Summary of Revised and Supplemental Materials

Colon Mine Site

HDR Response to Comments, December 31, 2014

Section / Item	Action Needed	Comments
Binder		
Cover	replace	added revision date
Spine	replace	added revision date
Correspondence		
Coversheet	replace	updated for current content
HDR Response letter 12/31/14	add	
Permit Transfer Acceptance, 12/22/14	add	as requested by DEMLR Review Comment 1
Colon Site Debris Cleanup, 12/22/14	add	as requested by DEMLR Review Comment 5
NCDENR comment letter, 12/19/14	add	
Permit Modification Request Transmittal Letter, 11/14/14	relocate	provided with original submittal; move from front of binder to Correspondence section
Permit Transfer Request Transmittal Letter, 11/14/14	relocate	provided with original submittal; move from front of binder to Correspondence section
Calculations		
A – Stability	Replace entire section	updated headers, no change to calculation data
B - Stormwater		updated headers throughout Subcell Divider Berms revised due to supplemental hydrogeological data Sediment Basins revised per Erosion & Sediment Control Review Comment 1
C - Reclamation Timeline		new as requested by DEMLR Review Comment 2
Related Documents		
Coversheet	replace	updated for current content
NDPES Certificate of Coverage	add in date sequence as indicated on coversheet	as requested by DWR Review Comment 4
Reclamation Bond		as requested by DEMLR Review Comment 7
Threatened-Endangered Report		supplemental material
Mgmt Summary-Archeological Study		supplemental material
Drawings		
Complete set, half and full size	Replace entire section	revised per Erosion & Sediment Control Review Comments
CD		
PDF copy of all materials listed above.		

Mine Permit Transfer/Modification

Colon Mine Site

Charah, Inc.

Sanford, North Carolina

November 2014
Revised December 2014

Correspondence

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014
Revised December 2014

HDR Response to Comments, Dec 31, 2014
Permit Transfer Acceptance, Dec 22, 2014
Colon Mine Debris Cleanup, Dec 22, 2014
NCDENR Comment Letter, Dec 19, 2014
Permit Modification Request Transmittal Letter,
  Nov 14, 2014
Permit Transfer Request Transmittal Letter,
  Nov 14, 2014

December 31, 2014

Ms. Judith A Wehner
Land Quality Section
Division of Energy, Mineral, and land Resources
Department of Environment and Natural Resources
1612 Mail Service Center
Raleigh NC 27699-1612

Re: Colon Mine Site
Mining Permit No. 53-05

Dear Ms. Wehner,

On behalf of Green Meadow, LLC and Charah, Inc., HDR provides the following response to NCDENR's comments regarding the Mine Permit Transfer/Modification request for Colon Mine Site, Mining Permit No. 53-05.

Six complete sets of revised or supplement material for the permit application have been provided with this response to comments. Please insert the revised or supplemental material into the applicable sections of the permit application binder previously provided to you. Please discard any pages that are being replaced. A detailed summary of the specific revised and supplemental materials is included for your reference. In addition, one CD containing pdf files of the revised and supplemental material is provided for your use.

As a reminder, the application includes a Correspondence section which is intended to be used to track communication received from DENR or provided to DENR on behalf of the applicant while the application is under review. To that end, HDR has included copies of the Division of Energy, Mineral, and Land Resources (DEMLR) December 19, 2014 review letter as well as this response letter in that section of the application. Future correspondence will be handled similarly.

Comments from DEMLR are listed below as provided in your letter of December 19, 2014. HDR's responses follow in *italics*.

DEMLR Review Comments

1. Please request in writing that the existing permit be transferred and clearly state the new operator's name (Green Meadows LLC). In the letter please also indicate that you will accept any and all responsibilities and liabilities with respect to the Mining Act of 1971.

   The requested letter from Green Meadow LLC is included with this response.

2. Please provide time frames for the final reclamation of the Structural fill areas.

A table indicating anticipated timeframes for reclamation added to the Calculations section of the application submittal. A copy is provided with this response.

3. Please find enclosed the Division of Water Resources' Water Quality Operations comments regarding this site. Please contact Danny Smith at (919) 781-4200 to address these concerns and advise this office of any changes to your modification proposal.

   HDR's itemized response is provided below in the section entitled "Division of Water Resources Review Comments".

4. Please find enclosed comments from the NC Wildlife Resources Commission regarding this site. Please address the concerns outlined in the memorandum.

   HDR's itemized response is provided below in the section entitled "North Carolina Wildlife Resources Commission Review Comments".

5. In order to process the partial release request, please ensure that the debris from around the maintenance Storage Building has been properly disposed of.

   Written confirmation of the debris cleanup with attached site photographs was provided from Mr. Warren Paschal of General Shale to Ms. Judy Wehner on December 22, 2014. A copy is provided with this response.

6. Please find enclosed comments from our Raleigh Regional Office regarding the erosion and sediment control measures/plans. Please revise the erosion and sediment control plan to include these changes.

   HDR's itemized response is provided below in the section entitled "Erosion and Sediment Control Review Comments".

7. The reclamation bond calculation exceeds the reclamation bond cap of $500,000.00. Therefore, the reclamation bond for this site and the Brickhaven Mine #2 Tract A would be $500,000.00 and will be required prior to approval of this request.

   The reclamation bond in the amount of $500,000 is included with this response.

Division of Water Resources Review Comments

Comments provided by Danny Smith dated December 11, 2014

1. A review of an aerial, USGS map and a review of the site map that was included in the application packet depicted blue lines and crenulations that indicate stream(s) are present within and adjacent to the subject project.

Comment noted.

2. 404/401. It is recommended that the owner contact both the USACE and DWRs for a joint wetland and stream determination and to discuss permitting. Proposed impacts in application depict the following: 2,040 linear feet of stream, 0.62 ac of wetlands. If this is accurate, this will trigger an Individual permit from USACE and individual 401 Water Quality Certification from DWR.

   Comment noted. The owner's representative, ClearWater Environmental Consultants is in the process of permitting for mitigation of the impacted wetlands and streams that have been identified on the subject plans. No disturbance of these areas will occur without the issuance of the necessary permit(s).

3. Water Supply Watershed. The project is in the Cape Fear River Basin (UT to Roberts Creek a Water Supply IV waters). If "new development" occurs on this tract and a sediment and erosion control plan is required per the Sediment Act, the project may trigger local government approval per WS IV Supply Watershed Rules. [If this occurs, I recommend that you contact Julie Ventaloro (water supply watershed coordinator – DEMLR), review §130A-309.205 and 15A NCAC 02B .0216.]

   Comment noted. At this time no specific "new development" is proposed. The project represents a modification to the proposed reclamation plan for the existing mine and the sediment and erosion control plan for the proposed mine modification remains part of the overall mine permit.

4. The proposed land use/activity will need to comply with the appropriate stormwater permit (NCG010000, NCG020000m, or NCG120000.)

   NCG020000 (Certificate of Coverage NCG020854) has been transferred to Green Meadow, LLC and is in place and in effect based upon the mining operations. A copy of Certificate of Coverage NCG020854 is provided for your records.

5. Wetland and stream monitoring plan: It is recommends that mine site (owner) develop a wetland and stream monitoring plan such that they can demonstrate that the change of hydraulic gradient that results from the mining activity does not remove the hydrology from adjacent wetlands and streams. [This is to ensure: 1) the streams and wetlands do not get disturbed prior to permitting and 2) it is to ensure that adjacent mining, reclamation efforts, beneficial use preparation, or landfill efforts do not remove the hydrology prior to permitting.]

   Comment noted. The mining operations and subsequent reclamation plans have been phased in a manner to mitigate any impacts to the existing streams and wetlands that have been noted in the subject plans for impact. The Individual 401/404 Permits are in process and are *anticipated to be in place by late August 2015 at which time, the identified stream and wetland impacts could occur. An operational requirement is being placed on the mining plan (structural fill plan) that requires these permits be issued and in effect prior to any disturbance to the wetlands and streams, or the areas that contribute runoff that support the streams and wetlands, and therefore is planned in the overall mine operation.*

6. Any ash/mine pit discharges (beneficial fill or not) will need to be covered by an appropriate NDPES wastewater discharge permit if it discharges ash/comingled ash and stormwater. (The site is not permitted to discharge coal combustion products – coal ash and/or leachate collection system is not authorized to discharge to water or violate 2L groundwater standards.)

   Comment noted. Neither ash nor leachate discharge is planned for this project. As indicated in Section C.3. of the Mine Permit Application, contact water from the coal combustion product structural fill will be collected and conveyed to a local wastewater treatment facility. See also, response to Item 7 below.

7. Wastewater Pump and Haul System – Leachate will need to be addressed through 15A NCAC 02T .0203 (2). Please see attached industrial pump and haul application.

   At this time the applicant, Green Meadow, LLC, is working to secure necessary permit(s) for conveyance of contact water (i.e., leachate) to a local wastewater treatment facility via gravity or force main sewer system. Alternatively, a pump and haul permit may be utilized in the event the direct connection to a sewer system is not feasible or is not timely. In either event, a proper leachate discharge permit will be obtained prior to placement of ash.

North Carolina Wildlife Resources Commission Review Comments
Comments provided by David R. Cox, dated December 16, 2014

1. Maintain a minimum 100-foot and 50-foot undisturbed native, forested buffer along perennial streams and intermittent streams respectively. Maintaining undisturbed, forested buffers along these areas will reduce impacts to aquatic and terrestrial wildlife resources, water quality, and aquatic habitat both within and downstream of the site. We request that sediment and erosion control structure be located outside of these buffers.

   Comment noted. For areas impacted by the proposed facility design, permits will be obtained prior to disturbance. All other areas will adhere to buffer requirements in GS 130-309.216. No sediment and erosion control structures will be located within these buffers. See also response to Division of Water Resources Review Comments 2 and 5.

2. Calgon Cat-Floc DL has been used previously. Cationic polyelectrolytes are toxic to fish; therefore, measures should be used to prevent spills or direct discharge of Calgon Cat-Floc DL into any natural watercourses.

Comment noted. The flocculent noted is part of the approved permitted operation of the existing mine. Green Meadow, LLC will strive to implement measures to prevent spills or direct discharge of the material and will seek to minimize its use or identify alternative flocculants if feasible.

3. Water quality monitoring should be performed in Roberts Creek, downstream of the site. In addition to monitoring for the constituents in Appendix I (i.e., Appendix I to 40 C.P.R. Part 258), aluminum, boron and mercury should be added since these are not included in Appendix I and have the potential to adversely impact aquatic and terrestrial wildlife resources (RTI 2000). If constituents are found in downstream surface waters, then the applicant should notify NCDENR and measures to identify the source and contain the constituents should be implemented immediately.

   Comment noted. A water quality monitoring plan is included in the Hydrogeologic Report section of the Structural Fill Permit Application submitted to the Division of Waste Management for review. The plan currently includes proposed surface water monitoring locations at a tributary to Roberts Creek. Green Meadow, LLC will monitor onsite water quality as required by current regulations governing the operation of the mine and modified mine reclamation method and as required under the Coal Ash Management Act of 2014.

4. We support post-closure care for at least 30 years. Downstream water quality monitoring for constituents (i.e., Appendix I and aluminum, boron, and mercury) should continue during post-closure; however, at a minimum, monitoring of downstream water quality should be performed if constituents (i.e., Appendix I and aluminum, boron and mercury) are found during groundwater monitoring.

   Comment noted, refer also to the response above. The post-closure care plan included in the Structural Fill Permit Application includes water quality monitoring.

5. Use dust control measures to minimize aerial deposition of coal combustion products into surface waters and terrestrial landscapes. If chemical dust suppressants are used, the product should be non-toxic to plants and animals, and should be applied to minimize environmental impact.

   Comment noted. Dust control measures are discussed in the Operations Plan included in the Structural Fill Permit Application submitted to the Division of Waste Management, and will be provided throughout the project duration as required by the Coal Ash Management Act of 2014.

6. Consider using seed mixtures that are beneficial to wildlife (e.g., native warm season grasses) in the final reclamation plan. Additionally, for relatively shallow sediment basin reclamation, we recommend these areas be reclaimed as wetlands where practicable. We refer the applicant to Jason Allen, District Wildlife Biologist at (336) 524-9801 for additional information and ideas on reclamation for wildlife.

Comment noted. Mr. Allen will be consulted at the appropriate time.

Erosion and Sediment Control Review Comments
Comments provided by Raleigh Regional Office.

1. While the conceptual sediment basin designs appear acceptable, the construction details for the basins need updating. The reference to perforations in the riser structure must be removed, and ballast stone shown around the riser should be eliminated in that it will prevent proper operation of the flexible riser connection associated with the proposed skimmer. The detail dimensional table should include the anticipated dewatering time for the proposed basin, and in light of the fine-grained soils being dealt with during this project, it is recommended that you consider increasing the time closer to 5 days. In addition, the skimmer arm guides proposed should be eliminated and replaced with an access rope for retrieval and maintenance of the device. Emergency spillway locations should be clearly identified on the drawings. Finally, the baffle details should eliminate the spillway throats and should specify appropriate coir materials for effective operation.

   The sediment basin details on Drawing 01C-12 have been updated to removed the reference to perforation and ballast stone.

   The skimmer calculation has been revised to allow a dewatering time closer to five days. Table 1 on Drawing 01C-12 has been modified to indicate the skimmer dewatering time. In addition, the skimmer detail on Drawing 01C-12 has been modified to remove the guide posts and include a retrieval rope.

   Drawing 01C-02, 01C-03, 01C-04, 01C-05, 01C-07, 01C-08 and 01C-10 have been revised to indicate the locations of the emergency spillways.

   The sediment baffle detail on Drawing 01C-13 has been edited to eliminate the spillway throats and specify appropriate coir materials.

   Revised drawings and calculations are included with this response.

2. A specific construction sequence and more detailed sediment control measures are required for construction of basin #9 in the footprint of the existing settling pond. Dewatering into silt bags or other appropriate measures must be addressed as well construction of the multiple riser/barrel structures.

   A construction sequence for SB #9 has been added to Drawing 01C-05. The revised drawing is included with this response.

3. Silt fences should not be used on downhill grades where they will tend to divert and/or concentrate runoff. In addition, where one row of silt fence will not be appropriate, neither will two rows of silt fence. Please substitute appropriately designed diversion swales/berms

directing runoff to basins or traps, as appropriate, and use silt fence below basin construction areas and along roadway construction where the runoff will be relatively sheet flow. The reinforced silt fence outlets should be specified wherever minor concentration of runoff will occur along the silt fence alignment.

The use of silt fence is in part to provide a visual delineation of the limits of work. Diversion swales/berms are indicated in a number of locations adjacent to silt fenced to direct runoff. To further emphasize this, notes have been added to Drawing 02C-01 instructing the contractor to install diversion swales/berms in areas where silt fence may divert and/or concentrate runoff, and instructing the contractor to install rock outlets within silt fence wherever minor concentration of runoff will occur along the silt fence alignment. Silt fence is generally indicated below basin construction areas. Revised Drawing 02C-01 is provided with this response.

4. The protective linings for perimeter stormwater channels should be more specifically identified on the drawings. Where riprap slop drain outlet protection is proposed into grassed channel sections, the riprap should be extended to armor the entire transition cross section.

   A note has been added to Drawings 01C-07, 01C-08, 01C-09, and 01C-10 indicating the channel linings. Details 1 and 2 on Drawing 02C-04 have been edited to indicate the channel lining type and show riprap extended across the channel at the toe drain outlet location. Slope drains have been revised to tie directly into drop inlets.

   Revised drawings are provided with this response.

5. The proposed covering for construction entrances should be extended to at least 100 feet in length. The extent of all necessary access road for each phase should be identified in the drawings.

   The construction entrance detail on Drawing 01C-11 has been revised to indicate 100-ft in length. Drawing 02G-02 indicates the location of the construction entrance. A revised drawing is provided with this response.

6. All NCDOT class 1or B riprap linings or aprons must be placed at least 18" thick over a suitable geotextile fabric.

   All references to NCDOT Class1 and Class B rip rap linings and aprons have been revised to indicate 18" thickness.

Please refer to the enclosed Summary of Revised and Supplemental Materials for a complete list of documents provided with this response.

If you have any questions, comments, or require additional information, please contact me at 704. 338.6843.

Sincerely,
HDR Engineering, Inc. of the Carolinas

Michael D. Plummer, PE
Project Manager

Summary of Revised and Supplemental Materials

Colon Mine Site

HDR Response to Comments, December 31, 2014

Section / Item	Action Needed	Comments
Binder		
Cover	replace	added revision date
Spine	replace	added revision date
Correspondence		
Coversheet	replace	updated for current content
HDR Response letter 12/31/14	add	
Permit Transfer Acceptance, 12/22/14	add	as requested by DEMLR Review Comment 1
NCDENR comment letter, 12/19/14	add	
Colon Site Debris Cleanup, 12/08/14	add	as requested by DEMLR Review Comment 5
Permit Modification Request Transmittal Letter, 11/14/14	relocate	provided with original submittal; move from front of binder to Correspondence section
Permit Transfer Request Transmittal Letter, 11/14/14	relocate	provided with original submittal; move from front of binder to Correspondence section
Calculations		
A – Stability	Replace entire section	updated headers, no change to calculation data
B - Stormwater		updated headers throughout Subcell Divider Berms revised due to supplemental hydrogeological data Sediment Basins revised per Erosion & Sediment Control Review Comment 1
C - Reclamation Timeline		new as requested by DEMLR Review Comment 2
Related Documents		
Coversheet	replace	updated for current content
NDPES Certificate of Coverage	add in date sequence as indicated on coversheet	as requested by DWR Review Comment 4
Reclamation Bond		as requested by DEMLR Review Comment 7
Threatened-Endangered Report		supplemental material
Mgmt Summary-Archeological Study		supplemental material
Drawings		
Complete set, half and full size	Replace entire section	revised per Erosion & Sediment Control Review Comments
CD		
PDF copy of all materials listed above.		

December 22, 2014

North Carolina Department of Environment
And Natural Resources
Division of Energy, Mineral, and Land Resources
Land Quality Section
512 North Salisbury Street
Raleigh, NC 27604

Attention: Judy Wehner, Asst. State Mining Specialist

RE: Colon Mine
Mining Permit No. 53-05
Lee County
Cape Fear River Basin

Dear Ms. Wehner:

In response to comments received concerning our application requesting the transfer and modification of the aforementioned mining permit, we are clearly stating that Green Meadow, LLC is accepting the transference of the facility mining permit and do hereby accept all the responsibilities associated with the permit and the requirements of the Mining Act of 1971.

We are expecting to renew mining activities onsite in February 2015, with your approval and issuance of the mining permit. We anticipate the mine to remain active for the next seven years with the completion of reclamation activities associated with the development of the structural fill to be completed in 2022.

Attached please find enclosed the reclamation bond in the amount of $500,000. The surety has been issued to Green Meadow, LLC as directed and required per the mining permit application.

We appreciate your continued support of the mining project and should you have any questions, please do not hesitate to contact us.

Sincerest regards,
Green Meadow, LLC

Charles E. Price
Managing Partner

Green Meadow, LLC ● 12601 Plantside Drive ● Louisville, Kentucky 40299

From: Warren.Paschal@generalshale.com [mailto:Warren.Paschal@generalshale.com]
Sent: Monday, December 22, 2014 1:47 PM
To: Wehner, Judy (judy.wehner@ncdenr.gov)
Cc: Greg.Bowles@generalshale.com; Norman Divers
Subject: Colon Mine

Judy,

We have cleaned up all the materials around the old Sanford shop as we discussed except the Terex dump truck and the sand silo. I have attached pictures for your review. Please feel free to contact me should you need to schedule an inspection, have any questions or need additional information.

Thanks,
Warren Paschal
Manager of Environmental Compliance

General Shale | www.generalshale.com
300 Brick Plant Road
Moncure, NC 27559
Office: (919) 774-6533 (Ext. 221) Cell: (919) 353-1572 warren.paschal@generalshale.com

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

December 19, 2013

Certified Mail
Return Receipt Requested
7013 2630 0001 8990 0835

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

RE: Colon Mine
Mining Permit No. 53-05
Lee County
Cape Fear River Basin

Dear Mr. Price:

We have reviewed the transfer and modification application your company submitted for the referenced mine site. In order for this office to complete its review of the referenced project in accordance with GS 74-50, 51 and 52 of the Mining Act of 1971, please provide the additional or revised information in accordance with the following comments:

1. Please request in writing that the existing permit be transferred and clearly state the new operator's name (Green Meadows LLC). In the letter please also indicate that you will accept any and all responsibilities and liabilities with respect to the Mining Act of 1971.

2. Please provide time frames for the final reclamation of the Structural fill areas.

3. Please find enclosed the Division of Water Resources' Water Quality Operations comments regarding this site. Please contact Danny Smith at (919) 781-4200 to address these concerns and advise this office of any changes to your modification proposal.

4. Please find enclosed comments from the NC Wildlife Resources Commission regarding this site. Please address the concerns outlined in the memorandum.

5. In order to process the partial release request, please ensure that the debris from around the Maintenance Storage Building has been properly disposed of.

6. Please find enclosed comments from our Raleigh Regional Office regarding the erosion and sediment control measures/plans. Please revise the erosion and sediment control plan to include these changes.

Please note, the Land Quality Section may request additional information, not included in this letter, as the mining application review progresses.

The reclamation bond calculation exceeds the reclamation bond cap of $500,000.00. Therefore, the reclamation bond for this site and the Brickhaven Mine #2 Tract A would be $500,000.00 and will be required prior to approval of this request.

For your convenience, I have enclosed a bond form, an assignment of a savings account form and irrevocable standby letter of credit form for your use in securing the required bond. The name on the security must be the same as the name appearing on the application for a mining permit, i.e., **Green Meadow, LLC**. In addition to one of these alternatives, you may, upon request, substitute a cash deposit.

Please be advised that our review cannot be completed until all of the items listed above have been fully addressed.

In order to complete the processing of your application, please forward two (2) copies of the requested information and the bond to my attention at the following address:

Land Quality Section
Division of Land Resources
Department of Environment and Natural Resources
1612 Mail Service Center
Raleigh, NC 27699-1612

As required by 15A NCAC 5B.0013, you are hereby advised that you have 180 days from the date of your receipt of this letter to submit all of the requested information. If you are unable to meet this deadline and wish to request additional time, you must submit information, in writing, to the Director clearly indicating why the deadline cannot be met and request that an extension of time be granted. If an extension of time is not granted, a decision will be made to grant or deny the mining permit based upon the information currently in the Department's files at the end of the 180-day period.

Though the preceding statement cites the maximum time limit for your response, we encourage you to provide the additional information requested by this letter as soon as possible. Your prompt response will help us to expedite the processing your application.

Please contact me at (919) 733-4574 if you have any questions.

Sincerely,

Judith A. Wehner
Assistant State Mining Specialist
Land Quality Section

Enclosures: DWR Comments
NCWRC Comments
Bond Forms

cc: Mr. John Holley, PE
Mr. Michael Plummer, PE – HDR, via email.
Mr. Warren Paschal – General Shale Brick, via email
Ms. Elizabeth Werner – DWM, via email
Mr. Norman Divers, via email

Print this form to PDF *Return PDF of this form to DEMLR CO by email. cc DEMLR RO, DWR SPU.* *Send a copy to the permittee.*

MINING PERMIT APPLICATION REVIEW FORM

for the

DIVISION OF WATER RESOURCES

THIS SECTION TO BE FILLED OUT BY DEMLR:

Project Name: Colon Mine **DEMLR Permit #** 53-05 **County:** Lee **Applicant's Email:** joe.readling@hdrinc.com

PERMIT ACTION TYPE:

	YES	NO	Date Commencing
☐ (☐ (			
Have land disturbing activities started? Date?	☑ (	☐ (	>1972

Latitude: 35.5348 **Longitude: -79.1598**

Please return comments to (at DEMLR CO): Judy Wehner

Comments due by: 12/16/14

SECTION BELOW TO BE FILLED OUT BY DWR:

Is the RO concerned that the operation, as proposed, would violate standards of water quality? See comments listed below

Comments: see comments listed below

Watershed/Stream Name & Classification: Roberts Creek a Water Supply IV, Cape Fear River

DWR Compliance Status of Mine: NCG020854

Does this mine (or previous owner) have DWR back fees to pay? no If yes, amount: _________

Is this mine an active permit in BIMS? yes

	YES	NO
401 Wetland Cert. required?	☐ (_____	☐ (_____
401 Wetland Cert. existing?	☐ (Permit # _____	☐ (_____
Does DWR RO have enough information to determine if a 401 certification is required?	☐ (_____	☐ (_____

Is an O & M Plan needed?	YES	NO
Are wetlands disturbed at this site?	☐ (_____	☐ (_____
Does DWR RO suspect or know of nearby wetlands to the site?	☐ (_____	☐ (_____
Is a wetland delineation required prior to DWR issuing the permit?	☐ (JD _____ ☐ (Consultant _____ ☐ (Onsite? _____	☐ (_____

	☐ (Offsite?______	
Stream Determination Needed?	☐ (______	☐ (______
Stream Determination Completed?	☐ (______	☐ (______
Does DWR RO need a statement that no wetlands/streams are disturbed for this project from applicant?	☐ (______	☐ (______
Buffer Determination Needed?	☐ (______	☐ (______
Buffer Determination Completed?	☐ (______	☐ (______
Recycle system permit existing?*	☐ (Permit #______	☐ (______
New Recycle System permit required?* Enough information to determine?	☐ (______	☐ (______
Non-discharge permit existing?*	☐ (Permit #______	☐ (______
Will wastewaters discharge to HQW waters with a 7Q10=0? **	☐ (______	☐ (7Q10 Flow:______ ☐ (Unknown. Permittee must determine. ______
Does DWR require DEMLR to hold the permit (e.g. so DWR can review it further or because DWR requires more information)?	☐ (Has Violation ☐ (O&M Requirements ☐ (HQW/7Q10 Concerns ☐ (Pay back fees or renew DWR permit ☐ (Other. Please describe the reason to hold the permit: ______ RO contact: ______ ☐ (Hold Until: ______	☐ (______
Mine must wait to dewater until an O&M plan is approved?	☐ (______	☐ (______

joe.readling@hdrinc.com **Reviewed by:**

DWR RO Surface Water: Danny Smith Regional Office: RRO Date: December 11, 2014

RO Aquifer Protection Section: ______ Regional Office: ______ Date: ______

Colon Mine : Permit 53-05:

- A review of an aerial, USGS map and a review of the site map that was included in in the application packet depicted blue lines and crenulations that indicate stream(s) are present within and adjacent to the subject project.

- 404/401. It is recommended that the owner contact both the USACE and DWRs for a joint wetland and stream determination and to discuss permitting.

  Proposed impacts in application depict the following:
  2,040 linear feet of steam
  0.62 ac of wetlands
  If this is accurate, this will trigger an Individual permit from USACE and individual 401 Water Quality Certification from DWR

- Water supply Watershed. The project is in the Cape Fear River Basin (UT to Roberts Creek a Water Supply IV waters). If "new development" occurs on this tract and a sediment and erosion control plan is required per the Sediment Act, the project may trigger local government approval per WS IV Supply Watershed Rules. [If this occurs I recommend that you contact Julie Ventaloro (water supply watershed coordinator -DEMLR), review §130A-309.205 and 15A NCAC 02B .0216.]

- The proposed land use/activity will need to comply with the appropriate stormwater permit (NCG010000, NCG020000, or NCG120000.)

- Wetland and stream monitoring plan: It recommended that mine site (owner) develop a wetland and stream monitoring plan such that they can demonstrate that the change of hydraulic gradient that results from the mining activity does not remove the hydrology from adjacent wetlands and streams. This is to ensure: 1) the streams and wetlands do not get disturbed prior to permitting and 2) it is to ensure that adjacent mining, reclamation efforts, beneficial use preparation, or landfill efforts do does in effect or remove the hydrology prior to permitting.

- Any ash/mine pit discharges (beneficial fill or not) will need to be covered by an appropriate NPDES wastewater discharge permit if it discharges ash/comingled ash and stormwater. (The site is not permitted to discharge coal combustion products. - coal ash and/or leachate collection system is not authorized to discharge to waters or violate 2L groundwater standards.)

- Wastewater Pump and Haul - Leachate pump and haul will need to be addressed through 15A NCAC 02T .0203 (2) Please see attached industrial pump and haul application.

North Carolina Department of Environment and Natural Resources
Division of Water Quality
Raleigh Regional Office

(THIS FORM MAY BE PHOTOCOPIED FOR USE AS AN ORIGINAL)

PUMP AND HAUL OF INDUSTRIAL WASTEWATER

I. GENERAL INFORMATION:

1. Applicant (corporation, individual, other): ______________________________

2. Print owner or signing official name and title (the person who is legally responsible for the facility and its compliance): ______________________________

   ____

3. Mailing address: ____

   ____

   Telephone no.: ____

4. Project name (facility or establishment name): ______________________________

   ____

5. Application date: ____

6. County where facility being pumped is located: ______________________________

7. Specify whether the applicant is: _____ public or _____ private.

II. INFORMATION ON WASTEWATER:

1. Please provide a short description specifying the origin of the wastewater, such as school, hospital, commercial, etc.: ______________________________

2. Volume of wastewater to be pumped and hauled: ______________ gallons per day

3. Explanation of how wastewater volume was determined: ____________________

   ____

   ____

III. TREATMENT FACILITY INFORMATION:

1. Name of treatment facility receiving wastewater: ______________________________

   ____

2. Treatment facility NPDES permit no.: ______________________________________

3. Treatment facility contact person and telephone no.: __________________________

   ____

4. County where treatment facility is located: ____________________________________

IV. OTHER INFORMATION:

1. Brief project description: ____

   ____

   ____

2. Explanation of why pump and haul is being requested: _________________________

   ____

   ____

3. Specify how long pump and haul will be needed: ______________________________

4. Describe how the wastewater will be transported (truck, rail car, etc.) and provide the typical hauling volume of the vehicle providing the hauling: _________________

   ____

5. Name of owner/company of transporting (hauler) vehicle: ______________________

   ____

6. Mailing address of hauler: ____

   ____

   Telephone no. of hauler: ____

7. What type of tank or container will the wastewater be pumped from and what is the volume of this container: ____

8. Is the tank or container already in place or will it be installed for these activities?

____

9. What type of high water alarm(s) does the container have?

_____ audible and visual _____ auto dialer

PLEASE ENSURE THAT THE FOLLOWING INFORMATION IS PROVIDED AND THAT THE FOLLOWING ISSUES ARE ADDRESSED

a. Provide this completed and signed form.

b. It is the current policy of the Division of Water Quality that a permit is not required for pump and haul of industrial wastewater; **however, the regional office must approve such pumping and hauling. The owner and engineer, by signing this application, affirm that the conditions under which this pump and haul activity are to be conducted are in full compliance with North Carolina Administrative Code (NCAC), Title 15A NCAC .02T .0200.**

c. A fee is not currently required for approval to pump and haul industrial wastewater.

d. Two sets of detailed plans/specifications signed and sealed by a North Carolina Professional Engineer must be provided, showing the components associated with the pump and haul activity (drains, piping, tanks, etc.), a general location map, a plan view of the storage facility and its relationship to property lines, structures, etc. The tank detail should indicate the high water alarm (either audible and visual or an auto dialer). Each sheet of the plans and the first page of the specifications must be signed/sealed by the Professional Engineer.

e. A letter must be provided from the owner/authority of the receiving wastewater treatment facility stating that the pumped and hauled wastewater will be accepted and specifying the volume of wastewater that will be accepted.

f. A letter or contract from the hauler stating his capability and willingness to perform the pumping and hauling.

g. Please provide a cover letter explaining the circumstances associated with this pump and haul request.

Name and address of engineering firm: ____

____

____

Telephone no.: ______________________________ Fax No. ______________________________

North Carolina Professional Engineer Seal, Signature and Date:

Applicant's Certification:

I, ______________________________________, attest that this request for ________________________
(print owner name)

____
(print name of facility)

has been reviewed by me and is complete to the best of my knowledge. I understand that if all required parts of this document are not completed and that if all required supporting information and attachments are not included, this package will be returned as incomplete.

Signature: ______________________________________ Date: ________________________

SEND THE COMPLETED PUMP AND HAUL APPLICATION WITH ATTACHMENTS TO THE FOLLOWING MAIL ADDRESS

DWQ Surface Water Protection Supervisor
Department of Environment and Natural Resources
1628 Mail Service Center
Raleigh, N. C. 27699-1628
Telephone No.: 919-791-4200

North Carolina Wildlife Resources Commission
Gordon Myers, Executive Director

MEMORANDUM

TO: Brenda M. Harris, Mining Program Secretary
Land Quality Section

FROM: David R. Cox, Supervisor
Habitat Conservation
David R. Cox

DATE: December 16, 2014

SUBJECT: Mining Permit Modification and Transfer for General Shale Brick, Inc, and Green Meadow LLC: Colon Mine – Permit Number 53-05, Lee County, North Carolina

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject permit application. Our comments are provided in accordance with provisions of the Mining Act of 1971 (as amended, 1982)(G.S. 74-76 through 74-68 15 NCAC 5).

General Shale Brick, Inc. is requesting a transfer of their permit to Green Meadow, LLC. Green Meadow, LLC is requesting a modification of the permit to mine clay. The total permitted area is 351 acres, and the modification involves acreage within the approved permitted boundary. The operation will not discharge fresh or waste water. Flocculants and chemical dust suppressants may be used. According to the existing permit, a 50-foot buffer will be maintained along streams and wetlands except where impacts have been permitted. The site will be reclaimed as an encapsulated beneficial coal combustion product structural fill designed in accordance with General Statute §130A-309.216 in the Coal Ash Management Act of 2014.

Roberts Creek and unnamed tributaries to Roberts Creek in the Cape Fear River basin flow through the site. The Natural Heritage Program Natural Area – Cape Fear River/McKay Island Floodplain – is located downstream of the site.

The Environmental Protection Agency (2010) found landfills that used composite liners effectively reduced the risk of coal combustion products constituents being found in the environment. While disposing of coal combustion product as structural fill is preferred to storing it in surface impoundments, there is the potential for coal combustion product or its constituents to enter streams through aerial deposition, stormwater/erosion runoff, or leaching/infiltration. Additionally, the liners have an estimated safe life of 80 to 100 years if no mechanical stress is induced (Reddy 1999). If either of these occurs, aquatic and terrestrial wildlife resources can be exposed to coal combustion product or its constituents through direct contact with contaminated soil or surface water, or through ingestion of contaminated plants, soil, or aquatic and terrestrial invertebrates. Should the permit be transferred and modified, we offer the following recommendations to minimize the potential for these impacts to aquatic and terrestrial wildlife resources:

1. Maintain a minimum 100-foot and 50-foot undisturbed native, forested buffer along perennial streams and intermittent streams respectively. Maintaining undisturbed, forested buffers along these areas will reduce impacts to aquatic and terrestrial wildlife resources, water quality, and aquatic habitat both within and downstream of the site. We request that sediment and erosion control structures be located outside of these buffers.
2. Calgon Cat-Floc DL has been used previously. Cationic polyelectrolytes are toxic to fish; therefore, measures should be used to prevent spills or direct discharge of Calgon Cat-Floc DL into any natural watercourses.
3. Water quality monitoring should be performed in Roberts Creek, downstream of the site. In addition to monitoring for the constituents in Appendix I (i.e., Appendix I to 40 C.F.R. Part 258), aluminum, boron and mercury should be added since these are not included in Appendix I and have the potential to adversely impact aquatic and terrestrial wildlife resources (RTI 2000). If constituents are found in downstream surface waters, then the applicant should notify NCDENR and measures to identify the source and contain the constituents should be implemented immediately.
4. We support post-closure care for at least 30 years. Downstream water quality monitoring for constituents (i.e., Appendix I and aluminum, boron, and mercury) should continue during post-closure; however, at a minimum, monitoring of downstream water quality should be performed if constituents (i.e., Appendix I and aluminum, boron and mercury) are found during groundwater monitoring.
5. Use dust control measures to minimize aerial deposition of coal combustion products into surface waters and terrestrial landscapes. If chemical dust suppressants are used, the product should be non-toxic to plants and animals, and should be applied to minimize environmental impact.
6. Consider using seed mixtures that are beneficial to wildlife (e.g., native warm season grasses) in the final reclamation plan. Additionally, for relatively shallow sediment basin reclamation, we recommend these areas be reclaimed as wetlands where practicable. We refer the applicant to Jason Allen, District Wildlife Biologist at (336) 524-9801 for additional information and ideas on reclamation for wildlife.

Thank you for the opportunity to review and comment on this project. If I can be of further assistance, please contact me at (910) 409-7350 or gabriela.garrison@ncwildlife.org.

Literature cited

RTI. 2002. Constituent screening for coal combustion wastes. October 2002. (https://www.rti.org/pubs/epa-hq-rcra-2006-0796-04701.pdf)

Reddy, D.V. and B. Butul. 1999. A comprehensive literature review of liner failures and longevity. July 1999 (http://www.epa.gov/region5/waste/clintonlandfill/PDFClintonLFChemicalWaste_USEPAApplication/cl_044.pdf)

U.S. Environmental Protection Agency. 2010. Human and Ecological Risk Assessment of Coal Combustion Wastes. April 2010 (http://earthjustice.org/sites/default/files/library/reports/epa-coal-combustion-waste-risk-assessment.pdf)

cc: Gregory A. Bowles, General Shale Brick, Inc.
Charles Price, Green Meadow, LLC

RRO Comments – Transfer/Modification Application

Colon Mine (53-05)

(1) While the conceptual sediment basin designs appear acceptable, the construction details for the basins need updating. The reference to perforations in the riser structure must be removed, and ballast stone shown around the riser should be eliminated in that it will prevent proper operation of the flexible riser connection associated with the proposed skimmer. The detail dimensional table should include the anticipated dewatering time for the proposed basins, and in light of the fine-grained soils being dealt with during this project, it is recommended that you consider increasing the time closer to 5 days. In addition, the skimmer arm guides proposed should be eliminated and replaced with an access rope for retrieval and maintenance of the device. Emergency spillway locations should be clearly identified on the drawings. Finally, the baffle details should eliminate the spillway throats and should specify appropriate coir materials for effective operation.

(2) A specific construction sequence and more detailed sediment control measures are required for construction of basin #9 in the footprint of the existing settling pond. Dewatering into silt bags or other appropriate measures must be addressed as well construction of the multiple riser/barrel structures.

(3) Silt fences should not be used on downhill grades where they will tend to divert and/or concentrate runoff. In addition, where one row of silt fence will not be appropriate, neither will two rows of silt fence. Please substitute appropriately designed diversion swales/berms directing runoff to basins or traps, as appropriate, and use silt fence below basin construction areas and along roadway construction where the runoff will be relatively sheet flow. The reinforced silt fence outlets should be specified wherever minor concentration of runoff will occur along the silt fence alignment.

(4) The protective linings for perimeter stormwater channels should be more specifically identified on the drawings. Where riprap slope drain outlet protection is proposed into grassed channel sections, the riprap should be extended to armor the entire transition crossection.

(5) The proposed covering for construction entrances should be extended to at least 100 feet in length. The extent of all necessary access roads for each phase should be identified in the drawings.

(6) All NCDOT class 1 or B riprap linings or aprons must be placed at least 18" thick over a suitable geotextile fabric.

Calculations

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014
Revised December 2013

Table of Contents

This page intentionally left blank.

A

Stability

Slope Stability Analysis

This page intentionally left blank.

I Job No. 453925-235691-018

HDR Computation

Project:	Charah Colon Mine	Computed By:	TMY	Date:	10/27/2014
Subject:	Permit Application	Checked By:	**KP**	Date:	10/29/2014
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 site consists of approximately 5' soil horizon consisting of medium silty and clayey soils underlain by approximately 10' of stiff residuum. Hard partially weathered rock (PWR) underlies the residuum. For the purposes of global stability, it is assumed that failure surfaces will not penetrate the PWR. The estimated intervals of the soil horizon, residuum, and PWR are shown in Attachment A.

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

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

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

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

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

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

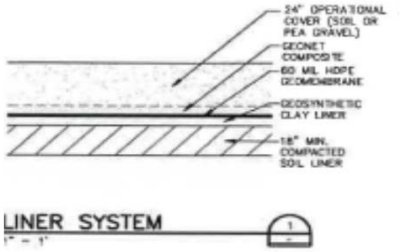
HDR Computation

Project:	Charah Colon Mine	Computed By:	TMY	Date:	10/27/2014
Subject:	Permit Application	Checked By:	**KP**	Date:	10/29/2014
Task:	Slope Stability Analyses	Sheet:	2	Of:	3

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

Final Cover soils: γ = 120 pcf, φ = 30˚ , 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: φ = 33˚ , c = 0
Critical → Geocomposite/Textured HDPE Interface: φ = 26˚ , c = 0
Textured HDPE/Saturated Reinforced GCL: φ = 23˚ , c = 167 psf
Saturated Reinforced GCL/Saturated Cohesive Soil: φ = 29˚ , c = 0

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

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

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

Results/Conclusions

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

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

HDR Computation

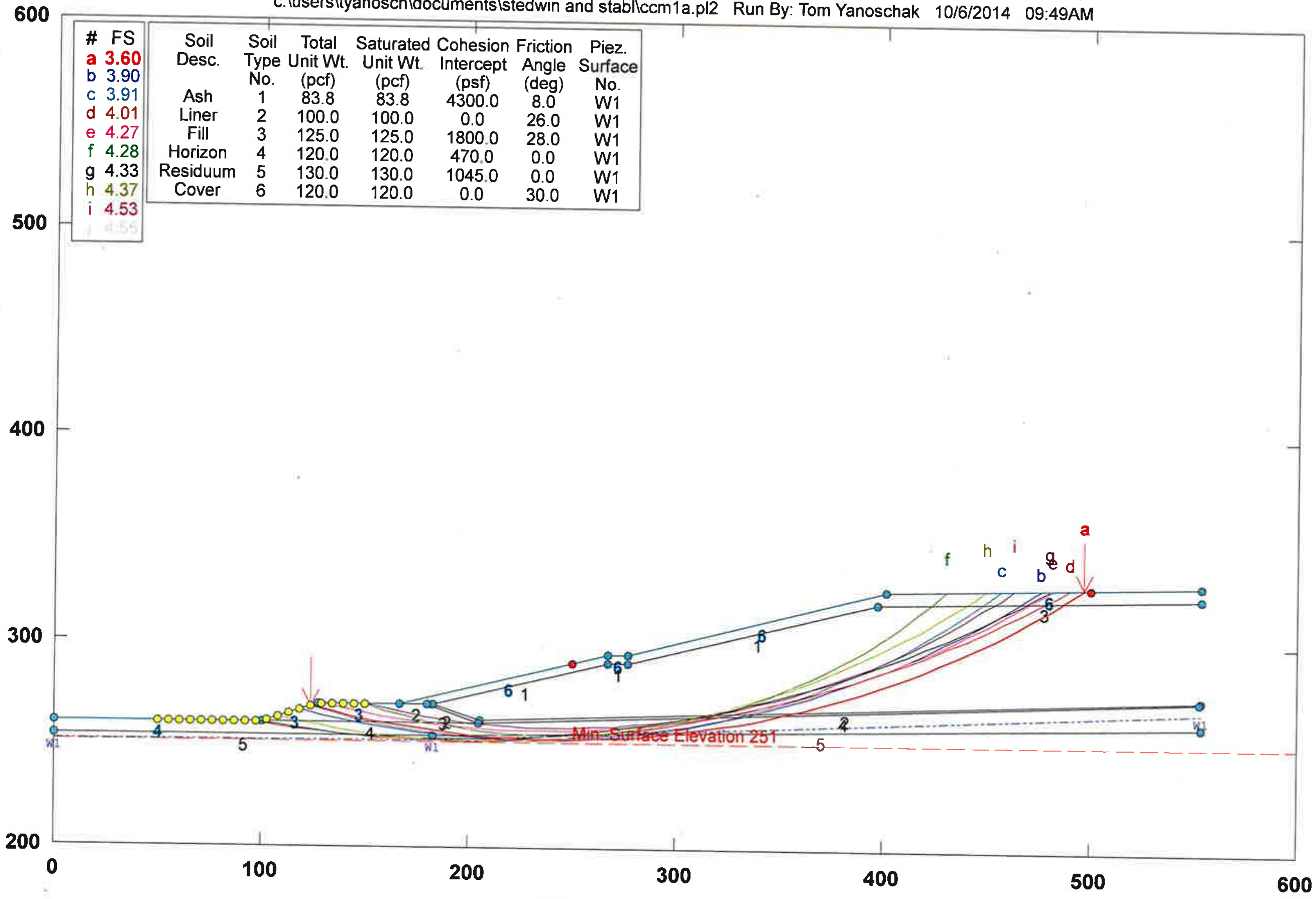
Project:	Charah Colon Mine	Computed By:	TMY	Date:	10/27/2014
Subject:	Permit Application	Checked By:	**KP**	Date:	10/29/2014
Task:	Slope Stability Analyses	Sheet:	3	Of:	3

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

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

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

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



#	FS
a	3.60
b	3.90
c	3.91
d	4.01
e	4.27
f	4.28
g	4.33
h	4.37
i	4.53
j	4.55

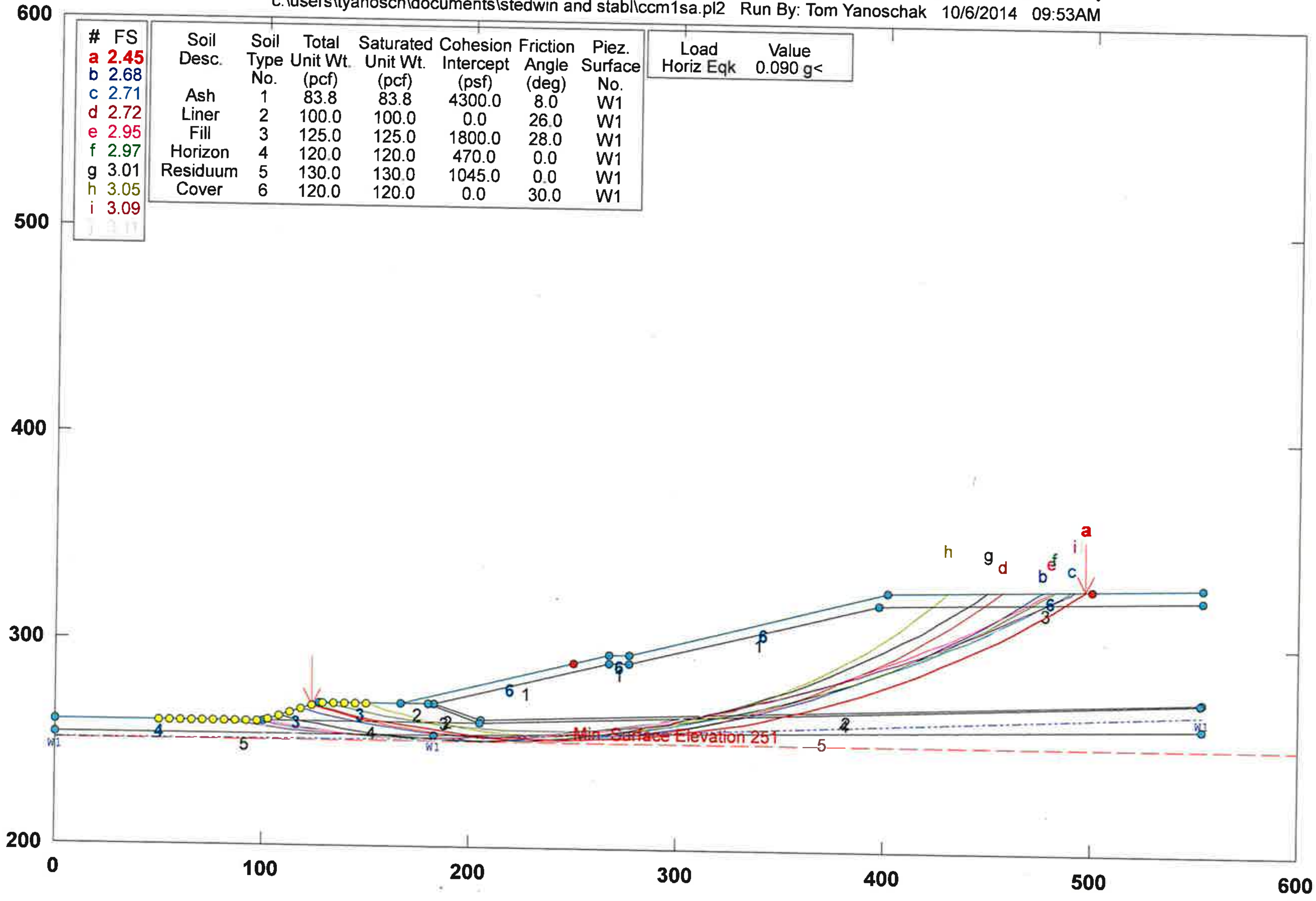
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1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

PCSTABL5M/si FSmin=3.60

Safety Factors Are Calculated By The Modified Bishop Method

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

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



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

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

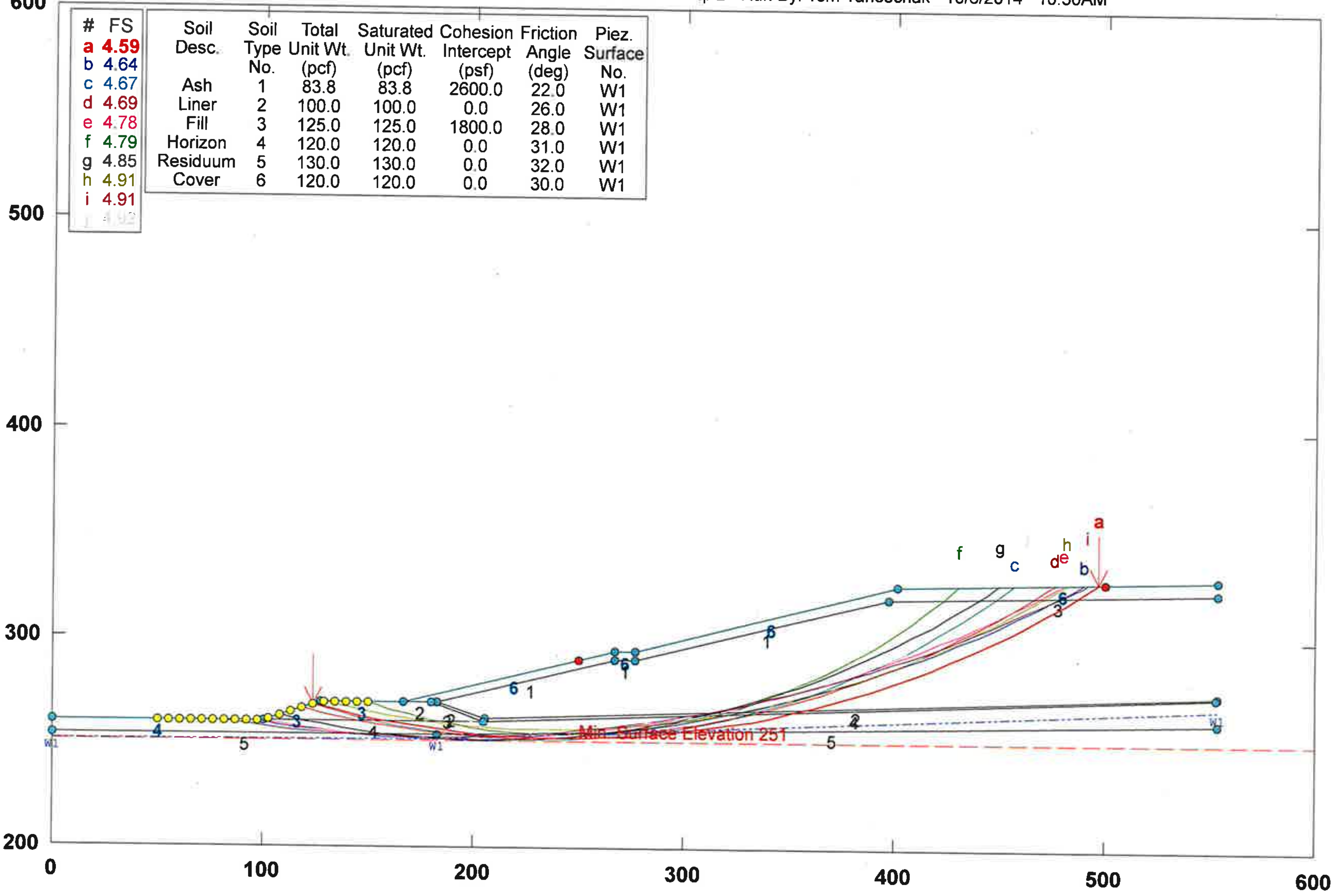
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=2.45

Safety Factors Are Calculated By The Modified Bishop Method

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

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



#	FS
a	4.59
b	4.64
c	4.67
d	4.69
e	4.78
f	4.79
g	4.85
h	4.91
i	4.91
j	4.92

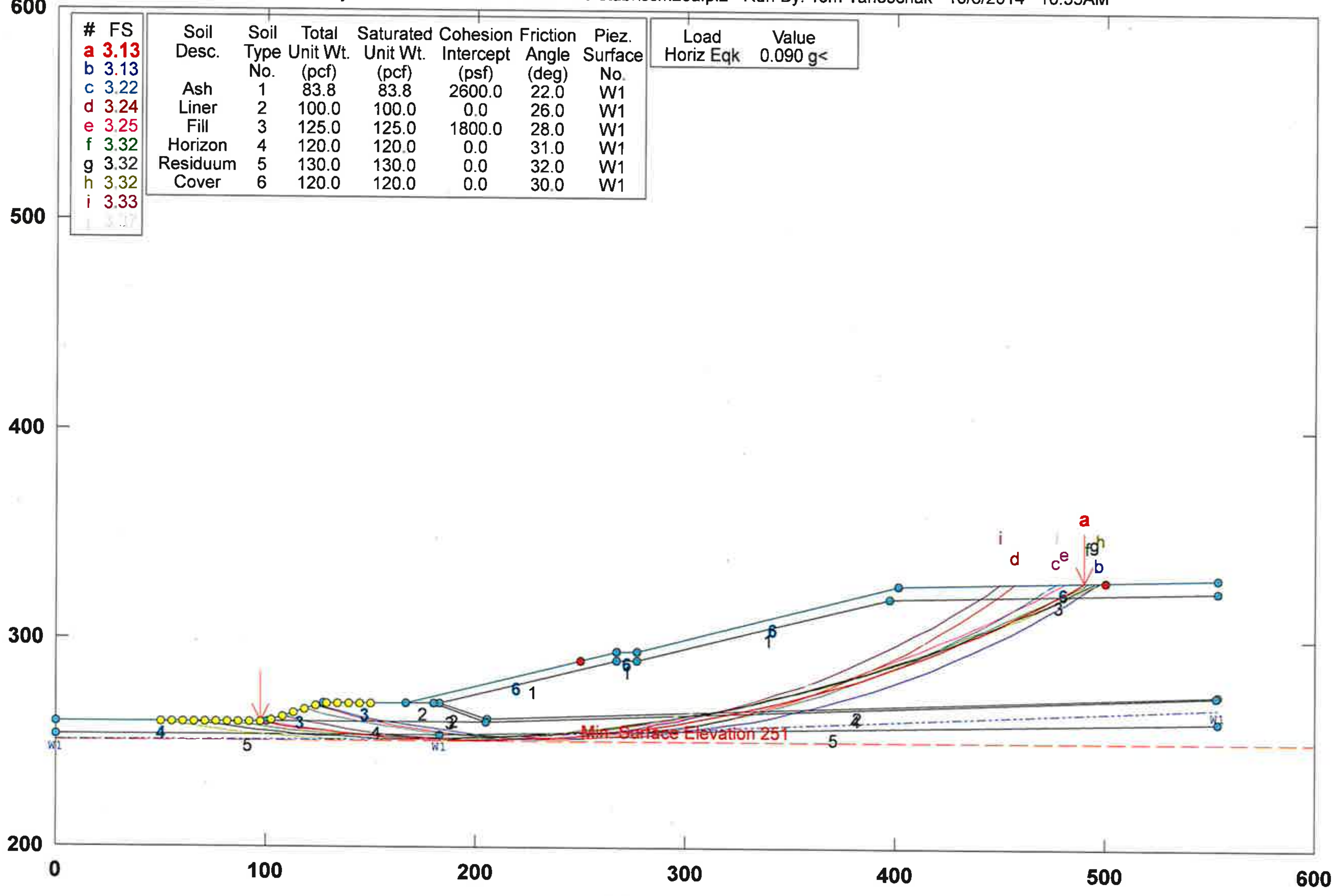
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1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

PCSTABL5M/si FSmin=4.59

Safety Factors Are Calculated By The Modified Bishop Method

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

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



#	FS
a	3.13
b	3.13
c	3.22
d	3.24
e	3.25
f	3.32
g	3.32
h	3.32
i	3.33
j	3.37

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

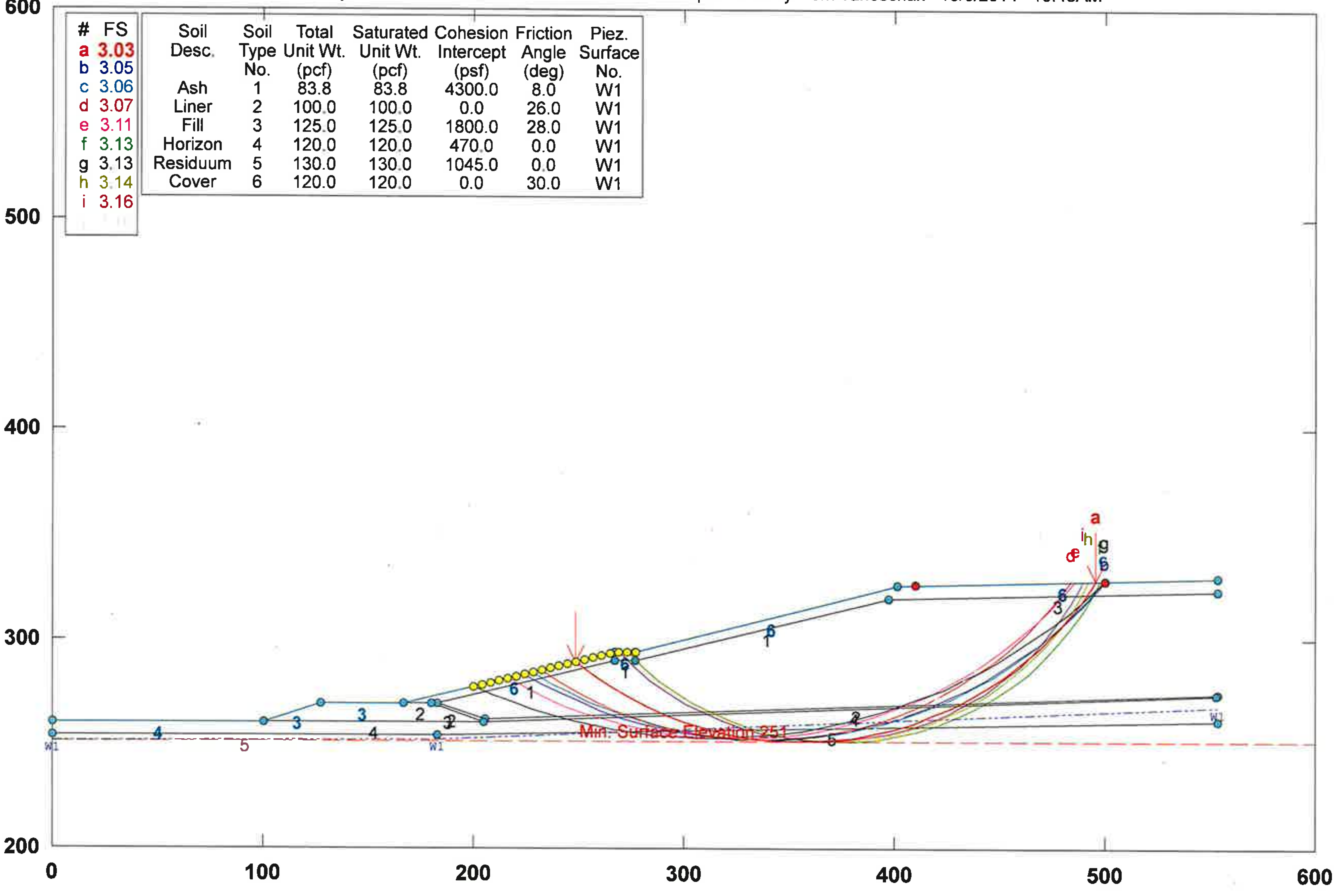
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=3.13

Safety Factors Are Calculated By The Modified Bishop Method

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

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



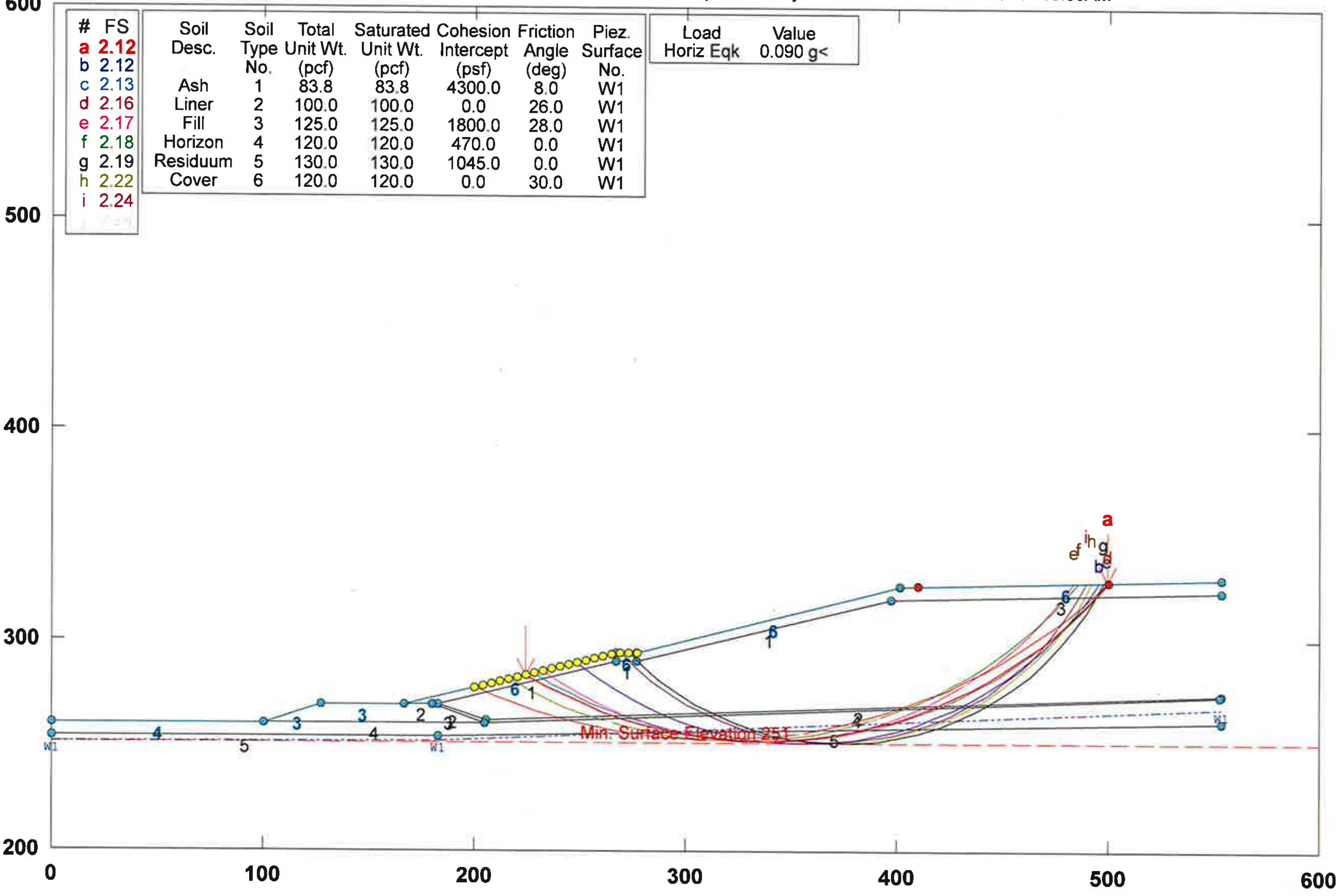
#	FS
a	3.03
b	3.05
c	3.06
d	3.07
e	3.11
f	3.13
g	3.13
h	3.14
i	3.16

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

PCSTABL5M/si FSmin=3.03
Safety Factors Are Calculated By The Modified Bishop Method

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

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



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

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

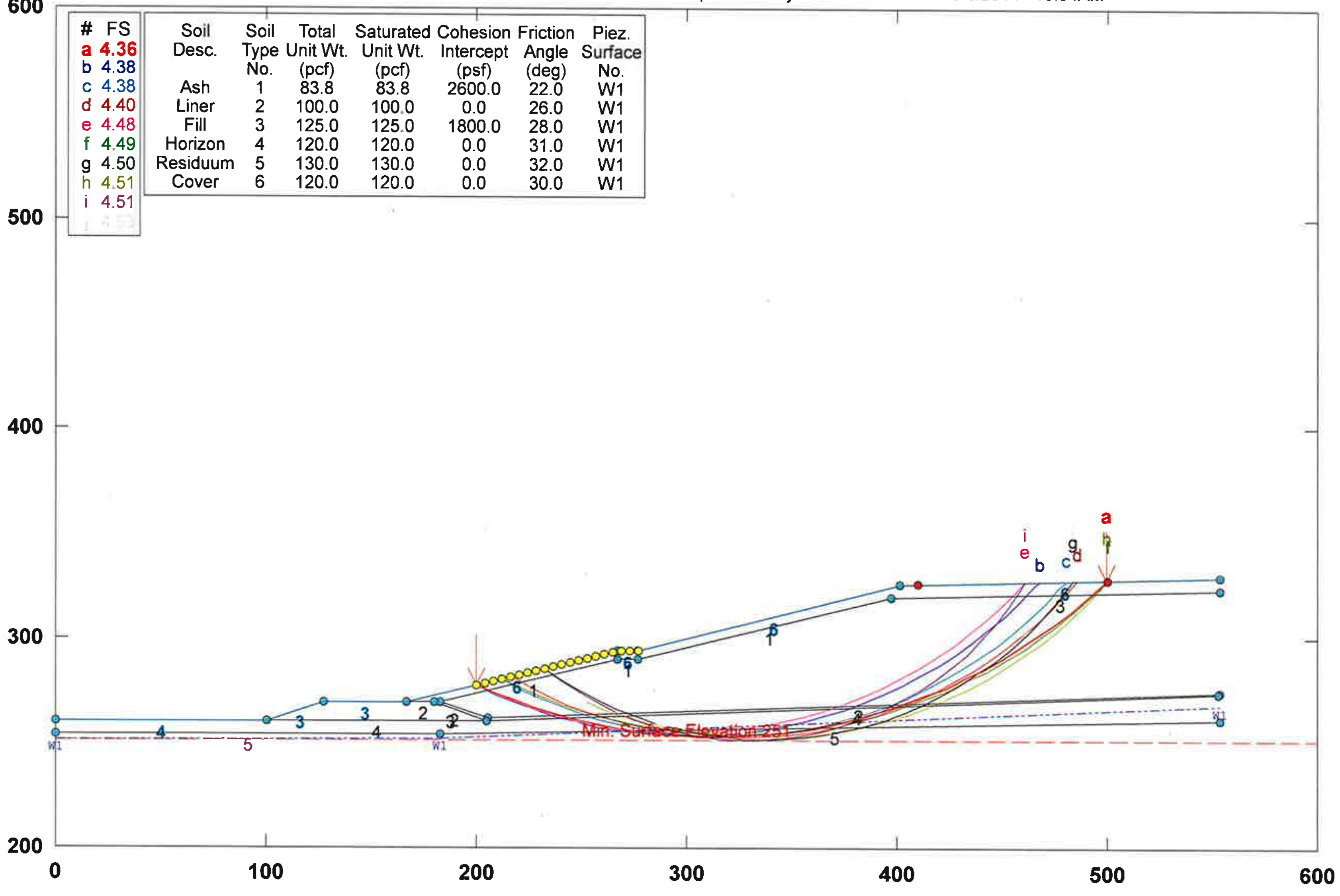
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=2.12

Safety Factors Are Calculated By The Modified Bishop Method

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

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



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

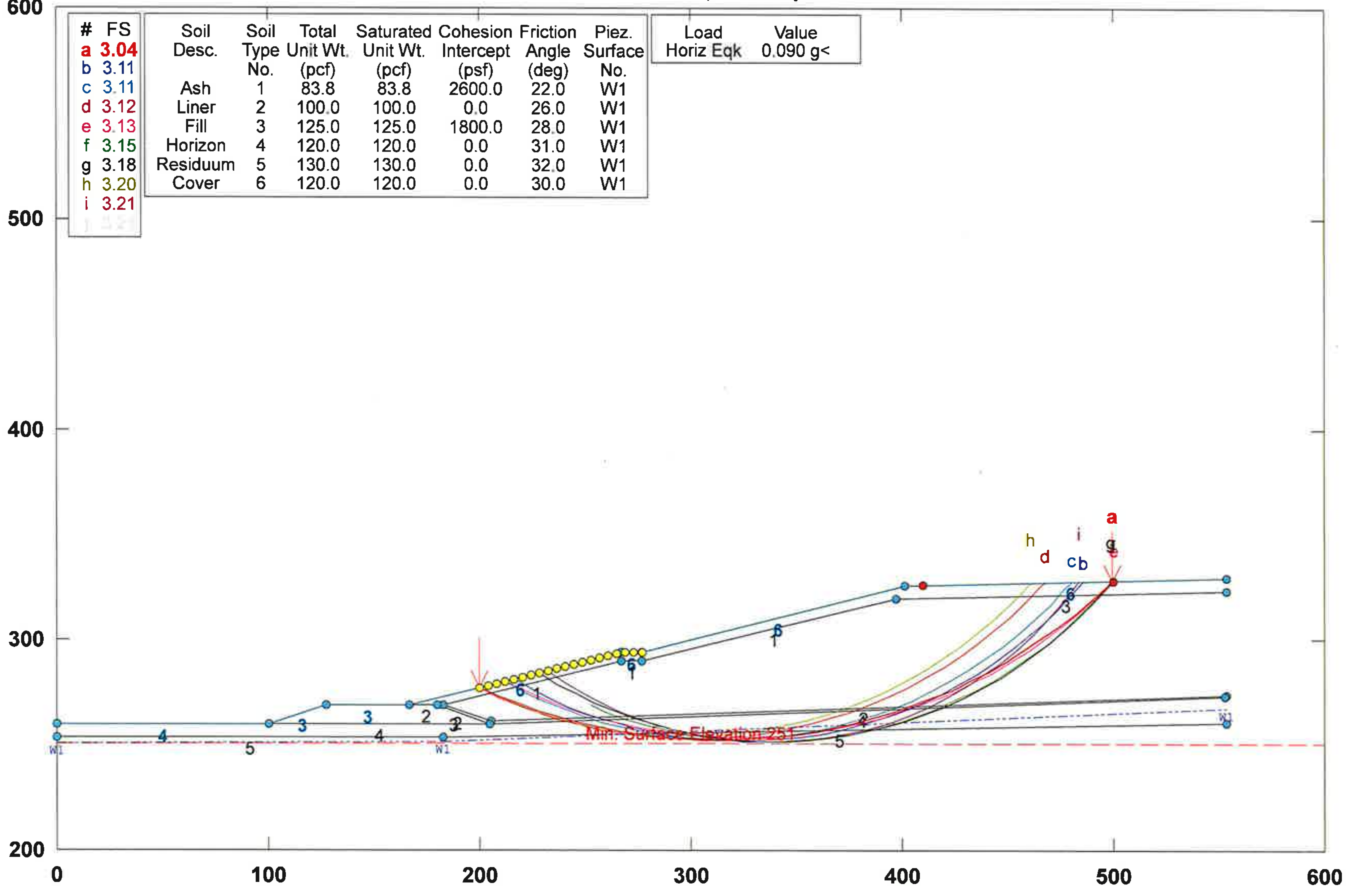
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1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

PCSTABL5M/si FSmin=4.36

Safety Factors Are Calculated By The Modified Bishop Method

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

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



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

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

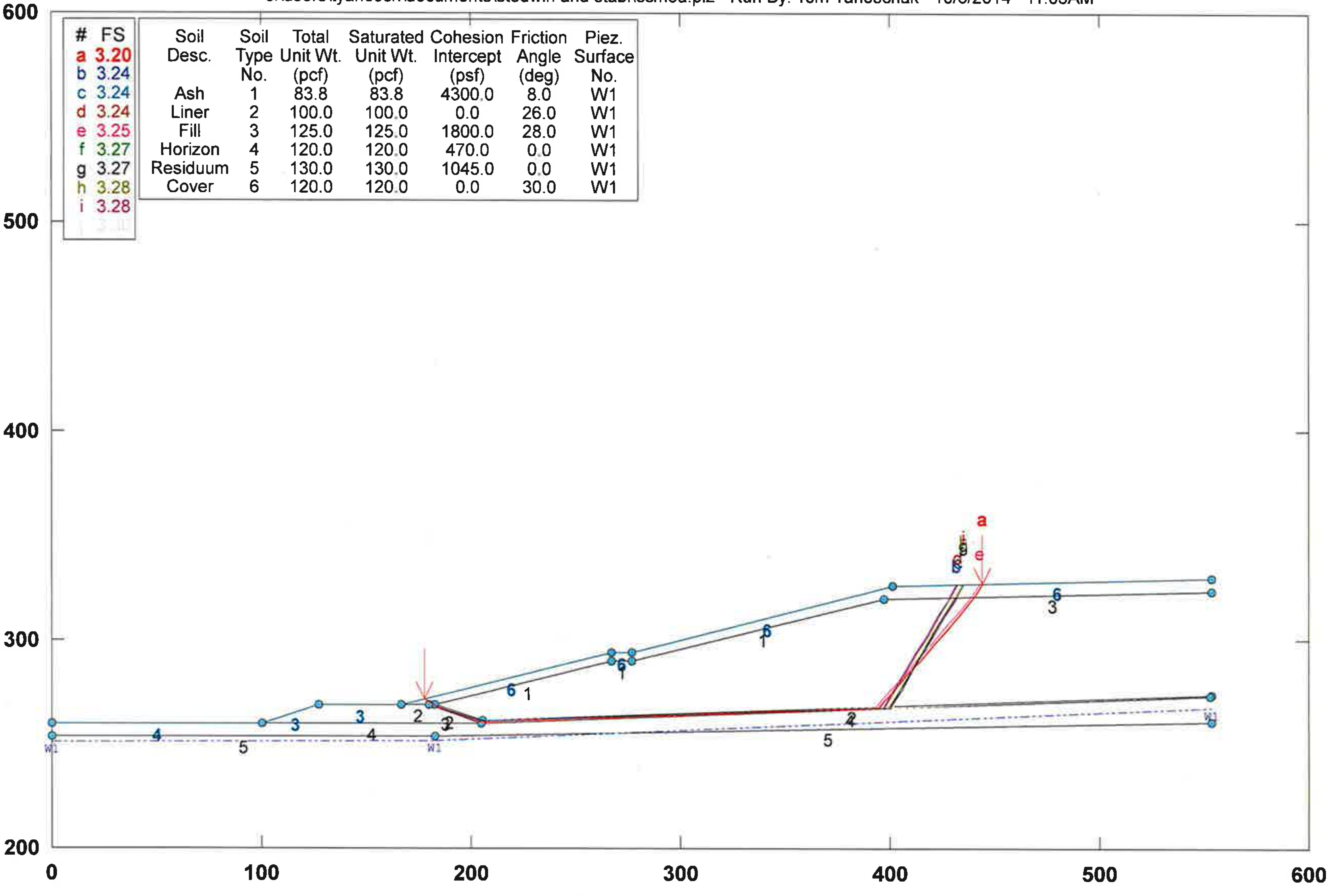
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=3.04

Safety Factors Are Calculated By The Modified Bishop Method

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

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



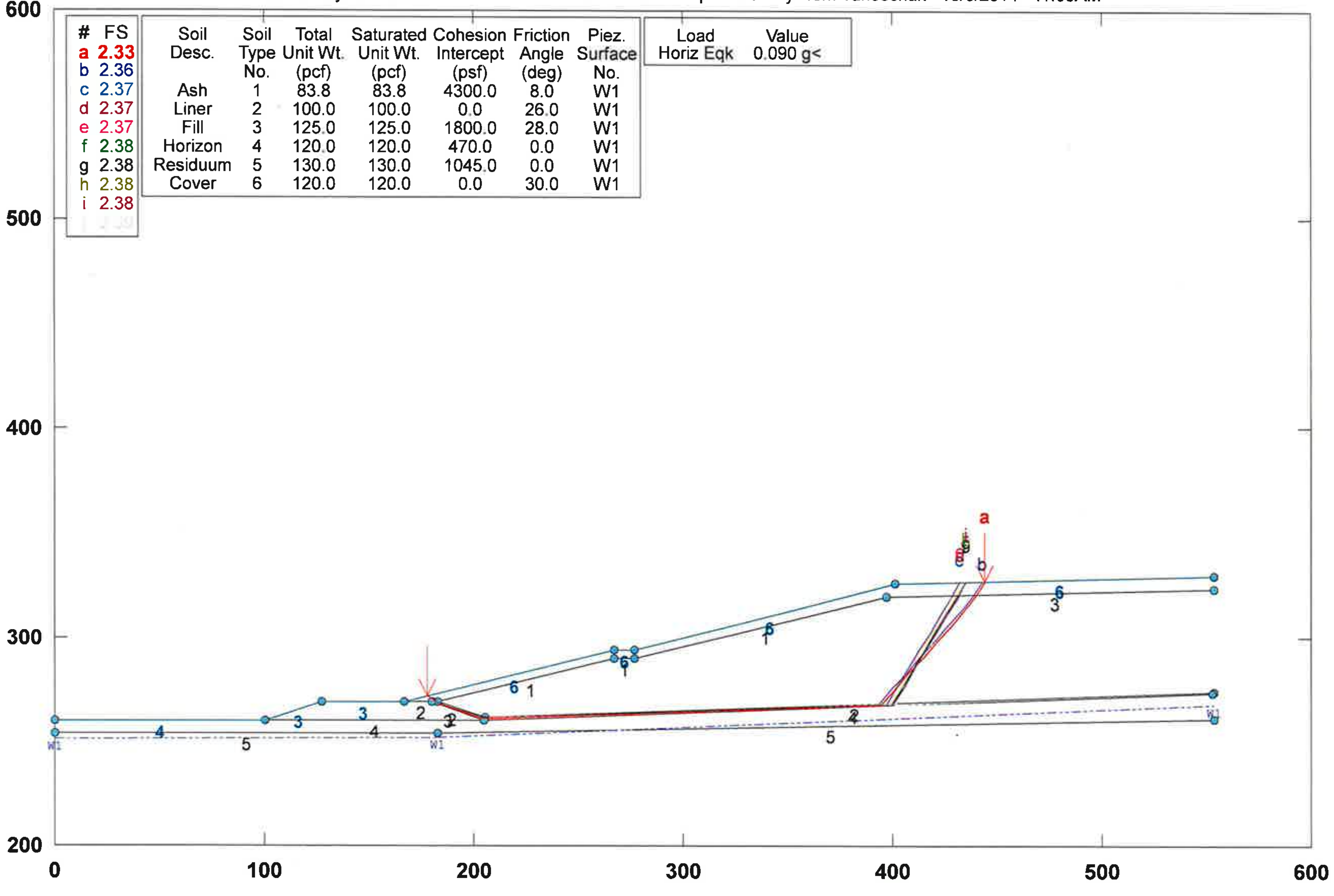
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1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

PCSTABL5M/si FSmin=3.20

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

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

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



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

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

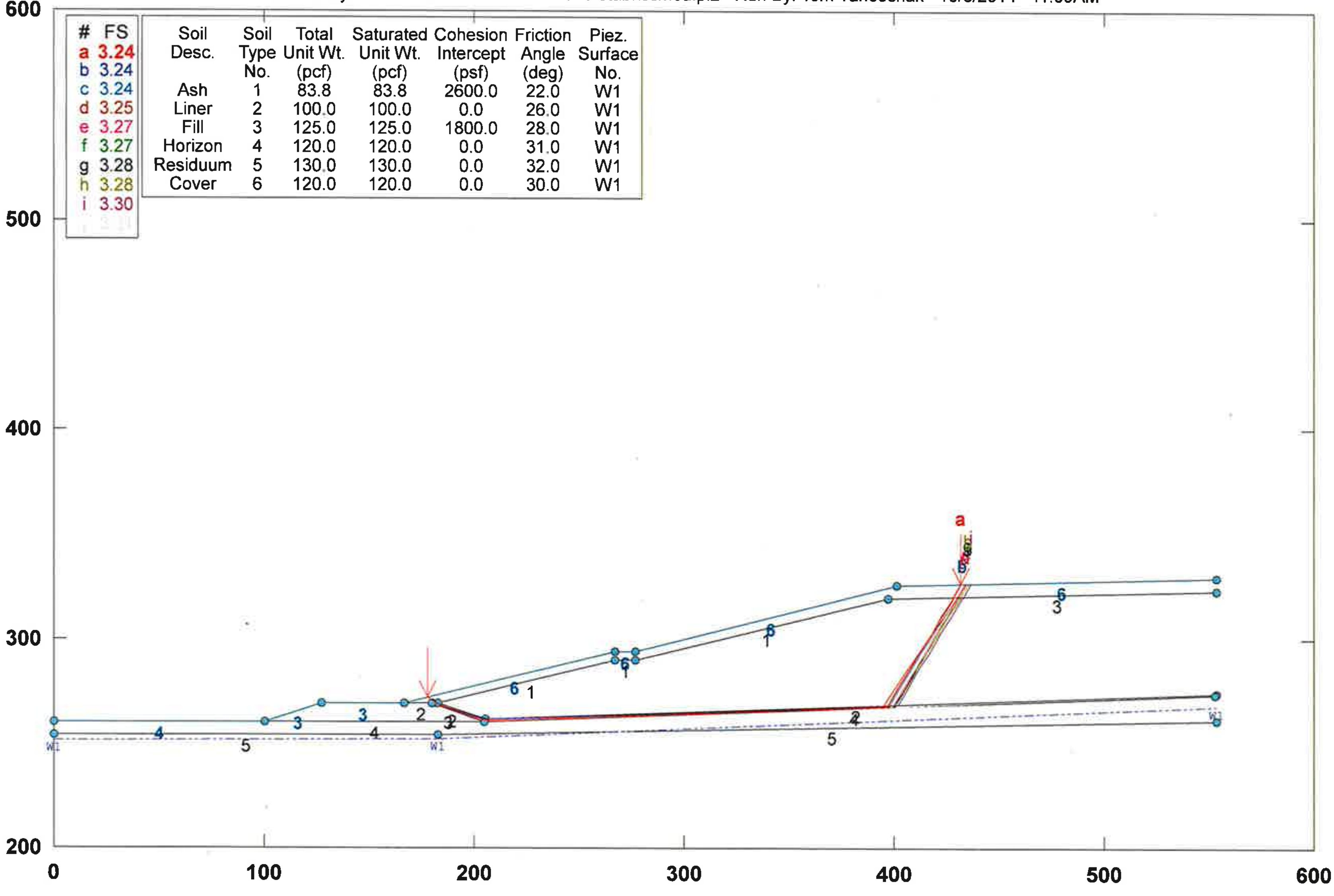
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=2.33

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

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

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



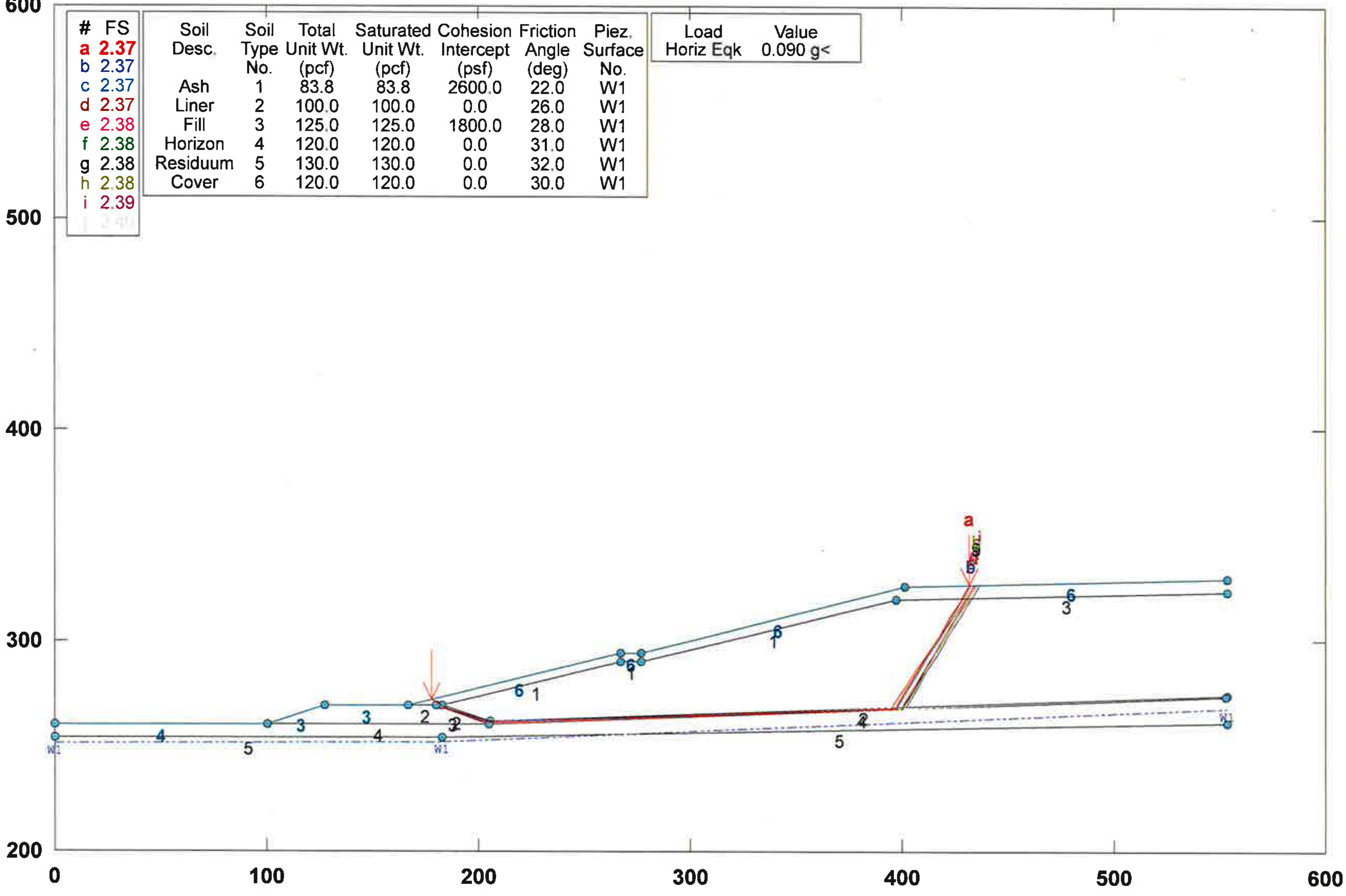
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	2600.0	22.0	W1
Liner	2	100.0	100.0	0.0	26.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	0.0	31.0	W1
Residuum	5	130.0	130.0	0.0	32.0	W1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

PCSTABL5M/si FSmin=3.24

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

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

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



#	FS
a	**2.37**
b	2.37
c	2.37
d	2.37
e	2.38
f	2.38
g	2.38
h	2.38
i	2.39
j	2.40

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

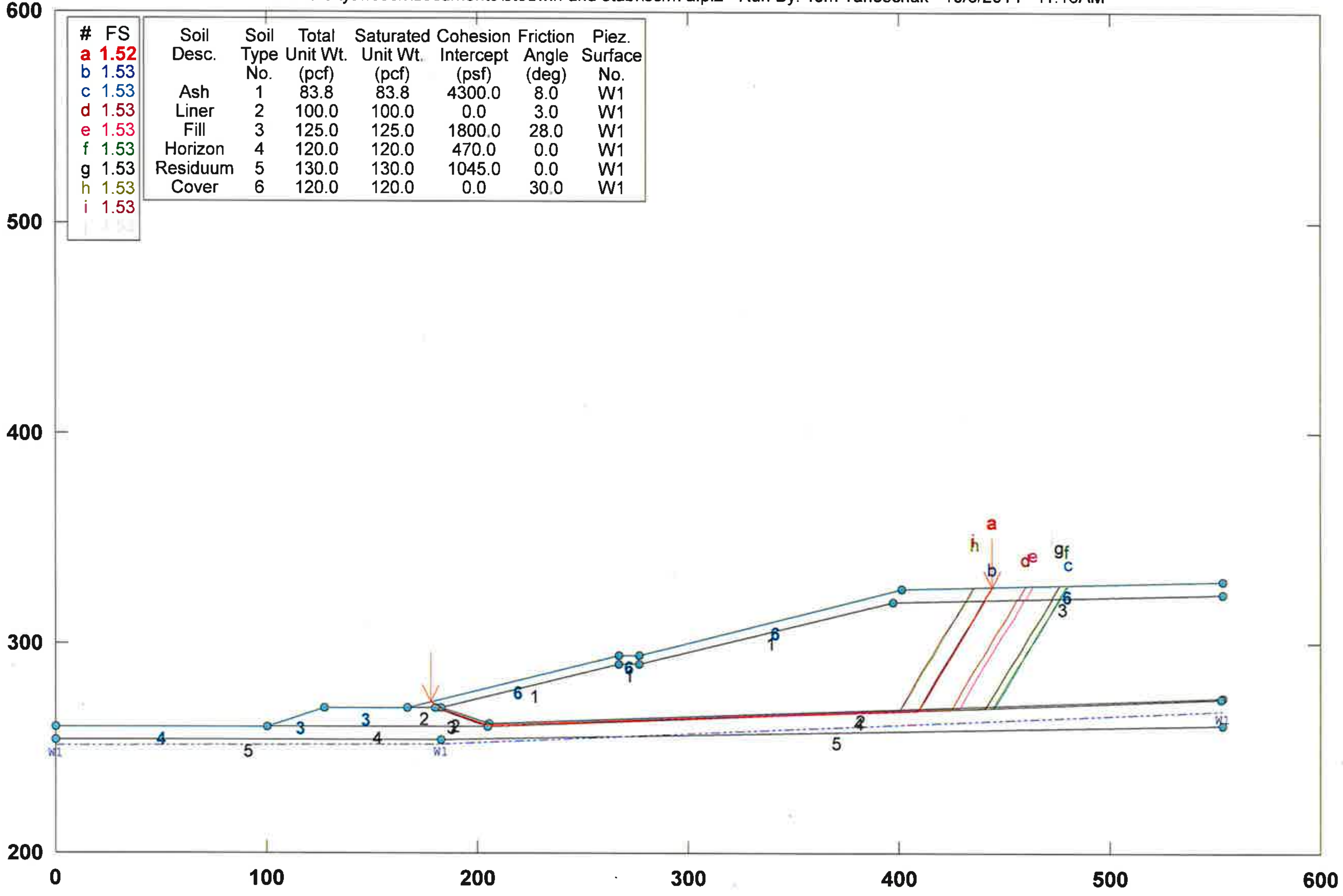
Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=2.37

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

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

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



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

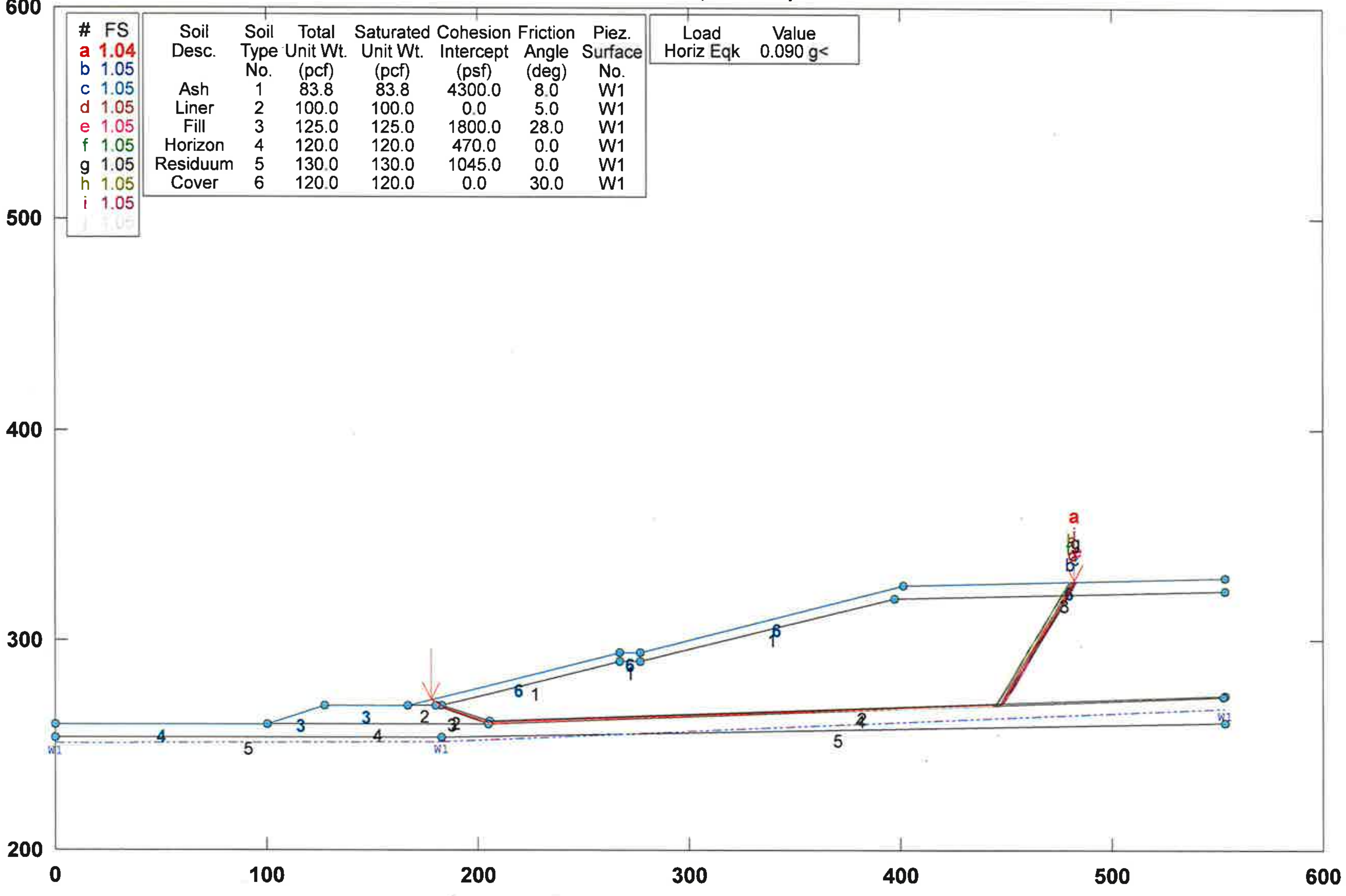
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Ash	1	83.8	83.8	4300.0	8.0	W1
Liner	2	100.0	100.0	0.0	3.0	W1
Fill	3	125.0	125.0	1800.0	28.0	W1
Horizon	4	120.0	120.0	470.0	0.0	W1
Residuum	5	130.0	130.0	1045.0	0.0	W1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

PCSTABL5M/si FSmin=1.52

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

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

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



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

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

Load	Value
Horiz Eqk	0.090 g<

PCSTABL5M/si FSmin=1.04

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

ATTACHMENT A

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, PZ-1

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/15/14
Date Completed: : 7/15/14
Drilling Company: : Red Dog Drilling
Drillers Name: : Mark Seiler
NC Driller Certification: : 2789A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-45C
Top-of-Casing Elev.: : 269.36'(Lawrence Survey)
Ground Surface Elev.: : 266.78'(Lawrence Survey)
Natural, Cut, Fill Grade: : Fill (road bed)

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

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

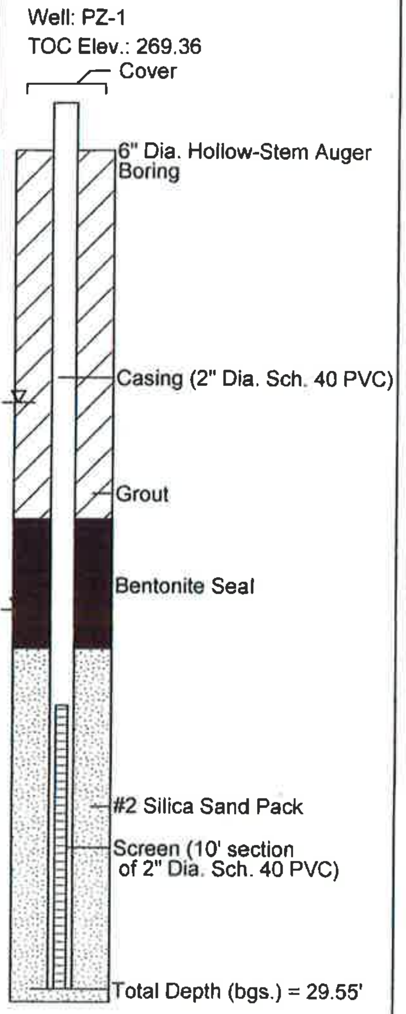
Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	266.78	4 32 35 67	SS	14	dry; very hard; red (2.5YR 4/6) with brown mottles; fine to carse sandy silty clay with brick gravel fragments; cohesive; medium plasticity; Fill ~~CH~~ CL
5	261.78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

Auger Refusal @ 30'

Fill
CL

CL

PWR



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, PZ-2s and 2

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/15/14
Date Completed: : 7/16/14
Drilling Company: : Red Dog Drilling
Drillers Name: : Mark Seiler
NC Driller Certification: : 2789A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-45C
Top-of-Casing Elev.: : 276.93'/276.84'
Ground Surface Elev.: : 274.31'
Natural, Cut, Fill Grade: : Fill (road bed)

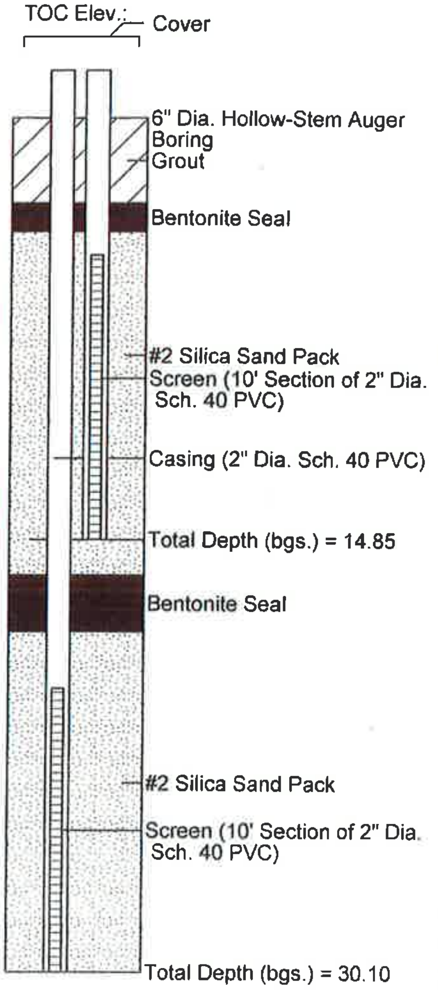
Water Levels
▼ 1 Hour = dry/16.10' bgs
▽ 24 Hours = dry/11.84' bgs

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

	Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
	0	274.31	17 18 24 42	SS	21	dry; compact; reddish yellow (7.5YR 6/8); horizontal fissle; clayey silt with gravel and brick fragments; no plasticity or cohesion; Fill MH
Fill MH	5	269.31	14 8 18 26	SS	20	moist; very stiff; brown (10YR 5/3) with gray and white mottles; quartz gravelly fine sandy clayey silt with roots and organic odor; low plasticity; cohesive; Fill MH
CH	10	264.31	4 4 6 10	SS,ST	20,24	moist; stiff; brownish yellow (10YR 6/6) with light gray and light orange mottles; coarse quartz sandy clayey silt; low plasticity; cohesive; Flood Plain; (Lab Results: PZ-2 UD (9-11'); USCS=CH; Gravel=2.1%; Sand=15.3%; Silt= 40.2%; Clay=42.4%; Specific Gravity=2.66' Hydraulic Conductivity= 6.23 x 10-5 cm/sec; Total Porosity=40.7%; Effective Porosity=2%; Atterberg Limits: PL=25, LL=50; PI=25) CH
PWR	15	259.31	30 50/4"	SS	12	dry; very hard; yellowish red (5YR 4/6) with black manganese horizontal planes between fissle layers; clayey silt; low plasticity; cohesive; Partially Weathered Rock
CL	20	254.31	12 12 20 32	SS	16	moist; hard; red (2.5YR 5/6) with yellow stringers; silty clay; CL low plasticity; cohesive; Residuum
PWR	25	249.31	26 20 30 50	SS	18	moist; hard; reddish brown (2.5YR 5/4) with light green gray and black stringers; horizontal fissle; fine sandy clayey silt; low plasticity; cohesive; Residuum MH
	30	244.31	17 22 50/2"	SS,BAG	14	wet; very hard; red (2.5YR 4/8); silty clay; low plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-2 Bag (29-30.5'); USCS=CL; Sand=2.2%; Silt=70.7%; Clay=27.1%; Effective Porosity=4; Atterberg Limits= PL=22, LL=43, PI=21)
	35	239.31				
	40	234.31				
	45					

Auger Refusal @ 30.5'

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



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, PZ-3s and 3

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

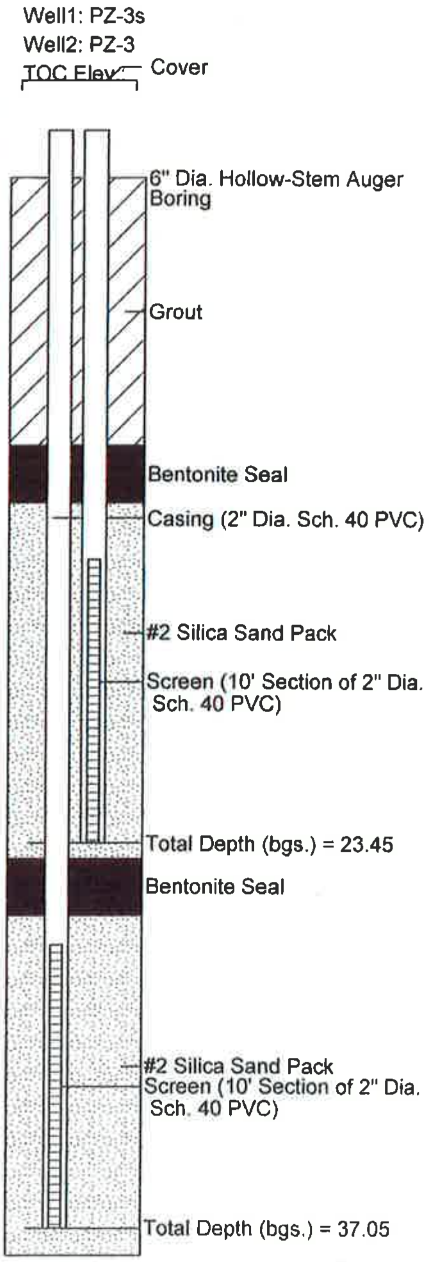
Date Started: : 7/16/14
Date Completed: : 7/16/14
Drilling Company: : Red Dog Drilling
Drillers Name: : Mark Seiler
NC Driller Certification: : 2789A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-45C
Top-of-Casing Elev.: : 299.12'/299.29'
Ground Surface Elev.: : 296.20'
Natural, Cut, Fill Grade: : slight cut

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

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

	Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
CL	0	296.2 SH	4 6 8 14	SS,ST	16,24	moist; stiff; yellowish red (5YR 5/6) with light gray and orange yellow mottled; fine to coarse sandy gravelly clayey silt; low plasticity; cohesive; Soil Horizon; (Lab Results: PZ-3 UD (0-2'); USCS=CL; Sand=6.7%; Silt=52.8%; Clay=40.5%; Specific Gravity=2.67; Hydraulic Conductivity=2.42 x 10-6 cm/sec; Total Porosity=39.3%; Effectuve Porosity=2%; Atterberg Limits: PL=27, LL=48, PI=21) CL
	5	291.2	7 8 11 19	SS	14	moist; very stiff; red (2.5YR 4/6) with white and brown specks; clayey fine to coarse sandy and gravelly silt; no plasticity; cohesive; Residuum MH
MH	10	286.2	7 16 16 32	SS	14	dry; hard; reddish brown (2.5YR 5/4) with light orange and maroon mottles; clayey silt; no plasticity; cohesive; Residuum MH
PWR	15	281.2	BG. 15 44 50/3"	SS	16	moist; very hard; red (10R 5/6) with maroon mottles and vertical manganese fracture planes; clayey silt; no plasticity; cohesive; Partially Weathered Rock
	20	276.2	50/6"	SS	7	dry; very hard; reddish brown (2.5YR 5/4) with olive green and white specks; fine to medium sandy silt with rock fragments; no plasticity; cohesive; Partially Weathered Rock
	25	271.2	50/5"	SS	9	dry; very compact; reddish brown (2.5YR 5/4) with white and green specks; medium horizontal fissle; silty fine to coarse sand with gravel; no plasticity or cohesion; Partially Weathered Rock
	30	266.2	50/2"	SS	5	dry; very hard; weak red (10R 5/3); highly horizontal fissle; fine mica sandy silt; no plasticity; cohesive; Partially Weathered Rock
	35	261.2	50/5"	SS,BAG	6	moist; weak red (10R 4/3) with green, yellow and black specks and mottles; slightly clayey silty fine to coarse sand with phyllite gravel; no plasticity or cohesion; Partially Weathered Rock; (Lab Results: PZ-3 Bag (34-34.5'); USCS=SM; Gravel=12.8%; Sand=59.7%; Silt and Clay=27.5%; Effective Porosity=30%)
	40	256.2				Auger Refual @ 38'
	45					



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, PZ-4

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

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

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

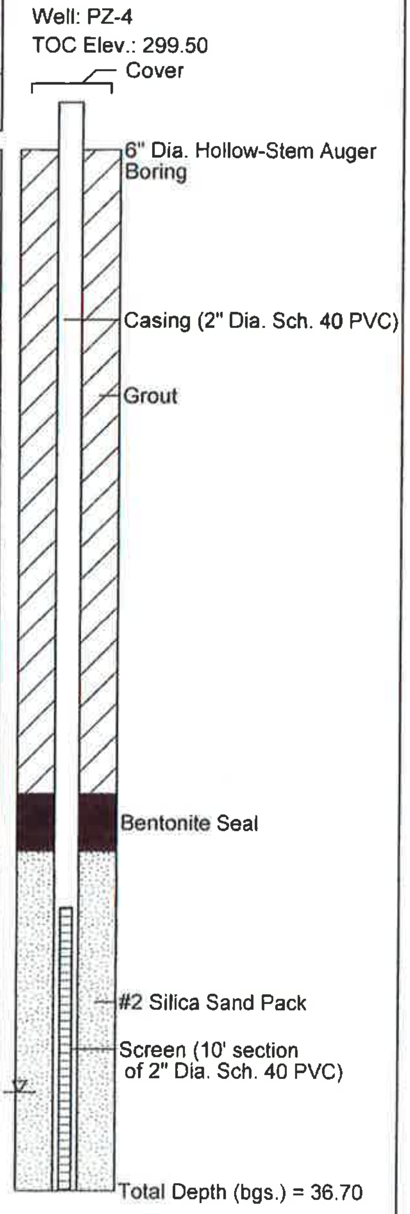
Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)
0	296.82
5	291.82
10	286.82
15	281.82
20	276.82
25	271.82
30	266.82
35	261.82
40	256.82
45	

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

Auger Refusal @ 36.7'

MH
CH
MH
PWR
5'H



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, PZ-4D

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/16/14
Date Completed: : 7/16/14
Drilling Company: : Geologic Exploration
Drillers Name: : Johnny Burr
NC Driller Certification: : 3098A

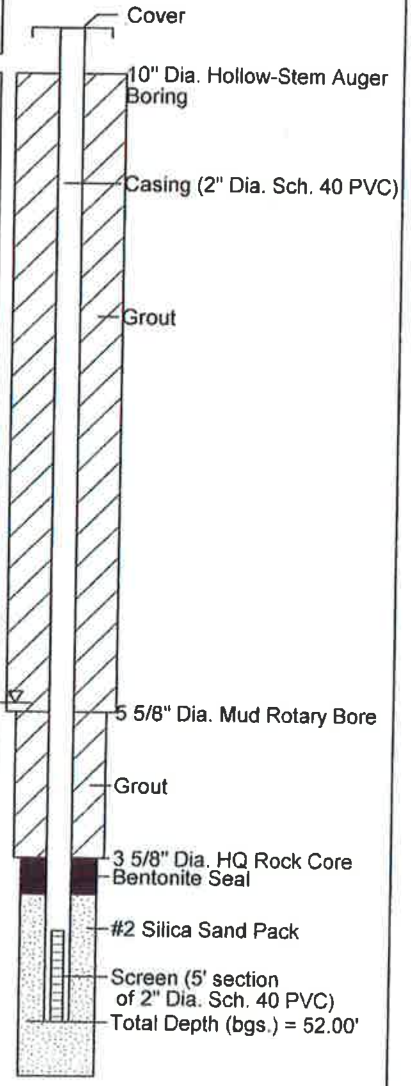
Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; Geoprobe 8040DT
Top-of-Casing Elev.: : 299.76'(Lawrence Survey)
Ground Surface Elev.: : 297.25'(Lawrence Survey)
Natural, Cut, Fill Grade: : slight cut

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

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

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

Well: PZ-4D
TOC Elev.: 299.76



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, PZ-5

(Page 1 of 1)

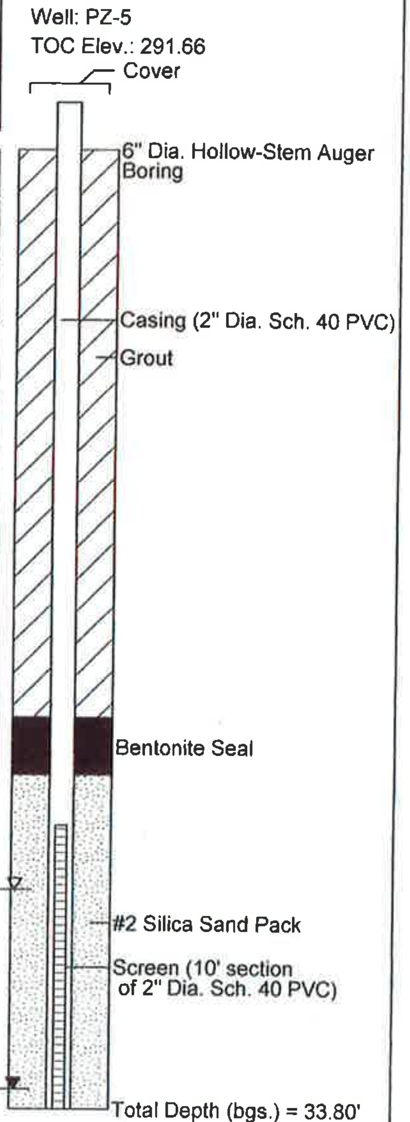
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

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

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

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

	Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
CL	0	289.11	3 5 6 11	SS	16	moist; stiff; yellow (10YR 7/8) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon CL
		slt				
	5	284.11	3 4 5 9	SS	19	wet; stiff; red (2.5YR 5/6) with yellow and light gray mottles; silty clay; low plasticity; cohesive; Soil Horizon CL
				ST	24	moist; red (2.5YR 4/6); clayey silt and silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-5 UD (6-8'); USCS=CL; Sand=2.2%; Silt=62.1%; Clay=35.7%; Specific Gravity=2.69; Hydraulic Conductivity=2.43 x 10-7 cm/sec; Total Porosity=30.6%; Effective Porosity=2%; Atterberg Limits: PL=26, LL=48, PI=22) CL
	10	279.11	10 22 37 59	SS	15	
MH						moist; very hard; red (2.5YR 4/6); medium horizontal fissle; clayey silt; low plasticity; cohesive; Residuum MH
	15	274.11	12 31 32 63	SS	18	moist; very hard; red (2.5YR 4/6); medium horizontal fissle; clayey silt; low plasticity; cohesive; Residuum MH
PWR	20	269.11	33 50/5"	SS	14	moist; very hard; weak red (10R 4/3) with dark gray mottles; blocky horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
	25	264.11	50/6"	SS	14	moist; very hard; red (10R 4/6); highly horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
	30	259.11	50/2"	SS	5	moist; very hard; red (10R 4/6) with gray pods; highly horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock
	35	254.11	50/6"	SS,BAG	8	wet; very hard; red (10R 4/6) with gray pods; highly horizontal fissle; slightly clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-5 Bag (34-34.5'); USCS=CL; Sand 13.7%; Silt=73.6; Clay=12.7%; Effective Porosity=8; Atterberg Limits: PL=20, LL=32, PI=12)
	40	249.11				
	45					



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, PZ-6

(Page 1 of 1)

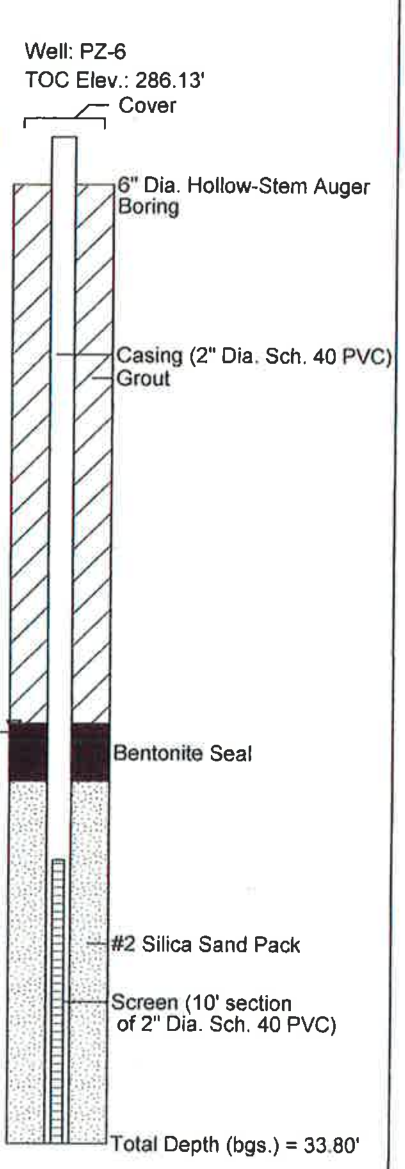
Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

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

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

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

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
ML 0	283.48	3 5 8 13	SS	10	moist; medium compact; yellow (10YR 7/6); horizontal fissle; silt; no plasticity or cohesion; Soil Horizon ML
				SM	
5	278.48	4 3 5 8	SS	13	moist; medium; pale yellow (2.5 Y 7/4) with light rust mottles; silty clay with roots; low plasticity; cohesive; Soil Horizon CL
CL					
10	273.48	7 11 15 26	SS	20	moist; very stiff; dark reddish gray (2.5YR 4/1) with white and yellow mottles; silty clay; low plasticity; cohesive; Residuum CL
			ST	7	moist; weak red (10R 4/4); clayey silt; no plasticity; cohesive; Residuum; (Lab Results: PZ-6 UD (10.5-11'); USCS=CL; Sand=11.3%, Silt=72.5%, Clay=16.2%; Specific Gravity=2.68; Hydraulic Conductivity=6.01 x 10-6 cm/sec; Total Porosity=30.7%; Effective Porosity=8%; Atterberg Limits: PL=23, LL=37, PI=14) CL
15 PWR	268.48	9 21 50/5"	SS	24	moist; very hard; red (2.5YR 4/6); fine to coarse sandy clayey silt with gravel and rock fragments; no plasticity; cohesive; Partially Weathered Rock
		50/4"	SS,BAG	6	dry; very hard; dark reddish brown (2.5YR 4/1); silty medium to coarse sand with rounded phyllite gravel; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-6 Bag (19-19.5'); USCS=SC; Sand=59.9%; Silt=27.1%; Clay=13.0%; Effective Porosity=16%; Atterberg Limits: PL=18, LL=33, PI=15)
20	263.48				
		50/1"	SS	1	moist; very hard; reddish brown (2.5YR 4/4); horizontal fissle; weathered mudstone; Partially Weathered Rock
25	258.48				
		50/.5"	SS	1	dry; very hard; weak red (2.5YR 5/2); horizontal fissle; sandy mudstone; Partially Weathered Rock
30	253.48				
		50/.5"	SS	1	dry; very hard; weak red (2.5YR 5/2); weathered silty conglomerate; Partially Weathered Rock
35	248.48				
40	243.48				
45					



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, PZ-7

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/17/14
Date Completed: : 7/17/14
Drilling Company: : Red Dog Drilling
Drillers Name: : Mark Seiler
NC Driller Certification: : 2789A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA
Top-of-Casing Elev.: : 290.57'(Lawrence Survey)
Ground Surface Elev.: : 287.92'(Lawrence Survey)
Natural, Cut, Fill Grade: : slight cut

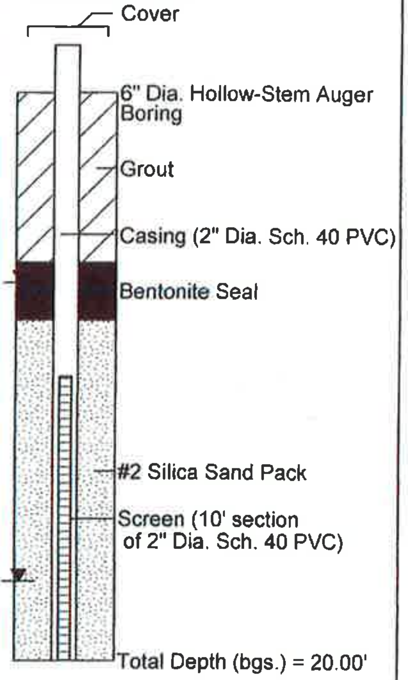
Water Levels
▼ 1 Hour = 17.20' bgs
▽ 24 Hours = 6.69' bgs

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

MH
SH
CL
PWR

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

Well: PZ-7
TOC Elev.: 290.57



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, PZ-8

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

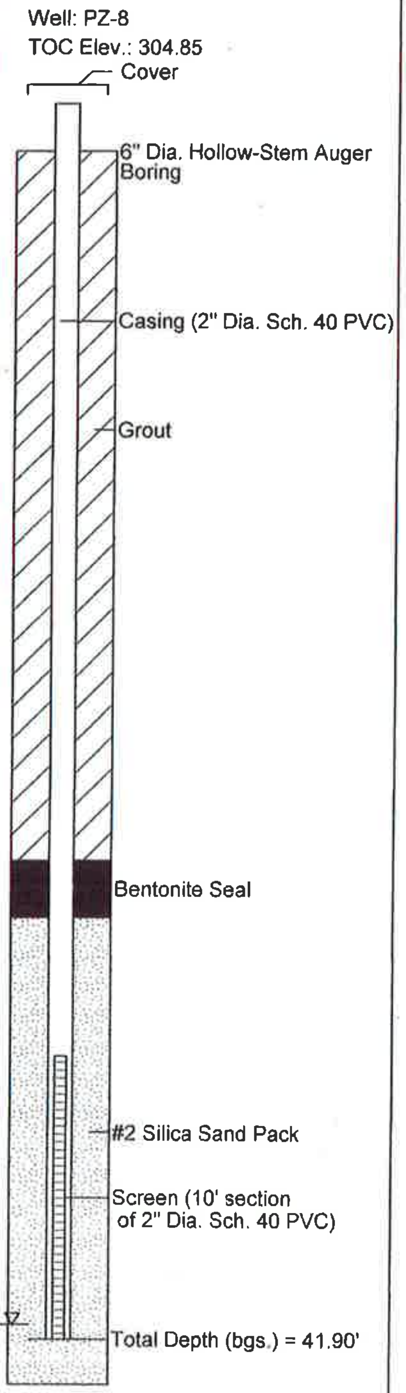
Date Started: : 7/21/14
Date Completed: : 7/21/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 304.85'(Lawrence Survey)
Ground Surface Elev.: : 302.56'(Lawrence Survey)
Natural, Cut, Fill Grade: : slight cut

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

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

	Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
	0	302.56	4 5 8 13	SS	18	moist; stiff; strong brown (7.5Y 5/8) with white specks; silty clay; medium plasticity; cohesive; Residuum CL
CL	5	297.56	3 4 6 10	SS	14	moist; stiff; red (2.5YR 4/6) with light orange mottles; silty clay; low plasticity; cohesive; Residuum CL
	10	292.56	4 6 9 15	SS	15	moist; stiff; red (2.5YR 4/6); silty clay; low plasticity; cohesive; Residuum CL
	15	287.56	10 13 13 26	SS,BAG	16	moist; very stiff; red (2.5YR 4/6) with orange mottles and black stringers; silty clay; low plasticity; cohesive; Residuum; (Lab Results: PZ-8 Bag (13.5-15'); USCS=CL; Sand=3.1%; Silt=68.1%; Clay=28.8%; Effective Porosity=3%; Atterberg Limits: PL=23, LL=39, PI=16) CL
ML	20	282.56	9 13 17 30 BG	SS	14	moist; very stiff; red (10R 4/8) with light gray and yellow mottles; clayey quartz and phyllite gravelly silt; no plasticity; cohesive; Residuum ML
	25	277.56	8 13 15 28	SS	20	moist; very stiff; red (10R 4/6) with light gray and yellow mottles; clayey quartz and phyllite gravelly silt; no plasticity; cohesive; Residuum ML
PWR	30	272.56	9 27 50/5"	SS	20	moist; very hard; red (10R 4/8) with maroon mottles; silty clay; low plasticity; cohesive; Residuum CL
	35	267.56	34 50/5"	SS	15	moist; very hard; red (10R 4/8) with maroon mottles; silty clay; low plasticity; cohesive; Residuum CL
	40	262.56	50/5"	SS	12	dry; very compact; weak red (10R 4/4); clayey silty fine to coarse sand; no plasticity or cohesion; Partially Weathered Rock SC
	45		50/5"	SS	10	moist; very hard; red (10R 4/8); highly horizontal fissle; silty clay; low plasticity; cohesive; Partially Weathered Rock CL



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, PZ-9s and 9

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/21/14
Date Completed: : 7/21/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

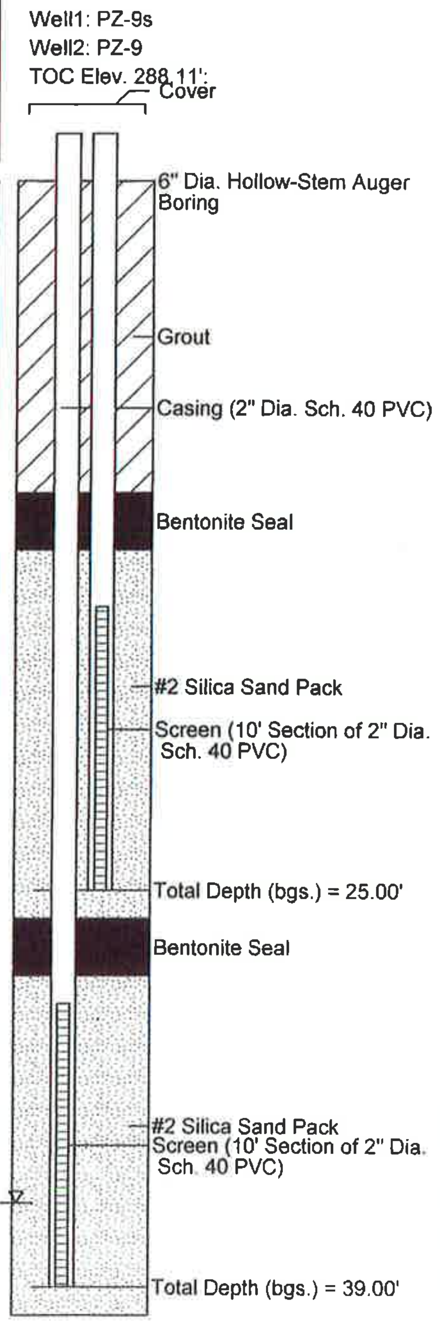
Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 288.11'/288.11'
Ground Surface Elev.: : 285.74'
Natural, Cut, Fill Grade: : slight cut

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

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

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

CL
SH
Basegrade
SC
PWR



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, PZ-10

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/21/14
Date Completed: : 7/21/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 266.51'(Lawrence Survey)
Ground Surface Elev.: : 263.48'(Lawrence Survey)
Natural, Cut, Fill Grade: : slight cut

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

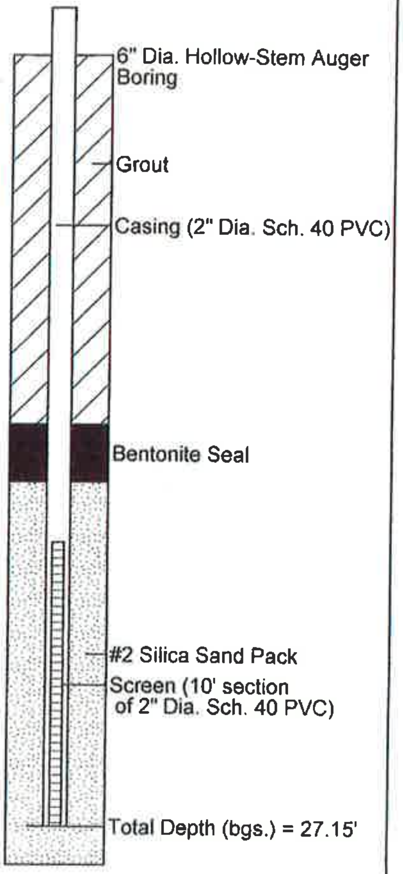
Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Well: PZ-10
TOC Elev.: 266.51

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.48	3 5 6 6 11	SS	24	moist; stiff; reddish yellow (7.5YR 6/6) with light gray and rust mottles; silty clay; no plasticity; cohesive; Soil Horizon CL
		11 13 14 27	SS	14	dry; very stiff; red (2.5YR 4/8) with maroon and light gray mottles; clayey fine sandy silt; no plasticity; cohesive; Residuum MH
5	258.48				
		13 50/4"	SS	12	dry; very hard; red (2.5YR 4/6) with black vertical planes; blocky; silty clay; no plasticity; cohesive; Partially Weathered Rock CL
10	253.48				
		50/3"	SS	3	dry; very hard; red (2.5YR 4/6) with black vertical planes; highly horizontal fissle; mica sandy silty clay; low plasticity; cohesive; Partially Weathered Rock
15	248.48				
		50/1"	SS	2	dry; very compact; weak red (10R 5/3); silty fine to coarse sand with quartz and phyllite gravel; no plasticity or cohesion; Partially Weathered Rock
20	243.48				
		50/6"	SS	12	dry; very hard; red (10R 4/6); highly horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
25	238.48				
		29 10 16	SS,BAG	18	moist; very hard; red (10R 4/6) with light orange mottles; highly horizontal fissle; silty clay; no plasticity; cohesive; Residuum; (Lab Results: PZ-10 Bag (28.5-30'); USCS=CL; Sand=5.7%; Silt=74.0%; Clay=20.3%; Effective Porosity=5%; Atterberg Limits: PL=18, LL=36; PI=18)
30	233.48				
35	228.48				
40	223.48				
45					

SH

PWR



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, PZ-11

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/22/14
Date Completed: : 7/22/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 262.30'(Lawrence Survey)
Ground Surface Elev.: : 259.56'(Lawrence Survey)
Natural, Cut, Fill Grade: : natural (drainage bottom)

Fill 91

Water Levels

▼ 1 Hour = dry
▽ 24 Hours = 19.59' bgs

Sample Type

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

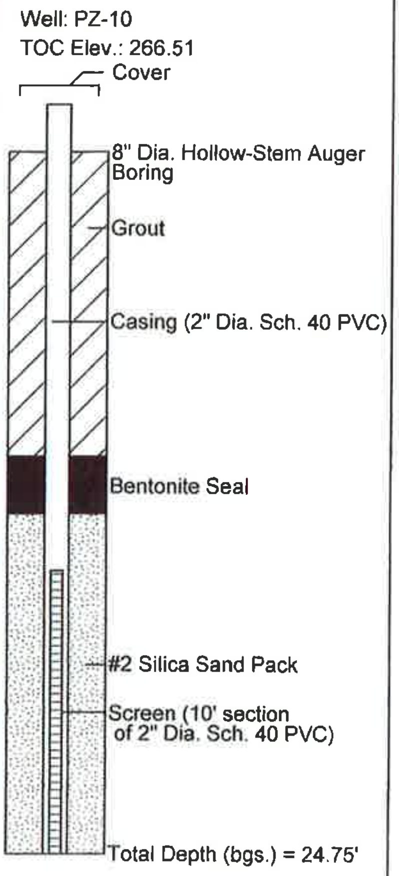
257.58

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	263.48	3 7 9 16	SS	20	moist; very stiff; reddish yellow (7.5YR 6/8) with rust and light gray mottles; quartz gravelly fine to coarse sandy clayey silt; no plasticity; cohesive; Soil Horizon MH
				Slt	
	254.58	3 7 5 12	SS	17	moist; stiff; yellowish red (5YR 4/6) with light gray mottles; fine mica sandy clayey silt; no plasticity; cohesive; Soil Horizon MH
5	258.48				
			ST	6	dry; red (2.5YR 4/6), mica and quartz sandy silt; low plasticity; cohesive; Residuum; (Lab Results: PZ-11 UD (6-6.5'); USCS=SM; Gravel=4.8%; Sand=65.5%; Silt=22.6%; Clay=7.1%; Specific Gravity=2.71; Hydraulic Conductivity=3.86 x 10-6 cm/sec; Total Porosity=19.7%; Effective Porosity=25%) SM
		39 50/3"	SS	12	
10	~~253.48~~ 249.58				
					dry; very hard; weak red (10R 4/3); silty fine to coarse sand with gravel; no plasticity; cohesive; Partially Weathered Rock
		16 36 50/6"	SS	15	moist; very hard; red (2.5YR 4/6) with black and purple mottles; medium horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
15	248.48				
		15 36 50/4"	SS	20	moist; very hard; red (2.5YR 4/6) with black and purple mottles; highly horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
20	243.48				
		20 10 8	SS,BAG	16	wet; very stiff; red (2.5YR 4/6) with black and purple mottles; highly horizonatl fissle; silty clay with rock and gravel layers; no plasticity; cohesive; Residuum
25	238.48				
30	233.48				
35	228.48				
40	223.48				
45					

MH

SM

PWR



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, PZ-12

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/22/14
Date Completed: : 7/22/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

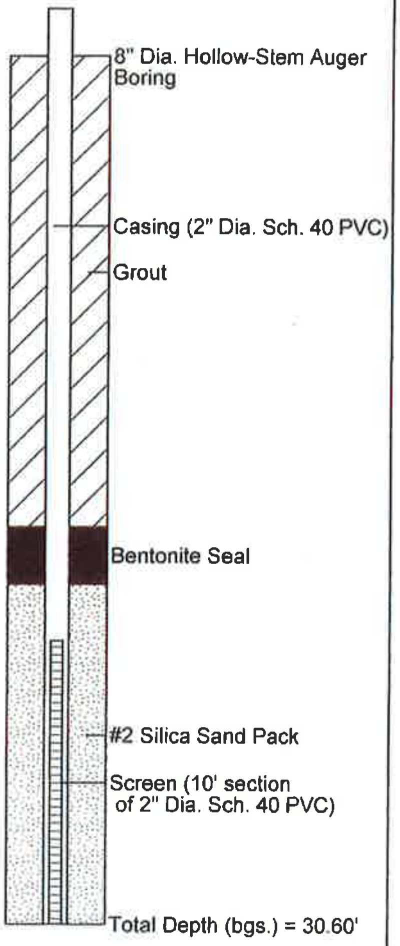
Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 287.15'(Lawrence Survey)
Ground Surface Elev.: : 284.32'(Lawrence Survey)
Natural, Cut, Fill Grade: : natural

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

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

Well: PZ-12
TOC Elev.: 287.15

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



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, PZ-13

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/22/14
Date Completed: : 7/22/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

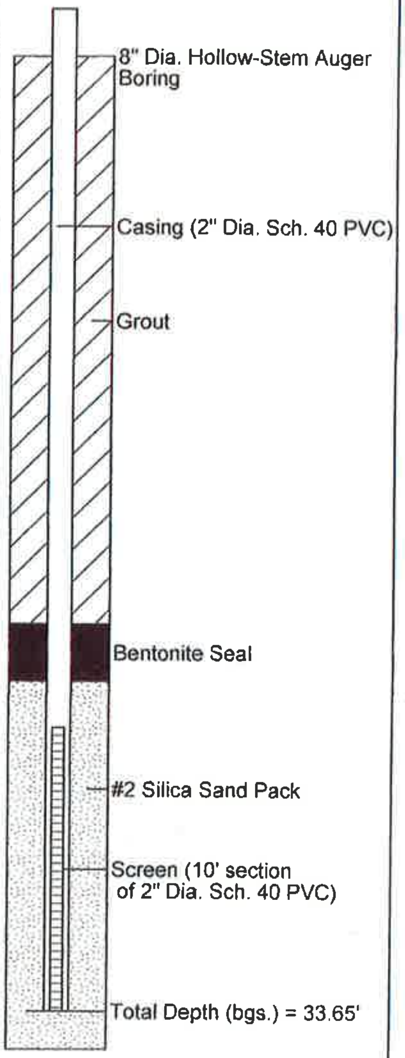
Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 296.59'(Lawrence Survey)
Ground Surface Elev.: : 293.48'(Lawrence Survey)
Natural, Cut, Fill Grade: : natural

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

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

Well: PZ-12
TOC Elev.: 296.59

	Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
	0	293.48	3 5 8 5 13	SS,BAG 3ft	10	moist; medium compact; brownish yellow (10YR 6/6) with white specks; clayey silty quartz sandy gravel; no plasticity or cohesion; Soil Horizon; (Lab Results: PZ-13 Bag (0-1.5'); USCS=SC-SM; Gravel=36.1%; Sand=37.2%; Silt=19.4%; Clay=7.3%; Effective Porosity=25%; Atterberg Limits: PL=17, LL=21, PI=4) SC-SM
SC-SM			4 6 6 6	SS	21	
ML	5	288.48	12		Cut	moist; stiff; red (2.5YR 4/6); fine to medium sandy silt and silty clay layers; low plasticity; cohesive; Residuum ML
			17 50/5" 50+	SS	6	moist; very hard; red (2.5YR 4/6); silty clay with large quartz gravel; no plasticity; cohesive; Residuum CL
CL	10	283.48				
			11 17 50/6" 50+	SS	24	moist; very hard; weak red (10R 5/3) with light green mottles; medium horizontal fissle; silty clay; no plasticity; cohesive; Residuum CL
	15	278.48				
			11 15 22 37	SS	20	moist; hard; pinkish gray (7.5YR 6/2) with black vertical and 45 degree planes; medium horizontal fissle; silty clay; no plasticity; cohesive; Residuum CL
	20	273.48				
PWR			11 50/6"	SS	18	moist; very hard; gray (7.5YR 5/1); medium horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
	25	268.48				
			11 15 50/5"	SS	22	moist; very hard; gray (7.5YR 5/1); medium horizontal fissle; silty clay; no plasticity; cohesive; Residuum
	30	263.48				
			50/1"	SS	3	dry; very hard; dark blueish gray (Gley 2 4/1); weathered mudstone; Partially Weathered Rock
	35	258.48				Auger Refusal @ 35'
	40	253.48				
	45					



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, PZ-14

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/23/14
Date Completed: : 7/23/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 322.15'(Lawrence Survey)
Ground Surface Elev.: : 319.44'(Lawrence Survey)
Natural, Cut, Fill Grade: : natural

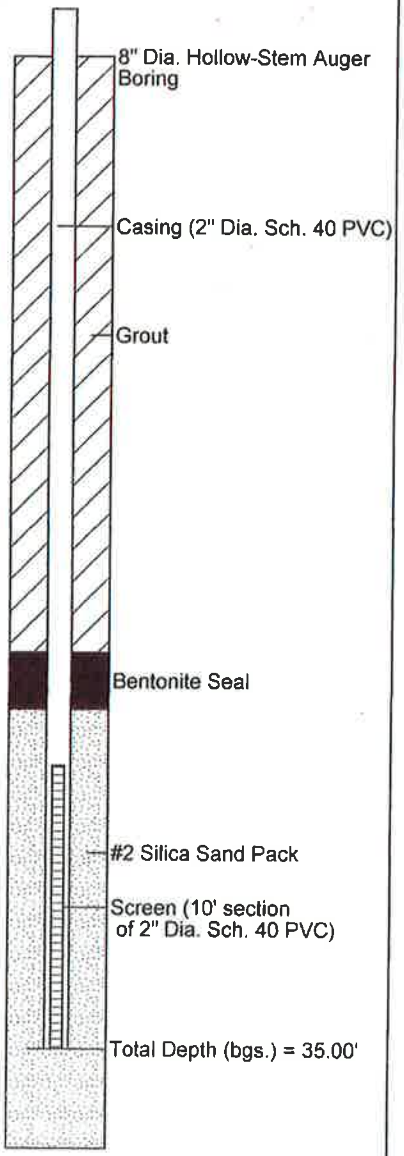
Water Levels
▼ 1 Hour = dry
▽ 24 Hours = dry

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

Well: PZ-14
TOC Elev.: 322.15

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

Auger Refusal @ 39'



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, PZ-15s and 15

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/23/14
Date Completed: : 7/23/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 303.11'/303.24'
Ground Surface Elev.: : 300.63'
Natural, Cut, Fill Grade: : natural

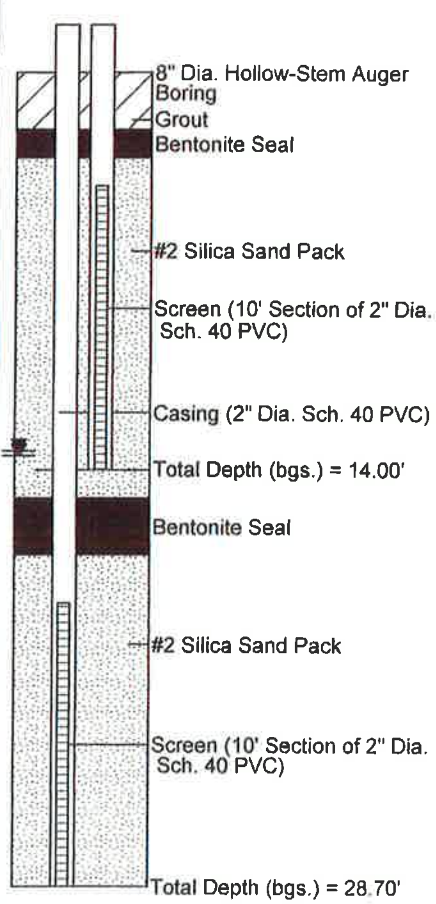
Water Levels
▼ 1 Hour = 13.48'/15.34' bgs
▽ 24 Hours = 13.65'/13.31' bgs

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

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

CL

Well1: PZ-15s
Well2: PZ-15
TOC Elev.: Cover



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, PZ-16

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 7/23/14
Date Completed: : 7/23/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 272.78'(Lawrence Survey)
Ground Surface Elev.: : 270.63'(Lawrence Survey)
Natural, Cut, Fill Grade: : natural (drainage bottom)

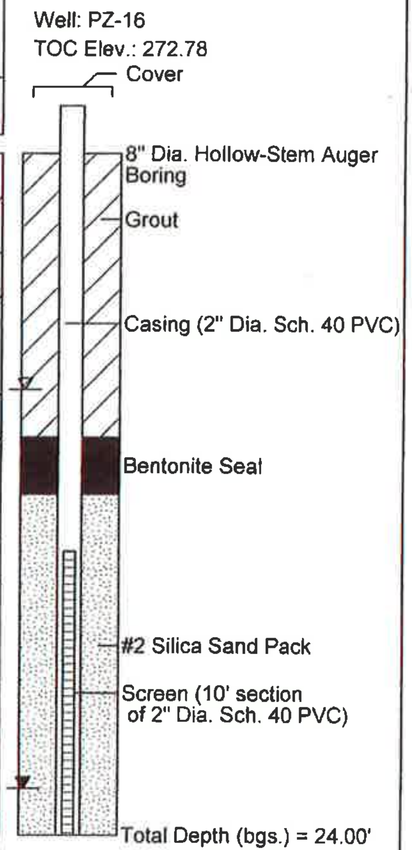
Water Levels
▼ 1 Hour = 22.35' bgs
▽ 24 Hours = 8.33' bgs

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

Depth (feet bgs.)	Elevation (feet asl.)
0	270.63
5	265.63
10	260.63
15	255.63
20	250.63
25	245.63
30	240.63
35	235.63
40	230.63
45	

MH
Silt
CL
CL
~~MH~~
PWR

Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
4 5 6 11	SS	24	moist; stiff; strong brown (7.5YR 5/6) with white specks; quartz gravelly clayey silt; no plasticity; cohesive; Soil Horizon MH
3 5 5 10	SS	16	moist; stiff; yellowish red (5YR 4/6) with light gray mottles; silty clay; low plasticity; cohesive; Soil Horizon CL
32 35 39 >50	SS	14	dry; very hard; dark red (10R 3/6); horizontal fissle; weathered mudstone; Residuum
17 31 50/5" >50	SS	16	moist; very hard; red (10R 4/6) with purple mottles; mica sandy silty clay; no plasticity; cohesive; Residuum ~~ML~~ ~~MH~~ CL
24 50/5"	SS,BAG	10	moist; very hard; red (10R 4/6) with purple mottles; silty clay; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-16 Bag (18.5-20'): USCS=CL; Sand=3.1%; Silt=65.5%; Clay=31.4%; Effective Porosity=3; Atterberg Limits: PI=19, LL=38, PI=19)
50/3"	SS	6	wet; very hard; red (10R 4/6) with purple mottles; highly horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock



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, PZ-17s and 17

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

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

Water Levels

▼ 1 Hour = dry/27.44"

▽ 24 Hours = dry/27.46" bgs

Sample Type

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

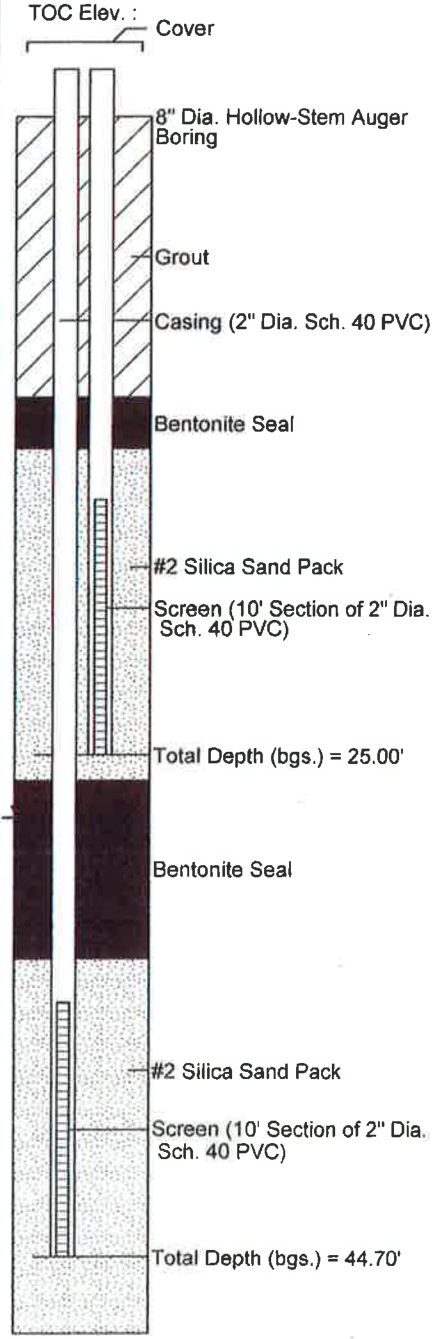
Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	304	3 4 5 9	SS	24	moist; stiff; reddish brown (5YR 4/4); silty clay; medium plasticity; cohesive; Residuum CL
5	299	3 5 7 12	SS	16	moist; stiff; reddish brown (5YR 4/4); silty clay with mudstone rock fragments; medium plasticity; cohesive; Residuum CL
10	294	50/4" >50	SS	14	dry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
15	289	50/6"	SS	8	ddry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
20	284	29 50/2"	SS	12	dry; very hard; reddish brown (2.5YR 5/4); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
25	279	18 34 26	SS	18	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissle; weathered mudstone; Residuum
30	274	25 50/3"	SS	12	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissle; weathered mica sandy mudstone; Partially Weathered Rock
35	269	50/3"	SS	8	dry; very hard; weak red (2.5YR 4/2); medium horizontal fissle; weathered mica sandy mudstone; Partially Weathered Rock
40	264	50/4"	SS	6	very moist; very hard; weak red (2.5YR 4/2); blocky; fine sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
45	259	39 50/3"	SS,BAG	14	wet; very hard; reddish brown (2.5YR 4/4); medium horizontal fissle; weathered mudstone; Partially Weathered Rock; (Lab Results: PZ-17 Bag (43.5-44.5'); USCS=CL; Sand=40.2%; Silt=48.9%; Clay=10.9%; Effective Porosity=16%; Atterberg Limits: PL=19, LL=32, PI=13)
50					

CL

PWR

TpWR

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



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, PZ-18

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

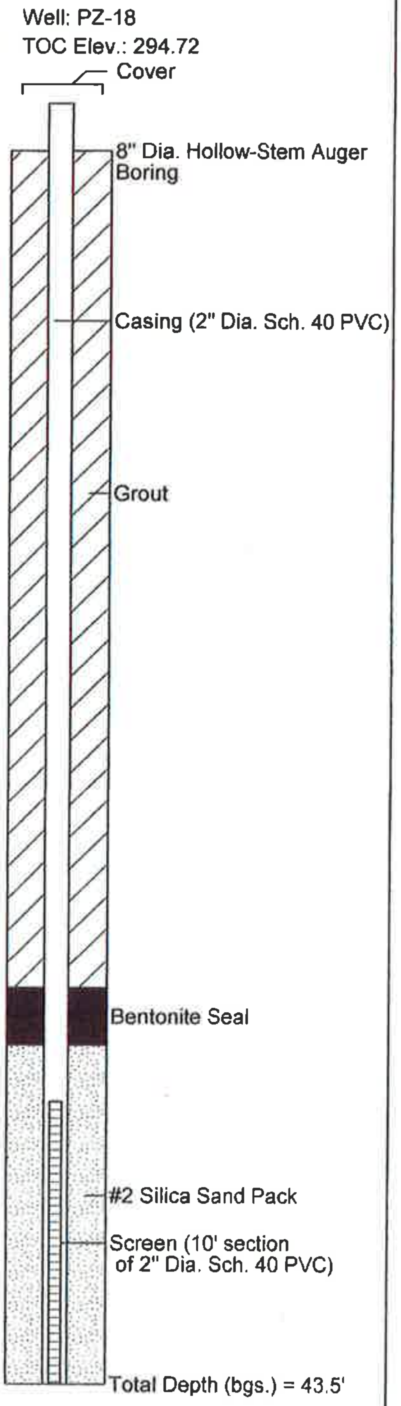
Date Started: : 7/23/14
Date Completed: : 7/23/14
Drilling Company: : Summit Engineering
Drillers Name: : Robert Cassell
NC Driller Certification: : 4143A

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; CME-550x
Top-of-Casing Elev.: : 294.72'(Lawrence Survey)
Ground Surface Elev.: : 292.27'(Lawrence Survey)
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
MH 0	292.27 5ft	1 5 6	SS	22	moist; medium, brownish yellow (10R 6/6); slightly clayey silt; no plasticity; cohesive; Soil Horizon MH
CL 5	287.27	4 4 5 9	SS	16	moist; stiff; reddish yellow (7.5YR 6/8) with tan and rust mottles; silty clay; medium plasticity; cohesive; Soil Horizon CL
10	282.27	5 7 12 19	SS	15	moist; very stiff; red (10R 4/8) with light green gray mottles; silty clay; low plasticity; cohesive; Residuum CL BG
MH 15	277.27	27 21 24 45	SS	18	moist; hard; red (10R 4/8) with light green gray mottles; highly horizontal fissle; very fine sandy clayey silt; no plasticity; cohesive; Residuum MH
PWR 20	272.27	40 50/3"	SS,BAG	12	moist; very hard; red (10R 4/8) with light green gray mottles; highly horizontal fissle; very fine sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock; (Lab Results: PZ-18 Bag (18.5-19.5'); USCS=CL; Sand=24.4%; Silt=55.7%; Clay=19.9%; Effective Porosity=8%; Atterberg Limits: PL=17, LL=32, PI=15)
25	267.27	9 50/3"	SS	10	moist; very hard; red (10R 4/8) with black horizontal planes; blocky and medium horizontal fissle; silty clay; no plasticity; cohesive; Partially Weathered Rock
30	262.27	50/6"	SS	6	moist; very hard; red (10R 4/8); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
35	257.27	50/3"	SS	6	dry; very hard; weak red (10R 4/3); highly horizontal fissle; fine mica sandy silt; no plasticity; cohesive; Partially Weathered Rock
40	252.27	50/3"	SS	5	moist; very hard; red (10R 4/8); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
45		50/3"	SS	4	moist; very hard; red (10R 4/8) with purple mottles; blocky; weathered mudstone; Partially Weathered Rock



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, PZ-19

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 8/29/14
Date Completed: : 8/29/14
Drilling Company: : Environmental Drilling & Probing
Drillers Name: : Tommy Bolyard
NC Driller Certification: : 3307

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; Geoprobe 7822
Top-of-Casing Elev.: : (Lawrence Survey)
Ground Surface Elev.: : 265.99'(Lawrence Survey)
Natural, Cut, Fill Grade: : slight cut

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

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

Fill

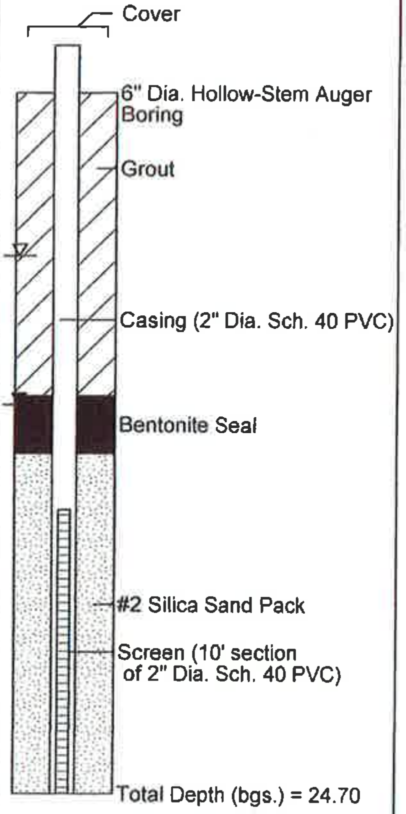
Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	265.99	2 2 3 3 5 5|4	SS	24	wet; medium; light brownish gray (10YR 6/2) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon CL
5	260.99	1 1 2 3	SS	18	wet; soft; light brownish gray (10YR 6/2) with light orange mottles; silty clay; medium plasticity; cohesive; Soil Horizon CL
10	255.99	15 20 27 47	SS	17	moist; hard; yellowish brown (10YR 5/4); medium horizontal fissle; clayey silt; no plasticity; cohesive; Residuum MH
15	250.99	6 18 50/4"	SS	24	moist; very hard; yellowish brown (10YR 5/4) with black manganese planes; medium horizontal fissle; clayey silt; no plasticity; cohesive; Residuum MH
20	245.99	24 50/3"	SS	10	dry; very hard; brown (10YR 5/3); highly horizontal fissle; weathered mudstone; Partially Weathered Rock
25	240.99	14 14 50/3"	SS	12	wet; very hard; reddish brown (5YR 4/3); medium horizontal fissle; weathered mudstone; Partially Weathered Rock
30	235.99				
35	230.99				
40	225.99				
45					

CL

MH

PWR

Well: PZ-19
TOC Elev.:



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, PZ-20

(Page 1 of 1)

Sanford Mine Reclamation Site
1303 Brickyard Road
Sanford, North Carolina

Date Started: : 8/29/14
Date Completed: : 8/29/14
Drilling Company: : Environmental Drilling & Probing
Drillers Name: : Tommy Bolyard
NC Driller Certification: : 3307

Logged By: : Ross Klingman, P.G.
Drilling Method: : HSA; Geoprobe 7822
Top-of-Casing Elev.: : (Lawrence Survey)
Ground Surface Elev.: : 296.51'(Lawrence Survey)
Natural, Cut, Fill Grade: : natural

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

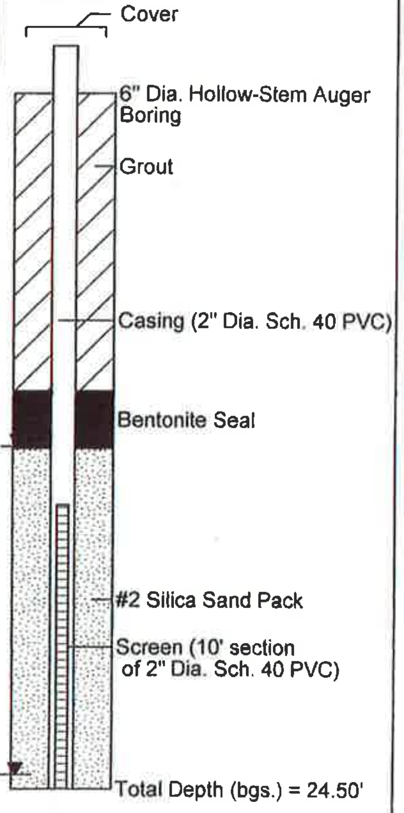
Sample Type
SS = Split Spoon
ST = Shelby Tube
RC = Rock Core
BAG = Bag Sample

Depth (feet bgs.)	Elevation (feet asl.)	Blow Count/6-inches	Sampler Type	Recovery (in.)	Lithologic Description
0	296.51	2 3 3 6	SS	24	moist; medium; Red (2.5YR 4/6) with yellow mottles; fine sandy silty clay; low plasticity; cohesive; Soil Horizon CL
		2 4 5 9	SS	24	moist; stiff; red (2.5YR 4/6) with yellow mottles; fine sandy silty clay; low plasticity; cohesive; Soil Horizon CL
5	291.51		3 14		
		5 5 6 11	SS	20	moist; stiff; red (2.5YR 4/6) with yellow mottles; mica sandy silty clay; low plasticity; cohesive; Soil Horizon CL
10	286.51				
		4 5 7 12	SS	18	very moist; stiff; weak red (10R 4/4) with white and light gray specks; phyllite and quartz gravelly sandy silty clay; no plasticity; cohesive; Residuum CL
15	281.51				
		50/3"	SS	8	dry; very hard; weak red (10R 4/4) with white and light gray specks; weathered mudstone; Partially Weathered Rock
20	276.51				
		50/4"	SS	8	wet; very hard; red (10R 4/6); highly horizontal fissle; mica sandy clayey silt; no plasticity; cohesive; Partially Weathered Rock
25	271.51				
30	266.51				
35	261.51				
40	256.51				
45					

CL

PWR

Well: PZ-20
TOC Elev.:



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

PE 17088
6/30/14
DAVID D. WILSON

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

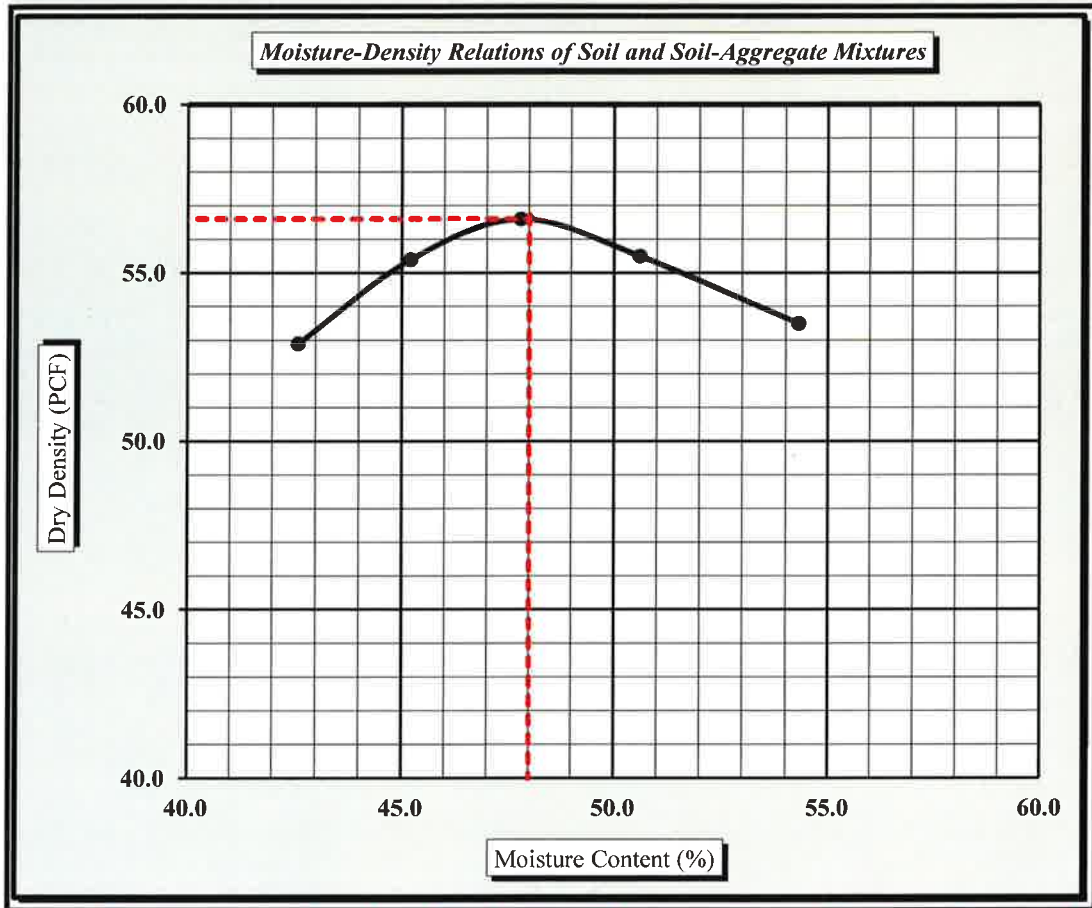
S&ME, Inc. - Greenville **281 Fairforest Way Greenville, SC 29607**

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*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

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

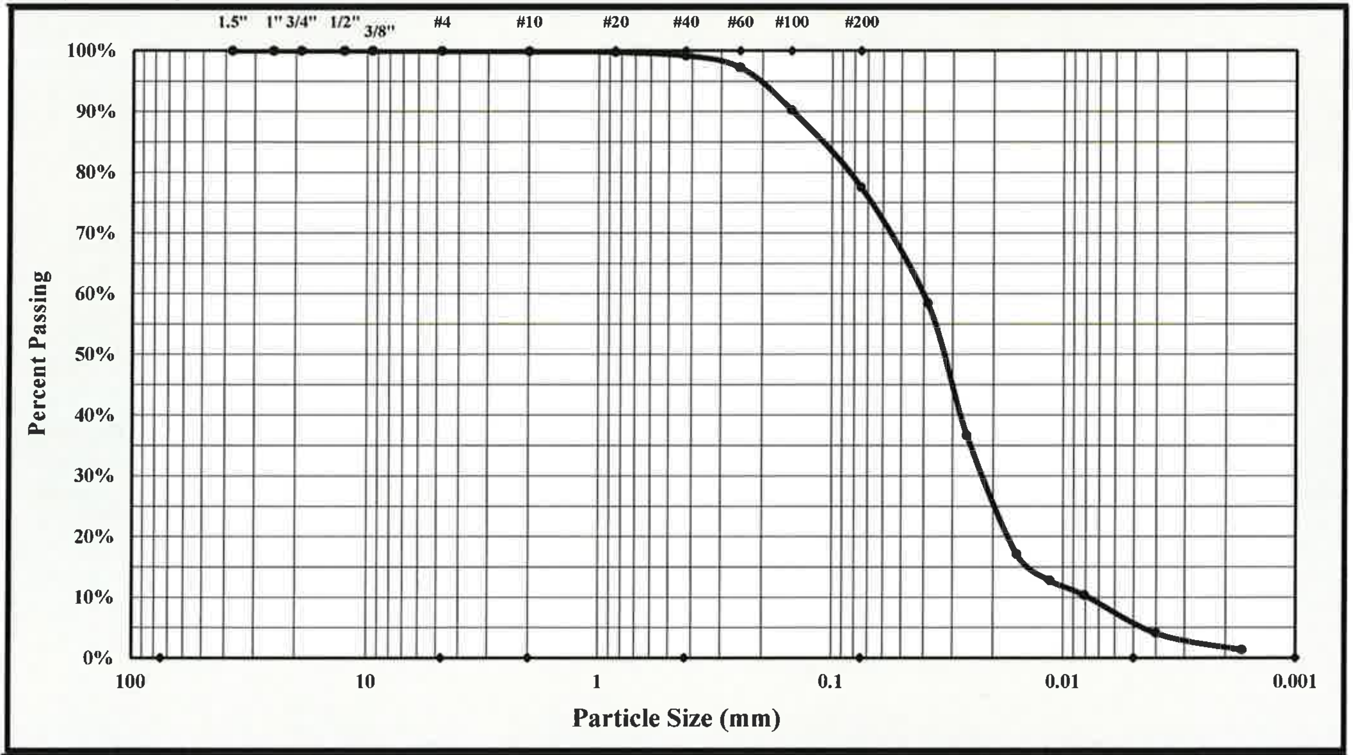
Particle Size Analysis of Soils

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

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

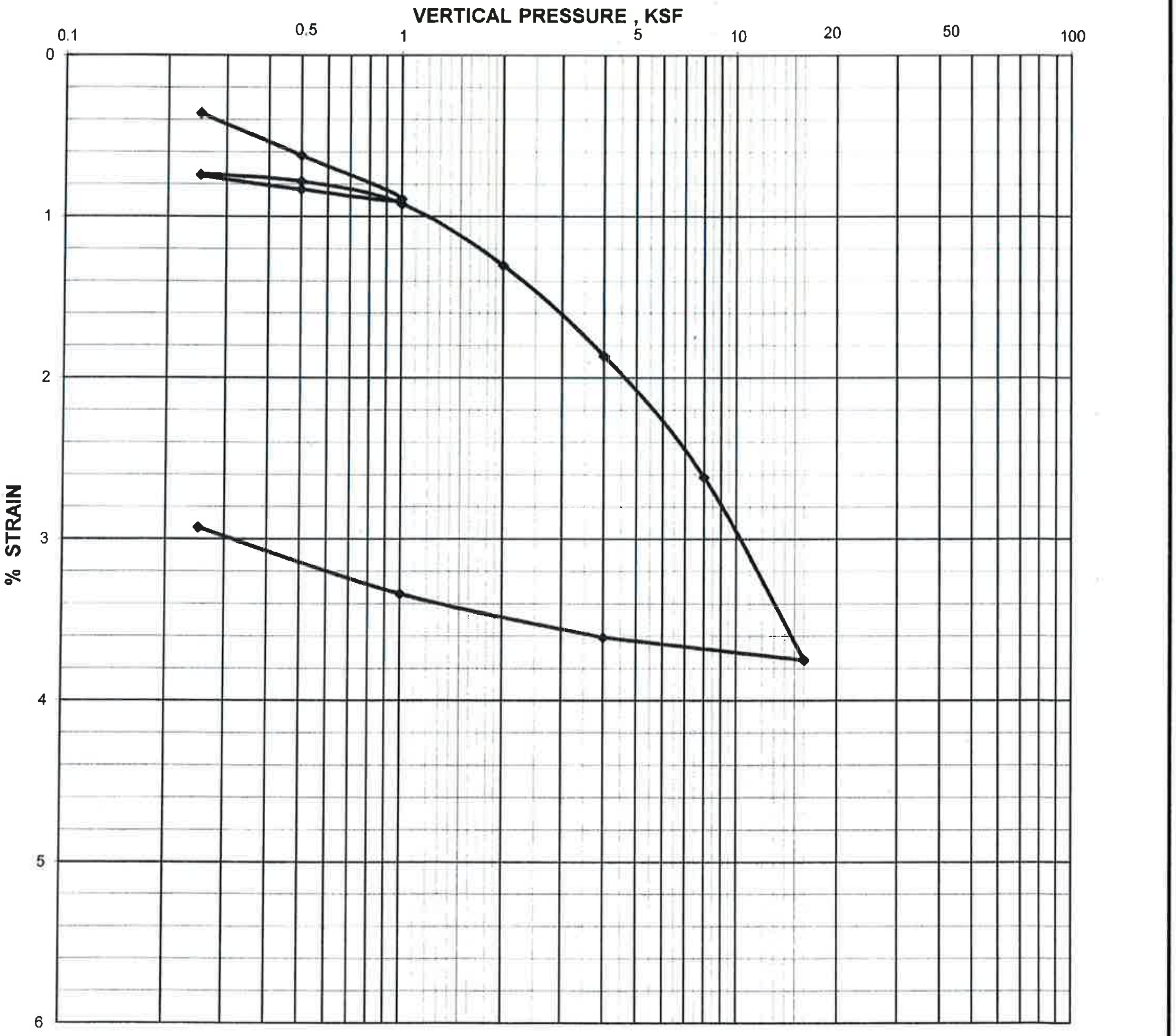
CONSOLIDATION TEST REPORT

(ASTM D 2435)

Page 1

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 Stress, P_o, ksf :**	1.0
Initial Moisture Content, %.:	48.0	**Final Moisture Content, %.:**	67.1		
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



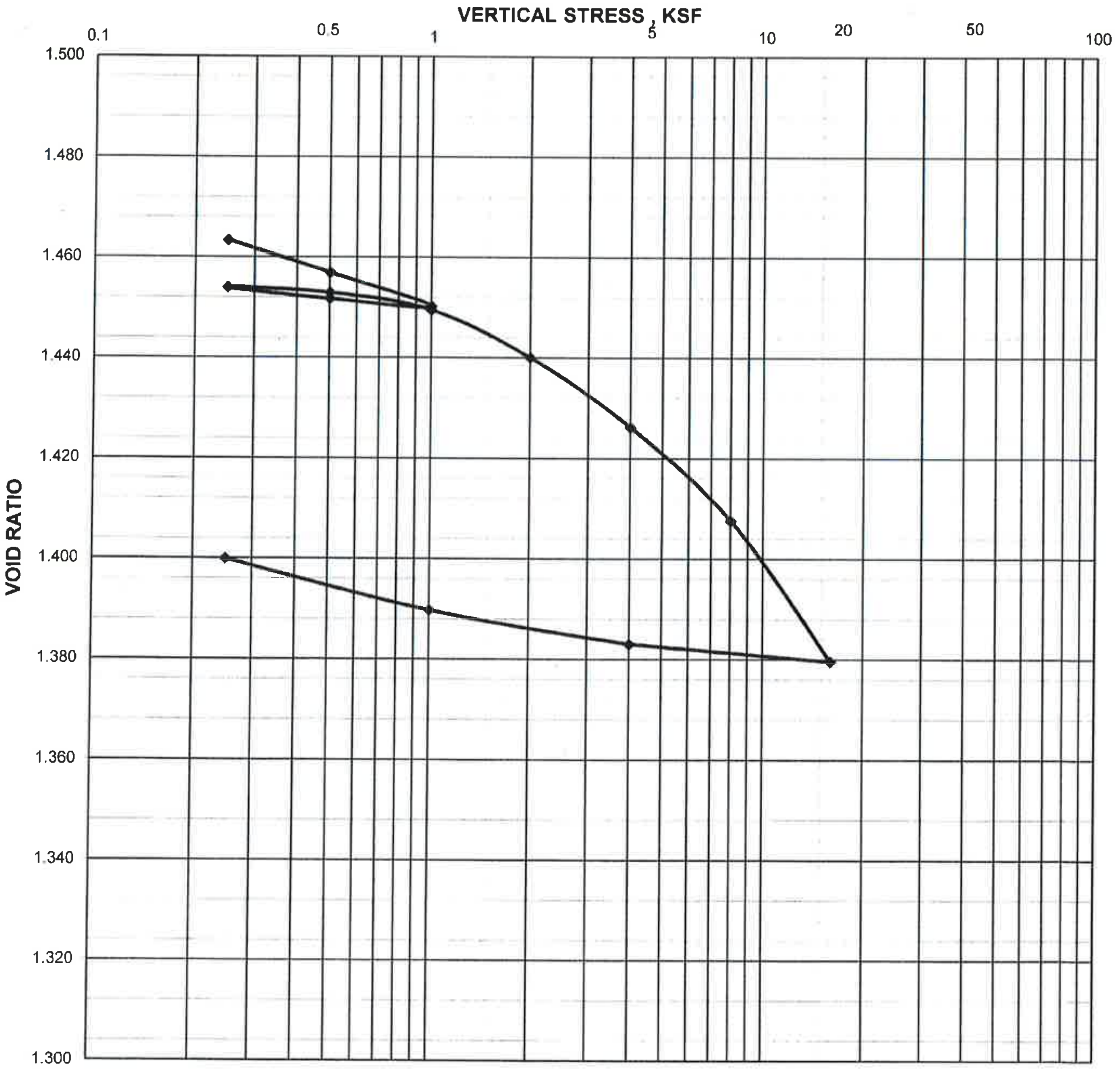
CONSOLIDATION TEST REPORT

(ASTM D 2435)

Page 2

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 Stress, P_o, ksf :**	1
Initial Moisture Content, %.:	48.0	**Final Moisture Content, %.:**	67.1		
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

AASHTO R18

REV4,1/13/04

Project Name: Geotrack Technologies, Inc. - 14-3425-N

Project No.: **1263-10-195** **Report Date:** 06/10/14

Client Name: Geotrack Technologies, Inc. **Test Date:** 6/9/14

Client Address: 3620 Pelham Road, PMB #292 Greenville, SC 29615

Boring #: N/A **Depth / Elev. :** N/A **Log #:** 44g **Type:** Bulk

Sample Location : Riverbend Pond

Sample Description : Coal Ash

LL, % : - **PI , % :** NP **Percent Passing #200 :** 77.5 **G_s :** 2.130

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

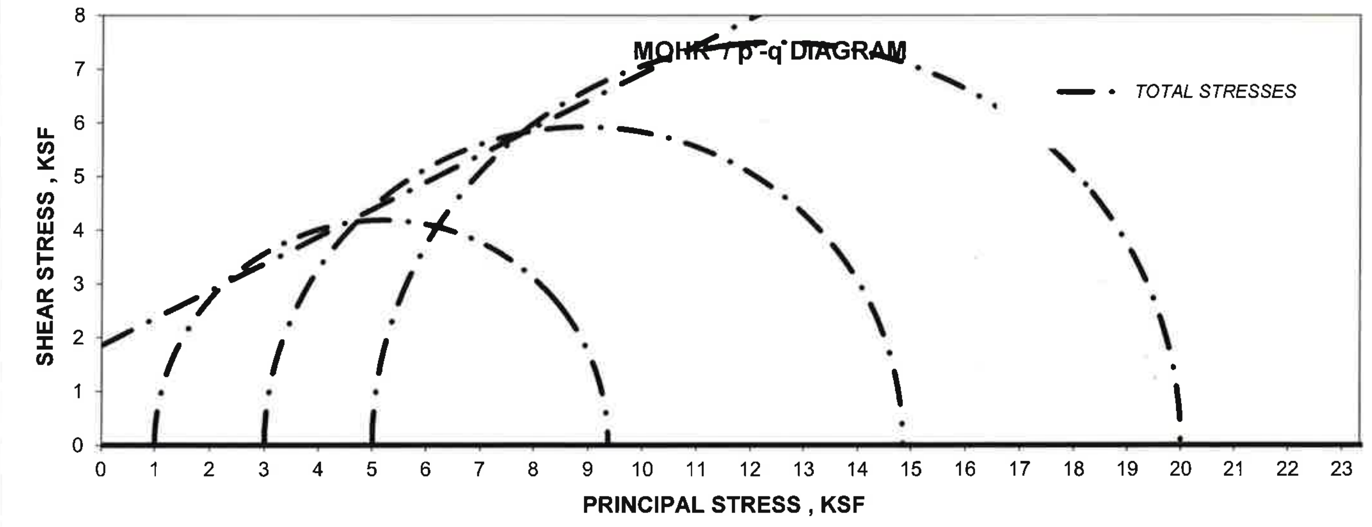
TEST PARAMETERS , TEST TYPE : UU				
SPECIMEN NO.		1	2	3
B Value		N/A	N/A	N/A
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	8.4	11.9	15.0
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.4	10.7	14.8
Specimen Shape @ Failure	Sheared			

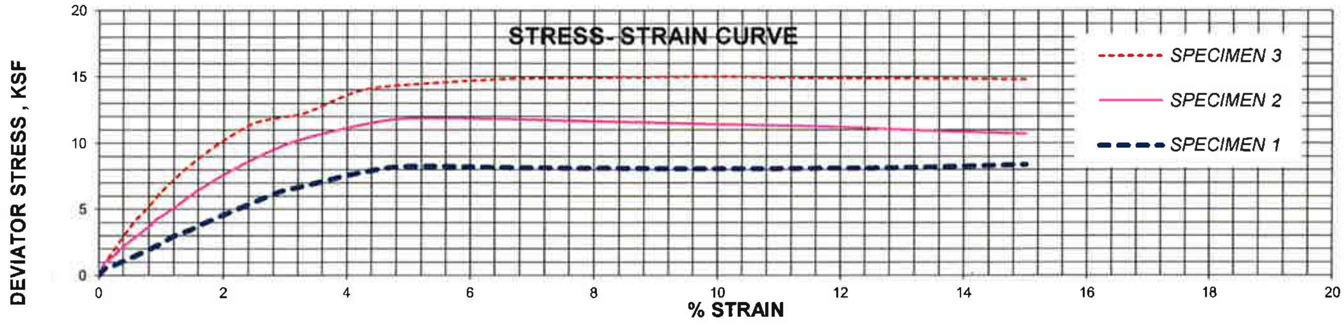
CONTROLLED : Strain @ 1.0 % per minute

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

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

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





Brian Vaughan, P.E.	Brian Vaughan	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

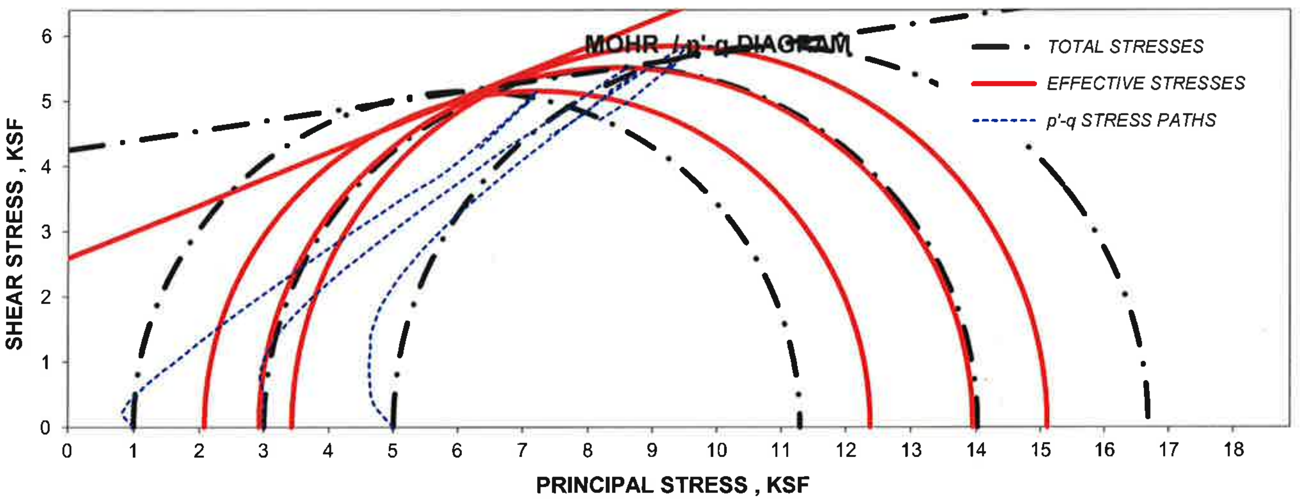
SPECIMEN NO.		1	2	3
B Value		0.95	0.95	0.95
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	10.3	11.0	11.7
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.5	9.0	9.4
Specimen Shape @ Failure	Sheared			

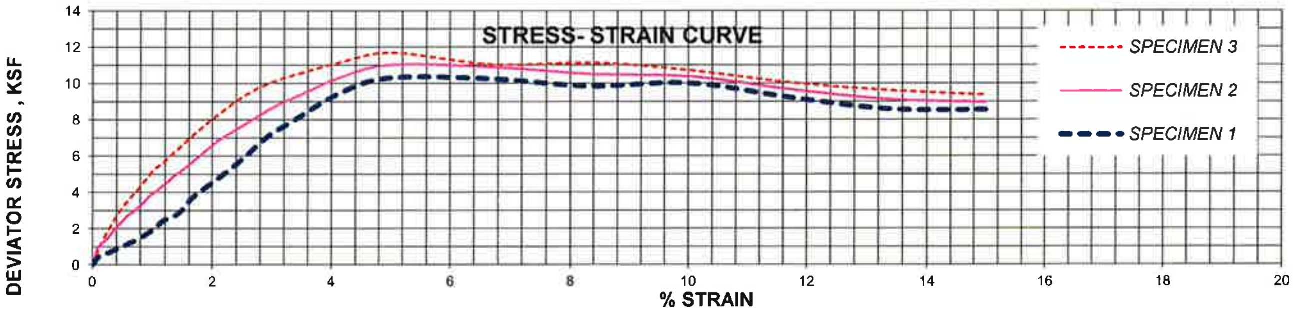
CONTROLLED : Strain @ 0.02 % per minute T50, Minutes = 18.0

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

Brian Vaughan, P.E.	Brian Vaughan	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

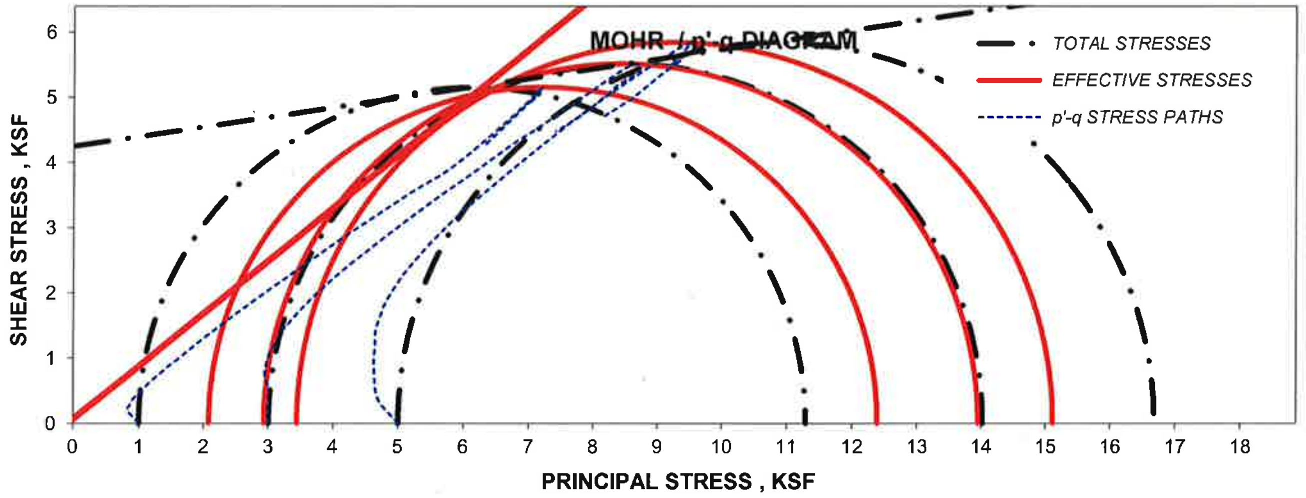
TEST PARAMETERS , TEST TYPE : CU/PP				
SPECIMEN NO.		**1**	**2**	**3**
B Value		0.95	0.95	0.95
BACK PRESSURE, ksf	U_o	7.2	7.2	7.2
CONFINING PRESSURE , ksf	σ_3	1.0	3.0	5.0
MAX. DEVIATOR STRESS ,ksf	σ_1-σ_3	10.3	11.0	11.7
ULT. DEVIATOR STRESS , ksf	σ_1-σ_3	8.5	9.0	9.4
Specimen Shape @ Failure	Sheared			

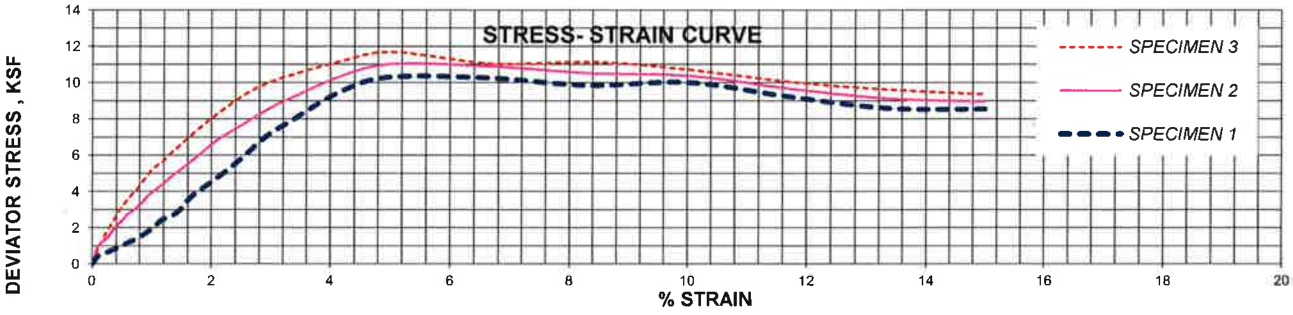
CONTROLLED : Strain @ 0.02 % per minute T50, Minutes = 18.0

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 (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.	Brian Vaughan	Location Coordinator	06/10/14
Technical Responsibility	*Signature*	*Position*	*Date*

ATTACHMENT C

TABLE 6
Typical Values of Soil Index Properties

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

See Ref. 1

a height of 760 mm (30 in).

ıg of the falling weight onto the ding to the ground surface, the *test*. The free fall and height of : of drill rigs use a rope wrapped ı the rope which then tightens on rope until the weight is visually ne the rope is released with the ;estion around the power pulley count will be obtained. Several ıechanical hoist-trip device. This factors such as pushing a rock, ɜ pressures also contribute error ducible in situ).

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

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

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

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

---

ATTACHMENT D

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/m³	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/m³	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.

1kn/m³ = 6.36pcf

SOIL HORIZON

RESIDUUM

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)

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

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

$$\ln N = C_2 + 2.06 \ln D_r + C_3 \ln \sigma'_v \tag{6-4}$$

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/m³. 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.

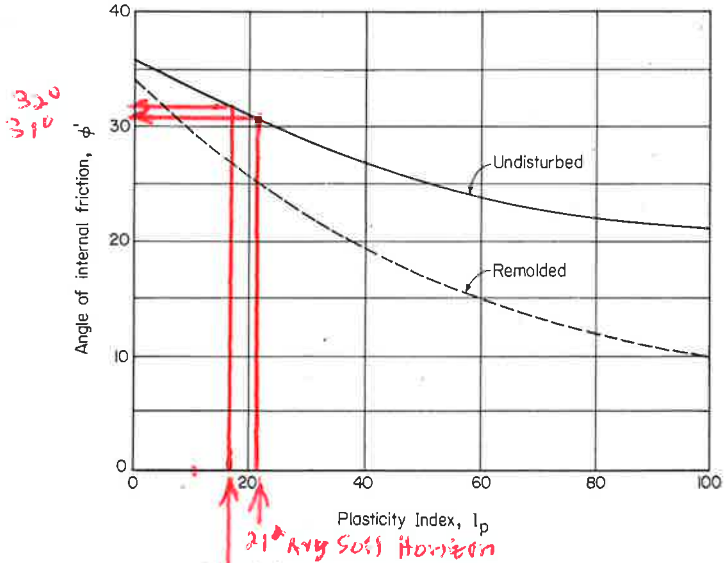


Figure 13-20 Correlation between angle of internal friction ϕ' (true) and plasticity index for both undisturbed and remolded soil. *(After Bjerrum and Simons, 1960.)*

See Ref. 2

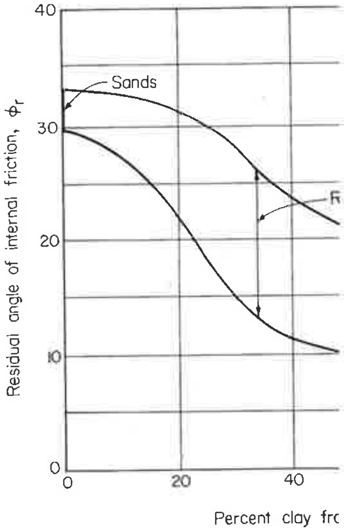


Figure 13-21 Correlation between r
ton, 1964.)

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

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

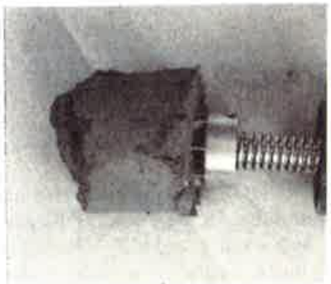


Figure 13-22 The torvane.

ATTACHMENT F

TABLE 1
Typical Properties of Compacted Soils

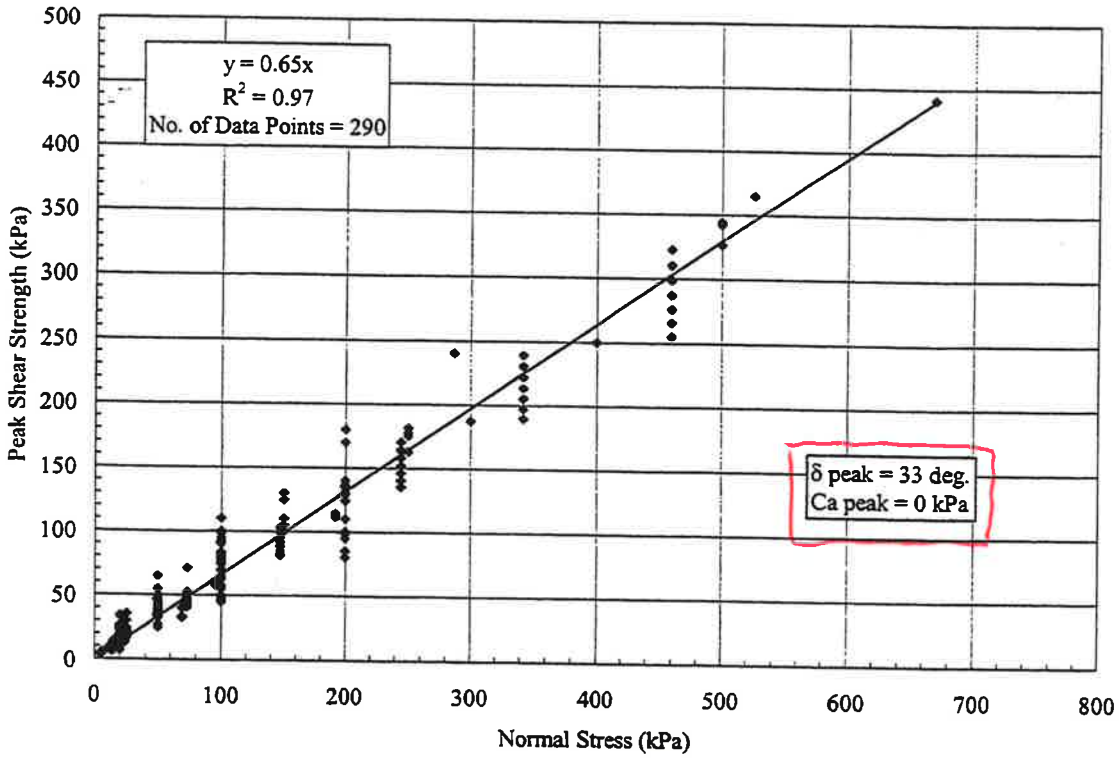
Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression		Typical Strength Characteristics				Typical Coefficient of Permeability ft./min.	Range of CBR Values	Range of Subgrade Modulus k ~~lbs/cu in.~~ psi/in
				At 1.4 tsf (20 psi)	At 3.6 tsf (50 psi)	Cohesion (as compacted) psf	Cohesion (saturated) psf	ø (Effective Stress Envelope Degrees)	Tan ø			
				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:

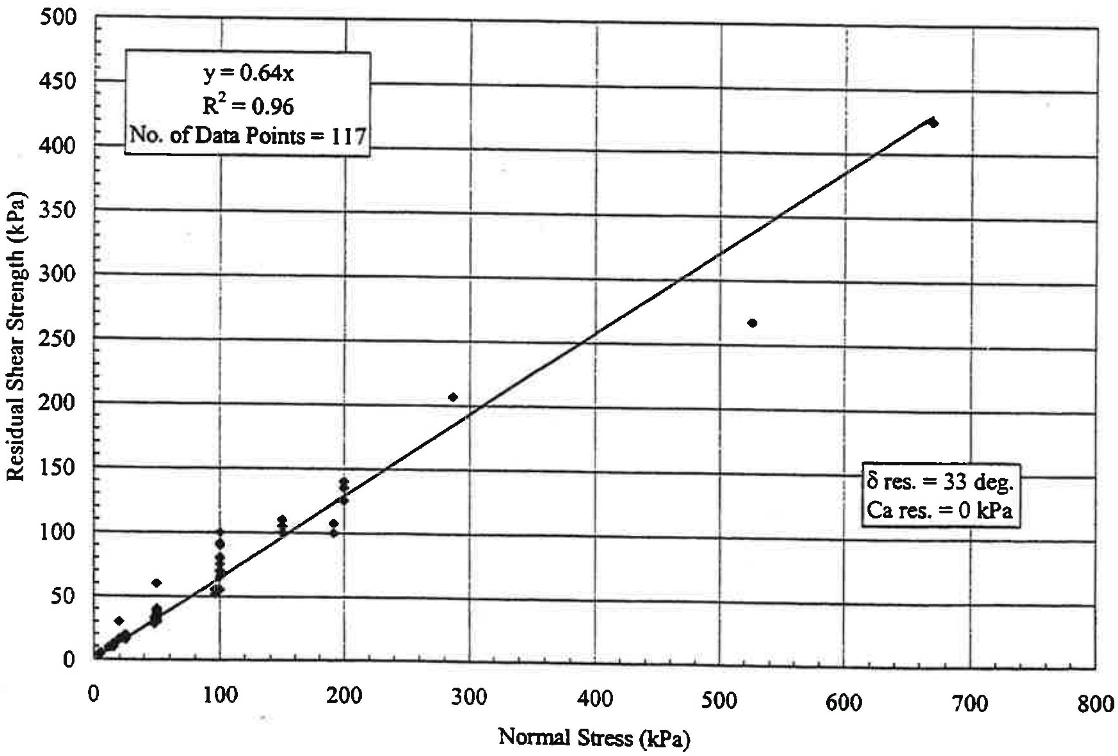
1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical stength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading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

See Ref. 4

ATTACHMENT G

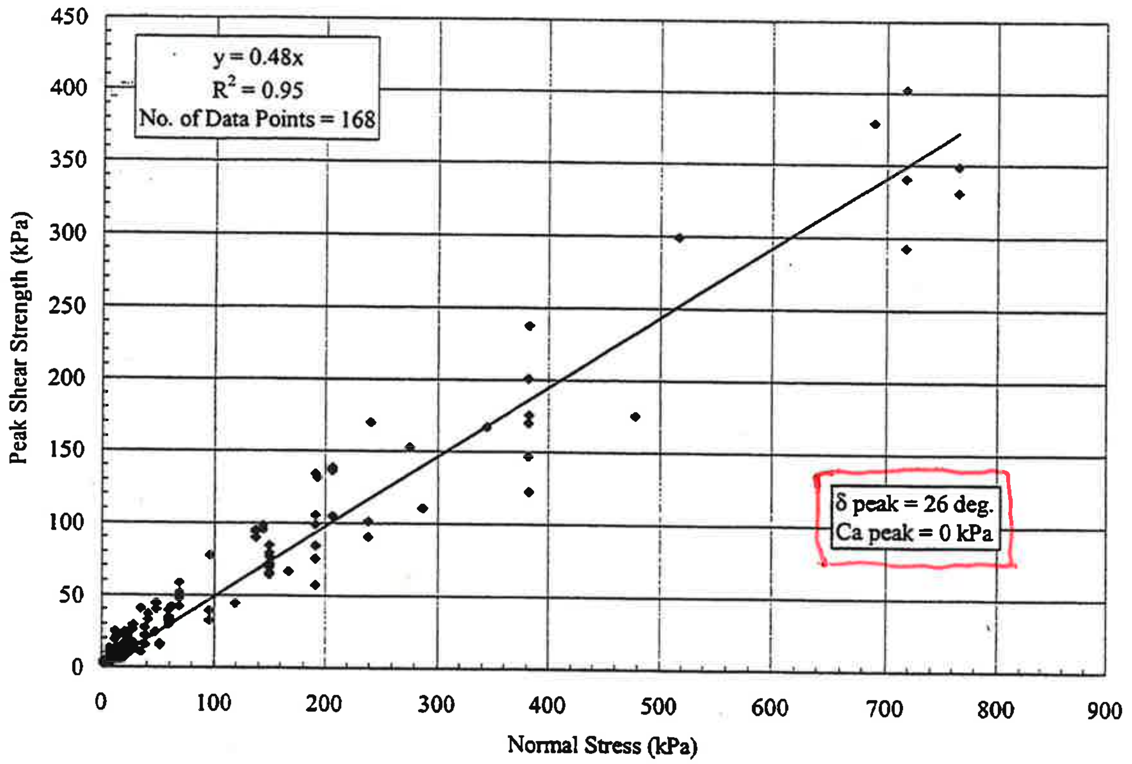


Appendix Figure 8a – Peak Shear Strength; NW-NP Geotextile against Granular Soil.

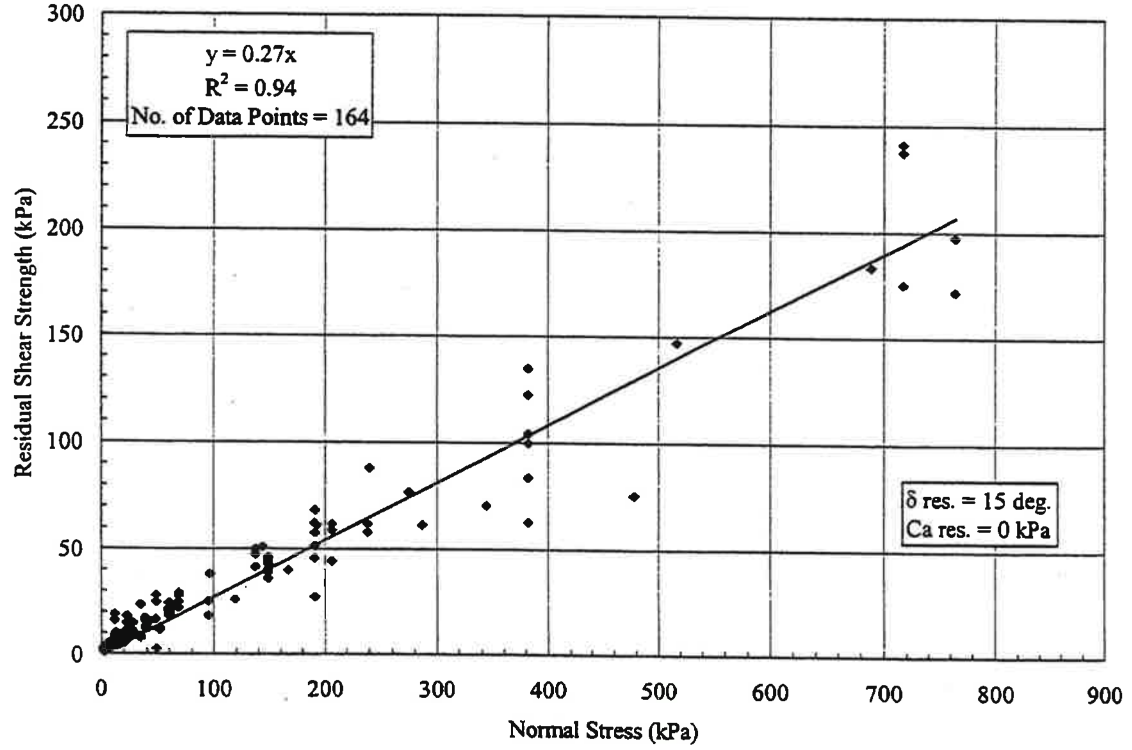


Appendix Figure 8b – Residual Shear Strength; NW-NP Geotextile against Granular Soil.

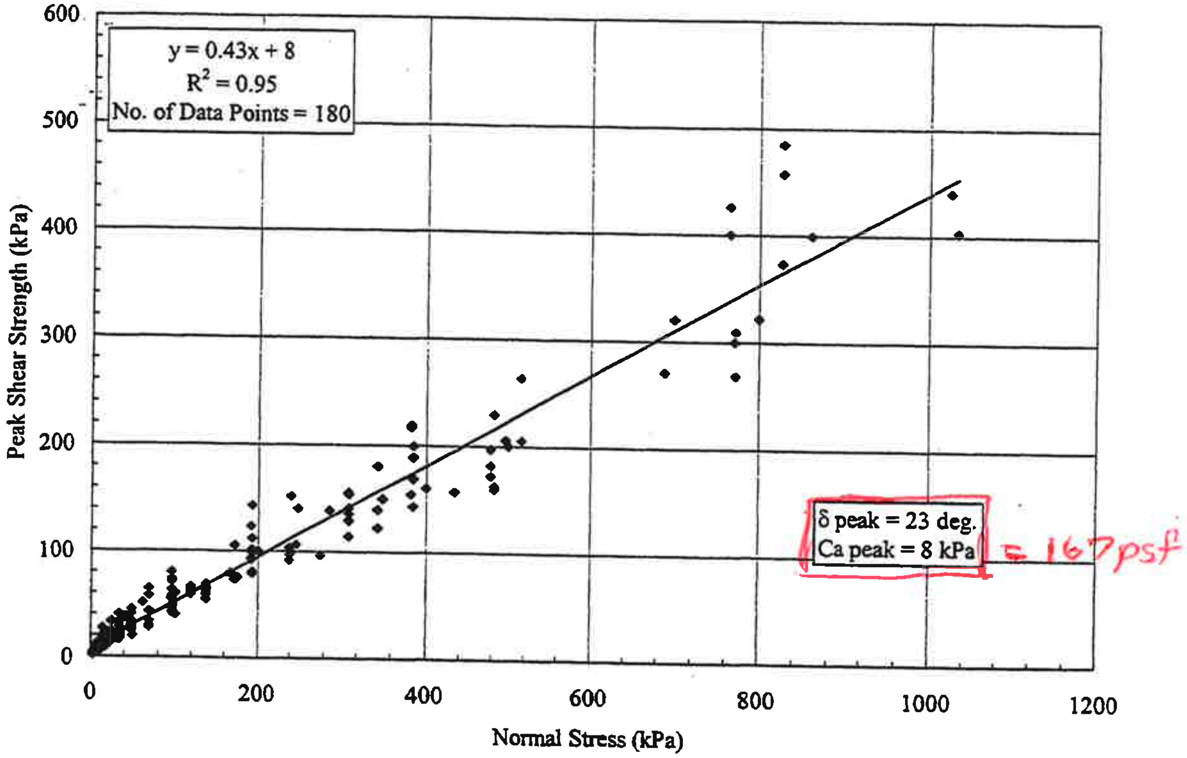
See Ref. 5



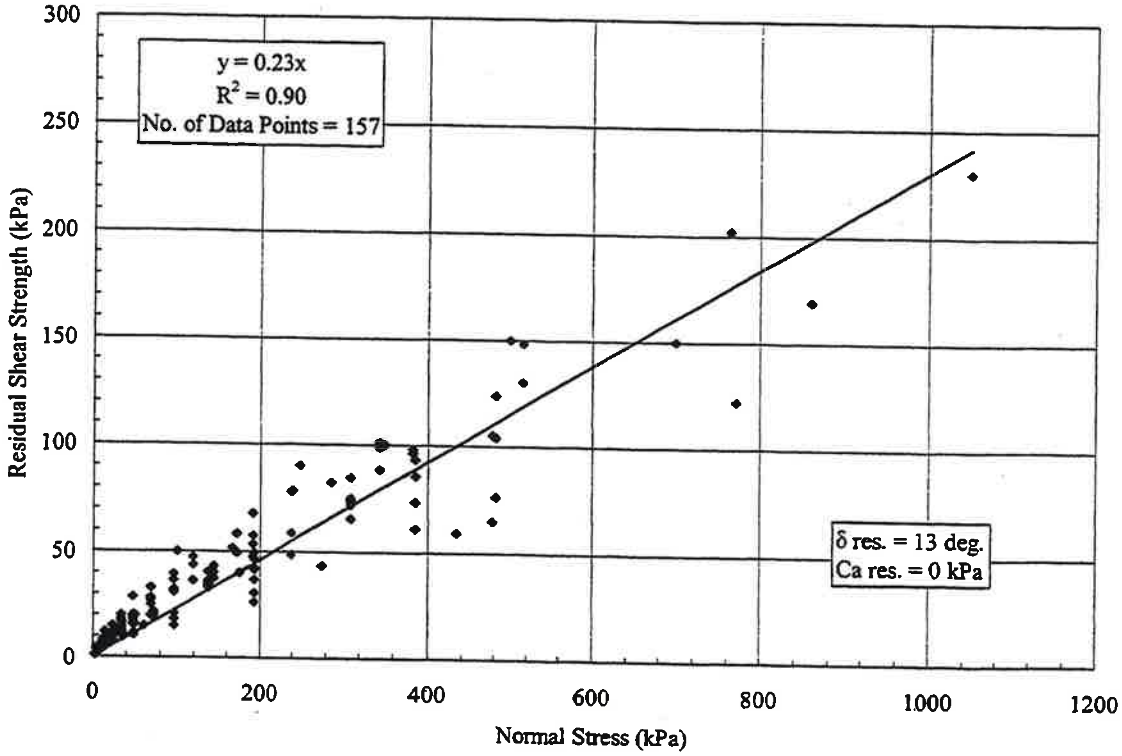
Appendix Figure 2i – Peak Shear Strength; Textured HDPE against NW-NP Geotextile on a Drainage Geocomposite.



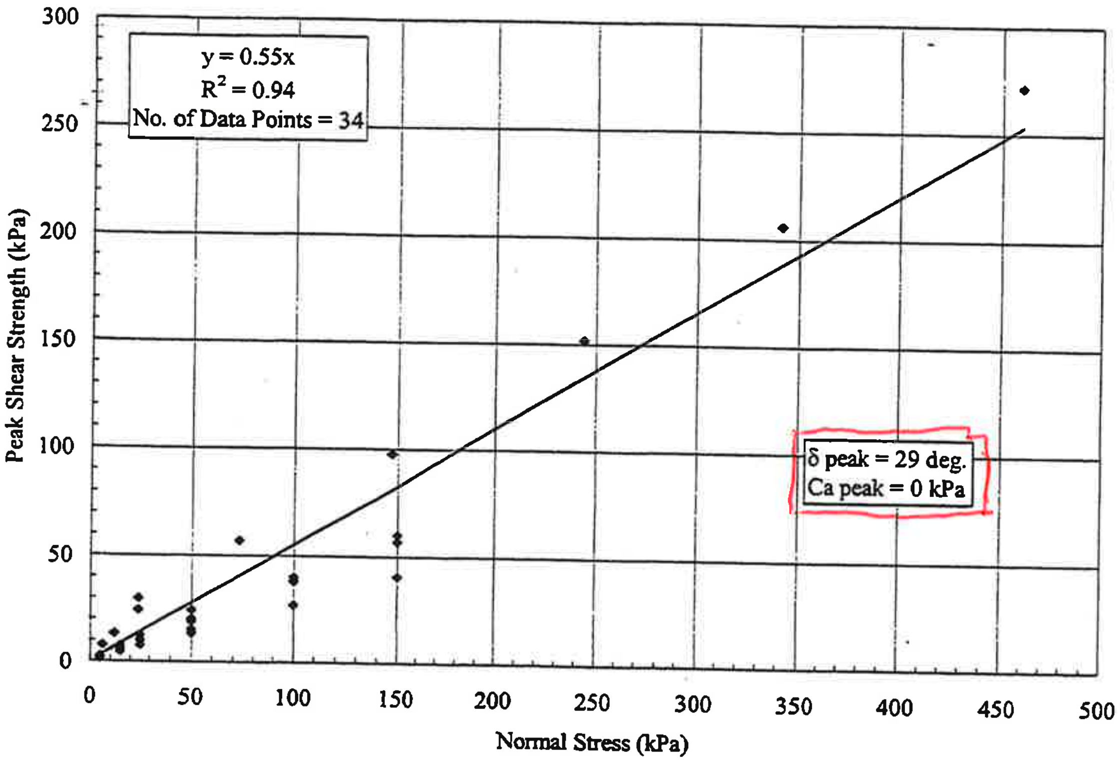
Appendix Figure 2j – Residual Shear Strength; Textured HDPE against NW-NP Geotextile on a Drainage Geocomposite.



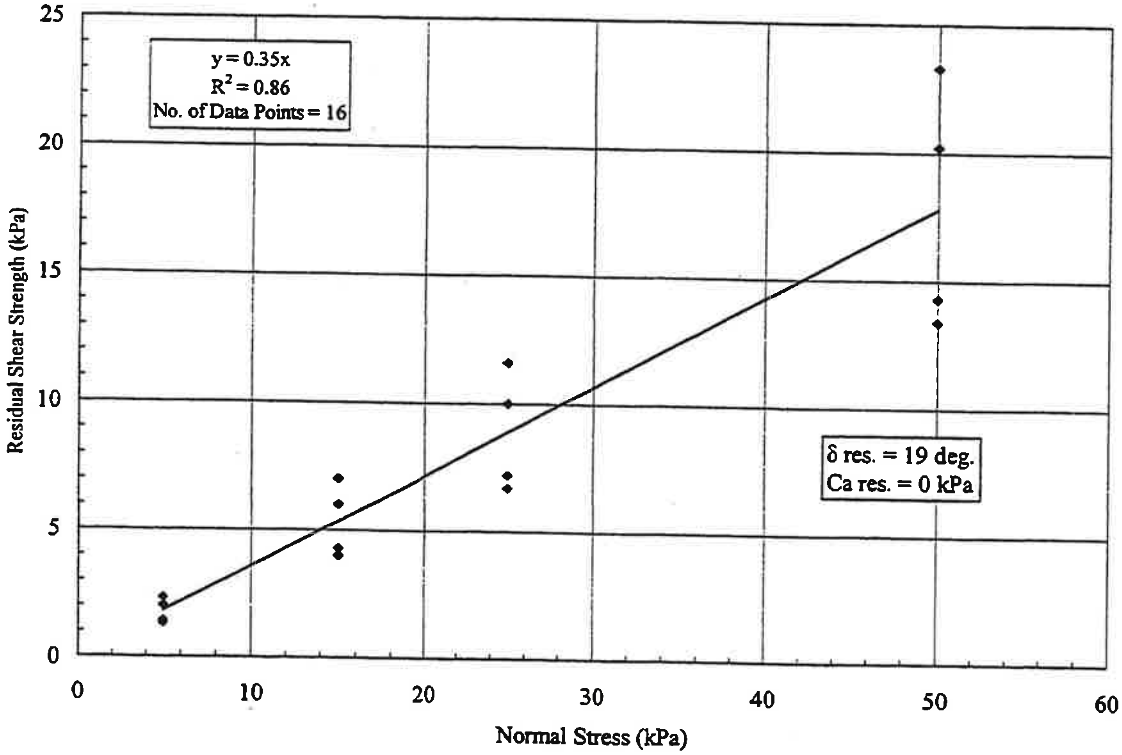
Appendix Figure 11a - Peak Shear Strength; Textured HDPE against NW-NP Side of Fabric-Reinforced GCL.



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

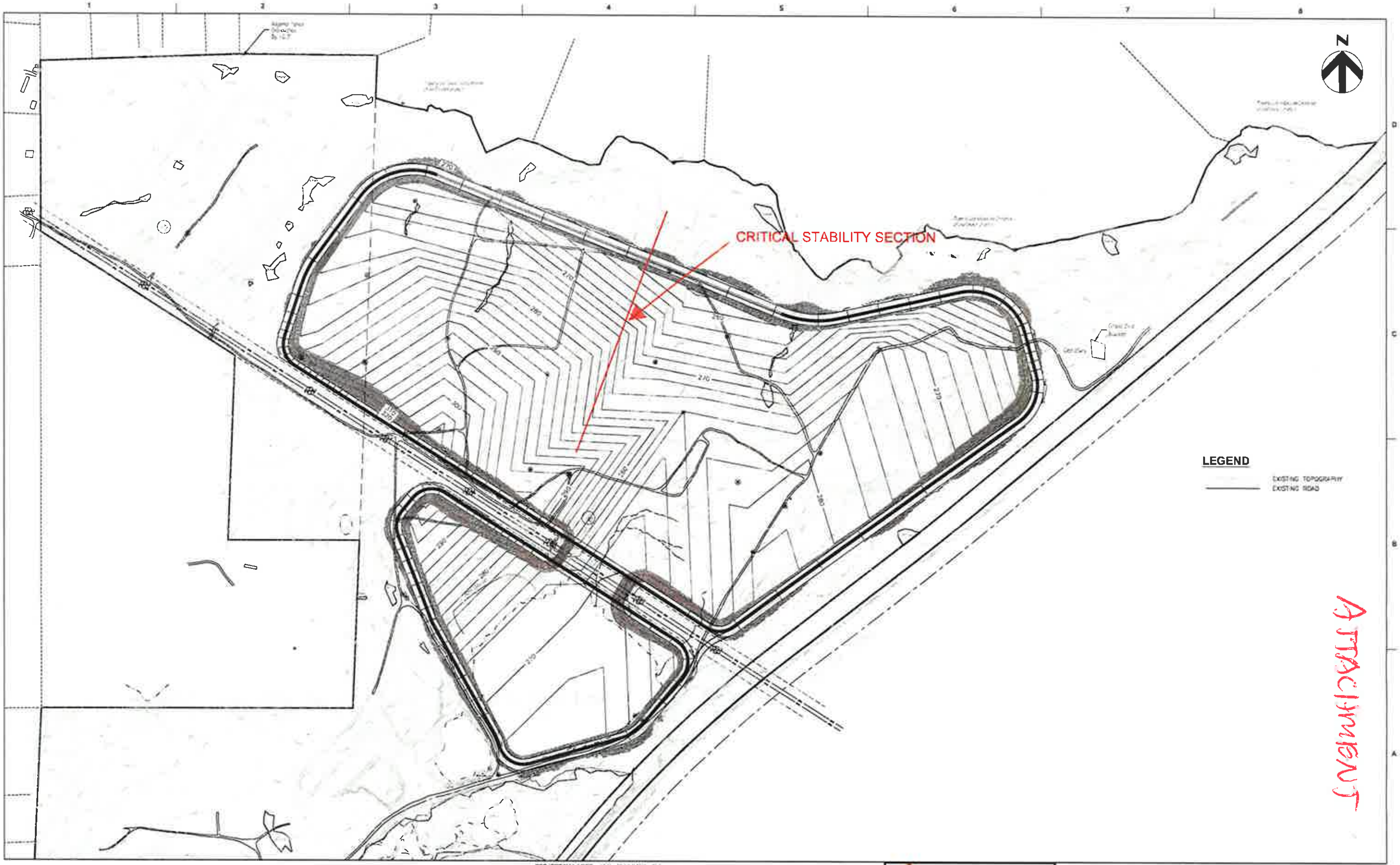


Appendix Figure 9e - Peak Shear Strength; Woven Geotextile against Cohesive Soil.



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

ATTACHMENT H



HDR Engineering Inc.
of the Carolinas

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

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

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

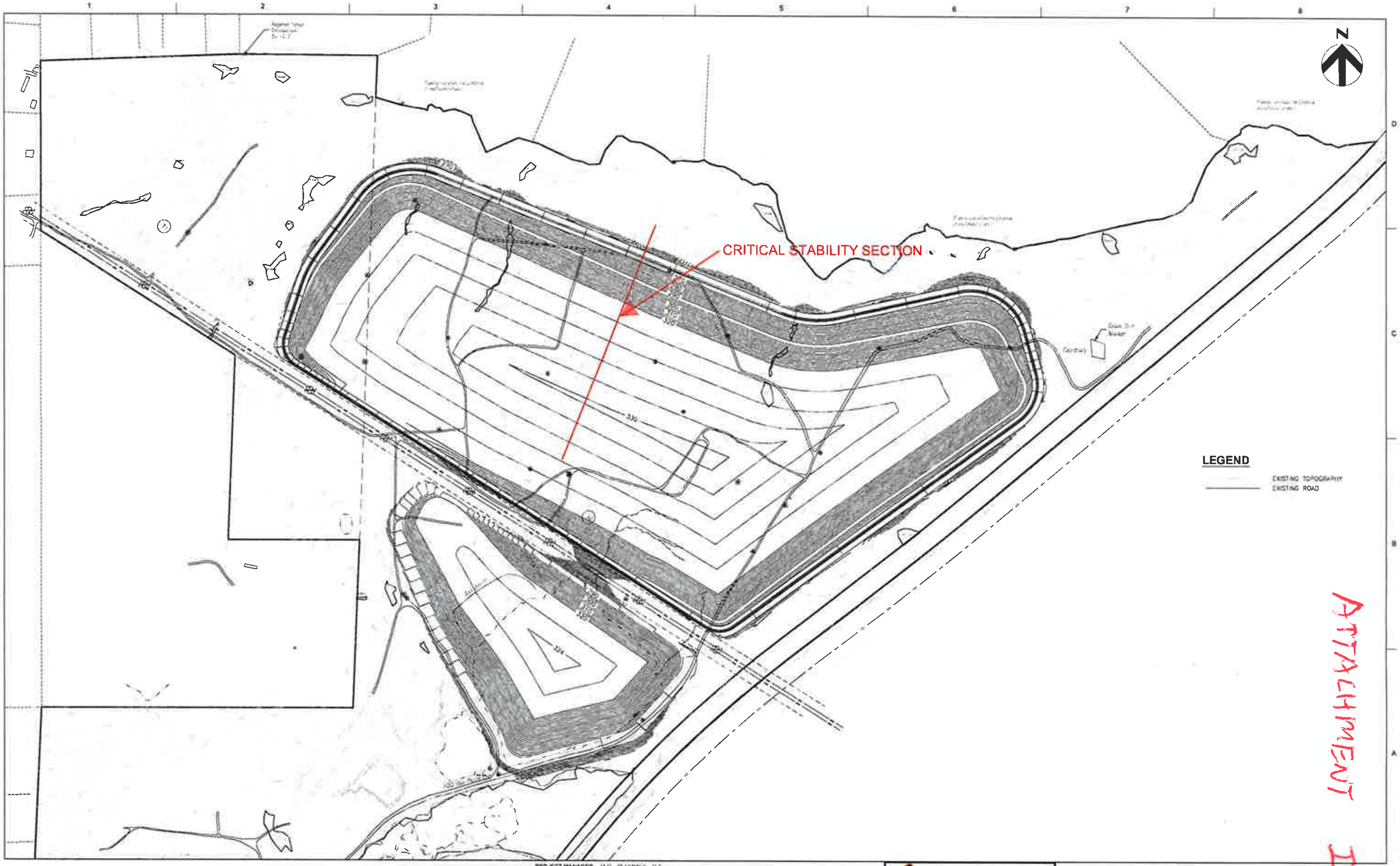
Charah®
COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

BASEGRADE PLAN (BOTTOM OF SOIL LINER)

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

SHEET
00C-03

ATTACHMENT I



CRITICAL STABILITY SECTION

HDR

HDR Engineering Inc.
of the Carolinas

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

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

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

Charah®

COLON MINE SITE STRUCTURAL FILL
SANFORD, NC

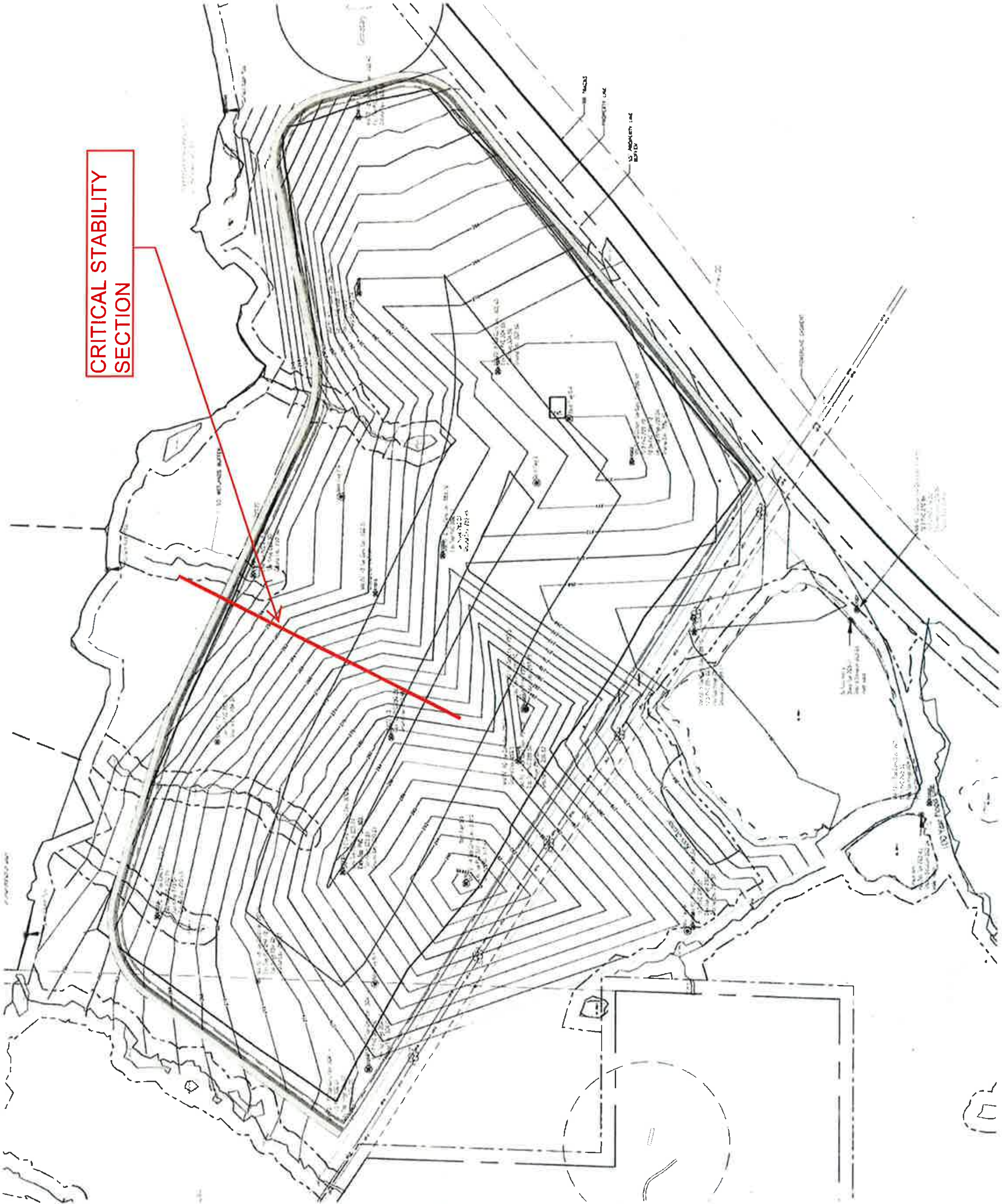
PROPOSED FINAL CLOSURE PLAN

0 1" 2"

FILENAME: 00C-02 dwg
SCALE: 1" - 200'

SHEET
00C-02

ATTACHMENT J



Groundwater Contours

ATTACHMENT K

USGS
science for a changing world

Earthquake Hazards Program

US Seismic Hazard 2008

Layers Tools

Hazard maps

Transparency

Peak ground acceleration (%g) with 10% probability of exceedance in 50 years

* Peak ground acceleration (%g) with 2% probability of exceedance in 50 years

0.2-second acceleration with 10% probability of exceedance in 50 years

0.2-second acceleration with 2% probability of exceedance in 50 years

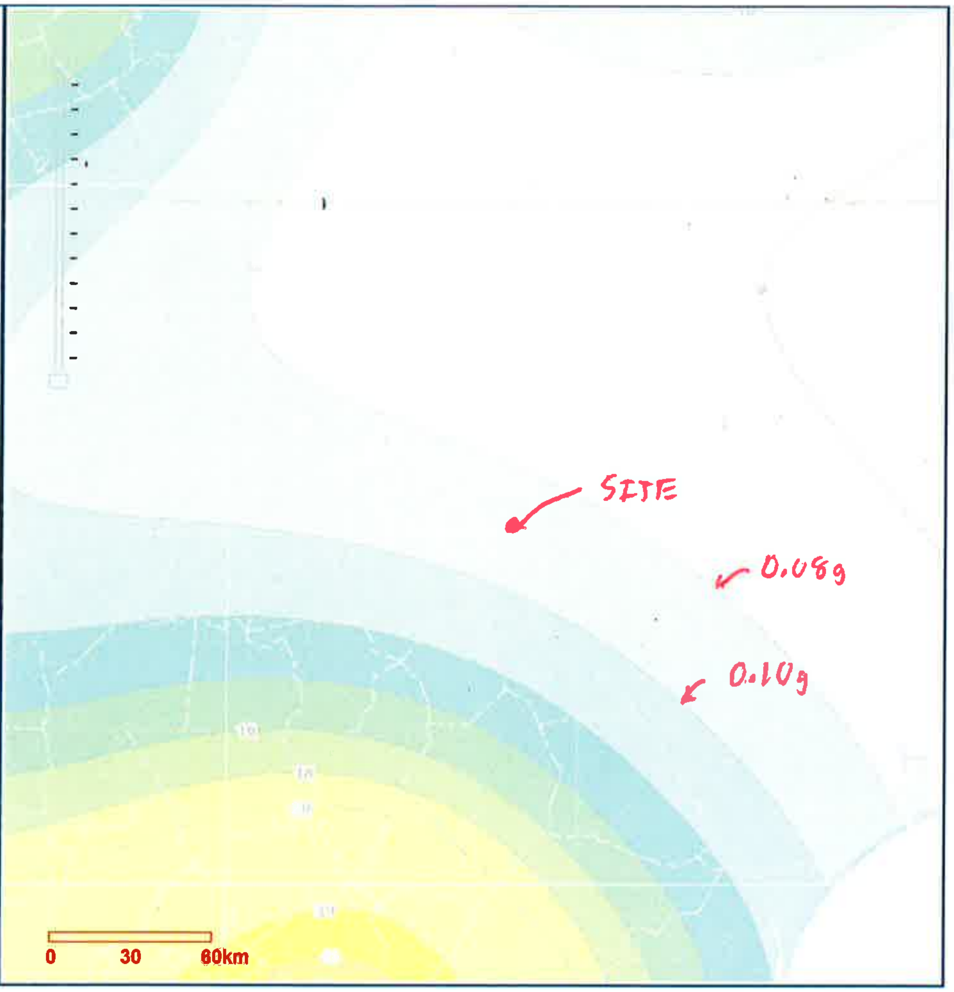
1.0-second acceleration with 10% probability of exceedance in 50 years

1.0-second acceleration with 2% probability of exceedance in 50 years

Hazard map faults

Basemap

Transparency



Share this page: Facebook Twitter Google Email

This page intentionally left blank.

B

Stormwater

This page intentionally left blank.

HDR Computation

Job Number	453925-235691-018	**No.**	

Project	Charah Colon Mine	**Computed**	EAW	**Date**	12/31/2014
Subject	Permit Application	**Checked**	MDP	**Date**	12/31/2014
Task	Subcell Divider Berms	**Sheet**	1	**Of**	1

Objective: Determine if the subcell berms are large enough to handle a 2-year, 24-hour storm event.

References:

1. NC Erosion and Sediment Control Planning and Design Manual.

Given:

3.6 in, 2-year, 24-hour precipitation event (Raleigh, NC) Ref 1

$$V_R = A \times \frac{43{,}560\, ft^2}{acre} \times p \times \frac{12in}{ft}$$

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

Where:

V_R = Precipitation event volume (ft^3)
A = Area (acres)
p = precipitation event (in)

V = Volume of Pond (pyramid) (ft^3)
h = Height of the berm (pyramid) (ft)
A= Area of ponding (pyramid base) (ft^2)

Case 1: Will Subcell Divider Berm handle precipitation into one subcell?

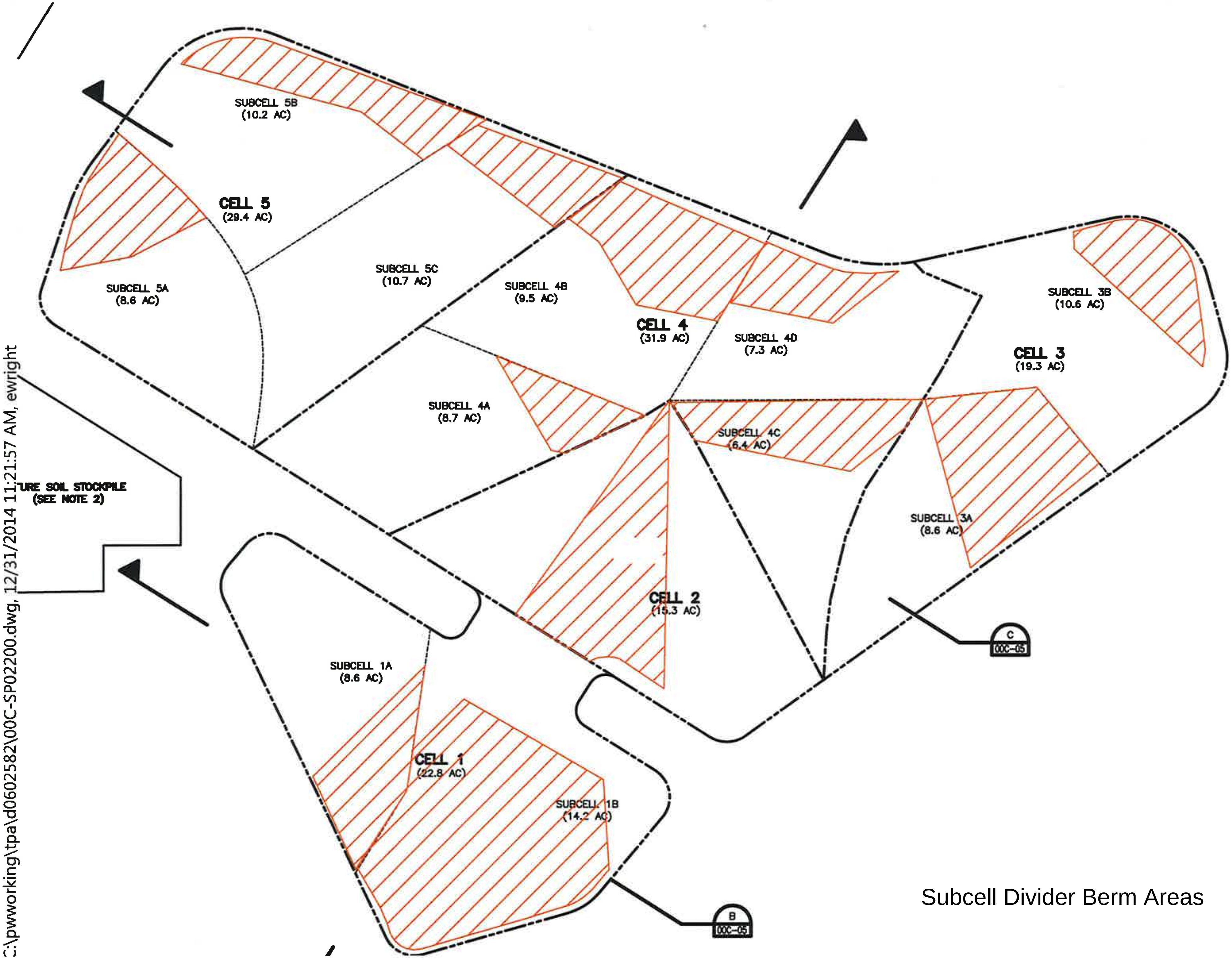
Subcell	Subcell Area (acres)	Required Volume (ft^3)	Berm Height (ft)	ponding behind berm (sf)	Area of Ponding (acres)	Available Volume (ft^3)	Factor of Safety	Check
1A	8.6	112,385	4	94,296	2.2	125,728	1.1	OK
1B	14.2	185,566	3	383,949	8.8	383,949	2.1	OK
2	15.3	199,940	5	203,207	4.7	338,678	1.7	OK
3A	8.6	112,385	7	166,645	3.8	388,838	3.5	OK
3B	10.6	138,521	8	89,500	2.1	238,667	1.7	OK
4A	8.7	113,692	8	53,449	1.2	142,531	1.3	OK
4B	9.5	124,146	8	139,070	3.2	370,853	3.0	OK
4C	6.4	83,635	5	111,427	2.6	185,712	2.2	OK
4D	7.3	95,396	7	64,806	1.5	151,214	1.6	OK
5A	8.6	112,385	6	96,540	2.2	193,080	1.7	OK
5B	10.2	133,294	8	110,178	2.5	293,808	2.2	OK
5C	10.7	139,828	11	72,321	1.7	265,177	1.9	OK

Case 2: Will downstream Subcell Divider Berm handle precipitation from upstream subcells?

Lower Subcell	Downstream Subcell Available Volume (ft^3)	Downstream Subcell Required Volume (ft^3)	Contributing Subcells	Contributing Subcells Required Volume (ft^3)	Total Required Volume (ft^3)	Factor of Safety	Check
1B	383,949	185,566	1A	112,385	297,950	1.3	OK
3B	238,667	138,521	3A	112,385	250,906	1.0	NOT OK!
4B	370,853	124,146	4A	113,692	237,838	1.6	OK
4D	151,214	95,396	4C	83,635	179,032	0.8	NOT OK!
5B	293,808	133,294	5A	112,385	245,678	1.2	OK

Conclusion:

Individual subcells can contain the design storm event.
Subcells 3B and 4D, can't contain the flow from the upstream subcells.
Therefore, the upstream subcells must be managed independently.



Subcell Divider Berm Areas

C:\pwworking\tpa\d0602582\00C-SP02200.dwg, 12/31/2014 11:21:57 AM, ewright

HDR Computation

Job Number	453925-235691-018	**No.**	
Project Charah Colon Mine			
Computed	MDP	**Date**	12/30/2014
Subject Permit Application			
Checked	**EAW**	**Date**	12/31/2014
Task Stormwater Pipe Perforations and Sizings			
	1	**Of**	3

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 = 15.3 acres
Storm Event Q_{cfs} = 312,129 cf/acre/day
Q_{gpm} = 1621.45 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 = 35.362 gpm (actual flow rate per acre for the drainage area of the pipe)

HDR Computation

Job Number 453925-235691-018
No.

Project Charah Colon Mine
Computed MDP
Date 12/30/2014

Subject Permit Application
Checked **EAW**
Date 12/31/2014

Task Stormwater Pipe Perforations and Sizings
2 **Of** 3

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**
35.362		**40.60**

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

HDR Computation

Job Number	453925-235691-018	**No.**	
Project	Charah Colon Mine	**Computed** MDP	**Date** 12/30/2014
Subject	Permit Application	**Checked** **EAW**	**Date** 12/31/2014
Task	Stormwater Pipe Perforations and Sizings	3	**Of** 3

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.

HDR Computation

Job No. 453925-235691-018

Project:	Charah Colon Mine	Computed	PAW	Date	11/3/14
Subject:	Permit Application	Checked	EAW	Date	11/6/2014
Task:	Drainage - Time of Concentration	Sheet	1	Of	1

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

References

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

Equations

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

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

Time of Concentration,(min) = t_c

Hydraulic length of watershed, (ft) = L

Elevation change along length, (ft) = H

Cells 2-5

Flow Path 1

Hydraulic length of watershed L (ft) = 1,371

Peak Elevation of watershed (ft) = 330

Low Elevation of watershed (ft) = 260

Elevation change along length H (ft) = 70

t_c (min) = 6.4

Flow Path 2

Hydraulic length of watershed L (ft) = 3,449

Peak Elevation of watershed (ft) = 328

Low Elevation of watershed (ft) = 268

Elevation change along length H (ft) = 60

t_c (min) = 19.7

Flow Path 3

Hydraulic length of watershed L (ft) = 2,657

Peak Elevation of watershed (ft) = 330

Low Elevation of watershed (ft) = 245

Elevation change along length H (ft) = 85

t_c (min) = 12.7

Cell 1

Flow Path 1

Hydraulic length of watershed L (ft) = 1,660

Peak Elevation of watershed (ft) = 322

Low Elevation of watershed (ft) = 270

Elevation change along length H (ft) = 52

t_c (min) = 8.9

CONCLUSION

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

This page intentionally left blank.

Job No. 453925-235691-018

HDR Computation

Project:	Charah Colon Mine	Computed PAW	Date 11/03/14
Subject:	Permit Application	Checked EAW	Date 11/6/14
Task:	Drainage - Perimeter Channels	Sheet 1	of 3

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) = $bd + z\ d^2$

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

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

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

Channel Design

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

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

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

HDR Computation

Job No. 453925-235691-018

Project:	Charah Colon Mine	Computed	PAW	Date	11/03/14
Subject:	Permit Application	Checked	EAW	Date	11/6/14
Task:	Drainage - Perimeter Channels	Sheet	2	of	3

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

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

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

HDR Computation

Job No. 453925-235691-018

Project:	Charah Colon Mine	Computed	PAW	Date	11/03/14
Subject:	Permit Application	Checked	EAW	Date	11/6/14
Task:	Drainage - Perimeter Channels	Sheet	3	of	3

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

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

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

CONCLUSION

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

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

This page intentionally left blank.

HDR Computation

I Job No. 453925-235691-018 I

Project: Charah Colon Mine		Computed PAW	Date 11/03/14
Subject: Permit Application		Checked EAW	Date 11/6/14
Task: Drainage - Sideslope Swales		Sheet 1	of 2

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) = $bd + z\,d^2$

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

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

Q (cfs) = CIA

$Z_{av} = Z_{req}$

Channel Design

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

Various Lining Types

Lining Type	Lining Description	Manning's n depths of 0-0.5	Manning's n depths of 0.5-	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

Job No. 453925-235691-018

HDR Computation

Project:	Charah Colon Mine	Computed *PAW*	Date *11/03/14*
Subject:	Permit Application	Checked EAW	Date 11/6/14
Task:	Drainage - Sideslope Swales	Sheet 2	of 2

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

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

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

CONCLUSION

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

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

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

HDR Computation

Job No. 453925-235691-018

Project:	Charah Colon Mine	Computed	PAW	Date 11/03/14	
Subject:	Permit Application	Checked:	EAW	Date: 11/6/14	
Task:	Drainage - Slope Drains	Sheet:	1	of:	1

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

Equations:

Q (cfs) = CIA

Runoff Coeff (initial)= 0.60 Ag land, smooth

Runoff Coeff (permanent)= 0.25 Pasture, Sandy

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

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

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

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 2.5 feet (depth of channel)

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

Conclusion:

Use 18" corrugated plastic pipe (smooth wall)

This page intentionally left blank.

HDR Computation

I Job No. 453925-235691-018 I

Project:	Charah Colon Mine	Computed:	PAW	Date:	11/3/2014
Subject:	Permit Application	Checked:	EAW	Date:	11/6/2014
Task:	Drainage - Drop Inlets	Sheet:	1	of :	2

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

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

Equations:

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

Q = cfs, discharge (based on permanent condition)

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

g = 32.2 ft/sec^2, gravity

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

A = sf, cross sectional open area

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

Allowable head 2.0 feet (depth of channel)

Max Flow from Slope Drains 22.5 cfs

Check for inlet control

	Perimeter Channel								
Channel Location	Side 1	Side 2	Slope Drain Flow (cfs)	Total Flow (cfs)		Grate	Open Area (sf)	Required head(ft)	
DI #1	1.6		22.5	24.1	C	R-3531-A	6.0	0.7	Ok
DI #2	4.9		22.5	27.4	C	R-3531-A	6.0	0.9	Ok
DI #3	8.8	3.9	22.5	35.2	C	R-3531-A	6.0	1.5	Ok
DI #4	Mininimal Flow								
DI #5	5.4	6.4	22.5	34.3	C	R-3531-A	6.0	1.5	Ok
DI #6	5.2	21.0	22.5	48.7	C	R-3531-A	6.0	2.9	Problem
DI #7	65.2	6.9	22.5	94.6	C	R-3531-A	6.0	11.1	Problem

Cut the flow in half then determine the required grate inlet area

DI #6	24.3	0.59	C	R-3531-A	6.0	0.7	Ok
DI #7	47.3	0.59	C	R-3531-A	6.0	2.8	Problem
DI #7	65.2	0.59	2 large grates will be necessary		9.8	2.0	Ok

HDR Computation

I Job No. 453925-235691-018 I

Project:	Charah Colon Mine	Computed:	PAW	Date:	11/3/2014
Subject:	Permit Application	Checked:	EAW	Date:	11/6/2014
Task:	Drainage - Drop Inlets	Sheet:	2	of :	2

Size the Outlet culvert

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

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

Check pipe size based on Gravity Flow

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

Conclusion:

For DI #1, #2, #3, #4, and #5 use a grate with 6 sf open area and a 30" RCP Outlet
For DI #6 use a two grates each with 6 sf open area and a 36" RCP Outlet
For DI #7, use two grates with 12 sf open area and 2- 36" RCP Outlet

HDR Computation

I Job No. 453925-235691-018 I

Project:	Charah Colon Mine	Computed:	PAW	Date 11/03/14	
Subject:	Permit Application	Checked	EAW	Date 11/6/14	
Task:	Drainage - Drop Inlet across Power Line Right-of-Way	Sheet	1	of	2

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

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

Equations:

Q (cfs) = CIA

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

Orifice Equation

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

Q = cfs, discharge (based on permanent condition)

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

g = 32.2 ft/sec^2, gravity

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

A = sf, cross sectional open area

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

Weir Equation

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

Q (cfs) = Discharge

3.2 = Cw Weir Coefficient (dimensionless)

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

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

Allowable head 2.0 feet (depth of channel)

Check for inlet control

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

HDR Computation

I Job No. 453925-235691-018 I

Project:	Charah Colon Mine	Computed:	PAW	Date 11/03/14
Subject:	Permit Application	Checked	EAW	Date 11/6/14
Task:	Drainage - Drop Inlet across Power Line Right-of-Way	Sheet	2	of 2

Size the Outlet culvert

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

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

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

Check pipe size based on Gravity Flow

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

Conclusion:

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

HDR Computation

I Job No. 453925-235691-018 I

Project:	Charah Colon Mine	Computed	PAW	Date	11/03/14
Subject:	Permit Application	Checked:	EAW	Date:	11/6/14
Task:	Drainage - Apron Outlets	Sheet	1	of:	1

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

$Z_{av} = Z_{req}$

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

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

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

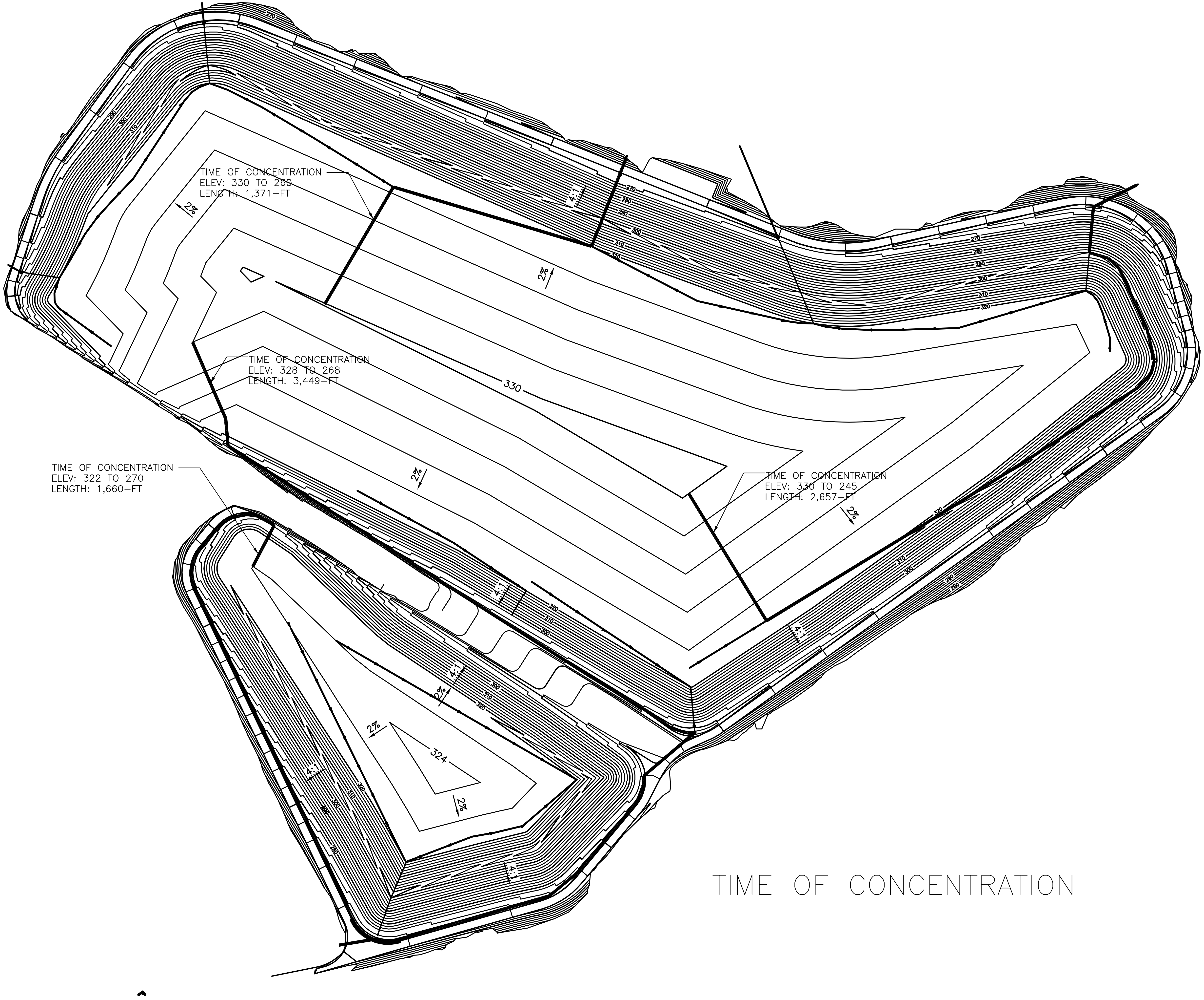
Diameter (in)	Q (cfs)	Z_{req}	Flow Depth, d (ft)	Cross Sectional Area (sf)	R (ft)	Z_{av}	Velocity (ft/sec)	Tailwater
30	35.2	16.28	1.13	18.9	0.80	16.28	1.9	Min
36	48.7	22.54	1.33	23.9	0.91	22.54	2.0	Min

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

Conclusion:

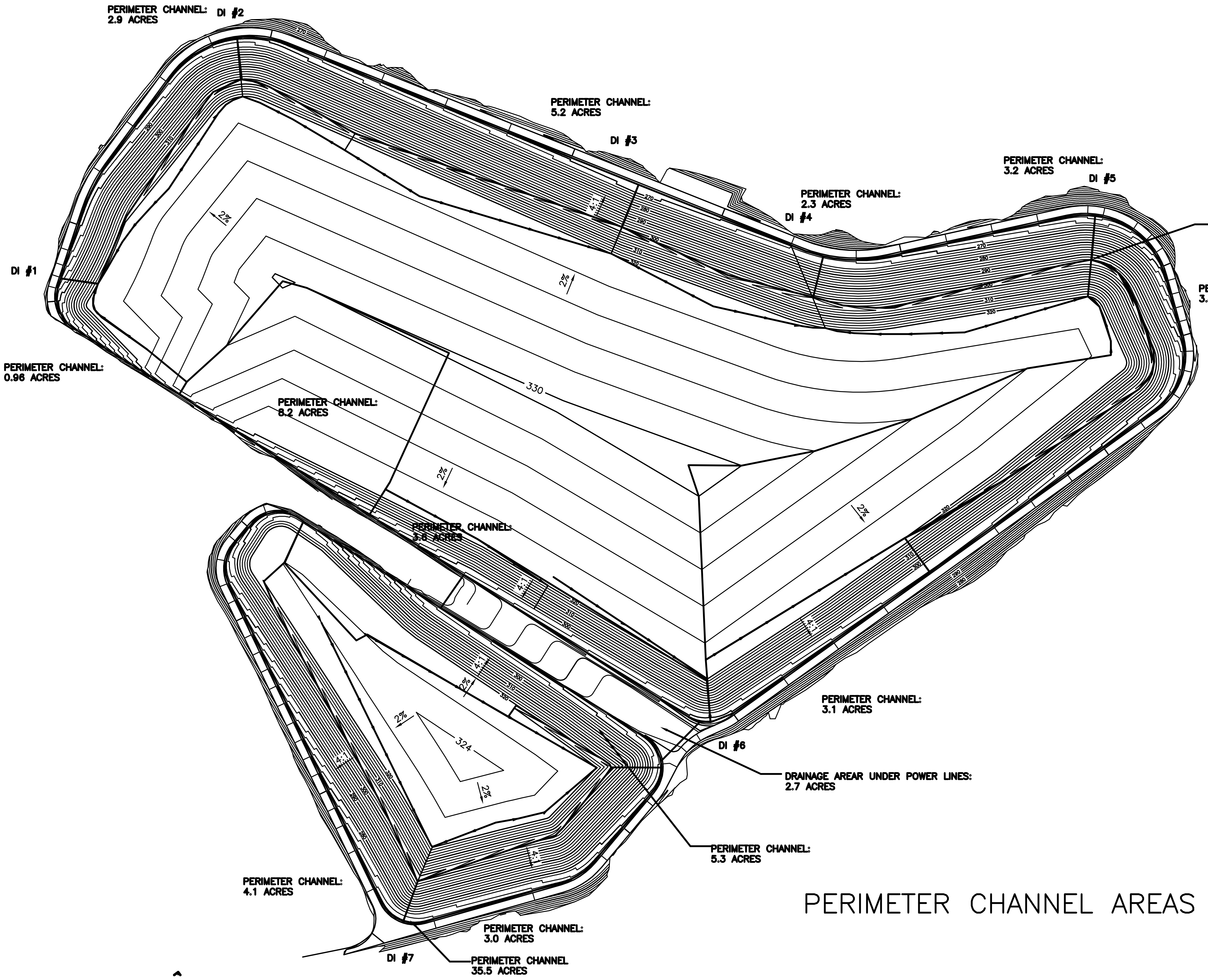
Culvert Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size (ft) d_{50}	Selected Rip Rap Size (in)
2.5	7.5	16	19	0.5	Class B
3	9	20	23	0.5	Class B

This page intentionally left blank.



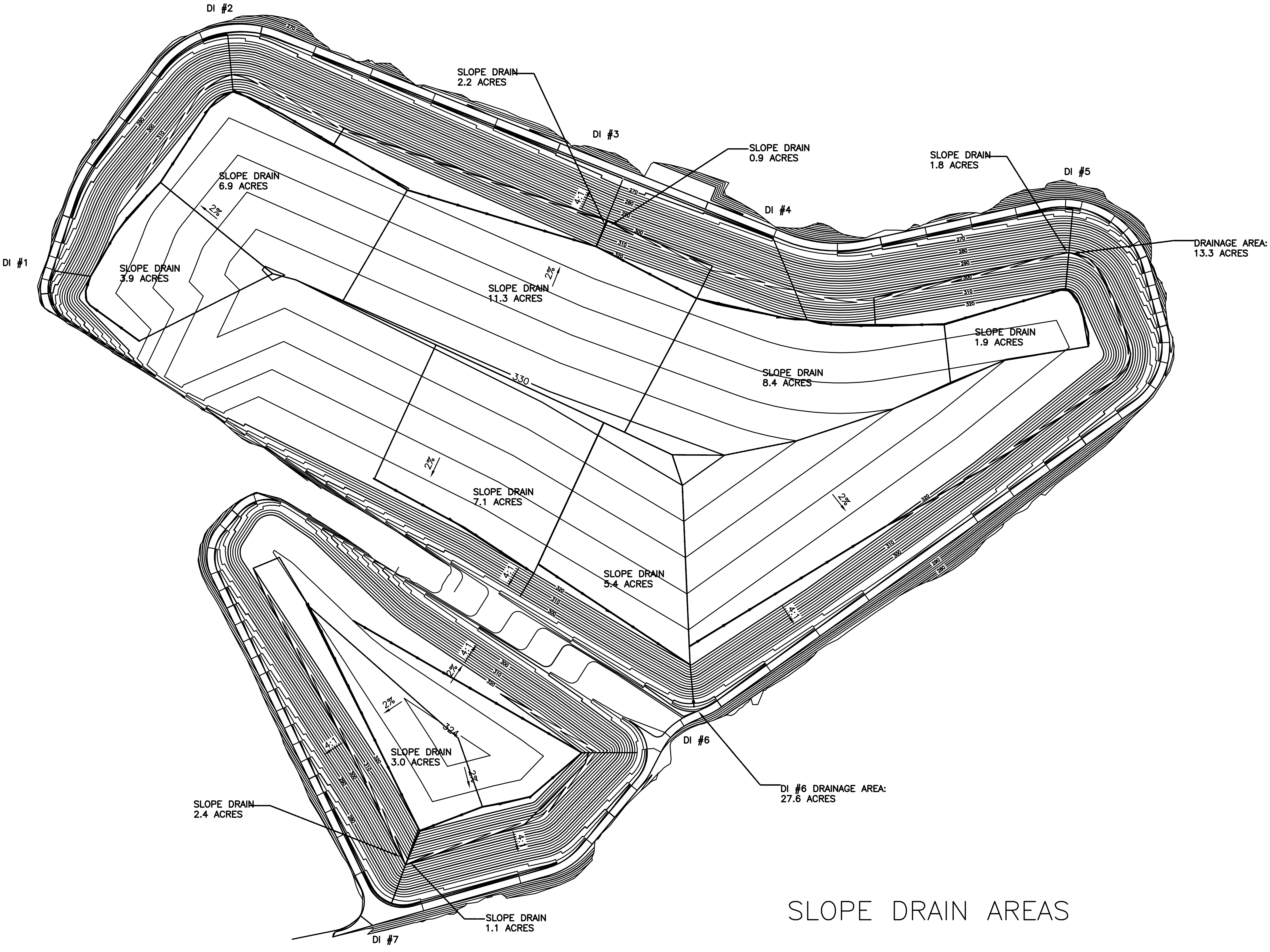
TIME OF CONCENTRATION

C:\pwworking\tpa\d0602582\00C-DP01200.dwg, Model, 11/6/2014 3:59:54 PM, pwestmor



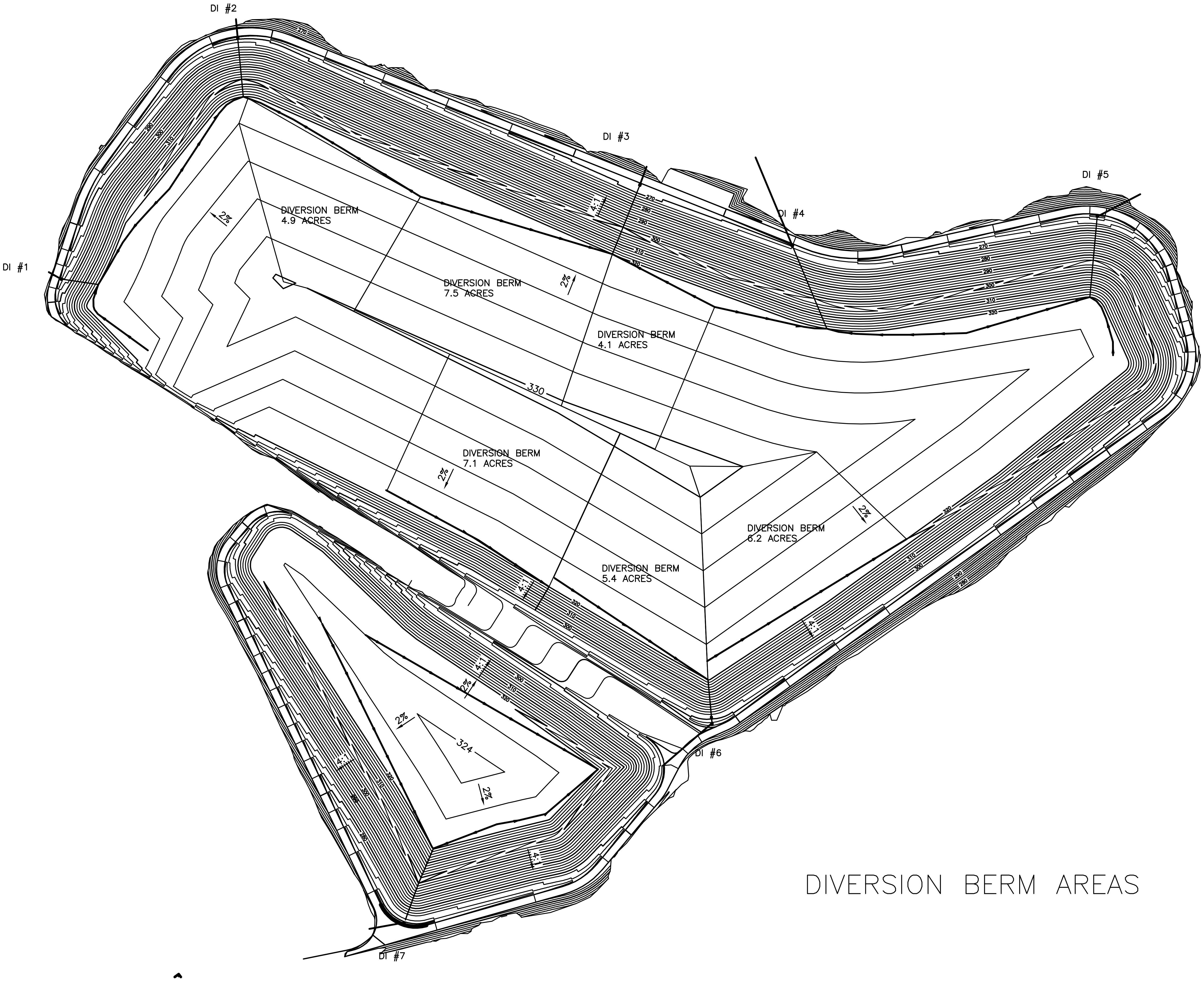
PERIMETER CHANNEL AREAS

C:\pwworking\tpa\d0602582\00C-DP01200.dwg, Model, 11/6/2014 12:20:31 AM, pwestmor



SLOPE DRAIN AREAS

C:\pwworking\tpa\d0602582\00C-DP01200.dwg, Model, 11/6/2014 12:18:48 AM, pwestmor



DIVERSION BERM AREAS

C:\pwworking\tpa\d0602582\00C-DP01200.dwg, Model, 11/6/2014 4:05:02 PM, pwestmor

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.

Back to Top

PF graphical

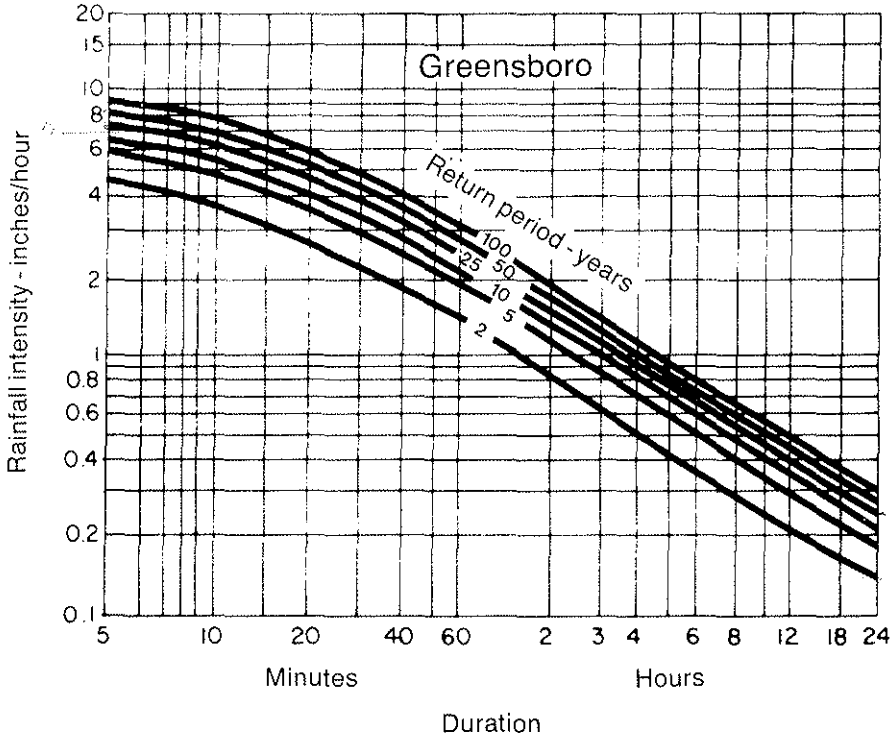


Figure 8.03d Rainfall intensity duration curves—Greensboro.

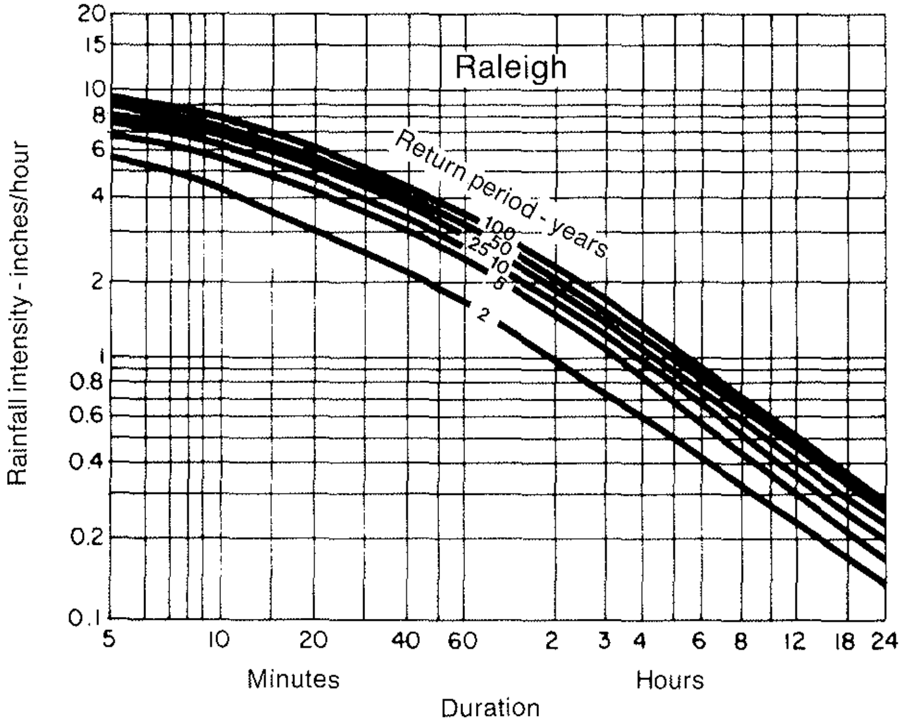


Figure 8.03e Rainfall intensity duration curves—Raleigh.

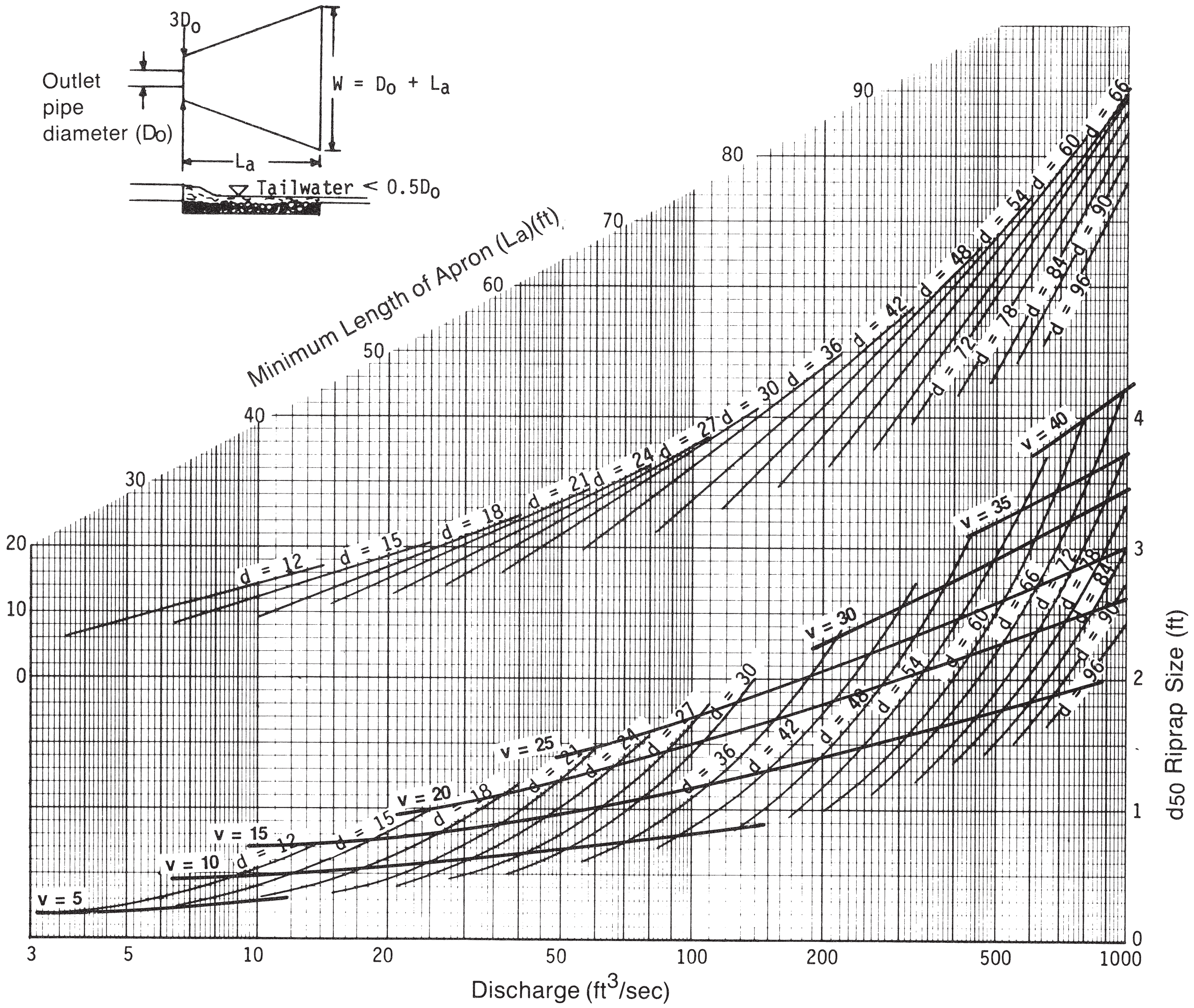
Table 8.03b
Value of Runoff Coefficient (C) for Rational Formula

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

Land Use	C
Lawns:	
Sandy soil, flat, 2%	0.05-0.10
Sandy soil, ave.,	0.10-0.15
2-7%	0.15-0.20
Sandy soil, steep,	0.13-0.17
7%	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	0.15-0.45
crop	0.05-0.25
Sandy soil no crop	0.05-0.25
Sandy soil with	
crop	0.10-0.25
Pasture	
Heavy soil	0.15-0.45
Sandy soil	0.05-0.25
Woodlands	0.05-0.25

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

Source: American Society of Civil Engineers



Curves may not be extrapolated.

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

HDR Computation

Job No. 0453925-237673-018

Project: Charah Colon Mine		Computed: EAW	Date: 1/4/15
Subject: Permit Application		Checked: PAW	Date: 1/4/15
Task: Sediment Basin #1		Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1	2	2	2		
Storm Event (yrs) =	10	10	25	100		
Total Drainage Area A (ac) =	5.4	9.3	9.3	9.3		
Disturbed Area (ac) =	5.4	9.3	9.3	9.3		
Curve Number CN =	86	86	86	86	Hydrographs	
Rainfall Depth P (in) =	5.28	5.28	6.28	7.88	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	32.86	43.09	53.49	70.07	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	16,740	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	18,744	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.

Calculate Volume of the Basin using Truncated Pyramid Method.

Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
283	0	0	-	-	-
283	0	13,792	0	0	0
284	1	15,414	14,595	14,595	541
285	2	17,133	16,266	30,861	1,143
286	3	18,947	18,032	48,894	1,811
287	4	21,463	20,192	69,086	2,559
288	5	23,731	22,588	91,673	3,395
289	6	26,305	25,007	116,680	4,321

Design Sediment Depth (ft) = 3

Sediment Storage (cf) = 48,894 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3

Surface Area (sf) = 18,947 *Required Surface Area Achieved*

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #1	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 48,894

Number of Skimmers 1

Days to Drain = 5 *assumed*

Q each (cf/day) = 9,779 0.11 cfs

Selected Skimmer Size (inches) = 4

Head on Skimmer (feet) = 0.333

Diameter of Orifice (inches) = 2.7

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

S = (1000/CN) - 10

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase	1	2	2	2
Storm Event (yrs) =	10	10	25	100
S =	1.63	1.63	1.63	1.63
Runoff Depth Q* (inches) =	3.73	3.73	4.68	6.22
Time to Peak T_p (min) =	26.67	35.03	35.39	35.90

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 48,894

Z_2 (ft) = 6 S_2 (cf) = 116,680

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.3 Ref 2, III-8

K_S = S_2/Z_2^b = 12,318

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #1	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (ν) = 1.14E-06 n^2 / sec @ 20° C — Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / \nu] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 7.00

Set Top of Dam at (ft) = 7.50

See Hydrograph

Emergency Spillway

Q_E (cfs) = 100-Yr Storm

Q_E (cfs) = 5.8

Cross Section = Trapezoid

Channel Side Slope (z) = 5 (enter X for X:1)

n = 0.03 Grass Lined

Vp (ft/sec) = 5.0 Permissible Velocity for lining — Ref 2, II-7

Allowable Shear Stress (psf) = 2.0 Allowable Shear Stress for lining

Bottom Width, b (ft) = 20

Calculate Required Depth of Spillway:

Normal-Depth Procedure

$AR^{2/3}=Qn/1.49s^{0.5}$ — Q=VA

$Z_{req}=Qn/1.49s^{0.5}$ — Area (A)= bd+z(d^2)

$Z_{av}=AR^{2/3}$ — R=Area/(b+2d((z^2)+1)^.5)

Avg Shear Stress(T) = K_b*d*s*unit weight of water

Channel Slope ft/ft	Depth, d (ft)	A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	T (psf)
0.01	0.18	3.77	1.17	0.17	1.17	1.5	0.1
0.02	0.15	3.03	0.82	0.14	0.82	1.9	0.2

Construct the channel to be :

20 ft, Bottom Width (measured at top of lining)

0.5 ft, depth (measured at top of lining)

1% slope

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 3

Use Anti-Seep Collar Size (ft) = 3 x 3

HDR Computation

Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #1	Sheet: 4	Of: 4

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 54 From Hydrograph
Avg Density of Concrete (lbs/cf) = 87.6
Density of Water (lbs/cf) = 62.4
Riser Displacement (cf) = 101.79 Pi * $(D_R/24)^2$ * Total Ht of Riser
Convert cf to cy = 27^{-1}
Min Concrete Needed (cy) = 2.69
Width & Length (ft) = 5.5
Thickness (ft) = 2.4

Anti-Vortex Device:

Diameter of Riser (in) = 54 From Hydrograph
Cylinder Diameter (in) = 78 Ref 3, III-104, Table 3.14-D
Cylinder Thickness (gage) = 16
Cylinder Height (in) = 25

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n =	0.069	6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) =	9	Permissible Velocity for lining
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	0.02	Outlet Slope (estimated)
Bottom Width (ft) =	9	6 * Barrel Diameter
Q_B (cfs) =	10.0	Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
10.0	3.26	0.51	5.9	0.41	3.26	1.7

Flow Depth = Tailwater, d (ft) = 0.51 0.5* Barrel Diameter (ft) = 0.75 Ref 1, 8.06.3
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
1.5	4.5	10	12	0.3	Class A

Conclusion

The basin can contain the 10-yr storm and pass the 100-yr storm without overtopping the berm.

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) =	54	
Circumference of Riser (in) =	169.6	
eight of Riser from bottom of barrel (in) =	77	From Hydrograph
Vertical spacing between holes (in) =	0	center to center
Water Stage increment (ft)	0.05	

Orifice Equation

$Q = C_d * A * (2 * g * h)^{0.5}$ Ref 1, p III-11

Q = cfs, discharge

C_d = 0.6 coefficient of discharge

A = sf, cross sectional area

g = 32.2 ft/sec^2, gravity

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

	Perforations					Skimmer	
Row	1	2	3	4	5	1	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.11	0.11
0.39	0.00	0.00	0.00			0.11	0.11
0.44	0.00	0.00	0.00			0.11	0.11
0.49	0.00	0.00	0.00			0.11	0.11
0.54	0.00	0.00	0.00			0.11	0.11
0.59	0.00	0.00	0.00			0.11	0.11
0.64	0.00	0.00	0.00			0.11	0.11
0.69	0.00	0.00	0.00			0.11	0.11
0.74	0.00	0.00	0.00			0.11	0.11
0.79	0.00	0.00	0.00			0.11	0.11
0.84	0.00	0.00	0.00			0.11	0.11
0.89	0.00	0.00	0.00			0.11	0.11
0.94	0.00	0.00	0.00			0.11	0.11
0.99	0.00	0.00	0.00			0.11	0.11
1.04	0.00	0.00	0.00			0.11	0.11
1.09	0.00	0.00	0.00			0.11	0.11
1.14	0.00	0.00	0.00			0.11	0.11
1.19	0.00	0.00	0.00			0.11	0.11
1.24	0.00	0.00	0.00			0.11	0.11
1.29	0.00	0.00	0.00			0.11	0.11
1.34	0.00	0.00	0.00			0.11	0.11
1.39	0.00	0.00	0.00			0.11	0.11
1.44	0.00	0.00	0.00			0.11	0.11
1.49	0.00	0.00	0.00			0.11	0.11
1.54	0.00	0.00	0.00			0.11	0.11
1.59	0.00	0.00	0.00			0.11	0.11

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.11	0.11
1.69	0.00	0.00	0.00	0.11	0.11
1.74	0.00	0.00	0.00	0.11	0.11
1.79	0.00	0.00	0.00	0.11	0.11
1.84	0.00	0.00	0.00	0.11	0.11
1.89	0.00	0.00	0.00	0.11	0.11
1.94	0.00	0.00	0.00	0.11	0.11
1.99	0.00	0.00	0.00	0.11	0.11
2.04	0.00	0.00	0.00	0.11	0.11
2.09	0.00	0.00	0.00	0.11	0.11
2.14	0.00	0.00	0.00	0.11	0.11
2.19	0.00	0.00	0.00	0.11	0.11
2.24	0.00	0.00	0.00	0.11	0.11
2.29	0.00	0.00	0.00	0.11	0.11
2.34	0.00	0.00	0.00	0.11	0.11
2.39	0.00	0.00	0.00	0.11	0.11
2.44	0.00	0.00	0.00	0.11	0.11
2.49	0.00	0.00	0.00	0.11	0.11
2.54	0.00	0.00	0.00	0.11	0.11
2.59	0.00	0.00	0.00	0.11	0.11
2.64	0.00	0.00	0.00	0.11	0.11
2.69	0.00	0.00	0.00	0.11	0.11
2.74	0.00	0.00	0.00	0.11	0.11
2.79	0.00	0.00	0.00	0.11	0.11
2.84	0.00	0.00	0.00	0.11	0.11
2.89	0.00	0.00	0.00	0.11	0.11
2.94	0.00	0.00	0.00	0.11	0.11
2.99	0.00	0.00	0.00	0.11	0.11
3.04	0.00	0.00	0.00	0.11	0.11
3.09	0.00	0.00	0.00	0.11	0.11
3.14	0.00	0.00	0.00	0.11	0.11
3.19	0.00	0.00	0.00	0.11	0.11
3.24	0.00	0.00	0.00	0.11	0.11
3.29	0.00	0.00	0.00	0.11	0.11
3.34	0.00	0.00	0.00	0.11	0.11
3.39	0.00	0.00	0.00	0.11	0.11
3.44	0.00	0.00	0.00	0.11	0.11
3.49	0.00	0.00	0.00	0.11	0.11
3.54	0.00	0.00	0.00	0.11	0.11
3.59	0.00	0.00	0.00	0.11	0.11
3.64	0.00	0.00	0.00	0.11	0.11
3.69	0.00	0.00	0.00	0.11	0.11
3.74	0.00	0.00	0.00	0.11	0.11
3.79	0.00	0.00	0.00	0.11	0.11
3.84	0.00	0.00	0.00	0.11	0.11
3.89	0.00	0.00	0.00	0.11	0.11
3.94	0.00	0.00	0.00	0.11	0.11
3.99	0.00	0.00	0.00	0.11	0.11

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of _2

Sediment Basin # 1 Colon

Phase 1

10 - year Storm Event

Qp = 32.86 cfs
Tp = 26.67 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.3
K_s = 12,318

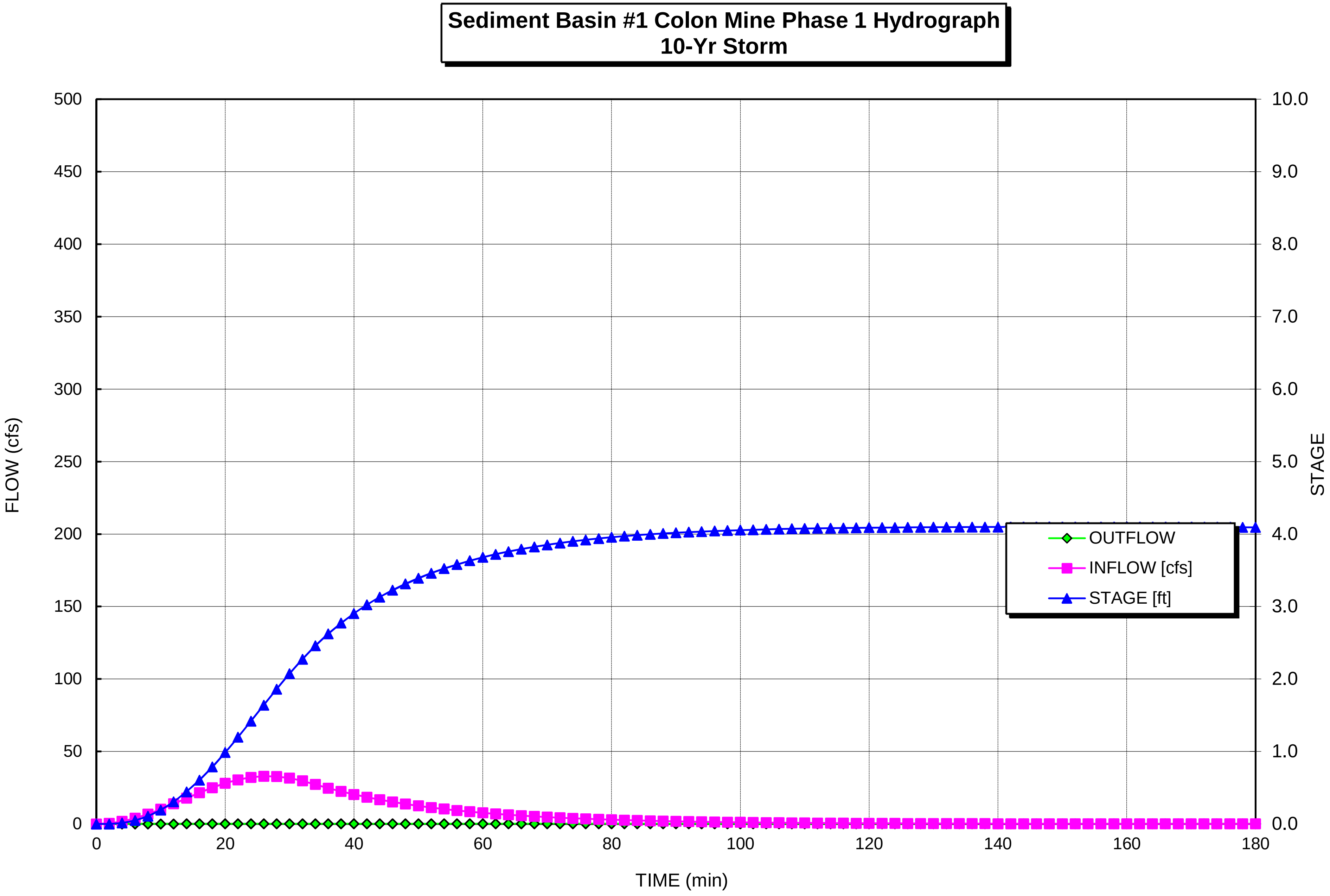
Number of Riser/Barrel Assemblies **1**
Diameter of Barrel = **18** (in)
Height of Riser above barrel = **4.9** (ft)
Height of Riser from bottom of barrel= **6.4** (ft) elevation 289.40
Emergency Spillway = **7.0** (ft) elevation 290.00
Total Height of Dam = **7.5** (ft) elevation 290.50
Length of Emergency Spillway = **20** (ft)
Diameter of Riser = **54** (in)
Permanent Pond Stage = **0** (ft) elevation 283.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
4.1 ft Maximum Stage 287.10 msl elevation
0.1 cfs Peak outflow
0.1 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

Notes:
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.5	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	1.8	54	0.0	0.00	0.00	0.00	0.00	0.00	11.31	5,140	N/A
6	3.9	269	0.0	0.00	0.00	0.00	0.00	0.00	15.64	7,111	N/A
8	6.8	741	0.1	0.00	0.00	0.00	0.00	0.00	19.22	8,735	N/A
10	10.1	1,554	0.2	0.00	0.00	0.00	0.00	0.00	22.33	10,151	N/A
12	13.9	2,770	0.3	0.00	0.00	0.00	0.00	0.00	25.12	11,416	N/A
14	17.7	4,433	0.4	0.11	0.11	0.00	0.11	0.11	27.63	12,560	100%
16	21.5	6,545	0.6	0.11	0.11	0.00	0.11	0.11	29.91	13,594	100%
18	25.0	9,111	0.8	0.11	0.11	0.00	0.11	0.11	31.99	14,539	100%
20	28.0	12,099	1.0	0.11	0.11	0.00	0.11	0.11	33.88	15,401	100%
22	30.4	15,450	1.2	0.11	0.11	0.00	0.11	0.11	35.61	16,185	100%
24	32.1	19,088	1.4	0.11	0.11	0.00	0.11	0.11	37.17	16,895	100%
26	32.8	22,921	1.6	0.11	0.11	0.00	0.11	0.11	38.58	17,535	100%
28	32.7	26,844	1.9	0.11	0.11	0.00	0.11	0.11	39.83	18,107	100%
30	31.6	30,750	2.1	0.11	0.11	0.00	0.11	0.11	40.95	18,613	100%
32	29.7	34,530	2.3	0.11	0.11	0.00	0.11	0.11	41.92	19,056	100%
34	27.2	38,084	2.5	0.11	0.11	0.00	0.11	0.11	42.77	19,439	100%
36	24.7	41,334	2.6	0.11	0.11	0.00	0.11	0.11	43.48	19,765	100%
38	22.4	44,281	2.8	0.11	0.11	0.00	0.11	0.11	44.10	20,044	100%
40	20.3	46,953	2.9	0.11	0.11	0.00	0.11	0.11	44.62	20,284	100%
42	18.4	49,375	3.0	0.11	0.11	0.00	0.11	0.11	45.08	20,492	100%
44	16.7	51,571	3.1	0.11	0.11	0.00	0.11	0.11	45.48	20,674	100%
46	15.2	53,562	3.2	0.11	0.11	0.00	0.11	0.11	45.83	20,834	100%
48	13.7	55,367	3.3	0.11	0.11	0.00	0.11	0.11	46.14	20,974	100%
50	12.5	57,003	3.4	0.11	0.11	0.00	0.11	0.11	46.42	21,099	100%
52	11.3	58,485	3.5	0.11	0.11	0.00	0.11	0.11	46.66	21,209	100%
54	10.3	59,829	3.5	0.11	0.11	0.00	0.11	0.11	46.88	21,307	100%
56	9.3	61,047	3.6	0.11	0.11	0.00	0.11	0.11	47.07	21,394	100%
58	8.4	62,150	3.6	0.11	0.11	0.00	0.11	0.11	47.24	21,472	100%
60	7.7	63,149	3.7	0.11	0.11	0.00	0.11	0.11	47.39	21,542	100%
62	6.9	64,055	3.7	0.11	0.11	0.00	0.11	0.11	47.53	21,604	100%
64	6.3	64,875	3.8	0.11	0.11	0.00	0.11	0.11	47.65	21,660	100%
66	5.7	65,618	3.8	0.11	0.11	0.00	0.11	0.11	47.76	21,710	100%
68	5.2	66,290	3.8	0.11	0.11	0.00	0.11	0.11	47.86	21,755	100%
70	4.7	66,899	3.9	0.11	0.11	0.00	0.11	0.11	47.95	21,796	100%
72	4.3	67,450	3.9	0.11	0.11	0.00	0.11	0.11	48.03	21,832	100%
74	3.9	67,948	3.9	0.11	0.11	0.00	0.11	0.11	48.10	21,865	100%
76	3.5	68,399	3.9	0.11	0.11	0.00	0.11	0.11	48.17	21,894	100%
78	3.2	68,807	3.9	0.11	0.11	0.00	0.11	0.11	48.23	21,921	100%
80	2.9	69,176	4.0	0.11	0.11	0.00	0.11	0.11	48.28	21,944	100%
82	2.6	69,509	4.0	0.11	0.11	0.00	0.11	0.11	48.32	21,966	100%

84	2.4	69,810	4.0	0.11	0.11	0.00	0.11	0.11	48.37	21,985	100%
86	2.2	70,081	4.0	0.11	0.11	0.00	0.11	0.11	48.41	22,002	100%
88	2.0	70,327	4.0	0.11	0.11	0.00	0.11	0.11	48.44	22,018	100%
90	1.8	70,548	4.0	0.11	0.11	0.00	0.11	0.11	48.47	22,032	100%
92	1.6	70,747	4.0	0.11	0.11	0.00	0.11	0.11	48.50	22,045	100%
94	1.5	70,927	4.0	0.11	0.11	0.00	0.11	0.11	48.52	22,056	100%
96	1.3	71,088	4.0	0.11	0.11	0.00	0.11	0.11	48.55	22,066	100%
98	1.2	71,234	4.0	0.11	0.11	0.00	0.11	0.11	48.57	22,075	100%
100	1.1	71,364	4.1	0.11	0.11	0.00	0.11	0.11	48.58	22,084	100%
102	1.0	71,482	4.1	0.11	0.11	0.00	0.11	0.11	48.60	22,091	100%
104	0.9	71,587	4.1	0.11	0.11	0.00	0.11	0.11	48.61	22,098	100%
106	0.8	71,681	4.1	0.11	0.11	0.00	0.11	0.11	48.63	22,104	100%
108	0.7	71,765	4.1	0.11	0.11	0.00	0.11	0.11	48.64	22,109	100%
110	0.7	71,840	4.1	0.11	0.11	0.00	0.11	0.11	48.65	22,113	100%
112	0.6	71,907	4.1	0.11	0.11	0.00	0.11	0.11	48.66	22,118	100%
114	0.6	71,966	4.1	0.11	0.11	0.00	0.11	0.11	48.67	22,121	100%
116	0.5	72,019	4.1	0.11	0.11	0.00	0.11	0.11	48.67	22,125	100%
118	0.5	72,065	4.1	0.11	0.11	0.00	0.11	0.11	48.68	22,128	100%
120	0.4	72,106	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,130	100%
122	0.4	72,142	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,132	100%
124	0.3	72,173	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,134	100%
126	0.3	72,200	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,136	100%
128	0.3	72,223	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,137	100%
130	0.3	72,243	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,139	100%
132	0.2	72,260	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,140	100%
134	0.2	72,274	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,141	100%
136	0.2	72,285	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,141	100%
138	0.2	72,294	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,142	100%
140	0.2	72,301	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,142	100%
142	0.1	72,306	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,143	100%
144	0.1	72,309	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,143	100%
146	0.1	72,311	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,143	100%
148	0.1	72,311	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,143	100%
150	0.1	72,310	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,143	100%
152	0.1	72,308	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,143	100%
154	0.1	72,305	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,142	100%
156	0.1	72,301	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,142	100%
158	0.1	72,296	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,142	100%
160	0.1	72,290	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,142	100%
162	0.1	72,283	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,141	100%
164	0.0	72,276	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,141	100%
166	0.0	72,268	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,140	100%
168	0.0	72,260	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,140	100%
170	0.0	72,251	4.1	0.11	0.11	0.00	0.11	0.11	48.71	22,139	100%
172	0.0	72,242	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,139	100%
174	0.0	72,232	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,138	100%
176	0.0	72,222	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,137	100%
178	0.0	72,212	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,137	100%
180	0.0	72,201	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,136	100%
182	0.0	72,190	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,135	100%
184	0.0	72,179	4.1	0.11	0.11	0.00	0.11	0.11	48.70	22,135	100%
186	0.0	72,168	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,134	100%
188	0.0	72,156	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,133	100%
190	0.0	72,144	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,132	100%
192	0.0	72,132	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,132	100%
194	0.0	72,120	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,131	100%
196	0.0	72,108	4.1	0.11	0.11	0.00	0.11	0.11	48.69	22,130	100%
198	0.0	72,096	4.1	0.11	0.11	0.00	0.11	0.11	48.68	22,129	100%
200	0.0	72,083	4.1	0.11	0.11	0.00	0.11	0.11	48.68	22,129	100%
202	0.0	72,071	4.1	0.11	0.11	0.00	0.11	0.11	48.68	22,128	100%
204	0.0	72,058	4.1	0.11	0.11	0.00	0.11	0.11	48.68	22,127	100%
206	0.0	72,045	4.1	0.11	0.11	0.00	0.11	0.11	48.68	22,126	100%



Sediment Basin #1 Colon Mine Phase 1 Hydrograph
10-Yr Storm

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 1 Colon

Phase 2

10 - year Storm Event

Qp = 43.09 cfs
Tp = 35.03 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.3
Ks = 12,318

Number of Riser/Barrel Assemblies 1
Diameter of Barrel = 18 (in)
Height of Riser above barrel = 4.9 (ft)
Height of Riser from bottom of barrel= 6.4 (ft) elevation 289.40
Emergency Spillway = 7 (ft) elevation 290.00
Total Height of Dam = 7.5 (ft) elevation 290.50
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 54 (in)
Permanent Pond Stage = 0 (ft) elevation 283.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

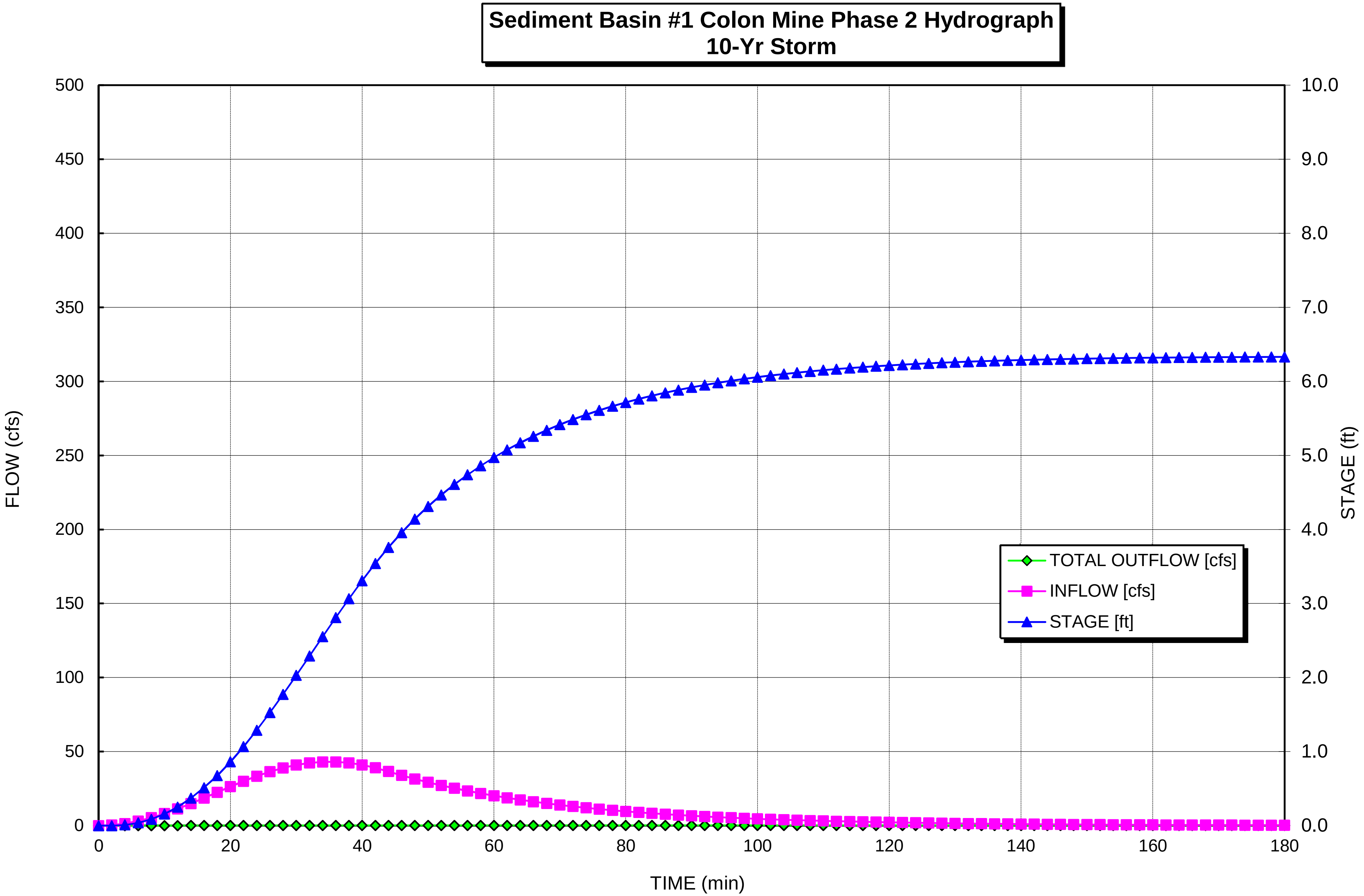
100% Minimum Settling Efficiency
6.3 ft Maximum Stage 289.33 msl elevation
0.1 cfs Peak outflow
0.1 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	1.4	41	0.0	0.00	0.00	0.00	0.00	0.00	10.70	4,864	N/A
6	3.0	206	0.0	0.00	0.00	0.00	0.00	0.00	14.82	6,735	N/A
8	5.3	571	0.1	0.00	0.00	0.00	0.00	0.00	18.23	8,285	N/A
10	8.1	1,209	0.2	0.00	0.00	0.00	0.00	0.00	21.22	9,647	N/A
12	11.3	2,181	0.3	0.00	0.00	0.00	0.00	0.00	23.92	10,875	N/A
14	14.9	3,539	0.4	0.11	0.11	0.00	0.11	0.11	26.40	11,998	100%
16	18.6	5,309	0.5	0.11	0.11	0.00	0.11	0.11	28.66	13,029	100%
18	22.5	7,530	0.7	0.11	0.11	0.00	0.11	0.11	30.77	13,987	100%
20	26.3	10,214	0.9	0.11	0.11	0.00	0.11	0.11	32.74	14,880	100%
22	30.0	13,358	1.1	0.11	0.11	0.00	0.11	0.11	34.57	15,714	100%
24	33.4	16,941	1.3	0.11	0.11	0.00	0.11	0.11	36.28	16,491	100%
26	36.4	20,933	1.5	0.11	0.11	0.00	0.11	0.11	37.87	17,215	100%
28	38.9	25,288	1.8	0.11	0.11	0.00	0.11	0.11	39.35	17,888	100%
30	40.9	29,948	2.0	0.11	0.11	0.00	0.11	0.11	40.73	18,513	100%
32	42.3	34,846	2.3	0.11	0.11	0.00	0.11	0.11	42.00	19,092	100%
34	43.0	39,909	2.6	0.11	0.11	0.00	0.11	0.11	43.18	19,625	100%
36	43.0	45,055	2.8	0.11	0.11	0.00	0.11	0.11	44.25	20,114	100%
38	42.3	50,202	3.1	0.11	0.11	0.00	0.11	0.11	45.23	20,561	100%
40	41.0	55,268	3.3	0.11	0.11	0.00	0.11	0.11	46.13	20,967	100%
42	39.0	60,173	3.5	0.11	0.11	0.00	0.11	0.11	46.93	21,332	100%
44	36.5	64,842	3.8	0.11	0.11	0.00	0.11	0.11	47.65	21,658	100%
46	33.9	69,213	4.0	0.11	0.11	0.00	0.11	0.11	48.28	21,947	100%
48	31.5	73,270	4.1	0.11	0.11	0.00	0.11	0.11	48.84	22,202	100%
50	29.2	77,036	4.3	0.11	0.11	0.00	0.11	0.11	49.34	22,429	100%
52	27.2	80,532	4.5	0.11	0.11	0.00	0.11	0.11	49.79	22,632	100%
54	25.2	83,776	4.6	0.11	0.11	0.00	0.11	0.11	50.19	22,815	100%
56	23.4	86,788	4.7	0.11	0.11	0.00	0.11	0.11	50.55	22,979	100%
58	21.7	89,583	4.9	0.11	0.11	0.00	0.11	0.11	50.88	23,127	100%
60	20.2	92,177	5.0	0.11	0.11	0.00	0.11	0.11	51.18	23,262	100%
62	18.7	94,585	5.1	0.11	0.11	0.00	0.11	0.11	51.44	23,384	100%
64	17.4	96,819	5.2	0.11	0.11	0.00	0.11	0.11	51.69	23,495	100%
66	16.1	98,893	5.3	0.11	0.11	0.00	0.11	0.11	51.91	23,596	100%
68	15.0	100,818	5.3	0.11	0.11	0.00	0.11	0.11	52.12	23,689	100%
70	13.9	102,603	5.4	0.11	0.11	0.00	0.11	0.11	52.30	23,774	100%
72	12.9	104,260	5.5	0.11	0.11	0.00	0.11	0.11	52.47	23,851	100%
74	12.0	105,798	5.5	0.11	0.11	0.00	0.11	0.11	52.63	23,922	100%
76	11.1	107,225	5.6	0.11	0.11	0.00	0.11	0.11	52.77	23,987	100%
78	10.3	108,548	5.7	0.11	0.11	0.00	0.11	0.11	52.90	24,047	100%
80	9.6	109,776	5.7	0.11	0.11	0.00	0.11	0.11	53.02	24,102	100%
82	8.9	110,915	5.8	0.11	0.11	0.00	0.11	0.11	53.14	24,153	100%
84	8.3	111,972	5.8	0.11	0.11	0.00	0.11	0.11	53.24	24,199	100%

86	7.7	112,952	5.8	0.11	0.11	0.00	0.11	0.11	53.33	24,242	100%
88	7.1	113,861	5.9	0.11	0.11	0.00	0.11	0.11	53.42	24,282	100%
90	6.6	114,704	5.9	0.11	0.11	0.00	0.11	0.11	53.50	24,318	100%
92	6.2	115,486	6.0	0.11	0.11	0.00	0.11	0.11	53.57	24,351	100%
94	5.7	116,211	6.0	0.11	0.11	0.00	0.11	0.11	53.64	24,382	100%
96	5.3	116,883	6.0	0.11	0.11	0.00	0.11	0.11	53.70	24,411	100%
98	4.9	117,506	6.0	0.11	0.11	0.00	0.11	0.11	53.76	24,437	100%
100	4.6	118,083	6.1	0.11	0.11	0.00	0.11	0.11	53.82	24,462	100%
102	4.2	118,618	6.1	0.11	0.11	0.00	0.11	0.11	53.87	24,484	100%
104	3.9	119,114	6.1	0.11	0.11	0.00	0.11	0.11	53.91	24,505	100%
106	3.7	119,574	6.1	0.11	0.11	0.00	0.11	0.11	53.95	24,524	100%
108	3.4	119,999	6.1	0.11	0.11	0.00	0.11	0.11	53.99	24,542	100%
110	3.2	120,394	6.2	0.11	0.11	0.00	0.11	0.11	54.03	24,558	100%
112	2.9	120,759	6.2	0.11	0.11	0.00	0.11	0.11	54.06	24,573	100%
114	2.7	121,097	6.2	0.11	0.11	0.00	0.11	0.11	54.09	24,587	100%
116	2.5	121,409	6.2	0.11	0.11	0.00	0.11	0.11	54.12	24,600	100%
118	2.3	121,699	6.2	0.11	0.11	0.00	0.11	0.11	54.15	24,612	100%
120	2.2	121,967	6.2	0.11	0.11	0.00	0.11	0.11	54.17	24,623	100%
122	2.0	122,214	6.2	0.11	0.11	0.00	0.11	0.11	54.19	24,633	100%
124	1.9	122,443	6.2	0.11	0.11	0.00	0.11	0.11	54.21	24,643	100%
126	1.7	122,655	6.2	0.11	0.11	0.00	0.11	0.11	54.23	24,651	100%
128	1.6	122,850	6.3	0.11	0.11	0.00	0.11	0.11	54.25	24,659	100%
130	1.5	123,031	6.3	0.11	0.11	0.00	0.11	0.11	54.27	24,666	100%
132	1.4	123,198	6.3	0.11	0.11	0.00	0.11	0.11	54.28	24,673	100%
134	1.3	123,351	6.3	0.11	0.11	0.00	0.11	0.11	54.29	24,680	100%
136	1.2	123,493	6.3	0.11	0.11	0.00	0.11	0.11	54.31	24,685	100%
138	1.1	123,624	6.3	0.11	0.11	0.00	0.11	0.11	54.32	24,691	100%
140	1.0	123,744	6.3	0.11	0.11	0.00	0.11	0.11	54.33	24,695	100%
142	1.0	123,855	6.3	0.11	0.11	0.00	0.11	0.11	54.34	24,700	100%
144	0.9	123,957	6.3	0.11	0.11	0.00	0.11	0.11	54.35	24,704	100%
146	0.8	124,051	6.3	0.11	0.11	0.00	0.11	0.11	54.36	24,708	100%
148	0.8	124,137	6.3	0.11	0.11	0.00	0.11	0.11	54.36	24,711	100%
150	0.7	124,215	6.3	0.11	0.11	0.00	0.11	0.11	54.37	24,715	100%
152	0.7	124,288	6.3	0.11	0.11	0.00	0.11	0.11	54.38	24,717	100%
154	0.6	124,354	6.3	0.11	0.11	0.00	0.11	0.11	54.38	24,720	100%
156	0.6	124,414	6.3	0.11	0.11	0.00	0.11	0.11	54.39	24,723	100%
158	0.5	124,469	6.3	0.11	0.11	0.00	0.11	0.11	54.39	24,725	100%
160	0.5	124,519	6.3	0.11	0.11	0.00	0.11	0.11	54.40	24,727	100%
162	0.5	124,565	6.3	0.11	0.11	0.00	0.11	0.11	54.40	24,729	100%
164	0.4	124,606	6.3	0.11	0.11	0.00	0.11	0.11	54.41	24,730	100%
166	0.4	124,644	6.3	0.11	0.11	0.00	0.11	0.11	54.41	24,732	100%
168	0.4	124,678	6.3	0.11	0.11	0.00	0.11	0.11	54.41	24,733	100%
170	0.3	124,708	6.3	0.11	0.11	0.00	0.11	0.11	54.42	24,734	100%
172	0.3	124,735	6.3	0.11	0.11	0.00	0.11	0.11	54.42	24,736	100%
174	0.3	124,760	6.3	0.11	0.11	0.00	0.11	0.11	54.42	24,736	100%
176	0.3	124,781	6.3	0.11	0.11	0.00	0.11	0.11	54.42	24,737	100%
178	0.3	124,801	6.3	0.11	0.11	0.00	0.11	0.11	54.42	24,738	100%
180	0.2	124,817	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,739	100%
182	0.2	124,832	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,739	100%
184	0.2	124,844	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,740	100%
186	0.2	124,855	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,740	100%
188	0.2	124,864	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,741	100%
190	0.2	124,872	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,741	100%
192	0.2	124,877	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,741	100%
194	0.1	124,882	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,741	100%
196	0.1	124,885	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,742	100%
198	0.1	124,887	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,742	100%
200	0.1	124,888	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,742	100%
202	0.1	124,888	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,742	100%
204	0.1	124,887	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,742	100%


Sediment Basin #1 Colon Mine Phase 2 Hydrograph
10-Yr Storm
FLOW (cfs)
STAGE (ft)
TIME (min)
500
450
400
350
300
250
200
150
100
50
0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
120
140
160
180
TOTAL OUTFLOW [cfs]
INFLOW [cfs]
STAGE [ft]

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of _2_

Sediment Basin # 1 Colon

Phase 2

25 - year Storm Event

Qp = 53.49 cfs
Tp = 35.39 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.3
Ks = 12,318

Number of Riser/Barrel Assemblies 1
Diameter of Barrel = 18 (in)
Height of Riser above barrel = 4.9 (ft)
Height of Riser from bottom of barrel= 6.4 (ft) elevation 289.40
Emergency Spillway = 7.0 (ft) elevation 290.00
Total Height of Dam = 7.5 (ft) elevation 290.50
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 54 (in)
Permanent Pond Stage = 0 (ft) elevation 283.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

97% Minimum Settling Efficiency
6.8 ft Maximum Stage 289.8 msl elevation
10.0 cfs Peak outflow
10.0 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

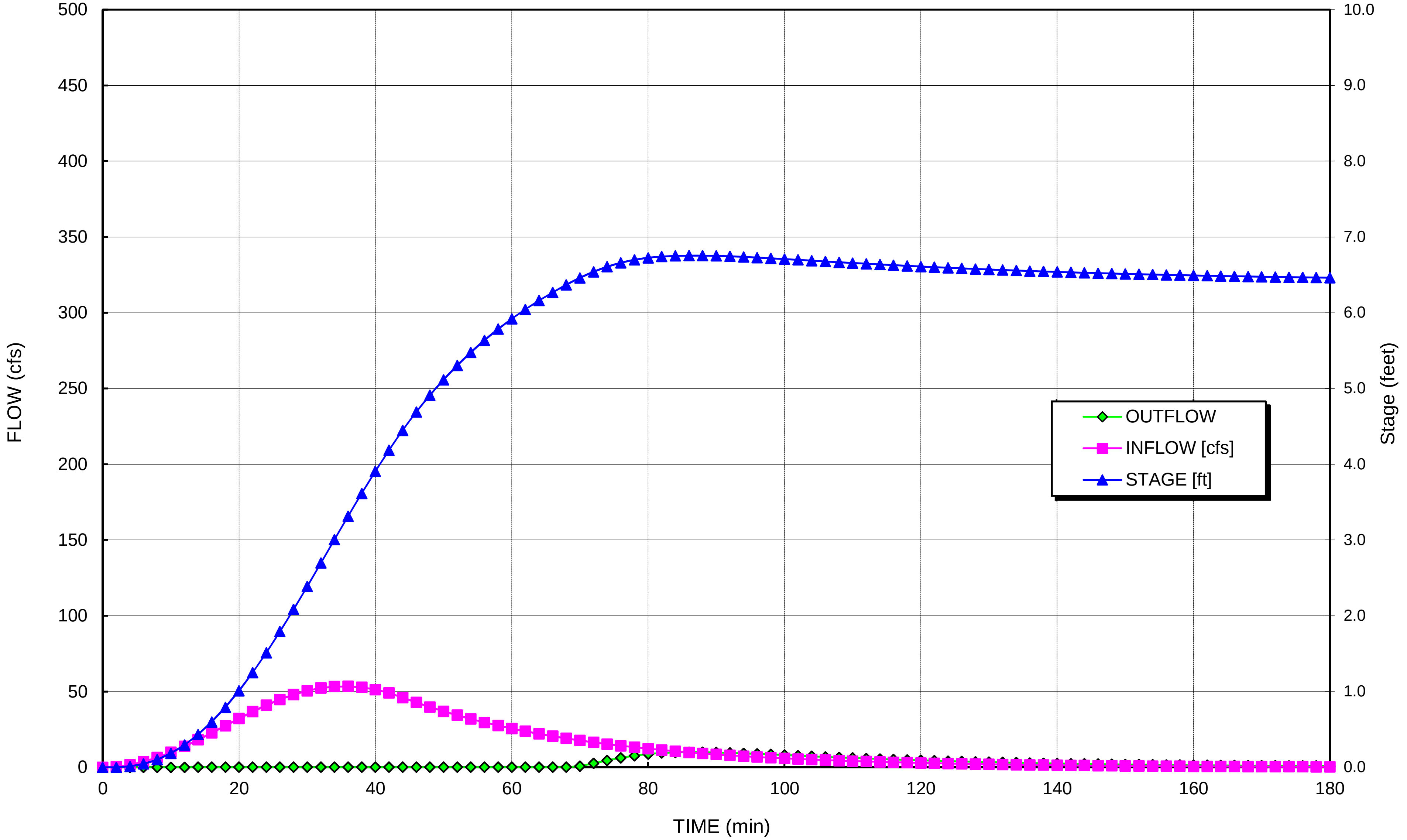
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.4	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	1.7	50	0.0	0.00	0.00	0.00	0.00	0.00	11.13	5,061	N/A
6	3.7	251	0.0	0.00	0.00	0.00	0.00	0.00	15.42	7,009	N/A
8	6.5	695	0.1	0.00	0.00	0.00	0.00	0.00	18.97	8,622	N/A
10	9.9	1,471	0.2	0.00	0.00	0.00	0.00	0.00	22.09	10,040	N/A
12	13.8	2,655	0.3	0.00	0.00	0.00	0.00	0.00	24.90	11,319	N/A
14	18.1	4,311	0.4	0.11	0.11	0.00	0.11	0.11	27.48	12,489	100%
16	22.7	6,473	0.6	0.11	0.11	0.00	0.11	0.11	29.84	13,564	100%
18	27.5	9,188	0.8	0.11	0.11	0.00	0.11	0.11	32.04	14,564	100%
20	32.2	12,472	1.0	0.11	0.11	0.00	0.11	0.11	34.09	15,496	100%
22	36.7	16,320	1.3	0.11	0.11	0.00	0.11	0.11	36.01	16,366	100%
24	41.0	20,714	1.5	0.11	0.11	0.00	0.11	0.11	37.79	17,178	100%
26	44.7	25,614	1.8	0.11	0.11	0.00	0.11	0.11	39.46	17,935	100%
28	47.9	30,968	2.1	0.11	0.11	0.00	0.11	0.11	41.01	18,640	100%
30	50.5	36,708	2.4	0.11	0.11	0.00	0.11	0.11	42.45	19,295	100%
32	52.3	42,753	2.7	0.11	0.11	0.00	0.11	0.11	43.78	19,901	100%
34	53.3	49,015	3.0	0.11	0.11	0.00	0.11	0.11	45.02	20,461	100%
36	53.5	55,396	3.3	0.11	0.11	0.00	0.11	0.11	46.15	20,976	100%
38	52.8	61,796	3.6	0.11	0.11	0.00	0.11	0.11	47.18	21,447	100%
40	51.3	68,115	3.9	0.11	0.11	0.00	0.11	0.11	48.13	21,876	100%
42	49.0	74,255	4.2	0.11	0.11	0.00	0.11	0.11	48.98	22,262	100%
44	46.0	80,122	4.4	0.11	0.11	0.00	0.11	0.11	49.74	22,609	100%
46	42.8	85,634	4.7	0.11	0.11	0.00	0.11	0.11	50.42	22,917	100%
48	39.8	90,761	4.9	0.11	0.11	0.00	0.11	0.11	51.02	23,189	100%
50	37.0	95,524	5.1	0.11	0.11	0.00	0.11	0.11	51.55	23,431	100%
52	34.4	99,948	5.3	0.11	0.11	0.00	0.11	0.11	52.02	23,647	100%
54	31.9	104,058	5.5	0.11	0.11	0.00	0.11	0.11	52.45	23,842	100%
56	29.7	107,876	5.6	0.11	0.11	0.00	0.11	0.11	52.84	24,017	100%
58	27.6	111,422	5.8	0.11	0.11	0.00	0.11	0.11	53.18	24,175	100%
60	25.6	114,717	5.9	0.11	0.11	0.00	0.11	0.11	53.50	24,318	100%
62	23.8	117,777	6.0	0.11	0.11	0.00	0.11	0.11	53.79	24,449	100%
64	22.1	120,619	6.2	0.11	0.11	0.00	0.11	0.11	54.05	24,568	100%
66	20.5	123,259	6.3	0.11	0.11	0.00	0.11	0.11	54.29	24,676	100%
68	19.1	125,711	6.4	0.11	0.11	0.00	0.11	0.11	54.50	24,775	100%
70	17.7	127,988	6.5	0.11	0.78	0.00	20.30	0.78	54.70	24,865	100%
72	16.5	130,023	6.5	0.11	2.58	0.00	20.44	2.58	54.88	24,945	100%
74	15.3	131,691	6.6	0.11	4.52	0.00	20.56	4.52	55.02	25,010	99%
76	14.2	132,986	6.7	0.11	6.27	0.00	20.65	6.27	55.13	25,059	99%
78	13.2	133,941	6.7	0.11	7.68	0.00	20.72	7.68	55.21	25,096	98%
80	12.3	134,607	6.7	0.11	8.71	0.00	20.76	8.71	55.27	25,121	98%
82	11.4	135,036	6.7	0.11	9.40	0.00	20.79	9.40	55.30	25,137	98%
84	10.6	135,278	6.8	0.11	9.79	0.00	20.81	9.79	55.32	25,146	97%

86	9.9	135,375	6.8	0.11	9.95	0.00	20.82	9.95	55.33	25,150	97%
88	9.2	135,363	6.8	0.11	9.93	0.00	20.82	9.93	55.33	25,150	97%
90	8.5	135,269	6.8	0.11	9.78	0.00	20.81	9.78	55.32	25,146	97%
92	7.9	135,117	6.7	0.11	9.53	0.00	20.80	9.53	55.31	25,140	97%
94	7.3	134,922	6.7	0.11	9.21	0.00	20.79	9.21	55.29	25,133	98%
96	6.8	134,697	6.7	0.11	8.85	0.00	20.77	8.85	55.27	25,125	98%
98	6.3	134,454	6.7	0.11	8.47	0.00	20.75	8.47	55.25	25,115	98%
100	5.9	134,199	6.7	0.11	8.07	0.00	20.74	8.07	55.23	25,106	98%
102	5.5	133,937	6.7	0.11	7.67	0.00	20.72	7.67	55.21	25,096	98%
104	5.1	133,674	6.7	0.11	7.27	0.00	20.70	7.27	55.19	25,086	98%
106	4.7	133,411	6.7	0.11	6.88	0.00	20.68	6.88	55.17	25,076	99%
108	4.4	133,152	6.7	0.11	6.51	0.00	20.66	6.51	55.14	25,066	99%
110	4.1	132,898	6.7	0.11	6.15	0.00	20.64	6.15	55.12	25,056	99%
112	3.8	132,650	6.6	0.11	5.80	0.00	20.63	5.80	55.10	25,047	99%
114	3.5	132,410	6.6	0.11	5.47	0.00	20.61	5.47	55.08	25,037	99%
116	3.3	132,176	6.6	0.11	5.15	0.00	20.59	5.15	55.06	25,028	99%
118	3.0	131,950	6.6	0.11	4.86	0.00	20.58	4.86	55.04	25,020	99%
120	2.8	131,732	6.6	0.11	4.58	0.00	20.56	4.58	55.02	25,011	99%
122	2.6	131,522	6.6	0.11	4.31	0.00	20.55	4.31	55.01	25,003	99%
124	2.4	131,320	6.6	0.11	4.06	0.00	20.53	4.06	54.99	24,995	99%
126	2.3	131,126	6.6	0.11	3.82	0.00	20.52	3.82	54.97	24,988	99%
128	2.1	130,940	6.6	0.11	3.60	0.00	20.51	3.60	54.96	24,981	100%
130	2.0	130,760	6.6	0.11	3.39	0.00	20.50	3.39	54.94	24,974	100%
132	1.8	130,588	6.6	0.11	3.19	0.00	20.48	3.19	54.93	24,967	100%
134	1.7	130,423	6.6	0.11	3.01	0.00	20.47	3.01	54.91	24,961	100%
136	1.6	130,265	6.6	0.11	2.83	0.00	20.46	2.83	54.90	24,954	100%
138	1.5	130,113	6.5	0.11	2.67	0.00	20.45	2.67	54.89	24,948	100%
140	1.4	129,968	6.5	0.11	2.52	0.00	20.44	2.52	54.87	24,943	100%
142	1.3	129,828	6.5	0.11	2.37	0.00	20.43	2.37	54.86	24,937	100%
144	1.2	129,695	6.5	0.11	2.24	0.00	20.42	2.24	54.85	24,932	100%
146	1.1	129,566	6.5	0.11	2.11	0.00	20.41	2.11	54.84	24,927	100%
148	1.0	129,444	6.5	0.11	1.99	0.00	20.40	1.99	54.83	24,922	100%
150	0.9	129,326	6.5	0.11	1.88	0.00	20.39	1.88	54.82	24,918	100%
152	0.9	129,213	6.5	0.11	1.77	0.00	20.39	1.77	54.81	24,913	100%
154	0.8	129,105	6.5	0.11	1.67	0.00	20.38	1.67	54.80	24,909	100%
156	0.8	129,001	6.5	0.11	1.58	0.00	20.37	1.58	54.79	24,905	100%
158	0.7	128,902	6.5	0.11	1.49	0.00	20.36	1.49	54.78	24,901	100%
160	0.7	128,806	6.5	0.11	1.41	0.00	20.36	1.41	54.77	24,897	100%
162	0.6	128,715	6.5	0.11	1.34	0.00	20.35	1.34	54.77	24,894	100%
164	0.6	128,627	6.5	0.11	1.26	0.00	20.34	1.26	54.76	24,890	100%
166	0.5	128,543	6.5	0.11	1.19	0.00	20.34	1.19	54.75	24,887	100%
168	0.5	128,462	6.5	0.11	1.13	0.00	20.33	1.13	54.74	24,884	100%
170	0.5	128,384	6.5	0.11	1.07	0.00	20.33	1.07	54.74	24,881	100%
172	0.4	128,310	6.5	0.11	1.01	0.00	20.32	1.01	54.73	24,878	100%
174	0.4	128,239	6.5	0.11	0.96	0.00	20.32	0.96	54.73	24,875	100%
176	0.4	128,170	6.5	0.11	0.91	0.00	20.31	0.91	54.72	24,872	100%
178	0.3	128,104	6.5	0.11	0.86	0.00	20.31	0.86	54.71	24,870	100%
180	0.3	128,041	6.5	0.11	0.82	0.00	20.30	0.82	54.71	24,867	100%
182	0.3	127,980	6.5	0.11	0.78	0.00	20.30	0.78	54.70	24,865	100%
184	0.3	127,922	6.5	0.11	0.74	0.00	20.29	0.74	54.70	24,863	100%
186	0.3	127,866	6.5	0.11	0.70	0.00	20.29	0.70	54.69	24,860	100%
188	0.2	127,812	6.5	0.11	0.66	0.00	20.29	0.66	54.69	24,858	100%
190	0.2	127,760	6.4	0.11	0.63	0.00	20.28	0.63	54.68	24,856	100%
192	0.2	127,710	6.4	0.11	0.60	0.00	20.28	0.60	54.68	24,854	100%
194	0.2	127,662	6.4	0.11	0.57	0.00	20.27	0.57	54.68	24,852	100%
196	0.2	127,616	6.4	0.11	0.54	0.00	20.27	0.54	54.67	24,850	100%
198	0.2	127,571	6.4	0.11	0.52	0.00	20.27	0.52	54.67	24,849	100%
200	0.1	127,528	6.4	0.11	0.49	0.00	20.27	0.49	54.66	24,847	100%
202	0.1	127,487	6.4	0.11	0.47	0.00	20.26	0.47	54.66	24,845	100%
204	0.1	127,447	6.4	0.11	0.45	0.00	20.26	0.45	54.66	24,844	100%
206	0.1	127,409	6.4	0.11	0.43	0.00	20.26	0.43	54.65	24,842	100%

Sediment Basin #1 Colon Mine Phase 2 Hydrograph
25-Yr Storm



Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: 1 of 2

Sediment Basin # 1 Colon

Phase 2

100 - year Storm Event

Qp = 70.1 cfs
Tp = 35.9 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.3
Ks = 12,318

Number of Riser/Barrel Assemblies 1
Diameter of Barrel = 18 (in)
Height of Riser above barrel = 4.9 (ft)
Height of Riser from bottom of barrel= 6.4 (ft) elevation 289.40
Emergency Spillway = 7.0 (ft) elevation 290.00
Total Height of Dam = 7.5 (ft) elevation 290.50
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 54 (in)
Permanent Pond Stage = 0 (ft) elevation 283.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

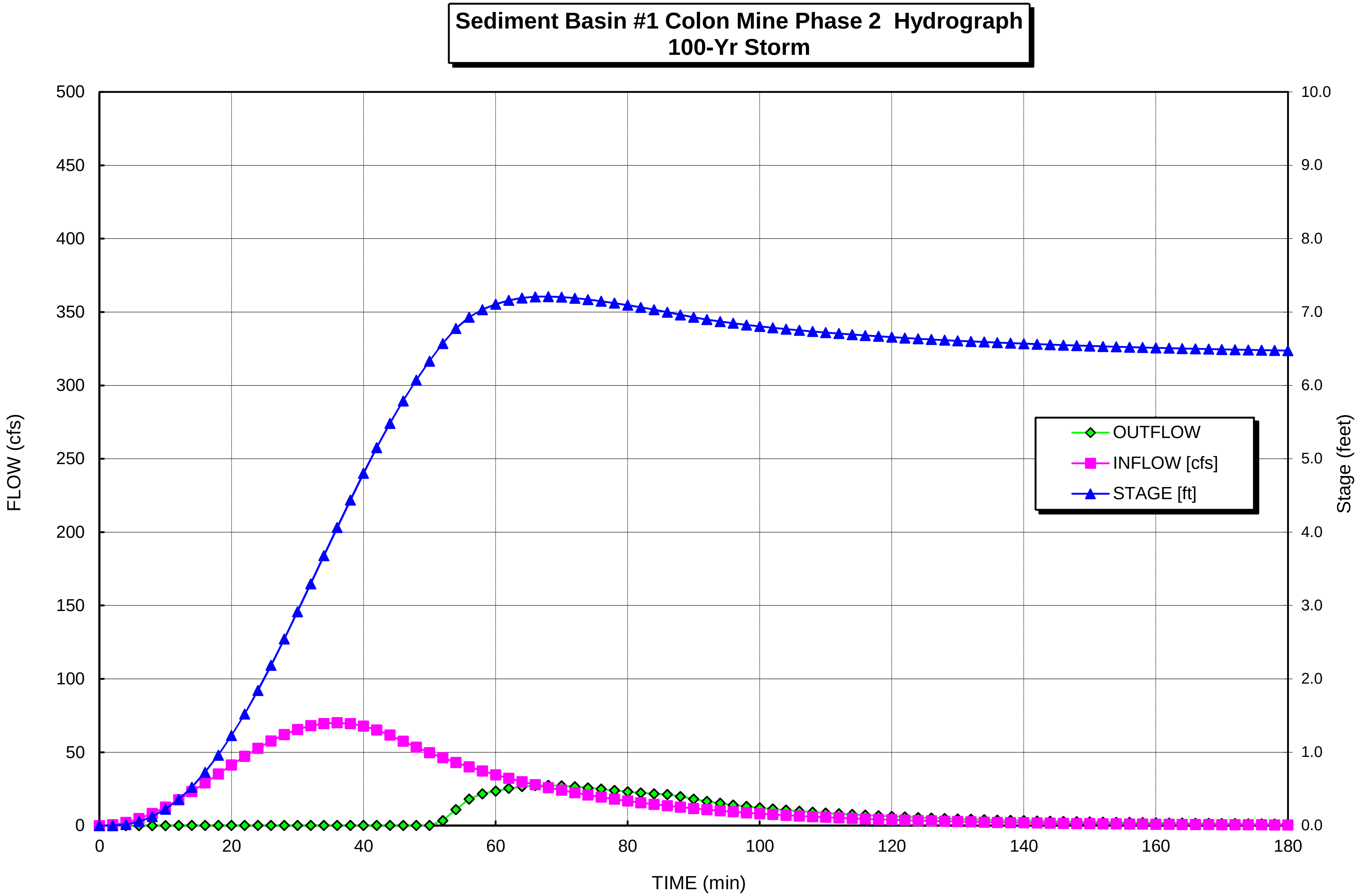
88% Minimum Settling Efficiency
7.2 ft Maximum Stage 290.2 msl elevation
27.4 cfs Peak outflow
21.6 cfs Peak Riser/Barrel outflow
5.8 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.5	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	2.1	64	0.0	0.00	0.00	0.00	0.00	0.00	11.69	5,315	N/A
6	4.7	319	0.1	0.00	0.00	0.00	0.00	0.00	16.19	7,361	N/A
8	8.2	885	0.1	0.00	0.00	0.00	0.00	0.00	19.92	9,056	N/A
10	12.6	1,874	0.2	0.00	0.00	0.00	0.00	0.00	23.20	10,545	N/A
12	17.6	3,383	0.4	0.11	0.11	0.00	0.11	0.11	26.16	11,889	100%
14	23.2	5,482	0.5	0.11	0.11	0.00	0.11	0.11	28.85	13,114	100%
16	29.1	8,248	0.7	0.11	0.11	0.00	0.11	0.11	31.35	14,248	100%
18	35.2	11,724	1.0	0.11	0.11	0.00	0.11	0.11	33.67	15,303	100%
20	41.3	15,932	1.2	0.11	0.11	0.00	0.11	0.11	35.83	16,286	100%
22	47.2	20,872	1.5	0.11	0.11	0.00	0.11	0.11	37.85	17,204	100%
24	52.7	26,521	1.8	0.11	0.11	0.00	0.11	0.11	39.74	18,062	100%
26	57.7	32,834	2.2	0.11	0.11	0.00	0.11	0.11	41.50	18,863	100%
28	62.0	39,747	2.5	0.11	0.11	0.00	0.11	0.11	43.14	19,609	100%
30	65.5	47,175	2.9	0.11	0.11	0.00	0.11	0.11	44.67	20,303	100%
32	68.0	55,022	3.3	0.11	0.11	0.00	0.11	0.11	46.08	20,948	100%
34	69.6	63,174	3.7	0.11	0.11	0.00	0.11	0.11	47.40	21,544	100%
36	70.1	71,510	4.1	0.11	0.11	0.00	0.11	0.11	48.60	22,093	100%
38	69.5	79,905	4.4	0.11	0.11	0.00	0.11	0.11	49.71	22,596	100%
40	67.8	88,229	4.8	0.11	0.11	0.00	0.11	0.11	50.72	23,056	100%
42	65.2	96,357	5.2	0.11	0.11	0.00	0.11	0.11	51.64	23,472	100%
44	61.6	104,168	5.5	0.11	0.11	0.00	0.11	0.11	52.46	23,847	100%
46	57.5	111,551	5.8	0.11	0.11	0.00	0.11	0.11	53.20	24,181	100%
48	53.5	118,437	6.1	0.11	0.11	0.00	0.11	0.11	53.85	24,477	100%
50	49.7	124,842	6.3	0.11	0.11	0.00	0.11	0.11	54.43	24,740	100%
52	46.3	130,798	6.6	0.11	3.43	0.00	20.50	3.43	54.95	24,975	100%
54	43.0	135,939	6.8	0.11	10.90	0.00	20.86	10.90	55.38	25,171	97%
56	40.0	139,795	6.9	0.11	18.09	0.00	21.12	18.09	55.69	25,315	93%
58	37.2	142,428	7.0	0.11	23.63	0.37	21.29	21.66	55.90	25,411	91%
60	34.6	144,298	7.1	0.11	27.84	2.10	21.42	23.51	56.05	25,478	90%
62	32.2	145,632	7.2	0.11	30.97	3.81	21.51	25.32	56.16	25,526	89%
64	30.0	146,460	7.2	0.11	32.97	5.03	21.56	26.59	56.22	25,555	88%
66	27.9	146,865	7.2	0.11	33.96	5.67	21.59	27.26	56.25	25,570	88%
68	25.9	146,939	7.2	0.11	34.14	5.79	21.59	27.38	56.26	25,572	88%
70	24.1	146,765	7.2	0.11	33.71	5.51	21.58	27.09	56.25	25,566	88%
72	22.4	146,408	7.2	0.11	32.84	4.95	21.56	26.51	56.22	25,553	88%
74	20.9	145,918	7.2	0.11	31.66	4.22	21.53	25.75	56.18	25,536	89%
76	19.4	145,332	7.1	0.11	30.26	3.40	21.49	24.88	56.13	25,515	89%
78	18.1	144,675	7.1	0.11	28.71	2.55	21.44	23.99	56.08	25,492	90%
80	16.8	143,962	7.1	0.11	27.07	1.72	21.40	23.12	56.03	25,466	90%
82	15.6	143,203	7.1	0.11	25.35	0.97	21.35	22.31	55.97	25,439	91%
84	14.5	142,399	7.0	0.11	23.57	0.35	21.29	21.64	55.90	25,410	91%

86	13.5	141,546	7.0	0.11	21.72	0.00	21.24	21.24	55.83	25,379	91%
88	12.6	140,619	7.0	0.11	19.77	0.00	21.17	19.77	55.76	25,345	92%
90	11.7	139,754	6.9	0.11	18.01	0.00	21.12	18.01	55.69	25,313	93%
92	10.9	138,996	6.9	0.11	16.51	0.00	21.06	16.51	55.63	25,285	94%
94	10.1	138,320	6.9	0.11	15.20	0.00	21.02	15.20	55.57	25,260	95%
96	9.4	137,709	6.8	0.11	14.06	0.00	20.98	14.06	55.52	25,238	95%
98	8.7	137,151	6.8	0.11	13.03	0.00	20.94	13.03	55.48	25,217	96%
100	8.1	136,637	6.8	0.11	12.12	0.00	20.90	12.12	55.43	25,198	96%
102	7.6	136,160	6.8	0.11	11.28	0.00	20.87	11.28	55.40	25,180	97%
104	7.0	135,714	6.8	0.11	10.52	0.00	20.84	10.52	55.36	25,163	97%
106	6.5	135,296	6.8	0.11	9.83	0.00	20.81	9.83	55.32	25,147	97%
108	6.1	134,903	6.7	0.11	9.18	0.00	20.78	9.18	55.29	25,132	98%
110	5.7	134,532	6.7	0.11	8.59	0.00	20.76	8.59	55.26	25,118	98%
112	5.3	134,181	6.7	0.11	8.04	0.00	20.73	8.04	55.23	25,105	98%
114	4.9	133,848	6.7	0.11	7.54	0.00	20.71	7.54	55.20	25,092	98%
116	4.6	133,532	6.7	0.11	7.06	0.00	20.69	7.06	55.18	25,080	98%
118	4.2	133,232	6.7	0.11	6.62	0.00	20.67	6.62	55.15	25,069	99%
120	3.9	132,946	6.7	0.11	6.21	0.00	20.65	6.21	55.13	25,058	99%
122	3.7	132,674	6.6	0.11	5.83	0.00	20.63	5.83	55.10	25,047	99%
124	3.4	132,414	6.6	0.11	5.48	0.00	20.61	5.48	55.08	25,037	99%
126	3.2	132,167	6.6	0.11	5.14	0.00	20.59	5.14	55.06	25,028	99%
128	3.0	131,931	6.6	0.11	4.83	0.00	20.58	4.83	55.04	25,019	99%
130	2.7	131,705	6.6	0.11	4.54	0.00	20.56	4.54	55.02	25,010	99%
132	2.6	131,490	6.6	0.11	4.27	0.00	20.55	4.27	55.00	25,002	99%
134	2.4	131,284	6.6	0.11	4.01	0.00	20.53	4.01	54.99	24,994	99%
136	2.2	131,088	6.6	0.11	3.78	0.00	20.52	3.78	54.97	24,986	100%
138	2.1	130,900	6.6	0.11	3.55	0.00	20.50	3.55	54.95	24,979	100%
140	1.9	130,720	6.6	0.11	3.34	0.00	20.49	3.34	54.94	24,972	100%
142	1.8	130,548	6.6	0.11	3.15	0.00	20.48	3.15	54.92	24,965	100%
144	1.7	130,384	6.6	0.11	2.96	0.00	20.47	2.96	54.91	24,959	100%
146	1.5	130,227	6.5	0.11	2.79	0.00	20.46	2.79	54.90	24,953	100%
148	1.4	130,076	6.5	0.11	2.63	0.00	20.45	2.63	54.88	24,947	100%
150	1.3	129,932	6.5	0.11	2.48	0.00	20.44	2.48	54.87	24,941	100%
152	1.2	129,794	6.5	0.11	2.34	0.00	20.43	2.34	54.86	24,936	100%
154	1.2	129,662	6.5	0.11	2.21	0.00	20.42	2.21	54.85	24,931	100%
156	1.1	129,536	6.5	0.11	2.08	0.00	20.41	2.08	54.84	24,926	100%
158	1.0	129,415	6.5	0.11	1.96	0.00	20.40	1.96	54.83	24,921	100%
160	0.9	129,299	6.5	0.11	1.85	0.00	20.39	1.85	54.82	24,917	100%
162	0.9	129,187	6.5	0.11	1.75	0.00	20.38	1.75	54.81	24,912	100%
164	0.8	129,081	6.5	0.11	1.65	0.00	20.38	1.65	54.80	24,908	100%
166	0.7	128,979	6.5	0.11	1.56	0.00	20.37	1.56	54.79	24,904	100%
168	0.7	128,881	6.5	0.11	1.48	0.00	20.36	1.48	54.78	24,900	100%
170	0.6	128,787	6.5	0.11	1.40	0.00	20.36	1.40	54.77	24,897	100%
172	0.6	128,697	6.5	0.11	1.32	0.00	20.35	1.32	54.76	24,893	100%
174	0.6	128,610	6.5	0.11	1.25	0.00	20.34	1.25	54.76	24,890	100%
176	0.5	128,527	6.5	0.11	1.18	0.00	20.34	1.18	54.75	24,886	100%
178	0.5	128,448	6.5	0.11	1.12	0.00	20.33	1.12	54.74	24,883	100%
180	0.4	128,371	6.5	0.11	1.06	0.00	20.33	1.06	54.74	24,880	100%
182	0.4	128,298	6.5	0.11	1.00	0.00	20.32	1.00	54.73	24,877	100%
184	0.4	128,228	6.5	0.11	0.95	0.00	20.32	0.95	54.72	24,875	100%
186	0.4	128,160	6.5	0.11	0.90	0.00	20.31	0.90	54.72	24,872	100%
188	0.3	128,095	6.5	0.11	0.86	0.00	20.31	0.86	54.71	24,869	100%
190	0.3	128,033	6.5	0.11	0.81	0.00	20.30	0.81	54.71	24,867	100%
192	0.3	127,973	6.5	0.11	0.77	0.00	20.30	0.77	54.70	24,865	100%
194	0.3	127,915	6.5	0.11	0.73	0.00	20.29	0.73	54.70	24,862	100%
196	0.3	127,860	6.5	0.11	0.70	0.00	20.29	0.70	54.69	24,860	100%
198	0.2	127,806	6.5	0.11	0.66	0.00	20.29	0.66	54.69	24,858	100%
200	0.2	127,755	6.4	0.11	0.63	0.00	20.28	0.63	54.68	24,856	100%
202	0.2	127,706	6.4	0.11	0.60	0.00	20.28	0.60	54.68	24,854	100%
204	0.2	127,658	6.4	0.11	0.57	0.00	20.27	0.57	54.67	24,852	100%


Sediment Basin #1 Colon Mine Phase 2 Hydrograph
100-Yr Storm
FLOW (cfs)
Stage (feet)
TIME (min)
0
50
100
150
200
250
300
350
400
450
500
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0
20
40
60
80
100
120
140
160
180
OUTFLOW
INFLOW [cfs]
STAGE [ft]

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #2	Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1	2	2	2		
Storm Event (yrs) =	10	10	25	100		
Total Drainage Area A (ac) =	17.6	14.8	14.8	14.8		
Disturbed Area (ac) =	17.6	14.8	14.8	14.8		
Curve Number CN =	86	87	87	87	Hydrographs	
Rainfall Depth P (in) =	5.28	5.28	6.28	7.88	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	101.32	79.90	98.71	128.64	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	31,680	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	44,074	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
259	0	0	-	-	-
259	0	37,790	0	0	0
260	1	40,921	39,345	39,345	1,457
261	2	44,109	42,505	81,850	3,031
262	3	47,355	45,722	127,573	4,725
263	4	50,658	48,997	176,570	6,540
264	5	54,018	52,329	228,899	8,478
265	6	57,435	55,718	284,617	10,541

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 127,573 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 47,355 *Required Surface Area Achieved*

Project: Charah Colon Mine		Computed: EAW	Date: 1/4/15
Subject: Permit Application		Checked: PAW	Date: 1/4/15
Task: Sediment Basin #2		Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 127,573

Number of Skimmers 2

Days to Drain = 5 *assumed*

Q each (cf/day) = 12,757 0.15 cfs

Selected Skimmer Size (inches) = 4

Head on Skimmer (feet) = 0.333

Diameter of Orifice (inches) = 3.1

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

$S = (1000/CN) - 10$

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase	1	2	2	2
Storm Event (yrs) =	10	10	25	100
S =	1.63	1.49	1.49	1.49
Runoff Depth Q* (inches) =	3.73	3.83	4.79	6.33
Time to Peak T_p (min) =	28.19	30.89	31.23	31.71

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 127,573

Z_2 (ft) = 6 S_2 (cf) = 284,617

$b = \ln(S_2/S_1)/\ln(Z_2/Z_1) =$ 1.2 Ref 2, III-8

$K_S = S_2/Z_2^b =$ 35,760

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #2	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20^o C Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 6.00

Set Top of Dam at (ft) = 7.00

See Hydrograph

Emergency Spillway

Q_E (cfs) = 100-Yr Storm

Q_E (cfs) = 0.0

Cross Section = Trapezoid

Channel Side Slope (z) = 5 (enter X for X:1)

n = 0.03 Grass Lined

Vp (ft/sec) = 5.0 Permissible Velocity for lining Ref 2, II-7

Allowable Shear Stress (psf) = 2.0 Allowable Shear Stress for lining

Bottom Width, b (ft) = 15

Calculate Required Depth of Spillway:

Normal-Depth Procedure

$AR^{2/3}$=Qn/1.49s$^{0.5}$ Q=VA

Z_{req}=Qn/1.49s$^{0.5}$ Area (A)= bd+z(d^2)

Z_{av}=AR$^{2/3}$ R=Area/(b+2d((z^2)+1)^.5)

Avg Shear Stress(T) = K_b*d*s*unit weight of water

Channel Slope ft/ft	Depth, d (ft)	A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	T (psf)
0.01	0.00	0.00	0.00	0.00	0.00	0.0	0.0
0.02	0.00	0.00	0.00	0.00	0.00	0.0	0.0

Construct the channel to be : 15 ft, Bottom Width (measured at top of lining)

1.0 ft, depth (measured at top of lining)

1% slope

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 4

Use Anti-Seep Collar Size (ft) = 4 x 4

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #2	Sheet: 4	Of: 4

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 60 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (lbs/cf) = 62.4

Riser Displacement (cf) = 102.10 $\text{Pi} * (D_R/24)^2 * \text{Total Ht of Riser}$

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 2.69

Width & Length (ft) = 6

Thickness (ft) = 2.0

Anti-Vortex Device:

Diameter of Riser (in) = 60 From Hydrograph

Cylinder Diameter (in) = 90 Ref 3, III-104, Table 3.14-D

Cylinder Thickness (gage) = 14

Cylinder Height (in) = 29

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n =	0.069	6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) =	9	Permissible Velocity for lining
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	0.02	Outlet Slope (estimated)
Bottom Width (ft) =	12	6 * Barrel Diameter
Q_B (cfs) =	3.8	Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
3.8	1.24	0.25	3.3	0.23	1.24	1.1

Flow Depth = Tailwater, d (ft) = 0.25 0.5* Barrel Diameter (ft) = 1.00 Ref 1, 8.06.3

Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe

Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
2	6	10	12	0.3	Class A

Conclusion

The basin can contain the 10-yr storm and pass the 100-yr storm without overtopping the berm.

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) = 60
Circumference of Riser (in) = 188.5
eight of Riser from bottom of barrel (in) = 62 From Hydrograph
Vertical spacing between holes (in) = 0 center to center
Water Stage increment (ft) 0.05

Orifice Equation

$Q = C_d * A * (2 * g * h)^{0.5}$ Ref 1, p III-11

Q = cfs, discharge
C_d = 0.6 coefficient of discharge
A = sf, cross sectional area
g = 32.2 ft/sec^2, gravity
h = ft, driving head measured from the center of the pipe

	Perforations					Skimmer	
Row	1	2	3	4	5	2	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.30	0.30
0.39	0.00	0.00	0.00			0.30	0.30
0.44	0.00	0.00	0.00			0.30	0.30
0.49	0.00	0.00	0.00			0.30	0.30
0.54	0.00	0.00	0.00			0.30	0.30
0.59	0.00	0.00	0.00			0.30	0.30
0.64	0.00	0.00	0.00			0.30	0.30
0.69	0.00	0.00	0.00			0.30	0.30
0.74	0.00	0.00	0.00			0.30	0.30
0.79	0.00	0.00	0.00			0.30	0.30
0.84	0.00	0.00	0.00			0.30	0.30
0.89	0.00	0.00	0.00			0.30	0.30
0.94	0.00	0.00	0.00			0.30	0.30
0.99	0.00	0.00	0.00			0.30	0.30
1.04	0.00	0.00	0.00			0.30	0.30
1.09	0.00	0.00	0.00			0.30	0.30
1.14	0.00	0.00	0.00			0.30	0.30
1.19	0.00	0.00	0.00			0.30	0.30
1.24	0.00	0.00	0.00			0.30	0.30
1.29	0.00	0.00	0.00			0.30	0.30
1.34	0.00	0.00	0.00			0.30	0.30
1.39	0.00	0.00	0.00			0.30	0.30
1.44	0.00	0.00	0.00			0.30	0.30
1.49	0.00	0.00	0.00			0.30	0.30
1.54	0.00	0.00	0.00			0.30	0.30
1.59	0.00	0.00	0.00			0.30	0.30

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.30	0.30
1.69	0.00	0.00	0.00	0.30	0.30
1.74	0.00	0.00	0.00	0.30	0.30
1.79	0.00	0.00	0.00	0.30	0.30
1.84	0.00	0.00	0.00	0.30	0.30
1.89	0.00	0.00	0.00	0.30	0.30
1.94	0.00	0.00	0.00	0.30	0.30
1.99	0.00	0.00	0.00	0.30	0.30
2.04	0.00	0.00	0.00	0.30	0.30
2.09	0.00	0.00	0.00	0.30	0.30
2.14	0.00	0.00	0.00	0.30	0.30
2.19	0.00	0.00	0.00	0.30	0.30
2.24	0.00	0.00	0.00	0.30	0.30
2.29	0.00	0.00	0.00	0.30	0.30
2.34	0.00	0.00	0.00	0.30	0.30
2.39	0.00	0.00	0.00	0.30	0.30
2.44	0.00	0.00	0.00	0.30	0.30
2.49	0.00	0.00	0.00	0.30	0.30
2.54	0.00	0.00	0.00	0.30	0.30
2.59	0.00	0.00	0.00	0.30	0.30
2.64	0.00	0.00	0.00	0.30	0.30
2.69	0.00	0.00	0.00	0.30	0.30
2.74	0.00	0.00	0.00	0.30	0.30
2.79	0.00	0.00	0.00	0.30	0.30
2.84	0.00	0.00	0.00	0.30	0.30
2.89	0.00	0.00	0.00	0.30	0.30
2.94	0.00	0.00	0.00	0.30	0.30
2.99	0.00	0.00	0.00	0.30	0.30
3.04	0.00	0.00	0.00	0.30	0.30
3.09	0.00	0.00	0.00	0.30	0.30
3.14	0.00	0.00	0.00	0.30	0.30
3.19	0.00	0.00	0.00	0.30	0.30
3.24	0.00	0.00	0.00	0.30	0.30
3.29	0.00	0.00	0.00	0.30	0.30
3.34	0.00	0.00	0.00	0.30	0.30
3.39	0.00	0.00	0.00	0.30	0.30
3.44	0.00	0.00	0.00	0.30	0.30
3.49	0.00	0.00	0.00	0.30	0.30
3.54	0.00	0.00	0.00	0.30	0.30
3.59	0.00	0.00	0.00	0.30	0.30
3.64	0.00	0.00	0.00	0.30	0.30
3.69	0.00	0.00	0.00	0.30	0.30
3.74	0.00	0.00	0.00	0.30	0.30
3.79	0.00	0.00	0.00	0.30	0.30
3.84	0.00	0.00	0.00	0.30	0.30
3.89	0.00	0.00	0.00	0.30	0.30
3.94	0.00	0.00	0.00	0.30	0.30
3.99	0.00	0.00	0.00	0.30	0.30

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 2 Colon

Phase 1

10 - year Storm Event

Qp = 101.32 cfs
Tp = 28.19 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.2
K_s = 35,760

Number of Riser/Barrel Assemblies **2**
Diameter of Barrel = **24** (in)
Height of Riser above barrel = **3.2** (ft)
Height of Riser from bottom of barrel= **5.2** (ft) elevation 264.20
Emergency Spillway = **6.0** (ft) elevation 265.00
Total Height of Dam = **7.0** (ft) elevation 266.00
Length of Emergency Spillway = **15** (ft)
Diameter of Riser = **60** (in)
Permanent Pond Stage = **0** (ft) elevation 259.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
5.1 ft Maximum Stage 264.06 msl elevation
0.6 cfs Peak outflow
0.6 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

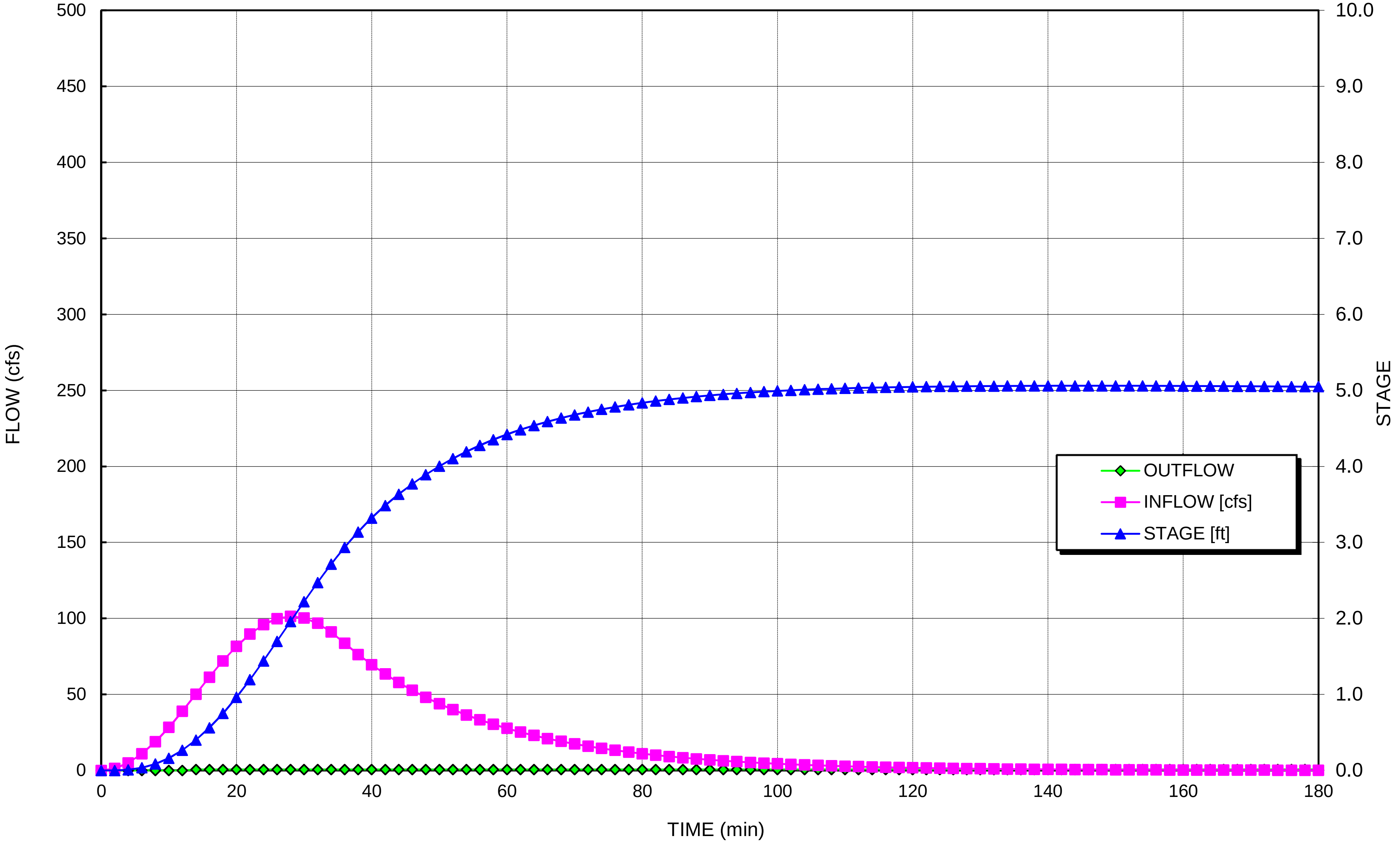
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	4.9	150	0.0	0.00	0.00	0.00	0.00	0.00	43.22	19,647	N/A
6	10.9	744	0.0	0.00	0.00	0.00	0.00	0.00	53.74	24,429	N/A
8	18.8	2,053	0.1	0.00	0.00	0.00	0.00	0.00	61.71	28,050	N/A
10	28.3	4,312	0.2	0.00	0.00	0.00	0.00	0.00	68.28	31,035	N/A
12	38.9	7,712	0.3	0.00	0.00	0.00	0.00	0.00	73.90	33,592	N/A
14	50.1	12,383	0.4	0.30	0.30	0.00	0.30	0.59	78.83	35,830	100%
16	61.3	18,326	0.6	0.30	0.30	0.00	0.30	0.59	83.15	37,796	100%
18	72.0	25,613	0.7	0.30	0.30	0.00	0.30	0.59	87.03	39,559	100%
20	81.6	34,183	1.0	0.30	0.30	0.00	0.30	0.59	90.52	41,145	100%
22	89.7	43,907	1.2	0.30	0.30	0.00	0.30	0.59	93.66	42,573	100%
24	95.9	54,603	1.4	0.30	0.30	0.00	0.30	0.59	96.48	43,856	100%
26	99.8	66,039	1.7	0.30	0.30	0.00	0.30	0.59	99.02	45,007	100%
28	101.3	77,946	2.0	0.30	0.30	0.00	0.30	0.59	101.28	46,035	100%
30	100.3	90,032	2.2	0.30	0.30	0.00	0.30	0.59	103.28	46,948	100%
32	96.8	101,997	2.5	0.30	0.30	0.00	0.30	0.59	105.06	47,752	100%
34	91.1	113,546	2.7	0.30	0.30	0.00	0.30	0.59	106.60	48,455	100%
36	83.6	124,405	2.9	0.30	0.30	0.00	0.30	0.59	107.94	49,062	100%
38	76.3	134,368	3.1	0.30	0.30	0.00	0.30	0.59	109.08	49,580	100%
40	69.5	143,448	3.3	0.30	0.30	0.00	0.30	0.59	110.05	50,023	100%
42	63.4	151,721	3.5	0.30	0.30	0.00	0.30	0.59	110.89	50,407	100%
44	57.8	159,259	3.6	0.30	0.30	0.00	0.30	0.59	111.63	50,741	100%
46	52.7	166,127	3.8	0.30	0.30	0.00	0.30	0.59	112.27	51,033	100%
48	48.1	172,384	3.9	0.30	0.30	0.00	0.30	0.59	112.84	51,291	100%
50	43.8	178,083	4.0	0.30	0.30	0.00	0.30	0.59	113.34	51,519	100%
52	40.0	183,274	4.1	0.30	0.30	0.00	0.30	0.59	113.79	51,721	100%
54	36.5	188,001	4.2	0.30	0.30	0.00	0.30	0.59	114.18	51,901	100%
56	33.3	192,306	4.3	0.30	0.30	0.00	0.30	0.59	114.53	52,061	100%
58	30.3	196,225	4.4	0.30	0.30	0.00	0.30	0.59	114.85	52,204	100%
60	27.7	199,793	4.4	0.30	0.30	0.00	0.30	0.59	115.13	52,332	100%
62	25.2	203,040	4.5	0.30	0.30	0.00	0.30	0.59	115.38	52,448	100%
64	23.0	205,995	4.5	0.30	0.30	0.00	0.30	0.59	115.61	52,551	100%
66	21.0	208,684	4.6	0.30	0.30	0.00	0.30	0.59	115.82	52,644	100%
68	19.1	211,129	4.6	0.30	0.30	0.00	0.30	0.59	116.00	52,727	100%
70	17.4	213,353	4.7	0.30	0.30	0.00	0.30	0.59	116.17	52,803	100%
72	15.9	215,374	4.7	0.30	0.30	0.00	0.30	0.59	116.32	52,871	100%
74	14.5	217,211	4.8	0.30	0.30	0.00	0.30	0.59	116.45	52,932	100%
76	13.2	218,881	4.8	0.30	0.30	0.00	0.30	0.59	116.57	52,987	100%
78	12.1	220,396	4.8	0.30	0.30	0.00	0.30	0.59	116.68	53,037	100%
80	11.0	221,772	4.8	0.30	0.30	0.00	0.30	0.59	116.78	53,082	100%
82	10.0	223,021	4.9	0.30	0.30	0.00	0.30	0.59	116.87	53,122	100%

84	9.1	224,153	4.9	0.30	0.30	0.00	0.30	0.59	116.95	53,159	100%
86	8.3	225,180	4.9	0.30	0.30	0.00	0.30	0.59	117.02	53,192	100%
88	7.6	226,110	4.9	0.30	0.30	0.00	0.30	0.59	117.09	53,222	100%
90	6.9	226,951	4.9	0.30	0.30	0.00	0.30	0.59	117.15	53,249	100%
92	6.3	227,712	4.9	0.30	0.30	0.00	0.30	0.59	117.20	53,273	100%
94	5.8	228,400	5.0	0.30	0.30	0.00	0.30	0.59	117.25	53,295	100%
96	5.3	229,021	5.0	0.30	0.30	0.00	0.30	0.59	117.29	53,315	100%
98	4.8	229,581	5.0	0.30	0.30	0.00	0.30	0.59	117.33	53,333	100%
100	4.4	230,086	5.0	0.30	0.30	0.00	0.30	0.59	117.37	53,349	100%
102	4.0	230,540	5.0	0.30	0.30	0.00	0.30	0.59	117.40	53,363	100%
104	3.6	230,947	5.0	0.30	0.30	0.00	0.30	0.59	117.43	53,376	100%
106	3.3	231,313	5.0	0.30	0.30	0.00	0.30	0.59	117.45	53,387	100%
108	3.0	231,640	5.0	0.30	0.30	0.00	0.30	0.59	117.47	53,398	100%
110	2.8	231,932	5.0	0.30	0.30	0.00	0.30	0.59	117.49	53,407	100%
112	2.5	232,192	5.0	0.30	0.30	0.00	0.30	0.59	117.51	53,415	100%
114	2.3	232,422	5.0	0.30	0.30	0.00	0.30	0.59	117.53	53,422	100%
116	2.1	232,627	5.0	0.30	0.30	0.00	0.30	0.59	117.54	53,428	100%
118	1.9	232,807	5.0	0.30	0.30	0.00	0.30	0.59	117.55	53,434	100%
120	1.7	232,965	5.0	0.30	0.30	0.00	0.30	0.59	117.57	53,439	100%
122	1.6	233,102	5.0	0.30	0.30	0.00	0.30	0.59	117.58	53,443	100%
124	1.4	233,222	5.1	0.30	0.30	0.00	0.30	0.59	117.58	53,447	100%
126	1.3	233,325	5.1	0.30	0.30	0.00	0.30	0.59	117.59	53,450	100%
128	1.2	233,412	5.1	0.30	0.30	0.00	0.30	0.59	117.60	53,453	100%
130	1.1	233,485	5.1	0.30	0.30	0.00	0.30	0.59	117.60	53,455	100%
132	1.0	233,546	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,457	100%
134	0.9	233,595	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,459	100%
136	0.8	233,634	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,460	100%
138	0.8	233,663	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,461	100%
140	0.7	233,683	5.1	0.30	0.30	0.00	0.30	0.59	117.62	53,461	100%
142	0.6	233,695	5.1	0.30	0.30	0.00	0.30	0.59	117.62	53,462	100%
144	0.6	233,700	5.1	0.30	0.30	0.00	0.30	0.59	117.62	53,462	100%
146	0.5	233,698	5.1	0.30	0.30	0.00	0.30	0.59	117.62	53,462	100%
148	0.5	233,690	5.1	0.30	0.30	0.00	0.30	0.59	117.62	53,462	100%
150	0.4	233,676	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,461	100%
152	0.4	233,658	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,461	100%
154	0.4	233,634	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,460	100%
156	0.3	233,607	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,459	100%
158	0.3	233,576	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,458	100%
160	0.3	233,541	5.1	0.30	0.30	0.00	0.30	0.59	117.61	53,457	100%
162	0.3	233,503	5.1	0.30	0.30	0.00	0.30	0.59	117.60	53,456	100%
164	0.2	233,463	5.1	0.30	0.30	0.00	0.30	0.59	117.60	53,455	100%
166	0.2	233,419	5.1	0.30	0.30	0.00	0.30	0.59	117.60	53,453	100%
168	0.2	233,373	5.1	0.30	0.30	0.00	0.30	0.59	117.59	53,452	100%
170	0.2	233,325	5.1	0.30	0.30	0.00	0.30	0.59	117.59	53,450	100%
172	0.2	233,275	5.1	0.30	0.30	0.00	0.30	0.59	117.59	53,449	100%
174	0.1	233,223	5.1	0.30	0.30	0.00	0.30	0.59	117.58	53,447	100%
176	0.1	233,170	5.1	0.30	0.30	0.00	0.30	0.59	117.58	53,445	100%
178	0.1	233,115	5.0	0.30	0.30	0.00	0.30	0.59	117.58	53,444	100%
180	0.1	233,058	5.0	0.30	0.30	0.00	0.30	0.59	117.57	53,442	100%
182	0.1	233,000	5.0	0.30	0.30	0.00	0.30	0.59	117.57	53,440	100%
184	0.1	232,941	5.0	0.30	0.30	0.00	0.30	0.59	117.56	53,438	100%
186	0.1	232,881	5.0	0.30	0.30	0.00	0.30	0.59	117.56	53,436	100%
188	0.1	232,821	5.0	0.30	0.30	0.00	0.30	0.59	117.56	53,435	100%
190	0.1	232,759	5.0	0.30	0.30	0.00	0.30	0.59	117.55	53,433	100%
192	0.1	232,696	5.0	0.30	0.30	0.00	0.30	0.59	117.55	53,431	100%
194	0.1	232,633	5.0	0.30	0.30	0.00	0.30	0.59	117.54	53,429	100%
196	0.1	232,569	5.0	0.30	0.30	0.00	0.30	0.59	117.54	53,427	100%
198	0.0	232,504	5.0	0.30	0.30	0.00	0.30	0.59	117.53	53,425	100%
200	0.0	232,439	5.0	0.30	0.30	0.00	0.30	0.59	117.53	53,423	100%
202	0.0	232,373	5.0	0.30	0.30	0.00	0.30	0.59	117.53	53,421	100%
204	0.0	232,307	5.0	0.30	0.30	0.00	0.30	0.59	117.52	53,418	100%
206	0.0	232,241	5.0	0.30	0.30	0.00	0.30	0.59	117.52	53,416	100%

Sediment Basin #2 Colon Mine Phase 1 Hydrograph
10-Yr Storm



Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of _2_

Qp = 79.90 cfs
Tp = 30.89 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

Sediment Basin # 2 Colon

Phase 2

10 - year Storm Event

b = 1.2
Ks = 35,760

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 3.2 (ft)
Height of Riser from bottom of barrel= 5.2 (ft) elevation 264.20
Emergency Spillway = 6 (ft) elevation 265.00
Total Height of Dam = 7 (ft) elevation 266.00
Length of Emergency Spillway = 15 (ft)
Diameter of Riser = 60 (in)
Permanent Pond Stage = 0 (ft) elevation 259.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

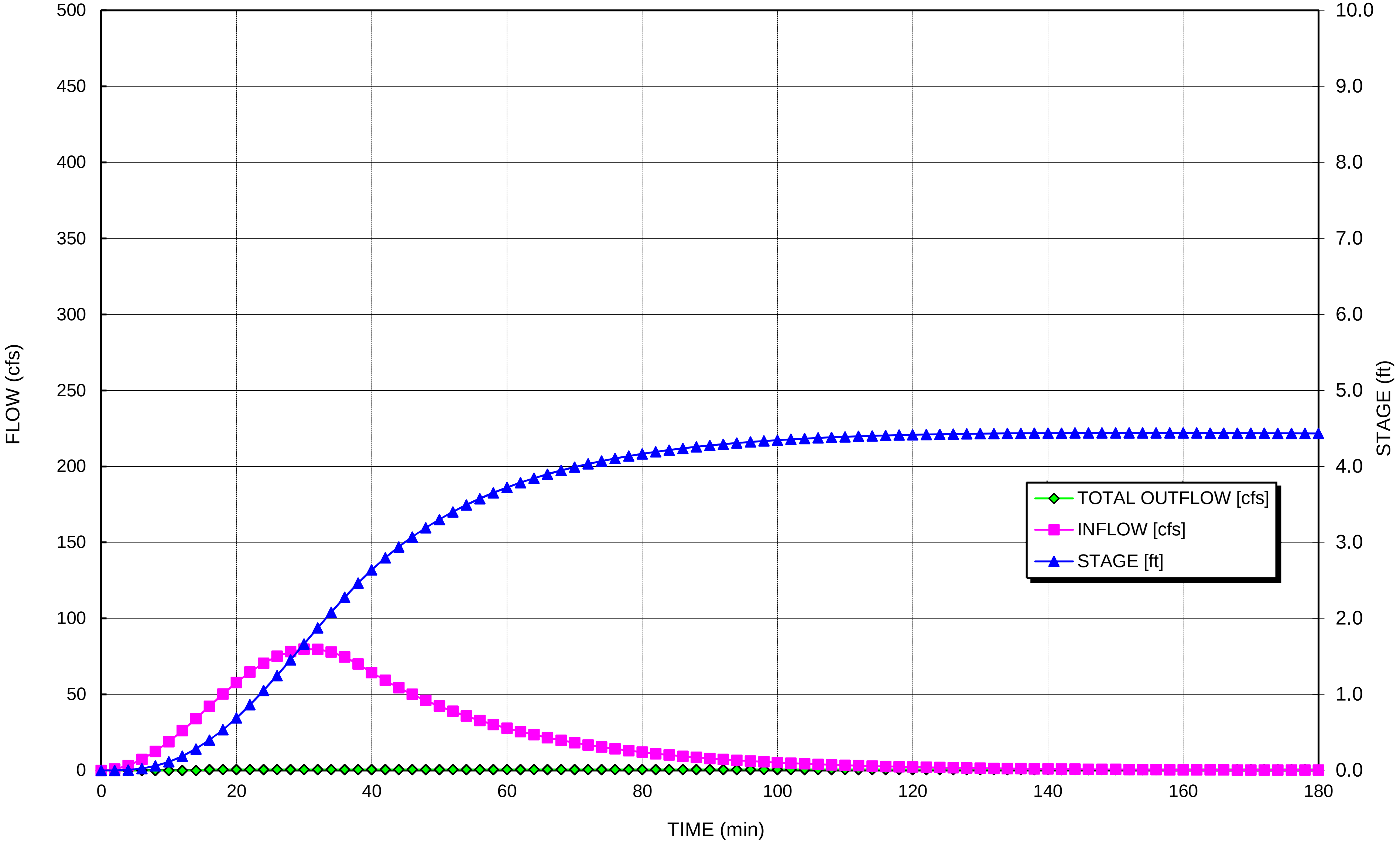
100% Minimum Settling Efficiency
4.4 ft Maximum Stage 263.44 msl elevation
0.6 cfs Peak outflow
0.6 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.8	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	3.3	99	0.0	0.00	0.00	0.00	0.00	0.00	40.82	18,555	N/A
6	7.2	490	0.0	0.00	0.00	0.00	0.00	0.00	50.77	23,077	N/A
8	12.5	1,355	0.1	0.00	0.00	0.00	0.00	0.00	58.32	26,507	N/A
10	18.9	2,856	0.1	0.00	0.00	0.00	0.00	0.00	64.55	29,341	N/A
12	26.2	5,129	0.2	0.00	0.00	0.00	0.00	0.00	69.91	31,776	N/A
14	34.1	8,277	0.3	0.00	0.00	0.00	0.00	0.00	74.62	33,917	N/A
16	42.2	12,368	0.4	0.30	0.30	0.00	0.30	0.59	78.81	35,825	100%
18	50.2	17,361	0.5	0.30	0.30	0.00	0.30	0.59	82.54	37,518	100%
20	57.8	23,316	0.7	0.30	0.30	0.00	0.30	0.59	85.92	39,056	100%
22	64.6	30,180	0.9	0.30	0.30	0.00	0.30	0.59	89.00	40,453	100%
24	70.5	37,867	1.1	0.30	0.30	0.00	0.30	0.59	91.79	41,723	100%
26	75.1	46,254	1.2	0.30	0.30	0.00	0.30	0.59	94.33	42,876	100%
28	78.2	55,190	1.5	0.30	0.30	0.00	0.30	0.59	96.62	43,920	100%
30	79.7	64,502	1.7	0.30	0.30	0.00	0.30	0.59	98.70	44,863	100%
32	79.6	73,999	1.9	0.30	0.30	0.00	0.30	0.59	100.56	45,710	100%
34	77.9	83,486	2.1	0.30	0.30	0.00	0.30	0.59	102.23	46,467	100%
36	74.6	92,765	2.3	0.30	0.30	0.00	0.30	0.59	103.71	47,139	100%
38	69.9	101,650	2.5	0.30	0.30	0.00	0.30	0.59	105.01	47,730	100%
40	64.4	109,968	2.6	0.30	0.30	0.00	0.30	0.59	106.14	48,245	100%
42	59.2	117,628	2.8	0.30	0.30	0.00	0.30	0.59	107.12	48,689	100%
44	54.4	124,663	2.9	0.30	0.30	0.00	0.30	0.59	107.97	49,076	100%
46	50.0	131,124	3.1	0.30	0.30	0.00	0.30	0.59	108.71	49,415	100%
48	46.0	137,059	3.2	0.30	0.30	0.00	0.30	0.59	109.37	49,714	100%
50	42.3	142,508	3.3	0.30	0.30	0.00	0.30	0.59	109.95	49,978	100%
52	38.9	147,512	3.4	0.30	0.30	0.00	0.30	0.59	110.47	50,214	100%
54	35.7	152,106	3.5	0.30	0.30	0.00	0.30	0.59	110.93	50,424	100%
56	32.9	156,324	3.6	0.30	0.30	0.00	0.30	0.59	111.35	50,612	100%
58	30.2	160,196	3.7	0.30	0.30	0.00	0.30	0.59	111.72	50,781	100%
60	27.8	163,749	3.7	0.30	0.30	0.00	0.30	0.59	112.05	50,933	100%
62	25.5	167,010	3.8	0.30	0.30	0.00	0.30	0.59	112.35	51,070	100%
64	23.5	170,002	3.8	0.30	0.30	0.00	0.30	0.59	112.63	51,194	100%
66	21.6	172,746	3.9	0.30	0.30	0.00	0.30	0.59	112.87	51,306	100%
68	19.8	175,264	3.9	0.30	0.30	0.00	0.30	0.59	113.10	51,407	100%
70	18.2	177,572	4.0	0.30	0.30	0.00	0.30	0.59	113.30	51,499	100%
72	16.8	179,689	4.0	0.30	0.30	0.00	0.30	0.59	113.48	51,582	100%
74	15.4	181,628	4.1	0.30	0.30	0.00	0.30	0.59	113.65	51,657	100%
76	14.2	183,406	4.1	0.30	0.30	0.00	0.30	0.59	113.80	51,726	100%
78	13.0	185,034	4.1	0.30	0.30	0.00	0.30	0.59	113.93	51,788	100%
80	12.0	186,525	4.2	0.30	0.30	0.00	0.30	0.59	114.06	51,845	100%
82	11.0	187,891	4.2	0.30	0.30	0.00	0.30	0.59	114.17	51,896	100%
84	10.1	189,140	4.2	0.30	0.30	0.00	0.30	0.59	114.28	51,943	100%

86	9.3	190,282	4.2	0.30	0.30	0.00	0.30	0.59	114.37	51,986	100%
88	8.5	191,327	4.3	0.30	0.30	0.00	0.30	0.59	114.45	52,025	100%
90	7.9	192,282	4.3	0.30	0.30	0.00	0.30	0.59	114.53	52,060	100%
92	7.2	193,154	4.3	0.30	0.30	0.00	0.30	0.59	114.60	52,092	100%
94	6.6	193,949	4.3	0.30	0.30	0.00	0.30	0.59	114.67	52,121	100%
96	6.1	194,675	4.3	0.30	0.30	0.00	0.30	0.59	114.73	52,148	100%
98	5.6	195,337	4.3	0.30	0.30	0.00	0.30	0.59	114.78	52,172	100%
100	5.2	195,939	4.3	0.30	0.30	0.00	0.30	0.59	114.83	52,194	100%
102	4.7	196,487	4.4	0.30	0.30	0.00	0.30	0.59	114.87	52,214	100%
104	4.4	196,985	4.4	0.30	0.30	0.00	0.30	0.59	114.91	52,232	100%
106	4.0	197,437	4.4	0.30	0.30	0.00	0.30	0.59	114.95	52,248	100%
108	3.7	197,847	4.4	0.30	0.30	0.00	0.30	0.59	114.98	52,263	100%
110	3.4	198,218	4.4	0.30	0.30	0.00	0.30	0.59	115.01	52,276	100%
112	3.1	198,554	4.4	0.30	0.30	0.00	0.30	0.59	115.03	52,288	100%
114	2.9	198,856	4.4	0.30	0.30	0.00	0.30	0.59	115.06	52,299	100%
116	2.6	199,129	4.4	0.30	0.30	0.00	0.30	0.59	115.08	52,309	100%
118	2.4	199,374	4.4	0.30	0.30	0.00	0.30	0.59	115.10	52,318	100%
120	2.2	199,593	4.4	0.30	0.30	0.00	0.30	0.59	115.12	52,325	100%
122	2.0	199,789	4.4	0.30	0.30	0.00	0.30	0.59	115.13	52,332	100%
124	1.9	199,963	4.4	0.30	0.30	0.00	0.30	0.59	115.14	52,339	100%
126	1.7	200,118	4.4	0.30	0.30	0.00	0.30	0.59	115.16	52,344	100%
128	1.6	200,254	4.4	0.30	0.30	0.00	0.30	0.59	115.17	52,349	100%
130	1.5	200,374	4.4	0.30	0.30	0.00	0.30	0.59	115.18	52,353	100%
132	1.3	200,478	4.4	0.30	0.30	0.00	0.30	0.59	115.19	52,357	100%
134	1.2	200,568	4.4	0.30	0.30	0.00	0.30	0.59	115.19	52,360	100%
136	1.1	200,645	4.4	0.30	0.30	0.00	0.30	0.59	115.20	52,363	100%
138	1.0	200,710	4.4	0.30	0.30	0.00	0.30	0.59	115.20	52,365	100%
140	1.0	200,764	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,367	100%
142	0.9	200,809	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,369	100%
144	0.8	200,843	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,370	100%
146	0.7	200,870	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,371	100%
148	0.7	200,888	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,371	100%
150	0.6	200,899	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,372	100%
152	0.6	200,904	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,372	100%
154	0.5	200,902	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,372	100%
156	0.5	200,895	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,372	100%
158	0.4	200,883	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,371	100%
160	0.4	200,866	4.4	0.30	0.30	0.00	0.30	0.59	115.22	52,371	100%
162	0.4	200,845	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,370	100%
164	0.3	200,820	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,369	100%
166	0.3	200,791	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,368	100%
168	0.3	200,758	4.4	0.30	0.30	0.00	0.30	0.59	115.21	52,367	100%
170	0.3	200,723	4.4	0.30	0.30	0.00	0.30	0.59	115.20	52,366	100%
172	0.2	200,684	4.4	0.30	0.30	0.00	0.30	0.59	115.20	52,364	100%
174	0.2	200,643	4.4	0.30	0.30	0.00	0.30	0.59	115.20	52,363	100%
176	0.2	200,600	4.4	0.30	0.30	0.00	0.30	0.59	115.19	52,361	100%
178	0.2	200,554	4.4	0.30	0.30	0.00	0.30	0.59	115.19	52,360	100%
180	0.2	200,507	4.4	0.30	0.30	0.00	0.30	0.59	115.19	52,358	100%
182	0.2	200,457	4.4	0.30	0.30	0.00	0.30	0.59	115.18	52,356	100%
184	0.2	200,406	4.4	0.30	0.30	0.00	0.30	0.59	115.18	52,354	100%
186	0.1	200,353	4.4	0.30	0.30	0.00	0.30	0.59	115.18	52,352	100%
188	0.1	200,299	4.4	0.30	0.30	0.00	0.30	0.59	115.17	52,351	100%
190	0.1	200,243	4.4	0.30	0.30	0.00	0.30	0.59	115.17	52,349	100%
192	0.1	200,186	4.4	0.30	0.30	0.00	0.30	0.59	115.16	52,347	100%
194	0.1	200,128	4.4	0.30	0.30	0.00	0.30	0.59	115.16	52,344	100%
196	0.1	200,069	4.4	0.30	0.30	0.00	0.30	0.59	115.15	52,342	100%
198	0.1	200,009	4.4	0.30	0.30	0.00	0.30	0.59	115.15	52,340	100%
200	0.1	199,949	4.4	0.30	0.30	0.00	0.30	0.59	115.14	52,338	100%
202	0.1	199,887	4.4	0.30	0.30	0.00	0.30	0.59	115.14	52,336	100%
204	0.1	199,824	4.4	0.30	0.30	0.00	0.30	0.59	115.13	52,334	100%

Sediment Basin #2 Colon Mine Phase 2 Hydrograph
10-Yr Storm



Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2__

Sediment Basin # 2 Colon

Phase 2

25 - year Storm Event

Qp = 98.71 cfs
Tp = 31.23 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.2
Ks = 35,760

Number of Riser/Barrel Assemblies	2		
Diameter of Barrel =	24	(in)	
Height of Riser above barrel =	3.2	(ft)	
Height of Riser from bottom of barrel=	5.2	(ft) elevatior	264.20
Emergency Spillway =	6.0	(ft) elevatior	265.00
Total Height of Dam =	7.0	(ft) elevatior	266.00
Length of Emergency Spillway =	15	(ft)	
Diameter of Riser =	60	(in)	
Permanent Pond Stage =	0	(ft) elevatior	259.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

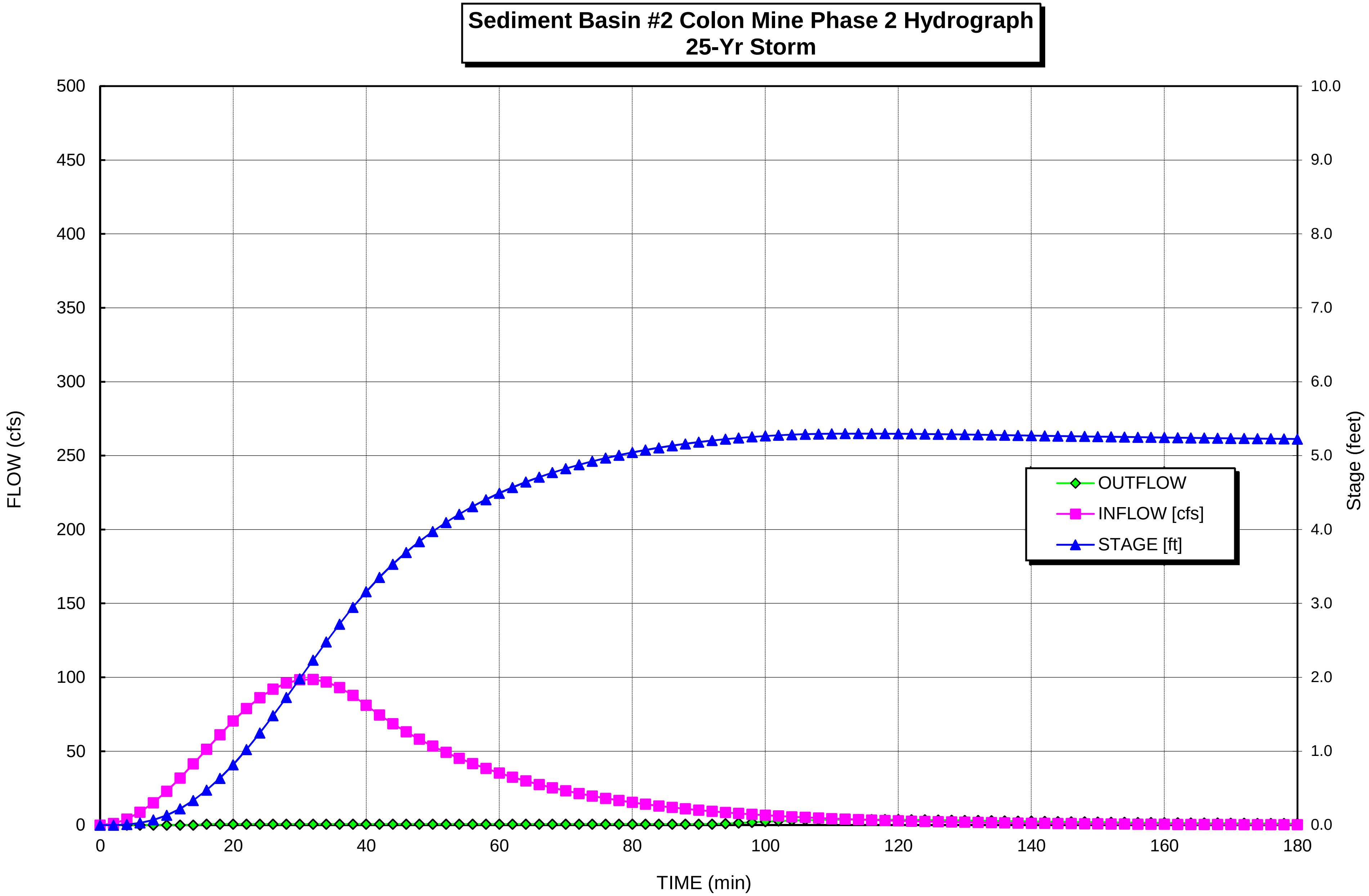
100% Minimum Settling Efficiency
5.3 ft Maximum Stage 264.3 msl elevation
3.8 cfs Peak outflow
3.8 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	3.9	119	0.0	0.00	0.00	0.00	0.00	0.00	41.89	19,041	N/A
6	8.7	592	0.0	0.00	0.00	0.00	0.00	0.00	52.10	23,682	N/A
8	15.1	1,639	0.1	0.00	0.00	0.00	0.00	0.00	59.85	27,203	N/A
10	22.9	3,455	0.1	0.00	0.00	0.00	0.00	0.00	66.25	30,112	N/A
12	31.8	6,208	0.2	0.00	0.00	0.00	0.00	0.00	71.75	32,614	N/A
14	41.4	10,024	0.3	0.00	0.00	0.00	0.00	0.00	76.59	34,813	N/A
16	51.3	14,988	0.5	0.30	0.30	0.00	0.30	0.59	80.90	36,775	100%
18	61.1	21,069	0.6	0.30	0.30	0.00	0.30	0.59	84.75	38,521	100%
20	70.4	28,328	0.8	0.30	0.30	0.00	0.30	0.59	88.23	40,106	100%
22	78.9	36,708	1.0	0.30	0.30	0.00	0.30	0.59	91.40	41,547	100%
24	86.2	46,108	1.2	0.30	0.30	0.00	0.30	0.59	94.29	42,857	100%
26	92.0	56,384	1.5	0.30	0.30	0.00	0.30	0.59	96.91	44,048	100%
28	96.1	67,357	1.7	0.30	0.30	0.00	0.30	0.59	99.28	45,128	100%
30	98.3	78,821	2.0	0.30	0.30	0.00	0.30	0.59	101.43	46,105	100%
32	98.6	90,550	2.2	0.30	0.30	0.00	0.30	0.59	103.37	46,984	100%
34	96.8	102,307	2.5	0.30	0.30	0.00	0.30	0.59	105.10	47,772	100%
36	93.1	113,853	2.7	0.30	0.30	0.00	0.30	0.59	106.64	48,473	100%
38	87.7	124,958	2.9	0.30	0.30	0.00	0.30	0.59	108.00	49,092	100%
40	81.0	135,412	3.2	0.30	0.30	0.00	0.30	0.59	109.19	49,632	100%
42	74.6	145,066	3.4	0.30	0.30	0.00	0.30	0.59	110.22	50,100	100%
44	68.6	153,944	3.5	0.30	0.30	0.00	0.30	0.59	111.11	50,507	100%
46	63.1	162,107	3.7	0.30	0.30	0.00	0.30	0.59	111.90	50,863	100%
48	58.1	169,612	3.8	0.30	0.30	0.00	0.30	0.59	112.59	51,178	100%
50	53.5	176,512	4.0	0.30	0.30	0.00	0.30	0.59	113.20	51,457	100%
52	49.2	182,855	4.1	0.30	0.30	0.00	0.30	0.59	113.75	51,705	100%
54	45.3	188,686	4.2	0.30	0.30	0.00	0.30	0.59	114.24	51,926	100%
56	41.6	194,045	4.3	0.30	0.30	0.00	0.30	0.59	114.67	52,125	100%
58	38.3	198,971	4.4	0.30	0.30	0.00	0.30	0.59	115.07	52,303	100%
60	35.3	203,497	4.5	0.30	0.30	0.00	0.30	0.59	115.42	52,464	100%
62	32.4	207,656	4.6	0.30	0.30	0.00	0.30	0.59	115.74	52,608	100%
64	29.8	211,478	4.6	0.30	0.30	0.00	0.30	0.59	116.03	52,739	100%
66	27.5	214,988	4.7	0.30	0.30	0.00	0.30	0.59	116.29	52,858	100%
68	25.3	218,212	4.8	0.30	0.30	0.00	0.30	0.59	116.52	52,965	100%
70	23.2	221,173	4.8	0.30	0.30	0.00	0.30	0.59	116.74	53,062	100%
72	21.4	223,892	4.9	0.30	0.30	0.00	0.30	0.59	116.93	53,151	100%
74	19.7	226,388	4.9	0.30	0.30	0.00	0.30	0.59	117.11	53,231	100%
76	18.1	228,679	5.0	0.30	0.30	0.00	0.30	0.59	117.27	53,304	100%
78	16.7	230,782	5.0	0.30	0.30	0.00	0.30	0.59	117.42	53,371	100%
80	15.3	232,710	5.0	0.30	0.30	0.00	0.30	0.59	117.55	53,431	100%
82	14.1	234,479	5.1	0.30	0.30	0.00	0.30	0.59	117.67	53,486	100%
84	13.0	236,101	5.1	0.30	0.30	0.00	0.30	0.59	117.78	53,536	100%

86	11.9	237,588	5.1	0.30	0.30	0.00	0.30	0.59	117.88	53,582	100%
88	11.0	238,951	5.2	0.30	0.30	0.00	0.30	0.59	117.97	53,624	100%
90	10.1	240,199	5.2	0.30	0.30	0.00	0.30	0.59	118.06	53,662	100%
92	9.3	241,341	5.2	0.30	0.31	0.00	30.96	0.61	118.13	53,697	100%
94	8.6	242,384	5.2	0.30	0.47	0.00	31.04	0.95	118.20	53,728	100%
96	7.9	243,298	5.2	0.30	0.71	0.00	31.10	1.41	118.26	53,756	100%
98	7.2	244,074	5.3	0.30	0.95	0.00	31.15	1.90	118.31	53,779	100%
100	6.7	244,716	5.3	0.30	1.18	0.00	31.19	2.35	118.36	53,798	100%
102	6.1	245,234	5.3	0.30	1.38	0.00	31.23	2.75	118.39	53,814	100%
104	5.6	245,640	5.3	0.30	1.54	0.00	31.26	3.08	118.42	53,826	100%
106	5.2	245,948	5.3	0.30	1.67	0.00	31.28	3.34	118.44	53,835	100%
108	4.8	246,170	5.3	0.30	1.77	0.00	31.29	3.54	118.45	53,842	100%
110	4.4	246,319	5.3	0.30	1.83	0.00	31.30	3.67	118.46	53,846	100%
112	4.0	246,407	5.3	0.30	1.87	0.00	31.31	3.75	118.47	53,849	100%
114	3.7	246,443	5.3	0.30	1.89	0.00	31.31	3.78	118.47	53,850	100%
116	3.4	246,436	5.3	0.30	1.89	0.00	31.31	3.77	118.47	53,850	100%
118	3.2	246,394	5.3	0.30	1.87	0.00	31.31	3.74	118.47	53,849	100%
120	2.9	246,324	5.3	0.30	1.84	0.00	31.30	3.67	118.46	53,846	100%
122	2.7	246,231	5.3	0.30	1.80	0.00	31.30	3.59	118.46	53,844	100%
124	2.5	246,121	5.3	0.30	1.75	0.00	31.29	3.49	118.45	53,840	100%
126	2.3	245,996	5.3	0.30	1.69	0.00	31.28	3.38	118.44	53,837	100%
128	2.1	245,861	5.3	0.30	1.63	0.00	31.27	3.27	118.43	53,833	100%
130	1.9	245,719	5.3	0.30	1.57	0.00	31.26	3.15	118.42	53,828	100%
132	1.8	245,570	5.3	0.30	1.51	0.00	31.25	3.02	118.41	53,824	100%
134	1.6	245,419	5.3	0.30	1.45	0.00	31.24	2.90	118.40	53,819	100%
136	1.5	245,265	5.3	0.30	1.39	0.00	31.23	2.78	118.39	53,815	100%
138	1.4	245,111	5.3	0.30	1.33	0.00	31.22	2.65	118.38	53,810	100%
140	1.3	244,957	5.3	0.30	1.27	0.00	31.21	2.53	118.37	53,806	100%
142	1.2	244,804	5.3	0.30	1.21	0.00	31.20	2.42	118.36	53,801	100%
144	1.1	244,653	5.3	0.30	1.15	0.00	31.19	2.31	118.35	53,797	100%
146	1.0	244,505	5.3	0.30	1.10	0.00	31.18	2.20	118.34	53,792	100%
148	0.9	244,359	5.3	0.30	1.05	0.00	31.17	2.09	118.33	53,788	100%
150	0.8	244,216	5.3	0.30	1.00	0.00	31.16	1.99	118.32	53,783	100%
152	0.8	244,077	5.3	0.30	0.95	0.00	31.15	1.90	118.31	53,779	100%
154	0.7	243,941	5.3	0.30	0.90	0.00	31.14	1.81	118.31	53,775	100%
156	0.6	243,808	5.2	0.30	0.86	0.00	31.13	1.72	118.30	53,771	100%
158	0.6	243,679	5.2	0.30	0.82	0.00	31.12	1.64	118.29	53,767	100%
160	0.5	243,554	5.2	0.30	0.78	0.00	31.11	1.56	118.28	53,764	100%
162	0.5	243,432	5.2	0.30	0.75	0.00	31.11	1.49	118.27	53,760	100%
164	0.5	243,314	5.2	0.30	0.71	0.00	31.10	1.42	118.26	53,756	100%
166	0.4	243,199	5.2	0.30	0.68	0.00	31.09	1.36	118.26	53,753	100%
168	0.4	243,088	5.2	0.30	0.65	0.00	31.08	1.29	118.25	53,750	100%
170	0.4	242,980	5.2	0.30	0.62	0.00	31.08	1.24	118.24	53,746	100%
172	0.3	242,875	5.2	0.30	0.59	0.00	31.07	1.18	118.23	53,743	100%
174	0.3	242,773	5.2	0.30	0.56	0.00	31.06	1.13	118.23	53,740	100%
176	0.3	242,675	5.2	0.30	0.54	0.00	31.05	1.08	118.22	53,737	100%
178	0.3	242,579	5.2	0.30	0.52	0.00	31.05	1.03	118.22	53,734	100%
180	0.2	242,486	5.2	0.30	0.50	0.00	31.04	0.99	118.21	53,731	100%
182	0.2	242,396	5.2	0.30	0.48	0.00	31.04	0.95	118.20	53,729	100%
184	0.2	242,308	5.2	0.30	0.46	0.00	31.03	0.91	118.20	53,726	100%
186	0.2	242,222	5.2	0.30	0.44	0.00	31.02	0.88	118.19	53,723	100%
188	0.2	242,139	5.2	0.30	0.42	0.00	31.02	0.84	118.19	53,721	100%
190	0.2	242,059	5.2	0.30	0.41	0.00	31.01	0.81	118.18	53,719	100%
192	0.1	241,980	5.2	0.30	0.39	0.00	31.01	0.78	118.18	53,716	100%
194	0.1	241,903	5.2	0.30	0.38	0.00	31.00	0.76	118.17	53,714	100%
196	0.1	241,828	5.2	0.30	0.37	0.00	31.00	0.73	118.17	53,712	100%
198	0.1	241,755	5.2	0.30	0.36	0.00	30.99	0.71	118.16	53,709	100%
200	0.1	241,683	5.2	0.30	0.34	0.00	30.99	0.69	118.16	53,707	100%
202	0.1	241,613	5.2	0.30	0.33	0.00	30.98	0.67	118.15	53,705	100%
204	0.1	241,544	5.2	0.30	0.33	0.00	30.98	0.65	118.15	53,703	100%
206	0.1	241,476	5.2	0.30	0.32	0.00	30.97	0.64	118.14	53,701	100%


Sediment Basin #2 Colon Mine Phase 2 Hydrograph
25-Yr Storm
FLOW (cfs)
500
450
400
350
300
250
200
150
100
50
0
Stage (feet)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
120
140
160
180
TIME (min)
OUTFLOW
INFLOW [cfs]
STAGE [ft]

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 2 Colon

Phase 2

100 - year Storm Event

Qp = 128.6 cfs
Tp = 31.7 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.2
Ks = 35,760

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 3.2 (ft)
Height of Riser from bottom of barrel= 5.2 (ft) elevation 264.20
Emergency Spillway = 6.0 (ft) elevation 265.00
Total Height of Dam = 7.0 (ft) elevation 266.00
Length of Emergency Spillway = 15 (ft)
Diameter of Riser = 60 (in)
Permanent Pond Stage = 0 (ft) elevation 259.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

94% Minimum Settling Efficiency
5.7 ft Maximum Stage 264.7 msl elevation
36.2 cfs Peak outflow
36.2 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	5.0	151	0.0	0.00	0.00	0.00	0.00	0.00	43.25	19,658	N/A
6	11.0	749	0.0	0.00	0.00	0.00	0.00	0.00	53.79	24,451	N/A
8	19.2	2,073	0.1	0.00	0.00	0.00	0.00	0.00	61.79	28,087	N/A
10	29.1	4,373	0.2	0.00	0.00	0.00	0.00	0.00	68.41	31,093	N/A
12	40.3	7,860	0.3	0.00	0.00	0.00	0.00	0.00	74.09	33,679	N/A
14	52.6	12,701	0.4	0.30	0.30	0.00	0.30	0.59	79.10	35,954	100%
16	65.2	18,937	0.6	0.30	0.30	0.00	0.30	0.59	83.52	37,965	100%
18	77.9	26,695	0.8	0.30	0.30	0.00	0.30	0.59	87.52	39,783	100%
20	90.0	35,969	1.0	0.30	0.30	0.00	0.30	0.59	91.15	41,432	100%
22	101.1	46,697	1.3	0.30	0.30	0.00	0.30	0.59	94.45	42,932	100%
24	110.8	58,757	1.5	0.30	0.30	0.00	0.30	0.59	97.45	44,296	100%
26	118.6	71,978	1.8	0.30	0.30	0.00	0.30	0.59	100.18	45,538	100%
28	124.3	86,141	2.1	0.30	0.30	0.00	0.30	0.59	102.67	46,666	100%
30	127.7	100,990	2.5	0.30	0.30	0.00	0.30	0.59	104.91	47,688	100%
32	128.6	116,245	2.8	0.30	0.30	0.00	0.30	0.59	106.94	48,611	100%
34	127.0	131,608	3.1	0.30	0.30	0.00	0.30	0.59	108.77	49,440	100%
36	122.9	146,777	3.4	0.30	0.30	0.00	0.30	0.59	110.40	50,180	100%
38	116.6	161,457	3.7	0.30	0.30	0.00	0.30	0.59	111.84	50,836	100%
40	108.3	175,373	3.9	0.30	0.30	0.00	0.30	0.59	113.10	51,411	100%
42	99.8	188,302	4.2	0.30	0.30	0.00	0.30	0.59	114.21	51,912	100%
44	91.9	200,207	4.4	0.30	0.30	0.00	0.30	0.59	115.16	52,347	100%
46	84.7	211,170	4.6	0.30	0.30	0.00	0.30	0.59	116.00	52,729	100%
48	78.0	221,264	4.8	0.30	0.30	0.00	0.30	0.59	116.74	53,065	100%
50	71.9	230,557	5.0	0.30	0.30	0.00	0.30	0.59	117.40	53,363	100%
52	66.2	239,114	5.2	0.30	0.30	0.00	0.30	0.59	117.98	53,629	100%
54	61.0	246,992	5.3	0.30	2.14	0.00	31.35	4.29	118.51	53,866	100%
56	56.2	253,800	5.4	0.30	6.18	0.00	31.80	12.37	118.95	54,066	99%
58	51.8	259,062	5.5	0.30	10.20	0.00	32.15	20.40	119.28	54,218	98%
60	47.7	262,830	5.6	0.30	13.47	0.00	32.40	26.93	119.51	54,324	96%
62	44.0	265,324	5.6	0.30	15.79	0.00	32.56	31.58	119.67	54,394	95%
64	40.5	266,810	5.7	0.30	17.23	0.00	32.65	34.46	119.76	54,436	94%
66	37.3	267,535	5.7	0.30	17.95	0.00	32.70	35.90	119.80	54,456	94%
68	34.4	267,705	5.7	0.30	18.12	0.00	32.71	36.24	119.81	54,461	94%
70	31.7	267,482	5.7	0.30	17.89	0.00	32.70	35.79	119.80	54,454	94%
72	29.2	266,988	5.7	0.30	17.40	0.00	32.66	34.81	119.77	54,441	94%
74	26.9	266,312	5.7	0.30	16.74	0.00	32.62	33.48	119.73	54,422	94%
76	24.8	265,519	5.7	0.30	15.98	0.00	32.57	31.95	119.68	54,400	95%
78	22.8	264,657	5.6	0.30	15.16	0.00	32.51	30.31	119.63	54,376	95%
80	21.0	263,757	5.6	0.30	14.32	0.00	32.46	28.63	119.57	54,350	96%
82	19.4	262,844	5.6	0.30	13.48	0.00	32.40	26.96	119.51	54,325	96%
84	17.8	261,933	5.6	0.30	12.66	0.00	32.34	25.32	119.46	54,299	96%

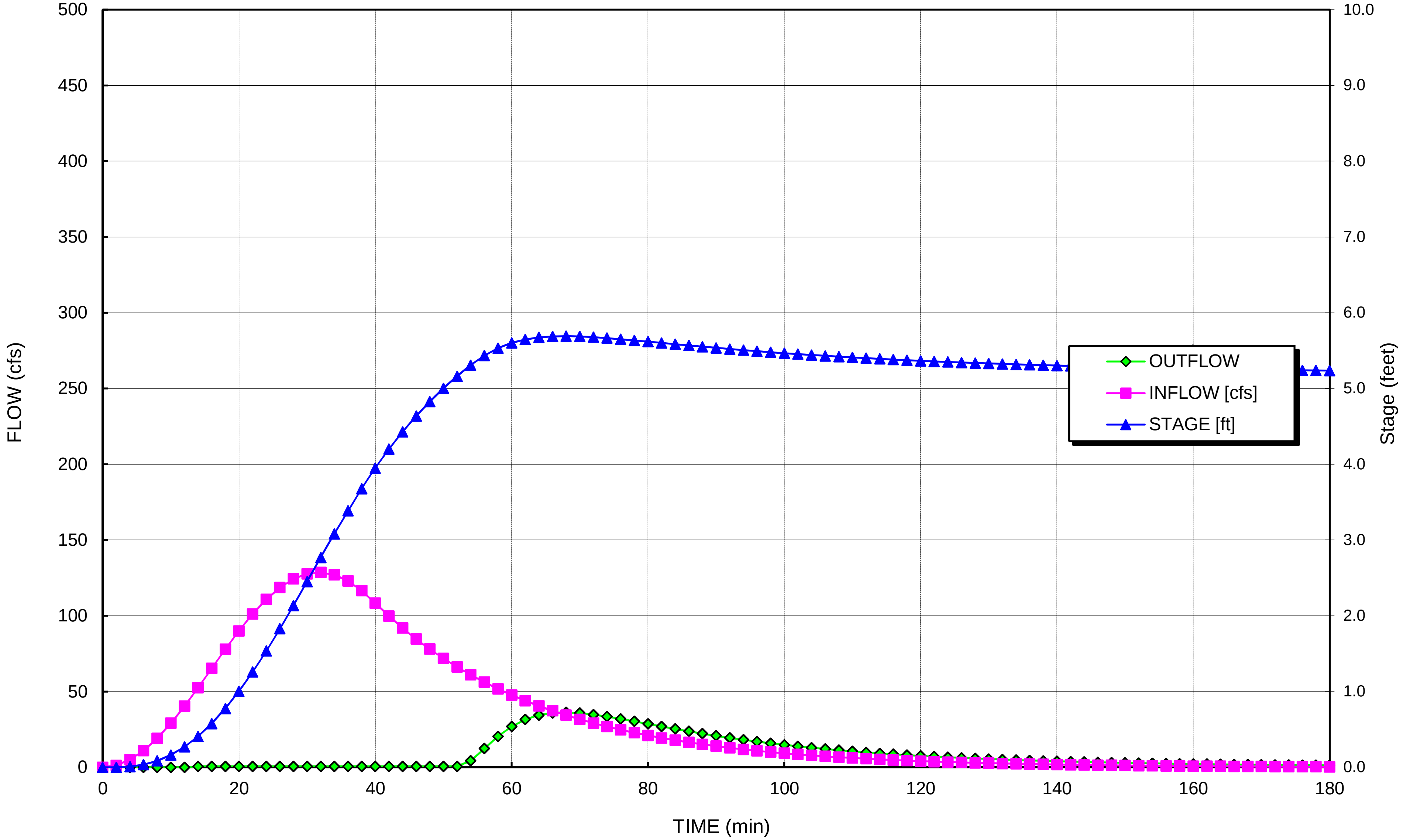
Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _2__of __2_

86	16.4	261,035	5.6	0.30	11.87	0.00	32.28	23.74	119.40	54,274	97%
88	15.1	260,158	5.6	0.30	11.12	0.00	32.22	22.24	119.35	54,249	97%
90	14.0	259,307	5.5	0.30	10.40	0.00	32.17	20.80	119.29	54,225	97%
92	12.9	258,485	5.5	0.30	9.73	0.00	32.11	19.45	119.24	54,201	98%
94	11.8	257,693	5.5	0.30	9.09	0.00	32.06	18.18	119.19	54,178	98%
96	10.9	256,932	5.5	0.30	8.49	0.00	32.01	16.98	119.14	54,157	98%
98	10.0	256,203	5.5	0.30	7.93	0.00	31.96	15.86	119.10	54,136	98%
100	9.3	255,505	5.5	0.30	7.41	0.00	31.92	14.82	119.05	54,116	99%
102	8.5	254,838	5.5	0.30	6.92	0.00	31.87	13.84	119.01	54,096	99%
104	7.9	254,201	5.4	0.30	6.46	0.00	31.83	12.93	118.97	54,078	99%
106	7.2	253,592	5.4	0.30	6.04	0.00	31.79	12.08	118.93	54,060	99%
108	6.7	253,012	5.4	0.30	5.64	0.00	31.75	11.29	118.90	54,043	99%
110	6.1	252,458	5.4	0.30	5.27	0.00	31.71	10.55	118.86	54,027	99%
112	5.7	251,930	5.4	0.30	4.93	0.00	31.68	9.86	118.83	54,012	99%
114	5.2	251,426	5.4	0.30	4.61	0.00	31.65	9.22	118.79	53,997	99%
116	4.8	250,946	5.4	0.30	4.31	0.00	31.61	8.62	118.76	53,983	99%
118	4.4	250,488	5.4	0.30	4.03	0.00	31.58	8.06	118.73	53,970	100%
120	4.1	250,052	5.4	0.30	3.77	0.00	31.55	7.55	118.70	53,957	100%
122	3.8	249,635	5.4	0.30	3.53	0.00	31.53	7.07	118.68	53,945	100%
124	3.5	249,238	5.4	0.30	3.31	0.00	31.50	6.62	118.65	53,933	100%
126	3.2	248,860	5.3	0.30	3.10	0.00	31.47	6.20	118.63	53,922	100%
128	2.9	248,499	5.3	0.30	2.90	0.00	31.45	5.81	118.60	53,911	100%
130	2.7	248,154	5.3	0.30	2.72	0.00	31.43	5.45	118.58	53,901	100%
132	2.5	247,825	5.3	0.30	2.55	0.00	31.40	5.11	118.56	53,891	100%
134	2.3	247,511	5.3	0.30	2.40	0.00	31.38	4.79	118.54	53,882	100%
136	2.1	247,212	5.3	0.30	2.25	0.00	31.36	4.50	118.52	53,873	100%
138	1.9	246,926	5.3	0.30	2.11	0.00	31.34	4.23	118.50	53,864	100%
140	1.8	246,652	5.3	0.30	1.99	0.00	31.33	3.97	118.48	53,856	100%
142	1.7	246,391	5.3	0.30	1.87	0.00	31.31	3.73	118.47	53,848	100%
144	1.5	246,142	5.3	0.30	1.76	0.00	31.29	3.51	118.45	53,841	100%
146	1.4	245,904	5.3	0.30	1.65	0.00	31.27	3.30	118.43	53,834	100%
148	1.3	245,676	5.3	0.30	1.56	0.00	31.26	3.11	118.42	53,827	100%
150	1.2	245,457	5.3	0.30	1.47	0.00	31.24	2.93	118.41	53,821	100%
152	1.1	245,249	5.3	0.30	1.38	0.00	31.23	2.76	118.39	53,814	100%
154	1.0	245,049	5.3	0.30	1.30	0.00	31.22	2.61	118.38	53,808	100%
156	0.9	244,858	5.3	0.30	1.23	0.00	31.20	2.46	118.37	53,803	100%
158	0.9	244,675	5.3	0.30	1.16	0.00	31.19	2.32	118.35	53,797	100%
160	0.8	244,499	5.3	0.30	1.10	0.00	31.18	2.19	118.34	53,792	100%
162	0.7	244,331	5.3	0.30	1.04	0.00	31.17	2.07	118.33	53,787	100%
164	0.7	244,169	5.3	0.30	0.98	0.00	31.16	1.96	118.32	53,782	100%
166	0.6	244,015	5.3	0.30	0.93	0.00	31.15	1.86	118.31	53,777	100%
168	0.6	243,866	5.3	0.30	0.88	0.00	31.14	1.76	118.30	53,773	100%
170	0.5	243,723	5.2	0.30	0.83	0.00	31.13	1.67	118.29	53,769	100%
172	0.5	243,586	5.2	0.30	0.79	0.00	31.12	1.58	118.28	53,765	100%
174	0.4	243,454	5.2	0.30	0.75	0.00	31.11	1.50	118.27	53,761	100%
176	0.4	243,327	5.2	0.30	0.71	0.00	31.10	1.43	118.26	53,757	100%
178	0.4	243,205	5.2	0.30	0.68	0.00	31.09	1.36	118.26	53,753	100%
180	0.3	243,087	5.2	0.30	0.65	0.00	31.08	1.29	118.25	53,750	100%
182	0.3	242,974	5.2	0.30	0.62	0.00	31.08	1.23	118.24	53,746	100%
184	0.3	242,865	5.2	0.30	0.59	0.00	31.07	1.17	118.23	53,743	100%
186	0.3	242,759	5.2	0.30	0.56	0.00	31.06	1.12	118.23	53,740	100%
188	0.3	242,657	5.2	0.30	0.54	0.00	31.05	1.07	118.22	53,737	100%
190	0.2	242,559	5.2	0.30	0.51	0.00	31.05	1.02	118.21	53,734	100%
192	0.2	242,464	5.2	0.30	0.49	0.00	31.04	0.98	118.21	53,731	100%
194	0.2	242,371	5.2	0.30	0.47	0.00	31.03	0.94	118.20	53,728	100%
196	0.2	242,282	5.2	0.30	0.45	0.00	31.03	0.90	118.20	53,725	100%
198	0.2	242,196	5.2	0.30	0.43	0.00	31.02	0.87	118.19	53,723	100%
200	0.2	242,112	5.2	0.30	0.42	0.00	31.02	0.83	118.18	53,720	100%
202	0.1	242,030	5.2	0.30	0.40	0.00	31.01	0.80	118.18	53,718	100%
204	0.1	241,951	5.2	0.30	0.39	0.00	31.01	0.77	118.17	53,715	100%

Sediment Basin #2 Colon Mine Phase 2 Hydrograph
100-Yr Storm



HDR Computation

Job No. 0453925-237673-018

Project: Charah Colon Mine		Computed: EAW	Date: 1/4/15
Subject: Permit Application		Checked: PAW	Date: 1/4/15
Task: Sediment Basin #3		Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1		
Storm Event (yrs) =	10		
Total Drainage Area A (ac) =	3.1		
Disturbed Area (ac) =	3.1		
Curve Number CN =	86	Hydrographs	
Rainfall Depth P (in) =	5.28	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	20.57	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	5,580	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	8,948	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
244	0	0	-	-	-
244	0	4,877	0	0	0
245	1	6,254	5,551	5,551	206
246	2	7,709	6,969	12,520	464
247	3	9,244	8,465	20,985	777
248	4	10,857	10,040	31,025	1,149
249	5	12,549	11,693	42,717	1,582
250	6	14,321	13,425	56,143	2,079

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 20,985 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 9,244 *Required Surface Area Achieved*

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #3	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 20,985
Number of Skimmers 1
Days to Drain = 5 *assumed*
Q each (cf/day) = 4,197 0.05 cfs

Selected Skimmer Size (inches) = 2.5
Head on Skimmer (feet) = 0.208
Diameter of Orifice (inches) = 2.0

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

$S = (1000/CN) - 10$

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase 1
Storm Event (yrs) = 10
S = 1.63
Runoff Depth Q* (inches) = 3.73
Time to Peak T_p (min) = 24.46

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 20,985
Z_2 (ft) = 6 S_2 (cf) = 56,143

$b = \ln(S_2/S_1)/\ln(Z_2/Z_1) =$ 1.4 Ref 2, III-8

$K_S = S_2/Z_2^{\,b} =$ 4,411

HDR Computation

I Job No. 0453925-237673-018 I

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #3	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20^o C — Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 5.00

Set Top of Dam at (ft) = 6.00

See Hydrograph

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 2

Use Anti-Seep Collar Size (ft) = 2 x 2

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 24 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (lbs/cf) = 62.4

Riser Displacement (cf) = 15.71 Pi * $(D_R/24)^2$ * Total Ht of Riser

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 0.41

Width & Length (ft) = 3

Thickness (ft) = 1.2

Anti-Vortex Device:

Diameter of Riser (in) = 24 From Hydrograph

Cylinder Diameter (in) = 36 — Ref 3, III-104, Table 3.14-D

Cylinder Thickness (gage) = 16

Cylinder Height (in) = 13

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #3	Sheet: 4	Of: 4

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n =	0.069	6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) =	9	Permissible Velocity for lining
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	0.02	Outlet Slope (estimated)
Bottom Width (ft) =	6	6 * Barrel Diameter
Q_B (cfs) =	0.0	Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.0	0.02	0.03	0.2	0.03	0.02	0.3

Flow Depth = Tailwater, d (ft) = 0.03 0.5* Barrel Diameter (ft) = 0.50 Ref 1, 8.06.3

Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe

Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
1	3	10	11	0.3	Class A

Conclusion Temporary basin, the 25 yr and 100 storms were not routed
The basin can contain the 10-yr storm.

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) = 24
Circumference of Riser (in) = 75.4
eight of Riser from bottom of barrel (in) = 60 From Hydrograph
Vertical spacing between holes (in) = 0 center to center
Water Stage increment (ft) 0.05

Orifice Equation

$$Q = C_d * A * (2 * g * h)^{0.5}$$ Ref 1, p III-11

Q = cfs, discharge
C_d = 0.6 coefficient of discharge
A = sf, cross sectional area
g = 32.2 ft/sec^2, gravity
h = ft, driving head measured from the center of the pipe

	Perforations					Skimmer	
Row	1	2	3	4	5	1	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.05	0.05
0.29	0.00	0.00	0.00			0.05	0.05
0.34	0.00	0.00	0.00			0.05	0.05
0.39	0.00	0.00	0.00			0.05	0.05
0.44	0.00	0.00	0.00			0.05	0.05
0.49	0.00	0.00	0.00			0.05	0.05
0.54	0.00	0.00	0.00			0.05	0.05
0.59	0.00	0.00	0.00			0.05	0.05
0.64	0.00	0.00	0.00			0.05	0.05
0.69	0.00	0.00	0.00			0.05	0.05
0.74	0.00	0.00	0.00			0.05	0.05
0.79	0.00	0.00	0.00			0.05	0.05
0.84	0.00	0.00	0.00			0.05	0.05
0.89	0.00	0.00	0.00			0.05	0.05
0.94	0.00	0.00	0.00			0.05	0.05
0.99	0.00	0.00	0.00			0.05	0.05
1.04	0.00	0.00	0.00			0.05	0.05
1.09	0.00	0.00	0.00			0.05	0.05
1.14	0.00	0.00	0.00			0.05	0.05
1.19	0.00	0.00	0.00			0.05	0.05
1.24	0.00	0.00	0.00			0.05	0.05
1.29	0.00	0.00	0.00			0.05	0.05
1.34	0.00	0.00	0.00			0.05	0.05
1.39	0.00	0.00	0.00			0.05	0.05
1.44	0.00	0.00	0.00			0.05	0.05
1.49	0.00	0.00	0.00			0.05	0.05
1.54	0.00	0.00	0.00			0.05	0.05
1.59	0.00	0.00	0.00			0.05	0.05

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.05	0.05
1.69	0.00	0.00	0.00	0.05	0.05
1.74	0.00	0.00	0.00	0.05	0.05
1.79	0.00	0.00	0.00	0.05	0.05
1.84	0.00	0.00	0.00	0.05	0.05
1.89	0.00	0.00	0.00	0.05	0.05
1.94	0.00	0.00	0.00	0.05	0.05
1.99	0.00	0.00	0.00	0.05	0.05
2.04	0.00	0.00	0.00	0.05	0.05
2.09	0.00	0.00	0.00	0.05	0.05
2.14	0.00	0.00	0.00	0.05	0.05
2.19	0.00	0.00	0.00	0.05	0.05
2.24	0.00	0.00	0.00	0.05	0.05
2.29	0.00	0.00	0.00	0.05	0.05
2.34	0.00	0.00	0.00	0.05	0.05
2.39	0.00	0.00	0.00	0.05	0.05
2.44	0.00	0.00	0.00	0.05	0.05
2.49	0.00	0.00	0.00	0.05	0.05
2.54	0.00	0.00	0.00	0.05	0.05
2.59	0.00	0.00	0.00	0.05	0.05
2.64	0.00	0.00	0.00	0.05	0.05
2.69	0.00	0.00	0.00	0.05	0.05
2.74	0.00	0.00	0.00	0.05	0.05
2.79	0.00	0.00	0.00	0.05	0.05
2.84	0.00	0.00	0.00	0.05	0.05
2.89	0.00	0.00	0.00	0.05	0.05
2.94	0.00	0.00	0.00	0.05	0.05
2.99	0.00	0.00	0.00	0.05	0.05
3.04	0.00	0.00	0.00	0.05	0.05
3.09	0.00	0.00	0.00	0.05	0.05
3.14	0.00	0.00	0.00	0.05	0.05
3.19	0.00	0.00	0.00	0.05	0.05
3.24	0.00	0.00	0.00	0.05	0.05
3.29	0.00	0.00	0.00	0.05	0.05
3.34	0.00	0.00	0.00	0.05	0.05
3.39	0.00	0.00	0.00	0.05	0.05
3.44	0.00	0.00	0.00	0.05	0.05
3.49	0.00	0.00	0.00	0.05	0.05
3.54	0.00	0.00	0.00	0.05	0.05
3.59	0.00	0.00	0.00	0.05	0.05
3.64	0.00	0.00	0.00	0.05	0.05
3.69	0.00	0.00	0.00	0.05	0.05
3.74	0.00	0.00	0.00	0.05	0.05
3.79	0.00	0.00	0.00	0.05	0.05
3.84	0.00	0.00	0.00	0.05	0.05
3.89	0.00	0.00	0.00	0.05	0.05
3.94	0.00	0.00	0.00	0.05	0.05
3.99	0.00	0.00	0.00	0.05	0.05

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of _2___

Sediment Basin # 3 Colon

Phase 1

10 - year Storm Event

Qp = 20.57 cfs
Tp = 24.46 minutes
dT = Max of 2 minutes
or 1.0% of increment to peak

b = 1.4
K_s = 4,411

Number of Riser/Barrel Assemblies 1
Diameter of Barrel = 12 (in)
Height of Riser above barrel = 4 (ft)
Height of Riser from bottom of barrel= 5 (ft) elevation 249.00
Emergency Spillway = 5.0 (ft) elevation 249.00
Total Height of Dam = 6.0 (ft) elevation 250.00
Length of Emergency Spillway = 10 (ft)
Diameter of Riser = 24 (in)
Permanent Pond Stage = 0 (ft) elevation 244.0

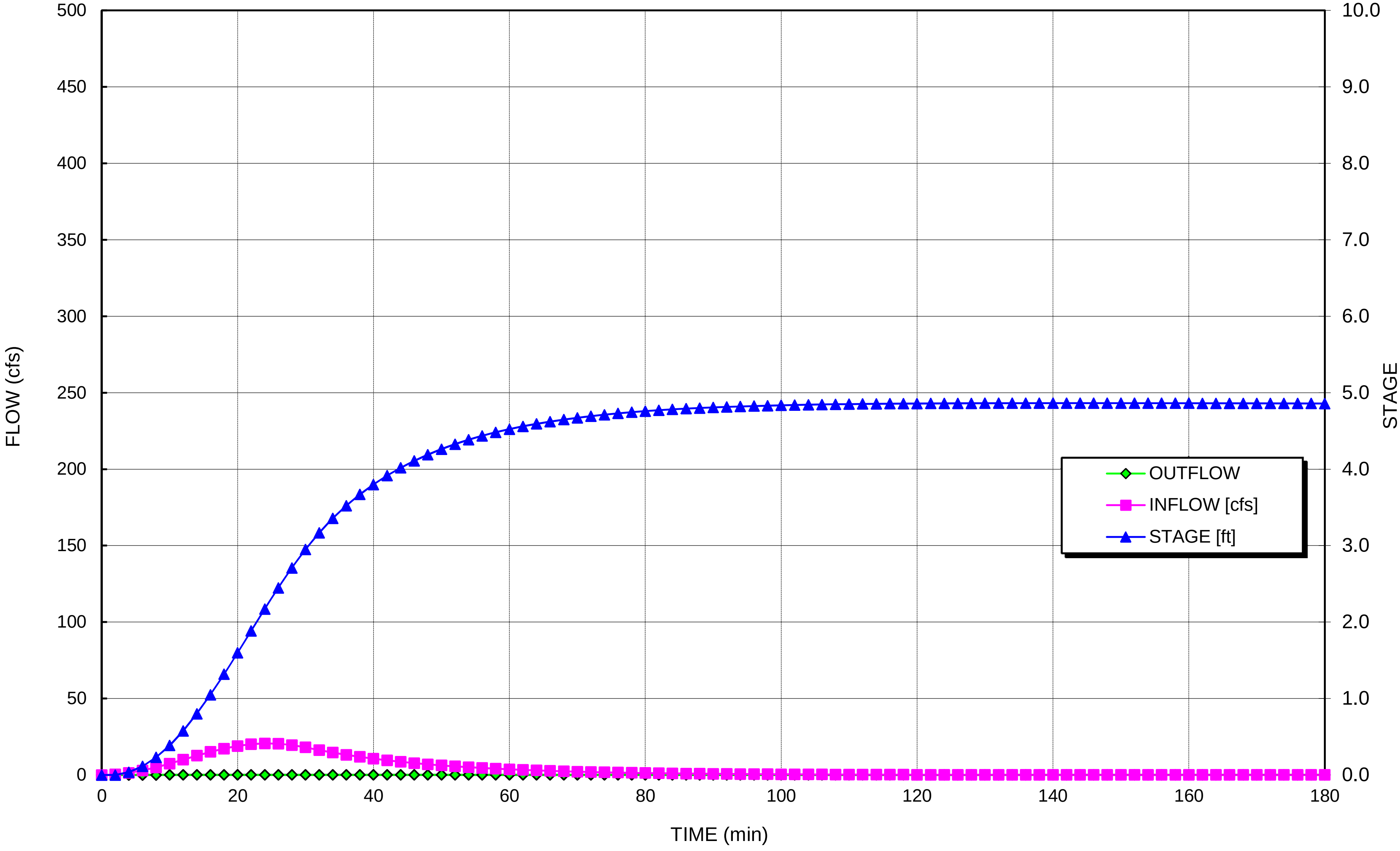
4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
4.9 ft Maximum Stage 248.86 msl elevation
0.0 cfs Peak outflow
0.0 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

Notes:
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	1.3	40	0.0	0.00	0.00	0.00	0.00	0.00	3.44	1,565	N/A
6	2.9	200	0.1	0.00	0.00	0.00	0.00	0.00	5.52	2,508	N/A
8	5.0	548	0.2	0.00	0.00	0.00	0.00	0.00	7.44	3,381	N/A
10	7.4	1,145	0.4	0.05	0.05	0.00	0.05	0.05	9.25	4,203	100%
12	10.0	2,024	0.6	0.05	0.05	0.00	0.05	0.05	10.94	4,974	100%
14	12.6	3,216	0.8	0.05	0.05	0.00	0.05	0.05	12.55	5,704	100%
16	15.1	4,723	1.0	0.05	0.05	0.00	0.05	0.05	14.06	6,390	100%
18	17.2	6,525	1.3	0.05	0.05	0.00	0.05	0.05	15.47	7,031	100%
20	18.9	8,587	1.6	0.05	0.05	0.00	0.05	0.05	16.78	7,625	100%
22	20.1	10,852	1.9	0.05	0.05	0.00	0.05	0.05	17.98	8,172	100%
24	20.6	13,254	2.2	0.05	0.05	0.00	0.05	0.05	19.07	8,670	100%
26	20.4	15,714	2.4	0.05	0.05	0.00	0.05	0.05	20.06	9,117	100%
28	19.5	18,153	2.7	0.05	0.05	0.00	0.05	0.05	20.93	9,514	100%
30	18.1	20,490	2.9	0.05	0.05	0.00	0.05	0.05	21.69	9,861	100%
32	16.3	22,653	3.2	0.05	0.05	0.00	0.05	0.05	22.35	10,158	100%
34	14.7	24,603	3.4	0.05	0.05	0.00	0.05	0.05	22.90	10,409	100%
36	13.2	26,356	3.5	0.05	0.05	0.00	0.05	0.05	23.37	10,623	100%
38	11.8	27,931	3.7	0.05	0.05	0.00	0.05	0.05	23.78	10,807	100%
40	10.7	29,347	3.8	0.05	0.05	0.00	0.05	0.05	24.13	10,966	100%
42	9.6	30,620	3.9	0.05	0.05	0.00	0.05	0.05	24.43	11,105	100%
44	8.6	31,763	4.0	0.05	0.05	0.00	0.05	0.05	24.70	11,226	100%
46	7.7	32,791	4.1	0.05	0.05	0.00	0.05	0.05	24.93	11,332	100%
48	7.0	33,715	4.2	0.05	0.05	0.00	0.05	0.05	25.14	11,425	100%
50	6.3	34,544	4.3	0.05	0.05	0.00	0.05	0.05	25.32	11,508	100%
52	5.6	35,290	4.3	0.05	0.05	0.00	0.05	0.05	25.48	11,581	100%
54	5.1	35,960	4.4	0.05	0.05	0.00	0.05	0.05	25.62	11,645	100%
56	4.6	36,561	4.4	0.05	0.05	0.00	0.05	0.05	25.75	11,703	100%
58	4.1	37,102	4.5	0.05	0.05	0.00	0.05	0.05	25.86	11,753	100%
60	3.7	37,587	4.5	0.05	0.05	0.00	0.05	0.05	25.96	11,799	100%
62	3.3	38,023	4.6	0.05	0.05	0.00	0.05	0.05	26.05	11,839	100%
64	3.0	38,414	4.6	0.05	0.05	0.00	0.05	0.05	26.12	11,875	100%
66	2.7	38,765	4.6	0.05	0.05	0.00	0.05	0.05	26.20	11,907	100%
68	2.4	39,081	4.6	0.05	0.05	0.00	0.05	0.05	26.26	11,935	100%
70	2.2	39,363	4.7	0.05	0.05	0.00	0.05	0.05	26.31	11,961	100%
72	1.9	39,617	4.7	0.05	0.05	0.00	0.05	0.05	26.36	11,984	100%
74	1.7	39,845	4.7	0.05	0.05	0.00	0.05	0.05	26.41	12,004	100%
76	1.6	40,049	4.7	0.05	0.05	0.00	0.05	0.05	26.45	12,022	100%
78	1.4	40,232	4.7	0.05	0.05	0.00	0.05	0.05	26.48	12,038	100%
80	1.3	40,395	4.8	0.05	0.05	0.00	0.05	0.05	26.52	12,053	100%
82	1.1	40,542	4.8	0.05	0.05	0.00	0.05	0.05	26.54	12,066	100%

84	1.0	40,674	4.8	0.05	0.05	0.00	0.05	0.05	26.57	12,077	100%
86	0.9	40,791	4.8	0.05	0.05	0.00	0.05	0.05	26.59	12,088	100%
88	0.8	40,896	4.8	0.05	0.05	0.00	0.05	0.05	26.61	12,097	100%
90	0.7	40,990	4.8	0.05	0.05	0.00	0.05	0.05	26.63	12,105	100%
92	0.7	41,074	4.8	0.05	0.05	0.00	0.05	0.05	26.65	12,112	100%
94	0.6	41,149	4.8	0.05	0.05	0.00	0.05	0.05	26.66	12,119	100%
96	0.5	41,215	4.8	0.05	0.05	0.00	0.05	0.05	26.67	12,125	100%
98	0.5	41,275	4.8	0.05	0.05	0.00	0.05	0.05	26.69	12,130	100%
100	0.4	41,327	4.8	0.05	0.05	0.00	0.05	0.05	26.70	12,134	100%
102	0.4	41,374	4.8	0.05	0.05	0.00	0.05	0.05	26.70	12,138	100%
104	0.4	41,416	4.8	0.05	0.05	0.00	0.05	0.05	26.71	12,142	100%
106	0.3	41,453	4.8	0.05	0.05	0.00	0.05	0.05	26.72	12,145	100%
108	0.3	41,485	4.8	0.05	0.05	0.00	0.05	0.05	26.73	12,148	100%
110	0.3	41,514	4.9	0.05	0.05	0.00	0.05	0.05	26.73	12,150	100%
112	0.2	41,539	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,153	100%
114	0.2	41,561	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,155	100%
116	0.2	41,580	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
118	0.2	41,597	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,158	100%
120	0.2	41,611	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,159	100%
122	0.1	41,624	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
124	0.1	41,634	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,161	100%
126	0.1	41,643	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
128	0.1	41,650	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
130	0.1	41,657	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
132	0.1	41,661	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
134	0.1	41,665	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
136	0.1	41,668	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
138	0.1	41,670	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
140	0.1	41,671	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
142	0.0	41,672	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
144	0.0	41,671	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
146	0.0	41,671	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
148	0.0	41,669	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
150	0.0	41,668	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
152	0.0	41,666	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
154	0.0	41,663	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
156	0.0	41,660	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
158	0.0	41,657	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
160	0.0	41,654	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
162	0.0	41,650	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
164	0.0	41,646	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
166	0.0	41,642	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
168	0.0	41,638	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,161	100%
170	0.0	41,633	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,161	100%
172	0.0	41,629	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
174	0.0	41,624	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
176	0.0	41,619	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
178	0.0	41,614	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,159	100%
180	0.0	41,609	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,159	100%
182	0.0	41,604	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,158	100%
184	0.0	41,599	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,158	100%
186	0.0	41,594	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,157	100%
188	0.0	41,589	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,157	100%
190	0.0	41,583	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
192	0.0	41,578	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
194	0.0	41,573	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
196	0.0	41,567	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,155	100%
198	0.0	41,562	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,155	100%
200	0.0	41,556	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,154	100%
202	0.0	41,550	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,154	100%
204	0.0	41,545	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,153	100%
206	0.0	41,539	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,153	100%

Sediment Basin #3 Colon Mine Phase 1 Hydrograph
10-Yr Storm



This page intentionally left blank.

HDR Computation

Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #3	Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1		
Storm Event (yrs) =	10		
Total Drainage Area A (ac) =	3.1		
Disturbed Area (ac) =	3.1		
Curve Number CN =	86	Hydrographs	
Rainfall Depth P (in) =	5.28	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	20.57	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	5,580	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	8,948	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
244	0	0	-	-	-
244	0	4,877	0	0	0
245	1	6,254	5,551	5,551	206
246	2	7,709	6,969	12,520	464
247	3	9,244	8,465	20,985	777
248	4	10,857	10,040	31,025	1,149
249	5	12,549	11,693	42,717	1,582
250	6	14,321	13,425	56,143	2,079

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 20,985 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 9,244 *Required Surface Area Achieved*

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #3	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 20,985

Number of Skimmers 1

Days to Drain = 5 *assumed*

Q each (cf/day) = 4,197 0.05 cfs

Selected Skimmer Size (inches) = 2.5

Head on Skimmer (feet) = 0.208

Diameter of Orifice (inches) = 2.0

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

S = (1000/CN) - 10

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase 1

Storm Event (yrs) = 10

S = 1.63

Runoff Depth Q* (inches) = 3.73

Time to Peak T_p (min) = 24.46

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 20,985

Z_2 (ft) = 6 S_2 (cf) = 56,143

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.4 Ref 2, III-8

$K_S = S_2/Z_2^b$ = 4,411

HDR Computation

I Job No. 0453925-237673-018 I

Project: Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject: Permit Application	Checked: PAW	Date: 1/4/15
Task: Sediment Basin #3	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20^o C — Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 5.00

Set Top of Dam at (ft) = 6.00

See Hydrograph

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 2

Use Anti-Seep Collar Size (ft) = 2 x 2

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 24 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (lbs/cf) = 62.4

Riser Displacement (cf) = 15.71 Pi * $(D_R/24)^2$ * Total Ht of Riser

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 0.41

Width & Length (ft) = 3

Thickness (ft) = 1.2

Anti-Vortex Device:

Diameter of Riser (in) = 24 From Hydrograph

Cylinder Diameter (in) = 36 — Ref 3, III-104, Table 3.14-D

Cylinder Thickness (gage) = 16

Cylinder Height (in) = 13

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #3	Sheet: 4	Of: 4

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n =	0.069	6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) =	9	Permissible Velocity for lining
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	0.02	Outlet Slope (estimated)
Bottom Width (ft) =	6	6 * Barrel Diameter
Q_B (cfs) =	0.0	Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.0	0.02	0.03	0.2	0.03	0.02	0.3

Flow Depth = Tailwater, d (ft) = 0.03 0.5* Barrel Diameter (ft) = 0.50 Ref 1, 8.06.3

Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe

Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
1	3	10	11	0.3	Class A

Conclusion Temporary basin, the 25 yr and 100 storms were not routed
The basin can contain the 10-yr storm.

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) = 24
Circumference of Riser (in) = 75.4
eight of Riser from bottom of barrel (in) = 60 From Hydrograph
Vertical spacing between holes (in) = 0 center to center
Water Stage increment (ft) 0.05

Orifice Equation

$$Q = C_d * A * (2 * g * h)^{0.5}$$ Ref 1, p III-11

Q = cfs, discharge
C_d = 0.6 coefficient of discharge
A = sf, cross sectional area
g = 32.2 ft/sec^2, gravity
h = ft, driving head measured from the center of the pipe

	Perforations					Skimmer	
Row	1	2	3	4	5	1	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.05	0.05
0.29	0.00	0.00	0.00			0.05	0.05
0.34	0.00	0.00	0.00			0.05	0.05
0.39	0.00	0.00	0.00			0.05	0.05
0.44	0.00	0.00	0.00			0.05	0.05
0.49	0.00	0.00	0.00			0.05	0.05
0.54	0.00	0.00	0.00			0.05	0.05
0.59	0.00	0.00	0.00			0.05	0.05
0.64	0.00	0.00	0.00			0.05	0.05
0.69	0.00	0.00	0.00			0.05	0.05
0.74	0.00	0.00	0.00			0.05	0.05
0.79	0.00	0.00	0.00			0.05	0.05
0.84	0.00	0.00	0.00			0.05	0.05
0.89	0.00	0.00	0.00			0.05	0.05
0.94	0.00	0.00	0.00			0.05	0.05
0.99	0.00	0.00	0.00			0.05	0.05
1.04	0.00	0.00	0.00			0.05	0.05
1.09	0.00	0.00	0.00			0.05	0.05
1.14	0.00	0.00	0.00			0.05	0.05
1.19	0.00	0.00	0.00			0.05	0.05
1.24	0.00	0.00	0.00			0.05	0.05
1.29	0.00	0.00	0.00			0.05	0.05
1.34	0.00	0.00	0.00			0.05	0.05
1.39	0.00	0.00	0.00			0.05	0.05
1.44	0.00	0.00	0.00			0.05	0.05
1.49	0.00	0.00	0.00			0.05	0.05
1.54	0.00	0.00	0.00			0.05	0.05
1.59	0.00	0.00	0.00			0.05	0.05

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.05	0.05
1.69	0.00	0.00	0.00	0.05	0.05
1.74	0.00	0.00	0.00	0.05	0.05
1.79	0.00	0.00	0.00	0.05	0.05
1.84	0.00	0.00	0.00	0.05	0.05
1.89	0.00	0.00	0.00	0.05	0.05
1.94	0.00	0.00	0.00	0.05	0.05
1.99	0.00	0.00	0.00	0.05	0.05
2.04	0.00	0.00	0.00	0.05	0.05
2.09	0.00	0.00	0.00	0.05	0.05
2.14	0.00	0.00	0.00	0.05	0.05
2.19	0.00	0.00	0.00	0.05	0.05
2.24	0.00	0.00	0.00	0.05	0.05
2.29	0.00	0.00	0.00	0.05	0.05
2.34	0.00	0.00	0.00	0.05	0.05
2.39	0.00	0.00	0.00	0.05	0.05
2.44	0.00	0.00	0.00	0.05	0.05
2.49	0.00	0.00	0.00	0.05	0.05
2.54	0.00	0.00	0.00	0.05	0.05
2.59	0.00	0.00	0.00	0.05	0.05
2.64	0.00	0.00	0.00	0.05	0.05
2.69	0.00	0.00	0.00	0.05	0.05
2.74	0.00	0.00	0.00	0.05	0.05
2.79	0.00	0.00	0.00	0.05	0.05
2.84	0.00	0.00	0.00	0.05	0.05
2.89	0.00	0.00	0.00	0.05	0.05
2.94	0.00	0.00	0.00	0.05	0.05
2.99	0.00	0.00	0.00	0.05	0.05
3.04	0.00	0.00	0.00	0.05	0.05
3.09	0.00	0.00	0.00	0.05	0.05
3.14	0.00	0.00	0.00	0.05	0.05
3.19	0.00	0.00	0.00	0.05	0.05
3.24	0.00	0.00	0.00	0.05	0.05
3.29	0.00	0.00	0.00	0.05	0.05
3.34	0.00	0.00	0.00	0.05	0.05
3.39	0.00	0.00	0.00	0.05	0.05
3.44	0.00	0.00	0.00	0.05	0.05
3.49	0.00	0.00	0.00	0.05	0.05
3.54	0.00	0.00	0.00	0.05	0.05
3.59	0.00	0.00	0.00	0.05	0.05
3.64	0.00	0.00	0.00	0.05	0.05
3.69	0.00	0.00	0.00	0.05	0.05
3.74	0.00	0.00	0.00	0.05	0.05
3.79	0.00	0.00	0.00	0.05	0.05
3.84	0.00	0.00	0.00	0.05	0.05
3.89	0.00	0.00	0.00	0.05	0.05
3.94	0.00	0.00	0.00	0.05	0.05
3.99	0.00	0.00	0.00	0.05	0.05

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of _2___

Sediment Basin # 3 Colon

Phase 1

10 - year Storm Event

Qp = 20.57 cfs
Tp = 24.46 minutes
dT = Max of 2 minutes
or 1.0% of increment to peak

b = 1.4
K_s = 4,411

Number of Riser/Barrel Assemblies 1
Diameter of Barrel = 12 (in)
Height of Riser above barrel = 4 (ft)
Height of Riser from bottom of barrel= 5 (ft) elevation 249.00
Emergency Spillway = 5.0 (ft) elevation 249.00
Total Height of Dam = 6.0 (ft) elevation 250.00
Length of Emergency Spillway = 10 (ft)
Diameter of Riser = 24 (in)
Permanent Pond Stage = 0 (ft) elevation 244.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
4.9 ft Maximum Stage 248.86 msl elevation
0.0 cfs Peak outflow
0.0 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

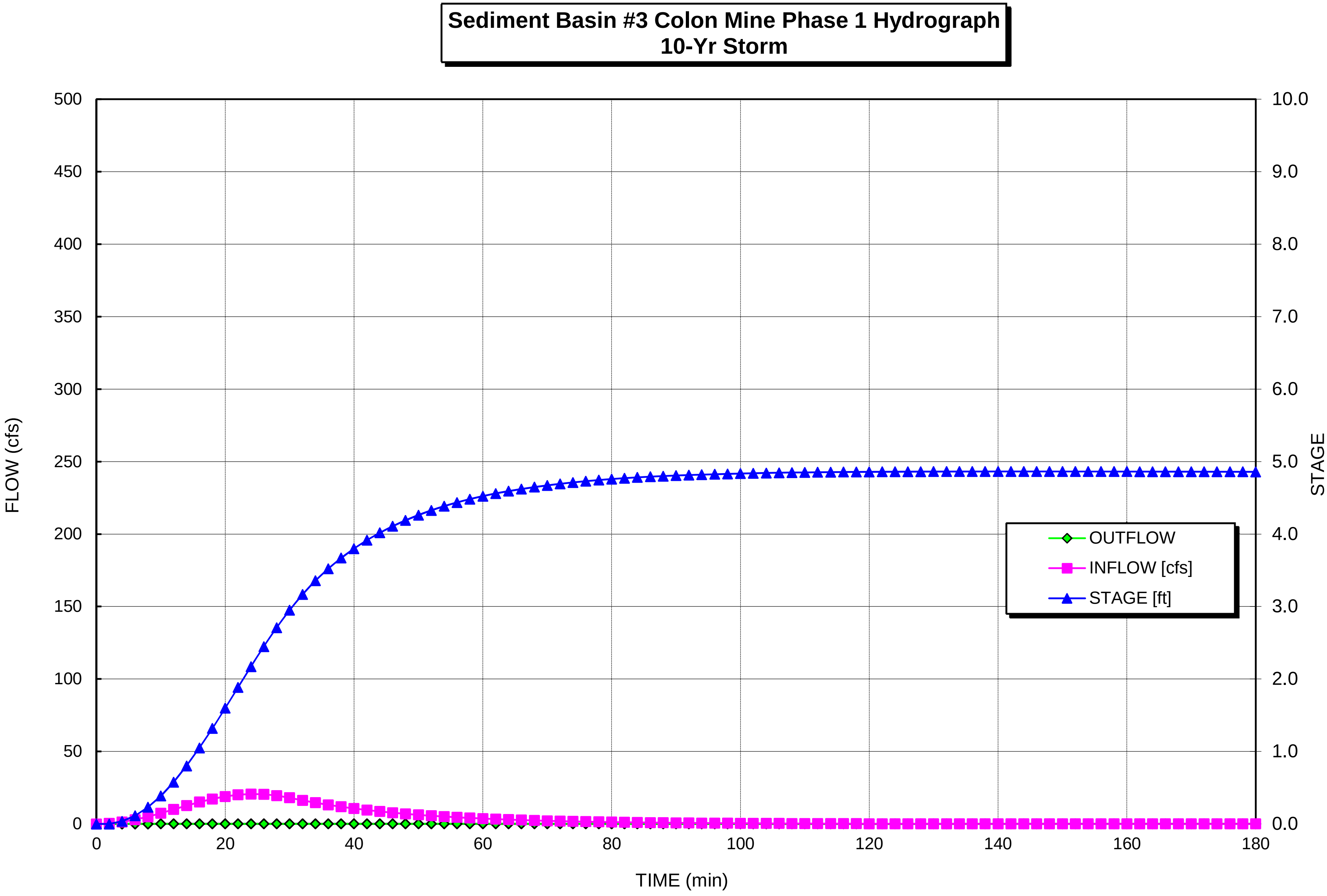
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	1.3	40	0.0	0.00	0.00	0.00	0.00	0.00	3.44	1,565	N/A
6	2.9	200	0.1	0.00	0.00	0.00	0.00	0.00	5.52	2,508	N/A
8	5.0	548	0.2	0.00	0.00	0.00	0.00	0.00	7.44	3,381	N/A
10	7.4	1,145	0.4	0.05	0.05	0.00	0.05	0.05	9.25	4,203	100%
12	10.0	2,024	0.6	0.05	0.05	0.00	0.05	0.05	10.94	4,974	100%
14	12.6	3,216	0.8	0.05	0.05	0.00	0.05	0.05	12.55	5,704	100%
16	15.1	4,723	1.0	0.05	0.05	0.00	0.05	0.05	14.06	6,390	100%
18	17.2	6,525	1.3	0.05	0.05	0.00	0.05	0.05	15.47	7,031	100%
20	18.9	8,587	1.6	0.05	0.05	0.00	0.05	0.05	16.78	7,625	100%
22	20.1	10,852	1.9	0.05	0.05	0.00	0.05	0.05	17.98	8,172	100%
24	20.6	13,254	2.2	0.05	0.05	0.00	0.05	0.05	19.07	8,670	100%
26	20.4	15,714	2.4	0.05	0.05	0.00	0.05	0.05	20.06	9,117	100%
28	19.5	18,153	2.7	0.05	0.05	0.00	0.05	0.05	20.93	9,514	100%
30	18.1	20,490	2.9	0.05	0.05	0.00	0.05	0.05	21.69	9,861	100%
32	16.3	22,653	3.2	0.05	0.05	0.00	0.05	0.05	22.35	10,158	100%
34	14.7	24,603	3.4	0.05	0.05	0.00	0.05	0.05	22.90	10,409	100%
36	13.2	26,356	3.5	0.05	0.05	0.00	0.05	0.05	23.37	10,623	100%
38	11.8	27,931	3.7	0.05	0.05	0.00	0.05	0.05	23.78	10,807	100%
40	10.7	29,347	3.8	0.05	0.05	0.00	0.05	0.05	24.13	10,966	100%
42	9.6	30,620	3.9	0.05	0.05	0.00	0.05	0.05	24.43	11,105	100%
44	8.6	31,763	4.0	0.05	0.05	0.00	0.05	0.05	24.70	11,226	100%
46	7.7	32,791	4.1	0.05	0.05	0.00	0.05	0.05	24.93	11,332	100%
48	7.0	33,715	4.2	0.05	0.05	0.00	0.05	0.05	25.14	11,425	100%
50	6.3	34,544	4.3	0.05	0.05	0.00	0.05	0.05	25.32	11,508	100%
52	5.6	35,290	4.3	0.05	0.05	0.00	0.05	0.05	25.48	11,581	100%
54	5.1	35,960	4.4	0.05	0.05	0.00	0.05	0.05	25.62	11,645	100%
56	4.6	36,561	4.4	0.05	0.05	0.00	0.05	0.05	25.75	11,703	100%
58	4.1	37,102	4.5	0.05	0.05	0.00	0.05	0.05	25.86	11,753	100%
60	3.7	37,587	4.5	0.05	0.05	0.00	0.05	0.05	25.96	11,799	100%
62	3.3	38,023	4.6	0.05	0.05	0.00	0.05	0.05	26.05	11,839	100%
64	3.0	38,414	4.6	0.05	0.05	0.00	0.05	0.05	26.12	11,875	100%
66	2.7	38,765	4.6	0.05	0.05	0.00	0.05	0.05	26.20	11,907	100%
68	2.4	39,081	4.6	0.05	0.05	0.00	0.05	0.05	26.26	11,935	100%
70	2.2	39,363	4.7	0.05	0.05	0.00	0.05	0.05	26.31	11,961	100%
72	1.9	39,617	4.7	0.05	0.05	0.00	0.05	0.05	26.36	11,984	100%
74	1.7	39,845	4.7	0.05	0.05	0.00	0.05	0.05	26.41	12,004	100%
76	1.6	40,049	4.7	0.05	0.05	0.00	0.05	0.05	26.45	12,022	100%
78	1.4	40,232	4.7	0.05	0.05	0.00	0.05	0.05	26.48	12,038	100%
80	1.3	40,395	4.8	0.05	0.05	0.00	0.05	0.05	26.52	12,053	100%
82	1.1	40,542	4.8	0.05	0.05	0.00	0.05	0.05	26.54	12,066	100%

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __2__of _2___

84	1.0	40,674	4.8	0.05	0.05	0.00	0.05	0.05	26.57	12,077	100%
86	0.9	40,791	4.8	0.05	0.05	0.00	0.05	0.05	26.59	12,088	100%
88	0.8	40,896	4.8	0.05	0.05	0.00	0.05	0.05	26.61	12,097	100%
90	0.7	40,990	4.8	0.05	0.05	0.00	0.05	0.05	26.63	12,105	100%
92	0.7	41,074	4.8	0.05	0.05	0.00	0.05	0.05	26.65	12,112	100%
94	0.6	41,149	4.8	0.05	0.05	0.00	0.05	0.05	26.66	12,119	100%
96	0.5	41,215	4.8	0.05	0.05	0.00	0.05	0.05	26.67	12,125	100%
98	0.5	41,275	4.8	0.05	0.05	0.00	0.05	0.05	26.69	12,130	100%
100	0.4	41,327	4.8	0.05	0.05	0.00	0.05	0.05	26.70	12,134	100%
102	0.4	41,374	4.8	0.05	0.05	0.00	0.05	0.05	26.70	12,138	100%
104	0.4	41,416	4.8	0.05	0.05	0.00	0.05	0.05	26.71	12,142	100%
106	0.3	41,453	4.8	0.05	0.05	0.00	0.05	0.05	26.72	12,145	100%
108	0.3	41,485	4.8	0.05	0.05	0.00	0.05	0.05	26.73	12,148	100%
110	0.3	41,514	4.9	0.05	0.05	0.00	0.05	0.05	26.73	12,150	100%
112	0.2	41,539	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,153	100%
114	0.2	41,561	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,155	100%
116	0.2	41,580	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
118	0.2	41,597	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,158	100%
120	0.2	41,611	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,159	100%
122	0.1	41,624	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
124	0.1	41,634	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,161	100%
126	0.1	41,643	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
128	0.1	41,650	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
130	0.1	41,657	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
132	0.1	41,661	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
134	0.1	41,665	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
136	0.1	41,668	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
138	0.1	41,670	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
140	0.1	41,671	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
142	0.0	41,672	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
144	0.0	41,671	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
146	0.0	41,671	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
148	0.0	41,669	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
150	0.0	41,668	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
152	0.0	41,666	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,164	100%
154	0.0	41,663	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
156	0.0	41,660	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
158	0.0	41,657	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
160	0.0	41,654	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,163	100%
162	0.0	41,650	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
164	0.0	41,646	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
166	0.0	41,642	4.9	0.05	0.05	0.00	0.05	0.05	26.76	12,162	100%
168	0.0	41,638	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,161	100%
170	0.0	41,633	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,161	100%
172	0.0	41,629	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
174	0.0	41,624	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
176	0.0	41,619	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,160	100%
178	0.0	41,614	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,159	100%
180	0.0	41,609	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,159	100%
182	0.0	41,604	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,158	100%
184	0.0	41,599	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,158	100%
186	0.0	41,594	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,157	100%
188	0.0	41,589	4.9	0.05	0.05	0.00	0.05	0.05	26.75	12,157	100%
190	0.0	41,583	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
192	0.0	41,578	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
194	0.0	41,573	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,156	100%
196	0.0	41,567	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,155	100%
198	0.0	41,562	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,155	100%
200	0.0	41,556	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,154	100%
202	0.0	41,550	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,154	100%
204	0.0	41,545	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,153	100%
206	0.0	41,539	4.9	0.05	0.05	0.00	0.05	0.05	26.74	12,153	100%


Sediment Basin #3 Colon Mine Phase 1 Hydrograph
10-Yr Storm
FLOW (cfs)
STAGE
TIME (min)
0
50
100
150
200
250
300
350
400
450
500
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0
20
40
60
80
100
120
140
160
180
OUTFLOW
INFLOW [cfs]
STAGE [ft]

This page intentionally left blank.

HDR Computation

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #5	Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1	2	2	2		
Storm Event (yrs) =	10	10	25	100		
Total Drainage Area A (ac) =	49.3	42.1	42.1	42.1		
Disturbed Area (ac) =	49.3	42.1	42.1	42.1		
Curve Number CN =	89	88	88	88	Hydrographs	
Rainfall Depth P (in) =	5.28	5.28	6.28	7.88	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	301.78	252.52	310.28	402.08	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	88,740	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	131,274	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
255	0	118,763	0	0	0
256	1	124,341	121,541	121,541	4,502
257	2	129,979	127,150	248,691	9,211
258	3	135,678	132,818	381,509	14,130
259	4	141,437	138,548	520,057	19,261
260	5	147,256	144,337	664,393	24,607
261	6	153,136	150,186	814,580	30,170

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 381,509 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 135,678 *Required Surface Area Achieved*

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #5	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 381,509

Number of Skimmers 2

Days to Drain = 5 *assumed*

Q each (cf/day) = 38,151 0.44 cfs

Selected Skimmer Size (inches) = 6

Head on Skimmer (feet) = 0.417

Diameter of Orifice (inches) = 5.1

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

S = (1000/CN) - 10

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase	1	2	2	2
Storm Event (yrs) =	10	10	25	100
S =	1.24	1.36	1.36	1.36
Runoff Depth Q* (inches) =	4.04	3.94	4.90	6.45
Time to Peak T_p (min) =	28.73	28.56	28.91	29.40

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 381,509

Z_2 (ft) = 6 S_2 (cf) = 814,580

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.1 Ref 2, III-8

$K_S = S_2/Z_2^{\ b}$ = 114,650

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #5	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20^o C Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v]\ d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 6.00

Set Top of Dam at (ft) = 7.00

See Hydrograph

Emergency Spillway

Q_E (cfs) = 100-Yr Storm

Q_E (cfs) = 2.9

Cross Section = Trapezoid

Channel Side Slope (z) = 5 (enter X for X:1)

n = 0.03 Grass Lined

Vp (ft/sec) = 5.0 Permissible Velocity for lining Ref 2, II-7

Allowable Shear Stress (psf) = 2.0 Allowable Shear Stress for lining

Bottom Width, b (ft) = 20

Calculate Required Depth of Spillway:

Normal-Depth Procedure

$AR^{2/3}=Qn/1.49s^{0.5}$ Q=VA

$Z_{req}=Qn/1.49s^{0.5}$ Area (A)= bd+z(d^2)

$Z_{av}=AR^{2/3}$ R=Area/(b+2d((z^2)+1)^.5)

Avg Shear Stress(T) = K_b*d*s*unit weight of water

Channel Slope ft/ft	Depth, d (ft)	A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	T (psf)
0.01	0.18	3.77	0.58	0.17	1.17	1.5	0.1
0.02	0.15	3.03	0.41	0.14	0.82	1.9	0.2

Construct the channel to be : 20 ft, Bottom Width (measured at top of lining)

1.0 ft, depth (measured at top of lining)

1% slope

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 4

Use Anti-Seep Collar Size (ft) = 4 x 4

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #5	Sheet: 4	Of: 4

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 48 From Hydrograph
Avg Density of Concrete (lbs/cf) = 87.6
Density of Water (lbs/cf) = 62.4
Riser Displacement (cf) = 66.60 Pi * $(D_R/24)^2$ * Total Ht of Riser
Convert cf to cy = 27^{-1}
Min Concrete Needed (cy) = 1.76
Width & Length (ft) = 5
Thickness (ft) = 1.9

Anti-Vortex Device:

Diameter of Riser (in) = 48 From Hydrograph
Cylinder Diameter (in) = 78 Ref 3, III-104, Table 3.14-D
Cylinder Thickness (gage) = 16
Cylinder Height (in) = 25

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n = 0.069 6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) = 9 Permissible Velocity for lining
Side Slope (z) = 5 enter X for X:1
s (ft/ft) = 0.02 Outlet Slope (estimated)
Bottom Width (ft) = 12 6 * Barrel Diameter
Q_B (cfs) = 5.1 Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
5.1	1.66	0.51	7.4	0.43	4.22	0.7

Flow Depth = Tailwater, d (ft) = 0.51 0.5* Barrel Diameter (ft) = 1.00 Ref 1, 8.06.3
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
2	6	10	12	0.3	Class A

Conclusion

The basin can contain the 10-yr storm and pass the 100-yr storm without overtopping the berm.

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) =	48	
Circumference of Riser (in) =	150.8	
eight of Riser from bottom of barrel (in) =	64	From Hydrograph
Vertical spacing between holes (in) =	0	center to center
Water Stage increment (ft)	0.05	

Orifice Equation

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

Ref 1, p III-11

Q = cfs, discharge

C_d = 0.6 coefficient of discharge

A = sf, cross sectional area

g = 32.2 ft/sec^2, gravity

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

			Perforations			Skimmer	
Row	1	2	3	4	5	2	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.00	0.00
0.39	0.00	0.00	0.00			0.00	0.00
0.44	0.00	0.00	0.00			0.88	0.88
0.49	0.00	0.00	0.00			0.88	0.88
0.54	0.00	0.00	0.00			0.88	0.88
0.59	0.00	0.00	0.00			0.88	0.88
0.64	0.00	0.00	0.00			0.88	0.88
0.69	0.00	0.00	0.00			0.88	0.88
0.74	0.00	0.00	0.00			0.88	0.88
0.79	0.00	0.00	0.00			0.88	0.88
0.84	0.00	0.00	0.00			0.88	0.88
0.89	0.00	0.00	0.00			0.88	0.88
0.94	0.00	0.00	0.00			0.88	0.88
0.99	0.00	0.00	0.00			0.88	0.88
1.04	0.00	0.00	0.00			0.88	0.88
1.09	0.00	0.00	0.00			0.88	0.88
1.14	0.00	0.00	0.00			0.88	0.88
1.19	0.00	0.00	0.00			0.88	0.88
1.24	0.00	0.00	0.00			0.88	0.88
1.29	0.00	0.00	0.00			0.88	0.88
1.34	0.00	0.00	0.00			0.88	0.88
1.39	0.00	0.00	0.00			0.88	0.88
1.44	0.00	0.00	0.00			0.88	0.88
1.49	0.00	0.00	0.00			0.88	0.88
1.54	0.00	0.00	0.00			0.88	0.88
1.59	0.00	0.00	0.00			0.88	0.88

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.88	0.88
1.69	0.00	0.00	0.00	0.88	0.88
1.74	0.00	0.00	0.00	0.88	0.88
1.79	0.00	0.00	0.00	0.88	0.88
1.84	0.00	0.00	0.00	0.88	0.88
1.89	0.00	0.00	0.00	0.88	0.88
1.94	0.00	0.00	0.00	0.88	0.88
1.99	0.00	0.00	0.00	0.88	0.88
2.04	0.00	0.00	0.00	0.88	0.88
2.09	0.00	0.00	0.00	0.88	0.88
2.14	0.00	0.00	0.00	0.88	0.88
2.19	0.00	0.00	0.00	0.88	0.88
2.24	0.00	0.00	0.00	0.88	0.88
2.29	0.00	0.00	0.00	0.88	0.88
2.34	0.00	0.00	0.00	0.88	0.88
2.39	0.00	0.00	0.00	0.88	0.88
2.44	0.00	0.00	0.00	0.88	0.88
2.49	0.00	0.00	0.00	0.88	0.88
2.54	0.00	0.00	0.00	0.88	0.88
2.59	0.00	0.00	0.00	0.88	0.88
2.64	0.00	0.00	0.00	0.88	0.88
2.69	0.00	0.00	0.00	0.88	0.88
2.74	0.00	0.00	0.00	0.88	0.88
2.79	0.00	0.00	0.00	0.88	0.88
2.84	0.00	0.00	0.00	0.88	0.88
2.89	0.00	0.00	0.00	0.88	0.88
2.94	0.00	0.00	0.00	0.88	0.88
2.99	0.00	0.00	0.00	0.88	0.88
3.04	0.00	0.00	0.00	0.88	0.88
3.09	0.00	0.00	0.00	0.88	0.88
3.14	0.00	0.00	0.00	0.88	0.88
3.19	0.00	0.00	0.00	0.88	0.88
3.24	0.00	0.00	0.00	0.88	0.88
3.29	0.00	0.00	0.00	0.88	0.88
3.34	0.00	0.00	0.00	0.88	0.88
3.39	0.00	0.00	0.00	0.88	0.88
3.44	0.00	0.00	0.00	0.88	0.88
3.49	0.00	0.00	0.00	0.88	0.88
3.54	0.00	0.00	0.00	0.88	0.88
3.59	0.00	0.00	0.00	0.88	0.88
3.64	0.00	0.00	0.00	0.88	0.88
3.69	0.00	0.00	0.00	0.88	0.88
3.74	0.00	0.00	0.00	0.88	0.88
3.79	0.00	0.00	0.00	0.88	0.88
3.84	0.00	0.00	0.00	0.88	0.88
3.89	0.00	0.00	0.00	0.88	0.88
3.94	0.00	0.00	0.00	0.88	0.88
3.99	0.00	0.00	0.00	0.88	0.88

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of _2_

Sediment Basin # 5 Colon

Phase 1

10 - year Storm Event

Qp = 301.78 cfs
Tp = 28.73 minutes
dT = Max of 2 minutes
or 1.0% of increment to peak

b = 1.1
K_s = 114,650

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 3.3 (ft)
Height of Riser from bottom of barrel= 5.3 (ft) elevation 260.30
Emergency Spillway = 6.0 (ft) elevation 261.00
Total Height of Dam = 7.0 (ft) elevation 262.00
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 48 (in)
Permanent Pond Stage = 0 (ft) elevation 255.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
5.3 ft Maximum Stage 260.29 msl elevation
1.8 cfs Peak outflow
1.8 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

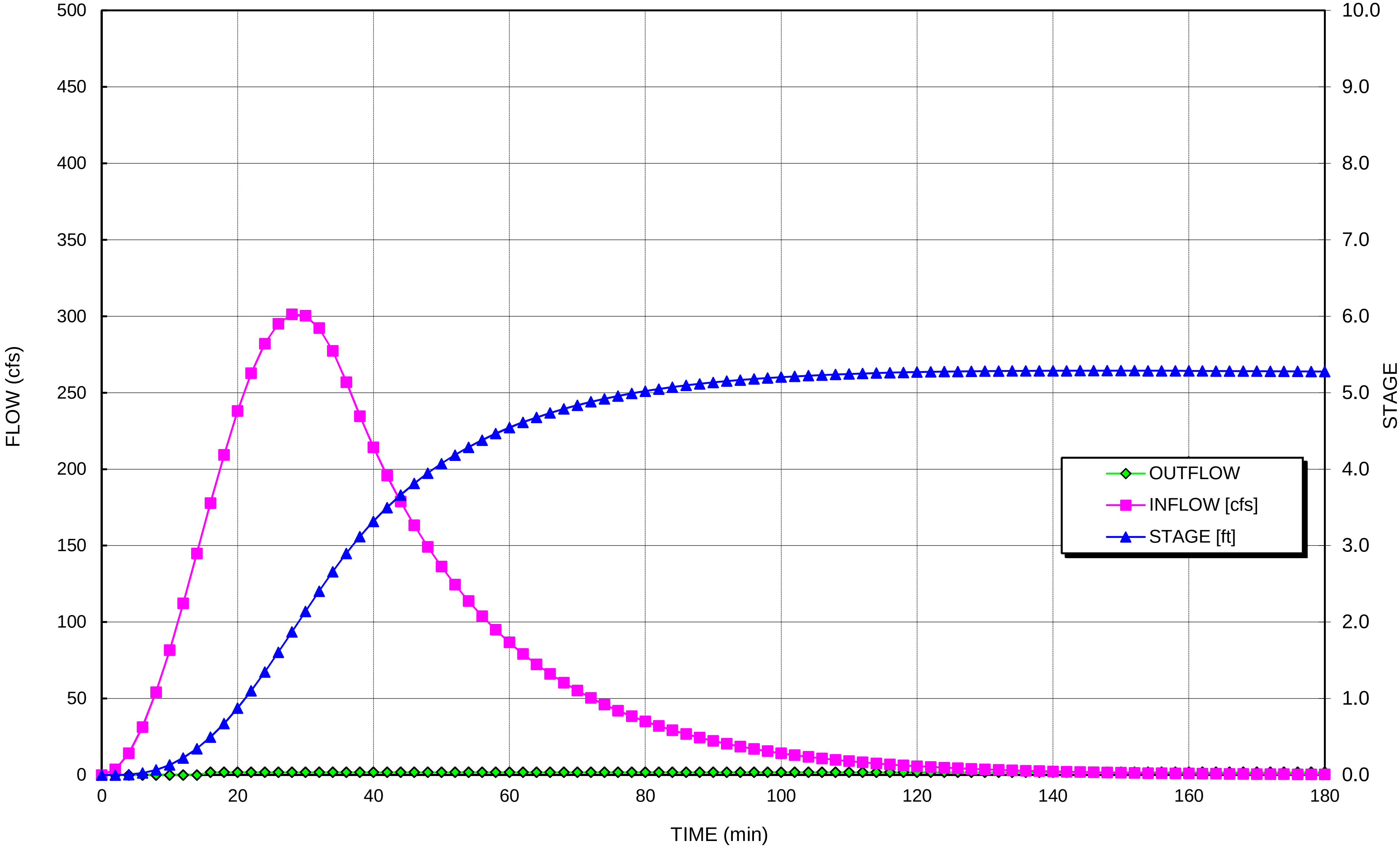
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	3.6	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	14.2	431	0.0	0.00	0.00	0.00	0.00	0.00	170.58	77,537	N/A
6	31.3	2,136	0.0	0.00	0.00	0.00	0.00	0.00	195.81	89,003	N/A
8	54.1	5,895	0.1	0.00	0.00	0.00	0.00	0.00	213.72	97,144	N/A
10	81.6	12,393	0.1	0.00	0.00	0.00	0.00	0.00	227.85	103,570	N/A
12	112.3	22,181	0.2	0.00	0.00	0.00	0.00	0.00	239.58	108,900	N/A
14	144.9	35,658	0.3	0.00	0.00	0.00	0.00	0.00	249.59	113,449	N/A
16	177.7	53,042	0.5	0.88	0.88	0.00	0.88	1.77	258.28	117,400	100%
18	209.3	74,157	0.7	0.88	0.88	0.00	0.88	1.77	265.85	120,840	100%
20	238.1	99,061	0.9	0.88	0.88	0.00	0.88	1.77	272.57	123,895	100%
22	262.7	127,420	1.1	0.88	0.88	0.00	0.88	1.77	278.55	126,613	100%
24	282.0	158,736	1.3	0.88	0.88	0.00	0.88	1.77	283.88	129,034	100%
26	295.1	192,369	1.6	0.88	0.88	0.00	0.88	1.77	288.62	131,190	100%
28	301.3	227,570	1.9	0.88	0.88	0.00	0.88	1.77	292.83	133,104	100%
30	300.3	263,514	2.1	0.88	0.88	0.00	0.88	1.77	296.55	134,798	100%
32	292.2	299,341	2.4	0.88	0.88	0.00	0.88	1.77	299.83	136,287	100%
34	277.4	334,197	2.7	0.88	0.88	0.00	0.88	1.77	302.69	137,587	100%
36	256.9	367,275	2.9	0.88	0.88	0.00	0.88	1.77	305.16	138,711	100%
38	234.7	397,889	3.1	0.88	0.88	0.00	0.88	1.77	307.28	139,672	100%
40	214.4	425,835	3.3	0.88	0.88	0.00	0.88	1.77	309.08	140,492	100%
42	195.8	451,346	3.5	0.88	0.88	0.00	0.88	1.77	310.64	141,198	100%
44	178.9	474,630	3.7	0.88	0.88	0.00	0.88	1.77	311.99	141,812	100%
46	163.4	495,882	3.8	0.88	0.88	0.00	0.88	1.77	313.17	142,348	100%
48	149.3	515,277	3.9	0.88	0.88	0.00	0.88	1.77	314.20	142,820	100%
50	136.3	532,975	4.1	0.88	0.88	0.00	0.88	1.77	315.12	143,236	100%
52	124.5	549,123	4.2	0.88	0.88	0.00	0.88	1.77	315.93	143,605	100%
54	113.8	563,856	4.3	0.88	0.88	0.00	0.88	1.77	316.65	143,933	100%
56	103.9	577,296	4.4	0.88	0.88	0.00	0.88	1.77	317.30	144,226	100%
58	94.9	589,555	4.5	0.88	0.88	0.00	0.88	1.77	317.87	144,487	100%
60	86.7	600,734	4.5	0.88	0.88	0.00	0.88	1.77	318.39	144,722	100%
62	79.2	610,928	4.6	0.88	0.88	0.00	0.88	1.77	318.85	144,932	100%
64	72.4	620,222	4.7	0.88	0.88	0.00	0.88	1.77	319.26	145,120	100%
66	66.1	628,693	4.7	0.88	0.88	0.00	0.88	1.77	319.64	145,290	100%
68	60.4	636,413	4.8	0.88	0.88	0.00	0.88	1.77	319.97	145,443	100%
70	55.2	643,447	4.8	0.88	0.88	0.00	0.88	1.77	320.28	145,581	100%
72	50.4	649,854	4.9	0.88	0.88	0.00	0.88	1.77	320.55	145,705	100%
74	46.0	655,688	4.9	0.88	0.88	0.00	0.88	1.77	320.80	145,818	100%
76	42.0	660,998	5.0	0.88	0.88	0.00	0.88	1.77	321.02	145,919	100%
78	38.4	665,832	5.0	0.88	0.88	0.00	0.88	1.77	321.22	146,011	100%
80	35.1	670,228	5.0	0.88	0.88	0.00	0.88	1.77	321.41	146,094	100%
82	32.0	674,226	5.0	0.88	0.88	0.00	0.88	1.77	321.57	146,169	100%

84	29.3	677,859	5.1	0.88	0.88	0.00	0.88	1.77	321.72	146,236	100%
86	26.7	681,160	5.1	0.88	0.88	0.00	0.88	1.77	321.85	146,298	100%
88	24.4	684,157	5.1	0.88	0.88	0.00	0.88	1.77	321.98	146,353	100%
90	22.3	686,876	5.1	0.88	0.88	0.00	0.88	1.77	322.09	146,403	100%
92	20.4	689,342	5.2	0.88	0.88	0.00	0.88	1.77	322.19	146,448	100%
94	18.6	691,576	5.2	0.88	0.88	0.00	0.88	1.77	322.28	146,489	100%
96	17.0	693,598	5.2	0.88	0.88	0.00	0.88	1.77	322.36	146,526	100%
98	15.5	695,427	5.2	0.88	0.88	0.00	0.88	1.77	322.43	146,559	100%
100	14.2	697,080	5.2	0.88	0.88	0.00	0.88	1.77	322.50	146,589	100%
102	13.0	698,571	5.2	0.88	0.88	0.00	0.88	1.77	322.56	146,616	100%
104	11.8	699,915	5.2	0.88	0.88	0.00	0.88	1.77	322.61	146,641	100%
106	10.8	701,124	5.2	0.88	0.88	0.00	0.88	1.77	322.66	146,662	100%
108	9.9	702,210	5.2	0.88	0.88	0.00	0.88	1.77	322.70	146,682	100%
110	9.0	703,184	5.2	0.88	0.88	0.00	0.88	1.77	322.74	146,699	100%
112	8.2	704,055	5.3	0.88	0.88	0.00	0.88	1.77	322.77	146,715	100%
114	7.5	704,833	5.3	0.88	0.88	0.00	0.88	1.77	322.80	146,729	100%
116	6.9	705,525	5.3	0.88	0.88	0.00	0.88	1.77	322.83	146,741	100%
118	6.3	706,138	5.3	0.88	0.88	0.00	0.88	1.77	322.86	146,752	100%
120	5.7	706,681	5.3	0.88	0.88	0.00	0.88	1.77	322.88	146,762	100%
122	5.2	707,158	5.3	0.88	0.88	0.00	0.88	1.77	322.90	146,771	100%
124	4.8	707,575	5.3	0.88	0.88	0.00	0.88	1.77	322.91	146,778	100%
126	4.4	707,938	5.3	0.88	0.88	0.00	0.88	1.77	322.93	146,785	100%
128	4.0	708,251	5.3	0.88	0.88	0.00	0.88	1.77	322.94	146,790	100%
130	3.7	708,519	5.3	0.88	0.88	0.00	0.88	1.77	322.95	146,795	100%
132	3.3	708,745	5.3	0.88	0.88	0.00	0.88	1.77	322.96	146,799	100%
134	3.0	708,934	5.3	0.88	0.88	0.00	0.88	1.77	322.97	146,802	100%
136	2.8	709,087	5.3	0.88	0.88	0.00	0.88	1.77	322.97	146,805	100%
138	2.5	709,209	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,807	100%
140	2.3	709,303	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,809	100%
142	2.1	709,369	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,810	100%
144	1.9	709,412	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,811	100%
146	1.8	709,433	5.3	0.88	0.88	0.00	0.88	1.77	322.99	146,811	100%
148	1.6	709,433	5.3	0.88	0.88	0.00	0.88	1.77	322.99	146,811	100%
150	1.5	709,415	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,811	100%
152	1.3	709,381	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,810	100%
154	1.2	709,331	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,810	100%
156	1.1	709,267	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,808	100%
158	1.0	709,190	5.3	0.88	0.88	0.00	0.88	1.77	322.98	146,807	100%
160	0.9	709,101	5.3	0.88	0.88	0.00	0.88	1.77	322.97	146,805	100%
162	0.9	709,002	5.3	0.88	0.88	0.00	0.88	1.77	322.97	146,804	100%
164	0.8	708,893	5.3	0.88	0.88	0.00	0.88	1.77	322.96	146,802	100%
166	0.7	708,775	5.3	0.88	0.88	0.00	0.88	1.77	322.96	146,800	100%
168	0.7	708,649	5.3	0.88	0.88	0.00	0.88	1.77	322.95	146,797	100%
170	0.6	708,516	5.3	0.88	0.88	0.00	0.88	1.77	322.95	146,795	100%
172	0.5	708,376	5.3	0.88	0.88	0.00	0.88	1.77	322.94	146,793	100%
174	0.5	708,229	5.3	0.88	0.88	0.00	0.88	1.77	322.94	146,790	100%
176	0.5	708,077	5.3	0.88	0.88	0.00	0.88	1.77	322.93	146,787	100%
178	0.4	707,920	5.3	0.88	0.88	0.00	0.88	1.77	322.93	146,784	100%
180	0.4	707,758	5.3	0.88	0.88	0.00	0.88	1.77	322.92	146,781	100%
182	0.3	707,591	5.3	0.88	0.88	0.00	0.88	1.77	322.91	146,778	100%
184	0.3	707,421	5.3	0.88	0.88	0.00	0.88	1.77	322.91	146,775	100%
186	0.3	707,247	5.3	0.88	0.88	0.00	0.88	1.77	322.90	146,772	100%
188	0.3	707,070	5.3	0.88	0.88	0.00	0.88	1.77	322.89	146,769	100%
190	0.2	706,890	5.3	0.88	0.88	0.00	0.88	1.77	322.89	146,766	100%
192	0.2	706,707	5.3	0.88	0.88	0.00	0.88	1.77	322.88	146,763	100%
194	0.2	706,522	5.3	0.88	0.88	0.00	0.88	1.77	322.87	146,759	100%
196	0.2	706,334	5.3	0.88	0.88	0.00	0.88	1.77	322.86	146,756	100%
198	0.2	706,144	5.3	0.88	0.88	0.00	0.88	1.77	322.86	146,753	100%
200	0.2	705,952	5.3	0.88	0.88	0.00	0.88	1.77	322.85	146,749	100%
202	0.1	705,759	5.3	0.88	0.88	0.00	0.88	1.77	322.84	146,746	100%
204	0.1	705,564	5.3	0.88	0.88	0.00	0.88	1.77	322.83	146,742	100%
206	0.1	705,367	5.3	0.88	0.88	0.00	0.88	1.77	322.83	146,739	100%

Sediment Basin #5 Colon Mine Phase 1 Hydrograph
10-Yr Storm



Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1_of __2_

Sediment Basin # 5 Colon

Phase 2

10 - year Storm Event

Qp = 252.52 cfs
Tp = 28.56 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 114,650

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 3.3 (ft)
Height of Riser from bottom of barrel= 5.3 (ft) elevation 260.30
Emergency Spillway = 6 (ft) elevation 261.00
Total Height of Dam = 7 (ft) elevation 262.00
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 48 (in)
Permanent Pond Stage = 0 (ft) elevation 255.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

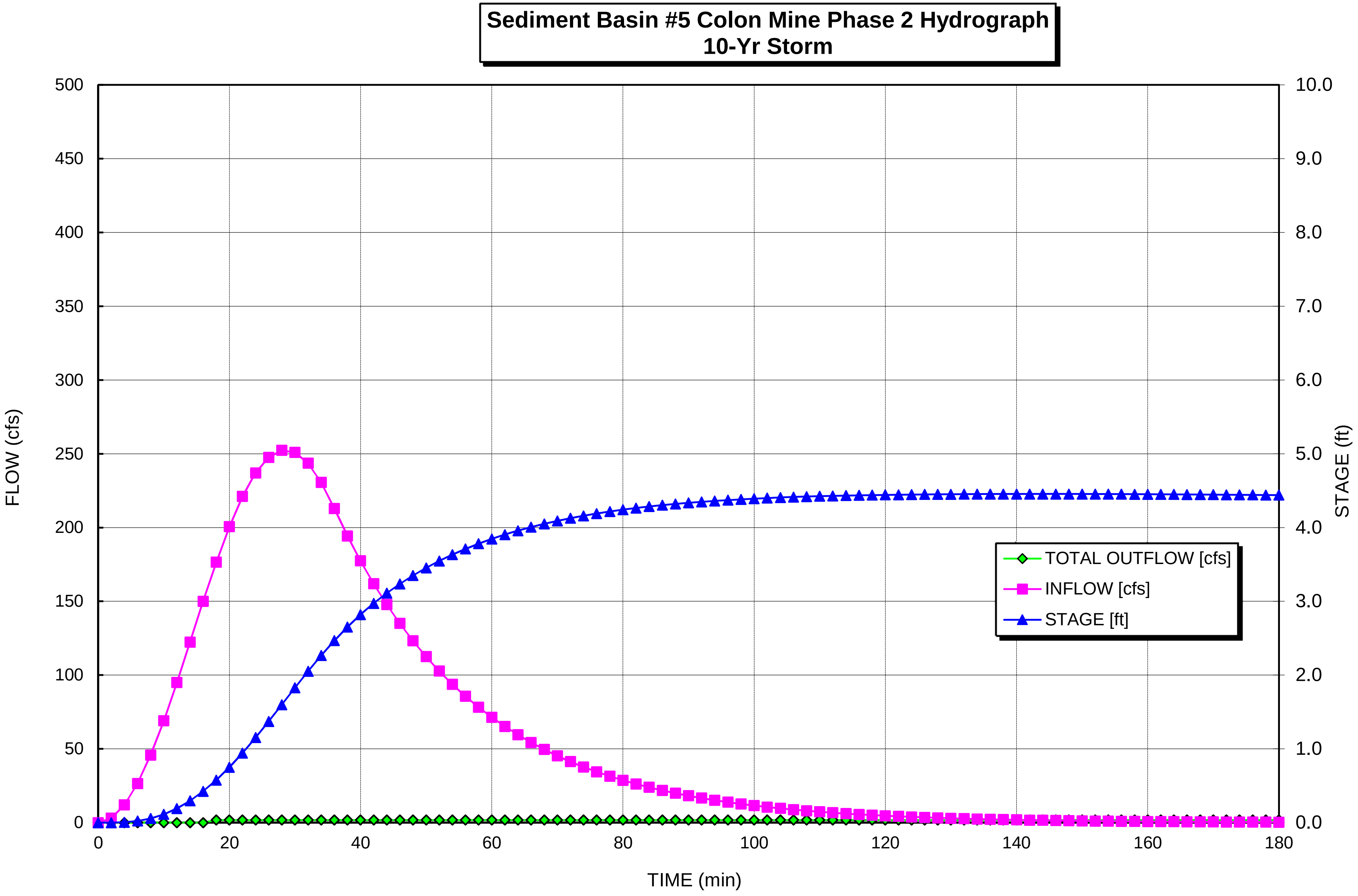
100% Minimum Settling Efficiency
4.5 ft Maximum Stage 259.46 msl elevation
1.8 cfs Peak outflow
1.8 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	3.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	12.0	365	0.0	0.00	0.00	0.00	0.00	0.00	168.15	76,434	N/A
6	26.5	1,809	0.0	0.00	0.00	0.00	0.00	0.00	193.02	87,736	N/A
8	45.8	4,991	0.1	0.00	0.00	0.00	0.00	0.00	210.67	95,759	N/A
10	69.0	10,489	0.1	0.00	0.00	0.00	0.00	0.00	224.60	102,091	N/A
12	94.9	18,769	0.2	0.00	0.00	0.00	0.00	0.00	236.15	107,343	N/A
14	122.4	30,161	0.3	0.00	0.00	0.00	0.00	0.00	246.01	111,823	N/A
16	150.0	44,847	0.4	0.00	0.00	0.00	0.00	0.00	254.57	115,713	N/A
18	176.5	62,850	0.6	0.88	0.88	0.00	0.88	1.77	262.08	119,129	100%
20	200.6	83,819	0.8	0.88	0.88	0.00	0.88	1.77	268.67	122,123	100%
22	221.1	107,677	0.9	0.88	0.88	0.00	0.88	1.77	274.54	124,789	100%
24	237.0	133,993	1.2	0.88	0.88	0.00	0.88	1.77	279.76	127,163	100%
26	247.6	162,218	1.4	0.88	0.88	0.00	0.88	1.77	284.41	129,276	100%
28	252.3	191,713	1.6	0.88	0.88	0.00	0.88	1.77	288.53	131,151	100%
30	250.9	221,774	1.8	0.88	0.88	0.00	0.88	1.77	292.18	132,808	100%
32	243.6	251,675	2.1	0.88	0.88	0.00	0.88	1.77	295.38	134,264	100%
34	230.6	280,692	2.3	0.88	0.88	0.00	0.88	1.77	298.17	135,533	100%
36	212.9	308,147	2.5	0.88	0.88	0.00	0.88	1.77	300.58	136,628	100%
38	194.3	333,478	2.7	0.88	0.88	0.00	0.88	1.77	302.64	137,562	100%
40	177.4	356,585	2.8	0.88	0.88	0.00	0.88	1.77	304.39	138,359	100%
42	162.0	377,663	3.0	0.88	0.88	0.00	0.88	1.77	305.90	139,045	100%
44	147.9	396,889	3.1	0.88	0.88	0.00	0.88	1.77	307.21	139,642	100%
46	135.0	414,423	3.2	0.88	0.88	0.00	0.88	1.77	308.36	140,163	100%
48	123.3	430,413	3.3	0.88	0.88	0.00	0.88	1.77	309.37	140,621	100%
50	112.5	444,993	3.5	0.88	0.88	0.00	0.88	1.77	310.26	141,026	100%
52	102.7	458,285	3.5	0.88	0.88	0.00	0.88	1.77	311.04	141,384	100%
54	93.8	470,403	3.6	0.88	0.88	0.00	0.88	1.77	311.75	141,702	100%
56	85.6	481,447	3.7	0.88	0.88	0.00	0.88	1.77	312.37	141,986	100%
58	78.2	491,512	3.8	0.88	0.88	0.00	0.88	1.77	312.93	142,240	100%
60	71.4	500,683	3.8	0.88	0.88	0.00	0.88	1.77	313.43	142,466	100%
62	65.2	509,037	3.9	0.88	0.88	0.00	0.88	1.77	313.87	142,670	100%
64	59.5	516,646	4.0	0.88	0.88	0.00	0.88	1.77	314.28	142,852	100%
66	54.3	523,574	4.0	0.88	0.88	0.00	0.88	1.77	314.64	143,017	100%
68	49.6	529,881	4.1	0.88	0.88	0.00	0.88	1.77	314.96	143,164	100%
70	45.3	535,621	4.1	0.88	0.88	0.00	0.88	1.77	315.25	143,297	100%
72	41.3	540,842	4.1	0.88	0.88	0.00	0.88	1.77	315.52	143,417	100%
74	37.7	545,591	4.2	0.88	0.88	0.00	0.88	1.77	315.76	143,525	100%
76	34.5	549,908	4.2	0.88	0.88	0.00	0.88	1.77	315.97	143,623	100%
78	31.5	553,831	4.2	0.88	0.88	0.00	0.88	1.77	316.16	143,711	100%
80	28.7	557,395	4.2	0.88	0.88	0.00	0.88	1.77	316.34	143,790	100%
82	26.2	560,629	4.3	0.88	0.88	0.00	0.88	1.77	316.50	143,862	100%
84	23.9	563,564	4.3	0.88	0.88	0.00	0.88	1.77	316.64	143,927	100%

86	21.9	566,225	4.3	0.88	0.88	0.00	0.88	1.77	316.77	143,985	100%
88	20.0	568,636	4.3	0.88	0.88	0.00	0.88	1.77	316.88	144,038	100%
90	18.2	570,818	4.3	0.88	0.88	0.00	0.88	1.77	316.99	144,086	100%
92	16.6	572,793	4.3	0.88	0.88	0.00	0.88	1.77	317.08	144,129	100%
94	15.2	574,577	4.4	0.88	0.88	0.00	0.88	1.77	317.17	144,167	100%
96	13.9	576,187	4.4	0.88	0.88	0.00	0.88	1.77	317.24	144,202	100%
98	12.7	577,639	4.4	0.88	0.88	0.00	0.88	1.77	317.31	144,233	100%
100	11.6	578,946	4.4	0.88	0.88	0.00	0.88	1.77	317.38	144,261	100%
102	10.6	580,121	4.4	0.88	0.88	0.00	0.88	1.77	317.43	144,287	100%
104	9.6	581,175	4.4	0.88	0.88	0.00	0.88	1.77	317.48	144,309	100%
106	8.8	582,119	4.4	0.88	0.88	0.00	0.88	1.77	317.52	144,329	100%
108	8.0	582,962	4.4	0.88	0.88	0.00	0.88	1.77	317.56	144,347	100%
110	7.3	583,714	4.4	0.88	0.88	0.00	0.88	1.77	317.60	144,363	100%
112	6.7	584,381	4.4	0.88	0.88	0.00	0.88	1.77	317.63	144,378	100%
114	6.1	584,972	4.4	0.88	0.88	0.00	0.88	1.77	317.66	144,390	100%
116	5.6	585,494	4.4	0.88	0.88	0.00	0.88	1.77	317.68	144,401	100%
118	5.1	585,951	4.4	0.88	0.88	0.00	0.88	1.77	317.70	144,411	100%
120	4.6	586,350	4.4	0.88	0.88	0.00	0.88	1.77	317.72	144,420	100%
122	4.2	586,696	4.4	0.88	0.88	0.00	0.88	1.77	317.74	144,427	100%
124	3.9	586,994	4.4	0.88	0.88	0.00	0.88	1.77	317.75	144,433	100%
126	3.5	587,247	4.4	0.88	0.88	0.00	0.88	1.77	317.76	144,439	100%
128	3.2	587,460	4.5	0.88	0.88	0.00	0.88	1.77	317.77	144,443	100%
130	2.9	587,635	4.5	0.88	0.88	0.00	0.88	1.77	317.78	144,447	100%
132	2.7	587,777	4.5	0.88	0.88	0.00	0.88	1.77	317.79	144,450	100%
134	2.5	587,888	4.5	0.88	0.88	0.00	0.88	1.77	317.79	144,452	100%
136	2.2	587,971	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,454	100%
138	2.0	588,029	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,455	100%
140	1.9	588,063	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,456	100%
142	1.7	588,075	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,456	100%
144	1.6	588,068	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,456	100%
146	1.4	588,044	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,455	100%
148	1.3	588,002	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,455	100%
150	1.2	587,946	4.5	0.88	0.88	0.00	0.88	1.77	317.80	144,453	100%
152	1.1	587,877	4.5	0.88	0.88	0.00	0.88	1.77	317.79	144,452	100%
154	1.0	587,795	4.5	0.88	0.88	0.00	0.88	1.77	317.79	144,450	100%
156	0.9	587,702	4.5	0.88	0.88	0.00	0.88	1.77	317.79	144,448	100%
158	0.8	587,598	4.5	0.88	0.88	0.00	0.88	1.77	317.78	144,446	100%
160	0.8	587,485	4.5	0.88	0.88	0.00	0.88	1.77	317.78	144,444	100%
162	0.7	587,363	4.5	0.88	0.88	0.00	0.88	1.77	317.77	144,441	100%
164	0.6	587,234	4.4	0.88	0.88	0.00	0.88	1.77	317.76	144,438	100%
166	0.6	587,097	4.4	0.88	0.88	0.00	0.88	1.77	317.76	144,435	100%
168	0.5	586,954	4.4	0.88	0.88	0.00	0.88	1.77	317.75	144,432	100%
170	0.5	586,805	4.4	0.88	0.88	0.00	0.88	1.77	317.74	144,429	100%
172	0.4	586,650	4.4	0.88	0.88	0.00	0.88	1.77	317.74	144,426	100%
174	0.4	586,491	4.4	0.88	0.88	0.00	0.88	1.77	317.73	144,422	100%
176	0.4	586,326	4.4	0.88	0.88	0.00	0.88	1.77	317.72	144,419	100%
178	0.3	586,158	4.4	0.88	0.88	0.00	0.88	1.77	317.71	144,415	100%
180	0.3	585,986	4.4	0.88	0.88	0.00	0.88	1.77	317.71	144,412	100%
182	0.3	585,810	4.4	0.88	0.88	0.00	0.88	1.77	317.70	144,408	100%
184	0.3	585,632	4.4	0.88	0.88	0.00	0.88	1.77	317.69	144,404	100%
186	0.2	585,450	4.4	0.88	0.88	0.00	0.88	1.77	317.68	144,400	100%
188	0.2	585,266	4.4	0.88	0.88	0.00	0.88	1.77	317.67	144,396	100%
190	0.2	585,079	4.4	0.88	0.88	0.00	0.88	1.77	317.66	144,392	100%
192	0.2	584,890	4.4	0.88	0.88	0.00	0.88	1.77	317.65	144,388	100%
194	0.2	584,699	4.4	0.88	0.88	0.00	0.88	1.77	317.65	144,384	100%
196	0.1	584,506	4.4	0.88	0.88	0.00	0.88	1.77	317.64	144,380	100%
198	0.1	584,312	4.4	0.88	0.88	0.00	0.88	1.77	317.63	144,376	100%
200	0.1	584,116	4.4	0.88	0.88	0.00	0.88	1.77	317.62	144,372	100%
202	0.1	583,919	4.4	0.88	0.88	0.00	0.88	1.77	317.61	144,368	100%
204	0.1	583,720	4.4	0.88	0.88	0.00	0.88	1.77	317.60	144,364	100%


Sediment Basin #5 Colon Mine Phase 2 Hydrograph
10-Yr Storm
FLOW (cfs)
500
450
400
350
300
250
200
150
100
50
0
STAGE (ft)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
120
140
160
180
TIME (min)
TOTAL OUTFLOW [cfs]
INFLOW [cfs]
STAGE [ft]

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of __2__

Sediment Basin # 5 Colon

Phase 2

25 - year Storm Event

Qp = 310.28 cfs
Tp = 28.91 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 114,650

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 3.3 (ft)
Height of Riser from bottom of barrel= 5.3 (ft) elevatior 260.30
Emergency Spillway = 6.0 (ft) elevatior 261.00
Total Height of Dam = 7.0 (ft) elevatior 262.00
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 48 (in)
Permanent Pond Stage = 0 (ft) elevatior 255.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

100% Minimum Settling Efficiency
5.4 ft Maximum Stage 260.4 msl elevation
5.1 cfs Peak outflow
5.1 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

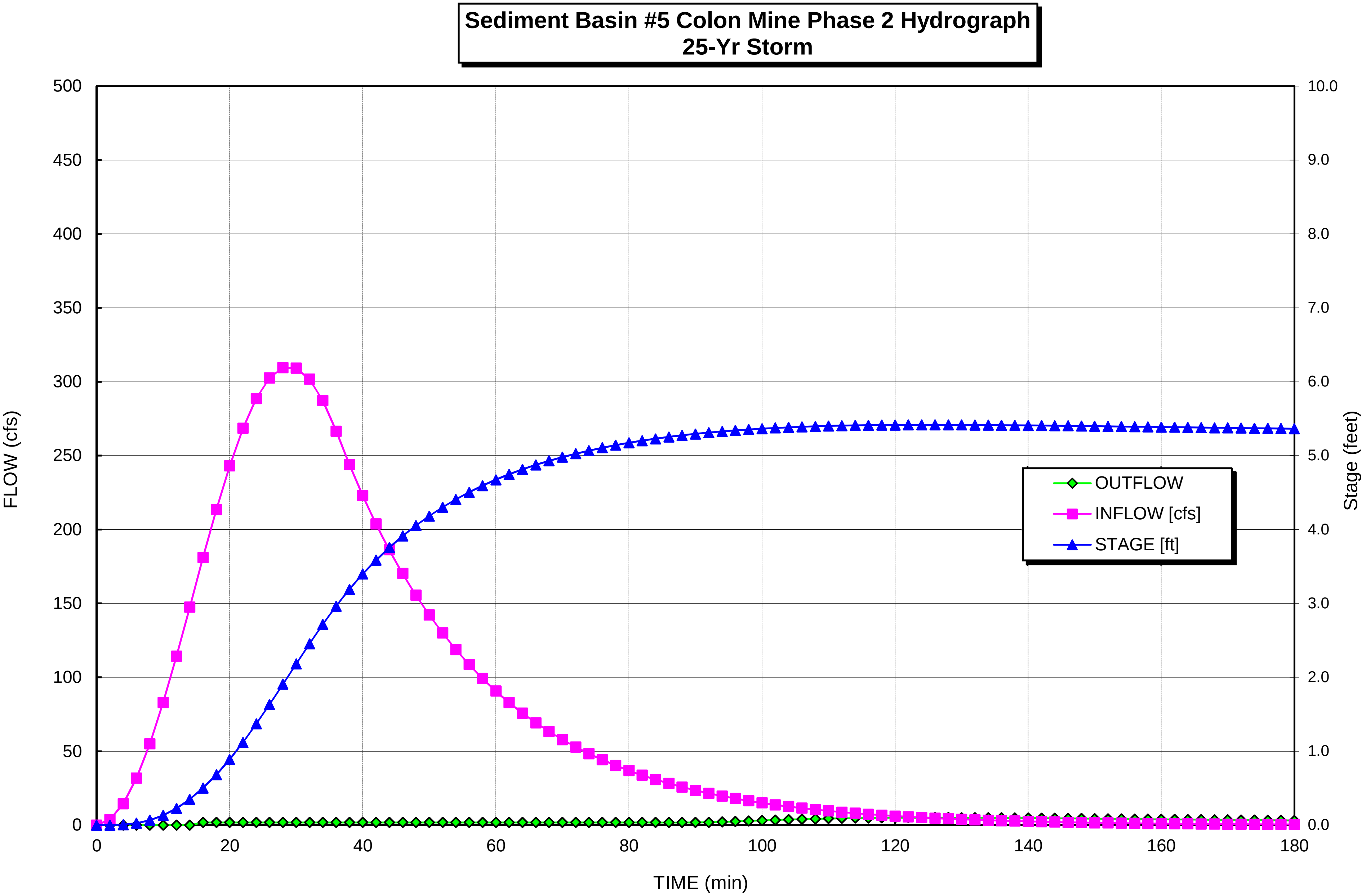
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	3.6	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	14.4	438	0.0	0.00	0.00	0.00	0.00	0.00	170.80	77,638	N/A
6	31.8	2,169	0.0	0.00	0.00	0.00	0.00	0.00	196.06	89,120	N/A
8	55.0	5,987	0.1	0.00	0.00	0.00	0.00	0.00	214.00	97,273	N/A
10	82.9	12,588	0.1	0.00	0.00	0.00	0.00	0.00	228.16	103,709	N/A
12	114.2	22,538	0.2	0.00	0.00	0.00	0.00	0.00	239.91	109,049	N/A
14	147.4	36,244	0.3	0.00	0.00	0.00	0.00	0.00	249.94	113,608	N/A
16	181.0	53,937	0.5	0.88	0.88	0.00	0.88	1.77	258.65	117,569	100%
18	213.4	75,449	0.7	0.88	0.88	0.00	0.88	1.77	266.25	121,021	100%
20	243.0	100,845	0.9	0.88	0.88	0.00	0.88	1.77	272.99	124,086	100%
22	268.5	129,797	1.1	0.88	0.88	0.00	0.88	1.77	278.99	126,815	100%
24	288.7	161,808	1.4	0.88	0.88	0.00	0.88	1.77	284.35	129,248	100%
26	302.6	196,239	1.6	0.88	0.88	0.00	0.88	1.77	289.11	131,415	100%
28	309.5	232,336	1.9	0.88	0.88	0.00	0.88	1.77	293.35	133,342	100%
30	309.2	269,266	2.2	0.88	0.88	0.00	0.88	1.77	297.11	135,049	100%
32	301.6	306,158	2.5	0.88	0.88	0.00	0.88	1.77	300.41	136,552	100%
34	287.2	342,142	2.7	0.88	0.88	0.00	0.88	1.77	303.31	137,866	100%
36	266.5	376,392	3.0	0.88	0.88	0.00	0.88	1.77	305.81	139,005	100%
38	243.9	408,163	3.2	0.88	0.88	0.00	0.88	1.77	307.95	139,979	100%
40	222.9	437,221	3.4	0.88	0.88	0.00	0.88	1.77	309.79	140,812	100%
42	203.8	463,761	3.6	0.88	0.88	0.00	0.88	1.77	311.36	141,529	100%
44	186.2	488,001	3.8	0.88	0.88	0.00	0.88	1.77	312.73	142,152	100%
46	170.2	510,138	3.9	0.88	0.88	0.00	0.88	1.77	313.93	142,696	100%
48	155.6	530,353	4.1	0.88	0.88	0.00	0.88	1.77	314.99	143,175	100%
50	142.2	548,811	4.2	0.88	0.88	0.00	0.88	1.77	315.92	143,598	100%
52	130.0	565,664	4.3	0.88	0.88	0.00	0.88	1.77	316.74	143,973	100%
54	118.8	581,049	4.4	0.88	0.88	0.00	0.88	1.77	317.47	144,306	100%
56	108.6	595,093	4.5	0.88	0.88	0.00	0.88	1.77	318.13	144,604	100%
58	99.2	607,911	4.6	0.88	0.88	0.00	0.88	1.77	318.71	144,870	100%
60	90.7	619,608	4.7	0.88	0.88	0.00	0.88	1.77	319.24	145,108	100%
62	82.9	630,281	4.7	0.88	0.88	0.00	0.88	1.77	319.71	145,322	100%
64	75.8	640,019	4.8	0.88	0.88	0.00	0.88	1.77	320.13	145,514	100%
66	69.3	648,900	4.9	0.88	0.88	0.00	0.88	1.77	320.51	145,687	100%
68	63.3	656,999	4.9	0.88	0.88	0.00	0.88	1.77	320.85	145,843	100%
70	57.9	664,384	5.0	0.88	0.88	0.00	0.88	1.77	321.16	145,983	100%
72	52.9	671,115	5.0	0.88	0.88	0.00	0.88	1.77	321.44	146,110	100%
74	48.3	677,250	5.1	0.88	0.88	0.00	0.88	1.77	321.69	146,225	100%
76	44.2	682,838	5.1	0.88	0.88	0.00	0.88	1.77	321.92	146,329	100%
78	40.4	687,928	5.1	0.88	0.88	0.00	0.88	1.77	322.13	146,422	100%
80	36.9	692,562	5.2	0.88	0.88	0.00	0.88	1.77	322.32	146,507	100%
82	33.7	696,779	5.2	0.88	0.88	0.00	0.88	1.77	322.48	146,584	100%
84	30.8	700,615	5.2	0.88	0.88	0.00	0.88	1.77	322.64	146,653	100%

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __2__of __2__

86	28.2	704,103	5.3	0.88	0.88	0.00	0.88	1.77	322.78	146,716	100%
88	25.8	707,273	5.3	0.88	0.88	0.00	0.88	1.77	322.90	146,773	100%
90	23.5	710,152	5.3	0.88	0.88	0.00	0.88	1.77	323.01	146,824	100%
92	21.5	712,765	5.3	0.88	0.93	0.00	31.36	1.86	323.12	146,871	100%
94	19.7	715,124	5.3	0.88	1.07	0.00	31.42	2.13	323.21	146,913	100%
96	18.0	717,228	5.3	0.88	1.23	0.00	31.47	2.46	323.29	146,950	100%
98	16.4	719,090	5.4	0.88	1.40	0.00	31.51	2.80	323.36	146,983	100%
100	15.0	720,725	5.4	0.88	1.57	0.00	31.55	3.14	323.43	147,011	100%
102	13.7	722,150	5.4	0.88	1.73	0.00	31.59	3.46	323.48	147,036	100%
104	12.5	723,382	5.4	0.88	1.88	0.00	31.62	3.75	323.53	147,058	100%
106	11.5	724,437	5.4	0.88	2.01	0.00	31.64	4.02	323.57	147,077	100%
108	10.5	725,332	5.4	0.88	2.12	0.00	31.67	4.25	323.60	147,092	100%
110	9.6	726,080	5.4	0.88	2.22	0.00	31.68	4.44	323.63	147,105	100%
112	8.8	726,696	5.4	0.88	2.31	0.00	31.70	4.61	323.66	147,116	100%
114	8.0	727,193	5.4	0.88	2.38	0.00	31.71	4.75	323.67	147,125	100%
116	7.3	727,583	5.4	0.88	2.43	0.00	31.72	4.86	323.69	147,131	100%
118	6.7	727,878	5.4	0.88	2.47	0.00	31.73	4.94	323.70	147,137	100%
120	6.1	728,087	5.4	0.88	2.50	0.00	31.73	5.00	323.71	147,140	100%
122	5.6	728,220	5.4	0.88	2.52	0.00	31.74	5.04	323.71	147,143	100%
124	5.1	728,285	5.4	0.88	2.53	0.00	31.74	5.06	323.72	147,144	100%
126	4.7	728,290	5.4	0.88	2.53	0.00	31.74	5.06	323.72	147,144	100%
128	4.3	728,243	5.4	0.88	2.52	0.00	31.74	5.05	323.71	147,143	100%
130	3.9	728,148	5.4	0.88	2.51	0.00	31.74	5.02	323.71	147,141	100%
132	3.6	728,014	5.4	0.88	2.49	0.00	31.73	4.98	323.71	147,139	100%
134	3.3	727,843	5.4	0.88	2.47	0.00	31.73	4.93	323.70	147,136	100%
136	3.0	727,642	5.4	0.88	2.44	0.00	31.72	4.88	323.69	147,132	100%
138	2.7	727,414	5.4	0.88	2.41	0.00	31.72	4.81	323.68	147,129	100%
140	2.5	727,163	5.4	0.88	2.37	0.00	31.71	4.74	323.67	147,124	100%
142	2.3	726,892	5.4	0.88	2.33	0.00	31.70	4.67	323.66	147,119	100%
144	2.1	726,605	5.4	0.88	2.29	0.00	31.70	4.59	323.65	147,114	100%
146	1.9	726,304	5.4	0.88	2.25	0.00	31.69	4.51	323.64	147,109	100%
148	1.7	725,991	5.4	0.88	2.21	0.00	31.68	4.42	323.63	147,104	100%
150	1.6	725,668	5.4	0.88	2.17	0.00	31.67	4.33	323.62	147,098	100%
152	1.4	725,339	5.4	0.88	2.12	0.00	31.67	4.25	323.60	147,092	100%
154	1.3	725,003	5.4	0.88	2.08	0.00	31.66	4.16	323.59	147,086	100%
156	1.2	724,662	5.4	0.88	2.04	0.00	31.65	4.07	323.58	147,080	100%
158	1.1	724,319	5.4	0.88	1.99	0.00	31.64	3.99	323.56	147,074	100%
160	1.0	723,974	5.4	0.88	1.95	0.00	31.63	3.90	323.55	147,068	100%
162	0.9	723,627	5.4	0.88	1.91	0.00	31.62	3.81	323.54	147,062	100%
164	0.8	723,281	5.4	0.88	1.86	0.00	31.62	3.73	323.52	147,056	100%
166	0.8	722,935	5.4	0.88	1.82	0.00	31.61	3.64	323.51	147,050	100%
168	0.7	722,590	5.4	0.88	1.78	0.00	31.60	3.56	323.50	147,044	100%
170	0.6	722,247	5.4	0.88	1.74	0.00	31.59	3.48	323.48	147,038	100%
172	0.6	721,907	5.4	0.88	1.70	0.00	31.58	3.40	323.47	147,032	100%
174	0.5	721,569	5.4	0.88	1.66	0.00	31.57	3.33	323.46	147,026	100%
176	0.5	721,235	5.4	0.88	1.63	0.00	31.57	3.25	323.44	147,020	100%
178	0.5	720,904	5.4	0.88	1.59	0.00	31.56	3.18	323.43	147,015	100%
180	0.4	720,576	5.4	0.88	1.55	0.00	31.55	3.11	323.42	147,009	100%
182	0.4	720,253	5.4	0.88	1.52	0.00	31.54	3.04	323.41	147,003	100%
184	0.3	719,933	5.4	0.88	1.49	0.00	31.53	2.97	323.39	146,997	100%
186	0.3	719,617	5.4	0.88	1.45	0.00	31.53	2.91	323.38	146,992	100%
188	0.3	719,306	5.4	0.88	1.42	0.00	31.52	2.85	323.37	146,986	100%
190	0.3	718,999	5.4	0.88	1.39	0.00	31.51	2.79	323.36	146,981	100%
192	0.2	718,696	5.4	0.88	1.36	0.00	31.50	2.73	323.35	146,976	100%
194	0.2	718,398	5.3	0.88	1.34	0.00	31.50	2.67	323.33	146,970	100%
196	0.2	718,103	5.3	0.88	1.31	0.00	31.49	2.62	323.32	146,965	100%
198	0.2	717,814	5.3	0.88	1.28	0.00	31.48	2.56	323.31	146,960	100%
200	0.2	717,528	5.3	0.88	1.26	0.00	31.47	2.51	323.30	146,955	100%
202	0.2	717,247	5.3	0.88	1.23	0.00	31.47	2.46	323.29	146,950	100%
204	0.1	716,969	5.3	0.88	1.21	0.00	31.46	2.42	323.28	146,945	100%
206	0.1	716,696	5.3	0.88	1.19	0.00	31.45	2.37	323.27	146,940	100%



Sediment Basin #5 Colon Mine Phase 2 Hydrograph
25-Yr Storm

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of __2___

Sediment Basin # 5 Colon

Phase 2

100 - year Storm Event

Qp = 402.1 cfs
Tp = 29.4 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 114,650

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 3.3 (ft)
Height of Riser from bottom of barrel= 5.3 (ft) elevation 260.30
Emergency Spillway = 6.0 (ft) elevation 261.00
Total Height of Dam = 7.0 (ft) elevation 262.00
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 48 (in)
Permanent Pond Stage = 0 (ft) elevation 255.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

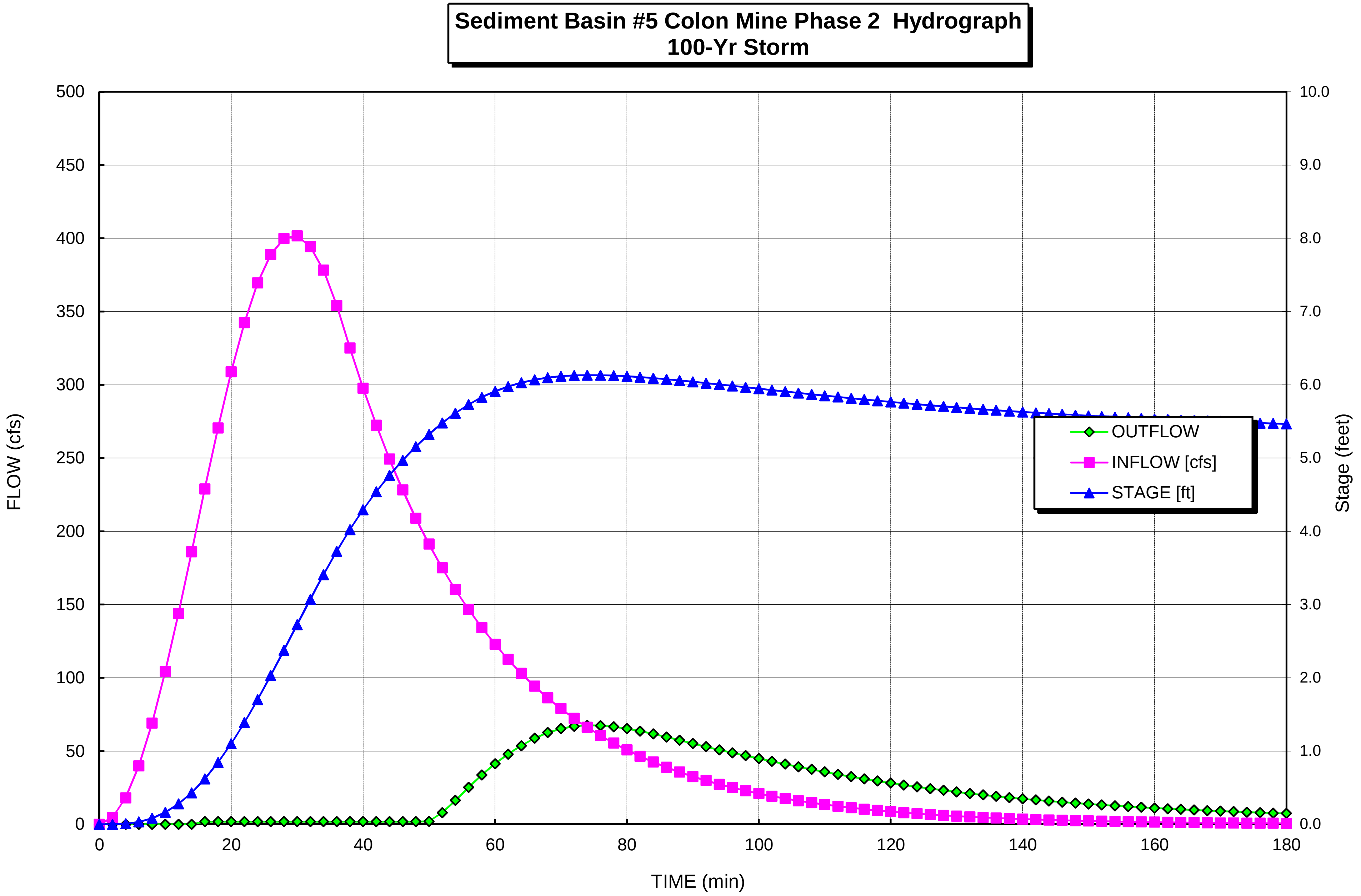
97% Minimum Settling Efficiency
6.1 ft Maximum Stage 261.1 msl elevation
67.5 cfs Peak outflow
64.7 cfs Peak Riser/Barrel outflow
2.9 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	4.6	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	18.1	549	0.0	0.00	0.00	0.00	0.00	0.00	174.16	79,166	N/A
6	39.9	2,719	0.0	0.00	0.00	0.00	0.00	0.00	199.93	90,876	N/A
8	69.1	7,511	0.1	0.00	0.00	0.00	0.00	0.00	218.23	99,193	N/A
10	104.3	15,802	0.2	0.00	0.00	0.00	0.00	0.00	232.68	105,762	N/A
12	143.8	28,315	0.3	0.00	0.00	0.00	0.00	0.00	244.67	111,216	N/A
14	186.0	45,576	0.4	0.00	0.00	0.00	0.00	0.00	254.92	115,874	N/A
16	228.9	67,900	0.6	0.88	0.88	0.00	0.88	1.77	263.84	119,926	100%
18	270.5	95,154	0.8	0.88	0.88	0.00	0.88	1.77	271.62	123,466	100%
20	308.9	127,401	1.1	0.88	0.88	0.00	0.88	1.77	278.55	126,611	100%
22	342.4	164,259	1.4	0.88	0.88	0.00	0.88	1.77	284.71	129,415	100%
24	369.5	205,141	1.7	0.88	0.88	0.00	0.88	1.77	290.22	131,919	100%
26	389.0	249,274	2.0	0.88	0.88	0.00	0.88	1.77	295.14	134,154	100%
28	399.8	295,737	2.4	0.88	0.88	0.00	0.88	1.77	299.52	136,145	100%
30	401.7	343,506	2.7	0.88	0.88	0.00	0.88	1.77	303.41	137,914	100%
32	394.4	391,494	3.1	0.88	0.88	0.00	0.88	1.77	306.85	139,477	100%
34	378.3	438,606	3.4	0.88	0.88	0.00	0.88	1.77	309.87	140,850	100%
36	354.1	483,786	3.7	0.88	0.88	0.00	0.88	1.77	312.50	142,045	100%
38	325.1	526,066	4.0	0.88	0.88	0.00	0.88	1.77	314.77	143,075	100%
40	297.6	564,868	4.3	0.88	0.88	0.00	0.88	1.77	316.70	143,956	100%
42	272.4	600,369	4.5	0.88	0.88	0.00	0.88	1.77	318.37	144,714	100%
44	249.4	632,846	4.8	0.88	0.88	0.00	0.88	1.77	319.82	145,373	100%
46	228.2	662,557	5.0	0.88	0.88	0.00	0.88	1.77	321.09	145,949	100%
48	208.9	689,735	5.2	0.88	0.88	0.00	0.88	1.77	322.20	146,455	100%
50	191.2	714,594	5.3	0.88	1.03	0.00	31.40	2.06	323.19	146,903	100%
52	175.1	737,297	5.5	0.88	3.99	0.00	31.96	7.97	324.06	147,300	100%
54	160.2	757,347	5.6	0.88	8.16	0.00	32.44	16.33	324.81	147,641	100%
56	146.7	774,616	5.7	0.88	12.59	0.00	32.85	25.19	325.44	147,928	99%
58	134.3	789,195	5.8	0.88	16.83	0.00	33.19	33.67	325.97	148,166	99%
60	122.9	801,267	5.9	0.88	20.66	0.00	33.47	41.31	326.39	148,360	99%
62	112.5	811,057	6.0	0.88	23.95	0.00	33.69	47.89	326.73	148,515	98%
64	103.0	818,810	6.0	0.88	26.67	0.29	33.87	53.62	327.00	148,637	98%
66	94.3	824,732	6.1	0.88	28.81	1.07	34.00	58.69	327.21	148,730	97%
68	86.3	829,001	6.1	0.88	30.39	1.81	34.10	62.59	327.35	148,796	97%
70	79.0	831,844	6.1	0.88	31.46	2.37	34.16	65.28	327.45	148,840	97%
72	72.3	833,487	6.1	0.88	32.08	2.72	34.20	66.88	327.50	148,865	97%
74	66.2	834,137	6.1	0.88	32.33	2.86	34.21	67.51	327.53	148,875	97%
76	60.6	833,976	6.1	0.88	32.26	2.83	34.21	67.35	327.52	148,873	97%
78	55.4	833,163	6.1	0.88	31.96	2.65	34.19	66.56	327.49	148,860	97%
80	50.8	831,829	6.1	0.88	31.45	2.37	34.16	65.27	327.45	148,840	97%
82	46.5	830,087	6.1	0.88	30.79	2.02	34.12	63.61	327.39	148,813	97%
84	42.5	828,029	6.1	0.88	30.03	1.63	34.07	61.69	327.32	148,781	97%

86	38.9	825,729	6.1	0.88	29.18	1.23	34.02	59.58	327.24	148,745	97%
88	35.6	823,250	6.1	0.88	28.27	0.85	33.97	57.38	327.15	148,707	97%
90	32.6	820,640	6.0	0.88	27.32	0.49	33.91	55.14	327.07	148,666	98%
92	29.9	817,938	6.0	0.88	26.36	0.20	33.85	52.91	326.97	148,624	98%
94	27.3	815,170	6.0	0.88	25.38	0.02	33.78	50.77	326.88	148,580	98%
96	25.0	812,357	6.0	0.88	24.40	0.00	33.72	48.79	326.78	148,536	98%
98	22.9	809,504	6.0	0.88	23.41	0.00	33.66	46.83	326.68	148,491	98%
100	21.0	806,633	5.9	0.88	22.44	0.00	33.59	44.88	326.58	148,445	98%
102	19.2	803,763	5.9	0.88	21.48	0.00	33.52	42.96	326.48	148,400	98%
104	17.6	800,910	5.9	0.88	20.54	0.00	33.46	41.08	326.38	148,354	99%
106	16.1	798,088	5.9	0.88	19.62	0.00	33.39	39.25	326.28	148,309	99%
108	14.7	795,307	5.9	0.88	18.74	0.00	33.33	37.47	326.18	148,265	99%
110	13.5	792,576	5.9	0.88	17.88	0.00	33.27	35.76	326.09	148,221	99%
112	12.3	789,902	5.8	0.88	17.05	0.00	33.20	34.10	325.99	148,177	99%
114	11.3	787,289	5.8	0.88	16.26	0.00	33.14	32.51	325.90	148,135	99%
116	10.3	784,742	5.8	0.88	15.49	0.00	33.08	30.99	325.81	148,094	99%
118	9.5	782,263	5.8	0.88	14.76	0.00	33.03	29.53	325.72	148,053	99%
120	8.7	779,855	5.8	0.88	14.07	0.00	32.97	28.14	325.63	148,014	99%
122	7.9	777,517	5.8	0.88	13.40	0.00	32.92	26.81	325.55	147,976	99%
124	7.3	775,251	5.7	0.88	12.77	0.00	32.86	25.54	325.46	147,939	99%
126	6.6	773,057	5.7	0.88	12.17	0.00	32.81	24.33	325.39	147,902	99%
128	6.1	770,933	5.7	0.88	11.59	0.00	32.76	23.18	325.31	147,867	99%
130	5.6	768,880	5.7	0.88	11.05	0.00	32.71	22.09	325.23	147,833	100%
132	5.1	766,897	5.7	0.88	10.53	0.00	32.67	21.06	325.16	147,800	100%
134	4.7	764,981	5.7	0.88	10.04	0.00	32.62	20.07	325.09	147,769	100%
136	4.3	763,131	5.7	0.88	9.57	0.00	32.58	19.14	325.02	147,738	100%
138	3.9	761,346	5.6	0.88	9.13	0.00	32.53	18.26	324.96	147,708	100%
140	3.6	759,624	5.6	0.88	8.71	0.00	32.49	17.42	324.89	147,679	100%
142	3.3	757,962	5.6	0.88	8.31	0.00	32.45	16.62	324.83	147,651	100%
144	3.0	756,360	5.6	0.88	7.93	0.00	32.42	15.87	324.77	147,624	100%
146	2.7	754,816	5.6	0.88	7.58	0.00	32.38	15.15	324.72	147,598	100%
148	2.5	753,327	5.6	0.88	7.24	0.00	32.34	14.47	324.66	147,573	100%
150	2.3	751,891	5.6	0.88	6.92	0.00	32.31	13.83	324.61	147,549	100%
152	2.1	750,507	5.6	0.88	6.61	0.00	32.28	13.22	324.56	147,525	100%
154	1.9	749,172	5.6	0.88	6.32	0.00	32.24	12.65	324.51	147,503	100%
156	1.8	747,885	5.5	0.88	6.05	0.00	32.21	12.10	324.46	147,481	100%
158	1.6	746,645	5.5	0.88	5.79	0.00	32.18	11.58	324.41	147,460	100%
160	1.5	745,449	5.5	0.88	5.55	0.00	32.15	11.09	324.37	147,439	100%
162	1.4	744,295	5.5	0.88	5.31	0.00	32.13	10.62	324.32	147,420	100%
164	1.2	743,182	5.5	0.88	5.09	0.00	32.10	10.18	324.28	147,401	100%
166	1.1	742,109	5.5	0.88	4.88	0.00	32.07	9.76	324.24	147,382	100%
168	1.0	741,073	5.5	0.88	4.68	0.00	32.05	9.37	324.20	147,365	100%
170	0.9	740,073	5.5	0.88	4.49	0.00	32.03	8.99	324.16	147,347	100%
172	0.9	739,108	5.5	0.88	4.32	0.00	32.00	8.63	324.13	147,331	100%
174	0.8	738,177	5.5	0.88	4.15	0.00	31.98	8.29	324.09	147,315	100%
176	0.7	737,277	5.5	0.88	3.98	0.00	31.96	7.97	324.06	147,299	100%
178	0.7	736,409	5.5	0.88	3.83	0.00	31.94	7.66	324.03	147,284	100%
180	0.6	735,569	5.5	0.88	3.69	0.00	31.92	7.37	323.99	147,270	100%
182	0.6	734,758	5.5	0.88	3.55	0.00	31.90	7.09	323.96	147,256	100%
184	0.5	733,974	5.5	0.88	3.42	0.00	31.88	6.83	323.93	147,242	100%
186	0.5	733,215	5.4	0.88	3.29	0.00	31.86	6.58	323.90	147,229	100%
188	0.4	732,482	5.4	0.88	3.17	0.00	31.84	6.34	323.88	147,217	100%
190	0.4	731,772	5.4	0.88	3.06	0.00	31.82	6.12	323.85	147,204	100%
192	0.4	731,085	5.4	0.88	2.95	0.00	31.81	5.90	323.82	147,192	100%
194	0.3	730,420	5.4	0.88	2.85	0.00	31.79	5.69	323.80	147,181	100%
196	0.3	729,776	5.4	0.88	2.75	0.00	31.78	5.50	323.77	147,170	100%
198	0.3	729,152	5.4	0.88	2.66	0.00	31.76	5.31	323.75	147,159	100%
200	0.3	728,548	5.4	0.88	2.57	0.00	31.75	5.14	323.73	147,148	100%
202	0.2	727,962	5.4	0.88	2.48	0.00	31.73	4.97	323.70	147,138	100%
204	0.2	727,393	5.4	0.88	2.40	0.00	31.72	4.81	323.68	147,128	100%


Sediment Basin #5 Colon Mine Phase 2 Hydrograph
100-Yr Storm
FLOW (cfs)
Stage (feet)
TIME (min)
500
450
400
350
300
250
200
150
100
50
0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
120
140
160
180
OUTFLOW
INFLOW [cfs]
STAGE [ft]

HDR Computation

I Job No. 0453925-237673-018 I

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #6	Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1		
Storm Event (yrs) =	10		
Total Drainage Area A (ac) =	15.3		
Disturbed Area (ac) =	15.3		
Curve Number CN =	89	Hydrographs	
Rainfall Depth P (in) =	5.28	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	93.60	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	27,540	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	40,716	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
249	0	30,723	-	-	-
250	1	34,084	32,389	32,389	1,200
251	2	37,519	35,788	68,177	2,525
252	3	41,027	39,260	107,437	3,979
253	4	44,808	42,904	150,340	5,568
254	5	48,997	46,887	197,227	7,305
255	6	52,981	50,976	248,203	9,193

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 107,437 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 41,027 *Required Surface Area Achieved*

HDR Computation

Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #6	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 107,437

Number of Skimmers 1

Days to Drain = 5 *assumed*

Q each (cf/day) = 21,487 0.25 cfs

Selected Skimmer Size (inches) = 5

Head on Skimmer (feet) = 0.333

Diameter of Orifice (inches) = 4.0

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

$S = (1000/CN) - 10$

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase 1

Storm Event (yrs) = 10

S = 1.24

Runoff Depth Q* (inches) = 4.04

Time to Peak T_p (min) = 28.75

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 107,437

Z_2 (ft) = 6 S_2 (cf) = 248,203

$b = \ln(S_2/S_1)/\ln(Z_2/Z_1) =$ 1.2 Ref 2, III-8

$K_S = S_2/Z_2^{\,b} =$ 28,495

HDR Computation

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #6	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20° C — Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v] d^2$ = 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 6.00

Set Top of Dam at (ft) = 7.00

See Hydrograph

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 2

Use Anti-Seep Collar Size (ft) = 2 x 2

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 12 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (lbs/cf) = 62.4

Riser Displacement (cf) = 4.32 $Pi * (D_R/24)^2$ * Total Ht of Riser

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 0.11

Width & Length (ft) = 2

Thickness (ft) = 0.8

Anti-Vortex Device:

Diameter of Riser (in) = 12 From Hydrograph

Cylinder Diameter (in) = 18 — Ref 3, III-104, Table 3.14-D

Cylinder Thickness (gage) = 16

Cylinder Height (in) = 6

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #6	Sheet: 4	Of: 4

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n =	0.069	6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) =	9	Permissible Velocity for lining
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	0.02	Outlet Slope (estimated)
Bottom Width (ft) =	6	6 * Barrel Diameter
Q_B (cfs) =	0.2	Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.2	0.08	0.07	0.5	0.07	0.08	0.5

Flow Depth = Tailwater, d (ft) = 0.07 0.5* Barrel Diameter (ft) = 0.50 Ref 1, 8.06.3

Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe

Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
1	3	10	11	0.3	Class A

Conclusion Temporary basin, the 25 yr and 100 storms were not routed

The basin can contain the 10-yr storm.

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) =	12	
Circumference of Riser (in) =	37.7	
eight of Riser from bottom of barrel (in) =	66	From Hydrograph
Vertical spacing between holes (in) =	0	center to center
Water Stage increment (ft)	0.05	

Orifice Equation

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

Ref 1, p III-11

Q = cfs, discharge

C_d = 0.6 coefficient of discharge

A = sf, cross sectional area

g = 32.2 ft/sec^2, gravity

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

	Perforations					Skimmer	
Row	1	2	3	4	5	1	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.25	0.25
0.39	0.00	0.00	0.00			0.25	0.25
0.44	0.00	0.00	0.00			0.25	0.25
0.49	0.00	0.00	0.00			0.25	0.25
0.54	0.00	0.00	0.00			0.25	0.25
0.59	0.00	0.00	0.00			0.25	0.25
0.64	0.00	0.00	0.00			0.25	0.25
0.69	0.00	0.00	0.00			0.25	0.25
0.74	0.00	0.00	0.00			0.25	0.25
0.79	0.00	0.00	0.00			0.25	0.25
0.84	0.00	0.00	0.00			0.25	0.25
0.89	0.00	0.00	0.00			0.25	0.25
0.94	0.00	0.00	0.00			0.25	0.25
0.99	0.00	0.00	0.00			0.25	0.25
1.04	0.00	0.00	0.00			0.25	0.25
1.09	0.00	0.00	0.00			0.25	0.25
1.14	0.00	0.00	0.00			0.25	0.25
1.19	0.00	0.00	0.00			0.25	0.25
1.24	0.00	0.00	0.00			0.25	0.25
1.29	0.00	0.00	0.00			0.25	0.25
1.34	0.00	0.00	0.00			0.25	0.25
1.39	0.00	0.00	0.00			0.25	0.25
1.44	0.00	0.00	0.00			0.25	0.25
1.49	0.00	0.00	0.00			0.25	0.25
1.54	0.00	0.00	0.00			0.25	0.25
1.59	0.00	0.00	0.00			0.25	0.25

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.25	0.25
1.69	0.00	0.00	0.00	0.25	0.25
1.74	0.00	0.00	0.00	0.25	0.25
1.79	0.00	0.00	0.00	0.25	0.25
1.84	0.00	0.00	0.00	0.25	0.25
1.89	0.00	0.00	0.00	0.25	0.25
1.94	0.00	0.00	0.00	0.25	0.25
1.99	0.00	0.00	0.00	0.25	0.25
2.04	0.00	0.00	0.00	0.25	0.25
2.09	0.00	0.00	0.00	0.25	0.25
2.14	0.00	0.00	0.00	0.25	0.25
2.19	0.00	0.00	0.00	0.25	0.25
2.24	0.00	0.00	0.00	0.25	0.25
2.29	0.00	0.00	0.00	0.25	0.25
2.34	0.00	0.00	0.00	0.25	0.25
2.39	0.00	0.00	0.00	0.25	0.25
2.44	0.00	0.00	0.00	0.25	0.25
2.49	0.00	0.00	0.00	0.25	0.25
2.54	0.00	0.00	0.00	0.25	0.25
2.59	0.00	0.00	0.00	0.25	0.25
2.64	0.00	0.00	0.00	0.25	0.25
2.69	0.00	0.00	0.00	0.25	0.25
2.74	0.00	0.00	0.00	0.25	0.25
2.79	0.00	0.00	0.00	0.25	0.25
2.84	0.00	0.00	0.00	0.25	0.25
2.89	0.00	0.00	0.00	0.25	0.25
2.94	0.00	0.00	0.00	0.25	0.25
2.99	0.00	0.00	0.00	0.25	0.25
3.04	0.00	0.00	0.00	0.25	0.25
3.09	0.00	0.00	0.00	0.25	0.25
3.14	0.00	0.00	0.00	0.25	0.25
3.19	0.00	0.00	0.00	0.25	0.25
3.24	0.00	0.00	0.00	0.25	0.25
3.29	0.00	0.00	0.00	0.25	0.25
3.34	0.00	0.00	0.00	0.25	0.25
3.39	0.00	0.00	0.00	0.25	0.25
3.44	0.00	0.00	0.00	0.25	0.25
3.49	0.00	0.00	0.00	0.25	0.25
3.54	0.00	0.00	0.00	0.25	0.25
3.59	0.00	0.00	0.00	0.25	0.25
3.64	0.00	0.00	0.00	0.25	0.25
3.69	0.00	0.00	0.00	0.25	0.25
3.74	0.00	0.00	0.00	0.25	0.25
3.79	0.00	0.00	0.00	0.25	0.25
3.84	0.00	0.00	0.00	0.25	0.25
3.89	0.00	0.00	0.00	0.25	0.25
3.94	0.00	0.00	0.00	0.25	0.25
3.99	0.00	0.00	0.00	0.25	0.25

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of _2__

Sediment Basin # 6 Colon

Phase 1

10 - year Storm Event

Qp = 93.60 cfs
Tp = 28.75 minutes
dT = Max of 2 minutes
or 1.0% of increment to peak

b = 1.2
K_s = 28,495

Number of Riser/Barrel Assemblies 1
Diameter of Barrel = 12 (in)
Height of Riser above barrel = 4.5 (ft)
Height of Riser from bottom of barrel= 5.5 (ft) elevation 254.50
Emergency Spillway = 6.0 (ft) elevation 255.00
Total Height of Dam = 7.0 (ft) elevation 256.00
Length of Emergency Spillway = 10 (ft)
Diameter of Riser = 12 (in)
Permanent Pond Stage = 0 (ft) elevation 249.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
5.5 ft Maximum Stage 254.48 msl elevation
0.2 cfs Peak outflow
0.2 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

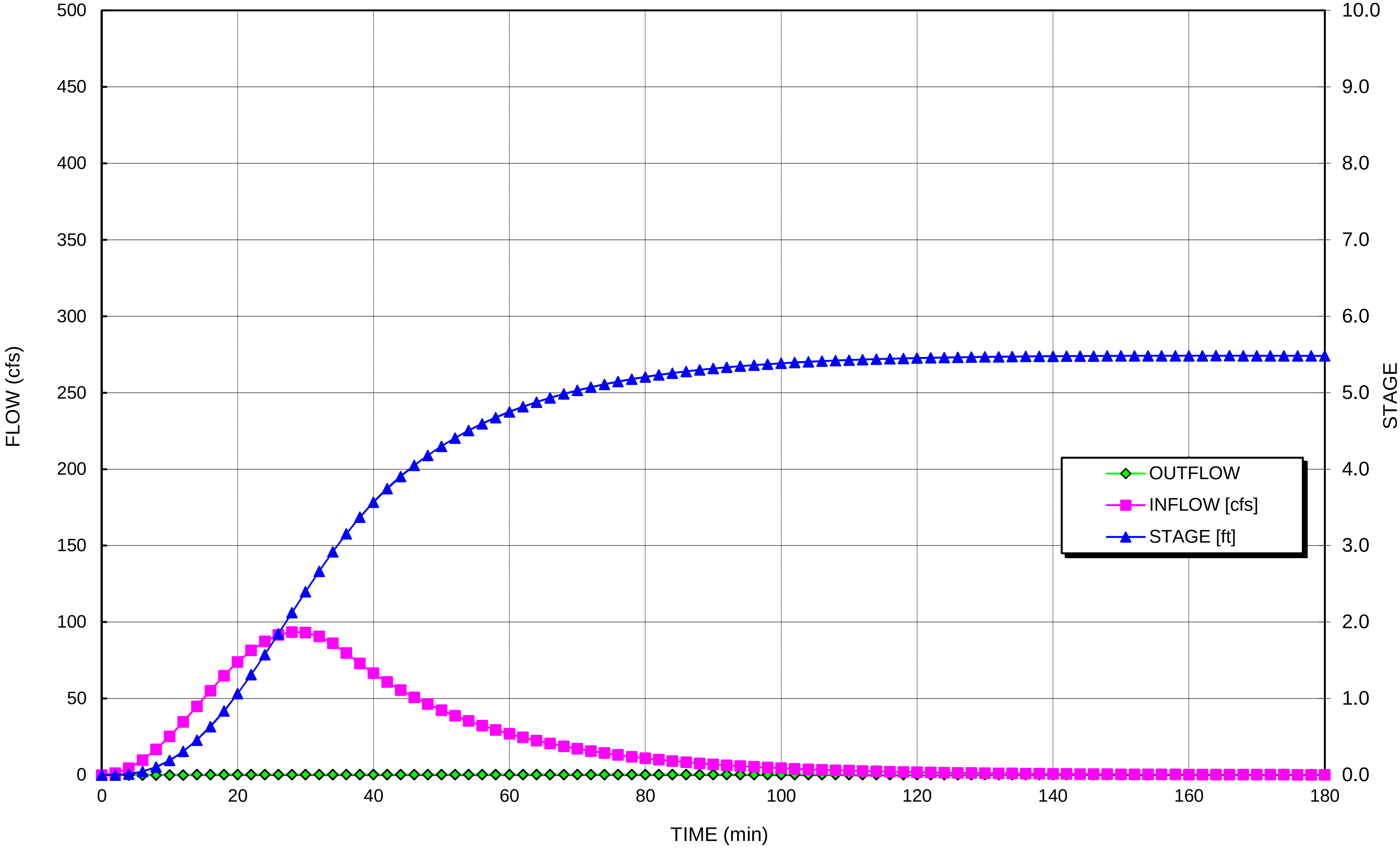
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.1	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	4.4	134	0.0	0.00	0.00	0.00	0.00	0.00	30.08	13,671	N/A
6	9.7	662	0.0	0.00	0.00	0.00	0.00	0.00	39.62	18,007	N/A
8	16.8	1,826	0.1	0.00	0.00	0.00	0.00	0.00	47.18	21,447	N/A
10	25.3	3,839	0.2	0.00	0.00	0.00	0.00	0.00	53.62	24,375	N/A
12	34.8	6,872	0.3	0.00	0.00	0.00	0.00	0.00	59.28	26,945	N/A
14	44.9	11,048	0.5	0.25	0.25	0.00	0.25	0.25	64.33	29,241	100%
16	55.1	16,405	0.6	0.25	0.25	0.00	0.25	0.25	68.86	31,301	100%
18	64.9	22,984	0.8	0.25	0.25	0.00	0.25	0.25	72.98	33,172	100%
20	73.8	30,738	1.1	0.25	0.25	0.00	0.25	0.25	76.73	34,875	100%
22	81.4	39,564	1.3	0.25	0.25	0.00	0.25	0.25	80.13	36,425	100%
24	87.4	49,307	1.6	0.25	0.25	0.00	0.25	0.25	83.23	37,832	100%
26	91.5	59,770	1.8	0.25	0.25	0.00	0.25	0.25	86.04	39,107	100%
28	93.4	70,721	2.1	0.25	0.25	0.00	0.25	0.25	88.56	40,257	100%
30	93.2	81,905	2.4	0.25	0.25	0.00	0.25	0.25	90.83	41,287	100%
32	90.7	93,054	2.7	0.25	0.25	0.00	0.25	0.25	92.85	42,205	100%
34	86.1	103,905	2.9	0.25	0.25	0.00	0.25	0.25	94.63	43,014	100%
36	79.8	114,207	3.2	0.25	0.25	0.00	0.25	0.25	96.18	43,720	100%
38	72.9	123,747	3.4	0.25	0.25	0.00	0.25	0.25	97.52	44,328	100%
40	66.6	132,460	3.6	0.25	0.25	0.00	0.25	0.25	98.67	44,851	100%
42	60.8	140,417	3.7	0.25	0.25	0.00	0.25	0.25	99.67	45,304	100%
44	55.5	147,683	3.9	0.25	0.25	0.00	0.25	0.25	100.54	45,699	100%
46	50.7	154,318	4.0	0.25	0.25	0.00	0.25	0.25	101.30	46,046	100%
48	46.4	160,377	4.2	0.25	0.25	0.00	0.25	0.25	101.98	46,353	100%
50	42.3	165,910	4.3	0.25	0.25	0.00	0.25	0.25	102.57	46,624	100%
52	38.7	170,961	4.4	0.25	0.25	0.00	0.25	0.25	103.10	46,866	100%
54	35.3	175,573	4.5	0.25	0.25	0.00	0.25	0.25	103.58	47,081	100%
56	32.3	179,784	4.6	0.25	0.25	0.00	0.25	0.25	104.00	47,273	100%
58	29.5	183,627	4.7	0.25	0.25	0.00	0.25	0.25	104.38	47,446	100%
60	26.9	187,136	4.7	0.25	0.25	0.00	0.25	0.25	104.72	47,601	100%
62	24.6	190,339	4.8	0.25	0.25	0.00	0.25	0.25	105.03	47,740	100%
64	22.5	193,263	4.9	0.25	0.25	0.00	0.25	0.25	105.30	47,866	100%
66	20.5	195,931	4.9	0.25	0.25	0.00	0.25	0.25	105.55	47,979	100%
68	18.8	198,365	5.0	0.25	0.25	0.00	0.25	0.25	105.78	48,081	100%
70	17.1	200,587	5.0	0.25	0.25	0.00	0.25	0.25	105.98	48,173	100%
72	15.7	202,614	5.1	0.25	0.25	0.00	0.25	0.25	106.16	48,257	100%
74	14.3	204,463	5.1	0.25	0.25	0.00	0.25	0.25	106.33	48,332	100%
76	13.1	206,149	5.1	0.25	0.25	0.00	0.25	0.25	106.48	48,401	100%
78	11.9	207,687	5.2	0.25	0.25	0.00	0.25	0.25	106.62	48,463	100%
80	10.9	209,090	5.2	0.25	0.25	0.00	0.25	0.25	106.74	48,519	100%
82	10.0	210,369	5.2	0.25	0.25	0.00	0.25	0.25	106.85	48,570	100%

84	9.1	211,534	5.3	0.25	0.25	0.00	0.25	0.25	106.96	48,616	100%
86	8.3	212,596	5.3	0.25	0.25	0.00	0.25	0.25	107.05	48,658	100%
88	7.6	213,564	5.3	0.25	0.25	0.00	0.25	0.25	107.13	48,696	100%
90	6.9	214,445	5.3	0.25	0.25	0.00	0.25	0.25	107.21	48,731	100%
92	6.3	215,248	5.3	0.25	0.25	0.00	0.25	0.25	107.28	48,762	100%
94	5.8	215,979	5.3	0.25	0.25	0.00	0.25	0.25	107.34	48,790	100%
96	5.3	216,644	5.4	0.25	0.25	0.00	0.25	0.25	107.40	48,816	100%
98	4.8	217,249	5.4	0.25	0.25	0.00	0.25	0.25	107.45	48,840	100%
100	4.4	217,798	5.4	0.25	0.25	0.00	0.25	0.25	107.49	48,861	100%
102	4.0	218,298	5.4	0.25	0.25	0.00	0.25	0.25	107.54	48,880	100%
104	3.7	218,752	5.4	0.25	0.25	0.00	0.25	0.25	107.58	48,898	100%
106	3.4	219,164	5.4	0.25	0.25	0.00	0.25	0.25	107.61	48,914	100%
108	3.1	219,538	5.4	0.25	0.25	0.00	0.25	0.25	107.64	48,928	100%
110	2.8	219,877	5.4	0.25	0.25	0.00	0.25	0.25	107.67	48,941	100%
112	2.6	220,185	5.4	0.25	0.25	0.00	0.25	0.25	107.70	48,953	100%
114	2.3	220,462	5.4	0.25	0.25	0.00	0.25	0.25	107.72	48,963	100%
116	2.1	220,714	5.4	0.25	0.25	0.00	0.25	0.25	107.74	48,973	100%
118	2.0	220,941	5.4	0.25	0.25	0.00	0.25	0.25	107.76	48,982	100%
120	1.8	221,146	5.5	0.25	0.25	0.00	0.25	0.25	107.78	48,990	100%
122	1.6	221,330	5.5	0.25	0.25	0.00	0.25	0.25	107.79	48,997	100%
124	1.5	221,496	5.5	0.25	0.25	0.00	0.25	0.25	107.81	49,003	100%
126	1.4	221,645	5.5	0.25	0.25	0.00	0.25	0.25	107.82	49,009	100%
128	1.2	221,779	5.5	0.25	0.25	0.00	0.25	0.25	107.83	49,014	100%
130	1.1	221,898	5.5	0.25	0.25	0.00	0.25	0.25	107.84	49,018	100%
132	1.0	222,005	5.5	0.25	0.25	0.00	0.25	0.25	107.85	49,022	100%
134	0.9	222,100	5.5	0.25	0.25	0.00	0.25	0.25	107.86	49,026	100%
136	0.9	222,184	5.5	0.25	0.25	0.00	0.25	0.25	107.86	49,029	100%
138	0.8	222,258	5.5	0.25	0.25	0.00	0.25	0.25	107.87	49,032	100%
140	0.7	222,323	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,034	100%
142	0.7	222,380	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,036	100%
144	0.6	222,429	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,038	100%
146	0.6	222,472	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,040	100%
148	0.5	222,508	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,041	100%
150	0.5	222,539	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,043	100%
152	0.4	222,564	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,043	100%
154	0.4	222,585	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,044	100%
156	0.4	222,601	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,045	100%
158	0.3	222,613	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,045	100%
160	0.3	222,622	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,046	100%
162	0.3	222,627	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,046	100%
164	0.2	222,629	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,046	100%
166	0.2	222,629	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,046	100%
168	0.2	222,626	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,046	100%
170	0.2	222,620	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,046	100%
172	0.2	222,613	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,045	100%
174	0.2	222,603	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,045	100%
176	0.1	222,592	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,045	100%
178	0.1	222,579	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,044	100%
180	0.1	222,565	5.5	0.25	0.25	0.00	0.25	0.25	107.90	49,044	100%
182	0.1	222,550	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,043	100%
184	0.1	222,533	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,042	100%
186	0.1	222,515	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,042	100%
188	0.1	222,496	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,041	100%
190	0.1	222,476	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,040	100%
192	0.1	222,455	5.5	0.25	0.25	0.00	0.25	0.25	107.89	49,039	100%
194	0.1	222,433	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,039	100%
196	0.1	222,411	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,038	100%
198	0.1	222,388	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,037	100%
200	0.0	222,365	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,036	100%
202	0.0	222,341	5.5	0.25	0.25	0.00	0.25	0.25	107.88	49,035	100%
204	0.0	222,316	5.5	0.25	0.25	0.00	0.25	0.25	107.87	49,034	100%
206	0.0	222,291	5.5	0.25	0.25	0.00	0.25	0.25	107.87	49,033	100%

Sediment Basin #6 Colon Mine Phase 1 Hydrograph
10-Yr Storm



HDR Computation

Job No. 0453925-237673-018

Project: Charah Colon Mine		Computed: EAW	Date: 1/4/15
Subject: Permit Application		Checked: PAW	Date: 1/4/15
Task: Sediment Basin #7		Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1	2	2	2		
Storm Event (yrs) =	10	10	25	100		
Total Drainage Area A (ac) =	16.4	33.1	33.1	33.1		
Disturbed Area (ac) =	12.5	29.3	29.3	29.3		
Curve Number CN =	82	81	81	81	Hydrographs	
Rainfall Depth P (in) =	5.28	5.28	6.28	7.88	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	85.59	134.71	171.36	230.40	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	59,580	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	58,599	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
238	0	49,034	0	0	0
239	1	52,537	50,775	50,775	1,881
240	2	56,098	54,308	105,083	3,892
241	3	59,717	57,898	162,981	6,036
242	4	63,393	61,546	224,527	8,316
243	5	67,128	65,252	289,779	10,733
244	6	70,920	69,015	358,794	13,289

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 162,981 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 59,717 *Required Surface Area Achieved*

HDR Computation

Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #7	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) =	162,981		
Number of Skimmers	2		
Days to Drain =	5	*assumed*	
Q each (cf/day) =	16,298		0.19 cfs

Selected Skimmer Size (inches) = 4

Head on Skimmer (feet) = 0.333

Diameter of Orifice (inches) = 3.5

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

$S = (1000/CN) - 10$

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase	1	2	2	2
Storm Event (yrs) =	10	10	25	100
S =	2.20	2.35	2.35	2.35
Runoff Depth Q* (inches) =	3.33	3.23	4.14	5.63
Time to Peak T_p (min) =	27.78	34.59	34.80	35.20

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 162,981

Z_2 (ft) = 6 S_2 (cf) = 358,794

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.1 Ref 2, III-8

$K_S = S_2/Z_2^b$ = 46,662

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #7	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec
Gravitational Acceleration, g (m/s^2) = 9.81
Specific Gravity of soil (s_s)= 2.6
Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20° C Ref 2, IV-11
Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 6.90
Set Top of Dam at (ft) = 7.50

See Hydrograph

Emergency Spillway

Q_E (cfs) = 100-Yr Storm
Q_E (cfs) = 21.1
Cross Section = Trapezoid
Channel Side Slope (z) = 5 (enter X for X:1)
n = 0.03 Grass Lined
Vp (ft/sec) = 5.0 Permissible Velocity for lining Ref 2, II-7
Allowable Shear Stress (psf) = 2.0 Allowable Shear Stress for lining
Bottom Width, b (ft) = 20

Calculate Required Depth of Spillway:

Normal-Depth Procedure

$AR^{2/3}=Qn/1.49s^{0.5}$ Q=VA
$Z_{req}=Qn/1.49s^{0.5}$ Area (A)= bd+z(d^2)
$Z_{av}=AR^{2/3}$ R=Area/(b+2d((z^2)+1)^.5)
Avg Shear Stress(T) = K_b*d*s*unit weight of water

Channel Slope ft/ft	Depth, d (ft)	A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	T (psf)
0.01	0.39	8.50	4.26	0.35	4.26	2.5	0.2
0.02	0.32	6.82	3.01	0.29	3.01	3.1	0.4

Construct the channel to be : 20 ft, Bottom Width (measured at top of lining)
0.6 ft, depth (measured at top of lining)
1% slope

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia
Anti-Seep Collar Size (ft) = 4
Use Anti-Seep Collar Size (ft) = 4 x 4

Project: Charah Colon Mine
Subject: Permit Application
Task: Sediment Basin #7

Computed: EAW
Checked: PAW
Sheet: 4

Date: 1/4/15
Date: 1/4/15
Of: 4

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 60 From Hydrograph
Avg Density of Concrete (lbs/cf) = 87.6
Density of Water (lbs/cf) = 62.4
Riser Displacement (cf) = 125.66 Pi * $(D_R/24)^2$ * Total Ht of Riser
Convert cf to cy = 27^{-1}
Min Concrete Needed (cy) = 3.32
Width & Length (ft) = 6
Thickness (ft) = 2.5

Anti-Vortex Device:

Diameter of Riser (in) = 60 From Hydrograph
Cylinder Diameter (in) = 90 Ref 3, III-104, Table 3.14-D
Cylinder Thickness (gage) = 14
Cylinder Height (in) = 29

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$
$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n = 0.069 6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) = 9 Permissible Velocity for lining
Side Slope (z) = 5 enter X for X:1
s (ft/ft) = 0.02 Outlet Slope (estimated)
Bottom Width (ft) = 12 6 * Barrel Diameter
Q_B (cfs) = 34.3 Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
34.3	11.23	0.88	14.4	0.69	11.23	2.4

Flow Depth = Tailwater, d (ft) = 0.88 0.5* Barrel Diameter (ft) = 1.00 Ref 1, 8.06.3
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
2	6	10	12	0.7	Class B

Conclusion

The basin can contain the 10-yr storm and pass the 100-yr storm without overtopping the berm.

HDR Computation

Job No. 06985-10570-018

Project: Charah Colon Mine		Computed: PAW	Date: 12/31/14
Subject: Permit Application		Checked: EAW	Date: 1/2/15
Task: Riser Pipe Perforations/Skimmer Flow		Sheet 1	Of 2

Diameter of Riser (in) = 60
Circumference of Riser (in) = 188.5
eight of Riser from bottom of barrel (in) = 77 From Hydrograph
Vertical spacing between holes (in) = 0 center to center
Water Stage increment (ft) 0.05

Orifice Equation

$Q = C_d * A * (2 * g * h)^{0.5}$ Ref 1, p III-11

Q = cfs, discharge
C_d = 0.6 coefficient of discharge
A = sf, cross sectional area
g = 32.2 ft/sec^2, gravity
h = ft, driving head measured from the center of the pipe

	Perforations					Skimmer	
Row	1	2	3	4	5	2	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.38	0.38
0.39	0.00	0.00	0.00			0.38	0.38
0.44	0.00	0.00	0.00			0.38	0.38
0.49	0.00	0.00	0.00			0.38	0.38
0.54	0.00	0.00	0.00			0.38	0.38
0.59	0.00	0.00	0.00			0.38	0.38
0.64	0.00	0.00	0.00			0.38	0.38
0.69	0.00	0.00	0.00			0.38	0.38
0.74	0.00	0.00	0.00			0.38	0.38
0.79	0.00	0.00	0.00			0.38	0.38
0.84	0.00	0.00	0.00			0.38	0.38
0.89	0.00	0.00	0.00			0.38	0.38
0.94	0.00	0.00	0.00			0.38	0.38
0.99	0.00	0.00	0.00			0.38	0.38
1.04	0.00	0.00	0.00			0.38	0.38
1.09	0.00	0.00	0.00			0.38	0.38
1.14	0.00	0.00	0.00			0.38	0.38
1.19	0.00	0.00	0.00			0.38	0.38
1.24	0.00	0.00	0.00			0.38	0.38
1.29	0.00	0.00	0.00			0.38	0.38
1.34	0.00	0.00	0.00			0.38	0.38
1.39	0.00	0.00	0.00			0.38	0.38
1.44	0.00	0.00	0.00			0.38	0.38
1.49	0.00	0.00	0.00			0.38	0.38
1.54	0.00	0.00	0.00			0.38	0.38
1.59	0.00	0.00	0.00			0.38	0.38

HDR Computation

I Job No. 06985-10570-018 I

Project: Charah Colon Mine		Computed: PAW	Date: 12/31/14
Subject: Permit Application		Checked: EAW	Date: 1/2/15
Task: Riser Pipe Perforations/Skimmer Flow		Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.38	0.38
1.69	0.00	0.00	0.00	0.38	0.38
1.74	0.00	0.00	0.00	0.38	0.38
1.79	0.00	0.00	0.00	0.38	0.38
1.84	0.00	0.00	0.00	0.38	0.38
1.89	0.00	0.00	0.00	0.38	0.38
1.94	0.00	0.00	0.00	0.38	0.38
1.99	0.00	0.00	0.00	0.38	0.38
2.04	0.00	0.00	0.00	0.38	0.38
2.09	0.00	0.00	0.00	0.38	0.38
2.14	0.00	0.00	0.00	0.38	0.38
2.19	0.00	0.00	0.00	0.38	0.38
2.24	0.00	0.00	0.00	0.38	0.38
2.29	0.00	0.00	0.00	0.38	0.38
2.34	0.00	0.00	0.00	0.38	0.38
2.39	0.00	0.00	0.00	0.38	0.38
2.44	0.00	0.00	0.00	0.38	0.38
2.49	0.00	0.00	0.00	0.38	0.38
2.54	0.00	0.00	0.00	0.38	0.38
2.59	0.00	0.00	0.00	0.38	0.38
2.64	0.00	0.00	0.00	0.38	0.38
2.69	0.00	0.00	0.00	0.38	0.38
2.74	0.00	0.00	0.00	0.38	0.38
2.79	0.00	0.00	0.00	0.38	0.38
2.84	0.00	0.00	0.00	0.38	0.38
2.89	0.00	0.00	0.00	0.38	0.38
2.94	0.00	0.00	0.00	0.38	0.38
2.99	0.00	0.00	0.00	0.38	0.38
3.04	0.00	0.00	0.00	0.38	0.38
3.09	0.00	0.00	0.00	0.38	0.38
3.14	0.00	0.00	0.00	0.38	0.38
3.19	0.00	0.00	0.00	0.38	0.38
3.24	0.00	0.00	0.00	0.38	0.38
3.29	0.00	0.00	0.00	0.38	0.38
3.34	0.00	0.00	0.00	0.38	0.38
3.39	0.00	0.00	0.00	0.38	0.38
3.44	0.00	0.00	0.00	0.38	0.38
3.49	0.00	0.00	0.00	0.38	0.38
3.54	0.00	0.00	0.00	0.38	0.38
3.59	0.00	0.00	0.00	0.38	0.38
3.64	0.00	0.00	0.00	0.38	0.38
3.69	0.00	0.00	0.00	0.38	0.38
3.74	0.00	0.00	0.00	0.38	0.38
3.79	0.00	0.00	0.00	0.38	0.38
3.84	0.00	0.00	0.00	0.38	0.38
3.89	0.00	0.00	0.00	0.38	0.38
3.94	0.00	0.00	0.00	0.38	0.38
3.99	0.00	0.00	0.00	0.38	0.38

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 7 Colon

Phase 1

10 - year Storm Event

Qp = 85.59 cfs
Tp = 27.78 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
K_s = 46,662

Number of Riser/Barrel Assemblies **2**
Diameter of Barrel = **24** (in)
Height of Riser above barrel = **4.4** (ft)
Height of Riser from bottom of barrel= **6.4** (ft) elevation 244.40
Emergency Spillway = **6.9** (ft) elevation 244.90
Total Height of Dam = **7.5** (ft) elevation 245.50
Length of Emergency Spillway = **20** (ft)
Diameter of Riser = **60** (in)
Permanent Pond Stage = **0** (ft) elevation 238.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
3.5 ft Maximum Stage 241.48 msl elevation
0.8 cfs Peak outflow
0.8 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

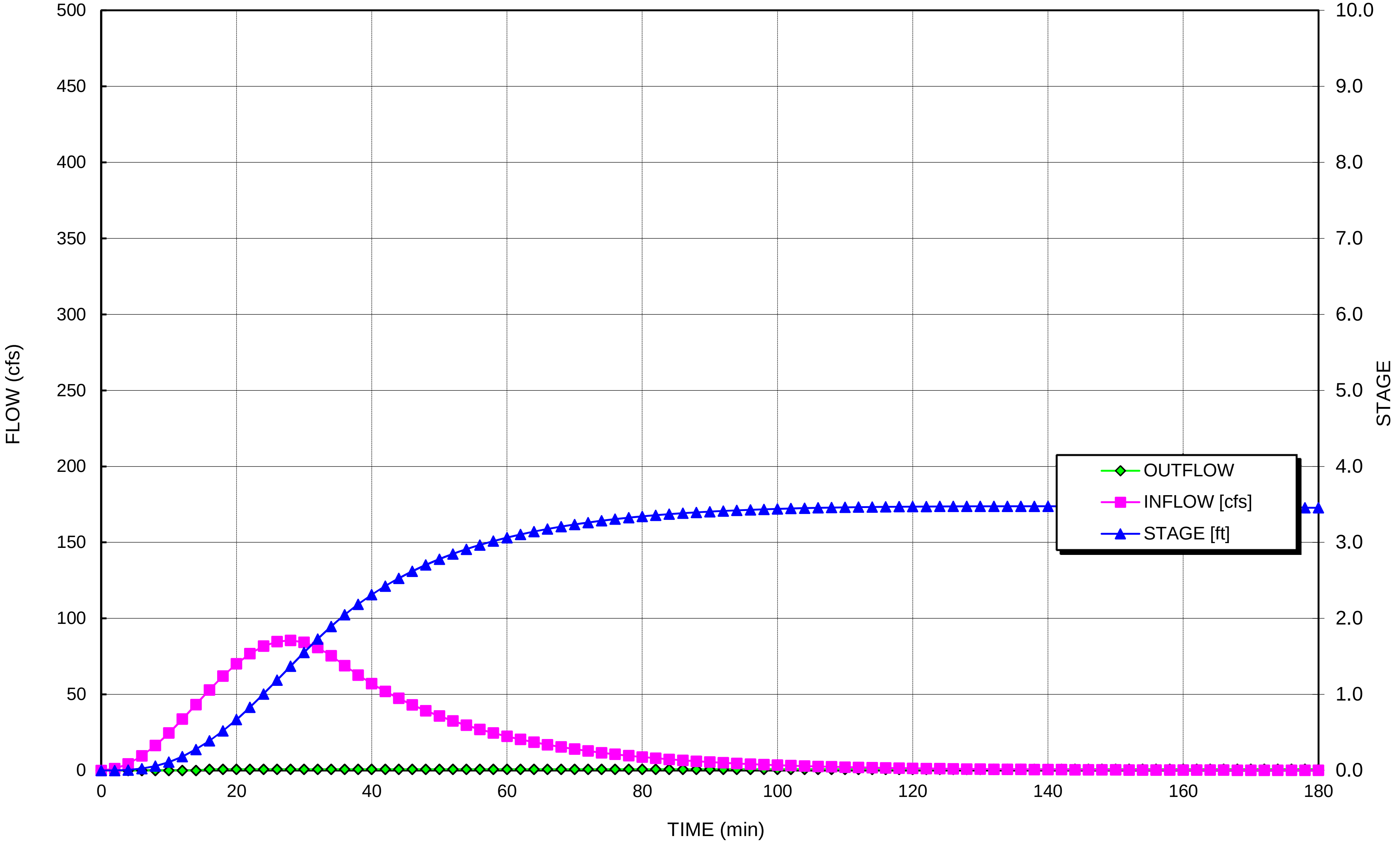
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.1	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	4.3	131	0.0	0.00	0.00	0.00	0.00	0.00	57.19	25,995	N/A
6	9.5	647	0.0	0.00	0.00	0.00	0.00	0.00	69.47	31,575	N/A
8	16.4	1,785	0.1	0.00	0.00	0.00	0.00	0.00	78.58	35,720	N/A
10	24.6	3,748	0.1	0.00	0.00	0.00	0.00	0.00	86.00	39,091	N/A
12	33.7	6,696	0.2	0.00	0.00	0.00	0.00	0.00	92.29	41,951	N/A
14	43.3	10,743	0.3	0.00	0.00	0.00	0.00	0.00	97.75	44,433	N/A
16	52.9	15,943	0.4	0.38	0.38	0.00	0.38	0.75	102.56	46,618	100%
18	62.0	22,203	0.5	0.38	0.38	0.00	0.38	0.75	106.77	48,534	100%
20	70.1	29,550	0.7	0.38	0.38	0.00	0.38	0.75	110.55	50,251	100%
22	76.8	37,868	0.8	0.38	0.38	0.00	0.38	0.75	113.94	51,790	100%
24	81.7	46,991	1.0	0.38	0.38	0.00	0.38	0.75	116.97	53,167	100%
26	84.7	56,709	1.2	0.38	0.38	0.00	0.38	0.75	119.67	54,397	100%
28	85.6	66,786	1.4	0.38	0.38	0.00	0.38	0.75	122.08	55,490	100%
30	84.2	76,965	1.6	0.38	0.38	0.00	0.38	0.75	124.20	56,455	100%
32	80.8	86,984	1.7	0.38	0.38	0.00	0.38	0.75	126.06	57,302	100%
34	75.4	96,589	1.9	0.38	0.38	0.00	0.38	0.75	127.68	58,036	100%
36	68.9	105,550	2.0	0.38	0.38	0.00	0.38	0.75	129.06	58,666	100%
38	62.7	113,727	2.2	0.38	0.38	0.00	0.38	0.75	130.24	59,201	100%
40	57.1	121,166	2.3	0.38	0.38	0.00	0.38	0.75	131.25	59,658	100%
42	52.0	127,931	2.4	0.38	0.38	0.00	0.38	0.75	132.12	60,054	100%
44	47.4	134,084	2.5	0.38	0.38	0.00	0.38	0.75	132.88	60,398	100%
46	43.1	139,680	2.6	0.38	0.38	0.00	0.38	0.75	133.54	60,699	100%
48	39.3	144,767	2.7	0.38	0.38	0.00	0.38	0.75	134.12	60,964	100%
50	35.8	149,391	2.8	0.38	0.38	0.00	0.38	0.75	134.63	61,197	100%
52	32.6	153,595	2.8	0.38	0.38	0.00	0.38	0.75	135.09	61,404	100%
54	29.7	157,414	2.9	0.38	0.38	0.00	0.38	0.75	135.49	61,588	100%
56	27.0	160,884	3.0	0.38	0.38	0.00	0.38	0.75	135.85	61,751	100%
58	24.6	164,036	3.0	0.38	0.38	0.00	0.38	0.75	136.17	61,897	100%
60	22.4	166,899	3.1	0.38	0.38	0.00	0.38	0.75	136.46	62,028	100%
62	20.4	169,497	3.1	0.38	0.38	0.00	0.38	0.75	136.72	62,144	100%
64	18.6	171,855	3.1	0.38	0.38	0.00	0.38	0.75	136.95	62,249	100%
66	16.9	173,995	3.2	0.38	0.38	0.00	0.38	0.75	137.15	62,342	100%
68	15.4	175,935	3.2	0.38	0.38	0.00	0.38	0.75	137.34	62,427	100%
70	14.0	177,693	3.2	0.38	0.38	0.00	0.38	0.75	137.50	62,502	100%
72	12.8	179,287	3.3	0.38	0.38	0.00	0.38	0.75	137.65	62,570	100%
74	11.6	180,730	3.3	0.38	0.38	0.00	0.38	0.75	137.79	62,631	100%
76	10.6	182,036	3.3	0.38	0.38	0.00	0.38	0.75	137.91	62,686	100%
78	9.7	183,217	3.3	0.38	0.38	0.00	0.38	0.75	138.02	62,735	100%
80	8.8	184,285	3.3	0.38	0.38	0.00	0.38	0.75	138.12	62,780	100%
82	8.0	185,249	3.4	0.38	0.38	0.00	0.38	0.75	138.20	62,819	100%

84	7.3	186,118	3.4	0.38	0.38	0.00	0.38	0.75	138.28	62,855	100%
86	6.6	186,902	3.4	0.38	0.38	0.00	0.38	0.75	138.35	62,887	100%
88	6.0	187,608	3.4	0.38	0.38	0.00	0.38	0.75	138.42	62,916	100%
90	5.5	188,243	3.4	0.38	0.38	0.00	0.38	0.75	138.47	62,942	100%
92	5.0	188,813	3.4	0.38	0.38	0.00	0.38	0.75	138.52	62,965	100%
94	4.6	189,324	3.4	0.38	0.38	0.00	0.38	0.75	138.57	62,986	100%
96	4.2	189,781	3.4	0.38	0.38	0.00	0.38	0.75	138.61	63,004	100%
98	3.8	190,189	3.4	0.38	0.38	0.00	0.38	0.75	138.65	63,021	100%
100	3.4	190,553	3.4	0.38	0.38	0.00	0.38	0.75	138.68	63,035	100%
102	3.1	190,876	3.4	0.38	0.38	0.00	0.38	0.75	138.71	63,048	100%
104	2.9	191,162	3.5	0.38	0.38	0.00	0.38	0.75	138.73	63,060	100%
106	2.6	191,414	3.5	0.38	0.38	0.00	0.38	0.75	138.75	63,070	100%
108	2.4	191,636	3.5	0.38	0.38	0.00	0.38	0.75	138.77	63,079	100%
110	2.2	191,830	3.5	0.38	0.38	0.00	0.38	0.75	138.79	63,087	100%
112	2.0	191,999	3.5	0.38	0.38	0.00	0.38	0.75	138.81	63,093	100%
114	1.8	192,144	3.5	0.38	0.38	0.00	0.38	0.75	138.82	63,099	100%
116	1.6	192,268	3.5	0.38	0.38	0.00	0.38	0.75	138.83	63,104	100%
118	1.5	192,373	3.5	0.38	0.38	0.00	0.38	0.75	138.84	63,108	100%
120	1.4	192,461	3.5	0.38	0.38	0.00	0.38	0.75	138.85	63,112	100%
122	1.2	192,532	3.5	0.38	0.38	0.00	0.38	0.75	138.85	63,115	100%
124	1.1	192,590	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,117	100%
126	1.0	192,634	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,119	100%
128	0.9	192,666	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,120	100%
130	0.8	192,687	3.5	0.38	0.38	0.00	0.38	0.75	138.87	63,121	100%
132	0.8	192,698	3.5	0.38	0.38	0.00	0.38	0.75	138.87	63,121	100%
134	0.7	192,700	3.5	0.38	0.38	0.00	0.38	0.75	138.87	63,121	100%
136	0.6	192,693	3.5	0.38	0.38	0.00	0.38	0.75	138.87	63,121	100%
138	0.6	192,679	3.5	0.38	0.38	0.00	0.38	0.75	138.87	63,121	100%
140	0.5	192,659	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,120	100%
142	0.5	192,632	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,119	100%
144	0.4	192,599	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,117	100%
146	0.4	192,561	3.5	0.38	0.38	0.00	0.38	0.75	138.86	63,116	100%
148	0.4	192,519	3.5	0.38	0.38	0.00	0.38	0.75	138.85	63,114	100%
150	0.3	192,472	3.5	0.38	0.38	0.00	0.38	0.75	138.85	63,112	100%
152	0.3	192,421	3.5	0.38	0.38	0.00	0.38	0.75	138.84	63,110	100%
154	0.3	192,367	3.5	0.38	0.38	0.00	0.38	0.75	138.84	63,108	100%
156	0.3	192,310	3.5	0.38	0.38	0.00	0.38	0.75	138.83	63,106	100%
158	0.2	192,249	3.5	0.38	0.38	0.00	0.38	0.75	138.83	63,103	100%
160	0.2	192,186	3.5	0.38	0.38	0.00	0.38	0.75	138.82	63,101	100%
162	0.2	192,120	3.5	0.38	0.38	0.00	0.38	0.75	138.82	63,098	100%
164	0.2	192,053	3.5	0.38	0.38	0.00	0.38	0.75	138.81	63,096	100%
166	0.2	191,983	3.5	0.38	0.38	0.00	0.38	0.75	138.80	63,093	100%
168	0.1	191,911	3.5	0.38	0.38	0.00	0.38	0.75	138.80	63,090	100%
170	0.1	191,838	3.5	0.38	0.38	0.00	0.38	0.75	138.79	63,087	100%
172	0.1	191,763	3.5	0.38	0.38	0.00	0.38	0.75	138.78	63,084	100%
174	0.1	191,686	3.5	0.38	0.38	0.00	0.38	0.75	138.78	63,081	100%
176	0.1	191,609	3.5	0.38	0.38	0.00	0.38	0.75	138.77	63,078	100%
178	0.1	191,530	3.5	0.38	0.38	0.00	0.38	0.75	138.76	63,075	100%
180	0.1	191,450	3.5	0.38	0.38	0.00	0.38	0.75	138.76	63,072	100%
182	0.1	191,370	3.5	0.38	0.38	0.00	0.38	0.75	138.75	63,068	100%
184	0.1	191,288	3.5	0.38	0.38	0.00	0.38	0.75	138.74	63,065	100%
186	0.1	191,205	3.5	0.38	0.38	0.00	0.38	0.75	138.74	63,062	100%
188	0.1	191,122	3.5	0.38	0.38	0.00	0.38	0.75	138.73	63,058	100%
190	0.1	191,039	3.4	0.38	0.38	0.00	0.38	0.75	138.72	63,055	100%
192	0.0	190,954	3.4	0.38	0.38	0.00	0.38	0.75	138.71	63,052	100%
194	0.0	190,869	3.4	0.38	0.38	0.00	0.38	0.75	138.71	63,048	100%
196	0.0	190,784	3.4	0.38	0.38	0.00	0.38	0.75	138.70	63,045	100%
198	0.0	190,698	3.4	0.38	0.38	0.00	0.38	0.75	138.69	63,041	100%
200	0.0	190,611	3.4	0.38	0.38	0.00	0.38	0.75	138.68	63,038	100%
202	0.0	190,525	3.4	0.38	0.38	0.00	0.38	0.75	138.68	63,034	100%
204	0.0	190,438	3.4	0.38	0.38	0.00	0.38	0.75	138.67	63,031	100%
206	0.0	190,350	3.4	0.38	0.38	0.00	0.38	0.75	138.66	63,027	100%

Sediment Basin #7 Colon Mine Phase 1 Hydrograph
10-Yr Storm



Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 7 Colon

Phase 2

10 - year Storm Event

Qp = 134.71 cfs
Tp = 34.59 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 46,662

Number of Riser/Barrel Assemblies	2			
Diameter of Barrel =	24	(in)		
Height of Riser above barrel =	4.4	(ft)		
Height of Riser from bottom of barrel=	6.4	(ft)	elevation	244.40
Emergency Spillway =	6.9	(ft)	elevation	244.90
Total Height of Dam =	7.5	(ft)	elevation	245.50
Length of Emergency Spillway =	20	(ft)		
Diameter of Riser =	60	(in)		
Permanent Pond Stage =	0	(ft)	elevation	238.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

100% Minimum Settling Efficiency
6.3 ft Maximum Stage 244.33 msl elevation
0.8 cfs Peak outflow
0.8 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

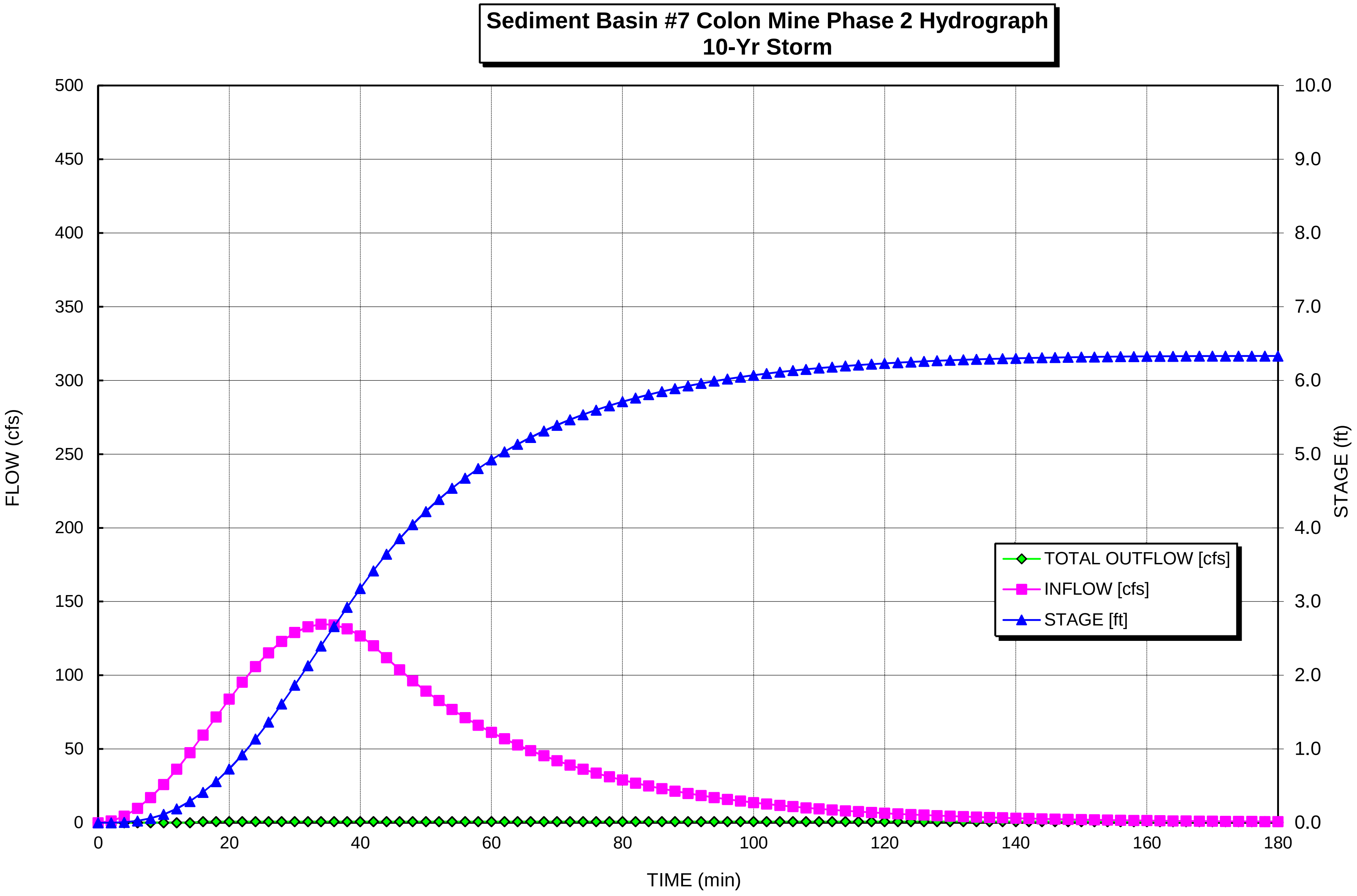
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.1	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	4.4	133	0.0	0.00	0.00	0.00	0.00	0.00	57.30	26,047	N/A
6	9.8	661	0.0	0.00	0.00	0.00	0.00	0.00	69.64	31,653	N/A
8	17.0	1,832	0.1	0.00	0.00	0.00	0.00	0.00	78.83	35,832	N/A
10	25.9	3,873	0.1	0.00	0.00	0.00	0.00	0.00	86.35	39,249	N/A
12	36.2	6,984	0.2	0.00	0.00	0.00	0.00	0.00	92.77	42,166	N/A
14	47.5	11,329	0.3	0.00	0.00	0.00	0.00	0.00	98.39	44,721	N/A
16	59.5	17,029	0.4	0.38	0.38	0.00	0.38	0.75	103.39	46,993	100%
18	71.7	24,074	0.6	0.38	0.38	0.00	0.38	0.75	107.83	49,014	100%
20	83.7	32,584	0.7	0.38	0.38	0.00	0.38	0.75	111.87	50,852	100%
22	95.3	42,544	0.9	0.38	0.38	0.00	0.38	0.75	115.56	52,528	100%
24	105.9	53,887	1.1	0.38	0.38	0.00	0.38	0.75	118.93	54,060	100%
26	115.2	66,504	1.4	0.38	0.38	0.00	0.38	0.75	122.01	55,461	100%
28	123.0	80,242	1.6	0.38	0.38	0.00	0.38	0.75	124.83	56,742	100%
30	128.9	94,912	1.9	0.38	0.38	0.00	0.38	0.75	127.41	57,913	100%
32	132.9	110,296	2.1	0.38	0.38	0.00	0.38	0.75	129.76	58,980	100%
34	134.6	126,148	2.4	0.38	0.38	0.00	0.38	0.75	131.89	59,952	100%
36	134.2	142,211	2.7	0.38	0.38	0.00	0.38	0.75	133.83	60,832	100%
38	131.5	158,220	2.9	0.38	0.38	0.00	0.38	0.75	135.58	61,626	100%
40	126.7	173,909	3.2	0.38	0.38	0.00	0.38	0.75	137.15	62,339	100%
42	120.0	189,026	3.4	0.38	0.38	0.00	0.38	0.75	138.54	62,974	100%
44	111.9	203,337	3.6	0.38	0.38	0.00	0.38	0.75	139.78	63,535	100%
46	103.8	216,669	3.9	0.38	0.38	0.00	0.38	0.75	140.86	64,028	100%
48	96.2	229,028	4.0	0.38	0.38	0.00	0.38	0.75	141.81	64,461	100%
50	89.3	240,487	4.2	0.38	0.38	0.00	0.38	0.75	142.66	64,845	100%
52	82.8	251,109	4.4	0.38	0.38	0.00	0.38	0.75	143.41	65,187	100%
54	76.8	260,955	4.5	0.38	0.38	0.00	0.38	0.75	144.08	65,492	100%
56	71.2	270,081	4.7	0.38	0.38	0.00	0.38	0.75	144.69	65,767	100%
58	66.1	278,541	4.8	0.38	0.38	0.00	0.38	0.75	145.23	66,014	100%
60	61.3	286,381	4.9	0.38	0.38	0.00	0.38	0.75	145.72	66,237	100%
62	56.9	293,646	5.0	0.38	0.38	0.00	0.38	0.75	146.17	66,439	100%
64	52.7	300,379	5.1	0.38	0.38	0.00	0.38	0.75	146.57	66,623	100%
66	48.9	306,618	5.2	0.38	0.38	0.00	0.38	0.75	146.94	66,789	100%
68	45.4	312,399	5.3	0.38	0.38	0.00	0.38	0.75	147.27	66,941	100%
70	42.1	317,754	5.4	0.38	0.38	0.00	0.38	0.75	147.58	67,080	100%
72	39.0	322,715	5.5	0.38	0.38	0.00	0.38	0.75	147.85	67,206	100%
74	36.2	327,310	5.5	0.38	0.38	0.00	0.38	0.75	148.11	67,322	100%
76	33.6	331,566	5.6	0.38	0.38	0.00	0.38	0.75	148.34	67,428	100%
78	31.2	335,507	5.7	0.38	0.38	0.00	0.38	0.75	148.55	67,525	100%
80	28.9	339,156	5.7	0.38	0.38	0.00	0.38	0.75	148.75	67,614	100%
82	26.8	342,534	5.8	0.38	0.38	0.00	0.38	0.75	148.93	67,695	100%
84	24.9	345,661	5.8	0.38	0.38	0.00	0.38	0.75	149.09	67,770	100%

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _2__of __2_

86	23.1	348,555	5.8	0.38	0.38	0.00	0.38	0.75	149.25	67,839	100%
88	21.4	351,233	5.9	0.38	0.38	0.00	0.38	0.75	149.38	67,902	100%
90	19.9	353,711	5.9	0.38	0.38	0.00	0.38	0.75	149.51	67,960	100%
92	18.4	356,002	6.0	0.38	0.38	0.00	0.38	0.75	149.63	68,014	100%
94	17.1	358,121	6.0	0.38	0.38	0.00	0.38	0.75	149.74	68,063	100%
96	15.8	360,080	6.0	0.38	0.38	0.00	0.38	0.75	149.84	68,108	100%
98	14.7	361,891	6.0	0.38	0.38	0.00	0.38	0.75	149.93	68,149	100%
100	13.6	363,563	6.1	0.38	0.38	0.00	0.38	0.75	150.01	68,188	100%
102	12.6	365,109	6.1	0.38	0.38	0.00	0.38	0.75	150.09	68,223	100%
104	11.7	366,535	6.1	0.38	0.38	0.00	0.38	0.75	150.16	68,255	100%
106	10.9	367,852	6.1	0.38	0.38	0.00	0.38	0.75	150.23	68,285	100%
108	10.1	369,067	6.2	0.38	0.38	0.00	0.38	0.75	150.29	68,312	100%
110	9.4	370,188	6.2	0.38	0.38	0.00	0.38	0.75	150.34	68,337	100%
112	8.7	371,220	6.2	0.38	0.38	0.00	0.38	0.75	150.39	68,361	100%
114	8.1	372,172	6.2	0.38	0.38	0.00	0.38	0.75	150.44	68,382	100%
116	7.5	373,048	6.2	0.38	0.38	0.00	0.38	0.75	150.48	68,401	100%
118	6.9	373,853	6.2	0.38	0.38	0.00	0.38	0.75	150.52	68,419	100%
120	6.4	374,594	6.2	0.38	0.38	0.00	0.38	0.75	150.56	68,436	100%
122	6.0	375,275	6.2	0.38	0.38	0.00	0.38	0.75	150.59	68,451	100%
124	5.5	375,900	6.3	0.38	0.38	0.00	0.38	0.75	150.62	68,465	100%
126	5.1	376,473	6.3	0.38	0.38	0.00	0.38	0.75	150.65	68,478	100%
128	4.8	376,998	6.3	0.38	0.38	0.00	0.38	0.75	150.68	68,489	100%
130	4.4	377,479	6.3	0.38	0.38	0.00	0.38	0.75	150.70	68,500	100%
132	4.1	377,918	6.3	0.38	0.38	0.00	0.38	0.75	150.72	68,509	100%
134	3.8	378,319	6.3	0.38	0.38	0.00	0.38	0.75	150.74	68,518	100%
136	3.5	378,684	6.3	0.38	0.38	0.00	0.38	0.75	150.76	68,526	100%
138	3.3	379,016	6.3	0.38	0.38	0.00	0.38	0.75	150.77	68,534	100%
140	3.0	379,318	6.3	0.38	0.38	0.00	0.38	0.75	150.79	68,540	100%
142	2.8	379,591	6.3	0.38	0.38	0.00	0.38	0.75	150.80	68,546	100%
144	2.6	379,838	6.3	0.38	0.38	0.00	0.38	0.75	150.81	68,552	100%
146	2.4	380,060	6.3	0.38	0.38	0.00	0.38	0.75	150.82	68,557	100%
148	2.2	380,260	6.3	0.38	0.38	0.00	0.38	0.75	150.83	68,561	100%
150	2.1	380,438	6.3	0.38	0.38	0.00	0.38	0.75	150.84	68,565	100%
152	1.9	380,598	6.3	0.38	0.38	0.00	0.38	0.75	150.85	68,568	100%
154	1.8	380,739	6.3	0.38	0.38	0.00	0.38	0.75	150.86	68,571	100%
156	1.7	380,863	6.3	0.38	0.38	0.00	0.38	0.75	150.86	68,574	100%
158	1.5	380,972	6.3	0.38	0.38	0.00	0.38	0.75	150.87	68,577	100%
160	1.4	381,066	6.3	0.38	0.38	0.00	0.38	0.75	150.87	68,579	100%
162	1.3	381,147	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,580	100%
164	1.2	381,216	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,582	100%
166	1.1	381,273	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,583	100%
168	1.1	381,319	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,584	100%
170	1.0	381,356	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,585	100%
172	0.9	381,383	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
174	0.8	381,402	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
176	0.8	381,412	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
178	0.7	381,416	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
180	0.7	381,412	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
182	0.6	381,403	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
184	0.6	381,387	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,586	100%
186	0.5	381,366	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,585	100%
188	0.5	381,340	6.3	0.38	0.38	0.00	0.38	0.75	150.89	68,585	100%
190	0.5	381,310	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,584	100%
192	0.4	381,275	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,583	100%
194	0.4	381,236	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,582	100%
196	0.4	381,193	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,581	100%
198	0.3	381,147	6.3	0.38	0.38	0.00	0.38	0.75	150.88	68,580	100%
200	0.3	381,097	6.3	0.38	0.38	0.00	0.38	0.75	150.87	68,579	100%
202	0.3	381,045	6.3	0.38	0.38	0.00	0.38	0.75	150.87	68,578	100%
204	0.3	380,990	6.3	0.38	0.38	0.00	0.38	0.75	150.87	68,577	100%


Sediment Basin #7 Colon Mine Phase 2 Hydrograph
10-Yr Storm
FLOW (cfs)
STAGE (ft)
TIME (min)
500
450
400
350
300
250
200
150
100
50
0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
120
140
160
180
TOTAL OUTFLOW [cfs]
INFLOW [cfs]
STAGE [ft]

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 7 Colon

Phase 2

25 - year Storm Event

Qp = 171.36 cfs
Tp = 34.80 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 46,662

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 4.4 (ft)
Height of Riser from bottom of barrel= 6.4 (ft) elevatior 244.40
Emergency Spillway = 6.9 (ft) elevatior 244.90
Total Height of Dam = 7.5 (ft) elevatior 245.50
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 60 (in)
Permanent Pond Stage = 0 (ft) elevatior 238.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

96% Minimum Settling Efficiency
6.9 ft Maximum Stage 244.9 msl elevation
34.3 cfs Peak outflow
34.3 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

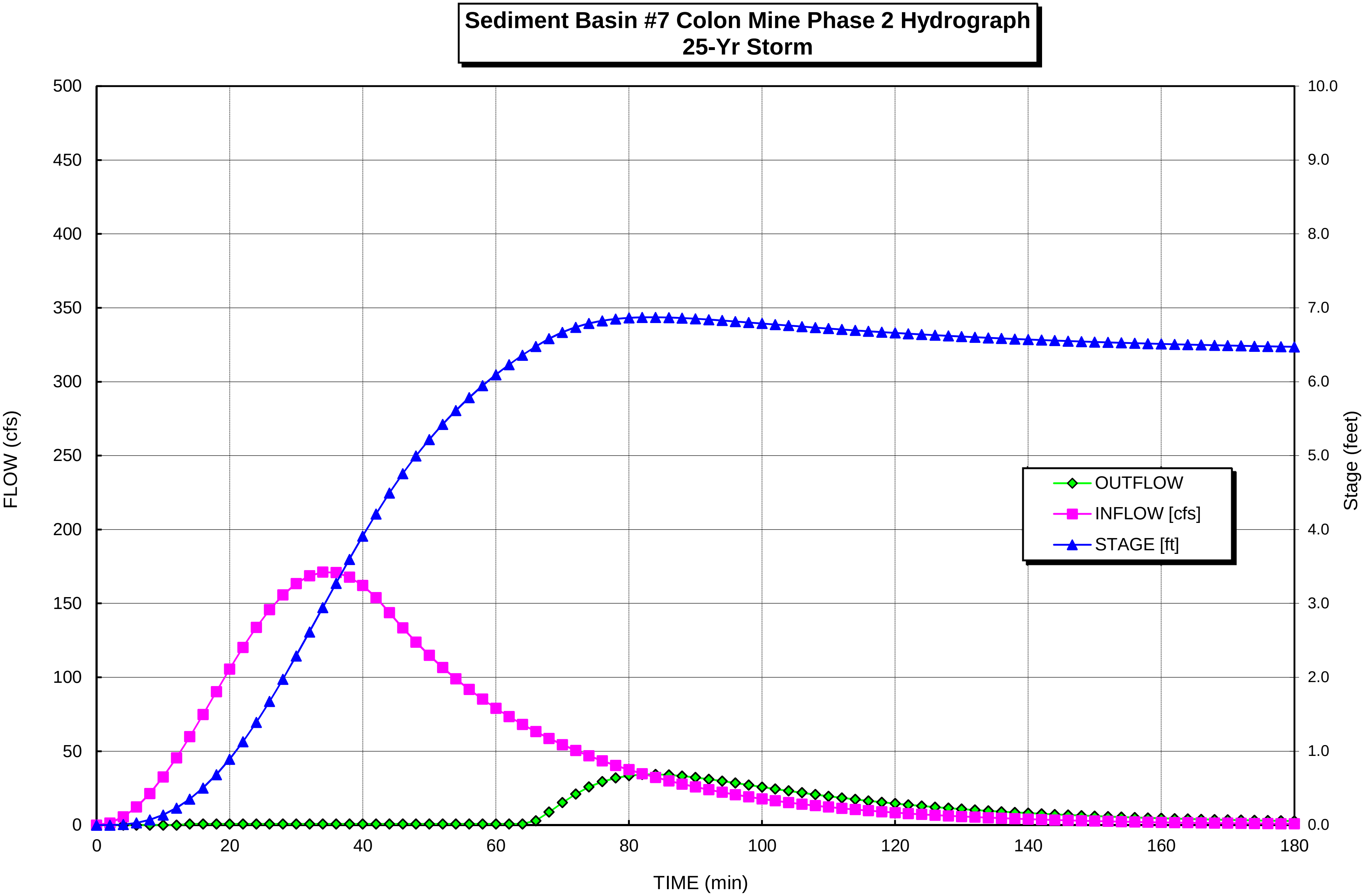
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.4	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	5.5	167	0.0	0.00	0.00	0.00	0.00	0.00	58.92	26,780	N/A
6	12.3	830	0.0	0.00	0.00	0.00	0.00	0.00	71.60	32,544	N/A
8	21.4	2,301	0.1	0.00	0.00	0.00	0.00	0.00	81.05	36,841	N/A
10	32.6	4,868	0.1	0.00	0.00	0.00	0.00	0.00	88.78	40,355	N/A
12	45.5	8,779	0.2	0.00	0.00	0.00	0.00	0.00	95.38	43,355	N/A
14	59.8	14,244	0.4	0.38	0.38	0.00	0.38	0.75	101.16	45,983	100%
16	74.9	21,327	0.5	0.38	0.38	0.00	0.38	0.75	106.25	48,297	100%
18	90.3	30,220	0.7	0.38	0.38	0.00	0.38	0.75	110.85	50,388	100%
20	105.6	40,965	0.9	0.38	0.38	0.00	0.38	0.75	115.03	52,287	100%
22	120.2	53,545	1.1	0.38	0.38	0.00	0.38	0.75	118.84	54,018	100%
24	133.7	67,882	1.4	0.38	0.38	0.00	0.38	0.75	122.32	55,600	100%
26	145.7	83,841	1.7	0.38	0.38	0.00	0.38	0.75	125.50	57,046	100%
28	155.7	101,234	2.0	0.38	0.38	0.00	0.38	0.75	128.41	58,369	100%
30	163.4	119,827	2.3	0.38	0.38	0.00	0.38	0.75	131.07	59,578	100%
32	168.6	139,348	2.6	0.38	0.38	0.00	0.38	0.75	133.50	60,681	100%
34	171.1	159,493	2.9	0.38	0.38	0.00	0.38	0.75	135.71	61,686	100%
36	170.9	179,939	3.3	0.38	0.38	0.00	0.38	0.75	137.71	62,598	100%
38	167.8	200,352	3.6	0.38	0.38	0.00	0.38	0.75	139.53	63,421	100%
40	162.1	220,399	3.9	0.38	0.38	0.00	0.38	0.75	141.15	64,161	100%
42	153.9	239,762	4.2	0.38	0.38	0.00	0.38	0.75	142.61	64,821	100%
44	143.8	258,141	4.5	0.38	0.38	0.00	0.38	0.75	143.89	65,406	100%
46	133.4	275,302	4.8	0.38	0.38	0.00	0.38	0.75	145.02	65,920	100%
48	123.8	291,222	5.0	0.38	0.38	0.00	0.38	0.75	146.02	66,372	100%
50	114.9	305,989	5.2	0.38	0.38	0.00	0.38	0.75	146.90	66,773	100%
52	106.6	319,686	5.4	0.38	0.38	0.00	0.38	0.75	147.68	67,129	100%
54	99.0	332,391	5.6	0.38	0.38	0.00	0.38	0.75	148.39	67,448	100%
56	91.8	344,175	5.8	0.38	0.38	0.00	0.38	0.75	149.02	67,735	100%
58	85.2	355,104	5.9	0.38	0.38	0.00	0.38	0.75	149.58	67,993	100%
60	79.1	365,240	6.1	0.38	0.38	0.00	0.38	0.75	150.10	68,226	100%
62	73.4	374,640	6.2	0.38	0.38	0.00	0.38	0.75	150.56	68,437	100%
64	68.1	383,357	6.4	0.38	0.38	0.00	0.38	0.75	150.98	68,629	100%
66	63.2	391,440	6.5	0.38	1.48	0.00	35.34	2.97	151.37	68,803	100%
68	58.7	398,668	6.6	0.38	4.40	0.00	35.68	8.80	151.70	68,956	100%
70	54.4	404,652	6.7	0.38	7.59	0.00	35.96	15.19	151.98	69,081	99%
72	50.5	409,362	6.7	0.38	10.51	0.00	36.17	21.01	152.19	69,179	98%
74	46.9	412,902	6.8	0.38	12.90	0.00	36.33	25.80	152.35	69,251	98%
76	43.5	415,432	6.8	0.38	14.71	0.00	36.45	29.42	152.47	69,303	97%
78	40.4	417,123	6.8	0.38	15.96	0.00	36.52	31.92	152.54	69,337	97%
80	37.5	418,137	6.9	0.38	16.73	0.00	36.57	33.46	152.59	69,357	96%
82	34.8	418,618	6.9	0.38	17.10	0.00	36.59	34.20	152.61	69,367	96%
84	32.3	418,687	6.9	0.38	17.15	0.00	36.60	34.30	152.61	69,368	96%

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _2__of __2_

86	29.9	418,443	6.9	0.38	16.96	0.00	36.58	33.93	152.60	69,363	96%
88	27.8	417,965	6.9	0.38	16.60	0.00	36.56	33.20	152.58	69,354	96%
90	25.8	417,316	6.9	0.38	16.11	0.00	36.53	32.22	152.55	69,341	96%
92	23.9	416,545	6.8	0.38	15.53	0.00	36.50	31.06	152.52	69,325	97%
94	22.2	415,690	6.8	0.38	14.90	0.00	36.46	29.80	152.48	69,308	97%
96	20.6	414,780	6.8	0.38	14.23	0.00	36.42	28.47	152.44	69,289	97%
98	19.1	413,837	6.8	0.38	13.56	0.00	36.38	27.12	152.39	69,270	97%
100	17.8	412,878	6.8	0.38	12.88	0.00	36.33	25.77	152.35	69,251	98%
102	16.5	411,916	6.8	0.38	12.22	0.00	36.29	24.43	152.31	69,231	98%
104	15.3	410,961	6.8	0.38	11.57	0.00	36.25	23.13	152.27	69,211	98%
106	14.2	410,020	6.7	0.38	10.94	0.00	36.20	21.88	152.22	69,192	98%
108	13.2	409,097	6.7	0.38	10.33	0.00	36.16	20.67	152.18	69,173	98%
110	12.2	408,197	6.7	0.38	9.76	0.00	36.12	19.51	152.14	69,155	98%
112	11.3	407,322	6.7	0.38	9.20	0.00	36.08	18.41	152.10	69,137	99%
114	10.5	406,473	6.7	0.38	8.68	0.00	36.04	17.36	152.06	69,119	99%
116	9.8	405,652	6.7	0.38	8.18	0.00	36.00	16.37	152.02	69,102	99%
118	9.1	404,860	6.7	0.38	7.72	0.00	35.97	15.43	151.99	69,086	99%
120	8.4	404,096	6.7	0.38	7.27	0.00	35.93	14.54	151.95	69,070	99%
122	7.8	403,360	6.6	0.38	6.85	0.00	35.90	13.71	151.92	69,054	99%
124	7.2	402,652	6.6	0.38	6.46	0.00	35.87	12.92	151.89	69,040	99%
126	6.7	401,971	6.6	0.38	6.09	0.00	35.83	12.17	151.86	69,025	99%
128	6.2	401,317	6.6	0.38	5.74	0.00	35.80	11.47	151.83	69,012	99%
130	5.8	400,688	6.6	0.38	5.41	0.00	35.78	10.82	151.80	68,999	99%
132	5.4	400,085	6.6	0.38	5.10	0.00	35.75	10.20	151.77	68,986	100%
134	5.0	399,506	6.6	0.38	4.81	0.00	35.72	9.62	151.74	68,974	100%
136	4.6	398,950	6.6	0.38	4.54	0.00	35.69	9.07	151.72	68,962	100%
138	4.3	398,417	6.6	0.38	4.28	0.00	35.67	8.56	151.69	68,951	100%
140	4.0	397,905	6.6	0.38	4.04	0.00	35.65	8.08	151.67	68,940	100%
142	3.7	397,414	6.6	0.38	3.81	0.00	35.62	7.62	151.65	68,930	100%
144	3.4	396,943	6.6	0.38	3.60	0.00	35.60	7.20	151.62	68,920	100%
146	3.2	396,491	6.6	0.38	3.40	0.00	35.58	6.80	151.60	68,910	100%
148	3.0	396,058	6.5	0.38	3.21	0.00	35.56	6.42	151.58	68,901	100%
150	2.7	395,642	6.5	0.38	3.03	0.00	35.54	6.07	151.56	68,892	100%
152	2.5	395,243	6.5	0.38	2.87	0.00	35.52	5.74	151.54	68,884	100%
154	2.4	394,860	6.5	0.38	2.71	0.00	35.50	5.43	151.53	68,876	100%
156	2.2	394,492	6.5	0.38	2.57	0.00	35.49	5.13	151.51	68,868	100%
158	2.0	394,139	6.5	0.38	2.43	0.00	35.47	4.86	151.49	68,860	100%
160	1.9	393,800	6.5	0.38	2.30	0.00	35.46	4.60	151.48	68,853	100%
162	1.8	393,474	6.5	0.38	2.18	0.00	35.44	4.36	151.46	68,846	100%
164	1.6	393,161	6.5	0.38	2.07	0.00	35.43	4.13	151.45	68,840	100%
166	1.5	392,860	6.5	0.38	1.96	0.00	35.41	3.92	151.43	68,833	100%
168	1.4	392,572	6.5	0.38	1.86	0.00	35.40	3.71	151.42	68,827	100%
170	1.3	392,294	6.5	0.38	1.76	0.00	35.38	3.52	151.41	68,821	100%
172	1.2	392,027	6.5	0.38	1.67	0.00	35.37	3.35	151.39	68,816	100%
174	1.1	391,770	6.5	0.38	1.59	0.00	35.36	3.18	151.38	68,810	100%
176	1.0	391,523	6.5	0.38	1.51	0.00	35.35	3.02	151.37	68,805	100%
178	1.0	391,285	6.5	0.38	1.44	0.00	35.34	2.87	151.36	68,800	100%
180	0.9	391,056	6.5	0.38	1.37	0.00	35.33	2.73	151.35	68,795	100%
182	0.8	390,836	6.5	0.38	1.30	0.00	35.32	2.60	151.34	68,790	100%
184	0.8	390,623	6.5	0.38	1.24	0.00	35.31	2.48	151.33	68,785	100%
186	0.7	390,418	6.5	0.38	1.18	0.00	35.30	2.36	151.32	68,781	100%
188	0.7	390,221	6.5	0.38	1.12	0.00	35.29	2.25	151.31	68,777	100%
190	0.6	390,031	6.5	0.38	1.07	0.00	35.28	2.15	151.30	68,773	100%
192	0.6	389,847	6.5	0.38	1.02	0.00	35.27	2.05	151.29	68,769	100%
194	0.5	389,670	6.5	0.38	0.98	0.00	35.26	1.96	151.28	68,765	100%
196	0.5	389,498	6.4	0.38	0.94	0.00	35.25	1.87	151.28	68,761	100%
198	0.5	389,333	6.4	0.38	0.89	0.00	35.25	1.79	151.27	68,758	100%
200	0.4	389,173	6.4	0.38	0.86	0.00	35.24	1.71	151.26	68,754	100%
202	0.4	389,019	6.4	0.38	0.82	0.00	35.23	1.64	151.25	68,751	100%
204	0.4	388,869	6.4	0.38	0.79	0.00	35.22	1.57	151.25	68,748	100%
206	0.3	388,724	6.4	0.38	0.75	0.00	35.22	1.51	151.24	68,745	100%


Sediment Basin #7 Colon Mine Phase 2 Hydrograph
25-Yr Storm
FLOW (cfs)
500
450
400
350
300
250
200
150
100
50
0
Stage (feet)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
20
40
60
80
100
120
140
160
180
TIME (min)
OUTFLOW
INFLOW [cfs]
STAGE [ft]

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of __2__

Sediment Basin # 7 Colon

Phase 2

100 - year Storm Event

Qp = 230.4 cfs
Tp = 35.2 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 46,662

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 24 (in)
Height of Riser above barrel = 4.4 (ft)
Height of Riser from bottom of barrel= 6.4 (ft) elevation 244.40
Emergency Spillway = 6.9 (ft) elevation 244.90
Total Height of Dam = 7.5 (ft) elevation 245.50
Length of Emergency Spillway = 20 (ft)
Diameter of Riser = 60 (in)
Permanent Pond Stage = 0 (ft) elevation 238.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

83% Minimum Settling Efficiency
7.4 ft Maximum Stage 245.4 msl elevation
97.5 cfs Peak outflow
76.4 cfs Peak Riser/Barrel outflow
21.1 cfs peak weir flow

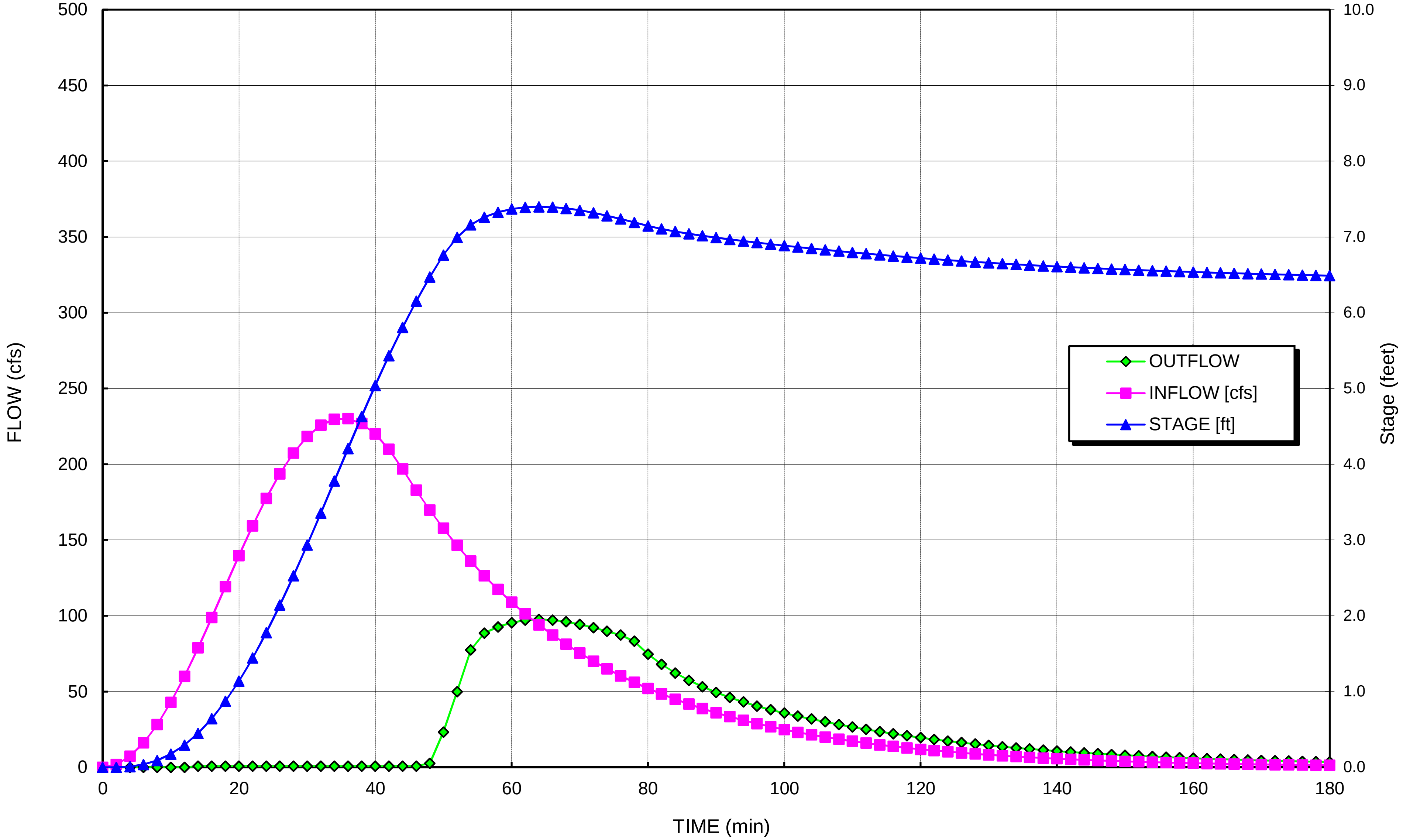
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.8	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	7.3	220	0.0	0.00	0.00	0.00	0.00	0.00	60.91	27,686	N/A
6	16.1	1,091	0.0	0.00	0.00	0.00	0.00	0.00	74.02	33,645	N/A
8	28.1	3,027	0.1	0.00	0.00	0.00	0.00	0.00	83.80	38,089	N/A
10	42.9	6,403	0.2	0.00	0.00	0.00	0.00	0.00	91.79	41,723	N/A
12	60.0	11,554	0.3	0.00	0.00	0.00	0.00	0.00	98.62	44,828	N/A
14	78.8	18,753	0.4	0.38	0.38	0.00	0.38	0.75	104.60	47,547	100%
16	98.8	28,121	0.6	0.38	0.38	0.00	0.38	0.75	109.89	49,949	100%
18	119.3	39,888	0.9	0.38	0.38	0.00	0.38	0.75	114.66	52,118	100%
20	139.7	54,116	1.1	0.38	0.38	0.00	0.38	0.75	118.99	54,088	100%
22	159.3	70,788	1.4	0.38	0.38	0.00	0.38	0.75	122.94	55,884	100%
24	177.5	89,813	1.8	0.38	0.38	0.00	0.38	0.75	126.56	57,525	100%
26	193.7	111,021	2.1	0.38	0.38	0.00	0.38	0.75	129.86	59,027	100%
28	207.4	134,175	2.5	0.38	0.38	0.00	0.38	0.75	132.89	60,403	100%
30	218.2	158,976	2.9	0.38	0.38	0.00	0.38	0.75	135.66	61,662	100%
32	225.7	185,072	3.4	0.38	0.38	0.00	0.38	0.75	138.19	62,812	100%
34	229.7	212,070	3.8	0.38	0.38	0.00	0.38	0.75	140.49	63,861	100%
36	230.1	239,548	4.2	0.38	0.38	0.00	0.38	0.75	142.59	64,814	100%
38	226.8	267,070	4.6	0.38	0.38	0.00	0.38	0.75	144.49	65,677	100%
40	220.0	294,198	5.0	0.38	0.38	0.00	0.38	0.75	146.20	66,454	100%
42	209.8	320,505	5.4	0.38	0.38	0.00	0.38	0.75	147.73	67,150	100%
44	196.9	345,593	5.8	0.38	0.38	0.00	0.38	0.75	149.09	67,769	100%
46	182.9	369,129	6.2	0.38	0.38	0.00	0.38	0.75	150.29	68,314	100%
48	169.8	390,983	6.5	0.38	1.34	0.00	35.32	2.69	151.35	68,793	100%
50	157.8	411,042	6.8	0.38	11.62	0.00	36.25	23.24	152.27	69,213	98%
52	146.5	427,183	7.0	0.38	24.09	1.72	36.97	49.90	152.98	69,538	93%
54	136.1	438,778	7.2	0.38	34.73	7.96	37.48	77.42	153.48	69,765	87%
56	126.4	445,818	7.3	0.38	41.79	13.01	37.79	88.59	153.78	69,900	85%
58	117.4	450,355	7.3	0.38	46.55	16.67	37.99	92.64	153.97	69,986	84%
60	109.0	453,325	7.4	0.38	49.76	19.23	38.11	95.45	154.09	70,042	84%
62	101.3	454,956	7.4	0.38	51.56	20.68	38.18	97.04	154.16	70,073	83%
64	94.1	455,464	7.4	0.38	52.12	21.14	38.20	97.54	154.18	70,082	83%
66	87.4	455,047	7.4	0.38	51.66	20.76	38.19	97.13	154.16	70,074	83%
68	81.1	453,875	7.4	0.38	50.37	19.71	38.14	95.98	154.12	70,052	84%
70	75.4	452,095	7.4	0.38	48.43	18.15	38.06	94.27	154.04	70,019	84%
72	70.0	449,826	7.3	0.38	45.99	16.23	37.96	92.16	153.95	69,976	84%
74	65.0	447,168	7.3	0.38	43.19	14.07	37.85	89.77	153.84	69,926	85%
76	60.4	444,198	7.2	0.38	40.13	11.78	37.72	87.22	153.71	69,869	85%
78	56.1	440,978	7.2	0.38	36.89	9.45	37.58	83.23	153.58	69,807	86%
80	52.1	437,721	7.1	0.38	33.71	7.28	37.44	74.69	153.44	69,744	88%
82	48.4	435,009	7.1	0.38	31.13	5.61	37.32	67.88	153.32	69,692	89%
84	44.9	432,669	7.1	0.38	28.97	4.30	37.22	62.23	153.22	69,646	91%

86	41.7	430,594	7.0	0.38	27.09	3.23	37.13	57.41	153.13	69,605	92%
88	38.8	428,714	7.0	0.38	25.42	2.36	37.04	53.20	153.05	69,568	92%
90	36.0	426,982	7.0	0.38	23.92	1.64	36.97	49.47	152.97	69,534	93%
92	33.4	425,366	7.0	0.38	22.54	1.05	36.89	46.13	152.90	69,502	94%
94	31.1	423,843	6.9	0.38	21.27	0.58	36.83	43.12	152.84	69,472	94%
96	28.9	422,396	6.9	0.38	20.08	0.23	36.76	40.40	152.77	69,443	95%
98	26.8	421,010	6.9	0.38	18.97	0.02	36.70	37.96	152.71	69,415	95%
100	24.9	419,670	6.9	0.38	17.91	0.00	36.64	35.83	152.65	69,388	96%
102	23.1	418,357	6.9	0.38	16.90	0.00	36.58	33.80	152.60	69,362	96%
104	21.5	417,076	6.8	0.38	15.93	0.00	36.52	31.85	152.54	69,336	97%
106	19.9	415,829	6.8	0.38	15.00	0.00	36.47	30.00	152.48	69,311	97%
108	18.5	414,622	6.8	0.38	14.12	0.00	36.41	28.24	152.43	69,286	97%
110	17.2	413,456	6.8	0.38	13.29	0.00	36.36	26.58	152.38	69,262	97%
112	16.0	412,331	6.8	0.38	12.50	0.00	36.31	25.00	152.33	69,239	98%
114	14.8	411,247	6.8	0.38	11.76	0.00	36.26	23.52	152.28	69,217	98%
116	13.8	410,206	6.7	0.38	11.06	0.00	36.21	22.12	152.23	69,196	98%
118	12.8	409,205	6.7	0.38	10.40	0.00	36.17	20.81	152.19	69,175	98%
120	11.9	408,244	6.7	0.38	9.79	0.00	36.12	19.57	152.14	69,156	98%
122	11.0	407,322	6.7	0.38	9.21	0.00	36.08	18.41	152.10	69,137	99%
124	10.3	406,438	6.7	0.38	8.66	0.00	36.04	17.32	152.06	69,118	99%
126	9.5	405,591	6.7	0.38	8.15	0.00	36.00	16.30	152.02	69,101	99%
128	8.8	404,779	6.7	0.38	7.67	0.00	35.96	15.33	151.98	69,084	99%
130	8.2	404,000	6.7	0.38	7.22	0.00	35.93	14.43	151.95	69,068	99%
132	7.6	403,254	6.6	0.38	6.79	0.00	35.89	13.59	151.91	69,052	99%
134	7.1	402,540	6.6	0.38	6.40	0.00	35.86	12.79	151.88	69,037	99%
136	6.6	401,855	6.6	0.38	6.02	0.00	35.83	12.05	151.85	69,023	99%
138	6.1	401,200	6.6	0.38	5.68	0.00	35.80	11.35	151.82	69,009	99%
140	5.7	400,572	6.6	0.38	5.35	0.00	35.77	10.70	151.79	68,996	99%
142	5.3	399,970	6.6	0.38	5.04	0.00	35.74	10.08	151.76	68,984	100%
144	4.9	399,393	6.6	0.38	4.75	0.00	35.72	9.51	151.74	68,971	100%
146	4.6	398,841	6.6	0.38	4.48	0.00	35.69	8.96	151.71	68,960	100%
148	4.2	398,311	6.6	0.38	4.23	0.00	35.67	8.46	151.69	68,949	100%
150	3.9	397,803	6.6	0.38	3.99	0.00	35.64	7.98	151.66	68,938	100%
152	3.6	397,317	6.6	0.38	3.77	0.00	35.62	7.53	151.64	68,928	100%
154	3.4	396,851	6.6	0.38	3.56	0.00	35.60	7.11	151.62	68,918	100%
156	3.1	396,403	6.5	0.38	3.36	0.00	35.58	6.72	151.60	68,908	100%
158	2.9	395,974	6.5	0.38	3.18	0.00	35.56	6.35	151.58	68,899	100%
160	2.7	395,563	6.5	0.38	3.00	0.00	35.54	6.00	151.56	68,891	100%
162	2.5	395,168	6.5	0.38	2.84	0.00	35.52	5.68	151.54	68,882	100%
164	2.3	394,789	6.5	0.38	2.69	0.00	35.50	5.37	151.52	68,874	100%
166	2.2	394,426	6.5	0.38	2.54	0.00	35.48	5.08	151.51	68,867	100%
168	2.0	394,077	6.5	0.38	2.41	0.00	35.47	4.81	151.49	68,859	100%
170	1.9	393,742	6.5	0.38	2.28	0.00	35.45	4.56	151.47	68,852	100%
172	1.7	393,420	6.5	0.38	2.16	0.00	35.44	4.32	151.46	68,845	100%
174	1.6	393,111	6.5	0.38	2.05	0.00	35.42	4.09	151.44	68,839	100%
176	1.5	392,814	6.5	0.38	1.94	0.00	35.41	3.88	151.43	68,832	100%
178	1.4	392,528	6.5	0.38	1.84	0.00	35.40	3.68	151.42	68,826	100%
180	1.3	392,253	6.5	0.38	1.75	0.00	35.38	3.50	151.40	68,820	100%
182	1.2	391,989	6.5	0.38	1.66	0.00	35.37	3.32	151.39	68,815	100%
184	1.1	391,735	6.5	0.38	1.58	0.00	35.36	3.16	151.38	68,809	100%
186	1.0	391,491	6.5	0.38	1.50	0.00	35.35	3.00	151.37	68,804	100%
188	1.0	391,255	6.5	0.38	1.43	0.00	35.34	2.85	151.36	68,799	100%
190	0.9	391,029	6.5	0.38	1.36	0.00	35.33	2.72	151.35	68,794	100%
192	0.8	390,810	6.5	0.38	1.29	0.00	35.32	2.59	151.34	68,790	100%
194	0.8	390,600	6.5	0.38	1.23	0.00	35.31	2.46	151.33	68,785	100%
196	0.7	390,397	6.5	0.38	1.17	0.00	35.30	2.35	151.32	68,781	100%
198	0.7	390,202	6.5	0.38	1.12	0.00	35.29	2.24	151.31	68,776	100%
200	0.6	390,013	6.5	0.38	1.07	0.00	35.28	2.14	151.30	68,772	100%
202	0.6	389,831	6.5	0.38	1.02	0.00	35.27	2.04	151.29	68,769	100%
204	0.5	389,655	6.5	0.38	0.97	0.00	35.26	1.95	151.28	68,765	100%

Sediment Basin #7 Colon Mine Phase 2 Hydrograph
100-Yr Storm



Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #8	Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1		
Storm Event (yrs) =	10		
Total Drainage Area A (ac) =	11.8		
Disturbed Area (ac) =	11.8		
Curve Number CN =	86	Hydrographs	
Rainfall Depth P (in) =	5.28	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	71.25	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	21,240	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	30,994	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.
Calculate Volume of the Basin using Truncated Pyramid Method.
Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
273	0	5,639	-	-	-
274	1	18,291	11,362	11,362	421
275	2	28,277	23,103	34,465	1,276
276	3	38,333	33,178	67,643	2,505
277	4	47,710	42,936	110,579	4,096
278	5	59,010	53,260	163,839	6,068
279	6	69,292	64,082	227,922	8,442

Design Sediment Depth (ft) = 3
Sediment Storage (cf) = 67,643 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3
Surface Area (sf) = 38,333 *Required Surface Area Achieved*

HDR Computation

Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #8	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) = 67,643

Number of Skimmers 1

Days to Drain = 5 *assumed*

Q each (cf/day) = 13,529 0.16 cfs

Selected Skimmer Size (inches) = 4

Head on Skimmer (feet) = 0.333

Diameter of Orifice (inches) = 3.2

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

S = (1000/CN) - 10

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase 1

Storm Event (yrs) = 10

S = 1.63

Runoff Depth Q* (inches) = 3.73

Time to Peak T_p (min) = 26.88

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 67,643

Z_2 (ft) = 6 S_2 (cf) = 227,922

b = $\ln(S_2/S_1)/\ln(Z_2/Z_1)$ = 1.8 Ref 2, III-8

$K_S = S_2/Z_2^{\,b}$ = 9,864

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #8	Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (v) = 1.14E-06 n^2 / sec @ 20^o C Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / v] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 5.00

Set Top of Dam at (ft) = 6.00

See Hydrograph

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 2

Use Anti-Seep Collar Size (ft) = 2 x 2

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 12 From Hydrograph

Avg Density of Concrete (lbs/cf) = 87.6

Density of Water (lbs/cf) = 62.4

Riser Displacement (cf) = 3.93 Pi * $(D_R/24)^2$ * Total Ht of Riser

Convert cf to cy = 27^{-1}

Min Concrete Needed (cy) = 0.10

Width & Length (ft) = 2

Thickness (ft) = 0.7

Anti-Vortex Device:

Diameter of Riser (in) = 12 From Hydrograph

Cylinder Diameter (in) = 18 Ref 3, III-104, Table 3.14-D

Cylinder Thickness (gage) = 16

Cylinder Height (in) = 6

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #8	Sheet: 4	Of: 4

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{\ req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n =	0.069	6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) =	9	Permissible Velocity for lining
Side Slope (z) =	5	enter X for X:1
s (ft/ft) =	0.02	Outlet Slope (estimated)
Bottom Width (ft) =	6	6 * Barrel Diameter
Q_B (cfs) =	0.2	Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
0.2	0.05	0.06	0.4	0.05	0.05	0.4

Flow Depth = Tailwater, d (ft) = 0.06 0.5* Barrel Diameter (ft) = 0.50 Ref 1, 8.06.3

Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe

Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
1	3	10	11	0.3	Class A

Conclusion Temporary basin, the 25 yr and 100 storms were not routed

The basin can contain the 10-yr storm.

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) = 12

Circumference of Riser (in) = 37.7

eight of Riser from bottom of barrel (in) = 60 From Hydrograph

Vertical spacing between holes (in) = 0 center to center

Water Stage increment (ft) 0.05

Orifice Equation

$$Q = C_d * A * (2 * g * h)^{0.5}$$ Ref 1, p III-11

Q = cfs, discharge

C_d = 0.6 coefficient of discharge

A = sf, cross sectional area

g = 32.2 ft/sec^2, gravity

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

	Perforations					Skimmer	
Row	1	2	3	4	5	1	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.16	0.16
0.39	0.00	0.00	0.00			0.16	0.16
0.44	0.00	0.00	0.00			0.16	0.16
0.49	0.00	0.00	0.00			0.16	0.16
0.54	0.00	0.00	0.00			0.16	0.16
0.59	0.00	0.00	0.00			0.16	0.16
0.64	0.00	0.00	0.00			0.16	0.16
0.69	0.00	0.00	0.00			0.16	0.16
0.74	0.00	0.00	0.00			0.16	0.16
0.79	0.00	0.00	0.00			0.16	0.16
0.84	0.00	0.00	0.00			0.16	0.16
0.89	0.00	0.00	0.00			0.16	0.16
0.94	0.00	0.00	0.00			0.16	0.16
0.99	0.00	0.00	0.00			0.16	0.16
1.04	0.00	0.00	0.00			0.16	0.16
1.09	0.00	0.00	0.00			0.16	0.16
1.14	0.00	0.00	0.00			0.16	0.16
1.19	0.00	0.00	0.00			0.16	0.16
1.24	0.00	0.00	0.00			0.16	0.16
1.29	0.00	0.00	0.00			0.16	0.16
1.34	0.00	0.00	0.00			0.16	0.16
1.39	0.00	0.00	0.00			0.16	0.16
1.44	0.00	0.00	0.00			0.16	0.16
1.49	0.00	0.00	0.00			0.16	0.16
1.54	0.00	0.00	0.00			0.16	0.16
1.59	0.00	0.00	0.00			0.16	0.16

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.16	0.16
1.69	0.00	0.00	0.00	0.16	0.16
1.74	0.00	0.00	0.00	0.16	0.16
1.79	0.00	0.00	0.00	0.16	0.16
1.84	0.00	0.00	0.00	0.16	0.16
1.89	0.00	0.00	0.00	0.16	0.16
1.94	0.00	0.00	0.00	0.16	0.16
1.99	0.00	0.00	0.00	0.16	0.16
2.04	0.00	0.00	0.00	0.16	0.16
2.09	0.00	0.00	0.00	0.16	0.16
2.14	0.00	0.00	0.00	0.16	0.16
2.19	0.00	0.00	0.00	0.16	0.16
2.24	0.00	0.00	0.00	0.16	0.16
2.29	0.00	0.00	0.00	0.16	0.16
2.34	0.00	0.00	0.00	0.16	0.16
2.39	0.00	0.00	0.00	0.16	0.16
2.44	0.00	0.00	0.00	0.16	0.16
2.49	0.00	0.00	0.00	0.16	0.16
2.54	0.00	0.00	0.00	0.16	0.16
2.59	0.00	0.00	0.00	0.16	0.16
2.64	0.00	0.00	0.00	0.16	0.16
2.69	0.00	0.00	0.00	0.16	0.16
2.74	0.00	0.00	0.00	0.16	0.16
2.79	0.00	0.00	0.00	0.16	0.16
2.84	0.00	0.00	0.00	0.16	0.16
2.89	0.00	0.00	0.00	0.16	0.16
2.94	0.00	0.00	0.00	0.16	0.16
2.99	0.00	0.00	0.00	0.16	0.16
3.04	0.00	0.00	0.00	0.16	0.16
3.09	0.00	0.00	0.00	0.16	0.16
3.14	0.00	0.00	0.00	0.16	0.16
3.19	0.00	0.00	0.00	0.16	0.16
3.24	0.00	0.00	0.00	0.16	0.16
3.29	0.00	0.00	0.00	0.16	0.16
3.34	0.00	0.00	0.00	0.16	0.16
3.39	0.00	0.00	0.00	0.16	0.16
3.44	0.00	0.00	0.00	0.16	0.16
3.49	0.00	0.00	0.00	0.16	0.16
3.54	0.00	0.00	0.00	0.16	0.16
3.59	0.00	0.00	0.00	0.16	0.16
3.64	0.00	0.00	0.00	0.16	0.16
3.69	0.00	0.00	0.00	0.16	0.16
3.74	0.00	0.00	0.00	0.16	0.16
3.79	0.00	0.00	0.00	0.16	0.16
3.84	0.00	0.00	0.00	0.16	0.16
3.89	0.00	0.00	0.00	0.16	0.16
3.94	0.00	0.00	0.00	0.16	0.16
3.99	0.00	0.00	0.00	0.16	0.16

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of _2__

Sediment Basin # 8 Colon

Phase 1

10 - year Storm Event

Qp = 71.25 cfs
Tp = 26.88 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.8
K_s = 9,864

Number of Riser/Barrel Assemblies **1**
Diameter of Barrel = **12** (in)
Height of Riser above barrel = **4** (ft)
Height of Riser from bottom of barrel= **5** (ft) elevation 278.00
Emergency Spillway = **5.0** (ft) elevation 278.00
Total Height of Dam = **6.0** (ft) elevation 279.00
Length of Emergency Spillway = **10** (ft)
Diameter of Riser = **12** (in)
Permanent Pond Stage = **0** (ft) elevation 273.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)
100% Minimum Settling Efficiency
4.9 ft Maximum Stage 277.88 msl elevation
0.2 cfs Peak outflow
0.2 cfs Peak Riser/Barrel outflow
0.0 cfs Peak Weir flow

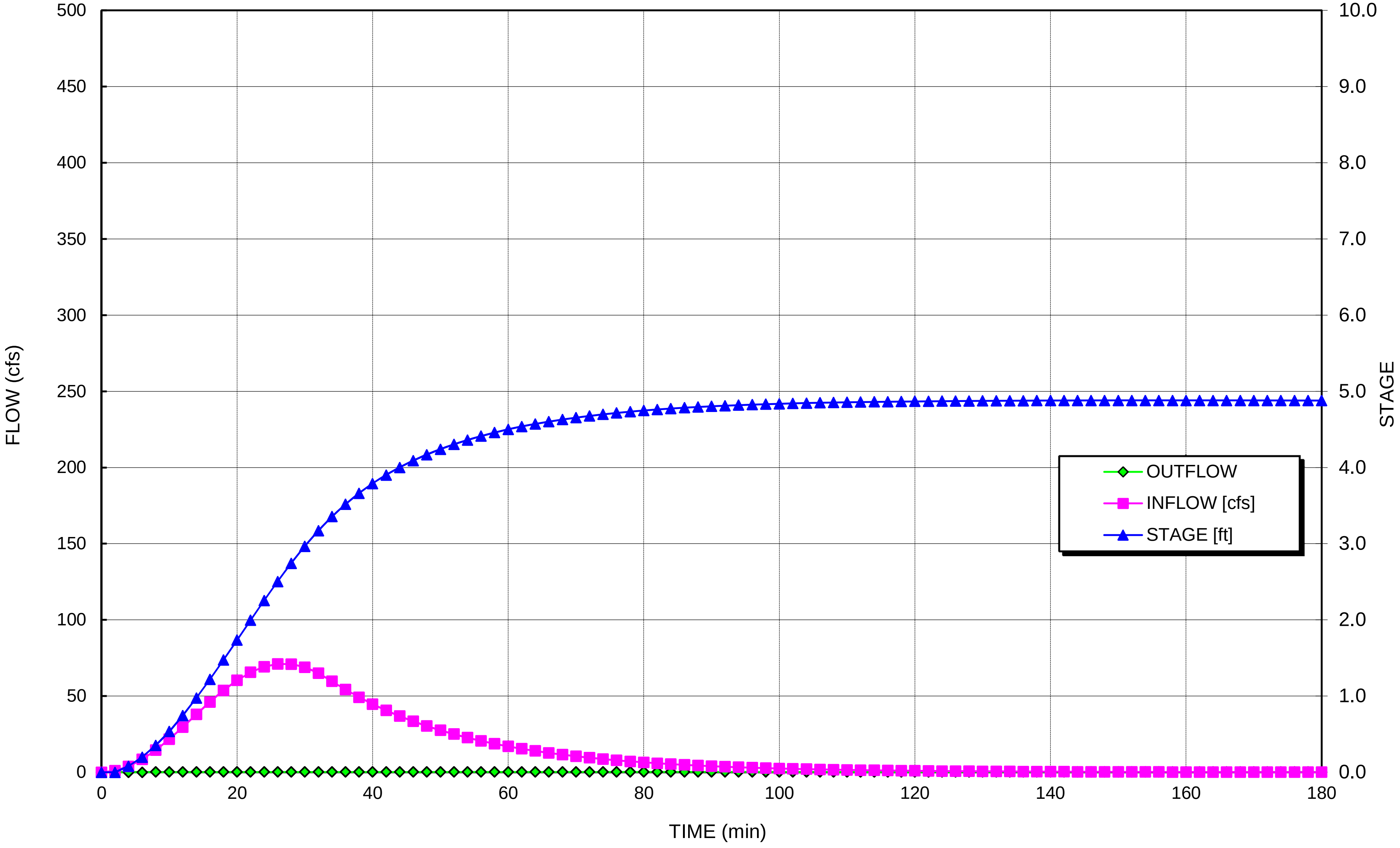
Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	3.8	116	0.1	0.00	0.00	0.00	0.00	0.00	5.65	2,568	N/A
6	8.4	575	0.2	0.00	0.00	0.00	0.00	0.00	11.22	5,101	N/A
8	14.5	1,584	0.4	0.16	0.16	0.00	0.16	0.16	17.34	7,881	100%
10	21.7	3,301	0.5	0.16	0.16	0.00	0.16	0.16	23.77	10,804	100%
12	29.7	5,884	0.7	0.16	0.16	0.00	0.16	0.16	30.47	13,848	100%
14	38.0	9,424	1.0	0.16	0.16	0.00	0.16	0.16	37.29	16,952	100%
16	46.1	13,960	1.2	0.16	0.16	0.00	0.16	0.16	44.15	20,067	100%
18	53.7	19,476	1.5	0.16	0.16	0.00	0.16	0.16	50.93	23,152	100%
20	60.3	25,904	1.7	0.16	0.16	0.00	0.16	0.16	57.57	26,168	100%
22	65.6	33,126	2.0	0.16	0.16	0.00	0.16	0.16	63.98	29,082	100%
24	69.2	40,980	2.3	0.16	0.16	0.00	0.16	0.16	70.10	31,865	100%
26	71.1	49,271	2.5	0.16	0.16	0.00	0.16	0.16	75.87	34,488	100%
28	70.9	57,780	2.7	0.16	0.16	0.00	0.16	0.16	81.25	36,930	100%
30	68.9	66,274	3.0	0.16	0.16	0.00	0.16	0.16	86.17	39,170	100%
32	65.1	74,525	3.2	0.16	0.16	0.00	0.16	0.16	90.63	41,194	100%
34	59.7	82,313	3.4	0.16	0.16	0.00	0.16	0.16	94.58	42,990	100%
36	54.2	89,462	3.5	0.16	0.16	0.00	0.16	0.16	98.02	44,555	100%
38	49.2	95,950	3.7	0.16	0.16	0.00	0.16	0.16	101.01	45,915	100%
40	44.7	101,837	3.8	0.16	0.16	0.00	0.16	0.16	103.63	47,104	100%
42	40.6	107,181	3.9	0.16	0.16	0.00	0.16	0.16	105.93	48,150	100%
44	36.8	112,029	4.0	0.16	0.16	0.00	0.16	0.16	107.96	49,074	100%
46	33.4	116,430	4.1	0.16	0.16	0.00	0.16	0.16	109.76	49,892	100%
48	30.3	120,422	4.2	0.16	0.16	0.00	0.16	0.16	111.36	50,620	100%
50	27.5	124,045	4.2	0.16	0.16	0.00	0.16	0.16	112.79	51,268	100%
52	25.0	127,333	4.3	0.16	0.16	0.00	0.16	0.16	114.06	51,847	100%
54	22.7	130,315	4.4	0.16	0.16	0.00	0.16	0.16	115.20	52,365	100%
56	20.6	133,021	4.4	0.16	0.16	0.00	0.16	0.16	116.22	52,830	100%
58	18.7	135,475	4.5	0.16	0.16	0.00	0.16	0.16	117.14	53,246	100%
60	17.0	137,702	4.5	0.16	0.16	0.00	0.16	0.16	117.96	53,620	100%
62	15.4	139,721	4.5	0.16	0.16	0.00	0.16	0.16	118.70	53,956	100%
64	14.0	141,553	4.6	0.16	0.16	0.00	0.16	0.16	119.37	54,259	100%
66	12.7	143,214	4.6	0.16	0.16	0.00	0.16	0.16	119.97	54,531	100%
68	11.5	144,720	4.6	0.16	0.16	0.00	0.16	0.16	120.51	54,777	100%
70	10.5	146,085	4.7	0.16	0.16	0.00	0.16	0.16	121.00	54,998	100%
72	9.5	147,323	4.7	0.16	0.16	0.00	0.16	0.16	121.44	55,198	100%
74	8.6	148,445	4.7	0.16	0.16	0.00	0.16	0.16	121.83	55,378	100%
76	7.8	149,462	4.7	0.16	0.16	0.00	0.16	0.16	122.19	55,540	100%
78	7.1	150,384	4.7	0.16	0.16	0.00	0.16	0.16	122.51	55,687	100%
80	6.5	151,218	4.7	0.16	0.16	0.00	0.16	0.16	122.80	55,820	100%
82	5.9	151,975	4.8	0.16	0.16	0.00	0.16	0.16	123.07	55,939	100%

84	5.3	152,659	4.8	0.16	0.16	0.00	0.16	0.16	123.30	56,047	100%
86	4.8	153,279	4.8	0.16	0.16	0.00	0.16	0.16	123.52	56,145	100%
88	4.4	153,840	4.8	0.16	0.16	0.00	0.16	0.16	123.71	56,233	100%
90	4.0	154,347	4.8	0.16	0.16	0.00	0.16	0.16	123.89	56,313	100%
92	3.6	154,806	4.8	0.16	0.16	0.00	0.16	0.16	124.05	56,385	100%
94	3.3	155,221	4.8	0.16	0.16	0.00	0.16	0.16	124.19	56,449	100%
96	3.0	155,596	4.8	0.16	0.16	0.00	0.16	0.16	124.32	56,508	100%
98	2.7	155,935	4.8	0.16	0.16	0.00	0.16	0.16	124.43	56,561	100%
100	2.5	156,240	4.8	0.16	0.16	0.00	0.16	0.16	124.54	56,608	100%
102	2.2	156,516	4.8	0.16	0.16	0.00	0.16	0.16	124.63	56,651	100%
104	2.0	156,765	4.8	0.16	0.16	0.00	0.16	0.16	124.72	56,690	100%
106	1.8	156,989	4.9	0.16	0.16	0.00	0.16	0.16	124.79	56,725	100%
108	1.7	157,190	4.9	0.16	0.16	0.00	0.16	0.16	124.86	56,756	100%
110	1.5	157,371	4.9	0.16	0.16	0.00	0.16	0.16	124.92	56,784	100%
112	1.4	157,534	4.9	0.16	0.16	0.00	0.16	0.16	124.98	56,809	100%
114	1.2	157,680	4.9	0.16	0.16	0.00	0.16	0.16	125.03	56,832	100%
116	1.1	157,811	4.9	0.16	0.16	0.00	0.16	0.16	125.07	56,852	100%
118	1.0	157,928	4.9	0.16	0.16	0.00	0.16	0.16	125.11	56,870	100%
120	0.9	158,033	4.9	0.16	0.16	0.00	0.16	0.16	125.15	56,886	100%
122	0.8	158,126	4.9	0.16	0.16	0.00	0.16	0.16	125.18	56,901	100%
124	0.8	158,209	4.9	0.16	0.16	0.00	0.16	0.16	125.21	56,913	100%
126	0.7	158,282	4.9	0.16	0.16	0.00	0.16	0.16	125.23	56,925	100%
128	0.6	158,347	4.9	0.16	0.16	0.00	0.16	0.16	125.26	56,935	100%
130	0.6	158,404	4.9	0.16	0.16	0.00	0.16	0.16	125.28	56,944	100%
132	0.5	158,455	4.9	0.16	0.16	0.00	0.16	0.16	125.29	56,951	100%
134	0.5	158,499	4.9	0.16	0.16	0.00	0.16	0.16	125.31	56,958	100%
136	0.4	158,537	4.9	0.16	0.16	0.00	0.16	0.16	125.32	56,964	100%
138	0.4	158,569	4.9	0.16	0.16	0.00	0.16	0.16	125.33	56,969	100%
140	0.4	158,598	4.9	0.16	0.16	0.00	0.16	0.16	125.34	56,973	100%
142	0.3	158,621	4.9	0.16	0.16	0.00	0.16	0.16	125.35	56,977	100%
144	0.3	158,641	4.9	0.16	0.16	0.00	0.16	0.16	125.36	56,980	100%
146	0.3	158,657	4.9	0.16	0.16	0.00	0.16	0.16	125.36	56,983	100%
148	0.2	158,671	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,985	100%
150	0.2	158,681	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,986	100%
152	0.2	158,688	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,987	100%
154	0.2	158,693	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,988	100%
156	0.2	158,696	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,989	100%
158	0.1	158,697	4.9	0.16	0.16	0.00	0.16	0.16	125.38	56,989	100%
160	0.1	158,696	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,989	100%
162	0.1	158,693	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,988	100%
164	0.1	158,689	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,988	100%
166	0.1	158,684	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,987	100%
168	0.1	158,677	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,986	100%
170	0.1	158,669	4.9	0.16	0.16	0.00	0.16	0.16	125.37	56,985	100%
172	0.1	158,660	4.9	0.16	0.16	0.00	0.16	0.16	125.36	56,983	100%
174	0.1	158,651	4.9	0.16	0.16	0.00	0.16	0.16	125.36	56,982	100%
176	0.1	158,640	4.9	0.16	0.16	0.00	0.16	0.16	125.36	56,980	100%
178	0.1	158,629	4.9	0.16	0.16	0.00	0.16	0.16	125.35	56,978	100%
180	0.1	158,617	4.9	0.16	0.16	0.00	0.16	0.16	125.35	56,976	100%
182	0.0	158,604	4.9	0.16	0.16	0.00	0.16	0.16	125.34	56,974	100%
184	0.0	158,591	4.9	0.16	0.16	0.00	0.16	0.16	125.34	56,972	100%
186	0.0	158,577	4.9	0.16	0.16	0.00	0.16	0.16	125.33	56,970	100%
188	0.0	158,563	4.9	0.16	0.16	0.00	0.16	0.16	125.33	56,968	100%
190	0.0	158,548	4.9	0.16	0.16	0.00	0.16	0.16	125.32	56,966	100%
192	0.0	158,533	4.9	0.16	0.16	0.00	0.16	0.16	125.32	56,964	100%
194	0.0	158,518	4.9	0.16	0.16	0.00	0.16	0.16	125.31	56,961	100%
196	0.0	158,502	4.9	0.16	0.16	0.00	0.16	0.16	125.31	56,959	100%
198	0.0	158,486	4.9	0.16	0.16	0.00	0.16	0.16	125.30	56,956	100%
200	0.0	158,470	4.9	0.16	0.16	0.00	0.16	0.16	125.30	56,954	100%
202	0.0	158,454	4.9	0.16	0.16	0.00	0.16	0.16	125.29	56,951	100%
204	0.0	158,437	4.9	0.16	0.16	0.00	0.16	0.16	125.29	56,949	100%
206	0.0	158,420	4.9	0.16	0.16	0.00	0.16	0.16	125.28	56,946	100%

Sediment Basin #8 Colon Mine Phase 1 Hydrograph
10-Yr Storm



HDR Computation

Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #9	Sheet: 1	Of: 4

Objective Design the sediment basin to contain the 10-year storm and pass the 100-year storm without over topping the berm.

References

1. NC Erosion and Sediment Control Planning and Design Manual.
2. "Elements of Urban Stormwater Design" by H. Rooney Malcom, P.E.
3. VA Erosion and Sediment Control Handbook
3. NOAA Atlas 14, Volume 2, Version 3

Given

Phase	1	2	2	2		
Storm Event (yrs) =	10	10	25	100		
Total Drainage Area A (ac) =	62.8	85.9	85.9	85.9		
Disturbed Area (ac) =	46.7	65.9	65.9	65.9		
Curve Number CN =	72	72	72	81	Hydrographs	
Rainfall Depth P (in) =	5.28	5.28	6.28	7.88	(24-hr rainfall)	Ref 3
Peak Flow Q_p (cfs) =	145.70	199.50	268.73	384.06	Hydrographs	

Design Criteria

Required sediment storage	1,800	cf / acre of drainage
Required sediment storage	154,620	cf (based on largest Phase)
Required Surface Area	435	sf/cfs of the 10-yr storm peak flow (based on the largest Phase in cfs)
Required Surface Area (SF)	86,783	of the 10-yr storm peak flow (based on the largest Phase)

Determine Shape of Basin:

Measure the area of the Basin using AutoCADD.

Calculate Volume of the Basin using Truncated Pyramid Method.

Shape factor used in hydrographs basin depth may be gretaer than indicated below

Elevation (ft)	Depth (ft)	Area (sf)	Volume (cf)	Cumulative Vol (cf)	Cumulative Vol (cy)
262	0	88,670	0	0	0
263	1	92,409	90,533	90,533	3,353
264	2	96,226	94,311	184,844	6,846
265	3	100,091	98,152	282,996	10,481
266	4	103,992	102,035	385,032	14,260
267	5	107,938	105,959	490,990	18,185
268	6	111,933	109,929	600,920	22,256

Design Sediment Depth (ft) = 3

Sediment Storage (cf) = 282,996 *Required Sediment Storage Achieved*

Design Surface Area Depth (ft) = 3

Surface Area (sf) = 100,091 *Required Surface Area Achieved*

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #9	Sheet: 2	Of: 4

Select Skimmer

A. R. Jarrett Method

$D = [Q / (2{,}310 * (H^{0.5})]^{0.5}$

D =Diameter of Orifice (inches)

Q = Dewater Rate (cf/day)

H = Head on orifice, varies based on skimmer size (ft)

Skimmer Sizes (Inches)	Head (ft)
1.5	0.125
2	0.167
2.5	0.167
3	0.250
4	0.333
5	0.333
6	0.417
8	0.500

Volume to Dewater (cf) =	282,996		
Number of Skimmers	2		
Days to Drain =	5	*assumed*	
Q each (cf/day) =	28,300		0.33 cfs

Selected Skimmer Size (inches) = 5

Head on Skimmer (feet) = 0.333

Diameter of Orifice (inches) = 4.6

Route the flow through the Basin

Riser is not perforated, but skimmer is attached.

$S = (1000/CN) - 10$

Runoff Depth Q* (inches) = $(P-0.2S)^2/(P+0.8S)$ Ref 2, III-4

T_P (min) = $60.5(Q^*)A/Q_P/1.39$

Phase	1	2	2	2
Storm Event (yrs) =	10	10	25	100
S =	3.89	3.89	3.89	2.35
Runoff Depth Q* (inches) =	2.42	2.42	3.22	5.63
Time to Peak T_p (min) =	45.32	45.27	44.85	54.80

Determine Pond Storage Elevation (Z_{Water}):

Pick one point near max expected water surface and the other at the mid depth.

Z_1 (ft) = 3 S_1 (cf)= 282,996

Z_2 (ft) = 6 S_2 (cf) = 600,920

$b = \ln(S_2/S_1)/\ln(Z_2/Z_1) =$ 1.1 Ref 2, III-8

$K_S = S_2/Z_2^{\,b} =$ 85,791

HDR Computation I Job No. 0453925-237673-018 I

Project: Charah Colon Mine		Computed: EAW	Date: 1/4/15
Subject: Permit Application		Checked: PAW	Date: 1/4/15
Task: Sediment Basin #9		Sheet: 3	Of: 4

Determine Settling Velocity

Conversion Factor = 3.281 ft/sec per m/sec

Gravitational Acceleration, g (m/s^2) = 9.81

Specific Gravity of soil (s_s)= 2.6

Kinematic Viscosity of water (ν) = 1.14E-06 n^2 / sec @ 20^o C — Ref 2, IV-11

Diameter of the Design Particle d_{15} = 40.00E-06 m

Design Particle Settling Velocity = $(g / 18) * [(s_s - 1) / \nu] d^2 =$ 4.02E-03 ft/sec

Route the Storm through the Basin using the Hydrograph Model

Set Height of Emergency Spillway at (ft) = 7.50

Set Top of Dam at (ft) = 8.50

See Hydrograph

Emergency Spillway

Q_E (cfs) = 100-Yr Storm

Q_E (cfs) = 133.2

Cross Section = Trapezoid

Channel Side Slope (z) = 5 (enter X for X:1)

n = 0.03 Grass Lined

Vp (ft/sec) = 5.0 Permissible Velocity for lining — Ref 2, II-7

Allowable Shear Stress (psf) = 2.0 Allowable Shear Stress for lining

Bottom Width, b (ft) = 50

Calculate Required Depth of Spillway:

Normal-Depth Procedure

$AR^{2/3}=Qn/1.49s^{0.5}$ — Q=VA

$Z_{req}=Qn/1.49s^{0.5}$ — Area (A)= bd+z(d^2)

$Z_{av}=AR^{2/3}$ — R=Area/(b+2d((z^2)+1)^.5)

Avg Shear Stress(T) = K_b*d*s*unit weight of water

Channel Slope ft/ft	Depth, d (ft)	A (sf)	Z_{req}	R	Z_{avail}	V (ft/sec)	T (psf)
0.01	0.68	36.24	26.82	0.64	26.82	3.7	0.4
0.02	0.55	29.17	18.97	0.52	18.97	4.6	0.7

Construct the channel to be : 50 ft, Bottom Width (measured at top of lining)

1.0 ft, depth (measured at top of lining)

1% slope

Anti-Seep Collar:

Anti-Seep Collar Size = 2 * Barrel Dia

Anti-Seep Collar Size (ft) = 7

Use Anti-Seep Collar Size (ft) = 7 x 7

HDR Computation Job No. 0453925-237673-018

Project:	Charah Colon Mine	Computed: EAW	Date: 1/4/15
Subject:	Permit Application	Checked: PAW	Date: 1/4/15
Task:	Sediment Basin #9	Sheet: 4	Of: 4

Minimum Concrete Base for Riser:

Diameter of Riser (in) = 72 From Hydrograph
Avg Density of Concrete (lbs/cf) = 87.6
Density of Water (lbs/cf) = 62.4
Riser Displacement (cf) = 203.58 $\text{Pi} * (D_R/24)^2 * \text{Total Ht of Riser}$
Convert cf to cy = 27^{-1}
Min Concrete Needed (cy) = 5.37
Width & Length (ft) = 7
Thickness (ft) = 3.0

Anti-Vortex Device:

Diameter of Riser (in) = 72 From Hydrograph
Cylinder Diameter (in) = 102 Ref 3, III-104, Table 3.14-D
Cylinder Thickness (gage) = 14
Cylinder Height (in) = 36

Determine Tailwater conditions to size outlet apron

Use Normal Depth Procedure (Manning's Eqn.) Ref 2, II-7

$A*R^{2/3} = Q*n/1.49\ s^{0.5}$ Area (A)= bd+z(d^2) $Z_{av} = A*R^{2/3}$

$Z_{req} = Q*n/1.49s^{0.5}$ R=Area/(b+2d((z^2)+1)^.5)

n = 0.069 6-inch diameter Rip Rap, Lined Channel
Vp (ft/sec) = 9 Permissible Velocity for lining
Side Slope (z) = 5 enter X for X:1
s (ft/ft) = 0.02 Outlet Slope (estimated)
Bottom Width (ft) = 21 6 * Barrel Diameter
Q_B (cfs) = 56.1 Peak Flow out of the barrel 25-yr Hydrograph

Q (cfs)	Z_{req}	Flow Depth d (ft)	A (sf)	R (ft)	Z_{av}	V (ft/sec)
56.1	18.38	0.88	22.4	0.75	18.38	2.5

Flow Depth = Tailwater, d (ft) = 0.88 0.5* Barrel Diameter (ft) = 1.75 Ref 1, 8.06.3
Minimum Tailwater Conditions: d<0.5*Diameter of Outlet Pipe
Maximum Tailwater Conditions: d>0.5*Diameter of Outlet Pipe

Since the Tailwater is less than half of the diameter of the outlet, use Minimum Tailwater conditions.

Barrel Diameter (ft)	Entrance (ft)	Length (ft)	Outlet Width (ft)	Median Rip Rap Size d_{50}	Selected Rip Rap Size (in)
3.5	10.5	20	24	0.6	Class B

Conclusion

The basin can contain the 10-yr storm and pass the 100-yr storm without overtopping the berm.

HDR Computation Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 1	Of 2

Diameter of Riser (in) = 72
Circumference of Riser (in) = 226.2
eight of Riser from bottom of barrel (in) = 86 From Hydrograph
Vertical spacing between holes (in) = 0 center to center
Water Stage increment (ft) 0.05

Orifice Equation

$$Q = C_d * A * (2 * g * h)^{0.5}$$ Ref 1, p III-11

Q = cfs, discharge
C_d = 0.6 coefficient of discharge
A = sf, cross sectional area
g = 32.2 ft/sec^2, gravity
h = ft, driving head measured from the center of the pipe

	Perforations					Skimmer	
Row	1	2	3	4	5	2	# of skimmers
Holes per row	0	0	0	0	0		
Hole Diameter (in)	0.75	0.75	0.75	0.75	0.75		
Spacing edge to edge (in)							
Inlet Area (sf)	0.000	0.000	0.000	0.000	0.000		
Hole Stage (in)	0.50	0.50	0.50	0.50	0.50		
Hole Stage (ft)	0.04	0.04	0.04	0.04	0.04		

Water Stage (ft)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Flow (cfs)	Total Flow (cfs)
0.00	0.00	0.00	0.00			0.00	0.00
0.04	0.00	0.00	0.00			0.00	0.00
0.09	0.00	0.00	0.00			0.00	0.00
0.14	0.00	0.00	0.00			0.00	0.00
0.19	0.00	0.00	0.00			0.00	0.00
0.24	0.00	0.00	0.00			0.00	0.00
0.29	0.00	0.00	0.00			0.00	0.00
0.34	0.00	0.00	0.00			0.66	0.66
0.39	0.00	0.00	0.00			0.66	0.66
0.44	0.00	0.00	0.00			0.66	0.66
0.49	0.00	0.00	0.00			0.66	0.66
0.54	0.00	0.00	0.00			0.66	0.66
0.59	0.00	0.00	0.00			0.66	0.66
0.64	0.00	0.00	0.00			0.66	0.66
0.69	0.00	0.00	0.00			0.66	0.66
0.74	0.00	0.00	0.00			0.66	0.66
0.79	0.00	0.00	0.00			0.66	0.66
0.84	0.00	0.00	0.00			0.66	0.66
0.89	0.00	0.00	0.00			0.66	0.66
0.94	0.00	0.00	0.00			0.66	0.66
0.99	0.00	0.00	0.00			0.66	0.66
1.04	0.00	0.00	0.00			0.66	0.66
1.09	0.00	0.00	0.00			0.66	0.66
1.14	0.00	0.00	0.00			0.66	0.66
1.19	0.00	0.00	0.00			0.66	0.66
1.24	0.00	0.00	0.00			0.66	0.66
1.29	0.00	0.00	0.00			0.66	0.66
1.34	0.00	0.00	0.00			0.66	0.66
1.39	0.00	0.00	0.00			0.66	0.66
1.44	0.00	0.00	0.00			0.66	0.66
1.49	0.00	0.00	0.00			0.66	0.66
1.54	0.00	0.00	0.00			0.66	0.66
1.59	0.00	0.00	0.00			0.66	0.66

HDR Computation

Job No. 06985-10570-018

Project:	Charah Colon Mine	Computed: PAW	Date: 12/31/14
Subject:	Permit Application	Checked: EAW	Date: 1/2/15
Task:	Riser Pipe Perforations/Skimmer Flow	Sheet 2	Of 2

1.64	0.00	0.00	0.00	0.66	0.66
1.69	0.00	0.00	0.00	0.66	0.66
1.74	0.00	0.00	0.00	0.66	0.66
1.79	0.00	0.00	0.00	0.66	0.66
1.84	0.00	0.00	0.00	0.66	0.66
1.89	0.00	0.00	0.00	0.66	0.66
1.94	0.00	0.00	0.00	0.66	0.66
1.99	0.00	0.00	0.00	0.66	0.66
2.04	0.00	0.00	0.00	0.66	0.66
2.09	0.00	0.00	0.00	0.66	0.66
2.14	0.00	0.00	0.00	0.66	0.66
2.19	0.00	0.00	0.00	0.66	0.66
2.24	0.00	0.00	0.00	0.66	0.66
2.29	0.00	0.00	0.00	0.66	0.66
2.34	0.00	0.00	0.00	0.66	0.66
2.39	0.00	0.00	0.00	0.66	0.66
2.44	0.00	0.00	0.00	0.66	0.66
2.49	0.00	0.00	0.00	0.66	0.66
2.54	0.00	0.00	0.00	0.66	0.66
2.59	0.00	0.00	0.00	0.66	0.66
2.64	0.00	0.00	0.00	0.66	0.66
2.69	0.00	0.00	0.00	0.66	0.66
2.74	0.00	0.00	0.00	0.66	0.66
2.79	0.00	0.00	0.00	0.66	0.66
2.84	0.00	0.00	0.00	0.66	0.66
2.89	0.00	0.00	0.00	0.66	0.66
2.94	0.00	0.00	0.00	0.66	0.66
2.99	0.00	0.00	0.00	0.66	0.66
3.04	0.00	0.00	0.00	0.66	0.66
3.09	0.00	0.00	0.00	0.66	0.66
3.14	0.00	0.00	0.00	0.66	0.66
3.19	0.00	0.00	0.00	0.66	0.66
3.24	0.00	0.00	0.00	0.66	0.66
3.29	0.00	0.00	0.00	0.66	0.66
3.34	0.00	0.00	0.00	0.66	0.66
3.39	0.00	0.00	0.00	0.66	0.66
3.44	0.00	0.00	0.00	0.66	0.66
3.49	0.00	0.00	0.00	0.66	0.66
3.54	0.00	0.00	0.00	0.66	0.66
3.59	0.00	0.00	0.00	0.66	0.66
3.64	0.00	0.00	0.00	0.66	0.66
3.69	0.00	0.00	0.00	0.66	0.66
3.74	0.00	0.00	0.00	0.66	0.66
3.79	0.00	0.00	0.00	0.66	0.66
3.84	0.00	0.00	0.00	0.66	0.66
3.89	0.00	0.00	0.00	0.66	0.66
3.94	0.00	0.00	0.00	0.66	0.66
3.99	0.00	0.00	0.00	0.66	0.66

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1___of __2__

Sediment Basin # 9 Colon

Phase 1

10 - year Storm Event

Qp = 145.70 cfs

Tp = 45.32 minutes

dT = Max of 2 minutes

or 1.0% of increment to peak

b = 1.1

K_s = 85,791

Number of Riser/Barrel Assemblies 2

Diameter of Barrel = 42 (in)

Height of Riser above barrel = 3.7 (ft)

Height of Riser from bottom of barrel= 7.2 (ft) elevation 269.20

Emergency Spillway = 7.5 (ft) elevation 269.50

Total Height of Dam = 8.5 (ft) elevation 270.50

Length of Emergency Spillway = 50 (ft)

Diameter of Riser = 72 (in)

Permanent Pond Stage = 0 (ft) elevation 262.0

4.0E-03 Settling Velocity of design particle (fps)

2 Effective number of cells (2 is construction site #)

100% Minimum Settling Efficiency

5.4 ft Maximum Stage 267.39 msl elevation

1.3 cfs Peak outflow

1.3 cfs Peak Riser/Barrel outflow

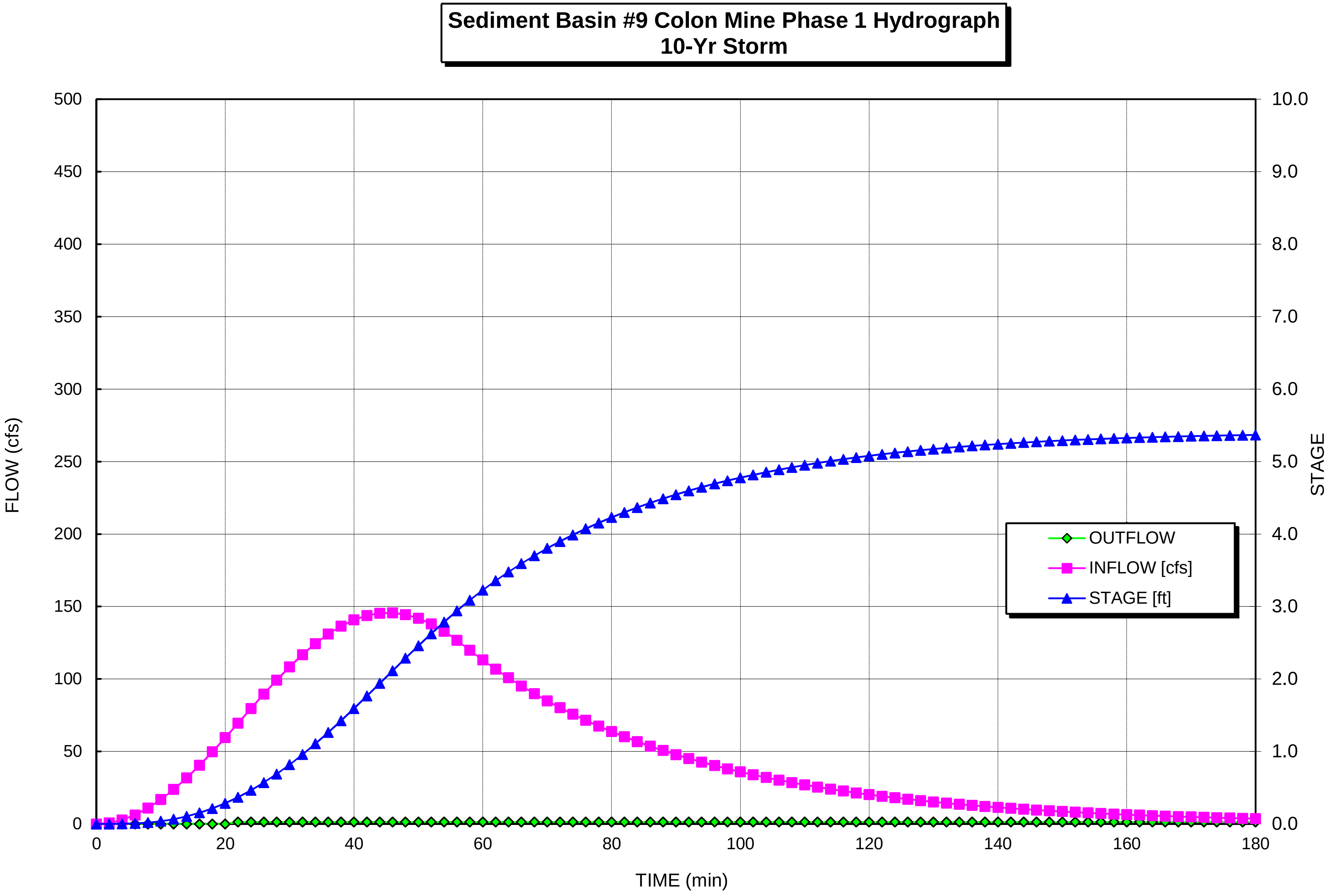
0.0 cfs Peak Weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.7	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	2.8	84	0.0	0.00	0.00	0.00	0.00	0.00	118.17	53,715	N/A
6	6.2	418	0.0	0.00	0.00	0.00	0.00	0.00	134.27	61,030	N/A
8	10.9	1,163	0.0	0.00	0.00	0.00	0.00	0.00	145.65	66,206	N/A
10	16.8	2,473	0.0	0.00	0.00	0.00	0.00	0.00	154.66	70,300	N/A
12	23.8	4,491	0.1	0.00	0.00	0.00	0.00	0.00	162.17	73,715	N/A
14	31.7	7,345	0.1	0.00	0.00	0.00	0.00	0.00	168.64	76,656	N/A
16	40.4	11,149	0.2	0.00	0.00	0.00	0.00	0.00	174.33	79,242	N/A
18	49.7	15,998	0.2	0.00	0.00	0.00	0.00	0.00	179.41	81,550	N/A
20	59.5	21,965	0.3	0.00	0.00	0.00	0.00	0.00	183.99	83,632	N/A
22	69.5	29,104	0.4	0.66	0.66	0.00	0.66	1.31	188.16	85,525	100%
24	79.6	37,290	0.5	0.66	0.66	0.00	0.66	1.31	191.90	87,227	100%
26	89.6	46,686	0.6	0.66	0.66	0.00	0.66	1.31	195.36	88,800	100%
28	99.2	57,277	0.7	0.66	0.66	0.00	0.66	1.31	198.56	90,256	100%
30	108.3	69,025	0.8	0.66	0.66	0.00	0.66	1.31	201.53	91,605	100%
32	116.8	81,869	1.0	0.66	0.66	0.00	0.66	1.31	204.28	92,856	100%
34	124.4	95,727	1.1	0.66	0.66	0.00	0.66	1.31	206.84	94,018	100%
36	131.0	110,498	1.3	0.66	0.66	0.00	0.66	1.31	209.21	95,097	100%
38	136.5	126,064	1.4	0.66	0.66	0.00	0.66	1.31	211.42	96,099	100%
40	140.8	142,289	1.6	0.66	0.66	0.00	0.66	1.31	213.46	97,029	100%
42	143.8	159,029	1.8	0.66	0.66	0.00	0.66	1.31	215.36	97,891	100%
44	145.4	176,125	1.9	0.66	0.66	0.00	0.66	1.31	217.12	98,689	100%
46	145.6	193,415	2.1	0.66	0.66	0.00	0.66	1.31	218.74	99,426	100%
48	144.4	210,732	2.3	0.66	0.66	0.00	0.66	1.31	220.23	100,107	100%
50	141.9	227,909	2.5	0.66	0.66	0.00	0.66	1.31	221.61	100,732	100%
52	138.0	244,779	2.6	0.66	0.66	0.00	0.66	1.31	222.87	101,306	100%
54	132.9	261,185	2.8	0.66	0.66	0.00	0.66	1.31	224.03	101,830	100%
56	126.6	276,976	2.9	0.66	0.66	0.00	0.66	1.31	225.07	102,306	100%
58	119.8	292,013	3.1	0.66	0.66	0.00	0.66	1.31	226.02	102,737	100%
60	113.1	306,229	3.2	0.66	0.66	0.00	0.66	1.31	226.88	103,126	100%
62	106.8	319,644	3.4	0.66	0.66	0.00	0.66	1.31	227.65	103,479	100%
64	100.8	332,302	3.5	0.66	0.66	0.00	0.66	1.31	228.36	103,799	100%
66	95.2	344,246	3.6	0.66	0.66	0.00	0.66	1.31	229.00	104,091	100%
68	89.9	355,514	3.7	0.66	0.66	0.00	0.66	1.31	229.59	104,357	100%
70	84.9	366,146	3.8	0.66	0.66	0.00	0.66	1.31	230.13	104,602	100%
72	80.2	376,176	3.9	0.66	0.66	0.00	0.66	1.31	230.62	104,827	100%
74	75.7	385,638	4.0	0.66	0.66	0.00	0.66	1.31	231.08	105,035	100%
76	71.5	394,564	4.1	0.66	0.66	0.00	0.66	1.31	231.50	105,226	100%
78	67.5	402,984	4.2	0.66	0.66	0.00	0.66	1.31	231.89	105,403	100%
80	63.7	410,925	4.2	0.66	0.66	0.00	0.66	1.31	232.25	105,566	100%
82	60.2	418,414	4.3	0.66	0.66	0.00	0.66	1.31	232.58	105,718	100%

84	56.8	425,478	4.4	0.66	0.66	0.00	0.66	1.31	232.89	105,859	100%
86	53.6	432,138	4.4	0.66	0.66	0.00	0.66	1.31	233.18	105,990	100%
88	50.7	438,419	4.5	0.66	0.66	0.00	0.66	1.31	233.45	106,112	100%
90	47.8	444,340	4.5	0.66	0.66	0.00	0.66	1.31	233.69	106,225	100%
92	45.2	449,923	4.6	0.66	0.66	0.00	0.66	1.31	233.93	106,330	100%
94	42.6	455,185	4.6	0.66	0.66	0.00	0.66	1.31	234.14	106,429	100%
96	40.3	460,146	4.7	0.66	0.66	0.00	0.66	1.31	234.34	106,520	100%
98	38.0	464,821	4.7	0.66	0.66	0.00	0.66	1.31	234.53	106,606	100%
100	35.9	469,226	4.8	0.66	0.66	0.00	0.66	1.31	234.71	106,686	100%
102	33.9	473,378	4.8	0.66	0.66	0.00	0.66	1.31	234.87	106,761	100%
104	32.0	477,289	4.9	0.66	0.66	0.00	0.66	1.31	235.03	106,831	100%
106	30.2	480,973	4.9	0.66	0.66	0.00	0.66	1.31	235.17	106,896	100%
108	28.5	484,443	4.9	0.66	0.66	0.00	0.66	1.31	235.31	106,957	100%
110	26.9	487,710	5.0	0.66	0.66	0.00	0.66	1.31	235.43	107,014	100%
112	25.4	490,787	5.0	0.66	0.66	0.00	0.66	1.31	235.55	107,068	100%
114	24.0	493,684	5.0	0.66	0.66	0.00	0.66	1.31	235.66	107,118	100%
116	22.7	496,410	5.0	0.66	0.66	0.00	0.66	1.31	235.76	107,165	100%
118	21.4	498,975	5.1	0.66	0.66	0.00	0.66	1.31	235.86	107,209	100%
120	20.2	501,389	5.1	0.66	0.66	0.00	0.66	1.31	235.95	107,250	100%
122	19.1	503,659	5.1	0.66	0.66	0.00	0.66	1.31	236.03	107,289	100%
124	18.0	505,794	5.1	0.66	0.66	0.00	0.66	1.31	236.11	107,325	100%
126	17.0	507,801	5.1	0.66	0.66	0.00	0.66	1.31	236.19	107,358	100%
128	16.1	509,688	5.2	0.66	0.66	0.00	0.66	1.31	236.26	107,390	100%
130	15.2	511,460	5.2	0.66	0.66	0.00	0.66	1.31	236.32	107,420	100%
132	14.3	513,125	5.2	0.66	0.66	0.00	0.66	1.31	236.38	107,448	100%
134	13.5	514,688	5.2	0.66	0.66	0.00	0.66	1.31	236.44	107,474	100%
136	12.8	516,156	5.2	0.66	0.66	0.00	0.66	1.31	236.50	107,498	100%
138	12.1	517,532	5.2	0.66	0.66	0.00	0.66	1.31	236.55	107,521	100%
140	11.4	518,824	5.2	0.66	0.66	0.00	0.66	1.31	236.59	107,542	100%
142	10.8	520,034	5.3	0.66	0.66	0.00	0.66	1.31	236.64	107,562	100%
144	10.2	521,168	5.3	0.66	0.66	0.00	0.66	1.31	236.68	107,580	100%
146	9.6	522,231	5.3	0.66	0.66	0.00	0.66	1.31	236.72	107,598	100%
148	9.1	523,225	5.3	0.66	0.66	0.00	0.66	1.31	236.75	107,614	100%
150	8.6	524,155	5.3	0.66	0.66	0.00	0.66	1.31	236.78	107,629	100%
152	8.1	525,024	5.3	0.66	0.66	0.00	0.66	1.31	236.82	107,644	100%
154	7.6	525,836	5.3	0.66	0.66	0.00	0.66	1.31	236.84	107,657	100%
156	7.2	526,595	5.3	0.66	0.66	0.00	0.66	1.31	236.87	107,669	100%
158	6.8	527,302	5.3	0.66	0.66	0.00	0.66	1.31	236.90	107,681	100%
160	6.4	527,960	5.3	0.66	0.66	0.00	0.66	1.31	236.92	107,691	100%
162	6.1	528,574	5.3	0.66	0.66	0.00	0.66	1.31	236.94	107,701	100%
164	5.7	529,144	5.3	0.66	0.66	0.00	0.66	1.31	236.96	107,711	100%
166	5.4	529,674	5.3	0.66	0.66	0.00	0.66	1.31	236.98	107,719	100%
168	5.1	530,166	5.3	0.66	0.66	0.00	0.66	1.31	237.00	107,727	100%
170	4.8	530,621	5.4	0.66	0.66	0.00	0.66	1.31	237.02	107,734	100%
172	4.6	531,042	5.4	0.66	0.66	0.00	0.66	1.31	237.03	107,741	100%
174	4.3	531,431	5.4	0.66	0.66	0.00	0.66	1.31	237.04	107,747	100%
176	4.1	531,790	5.4	0.66	0.66	0.00	0.66	1.31	237.06	107,753	100%
178	3.8	532,119	5.4	0.66	0.66	0.00	0.66	1.31	237.07	107,759	100%
180	3.6	532,422	5.4	0.66	0.66	0.00	0.66	1.31	237.08	107,763	100%
182	3.4	532,699	5.4	0.66	0.66	0.00	0.66	1.31	237.09	107,768	100%
184	3.2	532,952	5.4	0.66	0.66	0.00	0.66	1.31	237.10	107,772	100%
186	3.0	533,182	5.4	0.66	0.66	0.00	0.66	1.31	237.11	107,776	100%
188	2.9	533,390	5.4	0.66	0.66	0.00	0.66	1.31	237.11	107,779	100%
190	2.7	533,578	5.4	0.66	0.66	0.00	0.66	1.31	237.12	107,782	100%
192	2.6	533,747	5.4	0.66	0.66	0.00	0.66	1.31	237.13	107,785	100%
194	2.4	533,897	5.4	0.66	0.66	0.00	0.66	1.31	237.13	107,787	100%
196	2.3	534,030	5.4	0.66	0.66	0.00	0.66	1.31	237.14	107,789	100%
198	2.2	534,148	5.4	0.66	0.66	0.00	0.66	1.31	237.14	107,791	100%
200	2.0	534,249	5.4	0.66	0.66	0.00	0.66	1.31	237.14	107,793	100%
202	1.9	534,337	5.4	0.66	0.66	0.00	0.66	1.31	237.15	107,794	100%
204	1.8	534,411	5.4	0.66	0.66	0.00	0.66	1.31	237.15	107,795	100%
206	1.7	534,471	5.4	0.66	0.66	0.00	0.66	1.31	237.15	107,796	100%



Sediment Basin #9 Colon Mine Phase 1 Hydrograph
10-Yr Storm

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1___of _2_

Sediment Basin # 9 Colon

Phase 2

10 - year Storm Event

Qp = 199.50 cfs
Tp = 45.27 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 85,791

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 42 (in)
Height of Riser above barrel = 3.7 (ft)
Height of Riser from bottom of barrel= 7.2 (ft) elevation 269.20
Emergency Spillway = 7.5 (ft) elevation 269.50
Total Height of Dam = 8.5 (ft) elevation 270.50
Length of Emergency Spillway = 50 (ft)
Diameter of Riser = 72 (in)
Permanent Pond Stage = 0 (ft) elevation 262.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

100% Minimum Settling Efficiency
7.2 ft Maximum Stage 269.23 msl elevation
1.9 cfs Peak outflow
1.9 cfs Peak Riser/Barrel outflow
0.0 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

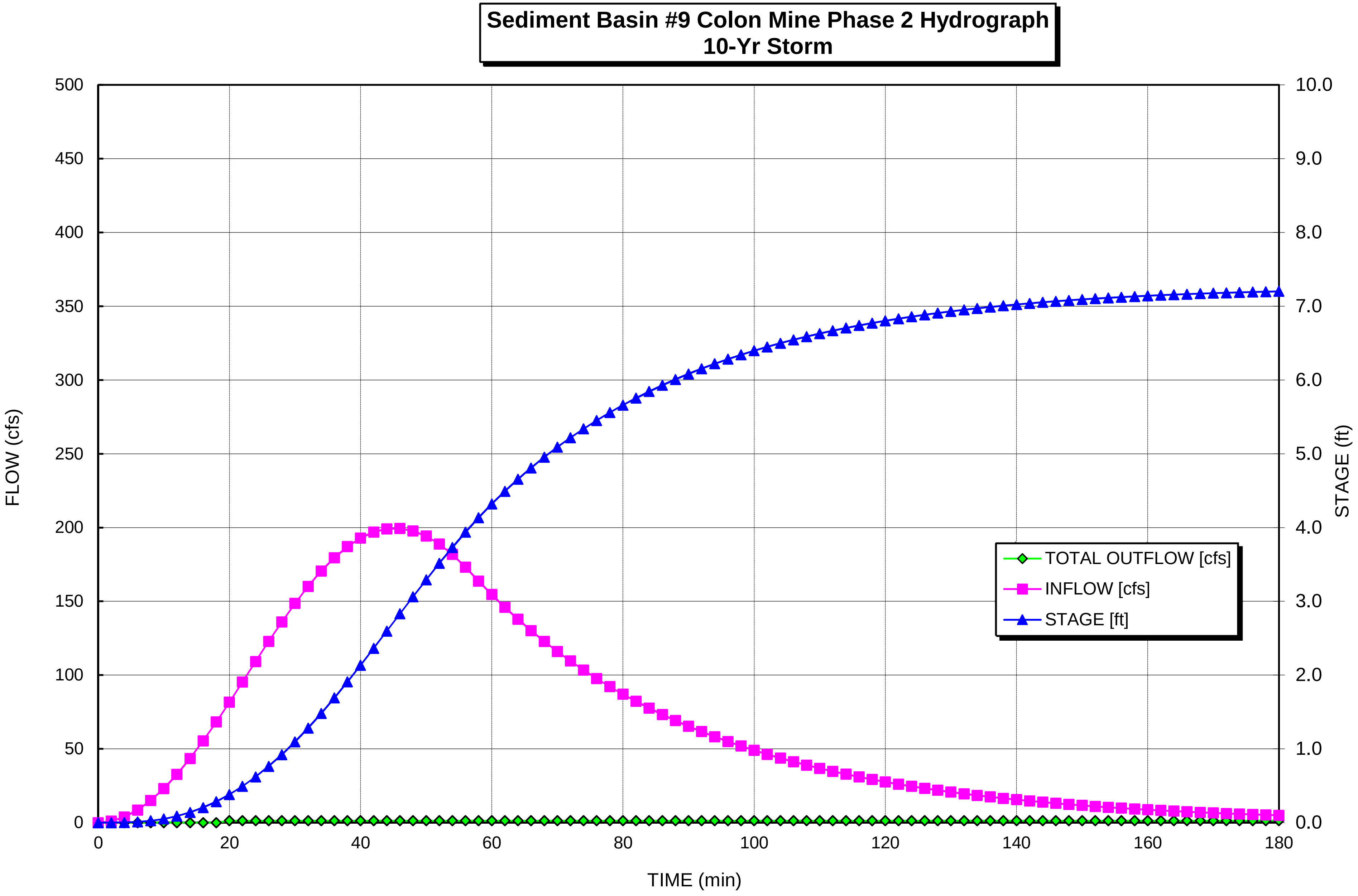
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	3.8	115	0.0	0.00	0.00	0.00	0.00	0.00	121.18	55,083	N/A
6	8.5	573	0.0	0.00	0.00	0.00	0.00	0.00	137.69	62,584	N/A
8	15.0	1,596	0.0	0.00	0.00	0.00	0.00	0.00	149.36	67,893	N/A
10	23.1	3,394	0.1	0.00	0.00	0.00	0.00	0.00	158.60	72,091	N/A
12	32.6	6,162	0.1	0.00	0.00	0.00	0.00	0.00	166.30	75,592	N/A
14	43.5	10,078	0.1	0.00	0.00	0.00	0.00	0.00	172.94	78,608	N/A
16	55.4	15,296	0.2	0.00	0.00	0.00	0.00	0.00	178.77	81,260	N/A
18	68.2	21,947	0.3	0.00	0.00	0.00	0.00	0.00	183.98	83,627	N/A
20	81.6	30,132	0.4	0.66	0.66	0.00	0.66	1.31	188.68	85,761	100%
22	95.4	39,768	0.5	0.66	0.66	0.00	0.66	1.31	192.88	87,675	100%
24	109.2	51,053	0.6	0.66	0.66	0.00	0.66	1.31	196.75	89,434	100%
26	122.8	63,997	0.8	0.66	0.66	0.00	0.66	1.31	200.32	91,055	100%
28	136.0	78,579	0.9	0.66	0.66	0.00	0.66	1.31	203.62	92,554	100%
30	148.5	94,745	1.1	0.66	0.66	0.00	0.66	1.31	206.67	93,941	100%
32	160.1	112,413	1.3	0.66	0.66	0.00	0.66	1.31	209.50	95,227	100%
34	170.5	131,468	1.5	0.66	0.66	0.00	0.66	1.31	212.12	96,420	100%
36	179.6	151,772	1.7	0.66	0.66	0.00	0.66	1.31	214.56	97,528	100%
38	187.1	173,161	1.9	0.66	0.66	0.00	0.66	1.31	216.82	98,556	100%
40	192.9	195,452	2.1	0.66	0.66	0.00	0.66	1.31	218.92	99,509	100%
42	196.9	218,443	2.4	0.66	0.66	0.00	0.66	1.31	220.86	100,393	100%
44	199.1	241,919	2.6	0.66	0.66	0.00	0.66	1.31	222.66	101,211	100%
46	199.4	265,655	2.8	0.66	0.66	0.00	0.66	1.31	224.33	101,967	100%
48	197.7	289,422	3.1	0.66	0.66	0.00	0.66	1.31	225.86	102,665	100%
50	194.2	312,991	3.3	0.66	0.66	0.00	0.66	1.31	227.27	103,306	100%
52	188.8	336,135	3.5	0.66	0.66	0.00	0.66	1.31	228.57	103,893	100%
54	181.8	358,637	3.7	0.66	0.66	0.00	0.66	1.31	229.75	104,430	100%
56	173.1	380,290	3.9	0.66	0.66	0.00	0.66	1.31	230.82	104,918	100%
58	163.7	400,906	4.1	0.66	0.66	0.00	0.66	1.31	231.79	105,359	100%
60	154.6	420,396	4.3	0.66	0.66	0.00	0.66	1.31	232.67	105,758	100%
62	146.0	438,789	4.5	0.66	0.66	0.00	0.66	1.31	233.46	106,119	100%
64	137.8	456,147	4.7	0.66	0.66	0.00	0.66	1.31	234.18	106,447	100%
66	130.1	472,527	4.8	0.66	0.66	0.00	0.66	1.31	234.84	106,746	100%
68	122.9	487,984	5.0	0.66	0.66	0.00	0.66	1.31	235.44	107,019	100%
70	116.0	502,570	5.1	0.66	0.66	0.00	0.66	1.31	235.99	107,270	100%
72	109.5	516,332	5.2	0.66	0.66	0.00	0.66	1.31	236.50	107,501	100%
74	103.4	529,318	5.3	0.66	0.66	0.00	0.66	1.31	236.97	107,713	100%
76	97.6	541,571	5.5	0.66	0.66	0.00	0.66	1.31	237.40	107,910	100%
78	92.2	553,131	5.6	0.66	0.66	0.00	0.66	1.31	237.80	108,091	100%
80	87.0	564,036	5.7	0.66	0.66	0.00	0.66	1.31	238.17	108,259	100%
82	82.2	574,325	5.8	0.66	0.66	0.00	0.66	1.31	238.51	108,415	100%
84	77.6	584,030	5.8	0.66	0.66	0.00	0.66	1.31	238.83	108,559	100%

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _2___of _2_

86	73.3	593,185	5.9	0.66	0.66	0.00	0.66	1.31	239.13	108,693	100%
88	69.2	601,820	6.0	0.66	0.66	0.00	0.66	1.31	239.40	108,818	100%
90	65.3	609,964	6.1	0.66	0.66	0.00	0.66	1.31	239.66	108,935	100%
92	61.7	617,645	6.2	0.66	0.66	0.00	0.66	1.31	239.90	109,043	100%
94	58.2	624,889	6.2	0.66	0.66	0.00	0.66	1.31	240.12	109,144	100%
96	55.0	631,720	6.3	0.66	0.66	0.00	0.66	1.31	240.33	109,239	100%
98	51.9	638,160	6.3	0.66	0.66	0.00	0.66	1.31	240.52	109,327	100%
100	49.0	644,232	6.4	0.66	0.66	0.00	0.66	1.31	240.70	109,409	100%
102	46.3	649,957	6.4	0.66	0.66	0.00	0.66	1.31	240.87	109,486	100%
104	43.7	655,353	6.5	0.66	0.66	0.00	0.66	1.31	241.03	109,558	100%
106	41.3	660,440	6.5	0.66	0.66	0.00	0.66	1.31	241.18	109,626	100%
108	39.0	665,233	6.6	0.66	0.66	0.00	0.66	1.31	241.32	109,689	100%
110	36.8	669,751	6.6	0.66	0.66	0.00	0.66	1.31	241.45	109,748	100%
112	34.7	674,007	6.7	0.66	0.66	0.00	0.66	1.31	241.57	109,803	100%
114	32.8	678,017	6.7	0.66	0.66	0.00	0.66	1.31	241.68	109,855	100%
116	31.0	681,795	6.7	0.66	0.66	0.00	0.66	1.31	241.79	109,904	100%
118	29.2	685,353	6.8	0.66	0.66	0.00	0.66	1.31	241.89	109,949	100%
120	27.6	688,703	6.8	0.66	0.66	0.00	0.66	1.31	241.98	109,992	100%
122	26.1	691,858	6.8	0.66	0.66	0.00	0.66	1.31	242.07	110,032	100%
124	24.6	694,828	6.9	0.66	0.66	0.00	0.66	1.31	242.15	110,069	100%
126	23.2	697,623	6.9	0.66	0.66	0.00	0.66	1.31	242.23	110,104	100%
128	21.9	700,254	6.9	0.66	0.66	0.00	0.66	1.31	242.30	110,137	100%
130	20.7	702,729	6.9	0.66	0.66	0.00	0.66	1.31	242.37	110,168	100%
132	19.6	705,057	7.0	0.66	0.66	0.00	0.66	1.31	242.43	110,197	100%
134	18.5	707,246	7.0	0.66	0.66	0.00	0.66	1.31	242.49	110,224	100%
136	17.4	709,305	7.0	0.66	0.66	0.00	0.66	1.31	242.55	110,250	100%
138	16.5	711,239	7.0	0.66	0.66	0.00	0.66	1.31	242.60	110,274	100%
140	15.5	713,057	7.0	0.66	0.66	0.00	0.66	1.31	242.65	110,296	100%
142	14.7	714,765	7.0	0.66	0.66	0.00	0.66	1.31	242.70	110,317	100%
144	13.9	716,369	7.1	0.66	0.66	0.00	0.66	1.31	242.74	110,337	100%
146	13.1	717,874	7.1	0.66	0.66	0.00	0.66	1.31	242.78	110,355	100%
148	12.4	719,287	7.1	0.66	0.66	0.00	0.66	1.31	242.82	110,372	100%
150	11.7	720,612	7.1	0.66	0.66	0.00	0.66	1.31	242.85	110,388	100%
152	11.0	721,854	7.1	0.66	0.66	0.00	0.66	1.31	242.89	110,404	100%
154	10.4	723,018	7.1	0.66	0.66	0.00	0.66	1.31	242.92	110,418	100%
156	9.8	724,108	7.1	0.66	0.66	0.00	0.66	1.31	242.95	110,431	100%
158	9.3	725,129	7.1	0.66	0.66	0.00	0.66	1.31	242.98	110,443	100%
160	8.8	726,084	7.1	0.66	0.66	0.00	0.66	1.31	243.00	110,455	100%
162	8.3	726,977	7.1	0.66	0.66	0.00	0.66	1.31	243.02	110,466	100%
164	7.8	727,811	7.2	0.66	0.66	0.00	0.66	1.31	243.05	110,476	100%
166	7.4	728,590	7.2	0.66	0.66	0.00	0.66	1.31	243.07	110,485	100%
168	7.0	729,317	7.2	0.66	0.66	0.00	0.66	1.31	243.09	110,494	100%
170	6.6	729,994	7.2	0.66	0.66	0.00	0.66	1.31	243.10	110,502	100%
172	6.2	730,625	7.2	0.66	0.66	0.00	0.66	1.31	243.12	110,510	100%
174	5.9	731,212	7.2	0.66	0.66	0.00	0.66	1.31	243.14	110,517	100%
176	5.5	731,757	7.2	0.66	0.66	0.00	0.66	1.31	243.15	110,523	100%
178	5.2	732,263	7.2	0.66	0.66	0.00	0.66	1.31	243.16	110,529	100%
180	4.9	732,733	7.2	0.66	0.66	0.00	107.99	1.32	243.18	110,535	100%
182	4.7	733,166	7.2	0.66	0.68	0.00	108.03	1.36	243.19	110,540	100%
184	4.4	733,561	7.2	0.66	0.71	0.00	108.07	1.42	243.20	110,545	100%
186	4.1	733,918	7.2	0.66	0.74	0.00	108.10	1.48	243.21	110,549	100%
188	3.9	734,238	7.2	0.66	0.77	0.00	108.13	1.54	243.22	110,553	100%
190	3.7	734,522	7.2	0.66	0.80	0.00	108.15	1.61	243.22	110,556	100%
192	3.5	734,773	7.2	0.66	0.83	0.00	108.18	1.66	243.23	110,559	100%
194	3.3	734,992	7.2	0.66	0.86	0.00	108.20	1.72	243.24	110,562	100%
196	3.1	735,182	7.2	0.66	0.88	0.00	108.21	1.77	243.24	110,564	100%
198	2.9	735,343	7.2	0.66	0.90	0.00	108.23	1.81	243.25	110,566	100%
200	2.8	735,479	7.2	0.66	0.92	0.00	108.24	1.85	243.25	110,568	100%
202	2.6	735,590	7.2	0.66	0.94	0.00	108.25	1.88	243.25	110,569	100%
204	2.5	735,679	7.2	0.66	0.95	0.00	108.26	1.90	243.25	110,570	100%


Sediment Basin #9 Colon Mine Phase 2 Hydrograph
10-Yr Storm
FLOW (cfs)
500
450
400
350
300
250
200
150
100
50
0
STAGE (ft)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
TIME (min)
0
20
40
60
80
100
120
140
160
180
TOTAL OUTFLOW [cfs]
INFLOW [cfs]
STAGE [ft]

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __1__of __2__

Sediment Basin # 9 Colon

Phase 2

25 - year Storm Event

Qp = 268.73 cfs
Tp = 44.85 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 85,791

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 42 (in)
Height of Riser above barrel = 3.7 (ft)
Height of Riser from bottom of barrel= 7.2 (ft) elevatior 269.20
Emergency Spillway = 7.5 (ft) elevatior 269.50
Total Height of Dam = 8.5 (ft) elevatior 270.50
Length of Emergency Spillway = 50 (ft)
Diameter of Riser = 72 (in)
Permanent Pond Stage = 0 (ft) elevatior 262.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

93% Minimum Settling Efficiency
7.8 ft Maximum Stage 269.8 msl elevation
78.3 cfs Peak outflow
56.1 cfs Peak Riser/Barrel outflow
22.1 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACITY [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	5.2	158	0.0	0.00	0.00	0.00	0.00	0.00	124.27	56,487	N/A
6	11.7	787	0.0	0.00	0.00	0.00	0.00	0.00	141.19	64,179	N/A
8	20.5	2,190	0.0	0.00	0.00	0.00	0.00	0.00	153.17	69,622	N/A
10	31.6	4,656	0.1	0.00	0.00	0.00	0.00	0.00	162.64	73,926	N/A
12	44.7	8,452	0.1	0.00	0.00	0.00	0.00	0.00	170.54	77,516	N/A
14	59.6	13,820	0.2	0.00	0.00	0.00	0.00	0.00	177.34	80,607	N/A
16	75.9	20,971	0.3	0.00	0.00	0.00	0.00	0.00	183.31	83,325	N/A
18	93.4	30,080	0.4	0.66	0.66	0.00	0.66	1.31	188.65	85,750	100%
20	111.6	41,128	0.5	0.66	0.66	0.00	0.66	1.31	193.40	87,909	100%
22	130.4	54,368	0.7	0.66	0.66	0.00	0.66	1.31	197.74	89,882	100%
24	149.2	69,854	0.8	0.66	0.66	0.00	0.66	1.31	201.72	91,692	100%
26	167.7	87,595	1.0	0.66	0.66	0.00	0.66	1.31	205.38	93,357	100%
28	185.5	107,556	1.2	0.66	0.66	0.00	0.66	1.31	208.77	94,893	100%
30	202.4	129,659	1.5	0.66	0.66	0.00	0.66	1.31	211.89	96,314	100%
32	217.9	153,785	1.7	0.66	0.66	0.00	0.66	1.31	214.79	97,630	100%
34	231.7	179,772	2.0	0.66	0.66	0.00	0.66	1.31	217.47	98,850	100%
36	243.7	207,424	2.3	0.66	0.66	0.00	0.66	1.31	219.96	99,981	100%
38	253.6	236,514	2.5	0.66	0.66	0.00	0.66	1.31	222.27	101,030	100%
40	261.0	266,783	2.8	0.66	0.66	0.00	0.66	1.31	224.40	102,002	100%
42	266.1	297,951	3.1	0.66	0.66	0.00	0.66	1.31	226.38	102,902	100%
44	268.5	329,721	3.5	0.66	0.66	0.00	0.66	1.31	228.22	103,734	100%
46	268.3	361,783	3.8	0.66	0.66	0.00	0.66	1.31	229.91	104,503	100%
48	265.5	393,821	4.1	0.66	0.66	0.00	0.66	1.31	231.46	105,210	100%
50	260.1	425,521	4.4	0.66	0.66	0.00	0.66	1.31	232.89	105,860	100%
52	252.2	456,574	4.7	0.66	0.66	0.00	0.66	1.31	234.20	106,454	100%
54	242.1	486,685	4.9	0.66	0.66	0.00	0.66	1.31	235.39	106,996	100%
56	229.8	515,577	5.2	0.66	0.66	0.00	0.66	1.31	236.47	107,488	100%
58	217.1	542,996	5.5	0.66	0.66	0.00	0.66	1.31	237.45	107,932	100%
60	204.9	568,894	5.7	0.66	0.66	0.00	0.66	1.31	238.33	108,333	100%
62	193.4	593,324	5.9	0.66	0.66	0.00	0.66	1.31	239.13	108,696	100%
64	182.5	616,370	6.1	0.66	0.66	0.00	0.66	1.31	239.86	109,025	100%
66	172.2	638,109	6.3	0.66	0.66	0.00	0.66	1.31	240.52	109,326	100%
68	162.5	658,614	6.5	0.66	0.66	0.00	0.66	1.31	241.12	109,602	100%
70	153.3	677,956	6.7	0.66	0.66	0.00	0.66	1.31	241.68	109,854	100%
72	144.7	696,200	6.9	0.66	0.66	0.00	0.66	1.31	242.19	110,086	100%
74	136.6	713,407	7.0	0.66	0.66	0.00	0.66	1.31	242.66	110,300	100%
76	128.9	729,637	7.2	0.66	0.66	0.00	0.66	1.31	243.10	110,498	100%
78	121.6	744,943	7.3	0.66	2.99	0.00	109.08	5.98	243.50	110,680	100%
80	114.8	758,819	7.4	0.66	7.85	0.00	110.30	15.69	243.85	110,843	100%
82	108.3	770,707	7.5	0.66	13.23	1.41	111.34	27.87	244.16	110,980	99%
84	102.2	780,357	7.6	0.66	18.28	7.15	112.17	43.71	244.40	111,090	97%

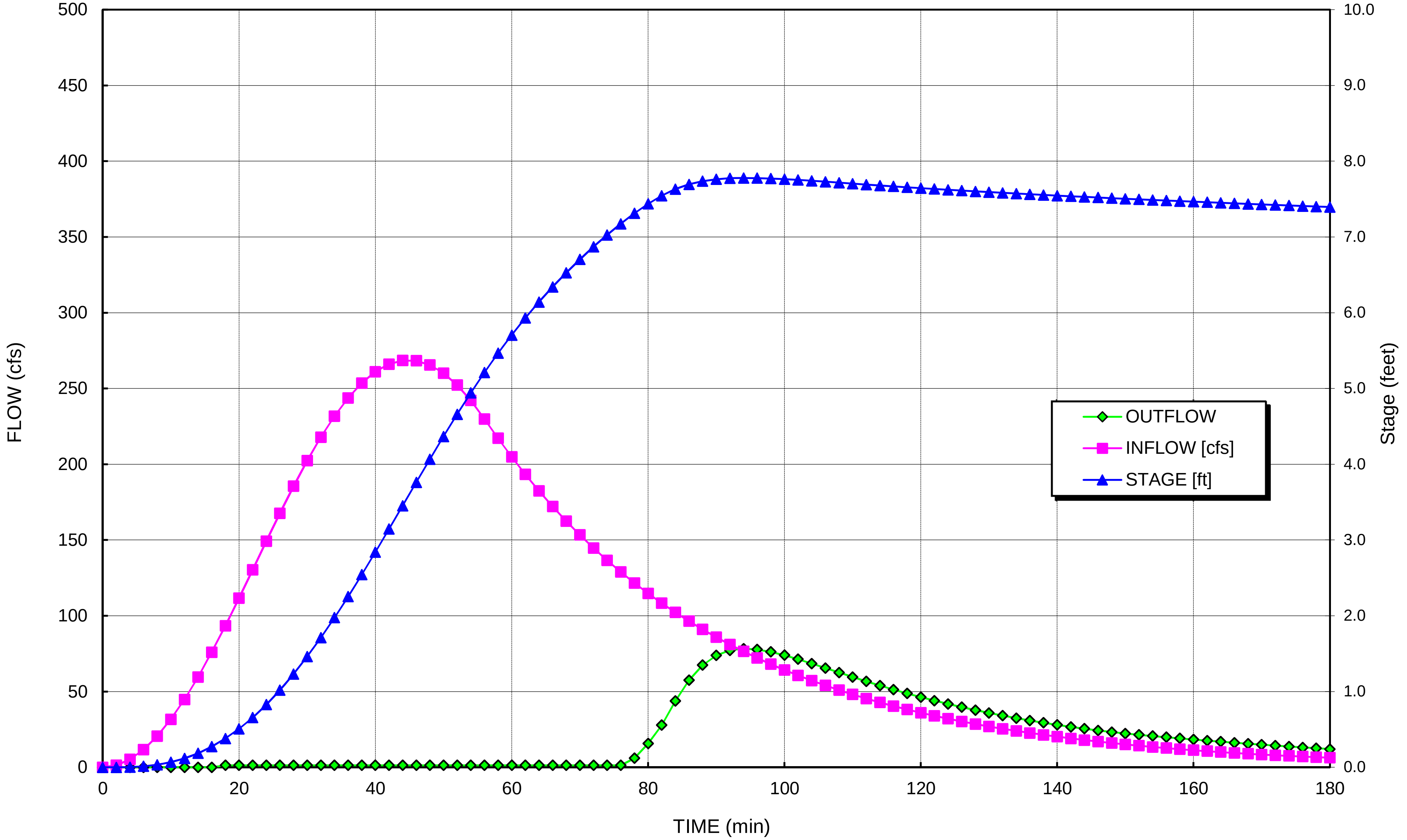
Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: __2__of __2__

86	96.4	787,376	7.7	0.66	22.29	12.87	112.77	57.45	244.57	111,169	96%
88	91.0	792,054	7.7	0.66	25.11	17.27	113.17	67.48	244.69	111,221	95%
90	85.9	794,877	7.8	0.66	26.86	20.12	113.41	73.84	244.76	111,253	94%
92	81.0	796,322	7.8	0.66	27.78	21.63	113.53	77.18	244.79	111,269	93%
94	76.5	796,785	7.8	0.66	28.07	22.12	113.57	78.27	244.80	111,274	93%
96	72.2	796,571	7.8	0.66	27.93	21.90	113.55	77.77	244.80	111,272	93%
98	68.1	795,899	7.8	0.66	27.51	21.19	113.49	76.20	244.78	111,264	94%
100	64.3	794,928	7.8	0.66	26.90	20.17	113.41	73.96	244.76	111,253	94%
102	60.7	793,766	7.8	0.66	26.17	18.98	113.31	71.31	244.73	111,241	94%
104	57.2	792,486	7.7	0.66	25.37	17.69	113.20	68.44	244.70	111,226	94%
106	54.0	791,142	7.7	0.66	24.55	16.38	113.09	65.48	244.66	111,211	95%
108	51.0	789,766	7.7	0.66	23.72	15.06	112.97	62.50	244.63	111,196	95%
110	48.1	788,383	7.7	0.66	22.89	13.78	112.86	59.56	244.60	111,180	96%
112	45.4	787,008	7.7	0.66	22.07	12.55	112.74	56.69	244.56	111,165	96%
114	42.8	785,652	7.7	0.66	21.28	11.37	112.62	53.93	244.53	111,150	96%
116	40.4	784,321	7.7	0.66	20.51	10.24	112.51	51.27	244.50	111,135	97%
118	38.1	783,020	7.7	0.66	19.77	9.19	112.40	48.73	244.46	111,120	97%
120	36.0	781,750	7.6	0.66	19.05	8.19	112.29	46.30	244.43	111,106	97%
122	34.0	780,514	7.6	0.66	18.37	7.26	112.18	43.99	244.40	111,092	97%
124	32.1	779,311	7.6	0.66	17.71	6.39	112.08	41.80	244.37	111,078	98%
126	30.3	778,141	7.6	0.66	17.07	5.58	111.98	39.73	244.34	111,065	98%
128	28.5	777,004	7.6	0.66	16.46	4.83	111.88	37.76	244.31	111,052	98%
130	26.9	775,899	7.6	0.66	15.88	4.14	111.79	35.89	244.29	111,039	98%
132	25.4	774,825	7.6	0.66	15.32	3.50	111.69	34.13	244.26	111,027	98%
134	24.0	773,780	7.6	0.66	14.78	2.91	111.60	32.47	244.23	111,015	98%
136	22.6	772,763	7.6	0.66	14.26	2.37	111.51	30.89	244.21	111,004	99%
138	21.4	771,772	7.6	0.66	13.76	1.89	111.43	29.41	244.18	110,992	99%
140	20.2	770,807	7.5	0.66	13.28	1.45	111.35	28.01	244.16	110,981	99%
142	19.0	769,864	7.5	0.66	12.82	1.06	111.26	26.70	244.13	110,970	99%
144	18.0	768,943	7.5	0.66	12.37	0.73	111.18	25.47	244.11	110,960	99%
146	16.9	768,041	7.5	0.66	11.94	0.44	111.11	24.32	244.09	110,949	99%
148	16.0	767,156	7.5	0.66	11.52	0.21	111.03	23.25	244.07	110,939	99%
150	15.1	766,285	7.5	0.66	11.11	0.05	110.95	22.28	244.04	110,929	99%
152	14.2	765,422	7.5	0.66	10.72	0.00	110.88	21.43	244.02	110,919	99%
154	13.4	764,559	7.5	0.66	10.32	0.00	110.80	20.65	244.00	110,909	99%
156	12.7	763,694	7.5	0.66	9.93	0.00	110.73	19.87	243.98	110,899	99%
158	12.0	762,831	7.5	0.66	9.55	0.00	110.65	19.10	243.96	110,889	99%
160	11.3	761,974	7.5	0.66	9.18	0.00	110.58	18.36	243.93	110,880	99%
162	10.7	761,127	7.5	0.66	8.81	0.00	110.50	17.63	243.91	110,870	99%
164	10.1	760,290	7.5	0.66	8.46	0.00	110.43	16.92	243.89	110,860	100%
166	9.5	759,467	7.4	0.66	8.11	0.00	110.36	16.23	243.87	110,850	100%
168	9.0	758,659	7.4	0.66	7.78	0.00	110.29	15.56	243.85	110,841	100%
170	8.5	757,866	7.4	0.66	7.46	0.00	110.22	14.92	243.83	110,832	100%
172	8.0	757,090	7.4	0.66	7.15	0.00	110.15	14.30	243.81	110,823	100%
174	7.5	756,331	7.4	0.66	6.85	0.00	110.08	13.70	243.79	110,814	100%
176	7.1	755,590	7.4	0.66	6.56	0.00	110.02	13.13	243.77	110,805	100%
178	6.7	754,867	7.4	0.66	6.29	0.00	109.96	12.58	243.75	110,797	100%
180	6.3	754,162	7.4	0.66	6.02	0.00	109.89	12.05	243.74	110,789	100%
182	6.0	753,476	7.4	0.66	5.77	0.00	109.83	11.54	243.72	110,781	100%
184	5.6	752,807	7.4	0.66	5.53	0.00	109.77	11.05	243.70	110,773	100%
186	5.3	752,156	7.4	0.66	5.29	0.00	109.72	10.59	243.68	110,765	100%
188	5.0	751,524	7.4	0.66	5.07	0.00	109.66	10.14	243.67	110,758	100%
190	4.7	750,908	7.4	0.66	4.86	0.00	109.61	9.72	243.65	110,751	100%
192	4.5	750,310	7.4	0.66	4.66	0.00	109.56	9.31	243.64	110,744	100%
194	4.2	749,729	7.4	0.66	4.46	0.00	109.50	8.92	243.62	110,737	100%
196	4.0	749,164	7.4	0.66	4.27	0.00	109.45	8.55	243.61	110,730	100%
198	3.8	748,615	7.3	0.66	4.10	0.00	109.41	8.19	243.59	110,724	100%
200	3.5	748,083	7.3	0.66	3.93	0.00	109.36	7.85	243.58	110,717	100%
202	3.3	747,565	7.3	0.66	3.77	0.00	109.31	7.53	243.56	110,711	100%
204	3.2	747,063	7.3	0.66	3.61	0.00	109.27	7.22	243.55	110,705	100%
206	3.0	746,575	7.3	0.66	3.46	0.00	109.23	6.93	243.54	110,700	100%

Sediment Basin #9 Colon Mine Phase 2 Hydrograph
25-Yr Storm



Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _1__of __2_

Sediment Basin # 9 Colon

Phase 2

100 - year Storm Event

Qp = 384.1 cfs
Tp = 54.8 minutes
dT = Max of **2** minutes
or **1.0%** of increment to peak

b = 1.1
Ks = 85,791

Number of Riser/Barrel Assemblies 2
Diameter of Barrel = 42 (in)
Height of Riser above barrel = 3.7 (ft)
Height of Riser from bottom of barrel= 7.2 (ft) elevation 269.20
Emergency Spillway = 7.5 (ft) elevation 269.50
Total Height of Dam = 8.5 (ft) elevation 270.50
Length of Emergency Spillway = 50 (ft)
Diameter of Riser = 72 (in)
Permanent Pond Stage = 0 (ft) elevation 262.0

4.0E-03 Settling Velocity of design particle (fps)
2 Effective number of cells (2 is construction site #)

67% Minimum Settling Efficiency
8.4 ft Maximum Stage 270.4 msl elevation
303.0 cfs Peak outflow
169.8 cfs Peak Riser/Barrel outflow
133.2 cfs peak weir flow

Notes:

1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

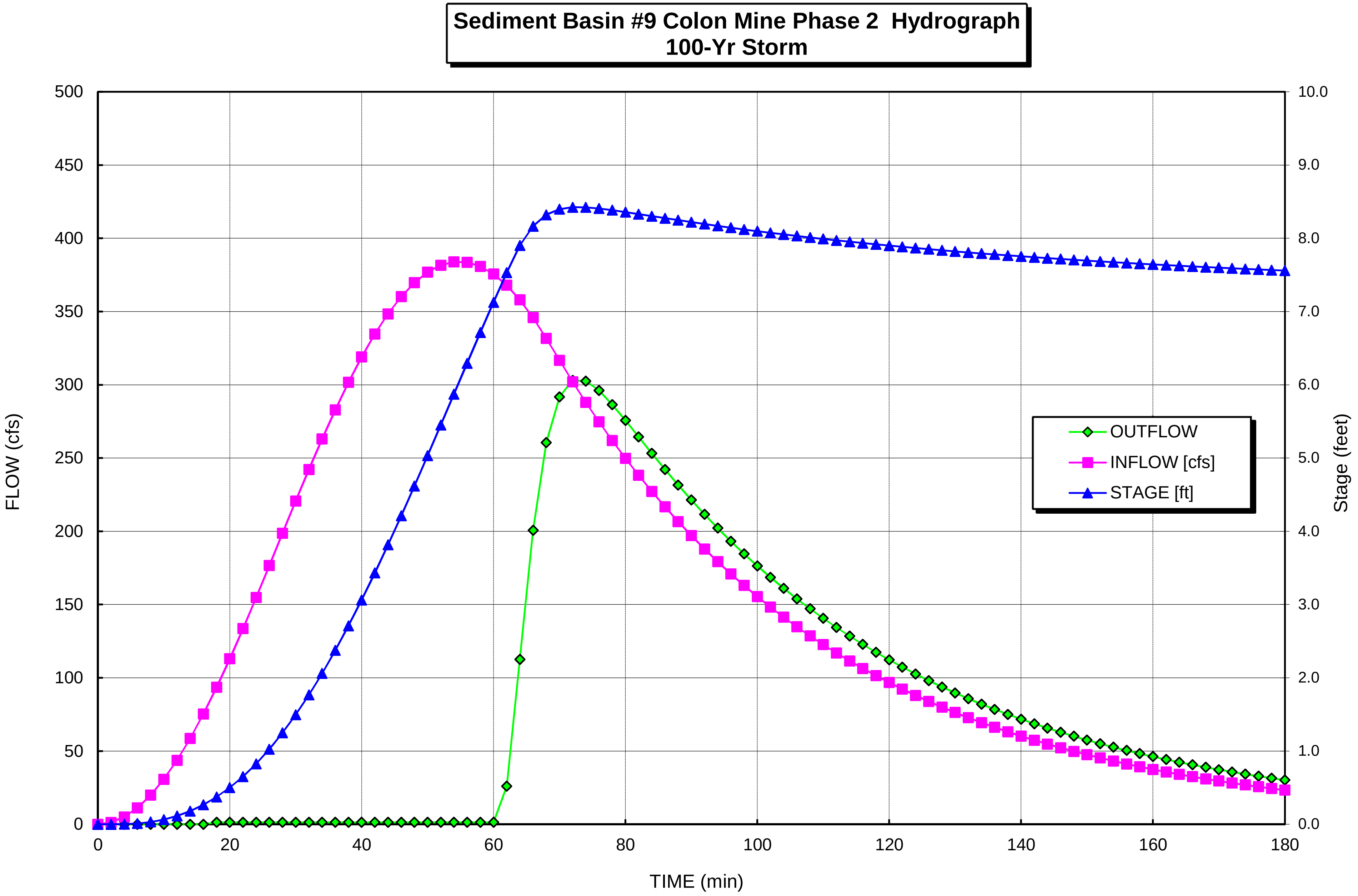
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	1.3	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
4	5.0	151	0.0	0.00	0.00	0.00	0.00	0.00	123.85	56,294	N/A
6	11.2	755	0.0	0.00	0.00	0.00	0.00	0.00	140.73	63,967	N/A
8	19.8	2,104	0.0	0.00	0.00	0.00	0.00	0.00	152.69	69,402	N/A
10	30.7	4,486	0.1	0.00	0.00	0.00	0.00	0.00	162.16	73,708	N/A
12	43.7	8,170	0.1	0.00	0.00	0.00	0.00	0.00	170.08	77,307	N/A
14	58.6	13,411	0.2	0.00	0.00	0.00	0.00	0.00	176.91	80,415	N/A
16	75.3	20,443	0.3	0.00	0.00	0.00	0.00	0.00	182.94	83,156	N/A
18	93.5	29,476	0.4	0.66	0.66	0.00	0.66	1.31	188.35	85,612	100%
20	113.0	40,537	0.5	0.66	0.66	0.00	0.66	1.31	193.18	87,808	100%
22	133.5	53,939	0.7	0.66	0.66	0.00	0.66	1.31	197.62	89,826	100%
24	154.8	69,805	0.8	0.66	0.66	0.00	0.66	1.31	201.71	91,687	100%
26	176.6	88,229	1.0	0.66	0.66	0.00	0.66	1.31	205.50	93,410	100%
28	198.6	109,268	1.2	0.66	0.66	0.00	0.66	1.31	209.03	95,012	100%
30	220.6	132,947	1.5	0.66	0.66	0.00	0.66	1.31	212.31	96,506	100%
32	242.1	159,256	1.8	0.66	0.66	0.00	0.66	1.31	215.38	97,902	100%
34	263.0	188,149	2.1	0.66	0.66	0.00	0.66	1.31	218.26	99,208	100%
36	282.9	219,549	2.4	0.66	0.66	0.00	0.66	1.31	220.95	100,433	100%
38	301.7	253,342	2.7	0.66	0.66	0.00	0.66	1.31	223.48	101,583	100%
40	319.0	289,385	3.1	0.66	0.66	0.00	0.66	1.31	225.86	102,664	100%
42	334.6	327,507	3.4	0.66	0.66	0.00	0.66	1.31	228.09	103,679	100%
44	348.4	367,507	3.8	0.66	0.66	0.00	0.66	1.31	230.19	104,633	100%
46	360.1	409,160	4.2	0.66	0.66	0.00	0.66	1.31	232.17	105,530	100%
48	369.7	452,219	4.6	0.66	0.66	0.00	0.66	1.31	234.02	106,373	100%
50	376.8	496,421	5.0	0.66	0.66	0.00	0.66	1.31	235.76	107,165	100%
52	381.6	541,484	5.5	0.66	0.66	0.00	0.66	1.31	237.40	107,908	100%
54	383.9	587,118	5.9	0.66	0.66	0.00	0.66	1.31	238.93	108,605	100%
56	383.6	633,023	6.3	0.66	0.66	0.00	0.66	1.31	240.36	109,257	100%
58	380.8	678,899	6.7	0.66	0.66	0.00	0.66	1.31	241.71	109,866	100%
60	375.6	724,442	7.1	0.66	0.66	0.00	0.66	1.31	242.96	110,435	100%
62	367.9	769,355	7.5	0.66	12.57	0.87	111.22	26.01	244.12	110,965	99%
64	358.0	810,385	7.9	0.66	37.19	38.13	114.71	112.51	245.13	111,424	89%
66	345.8	839,840	8.2	0.66	59.65	81.39	117.15	200.69	245.83	111,741	78%
68	331.6	857,255	8.3	0.66	74.48	111.58	118.56	260.55	246.23	111,923	71%
70	316.7	865,787	8.4	0.66	82.14	127.47	119.25	291.75	246.43	112,011	68%
72	302.1	868,785	8.4	0.66	84.89	133.22	119.49	302.99	246.49	112,042	67%
74	288.1	868,674	8.4	0.66	84.78	133.01	119.48	302.57	246.49	112,041	67%
76	274.7	866,933	8.4	0.66	83.18	129.66	119.34	296.03	246.45	112,023	68%
78	262.0	864,375	8.4	0.66	80.85	124.80	119.13	286.51	246.39	111,997	69%
80	249.8	861,433	8.4	0.66	78.20	119.28	118.90	275.68	246.33	111,967	70%
82	238.3	858,333	8.3	0.66	75.44	113.55	118.65	264.43	246.26	111,934	71%
84	227.2	855,194	8.3	0.66	72.67	107.85	118.40	253.19	246.18	111,902	72%

Computed By: PAW Date: 12/31/14

Checked By: EAW Date: 1/2/15

Sheet: _2__of __2_

86	216.7	852,078	8.3	0.66	69.96	102.29	118.14	242.21	246.11	111,869	73%
88	206.7	849,017	8.2	0.66	67.33	96.91	117.90	231.57	246.04	111,837	74%
90	197.1	846,027	8.2	0.66	64.79	91.76	117.65	221.35	245.97	111,806	75%
92	187.9	843,115	8.2	0.66	62.35	86.83	117.42	211.54	245.91	111,775	76%
94	179.2	840,285	8.2	0.66	60.01	82.12	117.19	202.15	245.84	111,745	78%
96	170.9	837,536	8.1	0.66	57.77	77.64	116.96	193.17	245.78	111,716	79%
98	163.0	834,867	8.1	0.66	55.61	73.36	116.74	184.59	245.71	111,688	80%
100	155.5	832,278	8.1	0.66	53.55	69.29	116.53	176.39	245.65	111,660	81%
102	148.3	829,766	8.1	0.66	51.57	65.42	116.32	168.56	245.59	111,634	82%
104	141.4	827,329	8.1	0.66	49.68	61.73	116.12	161.09	245.54	111,607	83%
106	134.8	824,965	8.0	0.66	47.87	58.21	115.93	153.95	245.48	111,582	83%
108	128.6	822,672	8.0	0.66	46.13	54.87	115.74	147.13	245.43	111,557	84%
110	122.6	820,447	8.0	0.66	44.46	51.70	115.55	140.62	245.37	111,533	85%
112	116.9	818,288	8.0	0.66	42.86	48.67	115.37	134.40	245.32	111,510	86%
114	111.5	816,193	8.0	0.66	41.33	45.80	115.20	128.46	245.27	111,487	87%
116	106.4	814,161	7.9	0.66	39.87	43.06	115.03	122.79	245.22	111,465	87%
118	101.4	812,189	7.9	0.66	38.46	40.46	114.86	117.38	245.18	111,444	88%
120	96.7	810,275	7.9	0.66	37.11	37.99	114.70	112.21	245.13	111,423	89%
122	92.2	808,417	7.9	0.66	35.82	35.64	114.55	107.27	245.09	111,402	89%
124	88.0	806,614	7.9	0.66	34.57	33.41	114.40	102.56	245.04	111,383	90%
126	83.9	804,864	7.9	0.66	33.38	31.29	114.25	98.06	245.00	111,363	91%
128	80.0	803,165	7.8	0.66	32.24	29.28	114.11	93.76	244.96	111,345	91%
130	76.3	801,515	7.8	0.66	31.14	27.36	113.97	89.65	244.92	111,326	92%
132	72.8	799,913	7.8	0.66	30.09	25.55	113.83	85.73	244.88	111,309	92%
134	69.4	798,357	7.8	0.66	29.08	23.83	113.70	81.99	244.84	111,292	93%
136	66.2	796,846	7.8	0.66	28.11	22.19	113.57	78.41	244.80	111,275	93%
138	63.1	795,378	7.8	0.66	27.18	20.64	113.45	75.00	244.77	111,258	94%
140	60.2	793,952	7.8	0.66	26.28	19.17	113.33	71.74	244.73	111,243	94%
142	57.4	792,567	7.7	0.66	25.42	17.77	113.21	68.62	244.70	111,227	94%
144	54.7	791,220	7.7	0.66	24.60	16.45	113.10	65.65	244.67	111,212	95%
146	52.2	789,911	7.7	0.66	23.80	15.20	112.99	62.81	244.63	111,197	95%
148	49.8	788,639	7.7	0.66	23.04	14.02	112.88	60.09	244.60	111,183	96%
150	47.5	787,401	7.7	0.66	22.30	12.90	112.77	57.50	244.57	111,169	96%
152	45.3	786,198	7.7	0.66	21.60	11.84	112.67	55.03	244.54	111,156	96%
154	43.2	785,027	7.7	0.66	20.92	10.83	112.57	52.67	244.51	111,143	96%
156	41.2	783,888	7.7	0.66	20.26	9.89	112.47	50.42	244.49	111,130	97%
158	39.3	782,780	7.7	0.66	19.63	9.00	112.38	48.26	244.46	111,117	97%
160	37.5	781,701	7.6	0.66	19.03	8.15	112.28	46.21	244.43	111,105	97%
162	35.7	780,650	7.6	0.66	18.44	7.36	112.19	44.25	244.41	111,093	97%
164	34.1	779,626	7.6	0.66	17.88	6.62	112.11	42.37	244.38	111,082	97%
166	32.5	778,629	7.6	0.66	17.34	5.91	112.02	40.59	244.35	111,070	98%
168	31.0	777,656	7.6	0.66	16.81	5.26	111.94	38.88	244.33	111,059	98%
170	29.5	776,708	7.6	0.66	16.31	4.64	111.85	37.25	244.31	111,049	98%
172	28.2	775,783	7.6	0.66	15.82	4.06	111.78	35.70	244.28	111,038	98%
174	26.9	774,879	7.6	0.66	15.35	3.53	111.70	34.22	244.26	111,028	98%
176	25.6	773,997	7.6	0.66	14.89	3.03	111.62	32.81	244.24	111,018	98%
178	24.4	773,135	7.6	0.66	14.45	2.56	111.55	31.46	244.22	111,008	98%
180	23.3	772,291	7.6	0.66	14.02	2.14	111.47	30.18	244.20	110,998	99%
182	22.2	771,466	7.6	0.66	13.61	1.74	111.40	28.96	244.18	110,989	99%
184	21.2	770,657	7.5	0.66	13.21	1.39	111.33	27.80	244.15	110,979	99%
186	20.2	769,864	7.5	0.66	12.82	1.06	111.26	26.70	244.13	110,970	99%
188	19.3	769,085	7.5	0.66	12.44	0.77	111.20	25.66	244.12	110,961	99%
190	18.4	768,320	7.5	0.66	12.07	0.52	111.13	24.67	244.10	110,953	99%
192	17.5	767,565	7.5	0.66	11.71	0.31	111.06	23.74	244.08	110,944	99%
194	16.7	766,820	7.5	0.66	11.36	0.14	111.00	22.87	244.06	110,935	99%
196	15.9	766,083	7.5	0.66	11.02	0.02	110.94	22.06	244.04	110,927	99%
198	15.2	765,348	7.5	0.66	10.68	0.00	110.87	21.36	244.02	110,918	99%
200	14.5	764,609	7.5	0.66	10.35	0.00	110.81	20.69	244.00	110,910	99%
202	13.8	763,866	7.5	0.66	10.01	0.00	110.74	20.02	243.98	110,901	99%
204	13.2	763,122	7.5	0.66	9.68	0.00	110.68	19.36	243.96	110,893	99%


Sediment Basin #9 Colon Mine Phase 2 Hydrograph
100-Yr Storm
FLOW (cfs)
0
50
100
150
200
250
300
350
400
450
500
Stage (feet)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
TIME (min)
0
20
40
60
80
100
120
140
160
180
OUTFLOW
INFLOW [cfs]
STAGE [ft]

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	32.86	2	716	68,783	------	------	------	BASIN #1
2	SCS Runoff	101.32	2	718	238,246	------	------	------	BASIN #2
3	SCS Runoff	20.57	2	716	44,737	------	------	------	BASIN #3
4	SCS Runoff	77.74	2	718	186,273	------	------	------	BASIN #4
5	SCS Runoff	301.78	2	718	723,090	------	------	------	BASIN #5
6	SCS Runoff	93.60	2	718	224,261	------	------	------	BASIN #6
7	SCS Runoff	85.59	2	718	197,920	------	------	------	BASIN #7
8	SCS Runoff	71.25	2	716	149,115	------	------	------	BASIN #8
9	SCS Runoff	145.70	2	728	541,646	------	------	------	BASIN #9

Basins-Phase 1.gpw	Return Period: 10 Year	Friday, 10 / 31 / 2014

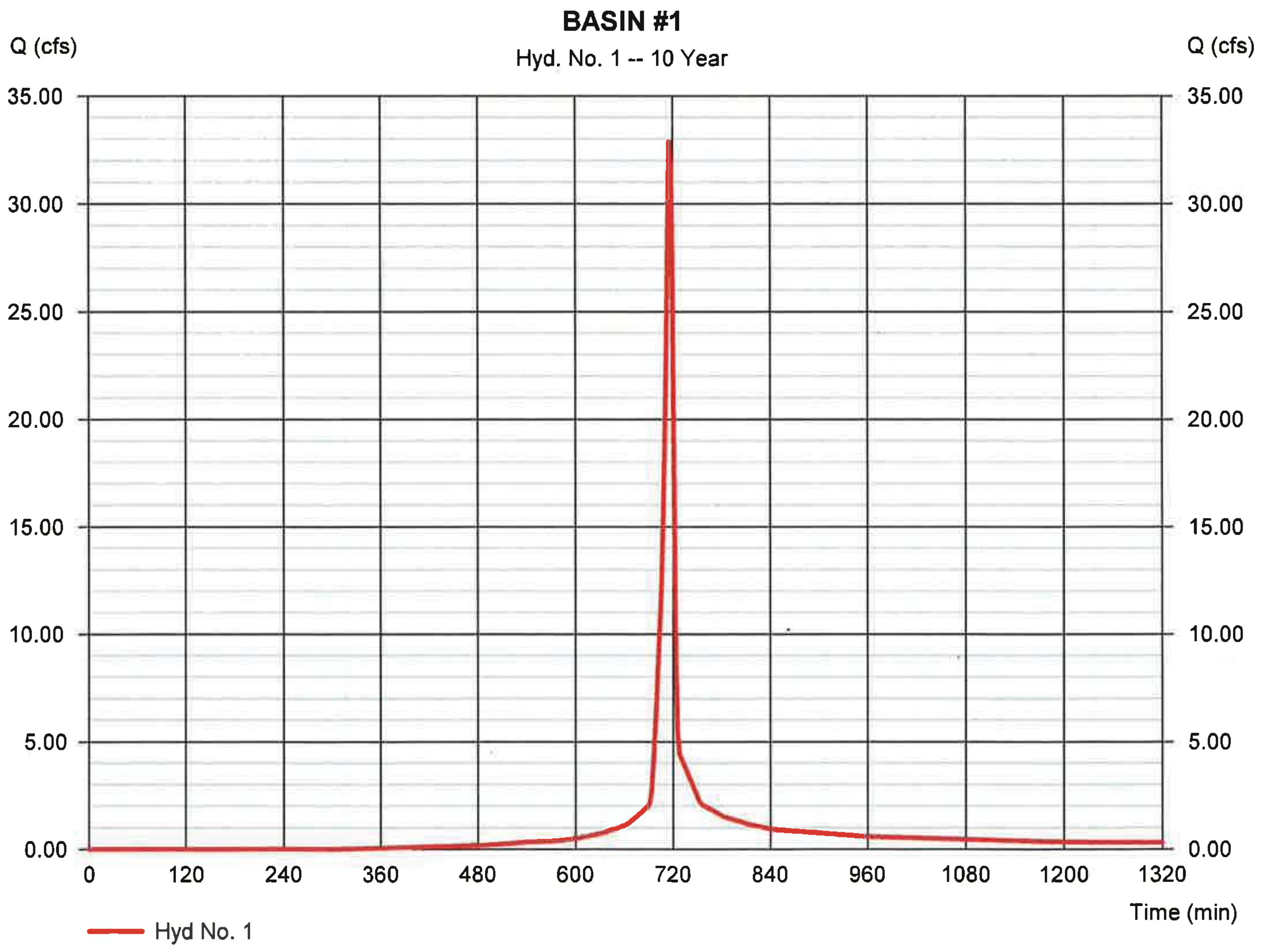
Hydrograph Report

Hyd. No. 1

BASIN #1

Hydrograph type	= SCS Runoff	Peak discharge	= 32.86 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 68,783 cuft
Drainage area	= 5.420 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.420 x 86)] / 5.420



TR55 Tc Worksheet

Hyd. No. 1

BASIN #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)	= 3.62	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	**= 3.83**	**+ 0.00**	**+ 0.00**	**= 3.83**
Shallow Concentrated Flow				
Flow length (ft)	= 282.46	0.00	0.00	
Watercourse slope (%)	= 7.43	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.40	0.00	0.00	
Travel Time (min)	**= 1.07**	**+ 0.00**	**+ 0.00**	**= 1.07**
Channel Flow				
X sectional flow area (sqft)	= 20.00	0.00	0.00	
Wetted perimeter (ft)	= 14.00	0.00	0.00	
Channel slope (%)	= 5.79	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=9.11			
		0.00		
			0.00	
Flow length (ft)	({0})345.6	0.0	0.0	
Travel Time (min)	**= 0.63**	**+ 0.00**	**+ 0.00**	**= 0.63**

Total Travel Time, Tc .... 5.50 min

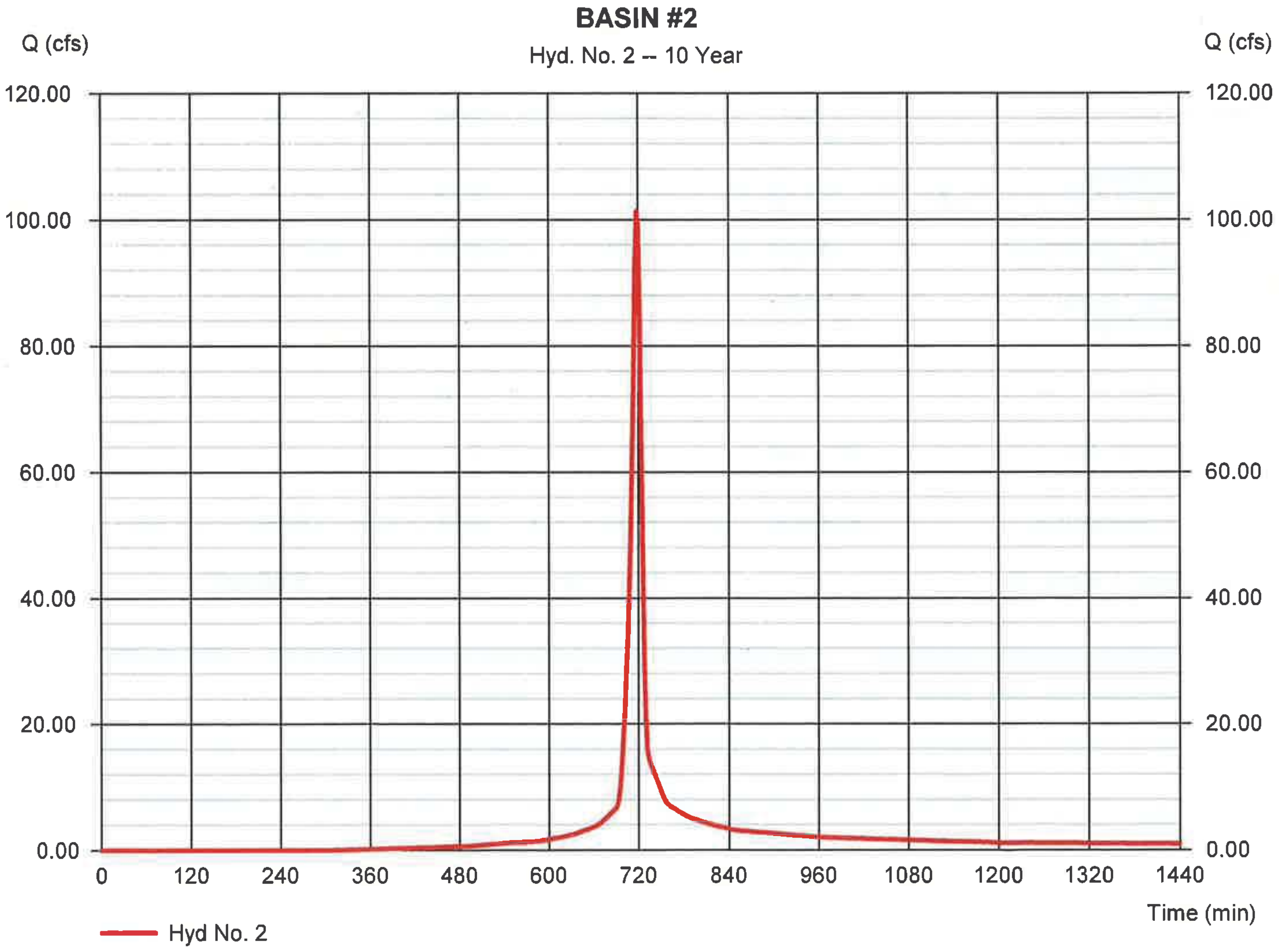
Hydrograph Report

Hyd. No. 2

BASIN #2

Hydrograph type	= SCS Runoff	Peak discharge	= 101.32 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 238,246 cuft
Drainage area	= 17.600 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.90 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(17.600 x 86)] / 17.600



TR55 Tc Worksheet

Hyd. No. 2

BASIN #2

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)	= 3.62		0.00		0.00		
Land slope (%)	= 5.50		0.00		0.00		
Travel Time (min)	**= 2.55**	**+**	**0.00**	**+**	**0.00**	**=**	**2.55**
Shallow Concentrated Flow							
Flow length (ft)	= 771.00		0.00		0.00		
Watercourse slope (%)	= 5.38		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.74		0.00		0.00		
Travel Time (min)	**= 3.43**	**+**	**0.00**	**+**	**0.00**	**=**	**3.43**
Channel Flow							
X sectional flow area (sqft)	= 10.00		0.00		0.00		
Wetted perimeter (ft)	= 9.00		0.00		0.00		
Channel slope (%)	= 2.70		0.00		0.00		
Manning's n-value	= 0.050		0.015		0.015		
Velocity (ft/s)	=5.25						
			0.00				
					0.00		
Flow length (ft)	({0})595.4		0.0		0.0		
Travel Time (min)	**= 1.89**	**+**	**0.00**	**+**	**0.00**	**=**	**1.89**

Total Travel Time, Tc .... **7.90 min**

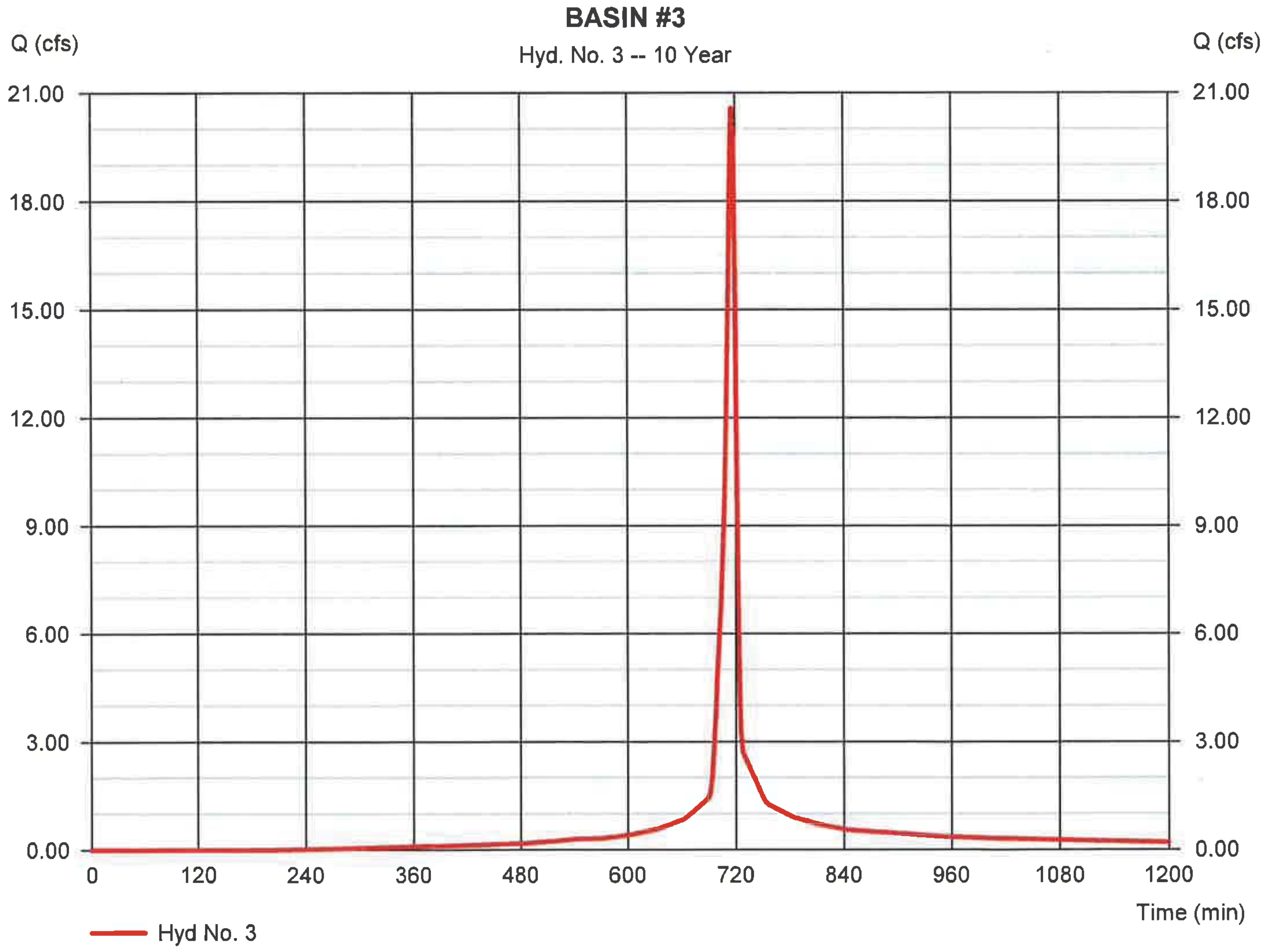
Hydrograph Report

Hyd. No. 3

BASIN #3

Hydrograph type	= SCS Runoff	Peak discharge	= 20.57 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 44,737 cuft
Drainage area	= 3.090 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.090 x 91)] / 3.090



Hydrograph Report

Colon Mine Phase 1

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

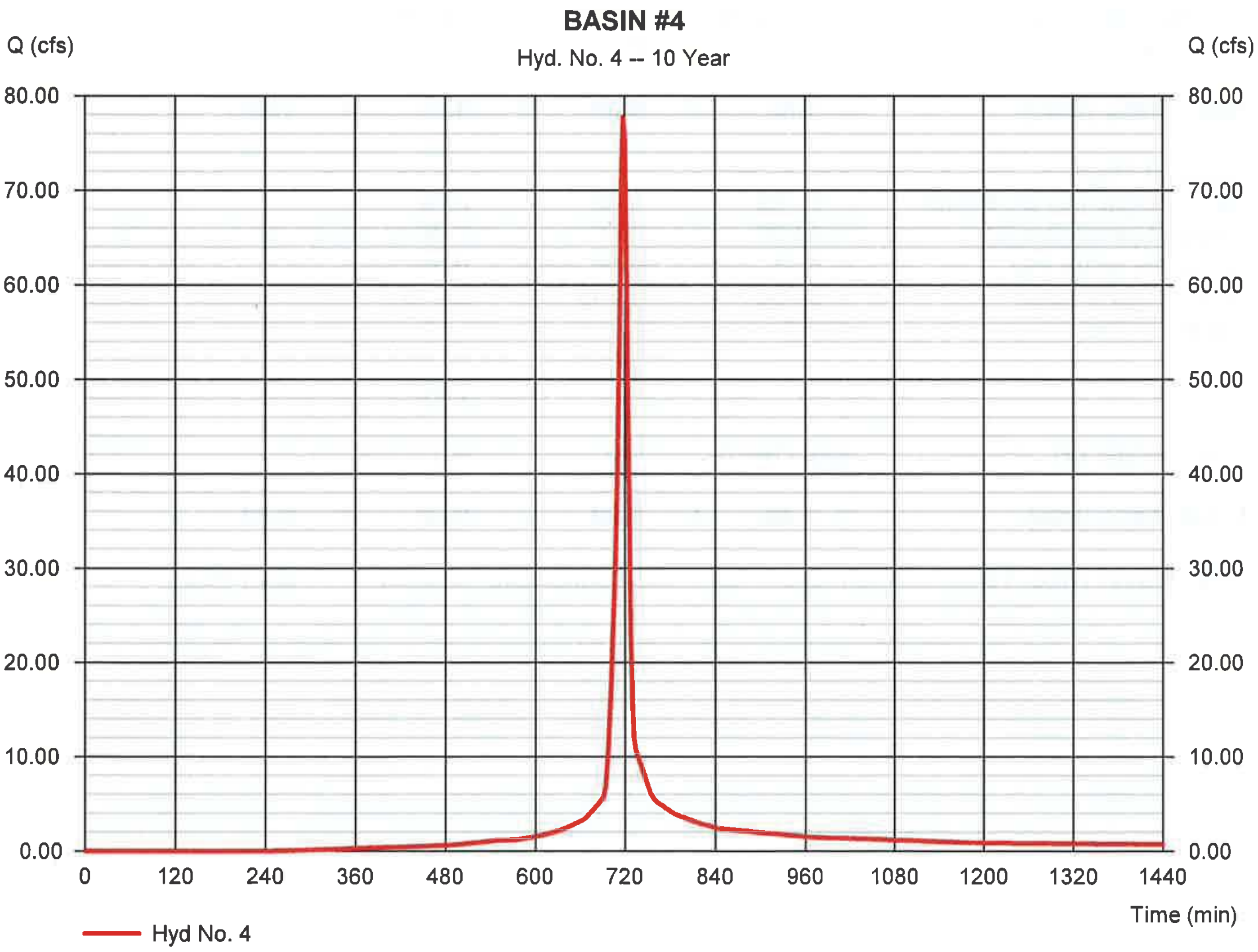
Friday, 10 / 31 / 2014

Hyd. No. 4

BASIN #4

Hydrograph type	= SCS Runoff	Peak discharge	= 77.74 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 186,273 cuft
Drainage area	= 12.700 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.60 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.880 x 86) + (6.820 x 91)] / 12.700



TR55 Tc Worksheet

Hyd. No. 4

BASIN #4

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)	= 3.62	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
Travel Time (min)	**= 5.05**	**+ 0.00**	**+ 0.00**	**= 5.05**
Shallow Concentrated Flow				
Flow length (ft)	= 252.20	0.00	0.00	
Watercourse slope (%)	= 6.54	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.13	0.00	0.00	
Travel Time (min)	**= 1.02**	**+ 0.00**	**+ 0.00**	**= 1.02**
Channel Flow				
X sectional flow area (sqft)	= 20.00	0.00	0.00	
Wetted perimeter (ft)	= 14.00	0.00	0.00	
Channel slope (%)	= 4.11	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=7.67	0.00	0.00	
Flow length (ft)	({0})1144.0	0.0	0.0	
Travel Time (min)	**= 2.49**	**+ 0.00**	**+ 0.00**	**= 2.49**
Total Travel Time, Tc				**8.60 min**

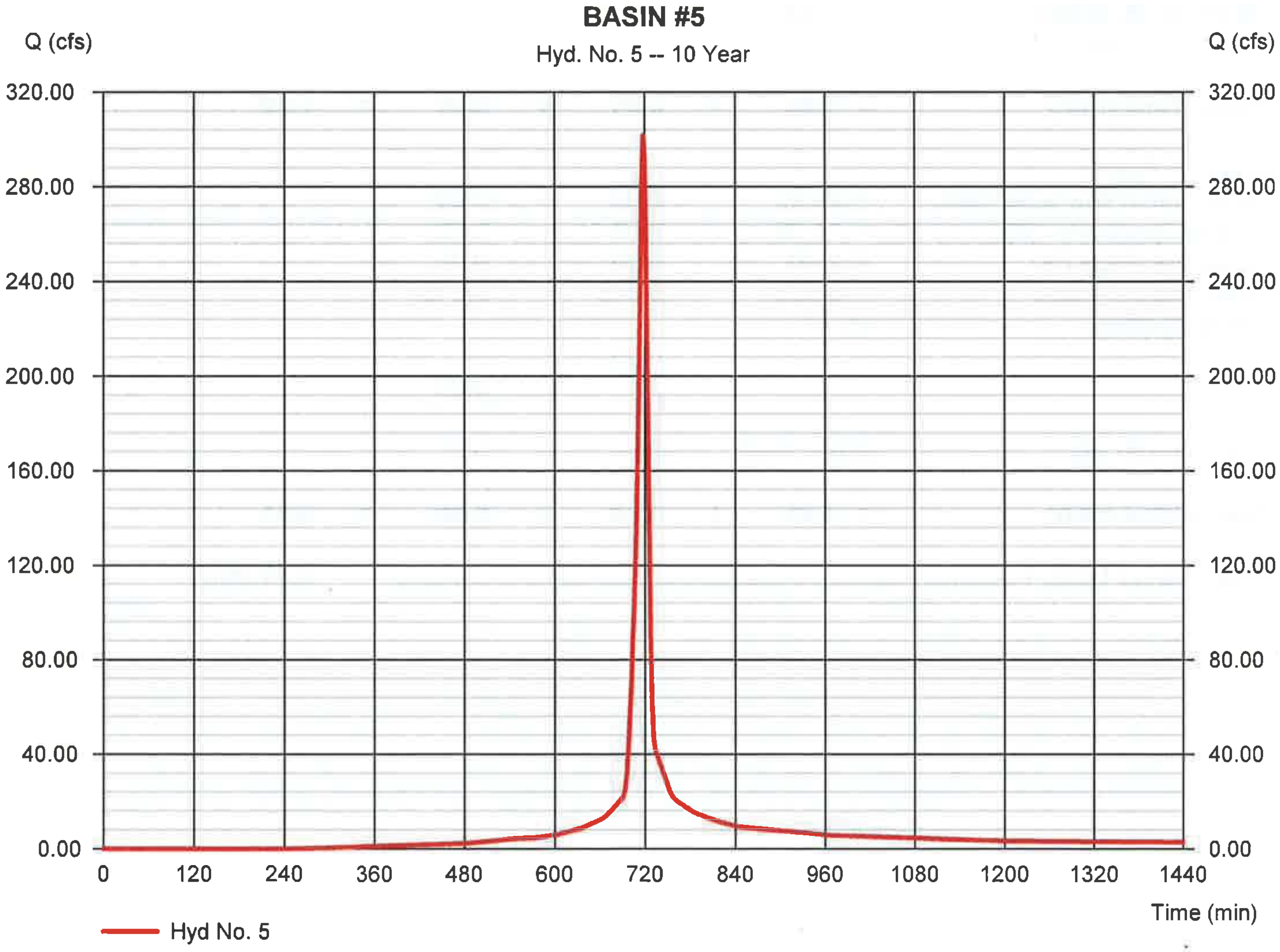
Hydrograph Report

Hyd. No. 5

BASIN #5

Hydrograph type	= SCS Runoff	Peak discharge	= 301.78 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 723,090 cuft
Drainage area	= 49.300 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.50 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(24.900 x 86) + (21.230 x 91) + (3.170 x 94)] / 49.300



TR55 Tc Worksheet

Hyd. No. 5

BASIN #5

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)	= 3.62	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	**= 3.83**	**+ 0.00**	**+ 0.00**	**= 3.83**
Shallow Concentrated Flow				
Flow length (ft)	= 316.00	0.00	0.00	
Watercourse slope (%)	= 8.90	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.81	0.00	0.00	
Travel Time (min)	**= 1.09**	**+ 0.00**	**+ 0.00**	**= 1.09**
Channel Flow				
X sectional flow area (sqft)	= 20.00	0.00	0.00	
Wetted perimeter (ft)	= 14.00	0.00	0.00	
Channel slope (%)	= 2.30	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=5.74	0.00	0.00	
Flow length (ft)	({0})1588.0	0.0	0.0	
Travel Time (min)	**= 4.61**	**+ 0.00**	**+ 0.00**	**= 4.61**
Total Travel Time, Tc				**9.50 min**

Hyd. No. 6

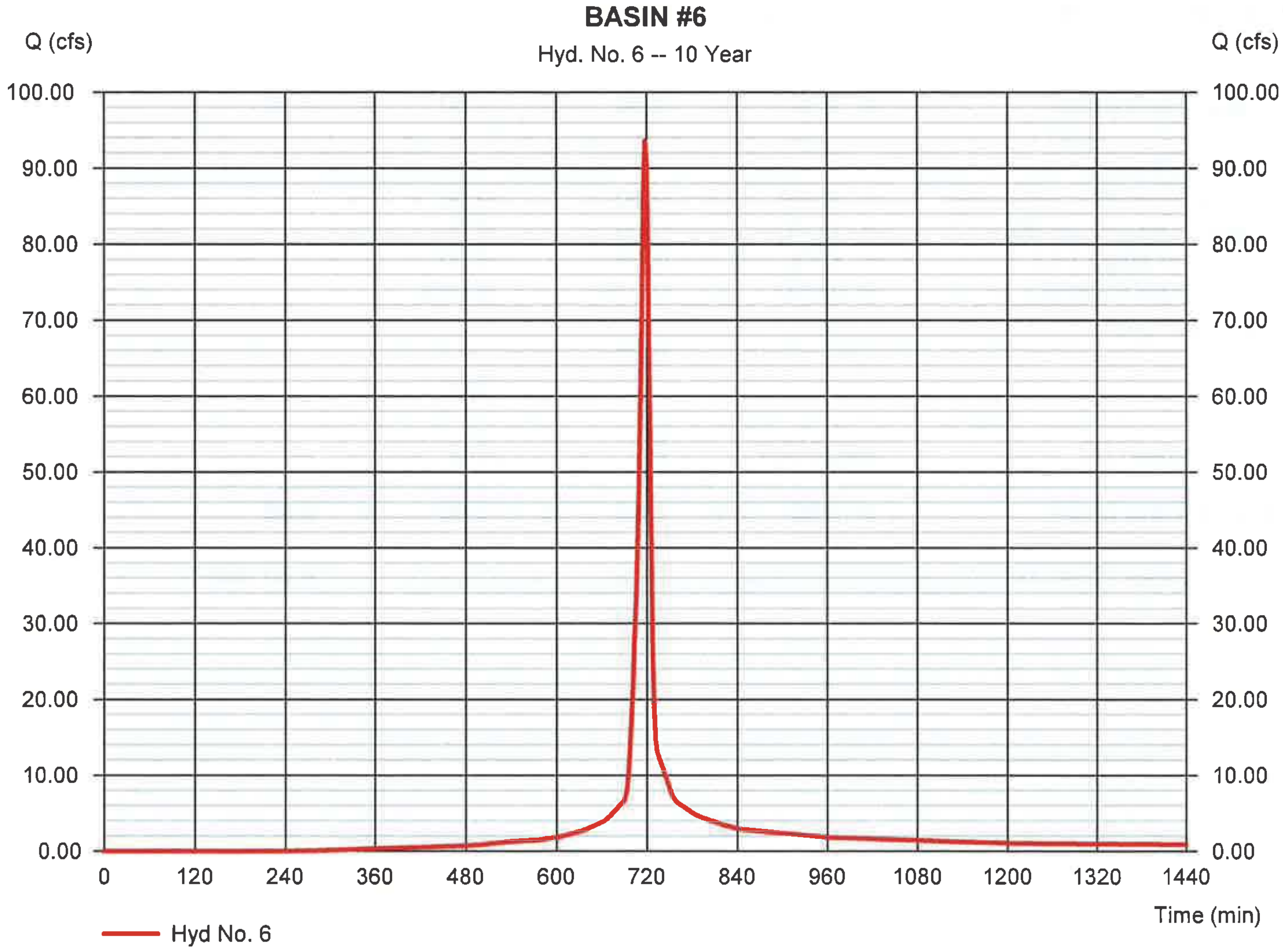
BASIN #6

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 15.290 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.28 in
Storm duration = 24 hrs

Peak discharge = 93.60 cfs
Time to peak = 718 min
Hyd. volume = 224,261 cuft
Curve number = 89*
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.30 min
Distribution = Type II
Shape factor = 484

---

* Composite (Area/CN) = [(5.550 x 86) + (9.740 x 91)] / 15.290



TR55 Tc Worksheet

Hyd. No. 6

BASIN #6

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)	= 3.62	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
Travel Time (min)	**= 5.05**	**+ 0.00**	**+ 0.00**	**= 5.05**
Shallow Concentrated Flow				
Flow length (ft)	= 592.93	0.00	0.00	
Watercourse slope (%)	= 6.62	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.15	0.00	0.00	
Travel Time (min)	**= 2.38**	**+ 0.00**	**+ 0.00**	**= 2.38**
Channel Flow				
X sectional flow area (sqft)	= 20.00	0.00	0.00	
Wetted perimeter (ft)	= 14.00	0.00	0.00	
Channel slope (%)	= 4.13	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=7.69	0.00	0.00	
Flow length (ft)	({0})392.9	0.0	0.0	
Travel Time (min)	**= 0.85**	**+ 0.00**	**+ 0.00**	**= 0.85**
Total Travel Time, Tc				**8.30 min**

Hydrograph Report

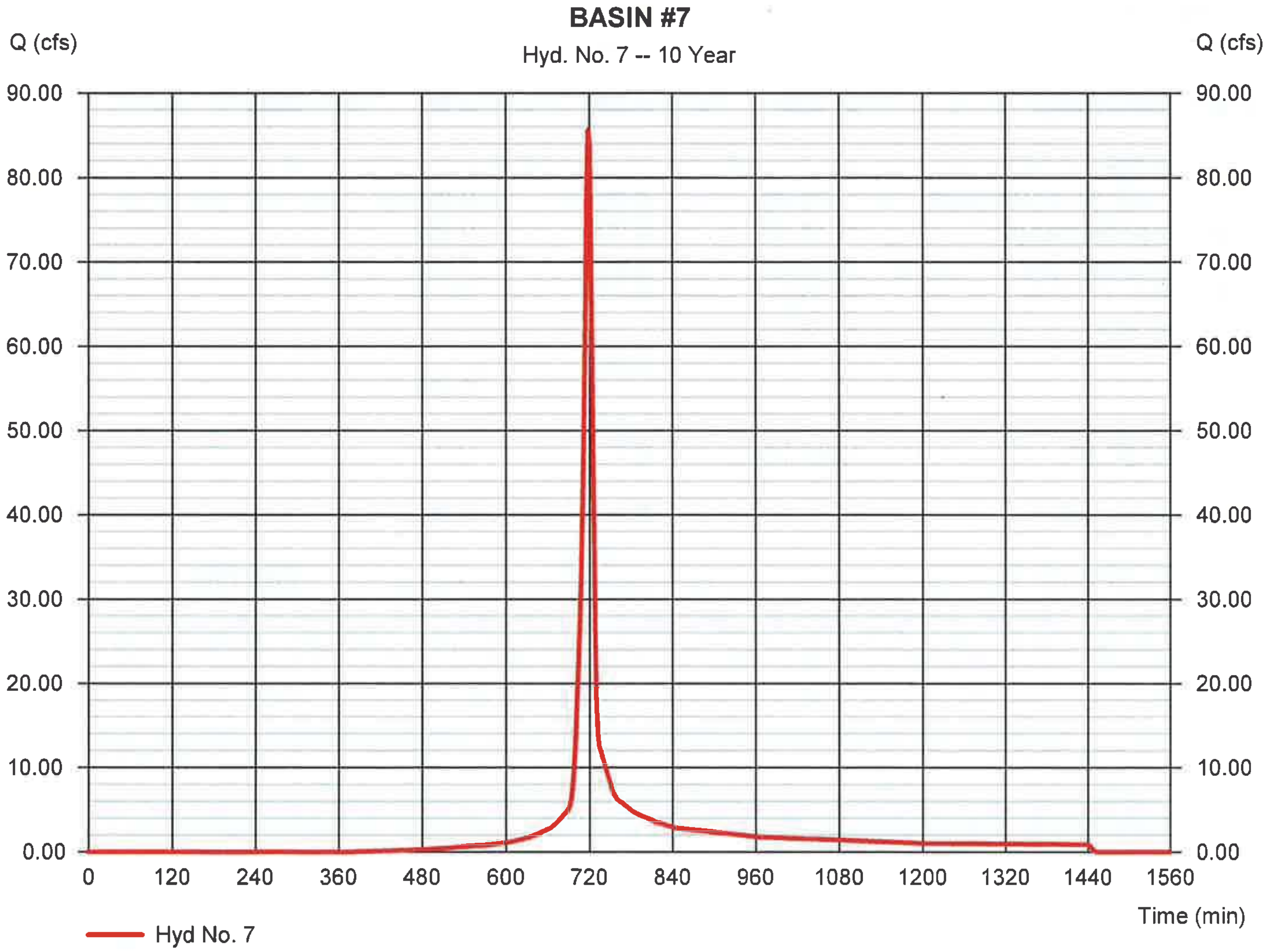
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Friday, 10 / 31 / 2014

Hyd. No. 7

BASIN #7

Hydrograph type	= SCS Runoff	Peak discharge	= 85.59 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 197,920 cuft
Drainage area	= 16.370 ac	Curve number	= 82*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.40 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(7.330 x 86) + (5.180 x 91) + (3.330 x 61) + (0.530 x 74)] / 16.370



TR55 Tc Worksheet

Hyd. No. 7

BASIN #7

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)	=	3.62		0.00		0.00		
Land slope (%)	=	1.00		0.00		0.00		
Travel Time (min)	**=**	**5.05**	**+**	**0.00**	**+**	**0.00**	**=**	**5.05**
Shallow Concentrated Flow								
Flow length (ft)	=	290.20		0.00		0.00		
Watercourse slope (%)	=	10.33		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=5.19			0.00		0.00		
Travel Time (min)	**=**	**0.93**	**+**	**0.00**	**+**	**0.00**	**=**	**0.93**
Channel Flow								
X sectional flow area (sqft)	=	20.00		0.00		0.00		
Wetted perimeter (ft)	=	14.00		0.00		0.00		
Channel slope (%)	=	4.10		0.00		0.00		
Manning's n-value	=	0.050		0.015		0.015		
Velocity (ft/s)	=7.66							
				0.00				
						0.00		
Flow length (ft)	({0})658.3			0.0		0.0		
Travel Time (min)	**=**	**1.43**	**+**	**0.00**	**+**	**0.00**	**=**	**1.43**

Total Travel Time, Tc .... **7.40 min**

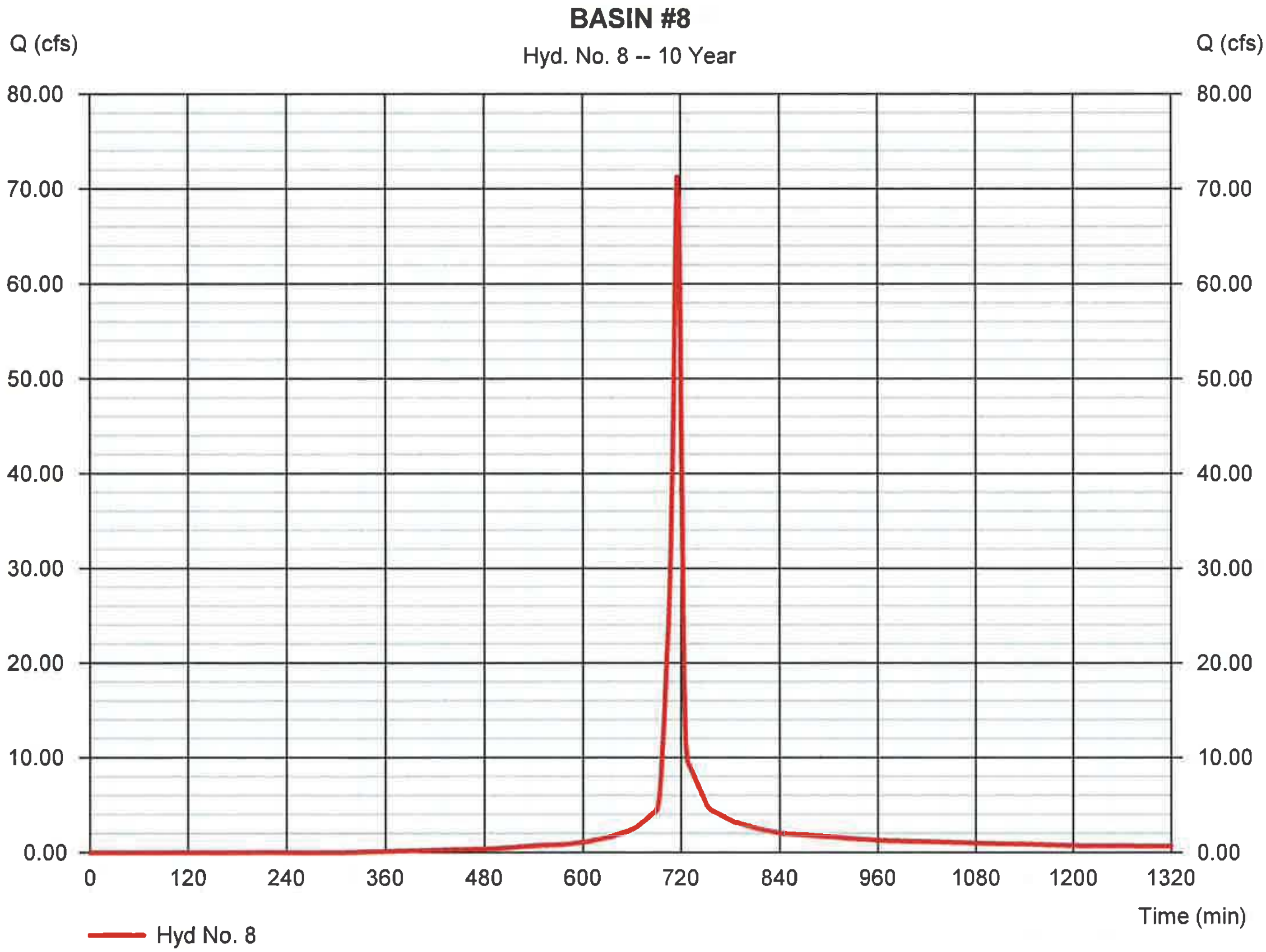
Hydrograph Report

Hyd. No. 8

BASIN #8

Hydrograph type	= SCS Runoff	Peak discharge	= 71.25 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 149,115 cuft
Drainage area	= 11.750 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(11.750 x 86)] / 11.750



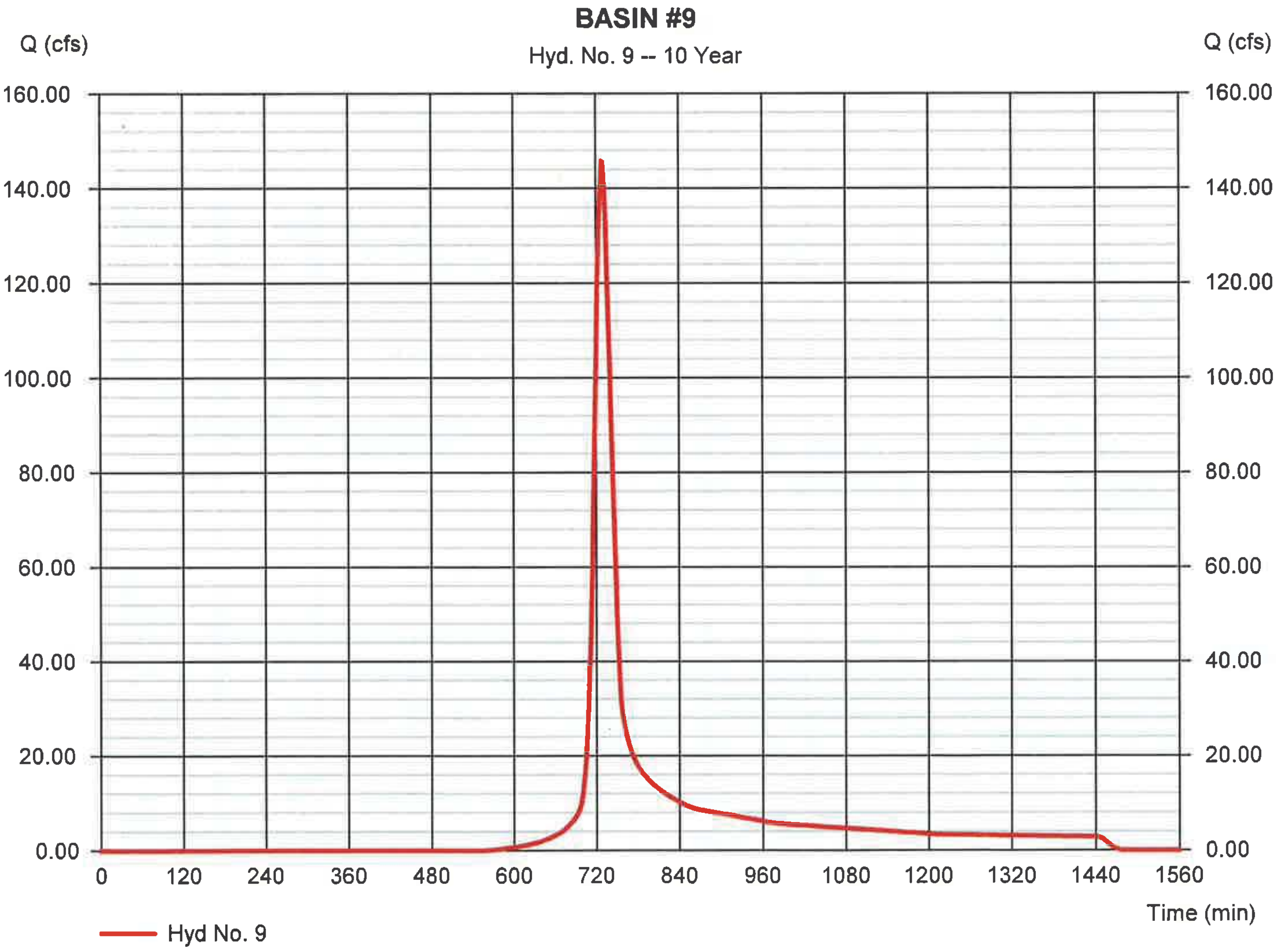
Hydrograph Report

Hyd. No. 9

BASIN #9

Hydrograph type	= SCS Runoff	Peak discharge	= 145.70 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 541,646 cuft
Drainage area	= 62.750 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.80 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(32.830 x 86) + (16.030 x 55) + (9.190 x 91)] / 62.750



Hyd. No. 9

BASIN #9

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)	= 3.62	0.00	0.00	
Land slope (%)	= 1.50	0.00	0.00	
Travel Time (min)	**= 22.65**	**+ 0.00**	**+ 0.00**	**= 22.65**
Shallow Concentrated Flow				
Flow length (ft)	= 230.00	0.00	0.00	
Watercourse slope (%)	= 7.80	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.51	0.00	0.00	
Travel Time (min)	**= 0.85**	**+ 0.00**	**+ 0.00**	**= 0.85**
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	= 0.050	0.015	0.015	
Velocity (ft/s)	=6.87			
		0.00		
			0.00	
Flow length (ft)	({0})1351.0	0.0	0.0	
Travel Time (min)	**= 3.28**	**+ 0.00**	**+ 0.00**	**= 3.28**

Total Travel Time, Tc .... **26.80 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	40.68	2	716	86,249	------	------	------	BASIN #1
2	SCS Runoff	125.58	2	718	298,742	------	------	------	BASIN #2
3	SCS Runoff	24.96	2	716	55,013	------	------	------	BASIN #3
4	SCS Runoff	95.13	2	718	230,828	------	------	------	BASIN #4
5	SCS Runoff	369.28	2	718	896,050	------	------	------	BASIN #5
6	SCS Runoff	114.53	2	718	277,903	------	------	------	BASIN #6
7	SCS Runoff	108.11	2	718	252,279	------	------	------	BASIN #7
8	SCS Runoff	88.20	2	716	186,979	------	------	------	BASIN #8
9	SCS Runoff	196.26	2	728	722,837	------	------	------	BASIN #9

Basins-Phase 1.gpw	Return Period: 25 Year	Friday, 10 / 31 / 2014

Hyd. No. 1

BASIN #1

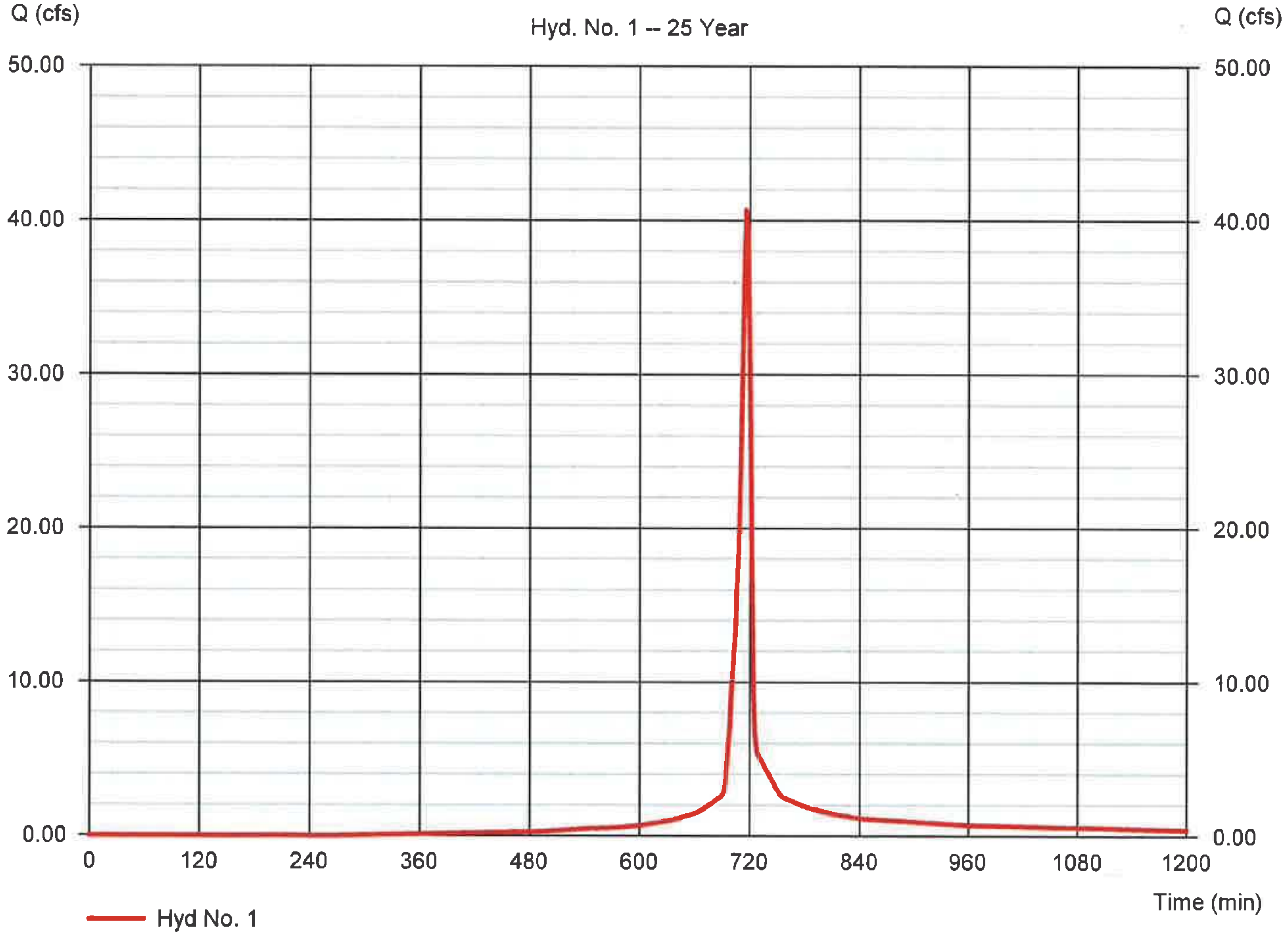
Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 5.420 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.28 in
Storm duration = 24 hrs

Peak discharge = 40.68 cfs
Time to peak = 716 min
Hyd. volume = 86,249 cuft
Curve number = 86*
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.50 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(5.420 x 86)] / 5.420

BASIN #1

Hyd. No. 1 -- 25 Year



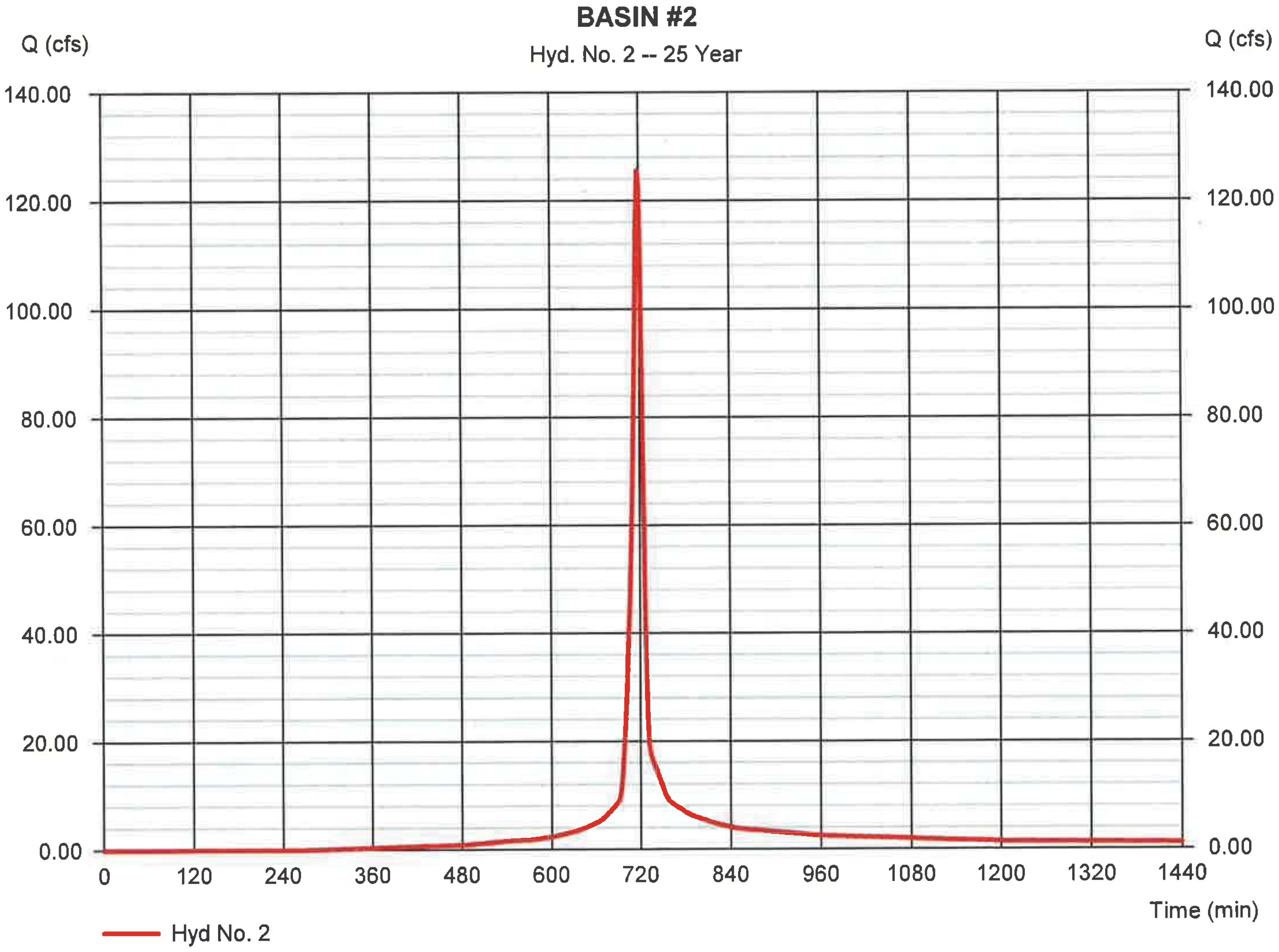
Hydrograph Report

Hyd. No. 2

BASIN #2

Hydrograph type	= SCS Runoff	Peak discharge	= 125.58 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 298,742 cuft
Drainage area	= 17.600 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.90 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(17.600 x 86)] / 17.600



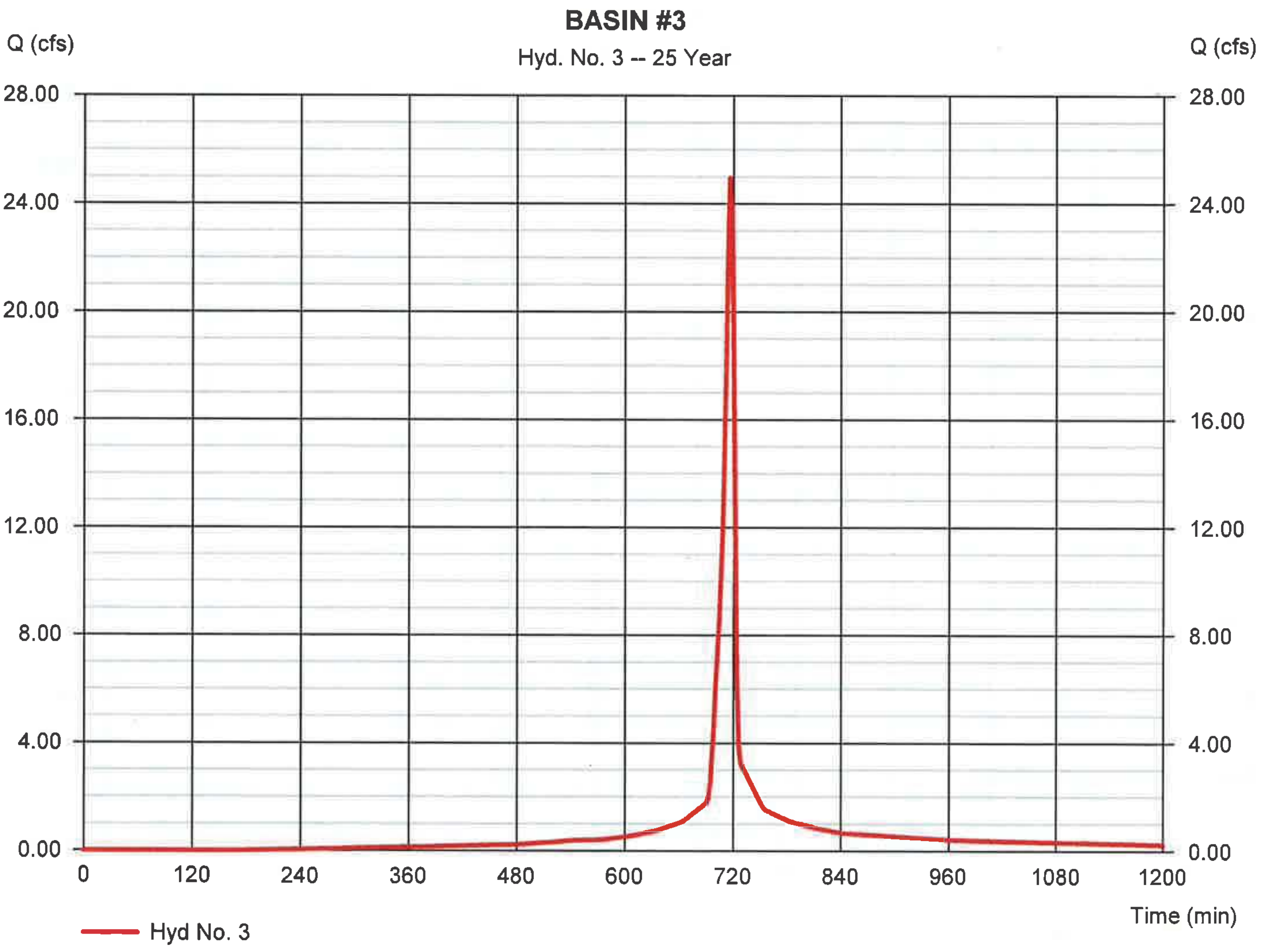
Hydrograph Report

Hyd. No. 3

BASIN #3

Hydrograph type	= SCS Runoff	Peak discharge	= 24.96 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 55,013 cuft
Drainage area	= 3.090 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.090 x 91)] / 3.090



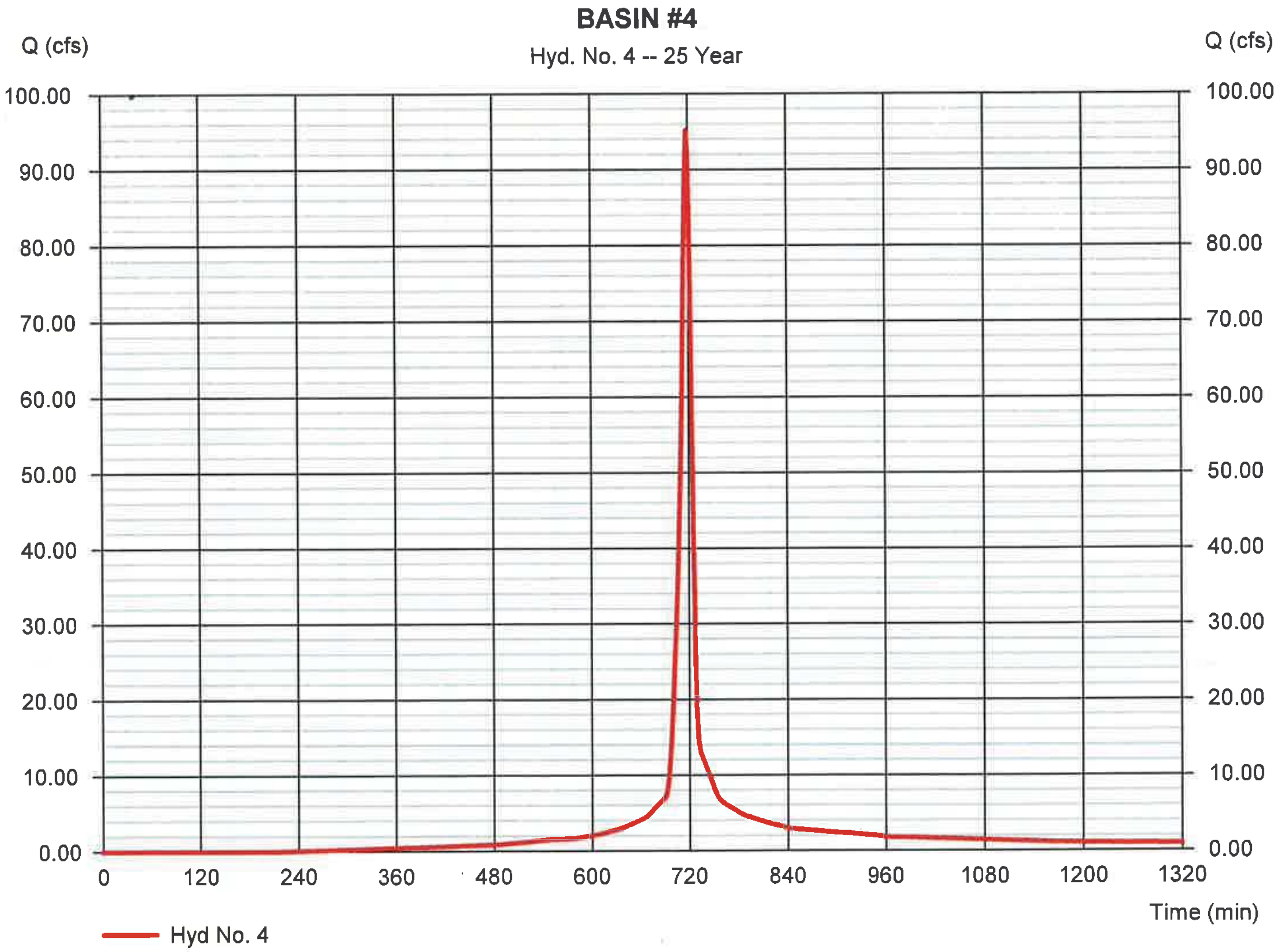
Hydrograph Report

Hyd. No. 4

BASIN #4

Hydrograph type	= SCS Runoff	Peak discharge	= 95.13 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 230,828 cuft
Drainage area	= 12.700 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.60 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.880 x 86) + (6.820 x 91)] / 12.700



Hydrograph Report

Colon Mine Phase 1

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

Friday, 10 / 31 / 2014

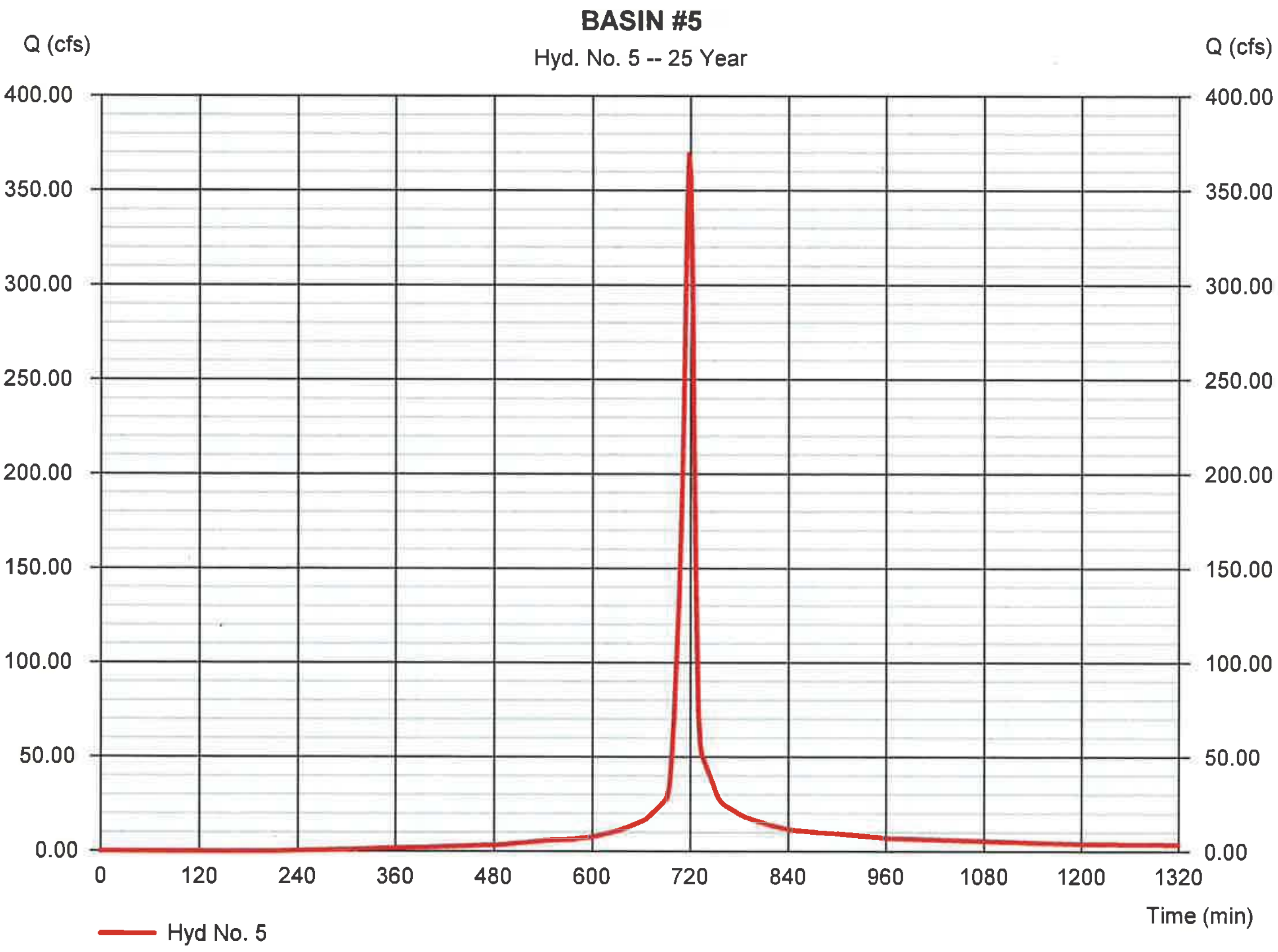
Hyd. No. 5

BASIN #5

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 49.300 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.28 in
Storm duration = 24 hrs

Peak discharge = 369.28 cfs
Time to peak = 718 min
Hyd. volume = 896,050 cuft
Curve number = 89*
Hydraulic length = 0 ft
Time of conc. (Tc) = 9.50 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(24.900 x 86) + (21.230 x 91) + (3.170 x 94)] / 49.300



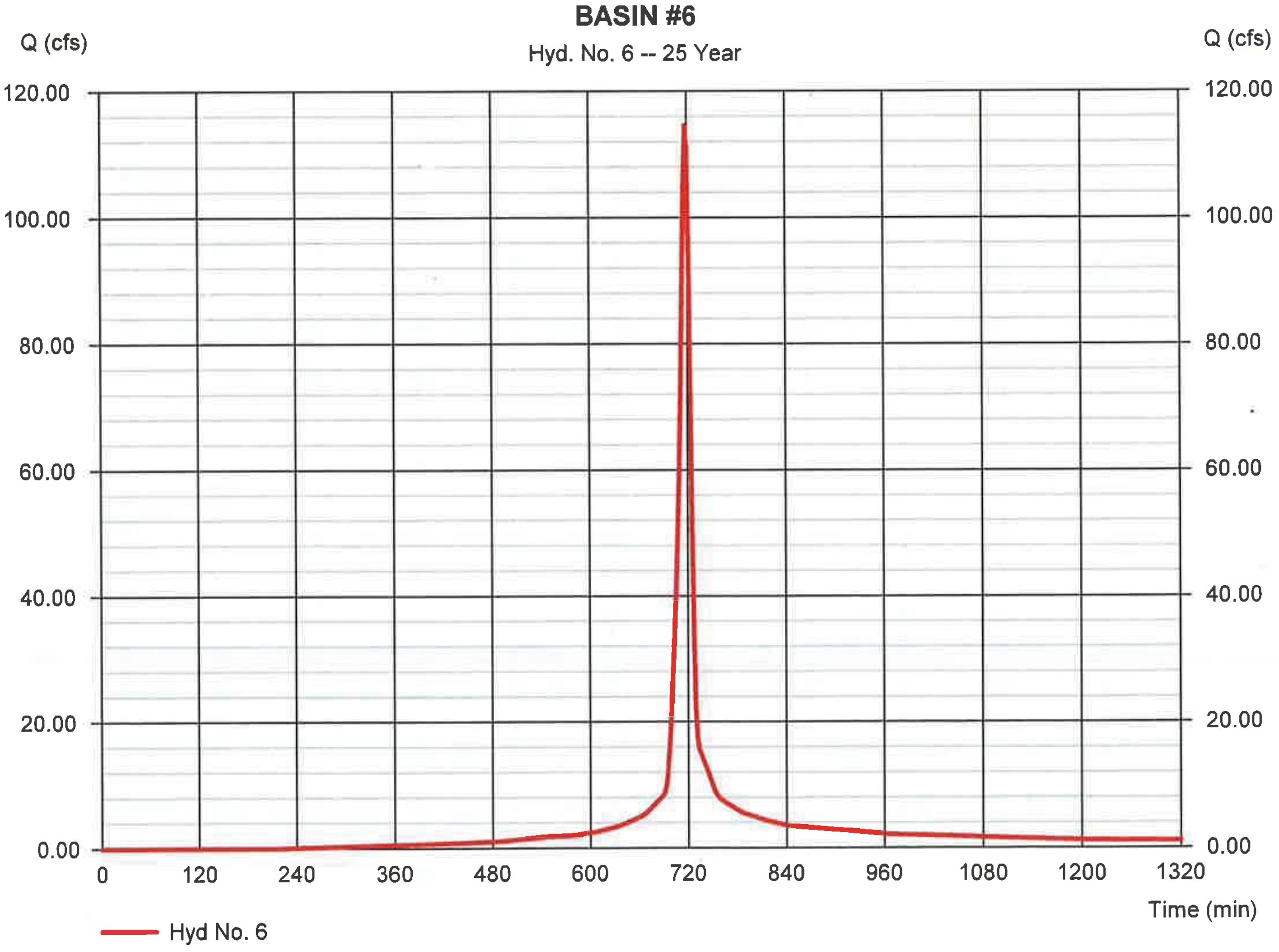
Hydrograph Report

Hyd. No. 6

BASIN #6

Hydrograph type	= SCS Runoff	Peak discharge	= 114.53 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 277,903 cuft
Drainage area	= 15.290 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.30 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.550 x 86) + (9.740 x 91)] / 15.290



Hydrograph Report

Hyd. No. 7

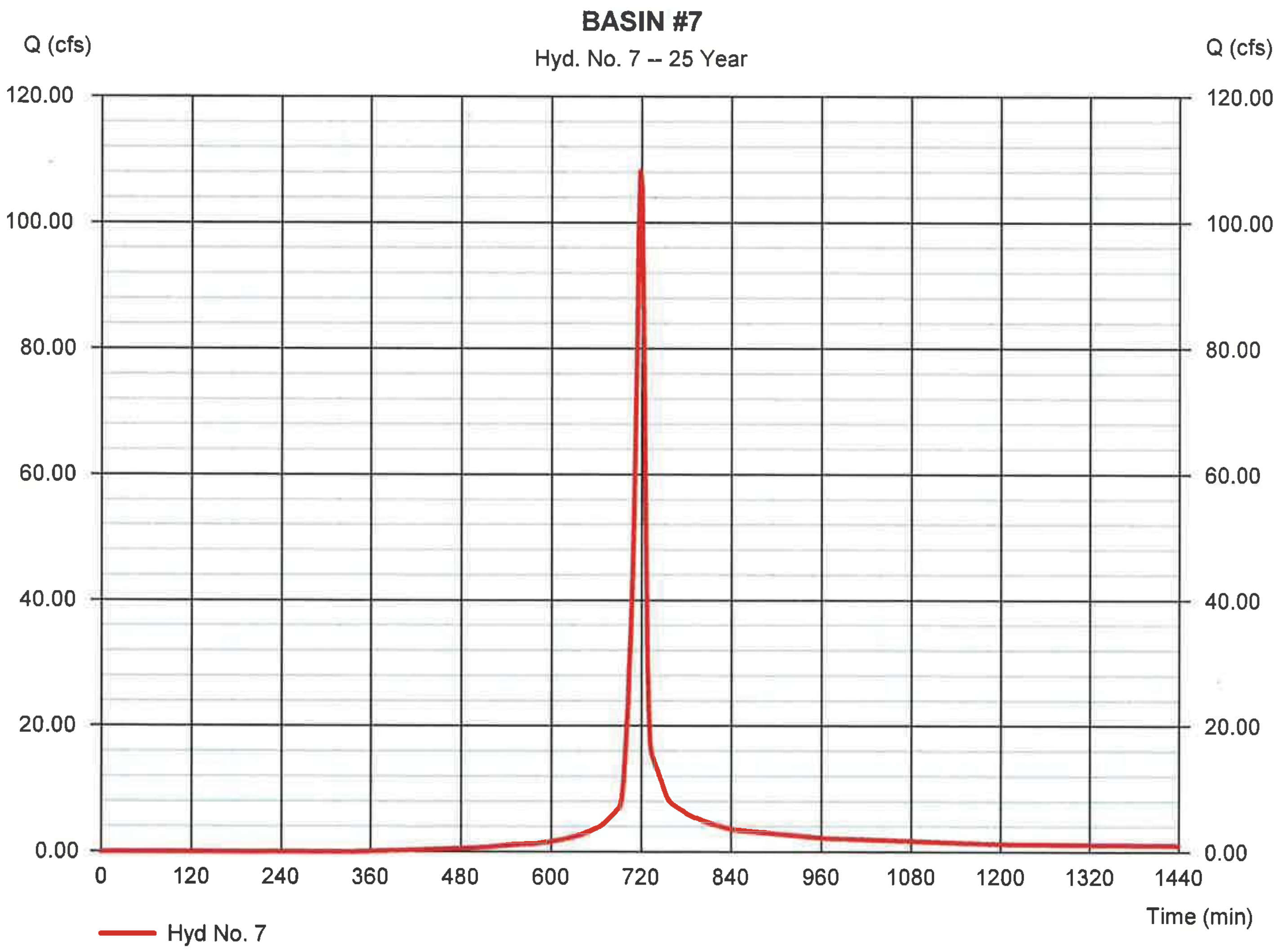
BASIN #7

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 16.370 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.28 in
Storm duration = 24 hrs

Peak discharge = 108.11 cfs
Time to peak = 718 min
Hyd. volume = 252,279 cuft
Curve number = 82*
Hydraulic length = 0 ft
Time of conc. (Tc) = 7.40 min
Distribution = Type II
Shape factor = 484

---

* Composite (Area/CN) = [(7.330 x 86) + (5.180 x 91) + (3.330 x 61) + (0.530 x 74)] / 16.370



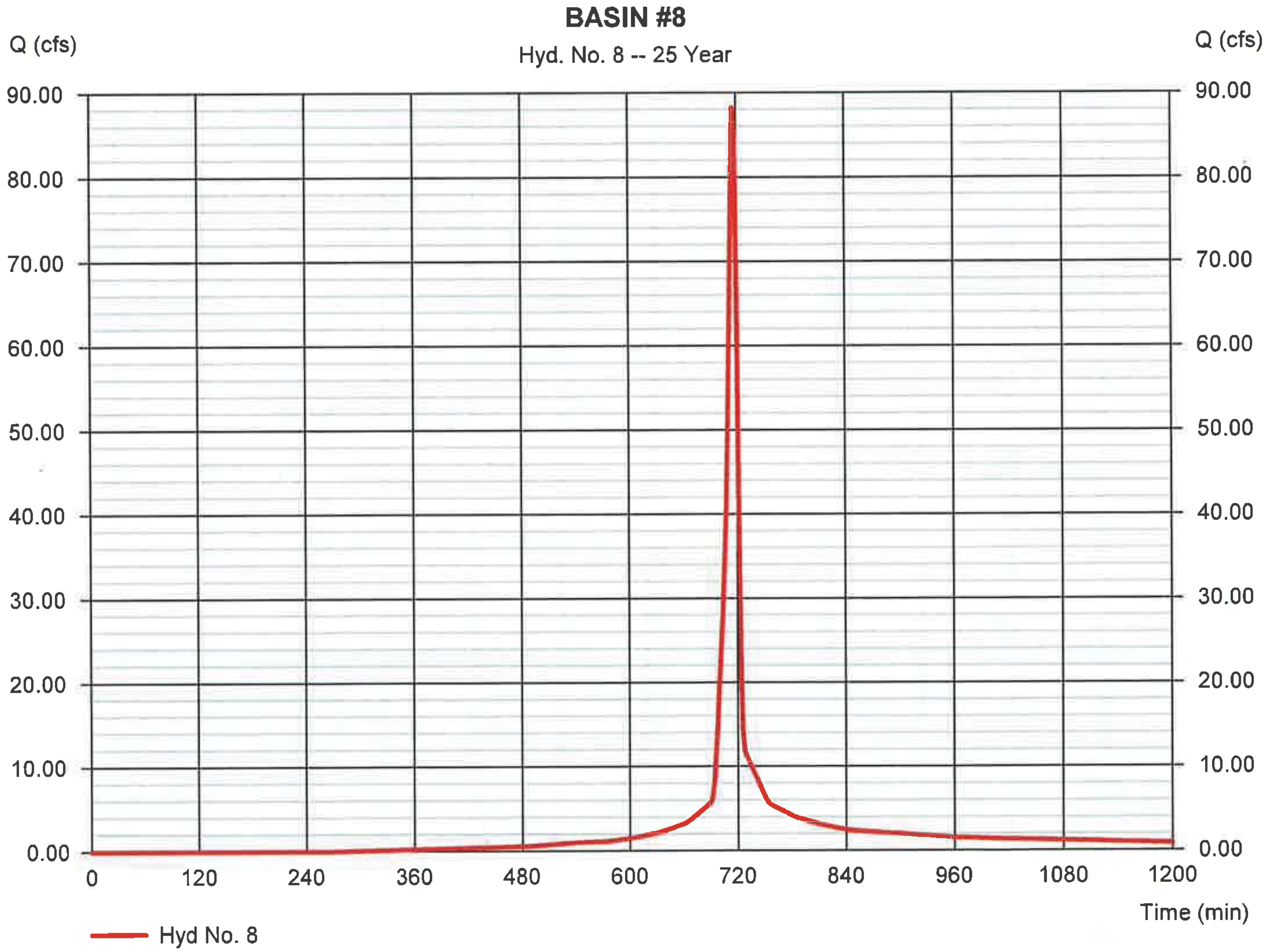
Hydrograph Report

Hyd. No. 8

BASIN #8

Hydrograph type	= SCS Runoff	Peak discharge	= 88.20 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 186,979 cuft
Drainage area	= 11.750 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(11.750 x 86)] / 11.750



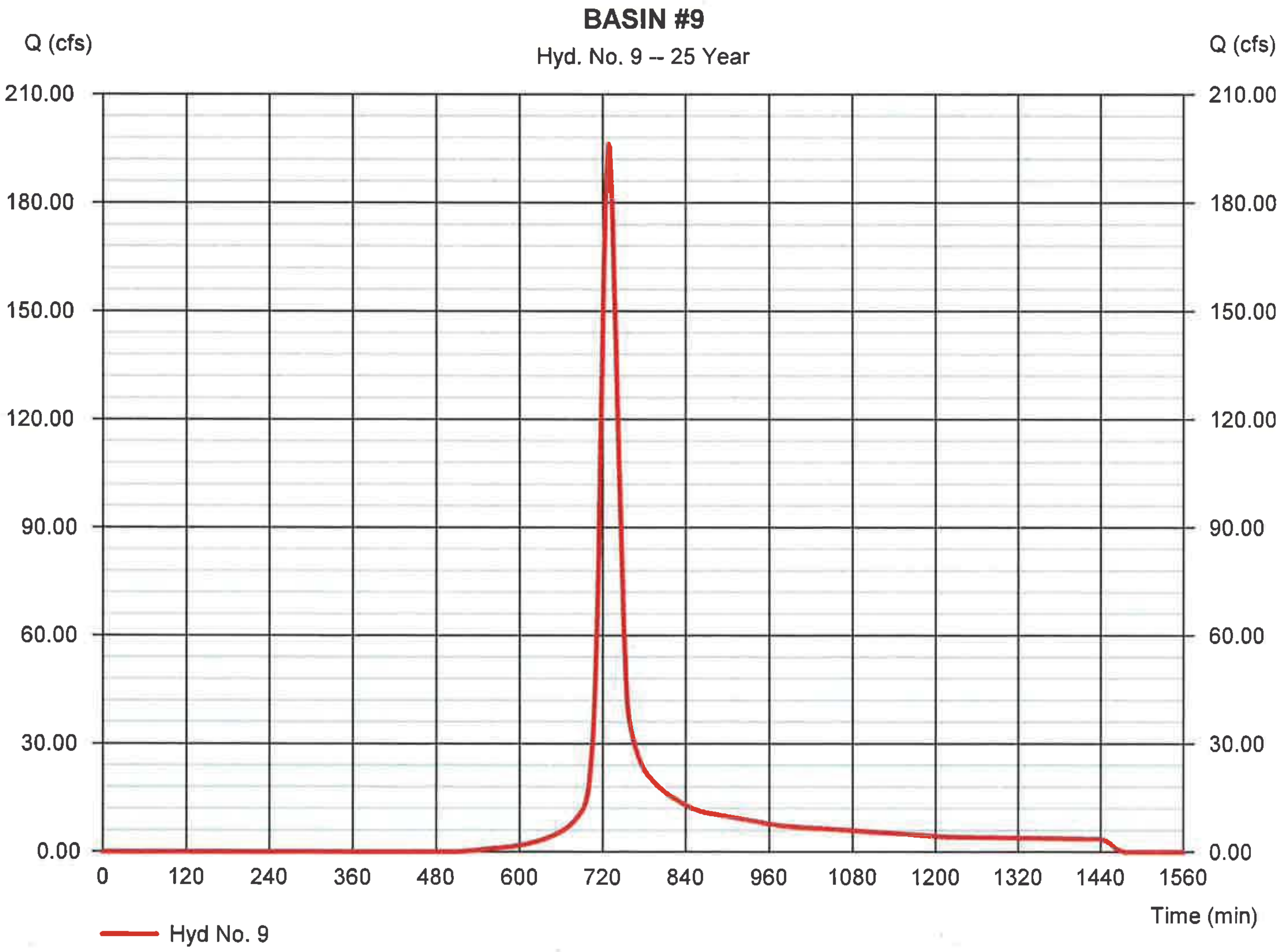
Hydrograph Report

Hyd. No. 9

BASIN #9

Hydrograph type	= SCS Runoff	Peak discharge	= 196.26 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 722,837 cuft
Drainage area	= 62.750 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.80 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(32.830 x 86) + (16.030 x 55) + (9.190 x 91)] / 62.750



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	53.13	2	716	114,638	------	------	------	BASIN #1
2	SCS Runoff	164.22	2	718	397,071	------	------	------	BASIN #2
3	SCS Runoff	31.93	2	716	71,569	------	------	------	BASIN #3
4	SCS Runoff	122.75	2	718	302,842	------	------	------	BASIN #4
5	SCS Runoff	476.49	2	718	1,175,598	------	------	------	BASIN #5
6	SCS Runoff	147.78	2	718	364,603	------	------	------	BASIN #6
7	SCS Runoff	144.24	2	718	341,440	------	------	------	BASIN #7
8	SCS Runoff	115.17	2	716	248,522	------	------	------	BASIN #8
9	SCS Runoff	280.49	2	728	1,029,030	------	------	------	BASIN #9

Basins-Phase 1.gpw	Return Period: 100 Year	Friday, 10 / 31 / 2014

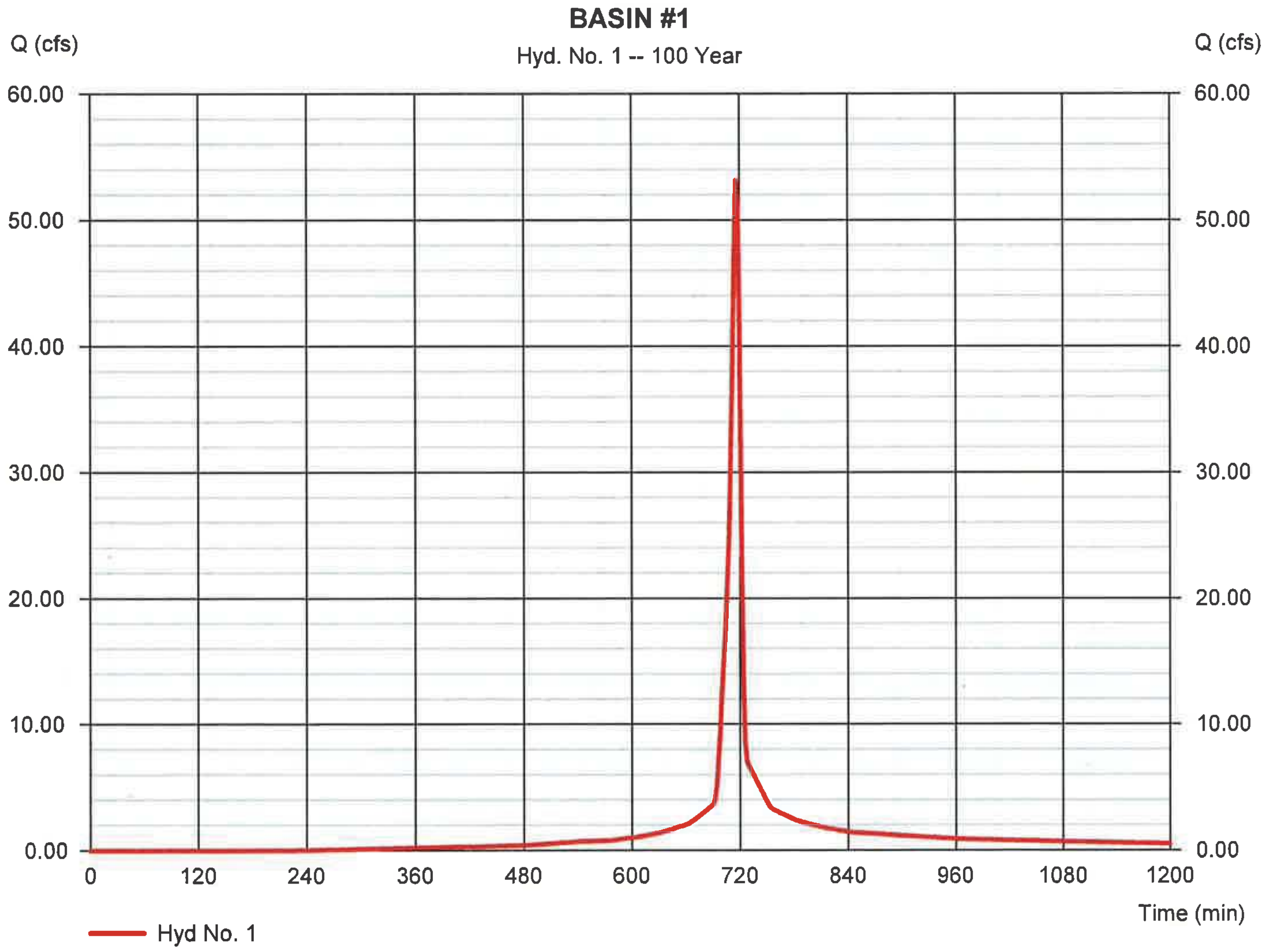
Hydrograph Report

Hyd. No. 1

BASIN #1

Hydrograph type	= SCS Runoff	Peak discharge	= 53.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 114,638 cuft
Drainage area	= 5.420 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.50 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(5.420 x 86)] / 5.420



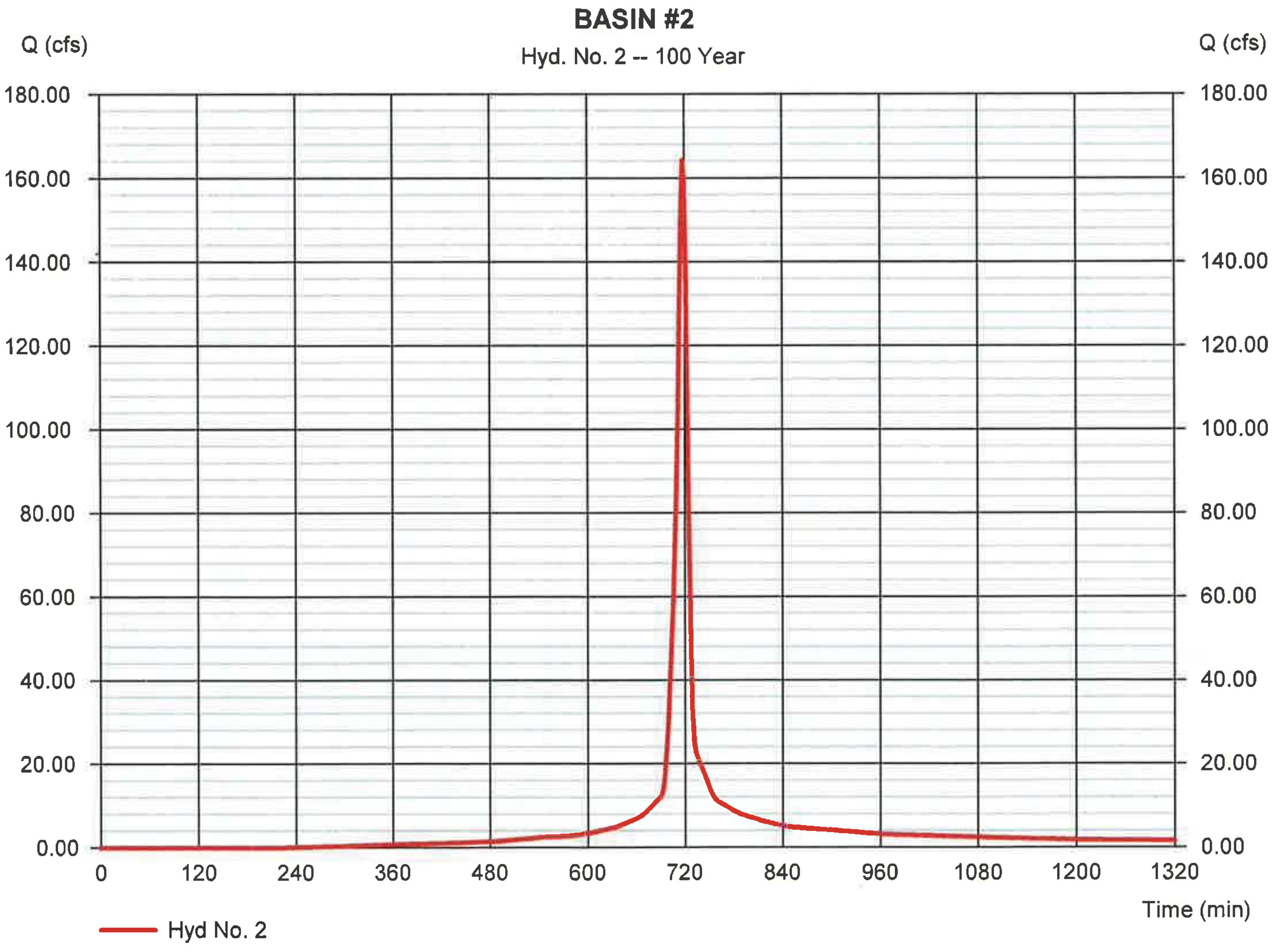
Hydrograph Report

Hyd. No. 2

BASIN #2

Hydrograph type	= SCS Runoff	Peak discharge	= 164.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 397,071 cuft
Drainage area	= 17.600 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.90 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(17.600 x 86)] / 17.600



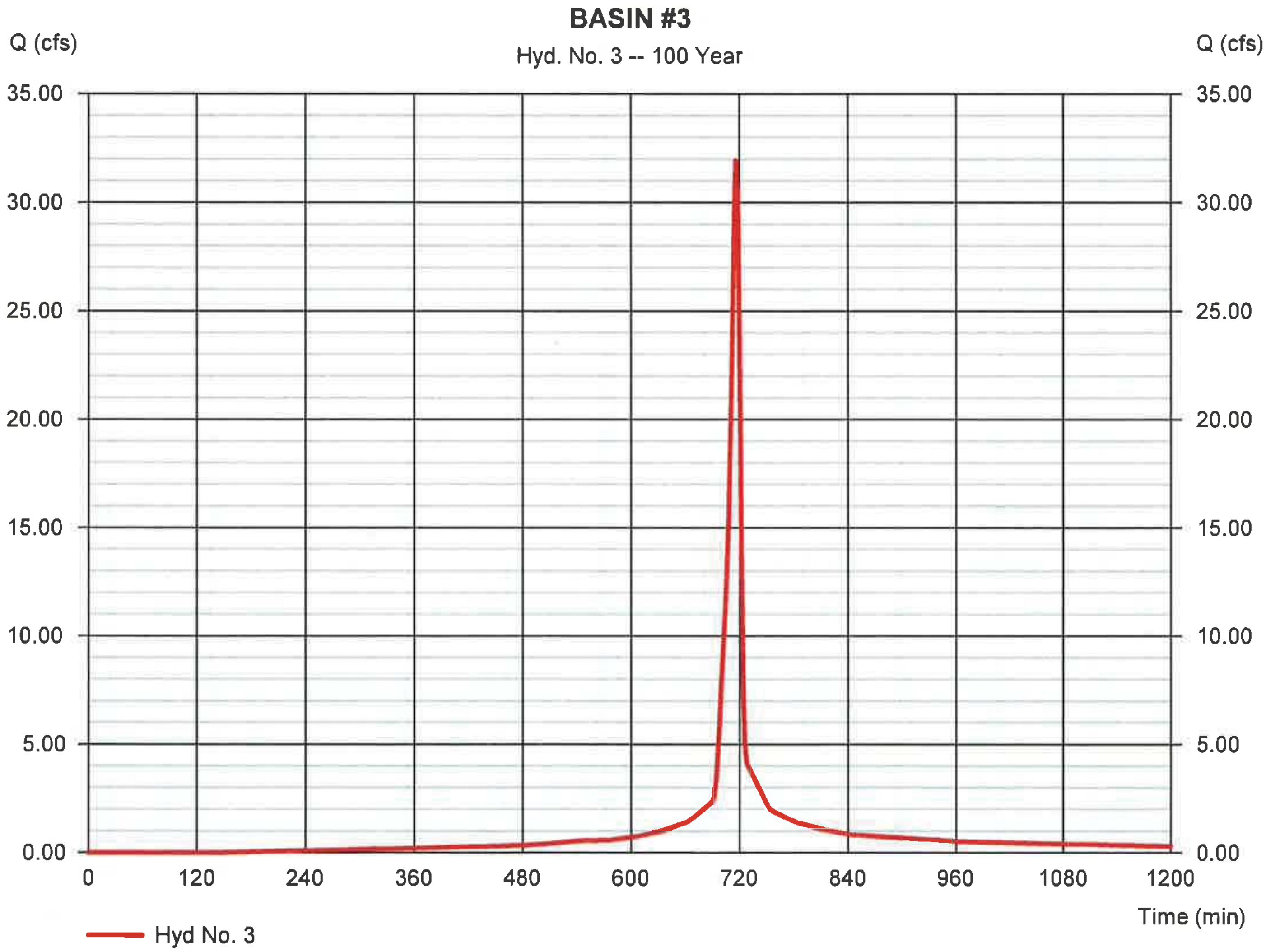
Hydrograph Report

Hyd. No. 3

BASIN #3

Hydrograph type	= SCS Runoff	Peak discharge	= 31.93 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 71,569 cuft
Drainage area	= 3.090 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.090 x 91)] / 3.090



Hydrograph Report

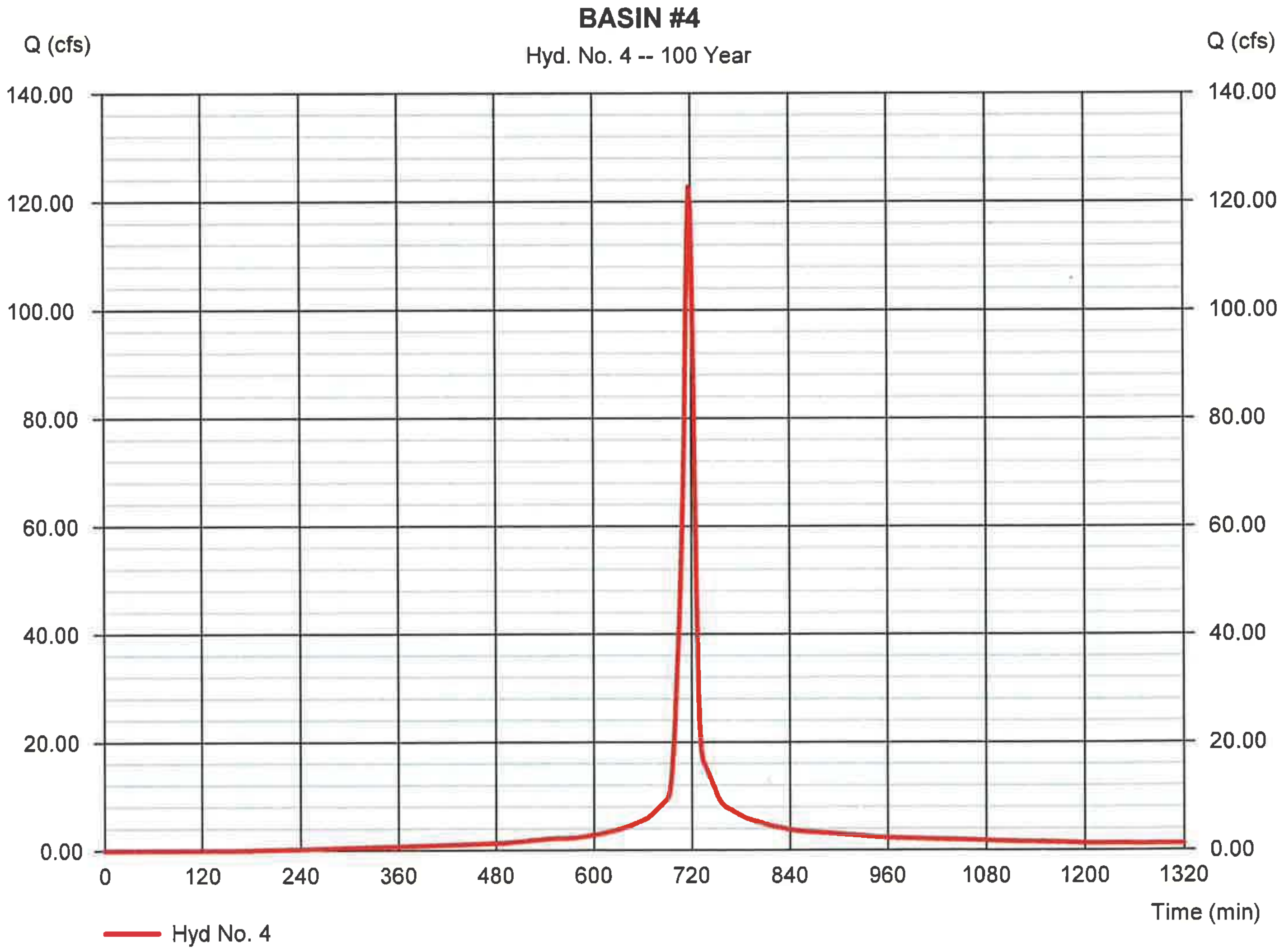
Hyd. No. 4

BASIN #4

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 12.700 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 7.88 in
Storm duration = 24 hrs

Peak discharge = 122.75 cfs
Time to peak = 718 min
Hyd. volume = 302,842 cuft
Curve number = 89*
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.60 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(5.880 x 86) + (6.820 x 91)] / 12.700



Hydrograph Report

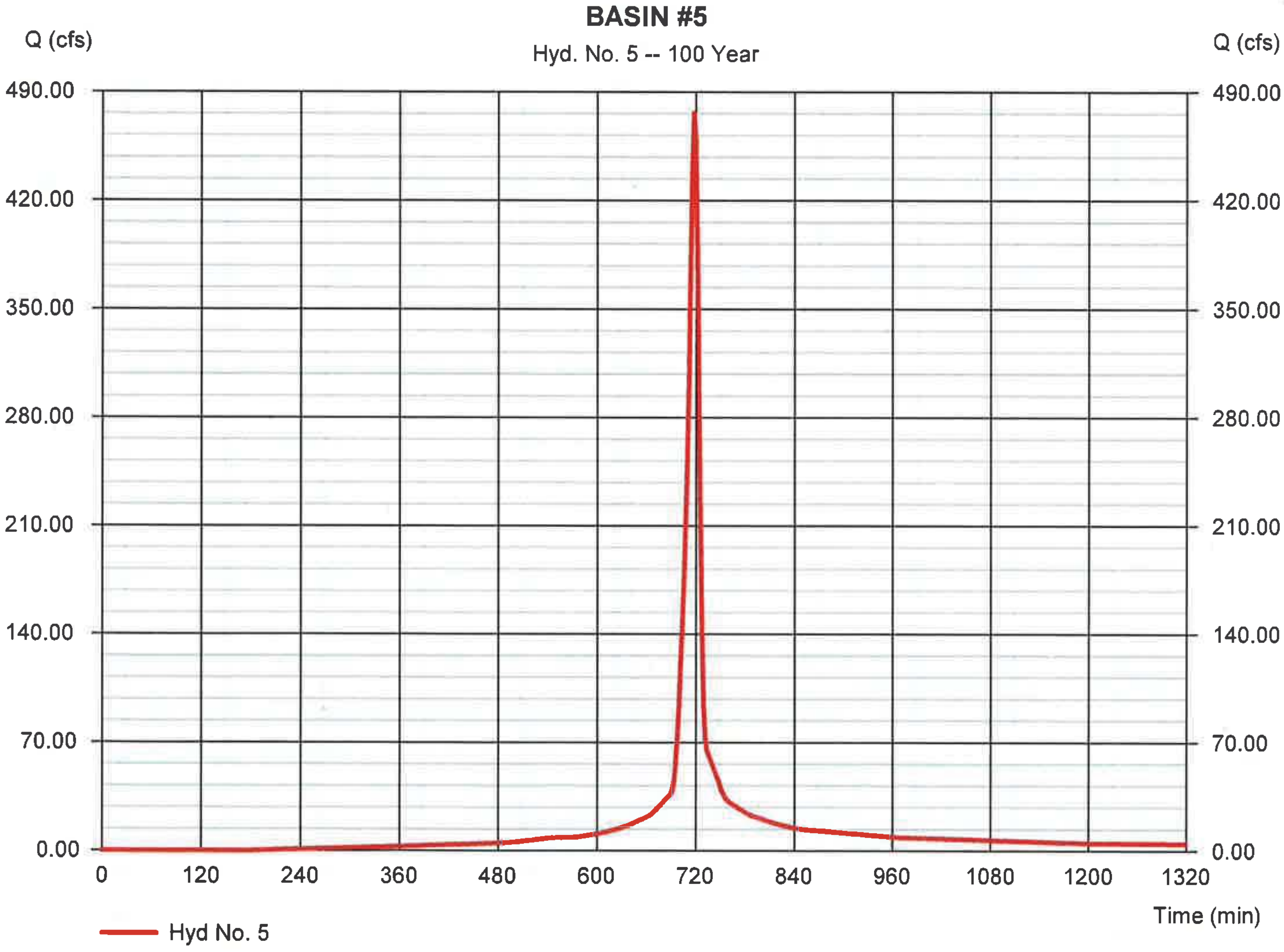
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Friday, 10 / 31 / 2014

Hyd. No. 5

BASIN #5

Hydrograph type	= SCS Runoff	Peak discharge	= 476.49 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,175,598 cuft
Drainage area	= 49.300 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.50 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(24.900 x 86) + (21.230 x 91) + (3.170 x 94)] / 49.300



Hydrograph Report

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

Friday, 10 / 31 / 2014

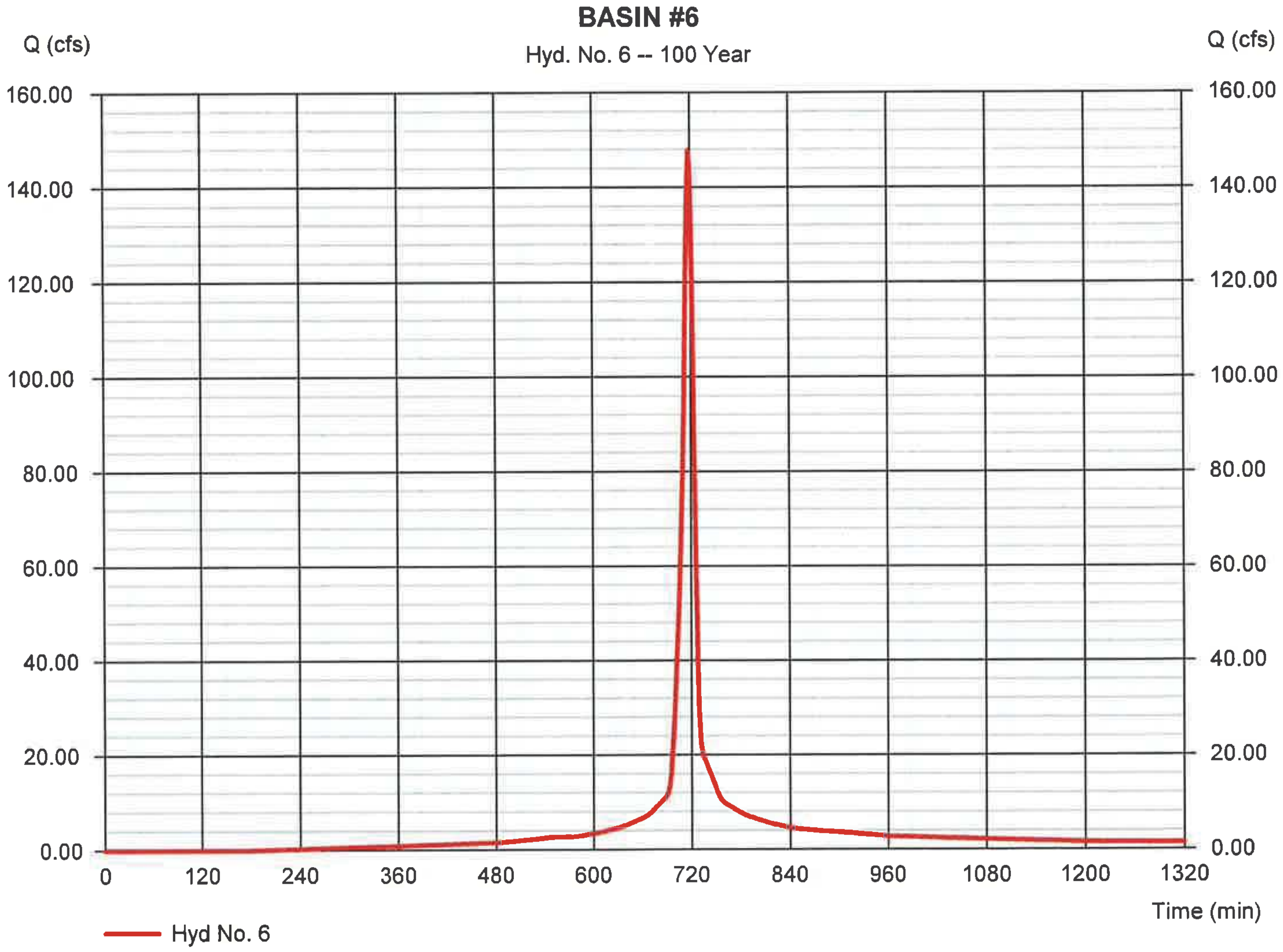
Hyd. No. 6

BASIN #6

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 15.290 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 7.88 in
Storm duration = 24 hrs

Peak discharge = 147.78 cfs
Time to peak = 718 min
Hyd. volume = 364,603 cuft
Curve number = 89*
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.30 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(5.550 x 86) + (9.740 x 91)] / 15.290

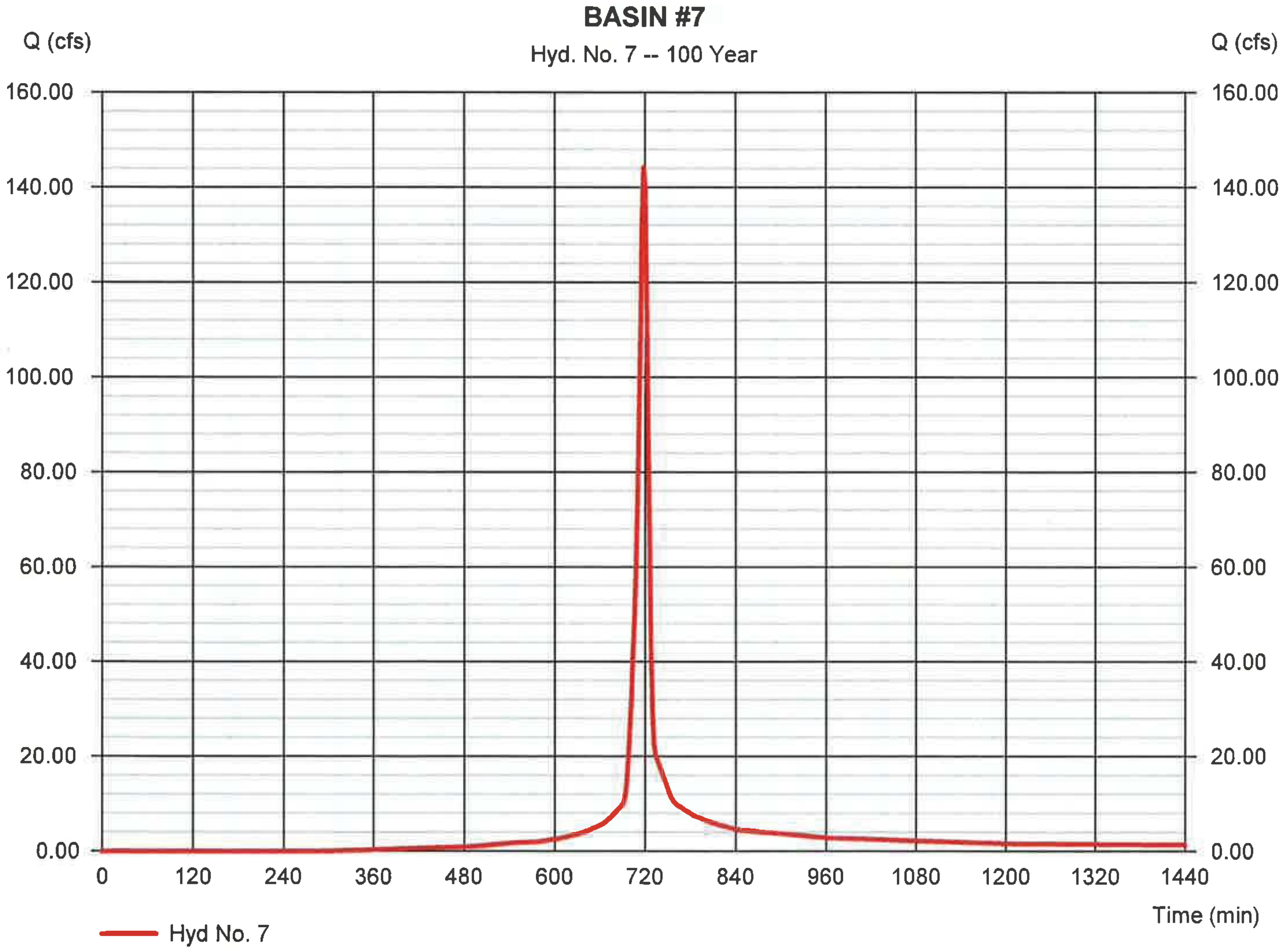


Hyd. No. 7

BASIN #7

Hydrograph type	= SCS Runoff	Peak discharge	= 144.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 341,440 cuft
Drainage area	= 16.370 ac	Curve number	= 82*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.40 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(7.330 x 86) + (5.180 x 91) + (3.330 x 61) + (0.530 x 74)] / 16.370



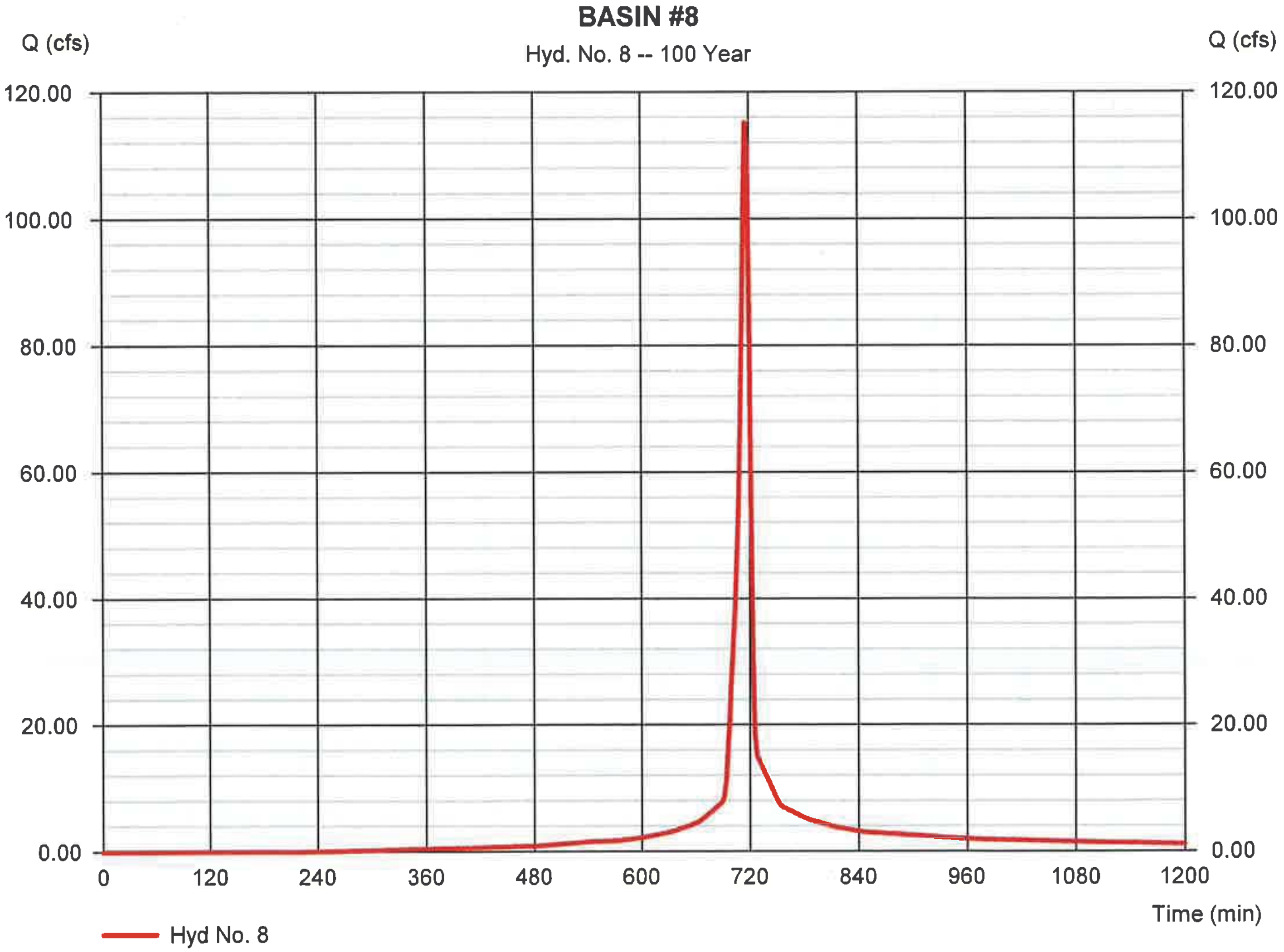
Hydrograph Report

Hyd. No. 8

BASIN #8

Hydrograph type	= SCS Runoff	Peak discharge	= 115.17 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 248,522 cuft
Drainage area	= 11.750 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(11.750 x 86)] / 11.750



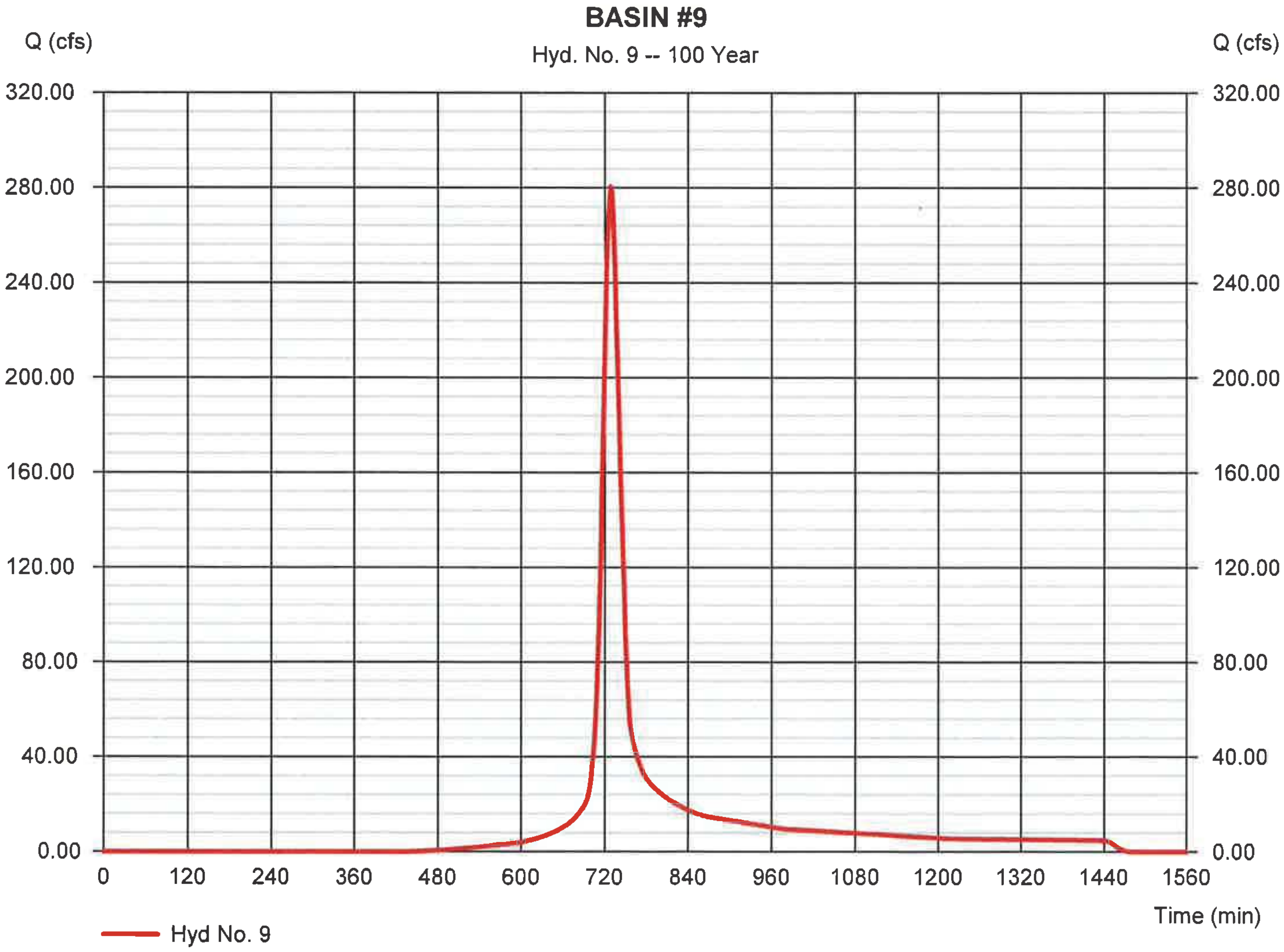
Hydrograph Report

Hyd. No. 9

BASIN #9

Hydrograph type	= SCS Runoff	Peak discharge	= 280.49 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 1,029,030 cuft
Drainage area	= 62.750 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(32.830 x 86) + (16.030 x 55) + (9.190 x 91)] / 62.750



This page intentionally left blank.

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	252.52	2	718	600,865	------	------	------	BASIN #5
2	SCS Runoff	43.09	2	722	123,140	------	------	------	BASIN #1
3	SCS Runoff	79.90	2	720	212,575	------	------	------	BASIN #2
4	SCS Runoff	134.71	2	722	378,978	------	------	------	BASIN #7
5	SCS Runoff	199.50	2	728	741,644	------	------	------	BASIN #9

Basins-Phase 2.gpw	Return Period: 10 Year	Friday, 10 / 31 / 2014

Hydrograph Report

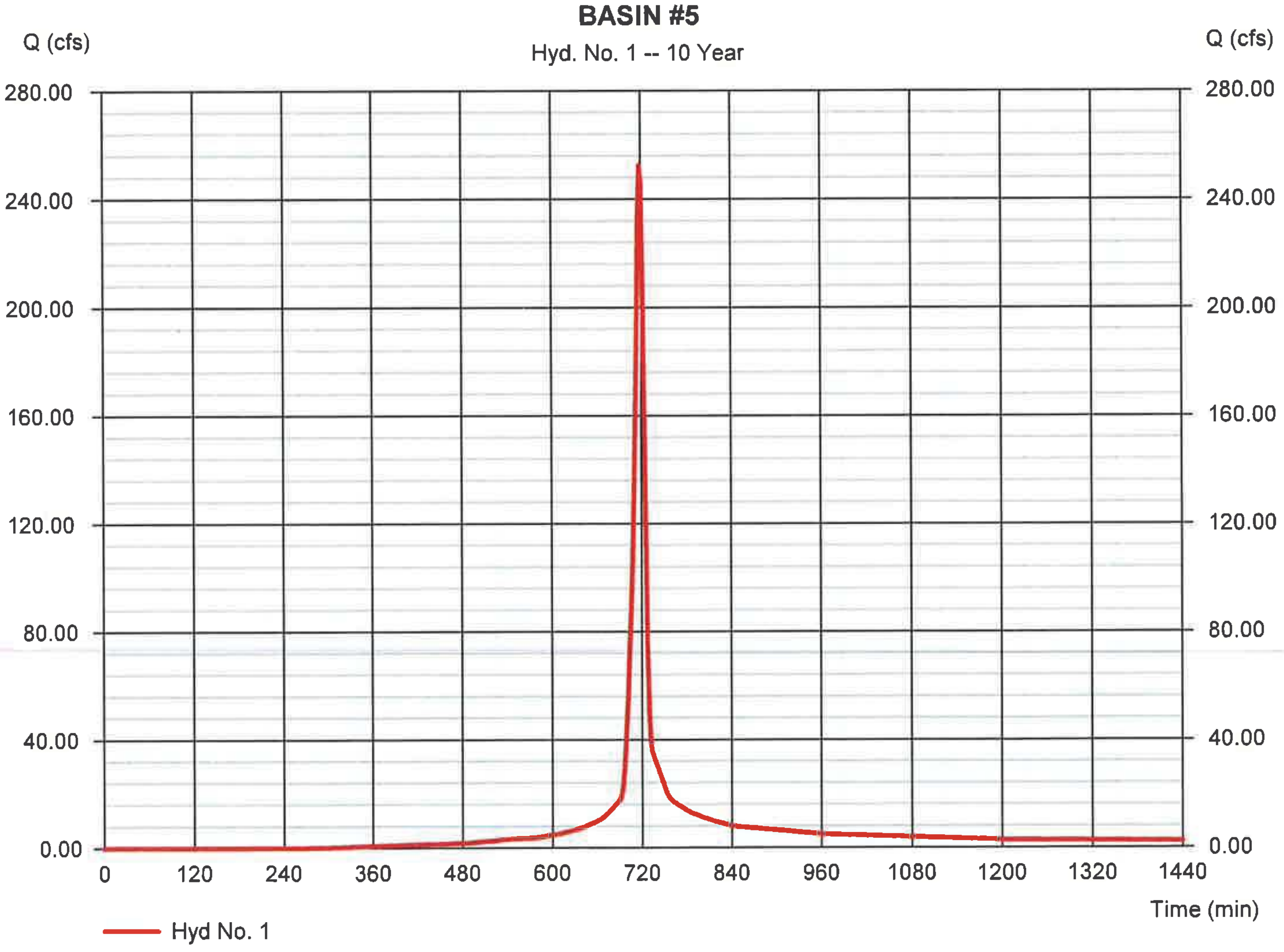
Hyd. No. 1

BASIN #5

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 42.060 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.28 in
Storm duration = 24 hrs

Peak discharge = 252.52 cfs
Time to peak = 718 min
Hyd. volume = 600,865 cuft
Curve number = 88*
Hydraulic length = 0 ft
Time of conc. (Tc) = 9.50 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(35.010 x 86) + (3.880 x 91) + (3.170 x 94)] / 42.060



Hyd. No. 1

BASIN #5

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)	= 3.62	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	**= 3.83**	**+ 0.00**	**+ 0.00**	**= 3.83**
Shallow Concentrated Flow				
Flow length (ft)	= 316.00	0.00	0.00	
Watercourse slope (%)	= 8.90	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.81	0.00	0.00	
Travel Time (min)	**= 1.09**	**+ 0.00**	**+ 0.00**	**= 1.09**
Channel Flow				
X sectional flow area (sqft)	= 20.00	0.00	0.00	
Wetted perimeter (ft)	= 14.00	0.00	0.00	
Channel slope (%)	= 2.30	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=5.74			
		0.00		
			0.00	
Flow length (ft)	({0})1588.0	0.0	0.0	
Travel Time (min)	**= 4.61**	**+ 0.00**	**+ 0.00**	**= 4.61**
Total Travel Time, Tc				**9.50 min**

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Friday, 10 / 31 / 2014

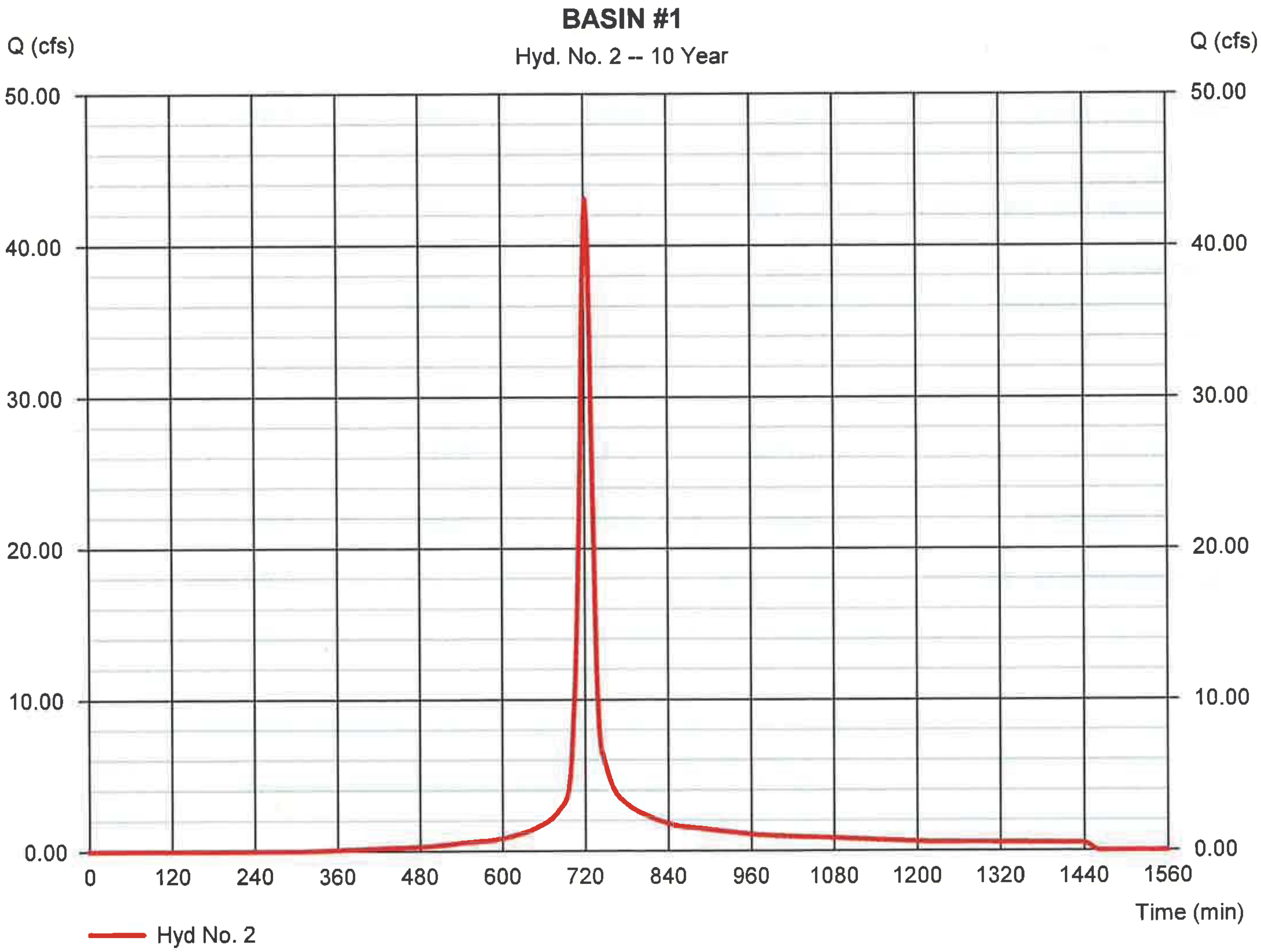
Hyd. No. 2

BASIN #1

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 9.330 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.28 in
Storm duration = 24 hrs

Peak discharge = 43.09 cfs
Time to peak = 722 min
Hyd. volume = 123,140 cuft
Curve number = 86*
Hydraulic length = 0 ft
Time of conc. (Tc) = 13.80 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(9.330 x 86)] / 9.330



Hyd. No. 2

BASIN #1

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.050		0.011		0.011		
Flow length (ft)	=	200.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.62		0.00		0.00		
Land slope (%)	=	1.00		0.00		0.00		
Travel Time (min)	**=**	**8.79**	**+**	**0.00**	**+**	**0.00**	**=**	**8.79**
Shallow Concentrated Flow								
Flow length (ft)	=	400.00		0.00		0.00		
Watercourse slope (%)	=	1.00		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	1.61		0.00		0.00		
Travel Time (min)	**=**	**4.13**	**+**	**0.00**	**+**	**0.00**	**=**	**4.13**
Channel Flow								
X sectional flow area (sqft)	=	20.00		0.00		0.00		
Wetted perimeter (ft)	=	14.00		0.00		0.00		
Channel slope (%)	=	7.00		0.00		0.00		
Manning's n-value	=	0.050		0.015		0.015		
Velocity (ft/s)	=	10.01		0.00		0.00		
Flow length (ft)		({0})526.0		0.0		0.0		
Travel Time (min)	**=**	**0.88**	**+**	**0.00**	**+**	**0.00**	**=**	**0.88**

Total Travel Time, Tc .... **13.80 min**

Hydrograph Report

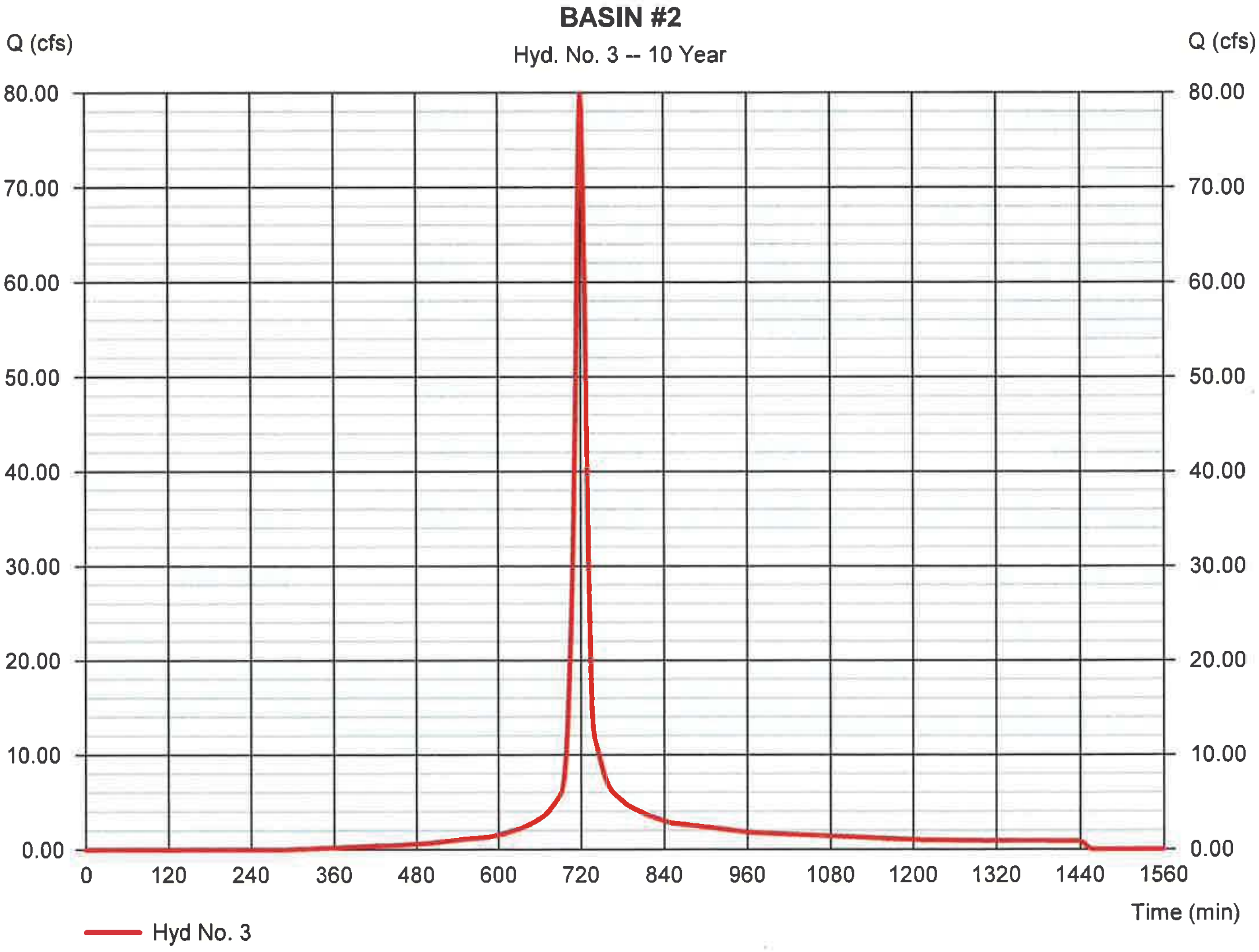
Hyd. No. 3

BASIN #2

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 14.820 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.28 in
Storm duration = 24 hrs

Peak discharge = 79.90 cfs
Time to peak = 720 min
Hyd. volume = 212,575 cuft
Curve number = 87*
Hydraulic length = 0 ft
Time of conc. (Tc) = 13.30 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(11.890 x 86) + (2.930 x 91)] / 14.820



TR55 Tc Worksheet

Hyd. No. 3

BASIN #2

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.050	0.011	0.011	
Flow length (ft)	= 200.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.62	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
Travel Time (min)	**= 8.79**	**+ 0.00**	**+ 0.00**	**= 8.79**
Shallow Concentrated Flow				
Flow length (ft)	= 594.00	0.00	0.00	
Watercourse slope (%)	= 6.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=4.08	0.00	0.00	
Travel Time (min)	**= 2.43**	**+ 0.00**	**+ 0.00**	**= 2.43**
Channel Flow				
X sectional flow area (sqft)	= 10.00	0.00	0.00	
Wetted perimeter (ft)	= 9.00	0.00	0.00	
Channel slope (%)	= 3.50	0.00	0.00	
Manning's n-value	= 0.050	0.015	0.015	
Velocity (ft/s)	=5.98			
		0.00		
			0.00	
Flow length (ft)	({0})739.0	0.0	0.0	
Travel Time (min)	**= 2.06**	**+ 0.00**	**+ 0.00**	**= 2.06**
Total Travel Time, Tc				**13.30 min**

Hydrograph Report

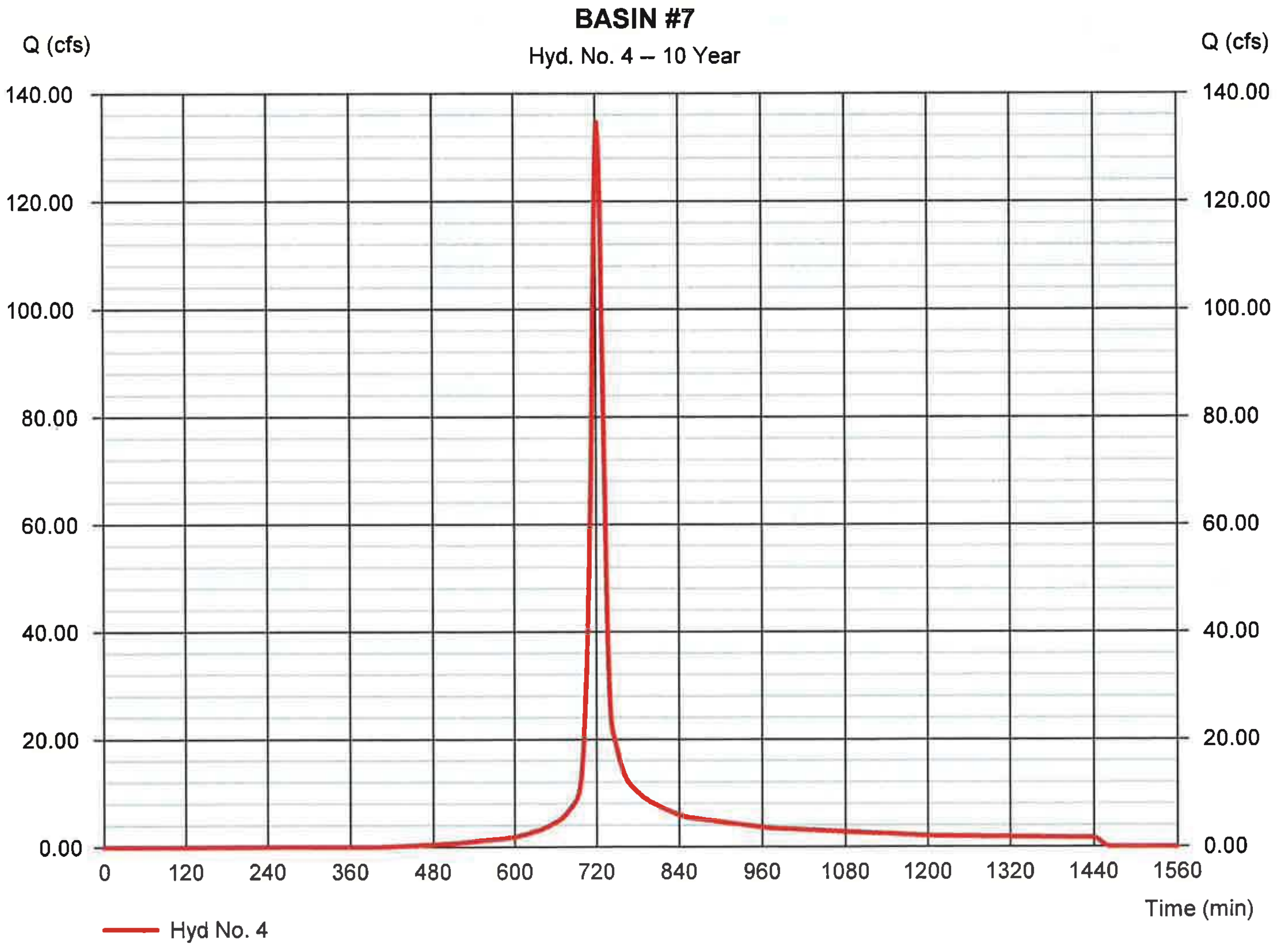
Hyd. No. 4

BASIN #7

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 33.110 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.28 in
Storm duration = 24 hrs

Peak discharge = 134.71 cfs
Time to peak = 722 min
Hyd. volume = 378,978 cuft
Curve number = 81*
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.30 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(26.860 x 86) + (2.390 x 91) + (0.530 x 61) + (3.330 x 74)] / 33.110



TR55 Tc Worksheet

Hyd. No. 4

BASIN #7

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.050		0.011		0.011		
Flow length (ft)	= 200.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.62		0.00		0.00		
Land slope (%)	= 1.70		0.00		0.00		
Travel Time (min)	**= 7.11**	**+**	**0.00**	**+**	**0.00**	**=**	**7.11**
Shallow Concentrated Flow							
Flow length (ft)	= 506.00		0.00		0.00		
Watercourse slope (%)	= 8.10		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.59		0.00		0.00		
Travel Time (min)	**= 1.84**	**+**	**0.00**	**+**	**0.00**	**=**	**1.84**
Channel Flow							
X sectional flow area (sqft)	= 20.00		0.00		0.00		
Wetted perimeter (ft)	= 14.00		0.00		0.00		
Channel slope (%)	= 2.10		0.00		0.00		
Manning's n-value	= 0.050		0.015		0.015		
Velocity (ft/s)	=5.48						
			0.00				
					0.00		
Flow length (ft)	({0})2086.0		0.0		0.0		
Travel Time (min)	**= 6.34**	**+**	**0.00**	**+**	**0.00**	**=**	**6.34**

Total Travel Time, Tc .... **15.30 min**

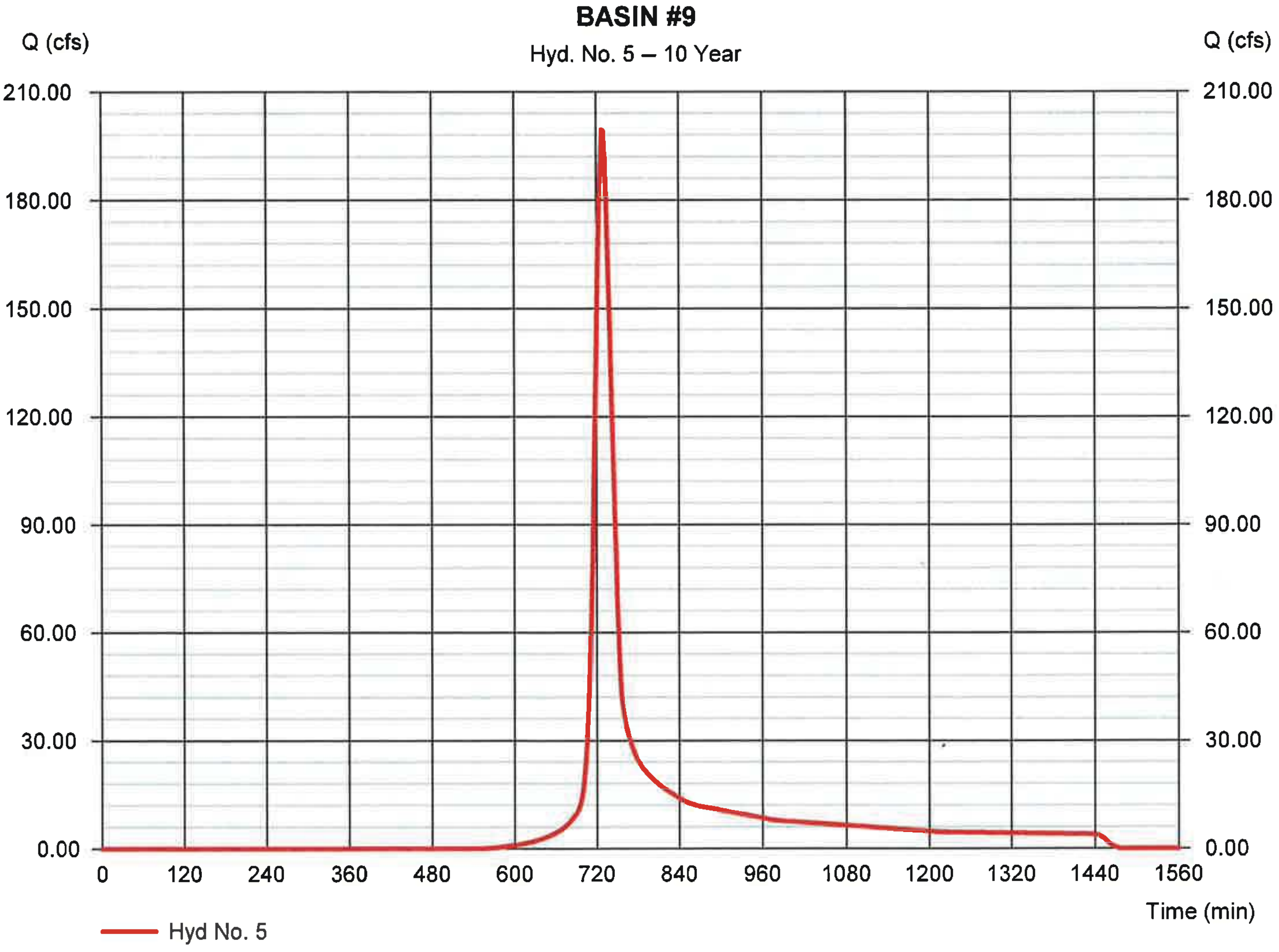
Hydrograph Report

Hyd. No. 5

BASIN #9

Hydrograph type	= SCS Runoff	Peak discharge	= 199.50 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 741,644 cuft
Drainage area	= 85.920 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.80 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(56.000 x 86) + (16.030 x 55) + (9.190 x 91)] / 85.920



TR55 Tc Worksheet

Hyd. No. 5

BASIN #9

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)	=	3.62		0.00		0.00		
Land slope (%)	=	1.50		0.00		0.00		
Travel Time (min)	**=**	**22.65**	**+**	**0.00**	**+**	**0.00**	**=**	**22.65**
Shallow Concentrated Flow								
Flow length (ft)	=	230.00		0.00		0.00		
Watercourse slope (%)	=	7.80		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.51			0.00		0.00		
Travel Time (min)	**=**	**0.85**	**+**	**0.00**	**+**	**0.00**	**=**	**0.85**
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	=	0.050		0.015		0.015		
Velocity (ft/s)	=6.87							
				0.00				
						0.00		
Flow length (ft)	({0})1351.0			0.0		0.0		
Travel Time (min)	**=**	**3.28**	**+**	**0.00**	**+**	**0.00**	**=**	**3.28**

Total Travel Time, Tc .... 26.80 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	310.28	2	718	747,497	------	------	------	BASIN #5
2	SCS Runoff	53.49	2	722	154,408	------	------	------	BASIN #1
3	SCS Runoff	98.71	2	720	265,493	------	------	------	BASIN #2
4	SCS Runoff	171.36	2	722	485,116	------	------	------	BASIN #7
5	SCS Runoff	268.73	2	728	989,740	------	------	------	BASIN #9

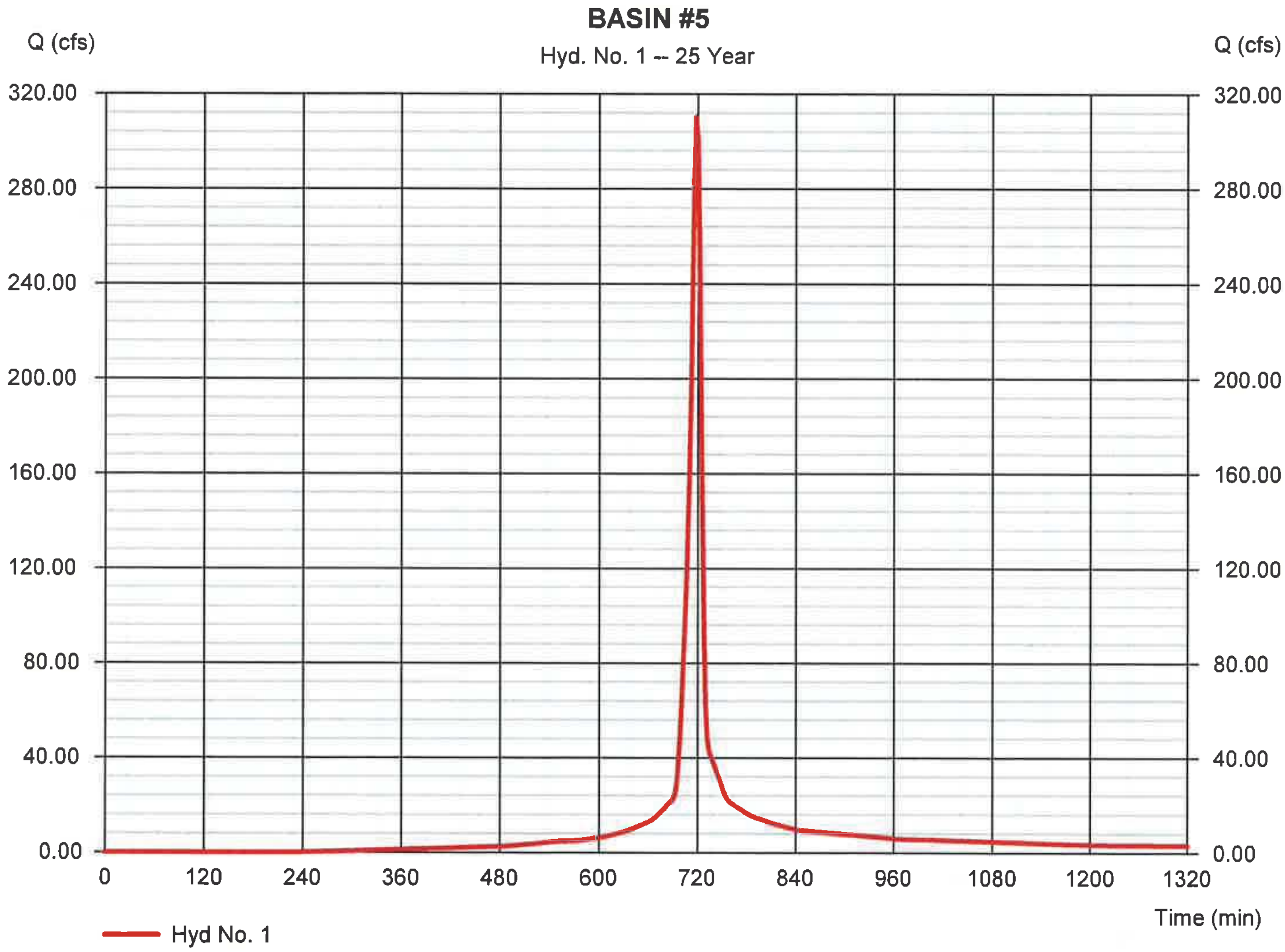
Hydrograph Report

Hyd. No. 1

BASIN #5

Hydrograph type	= SCS Runoff	Peak discharge	= 310.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 747,497 cuft
Drainage area	= 42.060 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.50 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(35.010 x 86) + (3.880 x 91) + (3.170 x 94)] / 42.060



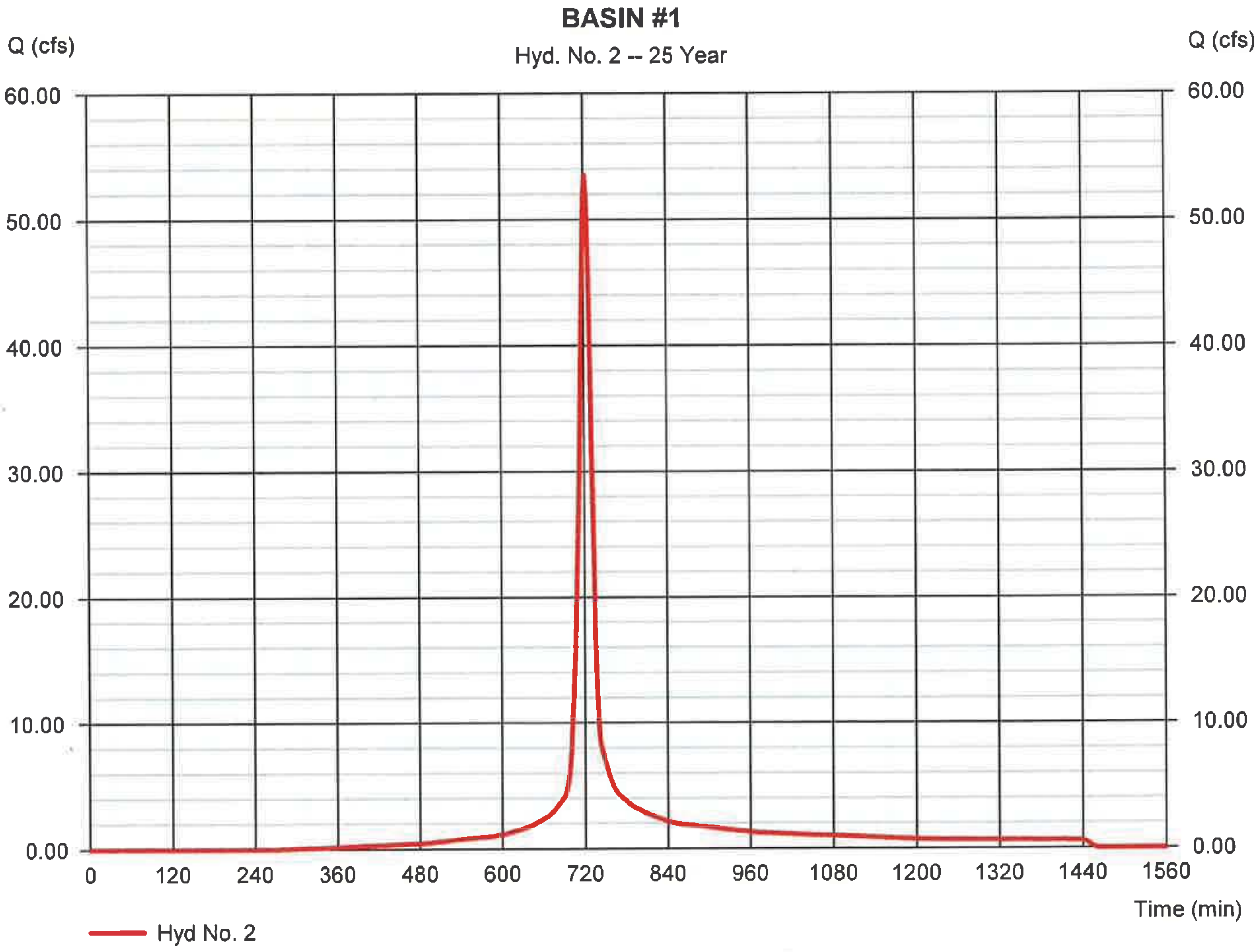
Hydrograph Report

Hyd. No. 2

BASIN #1

Hydrograph type	= SCS Runoff	Peak discharge	= 53.49 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 154,408 cuft
Drainage area	= 9.330 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.80 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.330 x 86)] / 9.330



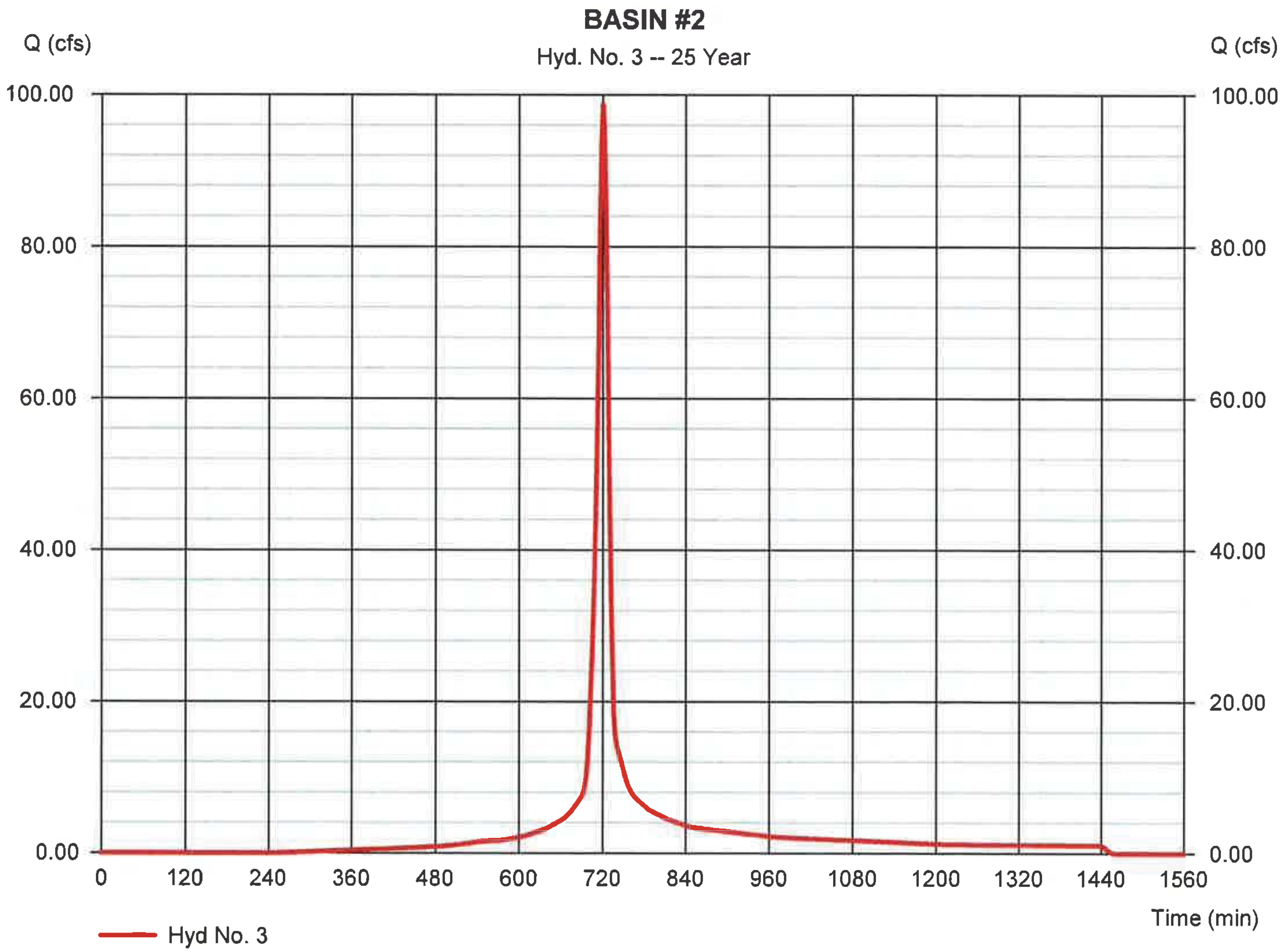
Hydrograph Report

Hyd. No. 3

BASIN #2

Hydrograph type	= SCS Runoff	Peak discharge	= 98.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 265,493 cuft
Drainage area	= 14.820 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.30 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(11.890 x 86) + (2.930 x 91)] / 14.820



Hydrograph Report

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

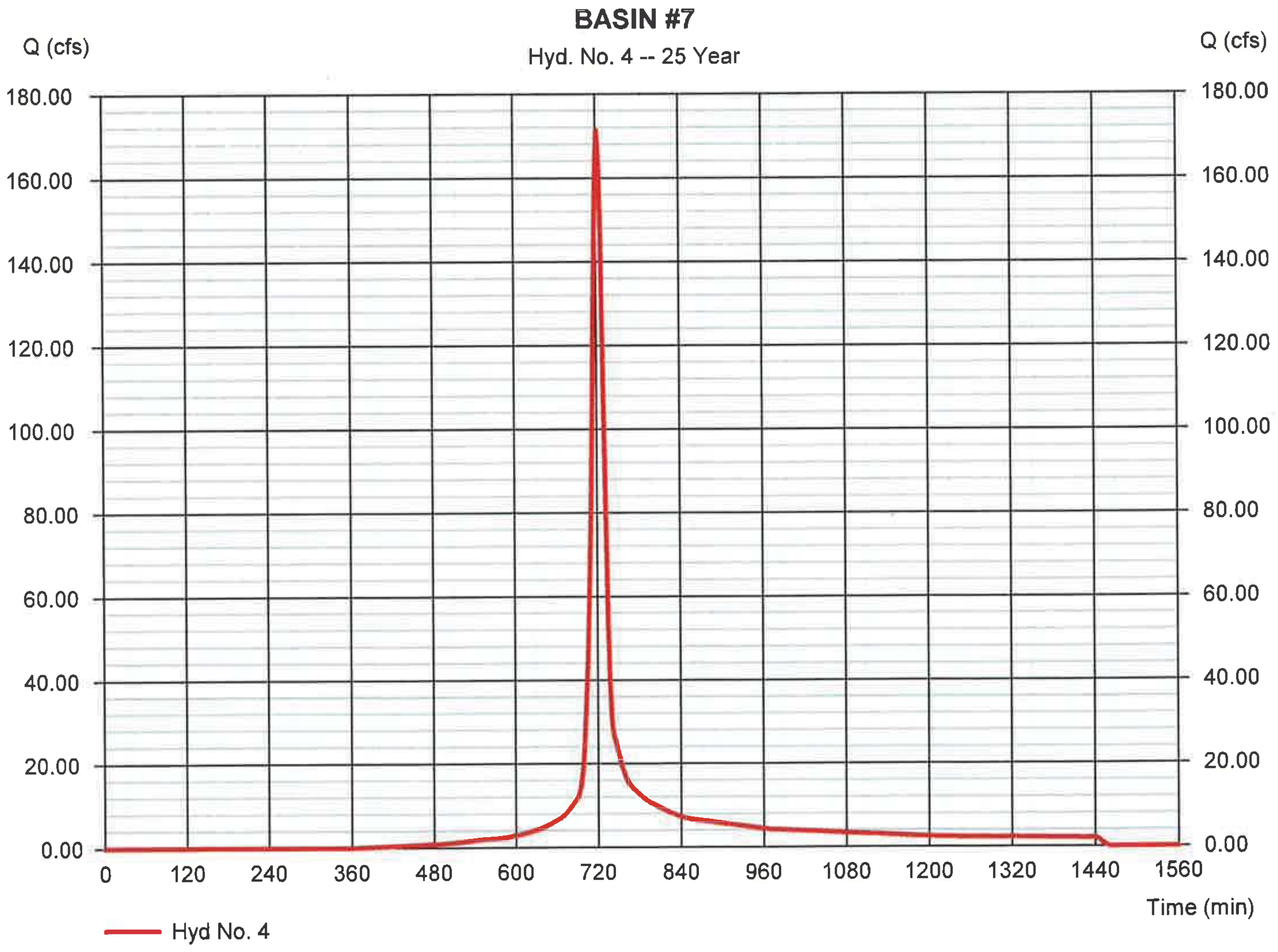
Friday, 10 / 31 / 2014

Hyd. No. 4

BASIN #7

Hydrograph type	= SCS Runoff	Peak discharge	= 171.36 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 485,116 cuft
Drainage area	= 33.110 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.30 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(26.860 x 86) + (2.390 x 91) + (0.530 x 61) + (3.330 x 74)] / 33.110



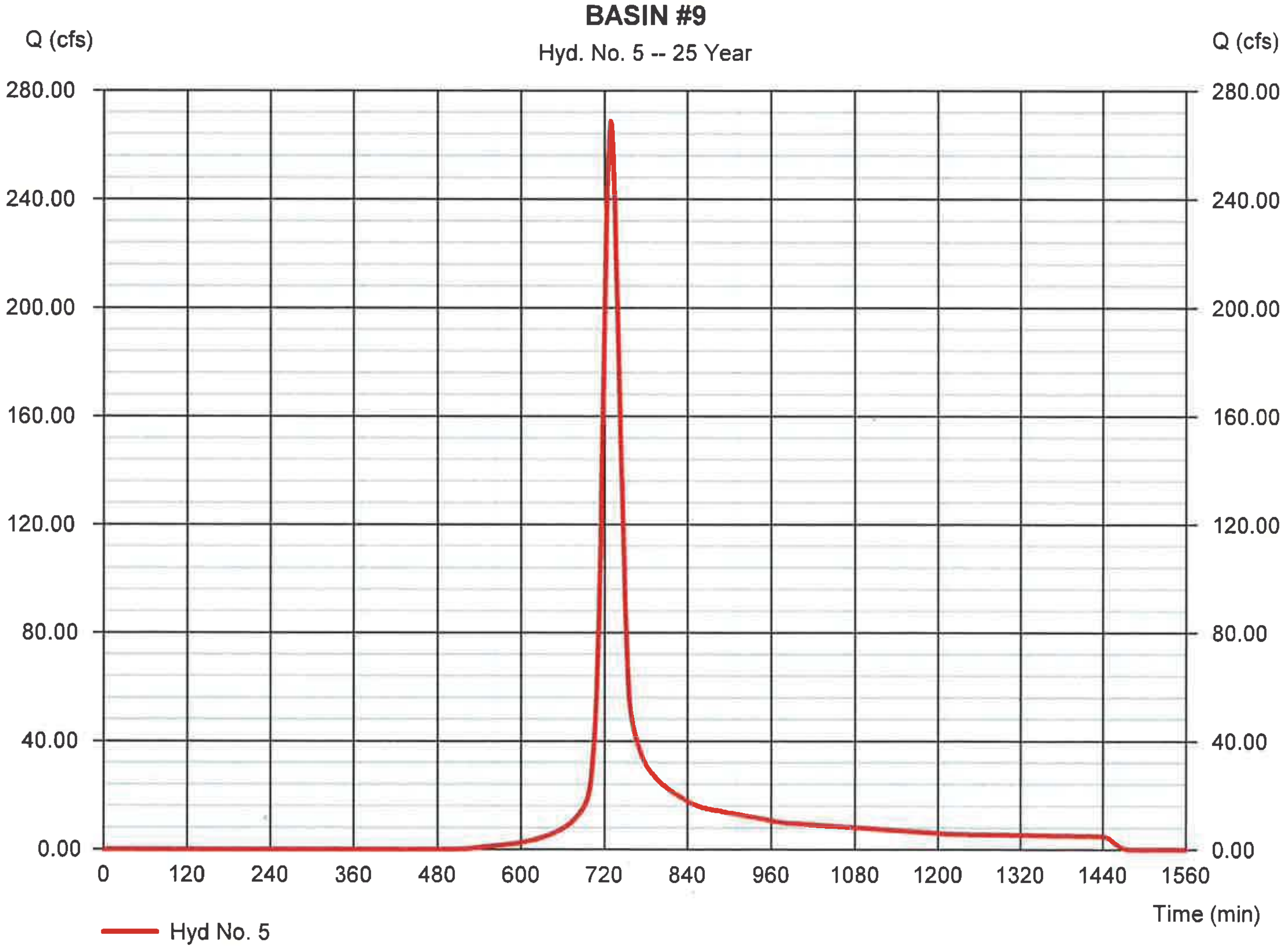
Hydrograph Report

Hyd. No. 5

BASIN #9

Hydrograph type	= SCS Runoff	Peak discharge	= 268.73 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 989,740 cuft
Drainage area	= 85.920 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.80 min
Total precip.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(56.000 x 86) + (16.030 x 55) + (9.190 x 91)] / 85.920



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	402.08	2	718	984,912	------	------	------	BASIN #5
2	SCS Runoff	70.07	2	722	205,231	------	------	------	BASIN #1
3	SCS Runoff	128.64	2	720	351,336	------	------	------	BASIN #2
4	SCS Runoff	230.40	2	722	659,648	------	------	------	BASIN #7
5	SCS Runoff	384.06	2	728	1,408,990	------	------	------	BASIN #9

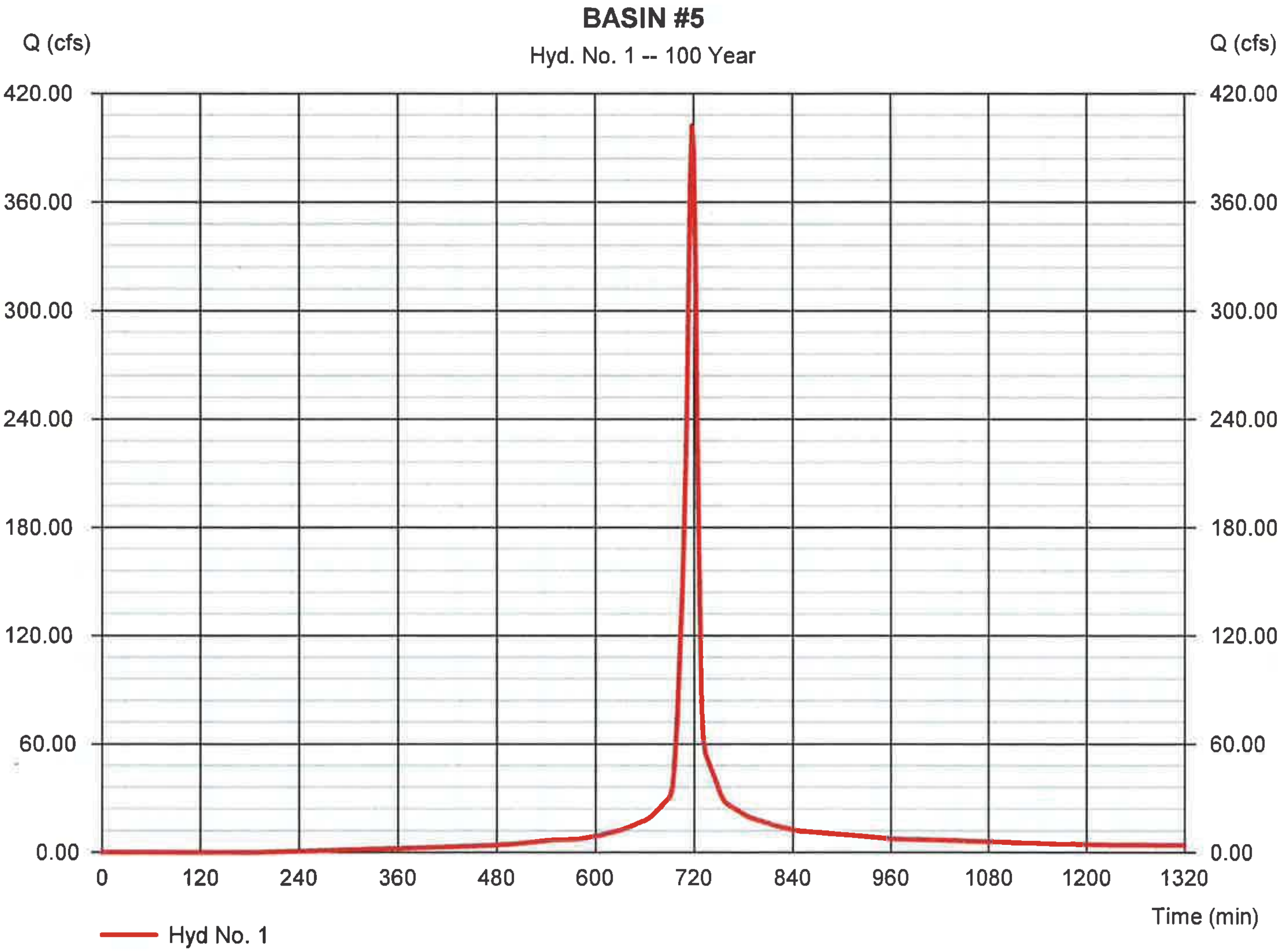
Hydrograph Report

Hyd. No. 1

BASIN #5

Hydrograph type	= SCS Runoff	Peak discharge	= 402.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 984,912 cuft
Drainage area	= 42.060 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.50 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(35.010 x 86) + (3.880 x 91) + (3.170 x 94)] / 42.060



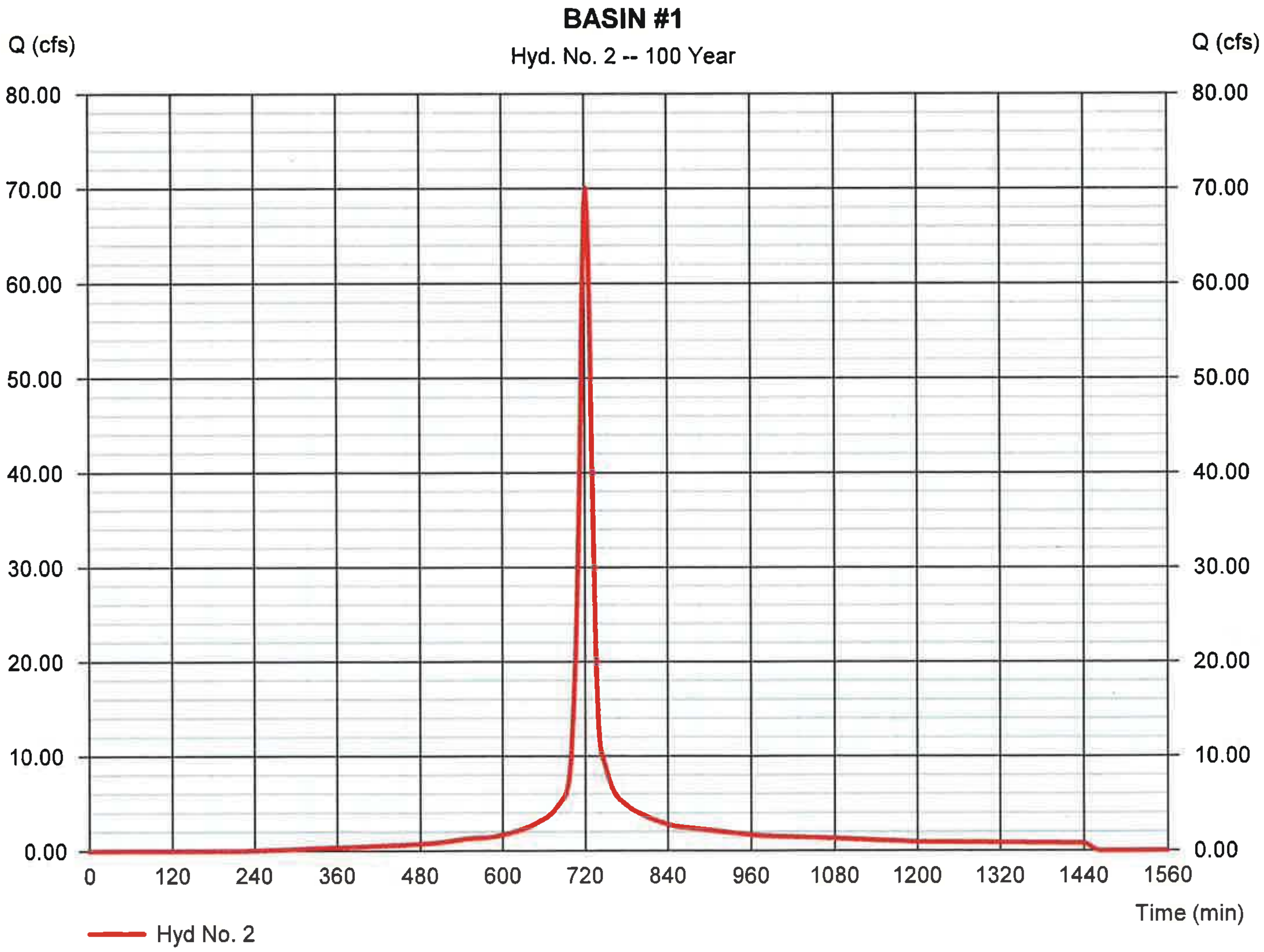
Hydrograph Report

Hyd. No. 2

BASIN #1

Hydrograph type	= SCS Runoff	Peak discharge	= 70.07 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 205,231 cuft
Drainage area	= 9.330 ac	Curve number	= 86*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.80 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(9.330 x 86)] / 9.330



Hydrograph Report

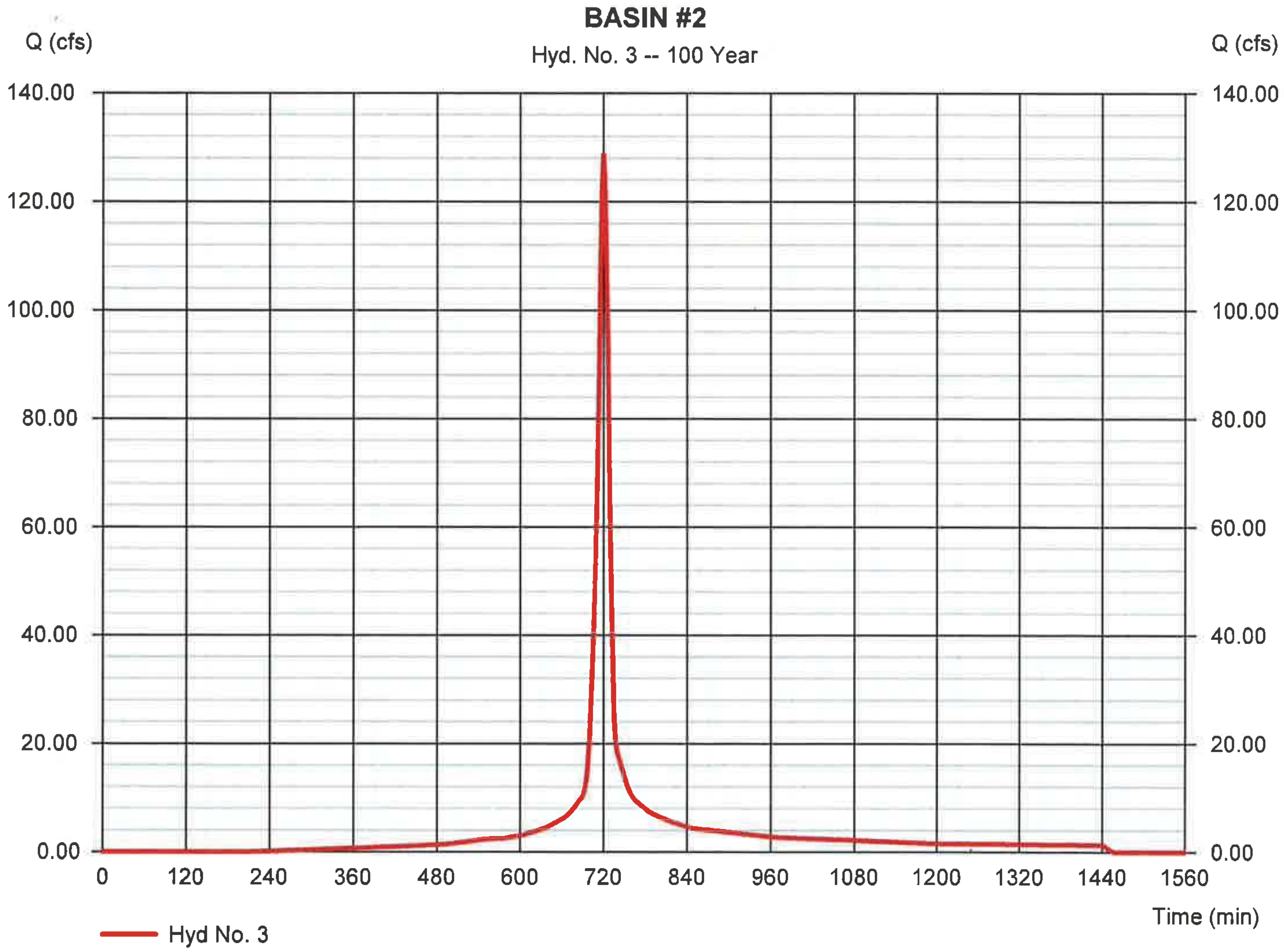
Hyd. No. 3

BASIN #2

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 14.820 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 7.88 in
Storm duration = 24 hrs

Peak discharge = 128.64 cfs
Time to peak = 720 min
Hyd. volume = 351,336 cuft
Curve number = 87*
Hydraulic length = 0 ft
Time of conc. (Tc) = 13.30 min
Distribution = Type II
Shape factor = 484

* Composite (Area/CN) = [(11.890 x 86) + (2.930 x 91)] / 14.820



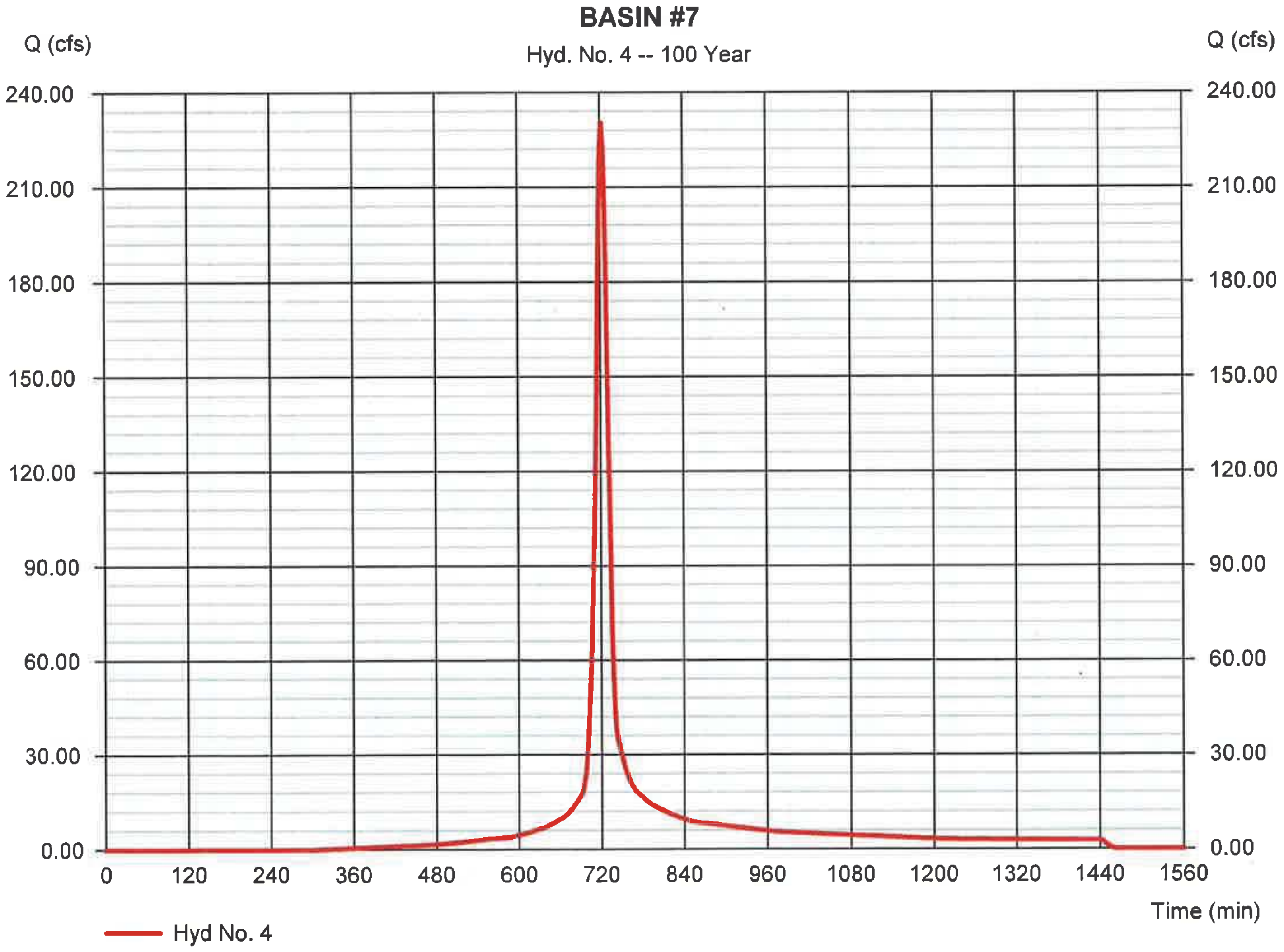
Hydrograph Report

Hyd. No. 4

BASIN #7

Hydrograph type	= SCS Runoff	Peak discharge	= 230.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 659,648 cuft
Drainage area	= 33.110 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.30 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(26.860 x 86) + (2.390 x 91) + (0.530 x 61) + (3.330 x 74)] / 33.110



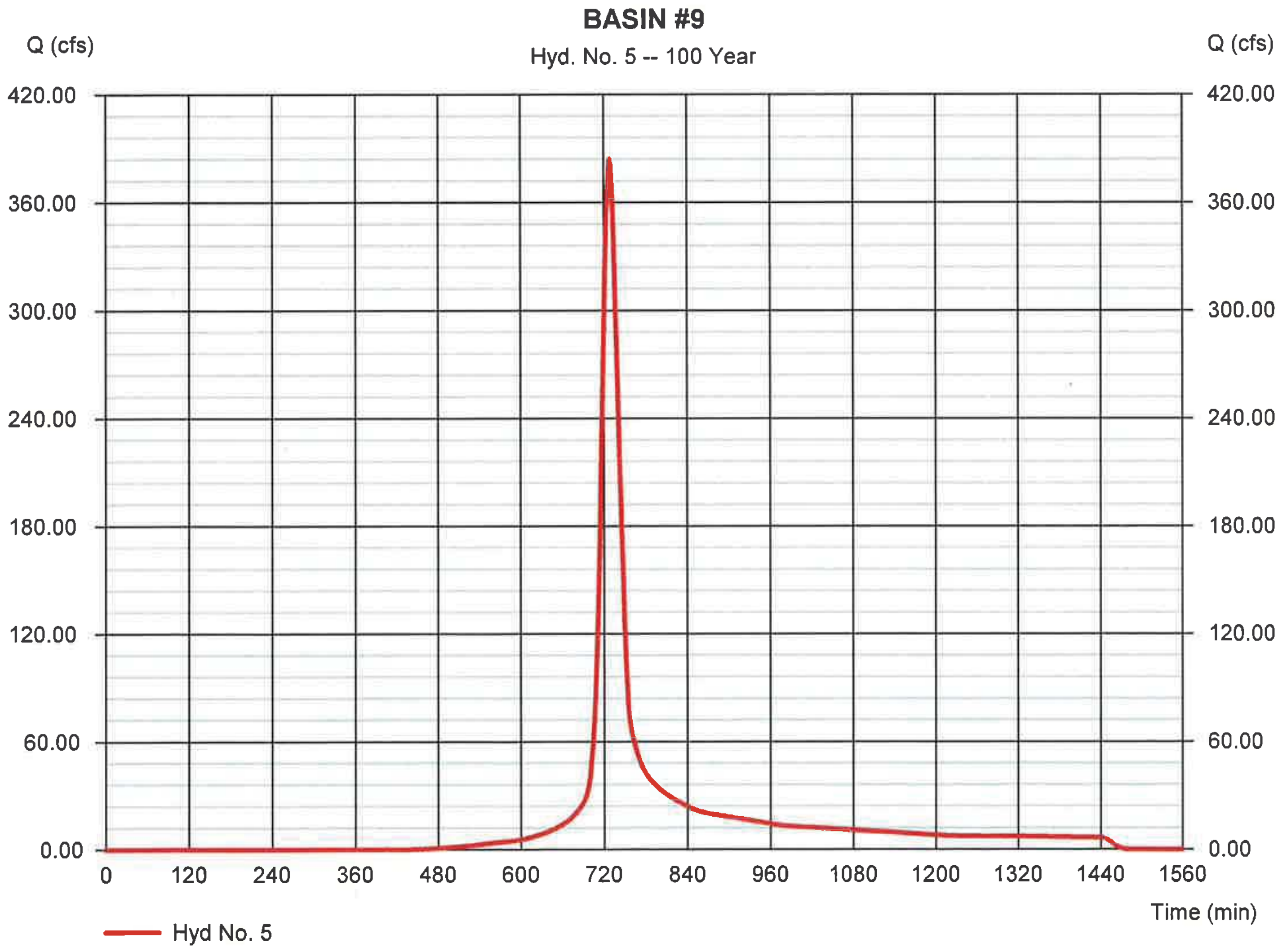
Hydrograph Report

Hyd. No. 5

BASIN #9

Hydrograph type	= SCS Runoff	Peak discharge	= 384.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 1,408,990 cuft
Drainage area	= 85.920 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(56.000 x 86) + (16.030 x 55) + (9.190 x 91)] / 85.920



This page intentionally left blank.

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

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.425** (0.388–0.468)	**0.503** (0.459–0.553)	**0.583** (0.532–0.642)	**0.641** (0.583–0.704)	**0.707** (0.640–0.776)	**0.751** (0.678–0.824)	**0.793** (0.711–0.869)	**0.829** (0.740–0.909)	**0.870** (0.769–0.953)	**0.900** (0.790–0.987)
10-min	**0.680** (0.620–0.747)	**0.804** (0.733–0.885)	**0.934** (0.852–1.03)	**1.03** (0.933–1.13)	**1.13** (1.02–1.24)	**1.20** (1.08–1.31)	**1.26** (1.13–1.38)	**1.31** (1.17–1.44)	**1.38** (1.22–1.51)	**1.42** (1.24–1.56)
15-min	**0.849** (0.775–0.934)	**1.01** (0.922–1.11)	**1.18** (1.08–1.30)	**1.30** (1.18–1.42)	**1.43** (1.29–1.57)	**1.52** (1.37–1.66)	**1.59** (1.43–1.75)	**1.66** (1.48–1.82)	**1.73** (1.53–1.90)	**1.78** (1.56–1.95)
30-min	**1.17** (1.06–1.28)	**1.40** (1.27–1.54)	**1.68** (1.53–1.85)	**1.88** (1.71–2.06)	**2.12** (1.91–2.32)	**2.28** (2.06–2.50)	**2.44** (2.19–2.67)	**2.58** (2.30–2.83)	**2.76** (2.44–3.02)	**2.88** (2.53–3.16)
60-min	**1.45** (1.33–1.60)	**1.75** (1.60–1.93)	**2.15** (1.96–2.37)	**2.45** (2.23–2.69)	**2.82** (2.55–3.09)	**3.09** (2.79–3.39)	**3.36** (3.01–3.68)	**3.62** (3.23–3.97)	**3.95** (3.50–4.33)	**4.20** (3.69–4.61)
2-hr	**1.71** (1.55–1.90)	**2.07** (1.88–2.30)	**2.58** (2.34–2.87)	**2.96** (2.67–3.28)	**3.45** (3.10–3.82)	**3.83** (3.42–4.24)	**4.20** (3.73–4.65)	**4.58** (4.03–5.06)	**5.06** (4.42–5.60)	**5.44** (4.71–6.02)
3-hr	**1.82** (1.65–2.02)	**2.20** (2.00–2.45)	**2.75** (2.50–3.05)	**3.18** (2.87–3.52)	**3.74** (3.36–4.14)	**4.19** (3.74–4.63)	**4.64** (4.11–5.13)	**5.11** (4.49–5.64)	**5.74** (4.99–6.35)	**6.24** (5.36–6.90)
6-hr	**2.17** (1.99–2.40)	**2.63** (2.40–2.90)	**3.29** (3.00–3.63)	**3.81** (3.46–4.19)	**4.51** (4.07–4.95)	**5.07** (4.54–5.56)	**5.64** (5.01–6.18)	**6.23** (5.48–6.83)	**7.05** (6.12–7.72)	**7.70** (6.60–8.44)
12-hr	**2.57** (2.35–2.84)	**3.11** (2.84–3.44)	**3.91** (3.56–4.32)	**4.56** (4.13–5.02)	**5.44** (4.89–5.98)	**6.16** (5.49–6.75)	**6.90** (6.10–7.56)	**7.69** (6.72–8.41)	**8.80** (7.56–9.62)	**9.69** (8.21–10.6)
24-hr	**3.00** (2.80–3.22)	**3.62** (3.38–3.89)	**4.55** (4.24–4.89)	**5.28** (4.91–5.67)	**6.28** (5.82–6.75)	**7.07** (6.54–7.59)	**7.88** (7.27–8.46)	**8.72** (8.03–9.37)	**9.88** (9.05–10.6)	**10.8** (9.85–11.6)
2-day	**3.49** (3.25–3.75)	**4.20** (3.92–4.52)	**5.25** (4.88–5.64)	**6.07** (5.64–6.52)	**7.18** (6.65–7.71)	**8.06** (7.45–8.66)	**8.97** (8.26–9.63)	**9.90** (9.09–10.6)	**11.2** (10.2–12.0)	**12.2** (11.1–13.1)
3-day	**3.70** (3.44–3.96)	**4.45** (4.15–4.77)	**5.52** (5.14–5.92)	**6.36** (5.91–6.82)	**7.52** (6.96–8.06)	**8.44** (7.78–9.04)	**9.37** (8.63–10.0)	**10.3** (9.49–11.1)	**11.7** (10.7–12.5)	**12.7** (11.6–13.7)
4-day	**3.90** (3.64–4.18)	**4.69** (4.37–5.02)	**5.79** (5.39–6.19)	**6.66** (6.19–7.12)	**7.86** (7.27–8.41)	**8.81** (8.12–9.42)	**9.78** (8.99–10.5)	**10.8** (9.89–11.6)	**12.2** (11.1–13.0)	**13.2** (12.0–14.2)
7-day	**4.49** (4.20–4.80)	**5.36** (5.02–5.74)	**6.54** (6.11–6.99)	**7.47** (6.97–7.99)	**8.76** (8.15–9.35)	**9.78** (9.07–10.4)	**10.8** (10.0–11.6)	**11.9** (11.0–12.7)	**13.4** (12.3–14.3)	**14.5** (13.3–15.6)
10-day	**5.12** (4.82–5.46)	**6.10** (5.73–6.50)	**7.34** (6.89–7.81)	**8.31** (7.79–8.85)	**9.62** (8.99–10.2)	**10.6** (9.92–11.3)	**11.7** (10.9–12.4)	**12.7** (11.8–13.6)	**14.2** (13.1–15.1)	**15.3** (14.1–16.3)
20-day	**6.89** (6.49–7.33)	**8.14** (7.66–8.64)	**9.62** (9.04–10.2)	**10.8** (10.1–11.4)	**12.4** (11.6–13.1)	**13.6** (12.7–14.4)	**14.8** (13.8–15.8)	**16.1** (14.9–17.1)	**17.8** (16.5–19.0)	**19.1** (17.6–20.4)
30-day	**8.57** (8.09–9.09)	**10.1** (9.50–10.7)	**11.7** (11.1–12.5)	**13.0** (12.2–13.8)	**14.7** (13.8–15.6)	**16.0** (15.0–17.0)	**17.3** (16.2–18.4)	**18.5** (17.3–19.7)	**20.3** (18.8–21.6)	**21.6** (20.0–23.0)
45-day	**10.9** (10.4–11.5)	**12.8** (12.1–13.5)	**14.6** (13.9–15.4)	**16.0** (15.2–16.9)	**17.9** (16.9–18.9)	**19.3** (18.2–20.3)	**20.6** (19.4–21.8)	**22.0** (20.6–23.2)	**23.7** (22.2–25.1)	**25.1** (23.4–26.5)
60-day	**13.0** (12.4–13.7)	**15.2** (14.5–16.0)	**17.2** (16.3–18.1)	**18.8** (17.8–19.8)	**20.8** (19.7–21.9)	**22.3** (21.1–23.5)	**23.7** (22.4–25.0)	**25.1** (23.7–26.5)	**26.9** (25.3–28.5)	**28.3** (26.6–30.0)

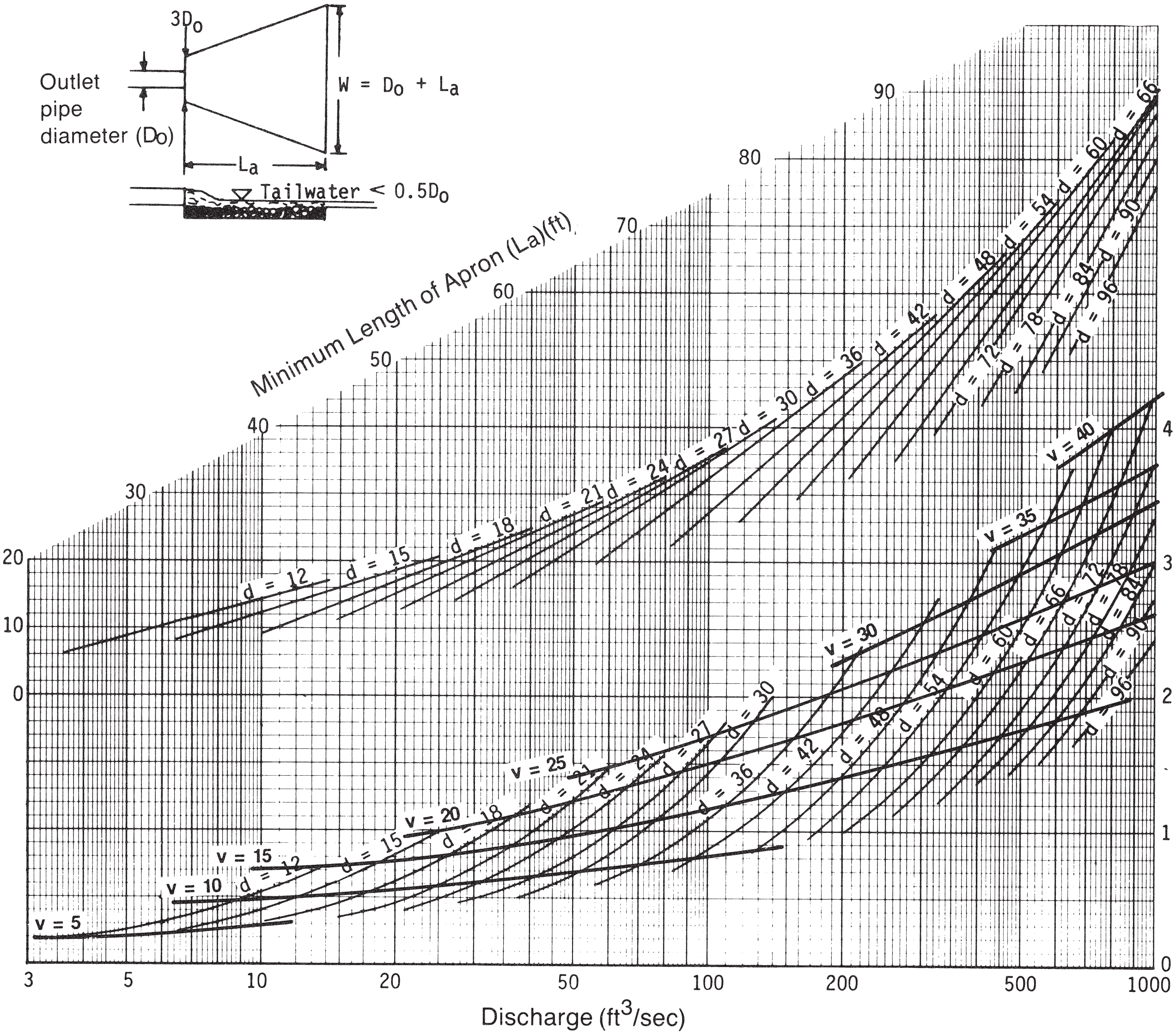
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



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

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

---

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

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

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

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

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

TABLE 3.14-D

CONCENTRIC TRASH RACK AND ANTI-VORTEX DEVICE DESIGN TABLE

Riser Diam., in.	Cylinder		Height, inches	Minimum Size Support Bar	Minimum Top	
	Diameter, inches	Thickness, gage			Thickness	Stiffener
12	18	16	6	#6 Rebar or 1½ x 1½ x 3/16 angle	16 ga. (F&C)	-
15	21	16	7	" "	" "	-
18	27	16	8	" "	" "	-
21	30	16	11	" "	16 ga.(C), 14 ga.(F)	-
24	36	16	13	" "	" "	-
27	42	16	15	" "	" "	-
36	54	14	17	#8 Rebar	14 ga.(C), 12 ga.(F)	-
42	60	16	19	" "	" "	-
48	72	16	21	1¼" pipe or 1¼ x 1¼ x ¼ angle	14 ga.(C), 10 ga.(F)	-
54	78	16	25	" "	" "	-
60	90	14	29	1½" pipe or 1½ x 1½ x ¼ angle	12 ga.(C), 8 ga.(F)	-
66	96	14	33	2" pipe or 2 x 2 x 3/16 angle	12 ga.(C), 8 ga.(F) w/stiffener	2 x 2 x ¼ angle
72	102	14	36	" "	" "	2½ x 2½ x ¼ angle
78	114	14	39	2½" pipe or 2 x 2 x ¼ angle	" "	" "
84	120	12	42	2½" pipe or 2½ x 2½ x ¼ angle	" "	2½ x 2½ x 5/16 angle

Note$_1$: The criterion for sizing the cylinder is that the area between the inside of the cylinder and the outside of the riser is equal to or greater than the area inside the riser. Therefore, the above table is invalid for use with concrete pipe risers.

Note$_2$: Corrugation for 12"-36" pipe measures 2⅔" x ½"; for 42" -84" the corrugation measures 5" x 1" or 8" x 1".

Note$_3$: C = corrugated; F = flat.

Source: Adapted from USDA-SCS and Carl M. Henshaw Drainage Products Information.

United States
Department of
Agriculture

NRCS

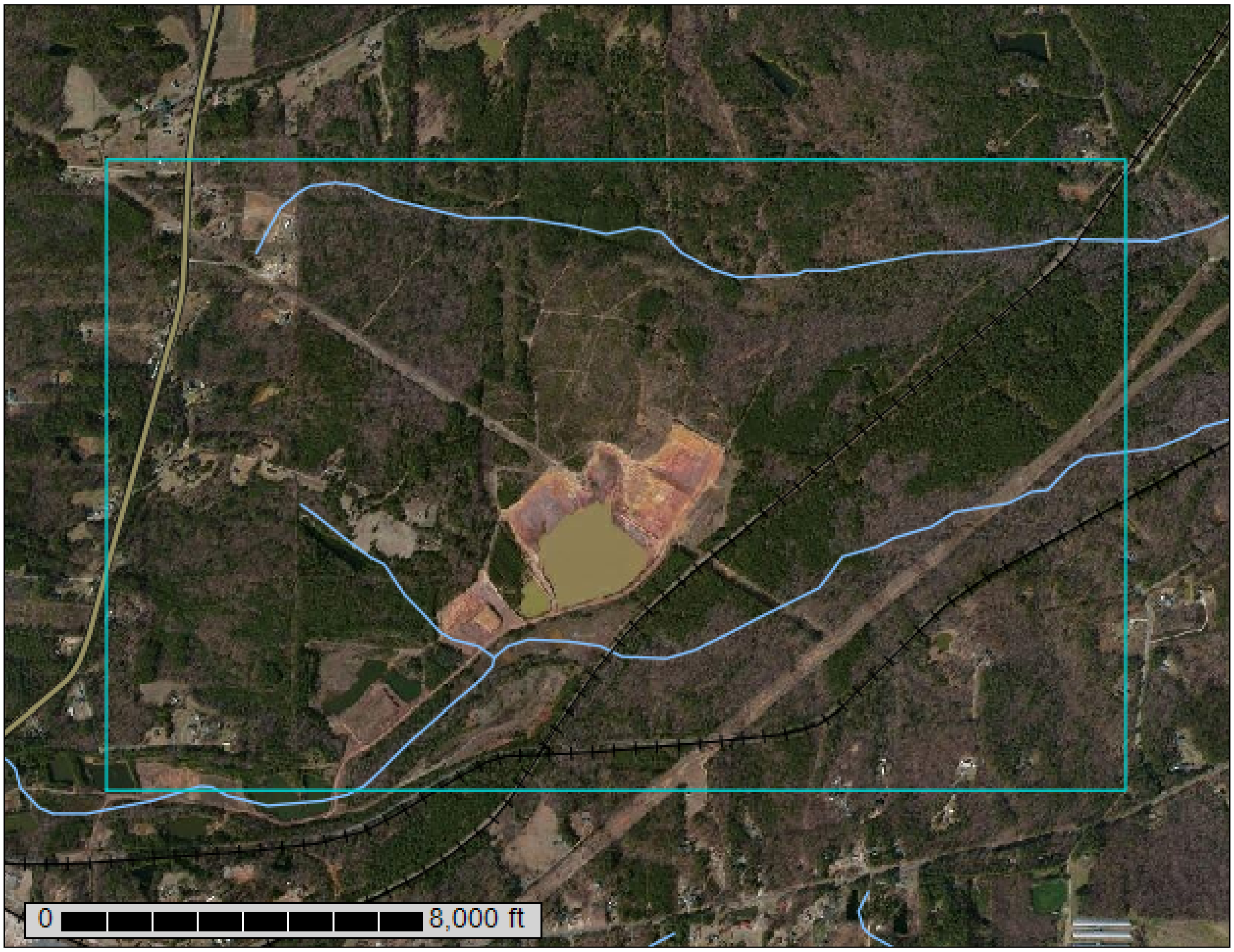
Natural
Resources
Conservation
Service

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

Custom Soil Resource Report for

Lee County, North Carolina

Sanford



September 16, 2014

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

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.

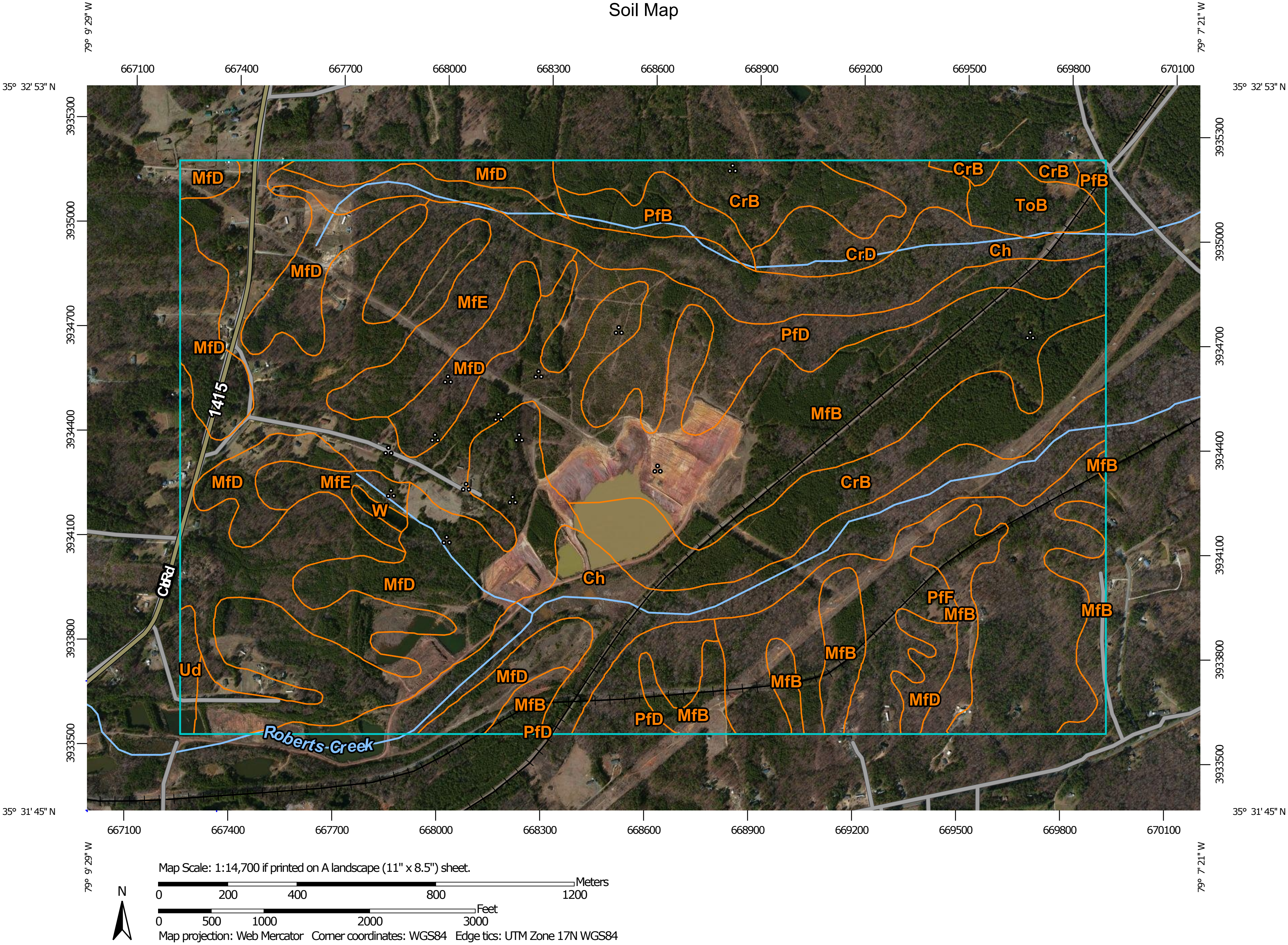
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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.

Soil Map



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

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

MAP LEGEND

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

Soils
- ▭ Soil Map Unit Polygons
- 〰 Soil Map Unit Lines
- ■ Soil Map Unit Points

Special Point Features
- ◎ Blowout
- ⊠ Borrow Pit
- ✱ Clay Spot
- ◇ Closed Depression
- ✕ Gravel Pit
- ∴ Gravelly Spot
- ● Landfill
- Λ Lava Flow
- ⩩ Marsh or swamp
- ⚒ Mine or Quarry
- ◎ Miscellaneous Water
- ◎ Perennial Water
- ∨ Rock Outcrop
- ＋ Saline Spot
- ⁙ Sandy Spot
- ⊜ Severely Eroded Spot
- ◇ Sinkhole
- ⋑ Slide or Slip
- ⊘ Sodic Spot
- ≣ Spoil Area
- ◊ Stony Spot
- ◊◊ Very Stony Spot
- ⚲ Wet Spot
- △ Other
- ╌ Special Line Features

Water Features
- ～ Streams and Canals

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

Background
- ▨ Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Map Unit Legend

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

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Lee County, North Carolina

Ch—Chewacla silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2mz3q
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Chewacla and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chewacla

Setting

Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loamy alluvium derived from igneous and metamorphic rock

Typical profile

A - 0 to 4 inches: silt loam
Bw1 - 4 to 26 inches: silty clay loam
Bw2 - 26 to 38 inches: loam
Bw3 - 38 to 60 inches: clay loam
C - 60 to 80 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D

Minor Components

Congaree

Percent of map unit: 8 percent
Landform: Flood plains
Down-slope shape: Linear

Across-slope shape: Linear

Wehadkee, undrained

Percent of map unit: 5 percent
Landform: Depressions on flood plains
Down-slope shape: Concave
Across-slope shape: Linear

CrB—Creedmoor fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3t5w
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Creedmoor and similar soils: 90 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Creedmoor

Setting

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

Typical profile

Ap - 0 to 14 inches: fine sandy loam
Bt1 - 14 to 29 inches: silty clay loam
Bt2 - 29 to 56 inches: silty clay
BCg - 56 to 72 inches: loam
Cr - 72 to 96 inches: weathered bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 72 to 100 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None

Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

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

Minor Components

Mayodan

Percent of map unit: 8 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex

CrD—Creedmoor fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 3t5x
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Creedmoor and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Creedmoor

Setting

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

Typical profile

Ap - 0 to 14 inches: fine sandy loam
Bt1 - 14 to 29 inches: silty clay loam
Bt2 - 29 to 56 inches: silty clay
BCg - 56 to 72 inches: loam
Cr - 72 to 96 inches: weathered bedrock
R - 96 to 100 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 72 to 100 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

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

MfB—Mayodan fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3t64
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Mayodan and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mayodan

Setting

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

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 9 inches: sandy clay loam
Bt - 9 to 33 inches: clay
BC - 33 to 40 inches: sandy clay loam
C - 40 to 80 inches: sandy clay loam

Properties and qualities

Slope: 2 to 8 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

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

MfD—Mayodan fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 3t65
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Mayodan and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mayodan

Setting

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

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 9 inches: sandy clay loam
Bt - 9 to 33 inches: clay
BC - 33 to 40 inches: sandy clay loam
C - 40 to 80 inches: sandy clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

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

MfE—Mayodan fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 3t66
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Mayodan and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mayodan

Setting

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

Typical profile

Ap - 0 to 6 inches: fine sandy loam
BE - 6 to 9 inches: sandy clay loam
Bt - 9 to 33 inches: clay
BC - 33 to 40 inches: sandy clay loam
C - 40 to 80 inches: sandy clay loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 7.0
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

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

PfB—Pinkston silt loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3t6c
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Pinkston

Setting

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

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 16 inches: silt loam
C - 16 to 38 inches: silt loam
R - 38 to 80 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

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

PfD—Pinkston silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 3t6d
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Pinkston and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinkston

Setting

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

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 16 inches: silt loam
C - 16 to 38 inches: silt loam
R - 38 to 80 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0

Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

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

PfF—Pinkston silt loam, 15 to 40 percent slopes

Map Unit Setting

National map unit symbol: 3t6f
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Pinkston and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pinkston

Setting

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

Typical profile

A - 0 to 6 inches: silt loam
Bw - 6 to 16 inches: silt loam
C - 16 to 38 inches: silt loam
R - 38 to 80 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

ToB—Tillery fine sandy loam, 1 to 4 percent slopes, rarely flooded

Map Unit Setting

National map unit symbol: 2ml49
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 200 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Tillery

Setting

Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from igneous and metamorphic rock

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bt - 7 to 48 inches: silty clay loam
Cg - 48 to 80 inches: silt loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

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

Ud—Udorthents, loamy

Map Unit Setting

National map unit symbol: 3t6p
Elevation: 200 to 1,400 feet
Mean annual precipitation: 37 to 60 inches
Mean annual air temperature: 50 to 66 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform: Hillslopes on ridges
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy and clayey human transported material derived from igneous, metamorphic and sedimentary rock

Typical profile

C - 0 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C

Minor Components

Urban land

Percent of map unit: 8 percent
Landform: Hillslopes on ridges
Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

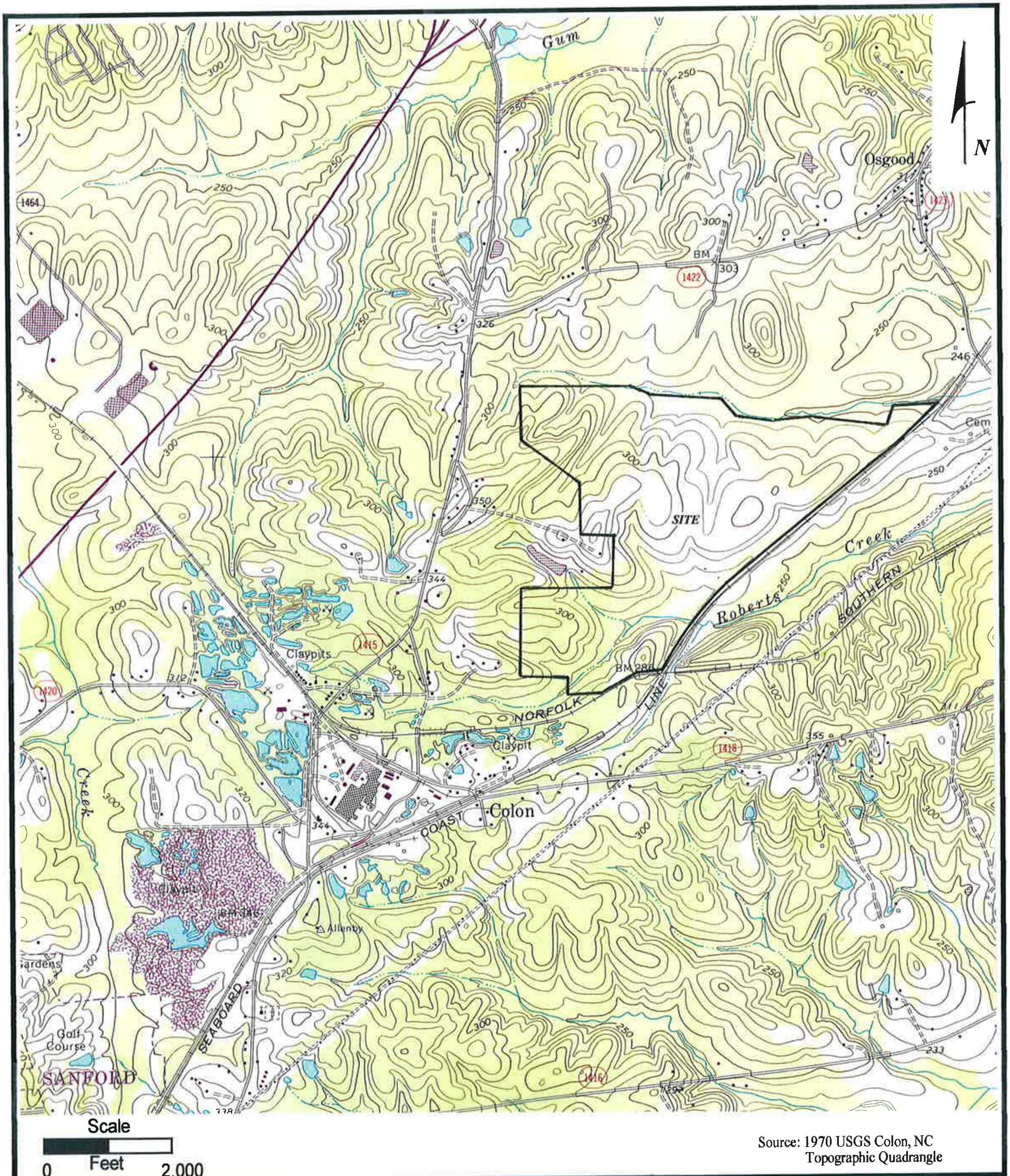
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



Source: 1970 USGS Colon, NC
Topographic Quadrangle

Colon Mine Reclamation Fill Site 1303 Brickyard Road Sanford, North Carolina	Buxton Environmental, Inc.	Figure 1. Site Location Map

C

Reclamation Timeline

This page intentionally left blank.

Charah Colon Mine
Reclamation Timeline

Estimated Daily Ash Placement = 6,000 tons per day
Operational days = 260 days per year
Estimated Annual Ash Placement = 1,560,000 tons per year or 1,248,000 cys per year
Estimated Ash Density = 1.25 tons per cy
Estimated Start of Filling = Aug-15

	Footprint (Ac)	Ash Volume (cy)*	Estimated Time for Ash Placement (yr)	Estimated Start of Closure Date	Estimated Closure Completion Date**
Phase 1	38.1	2,250,000	1.80	May-17	Nov-18
Phase 2	51.2	3,363,800	2.70	Jan-20	Jul-21
Phase 3	29.4	1,636,000	1.31	May-21	Nov-22

*Ash volume assumes vertical boundaries between phases

**Assumes 18 months to close from date of last ash placement

This page intentionally left blank.

Related Documents

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014
Revised December 2014

NPDES Permit NCG020854, December 2014
Reclamation Bond, November 2014
Wetlands Determination, August 2014
Threatened/Endangered Study, August 2014
Archeological Study, August 2014
SWPPP, April 2014
Application for Mining Permit, March 2014
Colon Mine Drawings, February 2014
NPDES Permit NCG020854, November 2013
NCDENR Mine Permit 53-05, April 2005

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

John E. Skvarla, III
Secretary

December 16, 2014

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

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

Dear Mr. Price:

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

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

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

Sincerely,

Bethany A. Georgoulias

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

cc: Raleigh Regional Office
Stormwater Permitting Program Files
Central Files

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

GENERAL PERMIT NO. NCG020000
CERTIFICATE OF COVERAGE No. NCG020854

STORMWATER DISCHARGES

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

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

Green Meadow, LLC

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

Colon Mine
1604 Colon Road
Sanford
Lee County

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

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

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

Signed this day December 16, 2014.

Ken Pickle

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

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Land Quality Section

Bond Pursuant to "The Mining Act of 1971"
(G.S. 74-46 through G.S. 74-68)

KNOW ALL MEN BY THESE PRESENTS, That Green Meadow, LLC a Limited Liability Company and having its principal office at 100 N. Tryon St, Ste 4700, Charlotte in the State of NC, as principal, and U.S. Specialty Insurance Company a corporation organized under the laws of the State of Texas and duly authorized by the Insurance Commissioner of North Carolina to do business in North Carolina, with an office located at 4700 Homewood Court, in the City of Raleigh, North Carolina, as surety, are held and firmly bound unto the State of North Carolina in the sum Five Hundred Thousand and 00/100 ($500,000.00) of Bond No. 1001032762 lawful money of the United States of America, to the payment of which will and truly be made, we bind ourselves, our heirs, administrators and successors jointly and severally, firmly by these presents.

Signed, sealed and delivered this 5th day of November, 2014.

THE CONDITIONS OF THIS BOND ARE SUCH, That Whereas, the said Green Meadow, LLC conducts or will conduct mining operations in North Carolina as described in the application for an operating permit which includes a Reclamation Plan as provided in G.S. 74-53 and has obtained approval of this application on the 19th day of December, 2014, from the Department of Environment and Natural Resources.

NOW THEREFORE, if the said Green Meadow, LLC shall comply with the requirements set forth in "The Mining Act of 1971" (G.S. 74-46 through 74-68) and with the rules and regulations adopted pursuant thereto and faithfully perform all obligations under his approved Reclamation Plan then this obligation shall be null and void; otherwise to be and remain in full force and effect until released by the Department of Environment and Natural Resources in accordance with G.S. 74-56 or canceled by the surety. Cancellation by the surety shall be effectuated only upon 60 days written notice thereof to the Department of Environment and Natural Resources and the operator as provided in G.S. 74-54.

ATTEST:

Secretary or
Assistant Secretary

Green Meadow, LLC
Principal

(Attach)
(Corporate Seal)
(here of Corporation)

By
President, Vice President,
Partners, or Owner

U.S. Specialty Insurance Company
Surety

Countersigned at Raleigh, North Carolina

By:
Resident Agent of NC Robert W. Moore

Agent and Attorney in Fact Todd P. Loehnert

***PLEASE MAIL THIS FORM AND THE ATTACHED INSTRUMENT**
TO THE FOLLOWING ADDRESS:

LAND QUALITY SECTION
1612 MAIL SERVICE CENTER
RALEIGH, NC 27699

POWER OF ATTORNEY

AMERICAN CONTRACTORS INDEMNITY COMPANY U.S. SPECIALTY INSURANCE COMPANY

KNOW ALL MEN BY THESE PRESENTS: That American Contractors Indemnity Company, a California corporation, and U.S. Specialty Insurance Company, a Texas corporation (collectively, the "Companies"), do by these presents make, constitute and appoint:

Monica A. Kaiser, John B. Ayres, Todd P. Loehnert or Paula J. Teague of Louisville, Kentucky

its true and lawful Attorney(s)-in-fact, each in their separate capacity if more than one is named above, with full power and authority hereby conferred in its name, place and stead, to execute, acknowledge and deliver **any and all bonds, recognizances, undertakings or other instruments or contracts of suretyship to include riders, amendments, and consents of surety, providing the bond penalty does not exceed** ******Twenty Five Million****** **Dollars ($** **25,000,000.00** **).** This Power of Attorney shall expire without further action on March 18, 2015. This Power of Attorney is granted under and by authority of the following resolutions adopted by the Boards of Directors of the Companies:

Be it Resolved, that the President, any Vice-President, any Assistant Vice-President, any Secretary or any Assistant Secretary shall be and is hereby vested with full power and authority to appoint any one or more suitable persons as Attorney(s)-in-Fact to represent and act for and on behalf of the Company subject to the following provisions:

Attorney-in-Fact may be given full power and authority for and in the name of and on behalf of the Company, to execute, acknowledge and deliver, any and all bonds, recognizances, contracts, agreements or indemnity and other conditional or obligatory undertakings, including any and all consents for the release of retained percentages and/or final estimates on engineering and construction contracts, and any and all notices and documents canceling or terminating the Company's liability thereunder, and any such instruments so executed by any such Attorney-in-Fact shall be binding upon the Company as if signed by the President and sealed end effected by the Corporate Secretary.

Be it Resolved, that the signature of any authorized officer and seal of the Company heretofore or hereafter affixed to any power of attorney or any certificate relating thereto by facsimile, and any power of attorney or certificate bearing facsimile signature or facsimile seal shall be valid and binding upon the Company with respect to any bond or undertaking to which it is attached.

IN WITNESS WHEREOF, The Companies have caused this instrument to be signed and their corporate seals to be hereto affixed, this 3rd day of October, 2011.

AMERICAN CONTRACTORS INDEMNITY COMPANY U.S. SPECIALTY INSURANCE COMPANY

Corporate Seals

INCORPORATED SEPT. 25, 1990

By: ______________________

Daniel P. Aguilar, Vice President

State of California

County of Los Angeles SS:

On this 3rd day of October, 2011, before me, Deborah Reese, a notary public, personally appeared Daniel P. Aguilar, Vice President of American Contractors Indemnity Company and U.S. Specialty Insurance Company who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct. WITNESS my hand and official seal.

Signature deborah reese (Seal)

DEBORAH REESE
Commission # 1926048
Notary Public - California
Los Angeles County
My Comm. Expires Mar 18, 2015

I, Jeannie Lee, Assistant Secretary of American Contractors Indemnity Company and U.S. Specialty Insurance Company, do hereby certify that the above and foregoing is a true and correct copy of a Power of Attorney, executed by said Companies, which is still in full force and effect; furthermore, the resolutions of the Boards of Directors, set out in the Power of Attorney are in full force and effect.

In Witness Whereof, I have hereunto set my hand and affixed the seals of said Companies at Los Angeles, California this 5th day of November, 2014

Corporate Seals

INCORPORATED SEPT. 25, 1990

Jeannie Lee

Jeannie Lee, Assistant Secretary

Bond No. ______________

Agency No. 16578

To inquire about this bond, please write to us at surety-bond-inquiry@hcc.com

Colon Mine
Approximately 408 Acres
Lee County, NC

Threatened and Endangered Species Review and Habitat Assessment

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

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

August 8, 2014

Table of Contents

List of Tables

List of Figures

Appendices

1.0 INTRODUCTION

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

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

2.0 METHODOLOGY

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

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

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

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

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

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

The protected species survey consisted of a pedestrian survey by CEC staff. During field surveys, site habitats were identified and compared with recognized habitats for each of the four species potentially occurring on the site. Potential flora were identified to the taxonomic unit level necessary to determine if the observed specimen was a protected species.

3.0 HABITAT CLASSIFICATION

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

3.1 Ruderal Corridors

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

3.2 Early Successional Field

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

3.3 Stream Bank and Riparian

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

3.4 Mixed Pine/Hardwood Forest

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

3.5 Oak Hickory Forest

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

3.6 Loblolly Pine Forest

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

3.7 Wetland

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

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

3.8 Soils

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

4.0 PROTECTED SPECIES

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

4.1 Red-cockaded woodpecker

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

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

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

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

4.2 Cape Fear shiner

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

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

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

4.3 Harperella

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

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

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

4.4 Northern long-eared bat

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

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

5.0 CONCLUSION AND RECOMMENDATIONS

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

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

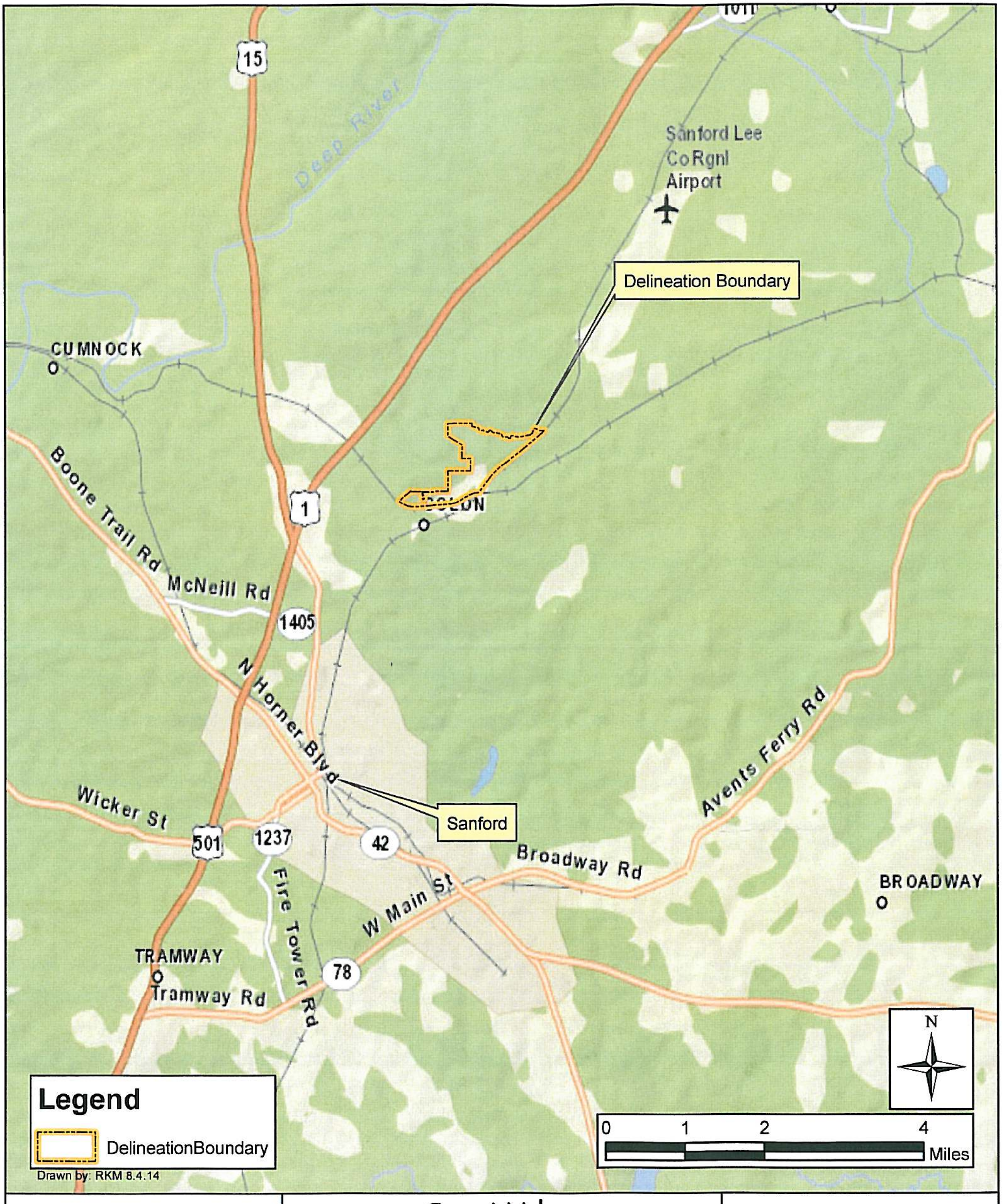
6.0 REFERENCES

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

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

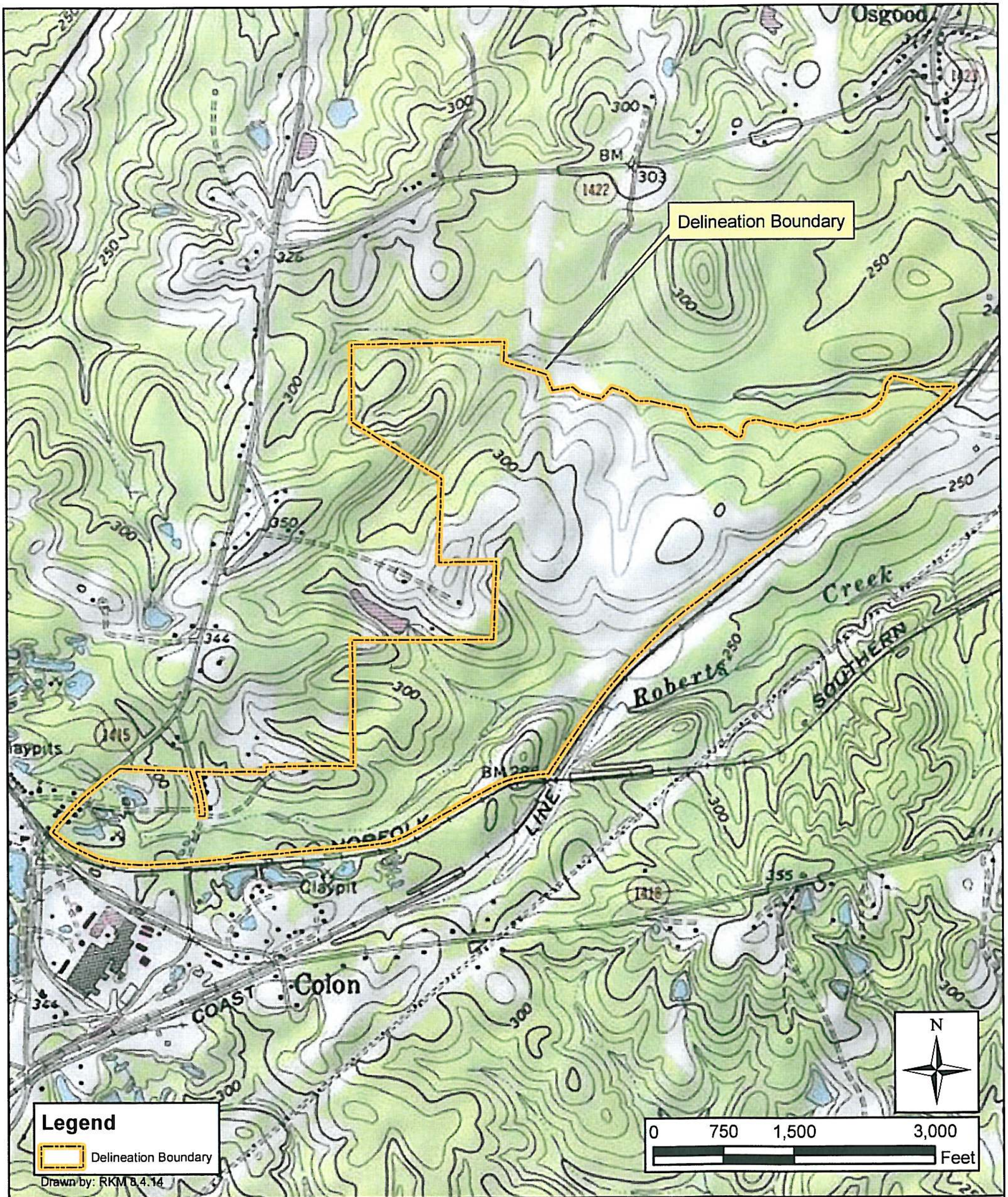
USFWS (United States Fish and Wildlife Service Database). 2014. http//www.fws.gov/Raleigh/species/cntylist/nc_counties.html. accessed July 2014.

Colon Mine (+/-408 AC)



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

Colon Mine (+/-408 AC)



Drawn by: RKM 8.4.14

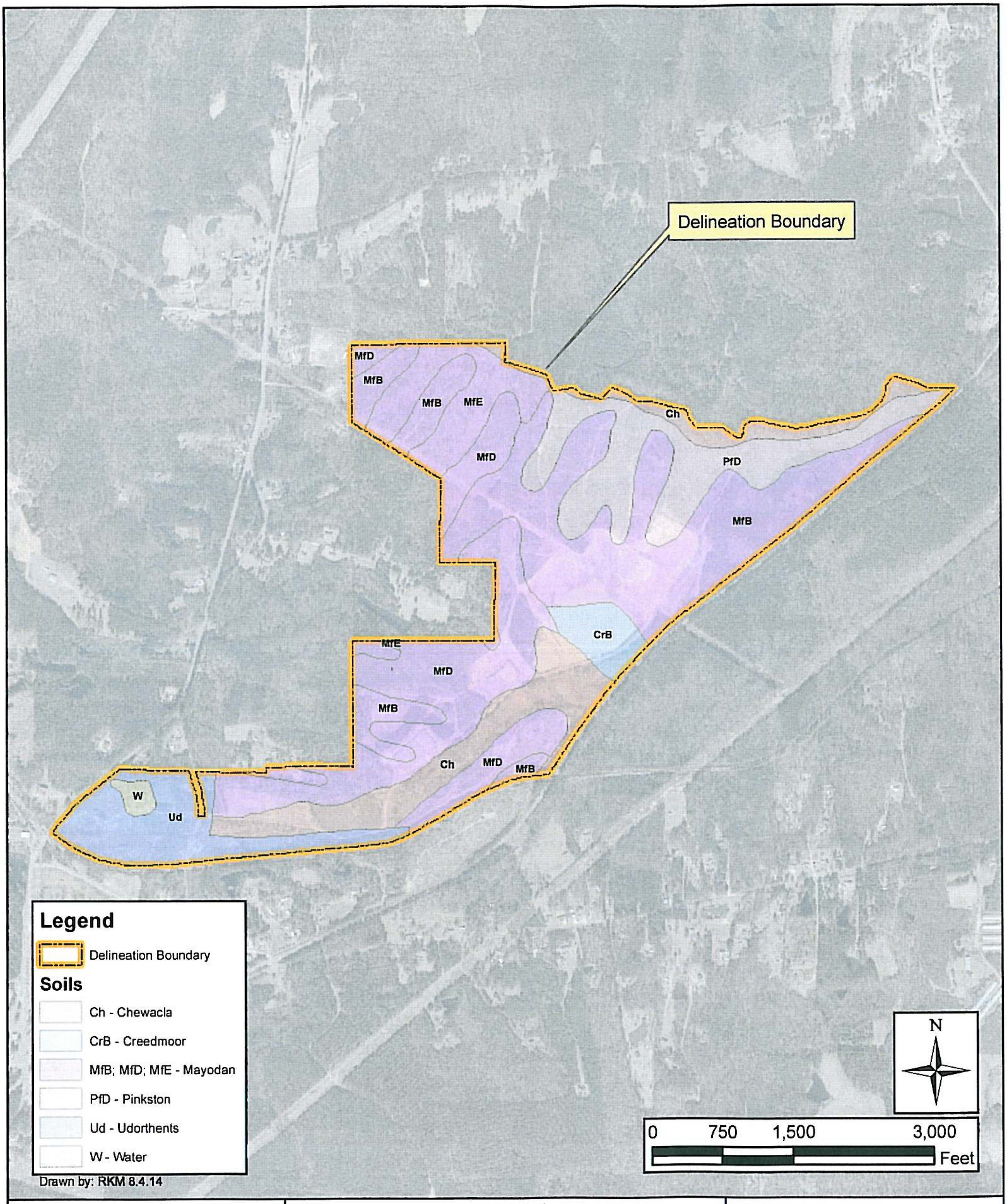
Lee County,
North Carolina

ClearWater

224 South Grove Street, Suite F
Hendersonville, North Carolina 28792

USGS Topographic Map
Colon Quad
Figure 2

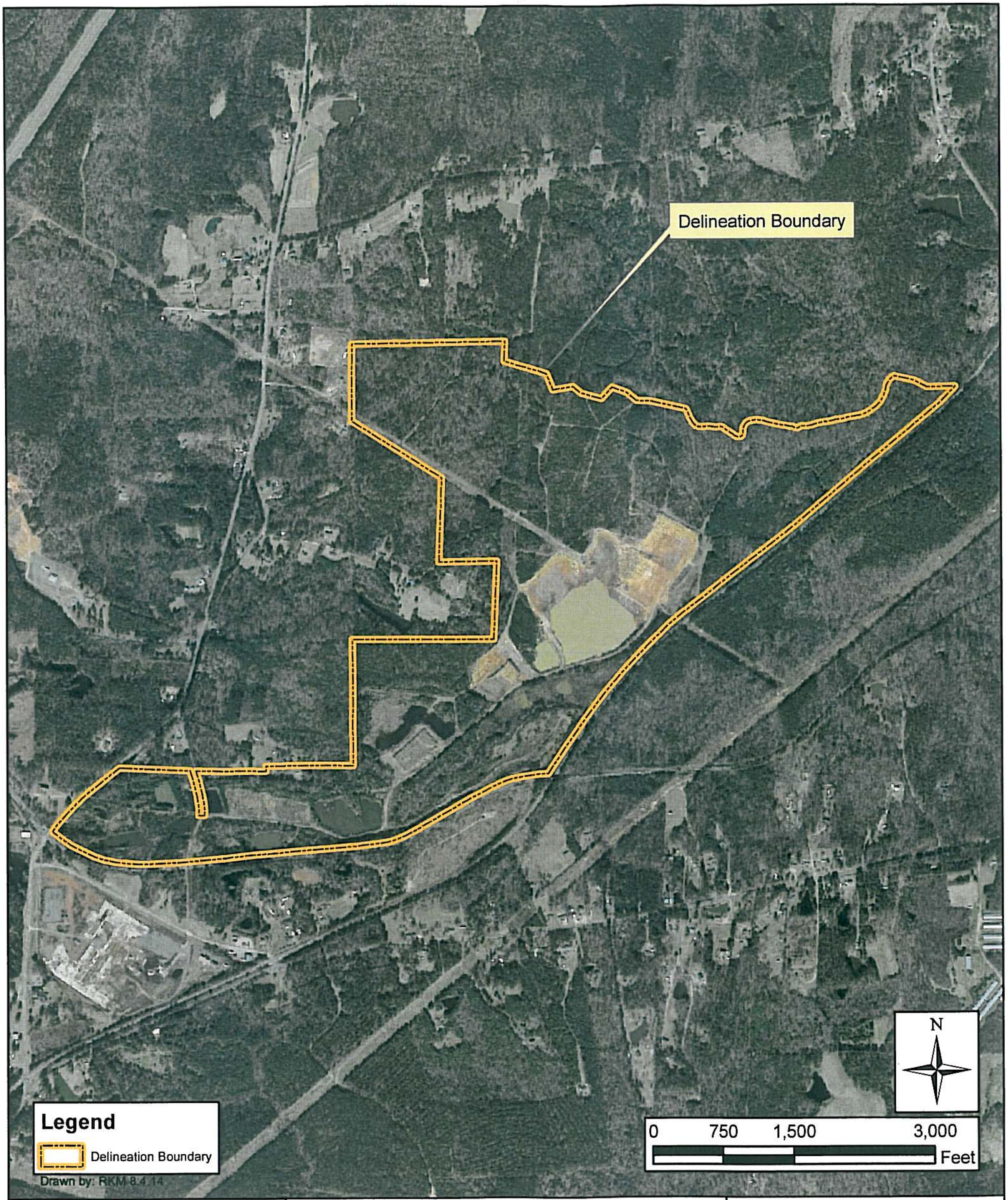
Colon Mine (+/-408 AC)



Drawn by: RKM 8.4.14

Lee County, North Carolina	ClearWater 224 South Grove Street, Suite F Hendersonville, North Carolina 28792	USDA Soils Figure 3

Colon Mine (+/-408 AC)



Lee County,
North Carolina

ClearWater

224 South Grove Street, Suite F
Hendersonville, North Carolina 28792

Aerial (2010)
NCCGIA
Figure 4

Appendix A

Database Information July 14, 2014

US Fish and Wildlife Service

&

North Carolina Natural Heritage Program

U.S. Fish & Wildlife Service

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

Lee County, North Carolina

Updated: 1-22-2014

Critical Habitat Designations:

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

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

Vascular Plant:

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

Nonvascular Plant:

Lichen:

Definitions of Federal Status Codes:

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

Bald and Golden Eagle Protection Act (BGPA):

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

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

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

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

Definitions of Record Status:

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

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

5MileEO, 7/14/2014, Page 1-2

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

This page intentionally left blank.

TRC

50101 Governor's Drive
Suite 250
Chapel Hill, NC 27517

919.530.8446 PHONE
919.530.8525 FAX

www.TRCsolutions.com

August 8, 2014

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

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

Dear Mr. Riddle:

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

PROJECT DEFINITION

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

FIELDWORK RESULTS

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

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

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

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

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

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

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

SUMMARY

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

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

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

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

Sincerely,

Brooke Kenline
Field Director

Paul G Webb

Paul Webb
Principal Investigator/Project Manager

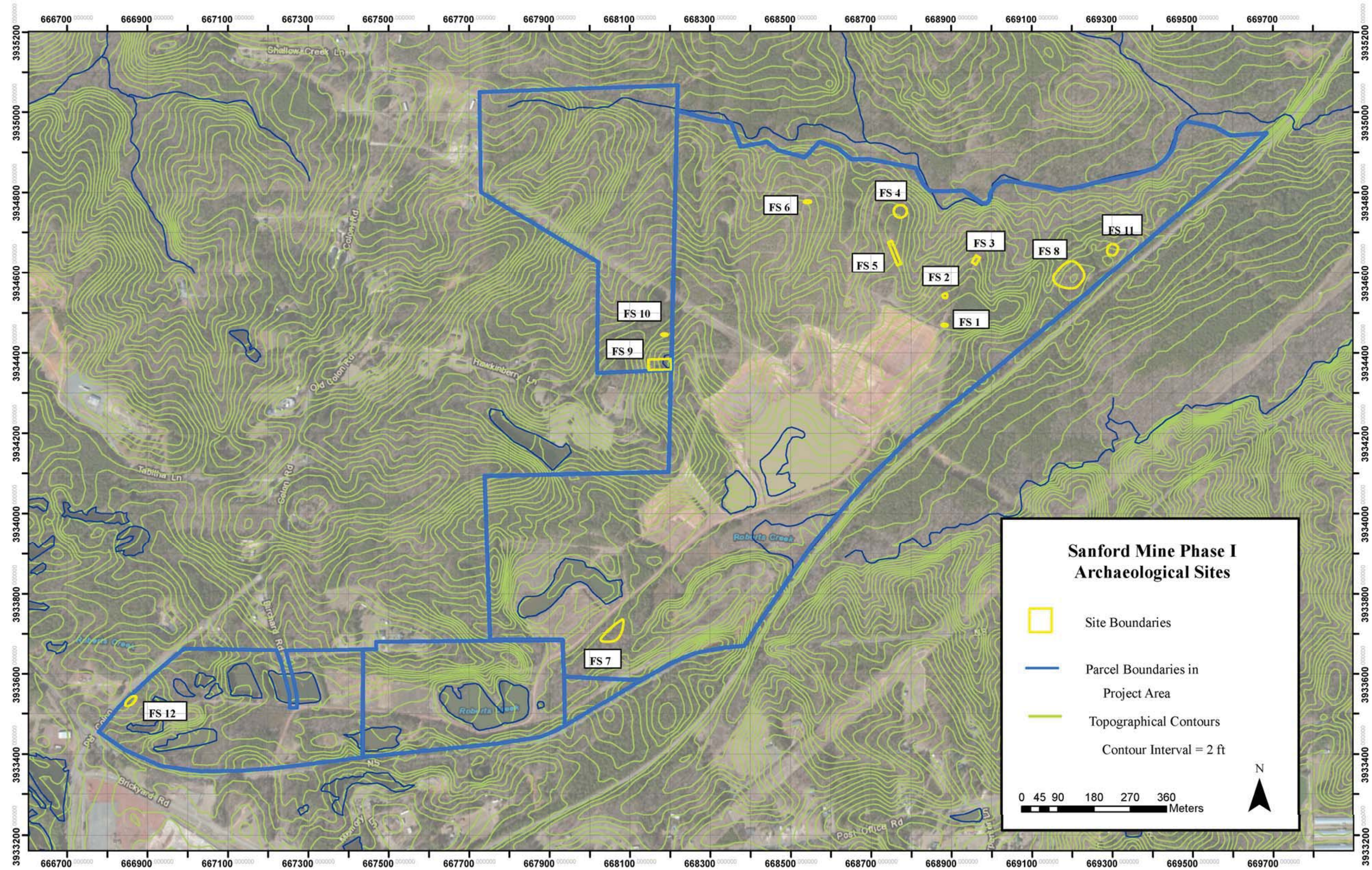


Figure 1. Archaeological Sites Identified within Project Area.

APPENDIX A. SELECTED NORTH CAROLINA GENERAL STATUTES RELATING TO CEMETERIES

§ 14-148. Defacing or desecrating grave sites.

(a) It is unlawful to willfully:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Chapter 65.
Cemeteries.

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

§ 65-85. Definitions.

As used in this Article, the following terms mean:

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

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

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

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

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

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

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

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

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

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

Part 4. Removal of Graves.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 70-26. Short title.

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

§ 70-27. Findings and purpose.

(a) The General Assembly finds that:

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

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

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

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

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

§ 70-28. Definitions.

As used in this Article:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 70-30. Jurisdiction over remains.

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

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

(c) If the county medical examiner determines that the remains are not subject to the provisions of G.S. 130A-383, the county medical examiner shall so notify the Chief Medical Examiner. The Chief Medical Examiner shall notify the State Archaeologist of the discovery of the human skeletal remains and the findings of the county medical examiner. The State Archaeologist shall immediately take charge of the remains.

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

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

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

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

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

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

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

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

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

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

(1) Designation of a qualified skeletal analyst to work on the skeletal remains;
(2) The type of analysis and the specific period of time to be provided for analysis of the skeletal remains;
(3) The timetable for written progress reports and the final report concerning the skeletal analysis to be provided to the State Archaeologist and the Executive Director by the skeletal analyst; and
(4) A plan for the ultimate disposition of the Native American remains subsequent to the completion of adequate skeletal analysis.

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

§ 70-33. Consultation with other individuals.

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

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

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

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

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

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

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

§ 70-34. Skeletal analysis.

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

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

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

(1) Methodology and techniques to be utilized;

(2) Research objectives;

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

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

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

§ 70-35. Disposition of human skeletal remains.

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

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

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

§ 70-36. Financial responsibility.

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

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

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

§ 70-37. Prohibited acts.

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

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

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

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

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

§ 70-40. Penalties.

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

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

Drawings

Colon Mine Site

Charah, Inc.

Sanford, NC

November 2014
Revised December 2014