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MAR 23 2015

LAND QUALITY SECTION

March 20, 2015

Ashley Rodgers, PE  
State Sedimentation Specialist  
NCDENR - Division of Energy, Mineral, and Land Resources  
1612 Mail Service Center  
Raleigh, NC 27699

Dear Ms. Rodgers,

Attached please find two copies of the application for an expedited review of the Erosion and Sedimentation Control Plan for the Northwest Area of the proposed Colon Mine Site Structural Fill project. Separate checks for the application and expedited review are also included as requested, along with the executed and notarized Financial Responsibility/Ownership form.

As we discussed by telephone, the proposed structural fill project is predominantly located within the DEMLR Mine Permit 53-05. This application relates to an approximately 11-acre proposed disturbance which lies to the northwest, outside the currently permitted mine boundary. The erosion control features were designed as one complete project, including the 11-acre area, and all details and computations were included in the mine modification submittal. That submittal was reviewed by John Holley and his comments addressed in a follow-on response. All comments were satisfactorily addressed, and Judy Wehner has issued the draft permit for the mine modification application. Therefore, for this submittal, we have simply extracted the pertinent plans, details, specifications, and computations from the mine modification submittal to address the 11-acre proposed disturbance that lies outside the limits of the current mine boundary.

If you have any questions regarding this submittal, please don't hesitate to contact me, or my co-worker Mike Plummer, PE. Mike is HDR's overall project manager for the proposed structural fill project.

Sincerely,  
HDR Engineering, Inc. of the Carolinas

Joseph C. Readling, PE  
Vice President

Erosion & Sedimentation Control Plan -  
Northwest Area

# Colon Mine Site Structural Fill

Charah, Inc.

*Sanford, North Carolina*

March 20, 2015



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## Purpose

The purpose of this Erosion and Sediment Control Plan is to obtain a Certificate of Plan Approval from the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Land Resources to use land on the property northwest of the Colon Mine Site for structural fill. The plan describes the erosion and sedimentation control features for the development of this area, referred to as the Northwest Area, and addresses disturbance for approximately 11 acres. The plan has been prepared in general accordance with the North Carolina Erosion and Sediment Control Planning and Design Manual guidelines.

## Background

Green Meadow, LLC owns, and Charah, Inc. will operate the Colon Mine Site located in Lee County, off Brickyard Road in Sanford, North Carolina under NCDENR Permit No. 53-05. The site consists of approximately 411 acres, inclusive of the mining operations and the structural fill area. Sheet 00G-02 in Appendix D shows the property line including all property, structures, and appurtenances designated as Colon Mine Site property.

The property was previously owned and operated by General Shale and was originally permitted in October 1972. A Mine Permit Transfer/Modification application (revised March 2015) and a Structural Fill Permit Application (revised March 2015) for the site have been submitted to NCDENR for review and approval.




As is typical, the erosion control measures are included as part of the mine permit application and covered within the mine permit. However, the structural fill project includes 11 acres of planned disturbance in the northwest portion of the property that is not currently within the mine permit boundary. This Erosion and Sedimentation Control Plan has been compiled to address that 11-acre Northwest Area. This plan involves only Sediment Basins #1 and #2.

## Contact Information

Owner: The owner of the Colon Mine Site is as follows. The Owner is also the Permittee and is responsible for this plan.

Owner: Green Meadow, LLC  
12601 Plantside Drive Louisville, KY 40299  
(877) 314-7724, (502) 245-1353  
Facility Contact: Mr. Charles E. Price

Person to Contact: Should sediment control issues arise during the land-disturbing activity, please contact the following:



Mr. Norman Divers  
Engineering and Environmental Manager, Charah, Inc.  
330 South Tryon Street, 5<sup>th</sup> Floor  
Charlotte, NC 28202  
Telephone: (704) 472-3919, Cell: (502) 475-0725

Engineer: For questions regarding this plan, please contact the following.

HDR Engineering, Inc. of the Carolinas  
Attn: Michael D. Plummer, P.E.  
440 South Church Street, Suite 1000  
Charlotte, NC 28202-2075  
Telephone: (704) 338-6700

## Project Description

This is a project to reclaim the Colon Mine Site located in Lee County, North Carolina with coal combustion products (CCP) structural fill. The mine, once complete, will be reclaimed by encapsulating CCPs in a lined containment in order to re-establish the mine contours to a useful design.

The structural fill, including associated perimeter berms, channels, and haul roads, will encompass approximately 137 acres, of which approximately 118 acres will be covered with a composite liner system for subsequent placement of coal combustion products (CCP). Pending approval of the Structural Fill Permit Application, the structural fill is scheduled for construction in early 2015 to be in a position to comply with the schedule defined in the Coal Ash Management Act of 2014. Construction of the composite base liner system is anticipated to be completed in two phases. The Owner anticipates placing approximately 1,600,000 tons of CCPs a year in the 7.25 million cubic yard (cy) structural fill; therefore, placement will last approximately 5 to 5.5 years. The final closure cap is designed to minimize infiltration and erosion. In accordance with the North Carolina General Statutes, post-closure care will be performed for 30 years unless a revised schedule is approved by NCDENR.

## Existing Conditions

The Colon Mine Site Structural Fill is located approximately five miles northeast of Sanford, North Carolina. The area surrounding the site consists of rural residential, wooded, and agricultural property. The site is bounded on the north by an unnamed tributary to Roberts Creek, on the east by the CSX railroad, and on the south by the Norfolk Southern railroad. The site is bisected by a Duke Energy power line right-of-way and consists of previously mined and wooded, unmined areas. There are several ponds on the southern half from previous mining activities. Onsite elevations range from approximately 226 to 336 mean sea level. The location of the Northwest Area is shown on Drawing 00G-02.

## Erosion and Sediment Control Measures

The following erosion and sedimentation control measures are to be used in construction of the site: vegetative stabilization, sediment basins, silt fence, channels, diversion berms, slope drains, outlet protection, diversion berms, subcell divider berms, and drop inlets.

The erosion and sediment control structures are designed and maintained to manage the run-off generated by the 25-year storm event, convey it to the sediment basins, and conform to the requirements of the Sedimentation Pollution Control Law. As part of the final cap system, diversion berms, side slope swales, and slope drains will be constructed to intercept run-off and prevent erosion. The side slope swales and diversion berms will be longitudinally sloped will carry run-off to slope drains that discharge into a perimeter channel. Channels will direct stormwater flow to sediment basins within the property.

Calculations demonstrating the adequacy of the drainage and erosion and sediment control structures are provided in Appendix B. Technical specifications for the construction of erosion and sediment control measures are provided in Appendix C.

## **Vegetative Stabilization**

Vegetation shall be established to protect the final cover system from erosion and to enhance the aesthetics of the closed structural fill. Plant species shall be selected based on the following criteria.

- Vegetation depth of rooting shall not extend to the geosynthetics per final cover design
- Final cover vegetation to be generally tolerant to local cover soil conditions
- Site climate adaptability (temperature, rainfall or drought tolerance, wind effects, exposure, and sunshine)
- Plant species shall be persistent and self-propagating
- Plant species shall exhibit a high percentage of surface coverage
- Plant species shall exhibit low long-term maintenance needs
- Additional procedures will be developed to implement and protect the integrity and quality of the final cover, and prevent soil erosion in disturbed areas

## **Sediment Basins**

The structural fill project has a total of nine sediment basins which receive drainage from the disturbed area on the Colon Mine Site. The sediment basins were designed to contain the 25-year 24-hour design storm without employing use of the emergency spillways. Additional routing was performed to confirm that the emergency spillways can successfully pass the 100-year storm events.

The sediment basins were designed and analyzed for two phases in the life of the structural fill. Phase 1, when the basins are installed and clearing and grubbing occurs; and Phase 2, when the structural fill has reached its final height and has been capped.

This plan involves only Sediment Basins #1 and #2 as these are the two basins which receive drainage from the disturbed portion of the Northwest Area. Each sediment basin will utilize skimmers to drain the basin.

## Silt Fence

Silt fence will be installed at or outside the limits of disturbance as shown on the plans prior to land-disturbing activity. The silt fence will not be installed at the outlets of sediment basins or across drainage features.

## Channels

Drainage channels will be utilized to direct flow to the downslope drains, and permanent sediment basins. Sideslope swales with triangular channels will be used along the sideslopes of the structural fill to direct flow to a downslope drain. A diversion berm will be installed along the top of the structural fill to direct flow to a downslope drain. Perimeter drainage channels will be installed at the toe of slope around the structural fill to direct runoff to the sediment basins. The lining for all types of channel was determined based on flow velocity and shear stress.

## Slope Drains

Slope drains will be used to divert flow down the slopes of the structural fill. The slope drain calculations indicate that an 18-inch corrugated plastic pipe (smooth wall) should be used.

## Drop Inlets

Drop inlets will be used to divert flow from the perimeter channels.

## Outlet Protection

Apron outlets will be provided for the drop inlets and sediment basin outlets to provide protection from erosion.

# Maintenance and Sediment Disposal

All erosion and sedimentation control devices will be inspected at regular intervals and immediately following any major storm event and the following activities performed, as needed.

- Removal of debris, if any
- Inspection of inlets, outlets and culverts
- Removal of sediments when the storage volume or conveyance capacity of the system is below design level or when the system is rendered ineffective on account of clogging/sedimentation of the pond bottom
- Any breach of the system's integrity shall be immediately repaired. Whenever erosion is detected, measures shall be taken to stabilize and protect the affected area
- Mowing and removal of grass clippings

All sediment removed from erosion and sedimentation control measures will be disposed of in a manner such that further erosion and sedimentation will not occur.

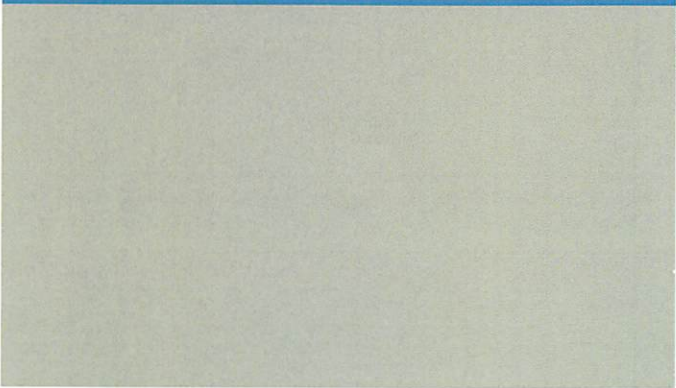
## Construction Sequence

The construction sequence for the structural fill erosion and sedimentation control elements is shown on the drawings provided in Appendix D.




# A

## Ownership Documents



Financial Responsibility/Ownership Form  
Property Deed



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**FINANCIAL RESPONSIBILITY/OWNERSHIP FORM  
SEDIMENTATION POLLUTION CONTROL ACT  
EXPRESS PERMITTING OPTION 08012007**

No person may initiate any land-disturbing activity on one or more acres as covered by the Act before this form and an acceptable erosion and sedimentation control plan have been completed and approved by the Land Quality Section, N.C. Department of Environment and Natural Resources. (Please type or print and, if the question is not applicable or the e-mail and/or fax information unavailable, place N/A in the blank.)

**Part A.**

1. Project Name: **Colon Mine Site Structural Fill**
2. Location of land-disturbing activity: County: **Lee** City or Township: **Sanford, NC**  
Highway/Street: **1303 Brickyard Road, Sanford, NC** Latitude **35.5348** Longitude **-79.1598**
3. Approximate date land-disturbing activity will commence: **April, 2015**
4. Purpose of development (residential, commercial, industrial, institutional, etc.): **Industrial**
5. Total acreage disturbed or uncovered (including off-site borrow and waste areas): **11 acres**
6. Amount of fee enclosed: **\$2715**. The Express Permitting application fee is a dual charge. The normal fee of \$65.00 per acre is assessed without a ceiling amount. In addition, the Express Permitting supplement is \$250.00 per acre up to eight acres, after which the Express Permitting supplemental fee is a fixed \$2,000.00 (Example: 9 acres total is \$2,585). NOTE: Both fees are rounded up to the next whole acre and need to be paid by separate checks to NCDENR.
7. Has an erosion and sediment control plan been filed? Yes \_\_\_\_\_ No \_\_\_\_\_ Enclosed ☒
8. Person to contact should erosion and sediment control issues arise during land-disturbing activity:  
Name: **Mr. Norman Divers, Engr. and Env. Mgr.** E-mail Address: **ndivers@charah.com**  
Telephone: **704.472.3919** Cell # **502.475.0725** Fax # **866.728.2444**
9. Landowner(s) of Record (attach accompanied page to list additional owners):

<u><b>Green Meadow, LLC</b></u>	<u><b>502.245.1353</b></u>	<u><b>866.728.2444</b></u>
Name	Telephone	Fax Number
<u><b>12601 Plantside Drive</b></u>		
Current Mailing Address Current Street Address		
<u>City</u>	<u>State</u>	<u>Zip</u>
<u><b>Louisville</b></u>	<u><b>KY</b></u>	<u><b>40299</b></u>
City	State	Zip
10. Deed Book No. **01372** Page No. **0467 - 0476** Provide a copy of the most current deed.

**Part B.**

1. Person(s) or firm(s) who are financially responsible for the land-disturbing activity (Provide a comprehensive list of all responsible parties on an attached sheet):

<u><b>Green Meadow, LLC</b></u>	<u><b>cprice@charah.com</b></u>	
Name	E-mail Address	
<u><b>12601 Plantside Drive</b></u>		
Current Mailing Address Current Street Address		
<u>City</u>	<u>State</u>	<u>Zip</u>
<u><b>Louisville</b></u>	<u><b>KY</b></u>	<u><b>40299</b></u>
City	State	Zip
Telephone <u><b>502.245.1353</b></u>	Fax Number <u><b>866.728.2444</b></u>	

2. (a) If the Financially Responsible Party is not a resident of North Carolina, give name and street address of the designated North Carolina Agent:

Mr. Norman Divers, Engr. and Env. Mgr.  
Name

ndivers@charah.com  
E-mail Address

Current Mailing Address

330 South Tryon Street 5<sup>th</sup> Floor  
Current Street Address

City State Zip

Charlotte, NC 28202  
City State Zip

Telephone 704-472-3919

Fax Number \_\_\_\_\_

(b) If the Financially Responsible Party is a Partnership or other person engaging in business under an assumed name, **attach a copy of the Certificate of Assumed Name**. If the Financially Responsible Party is a Corporation, give name and street address of the Registered Agent:

N/A  
Name of Registered Agent

E-mail Address

Current Mailing Address

Current Street Address

City State Zip

City State Zip

Telephone \_\_\_\_\_

Fax Number \_\_\_\_\_

(c) In order to facilitate **Express Permitting**, it is necessary to be able to contact the Engineer or other consultant who can assist in providing any necessary information regarding the plan and its preparation:

HDR Engineering, Inc. of North Carolina  
Engineering Firm or other consultant

Michael.Plummer@hdrinc.com  
E-mail Address

Michael Plummer, PE  
Individual contact person (type or print)

704.338.6843  
Telephone

704.338.6760  
Fax Number

The above information is true and correct to the best of my knowledge and belief and was provided by me under oath (This form must be signed by the Financially Responsible Person if an individual or his attorney-in-fact, or if not an individual, by an officer, director, partner, or registered agent with the authority to execute instruments for the Financially Responsible Person). I agree to provide corrected information should there be any change in the information provided herein.

Mr. Norman Divers  
Type or print name

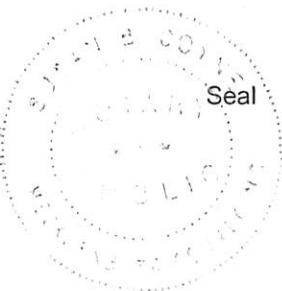
Engineering and Environmental Manager  
Title or Authority

Signature

March 20, 2015  
Date

I, Susan Coyne, a Notary Public of the County of Mecklenburg County, State of North Carolina, hereby certify that Mr. Norman Divers appeared personally before me this day and being duly sworn acknowledged that the above form was executed by him.

Witness my hand and notarial seal, this 20<sup>th</sup> day of March, 2015



Susan B. Coyne  
Notary

My commission expires 9/19/2015

1372  
0467

BK:01372 PG:0467

FILED  
LEE COUNTY  
MOLLIE A. MCINNIS  
REGISTER OF DEEDS

FILED Nov 13, 2014  
AT 01:41:28 pm  
BOOK 01372  
START PAGE 0467  
END PAGE 0476  
INSTRUMENT # 06088

Lee County 11-13-2014  
NORTH CAROLINA  
Real Estate  
Excise Tax \$7,000.00

**NORTH CAROLINA SPECIAL WARRANTY DEED**

Excise Tax: \$7,000.00

Parcel Identifier No. 9654-38-3247 (portion), 9654-58-2312, 9654-68-2373, 9655-81-9374 and 9655-62-2672 Verified by  
County on the day of , 2014 By:

Mail/Box to: Moore & Van Allen PLLC (MPH), 100 N. Tryon Street, Suite 4700, Charlotte, NC 28202

This instrument was prepared by: Bradshaw & Robinson, LLP, P.O. Box 607, Pittsboro, NC 27312 (without title examination)

Brief description for the Index: 410.56 acres, more or less, West Sanford Township, Lee County

THIS DEED made this 13th day of November, 2014 (the "Effective Date"), by and between

**GRANTOR**

**GENERAL SHALE BRICK, INC.,**  
a Delaware corporation

3015 Bristol Highway  
Johnson City, Tennessee 37601

**GRANTEE**

**GREEN MEADOW, LLC,**  
a North Carolina limited liability company

12601 Plantside Drive  
Louisville, Kentucky 40299

Enter in appropriate block for each Grantor and Grantee: name, mailing address, and, if appropriate, character of entity, e.g. corporation or partnership.

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot, parcel of land or condominium unit situated in West Sanford Township, Lee County, North Carolina and more particularly described as follows (the "Property"):

Being all of that certain parcel or tract of land containing 410.56 acres, more or less, as shown on map or plat entitled, "Recombination Survey of General Shale Brick, Inc. Property for Charah, Inc.," prepared by WNC Professional Engineers & Surveyors recorded in Plat Slide 2014- 110, Lee County Public Registry, reference to which is hereby made for a more particular description.

The Property was acquired by Grantor by instruments recorded in Book 584, Page 50, and in Book 1067, Page 682, Lee County Registry. Grantor is the successor-by-merger to Cherokee Sanford Group, LLC, a Delaware limited liability company.

All or a portion of the Property does not include the primary residence of the Grantor.

Grantor hereby expressly conveys the Property subject to, and Grantor hereby expressly reserves from this conveyance, the Use Restriction, and all other terms and conditions, and rights of the Grantor, pursuant to Exhibit A attached hereto and incorporated herein by reference.

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And the Grantor covenants with the Grantee, that Grantor has done nothing to impair such title as Grantor received, and Grantor will warrant and defend the title against the lawful claims of all persons claiming by, under or through Grantor, other than the following exceptions:

1. Any defects in, interests in, objections to, exceptions to, or conditions, liens, encumbrances or other matters of record relating to the title to the Property, whether evidenced by written instrument, or, if not evidenced by written instrument, then any such matters that would be revealed by an accurate survey of the Property completed on the Effective Date in accordance with exception #7, below.
2. Any encroachments upon or by the Property, any boundary disputes or conflicts regarding the boundaries of the Property, any claims, rights-of-way, easements, restrictions and restrictive covenants upon or relating to the Property, any encumbrances or other title defect(s), and the terms, provisions and conditions set forth in any instruments evidencing or referring to any such defects, exceptions, conditions, liens, encumbrances, overlaps, encroachments or boundary disputes or other matters.
3. All matters listed in Schedule B – Section II of the ALTA Commitment Form Commitment for Title Insurance issued by Chicago Title Insurance Company as Commitment Number 14-12874CH (Revision 7, dated November 7, 2014), which matters are incorporated herein by reference.
4. The lien of non-delinquent real property taxes and assessments, and any other non-delinquent impositions or exactions of any governmental or quasi-governmental authority or body politic, or political subdivision, agency or department thereof.
5. Any service, installation, connection, maintenance or construction charges due subsequent to the Effective Date.
6. The effect of any federal, state or municipal laws, rules, regulations or ordinances having applicability to the Property, or any portion thereof, or the use or enjoyment of the same, whether now or hereafter in effect, including, but not limited to, zoning, building, health, safety and environmental laws, rules and regulations, and notices of record relating thereto.
7. Any defects in, interests in, objection to, exceptions to, or conditions, liens, encumbrances or other matters that would have been disclosed on a current ALTA/ACSM Land Title Survey of the Property prepared as of the Effective Date in accordance with the 2011 Minimum Standard Detail Requirements for ALTA/ACSM Land Title Surveys jointly established and adopted by ALTA, ACSM and NSPS.
8. Any discrepancies, shortages in area, or state of facts which an inspection of the Property would disclose and which are not shown by the public records.
9. Any creditors' rights exceptions customarily taken by title insurance companies.

[The remainder of this page is intentionally left blank; Grantor's signature is on the following page.]

IN WITNESS WHEREOF, the Grantor has duly executed the foregoing as of the day and year first above written.

GENERAL SHALE BRICK, INC.,  
a Delaware corporation

By:

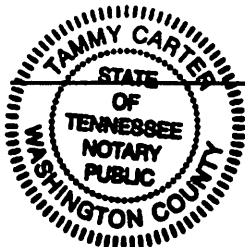
Kevin H. Ham  
Kevin H. Ham, Vice President

State of Tennessee - County of Washington

I, the undersigned Notary Public of the County of Washington and State aforesaid, certify that Kevin H. Ham personally came before me this day and acknowledged that he is the Vice President of General Shale Brick, Inc., a Delaware corporation, and that by authority duly given and as the act of such entity, he signed the foregoing instrument in its name on its behalf as its act and deed. Witness my hand and Notarial stamp or seal, this 5 day of November, 2014.

My Commission Expires: 6-29-2016  
(Affix Seal)

Tammy Carter  
Tammy Carter Notary Public  
Notary's Printed or Typed Name



**EXHIBIT A TO  
NORTH CAROLINA SPECIAL WARRANTY DEED**

THIS EXHIBIT A TO NORTH CAROLINA SPECIAL WARRANTY DEED (this "Agreement") is entered into as of November 13, 2014 (the "Effective Date") by and between GENERAL SHALE BRICK, INC., a Delaware corporation (the "Grantor") and GREEN MEADOW, LLC, a North Carolina limited liability company (the "Grantee"). Grantor and Grantee are sometimes referred to herein individually as a "Party" and collectively as the "Parties."

WITNESSETH:

THAT, WHEREAS, the Parties entered into that certain Agreement for Purchase and Sale of Property dated November 12, 2014 (the "Contract"); and

WHEREAS, the Parties wish to provide record notice of certain terms of the Contract including, but not limited to, matters regarding the Use Restriction.

NOW, THEREFORE, in consideration of ten dollars (\$10.00), and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Grantor and Grantee hereby agree as follows:

**SECTION 1. Declaration of Covenants.** Grantor, with the joinder and the consent of the Grantee, hereby declares that the Property shall be held, conveyed, encumbered, used, occupied and improved subject to the following covenants, which shall encumber the title to the Property and shall be binding upon all persons now having or hereafter acquiring any right, title, or interest in the Property, and their respective heirs, successors, and assigns, and which shall inure to the benefit of the Grantor, its successors and assigns (the "Use Restriction"):

(a) **Use Restriction.** Prior to October 31, 2049, the Property shall not be used for the production, manufacturing, storage, transportation or distribution of bricks, ceramic clay products or concrete masonry units. This restriction on use shall run with the title to the Property and shall be enforceable by Grantee, its successors and assigns. The Use Restriction shall expire and be null and void without further action of any Party on October 31, 2049 at 11:59 p.m. (local time).

**SECTION 2. Environmental Release.** Grantee, on behalf of itself and its members, managers and affiliates and each of their respective successors and assigns (collectively, the "Releasors"), as of the Effective Date, hereby waives, releases, and absolutely and forever discharges Grantor and its officers, directors, shareholders, subsidiaries, affiliates, employees, agents and representatives, and their respective heirs, successors and assigns (collectively, the "Releasees"), from any and all present or future rights, claims, actions, causes of action, demands, damages, liabilities, attorneys' fees, costs, fines, penalties and expenses of every kind and nature whatsoever, now known or unknown, direct or indirect, which any of the Releasors may have with respect to any of the Releasees, directly or indirectly arising from or relating to (x) the presence or alleged presence of Hazardous Materials in, on, under, about, originating from or relating to the Property if such Hazardous Materials were present at the Property on or prior to the Effective Date including, without limitation, any such claims under or on account of any Environmental Law or this Agreement, (y) any violation or alleged violation of any Environmental Law in connection with the Property that occurred or is alleged to have occurred on or prior to the Effective Date, and (z) the ownership, use, occupancy or operation of the Property by Releasees on and prior to the Effective Date, including the use and/or operation of the Property for the mining of clay or other mineral substances, and the conduct of any activities affecting the air, soil and/or water of the Property, and activities related to the foregoing.

**SECTION 3. Environmental Indemnity.** From and after the Effective Date, Grantee shall indemnify, defend and hold harmless Grantor and the other Releasees (individually, a "**Grantor Indemnitee**" and collectively, "**Grantor Indemnitees**") from and against, and pay for (a) any and all actions, allegations, appeals, causes of action (including removal and remedial actions), claims, demands, investigations, and lawsuits, of any kind, brought by Grantee, a third party or any government entity against any Grantor Indemnitees based on, or arising or resulting from (1) the actual or alleged presence of Hazardous Materials at, on, under or adjacent to the Property, to the extent such Hazardous Material was first present or first alleged to be present at, on, under or adjacent to the Property on or after the Effective Date, (2) any activity by Grantee, or any Person affiliated with Grantee, in connection with any actual, proposed or threatened use, treatment, storage, holding, existence, disposition or other Release, generation, production, manufacturing, processing, refining, control, management, abatement, removal, arrangement for disposal, handling, transfer or transportation to or from the Property of any Hazardous Materials at any time located in, under, on or above the Property, (3) the imposition, recording or filing or the threatened imposition, recording or filing of any Environmental Lien encumbering the Property relating in any way to the activities conducted on, or operation or use of, the Property on or after the Effective Date; (4) any actual or threatened injury to, destruction of, or loss of natural resources in any way connected with the Property arising on or after the Effective Date, including, but not limited to, costs to investigate and assess such injury, destruction or loss relating in any way to the activities conducted on, or operation or use of, the Property on or after the Effective Date; (5) any personal injury, wrongful death, or property or other damage arising on or after the Effective Date under any statutory or common law or tort law theory, related to environmental hazards on the Property, including, but not limited to, damages assessed for private or public nuisance or for the conducting of an abnormally dangerous activity on the Property relating in any way to the activities conducted on, or operation or use of, the Property on or after the Effective Date; and (6) any Environmental Claim relating in any way to the Grantee's operation or use of the Property on or after the Effective Date (individually, a "**Claim**" and collectively, "**Claims**"); and (b) any and all assessments, civil penalties, out-of-pocket costs and expenses (including court costs and reasonable attorneys' fees) actually incurred by a Grantor Indemnitee (but excluding costs and expenses of defending any Claim incurred by any such Grantor Indemnitee after Grantee has accepted and is diligently pursuing defense of such Claim, unless such costs and expenses of defending such Claim are incurred with Grantee's prior written consent), damages (including consequential and punitive damages awarded to any third-party), decrees, fines, judgments, liabilities (including for strict liability), losses, obligations, orders and penalties (whether compensatory or punitive) which may be assessed against or suffered or incurred by any Grantor Indemnitee based upon, or arising or resulting from (i) any Claim that is (y) owed to Grantee, a third-party or any governmental entity, or (z) related to any remedial actions to the Property required of Grantor under any applicable Environmental Law; or (ii) to the extent arising out of, relating to or resulting from the Release or Threatened Release of Hazardous Materials from the Property to, on, under, adjacent to, or otherwise affecting the real property owned by Grantor (including as successor in interest to Cherokee Sanford Group, LLC, a Delaware limited liability company), or General Shale, Inc., on the date hereof (the "**Subject Property**"), any remedial actions reasonably appropriate to enable clay to be mined from the Subject Property or required to comply with applicable Environmental Law, including, without limitation, action to (x) test, identify, investigate and monitor such Hazardous Materials or Release, and (y) clean-up, contain and remove such Hazardous Materials (all of the foregoing, collectively, "**Losses**").

In the event that any Grantor Indemnitee receives written notice of the assertion of any Claim by any third-party or any governmental entity with respect to which the Grantee is required to provide indemnification under this Agreement, the Grantor Indemnitee shall provide Grantee with prompt written notice (a "**Claim Notice**") of any Claim for which indemnity is sought, which Claim Notice shall set forth in reasonable detail a statement of the pertinent facts known to the Grantor Indemnitee concerning the Claim(s) that are the subject of the Claim Notice; provided, however, that any failure by a Grantor Indemnitee to give a timely, complete or accurate Claim Notice shall not affect the rights or obligations of any party hereunder except and only to the extent that, as a result of such failure, Grantee's defense of any such Claim was materially and adversely prejudiced. Grantee shall have the right, upon delivering written notice (the "**Defense Notice**") to the Grantor Indemnitee within six (6) months after receipt from a Grantor Indemnitee of a Claim Notice, to assume and conduct, at Grantee's sole cost and expense, the defense against those Claims identified in the Claim Notice that are identified in the Defense Notice; provided, however, that (i) delivery by Grantee of a Defense Notice shall constitute Grantee's irrevocable agreement that the Grantor Indemnitee(s) are entitled to



indemnification under this Agreement with respect to the Claims set forth in the Defense Notice, and (ii) Grantor shall have the right to approve the defense counsel engaged by Grantee, such approval not to be unreasonably withheld, conditioned or delayed (provided that Grantor hereby approves Moore & Van Allen PLLC). In the event that Grantee shall fail to give a Defense Notice for any Claims identified in the Claims Notice within six (6) months after receipt from a Grantor Indemnitee of such Claim Notice, then in any such event the Grantor Indemnitees shall have the right to conduct the defense of the Claims identified in the Claim Notice in good faith, provided that Grantor Indemnitees shall be prohibited from compromising or settling any such Claims without the prior written consent of Grantee, which consent shall not be unreasonably withheld, conditioned or delayed. In order to seek Grantee's consent, a Grantor Indemnitee must provide to Grantee written notice detailing all of the terms, conditions and obligations of any proposed settlement or compromise, including providing a copy of any proposed settlement agreement or other contractual arrangement to be executed by parties to the proposed settlement or compromise (a "Grantor Indemnitee Settlement Notice"). If Grantee does not provide to the respective Grantor Indemnitee(s) a written response to a Grantor Indemnitee Settlement Notice within twenty (20) Business Days of Grantee's receipt of the Grantor Indemnitee Settlement Notice (as provided in Section 18(b) herein), then Grantee's consent will be deemed given to the respective Grantor Indemnitee. In the event the Grantee does timely deliver a Defense Notice and thereby elects to conduct the defense of the Claims identified in the Defense Notice, the Grantor Indemnitees will cooperate with and make available to the Grantee such assistance and materials as Grantee may reasonably request, all at the sole cost and expense of Grantee. Regardless of which party defends such Claims, the other party hereto shall have the right at its own cost and expense to participate in the defense assisted by counsel of its own choosing. Without the prior written consent of the Grantor Indemnitees, which shall not be unreasonably withheld, conditioned or delayed, Grantee shall not approve the entry of any judgment or enter into any settlement or compromise of any such Claims if (a) pursuant to or as a result of such judgment, settlement or compromise, such judgment, settlement or compromise would lead to liability or create any financial or other obligation on the part of any Grantor Indemnitee for which the Grantor Indemnitee is not fully indemnified and made whole hereunder, (b) the terms of such judgment, settlement or compromise do not provide for a full and complete release of all such Claims in favor of each Grantor Indemnitee that is the subject of the Claim, and (c) injunctive or other equitable relief will be imposed against any Grantor Indemnitee. In order to seek a Grantor Indemnitee's consent, Grantee must provide to the Grantor Indemnitee written notice detailing all of the terms, conditions and obligations of any proposed judgment, settlement or compromise, including providing a copy of any proposed settlement agreement or other contractual arrangement to be executed by parties to the proposed settlement or compromise (a "Grantee Settlement Notice"). If a Grantor Indemnitee does not provide to Grantee a written response to a Grantee Settlement Notice, within twenty (20) Business Days of the Grantor Indemnitee's receipt of the Grantee Settlement Notice (as provided under Section 4 herein), then the Grantor Indemnitee's consent shall be deemed given to the Grantee. Any judgment entered or settlement or compromise agreed upon as set forth in a Grantor Indemnitee Settlement Notice that is consented to by Grantee or a Grantee Settlement Notice that is consented to by Grantor, in the manner provided herein, shall be binding upon Grantee, and shall be conclusively deemed to be an obligation with respect to which the Grantor Indemnitees are entitled to prompt indemnification hereunder, subject to Grantee's right to appeal an appealable judgment or order.

For purposes of this Agreement, the term "Hazardous Materials" means chemicals, pollutants, contaminants, wastes, toxic substances, hazardous substances, radioactive materials or genetically modified organisms, which are, have been or become regulated by any federal, state or local government authority including, without limitation, (w) petroleum or any fraction thereof, (x) asbestos, (y) any substance or material defined as a "hazardous substance" pursuant to § 101 of the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. § 9601), or (z) any substance or material defined as a "hazardous chemical" pursuant to the federal Hazard Communication Standard (29 C.F.R. § 1910.1200); the term "Environmental Claim" means any claim, action, cause of action, investigation, or notice (written or oral) by any person or entity alleging potential liability (including, without limitation, potential liability for investigatory costs, cleanup costs, governmental response costs, natural resource damages, property damages, personal injuries, or civil or criminal penalties) arising out of or resulting from (yy) the actual or alleged presence or release into the environment of any Hazardous Materials at any location, whether or not owned or operated by the Grantor, or (zz) circumstances forming the basis of any actual or alleged violation of any Environmental Law; and the term "Environmental Law" means all federal, state, local, and foreign laws and regulations relating to pollution or protection of human health or the environment (including, without limitation, ambient air, surface water, ground

water, wetlands, land surface, subsurface strata, and indoor and outdoor workplace), including, without limitation, (yyy) laws and regulations relating to emissions, discharges, releases, or threatened releases of Hazardous Materials, and (zzz) common law principles of tort liability. The terms "Release" and "Threatened Release" shall have the meanings defined under Environmental Law. The term "Environmental Lien" means any mortgage, pledge, hypothecation, assignment, deposit arrangement, encumbrance, lien (statutory or other), charge, or preference, priority or other security interest or preferential arrangement arising pursuant to any Environmental Law or as a result of the presence, Release or threatened Release or disposal of any Hazardous Materials. Grantee and Grantor agree that, in the event of any Release or Threatened Release of Hazardous Materials in, at, on, under, about, originating from or relating to the Property, or any Claims or Losses relating thereto, then (i) there shall be a presumption that such Hazardous Materials were first introduced and first present in, at, on, under or about the Property after the Effective Date, and (ii) Grantee shall bear the burden of proof if Grantee claims or asserts that such Hazardous Materials were present in, at, on, under or about the Property on or prior to the Effective Date.

Grantee agrees that it shall not sell, assign or otherwise transfer any of the Property unless the purchaser, assignee or transferee thereof, at or prior to such sale, assignment or transfer, agrees in writing (x) to be bound by and comply with the terms of this Section 3 as if it were the Grantee hereunder, and (y) that Grantor is an intended beneficiary of such writing. The immediately preceding sentence shall expire and be of no further force and effect at such time as none of the following owns any portion of the Subject Property: (i) Grantor, (ii) Grantor's affiliates, (iii) any successor to all or substantially all of the business of Grantor or its affiliates, and (iv) any direct or indirect subsidiary of Wienerberger AG.

**SECTION 4. Notice.** Any notice required or permitted to be given under this Agreement shall be in writing and shall be deemed to have been given when deposited in Federal Express (or any other reputable national "next day" delivery service) or in the United States mail via registered or certified mail, postage prepaid, return receipt requested, and addressed as follows:

GRANTOR: General Shale Brick, Inc.  
3015 Bristol Highway  
Johnson City, Tennessee 37601  
Attn: Real Estate Department  
Phone: (423) 282-4661

and a copy (which shall  
not constitute notice)

to: John A. Flaherty, Esq.  
Dickstein Shapiro LLP  
One Stamford Plaza  
263 Tresser Blvd  
Stamford, CT 06902  
Phone: (203) 905-4527

GRANTEE: Green Meadows, LLC  
12601 Plantside Drive  
Louisville, KY 40299  
Phone: (502) 245-1353

and a copy (which shall  
not constitute notice)  
to:

Moore & Van Allen PLLC  
100 N. Tryon Street, Suite 4700  
Charlotte, North Carolina 28202-4003  
Attention: Henry B. Ward, III  
Phone: (704) 331-1027

Either Party may, from time to time, by notice as herein provided, designate a different address to which notices shall be sent. Rejection or other refusal to accept or inability to deliver a notice required hereunder because of a changed address of which no notice was given shall be deemed to be receipt of the notice. Grantee and Grantor agree that the counsel for the Parties may deliver notice on behalf of the Parties.

**SECTION 7. General Provisions.**

- (a) Applicable Law. This Agreement shall be governed by and construed in accordance with the substantive laws of the State of North Carolina, without giving effect to its conflict of laws provisions.
- (b) Entire Agreement. This Agreement and the Contract contain the entire understanding and agreement by and between the Parties with respect to the Use Restriction, and all prior or contemporaneous oral or written agreements regarding the Use Restriction, except for the Contract, are merged herein.
- (c) Binding Effect. This Agreement shall be binding upon and shall inure to the benefit of the Parties, and their respective heirs, successors and assigns.
- (d) Severability. If any term or provision, or any portion thereof, of this Agreement, or the application thereof to any person or circumstances shall, to any extent, be determined by a court of competent jurisdiction to be invalid or unenforceable, then the remainder of this Agreement, or the application of such term or provision to persons or circumstances, other than those as to which it is held invalid or unenforceable, shall not be affected thereby, and each term and provision of this Agreement shall be valid and be enforced to the fullest extent permitted by law.
- (e) Captions and Headings. The captions and headings throughout this Agreement are for convenience and reference only and the words set forth therein shall in no way be held to define or add to the interpretation, construction or meaning of any provision of this Agreement.
- (f) No Waiver. Failure of any Party to insist upon compliance of any provision of this Agreement shall not constitute a waiver of the rights of such Party to subsequently insist upon compliance with that provision or any other provision of this Agreement, nor in any way to affect the validity of all or any part of this Agreement.
- (g) Amendment. No amendment to this Agreement shall be effective unless made in a writing signed by the Parties, or their respective successors and assigns, and recorded on the Lee County Registry.

[The remainder of this page is intentionally left blank; signatures begin on the following page.]

IN WITNESS WHEREOF, Grantor and Grantee have duly executed this Agreement as of the day and year first above written.

GENERAL SHALE BRICK, INC.,  
a Delaware corporation

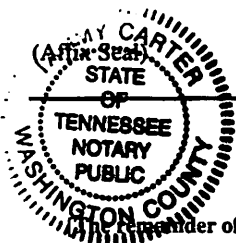
By: Kevin H. Ham  
Kevin H. Ham, Vice President

State of Tennessee - County of Washington

I, the undersigned Notary Public of the County of Washington and State aforesaid, certify that Kevin H. Ham personally came before me this day and acknowledged that he is the Vice President of General Shale Brick, Inc., a Delaware corporation, and that by authority duly given and as the act of such entity, he signed the foregoing instrument in its name on its behalf as its act and deed. Witness my hand and Notarial stamp or seal, this 5 day of November, 2014.

My Commission Expires:  
6-29-2016

Tammy Carter  
Tammy Carter, Notary Public  
Notary's Printed or Typed Name



[The remainder of this page is intentionally left blank; Grantee's signature is on the following page.]

GREEN MEADOW, LLC,  
a North Carolina limited liability company

By: Charah, Inc., its Member/Manager

By: Charles E Price

Print Name: Charles E. Price

Title: President & CEO

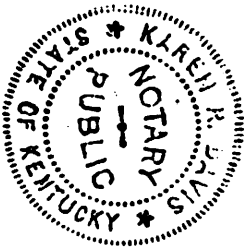
State of Kentucky - County of Johnson

I, the undersigned Notary Public of the County of Johnson and State aforesaid, certify that Charles E. Price personally came before me this day and acknowledged that he is the President & CEO of Charah, Inc., the Member/Manager of Green Meadow, LLC, a North Carolina limited liability company, and that by authority duly given and as the act of such entity, he signed the foregoing instrument in its name on its behalf as its act and deed. Witness my hand and Notarial stamp or seal, this 23 day of November, 2014.

My Commission Expires:  
8-1-2017

Karen R Davis  
KAREN R DAVIS, Notary Public  
Notary's Printed or Typed Name

(Affix Seal)



# B

## Calculations

Stormwater Management System  
Sediment Basins #1 and #2

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## 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 area is within the Flow Path 1 and 3 areas.  
 Use a Time of Concentration of 10-Minutes

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## 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	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 sloop 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

$$Z_{av} = AR^{2/3}$$

$$Z_{req} = Q n / 1.49s^{0.5}$$

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

$$Q \text{ (cfs)} = CIA$$

$$\text{Area (A)} = bd + z d^2$$

$$R = \text{Area} / (b + 2d(z^2 + 1)^{0.5})$$

$$\text{Avg Shear Stress (T)} = d * s * \text{unit weight of water}$$

$$Z_{av} = Z_{req}$$

### 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		Vp (ft/sec)	Allowable Shear Stress (psf)
		depths of 0-0.5 ft	depths of 0.5-2.0 ft		
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

Node	Drainage Area (acres)	elev 2	elev 1	length (ft)	Channel Side Slope			Bottom Width, b (ft)
					Channel Slope	Inside (X:1)	Outside (X:1)	
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 <sub>req</sub>	Flow	Cross	R	Z <sub>av</sub>	Avg Shear		Comment
					Depth	Sectional			Velocity	Stress	
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 <sub>req</sub>	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z <sub>av</sub>	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 <sub>req</sub>	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z <sub>av</sub>	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

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

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## HDR Computation

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

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

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

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

$$Q \text{ (cfs)} = CIA$$

$$Z_{av} = Z_{req}$$

### 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		Vp (ft/sec)	Allowable Shear Stress (psf)
		depths of 0-0.5	depths of 0.5-		
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



## 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 - 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 Location	Drainage Area (acres)	Channel Side Slope		Bottom Width, b (ft)						
		Channel Slope	Inside (X:1)	Outside (X:1)						
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 <sub>req</sub>	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z <sub>av</sub>	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 <sub>req</sub>	Flow Depth d (ft)	Cross Sectional Area (sf)	R	Z <sub>av</sub>	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	Outside Channel	Bottom Width, b	Slope	Depth	Top Width
	(X:1)	(X:1)	(ft)	(%)	(ft)	(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 tmeprorary condnion 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 established.

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:

$$Q \text{ (cfs)} = CIA$$

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

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

## 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)

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

Q (cfs) = Discharge

0.60 = C<sub>d</sub> Coefficient of Discharge (dimensionless)

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

32.2 = Acceleration of Gravity g (ft/sec<sup>2</sup>)

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

## Conclusion:

Use 18" corrugated plastic pipe (smooth wall)

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# HDR Computation

Job No. 453925-235691-018

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<sup>2</sup>, gravity  
 $h =$  ft, driving head measured from the center of the pipe  
 $A =$  sf, cross sectional open area

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

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

## Check for inlet control

Channel Location	Perimeter Channel		Slope Drain Flow (cfs)	Total Flow (cfs)	Grate	Open Area (sf)	Required head(ft)	
	Side 1	Side 2						
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	Minimal 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

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 - Apron Outlets	Sheet	1	of:	1

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

### References:

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

$$Z_{av} = AR^{2/3}$$

$$Z_{req} = Q n / 1.49s^{0.5}$$

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

$$Z_{av} = Z_{req}$$

$$\text{Area (A)} = bd + z d^2$$

$$R = \text{Area} / (b + 2d(z^2 + 1)^{0.5})$$

$$\text{Avg Shear Stress (T)} = d * s * \text{unit weight of water}$$

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 calculation.  
For the Perm Rd North, the flow is doubles since there are 2 pipes.

$$0.5 * \text{Barrel Diameter (ft)} = 1.25$$

Ref 2, 8.06.1

$$0.5 * \text{Barrel Diameter (ft)} = 1.50$$

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 <sub>req</sub>	Flow Depth, d (ft)	Cross Sectional Area (sf)	R (ft)	Z <sub>av</sub>	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

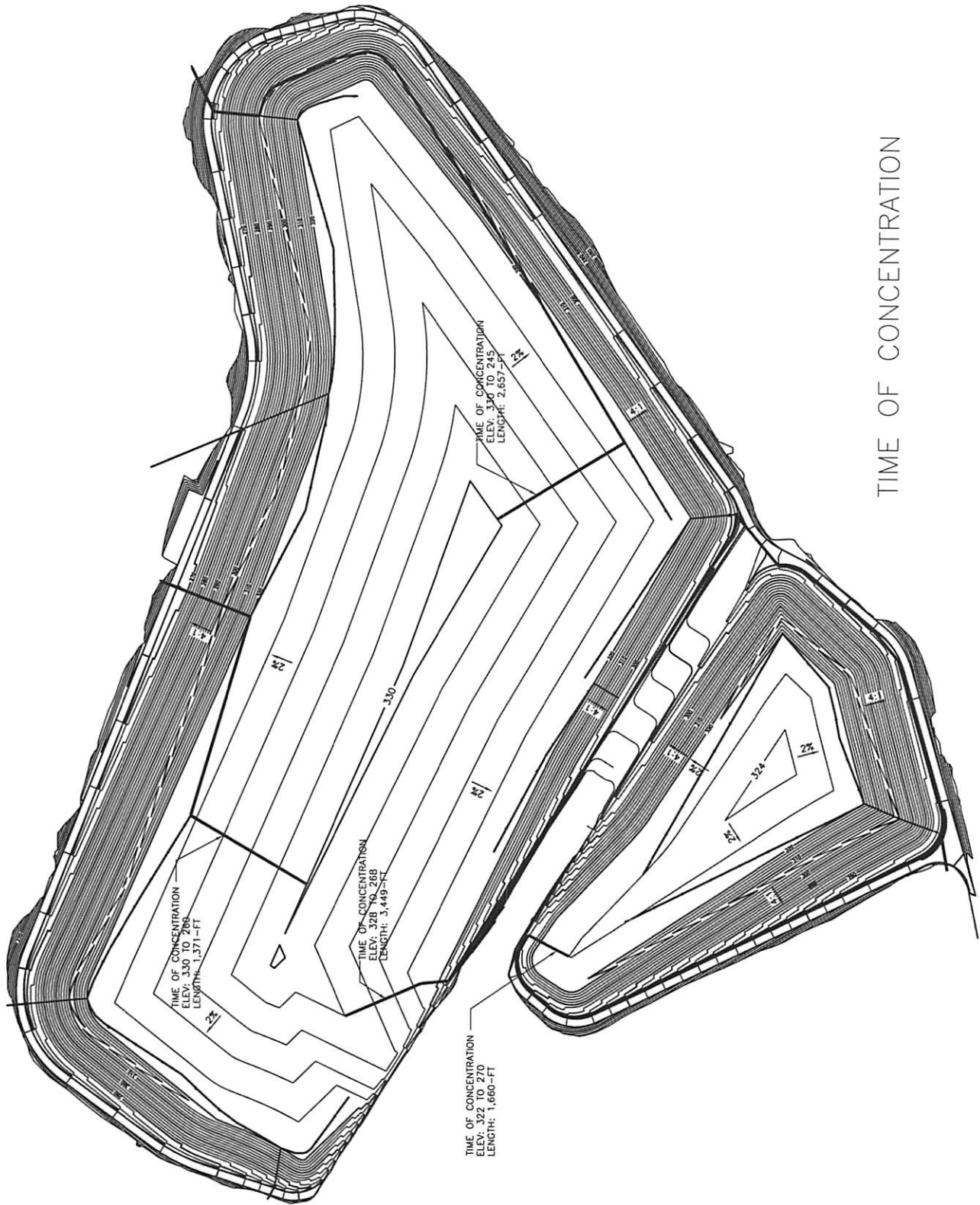
Size the aprons for each pipe using Ref 2:

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 <sub>50</sub>	Selected Rip Rap Size (in)
2.5	7.5	16	19	0.5	Class B
3	9	20	23	0.5	Class B

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TIME OF CONCENTRATION

TIME OF CONCENTRATION  
ELEV: 330 TO 288  
LENGTH: 1,371-FT

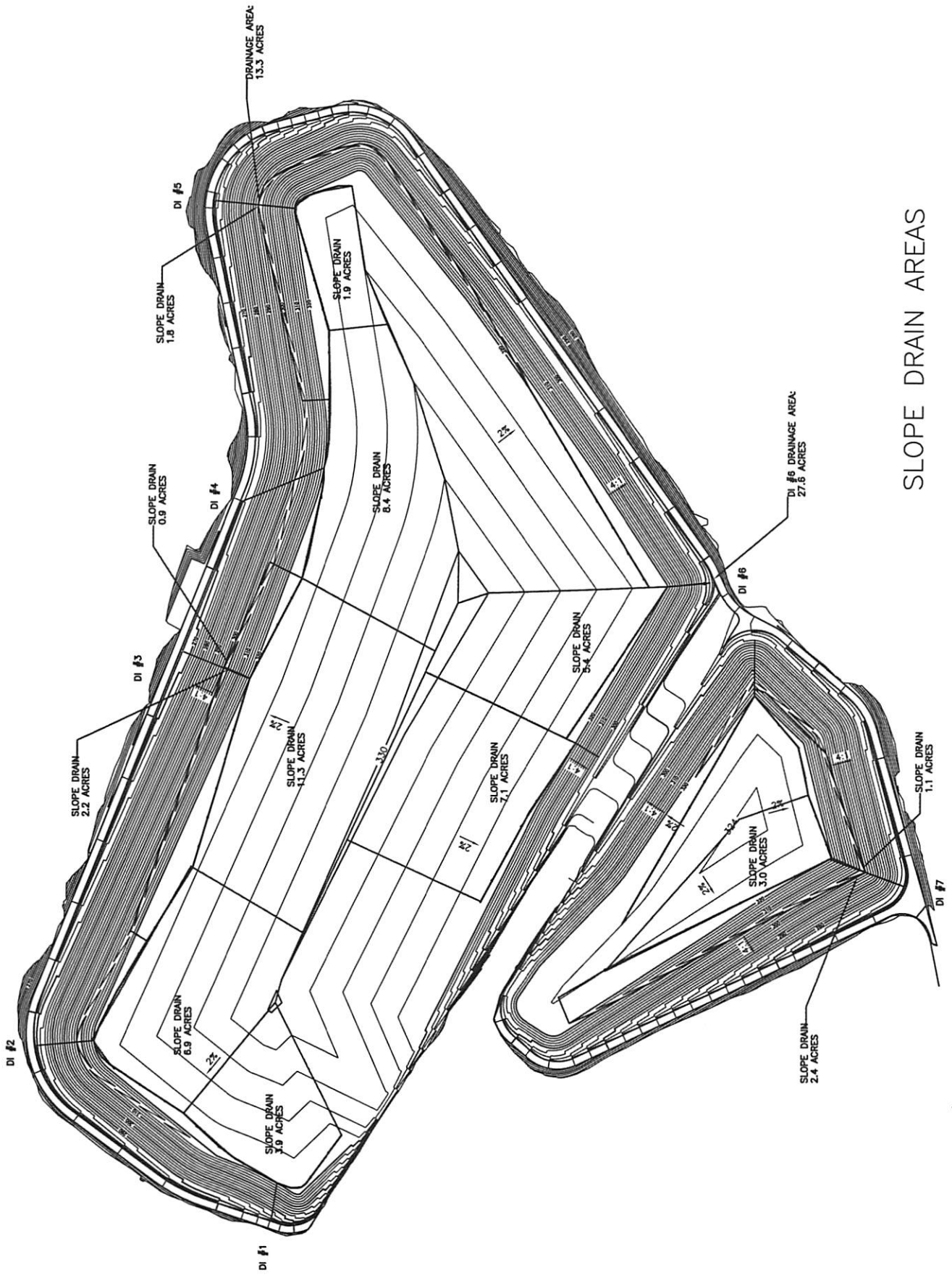
TIME OF CONCENTRATION  
ELEV: 328 TO 288  
LENGTH: 3,449-FT

TIME OF CONCENTRATION  
ELEV: 322 TO 270  
LENGTH: 1,660-FT

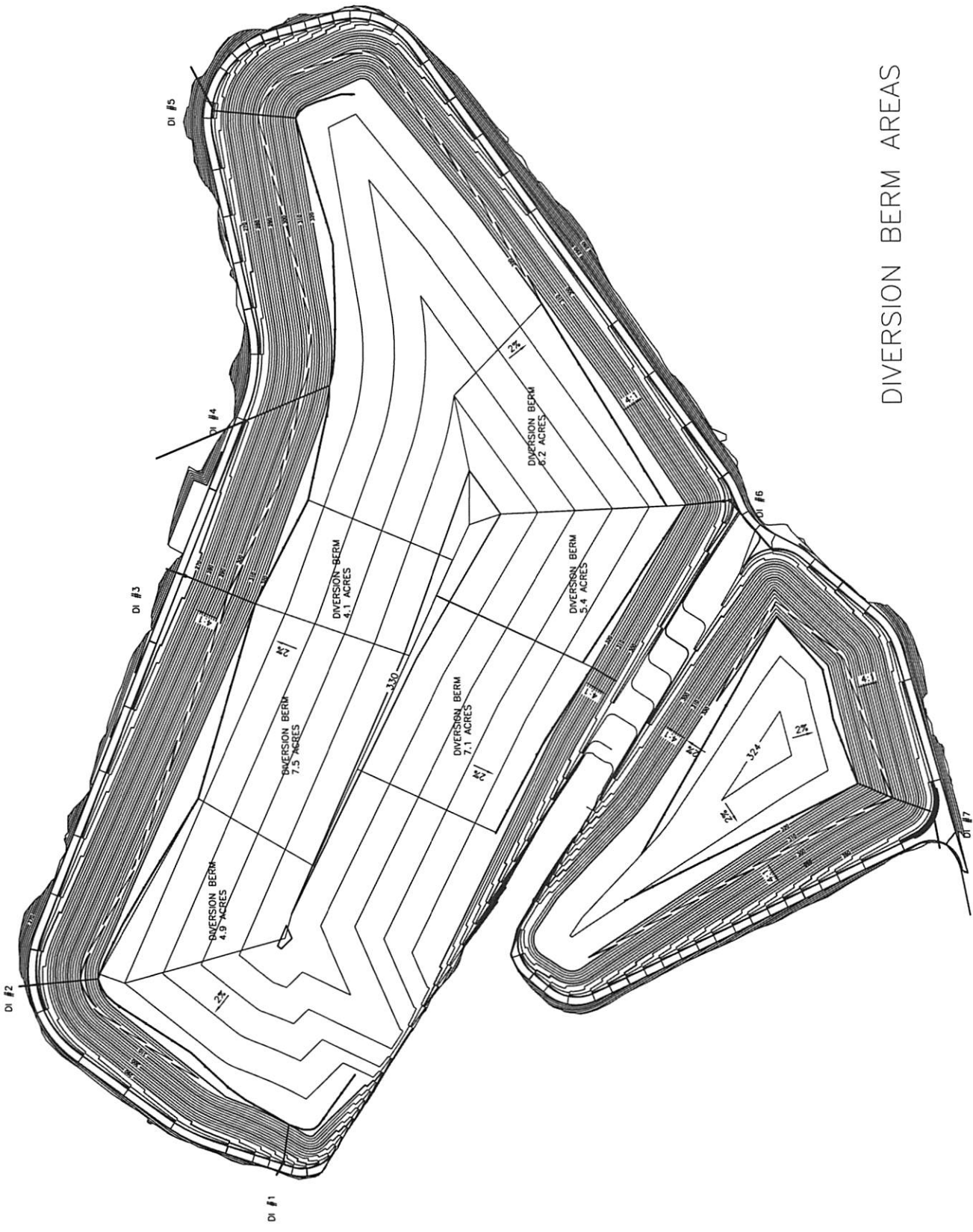
TIME OF CONCENTRATION  
ELEV: 330 TO 245  
LENGTH: 2,657-FT







## SLOPE DRAIN AREAS



DIVERSION BERM AREAS



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



## POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) <sup>1</sup>										
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 (0.236-0.285)	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)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).  
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.  
Please refer to NOAA Atlas 14 document for more information.

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### PF graphical

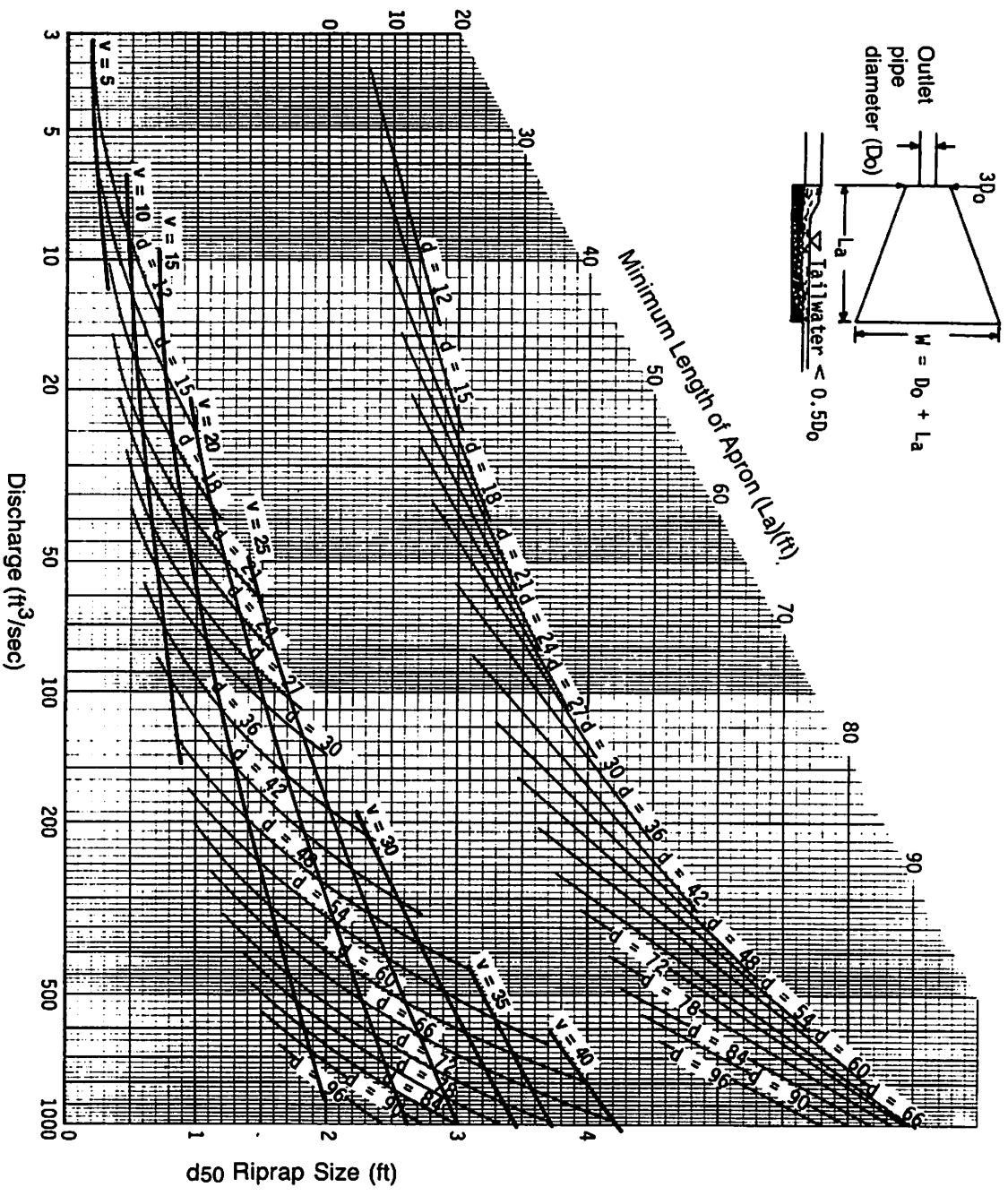
**Table 8.03b**  
**Value of Runoff Coefficient**  
**(C) for Rational Formula**

Land Use	C	Land Use	C
Business:		Lawns:	
Downtown areas	0.70-0.95	Sandy soil, flat, 2%	0.05-0.10
Neighborhood areas	0.50-0.70	Sandy soil, ave., 2-7%	0.10-0.15
Residential:			0.15-0.20
Single-family areas	0.30-0.50	Sandy soil, steep, 7%	0.13-0.17
Multi units, detached	0.40-0.60		0.18-0.22
Multi units, Attached	0.60-0.75	Heavy soil, flat, 2%	0.25-0.35
Suburban	0.25-0.40	Heavy soil, ave., 2-7%	
Industrial:		Heavy soil, steep, 7%	0.30-0.60
Light areas	0.50-0.80		0.20-0.50
Heavy areas	0.60-0.90	Agricultural land:	
Parks, cemeteries	0.10-0.25	Bare packed soil	0.30-0.60
Playgrounds	0.20-0.35	Smooth	0.20-0.50
Railroad yard areas	0.20-0.40	Rough	0.20-0.40
Unimproved areas	0.10-0.30	Cultivated rows	0.10-0.25
Streets:		Heavy soil no crop	
Asphalt	0.70-0.95	Heavy soil with crop	0.15-0.45
Concrete	0.80-0.95		0.05-0.25
Brick	0.70-0.85	Sandy soil no crop	0.05-0.25
Drives and walks	0.75-0.85	Sandy soil with crop	0.10-0.25
Roofs	0.75-0.85	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 from a round pipe flowing full, minimum tailwater condition ( $T_w < 0.5$  diameter).

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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 <sub>p</sub> (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 greater 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.

$$S = (1000/CN) - 10$$

$$\text{Runoff Depth } Q^* \text{ (inches)} = (P - 0.2S)^2 / (P + 0.8S)$$

$$T_p \text{ (min)} = 60.5(Q^*)A/Q_p/1.39$$

Ref 2, III-4

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 <sub>p</sub> (min) =	26.67	35.03	35.39	35.90

**Determine Pond Storage Elevation (Z<sub>Water</sub>):**

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

$$Z_1 \text{ (ft)} = 3 \quad S_1 \text{ (cf)} = 48,894$$

$$Z_2 \text{ (ft)} = 6 \quad S_2 \text{ (cf)} = 116,680$$

$$b = \ln(S_2/S_1)/\ln(Z_2/Z_1) = 1.3$$

$$K_S = S_2/Z_2^b = 12,318$$

Ref 2, III-8

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 ( $\nu$ ) =	$1.14E-06$ $m^2 / sec @ 20^\circ C$	Ref 2, IV-11
Diameter of the Design Particle $d_{15}$ =	$40.00E-06$ m	

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

**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
$V_p$ (ft/sec) = 5.0	Permissible Velocity for lining
Allowable Shear Stress (psf) = 2.0	Allowable Shear Stress for lining
Bottom Width, b (ft) = 20	

Calculate Required Depth of Spillway:

Normal-Depth Procedure

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

$$Z_{req} = Qn / 1.49s^{0.5}$$

$$Z_{av} = AR^{2/3}$$

$$Q = VA$$

$$\text{Area (A)} = bd + z(d^2)$$

$$R = \text{Area} / (b + 2d((z^2 + 1)^{0.5}))$$

$$\text{Avg Shear Stress (T)} = K_b * d * s * \text{unit weight of water}$$

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

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	$\text{Pi} * (D_R/24)^2 * \text{Total Ht of Riser}$
Convert cf to cy =	$27^{-1}$	
Min Concrete Needed (cy) =	2.69	
Width & Length (ft) =	5.5	
Thickness (ft) =	2.4	

**Anti-Vortex Device:**

Diameter of Riser (in) =	54	From Hydrograph
Cylinder Diameter (in) =	78	
Cylinder Thickness (gage) =	16	
Cylinder Height (in) =	25	

Ref 3, III-104, Table 3.14-D

**Determine Tailwater conditions to size outlet apron**

Use Normal Depth Procedure (Manning's Eqn.)

Ref 2, II-7

$$A * R^{2/3} = Q * n / 1.49 s^{0.5}$$

$$Z_{\text{req}} = Q * n / 1.49 s^{0.5}$$

$$\text{Area (A)} = bd + z(d^2)$$

$$R = \text{Area} / (b + 2d((z^2) + 1)^{0.5})$$

$$Z_{\text{av}} = A * R^{2/3}$$

n =	0.069	6-inch diameter Rip Rap, Lined Channel
V <sub>p</sub> (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 <sub>B</sub> (cfs) =	10.0	Peak Flow out of the barrel 25-yr Hydrograph

Flow Depth						
Q (cfs)	Z <sub>req</sub>	d (ft)	A (sf)	R (ft)	Z <sub>av</sub>	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 &lt; 0.5 \* Diameter of Outlet Pipe

Maximum Tailwater Conditions: d &gt; 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 <sub>50</sub>	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.

# 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 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<sup>2</sup>, gravity

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

	Perforations					Skimmer	# of skimmers
Row	1	2	3	4	5	1	
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			0.11	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



$Q_p =$  32.86 cfs  
 $t_p =$  26.67 minutes  
 $dT =$  Max of 2 minutes  
 or 1.0% of increment to peak

## Sediment Basin # 1

### Phase 1

### 10 - year Storm Event

Colon

$b =$  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:

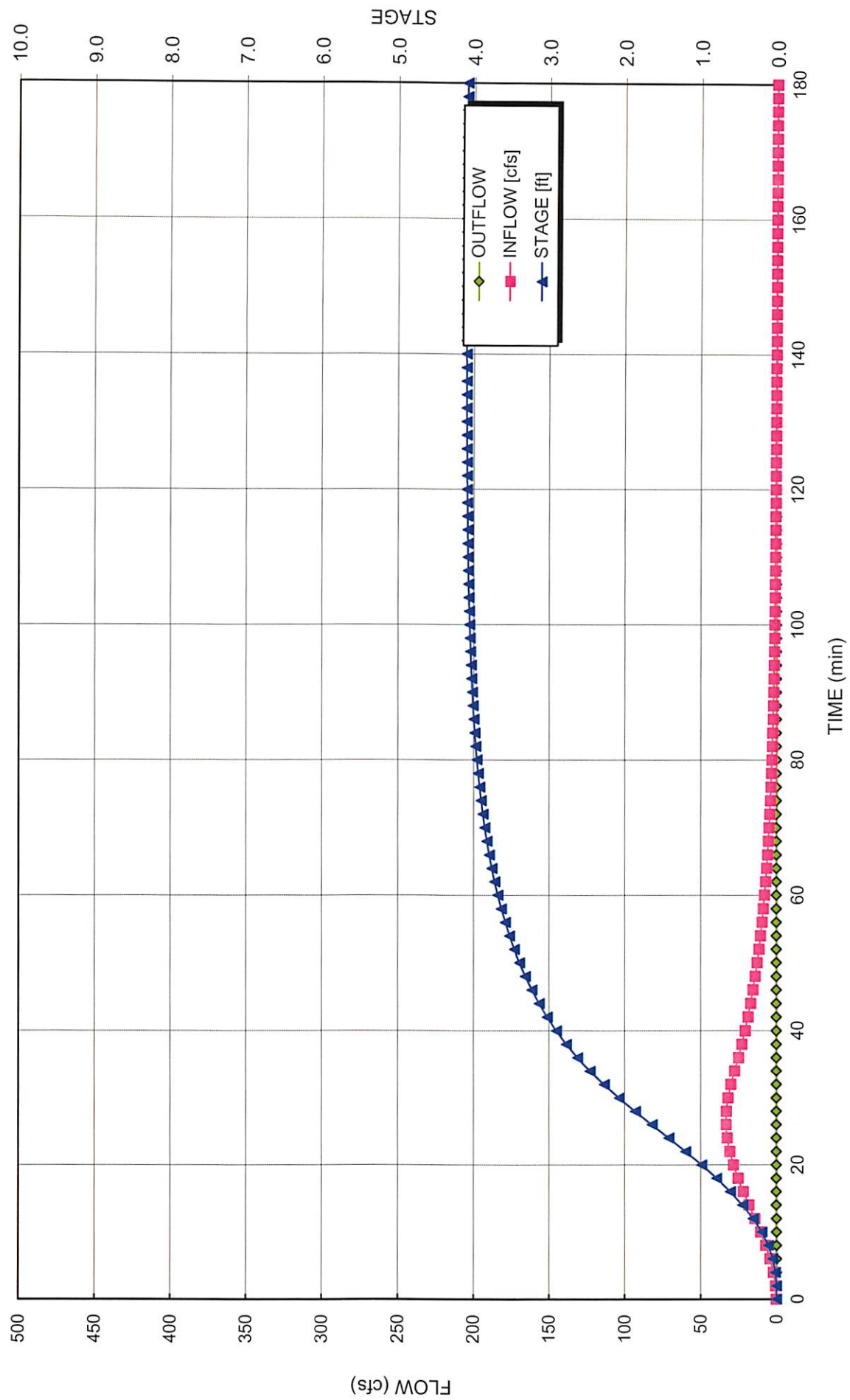
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimate d 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





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

## Sediment Basin # 1 Colon

Phase 2  
 10 - year Storm Event

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

b = 1.3  
 Ks = 12,318

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:

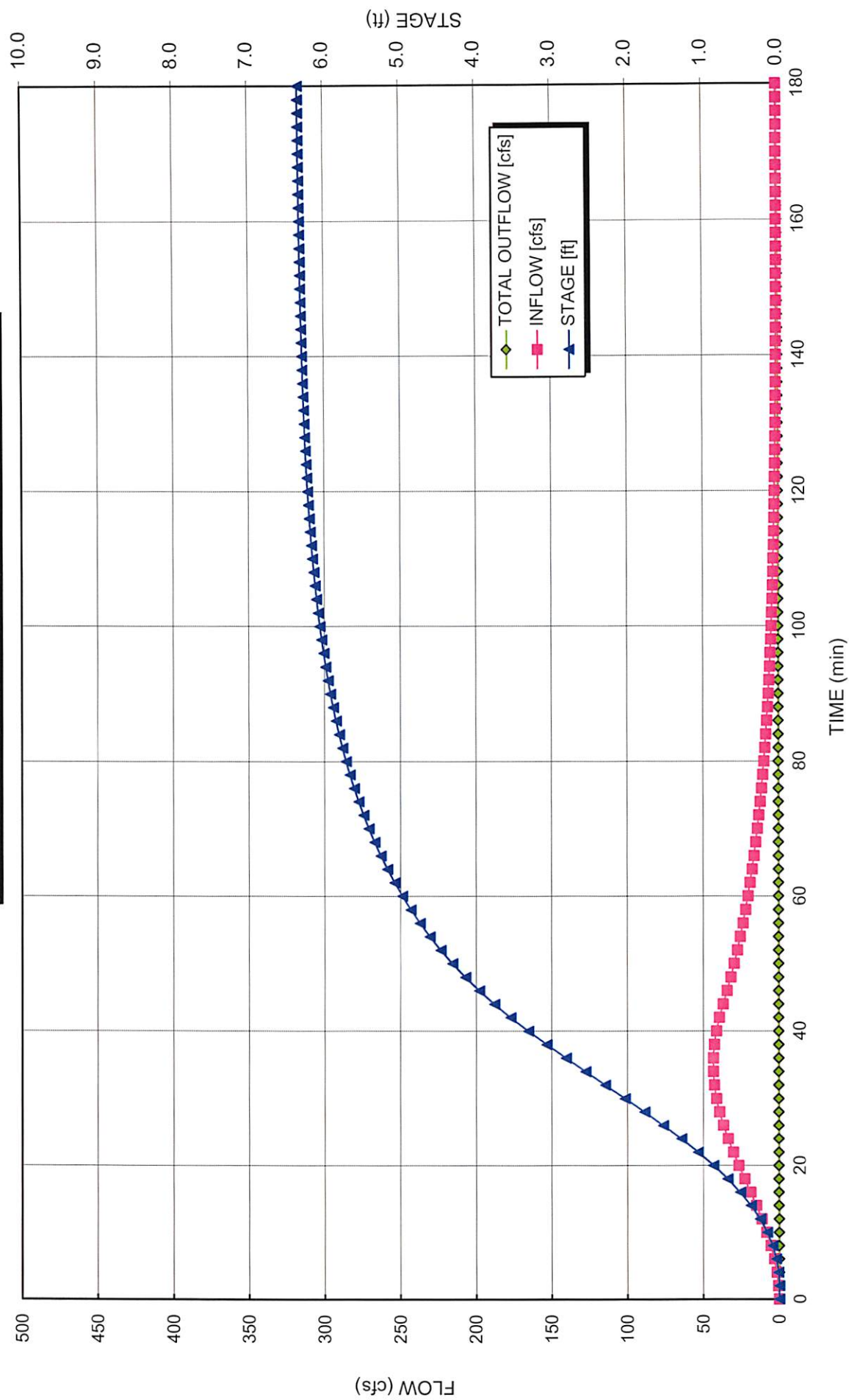
- Length of emergency spillway is the bottom width of the emergency spillway.
- Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACIT Y [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**





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

# Sediment Basin # 1

## Colon

Phase 2  
 25 - year Storm Event

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

b = 1.3  
 Ks = 12,318

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:

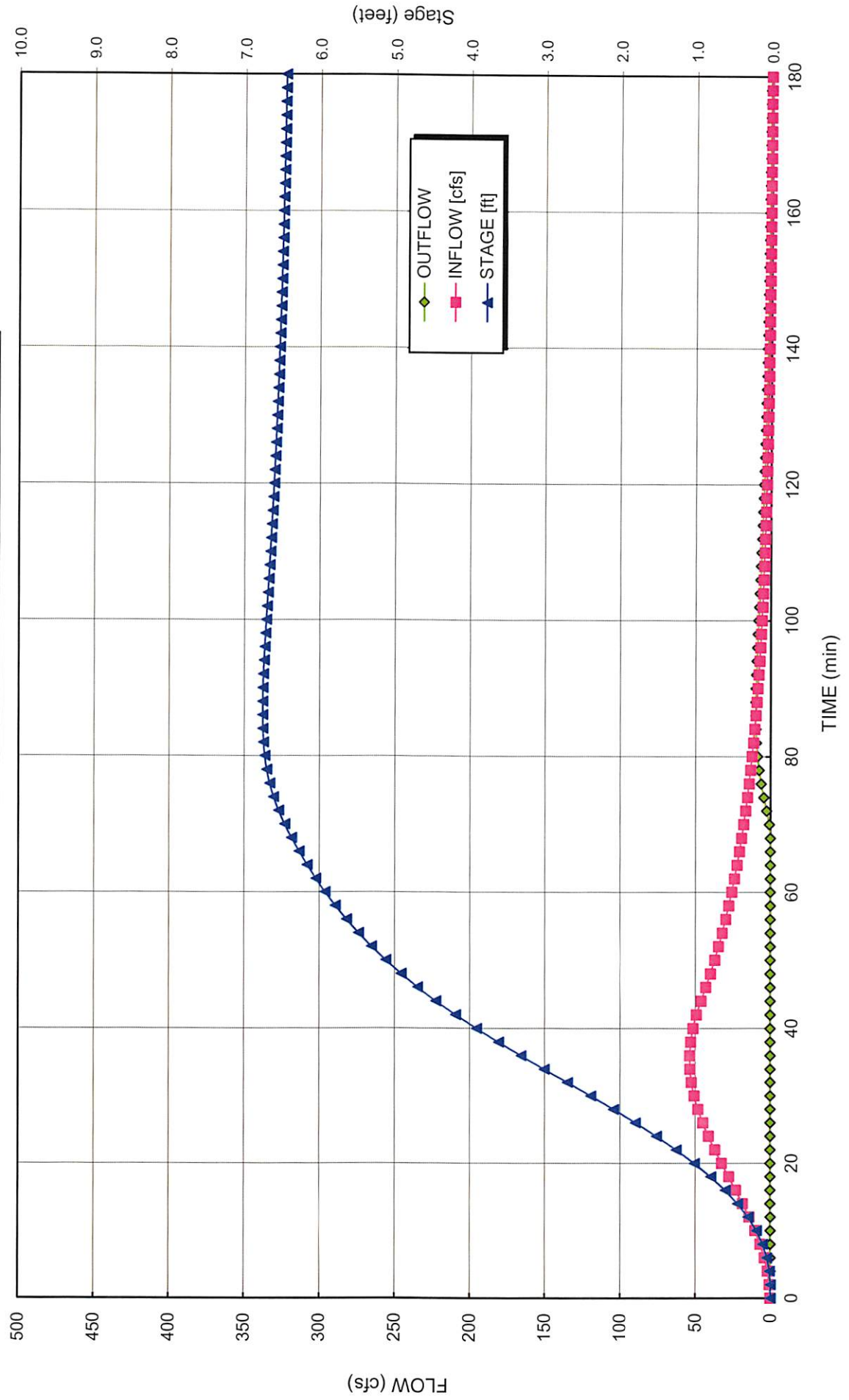
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFL OW [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





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

# Sediment Basin # 1

## Colon

### Phase 2

### 100 - year Storm Event

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:

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

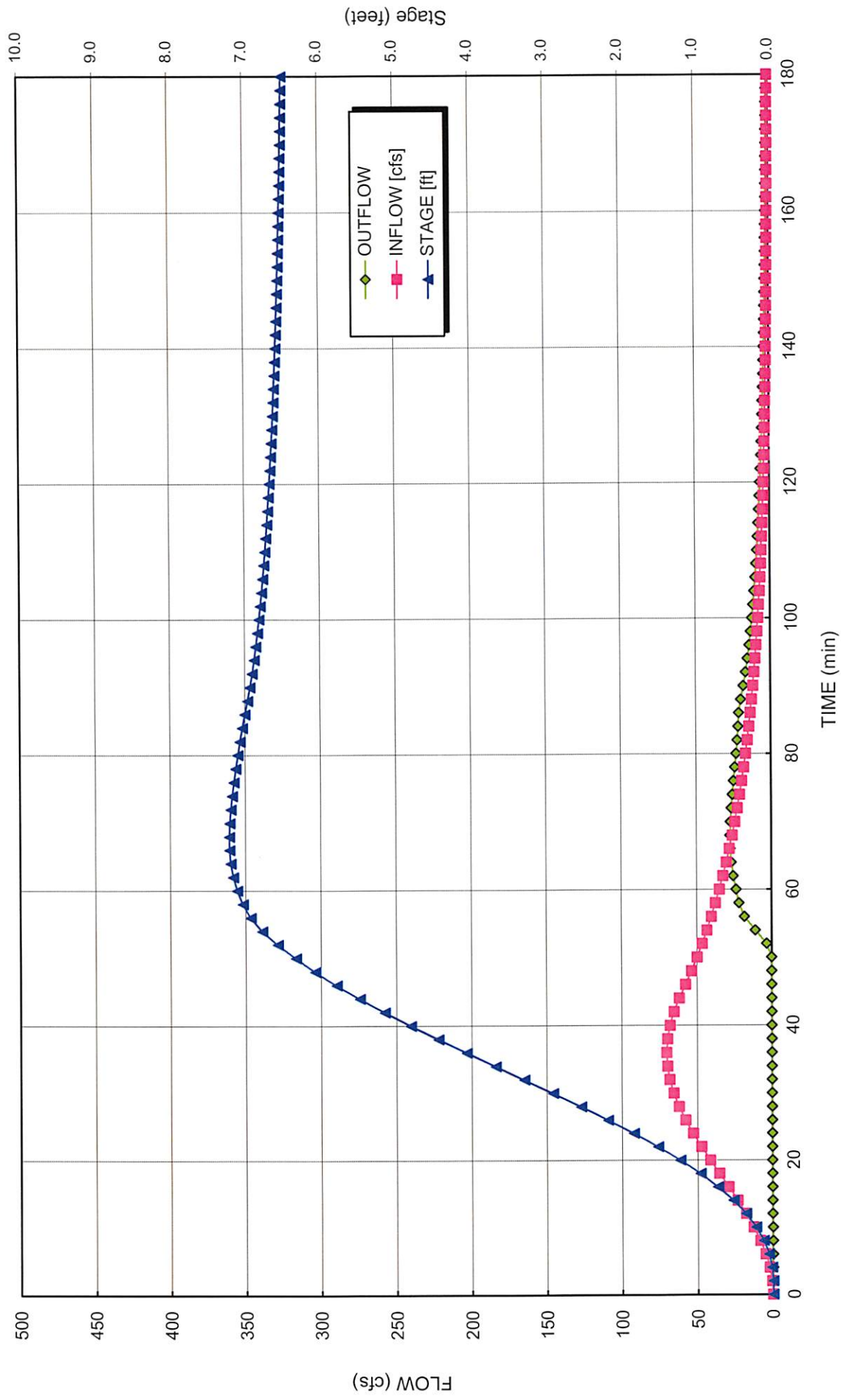
TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFLOW [cfs]	Bound Discharge [cfs]	Estimated Surface Area (sf)	Settling Efficiency [%]
0	0.0	0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	-	N/A
2	0.5	0	0.0	0.00	0.00	0.00	0.00	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**



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 greater 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
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**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.

$$S = (1000/CN) - 10$$

$$\text{Runoff Depth } Q^* \text{ (inches)} = (P - 0.2S)^2 / (P + 0.8S)$$

$$T_p \text{ (min)} = 60.5(Q^*)A/Q_p/1.39$$

Ref 2, III-4

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 <sub>p</sub> (min) =	28.19	30.89	31.23	31.71

**Determine Pond Storage Elevation (Z<sub>Water</sub>):**

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

$$Z_1 \text{ (ft)} = 3 \quad S_1 \text{ (cf)} = 127,573$$

$$Z_2 \text{ (ft)} = 6 \quad S_2 \text{ (cf)} = 284,617$$

$$b = \ln(S_2/S_1) / \ln(Z_2/Z_1) = 1.2$$

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

Ref 2, III-8

Project:	Charah Colon Mine	Computed:	EAW	Date:	1/4/15
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**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 ( $\nu$ ) =	$1.14E-06$ $m^2/sec$ @ $20^\circ C$	Ref 2, IV-11
Diameter of the Design Particle $d_{15}$ =	$40.00E-06$ m	

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

**Route the Storm through the Basin using the Hydrograph Model**

Set Height of Emergency Spillway at (ft) = 6.00	See Hydrograph
Set Top of Dam at (ft) = 7.00	

**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
$V_p$ (ft/sec) = 5.0	Permissible Velocity for lining
Allowable Shear Stress (psf) = 2.0	Allowable Shear Stress for lining
Bottom Width, b (ft) = 15	

Calculate Required Depth of Spillway:

Normal-Depth Procedure

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

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

$$Z_{av} = AR^{2/3} \quad R = \text{Area} / (b + 2d((z^2 + 1)^{0.5}))$$

$$\text{Avg Shear Stress (T)} = K_b * d * s * \text{unit weight of water}$$

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

$$A * R^{2/3} = Q * n / 1.49 s^{0.5}$$

$$Z_{\text{req}} = Q * n / 1.49 s^{0.5}$$

$$\text{Area (A)} = bd + z(d^2)$$

$$R = \text{Area} / (b + 2d((z^2) + 1)^{0.5})$$

$$Z_{\text{av}} = A * R^{2/3}$$

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 <sub>B</sub> (cfs) =	3.8	Peak Flow out of the barrel 25-yr Hydrograph

Flow Depth						
Q (cfs)	Z <sub>req</sub>	d (ft)	A (sf)	R (ft)	Z <sub>av</sub>	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 &lt; 0.5 \* Diameter of Outlet Pipe

Maximum Tailwater Conditions: d &gt; 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 <sub>50</sub>	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

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 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<sup>2</sup>, gravity

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

	Perforations					Skimmer	# of skimmers
Row	1	2	3	4	5	2	
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



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

## Sediment Basin # 2 Colon

Phase 1  
 10 - year Storm Event

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

b = 1.2  
 K<sub>s</sub> = 35,760

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:

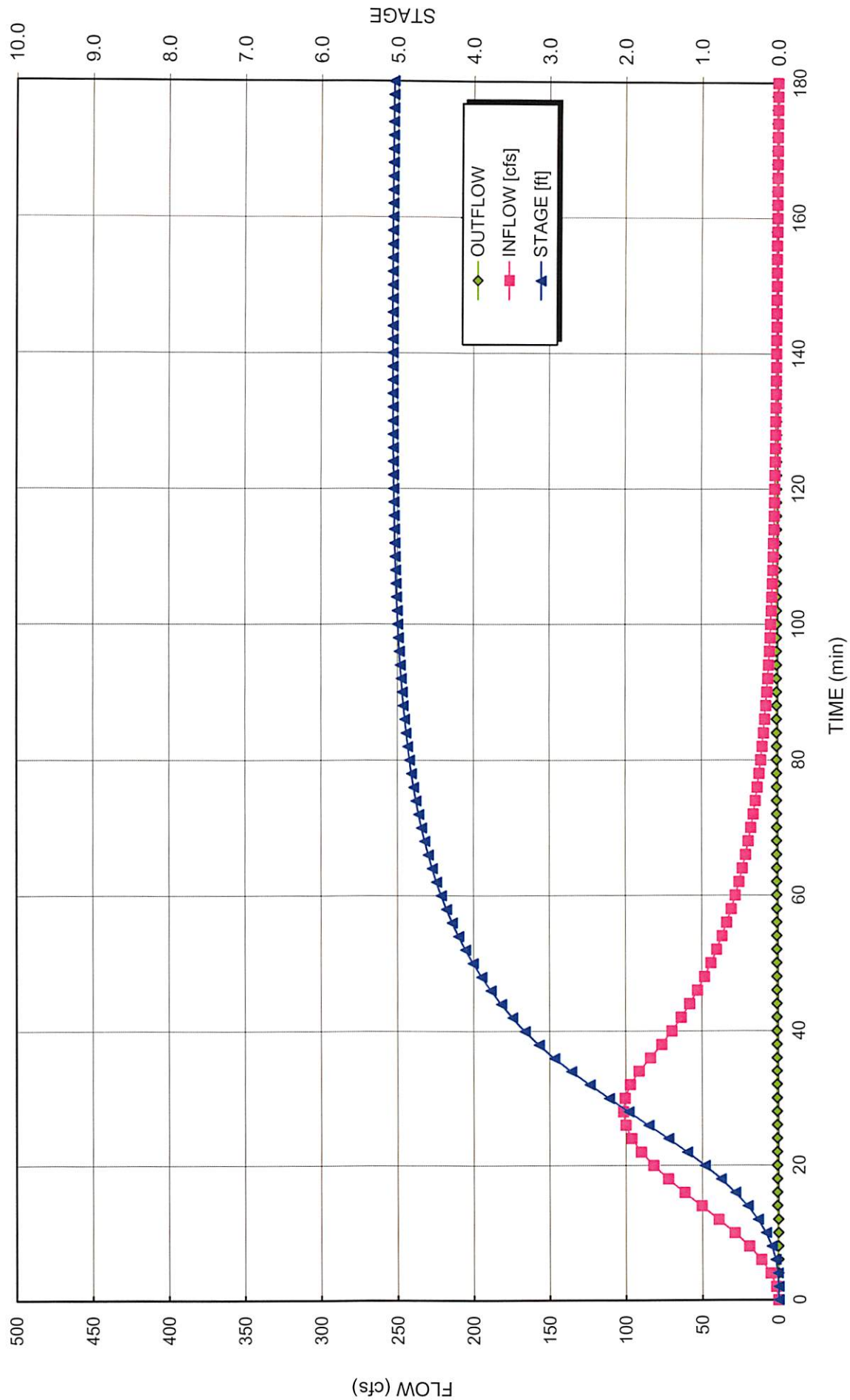
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER 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	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





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

## Sediment Basin # 2

### Phase 2

### 10 - year Storm Event

Colon

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:

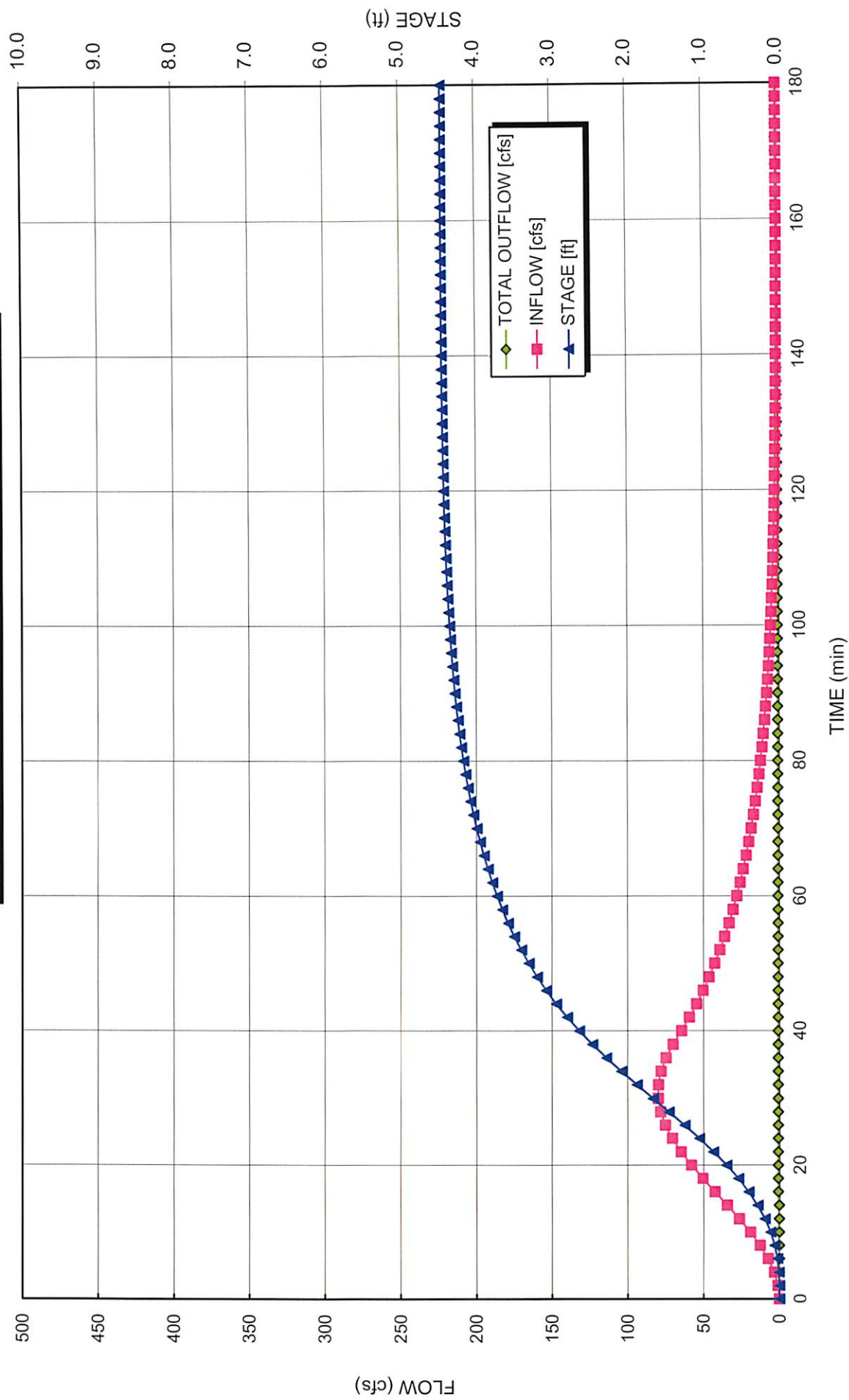
- Length of emergency spillway is the bottom width of the emergency spillway.
- Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACIT Y [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**





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

## Sediment Basin # 2

### Phase 2

### 25 - 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 = 6.0 (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

5.3 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:

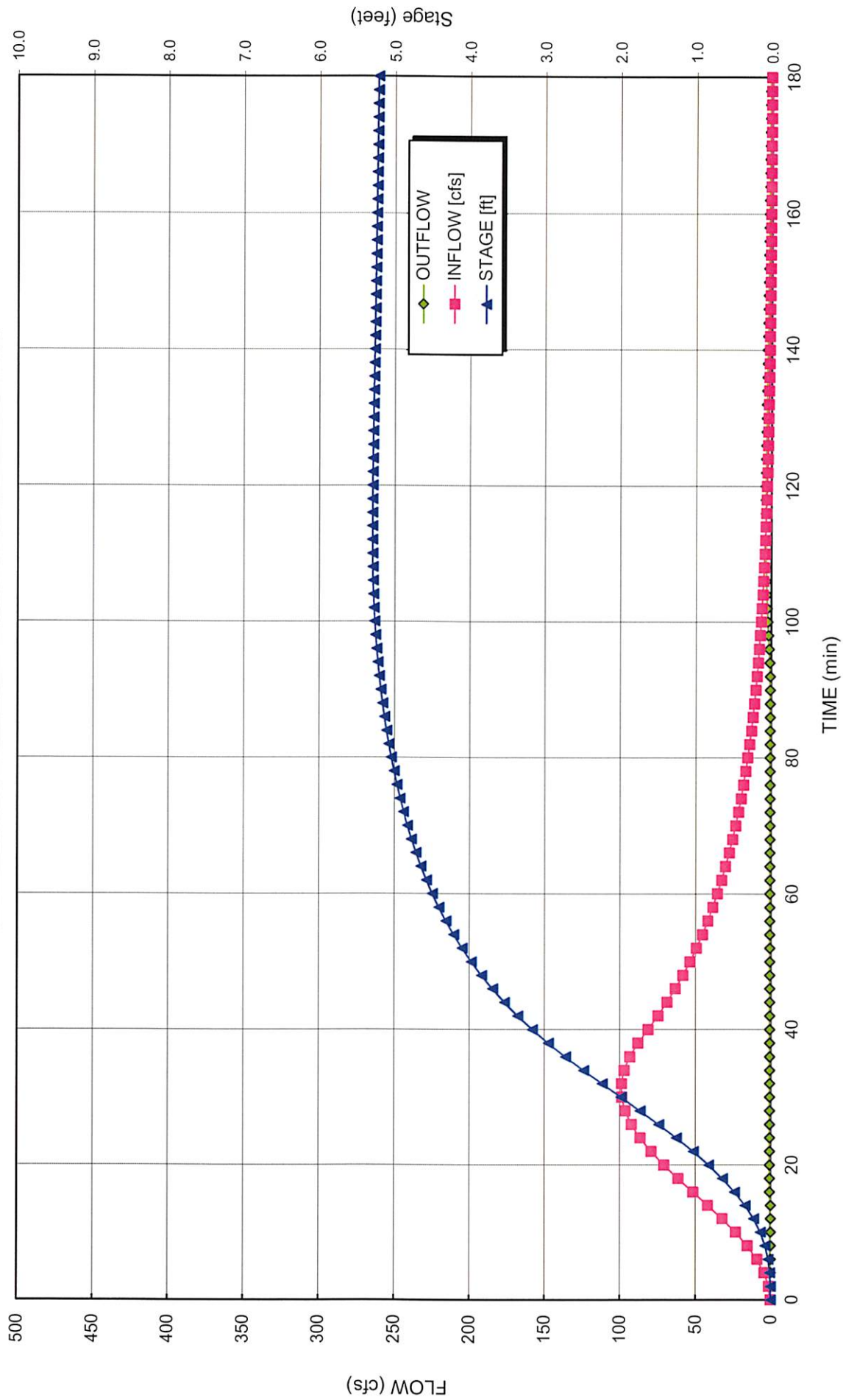
- Length of emergency spillway is the bottom width of the emergency spillway.
- Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER CAPACIT Y [cfs]	WEIR FLOW [cfs]	BARREL CAPACITY [cfs]	TOTAL OUTFL OW [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





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

## Sediment Basin # 2

### Phase 2

### 100 - 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 = 6.0 (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:

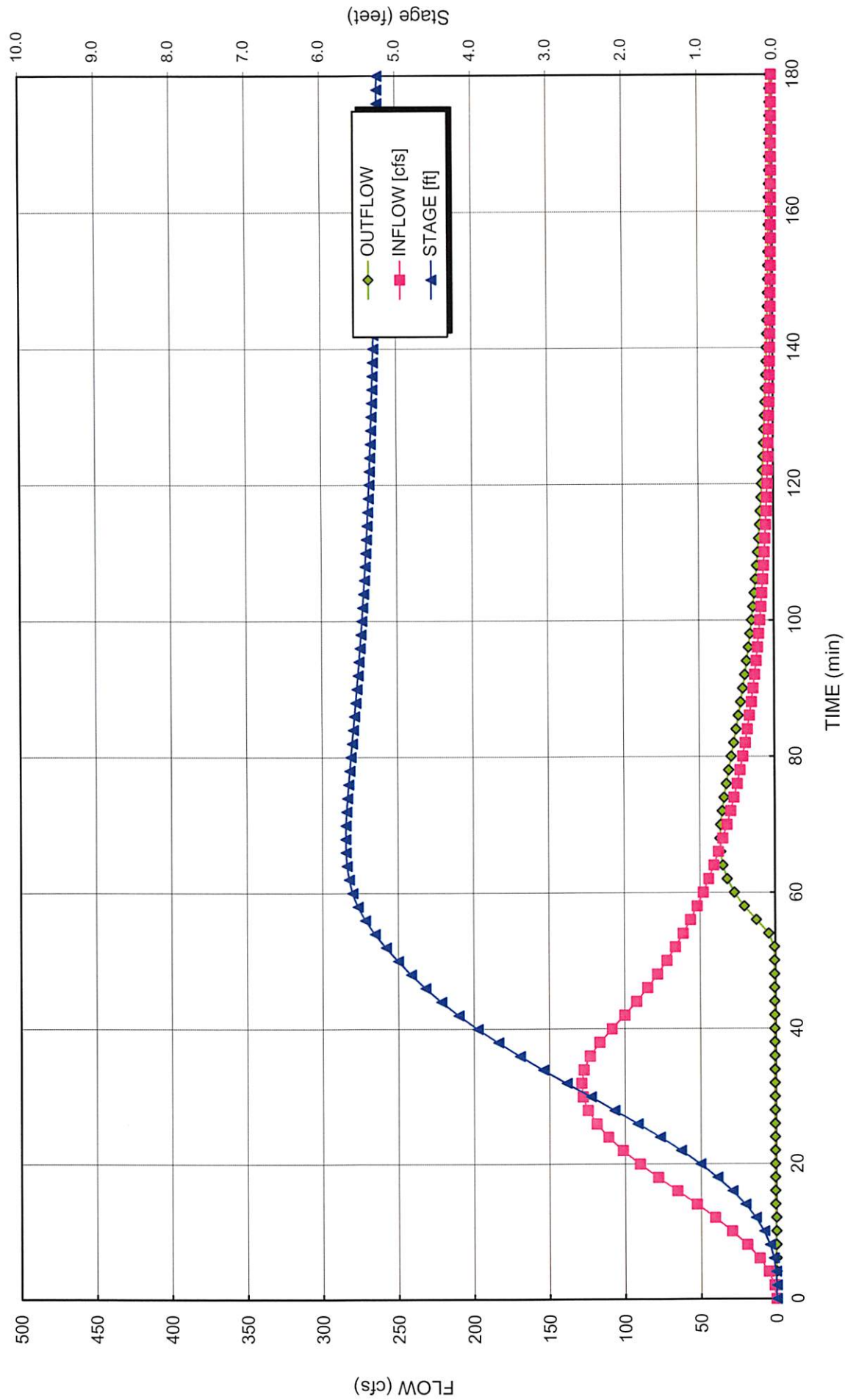
1. Length of emergency spillway is the bottom width of the emergency spillway.
2. Settling efficiency neglects permanent pond volume

TIME (min)	INFLOW [cfs]	STORAGE [cu ft]	STAGE [ft]	Skimmer Flow [cfs]	RISER 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	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%



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



# 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 strgs 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
<del>3</del>	<del>SCS Runoff</del>	<del>20.67</del>	<del>2</del>	<del>716</del>	<del>44,737</del>				<del>BASIN #3</del>
<del>4</del>	<del>SCS Runoff</del>	<del>77.74</del>	<del>2</del>	<del>718</del>	<del>186,273</del>				<del>BASIN #4</del>
<del>5</del>	<del>SCS Runoff</del>	<del>301.78</del>	<del>2</del>	<del>718</del>	<del>723,090</del>				<del>BASIN #5</del>
<del>6</del>	<del>SCS Runoff</del>	<del>93.66</del>	<del>2</del>	<del>718</del>	<del>224,201</del>				<del>BASIN #6</del>
<del>7</del>	<del>SCS Runoff</del>	<del>86.60</del>	<del>2</del>	<del>718</del>	<del>107,020</del>				<del>BASIN #7</del>
<del>8</del>	<del>SCS Runoff</del>	<del>71.25</del>	<del>2</del>	<del>716</del>	<del>149,115</del>				<del>BASIN #8</del>
<del>9</del>	<del>SCS Runoff</del>	<del>145.70</del>	<del>2</del>	<del>728</del>	<del>541,646</del>				<del>BASIN #9</del>
<div>Note: Sediment Basins with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and are not included here.</div>									
Basins-Phase 1.gpw					Return Period: 10 Year			Friday, 10 / 31 / 2014	



# Hydrograph Report

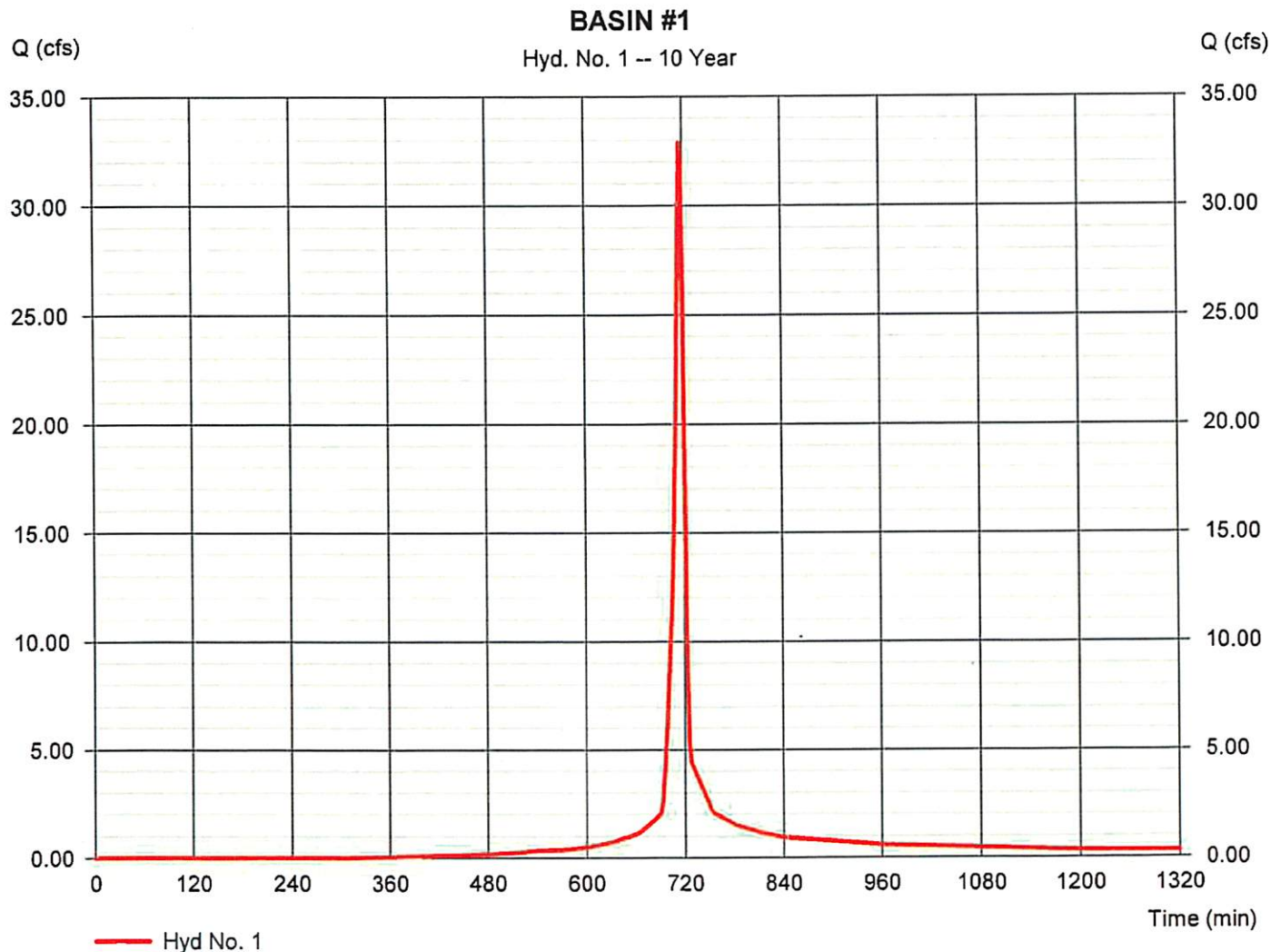
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Friday, 10 / 31 / 2014

## 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) =  $[(5.420 \times 86)] / 5.420$ 

# TR55 Tc Worksheet

Colon Mine Phase 1

4

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

## Hyd. No. 1

BASIN #1

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
<b>Sheet Flow</b>							
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				
<b>Travel Time (min)</b>	<b>= 3.83</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>3.83</b>
<b>Shallow Concentrated Flow</b>							
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				
<b>Travel Time (min)</b>	<b>= 1.07</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>1.07</b>
<b>Channel Flow</b>							
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)	345.6	0.0	0.0				
<b>Travel Time (min)</b>	<b>= 0.63</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>0.63</b>
<b>Total Travel Time, Tc .....</b>					<b>5.50 min</b>		

# Hydrograph Report

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

Friday, 10 / 31 / 2014

## Hyd. No. 2

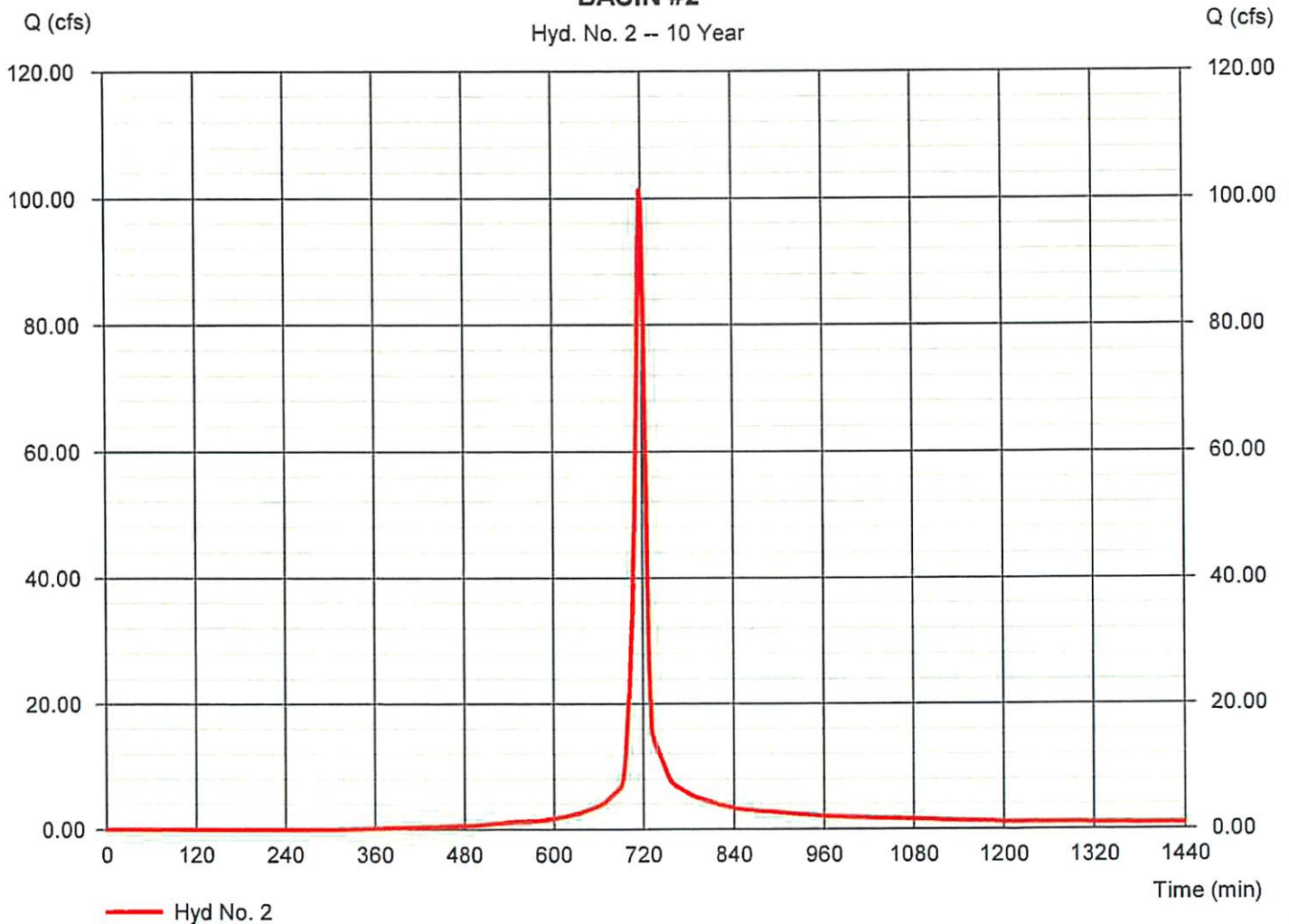
### BASIN #2

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) =  $[(17.600 \times 86)] / 17.600$

### BASIN #2

Hyd. No. 2 -- 10 Year



# TR55 Tc Worksheet

Colon Mine Phase 1

6

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

## Hyd. No. 2

BASIN #2

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
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### 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

<b>Travel Time (min)</b>	<b>= 2.55</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>2.55</b>
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### 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

<b>Travel Time (min)</b>	<b>= 3.43</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>3.43</b>
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### 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
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<b>Travel Time (min)</b>	<b>= 1.89</b>	<b>+</b>	<b>0.00</b>	<b>+</b>	<b>0.00</b>	<b>=</b>	<b>1.89</b>
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<b>Total Travel Time, Tc .....</b>	<b>7.90 min</b>
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# 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
<del>3</del>	<del>SCS Runoff</del>	<del>24.06</del>	<del>2</del>	<del>716</del>	<del>55,043</del>	---	---	---	<del>BASIN #3</del>
<del>4</del>	<del>SCS Runoff</del>	<del>86.13</del>	<del>2</del>	<del>718</del>	<del>230,828</del>	---	---	---	<del>BASIN #4</del>
<del>5</del>	<del>SCS Runoff</del>	<del>360.28</del>	<del>2</del>	<del>718</del>	<del>896,050</del>	---	---	---	<del>BASIN #5</del>
<del>6</del>	<del>SCS Runoff</del>	<del>114.53</del>	<del>2</del>	<del>718</del>	<del>277,903</del>	---	---	---	<del>BASIN #6</del>
<del>7</del>	<del>SCS Runoff</del>	<del>108.11</del>	<del>2</del>	<del>716</del>	<del>252,279</del>	---	---	---	<del>BASIN #7</del>
<del>8</del>	<del>SCS Runoff</del>	<del>88.20</del>	<del>2</del>	<del>716</del>	<del>186,070</del>	---	---	---	<del>BASIN #8</del>
<del>9</del>	<del>SCS Runoff</del>	<del>106.26</del>	<del>2</del>	<del>720</del>	<del>722,837</del>	---	---	---	<del>BASIN #9</del>
<div>Note: Sediment Basins with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and are not included here.</div>									
Basins-Phase 1.gpw					Return Period: 25 Year			Friday, 10 / 31 / 2014	

# Hydrograph Report

Colon Mine Phase 1

20

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

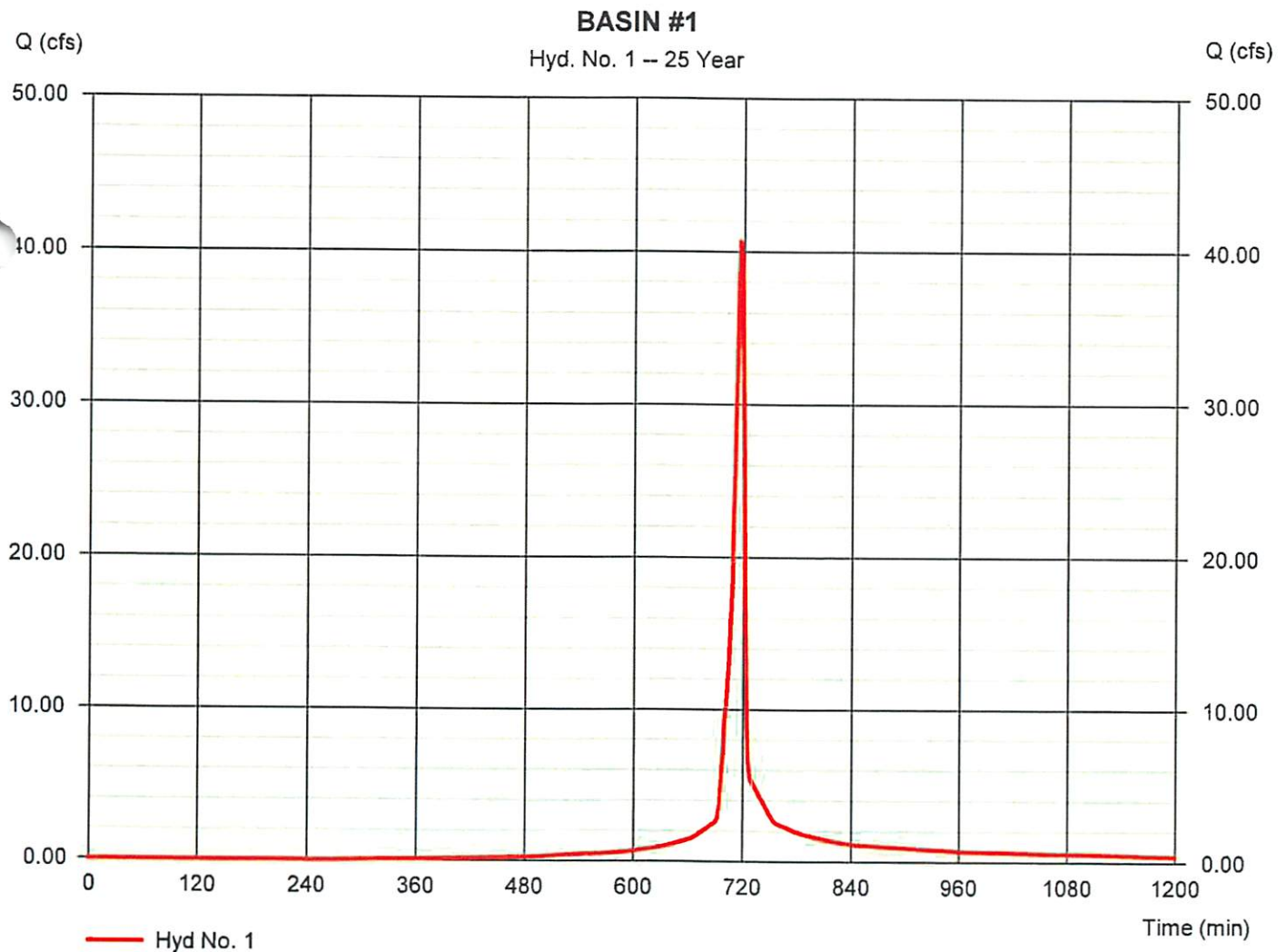
Friday, 10 / 31 / 2014

## Hyd. No. 1

### BASIN #1

Hydrograph type	= SCS Runoff	Peak discharge	= 40.68 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 86,249 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.	= 6.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) =  $[(5.420 \times 86)] / 5.420$





# Hydrograph Report

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

Friday, 10 / 31 / 2014

## Hyd. No. 2

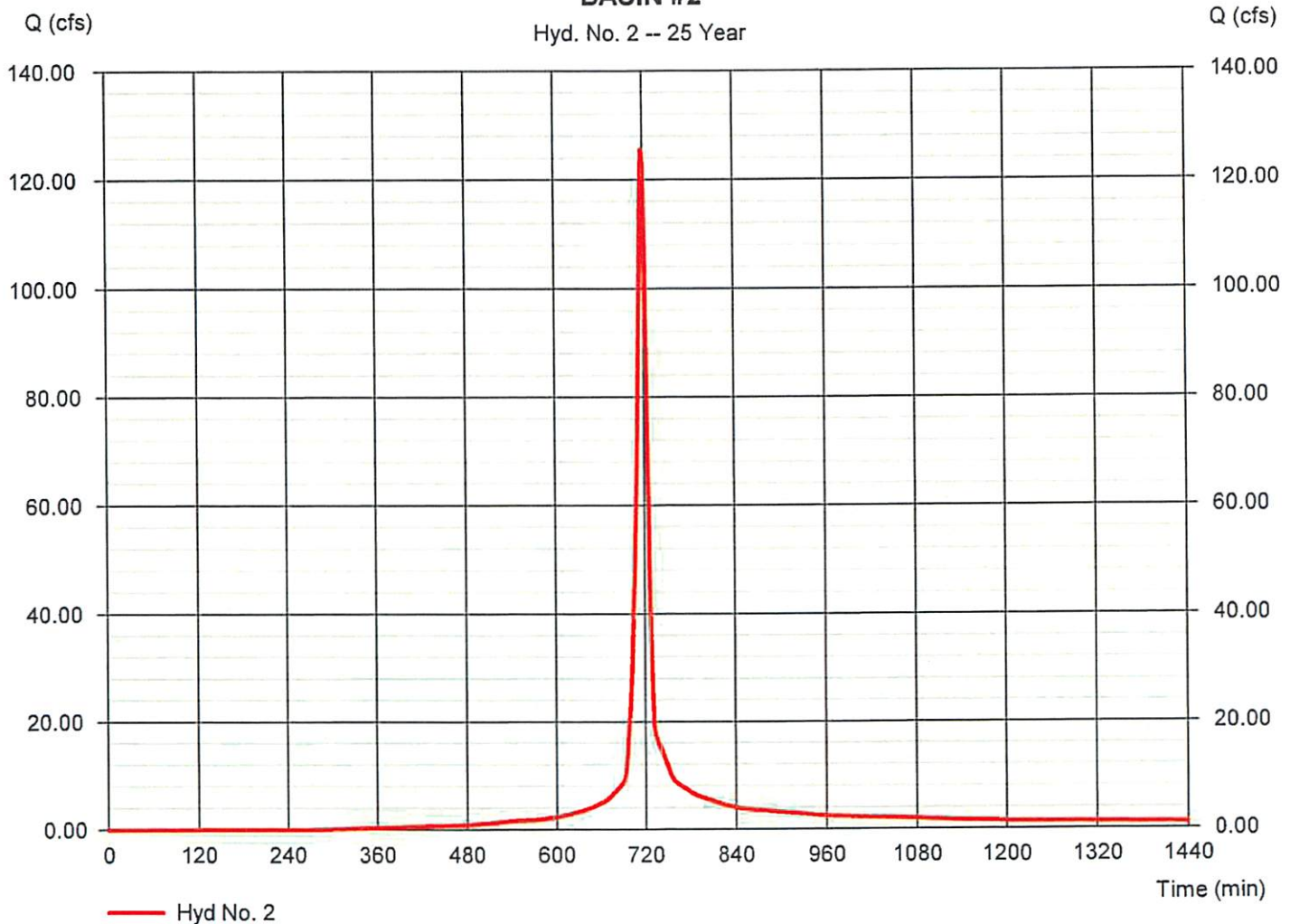
### BASIN #2

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) =  $[(17.600 \times 86)] / 17.600$ 

### BASIN #2

Hyd. No. 2 -- 25 Year



# Hydrograph Summary Report

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

Id.	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
<del>3</del>	<del>SCS Runoff</del>	<del>31.03</del>	<del>2</del>	<del>716</del>	<del>71,560</del>				<del>BASIN #3</del>
<del>4</del>	<del>SCS Runoff</del>	<del>122.75</del>	<del>2</del>	<del>718</del>	<del>302,842</del>				<del>BASIN #4</del>
<del>5</del>	<del>SCS Runoff</del>	<del>476.40</del>	<del>2</del>	<del>718</del>	<del>1,175,500</del>				<del>BASIN #5</del>
<del>6</del>	<del>SCS Runoff</del>	<del>147.78</del>	<del>2</del>	<del>718</del>	<del>364,603</del>	---	---	---	<del>BASIN #6</del>
<del>7</del>	<del>SCS Runoff</del>	<del>144.24</del>	<del>2</del>	<del>718</del>	<del>341,440</del>	---	---	---	<del>BASIN #7</del>
<del>8</del>	<del>SCS Runoff</del>	<del>115.17</del>	<del>2</del>	<del>710</del>	<del>240,522</del>	---	---	---	<del>BASIN #8</del>
<del>9</del>	<del>SCS Runoff</del>	<del>280.40</del>	<del>2</del>	<del>720</del>	<del>1,029,030</del>	---	---	---	<del>BASIN #9</del>
<p>Note: Sediment Basins with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and are not included here.</p>									
Basins-Phase 1.gpw					Return Period: 100 Year			Friday, 10 / 31 / 2014	

# Hydrograph Report

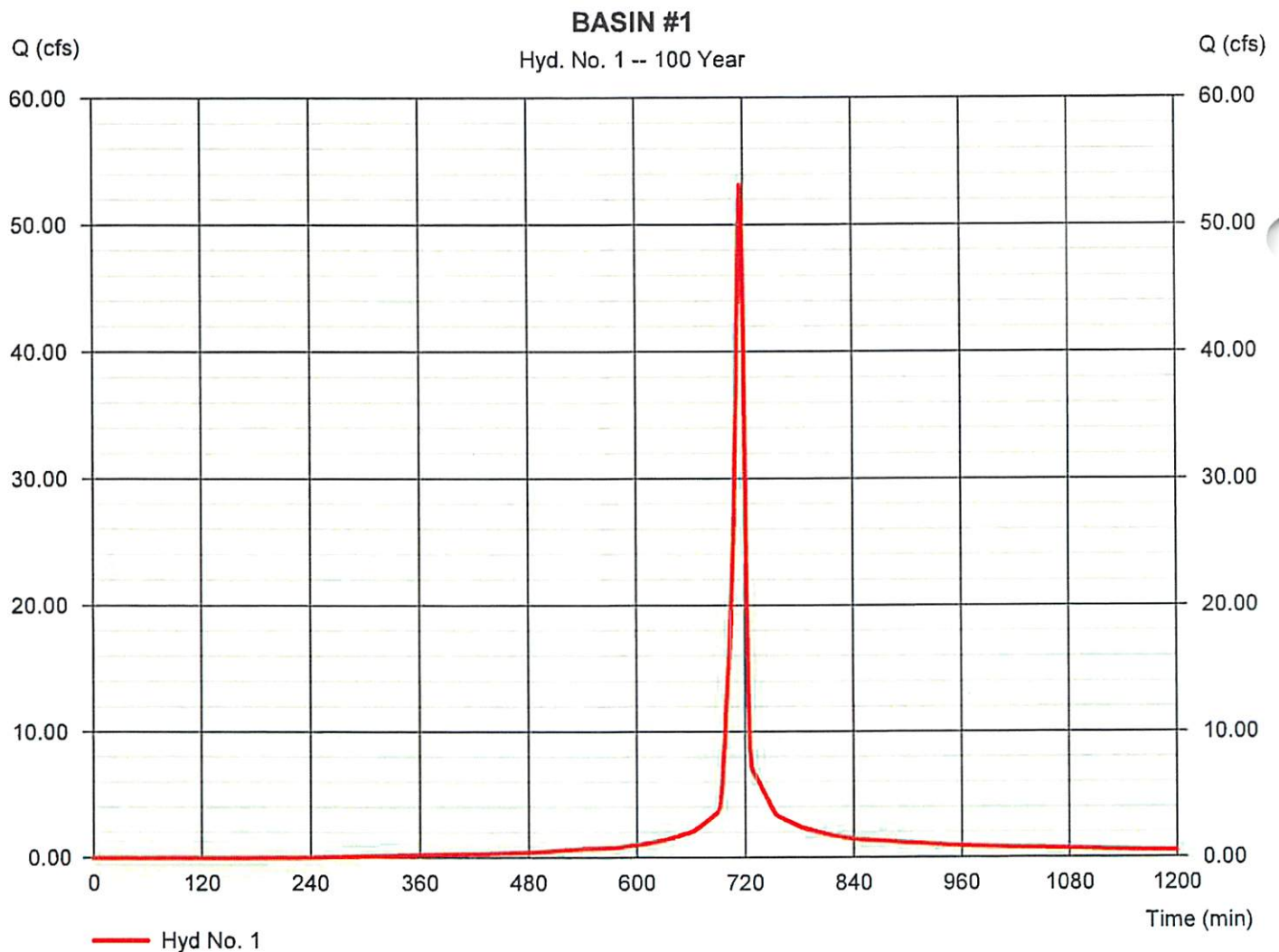
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Friday, 10 / 31 / 2014

## 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) =  $[(5.420 \times 86)] / 5.420$ 

# Hydrograph Report

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

Friday, 10 / 31 / 2014

## Hyd. No. 2

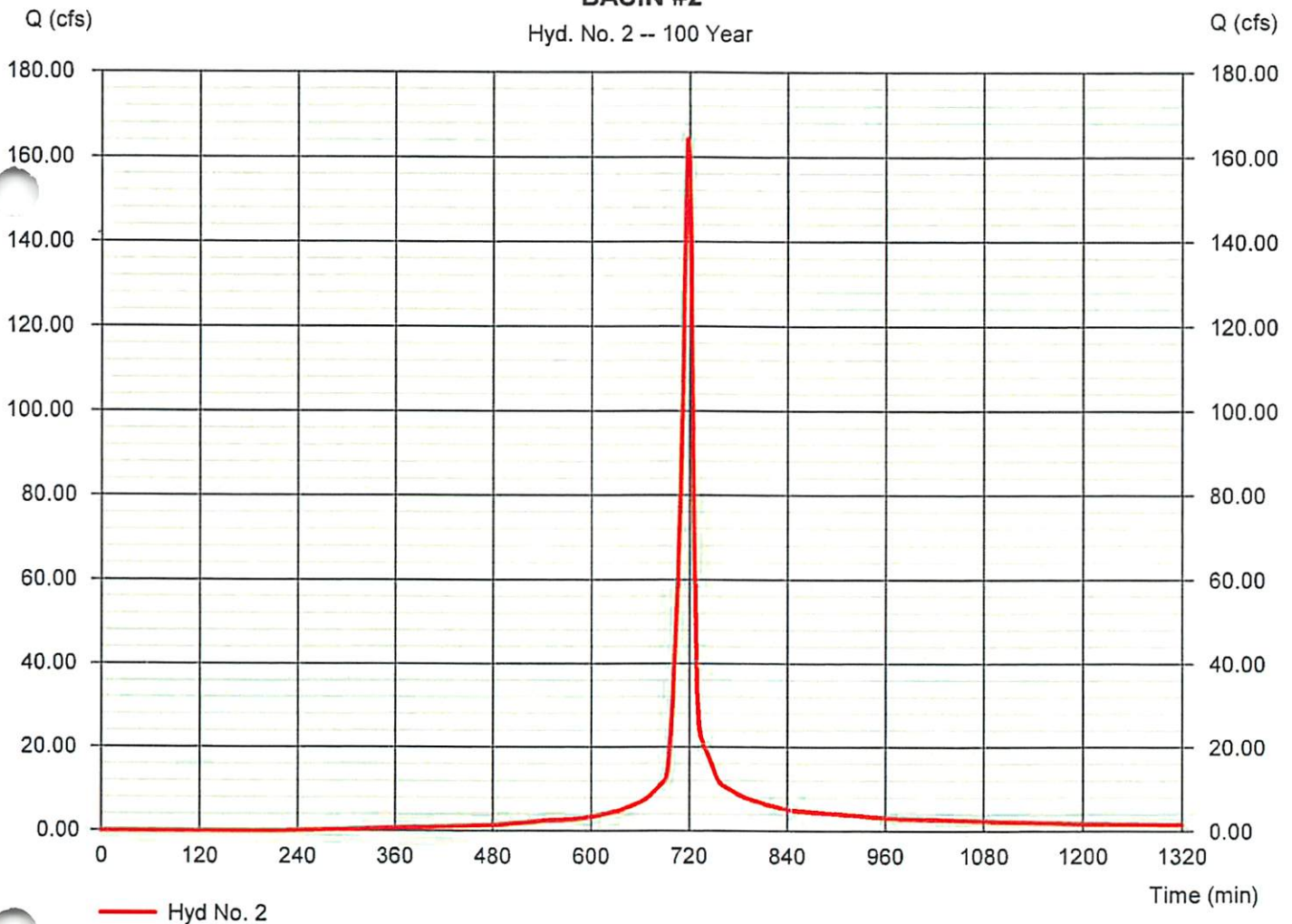
### BASIN #2

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) =  $[(17.600 \times 86)] / 17.600$ 

### BASIN #2

Hyd. No. 2 -- 100 Year





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# Hydrograph Summary Report

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

Hyd.	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
<del>1</del>	<del>SCS Runoff</del>	<del>252.52</del>	<del>2</del>	<del>710</del>	<del>888,885</del>	<del>---</del>	<del>---</del>	<del>---</del>	<del>BASIN #5</del>
2	SCS Runoff	43.09	2	722	123,140	---	---	---	BASIN #1
3	SCS Runoff	79.90	2	720	212,575	---	---	---	BASIN #2
<del>4</del>	<del>SCS Runoff</del>	<del>134.71</del>	<del>2</del>	<del>722</del>	<del>378,078</del>	<del>---</del>	<del>---</del>	<del>---</del>	<del>BASIN #7</del>
<del>5</del>	<del>SCS Runoff</del>	<del>100.60</del>	<del>2</del>	<del>728</del>	<del>741,644</del>	<del>---</del>	<del>---</del>	<del>---</del>	<del>BASIN #8</del>
<p>Note: Sediment Basins with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and are not included here.</p>									
Basins-Phase 2.gpw					Return Period: 10 Year			Friday, 10 / 31 / 2014	

# Hydrograph Report

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

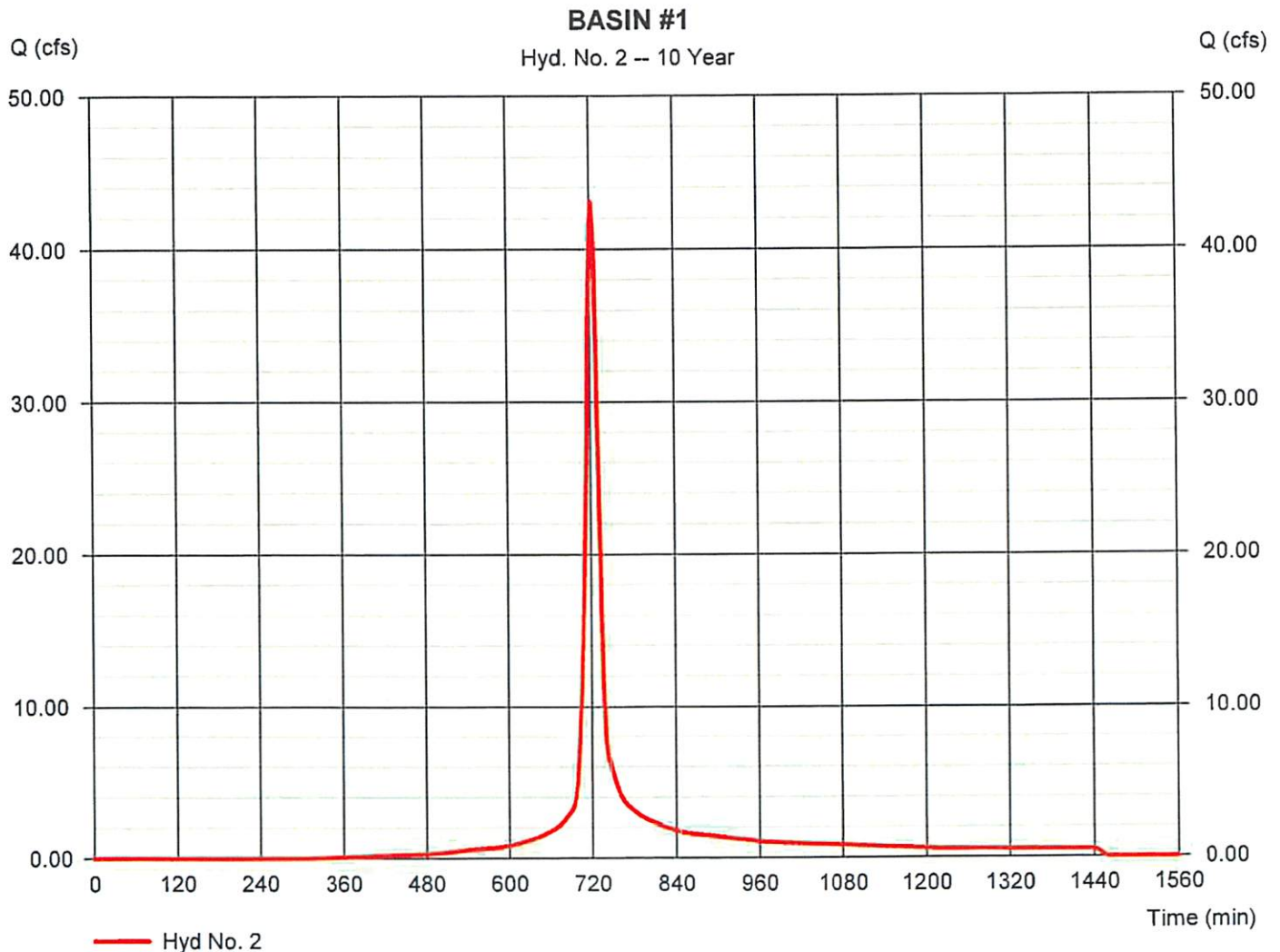
Friday, 10 / 31 / 2014

## Hyd. No. 2

### BASIN #1

Hydrograph type	= SCS Runoff	Peak discharge	= 43.09 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 123,140 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.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) =  $[(9.330 \times 86)] / 9.330$



# TR55 Tc Worksheet

Colon Mine Phase 2

6

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



## Hyd. No. 2

BASIN #1

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 8.79</b>	<b>+</b>	<b>0.00</b>	<b>+</b>
<b>Shallow Concentrated Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 4.13</b>	<b>+</b>	<b>0.00</b>	<b>+</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.88</b>	<b>+</b>	<b>0.00</b>	<b>+</b>
<b>Total Travel Time, Tc .....</b>				<b>13.80 min</b>





# Hydrograph Report

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

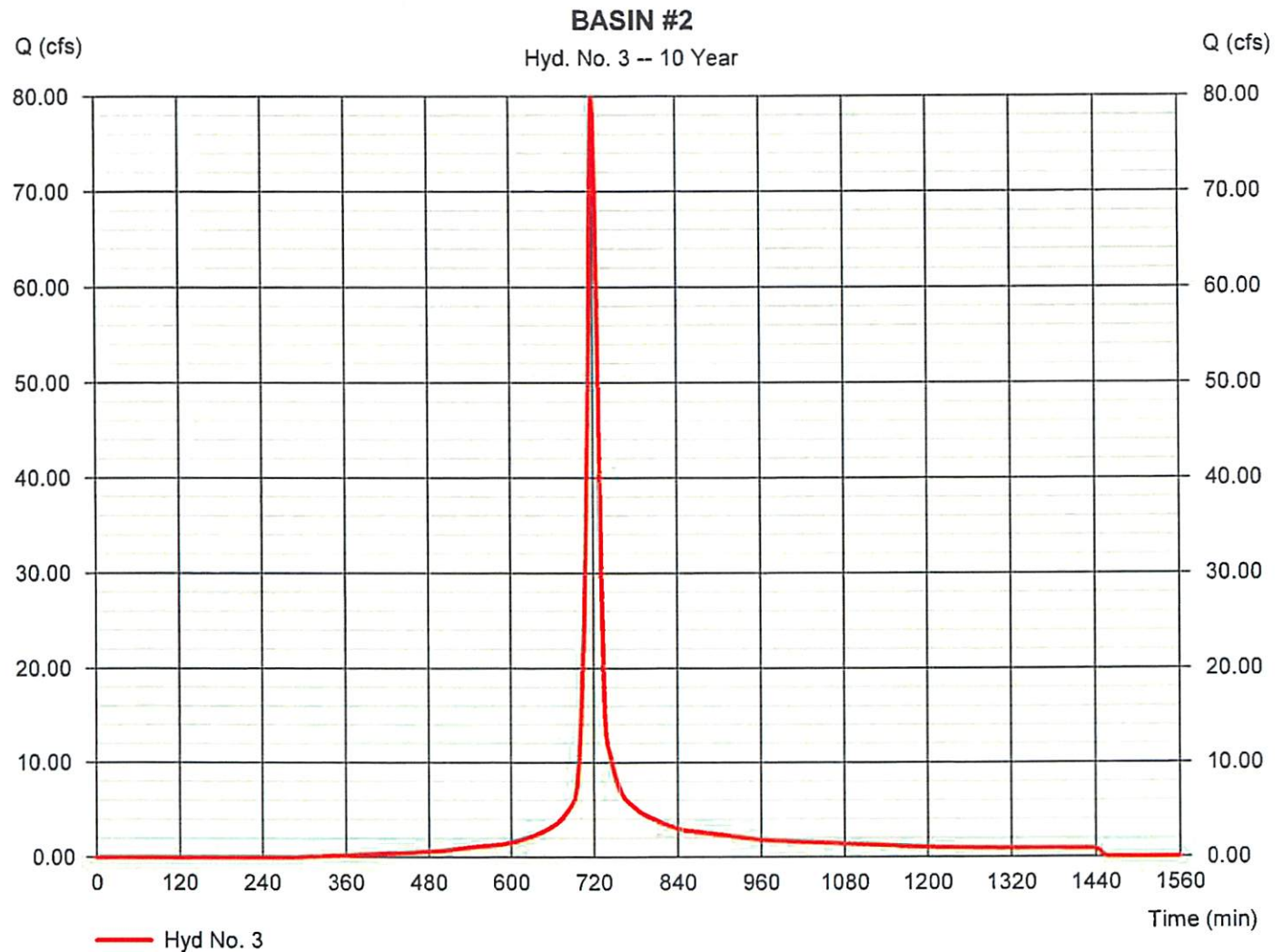
Friday, 10 / 31 / 2014

## Hyd. No. 3

### BASIN #2

Hydrograph type	= SCS Runoff	Peak discharge	= 79.90 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 212,575 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.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) =  $[(11.890 \times 86) + (2.930 \times 91)] / 14.820$





# 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
<del>1</del>	<del>SCS Runoff</del>	<del>340.28</del>	<del>2</del>	<del>710</del>	<del>747,497</del>	<del>---</del>	<del>---</del>	<del>---</del>	<del>BASIN #5</del>
2	SCS Runoff	53.49	2	722	154,408	---	---	---	BASIN #1
3	SCS Runoff	98.71	2	720	265,493	---	---	---	BASIN #2
<del>4</del>	<del>SCS Runoff</del>	<del>171.36</del>	<del>2</del>	<del>722</del>	<del>486,116</del>	<del>---</del>	<del>---</del>	<del>---</del>	<del>BASIN #7</del>
<del>5</del>	<del>SCS Runoff</del>	<del>268.73</del>	<del>2</del>	<del>728</del>	<del>980,740</del>	<del>---</del>	<del>---</del>	<del>---</del>	<del>BASIN #9</del>
<div> <p>Note:</p> <p>Sediment Basins with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and are not included here.</p> </div>									
Basins-Phase 2.gpw					Return Period: 25 Year			Friday, 10 / 31 / 2014	

# Hydrograph Report

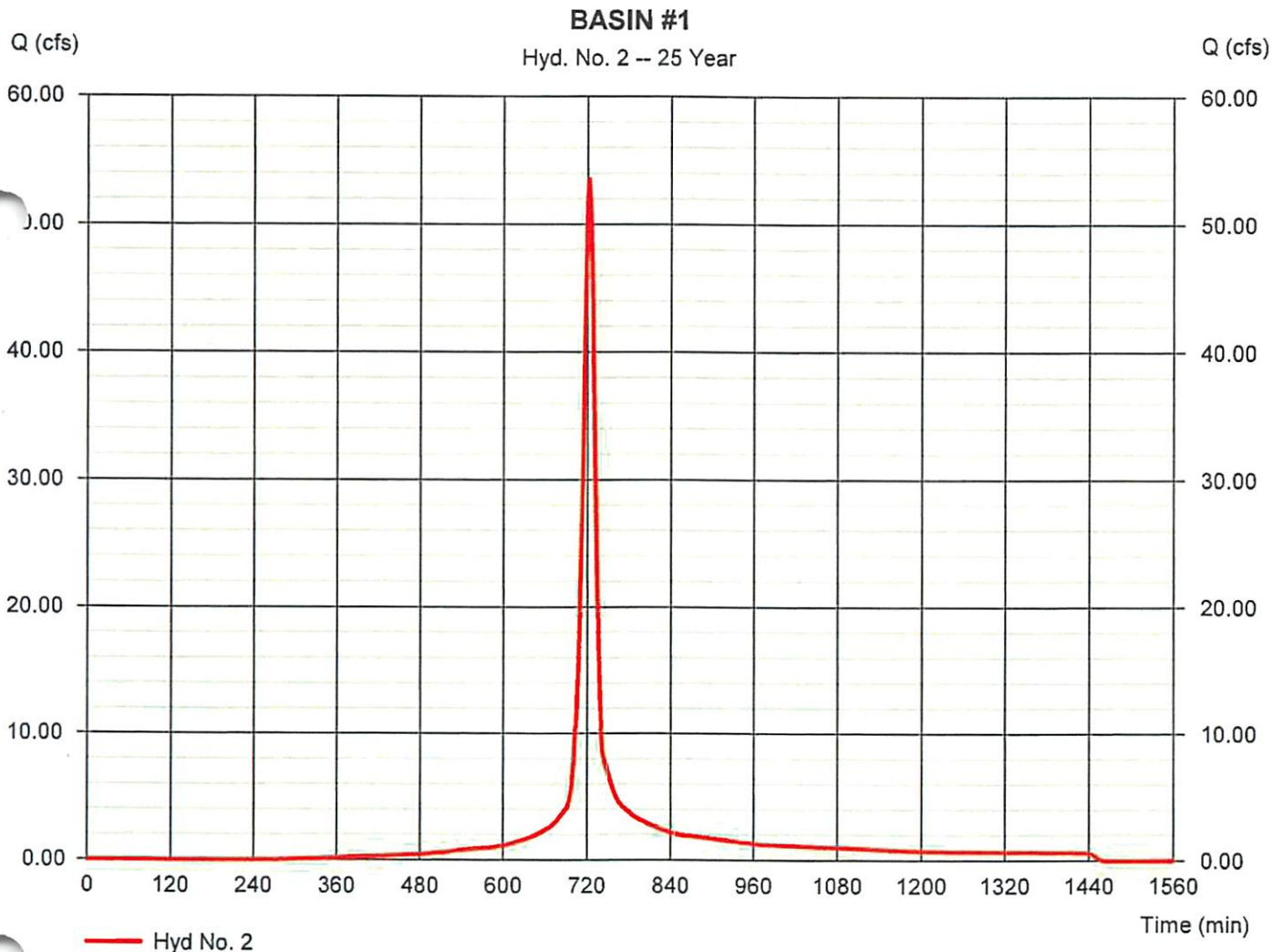
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Friday, 10 / 31 / 2014

## Hyd. No. 2

### BASIN #1

Hydrograph type	= SCS Runoff	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) =  $[(9.330 \times 86)] / 9.330$ 



# Hydrograph Report

Colon Mine Phase 2

16

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

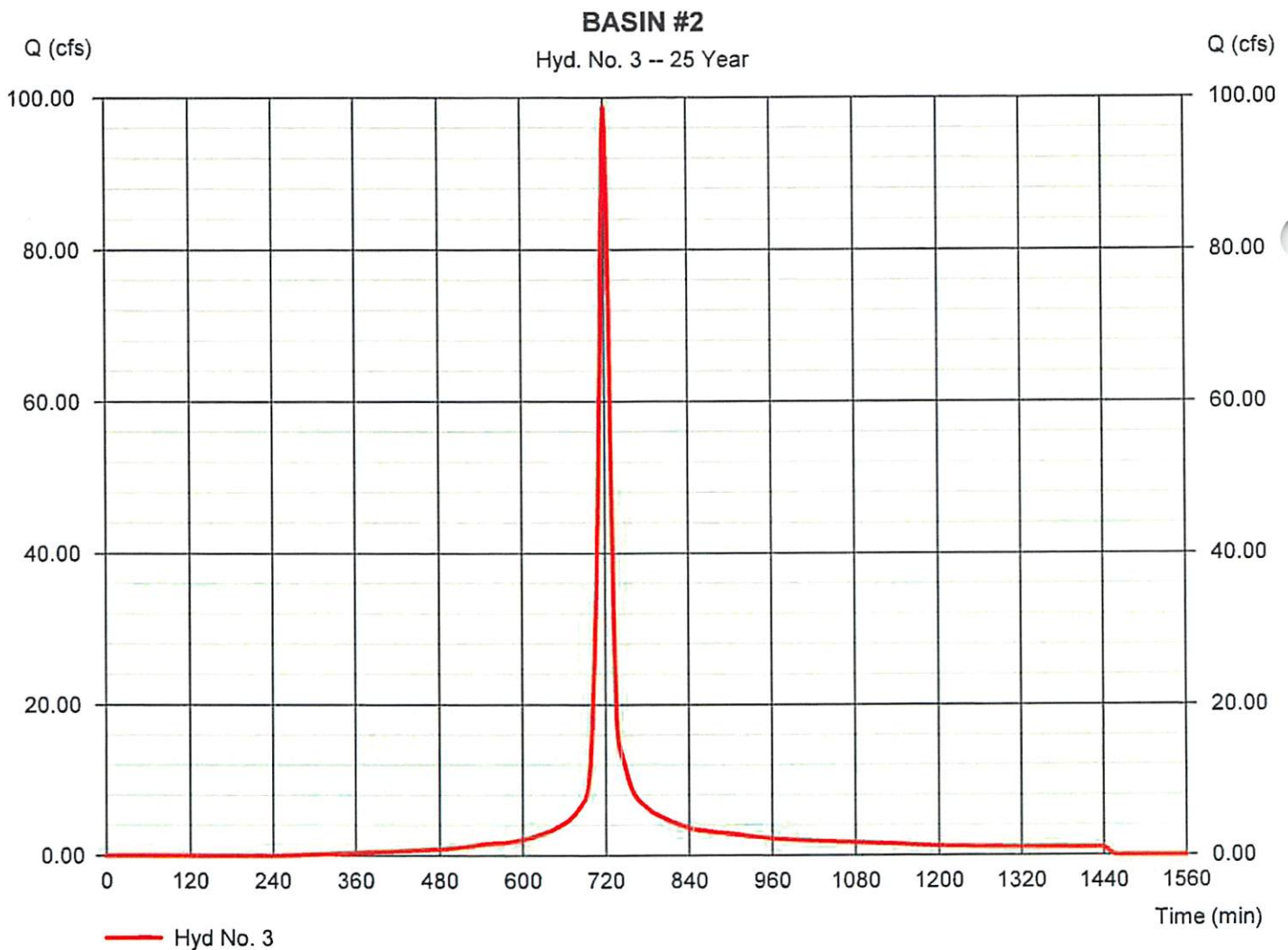
Friday, 10 / 31 / 2014

## 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) =  $[(11.890 \times 86) + (2.930 \times 91)] / 14.820$



# Hydrograph Summary Report

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

d.	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
<del>1</del>	<del>SCS Runoff</del>	<del>462.06</del>	<del>2</del>	<del>716</del>	<del>984,912</del>	<del>-----</del>	<del>-----</del>	<del>-----</del>	<del>BASIN #5</del>
2	SCS Runoff	70.07	2	722	205,231	-----	-----	-----	BASIN #1
3	SCS Runoff	128.64	2	720	351,336	-----	-----	-----	BASIN #2
<del>4</del>	<del>SCS Runoff</del>	<del>230.40</del>	<del>2</del>	<del>722</del>	<del>659,640</del>	<del>-----</del>	<del>-----</del>	<del>-----</del>	<del>BASIN #7</del>
<del>5</del>	<del>SCS Runoff</del>	<del>384.06</del>	<del>2</del>	<del>728</del>	<del>1,408,000</del>	<del>-----</del>	<del>-----</del>	<del>-----</del>	<del>BASIN #9</del>
<div>Note: Sediment Basins with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and are not included here.</div>									
Basins-Phase 2.gpw					Return Period: 100 Year			Friday, 10 / 31 / 2014	

# Hydrograph Report

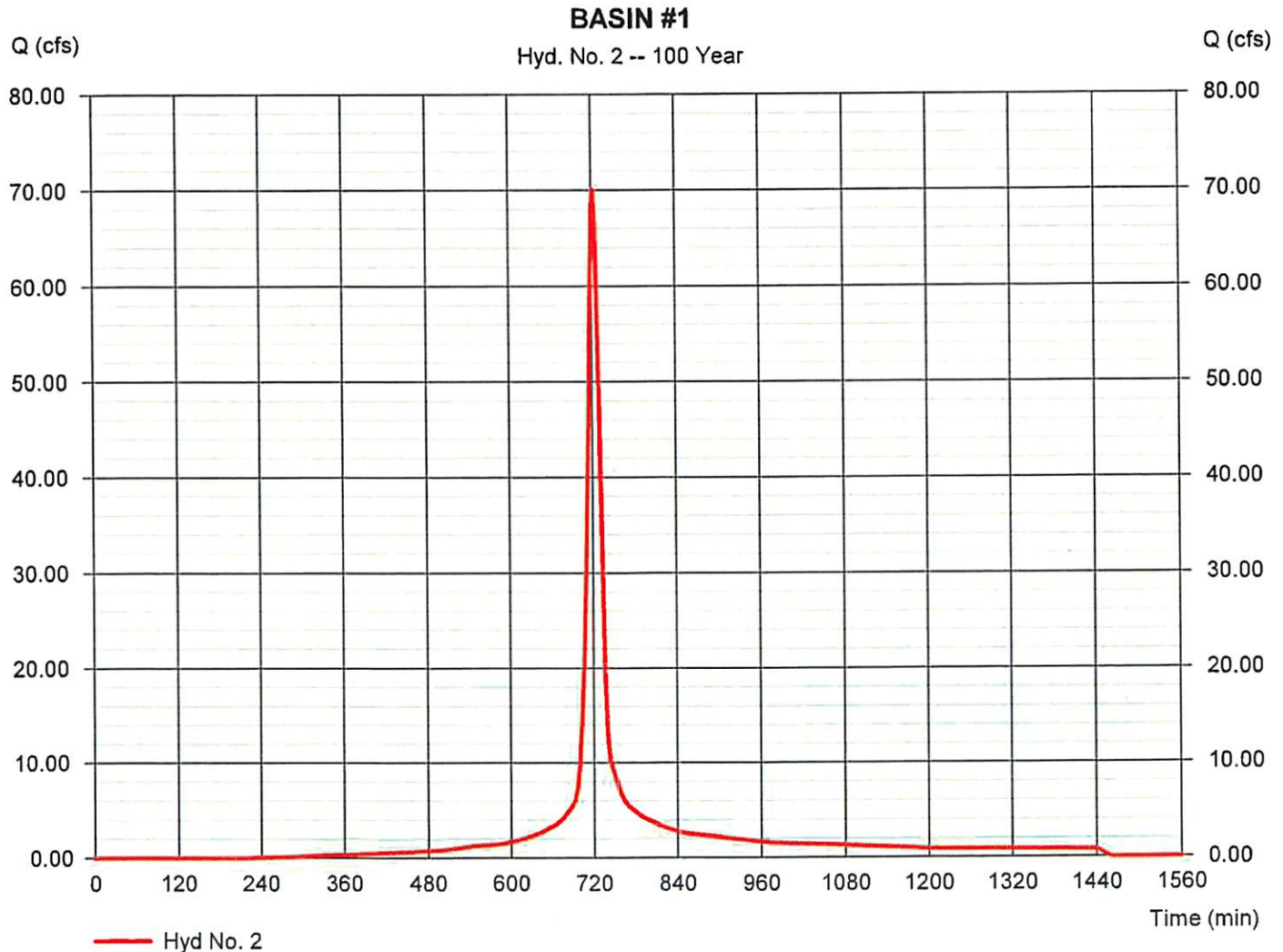
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Friday, 10 / 31 / 2014

## Hyd. No. 2

### BASIN #1

Hydrograph type	= SCS Runoff	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) =  $[(9.330 \times 86)] / 9.330$ 

# Hydrograph Report

Colon Mine Phase 2

22

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

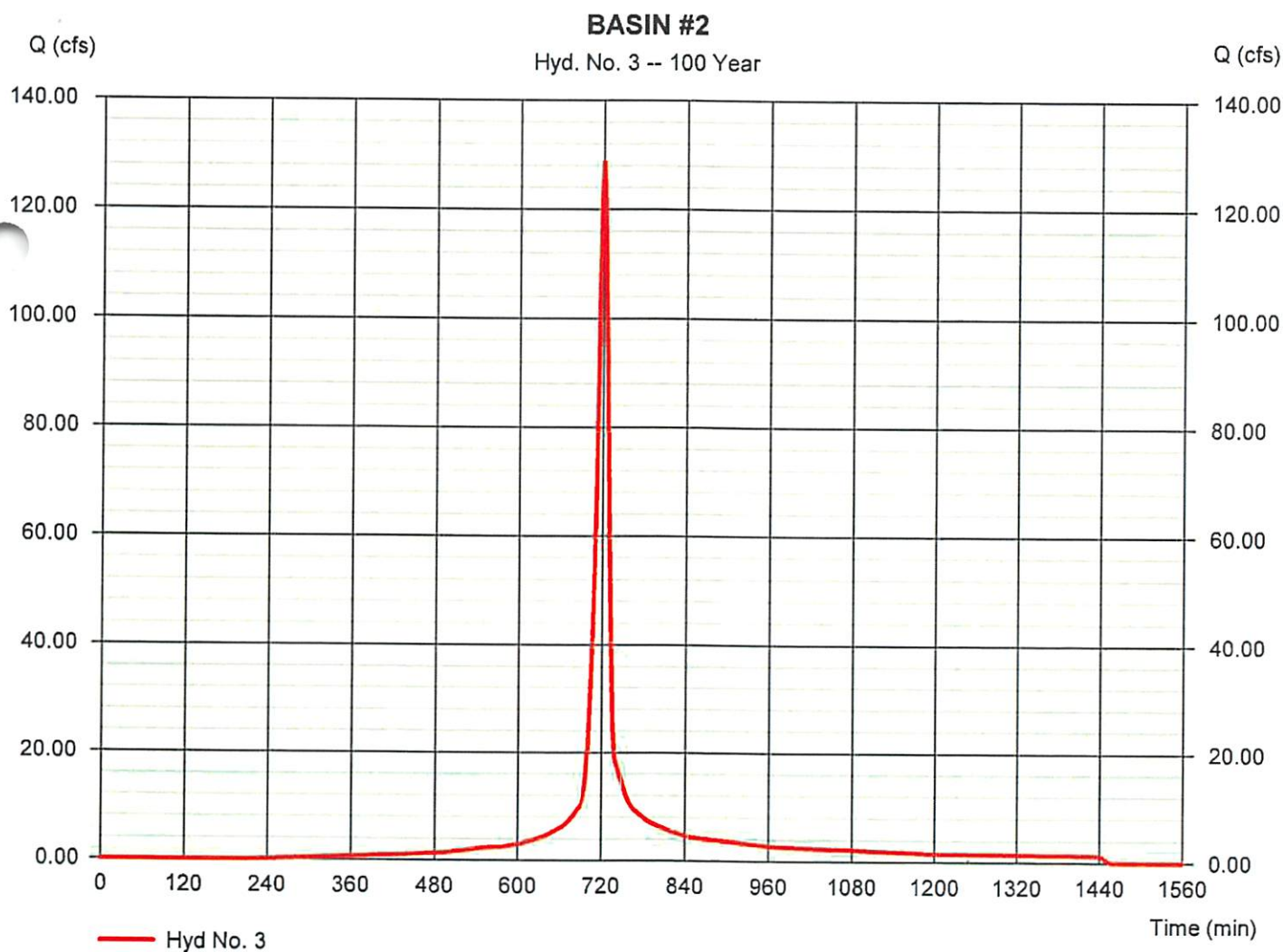
Friday, 10 / 31 / 2014

## Hyd. No. 3

### BASIN #2

Hydrograph type	= SCS Runoff	Peak discharge	= 128.64 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 351,336 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.	= 7.88 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) =  $[(11.890 \times 86) + (2.930 \times 91)] / 14.820$





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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 & aerals](#)

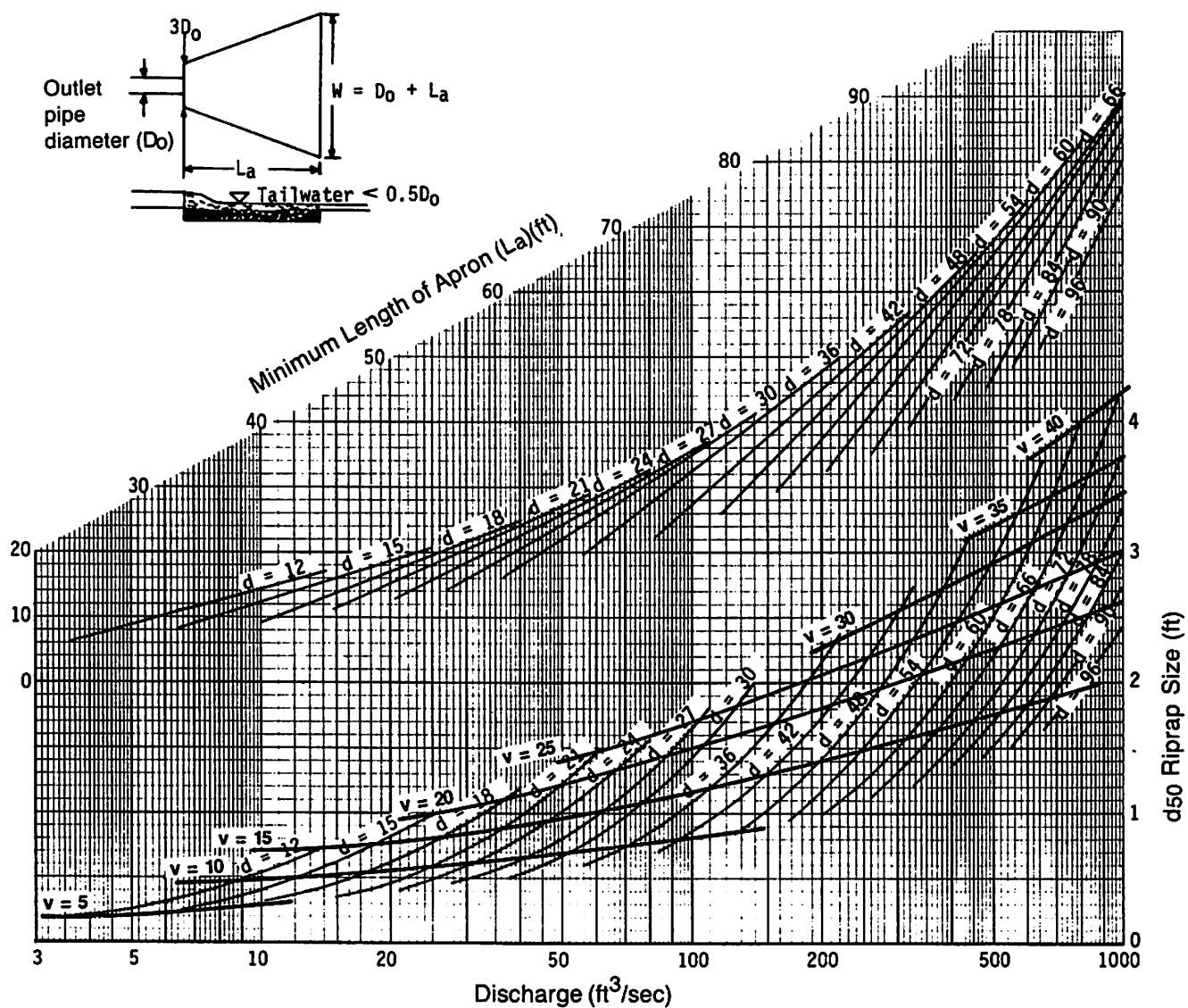
### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
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 (4.24-4.86)	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)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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### PF graphical



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 <sup>1/</sup>

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area <sup>2/</sup>	A	B	C	D
<b>Fully developed urban areas (vegetation established)</b>					
Open space (lawns, parks, golf courses, cemeteries, etc.) <sup>3/</sup> :					
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) <sup>4/</sup> .....		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
<b>Developing urban areas</b>					
Newly graded areas					
(pervious areas only, no vegetation) <sup>5/</sup> .....		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

<sup>1/</sup> Average runoff condition, and  $I_a = 0.2S$ .<sup>2/</sup> 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.<sup>3/</sup> CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.<sup>4/</sup> 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.<sup>5/</sup> 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<sub>1</sub>: 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<sub>2</sub>: Corrugation for 12"-36" pipe measures 2¾" x ½"; for 42" -84" the corrugation measures 5" x 1" or 8" x 1".

Note<sub>3</sub>: C = corrugated; F = flat.

Source: Adapted from USDA-SCS and Carl M. Henshaw Drainage Products Information.



United States  
Department of  
Agriculture

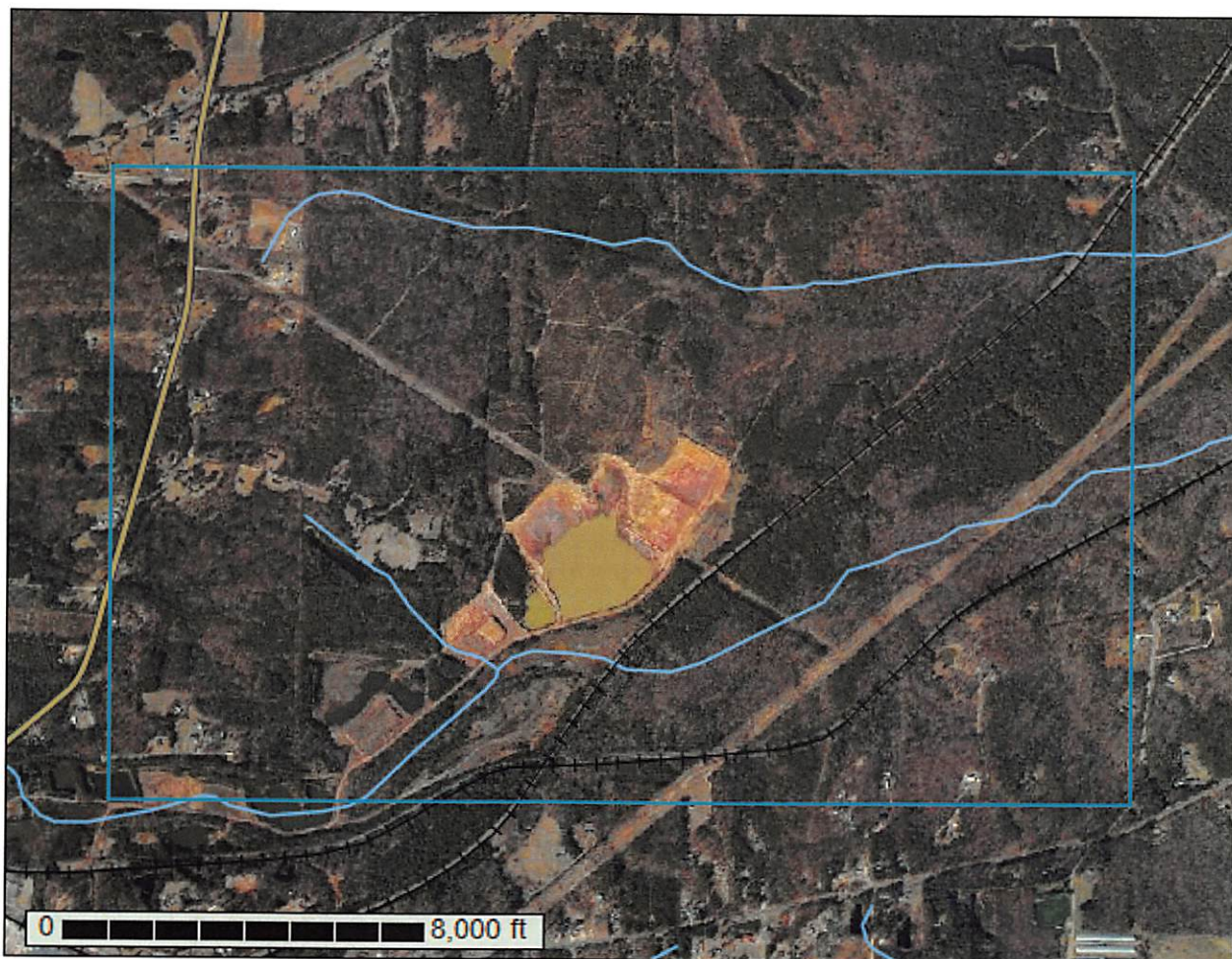
**NRCS**

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

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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](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

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

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

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

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# **How Soil Surveys Are Made**

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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

## Custom Soil Resource Report

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.

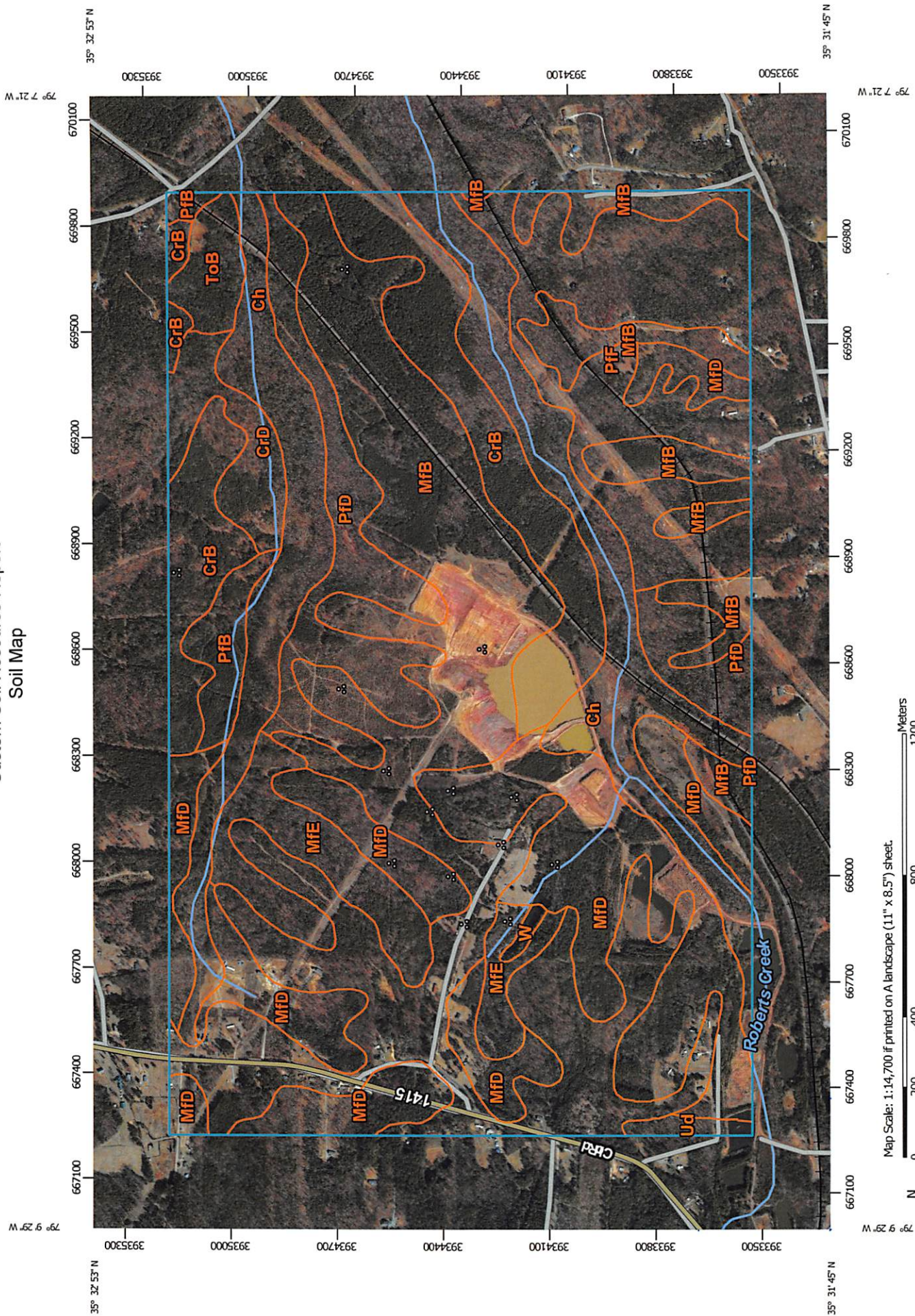
# Soil Map

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



# Custom Soil Resource Report Soil Map




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

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



## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)


### Soils


 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

### Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry


 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot


 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip


 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

### Water Features

 Streams and Canals

### Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

## Map Unit Legend

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

## Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be



## Custom Soil Resource Report

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

## Custom Soil Resource Report

*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

## Custom Soil Resource Report

*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*



## Custom Soil Resource Report

### 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

## Custom Soil Resource Report

*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

## Custom Soil Resource Report

*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

## Custom Soil Resource Report

*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



## Custom Soil Resource Report

*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

## Custom Soil Resource Report

*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

## Custom Soil Resource Report

*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



## Custom Soil Resource Report

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Convex

### **W—Water**

#### **Map Unit Composition**

*Water:* 100 percent

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

#### **Description of Water**

##### **Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 8w

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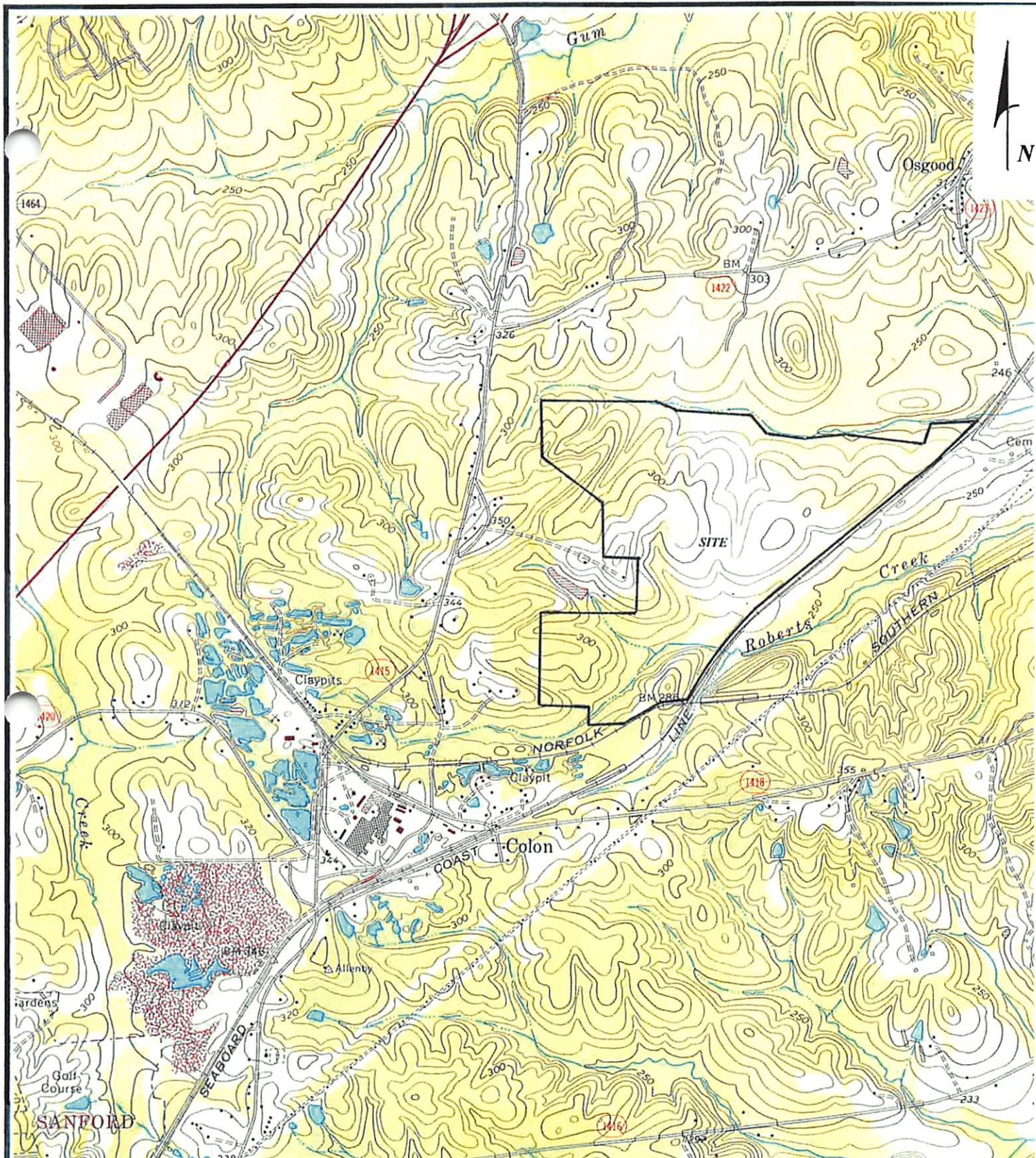
## Custom Soil Resource Report

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Colon Mine Reclamation Fill Site  
1503 Brickyard Road  
Sanford, North Carolina

Buxton Environmental, Inc.

Figure 1.  
Site Location Map



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# C

Technical Specifications

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# Technical Specifications

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15079 PIPE: CORRUGATED POLYETHYLENE

#### Notes:

<sup>1</sup> Source: Colon Mine Site Structural Fill Permit Application, March 2015

<sup>2</sup> Specification sections in grey with strikethrough are not pertinent to the Erosion and Sedimentation Control Plan for the Northwest Area and have not been included.

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**SECTION 01060**  
**SPECIAL CONDITIONS**

**PART 1 - GENERAL**

**1.1 CONDITIONS SPECIFIC TO THIS PROJECT**

- A. CQC/CQA Duties: The CQA Consultant may conduct all required testing and certify the project. If utilized, the CQC Consultant will provide all documentation to the CQA Consultant for review and inclusion in the certification to NCDENR. Refer to the CQA Plan.
- B. The CONTRACTOR is responsible for construction/maintenance of any additional access/haul roads as approved by the OWNER.
- C. The CONTRACTOR is responsible for maintaining the Erosion and Sediment Control measures.
- D. CONTRACTOR is to obtain all soil material from on-site. Stockpiling of soil material shall be within the limits of disturbance as shown on the Drawings.
- E. Limits of Disturbance:
  - 1. As defined on the Drawings.
- F. Site Access:
  - 1. The only access to the site available to the CONTRACTOR is entering through the existing entrance on Colon Road.
- G. Hours of Construction shall be as agreed by the OWNER. Construction may occur on Legal Holidays with permission from the OWNER. The OWNER may allow the CONTRACTOR to extend the Hours of Construction provided there are not complaints from the community and the OWNER approves of the extension. If the OWNER receives any complaints, then the OWNER may revoke the extended hours of construction.

**1.2 PROJECT MEETINGS**

- A. A preconstruction conference shall be held at the site with the ENGINEER, CONTRACTOR's Project Manager and Project Superintendent and CONTRACTOR's Subcontractor Representatives. The purpose is to review sequence of work and communication procedures.
- B. Pre-Installation Conferences:
  - 1. Coordinate and schedule with Resident Project Representative and ENGINEER for each material, product or system specified. Conferences to be held prior to initiating installation, but not more than two (2) weeks before scheduled initiation of installation.
    - a. Conferences may be combined if installation schedule of multiple components occurs within the same two (2) week interval.
    - b. Review manufacturers recommendations and Contract Documents Specifications.
  - 2. CONTRACTOR's Superintendent and individual who will actually act as foreman of the installation crew (installer), if other than the Superintendent, shall attend.
- C. Construction Meetings:
  - 1. The ENGINEER will conduct construction meetings involving:
    - a. CONTRACTOR's project manager.
    - b. CONTRACTOR's project superintendent.
    - c. OWNER's designated representative(s).
    - d. ENGINEER's designated representative(s).
    - e. CONTRACTOR's subcontractors as appropriate to the work in progress.
    - f. OWNER's Construction Quality Control Consultant.
  - 2. Frequency of meetings to be as agreed upon at the Pre-Construction Meeting.

3. The ENGINEER will take meeting minutes and submit copies of meeting minutes to participants and designated recipients identified at the Preconstruction Conference. Corrections, additions or deletions to the minutes shall be noted and addressed at the following meeting.
4. The CONTRACTOR shall have available at each meeting up-to-date record drawings

### 1.3 DATA AND MEASUREMENTS

- A. The data given in the Specifications and shown on the Drawings is believed to be accurate but the accuracy is not guaranteed. The Contractor must take all levels, locations, measurements, and verify all dimensions of the job site prior to construction and must adapt his work into the exact construction. Larger scale Drawings take precedence over smaller scale Drawings, and approved shop drawings take precedence over all others.
- B. All survey's shall be sealed by a North Carolina registered land surveyor and submitted to the Engineer. The Contractor shall provide the Engineer with an electronic version of the sealed survey in AutoCAD readable format. Provide unique layers for 1 FT contours, index contours, text, water, vegetation, buildings, roads, etc. Utilize North Carolina grid coordinate system and locate all features in x, y, and z dimensions.
- C. Initial survey shall include the following:
  1. Topography of the cell area
  2. Topography of the stockpile areas.
  3. Topography within limits of construction including:
    - a. Topography of all sediment basins.
    - b. Location of existing channels.
    - c. Location of structures.
    - d. Inverts of pipe, size, and pipe location.
- D. Final as-built survey shall include the following, for example:
  1. Topography of the entire area within limits of construction.
  2. Limits of liner placement.
  3. Topography of the stockpile areas and all other disturbed areas.
  4. Location of roads.
  5. Location of channels.
  6. Topography of all sediment basins and associated outlet structures.
  7. Culverts (invert, size, locations).
  8. Location of utility poles on the property.
  9. Other areas or items that were a part of the Work as directed by the Engineer.
  10. Locations of leachate pipes, valves, sumps, and subcell divider berms.
- E. During construction, the contractor shall submit to the Engineer for review preliminary surveys that depict thickness verification of the soil layers.
- F. Thickness verification may be done with a table or by electronic comparison of drawing files. The method shall be agreed to by the CQA and ENGINEER prior to construction. If the table method is selected, the same point on each soil layer must be used. The thickness is to be measured perpendicular to the slope. Refer to the soil specifications for frequency of points.
- G. Contractor shall preserve and protect all reference points and pay for replacement of any destroyed referenced points.
- H. Additional requirements are set forth in Section 9.0 of the CQA Plan.

### 1.4 SPECIAL CONSIDERATIONS

- A. CONTRACTOR shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.
- B. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.

1 C. Safety:

- 2 1. The CONTRACTOR alone shall be solely and completely responsible for conditions of the  
3 job site in connection with his work, including safety of all persons and property,  
4 preparatory to and during performance of the work. This requirement shall apply  
5 continuously and not be limited to normal working hours.  
6 2. The Construction Documents and the construction hereby contemplated, are to be governed,  
7 at all times, by applicable provisions of local and state laws and regulations, and federal  
8 laws, including, but not limited to, the latest amendments of the following: Department of  
9 Labor, Bureau of Labor Standards Safety and Health Regulations for Construction, and  
10 Williams and Steiger Occupational Safety and Health Act of 1970, including rules and  
11 regulations pursuant thereto, applicable to the Work and performance of the Contract.  
12 (OSHA).  
13 3. The duty of the ENGINEER to conduct construction review of the CONTRACTOR's  
14 performance is not intended to include review of the adequacy of the CONTRACTOR's  
15 safety measures in, on, or near the construction site.  
16 4. All explosives shall be stored in a secure manner and all storage places shall be marked  
17 clearly "DANGEROUS EXPLOSIVES," and shall be in the care of competent watchmen at  
18 all times.

19 D. Inspections by Federal and State Agencies: Authorized representative and agents of the state  
20 and federal government shall be permitted to inspect all work, materials, records of personnel,  
21 invoices of materials, and other relevant data and records.

22 E. Water:

- 23 1. CONTRACTOR is responsible for all water necessary for the completion of the Work.  
24 Water used on the project shall be fresh and of drinkable quality. The CONTRACTOR  
25 shall make arrangements to obtain fresh water for his drinking.  
26 2. Water for other uses such as dust control and moisture control of fill may be obtained from  
27 storm water basins as approved by the CQC and CQA Consultants. The CONTRACTOR  
28 shall obtain any required permits.  
29 3. CONTRACTOR is responsible for coordinating use of, and all costs associated with use of,  
30 water from local sources.

31 F. The CONTRACTOR shall provide sanitary facilities during construction.

32 G. Order of Construction: The CONTRACTOR will schedule construction operations to allow the  
33 other contractors access to the site.

34 **1.5 HISTORICAL AND ARCHAEOLOGICAL**

- 35 A. If during the course of construction, evidence of deposits of historical or archeological interest is  
36 found, the CONTRACTOR shall cease operations affecting the find and shall notify OWNER.  
37 No further disturbance of the deposits shall ensue until the CONTRACTOR has been notified by  
38 OWNER that CONTRACTOR may proceed. OWNER will issue a notice to proceed after  
39 appropriate authorities have surveyed the find and made a determination to OWNER.  
40 Compensation to the CONTRACTOR, if any, for lost time or changes in construction resulting  
41 from the find, shall be determined in accordance with changed or extra work provisions of the  
42 Contract Documents. The site has been previously investigated and has no known history of  
43 historical or archaeological finds.

44 **PART 2 - PRODUCTS**

45 **2.1 INTERFACE FRICTION TESTS**

- 46 A. Laboratory friction tests shall be conducted, on behalf of the OWNER by the CQA Consultant,  
47 with representative samples of the materials selected by the CONTRACTOR for use in the  
48 Work. The CQA Consultant must approve the testing laboratory used for these tests. The  
49 CONTRACTOR is responsible for shipping materials to the testing laboratory. The initial set of  
50 testing and subsequent conformance tests (if any) shall be paid for by the CQA Consultant. If

any interface doesn't meet the requirements, or if the CONTRACTOR changes geosynthetic materials, then the additional cost to qualify those materials shall be borne by the CONTRACTOR.

**B. Base Liner**

1. Testing will include the interfaces between the following adjacent materials with a minimum peak friction angle of 26 degrees is required for each interface.

MATERIAL	SPECIFICATION SECTION
Ash	----
Drainage Composite	02777
60 Mil HDPE (textured)	02775
Geosynthetic Clay Liner (GCL)	02800
Soil liner	02276

**C. Cap System**

1. The CONTRACTOR may select one of the following cap systems. Testing will include the interfaces between the following adjacent materials with a minimum peak friction angle of 26 degrees is required for each interface.

a. Option 1

MATERIAL	SPECIFICATION SECTION
Drainage Soil	N/A
40 Mil (textured HDPE or textured LLDPE)	02775 or 02774
Ash	---

b. Option 2

MATERIAL	SPECIFICATION SECTION
Unclassified Soil	N/A
Drainage Composite	02777
40 Mil (textured HDPE or textured LLDPE)	02775 or 02774
Ash	----

- D. Testing shall be performed in accordance with ASTM D6243. The liner system materials shall be tested at normal stressed of 2,000, 4,000, and 6,250 psf. The cap system materials shall be tested at normal stressed of 500, 1,000, and 1,500 psf. Displacement rates shall be in accordance with ASTM D6243 Procedure A for geosynthetic to geosynthetic interfaces and Procedure B for soil to geosynthetic interfaces. Soil components shall be compacted to the same moisture-density requirements specified for full-scale field placement and saturated prior to shear for 24 hours. All geosynthetic interfaces shall be tested in a wet condition. Geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. The testing laboratory shall confirm these criteria with the CQA firm prior to performing the tests.

- E. Report results in accordance with ASTM D6243 provide complete test data, including plots of shear force versus horizontal displacement and a plot of peak shear stress versus normal stress for the tests conducted. Test results must be satisfactory for material shop drawings to be approved.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**



**SECTION 02110**  
**SITE CLEARING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Site clearing, tree protection, stripping topsoil and demolition.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 02220 - Sitework.
  - 2. Section 02270 - Soil Erosion and Sediment Control.

**1.2 QUALITY ASSURANCE**

- A. North Carolina Erosion and Sediment Control Planning and Design Manual, Current Edition.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)**

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Protect existing trees and other vegetation to remain outside limits of clearing against damage.
  - 1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
  - 2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
  - 3. Provide temporary protection as required.
- B. Repair or replace trees and vegetation outside clearing limits damaged by construction operations.
  - 1. Repair to be performed by a qualified tree surgeon.
  - 2. Remove trees which cannot be repaired and restore to full-growth status.
  - 3. Replace with new trees of minimum 4 IN caliper.

**3.2 SITE CLEARING**

- A. Topsoil within the limits of construction to be removed upon completion of the clearing and grubbing. Topsoil to be stockpiled in a designated area and to be paid for as part of the Clearing and Grubbing Line Item. Do not use topsoil material as structural fill.
- B. Clearing and Grubbing:
  - 1. Clear from within limits of construction all trees not marked to remain.
    - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
  - 2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
- C. Disposal of Waste Materials (Non-Saleable Material):
  - 1. Do not burn combustible materials on site.
  - 2. Do not bury organic matter on site.
  - 3. All waste materials shall be hauled and disposed of properly.

- 



**SECTION 02220**  
**EARTHWORK**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Earthwork.

B. Related Sections include but are not necessarily limited to:

1. Section 02270 – Soil Erosion and Sediment Control.
2. Section 02276 - Soil Liner System.
3. Construction Quality Assurance Plan.

**1.2 QUALITY ASSURANCE**

A. Referenced Standards:

1. American Society for Testing and Materials (ASTM):
  - a. C33, Standard Specification for Concrete Aggregates.
  - b. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup>).
  - c. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft<sup>3</sup> (2,700 kN-m/m)).
  - d. D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
  - e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
  - f. D4253, Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
  - g. D4254, Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
2. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
3. North Carolina Department of Transportation Standard Specification for Roads and Structures, current edition.

- B. Employ a Geotech Engineer and laboratory to conduct the specified tests to assure that all work complies with this Specification.

**1.3 SUBMITTALS**

A. Shop Drawings:

1. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
2. Certifications.
3. Test reports:
  - a. Soils inspection and testing results.

B. Samples:

1. Submit samples and source of fill and backfill materials proposed for use.
2. Submit samples and source of borrow materials proposed for use.
3. Submit soil samples directly to soils laboratory with notification to the Engineer.

## 1.4 SOILS/GEOTECHNICAL

- A. The Soils Engineer will selectively test materials and monitor compliance with the requirements of these Specifications.
- B. The Contractor will afford these representatives access to the job site for the performance of their duties as described in the Contract Documents.
- C. General Duties and Responsibilities of the Contractor's Geotech Engineer: Under the direction of a qualified registered engineer or geologist:
  - 1. Perform stockpile and in-place testing of all soil and rock materials used in the work in conformance with these Specifications and the CQA Plan.
  - 2. Inspect subgrades and excavations and evaluate/determine suitability of materials encountered. Determine extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction.
  - 3. Document placement of fill materials and perform testing to confirm compliance with these Specifications.
  - 4. Evaluate the suitability of existing on-site materials for use in construction of embankments and fills within the proposed grading shown on the Contract Drawings.
  - 5. Measure quantity of unsuitable materials under contract provisions for authorized overexcavation and backfill.
- D. General Duties and Responsibilities of the Engineer:
  - 1. Approve materials proposed for incorporation into the work by the Geotech Engineer.
  - 2. Review subgrades and excavations and approve suitability of materials encountered as proposed by the Geotech Engineer. Approve extent of any overexcavation required to remove unsuitable materials under roadways, structures, or other areas of construction, as proposed by the Geotech Engineer.
  - 3. Review placement of fill materials and testing by Geotech Engineer for compliance with these specifications.
  - 4. Review/approve the suitability of existing on-site materials for use in construction of embankments and fills.
  - 5. Review construction operations and monitor for compliance with Contract Documents.
  - 6. Review/approve Geotech Engineer quantity of unsuitable materials for payment on a unit price basis under contract provisions for authorized overexcavation and backfill.
- E. Available Subsurface Information: Data provided in these specifications on subsurface soil conditions are not intended as representations or warranties of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that neither the Owner nor the Engineer will be responsible for any interpretation or conclusion drawn therefrom by the Contractor. Data is made available for the convenience of the Contractor.
- F. Additional or supplementary soil borings or other exploratory operations may be made by the Contractor. The Contractor shall provide a copy of any data obtained/developed during such work. Such additional work shall be performed in a timely manner in accordance with and not impacting or changing the project schedule set forth in the Contract Documents.

## 1.5 TOLERANCES

- A. Grading shall be to a tolerance of + 0.25 FT unless otherwise noted in the construction documents and then the stricter criteria shall be used.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Fill and Backfill: Selected material approved by Engineer and Owner from site excavation or other approved source.

- 1 B. The Contractor shall conduct his own quantity and quality investigations and testing to  
2 determine availability and suitability of (on-site and/or off-site) borrow materials, as allowed by  
3 the Owner.
- 4 C. All earth materials proposed for use in the Work shall be adequately characterized prior to the  
5 Work by the Geotech Engineer.

## 6 **PART 3 - EXECUTION**

### 7 **3.1 PROTECTION**

- 8 A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
- 9 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to  
10 existing items indicated to remain in place.
- 11 2. Protect and maintain benchmarks, monitoring wells, existing structures, monuments, or  
12 other established reference points and property corners. If disturbed or destroyed, replace at  
13 own expense to full satisfaction of controlling agency.
- 14 3. Verify location of utilities. Omission or inclusion of utility items does not constitute non-  
15 existence or definite location. Secure and examine local utility records for location data.
- 16 a. Take necessary precautions to protect existing utilities from damage due to any  
17 construction activity.
- 18 b. Repair damages to utility items at own expense.
- 19 c. In case of damage, notify Engineer at once so required protective measures may be  
20 taken.
- 21 4. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage  
22 to structures on-site or on adjoining property.
- 23 5. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.
- 24 B. Construct erosion and sedimentation controls prior to beginning earthwork.

### 25 **3.2 SITE EXCAVATION AND GRADING**

- 26 A. The Work includes all operations in connection with excavation, borrow, construction of fills  
27 and embankments, rough grading, and disposal of excess materials in connection with the  
28 preparation of the site(s) for construction of the proposed facilities.
- 29 B. Excavation and Grading: Perform as required by the Contract Drawings.
- 30 1. Contract Drawings may indicate both existing grade and finished grade required for  
31 construction of Project. Stake all units, structures, piping, roads, parking areas and walks  
32 and establish their elevations. Perform other layout work required. Replace property corner  
33 markers to original location if disturbed or destroyed.
- 34 2. Preparation of ground surface for embankments or fills: Before fill is started, scarify to a  
35 minimum depth of 6 IN in all proposed embankment and fill areas. Where ground surface is  
36 steeper than one vertical to four horizontal, plow surface in a manner to bench and break up  
37 surface so that fill material will bind with existing surface.
- 38 3. Protection of finish grade: During construction, shape and drain embankment and  
39 excavations. Maintain ditches and drains to provide drainage at all times. Protect graded  
40 areas against action of elements prior to acceptance of work. Re-establish grade where  
41 settlement or erosion occurs.
- 42 C. Borrow: Provide necessary amount of approved fill compacted to density equal to that indicated  
43 in this Specification. Fill material to be approved by Soils Engineer prior to placement.
- 44 D. Embankments and Fills:
- 45 1. Construct embankments and fills at locations and to lines of grade indicated. Completed fill  
46 shall correspond to shape of typical cross section or contour indicated regardless of method  
47 used to show shape, size, and extent of line and grade of completed work.



2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 3 IN are not placed in upper 6 IN of fill or embankment.
  3. Place material in layers no greater than 8 IN loose thickness. However, thicker lifts may be allowed if it can be demonstrated that compaction requirements are met and approved by the Engineer. Place layers horizontally and compact each layer prior to placing additional fill. Perform testing as indicated in Part 3.6 of this Section.
  4. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density. Control moisture for each layer necessary to meet requirements of compaction.
- E. Upon reaching subgrade elevations shown, proofroll subgrade soils and obtain the Geotech Engineer's review/recommendation and approval. If unsuitable materials are encountered at the subgrade elevation, repair as directed by the Geotech Engineer to remove unsuitable materials. Excavation of 1 cy or greater should be preapproved by the Geotech Engineer.
- F. Proofrolling shall be conducted with a pneumatic-tired vehicle of at least 20 tons Gross Vehicle Weight (GVW), approved by the Geotech Engineer. An alternate method may be approved by the Geotech Engineer may be used in constricted areas.
- G. Where subgrade materials are determined to be unsuitable, such materials shall be removed to the lengths, widths, and depths directed by the Geotech Engineer and backfilled with suitable material unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 6 IN or less than the finished subgrade. Payment for unsuitable material excavation greater than 6 IN beneath the finished subgrade shall be negotiated.
- H. The subgrade of areas to receive fill shall be smooth and free of all vegetation, sticks, roots, rocks, and debris.
- I. Dewatering (as required): Provide and maintain dewatering of all surface water and/or groundwater as required for excavation.
- J. Do not place fill when the subgrade is frozen, wet, loose, or soft.
- K. Moisture control:
1. Moisture content of materials prior to, and during compaction, shall be uniform throughout each layer of material.
  2. Granular materials shall be thoroughly wetted during or immediately prior to compaction.
  3. Supplementary water shall be added as required to materials by sprinkling and mixing uniformly throughout layer.
  4. Materials too wet for placing shall be temporarily spread or aerated until moisture content is acceptable. If these materials cannot be processed in time to use, the Contractor shall find alternatives acceptable to the Geotech Engineer.

### **3.3 USE OF EXPLOSIVES**

- A. Blasting with any type of explosive must be in compliance with 3.4 of this Section.

### **3.4 ROCK EXCAVATION**

- A. Rock is defined as natural material that cannot be moved or ripped with a Caterpillar D8N (or newer version) equipped with a single tooth ripper or approved equal. A demonstration is required. The Contractor shall not remove rock until authorized by the Engineer.
- B. All rock excavation shall be under one classification. This classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, and/or blasting for its removal and also boulders that exceed 1 CY in volume.
- C. The use of explosives shall be limited to the magnitude and location of the charge that will not cause damage to adjacent existing construction and utilities through shock vibrations or other stress loadings. Provide adequate blanket protection to ensure that there will not be fragments of

rock or other debris flying through the air when discharging explosives. Any damage to existing construction or other features caused by blasting operations to be repaired and paid for by Contractor.

1. Explosive permits shall be obtained from the appropriate local authorities.

- D. Where explosives and blasting are used, comply with all laws and ordinances of municipal, state and Federal agencies relating to the use of explosives. Use qualified personnel for blasting and take proper precautions to protect persons, property or the work from damage or injury from blast or explosion. Conduct preblast survey in the company of the Geotech Engineer to aid in determining any damage caused by blasting.

### 3.5 FIELD QUALITY CONTROL

- A. Moisture density relations, to be established by the Geotech Engineer are required for all materials to be compacted.
- B. Extent of compaction testing will be as necessary to assure compliance with Specifications.
- C. Give minimum of 24 HR advance notice to Geotech Engineer when ready for compaction or subgrade testing and inspection.
- D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.
- E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

### 3.6 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.
- B. Provide dewatering system necessary to successfully complete compaction and construction requirements.
- C. Remove frozen, loose, wet, or soft, material and replace with approved material as directed by Soils Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.
- E. Assure by results of testing that compaction densities comply with the following requirements:
1. Sitework:

#### SOIL TYPE

#### COMPACTION DENSITY

Cohesive Soils

95 percent, ASTM D698

Cohesionless Soils

75 percent relative density  
per ASTM D4253 and D4254

Structural Fill Under Slabs-On-Grade

75 percent relative density  
per ASTM D4253 and D4254

Stockpile Material

90 percent, ASTM D698

2. Perform testing at a minimum frequency of 1 test per lift per 10,000 square feet for structural fill.

3. Test locations shall be selected to be representative of conditions encountered.

### 3.7 SPECIAL REQUIREMENTS

- A. Erosion Control: Conduct work to minimize erosion of site. Construct stilling areas to settle and detain eroded material. Remove eroded material washed off site. Clean streets daily of any spillage of dirt, rocks, or debris from equipment entering or leaving site.

## END OF SECTION

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**SECTION 02270**  
**SOIL EROSION AND SEDIMENT CONTROL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Soil erosion and sediment control.

**B. Related Sections include but are not necessarily limited to:**

1. Division 1 - General Requirements.
2. Section 02110 – Site Clearing.
3. Section 02220 – Earthwork.
4. Section 02270 – Soil Erosion and Sediment Control.
5. Section 02485 – Seeding.

**1.2 QUALITY ASSURANCE**

**A. Referenced Standards:**

1. North Carolina Erosion and Sediment Control Planning and Design Manual, current edition.
2. North Carolina State Department of Transportation Standard Specifications for Roads and Structures Construction, current edition.

**1.3 SITE CONDITIONS**

- A. The Contractor shall protect all streams, creeks, and drainage features from sediment laden runoff.**

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Stone for Stone Filter: 2 IN graded gravel or crushed stone.**
- B. Grass Seed: Refer to Section 02485, Seeding.**
- C. Silt Fence: Premanufactured or constructed on site.**

**PART 3 - EXECUTION**

**3.1 PREPARATION**

**A. Prior to Generally Stripping Topsoil, Tree Clearing, and Excavating:**

1. Install silt fence, ditches, and channels.
2. Excavate and shape sediment basins and traps.
3. Construct pipe spillways and install stone filter where required.
4. Machine compact all berms, dikes, and embankments for basins and traps.
5. Refer to the construction sequence on the plans for further detail.

**B. Temporarily seed basin slopes and stockpiles:**

1. Rate: See Section 02485 - Seeding.
2. Reseed as required until good stand of grass is achieved.





**SECTION 02271**  
**STONE REVETMENT (RIP RAP)**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Furnish all labor, materials, tools, equipment and services for all stone revetment (rip rap) for protection of earthen slopes against erosion as indicated, in accord with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.
4. Work required in project includes but is not necessarily limited to:
  - a. Drainage Channels.
  - b. Sediment Basins.
  - c. Spillways.

**B. Related sections include but are not necessarily limited to:**

1. Section 02110 – Site Clearing.
2. Section 02220 – Earthwork.
3. Section 02270 – Soil Erosion and Sediment Control.

**1.2 QUALITY STANDARDS**

**A. Obtain samples in conformance with Corps of Engineers Specification CRD C 100-64 or other approved method.**

**B. Source Tests: Supply certified tests and service records to determine acceptability and application of stone materials. In event suitable test reports or a service record that is satisfactory are not available, as in case of newly operated sources, subject material to tests necessary to determine its acceptability for use. Tests to which materials may be subjected include but are not necessarily limited to:**

1. Petrographic analysis.
2. Specific gravity.
3. Abrasion.
4. Absorption.
5. Wetting and drying.
6. Soundness in magnesium sulfate.
7. Freezing.
8. Thawing.
9. Such other tests as may be considered necessary to demonstrate satisfactorily that materials are acceptable.

**C. Material acceptability tests:**

1. Initial test: On material from each ledge sampled, prior to start of construction:
  - a. Bulk specific gravity.
  - b. Soundness in magnesium sulfate solution.
  - c. Soundness in freezing and thawing.
2. Control tests: Perform control tests including one specific gravity, one soundness in magnesium sulfate solution test, and one soundness in freezing and thawing test for each type of stone protection material for every 1,000 tons of material.

**D. Specific gravity test: ASTM C127.**

1. Not less than 2.40 min.
- E. Soundness in magnesium sulfate solution test: ASTM C88, except maintain samples immersed in solution at a temperature of 80 degF (26 degC) plus or minus 2 deg.
  1. Loss at 5 cycles: Not more than 12 percent.
- F. Soundness of aggregates in freezing and thawing test:
  1. Ensure loss at 12 cycles of not more than 10 percent.
  2. Modify and use AASHTO Designation T 103 Method.
  3. Maintain temperature of cold liquid in range of -5 to 0 degF (-20 to -18 degC).
  4. Maintain thaw fluid temperature in range of 45 to 50 degF (7 to 10 degC).
  5. Permit length of freezing and of thawing cycles of two hours with one hour of freezing following by one hour of thawing.
  6. Perform thawing by circulating thaw fluid around pan containing stone immersed in a depth of 1/4 IN (6 mm) rather than by total immersion.

### 1.3 SUBMITTALS

- A. Shop Drawings.
  1. Supplier's certification of all materials.
  2. Submit all tests and certification in a single coordinated submittal. Partial submittals will not be accepted.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Stone: Approved durable broken stone quarry run.
  1. Durable and of such quality that it will not disintegrate on exposure to water or weathering and free from structural fractures and defects.
  2. Not containing shale, unsound sandstone, or other material which will readily disintegrate.
  3. Graded within limits specified.
  4. Neither breadth nor thickness of any stone less than one-third of its length.
  5. Ensure that dirt and fines accumulated from interledge layers or from blasting or handling operation is less than 5 percent by weight.
  6. The gradation of the material shall be well-graded from small to large of the sizes as indicated on the plans or as directed by the Engineer. The rock shall be sized so as to permit its interlocking.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Trim and dress all areas to conform to the Plans as indicated with tolerance of 3 IN from indicated slope lines and grades.
- B. Bring areas that are below allowable minus tolerance limit to grade by filling with embankment material similar to adjacent material.
- C. Compact to density specified for backfill.
- D. Do not place any stone material on prepared base prior to inspection and approval to proceed.
- E. Lay geotextile fabric prior to placing rip rap.

### 3.2 PLACING RIP RAP

- A. Place dumped riprap on prepared foundation within limits indicated.

- 1 B. Place on prepared base to produce a well-graded mass of rock with minimum practicable
- 2 percentage of voids, to required thickness and grades.
- 3 C. Place to full thickness in a single operation to avoid displacing the underlying material.
- 4 D. Distribute larger stones and entire mass in final position, roughly graded to conform to
- 5 approximate gradation specified.
- 6 E. Keep finished rip rap free from objectionable pockets of small stones or clusters of larger stone.
- 7 1. Hand place and rearrange individual stones as necessary to obtain a reasonably well-graded
- 8 distribution.
- 9 F. Ensure a final tolerance of within 3 IN (75 mm) from indicated grade lines.
- 10 1. Neither tolerance extreme continuous over an area greater than 200 SQ/FT (20 SM).
- 11 G. Distribute stones throughout mass either by selective loading at quarry or by controlled dumping
- 12 of successive loads during final placing or by a combination of these methods.
- 13 1. Do not place stone by dumping into chutes or by similar method likely to cause segregation.
- 14 H. Place stone revetment (rip rap) in conjunction with embankment construction at toe of revetment
- 15 as necessary to prevent mixture of embankment and stone protection materials.
- 16 1. Maintain stone revetment until accepted.
- 17 2. Replace any displaced material to lines and grades shown.

18 **END OF SECTION**

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**SECTION 02485**  
**SEEDING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

**A. General:**

1. Furnish all labor, materials, tools, equipment and services for seeding in accordance with provisions of Contract Documents.
2. Completely coordinate with work of all other trades.
3. See Division 1 for General Requirements.

**B. Related work specified elsewhere:**

1. Section 02220 - Earthwork.
2. Section 02270 - Soil Erosion and Sediment Control.
3. Section 02720 - Erosion Control Blankets.

**C. Location of work: All disturbed areas, exclusive of lined structural fill area.**

**1.2 QUALITY ASSURANCE**

**A. Reference Standards:**

1. AOAC International.
  - a. Current Methods of Fertilizer Testing.

**1.3 SUBMITTALS**

**A. Shop Drawings:**

1. Soil test results with recommendations of lime and nutrient needs.
2. Grass seed mix that will be used for the project and application rate.
3. Mulch type.
4. A plan view drawing of areas to be seeded that depicts the areas tested and proposed application rates of lime and fertilizer.
5. Certificates for each grass seed mixture, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed.

**B. Miscellaneous Submittals:**

1. Copies of fertilizer and lime invoices, showing grade furnished and total quantity applied.
2. A plan view drawing that depicts the areas that were seeded.

**C. Written warranty to maintain and repair as specified in Section 3.4 of this specification for a period of one year following final completion of the project.**

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

**A. Establish a smooth, healthy, uniform, close strand of grass from specified seed.**

**B. Grass seed: Fresh, clean, latest available crop.**

1. Seeds shall meet state seed requirements and those of the Federal Seed Act.
2. Species, proportions and minimum percentage of purity, germination, and maximum percentage of weed seed, as specified.
  - a. Minimum percent purity 96%.
  - b. Minimum percent germination 80%.
  - c. Maximum percent weed seed 1%.



3. All seed used shall comply with the state's noxious weed seed requirements.
- C. Mulch: Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, or other locally available mulch material.
1. Straw mulch:
    - a. Do not use mulch containing a quantity of matured noxious weed seeds or other species that will be detrimental to seeding, or provide a menace to surrounding land.
    - b. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
  2. Wood fiber and cellulose fiber mulch:
    - a. Materials: Wood fiber, cellulose fiber, dark green marker dye.
    - b. pH: 5.
    - c. Moisture content: 12%.
    - d. Wood fiber: 70% minimum.
    - e. Cellulose fiber: 30% maximum.
    - f. Organic content: 97%.
    - g. Ash content: 1.6%.
    - h. Water holding capacity: 1100% minimum.
- D. Fertilizer: Commercial grade fertilizer meeting applicable requirements of State and Federal law.
1. Do not use cyanamic compounds of hydrated lime.
- E. Limestone: agricultural grade ground limestone containing not less than 85 percent of combined calcium and magnesium carbonates.
1. 50 percent passing 100 mesh sieve.
  2. 90 percent passing 20 mesh sieve.
- F. Asphalt binder: not allowed.
- G. Water: Potable, free of substances harmful to growth.
- H. Erosion Control Matting: Refer to Section 02720.

## **2.2 DELIVERY, STORAGE AND HANDLING**

- A. Deliver seed in standard sealed containers labeled with producer's name and seed analysis, and in accord with US Department of Agriculture Rules and Regulations under Federal Seed Act.
- B. Deliver fertilizer in original containers labeled with content analysis.

## **PART 3 - EXECUTION**

### **3.1 JOB CONDITIONS**

- A. This project shall comply with the planting regime for the Central Piedmont Region.
- B. Perform seeding according to the appropriate seeding mixture for the date of seeding.
- C. Permanent Seeding
1. Spring (March 1 – April 30) and Fall (September 1 – November 15)
    - a. Kentucky-31: 175 lbs/ac.
    - b. Unhulled sercia lespedeza: 50 lbs/ac.
    - c. Rye grain: 1 bushel/ac.
  2. Winter (November 16 – February 28)
    - a. Kentucky-31: 200 lbs/ac.
    - b. Unhulled sercia lespedeza: 50 lbs/ac.
    - c. Rye Grain: 3 bushels/ac.
  3. Summer (May 1 – August 31)
    - a. Kentucky-31: 50 lbs/ac.
    - b. Unhulled sercia lespedeza: 50 lbs/ac.

- c. Korean or kobe lespedeza: 50 lbs/ac.
- d. Weeping love grass: 5 lbs/ac.
- e. Bermuda grass: 10 lbs/ac.
- f. Millet: 1 bushel/ac.

D. Temporary Seeding

- 1. Provide winter rye at a rate of 224 lbs/acre.

**3.2 SOIL PREPARATION**

- A. Engineer to approve area after the surface is prepared and prior to seeding. If area is seeded without approval from the Engineer and the Engineer requires the area to be disturbed, the Contractor shall reseed the area.
- B. Limit preparation to areas which will be planted soon after preparation.
- C. Loosen surface to minimum depth of four (4) IN.
- D. Remove stones over one IN in any dimension, sticks, roots, rubbish and other extraneous matter.
- E. Test soil pH per USDA NRCS recommendations. Use test results to determine rate of lime application needed to make soil circumneutral. Provide application rate to Engineer for approval prior to its application.
- F. Spread lime uniformly over designated areas at rate determined by soil testing.
- G. After application of lime, prior to applying fertilizer, loosen areas to be seeded with double disc or other suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
- H. Test soil fertility according to USDA NRCS approved methods. Use test results to determine rate of fertilizer application. Engineer will approve fertilizer application rate prior to application.
- I. Distribute fertilizer uniformly over areas to be seeded at a rate determined by soil testing.
  - 1. Use suitable distributor.
  - 2. Incorporate fertilizer into soil to depth of at least two IN.
  - 3. Remove stones or other substances which will interfere with turf development or subsequent mowing.
- J. Grade seeded areas to smooth, even surface with loose, uniformly fine texture.
  - 1. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
  - 2. Fine grade just prior to planting.
- K. Restore seeded areas to specified condition if eroded or otherwise disturbed between fine grading and planting.
- L. If fertilizer or limed application rate is determined (by invoices submitted) to be less than that specified, apply additional fertilizer and/or lime.
- M. Protect seeded areas.

**3.3 SEEDING**

- A. Do not use seed which is wet, moldy, or otherwise damaged.
- B. Use approved mechanical power driven drills or seeders, or mechanical hand seeders, or other approved equipment.
- C. Distribute seed evenly over entire area at not less than 7LB/1000 SF, 50 percent sown in one direction, remainder at right angles to first sowing.
- D. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds, excessive moisture, or other factors.

- 1 E. Resume work only when favorable condition develops.
- 2 F. Lightly rake seed into soil followed by light rolling or Culti-packing.
- 3 G. Immediately protect seeded areas against erosion by mulching or placing netting.
- 4 1. Spread mulch in a continuous blanket using 1-1/2 TON/ACRE to depth of 4 or 5 straws.
- 5 2. Protect all seeded slopes greater than 3:1 (horizontal to vertical) and ditches against erosion
- 6 with approved erosion control netting or mats.
- 7 H. Immediately after planting, water to a reasonable depth.

#### 8 **3.4 MAINTENANCE**

- 9 A. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance
- 10 operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
- 11 B. Replant bare areas using same materials specified as needed.
- 12 C. Contractor shall supply sufficient water until grass is established.
- 13 D. Restore seeded areas to specified condition if eroded or otherwise disturbed during construction.

14 **END OF SECTION**

**SECTION 02511**  
**AGGREGATE COURSE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Crushed stone paving course, compacted.
- B. Related Sections:
  - 1. Section 02220 - Earthwork

**1.2 QUALITY ASSURANCE**

- A. Reference Standards.
  - 1. North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Contractor to supply to Engineer certificate from supplier that proposed material meets specifications.
  - 2. Contractor to supply to CQA/CQC Consultants sample of material for determination of optimum moisture and density determination.
  - 3. Indicated location and thickness where the material will be used.
- B. Miscellaneous:
  - 1. Provide density and depth test results.

**PART 2 - PRODUCTS**

**2.1 MATERIAL**

- A. Material shall be ABC stone as provided in accordance with Section 1010 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures.

**PART 3 - EXECUTION**

**3.1 CONSTRUCTION**

- A. Construct aggregate course to grade, thickness, and typical section as indicated on drawings. Existing subgrade upon which aggregate course is to be placed shall be compacted in accordance with Section 02220.
- B. Aggregate course shall be constructed in accordance with Section 520 of the North Carolina Department of Transportation Standard Specifications for Roads and Structures, unless indicated otherwise on plans or specifications.

**3.2 COMPACTION**

- A. Compact by vibrating or other approved methods to 95 percent maximum dry density as determined by ASTM D1557.

- 1 B. Any irregularities in the surface shall be corrected by scarifying, remixing, reshaping and
- 2 recompactting until a smooth surface is secure.
- 3 C. The crushed stone will be tested for depth and density.

4 **END OF SECTION**



**SECTION 02720**  
**EROSION CONTROL BLANKETS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. The erosion control blankets are for the purpose of erosion control and revegetation as described herein.
2. This work shall consist of furnishing and installation of the erosion control blankets, including fine grading, blanketing, stapling, and miscellaneous related work, in accordance with these standard specifications and at the location(s) identified on Drawings or designated by Engineer. This work shall include all necessary materials, labor, supervision and equipment for installation of a complete system.
3. All work of this Section shall be performed in accordance with the Conditions and Requirements of the Contract Documents.
4. The erosion control blankets shall be used where surface erosion is not desirable. The blankets shall be suitable for the following applications:
  - a. Channel and ditch linings.
  - b. Slope protection.

**B. Related Sections include but are not necessarily limited to**

1. Section 02220 - Earthwork.
2. Section 02485 - Seeding.

**1.2 SUBMITTALS**

**A. Shop Drawings.**

1. Product technical data.
2. Indicate locations where the material will be used.
3. Manufacturer's installation procedures and methods.
4. Product samples.
5. Any alternative system submitted for approval shall include complete design data, including test evidence of compliance to the essential design parameters of Project and reference installations similar in size and scope to that specified for Project.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Erosion control blankets shall provide a temporary, biodegradable cover material to reduce erosion and enhance revegetation.**

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Erosion control blankets shall be furnished in rolls and wrapped with suitable material to protect against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled to provide identification sufficient for inventory and quality control purposes.**
- B. Erosion control blankets shall be free of defects that would interfere with the proper installation or impair the performance.**
- C. Erosion control blankets shall be stored by Contractor in a manner which protects them from damage by construction traffic.**

## **PART 2 - PRODUCTS**

### **2.1 EROSION CONTROL BLANKETS**

- A. Rolled matting (Engineer may adjust criteria as necessary):
1. Shear stress – 1.5 psf.
  2. Longevity – 8 months.
  3. Top Net – Photodegradable polypropylene.
  4. Bottom Net – None.
  5. Fiber Matrix – 100% straw (0.5 lbs/sy)
- B. Hydraulically applied (Engineer may adjust criteria as necessary):
- | 1. <u>Property</u>      | <u>Test Method</u> | <u>Test Value</u>       |
|-------------------------|--------------------|-------------------------|
| Mass per unit area      | ASTM D6566         | 11.5 oz/yd <sup>2</sup> |
| Thickness               | ASTM D6525         | 0.19 in                 |
| % Ground cover          | ASTM D6567         | 99%                     |
| Flexural Rigidity (wet) | ASTM D6575         | 0.138 oz-in             |
| Cure Time               | Observed           | < 2 hr.                 |
| Color (fugitive dye)    | Observed           | Green                   |
| Functional Longevity    | Observed           | Up to 1 year            |

### **2.2 TURF REINFORCED MATTING**

- A. Rolled Matting
1. Shear Stress: Short duration, unvegetated, 3.0 lb/ft<sup>2</sup>.
  2. Netting:
    - a. Top and bottom: UV stabilized polypropylene, 5 lb/1,000 ft<sup>2</sup>.
    - b. Middle: Corrugated UV stabilized polypropylene, 24 lb/1,000 ft<sup>2</sup>.
  3. Matrix:
    - a. 70% straw fiber: 0.35 lbs/yd<sup>2</sup>.
    - b. 30% coconut fiber: 0.15 lbs/yd<sup>2</sup>.
  4. Thread: Polypropylene, UV stable.

## **PART 3 - EXECUTION**

### **3.1 SITE PREPARATION**

- A. Before placing erosion control blanket, the subgrade shall be inspected by Contractor to insure that it has been properly compacted; has been graded smooth; has no depressed, void, soft or uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other foreign matter; and has been seeded. Contractor shall not proceed until all unsatisfactory conditions have been remedied. By beginning construction, Contractor signifies his approval of preceding work.
- B. Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations.
- C. No vehicular traffic shall be permitted directly on the blankets.

### **3.2 CHANNEL INSTALLATION**

- A. Erosion control blankets shall be installed as directed by the Engineer in accordance with manufacturer's instructions. The extent of erosion control blankets shall be as shown on Drawings.
- B. Rolled erosion control blankets shall be installed parallel to the flow of water. The first roll shall be centered longitudinally in mid-channel and anchored. Subsequent rolls shall follow from channel center outward.

- 1 C. Successive lengths of erosion control blankets shall be overlapped ("shingled") sufficiently for a  
2 common row of connections with the upstream end on top. Connect the overlap across the end of  
3 each of the overlapping lengths.
- 4 D. A trench shall be located at the upstream termination. Erosion control blanket shall be connected  
5 to the bottom of the trench. Backfill and compact the trench.
- 6 E. Staple in accordance with manufacturer's recommendation.

7 **3.3 SLOPE INSTALLATION**

- 8 A. Before placing erosion control blanket, the subgrade shall be inspected by Contractor to insure  
9 that it has been properly compacted; has been graded smooth; has no depressed, void, soft or  
10 uncompacted areas; is free from obstructions, such as tree roots, projecting stones or other  
11 foreign matter; and has been seeded. Contractor shall not proceed until all unsatisfactory  
12 conditions have been remedied. By beginning construction, Contractor signifies his approval of  
13 preceding work.
- 14 B. Place on all slopes outside structural fill construction baseline, excluding the stockpiles, on  
15 slopes greater than or equal to 3H:1V.

16 **3.4 QUALITY ASSURANCE**

- 17 A. Erosion control blankets shall not be defective or damaged. Any such problems shall be  
18 corrected by Contractor.

19 **3.5 CLEAN-UP**

- 20 A. At the completion of this scope of work, Contractor shall remove from the job site and properly  
21 dispose of all remaining debris, waste materials, excess materials, and equipment required of or  
22 created by Contractor. Disposal of waste materials shall be solely the responsibility of  
23 Contractor and shall be done in accordance with applicable waste disposal regulations.

24 **END OF SECTION**

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**SECTION 02778**  
**GEOTEXTILES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Non-woven geotextile material.
  2. Woven geotextile material.
- B. Related Sections:
1. Section 02220 - Earthwork.
  2. Section 02777 - Drainage Geocomposite.
  3. Construction Quality Assurance Plan.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
1. American Association of State Highway Transportation Officials (AASHTO):
    - a. M288, Standard Specification for Geotextile Specification for Highway Application.
  2. ASTM International (ASTM):
    - a. D1987, Biological Clogging of Geotextile or Soil/Geotextile Filters.
    - b. D3766, Standard Terminology Relating to Catalysts and Catalysis.
    - c. D3776, Test Method for Mass Per Unit Area of Woven Fabric.
    - d. D3786, Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.
    - e. D4354, Sampling of Geosynthetics for Testing.
    - f. D4355, Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
    - g. D4491, Water Permeability of Geotextiles by Permittivity.
    - h. D4533, Trapezoid Tearing Strength of Geotextiles.
    - i. D4595, Tensile Properties of Geotextiles by the Wide-Width Strip Method.
    - j. D4632, Grab Breaking Load and Elongation of Geotextiles.
    - k. D4751, Determining Apparent Opening Size of A Geotextile.
    - l. D4759, Determining the Specification Conformance of Geosynthetics.
    - m. D4833, Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
    - n. D4873, Identification, Storage, and Handling of Geosynthetic Rolls.
    - o. D5261, Test Method for Measuring Mass Per Unit Area of Geotextiles.
    - p. D6193, Standard Practice for Stitches and Seams.
    - q. D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
    - r. D7238, Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
- B. Qualifications:
1. Each manufacturing, fabricating firm shall demonstrate 5 years continuous experience, including a minimum of 10,000,000 SF of geotextile installation in the past 3 years.
  2. Installing firm shall demonstrate that the site Superintendent or Foreman has had responsible charge for installation of a minimum of 1,000,000 SF of geotextile.
  3. Installer shall attend pre-installation conference.

**1.3 DEFINITIONS:**

- A. Manufacturer: Manufacturer producing geotextile sheets from resin and additives.



1 B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

2 C. MARV: Minimum Average Roll Value

3 **1.4 SUBMITTALS**

4 A. Shop Drawings:

- 5 1. Manufacturer's documentation that raw materials and roll materials comply with required  
6 geotextile physical properties.  
7 2. Manufacturer and Installer quality control manuals.  
8 3. Original test results for resins, roll material and factory seam tests at frequency specified in  
9 respective quality control manuals. Results shall include or bracket the rolls delivered for  
10 use in the Work.  
11 4. Proposed details of anchoring and overlapping if different than included in Contract  
12 Documents.

13 B. Miscellaneous Submittals:

- 14 1. For needle punched geotextiles, the Manufacturer shall certify that the geotextile has been  
15 continuously inspected using permanent on-line full-width metal detectors and does not  
16 contain any needles which could damage other geosynthetic layers.  
17 2. Qualification documentation specified in Article 1.2.

18 **1.5 DELIVERY, STORAGE AND HANDLING**

- 19 A. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.  
20 B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage. Do not  
21 remove the plastic wrapping until deployment.  
22 C. Label each roll with the manufacturer's name, geotextile type, lot number, roll number, and roll  
23 dimensions (length, width, gross weight).  
24 D. Repair or replace geotextile or plastic wrapping damaged as a result of storage or handling, as  
25 directed.  
26 E. Do not expose geotextile to temperatures in excess of 71 DegC (160 DegF) or less than 0 DegC  
27 (32 DegF) unless recommended by the manufacturer.  
28 F. Do not use hooks, tongs or other sharp instruments for handling geotextile. Do not lift rolls lifted  
29 by use of cables or chains in contact with the geotextile. Do not drag geotextile along the  
30 ground.

31 **PART 2 - PRODUCTS**

32 **2.1 ACCEPTABLE MANUFACTURERS**

33 A. Subject to compliance with the Contract Documents, the following Manufacturers are  
34 acceptable:

- 35 1. Agru America, Inc.  
36 2. Carthage Mills.  
37 3. GSE Environmental  
38 4. TenCate Geosynthetics.

39 **2.2 MATERIALS AND MANUFACTURE**

40 A. Geotextile:

- 41 1. Geotextile fibers:  
42 a. Long-chain synthetic polymer composed of at least 85 percent by weight polyolefins,  
43 polyesters, or polyamides.  
44 b. Filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.

- c. Do not add reclaimed or recycled fibers or polymer to the formulation.
2. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages.
3. The geotextile physical properties shall equal or exceed the minimum average roll values listed below. Values shown are for the weaker principal direction. Acceptance of geotextile shall be in accordance with ASTM D4759.

B. Geotextile for Gecomposite:

1. Top Geotextile: The geotextile intended as the filter shall be a hybrid geotextile consisting of a woven and non-woven needle punched composite geotextile with the two geotextiles bonded together mechanically. The two geotextiles shall form a monolithic filter product with the woven side bonded to the top of the geonet. The top geotextile shall conform to the following properties:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Average Roll Value</u>
Composite mass per Unit Area, oz/yd <sup>2</sup>	ASTM D5261	14
Grab Tensile Strength, lb	ASTM D4632	200
Puncture Strength, lb	ASTM D6241	775
Trapezoidal Tear Strength, lb	ASTM D4533	85
Apparent Opening Size, US Sieve (mm)	ASTM D4751	170 (0.88)
Permittivity, (sec <sup>-1</sup> )	ASTM D4491	0.3
Flow Rate, gpm/ft <sup>2</sup>	ASTM D4491	20
UV Resistance, % Retained	ASTM D4355 (after 500 hours)	90

2. Bottom Geotextile: A nonwoven geotextile conforming to the following properties:

<u>Property</u>	<u>Test Method</u>	<u>Minimum Average Roll Value</u>
Mass per Unit Area, oz/yd <sup>2</sup>	ASTM D5261	6
Grab Tensile Strength, lb	ASTM D4632	160
Grab Elongation	ASTM D4632	50%
Puncture Strength, lb	ASTM D6241	435
Trapezoidal Tear Strength, lb	ASTM D4533	65
Apparent Opening Size, US Sieve (mm)	ASTM D4751	70 (0.212)
Permittivity, (sec <sup>-1</sup> )	ASTM D4491	1.5
Flow Rate, gpm/ft <sup>2</sup>	ASTM D4491	110
UV Resistance, % Retained	ASTM D4355 (after 500 hours)	70

C. Separator Geotextile

<u>Property</u>	<u>Test Method</u>	<u>Minimum Average Roll Value</u>
Unit Weight	ASTM D5261	8 oz/sy
Grab Tensile Strength	ASTM D4632	210 lb
Elongation	ASTM D4632	50%
Puncture Strength	ASTM D4833	95 lb
Maximum Apparent Opening Size	ASTM D4751	#70 US Sieve
Permittivity	ASTM D4491	0.5 sec-1

- D. Roadbed Geotextile: The geotextile shall be composed of synthetic fibers formed into a woven fabric. Fibers used in the manufacture of the geotextile shall be polyolefins, polyesters or polyamides and conform to the following properties.

<u>Property</u>	<u>Test Method</u>	<u>Minimum Average Roll Value</u>
Grab Tensile	ASTM D4632	200 lbs
Grab Elongation	ASTM D4632	15 %
Puncture Strength	ASTM D4833	100 lbs
Trapezoidal Tear	ASTM D4533	75
UV Resistance	ASTM D4355 or D7238	90 %

- E. Thread:
  1. High-strength polyester, nylon, or other approved thread type.
  2. Equivalent chemical compatibility and ultraviolet light stability as the geotextile.
  3. Contrasting color with the geotextile.
- F. If the geotextile is exposed for greater than 75 days, additional index testing will be required to confirm that the material still meets the specification properties.


## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Construct the surface underlying the geotextiles smooth and free of ruts or protrusions which could damage the geotextiles.

### **3.2 INSTALLATION**

- A. Install geotextiles in accordance with manufacturer's written recommendations.
- B. Hand place geotextile. No equipment will be permitted to traffic in direct contact with the geotextile.
- C. Lay geotextile smooth so as to be free of tensile stresses, folds, and wrinkles.
- D. Seam Construction:
  1. Geotextile seams may be sewn or overlapped. Construct overlapped seams in accordance with manufacturer's recommendations or as shown on Drawings.
  2. Sew seams continuously using an SSA flat seam with one row of a two-thread 401 chain stitch unless otherwise recommended by the manufacturer.
  3. Minimum distance from the geotextile edge to the stitch line nearest to that edge: 2 IN unless otherwise recommended by the manufacturer.
  4. Test seams at the frequency specified in Article 3.3.
  5. Tie off thread at the end of each seam to prevent unraveling.
  6. Construct seams on the top side of the geotextile to allow inspection.
  7. Sew skipped stitches or discontinuities with an extra line of stitching with 18 IN of overlap.
  8. Heat tack the geotextile overlaps as shown on the Drawings.
  9. Overlap adjacent panels a minimum of 4 IN. Heat bond seam must develop a minimum of 60% of the tensile strength of the parent geotextile as measured in ASTM D4632.
- E. Protect geotextiles from clogging, tears, and other damage during installation.
- F. Geotextile Repair:
  1. Place a patch of the same type of geotextile which extends a minimum of 12 inches beyond the edge of the damage or defect.
  2. Fasten patches continuously using a sewn seam or other approved method.
  3. Align machine direction of the patch with the machine direction of the geotextile being repaired.
  4. Replace geotextile which cannot be repaired.
- G. Use adequate ballast (e.g. sand bags) to prevent uplift by wind.

- 
- 1 H. Do not use staples or pins to hold the geotextile in place.
- 2 I. Geotextile left uncovered for more than 90 days shall be replaced unless otherwise allowed by
- 3 Engineer.

4 **END OF SECTION**

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**SECTION 15079**  
**PIPE: CORRUGATED POLYETHYLENE**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

**A. General:**

1. This item shall consist of furnishing, fabricating, and installing corrugated polyethylene pipe of the types, classes, sizes, and dimensions as shown on the plans, at such places as are designated on the plans and profiles, or by the Engineer, in accordance with these specifications and in conformity with the lines and grades given.
2. Piping locations include, but may not be limited to slope drains.

**B. Related work specified elsewhere:**

1. Section 15060 – Pipe and Pipe Fittings: Basic Requirements.

**1.2 QUALITY ASSURANCE**

**A. Reference Standards**

1. American Society of Testing and Materials (ASTM) Standards.
  - a. D618, Methods of Conditioning Plastics and Electrical Insulating Materials for Testing.
  - b. D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
  - c. D1600, Terminology for Abbreviated Terms Relating to Plastics.
  - d. D1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
  - e. D2122, Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
  - f. D2321, Practice for Underground Installation of Flexible Thermoplastic Pipe and Sewers and Other Gravity-Flow Applications.
  - g. D2412, Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading.
  - h. D2444, Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
  - i. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
  - j. D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
  - k. F405, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
  - l. F412, Definitions of Terms Relating to Plastic Piping Systems.
  - m. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  - n. F667, Standard Specification for Large Diameter Corrugated Polyethylene (PE) Tubing and Fittings.
  - o. F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
2. American Association of State Highway and Transportation Officials (AASHTO) Standards.
  - a. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing, 75mm to 250mm (3" to 10") Diameter.
  - b. M294, Standard Specification for Corrugated Polyethylene Pipe, 300mm to 1200mm (12" to 36") Diameter.
  - c. MP6-95, Provisional Specification for Corrugated Polyethylene Pipe, 1050 and 1200mm (42" and 48") Diameter.

**1.3 SUBMITTALS**

- A. See submittal requirements of Section 15060 – Pipe and Pipe Fittings, Basic Requirements.**

- 1 B. Shop Drawings:
- 2 1. Layout drawings to include the following:
- 3 a. Dimensions.
- 4 b. Schedule of pipe.
- 5 c. Fittings.
- 6 d. Miscellaneous appurtenances.
- 7 e. When special fittings are necessary, verify locations of items and include complete
- 8 details.
- 9 2. Render copies of any manufacturer's written instructions regarding material handling,
- 10 delivery, storage, and installation.
- 11 C. Miscellaneous:
- 12 1. Submit As-built drawings of piping systems in project including project items and pre-
- 13 existing items. Identify complete location, elevation, and description of piping systems.
- 14 Relate piping systems to identified structures and appurtenances.

## 15 PART 2 - MATERIALS

### 16 2.1 ACCEPTABLE MANUFACTURERS:

- 17 A. Advanced Drain Systems.
- 18 B. Crumpler Plastic Pipe, Inc.
- 19 C. Or approved equal.

### 20 2.2 GENERAL

- 21 A. Corrugated Polyethylene Pipe and Fittings: This pipe and connections shall conform to the
- 22 requirements of AASHTO M252 and M294 and Section 15060, Schedule 17.
- 23 B. This pipe shall be Type "S" single-walled corrugated pipe outside and smooth inside.
- 24 C. Basic Materials: Pipe and fittings shall conform to the requirements of ASTM D3350, except
- 25 the carbon black content shall not exceed 5 percent.
- 26 D. Coupling Bands: Flexible pipe shall be firmly joined by coupling bands. These bands shall be
- 27 not more than two nominal sheet thicknesses lighter than the thickness of the pipe to be
- 28 connected. Only fittings supplied or recommended by the pipe manufacturer should be used.
- 29 Fittings shall be installed in accordance with the manufacturer's recommendations. Couplers
- 30 used with pipe and fittings shall be of a design that preserves alignment during construction and
- 31 prevents separation at the joints. Bell-and-spigot joints, external snap, or split couplers shall be
- 32 used. Annular split couplers shall overlap at least two full corrugations on each pipe end being
- 33 coupled. Helical split couplers shall be at least 6" long for 4" to 10" diameter, and one-half the
- 34 nominal pipe diameter in width for diameters 12" and above. If necessary, self-locking nylon
- 35 ties, HDPE tape, or rods can be used to secure the split coupling bands.
- 36 1. Joining systems shall be Type 3 (Water Tight) couplers used to connect individual pipe
- 37 sections.
- 38 2. Gasketed soil tight joints: Architectural weather-stripping material per ASTM D-1056 or
- 39 rubber per ASTM F477.
- 40 3. Gasketed integral bell/spigot: rubber gasket per ASTM F-477 installed on the spigot end.
- 41 4. Reinforced couplers shall be used where the possibility of separation is great. These
- 42 couplers shall be constructed of a heavy cross-laminated polyethylene backing, rubberized
- 43 mastic sealer, plastic straps with sheathing, and woven polypropylene reinforcing.
- 44 E. Perforations:
- 45 1. All perforations shall be cleanly cut.
- 46

2. The water inlet area shall be a minimum as follows:

4" to 10" pipe	1.0 in <sup>2</sup> /ft
12" to 18" pipe	1.5 in <sup>2</sup> /ft
pipe sizes larger than 18"	2.0 in <sup>2</sup> /ft

3. The width of slots shall not exceed 1/8". The length of slots shall not exceed 10% of the nominal inside circumference for 4" to 8" pipe, 2.5' for 10" to 15" pipe, and 3.0" for 18" and larger pipe.
4. Circular perforations shall not exceed:

4" through 10" pipe	3/16"
pipe sizes larger than 10"	3/8"

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Equipment: All equipment necessary and required for the proper construction of piping shall be on the project, in first class working condition. The Contractor shall provide such mechanical tampers as required to obtain the compaction of the pipe bedding and backfill as specified.
- B. Excavation: The Contractor shall perform all excavation to the depth shown on the plans. The bedding for the pipe shall be shaped so that the bottom of the pipe shall be in continuous contact with the bottom of the trench. Bedding shall be as shown on the plans.
- C. Placing Pipe: The pipe shall be laid with the separate sections joined firmly together with coupling bands with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. The pipe shall be laid carefully and true to lines and grades on a bed which is uniformly firm throughout its entire length. Any pipe which is not in true alignment, or which shows any undue settlement after laid or is damaged, shall be taken up and relaid or replaced without additional cost to the Owner. Pipe shall not be laid on frozen ground.
- D. Connections: Contractor shall follow manufacturer's recommendations in installing pipe connections.
- E. Backfill: The trench shall be backfilled with material indicated on the Drawings.

**END OF SECTION**

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