Mine Permit Transfer/Modification

Colon Mine Site

Charah, Inc.

Sanford, North Carolina

November 2014

Mine Permit Transfer/Modification

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014

HDR Engineering, Inc. of the Carolinas
440 South Church St, Suite 1000
Charlotte, NC 28202-2075
704.338.6700

NC License F0116

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General Shale
Building The American Dream®

GENERAL SHALE BRICK, INC.
P.O. Box 3547 / 3015 Bristol Highway, Johnson City, TN 37602
Ph. (423) 282-4661 / FAX (423) 952-4160

Gregory A. Bowles
Director of Real Estate, Environment, & Geology

November 14, 2014

VIA HAND DELIVERY

Mr. Tracy E. Davis, PE, CMP
Director
Division of Energy Mineral & Land Resources
Land Quality Section
NC Dept. of Environment and Natural Resources
1612 Mail Service Center
Raleigh, NC 27699

Re: Colon (Sanford) Mine, Permit No. 53-05

Dear Mr. Davis:

In accordance with the General Statute §74-52 of the Mining Act of 1971, and the Land Quality Section's mining permit modification checklist, we are requesting the State to transfer the permit noted above be transferred to Green Meadow, LLC. As we required, we are enclosing one original and five (5) copies of (i) this letter describing the transfer and modification request, (ii) the first three pages of the application form relating to the Permit as transferred and modified, (iii) updated mine maps complying with the requirements of the Mining Act identifying the area to be covered by the Permit as transferred.

We appreciate your prompt attention to this request. We understand that no public notice is necessary as the total acreage covered by the permit will not change and the area permitted will be identical to the area covered by the Permit. Please let me know if you have any questions or require additional information.

Very truly yours,
General Shale Brick, Inc.

Gregory A. Bowles
Director of Real Estate, Environment
& Geology

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Division of Energy Mineral & Land Resources
Land Quality Section
NC Dept. of Environment and Natural Resources
1612 Mail Service Center
Raleigh, NC 27699

Re: Colon (Sanford) Mine, Permit 53-05

Dear Mr. Davis:

General Shale Brick, Inc. ("General Shale") is the current permittee under the referenced permit (the "Permit"). General Shale intends to transfer the Permit to Green Meadow, LLC ("Green Meadow"). In addition, Green Meadow intends to modify the Permit by changing the method for reclaiming the mine by developing a large structural fill using Coal Combustion Byproducts ("CCBs"). The modified mine reclamation method has been designed in accordance with the provisions of General Statutes §130A-309.216 contained in the Coal Ash Management Act of 2014 ("CAMA").

In accordance with the General Statute §74-52 of the Mining Act of 1971, and the Land Quality Section's mining permit modification checklist, we are enclosing one original and five (5) copies of (i) this letter describing the transfer and modification request, (ii) the first three pages of the application form relating to the Permit as transferred and modified, (iii) updated mine maps complying with the requirements of the Mining Act identifying the area to be covered by the Permit as transferred and modified for the new large structural fill.

We appreciate your prompt attention to this request. We understand that no public notice is necessary as the total acreage covered by the permit will not change and the area permitted will be identical to the area covered by the Permit. Please let me know if you have any questions or require additional information.

Very truly yours,

General Shale Brick, Inc.

Gregory A. Bowles
Director of Real Estate, Environment
& Geology

Green Meadow, LLC

Charles E. Price
President & CEO

NORTH CAROLINA
MINING PERMIT APPLICATION

State of North Carolina
Department of Environment
and Natural Resources
Division of Land Resources
Land Quality Section

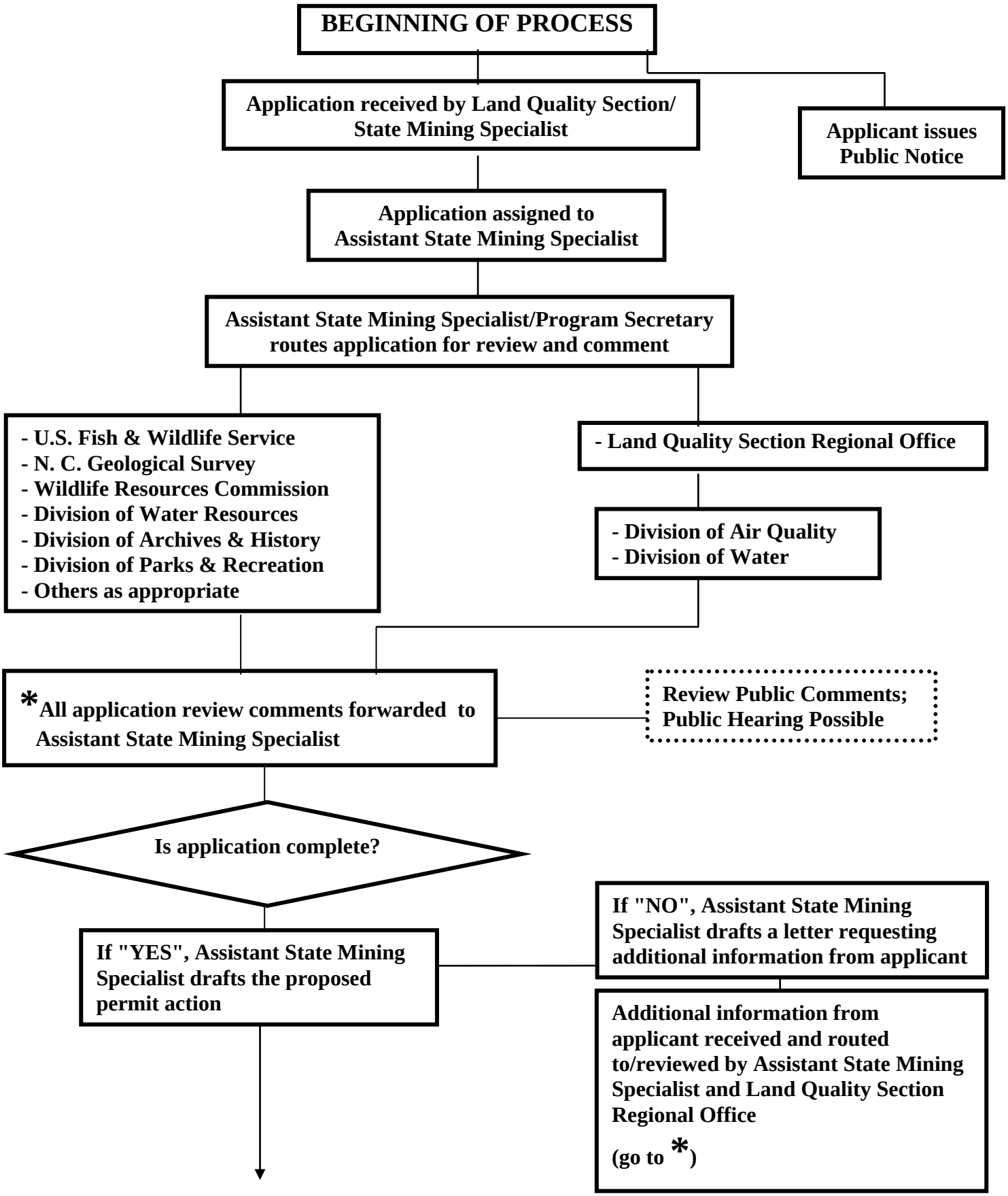
1612 Mail Service Center
Raleigh, North Carolina 27699-1612
(919) 707-9220

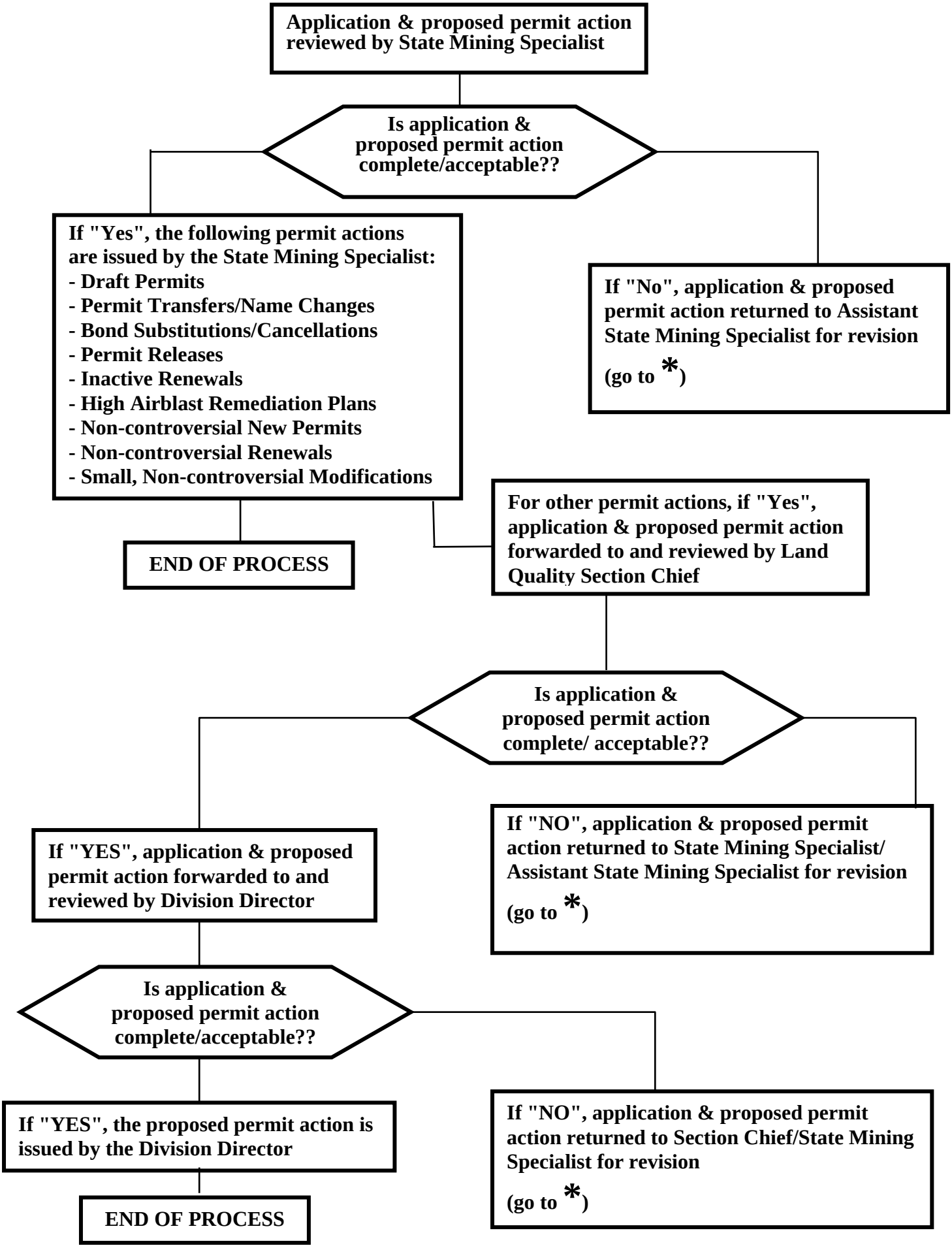
Revised: February 24, 2012

NOTE:

It is recommended that you contact the appropriate Regional Office (see Regional Office listing in the back of this booklet) or the Raleigh Central Office for a PRE-APPLICATION MEETING to discuss your intentions and address any questions.

MINING PERMIT APPLICATION REVIEW PROCESS FLOWCHART




Application & proposed permit action reviewed by State Mining Specialist
Is application & proposed permit action complete/acceptable??
If "Yes", the following permit actions are issued by the State Mining Specialist:
- Draft Permits
- Permit Transfers/Name Changes
- Bond Substitutions/Cancellations
- Permit Releases
- Inactive Renewals
- High Airblast Remediation Plans
- Non-controversial New Permits
- Non-controversial Renewals
- Small, Non-controversial Modifications
If "No", application & proposed permit action returned to Assistant State Mining Specialist for revision (go to *)
END OF PROCESS
For other permit actions, if "Yes", application & proposed permit action forwarded to and reviewed by Land Quality Section Chief
Is application & proposed permit action complete/ acceptable??
If "YES", application & proposed permit action forwarded to and reviewed by Division Director
If "NO", application & proposed permit action returned to State Mining Specialist/ Assistant State Mining Specialist for revision (go to *)
Is application & proposed permit action complete/acceptable??
If "YES", the proposed permit action is issued by the Division Director
END OF PROCESS
If "NO", application & proposed permit action returned to Section Chief/State Mining Specialist for revision (go to *)

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

LAND QUALITY SECTION

APPLICATION FOR A MINING PERMIT (TRANSFER)

(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 Road, Moncure, North Carolina 27559

   Telephone (919) 774-6533, ext. 243 Alternate No. ( )

4. Mine Office Address same as above

   Telephone ( )

5. Mine Manager Larry Cockerill

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  Date 11/14/14

Print Name Gregory A. Bowles

Title Director of Real Estate, Environment & Geology

* 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

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

LAND QUALITY SECTION

APPLICATION FOR A MINING PERMIT (MODIFICATION)

(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* Green Meadow, Inc.

3. Permanent address for receipt of official mail** 12601 Plantside Drive, Louisville, KY 40299

   Telephone (502) 245-1353 Alternate No. ( )

4. Mine Office Address same as above

   Telephone ( ) same as above

5. Mine Manager Charles E. Price

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 Charles Price Date 11-14-14

Print Name Charles E. Price

Title Managing Member

* 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.:_____ Total permitted acreage (this is the acreage that the "renewal" fee will be based upon): _____

☒ 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.: 53-05 Total permitted acreage: 351

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): 351

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.: 53-05 Total permitted acreage: 411

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: 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) 32
Depth is relative to what benchmark? (e.g., natural ground level, mean sea level, road elevation, etc.)
Natural ground elevation

b. Expected average depth of mine (feet) 10

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	13.24
Stockpiles	NA
Wastepiles	NA
Processing Area/Haul Roads	5.77
Mine Excavation	125.43
Other (Explain)	NA
Total Disturbed Acreage	144.44

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.

Mine operations will continue in the Phase 1 area and expand to the Phase 2 area. The base of the excavation will be lined and contain a leachate collection system for the reclamation structural fill. The structural fill will be capped.

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.

Mining operations will continue in the area designated as Phase 1 (Cells 1 and 2). Continued mine development will progress into the Phase 2 (Cells 3-5) area. Basins will be constructed as needed to collect stormwater and prevent offsite sedimentation. Interim stockpiling may occur in the mine footprint or one of two designated stockpile areas. Erosion and sediment control will be designed and permitted for the stockpile areas prior to use. Stormwater benches, slope drains and diversion berms will direct stormwater from the closed structural fill to an existing sediment basin.

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.

Contact water from the coal combustion product structural fill will be collected and discharged to the local wastewater treatment plant. No chemicals will be used. Flocculants may be used to control TSS in stormwater prior to discharge as allowed in the existing permit.

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).*

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:_____. *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.

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.

The current mine NPDES permit is included under related documents.

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?

Haul roads, stockpiles and structural fills will be wetted as necessary to control dust. Chemical dust suppressants may be utilized as needed to control dust from areas where construction activity may be extended for periods greater than 30 days.

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).*

A 50-foot undisturbed property line buffer is maintained. A 50-foot buffer to wetlands and stream is also maintained except where impacts are permitted through the USACE and NCDWQ. A 300-foot buffer is maintained to residences and private groundwater wells.

   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).*

50 feet

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.

2H:1V slopes will be maintained in the excavation area. Final cut slopes are designed at 3H:1V. The structural fill is designed to have a 4H:1V side slope.

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.*

See Drawing 00C-05

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 in the excavation area. Cut slopes will maintain a 3H:1V slope.

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).*

Gates will be installed at the mine entrances to prevent unwanted access. Fencing may also be constructed as needed.

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 wooded areas. Berms may also be constructed for screening purposes.

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?

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 will be stored onsite. Above ground petroleum tanks will be used for equipment and will have secondary containment. The mine operator will work under a Spill Prevention, Control and Countermeasures (SPCC) Plan in compliance with USEPA standards providing training and monthly inspections as required.

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 mine is intended to be reclaimed as an encapsulated beneficial coal combustion product structural fill. See the permit application for illustrations of the reclamation.

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.

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.*

N/A

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.*

All overburden is intended to be used in the construction of the structural fill. In the event that stockpiling is required, a permit modification will be submitted.

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

Roadways will remain in place for site access. Leachate storage facilities will be removed after NCDENR has released the owner of any further post-closure care.

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.

A perimeter roadway for the structural fill will be gravel and maintained for post-closure monitoring activities. All channels will be vegetated.

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 <u>off-site generated waste</u> shall be disposed of on the mine site without <u>prior</u> written approval from the NC Department of Environment and Natural Resources, Land Quality Section <u>and</u> 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.*

A permit for a large structural fill is being pursued through the Division of Waste Management with the submittal of this package. The new mining permit is anticipated to include the necessary permit allowing the large structural fill through the Division of Waste Management as specified in the Coal Ash Management Act of 2014.

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 previously approved plan (attached).

   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 See attached Date _____

   Print Name _____

   Title _____

   Agency _____

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:	13.24 Ac.	X	$ 2,500 /Ac.	=	$ 33,100
Stockpiles:	--- Ac.	X	$ -- /Ac.	=	$ ---
Wastepiles:	--- Ac.	X	$ -- /Ac.	=	$ ---
Processing Area/Haul Roads:	5.77 Ac.	X	$ 5,000 /Ac.	=	$ 28,850
Mine Excavation:	125.43 Ac.	X	$ 3,700 /Ac.	=	$ 464,091
Other:	--- Ac.	X	$ --- /Ac.	=	$ ---

TOTAL AFFECTED AC.: 144.44 Ac.

(TOTAL PERMITTED AC.: 351 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 144.44 Ac. X $1,500.00 = $ 216,660

SUBTOTAL COST: $742,701

Inflation Factor:

0.02 X SUBTOTAL COST: $ 14,854.02 X Permit Life (1 to 10 years): 10 years

INFLATION COST: $ 148,540.20

TOTAL COST = SUBTOTAL COST + INFLATION COST = $891,241.20

Total Reclamation Bond Cost: $ 891,200.00
(round down to the nearest $100.00)

APPLICATION FOR A MINING PERMIT

F. NOTIFICATION OF ADJOINING LANDOWNERS

The "Notice" form, or a facsimile thereof, attached to this application must be sent certified or registered mail, return receipt requested, to:

(1) the chief administrative officer of each county and municipality in which any part of the permitted area is located as indicated on the mine map(s);

(2) all 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, all owners of record of tracts adjoining these tracts must be notified (that are within 1,000 feet of the mining permit boundary) as indicated on the mine map(s); and

(3) all 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, all owners of record of tracts adjoining these tracts must be notified (that are within 1,000 feet of the mining permit boundary) as indicated on the mine map(s). "Highway" means a road that has four lanes of travel or less and is not designated as an Interstate Highway.

The only exception to the above method of giving notice is if another means of notice is approved in advance by the Director, Division of Land Resources.

A copy of a tax map (or other alternative acceptable to the Department) must be mailed with the completed "Notice" form **(the proposed overall permit boundaries and the names and locations of all owners of record of lands adjoining said boundaries must be clearly denoted on the tax map)**.

The "Affidavit of Notification" attached to this application must be completed, notarized and submitted to the Department, with the remainder of the completed application form, before the application will be considered complete.

NOTES:

THIS SECTION MUST BE COMPLETED FOR ALL APPLICATIONS FOR NEW MINING PERMITS AND ALL MODIFICATIONS OF A MINING PERMIT TO ADD LAND TO THE PERMITTED AREA, AS REQUIRED BY NCGS 74-50(b1).

SEE THE NEXT TWO PAGES FOR THE "NOTICE" FORM AND THE "AFFIDAVIT OF NOTIFICATION"

NOTICE

Pursuant to provisions G.S. 74-50(b1) of The Mining Act of 1971, Notice is hereby given that

_____ has applied on _____
(Applicant Name) (Date)

to the Land Quality Section, Division of Land Resources, North Carolina Department of Environment and Natural Resources, 1612 Mail Service Center, Raleigh, North Carolina 27699-1612, for (check one):

☐ a new surface mining permit,

☐ a modification of an existing surface mining permit to add land to the permitted area; or

☐ a modification of an existing surface mining permit to add land to the permitted area with no disturbance in the area proposed. **Please note that future modification(s) may be submitted by the applicant to allow disturbance within this area without re-notification of adjoining landowners.**

The applicant proposes to mine _____ on _____ acres located _____
(Mineral, Ore) (Number) (Miles)

_____of _____ off/near road _____
(Direction) (Nearest Town) (Number/Name)
in _____ County.

SEE ATTACHED MAP FOR PROPOSED PERMIT BOUNDARIES AND CORRESPONDING ADJOINING LANDOWNER NAMES AND LOCATIONS

In accordance with G.S. 74-50(b1), the mine operator is required to make a reasonable effort, satisfactory to the Department, to notify all 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, all owners of record of tracts adjoining these tracts must be notified (that are within 1,000 feet of the mining permit boundary). In addition, the mine operator must also notify the chief administrative officer of the county or municipality in which any part of the permitted area is located. Any person may file written comment(s) to the Department at the above address within thirty (30) days of the issuance of this Notice or the filing of the application for a permit, whichever is later. Should the Department determine that a significant public interest exists relative to G.S. 74-51, a public hearing will be held within 60 days of the end of the 30-day comment period specified above.

A copy of the permit application materials is on file and available for public review during normal business hours at the above listed address as well as at the appropriate regional office. **For information regarding the specifics of the proposed mining activity, please contact the applicant at the following telephone number: _____**. For information on the mining permit application review process, please contact the Mining Program staff at (919) 707-9220. Please note that the Department will consider any relevant written comments/documentation within the provisions of the Mining Act of 1971 throughout the application review process until a final decision is made on the application.

_____ _____
(Addressee/Owner of Record's Name and Address) (Name of Applicant: Include Contact Person & Company Name, if Applicable)

_____ _____
(Date of Issuance of this Notice/ Mailed to Addressee/Owner of Record) (Address of Applicant)

APPLICATION FOR A MINING PERMIT

AFFIDAVIT OF NOTIFICATION

I, _____, an applicant, or an agent, or employee of an applicant, for a new Mining Permit, or a modification of an existing Mining Permit to add land to the permitted area, from the N.C. Department of Environment and Natural Resources, being first duly sworn, do hereby attest that the following are all known owners of record, both public and private, of all tracts of land that are adjoining the mining permit boundary (including, where an adjoining tract is owned or leased by the applicant or is owned by the lessor of the mine tract, all owners of record of tracts adjoining these tracts, that are within 1,000 feet of the mining permit boundary) and that notice of the pending application has been caused to be mailed, by certified or registered mail, return receipt requested, to said owners of record at their addresses shown below, such notice being given on a form provided by the Department:

(Adjoining Landowner Name)	(Address)
_____	_____
_____	_____
_____	_____

(Attach additional list if necessary)

I do also attest that the following individual is the chief administrative officer of the county or municipality in which any part of the permitted area is located and that notice of the pending application has been caused to be mailed, by certified or registered mail, return receipt requested, to said office at the following address:

(Chief Administrative Officer Name) [i.e.: City Manager, County Manager, Mayor, etc.]	(Address)
_____	_____

The above attestation was made by me while under oath to provide proof satisfactory to the Department that a reasonable effort has been made to notify all known owners of record, both public and private, of all tracts of land that are adjoining the mining permit boundary (including, where an adjoining tract is owned or leased by the applicant or is owned by the lessor of the mine tract, all owners of record of tracts adjoining these tracts, that are within 1,000 feet of the mining permit boundary) and the chief administrative officer of the county or municipality in which any part of the permitted area is located in compliance with N.C.G.S. 74-50(b1) and 15A NCAC 5B .0004(d). I understand that it is the responsibility of the applicant to retain the receipts of mailing showing that the above notices were caused to be mailed and to provide them to the Department upon request.

_____	_____
Signature of Applicant or Agent	Date

If person executing Affidavit is an agent or employee of an applicant, provide the following information:
Name of applicant: _____
Title of person executing Affidavit_____

I, _____ a Notary Public of the County of _____,

State of North Carolina, do hereby certify that_____
appeared before me this day and under oath acknowledged that the above Affidavit was made by him/her.

Witness my hand and notarial seal, this _____day of_____20___.

Notary:_____ my Commission expires: _____

APPLICATION FOR A MINING PERMIT

G. LAND ENTRY AGREEMENT (TRANSFER)

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: Gregory A. Bowles

Print Name: Gregory A. Bowles
(Title, if applicable)

Company General Shale Brick, Inc.
(If applicable)

Address: 3015 Bristol Highway

Johnson City, TN. 37601

Telephone: (423) 282-4661

Date Signed: 11/14/14

APPLICANT:

Signature:* Charles Price

Print Name: Charles E. Price

Title: Managing Member

Company: Green Meadow, LLC

Mine Name: Colon Mine

Telephone: (502) 245-1353

Date Signed: 11-14-14

*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

G. LAND ENTRY AGREEMENT (MODIFICATION)

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: Charles Price

Print Name: Charles E. Price
(Title, if applicable)

Company Green Meadow, LLC
(If applicable)

Address: 12601 Plantside Drive

Louisville, KY 40299

Telephone: (502) 245-1353

Date Signed: 11-14-14

APPLICANT:

Signature:* Charles Price

Print Name: Charles E. Price

Title: Managing Member

Company: Green Meadow, LLC

Mine Name: Colon Mine

Telephone: (502) 245-1353

Date Signed: 11-14-14

*Signature must be the same as the individual who signed Page 1 of this application.

<u>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</u> (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 <u>Land Quality Section Central Office</u> 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

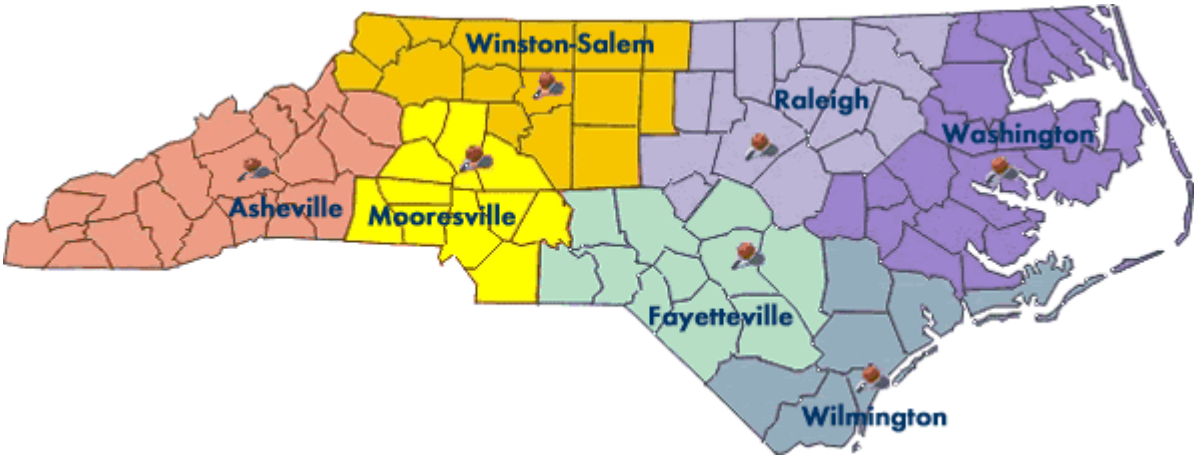
A nonrefundable permit application processing fee when filing for a new mining permit, a major permit modification or a renewal permit is required as follows:

	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.

There are seven Land Quality Section (LQS) Regional Offices. Use the map below to locate the Regional Office serving your county.



Asheville Regional Office

- Counties: Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Rutherford, Swain, Transylvania, Yancey
- Address: 2090 U.S. Highway 70, Swannanoa, NC 28778
- Voice: 828.296.4500
- FAX: 828.299.7043

Fayetteville Regional Office

- Counties: Anson, Bladen, Cumberland, Harnett, Hoke, Montgomery, Moore, Richmond, Robeson, Sampson, Scotland
- Address: 225 Green Street, (Systel Building), Suite 714, Fayetteville, NC 28301-5094
- Voice: 910.433.3300
- FAX: 910.486.0707

Mooresville Regional Office

- Counties: Alexander, Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, Union
- Address: 610 East Center Ave., Suite 301, Mooresville, NC 28115
- Voice: 704.663.1699
- FAX: 704.663.6040

Raleigh Regional Office

- Counties: Chatham, Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Lee, Nash, Northampton, Orange, Person, Vance, Wake, Warren, Wilson
- Address: 1628 Mail Service Center, Raleigh, NC 27699-1628 or 3800 Barrett Drive, Raleigh, NC 27609
- Voice: 919.791.4200
- FAX: 919.571.4718

Washington Regional Office

- Counties: Beaufort, Bertie, Camden, Chowan, Craven, Currituck, Dare, Gates, Greene, Hertford, Hyde, Jones, Lenoir, Martin, Pamlico, Pasquotank, Perquimans, Pitt, Tyrrell, Washington, Wayne
- Address: 943 Washington Square Mall, Washington, NC 27889
- Voice: 252.946.6481
- FAX: 252.975.3716

LAND QUALITY REGIONAL OFFICES (continued)

Wilmington Regional Office

- Counties: Brunswick, Carteret, Columbus, Duplin, New Hanover, Onslow, Pender
- Address: 127 Cardinal Drive Extension, Wilmington, NC 28405
- Voice: 910.796.7215
- FAX: 910.350.2018

Winston-Salem Regional Office

- Counties: Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Rockingham, Randolph, Stokes, Surry, Watauga, Wilkes, Yadkin
- Address: 585 Waughtown Street, Winston-Salem, NC 27107
- Voice: 336.771.5000
- FAX: 336.771.4631

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

AS PER NCAC 15A 5B.0003, IF YOU DISAGREE WITH THE BOND AMOUNT DETERMINED BY THE BOND CALCULATION WORKSHEET, YOU MAY SUBMIT AN ESTIMATE OF RECLAMATION COSTS FROM A THIRD PARTY CONTRACTOR. SAID ESTIMATE MUST BE PROVIDED WITHIN 30 DAYS TO THE FOLLOWING ADDRESS: Mining Program, Land Quality Section, 1612 Mail Service Center, Raleigh, North Carolina 27699-1612

ALL ESTIMATES MUST INCLUDE THE FOLLOWING, AS A MINIMUM:

- **FINAL GRADING COSTS PER ACRE**
- **LIME AND FERTILIZER COSTS PER ACRE**
- **YEAR-ROUND SEEDING MIXTURE COSTS PER ACRE (FROM APPROVED REVEGETATION PLAN IN APPLICATION/PERMIT DOCUMENT)**
- **MULCH AND ANCHORING COSTS PER ACRE**
- **ANY OTHER RECLAMATION COSTS NECESSARY TO COMPLY WITH THE APPROVED RECLAMATION PLAN FOR THE SITE IN QUESTION**

YOU WILL BE NOTIFIED AS SOON AS POSSIBLE OF THE DIRECTOR'S FINAL BOND DETERMINATION.

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.

Correspondence

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014

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Correspondence

Future correspondence regarding review and approval of this permit documentation will be placed in this section.

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Calculations

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014

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Table of Contents

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A

Stability

Slope Stability Analysis

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HDR Computation

Project:	Charah Colon Mine Structural Fill	Computed By:	TMY	Date:	10/27/2014
Subject:	Permit Application	Checked By:	**KP**	Date:	**10/29/2014**
Task:	Slope Stability Analyses	Sheet:		Of:	3

Objective:

Evaluate the slope stability of the proposed coal ash structural fill. Evaluate both global stability of the foundation soils, the stability of the structural fill ash slope, and the sliding block stability of the ash along the bottom liner system using PCSTABL 5M and the STEDwin editor (Ref. 3).

References:

1. Naval Facilities Engineering Command (1986). Design Manual 7.01 - Soil Mechanics.
2. Bowles, J.E. (1984). Physical and Geotechnical Properties of Soils. McGraw-Hill.
3. Van Aller, H.W. (1999 - 2013). STEDwin 2.88 (32 bit), The Smart Editor for PCSTABL 5M. Annapolis Engineering Software.
4. Naval Facitities Engineering Command (1982). Design Manual 7.02 - Foundations and Earth Structures.

5. Koerner, G.R. and D. Narejo (2005). Direct Shear Database of Geosynthetic-to-Geosynthetic and Geosynthetic-to-Soil Interfaces. GRI Report #30.

Steps:

1. Estimate subsurface conditions beneath the structural fill using soil boring logs provided by Buxton Environmental, Inc. (see Attachment A). Based on the boring logs, the typical soil profile for the site consists of approximately 5' soil horizon consisting of medium silty and clayey soils underlain by approximately 10' of stiff residuum. Hard partially weathered rock (PWR) underlies the residuum. For the purposes of global stability, it is assumed that failure surfaces will not penetrate the PWR. The estimated intervals of the soil horizon, residuum, and PWR are shown in Attachment A.

2. Estimate the coal ash parameters for input into PCSTABL 5M using physical characterization testing information provided by Charah for samples obtained at the Riverbend Steam Station. This testing information, performed by Geotrack Technologies, Inc., is provided in Attachment B. An estimate of the compacted unit weight (γ) of the ash was obtained based on the results of a standard Proctor test assuming the material would be placed at maximum dry density and optimum moisture content. Total and effective stress strength properties of the coal ash were obtained from the Triaxial Shear Test reports provided in Attachment B. The total stress parameters are applicable for undrained conditions when loading occurs over a relatively short time which leads to the development of excess pore water pressures within the ash. The effective stress parameters are applicable for drained conditions when loading occurs over a sufficient amount of time to allow excess pore water pressures to dissipate. Since typical hydraulic conductivity values for fly ash generally range between 1x10-4 to 1x10-5 cm/sec, it is not clear whether undrained or drained conditions will develop within the ash therefore both sets of parameters were analyzed. The assumed values for unit weight (γ), friction angle (φ), and cohesion (c) for the ash are provided below:

Compacted Ash (Total Stress): γ = 83.8 pcf, φ = 8˚ , c = 4,300 psf
Compacted Ash (Effective Stress): γ = 83.8 pcf, φ = 22˚ , c = 2,600 psf

3. Estimate foundation soil parameters for input into PCSTABL 5M. Use Ref. 1 to correlate γ based with soil type (see Attachment C). From information provided in soil borings (Attachment A), which includes geotechnical laboratory classification data, use Attachments D and E to correlate total and effective stress parameters for the soil horizon and residuum, respectively (see Ref. 2). Note that in Attachment D, $c = 1/2\ q_u$ where q_u is the unconfined compressive strength of the soil. Since the PWR at the site is classified as "hard" with blowcounts generally in excess of 50/6in, it is assumed that failure surfaces will not enter the PWR and therefore parameters were not assigned to this layer. Since the foundation soils are generally fine grained at the site, it is not clear whether undrained or drained conditions will develop within the soils, therefore both sets of parameters were analyzed. The assumed values for unit weight (γ), friction angle (φ), and cohesion (c) for the foundation soils are provided below:

Soil Horizon (Total Stress): γ = 120 pcf, φ =0˚ , c = 470 psf
Soil Horizon (Effective Stress): γ = 120 pcf, φ = 31˚ , c = 0
Residuum (Total Stress): γ = 130 pcf, φ =0˚ , c = 1,045 psf
Residuum (Effective Stress): γ = 130 pcf, φ = 32˚ , c = 0 psf

4. Estimate soil parameters for the compacted soil berm that will be constructed along the perimeter of the structural fill. Assume on site soils consisting of predominantly clayey and silt soils will be used. Use Attachment F (Ref. 1) to obtain obtain estimated strength parameters and Attachment C to estimate γ as shown below:

Compacted Clayey Fill: γ = 125 pcf, φ = 28˚ , c = 1,800 psf

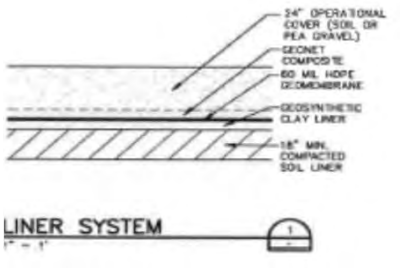
HDR Computation

Project:	Charah Colon Mine Structural Fill	Computed By:	TMY	Date:	10/27/2014
Subject:	Permit Application	Checked By:	**KP**	Date:	**10/29/2014**
Task:	Slope Stability Analyses	Sheet:		Of:	3

5. Estimate soil parameters for the final cover soils. Since a variety of soils may be used for final cover and considering that a high degree of compaction of the final cover probably can not be achieved without the risk of damaging the underlying geomembrane, conservatively assume the following parameters:

Final Cover soils: $\gamma = 120$ pcf, $\varphi = 30^\circ$, $c = 0$ psf

6. Determine critical liner interface for sliding block analyses. A detail of the proposed liner system is provided below. Determine typical interface strength parameters for each interface based on Attachment G (Ref. 5) for each interface as shown below. Use peak parameters which are appropriate to use before failure initiates. Based on this information, the critical (i.e. lowest strength) interface is between the textured 60 mil HDPE geomembrane and the saturated cohesive soil. Therefore, use these parameters for the critical interface.



Geocomposite/Granular Soil Interface: $\varphi = 33^\circ$, $c = 0$
Critical → Geocomposite/Textured HDPE Interface: $\varphi = 26^\circ$, $c = 0$
Textured HDPE/Saturated Reinforced GCL: $\varphi = 23^\circ$, $c = 167$ psf
Saturated Reinforced GCL/Saturated Cohesive Soil: $\varphi = 29^\circ$, $c = 0$

7. Determine most critical cross-section for stability analysis. Factors to consider include proposed ash height, liner slope, foundation conditions, perimeter berm height, and water table location. Using this criteria, a critical stability section was selected along the northern side of the structural fill. The location of this section is shown superimposed on the Basegrade Plan (Attachment H), the Proposed Final Closure Plan (Attachment I), and a groundwater contour map (Attachment J). This section (north slope) represents the greatest depth of waste that will be placed and therefore the greatest amount of driving forces leading to potential failure. The section also represents an area where the perimeter berm will be constructed above existing grade and therefore there will be less buttressing effect at the toe of the slope.

8. Determine the peak ground accelleration for the site for use in the seismic stability analyses. From Attachment K (Ref. 6), the estimated peak ground acceleration for the site with a 2% probability of exceedance in 50 years (equivalent to 10% probability of exceedance in 250 years) is 0.09g. This values was entered as a horizontal pseudo-static coefficient in the PCSTABL 5M seismic analyses.

9. Using the information developed in Steps 1 through 7, input the data into PCSTABL 5M using the STEDwin editor (Ref. 3). Evaluate the both the global stability of the foundation soils beneath the structural fill as well as the stability of the ash slope and sliding block failure along the bottom liner system.

Results/Conclusions

Plots showing the output results from the PCSTABL 5M analyses for the global, ash slope, and sliding block stability under both static and seismic conditions are attached to this calculation. The minimum factors of safety are summarized in the table below. The most critical analysis was for the sliding block failure along the bottom liner system under effective stress conditions with factors of safety of 4.33 and 3.03 for static and seismic conditions, respectively. The generally accepted minimum static and seismic factors of safety for landfill stability are 1.5 and 1.0, respectively. Since the calculated factors of safety exceed the minimum acceptable, the proposed structural fill is adequately stable.

Since the interface shear strength parameters for the liner system components can vary significantly based on soil and product properties, it is helpful to determine the minimum φ value required for the interfaces to achieve an adequate factor of safety. The last two plots show the minimum φ required to achieve factors of safety of 1.5 and 1.0 for static and seismic analyses, respectively. The plots show that along the critical cross section, very little friction is required along the bottom liner interfaces due to the buttressing effect of the perimeter berm. Due to variations of slope along the structural fill liner system and temporary loading conditions during filling, however, it is recommended that a minimum bottom liner interface φ of 26 be required. This requirement should be confirmed by project specific interface shear strength testing.

HDR Computation

Project:	Charah Colon Mine Structural Fill	Computed By:	TMY	Date:	10/27/2014
Subject:	Permit Application	Checked By:	KP	Date:	10/29/2014
Task:	Slope Stability Analyses	Sheet:		Of:	3

Analysis	Static FS	Seismic FS	
Global/Static/Total Stress	4.72	3.21	
Global/Static/Effective Stress	4.95	3.49	
Ash Slope/Static/Total Stress	4.50	3.08	
Ash Slope/Static/Effective Stress	5.20	3.69	
Sliding Block/Static/Total Stress	5.02	3.55	
Sliding Block/Static/Effective Stress	4.33	3.03	←Critical Analysis

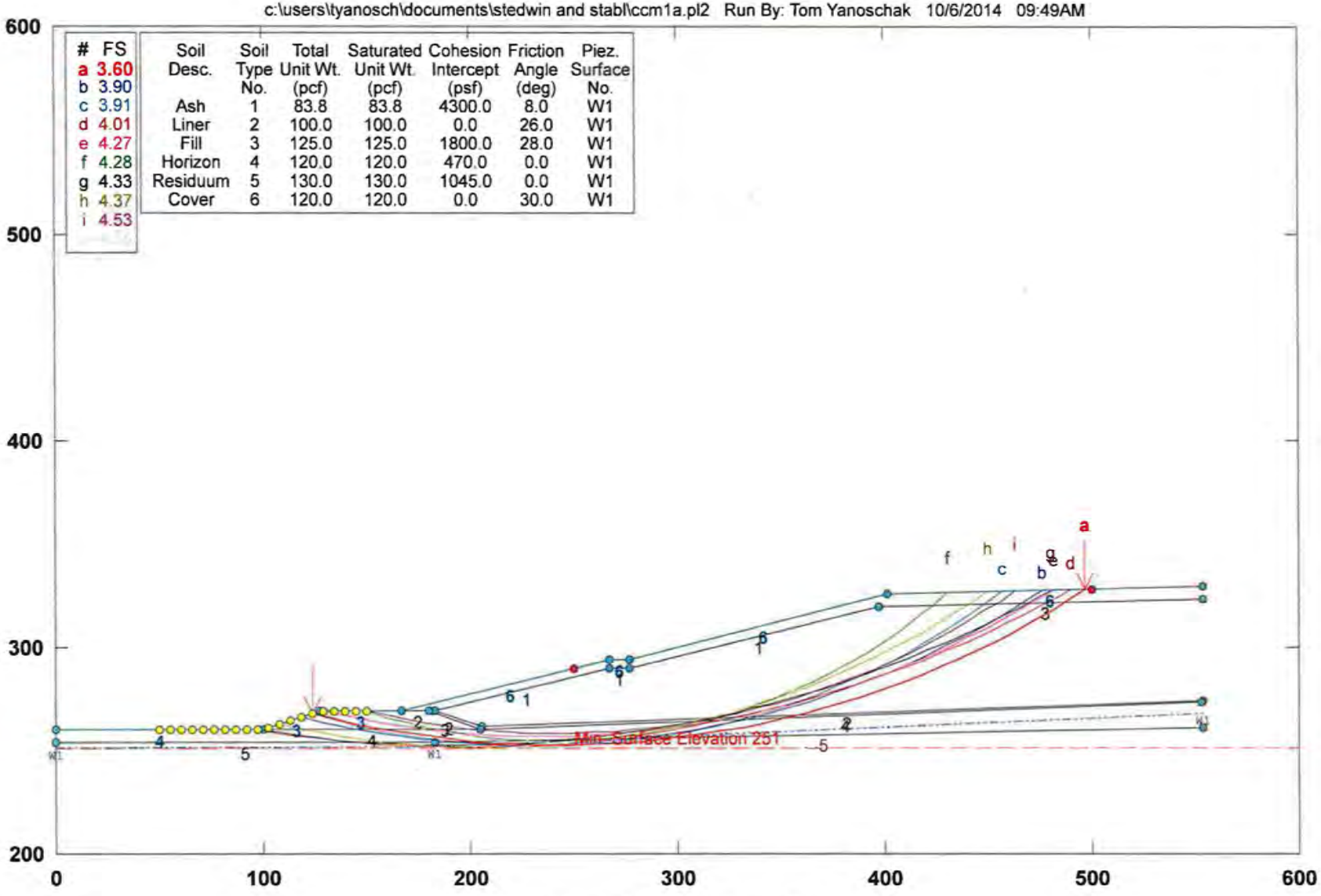
Minimum φ Required for Static FS = 1.5	0˚
Minimum φ Required for Seismic FS = 1.0	0˚

Charah Colon Mine Structural Fill Global - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm1a.pl2 Run By: Tom Yanoschak 10/6/2014 09:49AM

#	FS
a	3.60
b	3.90
c	3.91
d	4.01
e	4.27
f	4.28
g	4.33
h	4.37
i	4.53

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1



PCSTABL5M/si FSmin=3.60

Safety Factors Are Calculated By The Modified Bishop Method

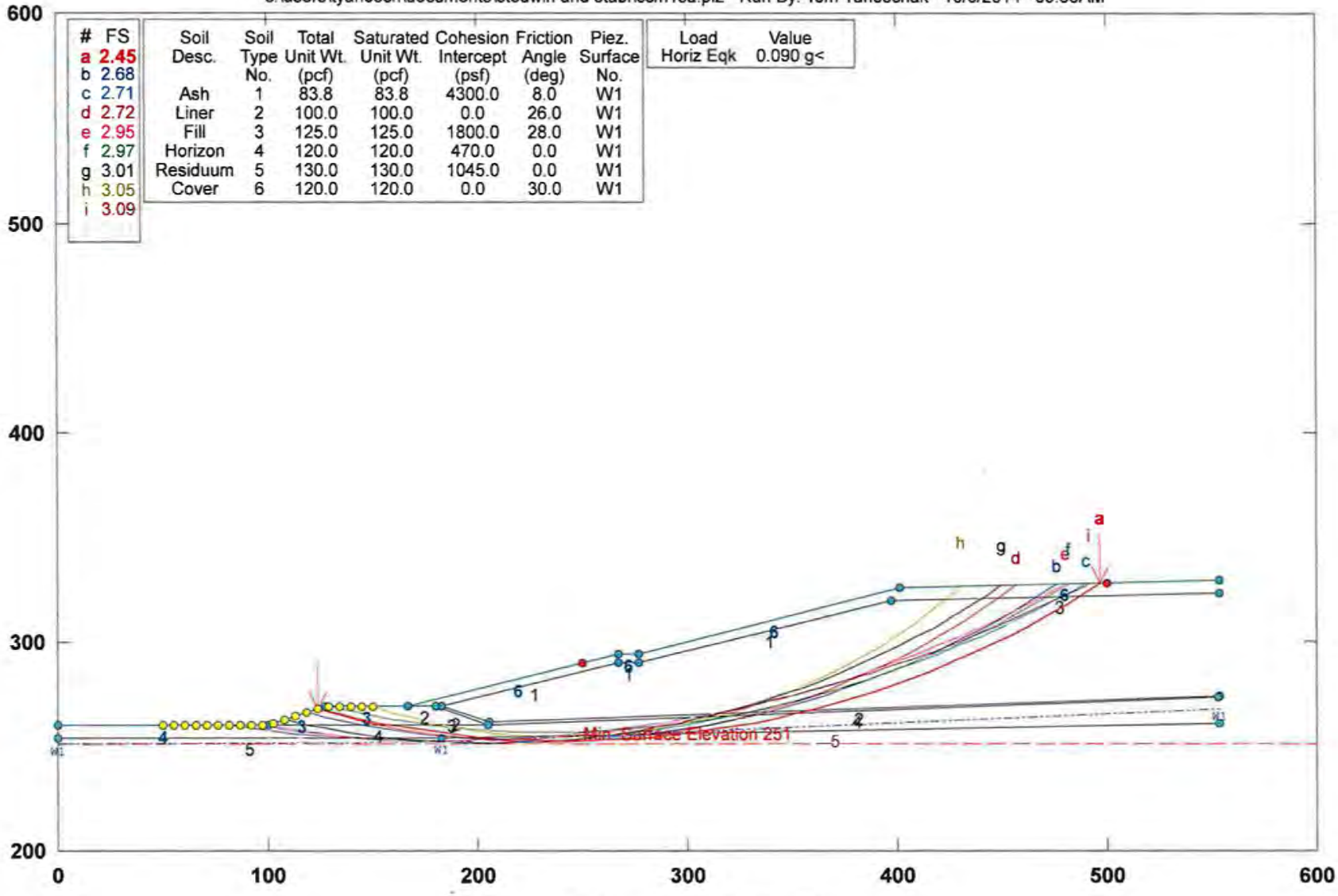
Charah Colon Mine Structural Fill Global - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm1sa.pl2 Run By: Tom Yanoschak 10/6/2014 09:53AM

#	FS
a	2.45
b	2.68
c	2.71
d	2.72
e	2.95
f	2.97
g	3.01
h	3.05
i	3.09

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=2.45

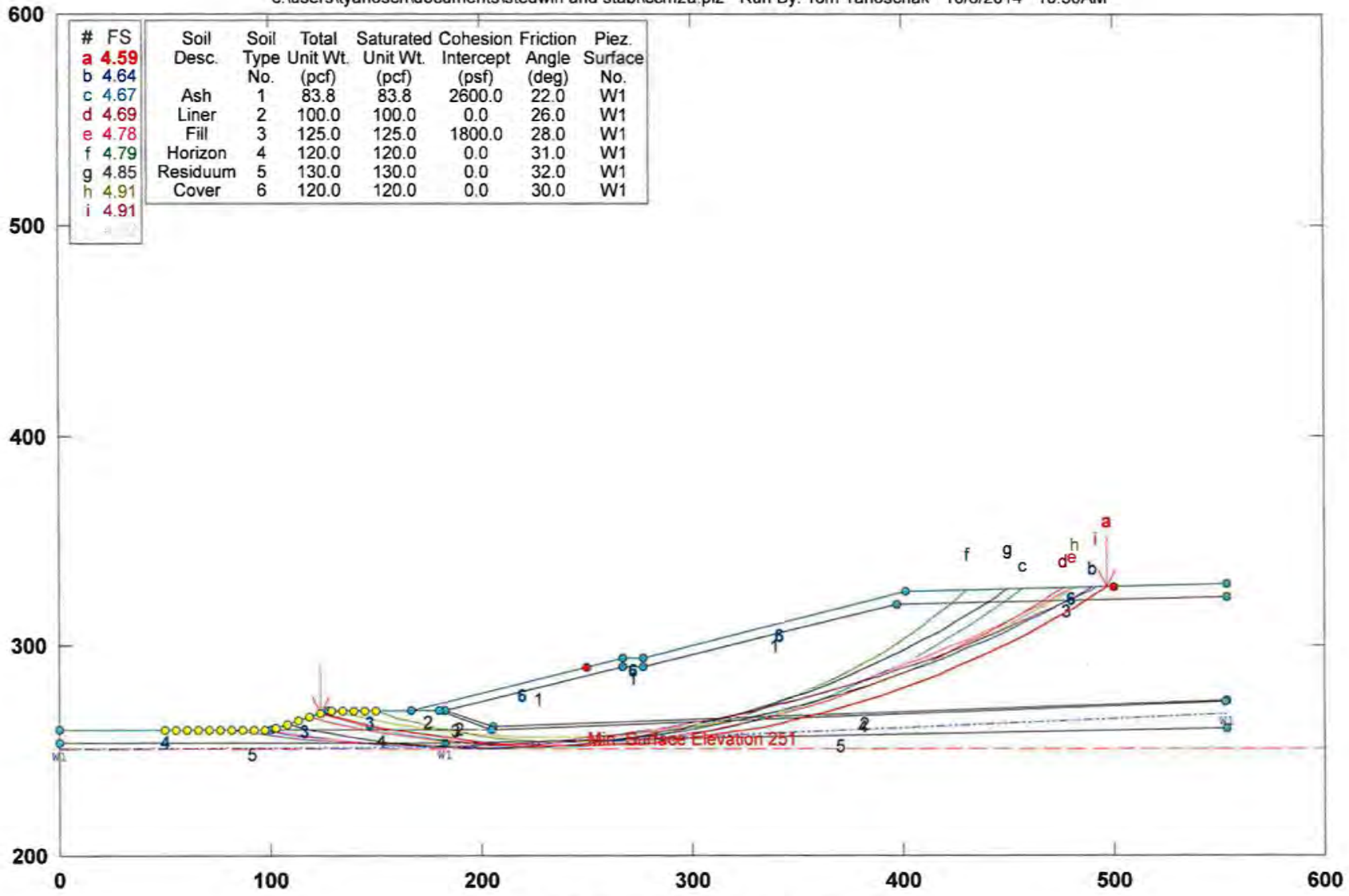
Safety Factors Are Calculated By The Modified Bishop Method

Charah Colon Mine Structural Fill Global - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm2a.pl2 Run By: Tom Yanoschak 10/6/2014 10:30AM

#	FS
a	4.59
b	4.64
c	4.67
d	4.69
e	4.78
f	4.79
g	4.85
h	4.91
i	4.91

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1



PCSTABL5M/si FSmin=4.59

Safety Factors Are Calculated By The Modified Bishop Method

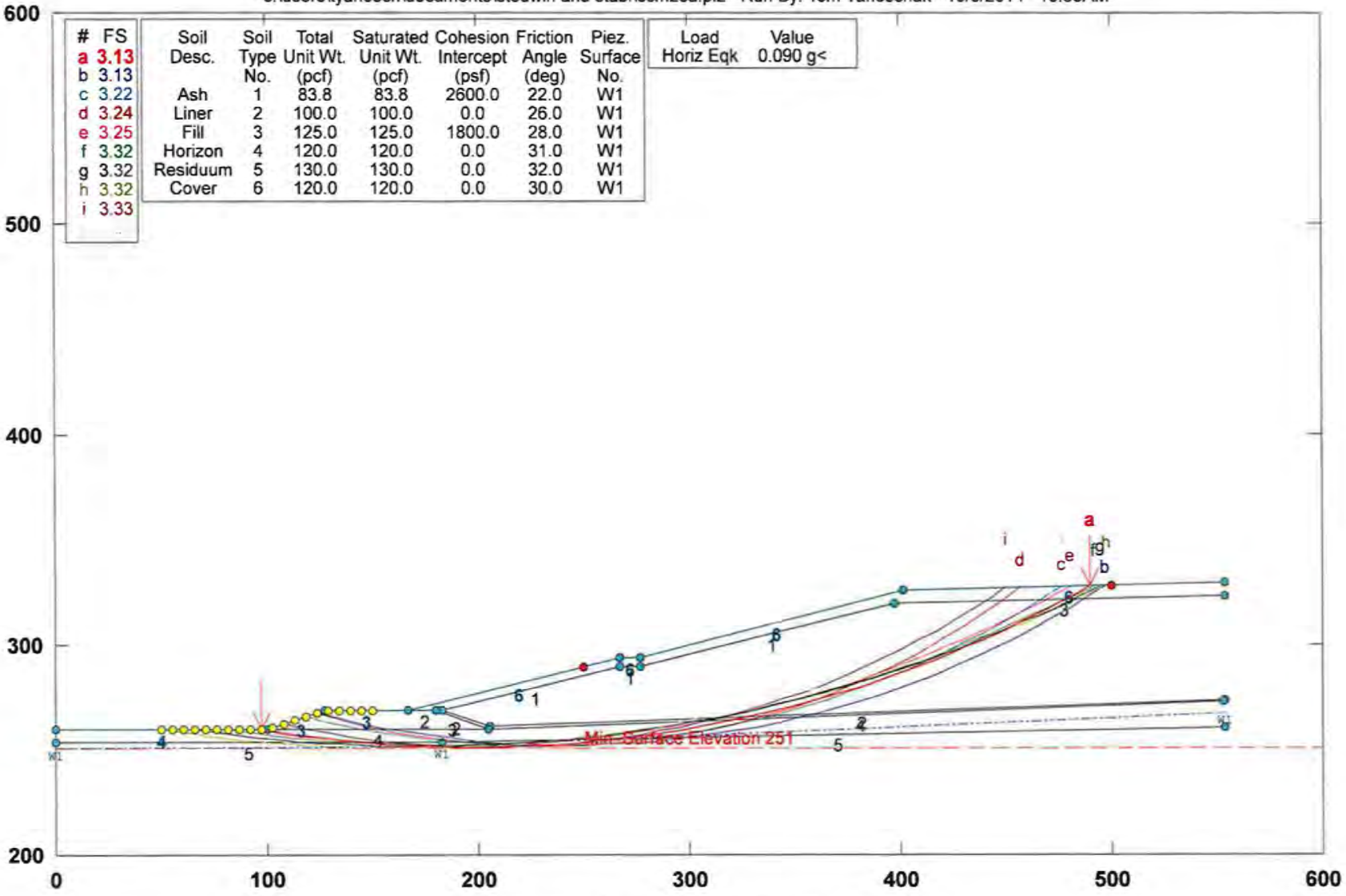
Charah Colon Mine Structural Fill Global - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm2sa.pl2 Run By: Tom Yanoschak 10/6/2014 10:35AM

#	FS
a	3.13
b	3.13
c	3.22
d	3.24
e	3.25
f	3.32
g	3.32
h	3.32
i	3.33

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=3.13

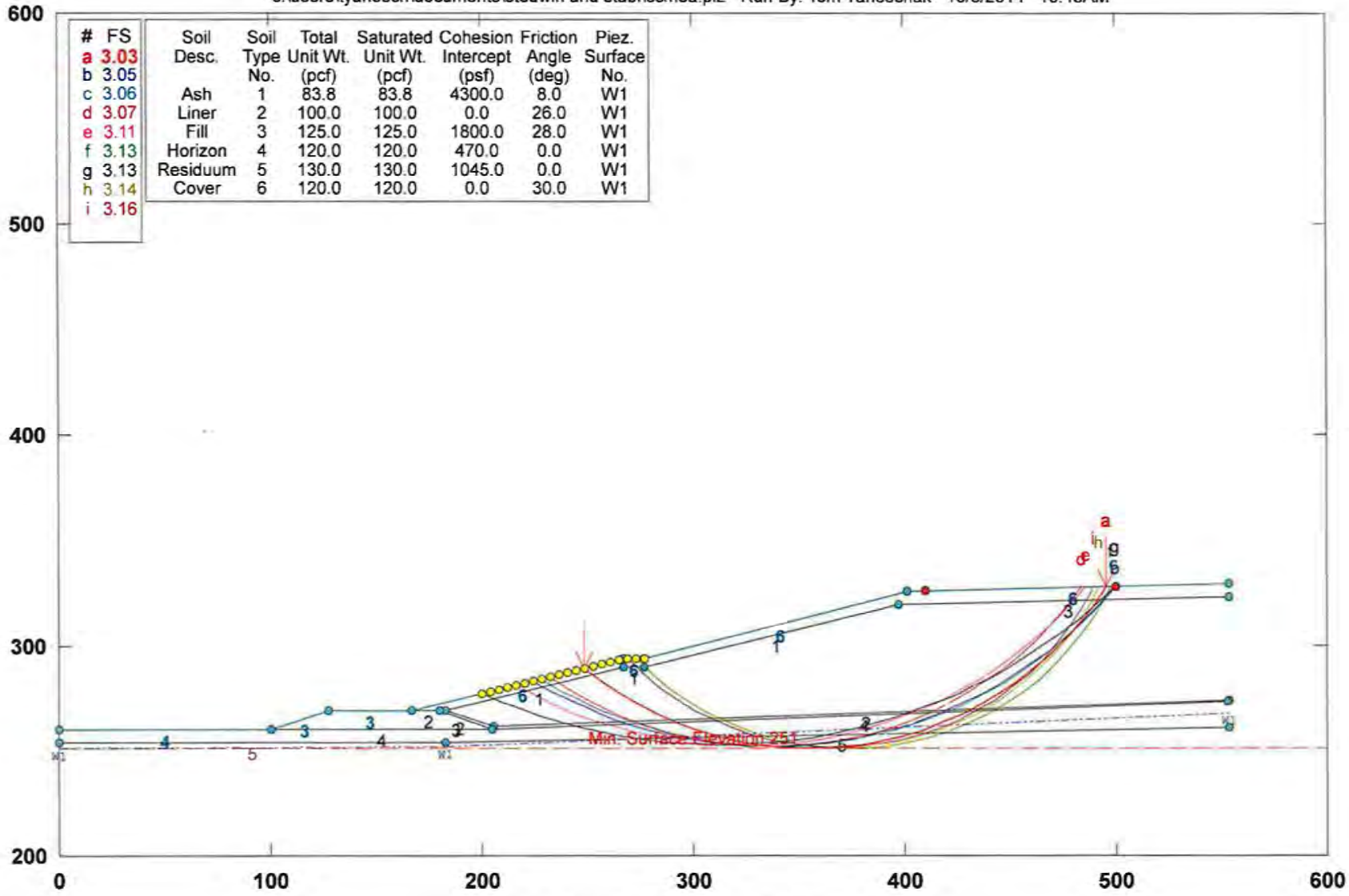
Safety Factors Are Calculated By The Modified Bishop Method

Charah Colon Mine Structural Fill Ash Slope - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm3a.pl2 Run By: Tom Yanoschak 10/6/2014 10:48AM

#	FS
a	3.03
b	3.05
c	3.06
d	3.07
e	3.11
f	3.13
g	3.13
h	3.14
i	3.16

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1



PCSTABL5M/si FSmin=3.03

Safety Factors Are Calculated By The Modified Bishop Method

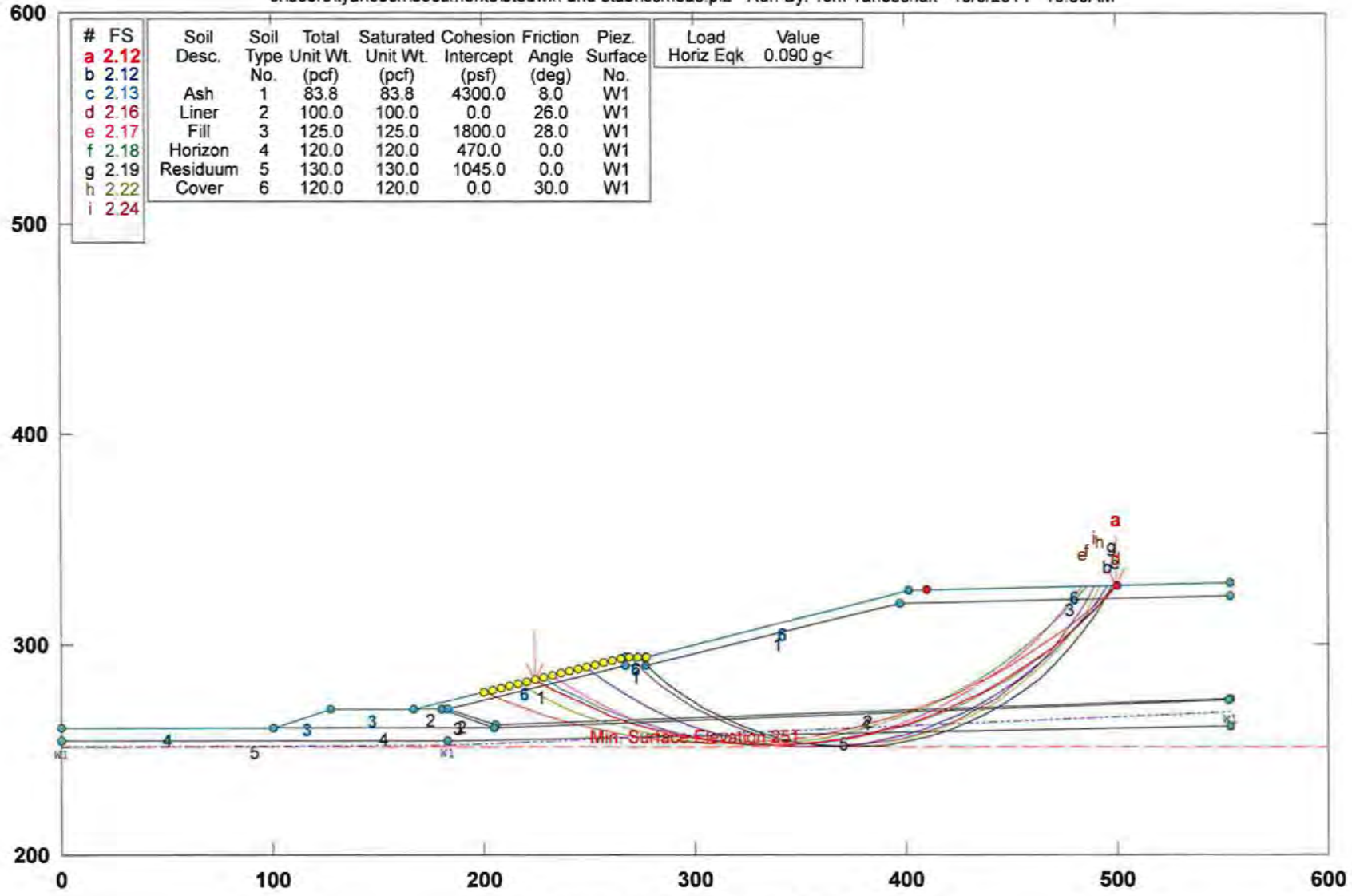
Charah Colon Mine Structural Fill Ash Slope - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm3as.pl2 Run By: Tom Yanoschak 10/6/2014 10:50AM

#	FS
a	2.12
b	2.12
c	2.13
d	2.16
e	2.17
f	2.18
g	2.19
h	2.22
i	2.24

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=2.12

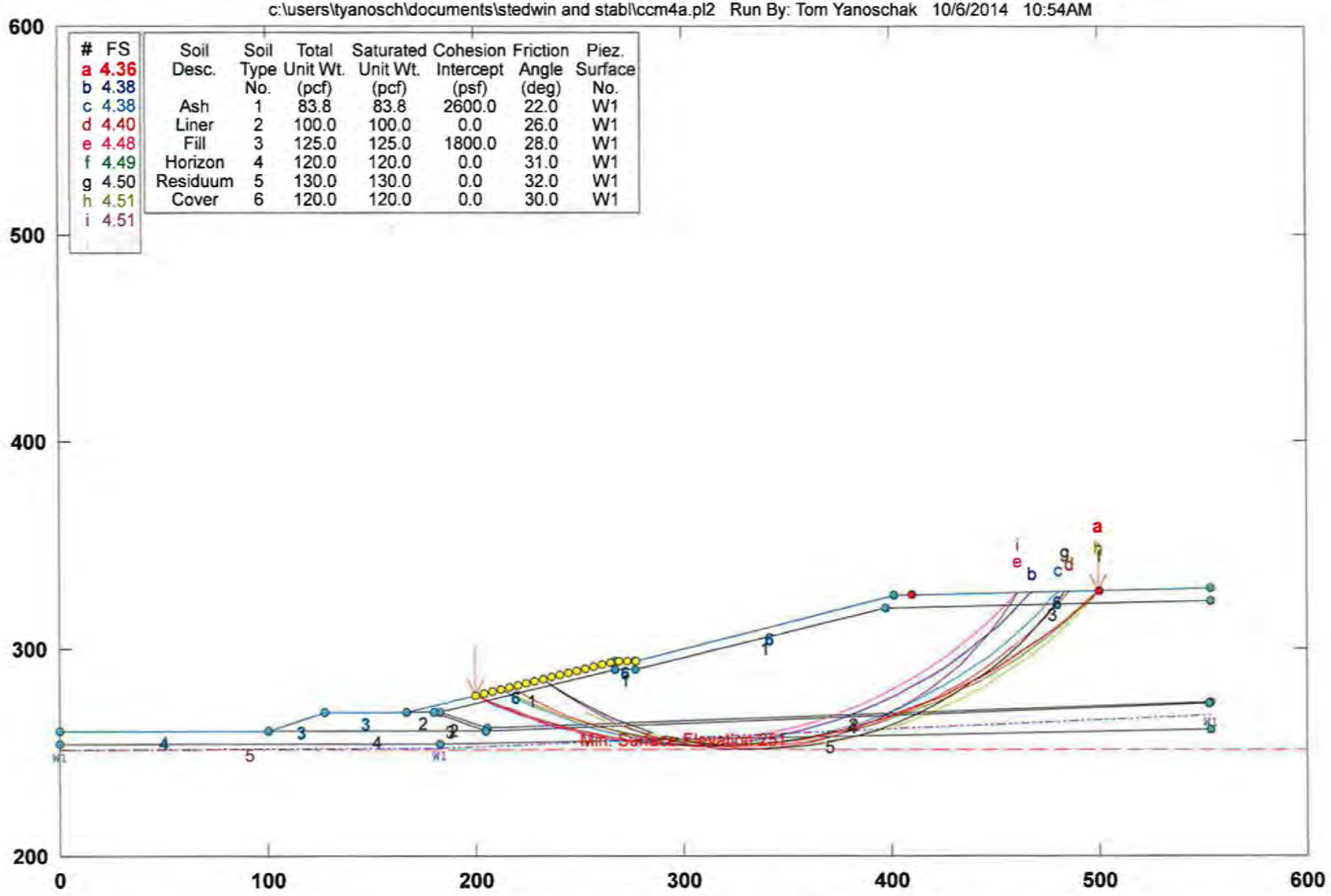
Safety Factors Are Calculated By The Modified Bishop Method

Charah Colon Mine Structural Fill Ash Slope - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm4a.pl2 Run By: Tom Yanoschak 10/6/2014 10:54AM

#	FS
a	4.36
b	4.38
c	4.38
d	4.40
e	4.48
f	4.49
g	4.50
h	4.51
i	4.51

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1



PCSTABL5M/si FSmin=4.36

Safety Factors Are Calculated By The Modified Bishop Method

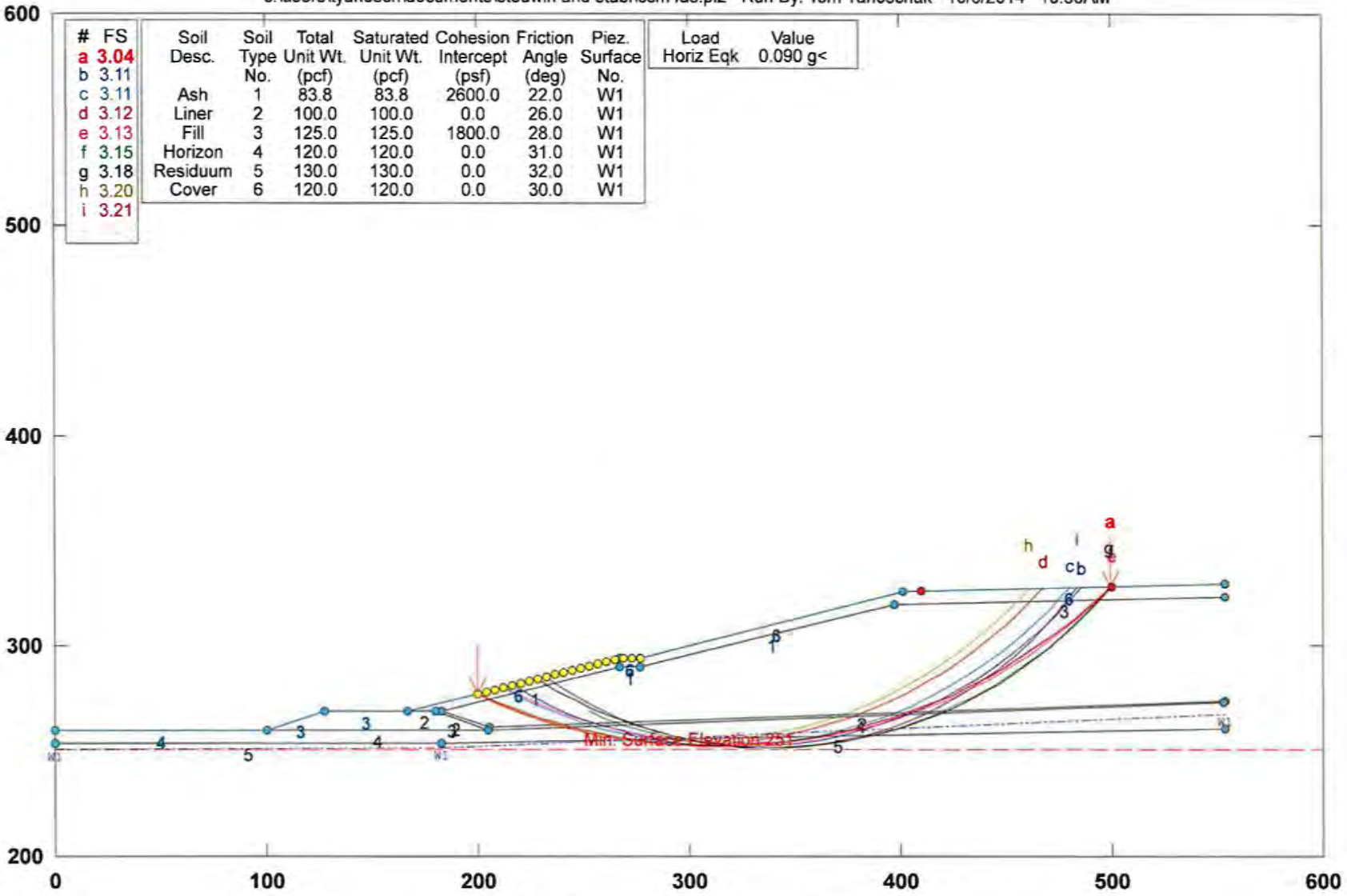
Charah Colon Mine Structural Fill Ash Slope - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm4as.pl2 Run By: Tom Yanoschak 10/6/2014 10:56AM

#	FS
a	3.04
b	3.11
c	3.11
d	3.12
e	3.13
f	3.15
g	3.18
h	3.20
i	3.21

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=3.04

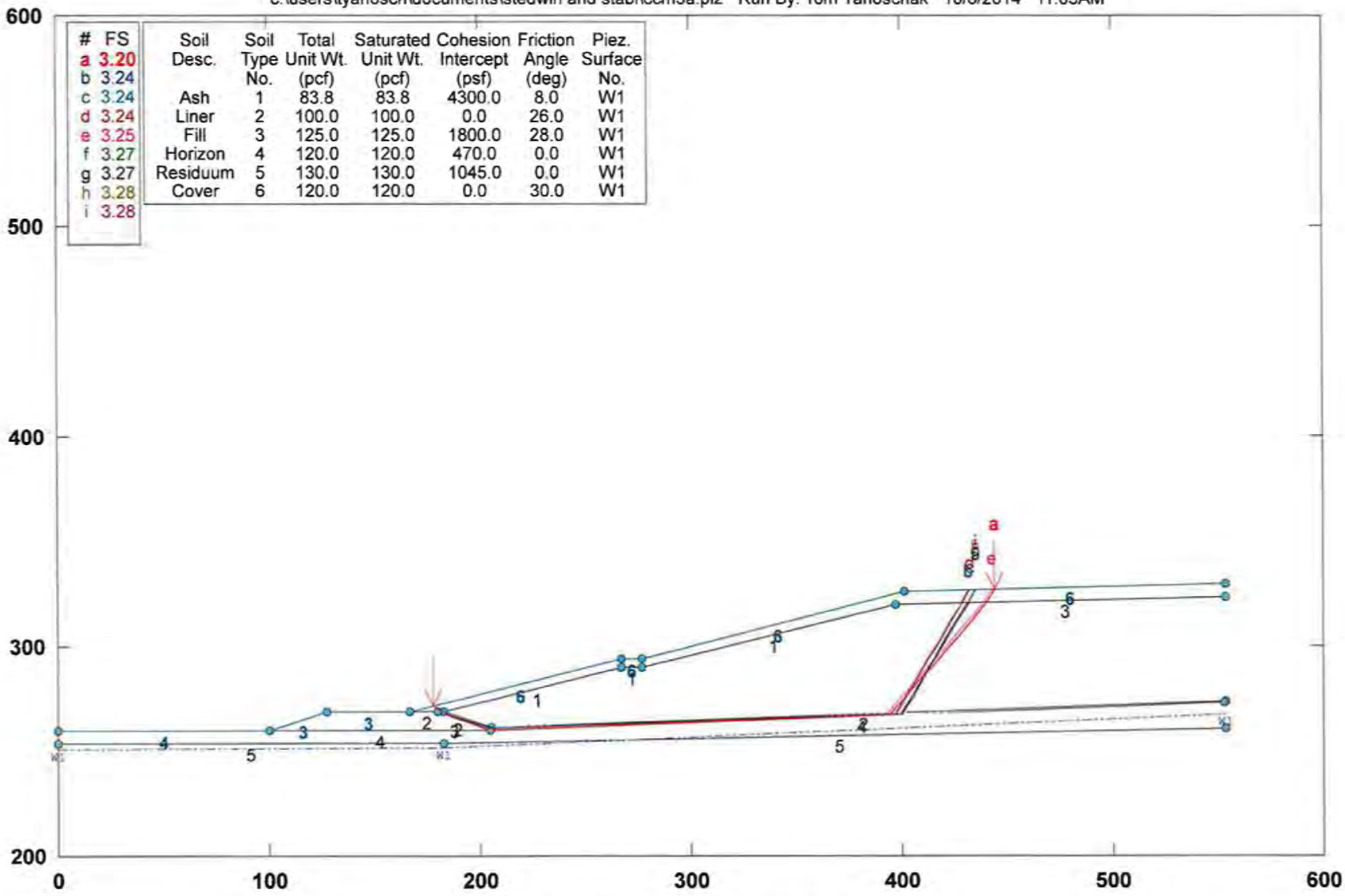
Safety Factors Are Calculated By The Modified Bishop Method

Charah Colon Mine Structural Fill Sliding Block - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm5a.pl2 Run By: Tom Yanoschak 10/6/2014 11:05AM

#	FS
a	3.20
b	3.24
c	3.24
d	3.24
e	3.25
f	3.27
g	3.27
h	3.28
i	3.28

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1



PCSTABL5M/si FSmin=3.20

Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

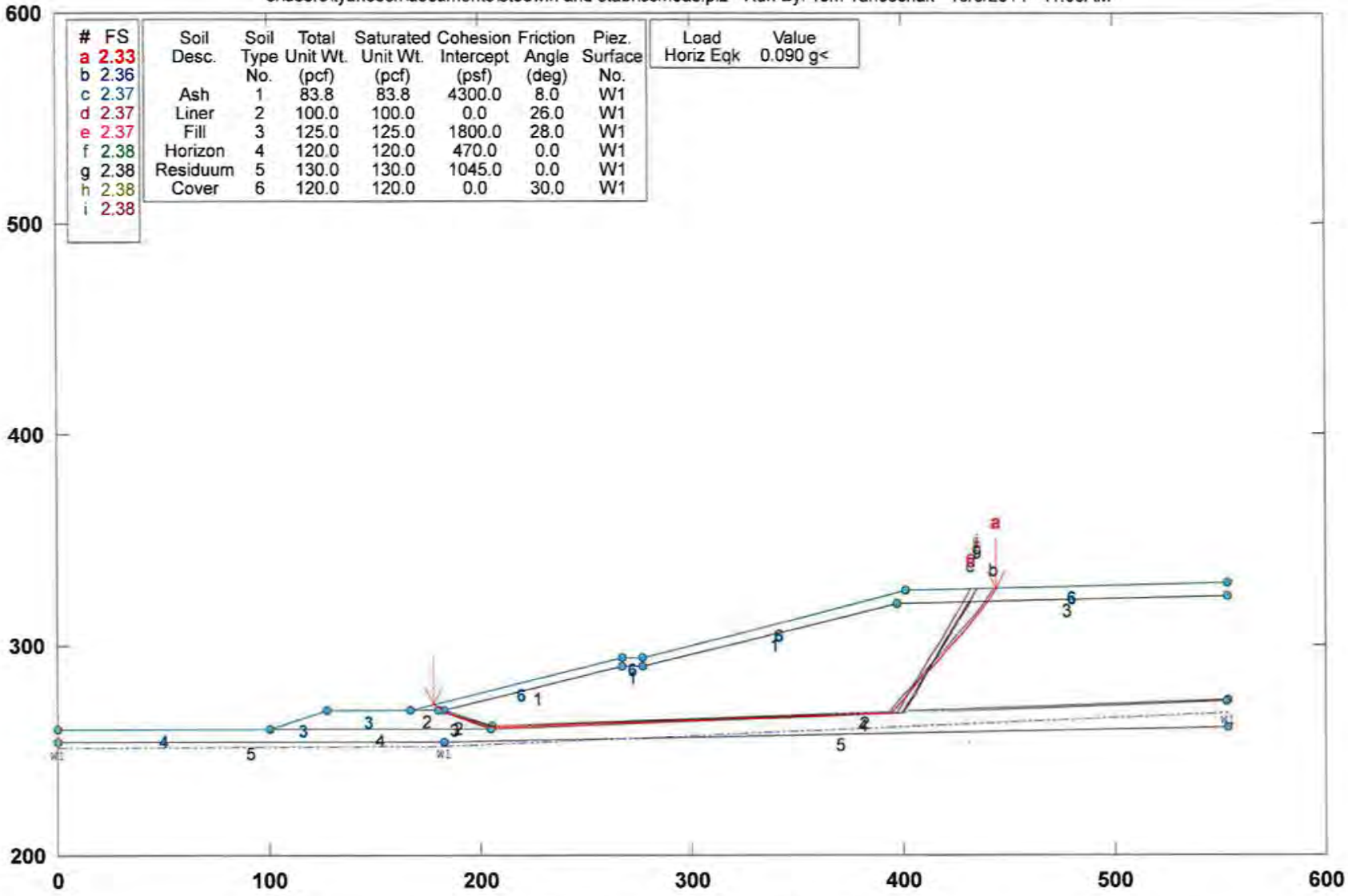
Charah Colon Mine Structural Fill Sliding Block - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm5as.pl2 Run By: Tom Yanoschak 10/6/2014 11:06AM

#	FS
a	2.33
b	2.36
c	2.37
d	2.37
e	2.37
f	2.38
g	2.38
h	2.38
i	2.38

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<

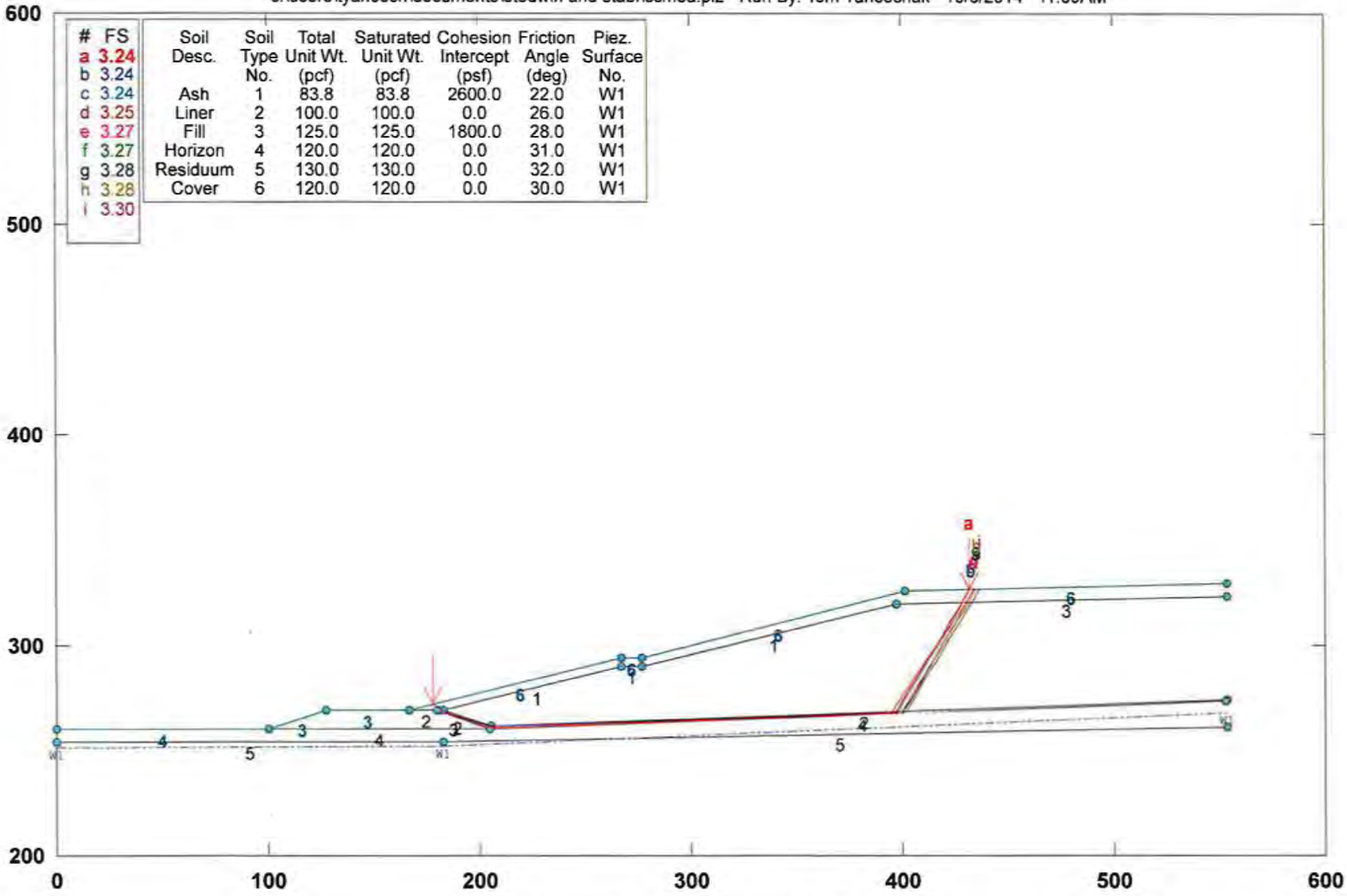


PCSTABL5M/si FSmin=2.33

Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

Charah Colon Mine Structural Fill Sliding Block - Static (Effectiv Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm6a.pl2 Run By: Tom Yanoschak 10/6/2014 11:09AM



#	FS
a	3.24
b	3.24
c	3.24
d	3.25
e	3.27
f	3.27
g	3.28
h	3.28
i	3.30

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

PCSTABL5M/si FSmin=3.24

Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

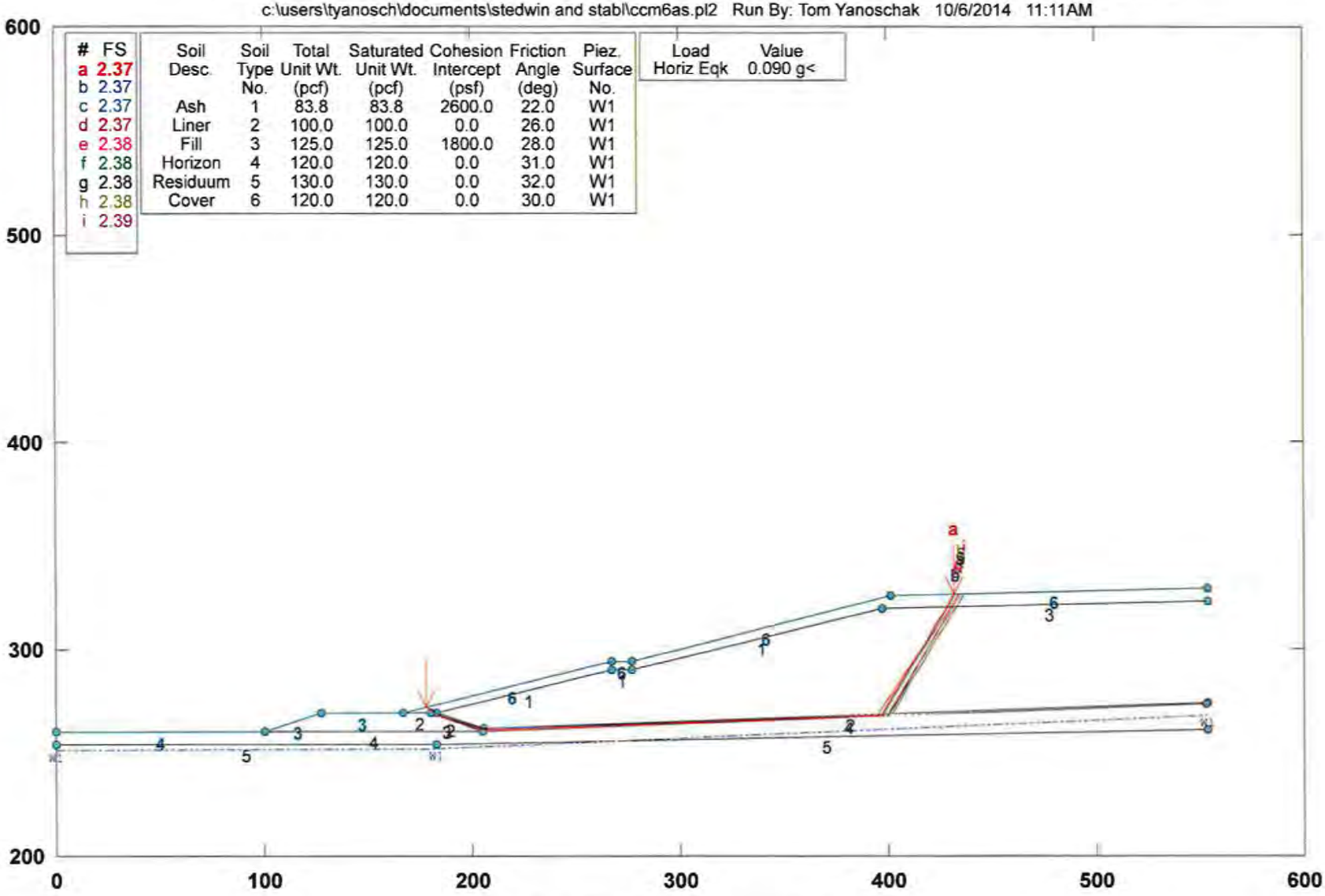
Charah Colon Mine Structural Fill Sliding Block - Seismi (Effectiv Stress)

c:\users\tyanosch\documents\stedwin and stabl\ccm6as.pl2 Run By: Tom Yanoschak 10/6/2014 11:11AM

#	FS
a	2.37
b	2.37
c	2.37
d	2.37
e	2.38
f	2.38
g	2.38
h	2.38
i	2.39

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<

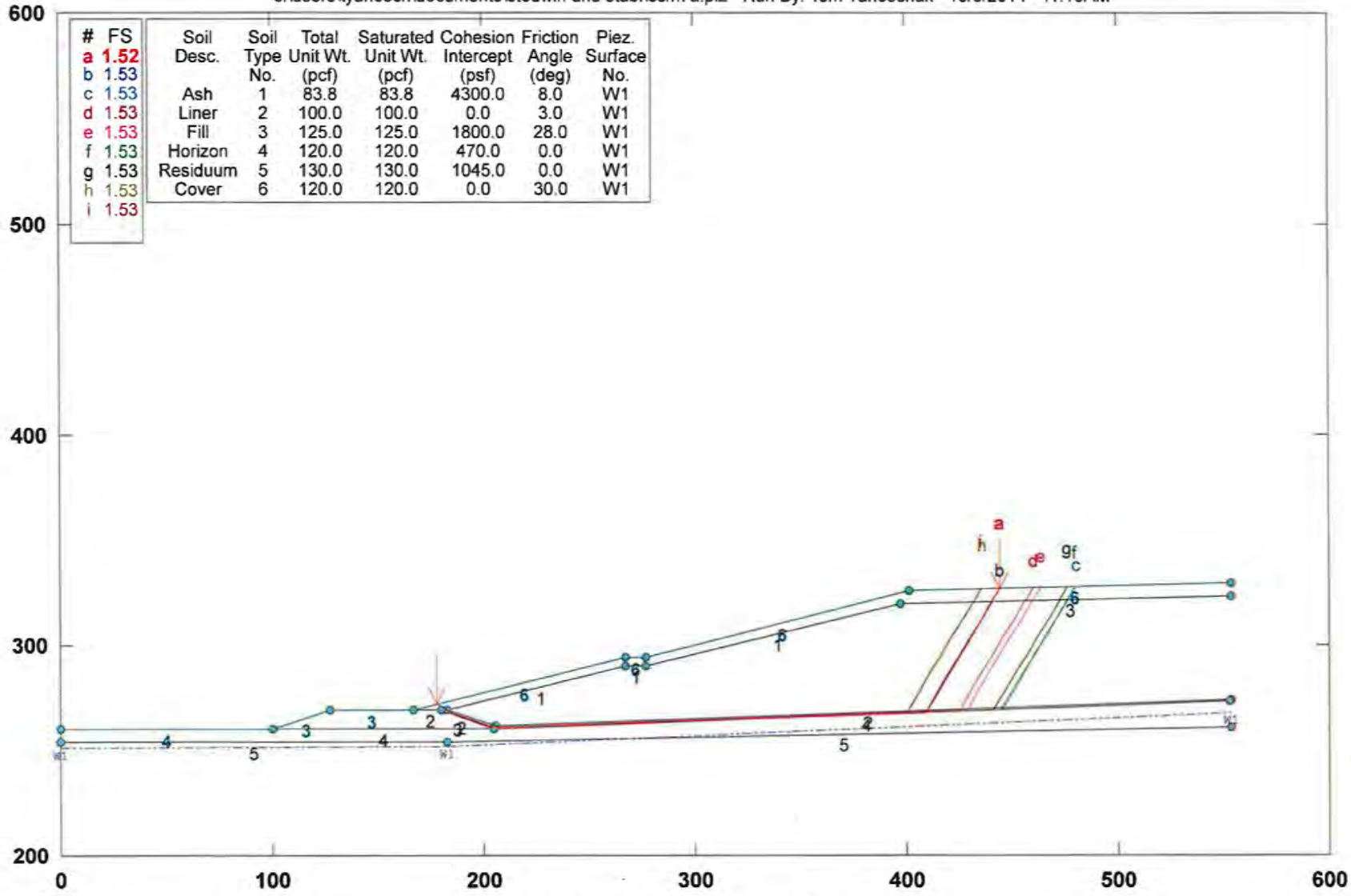


PCSTABL5M/si FSmin=2.37

Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

Charah Colon Mine Structural Fill Sliding Block - Static (Min Liner Phi)

c:\users\tyanosch\documents\stedwin and stabl\ccm7a.pl2 Run By: Tom Yanoschak 10/6/2014 11:16AM



#	FS
a	1.52
b	1.53
c	1.53
d	1.53
e	1.53
f	1.53
g	1.53
h	1.53
i	1.53

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	3.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

PCSTABL5M/si FSmin=1.52

Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

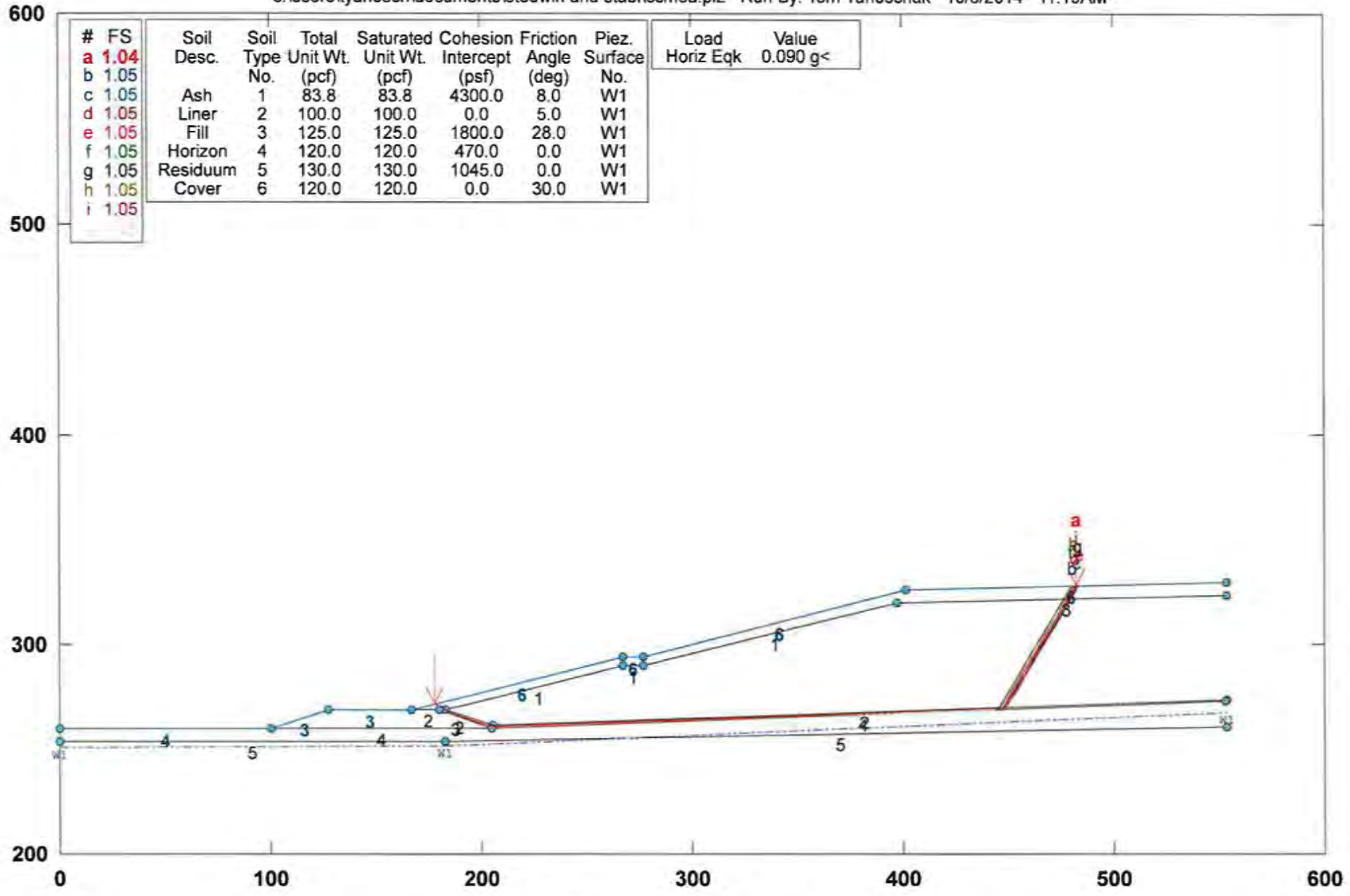
Charah Colon Mine Structural Fill Sliding Block - Seismic (Min Liner Phi)

c:\users\tyanosch\documents\stedwin and stabl\ccm8a.pl2 Run By: Tom Yanoschak 10/6/2014 11:19AM

#	FS
a	1.04
b	1.05
c	1.05
d	1.05
e	1.05
f	1.05
g	1.05
h	1.05
i	1.05

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	5.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=1.04

Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

ATTACHMENT A

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Boring Log, PZ-1

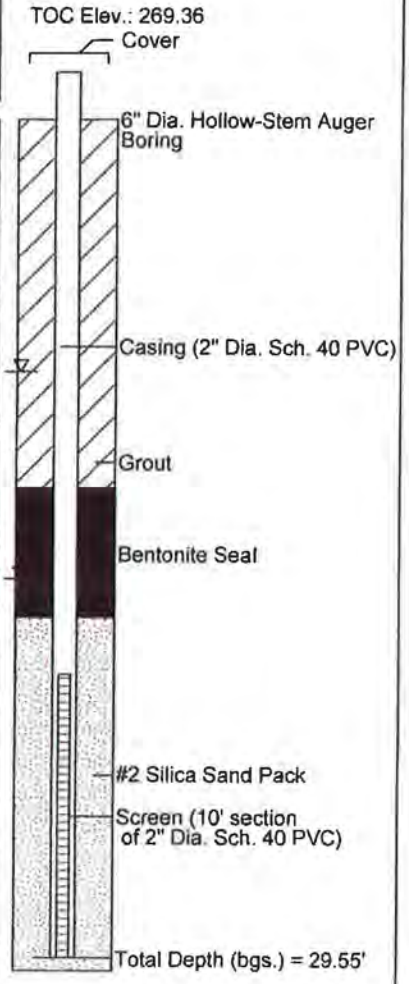
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/15/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/15/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	269.36'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	266.78'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	Fill (road bed)

Water Levels
▼ 1 Hour = 16.17' bgs
▽ 24 Hours = 8.89' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	266.78	4 32 35 (67)	SS	14	dry; very hard; red (2.5YR 4/6) with brown mottles; fine to carse sandy silty clay with brick gravel fragments; cohesive; medium plasticity; Fill
5	261.78	5 7 9 (16)	SS	16	moist; very stiff; reddish brown (2.5 YR 4/3) with orange and yellow mottles and black vertical stringers; quartz gravelly silty clay; high plasticity; cohesive; Fill
10	256.78	7 5 8 (13)	SS	18	moist; stiff; reddish yellow (5YR 6/6) with white and rust mottles and stringers; silty clay; medium plasticity; cohesive; Fill
15	251.78	17 50/4"	SS	10	moist; very hard; yellowish red (5YR 4/6) with black stringers; horizontal fissle; very fine mica sandy silty clay with large quartz gravel; low plasticity; cohesive; Partially Weathered Rock
20	246.78	7 50/4"	SS,BAG	8	dry; very compact; red (2.5YR 4/6); clayey silty medium sand; no plasticity or cohesion; Partially Weathered Rock; (Lab Results: PZ-1 Bag (19-20'); USCS=SC; Gravel=12.1%; Sand=58.9%; Silt=22.7%; Clay=6.3%; Effective Porosity=26%; Atterberg Limits: PL=17, LL=29, PI=12)
25	241.78	41 50/1"	SS, BAG	10	dry; very compact; weak red (2.5YR 4/6) with white mottles and specks; horizontal fissle; quartz gravelly clayey silt; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-1 Bag (24-25'); USCS=CL; Sand=38.9%; Silt=47.1%; Clay=14.0%; Effective Porosity=15%; Atterberg Limits: PL=17, LL=30, PI=13)
30	236.78	50/.5"	SS	4	wet; weak red (10R 4/4); weathered mudstone with quartz and phyllite gravel; Partially Weathered Rock
					Auger Refusal @ 30'
35	231.78				
40	226.78				
45					



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Boring Log, PZ-2s and 2

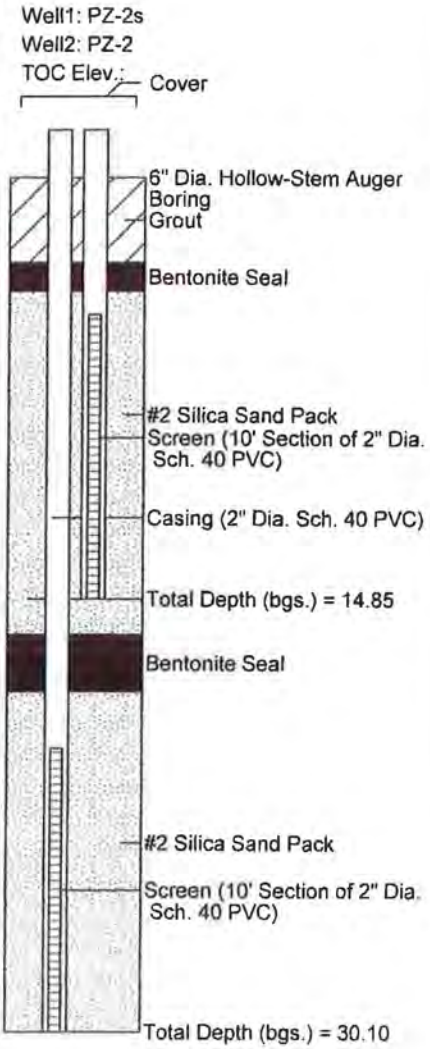
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/15/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/16/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	276.93'/276.84'
Drillers Name:	Mark Seiler	Ground Surface Elev.:	274.31'
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	Fill (road bed)

Water Levels
▼ 1 Hour = dry/16.10' bgs
▽ 24 Hours = dry/11.84' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	274.31	17 18 24	SS	21	dry; compact; reddish yellow (7.5YR 6/8); horizontal fissle; clayey silt with gravel and brick fragments; no plasticity or cohesion; Fill
5	269.31	14 8 18	SS	20	moist; very stiff; brown (10YR 5/3) with gray and white mottles; quartz gravelly fine sandy clayey silt with roots and organic odor; low plasticity; cohesive; Fill
10	264.31	4 4 6	SS,ST	20,24	moist; stiff; brownish yellow (10YR 6/6) with light gray and light orange mottles; coarse quartz sandy clayey silt; low plasticity; cohesive; Flood Plain; (Lab Results: PZ-2 UD (9-11'); USCS=CH; Gravel=2.1%; Sand=15.3%; Silt= 40.2%; Clay=42.4%; Specific Gravity=2.66' Hydraulic Conductivity= 6.23 x 10-5 cm/sec; Total Porosity=40.7%; Effective Porosity=2%; Atterberg Limits: PL=25, LL=50; PI=25)
15	259.31	30 50/4"	SS	12	dry; very hard; yellowish red (5YR 4/6) with black manganese horizontal planes between fissle layers; clayey silt; low plasticity; cohesive; Partially Weathered Rock
20	254.31	12 15 20	SS	16	moist; hard; red (2.5YR 5/6) with yellow stringers; silty clay; low plasticity; cohesive; Residuum
25	249.31	26 20 30	SS	18	moist; hard; reddish brown (2.5YR 5/4) with light green gray and black stringers; horizontal fissle; fine sandy clayey silt; low plasticity; cohesive; Residuum
30	244.31	17 22 50/2"	SS,BAG	14	wet; very hard; red (2.5YR 4/8); silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-2 Bag (29-30.5'); USCS=CL; Sand=2.2%; Silt=70.7%; Clay=27.1%; Effective Porosity=4; Atterberg Limits= PL=22, LL=43, PI=21)
35	239.31				Auger Refusal @ 30.5'
40	234.31				
45					



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Boring Log, PZ-3s and 3

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

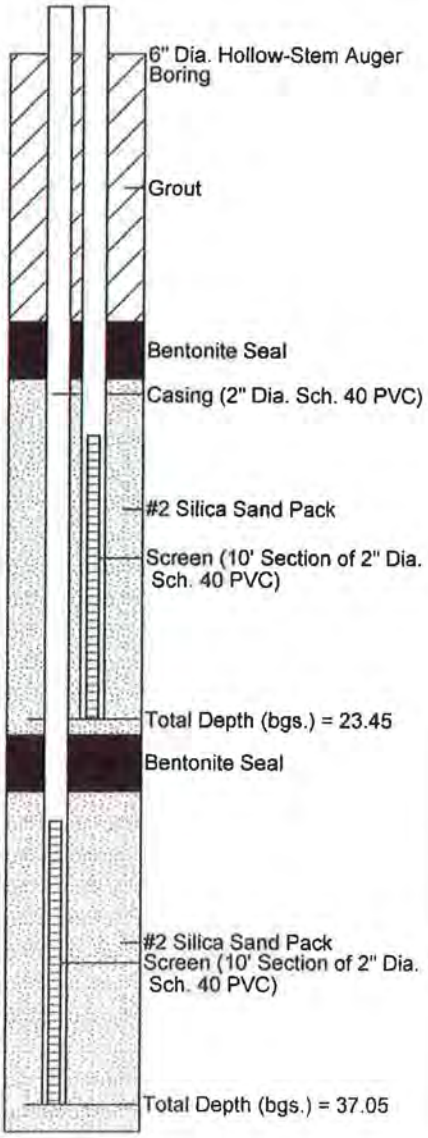
Date Started:	7/16/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/16/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	299.12'/299.29'
Drillers Name:	Mark Seiler	Ground Surface Elev.:	296.20'
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

Water Levels
1 Hour = dry/36.11'bgs
24 Hours = dry/30.91' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	296.2	4 6 8	SS,ST	16,24	moist; stiff; yellowish red (5YR 5/6) with light gray and orange yellow mottled; fine to coarse sandy gravelly clayey silt; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-3 UD (0-2'); USCS=CL; Sand=6.7%; Silt=52.8%; Clay=40.5%; Specific Gravity=2.67; Hydraulic Conductivity=2.42 x 10-6 cm/sec; Total Porosity=39.3%; Effectuve Porosity=2%; Atterberg Limits: PL=27, LL=48, PI=21)
5	291.2	7 8 11	SS	14	moist; very stiff; red (2.5YR 4/6) with white and brown specks; clayey fine to coarse sandy and gravelly silt; no plasticity; cohesive; Residuum
10	286.2	7 16 16	SS	14	dry; hard; reddish brown (2.5YR 5/4) with light orange and maroon mottles; clayey silt; no plasticity; cohesive; Residuum
15	281.2	15 44 50/3"	SS	16	moist; very hard; red (10R 5/6) with maroon mottles and vertical manganese fracture planes; clayey silt; no plasticity; cohesive; Partially Weathered Rock
20	276.2	50/6"	SS	7	dry; very hard; reddish brown (2.5YR 5/4) with olive green and white specks; fine to medium sandy silt with rock fragments; no plasticity; cohesive; Partially Weathered Rock
25	271.2	50/5"	SS	9	dry; very compact; reddish brown (2.5YR 5/4) with white and green specks; medium horizontal fissle; silty fine to coarse sand with gravel; no plasticity or cohesion; Partially Weathered Rock
30	266.2	50/2"	SS	5	dry; very hard; weak red (10R 5/3); highly horizontal fissle; fine mica sandy silt; no plasticity; cohesive; Partially Weathered Rock
35	261.2	50/5"	SS,BAG	6	moist; weak red (10R 4/3) with green, yellow and black specks and mottles; slightly clayey silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock; (Lab Results: PZ-3 Bag (34-34.5'); USCS=SM; Gravel=12.8%; Sand=59.7%; Silt and Clay=27.5%; Effective Porosity=30%)
40	256.2				Auger Refual @ 38'
45					

Well1: PZ-3s
Well2: PZ-3
TOC Elev. — Cover



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Boring Log, PZ-4

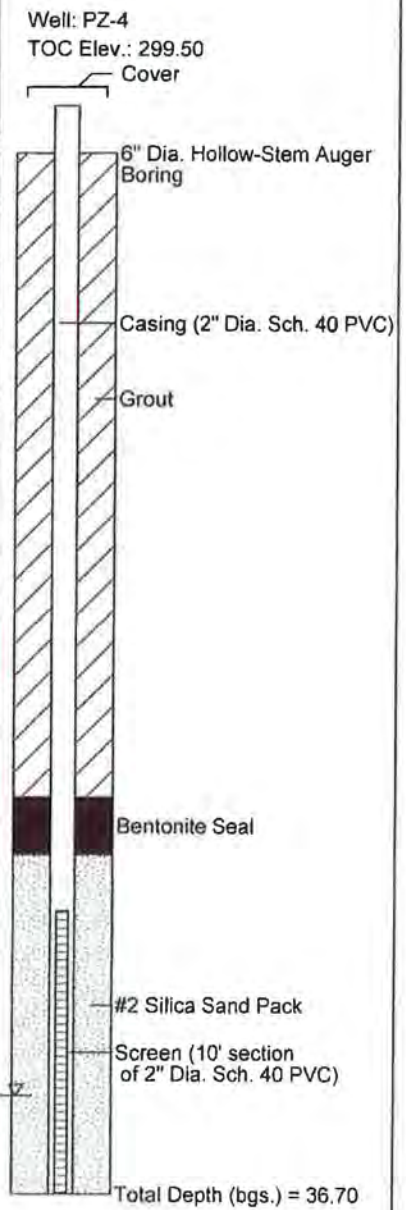
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/16/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/16/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	299.50'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	296.82'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

Water Levels
1 Hour = dry
24 Hours = 33.22' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	296.82	4 5 5 (10)	SS	14	moist; stiff; brownish yellow (10YR 6/8); fine to coarse sandy clayey silt with gravel; low plasticity; cohesive; Soil Horizon
5	291.82	4 5 6 (11)	SS,BAG	16	moist; stiff; brownish yellow (10YR 6/8) with rust mottles; silty clay; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-4 Bag (4-5.5'); USCS=CH; Sand=3.0%; Silt=50.9%; Clay=46.1%; Effective Porosity=2%; Atterberg Limits: PL=27, LL=60, PI=33)
10	286.82	9 9 12 (21)	SS	18	moist; very stiff; red (2.5YR 4/8) with olive green, rust, light gray and light purple mottled; gravelly clayey silt; no plasticity; cohesive; Residuum
15	281.82	27 50/5"	SS	12	dry; very hard; weak red (2.5YR 5/2) with light green specks; medium horizontal fissle; silt; no plasticity; cohesive; Partially Weathered Rock
20	276.82	29 50/3"	SS	12	dry; very hard; weak red (2.5YR 5/2) with white stringers and vertical black manganese fracture planes; silt; no plasticity; cohesive; Partially Weathered Rock
25	271.82	47 50/4"	SS, BAG	15	moist; very hard; red (2.5YR 4/6); highly horizontal fissle; very slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-4 Bag (24-24.5'); USCS=CL; Sand=21.0%; Silt=61.6%; Clay=17.4%; Effective Porosity=11%; Atterberg Limits: PL=16, LL=31, PI=15)
30	266.82	34 50/2"	SS	20	moist; very hard; weak red (10R 4/2) with white, black and yellow specks and stringers; medium horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
35	261.82	50/0"	SS	0	No Recovery
					Auger Refusal @ 36.7'
40	256.82				
45					



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Boring Log, PZ-4D

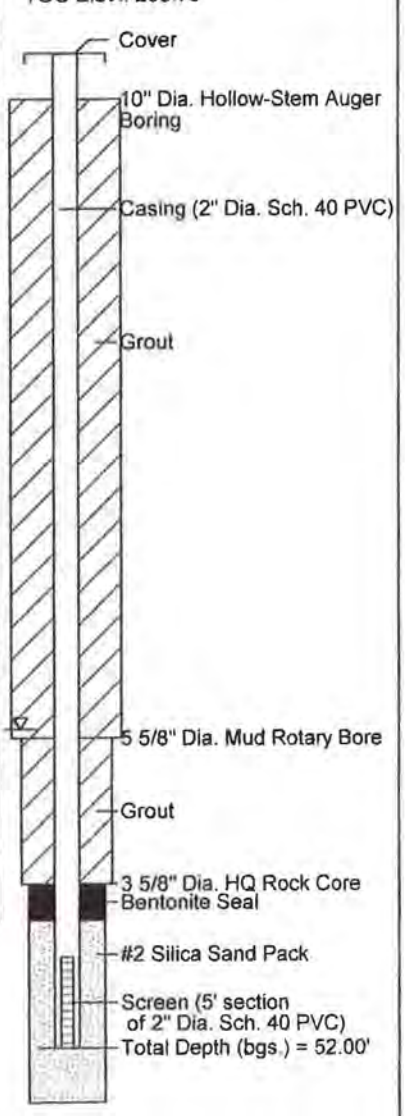
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/16/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/16/14	Drilling Method:	HSA; Geoprobe 8040DT
Drilling Company:	Geologic Exploration	Top-of-Casing Elev.:	299.76'(Lawrence Survey)
Drillers Name:	Johnny Burr	Ground Surface Elev.:	297 25'(Lawrence Survey)
NC Driller Certification:	3098A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = 35.00' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	297.25				Advance 10" diameter Hollow-Stem Augers from 0-35' See Boring Log PZ-4 for lithologic information from 0-36.5'
5	292.25				
10	287.25				
15	282.25				
20	277.25				
25	272.25				
30	267.25				
35	262.25				Auger Refusal @ 35' Advance 5 5/8" diameter mud-rotary drilling from 35-45', (layered rock and soil from 35-42'; moderately competent rock from 42-45')
40	257.25				
45	252.25				Advance HQ rock core (3 5/8" outer diameter) from 45-55' *1st Run from 45-50' (23.5" Recovery; RQD=39.2%; Rock Mass Quaility=Poor) Upper 9" core (blocky mudstone with healed 80 degree fracture; grading downward to muddy coarse sandstone) Lower 14.5" core (muddy sandy conglomerate; consiting of horizontally oriented rounded phyllite discs and rounded quartz gravel) *2nd Run (50-55') (45" Recovery; RQD=23.3%; Rock Mass Quality=Very Poor) Broken conglomerate as above (4" total length); grading downward into blocky mudstone with horizontal fractures every 1.5 to 5" (37.5" total length); grading downward into muddy coarse sandstone (3.5" length total)
50	247.25				
55	242.25				
60	237.25				
65	232.25				
70					



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Boring Log, PZ-5

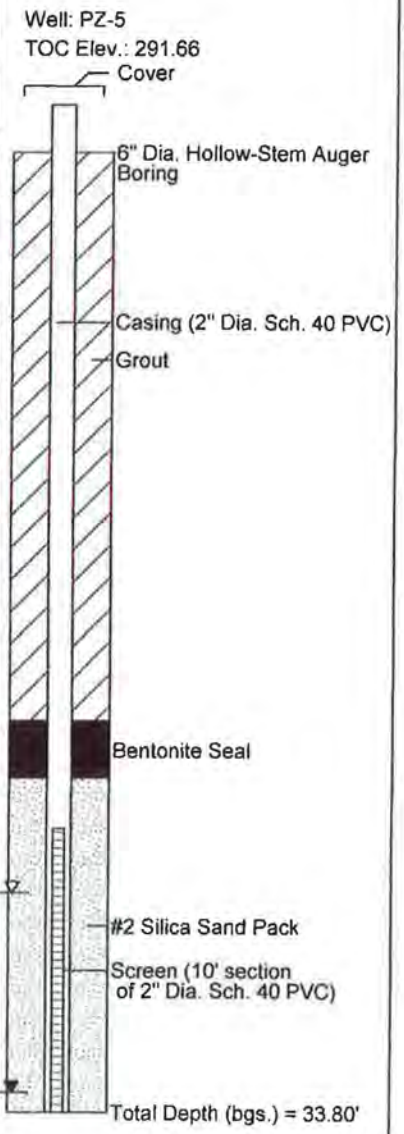
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/17/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/17/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	291.66'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	289.11'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = 33.10' bgs
▽ 24 Hours = 26.06' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	289.11	6 6 11	SS	16	moist; stiff; yellow (10YR 7/8) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
5	284.11	3 5 7	SS	19	wet; stiff; red (2.5YR 5/6) with yellow and light gray mottles; silty clay; low plasticity; cohesive; Soil Horizon
			ST	24	moist; red (2.5YR 4/6); clayey silt and silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-5 UD (6-8'); USCS=CL; Sand=2.2%; Silt=62.1%; Clay=35.7%; Specific Gravity=2.69; Hydraulic Conductivity=2.43 x 10-7 cm/sec; Total Porosity=30.6%; Effective Porosity=2%; Atterberg Limits: PL=26, LL=48, PI=22)
10	279.11	10 22 37 59	SS	15	moist; very hard; red (2.5YR 4/6); medium horizontal fissle; clayey silt; low plasticity; cohesive; Residuum
15	274.11	12 31 32 63	SS	18	moist; very hard; red (2.5YR 4/6); medium horizontal fissle; clayey silt; low plasticity; cohesive; Residuum
20	269.11	33 50/5"	SS	14	moist; very hard; weak red (10R 4/3) with dark gray mottles; blocky horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
25	264.11	50/6"	SS	14	moist; very hard; red (10R 4/6); highly horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
30	259.11	50/2"	SS	5	moist; very hard; red (10R 4/6) with gray pods; highly horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
35	254.11	50/6"	SS,BAG	8	wet; very hard; red (10R 4/6) with gray pods; highly horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-5 Bag (34-34.5'); USCS=CL; Sand 13.7%; Silt=73.6; Clay=12.7%; Effective Porosity=8; Atterberg Limits: PL=20, LL=32, PI=12)
40	249.11				
45					



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Boring Log, PZ-6

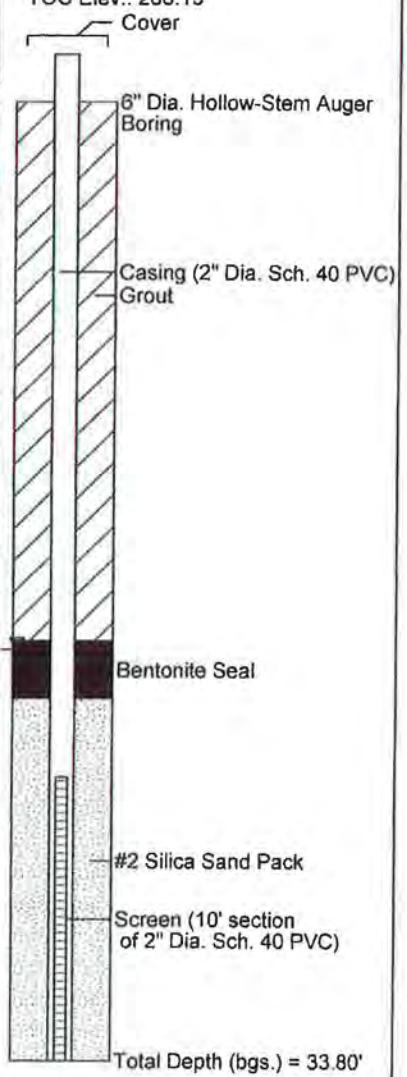
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/17/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/17/14	Drilling Method:	HSA; CME-45C
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	286.13'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	283.48'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = 19.30' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	283.48	8 8 13	SS	10	moist; medium compact; yellow (10YR 7/6); horizontal fissle; silt; no plasticity or cohesion; Soil Horizon
5	278.48	4 5 8	SS	13	moist; medium; pale yellow (2.5 Y 7/4) with light rust mottles; silty clay with roots; low plasticity; cohesive; Soil Horizon
10	273.48	7 11 15 26	SS ST	20 7	moist; very stiff; dark reddish gray (2.5YR 4/1) with white and yellow mottles; silty clay; low plasticity; cohesive; Residuum
15	268.48	9 21 50/5"	SS	24	moist; weak red (10R 4/4); clayey silt; no plasticity; cohesive; Residuum; (Lab Results: PZ-6 UD (10.5-11'); USCS=CL; Sand=11.3%, Silt=72.5%, Clay=16.2%; Specific Gravity=2.68; Hydraulic Conductivity=6.01 x 10-6 cm/sec; Total Porosity=30.7%; Effective Porosity=8%; Atterberg Limits: PL=23, LL=37, PI=14)
					moist; very hard; red (2.5YR 4/6); fine to coarse sandy clayey silt with gravel and rock fragments; no plasticity; cohesive; Partially Weathered Rock
20	263.48	50/4"	SS,BAG	6	dry; very hard; dark reddish brown (2.5YR 4/1); silty medium to coarse sand with rounded phyllite gravel; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-6 Bag (19-19.5'); USCS=SC; Sand=59.9%; Silt=27.1%; Clay=13.0%; Effective Porosity=16%; Atterberg Limits: PL=18, LL=33, PI=15)
25	258.48	50/1"	SS	1	moist; very hard; reddish brown (2.5YR 4/4); horizontal fissle; weathered mudstone; Partially Weathered Rock
30	253.48	50/.5"	SS	1	dry; very hard; weak red (2.5YR 5/2); horizontal fissle; sandy mudstone; Partially Weathered Rock
35	248.48	50/.5"	SS	1	dry; very hard; weak red (2.5YR 5/2); weathered silty conglomerate; Partially Weathered Rock
40	243.48				
45					



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Boring Log, PZ-7

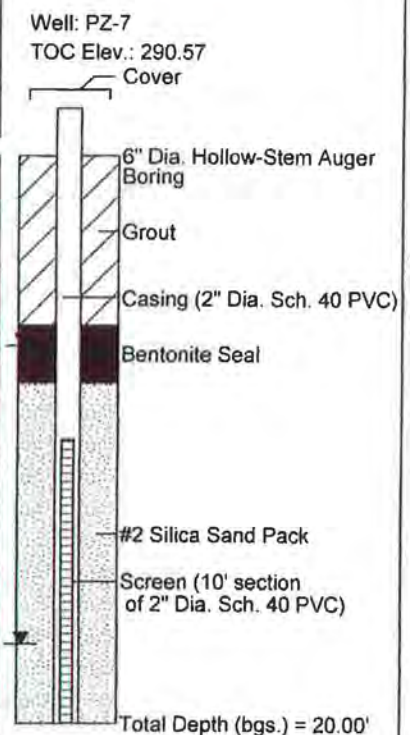
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/17/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/17/14	Drilling Method:	HSA
Drilling Company:	Red Dog Drilling	Top-of-Casing Elev.:	290.57'(Lawrence Survey)
Drillers Name:	Mark Seiler	Ground Surface Elev.:	287.92'(Lawrence Survey)
NC Driller Certification:	2789A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = 17.20' bgs
▽ 24 Hours = 6.69' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	287.92	5 5 8	SS	16	moist; medium; light yellowish brown (2.5Y 6/3); fine to coarse sandy clayey silt with roots; no plasticity; cohesive; Soil Horizon
5	282.92	5 12 20	SS	12	moist; very stiff; reddish brown (%YR 5/4) with light gray mottles; blocky; fine to coarse sandy silty clay; low plasticity; cohesive; Residuum
			ST	24	moist; reddish brown (5YR 5/4) with light gray mottles; blocky; fine to coarse sandy silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-7 UD (6-8'); USCS=CL; Sand=3.2%; Silt=67.5%; Clay=29.3%; Specific Gravity=2.74; Hydraulic Conductivity=1.76 x 10-6 cm/sec; Total Porosity=30.1; Effective Porosity=3; Atterberg Limits: PL=24, LL=40, PI=16)
10	277.92	11 13 15 28	SS	20	
15	272.92	50/6"	SS,BAG	15	moist/wet; very stiff; reddish brown (5YR 5/4) with vertical black manganese planes; silty clay; low plasticity; cohesive; Residuum
					moist/wet; very hard; red (2.5YR 5/8); highly horizontal fissle; clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-7 Bag (14-14.5); USCS=CL; Sand=0.4%; Silt=76.8%; Clay=22.8%; Effective Porosity=4%; Atterberg Limits: PL=22, LL=41, PI=19)
20	267.92	50/1"	SS	3	wet; very hard; reddish brown (5YR 5/4); highly horizontal fissle; weathered sandy mud stone; Partially Weathered Rock
25	262.92				
30	257.92				
35	252.92				
40	247.92				
45					



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Boring Log, PZ-8

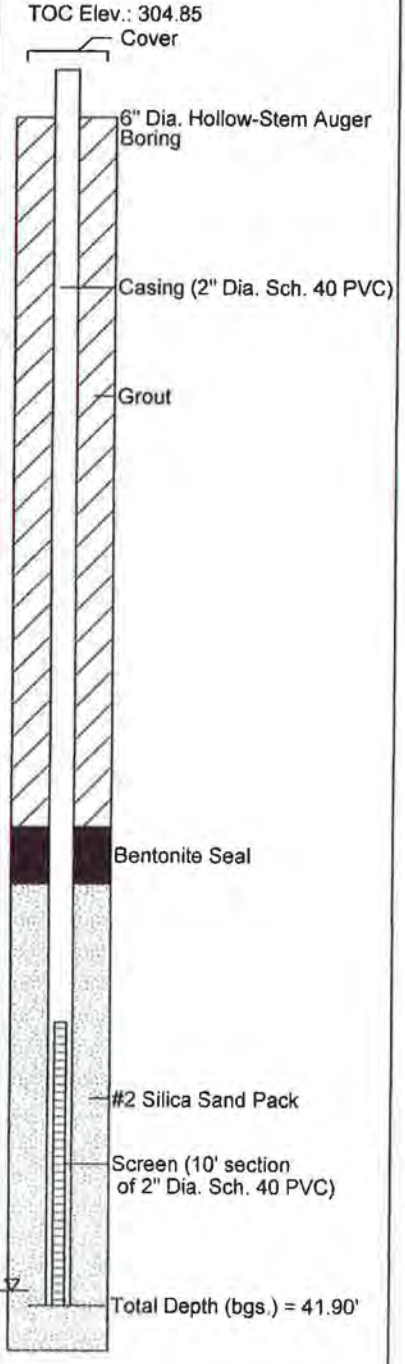
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/21/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/21/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	304.85'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	302.56'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = 41.38' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	302.56	4 8 7	SS	18	moist; stiff; strong brown (7.5Y 5/8) with white specks; silty clay; medium plasticity; cohesive; Residuum
5	297.56	3 4 6	SS	14	moist; stiff; red (2.5YR 4/6) with light orange mottles; silty clay; low plasticity; cohesive; Residuum
10	292.56	4 6 9	SS	15	moist; stiff; red (2.5YR 4/6); silty clay; low plasticity; cohesive; Residuum
15	287.56	10 13 13	SS,BAG	16	moist; very stiff; red (2.5YR 4/6) with orange mottles and black stringers; silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-8 Bag (13.5-15'); USCS=CL; Sand=3.1%; Silt=68.1%; Clay=28.8%; Effective Porosity=3%; Atterberg Limits: PL=23, LL=39, PI=16)
20	282.56	9 13 17	SS	14	moist; very stiff; red (10R 4/8) with light gray and yellow mottles; clayey quartz and phyllite gravelly silt; no plasticity; cohesive; Residuum
25	277.56	8 13 15	SS	20	moist; very stiff; red (10R 4/6) with light gray and yellow mottles; clayey quartz and phyllite gravelly silt; no plasticity; cohesive; Residuum
30	272.56	9 27 50/5"	SS	20	moist; very hard; red (10R 4/8) with maroon mottles; silty clay; low plasticity; cohesive; Residuum
35	267.56	34 50/5"	SS	15	moist; very hard; red (10R 4/8) with maroon mottles; silty clay; low plasticity; cohesive; Residuum
40	262.56	50/5"	SS	12	dry; very compact; weak red (10R 4/4); clayey silty fine to coarse sand; no plasticity or cohesion; Partially Weathered Rock
45		50/5"	SS	10	moist; very hard; red (10R 4/8); highly horizontal fissle; silty clay; low plasticity; cohesive; Partially Weathered Rock



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Boring Log, PZ-9s and 9

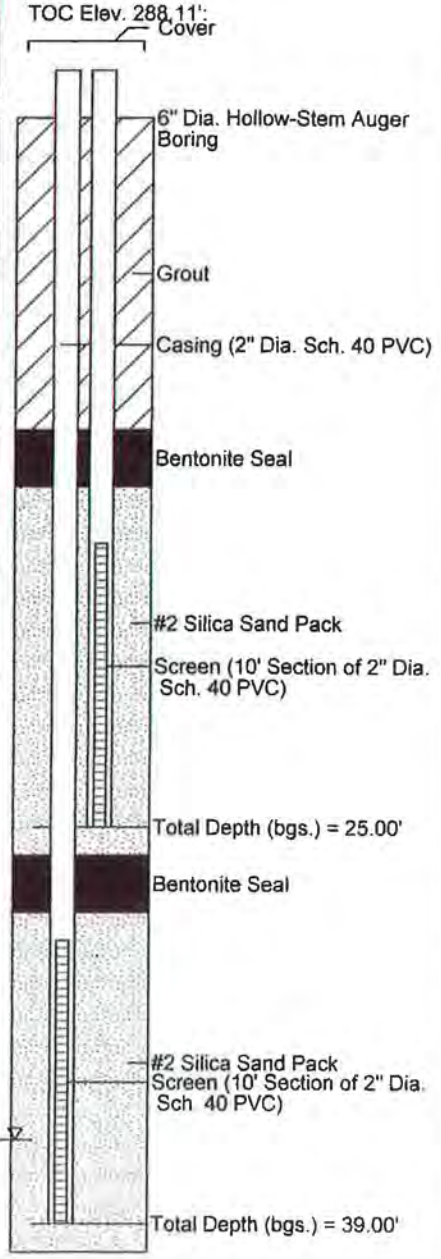
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/21/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/21/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	288.11'/288.11'
Drillers Name:	Robert Cassell	Ground Surface Elev.:	285.74'
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = dry/dry
▽ 24 Hours = dry/36.03' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	285.74	3 4 6 (10)	SS	16	moist; stiff; yellowish red (5YR 5/6) with rust mottles; silty clay; low plasticity; cohesive; Soil Horizon
5	280.74	3 4 8 (12)	SS	16	moist; stiff; light yellow brown (2.5 Y 6/3) with light orange mottles; silty clay; low plasticity; cohesive; Soil Horizon
10	275.74	3 4 7 (11)	SS	16	moist; stiff; light yellowish brown (2.5Y 6/3) with rust and maroon mottles; silty clay; low plasticity; cohesive; Soil Horizon
		Bouldergrade			
15	270.74	12 15 32 (47)	SS,BAG	22	dry; compact; weak red (10R 4/3) with white and gray specks; silty fine to coarse sand with phyllite gravel; no plasticity or plasticity; Residuum; (Lab Results: PZ-9 Bag (13.5-15'); USCS=SC, Gravel=0.4%; Sand=52.2; Silt=35.9; Clay=11.5%; Effective Porosity=17; Atterberg Limits: PL=20, LL=34, PI=14)
20	265.74	50/5"	SS	8	dry; very hard; weak red (10R 4/3); highly horizontal fissle; fine sandy silt; no plasticity; cohesive; Partially Weathered Rock
25	260.74	34 50/4"	SS	8	dry; very compact; weak red (10R 4/3) with white and gray specks; silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
30	255.74	50/5"	SS	6	dry; very compact; weak red (10R 4/3) with white and gray specks; silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
35	250.74	50/5"	SS	4	dry; very compact; weak red (10R 4/3) with white and gray specks; medium horizontal fissle; silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
40	245.74	50/5"	SS	8	dry; very hard; reddish brown (2.5YR 4/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
45					



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Boring Log, PZ-10

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/21/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/21/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	266.51'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	263.48'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.48	6 5 6	SS	24	moist; stiff; reddish yellow (7.5YR 6/6) with light gray and rust mottles; silty clay; no plasticity; cohesive; Soil Horizon
5	258.48	11 13 14	SS	14	dry; very stiff; red (2.5YR 4/8) with maroon and light gray mottles; clayey fine sandy silt; no plasticity; cohesive; Residuum
10	253.48	13 50/4"	SS	12	dry; very hard; red (2.5YR 4/6) with black vertical planes; blocky; silty clay; no plasticity; cohesive; Partially Weathered Rock
15	248.48	50/3"	SS	3	dry; very hard; red (2.5YR 4/6) with black vertical planes; highly horizontal fissle; mica sandy silty clay; low plasticity; cohesive; Partially Weathered Rock
20	243.48	50/1"	SS	2	dry; very compact; weak red (10R 5/3); silty fine to coarse sand with quartz and phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
25	238.48	50/6"	SS	12	dry; very hard; red (10R 4/6); highly horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	233.48	29 10 16	SS,BAG	18	moist; very hard; red (10R 4/6) with light orange mottles; highly horizontal fissle; silty clay; no plasticity; cohesive; Residuum; (Lab Results: PZ-10 Bag (28.5-30'); USCS=CL; Sand=5.7%; Silt=74.0%; Clay=20.3%; Effective Porosity=5%; Atterberg Limits: PL=18, LL=36; PI=18)
35	228.48				
40	223.48				
45					

Well: PZ-10
TOC Elev.: 266.51

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Boring Log, PZ-11

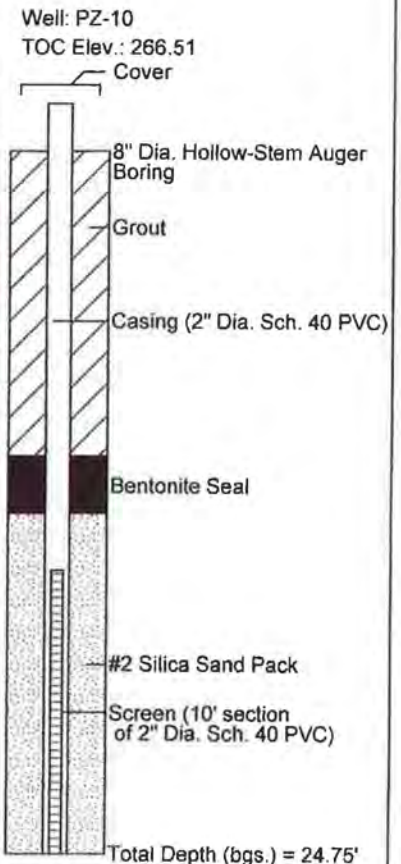
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/22/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/22/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	262.30'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	259.56'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural (drainage bottom)

Water Levels
1 Hour = dry
24 Hours = 19.59' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.48	3 7 9	SS	20	moist; very stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; quartz gravelly fine to coarse sandy clayey silt; no plasticity; cohesive; Soil Horizon
5	258.48	3 7 5	SS	17	moist; stiff; yellowish red (5YR 4/6) with light gray mottles; fine mica sandy clayey silt; no plasticity; cohesive; Soil Horizon
			ST	6	dry; red (2.5YR 4/6), mica and quartz sandy silt; low plasticity; cohesive; Residuum; (Lab Results: PZ-11 UD (6-6.5'); USCS=SM; Gravel=4.8%; Sand=65.5%; Silt=22.6%; Clay=7.1%; Specific Gravity=2.71; Hydraulic Conductivity=3.86 x 10-6 cm/sec; Total Porosity=19.7%; Effective Porosity=25%)
10	253.48	39 50/3"	SS	12	dry; very hard; weak red (10R 4/3); silty fine to coarse sand with gravel; no plasticity; cohesive; Partially Weathered Rock
15	248.48	16 36 50/6"	SS	15	moist; very hard; red (2.5YR 4/6) with black and purple mottles; medium horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
20	243.48	15 36 50/4"	SS	20	moist; very hard; red (2.5YR 4/6) with black and purple mottles; highly horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
25	238.48	20 10 8	SS,BAG	16	wet; very stiff; red (2.5YR 4/6) with black and purple mottles; highly horizonatl fissle; silty clay with rock and gravel layers; no plasticity; cohesive; Residuum
30	233.48				
35	228.48				
40	223.48				
45					



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Boring Log, PZ-12

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

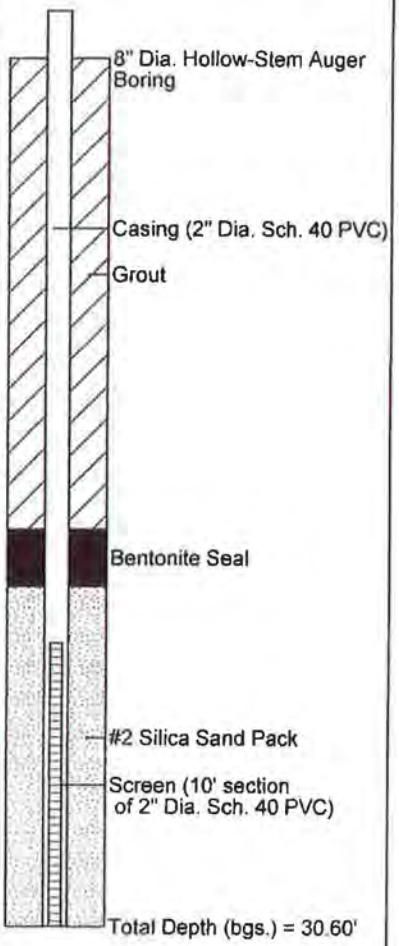
Date Started:	: 7/22/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 7/22/14	Drilling Method:	: HSA; CME-550x
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 287.15'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 284.32'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: natural

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	284.32	3 3 4 (7)	SS	16	moist; medium; yellowish red (5YR 5/8) with brown mottles; clayey, quartz gravelly silt and silty clay; low plasticity; cohesive; Soil Horizon
5	279.32	4 5 8 (13)	SS	14	moist; stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; silty clay; medium plasticity; cohesive; Soil Horizon
10	274.32	3 4 7 (10)	SS	13	moist; stiff; red (2.5YR 4/6) with green and black specks; fine to medium sandy clayey silt; low plasticity; cohesive; Residuum
15	269.32	5 26 50/4"	SS	15	moist; very hard; red (2.5YR 4/6) with green and black specks; medium horizontal fissle; mica sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
20	264.32	12 12 16	SS,BAG	21	moist; very stiff; red (2.5YR 4/6) with purple mottles; blocky; silty clay; no plasticity; cohesive; Residuum; (Lab Results: PZ-12 Bag (18.5-20'); USCS=CL; Sand=0.7%; Silt=66.5%; Clay=32.8%; Effective Porosity=2%; Atterberg Limits: PL=20, LL=42, PI=22)
25	259.32	50/3"	SS	8	dry; very hard; red (2.5YR 5/6); horizontal fissle; weathered fine sandy mudstone; Partially Weathered Rock
30	254.32	50/3"	SS	10	dry; very hard; red (2.5YR 5/6); horizontal fissle; weathered fine sandy mudstone; Partially Weathered Rock
35	249.32				
40	244.32				
45					

Well: PZ-12
TOC Elev.: 287.15



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Boring Log, PZ-13

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

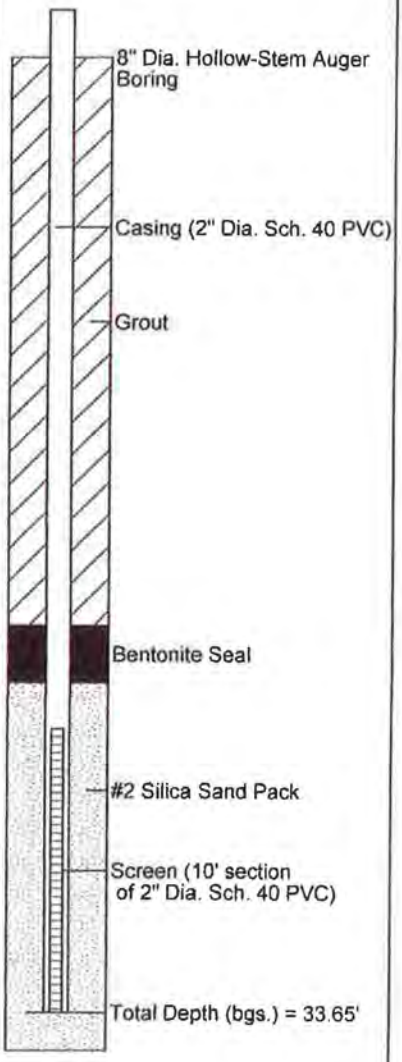
Date Started:	7/22/14	Logged By:	Ross Klingman, P.G
Date Completed:	7/22/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	296.59'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	293.48'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Well: PZ-12
TOC Elev.: 296.59

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	293.48	3 3 5	SS,BAG	10	moist; medium compact; brownish yellow (10YR 6/6) with white specks; clayey silty quartz sandy gravel; no plasticity or cohesion; Soil Horizon; (Lab Results: PZ-13 Bag (0-1.5'); USCS=SC-SM; Gravel=36.1%; Sand=37.2%; Silt=19.4%; Clay=7.3%; Effective Porosity=25%; Atterberg Limits: PL=17, LL=21, PI=4)
5	288.48	4 6 6	SS	21	moist; stiff; red (2.5YR 4/6); fine to medium sandy silt and silty clay layers; low plasticity; cohesive; Residuum
10	283.48	17 50/5"	SS	6	moist; very hard; red (2.5YR 4/6); silty clay with large quartz gravel; no plasticity; cohesive; Residuum
15	278.48	11 17 50/6"	SS	24	moist; very hard; weak red (10R 5/3) with light green mottles; medium horizontal fissle; silty clay; no plasticity; cohesive; Residuum
20	273.48	11 15 22	SS	20	moist; hard; pinkish gray (7.5YR 6/2) with black vertical and 45 degree planes; medium horizontal fissle; silty clay; no plasticity; cohesive; Residuum
25	268.48	11 50/6"	SS	18	moist; very hard; gray (7.5YR 5/1); medium horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	263.48	11 15 50/5"	SS	22	moist; very hard; gray (7.5YR 5/1); medium horizontal fissle; silty clay; no plasticity; cohesive; Residuum
35	258.48	50/1"	SS	3	dry; very hard; dark blueish gray (Gley 2 4/1); weathered mudstone; Partially Weathered Rock
40	253.48				Auger Refusal @ 35'
45					



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Boring Log, PZ-14

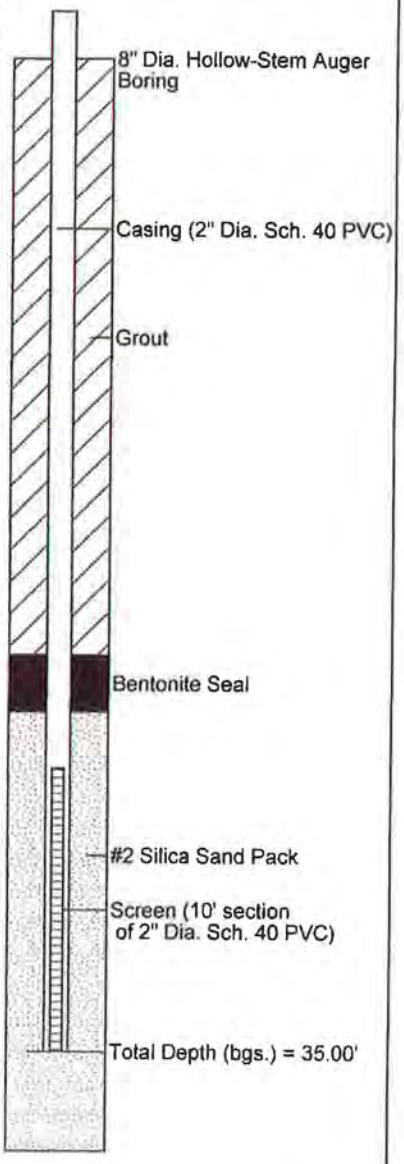
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	322.15'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	319.44'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	319.44	3 6 7 (13)	SS	16	moist; stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; gravelly silty clay; low plasticity; cohesive; Soil Horizon
5	314.44	4 5 6 (11)	SS	18	moist; stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; gravelly silty clay; low plasticity; cohesive; Soil Horizon
			ST	12	moist; reddish yellow (7.5YR 6/8) with rust and light gray mottles; large quartz gravelly silty clay; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-14 UD (6-7'); USCS=CH; Gravel=1.8% Sand=18.4%; Silt=37.7; Clay=42.1%; Specific Gravity=2.67; Hydraulic Conductivity=1.35 x 10-7 cm/sec; Total Porosity=38.6%; Effective Porosity=2%; Atterburg Limits: PI=28, LL=55, PI=27)
10	309.44	5 6 8 (14)	SS	15	
					moist; stiff; red (10R 4/6) with white specks; clayey quartz gravelly fine to coarse sandy silt; no plasticity, cohesive; Residuum
15	304.44	6 8 10 (18)	SS	18	moist; very stiff; red (10R 4/6) with white specks; clayey quartz gravelly fine to coarse sandy silt; no plasticity; cohesive; Residuum
20	299.44	6 7 11 (18)	SS	20	moist; very stiff; red (10R 4/8); silty clay; low plasticity; cohesive; Residuum
25	294.44	18 21 43 (64)	SS	18	moist; very hard; weak red (10R 5/3) with white and gray specks; fine to medium sandy silty clay; low plasticity; cohesive; Residuum
30	289.44	50/5"	SS	10	dry; very hard; red (10R 4/6); medium horizontal fissle; clayey fine to medium sandy silt; no plasticity; cohesive; Partially Weathered Rock
35	284.44	50/1"	SS	6	moist; very hard; weak red (10R 4/6); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
40	279.44	50/0"	SS	1	moist; very hard; weak red (10R 4/3); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
45					Auger Refusal @ 39'



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Boring Log, PZ-15s and 15

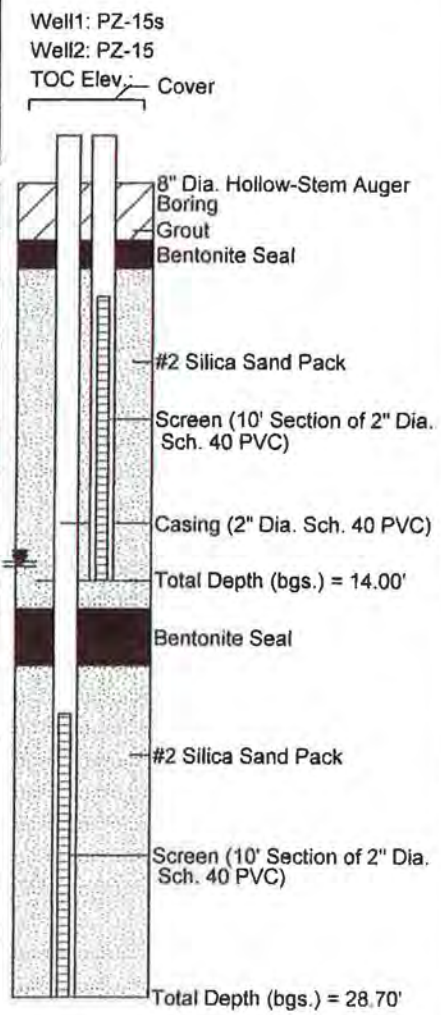
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	303.11'/303.24'
Drillers Name:	Robert Cassell	Ground Surface Elev.:	300.63'
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = 13.48'/15.34' bgs
▽ 24 Hours = 13.65'/13.31' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	300.63	5 6 6 (12)	SS	18	moist; medium; yellowish red (7.5YR 6/6); coarse quartz sandy silty clay; medium plasticity; cohesive; Soil Horizon
5	295.63	5 7 11 (18)	SS	20	moist; very stiff; yellow (10YR 7/6) with rust and orange mottles; coarse quartz sandy silty clay; low plasticity; cohesive; Soil Horizon
10	290.63	7 9 13 (22)	SS	21	moist; very stiff; red (2.5YR 4/6) with light gray and yellow mottles; silty clay; medium plasticity; cohesive; Residuum
15	285.63	12 17 28 (45)	SS	18	moist; hard; red (10R 4/6) with white specks; blocky; silty clay; low plasticity; cohesive; Residuum
20	280.63	24 50/4" (50/7)	SS	18	moist; very hard; red (2.5YR 4/6) with white specks; blocky; silty clay; low plasticity; cohesive; Residuum
25	275.63	50/6"	SS BAG	16	wet; very hard; red (10R 4/6) with white specks; medium horizontal fissle; silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-15 Bag (23.5-24'): USCS=CL; Gravel=0.7%; Sand=4.5%; Silt=52.8%; Clay=19.9%; Effective Porosity=8; Atterberg Limits: PI=16, LL=32, PI=16)
30	270.63	50/5"	SS	18	wet; very hard; weak red (10R 5/4) with light gray specks; highly horizontal fissle; weathered mudstone; Partially Weathered Rock
35	265.63				
40	260.63				
45					



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Boring Log, PZ-16

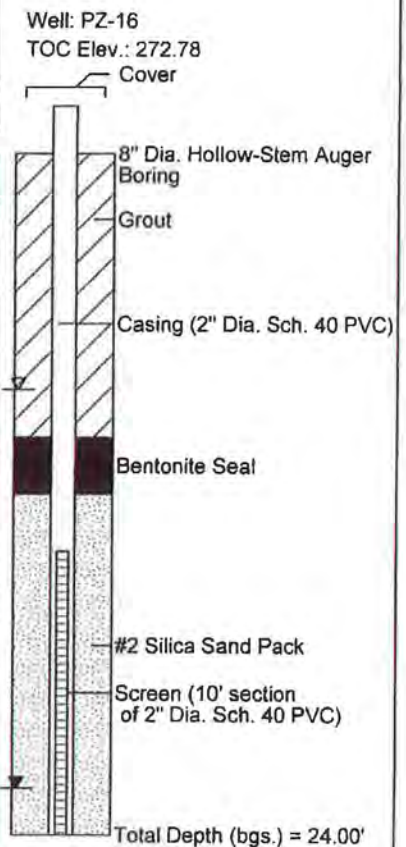
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	272.78'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	270.63'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural (drainage bottom)

Water Levels
1 Hour = 22.35' bgs
24 Hours = 8.33' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	270.63	4 5 6	SS	24	moist; stiff; strong brown (7.5YR 5/6) with white specks; quartz gravelly clayey silt; no plasticity; cohesive; Soil Horizon
5	265.63	3 5 5	SS	16	moist; stiff; yellowish red (5YR 4/6) with light gray mottles; silty clay; low plasticity; cohesive; Soil Horizon
10	260.63	32 35 39	SS	14	dry; very hard; dark red (10R 3/6); horizontal fissle; weathered mudstone; Residuum
15	255.63	17 31 50/5"	SS	16	moist; very hard; red (10R 4/6) with purple mottles; mica sandy silty clay; no plasticity; cohesive; Residuum
20	250.63	24 50/5"	SS,BAG	10	moist; very hard; red (10R 4/6) with purple mottles; silty clay; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-16 Bag (18.5-20'): USCS=CL; Sand=3.1%; Silt=65.5%; Clay=31.4%; Effective Porosity=3; Atterberg Limits: PI=19, LL=38, PI=19)
25	245.63	50/3"	SS	6	wet; very hard; red (10R 4/6) with purple mottles; highly horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	240.63				
35	235.63				
40	230.63				
45					



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Boring Log, PZ-17s and 17

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

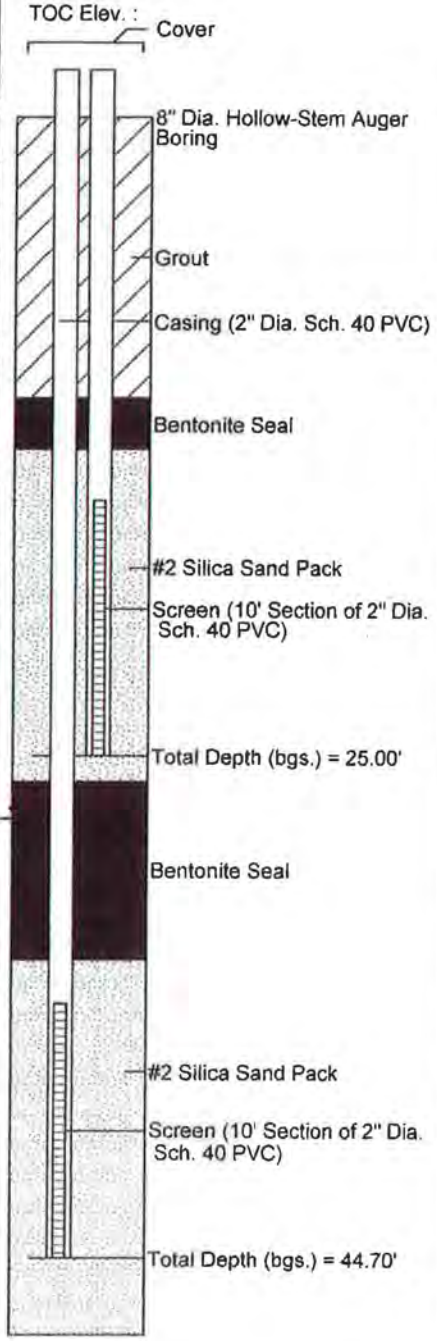
Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	306.62'/306.56'
Drillers Name:	Robert Cassell	Ground Surface Elev.:	304.00'
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = dry/27.44"
▽ 24 Hours = dry/27.46" bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	304	3 2 5	SS	24	moist; stiff; reddish brown (5YR 4/4); silty clay; medium plasticity; cohesive; Residuum
5	299	3 5 7	SS	16	moist; stiff; reddish brown (5YR 4/4); silty clay with mudstone rock fragments; medium plasticity; cohesive; Residuum
10	294	50/4"	SS	14	dry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
15	289	50/6"	SS	8	ddry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
20	284	29 50/2"	SS	12	dry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
25	279	18 24 26	SS	18	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissle; weathered mudstone; Residuum
30	274	25 50/3"	SS	12	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissle; weathered mica sandy mudstone; Partially Weathered Rock
35	269	50/3"	SS	8	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissle; weathered mica sandy mudstone; Partially Weathered Rock
40	264	50/4"	SS	6	very moist; very hard; weak red (2.5YR 4/2); blocky; fine sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
45	259	39 50/3"	SS,BAG	14	wet; very hard; reddish brown (2.5YR 4/4); medium horizontal fissle; weathered mudstone; Partially Weathered Rock; (Lab Results: PZ-17 Bag (43.5-44.5'); USCS=CL; Sand=40.2%; Silt=48.9%; Clay=10.9%; Effective Porosity=16%; Atterberg Limits: PL=19, LL=32, PI=13)
50					

Well1: PZ-17s
Well2: PZ-17
TOC Elev.:



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Boring Log, PZ-18

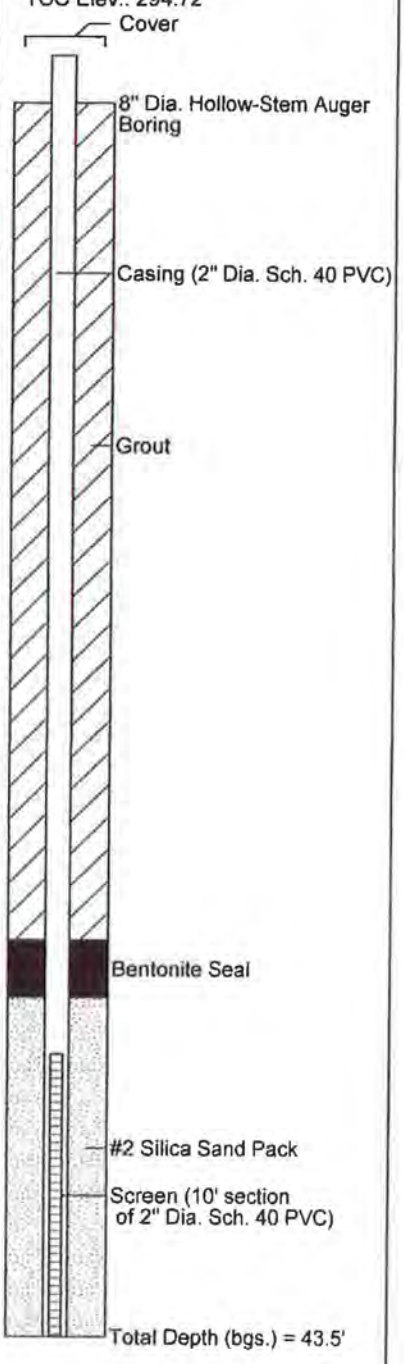
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	7/23/14	Logged By:	Ross Klingman, P.G.
Date Completed:	7/23/14	Drilling Method:	HSA; CME-550x
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	294.72'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	292.27'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	292.27	1 5 6	SS	22	moist; medium, brownish yellow (10R 6/6); slightly clayey silt; no plasticity; cohesive; Soil Horizon
5	287.27	4 4 5 9	SS	16	moist; stiff; reddish yellow (7.5YR 6/8) with tan and rust mottles; silty clay; medium plasticity; cohesive; Soil Horizon
10	282.27	5 7 12 19	SS	15	moist; very stiff; red (10R 4/8) with light green gray mottles; silty clay; low plasticity; cohesive; Residuum
15	277.27	21 21 24 45	SS	18	moist; hard; red (10R 4/8) with light green gray mottles; highly horizontal fissle; very fine sandy clayey silt; no plasticity; cohesive; Residuum
20	272.27	40 50/3"	SS,BAG	12	moist; very hard; red (10R 4/8) with light green gray mottles; highly horizontal fissle; very fine sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-18 Bag (18.5-19.5'); USCS=CL; Sand=24.4%; Silt=55.7%; Clay=19.9%; Effective Porosity=8%; Atterberg Limits: PL=17, LL=32, PI=15)
25	267.27	9 50/3"	SS	10	moist; very hard; red (10R 4/8) with black horizontal planes; blocky and medium horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	262.27	50/6"	SS	6	moist; very hard; red (10R 4/8); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
35	257.27	50/3"	SS	5	dry; very hard; weak red (10R 4/3); highly horizontal fissle; fine mica sandy silt; no plasticity; cohesive; Partially Weathered Rock
40	252.27	50/3"	SS	5	moist; very hard; red (10R 4/8); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
45		50/3"	SS	4	moist; very hard; red (10R 4/8) with purple mottles; blocky; weathered mudstone; Partially Weathered Rock



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Boring Log, PZ-19

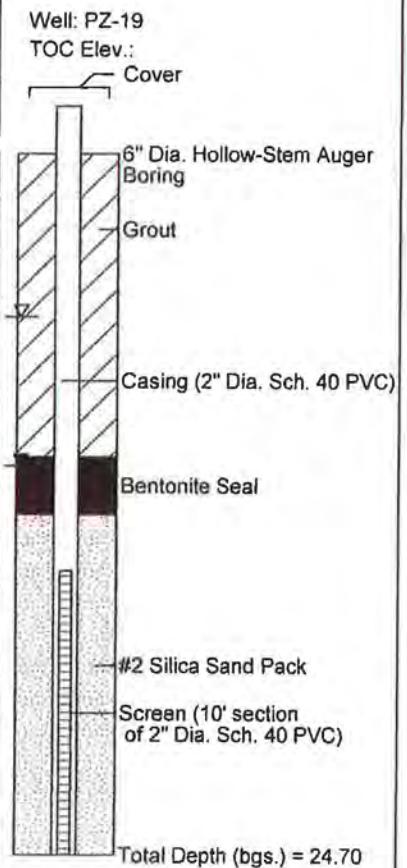
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	8/29/14	Logged By:	Ross Klingman, P.G.
Date Completed:	8/29/14	Drilling Method:	HSA; Geoprobe 7822
Drilling Company:	Environmental Drilling & Probing	Top-of-Casing Elev.:	(Lawrence Survey)
Drillers Name:	Tommy Bolyard	Ground Surface Elev.:	265.99'(Lawrence Survey)
NC Driller Certification:	3307	Natural, Cut, Fill Grade:	slight cut

Water Levels
▼ 1 Hour = 11.00' bgs
▽ 24 Hours = 5.75' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	265.99	3 2 3	SS	24	wet; medium; light brownish gray (10YR 6/2) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
5	260.99	1 1 2	SS	18	wet; soft; light brownish gray (10YR 6/2) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
10	255.99	15 20 27	SS	17	moist; hard; yellowish brown (10YR 5/4); medium horizontal fissle; clayey silt; no plasticity; cohesive; Residuum
15	250.99	6 18 50/4"	SS	24	moist; very hard; yellowish brown (10YR 5/4) with black manganese planes; medium horizontal fissle; clayey silt; no plasticity; cohesive; Residuum
20	245.99	24 50/3"	SS	10	dry; very hard; brown (10YR 5/3); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
25	240.99	14 14 50/3"	SS	12	wet; very hard; reddish brown (5YR 4/3); medium horizontal fissle; weathered mudstone; Partially Weathered Rock
30	235.99				
35	230.99				
40	225.99				
45					



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Boring Log, PZ-20

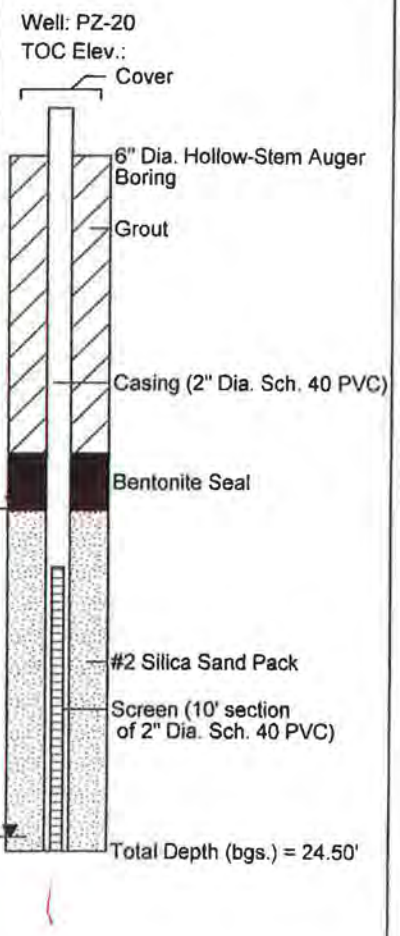
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started:	8/29/14	Logged By:	Ross Klingman, P.G.
Date Completed:	8/29/14	Drilling Method:	HSA; Geoprobe 7822
Drilling Company:	Environmental Drilling & Probing	Top-of-Casing Elev.:	(Lawrence Survey)
Drillers Name:	Tommy Bolyard	Ground Surface Elev.:	296.51'(Lawrence Survey)
NC Driller Certification:	3307	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = 24.00' bgs
▽ 24 Hours = 12.44' bgs

Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	296.51	3 3 3	SS	24	moist; medium; Red (2.5YR 4/6) with yellow mottles; fine sandy silty clay; low plasticity; cohesive; Soil Horizon
5	291.51	2 4 5	SS	24	moist; stiff; red (2.5YR 4/6) with yellow mottles; fine sandy silty clay; low plasticity; cohesive; Soil Horizon
10	286.51	5 5 6	SS	20	moist; stiff; red (2.5YR 4/6) with yellow mottles; mica sandy silty clay; low plasticity; cohesive; Soil Horizon
15	281.51	4 5 7	SS	18	very moist; stiff; weak red (10R 4/4) with white and light gray specks; phyllite and quartz gravelly sandy silty clay; no plasticity; cohesive; Residuum
20	276.51	50/3"	SS	8	dry; very hard; weak red (10R 4/4) with white and light gray specks; weathered mudstone; Partially Weathered Rock
25	271.51	50/4"	SS	8	wet; very hard; red (10R 4/6); highly horizontal fissle; mica sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
30	266.51				
35	261.51				
40	256.51				
45					



ATTACHMENT B

GEOTRACK
Technologies, Inc.

3620 Pelham Road, PMB #292 Phone: 864-329-0013
Greenville, SC 29615-5044 FAX: 864-329-0014

June 30, 2014

Charah, Inc
12601 Plantside Drive
Louisville, KY 40299

Attention: Mr. Norman E. Divers, III

Re; Physical Characterization Testing of Coal Combustion By-products
Riverbend Steam Station
Mount Holly, NC
GeoTrack Project No. 14-3425-N

Ladies and Gentlemen:

GeoTrack Technologies, Inc. has completed characterization testing of a sample from the referenced plant, and we present the results herein. The work was performed as a preliminary evaluation of whether the material is satisfactory for use as structural fill at the Charlotte-Douglas Airport, Area C. This letter presents a brief summary of the procedures and presents the testing results.

Project Description: The material in question includes coal combustion by-products that might include a mixture of fly ash and bottom ash that are collected and discharged to holding ponds on the power plant property. The combined combustion by-products (hereinafter referred to as CCB's) are proposed for use in an engineered fill. The engineered fill will be constructed by excavating native soils, constructing a composite (membrane) liner, placing the CCB as compacted fill, and covering the fill with a combination of a membrane cap and compacted soil. Subsequent uses of the completed fill have not been finalized; we anticipate that the property could be developed as part of nearby airport expansion, for commercial purposes (retail development, light industrial, etc), or to reclaim land that was previously excavated for other purposes.

Sampling Procedures: GeoTrack visited the power plant on May 15, 2014 and collected CCB samples. Grab samples were collected from the pond nearest the plant site (a wet pond). The sample locations included the northern corner, at the primary effluent structure, and the diagonally opposite corner, near the primary influent. Those locations were selected because they provided access to the CCB. Most areas of the exposed CCB were saturated and soft to both vehicular and pedestrian traffic.

Sampling was performed using procedures in general conformance with ASTM C 311 (ASTM D 75) for physical testing. The physical test sample was split in accordance with ASTM procedures

and subjected to various laboratory tests. The physical (engineering) tests included classification tests, strength tests, and consolidation tests.

Portions of the samples were also placed in laboratory-prepared containers in accordance with applicable EPA SW846 procedures for the chemical analyses. The chemical analyses are reported separately.

Physical (Engineering) Testing: Table 1 presents the physical (engineering) tests performed, the applicable test methods, and the results. Where applicable, individual test reports are attached. Detailed evaluation of the engineering characteristics is beyond the scope of this report, and the suitability of the various properties is dependent upon final site geometry and fill usage; however, a few comments are offered based upon our preliminary review of the test results.

The grain size characteristics and specific gravity are within expected ranges based on general experience with similar CCB's. The material consists predominantly of silt-sized particles that are essentially cohesionless in nature. Atterberg limits tests indicate the material to be non-plastic despite the fine grained size characteristics. The sand content of the sample might be influenced by the bottom ash content of this CCB.

The Standard Proctor Maximum Dry Density achieved for this sample (56.6 pounds per cubic foot (pcf) at an optimum moisture content of 48 percent) was low relative to the range typically achieved for similar products. The Proctor curve is relatively flat, indicating the material is not sensitive to moisture content. The compaction curve indicates that 95 percent compaction can be theoretically achieved with the standard Proctor compactive effort over a range of moisture contents spanning greater than 10 percent. Our experience indicates considerable variability in densities, moisture contents, etc. might be expected, and these properties are most likely influenced by long-term variations in plant procedures and the flow/sedimentation processes within the pond.

Three separate specimens were collected from the bulk sample and tested for field moisture content. They were selected based on their proximity to the prevailing water level within the pond at the time of sampling (collected from above and below the water surface). They ranged from 50.0 to 92.2 percent by dry weight. The average of the three moisture contents was 73.3 percent. While this average moisture content is well above the optimum moisture content, the wide variation in collected samples indicates that significant reductions in moisture content can occur simply by passively draining the materials. Also, more active moisture adjustment should require minor effort within temporary stockpiles and in the fill lifts.

Despite the low compacted dry density, the strength properties of this sample are favorable for most routine engineering applications. Three sets of strength properties were derived from two separate strength tests. The tests simulate both drained (effective or long-term) and undrained (total or short-term loading) conditions that might be experienced in service. The undrained strength test results indicate short-term strengths that varied, but are characteristic of fine grained materials. The undrained strength tests exhibited strength envelops that are combinations of cohesion and internal friction. They exhibited undrained cohesion ranging from moderate to high (C = 1,900 to 4,300 pounds per square foot; psf), with corresponding angles of internal friction

ranging from low to moderate (Ø = 8 to 27°). In combination, the two sets of computed undrained strength parameters represent moderately high overall strength characteristics.

The effective (drained) strength properties reported by the laboratory (C = 2,600 psf and Ø = 22°) based on a "best-fit" strength envelope were uncharacteristic of cohesionless materials. That result is assessed to be the result of scatter in the laboratory results, which is common with earthen materials. Often CCB materials and similar fine-grained, non-plastic materials exhibit low to non-existent cohesion, and the strength is derived almost entirely from internal friction. The reported drained parameters are more characteristic of undrained behavior; however, review of the graphical results indicates the drained test is subject to interpretation. A strength envelope drawn through the graphical origin (C = 0) and tangent to the lowest failure circle indicates a relatively high angle of internal friction (Ø = 39°), with little deviation from the other failure circles. That adjusted strength envelop is both characteristic of non-plastic, cohesionless materials, and relatively high internal strength. The adjusted test results are similar to drained strengths of CCB materials sampled from other plants. The laboratory interpretation and adjusted strength parameters are shown in attachments.

Similarly, the consolidation test results indicate settlement characteristics of the CCB's will be favorable. With total strain of less than 3 percent and 4 percent at applied pressures of 8 and 16 kips per square foot (psf), respectively, the material has characteristics of low compressibility. Our experience indicates that the settlement characteristics will be comparable, or more favorable (less compressible) than, typical area soils.

Closing: GeoTrack is pleased to be of service to you on this project. Please call if you have any questions concerning this letter or if we may provide additional assistance.

Respectfully submitted,
GeoTrack Technologies, Inc.

David D. Wilson, P.E.
Senior Engineer
NC Registration No. 17088

TABLE 1 – PHYSICAL/ENGINEERING CHARACTERISTICS
RIVERBEND STEAM STATION
GEOTRACK PROJECT NO. 14-3425-N

Physical/Engineering Characteristic	**Test Method**	**Test Result/ Applicable Parameters**	**Remarks**
Grain Size Distribution	ASTM 422	22 Percent Sand 72 Percent Silt 6 Percent Clay *Grain Size Distribution Attached*	Sieve and Hydrometer
Specific Gravity	ASTM 854	Specific Gravity: $G_s = 2.13$	
Water Content	ASTM D 2216	Field Moisture Content: w = 73.3 %	Moisture Content at Time of Sampling – Note 5
Compaction	ASTM D 698	Maximum Dry Density: $\gamma_{d\,max} = 56.6$ pcf Optimum Moisture Cont.: $w_{opt} = 48.0$ % *Moisture Density Relationship Attached*	Standard Proctor Compaction Test
Strength:			
Shear Strength	ASTM 4767	Total Cohesion: C = 4.3 ksf Total Angle of Int. Friction: = 8° Eff. Cohesion: C'= 2.6 ksf Eff. Angle of Int. Friction: Ø' = 22° *Triaxial Shear Test Report Attached*	Consolidated Undrained Triaxial Shear Test with Pore Pressure Measurements Note 3 Note 4
Compressive Strength	ASTM 2850	Total Cohesion: C = 1.9 ksf Total Angle of Int. Friction: Ø = 27° *Triaxial Shear Test Report Attached*	Unconsolidated Undrained Triaxial Shear Test. Unconfined Compressive Strength not Meaningful for Ash Samples Note 3
Compressibility	ASTM D 2435	*Consolidation Test Report Attached*	Note 3

See notes on next page

Notes:
1. Sample collected May 15, 2014
2. The referenced ASTM procedures are as suggested in ASTM E 2277, and common geotechnical practice.
3. Tests performed on specimens remolded in the laboratory to approx. 95% of the Standard Proctor Maximum Dry Density at approximately the Optimum Moisture Content.
4. An alternative strength envelope derived from the test data is shown graphically in the attachments.
5. The reported field moisture content is the average of three separate specimens with moisture contents ranging from 50.0 to 92.2 %.

Form No. TR-D698-2
Revision No. : 0
Revision Date: 11/21/07

Moisture - Density Report

S&ME

Quality Assurance

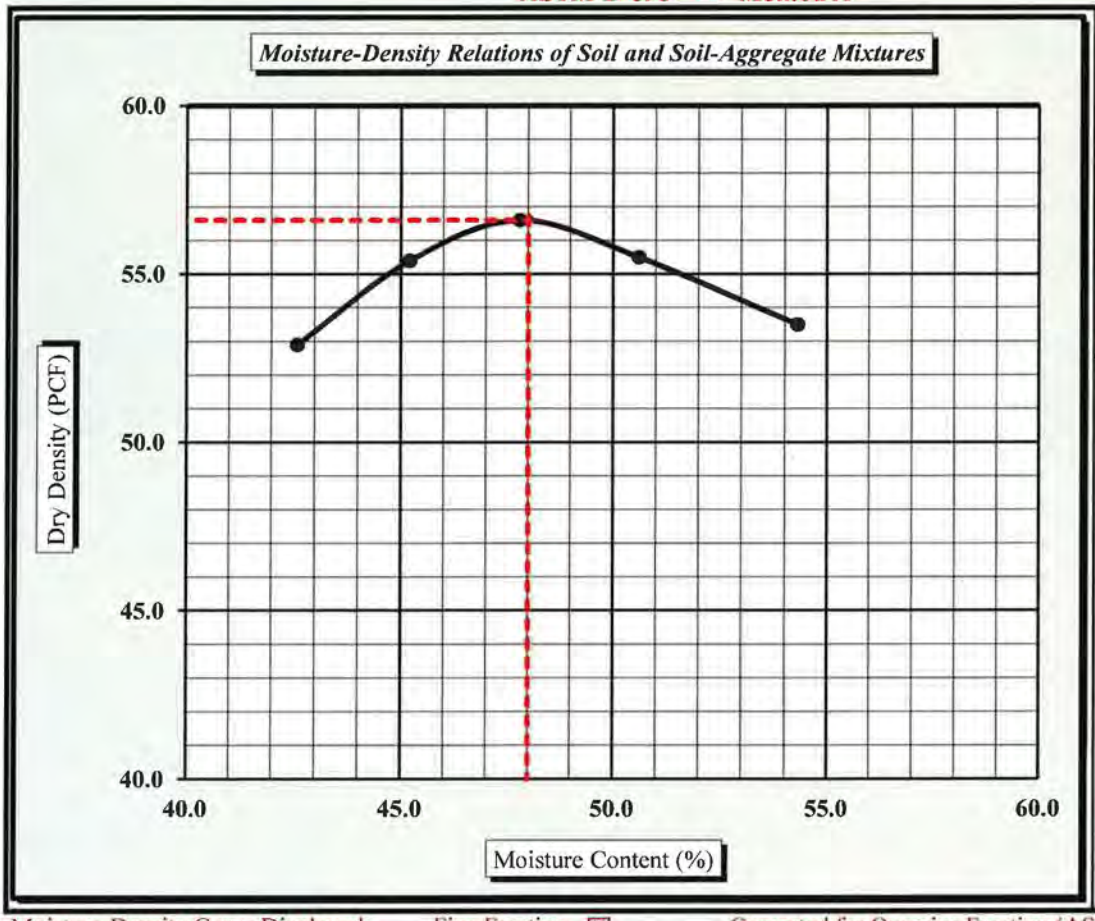
S&ME, Inc. - Greenville 281 Fairforest Way Greenville, SC 29607

S&ME Project #:	**1263-10-195**	Report Date:	6/02/14
Project Name:	Geotrack Technologies, Inc. - 14-3425-N	Test Date:	5/30/14
Client Name:	3620 Pelham Road, PMB #292 Greenville, SC 29615		
Client Address:	336 Longview Drive Piedmont, South Carolina 29673		

Boring #:	N/A	Log #:	44g	Sample Date:	5/15/14
Location:	Riverbend Pond	Type:	Bulk	Depth:	N/A
Sample Description:	Coal Ash				

Maximum Dry Density **56.6** **PCF.** **Optimum Moisture Content** **48.0%**

ASTM D 698 -- Method A



Soil Properties	
Natural Moisture Content	**N/A**
Specific Gravity of Soil (D 854)	**N/A**
Liquid Limit	-
Plastic Limit	**NP**
Plastic Index	**NP**

% Passing	
3/4"	-
3/8"	-
#4	99.9%
#10	
#40	
#60	
#100	
#200	

Oversize Fraction	
Bulk Gravity	
% Moisture	
% Oversize	
MDD	
Opt. MC	

Moisture-Density Curve Displayed: Fine Fraction ☒ Corrected for Oversize Fraction (ASTM D 4718) ☐

Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒ 3/8 inch Sieve ☐ 3/4 inch Sieve ☐

Mechanical Rammer ☐ Manual Rammer ☒ Moist Preparation ☐ Dry Preparation ☒

References / Comments / Deviations:

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

Brian Vaughan, P.E.	Brian Vaughan	Location Coordinator	6/02/14
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D422-3
Revision No. 0
Revision Date: 02/20/08

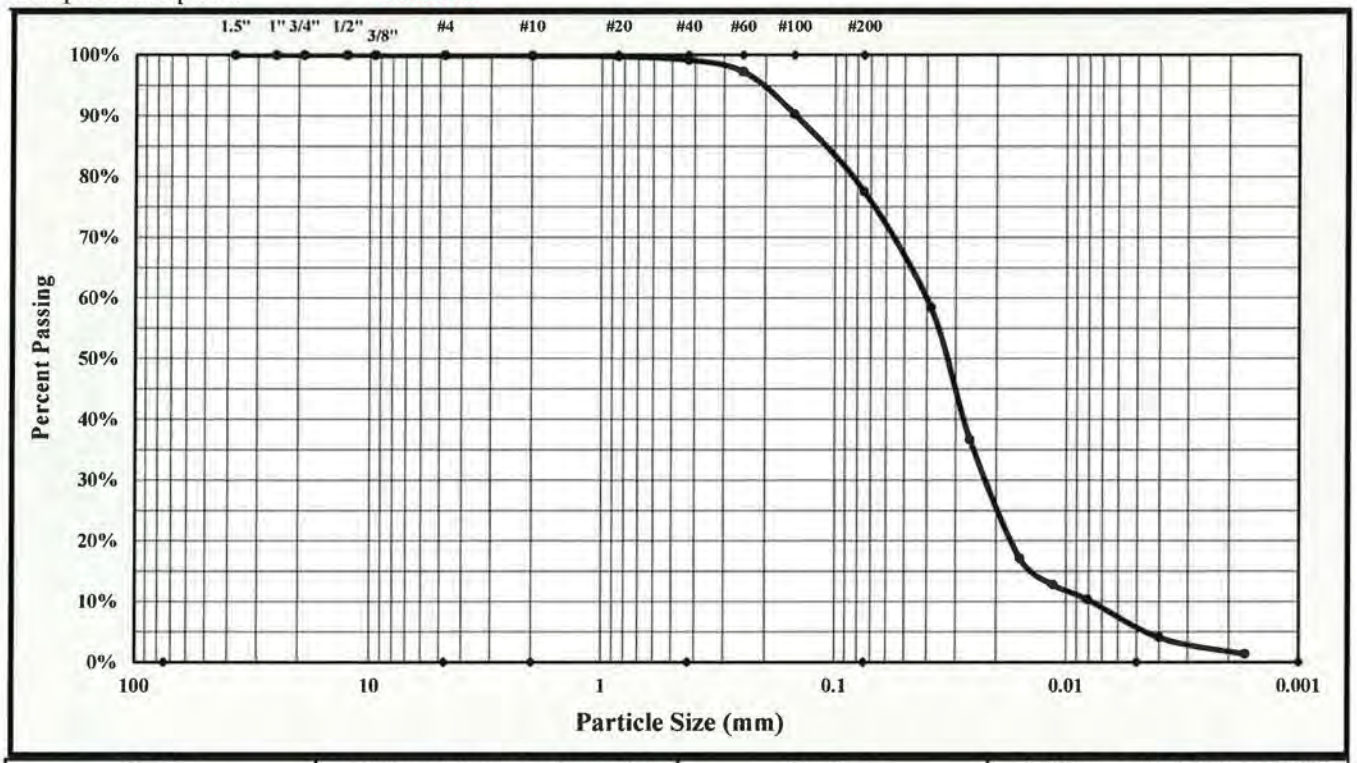
Particle Size Analysis of Soils

ASTM D 422

Quality Assurance

S&ME, Inc. - Greenville 281 Fairforest Way Greenville, SC 29607

S&ME Project #:	1263-10-195	Report Date:	6/05/14
Project Name:	Geotrack Technologies, Inc. - 14-3425-N	Test Date(s):	6/02 - 6/05/14
Client Name:	Geotrack Technologies, Inc.		
Address:	3620 Pelham Road, PMB #292 Greenville, SC 29615		
Boring #:	N/A Log #: 44g	Sample Date:	5/15/14
Location:	Riverbend Pond Type: Bulk	Sample Depth:	N/A
Sample Description:	Coal Ash		



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size:	.425 mm	Gravel:	0.1%	Silt	71.9%
Silt & Clay (% Passing #200):	77.5%	Total Sand:	22.4%	Clay	5.7%
Specific Gravity	2.130	Moisture Content		Colloids	1.0%
Liquid Limit	-	Plastic Limit	NP	Plastic Index	NP
Coarse Sand:	0.0%	Medium Sand:	0.7%	Fine Sand:	21.7%

Description of Sand and Gravel: Rounded ☐ Angular ☐ Hard & Durable ☐ Soft ☒ Weathered & Friable ☐

Mechanical Stirring Apparatus A — Dispersion Period: 1 min. Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References / Comments / Deviations: ASTM D 4318, D 854, D 2487

Brian Vaughan, P.E. — *Technical Responsibility*

Signature

Location Coordinator — *Position*

6/05/14 — *Date*

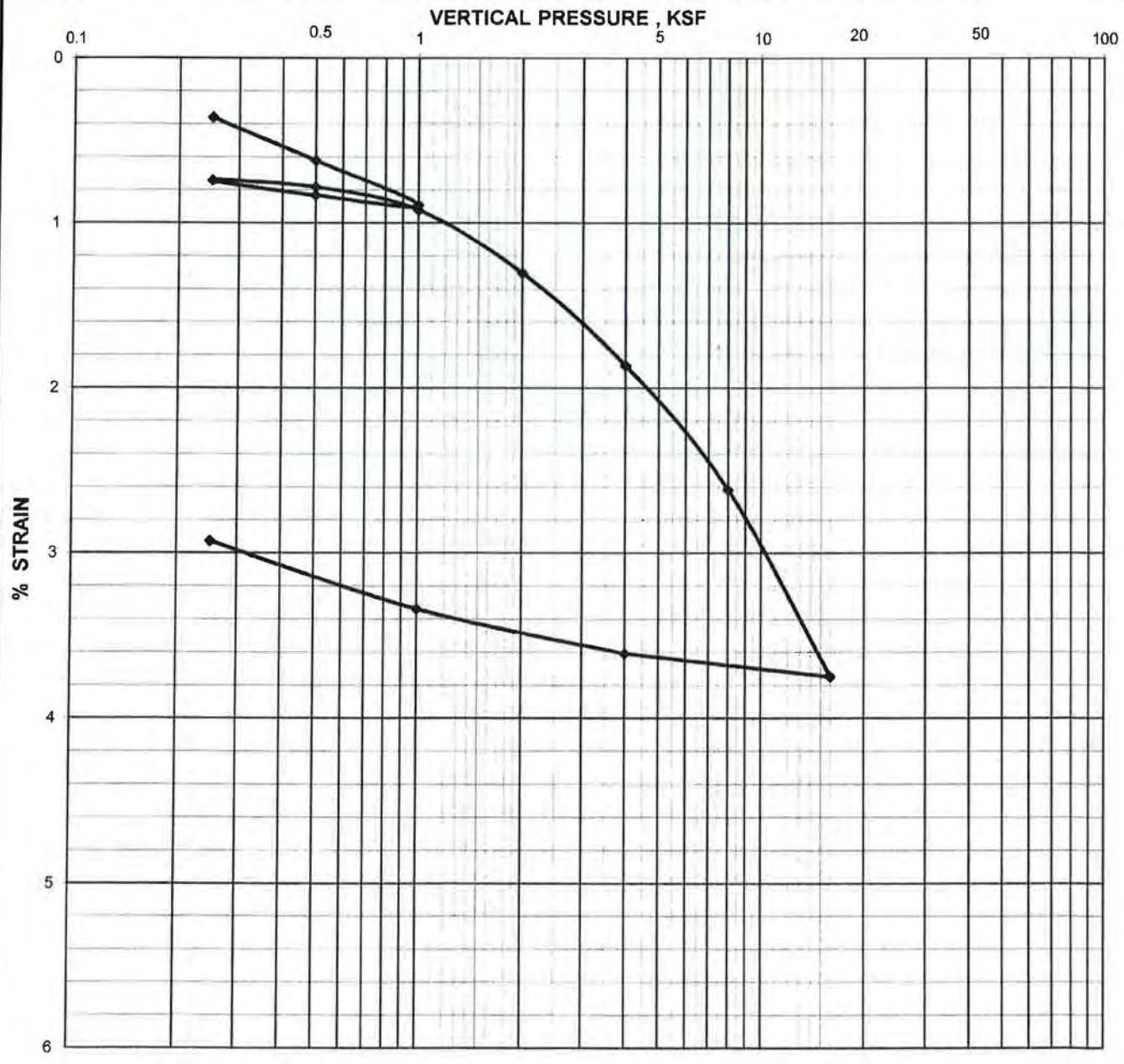
S&ME

CONSOLIDATION TEST REPORT

(ASTM D 2435)

Project Name :	Geotrack Technologies, Inc. - 14-3425-N				
Project No. :	**1263-10-195**			**Report Date:**	6/13/2014
Client Name :	Geotrack Technologies, Inc.			**Boring No.:**	N/A
Client Address :	3620 Pelham Road, PMB #292 Greenville, SC 29615			**Depth/Elev.:**	N/A
Initial Wet Density, γ_{wet}, pcf :	79.6	**Load vs. Time Plot :**	Log of time	**Sample Type:**	Bulk
Initial Void Ratio, e_o :	1.472	**Final Void Ratio, e_f :**	1.400	**Log No.:**	44g
Initial Saturation, S_O , % :	69.4	**Final Saturation, S_f , % :**	100.0	**Sp. Gravity , G_S :**	2.13
Initial Dry Density, γ_{DRY}, pcf :	53.8	**Final Dry Density, γ_{DRY}, pcf :**	54.7	**Estimated Preconsolidation**	
Initial Moisture Content,%.:	48.0	**Final Moisture Content, %.:**	67.1	**Stress, P_o, ksf :**	1.0
Liquid Limit, % :	-	**Plasticity Index, % :**	NP	**Fines, % :**	77.5
Sample Description :	Coal Ash				
Remolded Properties :	Specimen was remolded to 95% of maximum dry density at about 0% wet of optimum				

Notes: Loading Schedule - as requested by client (ksf)- 0.25, 0.5, 1.0, 0.5, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 4.0, 1.0, 0.25



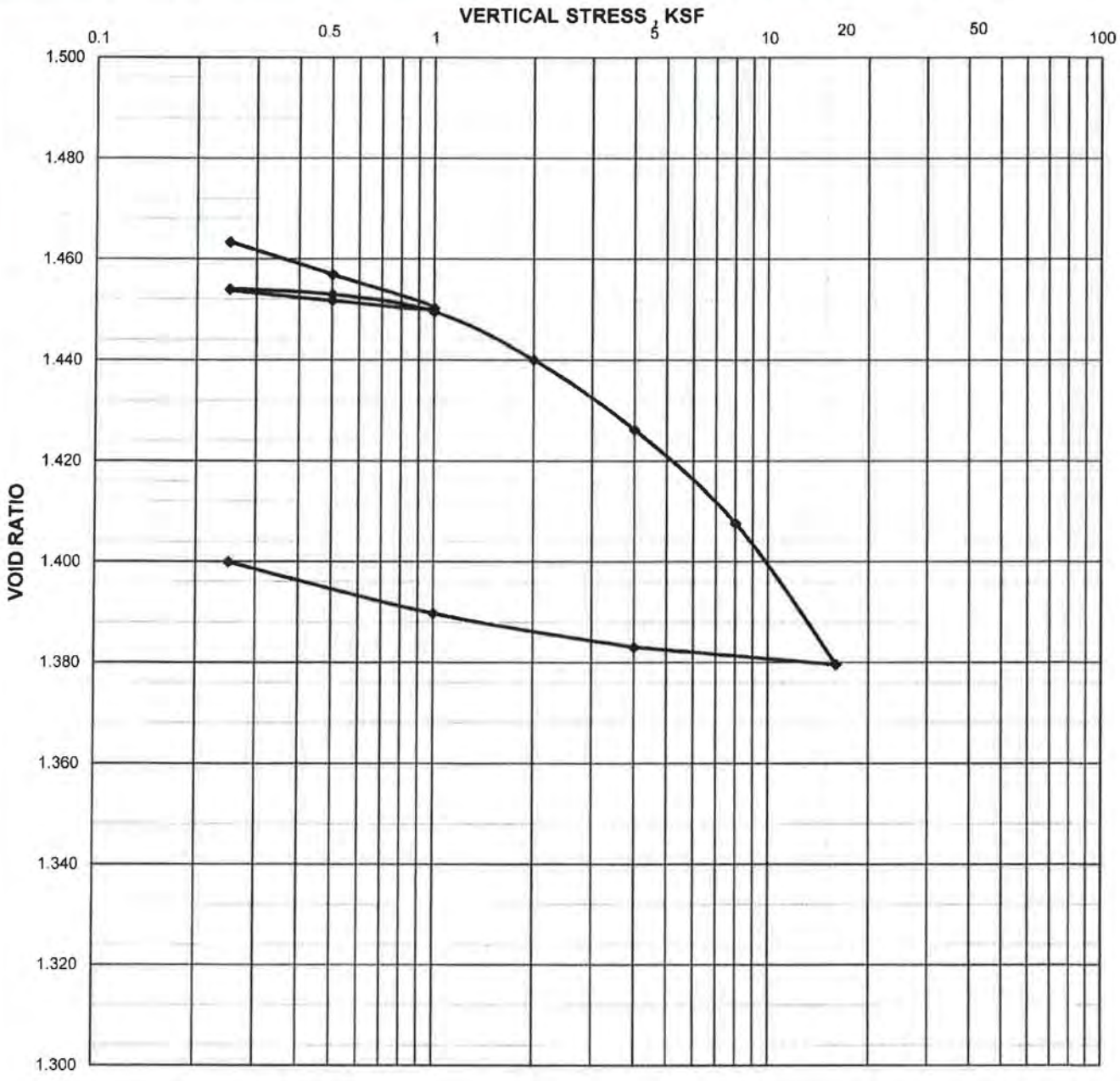
S&ME

CONSOLIDATION TEST REPORT

(ASTM D 2435)

Project Name :	Geotrack Technologies, Inc. - 14-3425-N				
Project No. :	**1263-10-195**			Report Date:	6/13/2014
Client Name :	Geotrack Technologies, Inc.			Boring No.:	N/A
Client Address :	3620 Pelham Road, PMB #292 Greenville, SC 29615			Depth/Elev.:	N/A
Initial Wet Density, γ_{wet}, pcf :	79.6	Load vs. Time Plot :	Log of time	Sample Type:	Bulk
Initial Void Ratio, e_o :	1.472	Final Void Ratio, e_f :	1.400	Log No.:	44g
Initial Saturation, S_O, % :	69.4	Final Saturation, S_f, % :	100.0	Sp. Gravity, G_S :	2.13
Initial Dry Density, γ_{DRY}, pcf :	53.8	Final Dry Density, γ_{DRY}, pcf :	54.7	Estimated Preconsolidation	
Initial Moisture Content, %.:	48.0	Final Moisture Content, %.:	67.1	Stress, P_e, ksf :	1
Liquid Limit, % :	-	Plasticity Index, % :	NP	Fines, % :	77.5
Sample Description :	Coal Ash				
Remolded Properties :	Specimen was remolded to 95% of maximum dry density at about 0% wet of optimum				

Notes: Loading Schedule - as requested by client (ksf)- 0.25, 0.5, 1.0, 0.5, 0.25, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 4.0, 1.0, 0.25



TRIAXIAL SHEAR TEST REPORT

(ASTM D 2850)

Unconsolidated Undrained

REV4,1/13/04

Project Name:	Geotrack Technologies, Inc. - 14-3425-N		
Project No.:	**1263-10-195**	**Report Date:**	06/10/14
Client Name:	Geotrack Technologies, Inc.	**Test Date:**	6/9/14
Client Address:	3620 Pelham Road, PMB #292 Greenville, SC 29615		
Boring #:	N/A **Depth / Elev. :** N/A	**Log #:**	44g **Type:** Bulk
Sample Location :	Riverbend Pond		
Sample Description :	Coal Ash		
LL, % :	- **PI , % :** NP	**Percent Passing #200 :**	77.5 **G_s :** 2.130

SPECIMEN PROPERTIES

		INITIAL				FINAL		
SPECIMEN NO.		1	2	3		1	2	3
DIAMETER , INCHES	D_o	2.82	2.81	2.82	D_c	N/A	N/A	N/A
HEIGHT , INCHES	H_o	6.04	6.02	6.03	H_c	N/A	N/A	N/A
WATER CONTENT, %	W_o	48.0	48.0	48.0	W_c	N/A	N/A	N/A
DRY DENSITY, PCF	γ_{dryo}	53.7	53.9	53.7	γ_{dryc}	N/A	N/A	N/A
SATURATION ,%	S_o	69.2	69.8	69.3	S_c	N/A	N/A	N/A
VOID RATIO	e_o	1.477	1.464	1.476	e_c	N/A	N/A	N/A

TEST PARAMETERS , TEST TYPE : UU

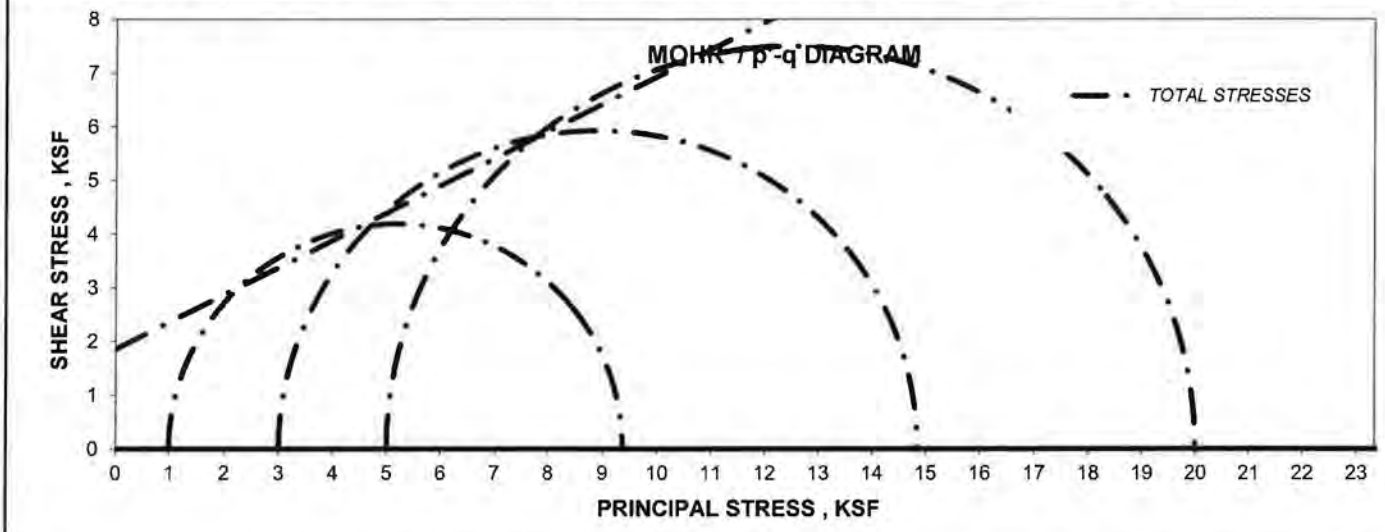
SPECIMEN NO.		1	2	3
B Value		N/A	N/A	N/A
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	8.4	11.9	15.0
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.4	10.7	14.8
Specimen Shape @ Failure	Sheared			

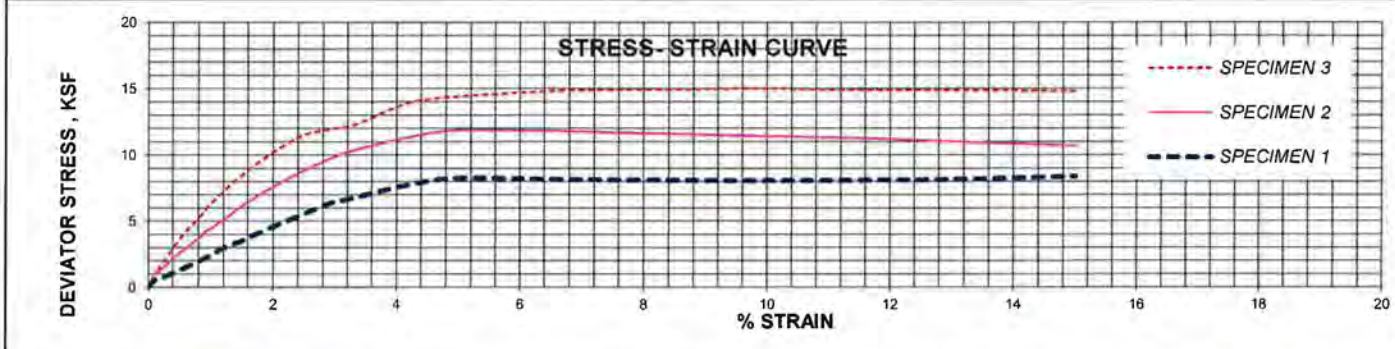
CONTROLLED : Strain @ 1.0 % per minute

PROCTOR TYPE : ***Standard*** , **MAXIMUM DRY DENSITY , PCF :** *56.6* **,OPTIMUM MOISTURE CONTENT , % :** *48.0*

REMOLDED : ***Specimens were remolded to 95 % of maximum dry density at about 0.0 % wet of o.m.c.***

SHEAR STRENGTH PARAMETERS	TOTAL	EFFECTIVE
	COHESION , C (ksf) : *1.9*	**APPARENT COHESION , (ksf) :** *N/A*
	ANGLE OF INTER. FRICTION, Φ(DEGREES) *27*	**ANGLE OF INTER. FRICTION, Φ' (DEGREES) :** *N/A*





Brian Vaughan, P.E.		Location Coordinator	06/10/14
Technical Responsibility	*Signature*	*Position*	*Date*

S&ME

TRIAXIAL SHEAR TEST REPORT

(ASTM D 4767)

REV4,1/13/04

AAR AASHTO R18

Project Name:	Geotrack Technologies, Inc. - 14-3425-N		
Project No.:	1263-10-195	**Report Date:**	06/10/14
Client Name:	Geotrack Technologies, Inc.	**Test Date:**	6/02 - 6/10/14
Client Address:	3620 Pelham Road, PMB #292 Greenville, SC 29615		
Boring No. :	N/A **Depth / Elev. :** N/A	**Sample No . :** 44g	**Type:** Bulk
Sample Location :	Riverbend Pond		
Sample Description :	Coal Ash		
LL, % :	- **PI , % :** NP	**Percent Passing #200 :** 77.5	**G_s :** 2.130

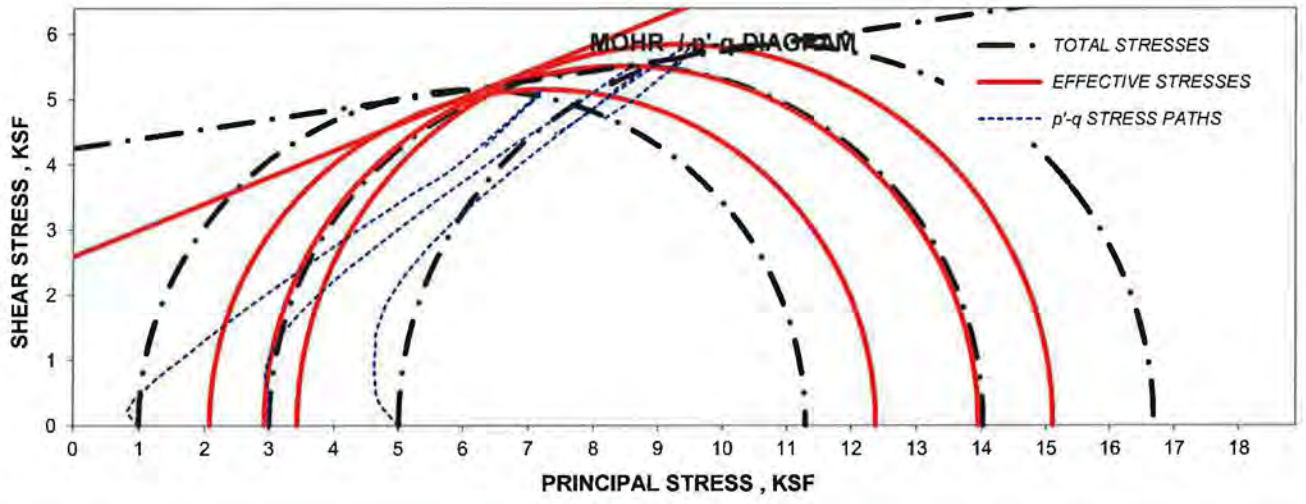
SPECIMEN PROPERTIES									TEST PARAMETERS , TEST TYPE : CU/PP				
		INITIAL			AFTER CONSOLIDATION				SPECIMEN NO.		1	2	3
SPECIMEN NO.		1	2	3		1	2	3	B Value		0.95	0.95	0.95
DIAMETER , INCHES	D_o	2.82	2.82	2.82	D_c	2.81	2.79	2.79	BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
HEIGHT , INCHES	H_o	6.03	6.01	6.01	H_c	6.00	5.96	5.95	CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
WATER CONTENT, %	W_o	48.0	48.0	48.0	W_c	67.6	65.8	65.0	MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	10.3	11.0	11.7
DRY DENSITY, PCF	γ_{dryo}	53.8	53.9	54.0	γ_{dryc}	54.5	55.4	55.8	ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.5	9.0	9.4
SATURATION ,%	S_o	69.4	69.7	70.0	S_c	100.0	100.0	100.0	Specimen Shape @ Failure	Sheared			
VOID RATIO	e_o	1.472	1.468	1.461	e_c	1.439	1.401	1.384					

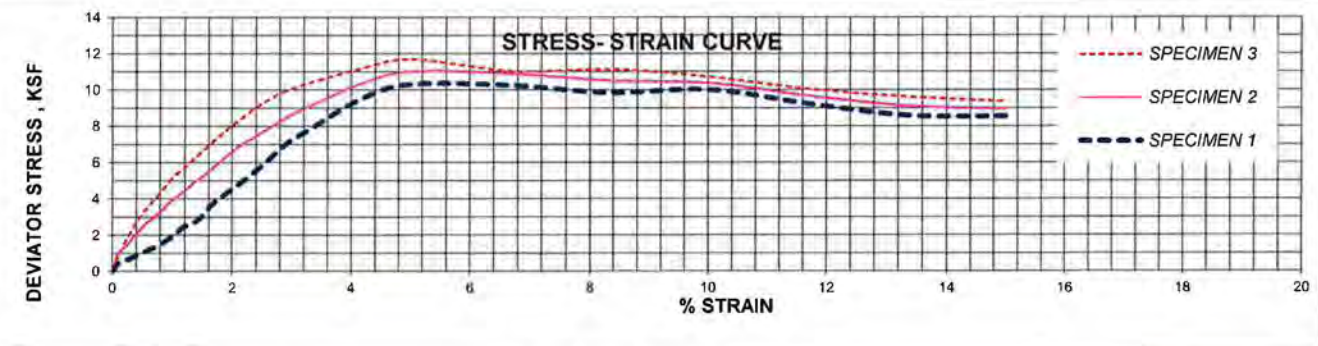
CONTROLLED : Strain @ 0.02 % per minute T50, Minutes = 18.0

PROCTOR TYPE : *Standard ,* MAXIMUM DRY DENSITY , PCF : 56.6 ,OPTIMUM MOISTURE CONTENT , % : 48.0

REMOLDED : *Specimens were remolded to 95 % of maximum dry density at about 0.0 % wet of o.m.c.*

SHEAR STRENGTH PARAMETERS	TOTAL		EFFECTIVE	
	COHESION , C (ksf) :	4.3	APPARENT COHESION , (ksf) :	2.6
	ANGLE OF INTER. FRICTION, Φ(DEGREES)	8	ANGLE OF INTER. FRICTION, Φ' (DEGREES) :	22





Brian Vaughan, P.E. — *Technical Responsibility*

Brian Vaughan — *Signature*

Location Coordinator — *Position*

06/10/14 — *Date*

TRIAXIAL SHEAR TEST REPORT

(ASTM D 4767)

REV4.1/13/04

Project Name:	Geotrack Technologies, Inc. - 14-3425-N		
Project No.:	**1263-10-195**	**Report Date:**	06/10/14
Client Name:	Geotrack Technologies, Inc.	**Test Date:**	6/02 - 6/10/14
Client Address:	3620 Pelham Road, PMB #292 Greenville, SC 29615		
Boring No. :	N/A **Depth / Elev. :** N/A	**Sample No . :** 44g	**Type:** Bulk
Sample Location :	Riverbend Pond		
Sample Description :	Coal Ash		
LL, % :	- **PI , % :** NP	**Percent Passing #200 :** 77.5	**G_s :** 2.130

SPECIMEN PROPERTIES — **TEST PARAMETERS , TEST TYPE : CU/PP**

		INITIAL				AFTER CONSOLIDATION		
SPECIMEN NO.		**1**	**2**	**3**		**1**	**2**	**3**
DIAMETER , INCHES	D_o	2.82	2.82	2.82	D_c	2.81	2.79	2.79
HEIGHT , INCHES	H_o	6.03	6.01	6.01	H_c	6.00	5.96	5.95
WATER CONTENT, %	W_o	48.0	48.0	48.0	W_c	67.6	65.8	65.0
DRY DENSITY, PCF	γ_{dryo}	53.8	53.9	54.0	γ_{dryc}	54.5	55.4	55.8
SATURATION ,%	S_o	69.4	69.7	70.0	S_c	100.0	100.0	100.0
VOID RATIO	e_o	1.472	1.468	1.461	e_c	1.439	1.401	1.384

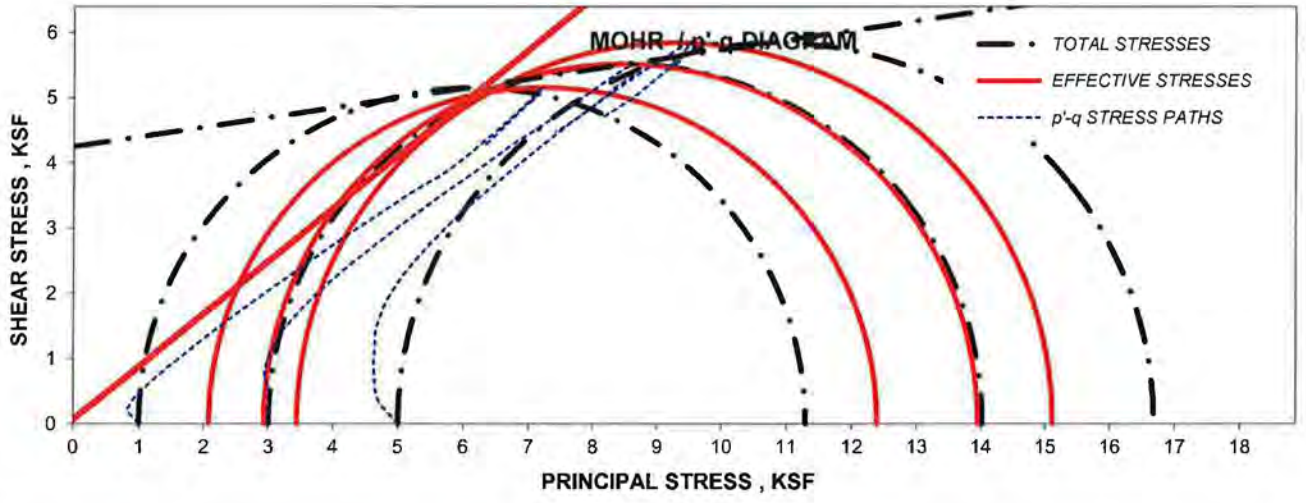
SPECIMEN NO.		**1**	**2**	**3**
B Value		0.95	0.95	0.95
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	10.3	11.0	11.7
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.5	9.0	9.4
Specimen Shape @ Failure	Sheared			

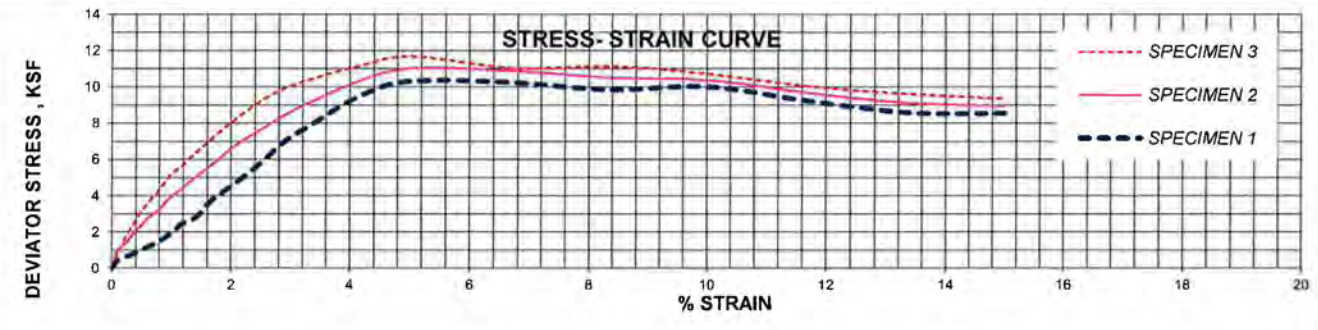
CONTROLLED : Strain @ 0.02 % per minute T50, Minutes = 18.0

PROCTOR TYPE : ***Standard*** , **MAXIMUM DRY DENSITY , PCF :** *56.6* **,OPTIMUM MOISTURE CONTENT , % :** *48.0*

REMOLDED : ***Specimens were remolded to 95 % of maximum dry density at about 0.0 % wet of o.m.c.***

SHEAR STRENGTH PARAMETERS	TOTAL	EFFECTIVE (ALT. FAILURE INTERPRETATION)
	COHESION , C (ksf) : *4.3*	**APPARENT COHESION , (ksf) :** *0*
	ANGLE OF INTER. FRICTION, Φ(DEGREES) *8*	**ANGLE OF INTER. FRICTION, Φ' (DEGREES) :** *39*





Brian Vaughan, P.E. — *Technical Responsibility*

Brian Vaughan — *Signature*

Location Coordinator — *Position*

06/10/14 — *Date*

See Ref. 1

TABLE 6
Typical Values of Soil Index Properties

	Particle Size and Gradation				Voids[1]					Unit Weight[2] (lb./cu.ft.)						
	Approximate Size Range (mm)		Approx. D_{10} (mm)	Approx. Range Uniform Coefficient C_u	Void Ratio			Porosity (%)		Dry Weight			Wet Weight		Submerged Weight	
	D_{max}	D_{min}			e_{max} loose	e_{cr}	e_{min} dense	n_{max} loose	n_{min} dense	Min loose	100% Mod. AASHO	Max dense	Min loose	Max dense	Min loose	Max dense
GRANULAR MATERIALS																
Uniform Materials																
a. Equal spheres (theoretical values)	–	–	–	1.0	0.92	–	0.35	47.6	26	–	–	–	–	–	–	–
b. Standard Ottawa SAND	0.84	0.59	0.67	1.1	0.80	0.75	0.50	44	33	92	–	110	93	131	57	69
c. Clean, uniform SAND (fine or medium)	–	–	–	1.2 to 2.0	1.0	0.80	0.40	50	29	83	115	118	84	136	52	73
d. Uniform, inorganic SILT	0.05	0.005	0.012	1.2 to 2.0	1.1	–	0.40	52	29	80	–	118	81	136	51	73
Well-graded Materials																
a. Silty SAND	2.0	0.005	0.02	5 to 10	0.90	–	0.30	47	23	87	122	127	88	142	54	79
b. Clean, fine to coarse SAND	2.0	0.05	0.09	4 to 6	0.95	0.70	0.20	49	17	85	132	138	86	148	53	86
c. Micaceous SAND	–	–	–	–	1.2	–	0.40	55	29	76	–	120	77	138	48	76
d. Silty SAND & GRAVEL	100	0.005	0.02	15 to 300	0.85	–	0.14	46	12	89	–	146[3]	90	155[3]	56	92
MIXED SOILS																
Sandy or Silty CLAY	2.0	0.001	0.003	10 to 30	1.8	–	0.25	64	20	60	130	135	100	147	38	85
Skip-graded Silty CLAY with stones or rk fgmts	250	0.001	–	–	1.0	–	0.20	50	17	84	–	140	115	151	53	89
Well-graded GRAVEL, SAND, SILT & CLAY mixture	250	0.001	0.002	25 to 1000	0.70	–	0.13	41	11	100	140	148[4]	125	156[4]	62	94
CLAY SOILS																
CLAY (30%-50% clay sizes)	0.05	0.5μ	0.001	–	2.4	–	0.50	71	33	50	105	112	94	133	31	71
Colloidal CLAY (-0.002 mm: 50%)	0.01	10Å	–	–	12	–	0.60	92	37	13	90	106	71	128	8	66
ORGANIC SOILS																
Organic SILT	–	–	–	–	3.0	–	0.55	75	35	40	–	110	87	131	25	69
Organic CLAY (30% - 50% clay sizes)	–	–	–	–	4.4	–	0.70	81	41	30		100	81	125	18	62

ATTACHMENT C

ATTACHMENT D

a height of 760 mm (30 in).

ıg of the falling weight onto the
ding to the ground surface, the
test. The free fall and height of
of drill rigs use a rope wrapped
the rope which then tightens on
rope until the weight is visually
ne the rope is released with the
estion around the power pulley
count will be obtained. Several
ıechanical hoist-trip device. This
factors such as pushing a rock,
pressures also contribute error
ducible in situ).
ow count $N \geq 100$. The log may
indicating 70 blows for 150 mm
ration. Large blow counts both
ause rapid equipment wear and
refusal" by ASTM at 100 assists
firm to better identify drilling

tigate the status of cohesionless
ly used in both cohesionless and
types of foundations. In loose
available to aid in retaining the
ithout falling out of the sampler

the string of rods, the sampler
lay (see Fig. 6-3*a*) the recovered
usually immediately tested for
(Fig. 6-3*a*) or a portable field
ıally stored in small glass jars
ımple depth, and blow count N.
as necessary for sieve analyses,
rg limits. The boxes of samples
ıboratory for a stated period of

roperties have been proposed.
than guesses. For example, in
nost meaningless. The estimate

Table 6-1 Standard penetration test (SPT) correlations

Strength correlations will be given in later chapters as needed. Values shown are primarily for "order of magnitude."

	Cohesionless Soil			
N	0–10	11–30	31–50	>50
Unit weight γ, kN/m^3	12–16	14–18	16–20	18–23
Angle of friction ϕ	25–32	28–36	30–40	>35
State	Loose	Medium	Dense	Very dense
Relative density D_r	see Eq. (6-3) and Eq. (6-4) since depends on $p_0 = \gamma y$			

1 kn/m^3 = 6.36 pcf

	Cohesive Soil				
N	<4	4–6	6–15	16–25	>25
Unit weight† γ, kN/m^3	14–18	16–18	16–18	16–20	>20
q_u, kPa†	<25	20–50	30–60	40–200	>100
Consistency	Very soft	Soft	Medium	Stiff	Hard

† Values heavily dependent on water content.

SILT, MORAINE, ALLUVIUM

for angle of internal friction ϕ is generally conservative, and (as noted in Chap. 13) it is common to estimate ϕ as 30 to 32° for many projects.

The relative density D_r is often related to N but is often a very poor correlation. This results from N being somewhat project- and site-dependent and from D_r being rather tenuous to define (or reliably compute). As a consequence of this and some recent work which seems promising, it was decided not to include D_r in Table 6-1, but rather provide the current "best estimate" equations.

According to Marcusson and Bieganousky (1977)

$$D_r = 0.086 + 0.0083(2311 + 222N - 711(OCR) - C_1\sigma'_v)^{1/2} \qquad (6\text{-}3)$$

and according to Fardis and Veneziano (1981), who applied much of the data used to develop Eq. (6-3), the relationship is

$$\ln N = C_2 + 2.06 \ln D_r + C_3 \ln \sigma'_v \qquad (6\text{-}4)$$

where $C_1 = 7.7$ for σ'_v in kPa; 53 for psi units
C_2 = depth function which should be determined at a site by measuring N and D_r†
$C_3 = 0.222$ for σ'_v in kPa; 0.442 for psi units
OCR = overconsolidation ratio defined by Eq. (11-2)

Both of these equations are based on regression analyses. Equation (6-3) is based on four dissimilar soils and a large number of tests and claims a 78 percent reliability with a ± 0.075 standard deviation.

Example 6-2 Given: the SPT blow count at a depth of 4 m is 12. The soil is very sandy with traces of gravel and has an estimated unit weight $\gamma = 17.9$ kN/m^3. The soil is damp but above the water table.

† If no correlation is made for C_2, use the value of $C_2 = 2.67$ obtained from the data base used for the equation.

See Ref. 2

ATTACHMENT E

as glacial till clays and those found in the *B* horizon of residual deposits, are of medium sensitivity. A few glacial clays and most fresh-water deposits are very sensitive. A few of the fresh-water and marine deposits are quick. The sensitivity of the large majority of cohesive deposits will range from 2 to 8. Sensitivities greater or less than this are much less commonly encountered. Most quick clays seem to be found (or at least reported) in Canada and Scandinavia.

13-10 EMPIRICAL METHODS FOR SHEAR STRENGTH

Numerous correlations for shear strength or shear strength parameters have been proposed in the literature. Several will be presented here to illustrate some of those available.

One of the earliest correlations is that between the SPT (Sec. 6-9) and the unconfined compression strength, as was illustrated in Table 6-1.

Correlations between ϕ and plasticity index I_P are shown in Fig. 13-20. A relationship between ϕ and percent clay fraction (Skempton, 1964) is shown in Fig. 13-21. Both of these curves should be used cautiously, as there are several major exceptions which can be found in the literature as well as substantial scatter in the data points used to establish the curves. For routine soil work, however, particularly in regions where w_L is on the order of 20 to 45 and I_P on the order of 15 to 30, these curves will be reasonably reliable.

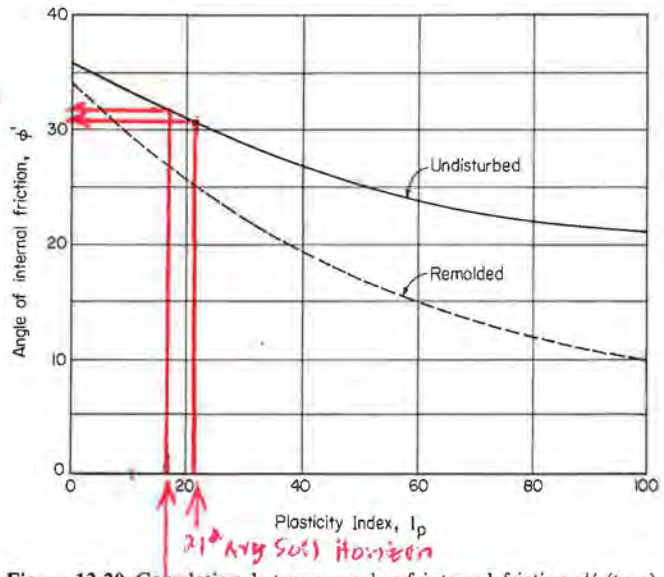


Figure 13-20 Correlation between angle of internal friction ϕ' (true) and plasticity index for both undisturbed and remolded soil. *(After Bjerrum and Simons, 1960.)*

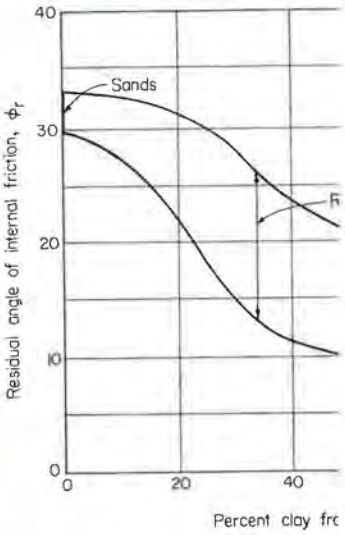


Figure 13-21 Correlation between r *ton, 1964.)*

Figure 13-22 illustrates t shear strength of soft to very be made for statistical deter test pits.

Figure 13-23 (also Fig. 6 can be used in test pits or where a person can be low works well in any fine-graine free location, pushes the pis

Figure 13-22 The torvane.

TABLE 1
Typical Properties of Compacted Soils

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression		Typical Strength Characteristics				Typical Coefficient of Permeability ft./min.	Range of CBR Values	Range of Subgrade Modulus k ~~lbs/cu in.~~ psi/in
				At 1.4 tsf (20 psi)	At 3.6 tsf (50 psi)	Cohesion (as compacted) psf	Cohesion (saturated) psf	ϕ (Effective Stress Envelope Degrees)	Tan ϕ			
				Percent of Original Height								
GW	Well graded clean gravels, gravel-aand mixtures.	125 - 135	11 - 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 - 80	300 - 500
GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	14 - 11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30 - 60	250 - 400
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	0.5	1.1	.....	.....	>34	>0.67	$>10^{-6}$	20 - 60	100 - 400
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1.6	.....	.....	>31	>0.60	$>10^{-7}$	20 - 40	100 - 300
SW	Well graded clean sands, gravelly sands.	110 - 130	16 - 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 - 40	200 - 300
SP	Poorly graded clean sands, sand-gravel mix.	100 - 120	21 - 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 - 40	200 - 300
SM	Silty sands, poorly graded sand-silt mix.	110 - 125	16 - 11	0.8	1.6	1050	420	34	0.67	$5 \times >10^{-5}$	10 - 40	100 - 300
SM-SC	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	300	33	0.66	$2 \times >10^{-6}$	5 - 30	100 - 300
SC	Clayey sands, poorly graded sand-clay-mix.	105 - 125	19 - 11	1.1	2.2	1550	230	31	0.60	$5 \times >10^{-7}$	5 - 20	100 - 300
ML	Inorganic silts and clayey silts.	95 - 120	24 - 12	0.9	1.7	1400	190	32	0.62	$>10^{-5}$	15 or less	100 - 200
ML-CL	Mixture of inorganic silt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	32	0.62	$5 \times >10^{-7}$	.....	
CL	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	$>10^{-7}$	15 or less	50 - 200
OL	Organic silts and silt-clays, low plasticity.	80 - 100	33 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	50 - 100
MH	Inorganic clayey silts, elastic silts.	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	$5 \times >10^{-7}$	10 or less	50 - 100
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2.6	3.9	2150	230	19	0.35	$>10^{-7}$	15 or less	50 - 150
OH	Organic clays and silty clays	65 - 100	45 - 21	.....	.....	.....	.....	.....	.....	.....	5 or less	25 - 100

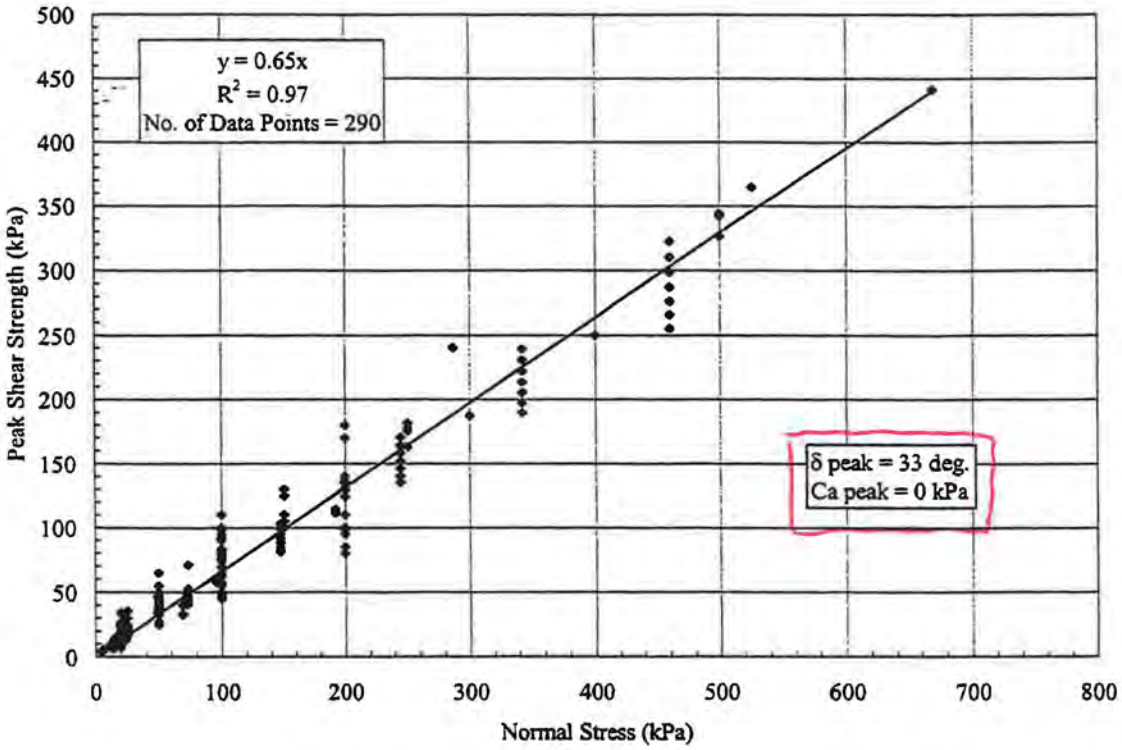
Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical stength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown.
   (..) indicates insufficient data available for an estimate.

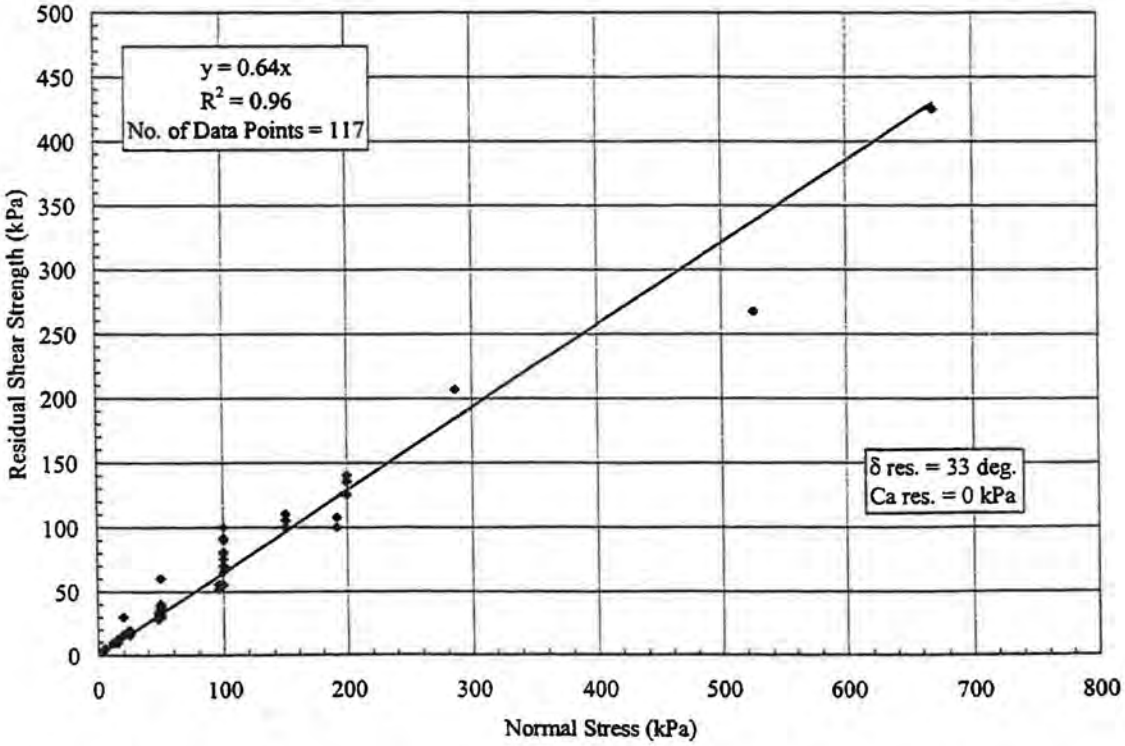
Spec Ref. 4

ATTACHMENT F

ATTACHMENT G

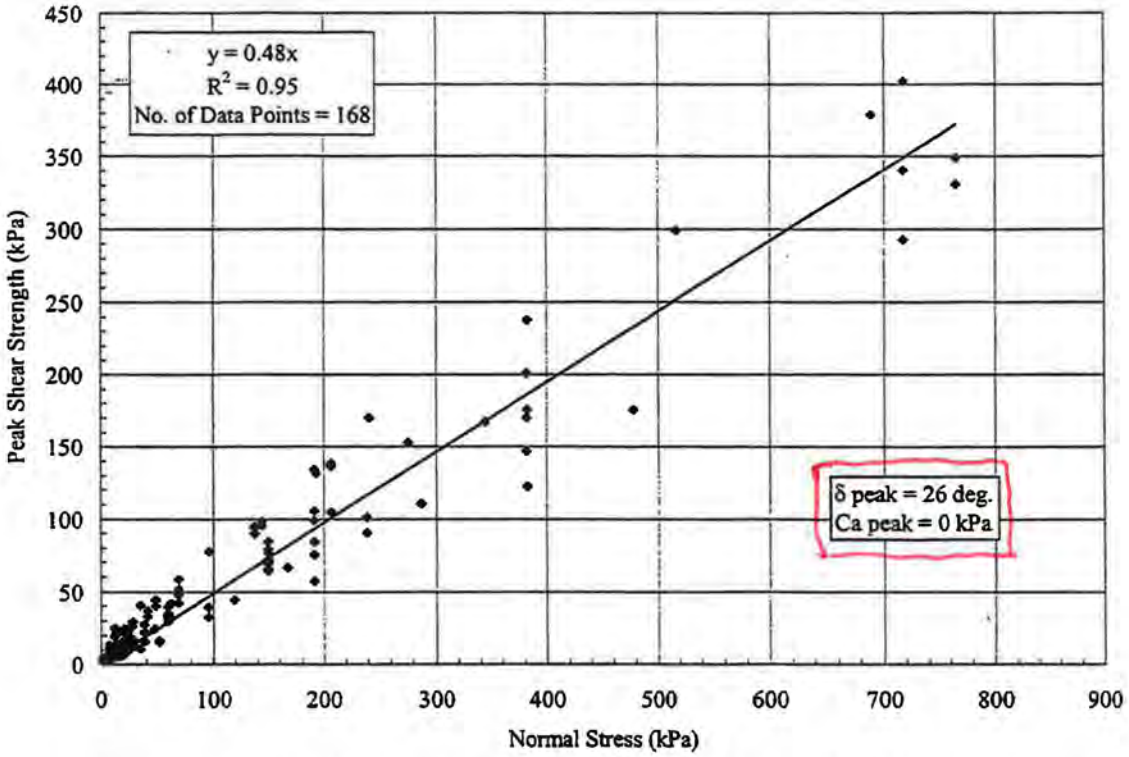


Appendix Figure 8a – Peak Shear Strength; NW-NP Geotextile against Granular Soil.

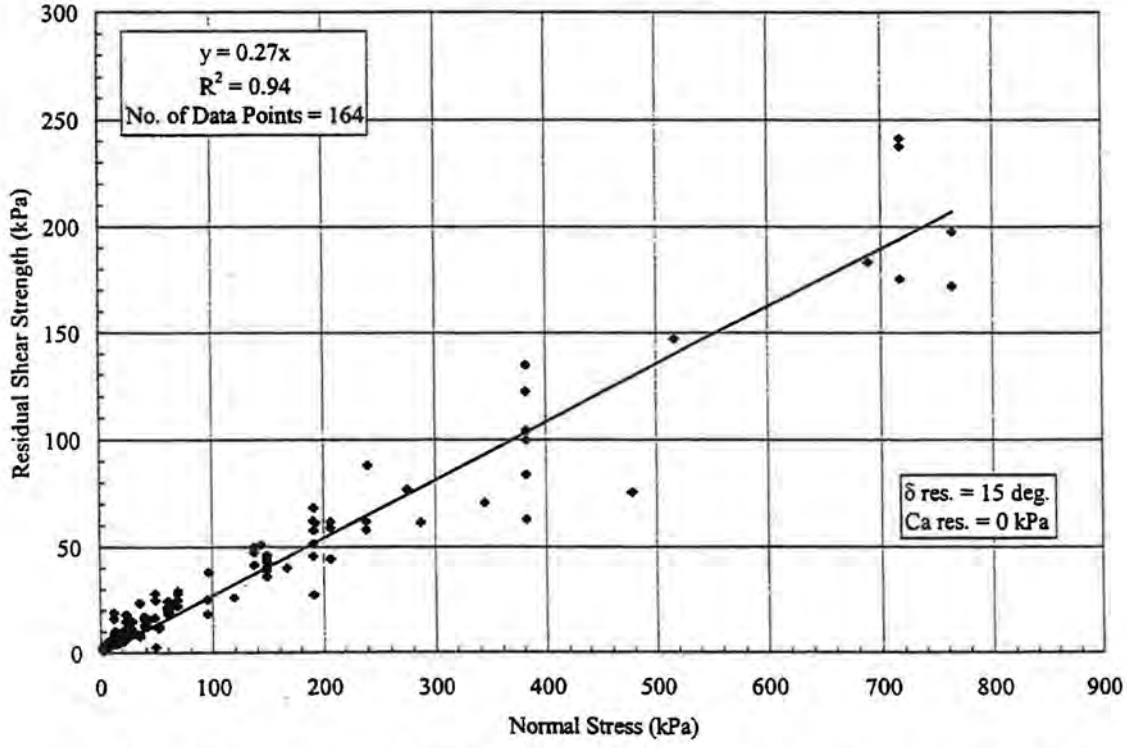


Appendix Figure 8b – Residual Shear Strength; NW-NP Geotextile against Granular Soil.

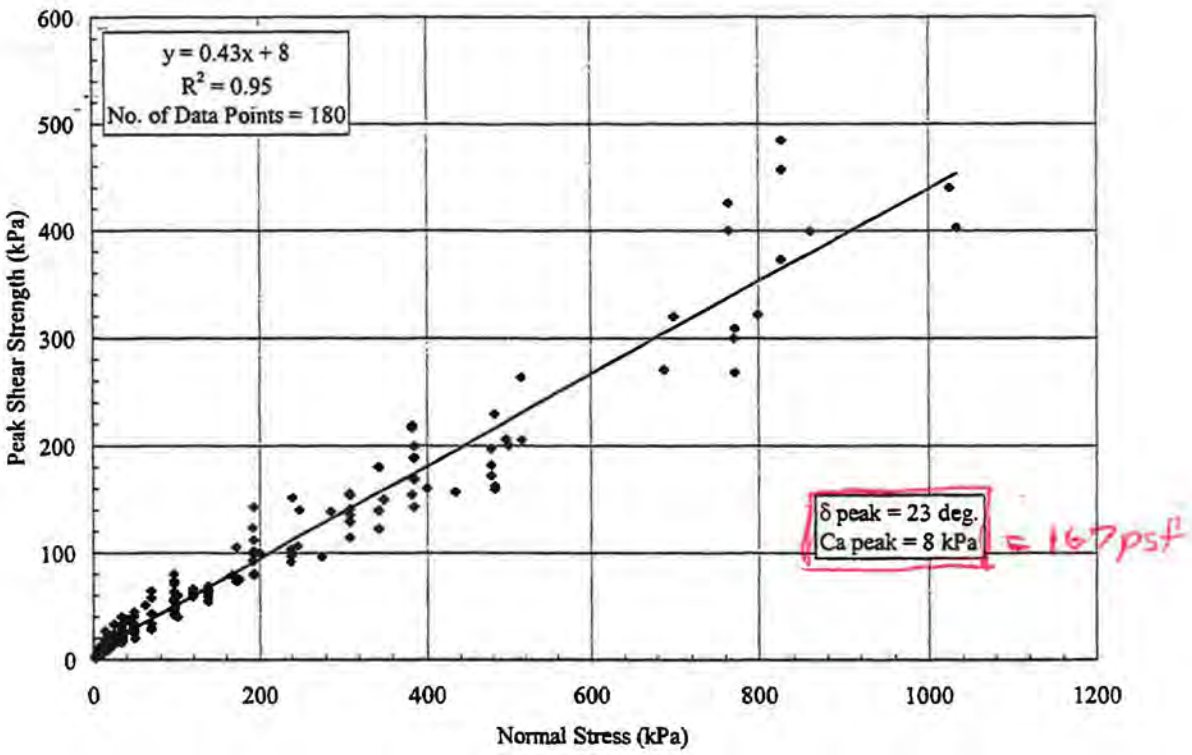
See Ref. 5



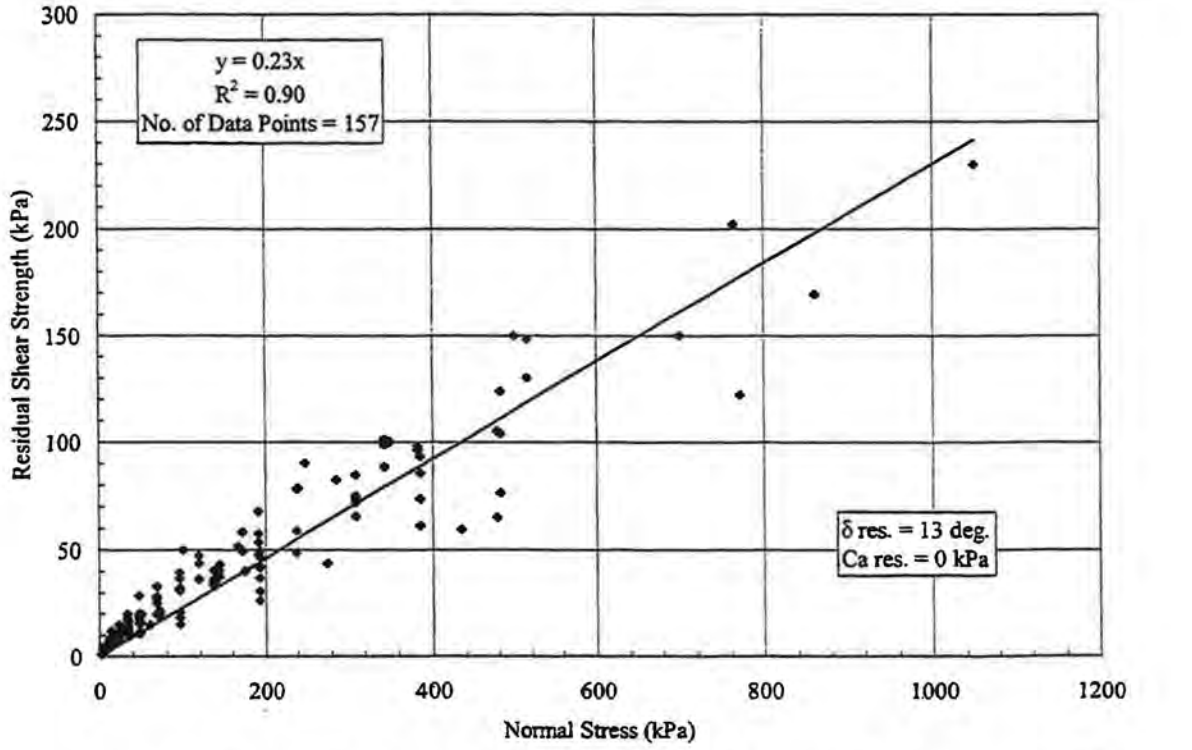
Appendix Figure 2i – Peak Shear Strength; Textured HDPE against NW-NP Geotextile on a Drainage Geocomposite.



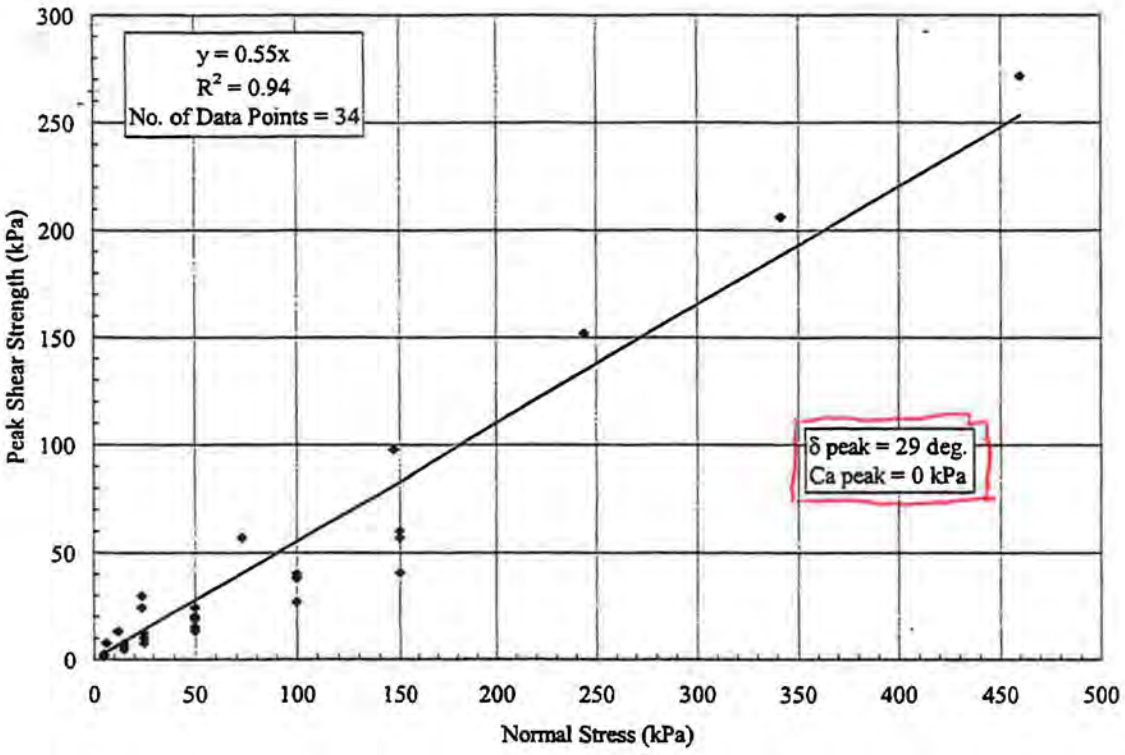
Appendix Figure 2j – Residual Shear Strength; Textured HDPE against NW-NP Geotextile on a Drainage Geocomposite.



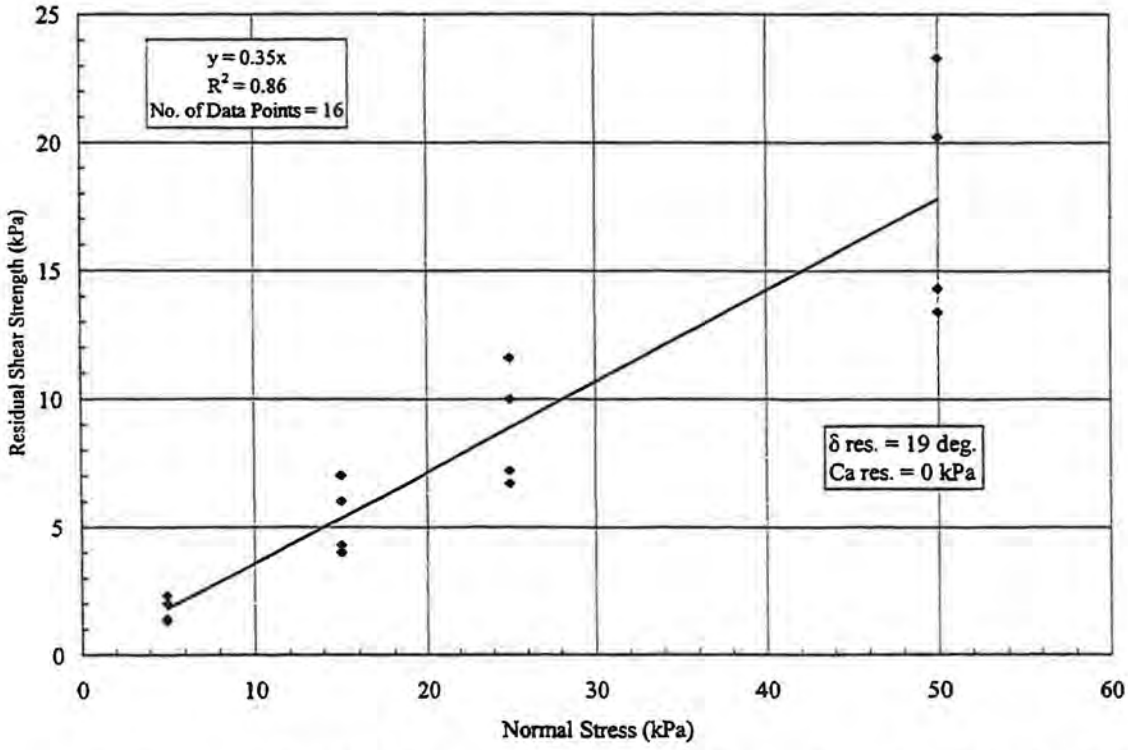
Appendix Figure 11a - Peak Shear Strength; Textured HDPE against NW-NP Side of Fabric-Reinforced GCL.



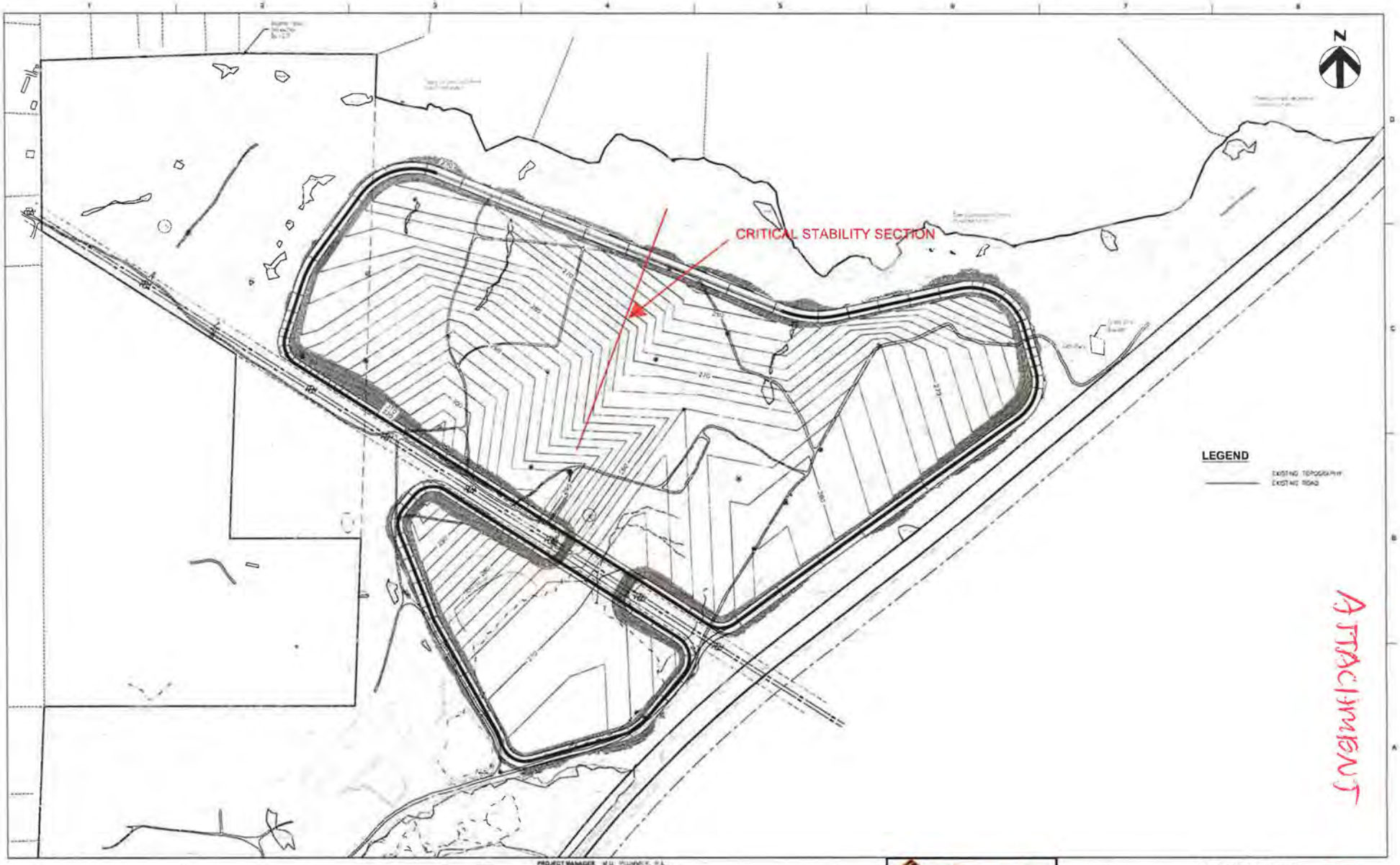
Appendix Figure 11b - Residual Shear Strength; Textured HDPE against NW-NP Side of Fabric-Reinforced GCL.



Appendix Figure 9e - Peak Shear Strength; Woven Geotextile against Cohesive Soil.



Appendix Figure 9f - Residual Shear Strength; Woven Geotextile against Cohesive Soil.



ATTACHMENT 4

HDR

HDR Engineering, Inc.
of the Carolinas

440 S. Church St. Suite 1000
Charlotte, NC 28202-2075
704 338 6700

ISSUE	DATE	DESCRIPTION
A	3/19/14	ISSUED FOR REVIEW

PROJECT MANAGER: M.D. PLUMMER, P.E.
J. GALL
PROJECT NUMBER

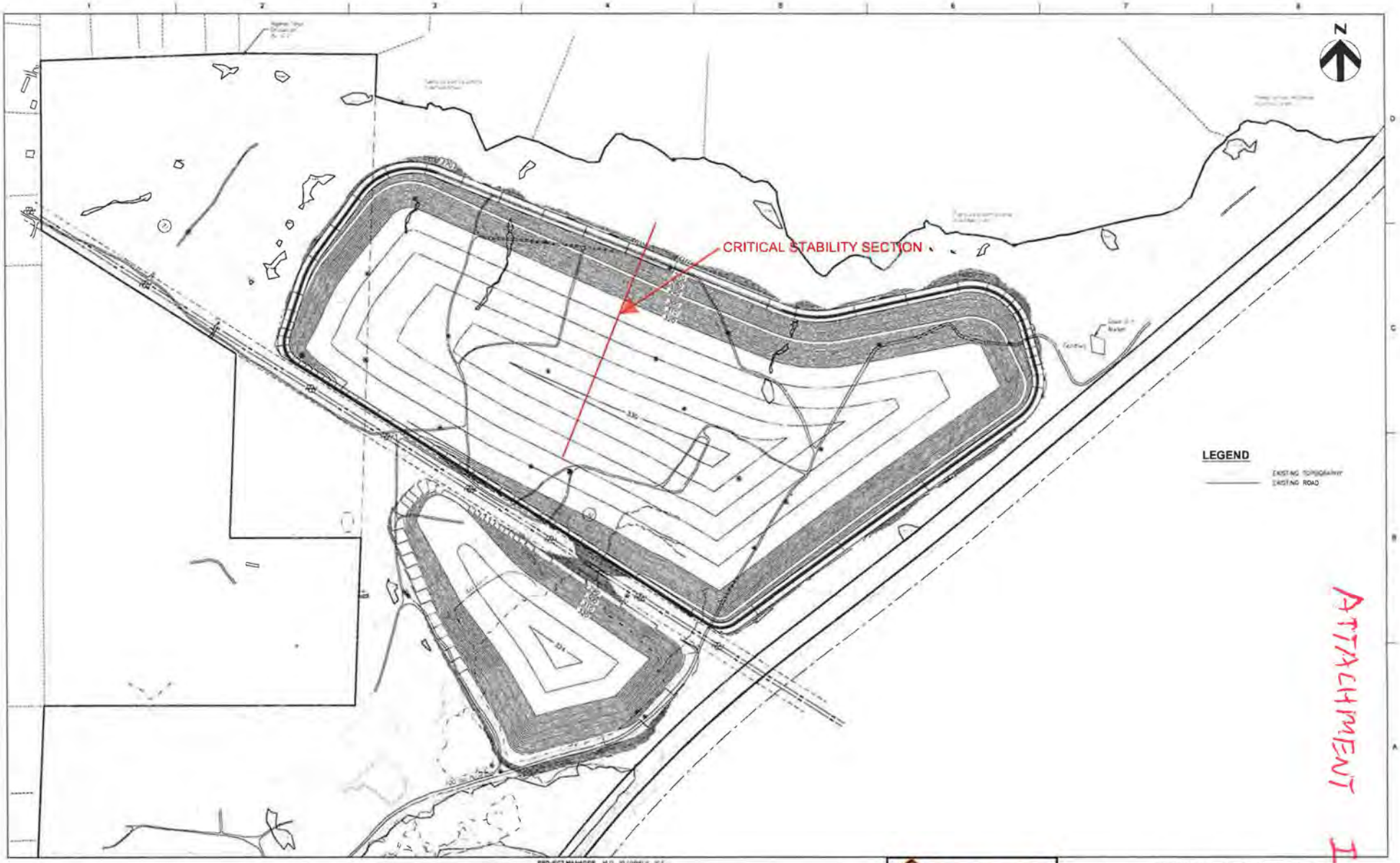
Charah

COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

BASEGRADE PLAN (BOTTOM OF SOIL LINER)

FILENAME: 00C-03.dwg
SCALE: 1" = 200'

SHEET: 00C-03



ATTACHMENT II

HDR Engineering Inc.
of the Carolinas

440 S. Church St. Suite 1000
Charlotte, NC 28202-2075
704.338.6700

ISSUE	DATE	DESCRIPTION
A	9/19/14	ISSUED FOR REVIEW

PROJECT MANAGER M.D. PLUMMER, P.E.
J. CAUL
PROJECT NUMBER

Charah

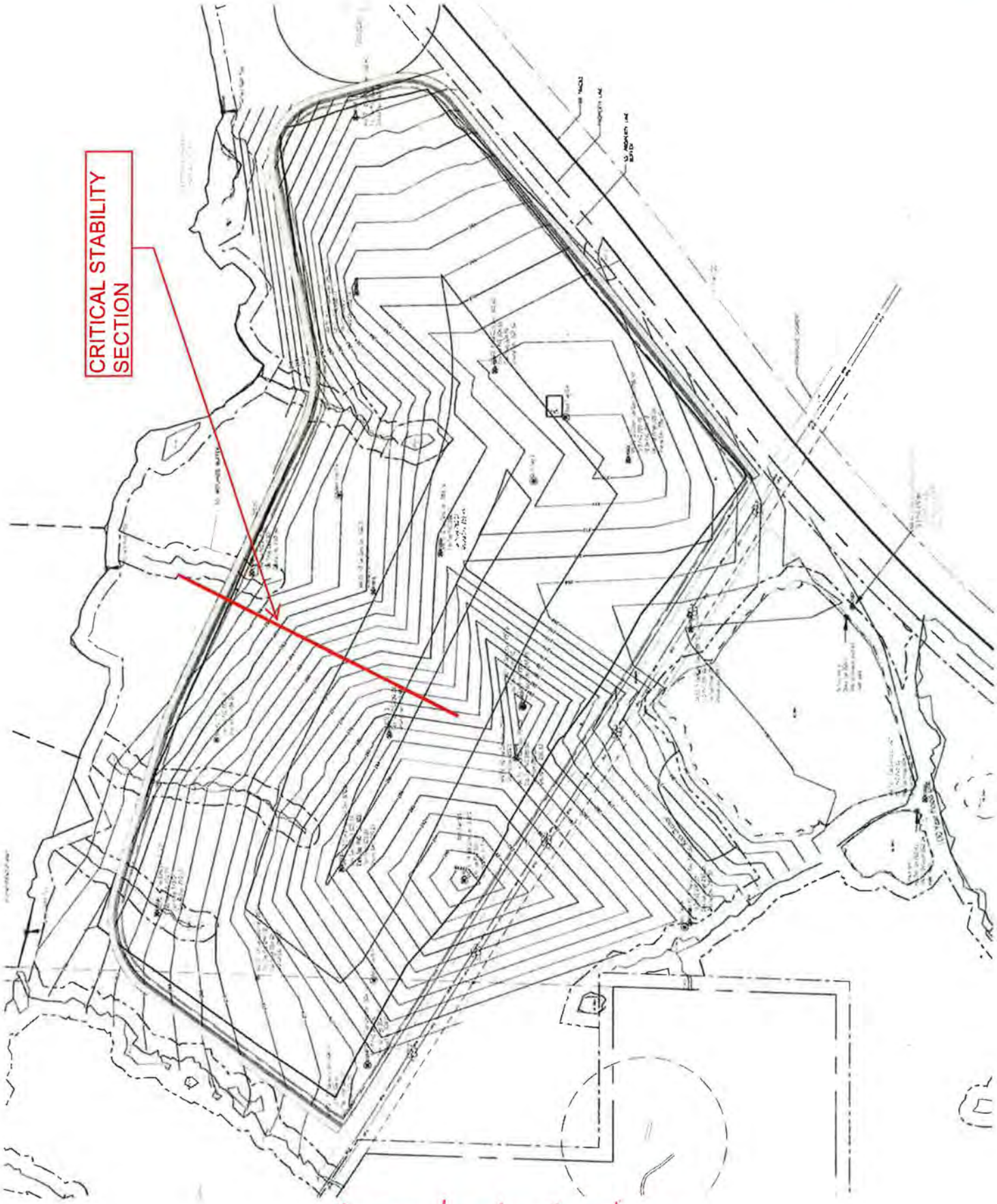
COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

PROPOSED FINAL CLOSURE PLAN

FILENAME 00C-02.dwg
SCALE 1" = 200'

SHEET 00C-02

ATTACHMENT J



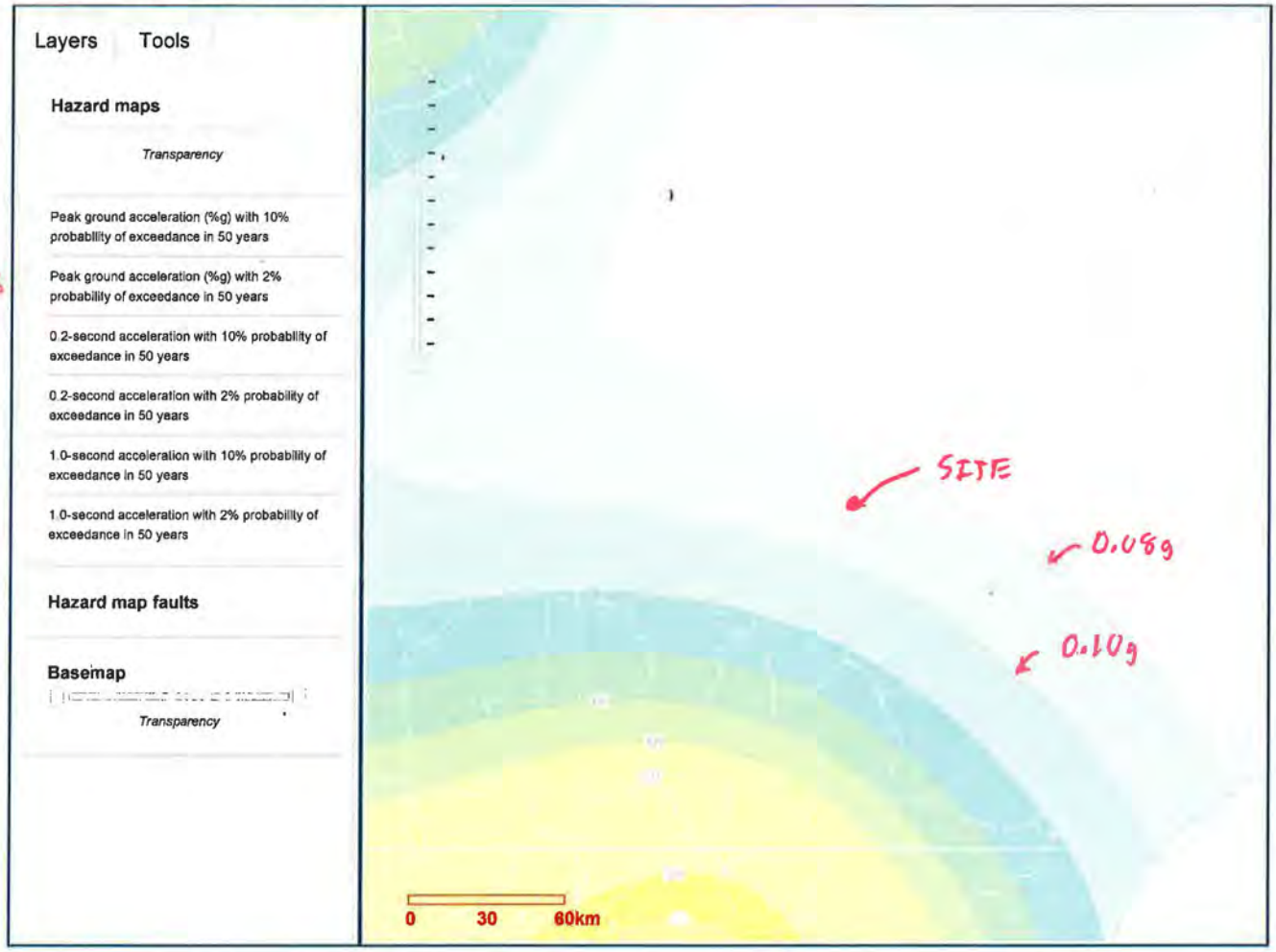
Groundwater Contours

ATTACHMENT K

USGS
science for a changing world

Earthquake Hazards Program

US Seismic Hazard 2008



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B

Stormwater

Subcell Divider Berms
Stormwater Pipe Perforations and Sizing
Stormwater Management System
Sediment Basins

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HDR Computation

Job Number	453925-235691-018	**No.**	
Project	Charah Colon Mine Site	**Computed** MDP	**Date** 10/7/2014
Subject	Permit Application	**Checked** EAW	**Date** 11/6/2014
Task	Subcell Divider Berms	**Sheet**	**Of**

Objective: Determine Available Volume given subcell berm height
*Assumes a pyramid shape

$$V = \frac{1}{3} hwl$$

Where: V = Volume of pyramid (ft^3)
h = Height of the pyramid (ft)
wl = width times length to get the Area of the bottom of the pyramid (ft^2)

Subcell 1A Berm Height = 4 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	4	2.19	95,360	127,146
	Total Available Volume for 1A =			127,146

Subcell 1B Berm Height = 3 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	3	6.63	288,595	288,595
	Total Available Volume for 1B =			288,595

Subcell 2 Berm Height = 5 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	5	6.41	279,164	465,273
	Total Available Volume for 2 =			465,273

HDR Computation

Job Number	453925-235691-018	No.	

Project	Charah Colon Mine Site	Computed	MDP	Date	10/7/2014
Subject	Permit Application	Checked	EAW	Date	11/6/2014
Task	Subcell Divider Berms	Sheet		Of	

Subcell 3A Berm Height = 7.5 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	7.5	3.83	166,645	416,613
	Total Available Volume for 3A =			416,613

Subcell 3B Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	0.87	37,946	75,891
	Total Available Volume for 3B =			75,891

Subcell 4A Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	1.77	77,041	154,083
	Total Available Volume for 4A =			154,083

Subcell 4B Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	2.04	88,871	177,742
	Total Available Volume for 4B =			177,742

Subcell 4C Berm Height = 4 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	4	3.89	169,256	225,675
	Total Available Volume for 4C =			225,675

HDR Computation

Job Number	453925-235691-018	No.	

Project	Charah Colon Mine Site	Computed	MDP	Date	10/7/2014
Subject	Permit Application	Checked	EAW	Date	11/6/2014
Task	Subcell Divider Berms	Sheet		Of	

Subcell 4D Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	1.49	64,806	129,611
	Total Available Volume for 4D =			129,611

Subcell 5A Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	2.14	93,244	186,488
	Total Available Volume for 5A =			186,488

Subcell 5B Berm Height = 8 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	8	3.43	149,544	398,783
	Total Available Volume for 5B =			398,783

Subcell 5C Berm Height = 8 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	8	1.66	72,321	192,855
	Total Available Volume for 5C =			192,855

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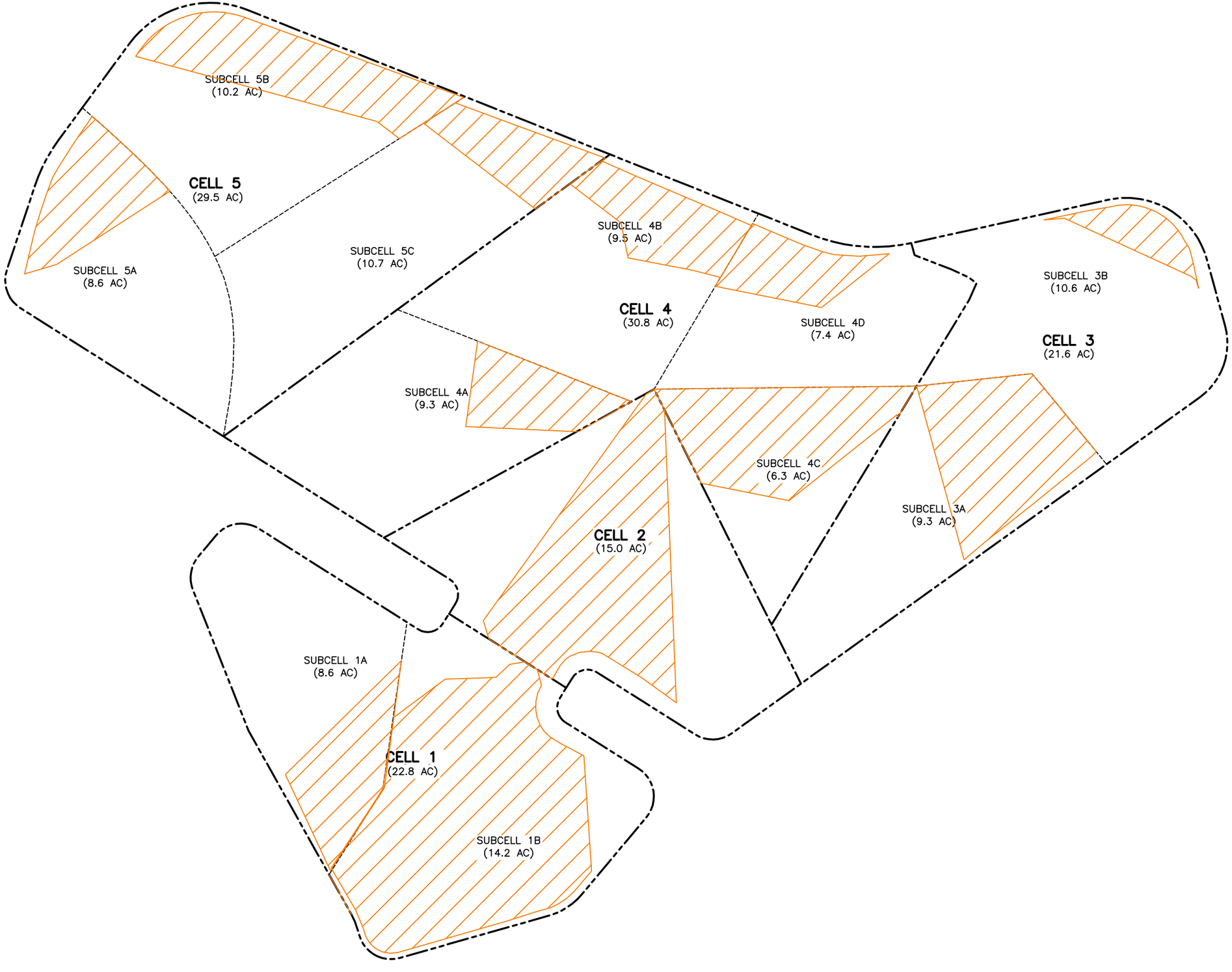

HDR Computation

Job Number	453925-235691-018	**No.**	
Project	Charah Colon Mine Site	**Computed** MDP	**Date** 11/5/2014
Subject	Permit Application	**Checked** EAW	**Date** 11/6/2014
Task	Stormwater Pipe Perforation & Size Calcs	**Sheet**	**Of**

Objective: Determine if the leachate pipes and perforations are large enough to handle the 10 year 24 hour storm event.

References:

1. Malcom, H. Rooney (1989). *Elements of Urban Stormwater Design* . Raleigh: NC State Univ.
2. Sharma, H. D., & Lewis, S. P. (1994). *Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation* . New York: John Wiley & Sons, Inc.

Calculations:

Eq. 1 $$\boxed{Q = C_d A\sqrt{2gh}}$$ Reference 1

Where:

Q =	Flow Rate (cfs)	
C_d =	Coefficient of Discharge (dimensionless)	
A =	Cross-sectional Area of Orifice	
g =	gravity (ft/s^2)	
h =	head (ft)	
7.48	gal/cf	12 in/ft
60	s/min	43,560 sf/acre
60	min/hr	
24	hr/day	

Determine the actual Flow Rate per Acre based on HELP model runs

Intensity $_{10yr,24hr}$ =	5.62	inches
Maximum Subcell Size =	14.8	acres
Storm Event Q_{cfs} =	301,929	cf/acre/day
Q_{gpm} =	1568.46	gal/acre/min
Maximum Drainage distance =	950	feet
Area of Drainage per foot of pipe =	950	sf
Area of Drainage per foot of pipe =	0.022	ac
Required Drainage per foot of pipe =	**34.207**	**gpm (actual flow rate per acre for the drainage area of the pipe)**

HDR Computation

Job Number	453925-235691-018	**No.**	
Project	Charah Colon Mine Site	**Computed** MDP	**Date** 11/5/2014
Subject	Permit Application	**Checked** EAW	**Date** 11/6/2014
Task	Stormwater Pipe Perforation & Size Calcs	**Sheet**	**Of**

Determine the maximum allowable flow in the pipe based on the perforations into the pipe and a maximum head

Diameter of perforation, $d_{perforation}$ = 0.375 in

$d_{perforation}$ = 0.03125 ft

Eq. 2 $$A = \pi\left(\frac{d}{2}\right)^2$$

$A_{perforation}$ = 0.00077 ft^2

Using Equation 1, determine the flow in the pipe

C_d = 0.6 typical default value (Ref. 1)

$A_{perforation}$ = 0.00077 ft^2

g = 32.2 ft/s^2

h = 8 in

h = 0.67 ft

The pipe is 8 inches in diameter. The head was assumed to be from the center of the pipe to 12 inches above the liner.

$Q_{perforation}$ = 0.003 cfs

$Q_{perforation}$ = 1.35 gpm per perforation

Number of Perforations per foot of pipe = 30 perforations per foot of pipe

$Q_{per\ foot\ of\ pipe}$ = 40.60 gpm

Required Flow Rate		Allowable Flow Rate
gpm	<	gpm
34.207		40.60

Conclusion:
The allowable flow rate is greater than the required flow rate. Therefore the allowable flow rate based on pipe perforations will be sufficient to meet the actual expected flow rate. Sufficient volume can get into the pipe through the orifices.

HDR Computation

Job Number	453925-235691-018	**No.**	
Project	Charah Colon Mine Site	**Computed** MDP	**Date** 11/5/2014
Subject	Permit Application	**Checked** EAW	**Date** 11/6/2014
Task	Stormwater Pipe Perforation & Size Calcs	**Sheet**	**Of**

Determine the maximum allowable flow in the pipe based on the pipe size and flowing full

Eq. 3 $$Q = \left(\frac{D}{16}\right)^{\frac{8}{3}} \frac{\sqrt{s}}{n}$$ Reference 1

Where:
- Q = Flow Rate (cfs)
- D = Theoretical Pipe Diameter (in) for just-full flow
- n = Manning roughness coefficient (dimensionless)
- s = Longitudinal slope (ft/ft)

D = 8 in
n = 0.009 Reference 2, page 472

Slope	Allowable Q (cfs)	Allowable Q (gpm)	Check
0.10%	0.55	248	Allowable Q is greater than Required Q
0.25%	0.87	393	Allowable Q is greater than Required Q
0.50%	1.24	555	Allowable Q is greater than Required Q
0.75%	1.52	680	Allowable Q is greater than Required Q
1.00%	1.75	785	Allowable Q is greater than Required Q
1.25%	1.96	878	Allowable Q is greater than Required Q
1.50%	2.14	962	Allowable Q is greater than Required Q
1.75%	2.31	1,039	Allowable Q is greater than Required Q
2.00%	2.47	1,111	Allowable Q is greater than Required Q
2.25%	2.62	1,178	Allowable Q is greater than Required Q
2.50%	2.77	1,242	Allowable Q is greater than Required Q
2.75%	2.90	1,302	Allowable Q is greater than Required Q
3.00%	3.03	1,360	Allowable Q is greater than Required Q
3.25%	3.15	1,416	Allowable Q is greater than Required Q
3.50%	3.27	1,469	Allowable Q is greater than Required Q
3.75%	3.39	1,521	Allowable Q is greater than Required Q

Conclusion:
The allowable flow rate is greater than the required flow rate for slopes 0.1% and above. Smaller pipe slopes were not run, but it is assumed that the bottom slope will not be smaller than 2% accounting for settlement. Therefore the allowable flow based on pipe size will be sufficient to meet the actual expected flow rate.

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Project:	Sanford Mine	Computed	PAW	Date	11/3/14
Subject:	Permit Application	Checked	Edw	Date	11/6/14
Task:	Drainage - Time of Concentration	Sheet		Of	

Objective Determine the Time of Concentration based on the proposed top of fill grades.

References

1. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.

Equations

Time of Concentration, (t_c) is the longest time of flow from points on the watershed ridge to the outlet of the watershed.

$$t_c = \frac{[L^3 / H]^{0.385}}{128}$$

Time of Concentration, (min) =	t_c
Hydraulic length of watershed, (ft) =	L
Elevation change along length, (ft) =	H

Cells 2-5

Flow Path 1	Hydraulic length of watershed L (ft) =	1,371
	Peak Elevation of watershed (ft) =	330
	Low Elevation of watershed (ft) =	260
	Elevation change along length H (ft) =	70
	t_c (min) =	**6.4**
Flow Path 2	Hydraulic length of watershed L (ft) =	3,449
	Peak Elevation of watershed (ft) =	328
	Low Elevation of watershed (ft) =	268
	Elevation change along length H (ft) =	60
	t_c (min) =	**19.7**
Flow Path 3	Hydraulic length of watershed L (ft) =	2,657
	Peak Elevation of watershed (ft) =	330
	Low Elevation of watershed (ft) =	245
	Elevation change along length H (ft) =	85
	t_c (min) =	**12.7**

Cell 1

Flow Path 1	Hydraulic length of watershed L (ft) =	1,660
	Peak Elevation of watershed (ft) =	322
	Low Elevation of watershed (ft) =	270
	Elevation change along length H (ft) =	52
	t_c (min) =	**8.9**

CONCLUSION

Most of the drainage ara is within the Flow Path 1 and 3 areas.
Use a Time of Concentration of 10-Minutes

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Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked EWR	Date 11/6/14
Task:	Drainage - Perimeter Channels	Sheet	Of

Objective Design the stormwater channels around the perimeter of the structural fill for the 25-yr storm.
Assume sideslope swales and/or sloe drains are installed as fill progresses. This will minimize the drainage area.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. NCDOT Standard Specifications for Roads and Structures
4. North American Green Product Brochure version 4.11
5. East Coast Erosion Blankets (ECS-1)
6. Maccaferri
7. Green Armor Systems
8. NOAA Atlas 14, Volume 2, Version 3 (Sanford, NC)

Equations

Normal Depth Procedure (Manning's Eqn) Ref 2

$Z_{av} = AR^{2/3}$ Area (A) = bd + z d^2

$Z_{req} = Q\,n / 1.49s^{0.5}$ R = Area / $(b+2d(z^2+1)^{0.5})$

$AR^{2/3} = Q\,n / 1.49s^{0.5}$ Avg Shear Stress (T) = d*s*unit weight of water

Q (cfs) = CIA $Z_{av} = Z_{req}$

Channel Design

Min Channel Freeboard =	0.2	ft	
Inside Channel Side Slope =	2	(enter X for X:1)	
Outside Channel Side Slope =	2	(enter X for X:1)	
Bottom Width, b =	4	ft	
Runoff Coeff (initial)=	0.60	Ag land, smooth	Ref 1
Runoff Coeff (permanent)=	0.25	Pasture, Sandy	Ref 1
I (in/hr) =	6.76	25-yr, 10-min Design Storm (Sanford, NC)	Ref 8

Various Lining Types *Depth of Flow is not specified for Manning's' n

Lining Type	Lining Description	Manning's n depths of 0-0.5 ft	Manning's n depths of 0.5-2.0 ft	Vp (ft/sec)	Allowable Shear Stress (psf)
A	Jute Net (HEC-15)		0.015	2.0	0.45
B	Erosion Control Blanket Single Net (Curlex 1)		0.034	5.0	1.55
C	Erosion Control Blanket, Straw w/ Single Net (Ref 4)*		0.025	6.7	1.50
D	Erosion Control Blanket Double Net (Curlex HV)		0.026	10.0	1.65
E	Ordinary Firm Loam (Ref 2)	0.023	0.020	3.5	2.0
F	Grass Lined (Ref 1)*		0.030	5.0	2.0
G	6" Rip Rap (Ref 2, Ref 1)		0.069	9.0	2.0
H	GreenArmor 7010 (vegetated)		0.034	16.0	8.0
I	Unvegetated Turf Reinforcement Mat (TRM) (NAG C350)		0.025	9.5	2.25
J	Class D Phase 2 (Partially vegetated) TRM (NAG C350)		0.048	14.0	3.34
K	12" Rip Rap (Ref 2, Ref 1)		0.078	12.5	4.0
L	Class B Phase 3 (Fully vegetated) TRM (NAG C350)		0.048	18.0	5.7
M	Reno Mattress (6-inch, unvegetated) Ref 6		0.0277	13.8	4.3
N	Reno Mattress (6-inch, vegetated) Ref 6		0.050	13.8	8.35
O	Smart Ditch (Pre-formed HDPE channel)		0.022	-	-
P	Concrete (HEC-15, EPA 832-F-99-002)		0.013	25.0	10.0

Drainage Area is measured in plan view and does not account slope. Refer to sheet "Channels" for drainage areas.
Select Lining System for each channel slope that will handle the design flow when vegetated and when initially placed

HDR Computation

Job No. 453925-235691-018

Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked EAW	Date 11/6/14
Task:	Drainage - Perimeter Channels	Sheet	Of

Node	Drainage Area (acres)	elev 2	elev 1	length (ft)	Channel Slope	Channel Side Slope Inside (X:1)	Channel Side Slope Outside (X:1)	Bottom Width, b (ft)
DI #1	0.96	324	294	529	5.7%	2	2	4
DI #2	2.9	288	279	823	1.1%	2	2	4
DI #3W	5.2	280	269	1,100	1.0%	2	2	4
DI #3E	2.3	270	269	530	0.2%	2	2	4
DI #5W	3.2	280	259	643	3.3%	2	2	4
DI #5S	3.8	282	259	614	3.7%	2	2	4
DI #6 N	3.1	297	288	600	1.5%	2	2	4
DI #6 W a	8.2	322	296	1,034	2.5%	2	2	4
DI #6 W b	12.4	294	288	676	0.9%	2	2	4
Cell 1 N	5.3	290	284	558	1.1%	2	2	4
DI #7E	38.6	278	272	706	0.8%	2	2	4
DI #7W	4.1	276	271	434	1.2%	2	2	4

	Channel Location	Flow Q (cfs)	Lining Type	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{av}	Velocity (ft/sec)	Avg Shear Stress (lb/sf)	Comment
Initial Lining											
	DI #1	3.9	E	0.22	0.17	0.75	0.16	0.22	5.2	0.6	Need Liner
	DI #2	11.8	E	1.51	0.53	2.69	0.42	1.51	4.4	0.4	Need Liner
	DI #3W	21.1	E	2.83	0.75	4.15	0.56	2.83	5.1	0.5	Need Liner
	DI #3E	9.3	E	2.88	0.76	4.20	0.57	2.88	2.2	0.1	OK
	DI #5W	13.0	E	0.96	0.41	1.98	0.34	0.96	6.6	0.8	Need Liner
	DI #5S	15.4	E	1.07	0.44	2.13	0.36	1.07	7.3	1.0	Need Liner
	DI #6 N	12.6	E	1.38	0.50	2.53	0.40	1.38	5.0	0.5	Need Liner
	DI #6 W a	33.3	E	2.82	0.75	4.14	0.56	2.82	8.0	1.2	Need Liner
	DI #6 W b	50.3	E	7.17	1.24	8.04	0.84	7.17	6.3	0.7	Need Liner
	Cell 1 N	21.5	E	2.78	0.75	4.10	0.56	2.78	5.2	0.5	Need Liner
	DI #7E	156.6	E	22.80	2.22	18.72	1.34	22.80	8.4	1.2	Need Liner
	DI #7W	16.6	E	2.08	0.64	3.35	0.49	2.08	5.0	0.5	Need Liner
Temp Lining											
	DI #1	3.9	C	0.27	0.20	0.86	0.18	0.27	4.5	0.7	OK
	DI #2	11.8	C	1.89	0.60	3.14	0.47	1.89	3.8	0.4	OK
	DI #3W	21.1	C	3.54	0.85	4.86	0.62	3.54	4.3	0.5	OK
	DI #3E	9.3	C	3.60	0.86	4.92	0.63	3.60	1.9	0.1	OK
	DI #5W	13.0	C	1.21	0.47	2.31	0.38	1.21	5.6	1.0	OK
	DI #5S	15.4	C	1.34	0.50	2.48	0.40	1.34	6.2	1.2	OK
	DI #6 N	12.6	C	1.72	0.57	2.94	0.45	1.72	4.3	0.5	OK
	DI #6 W a	33.3	C	3.52	0.85	4.84	0.62	3.52	6.9	1.3	Need Diff Liner
	DI #6 W b	50.3	C	8.96	1.38	9.37	0.92	8.86	5.4	0.8	OK
	Cell 1 N	21.5	C	3.48	0.84	4.80	0.62	3.48	4.5	0.6	OK
	DI #7E	156.6	C	28.49	2.47	22.07	1.47	28.49	7.1	1.3	Need Liner
	DI #7W	16.6	C	2.60	0.72	3.91	0.54	2.60	4.3	0.5	OK

Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked EAW	Date 11/6/14
Task:	Drainage - Perimeter Channels	Sheet	Of

Channel Location	Flow Q (cfs)	Lining Type	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{av}	Velocity (ft/sec)	Avg Shear Stress (lb/sf)	Comment
Permanent Lining										
DI #1	1.6	F	0.14	0.13	0.57	0.12	0.14	2.9	0.5	OK
DI #2	4.9	F	0.94	0.41	1.95	0.34	0.94	2.5	0.3	OK
DI #3W	8.8	F	1.77	0.58	3.00	0.45	1.77	2.9	0.4	OK
DI #3E	3.9	F	1.80	0.59	3.03	0.46	1.80	1.3	0.1	OK
DI #5W	5.4	F	0.60	0.31	1.44	0.27	0.60	3.7	0.6	OK
DI #5S	6.4	F	0.67	0.33	1.55	0.28	0.67	4.1	0.8	OK
DI #6 N	5.2	F	0.86	0.38	1.84	0.32	0.86	2.9	0.4	OK
DI #6 W a	13.9	F	1.76	0.58	2.98	0.45	1.76	4.6	0.9	OK
DI #6 W b	21.0	F	4.48	0.97	5.74	0.69	4.48	3.7	0.5	OK
Cell 1 N	9.0	F	1.74	0.57	2.96	0.45	1.74	3.0	0.4	OK
DI #7E	65.2	F	14.25	1.76	13.25	1.12	14.25	4.9	0.9	OK
DI #7W	6.9	F	1.30	0.49	2.43	0.39	1.30	2.9	0.4	OK

Select an appropriate temp liner for DI 6W a and DI #7E

Channel Location	Channel Slope	Lining Type	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{av}	Velocity (ft/sec)	Avg Shear Stress (lb/sf)	Comment
DI #6 W a	2.5%	H	4.72	0.99	5.96	0.71	4.72	0.7	1.6	OK
DI #7E	0.8%	H	12.27	1.63	11.88	1.05	12.27	0.5	0.9	OK

CONCLUSION

Channel	Inside Channel (X:1)	Outside Channel (X:1)	Bottom Width, b (ft)	Slope (%)	Min Depth (ft)	Build Depth (ft)	Top Width (ft)	Temporary Lining	Permanent Lining
DI #1	2	2	4	5.7%	1.2	2	12	Straw w/ Single Net	Grass Lined
DI #2	2	2	4	1.1%	0.8	2	12	Straw w/ Single Net	Grass Lined
DI #3W	2	2	4	1.0%	1.1	2	12	Straw w/ Single Net	Grass Lined
DI #3E	2	2	4	0.2%	1.1	2	12	Straw w/ Single Net	Grass Lined
DI #5W	2	2	4	3.3%	0.7	2	12	Straw w/ Single Net	Grass Lined
DI #5S	2	2	4	3.7%	0.7	2	12	Straw w/ Single Net	Grass Lined
DI #6 N	2	2	4	1.5%	0.8	2	12	Straw w/ Single Net	Grass Lined
DI #6 W a	2	2	4	2.5%	1.2	2	12	GreenArmor 7010	Grass Lined
DI #6 W b	2	2	4	0.9%	1.6	2	12	Straw w/ Single Net	Grass Lined
Cell 1 N	2	2	4	1.1%	1.0	2	12	Straw w/ Single Net	Grass Lined
DI #7E	2	2	4	0.8%	2.7	3	16	GreenArmor 7010	Grass Lined
DI #7W	2	2	4	1.2%	0.9	2	12	Straw w/ Single Net	Grass Lined

Though Channel DI #6Wa & DI #7E requires a heavier temporary liner than the other channels, the permanent liner for all channels is grass. Therefore, using the Straw w/ Single Net could be used but additional maintenance of the channel may be necessary until grass is established.

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HDR Computation

Job No. 453925-235691-018

Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked EAW	Date 11/6/14
Task:	Drainage - Sideslope Swales	Sheet	Of

Objective Design the sideslope channels on the structural fill for the 25-yr storm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. NCDOT Standard Specifications for Roads and Structures
4. North American Green Product Brochure version 4.11
5. East Coast Erosion Blankets (ECS-1)
6. Maccaferri
7. Green Armor Systems
8. NOAA Atlas 14, Volume 2, Version 3 (Sanford, NC)

Equations

Normal Depth Procedure (Manning's Eqn) Ref 2

$Z_{av} = AR^{2/3}$ Area (A) = bd + z d^2

$Z_{req} = Q\,n / 1.49s^{0.5}$ R = Area / $(b+2d(z^2+1)^{0.5})$

$AR^{2/3} = Q\,n / 1.49s^{0.5}$ Avg Shear Stress (T) = d*s*unit weight of water

$Q\ (cfs) = CIA$

$Z_{av} = Z_{req}$

Channel Design

Min Channel Freeboard =	0.2	ft	
Inside Channel Side Slope =	Varies	(enter X for X:1)	
Outside Channel Side Slope =	Varies	(enter X for X:1)	
Bottom Width, b =	Varies	ft	
Runoff Coeff (initial)=	0.60	Ag land, smooth	Ref 1
Runoff Coeff (permanent)=	0.25	Pasture, Sandy	Ref 1
I (in/hr) =	6.76	25-yr, 10-min Design Storm (Sanford, NC)	Ref 8

Various Lining Types

Lining Type	Lining Description	Manning's n depths of 0-0.5 ft	Manning's n depths of 0.5-2.0 ft	Vp (ft/sec)	Allowable Shear Stress (psf)
A	Jute Net (HEC-15)		0.015	2.0	0.45
B	Erosion Control Blanket Single Net (Curlex 1)		0.034	5.0	1.55
C	Erosion Control Blanket, Straw w/ Single Net (Ref 4)*		0.025	6.7	1.50
D	Erosion Control Blanket Double Net (Curlex HV)		0.026	10.0	1.65
E	Ordinary Firm Loam (Ref 2)	0.023	0.020	3.5	2.0
F	Grass Lined (Ref 1)*		0.030	5.0	2.0
G	6" Rip Rap (Ref 2, Ref 1)		0.069	9.0	2.0
H	GreenArmor 7010 (unvegetated)		0.034	12.0	3.3
I	Unvegetated Turf Reinforcement Mat (TRM) (NAG C350)		0.025	9.5	2.25
J	Class D Phase 2 (Partially vegetated) TRM (NAG C350)		0.048	14.0	3.34
K	12" Rip Rap (Ref 2, Ref 1)		0.078	12.5	4.0
L	Class B Phase 3 (Fully vegetated) TRM (NAG C350)		0.048	18.0	5.7
M	Reno Mattress (6-inch, unvegetated) Ref 6		0.0277	13.8	4.3
N	Reno Mattress (6-inch, vegetated) Ref 6		0.050	13.8	8.35
O	Smart Ditch (Pre-formed HDPE channel)		0.022	-	-
P	Concrete (HEC-15, EPA 832-F-99-002)		0.013	25.0	10.0

*Depth of Flow is not specified for Manning's' n

Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked EAW	Date 11/6/14
Task:	Drainage - Sideslope Swales	Sheet	Of

Drainage Area is measured in plan view and does not account slope.
Select Lining System for each channel slope that will handle the design flow when vegetated and when initially placed

Channel Location	Drainage Area (acres)	Channel Slope	Channel Side Slope Inside (X:1)	Channel Side Slope Outside (X:1)	Bottom Width, b (ft)	
Sideslope	13.3	2.0%	4	4	0	Largest Drainage Area (DI #5 on the Slope Drain Areas)
Diversion Berm	7.5	0.25%	2	2	0	Largest Drainage Area (DI #3)

Channel Location	Flow Q (cfs)	Lining Type	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{av}	Velocity (ft/sec)	Avg Shear Stress (lb/sf)	Comment
	Initial Lining									
Sideslope	53.9	E	5.12	1.31	6.91	0.64	5.12	7.8	1.6	Need Liner
Diversion Berm	30.4	E	8.17	2.07	8.59	0.93	8.17	3.5	0.3	Need Liner
	Temp Lining									
Sideslope	53.9	C	6.40	1.43	8.17	0.69	6.40	6.6	1.8	Needs Liner
Diversion Berm	30.4	C	10.21	2.25	10.16	1.01	10.21	3.0	0.4	OK

Channel Location	Flow Q (cfs)	Lining Type	Z_{req}	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z_{av}	Velocity (ft/sec)	Avg Shear Stress (lb/sf)	Comment
	Permanent Lining									
Sideslope	22.5	F	3.20	1.10	4.86	0.53	3.20	4.6	1.4	OK
Diversion Berm	12.7	F	5.10	1.74	6.04	0.78	5.10	2.1	0.3	OK

CONCLUSION

	Side Slope Inside Channel (X:1)	Side Slope Outside Channel (X:1)	Bottom Width, b (ft)	Min to Construct Slope (%)	Min to Construct Depth (ft)	Min to Construct Top Width (ft)
Sideslope	4	4	0	2.0%	1.1	8.8
Diversion Berm	2	2	0	0.25%	1.7	6.9

Though the Straw w/ Single Net temporary liner for the sideslope is greater than the allowable shear stress, since it a tmeporary condtion and the permanent liner is grass, the Straw w/ Single Net will work but the channel will need to be monitored and maintained until vegetation is extablished.

Channels to have a temporary liner (Straw w/ Single Net)
Permanent liner is grass.

Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked: [illegible]	Date: 11/6/14
Task:	Drainage - Slope Drains	Sheet:	Of:

Objective: Size the slope drains for the 25-year storm.

Equations:

Q (cfs) = CIA

Runoff Coeff (initial)= 0.60 Ag land, smooth

Runoff Coeff (permanent)= 0.25 Pasture, Sandy

I (in/hr) = 6.76 25-yr, 10-min Design Storm (Sanford, NC)

Drainage Area (acres) = **Use largest drainage area**

Drainage area to pipe is in "post" condition

Manning's

$$D_{REQD} = 16\left[\frac{Qn}{\sqrt{s}}\right]^{\frac{3}{8}}$$

Theoretical Size for pipe flowing full

D = Pipe diameter (inches)

Q = Peak Flow (cfs)

0.012 = n, Manning's Roughness Coefficient for ADS CPP

s = Pipe Slope (ft fall / ft run)

Orifice $Q = C_d * A * (2gh)^{0.5}$

Q (cfs) = Discharge

0.60 = C_d Coefficient of Discharge (dimensionless)

A (sf) = Cross Sectional Area of Flow at the orifice entrance

32.2 = Acceleration of Gravity g (ft/sec^2)

h (ft) = driving head measured from centroid of the orifice (pipe) to the water surface

"Driving Headwater Rqd for Total Flow" is the depth of water above the centerline of the pipe required to achieve the flow.
"Driving Head Available" is the depth of the channel from the center of the pipe to the top of the channel.

Allowable head 2.5 feet (depth of channel)

Scenario	Pipe Slope (ft fall / ft run)	Drainage Area (acres)	Flow Q (cfs)	Theoretical Size for pipe (in)	Pipe Dia Selected (in)	Cross Sectional Area of orifice (sf)	Driving Headwater Rqd for Total Flow (ft)	Driving Head Available (ft)	Manning's Possible Discharge Q (cfs)	Comments
Sideslope	25%	13.3	22.5	12.7	18	1.8	7.0	1.8	57.0	This assumes entire area trying to get into the pipe though some is already in the pipe due to sideslope swales.
Sideslope	25%	7	11.8	10.0	18	1.8	1.9	1.8	57.0	This is drainage from only the sideslope swale.
Diversion Berm	1.0%	2	3.4	11.4	12	0.8	0.8	2.0	3.9	
Diversion Berm	1.0%	7.5	12.7	18.7	18	1.8	2.2	1.8	11.4	

Conclusion:

Use 18" corrugated plastic pipe (smooth wall)

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Project:	Sanford Mine	Computed:	PAW	Date	11/03/14
Subject:	Permit Application	Checked		Date	11/6/14
Task:	Drainage - Drop Inlets	Sheet		Of	

Objective: Size the drop inlet outlet pipe and grates for the 25-year storm.

References: 1. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.

Equations:

$Q = C_d * A (2 * g * h)^{0.5}$ Orifice Equation

Q = cfs, discharge (based on permanent condition)

C_d = 0.59 coefficient of discharge Ref 1, p III-11

g = 32.2 ft/sec^2, gravity

h = ft, driving head measured from the center of the pipe

A = sf, cross sectional open area

	Open area (A)	Grate	Manufacturer
A	3.6	V-3610-7	East Jordan Iron Works
B	4.8	R-1792-KG	Neenah
C	6.0	R-3531-A	Neenah

Allowable head	2.0	feet (depth of channel)
Max Flow from Slope Drains	22.5	cfs

Check for inlet control

Channel Location	Perimeter Channel Side 1	Side 2	Slope Drain Flow (cfs)	Total Flow (cfs)		Grate	Open Area (sf)	Required head(ft)	
DI #1	1.6		22.5	24.1	C	R-3531-A	6.0	0.7	Ok
DI #2	4.9		22.5	27.4	C	R-3531-A	6.0	0.9	Ok
DI #3	8.8	3.9	22.5	35.2	C	R-3531-A	6.0	1.5	Ok
DI #4	Mininimal Flow								
DI #5	5.4	6.4	22.5	34.3	C	R-3531-A	6.0	1.5	Ok
DI #6	5.2	21.0	22.5	48.7	C	R-3531-A	6.0	2.9	Problem
DI #7	65.2	6.9	22.5	94.6	C	R-3531-A	6.0	11.1	Problem
Cut the flow in half then determine the required grate inlet area									
DI #6	24.3		0.59	C		R-3531-A	6.0	0.7	Ok
DI #7	47.3		0.59	C		R-3531-A	6.0	2.8	Problem
DI #7	65.2		0.59	2 large grates will be necessary			9.8	2.0	Ok

Project:	Sanford Mine	Computed:	PAW	Date	11/03/14
Subject:	Permit Application	Checked	[illegible]	Date	11/6/14
Task:	Drainage - Drop Inlets	Sheet		Of	

Size the Outlet culvert

$D=16*(Qn/s^{0.5})^{3/8}$ Theoretical Pipe Size (in) for pipe flowing full

D = Pipe diameter (inches)

Q = Peak Flow (cfs)

n = 0.013 Manning's Roughness Coefficient for RCP

s = Pipe Slope (ft fall / ft run)

Check pipe size based on Gravity Flow

	DI #1	DI #2	DI #3	DI #4	DI #5	DI #6	DI #7
Q (cfs) =	24.1	27.4	35.2	10.0	34.3	48.7	94.6
Number of pipes	1	1	1	1	1	1	2
Slope (%) =	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Theoretical Diameter (in) =	24.6	25.8	28.3	17.7	28.0	32.0	31.6
Culvert Diameter (in) =	30	30	30	18	30	36	36

Conclusion:

For DI #1, #2, #3, #4, and #5 use a grate with 6 sf open area and a 30" RCP Outlet

For DI #6 use a two grates each with 6 sf open area and a 36" RCP Outlet

For DI #7, use two grates with 12 sf open area and 2- 36" RCP Outlet

Project:	Sanford Mine	Computed:	PAW	Date	11/03/14
Subject:	Permit Application	Checked	[illegible]	Date	11/6/14
Task:	Drainage - Drop Inlet across Power Line Right-of-Way	Sheet		Of	

Objective: Design the grate, drop inlet and culvert for the power line right-of-way crossing for the 25-year storm.

References:

1. Elements of Urban Stormwater Design, H. Rooney Malcom, P.E.

Equations:

Q (cfs) = CIA

Runoff Coeff (initial)=	0.60	Ag land, smooth
Runoff Coeff (permanent)=	0.25	Pasture, Sandy
I (in/hr) =	6.76	25-yr, 10-min Design Storm (Sanford, NC)
A (acres) =	27.6	
Q initial (cfs) =	111.95	
Q permanent (cfs) =	46.64	

Orifice Equation

$Q = C_d * A (2 * g * h)^{0.5}$

Q = cfs, discharge (based on permanent condition)

C_d = coefficient of discharge 0.59 Ref 1, p III-11

g = 32.2 ft/sec^2, gravity

h = ft, driving head measured from the center of the pipe

A = sf, cross sectional open area

Type	Open area (A)	Perimeter of grate	Grate	Manufacturer
A	3.6	10.4	V-3610-7	East Jordan Iron Works
B	4.8	12.1	R-1792-KG	Neenah
C	6.0	13	R-3531-A	Neenah

Weir Equation

$Q = C_w * L * H^{1.5}$

Q (cfs) = Discharge

3.2 = Cw Weir Coefficient (dimensionless)

varies = L (ft) Length of weir measured along crest

H (ft) = driving head (crest of the weir to the water surface)

Allowable head 2.0 feet (depth of channel)

Check for inlet control

	Q (cfs)	C_d or C_w		Grate	Open Area (sf)	Required head(ft)		
Initial	111.95	0.59	C	R-3531-A	6.0	15.5	Problem	Remove grate, Assume weir.
Initial	111.95	3.2	C	R-3531-A	13.0	1.9	Ok	
Permanent	46.6	0.59	C	R-3531-A	6.0	2.7	Problem	Divide the flow
Permanent	23.3	0.59	C	R-3531-A	6.0	0.7	Ok	

Project:	Sanford Mine	Computed:	PAW	Date	11/03/14
Subject:	Permit Application	Checked	ECW	Date	11/6/14
Task:	Drainage - Drop Inlet across Power Line Right-of-Way	Sheet		Of	

Size the Outlet culvert

$D=16*(Qn/s^{0.5})^{3/8}$ Theoretical Pipe Size (in) for pipe flowing full

D = Pipe diameter (inches)
Q = Peak Flow (cfs)
n = 0.013 Mannings Roughness Coefficient for RCP
s = Pipe Slope (ft fall / ft run)

DI Rim Elev	288
Depth of DI	3
DI bottom Elev	285
Culvert Invert In	285
Culvert Invert Out	282
Culvert Length	206
Slope	1.5%

Check pipe size based on Gravity Flow

	Initial Flow	Half of Initial Flow	Permanent Flow	Half of Permanent Flow
Q (cfs) =	111.95	55.97	46.6	23.32
Theoretical Diameter (in) =	40.7	31.4	29.3	22.6
Culvert Diameter (in) =	42	30	30	24

Conclusion:

Use a grate with a minimum inlet area of 6 sf .
Use 2 24" RCP culverts out of the drop inlets at 1.5% slope.

Project:	Sanford Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked: EMW	Date: 11/6/14
Task:	Drainage - Apron Outlets	Sheet	Of

Objective: Design the apron outlets for the drop inlets for the 25-year storm.

References:

1. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
2. North Carolina Erosion and Sediment Control Planning and Design Manual

Equations:

Determine Tailwater conditions to size apron
Use Normal Depth Procedure (Manning's Eqn.) Ref 1, II-7

$Z_{av} = AR^{2/3}$ Area (A) = bd + z d^2

$Z_{req} = Q\,n / 1.49s^{0.5}$ R = Area / $(b+2d(z^2+1)^{0.5})$

$AR^{2/3} = Q\,n / 1.49s^{0.5}$ Avg Shear Stress (T) = d*s*unit weight of water

$Z_{av} = Z_{req}$

n =	0.104	6-Inch Rip Rap Lined Channel (for depths of 0 to 0.5 ft)	Ref 2
n =	0.069	6-Inch Rip Rap Lined Channel (for depths of 0.5 to 2 ft)	Ref 2
Vp (ft/sec) =	9	Permissible Velocity for lining	Ref 2
Side Slope (z) =	6	enter X for X:1 (assumed)	
s (ft/ft) =	1.0%	Outlet Slope (assumed)	
Diameter (in) =	varies	Drop Inlet Culvert	
Bottom Width (ft) =	10	Assumed	

Flows (Q) based on the "Manning's Possible Discharge Q (cfs)" from the pipe calcualation.
For the Perm Rd North, the flow is doubles since there are 2 pipes.

0.5* Barrel Diameter (ft) =	1.25	Ref 2, 8.06.1
0.5* Barrel Diameter (ft) =	1.50	
Minimum Tailwater Conditions:	Flow Depth (d) < 0.5*Diameter of Culvert	Ref 2 8.06a
Maximum Tailwater Conditions:	Flow Depth (d) > 0.5*Diameter of Culvert	Ref 2 8.06b

Diameter (in)	Q (cfs)	Z_{req}	Flow Depth, d (ft)	Cross Sectional Area (sf)	R (ft)	Z_{av}	Velocity (ft/sec)	Tailwater
30	35.2	16.28	1.13	18.9	0.80	16.28	1.9	Min
36	48.7	22.54	1.33	23.9	0.91	22.54	2.0	Min

Size the aprons for each pipe using Ref 2:
The discharge on Figure 8.06a do not intersect the pipe size. Use the minimum length.

Conclusion:

Culvert Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size (ft) d_{50}	Selected Rip Rap Size (in)
2.5	7.5	16	19	0.5	Class B
3	9	20	23	0.5	Class B

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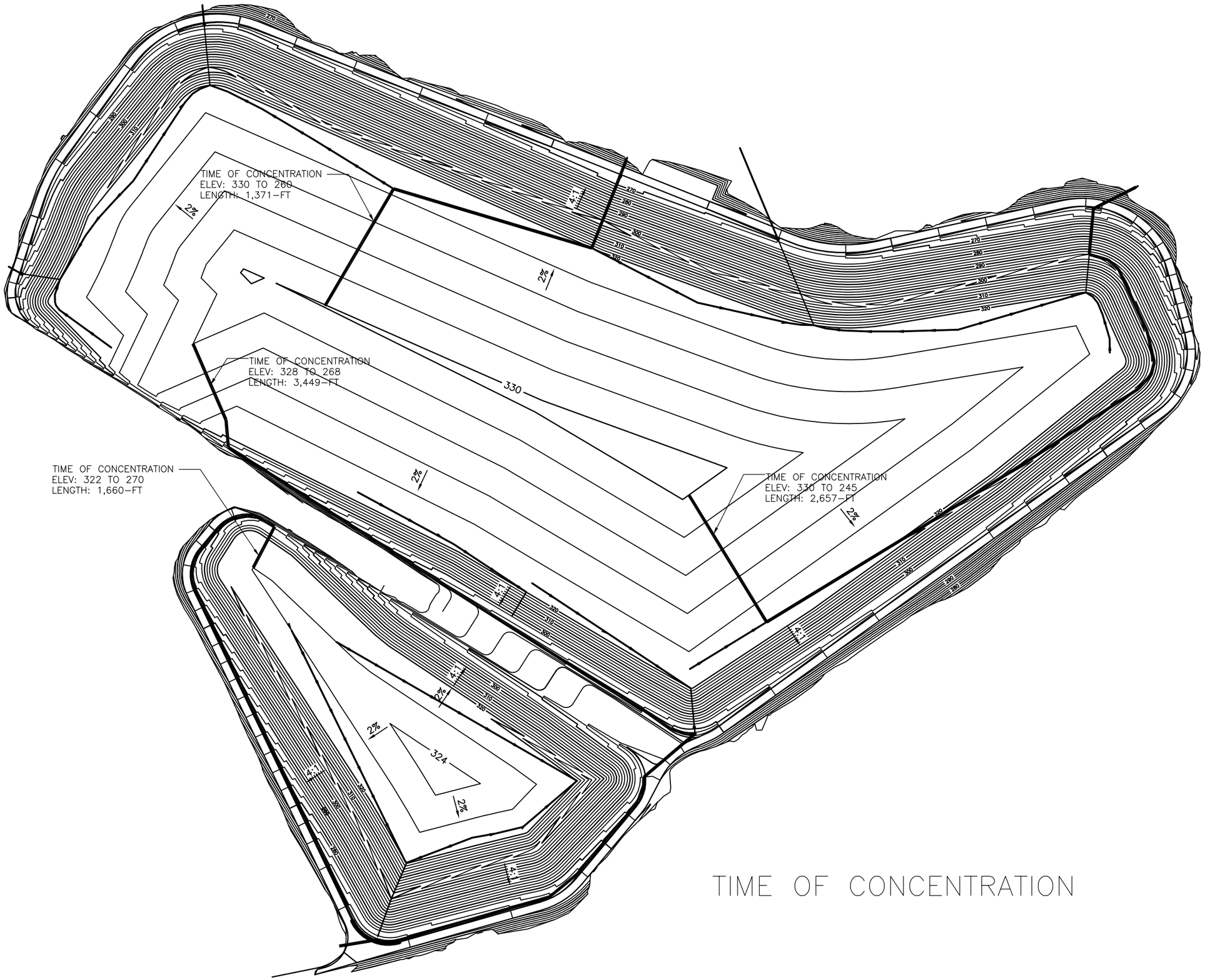
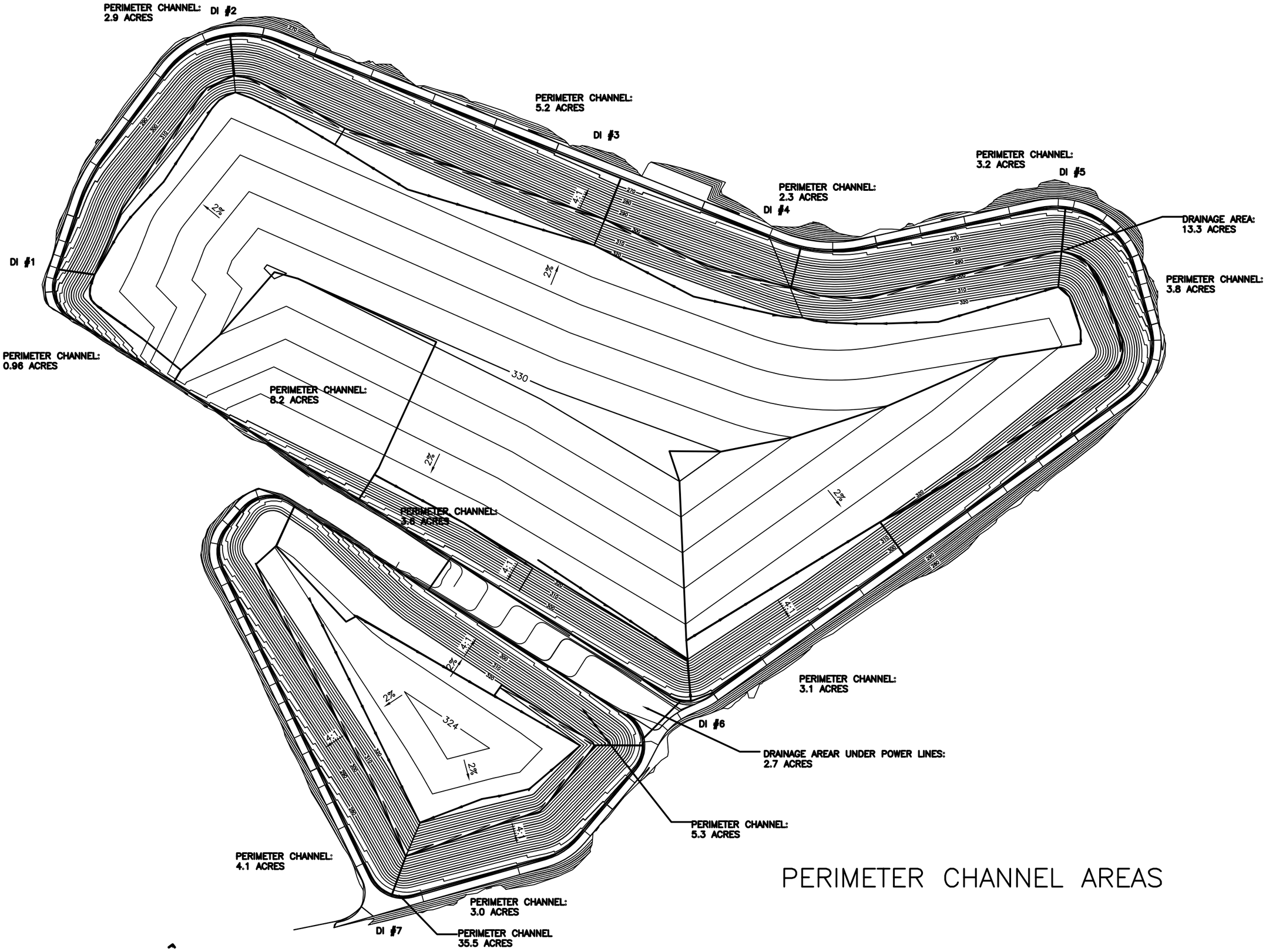
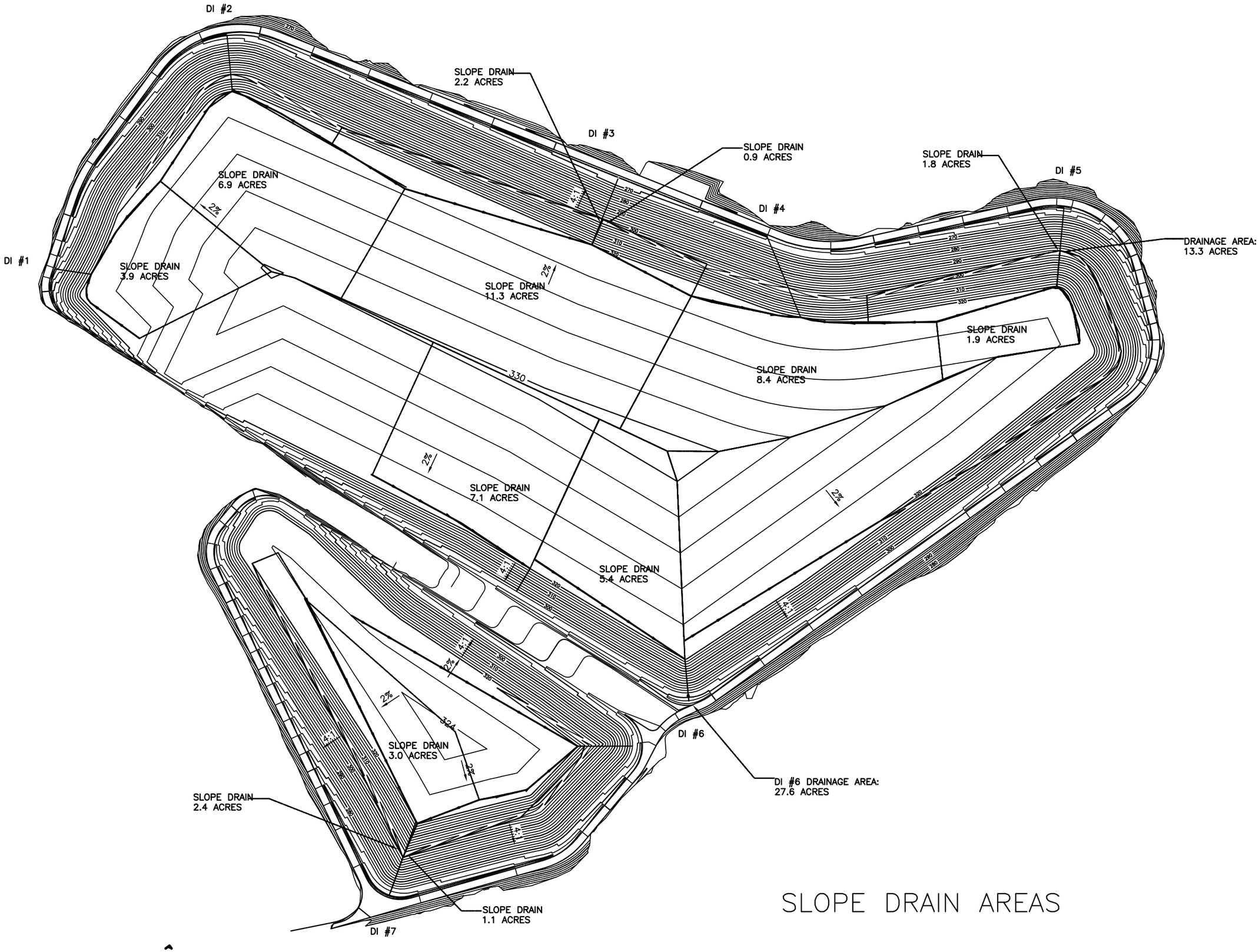


TIME OF CONCENTRATION



PERIMETER CHANNEL AREAS



SLOPE DRAIN AREAS

DI #1
DI #2
DI #3
DI #4
DI #5
DI #6
DI #7
DIVERSION BERM
4.9 ACRES
DIVERSION BERM
7.5 ACRES
DIVERSION BERM
4.1 ACRES
DIVERSION BERM
7.1 ACRES
DIVERSION BERM
6.2 ACRES
DIVERSION BERM
5.4 ACRES
330
324
2%
4:1

DIVERSION BERM AREAS

NOAA Atlas 14, Volume 2, Version 3
Location name: Sanford, North Carolina, US*
Latitude: 35.5361°, Longitude: -79.1459°
Elevation: 297ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	5.10 (4.66-5.62)	6.04 (5.51-6.64)	7.00 (6.38-7.70)	7.69 (7.00-8.45)	8.48 (7.68-9.31)	9.01 (8.14-9.89)	9.52 (8.53-10.4)	9.95 (8.88-10.9)	10.4 (9.23-11.4)	10.8 (9.48-11.8)
10-min	4.08 (3.72-4.48)	4.82 (4.40-5.31)	5.60 (5.11-6.17)	6.15 (5.60-6.76)	6.76 (6.12-7.42)	7.18 (6.48-7.87)	7.56 (6.78-8.28)	7.88 (7.03-8.64)	8.26 (7.30-9.05)	8.50 (7.46-9.33)
15-min	3.40 (3.10-3.74)	4.04 (3.69-4.45)	4.72 (4.31-5.20)	5.19 (4.72-5.70)	5.71 (5.17-6.27)	6.06 (5.47-6.64)	6.37 (5.72-6.98)	6.63 (5.92-7.27)	6.92 (6.13-7.59)	7.11 (6.24-7.81)
30-min	2.33 (2.13-2.56)	2.79 (2.55-3.07)	3.36 (3.06-3.69)	3.76 (3.42-4.13)	4.23 (3.83-4.64)	4.56 (4.12-5.00)	4.88 (4.38-5.34)	5.16 (4.61-5.66)	5.51 (4.87-6.04)	5.76 (5.06-6.32)
60-min	1.45 (1.33-1.60)	1.75 (1.60-1.93)	2.15 (1.96-2.37)	2.45 (2.23-2.69)	2.82 (2.55-3.09)	3.09 (2.79-3.39)	3.36 (3.01-3.68)	3.62 (3.23-3.97)	3.95 (3.50-4.33)	4.20 (3.69-4.61)
2-hr	0.856 (0.776-0.951)	1.04 (0.940-1.15)	1.29 (1.17-1.43)	1.48 (1.34-1.64)	1.73 (1.55-1.91)	1.92 (1.71-2.12)	2.10 (1.87-2.33)	2.29 (2.02-2.53)	2.53 (2.21-2.80)	2.72 (2.35-3.01)
3-hr	0.605 (0.550-0.672)	0.733 (0.666-0.814)	0.915 (0.831-1.02)	1.06 (0.957-1.17)	1.25 (1.12-1.38)	1.40 (1.25-1.54)	1.55 (1.37-1.71)	1.70 (1.50-1.88)	1.91 (1.66-2.11)	2.08 (1.79-2.30)
6-hr	0.363 (0.331-0.401)	0.439 (0.401-0.484)	0.549 (0.500-0.606)	0.636 (0.577-0.700)	0.753 (0.679-0.827)	0.846 (0.758-0.928)	0.942 (0.837-1.03)	1.04 (0.915-1.14)	1.18 (1.02-1.29)	1.29 (1.10-1.41)
12-hr	0.214 (0.195-0.236)	0.258 (0.236-0.286)	0.325 (0.296-0.359)	0.378 (0.342-0.417)	0.452 (0.406-0.496)	0.511 (0.456-0.560)	0.573 (0.506-0.627)	0.638 (0.558-0.698)	0.730 (0.627-0.799)	0.804 (0.681-0.880)
24-hr	0.125 (0.116-0.134)	0.151 (0.141-0.162)	0.190 (0.177-0.204)	0.220 (0.205-0.236)	0.262 (0.242-0.281)	0.295 (0.273-0.316)	0.328 (0.303-0.353)	0.364 (0.334-0.390)	0.412 (0.377-0.442)	0.449 (0.410-0.483)
2-day	0.073 (0.068-0.078)	0.088 (0.082-0.094)	0.109 (0.102-0.117)	0.126 (0.117-0.136)	0.150 (0.138-0.161)	0.168 (0.155-0.180)	0.187 (0.172-0.201)	0.206 (0.189-0.222)	0.233 (0.213-0.251)	0.254 (0.231-0.274)
3-day	0.051 (0.048-0.055)	0.062 (0.058-0.066)	0.077 (0.071-0.082)	0.088 (0.082-0.095)	0.104 (0.097-0.112)	0.117 (0.108-0.126)	0.130 (0.120-0.140)	0.144 (0.132-0.154)	0.162 (0.148-0.174)	0.177 (0.161-0.190)
4-day	0.041 (0.038-0.044)	0.049 (0.046-0.052)	0.060 (0.056-0.065)	0.069 (0.065-0.074)	0.082 (0.076-0.088)	0.092 (0.085-0.098)	0.102 (0.094-0.109)	0.112 (0.103-0.120)	0.127 (0.116-0.136)	0.138 (0.125-0.148)
7-day	0.027 (0.025-0.029)	0.032 (0.030-0.034)	0.039 (0.036-0.042)	0.044 (0.041-0.048)	0.052 (0.048-0.056)	0.058 (0.054-0.062)	0.064 (0.060-0.069)	0.071 (0.065-0.076)	0.080 (0.073-0.085)	0.087 (0.079-0.093)
10-day	0.021 (0.020-0.023)	0.025 (0.024-0.027)	0.031 (0.029-0.033)	0.035 (0.032-0.037)	0.040 (0.037-0.043)	0.044 (0.041-0.047)	0.049 (0.045-0.052)	0.053 (0.049-0.057)	0.059 (0.055-0.063)	0.064 (0.059-0.068)
20-day	0.014 (0.014-0.015)	0.017 (0.016-0.018)	0.020 (0.019-0.021)	0.022 (0.021-0.024)	0.026 (0.024-0.027)	0.028 (0.026-0.030)	0.031 (0.029-0.033)	0.034 (0.031-0.036)	0.037 (0.034-0.039)	0.040 (0.037-0.042)
30-day	0.012 (0.011-0.013)	0.014 (0.013-0.015)	0.016 (0.015-0.017)	0.018 (0.017-0.019)	0.020 (0.019-0.022)	0.022 (0.021-0.024)	0.024 (0.022-0.025)	0.026 (0.024-0.027)	0.028 (0.026-0.030)	0.030 (0.028-0.032)
45-day	0.010 (0.010-0.011)	0.012 (0.011-0.013)	0.014 (0.013-0.014)	0.015 (0.014-0.016)	0.017 (0.016-0.017)	0.018 (0.017-0.019)	0.019 (0.018-0.020)	0.020 (0.019-0.022)	0.022 (0.021-0.023)	0.023 (0.022-0.025)
60-day	0.009 (0.009-0.010)	0.011 (0.010-0.011)	0.012 (0.011-0.013)	0.013 (0.012-0.014)	0.014 (0.014-0.015)	0.015 (0.015-0.016)	0.016 (0.016-0.017)	0.017 (0.016-0.018)	0.019 (0.018-0.020)	0.020 (0.018-0.021)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

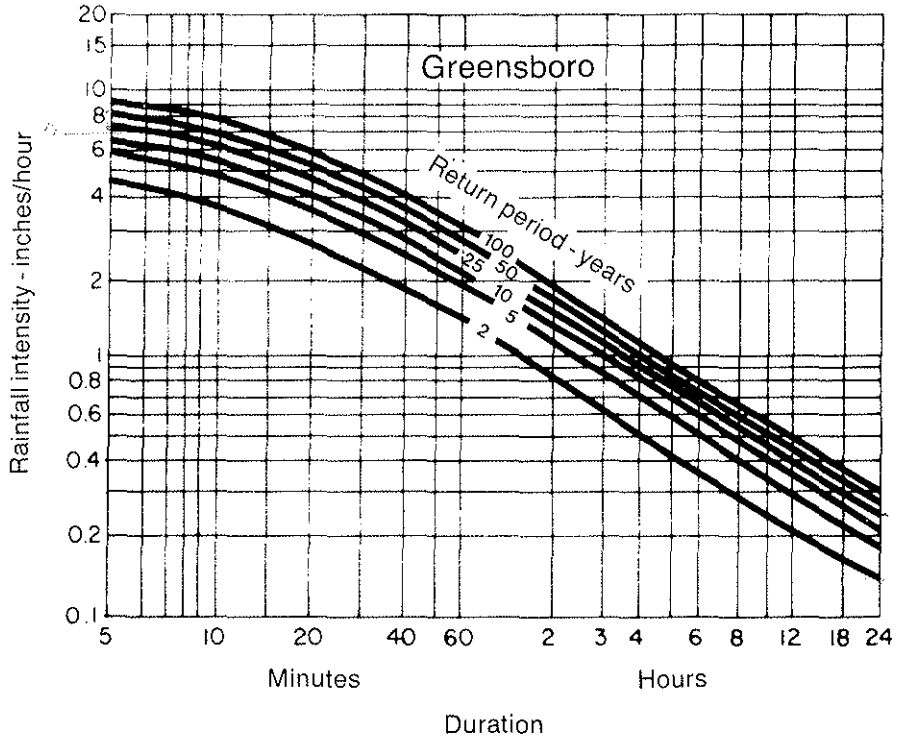


Figure 8.03d Rainfall intensity duration curves—Greensboro.

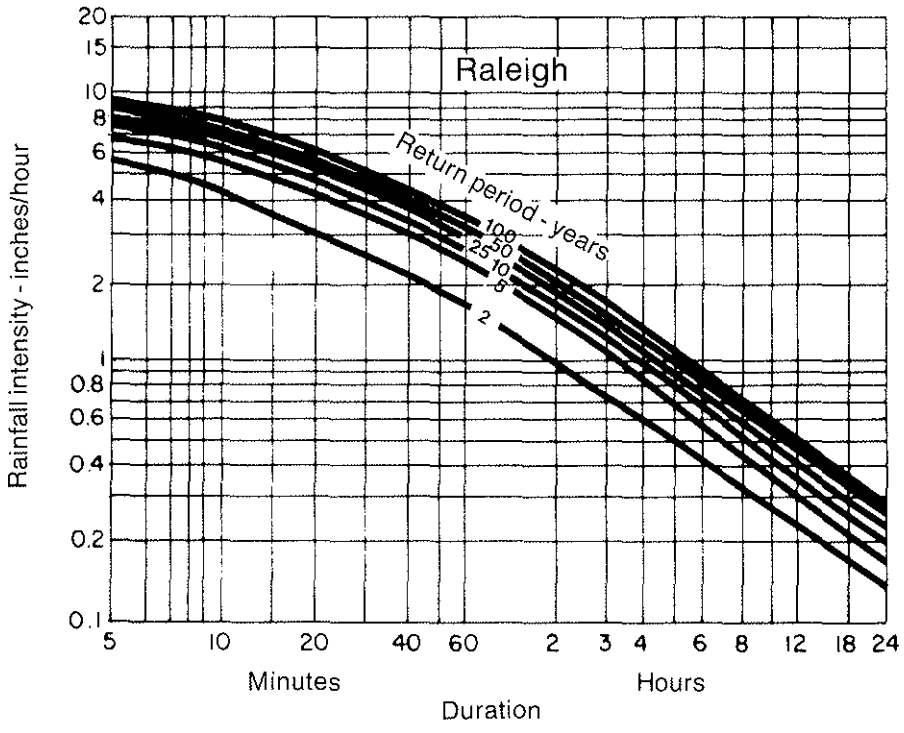


Figure 8.03e Rainfall intensity duration curves—Raleigh.

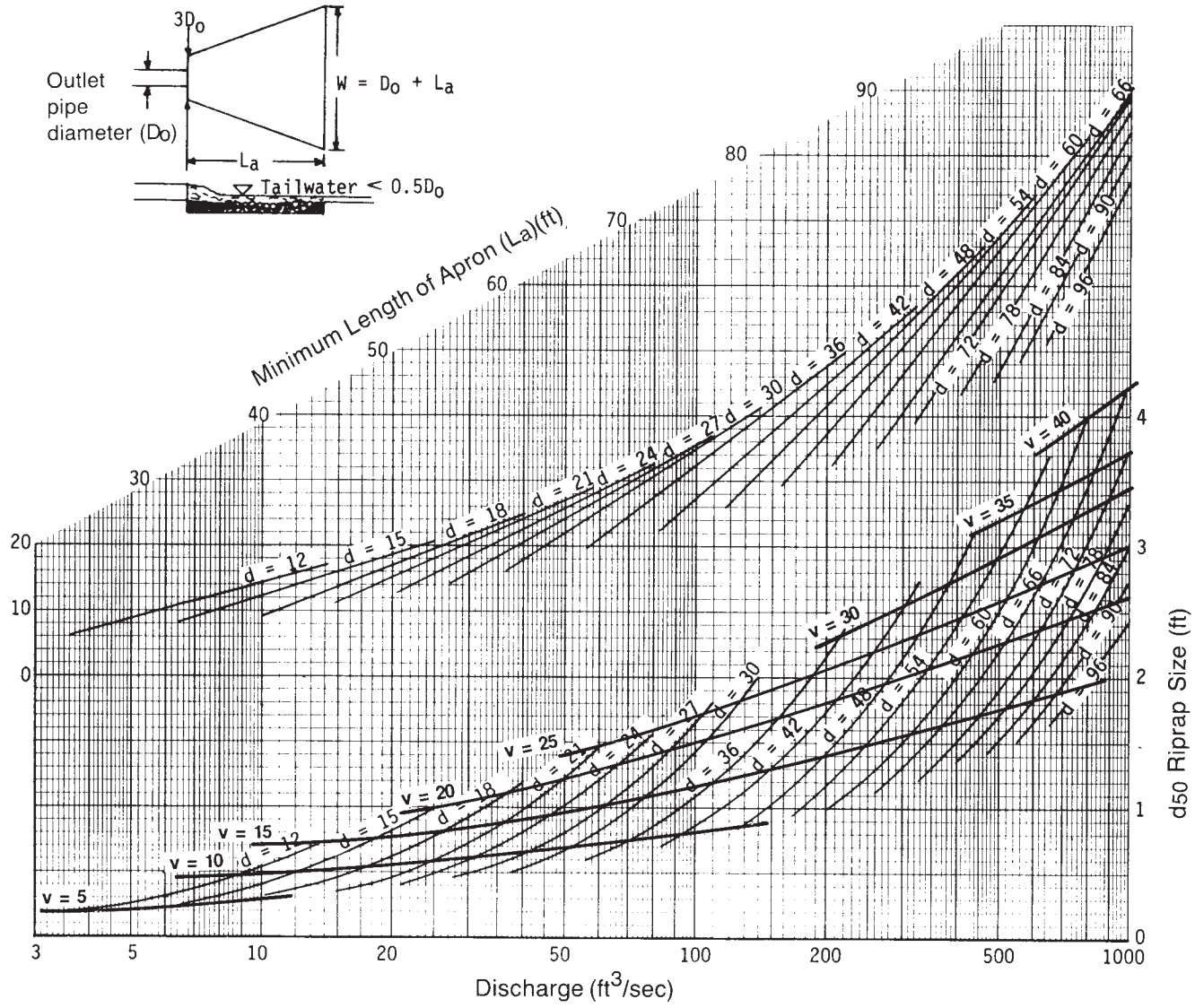
Table 8.03b
Value of Runoff Coefficient (C) for Rational Formula

Land Use	C
Business:	
Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Residential:	
Single-family areas	0.30-0.50
Multi units, detached	0.40-0.60
Multi units, Attached	0.60-0.75
Suburban	0.25-0.40
Industrial:	
Light areas	0.50-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.10-0.25
Playgrounds	0.20-0.35
Railroad yard areas	0.20-0.40
Unimproved areas	0.10-0.30
Streets:	
Asphalt	0.70-0.95
Concrete	0.80-0.95
Brick	0.70-0.85
Drives and walks	0.75-0.85
Roofs	0.75-0.85

Land Use	C
Lawns:	
Sandy soil, flat, 2%	0.05-0.10
Sandy soil, ave., 2-7%	0.10-0.15 0.15-0.20
Sandy soil, steep, 7%	0.13-0.17 0.18-0.22
Heavy soil, flat, 2%	0.25-0.35
Heavy soil, ave., 2-7%	
Heavy soil, steep, 7%	0.30-0.60 0.20-0.50
Agricultural land:	
Bare packed soil	0.30-0.60
Smooth	0.20-0.50
Rough	0.20-0.40
Cultivated rows	0.10-0.25
Heavy soil no crop	
Heavy soil with crop	0.15-0.45 0.05-0.25
Sandy soil no crop	0.05-0.25
Sandy soil with crop	0.10-0.25
Pasture	
Heavy soil	0.15-0.45
Sandy soil	0.05-0.25
Woodlands	0.05-0.25

NOTE: The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition (T_w < 0.5 diameter).

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #1 (Ph-1)

Phase 2 controls Basin #1 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		5.4	ac
Disturbed area(DA)		5.4	ac
Rqd sediment storage	(1800xDA)	9756	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	151	67
Top	169	85

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	283	msl
Sediment Storage elevation	286	msl
Spillway crest	286	msl
Top of Berm	289	msl
Emergency Spillway Elevation	287	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	32.86	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
283	13792	0
284	15414	14603
285	17133	30877
286	18947	48917
287	21463	69122
288	23731	91719
289	26305	116737
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)
0.333	Head on Skimmer (feet)
2	Orifice Size (1/4 inch increments)
1.83	Dewatering Time (days)
	Suggest about 3 days

Skimmer Size (Inches)
1.5
2
2.5
3
4
5
6
8

BASIN EFFICIENCY		
Sediment storage required:	9756	cf
Sediment storage provided:	48917	cf OKAY
Surface area required:	14294.1	sf
Surface area provided:	18947	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	36 in	Flow Depth:	1 ft		
Orifice Flow:	32.00 cfs	Controlling:	Orifice		
Weir Flow:	58.40 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			53.13
Q100 Flow - Flow through Barrel =			17
C	3	L=	16
h	0.5		

Barrel diameter	30	in	
Barrel slope (ft/ft)	0.01	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	283		
Barrel invert out	282.5		

Flow through barrel 36 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	4386	lbs	Anchor width	5.5	ft
Required Volume of Anchor =	30.3	cf	Anchor Length	5.5	ft
Actual Volume of Anchor=	45.375	cf	Anchor Thickness	1.5	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #1 (Ph-2)

Phase 2 controls Basin #1 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		9.3	ac
Disturbed area(DA)		9.3	ac
Rqd sediment storage	(1800xDA)	16794	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	176	79
Top	194	97

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	283	msl
Sediment Storage elevation	286	msl
Spillway crest	286	msl
Top of Berm	289	msl
Emergency Spillway Elevation	287	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	43.09	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
283	13792	0
284	15414	14603
285	17133	30877
286	18947	48917
287	21463	69122
288	23731	91719
289	26305	116737
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)
0.333	Head on Skimmer (feet)
2	Orifice Size (1/4 inch increments)
3.15	Dewatering Time (days)
	Suggest about 3 days

Skimmer Size (Inches)
1.5
2
2.5
3
4
5
6
8

BASIN EFFICIENCY		
Sediment storage required:	16794	cf
Sediment storage provided:	48917	cf OKAY
Surface area required:	18744.15	sf
Surface area provided:	18947	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	48 in	Flow Depth:		1 ft	
Orifice Flow:	42.00 cfs	Controlling:	Orifice		
Weir Flow:	77.87 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			70.07
Q100 Flow - Flow through Barrel =			20
C	3	L=	19
h	0.5		

Barrel diameter	36	in	
Barrel slope (ft/ft)	0.01	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	283		
Barrel invert out	282.5		

Flow through barrel 50 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.04 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	6763	lbs	Anchor width	6	ft
Required Volume of Anchor =	46.6	cf	Anchor Length	6	ft
Actual Volume of Anchor=	63	cf	Anchor Thickness	1.75	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #2 (Ph-1)

Phase 1 controls Basin #2 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		17.6	ac
Disturbed area(DA)		17.6	ac
Rqd sediment storage	(1800xDA)	31680	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	279	130
Top	297	148

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	259	msl
Sediment Storage elevation	262	msl
Spillway crest	262	msl
Top of Berm	265	msl
Emergency Spillway Elevation	263	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	101.32	cfs
1/2 10yr Computed flow from site, 'Q' =	50.66	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
259	37790	0
260	40921	39356
261	44109	81871
262	47355	127603
263	50658	176609
264	54018	228947
265	57435	284674
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
2	Orifice Size (1/4 inch increments)	2
2.97	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

BASIN EFFICIENCY		
Sediment storage required:	31680	cf
Sediment storage provided:	127603	cf OKAY
Surface area required:	44074.2	sf
Surface area provided:	47355	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	1	ft
Orifice Flow:	53.00	cfs	Controlling:	Orifice	
Weir Flow:	97.34	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			164.22
Q100 Flow - Flow through Barrel =			15
C	3	L=	14
h	0.5		

Barrel diameter	48	in
Barrel slope (ft/ft)	0.01	ft/ft
Barrel length(ft)	50	ft
Barrel invert in	259	
Barrel invert out	258.5	

Flow through barrel 75 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 5.94 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	11517	lbs	Anchor width	7	ft
Required Volume of Anchor =	79.4	cf	Anchor Length	7	ft
Actual Volume of Anchor=	98	cf	Anchor Thickness	2	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #2 (Ph-2)

Phase 1 controls Basin #2 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		14.8	ac
Disturbed area(DA)		14.8	ac
Rqd sediment storage	(1800xDA)	26676	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	275	129
Top	293	147

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	259	msl
Sediment Storage elevation	262	msl
Spillway crest	262	msl
Top of Berm	265	msl
Emergency Spillway Elevation	263	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	98.71	cfs
1/2 10yr Computed flow from site, 'Q' =	49.355	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
2	Orifice Size (1/4 inch increments)	2
2.50	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
259	37790	0
260	40921	39356
261	44109	81871
262	47355	127603
263	50658	176609
264	54018	228947
265	57435	284674
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	26676	cf
Sediment storage provided:	127603	cf OKAY
Surface area required:	42938.85	sf
Surface area provided:	47355	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	1	ft
Orifice Flow:	53.00	cfs	Controlling:	Orifice	
Weir Flow:	97.34	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =	128.64		
Q100 Flow - Flow through Barrel =	-21		
C=3.0	h = 1	L=	-7
Note: Q25 handled by Riser/Barrel			

Barrel diameter	48	in
Barrel slope (ft/ft)	0.01	ft/ft
Barrel length(ft)	50	ft
Barrel invert in	259	
Barrel invert out	258.5	

Flow through barrel 75 cfs (Each)

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	11517	lbs	Anchor width	7	ft
Required Volume of Anchor =	79.4	cf	Anchor Length	7	ft
Actual Volume of Anchor=	98	cf	Anchor Thickness	2	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #3 (Ph-1)

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		3.1	ac
Disturbed area(DA)		3.1	ac
Rqd sediment storage	(1800xDA)	5562	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	116	49
Top	134	67

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	244	msl
Sediment Storage elevation	247	msl
Spillway crest	247	msl
Top of Berm	250	msl
Emergency Spillway Elevation	248	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	20.51	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
244	4877	0
245	6254	5566
246	7709	12547
247	9244	21024
248	10857	31074
249	12549	42777
250	14321	56212
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

3	Skimmer Size (inches)
0.25	Head on Skimmer (feet)
1.25	Orifice Size (1/4 inch increments)
3.08	Dewatering Time (days)
	Suggest about 3 days

Skimmer Size (Inches)
1.5
2
2.5
3
4
5
6
8

BASIN EFFICIENCY		
Sediment storage required:	5562	cf
Sediment storage provided:	21024	cf OKAY
Surface area required:	8921.85	sf
Surface area provided:	9244	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	30 in	Flow Depth:		1	ft
Orifice Flow:	26.00 cfs	Controlling:	Orifice		
Weir Flow:	48.67 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			31.93
Q100 Flow - Flow through Barrel =			9
C	3	L=	9
h	0.5		

Barrel diameter	24	in	
Barrel slope (ft/ft)	0.01	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	244		
Barrel invert out	243.5		

Flow through barrel 23 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.25 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	2879	lbs	Anchor width	4.5	ft
Required Volume of Anchor =	19.9	cf	Anchor Length	4.5	ft
Actual Volume of Anchor=	30.375	cf	Anchor Thickness	1.5	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #4 (Ph-1)

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		12.7	ac
Disturbed area(DA)		12.7	ac
Rqd sediment storage	(1800xDA)	22860	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	242	112
Top	260	130

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	261	msl
Sediment Storage elevation	264	msl
Spillway crest	264	msl
Top of Berm	267	msl
Emergency Spillway Elevation	265	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	77.74	cfs
1/2 10yr Computed flow from site, 'Q' =	38.87	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
261	26486	0
262	29254	27870
263	32108	58551
264	35046	92128
265	38057	128680
266	41127	168272
267	44258	210964
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

3	Skimmer Size (inches)	Skimmer Size
0.25	Head on Skimmer (feet)	(Inches)
1.75	Orifice Size (1/4 inch increments)	1.5
3.23	Dewatering Time (days)	2
	Suggest about 3 days	2.5
		3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

BASIN EFFICIENCY		
Sediment storage required:	22860	cf
Sediment storage provided:	92128	cf OKAY
Surface area required:	33816.9	sf
Surface area provided:	35046	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	48	in	Flow Depth:	1	ft
Orifice Flow:	42.00	cfs	Controlling:	Orifice	
Weir Flow:	77.87	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			122.75
Q100 Flow - Flow through Barrel =			23
C	3	L=	22
h	0.5		

Barrel diameter	36	in
Barrel slope (ft/ft)	0.01	ft/ft
Barrel length(ft)	50	ft
Barrel invert in	261	
Barrel invert out	260.5	

Flow through barrel 50 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.04 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	6763	lbs	Anchor width	6	ft
Required Volume of Anchor =	46.6	cf	Anchor Length	6	ft
Actual Volume of Anchor=	63	cf	Anchor Thickness	1.75	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #5 (Ph-1)

Phase 1 controls Basin #5 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		49.4	ac
Disturbed area(DA)		49.4	ac
Rqd sediment storage	(1800xDA)	88992	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	494	238
Top	512	256

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	255	msl
Sediment Storage elevation	258	msl
Spillway crest	258	msl
Top of Berm	262	msl
Emergency Spillway Elevation	260	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	301.78	cfs
1/2 10yr Computed flow from site, 'Q' =	150.89	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
255	118763	0
256	124341	121552
257	129979	248712
258	135678	381541
259	141437	520098
260	147256	664445
261	153136	814641
262	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

		Skimmer Size
4	Skimmer Size (inches)	(Inches)
0.333	Head on Skimmer (feet)	1.5
3.25	Orifice Size (1/4 inch increments)	2
3.16	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

BASIN EFFICIENCY			
Sediment storage required:	88992	cf	
Sediment storage provided:	381541	cf	OKAY
Surface area required:	131274.3	sf	
Surface area provided:	135678	sf	OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	72	in	Flow Depth:	2	ft
Orifice Flow:	187.00	cfs	Controlling:	Orifice	
Weir Flow:	330.38	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			476.49
Q100 Flow - Flow through Barrel =			157
C	3	L=	52
h	1		

Barrel diameter	60	in	
Barrel slope (ft/ft)	0.025	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	255		
Barrel invert out	253.75		

Flow through barrel 160 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 8.13 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	17545	lbs	Anchor width	8	ft
Required Volume of Anchor =	121.0	cf	Anchor Length	8	ft
Actual Volume of Anchor=	160	cf	Anchor Thickness	2.5	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #5 (Ph-2)

Phase 1 controls Basin #5 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		42.1	ac
Disturbed area(DA)		42.1	ac
Rqd sediment storage	(1800xDA)	75708	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	451	216
Top	469	234

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	255	msl
Sediment Storage elevation	258	msl
Spillway crest	258	msl
Top of Berm	262	msl
Emergency Spillway Elevation	260	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	252.52	cfs
1/2 10yr Computed flow from site, 'Q' =	126.26	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
3.25	Orifice Size (1/4 inch increments)	2
2.69	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
255	118763	0
256	124341	121552
257	129979	248712
258	135678	381541
259	141437	520098
260	147256	664445
261	153136	814641
262	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	75708	cf
Sediment storage provided:	381541	cf OKAY
Surface area required:	109846.2	sf
Surface area provided:	135678	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	72 in	Flow Depth:		2 ft	
Orifice Flow:	187.00 cfs	Controlling:	Orifice		
Weir Flow:	330.38 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			402.08
Q100 Flow - Flow through Barrel =			83
C	3	L=	28
h	1		

Barrel diameter	60	in
Barrel slope (ft/ft)	0.025	ft/ft
Barrel length(ft)	50	ft
Barrel invert in	255	
Barrel invert out	253.75	

Flow through barrel 160 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 8.13 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	17545	lbs	Anchor width	8	ft
Required Volume of Anchor =	121.0	cf	Anchor Length	8	ft
Actual Volume of Anchor=	160	cf	Anchor Thickness	2.5	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #6 (Ph-1)

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		15.3	ac
Disturbed area(DA)		15.3	ac
Rqd sediment storage	(1800xDA)	27522	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	267	125
Top	285	143

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	249	msl
Sediment Storage elevation	252	msl
Spillway crest	252	msl
Top of Berm	256	msl
Emergency Spillway Elevation	254	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	93.6	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
249	30723	0
250	34084	32404
251	37519	68205
252	41027	107478
253	44808	150396
254	48997	197298
255	52981	248287
256	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)
0.333	Head on Skimmer (feet)
2.5	Orifice Size (1/4 inch increments)
3.30	Dewatering Time (days)
	Suggest about 3 days

Skimmer Size (Inches)
1.5
2
2.5
3
4
5
6
8

BASIN EFFICIENCY		
Sediment storage required:	27522	cf
Sediment storage provided:	107478	cf OKAY
Surface area required:	40716	sf
Surface area provided:	41027	sf OKAY

SPILLWAY DESIGN

RISER SPILLWAY DESIGN

Riser diameter:	60 in	Flow Depth:	2 ft
Orifice Flow:	156.00 cfs	Controlling:	Orifice
Weir Flow:	275.32 cfs	Controlling>Q10?	OKAY

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))		
100yr Flow from site, Q100 =		147.78
Q100 Flow - Flow through Barrel =		49
C=3.0	h = 1	L= 16

Barrel diameter	48 in
Barrel slope (ft/ft)	0.01 ft/ft
Barrel length(ft)	50 ft
Barrel invert in	249
Barrel invert out	248.5

Flow through barrel 99 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.90 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10 ft	Safety factor	1.2	
Buoyancy =	11517 lbs	Anchor width	7	ft
Required Volume of Anchor =	79.4 cf	Anchor Length	7	ft
Actual Volume of Anchor=	98 cf	Anchor Thickness	2	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #7 (Ph-1)

Phase 2 controls Basin #7 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		16.4	ac
Disturbed area(DA)		12.5	ac
Rqd sediment storage	(1800xDA)	29466	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	255	118
Top	273	136

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	238	msl
Sediment Storage elevation	241	msl
Spillway crest	241	msl
Top of Berm	245	msl
Emergency Spillway Elevation	243	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	85.59	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
238	49034	0
239	52537	50786
240	56098	105103
241	59717	163011
242	63393	224566
243	67128	289826
244	70920	358850
245	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)
0.333	Head on Skimmer (feet)
2.75	Orifice Size (1/4 inch increments)
2.92	Dewatering Time (days)
	Suggest about 3 days

Skimmer Size (Inches)
1.5
2
2.5
3
4
5
6
8

BASIN EFFICIENCY		
Sediment storage required:	29466	cf
Sediment storage provided:	163011	cf OKAY
Surface area required:	37231.65	sf
Surface area provided:	59717	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	2	ft
Orifice Flow:	156.00	cfs	Controlling:	Orifice	
Weir Flow:	275.32	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =	144.24		
Q100 Flow - Flow through Barrel =	45		
C=3.0	h = 1	L=	15

Barrel diameter	48	in
Barrel slope (ft/ft)	0.01	ft/ft
Barrel length(ft)	50	ft
Barrel invert in	238	
Barrel invert out	237.5	

Flow through barrel 99 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.90 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	11517	lbs	Anchor width	7.5	ft
Required Volume of Anchor =	79.4	cf	Anchor Length	7.5	ft
Actual Volume of Anchor=	112.5	cf	Anchor Thickness	2	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #7 (Ph-2)

Phase 2 controls Basin #7 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		33.1	ac
Disturbed area(DA)		29.3	ac
Rqd sediment storage	(1800xDA)	59598	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	324	153
Top	342	171

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	238	msl
Sediment Storage elevation	241	msl
Spillway crest	241	msl
Top of Berm	245	msl
Emergency Spillway Elevation	243	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	134.71	cfs
1/2 10yr Computed flow from site, 'Q' =	67.355	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
2.75	Orifice Size (1/4 inch increments)	2
2.96	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
238	49034	0
239	52537	50786
240	56098	105103
241	59717	163011
242	63393	224566
243	67128	289826
244	70920	358850
245	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	59598	cf
Sediment storage provided:	163011	cf OKAY
Surface area required:	58598.85	sf
Surface area provided:	59717	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	54 in	Flow Depth:	2 ft		
Orifice Flow:	140.00 cfs	Controlling:	Orifice		
Weir Flow:	247.79 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			230.4
Q100 Flow - Flow through Barrel =			71
C	3	L=	24
h	1		

Barrel diameter	42	in	
Barrel slope (ft/ft)	0.01	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	238		
Barrel invert out	237.5		

Flow through barrel 80 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 8.31 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	8981	lbs	Anchor width	7	ft
Required Volume of Anchor =	61.9	cf	Anchor Length	7	ft
Actual Volume of Anchor=	85.75	cf	Anchor Thickness	1.75	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #8 (Ph-1)

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		11.8	ac
Disturbed area(DA)		11.8	ac
Rqd sediment storage	(1800xDA)	21150	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	231	106
Top	249	124

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	273	msl
Sediment Storage elevation	276	msl
Spillway crest	276	msl
Top of Berm	279	msl
Emergency Spillway Elevation	277	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	71.25	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
273	5639	0
274	18291	11965
275	28277	35249
276	38333	68554
277	47710	111576
278	59010	164936
279	69292	229087
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

3	Skimmer Size (inches)
0.25	Head on Skimmer (feet)
2.5	Orifice Size (1/4 inch increments)
2.93	Dewatering Time (days)
	Suggest about 3 days

Skimmer Size (Inches)
1.5
2
2.5
3
4
5
6
8

BASIN EFFICIENCY		
Sediment storage required:	21150	cf
Sediment storage provided:	68554	cf OKAY
Surface area required:	30993.75	sf
Surface area provided:	38333	sf OKAY

SPILLWAY DESIGN

RISER SPILLWAY DESIGN

Riser diameter:	60 in	Flow Depth:	1 ft
Orifice Flow:	53.00 cfs	Controlling:	Orifice
Weir Flow:	97.34 cfs	Controlling>Q10?	OKAY

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))

100yr Flow from site, Q100 =			115.17
Q100 Flow - Flow through Barrel =			27
C=3.0	h = 1	L=	9

Barrel diameter	48 in
Barrel slope (ft/ft)	0.02 ft/ft
Barrel length(ft)	50 ft
Barrel invert in	273
Barrel invert out	272

Flow through barrel 88 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 6.99 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10 ft	Safety factor	1.2
Buoyancy =	11517 lbs	Anchor width	7.5 ft
Required Volume of Anchor =	79.4 cf	Anchor Length	7.5 ft
Actual Volume of Anchor=	112.5 cf	Anchor Thickness	2 ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #9 (Ph-1)

Phase 2 controls Basin #9 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		62.8	ac
Disturbed area(DA)		46.7	ac
Rqd sediment storage	(1800xDA)	112950	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	338	160
Top	356	178

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	262	msl
Sediment Storage elevation	265	msl
Spillway crest	265	msl
Top of Berm	269	msl
Emergency Spillway Elevation	267	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	145.7	cfs
1/2 10yr Computed flow from site, 'Q' =	72.85	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

5	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
4.25	Orifice Size (1/4 inch increments)	2
2.35	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
262	88670	0
263	92409	90540
264	96226	184857
265	100091	283016
266	103992	385057
267	107938	491022
268	111933	600958
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	112950	cf
Sediment storage provided:	283016	cf OKAY
Surface area required:	63379.5	sf
Surface area provided:	100091	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)

RISER SPILLWAY DESIGN

Riser diameter:	54 in	Flow Depth:	2 ft
Orifice Flow:	140.00 cfs	Controlling:	Orifice
Weir Flow:	247.79 cfs	Controlling>Q10?	OKAY

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))

100yr Flow from site, Q100 =			280.49
Q100 Flow - Flow through Barrel =			131
C=3.0	h = 1	L=	44

Barrel diameter	42	in	
Barrel slope (ft/ft)	0.0125	ft/ft	
Barrel length(ft)	100	ft	
Barrel invert in	262		
Barrel invert out	260.75		

Flow through barrel 75 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.75 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	8981	lbs	Anchor width	7.5	ft
Required Volume of Anchor =	61.9	cf	Anchor Length	7.5	ft
Actual Volume of Anchor=	84.375	cf	Anchor Thickness	1.5	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - SANFORD			
HDR PROJECT NO.:	235691		
DATE:	09.30.14	BY:	RMB
REVISED:	11.05.14	RVW:	PW

Basin #9 (Ph-2)

Phase 2 controls Basin #9 Design

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		85.9	ac
Disturbed area(DA)		65.9	ac
Rqd sediment storage	(1800xDA)	154656	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	399	190
Top	417	208

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	262	msl
Sediment Storage elevation	265	msl
Spillway crest	265	msl
Top of Berm	269	msl
Emergency Spillway Elevation	267	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	199.5	cfs
1/2 10yr Computed flow from site, 'Q' =	99.75	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
262	88670	0
263	92409	90540
264	96226	184857
265	100091	283016
266	103992	385057
267	107938	491022
268	111933	600958
X	X	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

5	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
4.25	Orifice Size (1/4 inch increments)	2
3.21	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 2 (one skimmer/riser)

BASIN EFFICIENCY		
Sediment storage required:	154656	cf
Sediment storage provided:	283016	cf OKAY
Surface area required:	86782.5	sf
Surface area provided:	100091	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	72	in	Flow Depth:	2	ft
Orifice Flow:	187.00	cfs	Controlling:	Orifice	
Weir Flow:	330.38	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			384.06
Q100 Flow - Flow through Barrel =			150
C=3.0	h = 1	L=	50

Barrel diameter	54	in	
Barrel slope (ft/ft)	0.0125	ft/ft	
Barrel length(ft)	100	ft	
Barrel invert in	262		
Barrel invert out	260.75		

Flow through barrel 117 cfs

(Note: Flow determined using outlet control and pipe 80% full)

BARREL FLOW>Q10? OKAY

Velocity= 7.37 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	15217	lbs	Anchor width	8	ft
Required Volume of Anchor =	104.9	cf	Anchor Length	8	ft
Actual Volume of Anchor=	128	cf	Anchor Thickness	2	ft
OKAY					

NOAA Atlas 14, Volume 2, Version 3
Location name: Sanford, North Carolina, US*
Latitude: 35.5361°, Longitude: -79.1459°
Elevation: 297 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.425 (0.388–0.468)	0.503 (0.459–0.553)	0.583 (0.532–0.642)	0.641 (0.583–0.704)	0.707 (0.640–0.776)	0.751 (0.678–0.824)	0.793 (0.711–0.869)	0.829 (0.740–0.909)	0.870 (0.769–0.953)	0.900 (0.790–0.987)
10-min	0.680 (0.620–0.747)	0.804 (0.733–0.885)	0.934 (0.852–1.03)	1.03 (0.933–1.13)	1.13 (1.02–1.24)	1.20 (1.08–1.31)	1.26 (1.13–1.38)	1.31 (1.17–1.44)	1.38 (1.22–1.51)	1.42 (1.24–1.56)
15-min	0.849 (0.775–0.934)	1.01 (0.922–1.11)	1.18 (1.08–1.30)	1.30 (1.18–1.42)	1.43 (1.29–1.57)	1.52 (1.37–1.66)	1.59 (1.43–1.75)	1.66 (1.48–1.82)	1.73 (1.53–1.90)	1.78 (1.56–1.95)
30-min	1.17 (1.06–1.28)	1.40 (1.27–1.54)	1.68 (1.53–1.85)	1.88 (1.71–2.06)	2.12 (1.91–2.32)	2.28 (2.06–2.50)	2.44 (2.19–2.67)	2.58 (2.30–2.83)	2.76 (2.44–3.02)	2.88 (2.53–3.16)
60-min	1.45 (1.33–1.60)	1.75 (1.60–1.93)	2.15 (1.96–2.37)	2.45 (2.23–2.69)	2.82 (2.55–3.09)	3.09 (2.79–3.39)	3.36 (3.01–3.68)	3.62 (3.23–3.97)	3.95 (3.50–4.33)	4.20 (3.69–4.61)
2-hr	1.71 (1.55–1.90)	2.07 (1.88–2.30)	2.58 (2.34–2.87)	2.96 (2.67–3.28)	3.45 (3.10–3.82)	3.83 (3.42–4.24)	4.20 (3.73–4.65)	4.58 (4.03–5.06)	5.06 (4.42–5.60)	5.44 (4.71–6.02)
3-hr	1.82 (1.65–2.02)	2.20 (2.00–2.45)	2.75 (2.50–3.05)	3.18 (2.87–3.52)	3.74 (3.36–4.14)	4.19 (3.74–4.63)	4.64 (4.11–5.13)	5.11 (4.49–5.64)	5.74 (4.99–6.35)	6.24 (5.36–6.90)
6-hr	2.17 (1.99–2.40)	2.63 (2.40–2.90)	3.29 (3.00–3.63)	3.81 (3.46–4.19)	4.51 (4.07–4.95)	5.07 (4.54–5.56)	5.64 (5.01–6.18)	6.23 (5.48–6.83)	7.05 (6.12–7.72)	7.70 (6.60–8.44)
12-hr	2.57 (2.35–2.84)	3.11 (2.84–3.44)	3.91 (3.56–4.32)	4.56 (4.13–5.02)	5.44 (4.89–5.98)	6.16 (5.49–6.75)	6.90 (6.10–7.56)	7.69 (6.72–8.41)	8.80 (7.56–9.62)	9.69 (8.21–10.6)
24-hr	3.00 (2.80–3.22)	3.62 (3.38–3.89)	4.55 (4.24–4.89)	5.28 (4.91–5.67)	6.28 (5.82–6.75)	7.07 (6.54–7.59)	7.88 (7.27–8.46)	8.72 (8.03–9.37)	9.88 (9.05–10.6)	10.8 (9.85–11.6)
2-day	3.49 (3.25–3.75)	4.20 (3.92–4.52)	5.25 (4.88–5.64)	6.07 (5.64–6.52)	7.18 (6.65–7.71)	8.06 (7.45–8.66)	8.97 (8.26–9.63)	9.90 (9.09–10.6)	11.2 (10.2–12.0)	12.2 (11.1–13.1)
3-day	3.70 (3.44–3.96)	4.45 (4.15–4.77)	5.52 (5.14–5.92)	6.36 (5.91–6.82)	7.52 (6.96–8.06)	8.44 (7.78–9.04)	9.37 (8.63–10.0)	10.3 (9.49–11.1)	11.7 (10.7–12.5)	12.7 (11.6–13.7)
4-day	3.90 (3.64–4.18)	4.69 (4.37–5.02)	5.79 (5.39–6.19)	6.66 (6.19–7.12)	7.86 (7.27–8.41)	8.81 (8.12–9.42)	9.78 (8.99–10.5)	10.8 (9.89–11.6)	12.2 (11.1–13.0)	13.2 (12.0–14.2)
7-day	4.49 (4.20–4.80)	5.36 (5.02–5.74)	6.54 (6.11–6.99)	7.47 (6.97–7.99)	8.76 (8.15–9.35)	9.78 (9.07–10.4)	10.8 (10.0–11.6)	11.9 (11.0–12.7)	13.4 (12.3–14.3)	14.5 (13.3–15.6)
10-day	5.12 (4.82–5.46)	6.10 (5.73–6.50)	7.34 (6.89–7.81)	8.31 (7.79–8.85)	9.62 (8.99–10.2)	10.6 (9.92–11.3)	11.7 (10.9–12.4)	12.7 (11.8–13.6)	14.2 (13.1–15.1)	15.3 (14.1–16.3)
20-day	6.89 (6.49–7.33)	8.14 (7.66–8.64)	9.62 (9.04–10.2)	10.8 (10.1–11.4)	12.4 (11.6–13.1)	13.6 (12.7–14.4)	14.8 (13.8–15.8)	16.1 (14.9–17.1)	17.8 (16.5–19.0)	19.1 (17.6–20.4)
30-day	8.57 (8.09–9.09)	10.1 (9.50–10.7)	11.7 (11.1–12.5)	13.0 (12.2–13.8)	14.7 (13.8–15.6)	16.0 (15.0–17.0)	17.3 (16.2–18.4)	18.5 (17.3–19.7)	20.3 (18.8–21.6)	21.6 (20.0–23.0)
45-day	10.9 (10.4–11.5)	12.8 (12.1–13.5)	14.6 (13.9–15.4)	16.0 (15.2–16.9)	17.9 (16.9–18.9)	19.3 (18.2–20.3)	20.6 (19.4–21.8)	22.0 (20.6–23.2)	23.7 (22.2–25.1)	25.1 (23.4–26.5)
60-day	13.0 (12.4–13.7)	15.2 (14.5–16.0)	17.2 (16.3–18.1)	18.8 (17.8–19.8)	20.8 (19.7–21.9)	22.3 (21.1–23.5)	23.7 (22.4–25.0)	25.1 (23.7–26.5)	26.9 (25.3–28.5)	28.3 (26.6–30.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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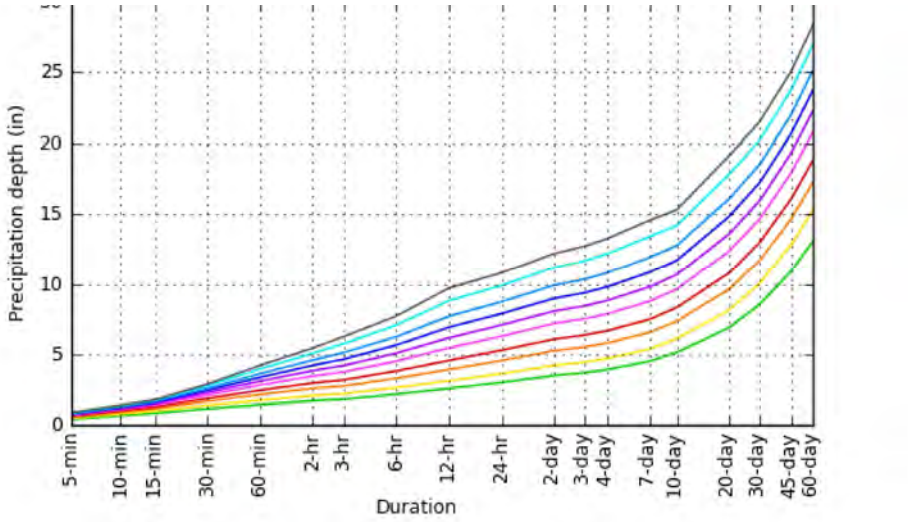
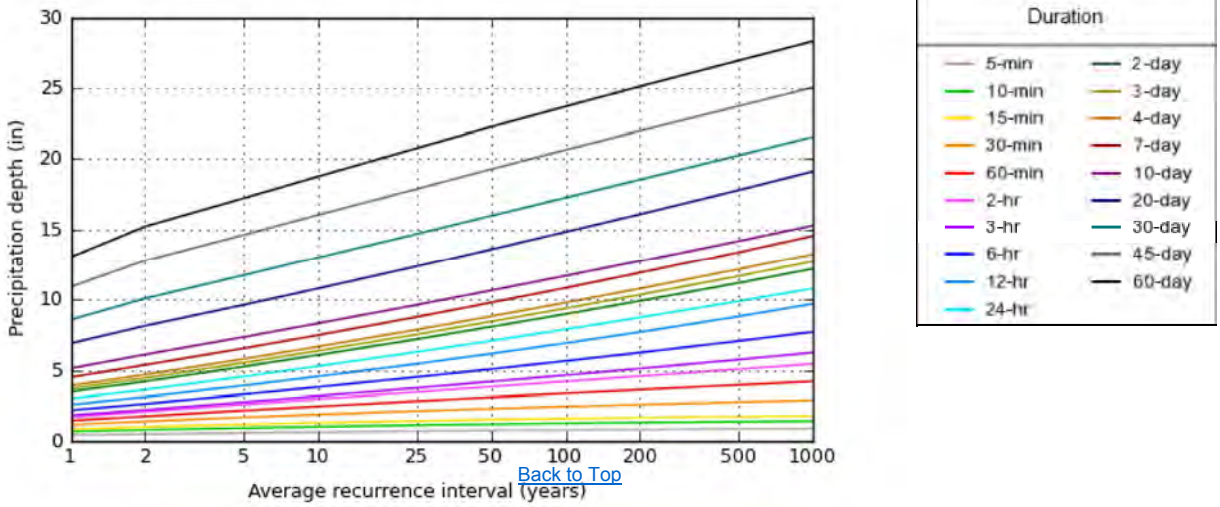
PF graphical





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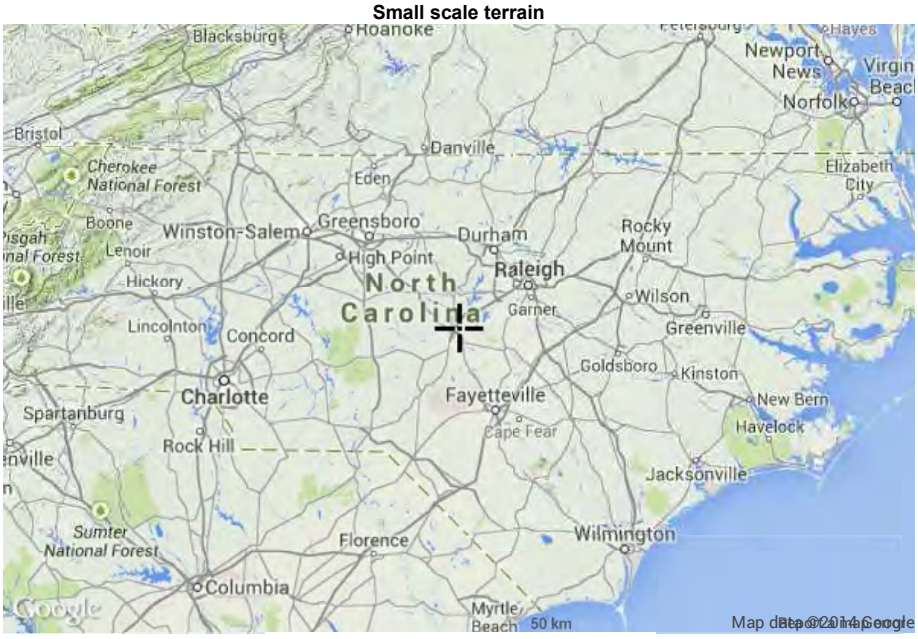
Maps & aerials

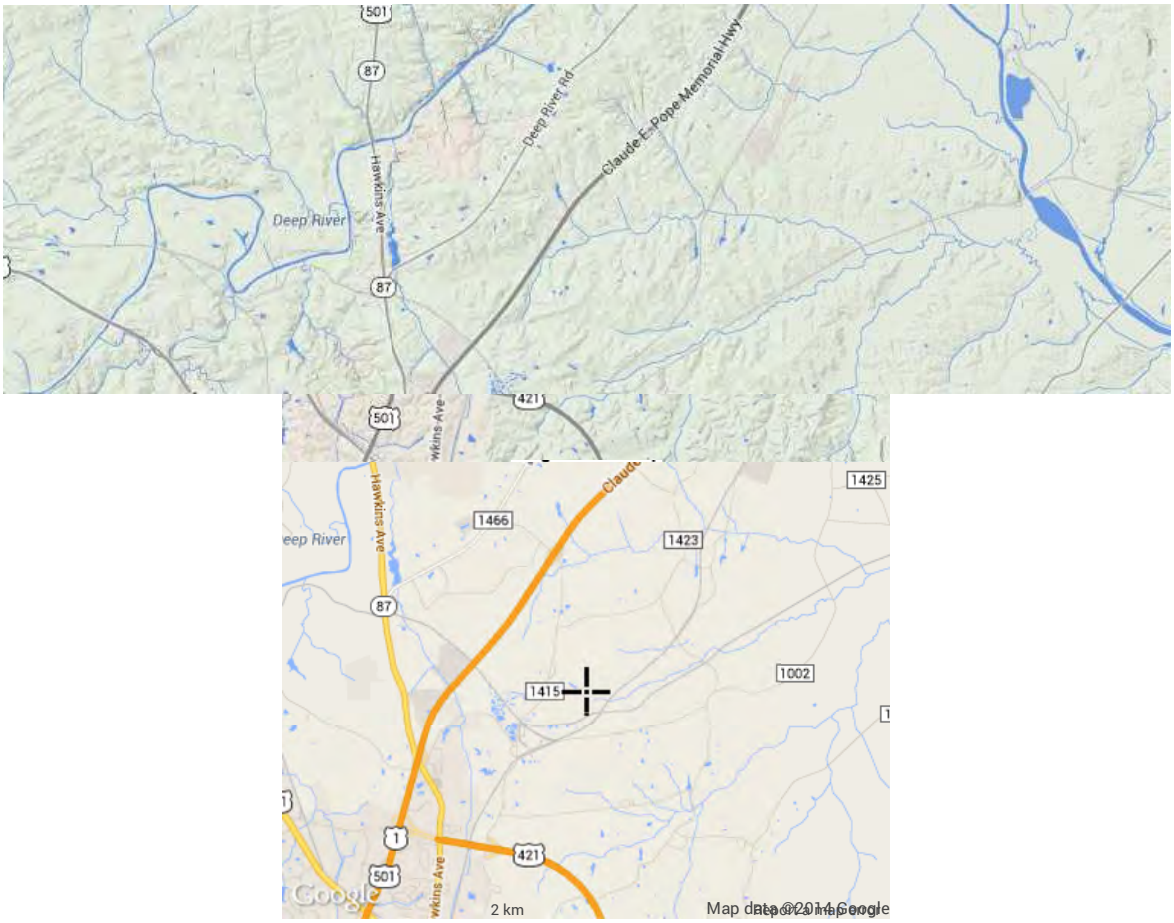
NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Tue Sep 16 15:17:33 2014

Small scale terrain



Large scale terrain



Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Hydrologic Development
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

BASIN #1

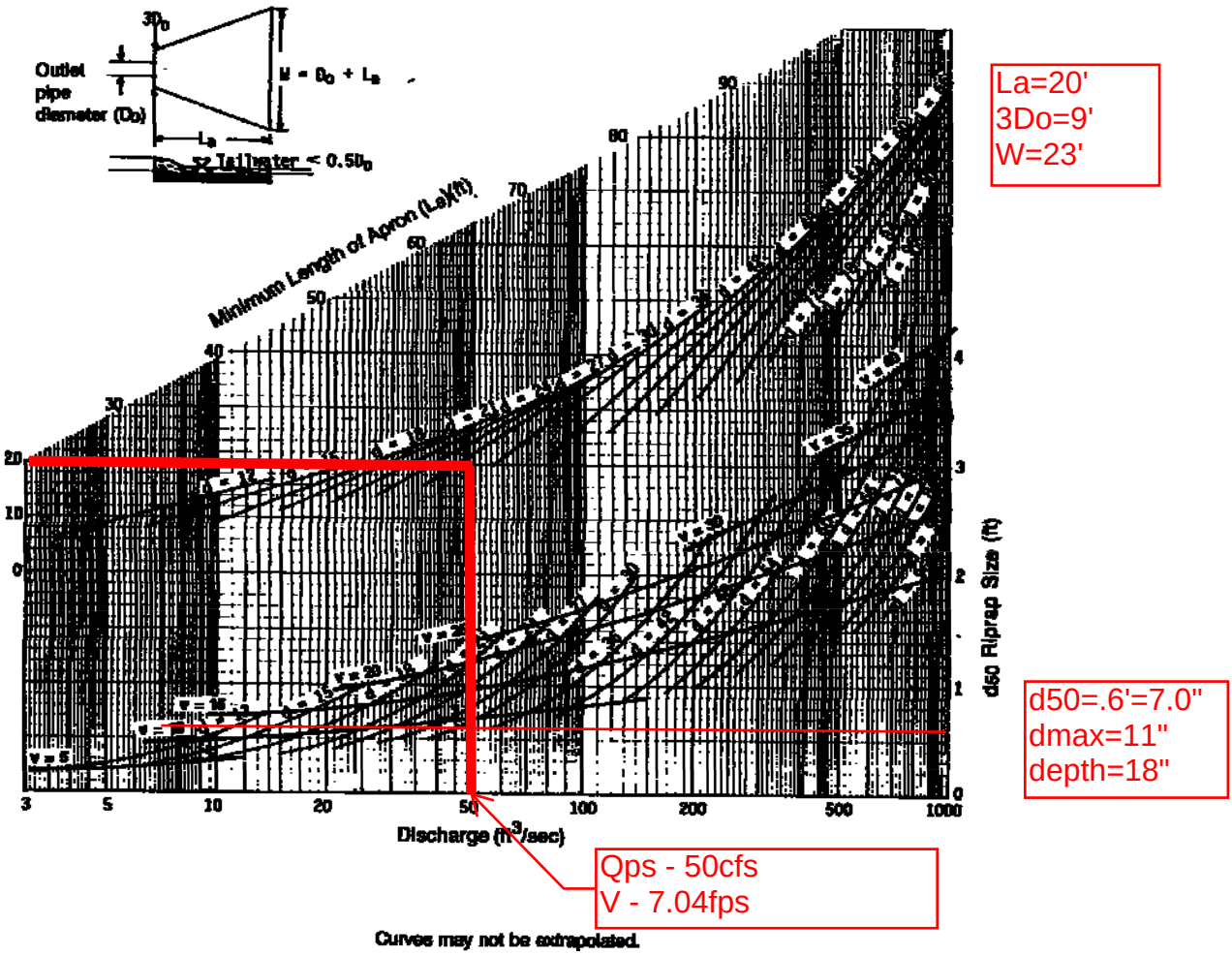
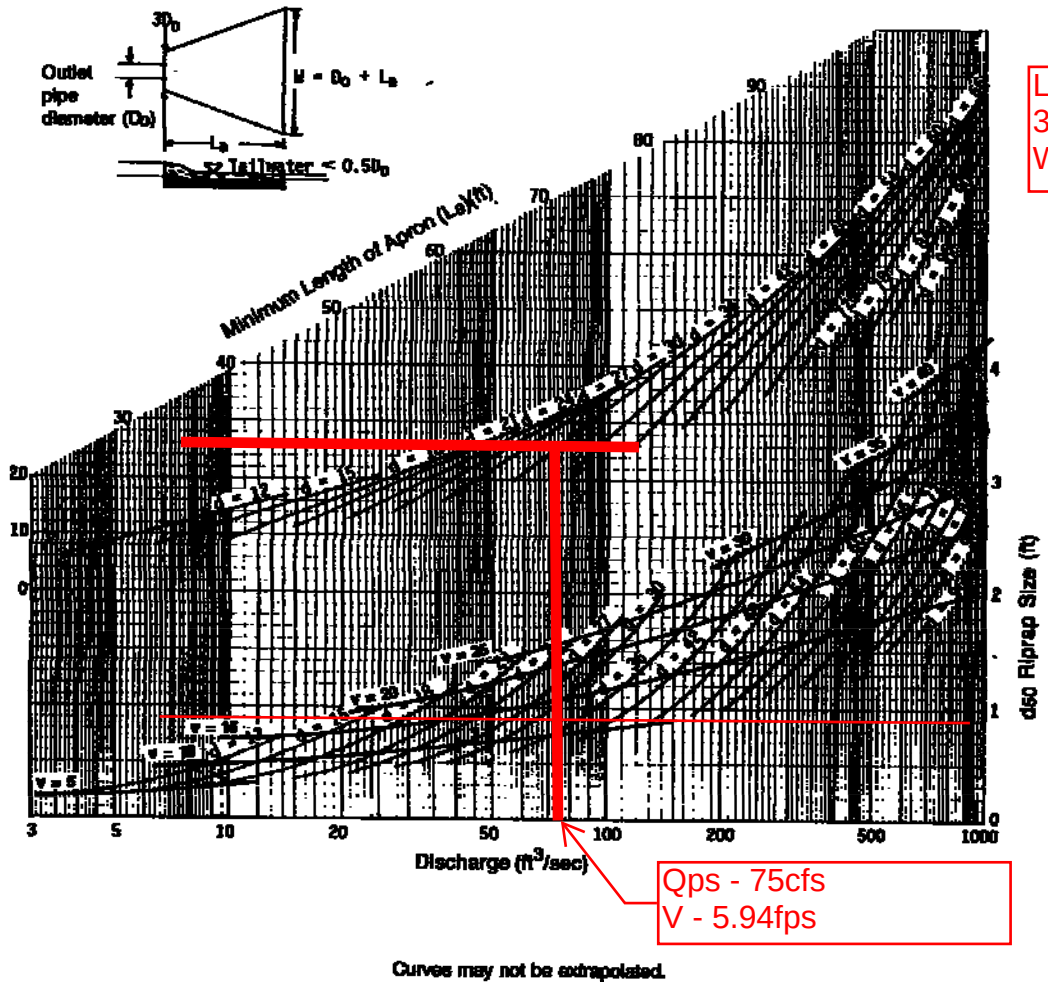


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #2

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=26', W=38', Outlet end=20'



La=26'
3Do=12'
W=30'

d50=.9'=11.0"
dmax=16"
depth=24"

Qps - 75cfs
V - 5.94fps

Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #3

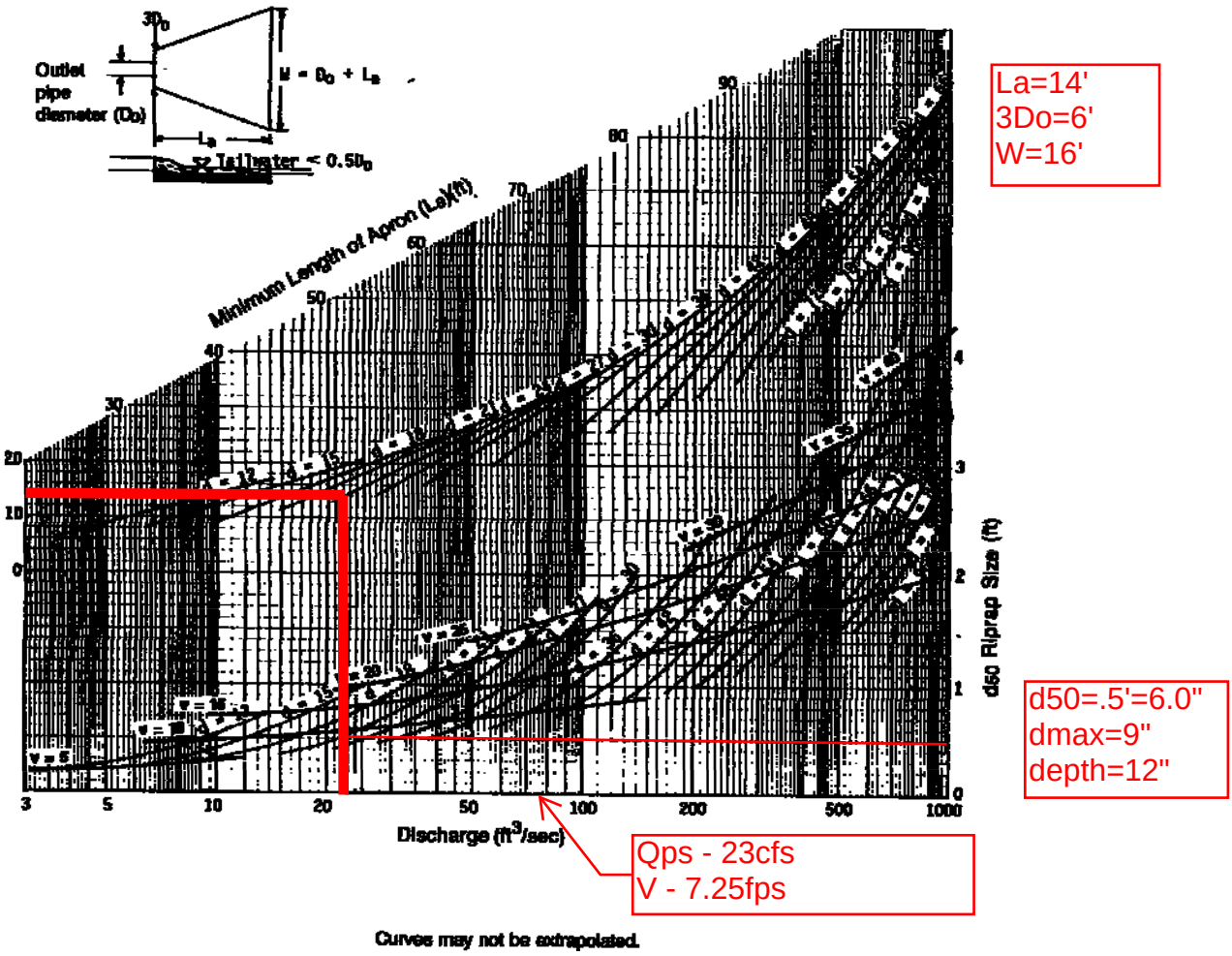
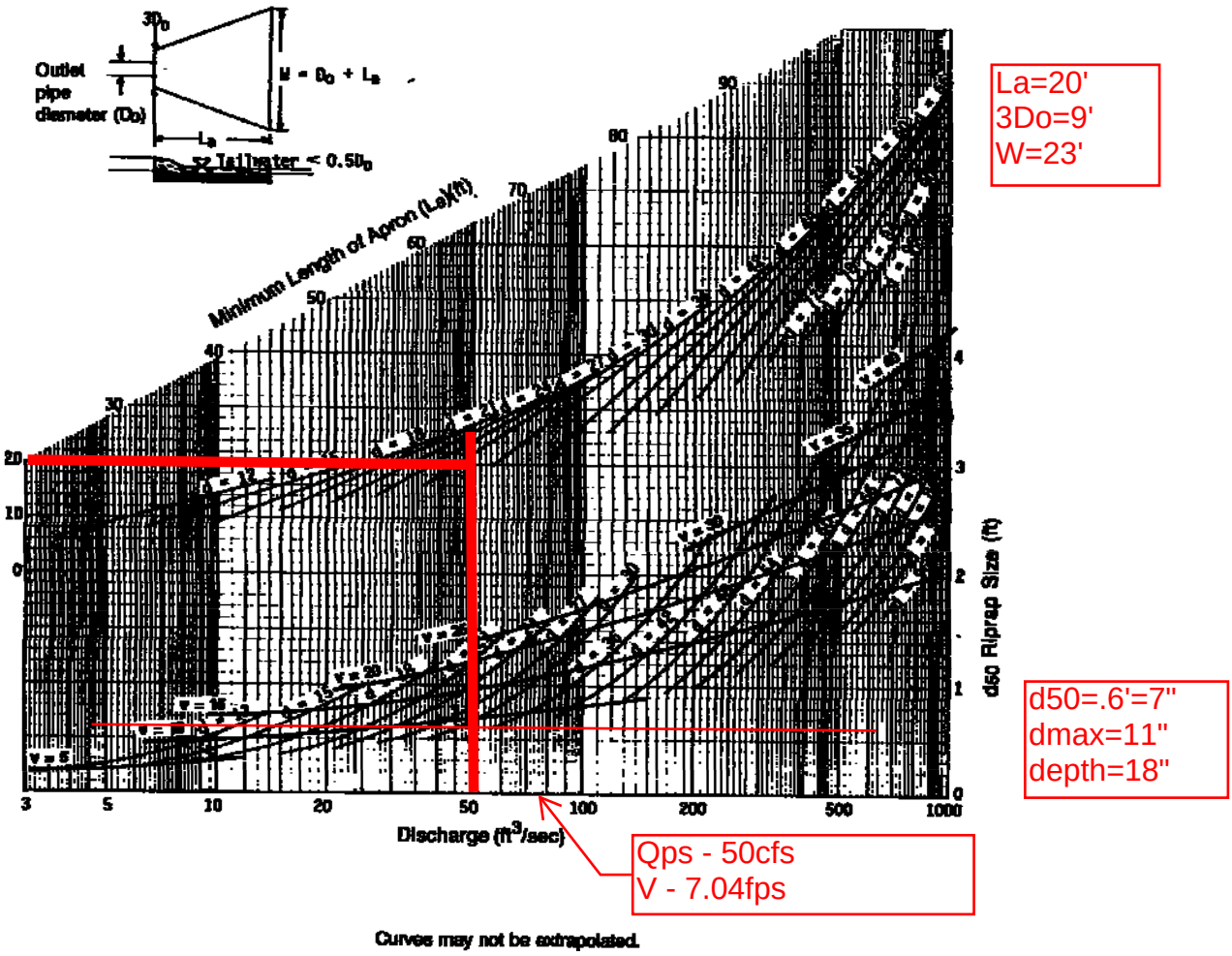


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #4

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=20', W=29', Outlet end=15'



La=20'
3Do=9'
W=23'

d50=.6'=7"
dmax=11"
depth=18"

Qps - 50cfs
V - 7.04fps

Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #5

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=38', W=53', Outlet end=25'

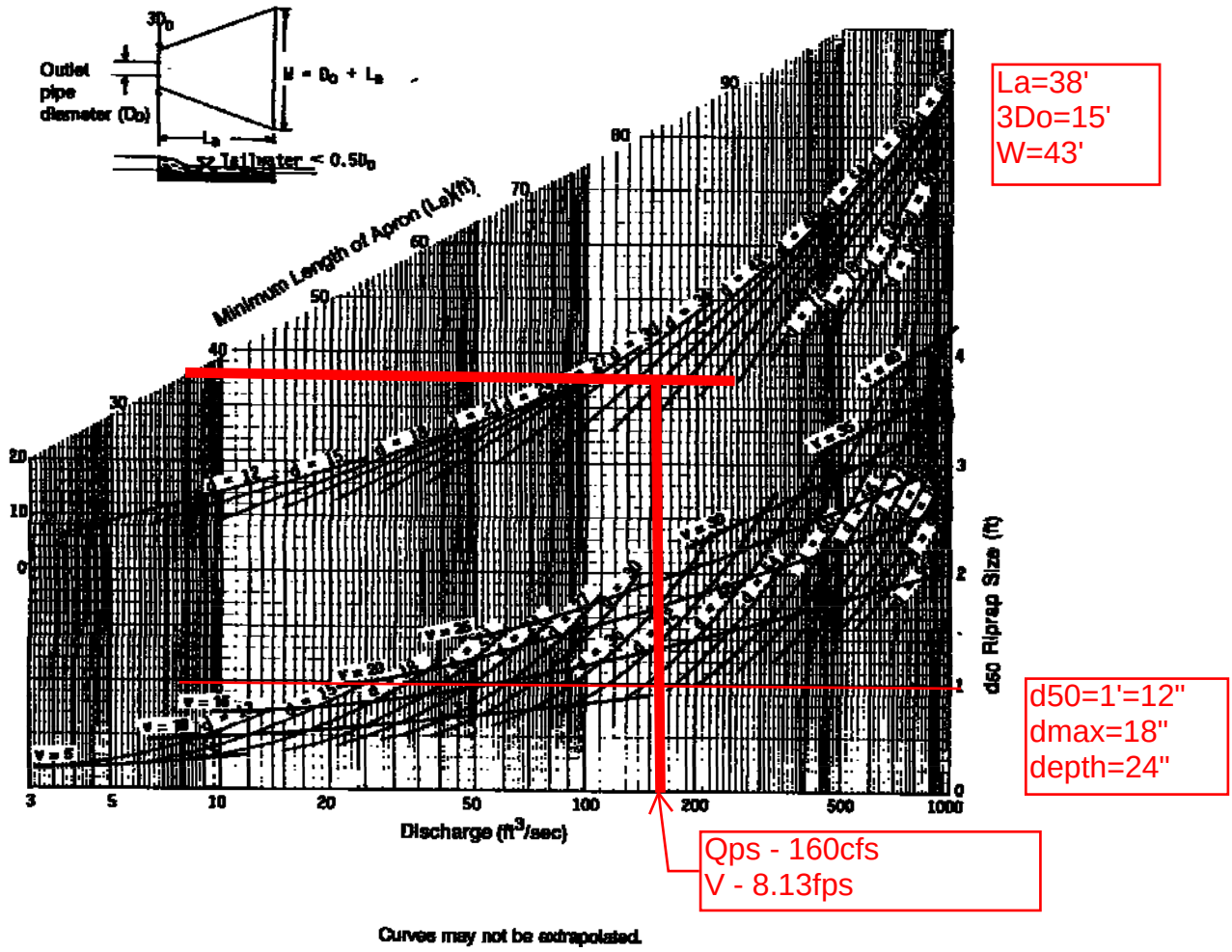


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #6

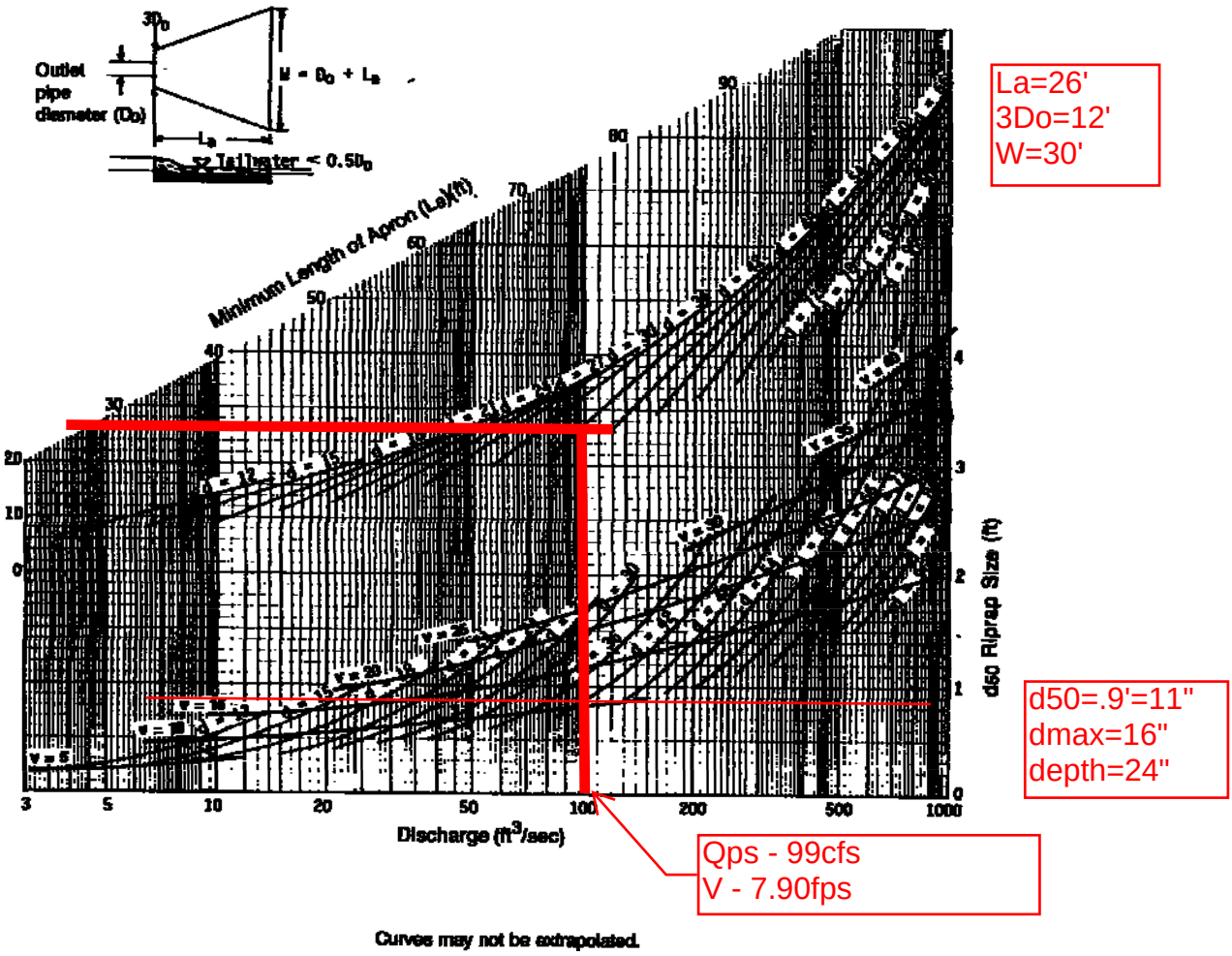


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #7

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=24', W=35', Outlet end=18'

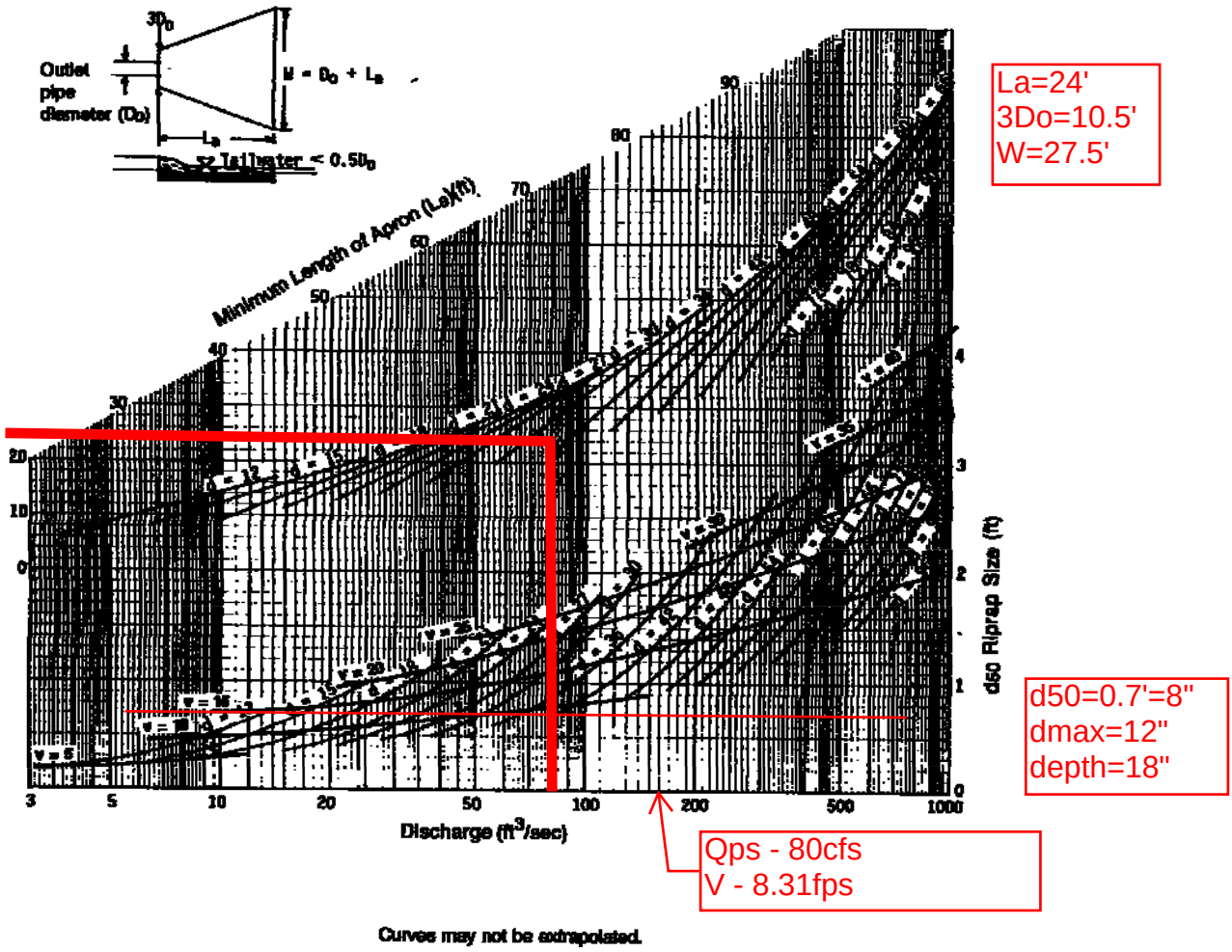


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #8

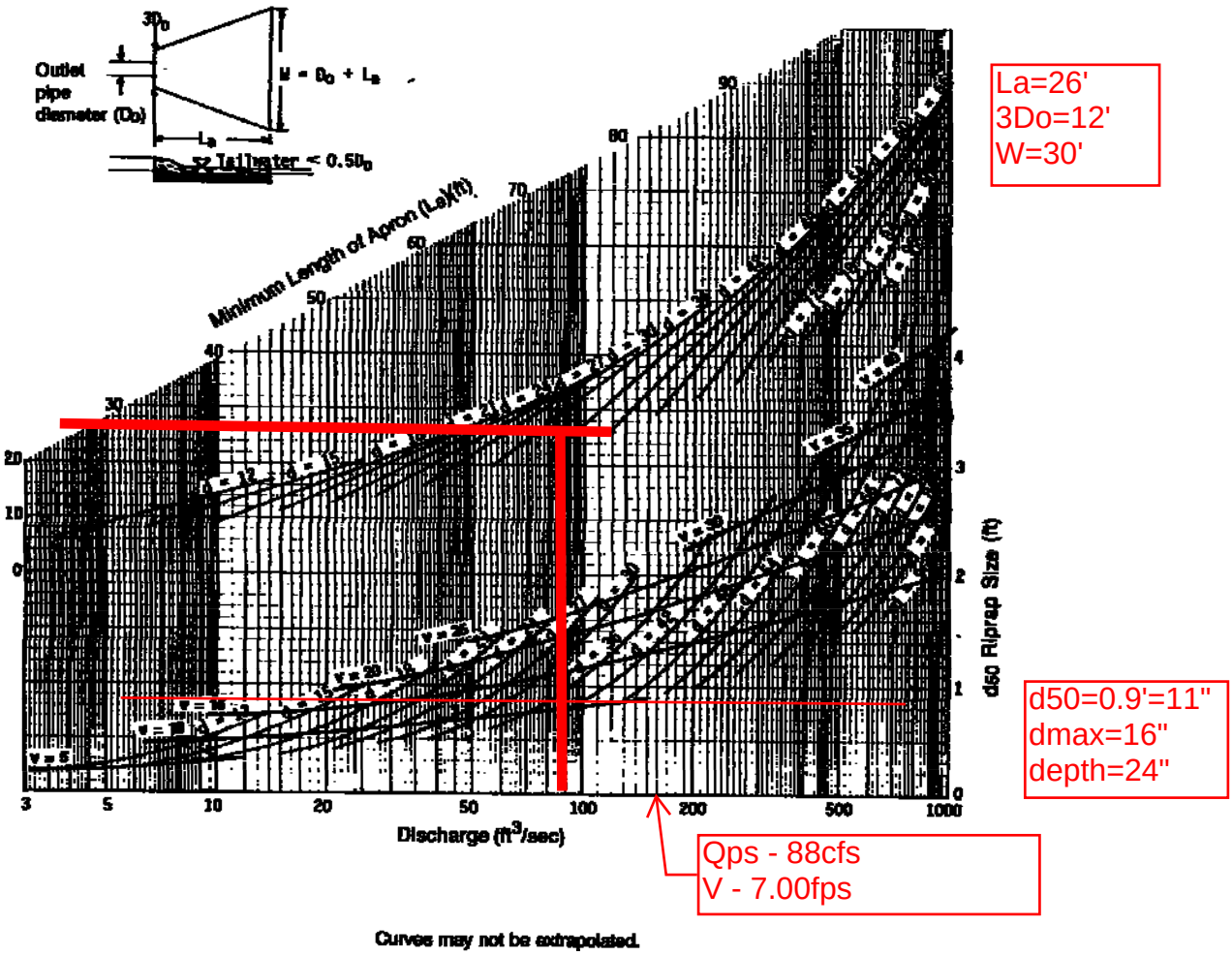


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #9

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=26', W=38', Outlet end=20'

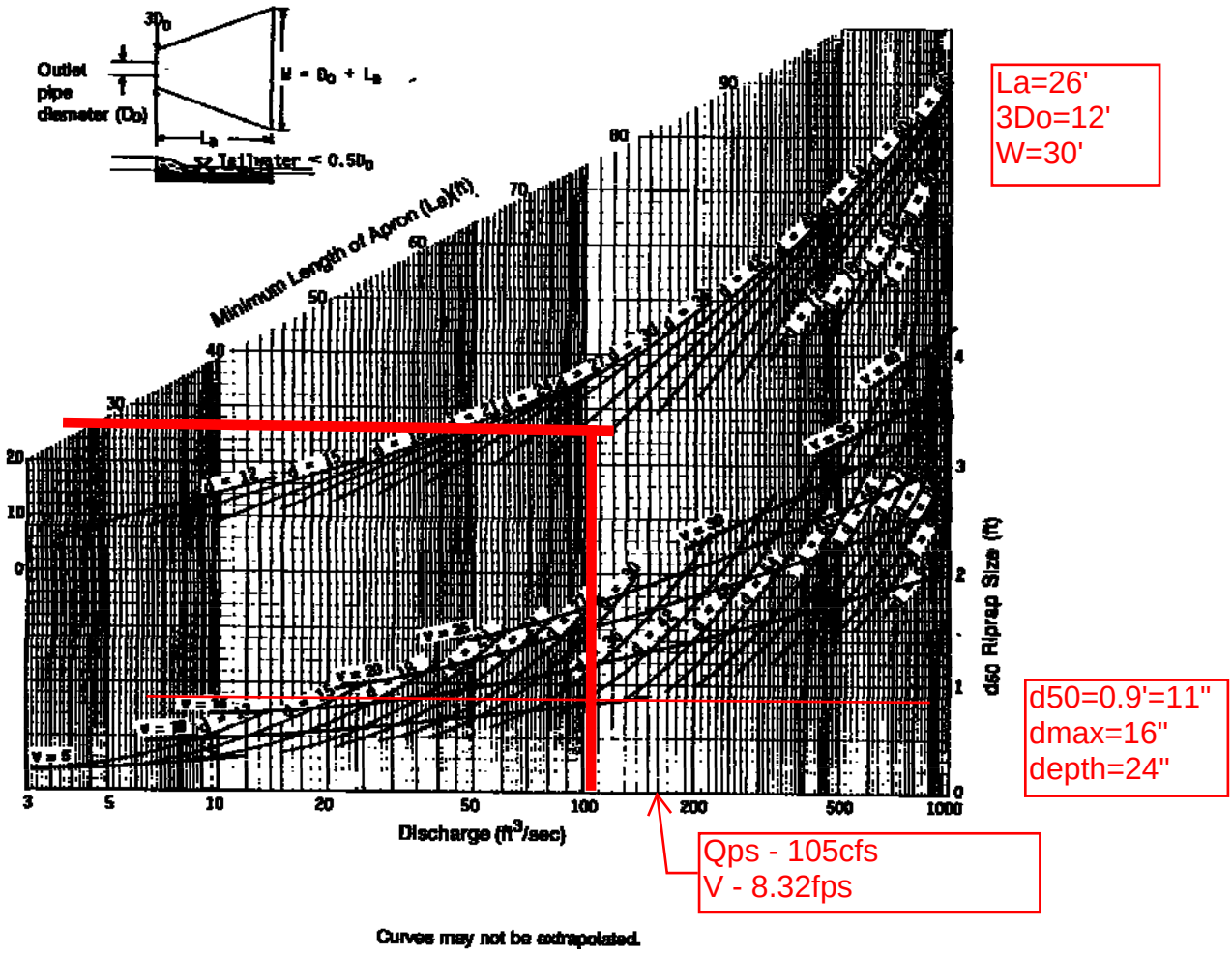


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

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United States Department of Agriculture

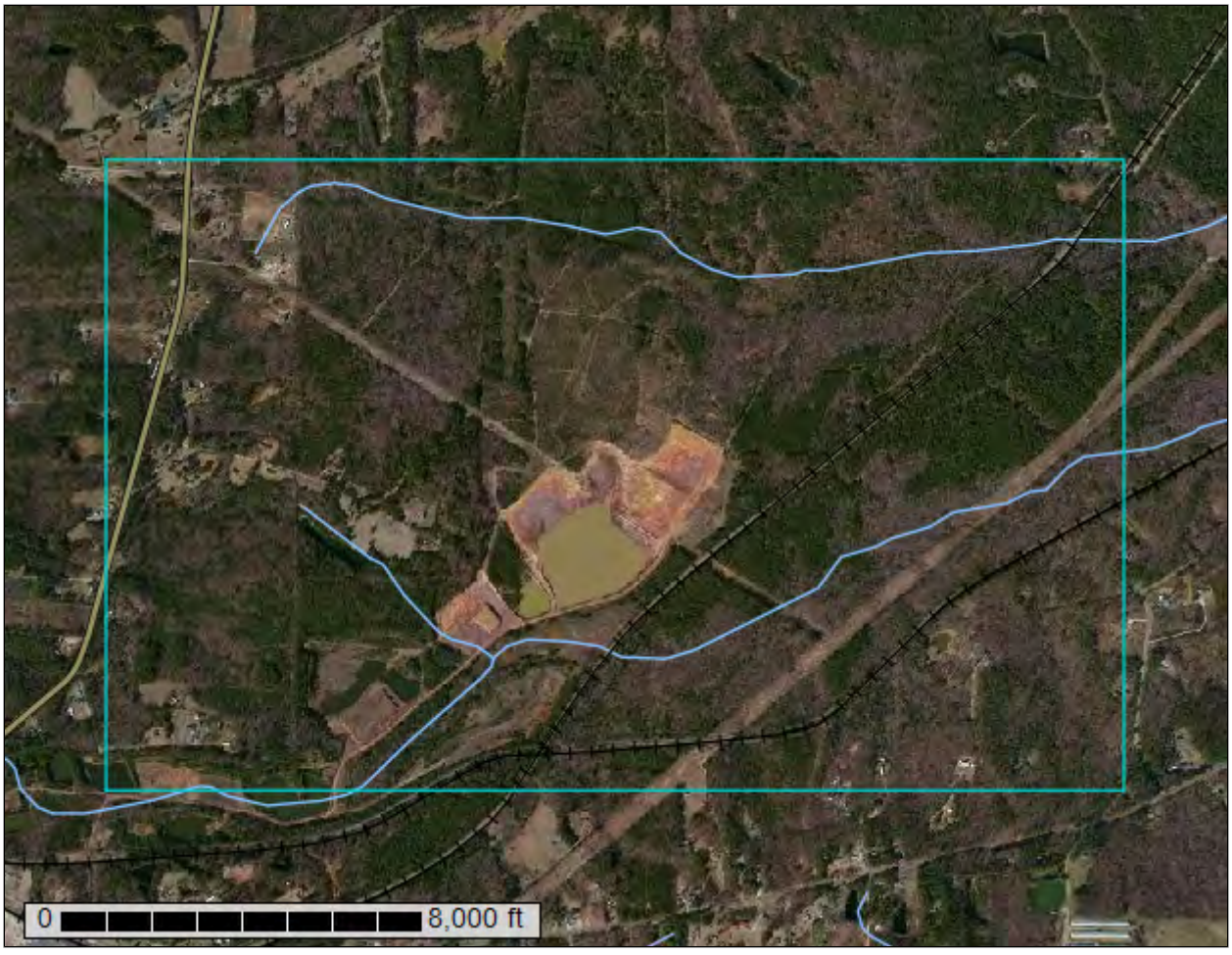
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Lee County, North Carolina

Sanford



September 16, 2014

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

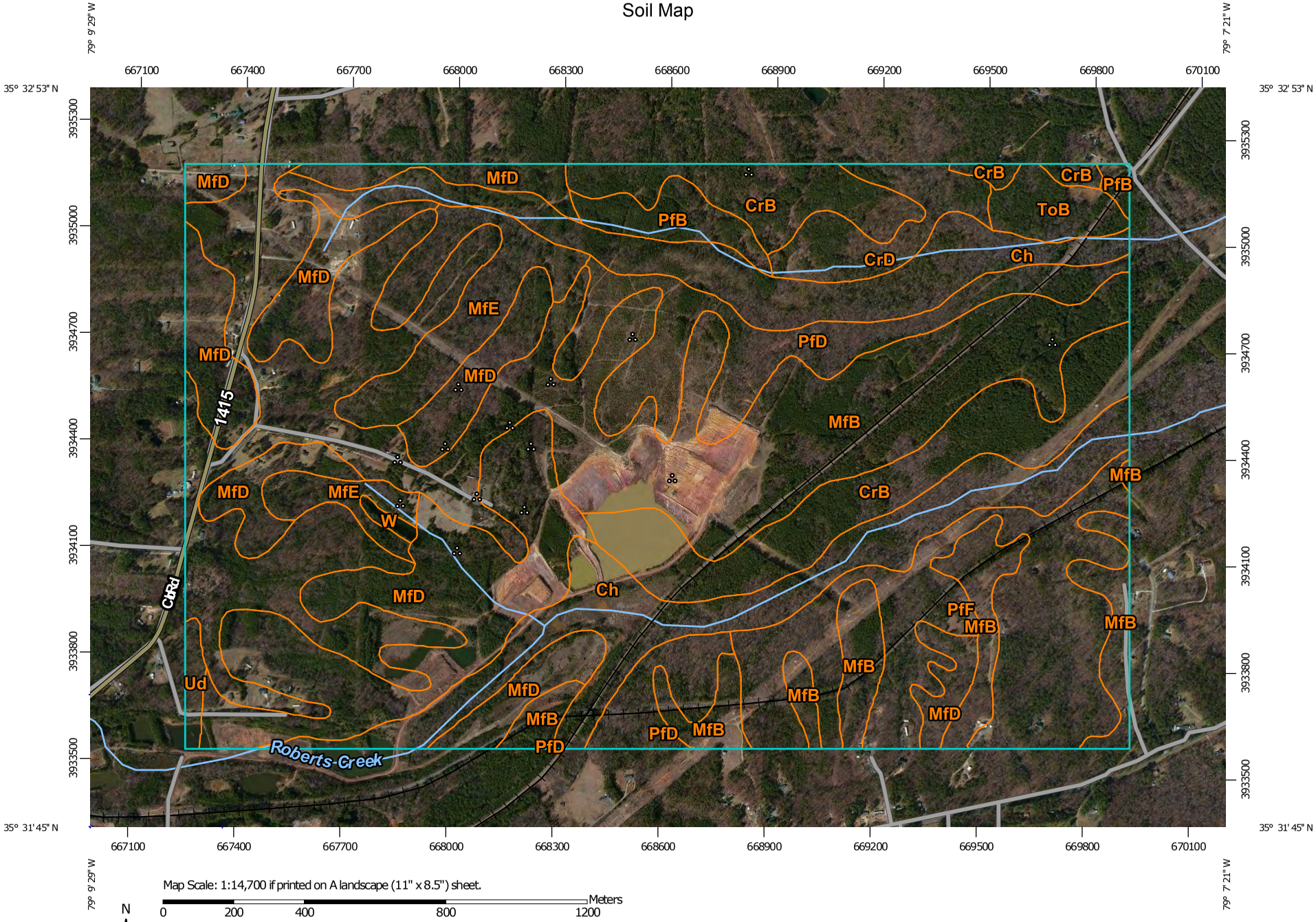
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:14,700 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lee County, North Carolina
Survey Area Data: Version 11, Dec 16, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 11, 2011—Apr 2, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Lee County, North Carolina (NC105)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ch	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	144.6	13.2%
CrB	Creedmoor fine sandy loam, 2 to 8 percent slopes	101.3	9.3%
CrD	Creedmoor fine sandy loam, 8 to 15 percent slopes	24.5	2.2%
MfB	Mayodan fine sandy loam, 2 to 8 percent slopes	344.6	31.6%
MfD	Mayodan fine sandy loam, 8 to 15 percent slopes	205.8	18.9%
MfE	Mayodan fine sandy loam, 15 to 25 percent slopes	50.6	4.6%
PfB	Pinkston silt loam, 2 to 8 percent slopes	17.6	1.6%
PfD	Pinkston silt loam, 8 to 15 percent slopes	76.9	7.0%
PfF	Pinkston silt loam, 15 to 40 percent slopes	104.9	9.6%
ToB	Tillery fine sandy loam, 1 to 4 percent slopes, rarely flooded	14.5	1.3%
Ud	Udorthents, loamy	4.4	0.4%
W	Water	1.9	0.2%
Totals for Area of Interest		**1,091.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be

made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Lee County, North Carolina

Ch—Chewacla silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2mz3q
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Chewacla and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chewacla

Setting

Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy alluvium derived from igneous and metamorphic rock

Typical profile

A - 0 to 4 inches: silt loam
Bw1 - 4 to 26 inches: silty clay loam
Bw2 - 26 to 38 inches: loam
Bw3 - 38 to 60 inches: clay loam
C - 60 to 80 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D

Minor Components

Congaree

Percent of map unit: 8 percent
Landform: Flood plains
Down-slope shape: Linear

Across-slope shape: Linear

Wehadkee, undrained

Percent of map unit: 5 percent
Landform: Depressions on flood plains
Down-slope shape: Concave
Across-slope shape: Linear

CrB—Creedmoor fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3t5w
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Creedmoor and similar soils: 90 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Creedmoor

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from shale and siltstone and/or mudstone and/or sandstone

Typical profile

Ap - 0 to 14 inches: fine sandy loam
Bt1 - 14 to 29 inches: silty clay loam
Bt2 - 29 to 56 inches: silty clay
BCg - 56 to 72 inches: loam
Cr - 72 to 96 inches: weathered bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 72 to 100 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None

Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D

Minor Components

Mayodan

Percent of map unit: 8 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex

CrD—Creedmoor fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 3t5x
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Creedmoor and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Creedmoor

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from shale and siltstone and/or mudstone and/or sandstone

Typical profile

Ap - 0 to 14 inches: fine sandy loam
Bt1 - 14 to 29 inches: silty clay loam
Bt2 - 29 to 56 inches: silty clay
BCg - 56 to 72 inches: loam
Cr - 72 to 96 inches: weathered bedrock
R - 96 to 100 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 72 to 100 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D

MfB—Mayodan fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3t64
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Mayodan and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mayodan

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 9 inches: sandy clay loam
Bt - 9 to 33 inches: clay
BC - 33 to 40 inches: sandy clay loam
C - 40 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 8 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

MfD—Mayodan fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 3t65
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Mayodan and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mayodan

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 9 inches: sandy clay loam
Bt - 9 to 33 inches: clay
BC - 33 to 40 inches: sandy clay loam
C - 40 to 80 inches: sandy clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B

MfE—Mayodan fine sandy loam, 15 to 25 percent slopes

Map Unit Setting
National map unit symbol: 3t66
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Mayodan and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mayodan

Setting
Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile
Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 9 inches: sandy clay loam
Bt - 9 to 33 inches: clay
BC - 33 to 40 inches: sandy clay loam
C - 40 to 80 inches: sandy clay loam

Properties and qualities
Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

PfB—Pinkston silt loam, 2 to 8 percent slopes

Map Unit Setting
National map unit symbol: 3t6c
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Pinkston and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinkston

Setting
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile
A - 0 to 6 inches: silt loam
Bw - 6 to 16 inches: silt loam
C - 16 to 38 inches: silt loam
R - 38 to 80 inches: unweathered bedrock

Properties and qualities
Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C

PfD—Pinkston silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 3t6d
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Pinkston and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinkston

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 16 inches: silt loam
C - 16 to 38 inches: silt loam
R - 38 to 80 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0

Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C

PfF—Pinkston silt loam, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 3t6f
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Pinkston and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinkston

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 16 inches: silt loam
C - 16 to 38 inches: silt loam
R - 38 to 80 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

ToB—Tillery fine sandy loam, 1 to 4 percent slopes, rarely flooded

Map Unit Setting

National map unit symbol: 2ml49
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Tillery and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tillery

Setting

Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from igneous and metamorphic rock

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bt - 7 to 48 inches: silty clay loam
Cg - 48 to 80 inches: silt loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Ud—Udorthents, loamy

Map Unit Setting

National map unit symbol: 3t6p
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 50 to 66 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy and clayey human transported material derived from igneous, metamorphic and sedimentary rock

Typical profile

C - 0 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C

Minor Components

Urban land

Percent of map unit: 8 percent
Landform: Hillslopes on ridges
Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w

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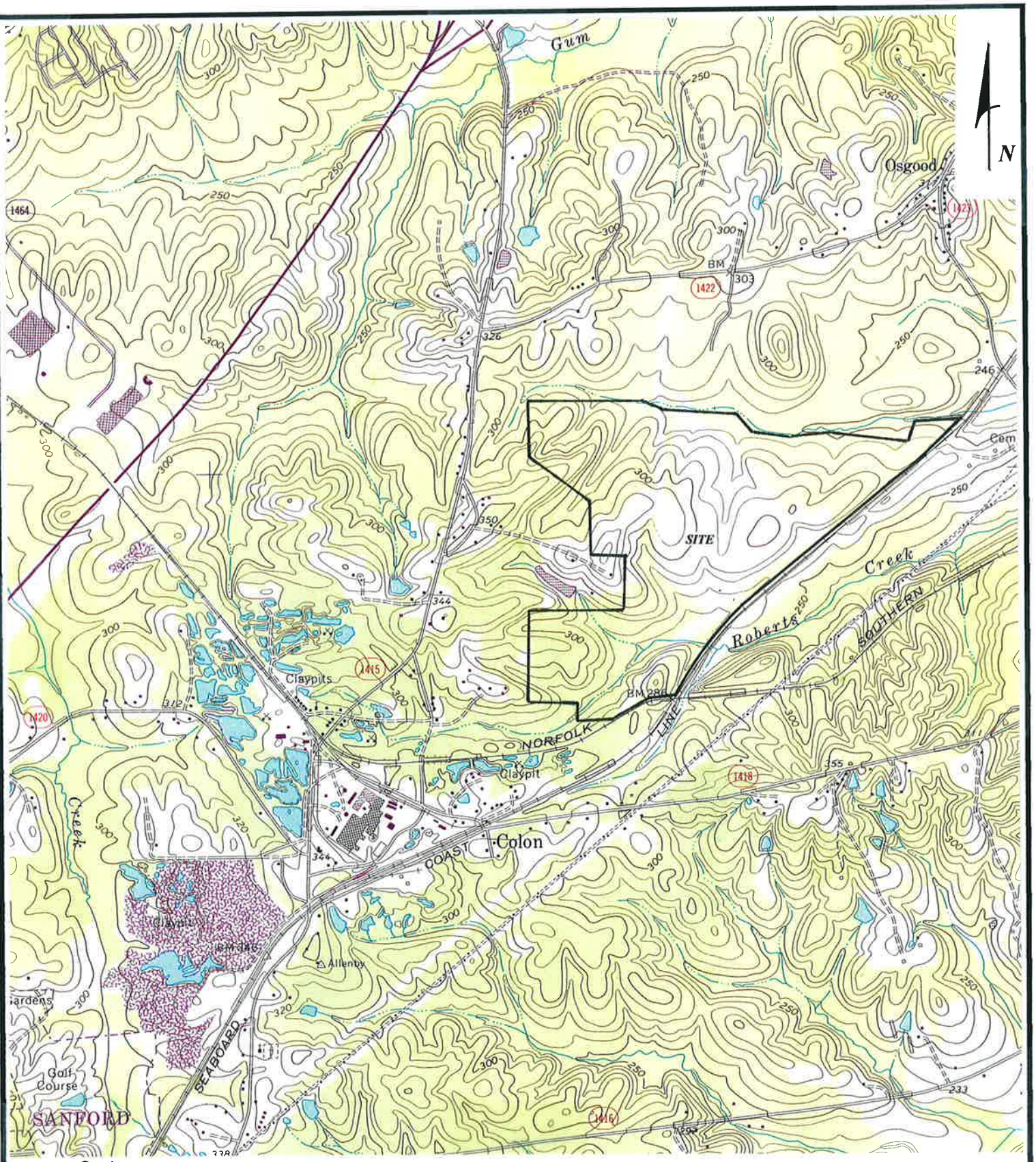

Source: 1970 USGS Colon, NC
Topographic Quadrangle

Colon Mine Reclamation Fill Site 1303 Brickyard Road Sanford, North Carolina		Site Location Map

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Related Documents

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014

Wetlands Determination, August 2014
SWPPP, April 2014
Application for Mining Permit, March 2014
Colon Mine Drawings, February 2014
NPDES Permit NCG020854, November 2013
NCDENR Mine Permit 53-05, April 2005

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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.

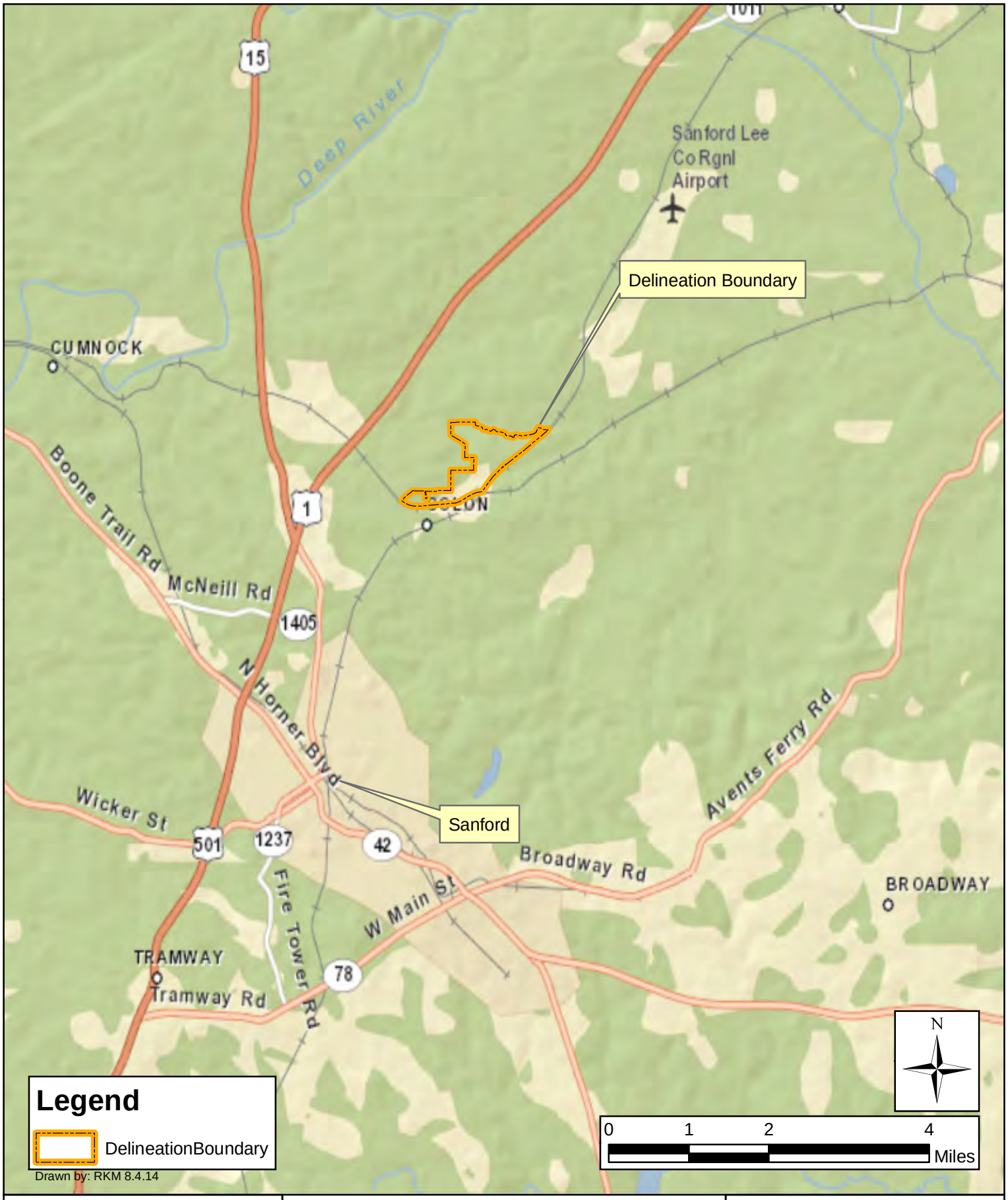
We appreciate the opportunity to provide this information to you. If you have any questions or comments concerning this letter please do not hesitate to contact me at 828-698-9800.

Sincerely,

Rebekah L. Newton
Project Biologist

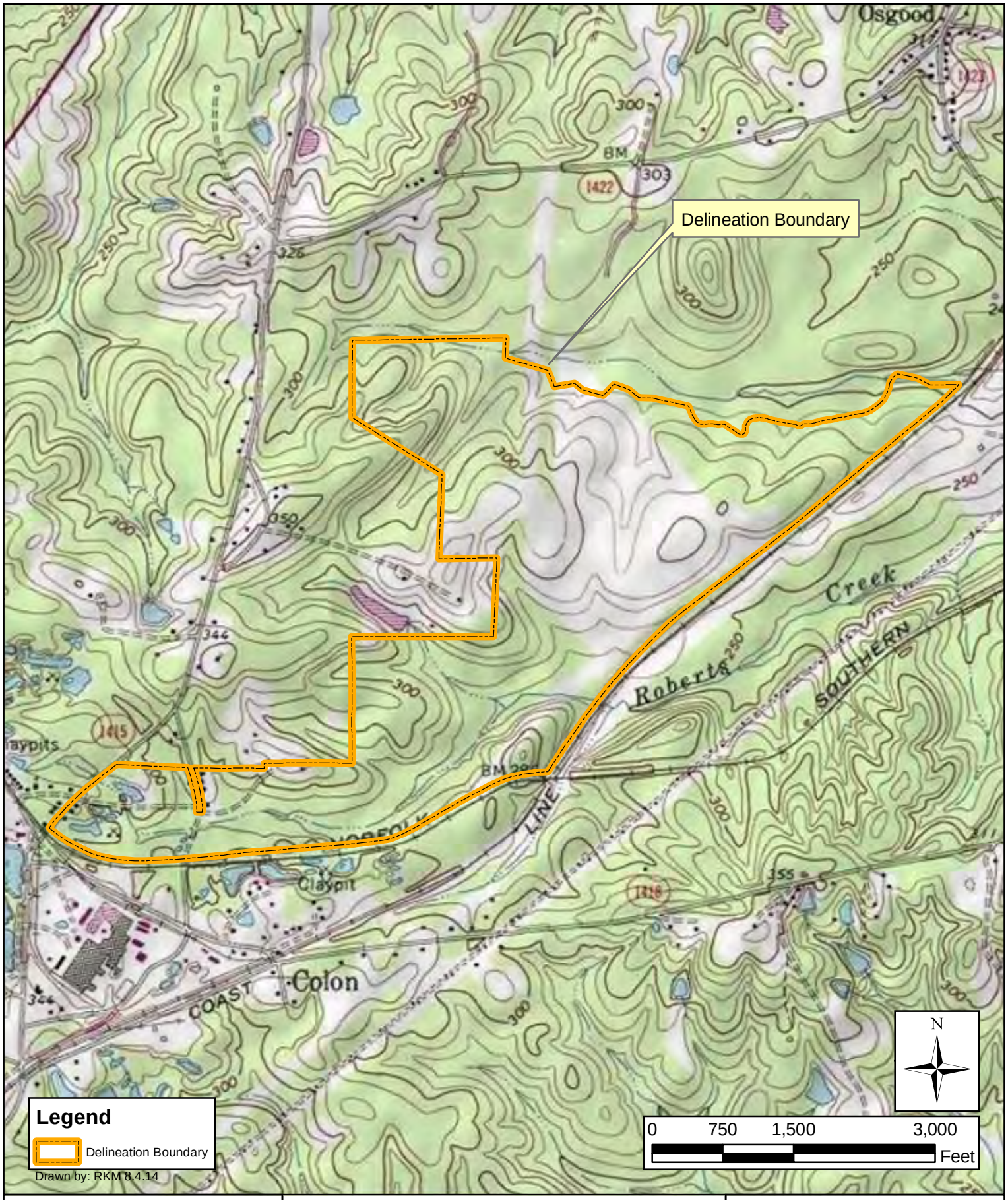
R. Clement Riddle, P.W.S.
Principal

Colon Mine (+/-408 AC)



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

Colon Mine (+/-408 AC)



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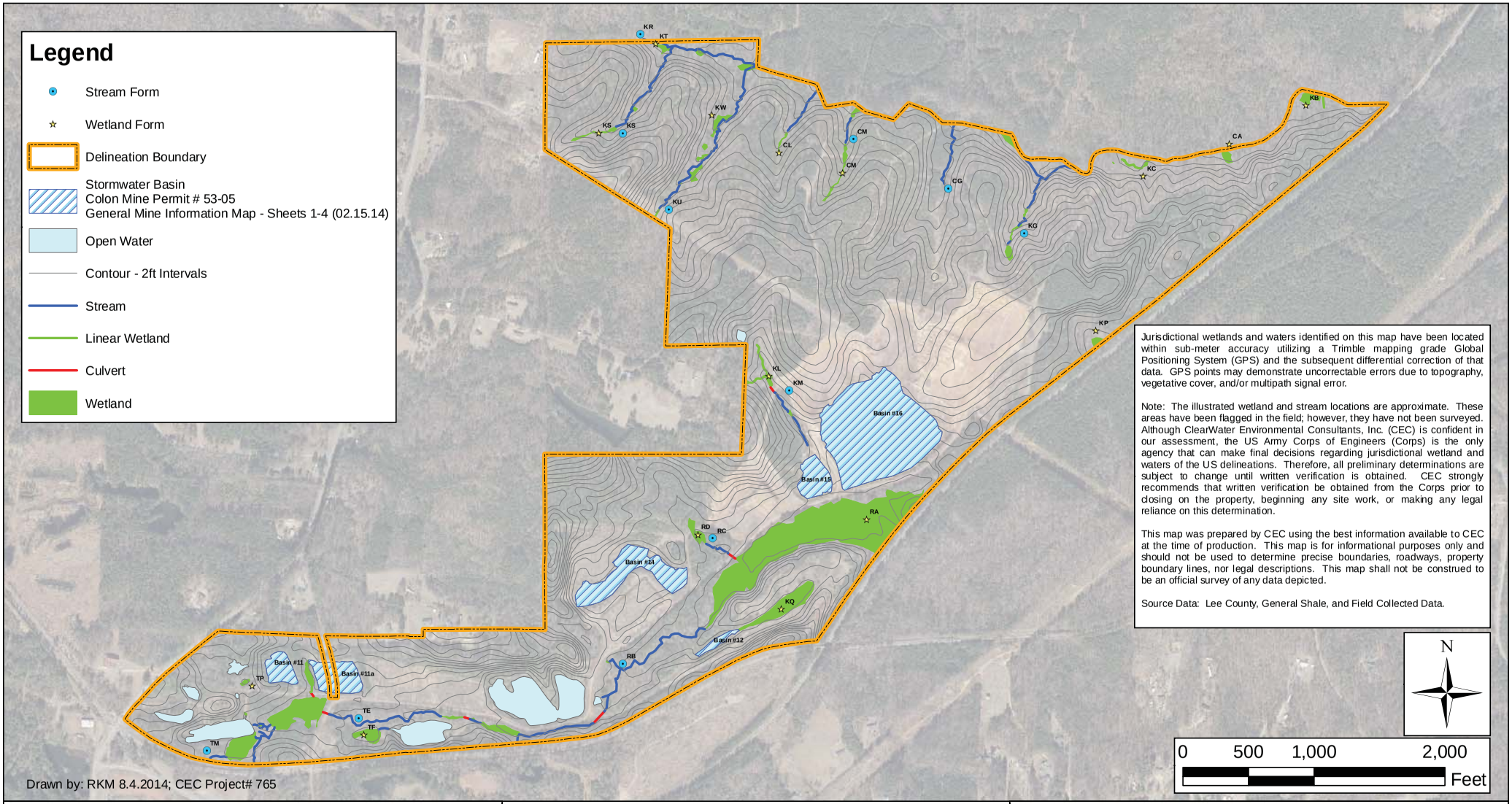
USGS Topographic Map
Colon Quad
Figure 2

Colon Mine (+/- 408 AC)



Lee County,
North Carolina

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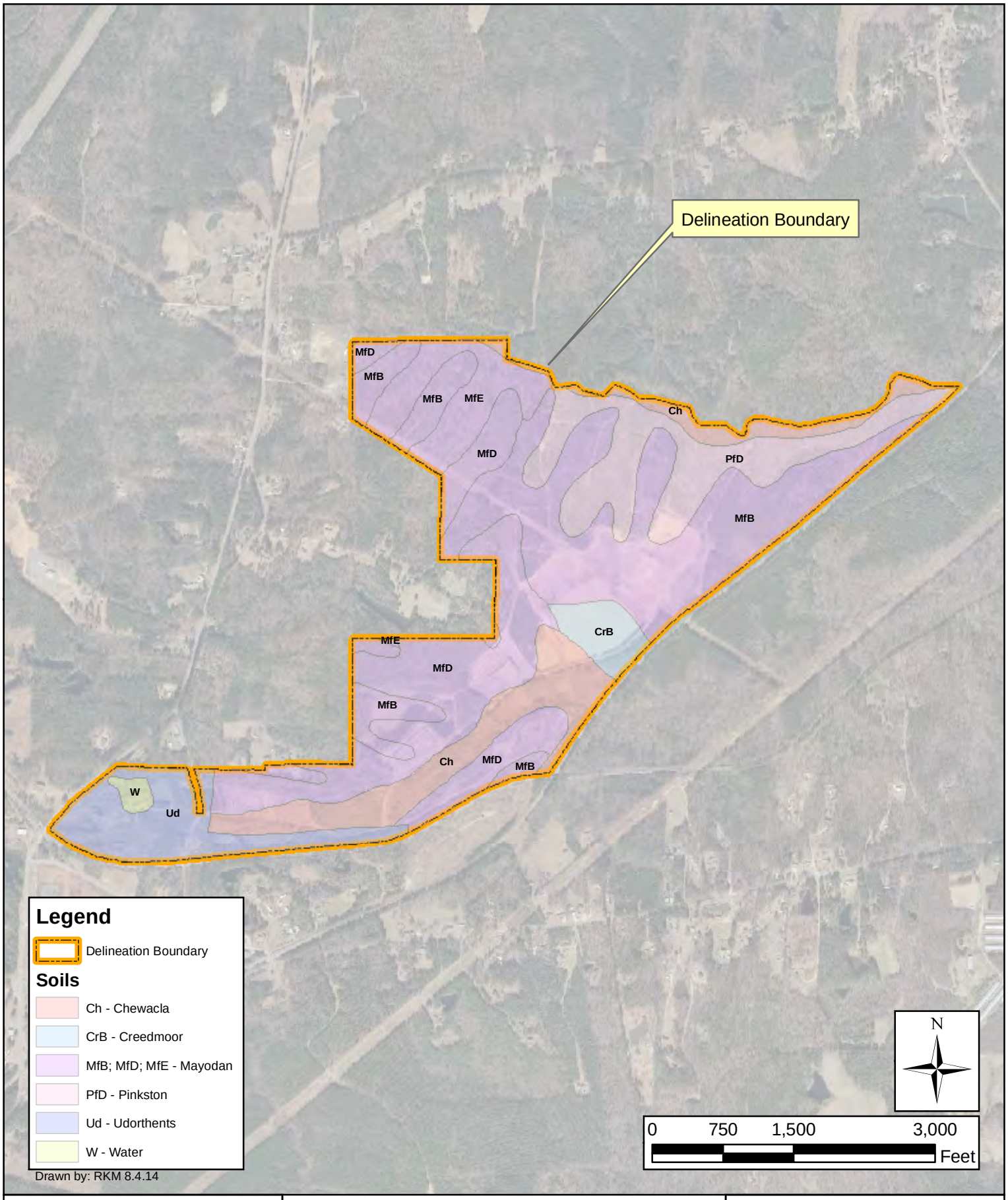
Figure 3
Stream and Wetland Delineation Map
Delineated: July 21, 22, 23, 24, 30, & 31, 2014.

Colon Mine (+/-408 AC)



Drawn by: RKM 8.4.14

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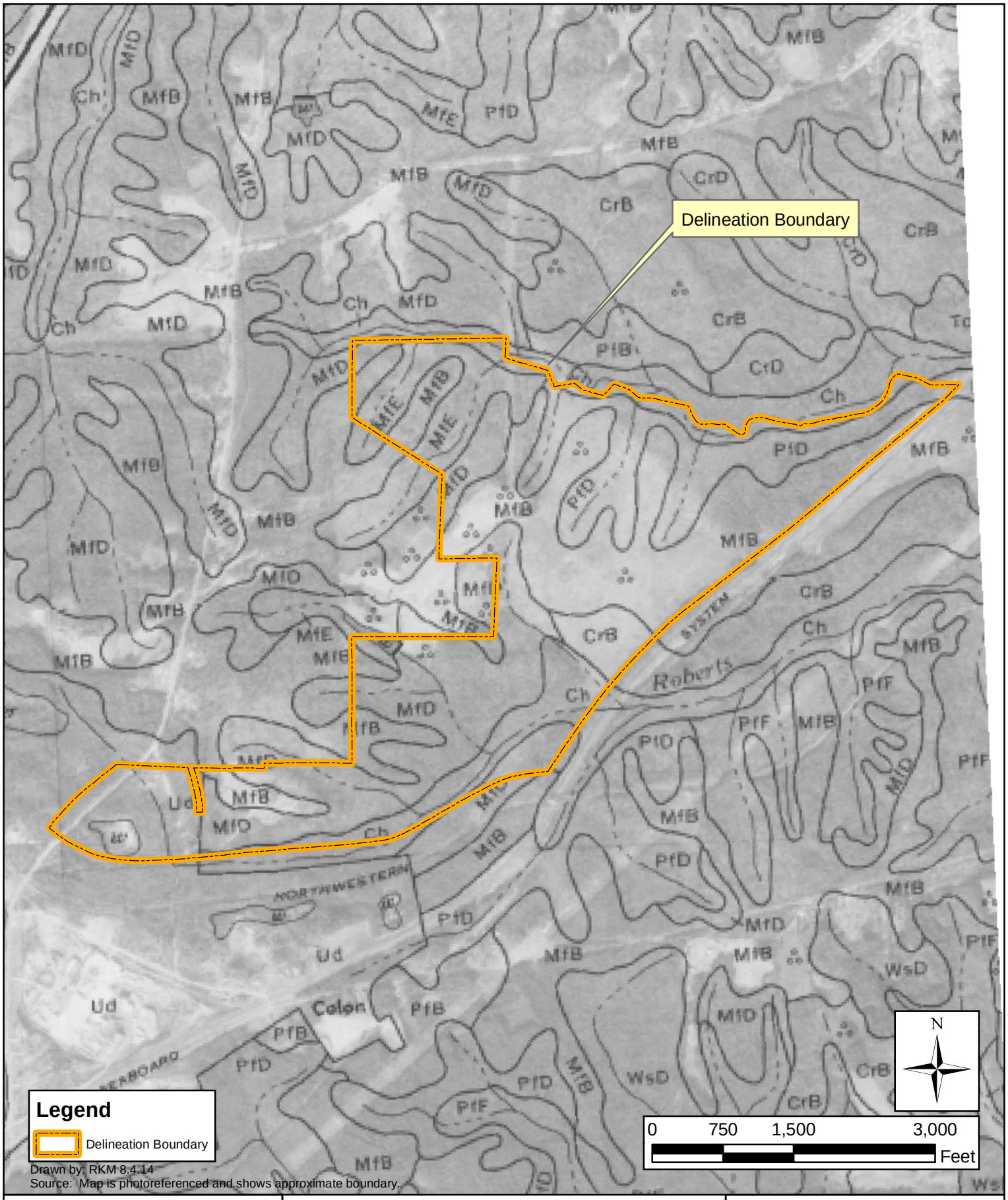
USDA Soils
Figure 4a

Colon Mine (+/-408 AC)



Lee County,
North Carolina

ClearWater

224 South Grove Street, Suite F
Hendersonville, North Carolina 28792

USDA Soils
Lee County Soils Suvey 1989
Figure 4b

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GENERAL SHALE
SANFORD, NC

COLON MINE

STORMWATER PERMIT NO. NCG020854

STORM WATER POLLUTION PREVENTION PLAN

DECEMBER 2013
UPDATED APRIL 2014

Table of Contents

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

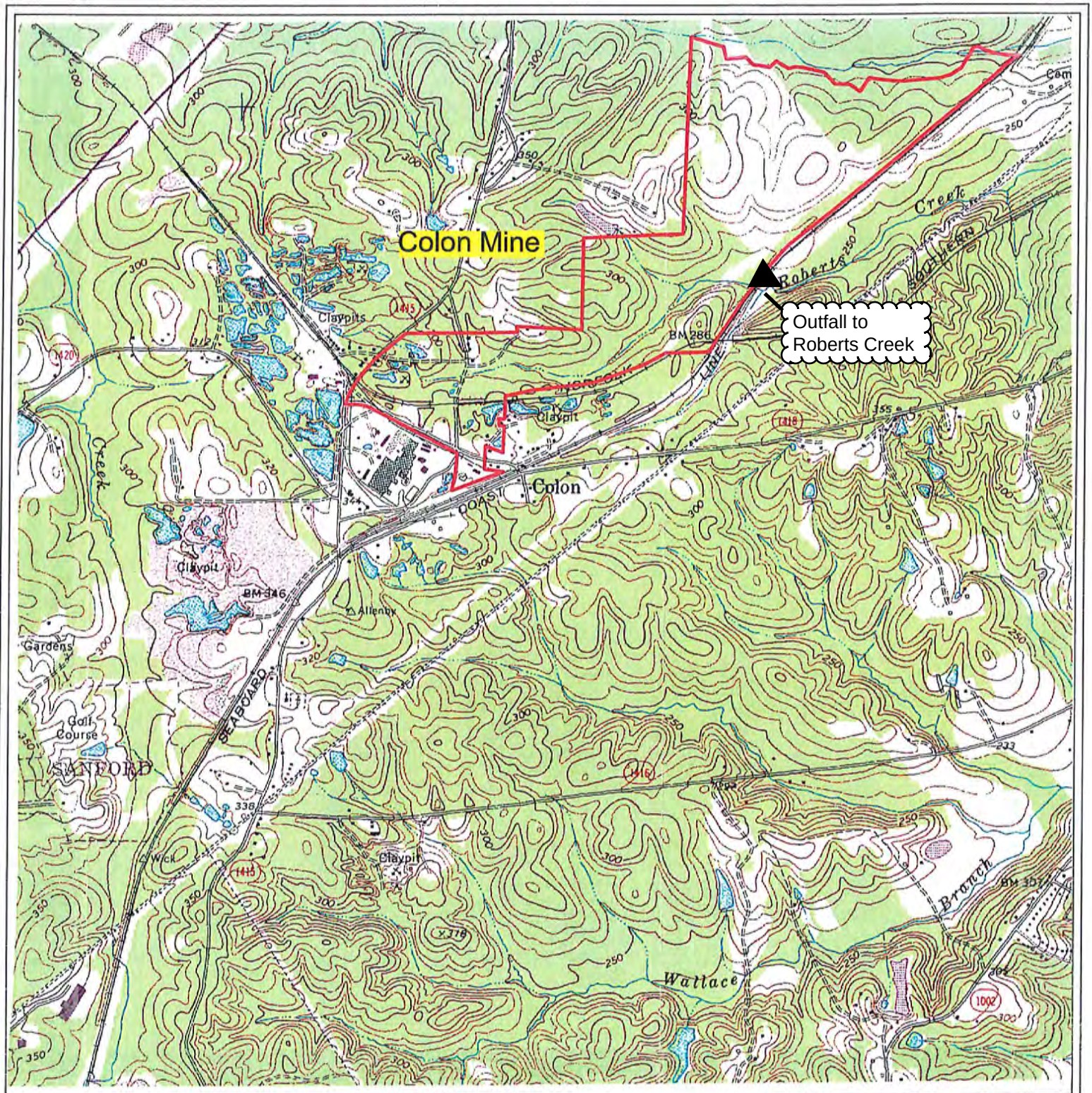
The following information will be recorded at the sample time: date, place sampled, and person sampling. The analytical results shall be submitted to the Division Central office no later than **March 1** of the following permit year. The general permit provides the specific requirements for collecting 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



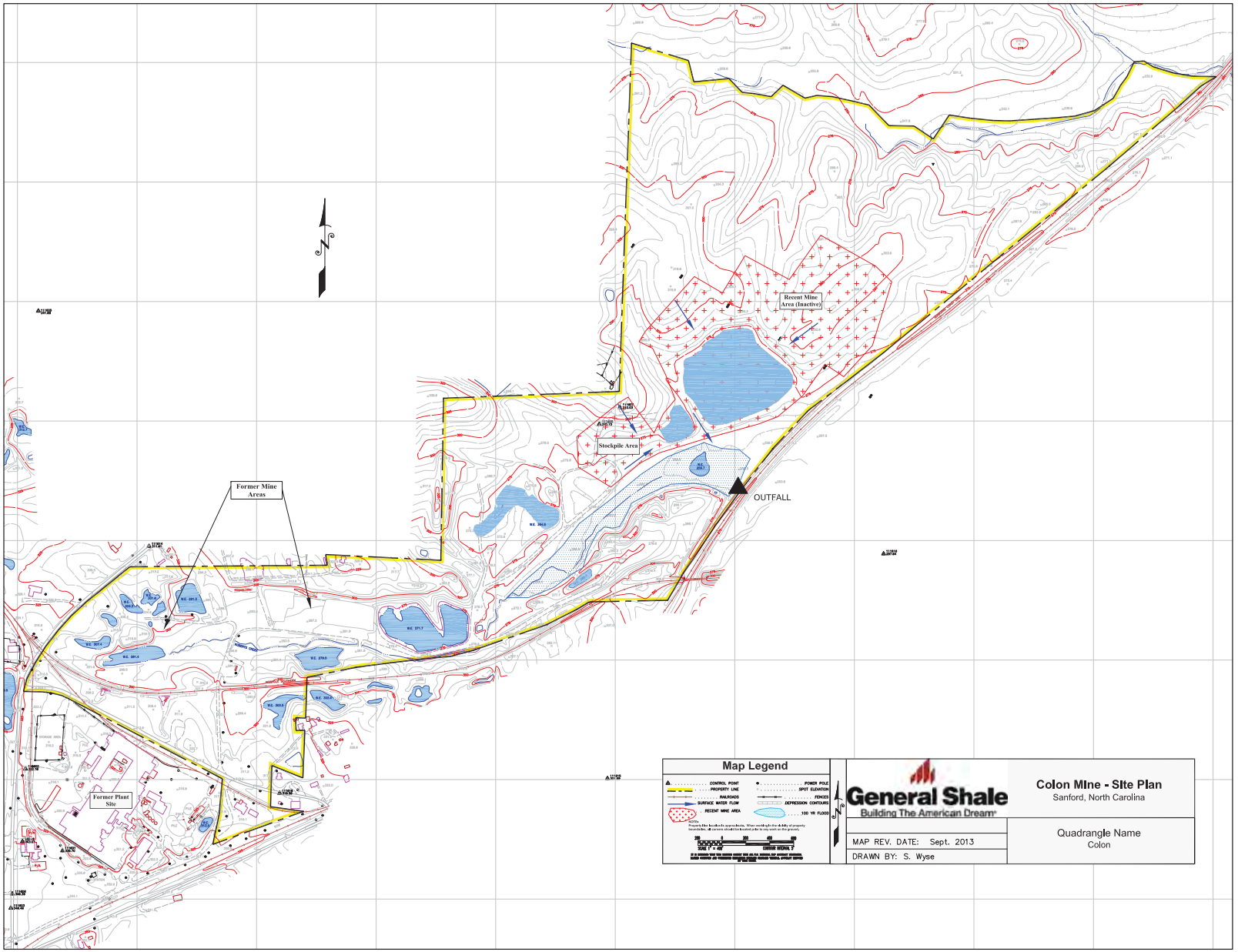
Latitude: 35°32'05.3" N
Longitude: -79°09'35.3" W
County: Lee
Stream Class: WS-IV
Receiving Stream: Roberts Creek
Sub-basin: 03-06-07 (Cape Fear River Basin)

NCG020854
General Shale, Inc.
Colon Mine

North

Facility Location

Not to Scale


Recent Mine Area (Inactive)
Stockpile Area
OUTFALL
Former Mine Areas
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.

APPLICATION FOR A MINING PERMIT

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)

APPLICATION FOR A MINING PERMIT

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.

APPLICATION FOR A MINING PERMIT

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

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.

APPLICATION FOR A MINING PERMIT

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.**

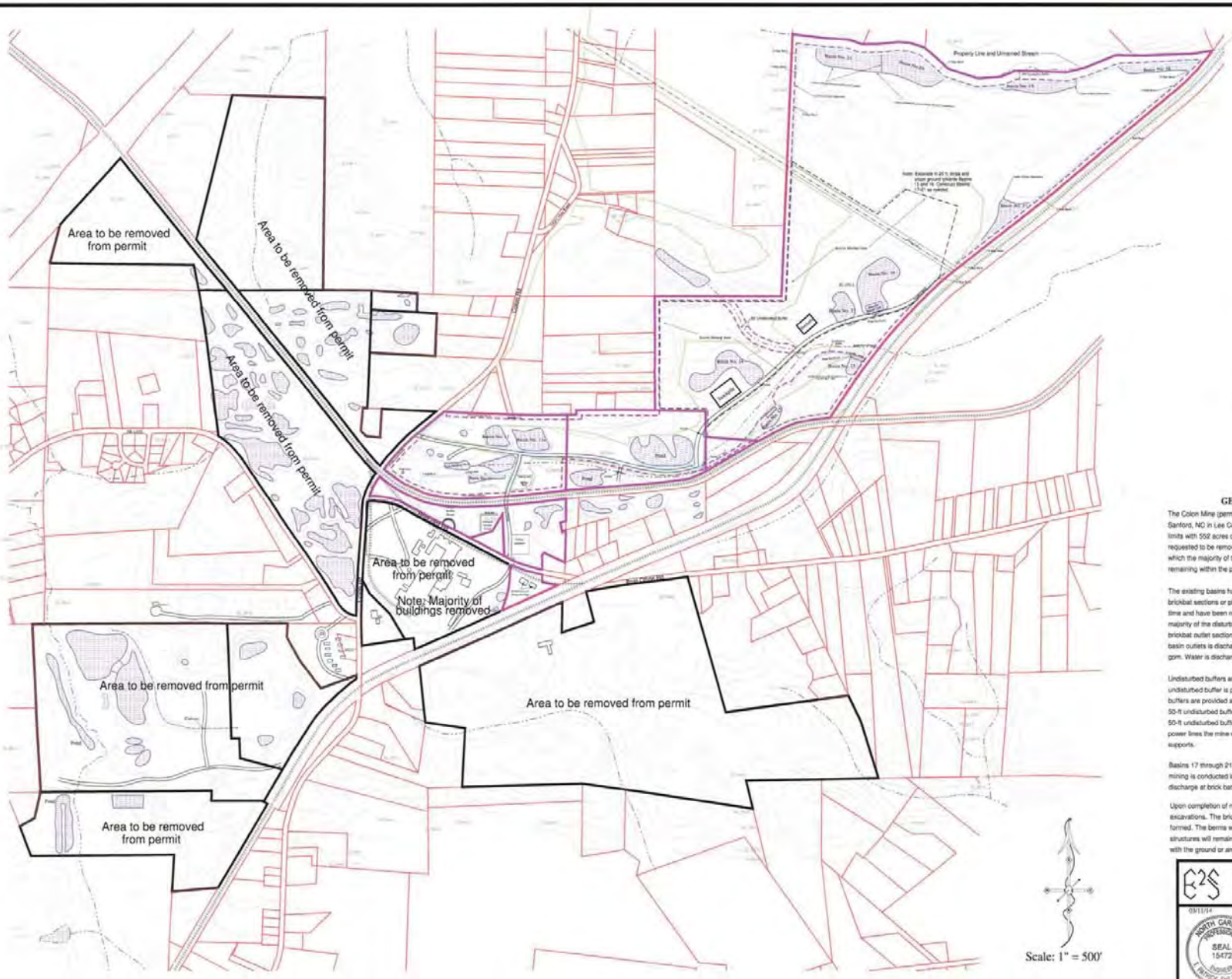
Acres for new permits and renewal permits means the total acreage at the site. Acres for major modification of permits means that area of land affected by the modification within the permitted mine area, or any additional land that is to be disturbed and added to an existing permitted area, or both.

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
- 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
- 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 1098 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 271 acres remaining within the permit limits with 249 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.

ENGINEERING & ENVIRONMENTAL SCIENCE COMPANY
3008 Anderson Drive
Raleigh, NC 27609
(919) 781-7798

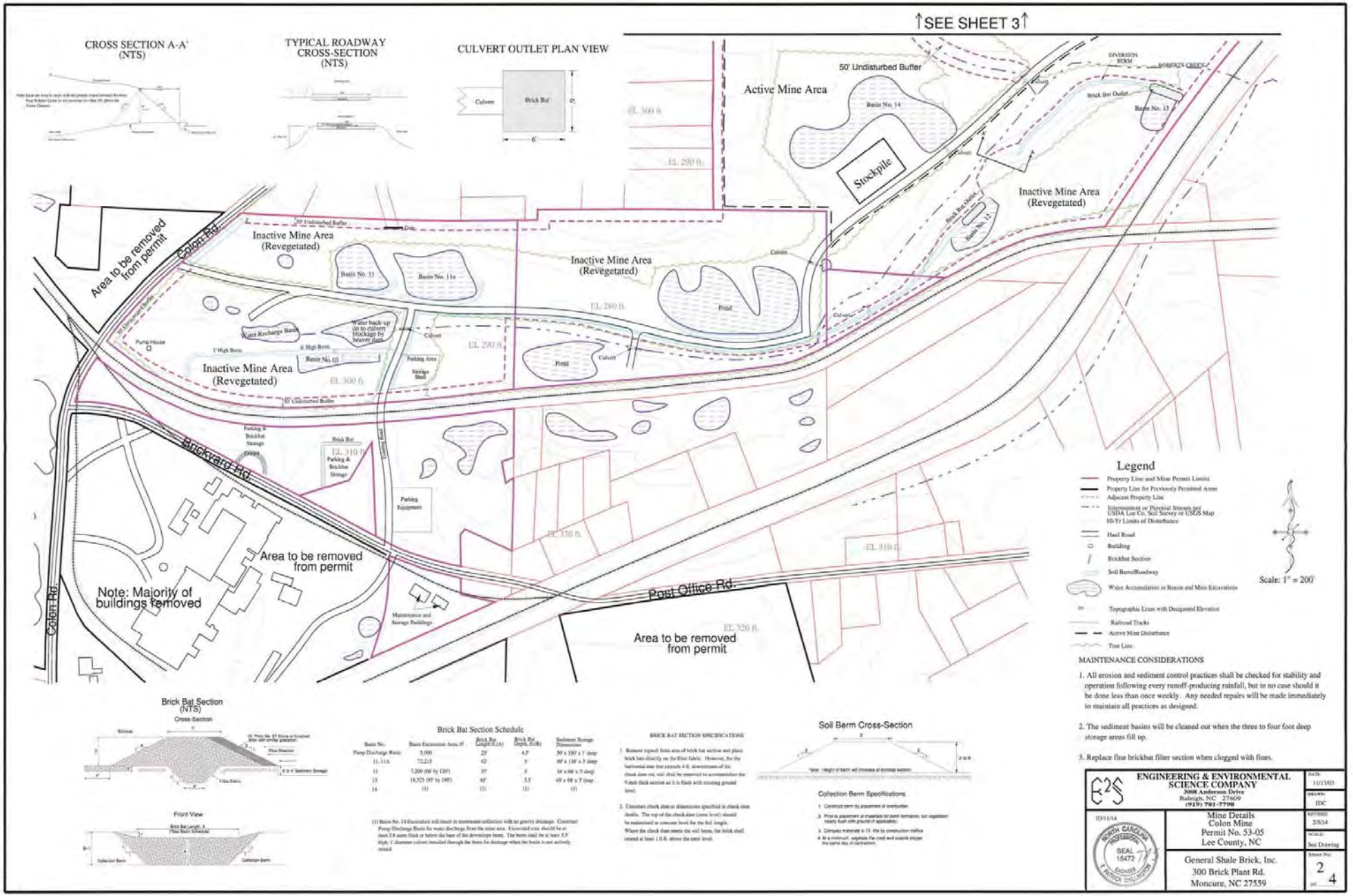
DATE:	11/13/03
DRAWN:	JDC
REVISED:	2/5/14
SCALE:	See Drawing
Sheet No.	1 of 4

09/11/14

NORTH CAROLINA REGISTERED SEAL 15472 ENGINEER

General Mine Information
Colon Mine
Permit No. 53-05
Lee County, NC

General Shale Brick, Inc.
300 Brick Plant Rd.
Moncure, NC 27559



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 (LBA)	Brick Bat Depth, (HBB)	Sediment Storage Dimensions
Pump Discharge Basin	5,000	25'	4.5'	50' x 100' x 1' deep
11, 11A	72,215	62'	3'	80' x 130' x 3' deep
13	7,200 (60' by 120')	37'	3'	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 thick 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 one foot extends 4 ft. downstream of the check dam cut, soil shall be removed to accommodate the 9 inch thick section so it is flush with existing ground level.

2. Crossmen check dam or dimensions specified in check dam details. The top of the check dam (cross level) should be maintained at concrete level for the full length. Where the check dam meets the soil berm, the brick shall extend at least 1.0 ft. above the inset level.

Soil Berm Cross-Section

Collection Berm Specifications

1. Construct berm by placement or overburden.
2. Prior to placement of materials for berm formation, but vegetation nearly flush with ground (if applicable).
3. Compact materials to 15 lbs by construction traffic.
4. At a minimum, vegetate the crest and outside slopes the same day of construction.

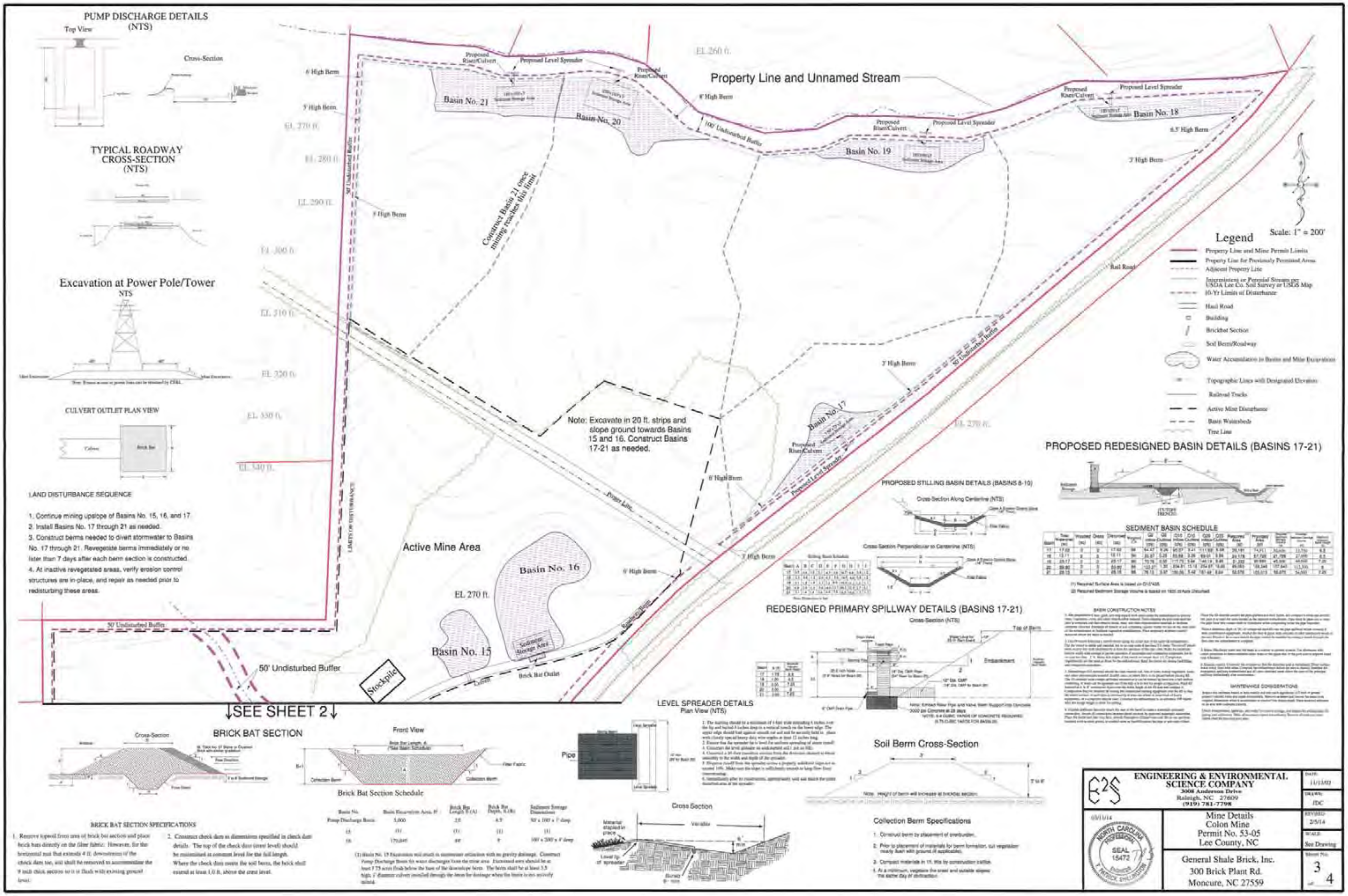
E²S
ENGINEERING & ENVIRONMENTAL SCIENCE COMPANY
3008 Anderson Drive
Raleigh, NC 27609
(919) 781-7790

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 J. BROOK SALLENGER

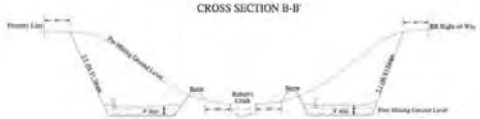
Mine Details
Colon Mine
Permit No. 53-05
Lee County, NC

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
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
5' High Berm
8' High Berm
6.5' High Berm
3' High Berm
100' Undisturbed Buffer
50' Undisturbed Buffer
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.
Construct Basin 21 once mining reaches this limit
Note: Excavate in 20 ft. strips and slope ground towards Basins 15 and 16. Construct Basins 17-21 as needed.
Active Mine Area
Power Line
Rail Road
Stockpile
Brick Bat Outlet
Sediment Storage Area
SEE SHEET 2
Scale: 1" = 200'
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
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
Soil Berm Cross-Section
Collection Berm Specifications
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
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 18472 ENGINEER J. PATRICK BROUGHTON

Mine Reclamation Plan
Colon Mine
Permit No. 53-05
Lee County, NC

General Shale Brick, Inc.
300 Brick Plant Rd.
Moncure, NC 27559

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Energy, Mineral, and Land Resources
Land Quality Section

Tracy E. Davis, PE, CPM
Director

Pat McCrory, Governor
John E. Skvarla, III, Secretary

November 21, 2013

Mr. Gregory Bowles
General Shale, Inc.
P. O. Box 3547
Johnson City, TN 37602

Subject: General Permit No. NCG020000
Colon Mine
COC NCG020854
Lee County

Dear Mr. Bowles:

In accordance with your application for a discharge permit received on October 3, 2013, we are forwarding herewith the subject certificate of coverage to discharge under the subject state – NPDES general permit. This permit is issued pursuant to the requirements of North Carolina General Statute 143-215.1 and the Memorandum of Agreement between North Carolina and the US Environmental Protection Agency dated October 15, 2007 (or as subsequently amended).

This certificate of coverage is not transferable. If the facility changes ownership or is closed, the Division of Energy Mineral & Land Resources may require modification, revocation or reissuance of the certificate of coverage.

This permit does not affect the legal obligation to obtain other permits which may be required by the Division of Energy, Mining, and Land Resources, or any other federal, state, or local authorities.

If you have any questions concerning this permit, please contact Larry Wade PE at telephone number (919) 807-6375.

Sincerely,

Ken Pichle

for Tracy E. Davis, P.E.

cc: Raleigh Regional Office
Central Files
Stormwater Permitting Program 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,

General Shale, Inc.

is hereby authorized to discharge stormwater from a facility located at

Colon Mine
1604 Colon Rd.
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, IV, V, and VI of General Permit No. NCG020000 as attached.

This certificate of coverage shall become effective November 21, 2013.

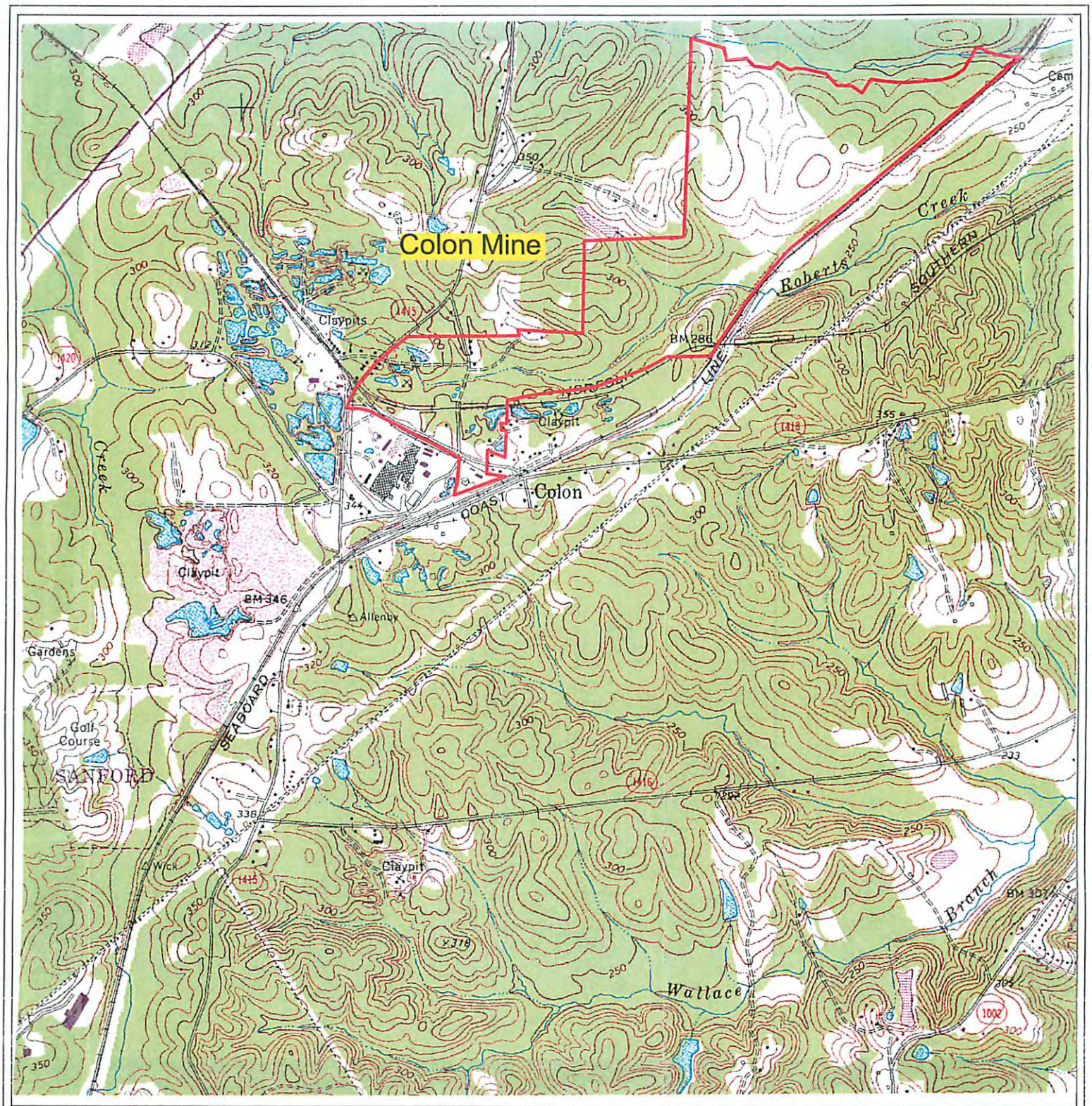
This Certificate of Coverage shall remain in effect for the duration of the General Permit.

Signed this day November 21, 2013.

Ken Pickle

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

LOCATION MAP:



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

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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

NCDENR
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