Mine Permit Transfer/Modification

Brickhaven No.2 Mine Tract “A”

Charah, Inc.

Moncure, North Carolina

November 2014

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Mine Permit Transfer/Modification

Brickhaven No.2 Mine Tract “A”

Charah, Inc.

Moncure, 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: Brickhaven No. 2, Tract A Mine, Permit No. 19-25

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 that the State transfer the permit noted above to Green Meadow, LLC. As 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, and (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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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: Brickhaven No. 2 – Tract A Mine, Permit No. 19-25

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

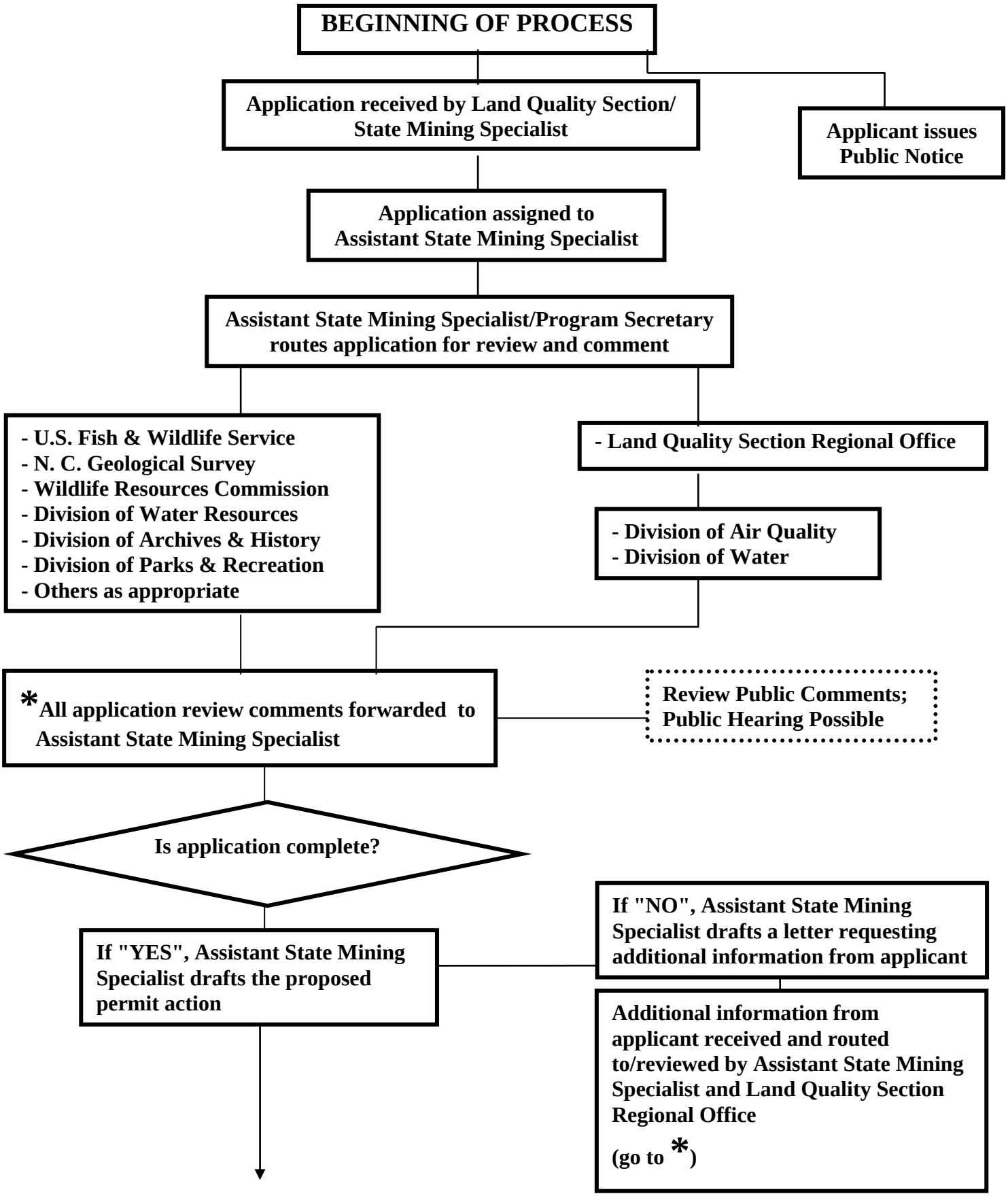
1612 Mail Service Center
Raleigh, North Carolina 27699-1612
(919) 707-9220

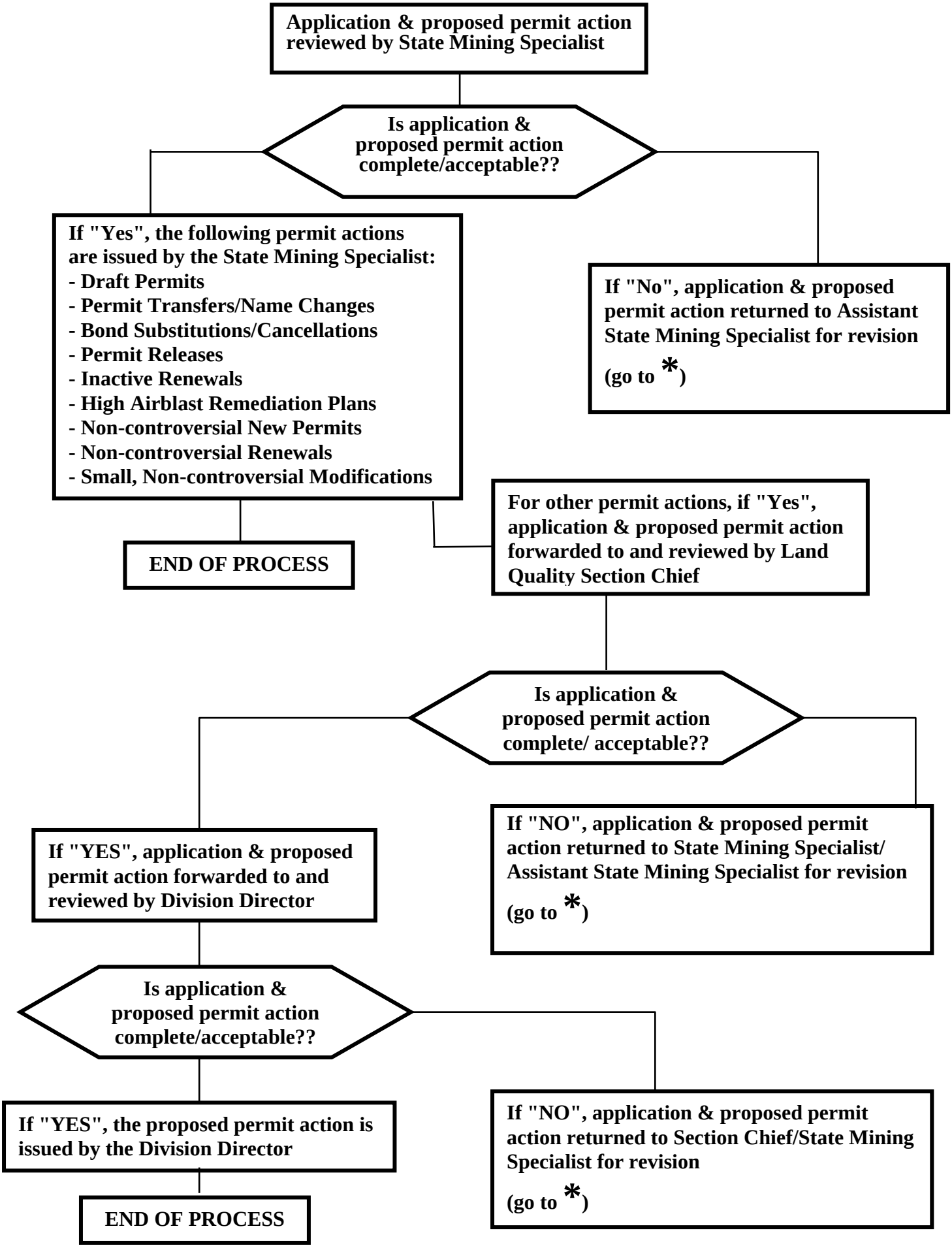
Revised: February 24, 2012

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 Brickhaven No. 2 Mine Tract "A" County Chatham

   River Basin Cape Fear

   Latitude (decimal degrees to four places) 35° 36′ 10″

   Longitude (decimal degrees to four places) 79° 01′ 02″

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: ( ) same as above

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 Gregory A Bowles 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.**

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 Brickhaven No. 2 Mine Tract "A" County Chatham

   River Basin Cape Fear

   Latitude (decimal degrees to four places) 35° 36′ 10″

   Longitude (decimal degrees to four places) 79° 01′ 02″

2. Name of Applicant* Green Meadow, LLC

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 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.: 19-25 Total permitted acreage: 301

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.: 19-25 Total permitted acreage: 301

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) 69
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

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? Cherokee Sanford Brick (1983-2000); General Shale Brick, Inc. (2000 to present)

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	13.42
Stockpiles	11.7
Wastepiles	NA
Processing Area/Haul Roads	7.2
Mine Excavation	159
Other (Explain)	NA
Total Disturbed Acreage	191.32

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 operations will continue in the area designated as Phase 1 (Cells 1 and 2). Drainage will be directed to Basin #9. Continued mine development will progress into the Phase 2 (Cells 3-5) area. Basins 1-8 will be constructed as the mine operations expand. 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.

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.

Mine operations will continue in the Phase 1 area and expand to the Phase 2 area. Basins will be constructed as needed to collect stormwater and prevent offsite sedimentation. 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.

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 site is situated away from roads and buildings and is naturally screened from the public view by existing wooded areas. Therefore, no additional visual screening is proposed.

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 onsite facility storage buildings. 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

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.*

All overburden is intended to be used in the construction of the structural fill or taken offsite. 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.

   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:	13.42 Ac.	X	$ 2,500 /Ac.	=	$ 33,500
Stockpiles:	11.7 Ac.	X	$ 2,500 /Ac.	=	$ 29,250
Wastepiles:	--- Ac.	X	$ --- /Ac.	=	$ ---
Processing Area/Haul Roads:	7.2 Ac.	X	$ 5,000 /Ac.	=	$ 36,000
Mine Excavation:	159 Ac.	X	$ 3,700 /Ac.	=	$ 588,300
Other:	--- Ac.	X	$ --- /Ac.	=	$ ---
TOTAL AFFECTED AC.:	**191.32 Ac.**				
(TOTAL PERMITTED AC.:	**301 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 191.32 Ac. X $1,500.00 = $ 286,980

SUBTOTAL COST: $974,030

Inflation Factor:

0.02 X SUBTOTAL COST: $19,480.60 X Permit Life (1 to 10 years): 10 years

INFLATION COST: $194,806

TOTAL COST = SUBTOTAL COST + INFLATION COST = $1,168,836

Total Reclamation Bond Cost: $1,168,800
(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: President / CEO

Company: Charah, Inc.

Mine Name: Brickhaven No.2 Mine Tract "A"

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.

(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: Brickhaven No.2 Mine Tract "A"

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

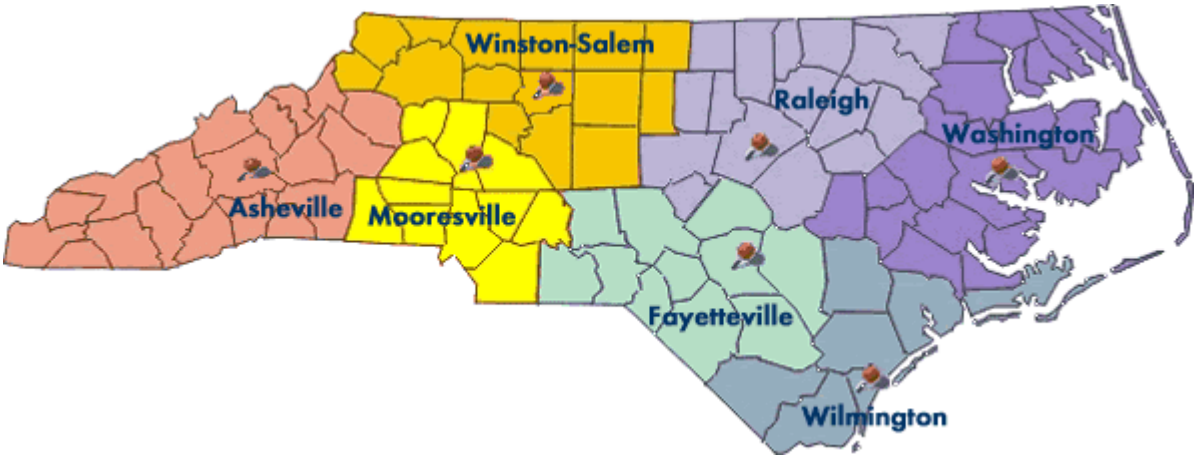
A nonrefundable permit application processing fee when filing for a new mining permit, a major permit modification or a renewal permit is required as follows:

	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.

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 permanent revegetation and, if necessary, 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):
4,000 lb/ac ground agricultural limestone

FERTILIZER - ANALYSIS AND RATE OF APPLICATION (pounds/acre):
1,000 lb/ac 10-10-10

SEED - TYPE (S) AND RATE (S) OF APPLICATION INCLUDING **YEAR-ROUND** SEEDING SCHEDULE (pounds/acre): [NOTE: Include Legumes]

Seed Types:	**Seeding Dates:**	**Seeding Rates:**
Common Bermuda grass (hulled)	Aug. 20- Oct. 25	6-8 lb/ac
Sericea lespedza (scarified)	Aug. 20- Oct. 25	50 lb/ac
German millet	May 1 – Aug. 15	10 lb/ac
Rye Grain	Aug. 15 – May 1	40 lb/ac

MULCH - TYPE AND RATE OF APPLICATION (pounds/acre) AND METHOD OF ANCHORING:
4,000-5,000 lb/ac grain straw; anchor by crimping or tacking

OTHER VEGETATIVE COVERS – TYPE (S) AND RATE (S) OF APPLICATION INCLUDING
Note : Seeding Schedule is based on existing mine permit requirement.

Revegetation and/or reforestation plan approved by:

Signature _____ Date 3/6/07

Print Name T. Patrick Shillington

Title Engineer

Agency Engineering & Environmental Science Company

Correspondence

Brickhaven No.2 Mine Tract “A”

Charah, Inc.

Moncure, 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

Brickhaven No.2 Mine Tract “A”

Charah, Inc.

Moncure, 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 Moncure Mine Structural Fill	Computed By:	TMY	Date:	11/6/2014
Subject:	Permit Application	Checked By:	K. Perera	Date:	11/7/2014
Task:	Slope Stability Analyses	Sheet:	1	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 in unmined areas of the site consists of approximately 5' soil horizon consisting of medium to very stiff silty and sandy clay soils underlain by approximately 10' to 20' of stiff to very stiff residuum. Very hard partially weathered rock (PWR) underlies the residuum. In areas that have been mined, the soil horizon has typically been removed leaving residuum at the surface. 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 typically classified as "very hard" with blowcounts generally in excess of 50/6in and often contains rock fragments, it is assumed the material behaves as a very dense sand (see Attachment D). Since the soil horizon and residuum 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
Partially Weathered Rock (PWR): γ = 135 pcf, φ = 35

4. Estimate soil parameters for the compacted soil berm that will be constructed along the perimeter of the structural fill and to fill low areas to achieve basegrades. 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

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

HDR Computation

Project:	Charah Moncure Mine Structural Fill	Computed By:	TMY	Date:	11/6/2014
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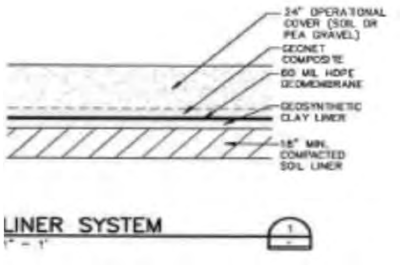
compaction of the final cover probably can not be achieved without the risk of damaging the underlying geomembrane, conservatively assume the following parameters:

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, two potential critical stability sections were selected for analysis. Section A is located on the west perimeter berm at a topographic low. Section B is located on the east perimeter berm and extends through the currently flooded pit at a location where the perimeter berm will be constructed across the pit. The locations of these sections are shown superimposed on the Basegrade Plan (Attachment H), the Proposed Final Closure Plan (Attachment I), and a groundwater contour map (Attachment J). These sections represent areas with the greatest depth of waste that will be placed resulting in the greatest amount of driving forces leading to potential failure, areas where the perimeter berm will be constructed above existing grade resulting in less buttressing effect at the toe of the slope, and areas with the greatest liner slopes resulting in greater potential for liner interface instability.

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 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 for Section A and Section B. The minimum factors of safety are summarized in the table below. The most critical analysis was for the Section A global failure under total stress conditions with factors of safety of 4.13 and 2.63 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.

HDR Computation

Project:	Charah Moncure Mine Structural Fill	Computed By:	TMY	Date:	11/6/2014
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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.

Analysis	Static FS	Seismic FS	
SECTION A			
Global/Static/Total Stress	4.13	2.63	←Critical Analysis
Global/Static/Effective Stress	4.56	2.87	
Ash Slope/Static/Total Stress	6.47	4.52	
Ash Slope/Static/Effective Stress	6.84	4.72	
Sliding Block/Static/Total Stress	6.96	4.68	
Sliding Block/Static/Effective Stress	5.75	3.98	
SECTION B			
Global/Static/Total Stress	5.71	3.54	
Global/Static/Effective Stress	5.39	3.37	
Ash Slope/Static/Total Stress	8.06	5.26	
Ash Slope/Static/Effective Stress	7.13	4.94	
Sliding Block/Static/Total Stress	5.71	4.00	
Sliding Block/Static/Effective Stress	4.93	3.43	

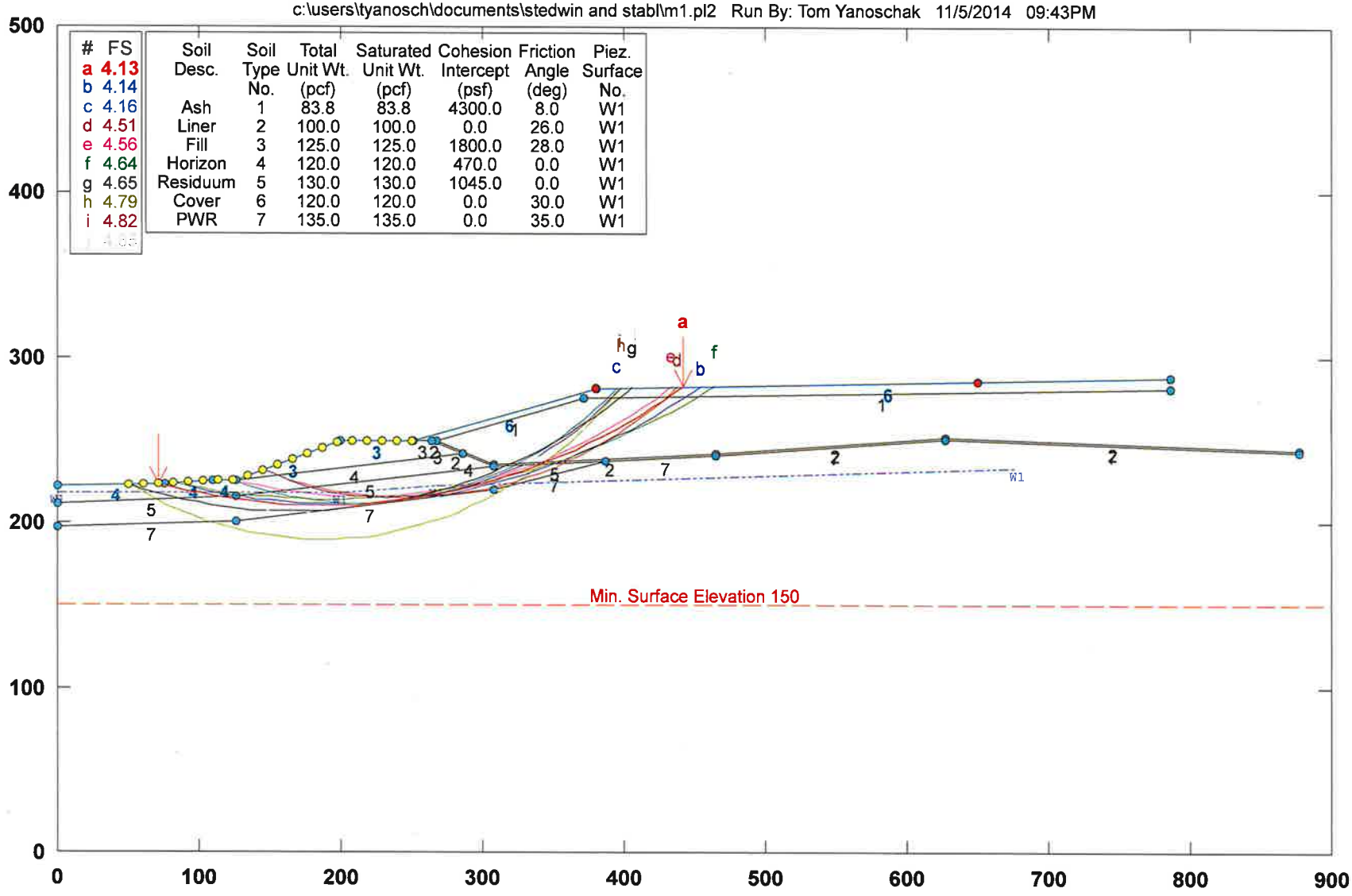
Minimum φ Required for Static FS = 1.5	0˚
Minimum φ Required for Seismic FS = 1.0	0˚

Moncure Mine Structural Fill - Section AGlobal - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m1.pl2 Run By: Tom Yanoschak 11/5/2014 09:43PM

#	FS
a	4.13
b	4.14
c	4.16
d	4.51
e	4.56
f	4.64
g	4.65
h	4.79
i	4.82

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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=4.13

Safety Factors Are Calculated By The Modified Bishop Method

SECTION A

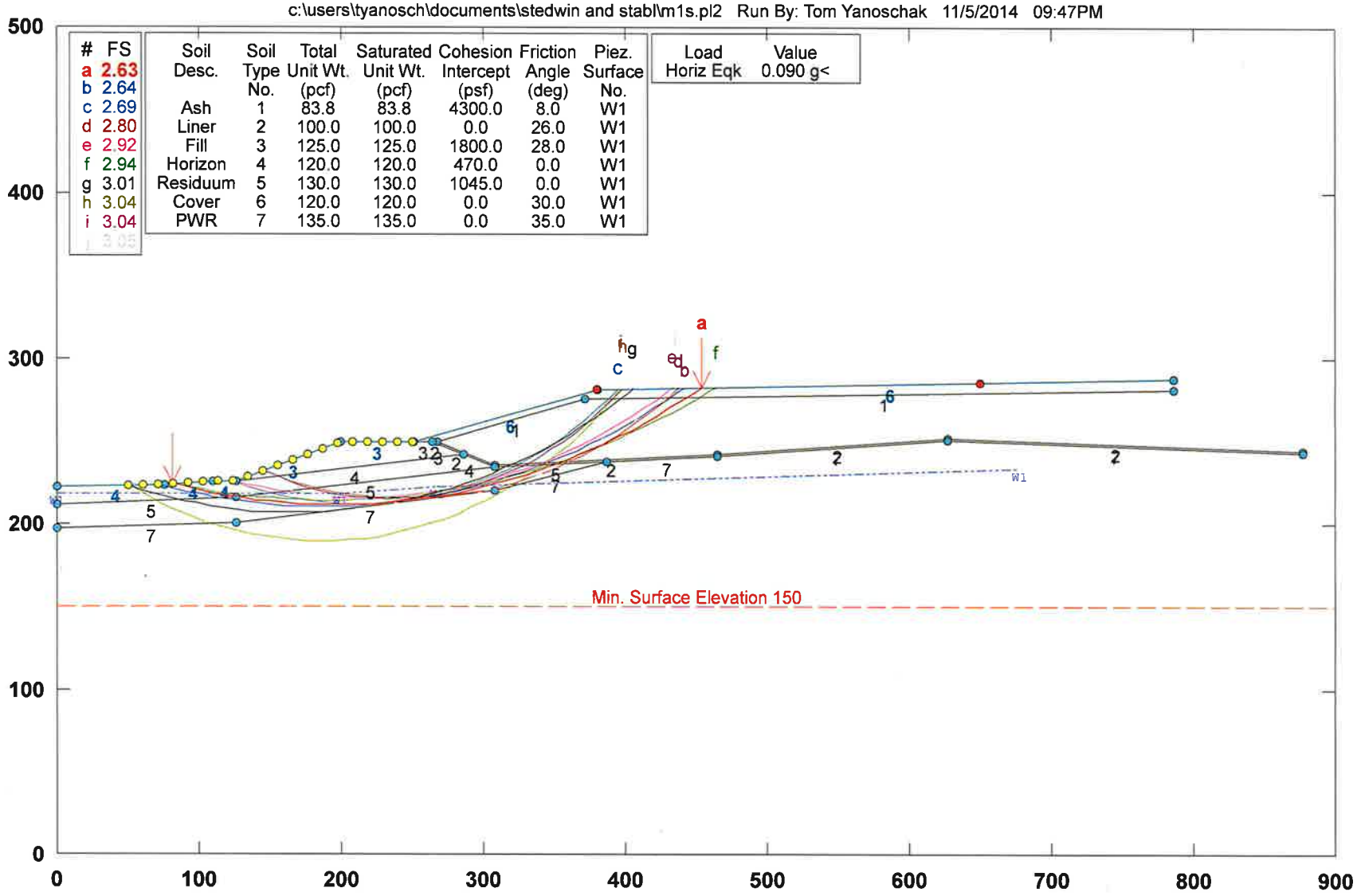
Moncure Mine Structural Fill - Section AGlobal - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m1s.pl2 Run By: Tom Yanoschak 11/5/2014 09:47PM

#	FS
a	2.63
b	2.64
c	2.69
d	2.80
e	2.92
f	2.94
g	3.01
h	3.04
i	3.04

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=2.63

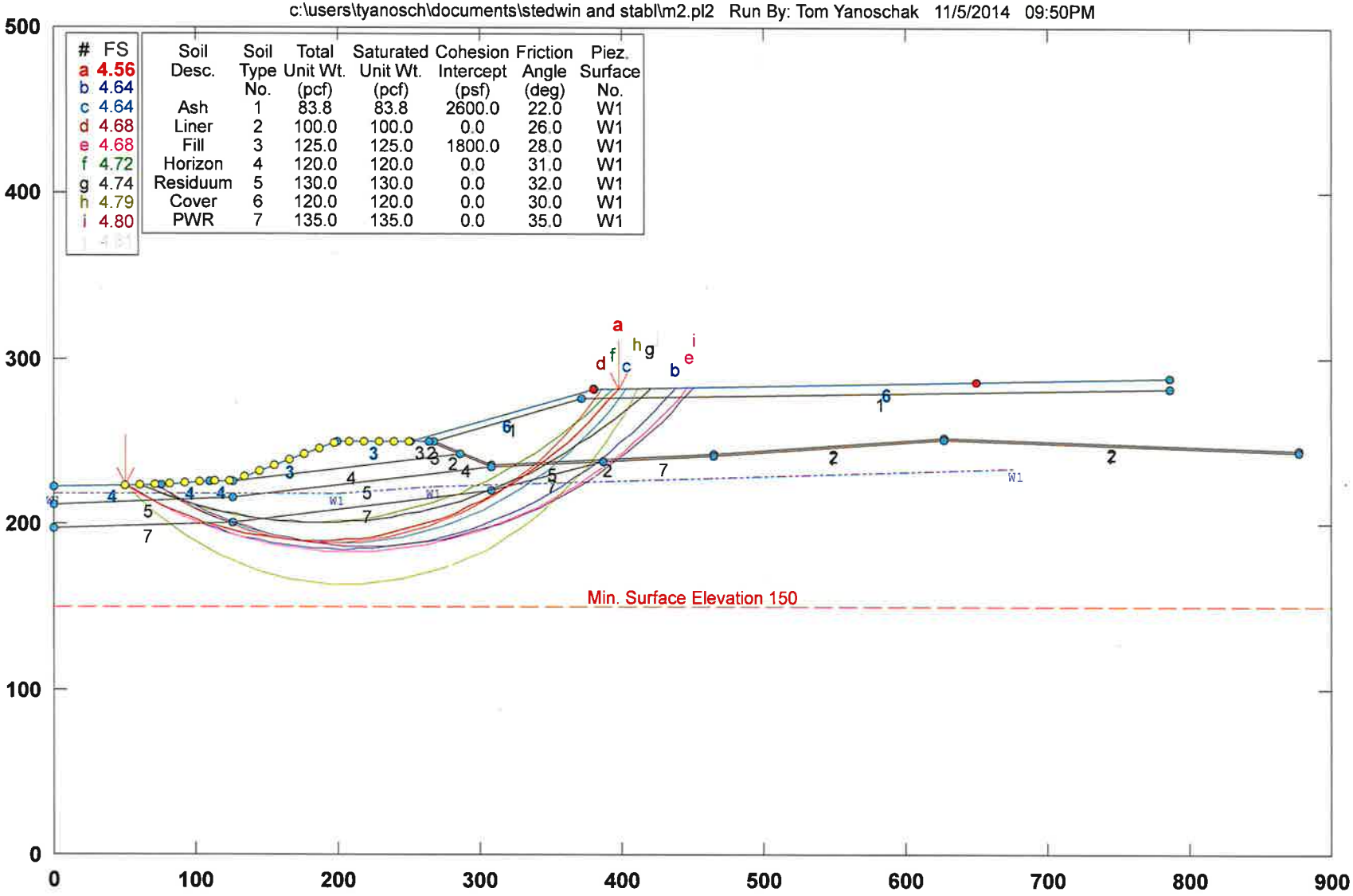
Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section AGlobal - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m2.pl2 Run By: Tom Yanoschak 11/5/2014 09:50PM

#	FS
a	4.56
b	4.64
c	4.64
d	4.68
e	4.68
f	4.72
g	4.74
h	4.79
i	4.80

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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=4.56

Safety Factors Are Calculated By The Modified Bishop Method

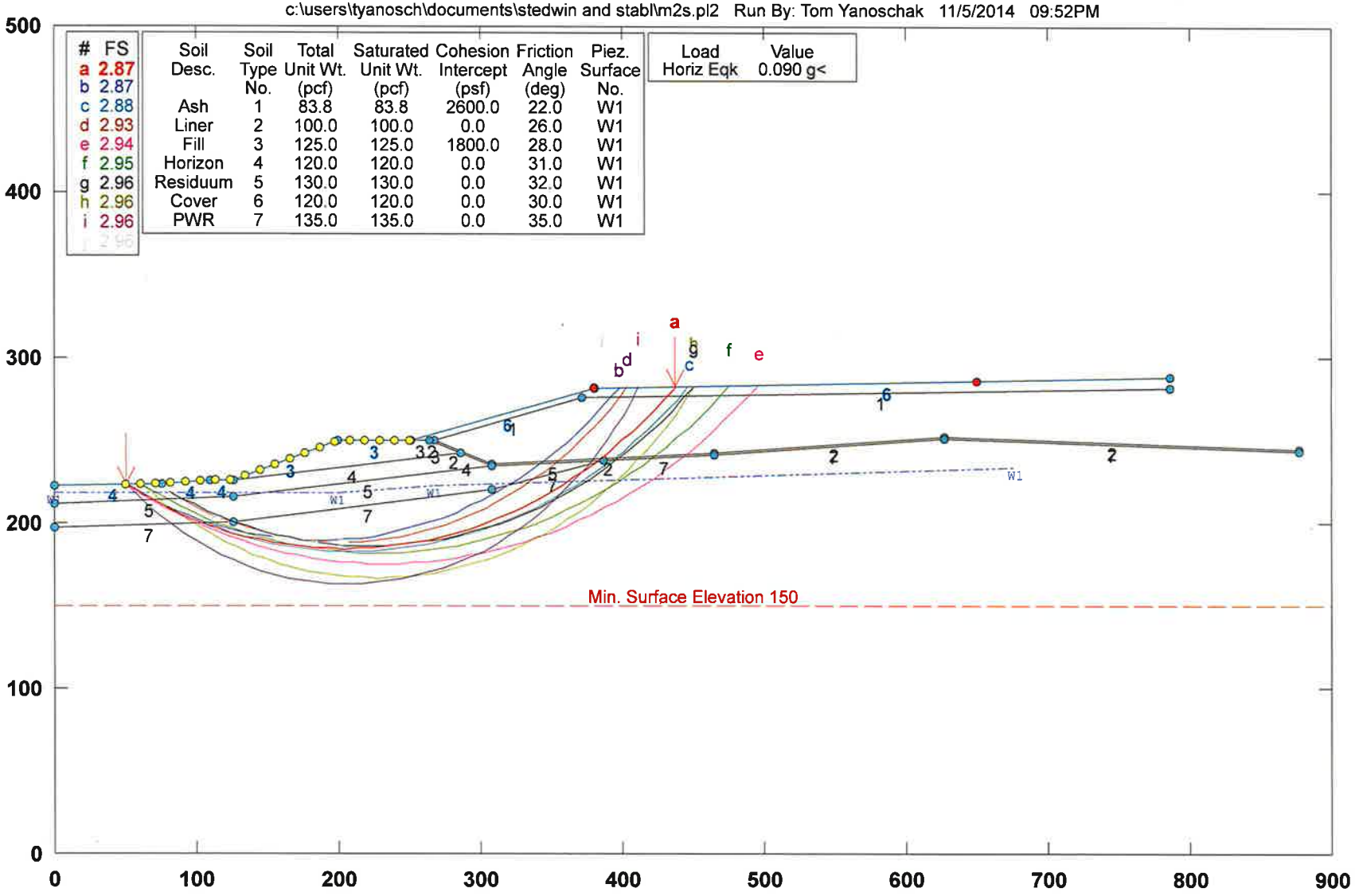
Moncure Mine Structural Fill - Section AGlobal - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m2s.pl2 Run By: Tom Yanoschak 11/5/2014 09:52PM

#	FS
a	2.87
b	2.87
c	2.88
d	2.93
e	2.94
f	2.95
g	2.96
h	2.96
i	2.96

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=2.87

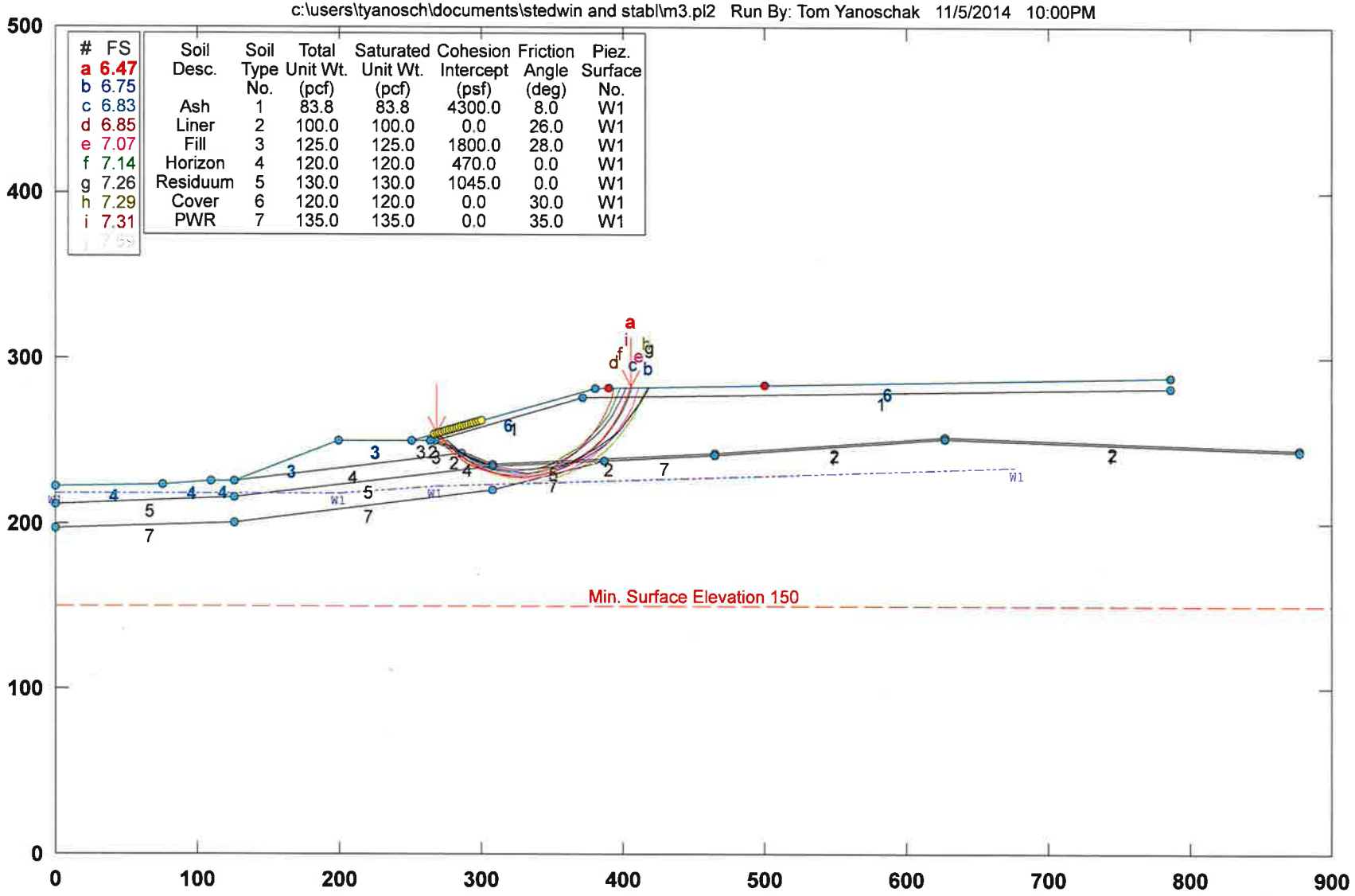
Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section AAsh Slope - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m3.pl2 Run By: Tom Yanoschak 11/5/2014 10:00PM

#	FS
a	6.47
b	6.75
c	6.83
d	6.85
e	7.07
f	7.14
g	7.26
h	7.29
i	7.31

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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=6.47

Safety Factors Are Calculated By The Modified Bishop Method

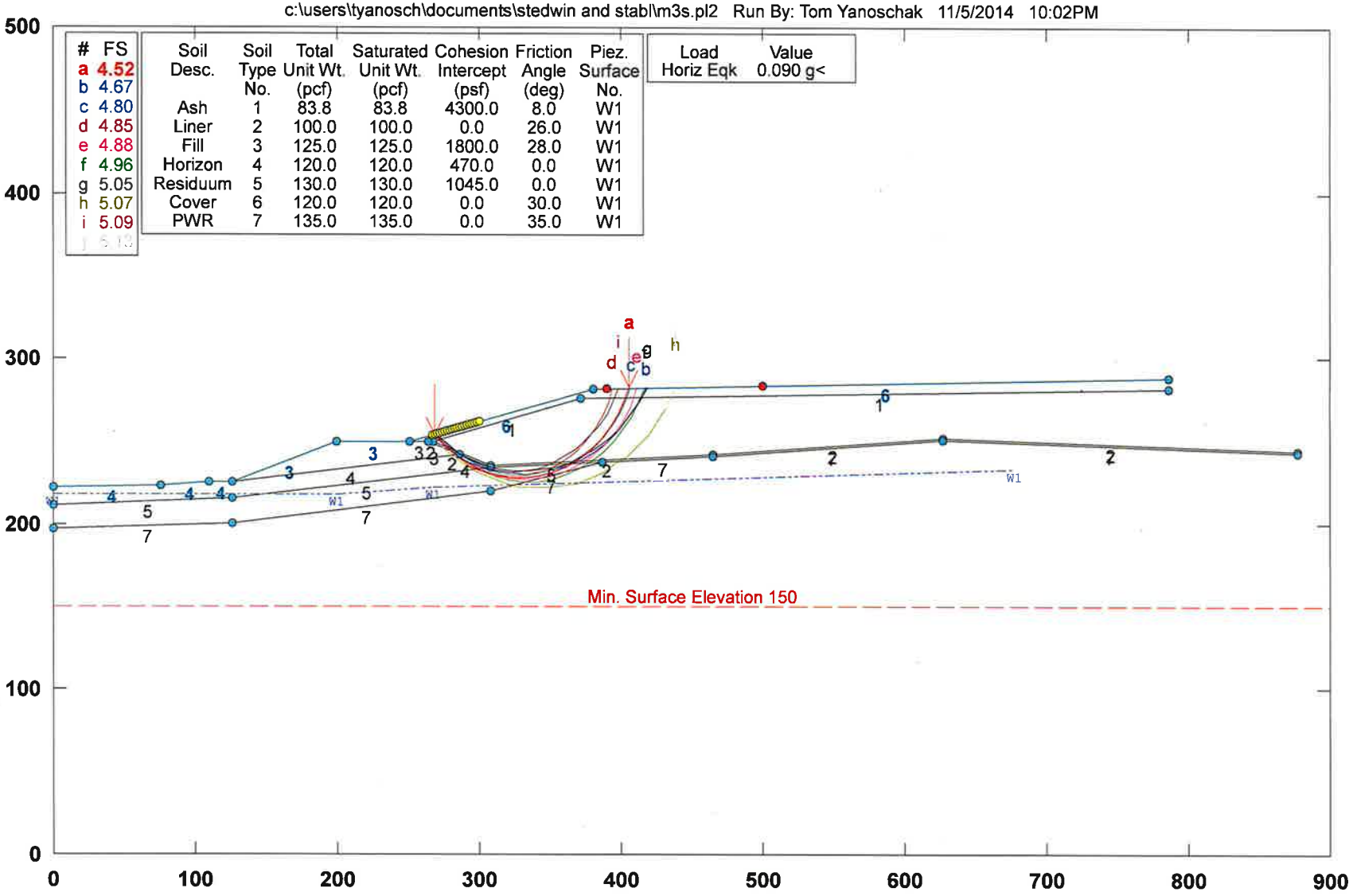
Moncure Mine Structural Fill - Section AAsh Slope - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m3s.pl2 Run By: Tom Yanoschak 11/5/2014 10:02PM

#	FS
a	4.52
b	4.67
c	4.80
d	4.85
e	4.88
f	4.96
g	5.05
h	5.07
i	5.09

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=4.52

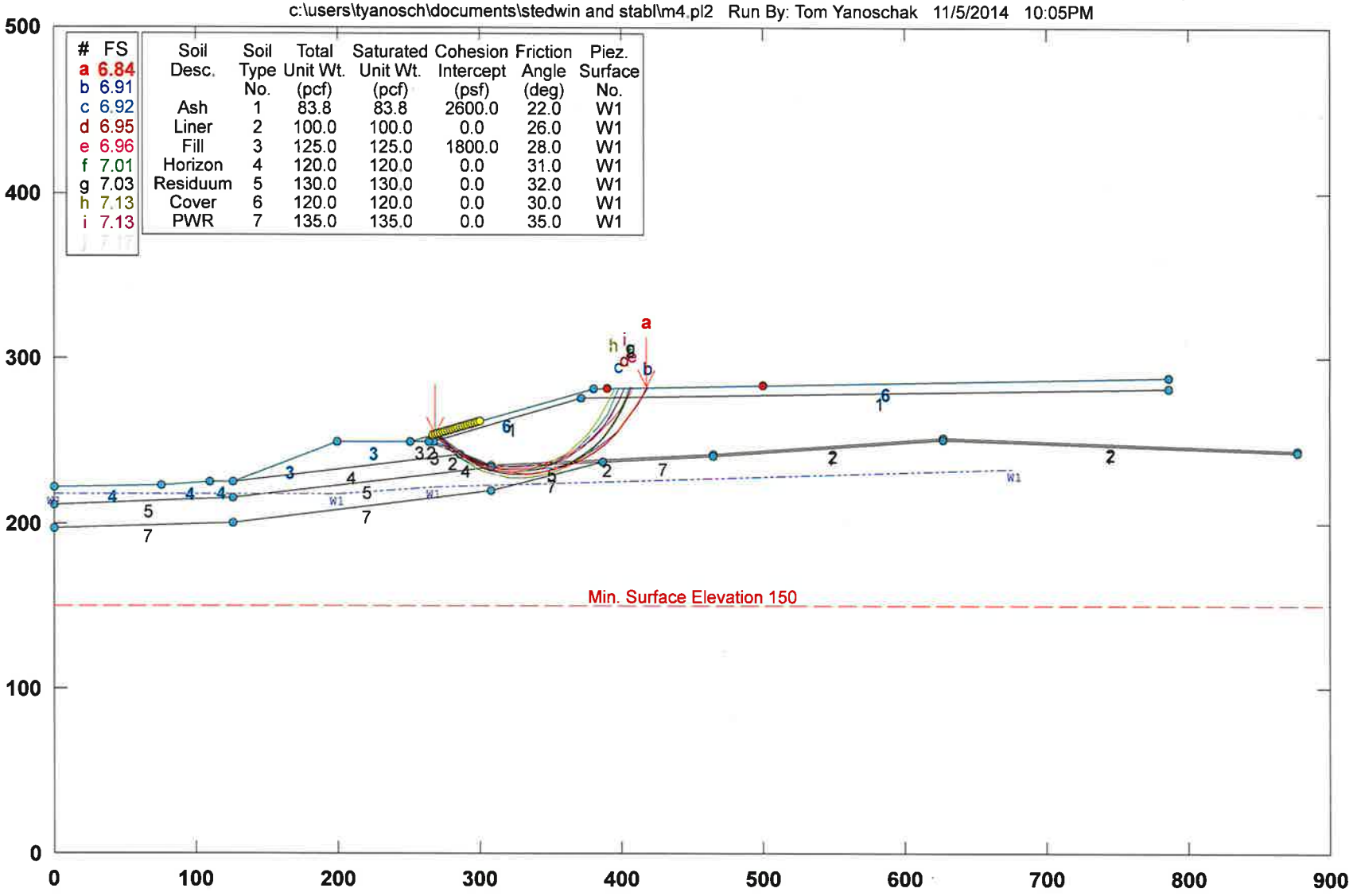
Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section AAsh Slope - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m4.pl2 Run By: Tom Yanoschak 11/5/2014 10:05PM

#	FS
a	6.84
b	6.91
c	6.92
d	6.95
e	6.96
f	7.01
g	7.03
h	7.13
i	7.13

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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=6.84

Safety Factors Are Calculated By The Modified Bishop Method

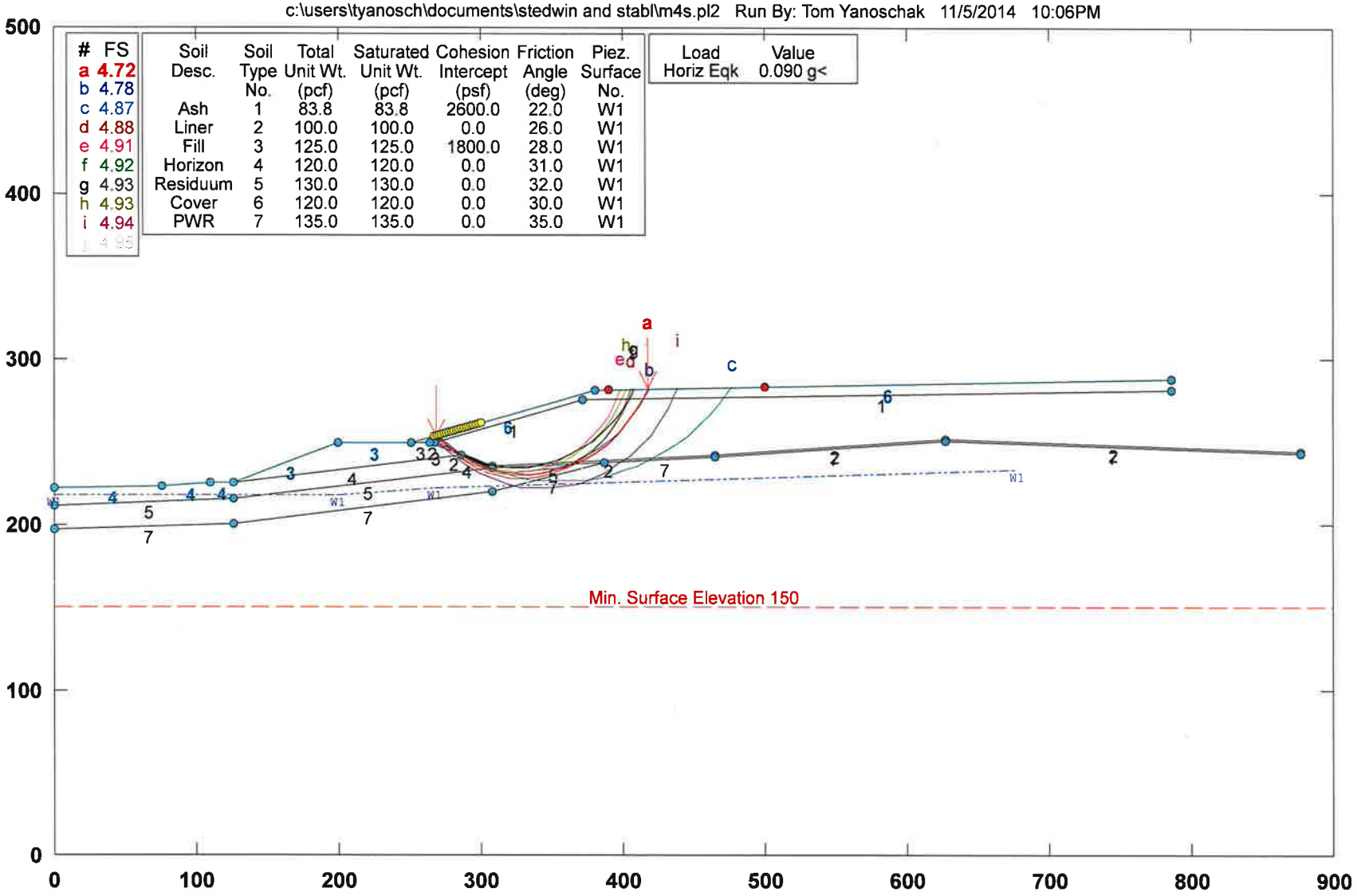
Moncure Mine Structural Fill - Section AAsh Slope - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m4s.pl2 Run By: Tom Yanoschak 11/5/2014 10:06PM

#	FS
a	4.72
b	4.78
c	4.87
d	4.88
e	4.91
f	4.92
g	4.93
h	4.93
i	4.94

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=4.72

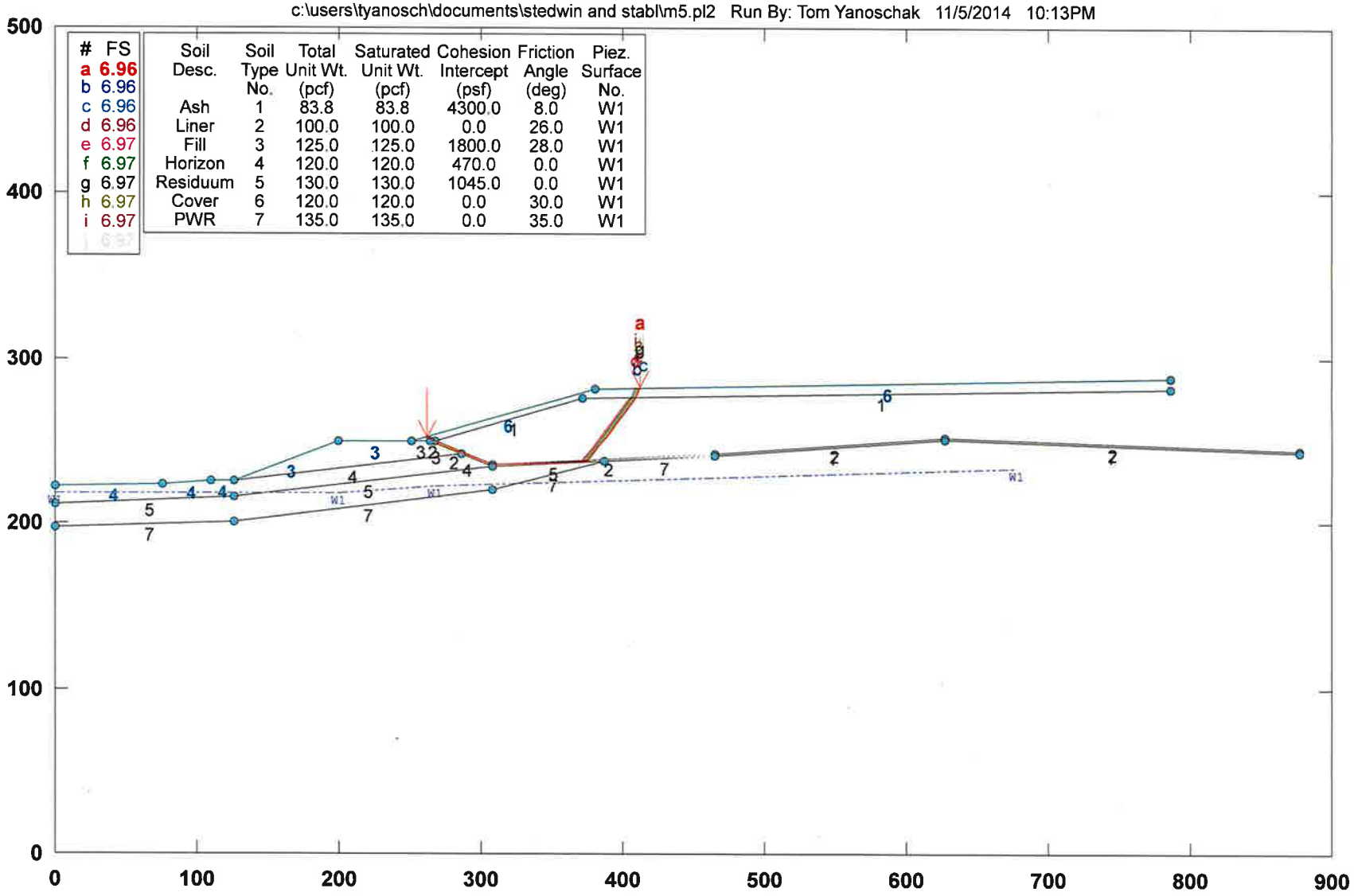
Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section ABlock - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m5.pl2 Run By: Tom Yanoschak 11/5/2014 10:13PM

#	FS
a	6.96
b	6.96
c	6.96
d	6.96
e	6.97
f	6.97
g	6.97
h	6.97
i	6.97

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
PWR	7	135.0	135.0	0.0	35.0	W1

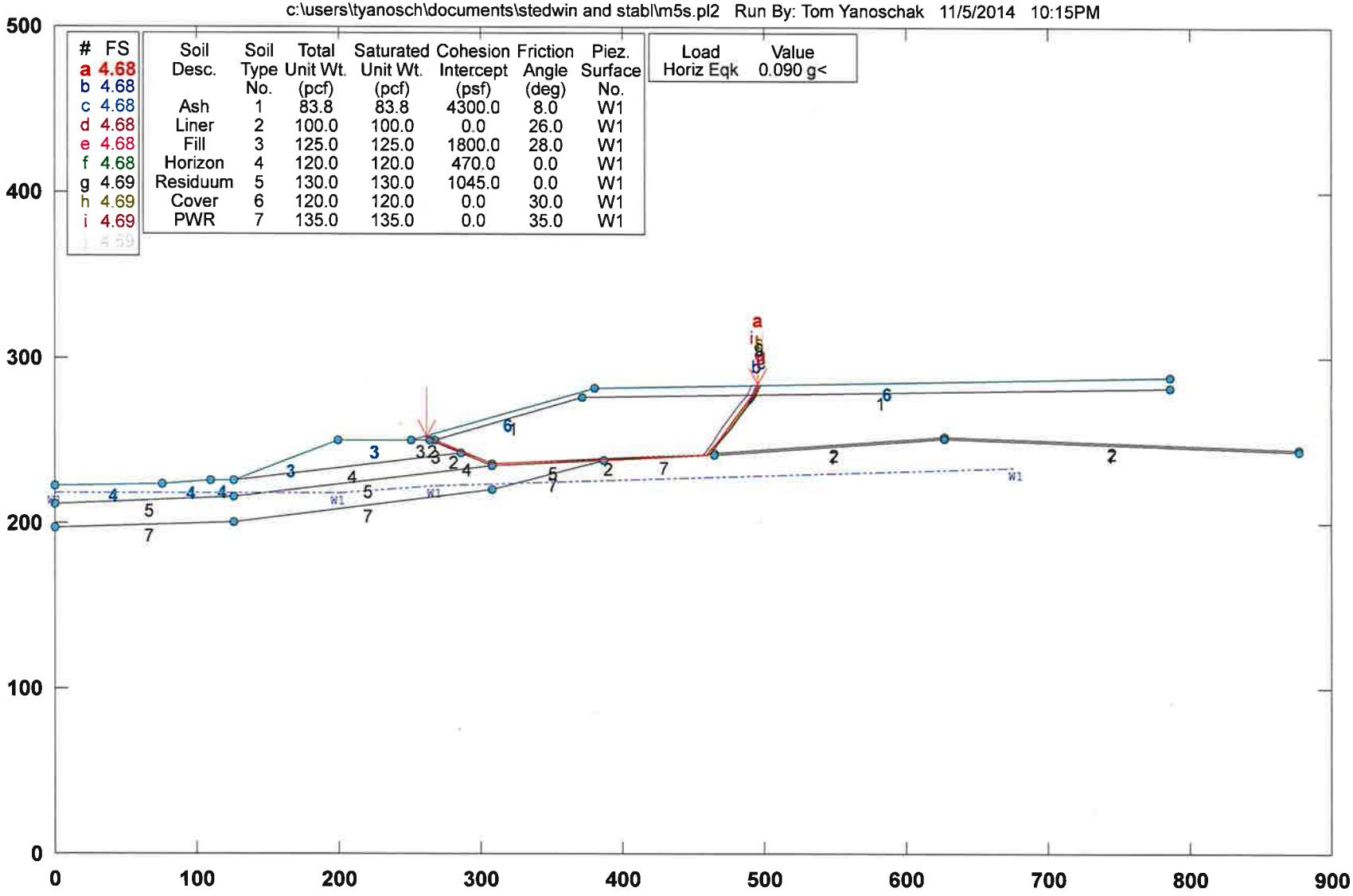


PCSTABL5M/si FSmin=6.96

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

Moncure Mine Structural Fill - Section ABlock - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m5s.pl2 Run By: Tom Yanoschak 11/5/2014 10:15PM



#	FS
a	4.68
b	4.68
c	4.68
d	4.68
e	4.68
f	4.68
g	4.69
h	4.69
i	4.69

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
PWR	7	135.0	135.0	0.0	35.0	W1

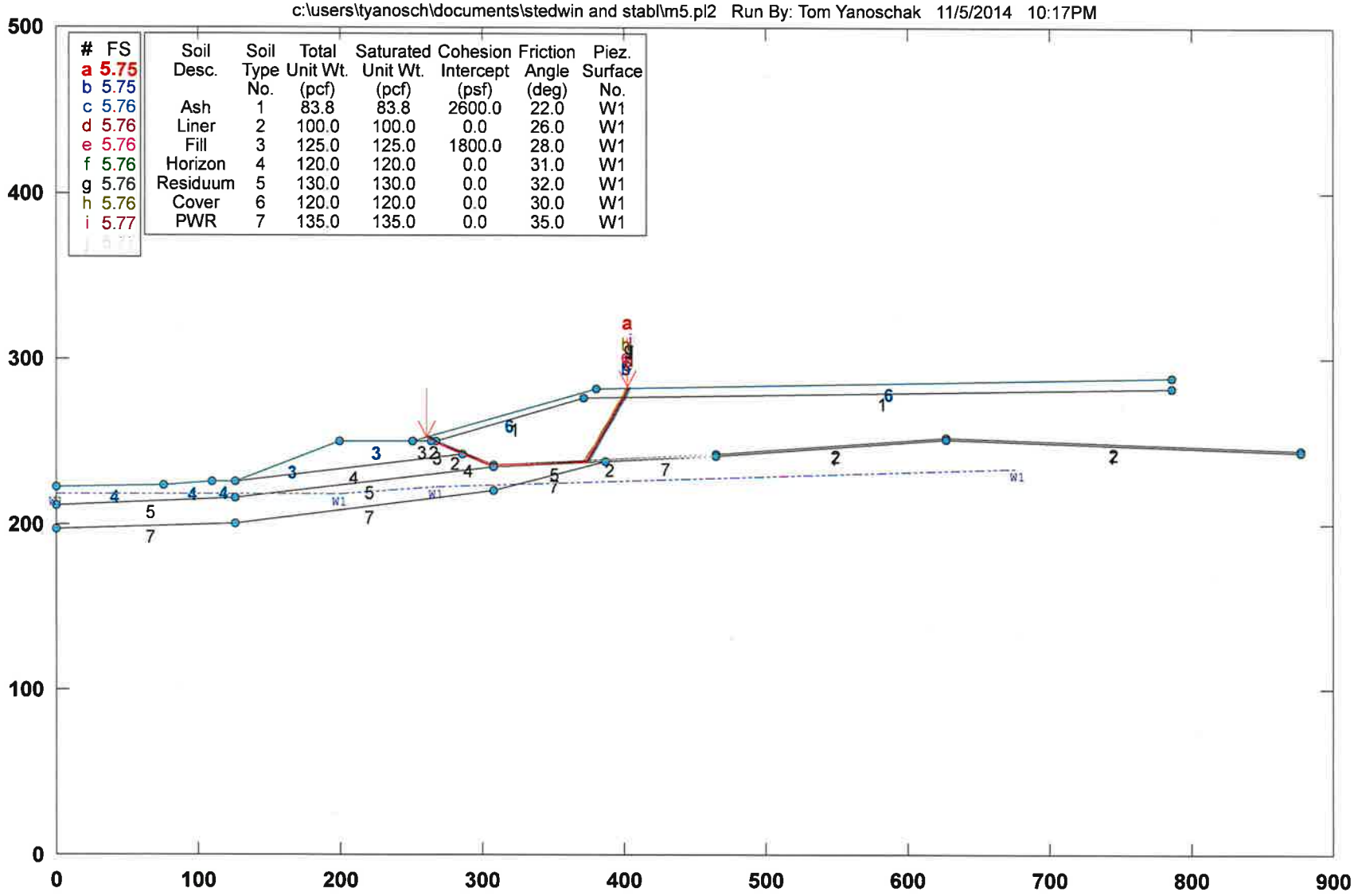
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=4.68

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

Moncure Mine Structural Fill - Section ABlock - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m5.pl2 Run By: Tom Yanoschak 11/5/2014 10:17PM



#	FS
a	5.75
b	5.75
c	5.76
d	5.76
e	5.76
f	5.76
g	5.76
h	5.76
i	5.77

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
PWR	7	135.0	135.0	0.0	35.0	W1

PCSTABL5M/si FSmin=5.75

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

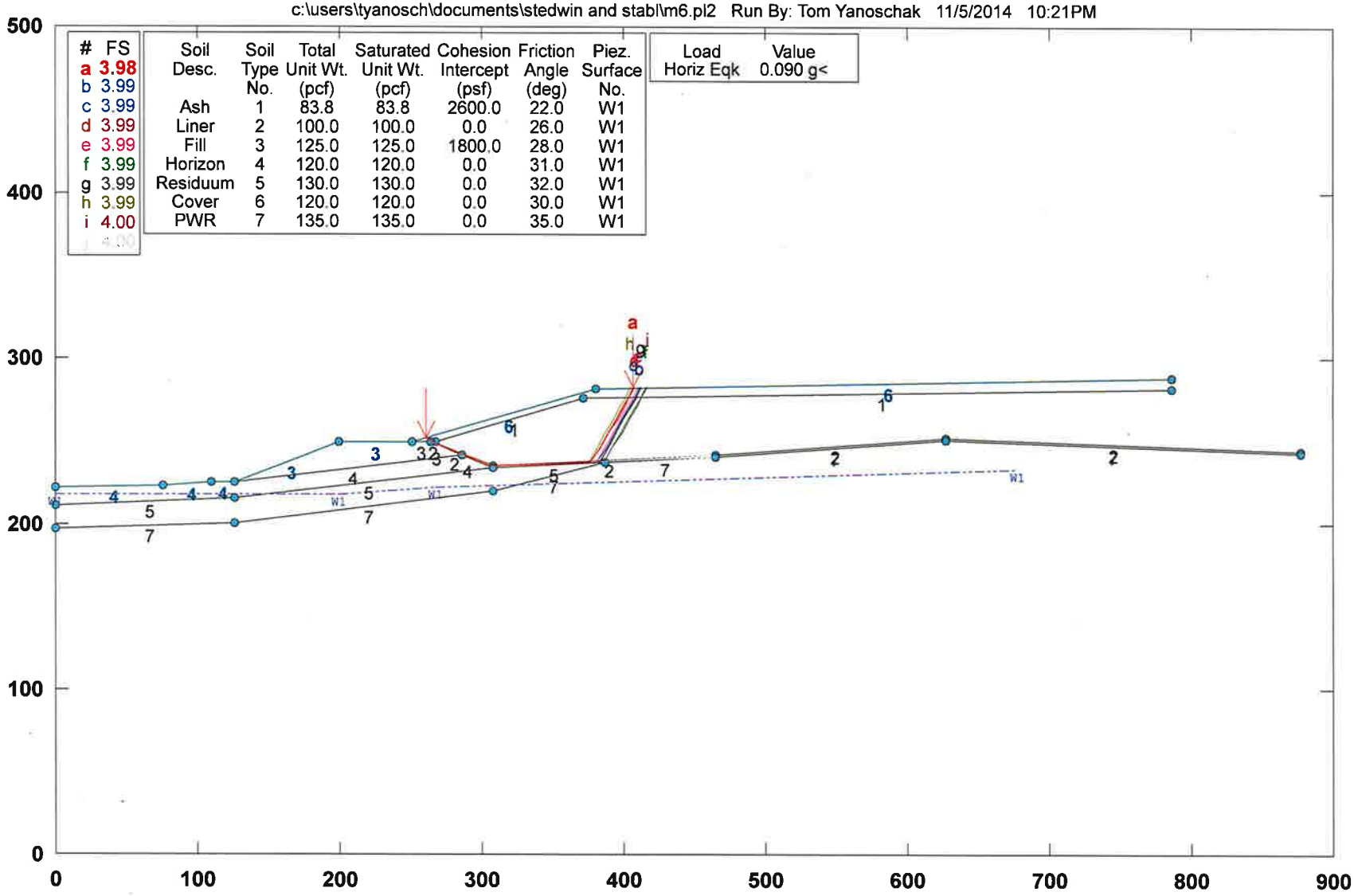
Moncure Mine Structural Fill - Section ABlock - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m6.pl2 Run By: Tom Yanoschak 11/5/2014 10:21PM

#	FS
a	3.98
b	3.99
c	3.99
d	3.99
e	3.99
f	3.99
g	3.99
h	3.99
i	4.00

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=3.98

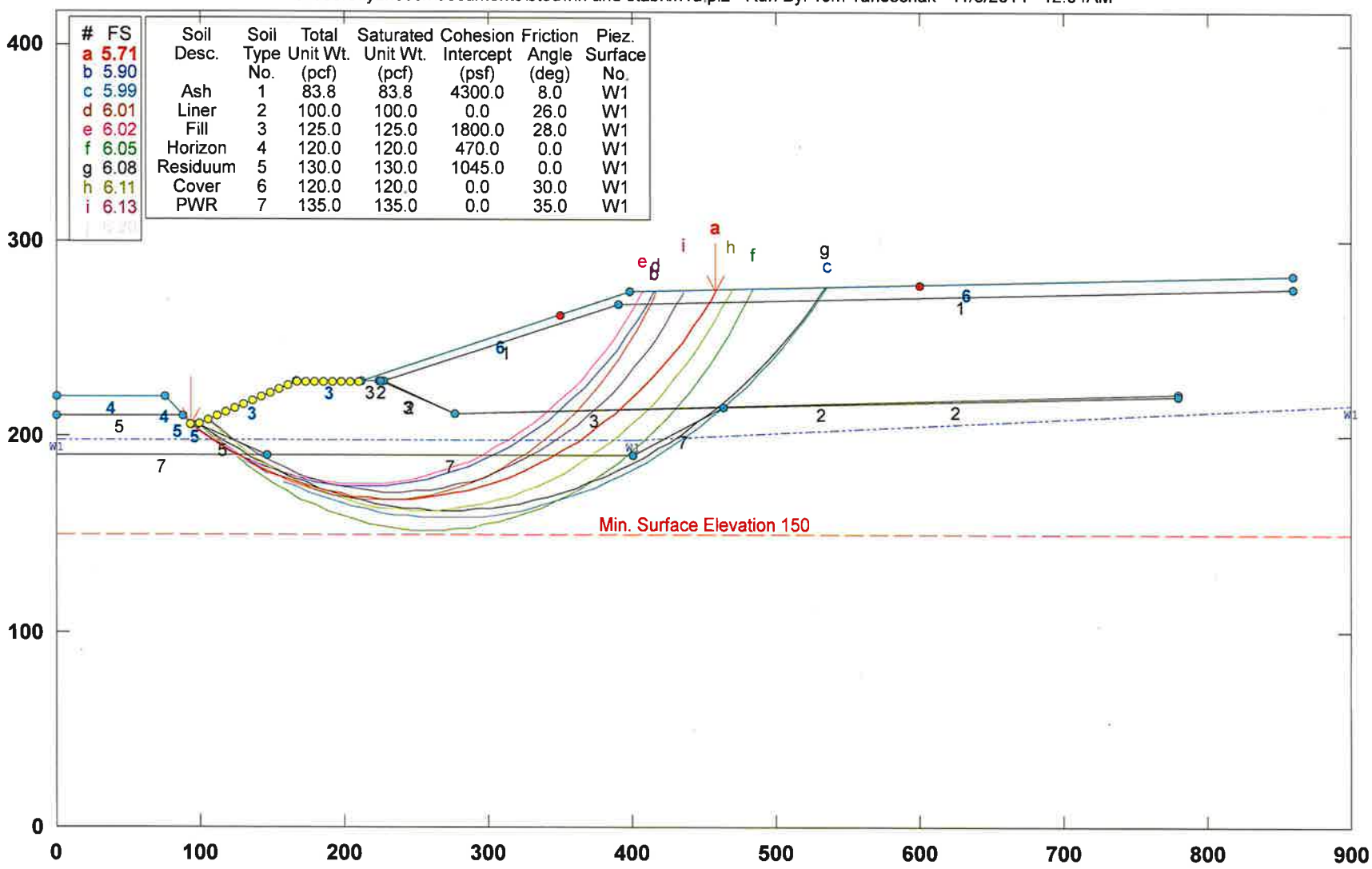
Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

Moncure Mine Structural Fill - Section BGlobal - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m1a.pl2 Run By: Tom Yanoschak 11/6/2014 12:04AM

#	FS
a	5.71
b	5.90
c	5.99
d	6.01
e	6.02
f	6.05
g	6.08
h	6.11
i	6.13

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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=5.71

Safety Factors Are Calculated By The Modified Bishop Method

SECTION B

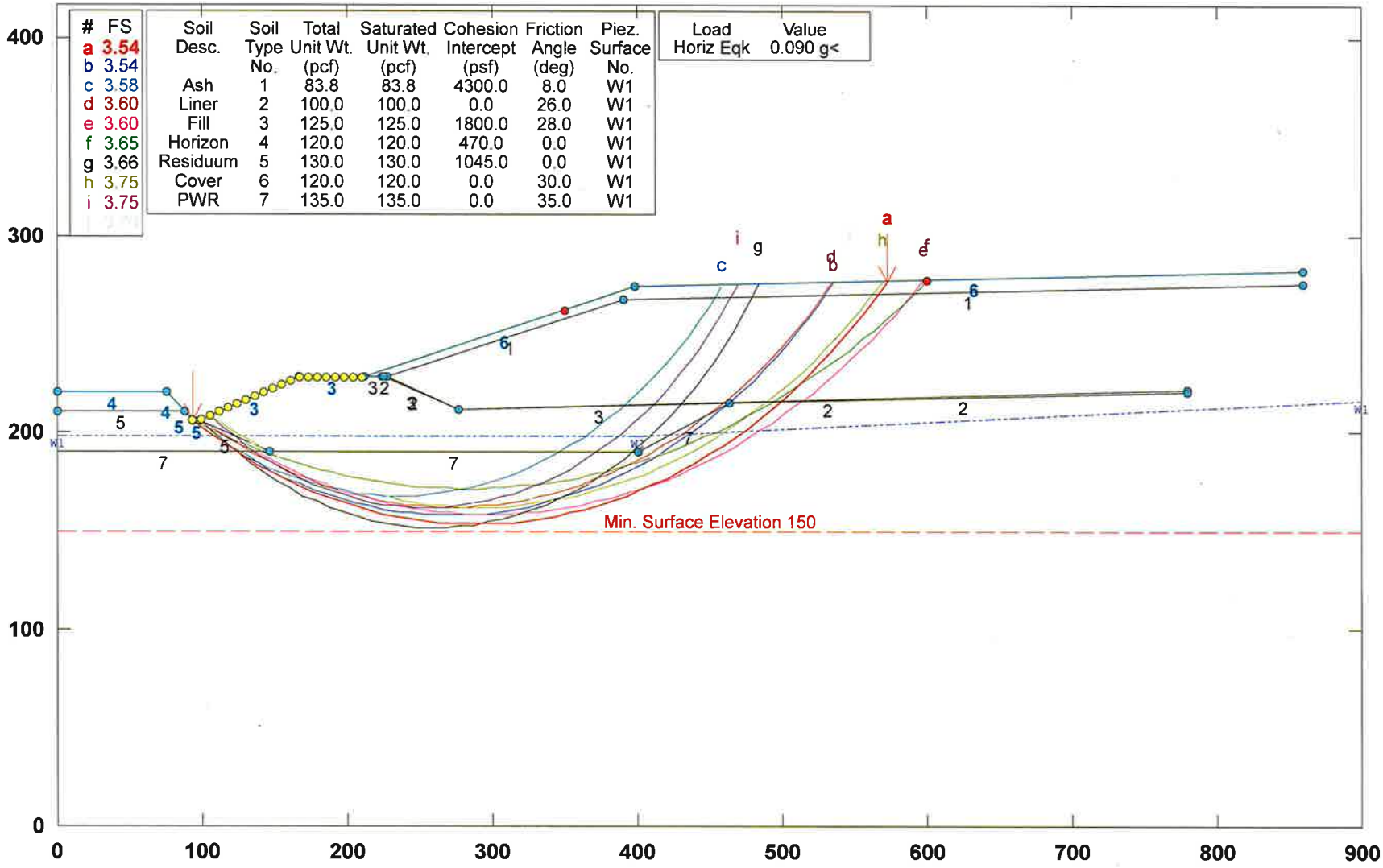
Moncure Mine Structural Fill - Section BGlobal - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m1as.pl2 Run By: Tom Yanoschak 11/6/2014 12:06AM

#	FS
a	3.54
b	3.54
c	3.58
d	3.60
e	3.60
f	3.65
g	3.66
h	3.75
i	3.75

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<

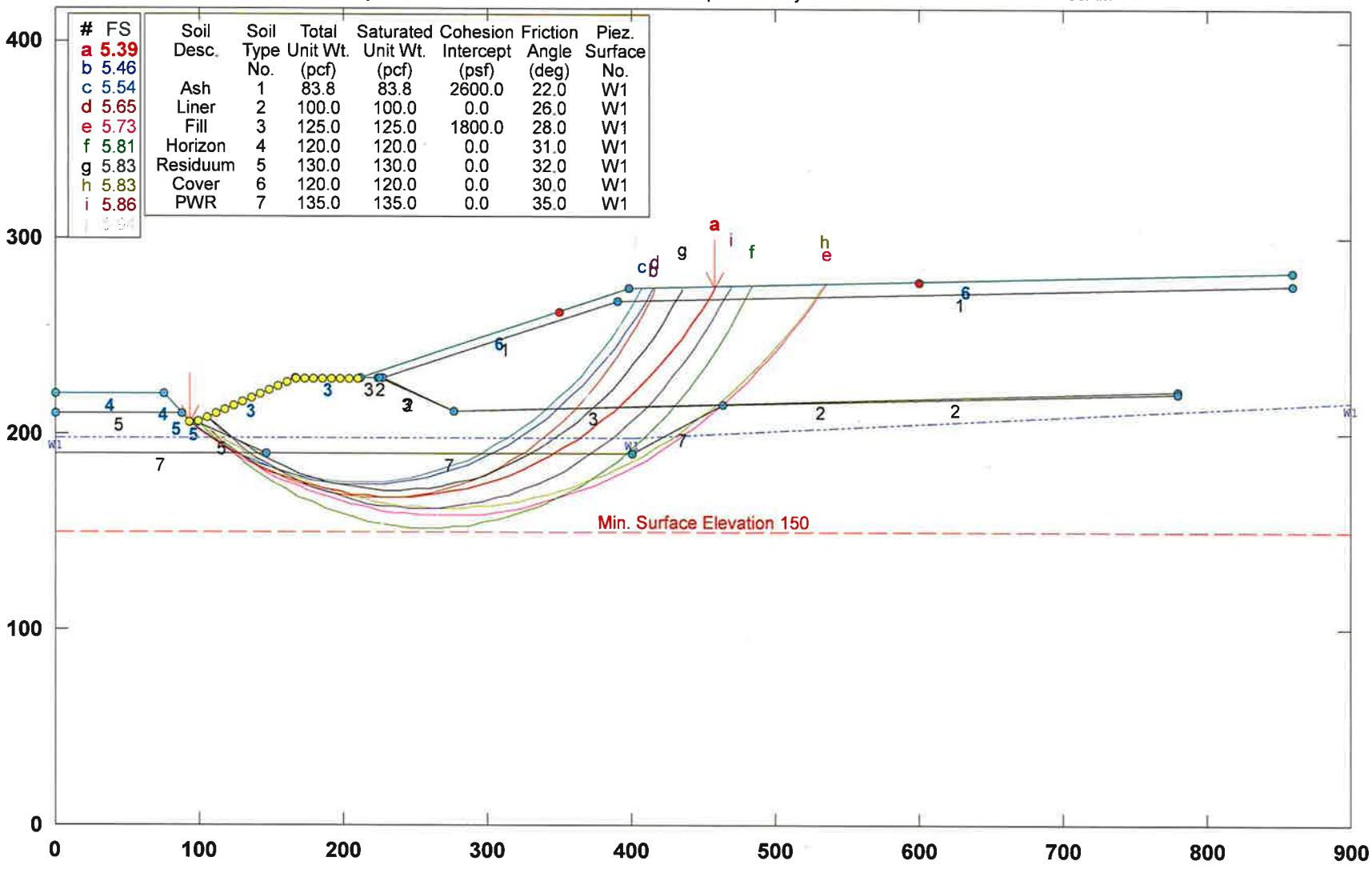


PCSTABL5M/si FSmin=3.54

Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section BGlobal - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m2a.pl2 Run By: Tom Yanoschak 11/6/2014 12:09AM



#	FS
a	5.39
b	5.46
c	5.54
d	5.65
e	5.73
f	5.81
g	5.83
h	5.83
i	5.86

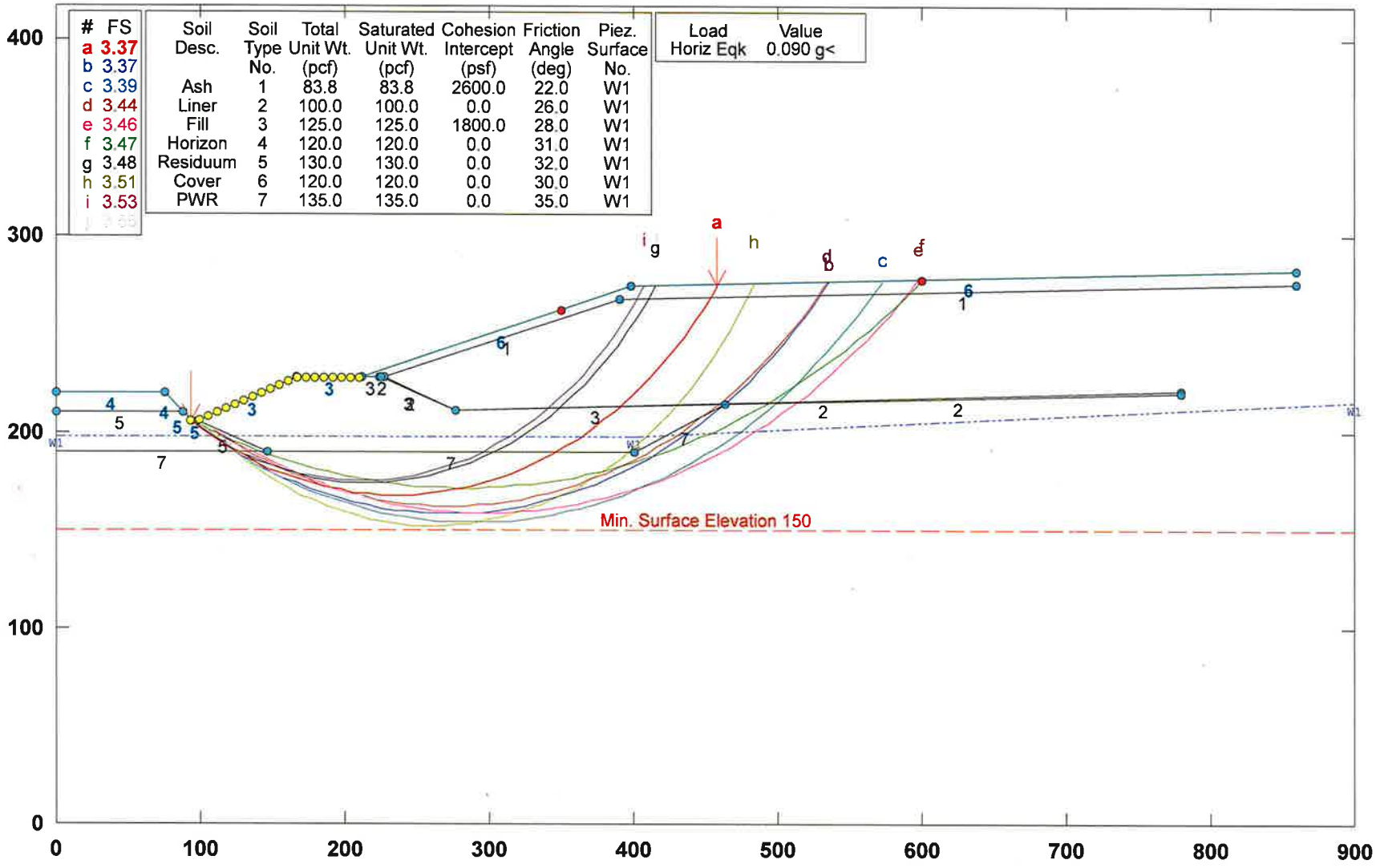
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1
PWR	7	135.0	135.0	0.0	35.0	W1

PCSTABL5M/si FSmin=5.39

Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section BGlobal - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m2as.pl2 Run By: Tom Yanoschak 11/6/2014 12:10AM



PCSTABL5M/si FSmin=3.37

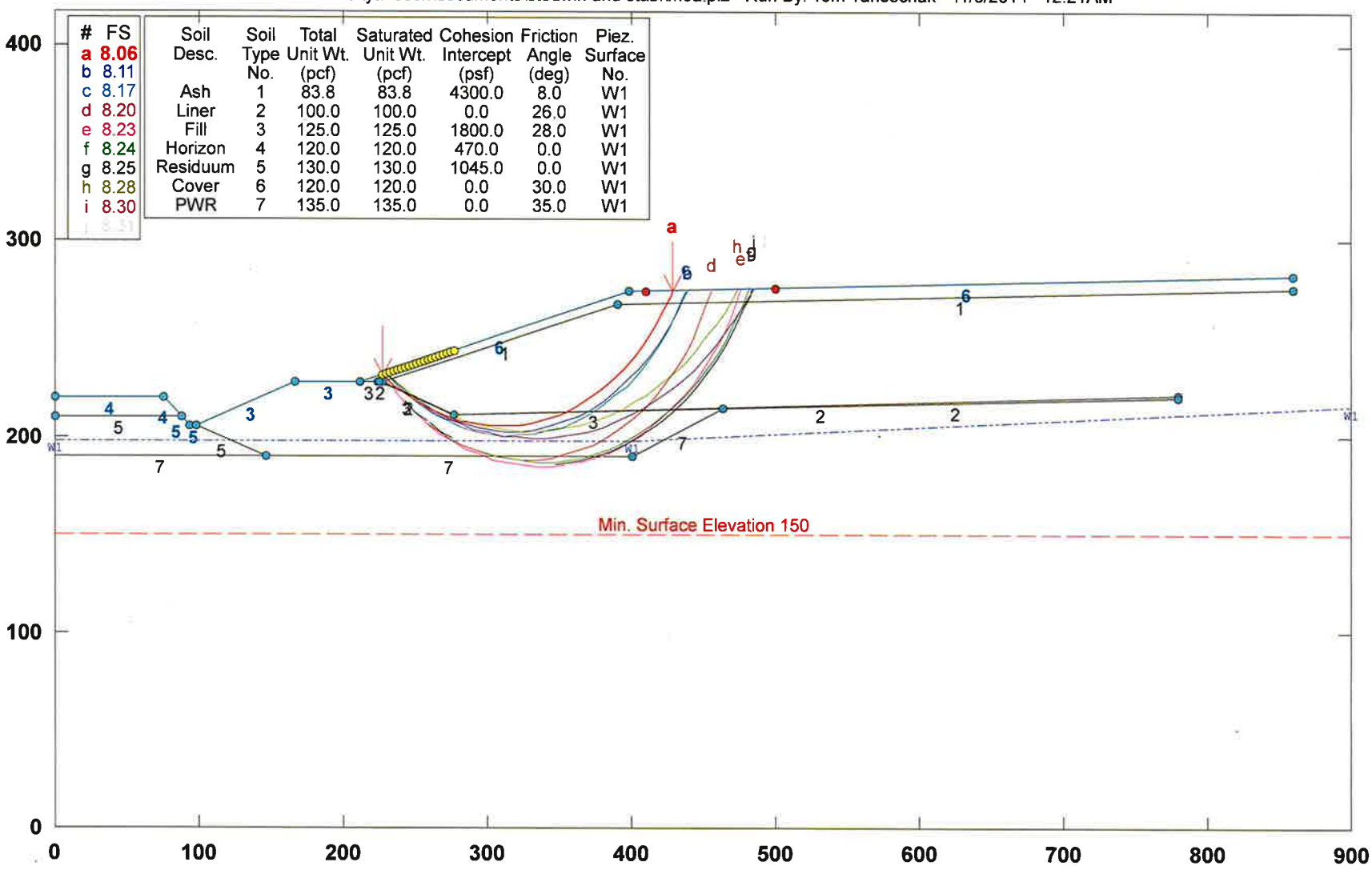
Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section BAsh Slope - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m3a.pl2 Run By: Tom Yanoschak 11/6/2014 12:21AM

#	FS
a	8.06
b	8.11
c	8.17
d	8.20
e	8.23
f	8.24
g	8.25
h	8.28
i	8.30

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	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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=8.06

Safety Factors Are Calculated By The Modified Bishop Method

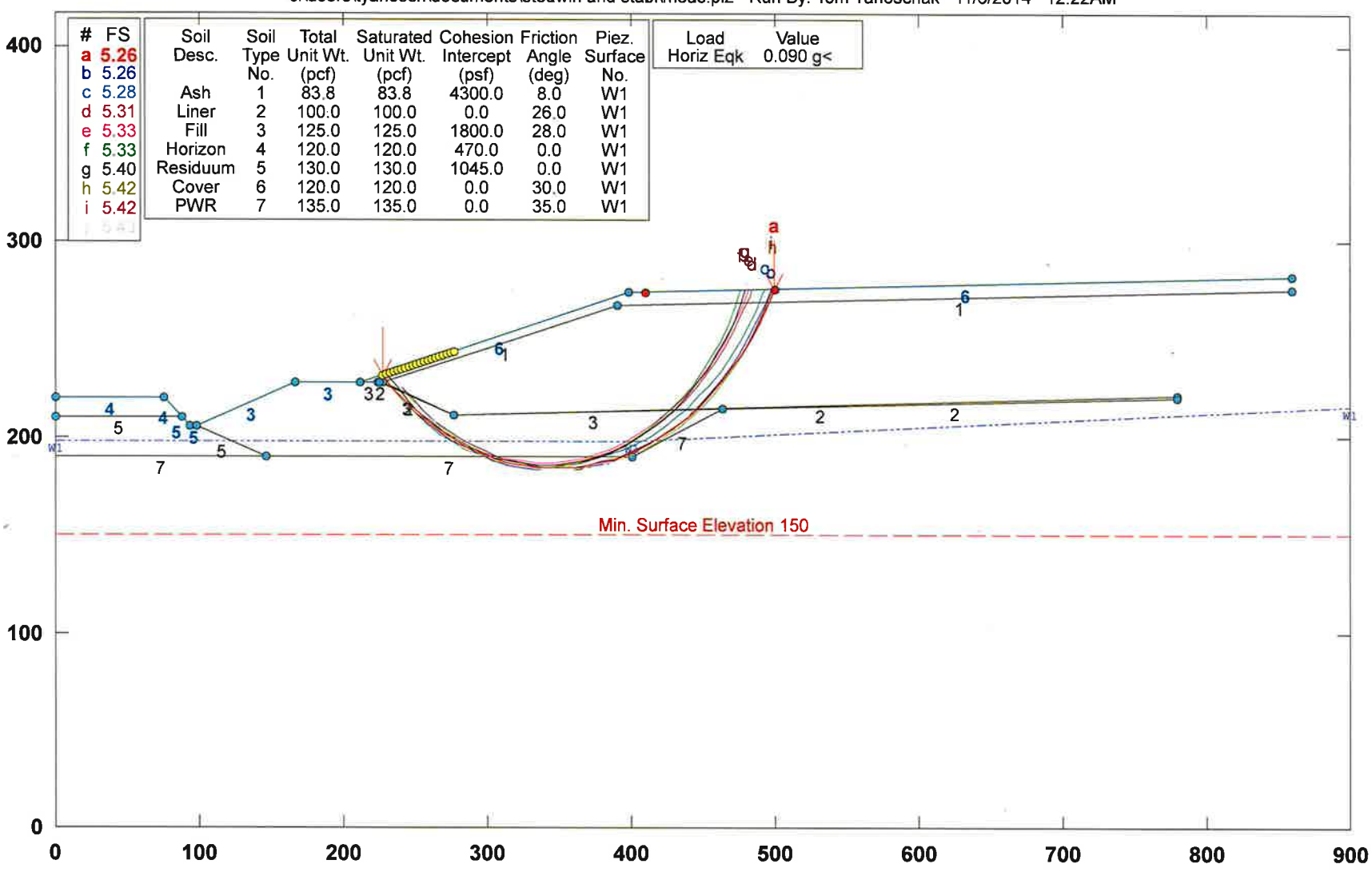
Moncure Mine Structural Fill - Section BAsh Slope - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m3as.pl2 Run By: Tom Yanoschak 11/6/2014 12:22AM

#	FS
a	5.26
b	5.26
c	5.28
d	5.31
e	5.33
f	5.33
g	5.40
h	5.42
i	5.42

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<

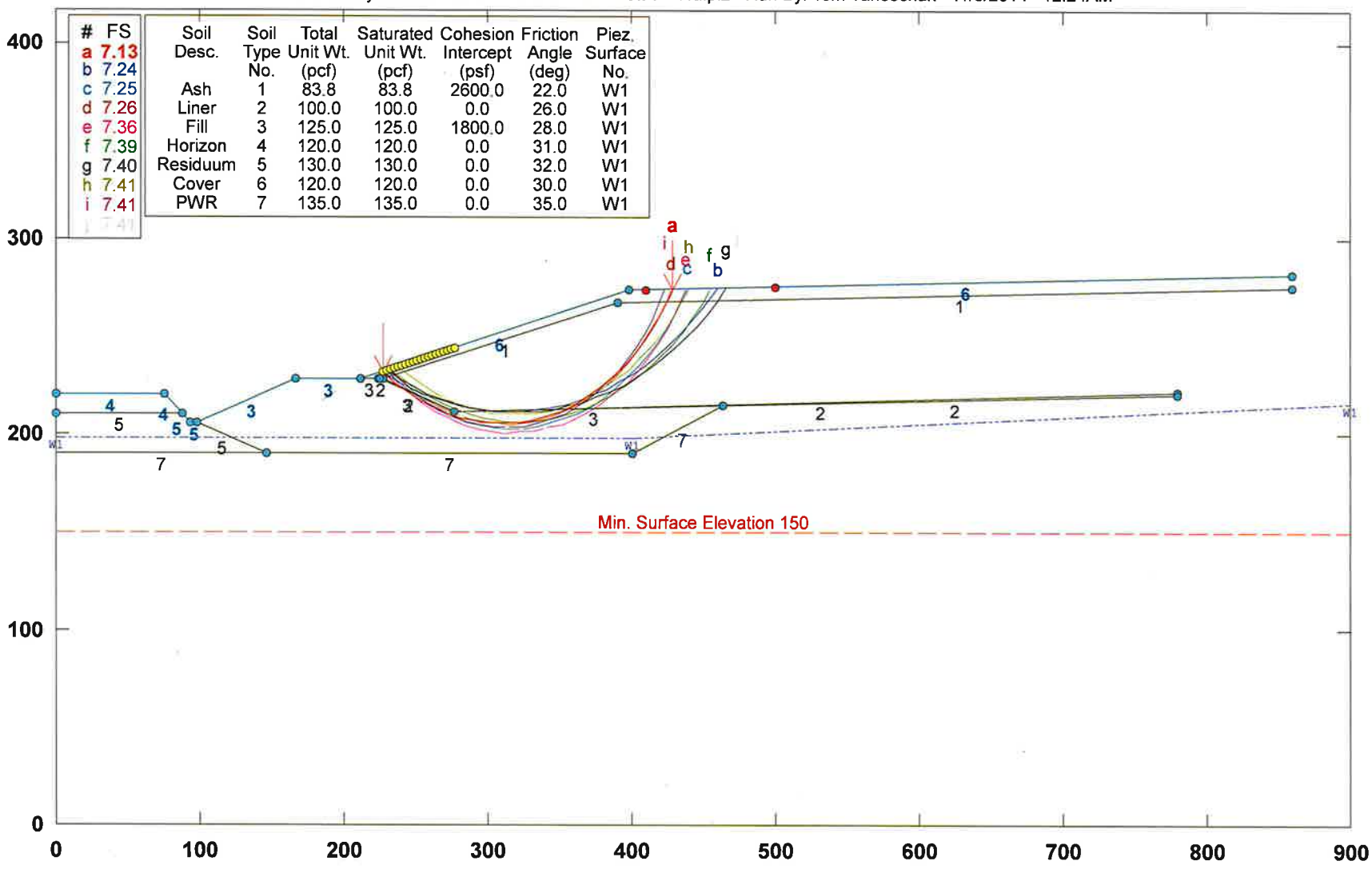


PCSTABL5M/si FSmin=5.26

Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section BAsh Slope - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m4a.pl2 Run By: Tom Yanoschak 11/6/2014 12:24AM



#	FS
a	7.13
b	7.24
c	7.25
d	7.26
e	7.36
f	7.39
g	7.40
h	7.41
i	7.41

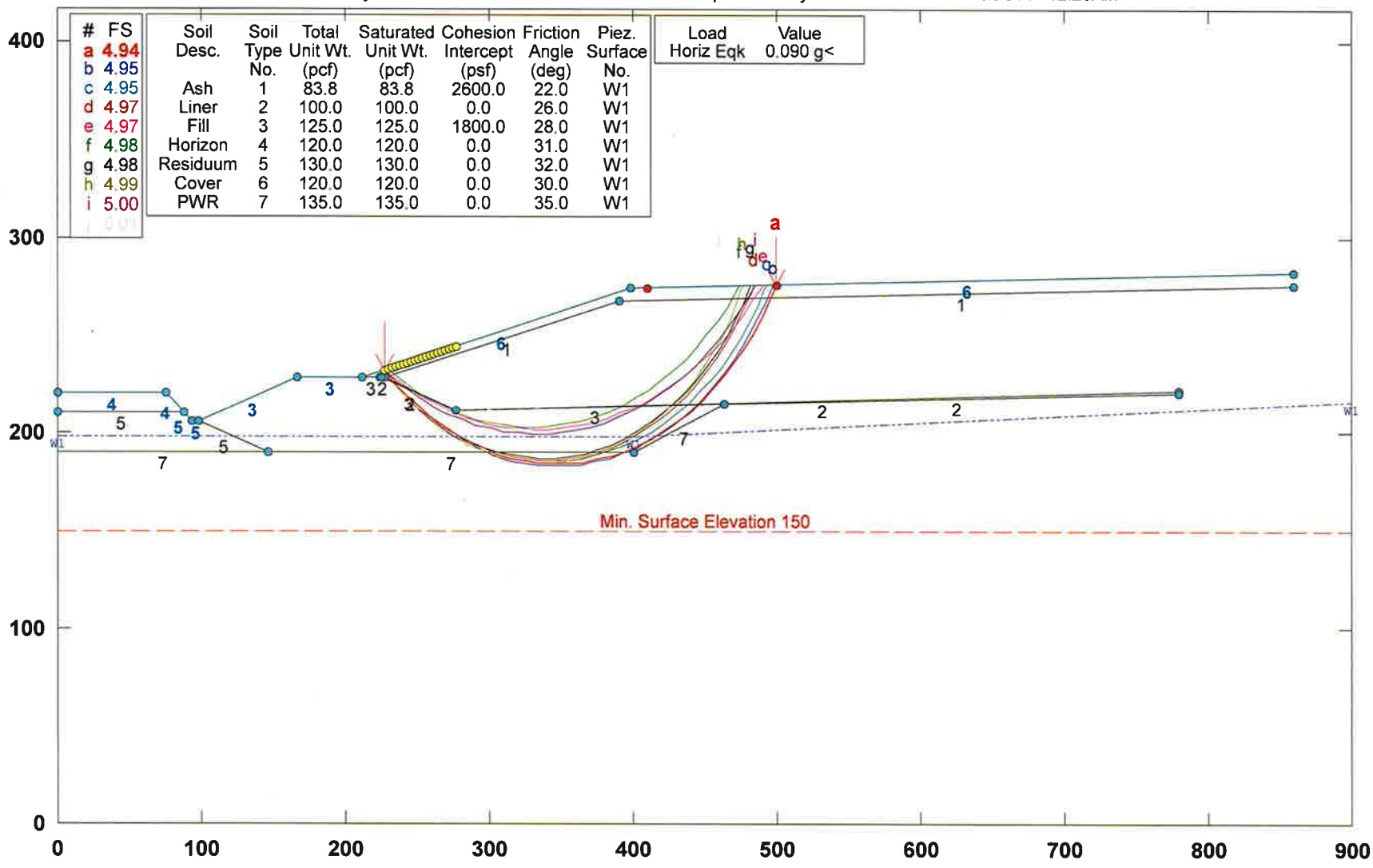
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1
PWR	7	135.0	135.0	0.0	35.0	W1

PCSTABL5M/si FSmin=7.13

Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section BAsh Slope - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m4as.pl2 Run By: Tom Yanoschak 11/6/2014 12:26AM



#	FS
a	4.94
b	4.95
c	4.95
d	4.97
e	4.97
f	4.98
g	4.98
h	4.99
i	5.00

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=4.94

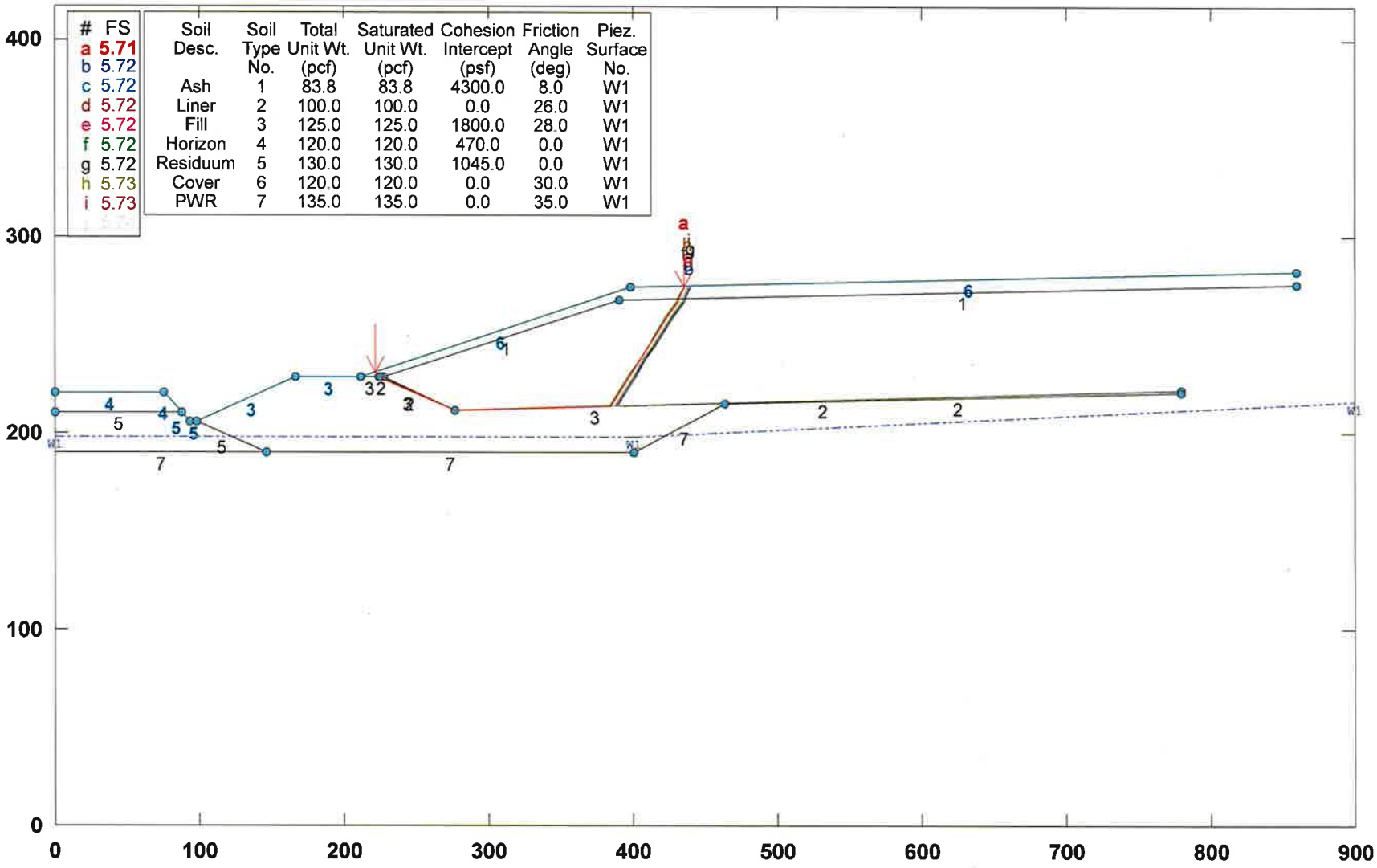
Safety Factors Are Calculated By The Modified Bishop Method

Moncure Mine Structural Fill - Section BBlock - Static (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m5a.pl2 Run By: Tom Yanoschak 11/6/2014 12:32AM

#	FS
a	5.71
b	5.72
c	5.72
d	5.72
e	5.72
f	5.72
g	5.72
h	5.73
i	5.73

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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=5.71

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

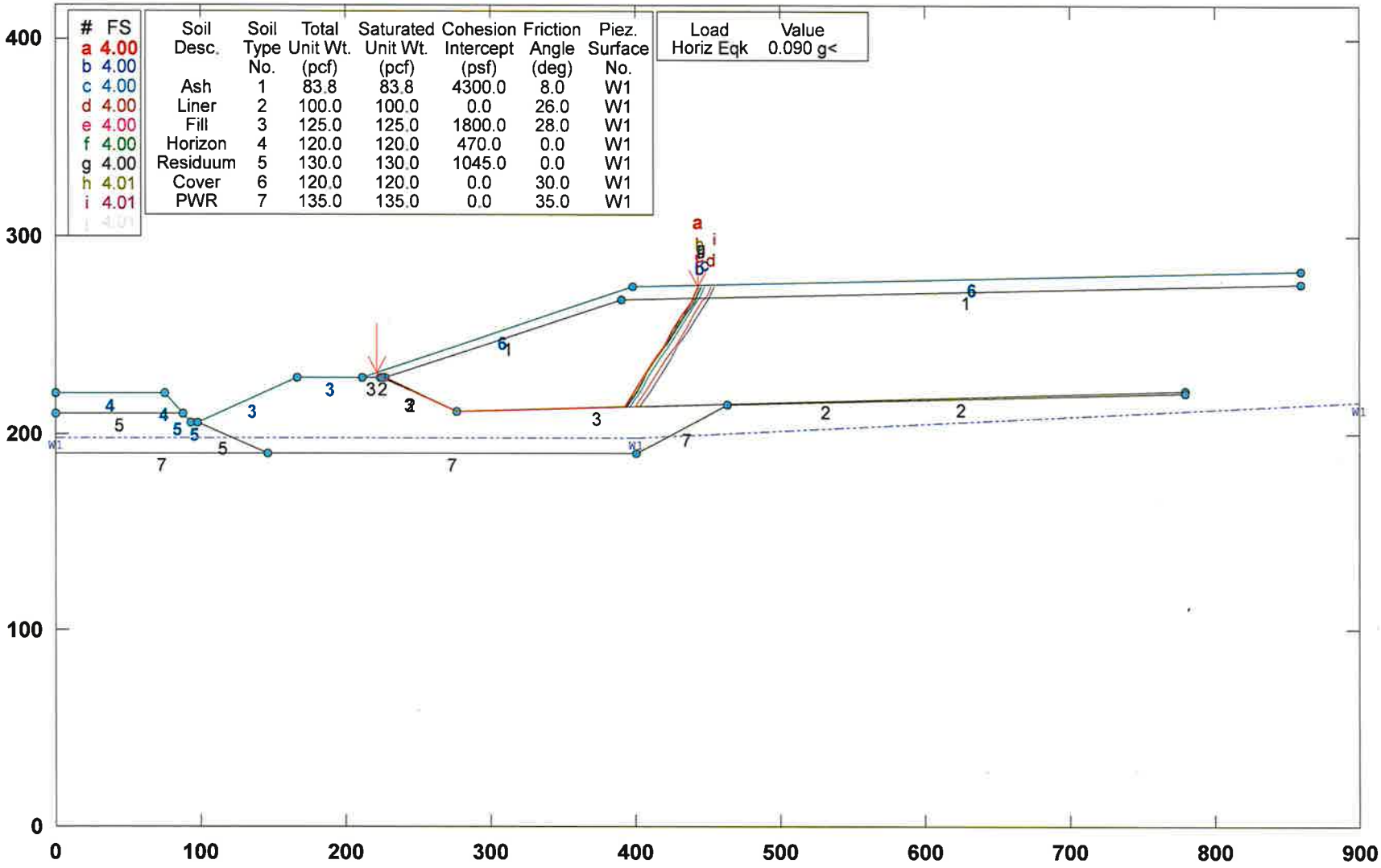
Moncure Mine Structural Fill - Section BBlock - Seismic (Total Stress)

c:\users\tyanosch\documents\stedwin and stabl\m5as.pl2 Run By: Tom Yanoschak 11/6/2014 12:35AM

#	FS
a	4.00
b	4.00
c	4.00
d	4.00
e	4.00
f	4.00
g	4.00
h	4.01
i	4.01

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<

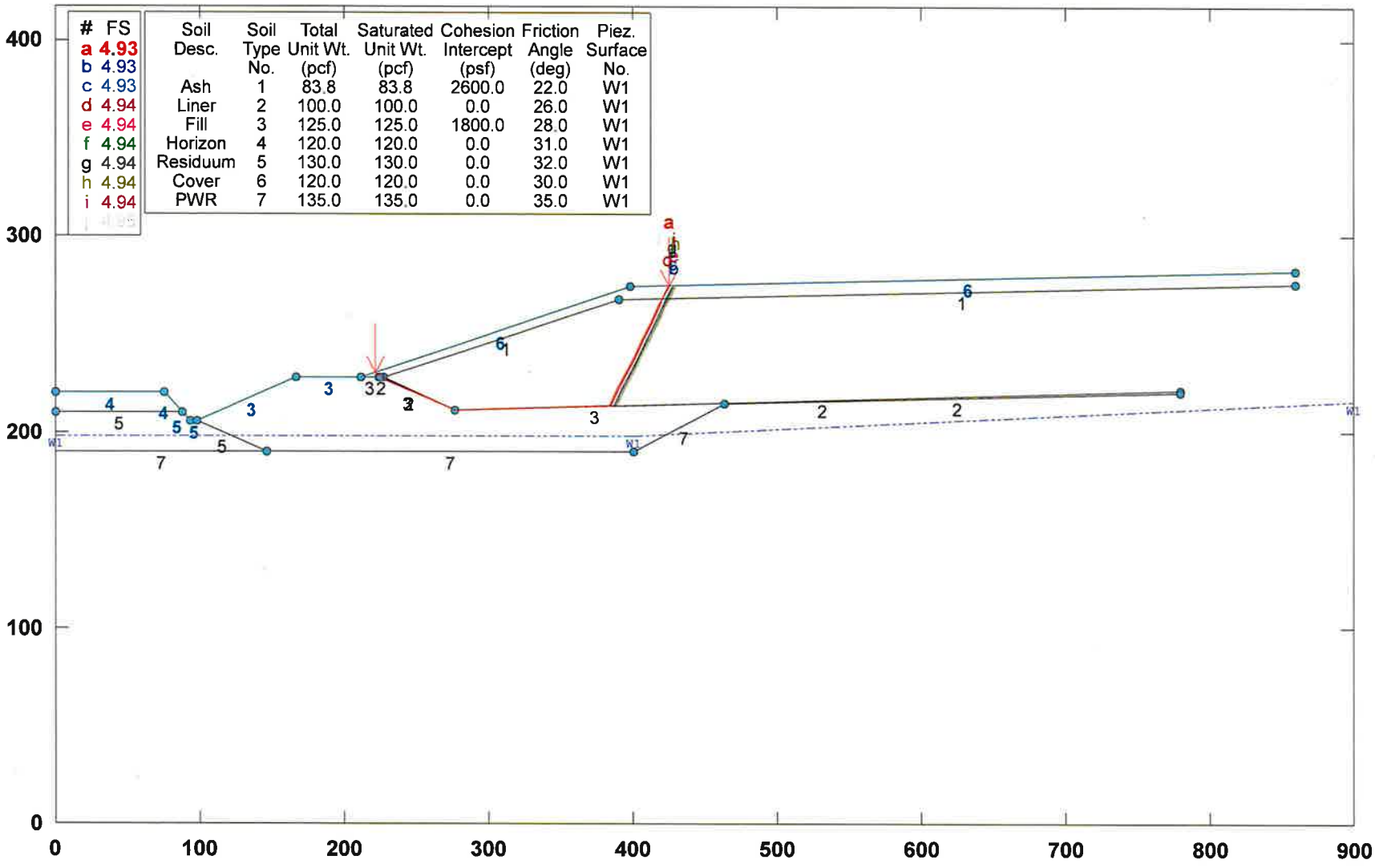


PCSTABL5M/si FSmin=4.00

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

Moncure Mine Structural Fill - Section BBlock - Static (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m6a.pl2 Run By: Tom Yanoschak 11/6/2014 12:38AM



#	FS
a	4.93
b	4.93
c	4.93
d	4.94
e	4.94
f	4.94
g	4.94
h	4.94
i	4.94

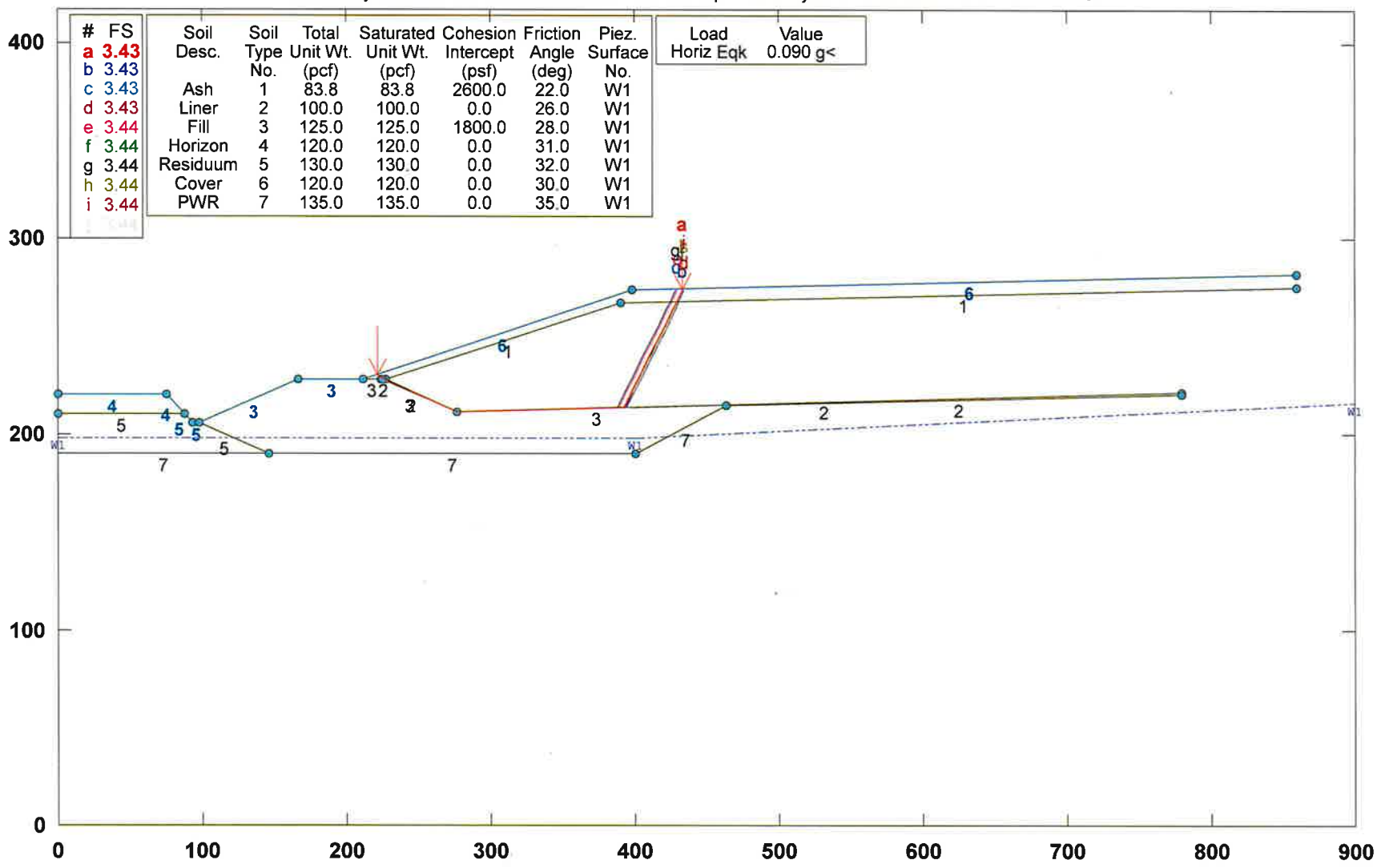
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1
Cover	6	120.0	120.0	0.0	30.0	W1
PWR	7	135.0	135.0	0.0	35.0	W1

PCSTABL5M/si FSmin=4.93

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

Moncure Mine Structural Fill - Section BBlock - Seismic (Effective Stress)

c:\users\tyanosch\documents\stedwin and stabl\m6as.pl2 Run By: Tom Yanoschak 11/6/2014 12:40AM



#	FS
a	3.43
b	3.43
c	3.43
d	3.43
e	3.44
f	3.44
g	3.44
h	3.44
i	3.44

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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=3.43

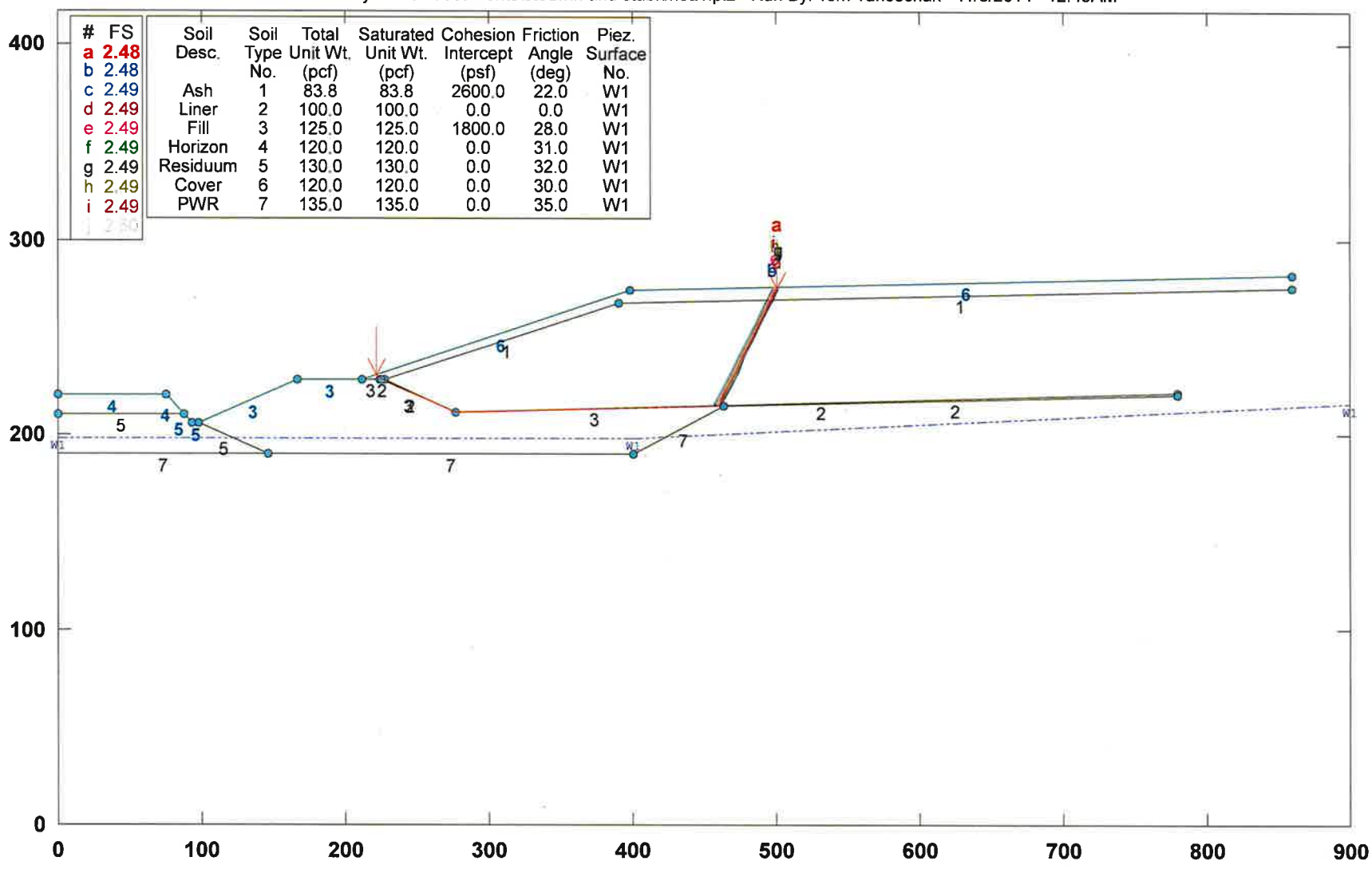
Safety Factors Are Calculated By The Modified Janbu Method for the case of c & phi both > 0

Moncure Mine Structural Fill - Section BBlock - Static (Min Liner Interface Phi)

c:\users\tyanosch\documents\stedwin and stabl\m6a1.pl2 Run By: Tom Yanoschak 11/6/2014 12:45AM

#	FS
a	2.48
b	2.48
c	2.49
d	2.49
e	2.49
f	2.49
g	2.49
h	2.49
i	2.49

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	0.0	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
PWR	7	135.0	135.0	0.0	35.0	W1



PCSTABL5M/si FSmin=2.48

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

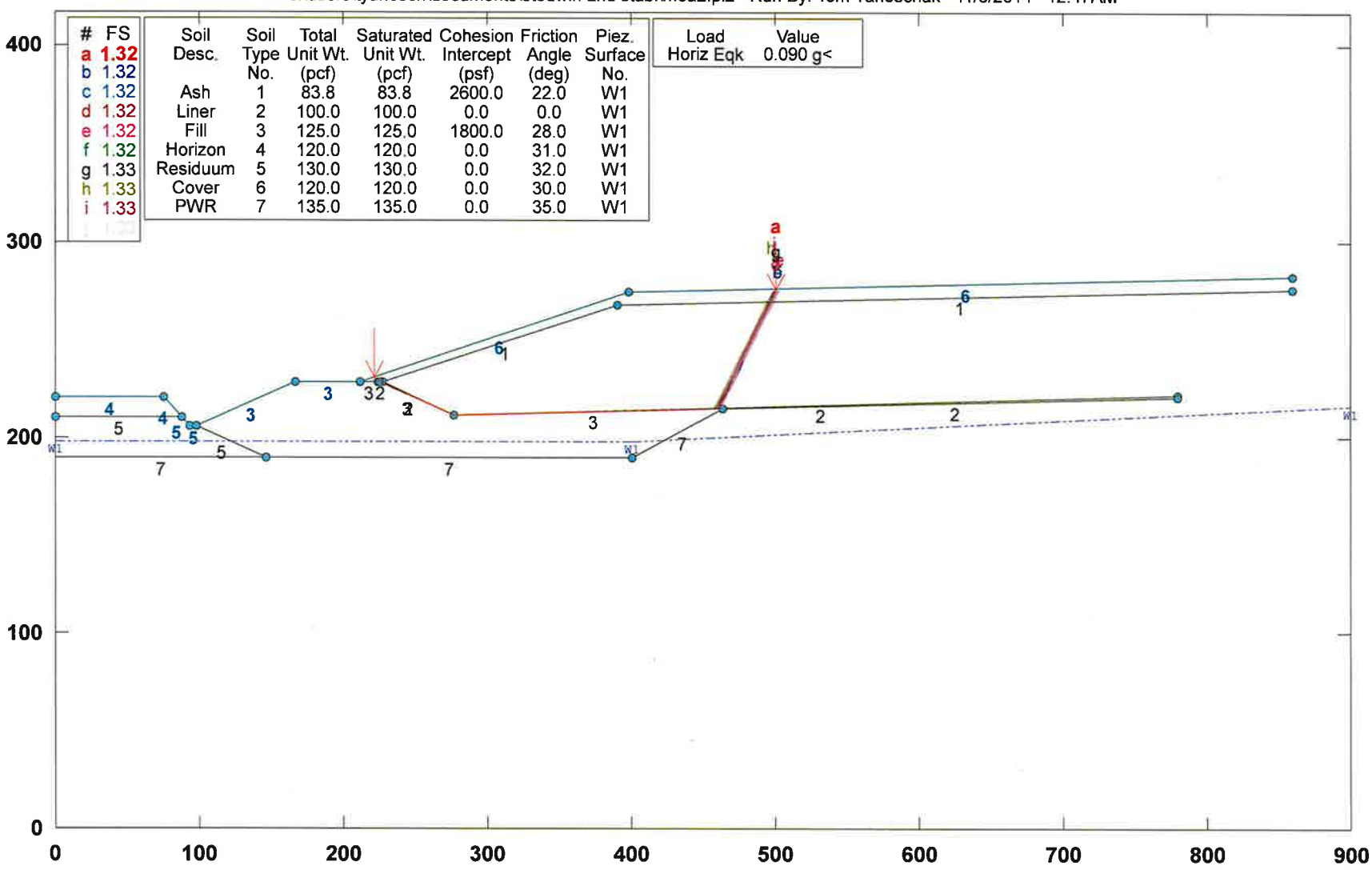
Moncure Mine Structural Fill - Section BBlock - Seismi (Min Liner Interface Phi)

c:\users\tyanosch\documents\stedwin and stabl\m6a2.pl2 Run By: Tom Yanoschak 11/6/2014 12:47AM

#	FS
a	1.32
b	1.32
c	1.32
d	1.32
e	1.32
f	1.32
g	1.33
h	1.33
i	1.33

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	0.0	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
PWR	7	135.0	135.0	0.0	35.0	W1

Load	Value
Horiz Eqk	0.090 g<



PCSTABL5M/si FSmin=1.32

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

Outside of Ash Limits
ATTACHMENT A

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZM-1

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

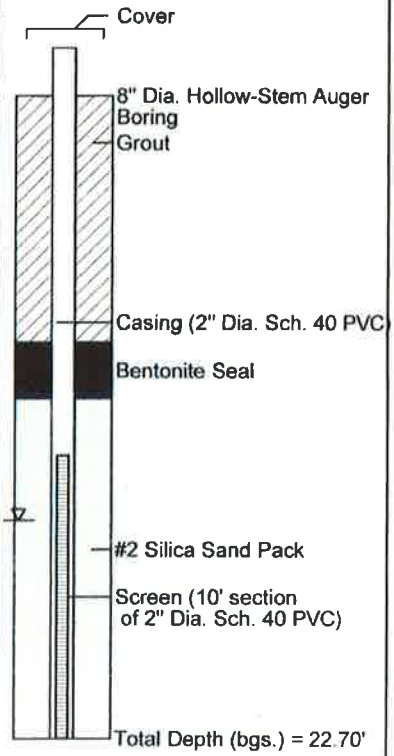
Date Started:	8/13/14	Logged By:	Ross Klingman, P.G.
Date Completed:	8/13/14	Drilling Method:	Geoprobe 8049DT
Drilling Company:	Geologic Exploration	Top-of-Casing Elev.:	217.13'(Lawrence Survey)
Drillers Name:	Johnny Burr	Ground Surface Elev.:	214.49'(Lawrence Survey)
NC Driller Certification:	3098A	Natural, Cut, Fill Grade:	Fill (road bed)

Water Levels
1 Hour = dry
24 Hours = 15.00' 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	214.49	4 14 12 (26)	SS	14	moist; very stiff; reddish yellow (7.5YR 6/6) with orange, yellow and light gray mottled; fine sandy silty clay with quartz gravel; low plasticity; cohesive; Fill CL
5	209.49	4 5 6 (11)	SS	9	moist; stiff; strong brown (7.5YR 5/6) with light gray and brown mottled; medium sandy silty clay with brick and quartz gravel; medium plasticity; cohesive; Fill CL
10	204.49	7 5 4 (9)	SS,BAG	12	moist; stiff; gray (5YR 6/1) with light orange mottles; very fine sandy coarse silty clay; low plasticity; cohesive; Flood Plain; (Lab Results: PZ-1 Bag (9-10.5'); USCS=CL; Gravel=0.3%; Sand=33.4%; Silt=38.7%; Clay=27.6%; Effective Porosity=5%; Atterberg Limits: PL=18; LL=34, PI=16) CL
	202.90				
15	199.49	7 10 50/5" (>50)	SS,BAG	13	moist/wet; reddish brown (5YR 4/3) with gray mottles; fine sandy silty clay; medium plasticity; cohesive; Residuum; (Lab Results: PZM-1 Bag (14.5-16'); USCS=CL; Gravel=0.1%; Sand=49.6%; Silt=33.1; Clay=17.2%; Effective Porosity=14%; Atterberg Limits: PL=16; LL=24; PI=8) CL
20	194.49	16 50/2" (>50)	SS	6	dry; light gray (5YR 7/1); horizontal fissle weathered mudstone; Partially Weathered Rock
					Auger Refusal @ 22.7'
25	189.49				
30	184.49				
35	179.49				
40	174.49				
45					

Fill
Flood Plain
RESID.
PWR



Outside of Ash Limits

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1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZM-2s and 2

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/6/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/6/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: HPC Land Services	Top-of-Casing Elev.:	: 222.37'/222.40'
Drillers Name:	: Jason Cain	Ground Surface Elev.:	: 219.73
NC Driller Certification:	: 3112A	Natural, Cut, Fill Grade:	: fill, road bed

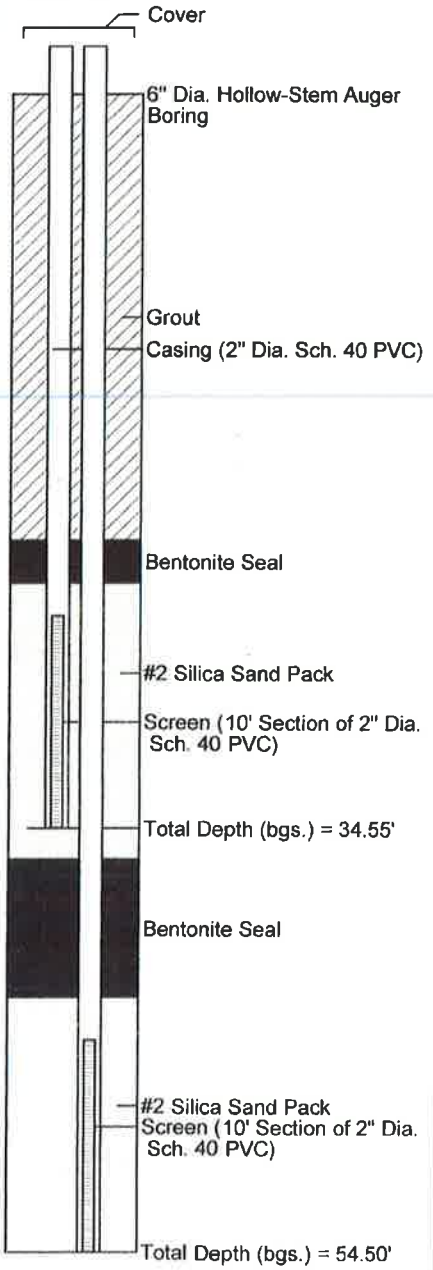
Water Levels
- 1 Hour = 32.00' bgs/dry
- 24 Hours = 16.76'/29.49' bgs

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

Well1: PZM-2s
Well2: PZM-2
TOC Elev.:

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	219.73	9 13 13	SS	10	moist/dry; very stiff; strong brown (7.5YR 5/6) with orange mottles; quartz gravelly clayey silt; no plasticity; cohesive; Fill
5	214.73	4 6 8	SS	8	wet; stiff; strong brown (7.5YR 5/6) with orange mottles; quartz gravelly silty clay with brick fragments; no plasticity; cohesive; Fill
10	209.73	3 3 5	SS	16	moist; stiff; light brownish gray (10YR 6/2) with orange mottles; silty fat clay with roots; high plastcity; cohesive; Soil Horizon
15	204.73	4 11 12	SS	24	moist; very stiff; reddish brown (5YR 4/4) with black mottles; medium horizontal fissile; silty clay; low plasticity; Residuum
20	199.73	50/4"	SS	8	moist; reddish gray (5YR 5/2); highly horizontal fissile; clayey silt; no plasticity; cohesive; Partially Weathered Rock
25	194.73	50/6"	SS,BAG	10	moist; very hard; reddish gray (5YR 5/2) with green flecks; medium horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-2 Bag (23.5-24); USCS=CL; Gravel=4.7%; Sand=19.9%; Silt=50.3%; Clay=25.1%; Effective Porosity=5%; Atterberg Limits: PL=20, LL=38, PI=18)
30	189.73	50/4"	SS	8	moist; very hard; reddish gray (5YR 5/2) with green flecks; highly horizontal fissile; weathered mudstone; Partially Weathered Rock
35	184.73	50/2"	SS	6	dry; very hard; dark reddish gray (5YR 4/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
40	179.73	50/1"	SS	6	dry; very hard; dark reddish gray (5YR 4/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
45	174.73	50/2"	SS	6	dry; very hard; dark reddish gray (5YR 4/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
50	169.73	50/3"	SS	8	dry; very hard; dark reddish gray (5/YR 4/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
55	164.73	50/3"	SS	4	dry; vary hard; dark reddish gray (5YR 4/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
60					

Fill
Soil Horizon
Residuum
Partially Weathered Rock



Outside Ash Limits

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Boring Log, PZM-3

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

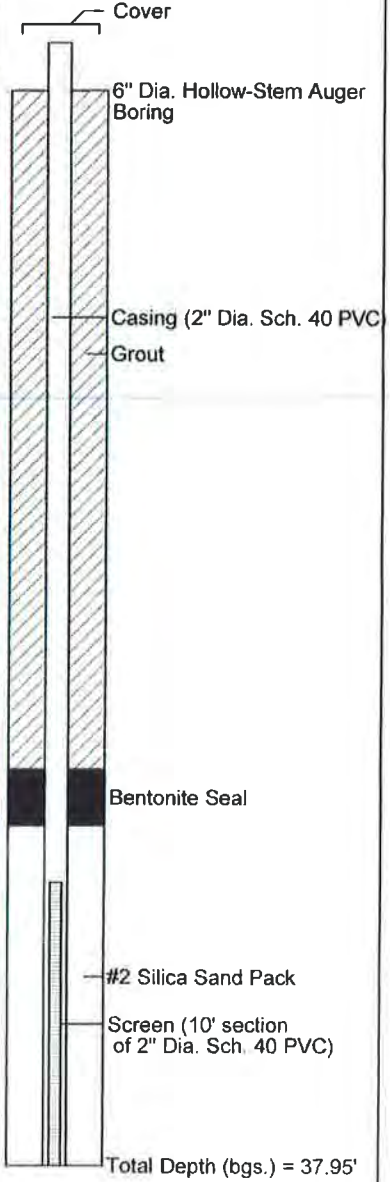
Date Started:	: 8/5/14	Logged By:	: Sean Quarry (HDR)
Date Completed:	: 8/6/14	Drilling Method:	: HSA; CME-55
Drilling Company:	: Environmental Drilling & Probing	Top-of-Casing Elev.:	: 231.52'(Lawrence Survey)
Drillers Name:	: David Brown	Ground Surface Elev.:	: 229.29'(Lawrence Survey)
NC Driller Certification:	: 4155	Natural, Cut, Fill Grade:	: Fill (road bed)

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	214.49	4 6 12 (18)	SS	5	dry; very stiff; red brown (7.5YR 5/3) with yellow mottles; fine sandy silty clay with minor gravel; low plasticity; cohesive; Fill CL
5	209.49	24 11 16 (27)	SS,BAG	14	moist; very stiff; strong brown (7.5YR 4/4) with gray; fine to medium sandy silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZM-3 Bag (4-5.5'); USCS=CL; Sand=5.4%; Silt=46.3%; Clay=48.3%; Effective Porosity=1%; Atterberg Limits: PL=23, LL=42, PI=19) CL
10	204.49	20 50/6"	SS	17	moist; very hard; dark reddish gray (5YR 4/2); silty clay; medium plasticity; cohesive; Partially Weathered Rock
	▽ 201.37				
15	199.49	16 50/2"	SS	8	moist; very hard; reddish brown (5YR 4/4); fine sandy silty clay; medium plasticity; cohesive; Partially Weathered Rock
20	194.49	20 35 50/3"	SS	12	moist; very hard; brown (7.5YR 5/4) with gray; silty clay; low plasticity; cohesive; Partially Weathered Rock
25	189.49	21 18 50/2"	SS,BAG	13	moist; very hard; brown (7.5YR 5/4) with gray; fine sandy silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-3 Bag (24-24.5'); USCS=CL; Gravel=0.8%; Sand=26.3%; Silt=50.2%; Clay=22.7%; Effective Porosity=6%; Atterberg Limits: PL=18, LL=31, PI=13)
30	184.49	50/2"	SS	7	moist; very hard; brown (7.5YR 5/3) with gray; silty clay; low plasticity; cohesive; Partially Weathered Rock
35	179.49	50/3"	SS	9	moist; brown (7.5YR 5/3) with gray; horizontal fissile; fine to medium sandy silty clay; medium plasticity; cohesive; Partially Weathered Rock
40	174.49				
45					

Fill
Resid.
PWR



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Boring Log, PZM-4

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/6/14	Logged By:	Sean Quarry (HDR)
Date Completed:	8/6/14	Drilling Method:	HSA, CME-550
Drilling Company:	HPC Land Services	Top-of-Casing Elev.	232.72'(Lawrence Survey)
Drillers Name:	Jason Cain	Ground Surface Elev :	229.85'(Lawrence Survey)
NC Driller Certification:	3112A	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	229.85	4 3 4	SS,BAG	20	moist; yellowish brown (10YR 5/6) with yellow mottles; silty clay; medium plasticity; cohesive; Soil Horizon; (Lab Results: PZM-4 Bag (0-1.5'); USCS=CL; Sand=15.6%; Silt=54.7%; Clay=29.7%; Effective Porosity=4%; Atterberg Limits: PL=17; LL=29, PI=12) CL
5	224.85	4 5 6	SS,ST	21	moist; stiff; light brownish gray (10YR 4/6) with dark yellowish brown mottles; silty sandy clay; medium plasticity; cohesive; Residuum; (Lab Results: PZM-4 UD (3.5-4.5'); USCS=CL; Gravel=0.9%; Sand=23.4%; Silt=41.2%; Clay=34.5%; Specific Gravity=2.56; Hydraulic Conductivity=7.69 x 10-8 cm/sec; Total Porosity=41%; Effective Porosity=3%; Atterberg Limits: PL=18, LL=38, PI=20) CL
10	219.85	6 10 12	SS	16	moist; very stiff; brown (7.5YR 4/4) with light green/gray; horizontal fissle; silty clay; medium plastic; cohesive; Residuum CL
15	214.85	42 50/3"	SS,BAG	16	moist; brown (7.5YR 4/3) with light green; fine sandy silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-4 Bag (13.5-15'); USCS=CL; Sand=42.6%; Silt=44.9%; Clay=12.5%; Effective Porosity=15%; Atterberg Limits: PL=18, LL=29, PI=11) CL
	213.00 ▽				
20	209.85	50/6"	SS	7	moist; very hard; brown (7.5YR 4/3) with light green; fine dsany silty clay; medium plasticity; cohesive; Partially Weathered Rock
25	204.85	50/2"	SS	2	moist; very hard; reddish brown (7.5YR 4/4); clayey silt; low plasticity; cohesive; Partially Weathered Rock
30	199.85	50/5"	SS	3	moist; very hard; reddish brown (7.5YR 4/4); clayey silt; low plasticity; cohesive; Partially Weathered Rock
35	194.85	50/1"	SS	0.5	moist; grayish brown (5YR 5/2); horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
40	189.85	50/1"	SS	1	dry; gray and dark gray; weathered mudstone; Partially Weathered Rock
45					Auger Refusal @ 39.5'

Soil Horizon
Residual
PWR

Well: PZM-4
TOC Elev.: 232.72
Cover
6" Dia. Hollow-Stem Auger Boring
Casing (2" Dia. Sch. 40 PVC)
Grout
Bentonite Seal
#2 Silica Sand Pack
Screen (10' section of 2" Dia. Sch. 40 PVC)
Total Depth (bgs.) = 38.50'

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Boring Log, PZM-5

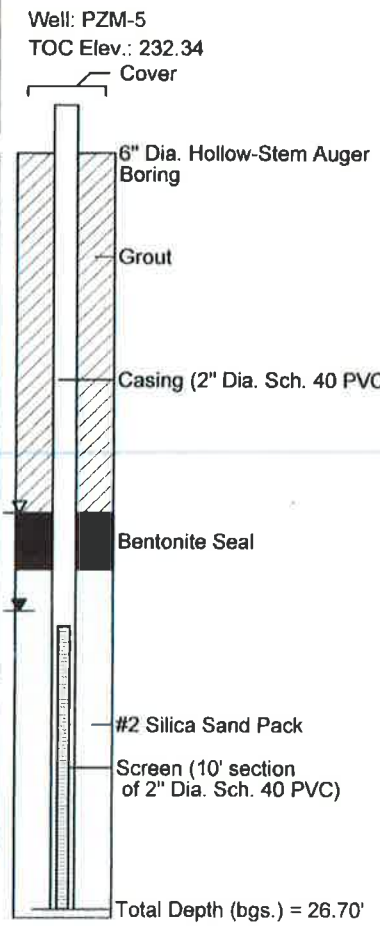
Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/6/14	Logged By:	Sean Quarry (HDR)
Date Completed:	8/6/14	Drilling Method:	HSA; CME-550
Drilling Company:	HPC Land Services	Top-of-Casing Elev.:	232.34'(Lawrence Survey)
Drillers Name:	Jason Cain	Ground Surface Elev.:	229.26'(Lawrence Survey)
NC Driller Certification:	3112A	Natural, Cut, Fill Grade:	natural

Water Levels
▼ 1 Hour = 15.95'
▽ 24 Hours = 12.49'

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	229.26	3 5 8 (13)	SS,BAG	18	moist; stiff; reddish brown (5 YR 4/4) with gray; fine sandy silty clay; medium plasticity; cohesive; Residuum; (Lab Results: PZM-5 Bag (0-1.5'); USCS=CL; Gravel=15.7; Sand=21.4%; Silt=48.3%; Clay=14.6%; Effective Porosity=15%; Atterberg Limits: PL=22, LL=35, PI=13) CL
5	224.26				
9	219.72	50/1"	SS	4	moist; very hard; reddish brown (5YR 4/4) with gray; fine sandy silty clay; medium plasticity; cohesive; Partially Weathered Rock
10	219.26				
15	214.26				
20	209.26	50/0.5"	SS	0	soil cuttings; moist; very hard; reddish brown (5YR 4/4); fine sandy silty clay; medium plasticity; cohesive; Partially Weathered Rock
25	204.26	50/0.5"	SS	0	soil cuttings; wet; very hard; dark reddish brown (5YR 3/3); fine sandy silty clay' medium plastic; cohesive; Partially Weathered Rock
30	199.26				Auger Refusal @ 27'
35	194.26				
40	189.26				
45					



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Boring Log, PZM-6

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

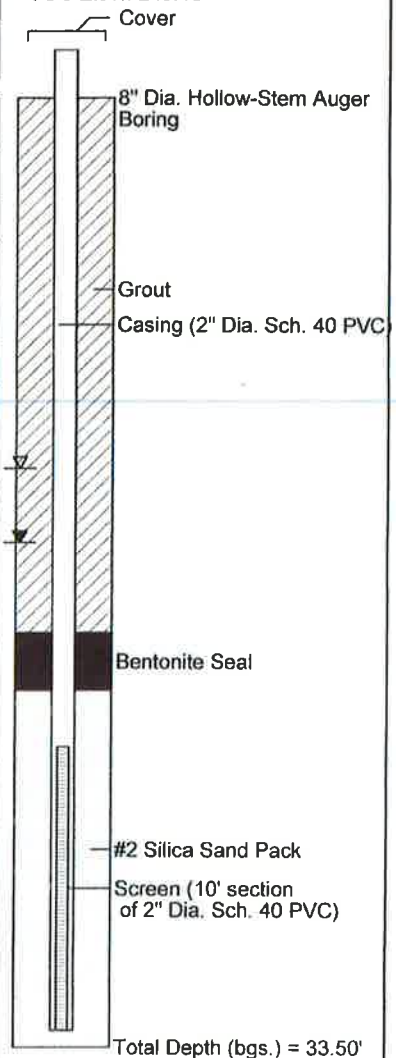
Date Started:	: 8/11/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/11/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 243.13'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 239.92'(Lawrence Survey)
NC Driller Certification:	: 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	239.92	3 4 6 10	SS	16	moist; stiff; strong brown (7.5YR 5/8) with light gray mottles; silty clay; high plasticity; cohesive; Soil Horizon CL
5	234.92	4 6 4 10	SS	18	moist; stiff; yellowish red (5YR 4/6) with ligh gray specks; silty clay; medium plasticity; cohesive; Soil Horizon CL
10	229.92	15 21 33 54	SS	12	moist; very hard; reddish brown (2.5YR 5/4); silty clay with quartz cobbles; low plasticity; cohesive; Residuum CL
		▽ 24 hr. 227.15			
15	224.92	50/2"	SS	6	moist; very hard; dark reddish brown (2.5YR 3/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
20	219.92	50/1"	SS	6	moist; very hard; dark reddish brown (2.5YR 3/4); blocky; weathered mudstone; Partially Weathered Rock
25	214.92	34 32 50/6"	SS,BAG	20	moist/wet; very hard; weak red (10R 5/2) with light gray stringers; silty clay with quartz cobbles; medium plasticity; cohesive; Residuum
30	209.92	50/2"	SS	10	moist; very hard; reddish brown (2.5YR 5/3); clayey silt; low plasticity; cohesive; Partially Weathered Rock
35	204.92	50/1"	SS	8	wet; very hard; reddish brown (2.5YR 5/3); blosky; weathered mudstone; Partially Weathered Rock
40	199.92				Auger Refusal @ 34'
45					

Well: PZM-6
TOC Elev.: 243.13'



50 ft Hor.
Resid.
Part

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Boring Log, PZM-7s and 7

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/11/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/11/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 266.04'/265.79'
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 263.59'
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade:	: slight cut

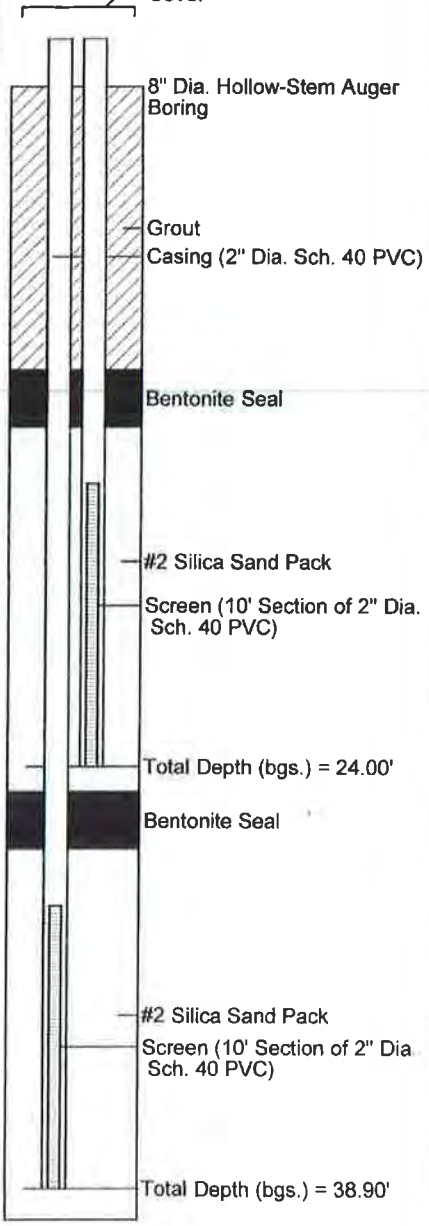
Water Levels
▼ 1 Hour = dry/dry
▽ 24 Hours = dry/dry

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	263.59	3 5 7	SS	18	moist; stiff; yellowish red (5YR 4/6) with yellow and orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon CL
5	258.59	5 7 15	SS,ST	24/4	moist; very stiff; weak red (2.5YR 5/2) with light green mottles; silty clay; no plasticity; cohesive; Residuum; (Lab Results: PZM-7 UD (5-5.5'); USCS=CL; Sand=2.2%; Silt=59.5%; Clay=38.3%; Specific Gravity=2.66; Hydraulic Conductivity=4.94 x 10-8 cm/sec; Total Porosity=22.7%; Effective Porosity=2%; Atterberg Limits: PL=22, LL=38; PI=16) CL
10	253.59	22 50/5"	SS	18	moist; very hard; weak red (10R 5/2) with orange yellow mottles; wavey horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
15	248.59	50/4"	SS	10	moist; very hard; weak red (10R 5/2) with orange yellow mottles; wavey horizontal fissile; weathered mudstone; Partially Weathered Rock
20	243.59	50/4"	SS	10	moist; very hard; weak red (10R 5/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
25	238.59	50/3"	SS	14	moist; very hard; red (2.5YR 4/6) with light green specks; highly horizontal fissile; weathered mudstone and sandstone layers; Partially Weathered Rock
30	233.59	50/3"	SS	6	moist; very hard; dark blueish gray (Glay 2 4/1); horizontal blocky; weathered mudstone; Partially Weathered Rock
35	228.59	50/0"	SS	3	dry; very hard; reddish brown (2.5YR 4/3) with light green specks; blocky; weathered mudstone; Partially Weathered Rock
40	223.59	50/0"	SS	1	wet; very hard; reddish brown (2.5YR 4/3) with light green specks; blocky; weathered mudstone; Partially Weathered Rock
45					Auger Refusal @ 40'

Soil Horizon
Residuum
PWR
▽ 239.36

Well1: PZM-2s
Well2: PZM-2
TOC Elev.:



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Boring Log, PZM-8

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/11/14	Logged By:	Ross Klingman, P.G.
Date Completed:	8/11/14	Drilling Method:	HSA; CME-550
Drilling Company:	Summit Engineering	Top-of-Casing Elev.	246.23'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	243.98'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

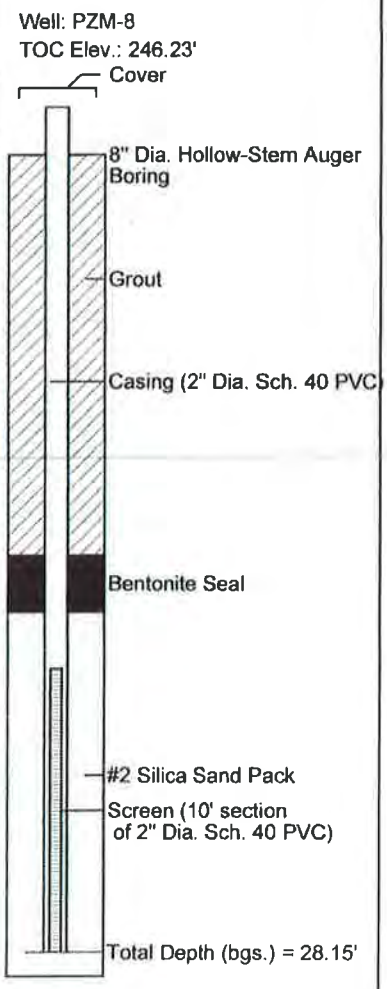
Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

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	243.98	5 5 8	SS,BAG	24	moist; stiff; light yellowish brown (10YR 6/4) with black and light gray specks; clayey silty fine to coarse sand; no plasticity; cohesive; Soil Horizon; (Lab Results: PZM-8 Bag (0-1.5'); USCS=SC; Sand=68%; Silt=19.3%; Clay=12.7%; Effective Porosity=20%; Atterberg Limits: PL=20, LL=37; PI=13) SC
5	238.98	5 5 8	SS	20	moist; stiff; weak red (2.5YR 4/2) with orange and gray mottles; silty clay; low plasticity; cohesive; Soil Horizon CL
10	233.98	50/1"	SS	3	moist/dry; very hard; weak red (10R 4/2); horizontal fissile; weathered sandy mudstone; Partially Weathered Rock
15	228.98	50/5"	SS	6	dry; very hard; red (2.5YR 4/6); highly horizontal fissle; weathered sandy mudstone; Partially Weathered Rock
	▽ 225.10				
20	223.98	50/5"	SS	6	dry; very hard; red (2.5YR 4/6); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
25	218.98	50/3"	SS	7	dry; very hard; red (2.5YR 4/6); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
30	213.98	50/1"	SS	3	dry; very hard; red (2.5YR); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
35	208.98				Auger Refusal @ 29'
40	203.98				
45					

Soil Horizon

PWR



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Boring Log, PZM-9s and 9

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

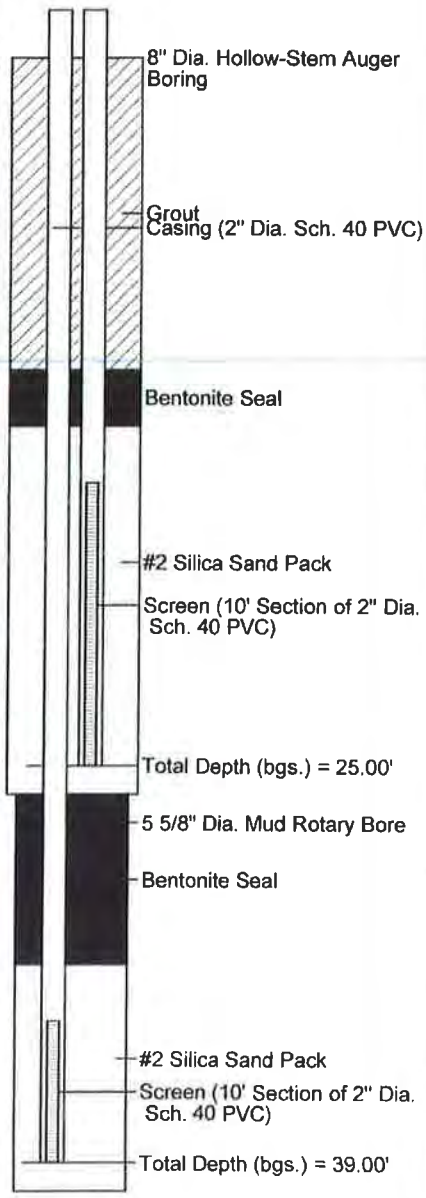
Date Started:	: 8/12/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/12/14	Drilling Method:	: Geoprobe 8040DT
Drilling Company:	: Geologic Exploration	Top-of-Casing Elev.:	: 227.03'/227.20'
Drillers Name:	: Johnny Burr	Ground Surface Elev.:	: 224.24'
NC Driller Certification:	: 3098A	Natural, Cut, Fill Grade::	slight cut

Water Levels
▼ 1 Hour = dry/dry
▽ 24 Hours = dry/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	224.24	5 / 19 / 15 (34)	SS	24	moist; hard; brownish yellow (10YR 6/6) with brown gray mottles; highly horizontal fissle; clayey silt; no plasticity; cohesive; Residuum (MH)
5	219.24	1 / 39 / 43 (82)	SS	24	very moist; very hard; yellowish brown (10YR 5/6) with gray and rust mottles; cleyey silt; no plasticity; cohesive; Residuum (MH)
10	214.24	6 / 8 / 39 (47)	SS	8	moist; hard; yellowish brown (10YR 5/6) with gray and rust mottles; silty clay; no plasticity; cohesive; Residuum (CL)
15	209.24	15 / 28 / 50/5" (>28)	SS	9	moist; very hard; dusky red (10R 3/2); silty clay; no plasticity; cohesive; Residuum (CL)
20	204.24	28 / 34 / 50/3" (>204)	SS,BAG	17	moist; very hard; dusky red (10R 3/2) with gray and yellow mottles; silty clay; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-9 Bag (18.5-20'); USCS=CL; Sand=2%; Silt=54.5%; Clay=43.5%; Effective Porosity=1%; Atterberg Limits: PL=22; LL=41; PI=19)
25	199.24	17 / 50/2"	SS	17	moist; very hard; dark greenish gray (Gley 2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
					Auger Refusal @ 26'
					Advance 5 5/8" Diameter Mud-Rotay Bit from 26-29' (solid rock)
30	194.24				Advance HQ rock core (3 5/8" outer diameter) from 29-31.5' (muddy sandstone rock), then break-through rock into muddy material clogging rock core barrel; remove rock core drilling equipment.
35	189.24				Advance bore with 5 5/8" diameter mud-rotary drilling from 31.5-40'; in and out of rock layers to terminus of the boring.
40	184.24				
45					

Result: PWR



Outside of Ash Limits

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Boring Log, PZM-10

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/12/14	Logged By:	Sean Quarry (HDR)
Date Completed:	8/12/14	Drilling Method:	HSA; CME-550
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	265.06'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	262.23'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade::	cut

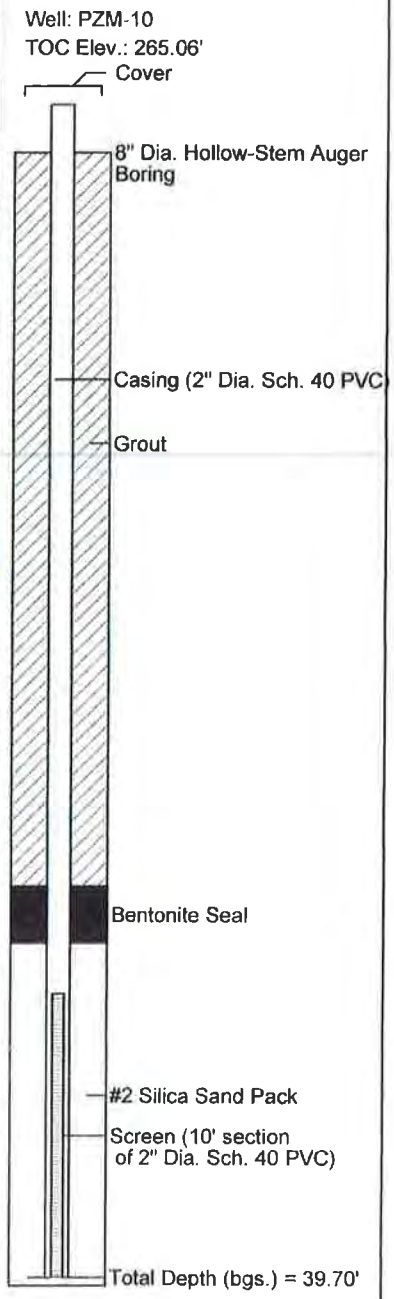
Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

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	262.23	4 4 6 (10)	SS	20	moist; stiff; dark reddish brown (5YR 3/4) with gray; silty clay; medium plasticity; cohesive; Residuum (CL)
5	257.23	7 11 14 (25)	SS	17	moist; very stiff; dark reddish brown (5YR 3/4) with gray; horizontal fissile; sandy silty clay; medium plasticity; cohesive; Residuum (CL)
10	252.23	7 9 22 (31)	SS	16	moist; very stiff; dark reddish brown (5YR 3/3) with gray, yellow and black; silty sandy clay; medium plasticity; cohesive; Residuum (CL)
15	247.23	24 50/5" (>50)	SS	13	moist; very hard; reddish brown (5YR 4/3) with gray; horizontal fissle; sandy silty clay; low plasticity; cohesive; Partially Weathered Rock (CL)
20	242.23	25 50/5"	SS,BAG	11	moist; very hard; reddish brown (5YR 6/3) with gray; sandy silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-10 Bag (18.5-20'); USCS=CL; Sand=11.9%; Silt=59.1%; Clay=29%; Effective Porosity=4%; Atterberg Limits: PL=19, LL=30, PI=11)
25	237.23	50/5" (>50)	SS	5	moist; very hard; dark reddish gray (5YR 4/2); horizontal fissle; silty sandy clay; low plasticity; cohesive; Partially Weathered Rock
30	232.23	50/2"	SS	2	moist; very hard; dark reddish gray (5YR 4/2); silty clay; low plasticity; cohesive; Partially Weathered Rock
35	227.23	43 50/2"	SS	10	moist/wet; very hard; yellowish red (5YR 4/6); silty clay; low plasticity; cohesive; Partially Weathered Rock
40	222.23	50/0.5"	SS	1	wet; very hard; yellowish red (5YR 4/6); silty clay; low plasticity; cohesive; Partially Weathered Rock
45					

Resid

PWR



TOA 290.87

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Boring Log, PZM-11

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/12/14	Logged By:	Sean Quarry (HDR)
Date Completed:	8/12/14	Drilling Method:	HSA; CME-550
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	248.71'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	246.27'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade::	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	246.27	8 9 17 (26)	SS	17	moist; very stiff; gray (5YR 6/1) with yellow mottles; silty clay; low plasticity; cohesive; Residuum CL
		14 50/3" (>50)	SS	10	moist; very hard; gray (5YR 6/2); fine sandy silty clay; low plasticity; cohesive; Partially Weathered Rock
5	241.27				
		50/3"	SS	3	moist; very hard; grayish green (Gley 1 4/2); weathered sandstone; Partially Weathered Rock
10	236.27				
		50/6"	SS	6	dry; very hard; grayish green (Gley 1 4/1) with gray; fine sandy silty clay and weathered mudstone; low plasticity; cohesive; Partially Weathered Rock
15	231.27				
		50/4" (226.0)	SS	4	dry; redish brown (5YR 4/4); horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
20	226.27				
		24 50/4"	SS	8	moist; very hard; dark gray (5YR 4/1) with gray and yellow mottles; silty clay with thin weathered mudstone; medium plasticity; cohesive; Partially Weathered Rock
25	221.27				
		50/3"	SS	4	moist; very hard; reddish brown (5YR 4/3); silty clay with mudstone; low plasticity; cohesive; Partially Weathered Rock
30	216.27				
		50/1"	SS	1	moist; very hard; reddish brown (5YR 4/3); silty clay with mudstone; low plasticity; cohesive; Partially Weathered Rock
35	211.27				
		50/3"	SS BAG	2	moist; very hard; reddish brown (5YR 4/3); silty clay with mudstone; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-11 Bag (38.5-40'); USCS=CL; Gravel=4.6%; Sand=12.6%; Silt=62.4%; Clay=20.4%; Effective Porosity=7%; Atterberg Limits: PL=21, LL=37, PI=16)
40	206.27				
45					

Resid.

PWR

BG 236.38

TOA 290.94

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Boring Log, PZM-12

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/14/14	Logged By:	Ross Klingman, P.G.
Date Completed:	8/14/14	Drilling Method:	HSA; CME-550
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	236.07'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	233.21'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	cut

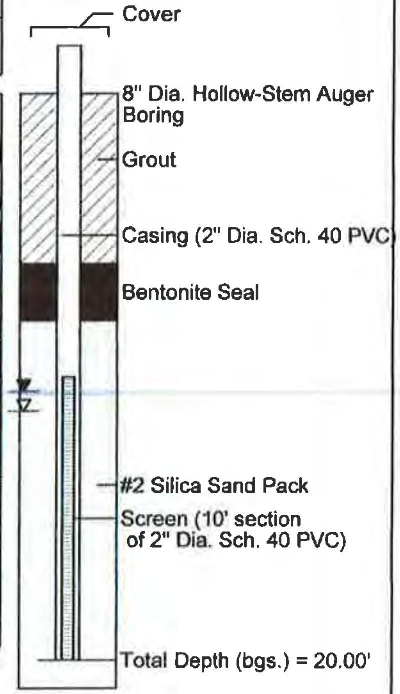
Water Levels
- ▼ 1 Hour = 10.50' bgs
- ▽ 24 Hours = 11.20' bgs

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	233.21	11, 12, 18 (30)	SS,ST	18	dry; very stiff; red (2.5YR 4/6) with black hroizontal planes; silty clay and weathered mudstone; no plasticity; cohesive; Residuum; (Lab Results: PZM-12 UD (0.5-1.5'); USCS=CL; Sand=16.3%; Silt=71.3%; Clay=12.4%; Specific Gravity=2.68; Hydraulic Conductivity=2.36 x 10-6 cm/sec; Total Porosity=19.2%; Effective Porosity=9%; Atterberg Limits: PL=20, LL=31, PI=11) CL
5	228.21	22, 50/5" (250)	SS	16	dry; very hard; red (2.5YR 4/6); horizontal to 5 degree fissile; silty clay and weathered mudstone; no plasticity; cohesive; Partially Weathered Rock
10	223.21	21, 50/6"	SS	13	dry; very hard; red (2.5YR 4/6) with light pink horizontal layers; highly horizontal fissile; silty clay and weathered mudstone; ; no plasticity; cohesive; Partially Weathered Rock
▽	221.49				
15	218.21	50/4"	SS	6	dry; very hard; reddish brown (2.5YR 4/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock hard rock layer 16-18.5'
20	213.21	32, 50/3"	SS	20	wet; hard; reddish brown (2.5YR 4/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
					Auger Refusal @ 21'
25	208.21				
30	203.21				
35	198.21				
40	193.21				
45					

Resid
BG 228.78
PWR

Well: PZM-12
TOC Elev.: 236.07'



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Boring Log, PZM-13

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

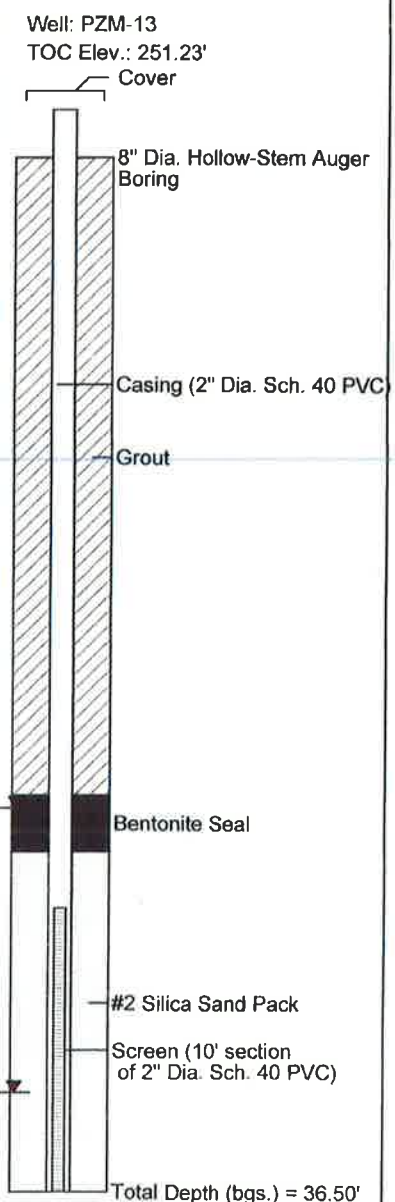
Date Started:	: 8/12/14	Logged By:	: Sean Quarry (HDR)
Date Completed:	: 8/12/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 251.23'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 249.19'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade::	natural

Water Levels
▼ 1 Hour = 33.00' bgs
▽ 24 Hours =22.96' 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	249.19	3 4 6	SS	19	moist; medium; reddish brown (5YR 5); silty clay; medium plasticity; cohesive; Soil Horizon
5	244.19	22 50/3"	SS	8	moist; very hard; reddish brown (5YR 4/3) with gray and yellow; sandy silty clay; low plasticity; cohesive; Partially Weathered Rock
10	239.19	5 7 14	SS,BAG	16	moist; very stiff; light gray (10YR 7/2) with red brown bands; silty sandy clay; low plasticity; cohesive; Residuum; (Lab Results: PZM-13 Bag (8.5-10'); USCS=CL; Sand=16.4%; Silt=59.8%; Clay=23.8%; Effective Porosity=4%; Atterberg Limits: PL=16, LL=31, PI=15)
15	234.19	50/1"	SS	1	moist; very hard; light gray (10YR 7/2) with red brown; silty sandy clay; low plasticity; cohesive; Partially Weathered Rock
20	229.19	50/6"	SS	5	moist; very harr; dark reddish brown (5YR 4/3) with gray; horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
25	224.19	50/4"	SS	3	dry; very hard; reddish brown (5YR 4/3); silty clay with weathered muddy sandstone; low plasticity; cohesive; Partially Weathered Rock
30	219.19	50/4"	SS	3	dry; very hard; gray; horizontal fissile; silty clay with weathered mudstone; low plasticity; cohesive; Partially Weathered Rock
35	214.19	50/3"	SS	2	dry; very hard; gray; weathered mudstone; Partially Weathered Rock
40	209.19				
45					

Auger Refusal @ 36.5'



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Boring Log, PZM-14s and 14

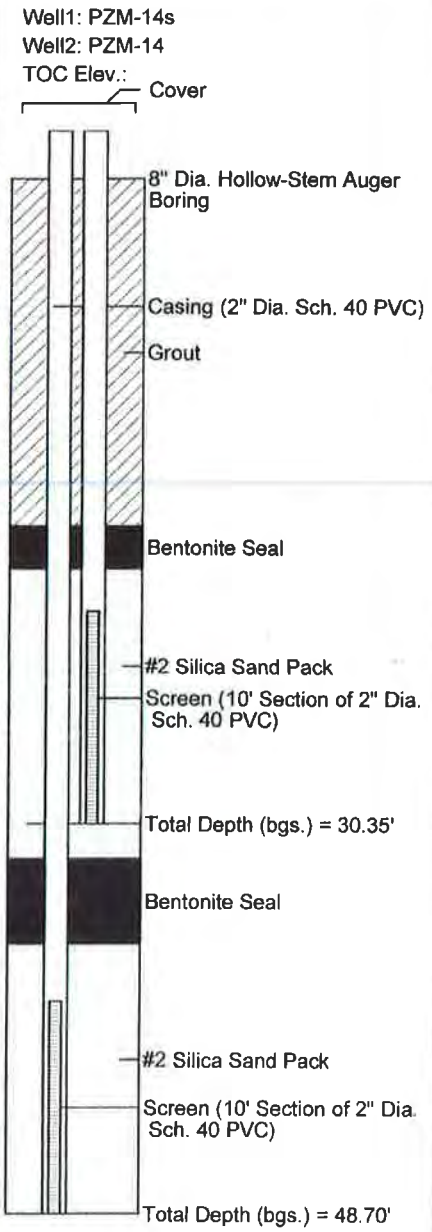
Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/13/14	Logged By:	: Sean Quarry (HDR)
Date Completed:	: 8/13/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 277.90'/277.75'
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 274.79'
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade::	natural

Water Levels
▼ 1 Hour = dry/dry
▽ 24 Hours = dry/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	274.79	3 3 3	SS	6	moist; medium; light reddish brown (5YR 6/4); sandy silty clay with rocks, gravel and roots; low plastiticy, cohesive; Soil Horizon
5	269.79	5 7 10	SS	18	moist; very stiff; yellowish red (5YR 4/6) with yellow and gray mottles; silty sandy clay; low plasticity; cohesive; Soil Horizon
10	264.79	10 18 23	SS	17	moist; hard; dark gray with red brown; silty clay; medium plasticity; cohesive; Residuum
15	259.79	13 25 50/6"	SS	17	moist; very hard; dark reddish brown (5YR 3/4) with gray; sandy silty clay; medium plasticity; cohesive; Residuum
20	254.79	8 20 50/6"	SS	15	moist; very hard; dark reddish brown (5YR 3/4) with gray; silty clay; medium plasticity; cohesive; Residuum
25	249.79	39 50/2"	SS	10	moist; very hard; reddish brown (5YR 4/3); horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
30	244.79	50/2"	SS	6	moist; very hard; reddish brown (5YR 4/3) with yellow mottles; horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
35	239.79	50/3"	SS	3	moist; very hard; reddish brown (5YR 4/3) with yellow mottles; horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
40	234.79	35 50/2"	SS	7	moist; very hard; reddish brown (5YR 4/4) with gray; horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
45	229.79	50/4"	SS	3	wet; very hard; reddish brown (5YR 4/4) with gray; horizontal fissile; low plasticity; cohesive; Partially Weathered Rock
50	224.79	50/6"	SS;BAG	5	wet; very hard, reddish brown (5YR 4/4) with gray and olive; horizontal fissile; silty clay; low plastcity; cohesive; Partially Weathered Rock; (Lab Results: PZM-14 Bag (48-50'): USCS=CL; Sand=1.3%; Silt=66%; Clay=32.7%; Effective Porosity=3%; Atterberg Limits: PL=19, LL=35, PI=16)
55	219.79				
60					



2-59.00 TOA

ON PERIMETER BERM

BG 234

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Boring Log, PZM-15

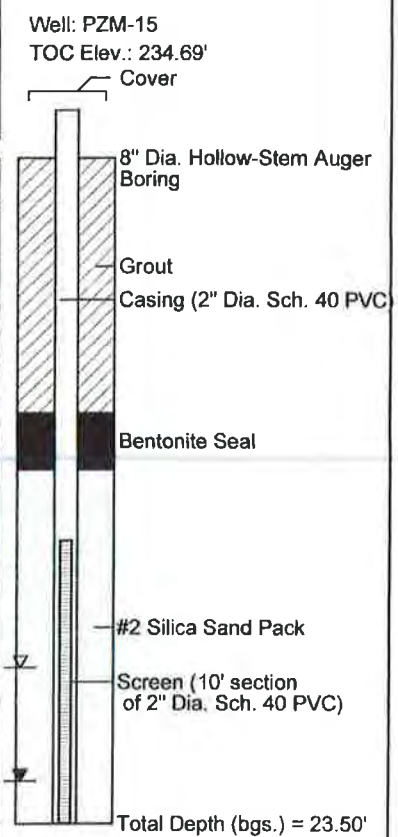
Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/13/14	Logged By:	: Sean Quarry (HDR)
Date Completed:	: 8/13/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 234.69'(Lawrence Survey)
Drillers Name:	: Robert Cassell	Ground Surface Elev.:	: 231.82'(Lawrence Survey)
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade::	natural

Water Levels
▼ 1 Hour = 22.00' bgs
▽ 24 Hours = 18.00' 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	231.82	3 3 4	SS	13	moist; medium; strong brown (7YR 5/6) with mottles; sandy silty clay with roots; low plasticity; cohesive; Soil Horizon
			ST	10	moist; reddish gray (5YR 5/2); silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZM-15 UD (3.5-4.5'); USCS=CL; Sand=12.1%; Silt=39.6%; Clay=48.3%; Specific Gravity=2.72; Hydraulic Conductivity=3.69 x 10-9 cm/sec; Total Porosity=39.2%; Effective Porosity=1%; Atterberg Limits: PL=19, LL=39, PI=20)
5	226.82	8 11 36	SS	18	
		22 50/3"	SS	11	moist; very hard; reddish gray (5YR 5/2); horizontal fissile; silty clay; low plasticity; cohesive; Residuum
10	221.82	>50			moist; very hard; reddish gray (5YR 5/2); horizontal fissile; silty clay; low plasticity; cohesive; Partially Weathered Rock
		50/2"	SS	1	moist; very hard; reddish brown (5YR 4/4); fine sandy clayey silt; low plasticity; cohesive; Partially Weathered Rock
15	216.82	216.85			
		50/2"	SS	2	moist; very hard; light reddish brown (5YR 6/3); horizontal fissile; fine sandy silt with weathered; low plasticity; cohesive; Partially Weathered Rock
20	211.82				
		50/3"	SS,BAG	3	wet; very hard; very dark gray; silty clay; medium plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-15 Bag (23.5-25'): USCS=CL; Sand=6.3%; Silt=60.7%; Clay=33%; Effective Porosity=3%; Atterberg Limits: PL=17, LL=36, PI=33)
25	206.82				Auger Refusal @ 23.5'
30	201.82				
35	196.82				
40	191.82				
45					



ON TOP OF POWER LINE ISLAND

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Boring Log, PZM-16

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	8/14/14	Logged By:	Ross Klingman, P.G.
Date Completed:	8/14/14	Drilling Method:	HSA; CME-550
Drilling Company:	Summit Engineering	Top-of-Casing Elev.:	269.68'(Lawrence Survey)
Drillers Name:	Robert Cassell	Ground Surface Elev.:	267.41'(Lawrence Survey)
NC Driller Certification:	4143A	Natural, Cut, Fill Grade:	natural

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

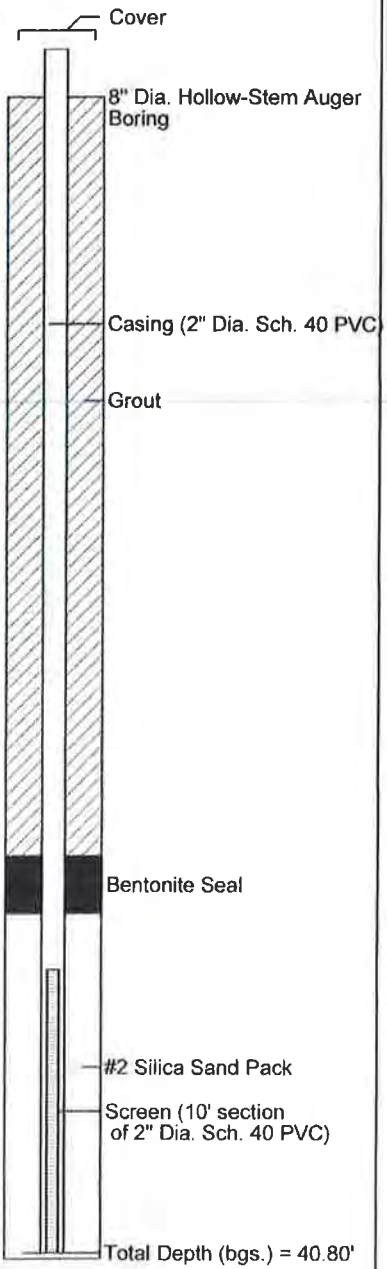
Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

TOA AND BG 265

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	267.41	1	SS	1	very moist; stiff; yellowish brown (10YR 6/6); fine to coarse sandy silty clay with quartz cobbles; medium plasticity; cohesive; Soil Horizon — CL
5	262.41	4 4 9 (13)	SS	16	moist; stiff; light yellowish brown (2.5YR 6/4) with red orange mottles; clay; high plasticity; cohesive; Soil Horizon — CH
10	257.41	2 3 4 (7)	SS	17	moist; medium; light yellowish brown (2.5YR 6/4) with red orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon — CL
			ST	10	moist; light yellowish brown (2.5YR 6/4) with red orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon; (Lab Results: PZM-16 UD (10-11'); USCS=MH; Gravel=0.1%; Sand=7.2%; Silt=51.1%; Clay=47.9%; Specific Gravity=2.70; Hydraulic Conductivity=2.86 x 10-7 cm/sec; Total Porosity=48%; Effective Porosity=1%; Atterberg Limits: PL=32, LL=56, PI=24) — CL
15	252.41	8 10 16 (26)	SS	18	moist; very stiff; weak red (10YR 4/3) with ligh gray and yellow stringers; silty clay; medium plasticity; cohesive; Residuum — CL
20	247.41	8 16 27 (43)	SS	20	moist; hard; gray (10YR 6/1) with light orange and light maroon mottles and stringers; silty clay; no plasticity; cohesive; Residuum — CL
25	242.41	21 50/6" (>50)	SS	14	moist; very hard; gray (10YR 6/1) with light orange and light maroon mottles and stringers; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	237.41	22 50/2"	SS	14	moist; very hard; reddish brown (2.5YR 4/4); wavey horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZM-16 Bag (28.5-30'): USCS=CL; Sand=21.3%; Silt=61.8%; Clay=16.9%; Effective Porosity=10; Atterberg Limits: PL=17, LL=32, PI=15)
35	232.41	50/6" (232.84)	SS	10	dry; very hard; pinkish gray (7.5YR 6/2); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
40	227.41	50/1"	SS	3	dry; very hard; pinkish gray (7.5YR 6/2); highly horizontal fissile; weathered sandy mudstone; Partially Weathered Rock
45					Auger Refusal @ 41'

Soil Horizon
Residuum
PWR

Well: PZM-16
TOC Elev.: 269.68'



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Boring Log, PZM-17s and 17

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/14/14	Logged By:	: Ross Klingman, P.G
Date Completed:	: 8/14/14	Drilling Method:	: HSA; CME-550
Drilling Company:	: Summit Engineering	Top-of-Casing Elev.:	: 266.74'/266.85'
Drillers Name:	: Robert Cassell	Ground Surface Elev :	: 263.78'
NC Driller Certification:	: 4143A	Natural, Cut, Fill Grade::	cut

TOA 263.93

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

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

Well1: PZM-17s
Well2: PZM-17
TOC Elev.: — Cover

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.78	4 10 17	SS	24	moist; very stiff; dark reddish brown (2.5YR 3/4) with tan and light gray mottles; sandy clay, clayey silt and clayey sand; no plasticity; cohesive; Soil Horizon CL
5	258.78	8 17 24 41	SS	18	moist; hard; dark red (2.5YR 3/6) with light green gray mottles; silty clay; no plasticity; cohesive; Residuum CL
10	253.78	8 21 29 40	SS	19	moist; hard; dark red (2.5YR 3/6) with light green gray mottles; silty clay; no plasticity; cohesive; Residuum CL
15	248.78	23 15 17 32	SS,BAG	14	moist; hard; dark red (2.5YR 3/6) with light green gray mottles; blocky horizontal fissile; silty clay; no plasticity; cohesive; Residuum; (Lab Results PZM-17 Bag (13.5-15'); USCS=CL; Sand 1.5%; Silt=75%; Clay 23.5%; Effective Porosity=4%; Atterberg Limits: PL=19, LL=35, PI=16) CL
20	243.78	50/3" 75/0	SS	10	moist; very hard; dark red (2.5YR 3/6); blocky horizontal fissile; silty clay; no plasticity, cohesive; Partially Weathered Rock
25	238.78	50/4" 20	SS	6	moist; very hard; dark red (2.5YR 3/6); blocky horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	233.78	50/4"	SS	6	moist; very hard; reddish brown (2.5YR 4/4); highly horizontal fissile; weathered sandy mudstone; Partially Weathered Rock
35	228.78	50/1" 229.64	SS	3	moist; very hard; dark red (2.5YR 3/6); silty clay with rock fragments; no plasticity; cohesive; Partially Weathered Rock
40	223.78	50/2"	SS	8	dry; very hard; weak red (10R 4/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock
45	218.78	50/1"	SS	6	wet; very hard; dark red (2.5YR 3/6); silty clay; no plasticity; cohesive; Partially Weathered Rock
50					

Auger Refusal @ 44.5'

Soil Horizon
Residuum
PWR
WG 241.86

8" Dia. Hollow-Stem Auger Boring
Casing (2" Dia. Sch. 40 PVC)
Grout
Bentonite Seal
#2 Silica Sand Pack
Screen (10' Section of 2" Dia. Sch. 40 PVC)
Total Depth (bgs.) = 30.20'
Bentonite Seal
#2 Silica Sand Pack
Screen (10' Section of 2" Dia. Sch. 40 PVC)
Total Depth (bgs.) = 44.50'

TOA 230.00

Buxton Environmental, Inc.
Consulting Services
1101 South Blvd., Suite 101
Charlotte, North Carolina 28203
Ph (704) 344-1450 Fax (704) 344-1451
buxtonenv@bellsouth.net

Boring Log, PZM-18

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

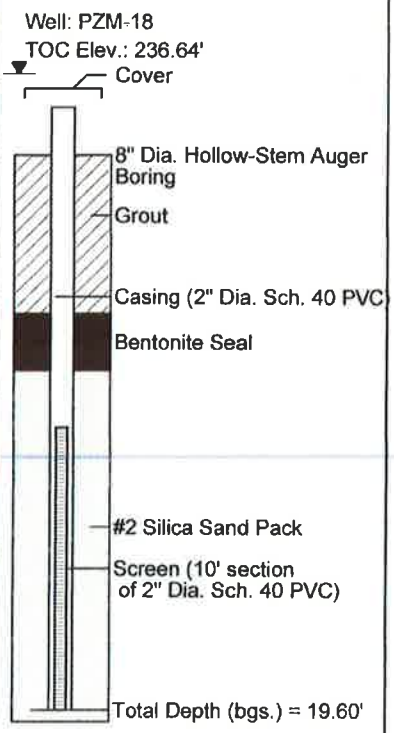
Date Started:	: 8/13/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/13/14	Drilling Method:	: HSA; Geoprobe 8040DT
Drilling Company:	: Geologic Exploration	Top-of-Casing Elev.:	: 236.64'(Lawrence Survey)
Drillers Name:	: Johnny Burr	Ground Surface Elev.:	: 233.78'(Lawrence Survey)
NC Driller Certification:	: 3098A	Natural, Cut, Fill Grade::	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	233.78	11 12 14 (>6)	SS	24	dry; very stiff; yellowish red (5YR 4/6) with light gray specks; silty clay with mudstone fragments; no plasticity; cohesive; Residuum CL
5	228.78	2 8 12 (20)	SS	18	dry; very stiff; gray (7.5YR 6/1) with brown and light gray mottles; horizontal fissile; silty clay; no plasticity; cohesive; Residuum CL
10	223.78	2 4 14 (18)	SS,BAG	24	moist; very stiff; grayish brown (10YR 5/2); silty clay with weathered mudstone fragments; no plasticity; cohesive; Residuum; (Lab Results: PZM-18 Bag (8.5-10'); USCS=CL; Sand=7.2%; Silt=56.3%; Clay=36.5%; Effective Porosity=3; PL=20, LL=39; PI=19) CL
15	218.78	50/2" (>50)	SS	8	moist; very hard; dark greenish gray (Gley 2 3/1); weathered sandy mudstone; Partially Weathered Rock
20	213.78	23 50/1" (>19.43)	SS	14	dry; very hard; gray (7.5YR 6/1) with maroon mottles; clayey silt with mudstone fragments; no plasticity; cohesive; Partially Weathered Rock
25	208.78				
30	203.78				
35	198.78				
40	193.78				
45					

Auger Refusal @ 20'



PWR

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Charlotte, North Carolina 28203
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buxtonenv@bellsouth.net

Boring Log, PZM-19

TOR 269.96

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/13/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/13/14	Drilling Method:	: HSA; Geoprobe 8040DT
Drilling Company:	: Geologic Exploration	Top-of-Casing Elev.:	: 243.23'(Lawrence Survey)
Drillers Name:	: Johnny Burr	Ground Surface Elev.:	: 240.56'(Lawrence Survey)
NC Driller Certification:	: 3098A	Natural, Cut, Fill Grade:	: road bed, 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	240.56	3 3 5	SS	19	wet; medium; reddish brown (5YR 4/4); sandy silty clay with roots; low plasticity; cohesive; Soil Horizon — CL
5	235.56	3 5 8	SS	14	wet; medium; reddish brown (5YR 4/4); sandy silty clay; medium plasticity; cohesive; Soil Horizon — CL
10	230.56	14 50/5" 7 50	SS	12	moist; very hard; reddish brown (5YR 4/4); sandy silty clay; medium plasticity; cohesive; Soil Horizon — CL
15	225.56	6 18 15 33	SS	18	moist; hard; light rust and light yellow green mottled; wavey horizontal fissile; silty clay; low plasticity; cohesive; Residuum — CL
20	220.56	7 14 50/1" 7 50	SS,BAG	16	moist; very hard; dark reddish brown (5YR 3/4); highly horizontal fissile; weathered mudstone; Partially Weathered Rock; (Lab Results: PZM-19 Bag (18.5-20'); USCS=CL; Sand=5.8%; Silt=69.5%; Clay=24.7%; Effective Porosity=3%; Atterberg Limits: PL=22, LL=42, PI=20)
25	215.56	50/3"	SS	10	moist; very hard; dark reddish brown (5YR 3/4); blocky horizontal fissle; weathered mudstone; Partially Weathered Rock
30	210.56				Auger Refusal @ 24'
35	205.56				
40	200.56				
45					

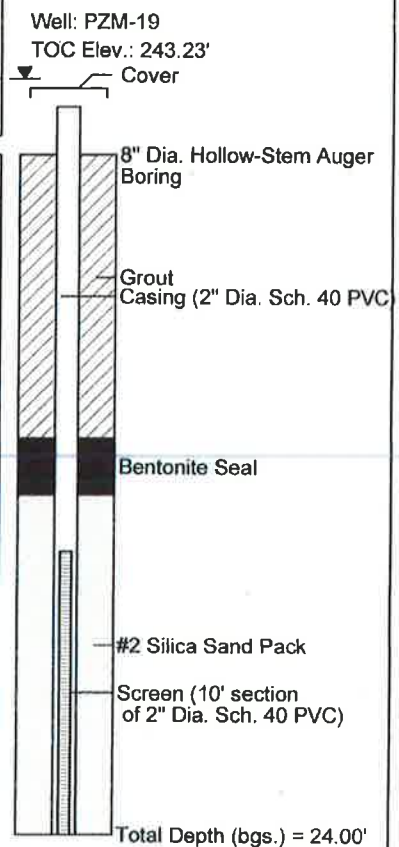
Soil Horizon

Residuum

Partially Weathered Rock

BG 211.56

201



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buxtonenv@bellsouth.net

Boring Log, PZM-20

TOR 265.58

Moncure Mine Reclamation Site
1315 Moncure-Flatwood Road
Moncure, North Carolina

Date Started:	: 8/13/14	Logged By:	: Ross Klingman, P.G.
Date Completed:	: 8/13/14	Drilling Method:	: HSA; Geoprobe 8040DT
Drilling Company:	: Geologic Exploration	Top-of-Casing Elev.:	: 236.58'(Lawrence Survey)
Drillers Name:	: Johnny Burr	Ground Surface Elev.:	: 233.93'(Lawrence Survey)
NC Driller Certification:	: 3098A	Natural, Cut, Fill Grade:	: road bed, fill

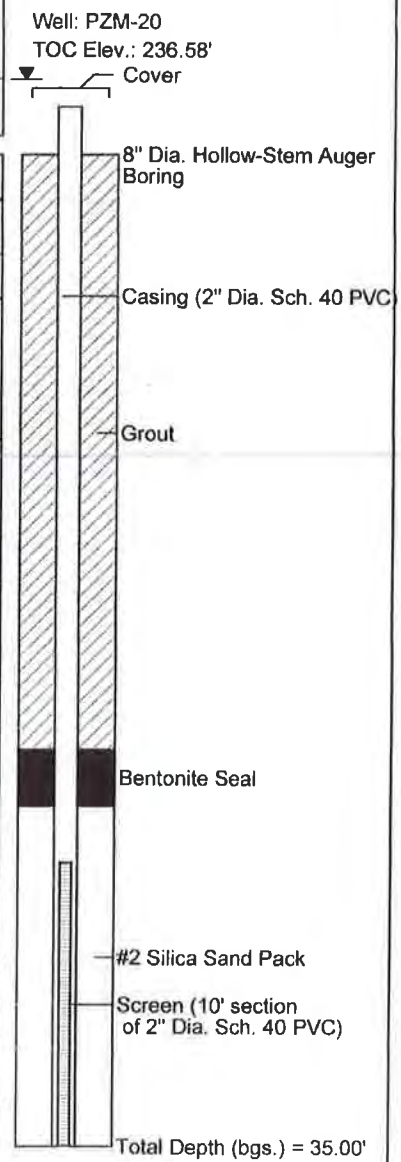
Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

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	233.93	2 3 6 — 9	SS	24	moist; stiff; reddish brown (5YR 5/4) with yellow and gray mottles; silty clay; medium plastic; cohesive; Fill
5	228.93	1 2 2 — 4	SS	20	moist; soft; reddish brown (2.5YR 4/4) with light gray mottles; silty clay; low plasticity; cohesive; Fill
10	223.93	2 2 4 — 6	SS	14	moist; medium; pinkish gray (7.5YR 7/2) with red orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon
15	218.93	14 13 21 — 34	SS	13	moist; hard; pale red (2.5YR 6/2) with light rust mottles; silty clay with quartz gravel; no plasticity; cohesive; Residuum
20	213.93	5 8 10 — 18	SS	16	moist; very stiff; dark gray, yellow and light rust mottled; wavey horizontal fissile; silty clay; no plasticity; cohesive; Residuum
25	208.93	6 48 50/1" — >50	SS	17	moist; very hard; weak red (10R 4/2) with light gray mottles; wavey highly horizontal fissile; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	203.93	12 28 36	SS,BAG	24	moist; very hard; weak red (10R 4/2) with light gray mottles; wavey highly horizontal fissile; silty clay; no plasticity; cohesive; Residuum;)Lab Results: PZM-20 Bag (28-30'); USCS=CL; Gravel=0.3%; Sand=3.7%; Silt=54.8%; Clay=41.2%; Effective Porosity=2%; Atterberg Limits: PL=22, LL=39; PI=17)
▽ 30.0					
35	198.93	19 50/4"	SS,BAG	15	moist; very hard; weak red (10R 4/2) with light gray mottles; wavey highly horizontal fissile; silty clay; no plasticity; Partially Weathered Rock; (Lab Results: PZM-20 Bag (33.5-34.5'); USCS=CL; Sand=9%; Silt=61.5%; Clay=29.5%; Effective Porosity=4%; Atterberg Limits: PL=20, LL=38, PI=18)
40	193.93				
45					

Fill
Soil Horizon
Residuum
210.78 BG
PWR

Well: PZM-20
TOC Elev.: 236.58'



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

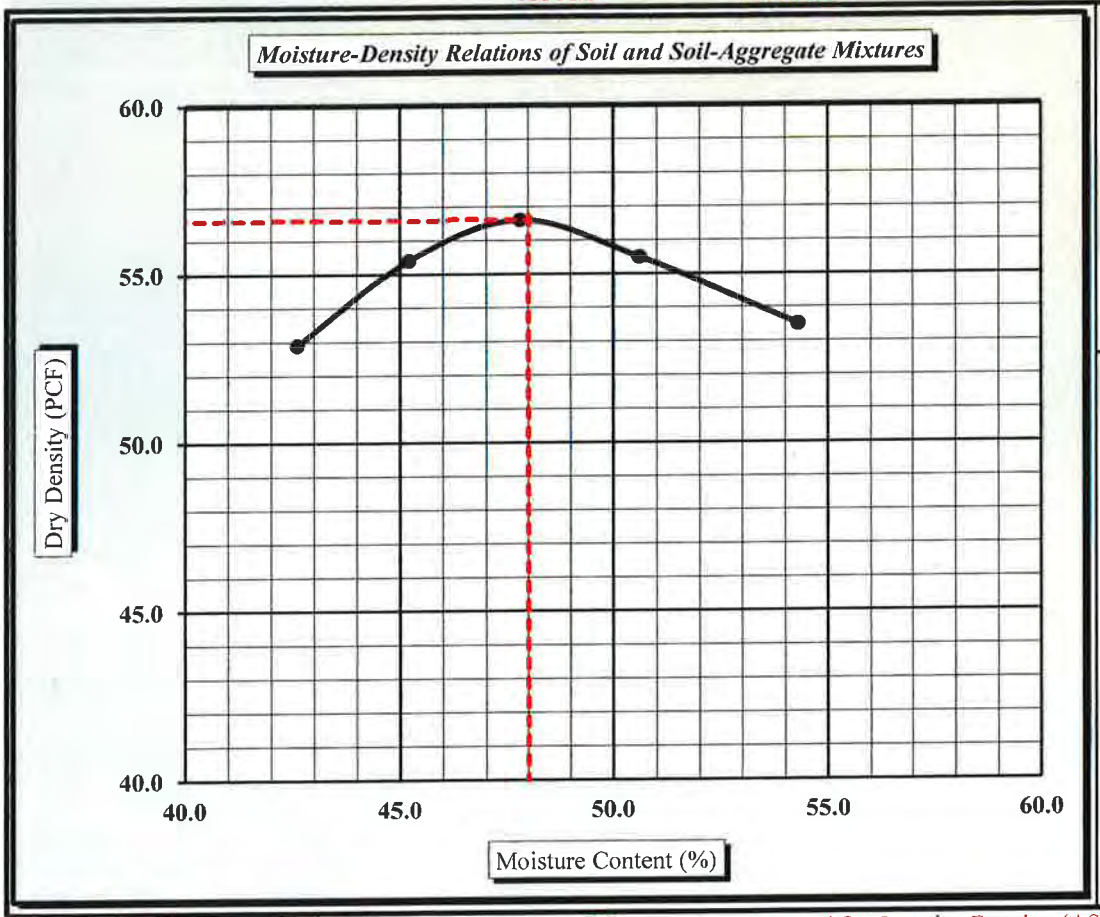
S&ME
Quality Assurance

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

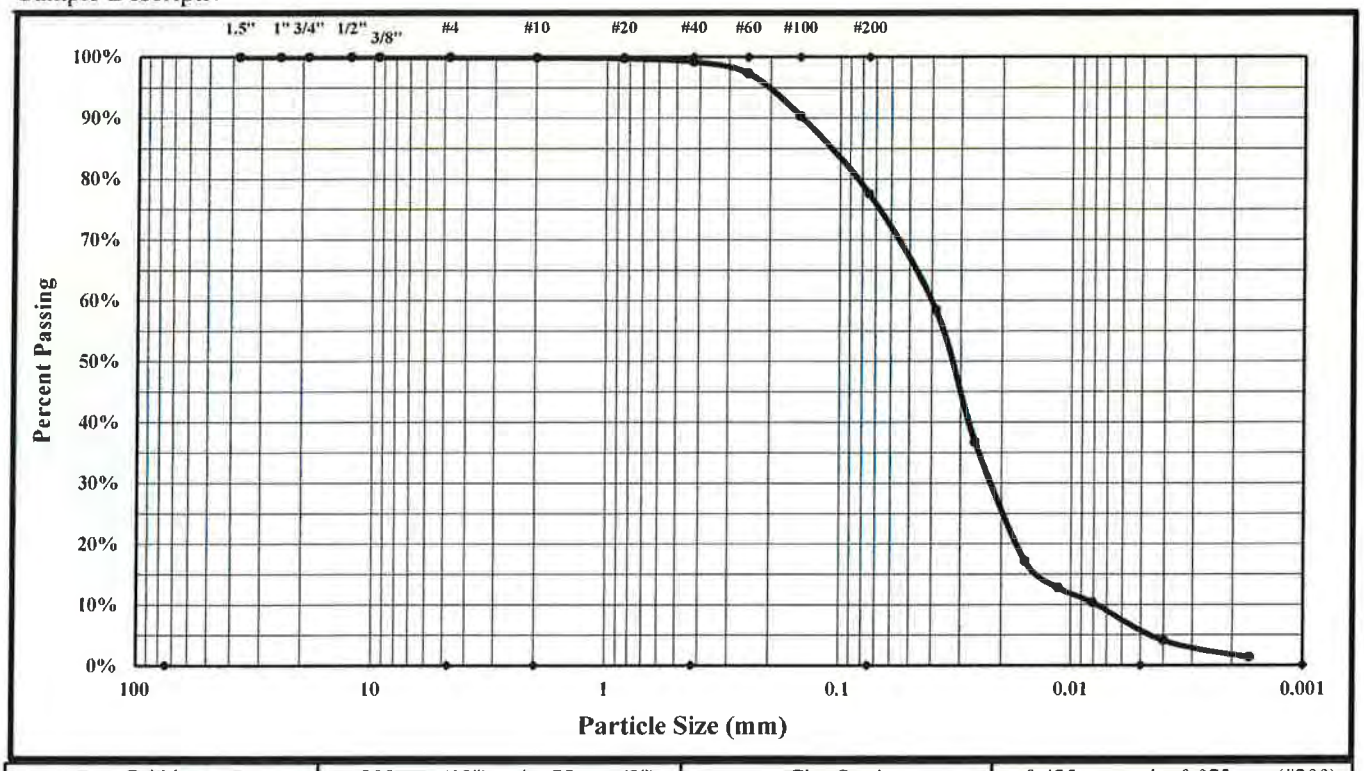
ASTM D 422

S&ME

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.		Location Coordinator	6/05/14
Technical Responsibility	*Signature*	*Position*	*Date*

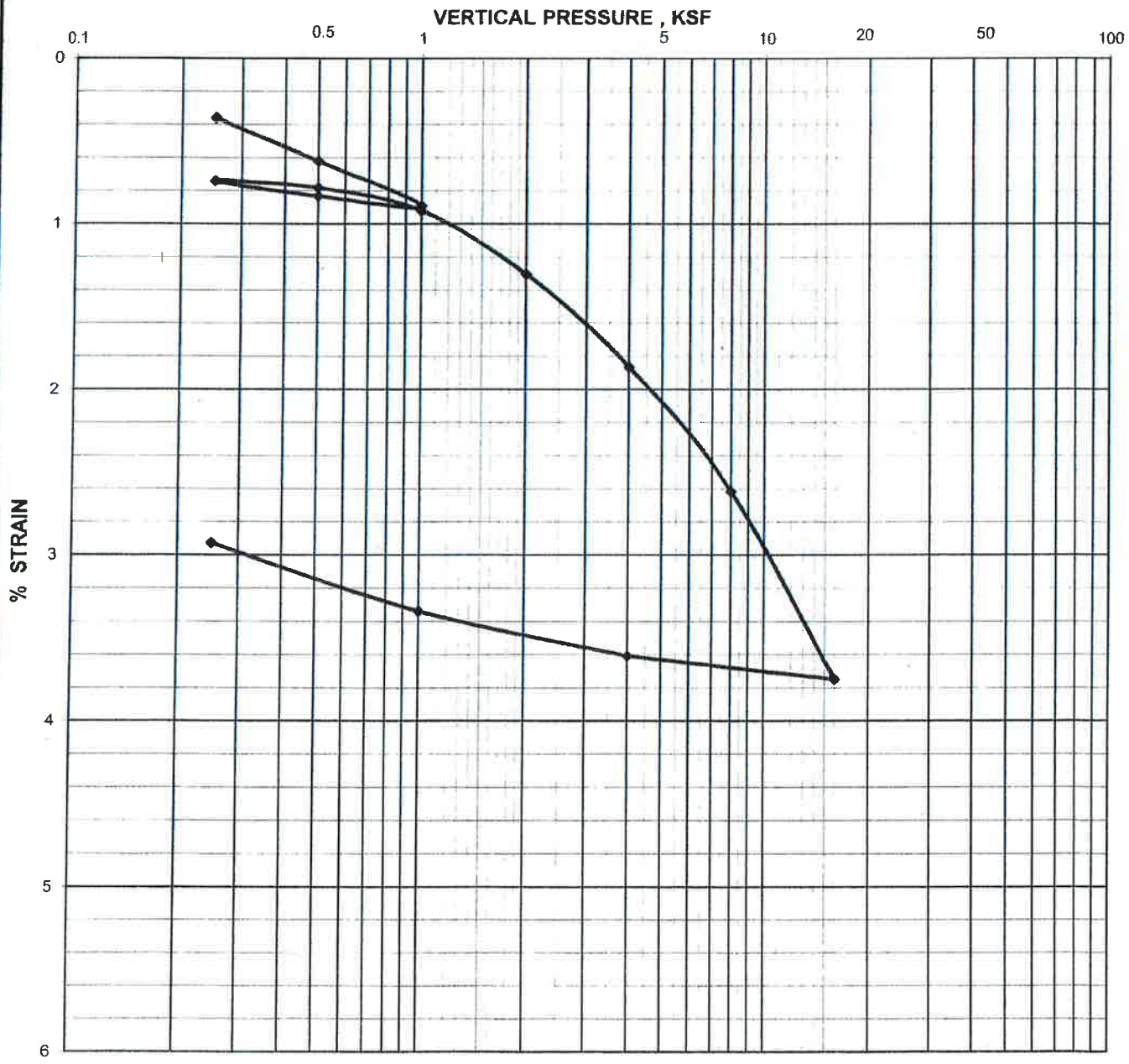
S&ME

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_e, 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

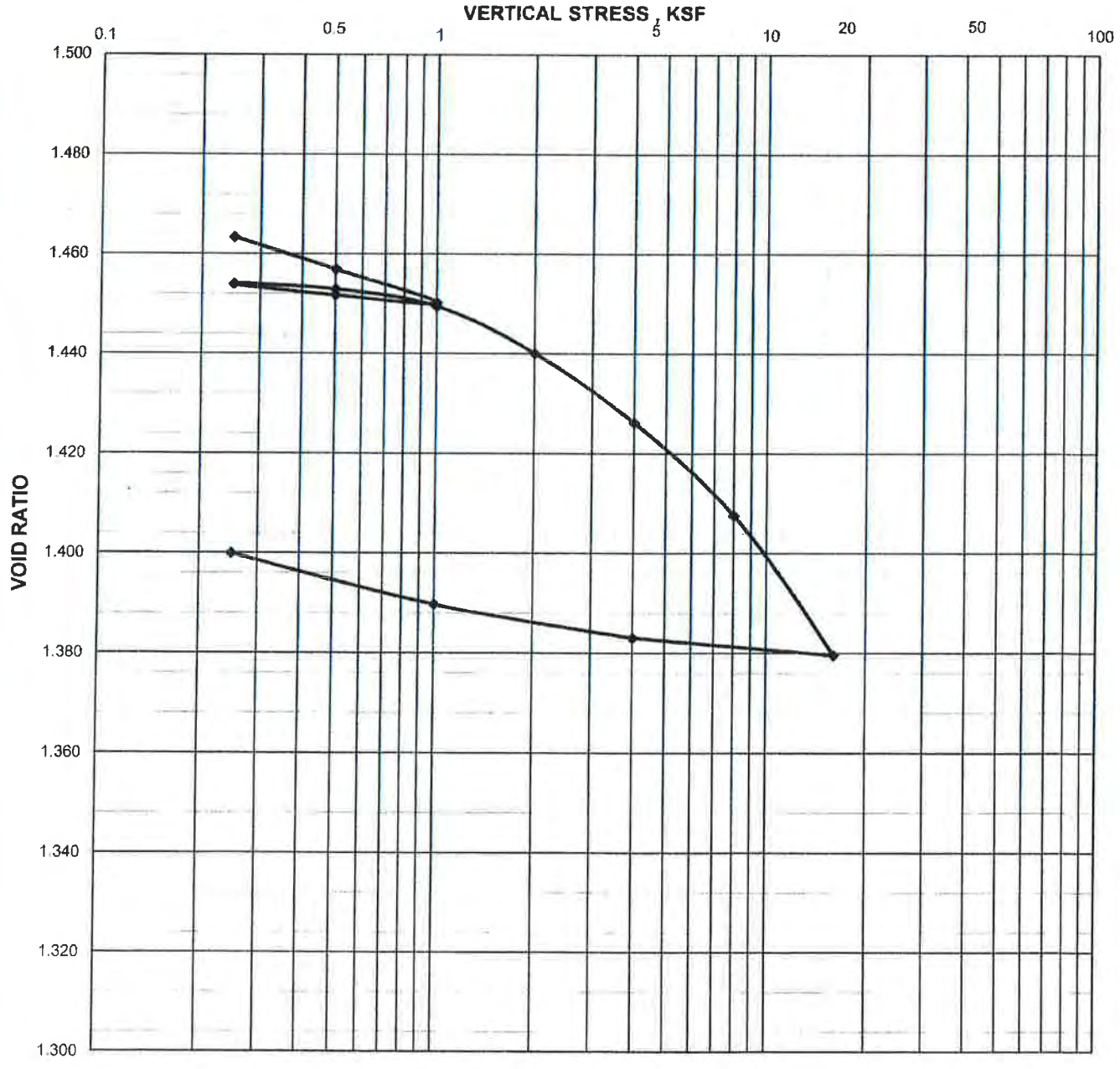


S&ME

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_c, 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

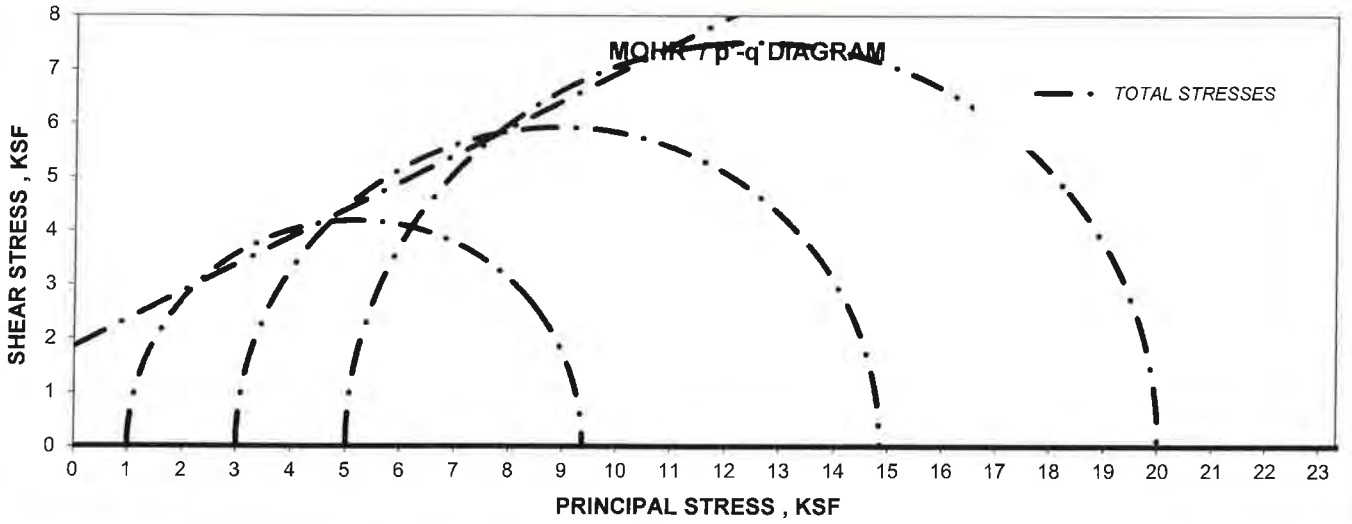
SPECIMEN NO.		**1**	**2**	**3**
B Value		N/A	N/A	N/A
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	$\sigma_1-\sigma_3$	8.4	11.9	15.0
ULT. DEVIATOR STRESS , ksf	$\sigma_1-\sigma_3$	8.4	10.7	14.8
Specimen Shape @ Failure	Sheared			

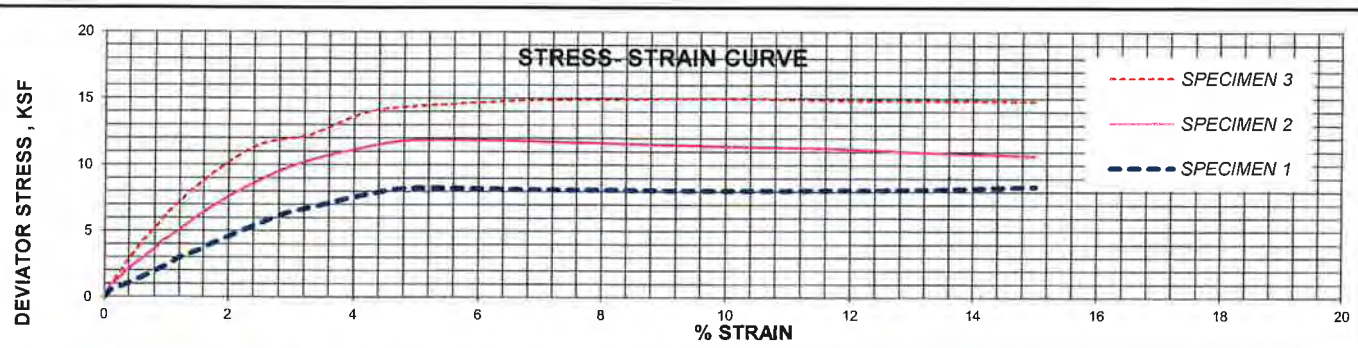
CONTROLLED : Strain @ 1.0 % per minute

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

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		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

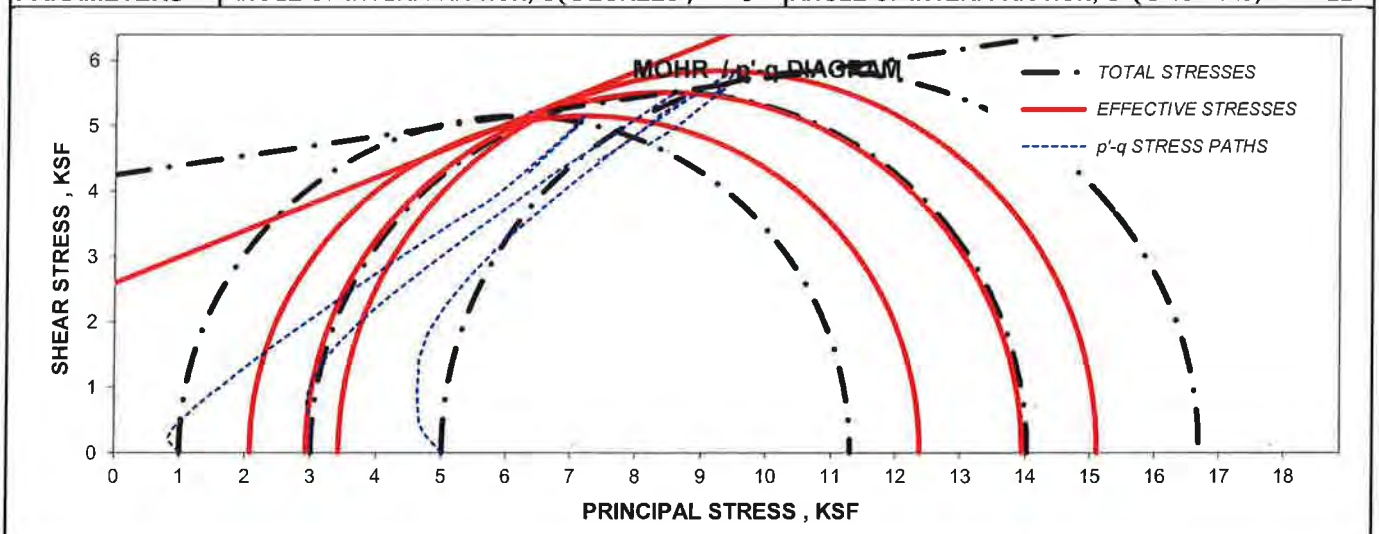
TEST PARAMETERS , TEST TYPE : CU/PP				
SPECIMEN NO.		**1**	**2**	**3**
B Value		0.95	0.95	0.95
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	10.3	11.0	11.7
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.5	9.0	9.4
Specimen Shape @ Failure	Sheared			

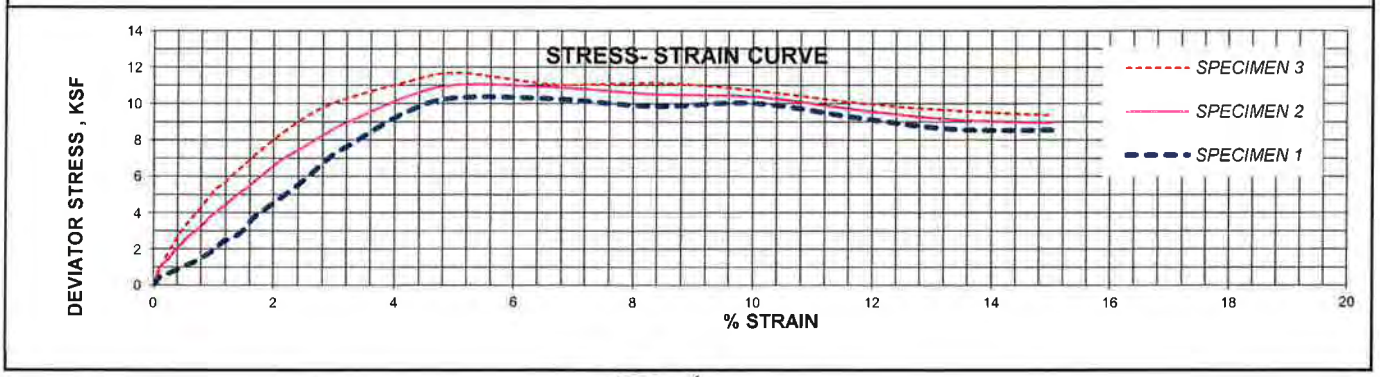
CONTROLLED : Strain @ 0.02 % per minute T50, Minutes = 18.0

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
	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*

Signature

Location Coordinator — *Position*

06/10/14 — *Date*

S&ME

TRIAXIAL SHEAR TEST REPORT

(ASTM D 4767)

REV4,1/13/04

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**		**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

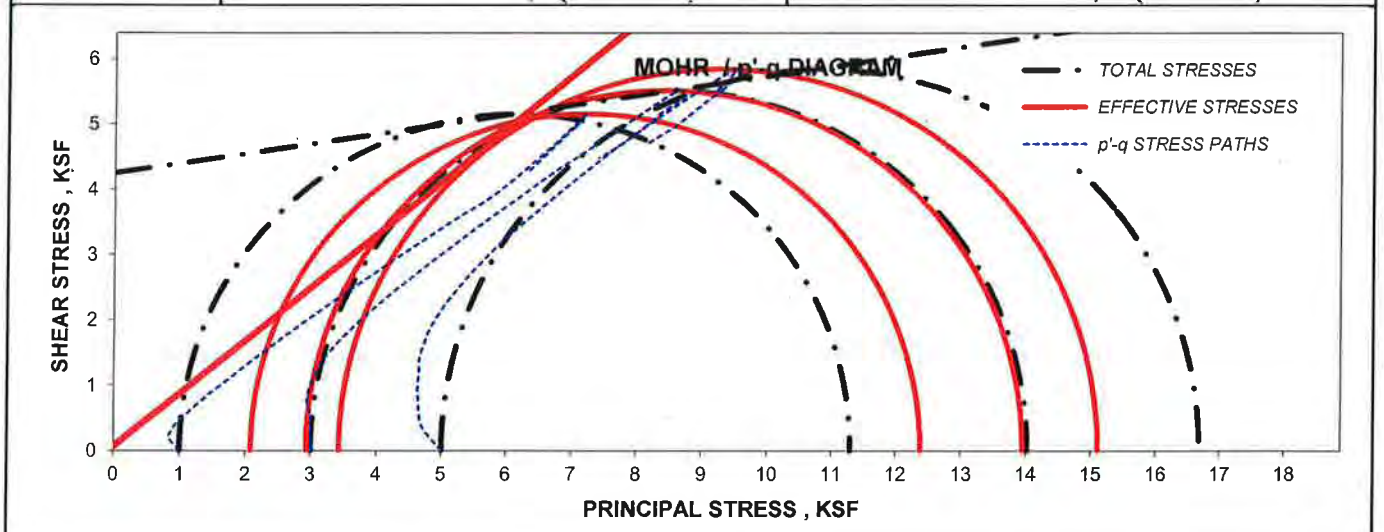
SPECIMEN NO.		**1**	**2**	**3**
B Value		0.95	0.95	0.95
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	10.3	11.0	11.7
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.5	9.0	9.4
Specimen Shape @ Failure		Sheared		

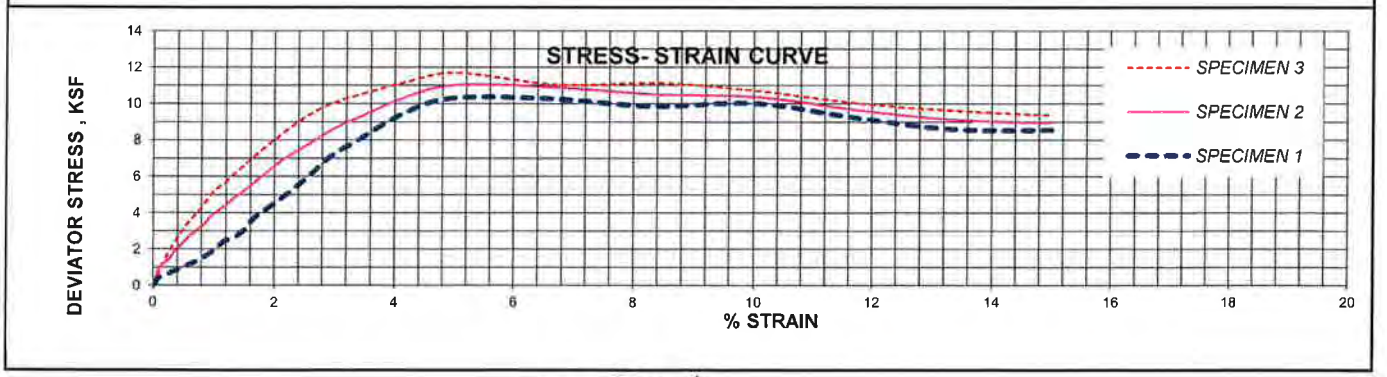
CONTROLLED : Strain @ 0.02 % per minute — T50, Minutes = 18.0

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*

Signature

Location Coordinator — *Position*

06/10/14 — *Date*

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	10 Å	-	-	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

See Ref. 1

ATTACHMENT C

ATTACHMENT D

a height of 760 mm (30 in).

g 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
ıe 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).
ɔw count $N \geq 100$. The log may
indicating 70 blows for 150 mm
ration. Large blow counts both
:ause rapid equipment wear and
:efusal" by ASTM at 100 assists
; firm to better identify drilling

igate the status of cohesionless
y 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
ay (see Fig. 6-3*a*) the recovered
ısually immediately tested for
(Fig. 6-3*a*) or a portable field
ıally stored in small glass jars
mple depth, and blow count N.
ıs necessary for sieve analyses,
rg limits. The boxes of samples
boratory for a stated period of

roperties have been proposed.
than guesses. For example, in
ıost 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 $p_0 = \gamma y$			

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.

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.

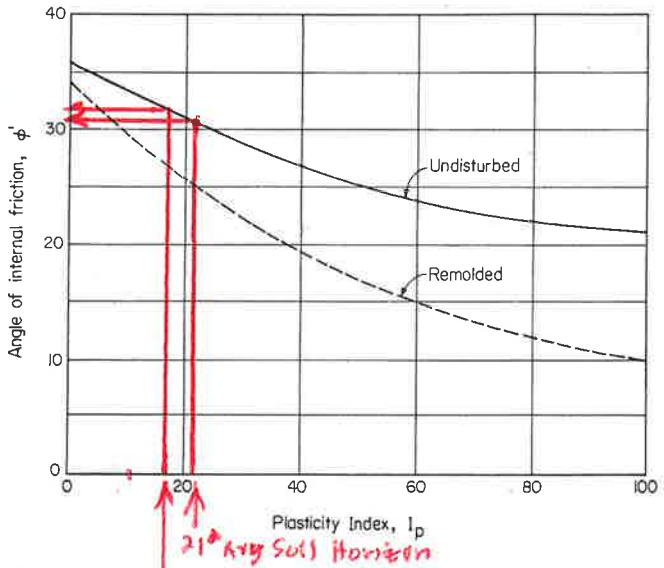


Figure 13-20 Correlation between angle of internal friction ϕ' (true) and plasticity index for both undisturbed and remolded soil. *(After Bjerrum and Simons, 1960.)*

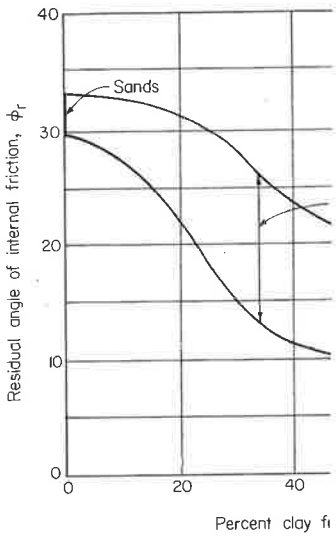


Figure 13-21 Correlation between
ton, 1964.)

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

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

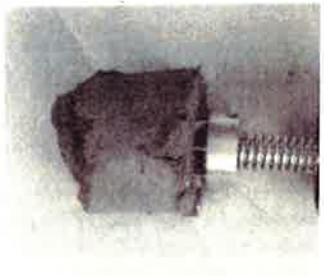


Figure 13-22 The torvane.

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-sand 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

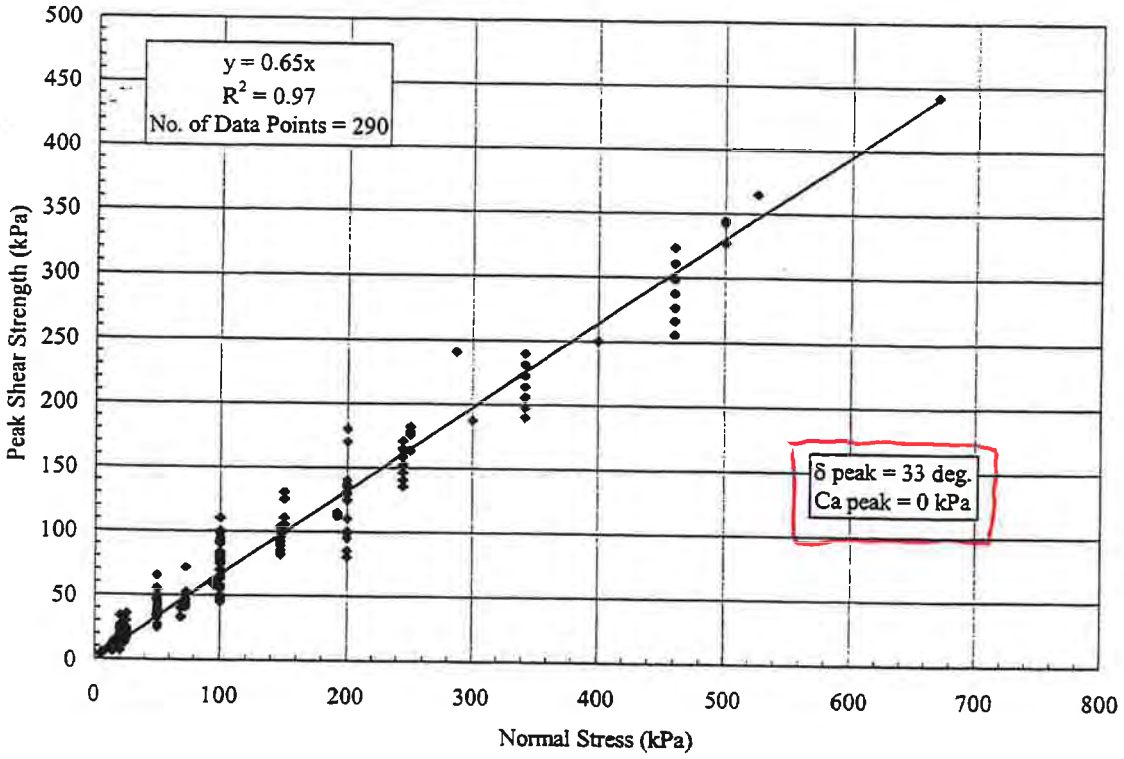
Notes:

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.

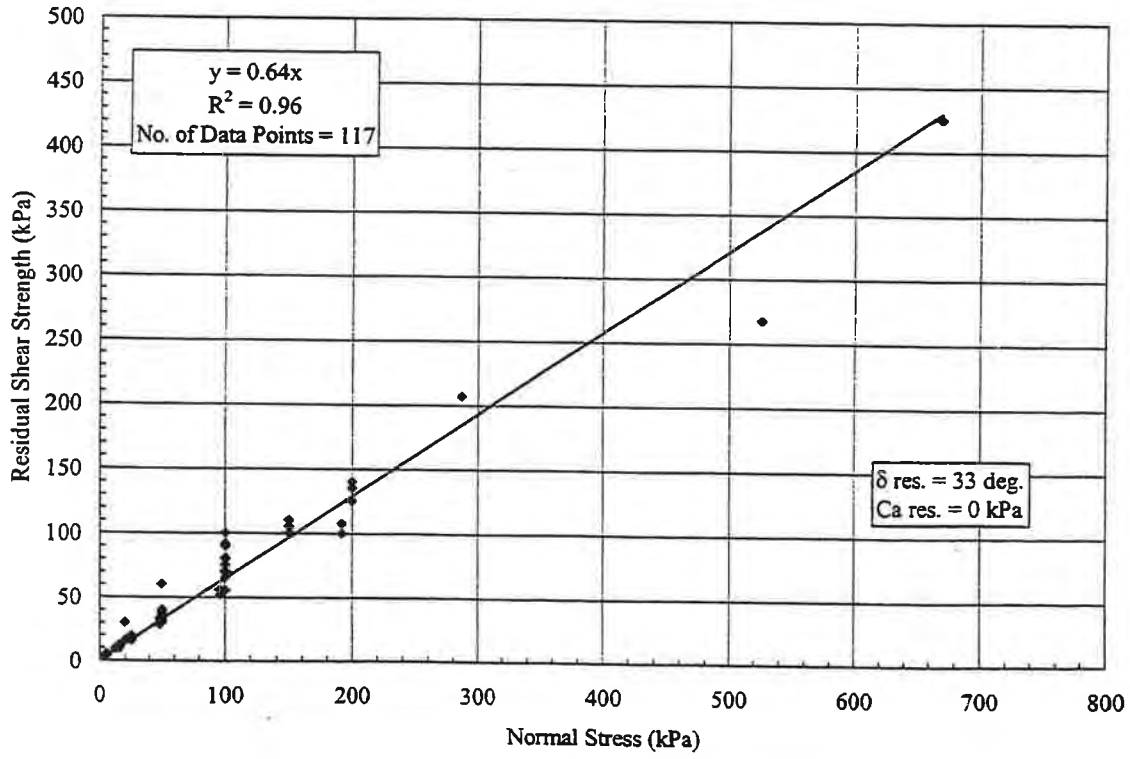
Spec Ref. 4

ATTACHMENT F

ATTACHMENT G

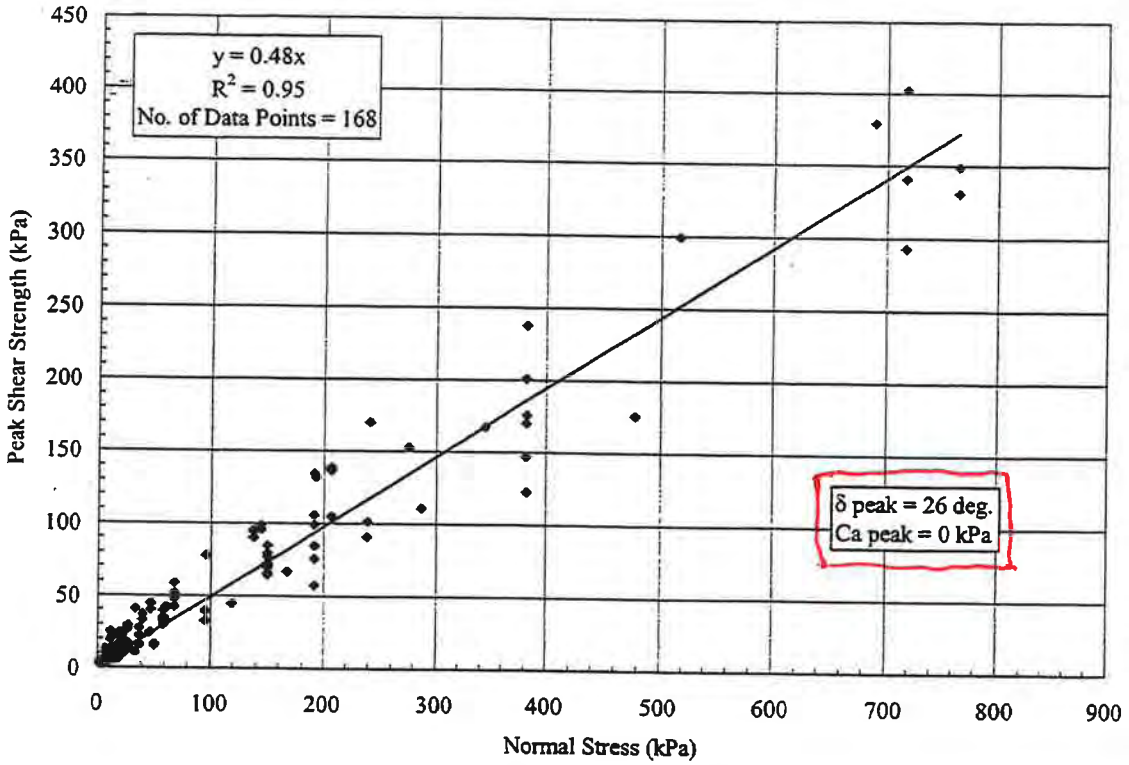


Appendix Figure 8a – Peak Shear Strength; NW-NP Geotextile against Granular Soil.

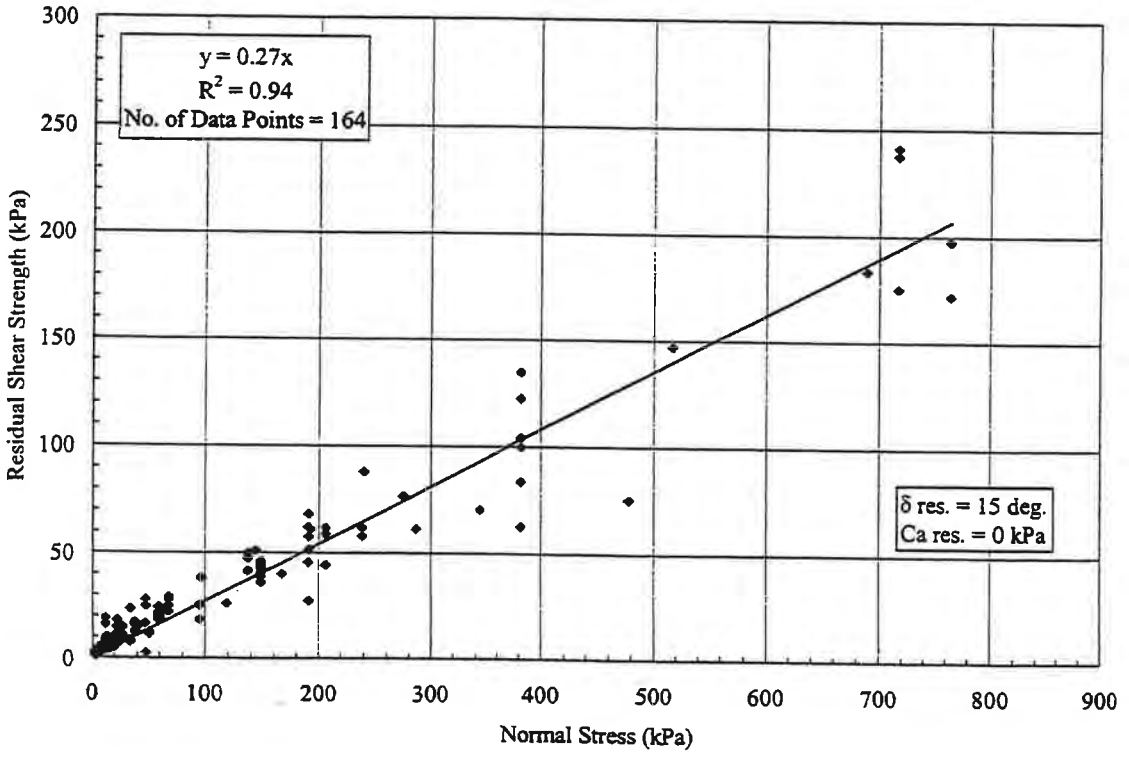


Appendix Figure 8b – Residual Shear Strength; NW-NP Geotextile against Granular Soil.

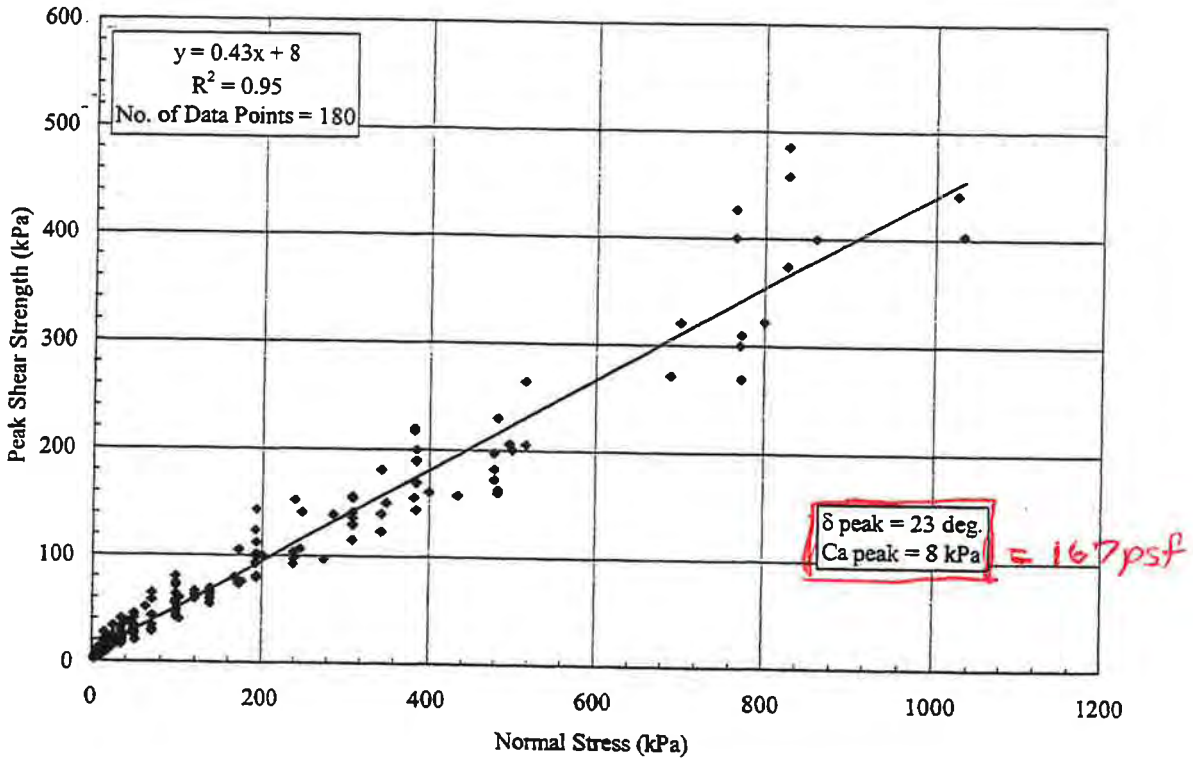
See Ref. 5



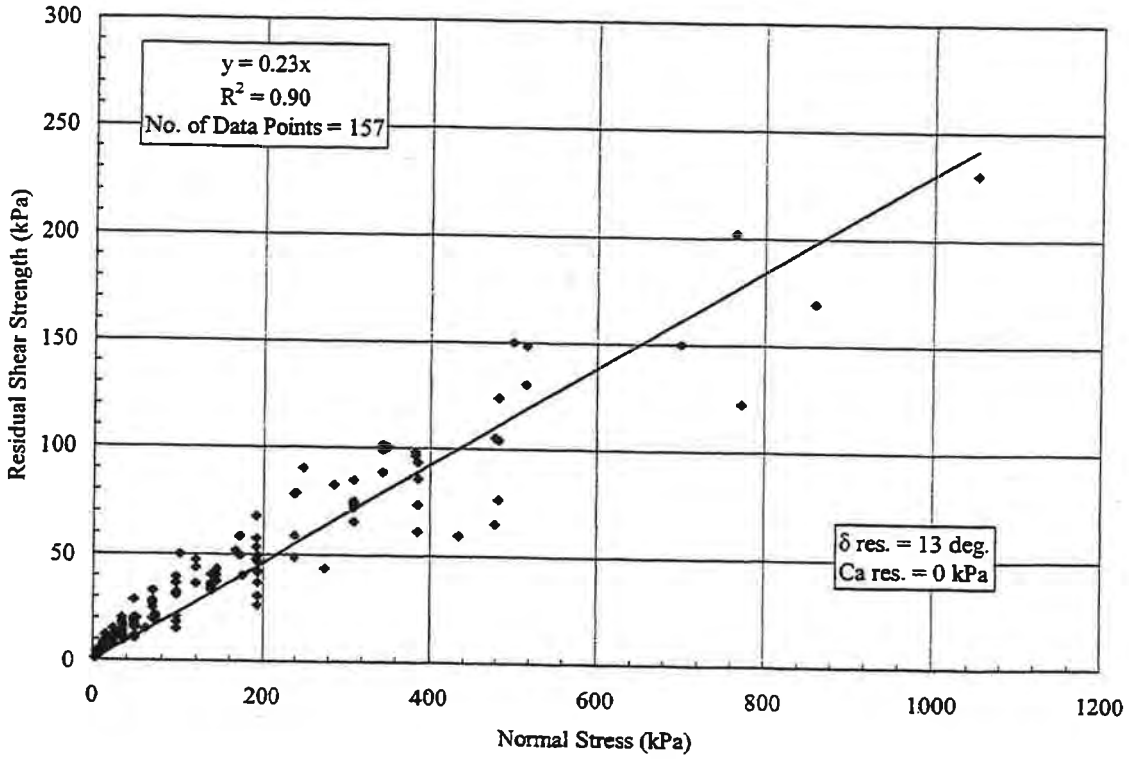
Appendix Figure 2i – Peak Shear Strength; Textured HDPE against NW-NP Geotextile on a Drainage Geocomposite.



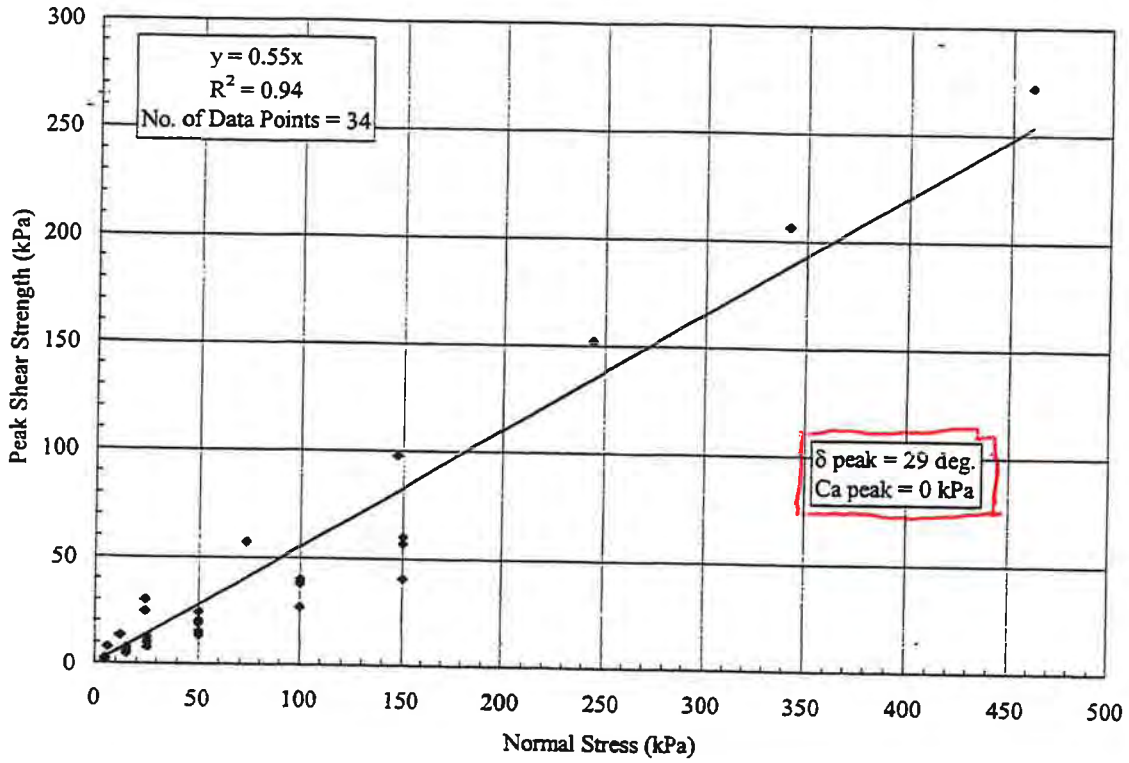
Appendix Figure 2j – Residual Shear Strength; Textured HDPE against NW-NP Geotextile on a Drainage Geocomposite.



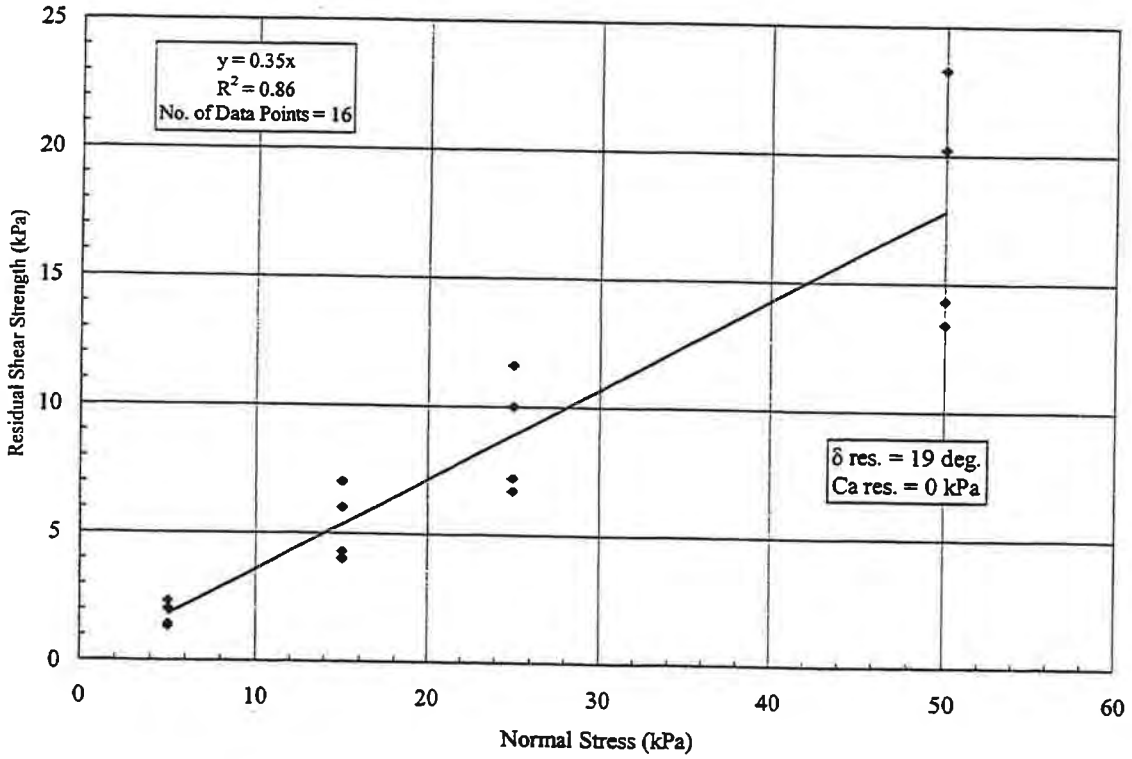
Appendix Figure 11a - Peak Shear Strength; Textured HDPE against NW-NP Side of Fabric-Reinforced GCL.



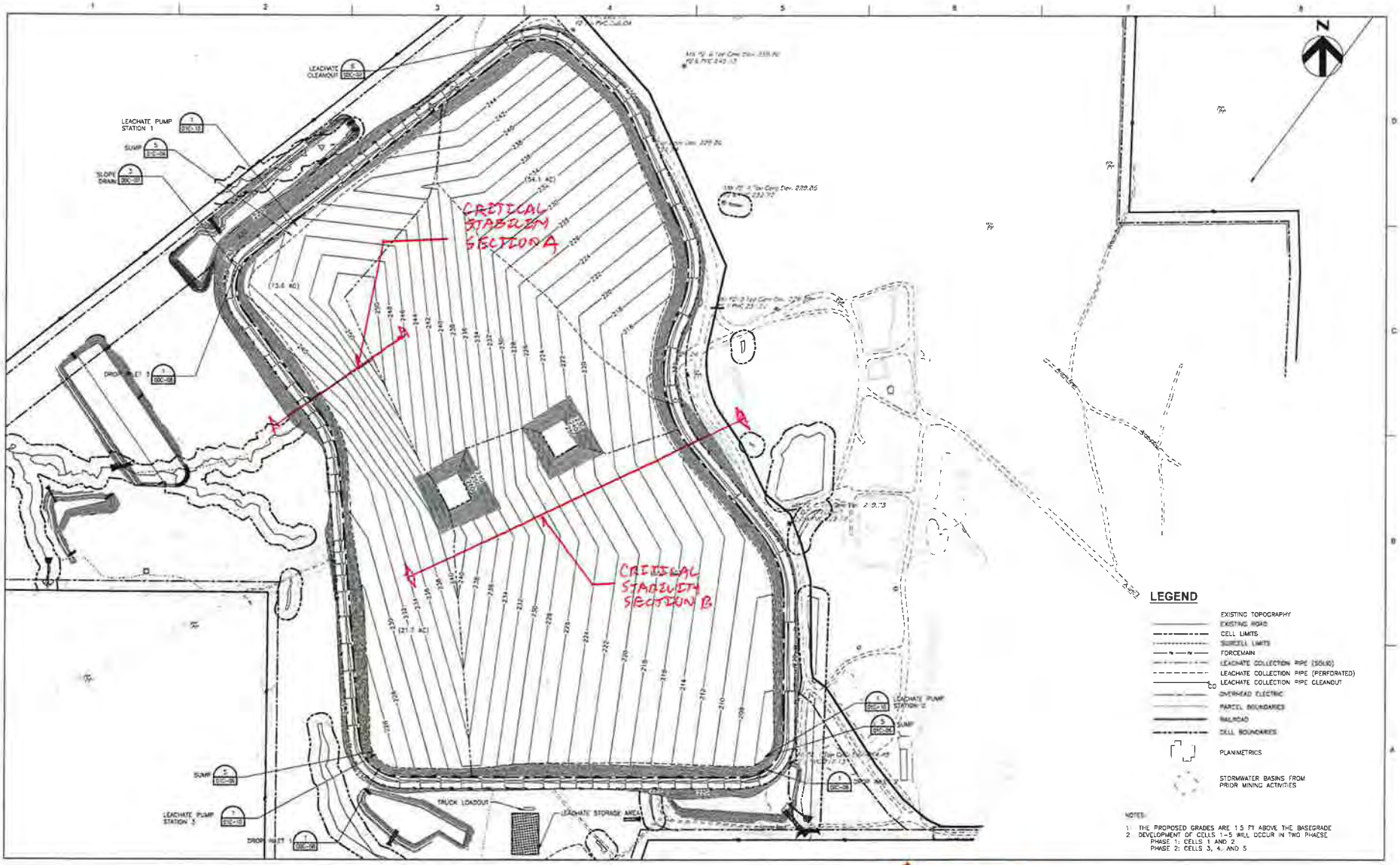
Appendix Figure 11b - Residual Shear Strength; Textured HDPE against NW-NP Side of Fabric-Reinforced GCL.



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



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



HDR Engineering Inc
of the Carolinas

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

ISSUE	DATE	DESCRIPTION
A	11/2014	ISSUED FOR APPROVAL

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

Charah

BRICKHAVEN No. 2 MINE TRACT "A" MINE
STRUCTURAL FILL
MONCURE, NC

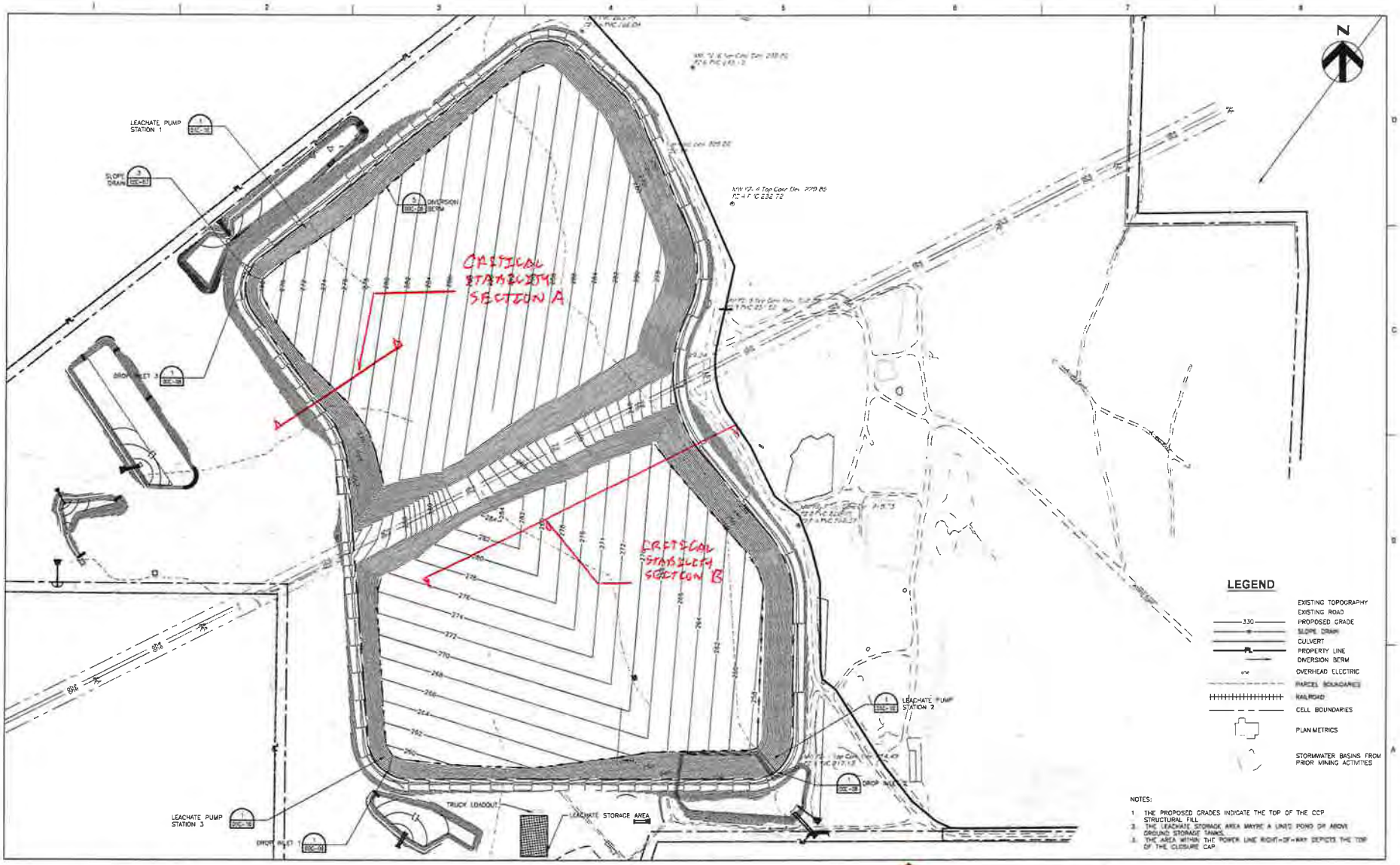
TOP OF LINER

0 1" 2"

FILENAME 01C-03.dwg
SCALE 1"=200'

SHEET 01C-03

ATTACHMENT H



HDR

HDR Engineering Inc of the Carolinas

ISSUE	DATE	DESCRIPTION
A	11/2014	ISSUED FOR APPROVAL

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

Charah®

BRICKHAVEN No. 2 MINE TRACT "A" MINE
STRUCTURAL FILL
MONCURE, NC

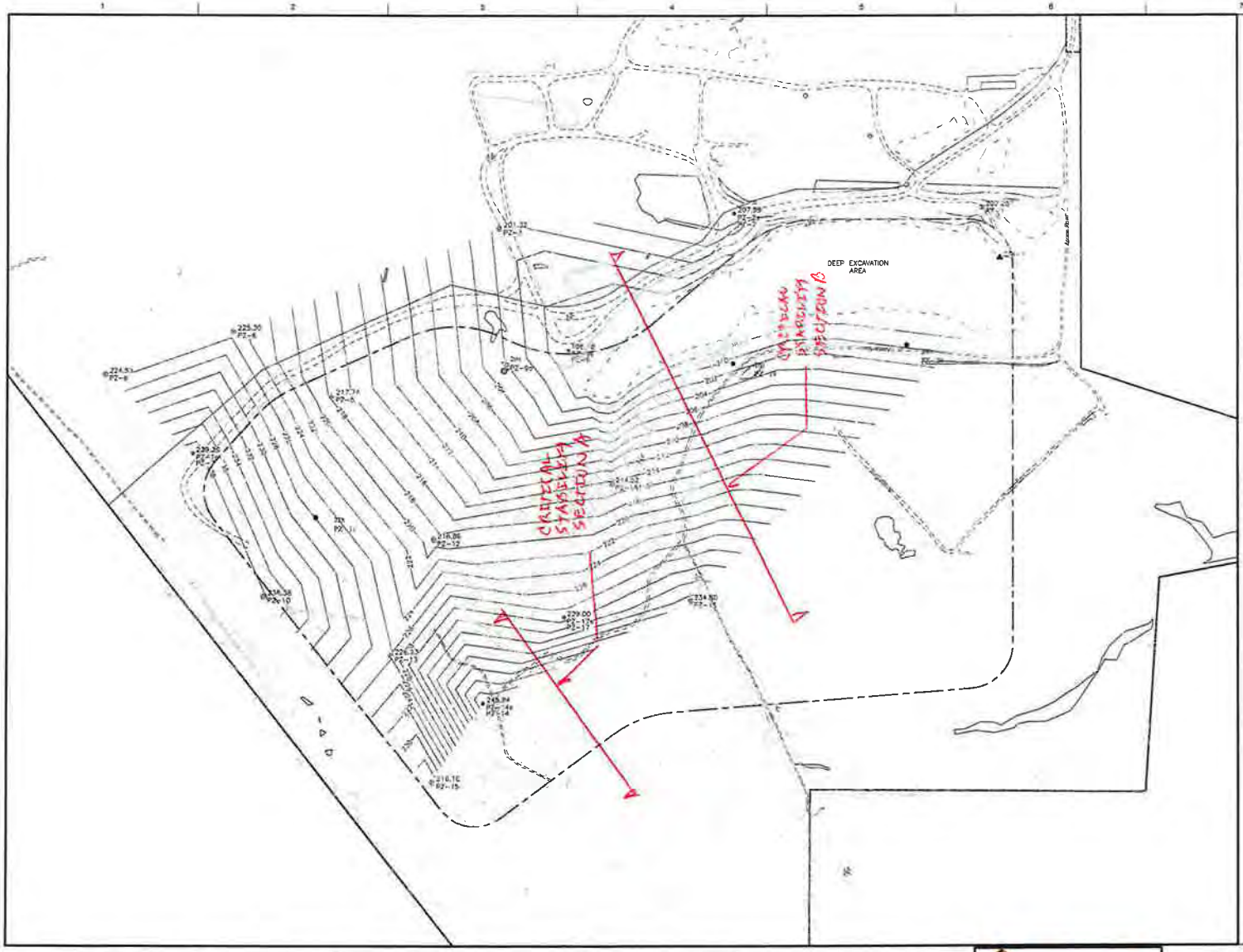
CLOSURE PLAN

0 1" 2"

FILENAME: 01C-04.dwg
SCALE: 1"=200'

SHEET: 01C-04

ATTACHMENT I.



NOTES:

1. SURVEY BASE MAP PREPARED BY LAWRENCE SURVEYING OF MONROE DATED AUGUST 21, 2014
2. GROUNDWATER POTENTIOMETRIC CONTOURS GENERATED UTILIZING AUTOCAD DRAFTING AND INTERPOLATION SOFTWARE BY HDR ENGINEERING INC WITH OVERSIGHT BY ROSS KLINGMAN P.G. WITH BUXTON ENVIRONMENTAL INC. GROUNDWATER CONTOURS WERE GENERATED WITH STABILIZED WATER LEVELS AT INTERMEDIATE AND DEEP PIEZOMETERS AND LARGE POND SURFACE WATER ELEVATION

LEGEND

- SINGLE SHALLOW OR INTERMEDIATE PIEZOMETER
- NESTED SHALLOW AND INTERMEDIATE PIEZOMETER PAIR
- NESTED SHALLOW AND INTERMEDIATE PIEZOMETER PAIR (WITH ROCK CORE)
- ATTEMPTED PIEZOMETER AND ROCK CORE
- GEOTECHNICAL SOIL BORING (GEOTRACK) (APPROX. LOCATIONS FOR B-2, B-4 & B-5)
- EXCAVATION WATER STAKE

HDR Engineering Inc. of the Carolinas

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

ISSUE	DATE	DESCRIPTION
A	11/20XX	ISSUED FOR APPROVAL

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

Charah

BRICKHAVEN MINE SITE STRUCTURAL FILL
MONCURE, NC

MONCURE MINE RECLAMATION STRUCTURAL FILL SITE PLAN WITH PIEZOMETER LOCATIONS

0 1" 2"

FILENAME 01G-11.dwg
SCALE 1"=200

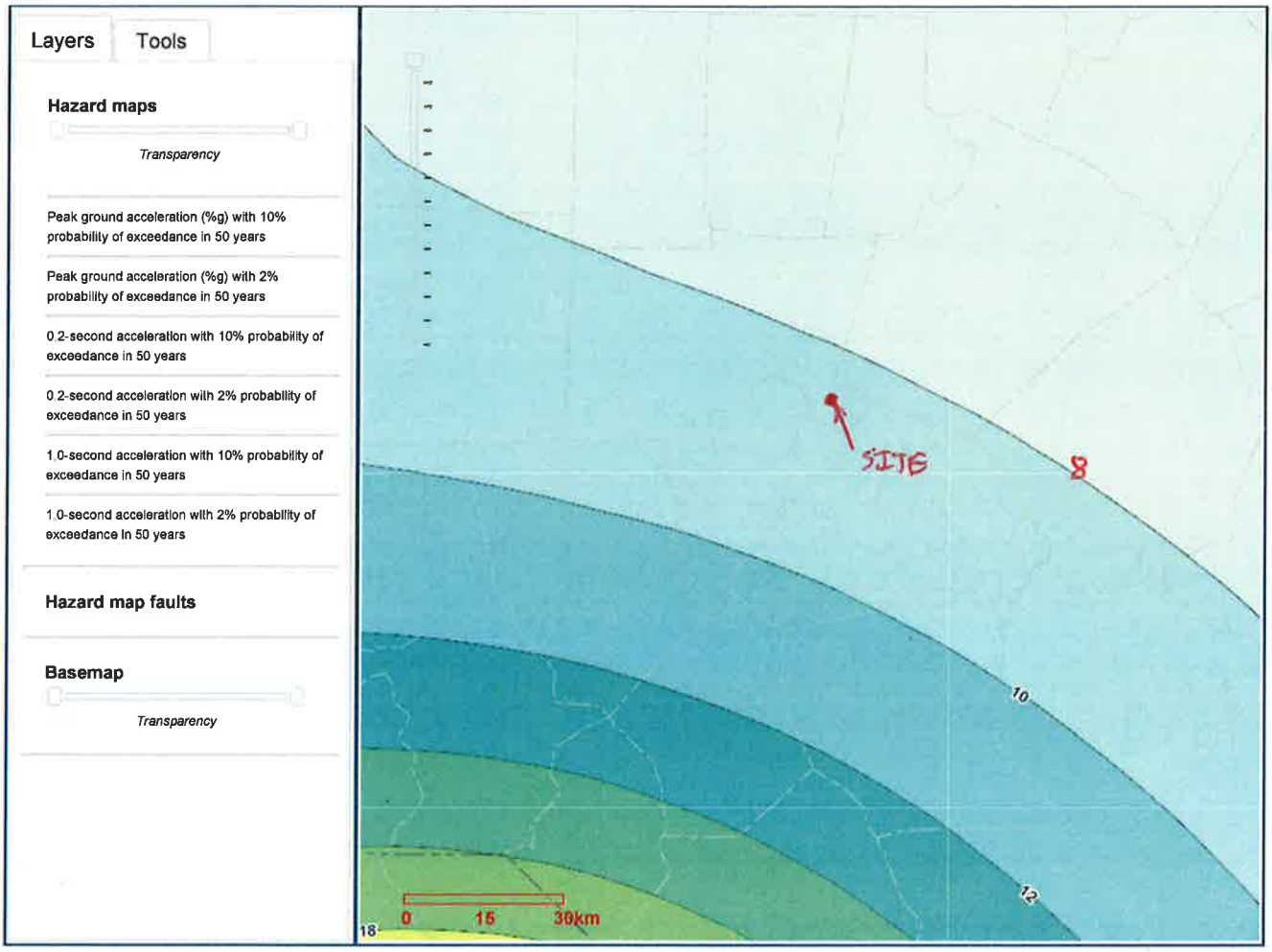
SHEET
FIGURE 3

ATTACHMENT J

ATTACHMENT K

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	453925-235673-018	No.	

Project	Charah Brickhaven Mine Site	Computed	MDP	Date	11/6/2014
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)

Phase 1, Cell 1, Subcell 1A Berm Height = 5 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	5	4.43	192,962	321,603
	Total Available Volume for =			321,603

Phase 1, Cell 1, Subcell 1B Berm Height = 8.0 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	8	3.06	133,280	355,413
	Total Available Volume for =			355,413

Phase 1, Cell 2, Subcell 2A Berm Height = 6.5 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6.5	2.45	106,919	231,659
	Total Available Volume for =			231,659

HDR Computation

Job Number	453925-235673-018	No.	

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

Phase 1, Cell 2, Subcell 2B Berm Height = 8 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	8.0	1.77	77,289	206,104
	Total Available Volume for =			206,104

Phase 2, Cell 3, Subcell 3A Berm Height = 8 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	8	8.87	386,486	1,030,629
	Total Available Volume for =			1,030,629

Phase 2, Cell 3, Subcell 3B Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	3.04	132,540	265,081
	Total Available Volume for =			265,081

Phase 2, Cell 4, Subcell 4A Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	4.32	188,058	376,116
	Total Available Volume for =			376,116

Phase 2, Cell 4, Subcell 4B Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	2.58	112,596	225,192
	Total Available Volume for =			225,192

HDR Computation

Job Number	453925-235673-018	No.	

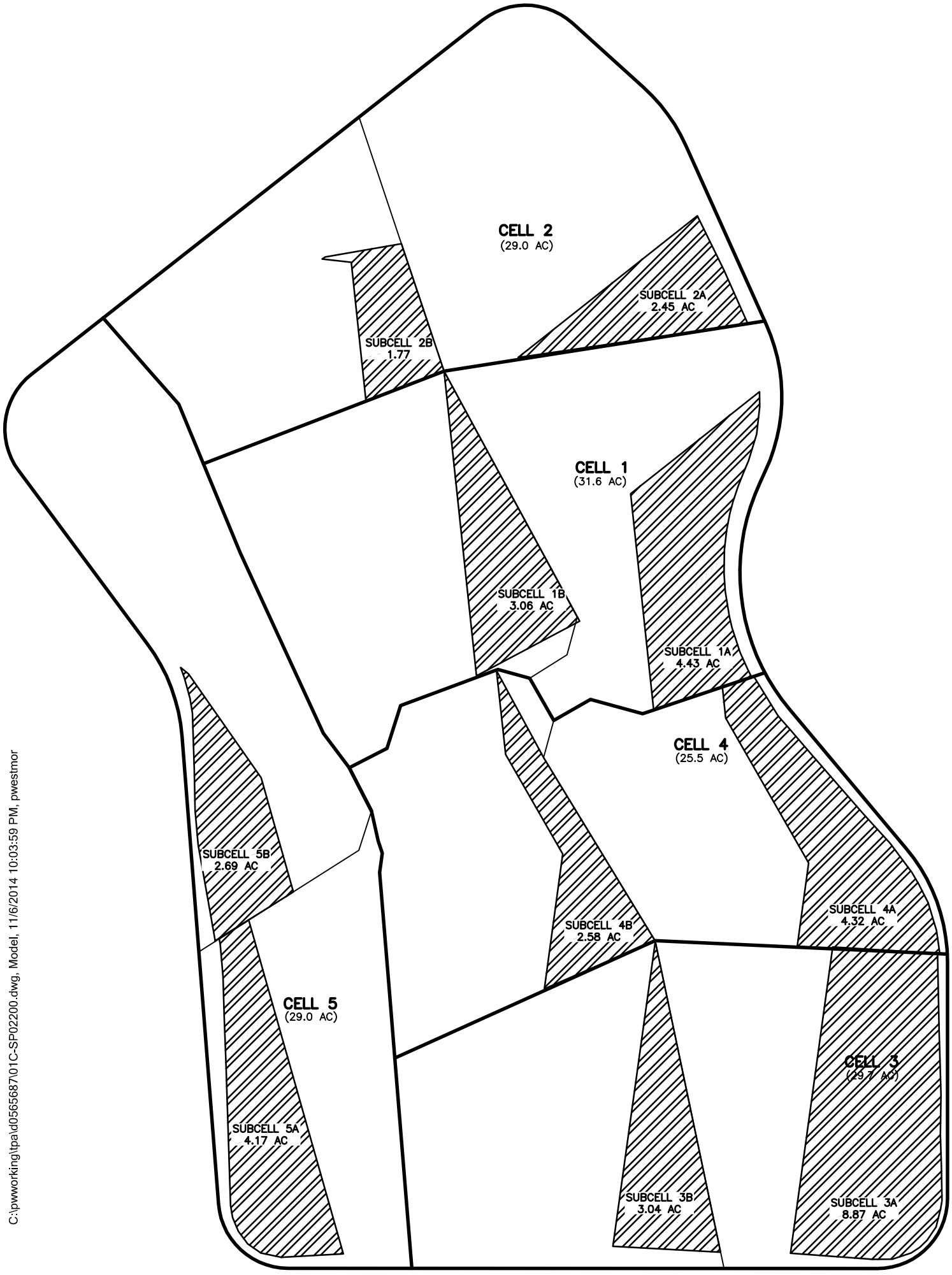
Project	Charah Brickhaven Mine Site	Computed	MDP	Date	11/6/2014
Subject	Permit Application	Checked	EAW	Date	11/6/2014
Task	Subcell Divider Berms	Sheet		Of	

Phase 3, Cell 5, Subcell 5A Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	4.17	181,643	363,287
		Total Available Volume for =		363,287

Phase 3, Cell 5, Subcell 5B Berm Height = 6 ft

	Elevation (ft)	Area (ac)	Area (ft^2)	Volume (ft^3)
base	0	0.0	0	
top	6	2.69	116,989	233,977
		Total Available Volume for =		233,977



C:\pwworking\tpa\d0565687\01C-SP02200.dwg, Model, 11/6/2014 10:03:59 PM, pwestmor

HDR Computation

Job Number	453925-237673-018	**No.**	
Project	Charah Brickhaven 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 =	17.5	acres
Storm Event Q_{cfs} =	357,011	cf/acre/day
Q_{gpm} =	1854.60	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 =	**40.447**	**gpm (actual flow rate per acre for the drainage area of the pipe)**

HDR Computation

Job Number	453925-237673-018	**No.**	
Project	Charah Brickhaven 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
40.447		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	453925-237673-018	**No.**	
Project	Charah Brickhaven 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:	Moncure Mine	Computed	EAW	Date	11/6/14
Subject:	Permit Application	Checked	TAW	Date	11-6-14
Task:	Drainage - Time of Concentration	Sheet	1	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

Drop Inlet #2	Hydraulic length of watershed L (ft) =	2,420
	Peak Elevation of watershed (ft) =	287
	Low Elevation of watershed (ft) =	218
	Elevation change along length H (ft) =	69
	t_c (min) =	**12.4**
Drop Inlet #1	Hydraulic length of watershed L (ft) =	1,498
	Peak Elevation of watershed (ft) =	287
	Low Elevation of watershed (ft) =	235
	Elevation change along length H (ft) =	52
	t_c (min) =	**8.0**
Drop Inlet #3	Hydraulic length of watershed L (ft) =	1,810
	Peak Elevation of watershed (ft) =	294
	Low Elevation of watershed (ft) =	249
	Elevation change along length H (ft) =	45
	t_c (min) =	**10.4**
North Cell to DI #2	Hydraulic length of watershed L (ft) =	3,889
	Peak Elevation of watershed (ft) =	294
	Low Elevation of watershed (ft) =	218
	Elevation change along length H (ft) =	76
	t_c (min) =	**20.7**

CONCLUSION

Use a Time of Concentration of 15-Minutes => 5.71 25-yr, 15-min Design Storm

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Project:	Moncure Mine	Computed EAW	11/6/2014
Subject:	Permit Application	Checked PAW	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) =	5.71	25-yr, 15-min Design Storm	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

Project:	Moncure Mine	Computed EAW	11/6/2014
Subject:	Permit Application	Checked PKW	Date 11-6-14
Task:	Drainage - Perimeter Channels	Sheet	Of

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

Node	Drainage Area (sf)	Drainage Area (acres)	Channel Slope	Channel Side Slope Inside (X:1)	Channel Side Slope Outside (X:1)	Bottom Width, b (ft)
DI #1	151,343	3.47	2.5%	2	2	4
DI #2	126,288	2.90	1.2%	2	2	4
DI #3	207,620	4.77	2.5%	2	2	4
DI #4	494,592	11.35	2.5%	2	2	4
DI #5	193,321	4.44	0.7%	2	2	4
DI #6	244,717	5.62	2.0%	2	2	4
A	302,929	6.95	2.5%	2	2	4
AB	1,153,885	26.49	1.1%	2	2	4
ABC	1,677,879	38.52	0.9%	2	2	4
ABCD	2,030,610	46.62	0.6%	2	2	4
E	1,177,817	27.04	0.5%	2	2	4
F	180,590	4.15	2.5%	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	11.9	E	1.01	0.42	2.04	0.35	1.01	5.8	0.7	Need Liner
	DI #2	9.9	E	1.21	0.47	2.31	0.38	1.21	4.3	0.4	Need Liner
	DI #3	16.3	E	1.39	0.51	2.54	0.41	1.39	6.4	0.8	Need Liner
	DI #4	38.9	E	3.30	0.82	4.62	0.60	3.30	8.4	1.3	Need Liner
	DI #5	15.2	E	2.36	0.68	3.66	0.52	2.36	4.2	0.3	Need Liner
	DI #6	19.2	E	1.83	0.59	3.07	0.46	1.83	6.3	0.7	Need Liner
	A	23.8	E	2.02	0.63	3.28	0.48	2.02	7.3	1.0	Need Liner
	AB	90.8	E	11.39	1.57	11.25	1.02	11.39	8.1	1.1	Need Liner
	ABC	132.0	E	18.67	2.01	16.15	1.24	18.67	8.2	1.1	Need Liner
	ABCD	159.7	E	27.70	2.44	21.61	1.45	27.70	7.4	0.9	Need Liner
	E	92.6	E	17.58	1.95	15.46	1.21	17.58	6.0	0.6	Need Liner
	F	14.2	E	1.21	0.47	2.31	0.38	1.21	6.1	0.7	Need Liner
Temp Lining											
	DI #1	11.9	D	1.31	0.49	2.44	0.39	1.31	4.9	0.8	OK
	DI #2	9.9	D	1.57	0.54	2.76	0.43	1.57	3.6	0.4	OK
	DI #3	16.3	D	1.80	0.59	3.03	0.46	1.80	5.4	0.9	OK
	DI #4	38.9	D	4.29	0.95	5.57	0.68	4.29	7.0	1.5	OK
	DI #5	15.2	D	3.07	0.79	4.39	0.58	3.07	3.5	0.4	OK
	DI #6	19.2	D	2.37	0.68	3.67	0.52	2.37	5.2	0.9	OK
	A	23.8	D	2.63	0.72	3.94	0.54	2.63	6.0	1.1	OK
	AB	90.8	D	14.81	1.80	13.63	1.13	14.81	6.7	1.3	OK
	ABC	132.0	D	24.27	2.29	19.60	1.38	24.27	6.7	1.3	OK
	ABCD	159.7	D	36.01	2.76	26.25	1.61	36.01	6.1	1.0	OK
	E	92.6	D	22.86	2.22	18.75	1.35	22.86	4.9	0.7	OK
	F	14.2	D	1.57	0.54	2.76	0.43	1.57	5.1	0.8	OK

Project:	Moncure Mine	Computed EAW	11/6/2014
Subject:	Permit Application	Checked PMW	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	5.0	F	0.63	0.32	1.49	0.27	0.63	3.3	0.5	OK
	DI #2	4.1	F	0.76	0.36	1.69	0.30	0.76	2.4	0.3	OK
	DI #3	6.8	F	0.87	0.39	1.85	0.32	0.87	3.7	0.6	OK
	DI #4	16.2	F	2.06	0.63	3.33	0.49	2.06	4.9	1.0	OK
	DI #5	6.3	F	1.47	0.52	2.64	0.42	1.47	2.4	0.2	OK
	DI #6	8.0	F	1.14	0.45	2.22	0.37	1.14	3.6	0.6	OK
	A	9.9	F	1.26	0.48	2.37	0.39	1.26	4.2	0.7	OK
	AB	37.8	F	7.12	1.24	8.00	0.84	7.12	4.7	0.9	OK
	ABC	55.0	P	5.06	1.03	6.26	0.73	5.06	8.8	0.6	OK
	ABCD	66.5	P	7.50	1.27	8.31	0.86	7.50	8.0	0.5	OK
	E	38.6	P	4.76	1.00	5.99	0.71	4.76	6.4	0.3	OK
	F	5.9	F	0.75	0.36	1.68	0.30	0.75	3.5	0.6	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	2.5%	0.7	2	12	Curlex HV (or equiv)	Grass Lined
DI #2	2	2	4	1.2%	0.7	2	12	Curlex HV (or equiv)	Grass Lined
DI #3	2	2	4	2.5%	0.8	2	12	Curlex HV (or equiv)	Grass Lined
DI #4	2	2	4	2.5%	1.1	2	12	Curlex HV (or equiv)	Grass Lined
DI #5	2	2	4	0.7%	1.0	2	12	Curlex HV (or equiv)	Grass Lined
DI #6	2	2	4	2.0%	0.9	2	12	Curlex HV (or equiv)	Grass Lined
A	2	2	4	2.5%	0.9	2	12	Curlex HV (or equiv)	Grass Lined
AB	2	2	4	1.1%	2.0	2	12	Curlex HV (or equiv)	Grass Lined
ABC	2	2	4	0.9%	1.2	2	12		Concrete
ABCD	2	2	4	0.6%	1.5	2	12		Concrete
E	2	2	4	0.5%	1.2	2	12		Concrete
F	2	2	4	2.5%	0.7	2	12	Curlex HV (or equiv)	Grass Lined

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Project:	Moncure Mine	Computed EAW	Date 11/06/14
Subject:	Permit Application	Checked PAW	Date 11-6-14
Task:	Drainage - Top slope 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) =	5.71	25-yr, 15-min Design Storm	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:	Moncure Mine	Computed EAW	Date 11/06/14
Subject:	Permit Application	Checked PMW	Date 11-6-14
Task:	Drainage - Top slope 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 Side Slope				
Berm Location	Drainage Area (sf)	Drainage Area (acres)	Channel Slope	Inside (X:1)	Outside (X:1)	Bottom Width, b (ft)	
Area E	1,177,817	27	0.17%	50	2	0	Largest Drainage Area
1/2 Area B	425478	12.1	0.63%	50	2	0	Largest Drainage Area

Berm 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									
Area E	92.6	E	30.46	1.26	41.50	0.63	30.46	2.2	0.1	OK
1/2 Area B	41.5	E	6.98	0.73	13.75	0.36	6.98	3.0	0.3	OK
	Temp Lining									
Area E	92.6	C	38.07	1.37	49.06	0.68	38.07	1.9	0.1	OK
1/2 Area B	41.5	C	8.73	0.79	16.26	0.39	8.73	2.5	0.3	OK
	Permanent Lining									
Area E	38.6	F	19.04	1.06	29.18	0.53	19.04	1.3	0.1	OK
1/2 Area B	17.3	F	4.36	0.61	9.66	0.30	4.36	1.8	0.2	OK

CONCLUSION

	Side Slope			Min to Construct		
	Inside Channel (X:1)	Outside Channel (X:1)	Bottom Width, b (ft)	Slope (%)	Depth (ft)	Top Width (ft)
Area E	50	2	0	0.17%	1.1	55.1
1/2 Area B	50	2	0	0.63%	0.6	31.7

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

Project:	Moncure Mine	Computed EAW	Date 11/06/14
Subject:	Permit Application	Checked: PAW	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 (permanent)= 0.25 Pasture, Sandy

I (in/hr) = 5.71 25-yr, 15-min Design Storm

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

$$D_{REQD} = 16\left[\frac{Qn}{\sqrt{s}}\right]^{\frac{3}{8}}$$ area to pipe is in "post" condition

Manning's

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 2.0 feet (depth of channel)

Location	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
B	25%	19.5	27.9	13.8	18	1.8	10.7	1.3	57.0	
E	25%	27.0	38.6	15.5	18	1.8	20.6	1.3	57.0	
H	25%	19.5	27.8	13.8	18	1.8	10.7	1.3	57.0	
L	25%	15.6	22.2	12.6	18	1.8	6.8	1.3	57.0	

Conclusion:

Use 18" corrugated plastic pipe (smooth wall)

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Project:	Moncure Mine	Computed: EAW	Date 11/06/14
Subject:	Permit Application	Checked PMW	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 = 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

	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)

Flow from Slope Drains 27.9

Check for inlet control

Channel Location	Contributing Area (sf)	Q (cfs)	C_d	# of Grates		Grate	Open Area (sf)	Required head(ft)	
DI #1	151,343	11.9	0.59	1	C	R-3531-A	6.0	0.2	Ok
DI #2	126,288	9.9	0.59	1	C	R-3531-A	6.0	0.1	Ok
DI #3	207,620	16.3	0.59	1	C	R-3531-A	6.0	0.3	Ok
DI #4	494,592	38.9	0.59	1	C	R-3531-A	6.0	1.9	Ok
DI #5	193,321	15.2	0.59	1	C	R-3531-A	6.0	0.3	Ok
DI #6	244,717	19.2	0.59	1	C	R-3531-A	6.0	0.5	Ok
DI #7	2,211,200	173.9	0.59	5	C	R-3531-A	30.0	1.5	Ok

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

Pipe	Q (cfs)	Slope (%)	# of pipes	Theoretical Diameter (in)	Culvert Diameter (in)
DI #1	11.9	0.5%	1	21.5	24
DI #2	9.9	0.5%	1	20.1	24
DI #3	16.3	0.5%	1	24.2	30
DI #4	38.9	0.5%	1	33.5	36
DI #5	15.2	0.5%	1	23.5	30
DI #6	19.2	0.5%	1	25.7	30
DI #7	173.9	0.5%	5	32.1	36

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Project:	Moncure Mine	Computed EAW	Date 11/06/14
Subject:	Permit Application	Checked: PAW	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) = $bd + z\,d^2$

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

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

Set $Z_{av} = Z_{req}$ by adjust flow depth

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) =	0.5%	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.

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
24	11.9	7.80	0.77	11.2	0.58	7.80	1.1	Min
30	19.2	12.60	0.99	15.8	0.72	12.60	1.2	Min
36	34.8	22.78	1.34	24.1	0.92	22.78	1.4	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 d_{50}	Selected Rip Rap Size (in)
2	6	14	16	0.5	Class B
2.5	7.5	16	19	0.5	Class B
3	9	20	23	0.5	Class B

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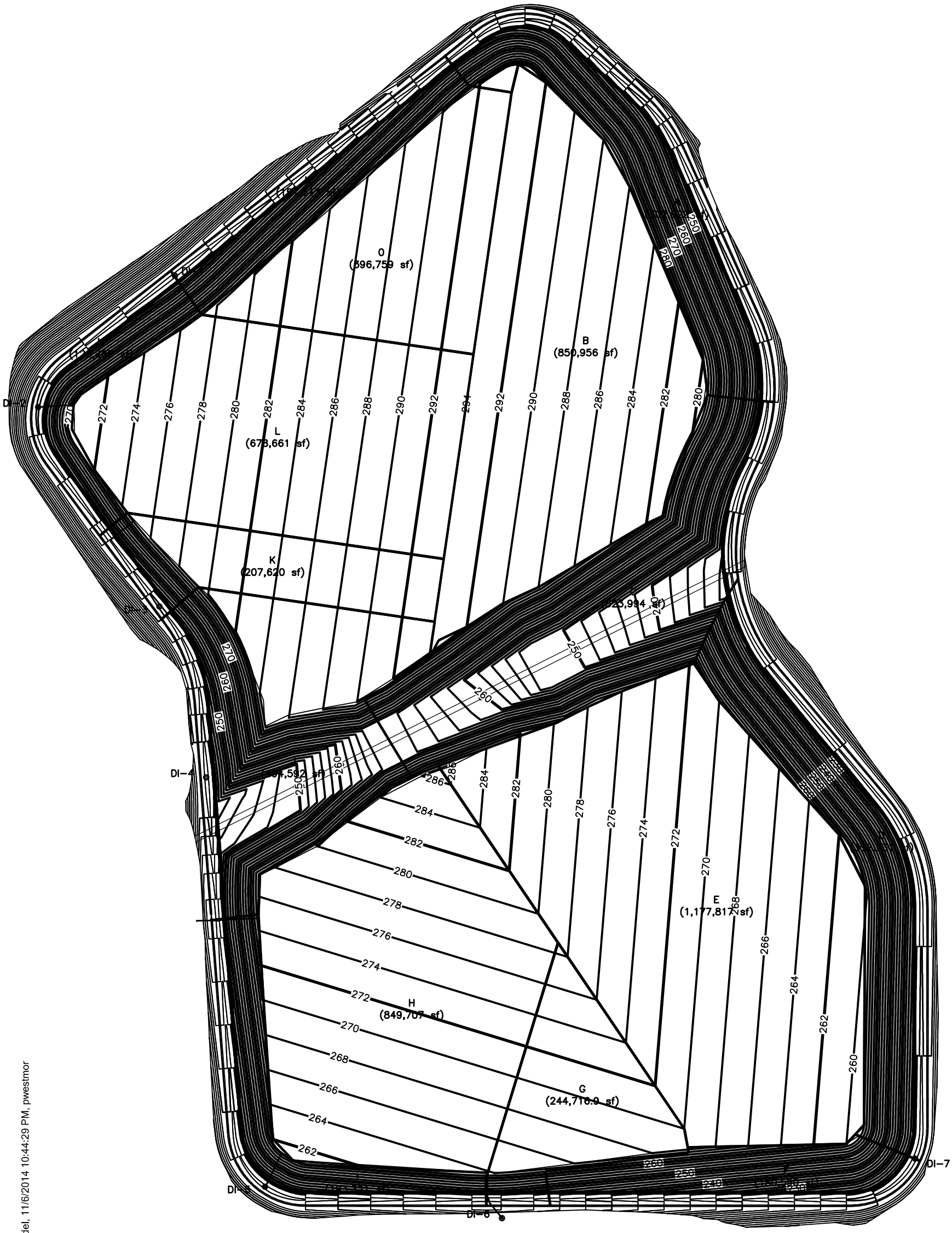
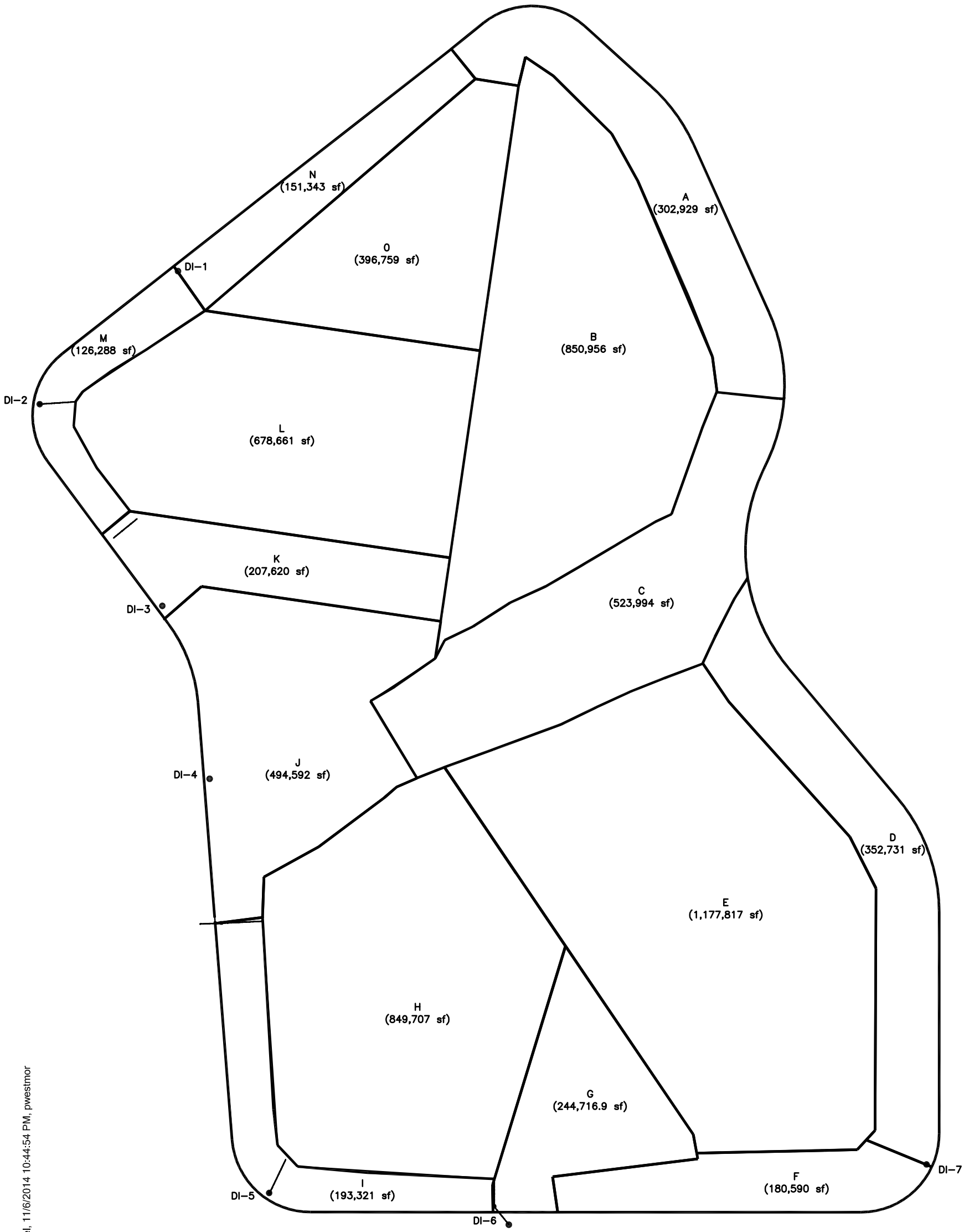


DRAINAGE AREAS



DRAINAGE 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

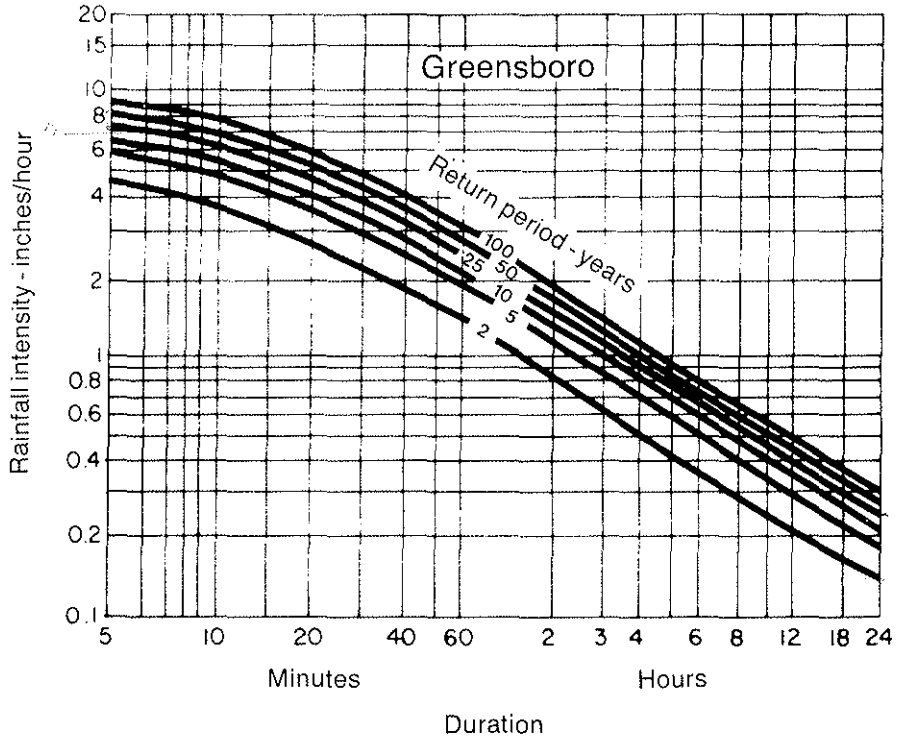


Figure 8.03d Rainfall intensity duration curves—Greensboro.

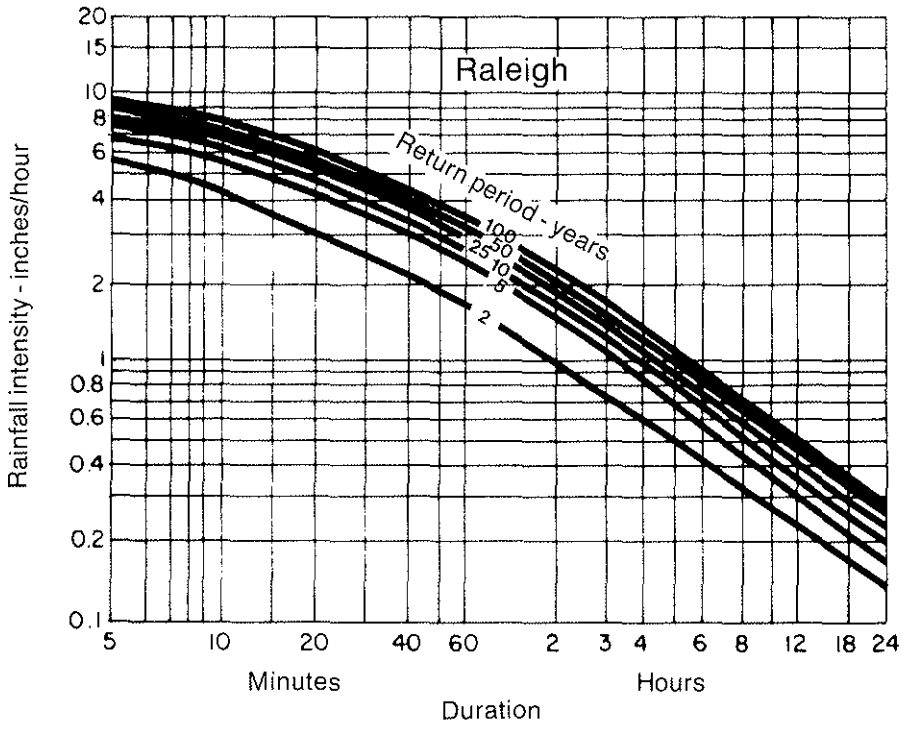
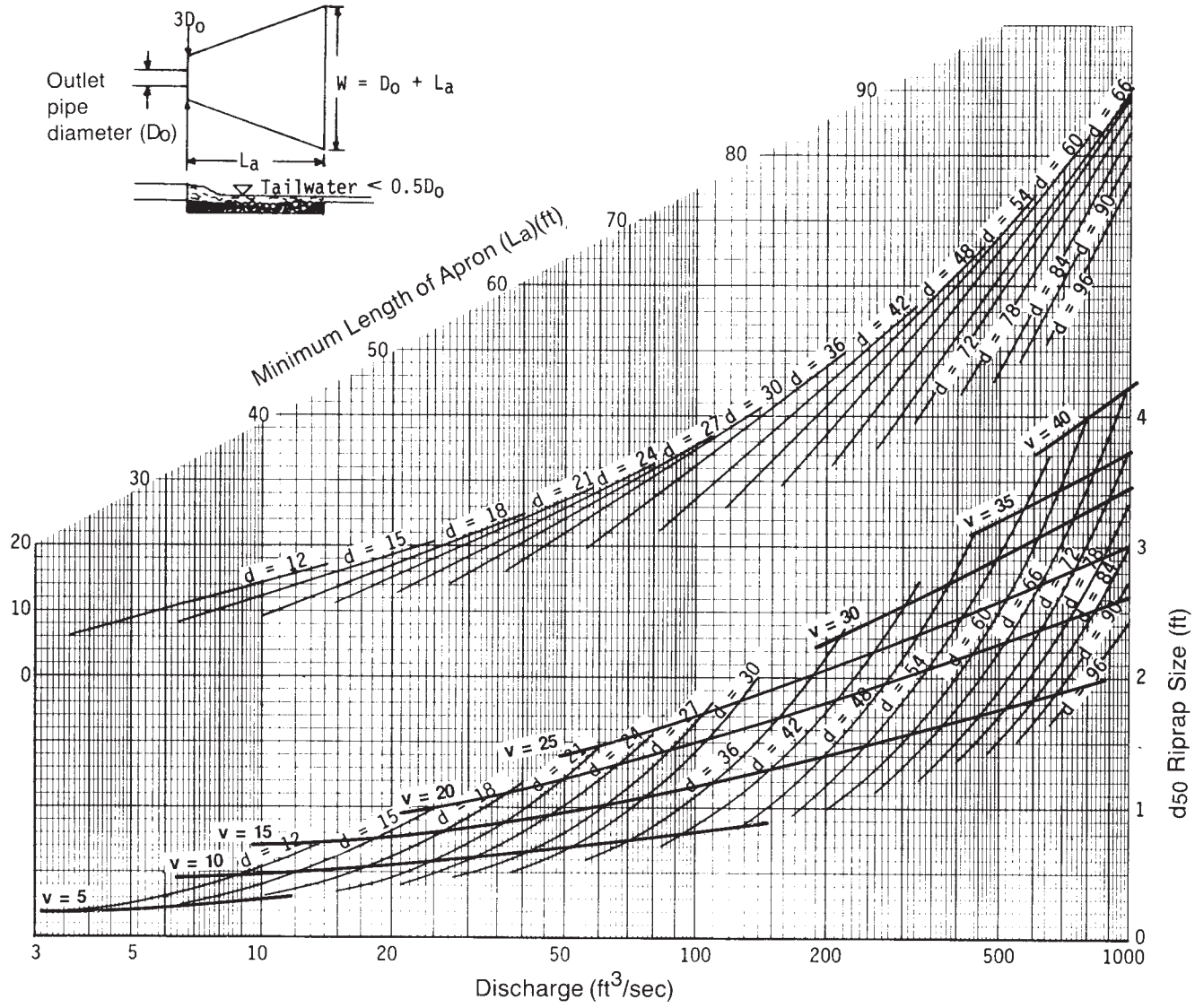


Figure 8.03e Rainfall intensity duration curves—Raleigh.



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).

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

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #1 (Ph-1)

Phase 2 Controls the Size of Basin #1

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		19.8	ac
Disturbed area(DA)		18.1	ac
Rqd sediment storage	(1800xDA)	35640	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	322	152
Top	340	170

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	213	msl
Sediment Storage elevation	216	msl
Spillway crest	216	msl
Top of Berm	219	msl
Emergency Spillway	217	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	132.65	cfs
1/2 10yr Computed flow from site, 'Q' =	66.325	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
213	1339	0
214	229994	115667
215	236344	348836
216	242747	588381
217	249202	834356
218	255711	1086812
219	262272	1345804
220	268886	1611383
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
2.75	Orifice Size (1/4 inch increments)	2
1.77	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:	35640	cf
Sediment storage provided:	588381	cf OKAY
Surface area required:	57702.75	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	2	ft
Orifice Flow:	53.00	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 =			203.11
Q100 Flow - Flow through Barrel =			25
C	3	L=	8
h	1		

Barrel diameter	48	in	
Barrel slope (ft/ft)	0.02	ft/ft	
Barrel length(ft)	60	ft	
Barrel invert in	213		
Barrel invert out	211.8		

Flow through barrel 89 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.07 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=	98.00	cf	Anchor Thickness	2	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #1 (Ph-2)

Phase 2 Controls the Size of Basin #1

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		40.4	ac
Disturbed area(DA)		38.7	ac
Rqd sediment storage	(1800xDA)	72774	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	408	195
Top	426	213

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	213	msl
Sediment Storage elevation	216	msl
Spillway crest	216	msl
Top of Berm	220	msl
Emergency Spillway	218	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	208.12	cfs
1/2 10yr Computed flow from site, 'Q' =	104.06	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

		Skimmer Size
4	Skimmer Size (inches)	(Inches)
0.333	Head on Skimmer (feet)	1.5
2.75	Orifice Size (1/4 inch increments)	2
3.61	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)
213	1339	0
214	229994	115667
215	236344	348836
216	242747	588381
217	249202	834356
218	255711	1086812
219	262272	1345804
220	268886	1611383
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	72774	cf
Sediment storage provided:	588381	cf OKAY
Surface area required:	90532.2	sf
Surface area provided:	242747	sf OKAY

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

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 =			319.48
Q100 Flow - Flow through Barrel =			102
C	3	L=	34
h	1		

Barrel diameter	48 in
Barrel slope (ft/ft)	0.02 ft/ft
Barrel length(ft)	60 ft
Barrel invert in	213
Barrel invert out	211.8

Flow through barrel 109 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 8.66 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=	98.00 cf	Anchor Thickness	2 ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #2 (Ph-1)

Phase 1 Controls the Size of Basin #2

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		54.6	ac
Disturbed area(DA)		54.6	ac
Rqd sediment storage	(1800xDA)	98298	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	537	259
Top	555	277

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	193	msl
Sediment Storage elevation	196	msl
Spillway crest	196	msl
Top of Berm	200	msl
Emergency Spillway	198	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	354	cfs
1/2 10yr Computed flow from site, 'Q' =	177	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

5	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
3.5	Orifice Size (1/4 inch increments)	2
3.01	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)
193	400	0
194	229994	115197
195	236344	348366
196	242747	587912
197	249202	833886
198	255711	1086343
199	262272	1345334
200	268886	1610913
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	98298	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	153990	sf
Surface area provided:	242747	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 =			539
Q100 Flow - Flow through Barrel =			156
C	3	L=	52
h	1		

Barrel diameter	60	in	
Barrel slope (ft/ft)	0.04	ft/ft	
Barrel length(ft)	64	ft	
Barrel invert in	193		
Barrel invert out	190.44		

Flow through barrel 192 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 9.76 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 - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #2 (Ph-2)

Phase 1 Controls the Size of Basin #2

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		53.8	ac
Disturbed area(DA)		53.8	ac
Rqd sediment storage	(1800xDA)	96840	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	477	229
Top	495	247

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2	ft
Bottom elevation of basin	193	msl
Sediment Storage elevation	196	msl
Spillway crest	196	msl
Top of Berm	200	msl
Emergency Spillway	198	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	281.1	cfs
1/2 10yr Computed flow from site, 'Q' =	140.55	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

5	Skimmer Size (inches)	Skimmer Size (Inches)
0.333	Head on Skimmer (feet)	1.5
3.5	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)

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
193	400	0
194	229994	115197
195	236344	348366
196	242747	587912
197	249202	833886
198	255711	1086343
199	262272	1345334
200	268886	1610913
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	96840	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	122278.5	sf
Surface area provided:	242747	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 =			429
Q100 Flow - Flow through Barrel =			46
C	3	L=	15
h	1		

Barrel diameter	60	in
Barrel slope (ft/ft)	0.04	ft/ft
Barrel length(ft)	64	ft
Barrel invert in	193	
Barrel invert out	190.44	

Flow through barrel 192 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 9.76 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 - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

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)		7.8	ac
Disturbed area(DA)		5.0	ac
Rqd sediment storage	(1800xDA)	13950	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	174	78
Top	192	96

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1	ft
Bottom elevation of basin	190	msl
Sediment Storage elevation	193	msl
Spillway crest	193	msl
Top of Berm	196	msl
Emergency Spillway	194	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	42.46	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
190	11418	0
191	229994	120706
192	236344	353875
193	242747	593421
194	249202	839395
195	255711	1091852
196	262272	1350843
X	268886	#VALUE!
X	X	#VALUE!
X	X	#VALUE!

FAIRCLOTH SKIMMER DESIGN TABLE

4	Skimmer Size (inches)
0.333	Head on Skimmer (feet)
1.75	Orifice Size (1/4 inch increments)
3.42	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:	13950	cf
Sediment storage provided:	593421	cf OKAY
Surface area required:	18470.1	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	54	in	Flow Depth:	1	ft
Orifice Flow:	48.00	cfs	Controlling:	Orifice	
Weir Flow:	87.61	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))				
100yr Flow from site, Q100 =	67.22			
Q100 Flow - Flow through Barrel =	19			
C	3	L=	6	Say 10' Min.
h	1			

Barrel diameter	36	in	
Barrel slope (ft/ft)	0.01	ft/ft	
Barrel length(ft)	60	ft	
Barrel invert in	190		
Barrel invert out	189.4		

Flow through barrel 48 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 6.86 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	7388	lbs	Anchor width	6	ft
Required Volume of Anchor =	51.0	cf	Anchor Length	6	ft
Actual Volume of Anchor=	72	cf	Anchor Thickness	2	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #4 (Ph-1)

Phase 2 Controls the Size of Basin #4

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		22.6	ac
Disturbed area(DA)		22.6	ac
Rqd sediment storage	(1800xDA)	40716	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	1.5	ft
Bottom elevation of basin	219	msl
Sediment Storage elevation	222	msl
Spillway crest	222	msl
Top of Berm	226	msl
Emergency Spillway	223.5	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	134.64	cfs
1/2 10yr Computed flow from site, 'Q' =	67.32	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
3.82	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)
219	400	0
220	229994	115197
221	236344	348366
222	242747	587912
223	249202	833886
224	255711	1086343
225	262272	1345334
226	268886	1610913
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	40716	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	58568.4	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	60 in	Flow Depth:	1.5 ft		
Orifice Flow:	99.00 cfs	Controlling:	Orifice		
Weir Flow:	178.82 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			205.24
Q100 Flow - Flow through Barrel =			63
C	3	L=	11
h	1.5		

Barrel diameter	42	in
Barrel slope (ft/ft)	0.01	ft/ft
Barrel length(ft)	55	ft
Barrel invert in	219	
Barrel invert out	218.45	

Flow through barrel 71 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.41 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	9679	lbs	Anchor width	6.5	ft
Required Volume of Anchor =	66.8	cf	Anchor Length	6.5	ft
Actual Volume of Anchor=	84.5	cf	Anchor Thickness	2	ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #4 (Ph-2)

Phase 2 Controls the Size of Basin #4

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		29.7	ac
Disturbed area(DA)		29.7	ac
Rqd sediment storage	(1800xDA)	53460	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	336	159
Top	354	177

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1.5	ft
Bottom elevation of basin	219	msl
Sediment Storage elevation	222	msl
Spillway crest	222	msl
Top of Berm	226	msl
Emergency Spillway	223.5	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	143.97	cfs
1/2 10yr Computed flow from site, 'Q' =	71.985	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
219	400	0
220	229994	115197
221	236344	348366
222	242747	587912
223	249202	833886
224	255711	1086343
225	262272	1345334
226	268886	1610913
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
2.5	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:	53460	cf	
Sediment storage provided:	587912	cf	OKAY
Surface area required:	62626.95	sf	
Surface area provided:	242747	sf	OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	1.5	ft
Orifice Flow:	99.00	cfs	Controlling:	Orifice	
Weir Flow:	178.82	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			219.72
Q100 Flow - Flow through Barrel =			75
C	3	L=	14
h	1.5		

Barrel diameter	42	in
Barrel slope (ft/ft)	0.011	ft/ft
Barrel length(ft)	55	ft
Barrel invert in	219	
Barrel invert out	218.395	

Flow through barrel 72 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.50 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	9679	lbs	Anchor width	6.5	ft
Required Volume of Anchor =	66.8	cf	Anchor Length	6.5	ft
Actual Volume of Anchor=	84.5	cf	Anchor Thickness	2	ft
OKAY					

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #5 (Ph-1)

Phase 1 Controls the Size of Basin #5

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		24.3	ac
Disturbed area(DA)		24.3	ac
Rqd sediment storage	(1800xDA)	43812	cf

ESTIMATED BASIN SIZE (RECTANGULAR)		
	Length(ft)	Width(ft)
Bottom	337	159
Top	355	177

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1.5	ft
Bottom elevation of basin	229	msl
Sediment Storage elevation	232	msl
Spillway crest	232	msl
Top of Berm	236	msl
Emergency Spillway	233.5	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	144.76	cfs
1/2 10yr Computed flow from site, 'Q' =	72.38	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

3	Skimmer Size (inches)	Skimmer Size
0.25	Head on Skimmer (feet)	(Inches)
2.5	Orifice Size (1/4 inch increments)	1.5
3.03	Dewatering Time (days)	2
	Suggest about 3 days	2.5
		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)
229	400	0
230	229994	115197
231	236344	348366
232	242747	587912
233	249202	833886
234	255711	1086343
235	262272	1345334
236	268886	1610913
a	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	43812	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	62970.6	sf
Surface area provided:	242747	sf OKAY

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

RISER SPILLWAY DESIGN

Riser diameter:	60 in	Flow Depth:	1.5 ft
Orifice Flow:	99.00 cfs	Controlling:	Orifice
Weir Flow:	178.82 cfs	Controlling>Q10?	OKAY

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

100yr Flow from site, Q100 =			220.68
Q100 Flow - Flow through Barrel =			68
C	3	L=	12
h	1.5		

Barrel diameter	42	in	
Barrel slope (ft/ft)	0.015	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	229		
Barrel invert out	228.25		

Flow through barrel 76 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.91 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2
Buoyancy =	9679	lbs	Anchor width	6.5 ft
Required Volume of Anchor =	66.8	cf	Anchor Length	6.5 ft
Actual Volume of Anchor=	84.5	cf	Anchor Thickness	2 ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #5 (Ph-2)

Phase 1 Controls the Size of Basin #5

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		8.9	ac
Disturbed area(DA)		8.9	ac
Rqd sediment storage	(1800xDA)	16002	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	197	89
Top	215	107

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1.5	ft
Bottom elevation of basin	229	msl
Sediment Storage elevation	232	msl
Spillway crest	232	msl
Top of Berm	236	msl
Emergency Spillway	233.5	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	52.96	cfs
1/2 10yr Computed flow from site, 'Q' =	26.48	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

3	Skimmer Size (inches)	Skimmer Size (Inches)
0.25	Head on Skimmer (feet)	1.5
1.5	Orifice Size (1/4 inch increments)	2
3.08	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)
229	400	0
230	229994	115197
231	236344	348366
232	242747	587912
233	249202	833886
234	255711	1086343
235	262272	1345334
236	268886	1610913
a	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	16002	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	23037.6	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN (Note: Need 2 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	60 in	Flow Depth:	1.5 ft		
Orifice Flow:	99.00 cfs	Controlling:	Orifice		
Weir Flow:	178.82 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			80.74
Q100 Flow - Flow through Barrel =			-72
C	3	L=	-13
h	1.5		

Barrel diameter	42	in	
Barrel slope (ft/ft)	0.015	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	229		
Barrel invert out	228.25		

Flow through barrel 76 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.91 fps

CONCRETE ANCHOR SIZE					
Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	9679	lbs	Anchor width	6	ft
Required Volume of Anchor =	66.8	cf	Anchor Length	6	ft
Actual Volume of Anchor=	72	cf	Anchor Thickness	2	ft

Increase Anchor Size

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #6 (Ph-1)

Phase 2 Controls the Size of Basin #6

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		13.6	ac
Disturbed area(DA)		13.6	ac
Rqd sediment storage	(1800xDA)	24480	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	258	120
Top	276	138

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1.5	ft
Bottom elevation of basin	211	msl
Sediment Storage elevation	214	msl
Spillway crest	214	msl
Top of Berm	218	msl
Emergency Spillway	215.5	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	87.79	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
211	400	0
212	229994	115197
213	236344	348366
214	242747	587912
215	249202	833886
216	255711	1086343
217	262272	1345334
218	268886	1610913
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)
2.94	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:	24480	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	38188.65	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	1.5	ft
Orifice Flow:	99.00	cfs	Controlling:	Orifice	
Weir Flow:	178.82	cfs	Controlling>Q10?	OKAY	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))				
100yr Flow from site, Q100 =	133.72			
Q100 Flow - Flow through Barrel =	29			
C	3	L=	5	Say 10' min.
h	1.5			

Barrel diameter	48	in
Barrel slope (ft/ft)	0.025	ft/ft
Barrel length(ft)	50	ft
Barrel invert in	211	
Barrel invert out	209.75	

Flow through barrel 105 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 8.32 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 - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #6 (Ph-2)

Phase 2 Controls the Size of Basin #6

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		16.8	ac
Disturbed area(DA)		16.8	ac
Rqd sediment storage	(1800xDA)	30312	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	277	130
Top	295	148

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	1.5	ft
Bottom elevation of basin	211	msl
Sediment Storage elevation	214	msl
Spillway crest	214	msl
Top of Berm	217.5	msl
Emergency Spillway	215.5	msl
DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	100.08	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
211	400	0
212	229994	115197
213	236344	348366
214	242747	587912
215	249202	833886
216	255711	1086343
217	262272	1345334
218	268886	1610913
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)
3.01	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:	30312	cf
Sediment storage provided:	587912	cf OKAY
Surface area required:	43534.8	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN					
RISER SPILLWAY DESIGN					
Riser diameter:	60	in	Flow Depth:	1.5	ft
Orifice Flow:	99.00	cfs	Controlling:	Orifice	
Weir Flow:	178.82	cfs	Controlling>Q10?	ERROR	

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))				
100yr Flow from site, Q100 =	152.57			
Q100 Flow - Flow through Barrel =	48			
C	3	L=	9	Say 10' min.
h	1.5			

Barrel diameter	48	in	
Barrel slope (ft/ft)	0.025	ft/ft	
Barrel length(ft)	50	ft	
Barrel invert in	211		
Barrel invert out	209.75		

Flow through barrel 105 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 8.32 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 - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #7 (Ph-1)

Phase 1 Controls the Size of Basin #7

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		93.1	ac
Disturbed area(DA)		93.1	ac
Rqd sediment storage	(1800xDA)	167544	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	677	329
Top	695	347

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2.5	ft
Bottom elevation of basin	209	msl
Sediment Storage elevation	212	msl
Spillway crest	212	msl
Top of Berm	217	msl
Emergency Spillway	214.5	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	555	cfs
1/4 10yr Computed flow from site, 'Q' =	138.75	cfs

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)

Elev.	Area (SF)	Cumulative Volume (CF)
209	2500	0
210	229994	116247
211	236344	349416
212	242747	588962
213	249202	834936
214	255711	1087393
215	262272	1346384
216	268886	1611963
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
3.75	Orifice Size (1/4 inch increments)	2
2.98	Dewatering Time (days)	2.5
	Suggest about 3 days	3
		4
		5
		6
		8

Note: Divided Sediment Storage by 3 (one skimmer/riser)

BASIN EFFICIENCY		
Sediment storage required:	167544	cf
Sediment storage provided:	588962	cf OKAY
Surface area required:	241425	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN (Note: Need 3 risers; therefore split flow)

RISER SPILLWAY DESIGN

Riser diameter:	72 in	Flow Depth:	2.5 ft
Orifice Flow:	267.00 cfs	Controlling:	Orifice
Weir Flow:	461.72 cfs	Controlling>Q10?	OKAY

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

100yr Flow from site, Q100 =			845.5
Q100 Flow - Flow through Barrel =			279
C	3	L=	51
h	1.5		

Barrel diameter	60 in
Barrel slope (ft/ft)	0.01 ft/ft
Barrel length(ft)	144 ft
Barrel invert in	209
Barrel invert out	207.56

Flow through barrel 142 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.22 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10 ft	Safety factor	1.2
Buoyancy =	17545 lbs	Anchor width	7.75 ft
Required Volume of Anchor =	121.0 cf	Anchor Length	7.75 ft
Actual Volume of Anchor=	150.15625 cf	Anchor Thickness	2.5 ft

OKAY

SEDIMENT BASIN CALCULATIONS			
CHARAH - MONCURE			
HDR PROJECT NO.:	232326		
DATE:	10.28.14	BY:	CPT
REVISED:	xx.xx.xx	RVW:	RMB

Basin #7 (Ph-2)

Phase 1 Controls the Size of Basin #7

FAIRCLOTH SKIMMER TYPE BASIN DESIGN WITH RISER

NCDENR? 1 ← IF Yes, Type: 1

DRAINAGE AREAS/REQ'D STORAGE			
Total drainage area (TDA)		91.8	ac
Disturbed area(DA)		44.9	ac
Rqd sediment storage	(1800xDA)	165240	cf

ESTIMATED BASIN SIZE (RECTANGULAR)	Length(ft)	Width(ft)
Bottom	511	247
Top	529	265

BASIN CONFIGURATION		
Proposed sediment depth	3	ft
Depth of flow over spillway	2.5	ft
Bottom elevation of basin	209	msl
Sediment Storage elevation	212	msl
Spillway crest	212	msl
Top of Berm	217	msl
Emergency Spillway	214.5	msl

DESIGN FLOW (SEE HYDROGRAPHS)		
10yr Computed flow from site, 'Q' =	322	cfs
1/4 10yr Computed flow from site, 'Q' =	80.5	cfs

FAIRCLOTH SKIMMER DESIGN TABLE

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

Note: Divided Sediment Storage by 3 (one skimmer/riser)

PLANNED BASIN SIZE (REFER TO EROSION CONTROL PLAN)		
Elev.	Area (SF)	Cumulative Volume (CF)
209	3329	0
210	229994	116662
211	236344	349831
212	242747	589376
213	249202	835351
214	255711	1087807
215	262272	1346799
216	268886	1612378
X	X	#VALUE!
X	X	#VALUE!

BASIN EFFICIENCY		
Sediment storage required:	165240	cf
Sediment storage provided:	589376	cf OKAY
Surface area required:	140070	sf
Surface area provided:	242747	sf OKAY

SPILLWAY DESIGN (Note: Need 3 risers; therefore split flow)					
RISER SPILLWAY DESIGN					
Riser diameter:	72 in	Flow Depth:		2.5 ft	
Orifice Flow:	267.00 cfs	Controlling:	Orifice		
Weir Flow:	461.72 cfs	Controlling>Q10?	OKAY		

EMERGENCY SPILLWAY SIZE (L=Q/(C*h^1.5))			
100yr Flow from site, Q100 =			511.71
Q100 Flow - Flow through Barrel =			-55
C	3	L=	-10
h	1.5		

Barrel diameter	60	in	
Barrel slope (ft/ft)	0.01	ft/ft	
Barrel length(ft)	144	ft	
Barrel invert in	209		
Barrel invert out	207.56		

Flow through barrel 142 cfs

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

BARREL FLOW>Q10? OKAY

Velocity= 7.22 fps

CONCRETE ANCHOR SIZE

Length of exposed outlet pipe	10	ft	Safety factor	1.2	
Buoyancy =	17545	lbs	Anchor width	7.75	ft
Required Volume of Anchor =	121.0	cf	Anchor Length	7.75	ft
Actual Volume of Anchor=	150.15625	cf	Anchor Thickness	2.5	ft

OKAY

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Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	86.81	-------	-------	132.65	159.67	-------	203.11	Basin #1 - Ph. 1
2	SCS Runoff	------	-------	233.34	-------	-------	353.56	424.45	-------	538.51	Basin #2 - Ph.1
3	SCS Runoff	------	-------	26.41	-------	-------	42.46	51.95	-------	67.22	Basin #3 - Ph.1
4	SCS Runoff	------	-------	88.73	-------	-------	134.64	161.70	-------	205.24	Basin #4 - Ph.1
5	SCS Runoff	------	-------	95.41	-------	-------	144.76	173.86	-------	220.68	Basin #5 - Ph.1
6	SCS Runoff	------	-------	57.94	-------	-------	87.79	105.39	-------	133.72	Basin #6 - Ph.1
7	SCS Runoff	------	-------	365.54	-------	-------	554.63	666.11	-------	845.50	Basin #7 - Ph.1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	132.65	2	716	294,117	------	------	------	Basin #1 - Ph. 1
2	SCS Runoff	353.56	2	718	887,249	------	------	------	Basin #2 - Ph.1
3	SCS Runoff	42.46	2	720	114,158	------	------	------	Basin #3 - Ph.1
4	SCS Runoff	134.64	2	720	378,657	------	------	------	Basin #4 - Ph.1
5	SCS Runoff	144.76	2	720	407,140	------	------	------	Basin #5 - Ph.1
6	SCS Runoff	87.79	2	718	220,310	------	------	------	Basin #6 - Ph.1
7	SCS Runoff	554.63	2	720	1,559,866	------	------	------	Basin #7 - Ph.1

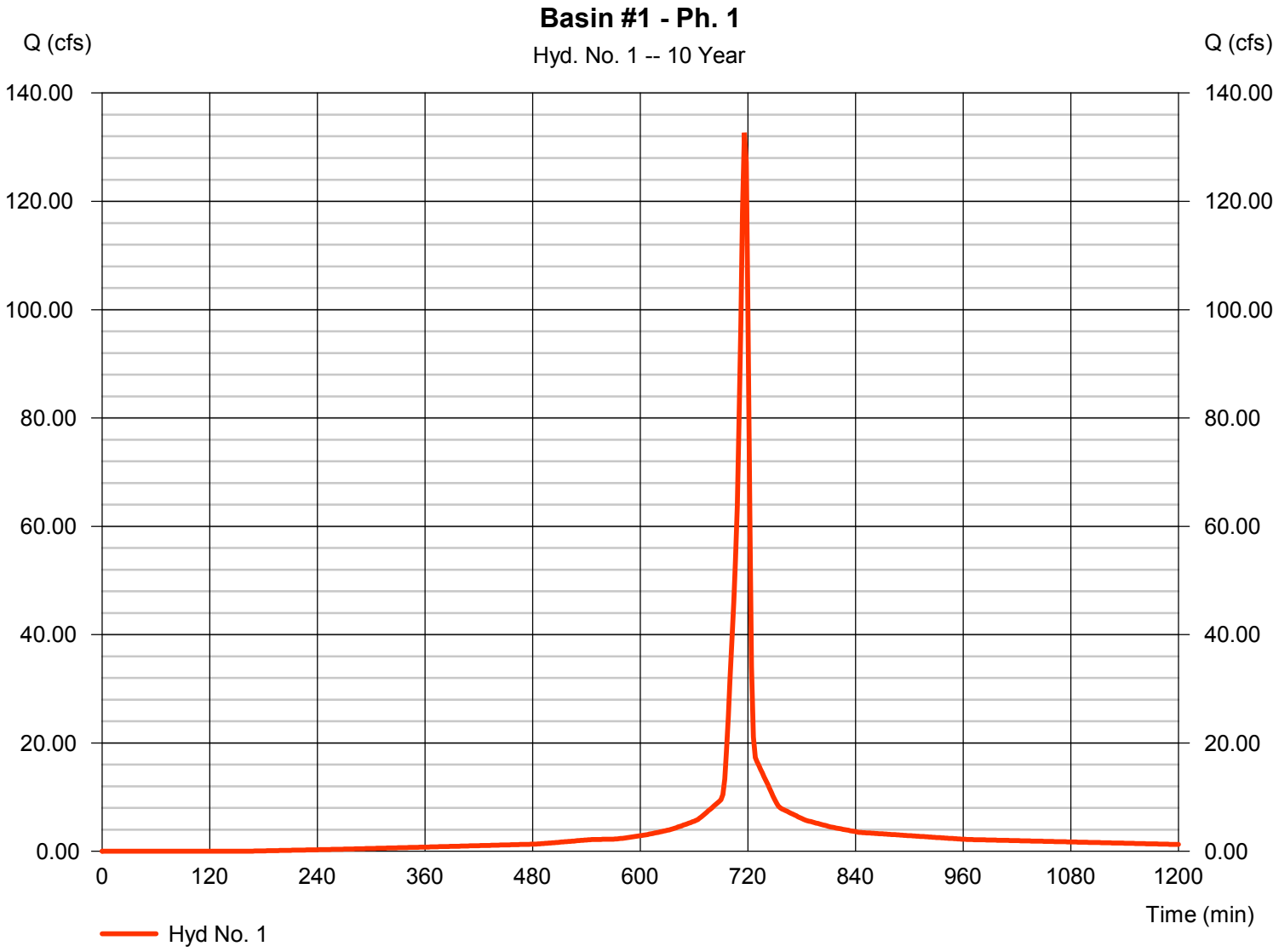
Hydrograph Report

Hyd. No. 1

Basin #1 - Ph. 1

Hydrograph type	= SCS Runoff	Peak discharge	= 132.65 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 294,117 cuft
Drainage area	= 19.800 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.700 x 80) + (18.100 x 94)] / 19.800

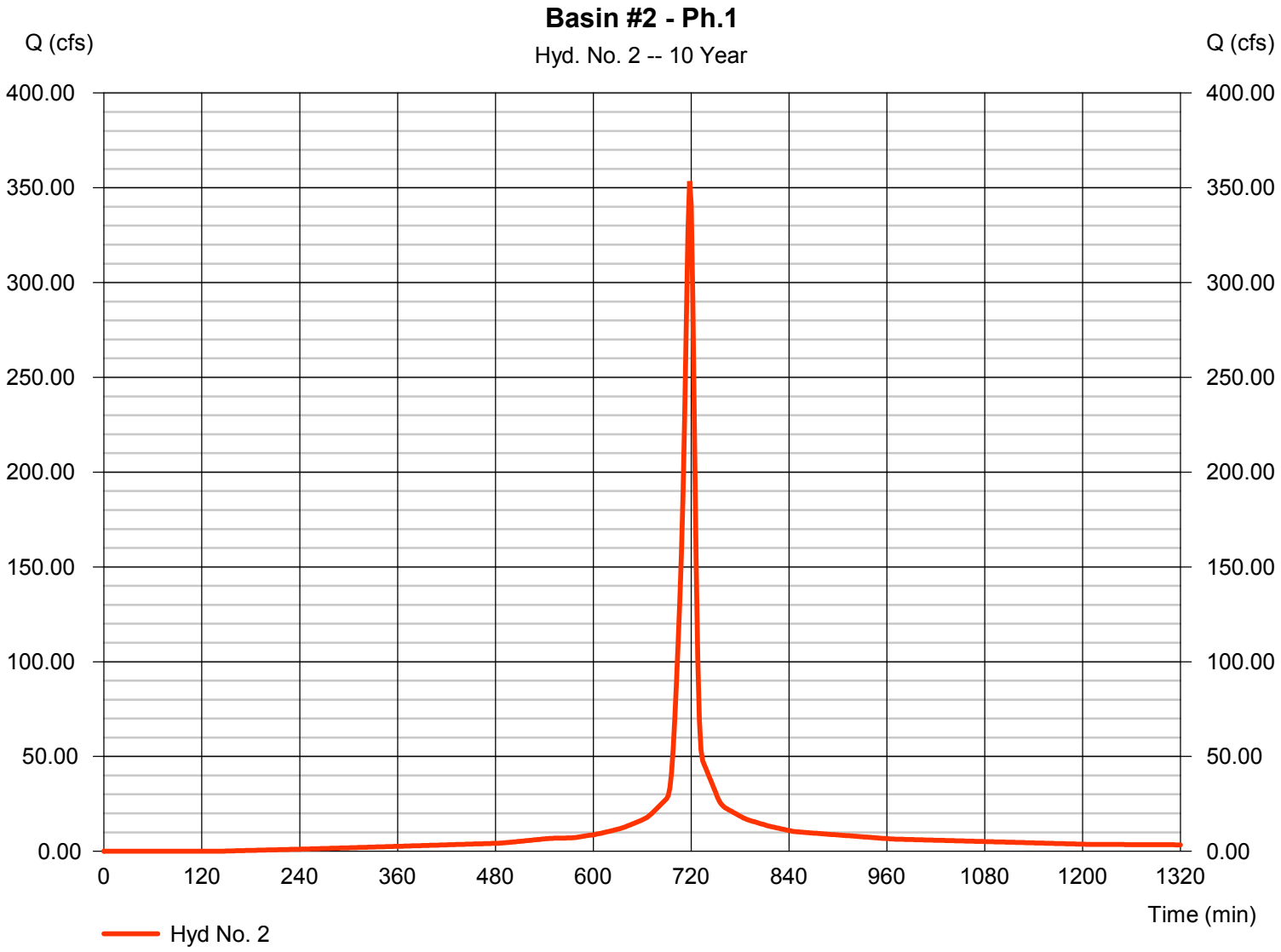


Hydrograph Report

Hyd. No. 2

Basin #2 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 353.56 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 887,249 cuft
Drainage area	= 54.610 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 2

Basin #2 - Ph.1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 1.00		0.00		0.00		
Travel Time (min)	**= 5.10**	**+**	**0.00**	**+**	**0.00**	**=**	**5.10**
Shallow Concentrated Flow							
Flow length (ft)	= 305.00		0.00		0.00		
Watercourse slope (%)	= 12.10		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=5.61		0.00		0.00		
Travel Time (min)	**= 0.91**	**+**	**0.00**	**+**	**0.00**	**=**	**0.91**
Channel Flow							
X sectional flow area (sqft)	= 19.00		0.00		0.00		
Wetted perimeter (ft)	= 12.00		0.00		0.00		
Channel slope (%)	= 3.80		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=26.35						
			0.00				
					0.00		
Flow length (ft)	({0})1024.0		0.0		0.0		
Travel Time (min)	**= 0.65**	**+**	**0.00**	**+**	**0.00**	**=**	**0.65**

Total Travel Time, Tc ..... 6.70 min

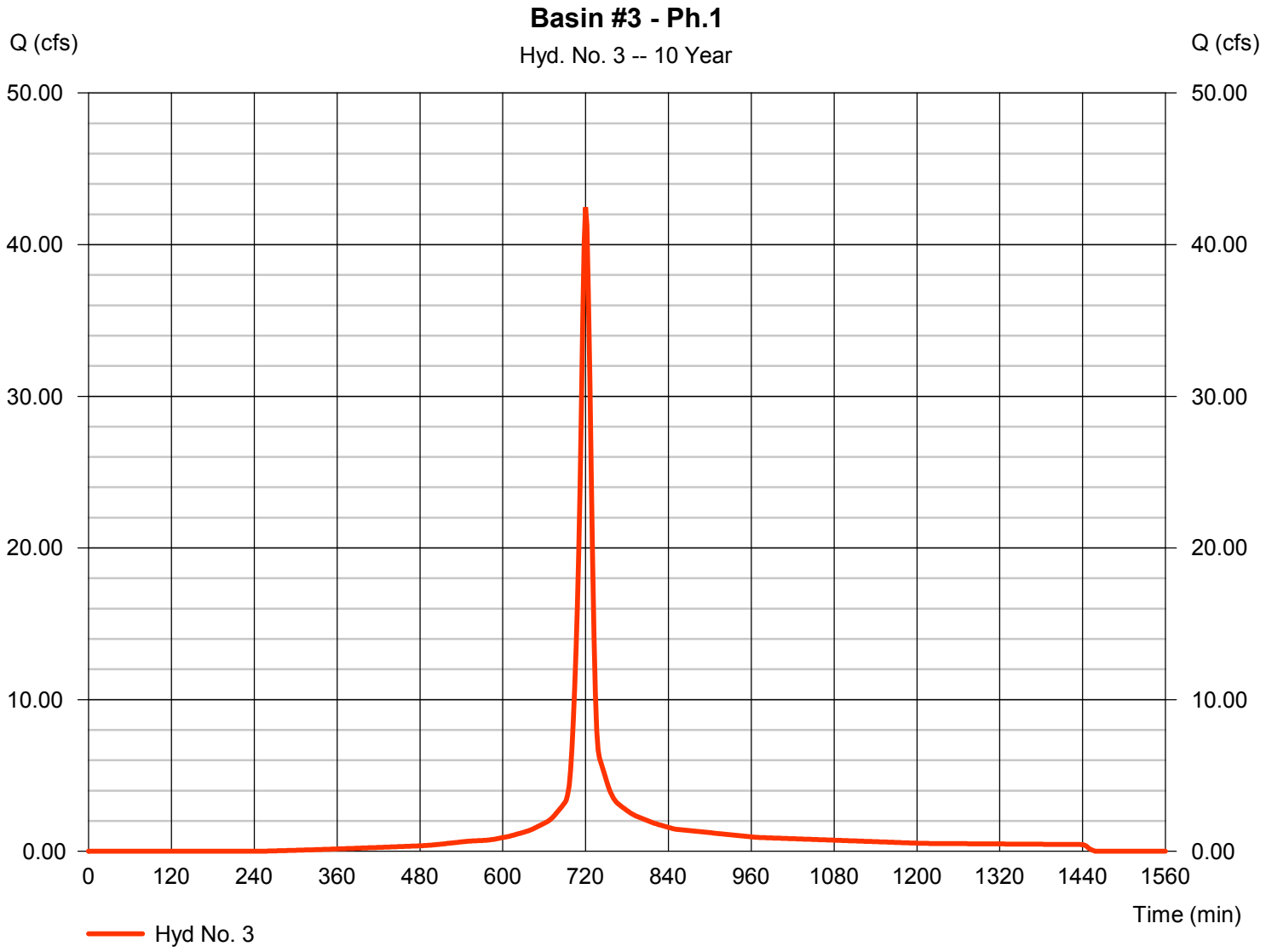
Hydrograph Report

Hyd. No. 3

Basin #3 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 42.46 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 114,158 cuft
Drainage area	= 7.750 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.80 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.000 x 94) + (2.750 x 80)] / 7.750



TR55 Tc Worksheet

Hyd. No. 3

Basin #3 - Ph.1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 9.00		0.00		0.00		
Travel Time (min)	**= 11.19**	**+**	**0.00**	**+**	**0.00**	**=**	**11.19**
Shallow Concentrated Flow							
Flow length (ft)	= 392.29		0.00		0.00		
Watercourse slope (%)	= 7.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.45		0.00		0.00		
Travel Time (min)	**= 1.47**	**+**	**0.00**	**+**	**0.00**	**=**	**1.47**
Channel Flow							
X sectional flow area (sqft)	= 31.00		0.00		0.00		
Wetted perimeter (ft)	= 13.00		0.00		0.00		
Channel slope (%)	= 4.13		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=36.14						
			0.00				
					0.00		
Flow length (ft)	({0})266.6		0.0		0.0		
Travel Time (min)	**= 0.12**	**+**	**0.00**	**+**	**0.00**	**=**	**0.12**

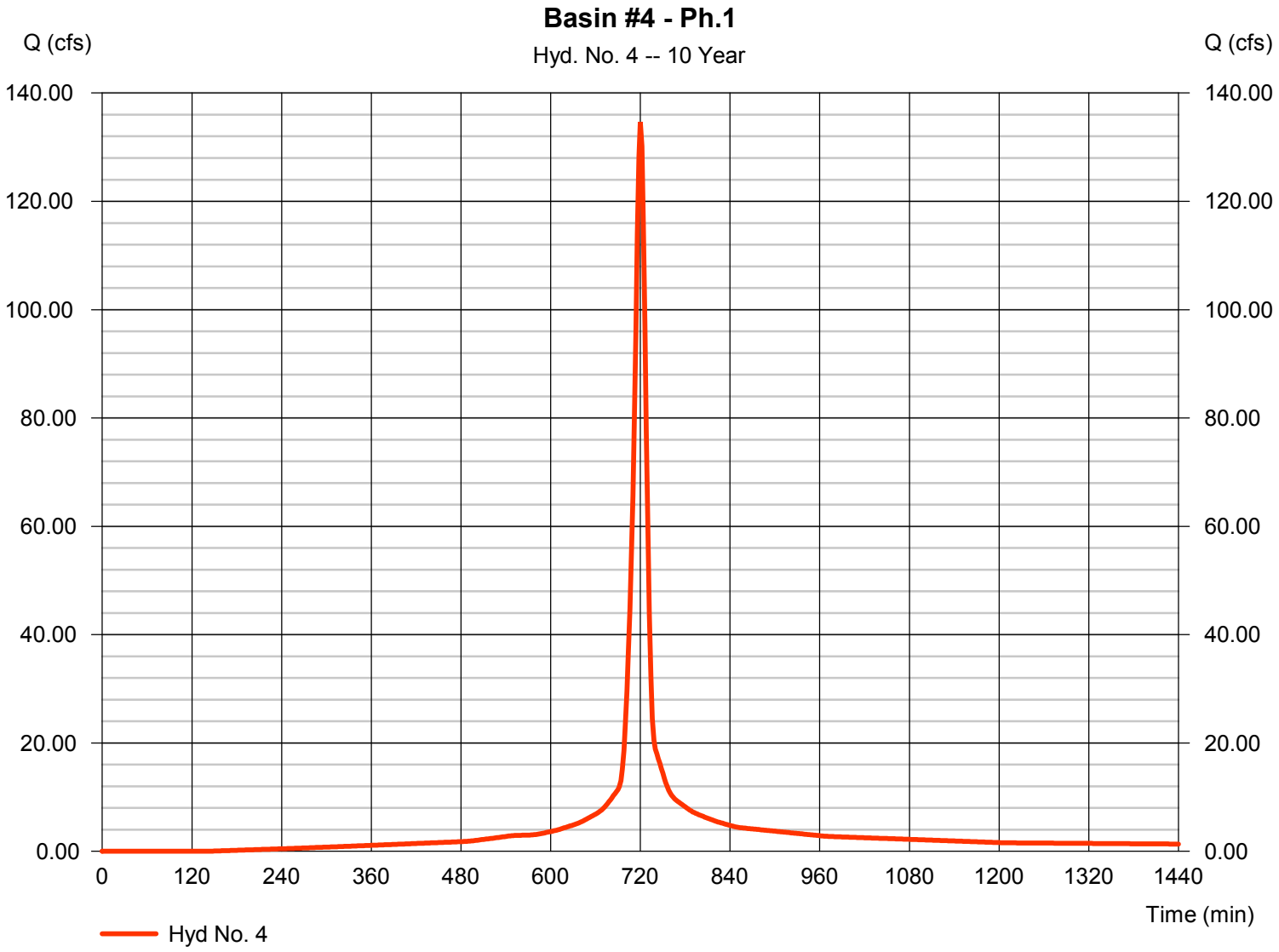
Total Travel Time, Tc ..... 12.80 min

Hydrograph Report

Hyd. No. 4

Basin #4 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 134.64 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 378,657 cuft
Drainage area	= 22.600 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.70 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 4

Basin #4 - Ph.1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 3.87**	**+**	**0.00**	**+**	**0.00**	**=**	**3.87**
Shallow Concentrated Flow							
Flow length (ft)	= 1085.00		0.00		0.00		
Watercourse slope (%)	= 3.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.79		0.00		0.00		
Travel Time (min)	**= 6.47**	**+**	**0.00**	**+**	**0.00**	**=**	**6.47**
Channel Flow							
X sectional flow area (sqft)	= 130.00		0.00		0.00		
Wetted perimeter (ft)	= 21.00		0.00		0.00		
Channel slope (%)	= 1.80		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=45.20						
			0.00				
					0.00		
Flow length (ft)	({0})1094.0		0.0		0.0		
Travel Time (min)	**= 0.40**	**+**	**0.00**	**+**	**0.00**	**=**	**0.40**

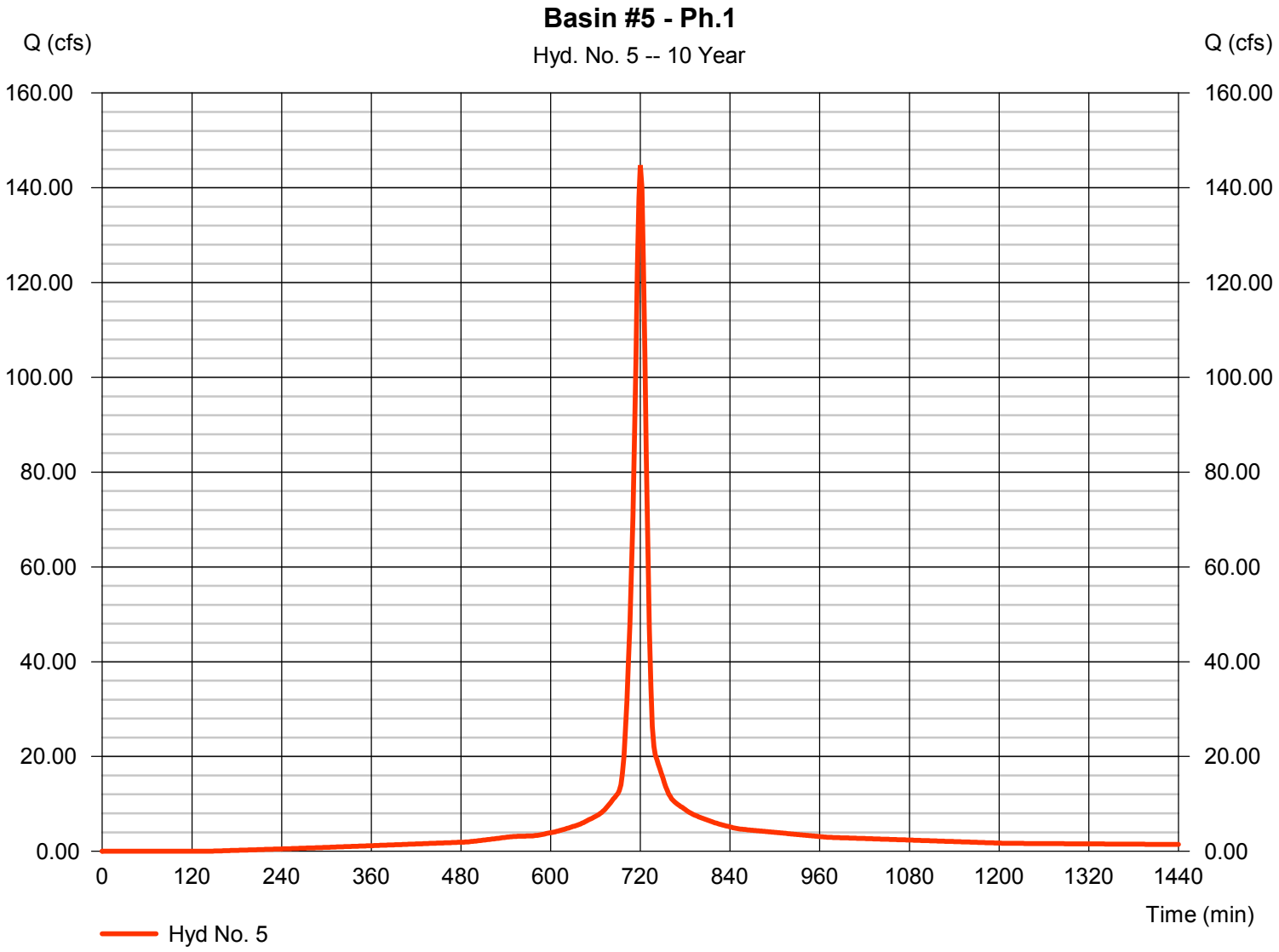
Total Travel Time, Tc ..... 10.70 min

Hydrograph Report

Hyd. No. 5

Basin #5 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 144.76 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 407,140 cuft
Drainage area	= 24.300 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.20 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 5

Basin #5 - Ph.1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 3.87**	**+**	**0.00**	**+**	**0.00**	**=**	**3.87**
Shallow Concentrated Flow							
Flow length (ft)	= 991.00		0.00		0.00		
Watercourse slope (%)	= 2.85		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.72		0.00		0.00		
Travel Time (min)	**= 6.06**	**+**	**0.00**	**+**	**0.00**	**=**	**6.06**
Channel Flow							
X sectional flow area (sqft)	= 24.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 2.40		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=22.08						
			0.00				
					0.00		
Flow length (ft)	({0})290.0		0.0		0.0		
Travel Time (min)	**= 0.22**	**+**	**0.00**	**+**	**0.00**	**=**	**0.22**

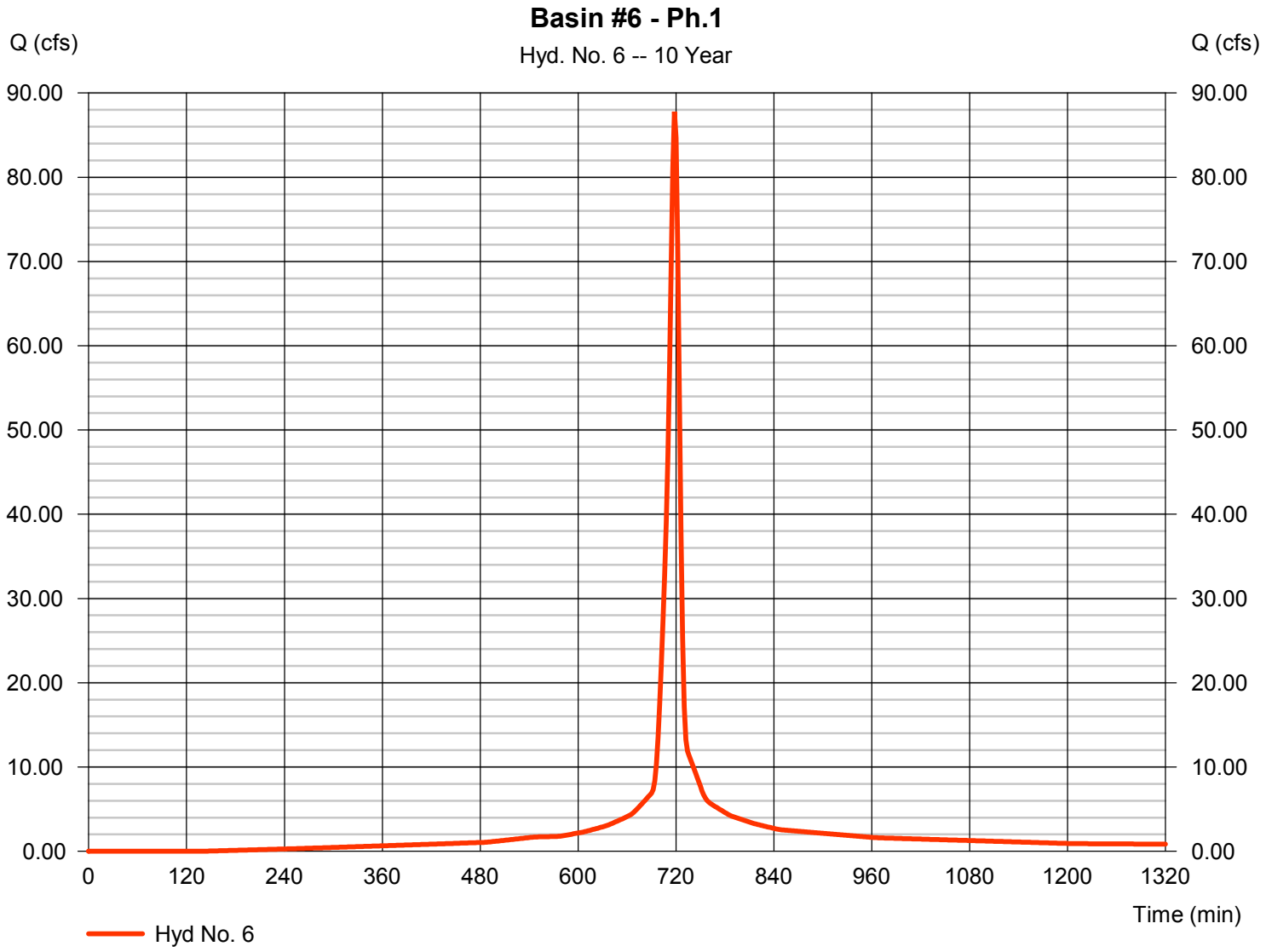
Total Travel Time, Tc ..... 10.20 min

Hydrograph Report

Hyd. No. 6

Basin #6 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 87.79 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 220,310 cuft
Drainage area	= 13.560 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.30 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 6

Basin #6 - Ph.1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 1.00		0.00		0.00		
Travel Time (min)	**= 5.10**	**+**	**0.00**	**+**	**0.00**	**=**	**5.10**
Shallow Concentrated Flow							
Flow length (ft)	= 612.00		0.00		0.00		
Watercourse slope (%)	= 3.30		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.93		0.00		0.00		
Travel Time (min)	**= 3.48**	**+**	**0.00**	**+**	**0.00**	**=**	**3.48**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 1.40		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=14.93						
			0.00				
					0.00		
Flow length (ft)	({0})661.0		0.0		0.0		
Travel Time (min)	**= 0.74**	**+**	**0.00**	**+**	**0.00**	**=**	**0.74**

Total Travel Time, Tc ..... 9.30 min

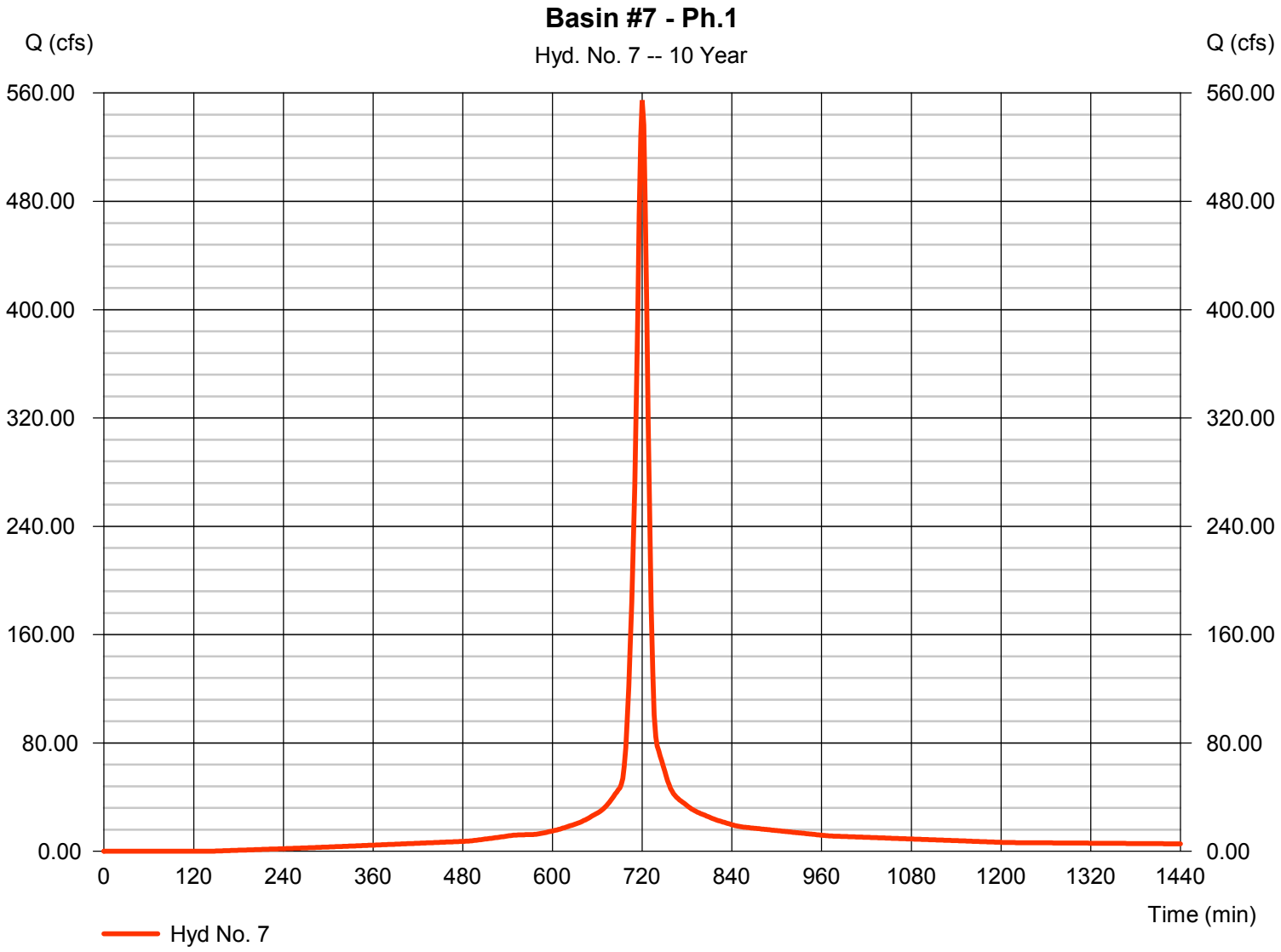
Hydrograph Report

Hyd. No. 7

Basin #7 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 554.63 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,559,866 cuft
Drainage area	= 93.100 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.50 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(92.100 x 94) + (1.000 x 80)] / 93.100



TR55 Tc Worksheet

Hyd. No. 7

Basin #7 - Ph.1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 3.87**	**+**	**0.00**	**+**	**0.00**	**=**	**3.87**
Shallow Concentrated Flow							
Flow length (ft)	= 1095.00		0.00		0.00		
Watercourse slope (%)	= 5.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.82		0.00		0.00		
Travel Time (min)	**= 4.78**	**+**	**0.00**	**+**	**0.00**	**=**	**4.78**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 1.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=12.61						
			0.00				
					0.00		
Flow length (ft)	({0})2886.0		0.0		0.0		
Travel Time (min)	**= 3.81**	**+**	**0.00**	**+**	**0.00**	**=**	**3.81**

Total Travel Time, Tc ..... 12.50 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	203.11	2	716	463,246	------	------	------	Basin #1 - Ph. 1
2	SCS Runoff	538.51	2	718	1,386,372	------	------	------	Basin #2 - Ph.1
3	SCS Runoff	67.22	2	720	185,746	------	------	------	Basin #3 - Ph.1
4	SCS Runoff	205.24	2	720	591,671	------	------	------	Basin #4 - Ph.1
5	SCS Runoff	220.68	2	720	636,177	------	------	------	Basin #5 - Ph.1
6	SCS Runoff	133.72	2	718	344,245	------	------	------	Basin #6 - Ph.1
7	SCS Runoff	845.50	2	720	2,437,370	------	------	------	Basin #7 - Ph.1

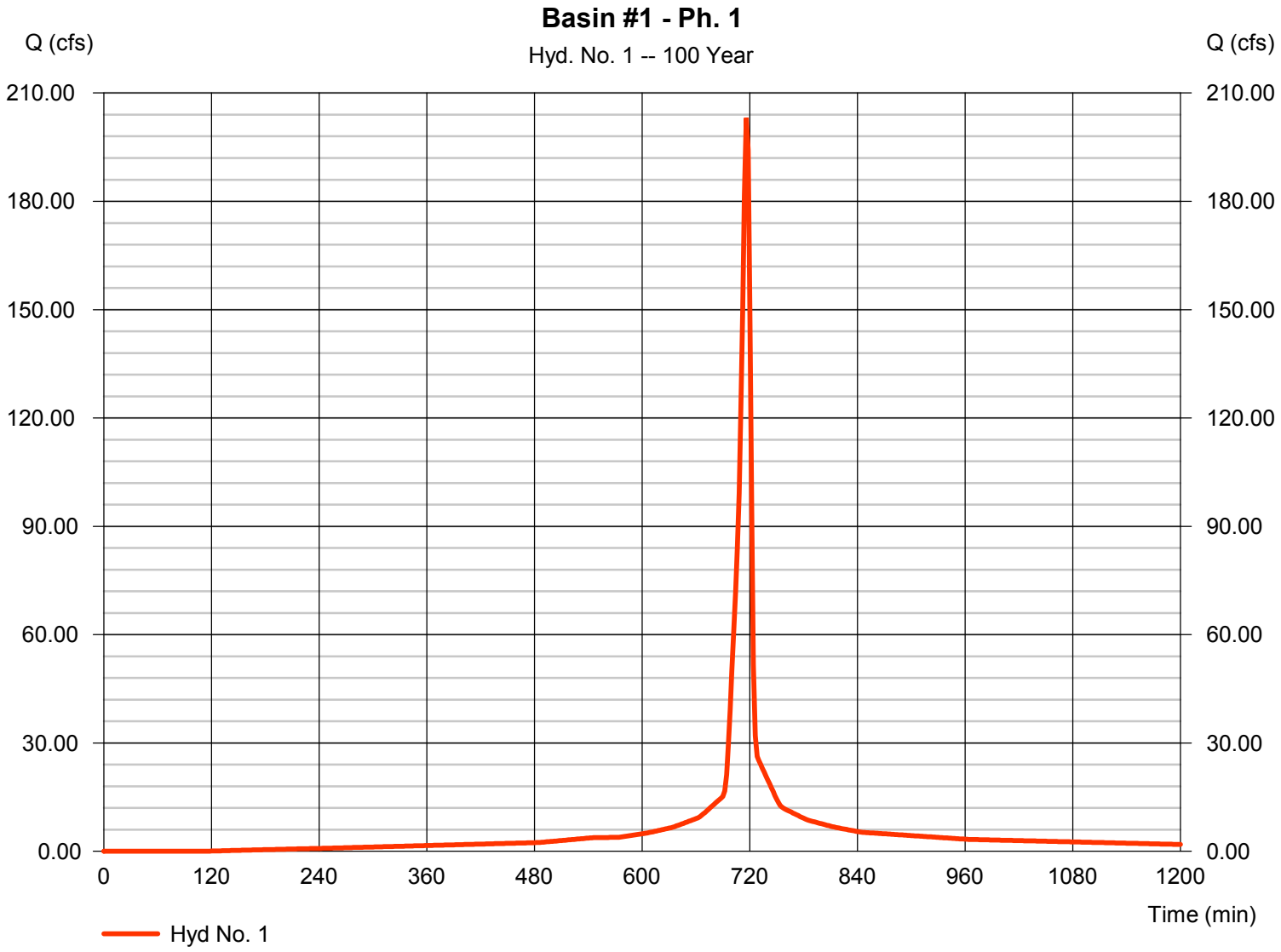
Hydrograph Report

Hyd. No. 1

Basin #1 - Ph. 1

Hydrograph type	= SCS Runoff	Peak discharge	= 203.11 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 463,246 cuft
Drainage area	= 19.800 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.700 x 80) + (18.100 x 94)] / 19.800

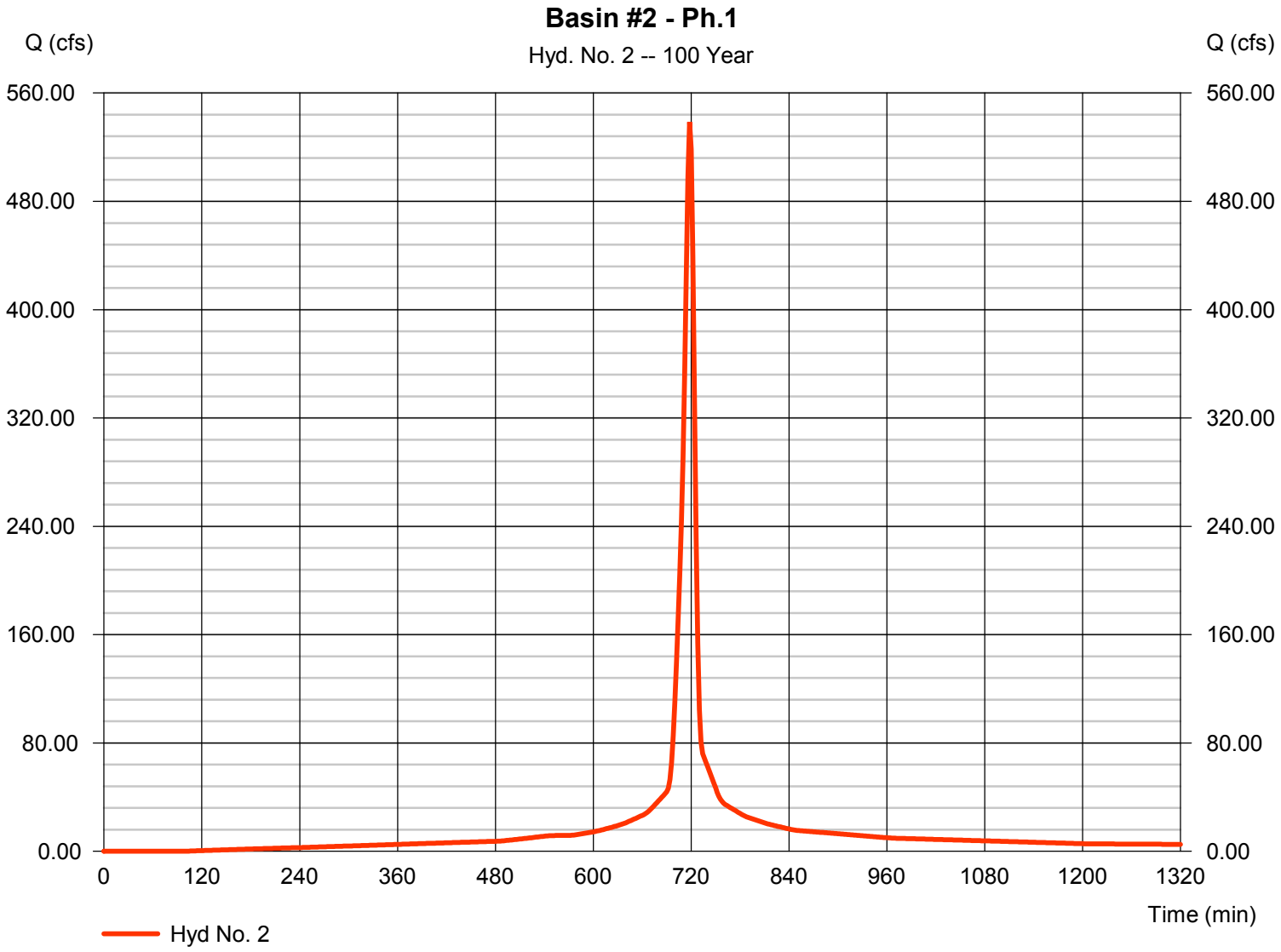


Hydrograph Report

Hyd. No. 2

Basin #2 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 538.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,386,372 cuft
Drainage area	= 54.610 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.70 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



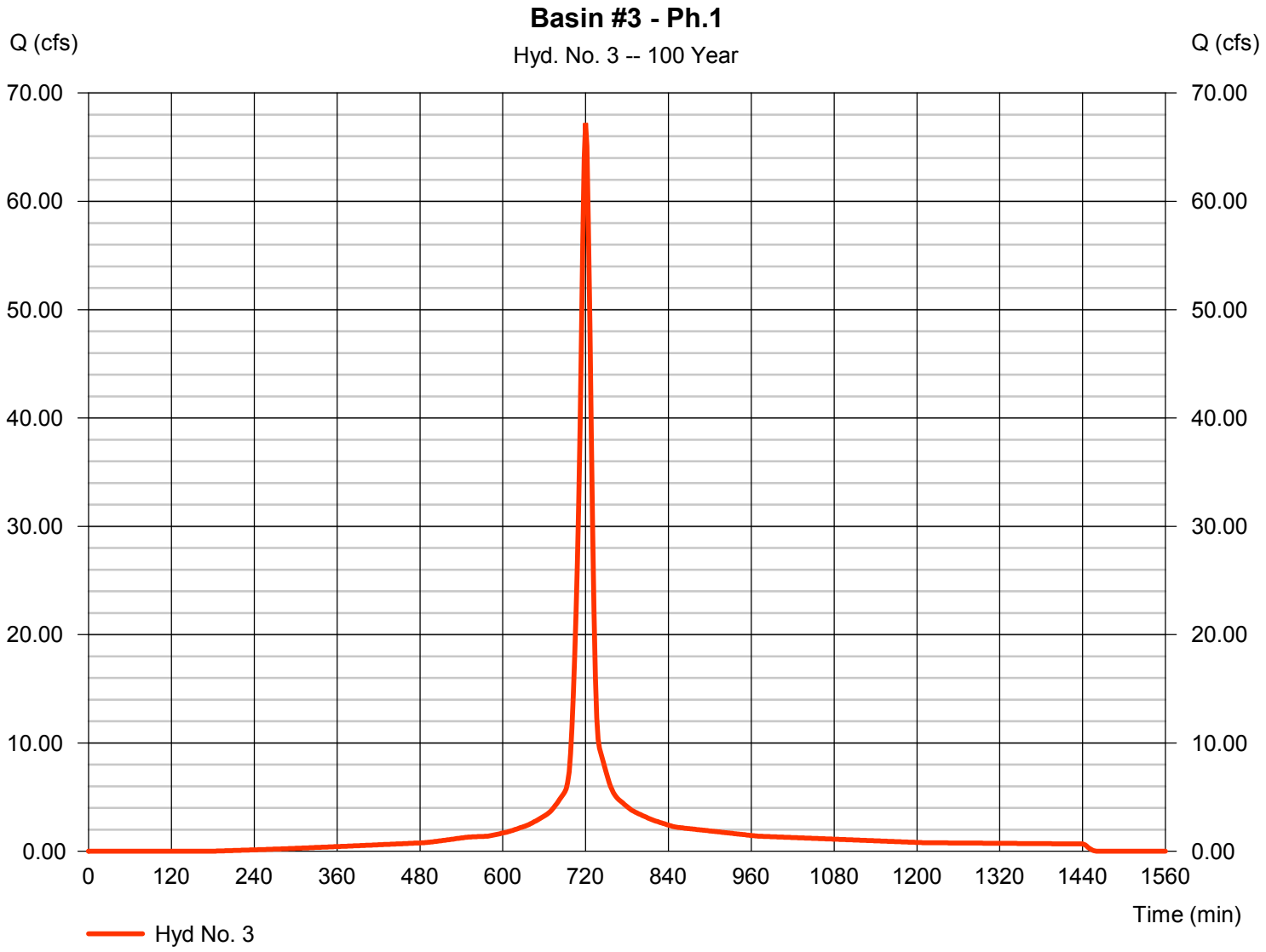
Hydrograph Report

Hyd. No. 3

Basin #3 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 67.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 185,746 cuft
Drainage area	= 7.750 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.80 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.000 x 94) + (2.750 x 80)] / 7.750

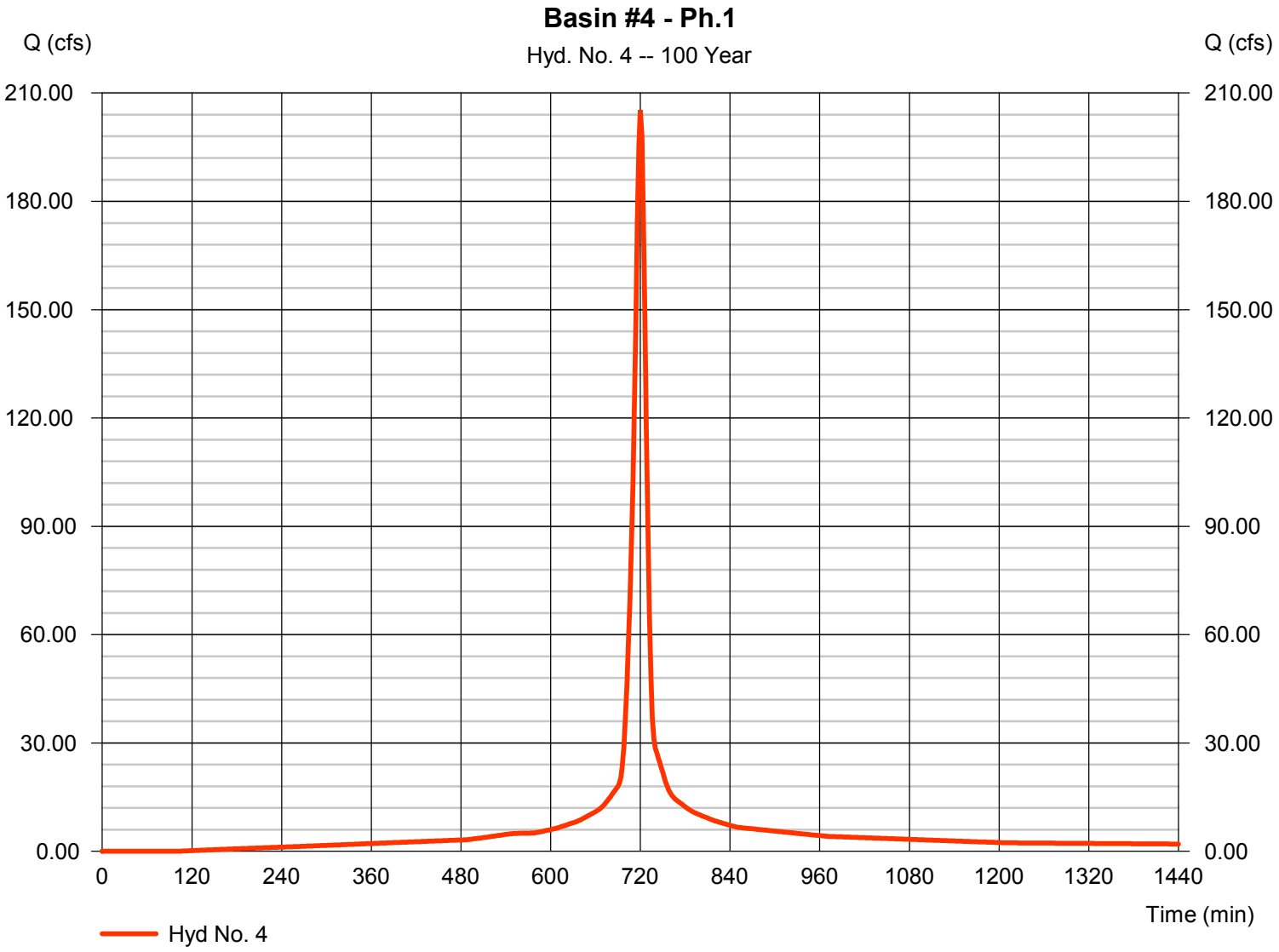


Hydrograph Report

Hyd. No. 4

Basin #4 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 205.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 591,671 cuft
Drainage area	= 22.600 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.70 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

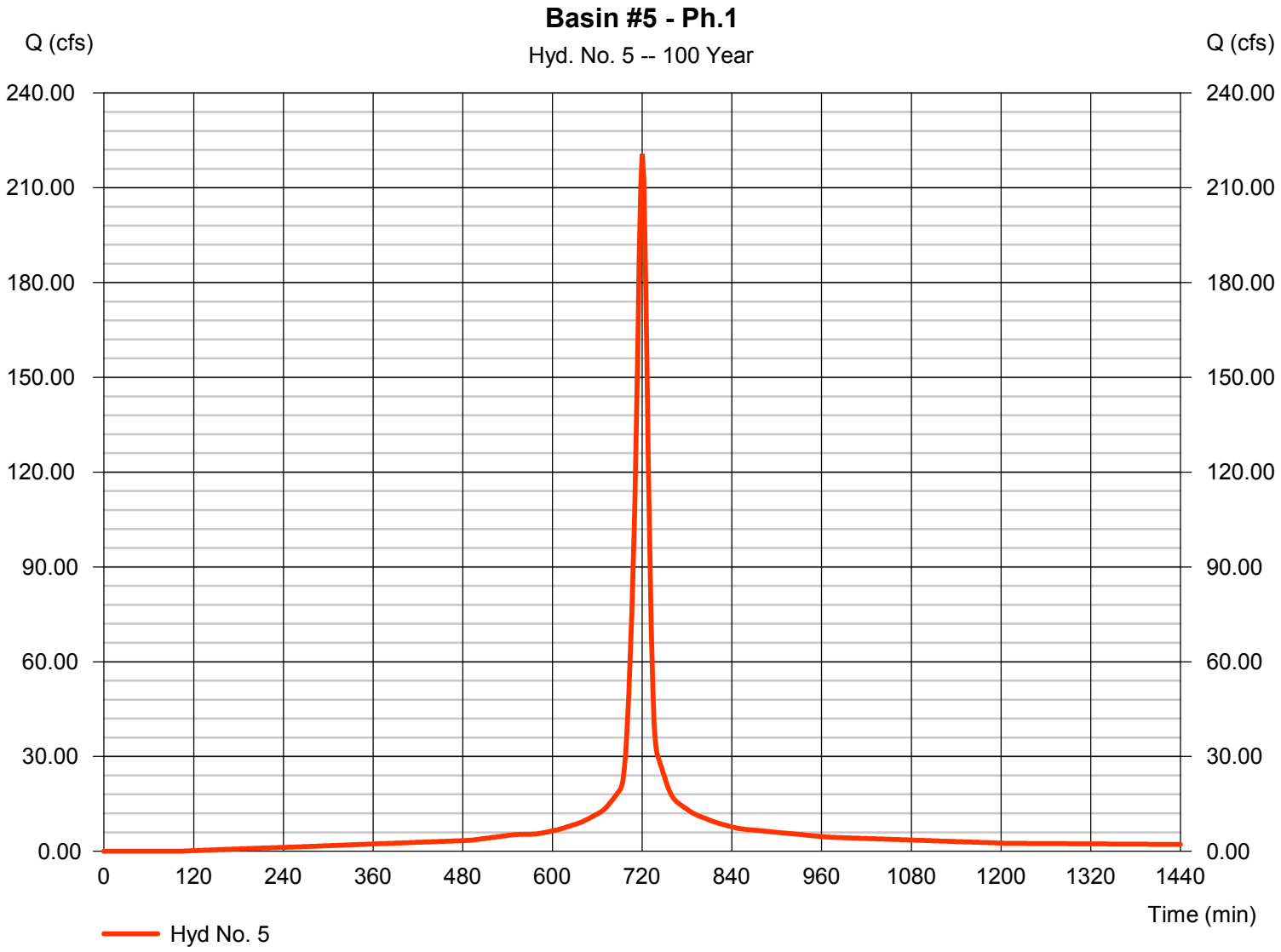


Hydrograph Report

Hyd. No. 5

Basin #5 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 220.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 636,177 cuft
Drainage area	= 24.300 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.20 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

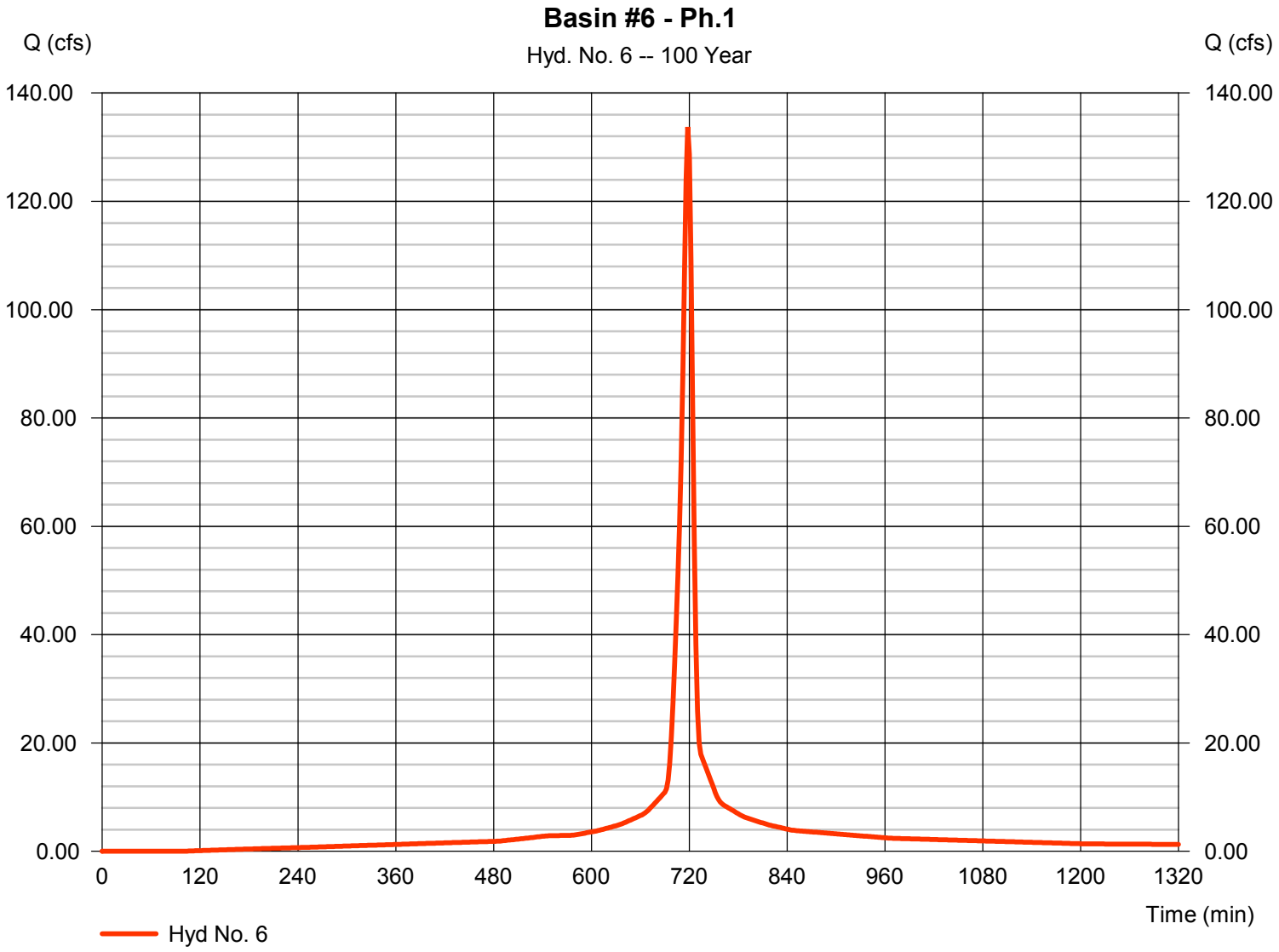


Hydrograph Report

Hyd. No. 6

Basin #6 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 133.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 344,245 cuft
Drainage area	= 13.560 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.30 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



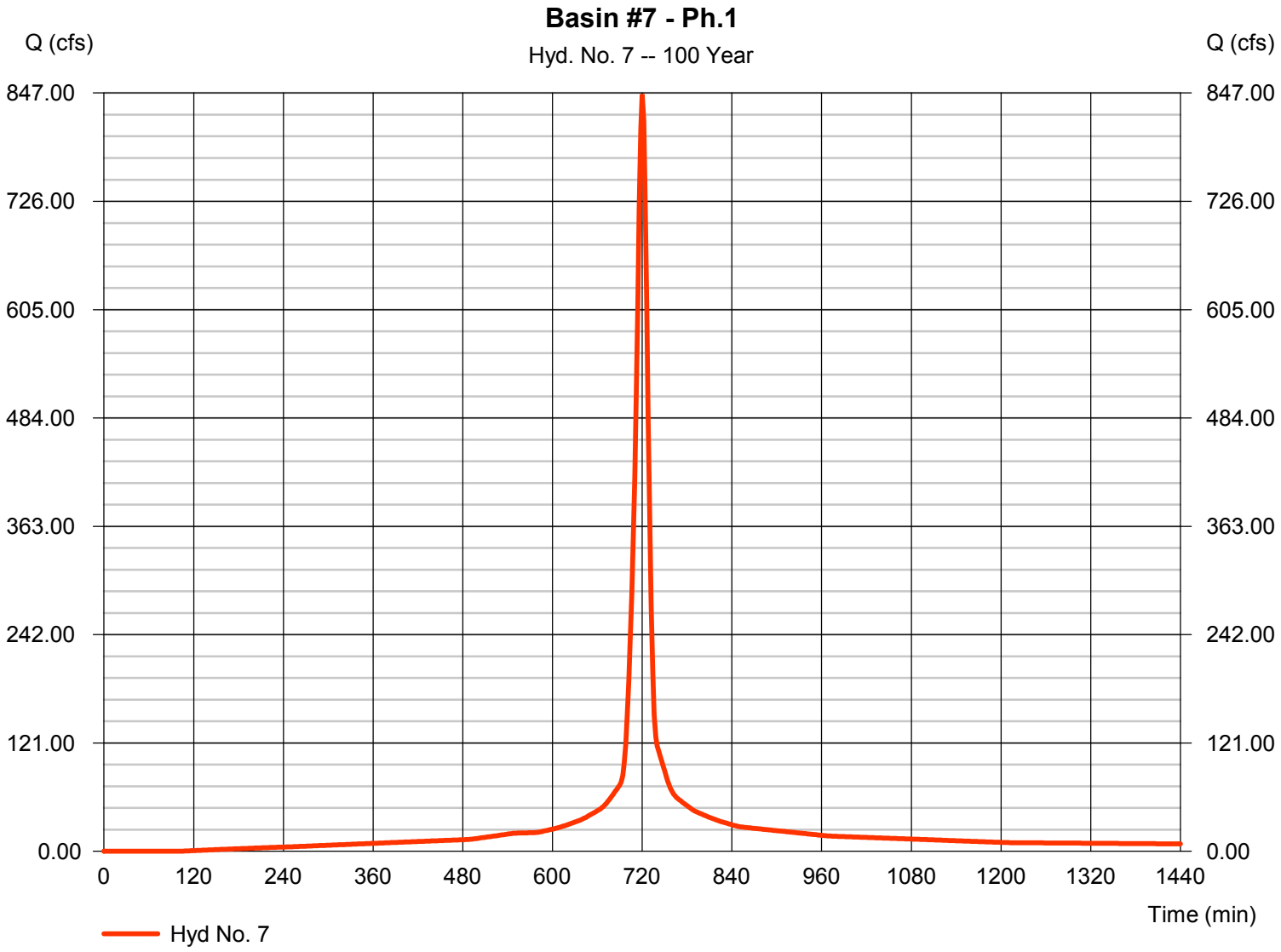
Hydrograph Report

Hyd. No. 7

Basin #7 - Ph.1

Hydrograph type	= SCS Runoff	Peak discharge	= 845.50 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,437,370 cuft
Drainage area	= 93.100 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.50 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(92.100 x 94) + (1.000 x 80)] / 93.100



Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	135.66	-------	-------	208.12	250.82	-------	319.48	Basin #1 - Ph. 2
2	SCS Runoff	------	-------	185.18	-------	-------	281.10	337.65	-------	428.64	Basin #2 - Ph.2
3	SCS Runoff	------	-------	26.41	-------	-------	42.46	51.95	-------	67.22	Basin #3 - Ph.2
4	SCS Runoff	------	-------	94.73	-------	-------	143.97	173.01	-------	219.72	Basin #4 - Ph.2
5	SCS Runoff	------	-------	34.90	-------	-------	52.96	63.61	-------	80.74	Basin #5 - Ph.2
6	SCS Runoff	------	-------	65.96	-------	-------	100.08	120.20	-------	152.57	Basin #6 - Ph.2
7	SCS Runoff	------	-------	198.73	-------	-------	321.57	394.45	-------	511.71	Basin #7 - Ph.2

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	208.12	2	722	624,121	------	------	------	Basin #1 - Ph. 2
2	SCS Runoff	281.10	2	722	852,238	------	------	------	Basin #2 - Ph.2
3	SCS Runoff	42.46	2	720	114,158	------	------	------	Basin #3 - Ph.2
4	SCS Runoff	143.97	2	724	482,537	------	------	------	Basin #4 - Ph.2
5	SCS Runoff	52.96	2	720	148,950	------	------	------	Basin #5 - Ph.2
6	SCS Runoff	100.08	2	720	281,480	------	------	------	Basin #6 - Ph.2
7	SCS Runoff	321.57	2	730	1,311,237	------	------	------	Basin #7 - Ph.2

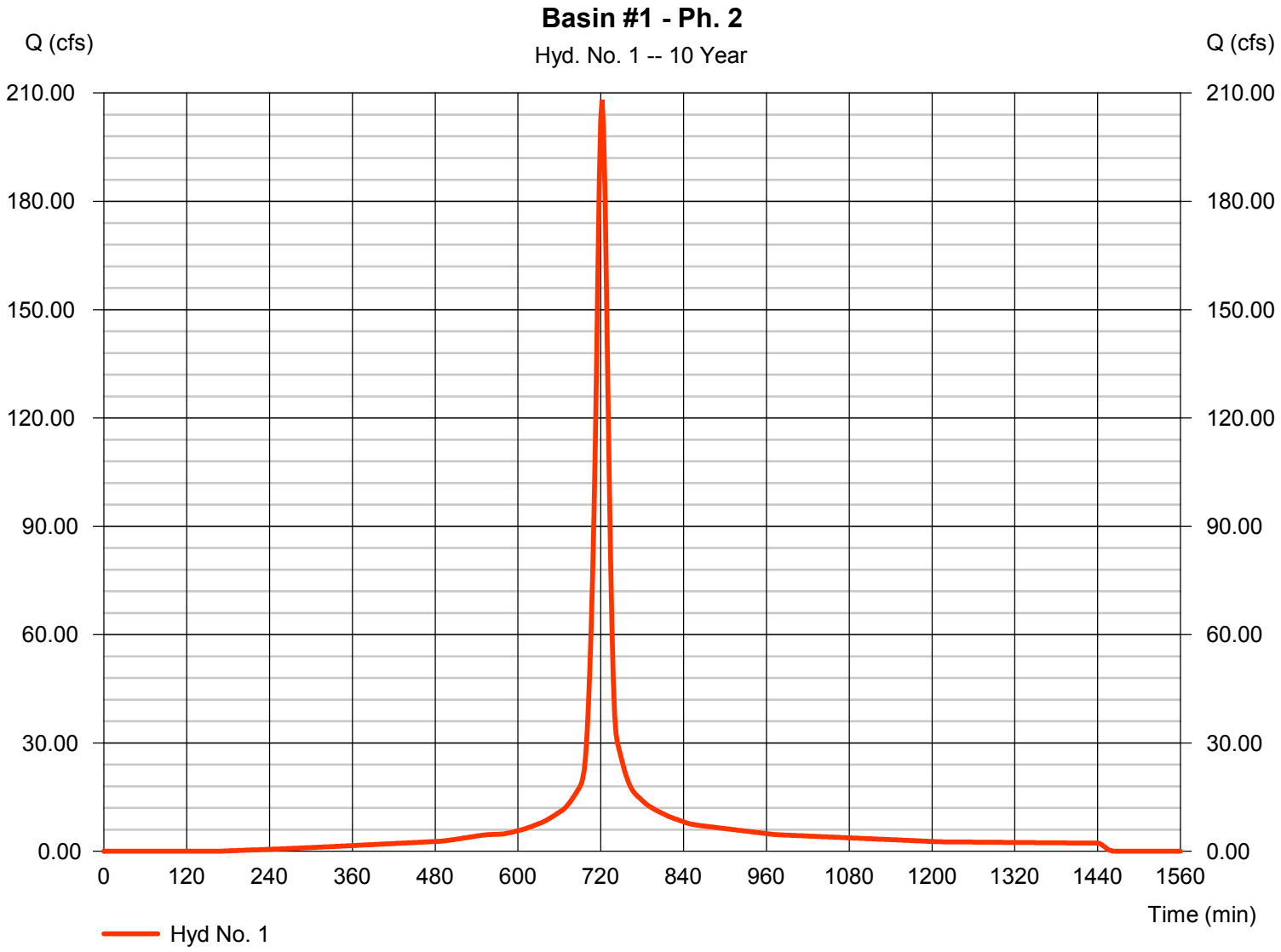
Hydrograph Report

Hyd. No. 1

Basin #1 - Ph. 2

Hydrograph type	= SCS Runoff	Peak discharge	= 208.12 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 624,121 cuft
Drainage area	= 40.400 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.50 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.700 x 80) + (38.700 x 94)] / 40.400



TR55 Tc Worksheet

Hyd. No. 1

Basin #1 - Ph. 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 9.32**	**+**	**0.00**	**+**	**0.00**	**=**	**9.32**
Shallow Concentrated Flow							
Flow length (ft)	= 917.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 6.70**	**+**	**0.00**	**+**	**0.00**	**=**	**6.70**
Channel Flow							
X sectional flow area (sqft)	= 24.00		0.00		0.00		
Wetted perimeter (ft)	= 16.00		0.00		0.00		
Channel slope (%)	= 6.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=31.93						
			0.00				
					0.00		
Flow length (ft)	({0})899.0		0.0		0.0		
Travel Time (min)	**= 0.47**	**+**	**0.00**	**+**	**0.00**	**=**	**0.47**

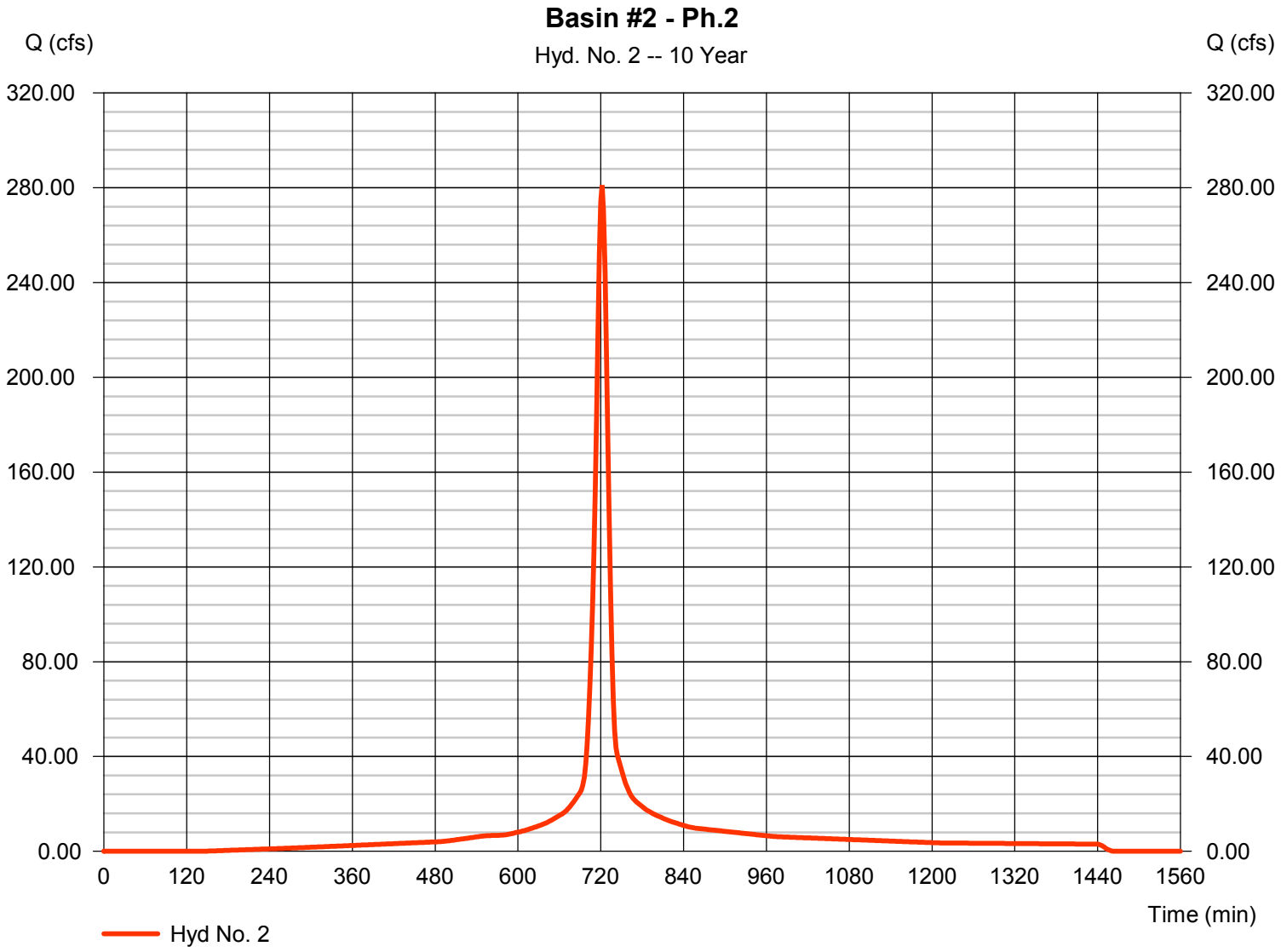
Total Travel Time, Tc ..... 16.50 min

Hydrograph Report

Hyd. No. 2

Basin #2 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 281.10 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 852,238 cuft
Drainage area	= 53.800 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.00 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 2

Basin #2 - Ph.2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		3.54		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 9.32**	**+**	**0.00**	**+**	**0.00**	**=**	**9.32**
Shallow Concentrated Flow							
Flow length (ft)	= 466.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 3.40**	**+**	**0.00**	**+**	**0.00**	**=**	**3.40**
Channel Flow							
X sectional flow area (sqft)	= 19.00		0.00		0.00		
Wetted perimeter (ft)	= 12.00		0.00		0.00		
Channel slope (%)	= 3.90		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=26.69						
			0.00				
					0.00		
Flow length (ft)	({0})2029.0		0.0		0.0		
Travel Time (min)	**= 1.27**	**+**	**0.00**	**+**	**0.00**	**=**	**1.27**

Total Travel Time, Tc ..... 14.00 min

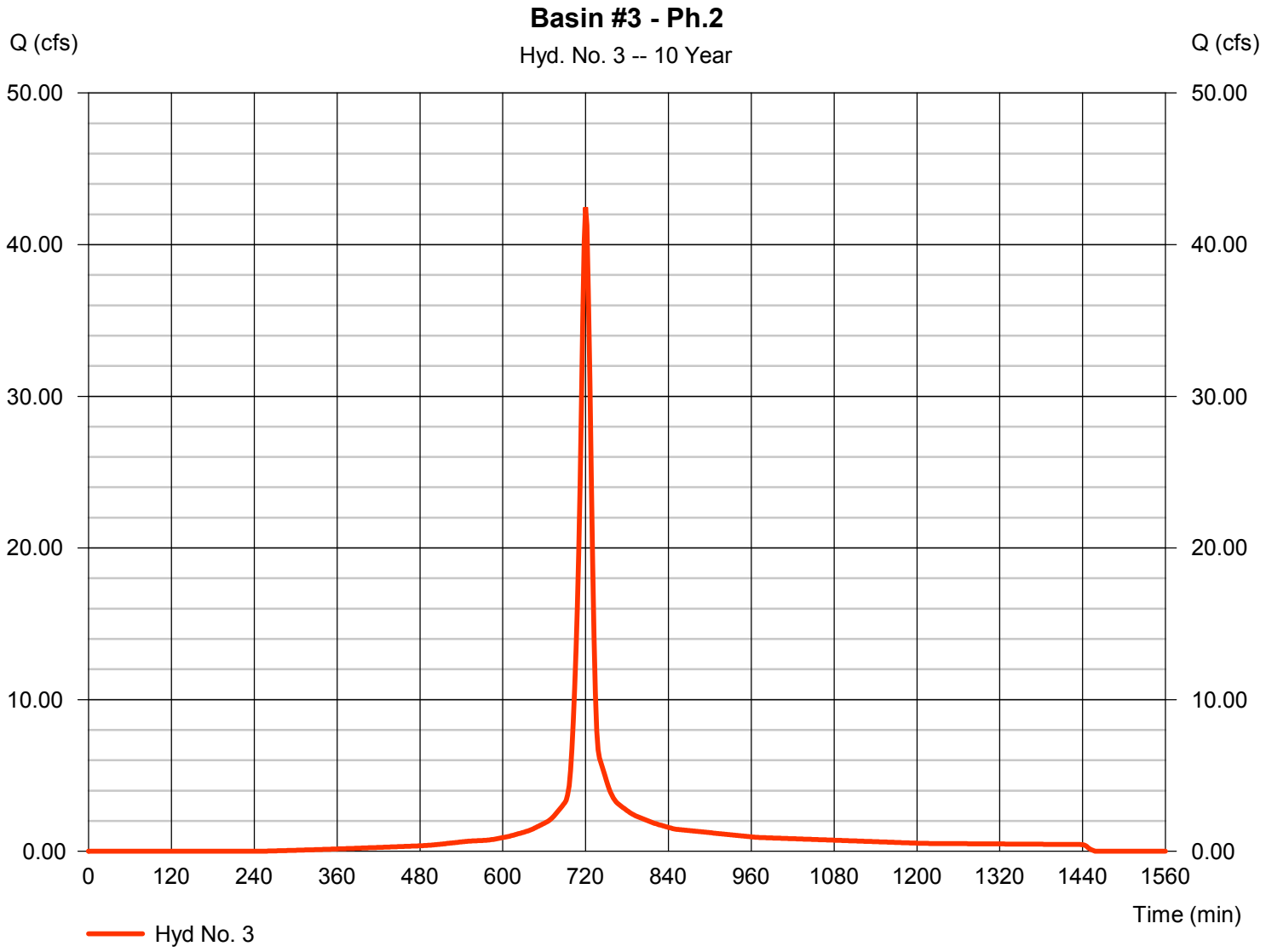
Hydrograph Report

Hyd. No. 3

Basin #3 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 42.46 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 114,158 cuft
Drainage area	= 7.750 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.80 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.000 x 94) + (2.750 x 80)] / 7.750



TR55 Tc Worksheet

Hyd. No. 3

Basin #3 - Ph.2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 9.00		0.00		0.00		
Travel Time (min)	**= 11.19**	**+**	**0.00**	**+**	**0.00**	**=**	**11.19**
Shallow Concentrated Flow							
Flow length (ft)	= 392.29		0.00		0.00		
Watercourse slope (%)	= 7.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.45		0.00		0.00		
Travel Time (min)	**= 1.47**	**+**	**0.00**	**+**	**0.00**	**=**	**1.47**
Channel Flow							
X sectional flow area (sqft)	= 31.00		0.00		0.00		
Wetted perimeter (ft)	= 13.00		0.00		0.00		
Channel slope (%)	= 4.13		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=36.14						
			0.00				
					0.00		
Flow length (ft)	({0})266.6		0.0		0.0		
Travel Time (min)	**= 0.12**	**+**	**0.00**	**+**	**0.00**	**=**	**0.12**

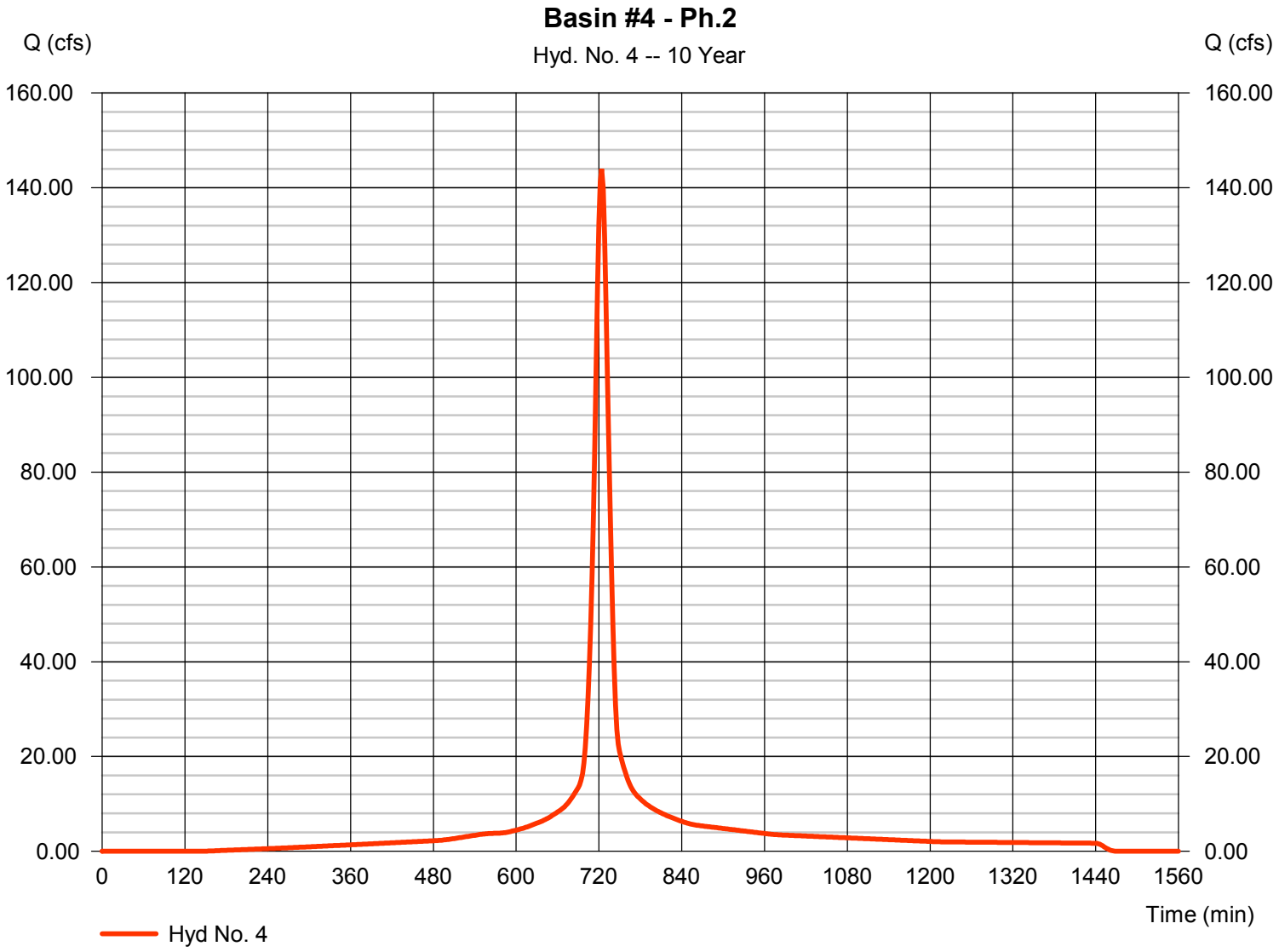
Total Travel Time, Tc ..... 12.80 min

Hydrograph Report

Hyd. No. 4

Basin #4 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 143.97 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 482,537 cuft
Drainage area	= 29.700 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.50 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 4

Basin #4 - Ph.2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 9.32**	**+**	**0.00**	**+**	**0.00**	**=**	**9.32**
Shallow Concentrated Flow							
Flow length (ft)	= 1079.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 7.88**	**+**	**0.00**	**+**	**0.00**	**=**	**7.88**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 18.50		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=54.26						
			0.00				
					0.00		
Flow length (ft)	({0})1094.0		0.0		0.0		
Travel Time (min)	**= 0.34**	**+**	**0.00**	**+**	**0.00**	**=**	**0.34**

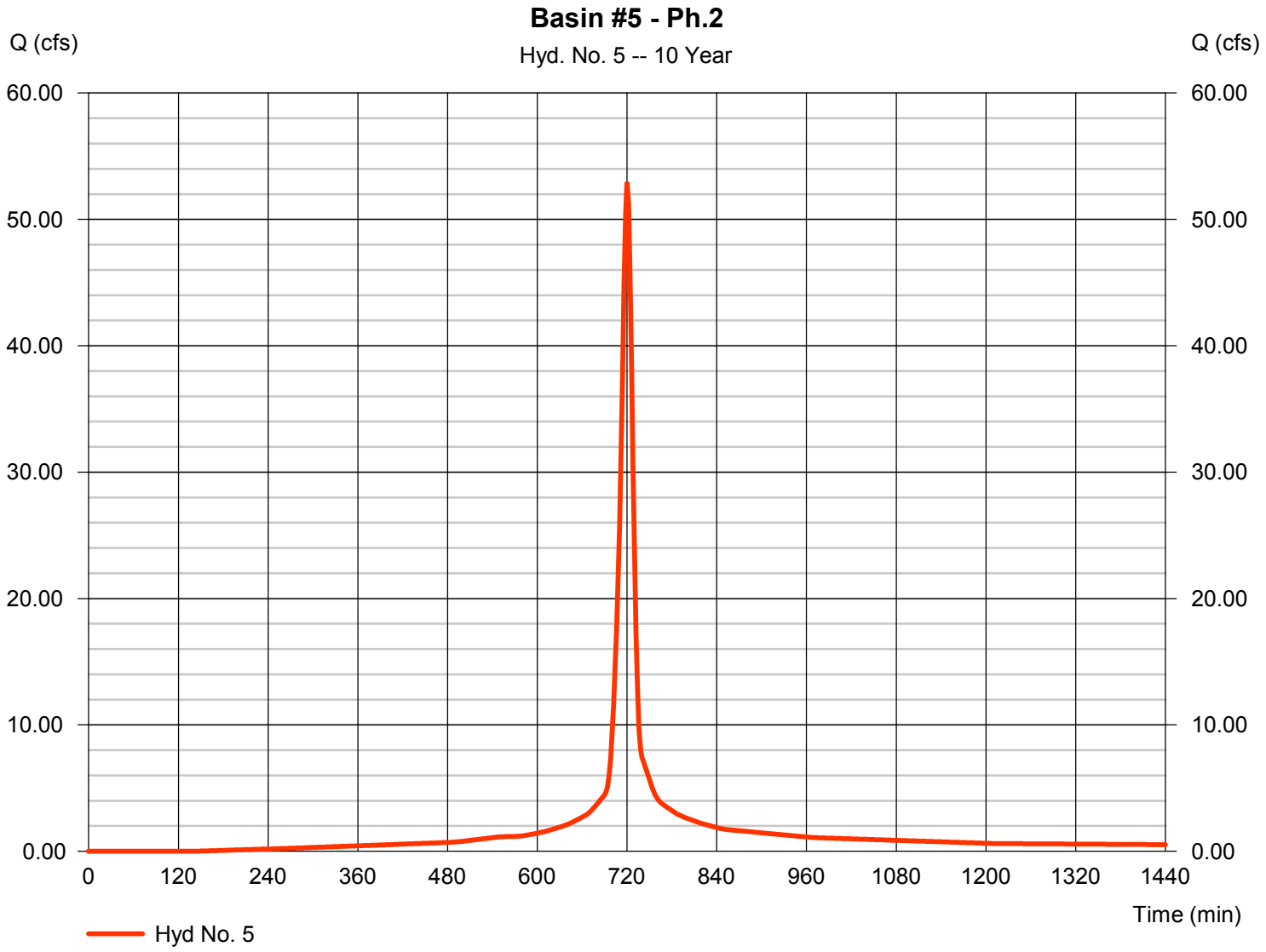
Total Travel Time, Tc ..... 17.50 min

Hydrograph Report

Hyd. No. 5

Basin #5 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 52.96 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 148,950 cuft
Drainage area	= 8.890 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.70 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 5

Basin #5 - Ph.2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 9.32**	**+**	**0.00**	**+**	**0.00**	**=**	**9.32**
Shallow Concentrated Flow							
Flow length (ft)	= 437.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 3.19**	**+**	**0.00**	**+**	**0.00**	**=**	**3.19**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 4.70		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=27.35						
			0.00				
					0.00		
Flow length (ft)	({0})290.0		0.0		0.0		
Travel Time (min)	**= 0.18**	**+**	**0.00**	**+**	**0.00**	**=**	**0.18**

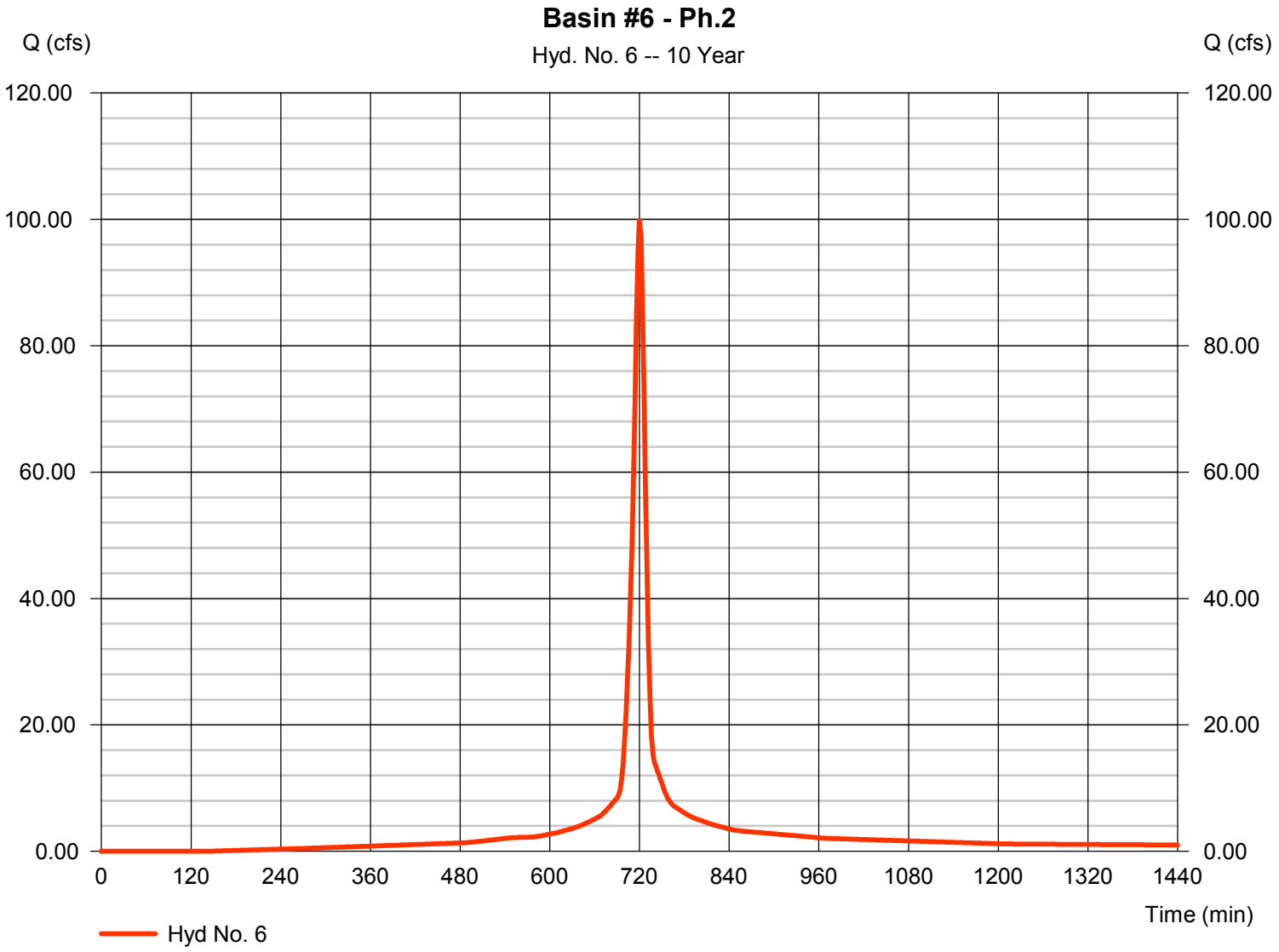
Total Travel Time, Tc ..... 12.70 min

Hydrograph Report

Hyd. No. 6

Basin #6 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 100.08 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 281,480 cuft
Drainage area	= 16.800 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.90 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 6

Basin #6 - Ph.2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 9.32**	**+**	**0.00**	**+**	**0.00**	**=**	**9.32**
Shallow Concentrated Flow							
Flow length (ft)	= 437.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 3.19**	**+**	**0.00**	**+**	**0.00**	**=**	**3.19**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 5.30		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=29.04						
			0.00				
					0.00		
Flow length (ft)	({0})757.0		0.0		0.0		
Travel Time (min)	**= 0.43**	**+**	**0.00**	**+**	**0.00**	**=**	**0.43**

Total Travel Time, Tc ..... 12.90 min

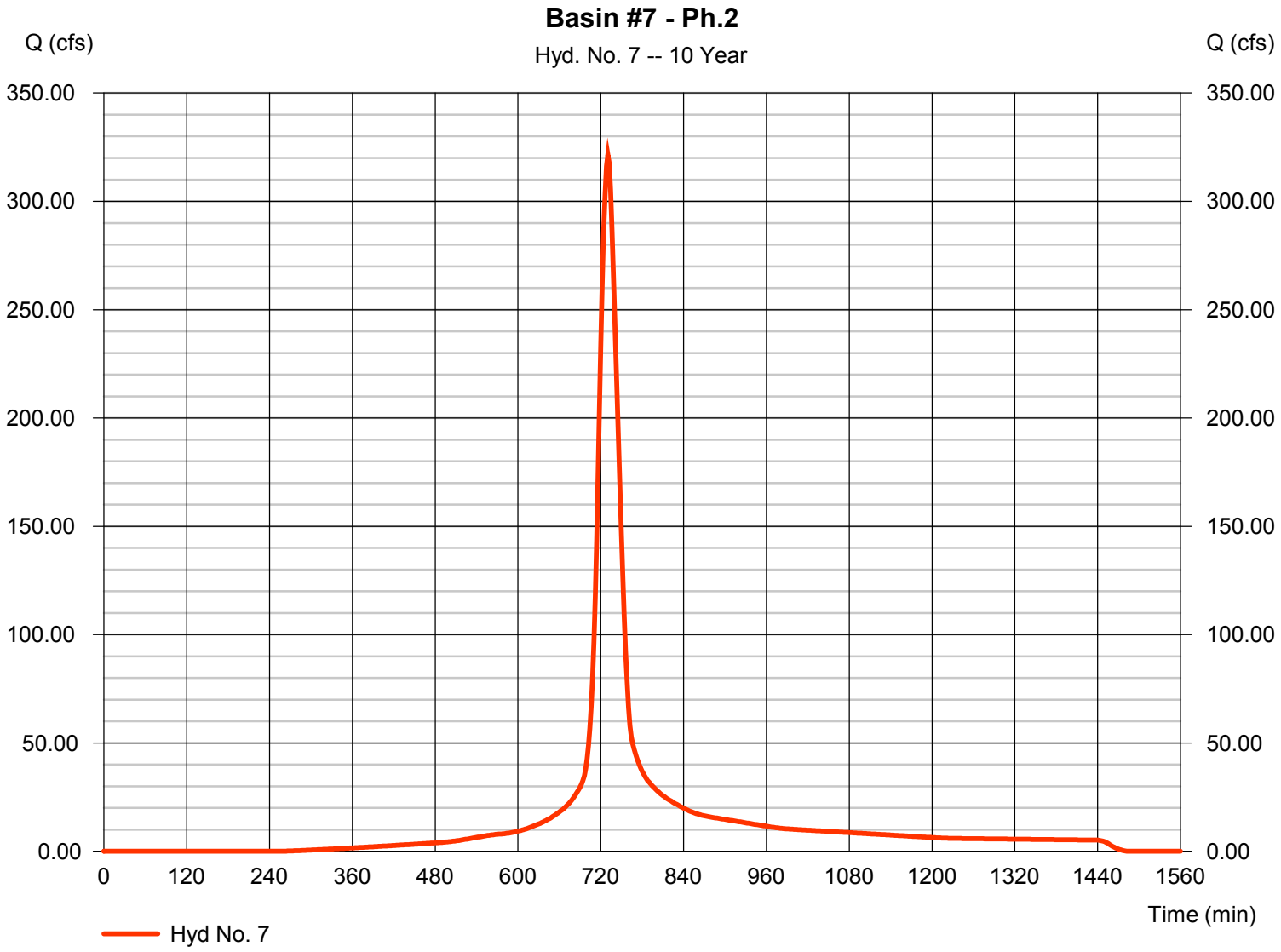
Hydrograph Report

Hyd. No. 7

Basin #7 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 321.57 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 1,311,237 cuft
Drainage area	= 91.800 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.80 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(46.900 x 84) + (44.900 x 94)] / 91.800



TR55 Tc Worksheet

Hyd. No. 7

Basin #7 - Ph.2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.54		3.54		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 22.43**	**+**	**0.00**	**+**	**0.00**	**=**	**22.43**
Shallow Concentrated Flow							
Flow length (ft)	= 862.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 6.30**	**+**	**0.00**	**+**	**0.00**	**=**	**6.30**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 3.30		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=22.92						
			0.00				
					0.00		
Flow length (ft)	({0})1449.0		0.0		0.0		
Travel Time (min)	**= 1.05**	**+**	**0.00**	**+**	**0.00**	**=**	**1.05**
Total Travel Time, Tc							**29.80 min**

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	319.48	2	722	983,017	------	------	------	Basin #1 - Ph. 2
2	SCS Runoff	428.64	2	722	1,331,664	------	------	------	Basin #2 - Ph.2
3	SCS Runoff	67.22	2	720	185,746	------	------	------	Basin #3 - Ph.2
4	SCS Runoff	219.72	2	724	753,987	------	------	------	Basin #4 - Ph.2
5	SCS Runoff	80.74	2	720	232,741	------	------	------	Basin #5 - Ph.2
6	SCS Runoff	152.57	2	720	439,826	------	------	------	Basin #6 - Ph.2
7	SCS Runoff	511.71	2	730	2,133,519	------	------	------	Basin #7 - Ph.2

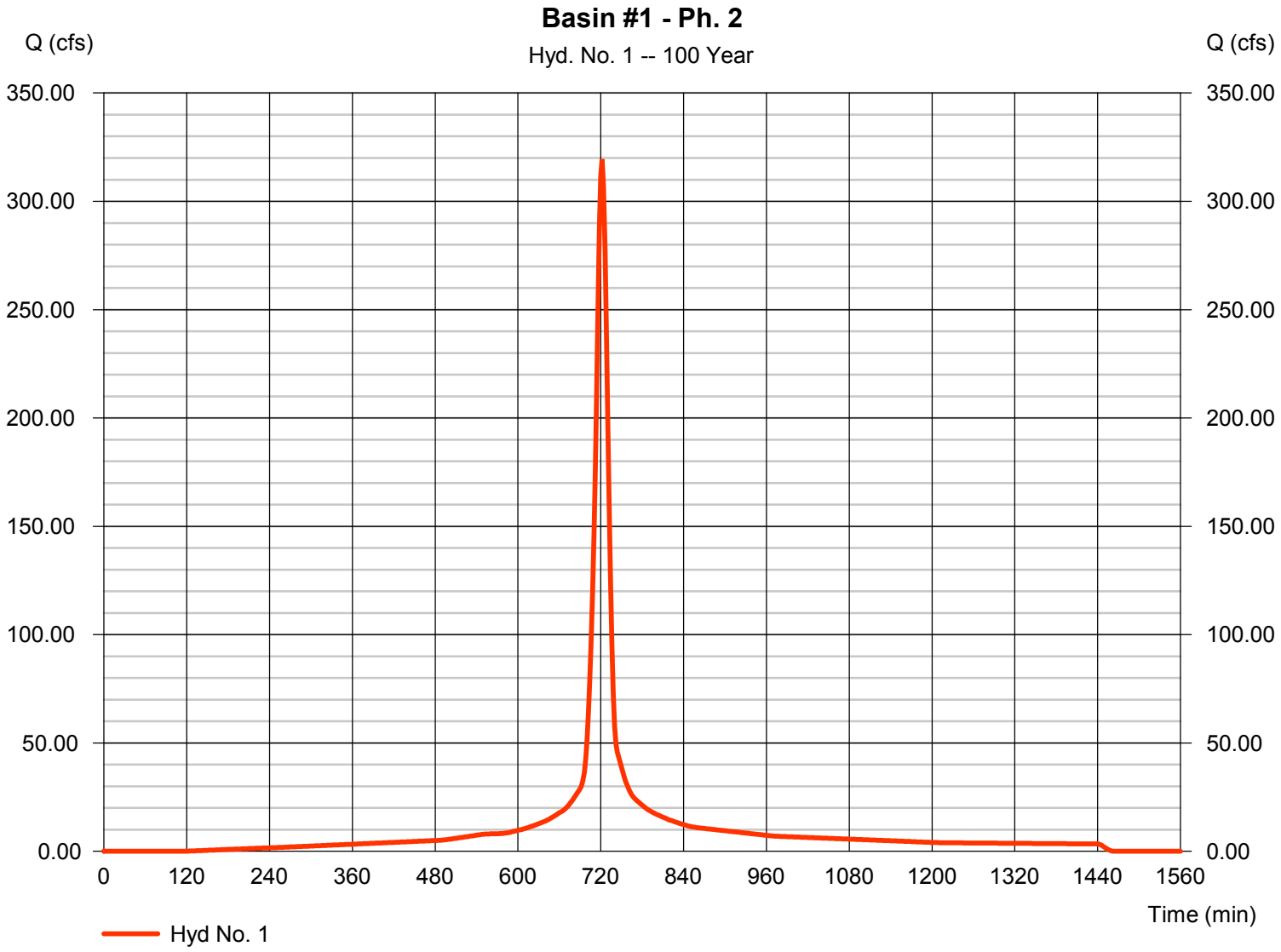
Hydrograph Report

Hyd. No. 1

Basin #1 - Ph. 2

Hydrograph type	= SCS Runoff	Peak discharge	= 319.48 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 983,017 cuft
Drainage area	= 40.400 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.50 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.700 x 80) + (38.700 x 94)] / 40.400

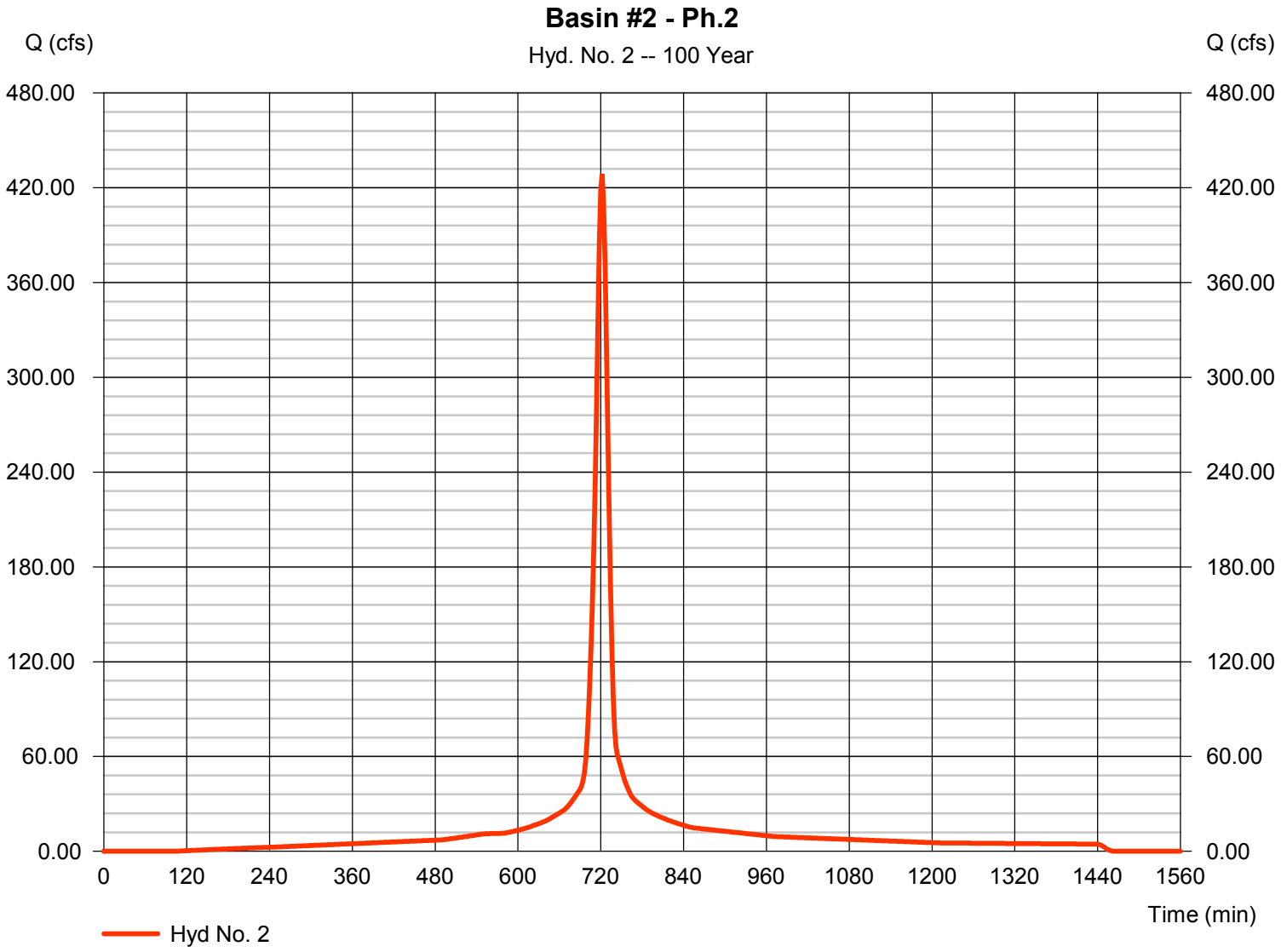


Hydrograph Report

Hyd. No. 2

Basin #2 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 428.64 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,331,664 cuft
Drainage area	= 53.800 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.00 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



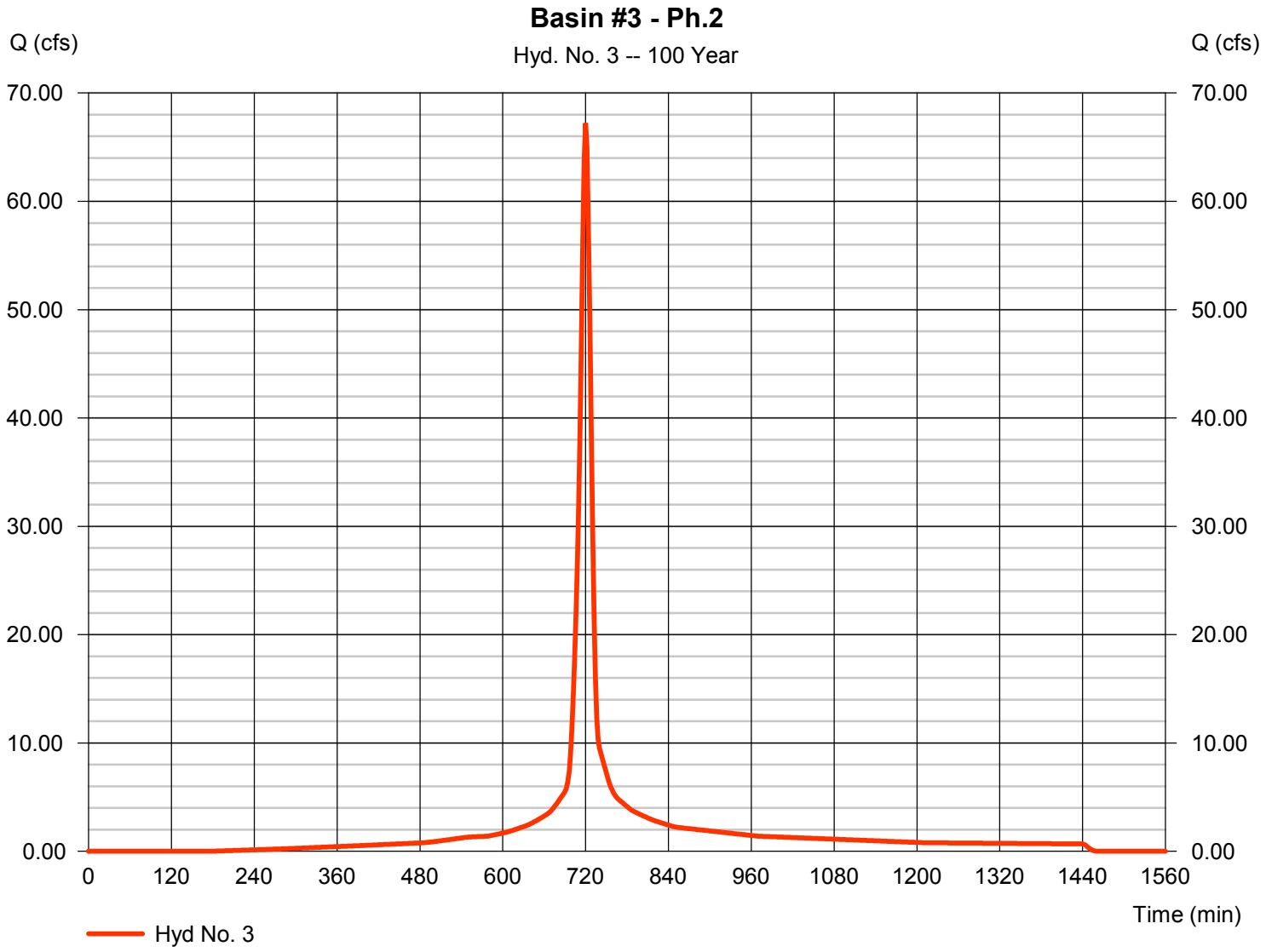
Hydrograph Report

Hyd. No. 3

Basin #3 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 67.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 185,746 cuft
Drainage area	= 7.750 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.80 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.000 x 94) + (2.750 x 80)] / 7.750

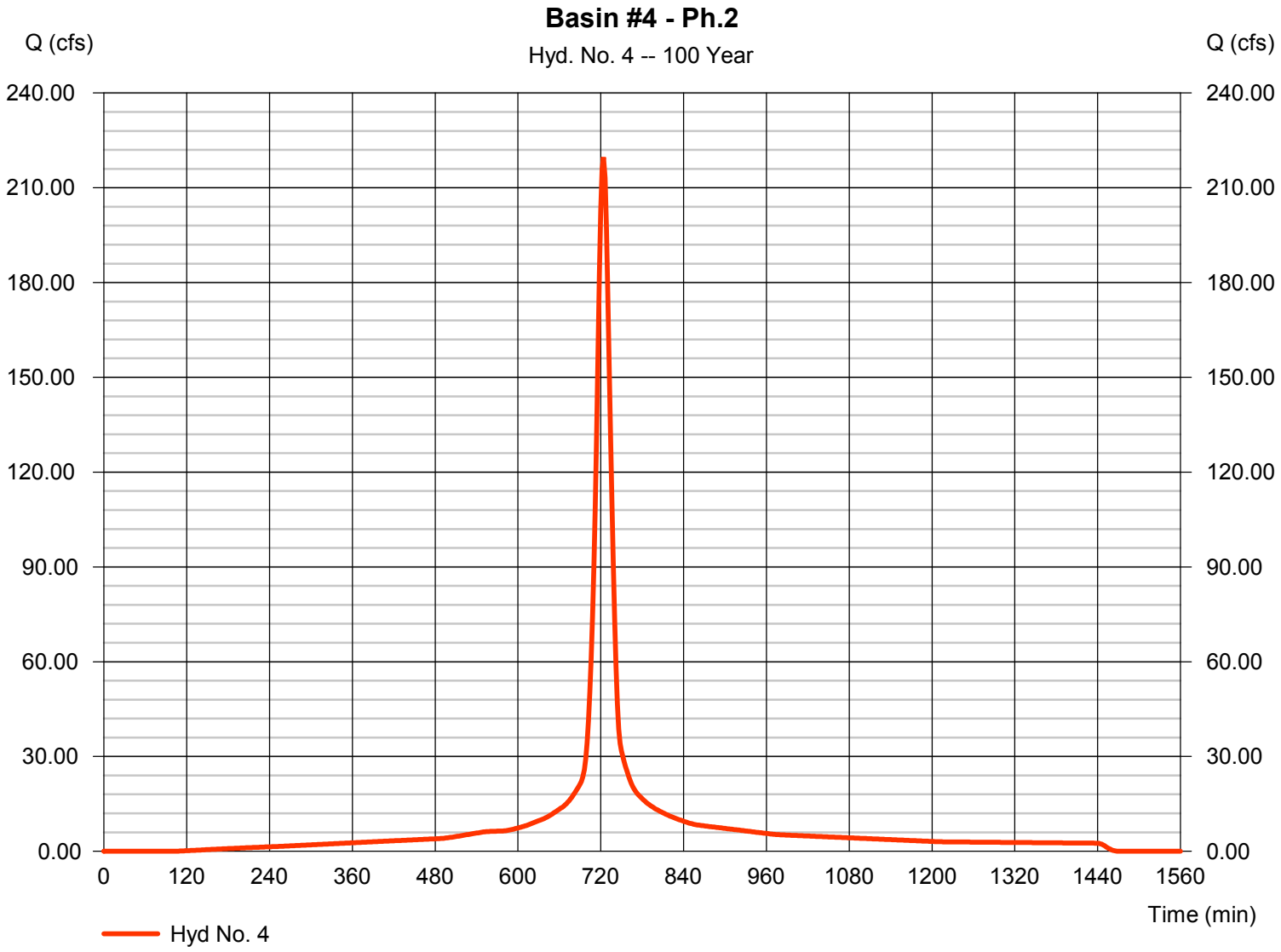


Hydrograph Report

Hyd. No. 4

Basin #4 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 219.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 753,987 cuft
Drainage area	= 29.700 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.50 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

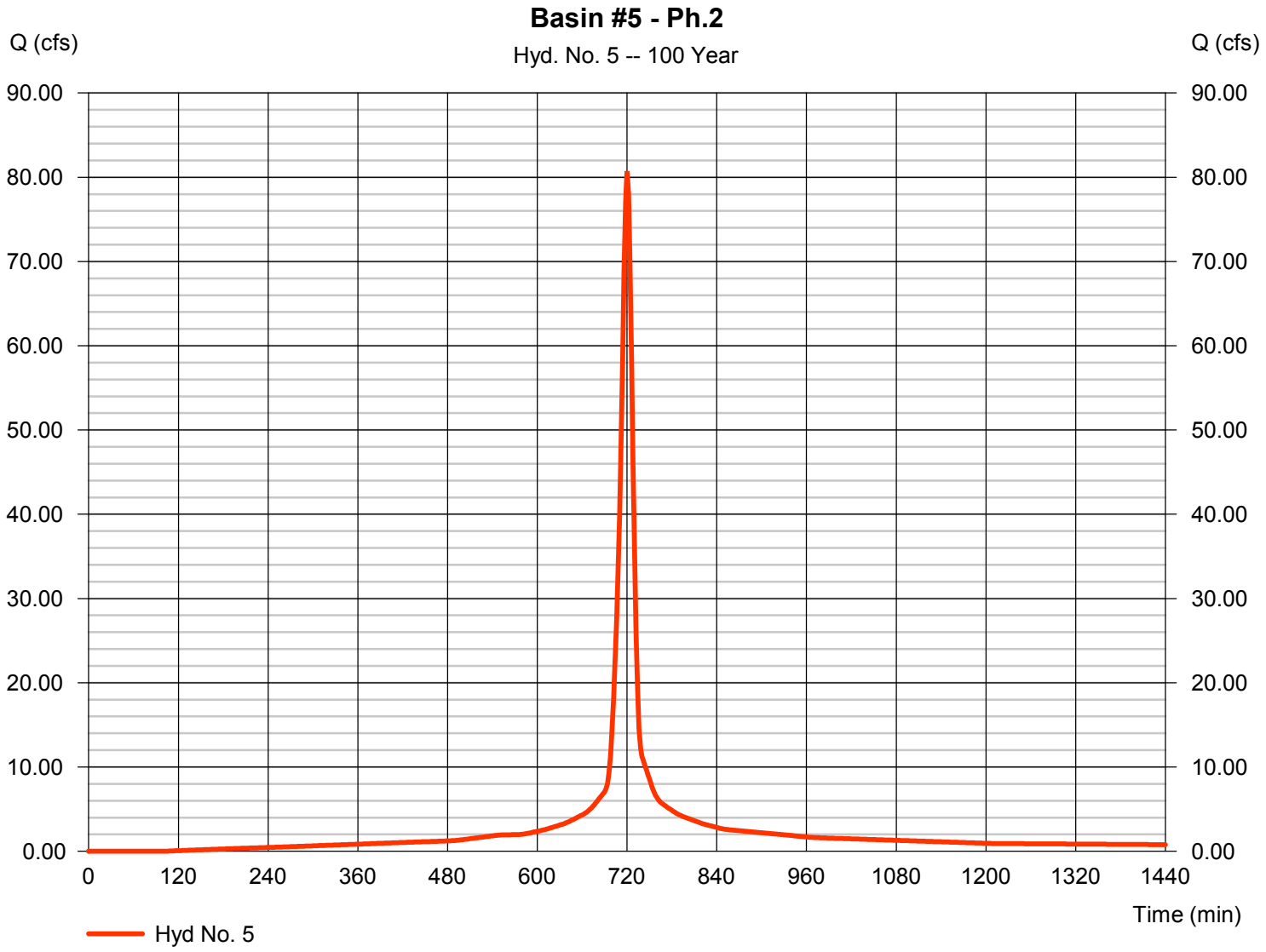


Hydrograph Report

Hyd. No. 5

Basin #5 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 80.74 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 232,741 cuft
Drainage area	= 8.890 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.70 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

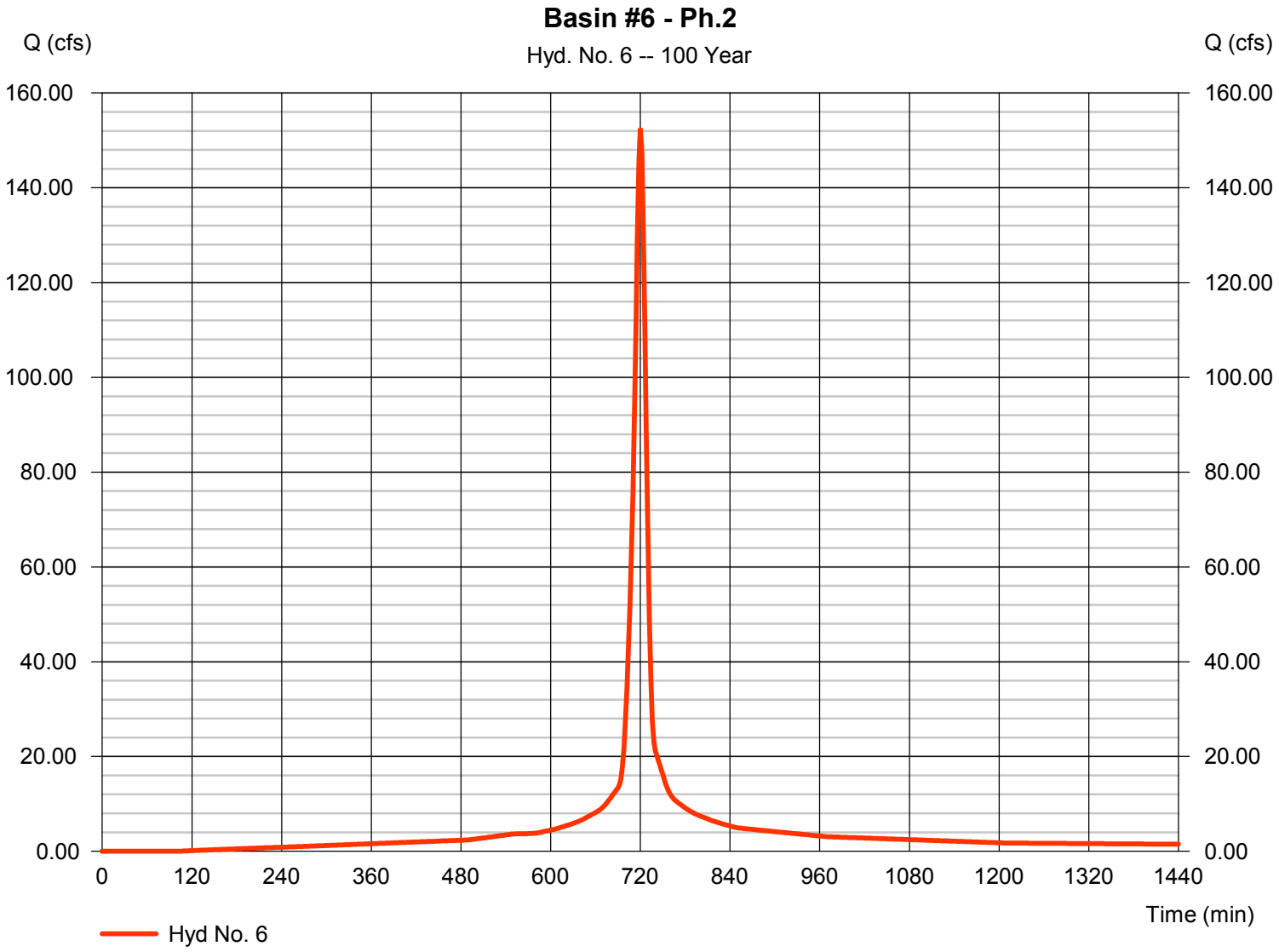


Hydrograph Report

Hyd. No. 6

Basin #6 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 152.57 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 439,826 cuft
Drainage area	= 16.800 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.90 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



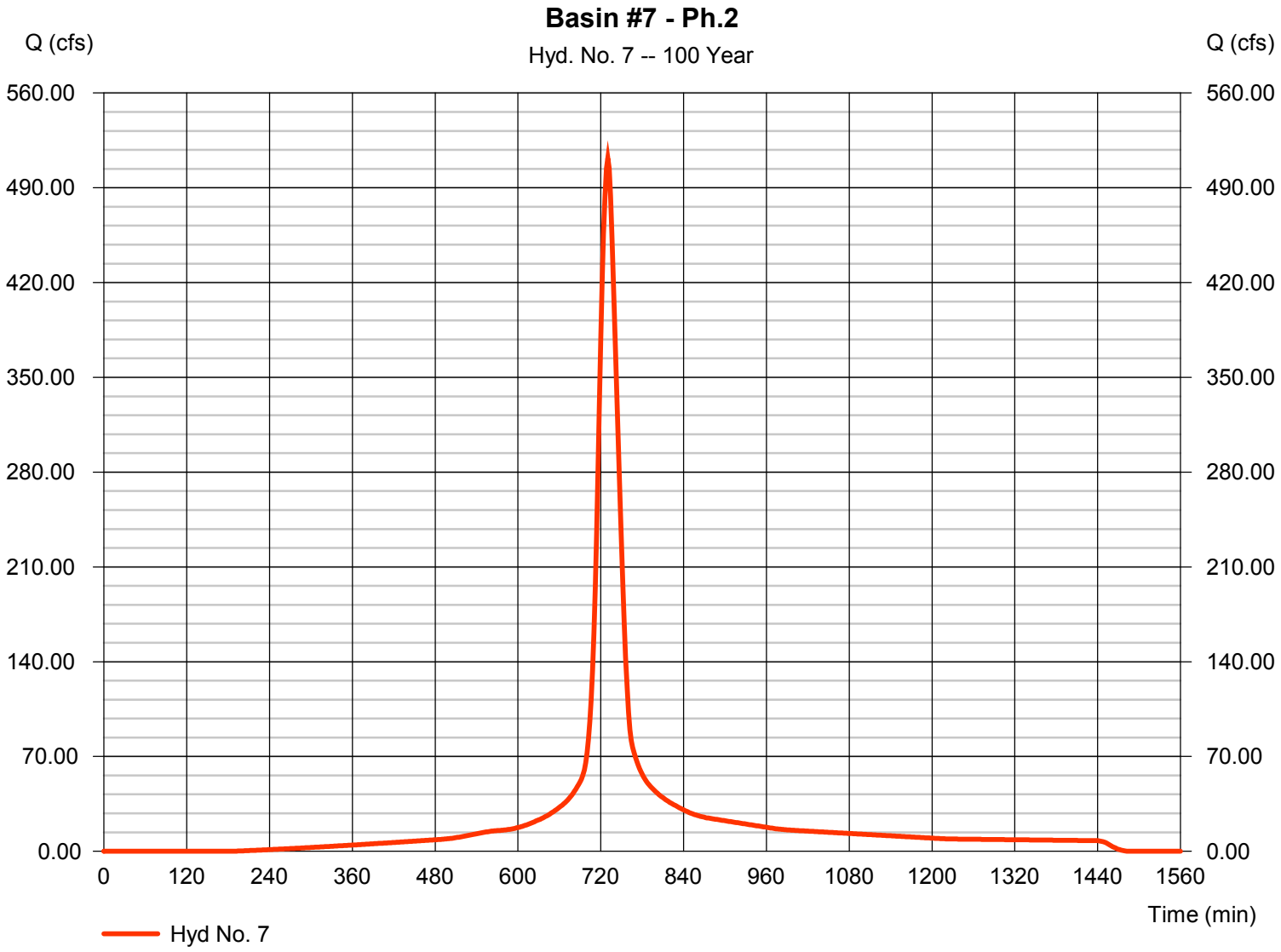
Hydrograph Report

Hyd. No. 7

Basin #7 - Ph.2

Hydrograph type	= SCS Runoff	Peak discharge	= 511.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 2,133,519 cuft
Drainage area	= 91.800 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.80 min
Total precip.	= 7.71 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(46.900 x 84) + (44.900 x 94)] / 91.800



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NOAA Atlas 14, Volume 2, Version 3
Location name: Moncure, North Carolina, US*
Latitude: 35.6094°, Longitude: -79.0156°
Elevation: 209 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	0.418 (0.382–0.459)	0.492 (0.450–0.541)	0.569 (0.520–0.624)	0.628 (0.573–0.689)	0.694 (0.629–0.759)	0.740 (0.669–0.809)	0.782 (0.703–0.855)	0.819 (0.733–0.897)	0.862 (0.764–0.943)	0.895 (0.787–0.980)
10-min	0.668 (0.611–0.733)	0.787 (0.720–0.865)	0.911 (0.833–1.00)	1.01 (0.916–1.10)	1.11 (1.00–1.21)	1.18 (1.07–1.29)	1.24 (1.12–1.36)	1.30 (1.16–1.42)	1.36 (1.21–1.49)	1.41 (1.24–1.54)
15-min	0.835 (0.763–0.916)	0.990 (0.905–1.09)	1.15 (1.05–1.27)	1.27 (1.16–1.39)	1.40 (1.27–1.53)	1.49 (1.35–1.63)	1.57 (1.41–1.72)	1.64 (1.47–1.79)	1.72 (1.52–1.88)	1.77 (1.56–1.94)
30-min	1.15 (1.05–1.26)	1.37 (1.25–1.50)	1.64 (1.50–1.80)	1.84 (1.68–2.02)	2.08 (1.88–2.27)	2.25 (2.03–2.46)	2.41 (2.16–2.63)	2.55 (2.28–2.79)	2.73 (2.42–2.99)	2.86 (2.52–3.14)
60-min	1.43 (1.31–1.57)	1.72 (1.57–1.88)	2.10 (1.92–2.30)	2.40 (2.19–2.63)	2.76 (2.51–3.03)	3.05 (2.75–3.33)	3.32 (2.98–3.62)	3.58 (3.20–3.92)	3.92 (3.47–4.29)	4.18 (3.68–4.58)
2-hr	1.67 (1.52–1.85)	2.02 (1.83–2.23)	2.50 (2.27–2.77)	2.89 (2.61–3.19)	3.37 (3.03–3.73)	3.76 (3.37–4.16)	4.14 (3.68–4.58)	4.53 (4.00–5.00)	5.03 (4.40–5.55)	5.44 (4.71–6.01)
3-hr	1.78 (1.62–1.97)	2.14 (1.95–2.37)	2.67 (2.42–2.95)	3.09 (2.80–3.42)	3.66 (3.29–4.04)	4.12 (3.68–4.54)	4.58 (4.06–5.05)	5.06 (4.45–5.57)	5.71 (4.97–6.29)	6.24 (5.38–6.89)
6-hr	2.13 (1.95–2.34)	2.56 (2.35–2.83)	3.19 (2.91–3.52)	3.71 (3.38–4.08)	4.41 (3.98–4.83)	4.98 (4.47–5.46)	5.56 (4.95–6.09)	6.17 (5.44–6.75)	7.01 (6.09–7.66)	7.70 (6.61–8.44)
12-hr	2.52 (2.30–2.77)	3.04 (2.78–3.35)	3.80 (3.46–4.19)	4.45 (4.03–4.89)	5.32 (4.79–5.83)	6.05 (5.41–6.61)	6.81 (6.02–7.43)	7.61 (6.66–8.30)	8.74 (7.52–9.53)	9.68 (8.21–10.6)
24-hr	2.94 (2.74–3.15)	3.54 (3.31–3.80)	4.45 (4.16–4.77)	5.17 (4.82–5.54)	6.14 (5.71–6.58)	6.92 (6.41–7.40)	7.71 (7.13–8.25)	8.53 (7.86–9.14)	9.65 (8.86–10.4)	10.5 (9.64–11.3)
2-day	3.41 (3.18–3.66)	4.11 (3.83–4.42)	5.13 (4.77–5.51)	5.93 (5.51–6.36)	7.01 (6.49–7.52)	7.86 (7.26–8.44)	8.74 (8.05–9.39)	9.65 (8.86–10.4)	10.9 (9.95–11.7)	11.9 (10.8–12.8)
3-day	3.61 (3.36–3.87)	4.34 (4.04–4.65)	5.38 (5.01–5.78)	6.21 (5.77–6.65)	7.33 (6.78–7.86)	8.22 (7.58–8.81)	9.13 (8.40–9.79)	10.1 (9.23–10.8)	11.3 (10.4–12.2)	12.4 (11.2–13.3)
4-day	3.80 (3.55–4.08)	4.57 (4.26–4.89)	5.64 (5.25–6.04)	6.49 (6.03–6.94)	7.65 (7.07–8.20)	8.57 (7.90–9.18)	9.51 (8.74–10.2)	10.5 (9.61–11.2)	11.8 (10.8–12.7)	12.9 (11.7–13.8)
7-day	4.38 (4.09–4.68)	5.23 (4.89–5.59)	6.37 (5.95–6.80)	7.28 (6.79–7.77)	8.52 (7.93–9.10)	9.52 (8.83–10.2)	10.5 (9.75–11.2)	11.6 (10.7–12.4)	13.0 (11.9–13.9)	14.1 (12.9–15.1)
10-day	5.00 (4.70–5.33)	5.95 (5.59–6.34)	7.16 (6.71–7.63)	8.11 (7.59–8.64)	9.39 (8.76–10.0)	10.4 (9.67–11.1)	11.4 (10.6–12.2)	12.4 (11.5–13.3)	13.8 (12.7–14.8)	14.9 (13.7–15.9)
20-day	6.71 (6.31–7.13)	7.92 (7.45–8.41)	9.36 (8.80–9.95)	10.5 (9.86–11.2)	12.0 (11.3–12.8)	13.2 (12.4–14.1)	14.5 (13.5–15.4)	15.7 (14.6–16.7)	17.3 (16.0–18.5)	18.6 (17.2–19.9)
30-day	8.34 (7.86–8.85)	9.81 (9.24–10.4)	11.4 (10.7–12.1)	12.7 (11.9–13.4)	14.3 (13.4–15.2)	15.5 (14.6–16.5)	16.8 (15.7–17.9)	18.0 (16.8–19.2)	19.7 (18.3–21.0)	21.0 (19.4–22.4)
45-day	10.6 (10.1–11.2)	12.5 (11.8–13.2)	14.3 (13.5–15.1)	15.7 (14.8–16.5)	17.5 (16.5–18.4)	18.8 (17.8–19.9)	20.2 (19.0–21.3)	21.5 (20.2–22.7)	23.2 (21.7–24.6)	24.5 (22.8–26.0)
60-day	12.7 (12.1–13.4)	14.9 (14.1–15.6)	16.8 (16.0–17.7)	18.3 (17.4–19.3)	20.3 (19.2–21.3)	21.7 (20.5–22.9)	23.1 (21.8–24.4)	24.5 (23.1–25.8)	26.3 (24.7–27.7)	27.6 (25.9–29.2)

[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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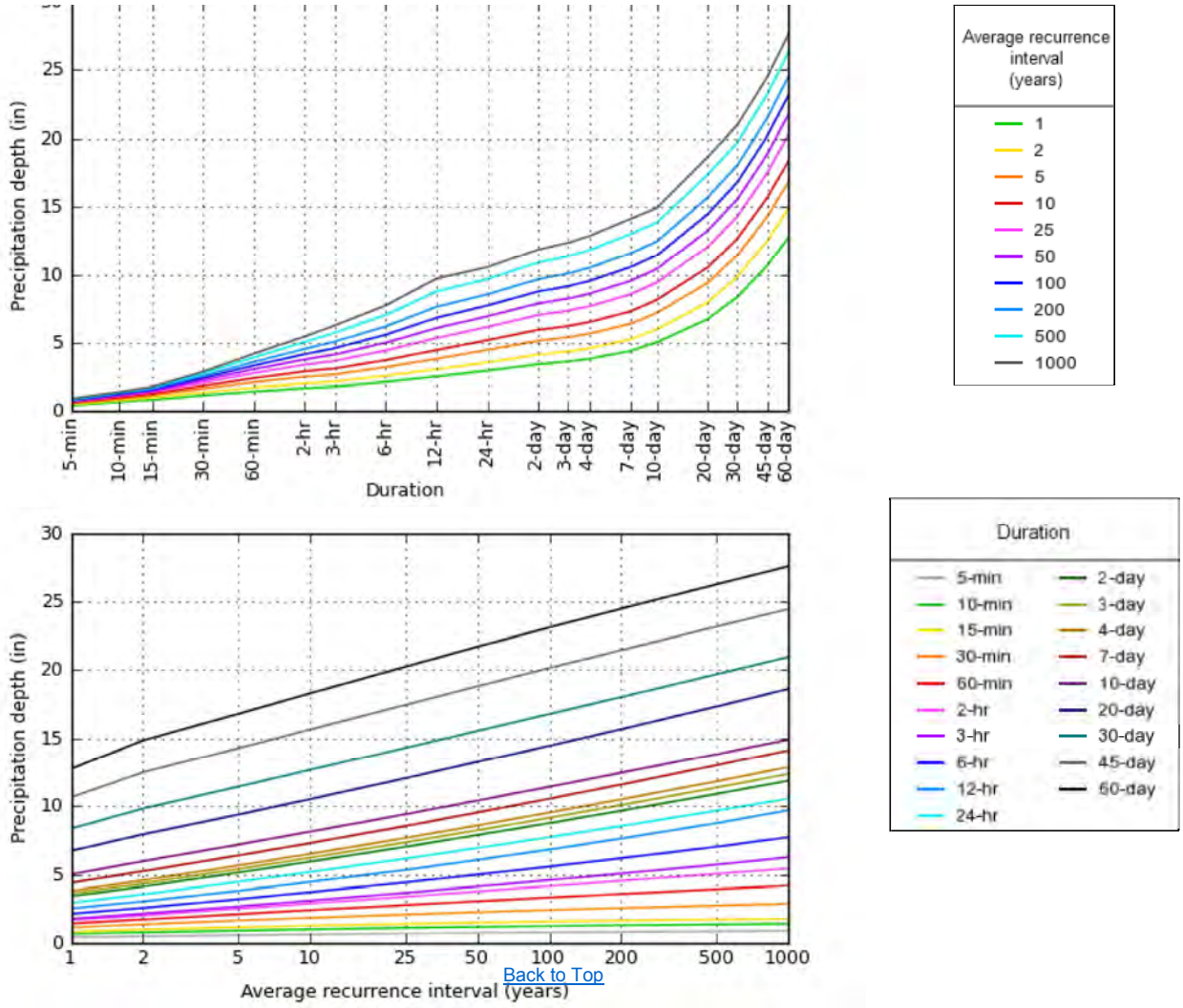
PF graphical



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Maps & aerials

NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Tue Oct 28 20:33:40 2014

Small scale terrain

Large scale terrain

Large scale map

Large scale aerial

Back to Top

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: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: 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.

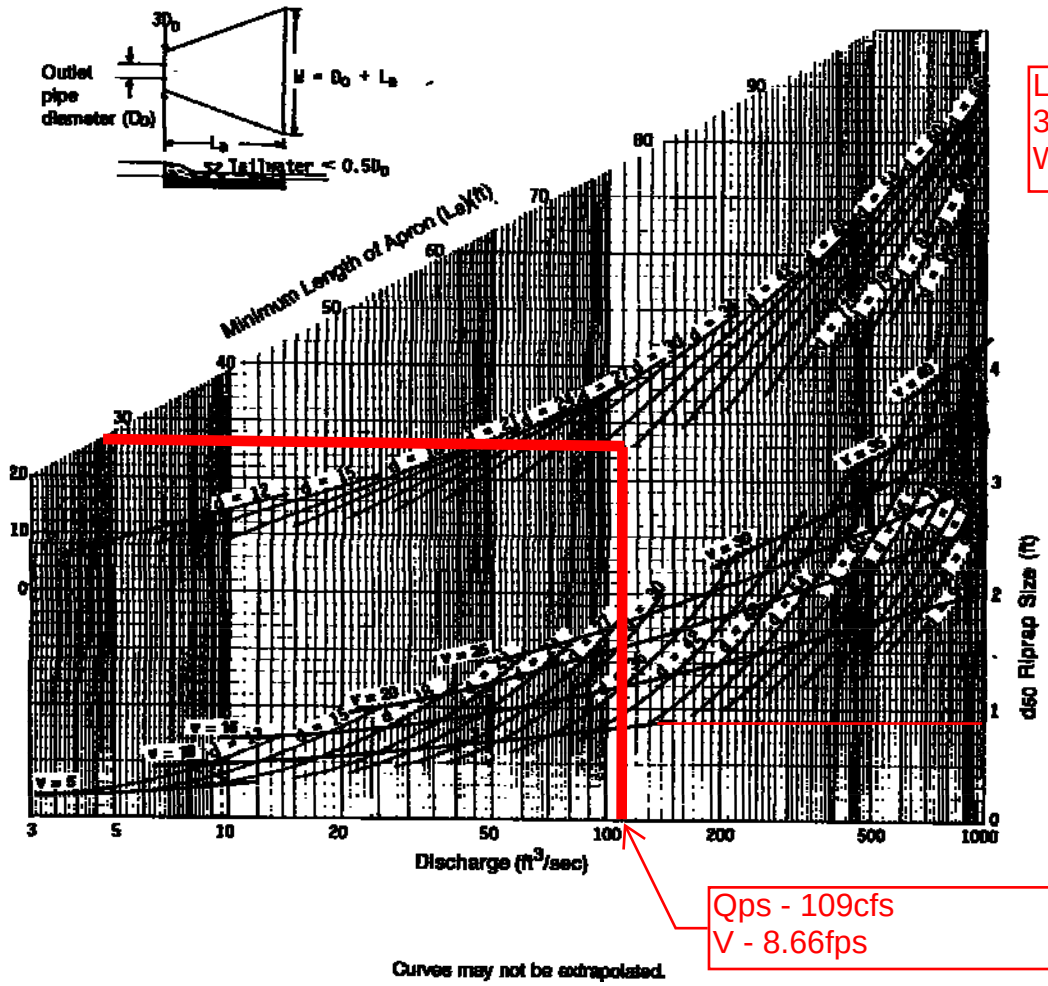
[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[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 (Phase 2 Controls)

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



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W=30'

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depth=24"

Qps - 109cfs
V - 8.66fps

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

BASIN #2 (Phase 1 Controls)

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=32', W=37', Outlet end=25'

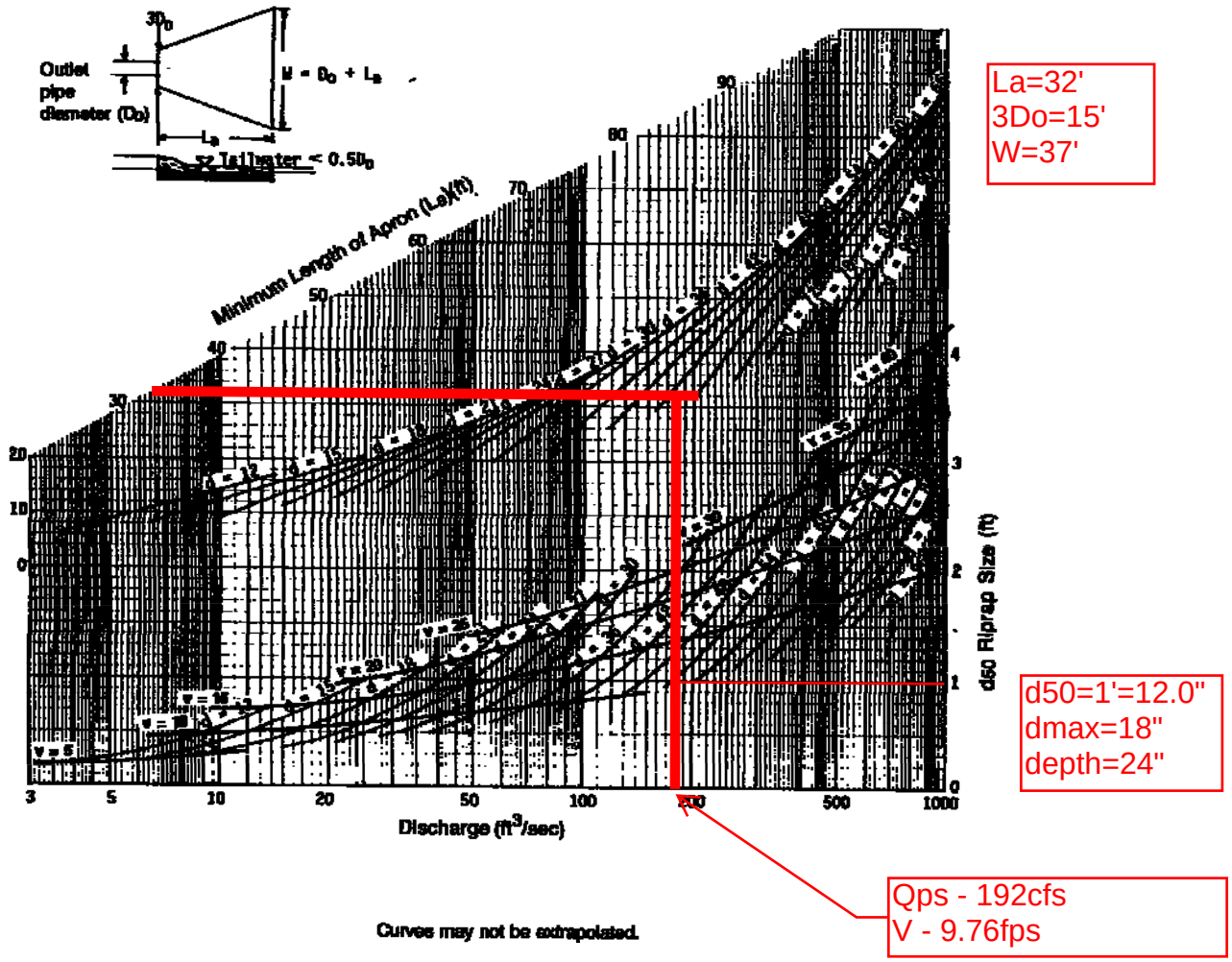


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #3

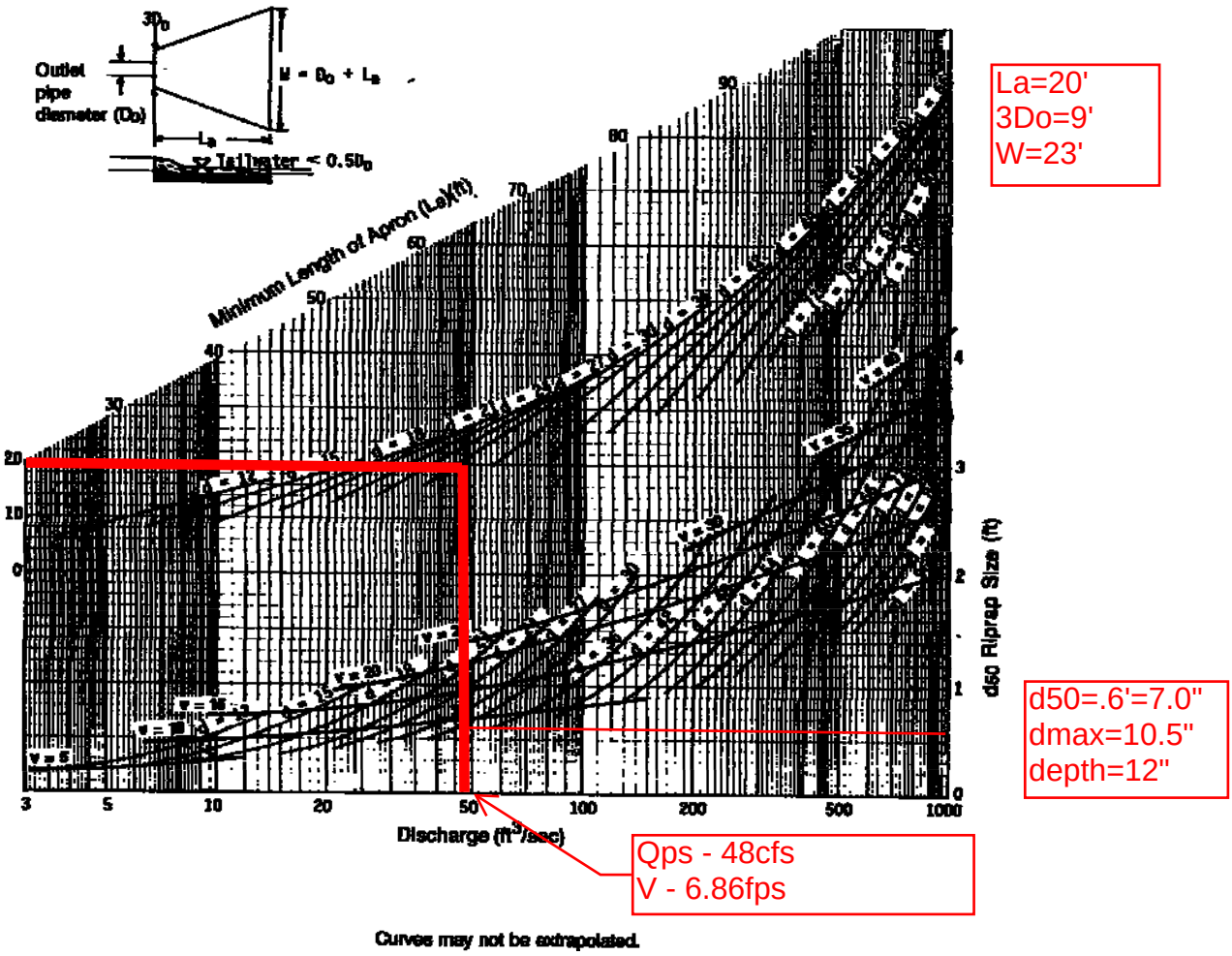


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #4 (Phase 2 Controls)

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=22', W=26', Outlet end=17.5'

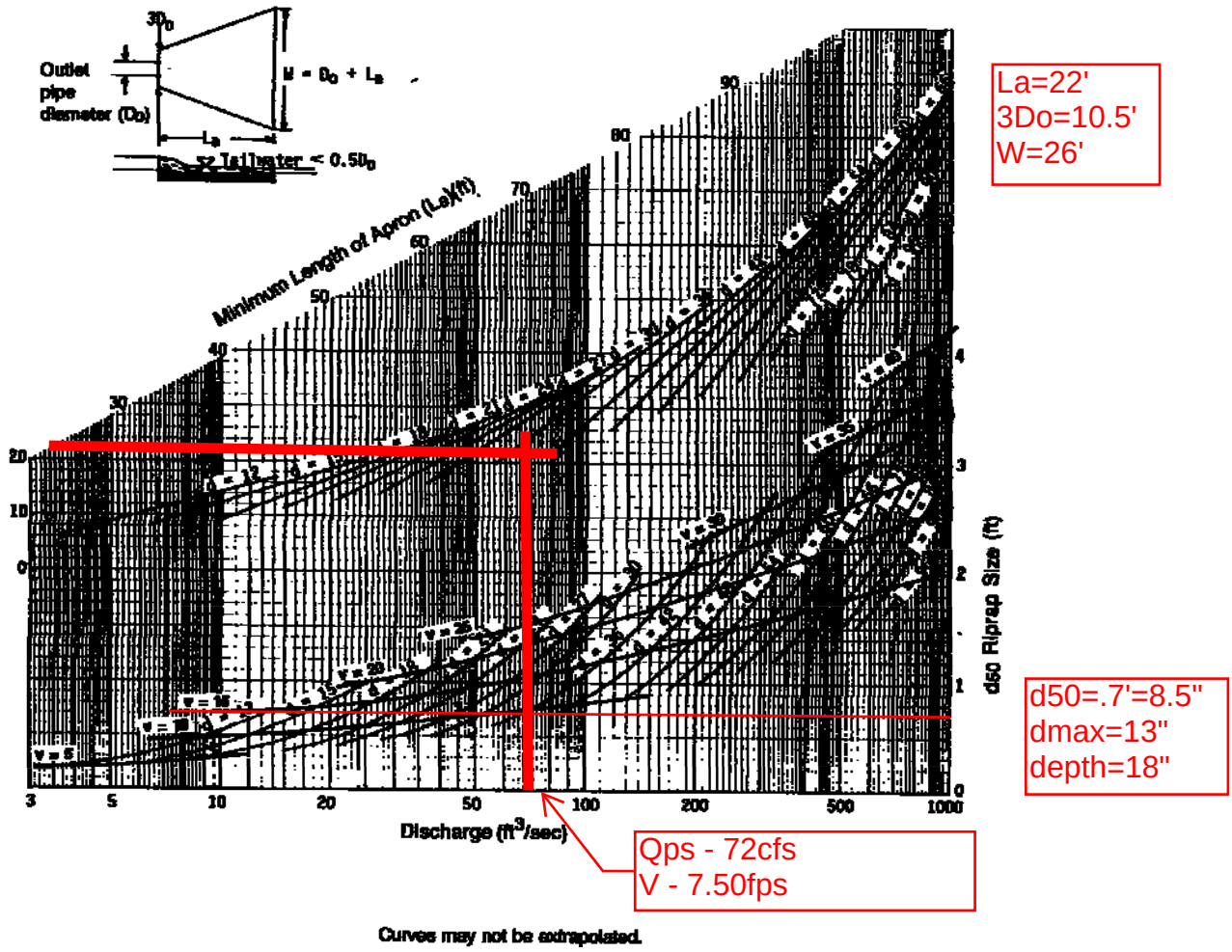


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #5 (Only exists in Phase 1)

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=22', W=26', Outlet end=17.5'

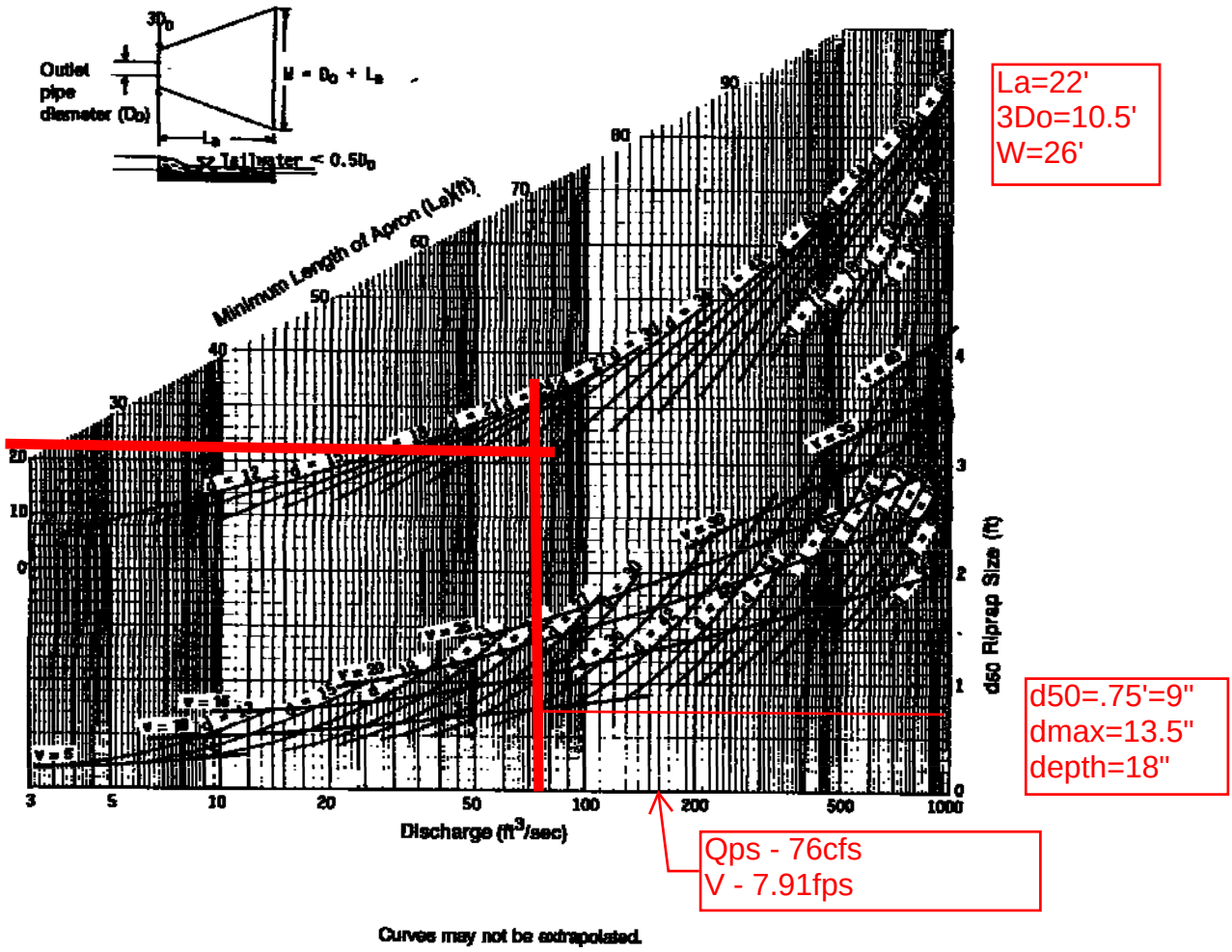
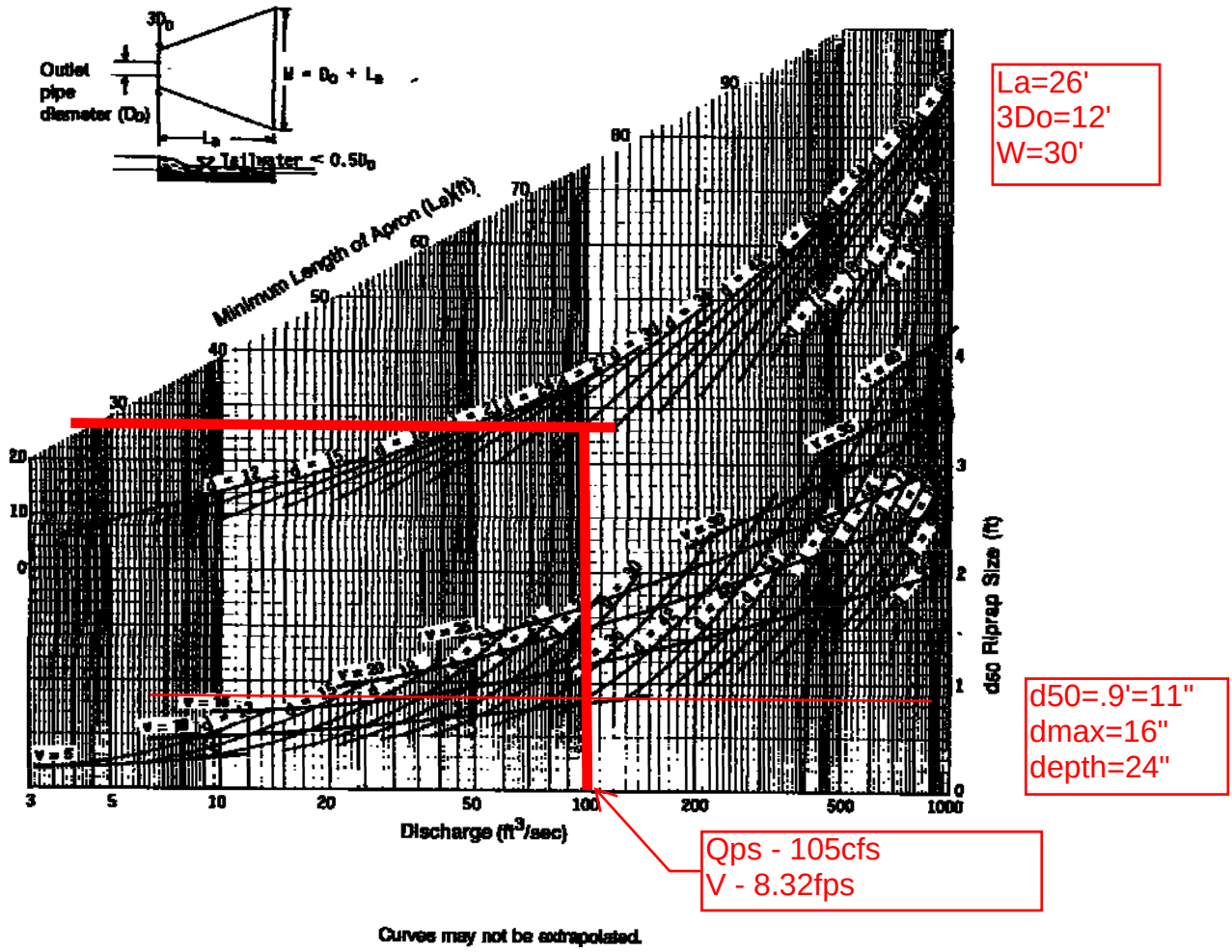


Figure 4.5-2 Design of Riprap Apron under Minimum Tailwater Conditions
(Source: USDA, SCS, 1975)

BASIN #6 (Phase 2 Controls)

NOTE: CALC IS FOR EACH OF TWO OUTLETS.
TOTAL DIMENSIONS ARE:
La=22', W=26', Outlet end=20'



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3Do=12'
W=30'

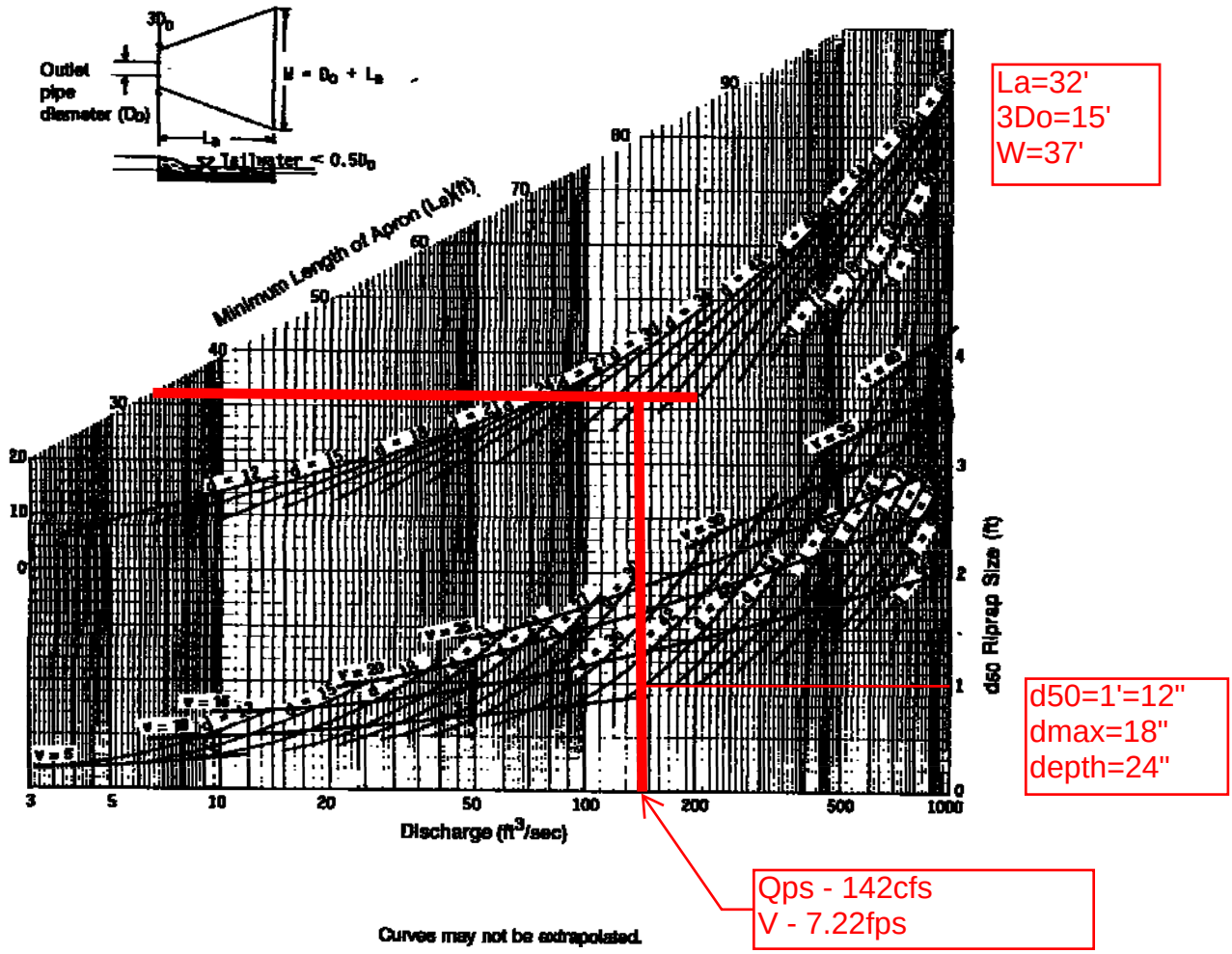
d50=.9'=11"
dmax=16"
depth=24"

Qps - 105cfs
V - 8.32fps

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

BASIN #7 (Phase 1 Controls)

NOTE: CALC IS FOR EACH OF FOUR OUTLETS. THERE ARE TWO DISCHARGE POINTS WITH TWO OUTLETS EACH. TOTAL DIMENSIONS ARE FOR EACH DISCHARGE POINT:
La=32', W=37', Outlet end=25'



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3Do=15'
W=37'

d50=1'=12"
dmax=18"
depth=24"

Qps - 142cfs
V - 7.22fps

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 Chatham County, North Carolina

Moncure

November 1, 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.

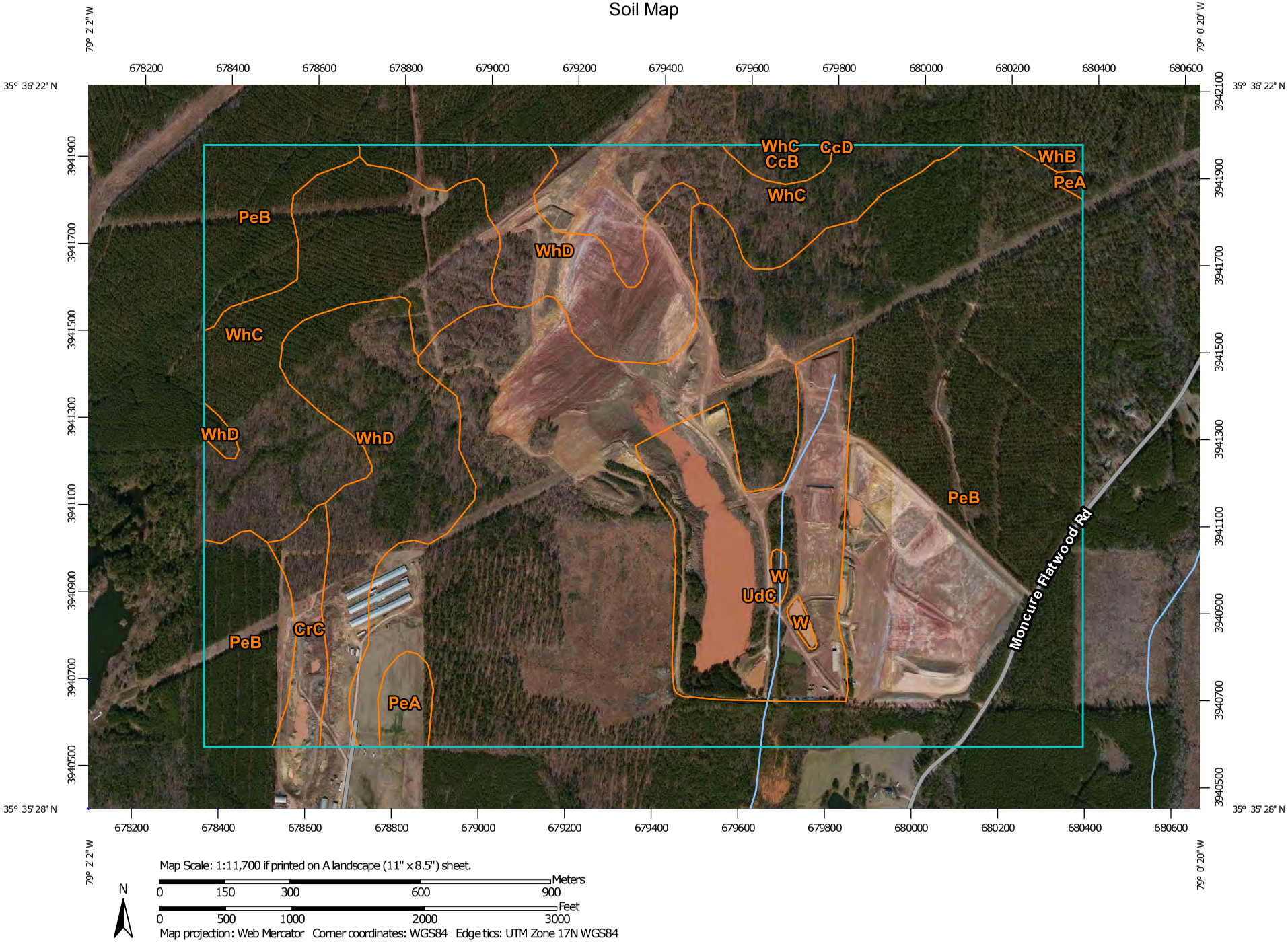
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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 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: Chatham County, North Carolina
Survey Area Data: Version 17, Sep 9, 2014

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

Date(s) aerial images were photographed: Jul 20, 2010—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

Chatham County, North Carolina (NC037)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CcB	Carbonton-Brickhaven complex, 2 to 6 percent slopes	4.0	0.6%
CcD	Carbonton-Brickhaven complex, 10 to 15 percent slopes	0.2	0.0%
CrC	Creedmoor-Green Level complex, 6 to 10 percent slopes	11.5	1.7%
PeA	Peawick fine sandy loam, 0 to 2 percent slopes	6.6	0.9%
PeB	Peawick fine sandy loam, 2 to 8 percent slopes	408.8	58.7%
UdC	Udorthents, loamy, 2 to 10 percent slopes	64.0	9.2%
W	Water	2.0	0.3%
WhB	White Store-Polkton complex, 2 to 6 percent slopes	1.7	0.2%
WhC	White Store-Polkton complex, 6 to 10 percent slopes	107.1	15.4%
WhD	White Store-Polkton complex, 10 to 15 percent slopes	90.4	13.0%
Totals for Area of Interest		**696.3**	**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.

Chatham County, North Carolina

CcB—Carbonton-Brickhaven complex, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lvsh
Elevation: 200 to 300 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

Carbonton and similar soils: 50 percent
Brickhaven and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carbonton

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 8 inches: silt loam
BE - 8 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
BCt - 28 to 34 inches: silty clay loam
Cr - 34 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D

Description of Brickhaven

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 4 inches: silt loam
E - 4 to 7 inches: silt loam
Bt1 - 7 to 12 inches: silty clay loam
Bt2 - 12 to 37 inches: silty clay
BCt - 37 to 51 inches: silty clay loam
Cr - 51 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D

CcD—Carbonton-Brickhaven complex, 10 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1lvsf
Elevation: 200 to 300 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

Carbonton and similar soils: 45 percent
Brickhaven and similar soils: 40 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carbonton

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

A - 0 to 8 inches: silt loam
BE - 8 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
BCt - 28 to 34 inches: silty clay loam
Cr - 34 to 80 inches: weathered bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D

Description of Brickhaven

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

A - 0 to 4 inches: silt loam
E - 4 to 7 inches: silt loam
Bt1 - 7 to 12 inches: silty clay loam
Bt2 - 12 to 37 inches: silty clay
BCt - 37 to 51 inches: silty clay loam
Cr - 51 to 80 inches: weathered bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D

CrC—Creedmoor-Green Level complex, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: 1lvtj
Elevation: 150 to 550 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: 65 percent
Green level and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Creedmoor

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 5 inches: sandy loam
E - 5 to 10 inches: sandy loam
Bt1 - 10 to 15 inches: sandy clay loam
Bt2 - 15 to 45 inches: clay
C - 45 to 80 inches: sandy clay loam

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
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 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D

Description of Green Level

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 7 inches: sandy loam
E - 7 to 10 inches: sandy loam
BE - 10 to 13 inches: sandy loam
Btss - 13 to 51 inches: clay
BCg - 51 to 65 inches: clay loam
CB - 65 to 80 inches: sandy loam

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly 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: About 12 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D

PeA—Peawick fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 1lvyg
Elevation: 150 to 440 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

Peawick and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peawick

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old clayey alluvium

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 10 inches: loam
Bt1 - 10 to 64 inches: clay
Bt2 - 64 to 80 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
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 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: D

PeB—Peawick fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 1lvyl
Elevation: 150 to 440 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

Peawick and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peawick

Setting

Landform: Stream terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Old clayey alluvium

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 10 inches: loam
Bt1 - 10 to 64 inches: clay
Bt2 - 64 to 80 inches: clay loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
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 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D

UdC—Udorthents, loamy, 2 to 10 percent slopes

Map Unit Setting

National map unit symbol: 1lvzw
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

WhB—White Store-Polkton complex, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 1lw1d
Elevation: 190 to 370 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

White store and similar soils: 55 percent
Polkton and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of White Store

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 8 inches: loam
Btss - 8 to 33 inches: clay
BC - 33 to 37 inches: clay loam
C - 37 to 42 inches: sandy loam
Cr - 42 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Moderately 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: About 12 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D

Description of Polkton

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 4 inches: silt loam
E - 4 to 8 inches: silt loam
BE - 8 to 15 inches: sandy clay loam
Btss - 15 to 27 inches: clay
BC - 27 to 30 inches: silty clay loam
C - 30 to 33 inches: silt loam
Cr - 33 to 80 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Medium
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 30 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D

WhC—White Store-Polkton complex, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: 1lw1g
Elevation: 190 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

White store and similar soils: 50 percent
Polkton and similar soils: 35 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of White Store

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 8 inches: loam
Btss - 8 to 33 inches: clay
BC - 33 to 37 inches: clay loam
C - 37 to 42 inches: sandy loam
Cr - 42 to 80 inches: weathered bedrock

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Moderately 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: About 12 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: D

Description of Polkton

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 4 inches: silt loam
E - 4 to 8 inches: silt loam
BE - 8 to 15 inches: sandy clay loam
Btss - 15 to 27 inches: clay
BC - 27 to 30 inches: silty clay loam
C - 30 to 33 inches: silt loam
Cr - 33 to 80 inches: weathered bedrock

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: 20 to 40 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 30 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D

Minor Components

Wehadkee, undrained

Percent of map unit: 1 percent
Landform: Depressions on flood plains
Down-slope shape: Concave
Across-slope shape: Linear

WhD—White Store-Polkton complex, 10 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1lw1b
Elevation: 190 to 370 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

White store and similar soils: 60 percent
Polkton and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of White Store

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 8 inches: loam
Btss - 8 to 33 inches: clay
BC - 33 to 37 inches: clay loam
C - 37 to 42 inches: sandy loam
Cr - 42 to 80 inches: weathered bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Moderately 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: About 12 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: D

Description of Polkton

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone and/or shale and siltstone and/or sandstone

Typical profile

Ap - 0 to 4 inches: silt loam
E - 4 to 8 inches: silt loam
BE - 8 to 15 inches: sandy clay loam
Btss - 15 to 27 inches: clay
BC - 27 to 30 inches: silty clay loam
C - 30 to 33 inches: silt loam
Cr - 33 to 80 inches: weathered bedrock

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: 20 to 40 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 30 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D

References

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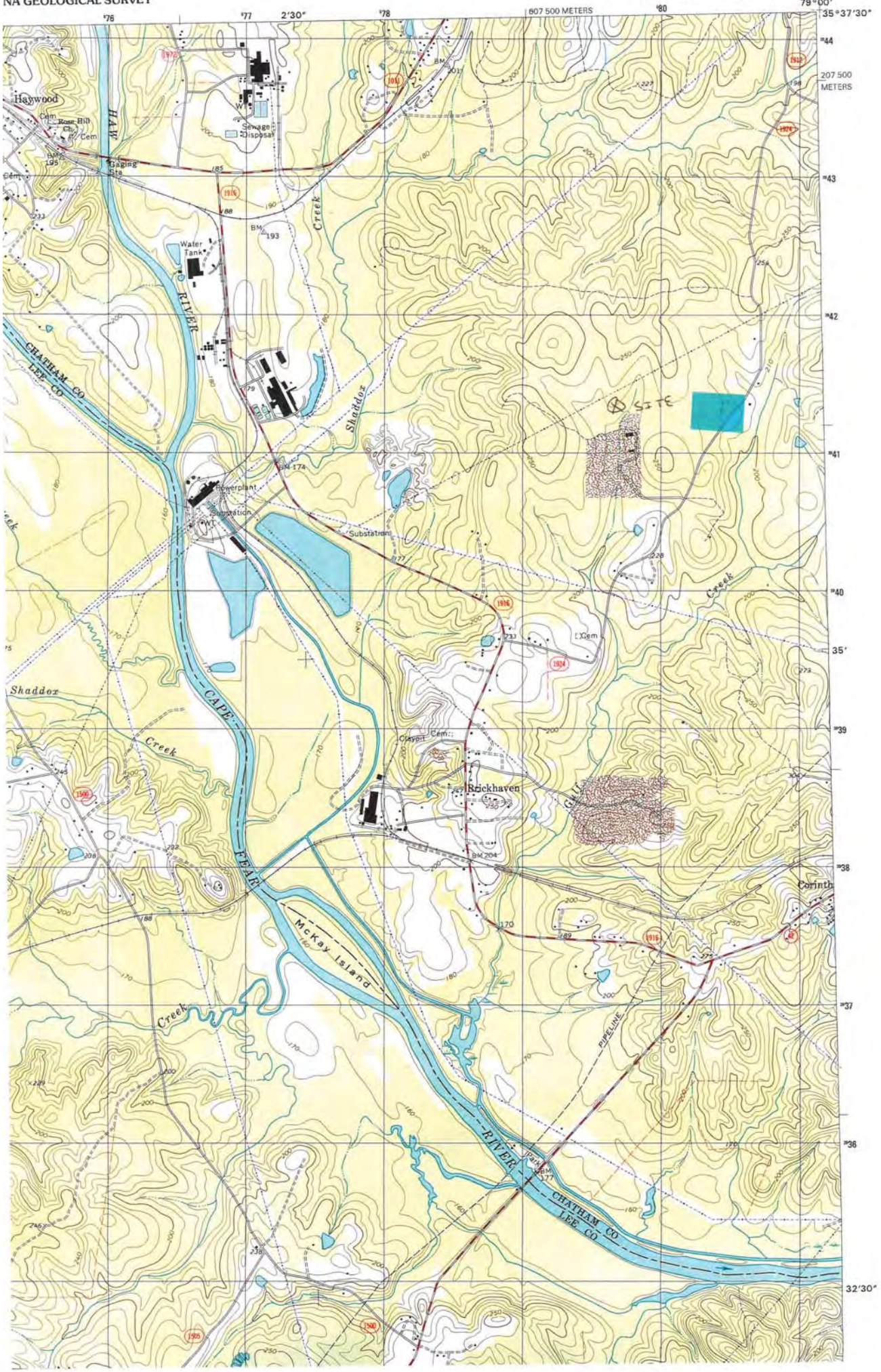
NORTH CAROLINA
NMENT AND NATURAL RESOURCES
OF LAND RESOURCES
NA GEOLOGICAL SURVEY

MONCURE QUADRANGLE
NORTH CAROLINA
7.5-MINUTE SERIES (TOPOGRAPHIC)



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Related Documents

Brickhaven No.2 Mine Tract “A”

Charah, Inc.

Moncure, NC

November 2014

NCDENR Permit Mod, October 2014
Wetlands Determination, August 2014
Threatened/Endangered Study, August 2014
Archeological Study, August 2014
Brickhaven Mine Drawings, January 2008
NCDENR Permit Mod, October 2007
NCDENR Permit Mod Review, July 2007

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North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

October 20, 2014

Mr. Gregory A. Bowles
General Shale Brick, Inc.
300 Brick Plant Road
Moncure, NC 27559

RE: Permit No. 19-25
Brickhaven No. 2 Mine Tract "A"
Chatham 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 establish the permitted acreage as 301 acres and the affected acreage at this site as 270.16 acres as indicated on the Tract "A" Overall Site Topography Map dated September 3, 2014. Mining Permit No. 19-08 has been split into two separate mining permits, Brickhaven No.2 Mine Tract "A" (mining permit No. 19-25) and Brickhaven No. 2 Mine Tract "B" (Mining Permit No. 19-08). A copy of the modified permit is enclosed.

The conditions in the modified permit were based primarily upon the initial application. Modifications were made as indicated by the modification request and as required to insure compliance with The Mining Act of 1971. The expiration date and permit number shall remain the same as before the modification. I would like to draw your particular attention to the following conditions where minor additions or changes were made: Operating Condition Nos.4G and 5.

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 301 acres and the amount of land you are approved to disturb is 270.16 acres.

Please note that Mining Permit No. 19-25 expires September 15, 2015. In order to continue mining operations at this site after September 15, 2015, a renewal request must be submitted prior to said date.

Please review the modified permit and contact Ms. Judy Wehner, Assistant Mining Specialist, at (919) 707-9220 should you have any questions concerning this matter.

Sincerely,

Janet S. Boyer, PE
State Mining Specialist
Land Quality Section

JSB/jw

Enclosures

cc: Mr. John Holley, PE
Mr. William Gerringer-Mine and Quarry Bureau, w/o enclosures

DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF ENERGY, MINERAL AND LAND RESOURCES

LAND QUALITY SECTION

P E R M I T

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.

Brickhaven No. 2 Mine Tract "A"

Chatham County - Permit No. 19-25

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: September 15, 2015

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DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF ENERGY, MINERAL AND LAND RESOURCES

LAND QUALITY SECTION

P E R M I T

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.

Brickhaven No. 2 Mine Tract "B"

Chatham County - Permit No. 19-08

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: September 15, 2015

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, lease, assignment or otherwise, the Department may release the permittee from the duties 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 a 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

Wherever 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

October 5, 1995: This permit has been modified to increase the affected acreage from 17 acres to 83.5 acres, approve the pit expansion and the upgrading of the associated sediment and erosion control measures as per the Mine Site Map dated August 27, 1995, and allow modification to the spray irrigation system as approved by the Division of Water Quality.

August 2, 1996: This permit has been modified to change the corporate name from Cherokee Sanford Group, Inc. to Cherokee Sanford Group, LLC.

September 24, 1998: This permit has been modified to allow the temporary use (two year approval) of Photafloc polymer for enhanced sediment control experimentation purposes, with stipulations as outlined in the approval letter.

November 4, 1999: This permit has been modified to increase the affected acreage at the site to 337 acres as indicated on the mine map dated September 9, 1999. This modification also includes the revised erosion and sediment control plan dated September 22, 1999 and allows the use of Calgon Catr-Floc DL for flocculation of fine particles in the basins onsite.

April 6, 2005: This permit has been modified to change the corporate name from Cherokee Sanford Group, LLC to General Shale Brick, Inc.

October 10, 2007: This permit has been modified to increase the permitted acreage to 648.65 acres and the affected acreage at this site to 590.89 acres as indicated on the Mine Details Map last revised April 23, 2007. The modification includes the addition of several tracts to the east and south of the existing permit boundaries. In addition, the modification includes expansion of the mine excavation area into said tracts and installation and includes the maintenance of all associated erosion and sediment control measures.

October 20, 2014: This permit has been modified to establish the permitted acreage as 301 acres and the affected acreage at this site as 270.16 acres as indicated on the Tract "A" Overall Site Topography Map dated September 3, 2014. Mining Permit No. 19-08 has been split into two separate mining permits, Brickhaven No.2 Mine Tract "A" (mining permit No. 19-25) and Brickhaven No. 2 Mine Tract "B" (Mining Permit No. 19-08).

Expiration Date

This permit shall be effective from the date of its issuance until September 15, 2015.

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 Protection Agency and enforced by the N.C. Environmental Management Commission. It shall be the permittee's responsibility to contact the Stormwater Program to secure any necessary stormwater permits or other approval documents.

C. Wastewater processing and mine dewatering shall be conducted in accordance with Permit No. WQ 0007589 issued and enforced by the Division of Water Quality.

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 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, waters 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.

4. A. Adequate mechanical barriers including but not limited to diversions, earthen dikes, check dams, sediment 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. All drainage from the affected area around the mine excavations shall be diverted internal to said excavation or into the sediment basins as indicated on the Mine Details map last revised April 23, 2007.

C. Mining activities, including the installation and maintenance of sediment and erosion control measures, shall be conducted as indicated on the Mine Details map and the Erosion Control Details plan last revised April 23, 2007.

D. All sediment and erosion control measures shall be dipped out when they become half full with sediment.

E. Mining activities associated with the expansion of the mine excavation areas to the east and south shall be conducted as indicated on the Mine Details Map, Reclamation Plan and Erosion Control Detail Sheet last revised April 23, 2007 and the supplemental information received by the Land Quality Section on April 27, 2007, and September 18, 2007.

F. Access to Progress Energy facilities must be maintained at all times along the transmission line rights of way.

G. Mining activities, including the installation and maintenance of all erosion and sediment control measures, shall occur as indicated on the Tract "A" Overall Site topography Map dated September 3, 2014 and the supplemental information received by the Land Quality on September 9, 2014.

5. All affected area boundaries (270.16 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 that 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. A. Sufficient buffer (minimum of 25 foot undisturbed) shall be maintained between any excavation and any mining permit boundary to protect adjacent property.

B. A minimum 40 foot undisturbed buffer (with adjacent excavation side slopes maintained at a minimum of three (3) horizontal to one (1) vertical) shall be maintained around all power line structures.

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 as 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 Energy, Mineral and 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 permit boundary, the following information must be provided to and approved by the Division of Energy, Mineral and 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.

E. Stockpiling of only petroleum-contaminated soil shall be conducted in accordance with Permit Nos. WQ0003219, WQ0007589 and SR0500046, issued by the North Carolina Environmental Management Commission and any revisions approved or new permits issued by the Division of Water Quality.

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 or any approved revision 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 are 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 regrade and revegetate any disturbed areas other than the mine excavations, which shall be restored to lake areas.

2. The specifications for surface gradient restoration to a surface suitable for the 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 to the water line and 2 horizontal to 1 vertical or flatter below the water line.

C. All the final perimeter side slopes shall be graded to a 3 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. Any areas used for wastepiles, screening, stockpiling or other processing shall be leveled and smoothed.

H. No contaminants shall be permanently disposed of at the mine site. On-site disposal of waste shall be in accordance with Operating Condition Nos. 11A through 11E.

I. The affected land shall be graded to prevent the collection of noxious or foul water.

3. Revegetation Plan:

After site preparation, all disturbed land areas shall be revegetated as per the Revegetation Plan submitted by Mr. T. Patrick Shillington, PE, of Engineering & Environmental Science Company, dated August 1, 2005.

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. 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 Cherokee Brick Company on August 30, 1985, transferred to Cherokee Sanford Group on November 4, 1988, simultaneously renewed and modified October 5, 1995, modified August 2, 1996 September 24, 1998, November 4, 1999, and April 6, 2005, renewed September 15, 2005 and modified October 10, 2007, is hereby modified this 20th day of October, 2014 pursuant to G.S. 74-52.

By: _____

Tracy E. Davis, Director
Division of Energy, Mineral and Land Resources
By Authority of the Secretary
Of the Department of Environment and Natural Resources

ClearWater Environmental Consultants, Inc.
www.cwenv.com

August 29, 2014

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

RE: Jurisdictional Determination
Brickhaven Mine (+/- 311 AC)
Chatham 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 Brickhaven Mine in Chatham County, North Carolina. The subject property totals approximately 311 acres and is accessed from Moncure Flatwood Road. A site vicinity map and USGS topographic map have been attached for review (Figures 1 and 2). CEC made field visits on August 18-20 and 22, 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

Streams

The Brickhaven Mine property contains perennial and intermittent streams throughout the tract (Figure 3). One stream, an unnamed tributary to Gulf Creek, is identified as a "blue-line" stream on the USGS topographic map, but was delineated as a wetland in the field (Figure 2). Other streams on site are unnamed tributaries to Shaddox Creek. Some of these tributaries are also identified on the most recent published Soil Survey of Chatham County, North Carolina (2006) (Attached soils maps Figures 4a and 4b).

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

- **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).

Open Water

The Brickhaven Mine property contains two 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 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.

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

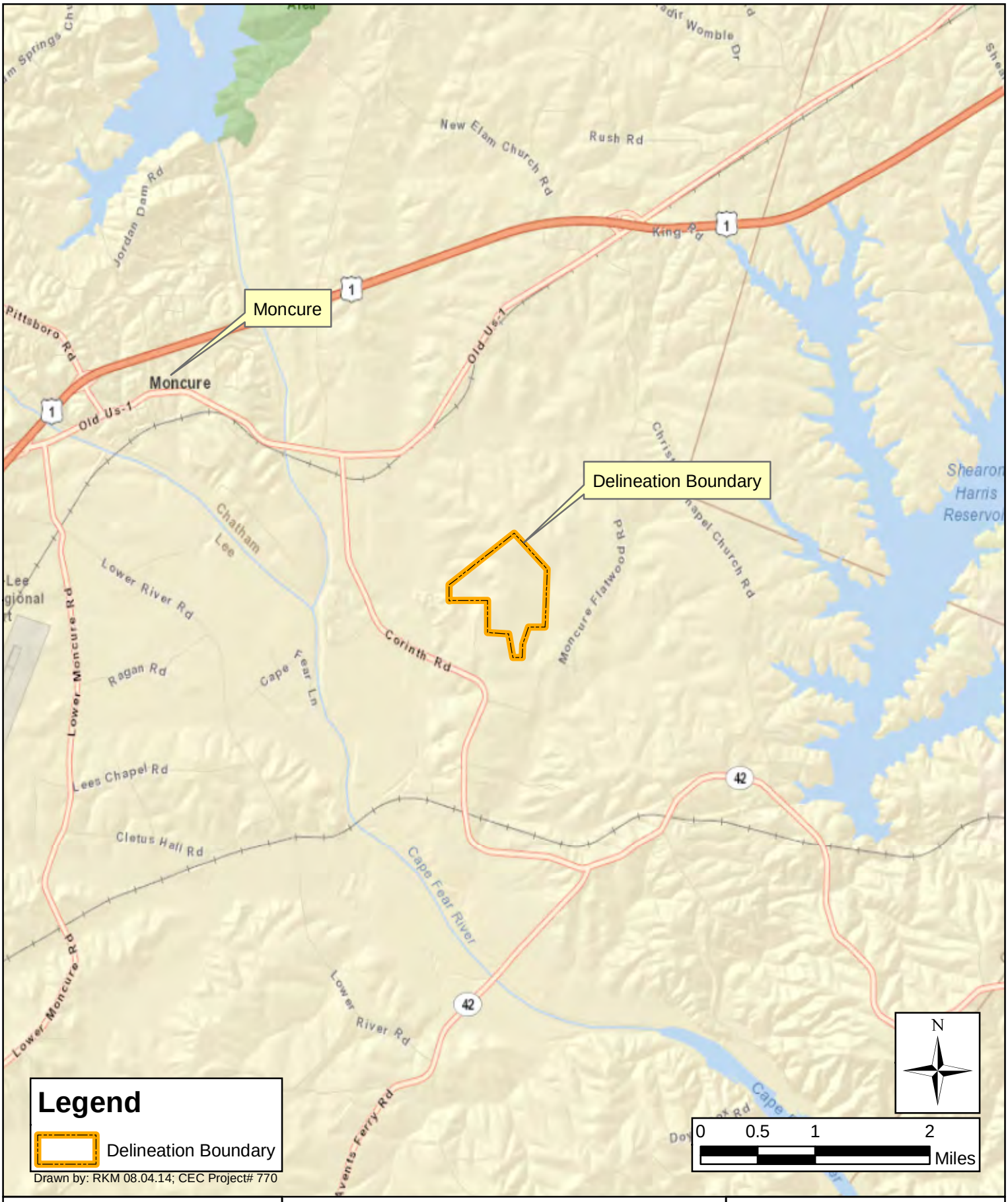
verification of the delineation if requested. The Raleigh Regulatory Field Office of the Corps of Engineers Wilmington District verifies wetland and stream delineations in central North Carolina.

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,

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

Brickhaven Mine (+/- 311 AC)



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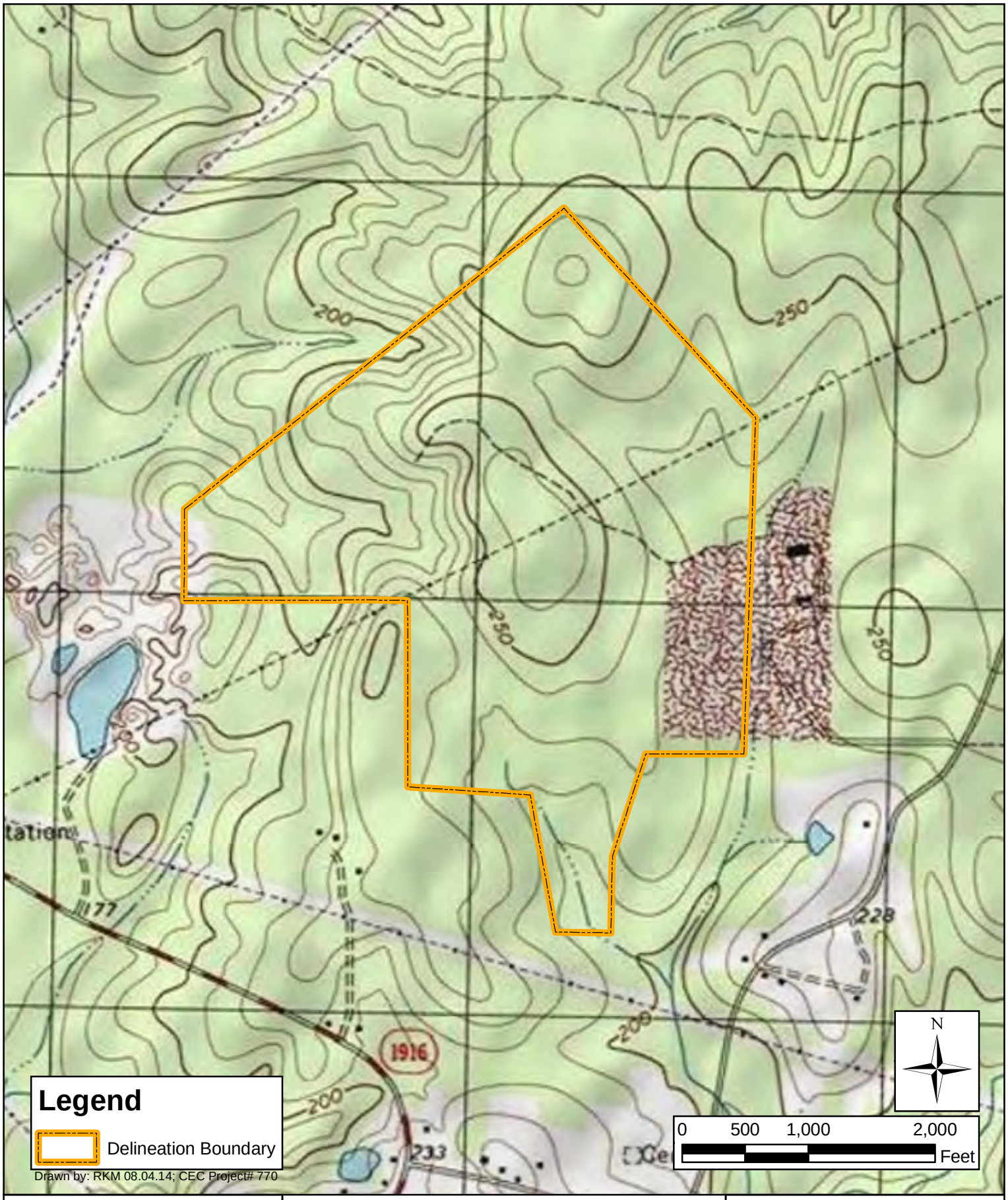
Site Vicinity
Figure 1

Brickhaven Mine (+/- 311 AC)



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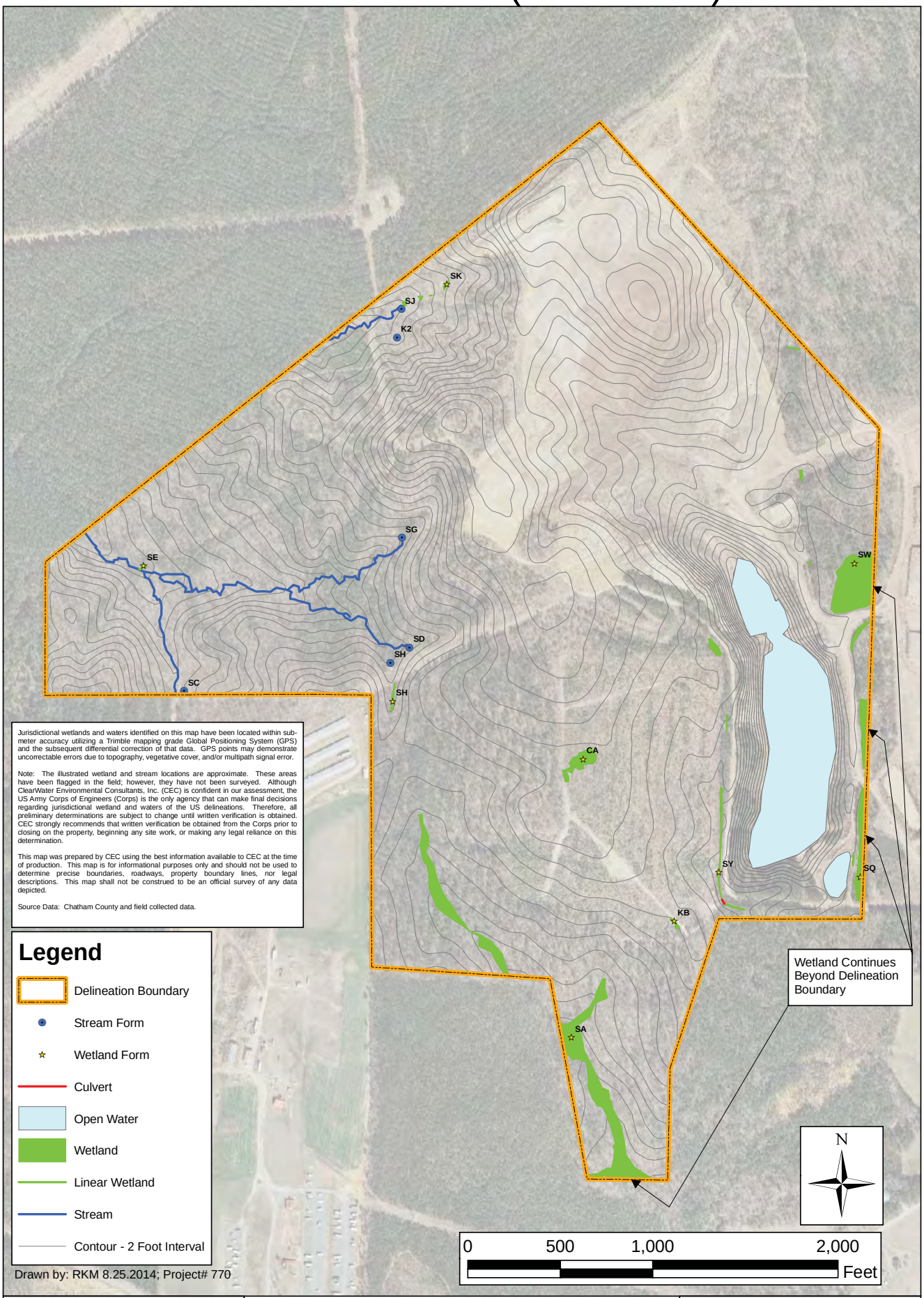
USGS Topographic Map
Moncure Quad
Figure 2

Brickhaven Mine (+/- 311 AC)



Jurisdictional wetlands and waters 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.

Note: The illustrated wetland and stream locations are approximate. These areas have been flagged in the field; however, they have not been surveyed. Although ClearWater Environmental Consultants, Inc. (CEC) is confident in our assessment, 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.

This map was prepared by CEC using the best information available to CEC at the time of production. This map is for informational purposes only and should not be used to determine precise boundaries, roadways, property boundary lines, nor legal descriptions. This map shall not be construed to be an official survey of any data depicted.

Source Data: Chatham County and field collected data.

Legend

- Delineation Boundary
- Stream Form
- Wetland Form
- Culvert
- Open Water
- Wetland
- Linear Wetland
- Stream
- Contour - 2 Foot Interval

Drawn by: RKM 8.25.2014; Project# 770

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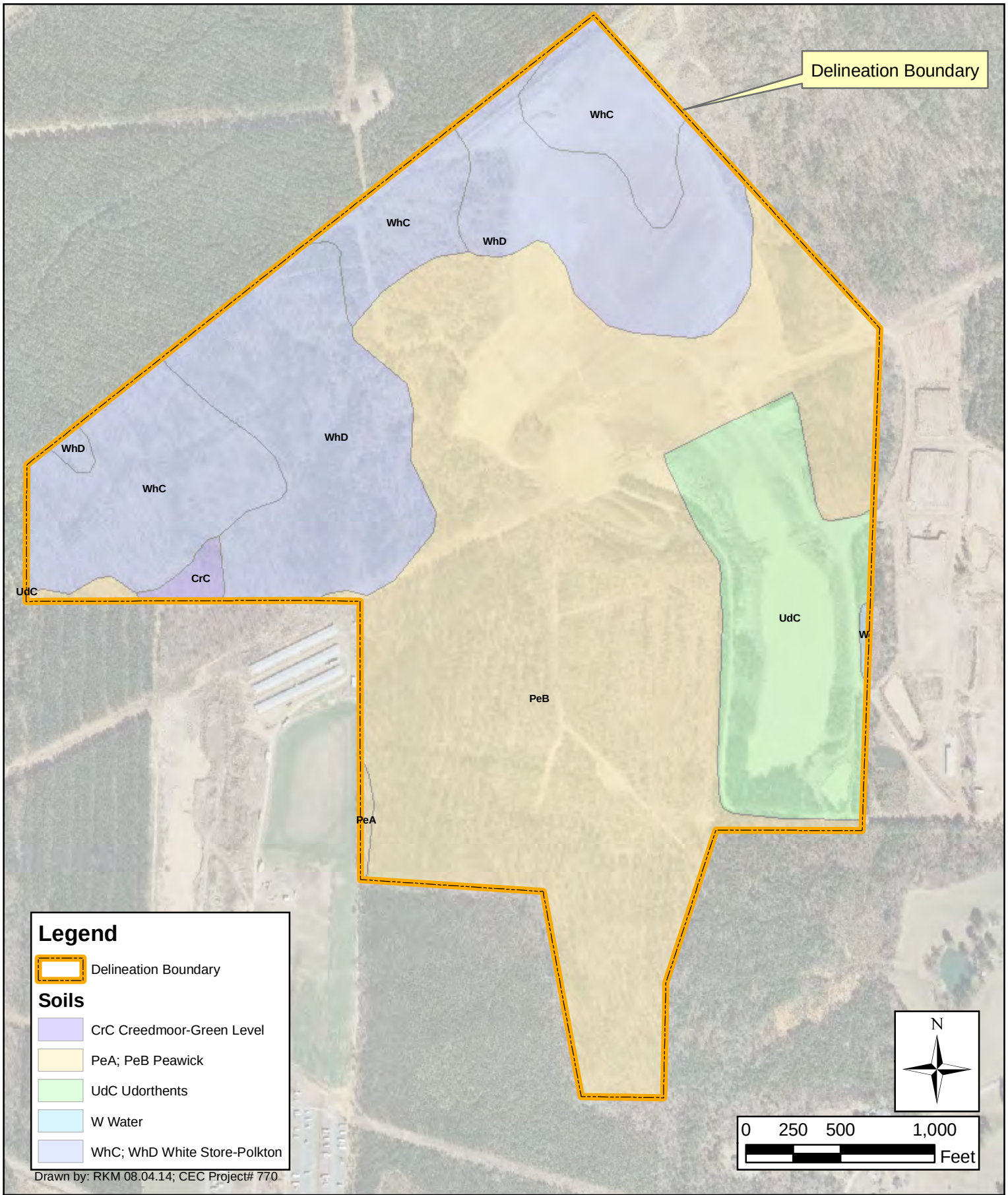
Stream and Wetland Delineation Map
Delineated August 18, 19, 20, & 22, 2014
Figure 3

Brickhaven Mine (+/- 311 AC)



Drawn by: RKM 08.04.14; CEC Project# 770

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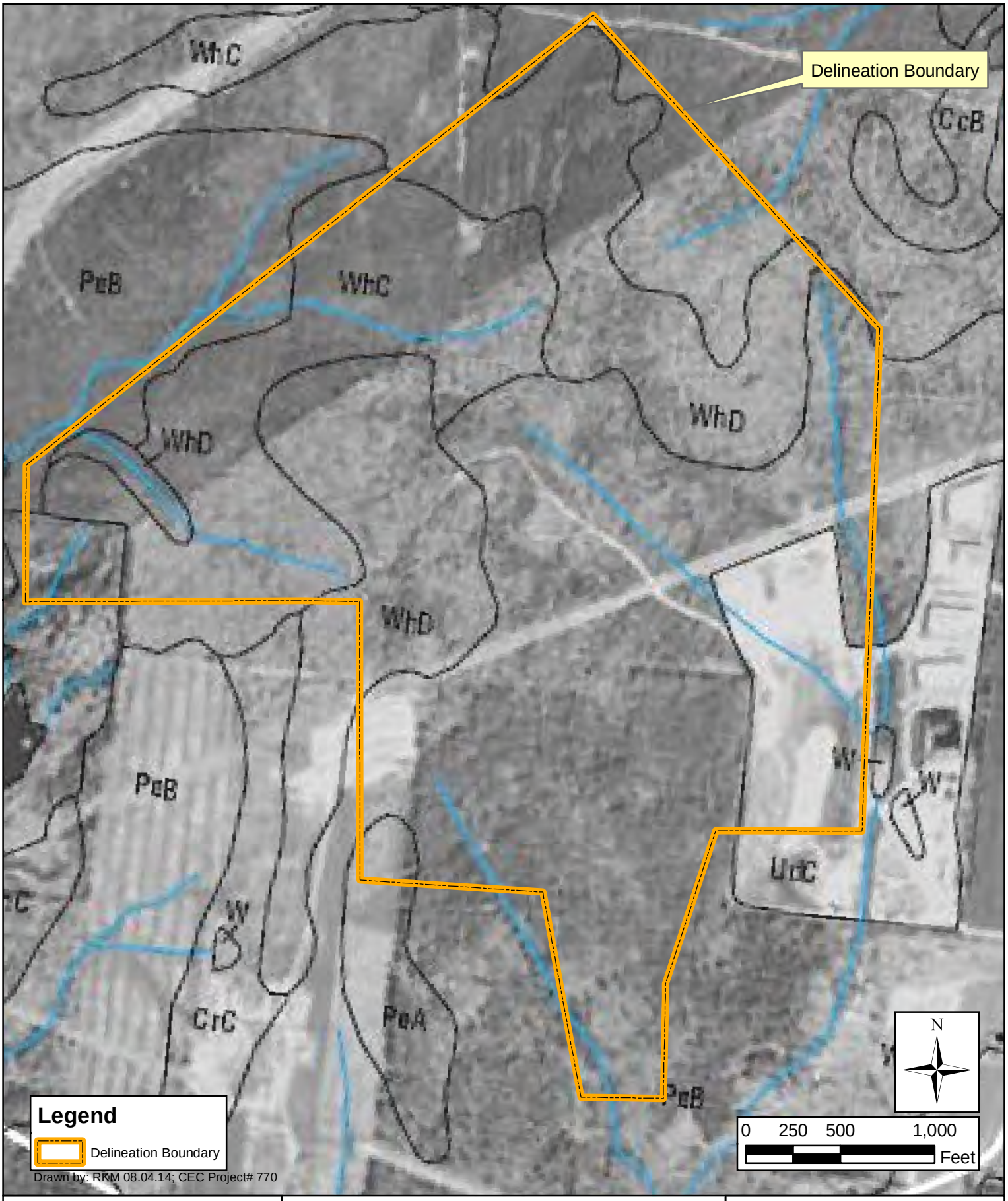
USDA Soils Map
Figure 4a

Brickhaven Mine (+/- 311 AC)



Chatham County, North Carolina	ClearWater 224 South Grove Street, Suite F Hendersonville, North Carolina 28792	USDA Soils Map Chatham County Soils Survey (2006) Figure 4b