 1088.17 acres.

Expiration Date

This permit shall be effective from the date of its issuance until March 22, 2014.

Conditions

This permit shall be subject to the provisions of the Mining Act, N.C.G.S. 74-46, et. seq., and to the following conditions and limitations:

OPERATING CONDITIONS:

1. A. Any wastewater processing or mine dewatering shall be in accordance with the permitting requirements and rules promulgated by the N.C. Environmental Management Commission.

   B. Any stormwater runoff from the affected areas at the site shall be in accordance with any applicable permit requirements and regulations promulgated by the Environmental Management Commission. It shall be the permittee's responsibility to contact the Water Quality Section, Division of Water Quality, to secure any necessary stormwater permits or other approval documents.

2. A. Any mining process producing air contamination emissions shall be subject to the permitting requirements and rules promulgated by the N.C. Environmental Management Commission and enforced by the Division of Air Quality.

   B. During mining operations, water trucks or other means that may be necessary shall be utilized to prevent dust from leaving the permitted area.

3. A. Sufficient buffer (minimum 50 foot undisturbed except as noted below in Operating Condition No. 3C) shall be maintained between any affected land and any adjoining waterway or wetland to prevent sedimentation of that waterway or wetland from erosion of the affected land and to preserve the integrity of the natural watercourse or wetland.

   B. Any mining activity affecting waters of the State, water of the U. S., or wetlands shall be in accordance with the requirements and regulations promulgated and enforced by the N. C. Environmental Management Commission.

   C. Mining activities shall be allowed within 15 feet of Roberts Creek as indicated on the mine maps, sheets 1 through 4, dated November 13, 2003 with the stipulation that mining activities be conducted in such a manner as to ensure that all runoff drains into the pit area. Immediately upon removal of material along the creek, a 100 foot buffer shall be established with hardwoods and shrubs.

4. A. Adequate mechanical barriers including but not limited to diversions, earthen dikes, silt check dams, silt retarding structures, rip rap pits, or ditches shall be provided in the initial stages of any land disturbance and maintained to prevent sediment from discharging onto adjacent surface areas or into any lake, wetland or natural watercourse in proximity to the affected land.

   B. The upstream face of all check dams shall be lined with ¼ inch to ¾ inch crushed brick with minimal fines.

   C. Whenever possible, all drainage from the affected areas around the mine excavations shall be diverted internal to said excavations.

   D. Mining activities, including the installation and maintenance of the approved sediment basins and associated diversion berms, shall be conducted as indicated on the mine maps, Sheets 1 through 4, dated November 13, 2003 with the following stipulation: immediately upon removal of the last mound of material along the creek, a 100 foot buffer shall be established with hardwoods and shrubs.

   E. Should the designed brick bat dams fail or stability problems develop in the structure itself or at its abutments, said dams shall be redesigned and reconstructed or replaced by other measures approved by the Department.

5. All affected acreage boundaries (551.97 acres) shall be permanently marked at the site on 100-foot intervals unless the line of sight allows for larger spacing intervals.

6. The angle for graded slopes and fills shall be no greater than the angle which can be retained by vegetative cover or other adequate erosion control measure, structure, or device. In any event, exposed slopes or any excavated channels, the erosion of which may cause off-site damage because of siltation, shall be planted or otherwise provided with ground cover, devices or structures sufficient to restrain such erosion.

7. The affected land shall be graded so as to prevent collection of pools of water that are, or likely to become, noxious or foul. Necessary structures such as drainage ditches or conduits shall be constructed or installed when required to prevent such conditions.

8. Existing vegetation or vegetated earthen berms shall be maintained between the mine and public thoroughfares whenever practical to screen the operation from the public.

9. Sufficient buffer (minimum 50 foot undisturbed) shall be maintained between any excavation and any mining permit boundary or right-of-way to protect adjacent property.

10. A physical barrier consisting of a fence or earthen berm, etc., shall be maintained around the perimeter of any highwall.

11. A. No on-site disposal of refuse or other solid waste that is generated outside of the mining permit area shall be allowed within the boundaries of the mining permit area unless authorization to conduct said disposal has first been obtained from both the Division of Waste Management and the Land Quality Section, Department of Environment and Natural Resources. The method of disposal shall be consistent with the approved reclamation plan.

B. Mining refuse defined by G.S. 74-49 (14) of The Mining Act of 1971 generated on-site and directly associated with the mining activity may be disposed of in a designated refuse area. All other waste products must be disposed of in a disposal facility approved by the Division of Waste Management. No petroleum products, acids, solvents or their storage containers or any other material that may be considered hazardous shall be disposed of within the permitted area.

C. For the purposes of this permit, the Division of Land Resources considers the following materials to be "mining refuse" (in addition to those specifically listed under G.S. 74-49 (14) of the N.C. Mining Act of 1971):

1. on-site generated land clearing debris
2. conveyor belts
3. wire cables
4. v-belts
5. steel reinforced air hoses
6. drill steel

D. If mining refuse is to be permanently disposed within the mining boundary, the following information must be provided to and approved by the Division of Land Resources prior to commencement of such disposal:

1. the approximate boundaries and size of the refuse disposal area;
2. a list of refuse items to be disposed;
3. verification that a minimum of 4 feet of cover will be provided over the refuse;

4. verification that the refuse will be disposed at least 4 feet above the seasonally high water table; and
5. verification that a permanent vegetative groundcover will be established.

12. An annual Reclamation Report shall be submitted on a form supplied by the Department by February 1 of each year until reclamation is completed and approved.

13. The operator shall notify the Department in writing of the desire to delete, modify or otherwise change any part of the mining, reclamation, or erosion/sediment control plan contained in the approved application for a mining permit and any approved revisions to it. Approval to implement such changes must be obtained from the Department prior to on-site implementation of the revisions.

14. The security, which was posted pursuant to N.C.G.S. 74-54 in the form of a $500,000.00 blanket bond, is sufficient to cover the operation as indicated in the approved application. This security must remain in force for this permit to be valid. The total affected land shall not exceed the bonded acreage.

15. A. Authorized representatives of the Division of Archives and History shall be granted access to the site to determine the presence of significant archaeological resources.

B. Pursuant to N. C. G. S. 70 Article 3, "The Unmarked Human Burial and Human Skeletal Remains Protection Act, " should the operator or any person in his employ encounter human skeletal remains, immediate notification shall be provided to the county medical examiner and the chief archaeologist, North Carolina Division of Archives and History.

APPROVED RECLAMATION PLAN

The Mining Permit incorporates this Reclamation Plan, the performance of which is a condition on the continuing validity of that Mining Permit. Additionally, the Reclamation Plan is a separable obligation of the permittee, which continues beyond the terms of the Mining Permit.

The approved plan provides:

Minimum Standards As Provided By G.S. 74-53

1. The final slopes in all excavations in soil, sand, gravel and other unconsolidated materials shall be at such an angle as to minimize the possibility of slides and be consistent with the future use of the land.

2. Provisions for safety to persons and to adjoining property must be provided in all excavations in rock.

3. All overburden and spoil shall be left in a configuration which is in accordance with accepted conservation practices and which is suitable for the proposed subsequent use of the land.

4. No small pools of water shall be allowed to collect or remain on the mined area that are, or likely to become noxious, odious or foul.

5. The revegetation plan shall conform to accepted and recommended agronomic and reforestation practices as established by the North Carolina Agricultural Experiment Station and the North Carolina Forest Service.

6. Permittee shall conduct reclamation activities pursuant to the Reclamation Plan herein incorporated. These activities shall be conducted according to the time schedule included in the plan, which shall to the extent feasible provide reclamation simultaneous with mining operations and in any event, provide reclamation at the earliest practicable time after completion or termination of mining on any segment of the permit area and shall be completed within two years after completion or termination of mining.

RECLAMATION CONDITIONS:

1. Provided further, and subject to the Reclamation schedule, the planned reclamation shall be to restore portions of the mine excavations to lake areas and to grade and satisfactorily revegetate any other disturbed areas.

2. The specifications for surface gradient restoration to a surface suitable for planned future use are as follows:

A. The lake area shall be excavated to maintain a minimum water depth of four feet measured from the low water table elevation.

B. The side slopes to the lake excavation shall be graded to a 3 horizontal to 1 vertical or flatter slope.

C. All remaining sideslopes shall be graded to a 2 horizontal to 1 vertical or flatter slope.

D. Any settling ponds or sediment basins shall be backfilled and stabilized.

E. The processing, stockpile, and other disturbed areas neighboring the mine excavation shall be leveled and smoothed.

F. Compacted surfaces shall be disced, subsoiled or otherwise prepared before revegetation.

G. No contaminants shall be permanently disposed of at the mine site. On-site disposal of waste shall be in accordance with Operating Condition 11.A through D.

H. The affected land shall be graded to prevent the collection of noxious or foul water.

~~3.~~ 6. Revegetation Plan:

After site preparation, all disturbed land areas shall be revegetated as per the revegetation plan approved by T. Patrick Shillington, P.E. on June 16, 2004 or by the following specifications:

Permanent Seeding Specifications

Dates	Species	Rate, Lbs/Acre
February 15 – April 1	Kobe Lespedeza	10
	Bahiagrass	50
	Redtop	1
	Winter rye (grain)	15
April 1 – July 31	Common Bermuda	50
August 1 – October 25	Lespedeza (unscarified)	30
	German millet	40
October 25 – February 15	Rye (grain – temporary)	120

Soil Amendments

Lime- 2000 lbs/acre or follow recommendations from a soil test.

Fertilizer- 1000 lbs/acre 8-8-8 or 10-10-10, or follow recommendations from a soil test.

Mulch- All seeded areas shall be mulched using small grain straw at a rate of 2000 lbs/acre and anchored appropriately.

Whenever possible, disturbed areas should be vegetated with native warm season grasses such as switch grass, Indian grass, bluestem and gamma grass.

In addition, the permittee shall consult with a professional wildlife biologist with the N.C. Wildlife Resources Commission to enhance post-project wildlife habitat at the site.

4.7. Reclamation Plan:

Reclamation shall be conducted simultaneously with mining to the extent feasible. In any event, reclamation shall be initiated as soon as feasible after completion or termination of mining of any mine segment under permit. Final reclamation, including revegetation, shall be completed within two years of completion or termination of mining.

This permit, issued to Sanford Brick and Tile Company October 3, 1972, renewed October 12, 1982, transferred to Cherokee Sanford Group, Inc. November 4, 1988, modified April 10, 1992 and July 21, 1992, renewed March 18, 1994, and modified February 13, 1995, August 2, 1996, October 24, 1997, and September 22, 1999, is hereby renewed this 22nd day of March, 2004 pursuant to GS 74-52.

By: Francis M. Nevils Jr

for James D. Simons, Director
Division of Land Resources
By Authority of the Secretary
Of the Department of Environment and Natural Resources

Construction Quality Assurance (CQA) Plan

Colon Mine Site Structural Fill

Charah, Inc.

Sanford, NC

November 2014
Revised December 2014

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Figure 1 CQA/CQC Lines of Authority and Communication 3

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1 General

This Construction Quality Assurance (CQA) Plan has been prepared to provide the Owner, Engineer, and CQA Consultant the means to govern the construction quality and to document construction operations in accordance with the engineering drawings.

More specifically, this CQA Plan addresses the components required to construct base liners systems and closure systems. The common components of a base liner system often include many of the following layers: soil subgrade, compacted soil liner, a geosynthetic clay liner, HDPE geomembrane, a drainage geocomposite, a granular drainage material, geotextiles, perforated collection piping, sumps/manholes, and fittings. The common components of a closure system often include many of the following layers: soil subgrade, compacted soil liner, a geosynthetic clay liner, HDPE geomembrane, a drainage geocomposite, a granular drainage material, geotextiles, perforated collection piping, soil ballast and topsoil. As many of the components are the same or similar, this CQA plan is organized by the components of the work. This plan is intended to be used for both liner systems and closure systems; therefore it includes material components that may not be used on every construction project.

The CQA Plan is divided into the following sections:

1 General
2 Soil Liner
3 Geosynthetic Clay Liner
4 Geomembrane Liner
5 Drainage Geocomposite
6 Earthen Drainage & Protective Components
7 Geotextile
8 High Density Polyethylene Pipe, Manholes, & Fittings
9 Surveying
10 Documentation

1.1 Scope of Construction Quality Assurance Plan

The scope of this CQA Plan includes the CQA of the soils and geosynthetic components of the liner and LCR systems for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope. This document is intended to be used in concert with the CQC requirements presented in the project specifications.

1.2 Definitions

1.2.1 Construction Quality Assurance

In the context of this plan, construction quality assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the constructed systems (ex. Liner systems, Leachate Collection and Removal (LCR) systems, and protective cover system) with the design drawings, and the project specifications. CQA is provided by the CQA Consultant as a representative of the Owner and is independent from the Contractor and all

manufacturers. The CQA program is designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

1.2.2 Construction Quality Control

Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, or the Contractor to ensure that the materials and the workmanship meet the requirements of the design plans and project specifications. For earthen components such as the soil liner, the leachate collection material and protective cover soils, CQC is often provided by the Contractor's CQC Consultant. In the case of geosynthetic components, material quality control is provided by manufacturer certifications and the CQC for the installation of the various geosynthetics is provided by the Contractor's CQC Consultant. The manufacturer's specifications and quality control (QC) requirements are included in this CQA Plan by reference only.

1.2.3 Minimum Average Roll Value (MARV)

Geosynthetics are commonly specified on a minimum or maximum average roll value (MARV). The MARV is the value two standard deviations away from the average value for the product.

1.2.4 CQA/CQC Certification Document

At the completion of construction, a certification document will be prepared by the CQA Consultant and be submitted to the state regulatory agency. The certification report will include all QC testing performed by the Geosynthetics Manufacturers, all CQC testing performed by the CQC Consultant, or Geosynthetic Installers, and all CQA conformance testing performed by the CQA Consultant.

1.2.5 Units

In this CQA Plan, all properties and dimensions are expressed in U.S. units.

1.2.6 References

The CQA Plan includes references to the test procedures of the ASTM International (ASTM), and the "Geosynthetic Research Institute" (GRI).

1.3 Governance between Documents

The CQA Plan is intended to be a supporting document to improve the overall documentation of the Work. The CQA Plan is less specific than the project specifications, and conflicts may exist between the documents. The Contractor is instructed to bring all apparent discrepancies or conflicts to the attention of the Engineer or CQA Consultant for resolution. The Engineer has the sole authority to determine resolution of conflicts existing within the Contract Documents. The more stringent requirement shall control the resolution, unless otherwise determined by the Engineer. The General Conditions of the contract documents should be consulted for guidance in conflict resolution; for many HDR projects this is Section 00700 - General Conditions.

1.4 Parties to Construction Quality Assurance

The lines of authority and communications between each of the parties involved in the CQA and CQC are illustrated in Figure 1.

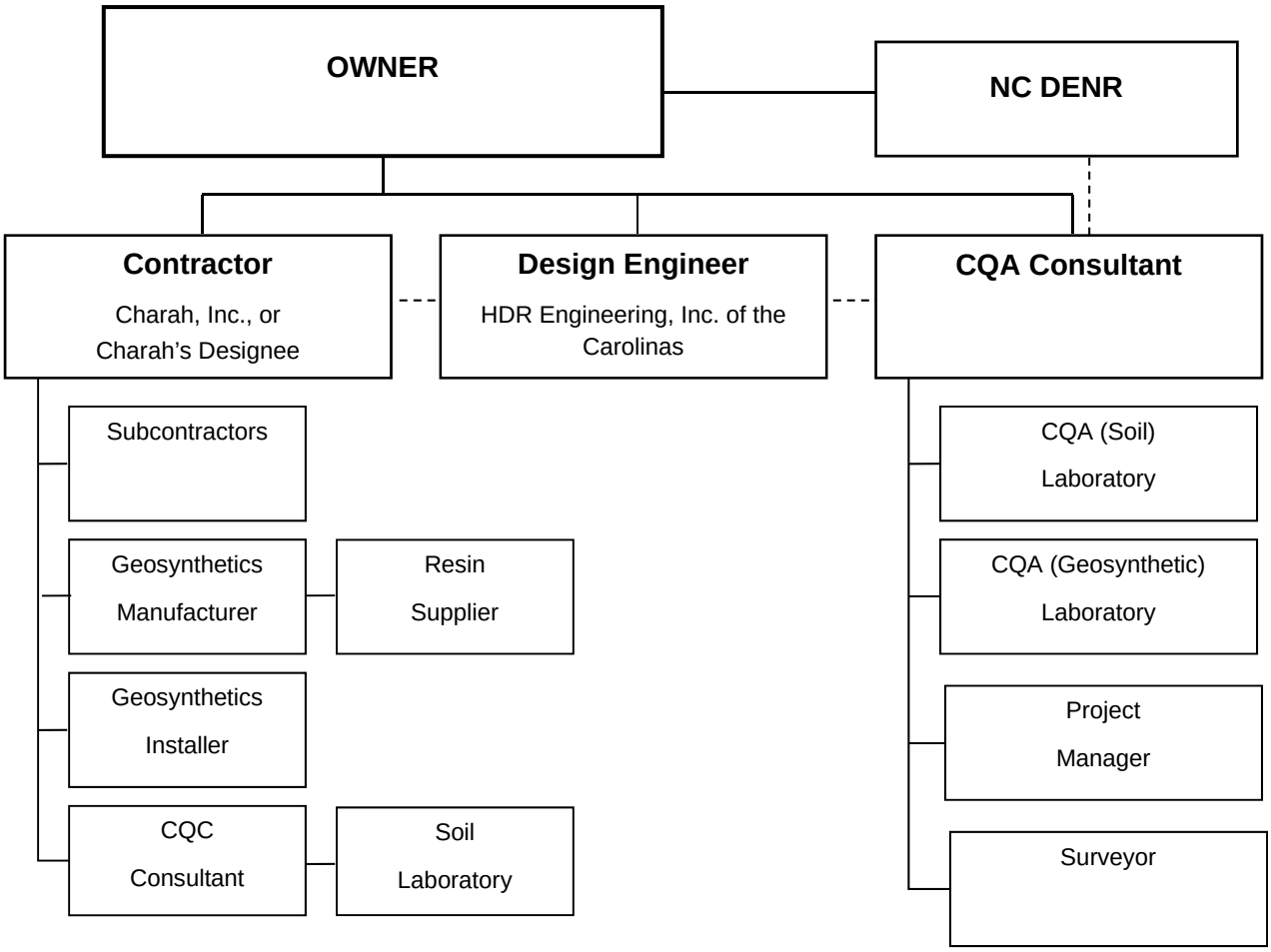

Figure 1 CQA/CQC Lines of Authority and Communication

1.4.1 Owner

The Owner is Green Meadow LLC, who owns and/or is responsible for the facility.

1.4.2 Project Manager

The Project Manager is the official representative of the Owner. The Project Manager serves as communications coordinator for the project, initiating the resolution, preconstruction, and construction meetings outlined in this section. The Project Manager shall also be responsible for proper resolution of all quality issues that arise during construction.

1.4.3 Engineer

The Engineer is responsible for the engineering design, drawings, plans and project specifications for the liner system and protective cover system. The Engineer is HDR Engineering, Inc. of the Carolinas.

1.4.4 Contractor

The Contractor is responsible for the construction of the project and system components in accordance with contract specifications. The Contractor is responsible for all of their subcontractors. The Contractor is responsible for submittal coordination and the overall CQC on the project. The Contractor may be the Owner.

1.4.5 Geosynthetics Manufacturer

The Geosynthetics Manufacturer(s) is (are) responsible for the production of geomembranes, geosynthetic clay liners, geonets, and geotextiles. The manufacturers are responsible for Quality Control (QC) during manufacture of the geosynthetic components, certification of the properties of the geosynthetic components, and field installation criteria.

1.4.6 Geosynthetics Installer

The Geosynthetics Installer(s) may be the Contractor or a subcontractor to the Contractor and is (are) responsible for field handling, storing, placing, seaming, protection of (against wind, etc.), and other aspects of the geosynthetics installations, including the geomembranes, geosynthetic clay liners and geotextiles. The Geosynthetics Installer may also be responsible for transportation of these materials to the site and for the preparation and completion of anchor trenches.

1.4.7 Construction Quality Assurance Consultant

The CQA Consultant is a representative of the Owner and is responsible for observing, testing, and documenting activities related to the CQC/CQA of the earthworks at the site and the installation of the geosynthetic components of the liner and leachate collection/removal systems. The CQA Consultant is also responsible for issuing a facility certification report sealed by a registered professional engineer.

1.4.8 Geosynthetics Construction Quality Assurance Laboratory

The Geosynthetics CQA Laboratory is a party, independent from the Owner, which is responsible for conducting tests on conformance samples of geosynthetics used in the liner and LCR systems. The Geosynthetics CQA Laboratory service cannot be provided by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components.

1.4.9 Soils Construction Quality Assurance Laboratory

The Soils Construction Quality Assurance Laboratory is a party, independent from the Owner, which is responsible for conducting geotechnical tests on conformance samples of soils used in the liner system. The Soils CQA Laboratory service cannot be provided by any party involved with the Contractor.

1.4.10 Construction Quality Control Consultant

The CQC Consultant is a representative of the Contractor and is responsible for the earthwork and soil liner quality control sampling and testing. The term CQC Consultant shall be used to designate the registered professional engineer in charge of the quality control work. The personnel of the CQC Consultant also include Quality Control Monitors who are also located at the site for construction observation and monitoring. The CQC Consultant is responsible for the timely conveyance of CQC testing results to the CQA Consultant.

1.4.10.1 GEOSYNTHETICS CONSTRUCTION QUALITY CONTROL LABORATORY

The Geosynthetics CQC Laboratory is responsible for conducting conformance tests on samples of geosynthetics at the direction of the CQC Consultant.

1.4.10.2 SOILS CONSTRUCTION QUALITY CONTROL LABORATORY

The Soils Construction Quality Control Laboratory is responsible for conducting geotechnical tests on soil samples at the direction of the CQC Consultant.

The Owner may choose to employ the CQA consultant to perform some, or all, of the CQC Consultant duties.

1.5 Qualifications of the Parties

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQC/CQA of all materials for the project. Where applicable, these qualifications shall be submitted by the Contractor to the Project Manager for review and approval.

1.5.1 Contractor

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Plan. A complete up to date version of each geosynthetic component manufacturer's QC Plan shall be incorporated into the Contractor's CQC Plan.

1.5.2 Geosynthetics Manufacturers

Each Geosynthetics Manufacturer must satisfy the qualifications presented in the project specifications and must be prequalified and approved by the Project Manager.

The physical properties of each geosynthetic product must be certified by the geosynthetics manufacturer. The properties certified must include, at a minimum, those identified in the project specifications. Manufacturer’s certification must be approved by the CQA Consultant before the product is used.

1.5.3 Geosynthetic Installer(s)

The Geosynthetic Installer(s) will be trained and qualified to install the geosynthetics components of the liner system. Each Geosynthetics Installer must meet the requirements of the project specifications and be approved by the Project Manager. The Geomembrane Installer must be approved by the Geomembrane Manufacturer.

1.5.4 Construction Quality Assurance Consultant

The CQA Consultant will act as the Owner's CQA representative and will report to the Project Manager. The CQA Consultant will perform conformance testing to satisfy the requirements of this CQA Plan, will observe the CQC work performed by the CQC Consultant, and will prepare the certification document incorporating both CQA and CQC test data. The CQA Consultant will have experience in the CQC/CQA aspects of geomembrane liner system construction and soils testing, and be familiar with ASTM and other related industry standards. The activities of the CQA Consultant will be performed under the supervision of a registered professional engineer.

1.5.5 Construction Quality Control Consultant

The CQC Consultant will be a subcontractor to the Contractor. The CQC Consultant will be experienced with soils, including soil liners, and geosynthetics, including geomembranes, geosynthetic clay liners geonets, and geotextiles. The CQC Consultant will satisfy the

requirements of the project specifications and be approved by the Project Manager. The activities of the CQC Consultant will be performed under the supervision of a registered professional engineer.

1.5.6 Geosynthetics Construction Quality Control Laboratory

The Geosynthetics CQC Laboratory is a subcontractor of the CQC Consultant and will have experience in testing geosynthetics and be familiar with ASTM, GRI, and other applicable test standards. The laboratory shall be accredited under the GAI-LAP program for all tests required for the project. The Geosynthetics CQC Laboratory will be capable of providing test results within 24 hours or a reasonable time after, as agreed to at the outset of the project, receipt of samples, and will maintain that standard throughout the installation.

1.6 Site and Project Control

To guarantee a high degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

1.6.1 CQA/CQC Resolution Meeting

Prior to field mobilization by the Contractor, a Resolution Meeting will be held. This meeting will include all parties then involved, including the Project Manager, the CQA Consultant, the Engineer, the Contractor, and the CQC Consultant.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the CQA and CQC Plans to all of the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the following activities.

- Provide relevant documents to all involved parties.
- Review critical design details of the project.
- Review the seam layout drawing provided by the Geomembrane/Geosynthetic Installer.
- Review the site-specific CQA and CQC Plans and make any appropriate modifications to the plans to ensure that all necessary testing activities are specified.
- Reach a consensus on the CQA/CQC quality control procedures, especially on methods for determining acceptability of the soils and geosynthetics.
- Review the proposed liner system and protective cover system.
- Select testing equipment and review protocols for testing and placement of general earthwork materials.
- Confirm methods for the soil liner material selection testing, acceptable zone determinations, and test strip installation.
- Confirm the methods for documenting and reporting, and for distributing documents and reports, and confirm the lines of authority and communication.

The meeting will be documented by the Project Manager and minutes will be transmitted to all parties.

1.6.2 Preconstruction Meeting

A Preconstruction Meeting will be held at the site prior to placement of the geosynthetic liner system. At a minimum, the meeting will be attended by the Project Manager, Engineer, the CQA Consultant, the Contractor, the CQC Consultant, and the Geosynthetic/Geomembrane Installation Superintendent.

Specific activities considered for this meeting include the following.

- Make any appropriate modifications to the CQA and CQC Plans.
- Review the responsibilities of each party.
- Review lines of authority and communication.
- Review methods for documenting and reporting, and for distributing documents and reports.
- Establish protocols for testing.
- Establish protocols for handling deficiencies, repairs, and retesting.
- Review the time schedule for all operations.
- Establish rules for writing on the geomembrane, i.e., who is authorized to write, what can be written, and in which color.
- Outline procedures for packaging and storing archive samples.
- Review panel layout and numbering systems for panels and seams.
- Establish procedures for use of the extrusion seaming apparatus, if applicable.
- Establish procedures for use of the fusion seaming apparatus, if applicable.
- Finalize field cutout sample sizes.
- Review seam testing procedures.
- Review repair procedures.
- Establish soil stockpiling locations (if any).

The meeting will be documented by the Project Manager and minutes will be transmitted to all parties. The Resolution Meeting and the Preconstruction Meeting may be held as one meeting or separate meetings, depending on the direction of the Project Manager.

1.6.3 Weekly Progress Meetings

A weekly progress meeting will be held between the Project Manager, the CQA Consultant, the Contractor, the CQC Consultant, the Geosynthetic/Geomembrane Installation Superintendent, and representatives from any other involved parties. This meeting will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Consultant will log any problems, decisions, or questions arising at this meeting in his daily report. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties.

Meeting frequency may be adjusted depending on the schedule of the project and the mutual agreement of all parties involved.

1.6.4 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by all interested parties, the Contractor, the Project Manager, and the CQA Consultant. If the problem requires a design modification, the Engineer should also be present. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Project Manager and minutes will be transmitted to affected parties.

2 Soil Liner

This section of the CQA Plan addresses the soil components of the liner system, and outlines the soils CQA program to be implemented with regard to materials confirmation, laboratory and field confirmation test requirements, overview and interfacing with the Contractor's CQC Program, and resolution of problems.

2.1 Earthwork Construction

2.1.1 Subgrade

The subgrade material below the controlled fill will be prepared by the Contractor prior to the placement of structural fill. The CQA and CQC Consultants will observe the proof roll by the Contractor. They must both agree that the pre-fill subgrade is acceptable before structural fill may be placed. If agreement cannot be reached, the Contractor shall further prepare the area or implement the plan from the work deficiency meeting. The CQA Consultant may conduct additional testing as deemed appropriate.

2.1.2 Structural/Controlled Fill

The Contractor shall place fill in accordance with the project specifications. The CQC Consultant shall provide testing of the controlled fill material in accordance with the project specifications. The CQA Consultant will provide confirmation testing of the controlled fill as deemed appropriate.

2.2 Soil Liner System

2.2.1 Soil Liner Subgrade

Testing will be conducted by the CQC Consultant as observed by the CQA Consultant. The subgrade material below the subbase is composed of controlled fill and in situ soils. The surface of the subgrade will be prepared prior to the construction of the subbase. The CQA Consultant will visually examine the surface of the subgrade to verify that any potentially deleterious materials have been removed.

2.2.2 Soil Liner Material

The soil liner material shall be placed and compacted in accordance with the project specifications. The CQC Consultant shall conduct field density and moisture tests at the frequency presented in the project specifications. The CQA Consultant shall provide conformance tests at a frequency of approximately 10 percent of the required CQC tests. Additional CQA conformance testing may be performed at the discretion of the CQA Consultant.

Hydraulic conductivity, Atterberg limits, and percent fines testing of the soil liner material shall be performed by the CQC Consultant in accordance with the project specifications. Additional CQA conformance testing may be performed at the discretion of the CQA Consultant.

Sealed topographic surveys shall be used to document thickness requirements. Interim thickness measurement shall be conducted in accordance with the project specifications by the CQC Consultant and observed by the CQA Consultant.

2.3 Soils Testing

2.3.1 Test Methods

All testing used to evaluate the suitability or conformance of soils materials will be carried out in accordance with the project specifications.

2.3.2 Soils Testing Requirements

The soil CQC testing must comply with the minimum frequencies presented in the project specifications. The frequency of CQA testing required will be determined by the CQA Consultant in light of the potential variability of materials and the acceptance/failure rate of the CQC testing.

2.4 Soils Construction Quality Assurance

CQA will be performed on all soil components of the liner construction. CQA evaluation will consist of: (1) monitoring the work and observing the CQC testing; and (2) performing laboratory and field conformance tests. Laboratory CQA conformance tests will be conducted on samples taken at the borrow source, stockpile, and during the course of the work prior to construction. Field CQA conformance tests will be conducted during the course of the work.

2.4.1 Monitoring

The CQA Consultant shall monitor and document the construction of all soil components. Monitoring the construction work for the subbase soil and the soil component of the liner system includes the following:

- observing CQC testing to determine the water content and other physical properties of the subbase and soil component of the liner system during compaction and compilation of the data;
- monitoring the loose thickness of lifts as placed;
- monitoring the action of the compaction and/or heavy hauling equipment on the construction surface (i.e., penetration, pumping, cracking. etc.); and
- monitoring the number of passes used to compact each lift.

2.4.2 Construction Quality Assurance Judgmental Testing

During construction, the frequency of conformance testing may be increased at the discretion of the CQA Consultant when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

2.4.3 Perforations in Soil Liner

Perforations that must be filled will include, but not be limited to:

- soil density test locations;
- permeability sampling locations; and/or
- destructive thickness checks.

Unless otherwise noted, or as directed by the Project Manager, all perforations of the subbase by probes or sample tubes will be backfilled with soil in accordance with project specifications or with bentonite. The CQA Consultant will observe and confirm that adequate procedures are being employed.

2.4.4 Deficiencies

If a defect is discovered in the earthwork product, the CQC Consultant will immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQC Consultant will determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQC Consultant will define the limits and nature of the defect.

2.4.4.1 NOTIFICATION

After determining the extent and nature of a defect, the CQC Consultant will notify the Project Manager, the CQA Consultant, and Contractor and schedule appropriate retests when the work deficiency is corrected. The CQA Consultant shall observe all retests on defects.

2.4.4.2 REPAIRS AND RETESTING

The Contractor will correct the deficiency to the satisfaction of the CQA Consultant. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQC Consultant will develop and present suggested solutions to the Project Manager and CQA Consultant for approval.

The CQC Consultant must retest all areas represented by failing tests after they have been reworked by the Contractor. All retests performed by the CQC Consultant must verify that the defect has been corrected before the Contractor proceeds with additional work in the area of the deficiency. The CQA Consultant will verify that all installation requirements are met and that all submittals are provided.

3 Geosynthetic Clay Liner (GCL)

3.1 Manufacturing

The Contractor will submit a list of material properties for the purposed product to the engineer for review as a shop drawing. When the material is approved, that list shall be provided to the CQA Consultant. The Contractor will also provide the CQA Consultant with a written certification from the GCL Manufacturer along with the manufacturers QC test results. These documents should demonstrate that the materials actually delivered have properties which meet or exceed all property values specified for the GCL.

The CQA Consultant will examine all manufacturer certifications to determine if the property values listed on the certifications meet or exceed those specified for the GCL. Any deviations will be reported to the Engineer.

3.2 Labeling

The GCL Manufacturer will label all rolls of GCL in accordance with the project specifications. The CQA Consultant will examine rolls upon delivery. Any rolls labeled for other projects or that otherwise deviate from the specification or the approved shop drawings will be marked as nonconforming. All nonconforming rolls shall be immediately identified to the Contractor and then reported to the Engineer.

3.3 Shipment and Storage

During shipment and storage, the GCL will be protected as required by the project specifications. The CQA Consultant will observe rolls upon delivery at the site. Any damage to the GCL during shipment and storage should be noted. The CQA Consultant shall determine if damaged rolls may be repaired and used or discarded. Use of repaired rolls shall be documented in the CQA report.

3.4 Handling and Placement

The Geosynthetic Installer will handle the GCL in such a manner as required by the project specifications. Any noncompliance will be noted by the CQA Consultant and reported to the Engineer.

3.5 Seams and Overlaps

The GCL will be seamed or overlapped in accordance with project specifications. If both seaming and overlapping is used on discrete locations of the project, then the areas that are seamed shall be noted in the CQA report, otherwise a note stating which method was used is sufficient.

3.6 Repair

All holes or tears in the GCL will be repaired in accordance with the project specifications. The CQA Consultant will observe all repairs and note them in the CQA report.

3.7 Placement and Materials

The CQA consultant shall observe placement of all materials placed directly above a GCL and inform the contractor immediately of any actions that are degrading the quality of the GCL or the overlying material.

4 Geomembrane Liner

4.1 Geomembrane Manufacturer's Certification

Compliance testing will be performed by the Geomembrane Manufacturer to demonstrate that the product meets the manufacturers' standards and the project specifications. The manufacturer shall submit a package of certifications and the quality control test results to the Contractor. The Contractor shall distribute the package upon receipt to the CQA consultant prior to the installation of any geomembrane material.

The quality control certificate will be signed by a responsible party employed by the Geomembrane Manufacturer, such as the production manager. In addition to the end product certifications and test results, the package should include the following information.

4.1.1 Raw Material

- Resin Supplier's name and resin production plant.
- Identification (brand name and number), and production date of the resin.
- Copies of the quality control certificates issued by the Resin Supplier.
- Reports on the tests conducted by the Geomembrane Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project.
- A statement that the percentage of reclaimed polymer added to the resin is in accordance with the project specifications.

4.1.2 Rolls and Sheets

- Roll numbers and identification.
- Property sheets including, at a minimum, all specified properties, measured using test methods indicated in the project technical specifications, or equivalent.
- Sampling procedures and results of testing.

4.2 Conformance Testing

The CQA Consultant may perform additional testing for purposes of conformance evaluation. If the results of the Geomembrane Manufacturer's and the CQA Consultant's testing differ, the testing will be repeated by the CQA Consultant's laboratory, and the Geomembrane Manufacturer will be allowed to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

The CQA Consultant will review the manufacturers' documents and verify that:

- the reported property values certified by the Geomembrane Manufacturer meet all of the project technical specifications; and
- the measurements of properties by the Geomembrane Manufacturer are properly documented and that the test methods used are acceptable.

The CQA Consultant shall report any discrepancies with the above requirements to the Project Manager.

4.3 Handling, and Storage

4.3.1 Handling

The CQA Consultant will verify that:

- handling equipment used on the site is adequate, meets manufacturer's recommendations, and does not pose any risk of damage to the geomembrane; and
- the Geomembrane Installer's personnel handle the geomembranes with care.

Upon delivery at the site, the CQA Consultant will conduct a surface observation of all rolls and sheets for defects and damage. This examination will be conducted without unrolling rolls or unfolding sheets unless defects or damages are found or suspected.

The CQA Consultant will indicate to the Project Manager:

- any rolls or sheets, or portions thereof, that should be rejected and removed from the site because they have severe flaws; and
- any rolls or sheets that have minor repairable flaws.

4.3.2 Storage

The CQA Consultant will document that the Contractor's storage of the geomembrane provides adequate protection against moisture, dirt, shock, and other sources of damage or contamination.

4.4 Geomembrane Installation

4.4.1 Earthwork

4.4.1.1 SURFACE PREPARATION

The CQC Consultant and the Geomembrane Installer will certify in writing that the surface on which the geomembrane will be installed meets line and grade, and the surface preparation requirements of the project specifications. The certificate of acceptance will be given by the CQC Consultant to the CQA Consultant prior to commencement of geomembrane installation in the area under consideration. The CQA Consultant will give a copy of this certificate to the Project Manager.

To ensure a timely covering of the soil liner surface, the Project Manager may allow subgrade acceptance in areas as small as one acre. After the supporting soil has been accepted by the Geomembrane Installer, it will be the Geomembrane Installer's responsibility to indicate to the Project Manager of any change in the supporting soil condition that may require repair work. If the CQA Consultant concurs with the Geomembrane Installer, then the Project Manager will ensure that the supporting soil is repaired.

4.4.1.2 ANCHORAGE SYSTEM

The CQA Consultant will verify that anchor trenches have been constructed according to project specifications and design drawings.

4.4.2 Geomembrane Placement

4.4.2.1 FIELD PANEL IDENTIFICATION

The CQA Consultant will document that the Geomembrane Installer labels each field panel with an "identification code" (number or letter-number consistent with the layout plan) agreed upon by the CQC Consultant, Geomembrane Installer, and CQA Consultant at the CQA/CQC Preconstruction Meeting.

The Geomembrane Installer will establish a table or chart showing correspondence between roll numbers and field panel identification codes. This documentation shall be submitted to the CQC Consultant and CQA Consultant weekly for review and verification. The field panel identification code will be used for all quality control and quality assurance records.

4.4.2.2 FIELD PANEL PLACEMENT

4.4.2.2.1 Location

The CQA Consultant will verify that field panels are installed at the location indicated in the Geomembrane Installer's layout plan, as approved.

4.4.2.2.2 Installation Schedule

The CQA Consultant will evaluate every change in the schedule proposed by the Geomembrane Installer and advise the Project Manger on the acceptability of that change. The CQA Consultant will verify that the condition of the supporting soil has not changed detrimentally during installation.

The CQA Consultant will record the identification code, location, and date of installation of each field panel.

4.4.2.2.3 Placement of Geomembrane

The CQA Consultant will verify that project specification related restrictions on placement of geomembrane are fulfilled. Additionally, the CQA Consultant will verify that the supporting soil has not been damaged by weather conditions.

Wrinkles and folds shall be prevented to the extent possible and repaired when they are not prevented.

The CQA Consultant will inform the Project Manager if the above conditions are not fulfilled.

4.4.2.2.4 Damage

The CQC Consultant will visually observe each panel for damage after placement and prior to seaming. The CQC Consultant will advise the CQA Consultant which panels or portion of panels were rejected or marked for repair. Damaged panels, or portions of damaged panels, which have been rejected will be marked and their removal from the work area recorded by the CQA Consultant.

4.4.3 Field Seaming

4.4.3.1 SEAM LAYOUT

The Geomembrane Installer will provide the CQA Consultant with a seam layout drawing, i.e. a drawing of the facility to be lined showing all expected seams. The CQA Consultant and Engineer will review the seam layout drawing and verify that it is consistent with the accepted state of engineering practice and this CQA Plan. In addition, panels not specifically shown on the seam layout drawing may not be used without the Project Manager's prior approval.

A seam numbering system compatible with the panel numbering system will be agreed upon at the Resolution and/or Preconstruction Meeting. An on-going written record of the seams and repair areas shall be maintained by the Geomembrane Installer with weekly review by the CQA Consultant.

4.4.3.2 REQUIREMENTS OF PERSONNEL

The Geomembrane Installer will provide the CQA Consultant with a list of proposed seaming personnel and their experience records. This document will be reviewed by the Project Manager and the CQA Consultant for compliance with project specifications.

4.4.3.3 SEAMING EQUIPMENT AND PRODUCTS

Field seaming processes must comply with project specifications. Proposed alternate processes will be documented and submitted to the CQA Consultant for his approval. Only seaming apparatus which have been specifically approved by make and model will be used.

4.4.3.4 NONDESTRUCTIVE SEAM CONTINUITY TESTING

The Geomembrane Installer will nondestructively test all field seams over their full length using test methods approved by the project specifications. The CQA Consultant shall periodically observe the nondestructive testing to ensure conformance with this CQA Plan and the project specifications.

For approximately 10% of the noncomplying tests, the CQA Consultant will:

- observe continuity testing of the repaired areas performed by the Geomembrane Installer;
- confirm the record location, date, test unit number, name of tester, and compile the record of testing provided by the Geomembrane Installer;
- provide a walkthrough inspection of all impacted seam areas and verify that the areas have been tested in accordance with the CQA Plan and project specifications; and
- verify that the Geomembrane Installer has marked repair areas with the appropriate color-coded marking pencil.

4.4.3.5 DESTRUCTIVE SEAM TESTING

Destructive seam tests will be performed by the CQC consultant at locations and a frequency in accordance with the project specifications. The CQA Consultant will perform conformance tests on a minimum of 10% of the CQC destructive seam test samples obtained. Additional destructive seam tests may be required at the CQA Consultant's discretion. Selection of such locations may be prompted by suspicion of contamination, excessive grinding, off center and/or offset seams, or any other potential cause of imperfect seaming.

4.4.3.5.1 Geosynthetics CQA Laboratory Testing

Destructive test samples will be packaged and shipped by the CQA Consultant in a manner that will not damage the test sample. The Project Manager will be responsible for storing the archive samples. These procedures will be fully outlined at the Resolution and/or Preconstruction Meeting. Samples will be tested by the Geosynthetics CQA Laboratory.

Conformance testing will include "Seam Strength" and “Peel Adhesion" in accordance with project specifications. All geomembrane destructive test samples that fail to meet project specifications shall be saved and sent to the CQA Consultant for observation.

The Geosynthetics CQA Laboratory will provide preliminary test results no more than 24 hours after they receive the samples. The CQA Consultant will review laboratory test results as soon as they become available.

4.4.3.5.2 Defining Extent of Destructive Seam Test Failure

All defective seam test failures must be bounded by seam tests from which destructive samples passing laboratory tests have been taken. The CQC Consultant will document repair actions taken in conjunction with all destructive seam test failures.

4.4.4 Defects and Repairs

All seams and non-seam areas of the geomembrane will be examined by the CQA Consultant for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Each suspected location, both in seam and non-seam areas, will be nondestructively tested using methods in accordance with the project specifications. Each location which fails the nondestructive testing will be marked by the CQC Consultant and repaired by the Geomembrane Installer. Repair procedures will be in accordance with project specifications or procedures agreed to by the Project Manager in the Preconstruction Meeting. The CQA Consultant will observe all repair procedures and advise the Project Manager of any problems.

4.4.5 Backfilling of Anchor Trench

Anchor trenches will be will be backfilled and compacted as outlined in the earthwork specifications. The soil used to backfill the anchor trench shall meet the specifications for soil liner and placed in a manner that doesn’t stress or damage the geosynthetics. The CQA Consultant will review the backfilling operation and advise the Project Manager of any problems.

Liner edges that are constructed with run-out instead of anchor trenches (such as construction phase boundaries) will be protected with plywood sheets above the geosynthetics. Subsequent cell construction must always lap the prior certification limits such that all areas are certified to

be in conformance with the plans and specifications. The CQA consultant shall review the procedures to excavate the plywood sheet prior to extending the liner section. The entire length of seam to previously constructed areas shall be thoroughly inspected for conformance. Any liner component (soil and geosynthetic) that is damaged, whether by excavation or other cause, shall be properly repaired and inspected by the CQA consultant. Any deficiencies noted such as insufficient GCL overlaps or failing seams shall be addressed to prevent reoccurrence in the new construction.

4.4.6 Materials in Contact with Geomembranes

The quality assurance procedures indicated in this subsection are only intended to assure that the installation of these materials does not damage the geomembrane. Although protective geosynthetics and geotextiles have been incorporated into the liner system, all reasonable measures to protect the geomembrane and provide additional quality assurance procedures are necessary to assure that systems built with these materials will be constructed to ensure proper performance.

4.4.6.1 SOILS

Prior to placement, the CQA Consultant will visually confirm that all soil materials to be placed against the geomembrane comply with project specifications. The Geomembrane Installer will provide the CQA Consultant a written surface acceptance certificate. All soil materials shall be placed and compacted in accordance with project specifications.

4.4.6.2 SUMPS AND APPURTENANCES

The CQA Consultant will review:

- installation of the geomembrane in appurtenance areas, and connection of the geomembrane to appurtenances;
- that extreme care is taken while seaming around appurtenances since neither nondestructive nor destructive testing may be feasible in all of these areas;
- testing is conducted in all areas that are feasible;
- the geomembrane has not been visibly damaged while making connections to appurtenances;
- the installation of the geomembrane shall be exercised so as not to damage sumps; and

The CQA Consultant will inform the Project Manager if the above conditions are not fulfilled or observed to be in accordance with project specifications.

5 Drainage Geocomposite

5.1 Material Requirements

All HDPE drainage composite shall be manufactured in accordance with the project specifications.

5.2 Manufacturing

The drainage composite manufacturer will provide the Contractor and the CQC Consultant with a written certification, signed by a responsible party, that the drainage composites actually delivered have properties which meet or exceed the specified properties.

The CQA Consultant will examine all manufacturers' certifications to ensure that the property values listed on the certifications meet or exceed the project specifications. Any deviations will be reported to the Project Manager.

5.3 Labeling

The drainage composite manufacturer will identify all rolls of drainage composite in accordance with project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Project Manager.

5.4 Shipment and Storage

Drainage composite cleanliness is essential to its performance; therefore, the shipping and storage of drainage composite must be in accordance with the project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Project Manager.

The CQA Consultant will check that drainage composites are free of dirt and dust just before installation. The CQA Consultant will report the outcome of this review to the Project Manager; and, if the drainage composites are judged dirty or dusty, they will be washed by the drainage composite Installer prior to installation.

Washing operations will be observed by the CQA Consultant and improper washing operations will be reported to the Project Manager.

5.5 Handling and Placement

The drainage composite Installer will handle all drainage composites in a manner in accordance with the project specifications. The CQA Consultant will note any noncompliance and report it to the Project Manager.

5.6 Stacking and Joining

Adjacent drainage composites will be joined according to construction drawings and project specifications. The CQA Consultant will note any noncompliance and report it to the Project Manager.

When several layers of drainage composites are stacked, care should be taken to ensure that stacked drainage composites are placed in the same direction. A stacked drainage composite will never be laid in perpendicular directions to the underlying drainage composite unless otherwise specified by the Engineer. The CQA Consultant will observe the stacking of drainage composites and will note any noncompliance and report it to the Project Manager.

5.7 Repair

Any holes or tears in the drainage composite will be repaired in accordance with project specifications. The CQA Consultant will observe any repair, note any noncompliance with the above requirements, and report them to the Project Manager.

5.8 Placement of Soil Materials

All soil materials placed over the drainage composite should be placed in accordance with project specifications so as to ensure:

- the drainage composite and underlying geomembrane are not damaged;
- wrinkles and folds are prevented to the extent possible and repaired when not prevented;
- minimal slippage of the drainage composite on the underlying geomembrane occurs;
- the material is not exposed for longer than is allowed by the project specifications; and
- no excess tensile stresses occur in the drainage composite.

Any noncompliance will be noted by the CQA Consultant and reported to the Project Manager.

6 Earthen Drainage & Protective Components

6.1 Introduction

This section of the CQA plan addresses the earthen components of a cap or liner system that will be placed above various geosynthetics. For cap systems these components include sand and gravel drains, “erosion layers” and topsoil layers. For liner systems these components include sand drains, gravel drains, and soil buffer layers (“protective cover”). This section outlines the CQA program to be implemented with regard to materials confirmation, laboratory and field test requirements, overview and interfacing with the Contractor's CQC Program, and resolution of problems.

6.2 General Placement

6.2.1 Wrinkles and Folds in Geosynthetics

All earthen materials placed directly above a geosynthetic shall be placed by the contractor in a manner that minimizes wrinkles and folds. The CQA Consultant shall monitor placement and document any areas in which folding occurs so that the Contractor can make repairs to the geosynthetics. It may be necessary to adjust the time of day or the method of placement in order to minimize wrinkling of the geosynthetics. Failure of the Contractor to control wrinkles shall be reported by the CQA consultant to the Project Manager for resolution.

6.2.2 Abrasion and Puncture of Geosynthetics

The CQA consultant shall be aware of activities during the placement of earthen materials above the geosynthetics that may result in abrasion or puncture. The CQA consultant shall investigate any activity that is a cause for concern and shall document all investigations. The

documentation shall include a description of the activity that is causing concern; the location; a description of the damage to the geosynthetic (if any); a description of the repair; and preventative measures to be implemented to avoid future incidents of a similar nature.

Activities that may be cause for concern include:

- sharp turns;
- spinning of wheels or tracks;
- digging in placed material; and
- pushing material across a geosynthetic.

6.2.3 Equipment Separation

The CQC consultant shall check that the specified separation between equipment and geosynthetics is maintained. That CQA consultant shall observe and report any problems to the Project Manager.

6.2.4 Exposure

Some geosynthetics, especially geotextiles, degrade when exposed to ultraviolet light. The project specifications may require that these materials be covered within a certain number of days. The CQA consultant shall document when these materials are covered in a timely fashion. If current progress indicates that any materials will not be covered within the time defined in the project specifications the CQA consultant shall report that information to the Project manager and Contractor.

6.3 Sand and Gravel (granular) Drainage Material

The CQC Consultant will provide testing of the granular material at the frequency specified in the project specifications. The CQA Consultant will observe that placement of the granular material is done in a manner to protect the geomembrane, and review the gradation and density test data provided by the CQC Consultant. The CQA Consultant may conduct confirmation testing as deemed appropriate.

6.4 Soil Buffer Layer Material

The soil buffer layer material (protective cover) shall be placed in accordance with project specifications. The CQC Consultant will provide classification testing of the material at the frequency specified in the project specifications. The CQA Consultant will observe that the placement of the soil buffer is done in a manner to protect any filter geotextile or cushion geotextile and review the classification data provided by the CQC Consultant. The CQA Consultant may conduct confirmation classification testing as deemed appropriate.

6.5 Erosion Layer Material

The erosion layer shall be placed in accordance with the project specifications. The CQC Consultant will provide gradation and thickness testing of the material at the frequency specified in the project specifications. The CQA Consultant will observe that placement of the material is accomplished in a manner to protect the geomembrane and review the gradation and thickness

test data provided by the CQC Consultant. The CQA Consultant may conduct confirmation gradation and thickness testing as deemed appropriate.

6.6 Topsoil Layer Material

The topsoil layer shall be placed in accordance with the project specifications. The CQC Consultant will provide nutrient and thickness testing of the material at the frequency specified in the project specifications. The CQA Consultant will observe that placement of the material is accomplished in a manner to protect the erosion layer, and review the test data provided by the CQC Consultant. The CQA Consultant may conduct confirmation testing as deemed appropriate.

6.7 Materials Testing

6.7.1 Test Methods

All testing used to evaluate the suitability or conformance of earthen materials will be carried out in accordance with the project specifications.

6.7.2 Material Testing Requirements

Laboratory CQA conformance tests may be conducted on samples taken at the borrow source, stockpile, and during the course of work prior to construction. Field conformance tests will be conducted by the CQC during the course of the work.

The material CQC testing must comply with the minimum frequencies presented in the project specifications. The frequency of CQA testing may be adjusted by the CQA Consultant in light of the potential variability of the materials and the acceptance/failure rate of the CQC testing.

6.8 Deficiencies

If a defect is discovered in the earthwork product, the CQC Consultant will immediately determine the extent and nature of the defect and report it to the CQA Consultant. If the defect is indicated by an unsatisfactory test result, the CQC Consultant will determine the extent of the deficient area by additional tests, observations, a review of records, or other means that the CQA Consultant deems appropriate.

6.8.1 Notification

After determining the extent and nature of a defect, the CQC Consultant will notify the Project Manager and Contractor and schedule appropriate retests when the work deficiency is corrected. The CQA Consultant shall observe all retests on defects.

6.8.2 Repairs and Retesting

The Contractor will correct the deficiency to the satisfaction of the CQA Consultant. If a project specification criterion cannot be met, or unusual weather conditions hinder work, then the CQC Consultant will develop and present to the Project Manager suggested solutions for his approval.

All retests recommended by the CQC Consultant must verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The

CQA Consultant will verify that all installation requirements are met and that all submittals are provided.

7 Geotextile

7.1 Manufacturing

Compliance testing will be performed by the manufacturer to demonstrate that the product meets the manufacturers' standards and the project specifications. The manufacturer shall submit a package of certifications and the quality control test results to the Contractor. The Contractor shall distribute the package upon receipt to the CQA consultant prior to the installation of any material.

The quality control certificate will be signed by a responsible party employed by the Geosynthetics Manufacturer, such as the production manager.

The CQA Consultant will examine all manufacturer certifications to ensure that the property values listed on the certifications meet or exceed those specified for the particular type of geotextile. Any deviations will be reported to the Project Manager.

The inspection methods, handling techniques, and property values identified in the specifications for the filter geotextile shall also apply to geotextile portion of the geocomposite drainage media.

7.2 Labeling

The Geosynthetics Manufacturer will identify all rolls of geotextile in conformance with the project specifications. The CQA Consultant will examine rolls upon delivery and any deviation from the above requirements will be reported to the Project Manager.

7.3 Shipment and Storage

During shipment and storage, the geotextile will be protected as required by the manufacturer’s recommendations and the project specifications. The CQA Consultant will observe rolls upon delivery at the site and any deviation from the above requirements will be reported to the Project Manager.

7.4 Handling

The Geosynthetics Installer will handle all geotextiles in such a manner as required by the project specifications. Any noncompliance will be noted by the CQA Consultant and reported to the Project Manager.

7.5 Seams and Overlaps

All geotextiles will be seamed or overlapped in accordance with project specifications or as approved by the CQA Consultant and Engineer. The CQA consultant shall walk the material after placement to confirm that the proper methods have been used.

7.6 Repair

Any holes or tears in the geotextile will be repaired in accordance with the project specifications. The CQA Consultant shall observe any repairs and note any noncompliance with the above requirements and shall report them to the Project Manager.

7.7 Exposure

The CQA consultant shall document the placement time of the material and track the exposure time until the material has been covered. Any material that is exposed to UV radiation longer than the time allowed by the project specifications shall be reported to the Project Manager.

8 High Density Polyethylene Pipe, Manholes, and Fittings

8.1 Material Requirements

All HDPE manholes, pipe, and fittings shall be produced in accordance with the project specifications.

8.2 Quality Control

8.2.1 Manufacturer

Prior to shipment of HDPE manholes or pipes, the manufacturer shall provide to the Contractor:

- a properties sheet including, at a minimum, all specified properties, measured using test methods indicated in the project technical specifications; and
- a certification by the HDPE pipe manufacturer that values given in the properties sheet are minimum values and are guaranteed by the HDPE pipe manufacturer.

8.2.2 Verification and Identification

Prior to the installation, the Contractor will provide the Project Manager and the CQA Consultant with a quality control certification for each lot/batch of HDPE pipe provided. The quality control certificate will be signed by a responsible party employed by the HDPE pipe manufacturer, such as the Production Manger. The quality control certificate will include:

- the lot/batch number and material identification; and
- sampling procedures and results of quality control tests.

The CQA Consultant will:

- review these documents and verify that the property values certified by the HDPE pipe manufacturer meet all of the project technical specifications;
- the measurements of properties by the HDPE pipe manufacturer are properly documented and that the test methods used are acceptable;

- verify that the quality control certificates have been provided at the specified frequency for all lots/batches of pipe, and that each certificate identifies the pipe lot/batch related to it; and
- report any discrepancies with the above requirements to the Project Manager.

8.3 Nondestructive Testing

The CQA Consultant will report any nonconformance of testing methods to the Project Manager.

8.3.1 Pressure Testing

All HDPE pipe used outside of the lined area must be nondestructively tested. These pipe joints will be tested using the pressure test as provided in the project technical specifications.

8.3.2 Video Surveying

All HDPE pipe used inside the lined area is to be free of deleterious materials and obstructions. If video inspection of the pipes is the method required by the specifications to demonstrate this, the CQA Consultant shall observe the actual videoing of the pipes and immediately report any problems noted to the Contractor and Project Manager.

The CQA consultant shall review the video documentation submitted by the Contractor and compare it to the notes and repairs made to confirm that the documentation is complete and accurate.

9 Surveying

9.1 Introduction

Surveying of lines and grades is conducted on an ongoing basis during construction. Close CQC of the surveying is absolutely essential to ensure that slopes are properly constructed. The surveying conducted at the site shall be performed by the Contractor.

9.2 Goals

The survey component of the work has two major goals, to construct the work per the plans and specifications and to document the completed work for the CQA report.

9.3 Survey Control

Permanent benchmarks and baseline control points are to be established for the site at locations convenient for daily tie-in. The vertical and horizontal controls for this benchmark will be established within normal land surveying standards. All surveys should note the horizontal and vertical datums used for control.

9.4 Surveying Personnel

The Contractor's survey crew will consist of a senior surveyor and as many assistants as are required to satisfactorily undertake the work. All surveying personnel will be experienced in the provision of these services including supplying detailed, accurate documentation.

All surveying will be performed under the direct supervision of a licensed land surveyor (PLS) licensed in the state in which the project is located. The licensed land surveyor may be the senior surveyor.

9.5 Precision and Accuracy

A wide variety of survey equipment is available to meet the requirements of this project. The survey instruments used for this work should be sufficiently precise and accurate to meet the needs of the project. All survey instruments should be capable of reading to a precision of 0.01 foot and with a setting accuracy of 20 seconds. (5.6×10^{-3} degrees).

The contour intervals and confidence level of all topographic drawings shall be clearly stated on the drawing and should be appropriate for the tolerances required by the specifications.

9.6 Lines and Grades

The subgrade, top of soil liner with final surfaces shall be surveyed to verify the lines and grades achieved during construction. The survey should at least include the following.

- One or more construction baselines.
- The edges of all surface breaks (ex. toes, crests, ridges and valleys).
- All structures.
- Invert elevation of and location of all HDPE piping at each lateral intersection and endpoint, and at least every 50 feet between the intersections and endpoints.
- Inverts of sumps, manholes and other appurtenances.
- Top/toe of all berms, roads, and channels.
- Location of edge of liner, anchor trenches tie-in seam to adjacent existing liner system (as applicable).
- Major patches of HDPE liner.

Laser planes or GPS systems are highly recommended for achieving the correct lines and grades during construction of each surface.

9.7 Thickness Measurements

The CQC surveyor as a representative of the Contractor shall obtain top and bottom elevations of the soil liner and other components as required by the project specifications. Thickness verification may be done with a table or by electronic comparison of drawing files. The procedure for obtaining top and bottom elevations of the soil liner shall be agreed to by the CQA Consultant and Engineer prior to construction. The CQC surveyor shall review the survey information with the Contractor to ensure that the survey demonstrates compliance with the project technical specifications. The Contractor is responsible for identifying and reporting to the CQA Consultant any areas of non-compliance evidenced by the survey, and for repairing such areas. The CQA Consultant and Contractor shall review the thickness measurements of the soil liner component prior to placement of the geomembrane liner. The CQA consultant should notify the Project Manager of areas the need to be corrected.

9.7.1 Tabular verification

If allowed by Engineer, a thickness verification table may be compiled containing the following information for each point.

- Proposed subgrade elevation.
- Actual subgrade elevation.
- Subgrade deviation.
- Proposed soil liner elevation.
- Actual soil liner elevation.
- Soil liner thickness.
- Elevation deviation.
- Proposed cover elevation.
- Actual cover elevation.
- Cover Thickness.
- Cover Elevation deviation.

Any deviations in elevation or thickness outside the tolerances allowed by specification shall be corrected.

9.7.2 Drawing verification

Electronically compare the surfaces for thickness verification. Supply the Engineer and/or the CQA Consultant with electronic files in agreed upon common format for comparison for review. These files may be for all or a portion of the work. The reviewer shall generate a drawing illustrating the areas of noncompliance and provide it to the Contractor for acquisition of additional data points or corrective action.

9.8 Tolerances

Except for liner components where no minus tolerances are acceptable, the following are maximum tolerances for survey points.

- On surfaces: the maximum tolerances shall be 0.25 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.
- On piping for leachate collection/detection lines: the maximum tolerance shall be 0.02 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.
- On cleanout risers: the tolerance shall be 0.25 foot. This tolerance must be set to the record elevation of the surface below it and not the design elevation.

9.9 Documentation

All field survey notes will be retained by the senior surveyor. The results from the field surveys will be documented on a set of survey record (as-built) drawings by the Contractor for submittal to the CQA Consultant. The Contractor shall certify to the CQA Consultant and Engineer that the results of the survey demonstrates compliance with the contract documents. Sealed surveys depicting the information gathered shall be supplied to the Engineer and CQA Consultant in

sufficient quantities. The surveys shall depict the information in a topographic format and illustrate actual data points.

10 Documentation

An effective CQA plan depends largely on recognition of all construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Consultant will document that all quality assurance requirements have been addressed and satisfied.

This CQA plan integrates the testing and inspection performed by the CQC Consultant in accordance with the project specifications with the CQA overview and conformance testing performed by the CQA Consultant in accordance with this CQA Plan.

The CQA Consultant will provide the Project Manager with the CQC Consultant's daily and weekly reports including signed descriptive remarks, data sheets, and logs to verify that all CQC monitoring activities have been carried out. The CQA Consultant will also provide the Project Manager with a weekly report summarizing CQA activities and identifying potential quality assurance problems. The CQA Consultant will also maintain a copy of this CQA plan and a complete file of plans, reports, project specifications, checklists, test procedures, daily logs, and other pertinent documents at the job site.

10.1 Recordkeeping

The CQC Consultant's reporting procedures will include preparation of a daily report which, at a minimum, will consist of: a) field notes, including memoranda of meetings and/or discussions with the Contractor; b) observation logs and testing data sheets; and c) construction problem and solution data sheets. The daily report must be completed at the end of each CQC Consultant's shift, prior to leaving the site. This information will be submitted weekly to and reviewed by the CQA Consultant.

The CQC Consultant's weekly reports must summarize the major events that occurred during that week. Critical problems that occur shall be communicated verbally to the Project Manager or CQA Consultant immediately as well as being included in the weekly reports. The CQC Consultant's weekly report must be submitted to the CQA Consultant no later than the Monday following the week reported.

The CQA Consultant's weekly report must summarize the CQC Consultant's weekly and daily reports, CQA conformance testing activities, construction problems that occurred, and the resolution of construction problems. The CQA Consultant's weekly report should identify all potential or actual compliance problems outstanding. The CQA Consultant's weekly report must be submitted to the Project Manager on the Wednesday following the week reported.

10.1.1 Memorandum of Discussion with CQC Consultant or Geosynthetic Installer

A report will be prepared summarizing each critical discussion between the CQA Consultant and the CQC Consultant or Geosynthetic Installer. At a minimum, the report will include the following information.

- Date, project name, location, and other identification.
- Name of parties to discussion at the time.
- Relevant subject matter or issues.
- Activities planned and schedule.
- Signature of the CQA Consultant.

10.1.2 CQA Observation Logs and Testing Data Sheets

CQA observation logs and conformance testing data sheets will be prepared by the CQA Consultant on a weekly basis. At a minimum, these logs and data sheets will include the following information.

- An identifying sheet number for cross referencing and document control.
- Date, project name, location, and other identifying information.
- Data on weather conditions.
- A scale site plan showing all proposed work areas and test locations.
- Descriptions and locations of ongoing construction.
- Descriptions and specific locations of areas, or units, of work being tested and/or observed and documented.
- Locations where tests and samples were taken.
- A summary of test results.
- Calibrations of test equipment, and actions taken as a result of recalibration.
- Offsite materials received, including quality verification documentation.
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality.
- The CQA Consultant's signature.

10.1.3 CQA Construction Problem and Solution Data Sheets

CQA sheets describing special construction situations will be cross-referenced with specific CQA observation logs and testing data sheets, and must include the following information, where available.

- An identifying sheet number for cross referencing and document control.
- A detailed description of the situation or deficiency.
- The location and probable cause of the situation or deficiency.
- How and when the situation or deficiency was found or located.
- Documentation of the response to the situation or deficiency.
- Final results of any responses.
- Any measures taken to prevent a similar situation from occurring in the future.

- The signature of the CQA Consultant, and signature of the Project Manager indicating concurrence if required by this CQA Plan.

The Project Manager will be made aware of any significant recurring nonconformance with the project specifications. The Project Manager will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and any revision to procedures or project specifications will be approved by the Owner and Engineer.

10.2 CQA Photographic Reporting Data Sheets

Photographic reporting data sheets, where used, will be cross-referenced with CQA observation logs and testing data sheets and/or CQA construction problem and solution data sheets. Photographs shall be taken at regular intervals during the construction process and in all areas deemed critical.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain color prints; negatives will also be stored in a separate file in chronological order. These records will be presented to the Project Manager upon completion of the project.

In lieu of photographic documentation, video may be used to record work progress, problems, and mitigation activities. The Project Manager may require that a portion of the documentation be recorded by photographic means in conjunction with video.

10.3 Design and/or Project Technical Specification Changes

Design and/or project specification changes may be required during construction. In such cases, the CQA Consultant will notify the Project Manager and the Engineer. The Project Manager will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Project Manager and the Engineer, and will take the form of an addendum to the project specifications. All design changes shall include a detail (if necessary) and state which detail it replaces in the plans.

10.4 CQA Progress Reports

The CQA Consultant will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information.

- A unique identifying sheet number for cross-referencing and document control.
- The date, project name, location, and other identifying information.
- A summary of work activities during progress reporting period.
- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period.

- Summary of all test results, failures and retests, and signature of the CQA Consultant.

10.5 Signature and Final Report

At the completion of each major construction activity at the structural fill unit, the CQA Consultant will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, construction problems and solution data sheets. The CQA Consultant will also provide a final report which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Consultant will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the record drawings will be done by the construction surveyor. These documents will be certified by the Contractor and CQC Consultant and delivered to the CQA Consultant and included as part of the CQA documentation (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency to expedite completion and review.

10.6 Storage of Records

All handwritten data sheet originals, especially those containing signatures, will be stored by the Project Manager in a safe repository on site. Other reports may be stored by any standard method which will allow for easy access. All written documents will become property of the Owner.

Technical Specifications

Colon Mine Site Structural Fill

Charah, Inc.

Sanford, NC

November 2014
Revised December 2014

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SECTION 02110
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site clearing, tree protection, stripping topsoil and demolition.

B. Related Sections include but are not necessarily limited to:
   1. Section 02220 - Sitework.
   2. Section 02270 - Soil Erosion and Sediment Control.

1.2 QUALITY ASSURANCE

A. North Carolina Erosion and Sediment Control Planning and Design Manual, Current Edition.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing trees and other vegetation to remain outside limits of clearing against damage.
   1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
   2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
   3. Provide temporary protection as required.

B. Repair or replace trees and vegetation outside clearing limits damaged by construction operations.
   1. Repair to be performed by a qualified tree surgeon.
   2. Remove trees which cannot be repaired and restore to full-growth status.
   3. Replace with new trees of minimum 4 IN caliper.

3.2 SITE CLEARING

A. Topsoil within the limits of construction to be removed upon completion of the clearing and grubbing. Topsoil to be stockpiled in a designated area and to be paid for as part of the Clearing and Grubbing Line Item. Do not use topsoil material as structural fill.

B. Clearing and Grubbing:
   1. Clear from within limits of construction all trees not marked to remain.
      a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
   2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.

C. Disposal of Waste Materials (Non-Saleable Material):
   1. Do not burn combustible materials on site.
   2. Do not bury organic matter on site.
   3. All waste materials shall be hauled and disposed of properly.

3.3 ACCEPTANCE

A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

SECTION 02220
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork.

B. Related Sections include but are not necessarily limited to:
   1. Section 01400 – Quality Control.
   2. Section 02270 – Soil Erosion and Sediment Control.
   3. Section 02276 - Soil Liner System (Alternate Liner).
   4. Construction Quality Assurance Plan.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3).
      c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f (2,700 kN-m/m)).
      d. D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
      e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
      g. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
   2. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
   3. North Carolina Department of Transportation Standard Specification for Roads and Structures, current edition.

B. Employ a Geotech Engineer and laboratory to conduct the specified tests to assure that all work complies with this Specification.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Certifications.
   3. Test reports:
      a. Soils inspection and testing results.

B. Samples:
   1. Submit samples and source of fill and backfill materials proposed for use.
   2. Submit samples and source of borrow materials proposed for use.
   3. Submit soil samples directly to soils laboratory with notification to the Engineer.

1.4 SOILS/GEOTECHNICAL

A. The Soils Engineer will selectively test materials and monitor compliance with the requirements of these Specifications.

B. The Contractor will afford these representatives access to the job site for the performance of their duties as described in the Contract Documents.

C. General Duties and Responsibilities of the Contractor's Geotech Engineer: Under the direction of a qualified registered engineer or geologist:
   1. Perform stockpile and in-place testing of all soil and rock materials used in the work in conformance with these Specifications and the CQA Plan.
   2. Inspect subgrades and excavations and evaluate/determine suitability of materials encountered. Determine extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction.
   3. Document placement of fill materials and perform testing to confirm compliance with these Specifications.
   4. Evaluate the suitability of existing on-site materials for use in construction of embankments and fills within the proposed grading shown on the Contract Drawings.
   5. Measure quantity of unsuitable materials under contract provisions for authorized overexcavation and backfill.

D. General Duties and Responsibilities of the Engineer:
   1. Approve materials proposed for incorporation into the work by the Geotech Engineer.
   2. Review subgrades and excavations and approve suitability of materials encountered as proposed by the Geotech Engineer. Approve extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction, as proposed by the Geotech Engineer.
   3. Review placement of fill materials and testing by Geotech Engineer for compliance with these specifications.
   4. Review/approve the suitability of existing on-site materials for use in construction of embankments and fills.
   5. Review construction operations and monitor for compliance with Contract Documents.
   6. Review/approve Geotech Engineer quantity of unsuitable materials for payment on a unit price basis under contract provisions for authorized overexcavation and backfill.

E. Available Subsurface Information: Data provided in these specifications on subsurface soil conditions are not intended as representations or warranties of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that neither the Owner nor the Engineer will be responsible for any interpretation or conclusion drawn therefrom by the Contractor. Data is made available for the convenience of the Contractor.

F. Additional or supplementary soil borings or other exploratory operations may be made by the Contractor. The Contractor shall provide a copy of any data obtained/developed during such work. Such additional work shall be performed in a timely manner in accordance with and not impacting or changing the project schedule set forth in the Contract Documents.

1.5 TOLERANCES

A. Grading shall be to a tolerance of + 0.25 FT unless otherwise noted in the construction documents and then the stricter criteria shall be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill: Selected material approved by Engineer and Owner from site excavation or other approved source.

B. The Contractor shall conduct his own quantity and quality investigations and testing to determine availability and suitability of (on-site and/or off-site) borrow materials, as allowed by the Owner.

C. All earth materials proposed for use in the Work shall be adequately characterized prior to the Work by the Geotech Engineer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain benchmarks, monitoring wells, existing structures, monuments, or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of controlling agency.
   3. Verify location of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data.
      a. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      b. Repair damages to utility items at own expense.
      c. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
   5. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

B. Construct erosion and sedimentation controls prior to beginning earthwork.

3.2 SITE EXCAVATION AND GRADING

A. The Work includes all operations in connection with excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. Excavation and Grading: Perform as required by the Contract Drawings.
   1. Contract Drawings may indicate both existing grade and finished grade required for construction of Project. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations. Perform other layout work required. Replace property corner markers to original location if disturbed or destroyed.
   2. Preparation of ground surface for embankments or fills: Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
   3. Protection of finish grade: During construction, shape and drain embankment and excavations. Maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work. Re-establish grade where settlement or erosion occurs.

C. Borrow: Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification. Fill material to be approved by Soils Engineer prior to placement.

D. Construct embankments and fills as required by the Contract Drawings:
   1. Construct embankments and fills at locations and to lines of grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.

2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 3 IN are not placed in upper 6 IN of fill or embankment. Do not place material in layers greater than 8 IN loose thickness. Place layers horizontally and compact each layer prior to placing additional fill.
3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer necessary to meet requirements of compaction.

E. Upon reaching subgrade elevations shown, proofroll subgrade soils and obtain the Geotech Engineer's review/recommendation and approval. If unsuitable materials are encountered at the subgrade elevation, repair as directed by the Geotech Engineer to remove unsuitable materials. Excavation of 1 cy or greater should be preapproved by the Geotech Engineer.

F. Proofrolling shall be conducted with a pneumatic-tired vehicle of at least 20 tons Gross Vehicle Weight (GVW), approved by the Geotech Engineer. An alternate method may be approved by the Geotech Engineer may be used in constricted areas.

G. Where subgrade materials are determined to be unsuitable, such materials shall be removed to the lengths, widths, and depths directed by the Geotech Engineer and backfilled with suitable material unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 6 IN or less than the finished subgrade. Payment for unsuitable material excavation greater than 6 IN beneath the finished subgrade shall be negotiated.

H. The subgrade of areas to receive fill shall be smooth and free of all vegetation, sticks, roots, rocks, and debris.

I. Dewatering (as required): Provide and maintain dewatering of all surface water and/or groundwater as required for excavation.

J. Do not place fill when the subgrade is frozen, wet, loose, or soft.

K. Moisture control:
1. Moisture content of materials prior to, and during compaction, shall be uniform throughout each layer of material.
2. Granular materials shall be thoroughly wetted during or immediately prior to compaction.
3. Supplementary water shall be added as required to materials by sprinkling and mixing uniformly throughout layer.
4. Materials too wet for placing shall be temporarily spread or aerated until moisture content is acceptable. If these materials cannot be processed in time to use, the Contractor shall find alternatives acceptable to the Geotech Engineer.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive must be in compliance with 3.4 of this Section.

3.4 ROCK EXCAVATION

A. Rock is defined as natural material that cannot be moved or ripped with a Caterpillar D8N (or newer version) equipped with a single tooth ripper or approved equal. A demonstration is required. The Contractor shall not remove rock until authorized by the Engineer.

B. All rock excavation shall be under one classification. This classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, and/or blasting for its removal and also boulders that exceed 1 CY in volume.

C. The use of explosives shall be limited to the magnitude and location of the charge that will not cause damage to adjacent existing construction and utilities through shock vibrations or other stress loadings. Provide adequate blanket protection to ensure that there will not be fragments of rock or other debris flying through the air when discharging explosives. Any damage to existing

construction or other features caused by blasting operations to be repaired and paid for by Contractor.

1. Explosive permits shall be obtained from the appropriate local authorities.

D. Where explosives and blasting are used, comply with all laws and ordinances of municipal, state and Federal agencies relating to the use of explosives. Use qualified personnel for blasting and take proper precautions to protect persons, property or the work from damage or injury from blast or explosion. Conduct preblast survey in the company of the Geotech Engineer to aid in determining any damage caused by blasting.

3.5 FIELD QUALITY CONTROL

A. Moisture density relations, to be established by the Geotech Engineer are required for all materials to be compacted.

B. Extent of compaction testing will be as necessary to assure compliance with Specifications.

C. Give minimum of 24 HR advance notice to Geotech Engineer when ready for compaction or subgrade testing and inspection.

D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.

E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

3.6 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft, material and replace with approved material as directed by Soils Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:
Sitework:

SOIL TYPE	COMPACTION DENSITY
Cohesive Soils	95 percent, ASTM D698
Cohesionless Soils	75 percent relative density per ASTM D4253 and D4254
Structural Fill Under Slabs-On-Grade	75 percent relative density per ASTM D4253 and D4254
Stockpile Material	90 percent, ASTM D698

2. Perform testing at a minimum frequency of 1 test per lift per 10,000 square feet for structural fill.

3.7 SPECIAL REQUIREMENTS

A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed off site. Clean streets daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

END OF SECTION

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SECTION 02240
LEACHATE COLLECTION STONE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Operational Cover.
   2. Leachate collection stone.

B. Related Sections Include But Are Not Necessarily Limited To:
   1. Section 01400 – Quality Control.
   2. Section 02220 – Earthwork.
   3. Section 02275 – Soil Liner System (Standard Liner).
   4. Section 02276 – Soil Liner System (Alternate Liner).
   5. Section 02775 – HDPE Geomembrane Liner System.
   6. Section 02778 – Geotextiles.
   7. Section 15067 – Pipe: High Density Polyethylene (HDPE).
   8. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards
   1. American Society for Testing and Materials:
      a. C117 or C136 - Particle Size Analysis.
      b. D2434 - Permeability of Granular Soils.
      c. D4373 - Calcium Carbonate Content of Soils.
      d. D5084 - Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
   2. North Carolina Department of Transportation (NCDOT), Standard Specifications for Roads and Structures current edition.

1.3 SUBMITTALS

A. Shop Drawings:
   1. At least four weeks prior to construction of the leachate collection layer, submit a bulk sample of each material from each source to the Geotech Engineeer for testing and forward results to Engineer for approval.

B. Miscellaneous Submittals.

C. Submit all required laboratory test data as required by Subparts 2.1 and 3.2 for materials used in the construction.
   1. Submit periodic surveys of each layer during construction for thickness verification. Frequency of survey submittals to be established between Contractor and Engineer prior to placement. Follow the CQA plan for surveying requirements.

1.4 JOB CONDITIONS

A. Take necessary precautions to protect synthetic liner from damage due to any construction activity. Repair damages to liner at own expense. Assess no cost to Engineer or auxiliary party for any damages to liner system or pipe resulting from placement of stone or activities of equipment operating on stone.

B. Protect and maintain benchmarks, monuments, or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling agency.

1.5 TOLERANCES

A. Materials shall be placed to the lines and grades as shown on the Contract Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material: Submit source test data to the Engineer prior to delivery to the site.
   1. Free of roots, sod or other organic matter, and frozen material.
   2. Materials must meet acceptance criteria presented in 3.2 of this Specification.
   3. Materials may be natural or manufactured.

B. Interface Friction Tests:
   1. Test materials using ASTM D 5321. Section 01060-Special Conditions, paragraph 2.1, outlines the conditions under which this material shall be tested at Contractor's expense.
   2. This material is part of a system. The system shall meet the requirements before the component materials can be deemed acceptable.

PART 3 - EXECUTION

3.1 GENERAL

A. The leachate collection stone is placed directly over the liner system; thus, extreme caution shall be exercised by the Contractor to prevent damage to the liner system materials.

B. Placement of these materials within the cell shall be conducted only when the Geotech Engineer or his representative is present at the site and informed in advance of the intent to complete this work.

C. Exercise care in maintaining a true line and grade an all piping during placement and spreading of the material.

D. Place materials over the Geomembrane only after areas have been released by the Geomembrane Installer and the CQA/CQC Consultants. The materials shall be placed as specified below.
   1. All materials shall be placed and spread with low ground pressure equipment (6 psi ground pressure or less) as approved by the Engineer to reduce potential damage to the Geomembrane. The Geomembrane surface shall be off limits to construction traffic. Hard turning of tracked equipment on the stone must be avoided.
   2. At least 24 IN of separation between the Geomembrane and all low ground pressure equipment shall be maintained.
   3. Material shall not be placed over standing water or ice.
   4. Material shall not be compacted within the cell limits.
   5. Material on slope shall be placed from the bottom to top of the slope.

E. The leachate collection stone shall be spread in a manner that minimizes development of folds in the Geosynthetics. Any portions of the Geosynthetics that develop a fold shall be repaired by the Contractor.
   1. If during spreading, excessive wrinkles develop, the Contractor shall adjust placement and spreading methods, or cease until the Geomembrane cools and wrinkles decrease in size.
   2. Wrinkles that exceed approximately 6 IN in height and cannot be eliminated by amended placement and spreading methods shall be cut and repaired by the Geomembrane Installer in a method approved by the CQA/CQC Consultants.

F. Any damage to the underlying soil, Geomembrane liners or Geotextiles shall be repaired in accordance with the applicable Section of these Specifications.

G. Stockpiling of materials within the limits of the cell shall be subject to advanced approval by the CQA/CQC Consultants. Any hauling equipment (dump trucks, etc.) operating within the cell limits, including access ramps, shall have a minimum of 3 FT. of separation between the vehicle wheels and the Geomembrane.

H. Any areas where unauthorized or tracked equipment has operated over the leachate collection system shall be subject to investigation for potential Geomembrane damage. Such investigations may include removal of overlying materials in the affected areas and visual inspection of the Geomembrane. These activities shall be conducted under direction by the CQA/CQC Consultants .

3.2 QUALITY CONTROL

A. The CQC Consultant shall perform testing of the materials.

B. Ensure CQA Consultant has at all times immediate access for the testing of all related work.

C. Assure by results of CQC testing that materials and installation comply with the following requirements:

Required Test	Minimum Frequency	Leachate Collection Stone
1. Gradation – ASTM D422	1 per 3,000 CY or portion thereof	NCDOT #57
2. Permeability, K – ASTM D5084 or D2434	1 per 3,000 CY or portion thereof	$K \geq 1$ cm/sec
3. Carbonate Content – ASTM D3042	1 per material source	15% by weight
4. Thickness	Minimum need for sealed survey	As specified

D. Permeability testing shall be performed for all materials listed above.

END OF SECTION

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SECTION 02270
SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil erosion and sediment control.

B. Related Sections include but are not necessarily limited to:
   1. Division 1 - General Requirements.
   2. Section 02110 – Site Clearing.
   3. Section 02220 – Earthwork.
   4. Section 02270 – Soil Erosion and Sediment Control.
   5. Section 02485 – Seeding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
   2. North Carolina State Department of Transportation Standard Specifications for Roads and Structures Construction, current edition.

1.3 SITE CONDITIONS

A. The Contractor shall protect all streams, creeks, and drainage features from sediment laden runoff.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stone for Stone Filter: 2 IN graded gravel or crushed stone.

B. Grass Seed: Refer to Section 02485, Seeding.

C. Silt Fence: Premanufactured or constructed on site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to Generally Stripping Topsoil, Tree Clearing, and Excavating:
   1. Install silt fence, ditches, and channels.
   2. Excavate and shape sediment basins and traps.
   3. Construct pipe spillways and install stone filter where required.
   4. Machine compact all berms, dikes, and embankments for basins and traps.
   5. Refer to the construction sequence on the plans for further detail.

B. Temporarily seed basin slopes and stockpiles:
   1. Rate: See Section 02485 - Seeding.
   2. Reseed as required until good stand of grass is achieved.

3.2 DURING CONSTRUCTION PERIOD

A. Maintain Basins, Dikes, Traps, Stone Filters, Straw Bales, Etc.:
   1. Inspect regularly especially after rainstorms.
   2. Repair or replace damaged or missing items.

B. After rough grading, sow temporary grass cover over all exposed earth areas not draining into sediment basin or trap.

C. Provide necessary swales and dikes to direct all water towards and into sediment basins and traps.

D. Do not disturb existing vegetation (grass and trees).

E. Excavate sediment out of basins and traps when capacity has been reduced by 50 percent.

F. Topsoil and Fine Grade Slopes and Swales, Etc.:
   1. Seed and mulch as soon as areas become ready.

G. Clean streets and roads daily of any spillage of dirt, rocks, or debris from equipment entering or leaving the site.

3.3 NEAR COMPLETION OF CONSTRUCTION

A. Grade to finished or existing grades.

B. Fine grade all remaining earth areas, then seed and mulch.

END OF SECTION

SECTION 02271
STONE REVETMENT (RIP RAP)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Furnish all labor, materials, tools, equipment and services for all stone revetment (rip rap) for protection of earthen slopes against erosion as indicated, in accord with provisions of Contract Documents.
   2. Completely coordinate with work of all other trades.
   3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.
   4. Work required in project includes but is not necessarily limited to:
      a. Drainage Channels.
      b. Sediment Basins.
      c. Spillways.

B. Related sections include but are not necessarily limited to:
   1. Section 02110 – Site Clearing.
   2. Section 02220 – Earthwork.
   3. Section 02270 – Soil Erosion and Sediment Control.

1.2 QUALITY STANDARDS

A. Obtain samples in conformance with Corps of Engineers Specification CRD C 100-64 or other approved method.

B. Source Tests: Supply certified tests and service records to determine acceptability and application of stone materials. In event suitable test reports or a service record that is satisfactory are not available, as in case of newly operated sources, subject material to tests necessary to determine its acceptability for use. Tests to which materials may be subjected include but are not necessarily limited to:
   1. Petrographic analysis.
   2. Specific gravity.
   3. Abrasion.
   4. Absorption.
   5. Wetting and drying.
   6. Soundness in magnesium sulfate.
   7. Freezing.
   8. Thawing.
   9. Such other tests as may be considered necessary to demonstrate satisfactorily that materials are acceptable.

C. Material acceptability tests:
   1. Initial test: On material from each ledge sampled, prior to start of construction:
      a. Bulk specific gravity.
      b. Soundness in magnesium sulfate solution.
      c. Soundness in freezing and thawing.
   2. Control tests: Perform control tests including one specific gravity, one soundness in magnesium sulfate solution test, and one soundness in freezing and thawing test for each type of stone protection material for every 1,000 tons of material.

D. Specific gravity test: ASTM C127.

1. Not less than 2.40 min.

E. Soundness in magnesium sulfate solution test: ASTM C88, except maintain samples immersed in solution at a temperature of 80 degF (26 degC) plus or minus 2 deg.
   1. Loss at 5 cycles: Not more than 12 percent.

F. Soundness of aggregates in freezing and thawing test:
   1. Ensure loss at 12 cycles of not more than 10 percent.
   2. Modify and use AASHTO Designation T 103 Method.
   3. Maintain temperature of cold liquid in range of -5 to 0 degF (-20 to -18 degC).
   4. Maintain thaw fluid temperature in range of 45 to 50 degF (7 to 10 degC).
   5. Permit length of freezing and of thawing cycles of two hours with one hour of freezing following by one hour of thawing.
   6. Perform thawing by circulating thaw fluid around pan containing stone immersed in a depth of 1/4 IN (6 mm) rather than by total immersion.

1.3 SUBMITTALS

A. Shop Drawings.
   1. Supplier's certification of all materials.
   2. Submit all tests and certification in a single coordinated submittal. Partial submittals will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stone: Approved durable broken stone quarry run.
   1. Durable and of such quality that it will not disintegrate on exposure to water or weathering and free from structural fractures and defects.
   2. Not containing shale, unsound sandstone, or other material which will readily disintegrate.
   3. Graded within limits specified.
   4. Neither breadth nor thickness of any stone less than one-third of its length.
   5. Ensure that dirt and fines accumulated from interledge layers or from blasting or handling operation is less than 5 percent by weight.
   6. The gradation of the material shall be well-graded from small to large of the sizes as indicated on the plans or as directed by the Engineer. The rock shall be sized so as to permit its interlocking.

PART 3 - EXECUTION

3.1 PREPARATION

A. Trim and dress all areas to conform to the Plans as indicated with tolerance of 3 IN from indicated slope lines and grades.

B. Bring areas that are below allowable minus tolerance limit to grade by filling with embankment material similar to adjacent material.

C. Compact to density specified for backfill.

D. Do not place any stone material on prepared base prior to inspection and approval to proceed.

E. Lay geotextile fabric prior to placing rip rap.

3.2 PLACING RIP RAP

A. Place dumped riprap on prepared foundation within limits indicated.

B. Place on prepared base to produce a well-graded mass of rock with minimum practicable percentage of voids, to required thickness and grades.

C. Place to full thickness in a single operation to avoid displacing the underlying material.

D. Distribute larger stones and entire mass in final position, roughly graded to conform to approximate gradation specified.

E. Keep finished rip rap free from objectionable pockets of small stones or clusters of larger stone.
   1. Hand place and rearrange individual stones as necessary to obtain a reasonably well-graded distribution.

F. Ensure a final tolerance of within 3 IN (75 mm) from indicated grade lines.
   1. Neither tolerance extreme continuous over an area greater than 200 SQ/FT (20 SM).

G. Distribute stones throughout mass either by selective loading at quarry or by controlled dumping of successive loads during final placing or by a combination of these methods.
   1. Do not place stone by dumping into chutes or by similar method likely to cause segregation.

H. Place stone revetment (rip rap) in conjunction with embankment construction at toe of revetment as necessary to prevent mixture of embankment and stone protection materials.
   1. Maintain stone revetment until accepted.
   2. Replace any displaced material to lines and grades shown.

END OF SECTION

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SECTION 02276
SOIL LINER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Soil used within structural fill footprint.

B. Related Sections include but are not necessarily limited to:
   1. Section 02110 - Site Clearing.
   2. Section 02220 - Earthwork.
   3. Section 02775 - HDPE Geomembrane Liner System.
   4. Section 02800 - Geosynthetic Clay Liner.
   5. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Reference Standards:
   1. ASTM - American Society for Testing and Materials:
      a. ASTM D-422 - Particle Size Analysis.
      b. ASTM D-698 - Standard Proctor.
      c. ASTM D-854 - Specific Gravity.
      d. ASTM D-1140 - Fines Content in Soils.
      e. ASTM D-1556 - In-situ Density Measurement Using the Sand Cone.
      f. ASTM D-1557 - Modified Proctor.
      g. ASTM D-2166 - Unconfined Compressive Strength.
      h. ASTM D-2216 - Moisture Content Using Over-Dry Method.
      i. ASTM D-2487 - Soils Classification.
      j. ASTM D-2573 - Field Vane Shear Test.
      k. ASTM D-2922 - In-situ Density Using Nuclear Methods.
      l. ASTM D-3017 - In-situ Moisture Content Using Nuclear Methods.
      m. ASTM D-4318 - Atterberg Limits.
      n. ASTM D-5084 - Flexible Wall permeameter.
   2. USEPA - United States Environmental Protection Agency
      a. EPA/600/R-93/182 -"Quality Assurance and Quality Control for Waste Containment Facilities," September, 1993.
   3. ASCE – American Society of Civil Engineers.
      a. ASCE Paper No. 25333 – Water Content – Density Criteria for Compacted Soil Liners (Daniel et at, 1998).
      b. ASCE Paper No. 23827 – In-Site Hydraulic Conductivity for Compacted Clay (Daniel et at, 1989).
   4. Construction Quality Assurance (CQA) Plan.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Borrow Source Characterization Study (BSCS).

B. Miscellaneous Submittals:
   1. Soil Liner Test Strip Report sealed by a professional engineer licensed in North Carolina, within 14 days of obtaining the last sample.
   2. Submit periodic surveys during construction for thickness verification. Schedule of survey to be established between Contractor and Engineer prior to placement.

3. Periodic reports of field and lab tests prior to placement of any HDPE in a given area. All applicable reports must be submitted for review.
4. As-built survey with thickness verification table. Refer to Section 01060 for survey requirements.
5. Comprehensive report of field and laboratory tests sealed by a professional engineer licensed in North Carolina, within 14 calendar days of completion of HDPE liner placement. Typed report to include:
    a. Method and equipment used to install the material.
    b. Confirmation the material delivered to the site meets the requirements of this specification.
    c. Daily field logs.
    d. Number of test required, performed, and failed.
    e. Date test performed.
    f. Remedy for failed tests.
    g. Site plan with location of tests.
    h. Field test results with summary log.
    i. Laboratory test results with summary log.
6. Certify the Work is constructed to the specified tolerances with sealed surveys to support the certification.
7. Certify that borrow material is not contaminated with hazardous materials or hazardous wastes.

1.4 JOB CONDITIONS

A. Verify conditions of subgrade prior to commencing work.

B. In accordance with these Specifications, the Contractor is responsible for conducting a borrow soil characterization study (BSCS).

C. Contractor shall provide the CQA Consultant and Owner access to information about the borrow source of the low permeability soil.

1.5 TOLERANCES

A. The soil liner system must meet the following tolerances:
1. The saturated hydraulic permeability of the soil liner must be equal to or less than 1.0×10^{-5} cm/sec, as determined by ASTM D5084.
2. The thickness of the soil liner must be equal to or greater than 18 inches. Any excess shall be below the elevation defined by the finished grade tolerance.
3. The work should be constructed to lines, grades, as defined by the control points indicated on the Drawings. Laser based grading systems are recommended.
4. Finished grade tolerance; design proposed grade to plus 0.25 FT.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Low Permeability Soil - General:
1. Contractor shall provide natural, fine-grained soil or bentonite amended soil that is capable of being worked to produce a soil layer of thickness shown on the Drawings that meets the hydraulic conductivity requirements.
2. The soil shall be relatively homogeneous in color and texture and shall be free from roots, stones, foreign objects, and other deleterious materials.

3. Some soils not meeting the requirements of B.1. and B.4. below, may be acceptable for use in the Work at the sole discretion of the Engineer. The contractor may submit data on soils for the Engineer's review. For the Engineer to approve the materials, the submittal should contain: a statement signed by a qualified professional Engineer that the proposed soils will meet the hydraulic conductivity requirement and are otherwise suitable for use in the Work; and, supporting geotechnical test results and data.
4. All soils must be approved for use by the Engineer prior to use in the Work.

B. Natural Fine-Grained Soil
1. Classification: Natural fine-grained soil shall have a classification of SC, SM, CH, CL, MH, or ML as determined by ASTM D2488.
2. Grain sizes shall be within the following gradation:

Sieve Size	Percent Passing by Weight
3/4 IN	100
No. 4	> 90
No. 200	> 30

3. Hydraulic Conductivity: The saturated hydraulic conductivity of the natural fine-grained soil shall meet the stated tolerances, when compacted in accordance with requirements established by the CQC Consultant and Contractor on the basis of the soil liner test strip as specified herein.
4. Other Soil Liner Properties:
   a. The liquid limit shall be at least 25 as measured by ASTM D4318.
   b. The plasticity index shall be at least 10 and less than 30 as measured by ASTM D4318.

C. Bentonite Amended Soil (where applicable):
1. Hydraulic conductivity of constructed bentonite amended soil shall meet the tolerances when compacted in accordance with requirements established by the CQC Consultant on the basis of test results from the soil liner test strip and the borrow soil characterization study.
2. Soil used in the bentonite amended soil shall be free from roots, organic matter, debris, particles larger than 3/4 IN, and other deleterious material. All soil used in the bentonite amended soil shall be taken from a borrow area approved by the CQA Consultant and Engineer.
3. Unless approved otherwise by the CQA Consultant, the soil used in the bentonite amended soil shall meet the following washed sieve gradation:

Sieve Size	Percent Passing by Weight
¾ IN	100
No. 4	55-100
No. 20	45-75
No. 200	10-40

4. Bentonite:
   a. Bentonite shall be free-flowing, powdered, high-swelling, sodium montmorillonite clay (bentonite) free of additives.
   b. Acceptable bentonite manufacturers are:
      1) American Colloid Co., (800) 276-2737.
      2) Bentonite Performance Minerals, LLC (281) 871-7900.
      3) WYO-BEN, Inc. (800) 548-7055.
      4) Approved equal.
   c. The Contractor may propose a bentonite supplier other than those listed above if it is demonstrated that its use in the amended soil satisfies the requirements of these Specifications.

D. Permeability Test
   1. Laboratory permeability tests (ASTM D-5084) shall be conducted in constant head, triaxial type permeameters. The specimens shall be consolidated under an isotropic effective consolidation stress not to exceed 10 psi for base liner. The inflow to and outflow from the specimens shall be monitored with time and the coefficient of permeability calculated for each recorded flow increment. The test shall continue until steady state flow is achieved and relatively constant values of coefficient of permeability are measured.

E. Interface Friction Tests.
   1. Test materials using ASTM D 6243. Consult with the Design Engineer to determine the required interface friction and the conditions under which this material shall be tested.
   2. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

2.2 SOIL LINER MATERIAL ACCEPTANCE

A. General: All imported, on-site, and processed materials specified in this Section are subject to the following requirements:
   1. All tests necessary for the Contractor to locate and define acceptable sources of materials shall be made by the CQC Consultant. Certification that the material conforms to the Specification requirements along with copies of the test results from a qualified commercial testing laboratory shall be submitted to the CQA Consultant for approval at least 10 days before the material is required for use. All material samples shall be furnished by the Contractor at the Contractor's sole expense.
   2. All samples required in this Section shall be representative and be clearly marked to show the source of the material and the intended use on the project. Sampling of the material source shall be done by the CQC Consultant in accordance with ASTM D75.
   3. Notify the CQA Consultant at least 24 hours prior to sampling so that they may observe the sampling procedures.
   4. Tentative acceptance of the material source shall be based on an inspection of the source by the CQA Consultant and the certified test results of the Borrow Source Characterization Study (BSCS) as submitted by the CQA Consultant to the Engineer. No imported materials shall be delivered to the site until the proposed source and materials tests have been accepted in writing by the Engineer.
   5. Final acceptance of any material will be based on results of tests made on material samples taken from the completed soil liner test strip, combined with the results of the BSCS. If tests conducted by the CQA/CQC Consultant indicate that the material does not meet Specification requirements, material placement will be terminated until corrective measures are taken. Material which does not conform to the Specification requirements and is placed in the work shall be removed and replaced.
   6. Contractor shall be solely responsible for obtaining all permits required to obtain acceptable sources of materials for use in the work.

B. Sampling and testing required herein shall be done at the Contractor's sole expense.

C. Borrow Source Characterization Study:
   1. The Contractor will be responsible for all processing and screening of the soil liner material at his own cost to meet the requirements of the Specifications. The Contractor will be responsible for the erosion protection of the stockpile and borrow area during his operation. The Contractor shall coordinate all aspects of this operation with the CQA/CQC Consultants and Engineer.
   2. CQC Consultant shall complete a BSCS of natural fine-grained soils or of soil that will be used in bentonite amended soils.
   3. Contractor shall conduct tests, including particle size, Atterberg limits, moisture-density, and hydraulic conductivity tests, as necessary to locate an acceptable source of material.
   4. Once a potential source of material has been located, the CQC Consultant shall develop and undertake a testing program to demonstrate the acceptability of the proposed material.

Certified results of all tests shall be submitted to the Engineer upon completion of tests. Tentative acceptance of the borrow source by the Engineer will be based upon the results of the study. The testing program shall include the following elements, at a minimum:

a. An excavation plan for the borrow source indicating proposed surface mining limits and depths of samples to be taken for testing.
b. Test pits for borrow source sampling shall be appropriately spaced to reflect site geomorphology and sampled at depth intervals appropriate to the proposed excavation methods.
c. A minimum of one (1) sample shall be collected per 15,000 cy and tested for the parameters required as described in the following paragraphs.

5. Test Parameters and Reporting for Natural Fine-Grained Soils: All samples collected from the proposed borrow area for natural fine-grained soils shall be tested for the following parameters:

Parameter	Test Method
Particle Size (sieve plus hydrometer)	ASTM D422
Atterberg Limits	ASTM D4318
Standard Proctor	ASTM D698
Hydraulic Conductivity(1)	ASTM D5084

(1) Hydraulic conductivity tests shall be performed on recompacted samples of the proposed material, compacted according to criteria developed by the Geotech Engineer using data from tests conducted in accordance with ASTM D698.

6. Test Parameter for Soil to be Used in Bentonite Amended Soil:
   a. Parameters and reporting for soils to be used in bentonite amended soil shall be the same as for natural fine-grained soil.
   b. Tests required under this paragraph are part of the BSCS. Additional tests on the bentonite amended soil product are required for soil liner acceptance. See 2.1E.

D. Bentonite Amended Soil Conformance Testing (where applicable):
1. Following acceptance of a source for soils to be used in bentonite amended soils, the Geotech Engineer shall perform a Design Mix Analysis and submit certifications for the imported bentonite material as described below.
2. Design Mix Analysis:
   a. Collect two of the coarsest samples of the soil taken from the approved borrow area (based on percent retained on #200 sieve). Soil samples for testing shall be at least 100 pounds each.
   b. Trial mix samples shall be prepared by mixing each soil sample with three trial application rates of bentonite. Compact each trial mix sample to a dry density equal to 95 percent relative compaction and at a moisture content within the range of optimum to optimum plus 3 percent (ASTM D-698) for the unamended soil.
   c. Test the hydraulic conductivity of the trial mix samples using ASTM D5084 and report all data to Engineer. Graph measured hydraulic conductivity vs. percent bentonite.
   d. Contractor shall select a minimum bentonite content needed to consistently achieve the required in-place hydraulic conductivity.
3. After mix design and initial testing, Geotech Engineer shall conduct tests of the mixed bentonite amended soil, after it has been discharged from the pugmill and before this is placed in the work using the following methods and at the following frequencies.

Test	Method	Minimum Frequency
Standard Proctor	ASTM D698	1 per 10,000 cu yd

4. Bentonite: Submit certifications from the supplier of the bentonite material that it meets the specified requirements.

E. Fine-Grained Material Dewatering, Mixing, and Staging
   1. Dewatering of soil liner borrow excavations, if required, shall be solely at the Contractor's expense.
   2. Drying, blending, or wetting required to maintain the soil liner soil at a suitable moisture content shall be solely at the Contractor's expense.

2.3 EQUIPMENT

A. Compaction Equipment:
   1. The compaction equipment shall be of a suitable type, adequate to obtain the permeability specified, that provides a kneading action, such as a wobble-wheeled roller or a sheepsfoot roller having tines as long as the maximum loose lift thickness to ensure proper lift interface compaction free of voids.
   2. The CQC Consultant shall confirm compaction equipment adequacy, and recommend changes if required, based on the soil liner test strip.
   3. The compaction equipment shall be maintained and operated in a condition that will deliver manufacturer's rated compactive effort.
   4. Hand-operated equipment shall be capable of achieving specified soil densities.
   5. The finished surface of the final lift shall be rolled with a smooth steel drum roller or rubber-tired roller to eliminate tine or roller marks and provide a smooth, dense surface for geomembrane placement.

B. Moisture Control Equipment:
   1. Equipment for applying water shall be of a type and quality adequate for the work, shall not leak, and shall be equipped with a distributor bar or other approved device to assure uniform application.
   2. Equipment for mixing and drying out material shall consist of blades, discs, or other equipment defined by the CQC Consultant and approved by the CQA Consultant.
   3. Mixing of natural fine-grained soils may also be required to get even distribution of moisture.
   4. Soil liner material must not be compacted within 24 hours of the adjustment of water content by the addition of water.

C. Bentonite Amended Soil Mixing Equipment (where applicable):
   1. Contractor shall mix, process, and condition the bentonite amended soil in a pugmill prior to placing and compacting the mixture.
   2. The pugmill shall have the capability to break up soil clumps and mix material to form a homogeneous blend. The pugmill shall have controls that allow a variable rate of discharge from it, to control the degree of mixing. The pugmill shall have automated controls to control the rate of feed of each material to within an accuracy of 2 percent by weight.
   3. The pugmill discharge shall be equipped with a batching bin having a drop outlet for loading hauling vehicles directly from the pugmill. Pugmill shall be positioned to allow direct discharge to hauling vehicles.
   4. Contractor shall not store amended soil in a manner or for a length of time that will cause any degradation of the project or amended soil.

PART 3 - EXECUTION

3.1 SOIL LINER TEST STRIP

A. Test Strip Installation:
   1. Prior to actual soil liner installation, a soil liner test strip of a dimension no less than 100 FT long by 30 FT wide by 1.5 FT thick shall be constructed by the Contractor over a compacted subgrade within the liner construction site.

2. The soil liner test strip shall be constructed in 6 IN lifts. The final compacted thickness of each lift shall be a maximum of 6 IN. Prior to placement of successive lifts, the surface of the lift in place shall be scarified or otherwise conditioned to eliminate lift interfaces.
3. The soil liner test strip shall be constructed using the same equipment and construction procedures that are anticipated for use during actual liner installation.
4. During test strip installation, the Contractor in coordination with the Engineer shall determine the field procedures that are best suited for his construction equipment to achieve the requirements specified herein.
5. If the test strip fails to achieve the desired results, the soil material of the strip shall be completely removed, and additional test strip(s) shall be constructed until the requirements are met.
6. Document that the subgrade of the test strip liner is properly compacted to at least 95 percent of the maximum dry density, as determined using the Standard Proctor test (ASTM D-698). Field density tests on the subgrade shall be performed by the Geotech Engineer and documented at a minimum of three test locations within the test strip area.
7. Perform at least five field density measurements on each lift of the liner test strip. The field density tests shall be conducted using a nuclear gauge (ASTM D-2922) or other method, as approved by the Engineer. Corresponding tests for moisture content to determine dry density shall likewise be performed by using a nuclear gauge (ASTM D-3017), or other approved method. On the test pad, the density measurement if performed by a nuclear gauge shall be verified through performance of one sand cone test (ASTM D-1556) or drive tube test (ASTM D-2937) at a location selected by the Engineer. The moisture content measurement, if performed by a nuclear gauge shall be verified by recovering at least five samples for oven-dry testing (ASTM D-2216) from the test location.
8. A composite sample will be taken from each lift for recompacted lab permeability (ASTM D-5084).
9. Measure the thickness of the test strip at a minimum of five random locations upon completion of the soil liner test strip.
10. Test a minimum of five random samples of the liner construction materials delivered to the site during test strip installation for moisture content (ASTM D-2216), sieve analyses (ASTM D-421, D-422) and Atterberg limits (ASTM D-4318).
11. Conduct at least one standard Proctor (ASTM D-698) and one modified Proctor (ASTM D-1557) compaction test on bag samples of the test strip material to determine the moisture-density relationships.
12. Take a minimum of one undisturbed sample from each lift of the test strip for laboratory hydraulic conductivity testing. The samples shall be taken within a 2 FT radius of the in-situ density and moisture tests. The Engineer may also conduct confirmatory in-situ hydraulic conductivity testing.
13. The data gathered from the test strip sampling (i.e., field density, moisture, undisturbed samples, and in-situ hydraulic conductivity) shall be used along with the Proctor curve for the soil to develop a range of acceptable moisture and density test values which are likely to be consistent with the required maximum permeability. Establish the range of moisture/density values to be utilized as a means to establish Pass/Fail Criteria for the area to be lined by the subject material.
14. The test strip will be considered acceptable if the measured hydraulic conductivity of the test strip as determined by ASTM D-5084 meets the requirements of the Specifications.
15. If field and laboratory test data indicate that the installed test strip meets the requirements of this Specification, it may be used as part of the liner provided that it is adequately protected by the Installer from drying and equipment damage after installation. The Installer shall scarify the liner material along the edge of the test strip. A minimum 2 FT overlap per lift is required for mixing and compaction between the test strip and the liner.
16. If the test strip fails to meet Specifications, additional mix designs (if bentonite amended) and/or test strips will be constructed until a test strip meets the requirements. No soil liner may be placed until a test strip has been accepted by the CQA Consultant.
17. Upon receipt of the test data from the CQA Consultant , the Engineer shall inform the Contractor if the test strip can remain in-place as part of the liner.

3.2 INSTALLATION

A. The subgrade to be lined shall be smooth and free of vegetation, sticks, roots, foreign objects, and debris. It shall be the responsibility of the Contractor to keep the receiving surfaces in the accepted condition until complete installation of the liner is accomplished.

B. The subgrade shall be proofrolled with a pneumatic tired vehicle of at least 20 tons GVW, making passes across the area as directed by the CQA/CQC Consultants . The soil liner shall not be placed over areas deemed unacceptable by CQA/CQC Consultants based on proofroll observations or inadequate test results.

C. The soil liner shall be installed in 6 IN compacted lifts. The material shall be placed consistent with criteria developed from construction of a satisfactory test strip.

D. When particles exceeding ¾ IN are observed at the final lift surface, they shall be removed by the Contractor prior to final rolling of the surface.

E. Equipment shall be used such that bonding of the lifts will occur. Equipment shall have cleats or other protrusions of such length necessary to completely penetrate into the loose lift. Compaction shall be performed using appropriately heavy, properly ballasted, penetrating foot compactor making a minimum number of passes as approved by the CQA/CQC Consultants based on the soil liner test strip.

F. If desiccation and crusting of the lift surface occurs prior to placement of the next lift, this area shall be scarified to a minimum depth of 2 IN or until sufficiently moist materials are encountered, whichever is greater. After scarification, the superficial material should be reworked to obtain a moisture content at least 2 percent above optimum moisture content. Alternately, the drier superficial soil may be stripped and mixed with additional moist soil to achieve a moisture content satisfying the project requirements.

G. No frozen material shall be placed.

H. Material shall not be placed on a previous lift which is frozen. Frozen in-place material shall be removed prior to placement of additional soil material.

I. Material which has been subjected to a freeze/thaw cycle(s) shall be disked and recompacted prior to placement of subsequent lifts.

J. During construction, exposed finished lifts of the soil liner material should be sprinkled with water to minimize desiccation, as necessary. The Contractor is responsible to protect the soil liner from rain, drying, desiccation, erosion and freezing. All defective areas shall be repaired by the Contractor to the satisfaction of the CQA/CQC Consultants .

K. At the end of each day's construction activities, completed lifts or sections of the compacted soil liner should be sealed. Common sealing methods include rolling with a rubber tired or smooth-drum roller, backdragging with a bulldozer, or placement of temporary cover soil over the compacted soil liner. The compacted soil liner should be sprinkled with water, as needed.

L. If testing shows that a lift is significantly thicker than 6 IN, the top of the lift will be shaved off so that the lift is approximately 6 IN thick.

3.3 FIELD QUALITY CONTROL AND QUALITY ASSURANCE

A. Refer to the CQA Plan.

B. Perform the following field and laboratory quality control tests during soil liner construction:

Test	Method	Minimum Frequency	Acceptable Criteria
1. Field Density	ASTM D2937	1/10,000 SF/lift	$\geq$ 95%
	or		
	ASTM D2937 and	1/5 D3017 tests	$\geq$ 95%
	ASTM D3017	1/10,000 SF/lift	$\geq$ 95%
2. Thickness	Surveyor	8 locations/acre	$\geq$ 18 IN
3. Atterberg Limits	ASTM D4318	1/acre/lift	BSCS Criteria
4. Fines Content	ASTM D1140	1/acre/lift	BSCS Criteria
5. Hydraulic Conductivity	ASTM D5084	1/acre/lift	$\leq 1.0 \times 10^{-5}$ cm/sec
6. Laboratory Moisture Density Relationship	ASTM D698	1/5,000 CY of placed liner material	NA

C. Test methods shall also conform to criteria set forth in Paragraph 3.1, Soil Liner Test Strip.

D. Test frequencies may be modified by the Engineer. If there are indications of declining or failing test results, frequencies may be increased. If hydraulic conductivity test results are well above acceptable, the frequency for Atterberg limit and fine content testing may be waived by the Engineer.

E. The acceptable criteria may be modified if supported by the test strip results and approved by the Engineer.

F. Holes in the compacted soil liner created as a result of destructive testing (e.g., thin-walled Shelby tube sampling and nuclear gauge, field density determinations) shall be backfilled and tamped by rod uniformly in 2 IN thick lifts. The backfill material shall be the same liner construction material or hydrated bentonite powder, if approved by the CQA Consultant . On the surface, the backfill material shall extend slightly beyond the holes to make sure that a good tie-in with the surrounding liner is achieved. Repaired areas shall be observed and documented by the CQC Consultant .

G. Give minimum of 24 HR advance notice to CQA Consultant when ready for soil testing and inspection in completed area of the soil liner.

H. For areas not meeting field and laboratory testing criteria, the Contractor shall scarify the full depth of the lift or replace the material as needed. The material shall be reshaped, rewetted as needed, rehomogenized and recompacted to the specified density. Areas not meeting the thickness requirements shall be augmented with additional materials. The added materials shall be reworked with the soil layer to ensure homogeneity and proper bonding. This may be done by scarification of the surface prior to addition of new material. The repaired area shall be properly documented, and field and laboratory quality control testing shall be performed to ensure the repaired liner section meets the requirements specified herein.

I. The Contractor shall pay for all costs associated with corrective work and retesting resulting from failing tests. The Engineer shall be informed immediately of all failing tests.

END OF SECTION

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SECTION 02485
SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:
   1. Furnish all labor, materials, tools, equipment and services for seeding in accordance with provisions of Contract Documents.
   2. Completely coordinate with work of all other trades.
   3. See Division 1 for General Requirements.

B. Related work specified elsewhere:
   1. Section 02220 - Earthwork.
   2. Section 02270 – Soil Erosion and Sediment Control.
   3. Section 02720 – Erosion Control Blankets.

C. Location of work: All disturbed areas, exclusive of lined structural fill area.

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. AOAC International.
      a. Current Methods of Fertilizer Testing.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Soil test results with recommendations of lime and nutrient needs.
   2. Grass seed mix that will be used for the project and application rate.
   3. Mulch type.
   4. A plan view drawing of areas to be seeded that depicts the areas tested and proposed application rates of lime and fertilizer.
   5. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed.

B. Miscellaneous Submittals:
   1. Copies of fertilizer and lime invoices, showing grade furnished and total quantity applied.
   2. A plan view drawing that depicts the areas that were seeded.

C. Written warranty to maintain and repair as specified in Section 3.4 of this specification for a period of one year following final completion of the project.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Establish a smooth, healthy, uniform, close strand of grass from specified seed.

B. Grass seed: Fresh, clean, latest available crop.
   1. Seeds shall meet state seed requirements and those of the Federal Seed Act.
   2. Species, proportions and minimum percentage of purity, germination, and maximum percentage of weed seed, as specified.
      a. Minimum percent purity 96%.
      b. Minimum percent germination 80%.
      c. Maximum percent weed seed 1%.

3. All seed used shall comply with the state's noxious weed seed requirements.

C. Mulch: Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.
   1. Straw mulch:
      a. Do not use mulch containing a quantity of matured noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.
      b. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
   2. Wood fiber and cellulose fiber mulch:
      a. Materials: Wood fiber, cellulose fiber, dark green marker dye.
      b. pH: 5.
      c. Moisture content: 12%.
      d. Wood fiber: 70% minimum.
      e. Cellulose fiber: 30% maximum.
      f. Organic content: 97%.
      g. Ash content: 1.6%.
      h. Water holding capacity: 1100% minimum.

D. Fertilizer: Commercial grade fertilizer meeting applicable requirements of State and Federal law.
   1. Do not use cyanamic compounds of hydrated lime.

E. Limestone: agricultural grade ground limestone containing not less than 85 percent of combined calcium and magnesium carbonates.
   1. 50 percent passing 100 mesh sieve.
   2. 90 percent passing 20 mesh sieve.

F. Asphalt binder: not allowed.

G. Water: Potable, free of substances harmful to growth.

H. Erosion Control Matting: Refer to Section 02720.

2.2 DELIVERY, STORAGE AND HANDLING

A. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.

B. Deliver fertilizer in original containers labeled with content analysis.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. This project shall comply with the planting regime for the Central Piedmont Region.

B. Perform seeding according to the appropriate seeding mixture for the date of seeding.

C. Permanent Seeding
   1. Spring (March 1 – April 30) and Fall (September 1 – November 15)
      a. Kentucky-31: 175 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Rye grain: 1 bushel/ac.
   2. Winter (November 16 – February 28)
      a. Kentucky-31: 200 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.
      c. Rye Grain: 3 bushels/ac.
   3. Summer (May 1 – August 31)
      a. Kentucky-31: 50 lbs/ac.
      b. Unhulled sercia lespedeza: 50 lbs/ac.

c. Korean or kobe lespedeza: 50 lbs/ac.
d. Weeping love grass: 5 lbs/ac.
e. Bermuda grass: 10 lbs/ac.
f. Millet: 1 bushel/ac.

D. Temporary Seeding

1. Provide winter rye at a rate of 224 lbs/acre.

3.2 SOIL PREPARATION

A. Engineer to approve area after the surface is prepared and prior to seeding. If area is seeded without approval from the Engineer and the Engineer requires the area to be disturbed, the Contractor shall reseed the area.

B. Limit preparation to areas which will be planted soon after preparation.

C. Loosen surface to minimum depth of four (4) IN.

D. Remove stones over one IN in any dimension, sticks, roots, rubbish and other extraneous matter.

E. Test soil pH per USDA NRCS recommendations. Use test results to determine rate of lime application needed to make soil circumneutral. Provide application rate to Engineer for approval prior to its application.

F. Spread lime uniformly over designated areas at rate determined by soil testing.

G. After application of lime, prior to applying fertilizer, loosen areas to be seeded with double disc or other suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.

H. Test soil fertility according to USDA NRCS approved methods. Use test results to determine rate of fertilizer application. Engineer will approve fertilizer application rate prior to application.

I. Distribute fertilizer uniformly over areas to be seeded at a rate determined by soil testing.
1. Use suitable distributor.
2. Incorporate fertilizer into soil to depth of at least two IN.
3. Remove stones or other substances which will interfere with turf development or subsequent mowing.

J. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.
1. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
2. Fine grade just prior to planting.

K. Restore seeded areas to specified condition if eroded or otherwise disturbed between fine grading and planting.

L. If fertilizer or limed application rate is determined (by invoices submitted) to be less than that specified, apply additional fertilizer and/or lime.

M. Protect seeded areas.

3.3 SEEDING

A. Do not use seed which is wet, moldy, or otherwise damaged.

B. Use approved mechanical power driven drills or seeders, or mechanical hand seeders, or other approved equipment.

C. Distribute seed evenly over entire area at not less than 7LB/1000 SF, 50 percent sown in one direction, remainder at right angles to first sowing.

D. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.

E. Resume work only when favorable condition develops.

F. Lightly rake seed into soil followed by light rolling or Culti-packing.

G. Immediately protect seeded areas against erosion by mulching or placing netting.
   1. Spread mulch in a continuous blanket using 1-1/2 TON/ACRE to depth of 4 or 5 straws.
   2. Protect all seeded slopes greater than 3:1 (horizontal to vertical) and ditches against erosion with approved erosion control netting or mats.

H. Immediately after planting, water to a reasonable depth.

3.4 MAINTENANCE

A. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

B. Replant bare areas using same materials specified as needed.

C. Contractor shall supply sufficient water until grass is established.

D. Restore seeded areas to specified condition if eroded or otherwise disturbed during construction.

END OF SECTION

SECTION 02511
AGGREGATE COURSE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Crushed stone paving course, compacted.

B. Related Sections:
   1. Section 02220 - Earthwork

1.2 QUALITY ASSUANCE

A. Reference Standards.
   1. North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Contractor to supply to Engineer certificate from supplier that proposed material meets specifications.
   2. Contractor to supply to CQA/CQC Consultants sample of material for determination of optimum moisture and density determination.
   3. Indicated location and thickness where the material will be used.

B. Miscellaneous:
   1. Provide density and depth test results.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Material shall be ABC stone as provided in accordance with Section 1010 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Construct aggregate course to grade, thickness, and typical section as indicated on drawings. Existing subgrade upon which aggregate course is to be placed shall be compacted in accordance with Section 02220.

B. Aggregate course shall be constructed in accordance with Section 520 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures, unless indicated otherwise on plans or specifications.

3.2 COMPACTION

A. Compact by vibrating or other approved methods to 95 percent maximum dry density as determined by ASTM D1557.

B. Any irregularities in the surface shall be corrected by scarifying, remixing, reshaping and recompacting until a smooth surface is secure.

C. The crushed stone will be tested for depth and density.

END OF SECTION

SECTION 02575

ENVIRONMENTAL CONTROL PROGRAM REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. This Section has been prepared based on the limited environmental investigations performed at the proposed project site to date.
   2. A site safety program shall be developed by the Contractor. The program will address:
      a. Personal safety requirements.

B. Related Sections include but are not necessarily limited to:
   1. Section 02220 – Earthwork.
   2. Section 02276 – Soil Liner System
   3. Section 02774 – LLDPE Geomembrane Liner System.
   4. Section 02775 – HDPE Geomembrane Liner System.

1.2 DEFINITIONS

A. Health and Safety Inspector (provided by Contractor): On-site environmental safety inspector responsible for development and implementation of Contractor's site Health and Safety Plan, monitoring of site conditions and supervision of site personnel on health and safety issues. Health and Safety Inspector shall be appropriately certified.

1.3 ON-SITE HEALTH AND SAFETY

A. General: A Health and Safety Plan developed by the Contractor shall be used as basis for safety precautions to be undertaken during construction. The Health and Safety Inspector (HSI) will instruct all site personnel on the level of protection required. Upon start-up of Work, the Contractor shall have available, on-site, the items outlined in Paragraph 2.1 for use by all construction and on-site personnel if required.

B. All on-site personnel shall attend any required health and safety training provided by the HSI prior to initiation of work at the site.

1.4 MINIMUM QUALIFICATIONS

A. The Contractor shall have on staff, as a permanent employee, a qualified Health and Safety Inspector or shall subcontract with a qualified firm for such services. At a minimum, the Health and Safety Inspector (HSI) must have five (5) years of experience related to on-site monitoring and supervision of health and safety programs for construction related activities. The experience must include monitoring of atmospheric conditions for toxic gas, combustible gas, and oxygen deficiency. The Contractor shall provide written Certification that his selected HSI meets this minimum qualification requirement.

B. Contractor or his approved Health and Safety subcontractor shall provide all required equipment and services necessary for site monitoring and analysis in accordance with these Contract Documents.

1.5 SUBMITTALS

A. Submit Health and Safety Plan to the Engineer prior to initiating any construction activity.

B. Submit certification of Health and Safety Plan inspector or subcontractor to Engineer.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND SUPPLIES

A. Decontamination: The Contractor shall supply all equipment and supplies required for decontamination for the duration of the project. A listing of the required supplies and equipment shall be included in the Contractor's Health and Safety Plan.

B. On-site Personnel: The Contractor shall provide all equipment and supplies for on-site personnel as required in the Contractor's Health and Safety Plan.

PART 3 - EXECUTION

3.1 COORDINATION AND PROJECT PROCEDURES

A. Coordinate Environmental Program requirements specified in this Section with other work or requirements as shown on drawings or specified in other Sections of the Contract Documents.

B. Sequence of work and general construction procedures shall be as follows:
   1. Contractor shall develop project Health and Safety Plan. Plan shall be submitted to Engineer before any further activities are commenced.
   2. Conduct on-site safety training in accordance with approved Health and Safety Plan.
   3. Prior to initiating excavation, HSI shall monitor the site for hazardous conditions.
   4. Based on findings, HSI shall establish protocol for continued monitoring as needed.
   5. As conditions warrant, the HSI shall be on-site or available as needed to monitor site conditions and to supervise personnel on health and safety issues.

3.2 DECONTAMINATION

A. All equipment, tools, etc. which have been in contact with hazardous materials shall be decontaminated with a water and detergent washdown and thorough rinse with spray equipment prior to leaving the site.

END OF SECTION

SECTION 02720
EROSION CONTROL BLANKETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The erosion control blankets are for the purpose of erosion control and revegetation as described herein.
   2. This work shall consist of furnishing and installation of the erosion control blankets, including fine grading, blanketing, stapling, and miscellaneous related work, in accordance with these standard specifications and at the location(s) identified on Drawings or designated by Engineer. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system.
   3. All work of this Section shall be performed in accordance with the Conditions and Requirements of the Contract Documents.
   4. The erosion control blankets shall be used where surface erosion is not desirable. The blankets shall be suitable for the following applications:
      a. Channel and ditch linings.
      b. Slope protection.

B. Related Sections include but are not necessarily limited to
   1. Section 02220 - Earthwork.
   2. Section 02485 - Seeding.

1.2 SUBMITTALS

A. Shop Drawings.
   1. Product technical data.
   2. Indicate locations where the material will be used.
   3. Manufacturer’s installation procedures and methods.
   4. Product samples.
   5. Any alternative system submitted for approval shall include complete design data, including test evidence of compliance to the essential design parameters of Project and reference installations similar in size and scope to that specified for Project.

1.3 PERFORMANCE REQUIREMENTS

A. Erosion control blankets shall provide a temporary, biodegradable cover material to reduce erosion and enhance revegetation.

1.4 DELIVERY, STORAGE AND HANDLING

A. Erosion control blankets shall be furnished in rolls and wrapped with suitable material to protect against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled to provide identification sufficient for inventory and quality control purposes.

B. Erosion control blankets shall be free of defects that would interfere with the proper installation or impair the performance.

C. Erosion control blankets shall be stored by Contractor in a manner which protects them from damage by construction traffic.

PART 2 - PRODUCTS

2.1 EROSION CONTROL BLANKETS

A. Rolled matting (Engineer may adjust criteria as necessary):
   1. Shear stress – 1.5 psf.
   2. Longevity – 8 months.
   3. Top Net – Photodegradable polypropylene.
   4. Bottom Net – None.
   5. Fiber Matrix – 100% straw (0.5 lbs/sy)

B. Hydraulically applied (Engineer may adjust criteria as necessary):

Property	Test Method	Test Value
Mass per unit area	ASTM D6566	11.5 oz/yd^2
Thickness	ASTM D6525	0.19 in
% Ground cover	ASTM D6567	99%
Flexural Rigidity (wet)	ASTM D6575	0.138 oz-in
Cure Time	Observed	< 2 hr.
Color (fugitive dye)	Observed	Green
Functional Longevity	Observed	Up to 1 year

2.2 TURF REINFORCED MATTING

A. Rolled Matting
   1. Shear Stress: Short duration, unvegetated, 3.0 lb/ft^2.
   2. Netting:
      a. Top and bottom: UV stabilized polypropylene, 5 lb/1,000 ft^2.
      b. Middle: Corrugated UV stabilized polypropylene, 24 lb/1,000 ft^2.
   3. Matrix:
      a. 70% straw fiber: 0.35 lbs/yd^2.
      b. 30% coconut fiber: 0.15 lbs/yd^2.
   4. Thread: Polypropylene, UV stable.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. Before placing erosion control blanket, the subgrade shall be inspected by Contractor to insure that it has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, Contractor signifies his approval of preceding work.

B. Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations.

C. No vehicular traffic shall be permitted directly on the blankets.

3.2 CHANNEL INSTALLATION

A. Erosion control blankets shall be installed as directed by the Engineer in accordance with manufacturer's instructions. The extent of erosion control blankets shall be as shown on Drawings.

B. Rolled erosion control blankets shall be installed parallel to the flow of water. The first roll shall be centered longitudinally in mid-channel and anchored. Subsequent rolls shall follow from channel center outward.

C. Successive lengths of erosion control blankets shall be overlapped ("shingled") sufficiently for a common row of connections with the upstream end on top. Connect the overlap across the end of each of the overlapping lengths.

D. A trench shall be located at the upstream termination. Erosion control blanket shall be connected to the bottom of the trench. Backfill and compact the trench.

E. Staple in accordance with manufacturer's recommendation.

3.3 SLOPE INSTALLATION

A. Before placing erosion control blanket, the subgrade shall be inspected by Contractor to insure that it has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, Contractor signifies his approval of preceding work.

B. Place on all slopes outside structural fill construction baseline, excluding the stockpiles, on slopes greater than or equal to 3H:1V.

3.4 QUALITY ASSURANCE

A. Erosion control blankets shall not be defective or damaged. Any such problems shall be corrected by Contractor.

3.5 CLEAN-UP

A. At the completion of this scope of work, Contractor shall remove from the job site and properly dispose of all remaining debris, waste materials, excess materials, and equipment required of or created by Contractor. Disposal of waste materials shall be solely the responsibility of Contractor and shall be done in accordance with applicable waste disposal regulations.

END OF SECTION

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SECTION 02774
LLDPE GEOMEMBRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Furnish all labor, materials, tools, and equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of an impermeable, LLDPE geomembrane as shown on Drawings for closure of the structural fill.
2. Completely coordinate work with that of all other trades.
3. Work items in project include, but are not necessarily limited to, the liner for the structural fill.
4. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.
5. Furnish CQC Consultant to monitor work of Geomembrane Installer and to perform CQC testing in accordance with provisions of the Contract Documents.
6. The Contractor, Geomembrane Installer, and CQC Consultant are required to attend the CQA/CQC Resolution Meeting and the CQA/CQC Preconstruction Meeting.

B. Related Sections include but are not necessarily limited to:
1. Section 02220 - Earthwork.
2. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards:
1. ASTM International (ASTM):
   a. D792, Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   b. D1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
   c. D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
   d. D1603 Standard Test Method for Carbon Black in Olefin Plastics.
   e. D3015 Standard Practice for Microscopic Examination of Pigment Dispersion in Plastic Compounds. Refer to Subpart 2.2 for property to be tested.
   f. D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
   g. D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
   h. D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   i. D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
   j. D5397 Procedure to Perform a Single Point Notched Constant Tensile Load – Appendix (SP-NCTL) Test.
   k. D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
   l. D5721 Practice for Air-Oven Aging of Polyolefin Geomembranes.
   m. D520 Pressured Air Channel Evaluation of Dual Seamed Geomembranes
   n. D5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
   o. D5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.

p. D6392 Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
q. D6693 Test Method for Determining Tensile Properties.
r. D7238 Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane.
s. D7466 Standard Test Method for Measuring the Asperity Height of Textured Geomembrane.

2. The Geosynthetic Research Institute (GRI).
a. GM6 Pressurized Air Channel Test for Dual Seam Geomembranes.
b. GM10 Specification for the Stress Crack Resistance of Geomembrane Sheet.
c. GM11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA-Condensation Exposure Device.
d. GM17 Test Methods, Test Properties, and Testing Frequency for HDPE Smooth and Textural Geomembrane.

B. Qualifications:
1. Each geomembrane manufacturing or installation firm shall demonstrate 5 years continuous experience, including a minimum of 10,000,000 SF of LLDPE geomembrane manufacture or installation.
2. Geomembrane Installer Personnel Qualifications:
a. Installation Superintendent shall have worked in a similar capacity on at least five LLDPE geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
b. The Master Welder shall have completed a minimum of 5,000,000 sf of LLDPE geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
c. Other welders shall have seamed a minimum of 1,000,000 sf of LLDPE geomembrane.

C. CQA Plan Implementation: Construction Quality Assurance for the LLDPE geomembrane installation will be performed for the Owner in accordance with the CQA Plan prepared for this project. The Contractor, CQC Consultant and Geomembrane Installer, however, should familiarize themselves with the CQA Plan and are responsible for providing reasonable notice of and access to work elements that the Geotech Engineer is required by the CQA Plan to overview.

1.3 SUBMITTALS

A. Shop Drawings: Submit for Engineer's approval prior to placement of geomembrane liner:
1. Manufacturer's Submittals.
a. Manufacturer's Quality Control (MQC) Program: Submit certification that program complies with GM17.
b. Manufacturer's Field Installation Procedures Manual: Submit complete geomembrane manufacturer's specifications, descriptive drawings, and literature for the recommended installation of the LLDPE geomembrane liner system, including recommended methods for handling and storage of all materials prior to installation, and field installation guidelines that the manufacturer feels are relevant and important to the success of this project. The manual clearly identifies any exceptions taken by the manufacturer in the specified execution of the Work. Unless excepted and approved by the Engineer, the procedures herein shall be considered part of the manual.
c. Manufacturer's Material Data: Submit statement of planned production date(s) for the geosynthetics to be provided for this Project. Prior to shipment of geomembrane, submit quality control certificates for each roll demonstrating conformance with the requirements of these Specifications. Submit statement of production dates for the resin and the LLDPE geomembrane for this work.
d. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the LLDPE geomembrane.
2. Geomembrane Installer's Submittals.

a. The Geomembrane Installer will submit written documentation that their personnel satisfy the qualifications of 1.2 B.
b. Geomembrane Installer's Construction Quality Control Program: Submit for review a complete description of the Geomembrane Installer's formal construction quality control programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.
c. Geomembrane Installer's Installation Procedures Manual: Submit for approval the Installer's installation manual to include: ambient temperature at which the seams are made, control of panel lift up by wind, acceptable condition of the subsurface beneath the geomembrane, quality and consistency of the welding material, proper preparation of the liner surfaces to be joined, cleanliness of the seam interface (e.g., the amount of airborne dust and debris present), and proposed details for connecting the LLDPE liner to appurtenances, i.e. penetrations of the containment facilities. The document shall include a complete description of seaming by extrusion welding and hot-wedge welding. The Geomembrane Installer's Installation Manual will by reference include requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer. After this manual has been approved by the Engineer, the Geomembrane Installer shall not deviate from the procedures included in the manual.
d. Geomembrane panel layout with proposed size, number, position, and sequencing of panels and showing the location and direction of all field joints. Joints shall be perpendicular to flow direction where possible, unless approved otherwise.
e. Warranty: The Geomembrane Installer shall agree in writing to warranty the geomembrane system.

3. Installer’s Submittals:
a. Installer shall submit written documentation that their personnel satisfy the qualifications of Section 01400.
b. Installer’s Geomembrane Manual: Submit CQA/CQC written program for meeting the geomembrane material conformance and CQA/CQC requirements of these Specifications.

4. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be approved prior to the Geomembrane Preconstruction Meeting.

B. Miscellaneous Submittals:
1. Geomembrane Installer's Submittals.
a. Warranty: Submit a warranty signed by the Geomembrane Installer that the installed geomembrane liner, attachments, and appurtenances are free of defects in material, manufacturing, and workmanship.
b. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material anchor trenches and the construction baseline.
c. Welder Certification: Submit certification for each welder and performance records that include linear feet of weld completed, number of samples tested, and test failure rate for each welder. Submit field notes with daily equipment reports.
d. Certification: Submit written certification that the geomembrane liner was installed in accordance with this Specification and with the approved shop drawings.
e. CQA/CQC Records: Submit copies of all material and seam test results. Each test shall be identified by date of sample, date of test, sample location, name of individual who performed the test, and standard test method used.

f. CQA/CQC Weld Test Summary Report: The CQA/CQC Consultant shall submit a report showing normal distribution of all CQC seam test results, identifying the high, low, and average of the five coupon samples in each test.

2. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted.

1.4 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Engineer until the weather conditions are satisfactory.

B. The Contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels.

C. The Contractor shall maintain natural surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices.

D. The Contractor shall be responsible to coordinate the installation of the leachate collection system which shall be in accordance with Geomembrane Installer's Installation Manual and as specified in these Specifications and shown on the Contract Drawings.

E. Vehicles will not be allowed on the liner area unless at least 24 inches of cover has been placed over the liner except as noted in these Specifications.

F. Vehicles larger than one and one-half ton pickup trucks are prohibited on the exterior berms. Contractor shall repair any damage to exterior berms prior to final payment.

1.5 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications. These responsibilities include but are not limited to:

1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.
2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
4. Shipping of the geomembrane sheet to installer designated facilities.
5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes is responsible for handling, fitting, welding, and testing of geomembrane sheets or blankets in the field. These responsibilities include but are not limited to:

1. Acceptance (in writing) of the geomembrane from the manufacturer.
2. Acceptance (in writing) of the CSL surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.

3. Handling, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
4. Performance of QA/QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
5. Repair or replacement of defects in the geomembrane as required by the CQA/CQC Consultant.

C. Engineer: Responsible for approval of submittals from the Contractor.

D. CQA/CQC Consultant: Responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications. The CQA/CQC Consultant reports to the Contractor and is part of this contract.

E. Engineer: Responsible for implementing CQA Plan including overviewing material conformance testing, field installation of the geomembrane, and CQC activities, and to perform limited CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The Engineer will use the written results of the CQA/CQC program in the preparation of the facility Certification Document.

F. Refer to the accompanying CQA Plan for additional definitions.

1.6 WARRANTIES

A. The Installer’s warranty shall be against defects in the system installed for a period of two years from the date of final acceptance of the Work by the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
1. LLDPE Geomembrane liners manufacturers:
   a. GSE, Inc., 19103 Gundle Road, Houston, Texas 77073.
   b. Raven Industries, 205 E. 6th Street, Sioux Falls, SD, 37104
   c. Sol Max International, Inc.
   d. Agru/America, Inc., 500 Garrison Road, Georgetown, SC 29440.
2. LLDPE Geomembrane Liner Installers:
   a. Authorized installers of approved manufacturers.
   b. Other installers may qualify for approval by providing references for a minimum of 10,000,000 SF of liner installations.

2.2 MATERIALS

A. LLDPE Geomembrane:
1. Geomembrane shall consist of unsupported polyethylene in thickness as shown on Drawings and manufactured from virgin, first quality resin designed and formulated specifically for liquid containment in hydraulic structures. Reclaimed polymer shall not be added to the resin; except use of polymer recycled during the manufacturing process shall be allowed provided that recycled polymer shall be clean and shall not exceed 2 percent by weight.
2. The geomembrane shall be manufactured to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defects shall be cause for rejection of the defective geomembrane material. Minor defects may be repaired in accordance with manufacturer's recommendations if this repair is approved by the Engineer.
3. The geomembrane liner shall be manufactured as seamless rolls or as prefabricated panels with a minimum width of 22 FT as delivered to the site. All factory seams shall be inspected and tested for strength and continuity prior to delivery to the site.

4. No additives or fillers may be added to the resin prior to or during manufacture of the geomembrane.
5. Prior to shipment, the geomembrane manufacturer will provide the Engineer and the Geotech Engineer with a quality control certificate for each roll of geomembrane provided. The quality control certificate will be signed by a responsible party employed by the geomembrane manufacturer and will include:
   a. Roll numbers and identification; and
   b. The results of quality control tests performed under the MQC program.
6. The CQA/CQC Consultant will verify that a control certificate has been received for each roll and that the certified roll properties meet the requirements of these Specifications.
7. Textured LLDPE sheet (both sides) shall be used on all lined slopes.
8. The geomembrane liner material shall consist of **40 MIL NOMINAL TEXTURED LLDPE** and meet or exceed GRI GM17 and the following requirements:

PROPERTY	TEST METHOD	TEST VALUE
a. Sheet Thickness, Mils	ASTM D5994	
• Minimum Average	(textured)	nominal - 5%
• Lowest Individual 8 of 10		nominal - 10%
• Lowest Individual 10 of 10		nominal - 15%
b. Sheet Density (g/cc)	ASTM D792 or D1505	0.920
c. Minimum Tensile Properties	ASTM D6693	
• Strength at Break		60 ppi
• Elongation at Break		250%
d. Min. Tear Resistance Initiation	ASTM D1004, Die C	22 lbs
e. Carbon Black	ASTM D1603 or ASTM D4218	2.0-3.0%
f. Carbon Black Dispersion	ASTM D5596	Category
• 10 of 10		1 or 2
g. Puncture Resistance, Minimum Average	ASTM D4833	44 lbs
h. Oxidative Induction Time,		
Minimum Average	ASTM D3895 or	100 min.
	ASTM D5885	400 min.
i. Asperity height, Minimum average	GRI GM17	10 mil

B. Extrusion rod shall be manufactured from identical resin to that used in geomembrane manufacture. Manufactured extrusion rod shall be tested for carbon black content and dispersion, specific gravity, and melt index at a frequency of not less than one test per batch.

2.3 INTERFACE FRICTION TESTS

A. Interface Friction Tests.
1. Test both materials using ASTM D 6243. Consult the Design Engineer for the required interface friction and the conditions under which this material shall be tested.
2. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

3. The costs associated with this testing shall be included in the Bid price for Construction Quality Control. Any retesting or other additional testing required to meet the Specification shall be at no additional cost to the Owner.

2.4 EQUIPMENT

A. Welding Equipment: Extrusion welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the extrudate. Radiant wedge welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the wedge. Equipment shall be maintained in adequate number to avoid delaying work, and shall be supplied by a power source capable of providing constant voltage under a combined-line load. Use a rub sheet, sand bags, or other method approved by the Geotech Engineer to separate the electric generators from the geomembrane.

B. Field Tensiometer: The Geomembrane Installer shall provide a tensiometer for on-site shear and peel testing of geomembrane seams. The tensiometer shall be in good working order, built to ASTM D6693 specifications, and accompanied by evidence of recent calibration. The tensiometer shall be motor driven and be equipped with a gauge that measures the force in unit pounds exerted between the jaws as displayed on a digital readout.

C. Vacuum Box: The Geomembrane Installer shall provide a minimum of 2 vacuum box assemblies consisting of a rigid housing, a transparent viewing window, a soft closed cell neoprene gasket attached to the bottom, a port hole or valve assembly, a vacuum gauge, a vacuum pump assembly equipped with a pressure control, a rubber pressure/vacuum hose with fittings and connections, and a soapy solution and an applicator. The equipment shall be capable of inducing and holding a minimum vacuum of 5 psi.

D. Air Pressure Test: The Geomembrane Installer shall provide the necessary air pump and fittings required to perform the GRI GM6 air pressure test on dual seams.

E. Roll Handling Equipment: The Geomembrane Installer shall provide handling equipment that is adequate and does not pose a risk to the geomembrane rolls. The Geotech Engineer shall inspect the equipment and confirm its adequacy.

PART 3 - EXECUTION

3.1 LINER SYSTEM CONSTRUCTION

A. Compacted Soil Liner (CSL) Component:
   1. The CSL component shall be constructed in accordance with Section 02276 and the Contractor shall protect the CSL from freezing, desiccation, flooding with water, and freezing.
   2. Prior to placement of the geomembrane, the CSL must be prepared as follows:
      a. Lines and grade must be verified by a Licensed Land Surveyor.
      b. The surface must be proofrolled to verify the supporting soil condition.
      c. The surface must be inspected for rocks larger than 0.75 IN.
      d. Steel drum rolled in preparation for the geomembrane.
      e. Thickness shall be verified by an approved method.
   3. CSL acceptance: Geomembrane liner materials shall not be placed until the required CSL preparation has been completed and the CSL has been accepted and certified in writing by the Geomembrane Installer and approved by the Engineer.

B. Geomembrane Liner:
   1. The geomembrane liner shall be manufactured in accordance with the approved MQC program. The manufacturer shall not deviate from the program without written approval of the Engineer.
   2. Transportation and handling of the geomembrane shall meet the following requirements:

a. Transportation of the geomembrane is the responsibility of the Geomembrane Installer, Contractor, or other party as agreed upon.
b. All handling on site is the responsibility of the Geomembrane Installer.
c. The CQA/CQC Consultants will verify that the handling equipment used on the site is adequate and will not damage the geomembrane.
d. Upon delivery to the site, the Geomembrane Installer and the CQA/CQC Consultants will conduct a surface examination of all rolls for defects or damage. This inspection will be conducted without unrolling rolls. The CQA/CQC Consultants will ensure that defective rolls are rejected and removed from the site.
e. The Geomembrane Installer will be responsible for the storage of the geomembrane on site. The Project Manager will provide a storage location on site. The Geomembrane Installer shall ensure that the storage space is adequate to protect the geomembrane from theft, vandalism, vehicular damage, etc.

3. Field Panel Identification: The CQA/CQC Consultants will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.
4. Geomembrane Installation: Geomembrane liner shall be installed in accordance with the approved Geomembrane Installer's Field Installation Procedure Manual and panel layout drawing. The Geomembrane Installer shall maintain a weekly updated as-built drawing showing the location of all field panels.
   a. Geomembrane shall not be placed upon standing water or other conditions which will result in deterioration of the soil liner.
   b. The Geomembrane Installer shall remove any materials placed to protect the soil liner prior to placement of the geomembrane liner.
   c. Geomembrane liner shall be handled and placed in a manner which minimizes wrinkles, scratches, and crimps.
   d. Test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed, or if significant changes in geomembrane temperature and weather conditions are observed. These test welds shall be tested using daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, and equipment on site using field tensiometer and, at a minimum, exhibit the required seam strength.
   e. Surfaces to be welded shall be clean and dry at the time of welding. Geomembrane shall not be welded when ambient temperatures are below 40 Deg F (5 Deg C) or above 104 Deg F (40 Deg C) unless the Geomembrane Installer can demonstrate that the seam quality is not compromised.
   f. Geomembrane liners shall be welded continuously without fishmouths or breaks in the weld. Where fishmouths are unavoidable, the geomembrane sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle. The two edges of the slit shall be welded together provided that the overlap for this weld shall be a minimum of 3 IN. Areas of the slit which do not achieve an overlap of 3 IN, including the terminus of the slit, shall be provided with a patch as discussed below.
   g. Defects in and damage to geomembrane sheets shall be repaired by welding a patch over the defect using extrusion welding equipment. The patch material shall consist of an undamaged piece of geomembrane cut to provide a minimum of 3 IN of overlap in all directions from the defect. Torn or permanently twisted geomembrane shall be replaced. Defects in and damage to double hot wedge welded seams are not to be repaired by welding a patch over the defect using extrusion welding equipment. Defective double hot wedge welded seams shall be cut out and reconstructed.
   h. Personnel walking on the geosynthetic shall not engage in activities or wear types of shoes, that could damage the geosynthetic. Smoking shall not be permitted while working on the geomembrane.

i. Vehicular traffic directly on the geosynthetic shall not be permitted. Equipment shall not damage the geosynthetic materials by handling, trafficking, leakage of hydrocarbons, or any other means. The unprotected geomembrane surface shall not be used as a work area, for preparing patches, storing tools and supplies, or other uses.

5. Geomembrane Testing (Nondestructive): The Geomembrane Installer shall test and document all seam welds continuously using one of the following nondestructive seam tests:
   a. Vacuum testing shall conform to the following procedure: Brush soapy solution on geomembrane. Place vacuum box over the wetted seam area. Ensure that a leak-tight seal is created. Apply a pressure of approximately five (5) psi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 15 seconds. All areas where soap bubbles appear shall be marked and repaired as described in this Section.
   b. Air Pressure Testing (for double seam with an enclosed space) shall conform to GRI GM6 requirements.

C. Destructive Seam Testing:
   1. Test and evaluate in accordance with GRI Test Method GM19.
   2. A minimum of one destructive test per 500 LF of seam, and as many other samples as CQA/CQC Consultant determines appropriate, shall be obtained at locations specified by the CQA/CQC Consultant.
      a. Sample locations shall not be identified prior to seaming.
      b. The samples shall be a minimum of 12 IN wide by 48 IN long with the seam centered lengthwise.
      c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to an Independent Testing Laboratory, and the remaining piece given to the CQA/CQC Consultant for quality assurance testing and/or permanent record.
      d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:
         1) Panel/sheet number.
         2) Seam number.
         3) Top sheet.
         4) Date and time cut.
         5) Ambient temperature.
         6) Seaming unit designation.
         7) Name of seamer.
         8) Seaming apparatus temperature and pressures (where applicable).
   3. A minimum of four 1 IN wide replicate specimens shall be cut from the Installer's sample.
      a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.
      b. To be acceptable, all replicate test specimens must meet the specified seam strength requirements and fail as Film Tear Bond.
      c. If the field tests pass, 5 specimens shall be tested at the Independent Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D4437.
      d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fail as Film Tear Bond.
   4. The minimum required seam strengths:

Description	Test Method	Hot Wedge (lbs/in width)	Extrusion (lbs/in width)
LLDPE Peel	ASTM D46392	50	44
LLDPE Shear	ASTM D6392	60	60

5. If the field tests pass, 5 specimens shall be tested at the Independent Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D6592.
    a. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fail as Film Tear Bond.
    b. If the field or laboratory tests fail, the seam shall be repaired in accordance with the Manufacturer's Quality Control manual.
    c. In addition, all destructive seam sample holes shall be repaired the same day as cut.
    d. Certified test results on all field seams shall be submitted to and approved by the CQA/CQC Consultants prior to acceptance of the seam.
6. Ten percent of all repaired areas shall be destructively tested.
    a. All repaired areas shall be non-destructively tested.
7. Destructive testing shall be performed by an Independent Testing Laboratory employed by the Contractor, not the Installer.
    a. The CQA Consultant may separately conduct destructive testing for quality assurance.
    b. If samples tested by CQA Consultant fail, based on above criteria, seam will be classified as failed.
8. A map showing the locations, number and type of all patches shall be prepared and provided to the Owner.
9. Documentation: The following documentation must be maintained at the project site for review by the Engineer or CQA Consultant:
    a. Geomembrane Installer's Documentation:
        1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, and equipment on site.
        2) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
        3) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
        4) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
        5) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.
    b. CQC Consultant's Documentation:
        1) Daily Log: daily record that summarizes panels deployed, seams completed, CQC seam testing, seam repair, personnel on site, equipment on site, weather conditions, etc.
        2) CQA/CQC Testing Log: record of all seam destructive tests and material conformance tests performed by the CQC Geosynthetics Laboratory.
        3) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
        4) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.

3.2 GEOMEMBRANE ACCEPTANCE

A. The Geomembrane Installer shall retain all Ownership and responsibility for the geomembrane liner system until final acceptance of the Work by the Owner. Owner will accept the geosynthetic installation when the installation is finished and all required submittals from the Geomembrane Installer and Geotech Engineer have been received, approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

SECTION 02775
HDPE GEOMEMBRANE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Furnish all labor, materials, tools, and equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of an impermeable, HDPE geomembrane liner as shown on Drawings and specified in accordance with provisions of the Contract Documents.
2. Completely coordinate work with that of all other trades.
3. Work items in project include, but are not necessarily limited to, the liner for the structural fill.
4. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.
5. Furnish CQA/CQC Consultant to monitor work of Geomembrane Installer and to perform CQA/CQC testing in accordance with provisions of the Contract Documents.
6. The Contractor, Geomembrane Installer, Geotech Engineer, and Engineer are required to attend the CQA/CQC Resolution Meeting and the CQA/CQC Preconstruction Meeting.

B. Related Sections include but are not necessarily limited to:
1. Section 02220 - Earthwork.
2. Section 02240 - Leachate Collection Stone.
3. Section 02276 - Soil Liner System
4. Section 02777 – Drainage Composite.
5. Construction Quality Assurance Plan.

1.2 QUALITY STANDARDS

A. Referenced Standards:
1. ASTM International (ASTM):
   a. D792, Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   b. D1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
   c. D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
   d. D1603 Standard Test Method for Carbon Black in Olefin Plastics.
   e. D3015 Standard Practice for Microscopic Examination of Pigment Dispersion in Plastic Compounds. Refer to Subpart 2.2 for property to be tested.
   f. D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
   g. D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
   h. D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
   i. D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
   j. D5397 Procedure to Perform a Single Point Notched Constant Tensile Load – Appendix (SP-NCTL) Test.
   k. D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
   l. D5721 Practice for Air-Oven Aging of Polyolefin Geomembranes.

m. D520 Pressured Air Channel Evaluation of Dual Seamed Geomembranes
n. D5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
o. D5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.
p. D6392, Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
q. D6693, Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
r. D7238 Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane.
s. D7466 Standard Test Method for Measuring the Asperity Height of Textured Geomembrane.

2. The Geosynthetic Research Institute (GRI).
   a. GM6 Pressurized Air Channel Test for Dual Seam Geomembranes.
   b. GM10 Specification for the Stress Crack Resistance of Geomembrane Sheet.
   c. GM11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA-Condensation Exposure Device.
   d. GM13 Standard Specification for Test Properties, Testing Frequency, and Recommended

B. Qualifications:
   1. Each geomembrane manufacturing or installation firm shall demonstrate 5 years continuous experience, including a minimum of 10,000,000 SF of HDPE geomembrane manufacture or installation.
   2. Geomembrane Installer Personnel Qualifications:
      a. Installation Superintendent shall have worked in a similar capacity on at least five HDPE geomembrane liner jobs similar in size and complexity to the project described in the Contract Documents.
      b. The Master Welder shall have completed a minimum of 5,000,000 sf of HDPE geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.
      c. Other welders shall have seamed a minimum of 1,000,000 sf of HDPE geomembrane.

C. CQA Plan Implementation: Construction Quality Assurance for the HDPE geomembrane installation will be performed for the Owner in accordance with the CQA Plan prepared for this project. The Owner, CQC Consultant , and Geomembrane Installer, however, should familiarize themselves with the CQA Plan and are responsible for providing reasonable notice of and access to work elements that is required by the CQA Plan to overview.

1.3 SUBMITTALS

A. Shop Drawings: Submit for Engineer's approval prior to placement of geomembrane liner.

B. Manufacturer's Submittals.
   1. Manufacturer's Quality Control (MQC) Program: Submit certification that the MQC program at a minimum conforms to GRI GM13 standards.
   2. Manufacturer's Field Installation Procedures Manual: Submit complete geomembrane manufacturer's specifications, descriptive drawings, and literature for the recommended installation of the HDPE geomembrane liner system, including recommended methods for handling and storage of all materials prior to installation, and field installation guidelines that the manufacturer feels are relevant and important to the success of this project. The manual clearly identifies any exceptions taken by the manufacturer in the specified execution of the Work. Unless excepted and approved by the Engineer, the procedures herein shall be considered part of the manual.

3. Manufacturer's Material Data: Submit statement of planned production date(s) for the geosynthetics to be provided for this Project. Prior to shipment of geomembrane, submit quality control certificates for each roll demonstrating conformance with the requirements of these Specifications. Submit statement of production dates for the resin and the HDPE geomembrane for this work.
4. Manufacturer's written acceptance of Geomembrane Installer's qualifications for installation of the HDPE geomembrane.

C. Geomembrane Installer's Submittals.
1. The Geomembrane Installer will submit written documentation that their personnel satisfy the qualifications of 1.2 B.
2. Geomembrane Installer's Construction Quality Control Program: Submit for review a complete description of the Geomembrane Installer's formal construction quality control programs to include, but not be limited to, product acceptance testing, installation testing, including both nondestructive and destructive quality control field testing of the sheets and seams during installation of the geomembrane, proposed methods of testing geosynthetic joints and connections at appurtenances for continuity, documentation and changes, alterations, repairs, retests, and acceptance.
3. Geomembrane Installer's Installation Procedures Manual: Submit for approval the Installer's installation manual to include: ambient temperature at which the seams are made, control of panel lift up by wind, acceptable condition of the subsurface beneath the geomembrane, quality and consistency of the welding material, proper preparation of the liner surfaces to be joined, cleanliness of the seam interface (e.g., the amount of airborne dust and debris present), and proposed details for connecting the HDPE liner to appurtenances, i.e. penetrations of the containment facilities. The document shall include a complete description of seaming by extrusion welding and hot-wedge welding. The Geomembrane Installer's Installation Manual will by reference include requirements of the Manufacturer's Installation Manual unless exceptions are noted and approved by the Engineer. After this manual has been approved by the Engineer, the Geomembrane Installer shall not deviate from the procedures included in the manual.
4. Geomembrane panel layout with proposed size, number, position, and sequencing of panels and showing the location and direction of all field joints. Joints shall be perpendicular to flow direction where possible, unless approved otherwise.
5. Warranty: Submit a sample warranty in accordance with Paragraph 1.6 Warranties.

D. Installer Submittals:
1. Installer shall submit written documentation that their personnel satisfy the project qualifications.
2. Installer Geomembrane Manual: Submit Installer's written program for meeting the geomembrane material conformance and CQA/CQC requirements of these Specifications.

E. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted. All submittals must be submitted prior to the Geomembrane Preconstruction Meeting, Section 01200.

F. Miscellaneous submittals for Engineer's Approval Required for Final Acceptance of HDPE Geomembrane Liner System:
1. Geomembrane Installer's Submittals.
a. Warranty: Submit a warranty signed by the Geomembrane Installer that the installed geomembrane liner, attachments, and appurtenances are free of defects in material, manufacturing, and workmanship.
b. Record Drawings: Submit reproducible drawings of record showing changes from the approved installation drawings. The record drawings shall include the identity and location of each repair, cap strip, penetration, boot, and sample taken from the installed geosynthetic for testing. The record drawings shall show locations of each type of material anchor trenches and the construction baseline.

c. Welder Certification: Submit certification for each welder and performance records that include linear feet of weld completed, number of samples tested, and test failure rate for each welder. Submit field notes with daily equipment reports.

d. Certification: Submit written certification that the geomembrane liner was installed in accordance with this Specification and with the approved shop drawings.

e. CQA/CQC Records: Submit copies of all material and seam test results. Each test shall be identified by date of sample, date of test, sample location, name of individual who performed the test, and standard test method used.

f. CQA/CQC Weld Test Summary Report: The Geotech Engineer shall submit a report showing normal distribution of all CQA/CQC seam test results, identifying the high, low, and average of the five coupon samples in each test.

2. Provide all submittals in a single coordinated transmittal. Partial submittals will not be accepted.

1.4 PROJECT CONDITIONS

A. When the weather is of such a nature as to endanger the integrity and quality of the installation, whether this is due to rain, high winds, cold temperatures, or other weather elements, the installation of the geomembrane shall be halted at the direction of, or with the concurrence of, the Engineer until the weather conditions are satisfactory.

B. The Contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces which hamper the efficient field seaming of geosynthetic panels.

C. The Contractor shall maintain natural surface water drainage diversions around the work area and provide for the disposal of water which may collect in the work area directly from precipitation falling within the area or from inadequate diversion structures or practices.

D. The Contractor shall be responsible to coordinate the installation of the leachate collection system which shall be in accordance with Geomembrane Installer's Installation Manual and as specified in these Specifications and shown on the Contract Drawings.

E. Vehicles will not be allowed on the liner area unless at least 24 inches of cover has been placed over the liner except as noted in these Specifications.

F. Vehicles larger than one and one-half ton pickup trucks are prohibited on the exterior berms. Contractor shall repair any damage to exterior berms prior to final payment.

1.5 DEFINITIONS AND RESPONSIBILITIES

A. Geomembrane Manufacturer: Manufacturer of geomembranes producing geomembrane sheets from resin and additives. The manufacturer is responsible for producing geomembrane sheet which complies with these Specifications. These responsibilities include but are not limited to:

1. Acceptance of the resin and additives from chemical formulators. Testing of the raw resin and additives to ensure compliance with the manufacturer's specifications and with this Specification.
2. Formulation of the resin and additives into geomembrane sheeting using mixing and extrusion equipment.
3. Testing of the geomembrane sheet to ensure compliance with manufacturer's specification and this Specification.
4. Shipping of the geomembrane sheet to installer designated facilities.
5. Certification of the raw materials and finished geomembrane sheet to comply with this Specification.
6. Certification of installer's training, experience, and methods for welding and inspection of geomembrane installations in compliance with manufacturer's standards.

B. Geomembrane Installer. Installer of geomembranes is responsible for handling, fitting, welding, and testing of geomembrane sheets or blankets in the field. These responsibilities include but are not limited to:
   1. Acceptance (in writing) of the geomembrane from the manufacturer.
   2. Acceptance (in writing) of the CSL surface which will serve as a base for the geomembrane. This acceptance shall precede installation of the geomembrane, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of geomembrane liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
   3. Handling, welding, testing, and repair geomembrane liners in compliance with this Specification and the Geomembrane Installer's Installation Procedures Manual.
   4. Performance of QA/QC testing and record keeping as required by the approved Geomembrane Installer's Field Installation Procedures Manual.
   5. Repair or replacement of defects in the geomembrane as required by the Geotech Engineer.

C. Engineer: Responsible for approval of submittals from the Contractor.

D. CQC Consultant/Geotech Engineer: Responsible for observing field installation of the geomembrane and performance of material conformance and CQC testing to provide the Contractor with verbal and written documentation of the compliance of the installation with these Specifications.

E. Engineer: Responsible for implementing CQA Plan including overviewing material conformance testing, field installation of the geomembrane, and CQC activities, and to perform limited CQA conformance testing to provide Owner with verbal and written documentation of the compliance of the installation with these Specifications. The Engineer will use the written results of the CQA/CQC program in the preparation of the facility Certification Document.

F. Refer to the accompanying CQA Plan for additional definitions.

1.6 WARRANTIES

A. The Installer’s warranty shall be against defects in the system installed for a period of two years from the date of final acceptance of the Work. .

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND/OR GEOMEMBRANE INSTALLERS

A. Subject to compliance with the Contract Documents, the following manufacturers and installers are acceptable:
   1. HDPE Geomembrane liners manufacturers::
      a. GSE, Inc., 19103 Gundle Road, Houston, Texas 77073.
      b. Agru/America, Inc., 500 Garrison Road, Georgetown, SC 29440.
      c. Solmax International Inc., 2801 Marie-Victorin Blvd., Varennes, Quebec, Canada J3X 1P7
   2. HDPE Geomembrane Liner Installers:
      a. Authorized installers of approved manufacturers.
      b. Other installers may qualify for approval by providing references for a minimum of 10,000,000 SF of liner installations.

2.2 MATERIALS

A. HDPE Geomembrane:
   1. Geomembrane shall consist of unsupported polyethylene in thickness as shown on Drawings and manufactured from virgin, first quality resin designed and formulated specifically for liquid containment in hydraulic structures. Reclaimed polymer shall not be added to the resin; except use of polymer recycled during the manufacturing process shall be allowed provided that recycled polymer shall be clean and shall not exceed 2 percent by weight.

2. The geomembrane shall be manufactured to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defects shall be cause for rejection of the defective geomembrane material. Minor defects may be repaired in accordance with manufacturer's recommendations if this repair is approved by the Engineer.
3. The geomembrane liner shall be manufactured as seamless rolls or as prefabricated panels with a minimum width of 22 FT as delivered to the site. All factory seams shall be inspected and tested for strength and continuity prior to delivery to the site.
4. No additives or fillers may be added to the resin prior to or during manufacture of the geomembrane.
5. Prior to shipment, the geomembrane manufacturer will provide the Engineer and the Geotech Engineer with a quality control certificate for each roll of geomembrane provided. The quality control certificate will be signed by a responsible party employed by the geomembrane manufacturer and will include:
   a. Roll numbers and identification; and
   b. The results of quality control tests performed under the MQC program.
6. The Geotech Engineer will verify that a control certificate has been received for each roll and that the certified roll properties meet the requirements of these Specifications.
7. Textured HDPE sheet (both sides) shall be used on all lined surfaces. Minimum 6 feet run out from toe of slope, of textured HDPE liner.
8. The geomembrane liner material shall consist of **HDPE** that meets or exceeds GRI GM13 and the following requirements:

PROPERTY	TEST METHOD	TEST VALUE	
a. Sheet Thickness, Mils	ASTM D5994	40	60
• Minimum Average		nominal -5%	-5%
• Lowest Individual 8 of 10		nominal -10%	-10%
• Lowest Individual 10 of 10		nominal -15%	-15%
b. Sheet Density (g/cc)	ASTM D792 or D1505	0.940	0.940
c. Minimum Tensile Properties	ASTM D6693		
• Yield Stress		84 ppi	126 ppi
• Break Stress		60 ppi	90 ppi
• Elongation at Yield		12%	12%
• Elongation at Break (2-inch gage length)		100%	100%
d. Min. Tear Resistance Initiation	ASTM D1004, Die C	28 lbs	42 lbs
e. Carbon Black	ASTM D1603 or ASTM D4218	2.0-3.0%	2.0-3.0%
f. Carbon Black Dispersion	ASTM D5596	Category	Category
• 8 of 10		1 or 2	1 or 2
• 10 of 10		1, 2, or 3	1, 2, or 3
g. Puncture Resistance, Minimum Average	ASTM D4833	60 lbs	90 lbs
h. Oxidative Induction Time, Minimum Average	ASTM D3895 or ASTM D5885	100 min. 400 min.	100 min. 400 min.
i. Asperity Height, Minimum Average	GRI GM12	10 mil	10 mil

B. Extrusion rod shall be manufactured from identical resin to that used in geomembrane manufacture. Manufactured extrusion rod shall be tested for carbon black content and dispersion, specific gravity, and melt index at a frequency of not less than one test per batch.

2.3 INTERFACE FRICTION TESTS

A. Interface Friction Tests.
   1. Test both materials using ASTM D 6243. Consult the Design Engineer for the required interface friction and conditions under which this material shall be tested.
   2. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

2.4 EQUIPMENT

A. Welding Equipment: Extrusion welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the extrudate. Radiant wedge welding equipment shall be provided with thermocouples and temperature readout devices which continuously monitor the temperature of the wedge. Equipment shall be maintained in adequate number to avoid delaying work, and shall be supplied by a power source capable of providing constant voltage under a combined-line load. Use a rub sheet, sand bags, or other method approved by the Geotech Engineer to separate the electric generators from the geomembrane.

B. Field Tensiometer: The Geomembrane Installer shall provide a tensiometer for on-site shear and peel testing of geomembrane seams. The tensiometer shall be in good working order, built to ASTM D6693 specifications, and accompanied by evidence of recent calibration. The tensiometer shall be motor driven and be equipped with a gauge that measures the force in unit pounds exerted between the jaws as displayed on a digital readout.

C. Vacuum Box: The Geomembrane Installer shall provide a minimum of 2 vacuum box assemblies consisting of a rigid housing, a transparent viewing window, a soft closed cell neoprene gasket attached to the bottom, a port hole or valve assembly, a vacuum gauge, a vacuum pump assembly equipped with a pressure control, a rubber pressure/vacuum hose with fittings and connections, and a soapy solution and an applicator. The equipment shall be capable of inducing and holding a minimum vacuum of 5 psi.

D. Air Pressure Test: The Geomembrane Installer shall provide the necessary air pump and fittings required to perform the GRI GM6 air pressure test on dual seams.

E. Roll Handling Equipment: The Geomembrane Installer shall provide handling equipment that is adequate and does not pose a risk to the geomembrane rolls. The Geotech Engineer shall inspect the equipment and confirm its adequacy.

PART 3 - EXECUTION

3.1 LINER SYSTEM CONSTRUCTION

A. Compacted Soil Liner (CSL) Component:
   1. The CSL component shall be constructed in accordance with Section 02276 and the Contractor shall protect the CSL from freezing, desiccation, flooding with water, and freezing.
   2. Prior to placement of the geomembrane, the CSL must be prepared as follows:
      a. Lines and grade must be verified by a Licensed Land Surveyor.
      b. The surface must be proofrolled to verify the supporting soil condition.
      c. The surface must be inspected for rocks larger than 0.75 IN.
      d. Steel drum rolled in preparation for the geomembrane.
      e. Thickness must be verified by an approved method.

3. CSL acceptance: Geomembrane liner materials shall not be placed until the required CSL preparation has been completed and the CSL has been accepted and certified in writing by the Geomembrane Installer and approved by the Engineer.

B. Geomembrane Liner:
   1. The geomembrane liner shall be manufactured in accordance with the approved MQC program. The manufacturer shall not deviate from the program without written approval of the Engineer.
   2. Transportation and handling of the geomembrane shall meet the following requirements:
      a. Transportation of the geomembrane is the responsibility of the Geomembrane Installer, Contractor, or other party as agreed upon.
      b. All handling on site is the responsibility of the Geomembrane Installer.
      c. The Geotech Engineer will verify that the handling equipment used on the site is adequate and will not damage the geomembrane.
      d. Upon delivery to the site, the Geomembrane Installer and the Geotech Engineer will conduct a surface examination of all rolls for defects or damage. This inspection will be conducted without unrolling rolls. The Geotech Engineer will ensure that defective rolls are rejected and removed from the site.
      e. The Geomembrane Installer will be responsible for the storage of the geomembrane on site. The Project Manager will provide a storage location on site. The Geomembrane Installer shall ensure that the storage space is adequate to protect the geomembrane from theft, vandalism, vehicular damage, etc.
   3. Field Panel Identification: The Geotech Engineer will document that the Geomembrane Installer labels each field panel with an "identification code" consistent with the approved panel layout plan. The location of the label and the color of marker used must be as agreed to in the QA/QC Preconstruction Meeting.
   4. Geomembrane Installation: Geomembrane liner shall be installed in accordance with the approved Geomembrane Installer's Field Installation Procedure Manual and panel layout drawing. The Geomembrane Installer shall maintain a weekly updated as-built drawing showing the location of all field panels.
      a. Geomembrane shall not be placed upon standing water or other conditions which will result in deterioration of the soil liner.
      b. The Geomembrane Installer shall remove any materials placed to protect the soil liner prior to placement of the geomembrane liner.
      c. Geomembrane liner shall be handled and placed in a manner which minimizes wrinkles, scratches, and crimps.
      d. Test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed, or if significant changes in geomembrane temperature and weather conditions are observed. These test welds shall be tested using daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, and equipment on site using field tensiometer and, at a minimum, exhibit the required seam strength.
      e. Surfaces to be welded shall be clean and dry at the time of welding. Geomembrane shall not be welded when ambient temperatures are below 40 Deg F (5 Deg C) or above 104 Deg F (40 Deg C) unless the Geomembrane Installer can demonstrate that the seam quality is not compromised.
      f. Geomembrane liners shall be welded continuously without fishmouths or breaks in the weld. Where fishmouths are unavoidable, the geomembrane sheet shall be slit to a point such that the sheet lies flat and with no remaining wrinkle. The two edges of the slit shall be welded together provided that the overlap for this weld shall be a minimum of 3 IN. Areas of the slit which do not achieve an overlap of 3 IN, including the terminus of the slit, shall be provided with a patch as discussed below.

g. Defects in and damage to geomembrane sheets shall be repaired by welding a patch over the defect using extrusion welding equipment. The patch material shall consist of an undamaged piece of geomembrane cut to provide a minimum of 3 IN of overlap in all directions from the defect. Torn or permanently twisted geomembrane shall be replaced.

h. Defects in and damage to double hot wedge welded seams are not to be repaired by welding a patch over the defect using extrusion welding equipment. Defective double hot wedge welded seams shall be cut out and reconstructed.

i. Personnel walking on the geosynthetic shall not engage in activities or wear types of shoes, that could damage the geosynthetic. Smoking shall not be permitted while working on the geomembrane.

j. Vehicular traffic directly on the geosynthetic shall not be permitted. Equipment shall not damage the geosynthetic materials by handling, trafficking, leakage of hydrocarbons, or any other means. The unprotected geomembrane surface shall not be used as a work area, for preparing patches, storing tools and supplies, or other uses.

5. Geomembrane Testing (Nondestructive): The Geomembrane Installer shall test and document all seam welds continuously using one of the following nondestructive seam tests:

a. Vacuum testing shall conform to the following procedure: Brush soapy solution on geomembrane. Place vacuum box over the wetted seam area. Ensure that a leak-tight seal is created. Apply a pressure of approximately five (5) psi. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 15 seconds. All areas where soap bubbles appear shall be marked and repaired as described in this Section.

b. Air Pressure Testing (for double seam with an enclosed space) shall conform to GRI GM6 requirements.

C. Destructive Seam Testing:

1. Test and evaluate in accordance with GRI Test Method GM19.

2. A minimum of one destructive test per 500 LF of seam, and as many other samples as Geotech Engineer determines appropriate, shall be obtained at locations specified by the Geotech Engineer.

a. Sample locations shall not be identified prior to seaming.

b. The samples shall be a minimum of 12 IN wide by 48 IN long with the seam centered lengthwise.

c. Each sample shall be cut into three equal pieces with one piece retained by the Installer, one piece given to an Independent Testing Laboratory, and the remaining piece given to the Geotech Engineer for quality assurance testing and/or permanent record.

d. Each sample shall be numbered and recorded on the final panel layout record drawing, and cross-referenced to a field log which identifies:

1) Panel/sheet number.
2) Seam number.
3) Top sheet.
4) Date and time cut.
5) Ambient temperature.
6) Seaming unit designation.
7) Name of seamer.
8) Seaming apparatus temperature and pressures (where applicable).

3. A minimum of four 1 IN wide replicate specimens shall be cut from the Installer's sample.

a. A minimum of 2 specimens shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 IN per minute.

b. To be acceptable, all replicate test specimens must meet the specified seam strength requirements and fail as Film Tear Bond.

c. If the field tests pass, 5 specimens shall be tested at the Independent Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D4437.

d. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fail as Film Tear Bond.

The minimum required seam strengths:

		40 mil		60 mil	
Description	Test Method	Hot Wedge (lbs/in width)	Extrusion (lbs/in width)	Hot Wedge (lbs/in width)	Extrusion (lbs/in width)
HDPE Peel	ASTM D6392	60	52	91	78
HDPE Shear	ASTM D6392	80	80	120	120

4. If the field tests pass, 5 specimens shall be tested at the Independent Testing Laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D6392.
   a. To be acceptable, 4 out of 5 replicate test specimens must meet the specified seam strength requirements and fail as Film Tear Bond.
   b. If the field or laboratory tests fail, the seam shall be repaired in accordance with the Manufacturer's Quality Control manual.
   c. In addition, all destructive seam sample holes shall be repaired the same day as cut.
   d. Certified test results on all field seams shall be submitted to and approved by the Geotech Engineer prior to acceptance of the seam.
5. Ten percent of all repaired areas shall be destructively tested.
   a. All repaired areas shall be non-destructively tested.
6. Destructive testing shall be performed by an Independent Testing Laboratory employed by the Contractor, not the Installer.
   a. The Geotech Engineer may separately conduct destructive testing for quality assurance.
   b. If samples tested by Geotech Engineer fail, based on above criteria, seam will be classified as failed.
7. A map showing the locations, number and type of all patches shall be prepared and provided to the Owner.
8. Documentation: The following documentation must be maintained at the project site for review by the Engineer:
   a. Geomembrane Installer's Documentation:
      1) Daily Log: daily record that summarizes panels deployed, seams completed, seam testing, seam repair, personnel on site, and equipment on site.
      2) Panel Log: provides geomembrane roll number used and subgrade acceptance for each panel deployed.
      3) Seam Testing Log: provides a complete record of all nondestructive and destructive seam tests performed as part of the Geomembrane Installer's QC program.
      4) Seam/Panel Repair Log: provides a complete record of all repairs and vacuum box testing of repairs made to defective seams or panels.
      5) As-Built Drawing: maintain an as-built drawing updated on a weekly basis.
   b. CQC Consultant’s Documentation:
      1) Daily Log: daily record that summarizes panels deployed, seams completed, CQC seam testing, seam repair, personnel on site, equipment on site, weather conditions, etc.
      2) CQA/CQC Testing Log: record of all seam destructive tests and material conformance tests performed by the CQA/CQC Geosynthetics Laboratory.
      3) Material Conformance: maintain original conformance certificate(s) from geomembrane manufacturer.
      4) Subgrade Acceptance Log: maintained originals of subgrade acceptance forms for each panel and signed by the Geomembrane Installer.

3.2 GEOMEMBRANE ACCEPTANCE

A. The Geomembrane Installer shall retain all Ownership and responsibility for the geomembrane liner system until final acceptance by the Owner. Owner will accept the geosynthetic installation when the installation is finished and all required submittals from the Geomembrane Installer and CQA/CQC Consultant have been received, approved, and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

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SECTION 02777
DRAINAGE COMPOSITE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bonded geotextile-geonet drainage composite.

B. Related sections include but are not necessarily limited to:
   1. Section 02775 – HDPE Geomembrane.
   2. Section 02778 - Geotextiles.
   3. Construction Quality Assurance Plan.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D413, Rubber Property - Adhesion to Flexible Substrate.
      b. D792, Standard Test Methods for Density and Specific Gravity of Plastic by Displacement.
      c. D1238, Flow Rates of Thermoplastics by Extrusion Plastometer.
      d. D1505, Density of Plastics by the Density-Gradient Technique.
      e. D1603, Carbon Black in Olefin Plastics.
      f. D4716, Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
      g. D4873, Identification, Storage and Handling of Geosynthetic Rolls.
      h. D5199, Standard Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
      i. D5321, Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
      j. D7005, Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites.

B. Qualifications:
   1. Each manufacturing and fabricating firm shall demonstrate 5 years continuous experience, including a minimum of 5,000,000 SF of drainage composite production in the past 3 years.
   2. Installer shall attend pre-installation conference.

1.3 DEFINITIONS:

A. Manufacturer: Manufacturer producing drainage composites from geonet cores and geotextiles.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

C. MARV: Minimum average roll value.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's documentation that raw materials and roll materials comply with required drainage composite physical properties.
   2. Manufacturer and Installer quality control manuals.
   3. Original test results for resins and roll material at frequency specified in respective quality control manuals. Include or bracket the rolls delivered for use in the Work.

4. Layout plan with proposed size, number, position and sequencing of drainage composite rolls and direction of all field seams.
5. Proposed details of anchor trench if different than included in Contract Documents.

B. Miscellaneous Submittals:
1. Qualification documentation specified in Article 1.2.

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store drainage composites in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, drainage composite type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace, as directed by the Engineer, drainage composite or plastic wrapping damaged as a result of storage or handling.

E. Do not expose drainage composite to temperatures in excess of 71 DegC (160 DegF) or below 0 DegC (32 DegF) unless recommended by the Manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling the drainage composite.

G. Do not lift rolls by use of cables or chains in contact with the drainage composite.

H. Do not drag drainage composite along the ground or across textured geomembranes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. GSE Environmental.
2. Agru-American, Inc.
3. Engineer approved equal.

2.2 MATERIALS AND MANUFACTURE

A. Geonet Core:
1. Use nonthermally degraded polyethylene polymer which is clean and free of any foreign contaminants.
2. Manufactured geonet to conform to the property requirements listed in Table 1 and be free of defects including tears, nodules or other manufacturing defects which may affect its serviceability.

TABLE 1 - GEONET PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE
Polymer Density	ASTM D1505	>0.93 g/cc
Polymer Melt Index	ASTM D1238	<1.1 g/10 min.
Carbon Black Content	ASTM D1603	2-3 percent
Thickness	ASTM D5199	≥0.300 in.

B. Geotextile:
1. Cover geonet core on both sides with a geotextile complying with requirements specified in Section 02778: Geotextiles, Separator.

C. Drainage Composite:

1. Create a composite by heat bonding geotextiles to the geonet. The bond between the geotextile and the geonet shall exhibit a MARV ply adhesion of 1 LBS/IN when tested in accordance with ASTM D7005
2. Effective Transmissivity MARV of $3.3x10^{-3}$ square meters per second @ 100 hrs.

2.3 SOURCE QUALITY CONTROL

A. Transmissivity Testing:
   1. Measure in place flow rate using water at 68 DegF with a normal compressive load of 10,000 psf, a hydraulic gradient of 0.3, and 100-hour loading.
   2. Attach geotextiles to the geonet in the same configuration as will be used in the field.
   3. Boundary conditions are soil interface on the upper geotextile and HDPE geomembrane against the lower geotextile.
   4. Testing frequency: 1 test for every 50,000 SF of installed product.
   5. Report shall include:
      a. Graph of flow rate vs. hydraulic gradient.
      b. Calculate transmissivity under laminer flow conditions.
      c. Calculated effective transmissivity at hydraulic gradient of 0.3.

B. Interface Friction Tests.
   1. Test materials using ASTM D 6243. Consult the Design Engineer for the required interface friction and the conditions under which this material must be tested .
   2. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to placement of the drainage composite, clean the substrate of all soil, rock, and other materials which could damage the composite.

B. The geocomponent drainage media shall be placed only on geomembrane that has been approved by the Geomembrane Installer and accepted by the Geotech Engineer.

3.2 INSTALLATION

A. Install geocomposite drain in accordance with manufacturer's written recommendations.

B. Deploy the drainage composite ensuring that the drainage composite and underlying materials are not damaged. Replace or repair faulty or damaged drainage composite as directed by Engineer.

C. Unroll drainage composite downslope keeping in slight tension to minimize wrinkles and folds.

D. Maintain free of dirt, mud, or any other foreign materials at all times during construction. Clean or replace rolls which are contaminated.

E. Place adequate ballast to prevent uplift by wind.

F. Overlap adjacent rolls a minimum of 6 IN. Overlap new drainage composite over existing as shown on the drawings.

G. Use manufacturer's fasteners to join adjacent rolls. Metallic fasteners will not be allowed. Space fasteners a maximum of 5 FT along downslope roll overlaps and a maximum of 1 FT along cross slope roll overlaps. Use fasteners of contrasting color from the drainage composite to facilitate visual inspection. Do not weld drainage composite to geomembranes.

H. Heat tack overlap of the upper geotextile to the upper geotextile of the adjacent rolls.

I. Repairs holes or tears in the drainage composite by placing a patch of drainage composite extending a minimum of 2 FT beyond the edges of the hole or tear. Use approved fasteners, spaced every 6 IN around the patch, to fasten the patch to the original roll.

J. Penetration details shall be as recommended by the Manufacturer and as approved by the Engineer.

3.3 FIELD QUALITY CONTROL

A. Provide as-constructed drawing showing roll number; layout; joint locations; and repair and patch locations.

B. Prior to installation of the drainage composite, provide the Engineer quality control certificates signed by the manufacturer's quality assurance manager for every 50,000 SF of geocomposite drainage media to be installed.

END OF SECTION

SECTION 02778
GEOTEXTILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-woven geotextile material.
   2. Woven geotextile material.

B. Related Sections:
   1. Section 02220 - Earthwork.
   2. Section 02777 - Drainage Geocomposite.
   3. Construction Quality Assurance Plan.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway Transportation Officials (AASHTO):
      a. M288, Standard Specification for Geotextile Specification for Highway Application.
   2. ASTM International (ASTM):
      a. D1987, Biological Clogging of Geotextile or Soil/Geotextile Filters.
      b. D3766, Standard Terminology Relating to Catalysts and Catalysis.
      c. D3776, Test Method for Mass Per Unit Area of Woven Fabric.
      d. D3786, Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
      e. D4354, Sampling of Geosynthetics for Testing.
      f. D4355, Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
      g. D4491, Water Permeability of Geotextiles by Permittivity.
      h. D4533, Trapezoid Tearing Strength of Geotextiles.
      i. D4595, Tensile Properties of Geotextiles by the Wide-Width Strip Method.
      j. D4632, Grab Breaking Load and Elongation of Geotextiles.
      k. D4751, Determining Apparent Opening Size of A Geotextile.
      l. D4759, Determining the Specification Conformance of Geosynthetics.
      m. D4833, Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      n. D4873, Identification, Storage, and Handling of Geosynthetic Rolls.
      o. D5261, Test Method for Measuring Mass Per Unit Area of Geotextiles.
      p. D6193, Standard Practice for Stitches and Seams.
      q. D7238, Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

B. Qualifications:
   1. Each manufacturing, fabricating firm shall demonstrate 5 years continuous experience, including a minimum of 10,000,000 SF of geotextile installation in the past 3 years.
   2. Installing firm shall demonstrate that the site Superintendent or Foreman has had responsible charge for installation of a minimum of 1,000,000 SF of geotextile.
   3. Installer shall attend pre-installation conference.

1.3 DEFINITIONS:

A. Manufacturer: Manufacturer producing geotextile sheets from resin and additives.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

C. MARV: Minimum Average Roll Value

1.4 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's documentation that raw materials and roll materials comply with required geotextile physical properties.
   2. Manufacturer and Installer quality control manuals.
   3. Original test results for resins, roll material and factory seam tests at frequency specified in respective quality control manuals. Results shall include or bracket the rolls delivered for use in the Work.
   4. Proposed details of anchoring and overlapping if different than included in Contract Documents.

B. Miscellaneous Submittals:
   1. For needle punched geotextiles, the Manufacturer shall certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers.
   2. Qualification documentation specified in Article 1.2.

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace geotextile or plastic wrapping damaged as a result of storage or handling, as directed.

E. Do not expose geotextile to temperatures in excess of 71 DegC (160 DegF) or less than 0 DegC (32 DegF) unless recommended by the manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling geotextile. Do not lift rolls lifted by use of cables or chains in contact with the geotextile. Do not drag geotextile along the ground.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Agru America, Inc.
   2. Carthage Mills.
   3. TenCate Geosynthetics.
   4. GSE Environmental

2.2 MATERIALS AND MANUFACTURE

A. Geotextile:
   1. Geotextile fibers:
      a. Long-chain synthetic polymer composed of at least 85 percent by weight polyolefins, polyesters, or polyamides.
      b. Filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
      c. Do not add reclaimed or recycled fibers or polymer to the formulation.

2. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages.
3. The geotextile physical properties shall equal or exceed the minimum average roll values listed below. Values shown are for the weaker principal direction. Acceptance of geotextile shall be in accordance with ASTM D4759.

Cushion Geotextile: Non-woven, needle punched; polyester or polypropylene; continuous filament or staple fibers; conforming to the following properties:

Property	Test Method	Minimum Required Value
Unit Weight	ASTM D5261	12 oz/sy
Grab Tensile Strength	ASTM D4632	300 lb
Puncture Strength	ASTM D4833	180 lb

Separator Geotextile: Non-woven, needle punched; polyester or polypropylene; continuous filament or staple fibers; conforming to the following properties:

Property	Test Method	Minimum Required Value
Unit Weight	ASTM D5261	8 oz/sy
Grab Tensile Strength	ASTM D4632	210 lb
Elongation	ASTM D4632	50%
Puncture Strength	ASTM D4833	95 lb
Maximum Apparent Opening Size	ASTM D4751	#70 US Sieve
Permittivity	ASTM D4491	0.5 sec-1

Roadbed Geotextile Fabric: The geotextile shall be composed of synthetic fibers formed into a woven fabric. Fibers used in the manufacture of the geotextile shall be polyolefins, polyesters or polyamides and conform to the following properties.

Property	Test Method	Minimum Required Value
Grab Tensile	ASTM D4632	200 lbs
Grab Elongation	ASTM D4632	15 %
Puncture Strength	ASTM D4833	100 lbs
Trapezoidal Tear	ASTM D4533	75
UV Resistance	ASTM D4355 or D7238	90 %

B. Thread:
1. High-strength polyester, nylon, or other approved thread type.
2. Equivalent chemical compatibility and ultraviolet light stability as the geotextile.
3. Contrasting color with the geotextile.

PART 3 - EXECUTION

3.1 PREPARATION

A. Construct the surface underlying the geotextiles smooth and free of ruts or protrusions which could damage the geotextiles.

3.2 INSTALLATION

A. Install geotextiles in accordance with manufacturer's written recommendations.

B. Hand place geotextile. No equipment will be permitted to traffic in direct contact with the geotextile.

C. Lay geotextile smooth so as to be free of tensile stresses, folds, and wrinkles.

D. Seam Construction:
   1. Geotextile seams may be sewn or overlapped. Construct overlapped seams in accordance with manufacturer's recommendations or as shown on Drawings.
   2. Sew seams continuously using an SSA flat seam with one row of a two-thread 401 chain stitch unless otherwise recommended by the manufacturer.
   3. Minimum distance from the geotextile edge to the stitch line nearest to that edge: 2 IN unless otherwise recommended by the manufacturer.
   4. Test seams at the frequency specified in Article 3.3.
   5. Tie off thread at the end of each seam to prevent unraveling.
   6. Construct seams on the top side of the geotextile to allow inspection.
   7. Sew skipped stitches or discontinuities with an extra line of stitching with 18 IN of overlap.
   8. Heat tack the geotextile overlaps as shown on the Drawings.
   9. Overlap adjacent panels a minimum of 4 IN. Heat bond seam must develop a minimum of 60% of the tensile strength of the parent geotextile as measured in ASTM D4632.

E. Protect geotextiles from clogging, tears, and other damage during installation.

F. Geotextile Repair:
   1. Place a patch of the same type of geotextile which extends a minimum of 12 inches beyond the edge of the damage or defect.
   2. Fasten patches continuously using a sewn seam or other approved method.
   3. Align machine direction of the patch with the machine direction of the geotextile being repaired.
   4. Replace geotextile which cannot be repaired.

G. Use adequate ballast (e.g. sand bags) to prevent uplift by wind.

H. Do not use staples or pins to hold the geotextile in place.

I. Geotextile left uncovered for more than 90 days shall be replaced unless otherwise allowed by Engineer.

END OF SECTION

SECTION 02800

GEOSYNTHETIC CLAY LINER (GCL) - STANDARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Furnish all labor, material, and equipment to complete installation of the GCL in accordance with the Contract Drawings and these Specifications.
   2. Completely coordinate work with that of other trades.
   3. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.
   4. Furnish Geotech Engineer to monitor the work of GCL Installer and to perform CQA/CQC testing in accordance with provisions of the Contract Documents.

B. Related Sections include but are not necessarily limited to:
   1. Section 02220 - Earthwork.
   2. Section 02775 - HDPE Geomembrane Liner System.

1.2 QUALITY STANDARDS

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D4632, Test Method for Grab Breaking Load and Elongation of Geotextile.
      b. D4643, Determination of Water Content of Soil by Microwave Oven Method.
      c. D4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      d. D5261, Measuring Mass Per Unit Area of Geotextiles.
      e. D5321, Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
      f. D5887, Measurement of Index Flux through Saturated GCL Specimens Using a Flexible Wall Permeameter.
      g. D5888, Storage and Handling of GCL.
      h. D5889, Quality Control of GCL.
      i. D5890, Swell Index Measurement of Clay Mineral Component of GCL.
      j. D5891, Fluid Loss of Clay Mineral Component of GCL.
      k. D5993, Measuring Mass Per Unit Area of GCL.
      l. D6072, Installation of GCL.
      m. D6766, Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.
   2. Geosynthetic Research Institute (GRI):
      a. GCL-3, Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs)

B. Qualifications:
   1. Manufacturer: The GCL shall be furnished by a manufacturer that has previously produced a minimum of 1,000,000 SF of the material for use in similar projects.

C. CQA Plan Implementation: Construction Quality Assurance documentation for the GCL installation will be performed for the Owner in accordance with the CQA Plan prepared for this project. The Owner, Geotech Engineer, and GCL Installer, however, should familiarize themselves with the CQA Plan.

1.3 DEFINITIONS:

A. Manufacturer: Manufacturer produces geosynthetic clay liner panels from first quality geotextiles and sodium bentonite. The manufacturer is responsible for producing panels which comply with this Specification. These responsibilities include but are not limited to:
   1. Acceptance of the geotextiles, bentonite, and additives from suppliers/manufacturers and testing of these materials to ensure compliance with the manufacturer's specifications and with this Specification.
   2. Fabrication of the geotextiles and bentonite into GCL panels using mixing and extrusion equipment.
   3. Testing of the GCL to ensure compliance with manufacturer's specification and this Specification.
   4. Shipping of the GCL to fabricator/installer designated facilities.
   5. Certification of the raw materials and finished GCL to comply with this Specification.
   6. Certification of fabricator's and installer's training, experience, and methods for seaming and inspecting GCL installations in compliance with manufacturer's standards and with Quality Assurance requirements of this Specification (Article 1.2).

B. Installer: Installers of GCLs are responsible for storing, handling, fitting, seaming, and testing of GCL panels in the field. These responsibilities include but are not limited to:
   1. Acceptance (in writing) of the GCL rolls from the transporter.
   2. Acceptance (in writing) of the soil material which will serve as a base for the GCL. This acceptance shall precede installation of the GCL, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of GCL liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
   3. Handling, seaming, testing, and repair of GCL liners in compliance with this Specification and with written procedure manuals prepared by the installer or the manufacturer.
   4. Repair or replacement of defects in the GCL as required by the Inspector or the Owner.
   5. Installer and manufacturer may be the same firm.

C. Inspector: Inspectors of GCL liner are responsible for observing field installation of the GCL and providing the manufacturer, installer, and Owner with verbal and written documentation of the compliance of the installation with this Specification and with written procedures manuals prepared by the manufacturer. Inspector’s responsibilities include, but are not limited to:
   1. Inspection of material, handling, and field installation of the GCL liner. Inspection of all seams, repair, and test results.
   2. All exceptions to material or installation shall be documented to the Engineer in writing within 48 hours of discovery.

D. Engineer: The Engineer is responsible for design of the geosynthetic liner system.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product Data and Factory Test Results: Published product properties and specifications for the proposed GCL, as well as factory test results of materials certified by the GCL manufacturer, shall be submitted showing conformance with the requirements of these Specifications. In addition, the Contractor shall submit the manufacturer's certification stating that the material is similar to and of the same formulation as that for which test results are submitted, and by which actual usage has been demonstrated to be satisfactory for the intended application.
   2. Samples: Samples of the GCL sheeting shall be provided to the Geotech Engineer. Samples shall have a width of 4.5 IN, and a length of 5 IN.
   3. Delivery, Storage, and Handling Instructions: The manufacturer's recommendations for delivery, storage, and handling shall be submitted to the Geotech Engineer for review.
   4. Delivery Date: The Geotech Engineer shall be notified of the scheduled delivery date for the materials.

5. Installation Drawings, Procedures, and Schedules: Installation drawings, procedures, and a schedule for carrying out the work shall be provided by the Contractor to the Geotech Engineer for review. Procedures addressed by the Contractor shall include but not be limited to material unloading, storage, installation, repair, and protection to be provided in the event of rain. A schedule showing the order of placement, location of panels, seams, and penetrations shall be submitted for the Geotech Engineer's review. Submit drawings showing the panel layout, seams, and associated details including pipe penetrations. Following review, these drawings will be used for installation of the GCL. Any deviations from these drawings must be approved by the Geotech Engineer.

B. Miscellaneous Submittals:
   1. A certificate stating that the GCL has been installed in accordance with the Plans, Specifications, and the manufacturer's recommendations.
   2. Manufacturer's Warranty: The material warranty shall be for defects or failures related to manufacture on a non-prorata basis for five (5) years after date of shipment.
   3. GCL Installer's Warranty: The GCL Installer's warranty shall warrant their workmanship to be free of defects on a non-prorata basis for five (5) years after the final acceptance of the Work. This warranty shall include but not be limited to overlapped seams, anchor trenches, attachments to appurtenances, and penetration seals.
   4. Record Drawing Information: Record drawings including but not limited to drawings showing the location of all seams, panels, repairs, patches, anchor trenches, pipe penetrations, and other appurtenances, including measurements and dimensions, shall be prepared by the Contractor and submitted to the Geotech Engineer following completion of the project.

1.5 PROJECT CONDITIONS

A. The GCL shall not be placed in standing water, high humidity, or while raining. Any material that becomes partially or completely hydrated in the opinion of the Geotech Engineer shall be removed and replaced at Contractor's expense.

B. Take necessary precautions to protect underlying soil and geomembrane liners from damage due to any construction activity. Damage to liners shall be repaired at Contractor’s expense.

C. The Contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces, which hampers the efficient field seaming of geosynthetic panels.

D. The Contractor shall maintain natural surface water drainage diversions around the work area. The Contractor shall provide for the disposal of water that may collect in the work area, from precipitation falling on the work or from inadequate diversion structures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Geosynthetic Clay Liners:
      a. Agru America, Inc.
      b. CETCO.
      c. GSE Environmental.
      d. Terrafix

2.2 MATERIALS

A. General:

1. The GCL shall consist of bentonite encased, front and back, with geotextile. GCL consisting of bentonite backed with geomembrane can be used only if approved by the Project Manager and Engineer. The materials supplied under these Specifications shall be first quality products designed and manufactured specifically for the purposes of this work.
2. The GCL shall be supplied in rolls which have a minimum width of 12 FT. The roll length shall be maximized to provide the largest manageable sheet for the fewest overlaps. Labels on the roll shall identify the sheet number, date of fabrication, proper direction of unrolling, and minimum recommended overlap. A quality control certificate shall be supplied with each roll.
3. **The GCL shall be reinforced.**
4. The bentonite shall be continuously adhered to both geotextiles to ensure that the bentonite will not be displaced during handling, transportation, storage and installation, including cutting, patching, and fitting around penetrations. The bentonite sealing compound or bentonite granules used to seal penetrations and make repairs shall be made of the same natural sodium bentonite as the GCL and shall be as recommended by the GCL manufacturer. The permeability of the GCL overlap seams shall be equal to or less than the permeability of the body of the GCL sheet.

B. Physical Properties: Physical properties of GCL shall be as shown in Table 1 of this Section. The manufacturer shall certify that materials provided meet these criteria according to ASTM D5889 and GRI GCL3 as modified by this Specification.

TABLE 1: REQUIRED GCL PROPERTIES

GCL PROPERTY	TEST METHOD	REQUIRED VALUE
Maximum Hydraulic Conductivity	ASTM D5887	$5x10^{-9}$ cm/s
Minimum Bentonite Content	ASTM D5993 (@ 0% moisture)	0.75 lb/sf
MARV Grab Tensile Strength	ASTM D4632	90 lbs
Hydrated Internal Shear Strength	ASTM D5321	500 psf
Minimum Free Swell	ASTM D5890	24 Ml
Maximum Fluid Loss	ASTM D5891	18 mL
Minimum Peel Strength, MD	ASTM D6496	3.5 ppi
MARV Tensile Strength, MD	ASTM 6768	30 ppi

C. Interface Friction Tests.
1. Test this and adjacent materials using ASTM D 6243. Consult the Design Engineer for the required interface and the conditions under which this material shall be tested.
2. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Shipping, Handling, and Storage:
   1. During periods of shipment and storage, all GCL shall be protected from direct sunlight, water, mud, dirt, dust, and debris. To the extent possible, the GCL shall be maintained wrapped in heavy-duty protective covering until use. GCL delivered to the project site without protective wrapping shall be rejected.
   2. The Engineer shall approve the shipping and delivery schedule prior to shipment. The Engineer shall approve the on-site storage area for the GCL. Unloading and storage of GCL shall be the responsibility of the Contractor.
   3. GCL that is damaged during shipping, handling, or storage shall be rejected and replaced at Contractor's expense.

B. Installation of GCL:
   1. GCL shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, GCL shall be rejected by the CQA/CQC Consultant if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.
   2. The surface receiving the GCL shall be prepared to a relatively smooth condition, free of obstructions, excessive depressions, debris, and very soft or loose pockets of soil. This surface shall be approved by the CQA/CQC Consultant prior to GCL placement.
   3. The GCL shall be placed smooth and free of excessive wrinkles.
   4. The GCL shall be installed on sideslopes with vertical seams only.
   5. When GCL is placed with upslope and downslope portions, the upslope portion shall be lapped such that it is the upper or exposed surface.
   6. The GCL shall not be placed in standing water or while raining. Any material that becomes partially/totally hydrated shall be removed and replaced.
   7. The GCL seams shall be laid with a minimum overlap equal to 6 IN or the manufacturer's recommendation, whichever is greater. Bentonite powder shall be placed at all GCL seams.
   8. GCL shall be temporarily secured in a manner approved by the Geotech Engineer Consultant prior to placement of overlying materials.
   9. Any GCL that is torn or punctured shall be repaired or replaced as directed by the Geotech Engineer, by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of GCL placed over the failed areas and shall overlap the existing GCL a minimum of 12 IN from any point of the rupture.
   10. If in-place GCL is not otherwise protected from hydration due to rainfall, the GCL shall be covered with a minimum of 12 IN of the overlying design material within 12 hours of GCL placement.

3.2 FIELD QUALITY CONTROL

A. The Geotech Engineer shall monitor and document the installation of GCL to ensure that the installation and necessary repairs are made in accordance with these Specifications.

3.3 GCL ACCEPTANCE

A. The GCL Installer shall retain all ownership and responsibility for the GCL until final acceptance by the Owner. The Owner will accept the GCL installation when the installation is finished, all required submittals have been received and approved, and CQC/CQA verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

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SECTION 02801

GEOSYNTHETIC CLAY LINER (GCL) - ALTERNATE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Furnish all labor, material, and equipment to complete installation of the GCL in accordance with the Contract Drawings and these Specifications.
   2. Completely coordinate work with that of other trades.
   3. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, complete, and compatible installation shall be furnished and installed as part of this work.
   4. Furnish Geotech Engineer Consultant to monitor the work of GCL Installer and to perform CQA/CQC testing in accordance with provisions of the Contract Documents.

B. Related Sections include but are not necessarily limited to:
   1. Section 02220 - Earthwork.
   2. Section 02775 - HDPE Geomembrane Liner System.

1.2 QUALITY STANDARDS

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D4632, Test Method for Grab Breaking Load and Elongation of Geotextile.
      b. D4643, Determination of Water Content of Soil by Microwave Oven Method.
      c. D4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
      d. D5261, Measuring Mass Per Unit Area of Geotextiles.
      e. D5321, Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
      f. D5887, Measurement of Index Flux through Saturated GCL Specimens Using a Flexible Wall Permeameter.
      g. D5888, Storage and Handling of GCL.
      h. D5889, Quality Control of GCL.
      i. D5890, Swell Index Measurement of Clay Mineral Component of GCL.
      j. D5891, Fluid Loss of Clay Mineral Component of GCL.
      k. D5993, Measuring Mass Per Unit Area of GCL.
      l. D6072, Installation of GCL.
      m. D6766, Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.
   2. Geosynthetic Research Institute (GRI):
      a. GCL-3, Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs)

B. Qualifications:
   1. Manufacturer: The GCL shall be furnished by a manufacturer that has previously produced a minimum of 1,000,000 SF of the material for use in similar projects.

C. CQA Plan Implementation: Construction Quality Assurance documentation for the GCL installation will be performed for the Owner in accordance with the CQA Plan prepared for this project. The Owner, CQC Consultant, and GCL Installer, however, should familiarize themselves with the CQA Plan.

1.3 DEFINITIONS:

A. Manufacturer: Manufacturer produces geosynthetic clay liner panels from first quality geotextiles and sodium bentonite. The manufacturer is responsible for producing panels which comply with this Specification. These responsibilities include but are not limited to:
   1. Acceptance of the geotextiles, bentonite, and additives from suppliers/manufacturers and testing of these materials to ensure compliance with the manufacturer's specifications and with this Specification.
   2. Fabrication of the geotextiles and bentonite into GCL panels using mixing and extrusion equipment.
   3. Testing of the GCL to ensure compliance with manufacturer's specification and this Specification.
   4. Shipping of the GCL to fabricator/installer designated facilities.
   5. Certification of the raw materials and finished GCL to comply with this Specification.
   6. Certification of fabricator's and installer's training, experience, and methods for seaming and inspecting GCL installations in compliance with manufacturer's standards and with Quality Assurance requirements of this Specification (Article 1.2).

B. Installer: Installers of GCLs are responsible for storing, handling, fitting, seaming, and testing of GCL panels in the field. These responsibilities include but are not limited to:
   1. Acceptance (in writing) of the GCL rolls from the transporter.
   2. Acceptance (in writing) of the soil material which will serve as a base for the GCL. This acceptance shall precede installation of the GCL, and shall state that the installer has inspected the surface, and reviewed the Specifications for material and placement, and finds all conditions acceptable for placement of GCL liners. The written acceptance shall explicitly state any and all exceptions to acceptance.
   3. Handling, seaming, testing, and repair of GCL liners in compliance with this Specification and with written procedure manuals prepared by the installer or the manufacturer.
   4. Repair or replacement of defects in the GCL as required by the Inspector or the Owner.
   5. Installer and manufacturer may be the same firm.

C. Inspector: Inspectors of GCL liner are responsible for observing field installation of the GCL and providing the manufacturer, installer, and Owner with verbal and written documentation of the compliance of the installation with this Specification and with written procedures manuals prepared by the manufacturer. Inspector’s responsibilities include, but are not limited to:
   1. Inspection of material, handling, and field installation of the GCL liner. Inspection of all seams, repair, and test results.
   2. All exceptions to material or installation shall be documented to the Engineer in writing within 48 hours of discovery.

D. Engineer: The Engineer is responsible for design of the geosynthetic liner system.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product Data and Factory Test Results: Published product properties and specifications for the proposed GCL, as well as factory test results of materials certified by the GCL manufacturer, shall be submitted showing conformance with the requirements of these Specifications. In addition, the Contractor shall submit the manufacturer's certification stating that the material is similar to and of the same formulation as that for which test results are submitted, and by which actual usage has been demonstrated to be satisfactory for the intended application.
   2. Samples: Samples of the GCL sheeting shall be provided to the CQA Consultant. Samples shall have a width of 4.5 IN, and a length of 5 IN.
   3. Delivery, Storage, and Handling Instructions: The manufacturer's recommendations for delivery, storage, and handling shall be submitted to the CQA Consultant for review.
   4. Delivery Date: The CQA Consultant shall be notified of the scheduled delivery date for the materials.

5. Installation Drawings, Procedures, and Schedules: Installation drawings, procedures, and a schedule for carrying out the work shall be provided by the Contractor to the CQA Consultant for review. Procedures addressed by the Contractor shall include but not be limited to material unloading, storage, installation, repair, and protection to be provided in the event of rain. A schedule showing the order of placement, location of panels, seams, and penetrations shall be submitted for the CQA Consultant's review. Submit drawings showing the panel layout, seams, and associated details including pipe penetrations. Following review, these drawings will be used for installation of the GCL. Any deviations from these drawings must be approved by the CQA Consultant.

B. Miscellaneous Submittals:
   1. A certificate stating that the GCL has been installed in accordance with the Plans, Specifications, and the manufacturer's recommendations.
   2. Manufacturer's Warranty: The material warranty shall be for defects or failures related to manufacture on a non-prorata basis for five (5) years after date of shipment.
   3. GCL Installer's Warranty: The GCL Installer's warranty shall warrant their workmanship to be free of defects on a non-prorata basis for five (5) years after the final acceptance of the Work. This warranty shall include but not be limited to overlapped seams, anchor trenches, attachments to appurtenances, and penetration seals.
   4. Record Drawing Information: Record drawings including but not limited to drawings showing the location of all seams, panels, repairs, patches, anchor trenches, pipe penetrations, and other appurtenances, including measurements and dimensions, shall be prepared by the Contractor and submitted to the CQA Consultant following completion of the project.

1.5 PROJECT CONDITIONS

A. The GCL shall not be placed in standing water, high humidity, or while raining. Any material that becomes partially or completely hydrated in the opinion of the CQA Consultant shall be removed and replaced at Contractor's expense.

B. Take necessary precautions to protect underlying soil and geomembrane liners from damage due to any construction activity. Damage to liners shall be repaired at Contractor's expense.

C. The Contractor shall ensure that adequate dust control methods are in effect to prevent the unnecessary accumulation of dust and dirt on geosynthetic surfaces, which hampers the efficient field seaming of geosynthetic panels.

D. The Contractor shall maintain natural surface water drainage diversions around the work area. The Contractor shall provide for the disposal of water that may collect in the work area, from precipitation falling on the work or from inadequate diversion structures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Geosynthetic Clay Liners:
      a. GSE Environmental.
      b. Cetco.

2.2 MATERIALS

A. General:
   1. The GCL shall consist of bentonite encased, front and back, with geotextile. The materials supplied under these Specifications shall be first quality products designed and manufactured specifically for the purposes of this work.

2. The GCL shall be supplied in rolls which have a minimum width of 12 FT. The roll length shall be maximized to provide the largest manageable sheet for the fewest overlaps. Labels on the roll shall identify the sheet number, date of fabrication, proper direction of unrolling, and minimum recommended overlap. A quality control certificate shall be supplied with each roll.
3. **The GCL shall be reinforced GSE BentoLiner CAR NSL, CAR NWL, or Engineer approved equal.**
4. The bentonite shall be continuously adhered to both geotextiles to ensure that the bentonite will not be displaced during handling, transportation, storage and installation, including cutting, patching, and fitting around penetrations. The bentonite sealing compound or bentonite granules used to seal penetrations and make repairs shall be made of the same natural sodium bentonite as the GCL and shall be as recommended by the GCL manufacturer. The permeability of the GCL overlap seams shall be equal to or less than the permeability of the body of the GCL sheet.

B. Physical Properties: Physical properties of GCL shall be as shown in Table 1 of this Section. The manufacturer shall certify that materials provided meet these criteria according to ASTM D5889 and GRI GCL3 as modified by this Specification.

TABLE 1: REQUIRED GCL PROPERTIES

GCL PROPERTY	TEST METHOD	REQUIRED VALUE
Maximum Hydraulic Conductivity	ASTM D5887	$5x10^{-9}$ cm/s
Minimum Bentonite Content	ASTM D5993 (@ 0% moisture)	0.75 lb/sf
Typical Shear Strength	ASTM D5321	500 psf (when hydrated)
Minimum Free Swell	ASTM D5890	24 mL
Maximum Fluid Loss	ASTM D5891	18 mL
Minimum Peel Strength, MD	ASTM D6496	3.5 ppi
MARV Tensile Strength, MD	ASTM D6768	30 ppi

C. Interface Friction Tests.
1. Test this and adjacent materials using ASTM D 6243. Consult the Design Engineer for required interface and the conditions under which this material shall be tested.
2. This material is part of a system. The system shall meet the requirements before the component material can be deemed acceptable.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Shipping, Handling, and Storage:
1. During periods of shipment and storage, all GCL shall be protected from direct sunlight, water, mud, dirt, dust, and debris. To the extent possible, the GCL shall be maintained wrapped in heavy-duty protective covering until use. GCL delivered to the project site without protective wrapping shall be rejected.

2. The Engineer shall approve the shipping and delivery schedule prior to shipment. The Engineer shall approve the on-site storage area for the GCL. Unloading and storage of GCL shall be the responsibility of the Contractor.
3. GCL that is damaged during shipping, handling, or storage shall be rejected and replaced at Contractor's expense.

B. Installation of GCL:
1. GCL shall be placed to the lines and grades shown on the Contract Drawings. At the time of installation, GCL shall be rejected by the CQA Consultant if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.
2. The surface receiving the GCL shall be prepared to a relatively smooth condition, free of obstructions, excessive depressions, debris, and very soft or loose pockets of soil. This surface shall be approved by the CQA Consultant prior to GCL placement.
3. The GCL shall be placed smooth and free of excessive wrinkles.
4. The GCL shall be installed on sideslopes with vertical seams only.
5. When GCL is placed with upslope and downslope portions, the upslope portion shall be lapped such that it is the upper or exposed surface.
6. The GCL shall not be placed in standing water or while raining. Any material that becomes partially/totally hydrated shall be removed and replaced.
7. The GCL seams shall be laid with a minimum overlap equal to 6 IN or the manufacturer's recommendation, whichever is greater. Bentonite powder shall be placed at all GCL seams.
8. GCL shall be temporarily secured in a manner approved by the CQA Consultant prior to placement of overlying materials.
9. Any GCL that is torn or punctured shall be repaired or replaced as directed by the Geotech Engineer, by the Contractor at no additional cost to the Owner. The repair shall consist of a patch of GCL placed over the failed areas and shall overlap the existing GCL a minimum of 12 IN from any point of the rupture.
10. If in-place GCL is not otherwise protected from hydration due to rainfall, the GCL shall be covered with a minimum of 12 IN of the overlying design material within 12 hours of GCL placement.

3.2 FIELD QUALITY CONTROL

A. The Geotech Engineer shall monitor and document the installation of GCL to ensure that the installation and necessary repairs are made in accordance with these Specifications.

3.3 GCL ACCEPTANCE

A. The GCL Installer shall retain all ownership and responsibility for the GCL until final acceptance by the Owner. The Owner will accept the GCL installation when the installation is finished, all required submittals have been received and approved, and CQC/CQA verification of the adequacy of all field seams and repairs, including associated testing, is complete.

END OF SECTION

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SECTION 13251
FACTORY COATED BOLTED STEEL TANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Atmospheric landfill wastewater (leachate) tank.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC).
   2. American Petroleum Institute (API)
      a. API 650 Welded Steel Tanks for Oil Storage
   3. American Society for Testing and Materials (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A285, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.
      c. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
   4. American Water Works Association (AWWA):
      a. D100, Welded Carbon Steel Tanks for Water Storage
      b. D103, Standard for Factory Coated Bolted Steel Tanks.
   5. Occupational, Safety and Health Administration (OSHA).
   6. Steel Structures Painting Council Standards (SSPC):
      a. SP-6, Commercial Blast Cleaning.
      b. SP-10, Near-White.

B. Qualifications: Manufacturers to have own fabricating plant and have designed, fabricated, and erected at least five storage tanks of capacity and type specified, for leachate storage.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that product submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Fabrication and/or layout drawings:
      a. Complete construction details. Anchor bolt sizes and locations for installation by Contractor.
      b. Complete detailed drawings of equipment furnished.
      c. Foundation load requirements.
      d. Tank design calculations.
      e. Location of penetrations and ancillary equipment.
   3. Test reports.
   4. Certifications: Certificates of compliance with standards specified for all major components incorporated into work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Steel Members:
   1. Handle and store steel members above ground on platforms, skids, or other supports.
   2. Keep members free of dirt, grease and other foreign material.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Tanks:
      a. Engineered Storage Products Company.
      b. Or approved equal.

2.2 MATERIALS

A. Atmospheric Wastewater Tank:
   1. In accordance with AWWA D103 or D100,

2.3 ATMOSPHERIC WASTEWATER TANK DESIGN REQUIREMENTS

A. Nominal Tank Size:
   1. Storage Tank:
      a. Capacity: 267,000 GAL.
      b. Inside diameter: 67 FT.
      c. Height: 10 FT.
   2. Containment Tank
      a. Capacity: 310,000 GAL.
      b. Inside diameter: 98 FT.
      c. Height: 6 FT.

B. Design tank in accordance with AISC specifications.

C. Environmental, Wind, Seismic, Live, Dead, Equipment, and Snow loads: In accordance with API 650.

D. Design tank to support stairs, dead and live load, plus any equipment supported by the tank.

E. Corrosion Allowance: 1/16"

F. Provide bolted steel walls and bottom with a 3-foot diameter sump as shown on Drawings.

G. Design Conditions:
   1. Pressure: Atmospheric - Open Top.
   2. Temperature: 5 to 100 Deg f.
   3. Specific Gravity: 1.05.

H. Provide anchor bolts, tie-down lugs, and other materials as required to install tank to foundation.

I. Connections: Design all openings and connections in accordance with AWWA D103 or D100, with sizes and locations as specified in the Drawings.

2.4 ACCESSORIES

A. Nominal 24-inch dia. manway with hinged cover and gasket, in accordance with AWWA D103 or D100.

B. Foundation:
   1. Footing design shall be based on soil bearing capacity determined by geotechnical analysis performed by a licensed soils engineer.
   2. The tank manufacturer shall confirm design loading and foundation design for the tank.

C. Tank shall be equipped with a stainless steel float and target type level indicator. Indicator shall be Varec, Series 6700, or equal, and numerically labeled in terms of feet. All wetted parts and top anchors shall be stainless steel. Cable guide shall be braced sufficient to support weight and thrust imposed by large roosting birds.

D. An aluminum gaugeboard shall be mounted on the inside of tank. The gaugeboard shall be vinyl coated and numerically labeled in terms of feet.

PART 3 - EXECUTION

3.1 ERECTION

A. Erect tanks in accordance with manufacturer's instructions.

B. Nameplates:
   1. Nameplate data to include:
      a. Manufacturer's name.
      b. Tank capacity.
      c. Equipment number.
      d. Design and operating pressure.
      e. Date of construction.

3.2 FIELD QUALITY CONTROL

A. FIELD QUALITY CONTROL
   1. Testing:
      a. After construction of tank is complete test in accordance with AWWA D103 or D100.
      b. Repair leaks. Do not perform work on any joint unless the water is at least 2 FT below the point being repaired.
      c. Properly restore any damaged coating.

END OF SECTION

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SECTION 15060

PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Leachate piping systems
   2. Utility piping systems.
   3. Plumbing piping systems.
   4. Culverts

B. Related Sections include but are not necessarily limited to:
   1. Section 15067 - Pipe: High Density Polyethylene (HDPE).
   2. Section 15079 – Pipe: Corrugated Polyethylene.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M36, Corrugated Steel Culverts and Underdrains.
      b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
      c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
      d. M278, Standard Specification for Class PS 46 Polyvinyl Chloride (PVC) Pipe.
      e. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
   2. American National Standards Institute (ANSI):
      a. B16.5, Pipe Flanges and Flanged Fittings.
      b. B36.19, Stainless Steel Pipe.
      c. B40.1, Gauges - Pressure Indicating Dial Type - Elastic Element.
   3. American National Standards Institute (ANSI)/American Water Works Association (AWWA):
      a. ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other Liquids.
      b. ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.
      c. ANSI/AWWA C151, Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand-Lined Molds for Water or Other Liquids.
      d. ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 IN Through 16 IN, for Water and Other Liquids.
   4. ASTM International (ASTM):
      a. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
      b. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
      c. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
      d. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
      e. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      f. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.
      g. F438, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
      h. F439, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

i. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

5. Underwriters Laboratory, Inc. (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

C. Minimum Bury. Unless otherwise shown on the drawings, provide a minimum of three (3) feet earth cover over exterior buried piping systems and appurtenances conveying water.

D. Comply with rules, regulations and policies of the North Carolina Department of Environment and Natural Resources (NCDENR).

E. All material or products which come into contact with drinking water shall be third party certified as meeting the specifications of the American National Institute/National Sanitation Foundation Standard 61, Drinking Water System Components – Health Effects. The certifying party shall be accredited by the American National Standards Institute.

F. All pipe, fittings, packing, and jointing materials, shall conform to Section C of the AWWA Standards.

1.3 SYSTEM DESCRIPTION

A. Piping Systems Organization and Definition:
1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size, and system materials of construction.
2. Table A below defines each service classification, its symbol, and the designated system classification number of each service.

TABLE A. PIPING SERVICES

SYMBOL	SERVICE	SYSTEM
L	Leachate	HDPE/SST
STM	Stormwater	RCP/CMP/HDPE
PW	Potable Water	PVC

1.4 SUBMITTALS

A. Shop Drawings:
1. Fabrication and/or layout drawings:
a. Piping drawings (minimum scale 1 IN equals 10 FT) with information including:
1) Pipe Dimensions, schedule, fittings, and supports.
2) Invert or centerline elevations of piping crossings.
3) Acknowledgement of bury depth and location requirements.
4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe, and line numbers.
6) Line slopes.
b. Schedule of interconnections to existing piping and method of connection.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
c. Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components. Attach technical product data on gaskets, pipe, fittings, and other components.

B. Test Report:
1. Copies of pressure test results on all piping systems.

2. Reports defining results of dielectric testing and corrective action taken.
3. Notification of time and date of piping pressure tests.

C. As-Built Drawings:
1. As work progresses and again when work is complete, submit "As-Recorded" drawings of piping systems including project items and pre-existing items. Identify complete location, elevation, and description of piping systems. Relate piping systems to identified structures and appurtenances.

D. Operation and Maintenance Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

C. Store materials on site under protective coverings above ground to keep materials clean and dry.

PART 2 - PRODUCTS

2.1 MATERIALS

1. See Drawings.

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals as shown on Drawings.

C. When entering or leaving structures or passing beneath the vertical projection of a structure wall use flexible joint piping with first joint installed within 2 FT of point where pipe enters or leaves structure. Install second joint not more than 6 FT nor less than 4 FT from first joint.

D. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure. Install second joint not more than 6 FT nor less than 4 FT from first joint.

E. Install expansion devices as necessary to allow expansion and contraction movement.

F. Laying Pipe in Trench:
1. Clean each pipe length thoroughly and inspect for compliance to Specifications.
2. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
3. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
4. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped along side of pipe or final with bedding material placed.
5. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water except where approved by Engineer.
6. Seal open end of line with watertight plug if pipe laying stopped.
7. Remove water in trench before removal of plug.

G. Anchorage and Blocking:

1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall. Concrete blocks shall not cover pipe joints.
3. Provide bearing area of concrete in accordance with drawing detail.

H. Install underground hazard warning tape.

I. Install insulating components where dissimilar metals are joined together.

3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 IN may not be shown. However, install according to Drawing intent and with clearance and allowance for:
1. Expansion and contraction.
2. System drainage and air removal.

C. Pipe Support:
1. Use methods of piping support as shown on Drawings.
2. Piping support systems for piping 12 IN and greater are shown on the Drawings. Support systems for piping smaller than 12 IN DIA are not necessarily shown on the Drawings. Contractor is responsible for design of these support systems.
3. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
4. Size pipe supports with consideration to specific gravity of liquid being piped.

D. Locate and size sleeves and castings required for piping system. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

E. Use reducing fittings throughout piping systems. Bushings will not be allowed unless specifically approved.

F. Unions:
1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

G. Install expansion devices as necessary to allow expansion/contraction movement.

H. Provide full face gaskets on all systems.

I. Anchorage and Blocking:
1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

J. Equipment Pipe Connections:
1. Equipment - General:
   a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
   b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
   c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint. Provide tightening torque in accordance with manufacturer's recommendations.

d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.
i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

K. Provide insulating components where dissimilar metals are joined together.

L. Instrument Connections:
1. See drawing details.

3.3 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

G. Where connection involves potable water systems, provide disinfection methods as required.

3.4 BUTT FUSION PROCEDURES

A. All HDPE pipe shall be joined using manufacturer's recommended procedures except as specifically noted otherwise.

3.5 FIELD QUALITY CONTROL

A. Pipe Testing - General:
1. Test piping systems as follows:
a. Test exposed, non-insulated piping systems upon completion of system.
b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
d. Test buried piping after backfilling has been complete.
2. Utilize pressures, media and pressure test durations as specified on Piping Specification Schedules.
3. Isolate equipment which may be damaged by the specified pressure test conditions.
4. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.

a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
b. Notify the Engineer 24 HRS prior to each test.

5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:

1. Testing medium: Unless otherwise specified in the Piping Specification Schedules, utilize the following test media.
   a. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 psig or less	Air or water
Above 48 IN	Gravity	25 psig or less	Water
All sizes	Pumped	200 psig or less	Water

2. Allowable leakage rates:
   a. Leachate systems, groundwater pumping systems, all exposed piping systems, all pressure piping systems, and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage at the specified test pressure throughout the duration of the test.
   b. Hydrostatic exfiltration and infiltration for sanitary and stormwater sewers (groundwater level is below the top of pipe):
      1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 FT.
      2) Average head is defined from groundwater elevation to average pipe crown.
      3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) = 115 x (actual test head to the 1/2 power).
   c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):
      1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.
      2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) = 82 x (actual head to the 1/2 power).
   d. For low pressure (less than 25 psig) air testing, the acceptable time for loss of 1 psig of air pressure shall be:

PIPE SIZE (IN DIA)	TIME, MINUTES/100 FT
2	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2

PIPE SIZE (IN DIA)	TIME, MINUTES/100 FT
30	4.8
33	5.4
36	6.0
42	7.3
48	7.6

3. Hydrostatic pressure testing methodology:
   a. General:
      1) All joints, including welds, are to be left exposed for examination during the test.
      2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      3) Provide temporary restraints for expansion joints for additional pressure load under test.
      4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
      5) Do not paint or insulate exposed piping until successful performance of pressure test.
4. Air testing methodology:
   a. General:
      1) Assure air is ambient temperature.
   b. Low pressure air testing:
      1) Place plugs in line and inflate to 25 psig.
      2) Check pneumatic plugs for proper sealing.
      3) Introduce low pressure air into sealed line segment until air pressure reaches 4 psig greater than ground water that may be over the pipe.
         a) Use test gage conforming to ANSI B40.1 with 0 to 15 psi scale and accuracy of 1 percent of full range.
      4) Allow 2 minutes for air pressure to stabilize.
      5) After stabilization period (3.5 psig minimum pressure in pipe) discontinue air supply to line segment.
      6) Record pressure at beginning and end of test.
      7) Repeat test procedure for verification.

3.6 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
   1. Clean interior of piping systems thoroughly before installing.
   2. Maintain pipe in clean condition during installation.
   3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
   4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
   5. At completion of work and prior to Final Acceptance, thoroughly flush all lines installed under these Specifications.

3.7 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

END OF SECTION

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SECTION 15067

PIPE - HIGH DENSITY POLYETHYLENE (HDPE)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. High density polyethylene (HDPE) pipe, fittings, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. Polyethylene (PE) materials:
         1) D2104, (PE) Plastic Pipe, Schedule 40.
         2) D2239, (PE) Plastic Pipe (SDR-PR).
         3) D2447, (PE) Plastic Pipe, Schedule 40 and 80 Based on Outside Diameter.
         4) D2609, Plastic Inserts Fittings for (PE) Plastic Pipe.
         5) D2657 Heat Joining Polyolefin Pipe and Fittings.
         6) D2737, (PE) Plastic Tubing.
         7) D2837 Obtaining Hydrostatic Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
         8) D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
         9) D3350 (PE) Plastic Pipe and Fittings Materials
         10) F1055 Electrofusion Type PE Fittings for OD Controlled PE Pipe and Tubing.
         11) F714 Standard Specification for Polyethylene (PE) Plastic Pipe.
      b. Installation:
         1) D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
         2) D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
   2. American Water Works Association (AWWA):
      a. Polyethylene (PE) materials:
         1) C901, Polyethylene (PE) Pressure Pipe Tubing and Fittings, 1/2 through 3 IN for Water.
         2) C906, Polyethylene (PE) Pressure Pipe and Fittings 4 IN through 63 IN for Water Distribution and Transmission.
   3. American National Standards Institute (ANSI).
      a. B36.10 standard dimensions of steel pipe (IPS).

1.3 DEFINITIONS:

A. SDR – Standard Dimension Ratio.

B. IPS – Iron Pipe Size.

C. CTS – Copper Tube Size.

D. DIPS – Ductile Iron Pipe Size.

E. ESCR – Environmental Stress Crack Resistance.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Pipe schedule identifying
      a. Style, type, size.
      b. Quantity.
      c. Location to be used.
   2. Perforation pattern(s).
   3. Schedule of fittings.
   4. Pipe data.
   5. Sample testing and video inspection report.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Subject to compliance with the Contract Documents, the following manufacturers of PE pipe are acceptable:
   a. Performance Pipe, Chevron Phillips Chemical Company LP
   b. PolyPipe.

2.2 HIGH DENSITY POLYTHELYENE (HDPE) PIPING

A. Materials: Furnish materials in full compliance with following requirements:
   1. Resin: PE 3408
   2. 3-24 IN: ASTM F714
   3. Joints for polyethylene pipe shall be fusion type in accordance with AWWA C901.
   4. 6 IN – 18 IN Pipe: SDR 11.
   5. 18 IN – 24 IN Pipe: SDR 21.

B. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

C. The pipe will be extruded from resin meeting the specifications of ASTM D3350 with a minimum cell classification of 345464C.

D. Installation: Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

2.3 HDPE FITTINGS

A. HDPE fittings shall be in accordance with AWWA C906 or ASTM F1055 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe conforming to this Specification. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2.5 safety factor. The fittings shall be manufactured from the same resin type and cell classification as the pipe itself. The fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.

B. All hardware to be stainless steel.

C. Flange dimensions bolt spacing and hardware size vary by pipe diameter per ANSI Standards.

2.4 PIPE MARKING

A. During extrusion production, the HDPE pipe shall be continuously marked in accordance with AWWA 906 with durable printing including the following information:

1. Nominal size.
2. Dimension ratio.
3. Pressure class.
4. Manufacturer name or trademark and product series.
5. Standard material code designation (ex: PE 3408).
6. Plant identification.
7. Production date.

2.5 PERFORATED PIPE

A. Provide perforations pattern size and spacing in accordance with design shown on the Drawings. The Contractor may submit alternate patterns or spacings that provide equivalent flow and function for Engineer's review.

PART 3 - EXECUTION

3.1 PIPE PACKAGING, HANDLING, AND STORAGE

A. The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to ensure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged.

B. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

C. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method.

D. Fused segments of pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

3.2 JOINING

A. Sections of polyethylene pipe shall be joined by the butt fusion process into continuous lengths at the job site. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.

B. Properly executed electrofusion fittings may be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings, and some mechanical couplings may be used to mechanically connect HDPE pipe where shown in details. Refer to the manufacturer's recommendations.

3.3 CONSTRUCTION PRACTICE

A. Trench Construction
   1. Trenching should be done in accordance with ASTM D2321, Section 6 and/or ASTM D 2774.
   2. Embedment materials should be Class I, Class II, or Class III materials as defined by ASTM D2321, Section 5. The use of Class IV and Class V materials for embedment is not acceptable. The embedment material shall have an installed density of at least 98% Standard Proctor Density through compaction or consolidation.

3. The pipe bedding should be constructed in accordance with ASTM D2321, Section 5, Table 2.

3.4 QUALITY AND WORKMANSHIP

A. Pipe which has been tested and falls outside of the appropriate limits set forth in this Specification will be cause for rejection.

3.5 CLEANING

A. General Cleaning:
   1. Clean interior of piping systems thoroughly of foreign matter before installing. Maintain pipe in clean condition during installation.
   2. Before jointing pipe, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
   3. Immediately prior to pressure testing of piping systems, clean and remove grease, dirt or other foreign materials which may have entered the system.
   4. Upon completion of work and prior to final acceptance, thoroughly clean work installed under these specifications. Clean pipe, valves and fittings of debris which may have accumulated by operation of system, from testing or from other causes.

3.6 TESTING AND INSPECTION

A. Perform testing and inspection prior to cleaning and final acceptance. Acknowledge satisfactory performance of test and inspections in writing of CQA Consultant prior to final acceptance.

B. Types of testing and inspection to be employed for the piping systems include:
   1. Pressure piping: Water should be used for testing all pressure piping unless otherwise approved by the project manager and CQA consultant.
   2. Leachate piping: Clean and repair as necessary to provide video documentation of a clean and operable pipe system. Documentation of all pipe shall be made after materials are in place and the structural fill cell is constructed.
      a. Video format: Electronic
      b. Video should illustrate:
         1) Camera progress in feet
         2) Pipe identification
         3) All pipe intersections, fittings, or other items of note by stopping at each
         4) All piping within the cell (construction baseline)
      c. Provide annotated map illustrating issues and extent of each video run.
      d. Provide two (2) copies of documentation.

C. Test and inspect all pipe, fittings, and joints. Provide all necessary equipment and perform all work required in connection with the tests and inspections.

D. Bear the cost of all testing and inspecting, locating and remedying of leaks, removal of debris, and any necessary retesting and re-examination.

END OF SECTION

SECTION 15079

PIPE: CORRUGATED POLYETHYLENE

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:
   1. This item shall consist of furnishing, fabricating, and installing corrugated polyethylene pipe of the types, classes, sizes, and dimensions as shown on the plans, at such places as are designated on the plans and profiles, or by the Engineer, in accordance with these specifications and in conformity with the lines and grades given.
   2. Piping locations include, but may not be limited to slope drains.

B. Related work specified elsewhere:
   1. Section 15060 – Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Reference Standards
   1. American Society of Testing and Materials (ASTM) Standards.
      a. D618, Methods of Conditioning Plastics and Electrical Insulating Materials for Testing.
      b. D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
      c. D1600, Terminology for Abbreviated Terms Relating to Plastics.
      d. D1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
      e. D2122, Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
      f. D2321, Practice for Underground Installation of Flexible Thermoplastic Pipe and Sewers and Other Gravity-Flow Applications.
      g. D2412, Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.
      h. D2444, Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
      i. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
      j. D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
      k. F405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
      l. F412, Definitions of Terms Relating to Plastic Piping Systems.
      m. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
      n. F667, Standard Specification for Large Diameter Corrugated Polyethylene (PE) Tubing and Fittings.
      o. F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
   2. American Association of State Highway and Transportation Officials (AASHTO) Standards.
      a. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing, 75mm to 250mm (3” to 10”) Diameter.
      b. M294, Standard Specification for Corrugated Polyethylene Pipe, 300mm to 1200mm (12” to 36”) Diameter.
      c. MP6-95, Provisional Specification for Corrugated Polyethylene Pipe, 1050 and 1200mm (42” and 48”) Diameter.

1.3 SUBMITTALS

A. See submittal requirements of Section 15060 – Pipe and Pipe Fittings, Basic Requirements.

B. Shop Drawings:
   1. Layout drawings to include the following:
      a. Dimensions.
      b. Schedule of pipe.
      c. Fittings.
      d. Miscellaneous appurtenances.
      e. When special fittings are necessary, verify locations of items and include complete details.
   2. Render copies of any manufacturer's written instructions regarding material handling, delivery, storage, and installation.

C. Miscellaneous:
   1. Submit As-built drawings of piping systems in project including project items and pre-existing items. Identify complete location, elevation, and description of piping systems. Relate piping systems to identified structures and appurtenances.

PART 2 - MATERIALS

2.1 ACCEPTABLE MANUFACTURERS:

A. Advanced Drain Systems.

B. Crumpler Plastic Pipe, Inc.

C. Or approved equal.

2.2 GENERAL

A. Corrugated Polyethylene Pipe and Fittings: This pipe and connections shall conform to the requirements of AASHTO M252 and M294 and Section 15060, Schedule 17.

B. This pipe shall be Type “S” single-walled corrugated pipe outside and smooth inside.

C. Basic Materials: Pipe and fittings shall conform to the requirements of ASTM D3350, except the carbon black content shall not exceed 5 percent.

D. Coupling Bands: Flexible pipe shall be firmly joined by coupling bands. These bands shall be not more than two nominal sheet thicknesses lighter than the thickness of the pipe to be connected. Only fittings supplied or recommended by the pipe manufacturer should be used. Fittings shall be installed in accordance with the manufacturer’s recommendations. Couplers used with pipe and fittings shall be of a design that preserves alignment during construction and prevents separation at the joints. Bell-and-spigot joints, external snap, or split couplers shall be used. Annular split couplers shall overlap at least two full corrugations on each pipe end being coupled. Helical split couples shall be at least 6” long for 4” to 10” diameter, and one-half the nominal pipe diameter in width for diameters 12” and above. If necessary, self-locking nylon ties, HDPE tape, or rods can be used to secure the split coupling bands.
   1. Joining systems shall be Type 3 (Water Tight) couplers used to connect individual pipe sections.
   2. Gasketed soil tight joints: Architectural weather-stripping material per ASTM D-1056 or rubber per ASTM F477.
   3. Gasketed integral bell/spigot: rubber gasket per ASTM F-477 installed on the spigot end.
   4. Reinforced couplers shall be used where the possibility of separation is great. These couplers shall be constructed of a heavy cross-laminated polyethylene backing, rubberized mastic sealer, plastic straps with sheathing, and woven polypropylene reinforcing.

E. Perforations:
   1. All perforations shall be cleanly cut.

2. The water inlet area shall be a minimum as follows:

4” to 10” pipe	1.0 in^2/ft
12” to 18” pipe	1.5 in^2/ft
pipe sizes larger than 18”	2.0 in^2/ft

3. The width of slots shall not exceed 1/8”. The length of slots shall not exceed 10% of the nominal inside circumference for 4” to 8’ pipe, 2.5’ for 10” to 15” pipe, and 3.0” for 18” and larger pipe.
4. Circular perforations shall not exceed:

4” through 10” pipe	3/16”
pipe sizes larger than 10”	3/8”

PART 3 - EXECUTION

3.1 GENERAL

A. Equipment: All equipment necessary and required for the proper construction of piping shall be on the project, in first class working condition. The Contractor shall provide such mechanical tampers as required to obtain the compaction of the pipe bedding and backfill as specified.

B. Excavation: The Contractor shall perform all excavation to the depth shown on the plans. The bedding for the pipe shall be shaped so that the bottom of the pipe shall be in continuous contact with the bottom of the trench. Bedding shall be as shown on the plans.

C. Placing Pipe: The pipe shall be laid with the separate sections joined firmly together with coupling bands with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. The pipe shall be laid carefully and true to lines and grades on a bed which is uniformly firm throughout its entire length. Any pipe which is not in true alignment, or which shows any undue settlement after laid or is damaged, shall be taken up and relaid or replaced without additional cost to the Owner. Pipe shall not be laid on frozen ground.

D. Connections: Contractor shall follow manufacturer's recommendations in installing pipe connections.

E. Backfill: The trench shall be backfilled with material indicated on the Drawings.

END OF SECTION

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